

Flight Training Center Yokota



C172M MANUAL

N1840V/N22905

January 2019

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INTRODUCTION

This manual contains reference materials for FTC C172M aircraft:

- N1840V (C172M)
- N22905 (C172M)

This manual includes but not limited to:

- Model 172 and Skyhawk Owner's Manual - 1975
- STC supplement for numerous aircraft upgrades
- Pilot Guide Supplements
- Original Airplane Flight Manual (AFM)

CAUTION: FTC aircraft have been modified and upgraded in several key areas (including the engine). Original owner's manual information and data will be inaccurate. Please see the relevant STC supplement for the correct data.

This manual does not include operating manuals for all avionics, etc. Please refer to the individual operating manuals for each piece of equipment. All supplements may be downloaded at your convenience.

CAUTION: This manual is not intended to be a replacement for, or faithful replication of any of the documents contained. In some cases, the documents have been edited for ease of use.

Please refer to the original documents, POH/AFM, STC supplements etc. for correct operational information. This manual is for quick reference and general study only.

MAX OPERATING WEIGHTS	
Max gross weight	2550 lbs
Max baggage	108 lbs (including aux fuel weight)
FUEL	
Main fuel	Two main tanks 38 US GAL usable (42 US GAL total)
Aux fuel	One aft aux tank 18 US GAL usable (18 US GAL total)
Fuel types	MoGas (91 octane or better) or 100LL Avgas (OK to mix)
Fuel drains	One under each wing root (main) + empennage (aux) + one under cowl (strainer) (fuel strainer knob located adjacent to the oil dipstick)
OIL	
Capacity	6-8 QTS. for all FTC sorties
Type	SAE 20WT-50 ashless dispersant
POWERPLANT	
Engine	Lycoming O-360, 180 HP
Normal operating range	2200 - 2699 RPM
ENVIRONMENTAL	
Heat & air	Cabin heat, cabin air, windows, crew vents

ELECTRICAL	
Electrical power	14V Alternator x 1 12V Battery x 1 + backup batteries in some avionics
Current	Max 60 amps
Engine Ignition	Magneto (engine driven) EIS (alt/bat powered)
AVIONICS	
PFD	Aspen EFD 1000 (SV)
MFD (L)	Aspen EFD 500
MFD (R)	Aspen EFD 1000
COM/NAV 1	Garmin GTN 650
COM/NAV 2	Garmin GTN 650
Transponder	Garmin GTX 300
Audio panel	Garmin GMA 340
TCAS	Garmin GTS 800
Autopilot	S-Tec Thirty
Stormscope	WX-500
Backup	L-3 Electronic Standby
V-SPEEDS	
Va (max wt.)	112 MPH
Va (2150 lbs)	109 MPH
Va (1750 lbs)	98 MPH
Max X/W	15 KTS
Vso	56 MPH
Vs1	64 MPH
Vx	71 MPH
Vy	84 MPH
Vg	78 MPH
Vfe	100 MPH
Vno	145 MPH
Vne	182 MPH



MORE PEOPLE BUY AND
FLY CESSNA AIRPLANES
THAN ANY OTHER MAKE

1975

WORLD'S LARGEST PRO-
DUCER OF GENERAL
AVIATION AIRCRAFT
SINCE 1956

**MODEL
172**

AND

Skyhawk



**OWNER'S
MANUAL**

PERFORMANCE - SPECIFICATIONS

Skyhawk*

SEE STC SUPPLEMENTS FOR UPDATED INFORMATION

GROSS WEIGHT	2300 lbs
SPEED:	
Top Speed at Sea Level	144 mph
Cruise, 75% Power at 8000 ft	138 mph
RANGE:	
Cruise, 75% Power at 8000 ft	650 mi
38 Gallons, No Reserve	4.7 hrs
Cruise, 75% Power at 8000 ft	138 mph
48 Gallons, No Reserve	815 mi
	5.9 hrs
Maximum Range at 10,000 ft	138 mph
38 Gallons, No Reserve	700 mi
	6.0 hrs
Maximum Range at 10,000 ft	117 mph
48 Gallons, No Reserve	875 mi
	7.5 hrs
	117 mph
RATE OF CLIMB AT SEA LEVEL	645 fpm
SERVICE CEILING	13,100 ft
TAKE-OFF:	
Ground Run	885 ft
Total Distance Over 50-Foot Obstacle	1525 ft
LANDING:	
Ground Roll	520 ft
Total Distance Over 50-Foot Obstacle	1250 ft
STALL SPEED:	
Flaps Up, Power Off	57 mph
Flaps Down, Power Off	49 mph
BAGGAGE	120 lbs
WING LOADING: Pounds/Sq Foot	13.2
POWER LOADING: Pounds/HP	15.3
FUEL CAPACITY: Total	
Standard Tanks	42 gal.
Optional Long Range Tanks	52 gal.
OIL CAPACITY	8 qts
PROPELLER: Fixed Pitch, Diameter	75 inches
ENGINE:	
Lycoming Engine	O-320-E2D
150 rated HP at 2700 RPM	

	172	Skyhawk	Skyhawk II	F172 Skyhawk	F172 Skyhawk II
EMPTY WEIGHT: (Approximate)	1305 lbs	1350 lbs	1375 lbs	1335 lbs	1410 lbs
USEFUL LOAD: (Approximate)	995 lbs	950 lbs	925 lbs	965 lbs	890 lbs

NOTE: Speed performance data is shown for the Skyhawk which is one to four mph faster than a standard equipped Model 172 (without speed fairings), with the maximum difference occurring at top speed. There is a corresponding difference in range while all other performance figures are the same for the Model 172 as shown for the Skyhawk.

*This manual covers operation of the Model 172/Skyhawk which is certificated as Model 172M under FAA Type Certificate No. 3A12. The manual also covers operation of the Reims/Cessna F172 Skyhawk which is certificated as Model F172M under French Type Certificate No. 25 and FAA Type Certificate No. A4E.

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 Owner's Manual has been prepared as a guide to help you get the most pleasure and utility from your Model 172/Skyhawk. It contains information about your Cessna's equipment, operating procedures, and performance; and suggestions for its servicing and care. We urge you to read it from cover to cover, and to refer to it frequently.

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

THE CESSNA WARRANTY -- It is designed to provide you with the most comprehensive coverage possible:

- a. No exclusions
- b. Coverage includes parts and labor
- c. Available at Cessna Dealers world wide
- d. Best in the industry

Specific benefits and provisions of the warranty plus other important benefits for you are contained in your Customer Care Program book supplied with your aircraft. Warranty service is available to you at any authorized Cessna Dealer 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.

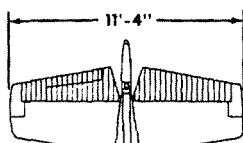
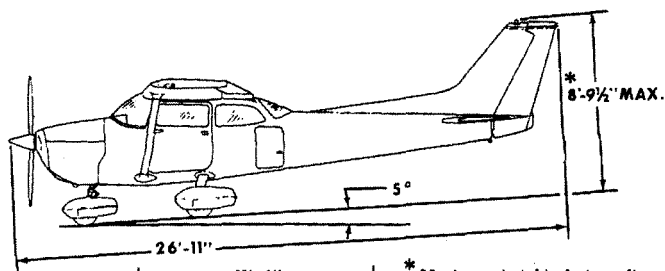
FACTORY APPROVED SERVICE EQUIPMENT to provide you with the most efficient and accurate workmanship possible.

A STOCK OF GENUINE CESSNA SERVICE PARTS on hand when you need them.

THE LATEST AUTHORITATIVE INFORMATION FOR SERVICING CESSNA AIRPLANES, since Cessna Dealers have all of the Service Manuals and Parts Catalogs, kept current by Service Letters and Service News Letters, published by Cessna Aircraft Company.

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

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



* Maximum height of aircraft with nose gear depressed, all tires and nose strut properly inflated, and optional flashing beacon installed.

** Wing span of aircraft with optional strobe lights installed.

PRINCIPAL DIMENSIONS

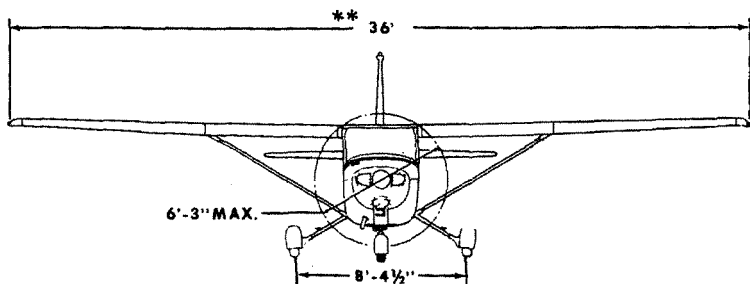
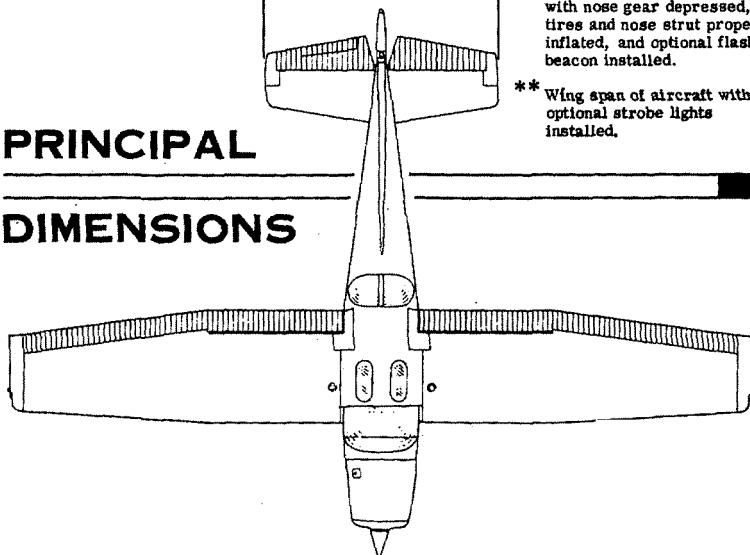


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This manual describes the operation and performance of the Model 172, the Skyhawk, and the Skyhawk II. Equipment described as "Optional" denotes that the subject equipment is optional on the Model 172. Much of this equipment is standard on the Skyhawk and Skyhawk II.

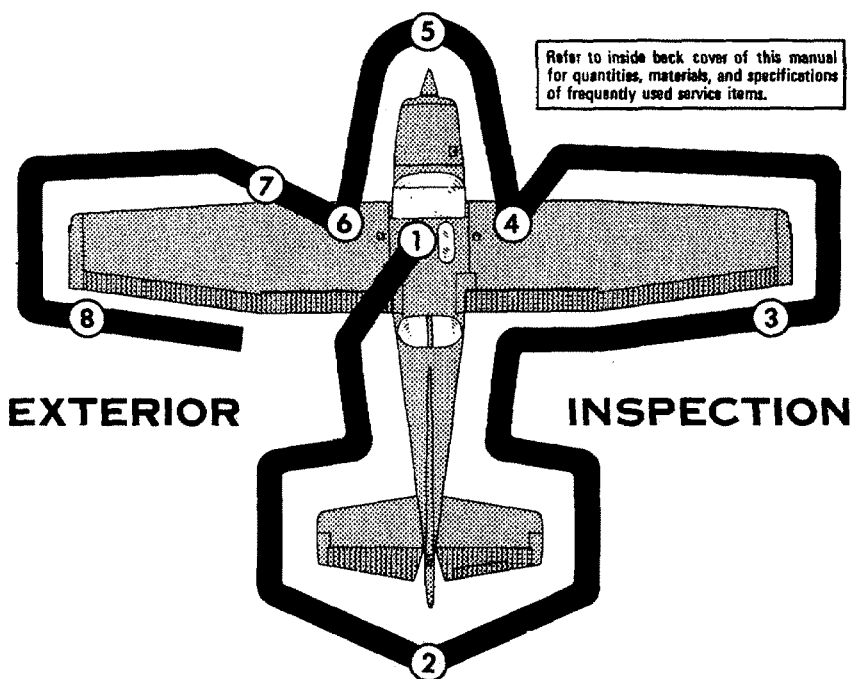
Section I

OPERATING CHECKLIST

One of the first steps in obtaining the utmost performance, service, and flying enjoyment from your Cessna is to familiarize yourself with your aircraft's equipment, systems, and controls. This can best be done by reviewing this equipment while sitting in the aircraft. Those items whose function and operation are not obvious are covered in Section II.

Section I lists, in Pilot's Checklist form, the steps necessary to operate your aircraft efficiently and safely. It is not a checklist in its true form as it is considerably longer, but it does cover briefly all of the points that you should know for a typical flight. A more convenient plastic enclosed checklist, stowed in the map compartment, is available for quickly checking that all important procedures have been performed. Since vigilance for other traffic is so important in crowded terminal areas, it is important that preoccupation with checklists be avoided in flight. Procedures should be carefully memorized and performed from memory. Then the checklist should be quickly scanned to ensure that nothing has been missed.

The flight and operational characteristics of your aircraft are normal in all respects. There are no "unconventional" characteristics or operations that need to be mastered. All controls respond in the normal way within the entire range of operation. All airspeeds mentioned in Sections I, II and III are indicated airspeeds. Corresponding calibrated airspeed may be obtained from the Airspeed Correction Table in Section VI.



Note

Visually check aircraft for general condition during walk-around inspection. In cold weather, remove even small accumulations of frost, ice or snow from wing, tail and control surfaces. Also, make sure that control surfaces contain no internal accumulations of ice or debris. If night flight is planned, check operation of all lights, and make sure a flashlight is available.

- ①
 - a. Remove control wheel lock.
 - b. Check ignition switch OFF.
 - c. Turn on master switch and check fuel quantity indicators; then turn off master switch.
 - d. Check fuel selector valve handle on BOTH.
 - e. Check baggage door for security. Lock with key if children are to occupy child's seat.

Figure

- ②
 - a. Remove rudder gust lock, if installed.
 - b. Disconnect tail tie-down.
 - c. Check control surfaces for freedom of movement and security.
- ③
 - a. Check aileron for freedom of movement and security.
- ④
 - a. Disconnect wing tie-down.
 - b. Check main wheel tire for proper inflation.
 - c. Before first flight of the day and after each refueling, use sampler cup and drain small quantity of fuel from fuel tank sump quick-drain valve to check for water, sediment, and proper fuel grade.
 - d. Visually check fuel quantity; then check fuel filler cap secure.
- ⑤
 - a. Check oil level. Do not operate with less than six quarts. Fill to eight quarts for extended flights.
 - b. Before first flight of the day and after each refueling, pull out strainer drain knob for about four seconds to clear fuel strainer of possible water and sediment. Check strainer drain closed. If water is observed, the fuel system may contain additional water, and further draining of the system at the strainer, fuel tank sumps, and fuel selector valve drain plug will be necessary.
 - c. Check propeller and spinner for nicks and security.
 - d. Check landing light(s) for condition and cleanliness.
 - e. Check carburetor air filter for restrictions by dust or other foreign matter.
 - f. Check nose wheel strut and tire for proper inflation.
 - g. Disconnect tie-down rope.
 - h. Inspect flight instrument static source opening on side of fuselage for stoppage (left side only).
- ⑥
 - a. Check main wheel tire for proper inflation.
 - b. Before first flight of the day and after each refueling, use sampler cup and drain small quantity of fuel from fuel tank sump quick-drain valve to check for water, sediment, and proper fuel grade.
 - c. Visually check fuel quantity, then check fuel filler cap secure.
- ⑦
 - a. Remove pitot tube cover, if installed, and check pitot tube opening for stoppage.
 - b. Check fuel tank vent opening for stoppage.
 - c. Check stall warning vent opening for stoppage.
 - d. Disconnect wing tie-down.
- ⑧
 - a. Check aileron for freedom of movement and security.

BEFORE STARTING ENGINE.

- (1) Exterior Preflight -- COMPLETE.
- (2) Seats, Belts, Shoulder Harnesses -- ADJUST and LOCK.
- (3) Fuel Selector Valve -- BOTH.
- (4) Radios, Autopilot, Electrical Equipment -- OFF.
- (5) Brakes -- TEST and SET.

STARTING ENGINE.

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

BEFORE TAKE-OFF.

- (1) Parking Brake -- SET.
- (2) Cabin Doors and Window -- CLOSED and LOCKED.
- (3) Flight Controls -- FREE and CORRECT.
- (4) Elevator Trim -- TAKE-OFF.
- (5) Fuel Selector Valve -- BOTH.
- (6) Mixture -- RICH (below 3000 ft.).
- (7) Throttle -- 1700 RPM.
 - a. Magnetos -- CHECK (RPM drop should not exceed 125 RPM on either magneto or 50 RPM differential between magnetos).
 - b. Carburetor Heat -- CHECK (for RPM drop).
 - c. Engine Instruments and Ammeter -- CHECK.
 - d. Suction Gage -- CHECK.
- (8) Flight Instruments and Radios -- SET.
- (9) Optional Autopilot -- OFF.
- (10) Throttle Friction Lock -- ADJUST.
- (11) Wing Flaps -- UP.

TAKE-OFF.

NORMAL TAKE-OFF.

- (1) Wing Flaps -- UP.
- (2) Carburetor Heat -- COLD.
- (3) Throttle -- FULL.
- (4) Elevator Control -- LIFT NOSE WHEEL (at 60 MPH).
- (5) Climb Speed -- 75 to 85 MPH.

MAXIMUM PERFORMANCE TAKE-OFF.

- (1) Wing Flaps -- UP.
- (2) Carburetor Heat -- COLD.
- (3) Brakes -- APPLY.
- (4) Throttle -- FULL.
- (5) Brakes -- RELEASE.
- (6) Airplane Attitude -- SLIGHTLY TAIL LOW.
- (7) Climb Speed -- 68 MPH (until all obstacles are cleared).

ENROUTE CLIMB.

- (1) Airspeed -- 80 to 90 MPH.

NOTE

If a maximum performance climb is necessary, use speeds shown in the Maximum Rate-Of-Climb Data chart in Section VI.

- (2) Throttle -- FULL.
- (3) Mixture -- FULL RICH (mixture may be leaned above 3000 feet).

CRUISE.

- (1) Power -- 2200 to 2700 RPM (no more than 75%).
- (2) Elevator Trim -- ADJUST.
- (3) Mixture -- LEAN.

LET-DOWN.

- (1) Mixture -- RICH.
- (2) Power -- AS DESIRED.
- (3) Carburetor Heat -- AS REQUIRED (to prevent carburetor icing).

BEFORE LANDING.

- (1) Fuel Selector Valve -- BOTH.
- (2) Mixture -- RICH.
- (3) Carburetor Heat -- ON (apply full heat before closing throttle).
- (4) Airspeed -- 70 - 80 MPH (flaps UP).
- (5) Wing Flaps -- AS DESIRED.
- (6) Airspeed -- 65 - 75 MPH (flaps DOWN).

BALKED LANDING.

- (1) Throttle -- FULL.
- (2) Carburetor Heat -- COLD.
- (3) Wing Flaps -- 20°.
- (4) Airspeed -- 65 MPH.
- (5) Wing Flaps -- RETRACT (slowly).

NORMAL LANDING.

- (1) Touchdown -- MAIN WHEELS FIRST.
- (2) Landing Roll -- LOWER NOSE WHEEL GENTLY.
- (3) Braking -- MINIMUM REQUIRED.

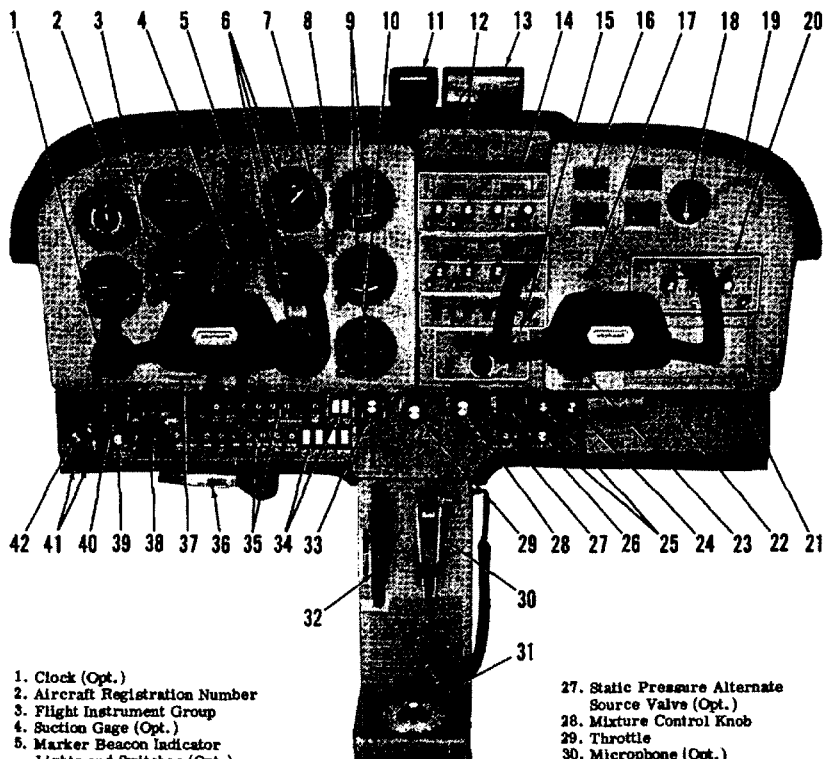
AFTER LANDING.

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

SECURING AIRCRAFT.

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

INSTRUMENT PANEL



1. Clock (Opt.)
2. Aircraft Registration Number
3. Flight Instrument Group
4. Suction Gage (Opt.)
5. Marker Beacon Indicator Lights and Switches (Opt.)
6. Altimeter, Vertical Speed Indicator (Opt.) and Tachometer
7. No. 2 LOC Reversed Indicator Light (Opt.)
8. No. 1 LOC Reversed Indicator Light (Opt.)
9. Omni Course Indicators (Opt.)
10. ADF Bearing Indicator (Opt.)
11. Magnetic Compass
12. Radio Selector Switches (Opt.)
13. Rear View Mirror (Opt.)
14. Radios and Transponder (Opt.)
15. Autopilot Control Unit (Opt.)

16. Fuel and Oil Gages
17. Over-Voltage Warning Light
18. Ammeter
19. Optional Instrument Space
20. ADF (Opt.)
21. Optional Radio Space
22. Map Compartment
23. Wing Flap Position Indicator
24. Cigar Lighter
25. Cabin Air/Heat Control Knobs
26. Wing Flap Switch

27. Static Pressure Alternate Source Valve (Opt.)
28. Mixture Control Knob
29. Throttle
30. Microphone (Opt.)
31. Fuel Selector Valve Handle
32. Elevator Trim Control Wheel
33. Carburetor Heat Control Knob
34. Electrical Switches
35. Circuit Breakers
36. Parking Brake Handle
37. Optional Instrument Space
38. Ignition Switch
39. Instrument and Radio Dial Light Rheostats
40. Master Switch
41. Auxiliary Mike and Phone Jacks (Opt.)
42. Primer

Figure 2-1.

Section II

DESCRIPTION AND OPERATING DETAILS

The following paragraphs describe the systems and equipment whose function and operation is not obvious when sitting in the aircraft. This section also covers in somewhat greater detail some of the items listed in Checklist form in Section I that require further explanation.

FUEL SYSTEM.

Fuel is supplied to the engine from two tanks, one in each wing. With the fuel selector valve on BOTH, the total usable fuel for all flight conditions is 38 gallons for the standard tanks.

Fuel from each wing tank flows by gravity to a selector valve. Depending upon the setting of the selector valve, fuel from the left, right, or both tanks flows through a fuel strainer and carburetor to the engine induction system.

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

NOTE

With low fuel (1/8th tank or less), a prolonged steep descent (1500 feet or more) with partial power, full flaps, and 80 MPH or greater should be avoided due to the possibility of the fuel tank outlets being uncovered, causing temporary fuel starvation. If starvation occurs, leveling the nose should restore power within 20 seconds.

NOTE

When the fuel selector valve handle is in the BOTH position in cruising flight, unequal fuel flow from each

FUEL SYSTEM SCHEMATIC

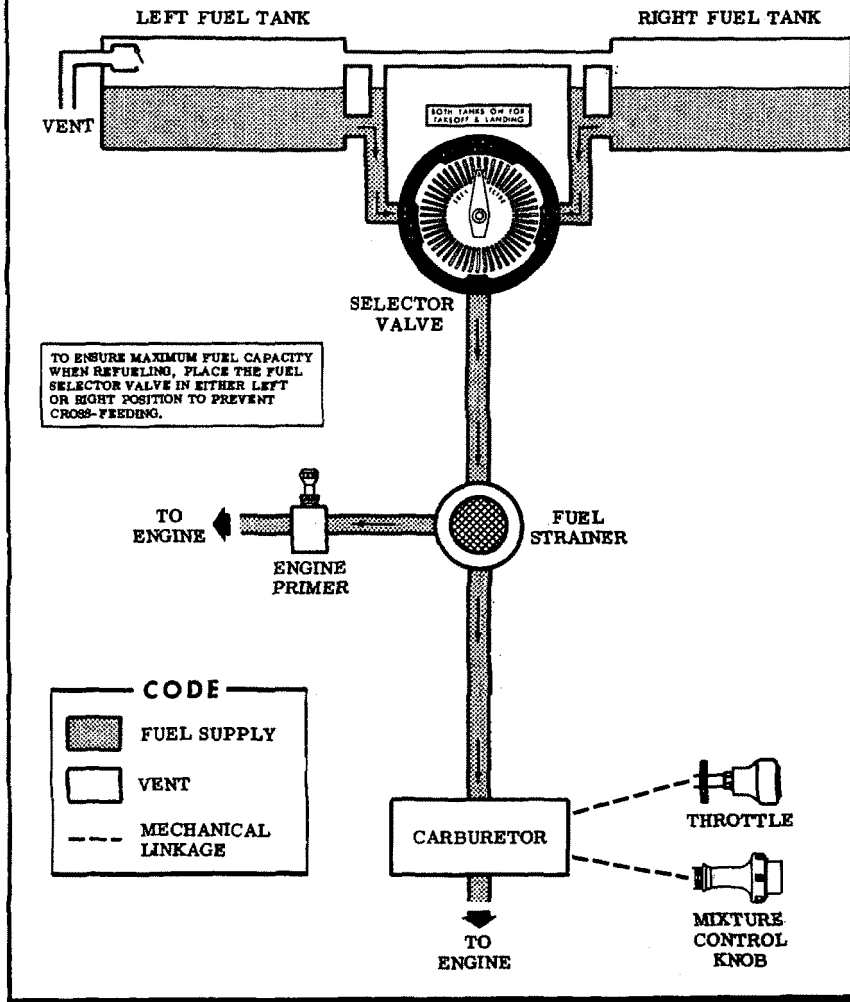


Figure 2-2.

tank may occur if the wings are not maintained exactly level. Resulting wing heaviness can be alleviated gradually by turning the selector valve handle to the tank in the "heavy" wing.

NOTE

It is not practical to measure the time required to consume all of the fuel in one tank, and, after switching to the opposite tank, expect an equal duration from the remaining fuel. The airspace in both fuel tanks is interconnected by a vent line (figure 2-2) and, therefore, some sloshing of fuel between tanks can be expected when the tanks are nearly full and the wings are not level.

For fuel system servicing information, refer to Servicing Requirements on the inside back cover.

FUEL TANK SUMP QUICK-DRAIN VALVES.

Each fuel tank sump is equipped with a fuel quick-drain valve to facilitate draining and/or examination of fuel for contamination and grade. The valve extends through the lower surface of the wing just outboard of the cabin door. A sampler cup stored in the aircraft is used to examine the fuel. Insert the probe in the sampler cup into the center of the quick-drain valve and push. Fuel will drain from the tank sump into the sampler cup until pressure on the valve is released.

LONG RANGE FUEL TANKS.

Special wings with long range fuel tanks are available to replace the standard wings and fuel tanks for greater endurance and range. When these tanks are installed, the total usable fuel for all flight conditions is 48 gallons.

ELECTRICAL SYSTEM.

Electrical energy is supplied by a 14-volt, direct-current system powered by an engine-driven alternator (see figure 2-3). A 12-volt battery is located on the left-hand forward portion of the firewall. Power is supplied to all electrical circuits through a split bus bar, one side con-

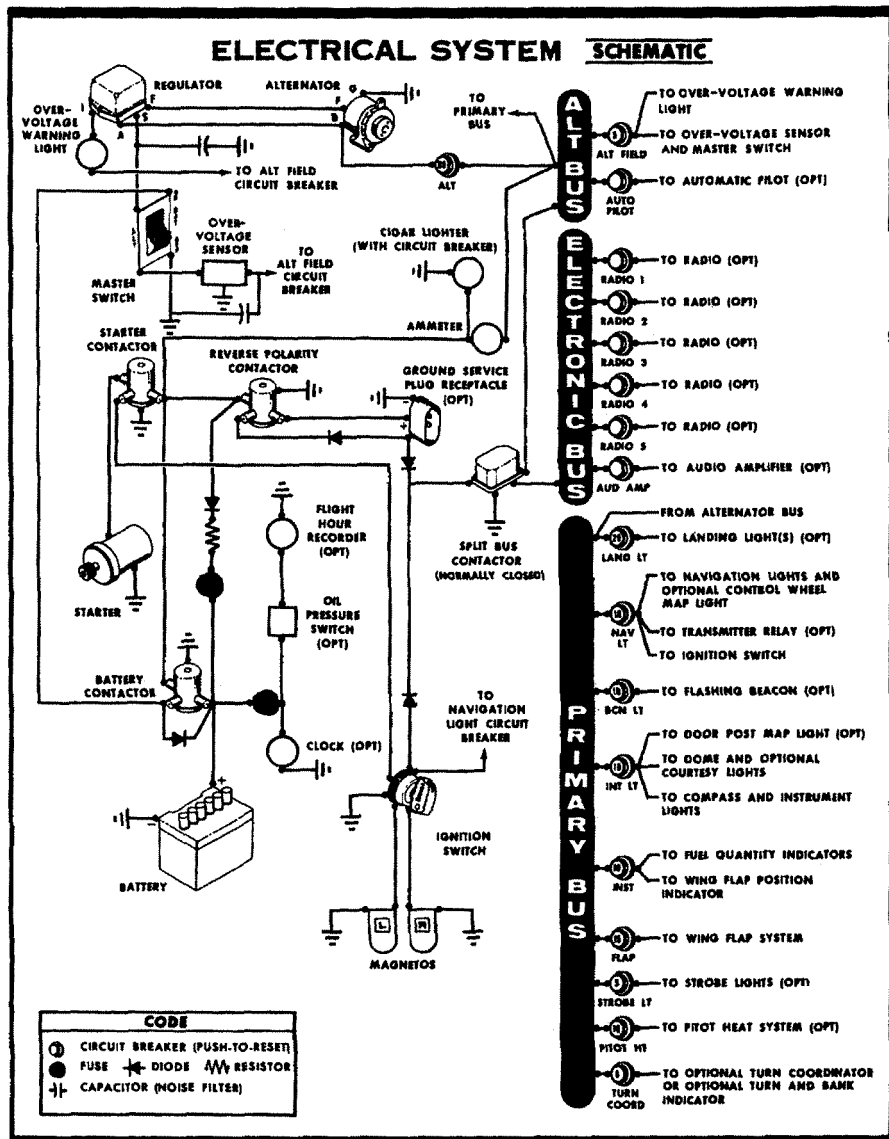


Figure 2-3.

taining electronic systems and the other side having general electrical systems. Both sides of the bus are on at all times except when either an external power source is connected or the ignition/starter switch is turned on; then a power contactor is automatically activated to open the circuit to the electronic bus. Isolating the electronic circuits in this manner prevents harmful transient voltages from damaging the transistors in the electronic equipment.

MASTER SWITCH.

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

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

AMMETER.

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

OVER-VOLTAGE SENSOR AND WARNING LIGHT.

The aircraft is equipped with an automatic over-voltage protection system consisting of an over-voltage sensor behind the instrument panel and a red warning light, labeled HIGH VOLTAGE, under the oil temperature and pressure gages.

In the event an over-voltage condition occurs, the over-voltage sensor automatically removes alternator field current and shuts down the

alternator. The red warning light will then turn on, indicating to the pilot that the alternator is not operating and the aircraft battery is supplying all electrical power.

The over-voltage sensor may be reset by turning the master switch off and back on again. If the warning light does not illuminate, normal alternator charging has resumed; however, if the light does illuminate again, a malfunction has occurred, and the flight should be terminated as soon as practical.

The over-voltage warning light may be tested by momentarily turning off the ALT portion of the master switch and leaving the BAT portion turned on.

CIRCUIT BREAKERS AND FUSES.

The majority of electrical circuits in the aircraft are protected by "push-to-reset" circuit breakers mounted on the instrument panel. Exceptions to this are the optional clock and flight hour recorder circuits, and the battery contactor closing (external power) circuit which have fuses mounted adjacent to the battery. Also, the cigar lighter is protected by a manually reset type circuit breaker mounted directly on the back of the lighter behind the instrument panel.

When more than one radio is installed, the radio transmitter relay (which is a part of the radio installation) is protected by the navigation lights circuit breaker labeled NAV LT. It is important to remember that any malfunction in the navigation lights system which causes the circuit breaker to open will de-activate both the navigation lights and the transmitter relay. In this event, the navigation light switch should be turned off to isolate the circuit; then reset the circuit breaker to re-activate the transmitter relay and permit its usage. Do not turn on the navigation lights switch until the malfunction has been corrected.

LIGHTING EQUIPMENT.

EXTERIOR LIGHTING.

Conventional navigation lights are located on the wing tips and top of the rudder. Optional lighting includes a single landing light or dual landing/taxi lights in the cowl nose cap, a flashing beacon on the top of

the vertical fin, a strobe light on each wing tip, and two courtesy lights, one under each wing, just outboard of the cabin door. The courtesy lights are controlled by the dome light switch located on the overhead console. All other exterior lights are controlled by rocker type switches located on the left switch and control panel. The switches are ON in the up position and OFF in the down position.

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

The two high intensity strobe lights will enhance anti-collision protection. However, the lights should be turned off when taxiing in the vicinity of other aircraft, or during flight through clouds, fog or haze.

INTERIOR LIGHTING.

Illumination of the instrument panel is provided by red flood lighting in the forward portion of the overhead console. The magnetic compass and radio equipment have integral lighting. A dual rheostat control on the left switch and control panel operates these lights. The inner knob, labeled PANEL, operates the instrument panel and compass lighting. The outer knob, labeled RADIO, controls all radio lighting.

A cabin dome light is located in the overhead console, and is operated by a switch adjacent to the light. To turn the light on, move the switch to the right. This will also operate the optional courtesy lights.

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

A doorpost map light is also offered as optional equipment, and is located at the top of the left forward doorpost. The light contains both red and white bulbs, and may be positioned to illuminate any area desired by the pilot. A switch on the left forward doorpost is labeled RED, OFF, and WHITE. Placing the switch in the top position will provide a red light. In the bottom position, standard white lighting is provided. The center position is OFF.

WING FLAP SYSTEM.

The wing flaps are electrically operated by a flap motor located in the right wing. Flap position is controlled by a switch, labeled WING FLAPS on the lower center portion of the instrument panel. Flap position is shown by an indicator on the lower right portion of the instrument panel below the right control wheel position.

To extend the wing flaps, the flap switch must be depressed and held in the DOWN position until the desired degree of extension is reached. Releasing the switch allows it to return to the center off position. Normal full flap extension in flight will require approximately 9 seconds. After the flaps reach maximum extension or retraction, limit switches will automatically shut off the flap motor.

To retract the flaps, place the flap switch in the UP position. The switch will remain in the UP position without manual assistance due to an over-center design of the switch. Full flap retraction in flight requires approximately 7 seconds. More gradual flap retraction can be accomplished by intermittent operation of the flap switch to the UP position. After full retraction, the switch is normally returned to the center off position.

CABIN HEATING, VENTILATING AND DEFROSTING SYSTEM.

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

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

Separate adjustable ventilators supply additional air; one near each upper corner of the windshield supplies air for the pilot and copilot, and two optional ventilators in the rear cabin ceiling supply air to the rear seat passengers.

SHOULDER HARNESES.

Shoulder harnesses are provided as standard equipment for the pilot and front seat passenger, and as optional equipment for the rear seat passengers. Seat belts are standard equipment for all passengers.

Each standard front seat harness is attached to a rear door post just above window line and is stowed behind a stowage sheath mounted above each cabin door. The optional rear seat shoulder harnesses are attached just behind the lower corners of the aft side windows. Each harness is stowed behind a stowage sheath located above the aft side window.

To use a standard front or optional rear seat shoulder harness, fasten and adjust the seat belt first. Remove the harness from the stowed position, and lengthen as required by pulling on the end of the harness and the narrow release strap. Snap the harness metal stud firmly into the retaining slot adjacent to the seat belt buckle. Then adjust to length by pulling down on the free end of the harness. A properly adjusted harness will permit the occupant to lean forward enough to sit completely erect but is tight enough to prevent excessive forward movement and contact with objects during sudden deceleration. Also, the pilot will want the freedom to reach all controls easily.

Releasing and removing the shoulder harness is accomplished by pulling upward on the narrow release strap and removing the harness stud from the slot in the seat belt buckle. In an emergency, the shoulder harness may be removed by releasing the seat belt first and pulling the harness over the head by pulling up on the release strap.

INTEGRATED SEAT BELT/SHOULDER HARNESES WITH INERTIA REEL.

Optional integrated seat belt/shoulder harnesses with inertia reels are available for the pilot and front seat passenger. The seat belt/shoulder harnesses extend from inertia reels located in the cabin ceiling to attach

points on the inboard side of the two front seats. A separate seat belt half and buckle is located on the outboard side of the seats. Inertia reels allow complete freedom of body movement. However, in the event of a sudden deceleration, they will lock up automatically to protect the occupants.

NOTE

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

To use the seat belt/shoulder harness, adjust the metal buckle half on the harness up far enough to allow it to be drawn across the lap of the occupant and be fastened into the outboard seat belt buckle. Adjust seat belt tension by pulling up on the shoulder harness. To remove the seat belt/shoulder harness, release the seat belt buckle and allow the inertia reel to draw the harness to the inboard side of the seat.

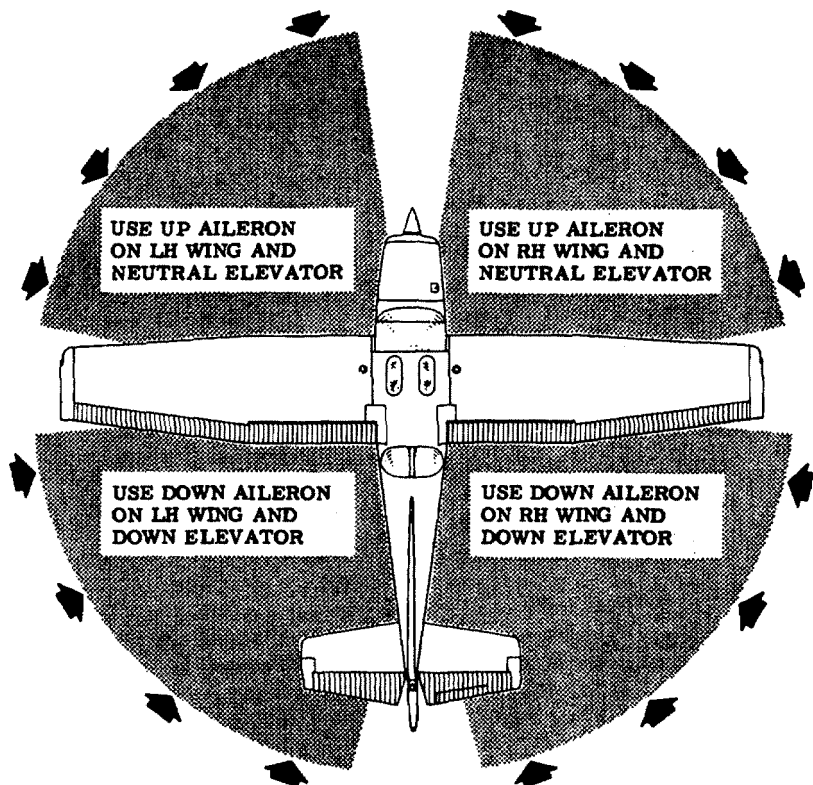
STARTING ENGINE.

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

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

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

TAXIING DIAGRAM



CODE

WIND DIRECTION



NOTE

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

Figure 2-4.

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

NOTE

Additional details for cold weather starting and operation may be found under Cold Weather Operation in this section.

TAXIING.

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

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

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

BEFORE TAKE-OFF.

WARM-UP.

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

MAGNETO CHECK.

The magneto check should be made at 1700 RPM as follows. Move ignition switch first to R position and note RPM. Next move switch back to BOTH to clear the other set of plugs. Then move switch to the L position, note RPM and return the switch to the BOTH position. RPM drop

should not exceed 125 RPM on either magneto or show greater than 50 RPM differential between magnetos. If there is a doubt concerning operation of the ignition system, RPM checks at higher engine speeds will usually confirm whether a deficiency exists.

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

ALTERNATOR CHECK.

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

TAKE-OFF.

POWER CHECK.

It is important to check full-throttle engine operation early in the take-off run. Any signs of rough engine operation or sluggish engine acceleration is good cause for discontinuing the take-off. If this occurs, you are justified in making a thorough full-throttle, static runup before another take-off is attempted. The engine should run smoothly and turn approximately 2270 to 2370 RPM with carburetor heat off and mixture full rich.

NOTE

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

Full-throttle runups over loose gravel are especially harmful to propeller tips. When take-offs must be made over a gravel surface, it is very important that the throttle be advanced slowly. This allows the airplane to start rolling before high RPM is developed, and the gravel will be blown back of the propeller rather than pulled into it. When unavoidable

able small dents appear in the propeller blades, they should be immediately corrected as described in Section V under propeller care.

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

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

WING FLAP SETTINGS.

Normal and obstacle clearance take-offs are performed with wing flaps up. The use of 10° flaps will shorten the ground run approximately 10%, but this advantage is lost in the climb to a 50-foot obstacle. Therefore, the use of 10° flaps is reserved for minimum ground runs or for take-off from soft or rough fields. If 10° of flaps are used for minimum ground runs, it is preferable to leave them extended rather than retract them in the climb to the obstacle. In this case, use an obstacle clearance speed of 65 MPH. As soon as the obstacle is cleared, the flaps may be retracted as the aircraft accelerates to the normal flaps-up climb speed of 80 to 90 MPH.

During a high altitude take-off in hot weather where climb would be marginal with 10° flaps, it is recommended that the flaps not be used for take-off. Flap settings greater than 10° are not recommended at any time for take-off.

PERFORMANCE CHARTS.

Consult the Take-Off Data chart in Section VI for take-off distances under various gross weight, altitude, headwind, temperature, and runway surface conditions.

CROSSWIND TAKE-OFFS.

Take-offs into strong crosswinds normally are performed with the minimum flap setting necessary for the field length to minimize the drift angle immediately after take-off. The aircraft is accelerated to a speed slightly higher than normal, then pulled off abruptly to prevent possible settling back to the runway while drifting. When clear of the ground, make a coordinated turn into the wind to correct for drift.

ENROUTE CLIMB.

CLIMB DATA.

For detailed data, refer to the Maximum Rate-Of-Climb Data chart in Section VI.

CLIMB SPEEDS.

Normal climbs are performed at 80 to 90 MPH with flaps up and full throttle for best engine cooling. The mixture should be full rich below 3000 feet and may be leaned above 3000 feet for smoother engine operation or to obtain maximum RPM for maximum performance climb. The maximum rate-of-climb speeds range from 91 MPH at sea level to 80 MPH at 10,000 feet. If an enroute obstruction dictates the use of a steep climb angle, climb at 75 MPH with flaps retracted.

NOTE

Steep climbs at low speeds should be of short duration to improve engine cooling.

CRUISE.

Normal cruising is done at power settings up to 75% power. The engine RPM and corresponding fuel consumption for various altitudes can be determined by using your Cessna Power Computer or the Operational Data in Section VI.

The Operational Data in Section VI shows the increased range and improved fuel economy that is obtainable when operating at lower power settings and higher altitudes. 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.

The Cruise Performance table on the following page shows the true airspeed and miles per gallon during cruise for various altitudes and percent powers. This table should be used as a guide, along with the available winds aloft information, to determine the most favorable altitude and power setting for a given trip.

CRUISE PERFORMANCE

SKYHAWK

	75% POWER		65% POWER		55% POWER	
ALTITUDE	TAS	MPG	TAS	MPG	TAS	MPG
Sea Level	128	15.4	121	16.8	111	17.3
4000 Feet	133	16.0	125	17.4	114	17.8
8000 Feet	138	16.6	129	17.9	117	18.3
Standard Conditions					Zero Wind	

To achieve the lean mixture fuel consumption figures shown in Section VI, the mixture should be leaned as follows:

- (1) Pull the mixture control out until engine RPM peaks and begins to fall off.
- (2) Enrichen slightly back to peak RPM.

For best fuel economy at 75% power or less, operate at the leanest mixture that results in smooth engine operation or at 50 RPM on the lean side of the peak RPM, whichever occurs first. This will result in approximately 5% greater range than shown in this manual.

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

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

In extremely heavy rain, the use of partial carburetor heat (control approximately 2/3 out), and part throttle (closed at least one inch), may

be necessary to retain adequate power. Power changes should be made cautiously followed by prompt adjustment of the mixture for smoothest operation.

STALLS.

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

Power-off stall speeds at maximum gross weight and aft c. g. position are presented on page 6-2 as calibrated airspeeds since indicated airspeeds are unreliable near the stall.

SPINS.

Intentional spins are approved in this aircraft in the Utility Category only. Although this aircraft is inherently resistant to spins, the following techniques may be used to perform intentional spins for training or practice. To obtain a clean entry, decelerate the aircraft at a faster rate than is used for stalls. Then, just as the stall occurs, apply full up elevator, full rudder in the desired spin direction, and momentarily use full engine power. As the aircraft begins to spin, reduce the power to idle and maintain full pro-spin elevator and rudder deflections. The application of ailerons in the direction of the desired spin may also help obtain a clean entry.

During extended spins of two to three turns or more, the spin will tend to change into a spiral, particularly to the right. This will be accompanied by an increase in airspeed and gravity loads on the aircraft. If this occurs, recovery should be accomplished quickly by leveling the wings and recovering from the resulting dive.

To recover from an intentional or inadvertent spin, use the following procedure:

- (1) Retard throttle to idle position.
- (2) Apply full rudder opposite to the direction of rotation.
- (3) After one-fourth turn, move the control wheel forward of neutral in a brisk motion.

(4) As the rotation stops, neutralize the rudder, and make a smooth recovery from the resulting dive.

Intentional spins with flaps extended are prohibited.

LANDINGS.

Normal landings are made power-off with any flap setting desired. Steep slips should be avoided with flap settings greater than 20° due to a slight tendency for the elevator to oscillate under certain combinations of airspeed, sideslip angle, and center of gravity loadings.

NOTE

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

NORMAL LANDING.

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

SHORT FIELD LANDING.

For short field landings, make a power-off approach at approximately 70 MPH indicated airspeed with 40° of flaps. Touchdown should be made on the main wheels first. Immediately after touchdown, lower the nose gear to the ground and apply heavy braking as required. For maximum brake effectiveness after all three wheels are on the ground, retract the flaps, hold full nose up elevator and apply maximum possible brake pressure without sliding the tires.

CROSSWIND LANDING.

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

may be used, the wing-low method gives the best control. After touch-down, hold a straight course with the steerable nose wheel and occasional braking if necessary.

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

BALKED LANDING.

In a bailed landing (go-around) climb, reduce the wing flap setting to 20° immediately after full power is applied. If the flaps were extended to 40°, the reduction to 20° may be approximated by placing the flap switch in the UP position for two seconds and then returning the switch to neutral. If obstacles must be cleared during the go-around climb, leave the wing flaps in the 10° to 20° range and maintain a climb speed of 65 to 75 MPH until the obstacles are cleared. Above 3000 feet, lean the mixture to obtain maximum RPM. After clearing any obstacles, the flaps may be retracted as the aircraft accelerates to the normal flaps-up climb speed of 80 to 90 MPH.

COLD WEATHER OPERATION.

STARTING.

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

NOTE

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

In extremely cold (0°F and lower) weather, the use of an external pre-heater and an external power source are recommended whenever possible to obtain positive starting and to reduce wear and abuse to the engine and electrical system. Pre-heat will thaw the oil trapped in the oil cooler, which probably will be congealed prior to starting in extremely cold temperatures. When using an external power source, the position of the master switch is important. Refer to Section VII under Ground Service Plug Receptacle for operating details.

Cold weather starting procedures are as follows:

With Preheat:

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

NOTE

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

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

Without Preheat:

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

NOTE

If the engine does not start during the first few attempts, or

if the engine firing diminishes in strength, it is probable that the spark plugs have been frosted over. Preheat must be used before another start is attempted.

IMPORTANT

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

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

FLIGHT OPERATIONS.

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

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

When operating in sub-zero temperature, avoid using partial carburetor heat. Partial heat may increase the carburetor air temperature to the 32° to 70°F range, where icing is critical under certain atmospheric conditions.

Refer to Section VII for cold weather equipment.

HOT WEATHER OPERATION.

Refer to the general warm temperature starting information under Starting Engine in this section. Avoid prolonged engine operation on the ground.

NOISE ABATEMENT.

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

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

- (1) Pilots operating aircraft under VFR over outdoor assemblies of persons, recreational and park areas, and other noise-sensitive areas should make every effort to fly not less than 2,000 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.

NOTE

The above recommended procedures do not apply where they would conflict with Air Traffic Control clearances or instructions, or where, in the pilot's judgement, an altitude of less than 2,000 feet is necessary for him to adequately exercise his duty to see and avoid other aircraft.

Section III

EMERGENCY PROCEDURES

Emergencies caused by aircraft or engine malfunctions are extremely rare if proper pre-flight inspections and maintenance are practiced. Enroute weather emergencies can be minimized or eliminated by careful flight planning and good judgement when unexpected weather is encountered. However, should an emergency arise the basic guidelines described in this section should be considered and applied as necessary to correct the problem.

ENGINE FAILURE.

ENGINE FAILURE AFTER TAKE-OFF.

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

- (1) Airspeed -- 75 MPH (flaps UP).
70 MPH (flaps DOWN).
- (2) Mixture -- IDLE CUT-OFF.
- (3) Fuel Selector Valve -- OFF.
- (4) Ignition Switch -- OFF.
- (5) Wing Flaps -- AS REQUIRED (40° recommended).
- (6) Master Switch -- OFF.

ENGINE FAILURE DURING FLIGHT.

While gliding toward a suitable landing area, an effort should be made to identify the cause of the failure. If time permits, and an engine restart

is feasible, proceed as follows:

- (1) Airspeed -- 80 MPH.
- (2) Carburetor Heat -- ON.
- (3) Fuel Selector Valve -- BOTH.
- (4) Mixture -- RICH.
- (5) Ignition Switch -- BOTH (or START if propeller is not windmilling)
- (6) Primer -- IN and LOCKED.

If the engine cannot be restarted, a forced landing without power must be executed. A recommended procedure for this is given in the following paragraph.

FORCED LANDINGS.

EMERGENCY LANDING WITHOUT ENGINE POWER.

If all attempts to restart the engine fail and a forced landing is imminent, select a suitable field and prepare for the landing as follows:

- (1) Airspeed -- 75 MPH (flaps UP).
70 MPH (flaps DOWN).
- (2) Mixture -- IDLE CUT-OFF.
- (3) Fuel Selector Valve -- OFF.
- (4) Ignition Switch -- OFF.
- (5) Wing Flaps -- AS REQUIRED (40° recommended).
- (6) Master Switch -- OFF.
- (7) Doors -- UNLATCH PRIOR TO TOUCHDOWN.
- (8) Touchdown -- SLIGHTLY TAIL LOW.
- (9) Brakes -- APPLY HEAVILY.

PRECAUTIONARY LANDING WITH ENGINE POWER.

Before attempting an "off airport" landing, one should drag the landing area at a safe but low altitude to inspect the terrain for obstructions and surface conditions, proceeding as follows:

- (1) Drag over selected field with flaps 20° and 70 MPH airspeed, noting the preferred area for touchdown for the next landing approach. Then retract flaps upon reaching a safe altitude and airspeed.
- (2) Radio, Electrical Switches -- OFF.
- (3) Wing Flaps -- 40° (on final approach).

- (4) Airspeed -- 70 MPH.
- (5) Master Switch -- OFF.
- (6) Doors -- UNLATCH PRIOR TO TOUCHDOWN.
- (7) Touchdown -- SLIGHTLY TAIL LOW.
- (8) Ignition Switch -- OFF.
- (9) Brakes -- APPLY HEAVILY.

DITCHING.

Prepare for ditching by securing or jettisoning heavy objects located in the baggage area, and collect folded coats or cushions for protection of occupant's face at touchdown. Transmit Mayday message on 121.5 MHz. giving location and intentions.

- (1) Plan approach into wind if winds are high and seas are heavy. With heavy swells and light wind, land parallel to swells.
- (2) Approach with flaps 40° and sufficient power for a 300 ft./min. rate of descent at 70 MPH
- (3) Unlatch the cabin doors.
- (4) Maintain a continuous descent until touchdown in level attitude. Avoid a landing flare because of difficulty in judging aircraft height over a water surface.
- (5) Place folded coat or cushion in front of face at time of touchdown.
- (6) Evacuate aircraft through cabin doors. If necessary, open window to flood cabin compartment for equalizing pressure so that door can be opened.
- (7) Inflate life vests and raft (if available) after evacuation of cabin. The aircraft cannot be depended on for flotation for more than a few minutes.

FIRES.

ENGINE FIRE DURING START ON GROUND.

Improper starting procedures during a difficult cold weather start can cause a backfire which could ignite fuel that has accumulated in the intake duct. In this event, proceed as follows:

- (1) Continue cranking in an attempt to get a start which would suck the flames and accumulated fuel through the carburetor and into the engine.
- (2) If the start is successful, run the engine at 1700 RPM for a few

minutes before shutting it down to inspect the damage.

(3) If engine start is unsuccessful, continue cranking for two or three minutes with throttle full open while ground attendants obtain fire extinguishers.

(4) When ready to extinguish fire, discontinue cranking and turn off master switch, ignition switch, and fuel selector valve.

(5) Smother flames with fire extinguisher, seat cushion, wool blanket, or loose dirt. If practical, try to remove carburetor air filter if it is ablaze.

(6) Make a thorough inspection of fire damage, and repair or replace damaged components before conducting another flight.

ENGINE FIRE IN FLIGHT.

Although engine fires are extremely rare in flight, the following steps should be taken if one is encountered:

(1) Mixture -- IDLE CUT-OFF.

(2) Fuel Selector Valve -- OFF.

(3) Master Switch -- OFF.

(4) Cabin Heat and Air -- OFF (except overhead vents).

(5) Airspeed -- 120 MPH. If fire is not extinguished, increase glide speed to find an airspeed which will provide an incombustible mixture.

Execute a forced landing as outlined in preceding paragraphs.

ELECTRICAL FIRE IN FLIGHT.

The initial indication of an electrical fire is usually the odor of burning insulation. The following procedure should then be used:

(1) Master Switch -- OFF.

(2) All Radio/Electrical Switches -- OFF.

(3) Vents/Cabin Air/Heat -- CLOSED.

(4) Fire Extinguisher -- ACTIVATE (if available).

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

(5) Master Switch -- ON.

(6) Circuit Breakers -- CHECK for faulty circuit, do not reset.

(7) Radio/Electrical Switches -- ON one at a time, with delay after each until short circuit is localized.

(8) Vents/Cabin Air/Heat -- OPEN when it is ascertained that fire is completely extinguished.

DISORIENTATION IN CLOUDS.

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

EXECUTING A 180° TURN IN CLOUDS.

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

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

EMERGENCY LET-DOWNS THROUGH CLOUDS.

If possible, obtain radio clearance for an emergency descent through clouds. To guard against a spiral dive, choose an easterly or westerly heading to minimize compass card swings due to changing bank angles. In addition, keep hands off the control wheel and steer a straight course with rudder control by monitoring the turn coordinator. Occasionally check the compass heading and make minor corrections to hold an approximate course. Before descending into the clouds, set up a stabilized let-

down condition as follows:

- (1) Apply full rich mixture.
- (2) Use full carburetor heat.
- (3) Reduce power to set up a 500 to 800 ft./min. rate of descent.
- (4) Adjust the elevator trim tab for a stabilized descent at 80 to 90 MPH.
- (5) Keep hands off the control wheel.
- (6) Monitor turn coordinator and make corrections by rudder alone.
- (7) Check trend of compass card movement and make cautious corrections with rudder to stop the turn.
- (8) Upon breaking out of clouds, resume normal cruising flight.

RECOVERY FROM A SPIRAL DIVE.

If a spiral is encountered, proceed as follows:

- (1) Close the throttle.
- (2) Stop the turn by using coordinated aileron and rudder control to align the symbolic aircraft in the turn coordinator with the horizon reference line.
- (3) Cautiously apply elevator back pressure to slowly reduce the indicated airspeed to 90 MPH.
- (4) Adjust the elevator trim control to maintain a 90 MPH glide.
- (5) Keep hands off the control wheel, using rudder control to hold a straight heading.
- (6) Apply carburetor heat.
- (7) Clear engine occasionally, but avoid using enough power to disturb the trimmed glide.
- (8) Upon breaking out of clouds, apply normal cruising power and resume flight.

FLIGHT IN ICING CONDITIONS.

Although flying in known icing conditions is prohibited, an unexpected icing encounter should be handled as follows:

- (1) Turn pitot heat switch ON (if installed).
- (2) Turn back or change altitude to obtain an outside air temperature that is less conducive to icing.
- (3) Pull cabin heat control full out and open defroster outlet to obtain maximum windshield defroster airflow. Adjust cabin air control to

get maximum defroster heat and airflow.

- (4) Open the throttle to increase engine speed and minimize ice build-up on propeller blades.
- (5) Watch for signs of carburetor air filter ice and apply carburetor heat as required. An unexplained loss in engine speed could be caused by carburetor ice or air intake filter ice. Lean the mixture for maximum RPM if carburetor heat is used continuously.
- (6) Plan a landing at the nearest airport. With an extremely rapid ice build-up, select a suitable "off airport" landing site.
- (7) With an ice accumulation of 1/4 inch or more on the wing leading edges, be prepared for significantly higher stall speed.
- (8) Leave wing flaps retracted. With a severe ice build-up on the horizontal tail, the change in wing wake airflow direction caused by wing flap extension could result in a loss of elevator effectiveness.
- (9) Open left window and, if practical, scrape ice from a portion of the windshield for visibility in the landing approach.
- (10) Perform a landing approach using a forward slip, if necessary, for improved visibility.
- (11) Approach at 75 to 85 MPH, depending upon the amount of ice accumulation.
- (12) Perform a landing in level attitude.

ROUGH ENGINE OPERATION OR LOSS OF POWER.

CARBURETOR ICING.

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

SPARK PLUG FOULING.

A slight engine roughness in flight may be caused by one or more spark plugs becoming fouled by carbon or lead deposits. This may be verified by turning the ignition switch momentarily from BOTH to either L or R position. An obvious power loss in single ignition operation is evidence of spark plug or magneto trouble. Assuming that spark plugs are the more likely cause, lean the mixture to the normal lean setting for

cruising flight. If the problem does not clear up in several minutes, determine if a richer mixture setting will produce smoother operation. If not, proceed to the nearest airport for repairs using the BOTH position of the ignition switch unless extreme roughness dictates the use of a single ignition position.

MAGNETO MALFUNCTION.

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

LOW OIL PRESSURE.

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

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

ELECTRICAL POWER SUPPLY SYSTEM MALFUNCTIONS.

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

The paragraphs below describe the recommended remedy for each situation.

EXCESSIVE RATE OF CHARGE.

After engine starting and heavy electrical usage at low engine speeds (such as extended taxiing) the battery condition will be low enough to accept above normal charging during the initial part of a flight. However, after thirty minutes of cruising flight, the ammeter should be indicating less than two needle widths of charging current. If the charging rate were to remain above this value on a long flight, the battery would overheat and evaporate the electrolyte at an excessive rate. Electronic components in the electrical system could be adversely affected by higher than normal voltage if a faulty voltage regulator setting is causing the overcharging. To preclude these possibilities, an over-voltage sensor will automatically shut down the alternator and the over-voltage warning light will illuminate if the charge voltage reaches approximately 16 volts. Assuming that the malfunction was only momentary, an attempt should be made to reactivate the alternator system. To do this, turn both sides of the master switch off and then on again. If the problem no longer exists, normal alternator charging will resume and the warning light will go off. If the light comes on again, a malfunction is confirmed. In this event, the flight should be terminated and/or the current drain on the battery minimized because the battery can supply the electrical system for only a limited period of time. If the emergency occurs at night, power must be conserved for later use of the landing light and flaps during landing.

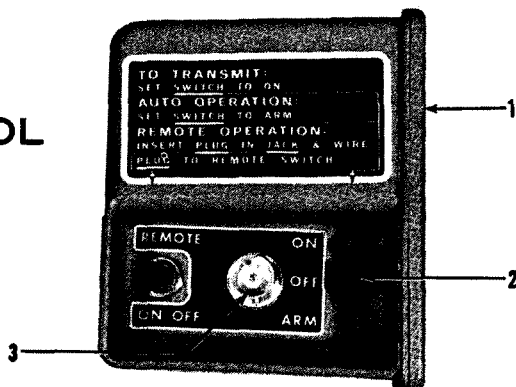
INSUFFICIENT RATE OF CHARGE.

If the ammeter indicates a continuous discharge rate in flight, the alternator is not supplying power to the system and should be shut down since the alternator field circuit may be placing an unnecessary load on the system. All non-essential equipment should be turned off and the flight terminated as soon as practical.

EMERGENCY LOCATOR TRANSMITTER (ELT).

The ELT consists of a self-contained dual-frequency radio transmitter and battery power supply, and is activated by an impact of 5g or more as may be experienced in a crash landing. The ELT emits an omni-directional signal on the international distress frequencies of 121.5 and 243.0 MHz. General aviation and commercial aircraft, the FAA, and CAP

ELT CONTROL PANEL



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

Figure 3-1.

monitor 121.5 MHz, and 243.0 MHz is monitored by the military. Following a crash landing, the ELT will provide line-of-sight transmission up to 100 miles at 10,000 feet. The duration of ELT transmissions is affected by ambient temperature. At temperatures of +70° to +130°F, continuous transmission for 115 hours can be expected; a temperature of -40°F will shorten the duration to 70 hours.

The ELT is readily identified as a bright orange unit mounted behind a cover in the aft baggage compartment on the right side of the fuselage.

To gain access to the unit, pull out on the black fasteners on the bottom of the cover and remove the cover. The ELT is operated by a control panel at the forward facing end of the unit. (see figure 3-1).

ELT OPERATION.

- (1) **NORMAL OPERATION:** As long as the function selector switch remains in the ARM position, the ELT automatically activates following an impact of 5 g or more over a short period of time.
- (2) **ELT FAILURE:** If "g" switch actuation is questioned following a minor crash landing, gain access to the ELT and place the function selector switch in the ON position.
- (3) **PRIOR TO SIGHTING RESCUE AIRCRAFT:** Conserve aircraft battery. Do not activate radio transceiver.
- (4) **AFTER SIGHTING RESCUE AIRCRAFT:** Place ELT function selector switch in the OFF position, preventing radio interference. Attempt contact with rescue aircraft with the radio transceiver set to a frequency of 121.5 MHz. If no contact is established, return the function selector switch to ON immediately.
- (5) **FOLLOWING RESCUE:** Place ELT function selector switch in the OFF position, terminating emergency transmissions.
- (6) **INADVERTENT ACTIVATION:** Following a lightning strike or an exceptionally hard landing, the ELT may activate although no emergency exists. Select 121.5 MHz on your radio transceiver. If the ELT can be heard transmitting, place the function selector switch in the OFF position; then immediately return the switch to ARM.

Section IV

OPERATING LIMITATIONS

OPERATIONS AUTHORIZED.

Your Cessna exceeds the requirements of airworthiness as set forth by the United States Government, and is certificated under FAA Type Certificate No. 3A12 as Cessna Model No. 172M.

The aircraft may be equipped for day, night, VFR, or IFR operation. Your Cessna Dealer will be happy to assist you in selecting equipment best suited to your needs.

Your aircraft must be operated in accordance with all FAA-approved markings and placards in the aircraft. If there is any information in this section which contradicts the FAA-approved markings and placards, it is to be disregarded.

MANEUVERS - NORMAL CATEGORY.

This aircraft is certificated in both the normal and utility category. The normal category is applicable to aircraft intended for non-aerobatic operations. These include any maneuvers incidental to normal flying, stalls (except whip stalls) and turns in which the angle of bank is not more than 60°. In connection with the foregoing, the following gross weight and flight load factors apply:

Gross Weight	2300 lbs	
Flight Load Factor		
*Flaps Up	+3.8	-1.52
*Flaps Down	+3.0	

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

MANEUVERS - UTILITY CATEGORY.

This aircraft is not designed for purely aerobatic flight. However, in the acquisition of various certificates such as commercial pilot, instrument pilot and flight instructor, certain maneuvers are required by the FAA. All of these maneuvers are permitted in this aircraft when operated in the utility category. In connection with the utility category, the following gross weight and flight load factors apply, with maximum entry speeds for maneuvers as shown:

Gross Weight	2000 lbs
Flight Load Factor	
Flaps Up	+4.4 -1.76
Flaps Down	+3.0

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

<u>MANEUVER</u>	<u>RECOMMENDED ENTRY SPEED*</u>
Chandelles	120 mph (104 knots)
Lazy Eights	120 mph (104 knots)
Steep Turns	112 mph (97 knots)
Spins	Slow Deceleration
Stalls (Except Whip Stalls).	Slow Deceleration

*Abrupt use of the controls is prohibited above 112 MPH.

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

AIRSPED LIMITATIONS (CAS).

The following is a list of the certificated calibrated airspeed (CAS) limitations for the aircraft.

Never Exceed Speed (glide or dive, smooth air)	182 MPH
Maximum Structural Cruising Speed	145 MPH
Maximum Speed, Flaps Extended	100 MPH
*Maneuvering Speed	112 MPH

*The maximum speed at which you may use abrupt control travel.

AIRSPED INDICATOR MARKINGS.

The following is a list of the certificated calibrated airspeed markings (CAS) for the aircraft.

Never Exceed (glide or dive, smooth air)	182 MPH (red line)
Caution Range	145-182 MPH (yellow arc)
Normal Operating Range	61-145 MPH (green arc)
Flap Operating Range	54-100 MPH (white arc)

ENGINE OPERATION LIMITATIONS.

Power and Speed 150 BHP at 2700 RPM

ENGINE INSTRUMENT MARKINGS.

OIL TEMPERATURE GAGE.

Normal Operating Range	Green Arc
Maximum Allowable	245°F (red line)

OIL PRESSURE GAGE.

Minimum Idling	25 psi (red line)
Normal Operating Range	60-90 psi (green arc)
Maximum	100 psi (red line)

FUEL QUANTITY INDICATORS.

Empty (2.0 gallons unusable each tank) E (red line)

TACHOMETER.

Normal Operating Range:

At sea level 2200-2500 RPM (inner green arc)

At 5000 feet 2200-2600 RPM (middle green arc)

At 10,000 feet 2200-2700 RPM (outer green arc)

Maximum Allowable 2700 RPM (red line)

CARBURETOR AIR TEMPERATURE GAGE (OPT).

Icing Range -15° to 5°C (yellow arc)

WEIGHT AND BALANCE.

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

Take the licensed empty weight and moment from appropriate weight and balance records carried in your aircraft, and write them down in the column titled YOUR AIRPLANE on the Sample Loading Problem.

NOTE

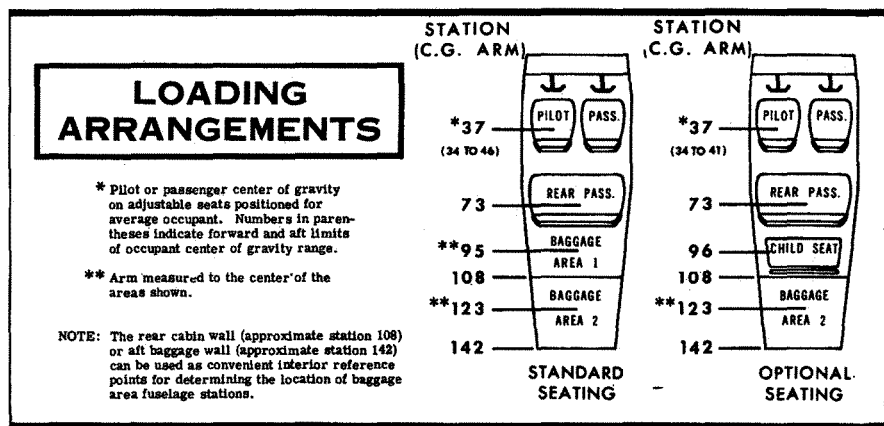
The licensed empty weight and moment are recorded on the Weight and Balance and Installed Equipment Data sheet, or on revised weight and balance records, and are included in the aircraft file. In addition to the licensed empty weight and moment noted on these records, the c.g. arm (fuselage station) is also shown, but need not be used on the Sample Loading Problem. The moment which is shown must be divided by 1000 and this value used as the moment/1000 on the loading problem.

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

NOTE

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

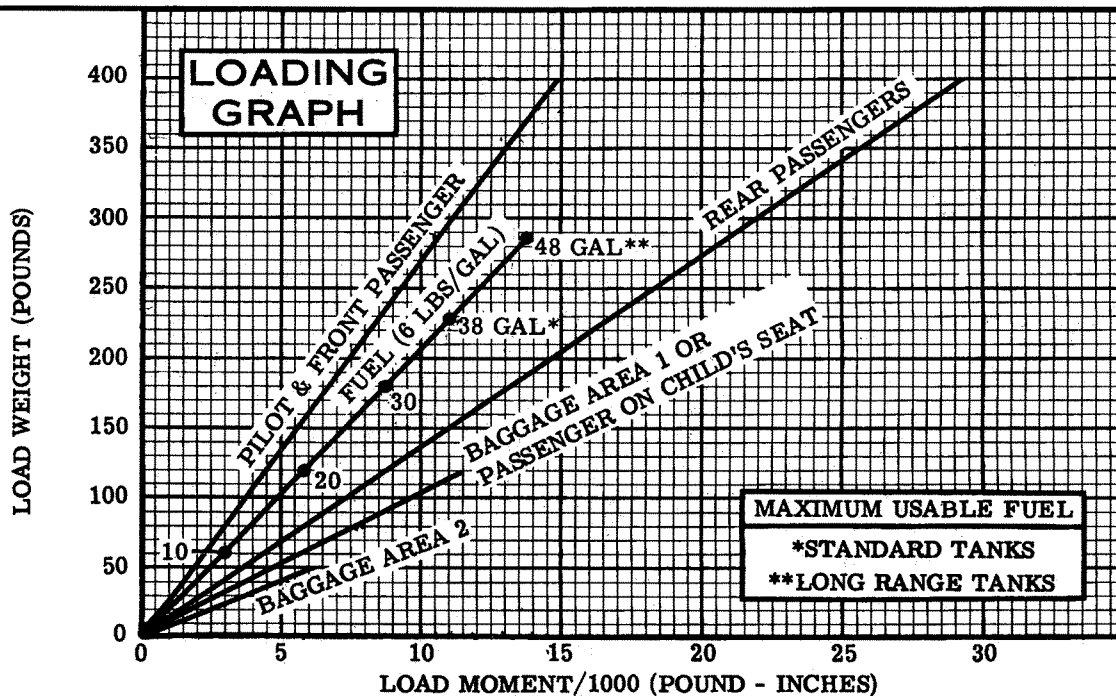
Total the weights and moments/1000 and plot these values on the Center of Gravity Moment Envelope to determine whether the point falls within the envelope, and if the loading is acceptable.



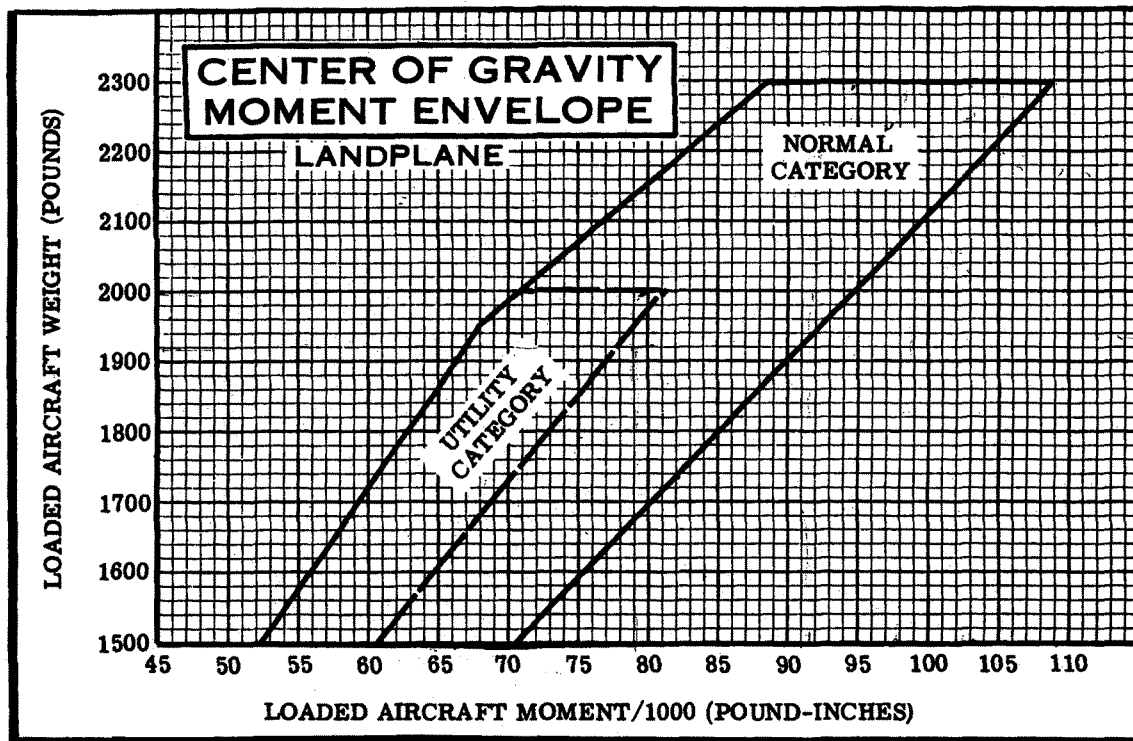
SAMPLE LOADING PROBLEM		SAMPLE AIRPLANE		YOUR AIRPLANE	
		Weight (lbs.)	Moment (lb. - ins. /1000)	Weight (lbs.)	Moment (lb. - ins. /1000)
1. Licensed Empty Weight (Use the data pertaining to your airplane as it is presently equipped. Includes unusable fuel.)		1366	53.8		
2. Oil (8 Qts. - The weight of full oil may be used for all calculations. 8 Qts. = 15 Lbs. at -0.2 Moment/1000).		15	-0.2	15	-0.2
3. Usable Fuel (At 6 Lbs./Gal.)					
Standard Tanks (38 Gal. Maximum)		228	10.9		
Long Range Tanks (48 Gal. Maximum)					
4. Pilot and Front Passenger (Station 34 to 46)		340	12.6		
5. Rear Passengers		340	24.8		
6.* Baggage Area 1 or Passenger on Child's Seat (Station 82 to 108) 120 Lbs. Max.		11	1.0		
7.* Baggage Area 2 (Station 108 to 142) 50 Lbs. Max. . .					
8. TOTAL WEIGHT AND MOMENT		2300	102.9		
9. Locate this point (2300 at 102.9) on the Center of Gravity Moment Envelope, and since this point falls within the envelope, the loading is acceptable. NOTE * The maximum allowable combined weight capacity for baggage areas 1 and 2 is 120 lbs.					

EMPTY TANKS
CG = 50

FULL TANKS
CG = 47.80



- NOTES: (1) Line representing adjustable seats shows the pilot or passenger center of gravity on adjustable seats positioned for an average occupant. Refer to the Loading Arrangements diagram for forward and aft limits of occupant c.g. range.
- (2) Engine Oil: 8 Qts. = 15 Lbs. at -0.2 Moment/1000.



Section V

CARE OF THE AIRPLANE

If your airplane is to retain that 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 Dealer and take advantage of his knowledge and experience. He knows your airplane and how to maintain it. He will remind you when lubrications and oil changes are necessary, and about other seasonal and periodic services.

GROUND HANDLING.

The airplane is most easily and safely maneuvered by hand with the tow-bar attached to the nose wheel. When towing with a vehicle, do not exceed the nose gear turning angle of 30° either side of center, or damage to the gear will result. If the airplane is towed or pushed over a rough surface during hangaring, watch that the normal cushioning action of the nose strut does not cause excessive vertical movement of the tail and the resulting contact with low hangar doors or structure. A flat nose wheel tire or deflated strut will also increase tail height.

MOORING YOUR AIRPLANE.

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

- (1) Set the parking brake and install the control wheel lock.
- (2) Tie sufficiently strong ropes or chains (700 pounds tensile strength) to wing, tail and nose tie-down rings and secure each rope to a ramp tie-down.

- (3) Install a surface control lock over the fin and rudder.
- (4) Install a pitot tube cover.

WINDSHIELD - WINDOWS.

The plastic windshield and windows should be cleaned with an aircraft windshield cleaner. Apply the cleaner sparingly with soft cloths, and rub with moderate pressure until all dirt, oil scum and bug stains are removed. Allow the cleaner to dry, then wipe it off with soft flannel cloths.

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

NOTE

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

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

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

PAINTED SURFACES.

The painted exterior surfaces of your new Cessna have a durable, long lasting finish and, under normal conditions, require no polishing or buffing. Approximately 15 days are required for the paint to cure completely; in most cases, the curing period will have been completed prior to delivery of the airplane. In the event that polishing or buffing is required within the curing period, it is recommended that the work be done by someone experienced in handling uncured paint. Any Cessna Dealer can accomplish this work.

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

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

When the airplane is parked outside in cold climates and it is necessary to remove ice before flight, care should be taken to protect the painted surfaces during ice removal with chemical liquids. A 50-50 solution of isopropyl alcohol and water will satisfactorily remove ice accumulations without damaging the paint. A solution with more than 50% alcohol is harmful and should be avoided. While applying the de-icing solution, keep it away from the windshield and cabin windows since the alcohol will attack the plastic and may cause it to craze.

ALUMINUM SURFACES.

The clad aluminum surfaces of your Cessna may be washed with clear water to remove dirt; oil and grease may be removed with gasoline, naphtha, carbon tetrachloride or other non-alkaline solvents. Dulled aluminum surfaces may be cleaned effectively with an aircraft aluminum polish.

After cleaning, and periodically thereafter, waxing with a good automotive wax will preserve the bright appearance and retard corrosion. Regular waxing is especially recommended for airplanes operated in salt water areas as a protection against corrosion.

PROPELLER CARE.

Preflight inspection of propeller blades for nicks, and wiping them occasionally with an oily cloth to clean off grass and bug stains will assure long, trouble-free service. Small nicks on the propeller, particularly near the tips and on the leading edges, should be dressed out as soon as possible since these nicks produce stress concentrations, and if

ignored, may result in cracks. Never use an alkaline cleaner on the blades; remove grease and dirt with carbon tetrachloride or Stoddard solvent.

INTERIOR CARE.

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

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

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

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

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

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

MAA PLATE/FINISH AND TRIM PLATE.

Information concerning the Type Certificate Number (TC), Production Certificate Number (PC), Model Number and Serial Number of your par-

ticular aircraft can be found on the MAA (Manufacturers Aircraft Association) plate located on the lower part of the left forward door post.

A Finish and Trim plate contains a code describing the interior color scheme and exterior paint combination of the aircraft. The code may be used in conjunction with an applicable Parts Catalog if finish and trim information is needed. This plate is located adjacent to the MAA plate on the left forward door post.

AIRCRAFT FILE.

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

A. To be displayed in the aircraft at all times:

- (1) Aircraft Airworthiness Certificate (FAA Form 8100-2).
- (2) Aircraft Registration Certificate (FAA Form 8050-3).
- (3) Aircraft Radio Station License, if transmitter installed (FCC Form 556).

B. To be carried in the aircraft at all times:

- (1) Weight and Balance, and associated papers (latest copy of the Repair and Alteration Form, FAA Form 337, if applicable).
- (2) Aircraft Equipment List.

C. To be made available upon request:

- (1) Aircraft Log Book.
- (2) Engine Log Book.

Most of the items listed are required by the United States Federal Aviation Regulations. Since the regulations of other nations may require other documents and data, owners of exported aircraft should check with their own aviation officials to determine their individual requirements.

Cessna recommends that these items, plus the Owner's Manual, Power Computer, Pilot's Checklist, Customer Care Program book and Customer Care Card, be carried in the aircraft at all times.

FLYABLE STORAGE.

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

IMPORTANT

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

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

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

INSPECTION REQUIREMENTS.

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

In lieu of the above requirements, an aircraft 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 aircraft inspection requirements of both the 100 HOUR and ANNUAL inspections as applicable to Cessna aircraft.

CESSNA PROGRESSIVE CARE.

The Cessna Progressive Care Program has been designed to help you realize maximum utilization of your aircraft at a minimum cost and downtime. Under this program, your aircraft 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 aircraft that are being flown 200 hours or more per year, and the 100-hour inspection for all other aircraft. 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 CUSTOMER CARE PROGRAM.

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

Coupons attached to the Program book entitle you to an initial inspection and either a Progressive Care Operation No. 1 or the first 100-hour inspection within the first 6 months of ownership at no charge to you. If you take delivery from your Dealer, the initial inspection will have been performed before delivery of the aircraft to you. If you pick up your aircraft 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 aircraft. 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 aircraft 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 on the inside back cover of this manual.

In addition to the EXTERIOR INSPECTION covered in Section I, COMPLETE servicing, inspection, and test requirements for your aircraft are detailed in the aircraft 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 Manual, it is recommended that you contact your Dealer concerning these requirements and begin scheduling your aircraft 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 aircraft is being operated.

OWNER FOLLOW-UP SYSTEM.

Your Cessna Dealer has an Owner Follow-Up System to notify you when he receives information that applies to your Cessna. In addition, if you wish, you may choose to receive similar notification, in the form of Service Letters, directly from the Cessna Customer Services Department.

A subscription form is supplied in your Customer Care Program book for your use, should you choose to request this service. Your Cessna Dealer will be glad to supply you with details concerning these follow-up programs, and stands ready, through his Service Department, to supply you with fast, efficient, low-cost service.

PUBLICATIONS.

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

- **CUSTOMER CARE PROGRAM BOOK**
- **OWNER'S MANUALS FOR YOUR
AIRCRAFT
AVIONICS AND AUTOPILOT**
- **POWER COMPUTER**
- **SALES AND SERVICE DEALER DIRECTORY**

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

- **SERVICE MANUALS AND PARTS CATALOGS FOR YOUR
AIRCRAFT
ENGINE AND ACCESSORIES
AVIONICS AND AUTOPILOT**

Your Cessna Dealer has a current catalog of all Customer Services Supplies that are available, many of which he keeps on hand. Supplies which are not in stock, he will be happy to order for you.

Section VI

OPERATIONAL DATA

The operational data shown on the following pages are compiled from actual tests with the aircraft and engine in good condition and using average piloting technique. You will find this data a valuable aid when planning your flights.

A power setting selected from the range chart usually will be more efficient than a random setting, since it will permit you to estimate your fuel consumption more accurately. You will find that using the charts and your Power Computer will pay dividends in overall efficiency.

Cruise and range performance shown in this section is based on the use of a McCauley 1C160/DTM7553 propeller and a standard equipped Skyhawk. Other conditions for the performance data are shown in the chart headings. Allowances for fuel reserve, headwinds, take-off and climb, and variations in mixture leaning technique should be made and are in addition to those shown on the chart. Other indeterminate variables such as carburetor metering characteristics, engine and propeller conditions, externally-mounted optional equipment and turbulence of the atmosphere may account for variations of 10% or more in maximum range.

Remember that the charts contained herein are based on standard day conditions. For more precise power, fuel consumption, and endurance information, consult the Cessna Power Computer supplied with your aircraft. With the Power Computer, you can easily take into account temperature variations from standard at any flight altitude.

AIRSPEED CORRECTION TABLE												
	IAS	40	50	60	70	80	90	100	110	120	130	140
FLAPS UP	CAS	53	58	64	72	79	88	97	107	117	127	137
FLAPS DOWN	CAS	49	55	63	72	81	90	100	•	•	•	•

Figure 6-1.

STALL SPEEDS – MPH CAS						
		ANGLE OF BANK				
	CONDITION	0°	20°	40°	60°	
2300 LBS. GROSS WEIGHT	FLAPS UP	57	59	65	81	
	FLAPS 10° 20°	52 50	54 52	59	74	
	FLAPS 40°	49	51	56	69	
POWER OFF — AFT CG						

Figure 6-2.

TAKE-OFF DATA

TAKE-OFF DISTANCE FROM HARD SURFACE RUNWAY WITH FLAPS UP

GROSS WEIGHT POUNDS	IAS AT 50' MPH	HEAD WIND KNOTS	AT SEA LEVEL & 59°F		AT 2500 FT. & 50°F		AT 5000 FT. & 41°F		AT 7500 FT. & 32°F	
			GROUND RUN	TOTAL TO CLEAR 50 FT OBS	GROUND RUN	TOTAL TO CLEAR 50 FT OBS	GROUND RUN	TOTAL TO CLEAR 50 FT OBS	GROUND RUN	TOTAL TO CLEAR 50 FT OBS
2300	68	0	865	1525	1040	1910	1255	2480	1565	3855
		10	615	1170	750	1485	920	1955	1160	3110
		20	405	850	505	1100	630	1480	810	2425
2000	63	0	830	1095	755	1325	905	1625	1120	2155
		10	435	820	530	1005	645	1250	810	1685
		20	275	580	340	720	425	910	595	1255
1700	58	0	435	780	520	920	625	1095	765	1370
		10	290	570	355	680	430	820	535	1040
		20	175	385	215	470	270	575	345	745

- NOTES: 1. Increase distance 10% for each 25°F above standard temperature for particular altitude.
 2. For operation on a dry, grass runway, increase distances (both "ground run" and "total to clear 50 ft. obstacle") by 7% of the "total to clear 50 ft. obstacle" figure.

MAXIMUM RATE-OF-CLIMB DATA

GROSS WEIGHT POUNDS	AT SEA LEVEL & 59°F			AT 5000 FT. & 41°F			AT 10,000 FT. & 23°F			AT 15,000 FT. & 5°F		
	IAS MPH	RATE OF CLIMB FT/MIN	GAL. OF FUEL USED	IAS MPH	RATE OF CLIMB FT/MIN	FROM S.L. FUEL USED	IAS MPH	RATE OF CLIMB FT/MIN	FROM S.L. FUEL USED	IAS MPH	RATE OF CLIMB FT/MIN	FROM S.L. FUEL USED
2300	91	645	1.0	85	435	2.6	80	230	4.8	73	20	11.5
2000	88	840	1.0	81	610	2.2	75	380	3.6	68	155	6.3
1700	83	1085	1.0	77	825	1.9	70	570	2.9	64	315	4.4

- NOTES: 1. Flaps up, full throttle, mixture leaned for smooth operation above 3000 ft.
 2. Fuel used includes warm up and take-off allowance.
 3. For hot weather, decrease rate of climb 20 ft./min. for each 10°F above standard day temperature for particular altitude.

Figure 6-3.

CRUISE PERFORMANCE SKYHAWK

Gross Weight- 2300 Lbs.
Standard Conditions
Zero Wind Lean Mixture

NOTE: Maximum cruise is normally limited to 75% power. Cruise speeds for the standard Model 172 are 1 to 3 MPH lower than shown with the maximum difference occurring at higher powers.

ALTITUDE	RPM	% BHP	TAS MPH	GAL/ HOUR	38 GAL (NO RESERVE)		48 GAL (NO RESERVE)	
					ENDR. HOURS	RANGE MILES	ENDR. HOURS	RANGE MILES
2500	2700	87	139	9.6	3.9	545	5.0	690
	2600	78	133	8.6	4.4	590	5.6	745
	2500	70	128	7.7	4.9	630	6.2	795
	2400	63	122	7.1	5.3	655	6.7	825
	2300	57	116	6.6	5.7	665	7.2	840
	2200	51	109	6.2	6.1	665	7.7	840
5000	2700	81	138	8.9	4.3	585	5.4	740
	2600	73	139	8.1	4.7	630	6.0	795
	2500	66	128	7.4	5.1	655	6.5	830
	2400	60	121	6.8	5.6	675	7.0	850
	2300	54	114	6.4	5.9	675	7.5	855
	2200	48	107	6.0	6.3	675	8.0	850
7500	2700	76	138	8.4	4.5	630	5.7	795
	2600	69	133	7.6	5.0	660	6.3	835
	2500	63	126	7.1	5.4	675	6.8	855
	2400	57	119	6.6	5.8	685	7.3	865
	2300	51	112	6.2	6.1	685	7.8	865
10,000	2700	72	138	7.9	4.8	665	6.1	840
	2600	66	131	7.3	5.2	685	6.6	860
	2500	59	124	6.8	5.6	695	7.1	875
	2400	54	117	6.4	6.0	700	7.5	880
	2300	48	110	6.0	6.3	700	8.0	880
12,500	2650	65	132	7.2	5.3	695	6.6	880
	2500	56	122	6.5	5.8	710	7.3	895
	2400	51	115	6.2	6.2	710	7.8	895

Figure 6-4.

LANDING DATA

**LANDING DISTANCE ON HARD SURFACE RUNWAY
NO WIND - 40° FLAPS - POWER OFF**

GROSS WEIGHT LBS.	APPROACH IAS MPH	AT SEA LEVEL & 59°F		AT 2500 FT. & 50°F		AT 5000 FT. & 41°F		AT 7500 FT. & 32°F	
		GROUND ROLL	TOTAL TO CLEAR 50' OBS.	GROUND ROLL	TOTAL TO CLEAR 50' OBS.	GROUND ROLL	TOTAL TO CLEAR 50' OBS.	GROUND ROLL	TOTAL TO CLEAR 50' OBS.
2300	70	520	1250	560	1310	605	1385	650	1455

- NOTES: 1. Reduce landing distance 10% for each 5 knot headwind.
2. For operation on a dry, grass runway, increase distances (both "ground roll" and "total to clear 50 ft. obstacle") by 20% of the "total to clear 50 ft. obstacle" figure.

Figure 6-5.

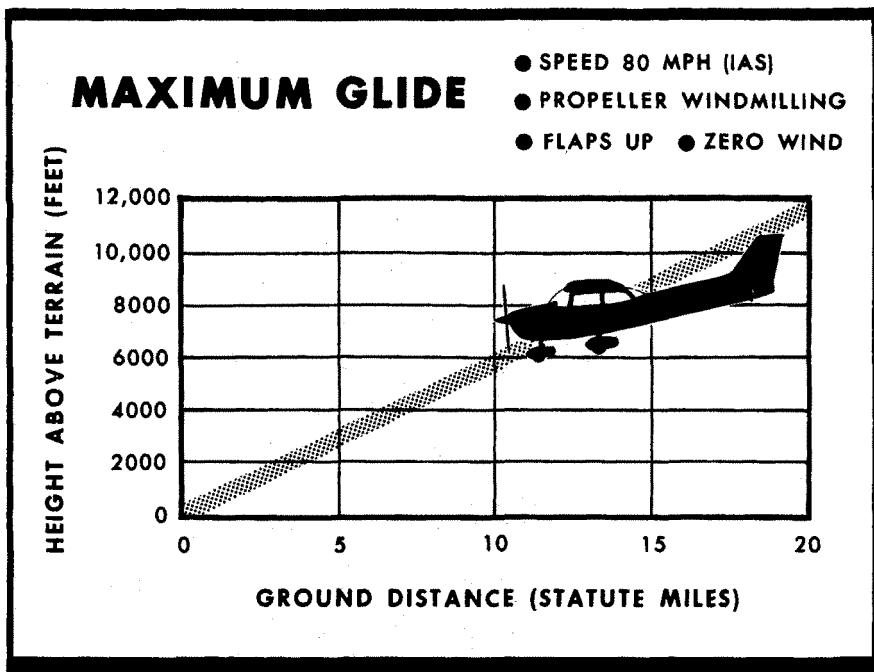


Figure 6-6.

Section VII

OPTIONAL SYSTEMS

This section contains a description, operating procedures, and performance data (when applicable) for some of the optional equipment which may be installed in your Cessna. Owner's Manual Supplements are provided to cover operation of other optional equipment systems when installed in your airplane. Contact your Cessna Dealer for a complete list of available optional equipment.

COLD WEATHER EQUIPMENT

WINTERIZATION KIT.

For continuous operation in temperatures consistently below 20°F, the Cessna winterization kit, available from your Cessna Dealer, should be installed to improve engine operation. The kit consists of two baffles which attach to the engine air intakes in the cowl, a restrictive cover plate for the oil cooler air inlet in the right rear vertical engine baffle, and insulation for the crankcase breather line. Once installed, the crankcase breather insulation is approved for permanent use in both cold and hot weather.

GROUND SERVICE PLUG RECEPTACLE.

A ground service plug receptacle may be installed to permit use of an external power source for cold weather starting and during lengthy maintenance work on the airplane electrical system (with the exception of electronic equipment).

NOTE

Electrical power for the airplane electrical circuits is pro-

vided through a split bus bar having all electronic circuits on one side of the bus and other electrical circuits on the other side of the bus. When an external power source is connected, a contactor automatically opens the circuit to the electronic portion of the split bus bar as a protection against damage to the transistors in the electronic equipment by transient voltages from the power source. Therefore, the external power source can not be used as a source of power when checking electronic components.

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

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

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

STATIC PRESSURE ALTERNATE SOURCE VALVE.

A static pressure alternate source valve may be installed in the static system for use when the external static source is malfunctioning.

If erroneous instrument readings are suspected due to water or ice in the static pressure lines, the static pressure alternate source valve control knob located below the wing flap switch should be opened, thereby supplying static pressure from the cabin. Cabin pressures will vary, however, with open cabin ventilators or windows. The most adverse combinations will result in airspeed and altimeter variations of no more than 2 MPH and 15 feet, respectively.

RADIO SELECTOR SWITCHES

RADIO SELECTOR SWITCH OPERATION.

Operation of the radio equipment is normal as covered in the respective radio manuals. When more than one radio is installed, an audio switching system is necessary. The operation of this switching system is described below.

TRANSMITTER SELECTOR SWITCH.

The transmitter selector switch, labeled TRANS, has two positions. When two transmitters are installed, it is necessary to switch the microphone to the radio unit the pilot desires to use for transmission. This is accomplished by placing the transmitter selector switch in the position corresponding to the radio unit which is to be used. The up position selects the upper transmitter and the down position selects the lower transmitter.

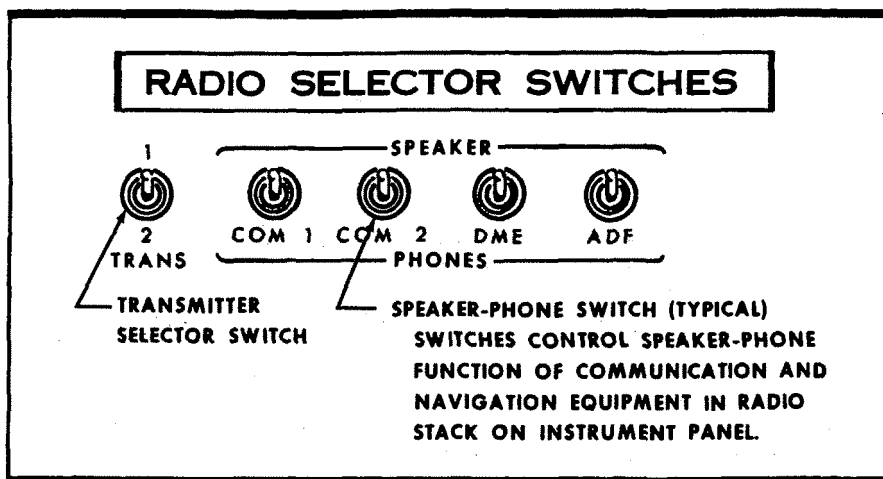


Figure 7-1.

The installation of Cessna radio equipment provides certain audio back-up capabilities and transmitter selector switch functions that the pilot should be familiar with. When the transmitter selector switch is placed in position 1 or 2, the audio amplifier of the corresponding transceiver is utilized to provide the speaker audio for all radios. If the audio amplifier in the selected transceiver fails, as evidenced by loss of speaker audio for all radios, place the transmitter selector switch in the other transceiver position. Since an audio amplifier is not utilized for headphones, a malfunctioning amplifier will not affect headphone operation.

SPEAKER PHONE SWITCHES.

The speaker-phone switches determine whether the output of the receiver in use is fed to the headphones or through the audio amplifier to the speaker. Place the switch for the desired receiving system either in the up position for speaker operation or in the down position for headphones.

MICROPHONE-HEADSET

A microphone-headset combination is offered as optional equipment. Using the microphone-headset and a microphone keying switch on the left side of the pilot's control wheel, the pilot can conduct radio communications without interrupting other control operations to handle a hand-held microphone. Also, passengers need not listen to all communications. The microphone and headset jacks are located near the lower left corner of the instrument panel.

TRUE AIRSPEED INDICATOR

A true airspeed indicator is available to replace the standard airspeed indicator in your airplane. The true airspeed indicator has a calibrated rotatable ring which works in conjunction with the airspeed indicator dial in a manner similar to the operation of a flight computer.

TO OBTAIN TRUE AIRSPEED, rotate ring until pressure altitude is aligned with outside air temperature in degrees Fahrenheit. Then read true airspeed on rotatable ring opposite airspeed needle.

NOTE

Pressure altitude should not be confused with indicated altitude. To obtain pressure altitude, set barometric scale on altimeter to "29.92" and read pressure altitude on altimeter. Be sure to return altimeter barometric scale to original barometric setting after pressure altitude has been obtained.

CARBURETOR AIR TEMPERATURE GAGE

A carburetor air temperature gage may be installed in the aircraft to help detect carburetor icing conditions. The gage is marked with a yellow arc between -15° and $+5^{\circ}\text{C}$. The yellow arc indicates the carburetor temperature range where carburetor icing can occur; a placard on the gage reads **KEEP NEEDLE OUT OF YELLOW ARC DURING POSSIBLE ICING CONDITIONS**.

Visible moisture or high humidity can cause carburetor ice formation, especially in idle or low power conditions. Under cruising conditions, the formation of ice is usually slow, providing time to detect the loss of RPM caused by the ice. Carburetor icing during take-off is rare since the full-open throttle condition is less susceptible to ice obstruction.

If the carburetor air temperature gage needle moves into the yellow arc during potential carburetor icing conditions, or there is an unexplained drop in RPM, apply full carburetor heat. Upon regaining the original RPM (with heat off), determine by trial and error the minimum amount of carburetor heat required for ice-free operation.

NOTE

Carburetor heat should not be applied during take-off unless absolutely necessary to obtain smooth engine acceleration (usually in sub-zero temperatures).

OIL QUICK-DRAIN VALVE

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

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SERVICING REQUIREMENTS*

ENGINE OIL:

GRADE -- Aviation Grade SAE 50 Above 60°F.

Aviation Grade SAE 10W30 or SAE 30 Between 0° and 70°F.

Aviation Grade SAE 10W30 or SAE 20 Below 10°F.

Multi-viscosity oil with a range of SAE 10W30 is recommended for improved starting in cold weather. Detergent or dispersant oil, conforming to Specification No. MIL-L-22851, must be used.

NOTE

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

CAPACITY OF ENGINE SUMP -- 8 Quarts.

Do not operate on less than 6 quarts. To minimize loss of oil through breather, fill to 7 quart level for normal flights of less than 3 hours. For extended flight, fill to 8 quarts. These quantities refer to oil dipstick level readings. During oil and oil filter changes, one additional quart is required when the filter element is changed.

OIL AND OIL FILTER CHANGE---

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

SERVICING REQUIREMENTS*

FUEL:

GRADE -- 80/87 Minimum Grade Aviation Fuel.

Alternate fuels which are also approved are:

100/130 Low Lead AVGAS (maximum lead content of 2 c. c. per gallon)

100/130 Aviation Grade Fuel (maximum lead content of 4.6 c. c. per gallon)

NOTE

When substituting a higher octane fuel, low lead AVGAS 100 should be used whenever possible since it will result in less lead contamination of the engine.

CAPACITY EACH STANDARD TANK -- 21 Gallons.

CAPACITY EACH LONG RANGE TANK -- 26 Gallons.

NOTE

To ensure maximum fuel capacity when refueling, place the fuel selector valve in either LEFT or RIGHT position to prevent cross-feeding.

LANDING GEAR:

NOSE WHEEL TIRE PRESSURE -- 31 PSI on 5.00-5, 4-Ply Rated Tire.

26 PSI on 6.00-6, 4-Ply Rated Tire.

MAIN WHEEL TIRE PRESSURE -- 29 PSI on 6.00-6, 4-Ply Rated Tires.

NOSE GEAR SHOCK STRUT --

Keep filled with MIL-H-5606 hydraulic fluid and inflated with air to 45 PSI.

*** For complete servicing requirements,
refer to the aircraft Service Manual.**



"TAKE YOUR CESSNA HOME
FOR SERVICE AT THE SIGN
OF THE CESSNA SHIELD"



CESSNA AIRCRAFT COMPANY

WICHITA, KANSAS





Petersen Aviation, Inc.

Auto Fuel STC's
984 K Road
Minden, NE 68959

Phone 308-832-2200
todd@gtmc.net
www.autofuelstc.com

Permission Certificate

This certificate constitutes permission for Yokota Aero Club

to apply Supplemental Type Certificate (STC) number: SA2600CE

to one Aircraft serial number: 17263767

Registration number: N1840V and

Engine STC number SE2563CE

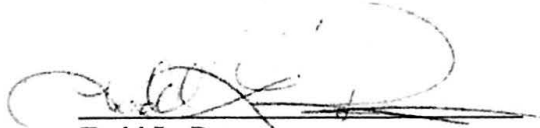
to one engine serial number: L-41867-36E

This certificate is required by order 8110.69 and as such is to remain part of the permanent aircraft maintenance records along with the STC paperwork. This document is invalid without an **original** signature of the STC holder and the corporate seal of Petersen Aviation, Inc.

Petersen Tracking Number 8 1 2 4 2 5 4

Date: August 18, 2011*

*Original purchase date: Sept. 28, 1993


Todd L. Petersen
Petersen Aviation, Inc.

United States of America
Department of Transportation -- Federal Aviation Administration

Supplemental Type Certificate

Number SE2563CE

This certificate issued to Petersen Aviation, Inc.
984 K Road
Minden, NE 68959

certifies that the change in the type design for the following product with the limitations and conditions therefor as specified hereon meets the airworthiness requirements of Part 13 of the Civil Air Regulations.

Original Product - Type Certificate Number: E-286

Make: Lycoming

Model: O-360 -A1A, -A1AD, -A1D, -A1F, -A1F6, -A1F6D, -A1G, -A1G6, -A1G6D, -A1H, -A1H6, -A1LD, -A1P, -A2A, -A2D, -A2E, -A2F, -A2G, -A2H, -A3A, -A3AD, -A3D, -A4A, -A4AD, -A4D, -A4G, -A4J, -A4K, -A4M, -A4N, -A5AD, -C1A, -C1C, -C1E, -C1F, -C1G, -C2A, -C2C, -C2E, -C4F, -C4P, -F1A6, -G1A6, -J2A, HO-360-C1A

Description of Type Design Change: Add the following approved fuel: Leaded and unleaded automotive gasoline, 91 minimum antiknock index (RON+MON)/2 per ASTM specification D-439. Intermixing with aviation gasoline also approved.
Data Required: 1. A copy of this certificate. 2. Petersen Drawing No. 360-2 dated December 14, 1989, or later "FAA Approved" revisions.

Limitations and Conditions: Compatibility of this design change with previously approved modifications must be determined by the installer. Specific approval must be obtained for each model aircraft to insure compatibility with its fuel system. This approval is limited to engines equipped with float type carburetors only. If the holder agrees to permit another person to use this certificate to alter the product, the holder shall give the other person written evidence of that permission.

This certificate and the supporting data which is the basis for approval shall remain in effect until surrendered, suspended, revoked or a termination date is otherwise established by the Administrator of the Federal Aviation Administration.

Date of application: September 05, 1985

Date reissued: November 4, 1999

8124254

Date of issuance: December 22, 1989

Date amended: October 17, 1990; November 29, 1993; November 29, 1995; February 24, 1997; November 4, 1999



By direction of the Administrator

Joel M. Ligon
(Signature)

Joel M. Ligon
Program Manager
Wichita Aircraft Certification Office

(Title)

Any alteration of this certificate is punishable by a fine of not exceeding \$1,000, or imprisonment not exceeding 3 years, or both.



Petersen Aviation, Inc.

Auto Fuel STC's
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Minden, NE 68959

Phone 308-832-2200
todd@gtmc.net
www.autofuelstc.com

Your auto fuel STC is enclosed. Thank you for ordering. Please read through all the paperwork carefully to insure that the information on your STC is correct. Check to make certain that the serial numbers match those of your airplane. Check also the final paragraph on the airframe STC to make certain that if a specific engine model number is called for that it corresponds to the model number of your engine. Some of our airframe STC's may require different model number engines, or may not specify a model number or an engine at all. **DO NOT LOSE THIS PAPERWORK.** It is intended to become a part of the permanent aircraft record. Lost paperwork will be replaced for 1/2 price for STC's sold in the preceding 20 years. Requests for replacing lost paperwork for STC's sold more than 20 years before the request will be charged full price.

If you have purchased an engine STC only then it will be necessary for you to obtain airframe approval from the FAA if you intend to use the STC in a certificated airplane. Airframe approval must be obtained to legally install the engine STC and use auto fuel in certificated aircraft.

In the United States, an IA mechanic or Certified Repair Station must install these STC's, make a log book entry and send in FAA form 337. Aviation officials in other countries may require additional paperwork when installing the STC.

If a Flight Manual Supplement is enclosed with the STC paperwork, place it in your Airplane Flight Manual. Not all airplanes require a Flight Manual Supplement. Some airplanes require Flight Manual Supplements only for certain serial numbers. If a Flight Manual Supplement is not included with your paperwork it is because your serial number does not indicate that it is required.

A change from an 87 octane engine to one requiring 91 octane such as the 160hp 0-320 or the 0-360 requires a different set of STC's. The red number on your STC paperwork is used by us to look up your file. Please refer to the red number or your "N" number when requesting information regarding your paperwork. STC's are not transferable from one airplane to another.

Pay close attention to the octane called for on the engine STC and the fuel placards which are enclosed. Do not use an octane lower than what is called for on the engine STC. The placards that are enclosed must match the octane specified on the engine STC, and are to be installed near the fuel filler openings. Placards that do not originate at Petersen Aviation cannot be used in conjunction with the STC's. Airplanes that were originally certified on 80/87 octane fuel, or less, and which have an auto fuel STC installed, are approved for the use of 82UL aviation gasoline. 82UL must not be used in engines requiring an antiknock index greater than 87.

The octane rating you see on the STC and fuel placards is arrived at by taking the Research Octane Number and adding it to the Motor Octane Number and averaging the two, hence $RON+MON/2 = \text{octane rating}$.

If you reside outside North America then the octane rating posted on the gasoline pump will most likely only refer to the Research Octane Number (RON). In order to know that the fuel you are

Page 1 of 4

**DO NOT USE FUEL
CONTAINING ETHANOL**

buying will have a high enough octane rating you must find out what the Motor Octane Number (MON) is then add it to the RON and average the two. Make sure it is at or above the number referred to on your STC and fuel placards.

Ethanol is not approved for use with auto fuel STC's. You must avoid fuel containing any type of alcohol. Alcohol is corrosive and can damage the fuel system. Alcohol makes vapor lock more likely and reduces range. Gasoline containing ethanol is frequently sold throughout the US without the fuel pumps being labeled as containing ethanol. Be very careful to only use conventional, non-ethanol gasoline. If you cannot find conventional gasoline, you must revert to using 100LL aviation gasoline. Run the alcohol test on all the fuel you intend to use. Check our web site (www.autofuelstc.com) for updates on ethanol.

ENGINE OVERHAUL

Lead content of gasoline (per gallon)

100LL = 2 grams

80/87 = 1/2 gram

automotive gasoline = .001 gram

Following the lead phase out rules imposed since the 1980's it is no longer possible to obtain leaded automotive gasoline in the United States. 100LL is now the only source of lead that remains available. There are no additives available that contain lead.

When you overhaul your engine use 100LL aviation gasoline for the first 25 hours to insure adequate lead during the break-in period. Radial engines should have lead provided constantly. A mixture of 25% 100LL and 75% unleaded automotive gasoline yields a lead content equivalent to leaded 80/87 octane aviation gasoline. Flat engines should have lead provided either as suggested here for radials, or by using a tank full of 100LL approximately every 75 hours. Depending on the spec. number used during production of the valves and seats some horizontally opposed engines may not require any lead whatsoever. However since it is impossible for the aircraft owner to determine which spec. number was used on the valves and seats, one fill-up with 100LL every 75 hours will solve the problem regardless of the spec. number of these parts.

VAPOR/PNEUMATIC LOCK - Under the right conditions, vapor lock can occur with either aviation or automotive gasoline. Due to its higher volatility and Initial Boiling Point (IBP) automotive gasoline has more potential for vapor and pneumatic lock. High wing gravity feed fuel systems are less prone to vapor formation than are pump fed systems. Vapor lock is a product of the fuel delivery system. Agitation of hot fuel or boiling of the fuel can result in vapor blockages in the fuel system which in turn starves the engine of a constant supply of liquid fuel. Pneumatic lock occurs when the carburetor is so hot that the fuel boils when it enters and the engine dies because it is too rich. The situation most conducive to vapor formation and pneumatic lock is using winter blend fuel during hot weather. Spring is the time of year when this combination of circumstances is most likely to be encountered. Caution should be exercised when flying with winter grade gasoline during warm days. Before takeoff conduct a full power runup to determine that full power is being developed. A full power runup will aid in removing hot fuel from within the engine compartment and replace it with cooler fuel from the tanks. Do not attempt a take off if full power cannot be obtained.

Aviation gasoline is blended with a Reid Vapor Pressure (RVP) between 5-7 year around. Automotive gasoline is blended with an RVP which the spec allows to be as high as 15 during the winter and as low as 7 during the summer depending upon geographic location. It is seldom above 10. There is nothing wrong with using winter blend fuel in the winter. Storing fuel purchased during winter months, and then using it in your airplane during operations in an O.A.T. exceeding 75 degrees F is, however, not recommended. If you are transporting your fuel to the airport, purchase it from a busy service station that has a high turnover rate to insure that you are obtaining fresh fuel.

Aside from having fuel analyzed in a lab, the only way to determine the vapor lock potential of your gasoline is to use a Hodges Volatility Tester. We have these available for \$65.00. They are highly recommended for any airplane considered high performance. High wing, gravity feed fuel systems aren't immune from vapor lock but are less likely to give vapor problems than pump fed systems. RVP's have been lowered in the US since the mid 1990's making vapor lock less likely today than it was twenty years ago.

Some things which can be done to help avoid vapor lock include checking the condition of all fuel system hoses and fittings. Be sure the hoses have not collapsed, or that old hoses are not allowing air to enter the fuel system through the hose wall. Fittings must be very tight to prevent air from entering the fuel system. Fittings and elbows in the fuel system introduce turbulence into the fuel and therefore increase the possibility of vapor lock. Therefore long runs of tubing are superior to lines that use more fittings. Also check to be sure that fuel system lines cannot shift in flight and come into contact with hot spots within the engine compartment. Fuel lines should be secured in place in a manner that prevents the line from vibrating and hence adding turbulence to the fuel. Adding fire sleeve to fuel lines within the engine compartment will insulate the lines and cut down on heat absorbed from the engine. Vent position and condition should also be checked, as should the condition of "O" rings around the fuel filler caps. Deteriorating "O" rings in the fuel filler caps can result in creation of a vacuum in the fuel tank and subsequent loss of head pressure in the fuel system.

The most likely scenario for vapor lock occurs during a subsequent takeoff. That is, when the airplane is flown, and then parked for a short time, and then restarted for the next flight. Following engine shutdown, the temperature of the engine compartment will significantly rise due to the sudden loss of cooling air flow and the thermal mass of the hot engine. If the engine is started again shortly thereafter, the temperature of the fuel in the engine compartment may be beyond its IBP, and thus the risk of vapor lock is at its highest. Cooling the engine compartment after shutdowns of short duration and prior to restarting will help to alleviate this condition. Opening the cowl, or oil filler access door between flights provides a means for excess heat to exit the engine compartment and cuts down on heat soak. Draining the gascolator prior to starting the engine can also help. Vapor lock frequently occurs in the gascolator. Always make sure you have full power before committing to a takeoff.

If the fuel becomes hot not from heat within the engine compartment, but from sitting on a hot ramp in direct sunlight, then no amount of engine runnup will clear the hot fuel from the system. To prevent this situation, one should wait to fuel the airplane until the time comes to make the flight. In this way the fuel temperature will be that of the storage container, be it a truck or underground tank. When fueling in this manner, one must be more careful regarding water in the fuel due to condensation within the partially filled tanks of the airplane, and take appropriate measures.

If vapor lock is encountered in flight, the first signs would be an increase in exhaust gas temperature (EGT) readings, since fuel flow would be restricted due to vapor formation. If the vapor lock becomes severe enough the engine runs rough, much as it would if too lean, or it quits altogether. Once the engine begins to run rough, the pilot should immediately lower the nose and reduce the throttle setting to the minimum required to sustain flight. This reduces fuel flow and hence the demand placed on the fuel system. Normal throttle settings may be resumed when smooth running returns. If the airplane has a fuel boost pump and the engine begins to run rough, the boost pump should be turned on. If the pump is already on when the engine begins to run rough or quits, then the pump should be turned off. Adjusting the mixture control can also help to alleviate these conditions. Make the mixture rich to counter a vapor lock, lean for pneumatic lock. The first symptom of pneumatic lock is an increase in fuel pressure followed by rough running or engine failure. Fuel blended with ethanol is more likely to produce vapor lock than straight gasoline.

CARB ICE - The higher volatility of auto fuel allows the fuel to absorb more heat from the mixing air when vaporizing, resulting in ice accumulation at higher ambient temperatures. Therefore the likelihood of carb icing is higher on automotive gasoline than on aviation gasoline. The severity of carb icing and the methods for dealing with it are similar for both aviation and automotive gasoline, but its onset is likely to occur at higher ambient temperatures and at lower humidity with auto fuel. This may result in the need to select "carb heat on" in less severe icing conditions and for a longer duration when using automotive gasoline. Total carburetor ice accumulation with automotive gasoline is no worse than with aviation gasoline. Existing standard cockpit instrumentation is adequate to detect carb ice formation with automotive gasoline or aviation gasoline. You should select carb heat at the earliest onset of icing whether or not the obvious symptoms of loss of power are experienced. Review the procedures outlined in your owners manual for dealing with carb ice. Consult the carb ice probability charts during your preflight planning.

LYCOMING 0-320 ENGINES - New data plates or revised engine model numbers are not always provided when 0-320's are overhauled and the compression and power are increased. Therefore it is possible for a 160hp 0-320 engine to have a model number indicating 150hp. If you have what you think is a 150hp 0-320, make certain by thoroughly examining the engine logbooks and/or by contacting the overhaul shop, that the horsepower is indeed 150, not 160. The 150hp 0-320 may use 87 octane but the 160hp version requires a minimum octane rating of 91. A change from an 87 octane engine to one requiring 91 octane requires a new STC and different fuel placards. Please contact us if you have any questions.

CANADA - The requirements of Transport Canada in regard to the installation of the auto fuel STC's are outlined in Transport Canada document TP10737. Canadians should refer to this document for instructions on installation of the automotive fuel STC's and proper log book entries which need to be made in conjunction with these STC's.

If you have any questions regarding the use of automotive gasoline in your airplane please do not hesitate to contact us. 308/832-2200, todd@gtmc.net. For the latest updates on using automotive fuel in general aviation aircraft check the web site <http://www.autofuelstc.com>

Petersen Aviation Inc.
Route 1 Box 18
Minden, NE 68959

Supplement No. 1

FAA APPROVED

AIRPLANE FLIGHT MANUAL SUPPLEMENT

FOR

CESSNA 172N, Serial Number 17270050 & 17271035 thru 17274009, 172P

Registration Number N1840V

Serial Number 17263767

CONTACT MAINTENANCE FOR THE MOST CURENT STC

This Supplement must be attached to the FAA approved Airplane Flight Manual applicable to that particular airplane when the airplane has been modified in accordance with STC SA2601CE. The information contained herein supplements or supersedes the basic manual only in those areas listed herein. For limitations, procedures and performance information not contained in this supplement, consult the basic Airplane Flight Manual.

LIMITATIONS:

Fuel: The use of unleaded and leaded automotive gasoline, 91 minimum antiknock index (RON+MON)/2 per ASTM Specification D-439 is approved. Intermixing with aviation gasoline is also approved. The Lycoming O-320-H2AD Engine installation is not approved.

FAA APPROVED Eugene L. Bollin

for Lawrence A. Herron, Manager
Aircraft Certification Office
Federal Aviation Administration
Wichita, Kansas

Date: March 30, 1990

8124254

O&N AIRCRAFT MODIFICATIONS
210 WINDSOCK LANE, SEAMANS AIRPORT
FACTORYVILLE, PA 18419

FAA APPROVE AIRPLANE
SUPPLEMENTAL FLIGHT MANUAL NO. 17

for

CESSN MODELS: 172F,G,H,I,K,L,M,&N
S/N 17251823 through 17271034 {1978}

With 18 gal. Aft Baggage Compartment Fuel Tank

REG. NO. N1840V / N22905

SER. NO. 17263767 / 17264078

This Supplemental Flight Manual must be installed in the aircraft when an 18 gal. Aft Baggage Compartment Fuel Tank is installed in accordance with Supplemental Type Certificate No. SA615NE dated October 18, 1988.

The information contained in this document supplements or supersedes the information contained in the form of Placards, Markings, and the Type Certificate Data Sheet, only in those areas listed herein. For limitations, procedures, and performance not contained in this manual, consult the original Placards, Markings, and Type Certificate Data Sheet.

FAA APPROVED: /s/ Norman J. Glenn

for Irwin N. Brumer
Manager, New York Aircraft Certification Office

O&N AIRCRAFT MODIFICATIONS
210 WINDSOCK LANE
FACTORYVILLE, PA 18419

Supplemental Flight
Manual No. 17
Cessna Models:F,G,H,I,K,L,M,N

REVISION CONTROL PAGE

REV.	PAGES AFFECTED	DESCRIPTION	APPROVED/DATE
A	ALL	Added F&G Models	s/Irwin N. Brumer Manager, NYACO June 12, 1989

O&N AIRCRAFT MODIFICATIONS
210 WINDSOCK LANE
FACTORYVILLE, PA 18419

Supplemental Flight
Manual No. 17
Cessna Models: 172F,G,H,I,K,L,M,N

I. GENERAL:

FUEL:

Aft Baggage Compartment Fuel Tank
Capacity: 18.0 Gal.

II. LIMITATIONS:

FUEL:

Aft Baggage Compartment Fuel Tank
Capacity: 18.0 Gal.
Usable: 18.0 Gal.

OIL:

With all fuel tanks full, oil must be full.

UTILITY CATEGORY:

No fuel may be in the baggage compartment tank when the aircraft is operated in the utility category.

REQUIRED PLACARDS:

- A. On Pedestal above Fuel Selector Valve:
"Aft transfer system capacity 18 gal.
1. Operate on main tanks until right fuel gauge reads 2/3 full.
2. Transfer while operating on right main tank in straight and level flight only.
3. Transfer in progress when transfer light illuminates."
- B. On Baggage Compartment door:
"Max. Compartment weight with fuel tank installed is 108.0 lbs. Fuel and/or baggage weight must not exceed this limit."
- C. Near Fuel Filler Cap:
"Aux Fuel 18.0 gal. usable 100/130 min..."
- D. Adjacent to drain tube:
"Tank sump drain..."
- E. On instrument panel below existing circuit breakers:
"Fuel Trans. Fuse."

WEIGHT & BALANCE:

- A. Center of gravity of the aircraft must be within the FAA Approved gross weight, e.g. envelope with the aft baggage compartment fuel tank full and empty. See Section VI, Weight and Balance.

O&N AIRCRAFT MODIFICATIONS
DATE: JUNE 12, 1989
210 WINDSOCK LANE

Supplemental Flight
Manual No. 17 Page 3 of 5

O&N AIRCRAFT MODIFICATIONS
210 WINDSOCK LANE
FACTORYVILLE, PA 18419

Supplemental Flight
Manual No. 17
Cessna Models:172F,G,H,I,K,L,M,N

III. EMERGENCY PROCEDURES: No Change

IV. NORMAL PROCEDURES:

AFT BAGGAGE FUEL TRANSFER SYSTEM OPERATION:

1. Operate on main tanks until right fuel gauge reads 2/3 full.
2. Move transfer switch to momentary position and hold for 10 seconds. Light should illuminate and remain illuminated when switch is released.
3. If light does not stay illuminated, repeat step 2.
4. Transfer while operating on right main tank in straight and level flight only.
5. Transfer is in progress when transfer light is illuminated.

V. PERFORMANCE: No Change

VI. WEIGHT AND BALANCE:

LOADING CHART	WEIGHT	MOMENT
Basic Empty Weight (includes unusable fuel and full oil)		
Usable Fuel (At 6 lbs./gal.) (38 gal. max.) (Sta. 48)		
Aft Baggage Fuel (18 gal.) (Sta. 95)		
Pilot and Front Passengers (Sta. 34 to 46)		
Rear Passengers (Sta. 73)		
Baggage (Sta. 82 to 108, 108 lbs.)		
TOTAL		

O&N AIRCRAFT MODIFICATIONS
210 WINDSOCK LANE
FACTORYVILLE, PA 18419

Supplemental Flight
Manual No. 17
Cessna Models: 172F,G,H,I,K,L,M,N

- Notes:
1. Refer to the original weight and balance information for basic C.G. moment envelope.
 2. The maximum baggage compartment weight is **108.0**. This can be a combination of fuel and/or baggage. The fuel and/or baggage weight must not exceed this limit.
In. lbs.
 3. If your takeoff C.G. is within 2 inches of the forward C.G. limit, the aircraft loading and fuel management must be investigated to assure that the aircraft C.G. after fuel transfer remains within the approved C.G. limits.



**FAA Approved
Supplemental Airplane Flight Manual**

DOCUMENT NUMBER 172055

For

Cessna 172M

Serial No. 17260759 to 17265684

Serial No. 17263767 / 17264078 Reg. # N1840V / N22905

The information contained in this flight manual is FAA Approved Material, which, Along with the FAA Approved placards and instrument markings, is applicable to the operation of the airplane when modified in accordance with STC 2196CE, which increases the maximum certificated takeoff weight to 2550 LBS and limits the flap travel to 30 degrees. The airplane must previously have been modified in accordance with ATS SA4428SW which installs a 180HP Lycoming O-360 series and a fixed pitch propeller.

for FAA Approved 
Margaret Kline
Manager, Wichita Aircraft Certification Office
FAA Central Region
Wichita, KS

Date: 2/3/2012

Original Date: 07/06/88

LOG OF REVISIONS

Revision	Pages	Description	Approved	Date
Orig	1-8	New Issue	G.M.B.	7/6/88
1	3, 4	Added O-360-A4N	B.L.S.	3/21/90
2	All	Added Document Number Moved Table of Contents Corrected Max Continuous RPM Reformatted Added Propeller Information Corrected Static RPM Added Power Plant Instrument Markings Added Fuel Consumption Chart Reworked Charts Add Section 7	<i>DM Baker</i>	<i>2/3/2012</i>

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SECTION 1: GENERAL

DESCRIPTIVE DATA

ENGINE

Engine Model Number: O-360-A2F, A3A, A4A, A4M, and A4N
Engine Type: Normally aspirated, direct drive, air cooled, horizontally opposed, carburetor equipped, four cylinder engine with 360 cu. in. displacement.
Horsepower Rating and Engine Speed 180 rated BHP at 2700RPM.
Maximum Continuous RPM: 2700 RPM

NOTE

Static RPM Limits: 2250 to 2450 RPM

PROPELLERS:

Sensenich Propellers approved on installations using the O-360-A4 series engines only

Propeller Manufacturer: Sensenich Corporation

Propeller Model Number: 76EM8S14-O-60

Number of Blades: 2.

Propeller Diameter: Maximum..... 76 inches.

Minimum:..... 76 inches.

Pitch Range: 62" to 56 "

Propeller Manufacturer: Sensenich Corporation.

Propeller Model Number: 76EM8S-O-60 (when using MKA3.5 prop spacer).

Number of Blades: 2.

Propeller Diameter: Maximum..... 76 inches.

Minimum: 76 inches.

Pitch Range: 62" to 56"

Approved on all approved engine installations:

Propeller Manufacturer: McCauley Accessory Division.

Propeller Model Number: 1A170/CFA
1A170E/CFA

Number of Blades: 2.

Propeller Diameter: Maximum:..... 76 inches.
Minimum: 74.5 inches.

Propeller Type: Fixed Pitch

Pitch Range: 60" to 56"

Approved on installations using the O-360-A4A, -A4M, -A4N, and A3A engines only:

Propeller Manufacturer: McCauley Accessory Division.

Propeller Model Number: 1A170/JFA

Number of Blades: 2.

Propeller Diameter: Maximum:..... 76 inches.
Minimum: 74.5 inches.

Propeller Type: Fixed Pitch

Pitch Range: 60" to 56"

MAXIMUM CERTIFICATED WEIGHTS

Takeoff,	Normal	2550 lbs.
	Utility	2000 lbs.
Landing,	Normal	2550 lbs.
	Utility	2000 lbs.

SECTION 2: LIMITATIONS

AIRSPEED INDICATOR MARKINGS

Air Plains Services PN: 172861 or 172861-2 or existing airspeed indicator, marked as follows:

MARKING	MPH CAS VALUE OR RANGE
White Arc	56-100 mph
Green Arc	64-145 mph
Yellow Arc.....	145-182 mph
Red Line	182 mph

AIRSPEED LIMITATIONS

VA Maneuvering Speed:
2550 Pounds..... 112 MPH CAS

POWER PLANT LIMITATIONS

Engine Model Number: O-360-A2F, A3A, A4A, A4M and A4N
Maximum Power: 180 BHP rating
Maximum Continuous RPM: 2700 RPM

WEIGHT LIMITS

Maximum Takeoff Weight,
Normal 2550 lbs.
Utility 2000 lbs.
Maximum Landing Weight,
Normal 2550 lbs.
Utility 2000 lbs.

FLAP TRAVEL - Limited to 30°

CENTER OF GRAVITY LIMITS - NORMAL CATEGORY

Center of Gravity Range:

Forward: 35 inches aft of datum at 1950 lbs. or less, with straight line variation to 41.0 inches aft of datum at 2550 lbs.

Aft: 47.3 inches aft of datum at all weights.

UTILITY CATEGORY

Center of Gravity:

Forward: 35 inches aft of datum at 1950 lbs. or less, with straight line variation to 35.5 inches aft of datum at 2000 lbs.

Aft: 40.5 inches aft of datum at all weights.

FLIGHT LOAD FACTORS

NORMAL CATEGORY

Flight Load Factors (Maximum Takeoff Weight – 2550 lbs.):

Flaps Up..... +3.8g, -1.52g

Flaps Down +3.5g

SECTION 3: EMERGENCY PROCEDURES

AIRSPEEDS FOR EMERGENCY OPERATIONS

Engine Failure After Takeoff:

Wing Flaps Up..... 79-88 MPH IAS

Wing Flaps Down 71-83 MPH IAS

Maneuvering Speed:

2550 lbs..... 112 MPH IAS

2150 lbs..... 109 MPH IAS

1750 lbs..... 98 MPH IAS

Maximum Glide:

2550 lbs..... 78 MPH IAS

Precautionary Landing With Engine Power 75 MPH IAS

Landing Without Engine Power:

Wing Flaps Up..... 79-88 MPH IAS

Wing Flaps Down 71-83 MPH IAS

DITCHING

If no power is available, approach at 76 MPH IAS with flaps at 30°.

FLIGHT IN ICING CONDITIONS

Approach at 92 to 104 MPH IAS, depending on the accumulation.

SECTION 4: NORMAL PROCEDURES

NORMAL PROCEDURES

SPEEDS FOR NORMAL OPERATION

Unless otherwise noted, the following speeds are based on a maximum weight of 2550 pounds and may be used for any lesser weight.

Takeoff:

Normal Climb Out..... 86-98 MPH IAS
Short Field Takeoff, Flaps 10°, Speed at 50 ft..... 66 MPH IAS

Enroute Climb, Flaps Up:

Normal Sea Level..... 86-98 MPH IAS
Normal, 10,000 Feet 81-92 MPH IAS
Best Rate of Climb, Sea Level 84 MPH IAS
Best Rate of Climb, 10,000 Feet 86 MPH IAS
Best Angle of Climb, Sea level 71 MPH IAS

Landing Approach:

Normal Approach, Flaps Up 75-86 MPH IAS
Normal Approach, Flaps 30° 69-81 MPH IAS

Balked Landing:

Maximum Power, Flaps 20° 69 MPH IAS

Maximum Recommended - Turbulent Air penetration Speed:

2550 lbs..... 112 MPH IAS
2150 lbs..... 109 MPH IAS
1750 lbs..... 98 MPH IAS

SECTION 5: PERFORMANCE

LANDING DISTANCE - SHORT FIELD

CONDITIONS

Flaps Down 30°

If a landing with flaps up is necessary, increase approach speed by 10 mph IAS and allow for 35% longer distance.

			0°C		10°C		20°C		30°C		40°C	
WEIGHT LBS	SPEED AT 50 FT IAS	PRESS ALT FT.	GRND ROLL FT	TOTAL FT TO CLEAR 50 FT OBS.	GRND ROLL FT	TOTAL FT TO CLEAR 50 FT OBS.	GRND ROLL FT	TOTAL FT TO CLEAR 50 FT OBS.	GRND ROLL FT	TOTAL FT TO CLEAR 50 FT OBS.	GRND ROLL FT	TOTAL FT TO CLEAR 50 FT OBS.
2550	71	S.L.	545	1290	565	1320	585	1350	605	1380	625	1415
		1000	565	1320	585	1350	605	1385	625	1420	650	1450
		2000	585	1355	610	1385	630	1420	650	1455	670	1490
		3000	610	1385	630	1425	655	1460	675	1495	695	1530
		4000	630	1425	655	1460	675	1495	700	1535	725	1570
		5000	655	1460	680	1500	705	1535	725	1575	750	1615
		6000	680	1500	705	1540	730	1580	755	1620	780	1660
		7000	705	1545	730	1585	760	1625	785	1665	810	1705
		8000	735	1585	760	1630	790	1670	815	1715	840	1755

CRUISE FUEL CONSUMPTION

(Not FAA Approved)

Conditions:

2550 Pounds

Recommended Lean Mixture

		20°C Below Standard Temp.		Standard Temperature		20°C Above Standard Temp.	
Press. Alt Feet	RPM	% BHP	GPH	% BHP	GPH	% BHP	GPH
2000	2550	---	---	76	10.2	72	9.6
	2500	77	10.3	72	9.6	68	9.1
	2400	69	9.2	64	8.7	61	8.3
	2300	61	8.3	58	7.9	55	7.6
	2200	55	7.5	52	7.2	49	6.9
	2100	49	6.8	46	6.6	43	6.3
4000	2600	---	---	76	10.2	72	9.6
	2500	73	9.7	68	9.2	65	8.7
	2400	65	8.8	62	8.3	58	8.0
	2300	58	8.0	55	7.6	52	7.3
	2200	52	7.3	49	6.9	47	6.6
	2100	46	6.6	44	6.3	41	6.1
6000	2650	---	---	76	10.1	72	9.6
	2600	77	10.3	72	9.6	68	9.1
	2500	69	9.3	65	8.8	62	8.4
	2400	62	8.4	59	8.0	56	7.6
	2300	56	7.7	53	7.3	50	7.0
	2200	50	7.0	47	6.7	44	6.4
8000	2700	---	---	76	10.1	71	9.5
	2600	73	9.8	69	9.2	65	8.7
	2500	66	8.8	62	8.4	59	8.0
	2400	59	8.1	56	7.7	53	7.3
	2300	53	7.4	50	7.0	47	6.7
	2200	47	6.7	45	6.4	42	6.1
10,000	2700	77	10.2	72	9.6	68	9.1
	2600	69	9.3	65	8.8	62	8.4
	2500	63	8.5	59	8.1	56	7.7
	2400	57	7.8	53	7.4	50	7.0
	2300	51	7.1	48	6.8	45	6.5
12,000	2700	69	9.3	65	8.8	62	8.4
	2600	66	8.9	62	8.4	59	8.0
	2500	60	8.2	56	7.7	53	7.4
	2400	54	7.5	51	7.1	48	6.7
	2300	48	6.8	45	6.5	42	6.2



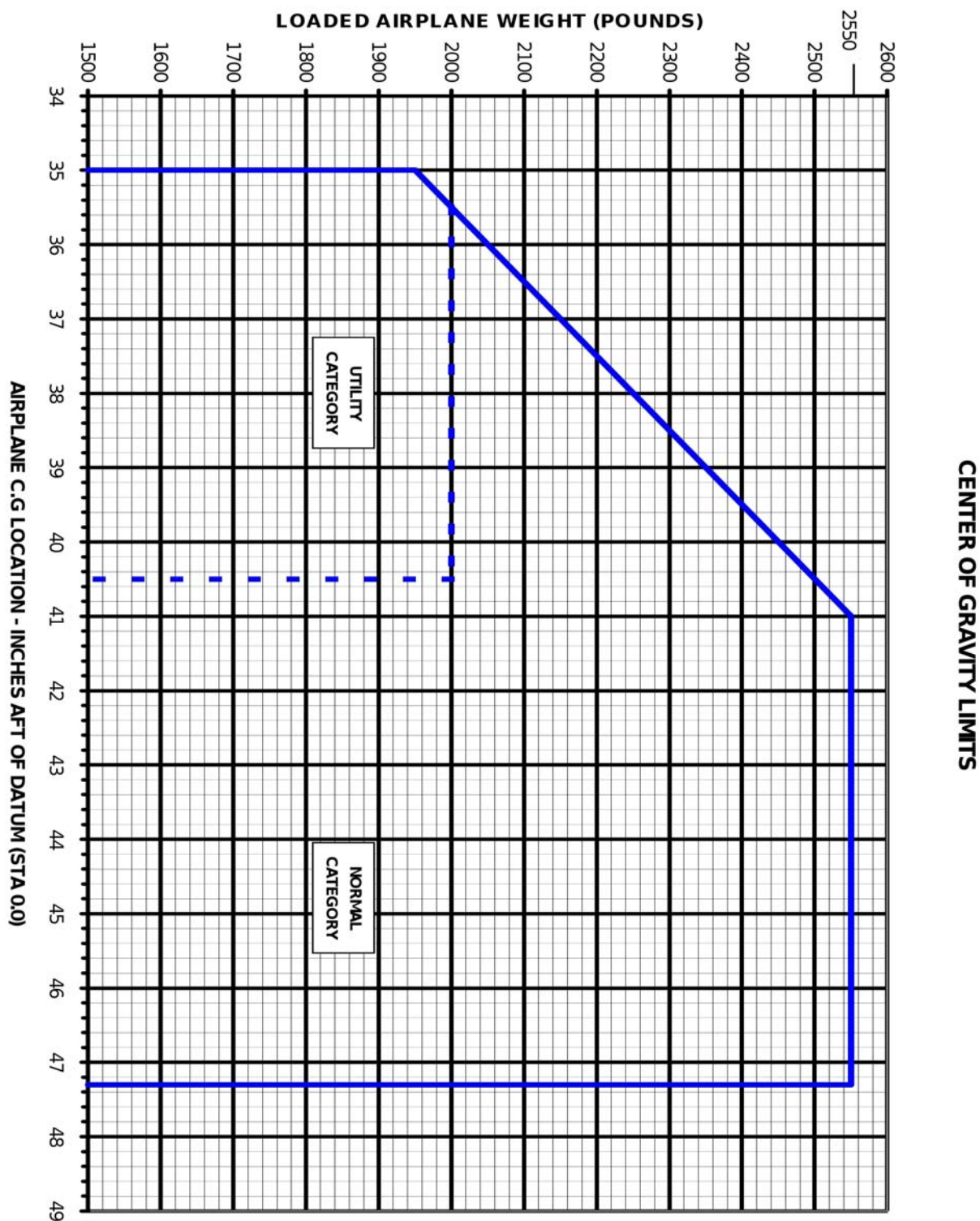
RANGE PROFILE

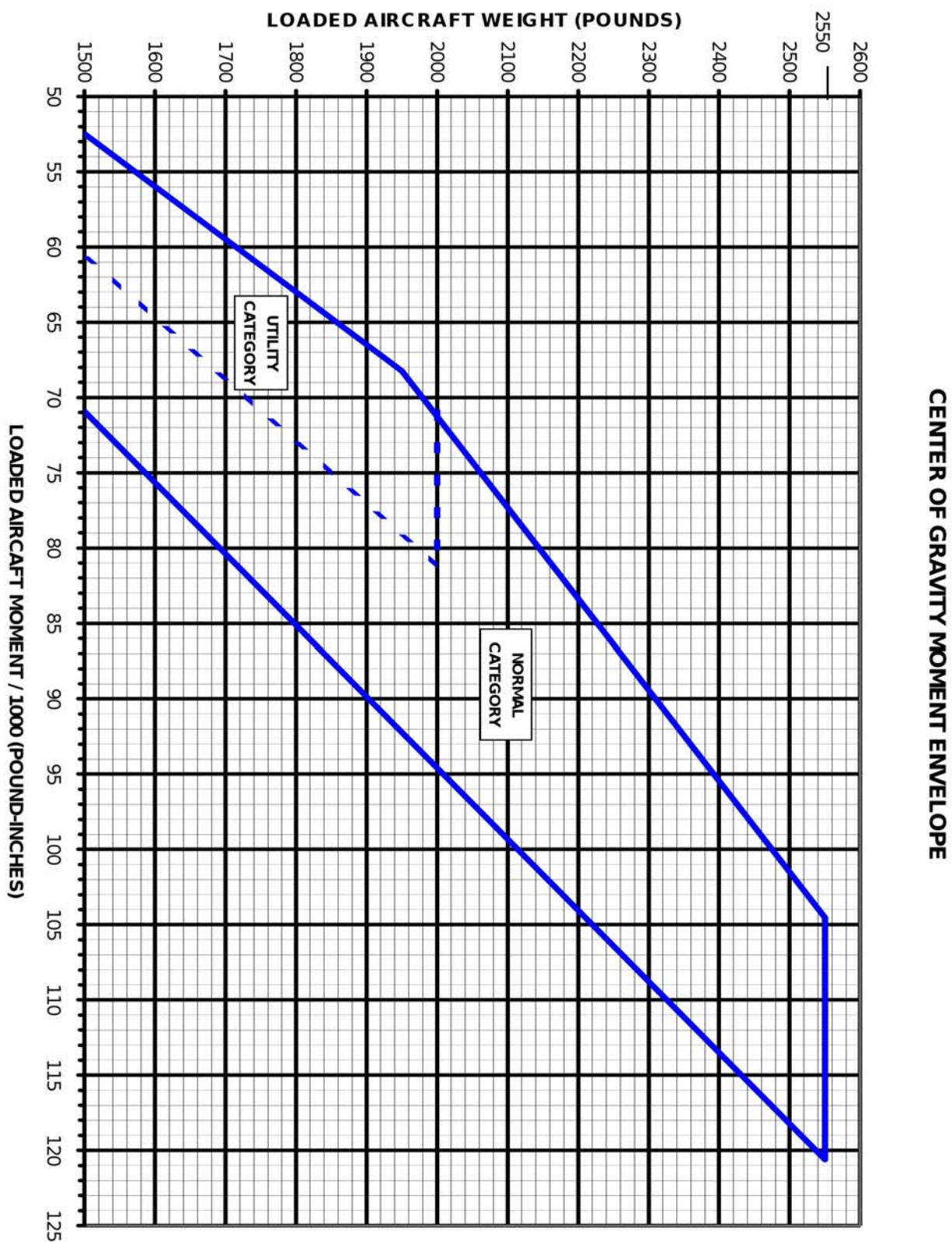
Compute range based on the available fuel load on the aircraft, altitude, ground speed and engine fuel consumption.

ENDURANCE PROFILE

Compute endurance based on the available fuel load on the aircraft and engine fuel consumption.

SECTION 6: WEIGHT AND BALANCE





SECTION 7: SERVICING REQUIREMENTS

To operate at the 2550 gross weight, the aircraft must be equipped with 6 or more ply tires on both the main wheels and nose wheel on all models.

- Tire Pressure should be:
 - ◆ Nose Gear 45 psi
 - ◆ Main Gear 38 psi

FAA APPROVED

AIRCRAFT FLIGHT MANUAL SUPPLEMENT

For

SYSTEM INSTALLATION

Of

EIS-41000 ELECTRONIC IGNITION SYSTEMS

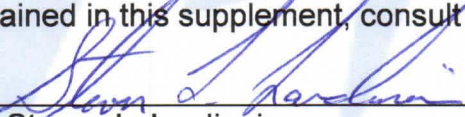
Registration No. N1840V / N22905

Serial No. 17263767 / 17264078

This supplement must be attached to the FAA approved Aircraft Flight Manual when the Electroair electronic ignition system has been installed per FAA STC #SA02987CH.

The information contained herein supplements or supersedes the basic Aircraft Flight Manual only in those areas listed. For limitations, procedures, and performance information not contained in this supplement, consult the basic Aircraft Flight Manual.

FAA APPROVED:


Steven L. Lardinois
Manager, Systems and Flight Test Branch
Chicago Aircraft Certification Office
Federal Aviation Administration

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The information contained therein is reserved for the exclusive use of Electroair.
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ELECTROAIR RESTRICTED

Log of Revisions:

Revision	Date of Revision	Description of Revision	Approved by	Date of Approval
00		Skipped		
01		Initial Release		
02				
03			Joseph Miess	07/05/2011
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05	03/12/2012		Joseph Miess	04/02/2012
06	03/14/2014	Updated for format changes made to the 6 cylinder AFMS	Ronald D. McElroy	03/31/2014
07	11/13/2014	ECO 1116-0094	<i>8.2.2</i>	<i>3-10-15</i>

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Section 1: General:

This Aircraft Flight Manual Supplement contains the necessary information required for the operation of an electronic ignition system (EIS) as installed on 4-cylinder Continental A65, A75, C75, A80, C85, C90, O-200, and IO-240 series engines along with Lycoming O-235, O-290, O/IO-320, O/IO-360, and IO/AEIO-390 series engines.

A. FUNCTIONAL OVERVIEW

The Electroair EIS-41000 Electronic Ignition System is a single magneto replacement. The aircraft is now equipped with an EIS-41000 and a single magneto; both units make up the dual ignition system. The EIS-41000 kit consists of the following components: Controller (EA-1000), Coil Pack (EA-2000), MAP Sensor (EA-5000), Spark Plug Wires (EA-4000), Wire Harness (EA-6000), and Trigger Mechanism (EA-3000).

The EIS-41000 Electronic Ignition System performs its function by delivering energy generated by the coil pack to each spark plug attached to the system. This high voltage from the coil pack (on the order of 70,000V), creates a high intensity, long duration spark which more effectively ignites a wide range of fuel/air mixtures inside of the cylinder. The EIS-41000 is also able to vary the ignition timing (spark event) during the combustion cycle so as to more closely have the peak pressure as a result of combustion occur at an optimal range for a piston engine. The adjustment of ignition timing is based on MAP inside the engine. The combination of a high energy spark and variable timing, the two principle differences between the EIS-41000 and a magneto, permits more an efficient operation of the engine.

The EIS-41000 is operated by DC power provided by the aircraft's power bus. There are two circuit protection devices used for the EIS-41000; reference table one for the type and size of the protection devices. These circuit protection devices are not normally accessed during flight.

The EIS-41000 is controlled by using the switch labeled "EIS". The EIS-41000 may be disabled by setting the switch labeled "EIS" to the OFF position. The pilot should familiarize him/herself with the location of the "EIS" before proceeding with the pre-flight checklist.

FUNCTION	IDENT	RATING	BUS	POWER SUPPLY
EA-1000 Power	EIS	2.0 AMP	Aircraft Power	12/24VDC
EA-2000 Power	EIS	10.0 AMP	Aircraft Power	12/24VDC

Table One: DC Circuit Protection

B. SYSTEM OPERATION

Under normal operating conditions, the EIS-41000 Electronic Ignition System will be controlled by the flight crew in the same manner as the magneto that was previously installed. The AFM shall be updated by adding the task of turning ON the system (EIS) after the Master Switch is turned ON; and by turning OFF the system (EIS) prior to the Master Switch being turned OFF (reference Section 4: Normal Procedures for AFM updates). The AFM shall also be updated in the magneto trouble-shooting section to change wording to reflect the fact that an Electronic Ignition System has been installed (reference Section 3: Emergency/Abnormal Procedures for AFM updates).

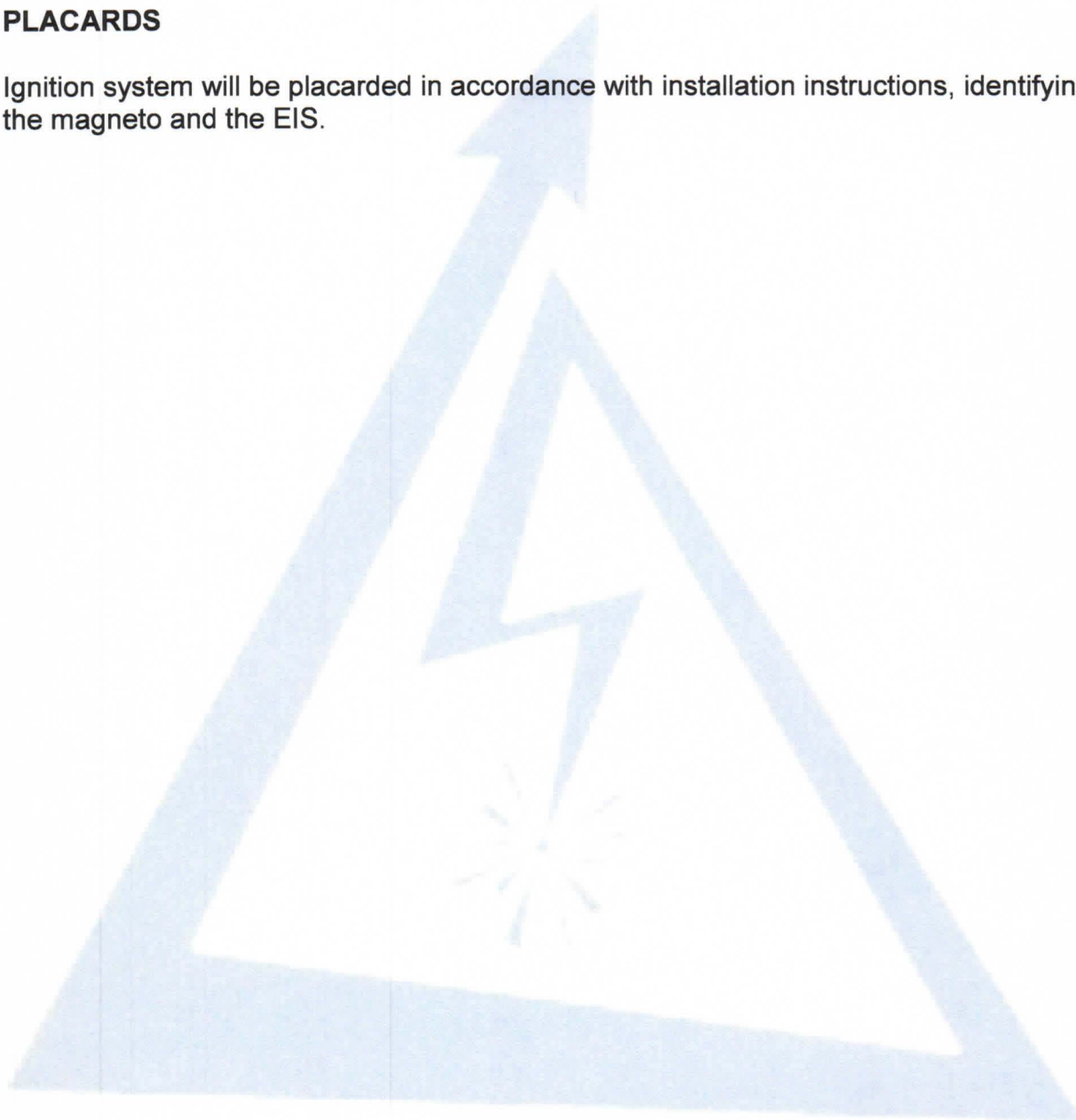
Section 2: Limitations:

VOLTAGE

System voltage to EIS-41000 shall be at least 8VDC, or EIS will not function.

PLACARDS

Ignition system will be placarded in accordance with installation instructions, identifying the magneto and the EIS.



Section 3: Emergency/Abnormal Procedures:

Emergency Procedures

No Change

Abnormal Procedures

Alternator/Generator Failure:

No Change

Note: It is important to take into consideration that the EIS-41000(s) will be drawing power from the aircraft's remaining power supply. For load shedding calculations, use the value of 0.75 Amps for what one EIS-41000 will draw. It is NOT recommended to load shed the EIS.

Problem: Rough running engine and/or high CHTs:

Perform in-flight troubleshooting in accordance with POH. Determine if one of the ignition systems is bad and isolate the bad/suspected ignition system.

Problem: Severe loss in engine power and/or low CHTs, engine operating smoothly:

Perform in-flight troubleshooting in accordance with POH. Determine if one of the ignition systems is bad and isolate the bad/suspected ignition system.

Section 4: Normal Procedures:

I. Preflight:

Update the POH to include turn "EIS-ON" after turn Master Switch ON.

II. Starting:

"EIS Switch – ON" Procedure:

Verify the switch labeled "EIS" to the ON position.

III. Ignition Check:

Procedure, With Rotary or Key Switch:

The ignition check shall be made at the same RPM as defined in the AFM.

Ignition switch to "BOTH" position

Ignition switch to "R" position – Note RPM Drop _____

Ignition switch to "BOTH"

Ignition switch to "L" position – Note RPM Drop _____

Ignition to "BOTH" position

Magneto RPM drop should not exceed the RPM defined in the AFM. EIS RPM drop is defined below. If there is a doubt concerning operation of the ignition systems, RPM checks at higher engine speeds will usually confirm whether a deficiency exists. At the end of the ignition check move ignition switch back to "BOTH" position.

RPM Drops:

Magneto – as defined in POH.

EIS – 30-40 RPM max

Procedure, With Standard or Rocker Switch:

The ignition check shall be made at the same RPM as defined in the AFM.

Ignition BOTH ON

EIS OFF – Note RPM Drop _____

EIS ON

Magneto OFF – Note RPM Drop _____

Magneto ON

Magneto RPM drop should not exceed the RPM defined in the POH. EIS RPM drop is defined below. If there is a doubt concerning operation of the ignition systems, RPM checks at higher engine speeds will usually confirm whether a deficiency exists. At the end of the ignition check move ignition switches back to "ON" position.

RPM Drops:

Magneto – as defined in POH.

EIS – 30-40 RPM max

IV. Takeoff:

No Change

V. Cruise:

No Change

VI. Descent:

No Change

VII. Landing:

No Change

VIII. Shutdown:

"EIS Switch – OFF" Procedure:

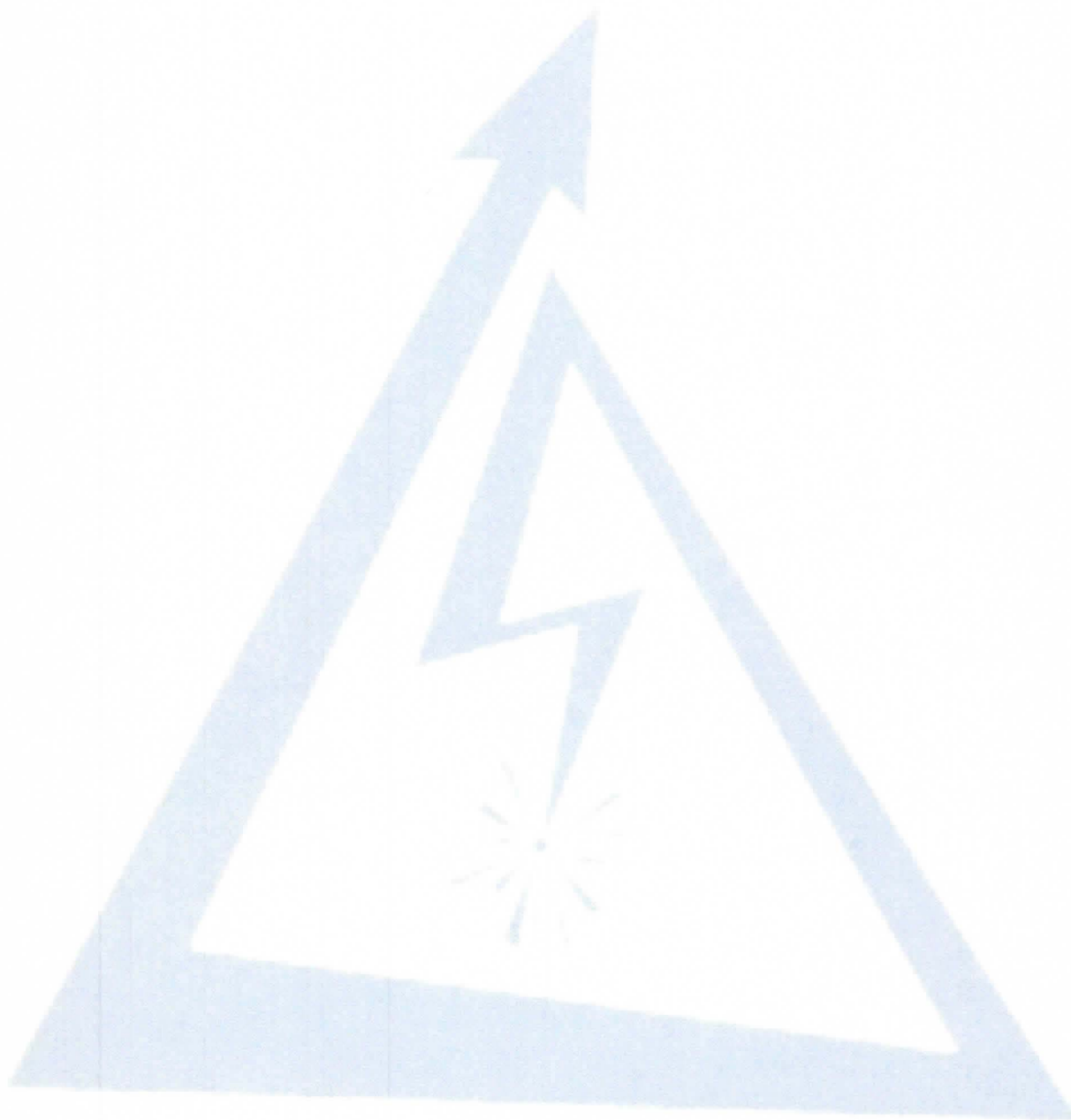
In the POH, add turn the switch labeled "EIS" to the OFF position before turn Master Switch OFF.

IX. Post-flight:

No Change

Section 5: Performance:

No Changes



Section 6: Weight and Balance:

The installation of the EIS-41000 requires the removal of one Magneto and the installation of the six EIS-41000 components. This installation results in a change to the aircraft's weight and balance. A new weight and balance should be calculated for the aircraft after the installation of the EIS-41000(s). All future loading calculations should use the updated aircraft weight and balance. The individual EA part weights are below. NOTE: For the twin engine aircraft, the weight and balance must include the weight of both sets of EIS-41000 components.

1. EA-1000: 0.8 pounds (Controller)
2. EA-2000: 2.9 pounds (Coil Pack)
3. EA-3000: 1.5 pounds (Mag Timing Housing)
4. EA-4000: 1.1 pounds (Spark Plug Wires)
5. EA-5000: 0.4 pounds (MAP Sensor)
6. EA-6000: 0.8 pounds (Controller Wire Harness)

Section 7: Glossary and Abbreviations:

AD(s) – Airworthiness Directive(s)

AFM – Aircraft Flight Manual

AFMS – Aircraft Flight Manual Supplement

ALS – Aircraft Limitations Section

AML – Approved Model List

APU – Auxiliary Power Unit

BTDC – Before Top Dead Center

CFR – Code of Federal Regulations

CSTW – Crank Shaft Trigger Wheel

EIS – Electronic Ignition System

FAA – Federal Aviation Administration

Ignition Timing – is the process of setting the angle relative to piston position and crankshaft angular velocity that a spark will occur in the combustion chamber near the end of the compression stroke.

MAG – magneto

MAP – Manifold Absolute Pressure

May/Should – an optional requirement

MTH – Mag Timing Housing

Must/Shall – a mandatory requirement

RPM – Revolutions per Minute

POH – Pilot's Operating Handbook

STC – Supplemental Type Certificate

TDC – Top Dead Center

Operator's Manual

Lycoming

O-360, HO-360,

IO-360, AIO-360,

HIO-360 & TIO-360 Series

Approved by FAA

8th Edition

Part No. 60297-12

LYCOMING

652 Oliver Street
Williamsport, PA. 17701 U.S.A.
570/323-6181

October 2005

LYCOMING OPERATOR’S MANUAL

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**SECTION 1
DESCRIPTION**

The O, HO, IO, AIO, HIO, LIO and TIO-360 series are four cylinder, direct drive, horizontally opposed, air-cooled engines.

In referring to the location of the various engine components, the parts are described as installed in the airframe. Thus, the power take-off end is the front and the accessory drive end the rear. The sump section is the bottom and the opposite side of the engine where the shroud tubes are located the top. Reference to the left and right side is made with the observer facing the rear of the engine. The cylinders are numbered from front to rear, odd numbers on the right. The direction of rotation of the crankshaft, viewed from the rear, is clockwise. Rotation for accessory drives is determined with the observer facing the drive pad.

NOTE

The letter "L" in the model prefix denotes the reverse rotation of the basic model. Example: model IO-360-C has clockwise rotation of the crankshaft. Therefore, LIO-360-C has counterclockwise rotation of the crankshaft. Likewise, the rotation of the accessory drives of the LIO-360-C is opposite those of the basic model as listed in Section 2 of this manual.

The letter "D" used as the 4th or 5th character in the model suffix denotes that the particular model employs dual magnetos housed in a single housing. Example: All information pertinent to the O-360-A1F6 will apply to the O-360-A1F6D.

Operational aspects of engines are the same and performance curves and specifications for the basic model will apply.

Cylinders – The cylinders are of conventional air-cooled construction with the two major parts, head and barrel, screwed and shrunk together. The heads are made from an aluminum alloy casting with a fully machined combustion chamber. Rocker shaft bearing supports are cast integral with the head along with housings to form the rocker boxes. The cylinder barrels have deep integral cooling fins and the inside of the barrels are ground and honed to a specified finish.

Valve Operating Mechanism – A conventional type camshaft is located above and parallel to the crankshaft. The camshaft actuates hydraulic tappets, which operate the valves through push rods and valve rockers. The valve rockers are supported on full floating steel shafts. The valve springs bear against hardened steel seats and are retained on the valve stems by means of split keys.

Crankcase – The crankcase assembly consists of two reinforced aluminum alloy castings, fastened together by means of studs, bolts and nuts. The mating surfaces of the two castings are joined without the use of a gasket, and the main bearing bores are machined for use of precision type main bearing inserts.

Crankshaft – The crankshaft is made from a chrome nickel molybdenum steel forging. All bearing journal surfaces are nitrided.

SECTION 1 DESCRIPTION

LYCOMING OPERATOR'S MANUAL O-360 AND ASSOCIATED MODELS

Connecting Rods – The connecting rods are made in the form of “H” sections from alloy steel forgings. They have replaceable bearing inserts in the crankshaft ends and bronze bushings in the piston ends. Two bolts and nuts through each cap retain the bearing caps on the crankshaft ends.

Pistons – The pistons are machined from an aluminum alloy. The piston pin is of a full floating type with a plug located in each end of the pin. Depending on the cylinder assembly, pistons may be machined for either three or four rings and may employ either half wedge or full wedge rings. Consult the latest revision of Service Instruction No. 1037 for proper piston and ring combinations.

Accessory Housing – The accessory housing is made from an aluminum casting and is fastened to the rear of the crankcase and the top rear of the sump. It forms a housing for the oil pump and the various accessory drives.

Oil Sump (Except AIO Series) – The sump incorporates an oil drain plug, oil suction screen, mounting pad for carburetor or fuel injector, the intake riser and intake pipe connections.

Crankcase Covers (AIO Series) – Crankcase covers are employed on the top and bottom of the engine. These covers incorporate oil suction screens, oil scavenge line connections. The top cover incorporates a connection for a breather line and the lower cover a connection for an oil suction line.

Cooling System – These engines are designed to be cooled by air pressure. Baffles are provided to build up a pressure and force the air through the cylinder fins. The air is then exhausted to the atmosphere through gills or augmentor tubes usually located at the rear of the cowling.

Induction System – Lycoming O-360 and HO-360 series engines are equipped with either a float type or pressure type carburetor. See Table 1 for model application. Particularly good distribution of the fuel-air mixture to each cylinder is obtained through the center zone induction system, which is integral with the oil sump and is submerged in oil, insuring a more uniform vaporization of fuel and aiding in cooling the oil in the sump. From the riser the fuel-air mixture is distributed to each cylinder by individual intake pipes.

Lycoming IO-360, AIO-360, HIO-360 and TIO-360 series engines are equipped with a Bendix type RSA fuel injector, with the exception of model IO-360-B1A that is equipped with a Simmonds type 530 fuel injector. (See Table 1 of model application.) The fuel injection system schedules fuel flow in proportion to air flow and fuel vaporization takes place at the intake ports. A turbocharger is mounted as an integral part of the TIO-360 series engines. Automatic waste gate control of the turbocharger provides constant air density to the fuel injector inlet from sea level to critical altitude.

A brief description of the carburetors and fuel injectors follows:

The Marvel-Schebler MA-4-5 and HA-6 carburetors are of the single barrel float type equipped with a manual mixture control and an idle cut-off.

The Marvel-Schebler MA-4-5AA carburetor is of the single barrel float type with automatic pressure altitude mixture control. This carburetor is equipped with idle cut-off but does not have a manual mixture control.

The Bendix-Stromberg PSH-5BD is a pressure operated, single barrel horizontal carburetor, incorporating an airflow operated power enrichment valve and an automatic mixture control unit. It is equipped with an idle cut-off and a manual mixture control. The AMC unit works independently of, and in parallel with, the manual mixture control.

**LYCOMING OPERATOR'S MANUAL
O-360 AND ASSOCIATED MODELS**

**SECTION 1
DESCRIPTION**

The Bendix RSA type fuel injection system is based on the principle of measuring air flow and using the air flow signal in a stem type regulator to convert the air force into a fuel force. This fuel force (fuel pressure differential) when applied across the fuel metering section (jetting system) makes fuel flow proportional to airflow.

The Simmonds type 530 is a continuous flow fuel injection system. This continuous flow system has three separate components:

1. A fuel pump assembly.
2. A throttle body assembly.
3. Four fuel flow nozzles.

This system is throttle actuated. Fuel is injected into the engine intake valve ports by the nozzles. The system continuously delivers metered fuel to each intake valve port in response to throttle position, engine speed and mixture control position. Complete flexibility of operation is provided by the manual mixture control, which permits the adjustment of the amount of injected fuel to suit all operating conditions. Moving the mixture control to "Idle Cut-Off" results in a complete cut-off of fuel to the engine.

Lubrication System – (All models except AIO-360 series). An impeller type pump contained within the accessory housing actuates the full pressure wet sump lubrication system.

AIO-360 Series – The AIO-360 series is designed for aerobatic flying and is of the dry sump type. A double scavenge pump is installed on the accessory housing.

Priming System – Provision for a primer system is provided on all engines employing a carburetor. Fuel injected engines do not require a priming system.

Ignition System – Dual ignition is furnished by two Bendix magnetos. Consult Table 1 for model application.

Counterweight System – Models designated by the numeral 6 in the suffix of the model number (Example: O-360-A1G6) are equipped with crankshafts with pendulum type counterweights attached.

TABLE 1

MODEL APPLICATION			
Model	Left**	Right**	Carburetor
<u>O-360</u>			
-A1A, -A2A, -A3A, -A4A	S4LN-21	S4LN-20	MA-4-5
-A1C, -C2D	S4LN-200	S4LN-204	PSH-5BD
-A1D, -A2D, -A3D, -A4D, -A2E	S4LN-200	S4LN-204	MA-4-5
-A1F, -A2F, -A1F6	S4LN-1227	S4LN-1209	MA-4-5
-A1G, -A2G, -A4G, -A1G6	S4LN-1227	S4LN-1209	HA-6
-A1H, -A2H, -A4J	S4LN-21	S4LN-204	HA-6
-A1H6	4273	4270	HA-6
-A1P, -A4P, -B2C, -C4P	4373	4370	MA-4-5
-A4K, -C1F, -C4F	4371	4370	HA-6
-A4M	4371	4370	MA-4-5

* - Models with counterclockwise rotation employ S4RN series.

** - See latest revision of Service Instruction No. 1443 for alternate magnetos.

LYCOMING OPERATOR’S MANUAL

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SECTION 3

OPERATING INSTRUCTIONS

1. *GENERAL.* Close adherence to these instructions will greatly contribute to long life, economy and satisfactory operation of the engine.

NOTE

YOUR ATTENTION IS DIRECTED TO THE WARRANTIES THAT APPEAR IN THE FRONT OF THIS MANUAL REGARDING ENGINE SPEED, THE USE OF SPECIFIED FUELS AND LUBRICANTS, REPAIR AND ALTERATIONS. PERHAPS NO OTHER ITEM OF ENGINE OPERATION AND MAINTENANCE CONTRIBUTES QUITE SO MUCH TO SATISFACTORY PERFORMANCE AND LONG LIFE AS THE CONSTANT USE OF CORRECT GRADES OF FUEL AND OIL, CORRECT ENGINE TIMING, AND FLYING THE AIRCRAFT AT ALL TIMES WITHIN THE SPEED AND POWER RANGE SPECIFIED FOR THE ENGINE. DO NOT FORGET THAT VIOLATION OF THE OPERATION AND MAINTENANCE SPECIFICATIONS FOR YOUR ENGINE WILL NOT ONLY VOID YOUR WARRANTY BUT WILL SHORTEN THE LIFE OF YOUR ENGINE AFTER ITS WARRANTY PERIOD HAS PASSED.

New engines have been carefully run-in by Lycoming and therefore, no further break-in is necessary insofar as operation is concerned; however, new or newly overhauled engines should be operated on straight mineral oil for a minimum of 50 hours or until oil consumption has stabilized. After this period, a change to an approved additive oil may be made, if so desired.

NOTE

Cruising should be done at 65% to 75% power until a total of 50 hours has accumulated or oil consumption has stabilized. This is to ensure proper seating of the rings and is applicable to new engines, and engines in service following cylinder replacement or top overhaul of one or more cylinders.

The minimum fuel octane rating is listed in the flight chart, Part 8 of this section. Under no circumstances should fuel of a lower octane rating or automotive fuel (regardless of octane rating) be used.

2. *PRESTARTING ITEMS OF MAINTENANCE.* Before starting the aircraft engine for the first flight of the day, there are several items of maintenance inspection that should be performed. These are described in Section 4 under Daily Pre-Flight Inspection. They must be observed before the engine is started.

3. *STARTING PROCEDURES.* O-360, HO-360, IO-360, AIO-360, HIO-360, TIO-360 Series.

The following starting procedures are recommended, however, the starting characteristics of various installations will necessitate some variation from these procedures.

a. *Engines Equipped with Float Type Carburetors.*

(1) Perform pre-flight inspection.

SECTION 3 OPERATING INSTRUCTIONS

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- (2) Set carburetor heat control in "off" position.
- (3) Set propeller governor control in "Full RPM" position (where applicable).
- (4) Turn fuel valves "On".
- (5) Move mixture control to "Full Rich".
- (6) Turn on boost pump.
- (7) Open throttle approximately $\frac{1}{4}$ travel.
- (8) Prime with 1 to 3 strokes of manual priming pump or activate electric primer for 1 or 2 seconds.
- (9) Set magneto selector switch (consult airframe manufacturer's handbook for correct position).
- (10) Engage starter.
- (11) When engine fires, move the magneto switch to "Both".
- (12) Check oil pressure gage. If minimum oil pressure is not indicated within thirty seconds, stop engine and determine trouble.

b. Engines Equipped with Pressure Carburetors or Bendix Fuel Injectors.

- (1) Perform pre-flight inspection.
- (2) Set carburetor heat or alternate air control in "Off" position.
- (3) Set propeller governor control in "Full RPM" position (where applicable).
- (4) Turn fuel valve "On".
- (5) Turn boost pump "On".
- (6) Open throttle wide open, move mixture control to "Full Rich" until a slight but steady fuel flow is noted (approximately 3 to 5 seconds) then return throttle to "Closed" and return mixture control to "Idle Cut-Off".
- (7) Turn boost pump "Off".
- (8) Open throttle $\frac{1}{4}$ of travel.
- (9) Set magneto selector switch (consult airframe manufacturer's handbook for correct position).
- (10) Engage starter.

- (11) Move mixture control slowly and smoothly to "Full Rich".
- (12) Check oil pressure gage. If minimum oil pressure is not indicated within thirty seconds, stop engine and determine trouble.

c. Engines Equipped with Simmonds Type 530 Fuel Injector.

- (1) Perform pre-flight inspection.
- (2) Set alternate air control in "Off" position.
- (3) Set propeller governor control in "Full RPM" position.
- (4) Turn fuel valve "On".
- (5) Turn boost pump "On".
- (6) Open throttle approximately $\frac{1}{4}$ travel, move mixture control to "Full Rich" until a slight but steady fuel flow is noted (approximately 3 to 5 seconds) then return throttle to "Closed" and return mixture control to "Idle Cut-Off".
- (7) Turn boost pump "Off".
- (8) Open throttle $\frac{1}{4}$ travel.
- (9) Move combination magneto switch to "Start", using accelerator pump as a primer while cranking engine.
- (10) When engine fires allow the switch to return to "Both".
- (11) Check oil pressure gage. If minimum oil pressure is not indicated within thirty seconds, stop engine and determine trouble.

4. **COLD WEATHER STARTING.** During extreme cold weather, it may be necessary to preheat the engine and oil before starting.

5. **GROUND RUNNING AND WARM-UP.**

The engines covered in this manual are air-pressure cooled and depend on the forward speed of the aircraft to maintain proper cooling. Particular care is necessary, therefore, when operating these engines on the ground. To prevent overheating, it is recommended that the following precautions be observed.

NOTE

Any ground check that requires full throttle operation must be limited to three minutes, or less if the cylinder head temperature should exceed the maximum as stated in this manual.

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a. Fixed Wing.

- (1) Head the aircraft into the wind.
- (2) Leave mixture in "Full Rich".
- (3) Operate only with the propeller in minimum blade angle setting.
- (4) Warm-up to approximately 1000-1200 RPM. Avoid prolonged idling and do not exceed 2200 RPM on the ground.
- (5) Engine is warm enough for take-off when the throttle can be opened without the engine faltering.
| Take-off with a turbocharged engine must not be started if indicated lubricating oil pressure, due to cold temperature is above maximum. Excessive oil pressure can cause overboost and consequent engine damage.

b. Helicopter.

- (1) Warm-up at approximately 2000 RPM with rotor engaged as directed in the airframe manufacturer's handbook.

6. GROUND CHECK.

- a. Warm-up as directed above.
- b. Check both oil pressure and oil temperature.
- c. Leave mixture control in "Full Rich".
- d. *Fixed Wing Aircraft (where applicable).* Move the propeller control through its complete range to check operation and return to full low pitch position. Full feathering check (twin engine) on the ground is not recommended but the feathering action can be checked by running the engine between
| 1000-1500 RPM, then momentarily pulling the propeller control into the feathering position. Do not allow the RPM to drop more than 500 RPM.
- e. A proper magneto check is important. Additional factors, other than the ignition system, affect magneto drop-off. They are load-power output, propeller pitch, and mixture strength. The important point is that the engine runs smoothly because magneto drop-off is affected by the variables listed above. Make the magneto check in accordance with the following procedures.

(1) Fixed Wing Aircraft.

- | (a) *(Controllable pitch propeller).* With the propeller in minimum pitch angle, set the engine to produce 50-65% power as indicated by the manifold pressure gage unless otherwise specified in the aircraft manufacturer's manual. At these settings, the ignition system and spark plugs must work harder because of the greater pressure within the cylinders. Under these conditions, ignition problems can occur. Magneto checks at low power settings will only indicate fuel/air distribution quality.

- (b) (*Fixed pitch propeller*). Aircraft that are equipped with fixed pitch propellers, or not equipped with manifold pressure gage, may check magneto drop-off with engine operating at approximately 1800 RPM (2000 RPM maximum).
- (c) Switch from both magnetos to one and note drop-off; return to both until engine regains speed and switch to the other magneto and note drop-off, then return to both. Drop-off must not exceed 175 RPM and must not exceed 50 RPM between magnetos. Smooth operation of the engine but with a drop-off that exceeds the normal specification of 175 RPM is usually a sign of propeller load condition at a rich mixture. Proceed to step e. (1) (d).
- (d) If the RPM drop exceeds 175 RPM, slowly lean the mixture until the RPM peaks. Then retard the throttle to the RPM specified in step e.(1)(a) or e.(1)(b) for the magneto check and repeat the check. If the drop-off does not exceed 175 RPM, the difference between the magnetos does not exceed 50 RPM, and the engine is running smoothly, then the ignition system is operating properly. Return the mixture to full rich.

(2) *Helicopter.*

Raise collective pitch stick to obtain 15 inches manifold pressure at 2000 RPM.

Switch from both magnetos to one and note drop-off; return to both until engine regains speed and switch to the other magneto and note drop-off. Drop-off must not exceed 200 RPM. Drop-off between magnetos must not exceed 50 RPM. A smooth drop-off past normal is usually a sign of a too lean or too rich mixture.

- f. Do not operate on a single magneto for too long a period; a few seconds is usually sufficient to check drop-off and to minimize plug fouling.

7. OPERATION IN FLIGHT.

- a. See airframe manufacturer's instructions for recommended power settings.
- b. Throttle movements from full power to idle or from idle to full power are full range movements. Full range throttle movements must be performed over a minimum time duration of 2 to 3 seconds. Performing a full range throttle movement at a rate of less than 2 seconds is considered a rapid or instant movement. Performing rapid movements may result in detuned counterweights which may lead to failure of the counterweight lobes and subsequent engine damage.

c. *Fuel Mixture Leaning Procedure.*

Improper fuel/air mixture during flight is responsible for engine problems, particularly during take-off and climb power settings. The procedures described in this manual provide proper fuel/air mixture when leaning Lycoming engines; they have proven to be both economical and practical by eliminating excessive fuel consumption and reducing damaged parts replacement. It is therefore recommended that operators of all Lycoming aircraft engines utilize the instructions in this publication any time the fuel/air mixture is adjusted during flight.

Manual leaning may be monitored by exhaust gas temperature indication, fuel flow indication, and by observation of engine speed and/or airspeed. However, whatever instruments are used in monitoring the mixture, the following general rules must be observed by the operator of Lycoming aircraft engines.

GENERAL RULES

Never exceed the maximum red line cylinder head temperature limit.

For maximum service life, cylinder head temperatures should be maintained below 435°F (224°C) during high performance cruise operation and below 400°F (205°C) for economy cruise powers.

Do not manually lean engines equipped with automatically controlled fuel system.

On engines with manual mixture control, maintain mixture control in "Full Rich" position for rated take-off, climb, and maximum cruise powers (above approximately 75%). However, during take-off from high elevation airport or during climb, roughness or loss of power may result from over-richness. In such a case adjust mixture control only enough to obtain smooth operation – not for economy. Observe instruments for temperature rise. Rough operation due to over-rich fuel/air mixture is most likely to be encountered in carbureted engines at altitude above 5,000 feet.

Always return the mixture to full rich before increasing power settings.

Operate the engine at maximum power mixture for performance cruise powers and at best economy mixture for economy cruise power; unless otherwise specified in the airplane owner's manual.

During letdown flight operations it may be necessary to manually lean uncompensated carbureted or fuel injected engines to obtain smooth operation.

On turbocharged engines never exceed 1650°F turbine inlet temperature (TIT).

1. LEANING TO EXHAUST GAS TEMPERATURE GAGE.

a. Normally aspirated engines with fuel injectors or uncompensated carburetors.

(1) Maximum Power Cruise (approximately 75% power) – Never lean beyond 150°F on rich side of peak EGT unless aircraft operator's manual shows otherwise. Monitor cylinder head temperatures.

(2) Best Economy Cruise (approximately 75% power and below) – Operate at peak EGT.

b. Turbocharged engines.

(1) Best Economy Cruise – Lean to peak turbine inlet temperature (TIT) or 1650°F, whichever occurs first.

(2) Maximum Power Cruise – The engine must always be operated on the rich side of peak EGT or TIT. Before leaning to obtain maximum power mixture it is necessary to establish a reference point. This is accomplished as follows:

(a) Establish a peak EGT or TIT for best economy operation at the highest economy cruise power without exceeding 1650°F.

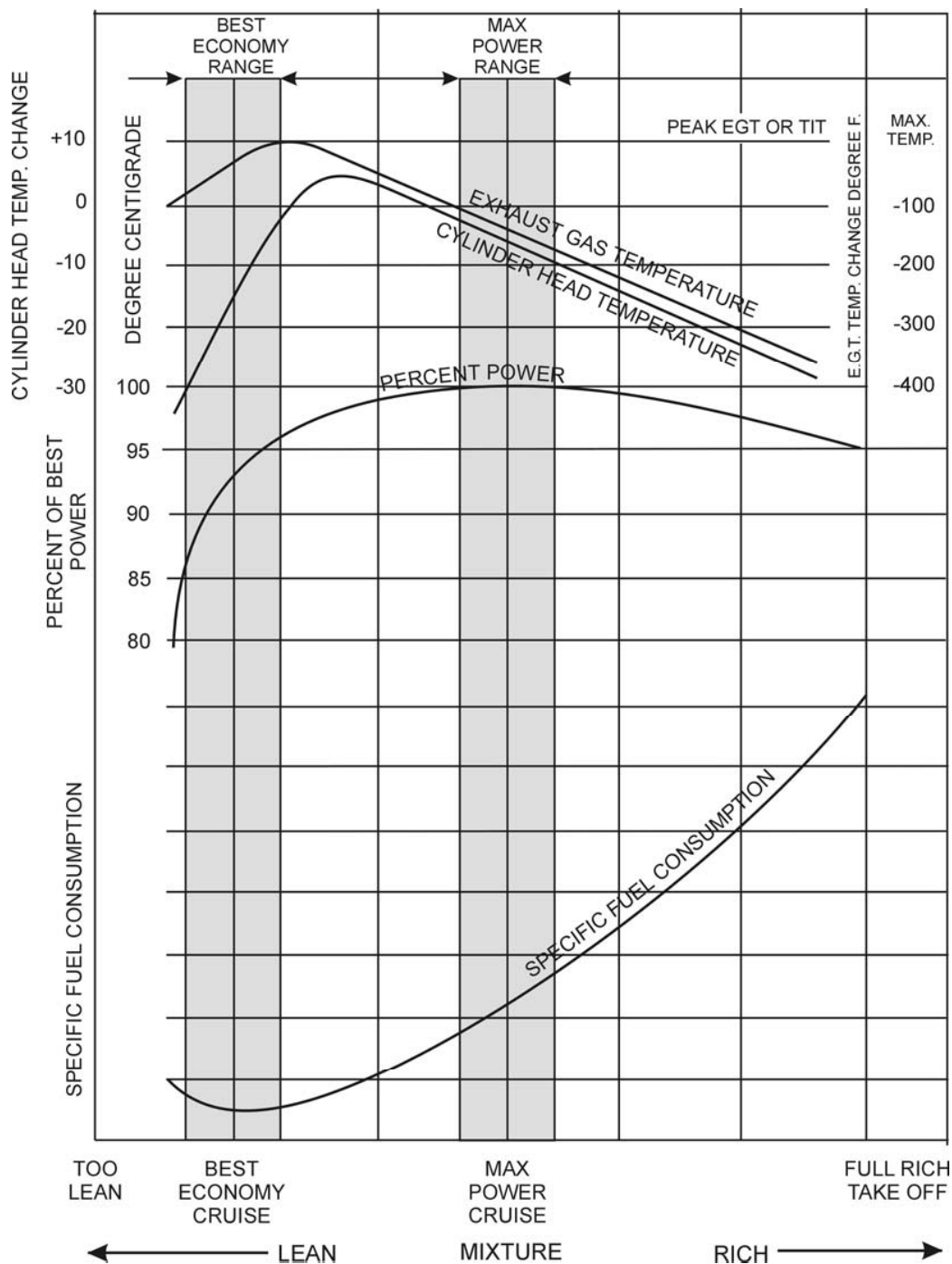


Figure 3-1. Representative Effect of Fuel/Air Ratio on Cylinder Head Temperature, Power and Specific Fuel Consumption at Constant RPM and Manifold Pressure in Cruise Range Operation

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- (b) Deduct 125°F from this temperature and thus establish the temperature reference point for use when operating at maximum power mixture.
- (c) Return mixture control to full rich and adjust the RPM and manifold pressure for desired performance cruise operation.
- (d) Lean out mixture until EGT or TIT is the value established in step (b). This sets the mixture at best power.

2. *LEANING TO FLOWMETER.*

Lean to applicable fuel-flow tables or lean to indicator marked for correct fuel flow for each power setting.

3. *LEANING WITH MANUAL MIXTURE CONTROL.* (Economy cruise, 75% power or less, without flowmeter or EGT gauge.)

a. Carbureted Engines.

- (1) Slowly move mixture control from “Full Rich” position toward lean position.
- (2) Continue leaning until engine roughness is noted.
- (3) Enrich until engine runs smoothly and power is regained.

b. Fuel Injected Engines.

- (1) Slowly move mixture control from “Full Rich” position toward lean position.
- (2) Continue leaning until slight loss of power is noted (loss of power may or may not be accompanied by roughness).
- (3) Enrich until engine runs smoothly and power is regained.

WARNING

REFER TO THE PILOT'S OPERATING HANDBOOK OR AIRFRAME MANUFACTURER'S MANUAL FOR ADDITIONAL INSTRUCTIONS ON THE USE OF CARBURETOR HEAT CONTROL. INSTRUCTIONS FOUND IN EITHER PUBLICATION SUPERSEDE THE FOLLOWING INFORMATION.

- c. Use of Carburetor Heat Control* – Under certain moist atmospheric conditions (generally at a relative humidity of 50% or greater) and at temperatures of 20° to 90°F it is possible for ice to form in the induction system. Even in summer weather ice may form. This is due to the high air velocity through the carburetor venturi and the absorption of heat from this air by vaporization of the fuel. The temperature in the mixture chamber may drop as much as 70°F below the temperature of the incoming air. If this air contains a large amount of moisture, the cooling process can cause precipitation in the form of ice. Ice formation generally begins in the vicinity of the butterfly and may build up to such an extent that a drop in power output could result. In installations equipped with fixed pitch propellers, a loss of power is reflected by a drop in manifold pressure and RPM. In installations equipped with constant speed propellers, a loss of power is reflected by a drop in manifold pressure. If not corrected, this condition may cause complete engine stoppage.

To avoid this, all installations are equipped with a system for preheating the incoming air supply to the carburetor. In this way sufficient heat is added to replace the heat loss of vaporization of fuel, and the mixing chamber temperature cannot drop to the freezing point of water (32°F). The air preheater is a tube or jacket through which the exhaust pipe from one or more cylinders is passed, and the air flowing over these surfaces is raised to the required temperature before entering the carburetor. Consistently high temperatures are to be avoided because of a loss in power and a decided variation of mixture. High charge temperatures also favor detonation and preignition, both of which are to be avoided if normal service life is to be expected from the engine. The following outline is the proper method of utilizing the carburetor heat control.

- (1) *Ground Operation* – Use of the carburetor air heat on the ground must be held to an absolute minimum. On some installations the air does not pass through the air filter, and dirt and foreign substances can be taken into the engine with the resultant cylinder and piston ring wear. Only use carburetor air heat on the ground to make certain it is functioning properly.
- (2) *Take-Off* – Set the carburetor heat in full cold position. For take-off and full throttle operation the possibility of expansion or throttle icing at wide throttle openings is very remote.
- (3) *Climbing* – When climbing at part throttle power settings of 80% or above, set the carburetor heat control in the full cold position; however, if it is necessary to use carburetor heat to prevent icing it is possible for engine roughness to occur due to the over-rich fuel/air mixture produced by the additional carburetor heat. When this happens, lean the mixture with the mixture control only enough to produce smooth engine operation. Do not continue to use carburetor heat after flight is out of icing conditions, and return mixture to full rich when carburetor heat is removed.
- (4) *Flight Operation* – During normal flight, leave the carburetor air heat control in the full cold position. On damp, cloudy, foggy or hazy days, regardless of the outside air temperature, be alert for loss of power. This will be evidenced by an unaccountable loss in manifold pressure or RPM or both, depending on whether a constant speed or fixed pitch propeller is installed on the aircraft. If this happens, apply full carburetor air heat and open the throttle to limiting manifold pressure and RPM. This will result in a slight additional drop in manifold pressure, which is normal, and this drop will be regained as the ice is melted out of the induction system. When ice has been melted from the induction system, return the carburetor heat control to the full cold position. In those aircraft equipped with a carburetor air temperature gauge, partial heat may be used to keep the mixture temperature above the freezing point of water (32°F).

WARNING

CAUTION MUST BE EXERCISED WHEN OPERATING WITH PARTIAL HEAT ON AIRCRAFT THAT DO NOT HAVE A CARBURETOR AIR TEMPERATURE GAUGE. USE EITHER FULL HEAT OR NO HEAT IN AIRCRAFT THAT ARE NOT EQUIPPED WITH A CARBURETOR AIR TEMPERATURE GAUGE.

- (5) *Landing Approach* – In making a landing approach, the carburetor heat is generally in the “Full Cold” position. However, if icing conditions are suspected, apply “Full Heat”. In the case that full power needs to be applied under these conditions, as for an aborted landing, return the carburetor heat to “Full Cold” after full power application.

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8. ENGINE FLIGHT CHART.

FUEL AND OIL –

Model Series	*Aviation Grade Fuel Minimum Grade
O-360-B, -D	80/87
O-360-A1P, -C1F, -C4F; HO-360-C1A	91/96
O-360-C, -F; HO-360-A, -B; IO-360-B, -E; HIO-360-B	91/96 or 100/130
O-360-J2A	91/96 or 100/100LL
IO-360-L2A, -M1A, -M1B	91/96 or 100LL
HIO-360-G1A	91/96 or 100LL
O-360-A, -C1G, -C4P, -A1H6; TIO-360-C1A6D	100/100LL
IO-360-B1G6, -C1G6, -J, -K2A, -A1D6D, -A3B6, -A3D6D; HIO-360-A1B	100/100LL
AIO-360-A, -B; IO-360-A, -C, -D, -F	100/130
HIO-360-A, -C, -D, -E, -F	100/130
TIO-360-A	100/130

NOTE

Aviation grade 100LL fuels in which the lead content is limited to 2 c.c. per gal. are approved for continuous use in the above listed engines.

* - Refer to latest revision of Service Instruction No. 1070.

FUEL PRESSURE, PSI –

Model	Max.	Desired	Min.
O-360 Series (Except -A1C, -C2B, -C2D); HO-360-A, -C Series Inlet to carburetor	8.0	3.0	0.5
O-360-A1C, -C2B, -C1D; HO-360-B Series Inlet to carburetor	18	13	9.0
HIO-360-A1B Inlet to fuel pump	30	-----	-2
IO-360 Series (Except -B1A, -F1A); AIO-360 Series, HIO-360 Series (Except -A1B) Inlet to fuel pump	35	-----	-2
IO-360-F1A Inlet to fuel pump	35	-----	-2
IO-360 Series (Except -B1A), AIO-360 Series; HIO-360 Series Inlet to fuel injector	45		14
IO-360-B1A Inlet to fuel injector	2		-2

FUEL PRESSURE, PSI (CONT.) –

Model	Max.	Desired	Max.
HIO-360-E, -F Series			
Inlet to fuel pump	55		-2
Inlet to fuel injector	55		27
TIO-360-A Series			
Inlet to fuel pump	50		-2
Inlet to fuel injector	45		20
TIO-360-C1A6D			
Inlet to fuel pump	65		-2
Inlet to fuel injector	65		22

OIL – (All Models) –

***Recommended Grade Oil**

Average Ambient Air	MIL-L-6082B Grades	MIL-L-22851 Ashless Dispersant Grades
All Temperatures	-----	SAE 15W-50 or 20W-50
Above 80°F	SAE 60	SAE60
Above 60°F	SAE 50	SAE 40 or SAE 50
30° to 90°F	SAE 40	SAE 40
0° to 70°F	SAE 30	SAE 40, 30 or 20W40
Below 10°F	SAE 20	SAE 30 or 20W30

* - Refer to latest revision of Service Instruction No. 1014.

OIL SUMP CAPACITY

I All Models (Except AIO-360 Series, O-360-J2A)	8 U.S. Quarts
Minimum Safe Quantity in Sump	
(Except – IO-360-M1A, -M1B; HIO-360-G1A)	2 U.S. Quarts
IO-360-M1A, -M1B; HIO-360-G1A	4 U.S. Quarts
AIO-360 Series	Dry Sump
I O-360-J2A.....	6 U.S. Quarts

OPERATING CONDITIONS

Average Ambient Air	Desired	*Oil Inlet Temperature Maximum
Above 80°F	180°F (82°C)	245°F (118°C)
Above 60°F	180°F (82°C)	245°F (118°C)
30° to 90°F	180°F (82°C)	245°F (118°C)
0° to 70°F	170°F (77°C)	245°F (118°C)
Below 10°F	160°F (71°C)	245°F (118°C)

* - Engine oil temperature should not be below 140°F (60°C) during continuous operation.

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OPERATING CONDITIONS (CONT.)

Oil Pressure, psi (Rear)	Maximum	Minimum	Idling
Normal Operation, All Models (Except Below)	95	55	25
TIO-360-C1A6D	95	50	25
Oil Pressure, psi (Front)			
O-360-A4N, -F1A6	90	50	20
Start, Warm-up, Taxi, and Take-off (All Models)	115		

Operation	RPM	HP	Fuel Cons. Gal/Hr.	Max. Oil Cons. Qts./Hr.	*Max. Cyl. Head Temp.
O-360-A, -C** Series					
Normal Rated	2700	180	-----	.80	500°F (260°C)
Performance Cruise (75% Rated)	2450	135	10.5	.45	500°F (260°C)
Economy Cruise (65% Rated)	2350	117	9.5	.39	500°F (260°C)
O-360-B, -D Series					
Normal Rated	2700	168	-----	.75	500°F (260°C)
Performance Cruise (75% Rated)	2450	126	11.6	.42	500°F (260°C)
Economy Cruise (65% Rated)	2350	109	9.0	.37	500°F (260°C)
O-360-A1P, -A4D, -A4P, -C4P, -F, -G Series					
Normal Rated	2700	180	-----	.80	500°F (260°C)
Performance Cruise (75% Rated)	2450	135	9.7	.45	500°F (260°C)
Economy Cruise (65% Rated)	2350	117	8.3	.39	500°F (260°C)

* - At Bayonet Location – For maximum service life of the engine maintain cylinder head temperature between 150°F and 400°F during continuous operation.

** - O-360-C2D Only – Take-off rating 180 HP at 2900 RPM, 28 in. Hg.

OPERATING CONDITIONS (CONT.)

Operation	RPM	HP	Fuel Cons. Gal./Hr.	Max. Oil Cons. Qts./Hr.	*Max. Cyl. Head Temp.
O-360-J2A					
Normal Rated	2400/2700	145	-----	.50	500°F (260°C)
Performance Cruise (75% Rated)	1800/2025	109	9.3	.36	500°F (260°C)
Economy Cruise (65% Rated)	1560/1755	94	6.8	.31	500°F (260°C)
HO-360-A, -C Series; HIO-360-G1A					
Normal Rated	2700	180	-----	.80	500°F (260°C)
Performance Cruise (75% Rated)	2450	135	9.7	.45	500°F (260°C)
Economy Cruise (65% Rated)	2350	117	9.0	.39	500°F (260°C)
HO-360-B Series					
Normal Rated	2900	180	-----	.80	500°F (260°C)
Performance Cruise (75% Rated)	2700	135	10.5	.45	500°F (260°C)
Economy Cruise (65% Rated)	2700	117	9.0	.39	500°F (260°C)
IO-360-A, -C, -D, -J, -K; AIO-360 Series					
Normal Rated	2700	200	-----	.89	500°F (260°C)
Performance Cruise (75% Rated)	2450	150	12.3	.50	500°F (260°C)
Economy Cruise (65% Rated)	2350	130	9.5	.44	500°F (260°C)
IO-360-B, -E, -F Series (Except -B1C); IO-360-M1A**, -M1B**					
Normal Rated	2700	180	-----	.80	500°F (260°C)
Performance Cruise (75% Rated)	2450	135	11.0	.45	500°F (260°C)
Economy Cruise (65% Rated)	2350	117	8.5	.39	500°F (260°C)

* - At Bayonet Location – For maximum service life of the engine maintain cylinder head temperature between 150°F and 400°F during continuous operation.

** - This engine has an alternate rating of 160 HP at 2400 RPM.

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OPERATING INSTRUCTIONS**

**LYCOMING OPERATOR'S MANUAL
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OPERATING CONDITIONS (CONT.)

Operation	RPM	HP	Fuel Cons. Gal./Hr.	Max. Oil Cons. Qts./Hr.	*Max. Cyl. Head Temp.
IO-360-B1C					
Normal Rated	2700	177	-----	.79	500°F (260°C)
Performance Cruise (75% Rated)	2450	133	11.0	.45	500°F (260°C)
Economy Cruise (65% Rated)	2350	115	8.5	.39	500°F (260°C)
IO-360-L2A					
Normal Rated	2400	160	-----	.52	500°F (260°C)
Performance Cruise (75% Rated)	2180	120	8.8	.39	500°F (260°C)
Economy Cruise (65% Rated)	2080	104	7.6	.34	500°F (260°C)
HIO-360-A Series					
Normal Rated	2900	180†	-----	.80	500°F (260°C)
Performance Cruise (75% Rated)	2700	135	11.0	.45	500°F (260°C)
Economy Cruise (65% Rated)	2700	117	9.5	.39	500°F (260°C)
HIO-360-B Series					
Normal Rated	2900	180	-----	.80	500°F (260°C)
Performance Cruise (75% Rated)	2700	135	12.0	.45	500°F (260°C)
Economy Cruise (65% Rated)	2700	117	10.0	.39	500°F (260°C)
HIO-360-C Series					
Normal Rated	2900	205	-----	.91	500°F (260°C)
Performance Cruise (75% Rated)	2700	154	12.5	.52	500°F (260°C)
Economy Cruise (65% Rated)	2700	133	10.5	.45	500°F (260°C)

* - At Bayonet Location – For maximum service life of the engine maintain cylinder head temperature between 150°F and 400°F during continuous operation.

† - At 26 in. Hg. manifold pressure.

OPERATING CONDITIONS (CONT.)

Operation	RPM	HP	Fuel Cons. Gal./Hr.	Max. Oil Cons. Qts./Hr.	*Max. Cyl. Head Temp.
HIO-360-D Series					
Normal Rated	3200	190	-----	.85	500°F (260°C)
Performance Cruise (75% Rated)	3200	142	12.0	.48	500°F (260°C)
Economy Cruise (65% Rated)	3200	123	10.0	.41	500°F (260°C)
HIO-360-E Series					
Normal Rated	2900	190	-----	.85	500°F (260°C)
Performance Cruise (75% Rated)	2700	142	11.8	.47	500°F (260°C)
Economy Cruise (65% Rated)	2700	123	10.0	.41	500°F (260°C)
HIO-360-F Series					
Normal Rated	3050	190	-----	.84	500°F (260°C)
Performance Cruise (75% Rated)	2700	142	11.8	.47	500°F (260°C)
Economy Cruise (65% Rated)	2700	123	10.0	.46	500°F (260°C)
TIO-360-A Series**					
Normal Rated	2700	200	-----	.89	500°F (260°C)
Performance Cruise (75% Rated)	2450	150	14.0	.50	500°F (260°C)
Economy Cruise (65% Rated)	2350	130	10.2	.44	500°F (260°C)
TIO-360-C Series**					
Normal Rated	2575	210	-----	.70	500°F (260°C)
Performance Cruise (75% Rated)	2400	157.5	13.2	.53	500°F (260°C)
Economy Cruise (65% Rated)	2200	136.5	10.2	.46	500°F (260°C)

* - At Bayonet Location – For maximum service life of the engine maintain cylinder head temperature between 150°F and 400°F during continuous operation.

** - MAXIMUM TURBINE INLET TEMPERATURE 1650°F (898.8°C).

SECTION 3
OPERATING INSTRUCTIONS

LYCOMING OPERATOR'S MANUAL
O-360 AND ASSOCIATED MODELS

9. SHUT DOWN PROCEDURE.

a. Fixed Wing.

- (1) Set propeller governor control for minimum blade angle when applicable.
- (2) Idle until there is a decided drop in cylinder head temperature.
- (3) Move mixture control to "Idle Cut-Off".
- (4) When engine stops, turn off switches.

b. Helicopters.

- (1) Idle as directed in the airframe manufacturer's handbook, until there is a decided drop in cylinder head temperature.
- (2) Move mixture control to "Idle Cut-Off".
- (3) When engine stops, turn off switches.

LYCOMING OPERATOR'S MANUAL

**SECTION 8
TABLES**

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SECTION 8
TABLES

LYCOMING OPERATOR'S MANUAL
O-360 AND ASSOCIATED MODELS

FULL THROTTLE HP AT ALTITUDE
(Normally Aspirated Engines)

Altitude Ft.	% S.L. H.P.	Altitude Ft.	% S.L. H.P.	Altitude Ft.	% S.L. H.P.
0	100	10,000	70.8	19,500	49.1
500	98.5	11,000	68.3	20,000	48.0
1,000	96.8	12,000	65.8	20,500	47.6
2,000	93.6	13,000	63.4	21,000	46.0
2,500	92.0	14,000	61.0	21,500	45.2
3,000	90.5	15,000	58.7	22,000	44.0
4,000	87.5	16,000	56.5	22,500	43.3
5,000	84.6	17,000	54.3	23,000	42.2
6,000	81.7	17,500	53.1	23,500	41.4
7,000	78.9	18,000	52.1	24,000	40.3
8,000	76.2	18,500	51.4	24,500	39.5
9,000	73.5	19,000	50.0	25,000	38.5

TABLE OF SPEED EQUIVALENTS

Sec./Mi.	M.P.H.	Sec./Mi.	M.P.H.	Sec./Mi.	M.P.H.
72.0	50	24.0	150	14.4	250
60.0	60	22.5	160	13.8	260
51.4	70	21.2	170	13.3	270
45.0	80	20.0	180	12.8	280
40.0	90	18.9	190	12.4	290
36.0	100	18.0	200	12.0	300
32.7	110	17.1	210	11.6	310
30.0	120	16.4	220	11.2	320
27.7	130	15.6	230	10.9	330
25.7	140	15.0	240	10.6	340

Dan Buzz & Associates LLC
9199 Cotters Ridge
Richland MI 49083

AFMS DB1502027
Revision IR
FAA Approved Model List

FAA APPROVED

AIRPLANE FLIGHT MANUAL SUPPLEMENT

Document No: DB1502027 Rev. IR

L3 Communication Avionics Systems ESI-500 Standby Instrument System

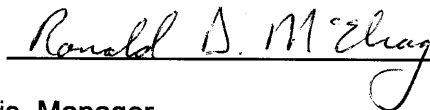
Aircraft Manufacturer/Model CESSNA 172M

Aircraft Serial Number 17263767 / 17264078

This Supplement must be attached to the Approved Airplane Flight Manual when a L3 Communication Avionics Systems ESI-500 Standby Instrument System is installed in accordance with STC SA04046CH and Dan Buzz & Associates Master Document List DB1502025.

The information contained herein supplements the information of the Pilots Operating Manual and/or Airplane Flight Manual. For Limitations, Procedures and Performance information not contained in this Supplement, consult the basic Airplane Flight Manual.

FAA APPROVED



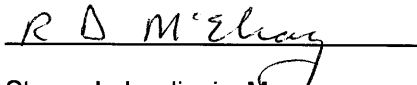
for Steven L. Lardinois, Manager
Systems and Flight Test Branch, ACE-117C
Chicago Aircraft Certification Office
2300 E. Devon Ave.
Des Plaines, IL 60018
FAA Central Region

Date: DEC 17 2015

Dan Buzz & Associates LLC
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AFMS DB1502027
Revision IR
FAA Approved Model List

LOG OF REVISIONS

REV.	PAGES	DESCRIPTION	FAA-APPROVED	DATE
IR	1 – 12	Initial Release	 Steven L. Lardinois, Manager Systems and Flight Test Branch, ACE-117C Chicago Aircraft Certification Office 2300 E. Devon Ave. Des Plaines, IL 60018 FAA Central Region	DEC 17 2015

FAA Approved
Date: DEC 17 2015

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1.0 GENERAL

This supplement provides pilot information in regards to the operation of the ESI-500 Electronic Standby Indicator as installed.

The Electronic Standby Instrument System is comprised of the panel mounted ESI-500 Electronic Standby Indicator and the optional remote mounted MAG-500 Magnetometer. The system provides the flight crew with the display of attitude, slip, altitude, airspeed, and heading. The ESI-500 provides a means of setting barometric correction and selected course for display. In addition, functional options are available for navigation information and the display of synthetic vision, including terrain and obstacles. Refer to the ESI-500 Pilots Guide for optional input displays.

Synthetic Vision is an geocentric 3-dimensional display of terrain and obstacles, based on GPS location of the aircraft, attitude, altitude, and heading. Synthetic Vision provides situational awareness to the pilot by providing a means to aid in visually acquiring potential impact threats of terrain and obstacles. Synthetic vision uses a database consisting of DTED (digital terrain elevation data) and obstacles. Terrain is shaded to give dimension to the terrain, water is shown in blue, and gridlines are shown to aid in determining relative distances. If the aircraft does not already have a TAWS or Terrain alerting system installed, the Synthetic Vision can be configured to display alert shading (red and yellow) of the 3D terrain display, for caution and warning annunciations of terrain impact.

The navigation function can be configured for VOR/ILS or GPS single source or both. The VOR/ILS provides the following display indications: VOR/ILS Indications, Navigation Source, Selected Course, To/From Indicator (VOR), Lateral Deviation, BC Annunciation (Auto detected with a heading input), Vertical Deviation (ILS), and Marker Beacon(if supported by nav source).

The GPS provides the following display indications: Navigation Source, Selected Course, Lateral/Vertical Deviation, To/From indication, and Desired Track.

The internal battery pack automatically powers the ESI-500 without interruption upon loss of main input power. The battery pack has three lithium ion cells that are recharged using aircraft power.

The battery pack includes monitoring and safety functionality that provides continual operational checks and oversight of operation to ensure the battery cannot be overcharged, overly depleted or detrimentally charged due to temperature limitations.

2.0 LIMITATIONS

When air data is failed, the ESI-500 can operate in an Attitude Degraded Mode, which means that the ESI-500 is not operating within the normal performance parameters. The pilot is alerted to this by an amber "ATT DEGRADED" message on the display.

- When air data is failed, heading is invalid.

For installations with a MAG-500, the Heading Degraded operation occurs if the Roll value is greater than 11.5° for three minutes, or if the "ATT DEGRADED" indication is shown. The unit is able to continue displaying heading information at a lesser performance. The pilot is alerted to this degraded mode of operation by an amber "HDG DEGRADED" indication on the display.

- During flight, if air data is not failed and the "HDG DEGRADED" indication is displayed, cross check the heading with another source or outside reference. Return to straight and level until the message clears for full performance.
- During flight, if air data is failed and "HDG DEGRADED" indication is displayed, cross check the heading with another source or outside reference.

RVSM Qualified Aircraft: The altitude display is not corrected for static source errors and is not RVSM compliant. Do not enter RVSM airspace when altitude keeping is predicated on the ESI-500 system.

3.0 BATTERY

1. Battery operation is inhibited due to low and high temperatures as follows:
 - a. Battery will not discharge when temperature is: $> +65^{\circ}\text{C}$ ($> +149^{\circ}\text{F}$).
 - b. Battery will not charge when temperature is: $< +5^{\circ}\text{C}$ and $> +40^{\circ}\text{C}$ ($< +41^{\circ}\text{F}$ and $> +104^{\circ}\text{F}$).
 - c. Battery capacity not guaranteed when battery temperature is $< -20^{\circ}\text{C}$ ($< 4^{\circ}\text{F}$). Battery may not be available when battery temperature is $< -20^{\circ}\text{C}$ or $> +60^{\circ}\text{C}$ ($< -4^{\circ}\text{F}$ or $> +140^{\circ}\text{F}$).
 - d. Storage or operation in extreme high temperature $> 90^{\circ}\text{C}$ ($> 194^{\circ}\text{F}$) may cause the chemical fuse in the Battery Pack to permanently disable the battery.
2. Battery operation can also be inhibited due to low input voltage.

4.0 HEADING (if enabled)

1. When configured to operate with a MAG-500 for heading reference input; the use of heading is not authorized to operate in the following regions due to magnetic field unsuitability:
 - a. North of 70° N latitude
 - b. South of 70° S latitude
 - c. North of 65° N latitude between 75° and 120° W longitude (Northern Canada)
 - d. South of 55° S latitude between 120° and 165° E longitude (South of Australia and New Zealand)
2. The heading will fail if the magnetic dip angle exceeds 82 deg.
3. Attitude and air data information is still usable.

5.0 SYNTHETIC VISION (if enabled)

1. The Synthetic Vision (SVS) option has the following limitations:
 - a. Areas with densely populated objects (exceeds 500 objects in a ¼ degree square area) and are >200ft AGL may not all obstacles shown on the display (e.g. windmill farms).
 - b. . The Synthetic Vision alert function (red and yellow shading of the 3D terrain display) does NOT meet the requirements of TSO-C151 (TAWS) or TSO-194 (HTAWS)
 - c. The Synthetic Vision function only works when the aircraft is between 70° N and 70° S.
 - d. For QFE operation the Synthetic Vision must be disabled in the menu.

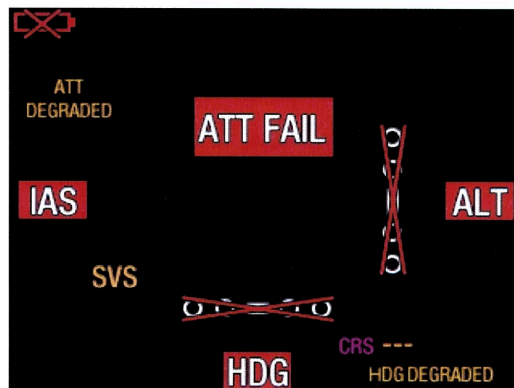
6.0 EMERGENCY/ABNORMAL PROCEDURES

During loss of aircraft power the ESI-500 will continue to display attitude, altitude, airspeed, and heading (MAG-500 INSTALLATIONS ONLY) for approximately 1 hour. External sensor inputs such as GPS/VHF NAV and Heading (if ARINC 429 Input) functions will not be available unless an independent standby power source is provided to the sensors.

The following figure shows the possible invalidity indications. Refer to Table 4.1 in the ESI-500 Pilots Guide for a list of indications and possible display conditions with a description and any corrective action.

The ALT, ATT FAIL, IAS, HDG, ATT DEGRADED, and HDG DEGRADED invalidity flash on/off for 5 seconds and then remains on. The invalidity is removed when the condition is resolved.

It is recommended to crosscheck other cockpit displays/instruments for errors and/or data inconsistency.



7.0 NORMAL PROCEDURES

7.1 OPERATION

The ESI-500 Electronic Standby Indicator Pilots Guide, Document No. 0040-15000-01 Revision B, dated November 16 , 2015 (or later FAA approved revision), must be available to flight crew whenever the ESI-500 is in operation.

Caution: To prevent potential damage to the ESI-500 unit and the MicroSD Card, the MicroSD card must be removed from the card slot on the front of the unit during normal unit operations.

7.1.1 System Power

The ESI-500 is protected by the following circuit breaker.

C/B Name	Amps	Bus
STBY IND	3	Aircraft Battery Bus

7.1.2 System Display

An example of the ESI-500 in normal operation is shown below. Display features such as heading tape/readout, vertical speed readout, metric readout, and navigation information are configurable and shown for reference only.



7.1.3 Optional Synthetic Vision

Synthetic Vision is a 3-dimensional display of terrain and obstacles, based on GPS location of the aircraft, attitude, altitude, and heading. Synthetic Vision provides situational awareness to the pilot by providing a means to aid in visually acquiring potential impact threats of terrain and obstacles. Synthetic vision uses a terrain database consisting of DTED (digital terrain elevation data) and an obstacles database for the display of obstacles. Terrain is shaded to give dimension to the terrain, water is shown in blue, and gridlines are shown to aid in determining relative distances. Terrain coloring gradually varies based on terrain elevations from green at lower elevations to brown to white at higher elevations.



7.1.4 Increase Display Brightness

When the pilot menu is not active, pressing and holding the Menu button will increase the display brightness. Use the pilot menu item 'Set Brightness Offset' to adjust the brightness level.

7.1.5 Adjust Barometric Pressure

Adjust barometric pressure by rotating the knob when the pilot menu is not active. Millibars (MB) and Hectopascals (hPa) are adjusted in increments of 1.0 and Inches of Mercury (IN) are adjusted in increments of 0.01. Press the knob to set the Standard Pressure Barometric Setting (29.92 In.Hg, 1013 hPa, 1013 mb) when the menu is not active. The barometric display will indicate "STD".

7.2 Pilot Menu

Press the Menu button to open the Pilot Menu across the lower portion of the display. The heading and some navigation data located at the bottom of the screen are hidden while the menu is open.

Rotate the knob to scroll the menu left or right. The active menu item is centered on the scroll bar and has cyan text. Menu items that have gray text are not selectable.

Pressing the knob initiates a change to the menu item option. The main menu shifts up and becomes the sub menu title, the submenu slides in from bottom and is displayed below the title. This submenu provides only one line of data and has a cyan knob icon to the right of numeric entry items indicating that turning the adjustment knob changes the submenu item and initiates the change.

Some menu items require a confirmation, have multiple selections, have numeric entries, or are system information menus with submenus. These menu items are followed by "...". The only menu items that do not have submenus are toggle items.

Remove the Pilot Menu from the display by pressing the Menu button or allowing it to time out due to inactivity.

Pilot Menu List

ITEM	DESCRIPTION
Battery Shutdown	Initiate battery shutdown. Only available when aircraft power is removed from the ESI-500.
NAV Mode	Toggle navigation display on/off. Only available when VOR/ILS or GPS Navigation configuration option is enabled.
CRS Direct To	Changes the selected course to the current VOR omnibearing. Course arrows on the heading tape also reflect current course. Only available when VOR/ILS Navigation is enabled via NAV Mode.
Set Course	Adjust the selected course value. Only available when VOR/ILS Navigation is enabled via NAV Mode.
SynVis Mode	Toggle Synthetic Vision Mode on/off. Only available when SynVis is enabled via option activation.
SynVis Gridlines	Toggle Synthetic Gridlines on/off. Only available when SynVis is enabled via option activation.
Set Brightness Offset	Adjusts display brightness in increments of 1 from 0 (lowest brightness level) to 100 (highest brightness level).
BARO Type	Select the barometric pressure unit. The options are Inches of Mercury, Hectopascals, and Millibars.
Metric Altitude	Toggle Metric Altitude readout on/off. Only available when Metric Altitude Display configuration option is enabled.
Alignment	Activates the Alignment function.
Battery Calibration	Initiate the battery calibration function. Only available when aircraft power is removed from the ESI-500.
System Status	Display the status of the following battery information: state of charge, temperature, last calibration date, and next calibration due date. It also shows aircraft effectivity.

7.3 Shutdown Procedure

Remove aircraft power from the ESI-500. (Battery backup is now functioning as indicated by battery icon in upper left side of display.)

- Press Menu button. The BATT Shutdown menu item should be highlighted.
- Press the knob to select BATT Shutdown.
- Press the knob to Confirm.
- Cancel can be chosen by rotating the knob until it is selected (highlighted in blue).
- Press the knob to return to the Menu list.

7.4 Auto Off Feature

If configured for Auto Off, the unit automatically removes power after the user configurable time (5, 40, 70 minutes) has expired. Anytime within the time configured remaining in the Auto Off cycle, the pilot is given the option to remain in the Discharge Mode or the unit will shutdown.

7.5 Startup in Battery Backup Mode

Press and hold the Menu button for approximately 10 seconds. The unit will begin normal start up showing the splash screen followed by the acknowledgement screen (if applicable).

Normal operation begins with the battery discharge icon showing in the upper left corner of the screen.

For all other ESI-500 Displays and functions refer to the ESI-500 Pilots Guide.

J.P. INSTRUMENTS
Supplement No. 1
P.O. Box 7033
Huntington Beach, CA 92646

FAA APPROVED
AIRPLANE/ROTORCRAFT FLIGHT MANUAL SUPPLEMENT OR
SUPPLEMENTAL AIRPLANE FLIGHT MANUAL (INCLUDING POH AND
FAA AFM)
(FOR THOSE AIRCRAFT WITHOUT A BASIC AIRPLANE FLIGHT
MANUAL)

FS-450 FUEL FLOW INDICATOR
FOR

Single and Twin, Reciprocating Engine Powered Aircraft as listed
On Approved Model List of

STC SA00861SE

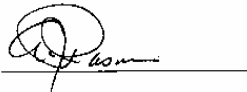
REG. NO. N22905 / N1840V

SER. NO. 17264078 / 17263767

This Supplement must be attached to the
FAA Approved Airplane/Rotorcraft Flight Manual when the J.P. Instruments FS-450
is installed in accordance with Supplemental Type Certificate SA 00432SE. For those
airplanes without a basic Airplane Flight Manual, the Supplemental AFM must be in the
aircraft when the FS-450 is installed.

The information contained in this **Airplane/Rotorcraft Flight Manual Supplement/**
Supplemental Aircraft Flight Manual supplements or supersedes the basic manual/
placards only in those areas listed. For limitations, procedures and performance information
not contained in this supplement, consult the basic Airplane Flight manual, Markings and
Placards

FAA APPROVED:



Manager, Special Certification Branch, ANM-190S
Federal Aviation Administration
Seattle Aircraft Certification Office
Transport Airplane Directorate

Date: December 18, 2000

Revision No.	Description	Affected Pages	Approval
Original	Complete Flight Manual Supplement for FS-450	1 thru 4	 Mgr. Special Certification Branch, ANM-190S FAA, Seattle ACO Transport Airplane Directorate Date: <u>Dec. 18, 2000</u>

FAA APPROVED Date December 18, 2000

I GENERAL OPERATION

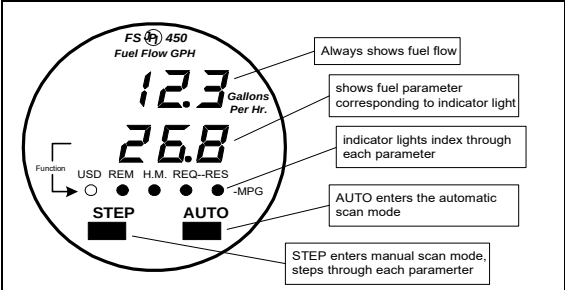
The FS-450 Fuel Scan uses a small turbine transducer that measures the fuel flowing into the engine. Higher fuel flow causes the transducer turbine to rotate faster which generates a faster pulse rate. Prior to engine start you inform the FS-450 Fuel Scan of the known quantity of fuel aboard, and it will keep track of all fuel used.

Start Up Fuel : After initial self-test, you will be asked to inform the FS-450 of start up fuel. The FS-450 will display **FUEL GAL** (or **Ltr** or **Lbs**) for one second, and then flash **FILL Pn** until any button is pressed. Refer to the column in the chart below corresponding to your fuel tank configuration. Tap the AUTO button to select one of the four following fueling choices on the left column of the chart.

AUTO to choose↓	Main tanks only, no tabs	Main tanks with tabs	Main & Auxiliary tanks
FILL Pn	Did not add any fuel since last shutdown.		
FILL 75*	Topped the main tanks.	Filled only to the tabs.	Topped the main tanks. If some additional fuel is added to the auxiliary tanks, you will input this next when 0.0 GAL is displayed
FILL 120*	(not available)	Topped the main tanks.	Topped both the main and auxiliary tanks.
FILL Add	Did not top, but added additional fuel to the aircraft, or removed fuel from the aircraft.		

The FS-450 has programmable alarms. When the remaining amount of fuel falls below the alarm limit the bottom display will show the amount of fuel REMaining and the specific cue light will flash. When the remaining time falls below the alarm limit the bottom display will show the MINutes of fuel remaining and the specific cue light will flash. When an alarm is displayed, tapping the STEP button will temporarily disable the alarm indication for the next ten minutes. When an alarm is displayed, holding the STEP button until the word **OFF** appears will disable that alarm indication for the remainder of the flight. After initial self-test, you will be asked to inform the FS-450 of start up fuel. The FS-450 will display **FUEL GAL** (or **Ltr** or **Lbs** pounds) for one second, and then flash **FILL Pn** until any button is pressed. The display will pause at each parameter for a few seconds in the Automatic indexing mode. In the Manual indexing mode, tap the STEP button to advance to next parameter. Holding the STEP button will display the previous parameters in the sequence (rapidly backwards).

- Digital display for numeric readouts and messages: top display is fuel flow and the lower display for all other parameters.
- Indicator lights to show what information is being displayed on the digital display



GENERAL OPERATION (CONT.)

Parameter Description	Example	Comments
USD —Total Fuel Used	38 . 2	Since last refueling or trip total.
REM —Fuel Remaining	37 . 2	In gallons, liters or pounds
H.M. —Time to Empty	02 . 45	Hours. Minutes Remaining at current fuel burn
REQ —Fuel required to next GPS WPT or Destination	25 . 8	Present with GPS interface Valid signal and way point
RES —Fuel Reserve at next GPS WPT or Destination	I I . 3	Present with GPS interface Valid signal and way point

II OPERATING LIMITATIONS

- A. The FS-450 may not replace any existing instrument or indicator required by the aircraft type design or operating limits.
- B. The FS-450 display may not be used in lieu of, or to supersede, engine-operating limitations established by the airframe or engine manufacturer during certification.

III. EMERGENCY PROCEDURES

No change

IV. NORMAL PROCEDURES

CAUTION

Comply with manufacturer's Airplane
Flight Manual leaning procedures.
Do not exceed applicable engine
or aircraft limitations.

Upon starting the engine, the FS-450 will flash, waiting for the pilot to enter the new fuel on board. If no fuel was added, tap the step button, informing the FS-450 no fuel was added. If fuel was added proceed with the fuel add sequence. With the engine running the upper display will show the actual gallons being used per hour. During flight the cue lights will indicate specific functions like REMaining etc. The upper display will always show fuel flow per hour.

FAA APPROVED Date December 18, 2000

Garmin International, Inc.
1200 E. 151st Street
Olathe, Kansas 66062 U.S.A.

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 172M

Make and Model Airplane

Registration Number: N1840V/N22905 Serial Number: 17263767 /17264078

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 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 by: Erik Frisk

Erik Frisk
ODA STC Unit Administrator
Garmin International, Inc.
ODA-240087-CE

Date: 2-NOV-2017

LOG OF REVISIONS				
Revision Number	Page		Description	FAA Approved
	Date	Number		
1	03/18/11	All	Complete Supplement	<i>Robert Grove</i> ODA STC Unit Administrator Garmin International, Inc. ODA-240087-CE Date: <u>03/18/2011</u>
2	12/18/12		See Revision 3	<u>Michael Warren</u> ODA STC Unit Administrator Garmin International, Inc. ODA-240087-CE Date: <u>12/18/2012</u>
3	03/26/13		See Revision 4	<u>Michael Warren</u> ODA STC Unit Administrator Garmin International, Inc. ODA-240087-CE Date: <u>04/12/2013</u>
4	11/24/14	7 11 16 18 20 20 & 21 26 27 32 34	<u>Table 1</u> - Added new functions <u>Section 1.4</u> - New section <u>Section 2.7</u> - Modified limitation <u>Section 2.12</u> - Added wire obstacles <u>Section 2.21</u> - Modified limitation <u>Section 2.22 & 2.23</u> - Added limitations <u>Section 3.2.10</u> - Added Flight Stream 210 to procedure <u>Section 4.1</u> - Removed telephone audio deactivation procedure <u>Section 7.5</u> - Added wire obstacles <u>Section 7.9</u> - Added Flight Stream 210	<u>Michael Warren</u> ODA STC Unit Administrator Garmin International, Inc. ODA-240087-CE Date : <u>11/25/2014</u>

LOG OF REVISIONS				
Revision Number	Page		Description	FAA Approved
	Date	Number		
5	02/25/16	34	<u>Section 7.10</u> • Added wire obstacles	<i>Michael Warren</i> ODA STC Unit Administrator Garmin International, Inc. ODA-240087-CE Date : <u>02/25/2016</u>
		37	<u>Section 7.17</u> • Added section	
		All	<u>All Sections</u> • Reformatted and updated sections to better coincide with the VFR AFMS. <u>Section 2</u> • Added RF leg description and limitations • Added QFE limitations • Added Autopilot limitations • Added polar operation limitation • Added text regarding new data units in the GTN • Added Fuel Range Ring description and limitations • Added Flight Stream 210 limitation <u>Section 4</u> • Added autopilot capability assessment regarding RF legs • Updated installer descriptions of configuration checkboxes • Added Search and Rescue autopilot note • Added RNP 1.0 installation options <u>Section 7</u> • Added GMA 35c information • Removed references to GDL 88 and replaced with generic ADS-B	

LOG OF REVISIONS				
Revision Number	Page		Description	FAA Approved
	Date	Number		
		32	<u>Section 7.9</u> • Added Flight Stream 510	
		33	<u>Section 7.10</u> • Reworded	
		34	<u>Table 4</u> • Added PTC	
		38	<u>Section 7.19</u> • Flight Stream 510 content added	
		41-42	<u>Sections 7.25-7.26</u> • New sections	
7	10/17/17	6-8	<u>Sections 1.5</u> • New definitions	See Page i
		9	<u>Section 2.1</u> • Updated CRG Revisions	
		10	<u>Section 2.4</u> • Updated FDE compliance text	
		12	<u>Section 2.6</u> • Updated software grid	
		13	<u>Section 2.10</u> • Renamed section	
		19-20	<u>Section 2.32-2.33</u> • New sections	
		22	<u>Section 3.2.1-2</u> • Updated text	
		32	<u>Section 7.27</u> • Updated PG Revisions	
		45	<u>Section 7.27</u> • New section	

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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). The GTN navigation system is installed in accordance with AC 20-138A.

	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, SiriusXM, FIS-B, Connex (all optional)	X	X	X	X	X
Control and display of airborne weather radar (optional)				X	X
Display of terminal procedures data (optional)				X	X
Display of traffic data, including ADS-B (optional)	X	X	X	X	X
Display of StormScope® data (optional)	X	X	X	X	X
Display of marker beacon annunciators (optional)	X*	X*	X*	X	X
Remote audio panel control (optional)				X	X
Remote transponder control (optional)	X	X	X	X	X
Remote audio entertainment datalink control (optional)	X	X	X	X	X
TSO-C151c Class B TAWS (optional)	X	X	X	X	X
Supplemental calculators and timers	X	X	X	X	X
Control of GSR 56 Iridium Satellite Phone and SMS Text	X	X	X	X	X
Control of Flight Stream 210 (optional)	X	X	X	X	X
Control of Flight Stream 510 (optional)	X	X	X	X	X

* Display of marker beacon annunciators on the GTN 6XX is only possible when installed with a Garmin GMA 350 audio panel.

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

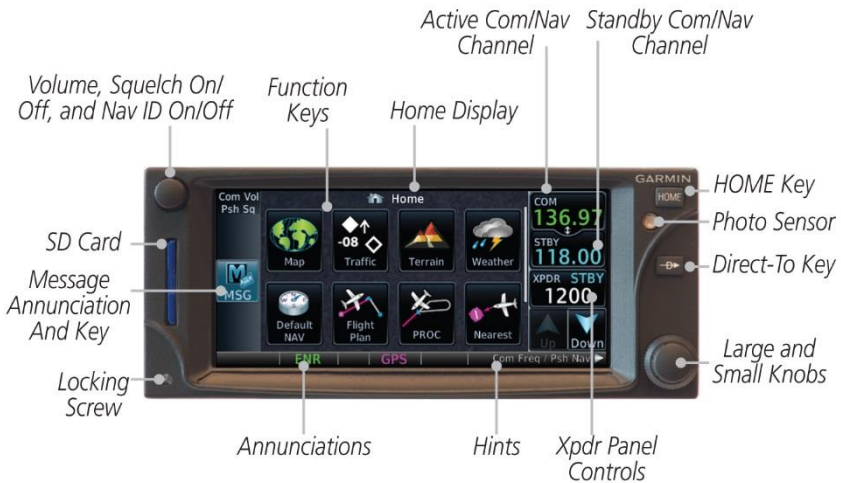


Figure 2 - GTN 635/650 Control and Display Layout

1.2 System Capabilities

This Flight Manual Supplement documents the installed capabilities of the GTN specific to the aircraft for which this manual is created.

NOTE

In sections which contain a square checkbox (☐) the installer will have placed an “X” in the boxes next to the capabilities applicable to the installation.

The GTN system and associated navigation interface in this aircraft have the following capabilities, in addition to the core multifunction display capability:

- ☐ VHF Communication Radio
- ☐ Primary VHF Navigation
- ☐ Primary GPS Navigation (Enroute) and Approach Capability (LP/LNAV) – See below
- ☐ Primary GPS Approach Capability with Vertical Guidance (LNAV/VNAV, LPV) – See below
- ☐ TSO-C151c Terrain Awareness and Warning System – See section 2.15

GPS/SBAS TSO-C146c Class 3 Operation

The GTN complies with AC 20-138A and 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 enroute, 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” and without vertical guidance including “LP” and “LNAV”.

The Garmin GNSS navigation system 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 including procedures with RF legs subject to the limitations herein. Part 91 subpart K, 121, 125, 129, and 135 operators require operational approval from the FAA.

The Garmin GNSS navigation system 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 Garmin

GNSS units: The Garmin GNSS navigation system 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.

The Garmin GNSS navigation system 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 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 consists of one or more TSO-C146c Class 3 approved Garmin GTN Navigation Systems. The Garmin GNSS navigation system complies with the accuracy, integrity, and continuity of function, and contains the minimum system functions required for B-RNAV operations in accordance with EASA AMC 20-4. The Garmin GNSS navigation system complies with the equipment requirements for P-RNAV and B-RNAV/RNAV-5 operations in accordance with AC 90-96A CHG 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 the 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.

Advanced RNP Capabilities

The GTN includes 3 out of 6 of the features required for operations in airspace requiring Advance RNP based on the *ICAO document 9613 Performance Based Navigation (PBN) Manual, fourth edition, 2013* and is therefore not approved for Advanced RNP operations. The following table describes the six Advanced RNP capabilities and the GTN capabilities.

Advanced RNP Feature	GTN Capability
RF legs	Available if enabled for installation. See Section 2.12 for limitations.
Parallel offsets	Available.
Scalable RNP	GTN provides CDI scalability in compliance with TSO-C146c. RNP scalability is not available.
RNAV holding	Available.
Fixed radius transitions	Not available in GTN.
Time of arrival control (TOAC)	Not available in GTN.

1.3 Electronic Flight Bag

The GTN 750/725 are operationally suitable as Class 3 Hardware, Type B Software in accordance with AC 120-76B EFB electronic aeronautical information when using current FliteChart or ChartView data.

Use of the Flight Stream interface and data for the purpose of Electronic Flight Bag applications is not approved as part of this STC. Additional approval may be required to obtain operational approval for use of the Flight Stream and supplied data to supplement EFB systems.

1.4 Electronic Checklists

The GTN checklist functions are designed to DO-178B software design assurance level B and support a minor failure classification. While this STC does not grant operational approval for operators requiring such approval, there are no limitations precluding operators from obtaining their own operational approval for the checklist function.

1.5 Definitions

The following terminology is used within this document:

ADF:	Automatic Direction Finder
ADS-B:	Automatic Dependent Surveillance Broadcast
AEG:	Aircraft Evaluation Group (FAA)
APR:	Approach
CDI:	Course Deviation Indicator
DME:	Distance Measuring Equipment
ECAC:	European Civil Aviation Conference
EFB:	Electronic Flight Bag
EGNOS:	European Geostationary Navigation Overlay Service
EHSI:	Electronic Horizontal Situation Indicator
FIS-B:	Flight Information Services Broadcast
GAGAN:	GPS Aided GEO Augmented Navigation
GNSS:	Global Navigation Satellite System
GPA:	Glidepath Angle
GPS:	Global Positioning System
GPSS:	GPS Roll Steering
GTN:	Garmin Touchscreen Navigator
HOT:	Hazardous Obstacle Transmission wires
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
LP +V:	Localizer Performance with Advisory Vertical Guidance
MLS:	Microwave Landing System
MMC:	Multi-Media Card
NOTAM:	Notice to Airmen
OBS:	Omni Bearing Selector
PED:	Portable Electronic Device
RAIM:	Receiver Autonomous Integrity Monitoring
RF Leg:	Radius-To-Fix Leg of a Charted Instrument Procedure
RMT:	Remote
RNAV:	Area Navigation
RNP:	Required Navigational Performance
SAR:	Search and Rescue
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
TCH:	Threshold Crossing Height
TFR:	Temporary Flight Restriction
TIS:	Traffic Information Service
VHF:	Very High Frequency
VFR:	Visual Flight Rules
VGSI:	Visual Glide-Slope Indicator
VLOC:	VOR/Localizer
VMC:	Visual Meteorological Conditions

VOR: VHF Omnidirectional Range
VRP: Visual Reporting Point
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 L
- GTN 7XX Cockpit Reference Guide P/N 190-01007-04 Rev K

2.2 Kinds of Operation

This AFM supplement does not grant approval for IFR operations to aircraft limited to VFR operations.

2.3 Minimum Equipment

The GTN must have the following system interfaces fully functional in order to be used for primary navigation during 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 2 – Required Equipment

Note 1: Certain installations require an external GPS annunciator panel. If installed, this annunciator must be fully functional to use the GTN GPS navigation for IFR operations.

Single engine piston aircraft under 6,000 lbs. maximum takeoff weight:

Required Equipment for IFR operations utilizing GPS navigation: Single GTN Navigator

All other aircraft:

Required Equipment for IFR operations utilizing GPS navigation: Single GTN Navigator plus a second source of GPS navigation or a separate source of VHF navigation. The separate source of VHF navigation must not be the primary GTN, but it may be a secondary GTN.

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 flight crew must check RAIM availability. An acceptable means of compliance for FDE prediction programs is to use a certified service which meets the requirements of FAA AC 20-138 and FAA AC 90-105A for prediction.

The following table describes some of the available RAIM prediction programs.

Prediction Program	Internet address or program details	Coverage Area
Garmin RAIM Prediction Tool	https://fly.garmin.com/fly-garmin/support/raim/	Worldwide
Garmin WFDE Prediction program	PC-based program included in GTN trainer v3.00 – 6.30. Instructions provided via Garmin part number 190-00643-01	Worldwide
FAA Service Availability Prediction Tool	http://sapt.faa.gov	US Only
Flight Service Station	1-800-WXBRIEF https://www.1800wxbrief.com	US Only
AUGER GPS RAIM Prediction Tool	http://augur.ecacnav.com/augur/app/home	ECAC Airspace Only

This RAIM availability requirement is not necessary if SBAS coverage is confirmed to be available along the entire route of flight.

For flight planning purposes, for 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 shall 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 shall be delayed, canceled, or rerouted on a track where RAIM requirements can be met.

Applicable to dual installations consisting of two Garmin GNSS units:

For flight planning purposes, for operations where the route requires Class II navigation the aircraft’s operator or flight crew 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) will be unavailable for more than 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.

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 internal GPS receiver.

Whenever possible, RNP and RNAV routes including Standard Instrument Departures (SIDs), 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 2) the GTN connected to the external GPS annunciator must be used as the navigation source for all IFR operations.

The only approved sources of course guidance are on the external CDI, HSI, or EHSDI 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 3.

The Main and GPS software versions are displayed on the start-up page immediately after power-on. All software versions displayed in Table 3 can be viewed on the System – System Status or Connex Setup pages.

Software Item	Software Version <i>(or later FAA Approved versions for this STC)</i>
Main SW Version	6.41
GPS SW Version	5.2
Com SW Version	2.20
Nav SW Version	6.03
Flight Stream 210	2.70
Flight Stream 510	2.30

Table 3 - Software Versions

2.7 MMC / SD Database Cards

It is required that the SD database card or Flight Stream 510 (MMC) be present in the GTN at all times. The SD or MMC device must not be removed or inserted during flight or while the GTN is powered on.

NOTE

Removal of the SD or MMC device will result in certain features and databases not being available and may slow system performance.

2.8 Navigation Database

GPS/SBAS based IFR enroute, oceanic, and terminal navigation is prohibited unless the flight crew 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 flight crew 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 flight crew 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.

See Section 2.29 for limitations regarding database update procedures.

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 flight crew situational awareness during ground operations.

2.10 Instrument 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, LP, or LP +V)
- 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 or LP +V. Vertical guidance information displayed on the VDI in this mode is only an aid to help flight crews comply with altitude restrictions. When using advisory vertical guidance, the flight crew 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. Flight crews 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. Pilots 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 Barometric Setting

The barometric altimeter setting used for any barometric corrected altitude source interfaced to the GTN must be set appropriate to the altitude type depicted on the procedure (QNH or QFE).

2.12 RF Legs

This STC does not grant operational approval for RF leg navigation for those operators requiring operational approval. Additional FAA approval may be required for those aircraft intending to use the GTN as a means to provide RNP 1 navigation in accordance with FAA Advisory Circular AC 90-105.

The following limitations apply to procedures with RF legs:

- Aircraft is limited to 180 KIAS while on the RF leg
- RF legs are limited to RNP 1 procedures. RNP AR and RNP <1 are not approved
- Primary navigation guidance on RF legs must be shown on an EHSI indicator with auto-slew capability turned ON
- GTN Moving Map, EHSI Map, or Distance to Next Waypoint information must be displayed to the pilot during the RF leg when flying without the aid of the autopilot or flight director.
- The active waypoint must be displayed in the pilot's primary field of view.

2.13 Autopilot Coupling

The flight crew may fly all phases of flight based on the navigation information presented to the flight crew; 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.

It is possible to create flight plan waypoint sequences, including Search and Rescue patterns, which exceed the autopilot's bank angle capabilities. The pilot shall monitor autopilot performance with regard to flight path deviation.

2.13.1 RNP 1.0 RF Leg Types

AC 90-105 states that procedures with RF legs must be flown using either a flight director or coupled to the autopilot.

This STC has demonstrated acceptable crew workload and Flight Technical Error for hand flown procedures with RF legs when the GTN installation complies with limitation set forth in Section 2.12 of this document. It is recommended to couple the autopilot for RF procedures, if available, but it is

not required to do so. See section 4.5 of this manual to determine if this capability is supported in this installation.

2.14 Terrain Proximity Function (All Units)

Terrain, point obstacle, and wire obstacle information appears on the map and terrain display pages as red and amber terrain, obstacles, or wires and is depicted for advisory use only. Aircraft maneuvers and navigation must not be predicated upon the use of the terrain display. Terrain, obstacle and wire 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.

2.15 TAWS Function (Optional)

Flight crews 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.

TAWS shall be inhibited when landing at an airport that is not included in the airport database.

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.

2.16 Polar Operations

Use of the GTN for primary navigation for latitudes above 89.00° N and below 89.00° S is prohibited.

2.17 Datalink Weather Display (Optional)

This limitation applies to datalink weather products from SiriusXM via a GDL 69/69A, FIS-B via a GDL 88 or GTX 345, and Connex via a GSR 56.

Do not use data link weather information for maneuvering in, near, or around areas of hazardous weather. Information provided by data link weather products may not accurately depict current weather conditions.

Do not use the indicated data link weather product age to determine the age of the weather information shown by the data link weather product. Due to time delays inherent in gathering and processing weather data for data link transmission, the weather information shown by the data link weather product may be significantly older than the indicated weather product age.

Do not rely solely upon data link services to provide Temporary Flight Restriction (TFR) or Notice to Airmen (NOTAM) information. Not all TFRs and NOTAMS can be depicted on the GTN.

Datalink text weather is decoded for the convenience of the pilot, however it is possible that the decoding may be affected by anomalies in the data or differences in the units of measure between the decoding system and the text weather source. All text weather displayed on the GTN also includes the raw weather text for pilot review.

2.18 Traffic Display (Optional)

Traffic may be displayed on the GTN when connected to an approved optional TCAS I, TAS, TIS, or ADS-B traffic device. These systems are capable of providing traffic monitoring and alerting to the flight crew. 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 for aircraft maneuvering.

Traffic is displayed in feet regardless of the unit settings for altitude. If the units for altitude are different than feet, a “FT” label will appear on the traffic icon on and main map page, and the dedicated traffic page will include an “ALT IN FT” notification.

2.19 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 flight crew’s responsibility to avoid hazardous weather using official weather data sources.

When the GTN StormScope® page is operating without a heading source, as indicated by the “HDG N/A” label at the upper right corner of the StormScope® page, strikes must be cleared after each heading change.

2.20 Flight Planner/Calculator Functions

The Fuel Planning page uses Fuel on Board or Fuel Flow as received from an on board fuel totalizer, as entered by the pilot at system startup, or as entered by the pilot when on the Fuel Planning page. This *is not* a direct indication of actual aircraft fuel flow or fuel on board and those values are only used for the Fuel Planning page. The fuel required to destination is only a calculated and predicted value based on the data entered into the planner. It is not a direct indication of how much fuel the aircraft will have upon reaching the destination.

2.21 Fuel Range Rings

The fuel range rings displayed on the moving map are intended for situational awareness and do not represent a direct indication of endurance or fuel remaining. The distance between the segmented green reserve ring and the yellow zero fuel ring is 45 minutes by default. The reserve value can be changed from the GTN map setup menu.

Fuel range data is derived by the interfaced fuel totalizer data. Data entered in the Fuel Planning pages will not update the fuel range ring.

2.22 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/Cockpit Reference Guide has been successfully completed. The Glove Qualification Procedure is specific to a pilot / glove / GTN 725, 750 or GTN 625, 635, 650 combinations.

2.23 Demo Mode

Demo mode may not be used in flight under any circumstances.

2.24 Active Weather Radar

Radar is broadcasting energy while in Weather or Ground mapping modes. If the GTN 750/725 system is configured to control an airborne weather radar unit, observe all safety precautions, including:

- Do not operate in the vicinity of refueling operations.
- Do not operate while personnel are in the vicinity (approximately 20 feet) of the radar sweep area.

CAUTION

If a radar system is installed, it generates microwave radiation and improper use, or exposure, may cause serious bodily injury. Do not operate the radar equipment until you have read and carefully followed the safety precautions and instructions in the weather radar user manual and/or pilot's guide.

2.25 Telephone Audio

Telephone audio must not be distributed to the pilot or co-pilot unless a phone call is active.

CAUTION

Failure to turn off telephone audio when the telephone is not in use may result in telephone ringer or text message aural notifications being received during critical phases of flight.

2.26 Multi Crew Aircraft (GMA 35 Only)*

For aircraft type certified with more than one required pilot, or operations requiring more than one pilot, the “Group Co-Pilot with Passenger” audio panel option shall not be activated. This option is found in the Intercom Setup Menu when a Garmin GMA 35 audio panel is installed.

2.27 Wire Obstacle Database

Only the “Obstacle/HOT Line” database may be used. Use of the “Obstacle/Wire” database is prohibited. The database version can be viewed on the start-up database verification or System- System Status pages.

2.28 Portable Electronic Devices

This STC does not relieve the operator from complying with the requirements of 91.21 or any other operational regulation regarding portable electronic devices.

The Flight Stream interface and data provided to a portable electronic device is not approved to replace any aircraft display equipment, including navigation or traffic/weather display equipment.

2.29 Database Updates

Database updates via MMC / SD card or Flight Stream wireless transfers must be done while the aircraft is on the ground and stationary. In-flight database transfers or updates are prohibited in flight unless part of the Database SYNC function that occurs in the background to move databases from one LRU to another.

2.30 Charts Database (Dual GTN7XX)

When the aircraft installation includes 2 GTNs capable of displaying charts (GTN 700, 725 or 750) and crossfill is enabled between the GTNs, the GTNs must have identical charts types (ChartView or FliteCharts) and charts cycles installed. Failure to have identical charts could affect the chart lookup features and automatic chart selection.

2.31 Automatic Speech Recognition

Pilots may not use the ASR function to operate the GTN/GMA unless they have completed the ASR Qualification Procedure located in the GTN Cockpit Reference Guide successfully. The ASR Qualification Procedure is specific to each pilot / headset / aircraft combination.

2.32 OBS Mode

Use of OBS mode for flight plan segments greater than 250_{NM} is prohibited.

* Includes GMA 35 and GMA 35c Audio Panels

2.33 Advisory Visual Approaches

All advisory visual approaches shall be conducted in VMC. Advisory visual approaches are intended to be used as an aid to situational awareness and do not guarantee terrain or obstruction clearance along the approach path. Use of advisory visual approaches in IMC is prohibited.

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:
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 flight crew determines, based on all available information, that turning in addition to the vertical escape maneuver is the safest course of action, or both.

NOTE
TAWS annunciators external to the GTN may not indicate the exact threat causing the alert. Example: WIRE alerts may be annunciated as TERR or OBSTACLE on external devices.

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” and/or “LOI”.

If the LOI annunciation is displayed, revert to an alternate means of navigation appropriate to the route and phase of flight. If LOI occurs while the GTN is in the ENR or OCN phase of flight, it may also display DR.

If the DR 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.

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 (no DR annunciated on the GTN):

Navigation **FLY TOWARDS KNOWN VISUAL CONDITIONS**

NOTE

All information derived from GPS will be removed.

NOTE

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 LPV, LP +V, 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 to LNAV. The approach may be continued using the LNAV only minimums. If the VISUAL approach is downgraded, the GTN will remove the vertical deviation indication from the VDI, but continue to annunciate VISUAL in amber.

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 flight crew 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 into fail safe mode which provides only the pilot with communications and only on a single COM radio. If any non GTN 750 COM is installed, communication will be only on that radio. If only a GTN 750 is installed in the aircraft, then the pilot will have only the GTN 750 COM available. No other audio panel functions including aural alerting and the crew and passenger intercom will 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.

NOTE

TAWS annunciators external to the GTN may not indicate the exact threat causing the alert. Example: WIRE alerts may be annunciated as TERR or OBSTACLE on external devices.

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 DATA SOURCE - HEADING SOURCE INOPERATIVE OR CONNECTION TO GTN LOST MESSAGE

- Without a heading source to the GTN, the following limitations apply:
- Roll steering 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.
 - Overlaying traffic data from a TAS/TCAS I or Garmin ADS-B-IN unit interfaced to an on board traffic system will not be displayed on the main map display. The flight crew must use the dedicated traffic page on the GTN system to display TAS/TCAS I or Garmin ADS-B-IN traffic data.
 - All overlaying StormScope® data on the main map display will be removed. The flight crew must use the dedicated StormScope® page on the GTN system to display StormScope® data.
 - Onboard weather radar overlay on the main map will not be displayed. The flight crew must utilize the dedicated weather radar page on the GTN system to view weather radar data from the onboard weather radar.

StormScope® must be operated in accordance with Section 7.8 when no heading is available.

3.2.9 ASR (VOICE COMMAND) SYSTEM FAILURES

In the event the ASR system fails and there is a need to disable the voice command inputs to the GTN:

To Disable ASR:

- Home Hardkey**PRESS**
- System Button**PRESS**
- Voice Commands Button**PRESS**
- Voice Commands Enable Button **TOGGLE OFF**

3.2.10 LOSS OF GTN TOUCH CONTROL

In the event the GTN becomes unusable due to uncommanded page changes, the ASR function may be the source.

To Disable ASR:

- Audio Panel Circuit Breaker**PULL**
- Home Hardkey**PRESS**
- System Button**PRESS**
- Voice Commands Button**PRESS**
- Voice Commands Enable Button **TOGGLE OFF**
- Audio Panel Circuit Breaker**PUSH**

**3.2.11 DATA SOURCE – PRESSURE ALTITUDE SOURCE
INOPERATIVE OR CONNECTION TO GTN LOST MESSAGE**

Without a barometric corrected altitude source to the GTN, the following features will not operate:

- Automatic leg sequencing of legs requiring an altitude source. The flight crew must manually sequence altitude legs, as prompted by the system.

**3.2.12 UNRECOVERABLE LOSS OF ALL ELECTRICAL
GENERATORS OR ALTERNATORS**

Remove power from all equipment which is not necessary for flight, including GTN #2 (NAV/GPS 2, COM 2) and the Flight Stream 210 (BT LINK), if installed.

3.2.13 IN-AIR RESTART OF GTN

In the event of a GTN restart in the air, the crew should utilize the CANCEL button if presented with the database update screen after the GTN is restarted. This will ensure restoration of the navigation functions as soon as possible.

Section 4. NORMAL PROCEDURES

Refer to the GTN 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 flight crew 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 avoid 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

Databases	REVIEW 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
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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 the active course and waypoint for each flight plan leg. The pilot must verify proper course selection each time the CDI source is changed from GPS to VLOC.

See Section 4.5 for RF leg capabilities related to EHSI.

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 a roll steering mode.

The GTN supports autopilot roll steering for heading legs when an approved heading source is interfaced to the GTN. This heading interface can also provide map orientation, traffic and StormScope heading data and wind calculations.

CAUTION

The GTN does not provide course deviation to the autopilot for heading legs. Some autopilots do not allow the use of roll steering when course deviation is not provided.

- ☐ This installation *has* a heading source. The GTN will provide roll steering on heading legs for the autopilot.
- ☐ This installation *does not have* a heading source. The crew cannot use the GTN roll steering to fly heading legs with the autopilot.

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.

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.

- This installation prompts the flight crew 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 installation *does not* support any vertical capture or vertical tracking.

The GTN allows for the utilization of IFR procedures that include RF (Radius to Fix) legs as part of RNP 1.0 capabilities.

- ☐ This installation is equipped to support coupled RF leg navigation up to RNP 1.0.
- ☐ This installation is equipped to support *un-coupled* RF leg navigation up to RNP 1.0.
- ☐ This installation *does not* support RF leg navigation.

4.6 Coupling the Autopilot during Search and Rescue Operations

Search and Rescue (SAR) patterns created in the GTN flight plan may include turns that cannot be accomplished with standard autopilot turn rates. Monitor autopilot performance relative to the desired path if coupled when using Search and Rescue patterns.

4.7 Database Conflict Resolution

When a conflict occurs between databases on different GTNs that are utilizing Database SYNC the pilot should resolve that conflict by pressing the “Resolve Conflict” button on the GTN that has the desired databases. This would be the GTN with the newest database on the SD card or Flight Stream 510. After initiating the conflict resolution, the pilot can view the SYNC status of the database on the other GTN by viewing the System -> Standby Database page. Once the database SYNC is complete, the receiving GTN must be restarted to install the new database and complete the conflict resolution process.

NOTE

The databases on the receiving LRU will be overwritten by the databases from the LRU from which the “Resolve Conflicts” action was initiated.

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 L or later |
| • GTN 7XX Pilot's Guide | P/N 190-01007-03 Rev N 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 flight crew 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 flight crew 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

- ☐ This installation *will* autoswitch from VLOC to GPS when the “Activate GPS Missed Approach” button is pressed.
- ☐ This installation *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

CAUTION

Not all obstacles and wires are contained in the Obstacle/HOT Line database. The system provides depiction (and alerts, if TAWS is installed) only for obstacles and wires contained in the 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.

Terrain on the dedicated terrain page or main map overlay is depicted in the following manner:

- Terrain more than 1,000 feet below the aircraft is not depicted, or depicted as black.
- Terrain between 1,000 feet and 100 feet below the aircraft is depicted as amber.
- Terrain within 100 feet below the aircraft, or above the aircraft, is depicted as red.

Obstacles and wires on the dedicated terrain page or main map are depicted in the following manner:

- Obstacles and wires more than 2,000 feet below the aircraft are not depicted.
- Obstacles and wires between 2,000 feet and 1,000 feet below the aircraft are depicted as white.
- Obstacles and wires between 1,000 feet and 100 feet below the aircraft are depicted as amber.
- Obstacles and wires within 100 feet below the aircraft, or above the aircraft, are depicted as red.

Multiple obstacles may be depicted using a single obstacle icon and an asterisk to indicate obstacle grouping is occurring. The color of the asterisk indicates the relative altitude of the tallest obstacle in the group. The asterisk does not indicate any information about the relative altitude or number of obstacles not being displayed in the obstacle group.

The Garmin GTN 6XX or GTN 7XX Cockpit Reference Guide or Garmin GTN 6XX or GTN 7XX Pilot's Guide provides additional information regarding terrain and obstacle colors and grouped obstacle icons.

7.6 GMA 35/35c Audio Panel (Optional)

The GTN 725 and 750 can interface to a GMA 35/35c 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. Optional Bluetooth pairing functionality can be accessed from the associated System /Connex Setup page (GMA 35c only). Volume controls for the audio panel are accessed by pressing the "Intercom" button on the GTN display screen.

Aircraft alerting audio may be routed through the GMA 35/35c audio panel. There are no pilot controls for alert audio volumes. In the event of a loss of GMA35/35c function alert audio routed through the audio panel may not be heard.

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.
- ☐ A TCAD traffic system is interfaced to the GTN.
- ☐ A Garmin ADS-B traffic system is interfaced to the GTN.
- ☐ A Garmin ADS-B traffic system is interfaced to the GTN. The ADS-B traffic system is also interfaced to an on board traffic system.

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.

Heading Not Available 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 continue to operate without a heading source and indicate “HDG N/A” in the upper right corner of the GTN display. In this mode, information provided by the StormScope® system is displayed relative to the nose of the aircraft but is *not* automatically rotated to the correct relative position as the aircraft turns. When operating in this mode, StormScope® strikes must be cleared after each turn the aircraft performs.

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 COM (1/2).
- Power to the optional GMA 35 is provided through a circuit breaker labeled AUDIO.
- Power to the optional Flight Stream 210 is provided through a circuit breaker labeled BT LINK.
- Power to the optional Flight Stream 510 is provided through the GTN MMC/SD card slot and protected via the GTN circuit breaker.

7.10 Databases and Flight Plan Waypoints/Procedures

Database versions (or cycles) and effective dates are displayed on the start-up database verification page immediately after power-on for those databases with an effective or expiration date. Databases with no effective or expiration date (e.g. - terrain database) are considered effective upon installation in the GTN. Database information can also be viewed on the System – System Status page.

The Obstacle Database has an area of coverage that includes the United States and Europe, and is updated as frequently as every 56 days. The HOT Line wire database only includes the continental United States and portions of Canada/Mexico.

Only the Obstacle/HOT Line wire database may be used in accordance with the limitation found in Section 2.27.

If a stored flight plan contains a waypoint or procedure that does not correspond to a waypoint or procedure in the navigation database in use, the waypoint or procedure will become locked (depicted as “lockd”) in the flight plan. Flight plans with locked waypoints may be placed in the active flight plan portion of the system but no navigation will be provided. The locked waypoint/procedure must be resolved by removing or replacing it with the correct waypoint/procedures in the flight plan before the system will provide navigation.

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 4 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.
PTC	Push-to-Command switch for Voice Command input to the GMA and the GTN.

Table 4 – External Switches

7.12 Airspace Depiction and Alerts

The GTN aides the flight crew in avoiding certain airspaces with Smart Airspace and airspace alerts. Smart Airspace de-emphasizes depicted airspace that is not near the aircraft’s current altitude. Airspace Alerts provide a message indication to the flight crew when the aircraft’s current ground track will intercept an airspace type that has been selected for alerting.

NOTE

Smart Airspace and Airspace Alerts are separate features. Turning on/off Smart Airspace does not affect Airspace Alerts, and vice versa.

7.13 Garmin ADS-B Traffic System Interface (Optional)

A Garmin ADS-B traffic system may be interfaced to the GTN. The *nose* of the ownship symbol on both the GTN main map page and dedicated traffic page serves as the actual location of your aircraft. The *center* of the traffic target icon serves as the reported location for the target aircraft. Motion vectors for traffic may be displayed in either absolute or relative motion. The location of the traffic targets relative to the ownship are the same, regardless of the selected motion vector.

Absolute motion vectors are colored either cyan or white, depending on unit configuration. Absolute motion vectors depict the reported track of the traffic target referenced to the ground. An absolute motion vector pointed towards your ownship symbol *does not* necessarily mean the traffic target is getting closer to your aircraft.

Relative motion vectors are always colored green and depict the motion of the traffic target relative to your ownship symbol. The direction the traffic target is pointed may vary greatly from the motion vector and a target may be getting closer to your aircraft independent of the direction the target is pointed. A green relative motion vector pointed towards your ownship indicates that the traffic target *is* converging on your aircraft.

If more than one target is occupying the same area of the screen, the GTN will combine the two or more traffic targets into one traffic group. The presence of an asterisk to the left of a target indicates that traffic has been grouped. The highest priority traffic target in the group is displayed to the pilot. When applied to airborne targets the asterisk will be displayed in white or cyan depending on the traffic depiction color used in the installation. The asterisk will be brown for grouped ground targets. The asterisk will not turn amber, even if an alerted target is included in the group.

An alerted target may be placed in the same group as non-alerted targets. In this case, the alerted target will be displayed. Two alerted targets will not be placed in the same group. All alerted targets will be displayed on the screen.

Traffic targets displayed on the dedicated traffic page may be selected in order to obtain additional information about a traffic target or to view all targets in a grouped target. When a grouped target is selected, the “Next” button on the dedicated traffic page will cycle through all targets located in close proximity to where the screen has been touched.

7.14 GWX 70 Weather Radar (Optional)

The GWX 70 Weather Radar uses Doppler technology to optionally provide advanced features to the flight crew such as turbulence detection and ground clutter suppression. Turbulence detection can detect turbulence up to 40nm from the aircraft and will be displayed at radar ranges of 160nm or less.

NOTE

Turbulence detection does not detect all turbulence especially that which is occurring in clear air. The display of turbulence indicates the possibility of severe or greater turbulence, as defined in the Aeronautical Information Manual.

7.15 Charts (Optional)

The GTN 750/725 can display both procedure charts and weather data on the main map page at the same time. When datalink NEXRAD or Precipitation is overlaid on the main map page, the weather data is displayed *below* an overlaid procedure chart. When airborne weather radar is overlaid on the main map page, the radar data is displayed *above* an overlaid procedure chart.

7.16 Transponder Control (Optional)

The GTN can be interfaced to a Garmin transponder for control and display of squawk code, mode, and additional transponder functions. The activation of the “Enable ES” button on the transponder page does not indicate the aircraft is in full compliance with an ADS-B Out solution in accordance with TSO-C166b (1090ES). Consult your transponder documentation for additional information.

7.17 Telephone Audio (Optional)

Telephone audio distribution to the crew defaults to OFF on each power cycle of the GTN. Prior to utilizing the telephone function, the crew must distribute telephone audio to the desired recipients. If the crew is utilizing the telephone function it is required that the telephone audio be turned off upon completing telephone usage.

7.18 Depiction of Obstacles and Wires

7.18.1 Dedicated Terrain Page

The dedicated Terrain page will always depict point obstacles at zoom scales of 10 nm or less and depict wire obstacles at zoom scales of 5 nm or less. The obstacle or wire overlay icon (see Figure 3) will be shown near the bottom of the display when the obstacle or wire depiction is active based on the zoom scale.

NOTE

Only obstacles and wires within 2,000 feet vertically of the aircraft will be drawn on the Terrain page. It is therefore possible to have an obstacle or wire overlay icon displayed with no obstacles or wires being depicted on the display.



Figure 3 – Obstacle Overlay Icon (Left), Wire Overlay Icon (Right)

7.18.2 Map Page

The Map page may be configured to depict point obstacles and wire obstacles at various zoom scales by the pilot by using the Map page menu. The obstacle or wire overlay icon (see Figure 4) will be shown near the bottom of the display when the obstacle or wire overlay is active based on the current zoom scale and setting selected by the pilot.

The settings chosen by the pilot on the Map page menu (including obstacle and wire display ranges) are saved over a power cycle.

NOTE

Only obstacles and wires within 2,000 feet vertically of the aircraft will be drawn on the Map page. It is therefore possible to have an obstacle or wire overlay icon displayed with no obstacles or wires being depicted on the display.

NOTE

The Map page may be configured by the pilot to not show any obstacles or wires at any zoom scale.



Figure 4 – Obstacle Overlay Icon (Left), Wire Overlay Icon (Right)

7.19 Flight Stream 210/510 (Optional)

The Flight Stream product line uses a wireless transceiver to provide data to and from a GTN to personal electronic devices (PEDs).

The Flight Stream 210 is a remotely mounted unit that provides the capability to interface Portable Electronic Devices (PEDs) to the GTN via Bluetooth. The Flight Stream 510 is mounted in the GTN SD card slot and includes a Bluetooth and Wi-Fi transceiver.

Data such as traffic, flight plan, datalink weather, entertainment audio information, and attitude information is sent from the Flight Stream to the PED. The PED is capable of sending flight plans and databases (510 only) to the Flight Stream which will then be available on the GTN. Limitations regarding database operations are found in Section 2.29.

Garmin provides a list of tested and compatible devices that can be used with the Flight Stream. Connection to the Flight Stream may be possible with devices other than those on the supported device list, but Bluetooth® and/or Wi-Fi stability and wireless data integrity cannot be guaranteed.

For details about the Garmin supported devices and apps for use with the Flight Stream product line, please visit: http://garmin.com/connex/supported_devices

7.20 Map Page

7.20.1 Configuration

The moving map and weather pages are capable of displaying a large quantity and variety of data. Map data is layered to ensure that data which is typically more critical is drawn above less critical data, however at some zoom scales and configurations the map may be cluttered with large amounts of data. Controls are provided on the Map and Weather pages for the pilot to select which data displayed, the declutter level, and the zoom scales at which data is added to or removed from the display. It is the responsibility of the pilot to select settings for the map page that will provide the display of data most appropriate to the operation being conducted.

7.20.2 Flight Plan Depiction

The map page depicts the current active flight plan. When an off-route Direct To is active the flight plan will no longer be depicted on the map.

7.20.3 Fuel Range Ring

The distance between the segmented green reserve ring and the yellow zero fuel ring is 45 minutes at the current aircraft groundspeed by default. The pilot may change the fuel reserve time value on the map setup menu. Changes to the fuel reserve time are persisted over GTN power cycles.

Visibility of the fuel range ring may be affected by the underlying map data selectable by the pilot. The pilot may make changes to the topographic or terrain data in order or more clearly observe the fuel range ring at any time.

Fuel range data is derived from the interfaced fuel totalizer data. Data entered in the Fuel Planning pages will not update the fuel range ring.

7.21 User Defined Waypoints

When a User Defined Waypoint is created a default name will automatically be provided and the pilot is given the option to provide a different name for the waypoint. Pages which have the autofill function will prevent some waypoint names from being used. If it is desired to name the waypoint with a subset of the name of an existing waypoint in the database then this must be accomplished on the Waypoint Info / User Waypoints page.

Waypoints which are created when a Search and Rescue pattern is created are not considered User Waypoints and therefore functions associated with User Waypoints are not provided for these waypoints.

7.22 Times and Distances

Time and Distance data to the next waypoint is always calculated from the present position to that waypoint and does not account for the path which may be flown (such as intercepting a course) to reach the waypoint.

When navigating using GPS guidance most legs are TO type legs where distance to the next waypoint decreases along the route. However, some procedures include FROM type legs. When navigating on a leg that is a FROM leg indications that it is a FROM leg include the TO/FROM flag indicating FROM and distances increasing in distance fields.

7.23 GTN-GTN Crossfill

Certain data will sync between GTNs when installed in a dual GTN configuration. The following data will crossfill between the two GTNs with CROSSFILL ON or OFF:

- User Waypoints
- FPL Catalog
- Traffic Alerts
- Missed Approach Popups
- Altitude Leg Popups
- Heading
- Date/Time Conventions
- CDI Scale

The following unit changes will crossfill:

- Temperature
- NAV Angle
- Fuel

The following items are crossfilled only when the GTNs are set to CROSSFILL ON:

- User Holds
- Approaches
- Flight Plan Changes
- Direct-To
- Selected OBS Course Changes

7.24 Direct-To Operations

When conducting Direct-To operations the Flight Plan tab provides a list of waypoints in the flight plan for which Direct-To is available. Some entries in the flight plan such as Holds and Course Reversals are not eligible for Direct-To and the pilot must instead select the associated waypoint if Direct-To operation is desired.

7.25 Automatic Speech Recognition (ASR)

ASR allows the pilot to interact with the GMA and GTN via voice commands. Commands are constructed around the “Verb – Noun – (Suffix)” syntax for most ASR commands.

- **“SHOW”** Commands – Used to show pages or data fields on the GTN
- **“SAY”** Commands – Used to instruct the ASR engine to say certain phrases related to the flight
- **“TUNE”** Commands – Used to tune certain frequencies into the standby position of the ASR GTN (usually GTN #1)

The “Page” suffix is used in conjunction with the “Show” phrase to command pages to be displayed on the GTN. (e.g.- “Show Main Map Page”)

Audio Panel commands are available to switch audio sources.

- **“SELECT”** to choose which radio the MIC will be selected
- **“TOGGLE”** to toggle the monitor of a specific NAV/COM radio
- **“DISTRIBUTE”** to change the source of audio for the respective seat positions
- **“MUTE”** to mute audio inputs on the audio panel for the respective seat positions

Supplemental commands that allow map zooming, and page navigation are also available.

- **“BACK”**
- **“CANCEL”**
- **“ZOOM IN”**
- **“ZOOM OUT”**

Each command is initiated via the Push-to-Command (PTC) switch. Aural tones will indicate to the pilot the status of the command. A positive tone (low to high) will indicate the system executed a command. A negative tone (high to low) will indicate the system did not understand the command or could not execute due to system state or configuration. “SAY” commands do not provide aural tones as feedback.

The pilot must maintain vigilance regarding ASR command information. Due to the nature of voice recognition, there are times when ASR will interpret a command differently than the pilot intended. The pilot should always cross check the ASR response to the information contained within the GTN as appropriate to ensure in-flight information is accurately understood. If a conflict exists between information gathered via ASR and that available in the GTN system, the pilot should defer to the GTN system information.

Prior to using ASR, the pilot must complete the ASR Qualification Procedure from the GTN Cockpit Reference Guide.

The Command History Page details the commands received by ASR for that power cycle. A full list of commands and a tips for using ASR can be found in the *GTN 6XX/7XX Telligence Voice Command Guide*, 190-01007-50.

When using ASR for “TUNE” commands, it is recommended that the pilot enable Reverse Frequency Lookup (RFL) on the associated GTN.

7.26 European Visual Reporting Points

If the GTN is interfaced with a G500/600 PFD/MFD, and a flight plan in the GTN contains a VRP, the G500/600 must have a database that contains the VRP in order to appropriately display the VRP on the MFD map. If the database on the PFD/MFD does not contain the VRP, the VRP will display on the MFD map as an intersection.

7.27 Advisory Visual Approaches

The GTN will provide advisory visual approaches to many runways in the aviation database. Lateral guidance for the visual approach is aligned with the runway bearing. Vertical guidance is provided for those runways with VGSI information for distances up to 4.0NM from the runway. If a terrain database is installed in the GTN, the GTN provides vertical guidance up to 28NM from the runway end unless the computed glideslope would impact terrain or obstacles from the database. If the projected impact point is under 28NM and greater than 4NM, the flight plan line for the approach is shortened to indicate where vertical guidance is active for the approach. If the terrain impact point is less than 4NM from the runway and there is no VGSI data available, vertical guidance is not provided for that approach. Lateral guidance is still available when vertical guidance is removed.

CDI and VDI indications are equivalent to those of other GPS-based approaches (e.g.- LPV or LNAV+V). The GTN annunciates “VISUAL” in the annunciator bar to indicate a visual approach is active.

When loading, or activating the approach, the GPA and TCH information for that approach will be displayed on a popup. If there is no vertical guidance available, the popup will display “(NO VERTICAL GUIDANCE)”.

Visual approaches are intended to be used as an aid to situational awareness. Visual approaches are advisory in nature and do not guarantee terrain and obstacle clearance for the approach runway.

RPM (R-1)

(Primary Replacement Instrument)

Operating and Installation Instructions

OI 0517911

5/17/91

Rev. C 9/24/97 *

You must read this manual before installing or operating the instrument. This manual contains warranty and other information that may affect your decision to install this product and/or the safety of your aircraft.



Model: CESSNA 172M

S/N: 17263767 /17264078



Electronics International Inc. ®

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Important Notice

******* MUST READ *******

If you think it is not important to read this manual, you're wrong!
This manual contains important installation information that may affect the safety of your aircraft, delay your installation or affect the operation of your instrument. You Must read this manual prior to installing your instrument. Any deviation from these installation instructions is the sole responsibility of the installer/pilot and may render the STC invalid.

Check that the instrument make and model marked on the side of the instrument and on the invoice are correct before starting the installation. A R-1-6 is used on a 6-cylinder engine and a R-1-4 is used on a 4-cylinder engine. Also, check the invoice for proper tach time.

Check that the limit information on this instrument matches the published limits in your aircraft's P.O.H. or Flight Manual. Also, this information may be listed in the T.C. Data Sheet for your aircraft. Any AD's and/or STC's may set forth additional limitations on the operation of your engine. The limit information listed in the AML is for unmodified aircraft and is intended for reference only. **It is the aircraft owner's and/or installer's responsibility to determine proper instrument calibration and range markings using the aircraft's P.O.H.**

On the front of this instrument you will find a red light marked with the maximum RPM information. If there are any additional red or yellow lights on this instrument, the operating range of these lights can be found on a sticker located on the side of the instrument (see the AML at the back of this manual to decode this information). This instrument designates any "Caution Range" with yellow LEDs, any "Maximum and Minimum Limits" with Red LEDs and the "Safe Operating Range" with green LEDs. The "Safe Operating Range" on this instrument is equivalent to the green "Normal Operating Range" and any unmarked areas on a analog gauge.

Read the Warranty / Agreement. There is information in the Warranty / Agreement that may alter your decision to install this product. **If you do not accept the terms of the Warranty / Agreement, do not install this product.** This product may be returned for a refund. Contact Electronics International inc. for details.

It is possible for any instrument to fail thereby displaying inaccurate high, low or jumpy RPM readings. Therefore, you must be able to recognize an instrument failure and you must be proficient in operating your aircraft safely in spite of an RPM instrument failure. If you do not have this knowledge, contact the FAA or a local flight instructor for training.

The pilot **must** understand the operation of this product before flying the aircraft. Do not allow anyone to operate the aircraft that does not know the operation of this product. Keep the Operating Manual in the aircraft at all times.

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Warranty / Agreement

Electronics International Inc. warrants this instrument and system components to be free from defects in materials and workmanship for a period of one year from the user invoice date. Electronics International Inc. will repair or replace any item under the terms of this Warranty provided the item is returned to the factory prepaid.

1. This Warranty shall not apply to any product that has been repaired or altered by any person other than Electronics International Inc., or that has been subjected to misuse, accident, incorrect wiring, negligence, improper or unprofessional assembly or improper installation by any person. **This warranty does not cover any reimbursement for any person's time for installation, removal, assembly or repair.** Electronics International retains the right to determine the reason or cause for warranty repair.
2. This warranty does not extend to any machine, vehicle, boat, aircraft or any other device to which the Electronics International Inc. product may be connected, attached, interconnected or used in conjunction with in any way.
3. The obligation assumed by Electronics International Inc. under this warranty is limited to repair, replacement or refund of the product, at the sole discretion of Electronics International Inc.
4. Electronics International Inc. is not liable for expenses incurred by the customer or installer due to factory updates, modifications, improvements, upgrades, changes, or any other alterations to the product that may affect the form, fit, function or operation of the product.
5. Personal injury or property damage do to misinterpretation or lack of understanding this product is solely the pilots responsibility. The pilot **must** understand the operation of this product before flying the aircraft. Do not allow anyone to operate the aircraft that does not know the operation of this product. Keep the Operating Manual in the aircraft at all times.
6. E. I. Inc. is not responsible for shipping charges or damages incurred under this Warranty.
7. No representative is authorized to assume any other liability for Electronics International Inc. in connection with the sale of Electronics International Inc. products.
8. **If you do not agree to and accept the terms of this warranty, you may return the product for a refund.**

This Warranty is made only to the original user. **THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES OR OBLIGATIONS: EXPRESS OR IMPLIED. MANUFACTURER EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. PURCHASER AGREES THAT IN NO EVENT SHALL MANUFACTURER BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING LOST PROFITS OR LOSS OF USE OR OTHER ECONOMIC LOSS. EXCEPT AS EXPRESSLY PROVIDED HEREIN, MANUFACTURER DISCLAIMS ALL OTHER LIABILITY TO PURCHASER OR ANY OTHER PERSON IN CONNECTION WITH THE USE OR PERFORMANCE OF MANUFACTURER'S PRODUCTS, INCLUDING SPECIFICALLY LIABILITY IN TORT.**

Operating Instructions

R-1

0517911

Instrument:

The R-1 is a precision RPM instrument featuring a 210 degree analog display and a full four-digit digital display. These two displays have many advantages over conventional analog gauges as described below.

Also, the R-1 features long-term accuracy and reliability. Since the R-1 does not incorporate any moving parts (needles, bearings, springs, etc.) there is little to go wrong or wear out. The internal micro-processor assures accuracy and repeatability.

Analog Display:

The 210 degree analog display provides a quick reference of the engine's RPM with respect to its operating range. With a glance you can get a relative idea of how close to the maximum RPM limit the engine is being operated and approximately how far the RPM has to increase to reach its limit. Precise information is provided in the digital display.

An advantage of the analog display is its ability to emit a green, yellow or red light. With a quick glance you can determine if you're operating in a normal, caution or restricted range. Also, when you exceed a maximum limit the red light will blink 20 times at full intensity to catch your attention and warn you that a maximum limit has been violated. After 20 blinks the red light will stop blinking and display continuous red so it does not distract you. The digital display will continue to display accurate RPM readings well beyond the red line limit of the analog display.

During night operation the analog lights may be too bright. If so, turn the panel light rheostat up and the analog lights will dim. The red (maximum limit) light will always be displayed at full intensity.

Digital Display:

The digital display provides RPM information in 10 RPM increments. This allows for precise setting and monitoring of the engine RPM. Also, the digital display is excellent for monitoring trends or changes in the engine's performance.

For aircraft fitted with a fixed pitch prop a relative indication of an engine's ability to produce power can be measured by accurately monitoring the engine's RPM during the first 5 seconds of a full power take-off. A normal reduction in power will occur from high outside air temperatures, high altitudes and excessively rich mixtures. Getting to know your engine's normal take-off RPM can go a long way in detecting engine problems early.

The 10 RPM resolution of the R-1 can also help in setting the mixture control for maximum horsepower for aircraft fitted with either a fixed or variable pitch prop. This is most helpful during high altitude climbs or take-offs. As your engine is leaned at high altitudes it may exhibit an increase in RPM. This increase in RPM indicates an increase in power. For a variable pitch prop this will be a small change. It is not recommended to lean an engine when operated above 75% power. Consult your engine manufacturer's operating procedures for proper operation.

If the digital display backlight has been permanently powered up (as recommended), the digital display will be easier to see during low ambient light conditions and at night.

Mag Drop:

The mag drop feature allows you to view a change in RPM from a base line. Start by setting the throttle to achieve normal run-up RPM. Then push both buttons on the R-1. This establishes your base line RPM and the display will show "000". Any change in RPM (up or down from the base line) will be displayed. RPM drops will be displayed as negative numbers (i.e.: a "- 200" display means a 200 RPM drop from the base line). Now switch the mag to "Left" or "Right" and the RPM drop will be displayed. Switch your mag back to "Both" and the display will return to " 000" or near " 000". Most mags will not totally recover back to " 000". A problem (fouled plug, bad mag wire, mag problems, etc.) will show up as excessive drop in one mag and the recover RPM (how close it returns to " 000") will be excessive. The mag drop feature can be used to check prop governors, horsepower gain or loss during leaning and may other engine operations.

During mag drop operation the analog display will continue to show proper engine RPM. The Mag drop operation will automatically be canceled in 60 seconds or it may be canceled at any time by pushing any button on the R-1.

Tach Time:

The tach timer keeps a running total of time the engine is above 1300 RPM. The time is stored in memory for life. There are no internal batteries and bus power is not required to keep the memory alive. The maximum reading is 99,999.9 hours.

To display the time on the tach in thousands of hours, press the right push button marked "Tach Time" and hold the button in. The digital display will show two digits which represent thousands of hours on the tach.

To display the hundreds, tens, units and 1/10 hours on the tach, release the "Tach Time" button for no more than two seconds and press it again and hold it in. The display will show four digits with a decimal point. The digits represent hundreds, tens, units and 1/10 hours on the tach. Each time the "Tach Time" button is pushed and held in the display will toggle between the two displays. If the "Tach Time" button is released for more than three seconds the digital and analog displays will revert back to RPM.

Flight Timer and Peak RPM:

This instrument includes an automatic flight timer. When the RPM meets or exceeds 2000 RPM for 10 seconds (as would occur on takeoff), the flight timer will reset to "00.00" and start timing in one-minute increments. The peak RPM register will also be reset to "0000". The flight timer will continue to count until the RPM drops below 1200 RPM for 10 seconds (as would occur on the landing roll-out). At this point the flight time and peak RPM will be stored in memory. There are no internal batteries and bus power is not required to keep the memory alive. Your last flight time and peak RPM will always be available even if the power is turned off.

As the flight timer is counting, the maximum RPM is also being recorded. For an RPM to be recorded as "peak" it must exceed the last recorded RPM for three seconds or longer.

To display flight time, press the push button marked "Flt Time" and hold it in. The digital display will show your flight time in hours and minutes.

To display the highest RPM your engine reached during the flight release the "Flt Time" button for no more than two seconds and press it again and hold it in. The digital display will show the peak RPM reached during the flight. Each time the "Flt Time" button is pushed and held in the display will toggle between flight time and peak RPM. If the "Flt Time" button is released for more than three seconds the digital and analog display will revert back to RPM.

Installation Instructions

R-1

Important Information and Initial Check Out:

1. **The installer and aircraft owner must read the Warranty before starting the installation.** There is information in the Warranty that may alter your decision to install this instrument. **If you do not accept the terms of the Warranty, do not install this instrument.**
2. **If you are not an FAA Certified Aircraft Mechanic familiar with the issues of installing aircraft RPM instruments, Do Not attempt to install this instrument. The installer should use current aircraft standards and practices to install this instrument (refer to AC 43.13).**
3. **Check that any necessary FAA Approvals (STC's, etc.) are available for your aircraft before starting the installation. The FAA Approved Model List (AML) is located at the back of this manual. Resolve any issues you may have before starting the installation.**
4. Before starting installation, read the entire Installation Instructions and resolve any installation, operating and performance issues you may have. This may eliminate any delays once the installation is started. If the tach cable is removed, a RPM cap is available to cover the port (see price sheet).

5. Check that the instrument make and model marked on the side of the instrument and on the invoice are correct before starting the installation. A R-1-6 is used on a 6-cylinder engine and a R-1-4 is used on a 4-cylinder engine. The R-1-S1 or R-1-S2 is to be used on a Lasar ignition system (or any system with a tach out). Also, check the invoice for proper tach time.
6. Check that the limit information on this instrument matches the published limits in your aircraft's P.O.H. or Flight Manual. Also, this information may be listed in the T.C. Data Sheet for your aircraft. Any AD's and/or STC's may set forth additional limitations on the operation of your engine. The limit information listed in the AML is for unmodified aircraft and is intended for reference only. **It is the aircraft owner's and/or installer's responsibility to determine proper instrument calibration and range markings for your aircraft.**

On the front of this instrument you will find a red light marked with the maximum RPM information. If there are any additional red or yellow lights on this instrument, the operating range of these lights can be found on a sticker located on the side of the instrument (see the AML at the back of this manual to decode this information). This instrument designates any "Caution Range" with yellow LEDs, any "Maximum and Minimum Limits" with Red LEDs and the "Safe Operating Range" with green LEDs. The "Safe Operating Range" on this instrument is equivalent to the green "Normal Operating Range" and any unmarked areas on a analog gauge.

Do not attempt to remove or replace the limit stickers on this instrument. If the RPM limits for your engine do not match those which are marked on this instrument send this unit back to Electronics International Inc. for re-calibration. **DO NOT install or use a primary engine instrument that is not properly calibrated for your aircraft.**

7. Before starting the installation make sure the unit will fit in the location you intend to install it without obstructing the operation of any controls.
8. If this instrument is to replace an existing unit in the aircraft, it is the installer's responsibility to move or replace any existing instruments or components in accordance with FAA approved methods and procedures. The following Installation Instructions do not cover moving or the removal of any existing instruments or components.

Route The Circular Connector:

Starting from under the instrument panel, route the circular connector end of the wire harness up to the instrument mounting location. (See the wiring diagram at the back of this manual). Place the circular connector about 8 inches back from the panel. Tie wrap the harness in place approximately 1 foot back from the circular connector. This will allow the harness to be flexible and accommodate varying lengths in instrument wires. **Be sure these wires do not obstruct the freedom of travel of any controls.**

Install the Isolators:

On the back of the mag switch will be a number of lugs. Locate the two lugs connected to the left and right mag leads (P leads). Connect the two isolators supplied with the kit to these lugs (see wiring diagram). When installing these isolators do not remove the existing mag leads (P leads). **These isola-**

tors should not be changed, lengthened or altered in any way. There is another set of isolators in the instrument. These isolators insure safe operation while providing an easy and simple installation free of mechanical cables and pickups. **Make sure the mag lead screws are tight and the connectors are not interfering or shorting to any other terminals on the mag switch.**

Route the Pickup Wires:

Route the orange wire and the brown wire from the wire harness to the isolators. Cut to length and install a male slip-on connector on each wire. Double over the stripped wire before inserting it into the male connector. Double crimp the connector making sure the crimping tool closes completely. Now mate the orange wire and the brown wire to the female connectors on the isolators. Either wire may connect to either isolator. Be sure the connectors mate properly. If the tab in the male connector gets bent, it can wedge itself between the red nylon and the female metal receptacle. This can result in an intermittent connection after about a month or more. If the connectors are removed several times, the female connector can become loose. If this happens, use a pair of needle nose pliers and tighten the metal receptacle inside the female connector. **Tie wrap these wires so they do not obstruct the freedom of travel of any controls.**

Route the Power and Ground Wires:

Route the red wire in the wire harness to the aircraft's 12 or 24 volt main or emergency bus as applicable via an independent circuit breaker (five amps or less). An alternate method would be to route the red lead to the bus via a one amp in-line fuse. With this method a spare fuse should be kept in the aircraft.

Route the black wire in the wire harness to a good ground . **Tie wrap these wires so they do not obstruct the freedom of travel of any controls.**

Route the Backlight Wires:

Connect the backlight wires as follows:

1. It is recommended to permanently power up the digital display backlight.
 - a) For a 12-volt system connect the white/brown wire to the instrument red power lead. Connect the white/red wire to ground (see Wiring Diagram).
 - b) For a 24-volt system leave the white/brown open and connect the white/red wire to the instrument red power lead (see Wiring Diagram).
2. Connect the white/orange wire to the panel light rheostat. This wire will dim the analog LED's for night operation when the panel lights are turned on. If this line is left open, the analog LED's will remain at full intensity at all times. Also, if the voltage on this line drops below 11.5 volts, the analog LED's will be displayed at full intensity. **Tie wrap all wires so they do not obstruct the freedom of travel of any controls.** Note: This line may be connected to the CP-1 Intensity Control Pot (see price sheet).

Route the External Warning Control Line:

The white/yellow wire can be connected to an external light (AL-1), buzzer (ATG-1), voice annunciator (AV-17), a relay, etc. This wire grounds when the red warning light is on. The current in this line must be limited to 1/10 of an amp maximum. Exceeding this limit will damage the unit. If this feature is not used leave this line open. **Tie wrap this wire so it does not obstruct the freedom of travel of any controls.**

Install the Instrument in the Panel:

Install the instrument from behind the instrument panel using 6 x 32 screws. These screws should not be any longer than 1/2".

Connect the Circular Connector to the Instrument:

1. Push the two mating connectors together and twist them until they snap into position.
2. Turn the locking ring on the instrument connector clockwise (1 1/2 turns) until it locks into position.

Check Instrument Operation:

To check instrument operation perform the follows:

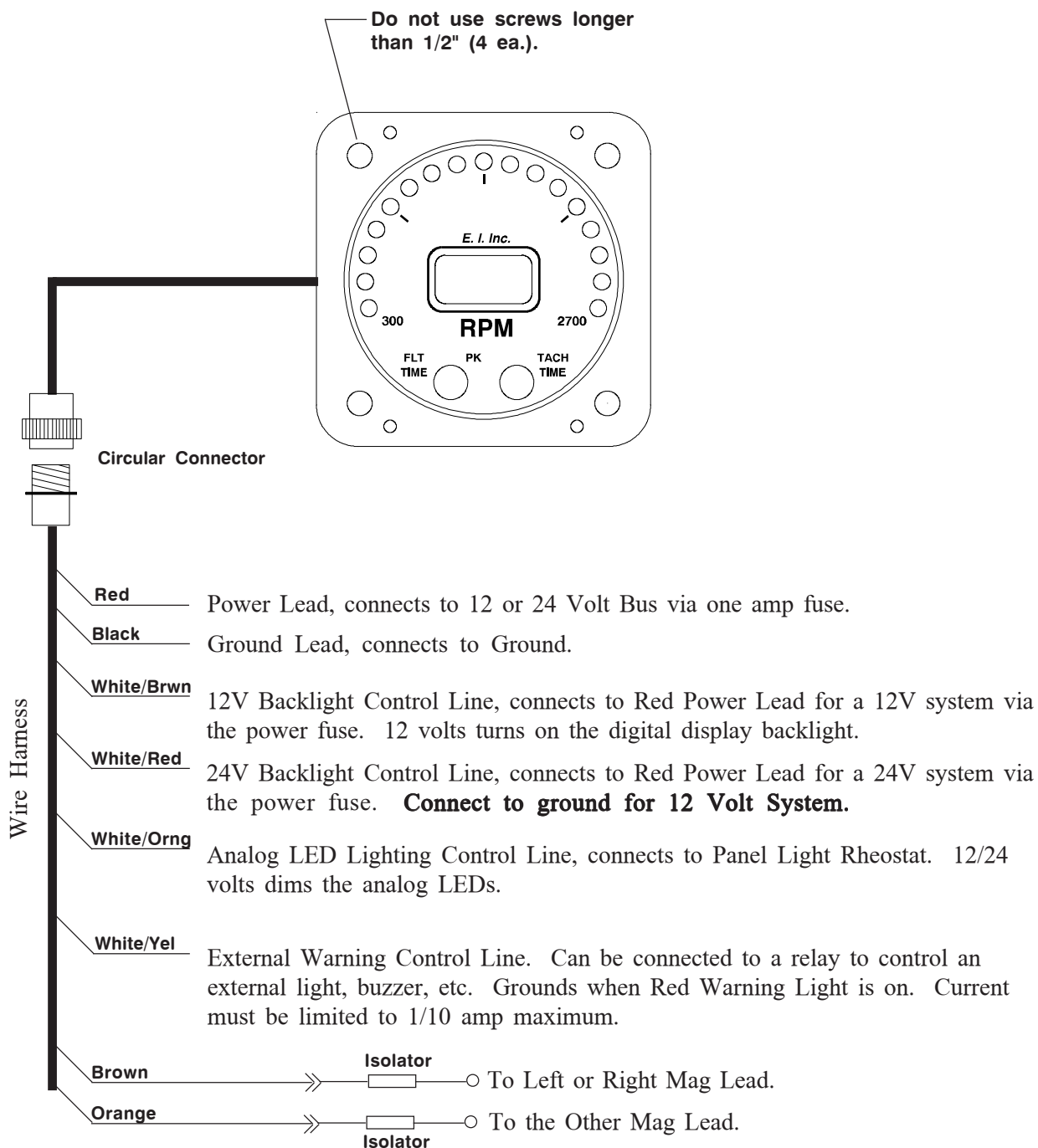
1. Turn the master switch on and verify that the instrument sequences through all the analog lights and reads "8888" on the digital display for 3 seconds or less and then switches to "0000." A problem at this step could be caused by poor connections on the red and/or black leads.
2. Check the digital display backlight. With high or medium ambient light it is hard to see the digital display backlight (it is only required during low ambient light conditions but should be on all the time).
3. Start the aircraft engine and allow it to idle with the mag switch on "Both." The digital and analog display should be reading properly. An engine's RPM will fluctuate 10 to 20 RPM at low idle. A problem at this step could be caused by a poor or improper connection on the brown or orange mag wires. To troubleshoot, connect the brown mag wire to the mag (through an isolator), leave the orange mag wire disconnected and look for proper operation with the engine at a stable idle RPM. Then connect the orange mag wire to the mag (through an isolator) and leave the brown mag wire disconnected. Look for proper operation with the engine at a stable idle RPM.
4. With all wires connected and the engine at idle select "Left" on the mag switch. Check the analog and digital display for proper operation. A large drop in the RPM for one second is normal. The microprocessor is switching to the other mag. Do this same test for the right mag. A problem at this step could be caused by a poor or improper connection on the brown or orange pickup cables. To troubleshoot see step 3 above.

5. Bring the engine RPM up to 1500 and look for proper operation. A jumpy high RPM reading at this step may be caused by a higher than normal voltage output from a Bendix Mag. If this is the case, install the Bendix Isolators supplied in your R-1 package.
6. Check that the screws on the mag switch have been properly tightened and the connectors are not interfering or shorting to any other terminals on the mag switch.

RPM (R-1)

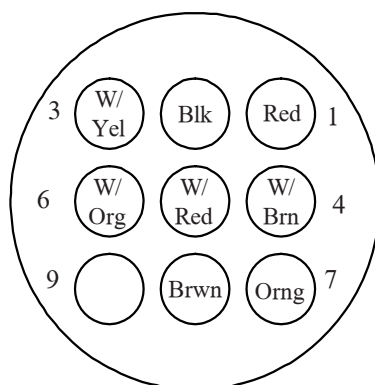
Wiring Diagram

WD 0311911



R-1 Circular Connector

Connecting Cable Harness, Back View (wire side)



Note: See Wiring Diagram for hook up information.

Specifications and Operating Features

S0520911

Model:

R-1 (RPM Instrument)

Case Dimensions:

2.5" x 2.5" x 3.65" depth, 2 1/4" Bezel.

Weight:

10 Oz.

Environmental:

Meets TSO C49a.

Power Requirements:

7.5 to 30 Volts, 1/10 Amp.

Analog Display:

17 High Intensity Light Emitting Diodes (LEDs) in a 210 degree arc with Intensity Control Line available for dimming. Sequential flash test on power up. Microprocessor eliminates LED hunting (flicker).

Red LEDs:

If the Analog Display goes from a Green LED or Yellow LED to a Red LED, the Red LED will blink 20 times then go solid red. The Red Max Limit LED is always displayed at full intensity.

Digital Display:

LCD (viewable in direct sunlight), with 12 and 24 volt backlight control wires for night operation. Readings below 300 RPM will be displayed as "0000". Display will read "8888" on power up.

Accuracy:

1% in accordance with TSO C49a.

Resolution:

10 RPM.

Max Digital Range:

4300 RPM.

Update Time:

3 times per second.

Signal Pickup:

Connects to Left and Right Mag Leads through isolators. Safety insured by additional in-line isolators located in the unit. Instrument will operate on Mags, CDIs and automotive ignition systems. No cables or mechanical connections required.

Tach Time:

Keeps a running total time for RPM readings at or above 1300 RPM. Time is stored in memory for life. There are no internal batteries and power is not required to keep memory alive. Maximum reading is 99,999.9 hours. Displayed in .1 hour increments.

Automatic Flight Time:

Resets to "00.00" and starts timing when RPM reading reaches or exceeds 2000 for 10 seconds. Stops Flight Timer and holds reading in memory when RPM drops below 1200 RPM for 10 seconds. Maximum reading is 99.59 (99 hours and 59 minutes). Displayed in 1 minute increments.

Peak RPM:

Operates in conjunction with the Automatic Flight Timer. Stores the highest RPM for the flight. For an RPM to be recorded as "peak" it must exceed the last recorded peak RPM for 3 seconds or longer.

External Warning Control Line:

Grounds when any Red Warning Light is on or blinking. Current should be limited to 2/10 amp.

STC Information

The R-1 is TSO'd, STC'd and PMA'd as a primary instrument. If you have any question on which aircraft are included on our Approved Model List (AML), please call our factory.

GARMIN[®]

GTS Traffic Systems

Pilot's Guide



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Record of Revisions		
Revision	Date	Description
B	3/21/14	Added new GTS models and reorganized/edited content.
C	08/30/16	Updated ADS-B info
D	11/08/17	Updated per latest SW
E	07/20/18	Updated per latest SW



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*All new G3X units, including Non-TSO remote-mount or Non-TSO panel-mount, are warranted to be free from defects in materials or workmanship for the earlier of: 2 years or 800 flight hours from the date of purchase.



WARNINGS AND CAUTIONS



WARNING: *The GTS TAS and TCAS I systems are intended for advisory use only to aid the pilot in visually acquiring traffic. No avoidance maneuvers should be based solely upon traffic information. It is the responsibility of the pilot in command to see and maneuver to avoid traffic.*



CAUTION: *Pilots should be aware of TAS/TCAS I system limitations. TAS/TCAS I systems require intruder transponders to respond to system interrogations. If an intruder transponder does not respond to interrogations due to antenna shading or marginal transponder performance, it will not be displayed, or display may be intermittent. Pilots should remain vigilant for traffic at all times when using TAS/TCAS I systems for non-transponder equipped airplanes or unresponsive airplanes.*



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SECTION 1 SYSTEM DESCRIPTION

Garmin GTS Traffic Systems are a family of Traffic Advisory Systems (TAS) and Traffic Alert and Collision Avoidance Systems (TCAS). The systems feature both active interrogation of aircraft transponders and reception of 1090 MHz Extended Squitter ADS-B broadcasts (ADS-B IN).

GTS Traffic Systems include the following products:

- GTS 800 TAS
- GTS 820 TAS and GTS 850 TCAS I
- GTS 825 TAS and GTS 855 TCAS I
- GTS 8000 TCAS II

Terms used in this Pilot's Guide:

- TAS: Refers to any TAS system (GTS 800/820/825)
- TCAS I: Refers to any TCAS I system (GTS 850/855)
- TAS / TCAS I: Refers to any TAS or TCAS I system (GTS 800/820/825/850/855)
- TCAS II: Refers to the GTS 8000



NOTE: Details on the GTS 8000 TCAS II operation are not included in this guide. For information on a GTS 8000 TCAS II system, refer to the aircraft-specific installation documentation.

SECTION 2 GENERAL THEORY OF OPERATION

2.1 Active Surveillance

GTS Traffic Systems actively interrogate the transponders of other nearby aircraft to determine their bearing, distance, altitude and vertical trend relative to your aircraft. Aircraft with operating transponders are detected, and aircraft with altitude reporting transponders will also include altitude and vertical trend information (level, climbing, or descending). This information is then shown on a compatible traffic display.

GTS Traffic Systems also provide visual and aural alerts to assist in visually acquiring traffic. Aural and visual alerts are provided as a Traffic Advisory (TA) for conflicting traffic.

2.2 ADS-B IN

The GTS ADS-B In capability allows it to receive traffic data through a built in 1090 MHz Extended Squitter (1090 ES) receiver. ADS-B IN is a core technology in the FAA NextGen air traffic control system and is comprised of three segments: ADS-B (Broadcast), ADS-R (Rebroadcast), and TIS-B. The ADS-B In function must be enabled at the time of system installation. If the ADS-B In function is disabled, only active surveillance is used.



NOTE: Full ADS-B In functionality is only available in GTS 800, GTS 820, and GTS 850 systems with system software version 4.00 and later; and in GTS 825 and GTS 855 systems with system software version 3.00 and later. Earlier software versions provide limited ADS-B IN functionality: Position data from the 1090 ES ADS-B is used to derive bearing for a correlated intruder tracked with active surveillance.

Automatic Dependent Surveillance - Broadcast (ADS-B) is the automatic broadcast of position reports by aircraft, surface vehicles, and transmitters on fixed objects. These broadcasts contain much more data than just a simple position report, they include: identity (Flight ID/Tail Number, ICAO registration number, etc), ground track, ground speed, pressure altitude, indications of equipment capabilities, and emergency status.

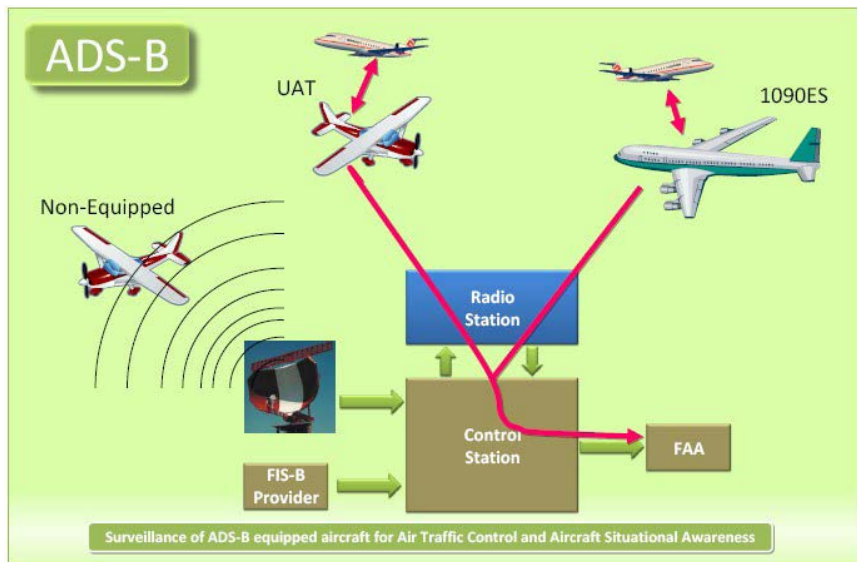


Figure 1 ADS-B Operation - FAA Illustration

Automatic Dependent Surveillance - Rebroadcast (ADS-R) is the rebroadcast of ADS-B data. ADS-B may be transmitted on either 1090 MHz or 978 MHz. ADS-B In capable aircraft may only be able to receive data on one link. Therefore, a means to get data from one data link to the other is required. ADS-R is the rebroadcast of ADS-B data by FAA ground stations and provides this service by taking data from one link and rebroadcasting it on the other. For example, two aircraft are in the service volume for a ground station, and one transmitting on 1090 MHz and the other 978 MHz, the ground station will retransmit the data from each aircraft on the other link to ensure the two aircraft can “see” each other. The GTS is capable of receiving ADS-B directly on the 1090 MHz data link only. ADS-R allows the GTS to “see” the aircraft that transmits ADS-B on the 978 MHz data link.

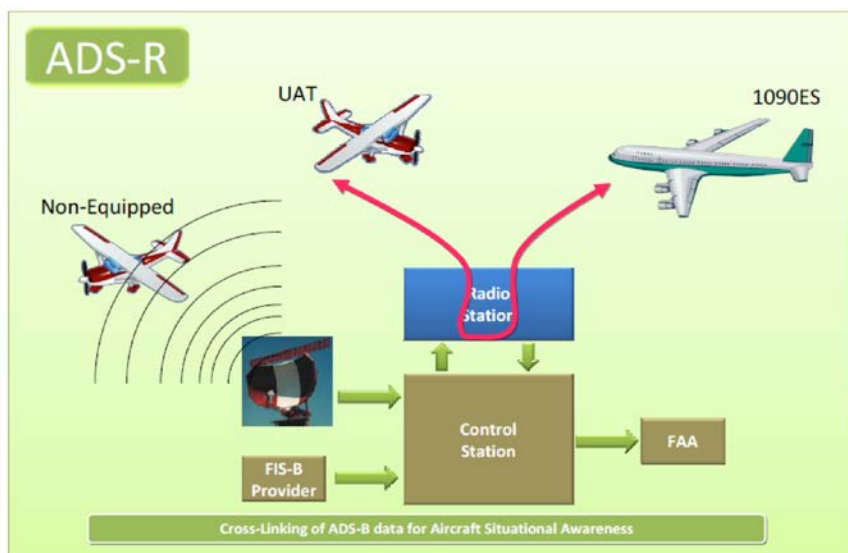


Figure 2 ADS-R Operation - FAA Illustration

Traffic Information Service - Broadcast (TIS-B) provides a bridge between the radar based ATC system and the ADS-B based system. When an ADS-B In capable aircraft is within the service volume of an FAA ADS-B ground station, the ground station will begin to broadcast a portion of the ATC radar picture to the aircraft. This aircraft is then included in the list of aircraft that is being provided TIS-B service and is then considered a “TIS-B participant.”

TIS-B coverage is available when the aircraft is within ground station coverage, in Secondary Surveillance Radar coverage, and the other aircraft is in secondary surveillance radar coverage and transmitting altitude.

ATC radar tracks for other aircraft within $\pm 3,500$ feet and 15 NM of the participant is provided by the ground station, to include altitude, position, ground speed, and ground track. TIS-B data is broadcast once every three to thirteen seconds depending on the characteristics of the FAA radar ground station.

The GTS is capable of active surveillance and will directly track most targets provided via TIS-B. If the GTS is not able to track a target using active surveillance (e.g. it is at a range too far to track reliably), it can still be displayed if provided via TIS-B.

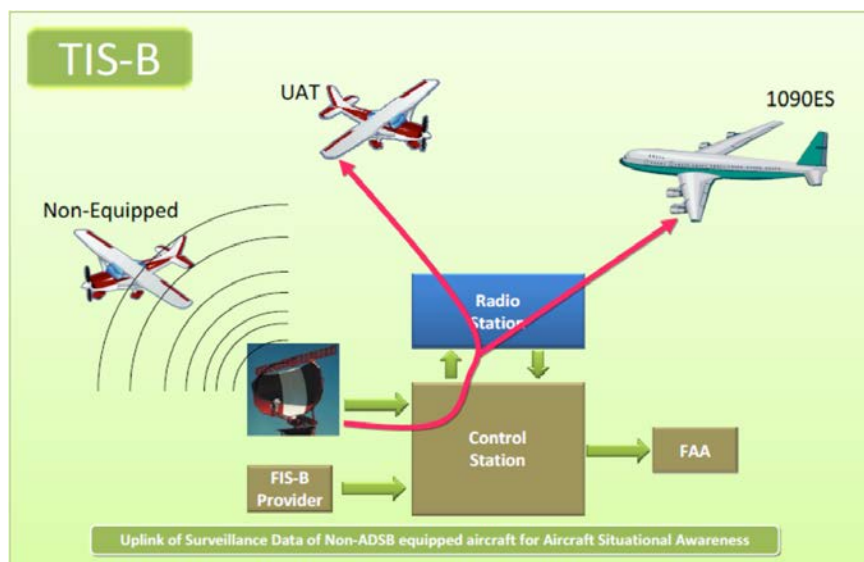


Figure 3 TIS-B Operation - FAA Illustration



NOTE: Even if the display is showing TIS-B traffic, unless the TIS-B participant indication is present (see Table 1) TIS-B services are not being provided specific to your aircraft.

Garmin display units have the capability to show the status of the ground station services being received. An example for the GTN is shown below. See the display device Pilot Guide for the symbology used on that display.

Unit	Symbol	Description
GTN		Within coverage of a TIS-B ground station.
GTN		Not within coverage of a TIS-B ground station.

Table 1 Map TIS-B Availability Symbols for the GDL 88

SECTION 3 SYSTEM SPECIFICATIONS

The specifications for each member of the GTS Traffic Systems family are contained in Table 2.

Product	GTS 800	GTS 820	GTS 825	GTS 850	GTS 855
Type	TAS TSO-C147 (Class A)	TAS TSO-C147 (Class A)	TAS TSO-C147 (Class A)	TCAS I TSO-C118	TCAS I TSO-C118
ADS-B Capability	TSO-C166b TSO-C195b [Note 1, 2]	TSO-C166b TSO-C195b [Note 1, 2]	TSO-C166b TSO-C195a [Note 2]	TSO-C166b TSO-C195b [Note 1, 2]	TSO-C166b TSO-C195a [Note 2]
Transmit Power	40 Watts	250 Watts	400 Watts	250 Watts	400 Watts
Maximum Range	22 NM	40 NM	40 NM	40 NM	80 NM
# Targets Tracked	45	75	75	75	75

Table 2 GTS Traffic Systems Specifications

- Note 1: GTS 800/820/850 require system software version 3.00 or later for TSO-C166b compliance.
- Note 2: For TSO-C195b compliance, GTS 800/820/850 require system software version 4.00 or later. For TSO-C195a compliance, GTS 825/855 require system software version 3.00 or later.

SECTION 4 SYSTEM COMPONENTS

4.1 System Processor

Each GTS Traffic System includes a system processor. The system processor connects to all of the required and optional antennas, displays, controls, and aircraft interfaces.



Figure 4 GTS System Processor

4.1.1 GTS 800/820/850 System Processors

The GTS 800/820/850 systems use a unique system processor. The GTS 800 system processor is different from a GTS 820 or GTS 850 system processor.

4.1.2 GTS 825/855 System Processor

The GTS 825/855 systems share a common system processor known as the “GTS Processor.” The GTS Processor can be configured during installation to be either a GTS 825 TAS or a GTS 855 TCAS I.

4.2 Antennas

The GTS Traffic Systems use one or two dedicated externally-mounted antennas to transmit transponder interrogations to other aircraft. The same antenna or antennas are used to receive transponder replies and ADS-B broadcasts from other aircraft.

A directional antenna on top of the aircraft is always required and is used to determine the bearing to the intruder aircraft. Interrogations transmitted from the top antenna are directional, which reduces the number of transponders that reply to the interrogation and reduces congestion on the 1090 MHz frequency.

An optional second antenna may be installed on the bottom of the aircraft to improve performance. A bottom mounted antenna adds additional visibility for targets that could be shaded from the top antenna (for example, targets that are underneath the aircraft). The bottom antenna may be a directional antenna or an omni-directional antenna. If a directional antenna is installed on the bottom, it may be used to determine the bearing to the intruder aircraft (omni-directional antennas cannot determine bearing). The bearing accuracy of a bottom directional antenna on a fixed gear airplane may be less than that of the top antenna, due to the presence of the landing gear. Bearing from the bottom antenna on a retractable gear airplane is not used when the landing gear is extended. Interrogations transmitted from the bottom antenna are always omni-directional, regardless of the antenna type.

4.2.1 Directional Antennas

4.2.1.1 GA 58 Directional Antenna

The GA 58 is a directional four-element antenna that may be installed on the top and/or bottom of the aircraft.



Figure 5 GA 58 Directional Antenna

4.2.1.2 Sensor Systems Low-Profile Antenna

Sensor Systems antennas are low-profile directional antennas that may be installed on the top and/or bottom of the aircraft.



Figure 6 Sensor Systems Low-Profile Directional Antenna

4.2.2 Omni-Directional Antenna

Numerous omni-directional (monopole) antennas are suitable for installation on the bottom of the aircraft. Omni-directional antennas cannot determine the bearing to an intruder aircraft.



Figure 7 Bottom-Mounted Omni-Directional (Monopole) Antenna

4.3 External Amplifier

4.3.1 GPA 65 Amplifier Module (GTS 820 & 850 only)

The GPA 65 is a combined Power Amplifier and Low Noise Amplifier that is required for use with the GTS 820 and GTS 850 systems only.



Figure 8 GPA 65 PA/LNA Module

SECTION 5 SYSTEM INTERFACES

The GTS Traffic System includes interfaces to various required and optional aircraft systems.

5.1 Altitude Source

At least one pressure altitude source is required for system operation. The pressure altitude source is compared to the pressure altitude replies from other aircraft to calculate their relative altitudes. Pressure altitude interfaces are available from a serial altitude encoder or digital air data computer.

5.2 Transponder Interface

All GTS Traffic Systems except the GTS 800 require an interface to a compatible Mode S transponder. The transponder interface allows the high-power GTS systems to determine how many TCAS-equipped aircraft are in the area. To reduce frequency congestion, transmit power is adjusted based on the number of other TCAS-equipped aircraft in the area. The GTS 800 systems transmit at a lower power level and do not require a transponder interface.

5.3 Traffic Display

At least one traffic display is required, and multiple traffic displays are supported. The traffic display shows a two-dimensional (top-down) view of traffic that is detected by the GTS system. Bearing, distance, relative altitude, and vertical trend can be depicted on the traffic display. When the ADS-B In function is installed and active, additional data provided by ADS-B (e.g. directionality) is shown on compatible displays. Some traffic displays include integrated controls for selecting the system operating mode and altitude filter. For details on the capabilities of a compatible traffic display, refer to the documentation for that display.

Contact your Garmin dealer to learn which displays are compatible with the GTS systems. Some displays may require the purchase and installation of additional modules and/or software.

5.4 Audio System

The GTS must be interfaced to an audio system so that traffic advisory aural alerts and self-test messages can be heard by the crew.

5.5 Landing Gear Position

Landing gear position for retractable gear aircraft is interfaced to the GTS system. Landing gear position may be used to mute traffic advisory audio, adjust the sensitivity of traffic alerts, or compensate a bottom directional antenna.

5.6 Radar Altimeter

A radar altimeter may be optionally interfaced to the GTS system. Radar altimeter height may be used to mute traffic advisory audio, adjust the sensitivity of traffic alerts, or filter out traffic targets that are on/near the ground.

For GTS 800, GTS 820, and GTS 850 systems using SW v4.12 or later, or GTS 825 and GTS 855 systems using SW v3.12 or later, the GTS will continue to function if the system detects a radar altimeter failure.

5.7 GPS

GPS is an optional interface to the GTS system that can provide position, groundspeed, and altitude (GPS-calculated). GPS input may be used to enable several functions, including ADS-B In, automatic air/ground determination, or calculated height above ground.

5.8 Magnetic Heading

Magnetic heading is an optional interface to the GTS system. Magnetic heading may be used to correct the bearing of traffic targets during turns, and it also aids the ADS-B In function. Magnetic heading interfaces are available from analog gyro systems or digital AHRS.

5.9 Air/Ground Switch

An air/ground switch (e.g. squat or airspeed switch) is an optional interface to the GTS system which may be used for automatic air/ground determination.

5.10 Control Switches

The GTS system supports external switches for selecting the operating mode (operate/standby), initiating a self-test, or canceling/muting traffic advisories. Use of external switches is required with certain traffic displays that do not include integrated controls. External switches, when installed, are a momentary pushbutton type.

SECTION 6 SYSTEM OPERATION

6.1 Operating Modes

The system typically powers up in Standby mode. In Standby mode, the system is powered on, but no traffic surveillance functions are performed.

Operate mode is the normal mode for operations. All active and ADS-B In traffic surveillance functions are performed in Operate mode.

Self-test mode is a manually-selected mode that briefly performs a test of the system. Refer to the self-test section of this guide for additional information.

If the system detects a fault that will prevent normal operation, the system will enter and remain in Fail mode.

For GTS 800, GTS 820, and GTS 850 systems using SW v4.12 or later or GTS 825 and GTS 855 systems using SW v3.12 or later, the unit can be configured to have the ADS-B In function operate independent of active surveillance. When configured to operate independently, the ADS-B In feature turns on automatically after power up and also after becoming airborne. The ADS-B In feature will also continue to function if the system detects a failure due to altitude source failure or transponder interface failure.

6.1.1 Control of Modes

Standby, Operate, and Self-test modes may be manually selected via system controls. When the ADS-B In function is installed and the unit is in Operate mode, the ADS-B In feature can be turned on and off. The controls are either integrated with the traffic display(s) or installed as external control switches.

For display(s) that integrate control of ADS-B In and GTS Modes, configuration can be set to allow ADS-B In feature to be turned on or off while GTS is in Standby. This feature requires display(s) support.

6.2 Traffic Information

The function of the GTS Traffic System is to provide information regarding nearby traffic to the crew. For each traffic target that is tracked by the GTS, the system computes the bearing, range, relative altitude, and vertical trend for the target. Relative altitude and vertical trend are available for targets with altitude reporting capability. When ADS-B data is received for a traffic target, additional information is available such as directionality, ground track, and other identifying information (ICAO address, flight ID, tail number). Traffic information may be available from several sources such as active surveillance, ADS-B, ADS-R, and TIS-B. The GTS correlates data from multiple sources to create a single, fused traffic picture for the flight crew. This traffic information is displayed to the crew on an interfaced display. See the display device Pilot Guide for the display capabilities and symbology (Table 3) used on that display. Figure 9 shows an example traffic display showing range, bearing, relative altitude, and vertical trend. Figure 10 shows an example traffic display capable of showing additional data received via ADS-B.

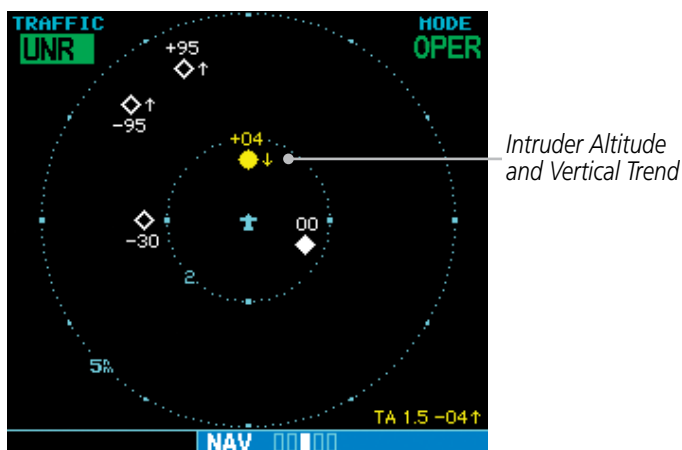


Figure 9 Example Traffic Display

6.2.1 No-Bearing TAs

If the bearing of a TA target cannot be determined, a No-Bearing TA will be issued (Figure 9). No-Bearing TAs are typically displayed as a yellow text banner on the traffic display. The text typically includes “TA” followed by the distance, relative altitude, and vertical trend arrow. Relative altitude and vertical trend arrow are not available for targets that do not report altitude.

** Indicates Multiple Targets. Touch the target to show all targets. Then touch Next to get info on each of the targets.*

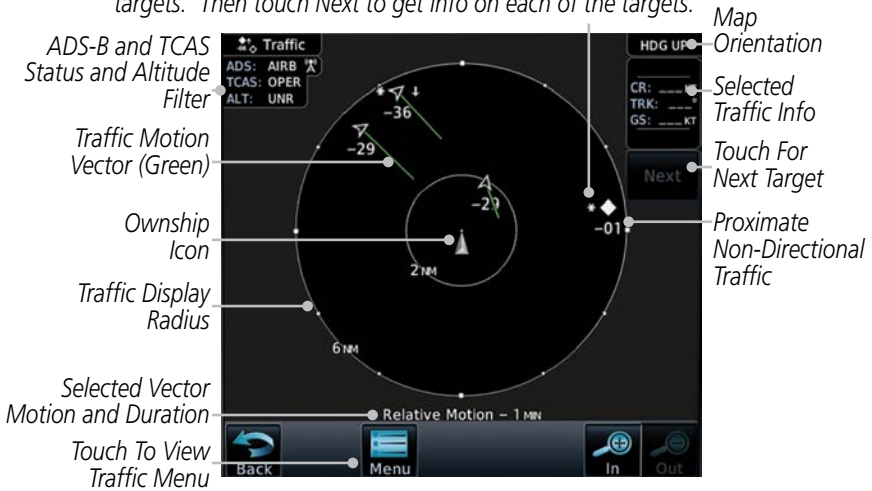


Figure 10 Example Traffic Display



NOTE: Always refer to the traffic display documentation for details on how traffic information is depicted on each display.

Symbol	Description
	Traffic Advisory with directional information. Points in the direction of the intruder aircraft track.
	Traffic Advisory without directional information. Traffic Advisory (TA) targets are typically displayed as a yellow circle and are generated when the GTS predicts that a target may pose a collision threat. Traffic Advisory sensitivity, criteria, and types are described in the following sections.
	Traffic Advisory out of the selected display range. Displayed at outer range ring at proper bearing. If a TA is beyond the currently-selected traffic display range, it is typically shown with a half-circle icon at the edge of the display range. Refer to the traffic display documentation for details regarding off-scale TA depictions.
	Proximity Advisory with directional information. Points in the direction of the aircraft track.
	Proximity Advisory (PA) without directional information. PA targets are typically displayed as a solid diamond. PAs are defined as traffic within 6 NM horizontally and 1200 feet vertically that are not a Traffic Advisory.
	Non-threat traffic with directional information. Points in the direction of the intruder aircraft track.
	Non-threat traffic without directional information. Other Traffic (OT) targets are typically displayed as a hollow diamond and do not meet the criteria for any other traffic type.
	Traffic located on the ground with directional information. Points in the direction of the aircraft track. Ground traffic is only displayed when ADS-B is in Surface (SURF) Mode or own aircraft is on the ground.
	Ground traffic without directional information. Ground traffic is only displayed when ADS-B is in Surface (SURF) Mode or own aircraft is on the ground.

Symbol	Description
	Non-aircraft ground traffic. Ground traffic is only displayed when ADS-B is in Surface (SURF) Mode or own aircraft is on the ground.

Table 3 GTS Traffic Symbolology

6.3 ADS-B In Applications - SURF, AIRB

When the ADS-B In function is installed and the GTS is interfaced to a certified compatible display unit, ADS-B display is available for the flight crew's situational awareness and to enhance the visual acquisition of surrounding traffic. The GTS is capable of supporting two display "modes:" Airborne Situational Awareness (AIRB) and Surface Situational Awareness (SURF).

AIRB is in operation in the en route environment, outside of five NM from or more than 1,500 feet above the nearest airport. AIRB supports the flight crew's situational awareness and visual acquisition of surrounding airborne traffic (see Figure 10).

SURF is in operation within the terminal environment (within five NM and less than 1,500 feet above field elevation). When SURF is active, and the zoom scale on the traffic display is less than two NM, the airport environment (including taxiways and runways) is displayed in addition to traffic. This is to aid in situational awareness of runway occupancy/availability, etc (see Figure 11).



Figure 11 Example Traffic Display

6.4 Traffic Alerting

GTS provides visual and aural alerts to assist in visually acquiring traffic. Aural and visual alerts are provided as a Traffic Advisory (TA) for conflicting traffic. A TA is generated based on range and altitude closure rate (time until collision) or if the intruder aircraft encroaches within a minimum distance.

When an intruder aircraft is tracked with active surveillance, TAS/TCAS I alerting is used for that aircraft. If an intruder cannot be tracked with active surveillance but is tracked by ADS-B In, then ADS-B alerting is used for that aircraft. Intruder aircraft can only be tracked by ADS-B In when ADS-B In is installed and operating.



NOTE: *The GTS Traffic System does not provide the ADS-B Traffic Awareness System (ATAS) application defined by TSO-C195b.*

6.4.1 TAS/TCAS I Alerting

6.4.1.1 Sensitivity Level

To prevent nuisance TAs in the airport environment, there are two sensitivity levels available: Sensitivity Level A (SL A) and Sensitivity Level B (SL B). The Sensitivity Level determines what criteria will be used for TAs. SL A is less sensitive and traffic must be closer before it will generate an alert. SL B is more sensitive and traffic may be farther away to generate an alert. The logic for choosing the sensitivity level is based on available system inputs. If none of the inputs described below are available, the system will always remain in the most sensitive level, SL B.

6.4.1.1.1 Height Above ground

If the aircraft is equipped with a radar altimeter, it will be used as the source of height above ground. If the aircraft is not equipped with a radar altimeter, calculated height above ground (see below) will be used. SL A will be used when the height above ground is less than 2,000 feet. SL B will be used when the height above ground is greater than 2,000 feet.



NOTE: *Calculated Height Above Ground is used for sensitivity level selection in GTS 800, GTS 820, and GTS 850 systems with software version 4.00 and later; and in GTS 825 and GTS 855 systems with system software version 3.00 and later. In earlier software versions, only radar altimeter is used for sensitivity level selection.*

6.4.1.1.2 *Landing Gear Position*

If the aircraft has retractable landing gear, SL A will be used when the landing gear is extended. SL B will be used when the landing gear is retracted. Landing gear position does not affect sensitivity level if height above ground is available.

6.4.1.1.3 *Groundspeed*

GPS groundspeed may be used to select the sensitivity level only if height above ground and landing gear position is not available. SL A will be used when the groundspeed is less than 120 knots. SL B will be used when the groundspeed is greater than 120 knots.

6.4.1.1.4 *No Available Inputs*

If none of the above inputs are available (radar altimeter, calculated height above ground, landing gear position, or groundspeed), the system will always remain in the most sensitive level, SL B.

6.4.1.2 TA Criteria

Targets may become a TA based on closure rate (time until collision) or if they encroach within a minimum distance. The criteria used depend on the current sensitivity level and whether the target has altitude reporting capability. Once a TA is generated, it will remain a TA for at least 8 seconds, even if the target no longer satisfies the criteria for a TA. Table 4 summarizes the criteria used for TAs.

Sensitivity Level	Intruder Altitude Available	TA Alerting Conditions
A	Yes	Intruder closing rate provides less than 20 seconds of vertical and horizontal separation. Or: Intruder closing rate provides less than 20 seconds of horizontal separation and vertical separation is within 600 feet. Or: Intruder range is within 0.2 NM and vertical separation is within 600 feet.
A	No	Intruder closing rate provides less than 15 seconds of separation or intruder range is within 0.2 NM.
B	Yes	Intruder closing rate provides less than 30 seconds of vertical and horizontal separation. Or: Intruder closing rate provides less than 30 seconds of horizontal separation and vertical separation is within 800 feet. Or: Intruder range is within 0.55 NM and vertical separation is within 800 feet.
B	No	Intruder closing rate provides less than 20 seconds of separation or intruder range is within 0.55 NM.

Table 4 TA Alerting Criteria

6.4.2 ADS-B In Alerting

To be tracked with active surveillance, an intruder aircraft must receive interrogations and transmit replies. If the intruder aircraft does not detect interrogations (e.g. it is too far to receive interrogations), it cannot be tracked by GTS active surveillance. When ADS-B In is installed and active, GTS may receive ADS-B, ADS-R, or TIS-B for an intruder aircraft that can't be tracked with active surveillance. Such targets are tracked with ADS-B In only, and are included in the display of traffic. GTS will also generate alerts for targets tracked with ADS-B In only.

6.4.2.1 Sensitivity Level

As with TAS/TCAS I TA implementations, height above ground is used to adjust the sensitivity of the ADS-B In alerting algorithm. Radar Altitude (if available), Calculated Height Above Ground, and ownship altitude are used to adjust the sensitivity of the ADS-B In alerting algorithm in accordance with Table 5:

Sensitivity Level	Height Above Airport (HAA) (feet)	Radar Altitude (feet)	Height Above Terrain (HAT) (if available)*	Ownship Altitude (feet)
4	≤ 1,500 and w/in 5 NM of airport reference point	Any	Any	Any
4	Unavailable	≤ 1,500	Any	Any
4	Unavailable	Unavailable	≤ 1,500	Any
5	Unavailable or > 1,500	Unavailable or > 1,500	Unavailable or > 1,500	≤ 5,000
6	Unavailable or > 1,500	Unavailable or > 1,500	Unavailable or > 1,500	> 5,000 and ≤ 10,000
7	Unavailable or > 1,500	Unavailable or > 1,500	Unavailable or > 1,500	> 10,000 and ≤ 20,000
8	Unavailable or > 1,500	Unavailable or > 1,500	Unavailable or > 1,500	> 20,000

Table 5 Alerting Thresholds for ADS-B Traffic

6.4.2.2 TA Criteria

Targets may become a TA based on closure rate (time until collision) or if they encroach within a minimum distance. The criteria used depends on the current sensitivity level. Once a TA is generated, it will remain a TA for at least 5 seconds, even if the target no longer satisfies the criteria for a TA. Table 6 summarizes the criteria used for TAs.

Sensitivity Level	TA Alerting Conditions
4	Within the next 30 seconds, intruder range and relative altitude are predicted to be within 0.20 NM and 400 ft.
5	Within the next 35 seconds, intruder range and relative altitude are predicted to be within 0.35 NM and 700 ft.
6	Within the next 40 seconds, intruder range and relative altitude are predicted to be within 0.55 NM and 700 ft.
7	Within the next 45 seconds, intruder range and relative altitude are predicted to be within 0.80 NM and 700 ft.
8	Within the next 48 seconds, intruder range and relative altitude are predicted to be within 1.10 NM and 700 ft.

Table 6 TA Alerting Conditions

6.4.3 TA Aural Alerts

When a target becomes a TA, an aural alert message is played to advise the crew. The aural alert may include an ATC-description of the target's bearing, altitude, and distance. For example, "Traffic! One o'clock, High, Two miles."

The aural alert format is shown in Table 7:

Bearing	Relative Altitude	Distance
"One o'clock" through "Twelve o'clock" or "No Bearing"	"High", "Low", "Same Altitude" (if within 200 feet of own altitude), or "Altitude not available"	"Less than one mile", "One Mile" through "Ten Miles", or "More than ten miles"

Table 7 Aural Alerts

Optionally, TA aural alerts may be shortened under some circumstances. A TA aural alert may be shortened to "Traffic, Traffic!" in the following cases:

- Another TA is already present, or
- The range to the TA target is less than 0.25 NM



NOTE: Shortened TA aural alerts are currently only available in GTS 800, GTS 820, and GTS 850 systems with system software version 4.00 or later, and GTS 825 and GTS 855 systems with system software version 2.20 or later.

6.4.3.1 TA Aural Muting

TA aural alerts may be muted or canceled under some circumstances. Muting or canceling of the TA aural alert does not affect the visual display of the TA.

6.4.3.1.1 Height Above Ground

If the aircraft is equipped with a radar altimeter or Calculated Height Above Ground is enabled, all TA aural alerts will be muted when the height above ground is less than 400 feet.

6.4.3.1.2 Landing Gear Position

If the aircraft has retractable landing gear, all TA aural alerts will be muted when the landing gear is extended. Landing gear position does not mute TA aural alerts if height above ground is available.

6.4.3.1.3 TAWS/Windshear Alerts

TA aural alerts may be temporarily muted by higher-priority aural alerts, such as TAWS or windshear. The TA aural alert will resume when the higher-priority aural alert is no longer active.

6.4.3.1.4 External Switch

A TA aural alert may be canceled with an optional momentary pushbutton switch. Pressing this switch during a TA aural alert will cancel/mute that aural alert. Subsequent TA aural alerts will be played, and the switch must be pressed each time that it is desired to cancel/mute a TA aural alert.

6.5 Ownship Air/Ground Detection

Optional external interfaces can be used to determine whether the ownship is on the ground or in the air. Interfaces that may be used for determining the air/ground state include:

- An air/ground switch (e.g. squat or airspeed switch).
- GPS groundspeed. Greater than 35 knots indicates in air, and less than 30 knots indicates on ground.
- Air/ground message from a Garmin avionics system.

Ownship air/ground detection is used for the automatic mode switching and calculated height above ground features.

6.6 Automatic Mode Switching

The system can automatically switch between Operate and Standby modes based on whether the ownship is in the air or on the ground. The system will automatically select Operate mode 8 seconds after becoming airborne. Standby mode will automatically be selected 24 seconds after landing.

The system can automatically turn on the ADS-B In feature shortly after power up if the unit is configured to have the ADS-B In function operate independent of active surveillance. The ADS-B In feature is turned on 8 seconds after power up. If the ADS-B In feature was turned off while on the ground, the ADS-B In feature will be turned on 8 seconds after becoming airborne. The ADS-B In feature will not be turned off automatically.

For GTS 800, GTS 820, and GTS 850 systems using SW v4.10 or later or GTS 825 and GTS 855 systems using SW v3.10 or later, when a Pressure Altitude

fault clears, the GTS unit will go into Operate mode if it was operating prior to the fault.

6.7 Calculated Height Above Ground

For aircraft that are not equipped with a radar altimeter, the system can calculate the height above ground using information from various optional interfaces. This calculation can enable additional functionality (such as ground traffic filtering), without requiring a radar altimeter interface.



NOTE: The Calculated Height Above Ground feature is only available in GTS 800, GTS 820, and GTS 850 systems with system software version 4.00 or later; and only available in GTS 825 and GTS 855 systems with system software version 2.20 or later.

Height above ground can be calculated using data provided by a connected display. If provided by the display, the GTS can use Height Above Terrain provided by a display's TAWS function, or it can calculate height above ground using altitude data provided for nearby airports.



NOTE: *Height above ground data from a connected display can only be used by GTS 800, GTS 820, and GTS 850 systems with system software version 4.00 and later; or by GTS 825 and GTS 855 systems with system software version 3.00 and later.*

Height above ground can be calculated using an internal airport database and optional 3-D GPS interface. The system's internal airport database contains locations and elevations for airports throughout the world. By comparing the 3-D GPS position and altitude to the airport database, the ownship's height above ground can be calculated. If GPS altitude is not available, 2-D GPS input (position only) can be used along with baro-corrected altitude from an air data computer to perform the calculation.

Additionally, if the system has detected that it is on the ground, the on-ground position and pressure altitude will be used as a known ground reference point. If GPS position is not available, the on-ground altitude will still be used as a reference point as long as the ownship is on the ground and for up to 60 seconds after takeoff.

6.8 Ground Traffic Filtering

To reduce nuisance alerts and reduce traffic display clutter, traffic that is on or near the ground may not be shown on the traffic display or generate traffic alerts. When ADS-B In is installed and the SURF application is active, on-ground traffic may be displayed. On-ground traffic will be shown on compatible displays using distinct symbols if the traffic is tracked using ADS-B In. See the display device Pilot Guide for the capabilities and symbology used on that display. On-ground traffic will not generate alerts. There are several methods used for filtering out ground traffic.

6.8.1 Mode S Targets

Mode S transponders include in their replies an indication of whether the aircraft is on the ground or in the air. Mode S traffic that indicates the traffic is on the ground will not be displayed unless SURF is active and the target is tracked with ADS-B In. This is the only method used to determine whether Mode S traffic is on the ground.



NOTE: *The system does not indicate to the crew which traffic targets are Mode S equipped.*

6.8.2 Radar Altimeter

Radar altitude, if available, may be used to determine which traffic targets are on the ground. For example, if the current radar altitude is 1000 feet, then traffic with a relative altitude of -1000 feet would be considered to be on the ground and would not be displayed unless SURF is active and the target is tracked with ADS-B In. Ground traffic is only filtered when the radar altitude is less than 1,700 feet.

6.8.3 Calculated Height Above Ground

If radar altitude is not available, calculated height above ground may be used to filter out ground traffic. Calculated height above ground is used similarly to how radar altitude is used. Ground traffic is only filtered when the calculated height above ground is less than 1,700 feet.

6.9 Self-Test



NOTE: Traffic surveillance is not available during the self-test.

The self-test mode is used to verify that the system is functioning normally. Self-test must be manually initiated from the Standby mode and takes approximately ten seconds to complete. During the self-test, a pattern of traffic symbols is shown on the traffic display. The test pattern consists of the following traffic:

- A Traffic Advisory at 9 o'clock, 2 miles, 200 feet below and climbing. There is no Traffic Advisory aural alert for this test traffic.
- A Proximity Advisory at approximately 1 o'clock, 3.6 miles, 1000 feet below and descending.
- Other Traffic at approximately 11 o'clock, 3.6 miles, 1000 feet above and level.



Figure 12 Self-Test Mode

If the self-test is successful, the aural announcement “[TAS / TCAS I] System Test Passed” (depending on the system type) will be played. If the self-test is unsuccessful, the aural announcement “[TAS / TCAS I] System Test Failed” will be played.

The system may be installed so that the self-test cannot be initiated while airborne.

SECTION 7 Q AND A

7.1 What are the benefits of ADS-B?

ADS-B data contains additional information about a target aircraft including flight ID, latitude, longitude, barometric and geometric altitude, velocity, and direction. The additional data provided by ADS-B can be shown on a compatible display to enhance flight crew situational awareness of traffic.

7.2 When is ADS-B In available?

ADS-B In functionality is available when the feature is enabled via configuration settings during equipment installation. When installed, the feature can be enabled or disabled by the flight crew when the GTS system is in Operate mode. A compatible display is required to allow pilot control of ADS-B In and display of additional ADS-B In data for intruder aircraft.

7.3 How are active and ADS-B In targets displayed?

Refer to the traffic display documentation to determine the capabilities of each display.

7.4 What capabilities does GPS data provide?

GPS data is required for the ADS-B In feature. GPS data is also used in some installations for air/ground detection, automatic mode switching, and calculated height above ground.

GPS data is optional and the system can provide active traffic surveillance with or without GPS data.

7.5 What kind of transponder is required for use with the GTS Traffic System?

All installations except the GTS 800 require the use of a compatible Mode S transponder. The transponder provides an indication of how many other TCAS-equipped aircraft are nearby, so that the GTS traffic system can adjust its transmit power and reduce frequency congestion.

The GTS 800 does not require a transponder interface (regulatory requirements for transponder usage still apply).

7.6 Is ADS-B Out required with the GTS Traffic System?

No. The ADS-B In feature uses ADS-B, ADS-R, and TIS-B, but the ownship is not required to be equipped with ADS-B Out.

SECTION 8 GLOSSARY

Active Surveillance:	Tracking of traffic targets using aircraft transponders
ADS-B:	Automatic Dependent Surveillance – Broadcast
ADS-B IN:	Traffic Surveillance using position and state data received from ADS-B, ADS-R, and TIS-B messages.
ADS-R:	Automatic Dependent Surveillance - Rebroadcast
ASA:	Aircraft Surveillance Applications
ATCRBS:	Air Traffic Control Radio Beacon Service - A surveillance system that uses active interrogations and Mode A/C replies from transponders
GPS:	Global Positioning System
MHz:	MegaHertz - A unit of measure for radio frequency
Mode A:	A type of ATCRBS transmission which requests (via Mode A interrogations) or reports (via Mode A replies) aircraft identity information
Mode C:	A type of ATCRBS transmission which requests (via Mode C interrogations) or reports (via Mode C replies) aircraft altitude information
Mode S:	A type of secondary surveillance radar transmission which contains a unique 24-bit discrete address, thus allowing interrogations to be addressed to individual aircraft. Mode S transmissions can be short (56 bits) or long (112 bits), with long transmissions containing a 56-bit “message” field.
NM:	Nautical Mile
OT:	Other Traffic (other than TA or PA traffic)
PA:	Proximity Advisory
TA:	Traffic Advisory
TAS:	Traffic Advisory System
TCAS:	Traffic Alert and Collision Avoidance System
TIS-B:	Traffic Information Service - Broadcast



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FAA APPROVED

AIRPLANE FLIGHT MANUAL SUPPLEMENT
or
SUPPLEMENTAL AIRPLANE FLIGHT MANUAL
for the
Garmin GTX 33X and GTX 3X5 Transponders with ADS-B
as installed in

CESSNA 172M

Make and Model Airplane

Registration Number: N1840V / N22905 Serial Number: 17263767 / 17264078

This document serves as an FAA Approved Airplane Flight Manual Supplement or Supplemental Airplane Flight Manual when the GTX 33X or GTX 3X5 with ADS-B 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.

FAA Approved By: 

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Section 1. GENERAL

1.1 GTX 33X

The Garmin GTX 33X family consists of the GTX 330 ES and GTX 33 ES (Non-Diversity Mode S Transponders) and the GTX 330D ES and GTX 33D ES (Diversity Mode S Transponders). The ES option of any of the transponders provides ADS-B extended squitter functionality.

All Garmin GTX 33X 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 to initiate the SPI (special position identification) pulse for 18 seconds and will reply to ATCRBS Mode A, Mode C and Mode S All-Call interrogation. Interfaces to the GTX 33X are shown in the following block diagrams.

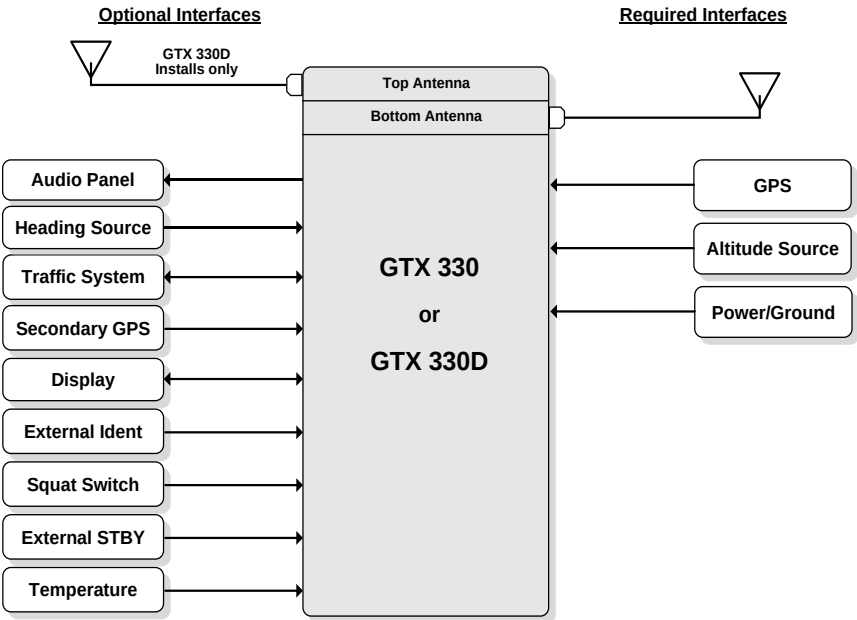


Figure 1 – GTX 330 or GTX 33D Interface Summary

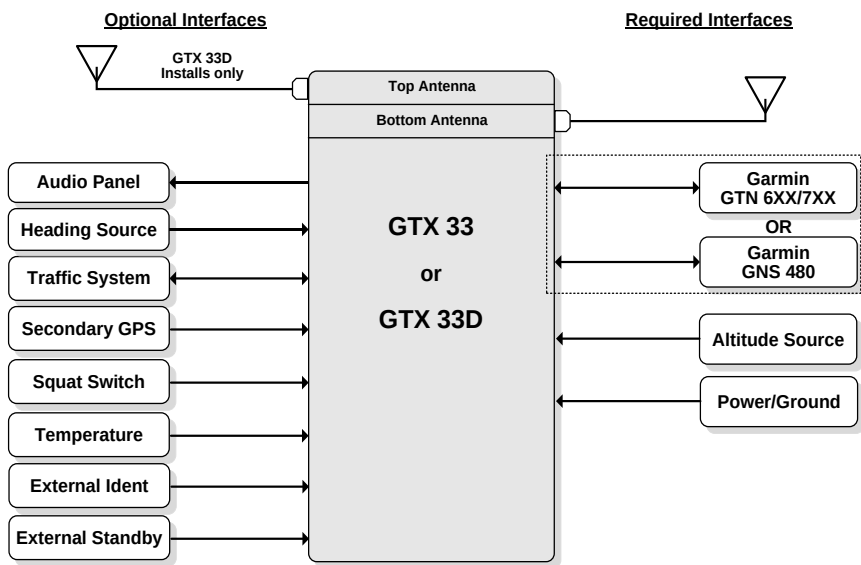


Figure 2 – GTX 33 or GTX 33D Interface Summary

The GTX 33X performs the following functions:

- Transmission of ADS-B out data on 1090 extended squitter (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 Codes between 0000-7777.
 - Emergency Status
 - IDENT - initiates SPI (special position identification) pulse for 18 seconds
 - Pressure Altitude Broadcast Inhibit
- Reception of TIS-A traffic data from a ground station
- Provides TIS-A traffic alerting to the pilot via interfaced display and audio output

1.2 GTX 3X5

The Garmin GTX 3X5 family consists of the GTX 335, 335R, 345, and 345R transponders. The functional differences between each of these transponders are described in Table 1.

Function	GTX 335	GTX 335 w/GPS	GTX 335R	GTX 335R w/GPS	GTX 345	GTX 345 w/GPS	GTX 345R	GTX 345R w/GPS
Panel mount	x	x			x	x		
Remote mount			x	x			x	x
Mode S	x	x	x	x	x	x	x	x
ADS-B (out)	x	x	x	x	x	x	x	x
ADS-B Traffic					x	x	x	x
FIS-B					x	x	x	x
Internal GPS		x		x		x		x
Bluetooth					x	x	x	x
Optional Garmin Altitude Encoder	x	x	x	x	x	x	x	x

Table 1 – GTX 3X5 Unit Configurations

Interfaces to the GTX 3X5 are shown in Figure 3.

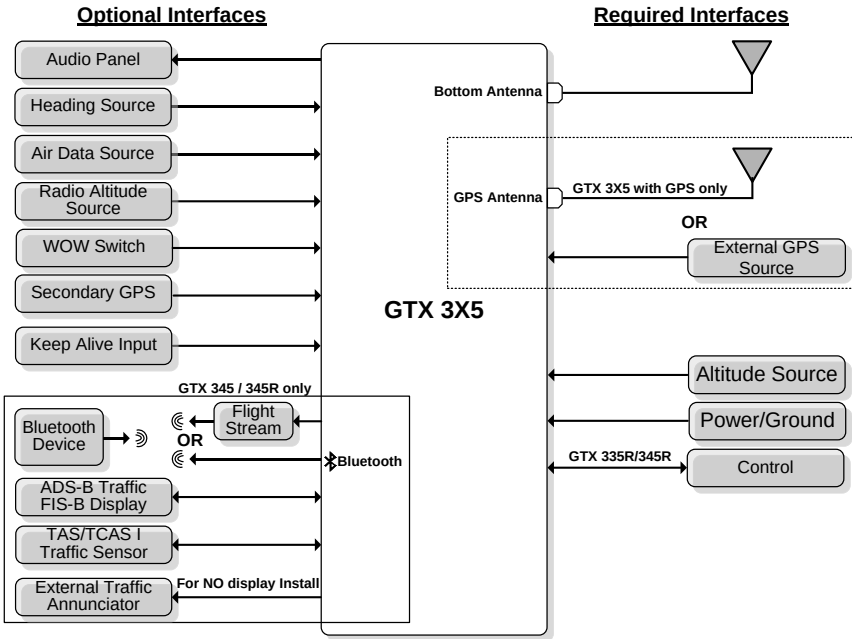


Figure 3 – GTX 3X5 Interface Summary

The GTX 3X5 performs the following functions:

- Transmission of ADS-B out data on 1090 extended squitter (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 Codes between 0000-7777.
 - Emergency Status
 - IDENT - initiates SPI (special position identification) pulse for 18 seconds
 - Pressure Altitude Broadcast Inhibit

The GTX 335 performs the following additional functions:

- Reception of TIS-A traffic data from a ground station
- Provide TIS-A traffic alerting to the pilot via interfaced display and audio output.

The GTX 345 performs the following additional functions:

- 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)
- 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)
- Provide ADS-B traffic information and alerting to the pilot via an interfaced display

- Correlation and consolidation of traffic data from multiple traffic sources
- Aural and visual traffic alerting
- Provide FIS-B data to the pilot via an interfaced display
 - Graphical and textual weather products
 - NEXRAD
 - PIREPs
 - AIRMET/SIGMETs
 - METARs
 - TAFs
 - Winds Aloft
 - Aviation Data
 - TFRs
 - NOTAMs

1.3 Capabilities

The Garmin GTX 33X and GTX 3X5 as installed in this aircraft have been shown to meet the equipment requirements of 14 CFR § 91.227 when operating in accordance with sections 2.1 and 2.2 of this supplement.

1.4 Installation Configuration

This aircraft is equipped with a GTX 33X and/or GTX 3X5 with the following interfaces/ features:

Equipment Installed:

Transponder #1

- ☐ GTX 330
- ☐ GTX 330D
- ☐ GTX 33
- ☐ GTX 33D
- ☐ GTX 335
- ☐ GTX 335R
- ☐ GTX 345
- ☐ GTX 345R

Transponder #2 (if installed)

- ☐ GTX 330
- ☐ GTX 330D
- ☐ GTX 33
- ☐ GTX 33D
- ☐ GTX 335
- ☐ GTX 335R
- ☐ GTX 345
- ☐ GTX 345R

Interfaced GPS/SBAS Position Source(s):

GPS #1

- ☐ Internal
- ☐ GTN 6XX/7XX Series
- ☐ GNS 400W/500W Series
- ☐ GNS 480
- ☐ GIA 63W
- ☐ GDL 88 (GTX 330 only)

GPS #2 (if installed)

- ☐ Internal
- ☐ GTN 6XX/7XX Series
- ☐ GNS 400W/500W Series
- ☐ GNS 480
- ☐ GIA 63W
- ☐ GDL 88 (GTX 330 only)

Interfaced Pressure Altitude Source:

Pressure Altitude Source #1

- ☐ _____
- ☐ Garmin Altitude Encoder

Pressure Altitude Source #2 (if installed)

- ☐ _____
- ☐ Garmin Altitude Encoder

Interfaced Remote Control Display (Required for remotely mounted GTX variants):

Transponder #1 Remote Control Display

- ☐ GTN 6XX/7XX
- ☐ GNS 480
- ☐ G950/1000 Display
- ☐ Gables 7534 Controller

Transponder #2 Remote Control Display (if installed)

- ☐ GTN 6XX/7XX
- ☐ GNS 480
- ☐ G950/1000 Display
- ☐ Gables 7534 Controller

Interfaced Active Traffic System:

- ☐ None
- ☐ TCAD
- ☐ TAS/TCAS

NOTE

If the system includes all of the following components:

- GTX 345R,
- G950/1000 Display, and
- TCAD or TAS/TCAS

Then the aircraft is no longer equipped with a TSO compliant active TCAD, TAS or TCAS system. Any operational requirement to be equipped with such system is no longer met.

1.5 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

TIS: Traffic Information Service

TX: Transmit

Section 2. LIMITATIONS

2.1 Minimum Equipment

The GTX 33X and GTX 3X5 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
Uncorrected Pressure Altitude Source	1	1
GPS SBAS Position Source	1 or more	1
Remote Control Display (for remotely mounted transponders)	1 or more	1

Table 2 – Required Equipment

2.2 ADS-B Out

The GTX 33X and GTX 3X5 only comply 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 remote control display interface, or the GTX 330 or GTX 3X5 panel display. If a Gables 7534 controller is being used the ADS-B equipment failure condition will be annunciated on the Gables display “Transponder Fail” while the ADS-B Out Position failure will be annunciated by the remotely installed “ADS-B POSN FAIL” Annunciator.

2.3 TIS Traffic Display with User Navigation Angle

Display of TIS traffic from a GTX 33/330 or GTX 335 is not permitted with an interfacing display configured for a navigation angle of “user”.

2.4 **Applicable System Software**

This AFMS/AFM is applicable to the software versions shown in Table 3.

The Main GTX software version is displayed on the splash screen during start up for the GTX 330 and GTX 3X5 panel mounted units, and the External LRU or System page on the interfaced remote control display for remotely mounted GTX transponders.

Software Item	Software Version <i>(or later FAA Approved versions for this STC)</i>
GTX 33X Main SW Version	8.04
GTX 3X5 Main SW Version	2.12

Table 3 - Software Versions

2.5 **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. PABI is enabled by selecting the GTX to ON mode.

2.6 **Datalinked Weather Display (GTX 345 Only)**

Do not use datalink weather information for maneuvering in, near, or around areas of hazardous weather. Information provided by datalink weather products may not accurately depict current weather conditions.

Do not use the indicated datalink weather product age to determine the age of the weather information shown by the datalink weather product. Due to time delays inherent in gathering and processing weather data for datalink transmission, the weather information shown by the datalink weather product may be significantly older than the indicated weather product age.

Do not rely solely upon datalink services to provide Temporary Flight Restriction (TFR) or Notice to Airmen (NOTAM) information.

2.7 **Portable Electronic Devices**

This STC does not relieve the operator from complying with the requirements of 91.21 or any other operational regulation regarding portable electronic devices.

Section 3. EMERGENCY PROCEDURES

3.1 Emergency Procedures

No Change.

3.2 Abnormal Procedures

3.2.1 LOSS OF AIRCRAFT ELECTRICAL POWER GENERATION

XPDR Circuit Breaker **PULL**

Transponder and ADS-B Out functions 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.

3.2.2 LOSS OF GPS/SBAS POSITION 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 3X5 installations:

NO 1090ES TX annunciator illuminated:

Interfaced GPS position sources **VERIFY VALID POSITION**

For GTX 33 and GTX 3X5R 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 panel mounted GTX 330 or GTX 3X5 transponders. Cockpit Reference Guides and Pilot Guides for interfaced remote control 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 and GTX 3X5 Series Transponder Pilot’s Guide.

4.1 Unit Power On

For GTX 330 installations:

GTX Mode **VERIFY ALT**
NO ADSB **CONSIDERED**

For GTX 3X5 installations:

GTX Mode **VERIFY ALT**
NO 1090ES TX **CONSIDERED**

NOTE

The NO ADS-B or NO 1090ES TX 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

For GTX 330 installations:

ADS-B TX..... **VERIFY ON**
NO ADSB..... **EXTINGUISHED**

For GTX 3X5 installations:

1090ES TX CTL..... **VERIFY ON**
NO 1090ES TX **EXTINGUISHED**

NOTE

The ADS-B TX or 1090ES TX CTL must be turned on and the NO ADS-B or NO 1090ES TX 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 in certain airspace 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. SYSTEM DESCRIPTION

The Garmin GTX 330 and GTX 3X5 Pilot’s Guides, part numbers, and revisions listed below contain additional information regarding GTX system description, control, and function.

<u>Title</u>	<u>Part Number</u>	<u>Revision</u>
GTX 330 Pilot’s Guide	190-00207-00	Rev. G (or later)
GTX 3X5 Pilot’s Guide	190-01499-00	Rev. A (or later)

Pilot’s Guides for interfaced displays, part numbers and revisions listed below, provide additional operating information for the Garmin GTX 33 and GTX 3X5R.

<u>Title</u>	<u>Part Number</u>	<u>Revision</u>
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)
GNS 480 Pilot’s Guide	190-00502-00	Rev. D (or later)
GTX 3X5 Series Transponder G1000 Pilot’s Guide	190-01499-01	Rev. A (or later)

7.1 GTX TIS Behavior

The TIS Standby/Operate controls for GTX 33/330 and GTX 335 units only function when the aircraft is airborne.

7.2 GTX 345R and G950/1000 No Bearing Traffic Alerts

No visual indication is provided for no bearing traffic alerts. Only an aural indication of the no bearing traffic alert is provided. If an aural alert for no bearing traffic has been previously issued, a “no bearing traffic clear” aural indication will be provided once all traffic alerts are resolved.

All aural alerts are inhibited below 500’ AGL, therefore a “no bearing traffic clear” aural may not be heard in a landing or touch and go flight scenario.

SUPPLEMENT 2

GARMIN AUDIO PANEL (GMA 340)

GENERAL DESCRIPTION: Modification PAC/XL/0014

Modification PAC/XL/0014 installs a Garmin GMA audio panel in the airplane.

SECTION 1

GENERAL

The Garmin GMA 340 is a panel mounted audio panel.



KEY FUNCTIONALITY

The GMA 340 has a number of keys which control the following functions:

PILOT

Rotation of the smaller inner knob turns the unit ON/OFF and adjusts the pilot's Intercom System (ICS) volume. The unit is turned off by rotating the knob fully counter clockwise into the detent. To turn the unit on, rotate the knob clockwise past the click. To increase the volume rotate the knob clockwise and to decrease the volume rotate the knob counter clockwise. A fail-safe circuit

connects the pilot's headset and microphone directly to COM 1 in case power is interrupted or the unit is turned off.

The larger outer knob controls the pilot's Voice Activated Intercom Squelch level. Rotating the knob clockwise increases the amount of microphone Voice Activated (VOX) required to break squelch. Full counter clockwise rotation of the knob is the "HOT MIC" position (no squelch).

COPILOT

Rotation of the small inner knob controls the copilot and passenger ICS. To adjust the volume on the copilot's ICS ensure the knob is pushed in. To increase the volume rotate the knob clockwise and to decrease the volume rotate the knob counter clockwise. To adjust the passenger ICS volume pull the knob out. To increase the volume rotate the knob clockwise and to decrease the volume rotate the knob counter clockwise.

The larger outer knob controls the copilot's and passenger's VOX squelch level. Rotating the knob clockwise increases the amount of microphone Voice Activated (VOX) required to break squelch. Full counter clockwise rotation of the knob is the "HOT MIC" position (no squelch).

MKR MUTE

The marker beacon audio is initially selected by pressing the "MKR/MUTE" button. If no marker beacon signal is received, then a second button press will deselect the marker audio. If the second button press occurs while a marker beacon signal is received, then the marker audio is muted but not deselected. The button's LED will remain lit to indicate that the source is still selected. When the current marker is no longer received, the audio is automatically un-muted. While in the muted state, pressing the "MKR/MUTE" button deselects the marker audio. The button's LED will extinguish to indicate that the marker audio is no longer selected.

SENS

This button selects either high or low sensitivity as indicated by the "HI" or "LO" LED being lit. Low sensitivity is used on ILS approaches while high sensitivity allows operation over airway markers or to get earlier indication of nearing the outer marker during an approach.

NOTE

The marker beacon audio level is aligned at the factory to produce its rated audio output.

AOM

The Airways (A), Outer (O) and Middle (M) marker beacon lamps operate independently of any audio selection and cannot be turned off.

NOTE

The lamp and audio keying for ILS approach operation are summarized below.

Audio Frequency	Audio Keying	Lamp Actuated
400	- - - - -	Blue (Outer)
1300	●-●-●-●-●	Amber (Middle)
3000	●●●●●●●	White (Airway/Inner)

COM 1/2/3 MIC

Selection of “COM 1”, “COM 2” or “COM 3” for both MIC and audio source is accomplished by pressing either “COM 1 MIC”, “COM 2 MIC” or “COM 3 MIC” transmitter (Audio/Mic) selection buttons. The active COM audio is always heard on the headphones.

When a microphone is keyed, the active transceiver’s MIC button LED blinks approximately once per second to indicate that the radio is transmitting.

Audio level is controlled by the volume control on the selected radio unit volume control.

COM 1/2/3

Pressing the “COM 1”, “COM 2” and “COM 3” button allows the audio on the associated radio to be heard. When selected this way, they remain active as audio sources regardless of which transceiver has been selected for microphone use.

COM1/2

Pressing the “COM1/2” button activates the split COM function, if fitted. When this mode is active, COM 1 is dedicated solely to the pilot for MIC/audio while COM 2 is dedicated to the copilot for MIC/audio. The pilot and copilot can simultaneously transmit in this mode over separate radios. Both pilots can still listen to COM 3, NAV1, NAV2, DME, ADF and MKR as selected. The split COM mode is cancelled by pressing the “COM ½” button a second time.

When in the split COM mode the copilot may make PA announcements while the pilot continues using COM1 independently. When the PA button is pressed after the split com mode is activated, the copilots mic is output over

the cabin speaker when keyed. A second press of the “PA” button returns the copilot to normal split COM operation.

- NAV1/2, ADF, DME** Pressing “NAV”, “NAV2”, “ADF” and “DME” selects the audio source for the associated navigation unit. A second press deselects the audio. Audio level is controlled by the volume control on the selected navigation radio unit volume control.
- SPKR** Pressing “SPKR” selects the aircraft radios over the cabin speaker, if fitted. The speaker output is muted when a COM microphone is keyed. Adjustment of the GMA 340 speaker output level is completed by the installing agency.
- PA** The PA mode is activated by pressing the “PA” button. Then, when either the pilot’s or copilot’s microphone is keyed, the corresponding mic audio is heard over the cabin speaker, if fitted. If the “SPKR” button is also active, then any selected audio is muted while the microphone is keyed. The “SPKR” button does not have to be previously active in order to use the PA function. Pilot and copilot microphone speaker levels are adjustable by the installing agency.
- TEST** Pressing the TEST button allows the function of the annunciator lights to be checked. All lights should illuminate when the TEST button is pressed.

NOTE

Technical assistance should be sought if an annunciator light fails to illuminate.

- ICS ISOLATION** The GMA 340 provides three intercom modes: PILOT, CREW and ALL. Mode selections accomplished using the “PILOT” and/or “CREW” buttons. Pressing a mode button activates the corresponding ICS mode. Pressing again deactivates the mode. The ALL mode is active when neither PILOT nor CREW LEDs are lit. To switch from PILOT to CREW mode press the “CREW” button; from “CREW” to “PILOT” press the “PILOT” button. An LED ON indicates the isolation is active.

Pushing the “PILOT” button isolates the pilot from everyone else and dedicates the aircraft radios to the pilot exclusively. The copilot and passengers share communications between themselves but cannot communicate with the pilot or hear the aircraft radios.

Pushing the “CREW” button places the pilot and copilot on a common ICS communication channel with the aircraft radios. The passengers are on their own intercom channel and can communicate with each other, but cannot communicate with the crew or hear the aircraft radios.

With neither the “PILOT” or “CREW” button selected the pilot, copilot and passengers are able to communicate with one another on the ICS and listen to all radios.

MUSIC1 and MUSIC2 stereo entertainment inputs are affected by the intercom mode selection.

MODE	PILOT HEARS	COPILOT HEARS	PASSENGER HEARS	MUSIC MUTING TRIGGERED BY	1
PILOT (LED LIT)	Selected Radios. Pilot.	Copilot. Passengers. MUSIC1.	Passengers. Copilot. MUSIC1.	Copilot or passenger intercom activity.	
CREW (LED LIT)	Selected Radios. Pilot. Copilot. MUSIC1	Selected Radios. Copilot. Pilot. MUSIC1.	Passengers. MUSIC2.	Aircraft radio activity. MKR activity. Pilot or copilot activity.	
ALL (LEDS OFF)	Selected Radios. Pilot. Copilot. Passengers MUSIC1	Selected Radios. Pilot. Copilot. Passengers MUSIC1	Selected Radios. Pilot. Copilot. Passengers MUSIC1	Aircraft radio activity. MKR activity. Intercom activity	

LIGHTING

LED button enunciator and marker beacon lamp intensity are controlled automatically by built-in photocell on the front panel. Nomenclature backlighting is controlled by the aircraft dimmer bus.

AUXILLARY ENTERTAINMENT INPUTS

The GMA 340 provides two stereo entertainment inputs: MUSIC1 and MUSIC2. MUSIC1 is soft muted during all aircraft radio activity and normally during ICS activity. MUSIC2 is a non muted input. These inputs are compatible with popular portable equipment devices such as cassette tape or CD players. The headphone outputs of these devices are used and plugged into MUSIC1or MUSIC2. Two 3.5mm stereo phone

jacks should be installed in a convenient location for this purpose. MUSIC1 and MUSIC2 have characteristics that are affected by the active intercom mode.

SECTION 2

LIMITATIONS

There is no change to the airplane limitations when the Garmin GMA 340 Audio Panel is installed.

SECTION 3

EMERGENCY PROCEDURES

There is no change to the airplane emergency procedures when the Garmin GMA 340 Audio Panel is fitted.

SECTION 4

NORMAL PROCEDURES

AUDIO PANEL OPERATIONS

- | | |
|--------------------------|--|
| 1. PILOT Selector Knob | ROTATE smaller knob to turn unit on |
| 2. TEST Button | PRESS to verify all lights operational |
| 3. COM/MIC Button | PUSH required transceiver button (COM 1 MIC, COM 2 MIC OR COM 3 MIC) |
| 4. COM Button | PRESS required audio selector buttons. |
| 5. PILOT Selector Knob | Rotate smaller knob to adjust Intercom System volume |
| 6. COPILOT Selector Knob | Rotate smaller knob to adjust Intercom System volume |
| 7 PILOT Selector Knob | ROTATE larger knob to adjust Voice Activated Intercom Squelch level. |

- | | |
|--------------------------|--|
| 8. COPILOT Selector Knob | ROTATE larger knob to adjust Voice Activated Intercom Squelch level. |
|--------------------------|--|

NOTE

When the microphone is keyed the active transceiver's MIC button LED blinks approximately once per second to indicate that the radio is transmitting.

MARKER BEACON OPERATIONS

- | | |
|------------------------|--|
| 1. PILOT Selector Knob | ROTATE smaller knob to turn unit on |
| 2. TEST Button | PRESS to verify all lights operational |
| 3. SENS Button | PRESS to select HI or LO sensitivity. |
| 4. MKR/Mute Button | PRESS to select required marker audio. |

SECTION 5

PERFORMANCE

There is no change to the airplane performance when the Garmin GMA 340 audio panel is fitted in the instrument panel.



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CONTROL # 143/1989/16

FAA APPROVED
AIRPLANE FLIGHT MANUAL SUPPLEMENT
or
SUPPLEMENTAL AIRPLANE FLIGHT MANUAL
for the
ASPEN AVIONICS EVOLUTION FLIGHT DISPLAY SYSTEM
EFD1000 PRIMARY FLIGHT DISPLAY
Optionally with
EFD1000 AND/OR EFD500 MULTI-FUNCTION DISPLAYS
or
Aspen Evolution Backup Display

The information contained in this Supplement must be attached to the FAA Approved Airplane Flight Manual or placed with the Pilot's Operating Handbook or other operating information when the Aspen EFD1000 PFD and optionally the Aspen EFD1000 MFD and/or EFD500 MFD are installed in accordance with AML STC SA10822SC. This document must be carried in the aircraft at all times.

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

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

Airplane Make: CESSNA
Airplane Model: 172M
Airplane Registration Number: N1840V / N22905
Airplane Serial Number: 17263767 / 17264078

FAA APPROVED By: 
Manager, Aircraft Certification Office
Fort Worth, Texas

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DOCUMENT REVISIONS FAA APPROVED PAGES

Document Revision	FAA Approved Pages Revised	Description of Change	FAA Approval Date	ECO
Earlier revisions are on file				
W	All	Complete Rewrite, added ADS-B integration	2/20/2015	4258
Y	All	Updated based on FAA comments. Added AOA Functionality.	None	4502
Z	All	Addressed FAA Comments.	17JUL2015	4525
AA	All	Removed references to Pilot Guides from the Limitations Section and added references to the Pilot Guides in the Systems Description section. Updated Copyright to 2016. Added the EBD Model. Added GDL 88 integration information.	None	4712
AB	All	Added caution into Sections 7.9 & 7.11.	31 March 2016	4732
AC	All	Added S-TEC 55X integration to the Installed Equipment List Table and clarified some entries to correspond with the Installation Manual. Added S-TEC 55X integration and new FIS-B annunciations to the Warnings, Cautions and Advisories table and clarified some entries to correspond with the Installation Manual. Updated Pilot Guide revisions, added reference to the VFR PFD Pilot's Guide.	9/26/16	4821
AD	All	Added GTX 345 integration information	12/8/2016 (AFMS/SAFM DATED 18 November 2016)	4964
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1 General

1.1 System Overview

The Evolution Flight Display System consists of one or more integrated Electronic Flight Display (EFD1000 or EFD500) systems. The EFD1000 system can be configured as a primary flight display (PFD) or as a multi-function display (MFD) and the EFD500 system can only be configured as a MFD.

When the EFD1000 is configured as a PFD, the EFD1000 provides display of attitude, airspeed, altitude, vertical speed, turn rate, slip/skid and direction of flight. Depending on the optional equipment connected to the EFD1000 and the PFD version, the system can also provide display of lateral and vertical navigation deviations, flight director commands, synthetic vision, weather information, traffic information, and several other features. The following PFD versions are supported on the EFD1000: PFD PRO, PFD PRO C3, PFD VFR, PFD PILOT, PFD EBD Advanced and PFD EBD Basic.

When the EFD1000 is configured as an MFD, the EFD1000 provides navigation and weather information, terrain and obstacle data, and traffic information that can be displayed on a moving map. The EFD1000 MFD also provides PFD reversion capability, synthetic vision, terminal procedure charts, a secondary display of attitude, airspeed, and altitude, and several other features depending on the optional equipment that is connected to the EFD1000.

The EFD500 MFD provides all of the features of the EFD1000 MFD except for PFD reversion capability and a secondary display of attitude, airspeed and altitude.

1.2 Installed Equipment List

Table 1 shows the list of Aspen Equipment installed in this aircraft. Use the table to determine the parts of the AFMS that are applicable to this aircraft.

Table 1 - Installed Equipment List

Installed Equipment	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD1000 PFD PRO C3	EFD1000 PFD PILOT -or- EFD1000 PFD EBD Basic	EFD1000 PFD VFR	EFD1000 MFD	EFD500 MFD	Remarks
N/A = Not Available							
Evolution Flight Display System with Internal Battery Software Version (MAP \ IOP)							
Evolution Flight Display System with Emergency Backup Battery (EBB) Software Version (MAP \ IOP)		N/A		N/A		N/A	
RSM with GPS						N/A	
RSM without GPS						N/A	
Angle of Attack (AOA) System		N/A					

Installed Equipment	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD1000 PFD PRO C3	EFD1000 PFD PILOT -or- EFD1000 PFD EBD Basic	EFD1000 PFD VFR	EFD1000 MFD	EFD500 MFD	Remarks
ADS-B OUT integrated with the Aspen PFD		N/A	N/A		N/A	N/A	ADS-B OUT Make and Model:
ADS-B IN Traffic Interface without TCAS 1 or TAS incorporated		N/A	N/A				ADS-B IN Traffic Interface Make and Model:
Conflict Situational Awareness- traffic alerting (CSA)		N/A	N/A				GDL 88 or GTX 345 integration only
ADS-B IN Traffic Interface with TCAS I incorporated		N/A	N/A				ADS-B IN Traffic Interface Make and Model:
ADS-B IN Traffic Interface with TAS incorporated		N/A	N/A				ADS-B IN Traffic Interface Make and Model:
TCAS I Traffic Interface			N/A				
TAS Traffic Interface			N/A				
TIS-A Traffic Interface			N/A				
XM Datalink Weather Interface (EWR50)		N/A	N/A				
ADS-B IN (FIS-B) Weather Interface		N/A	N/A				ADS-B IN (FIS-B) Weather Interface Make and Model:
L3 Stormscope® Interface (STRK)		N/A	N/A				
Terminal Procedure Charts	N/A	N/A	N/A	N/A			Requires a database.
MFD NAV Map	N/A	N/A	N/A	N/A	√	√	Requires a database.
EA100 Autopilot AHRS Software Version			N/A			N/A	
Evolution Synthetic Vision and the Aspen Terrain Warning System (TWS)		N/A	N/A	N/A			Requires a database.
10-Hour Evolution Synthetic Vision Demo and the Aspen Terrain Warning System (TWS)		N/A	N/A	N/A	N/A	N/A	Only enabled for a trial period. Acknowledgment page shows the status of the trial period. Requires a database.
Audible alerts for the Aspen Terrain Warning System (TWS)			N/A	N/A	N/A	N/A	Audible alerts are only available if TAWS is not installed.
Aspen Connected Gateway (CG100) Software Version	N/A	N/A	N/A	N/A			Not authorized for EASA-registered aircraft.

Installed Equipment	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD1000 PFD PRO C3	EFD1000 PFD PILOT -or- EFD1000 PFD EBD Basic	EFD1000 PFD VFR	EFD1000 MFD	EFD500 MFD	Remarks
Radar Altitude Numeric Display Input			N/A	N/A		N/A	
Radar Altitude Decision Height Input			N/A	N/A		N/A	
ADF1 Interface			N/A	N/A		N/A	
ADF2 Interface			N/A	N/A		N/A	
VHF1 (VLOC1) Navigation Radio Interface			N/A			N/A	
VHF2 (VLOC2) Navigation Radio Interface			N/A			N/A	
GPS1 Interface							GPS Make and Model:
GPS2 Interface			N/A				GPS Make and Model:
Avionik Straubing APS4A Altitude Pre-selector Function			N/A		N/A	N/A	Not available on the EFD1000 PFD EBD Advanced
A/P Source Select			N/A	N/A		N/A	Not available on the EFD1000 PFD EBD Advanced
Autopilot Mode Annunciations Altitude Preselect and Vertical Speed Control for the S-TEC 55X autopilot with Flight Director		N/A	N/A	N/A		N/A	Available on the EFD1000 MFD in reversion with A/P Source Select installed. Not available on the EFD1000 PFD EBD Advanced
Autopilot Mode Annunciations Altitude Preselect and Vertical Speed Control for the S-TEC 55X autopilot with no Flight Director		N/A	N/A	N/A		N/A	Available on the EFD1000 MFD in reversion with A/P Source Select installed. Not available on the EFD1000 PFD EBD Advanced

Table 2 is used to identify the backup equipment applicable to this aircraft's installation. This table is completed during installation by the installation facility.

Table 2 - Backup Instruments Configuration for the PFD PRO, PFD PRO C3, PFD PILOT or PFD VFR

Model of backup Attitude Indicator in this aircraft:	
Type of Standby Airspeed Indicator in this aircraft: (EFD1000 MFD with EBB or Mechanical Airspeed indicator) *	
Type of Standby Altimeter in this aircraft: (EFD1000 MFD with EBB or Mechanical Altimeter) *	

*An EFD1000 MFD connected to an EBB is required unless a standby mechanical Airspeed indicator and standby Altimeter are installed.

1.3 List of Acronyms and Abbreviations

A.....	Alert
A/P	Autopilot
ACU	Analog Converter Unit
ADAHRS	Air Data Attitude Heading Reference System
ADF	Automatic Direction Finder
ADS-B	Automatic Dependent Surveillance- Broadcast
AHRS	Attitude Heading Reference System
AFM	Airplane Flight Manual
AFMS	Airplane Flight Manual Supplement
AGL	Above Ground Level
AIR	AIRMET
AIRMET	Airmen's Meteorological Information
AML.....	Approved Model List
AMMD	Aerodrome Moving Map Display
ANT	Antenna
AOA	Angle of Attack
APPR	Approach
ASPEN GTWY	See GTWY
BARO	Barometric Pressure Setting
BAT	Battery
C.....	Caution
C3	Class III
CG100	Connected Gateway remote LRU
CHG	Change
CM	Configuration Module
CNUS.....	Continental United States
Config.....	Configuration
CSA.....	Conflict Situational Awareness -traffic alerting
CTL	Control
CWS.....	(autopilot) Control Wheel Steering
DH.....	Decision Height
DISC	Disconnect
EA	Evolution Adapter
EASA	European Aviation Safety Agency
EBB.....	Emergency Backup Battery
EBD.....	Evolution Backup Display
ECO	Engineering Change Order
EFB	Electronic Flight Bag
EFD.....	Evolution Flight Display
EFIS	Electronic Flight Instrument System
EMER.....	Emergency
EOC	Executable Object Code
ESV	Evolution Synthetic Vision
EWR.....	Evolution Weather Receiver
EXT PWR.....	External Power
FAA	Federal Aviation Administration
FIS-B.....	Flight Information Service- Broadcast
FPL	Flight Plan
FPM	Flight Path Marker
Ft.....	Fort
FOV.....	Field of View
GEO-REFERENCED	Chart scaling that permits ownship depiction
GTWY	Aspen Connected Gateway, including the CG100
GPS	Global Positioning System
GPSS	GPS Steering

HDG	Heading
HORZ	Horizontal
HSI	Horizontal Situation Indicator
IAS	Indicated Airspeed
ID	Identification
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
Inc.	Incorporated
INIT	Initialization
INTEG	Integrity
IOP	Input-Output Processor
JSUM	Jeppesen Services Update Manager
KIAS	Knots Indicated Airspeed
KOEL	Kinds of Operations Equipment List
L3	L3 Communications
LRU	Line replaceable Unit
LTNG	Lightning
LOC	Localizer
MAP	Main Application Processor
MEMS	Micro Electromechanical Systems
MFD	Multi-Function Display
MIC	Microphone
MIN	Minimums
MSG	Message
N/A	Not Applicable
NACO	National Aeronautical Charting Office
NAV	Navigation
NAVAIDS	Navigational Aids
NE	Northeast
NEXRAD	Next Generation Radar
NM	New Mexico
NORM	Normal
NOTAM	Notices To Airmen
NXRD	NEXRAD
OAT	Outside Air Temperature
PFD	Primary Flight Display
POM	Pitot Obstruction Monitor
POS	Position
PRESEL	Altitude Preselect
RA	Radar Altitude
REV	Reversion
RGNL	Regional
RMVD	Removed
RSM	Remote Sensor Module
SAI	Secondary Attitude Indicator
SDHC	Secure Digital, High-Capacity
SHSI	Secondary Horizontal Situation Indicator
SID	Standard Instrument Departure
SIG	SIGMET
SIGMET	Significant Meteorological Information
STAR	Standard Terminal Arrival Route
STC	Supplemental Type Certificate
STRK	Strikes (Stormscope)
SV	Synthetic Vision
TAS	True Airspeed
TAS	Traffic Advisory System
TCAS	Traffic and Collision Avoidance System

TERR	Terrain
TFR	Temporary Flight Restriction
TIS	Traffic Information System
TWS	Terrain Warning System
TFC	Traffic
TFCA	Traffic altitude filter "Above"
TFCB	Traffic altitude filter "Below"
TFCN	Traffic altitude filter "Normal"
TFCU	Traffic altitude filter "Unrestricted"
TRFC	Traffic
UAT	Universal Access Transceiver
UNAV	Unavailable
V	Volts
VECT	Vector
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VOR	VHF Omni-directional Radio Range
VLOC	VOR / Localizer
W	Warning
WPT	Waypoint
XFILL	Cross fill
XM	XM Satellite-based weather information

2 Limitations

The following limitations pertain to the installed equipment in the aircraft. See Table 1 for the list of installed equipment in this aircraft.

2.1 Kinds of Operation for the PFD PRO, PFD PRO C3, PFD PILOT or PFD VFR

This is a list of installed Aspen equipment that affects flight operations. This list does not preclude any approved Minimum Equipment List or other equipment required by regulation.

See the aircraft placard located on the flight deck to determine if this aircraft is authorized for Day, Night, VFR or IFR.

At minimum, one vertical column of equipment must be operational for flight. See Table 1 for the equipment installed in this aircraft:

Example: There is a placard in clear view of the pilot that specifies the kind of operations to which the operation of the airplane is limited or from which it is prohibited. If the placard shows authorization for IFR and the aircraft has an operational EFD1000 PFD and EFD1000 MFD, Magnetic Compass, Standby Altimeter, Standby Airspeed Indicator and IFR GPS (Configuration 2), and the aircraft has all the other equipment and certifications required by regulation, the aircraft is qualified for IFR flight.

Table 3 - Minimum Equipment Required for a Flight Operation

	Day VFR	Day/ Night VFR	Day/ Night VFR	IFR Config. 1	IFR Config. 2	IFR Config. 3
EFD1000 PFD (includes PRO, VFR or PILOT)	✓	✓		✓	✓	✓
EFD1000 MFD with EBB		✓		✓		
EFD1000 MFD with Internal Battery					✓	
Magnetic Compass	✓	✓	✓	✓	✓	✓
Standby Attitude Indicator				✓	✓	✓
Standby Airspeed Indicator			✓		✓	✓
Standby Altimeter			✓		✓	✓
IFR Approved GPS				✓	✓	

2.2 EFD1000 PFD System Limitations

- The moving map display is not a substitute for approved maps or charts required by the operating rules.
- For the Evolution **Synthetic Vision** option, the following limitations apply:
 - Maneuvering based solely on the EFD1000 terrain and obstacle depiction is not authorized.
 - Obstacles on the Synthetic Vision display can be concealed by overlaid indicators such as AOA.
 - Navigation or maneuvering based solely on the EFD1000 Synthetic Vision background display and associated Terrain Warning System (TWS) is not authorized.
 - Barometric pressure must be set accurately for proper operation.

- e. Cold temperatures affect the accuracy of the SV system.
3. For the **Traffic and Weather** options, the following limitations apply:
 - a. Maneuvering based solely on the traffic display is not authorized.
 - b. XM Weather information shown on the EFD1000 PFD is supplemental to data available from official sources.
 - c. NEXRAD data is limited to the contiguous United States.
 - d. FIS-B information is to be used for pilot planning decisions and pilot near-term decisions focused on avoiding areas of inclement weather that are beyond visual range or where poor visibility precludes visual acquisition of inclement weather.
 - e. FIS-B information, including, weather information, NOTAMs, and TFR areas, are intended for the sole purpose of assisting in long- and near-term planning decision making. The system lacks sufficient resolution and updating capability necessary for aerial maneuvering associated with immediate decisions.
4. For **IFR operations** (if this aircraft is authorized for IFR operations) the following limitations apply. See the aircraft placard located on the flight deck to determine if this aircraft is authorized for Day/Night/VFR or IFR.
 - a. Use of the EFD1000 for IFR operations in the region within 750 nautical miles of the magnetic North or South Pole, based solely upon the attitude and heading data provided by the EFD1000, is NOT AUTHORIZED.
 - b. For seaplane operation, if the ADAHRS is unable to align due to wave action, departure under IMC or IFR is PROHIBITED.
 - c. Takeoff with aircraft voltage (as indicated on the EFD) below 12.3V (14V electrical system) or 24.6V (28V electrical system) is NOT AUTHORIZED.
5. The RSM GPS is limited to EMERGENCY USE ONLY.
6. Barometric pressure must be set accurately for proper terrain depiction.
7. Cold temperatures affect the accuracy of the terrain depiction.
8. For the **EFD1000 PFD VFR**, flying coupled approaches with vertical guidance based solely on the EFD1000 PFD VFR is not authorized. The EFD1000 PFD VFR does not display vertical deviations for the pilot to monitor glide path performance.
9. For the **AOA SYSTEM**, the following limitations apply:
 - a. The AOA system is non-required and is to be used only as supplemental information to show the stall margin and trend toward stall. The AOA system is not a substitute for the certified aircraft stall warning system.
 - b. Airspeed failure or erroneous airspeed will result in erroneous AOA indications.
 - c. No operational credit may be taken for such items as reduced approach speed and shorter landing distances.
 - d. The AOA indications are not to be used for takeoff reference.
 - e. The AOA indications are not valid when the wings or empennage are frost or ice-contaminated.
 - f. The AOA indications are not valid when spoilers or speed brakes are deployed.
10. When the **EFD1000 PFD EBD Advanced or EFD1000 PFD EBD Basic** is required for operation, the following limitations apply:
 - a. When the EBB charge status is less than 80% or has failed, takeoff is NOT AUTHORIZED.

- b. When the cabin temperature is below -20°C, takeoff is NOT AUTHORIZED.
- c. When the “ON BAT” annunciation is shown on any EFD display, takeoff is NOT AUTHORIZED.
- d. Barometric pressure must be set on the EBD.

2.3 EFD1000 and EFD500 MFD System Limitations

1. Maneuvering based solely on the EFD1000 terrain and obstacle depiction is not authorized.
2. For the Evolution **Synthetic Vision** option, the following limitations apply:
 - a. Obstacles on the Synthetic Vision display can be concealed by overlaid indicators such as AOA.
 - b. Navigation or maneuvering based solely on the EFD1000 or MFD500 Synthetic Vision background display and associated Terrain Warning System (TWS) is not authorized.
 - c. Barometric pressure must be set accurately for proper operation.
 - d. Cold temperatures affect the accuracy of the SV system.
3. The moving map displays are not a substitute for approved maps or charts required by the operating rules.
4. The RSM GPS is limited to EMERGENCY USE ONLY.
5. Barometric pressure must be set accurately for proper terrain depiction.
6. Cold temperatures affect the accuracy of the terrain depiction.
7. When the EFD1000 MFD is used as the **backup altimeter and/or airspeed indicator** (see Table 2), the following limitations apply:
 - a. When the EBB charge status is less than 80% or has failed, takeoff is NOT AUTHORIZED.
 - b. When the cabin temperature is below -20°C, takeoff is NOT AUTHORIZED.
 - c. When the “ON BAT” annunciation is shown on any EFD display, takeoff is NOT AUTHORIZED.
8. For **Traffic and Weather** options, the following limitations apply:
 - a. Maneuvering based solely on the traffic display is not authorized.
 - b. XM Weather information is supplemental to data available from official sources.
 - c. NEXRAD data is limited to the contiguous United States.
 - d. FIS-B information is to be used for pilot planning decisions and pilot near-term decisions focused on avoiding areas of inclement weather that are beyond visual range or where poor visibility precludes visual acquisition of inclement weather.
 - e. FIS-B information, including, weather information, NOTAMs, and TFR areas, are intended for the sole purpose of assisting in long- and near-term planning decision making. The system lacks sufficient resolution and updating capability necessary for aerial maneuvering associated with immediate decisions.
9. For the **Terminal Procedure Charts** option, the following limitations apply:
 - a. The aircraft ownship position presented on the Airport Diagrams and Terminal Procedures charts may be inaccurate – reference to ownship position for navigation or maneuvering is prohibited.
 - b. Except as provided for by regulation, the Terminal Procedures Charts depictions on the EFD are not substitutes for aeronautical charts required to be carried aboard the

aircraft. This function does not replace any system or equipment required by the regulations.

10. For the **Aspen CG100 Connected Gateway (CG100)** option, the following limitations apply:
 - a. The Flight Plan Review Map is not to be used for navigation.
 - b. The pilot must verify that the flight plan as shown on the MFD is correct and authorized before sending the flight plan to the navigator(s).
 - c. The Aspen GTWY and the associated applications on the wireless portable device are only to be used as intended by Aspen Avionics. Any manipulation of the system or unauthorized access is prohibited.
11. For the **AOA SYSTEM**, the following limitations apply:
 - a. The AOA system is non-required and is to be used only as supplemental information to show the stall margin and trend toward stall. The AOA system is not a substitute for the certified aircraft stall warning system.
 - b. Airspeed failure or erroneous airspeed will result in erroneous AOA indications.
 - c. No operational credit may be taken for such items as reduced approach speed and shorter landing distances.
 - d. The AOA indications are not to be used for takeoff reference.
 - e. The AOA indications are not valid when the wings or empennage are frost or ice-contaminated.
 - f. The AOA indications are not valid when spoilers or speed brakes are deployed.

2.4 Placards

1. When the EBB is installed, the following placard must be installed in full view of the pilot:

**EMER BAT DISPATCH LIMIT 80%
SEE EFD AFMS**

2. When the EA100 is installed, the following placard must be installed in full view of the pilot:

A/P AHRS FAIL

3. When the EFD1000 VFR PFD is installed, the following placard must be installed in full view of the pilot:

No Vertical Deviation on PFD

4. During initialization of the EFD1000 MFD and EFD500 MFD, the following electronic placard is displayed if Synthetic Vision and instrument procedure charts are configured:

CAUTION:

Synthetic Vision information and terrain information are for awareness Only. Do not maneuver based solely on this Information.

The aircraft ownship position presented on Instrument Procedure Charts and Airport Diagrams may be inaccurate - reference to ownship position for navigation or maneuvering is prohibited.

5. During initialization of the EFD1000 PFD, the following electronic placard is displayed if Synthetic Vision is configured:

CAUTION:

Synthetic Vision information and terrain information are for awareness Only. Do not maneuver based solely on this Information.

6. When the Aspen Synthetic Vision Demo is configured and the trial period is not expired, the following electronic placard is displayed:

CAUTION:

Aspen Synthetic Vision Demo
Time Remaining: ## Hours ## Minutes

Synthetic Vision information and Terrain information are for awareness Only. Do not maneuver based solely on this Information.

7. When the Aspen Synthetic Vision Demo is configured and the trial period has expired, the following electronic placard is displayed:

CAUTION:

Aspen Synthetic Vision Demo has Expired
To Re-Enable SV, See your Authorized Dealer

8. During initialization of the EFD1000 PFD and EFD1000/500 MFD, the following electronic placard is displayed if the AOA System is configured:

CAUTION:

The AOA Indicator is not for use as a primary instrument for flight.

3 Emergency/Abnormal Procedures

3.1 Emergency Procedures

No Change to the aircraft procedures.

3.2 Abnormal Procedures

3.2.1 Pitot Tube Icing resulting in Attitude Indicator Failure and Erroneous Airspeed indication

1. PITOT HEAT..... ON
2. AUTOPILOT DISCONNECT
3. ATTITUDE Maintain attitude by reference to standby sources of Attitude
4. Consider Exiting IMC

3.2.2 “ON BAT” Annunciation

The “ON BAT” annunciation is an indication that the alternator or generator has failed.

1. Aircraft Electrical Power Follow AFM Procedures to Restore Power. If unable to restore the alternator or generator, proceed as follows:
2. EFD1000/500 Circuit Breaker / Switch..... Pull / Open (turn off) for each Display
3. Press MENU then turn the Left knob..... Reduce the Display brightness to the lowest practical brightness to conserve battery energy.
4. Exit IMC as soon as practical.

NOTE:

The duration of the internal battery system (at 99% remaining) is less than 30 minutes. The duration of the Emergency Backup Battery (at 99% remaining) is more than 30 minutes.

CAUTION:

When the EFD is operated until its battery is exhausted, the screen may fade to solid white for several seconds before blanking. To avoid this condition at night, manually turn off the EFD once the display shows 0% battery remaining.

3.2.3 EFD1000 MFD reversion to a PFD

1. Autopilot..... DISCONNECT
2. EFD1000 MFD REV Button..... MOMENTARY PRESS to show the Reversionary PFD Display
3. REVERSIONARY PFD Display Select XFILL as desired
4. BARO SETTING Verify
5. A/P Source Select (if installed) MFD
6. AutopilotCONNECT AS DESIRED

NOTE:

The altitude level-off alert tone, altitude deviation alert tone and synthetic vision caution and warning tones are not available on a reversionary PFD

3.2.4 Attitude and Heading (AHRS) Reset

1. AUTOPILOT MANUALLY DISCONNECT
2. MENU Select the first page, titled "GENERAL SETTINGS"
3. "AHRS: RESET?" LINE SELECT KEY PRESS
4. "AHRS: RESET?" LINE SELECT KEY PRESS AGAIN TO CONFIRM RESET

3.2.5 Turn Off the EFD in Flight

EFD1000 MFD (with EBB), EFD1000 PFD EBD Advanced or EFD1000 PFD EBD Basic

1. EFD (Aspen) Circuit Breaker / Switch PULL / OFF
2. EBB Disconnect Switch DISC

EFD1000/500 PFD or MFD with Internal Battery

1. EFD Circuit Breaker / Switch PULL / OFF
2. REV Button Push and hold until the display turns off

3.2.6 Continuous EFD1000 or EFD500 System Reset (does not apply to C3 PFD)

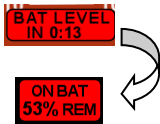
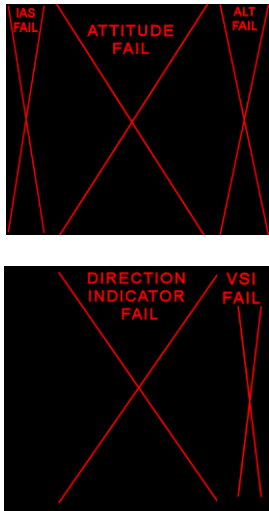
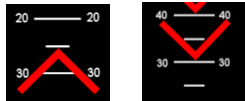
In the event of a condition that causes the system to continually reset, proceed as follows:

1. REMOVE THE DATABASE CARD PERMIT THE SYSTEM TO REINITIALIZE.
If the condition persists, then:
2. TURN OFF THE Aspen GTWY SWITCH. PERMIT THE SYSTEM TO REINITIALIZE.
If the condition persists, then:
3. PULL THE ADS-B
CIRCUIT BREAKER PERMIT THE SYSTEM TO REINITIALIZE
If the condition persists, then:
4. PULL THE XM WEATHER
CIRCUIT BREAKER PERMIT THE SYSTEM TO REINITIALIZE.
If the condition persists, then:
5. PULL THE STORMSCOPE
CIRCUIT BREAKER PERMIT THE SYSTEM TO REINITIALIZE.

3.3 Warnings, Cautions and Advisories

The following table shows the Warning, Caution and Advisory indication on the EFD1000 and EFD500 and identifies the appropriate pilot action. Several Warning, Caution and Advisory messages are dependent on the options and equipment installed in the airplane. Refer to Table 1 to determine the options and equipment installed in this airplane.

Table 4 - Warning, Caution and Advisory Annunciations

Warning	W	Caution	C	Advisory	A						
	Applies to:							Annunciation	Description	Pilot Action	
	EFD1000 PFD PRO C3	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD 1000 VFR	EFD1000 PFD PILOT -or- EBD1000 PFD EBD Basic	EFD 1000 MFD REV	EFD 1000 MFD	EFD 500 MFD				
W	✓	✓	✓	✓	✓	✓	✓		Presented whenever the EFD1000 is operating on the internal battery or EBB. The countdown timer appears first, and is then replaced by the ON BAT and % charge annunciation	Reduce the screen brightness to maximize battery duration. See Section 3.2.2 “ON BAT” Annunciation.	
W	✓	✓	✓	✓	✓	✓			Attitude and Heading indications have failed.	Use standby instruments for attitude reference. Perform AHRS Reset if practical.	
W	✓	✓	✓	✓	✓	✓			Red chevrons displayed on the Attitude Indicator's pitch scale to indicate extreme pitch up and down attitudes.	Pitch the aircraft in the direction of the chevrons to restore level flight.	

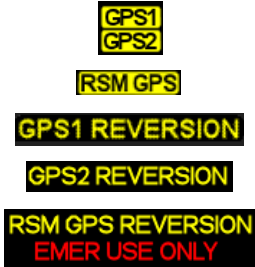
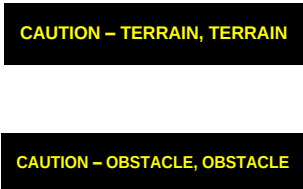
	Applies to:							Annunciation	Description	Pilot Action
	EFD1000 PFD PRO C3	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD 1000 VFR	EFD1000 PFD PILOT -or- EBD1000 PFD EBD Basic	EFD 1000 MFD REV	EFD 1000 MFD	EFD 500 MFD			
W		✓			✓	✓	✓		Synthetic Vision Flight Path marker. Terrain or obstacle conflict within 30 seconds.	Avoid the terrain or obstacle.
W	✓	✓			✓				Radar Altitude Failed	Use alternate means for altitude determination.
W		✓			✓	✓	✓	WARNING – TERRAIN, TERRAIN Or WARNING – OBSTACLE, OBSTACLE	Synthetic Vision system terrain or obstacle conflict within 30 seconds.	Avoid the terrain or obstacle.
W	✓	✓	✓		✓	✓	✓	MAP SW 2.6 and earlier: LTNC : NXRD : TRFC MAP SW 2.7.2 and later: LTNC : NXRD : MAP SW 2.7.2: TRFC MAP SW 2.8 and later: TRFC	XM Weather or Traffic Failure	Use an alternate weather information source Increase vigilance for traffic.

	Applies to:							Annunciation	Description	Pilot Action
	EFD1000 PFD PRO C3	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD 1000 VFR	EFD1000 PFD PILOT -or- EBD1000 PFD EBD Basic	EFD 1000 MFD REV	EFD 1000 MFD	EFD 500 MFD			
W		✓	✓		✓	✓	✓		FIS-B Regional NEXRAD data is not valid	Use an alternate weather information source.
W						✓	✓		FIS-B CONUS NEXRAD data is not valid	Use an alternate weather information source.
W						✓	✓		FIS-B METAR data is not valid	Use an alternate weather information source.
W						✓	✓		FIS-B AIRMET/SIGMET data is not valid.	Use an alternate weather information source.
W						✓	✓		FIS-B wind and temperature data is not valid	Use an alternate weather information source.
W						✓	✓		FIS-B TFR data not received.	Use an alternate weather information source.
W		✓	✓		✓	✓	✓	MAP SW 2.6 and earlier  MAP SW 2.7 and later 	Stormscope (STRK) has failed.	No action. Avoid thunderstorms.
W	✓	✓	✓		✓			 	The navigation source is not available.	Use an alternate navigation source

	Applies to:							Annunciation	Description	Pilot Action
	EFD1000 PFD PRO C3	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD 1000 VFR	EFD1000 PFD PILOT -or- EBD1000 PFD EBD Basic	EFD 1000 MFD REV	EFD 1000 MFD	EFD 500 MFD			
W	✓	✓	✓		✓	✓			The navigation source is not available.	Use an alternate navigation source.
W						✓	✓		The Angle Of Attack System has failed.	No Action- The AOA is unusable.
W		✓	✓	✓	✓				The Angle Of Attack System has failed	No Action – The AOA is unusable. The AOA indication can be removed using the menu.
C								Panel Mounted Indicator Lamp  A/P AHRS Fail or 	The attitude system provided to the autopilot has failed.	Fly manually. The autopilot will disconnect and cannot be re-engaged.
C	✓	✓	✓	✓	✓	✓			Attitude indication could be degraded.	Cross check attitude, airspeed and altitude indications against alternate sources.
C						✓			MFD Attitude failure.	No immediate action. MFD reversion is not available.

	Applies to:							Annunciation	Description	Pilot Action
	EFD1000 PFD PRO C3	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD 1000 VFR	EFD1000 PFD PILOT -or- EBD1000 PFD EBD Basic	EFD 1000 MFD REV	EFD 1000 MFD	EFD 500 MFD			
C						✓		CHECK AHRS	MFD attitude could be degraded.	No immediate action. MFD reversion attitude indicator could be degraded.
C						✓	✓	CROSS LINK FAILURE	No communication between PFD and MFD(s).	Barometric pressure must be set on PFD and MFD.
C						✓	✓	(HDG FAIL)	Failed heading on the MFD	No immediate action. MFD Heading up map orientation is not available, reverts to track-up. Fails Strikes (Stormscope) system.
C	✓	✓	✓	✓	✓	✓		CHECK PITOT HEAT	Possible Pitot Obstruction. Accompanied by Red X attitude and heading.	Use an alternate attitude and heading source. Turn on Pitot Heat to clear the condition if icing is the cause.

	Applies to:							Annunciation	Description	Pilot Action
	EFD1000 PFD PRO C3	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD 1000 VFR	EFD1000 PFD PILOT -or- EBD1000 PFD EBD Basic	EFD 1000 MFD REV	EFD 1000 MFD	EFD 500 MFD			
C		✓			✓			     	(Flashing) Invalid Lateral Navigation Signal on the S-TEC 55X. Corresponds to NAV, APR, GPSS or REV and diagonal FAIL indication on the 55X Programmer/Computer.	According to the S-TEC 55X AFMS.
C		✓			✓			 	(Flashing) Invalid Vertical Navigation Signal on the S-TEC 55X. Corresponds to ALT and GS, and diagonal FAIL indication on the 55X Programmer/Computer.	According to the S-TEC 55X AFMS.
C		✓			✓				S-TEC 55X Trimming Alert. Corresponds to TRIM on the S-TEC 55X Programmer/Computer.	Monitor for runaway trim.
C		✓			✓				No communication from the autopilot. Vertical speed control and altitude preselect are not available on the EFD1000 PFD.	Control the autopilot from the S-TEC 55X Programmer/Computer.

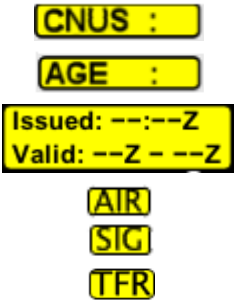
	Applies to:							Annunciation	Description	Pilot Action
	EFD1000 PFD PRO C3	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD 1000 VFR	EFD1000 PFD PILOT -or- EBD1000 PFD EBD Basic	EFD 1000 MFD REV	EFD 1000 MFD	EFD 500 MFD			
C		✓	✓		✓				S-TEC 55X Failure Annunciation.	Disconnect the autopilot and manually fly the airplane.
C	✓	✓	✓	✓	✓	✓	✓		GPS Invalid indications	Select an operational GPS or alternate navigation.
C		✓			✓	✓	✓		Synthetic Vision Flight Path marker. Terrain or obstacle conflict within 45 seconds.	Avoid the terrain or obstacle.
C		✓			✓	✓	✓		Synthetic Vision system terrain or obstacle conflict within 45 seconds.	Avoid the terrain or obstacle.
C						✓	✓		NAV and Terrain Map indication when of all Navigation GPS devices have failed.	No immediate action. NAV and terrain maps no longer move with the aircraft.

	Applies to:							Annunciation	Description	Pilot Action
	EFD1000 PFD PRO C3	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD 1000 VFR	EFD1000 PFD PILOT -or- EBD1000 PFD EBD Basic	EFD 1000 MFD REV	EFD 1000 MFD	EFD 500 MFD			
C	✓	✓	✓	✓	✓	✓			GPS Integrity indication	The GPS in use is degraded. See the applicable GPS AFMS for more information.
C	✓	✓			✓				The aircraft has reached or is below the set MINIMUMS. Accompanied by a one-second stuttered tone when the optional tone generator is installed.	Pilot action is based on the reason the minimums setting was enabled.
C	✓	✓	✓	✓	✓				The aircraft has reached (steady) or deviated from (flashing) the selected altitude. Accompanied by a one-second steady tone when the optional tone generator is installed.	Pilot action is based on the reason the altitude alerting setting was enabled.
C	✓	✓			✓				The optional radar altimeter Decision height input indicates the aircraft is at or below the radar altitude set by the pilot.	Pilot action is based on the reason the DH was set on the radar altimeter.
C	✓	✓	✓		✓				Indicates the GPSS source is invalid (e.g. the flight plan was deleted) or a different GPS was selected by the pilot. The autopilot will fly wings-level until valid GPSS signal is available and GPSS is re-engaged.	No immediate action. Select a new flight plan to permit GPSS re-engagement.

	Applies to:							Annunciation	Description	Pilot Action
	EFD1000 PFD PRO C3	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD 1000 VFR	EFD1000 PFD PILOT -or- EBD1000 PFD EBD Basic	EFD 1000 MFD REV	EFD 1000 MFD	EFD 500 MFD			
C						✓	✓	TERRAIN FAIL	The dedicated terrain display is unusable.	No immediate action.
C		✓			✓	✓	✓	TRAFFIC 	Traffic Alert. TFC is shown instead of TRFC for MAP SW 2.8 and later.	See and avoid the traffic. Press TRFC (lower center button) to display a plan view of the traffic.
C	✓	✓	✓		✓	✓	✓	MAP SW 2.7.2 and earlier: TRFC UNAV MAP SW 2.8 and later: TFC UNAV	TIS-A option: Traffic data is unavailable.	No immediate action. See and avoid traffic.
C	✓	✓	✓		✓	✓	✓	MAP SW 2.7.2 and earlier: TRFC RMVD MAP SW 2.8 and later: TFC RMVD	TIS-A option: Traffic was removed. The PFD does not display the AGE.	No immediate action. See and avoid traffic.
C						✓	✓	MAP SW 2.7.2 and earlier: TRFC FAIL MAP SW 2.8 and later: TFC FAIL	TIS-A option: Traffic sensor failure.	No immediate action. See and avoid traffic.

	Applies to:							Annunciation	Description	Pilot Action
	EFD1000 PFD PRO C3	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD 1000 VFR	EFD1000 PFD PILOT -or- EBD1000 PFD EBD Basic	EFD 1000 MFD REV	EFD 1000 MFD	EFD 500 MFD			
C		✓	✓					UAT LINK	ADS-B OUT: The UAT link between the ADS-B system and the PFD has failed. This message can only be presented when integrated with the Aspen or FreeFlight ADS-B OUT System.	No immediate action.
C		✓	✓					UAT POS	ADS-B OUT: The UAT position source has failed. This message can only be presented when integrated with the Aspen or FreeFlight ADS-B OUT System.	No immediate action.
C		✓	✓					UAT FAIL	ADS-B OUT: The UAT transmitter has failed. This message can only be presented when integrated with the Aspen or FreeFlight ADS-B OUT System.	No immediate action.
C						✓	✓	TFC DEGRADED	No ADS-B Traffic data uplinked from the ground or GDL 88 or GTX 345 is in Standby.	No immediate action. See and avoid traffic.
C		✓	✓		✓	✓	✓	TFC	No ADS-B Traffic data uplinked from the ground or GDL 88 or GTX 345 is in Standby.	No immediate action. See and avoid traffic.
C		✓	✓		✓	✓	✓	CSA FAIL	Conflict Situational Awareness -traffic alerting is inoperative. GDL 88 or GTX 345 integration only.	Traffic alerting is not provided. See and avoid traffic.

	Applies to:							Annunciation	Description	Pilot Action
	EFD1000 PFD PRO C3	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD 1000 VFR	EFD1000 PFD PILOT -or- EBD1000 PFD EBD Basic	EFD 1000 MFD REV	EFD 1000 MFD	EFD 500 MFD			
C						✓	✓	FAIL	Stormscope Option: Sensor has failed.	No immediate action. Use an alternate means to detect thunderstorms.
C						✓	✓	ERROR	Stormscope Option: Sensor has failed.	No immediate action. Use an alternate means to detect thunderstorms.
C		✓	✓		✓	✓	✓	NXRD : LTNG : SIG : AIR : AGE : TFR :	XM Datalink weather product data not received.	No immediate action. Use alternate means to acquire weather and TFR information.
C		✓	✓		✓	✓	✓	RGNL :	FIS-B Datalink weather product data not received.	No immediate action. Use alternate means to acquire weather and TFR information.

	Applies to:							Annunciation	Description	Pilot Action
	EFD1000 PFD PRO C3	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD 1000 VFR	EFD1000 PFD PILOT -or- EBD1000 PFD EBD Basic	EFD 1000 MFD REV	EFD 1000 MFD	EFD 500 MFD			
C						✓	✓		FIS-B Datalink weather product data not received.	No immediate action. Use alternate means to acquire weather and TFR information.
C	✓	✓	✓	✓	✓	✓			Annunciation presented on the HSI whenever the HSI compass card is no longer receiving magnetic corrections. After 6 minutes of free gyro operation the attitude and heading solutions will be removed.	No immediate action. Expect attitude loss after six minutes.
C	✓	✓	✓	✓	✓	✓	✓		Annunciation presented in the menus when the connected EFD battery is not detected or failed	No immediate action. The EFD display will not be available in the event of an aircraft power loss. If the MFD is used for backup altimeter and/or airspeed indicator, takeoff is not authorized. See Section 2.3.

	Applies to:							Annunciation	Description	Pilot Action
	EFD1000 PFD PRO C3	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD 1000 VFR	EFD1000 PFD PILOT -or- EBD1000 PFD EBD Basic	EFD 1000 MFD REV	EFD 1000 MFD	EFD 500 MFD			
C		✓	✓	✓	✓	✓	✓		When the Upper Pointer points in the yellow/black band, stall is imminent in the Flaps Up configuration.	Reduce the Angle of Attack.
C		✓	✓	✓	✓	✓	✓		When the Lower Pointer points in the yellow/black band, stall is imminent in the Flaps Down configuration.	Reduce the Angle of Attack.
C		✓	✓	✓	✓	✓	✓		When the Upper Pointer points in the yellow band, the airplane is nearing stall in the Flaps Up configuration. When the Lower Pointer points in the yellow band, the airplane is nearing stall in the Flaps Down configuration.	Reduce the Angle of Attack.
A		✓	✓	✓	✓	✓	✓		When the Upper Pointer points in the green band, the stall margin for the Flaps Up configuration is well above stall.	No action.

	Applies to:							Annunciation	Description	Pilot Action
	EFD1000 PFD PRO C3	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD 1000 VFR	EFD1000 PFD PILOT -or- EBD1000 PFD EBD Basic	EFD 1000 MFD REV	EFD 1000 MFD	EFD 500 MFD			
A		✓	✓	✓	✓	✓	✓		When the Lower Pointer points in the green band, the stall margin for the Flaps Down configuration is well above stall.	No action.
A	✓	✓	✓		✓				GPSS is operational	No action. GPSS can be used if desired.
A	✓	✓	✓		✓	✓			GPS annunciations that are provided by the GPS source. TERM can also be displayed in the same location as APPR.	No action. See the GPS AFMS for additional information on the meaning of these annunciations.
A		✓	✓						When this message is displayed, the PFD is the UAT controller.	Press MENU to access the page to change the Code or to IDENT.

	Applies to:							Annunciation	Description	Pilot Action
	EFD1000 PFD PRO C3	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD 1000 VFR	EFD1000 PFD PILOT -or- EBD1000 PFD EBD Basic	EFD 1000 MFD REV	EFD 1000 MFD	EFD 500 MFD			
A	✓	✓	✓		✓	✓	✓	MAP SW 2.7.2 and earlier:  MAP SW 2.8 and later:  	Green annunciation that indicates that the traffic sensor is enabled. ID after TFC indicates that traffic identification is displayed if available. This annunciation does not indicate the status of the ADS-B traffic data uplinked from the ground.	No action. See and avoid traffic.
A						✓	✓	MAP SW 2.7.2 and earlier:  MAP SW 2.8 and later: 	Green annunciation that indicates that the traffic sensor is in standby.	No action. See and avoid traffic.
A	✓	✓	✓		✓	✓	✓	MAP SW 2.7.2 and earlier:  MAP SW 2.8 and later: 	Green annunciation that indicates that the TIS A traffic data has not been refreshed within 6 seconds.	No action. See and avoid traffic.
A		✓	✓		✓	✓	✓		Stormscope (strike) option: The rate indicates the approximate number of lightning strikes detected per minute.	No action. Avoid thunderstorms.

	Applies to:							Annunciation	Description	Pilot Action
	EFD1000 PFD PRO C3	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD 1000 VFR	EFD1000 PFD PILOT -or- EBD1000 PFD EBD Basic	EFD 1000 MFD REV	EFD 1000 MFD	EFD 500 MFD			
A		✓	✓		✓	✓	✓		Stormscope (strike) option: Cell clustering display mode selected. The rate indicates the approximate number of lightning strikes detected per minute.	No action. Avoid thunderstorms.
A		✓	✓		✓	✓	✓		A data age annunciation for XM Datalink products	No action. Useful reference for weather data evaluation. NOTE: The data may be several minutes older than the time shown. It is not real-time data.
A		✓	✓		✓	✓	✓		A data age annunciation for ADS-B weather products.	No action. Useful reference for weather data evaluation. NOTE: The data may be several minutes older than the time shown. It is not real-time data.
A						✓	✓		A data age annunciation for ADS-B weather products.	No action. Useful reference for weather data evaluation. NOTE: The data may be several minutes older than the time shown. It is not real-time data.

	Applies to:							Annunciation	Description	Pilot Action
	EFD1000 PFD PRO C3	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD 1000 VFR	EFD1000 PFD PILOT -or- EBD1000 PFD EBD Basic	EFD 1000 MFD REV	EFD 1000 MFD	EFD 500 MFD			
A		✓			✓			AP FD RDY CWS	S-TEC 55X annunciations.	No action.
A		✓			✓			HDG NAV REV HDG NAV APR HDG APR REV HDG NAV GPSS HDG REV NAV GPSS NAV APR APR REV	S-TEC 55X annunciations.	No action.

	Applies to:							Annunciation	Description	Pilot Action
	EFD1000 PFD PRO C3	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD 1000 VFR	EFD1000 PFD PILOT -or- EBD1000 PFD EBD Basic	EFD 1000 MFD REV	EFD 1000 MFD	EFD 500 MFD			
A		✓			✓			   	S-TEC 55X annunciations.	No action.
A						✓	✓	DATABASE FAIL	Database Failure	No action. Functions that require a database are not available. See Table 1.
A						✓	✓	MAP LOADING...	The Database for the NAV Map is loading	No action. Not all the available data on the NAV Map is displayed yet.
A						✓	✓	OWNSHIP NOT AVAILABLE	Charts Option: The ownship cannot be displayed.	No action.
A						✓	✓	OWNSHIP OFF CHART	Charts Option: The ownship is off the chart.	No action.
A		✓			✓	✓	✓	SV UNAVAILABLE : ADAHRS FAIL	Synthetic Vision Option: Failed	No action
A		✓			✓	✓	✓	SV POSITION INVALID	Synthetic Vision Option: Failed	No action
A		✓			✓	✓	✓	DATABASE FAIL	Synthetic Vision Option: Failed	No action
A		✓			✓	✓	✓	DATABASE INIT	Synthetic Vision Option: Not yet operational	No action

	Applies to:							Annunciation	Description	Pilot Action
	EFD1000 PFD PRO C3	EFD1000 PFD PRO -or- EFD1000 PFD EBD Advanced	EFD 1000 VFR	EFD1000 PFD PILOT -or- EBD1000 PFD EBD Basic	EFD 1000 MFD REV	EFD 1000 MFD	EFD 500 MFD			
A		✓			✓	✓	✓	SV DATABASE UNAVAILABLE	Synthetic Vision Option: Failed	No action
A		✓			✓	✓	✓	SV LOADING...	Synthetic Vision Option: Not yet operational	No action
A		✓			✓	✓	✓	MAP LOADING...	Synthetic Vision Option: Not yet operational	No action
A		✓			✓	✓	✓		A white flight path marker indicates that approach TWS alerts are available (Terrain Alerts will be generated by terrain 100 feet higher than the runway elevation and all mapped obstacles).	No action
A		✓	✓		✓			OBSTACLE BEHIND AOA	Synthetic Vision Option: An obstacle that is behind the AOA indicator for more than five seconds will elicit this message.	No action
A		✓	✓	✓	✓			AOA AUTO	The AOA indicator is available for display but removed to reduce clutter. This message will be shown until the AOA indicator presents useful information.	No action

4 Normal Procedures

4.1 Exterior Inspection

1. RSM Check for condition and security
2. RSM Vent Hole Check Clear of obstructions
3. RSM Lightning Tape Check for condition and security

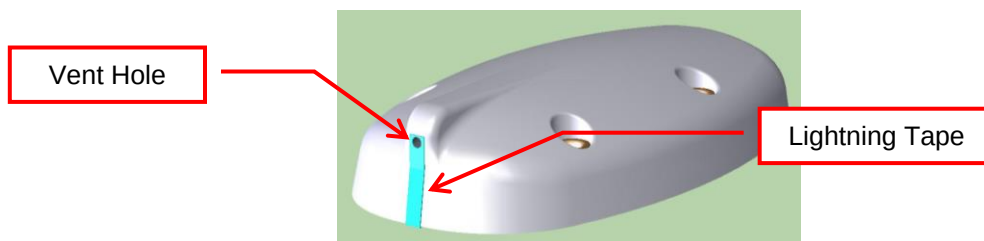


Figure 1 - Remote Sensor Module (RSM)

4.2 Before Take-Off Checks

4.2.1 EFD1000 PFD PRO, EFD1000 PFD PRO C3, EFD1000 PFD PILOT, EFD1000 PFD VFR

1. PFD Configure for departure

4.2.2 EFD1000 MFD (without EBB) or EFD500 MFD

1. MFD Configure for departure

4.2.3 EFD1000 MFD with EBB

If an EFD1000 MFD with EBB is installed in lieu of a backup altimeter and/or airspeed indicator (see Table 2), perform the following:

1. EBB Switch NORM
2. MENU Select POWER SETTINGS page
3. EXT PWR: (Aircraft Input Voltage) Check > 12.3V/24.6V
4. BAT Verify battery status is not shown as "FAIL"
5. EFD1000 MFD Select "BATTERY"
6. EFD1000 MFD Verify battery charge is above 80%
7. EFD1000 MFD Select EXT PWR
8. MENU Press the MENU button to return to normal operation.
9. EFD1000 MFD Select REV then press XFILL. The MFD must be operated in the PFD reversion mode for takeoff.

Except as instructed in Section 3.2.2, the EBB switch should be left in the NORM position at all times, including when away from the aircraft.

4.2.4 EFD1000 PFD EBD Advanced or EFD1000 PFD EBD Basic

1. EBB Switch NORM
2. MENU..... Select POWER SETTINGS page
3. EXT PWR: (Aircraft Input Voltage) Check > 12.3V/24.6V
4. BAT Verify battery status is not shown as "FAIL"
5. EFD1000 PFD EBD Select "BATTERY"
6. EFD1000 PFD EBD Verify battery charge is above 80%
7. EFD1000 PFD EBD Select EXT PWR
8. MENU Press the MENU button to return to normal operation
9. BARO Set

Except as instructed in Section 3.2.2, the EBB switch should be left in the NORM position at all times, including when away from the aircraft.

4.3 Avionik Straubing APS4A Altitude Preselector

1. Altitude Alerter Set as desired
2. PRESEL..... Press for ARMED
- To deselect:
3. PRESEL..... Press to Disarm

4.4 S-TEC 55X Altitude Preselect and Vertical Speed Control

Except as described here, refer to the S-TEC 55X AFMS and Pilot's Guide for S-TEC 55X information.

Preflight:

When the EFD1000 PFD displays "RDY", perform the following steps:

1. Select the STEC55X A/P menu page on the EFD1000 PFD and change the VERT SPD CNTL: option from PFD to STEC55X.
2. Conduct the S-TEC 55X Autopilot Tests per the FAA-approved Airplane Flight Manual Supplement for the autopilot system installation.
3. Select the STEC55X A/P menu page on the EFD1000 PFD and change the VERT SPD CNTL option from STEC55X to PFD.

Operation:

To select a vertical speed, and to preselect and capture a selected altitude:

1. Vertical Speed Bug Set as desired on the PFD.
2. Altitude Bug Set as desired on the PFD.
3. S-TEC 55X Programmer/Computer..... Engage the VS mode. For preselected altitude, engage ALT and VS simultaneously.

4.5 ADS-B OUT Control

When the EFD1000 PFD displays “UAT CTL: MENU”, perform the following steps to set the squawk or IDENT:

To set the squawk:

1. Transponder Set the squawk
2. Press MENU Set the squawk. Press MENU to return

To IDENT:

1. Press MENU Press IDENT. Press MENU to return

4.6 Before Approach Checks

1. PFD..... Configure for arrival

If an EFD1000 MFD with EBB is installed in lieu of a backup altimeter and/or airspeed indicator (see Table 2), perform the following:

1. EFD1000 MFD Select REV then press XFILL. The MFD must be operated in the PFD reversion mode for landing.

4.7 Shutdown Checks

After conducting normal Shutdown checklist items, ensure the following:

1. EFD1000/500 Switches OFF

4.8 Turning the AOA System On, Off or Auto on the PFD

To turn the AOA system On, Off or Auto on the PFD, proceed as follows:

1. Press MENU to enter the menu pages.
2. Rotate the right knob to select the GENERAL SETTINGS C menu page.
3. Press the AOA DSPL button until the label turns magenta.
4. Rotate the right knob to select ON, OFF or AUTO.
5. Push the AOA DSPL button to retain the selection.
6. Press MENU to exit the menu pages.

5 Performance

There is no change to the airplane performance.

6 Weight and Balance

See the current weight and balance documents for this aircraft.

7 Systems Description

The following paragraphs describe the evaluation flight display and the optional interfaces shown in Table 1.

7.1 Evolution Flight Display

The Evolution Flight Display System consists of one or more integrated Electronic Flight Display (EFD1000 or EFD500) systems. The EFD1000 system can be configured as a Primary Flight Display (PFD) or as a multi-function display (MFD). The EFD500 system can be configured as an MFD only. The EBD Basic or the EBD Advanced are Primary Flight Displays used as backup to a non-Aspen Primary Flight Display.

The following Pilot Guides should be carried in the aircraft and available to the pilot as appropriate for the equipment installed in the airplane:

- a. For the EFD1000 PFD PILOT, PFD PRO, EBD Basic and EBD Advanced: Aspen Avionics document 091-00005-001, EFD1000 PFD Pilot's Guide, Revision F or subsequent revision.
- b. For the EFD1000 PFD VFR: Aspen Avionics document 091-00028-001, EFD1000 VFR PFD Pilot's Guide, Revision () or subsequent revision.
- c. For the EFD1000 PFD PRO C3: Aspen Avionics document 091-00019-001, EFD1000 C3 Pro PFD Pilot's Guide Revision B or subsequent revision.
- d. For the EFD1000 MFD or EFD500 MFD: Aspen Avionics document 091-00006-001, EFD1000/500 MFD Pilot's Guide Revision B or subsequent revision.

Go to www.aspenavionics.com/support for current Pilot Guides and Pilot Guides Errata and Addenda.

7.1.1 Internal Battery

The EFD1000 and EFD500 contain internal batteries which provide for continued operation for approximately 30 minutes (at a full charge and a shirt-sleeve environment) in the event of a complete loss of electrical power to the systems.

7.1.2 Emergency Backup Battery (EBB)

The EBB is an external rechargeable battery for the EFD1000 MFD, the EFD1000 EBD Advanced and the EFD1000 EBD Basic. This is a larger battery that will provide at least 30 minutes operation (at 80% charge) in the event of complete loss of electrical power.

7.1.3 Intercommunication

The EFD1000 PFD and the EFD1000/500 MFD intercommunicate barometric pressure and other data among these systems. The EFD1000 EBD does not intercommunicate barometric pressure with the non-Aspen Primary Flight display. It is necessary to adjust the barometric pressure directly on the Aspen EFD1000 EBD.

7.2 Databases

The following table provides information regarding the databases in the EFD.

Table 5 - Databases

Database Type	Includes	Update Cycle	Used In	Database Provider	Comment
Terrain	High resolution terrain data for Americas, International, or Worldwide geographic regions. Terrain depiction is limited to the region between 65° North latitude to 65° South latitude	Delivered with the EFD, updated intermittently as announced by Jeppesen	Synthetic Vision, Nav Maps and Terrain Maps	Jeppesen mail order	These databases are not to be used for navigation.
NavData	Includes Navaids, Controlled Airspace, Restricted, Prohibited and Special Use Airspace, Airports, etc.	28 day update cycle	Synthetic Vision and Nav Maps	Jeppesen JSUM®	
Cultural	Includes Roads, Rivers, Railroads, Political boundaries, Cities, etc.	28 day update cycle	Synthetic Vision and Nav Maps	Jeppesen JSUM®	
Obstacles	Includes man made obstacles greater than 200 ft. AGL. This database relies upon data reported by government agencies and may not include all obstacles due to inherent reporting and processing delays in the data. In addition, obstacle data may not be available for all regions within the data card coverage area.	28 day update cycle	Synthetic Vision and Nav Maps and Terrain maps	Jeppesen JSUM®	
Charts	AeroNav Terminal Procedures Charts	28 day update cycle	Terminal Procedures and Airport Diagrams	Seattle Avionics	

7.3 Remote Sensor Module (RSM)

The RSM provides heading information to the EFD1000 and is powered by the EFD1000. Some models have an internal GPS for emergency use that will automatically operate when the external GPS systems fail.

7.4 Traffic Display

There are several Traffic Interfaces that are available. Table 1 Installed Equipment List identifies the equipment in this aircraft.

The traffic data can be displayed on the moving map or as a dedicated view on the MFD when connected to the approved TCAS I, TAS, TIS or ADS-B external sensor. The dedicated view is titled TFC.

Traffic data provides a graphical depiction of aircraft relative to the aircraft heading. When the traffic data is not displayed on the PFD's moving map, the traffic automatically displays during a Traffic Advisory. When the dedicated traffic view is not displayed on the MFD and a Traffic Advisory occurs, a traffic popup is displayed to allow quick selection to view the Traffic Advisory.

The horizontal position reference point for each traffic image on the display is the center of the traffic image. The horizontal position reference point for the ownship on the display is the

intersection of the geometric centerline of the wing and the geometric centerline of the ownship symbol fuselage.

7.5 ADS-B

7.5.1 ADS-B OUT

The Aspen or FreeFlight ADS-B OUT system automatically transmits surveillance data to Air Traffic Control and other entities. The ADS-B OUT interfaces with an onboard altimeter and GPS to transmit the squawk, registration, altitude and position. When “UAT CTL: MENU” is displayed on the on the PFD, then control of the squawk and IDENT is temporarily transferred to the PFD MENU.

If the ADS-B OUT system is turned off then ATC will not receive the surveillance data.

If the transponder is turned off, the UAT control will be transferred to the Aspen Display.

7.5.2 ADS-B IN

The Aspen PFD and MFD systems can display weather and traffic information when integrated with a compatible ADS-B system.

7.6 Weather Interface

The Datalink weather data can be displayed on the moving map or as a dedicated view on the MFD when connected to the EWR50 or FIS-B external sensor. The dedicated view is titled WX.

NEXRAD consists of composite images from many radar sites that are collected and compiled. The oldest portions of the contributing NEXRAD sites could be 0 to 20 minutes older than the age depicted.

7.7 Stormscope

The Strikes data shows the electrical discharges (associated with thunderstorms) that are detected by the L3 Stormscope®.

7.8 Terminal Procedure Charts

The MFD supports a dedicated charts view. The dedicated view is titled CHARTS.

The dedicated charts view displays pre-composed terminal procedures from the Seattle Avionics Instrument Procedures Charts Database. The dedicated charts view allows the pilot to overlay the ownship on geo-reference instrument approach procedures and airport diagrams. The ownship is only available for display on the airport diagram when the aircraft is on the ground.

The ownship position is centered at the intersection of the wings and fuselage.

The Terminal Procedures Charts require a database.

Only Geo-referenced charts are eligible for ownship depiction.

7.9 NAV and Terrain Maps

The PFD and MFD both support a moving map.

The PFD moving map is integrated into the navigation display on the bottom-half of the PFD.

The MFD moving map is a dedicated view that displays NAVAIDs, Controlled Airspace, Restricted, Prohibited and Special Use Airspace, Airports, etc.

The terrain and obstacle data can be displayed on the moving map or as a dedicated view on the MFD. The dedicated view is titled TERR. The terrain and obstacle data is advisory only.

CAUTION:

Accurate barometric pressure is essential for accurate terrain and obstacle data.

The terrain and obstacle data is colorized information based on the aircraft's proximity to terrain and obstacles. The aircraft's proximity to terrain and obstacles is determined by computing the altitude difference between the terrain and obstacles in the database and the aircraft's baro-corrected altitude.

The MFD Nav and Terrain maps require a database. The PFD moving map does not require a database.

7.10 EA100 Autopilot AHRS

The EA100 provides pitch and roll signals information to the autopilot.

7.11 Synthetic Vision and Terrain Warning System

The PFD and MFD can both support the display of Synthetic Vision. The display of the Synthetic Vision depiction is advisory only.

The Synthetic Vision depiction is a computer-derived perspective view of the nearby terrain obstacles and airports. The Synthetic Vision depiction supports a flight path marker to display the vertical and lateral path of the aircraft based on two parameters, barometric vertical speed and GPS track. The Synthetic Vision depiction also supports a Terrain Warning System (TWS) that uses the flight path marker to present an estimated time-to-collision function for terrain and obstacles. Unless inhibited by the pilot, TWS operates even when Synthetic Vision is turned off.

The MFD Nav and Terrain maps require a database.

CAUTION:

Accurate barometric pressure is essential for accurate Synthetic Vision and Terrain Warning.

7.12 Connected Gateway

The Connected Gateway provides a means to communicate flight plan information from a portable device to the navigation system.

7.13 Radar Altitude

When installed and configured, Radar Altitude information can be presented on the PFD. When the height exceeds the Radar Altitude maximum height, the indication is suppressed. When the Radar Altitude is at or below the maximum height, the Radar Altitude is shown as a number marked RA on the PFD.

Separately, the Decision Height can be shown as an amber balloon on the PFD.

7.14 ADF Interface

When installed and configured, ADF #1, #2 or both can be shown on the needles controlled by the left and right lower buttons.

7.15 VHF Interface

When installed and configured, VLOC 1 or VLOC 2 can be selected by the lower center button.

7.16 GPS Interface

When installed and configured, GPS1 or GPS2 can be selected using the lower center button.

7.17 Avionik Straubing APS4A Altitude Preselector

The Altitude Preselector is a remote altitude hold function. When armed, the altitude hold will be engaged at the selected altitude.

7.18 S-TEC 55X Vertical Speed Control/Altitude Preselect

When installed and configured, the PFD provides vertical speed command and altitude preselect for the S-TEC 55X autopilot.

7.19 Autopilot Source Select

The autopilot normally is connected to the PFD. If the MFD is reverted to a PFD, then the MFD can be selected as the autopilot source.

7.20 AOA System

The Aspen AOA System is a derived AOA system, meaning it uses the air data and inertial functions in the EFD1000 to calculate the approximate AOA. It does not indicate stall warning.

The AOA system is designed to show trend toward stall and stall margin. Stall margin is the actual AOA compared to the stall AOA.

WARNING:

The AOA indications are not valid for takeoff.

There are two pointers that move together. The Upper Pointer indicates stall margin in the flaps up configuration. The Lower Pointer indicates stall margin in the full flaps down configuration.

NOTE:

There is no indication of derived AOA for intermediate flap settings.

When the airplane moves toward stall, the pointers will move from the green band into the yellow band, and eventually to the black/yellow band. Whenever the pointers are rapidly moving toward the yellow/black band, the airplane is rapidly approaching stall.

Conversely, as the airplane accelerates toward cruise speed, both pointers will move toward the blue band and will eventually park at the end of the blue band.

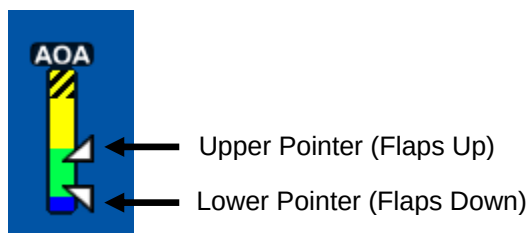


Figure 2 - AOA Indicator

7.20.1 AOA Display Modes

The PFD supports three AOA display modes, Auto, On and Off. The MFD supports one mode, On.

Table 6 - AOA Display Modes

Mode	Description
AUTO	From cruise, the AOA indicator fades in when the Upper Pointer trends past the green/blue transition. This minimizes the indication on the PFD until the AOA presents useful information.
ON	The AOA indicator is always displayed.
OFF	The PFD does not display the AOA indicator.

See Section 4.7 for information on how to select the modes of operation.

7.20.2 AOA Operation by Phase of Flight

The following tables describe the typical AOA indications in various phases of flight in the On and Auto modes.

Table 7 - AOA "ON" Mode

Phase of Flight	Description of the AOA indicator
Taxi	The AOA indicator is displayed with no pointers.
Takeoff	The AOA pointers fade in at about 35 KIAS. AOA indications are not valid for takeoff.
Climb	In the clean configuration, the AOA pointers will be in the green band.
Cruise	In normal cruise, the AOA pointers are parked at the bottom of the blue band.
Descent	In normal descent, the AOA pointers are parked at the bottom of the blue band.
Approach	As the airplane slows, the AOA trends from the blue band toward the green/yellow transition. When on-speed at one g and full flaps, the Lower Pointer nears the green/yellow transition.
Landing	The pointers trend toward stall during landing.
Rollout	The pointers fade out at approximately 35 KIAS.

Table 8 - AOA "AUTO" Mode

Phase of Flight	Description of the AOA indicator
Taxi	"AOA AUTO" is displayed.
Takeoff	The AOA indicator with pointers will fade in at about 35 KIAS. AOA indications are not valid for takeoff.
Climb	In the clean configuration, the AOA pointers will be in the green band.
Cruise	The AOA indicator will fade to "AOA AUTO" when the Upper Pointer parks at the end of the blue band.
Descent	"AOA AUTO" is displayed.
Approach	The AOA Indicator fades in when the Upper pointer trends above the blue band. As the airplane slows, the AOA trends toward the green/yellow transition. When on-speed at one g and full flaps, the Lower Pointer nears the green/yellow transition.
Landing	The pointers trend toward stall during landing.
Rollout	The indicator fades out at approximately 35 KIAS and the AOA AUTO message fades in.

7.20.3 Pointer Definition

The following table shows the pointer definitions.

Table 9 - Pointer Definition

Pointers	Meaning
Upper Pointer (Flaps Up) 	The Upper Pointer indicates stall margin in the flaps up configuration.
Lower Pointer (Flaps Down) 	The Lower Pointer indicates stall margin in the full flaps down configuration.

7.20.4 Color Band Definition

The color bands mean the following:

Table 10 - Color Band Definition

Color Band	Meaning
Yellow/black hash-marked band	Very little stall margin.
Yellow band	Reduced stall margin.
Green band	AOA is well above stall.
Blue band	Normal cruise, normal descent. AOA is well above stall.

Document Revisions

Revision	Description of Change
C	Add AOA pilot guide supplement content and reformat to accommodate
B	Updated for software v2.5. Blue tower obstacle threshold is reduced from 2,500 feet to 900 feet.
()	Initial Release
A	Grammatical, pictorial, and technical corrections and updates. Added Document Revisions page, Runways, microSD card loading, installation, operational check, and removal procedures.

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Chapter 1

Evolution Synthetic Vision Welcome and Introduction

Welcome to Aspen Avionics' Evolution Synthetic Vision (ESV), the most versatile and flexible synthetic vision technology available for certified avionics.

The Evolution Synthetic Vision option, when selected on your flight display, replaces the traditional blue-over-brown background of the legacy attitude indicator with a real-time, computer-generated 3D view of terrain, obstacles, and traffic¹ for the utmost in pilot situational awareness. ESV uses 9 arc-second and 3 arc-second resolution terrain data to render the Synthetic Vision VIEW.

You will find that Aspen's ESV is intuitive and easy to use. Aspen's exclusive flexible display layouts permit you to personalize a configuration that works best for you – on the Primary Flight Display, the Multi-Function Flight Display, or both. ESV may be presented on any of the window configurations – Full Screen, Split Screen, or Thumbnail LAYOUT.

ESV also has a field of view option, narrow or wide, which allows you to toggle to the view that best suits the phase of flight. The wide field of view is suited for enroute, while the narrow field of view is best for zooming in on the approach environment.

ESV's easy-to-read display features include: Flight Path Marker symbology that graphically depicts the lateral GPS track and vertical speed of the aircraft, a Distance Marker to assist in estimating the distance to a point ahead of the aircraft, and a Terrain Warning System (TWS) that provides visual, audio, and text warning annunciations when the system predicts a collision with terrain or an obstacle.

Aspen is proud to offer this enhancement to your glass panel system. Welcome to the next level of innovation and functionality for your Evolution Flight Displays.



1. Traffic is available when configured with Aspen's Evolution Hazard Awareness (EHA) option.

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Chapter 2

ESV Display Features

2.1. Zero Pitch Line - ZPL

The Zero Pitch Line (ZPL) is a white line on the Attitude Display that represents the horizon, similar to the horizon line on an attitude indicator. The center of the ZPL is removed to present a clear view of the center of the Synthetic Vision display (**Figure 2-1**). Terrain above the aircraft's altitude is presented above the ZPL while terrain below the aircraft's altitude is presented below the ZPL.



Figure 2-1 Zero Pitch Line (ZPL)

2.2. Flight Path Marker - FPM

The Flight Path Marker (FPM) displays the aircraft's lateral and vertical flight path (**Figure 2-2**). The FPM position is derived from the GPS ground track and vertical speed. When the FPM intercepts terrain, an obstacle, or a runway, this indicates that the aircraft is tracking in three dimensions toward that feature. When the FPM is above the Synthetic Vision terrain, this indicates the aircraft will clear that terrain. When the FPM is held on the ZPL, the aircraft is maintaining its current altitude. The Flight Path Marker can be removed from view to reduce display clutter.



Figure 2-2 Flight Path Marker (FPM)



The FPM is for use in steady state. Like the GPS Track and Vertical Speed it is based on, the FPM will lag during dynamic maneuvers.



Figure 2-3 Aircraft Reference Symbol

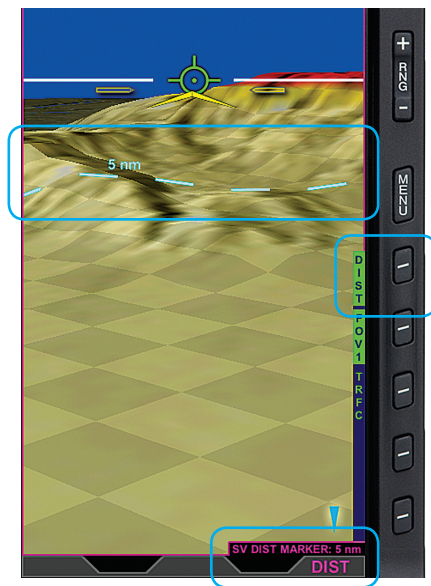


Figure 2-4 SV Distance Marker

2.3. Aircraft Reference Symbol

The Aircraft Reference Symbol (**Figure 2-3**) is used to determine the pitch attitude of the aircraft relative to the pitch scale on the PFD and relative to the depicted terrain on the MFD. The Aircraft Reference symbol can be removed from view on the MFD.

To display or remove the Aircraft Reference Symbol on the MFD

1. Press the MENU button and rotate the Right Knob to the CHART/SV SETTINGS A page.
2. Press the SV AIRCRAFT REF SYMBOL Menu Key and rotate the Right Knob to the desired setting (ON or OFF).

See Section 6, ESV Display Options MENU.

2.4. SV Distance Marker

The DIST Hot Key presents a cyan dashed line (Distance Line) representing the ground distance ahead of the aircraft (**Figure 2-4**). The Distance Marker is used to estimate the ground distance from the aircraft to a feature on the display. The selectable distance options are OFF, 1nm thru 20nm (in 1nm increments), 20nm, 25nm, 30nm, and 40nm. The maximum distance ESV presents the virtual horizon is 40nm.

To edit the Distance Line and SV Distance Marker

1. Press the DIST Hot Key (The Right Knob label turns magenta and displays "SV DIST MARKER" with the distance selected).
2. Rotate the Right Knob to the desired distance setting or press and hold the Right Knob to automatically SYNC the Distance Line to the 5nm range.

2.5. Airport Flags

An Airport Flag displays the airport's identifier and its location. A flag is presented when the aircraft is approximately 20nm away from an airport. When the aircraft is approximately 2nm away from the airport, the flag is removed from view.

The destination airport that has been loaded into the aircraft's GPS flight plan is identified with a magenta flag (**Figure 2-5**). Other airports are identified with a white flag (**Figure 2-6**).

The Airport Flag can be decluttered according to several parameters: Flight Plan Airports only, no flags shown, all hard surface runways, or only airports with runway lengths greater than 4500, 4000, 3500, 3000, 2500 feet.

The Airport Flag display option is found in the MENU of the PFD and MFD. The settings for the Airport Flags are; Flight Plan Airports Only, None, ON>4500, ON>4000, ON>3500, ON>3000, ON>2500, All Hard Surface, and ALL ON.

See Section 6 *ESV Display Options MENU*.



Figure 2-5 Magenta Airport Flag (destination airport)

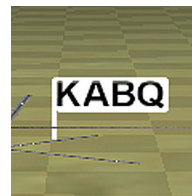


Figure 2-6 White Airport Flag



WARNING

The Terrain and Obstruction information is based on terrain and obstacle elevation information contained in a third party database. This data may contain inaccuracies and/or omissions and must only be used as an aid to situational awareness. The information provided should never be used for primary terrain avoidance or navigation.

2.6. Runways

Hard-surfaced runways are gray in color with white runway markings. Runway markings include the runway centerline, runway numbers, letters for parallel runways, runway threshold markings, and displaced thresholds (**Figure 2-7**).

Other than hard-surfaced runways, often referred to as a grass runway or a gravel runway, are colored differently depending on the airport field elevation. Runways at field elevations 2000 feet and greater are colored tan with gray (**Figure 2-8**). Runways at field elevations less than 2000 feet are colored green with gray (**Figure 2-9**).

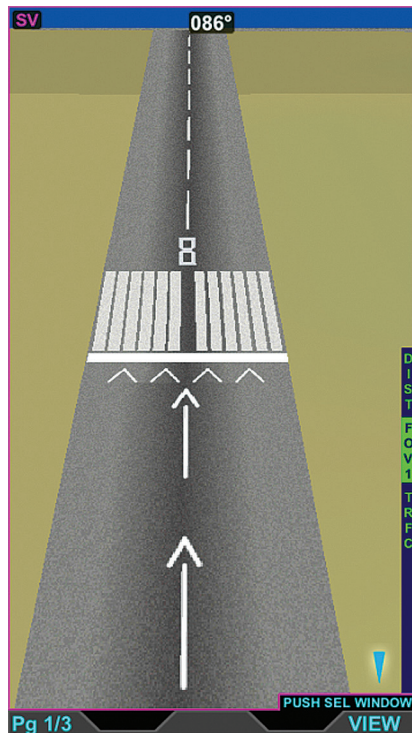
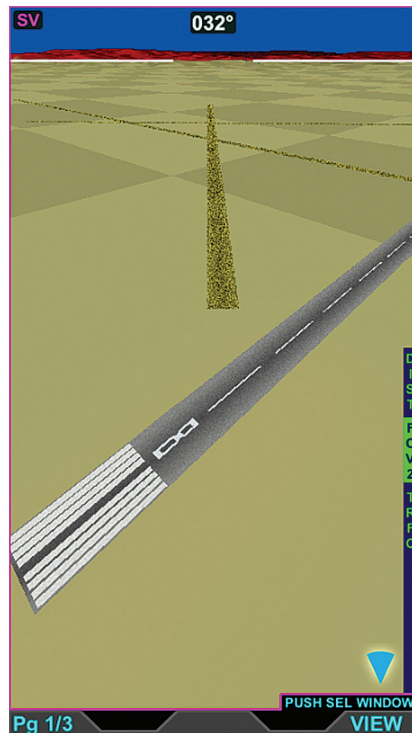
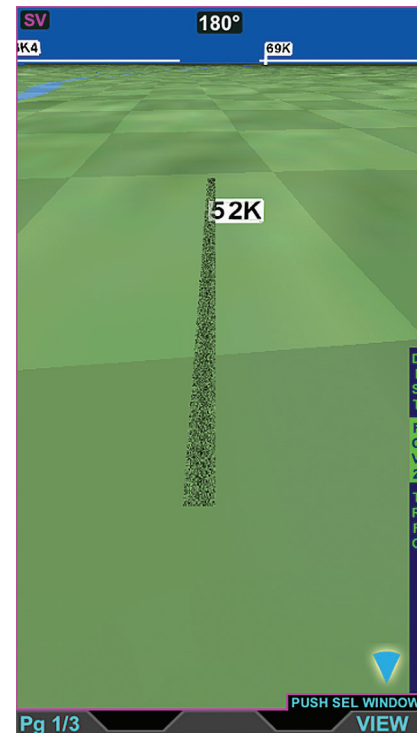


Figure 2-7 Runway Markings

Figure 2-8 Other than Hard-surfaced Runways,
Field elevation 2000 feet and greaterFigure 2-9 Other than Hard-surfaced Runways,
Field elevation less than 2000 feet

2.7. Obstacle Symbols - Towers

Three-dimensional obstacle symbols (**Table 2-1**) are presented in perspective on all Synthetic Vision VIEWS and also in a top-down two-dimensional view on the Nav Display of SV3 (**Figure 3-1**). ESV presents obstacles taller than 200 feet AGL that are within 2500 feet vertically of the aircraft altitude.

The obstacles presented in the Synthetic Vision VIEW appear small at first and grow larger as they get closer to the aircraft.

- Obstacles that are between 500 feet and 2500 feet below the aircraft's altitude are blue.
- Obstacles that are between 100 feet and 500 feet below the aircraft's altitude are amber.
- Obstacles that are above the aircraft's altitude or within 100 feet below the aircraft's altitude are red.

Obstacle Height < 1000' AGL		Obstacle Height > 1000' AGL		Obstacle Symbol Color Meaning
				Obstacle is between 500' and 900' below aircraft's altitude
				Obstacle is between 100' and 500' below aircraft's altitude
				Obstacle is above aircraft's altitude or within 100' below aircraft's altitude

Table 2-1, Obstacle Symbols and Meanings

Chapter 3

Displaying Evolution Synthetic Vision

ESV uses 9 and 3 arc-second resolution terrain data to render the Synthetic Vision VIEW. The Narrow Field of View, FOV1 is most like the outside view and is best used on an approach for landing. FOV2 is best used for enroute. The PFD display options for ESV are Full Screen, Split Screen with the standard Nav Display, or Split Screen with the Nav Display overlaying the Topographical Map (**Figure 3-1**).



Figure 3-1
(left to right) PFD Full Screen (SV1),
Split Screen with standard Nav Display (SV2),
and Split Screen with Nav Display
overlaying Topographical Map (SV3)



Figure 3-3 Hot Key Menu 3 / 3



Figure 3-4 Hot Key Label SV1

3.1. Primary Flight Display - PFD

The Evolution Synthetic Vision option is accessed by displaying the 3/3 Hot Key Menu (**Figure 3-2**). Pressing the SV Hot Key enables the ESV function and changes the SV Hot Key label to SV1 (**Figure 3-3**). Each successive press of the SV Hot Key cycles through the Synthetic Vision VIEWS; SV1, SV2, SV3, and SV Off (disabled).



NOTE

- The PFD and MFD(s) require a properly configured micro SD Card for Synthetic Vision loaded with Jeppesen terrain, obstacle, and navigation databases.
- For units configured without the Evolution Hazard Awareness option (Traffic, Stormscope, or NEXRAD), select the 2/2 Hot Key for Synthetic Vision.
- If the GPS position is invalid or ESV is unavailable, the gray SV label can be pressed to determine the reason for the unavailable SV.

3.1.1. SV1 - Full Screen

SV1 (Synthetic Vision 1) Full Screen presents Synthetic Vision under the entire primary flight data area of the PFD (**Figure 3-4**).

The CRS and HDG Fields are presented on SV1 whenever the Left or Right Knob is rotated to set the desired course/heading value (**Figure 3-5**). After 10 seconds of inactivity, the CRS/HDG Field is removed from view.

The Selected Heading Field with GPSS is presented on SV1 until the GPSS is disabled by the pilot (**Figure 3-6**).

OAT and Map features on the HSI are not shown. Winds are shown in an abbreviated style to maximize the screen area.



Figure 3-4 SV1 Full Screen



Figure 3-5 CRS and HDG display



Figure 3-6 GPSS display



Figure 3-7 Split Screen Standard Nav Display



Figure 3-8 Split Screen Nav Display with Topo Map

3.1.2. SV2 and SV3 – Split Screen

SV2 and SV3 present Synthetic Vision on the Attitude Display portion of the PFD. The lower half of the display presents the standard Nav Display, SV2 (**Figure 3-7**) or the Nav Display overlaying a high-resolution topographical map, SV3 (**Figure 3-8**).



NOTE

- When SV2 is selected, LTNG and NXRD Hot Keys are shown on Hot Key page 2/3.
- LTNG and NXRD are not available on SV3.

3.1.3. Unusual Attitudes

At extreme pitch attitudes (above 15° nose up or below 15° nose down), red Unusual Attitude Recovery chevrons come into view, pointing toward the horizon or ground as applicable. At these extreme pitch attitudes, some sky (blue) or ground (brown) will always be displayed to help maintain situational awareness, even though the Zero Pitch Line may be off-scale. The red chevrons aid the pilot in unusual attitude recovery by indicating the direction to restore to level flight.

In the Narrow Field of View (FOV1), the red chevrons are drawn on the pitch ladder every 5 degrees beginning at 20° above and below the Zero Pitch Line (**Figure 3-9**).

In the Wide Field of View (FOV2), the red chevrons are drawn on the pitch ladder every 10° beginning at 30° above and below the Zero Pitch Line (**Figure 3-10**).

Unusual Attitude functionality is the same as on the Standard display.



Figure 3-8 Unusual Attitude - Narrow Field of View



Figure 3-10 Unusual Attitude - Wide Field of View

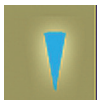


Figure 3-11 Narrow FOV Icon

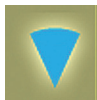


Figure 3-12 Wide FOV Icon



Figure 3-13 Narrow Horizontal FOV



Figure 3-14 Wide Horizontal FOV

3.2. Field of View

ESV can be presented in a Narrow Field of View or in a Wide Field of View by pressing the FOV1 (Narrow Field of View) or FOV2 (Wide Field of View) Hot Key. A quick glance at the FOV Icon (**Figure 3-11** and **Figure 3-12**) presented at the bottom right corner of all Synthetic Vision VIEWS indicates which field of view is currently displayed.

The FOV Icon correlates with the two-dashed lines radiating from the center of the ownship symbol on the Nav Display, indicating if a narrow horizontal field of view (**Figure 3-13**) or a wide horizontal field of view has been selected (**Figure 3-14**).

NOTE

The ends of the dashed lines do not imply a Synthetic Vision range limit. The range limit presented for the Synthetic Vision horizon is always 40 nautical miles.

3.2.1. FOV1 - Narrow Field of View

FOV1 (**Figure 3-15 and Figure 3-16**) presents an approximate 20° horizontal view (10° either side of the nose) and a visible pitch ladder range between 5° to -20° for SV1.

FOV1 (Narrow Field of View) is the most accurate representation of the outside view. FOV1 is best used for close range operation, such as final approach.



NOTE

The vertical Field of View is also narrow. See **Figure 3-19**



Figure 3-15 SV1 Narrow Field of View



Figure 3-16 SV2 Narrow Field of View



Figure 3-17 SV1 Wide Field of View

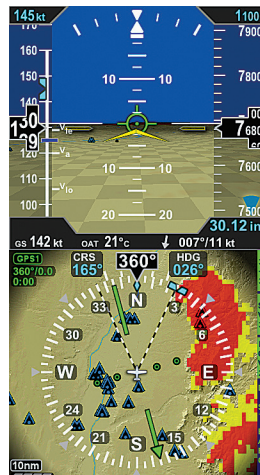


Figure 3-18 SV2 Wide Field of View

3.2.2. FOV2 - Wide Field of View

FOV2 (Figure 3-17 and Figure 3-18) presents an approximate 50° horizontal view (25° either side of the nose) and a visible pitch ladder range between 20° to -50° for SV1. The pitch ladder scale on FOV2 is equal to that on the standard display.

FOV2 is a wider field of view and objects on the display are closer than they appear. FOV2 is best used for enroute.

Figure 3-19 shows the portion of FOV1 display that is depicted in FOV2.

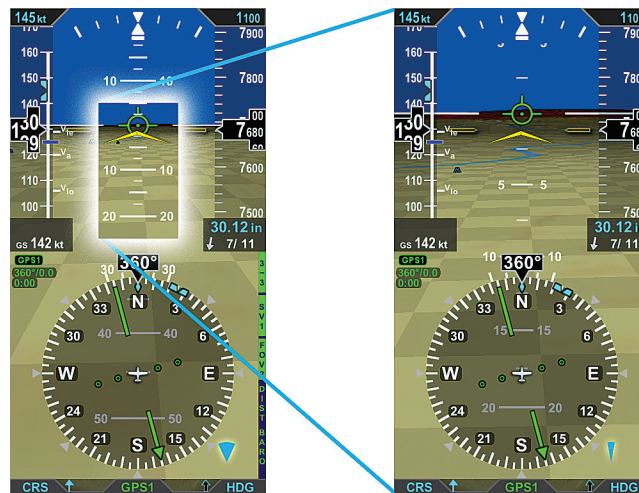


Figure 3-19 Wide and Narrow Fields of View, Relative Area

3.2.3. Field of View - MFD

FOV1 and FOV2 Hot Key selection is also available on all MFD WINDOWS that support ESV.

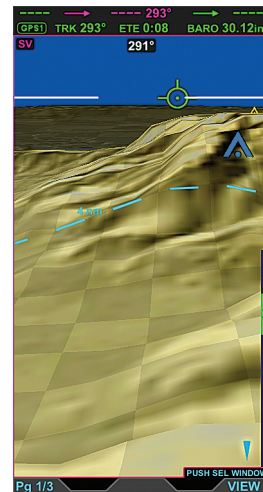


Figure 3-20 FOV1 Narrow Field of View

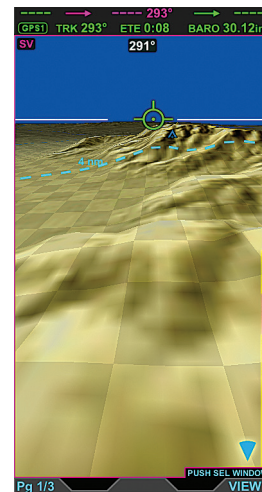


Figure 3-21 FOV2 Wide Field of View



Figure 3-22 SYNTHETIC VISION Indication



Figure 3-23 SV Indication

NOTE

The following VIEW combinations are not possible:

- ESV and the Nav Map presented at the same time
- ESV presented in multiple WINDOWS at the same time

3.3. Multi-Function Display - MFD

ESV can be presented on any WINDOW of the MFD. The Nav Map cannot be shown on the same screen as ESV, however the Terrain view can be shown with Synthetic Vision. The MFD can be reverted to an SV-enabled PFD showing SV above and a topographical map below.

When selected, “SYNTHETIC VISION” appears momentarily in the upper left of the Synthetic Vision view (**Figure 3-22**). After a few seconds, the phrase contracts to “SV” to provide more room for ESV depiction (**Figure 3-23**).

To change the VIEW of a WINDOW on the MFD

Full Screen (Pg 1/3)

- Rotate the Right Knob to select the desired WINDOW.

Split Screen (Pg 2/3) or Thumbnail (Pg 3/3)

- Push the Right Knob to select the desired WINDOW. A Magenta border will move from WINDOW to WINDOW as the Right Knob is pressed to indicate which WINDOW is selected. The selected VIEW name displays in the upper left of the active WINDOW.
- Rotate the Right Knob to display the desired VIEW for the selected WINDOW.

3.3.1. Full Screen LAYOUT (Pg 1/3)

ESV is presented in Full Screen LAYOUT on Pg 1/3. **Figure 3-24** shows the Full Screen LAYOUT with FOV2 (Wide Field of View) selected.

The following ESV display features are shown on **Figure 3-24** and **Figure 3-25**:

- Zero Pitch Line
- Flight Path Marker
- Blue obstacle
- SV Distance Marker
- Wide Field of View Icon

3.3.2. Split Screen LAYOUT (Pg 2/3)

ESV may be presented in either WINDOW of the Split Screen LAYOUT (**Figure 3-25**).

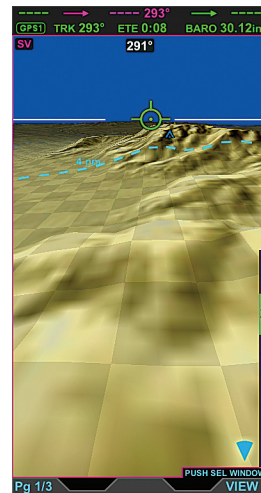


Figure 3-24 Full Screen Layout



Figure 3-25 Split Screen Layout



Figure 3-26 ESV in Bottom Window

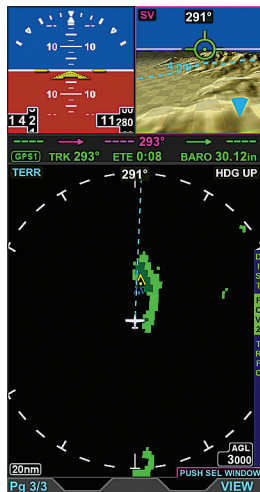


Figure 3-27 ESV in Thumbnail Window

3.3.3. Thumbnail LAYOUT (Pg 3/3)

ESV can be displayed in any window of the Thumbnail LAYOUT.

In this example, ESV is presented in the Bottom WINDOW (**Figure 3-26**) and in the Thumbnail WINDOW (**Figure 3-27**).

In the smaller Thumbnail WINDOW (**Figure 3-27**), all of the display features are visible as shown in the Bottom WINDOW (**Figure 3-26**) and in the Full Screen LAYOUT (**Figure 3-24**).

- Zero Pitch Line
- Flight Path Marker
- Blue obstacle
- SV Distance Marker
- Wide Field of View Icon

Chapter 4

Terrain Warning System – TWS

The Aspen Terrain Warning System (TWS) is included with the Evolution Synthetic Vision System to provide simple and effective terrain and obstacle alerting. To enhance the pilot's situational awareness of a potential terrain/obstacle collision, the Terrain Warning System employs the following TWS Alerts (**Figure 4-1**):

- Terrain Coloring
- FPM Coloring
- Caution/Warning Text Annunciations, and
- Aural Alert (*see note*)



NOTE

In aircraft certified with a Terrain Avoidance Warning System (TAWS), the Aspen TWS system does not provide audible alert or text alert information. Only the FPM coloring and the Terrain Coloring are displayed.



Figure 4-1 Terrain Warning System Alerts



Figure 4-2 Inflight Terrain Color Legend

4.1. Terrain Coloring

Red and yellow coloring are used for visual terrain awareness and alerting. This terrain coloring represents the relative terrain elevation compared to the aircraft's altitude.

Enroute terrain that is between 100 and 500 feet below the aircraft is shown as yellow. The terrain that is less than 100 feet below the aircraft and above is shown as red (**Figure 4-2**).

When operating within the airport environment, terrain coloring is removed except for terrain that is 100 feet above the airport elevation.



NOTE

Obstacles are always alerted and never removed.

4.2. Flight Path Marker Coloring

The Flight Path Marker (FPM) has a terrain warning function when a collision with terrain or an obstacle is predicted. The FPM will change shape and color, depending on the predicted time to collision. The FPM colors are green, white, amber, and red.

A green FPM indicates that full TWS Alerts are available (**Figure 4-3**).

A white FPM is a visual cue indicating that TWS terrain alerts are on; however, Terrain Alerts will be generated by terrain 100 feet higher than the runway elevation and all mapped obstacles (**Figure 4-4**).

An amber FPM is a Caution alert predicting terrain/obstacle collision within 45 seconds if the current flight path is maintained (**Figure 4-5**).

A red FPM is a Warning alert predicting terrain/obstacle collision within 30 seconds if the current flight path is maintained (**Figure 4-6**).

The FPM shows the predicted path of the aircraft and lags in dynamic maneuvers. See *Section 2.2 Flight Path Marker - FPM*.

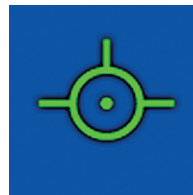


Figure 4-3 Green FPM



Figure 4-4 White FPM



Figure 4-5 Amber FPM

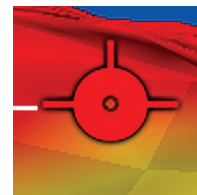


Figure 4-6 Red FPM

4.3. Caution/Warning Text Annunciations

Textual annunciations for TWS Alerts are annunciated on the Data Bar of the PFD and MFD announcing the type of threat, i.e. terrain or obstacle.

4.4. Aural Alert

The Aural Alert (an audible alarm from an external tone generator) provides a distinct stuttered, 3-second aural tone when a terrain/obstacle alert occurs. After the initial alert tone has sounded, the aural alert will sound again whenever a higher priority alert occurs.



NOTE

In aircraft certified with a Terrain Avoidance Warning System (TAWS), the Aspen TWS system does not provide audible alert or text alert information. Only the FPM Coloring and the Terrain Coloring is displayed.

4.5. TWS Elements and Warning Levels

The two basic elements of the Terrain Warning System are:

- Predictive Terrain/Obstacle Conflict, and
- Predictive Terrain/Obstacle Proximity

The two basic Warning Levels are:

- Normal Warning Level, and
- In-Range Warning Level

4.5.1. Predictive Terrain/Obstacle Conflict

The TWS uses the Flight Path Marker to predict a collision with terrain or an obstacle. When the Flight Path Marker is positioned over terrain or an obstacle and the Terrain Warning System predicts that a potential collision will occur within 45 seconds (if the current flight path is maintained) the audible alarm is sounded and the green Flight Path Marker changes its shape and turns to an amber color (**Figure 4-7**).

An amber text alert is annunciated on the Data Bar announcing the type of threat, e.g.

“CAUTION - TERRAIN, TERRAIN” (**Figure 4-7**) or

“CAUTION - OBSTACLE, OBSTACLE” (**Figure 4-8**).

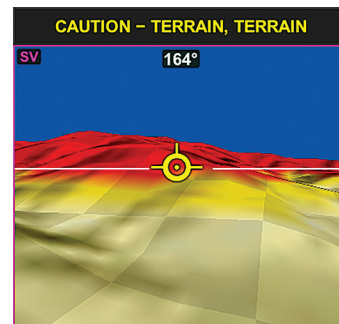


Figure 4-7 Amber FPM and CAUTION – Terrain



Figure 4-8 Amber FPM and CAUTION – Obstacle

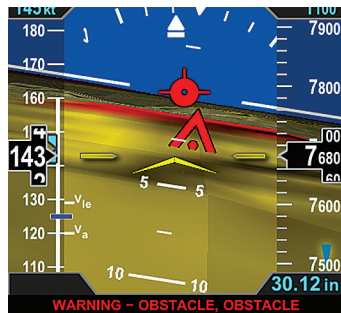


Figure 4-9 Red FPM and CAUTION - Obstacle

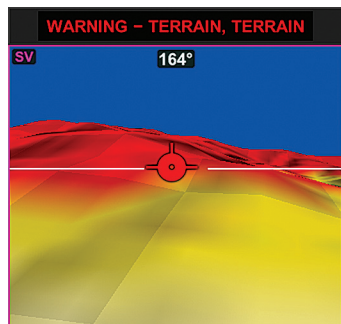


Figure 4-10 Red FPM and CAUTION - Terrain

Similarly, when TWS predicts that a potential collision will occur within 30 seconds (if the current flight path is maintained) the audible alarm is sounded and the Flight Path Marker changes its shape and turns to a red color (**Figure 4-9**).

A red text alert is announced on the Data Bar announcing the type of threat, e.g.

"WARNING - TERRAIN, TERRAIN" (Figure 4-9) or "WARNING - OBSTACLE, OBSTACLE" (Figure 4-10).

 WARNING

Changes in heading can cause an immediate conflict that is much less than the 45 or 30 seconds explained here.

4.5.2. Predictive Terrain/Obstacle Proximity

When the aircraft is close to the ground, the terrain and obstacles displayed in Synthetic Vision and on the SV3 moving map change color. The terrain and tops of obstacles ahead show yellow when within 500 feet of the aircraft and red when within 100 feet.

 WARNING

Accurate terrain information is predicated on the correct barometric pressure. Always ensure that you have accurate and timely barometric pressure information otherwise the terrain and obstacle elevation data could be erroneous.

4.5.3. Normal Warning Level

The Normal Warning Level is in effect when away from an airport. A green Flight Path Marker indicates that full terrain/obstacle colorization and alerting is used. (TWS is operating at the normal warning level).

4.5.4. In-Range Warning Level

When on approach to a runway, the terrain coloring is reduced. Only obstacles over 200 feet AGL, and terrain higher than 100 feet above the runway elevation will elicit a caution or warning indication. The terrain 100 feet above the aircraft will be red-colored. A white Flight Path Marker indicates that the system is operating within the airport environment where reduced terrain colorization and alerting is used. (TWS is operating at the in-range warning level).

On takeoff, the Flight Path Marker appears at 40 knots and is white in color until leaving the immediate runway vicinity or at 300 feet AGL.

What this means is under normal circumstances there should not be a terrain or obstacle conflict. In abnormal circumstances, cautions and warnings can be very helpful.

On a precision approach, terrain cautions or warnings are not anticipated. On a non-precision approach, a terrain caution or warning is probable depending on the rate of descent toward the terrain.

Landings at most airports do not generate an alert. Some airports with unusual topography may generate alerts when the Flight Path Marker points toward nearby higher terrain.

If multiple landings are anticipated at a runway that elicits alerts, TWS can be inhibited in the Menu.

Unless inhibited, TWS operates in the background even when Synthetic Vision is not selected. If a caution or warning is generated (non-TAWS aircraft) the conflict can be instantly displayed by pressing the Lower Middle button labeled TERR (Figure 4-11 and Figure 4-12).



Figure 4-11 PFD Terrain Alert, Synthetic Vision Not Selected

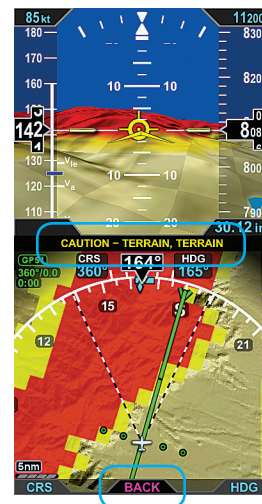


Figure 4-12 PFD Terrain Alert, Synthetic Vision View



Figure 4-13 MFD Obstacle WARNING, Synthetic Vision Not Selected

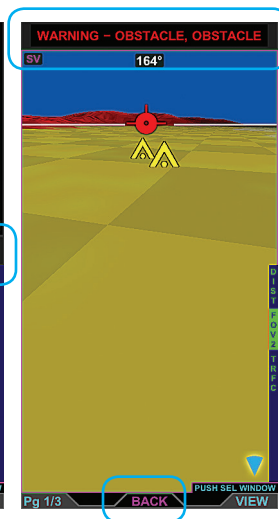


Figure 4-14 MFD Obstacle WARNING, Synthetic Vision VIEW

When a terrain alert occurs with Synthetic Vision not displayed on the PFD, pressing the Lower Middle button will switch the display to SV3 for situational awareness. SV3 automatically presents the ARC mode with a 5nm range set on the HSI. After selection, the Lower Middle button changes to BACK (**Figure 4-12**) to enable the pilot to quickly return to the previous display.

If the BACK button is not pressed, the BACK label will be removed after 30 seconds and the SV3 display remains. Press the SV3 Hot Key to return to the previous display.

When an advisory occurs on the MFD and Synthetic Vision is not shown, pressing the Lower Middle TERR button will switch the display to the Full Screen LAYOUT, presenting the Synthetic Vision VIEW for situational awareness (**Figure 4-13**). After selection, the Lower Middle button changes to BACK to enable the pilot to quickly return to the previous display (**Figure 4-14**).

If the BACK button is not pressed, the BACK label will be removed after 30 seconds and the Full Screen (Pg 1/3) LAYOUT remains. Rotate the Left Knob to return to the previous display.

4.6. TWS Settings

The Terrain Warning System (TWS) is enabled from the MENU and has three settings; ON, INH (Inhibit), and SV ONLY. See *Section 6 ESV Display Options MENU*.

- ON** The TWS is enabled. (TWS Alerts are on)
- INH** The TWS Alerts are inhibited. The terrain coloring, Aural Alert, and terrain/obstacle Caution and Warning text annunciations are turned off.
- SV ONLY** The TWS Alerts are enabled only when Synthetic Vision is displayed.

4.7. TWS INH (Inhibit) Annunciation

A “TWS INH” is annunciated on the Nav Display (**Figure 4-15**) whenever “INH” is selected from the TWS Menu. When INH is selected, the following are inhibited:

- Terrain Coloring
- FPM Coloring
- Caution/Warning Text Annunciations and
- Aural Alert



NOTE

In aircraft certified with a Terrain Avoidance Warning System (TAWS), the Aspen TWS system does not provide audible alert or text alert information. Only the FPM Coloring and the Terrain Coloring are displayed.

Figure 4-15 illustrates the Terrain Warning Inhibit message, meaning, the terrain coloring is not displayed and terrain alerting is not operating. Figure 4-1 shows the same conditions with Terrain Warning Enabled.

TWS INH is also annunciated whenever SV ONLY is selected and Synthetic Vision is not displayed (**Figure 4-16**).

See Section 6, *ESV Display Options MENU*.

Figure 4-17 illustrates the TWS INH annunciation on the Data Bar of the MFD.



Figure 4-15 TWS INH Annunciation



Figure 4-16 TWS INH Annunciation, PFD

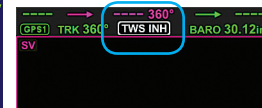


Figure 4-17 TWS INH Annunciation, MFD



Figure 4-18 Invalid TWS Annunciation, PFD

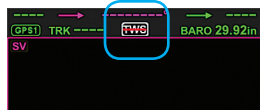


Figure 4-19 Invalid TWS Annunciation, MFD

4.8. Invalid TWS Annunciation

When ESV is detected as failed, an Invalid TWS message is shown with a red slash, indicating that Terrain Warning is unavailable.

The Invalid TWS is annunciated on the Nav Display of the PFD (**Figure 4-18**) and on the Data Bar of the MFD (**Figure 4-19**).

See Section 7, *ESV Failure Annunciations*.

Chapter 5

Traffic Symbols

For aircraft equipped with a compatible traffic detection system and the optional Evolution Hazard Awareness (EHA) option, ESV 3D Traffic Symbols (**Table 5-1**) are presented on the Synthetic Vision VIEWs. The traffic symbols are oriented in three dimensions. A traffic symbol will appear larger as the traffic approaches and smaller as the traffic recedes.

Traffic Advisory	Proximity Advisory	Other Traffic
		

Table 5-1 ESV 3D Traffic Symbols



NOTE

A compatible traffic detection system must be installed and the optional Evolution Hazard Awareness (EHA) must be enabled in the PFD software. EHA is included as a standard feature on all Aspen MFDs.



WARNING

Do not rely on the PFD/MFD as the sole source of data for traffic avoidance. It is the pilot's responsibility to visually acquire other aircraft for safe flight. Maneuver your aircraft based only on ATC guidance or positive acquisition of conflicting traffic. Traffic information is:

- *Provided as a proximity warning only.*
- *Intended to assist the pilot in the visual acquisition of other aircraft.*
- *Not intended to provide recommended avoidance maneuvers.*
- *Not provided for aircraft that are not transponder equipped, experiencing a transponder failure, or (in the case of TIS) out of radar coverage.*



Figure 5-1 PFD Traffic 2 / 3 Hot Key



Figure 5-2 Traffic Advisory



Figure 5-3 Traffic Display

5.1. PFD Traffic

When the optional Evolution Hazard Awareness (EHA) is installed, the PFD TRFC Hot Key (located in the 2/3 Hot Key Menu of the PFD) enables and disables the ESV 3D Traffic Overlay and the traffic Altitude Filter settings. Multiple presses of the TRFC Hot Key cycles through the traffic Altitude Filter settings; TRFC (Off)-TFCN (Normal)-TFCU (Unrestricted)-TFCA (Above) and TFCB (Below) in a round-robin sequence (**Figure 5-1**).

5.2. PFD Traffic Advisory

When a traffic advisory occurs on the Synthetic Vision VIEW, an amber TRAFFIC annunciation is automatically presented in the Data Bar. Additionally, TRFC appears in amber above the Lower Middle button (**Figure 5-2**).

Pressing the Lower Middle button when the amber TRFC appears, switches the display to SV2 and presents the traffic on the Nav Display for situational awareness on the Nav Display. After selection, the Lower Middle button label changes to BACK to enable the pilot to quickly return to the previous display (**Figure 5-3**).

All traffic shown on the Nav Display of SV2 and SV3 are presented in 2D plan view (top-down view) and represent the relative range and bearing to the aircraft. The range shown on the lower left of the view represents the range from the center of the compass rose to the edge of the compass rose.

5.3. MFD Traffic

The TRFC Hot Key selects the traffic Altitude Filter settings. Pressing the TRFC Hot Key will cycle through the filter settings; TRFC (Off) - TFCN (Normal)- TFCU (Unrestricted)- TFCA (Above) and TFCB (Below) in a round-robin sequence (**Figure 5-4**).

5.4. MFD Traffic Advisory

When a traffic advisory occurs while viewing the Full Screen (Pg 1/3) of the MFD, an amber TRAFFIC annunciation will be presented in the Data Bar. Additionally, TRFC appears in amber above the Lower Middle button (**Figure 5-5**). Pressing the Lower Middle button will switch the display to the Split Screen (Pg 2/3) and present the traffic in the upper window (Traffic VIEW) for situational awareness. The middle button label changes to BACK to enable the pilot to quickly return to the previous display (**Figure 5-6**).

If the BACK button is not pressed, the BACK label will be removed when the traffic is no longer a threat and the Split Screen (Pg 2/3) display remains. To return to the previous Full screen LAYOUT, rotate the Left Knob to Pg 1/3.



Figure 5-4 MFD Traffic Hot Key



Figure 5-5 MFD Traffic Advisory



Figure 5-6 MFD Traffic Display

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Chapter 6

ESV Display Options MENU

6.1. PFD Menu

The SV SETTINGS page in the MENU displays options for inhibiting the Terrain Warning System (terrain colorization and alerting), selecting the airports to be displayed or removing the Flight Path Marker from Synthetic Vision (Figure 6-1).

To access the SV SETTINGS page

1. Press the MENU Button and rotate the Right Knob to the SV SETTINGS page.
2. Select the Menu Key display option and rotate the Right Knob to the desired setting.
3. Press the MENU Button to exit.



Figure 6-1 PFD Menu



Figure 6-2 MFD Menu

6.2. MFD Menu

The CHART/SV SETTINGS page in the MENU displays options for Terrain Warning System (TWS), SV Airport Flag Display, and SV Aircraft Reference Symbol (**Figure 6-2**).

To access the CHART/SV SETTINGS A page

1. Press the MENU Button and rotate the Right Knob to the SV SETTINGS page.
2. Select the Menu Key display option and rotate the Right Knob to the desired setting.
3. Press the Menu Button to exit.

Chapter 7

ESV Failure Annunciations

All ESV Failure Annunciations are presented on the Data Bar of the PFD and on the bottom of each Synthetic Vision VIEW of the MFD. Additionally, an Invalid TWS (TWS slashed with a red line) is displayed whenever an ESV failure occurs.

When Synthetic Vision VIEW becomes unavailable on the PFD, the PFD reverts to the traditional blue over brown symbology and a text annunciation is presented on the display indicating the SV fault, e.g. "SV DATABASE UNAVAILABLE" (**Figure 7-1**).

When Synthetic Vision becomes unavailable on the MFD, the MFD Synthetic Vision VIEW turns black and a text annunciation indicating the failure is presented at the bottom of the SV VIEW, e.g. "SV POSITION INVALID" (**Figure 7-2**).

The following conditions will render ESV unavailable:

- Attitude, Altitude or Heading is invalid
- GPS is not receiving the position or the magnetic variation
- Database failure
- Aircraft is near or outside of the lateral limits of the database area
- While the terrain data is loading
- While the obstruction data is loading



Figure 7-1 SV DATABASE UNAVAILABLE Annunciation

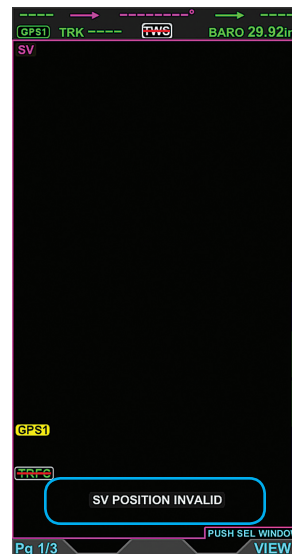


Figure 7-2 SV POSITION INVALID Annunciation

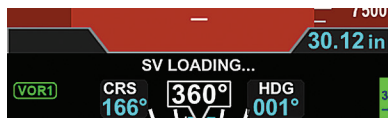


Figure 7-3 SV LOADING... Annunciation

NOTE

"SV LOADING..." is annunciated at start up or whenever SV Data is loading (Figure 7-3).

PFD Annunciation Display	Annunciation Description
	SV UNAVAILABLE : ADAHRS FAIL The attitude, altitude or heading have become invalid
	SV DATABASE UNAVAILABLE The aircraft is outside the valid database area
	DATABASE FAIL The Jeppesen database failed

Table 7-1 PFD ESV Failure Description

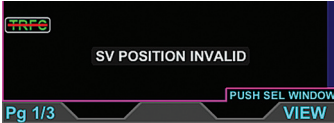
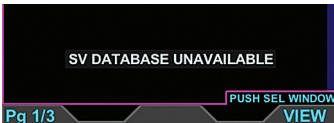
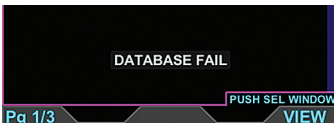
MFD Annunciation Display	Annunciation Description
	SV POSITION INVALID The GPS is not receiving the position or magnetic variation
	ADAHRS FAIL (Thumbnail VIEW) The attitude, altitude or heading have become invalid
	SV DATABASE UNAVAILABLE The aircraft is outside the valid database area
	DATABASE FAIL The Jeppesen database failed

Table 7-2 MFD ESV Failure Description

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Chapter 8

8.1 Database Confirmation Screen

The Confirmation Screen displays the validity dates of the currently loaded Jeppesen Database, the Synthetic Vision Awareness and Terrain Awareness messages (**Figure 8-1** and **Figure 8-2**).

The information presented on Synthetic Vision is advisory only. The pilot is responsible for terrain and obstacle avoidance by visual means or by following approved instrument procedures. At start up, the pilot must acknowledge this operational limitation and the validity dates on the confirmation screen by pressing either the Left or Right Knob.

8.2 MicroSD Card

This section contains the instructions for loading the Terrain, Obstacle, and Navigation databases into the EFD1000 or 500 system. Each Aspen MFD that uses the database must have a micro Secure Digital (microSD) card. If the EFD1000 PFD has Synthetic Vision, it too must have a microSD card loaded with the database.



Figure 8-1 Database Confirmation Screen

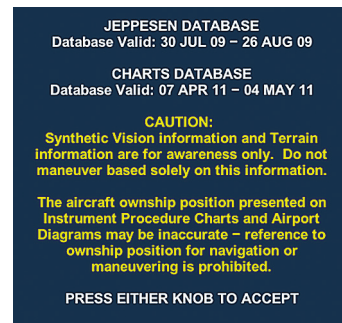


Figure 8-2 Database Confirmation Screen

8.3. Loading Database on microSD Card

The Terrain, Obstacle, and Navigation database information is loaded onto a microSD card that is shipped with the Aspen EFD1000 or EFD500 unit. Obstacle and Navigation databases data are combined and presented as a single update file from Jeppesen that is delivered every 28 days. Contact Jeppesen for information or subscribing to the data service and instructions for downloading data to the microSD card.



CAUTION

Do not expose the cards to electrostatic discharge or electrical interference.

Keep the cards out of direct sunlight.

If the microSD card is misplaced, contact Jeppesen directly to purchase an additional or replacement terrain card. Jeppesen Customer Service: 1-800-621-5377 or email captain@jeppesen.com.



NOTE

Only microSD cards received from Aspen Avionics or Jeppesen are authorized. Do not use other microSD cards for the Aspen systems.

**NOTE**

EFD1000 and EFD500 units with the Charts option have Charts loaded on the microSD card. Contact seattleavionics.com for update information.

8.4. Loading the microSD Card into the EFD System

The microSD card slot on the EFD is a small horizontal slot located on the lower part of the unit bezel in the center (Figure 8-3). The slot is spring-loaded with an integral locking mechanism. Pushing the card in once locks the card in place. Pushing it again releases the locking mechanism for removal.

8.4.1. Card Installation Procedure and Operational Check

Installation Procedure

1. Remove the card from the packaging.
2. Slide the card into the card slot with the label side face up and the metal contacts facing down and toward the unit.

**CAUTION**

Do not force the card. The microSD card only goes one way.

3. Press the card against the spring tension until it is fully inserted, then slowly



Figure 8-3 microSD Card Slot Locations

release the pressure. The card will lock into place.



NOTE

It is possible to jam the card between the bezel and the outer edge of the card slot. If the card does not slide in smoothly, something is wrong. Make sure the card is in the card slot and oriented correctly.

Operational Check after installing the microSD card

1. Turn on the EFD system(s) and select the functions that use databases (Moving Map, Terrain, Charts, and Synthetic Vision).
2. Verify the EFD(s) start properly and the functions can be accessed.

8.4.2 Removal Procedure

microSD card Removal

1. Have a suitable packaging available to accept the card.
2. Press the card against the spring tension, then slowly release the pressure. The card will unlock and is ready to be removed.
3. Grasp the card with the thumb and forefinger and remove the card.
4. Place the microSD card in the packaging.



CAUTION

It is possible to push the card in with a fingernail and then suddenly release it, ejecting the microSD card. If the card is dropped, keep in mind that it can be resting on its side.

Chapter 9

Glossary

2D	Two-dimension	FOV2	Field of View 2 (Wide Field of View)
3D	Three-dimension	FP APT ONLY	Flight Plan Airports Only
		FPM	Flight Path Marker
ADAHRS	Air Data, Attitude and Heading Reference System		
AGL	Above Ground Level	GPS	Global Positioning System
ALL HRD SFC	All Hard Surface Runway Airports		
ATC	Air Traffic Control	INH	Inhibit
DIST	Distance	MFD	Multi-Function Display
		microSD	micro Secure Digital card
EFD	Evolution Flight Display		
EHA	Evolution Hazard Awareness	NDB	Non-Directional Beacon
ESV	Evolution Synthetic Vision	nm	Nautical Mile
FD	Flight Director	OAT	Outside Air Temperature
FOV	Field of View		
FOV1	Field of View 1 (Narrow Field of View)	PFD	Primary Flight Display

SV	Synthetic Vision
SV1	Synthetic Vision 1 (PFD Full Screen)
SV2	Synthetic Vision 2 (PFD Split Screen)
SV3	Synthetic Vision 3 (PFD Split Screen)
SV APT FLG DSPL	Synthetic Vision Airport Flag Display
SYNC	Synchronize
TAWS	Terrain Awareness and Warning System
TERR WRN SYS	Terrain Warning System
TFCA	Traffic Above
TFCB	Traffic Below
TFCN	Traffic Normal
TFCU	Traffic Unrestricted
TIS	Traffic Information System
TRFC	Traffic
TWS	Terrain Warning System
TWS INH	Terrain Warning System Inhibit
VOR	VHF Omnidirectional Radio Range
ZPL	Zero Pitch Line

EVOLUTION

FLIGHT DISPLAY

Evolution Angle of Attack Pilot's Guide Supplement

ASPEN AVIONICS™
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Pilot Guide Supplement Overview

This Pilot's Guide supplement provides information on the use and operation of the Aspen Evolution Angle of Attack feature loaded on the Aspen Evolution Flight Display 1000 Pro / Pilot / VFR PFD, Evolution Flight Display 1000/ 500 Multifunction Flight Display and Portrait Evolution Back UP Display. This guide is current as of the Date Published. Specifications and operational details are subject to change without notice. Please visit the Aspen Avionics web site, aspenavionics.com, for the most up-to-date Pilot's Guide.

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Functional Operation

The Aspen Angle of Attack system uses instantaneous velocities derived from three-axis accelerations and the basic laws of motion to derive the Angle Of Attack (AOA). The display is a conditional indicator that provides a graphic depiction of the stall margin and trend toward stall for the airfoil when the flaps are up and when the flaps are DOWN. It incorporates sensory cues that provide a quick glance sense of rate and trend toward stall. No external devices or remote indicators are required. This is a software function of the Aspen EFD1000 and EFD 1000MFD. The Aspen system uses airspeed as one of the parameters to derive the AOA.

Functional Characteristics

- The pitch and roll angular operational range exceeds 80 degrees from level.
- The resolution of the AOA indication over the specified range is less than ½ degree.
- The minimum accuracy of the AOA indication over the specified range is less than 2 degrees.
- The range of sideslip angles for which the specifications above are valid is greater than 10 degrees.

Conventions

The following conventions, functionality, terminology and definitions are used in this manual and the Evolution EFD 1000 PFD, EFD 1000/500 MFD, and Evolution Back Up Display.

Covered Functionality

This pilot guide supplement covers all the Angle of Attack functions available in the EFD 1000 PFD and EFD 1000 / 500 MFD, Portrait Evolution Back UP Display. For instructions on: the operation of the EFD 1000 PFD PRO / Pilot refer to the Aspen Pro / Pilot PFD Pilot guide, document number 091-00005-001, the operation of the EFD 1000 VFR PFD, refer to the Aspen VFR Pilot guide, document number 091-00028-001, the operation of the EFD 1000 / 500 MFD, refer to the Aspen MFD

Pilot guide, document number 091-00006-001 and the Evolution Back Up Display refer to the Aspen Evolution Back Up Display Pilot guide, document number 091-00027-001.

Terminology

The abbreviation "AOA" is used extensively throughout this Pilots Guide and refers to Angle of Attack.

The term PFD refers to the Aspen EFD 1000 PFD PRO, Pilot and VFR Primary Flight Display, the term MFD refers to the Aspen 1000 / 500 Multi-Function Display's and the term EBD refers to the Aspen Evolution Back Up Display.

Example Graphics

The example graphics and screen shots used throughout this Pilot's Guide are provided for reference only. Actual equipment, software and display images contained in this supplement may differ from the most current release.

Note

For calibration instructions and a list of data needed for calibration refer to the Aspen Evolution Angle of Attack installation calibration instructions.

The coefficient of lift curves depicted in the pilot guide are provided for reference. The actual curves and corresponding angle of attack data for your aircraft may vary from those shown.

Caution

This AOA is designed to be accurate in the aerodynamic configuration the AOA was calibrated. When the airfoil changes shape due to icing, the AOA indicator may no longer accurately display the angle of attack.

Restrictions and Limitations

The Aspen Angle of Attack software is intended to be used in fixed wing aircraft and is not suitable for use in Helicopters or aerobatic aircraft flying outside of the utility category. The following AOA SYSTEM limitations apply:

- The AOA system is non-required and is to be used only as supplemental information to the pilot. The AOA system may not be used as a substitution for the certified aircraft stall warning system.
- The AOA indications are not to be used for takeoff reference.
- No operational credit may be taken for such items as reduced approach speed and shorter landing distances.
- Airspeed failure or erroneous airspeed will result in erroneous AOA indications.
- The AOA indications are not valid when the wings or empennage are frost or ice-contaminated.

Pilot Familiarity

While the Aspen AOA feature when installed in an Aspen PFD, MFD and Back UP Display is reasonably intuitive and easy to use, some familiarity

is required. Aspen Avionics strongly recommends that new users get some dual instruction from an experienced CFI, and spend some time becoming familiar with the AOA in day VFR conditions with a safety pilot.

LIMITED WARRANTY

Aspen Avionics, Inc.

1. **YOUR WARRANTY.** Aspen Avionics, Inc. ("Aspen") warrants to you, the original purchaser, that its Products (if purchased from an authorized dealer) will comply with applicable specifications (as set forth in the owner's manual) in all material respects and will be free from material defects in workmanship or materials for a period of twenty-four (24) months beginning with the date that the aircraft in which the Product has been installed has been returned to service following installation by an Aspen authorized dealer ("Return to Service Date"). "Product" means new end equipment or hardware items, replaceable units and components of those units.

2. **YOUR REMEDY.** During the term of this warranty, Aspen will repair or replace, at its discretion, without charge (see Section 13 below for information on covered transportation costs), any Product that does not comply with the warranty of Section 1 above (a "Nonconforming Product"), so long as the warranty claim is timely submitted and the procedures in Section 14 (below) are followed. Aspen warrants repaired and/or replacement items only for the unexpired portion of the original warranty period, or, if the warranty has expired, for six months from Aspen's shipment of the repaired or replacement Product.

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- A. Maintain records accurately reflecting operating time of and maintenance performed on the Product,
- B. Furnish proof sufficient to establish that the item is a Nonconforming Product, and
- C. Allow Aspen access to all relevant records in order to substantiate your warranty claim.

4. **EXCLUSIONS.** The following are not covered by (and are expressly excluded from) this warranty:

- A. Normal wear and tear and the need for regular overhaul and maintenance,
- B. Exposure of the Product to temperature, environmental, operating, or other conditions other than those prescribed in the owner's manual,
- C. Failure to install or operate the Product as prescribed in the owner's manual or as Aspen otherwise directs,
- D. Alterations or repairs made by anyone other than Aspen or its authorized service center,

- E. Maintenance, repair, installation, handling, transportation, storage, operation (including, without limitation, operation of the product's software or host medium), or use which is improper or otherwise does not comply with Aspen's instructions as set forth in the owner's manual,
 - F. Accident, contamination, damage from a foreign object or weather conditions, abuse, misuse, neglect, or negligence,
 - G. Exposure of the product or the product's host medium to any computer virus or other intentionally disruptive, destructive, or disabling computer code, and
 - H. Any damage precipitated by failure of a product Aspen has supplied that is not under warranty or by any product supplied by someone else.
5. **INVALIDATION OF WARRANTY.** This warranty is void if the product is altered or repair is attempted or made by anyone other than Aspen or its authorized service center.
6. **WARRANTY CARD.** The Return to Service Date must be included in an accurately completed Aspen warranty application form submitted by the installing authorized dealer within 30 days of the Return to Service Date. The warranty application must be signed by the authorized repairman who certifies that the equipment has been safely and properly installed in accordance with all Aspen supplied technical information and in accordance with all applicable FAA procedures and requirements. The warranty application form must note the repairman's FAA certificate number to be valid. FAILURE TO COMPLETE AND RETURN THE WARRANTY CARD MAY RESULT IN DENIAL OF WARRANTY CLAIMS.

MAKING CERTAIN THAT THE WARRANTY CARD IS COMPLETED, SIGNED, AND RETURNED IS YOUR RESPONSIBILITY.

7. **SOLE REMEDY.** Aspen's sole obligation, and your exclusive remedy under this warranty, is limited to either the repair or replacement, at Aspen's option, of any Nonconforming Product as provided herein.

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Some States do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

9. **INCIDENTAL DAMAGES.** ASPEN SHALL NOT UNDER ANY CIRCUMSTANCES BE LIABLE FOR ANY SPECIAL, DIRECT, INDIRECT, INCIDENTAL OR CONSEQUENTIAL LOSS OR DAMAGES OF ANY KIND (INCLUDING WITHOUT LIMITATION: DAMAGES FOR LOSS OF PROFITS, LOSS OF REVENUES, OR LOSS OF USE OR BUSINESS INTERRUPTION), EVEN IF ASPEN HAS BEEN ADVISED OF THE POSSIBILITY OR CERTAINTY OF THOSE DAMAGES OR IF ASPEN COULD HAVE REASONABLY FORESEEN THOSE DAMAGES.

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11. **EXTENSION OF WARRANTY.** No extension of this warranty will be binding upon Aspen unless set forth in writing and signed by Aspen's authorized representative.

12. **DEALER WARRANTIES.** Any express or implied warranty or remedy in addition to or different from those stated herein that is offered by a dealer ("Dealer Warranty") will be the sole responsibility of the dealer, who will be solely responsible for all liability, loss, cost, damage, or expense arising out of or in connection with any such Dealer Warranty. Although Aspen provides training and assistance to dealers, it cannot control the installation of its Products by its dealers, which are independent businesses not owned or controlled by Aspen.

13. **TRANSPORTATION COSTS.** Aspen will assume round trip transportation costs for a Product determined by Aspen to be a Nonconforming Product in an amount not to exceed normal (non express) shipping charges within the continental United States. You are responsible for all import/export fees, taxes, duties, customs, documentation fees, clearance fees, and similar fees and charges. You

may contact Aspen to obtain a freight courier account number for prepaid shipping of the return. If Aspen subsequently determines that the Product is not a Nonconforming Product, that this warranty is inapplicable, that the Product is out of warranty, that the defect or malfunction is excluded from coverage, or that the warranty is invalid, Aspen will invoice you for repair or replacement costs and the shipping costs. Risk of loss or damage for any Product in transit will be borne by the party initiating the transportation.

14. **WARRANTY PROCEDURE.** If you require warranty service, you may contact your local Aspen Authorized Dealer or you may contact Aspen directly as described below. An original or copy of the sales receipt from the original Aspen Authorized dealer will be required to obtain any warranty service. You may contact Aspen for warranty service directly by calling Aspen Customer Service at (505) 856-5034; by writing to Aspen Customer Service Department, Aspen Avionics, Inc., 5001 Indian School Road NE, Albuquerque, New Mexico, 87110; or by visiting the Aspen Website at <http://www.aspenavionics.com>.

This warranty gives you specific legal rights, and you may also have other rights, which vary from State to State.

Chapter 1

Welcome & Introduction

1.1. Welcome & Introduction

Welcome to Aspen's innovative patent pending Angle of Attack (AOA) indicator. It's the most unique, easy and cost effective way to add stall margin awareness to your aircraft today.

Why add AOA? In a recent report the General Aviation Joint Steering Committee claimed that "Loss of Control" accidents represented over 40% of the General Aviation fatal accidents from 2001-2010. The GAJSC's "Loss of control working group's" number one recommended safety enhancement was for the General Aviation community to install and use an AOA for better stall margin awareness. Adding an Evolution Angle of Attack feature is a great way to meet that safety enhancement and improve your stall margin awareness.

The AOA option, when added to your Aspen PFD, MFD or Portrait EBD, requires only a software upgrade, inputting of some basic aircraft weight and V speed data that is found in your Pilot Operating Handbook and a 15 minute calibration flight. Only Aspen's unique technology allows you to add AOA to your aircraft without having to cut holes in the aircraft skin to mount AOA sensors, tap into your pitot static system or run cables from your wing to the airframe and instrument panel.

Aspen's unique AOA display simultaneously displays both Flaps UP and Flaps DOWN AOA.

Combining a Flaps UP and Flaps DOWN indication into one display provides an easy to see visual reference of the difference between aircraft Flap UP and Flap DOWN AOA performance.

This is valuable information when you are implementing a GO AROUND.

Aspen's PFD "Auto" feature automatically displays the AOA indicator only when you need it and minimizes screen clutter when you don't. Which meets Aspen's goal to provide an easy to use user experience and provide you the information you need when you need it without creating unnecessary screen clutter and confusion.

The Evolution Angle of Attack can be added to an Aspen PFD, MFD and a Portrait Evolution Back UP Display. Aspen is known for its unique and innovative solutions for pilots. Welcome to the latest level of innovation from Aspen Avionics.

1.2. System Description

Aspen's Evolution Angle of Attack option for Aspen EFD 1000 PFD's, MFD's and a Portrait Evolution Back UP Display is a simple software upgrade. The patent pending software calculates and displays AOA from flight envelope data collected from the AHR'S, Air Data Computer and a certified GPS. When calibrated properly it calculates the aircraft AOA and displays the Flaps UP and Flaps DOWN AOA on the color coded AOA bar display.

The Evolution Angle of Attack provides the pilot a visual display of the AOA trend and the trend towards stall simultaneously in both the Flaps UP and Flaps DOWN configuration

1.3. Aspen Evolution AOA Configurations

Aspen's Evolution Angle of Attack can be loaded on the EFD 1000 Pro, Pilot, VFR PFD's; EFD 1000 / 500 MFD's and the Portrait Evolution Backup Display. The EFD 1000 Pro, Pilot, VFR PFD's; EFD 1000 MFD and the Portrait Evolution Backup Display calculate and display AOA. To operate properly the AOA function on these displays will need to be calibrated.

The Evolution 500 MFD receives AOA from the PFD or the MFD 1000 and displays it on the PAGE and window views selected. Since the MFD 500 is not calculating AOA it will not need to be calibrated.

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Chapter 2

AOA

2.1. Why AOA?

The lift a wing generates is dynamic and is based upon the air density, true airspeed, wing area, and the coefficient of lift. A simplified equation for calculating lift is:

$$L = \frac{1}{2} \rho v^2 A C_L$$

For our simplified explanation think of Lift as predominantly a factor of the coefficient of lift and airspeed. If air speed and the coefficient of lift are the dominant factors then perhaps one of them would make an ideal indicator of the wings available lift.

Unfortunately the airspeed at which an aircraft stalls varies with weight, load factor, center of gravity, etc. which makes it a relatively poor predictor of lift.

The coefficient of lift of a fixed wing aircraft changes with the angle of attack. As the angle of attack increases the corresponding coefficient of lift increases until you reach the critical angle of attack beyond which you lose lift and the wing stalls.

Unlike airspeed the wing always stalls at the same critical angle of attack which makes it an excellent predictor of lift regardless of airspeed, weight or attitude.

Since you were a student pilot you have been taught that an aircraft can stall at any airspeed, attitude or CG. With the addition of the Aspen Evolution Angle of Attack to your panel you now have a level of stall margin awareness well beyond the air speed indicator you may have previously relied on.

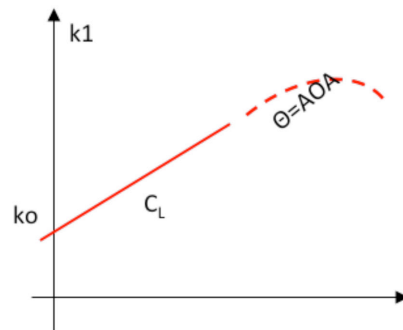


Figure 2-1 Coefficient of Lift Curve

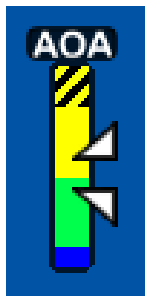


Figure 2-2
AOA Indicator

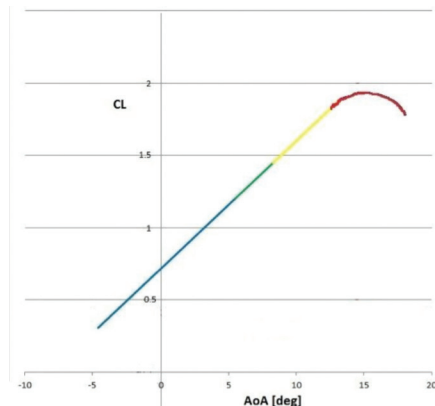


Figure 2-3
Display Color Bands VS Coefficient of Lift – Flaps DOWN¹

2.2 Display

The Aspen AOA indicator is comprised of a fixed colored tape with Blue, Green, Yellow and Yellow - Black Cross Hatch bands. Two pointers point to the AOA colored tape indicator. The top Flaps UP pointer and the bottom Flaps DOWN pointer. Due to the difference in the Flaps DOWN or Flaps UP aircraft performance it is possible for the two AOA pointers to simultaneously indicate two different AOA performance regions.

WARNING - *It's vital you refer to the pointer that corresponds to the current aircraft Flaps configuration for an accurate AOA indication. Failing to do so may result in inadvertently entering into a dangerous AOA condition.*

AOA Color Band Key

Color	AOA Condition
Yellow - Black Cross Hatch	Warning AOA
Yellow	Caution/High AOA
Green	Normal Approach AOA
Blue	Low AOA, Cruise flight

Table 2.1 AOA Color Band key

2.3 AOA Indicator Color Bands

Each colored band on the AOA indicator corresponds to a different position on an aircraft coefficient of lift curve. Each region depicts a different AOA or lift availability level. When flaps are deployed the shape of the wing is changed, lift increases and the coefficient of lift curve is shifted up. But even though the coefficient of lift curve has shifted the relative angle of attack performance points have not.

1. Example coefficient of lift curve. Does not represent an actual aircraft curve.

2.4. Low AOA (Blue)

When the pointer is in the Blue color band the aircraft is at a low angle of attack. This would most frequently be seen during normal or cruise flight .

2.5. Normal Approach AOA (Green)

When the pointer is in the Green color band, the AOA is indicating a normal approach stall margin. With the Flaps DOWN (**Figure2-3**) this occurs when the aircraft is at an AOA lower or equal to the minimum approach stall margin, which is typically near $1.3 V_{SO}$

The stall margin is greater than the short field approach stall margin¹

2.5.1. Green / Yellow transition

Approximately the short field approach AOA¹

2.6. Caution AOA (Yellow)

When the pointer is in the Yellow color band, the AOA is indicating a reduced stall margin. Cautioning you the current AOA is greater than normal and that should the AOA trend continue to increase it could result in entering the Yellow - Black Cross Hatch or Warning AOA region.

The stall margin is less than the short field approach stall margin¹

1. Stall margin at one g, maximum gross weight, zero bank angle, no acceleration. An approximate value due to calibration, weight, and calibrated vs indicated airspeed errors.

If the short field approach speed is not presented in the Airplane Flight Manual the normal approach speed is used. The instruction for Continued Airworthiness contain the calibration information for the airplane.

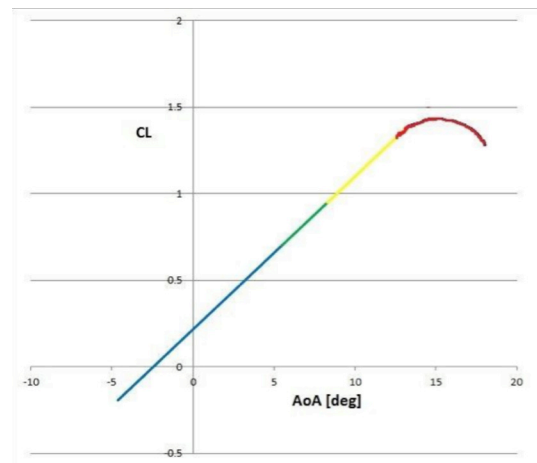


Figure 2-4
AOA display color bands vs coefficient of lift – Flaps Up¹

 NOTE

Reducing flaps while in a Caution or borderline Warning "Flaps DOWN" AOA state may result in a dangerous AOA condition..

 NOTE

The AOA system is non-required and is to be used only as supplemental information to the pilot. The AOA system may not be used as a substitution for the certified aircraft stall warning system.

2.6.1. Yellow / Yellow -Black Cross Hatch transition

Correlates approximately to the stall warning horn

2.7. Warning AOA (Yellow - Black Cross Hatch)

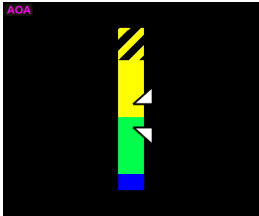
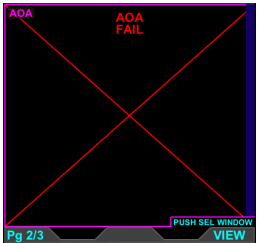
When the pointer is in the Yellow color band, the AOA is at a high / critical AOA and the aircraft could stall if the AOA increases further. Under this condition a stall is imminent and the pilot should maneuver to lower the AOA (pitch DOWN or speed up).

The stall margin is much less than the short field approach stall margin¹

2.7.1. Top of Yellow - Black Cross Hatch

Margin to actual stall is extremely small

2.8. AOA Annunciations

PFD	MFD	Description
		AOA indicator on. Top pointer indicates Flaps UP AOA, Bottom pointer indicates Flaps DOWN AOA
		AOA is either in calibration mode or out of calibration

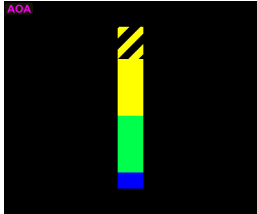
PFD	MFD	Description
		AOA is receiving insufficient or invalid data to accurately compute AOA.
In Auto mode the AOA indicator may display without pointers briefly before fading out when the aircraft is on the ground.		AOA indicator pointers fade out when the aircraft is on the ground and the wings are not creating lift.

Table 2.2
AOA Annunciations

2.9. AOA / Synthetic Vision Annunciation

In instances where AOA and Synthetic Vision are used simultaneously on a PFD or MFD 1000 in reversionary mode there is a small chance that the AOA indicator may cover a synthetic vision obstruction. In that rare instance when there is an obstacle behind the AOA for 5 seconds an "OBSTACLE BEHIND AOA" annunciation appears in the data bar. Once the AOA no longer covers the obstacle the annunciation fades out.



Figure 2.5
OBSTACLE BEHIND OBSTRUCTION Annunciation

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Chapter 3

Evolution AOA Operation

3.1. PFD / MFD 1000 Reversionary Mode / EBD

Overview

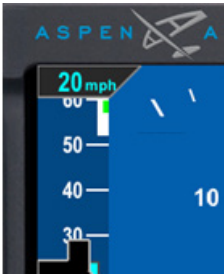
The Evolution AOA feature can be loaded on the EFD 1000 Pro, Pilot, VFR PFD; the EFD 1000MFD and the Portrait Evolution Back UP Display. Each of these implementations will need to be calibrated. If you plan to use AOA on your Evolution 1000 PFD and an Evolution 1000 MFD both displays will need to have the AOA feature loaded and calibrated independently.

Once loaded and calibrated the AOA feature is ON unless you change the menu setting to OFF or AUTO. The AOA OFF /AUTO selection is accessed on the PFD MENU General Setting C menu PAGE. Pressing the AOA DSPL hot key selects the AOA Display menu item, rotating the right knob steps the AOA display functionality between OFF and AUTO AOA settings.



Figure 3-1
PFD MENU General Setting C

3.1.1. ON / OFF/ Auto Annunciations

AOA OFF	 The PFD display shows the speed scale in mph (20, 30, 40, 50, 60) and the altitude scale in feet (10, 20, 30, 40, 50, 60). The AOA indicator is not displayed.	The AOA feature is off and the PFD does not display the AOA indicator.
AOA ON	 The PFD display shows the speed scale in kt (70, 80, 90, 100, 110) and the altitude scale in feet (10, 20, 30, 40, 50, 60). The AOA indicator is displayed, showing a yellow and red scale with a white needle pointing to 78.	The AOA feature is on and the PFD constantly displays the AOA indicator.

1. Example coefficient of lift curve. Does not represent an actual aircraft curve.

AOA Auto Mode	 The image shows a cockpit display for the AOA (Angle of Attack) indicator in 'AOA Auto' mode. The display features a vertical scale with markings at 30, 40, 50, and 60. A green bar is visible at the bottom of the scale, indicating the 'Blue' color band. The text 'AOA AUTO' is displayed in the center of the scale. The top of the display shows 'ASPEN' and a small aircraft icon.	AOA is in AOA Auto mode, "AOA Auto" is displayed when both AOA pointers are at the bottom of "Blue" Low AOA color band or the aircraft is on the ground.
AOA Auto Mode	 The image shows a cockpit display for the AOA (Angle of Attack) indicator in 'AOA Auto' mode. The display features a vertical scale with markings at 70, 80, 90, 100, and 110. A green bar is visible at the bottom of the scale, indicating the 'Green' color band. The text 'AOA' is displayed in the center of the scale. The top of the display shows 'ASPEN' and a small aircraft icon.	The AOA indicator appears when when the upper pointer is approximately 25% into the "Green" color band.

Table 3-1
AOA Off/On/ Auto Annunciations



Figure 3-2
WINDOW Selection Mode –Bottom WINDOW Selected

3.2. MFD

Overview

Both the EFD 500MFD and EFD 1000MFD can display the AOA indicator in any of the WINDOWS of PAGE 2 or 3. AOA is not available in the WINDOW of PAGE 1. The EFD 500 MFD uses the EFD 1000 PFD or EFD 1000MFD as its source of AOA data whereas the AOA feature needs to be loaded and calibrated separately on the EFD 1000MFD.

Adding AOA to a MFD WINDOW

3.2.1. Select Different PAGE or WINDOW

THE MFD contains three pages. Each Page contains either one, two or three windows. The arrangement of the windows on a page cannot be changed but the content of each window can be changed.

The EFD1000/500 MFD must be in Change VIEW Mode to change the current PAGE or WINDOW display. When the EFD1000/500 MFD is in Change VIEW Mode, the Right Knob label reads PUSH SEL WINDOW. When panning; viewing Airport, METAR, AIRMET/ SIGMET, or TFR information; or editing the airport identifier in the METAR view, the EFD1000/500 MFD is in VIEW Control Mode. When in VIEW Control Mode the Right Knob label changes to PUSH FOR BACK to allow the pilot to quickly exit VIEW Control Mode and return to Change VIEW Mode.

Viewing PAGES

- Rotate the Left Knob clockwise to select the next PAGE, counter-clockwise to select the previous PAGE. The label above the Left Knob will change to indicate the PAGE number currently displayed.

Selecting WINDOWS

- Push the Right Knob to activate WINDOW selection mode. The magenta border around the current WINDOW with FOCUS becomes bolder and the VIEW label above the Right Knob turns magenta. Each consecutive push of the Right Knob selects the next WINDOW on the PAGE and the magenta border will outline the selected WINDOW. (**Figures 3-2 and 3-3**).

3.2.2. Change VIEW

A WINDOW can display different VIEWS as outlined in Section 3.2.1. To select a different VIEW in any WINDOW you must first move the FOCUS to the WINDOW you want to change, and then select a different VIEW. The current VIEW name displays in the upper left of the active WINDOW (**Table 3-2**).

View	Name
Navigation Map	NAV MAP
Angle of Attack	AOA
Terrain Awareness	TERR
Traffic	TRFC
Stormscope	STRIKES
Data Link Weather	WEATHER
Secondary HSI	NONE
Synthetic Vision	SV
Secondary Attitude Indicator	NONE

Table 3-2
EFD1000/500 MFD VIEW Names



Figure 3-3
PAGE Selection Mode – Top Right WINDOW Selected



Figure 3-4
Change VIEW – New VIEW Selected

Change the VIEW of a WINDOW

1. Push the Right Knob to select the WINDOW you want to change. The Magenta border will move from WINDOW to WINDOW as the Right Knob is pressed to indicate which WINDOW is selected. The selected VIEW's name also displays in magenta.
2. Rotate the Right Knob to display the available VIEWS for that WINDOW until the VIEW you want displays (**Figure 3-4**).

Chapter 4

AOA Scenario's

AOA Usage Scenario's / What you will see / How to use AOA effectively in each scenario

4.1. Takeoff / Climb

PFD

The AOA indicator on the PFD will initially display "AOA AUTO" indicating that the AOA is operational but not yet providing useful AOA information. Shortly after the takeoff roll has begun, the AOA indicator will "come alive" and the indicator will appear with the pointers in the Yellow - Black Cross Hatch warning region. If your airplane uses flaps for takeoff, the "FLAPS UP" pointer will remain close to the Yellow - Black Cross Hatch color band and the "FLAPS DOWN" indication will move toward the GREEN color band. Takeoff is accomplished using airspeed. As the airplane climbs the "FLAPS UP" AOA pointer moves into the GREEN or perhaps in the blue region, indicating a large margin to stall. When both pointers enter the BLUE region, the AOA indicator will disappear, de-cluttering the PFD area.

MFD

The MFD will initially display the AOA indicator without the AOA pointers. Shortly after the takeoff roll has begun, the AOA indicator will "come alive" and the pointers will appear in the Yellow - Black Cross Hatch warning region. If your airplane uses flaps for takeoff, the "FLAPS UP" pointer will remain close to the Yellow - Black Cross

Hatch color band and the "FLAPS DOWN" pointer will move toward the GREEN color band. Takeoff is accomplished using airspeed. As the airplane climbs the "FLAPS UP" AOA pointer moves into the GREEN or perhaps in the blue region, indicating a large margin to stall.

4.2. Cruise Flight

PFD

During cruise flight both AOA pointers will be in the blue color band. If the PFD is in AOA AUTO mode the AOA indicator may not be visible and the AOA displays "AOA AUTO."

MFD

During low AOA conditions such as Cruise flight the AOA pointers should remain in or near the BLUE color band.

4.3. Approach

PFD / MFD

During approach, the "FLAPS UP" AOA pointer will lead the "FLAPS DOWN" pointer into the green color band as the airplane slows. As flaps are extended and the airplane slows the "FLAPS DOWN" AOA pointer should be near the center of the green region or slightly above. If the airplane slows to below the optimum (green) angle of attack, the "FLAPS DOWN" pointer will move into the yellow Caution region.

1. Example coefficient of lift curve. Does not represent an actual aircraft curve.

4.4. Approach to Landing Example

PFD / MFD

During down wind, when you are well above approach speed, both pointers will be in the blue region and the AOA will not be displayed on the PFD. As the airplane turns base and then to final, and slows, the FLAPS UP pointer will move into the green region and the AOA will appear. As the flaps are extended on the airplane the FLAPS DOWN AOA will be in the lower green range, toward the blue region. The FLAPS DOWN AOA will ordinarily remain in this region until landing. If the airplane slows, or there is a sudden maneuver such as a steep bank, the FLAPS DOWN AOA will show the condition and the margin to stall. If the airplane gets slow, the FLAPS DOWN AOA pointer will move into the yellow CAUTION color band. This normally means the airplane is on the back side of the power curve, and adding power and lowering the nose will restore the AOA. Further raising the nose will increase the rate of descent. After flare and rollout, the AOA will again disappear on the PFD, de-cluttering the attitude display.

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Chapter 5

Appendix

5.1. Operating Limitations

Refer to the latest version of the Airplane Flight Manual Supplement (AFMS), Aspen Avionics document 900-00008-001 for the limitations that apply to your specific aircraft installation.

5.2. Definitions

Stall Margin

Stall margin is the actual Angle of Attack compared to the stall Angle of Attack .

g

The airplane load factor. The load factor is defined as the ration of the lift of an aircraft to its weight. A load factor of one, or one g, occurs when the lift equals the weight of the aircraft.

5.3. Abbreviations

AFMS	Airplane Flight Manual Supplement
AHRS	Attitude Heading Reference System
AI	Attitude Indicator
AOA	Angle of Attack
CAS	Calibrated Air Speed
CG	Center of Gravity
CL	Coefficient of Lift
CL max	Coefficient of lift Maximum
CD	Coefficient of drag
CL/CD	Coefficient of lift over coefficient of drag
EBD	Evolution Back Up Display
EFD	Evolution Flight Display
GA	General Aviation
IAS	Indicated airspeed
Kt	Knots
MAC	Mean Aerodynamic Chord
MFD	Multi-Function Display
PFD	Primary Flight Display
V_s	Stall speed - clean
V_x	Best angle of climb speed
V_y	Best rate of climb speed



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S-TEC

Pilot's Operating Handbook Twenty | Thirty | Thirty Alt



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SECTION 1 OVERVIEW

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1.1 Document Organization

Section 1 Overview

Section 2 Pre-Flight Procedures

Section 3 In-Flight Procedures

Section 4 Operating Parameters

Section 5 Glossary

1.2 Purpose

This Pilot's Operating Handbook (POH) provides Pre-Flight and In-Flight operating procedures for the S-TEC System Twenty / Thirty / Thirty ALT Autopilot (AP).

Note:

This POH must be carried in the aircraft and made available to the pilot at all times. It can only be used in conjunction with the Federal Aviation Administration (FAA) approved Aircraft Flight Manual (AFM) or Aircraft Flight Manual Supplement (AFMS). Refer to the applicable AFM or AFMS for aircraft specific information, such as unique ground tests, limitations, and emergency procedures.

Note:

The System Twenty / Thirty / Thirty ALT autopilot is a tool provided to aircraft owners, that serves to assist them with cockpit workload management. The ability of the autopilot to provide optimum assistance and performance is directly proportional to the pilot's knowledge of its operating procedures. Therefore, it is highly recommended that the pilot develop a thorough understanding of the autopilot, its modes, and operating procedures in Visual Meteorological Conditions (VMC), prior to using it under Instrument Flight Rules (IFR).

1.3 General Control Theory

The System Twenty / Thirty / Thirty ALT is a rate based autopilot. When in control of the roll axis, the autopilot senses turn rate, along with the non-rate quantities of heading error and course deviation indication. When in control of the pitch axis, the autopilot senses acceleration, along with the non-rate quantity of altitude. These sensed data provide feedback to the autopilot, which processes them in order to control the aircraft through the use of mechanisms coupled to the control system. The roll servo is typically coupled to the ailerons, and the pitch servo is coupled to the elevator.

The System Twenty controls only the roll axis.

The System Thirty controls both the roll axis and pitch axis. Activation of roll axis control must always precede activation of pitch axis control.

The System Thirty ALT controls only the pitch axis.

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The optional Yaw Damper senses excessive adverse yaw about the yaw axis, and responds by driving the yaw servo in the proper direction to provide damping. The yaw servo is coupled to the rudder.

1.4 Modes of Operation

1.4.1 Roll Axis Control

Each press/release of the optional MODE SEL Switch typically located on the Control Wheel, or PUSH MODE Switch located on the bezel, successively engages the roll modes below.

Stabilizer (ST) Mode

Used to Hold Wings Level

Heading (HD) Mode

Used to Turn onto a Selected Heading and Hold it

Low Track (LO TRK) Mode

Used to Track a VOR Course

High Track (HI TRK) Mode

Used to Track a LOC Course

Note:

A heading system (HSI or DG) is optional. If the aircraft is equipped with a heading system, then the heading mode can be engaged. Otherwise, the heading mode cannot be engaged (i.e., it will be skipped over).

1.4.2 Pitch Axis Control

Each press of the ALT ENG/DSNG Switch typically located on the Control Wheel (optional for System Thirty ALT only), or ALT HOLD ON/OFF Switch located on the instrument panel (System Thirty ALT only), successively engages and disengages the single pitch mode below.

Altitude Hold (ALT HOLD) Mode

Used to Hold Altitude

1.5 Block Diagrams

The System Twenty Block Diagram is shown in Fig. 1-1.

The System Thirty Block Diagram is shown in Fig. 1-2.

The System Thirty ALT Block Diagram is shown in Fig. 1-3.

The Yaw Damper Block Diagram is shown in Fig. 1-4.

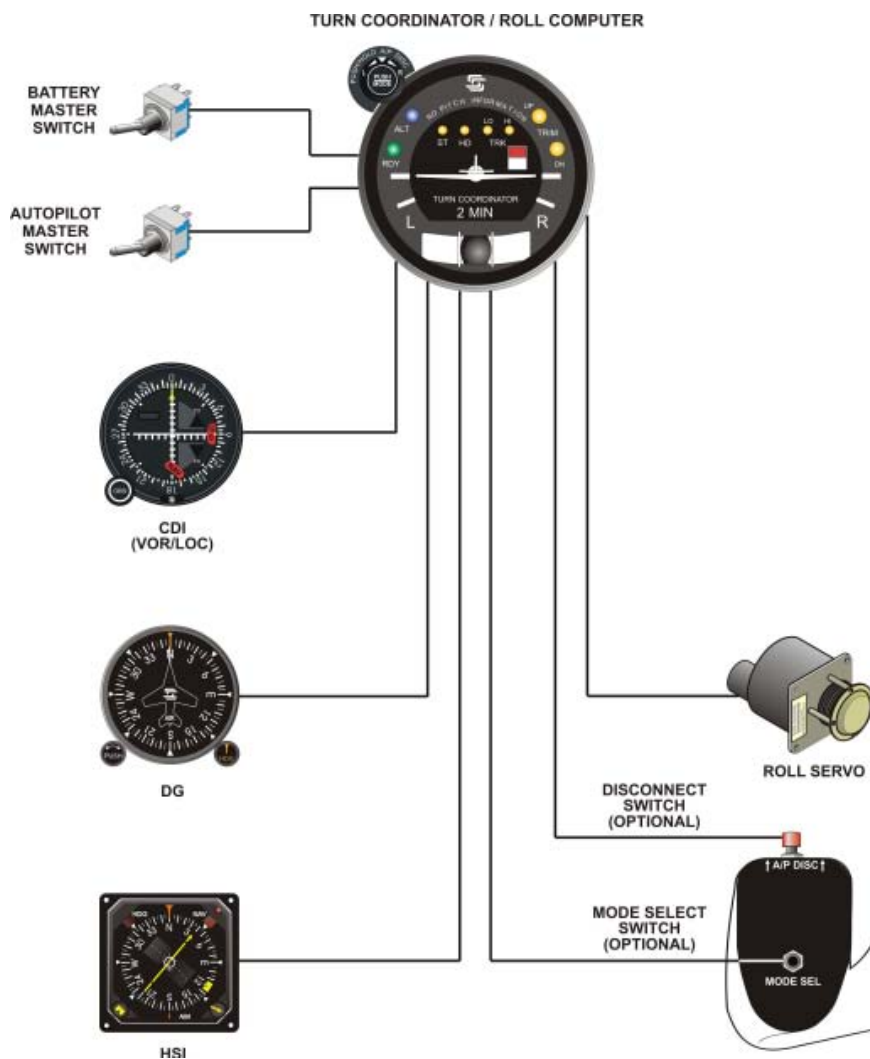


Fig. 1-1. System Twenty Block Diagram

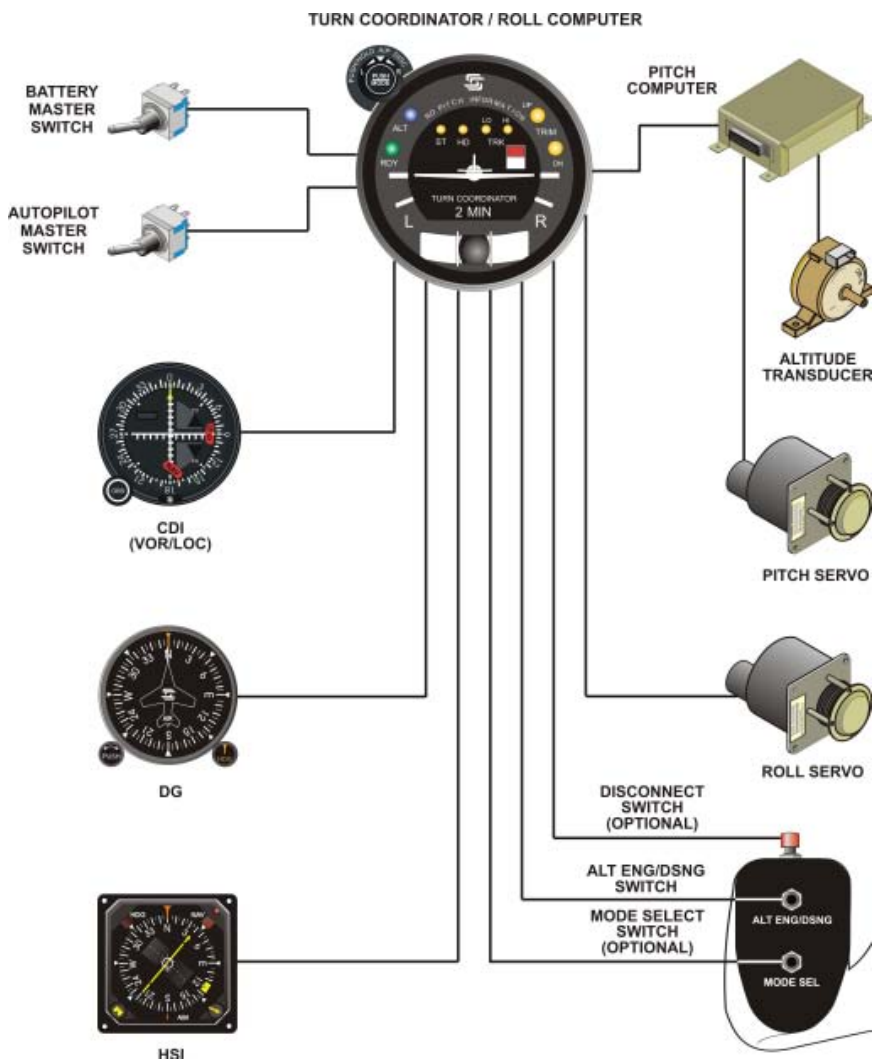


Fig. 1-2. System Thirty Block Diagram

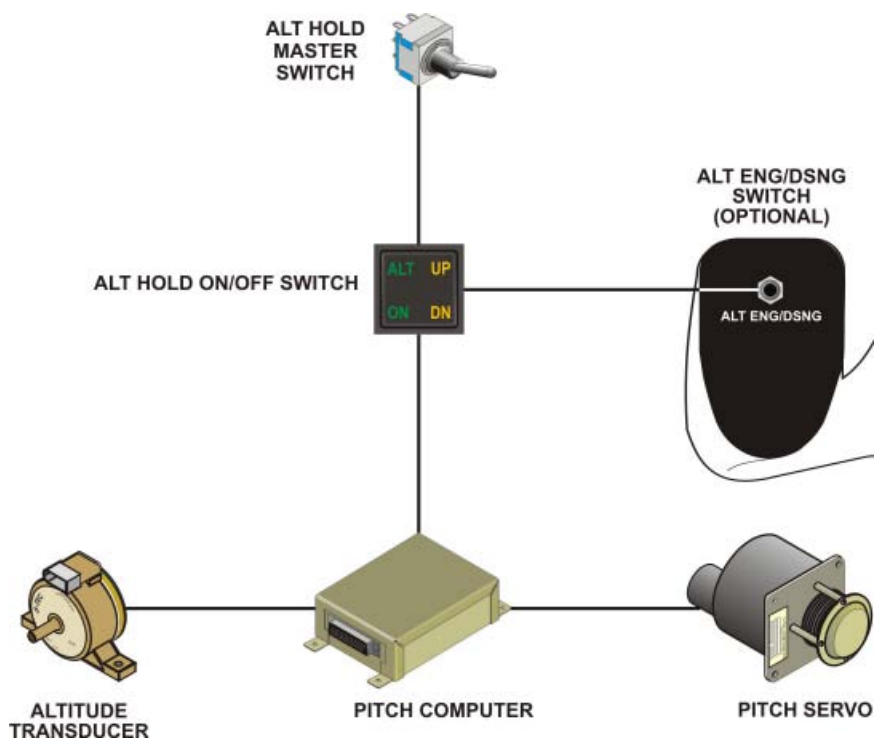


Fig. 1-3. System Thirty ALT Block Diagram

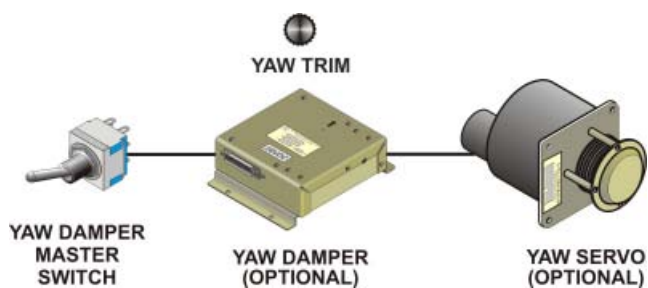


Fig. 1-4. Yaw Damper Block Diagram

SECTION 2

PRE-FLIGHT PROCEDURES

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2.1 Power-Up Test

2.1.1 System Twenty

Perform the actions shown in Table 2-1. For each action, verify the corresponding response where applicable.

Table 2-1. Power-Up Test, System Twenty

ACTION	RESPONSE
1. Set Yaw Damper Master Switch to OFF position (if installed).	-----
2. Set Battery Master Switch to ON position.	-----
3. Set Avionics Master Switch to ON position.	-----
4. Set Autopilot Master Switch to ON position.	RDY, ST, HD, LO TRK, and HI TRK lamps illuminate on AP display as shown in Fig. 2-1 for 7 seconds, and then extinguish as shown in Fig. 2-2. RDY lamp alone re-illuminates on AP display within 3 minutes, as shown in Fig. 2-3 (Note 1).

Notes:

1. Should a Turn Coordinator failure be detected, the RDY lamp on the AP display will not re-illuminate as shown in Fig. 2-4, and the autopilot will not operate.

2. Should T&B A+ be 30% below its rated value, the Low Voltage Flag will be in view on the AP display as shown in Fig. 2-5.



Fig. 2-1. AP Display, RDY, ST, HD, LO TRK, HI TRK Lamps Illuminated at Power-Up (System Twenty)



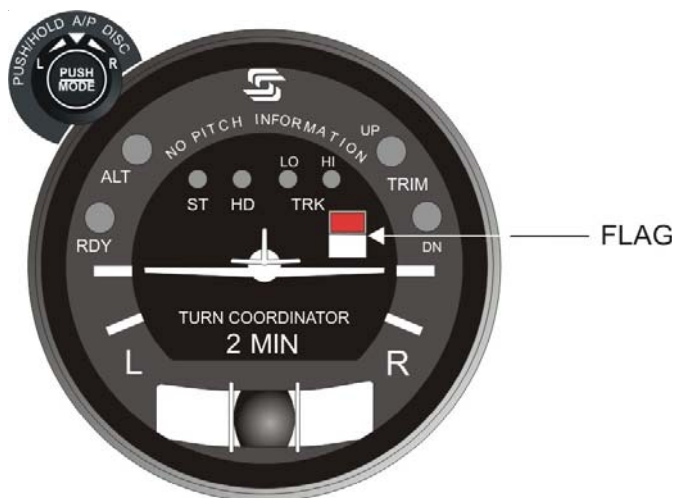
Fig. 2-2. AP Display, All Lamps Extinguished (System Twenty)



Fig. 2-3. AP Display, RDY for Operation (System Twenty)



Fig. 2-4. AP Display, Turn Coordinator Failure (System Twenty)



**Fig. 2-5. AP Display, Low Voltage Flag
(System Twenty)**

2.1.2 System Thirty

Perform the actions shown in Table 2-2. For each action, verify the corresponding response where applicable.

Table 2-2. Power-Up Test, System Thirty

ACTION	RESPONSE
1. Set Yaw Damper Master Switch to OFF position (if installed).	-----
2. Set Battery Master Switch to ON position.	-----
3. Set Avionics Master Switch to ON position.	-----
4. Set Autopilot Master Switch to ON position.	RDY, ALT, ST, HD, LO TRK, HI TRK, TRIM UP, and TRIM DN lamps illuminate on AP display as shown in Fig. 2-6. TRIM UP lamp extinguishes after 2 seconds, as shown in Fig. 2-7. RDY, ST, HD, LO TRK, HI TRK, and TRIM DN lamps extinguish after 7 seconds, as shown in Fig. 2-8. ALT lamp extinguishes after 10 seconds, as shown in Fig. 2-9. RDY lamp alone re-illuminates on AP display within 3 minutes, as shown in Fig. 2-10 (Note 1).

Notes:

1. Should a Turn Coordinator failure be detected, the RDY lamp on the AP display will not re-illuminate as shown in Fig. 2-11, and the autopilot will not operate.

2. Should T&B A+ be 30% below its rated value, the Low Voltage Flag will be in view on the AP display as shown in Fig. 2-12.



Fig. 2-6. AP Display, RDY, ALT, ST, HD, LO TRK, HI TRK, TRIM UP, TRIM DN Lamps Illuminated at Power-Up (System Thirty)



Fig. 2-7. AP Display, TRIM UP Lamp Extinguished (System Thirty)



Fig. 2-8. AP Display, ALT Lamp Only Illuminated (System Thirty)



Fig. 2-9. AP Display, All Lamps Extinguished (System Thirty)



Fig. 2-10. AP Display, RDY for Operation
(System Thirty)



Fig. 2-11. AP Display, Turn Coordinator Failure
(System Thirty)



Fig. 2-12. AP Display, Low Voltage Flag
(System Thirty)

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2.1.3 System Thirty ALT

Perform the actions shown in Table 2-3. For each action, verify the corresponding response where applicable.

Table 2-3. Power-Up Test, System Thirty ALT

ACTION	RESPONSE
1. Set Yaw Damper Master Switch to OFF position (if installed).	-----
2. Set Battery Master Switch to ON position.	-----
3. Set Avionics Master Switch to ON position.	-----
4. Set ALT HOLD Master Switch to ON position.	ALT ON, UP, and DN lamps illuminate on ALT HOLD ON/OFF Switch display, as shown in Fig. 2-13. UP lamp extinguishes after 2 seconds, as shown in Fig. 2-14. DN lamp extinguishes after 7 seconds, as shown in Fig. 2-15. ALT ON lamp extinguishes after 10 seconds, as shown in Fig. 2-16.



Fig. 2-13. ALT HOLD ON/OFF Switch Display, ALT ON, UP, and DN Lamps Illuminated at Power-Up (System Thirty ALT)



Fig. 2-14. ALT HOLD ON/OFF Switch Display, UP Lamp Extinguished (System Thirty ALT)



**Fig. 2-15. ALT HOLD ON/OFF Switch Display, DN Lamp Extinguished
(System Thirty ALT)**



**Fig. 2-16. ALT HOLD ON/OFF Switch Display, ALT ON Lamp Extinguished
(System Thirty ALT)**

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2.2 Pre-Flight Test

2.2.1 System Twenty

Prior to takeoff and with engine running, perform the actions shown in Table 2-4. For each action, verify the corresponding response where applicable.

Table 2-4. Pre-Flight Test, System Twenty (continued on page 2-18)

ACTION	RESPONSE
1. Move A/C Control Wheel left and right, to sense its freedom of movement about roll axis.	-----
2. Set L/R Turn Knob located on bezel under its index.	-----
3. Engage stabilizer mode.	ST lamp alone is illuminated on AP display, as shown in Fig. 2-17.
4. Attempt movement of A/C Control Wheel left and right.	A/C Control Wheel's reduced freedom of movement indicates that Roll Servo is engaged. Roll Servo can be overridden. If not, disconnect autopilot and do not use.
5. Turn L/R Turn Knob to the left side of its index.	A/C Control Wheel turns to the left.
6. Turn L/R Turn Knob to the right side of its index.	A/C Control Wheel turns to the right.
7. Set L/R Turn Knob under its index.	A/C Control Wheel stops.
<i>Note:</i> <i>If A/C is equipped with a heading system (HSI or DG), then proceed to step 8.</i> <i>If A/C is not equipped with a heading system, then proceed to step 13 only if a VOR frequency can be selected. Otherwise, proceed to step 26.</i>	

Table 2-4. Pre-Flight Test, System Twenty (continued from page 2-17)

ACTION	RESPONSE
8. Set Heading Bug under Lubber Line.	-----
9. Engage heading mode.	HD lamp alone is illuminated on AP display, as shown in Fig. 2-18.
10. Turn Heading Bug to the left side of Lubber Line.	A/C Control Wheel turns to the left.
11. Turn Heading Bug to the right side of Lubber Line.	A/C Control Wheel turns to the right.
12. Set Heading Bug under Lubber Line.	A/C Control Wheel stops.
<i>Note: If it is not possible to select a local VOR frequency on Navigation Receiver, then proceed to step 26. Otherwise, proceed to step 13.</i>	
13. Select local VOR frequency on Navigation Receiver.	-----
<i>Note: Proceed to either step 14 (HSI) or step 20 (DG).</i>	
14. Turn Course Pointer until CDI needle is centered.	-----
15. Engage low track mode.	LO TRK lamp alone is illuminated on AP display, as shown in Fig. 2-19.
16. Engage high track mode.	HI TRK lamp alone is illuminated on AP display, as shown in Fig. 2-20.
17. Turn Course Pointer left until CDI needle deflection is 2 dots right of center.	A/C Control Wheel turns to the right.



Fig. 2-17. AP Display, ST Mode Engaged (System Twenty)



Fig. 2-18. AP Display, HD Mode Engaged (System Twenty)

Table 2-4. Pre-Flight Test, System Twenty (continued from page 2-18)

ACTION	RESPONSE
18. Turn Course Pointer right until CDI needle deflection is 2 dots left of center.	A/C Control Wheel turns to the left.
19. Turn Course Pointer left until CDI needle is centered.	A/C Control Wheel stops.
<i>Note: Proceed to step 28.</i>	
20. Turn OBS until CDI needle is centered.	-----
21. Engage low track mode.	LO TRK lamp alone is illuminated on AP display, as shown in Fig. 2-19.
22. Engage high track mode.	HI TRK lamp alone is illuminated on AP display, as shown in Fig. 2-20.
23. Turn OBS until CDI needle deflection is 2 dots right of center.	A/C Control Wheel turns to the right.
24. Turn OBS until CDI needle deflection is 2 dots left of center.	A/C Control Wheel turns to the left.
25. Turn OBS until CDI needle is centered.	A/C Control Wheel stops.
<i>Note: Proceed to step 28.</i>	
26. Engage low track mode.	LO TRK lamp alone is illuminated on AP display, as shown in Fig. 2-19.
27. Engage high track mode.	HI TRK lamp alone is illuminated on AP display, as shown in Fig. 2-20.



Fig. 2-19. AP Display, LO TRK Mode Engaged (System Twenty)



Fig. 2-20. AP Display, HI TRK Mode Engaged (System Twenty)

Table 2-4. Pre-Flight Test, System Twenty (continued from page 2-20)

ACTION	RESPONSE
28. Disconnect autopilot by any one of the following means: a. Press optional AP DISC Switch typically located on Control Wheel. b. Press/Hold optional MODE SEL Switch typically located on Control Wheel for 3 seconds. c. Press/Hold PUSH MODE Switch located on bezel for 3 seconds.	RDY lamp flashes and audible alert sounds a periodic tone, while all other lamps are extinguished. After 5 seconds, RDY lamp stops flashing but remains illuminated, and audible alert is squelched.
29. Move A/C Control Wheel left and right.	A/C Control Wheel's increased freedom of movement indicates that Roll Servo is disengaged.
<i>Note: If a Yaw Damper is installed, then proceed to step 30. Otherwise, proceed to step 39.</i>	
30. Actuate A/C Rudder Pedals alternately in succession, to sense their freedom of movement about yaw axis.	-----
31. Set Yaw Damper Master Switch to ON position.	-----
32. Turn Yaw Trim Knob until A/C Rudder Pedals stop.	-----
33. Attempt actuation of A/C Rudder Pedals alternately in succession.	A/C Rudder Pedals' reduced freedom of movement indicates that Yaw Servo is engaged. Yaw Servo can be overridden. If not, set Yaw Damper Master Switch to OFF position, and do not use.

Table 2-4. Pre-Flight Test, System Twenty (continued from page 2-22)

ACTION	RESPONSE
34. Turn Yaw Trim Knob fully CCW.	Left A/C Rudder Pedal slowly moves forward.
35. Turn Yaw Trim Knob fully CW.	Right A/C Rudder Pedal slowly moves forward.
36. Turn Yaw Trim Knob CCW until A/C Rudder Pedals stop.	-----
37. Set Yaw Damper Master Switch to OFF position.	-----
38. Actuate A/C Rudder Pedals alternately in succession.	A/C Rudder Pedals' increased freedom of movement indicates that Yaw Servo is disengaged.
39. Trim A/C for takeoff.	-----

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2.2.2 System Thirty

Prior to takeoff and with engine running, perform the actions shown in Table 2-5. For each action, verify the corresponding response where applicable.

Table 2-5. Pre-Flight Test, System Thirty (continued on page 2-26)

ACTION	RESPONSE
1. Move A/C Control Wheel left and right, to sense its freedom of movement about roll axis.	-----
2. Set L/R Turn Knob located on bezel under its index.	-----
3. Engage stabilizer mode.	ST lamp alone is illuminated on AP display, as shown in Fig. 2-21.
4. Attempt movement of A/C Control Wheel left and right.	A/C Control Wheel's reduced freedom of movement indicates that Roll Servo is engaged. Roll Servo can be overridden. If not, disconnect autopilot and do not use.
5. Turn L/R Turn Knob to the left side of its index.	A/C Control Wheel turns to the left.
6. Turn L/R Turn Knob to the right side of its index.	A/C Control Wheel turns to the right.
7. Set L/R Turn Knob under its index.	A/C Control Wheel stops.
<i>Note:</i> <i>If A/C is equipped with a heading system (HSI or DG), then proceed to step 8.</i> <i>If A/C is not equipped with a heading system, then proceed to step 13 only if a VOR frequency can be selected. Otherwise, proceed to step 26.</i>	

Table 2-5. Pre-Flight Test, System Thirty (continued from page 2-25)

ACTION	RESPONSE
8. Set Heading Bug under Lubber Line.	-----
9. Engage heading mode.	HD lamp alone is illuminated on AP display, as shown in Fig. 2-22.
10. Turn Heading Bug to the left side of Lubber Line.	A/C Control Wheel turns to the left.
11. Turn Heading Bug to the right side of Lubber Line.	A/C Control Wheel turns to the right.
12. Set Heading Bug under Lubber Line.	A/C Control Wheel stops.
<i>Note: If it is not possible to select a local VOR frequency on Navigation Receiver, then proceed to step 26. Otherwise, proceed to step 13.</i>	
13. Select local VOR frequency on Navigation Receiver.	-----
<i>Note: Proceed to either step 14 (HSI) or step 20 (DG).</i>	
14. Turn Course Pointer until CDI needle is centered.	-----
15. Engage low track mode.	LO TRK lamp alone is illuminated on AP display, as shown in Fig. 2-23.
16. Engage high track mode.	HI TRK lamp alone is illuminated on AP display, as shown in Fig. 2-24.
17. Turn Course Pointer left until CDI needle deflection is 2 dots right of center.	A/C Control Wheel turns to the right.



Fig. 2-21. AP Display, ST Mode Engaged (System Thirty)



Fig. 2-22. AP Display, HD Mode Engaged (System Thirty)

Table 2-5. Pre-Flight Test, System Thirty (continued from page 2-26)

ACTION	RESPONSE
18. Turn Course Pointer right until CDI needle deflection is 2 dots left of center.	A/C Control Wheel turns to the left.
19. Turn Course Pointer left until CDI needle is centered.	A/C Control Wheel stops.
<i>Note: Proceed to step 28.</i>	
20. Turn OBS until CDI needle is centered.	-----
21. Engage low track mode.	LO TRK lamp alone is illuminated on AP display, as shown in Fig. 2-23.
22. Engage high track mode.	HI TRK lamp alone is illuminated on AP display, as shown in Fig. 2-24.
23. Turn OBS until CDI needle deflection is 2 dots right of center.	A/C Control Wheel turns to the right.
24. Turn OBS until CDI needle deflection is 2 dots left of center.	A/C Control Wheel turns to the left.
25. Turn OBS until CDI needle is centered.	A/C Control Wheel stops.
<i>Note: Proceed to step 28.</i>	
26. Engage low track mode.	LO TRK lamp alone is illuminated on AP display, as shown in Fig. 2-23.
27. Engage high track mode.	HI TRK lamp alone is illuminated on AP display, as shown in Fig. 2-24.



Fig. 2-23. AP Display, LO TRK Mode Engaged (System Thirty)



Fig. 2-24. AP Display, HI TRK Mode Engaged (System Thirty)

Table 2-5. Pre-Flight Test, System Thirty (continued from page 2-28)

ACTION	RESPONSE
28. Move A/C Control Wheel forward and aft, to sense its freedom of movement about pitch axis.	-----
29. Engage altitude hold mode.	ALT lamp is illuminated on AP display, as shown in Fig. 2-25.
30. Attempt movement of A/C Control Wheel forward and aft.	A/C Control Wheel's reduced freedom of movement indicates that Pitch Servo is engaged. Pitch Servo can be overridden. If not, disconnect autopilot and do not use.
31. Move A/C Control Wheel as far forward as possible.	After 3 seconds, TRIM UP lamp becomes illuminated on AP display as shown in Fig. 2-26, and audible alert sounds a steady tone. After 7 seconds, TRIM UP lamp flashes and audible alert becomes periodic.
32. Move A/C Control Wheel aft until TRIM UP lamp is extinguished.	Audible alert is squelched.
33. Move A/C Control Wheel as far aft as possible.	After 3 seconds, TRIM DN lamp becomes illuminated on AP display as shown in Fig. 2-27, and audible alert sounds a steady tone. After 7 seconds, TRIM DN lamp flashes and audible alert becomes periodic.
34. Move A/C Control Wheel forward until TRIM DN lamp is extinguished.	Audible alert is squelched.



Fig. 2-25. AP Display, HI TRK and ALT HOLD Modes Engaged (System Thirty)



Fig. 2-26. AP Display, HI TRK and ALT HOLD Modes Engaged, TRIM UP Required (System Thirty)



Fig. 2-27. AP Display, HI TRK and ALT HOLD Modes Engaged, TRIM DN Required (System Thirty)

Table 2-5. Pre-Flight Test, System Thirty (continued from page 2-30)

ACTION	RESPONSE
35. Disconnect autopilot by any one of the following means: a. Press optional AP DISC Switch typically located on Control Wheel. b. Press/Hold optional MODE SEL Switch typically located on Control Wheel for 3 seconds. c. Press/Hold PUSH MODE Switch located on bezel for 3 seconds.	RDY lamp flashes and audible alert sounds a periodic tone, while all other lamps are extinguished. After 5 seconds, RDY lamp stops flashing but remains illuminated, and audible alert is squelched.
36. Move A/C Control Wheel left and right.	A/C Control Wheel's increased freedom of movement indicates that Roll Servo is disengaged.
37. Move A/C Control Wheel forward and aft.	A/C Control Wheel's increased freedom of movement indicates that Pitch Servo is disengaged.
<i>Note: If a Yaw Damper is installed, then proceed to step 38. Otherwise, proceed to step 47.</i>	
38. Actuate A/C Rudder Pedals alternately in succession, to sense their freedom of movement about yaw axis.	-----
39. Set Yaw Damper Master Switch to ON position.	-----
40. Turn Yaw Trim Knob until A/C Rudder Pedals stop.	-----

Table 2-5. Pre-Flight Test, System Thirty (continued from page 2-33)

ACTION	RESPONSE
41. Attempt actuation of A/C Rudder Pedals alternately in succession.	A/C Rudder Pedals' reduced freedom of movement indicates that Yaw Servo is engaged. Yaw Servo can be overridden. If not, set Yaw Damper Master Switch to OFF position, and do not use.
42. Turn Yaw Trim Knob fully CCW.	Left A/C Rudder Pedal slowly moves forward.
43. Turn Yaw Trim Knob fully CW.	Right A/C Rudder Pedal slowly moves forward.
44. Turn Yaw Trim Knob CCW until A/C Rudder Pedals stop.	-----
45. Set Yaw Damper Master Switch to OFF position.	-----
46. Actuate A/C Rudder Pedals alternately in succession.	A/C Rudder Pedals' increased freedom of movement indicates that Yaw Servo is disengaged.
47. Trim A/C for takeoff.	-----

2.2.3 System Thirty ALT

Prior to takeoff and with engine running, perform the actions shown in Table 2-6. For each action, verify the corresponding response where applicable.

Table 2-6. Pre-Flight Test, System Thirty ALT (continued on page 2-37)

ACTION	RESPONSE
1. Move A/C Control Wheel forward and aft, to sense its freedom of movement about pitch axis.	-----
2. Engage altitude hold mode.	ALT ON lamp is illuminated on ALT HOLD ON/OFF Switch display, as shown in Fig. 2-28.
3. Attempt movement of A/C Control Wheel forward and aft.	A/C Control Wheel's reduced freedom of movement indicates that Pitch Servo is engaged. Pitch Servo can be overridden. If not, disconnect autopilot and do not use.
4. Move A/C Control Wheel as far forward as possible.	After 3 seconds, UP lamp becomes illuminated on ALT HOLD ON/OFF Switch display as shown in Fig. 2-29, and audible alert sounds a steady tone. After 7 seconds, UP lamp flashes and audible alert becomes periodic.
5. Move A/C Control Wheel aft until UP lamp is extinguished.	Audible alert is squelched.
6. Move A/C Control Wheel as far aft as possible.	After 3 seconds, DN lamp becomes illuminated on ALT HOLD ON/OFF Switch display as shown in Fig. 2-30, and audible alert sounds a steady tone. After 7 seconds, DN lamp flashes and audible alert becomes periodic.



Fig. 2-28. ALT HOLD ON/OFF Switch Display, ALT HOLD Mode Engaged
(System Thirty ALT)



Fig. 2-29. ALT HOLD ON/OFF Switch Display, ALT HOLD Mode Engaged,
TRIM UP Required
(System Thirty ALT)



Fig. 2-30. ALT HOLD ON/OFF Switch Display, ALT HOLD Mode Engaged,
TRIM DN Required
(System Thirty ALT)

Table 2-6. Pre-Flight Test, System Thirty ALT (continued from page 2-35)

ACTION	RESPONSE
7. Move A/C Control Wheel forward until DN lamp is extinguished.	Audible alert is squelched.
8. Disengage altitude hold mode.	ALT ON lamp is extinguished on ALT HOLD ON/OFF Switch display.
9. Move A/C Control Wheel forward and aft.	A/C Control Wheel's increased freedom of movement indicates that Pitch Servo is disengaged.
<i>Note: If a Yaw Damper is installed, then proceed to step 10. Otherwise, proceed to step 19.</i>	
10. Actuate A/C Rudder Pedals alternately in succession, to sense their freedom of movement about yaw axis.	-----
11. Set Yaw Damper Master Switch to ON position.	-----
12. Turn Yaw Trim Knob until A/C Rudder Pedals stop.	-----
13. Attempt actuation of A/C Rudder Pedals alternately in succession.	A/C Rudder Pedals' reduced freedom of movement indicates that Yaw Servo is engaged. Yaw Servo can be overridden. If not, set Yaw Damper Master Switch to OFF position, and do not use.
14. Turn Yaw Trim Knob fully CCW.	Left A/C Rudder Pedal slowly moves forward.
15. Turn Yaw Trim Knob fully CW.	Right A/C Rudder Pedal slowly moves forward.

Table 2-5. Pre-Flight Test, System Thirty ALT (continued from page 2-37)

ACTION	RESPONSE
16. Turn Yaw Trim Knob CCW until A/C Rudder Pedals stop.	-----
17. Set Yaw Damper Master Switch to OFF position.	-----
18. Actuate A/C Rudder Pedals alternately in succession.	A/C Rudder Pedals' increased freedom of movement indicates that Yaw Servo is disengaged.
19. Trim A/C for takeoff.	-----

SECTION 3

IN-FLIGHT PROCEDURES

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3.1 Normal Operating Procedures

3.1.1 Stabilizer (ST) Mode, System Twenty / Thirty

Set the L/R Turn Knob under its index, and then engage the stabilizer mode. The ST lamp alone will be illuminated as shown in Fig. 3-1, to acknowledge that this mode is engaged. The autopilot will hold the aircraft at wings level.

Turning the L/R Turn Knob to the left or right of its index will cause the aircraft to turn either left or right, respectively. The L/R Turn Knob is active only when the stabilizer mode is engaged.



Fig. 3-1. AP Display, ST Mode Engaged

3.1.2 Heading (HD) Mode, System Twenty / Thirty

Set the Heading Bug to the desired heading on the compass card (HSI or DG), and then engage the heading mode. The HD lamp alone will be illuminated as shown in Fig. 3-2, to acknowledge that this mode is engaged. The autopilot will turn the aircraft onto the selected heading and hold it. A new heading can be subsequently selected by setting the Heading Bug to it.



Fig. 3-2. AP Display, HD Mode Engaged

3.1.3 Low Track (LO TRK) Mode, System Twenty / Thirty

Select the VOR frequency on the Navigation Receiver. Maneuver the aircraft to within ± 1 CDI needle width and $\pm 10^\circ$ heading of the selected course. Engage the low track mode. The LO TRK lamp alone will be illuminated as shown in Fig. 3-3, to acknowledge that this mode is engaged. The autopilot will track the selected course with minimum authority, thereby ignoring short term CDI needle deflections (excursions) to inhibit aircraft scalloping during VOR station passage.



Fig. 3-3. AP Display, LO TRK Mode Engaged

3.1.4 High Track (HI TRK) Mode, System Twenty / Thirty

3.1.4.1 LOC Course Tracking

Select the LOC frequency on the Navigation Receiver. Maneuver the aircraft to within ± 1 CDI needle width and $\pm 10^\circ$ heading of the selected course. Engage the high track mode. The HI TRK lamp alone will be illuminated as shown in Fig. 3-4, to acknowledge that this mode is engaged. The autopilot will track the selected course with maximum authority.

3.1.4.2 GPS Course Tracking

Program a predefined course into the GPS Navigation Receiver, comprised of course segments connected by waypoints. Maneuver the aircraft to within ± 1 CDI needle width and $\pm 10^\circ$ heading of each successive course segment. Engage the high track mode. The HI TRK lamp alone will be illuminated as shown in Fig. 3-4, to acknowledge that this mode is engaged. The autopilot will track the selected course segment with maximum authority.

3.1.4.3 VOR Course Tracking

Select the VOR frequency on the Navigation Receiver. Maneuver the aircraft to within ± 1 CDI needle width and $\pm 10^\circ$ heading of the selected course. Engage the high track mode. The HI TRK lamp alone will be illuminated as shown in Fig. 3-4, to acknowledge that this mode is engaged. The autopilot will track the selected course with maximum authority. As a result, however, the aircraft may exhibit scalloping during VOR station passage.



Fig. 3-4. AP Display, HI TRK Mode Engaged

3.1.5 Altitude Hold (ALT HOLD) Mode, System Thirty / Thirty ALT

3.1.5.1 System Thirty

The altitude hold mode can only be engaged if a roll mode (ST, HD, LO TRK, HI TRK) is already engaged. Maneuver the aircraft to the desired altitude. Engage the altitude hold mode. The ALT lamp will be illuminated as shown in Fig. 3-5, to acknowledge that this mode is engaged. The autopilot will hold the aircraft at its current (captured) absolute pressure altitude.



Fig. 3-5. AP Display, ST and ALT HOLD Modes Engaged (System Thirty)

3.1.5.2 System Thirty ALT

Maneuver the aircraft to the desired altitude. Engage the altitude hold mode. The ALT ON lamp will be illuminated as shown in Fig. 3-6, to acknowledge that this mode is engaged. The autopilot will hold the aircraft at its current (captured) absolute pressure altitude.



Fig. 3-6. ALT HOLD ON/OFF Switch Display, ALT HOLD Mode Engaged (System Thirty ALT)

3.1.6 Manual Elevator Trim Prompts, System Thirty / Thirty ALT

3.1.6.1 System Thirty

If the altitude hold mode is engaged, then the autopilot will provide a prompt whenever it is necessary to manually trim the aircraft about the pitch axis using the Elevator Trim Wheel.

Should the pitch servo loading exceed a preset threshold for a period of three seconds, either the TRIM UP lamp or TRIM DN lamp will become illuminated, as a prompt to trim the aircraft in the indicated direction. This is shown in Fig. 3-7. In addition, an audible alert will sound a steady tone. If no action is taken after four more seconds, then the lamp will flash and the audible alert will become periodic. Once the aircraft has been sufficiently trimmed, such that the pitch servo loading is below the preset threshold, the lamp will extinguish and the audible alert will be squelched.

3.1.6.2 System Thirty ALT

If the altitude hold mode is engaged, then the autopilot will provide a prompt whenever it is necessary to manually trim the aircraft about the pitch axis using the Elevator Trim Wheel.

Should the pitch servo loading exceed a preset threshold for a period of three seconds, either the UP lamp or DN lamp will become illuminated, as a prompt to trim the aircraft in the indicated direction. This is shown in Fig. 3-8. In addition, an audible alert will sound a steady tone. If no action is taken after four more seconds, then the lamp will flash and the audible alert will become periodic. Once the aircraft has been sufficiently trimmed, such that the pitch servo loading is below the preset threshold, the lamp will extinguish and the audible alert will be squelched.



a. TRIM UP Required



b. TRIM DN Required

Fig. 3-7. AP Display, Manual Trim Prompts (System Thirty)



a. TRIM UP Required



b. TRIM DN Required

**Fig. 3-8. ALT HOLD ON/OFF Switch Display, Manual Trim Prompts
(System Thirty ALT)**

3.2 Approach Procedures

3.2.1 Straight-In LOC Approach

3.2.1.1 Heading System DG

Select the LOC frequency on the Navigation Receiver. Set the Heading Bug to the FRONT INBOUND LOC heading, and then engage the heading mode. At the appropriate point, turn the Heading Bug to establish the aircraft on the FRONT INBOUND LOC course. Engage the high track mode. The autopilot will track the FRONT INBOUND LOC course.

A summary pictorial of this procedure is shown in Fig. 3-9.

3.2.1.2 Heading System HSI

Select the LOC frequency on the Navigation Receiver. For reference only, set the Course Pointer to the FRONT INBOUND LOC course. Set the Heading Bug to the FRONT INBOUND LOC heading, and then engage the heading mode. At the appropriate point, turn the Heading Bug to establish the aircraft on the FRONT INBOUND LOC course. Engage the high track mode. The autopilot will track the FRONT INBOUND LOC course.

A summary pictorial of this procedure is shown in Fig. 3-10.

3.2.2 Straight-In VOR Approach

3.2.2.1 Heading System DG

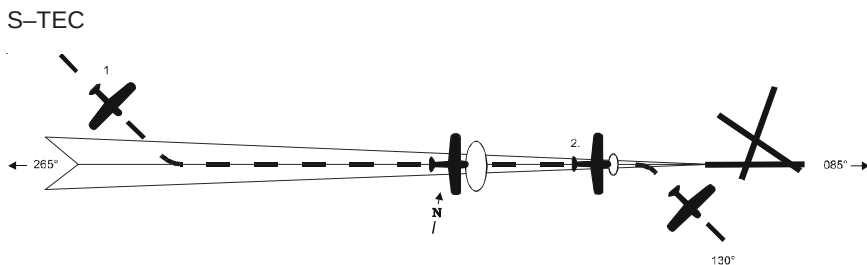
Select the VOR frequency on the Navigation Receiver. Set the OBS to the FRONT INBOUND VOR course. Set the Heading Bug to the FRONT INBOUND VOR heading, and then engage the heading mode. At the appropriate point, turn the Heading Bug to establish the aircraft on the FRONT INBOUND VOR course. Engage the high track mode. The autopilot will track the FRONT INBOUND VOR course.

A summary pictorial of this procedure is shown in Fig. 3-11.

3.2.2.2 Heading System HSI

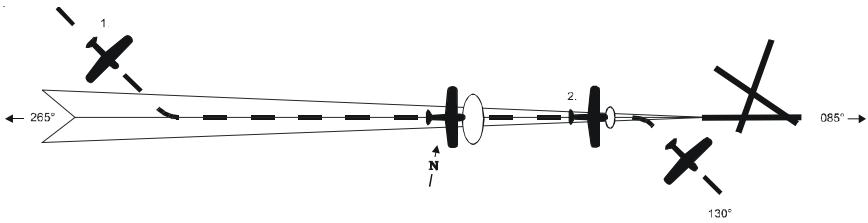
Select the VOR frequency on the Navigation Receiver. Set the Course Pointer to the FRONT INBOUND VOR course. Set the Heading Bug to the FRONT INBOUND VOR heading, and then engage the heading mode. At the appropriate point, turn the Heading Bug to establish the aircraft on the FRONT INBOUND VOR course. Engage the high track mode. The autopilot will track the FRONT INBOUND VOR course.

A summary pictorial of this procedure is shown in Fig. 3-12.



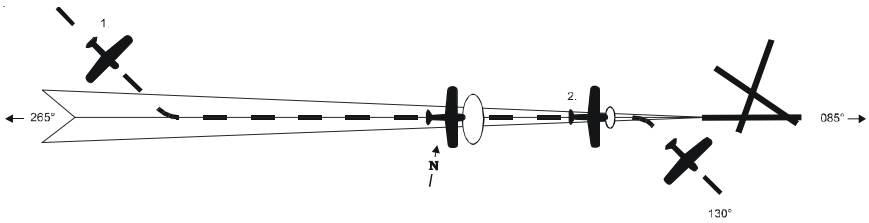
1. a. Select LOC frequency.
- b. Set Heading Bug to FRONT INBOUND LOC heading.
- c. Engage heading mode.
- d. Turn Heading Bug to establish aircraft on FRONT INBOUND LOC course.
- e. Engage high track mode.
- f. Track FRONT INBOUND LOC course.
2. a. At middle marker, if missed approach is declared, disconnect autopilot.
- b. Stabilize aircraft.
- c. Set Heading Bug to missed approach heading.
- d. Engage heading mode.

Fig. 3-9. Straight-In LOC Approach (DG)



1.
 - a. Select LOC frequency.
 - b. Set Course Pointer to FRONT INBOUND LOC course (reference only).
 - c. Set Heading Bug to FRONT INBOUND LOC heading.
 - d. Engage heading mode.
 - e. Turn Heading Bug to establish aircraft on FRONT INBOUND LOC course.
 - f. Engage high track mode.
 - g. Track FRONT INBOUND LOC course.
2.
 - a. At middle marker, if missed approach is declared, disconnect autopilot.
 - b. Stabilize aircraft.
 - c. Set Heading Bug to missed approach heading.
 - d. Engage heading mode.

Fig. 3-10. Straight-In LOC Approach (HSI)



1.
 - a. Select VOR frequency.
 - b. Set Course Pointer to FRONT INBOUND VOR course.
 - c. Set Heading Bug to FRONT INBOUND VOR heading.
 - d. Engage heading mode.
 - e. Turn Heading Bug to establish aircraft on FRONT INBOUND VOR course.
 - f. Engage high track mode.
 - g. Track FRONT INBOUND VOR course.
2.
 - a. At middle marker, if missed approach is declared, disconnect autopilot.
 - b. Stabilize aircraft.
 - c. Set Heading Bug to missed approach heading.
 - d. Engage heading mode.

Fig. 3-12. Straight-In VOR Approach (HSI)

3.2.3 LOC Approach with Procedure Turn

3.2.3.1 Heading System DG

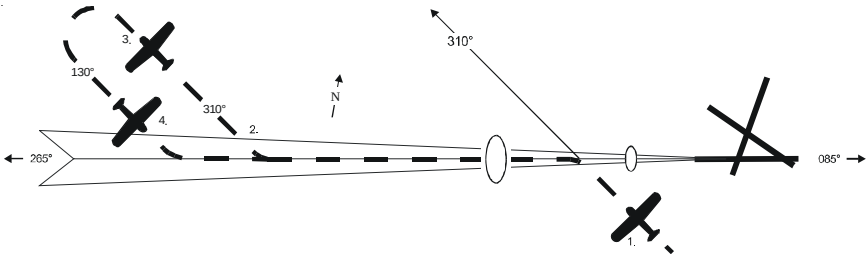
Select the LOC frequency on the Navigation Receiver. Set the Heading Bug to the FRONT OUTBOUND LOC heading, and then engage the heading mode. At the appropriate point, turn the Heading Bug to establish the aircraft on the FRONT OUTBOUND LOC course. At the appropriate point thereafter, set the Heading Bug to the FRONT OUTBOUND PROCEDURE TURN heading. Hold this heading until the point at which it is time to turn the aircraft again. At that point, turn the Heading Bug in two successive 90° increments, to establish the aircraft on the FRONT INBOUND PROCEDURE TURN heading. At the appropriate point, turn the Heading Bug to establish the aircraft on the FRONT INBOUND LOC course. Engage the high track mode. The autopilot will track the FRONT INBOUND LOC course.

A summary pictorial of this procedure is shown in Fig. 3-13.

3.2.3.2 Heading System HSI

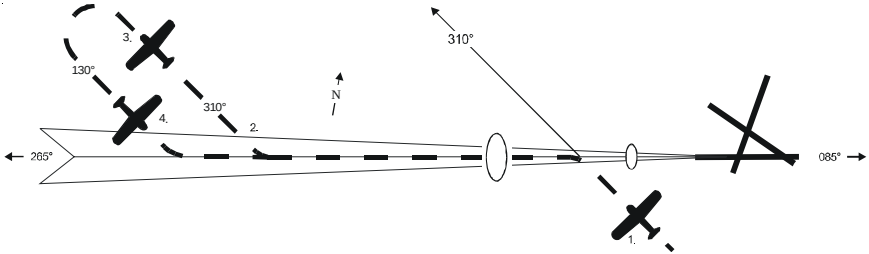
Select the LOC frequency on the Navigation Receiver. For reference only, set the Course Pointer to the FRONT INBOUND LOC course. Set the Heading Bug to the FRONT OUTBOUND LOC heading, and then engage the heading mode. At the appropriate point, turn the Heading Bug to establish the aircraft on the FRONT OUTBOUND LOC course. At the appropriate point thereafter, set the Heading Bug to the FRONT OUTBOUND PROCEDURE TURN heading. Hold this heading until the point at which it is time to turn the aircraft again. At that point, turn the Heading Bug in two successive 90° increments, to establish the aircraft on the FRONT INBOUND PROCEDURE TURN heading. At the appropriate point, turn the Heading Bug to establish the aircraft on the FRONT INBOUND LOC course. Engage the high track mode. The autopilot will track the FRONT INBOUND LOC course.

A summary pictorial of this procedure is shown in Fig. 3-14.



1. a. Select LOC frequency.
- b. Set Heading Bug to FRONT OUTBOUND LOC heading.
- c. Engage heading mode.
- d. Turn Heading Bug to establish aircraft on FRONT OUTBOUND LOC course.
2. a. Set Heading Bug to FRONT OUTBOUND PROCEDURE TURN heading.
3. a. Turn Heading Bug in two successive 90° increments, to establish aircraft on FRONT INBOUND PROCEDURE TURN heading.
4. a. Turn Heading Bug to establish aircraft on FRONT INBOUND LOC course.
- b. Engage high track mode.
- c. Track FRONT INBOUND LOC course.
5. a. At middle marker, if missed approach is declared, disconnect autopilot.
- b. Stabilize aircraft.
- c. Set Heading Bug to missed approach heading.
- d. Engage heading mode.

Fig. 3-13. LOC Approach with Procedure Turn (DG)



1. a. Select LOC frequency.
- b. Set Course Pointer to FRONT INBOUND LOC course (reference only).
- c. Set Heading Bug to FRONT OUTBOUND LOC heading.
- d. Engage heading mode.
- e. Turn Heading Bug to establish aircraft on FRONT OUTBOUND LOC course.
2. a. Set Heading Bug to FRONT OUTBOUND PROCEDURE TURN heading.
3. a. Turn Heading Bug in two successive 90° increments, to establish aircraft on FRONT INBOUND PROCEDURE TURN heading.
4. a. Turn Heading Bug to establish aircraft on FRONT INBOUND LOC course.
- b. Engage high track mode.
- c. Track FRONT INBOUND LOC course.
5. a. At middle marker, if missed approach is declared, disconnect autopilot.
- b. Stabilize aircraft.
- c. Set Heading Bug to missed approach heading.
- d. Engage heading mode.

Fig. 3-14. LOC Approach with Procedure Turn (HSI)

3.2.4 VOR Approach with Procedure Turn

3.2.4.1 Heading System DG

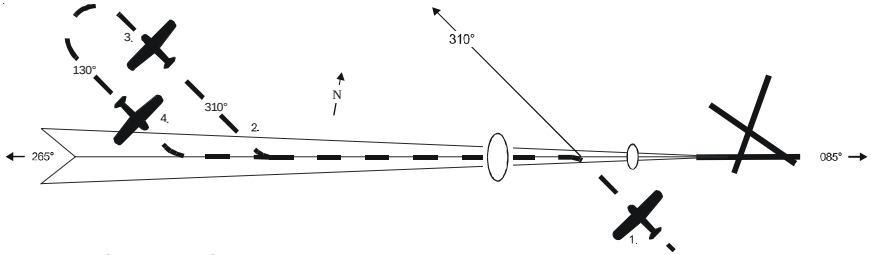
Select the VOR frequency on the Navigation Receiver. Set the OBS to the FRONT INBOUND VOR course. Set the Heading Bug to the FRONT OUTBOUND VOR heading, and then engage the heading mode. At the appropriate point, turn the Heading Bug to establish the aircraft on the FRONT OUTBOUND VOR course. At the appropriate point thereafter, set the Heading Bug to the FRONT OUTBOUND PROCEDURE TURN heading. Hold this heading until the point at which it is time to turn the aircraft again. At that point, turn the Heading Bug in two successive 90° increments, to establish the aircraft on the FRONT INBOUND PROCEDURE TURN heading. At the appropriate point, turn the Heading Bug to establish the aircraft on the FRONT INBOUND VOR course. Engage the high track mode. The autopilot will track the FRONT INBOUND VOR course.

A summary pictorial of this procedure is shown in Fig. 3-15.

3.2.4.2 Heading System HSI

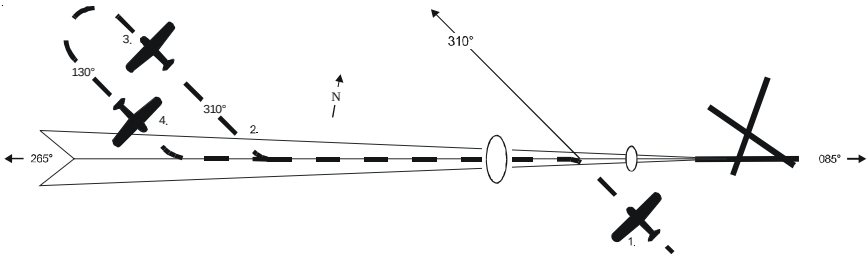
Select the VOR frequency on the Navigation Receiver. Set the Course Pointer to the FRONT INBOUND VOR course. Set the Heading Bug to the FRONT OUTBOUND VOR heading, and then engage the heading mode. At the appropriate point, turn the Heading Bug to establish the aircraft on the FRONT OUTBOUND VOR course. At the appropriate point thereafter, set the Heading Bug to the FRONT OUTBOUND PROCEDURE TURN heading. Hold this heading until the point at which it is time to turn the aircraft again. At that point, turn the Heading Bug in two successive 90° increments, to establish the aircraft on the FRONT INBOUND PROCEDURE TURN heading. At the appropriate point, turn the Heading Bug to establish the aircraft on the FRONT INBOUND VOR course. Engage the high track mode. The autopilot will track the FRONT INBOUND VOR course.

A summary pictorial of this procedure is shown in Fig. 3-16.



1. a. Select VOR frequency.
- b. Set OBS to FRONT INBOUND VOR course.
- c. Set Heading Bug to FRONT OUTBOUND VOR heading.
- d. Engage heading mode.
- e. Turn Heading Bug to establish aircraft on FRONT OUTBOUND VOR course.
2. a. Set Heading Bug to FRONT OUTBOUND PROCEDURE TURN heading.
3. a. Turn Heading Bug in two successive 90° increments, to establish aircraft on FRONT INBOUND PROCEDURE TURN heading.
4. a. Turn Heading Bug to establish aircraft on FRONT INBOUND VOR course.
- b. Engage high track mode.
- c. Track FRONT INBOUND VOR course.
5. a. At middle marker, if missed approach is declared, disconnect autopilot.
- b. Stabilize aircraft.
- c. Set Heading Bug to missed approach heading.
- d. Engage heading mode.

Fig. 3-15. VOR Approach with Procedure Turn (DG)



1. a. Select VOR frequency.
- b. Set Course Pointer to FRONT INBOUND VOR course.
- c. Set Heading Bug to FRONT OUTBOUND VOR heading.
- d. Engage heading mode.
- e. Turn Heading Bug to establish aircraft on FRONT OUTBOUND VOR course.
2. a. Set Heading Bug to FRONT OUTBOUND PROCEDURE TURN heading.
3. a. Turn Heading Bug in two successive 90° increments, to establish aircraft on FRONT INBOUND PROCEDURE TURN heading.
4. a. Turn Heading Bug to establish aircraft on FRONT INBOUND VOR course.
- b. Engage high track mode.
- c. Track FRONT INBOUND VOR course.
5. a. At middle marker, if missed approach is declared, disconnect autopilot.
- b. Stabilize aircraft.
- c. Set Heading Bug to missed approach heading.
- d. Engage heading mode.

Fig. 3-16. VOR Approach with Procedure Turn (HSI)

3.3 Yaw Damper Operation

The optional Yaw Damper serves to dampen excessive adverse yaw. It operates in either the AUTO mode or ON mode, depending upon the position of the Yaw Damper Master Switch shown in Fig. 3-17.

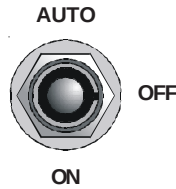


Fig. 3-17. Yaw Damper Master Switch

The Yaw Trim Knob, shown in Fig. 3-18, is used to center the slip/skid ball when the yaw servo is engaged.

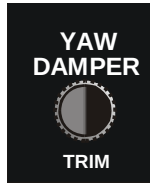


Fig. 3-18. Yaw Trim Knob

3.3.1 AUTO Mode

With the Yaw Damper Master Switch in the AUTO position, the yaw servo will become automatically engaged whenever a roll mode (ST, HD, LO TRK, HI TRK) is engaged.

3.3.2 ON Mode

With the Yaw Damper Master Switch in the ON position, the yaw servo will be engaged at all times, entirely independent of autopilot operation.

3.3.3 Yaw Damper Trim

With the yaw servo engaged, rotate the Yaw Trim Knob to center the slip/skid ball.

3.4 Autopilot Disconnect

3.4.1 System Twenty / Thirty

The autopilot can be disconnected by any of the following means:

1. Press optional AP DISC Switch typically located on Control Wheel.
2. Press/Hold optional MODE SEL Switch typically located on Control Wheel for 3 seconds.
3. Press/Hold PUSH MODE Switch located on bezel for 3 seconds.
4. Set Autopilot Master Switch to OFF position.
5. Pull Autopilot Circuit Breaker.

3.4.2 System Thirty ALT

The autopilot can be disconnected by any of the following means:

1. Press optional ALT ENG/DSNG Switch typically located on Control Wheel.
2. Press ALT HOLD ON/OFF Switch located on instrument panel.
3. Set ALT HOLD Master Switch to OFF position.
4. Pull ALT HOLD Circuit Breaker.

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SECTION 4

OPERATING PARAMETERS

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4.1 Roll Axis Limits

Turn Rate

Piston A/C:

90% Standard Rate Turn

Turboprop A/C:

75% Standard Rate Turn

4.2 Pitch Axis Limits

Altitude

32,000 FT

Vertical Force Due to Acceleration

0.60 g

Modes

For the System Thirty, the pitch mode (ALT HOLD) can only be engaged after a roll mode (ST, HD, LO TRK, HI TRK) has been engaged.

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SECTION 5 GLOSSARY

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Term	Meaning
A/C	Aircraft
ALT	Altitude
AP	Autopilot
CDI	Course Deviation Indication
CW	Clockwise
CCW	Counter–Clockwise
DG	Directional Gyro
DISC	Disconnect
DN	Down
DSNG	Disengage
ENG	Engage
FAA	Federal Aviation Administration
FT	Feet
GPS	Global Positioning System
HD	Heading
HI TRK	High Track
HSI	Horizontal Situation Indicator
IFR	Instrument Flight Rules
LO TRK	Low Track
LOC	Localizer
MAP	Missed Approach Point
OBS	Omnibearing Selector
PN	Part Number
POH	Pilot's Operating Handbook
RDY	Ready
ST	Stabilizer
UP	Up
VMC	Visual Meteorological Conditions
VOR	Very High Frequency Omnidirectional Radio Range

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Notice:

Contact S-TEC Customer Support at 800-872-7832 for a Return Material Authorization (RMA) number prior to the return of any component for any reason.

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DIGITAL CLOCK

UNIVERSAL TIME

LOCAL TIME

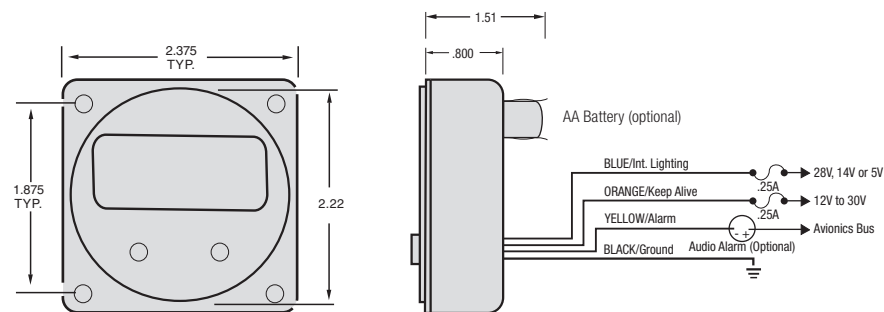
Elapsed Time - Count Up, Count Down, Alarm



M800

FEATURES

- Two button control system is natural and error free. Setting operations are identical for both alarm and time setting (US patent #4,486,077).
- Universal Time is in 24 hour format.
- Local time in 12 hour format or 24 hour format.
- Elapsed Time counter is from one second to 99 hours, 59 minutes.
- Elapsed Time countdown timer is from one second to one hour.
- Elapsed Time alarm is activated when countdown reaches zero.
- Alarm flashes display and has external output for optional audio alarm.
- Liquid Crystal Display has high contrast in bright sunlight and uniform night illumination. The display has an ultraviolet filter to prevent sunlight damage.
- NVIS Lighting Green A MIL-STD-3009 option available.



Mounting Hardware 4-40x3/8

MODEL 800 OPERATION

The SELECT button selects what is to be displayed on the four digit window and the CONTROL button controls what is being displayed. Pressing SELECT sequentially selects UT, Local Time, Elapsed Time and back to UT. The CONTROL button starts, stops, and resets Elapsed Time when momentarily pushed. Normal operation of the M800 cannot accidentally reset time.

Setting UT (Universal Time)

Select UT for display in the four digit window with the SELECT button. Simultaneously press both the SELECT and CONTROL buttons to enter the set mode. The tens of hours digit will start flashing. The CONTROL button has full control of the flashing digit and each button push increments the digit. Once the tens of hours is set, the SELECT button selects the next digit to be set. After the last digit has been selected and set with the CONTROL button, a final push of the SELECT button exits the mode. The lighted annunciator will resume its normal flashing, indicating the UT clock is running.

Setting LT (Local Time)

Select Local time, LT, using the SELECT button. Simultaneously push the SELECT and CONTROL buttons to enter set mode. The tens of hours digit will start flashing. The set operation is the same as for UT, except that minutes are already synchronized with the UT clock and can only be incremented by 15 minutes. LT may be switched from 12 to 24 hour format by pressing SELECT for 5 seconds while in LT mode. The display will show current hour format. Press CONTROL button to change hour format then press SELECT to exit.

Test Mode

In UT mode, hold the SELECT button down for five seconds and the display will indicate 88:88 and activate all three annunciators.

Elapsed Time Count Up

Select ET for display. Pressing the CONTROL button will start ET counting. Elapsed time counts up to 59 minutes, 59 seconds, and then switches to hours and minutes. It continues counting up to 99 hours and 59 minutes. Pressing the SELECT button again stops ET. Another press resets ET to zero.

Elapsed Time Count Down

Select ET for display and enter set mode by pressing both buttons. The countdown timer can now be set. Entering the time is identical to UT time setting. When the time is entered and the last digit is no longer flashing the clock is ready to start the countdown. Momentarily pressing the CONTROL button starts the countdown. When the count reaches zero the displays flash and the external alarm is activated. Pressing either SELECT or CONTROL will deactivate the alarm. ET continues counting up. Pressing CONTROL again will stop counting. Another press will reset to zero.

SPECIFICATIONS

- **Universal Time:** 24 hour format.
- **Local Time:** 12 hour or 24 hour format.
- **Elapsed Time Count Up:** Starts in minutes, seconds, then hours, minutes up to 99:59 hours.
- **Elapsed Time Alarm:** Activates at zero when counting down.
- **Internal Lighting:** 230 mA at 5V, 120mA at 14V, 50mA at 28V (Specify voltage when ordering).
- **Keep Alive Current:** .004 Amps. 14V to 24V.
- **Voltage:** 12V to 30V.
- **Crystal Reference:** -40C to +60C .001%
- **Warranty:** 1 year.
- **Option:** AA Memory Battery (Specify when ordering).



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PRECISE FLIGHT, INC.
63120 POWELL BUTTE ROAD
BEND, OR 97701

**FAA APPROVED
AIRPLANE FLIGHT MANUAL SUPPLEMENT
OR
SUPPLEMENTAL AIRPLANE FLIGHT MANUAL
FOR**

AIRPLANES LISTED ON STC SA4005NM

SERIAL NUMBER: 17263767 / 17264078

REGISTRATION NUMBER: N1840V / N22905

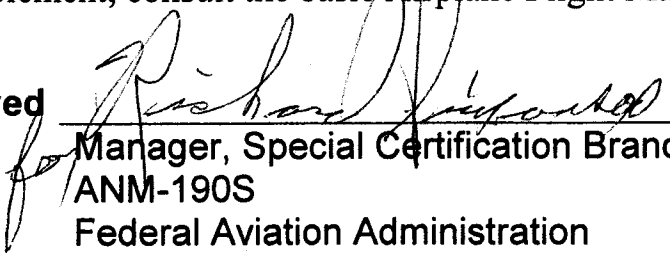
PFI Document: 000PMAN0001

Revision: A

This supplement must be attached to the FAA approved Airplane Flight Manual, when the Precise Flight **Pulselite**® system has been installed in accordance with STC SA4005NM.

The information contained in this document supplements or supersedes the basic manual only in those areas listed. For Limitations, Procedures, and Performance information not contained in this supplement, consult the basic Airplane Flight Manual.

FAA-Approved



Manager, Special Certification Branch,
ANM-190S
Federal Aviation Administration
Seattle Aircraft Certification Office
Transport Airplane Directorate

Date November 27, 2002

Revised Date July 24, 2003



PRECISE FLIGHT INC.
63120 Powell Butte Road
Bend, Oregon 97701
AFMS: SH4005NM-01 Rev A

SUPPLEMENTAL AFM TO
S/N: _____
REGISTRATION NUMBER: _____
STC: SA4005NM

SYSTEM DESCRIPTION

The Precise Flight Pulselite® system includes a solid-state switching device that flashes the Landing Lights. The pulsing lights create an illusion of exaggerated motion that allows the aircraft to be more easily recognized by others when they are in the field of coverage of the Landing Lights.

The **ON** and **OFF** positions of the Landing/Taxi Light Switch will override the Pulselite® system and operate the system as normal.

Optional: The system may be turned on with the TCAS/TCAD system utilizing the system Annunciator ground if the Pulselite® Switch is left in the down or **ACTIVE** position on a three position switch. This option may or may not be available on the installed Pulselite® unit. See the Pulselite installation manual for the model number installed.

The Pulselite® System is considered optional equipment and the aircraft may be dispatched with the system turned **OFF**. In case of a system malfunction the circuit breaker switch may be turned off to deactivate the system for dispatch.

1. LIMITATIONS

A. NIGHT OPERATION LIMITATIONS

1. Turn Pulselite® **OFF** at Landing Checklist.
2. Turn Pulselite® **OFF** in Clouds

2. EMERGENCY PROCEDURES

In the event of an electrical problem with the Pulselite® system, turn off the system and pull the Pulselite® circuit breaker.

3. NORMAL PROCEDURES

A. NORMAL PROCEDURES

- | | |
|---------------------------|-----------------------|
| 1. Landing Light Switches | - OFF Position |
| 2. Pulselite® Switch | - ON Position |

4. PERFORMANCE

No Change in Airplane Performance with the Pulselite® System Installed or Operating.

-- END --

ACK TECHNOLOGIES
INC.

MODEL E-04 ELT INSTALLATION MANUAL OPERATION MANUAL

IMPORTANT VISIT OUR WEBSITE WWW.ACKAVIONICS.COM FOR THE LATEST SERVICE BULLETINS AND INSTALLATION INFORMATION BEFORE STARTING THE INSTALLATION.

THE CONDITIONS AND TESTS REQUIRED FOR TSO APPROVAL OF THIS ARTICLE ARE MINIMUM PERFORMANCE STANDARDS. IT IS THE RESPONSIBILITY OF THOSE DESIRING TO INSTALL THIS ARTICLE ON A SPECIFIC TYPE OR CLASS OF AIRCRAFT TO DETERMINE THAT THE AIRCRAFT INSTALLATION CONDITIONS ARE WITHIN THE TSO STANDARDS. THE ARTICLE MAY BE INSTALLED ONLY IF FURTHER EVALUATION BY THE APPLICANT DOCUMENTS AN ACCEPTABLE INSTALLATION AND IT IS APPROVED BY THE ADMINISTRATOR.

APPROVALS

FAA /TRANSPORT CANADA
TSO C-126b
TSO C-142a
TSO C-91a

EASA
ETSO 2C126
ETSO 2C91a
ETSO C142a

COSPAS/SARSAT
T.007

INDUSTRY CANADA
1863A-E04AF

**Brazil ANAC
ANTEL**



P/N E04M REV DATE 04/02/2014
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Section 11	Lithium battery replacement
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Section 16	Major parts
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Section 18	RS 232 data formats / Installation notes
Section 19	Trouble shooting / Miscellaneous notes

SECTION 1 406 MHz ELT OVERVIEW

The model E-04 121.5/406 MHz ELT is designed for use in aircraft used for general and commercial aviation. Older generation ELT's were very limited in their ability to rapidly locate, and identify a downed aircraft. Often it took several passes of the orbiting satellites to get an approximate fix on a downed aircraft. The older generation ELT's gave rescuers no information on type of aircraft, owner/operator, or contact information. The new generation 406 MHz ELT's provide much better, and faster location accuracy. Along with providing information to search and rescue organizations about the aircraft type, ownership, and emergency contact information. Location accuracy with older generation ELT's was limited to about a 15 - 20 mile radius, and could take several hours to provide accurate location data. For new generation 406 MHz ELT's without GPS position information, the average time to process, and identify the aircraft location is 1-2 hours, with a search radius of about 2 miles or less. With GPS information, the time to locate the aircraft position is 10 minutes or less, with an accuracy of about 300 feet. The model E-04 ELT may be installed without interfacing it to the aircraft GPS system, however we strongly recommend that when available the GPS data be supplied to the ELT. For aircraft which do not have GPS data available, the unit can be interfaced with a low cost GPS data receiver, such as the Garmin GPS 18PC which is available for less than \$75.00. (Note: these receivers require a 5V supply. One model has a cigarette lighter plug with a built in regulator, or you can use a 5V switching power supply, such as Digi-Key P/N 811-1116-ND) You must register this beacon before activating it. Failure to do so can result in monetary fines, and other sanctions. See section 8 for registration instructions. You must update your registration every two years.

SECTION 2 ELT INSTALLATION

Several problems associated with previous TSO C-91, and C-91a ELT installations, is the result of poorly chosen mounting locations. Generally the most suitable location for fixed wing aircraft, is to position the ELT transmitter in the fuselage as far aft as possible. Antenna location, and accessibility for maintenance, are factors that should be considered when choosing a mounting location. The ELT must be mounted with the arrow printed on the battery case pointing in the direction of flight. The ELT should be mounted with it's longitudinal axis aligned within 10 degrees of the longitudinal axis of the aircraft fuselage. Avoid mounting the ELT near sources of strong EM/RFI radiation.

RTCA document DO-204 paragraph 3.1.8. prescribes the mounting requirements which must be met when installing this ELT, these requirements are as follows:

The ELT shall be mounted to primary load-carrying structures such as trusses, bulkheads, longerons, spars, or floor beams. (not aircraft skin) The mounts shall have a maximum static local deflection no greater than 2.5mm (0.1 inch) when a force of 450 newton's (100 lbs.) is applied to the mount in the most flexible direction. Deflection measurements shall

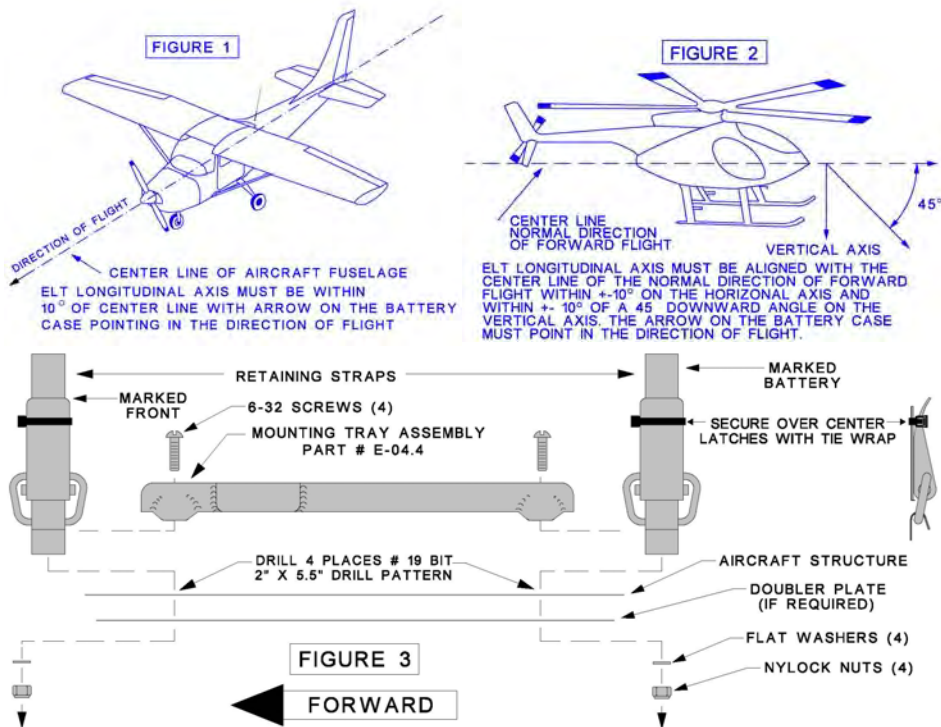
be made with reference to another part of the airframe not less than 0.3 meter (1 foot) nor more than 1.0 meter (3 feet) from the mounting location. After selecting a suitable location meeting all of the above requirements. Drill and mount the ELT tray assembly as shown in Fig 3. A doubler plate may be required. Secure latches with tie wrap as shown.

IMPORTANT

The quick release retaining straps which secure the ELT to the tray are slightly different in size. The strap that fits around the front of the ELT, (transmitter assembly) is marked "front." The strap that fits around the battery case end of the ELT, is marked "Battery."

Helicopter installation

The model E-04 ELT is suitable for helicopter installation. The procedures for installation, maintenance, and operation, are the same as for fixed wing aircraft, except for the orientation of the ELT in relation to the helicopter longitudinal axis. The arrow on the battery case of the ELT should be pointed in the normal direction of forward flight. The longitudinal axis should be aligned within ± 10 degrees of the longitudinal axis horizontally, and at a 45 degree downward angle as shown in Fig 2.



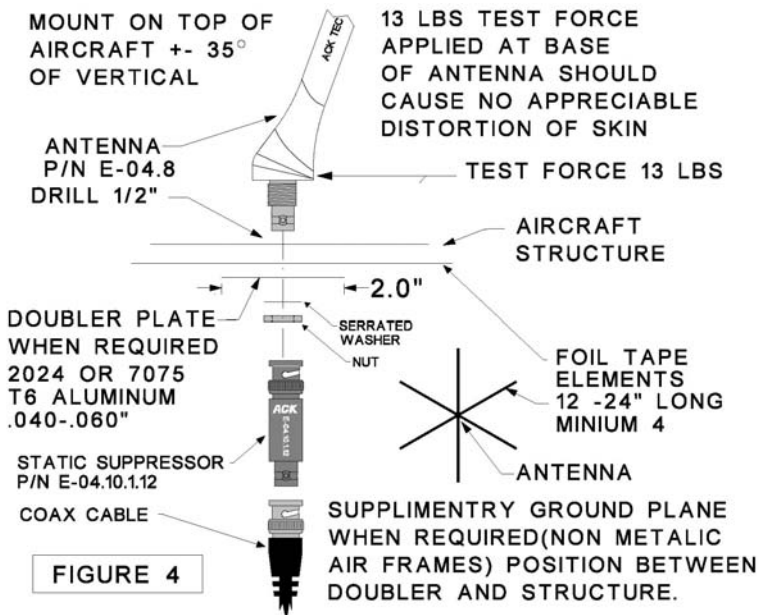
SECTION 3 ANTENNA INSTALLATION

In order to meet the requirements of COSPAS/SARSAT TSO C-126b, TSO C-91a, and FAR 91.207 an approved antenna must be used. The antenna supplied with the ELT P/N E-04.8 is a monopole, dual frequency antenna design. It has a recommended operating speed of up to 260 knots. We have a high speed blade antenna available, part number S65-1231-1 which is rated to Mach 1.0. Other antennas may be used provided they meet the minimum VSWR requirements as noted in the specifications section of this manual, (Section 15) and meet COSPAS/SARSAT approval for use with the model E-04 ELT. The coaxial cable supplied is RG-58, and is 5 feet long. A longer or shorter cable may be fabricated using RG-58 or equivalent cable, and Amp 227079-5 connectors. The insertion loss of the cable assembly at 406 MHz should not exceed 2 dB. At 121.5 MHz the insertion loss should not exceed 3 dB. The cable should be a minimum of 2 feet in length.

The antenna may be mounted internally in composite construction, and tubular fabric covered aircraft, as long as the fabric or composite material is of a non conductive nature. The antenna must be mounted externally, on airframes of metallic construction. The antenna should be mounted as close to the ELT transmitter as practical. The coaxial cable connecting the antenna to the ELT transmitter, should not run in close proximity to comm radio coaxial cables, and should avoid crossing aircraft production breaks. (i.e. Riveted fuselage sections) The antenna must be mounted within 30 degrees of vertical, when the aircraft is in normal flight attitude. The installed antenna must be able to withstand a static load of 100 (one hundred) times it's weight (13 lbs.) applied to the base of the antenna, along the longitudinal axis of the aircraft. The antenna should be mounted a minimum distance of three feet (1 meter) from any vertically polarized communication antennas. (i.e. Antennas radiating in the 118-137 MHz band.)

MODEL E-04.8 WHIP ANTENNA

- 1.) Drill a 1/2" (13mm) diameter hole in the aircraft at the antenna mounting location (Fig. 4)
- 2.) Install the antenna, and determine if the antenna meets the static load requirements. If not, a doubler plate should be fabricated.
- 3.) If the antenna is being mounted on a non conductive portion of the airframe, a supplementary ground plane must be installed. The supplemental ground plane must have a minimum diameter of 24" however 48" will provide maximum power at 121.5 MHz and is recommended. The ground plane must be centered around the base of the antenna. This may be fabricated out of copper, or aluminum tape. The tape should be cut into six elements 12" long, and the tape elements should be evenly spaced, radiating in a circular pattern from the base mounting point of the antenna. (Fig. 4) Make sure all elements are electrically bonded to the base of the antenna. The tape may follow the contour of the fuselage. The metallic airframe of fabric covered aircraft may be used as the ground plane. When installing the antenna, make sure the base of the antenna is electrically bonded to the tubing frame. A static suppressor is supplied install as shown in (Fig 4)
- 4.) Assemble the antenna as shown in figure 4. Make sure the rubber washer that forms a moisture seal between the antenna base, and aircraft structure, is in place before installing the antenna. Also make sure the serrated locking washer is in place. If the aircraft skin at the mounting point is less than .060" thick when installing the P/N E-04.8 whip antenna, a 2" diameter doubler plate must be fabricated using .040" thick 2024, or 7075 T6 aluminum.



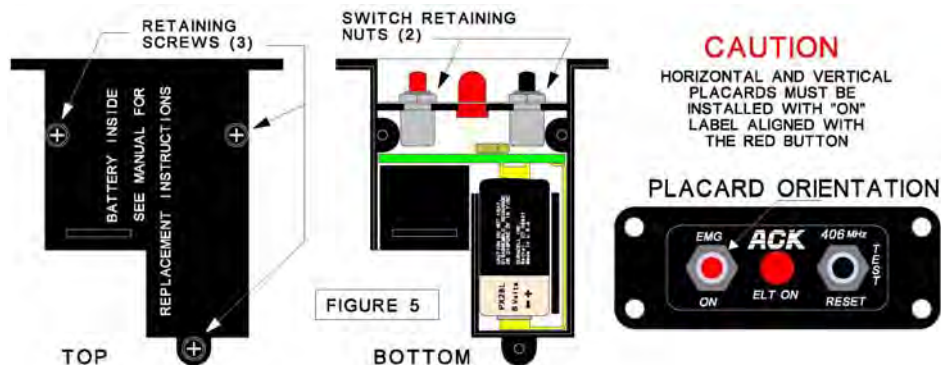
SECTION 4 REMOTE CONTROL INSTALLATION

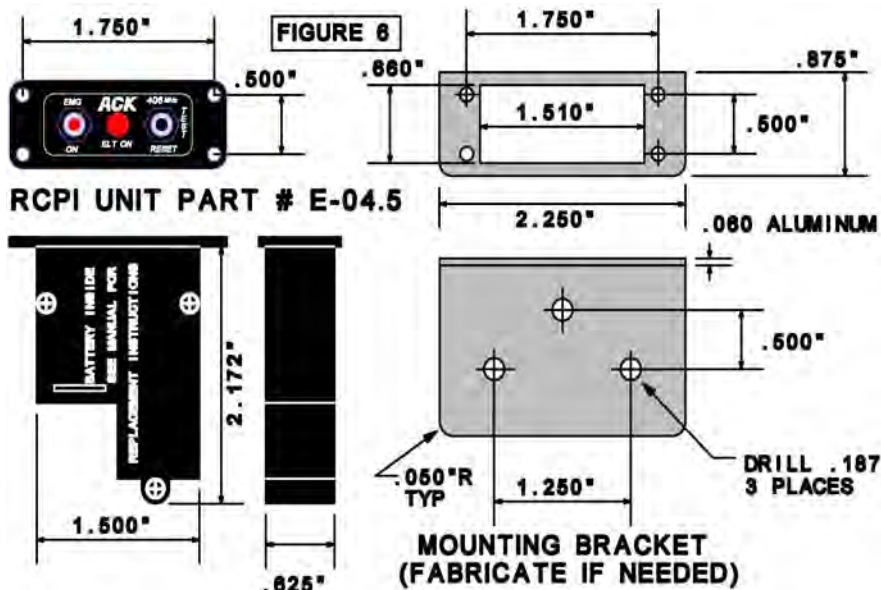
IMPORTANT YOU MUST INSTALL A BATTERY IN THE REMOTE.

The remote control panel indicator (RCPI) P/N E-04.5 is designed to be powered by a single Duracell PX28L 6 volt Lithium battery, or equivalent. Alkaline batteries may be used such as Eveready A 544, or equivalent. Under normal operating conditions, the Lithium battery must be replaced every 10 years. The alkaline batteries must be replaced every 5 years. If the ELT is activated for an unknown period of time, the battery must be replaced. Equivalent cross reference batteries from other manufacturers are acceptable for use in the remote control.

To install, or replace the RCPI battery follow these steps:

- 1.) Remove the three retaining screws which secure the top and bottom half of the RCPI unit. (Fig. 5)
 - 2.) Remove the two switch retaining nuts located on the face of the RCPI. There are two placards supplied with the remote, (a horizontal, and a vertical) remove the protective plastic film from the placard face, and install the vertical or horizontal placard. **Caution:** The "ON" position marking on the placard must be aligned with the red switch, the "TEST/RESET" marking must be over the black switch (Fig. 5)
 - 3.) Carefully remove the top half of the RCPI unit exposing the battery compartment. (Fig. 5) if replacing an old battery, carefully inspect the battery contacts for dirt or corrosion. If the contacts need cleaning, use only non abrasive electrical contact cleaner and a stiff brush. Abrasive cleaners will remove the nickel and gold plating from contacts.
 - 4.) Insert the battery with the polarity as shown in figure 5. The polarity is also engraved on the bottom of the battery compartment.
 - 5.) Replace the top half of the RCPI, and replace the three retaining screws, and two retaining nuts on the face of the RCPI.
 - 6.) The next RCPI battery replacement date should be recorded in the aircraft log book with a note indicating the battery expiration dates.
- IMPORTANT:** The RCPI must be mounted so that it can be seen, and operated by the pilot of the aircraft from a normal operating position. We strongly recommend that the RCPI be located within an area that is part of the pilots regular instrument scan.
- 5.) Mount the RCPI using four 4-40 screws, and nuts. Figure 6 shows the dimensions of the cut out for the RCPI unit. If the unit is to be mounted in a location that does not have a flush mounting surface (i.e. Beneath the panel glare shield.) an angle bracket should be fabricated. (Fig. 6)

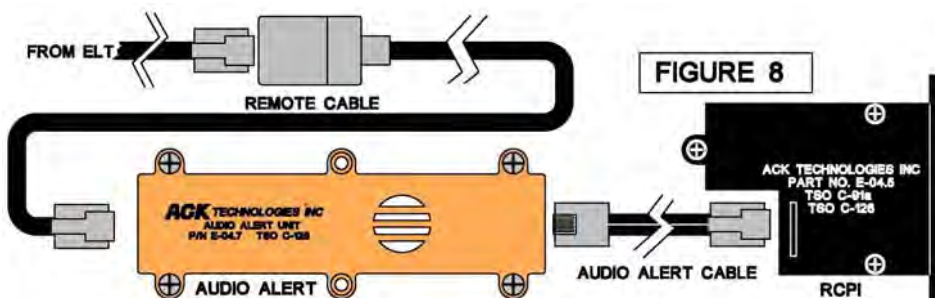
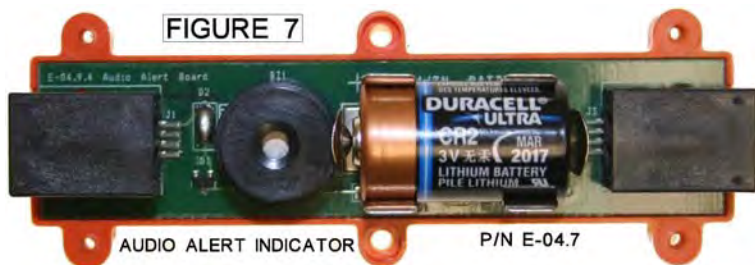




SECTION 5 AUDIO ALERT INDICATOR INSTALLATION

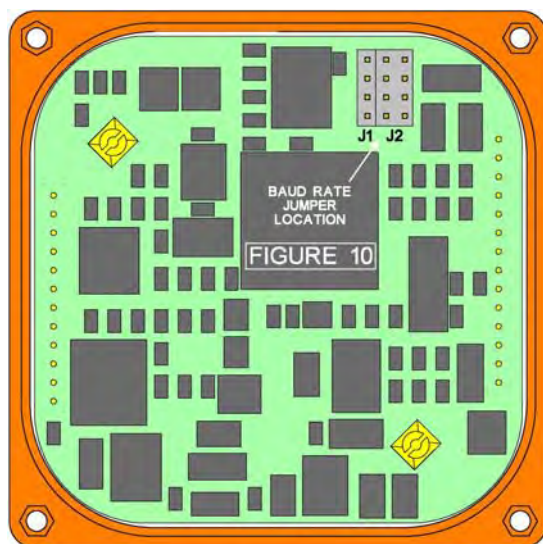
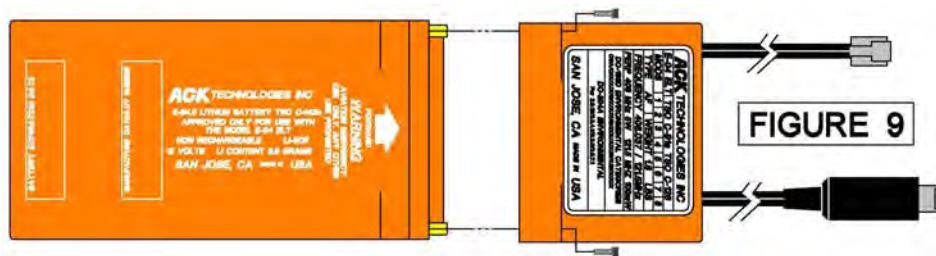
IMPORTANT: THERE IS NO BATTERY INSTALLED IN THE AUDIO ALERT INDICATOR.

Remove the four screws that attach the top cover to the audio alert indicator P/N E-04.7. Install a Duracell CR-2, 3 volt or equivalent battery. Make sure to observe the battery polarity (Fig. 7). Replace the top cover, making sure the grill portion of the indicator cover is positioned over the buzzer. The battery must be replaced every 10 years. The expiration date must be entered in the aircraft airframe log book.



The model E-04 ELT will interface and recognize EIA standard RS 232 data at 1200, 2400, 4800, and 9600 baud from NMEA 0183 sources, Garmin panel mount, and handheld GPS's along with Bendix/King GPS's. See section 18 for GPS data formats, and connection information, along with other manufacturers GPS's known to be compatible.

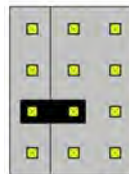
To change the baud rate, one or two jumpers are installed on the digital board of the ELT. To accomplish this remove the four screws at the front of the ELT, and remove the battery pack. (Fig. 9) Figure 10 shows how to position the jumper on the digital board for the various baud rates. After selecting the desired baud rate, replace the battery pack, and torque the screws to 3-4 in. lbs. The model E-04 ELT is interfaced to the aircraft source of navigation data through a four pin mini din connector. Three of the pins are used for interfacing with the aircraft systems, and the fourth pin is used to verify the ELT is receiving and processing the data properly after installing the ELT. A three conductor shielded cable 24 AWG or heavier, (Aircraft Spruce P/N 11-04478 or equivalent) should be used to connect the ELT RS 232 data and power to the aircraft systems. Figure 11 shows the pin outs for RS 232, and power input.



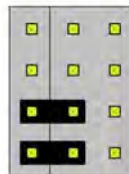
J1 J2
9600 BAUD
FACTORY
SETTING



J1 J2
4800 BAUD



J1 J2
2400 BAUD



J1 J2
1200 BAUD

- 1.) Disassemble the mini DIN connector, noting the position of the parts for reference when reassembling the connector .
- 2.) Connect one conductor to pin 1 of the DIN connector, and to 10 - 30 volts DC from the aircraft buss. Protect the circuit with a one amp fuse or circuit breaker. (Fig. 13)
- 3.) Connect one conductor to pin 3 (Fig. 12.1) and connect to aircraft ground at the cockpit. connect the outer shield to ground, at the cockpit end only. (Fig. 13)
- 4.) Connect one conductor to pin 4 of the din connector, for the RS 232 output from the navigation equipment providing data. Make sure this data conforms to one of our recognized data formats, and baud rates. (Fig.13)
- 5.) Bring a short 4" 24 AWG wire out from pin 2 to be used later in verifying that the ELT is receiving, and processing the GPS data properly. (Fig 12.4)

- 6.) Solder the connections, seal the back of the jack, and wire solder joints with silicon RTV sealant. (Loctite 59530 or equivalent) (Fig. 12.2)
- 7.) Apply RTV sealant to the inside of the outer cover to seal the wire where it enters the outer housing. (Fig. 12.3)



RS 232 CABLE DIN CONNECTOR	
PIN	FUNCTION
1	A+ 10-30V DC 40 ma TYP
2	RS 232 SEND
3	GROUND
4	RS 232 REC

FIGURE 11

LOOKING AT
BACK SIDE OF
JACK (SOLDER CUPS)

FIGURE 12

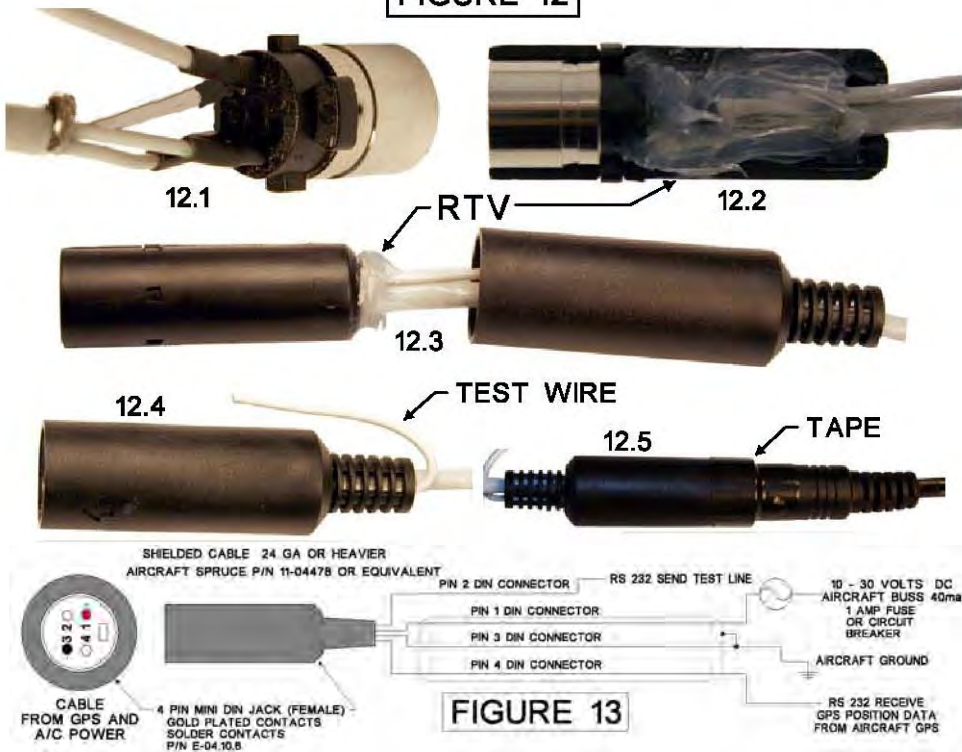


FIGURE 13

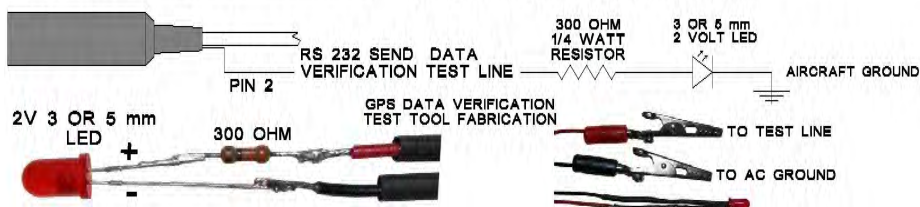
SECTION 7 FINAL INSTALLATION AND CHECK OUT

1.) After installing the ELT, antenna, and RCPI in the aircraft, install the coaxial cable between the ELT transmitter, and antenna base. If possible the cable should not cross any production breaks in the airframe, and must have a reasonable amount of slack at the transmitter. The slack is necessary for easy removal of the coaxial cable during maintenance. If a longer cable than the one supplied with the unit (5 foot) is needed, it may be fabricated using RG-58 cable or equivalent, and Amp 227079-5 connectors or their equivalent. Insertion loss of the cable at the 121.5 MHz frequency should not exceed 3dBm, and at the 406 MHz frequency 2dbm. Secure the coaxial cable using tie wraps or other appropriate methods. Make sure the cable is protected from abrasion.

- 2.) The RCPI unit is connected to the ELT transmitter via a RJ-11 standard type modular connectors. A 15 foot connecting cable is included with each ELT. To install the cable connect the modular plug on the ELT transmitter into the jack end of the interconnecting cable. Run the plug end of the cable to the audio alert unit. Run the short audio alert cable from the RCPI to the audio alert module (page 6 Fig. 8) avoid running this cable near sources of strong EMI/RFI radiation. (i.e. Comm cables, strobe light power cables, starter cables.) Secure the cable along its run using tie wraps, or other suitable methods. The interconnecting cable may be shortened, or a longer cable of up to 150ft. may be used if necessary. After connecting the mini DIN RS 232 jack and plug. Wrap electrical tape around the joint at the center of the connection to secure the two parts together, and seal the joint from moisture. (Page 8 Fig. 12.5)
- 3.) After installation, and wiring is complete, verify that the ELT is receiving and processing GPS data correctly. Apply power to both the ELT, and the GPS equipment supplying data. Make sure the GPS has a satellite fix, and is reporting position data. Fabricate a GPS verification tool as shown in figure 14.

FIGURE 14

GPS DATA VERIFICATION TEST TOOL SCHEMATIC



- 4.) Connect the test tool as shown in Fig 14. The main switch on the ELT should be in the "armed" position.
- 5.) With power supplied both to the ELT, and the GPS, make sure the GPS has acquired the satellites, and is transmitting valid position data. The LED should blink each time the ELT receives a valid GPS data position. (Typically once per second) This test verifies that the ELT is properly receiving, and processing position data from the GPS system. This is a very short duration low intensity flash make sure the LED is shielded from bright light.
- 6.) After verifying that the ELT is receiving, and processing GPS data correctly. Seal the end of the GPS verification test line using a adhesive lined end cap, (McMaster-Carr 72855k21) or other method to protect it from moisture. Secure the test wire to the shielded cable with a tie wrap.
- 7.) Complete the steps in section 8 (registration) before you verify the installed operation of the ELT. After you have registered the ELT, do the self test as described in section 9 to verify the complete system is functioning properly.
- 8.) Record the ELT battery expiration date marked on the ELT battery case, the expiration of the RCPI, and audio alert batteries in the airframe logbook.

SECTION 8 REGISTRATION

- 1.) Before completing the final check out of the ELT, **YOU MUST FIRST REGISTER YOUR BEACON FOLLOWING THE REGISTRATION REQUIREMENTS OF THE COUNTRY WHERE THE AIRCRAFT IS BASED. YOU CAN ONLY REGISTER THE ELT IN THE COUNTRY THE AIRCRAFT IS REGISTERED.**
- 2.) There is a preprinted self adhesive label supplied with the ELT that has the hex code, manufacturer, and model number on it which you should affix to the top of the registration form. Or you can refer to this label when registering over the internet. You can download the registration forms for your country from our website.

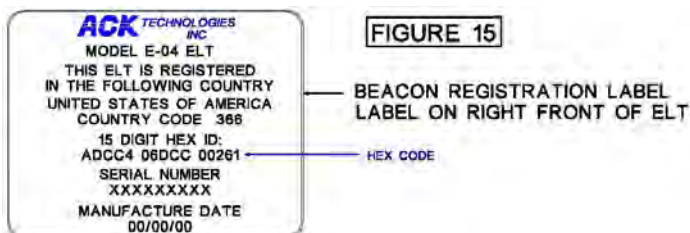
WWW.ACKAVIONICS.COM

- 3.) In the U.S. and Canada you can mail or fax the registration forms, however it is strongly recommend that beacon registration be completed on line at the following sites:

4.) For other countries contact the COSPAS/SARSAT regulating body for registration instructions. If allowed by your regulating country you may register at the COSPAS/SARSAT website.

5.) When filling out the registration the hex code identifier may also be found on the front right side of the ELT. (Fig 15)

6.) **YOU MUST UPDATE YOUR BEACON REGISTRATION** every two years, and any time the beacon is used in a different aircraft.



SECTION 9 OPERATION AND SELF TEST

THERE ARE THREE MODES THAT THE ELT MAY BE ACTIVATED:

- 1.) The ELT automatically activates when in the “armed” position, and a crash level deceleration force is applied to the ELT, in the forward direction as indicated by the arrow on the top of the battery pack.
- 2.) The ELT also may be activated by pressing the “On” button on the cockpit remote control (RCPI). (Page 11 Fig. 16)
- 3.) A third method of activating the ELT, is by means of placing the main on-off-armed switch, on the front of the ELT in the “On” position. (Page 11 Fig. 17)

The red rubber cover, covering the main switch on the ELT **SHOULD BE LEFT OFF AT ALL TIMES, EXCEPT WHEN THE ELT IS IN THE ARMED POSITION.** The cover has a center cone, that projects down into the switch recess, and provides for positive retention of the switch in the armed position.

There are two modes in which the ELT may be deactivated.

- 1.) Pressing the “Reset” button on the remote control (RCPI). (Page 11 Fig. 16)
- 2.) Placing the main switch on the ELT in the “Off” position. (Page 11 Fig. 17)

When the ELT is activated, and transmitting the 406 Mhz distress signal. The cockpit remote will flash, and the audio alert indicator will emit a series of 9 beeps, approximately every 50 seconds to alert the crew that the ELT is operating. If there is no emergency, reset the ELT using the “Reset” button on the remote, (Page 11 Fig. 16) and immediately notify the appropriate search and rescue operations office, or ATC of the false activation.

SELF TESTS:

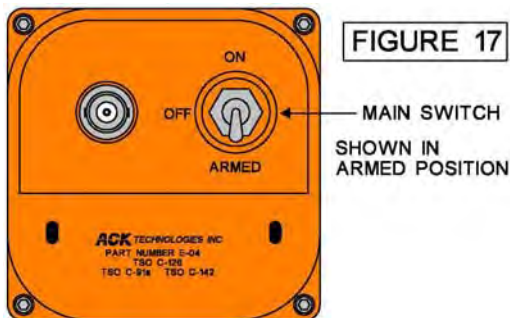
The ELT is capable of performing a self test to verify that major ELT systems are functioning properly.

During the self test, the ELT transmits on 121.5 MHz for 1 second, (3 audio sweeps) then transmits a 406 MHz test burst for 550ms, then returns to the armed mode.

There are two modes in which a self test can be initiated:

- 1.) When the ELT is in the “Armed” position, pressing the “Reset/Test” switch on the cockpit remote control (RCPI) initiates a self test. (Page 11 Fig. 16)

2.) When the main switch of the ELT is moved from the "Off" position to the "Armed" position, it does a self test. This mode is primarily designed to provide a method to bench test the ELT, with the remote control disconnected. (Fig. 17)



YOU MUST PERFORM A SELF TEST EVERY THREE MONTHS to verify the ELT is functioning properly.

To perform the self test, make sure **THE AIRCRAFT MASTER SWITCH IS OFF AND THERE IS NO POWER APPLIED TO THE ELT THROUGH THE GPS INTERFACE**. Tune an aircraft radio to 121.5 MHz, and turn the squelch all the way off to listen for the modulated carrier. With the ELT main switch in the "Armed" position, and not operating, press the "Reset/Test" button on the cockpit remote control (RCPI) once. You will hear one second of 121.5 audio on the radio, followed by either one beep from the audio alert indicator, or one beep followed by a two second delay, and a second beep if all systems are functioning properly. The light will also flash on the remote. (The flashes are random and have no meaning)

System OK codes: One Beep **or** One Beep followed by a second beep two seconds later.

A series of 2 – 5 fast beeps, a 2 second delay, and the beep series repeating again indicates there is a self test function that has returned a trouble condition. The ELT will not be disabled, but it should be inspected by a qualified avionics facility as soon as possible.

The trouble code returns a series of beeps with a two second delay, and then the trouble code is repeated one more time. The first beeps alert you that there is a trouble condition. The two second delay is to allow you to be ready to count the second set of beeps.

Trouble code sequence: 2-5 beeps — two second delay — 2-5 beeps

TROUBLE CODES:

2 BEEPS→ BATTERY LOW

3 BEEPS→ LOW RF POWER

4 BEEPS→ FREQUENCY NOT LOCKED

5 BEEPS→ HIGH VSWR OR HIGH CURRENT

SECTION 10 PERIODIC MAINTENANCE/CONTINUING AIRWORTHINESS

THE FOLLOWING TEST MUST BE PERFORMED EVERY THREE CALENDAR MONTHS.

ELT SELF TEST FUNCTION AS DESCRIBED IN SECTION 9 OF THIS MANUAL.

THE FOLLOWING TESTS MUST BE PERFORMED A MINIMUM OF EVERY TWELVE CALENDAR MONTHS, TO ASSURE THE CONTINUING AIRWORTHINESS OF THE ELT.

1.) Inspect the ELT transmitter and mounting tray to insure all fasteners, and mechanical assemblies are secure.

2.) Inspect the coaxial cable connecting the ELT transmitter to the antenna for cuts or abrasions on its outer jacket. Disconnect the BNC connector at each end. Examine both BNC connectors and the mating plug on the ELT transmitter, and antenna base for any signs of corrosion.

3.) Inspect the modular cable connecting the ELT to the RCPI unit for signs of wear or abrasion on its outer jacket. Remove the modular plug connecting the ELT transmitter

to the connecting cable, and inspect the jack and plug assembly for corrosion.

4.) If a GPS is interfaced to the ELT, inspect the modular cable connecting the ELT to the GPS unit for signs of wear or abrasion on its outer jacket. Remove the modular plug connecting the ELT transmitter to the GPS and inspect the jack and plug assembly for corrosion.

5.) Check the expiration date of the RCPI battery and audio alert battery in the aircraft log book. Check the expiration date of the battery pack and replace if necessary.

6.) Leave the ELT in the "Armed" position, then remove the ELT from the aircraft, and perform a G switch test as follows:

This test should be conducted between the hour, and 5 minutes after the hour per FCC requirements. Tune an aircraft radio, or hand held aircraft radio to 121.5 MHz. The radio should be in close proximity to the area where you will conduct the test.

TURN THE SQUELCH CONTROL ALL THE WAY DOWN, OR OFF. You should be hearing white noise on the radio. If switching the main switch from the "Off" to the "Armed" position wait at least 15 seconds before performing this test. While in the "Armed" position, hold the ELT at your waist with the arrow printed on the battery case facing away from you. Move the ELT rapidly away from your waist. When the ELT reaches the full extent of your arm, retract it back to your waist as fast as possible. You should hear the 121.5 MHz sweep tone in the radio. **AS SOON AS YOU HEAR THE TONE, IMMEDIATELY TURN THE MAIN SWITCH ON THE ELT TO THE "OFF" POSITION.**

The ELT when activated transmits on 121.5 MHz for approximately 50 seconds before a 406 MHz burst is sent to the satellites. This is a live burst which will immediately notify the COSPAS/SARSAT system that there is an emergency. **IT IS IMPERATIVE THAT YOU DO NOT ALLOW AN ACTIVATED ELT, TO TRANSMIT FOR MORE THAN 30 SECONDS DURING G SWITCH TESTING.**

7.) Reinstall the ELT, make sure the cables are secured, and properly connected. Make sure to seal the din connector if the ELT is connected to the aircraft GPS. (Page 8 Fig. 12.5) Place the main switch in the "Armed" position, and install the rubber cover over the main switch opening.

8.) Perform the self test described in section 9 to verify proper operation.

SECTION 11 E-04.0 LITHIUM BATTERY REPLACEMENT

REPLACEMENT OF THE MAIN LITHIUM BATTERY P/N E-04.0

The lithium battery (P/N E-04.0) must be replaced on, or before the battery expiration date marked on the battery. It is no longer airworthy after this date. See far 91.207 for other ELT requirements.

1.) Using a 3/32 hex wrench, remove the four retaining screws that attach the battery case to the ELT transmitter assembly, and gently pull the battery pack from the transmitter section. (Page 7 Fig. 9)

2.) **WITH THE MAIN SWITCH IN THE "OFF" POSITION,** install the new sealed battery pack. (P/N E-04.0) The battery pack is designed so the battery can only be installed in the proper orientation. Wet the O-ring with a mild dish soap solution, and shake off the excess solution, or use silicon vacuum grease. Install the O-ring onto the battery case. Remove the two protective caps from the battery contacts. (Page 13 Fig. 18) The battery pack should slide easily into the transmitter housing.

3.) Re-attach the transmitter assembly to the battery pack by replacing the four hex head screws. Tighten the screws to 3.5-4.0 in-lbs.

4.) Record the new battery expiration date in the airframe logbook.

5.) After re-installation of the ELT into the aircraft, a self test must be performed. Refer to section 9.

BATTERY AND ELT DOT/ IATA SHIPPING INFORMATION

The ELT with the battery attached is a DOT/IATA class 9 hazmat material under the category of life saving appliances not self inflating UN 3072. **THERE ARE NO AIR SHIPMENT RESTRICTIONS FOR SUCH DEVICES, AND THEY MAY BE SHIPPED IN ANY QUANTITY IN PASSENGER CARRYING, OR TRANSPORT AIRCRAFT.** The original ACK ELT shipping box complies with (UN) United Nations packaging specifications.

The battery when shipped alone is a class 9 hazmat, under the category of lithium batteries UN 3090. If the total weight of the shipment exceeds 5 kg they are restricted from carriage in passenger carrying aircraft.

THE FOLLOWING IS AN EXCERPT FROM FAA AC 91-44A PARAGRAPH 8.a WHICH DEFINES WHEN ELT BATTERY REPLACEMENT MAY BE DONE UNDER 14 CFR PART 43.3(h) AS PREVENTIVE MAINTENANCE.

"...The replacement can be done by the pilot if the preventive maintenance limitations of part 43.3(h) of the FAR, are complied with. For example, a portable type ELT that is readily accessible and can be removed and reinstalled in the aircraft by a simple operation should be considered preventive maintenance. Fixed type ELT installations are often permanently mounted in a remote area of the aircraft near flight control cables, vital aircraft components, and critical attachments to the aircraft structure. Installations of this nature require an external antenna and often a remote on/off transmitter control switch that is usually located near the pilots flight position. This type of installation is complex and battery replacement should be accomplished by a certified mechanic or certified repair station..."

DO NOT REMOVE SEALANT FROM BATTERY PACK SCREWS, OR DISASSEMBLE BATTERY PACK .TSO-C142a PROHIBITS OPENING OR REPLACING CELLS. IF THE BATTERY PACK IS OPENED BY ANYONE EXCEPT THE MANUFACTURER IT IS NO LONGER AIRWORTHY, AND THE WARRANTY IS VOID.



SECTION 12 PROGRAMMING

THE ELT IS FACTORY PROGRAMMED TO THE STANDARD LOCATION SERIAL NUMBER FORMAT WITH U.S.A. COUNTRY CODE. (366)

The ELT may be programmed in the field to the following formats:

Serial number (you may only reprogram the country code in this format.)

Standard location 24-bit address

Standard location with operator designator & serial number

To reprogram the ELT you must use our programming dongle.

(P/N E-04.prg Ver 2.1) the module interfaces to a PC operating Windows XP, Windows 7 Professional via a USB port.

The programming software and manual may be downloaded from our web site.

WWW.ACKAVIONICS.COM.

SECTION 13 WARRANTY PROCEDURE

Should it become necessary to return the ELT for warranty service. **REMOVE THE ELT BATTERY BEFORE SHIPPING THE UNIT TO OUR FACILITY.** The battery is **DOT/IATA CLASS 9 HAZARDOUS MATERIAL**, and DOT/IATA regulations must be followed whenever shipping the battery, or ELT and battery. See section 11 page 12 for additional shipping information.

All units must be returned to our facility freight prepaid. Our shipping Address is as follows:

ACK TECHNOLOGIES, INC.
440 W. JULIAN ST.

SAN JOSE, CA 95110 Provide an address that UPS will deliver to

return shipment. (no PO boxes, or APO numbers) Please include a short description of the problem you have been experiencing, and a telephone number where you may be reached during business hours if possible. No RMA number is required.

Any unit that is returned for warranty, and found not to be defective will be charged a minimum handling and service charge, and returned C.O.D.

RECORD YOUR AIRCRAFT AND ELT INFORMATION FOR FUTURE REFERENCE

AIRCRAFT _____

REGISTRATION NUMBER _____ COUNTRY _____

INSTALLATION DATE _____

ELT SERIAL NUMBER (FROM TSO LABEL) _____

ELT HEX CODE (FROM RIGHT SIDE LABEL) _____

UPDATE REGISTRATION EVERY TWO YEARS

NEXT REG DUE

NEXT REG DUE

NEXT REG DUE

NEXT REG DUE

NEXT REG DUE

SECTION 14 CANADIAN MAINTENANCE REQUIREMENTS

In addition to our periodic maintenance requirements of section 10 *In Canada you must comply with car part 5, chapter 571, appendix G maintenance requirements for continued airworthiness. We strongly recommend the "WS technologies inc" BT100av, or BT100avs tester be used to verify the performance characteristics of the ELT.*

WEBSITE: WWW.WST.CA

THESE TESTS SHOULD ONLY BE PREFORMED IN A RF SCREEN ROOM.

When using conventional test equipment to perform this test:

Connect the RF output of the ELT to a spectrum analyzer with a 50 ohm impedance capable of measuring frequency, power, and perform the following tests. **THE OUTPUT POWER DURING THE 406 MHz BURST IS + 37 dBm MAKE SURE THIS DOES NOT EXCEED THE MAXIMUM INPUT LEVEL OF THE ANALYZER.** An attenuator may be necessary to reduce the input power to the analyzer. The test results must fall within the following minimum and maximum values:

406 FREQUENCY: 406.037000 MHz +/- 2 kHz

POWER: 35 to 39 dBm

121.5 MHz FREQUENCY: 121.5 MHz +/- 6 kHz

POWER: + 17 to 23 dBm

The current draw requirements of the regulations may be confirmed by removing the battery case, separating it from the transmitter head and using jumpers to connect the battery in series with the current meter.

CAUTION: THE POWER INPUT IS NOT PROTECTED FROM REVERSE POLARITY. IF REVERSE POLARITY IS APPLIED SEVERE DAMAGE WILL OCCUR, AND VOID THE WARRANTY.

STANDBY CURRENT IN THE ARMED MODE: $\leq 30 \mu A$

THE G SWITCH ACTIVATION REQUIRED BY CAR PART 5, CHAPTER 571, APPENDIX G PAR (c) (3) (e) IS PREFORMED DURING THE SECTION 10 TESTING AND INSPECTION.

SECTION 15 SPECIFICATIONS

ELT PART NUMBER E-04

APPROVALS:

FAA / TRANSPORT CANADA
TSO C-126b TSO C-91a
ETSO 2C126 ETSO 2C91a
COSPAS/SARSAT T.001 T.007
INDUSTRY CANADA 1863A-E04AF
BRAZIL ANAC

TYPE:

TSO C-126, C-91a AF

FREQUENCY:

121.5 MHz & 406.037 MHz

MODULATION:

406 MHz +/-2 kHz Bi-Phase L (16KOG1D)
121.5 MHz +/- 6 kHz AM (3K20A3N)

SWEPT DOWNWARD 1400 – 400 Hz

REPETITION RATE 3 Hz

MODULATION FACTOR ≥ 90%

DUTY CYCLE ≥ 45%

POWER AT TERMINAL 50 Ω LOAD:

121.5 MHz 20.7 dBm 50 HOURS@ -20C

406.037 MHz 37.3 dBm 24.5 HOURS @ -20C

STANDBY CURRENT ARMED MODE 26 Ua

CURRENT 406 MHz BURST 1.4 average

CURRENT 121.5 MHz OPERATION 68 mA

PEAK EIRP WITH E-04.8 WHIP ANTENNA

AND E-04.10.4 COAX CABLE:

121.5 MHz +23 dBm 200 mW

406.037 MHz +39.79 dBm 13.7 W

OPERATING TEMPERATURE:

-20C TO +55C

STORAGE TEMPERATURE:

-55C TO +85C

CRASH ACTIVATION:

4.5 FpS +/- .5 FpS

DIMENSIONS:

7.750" x 2.850" x 2.850"

192 mm x 72 mm x 72 mm

WEIGHT:

ELT AND BATTERY PACK 1.6 lbs .73kg

ELT TRAY AND STRAPS .2 lbs .09kg

REMOTE CONTROL (RCPI) 1.1 oz 31g

AUDIO ALERT INDICATOR 1.5 oz 43g

ANTENNA PART NUMBER E-04.8

LENGTH 20.625" 524 mm SWEPT 20°

WEIGHT 2.1 oz 60g

IMPEDANCE 50 OHM NOMINAL

VSWR @ 121.5 MHz ≤ 2.5:1

VSWR @ 406 MHz ≤ 1.5:1

MAX 260 KNOTS@ SEA LEVEL

BATTERY PART NUMBER E-04.0

APPROVALS:

FAA / TRANSPORT CANADA
TSO C-142a
ETSO C-142a
BRAZIL ANAC

TYPE:

Li-SO₂

NON FLAMMABLE ELECTROLYTE

VOLTAGE:

12 VOLTS

OPERATING TEMPERATURE:

-20C TO +55C

DIMENSIONS:

5.750" x 2.850" x 2.850"

146mm x 72mm x 72mm

WEIGHT:

1.18 lbs .535 kg

AMP HOUR RATING:

7.75 Ah

NON RECHARGEABLE

LITHIUM CONTENT:

9.8 GRAMS

MAXIMUM DISCHARGE RATE:

2.5 AMPS

BATTERY LIFE:

5 YEARS

WHEN USED WITH THE MODEL E-04 ELT

LIMITATIONS: ANY OTHER USE OF THIS
BATTERY IN AIRCRAFT IS PROHIBITED UNLESS
APPROVED BY
ACK TECHNOLOGIES INC.

THE CONDITIONS AND TESTS FOR TSO
APPROVAL OF THIS ARTICLE ARE MINIMUM
PERFORMANCE STANDARDS. THOSE
INSTALLING THIS ARTICLE, ON OR IN A SPECIFIC
TYPE OR CLASS OF AIRCRAFT, MUST
DETERMINE THAT THE AIRCRAFT INSTALLATION
CONDITIONS ARE WITHIN THE TSO STANDARDS.
TSO ARTICLES MUST HAVE SEPARATE
APPROVAL FOR INSTALLATION IN AN AIRCRAFT.
THE ARTICLE MAY BE INSTALLED ONLY
ACCORDING TO 14 CFR PART 43 OR THE
APPLICABLE AIRWORTHINESS REQUIREMENTS.
LITHIUM CELL AND BATTERY SAFETY
CONCERNS INCLUDE THE POSSIBILITY OF FIRE
AND VENTING OF TOXIC GASES

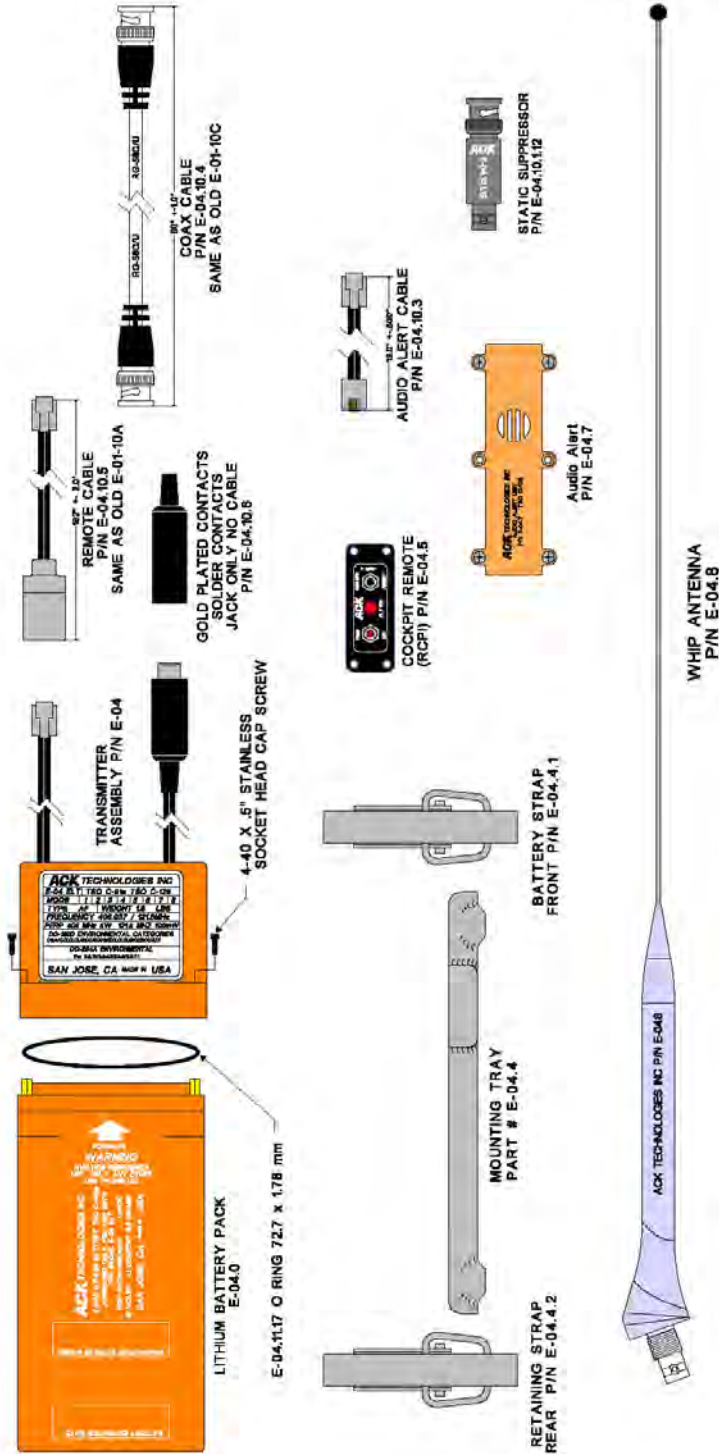
ELECTRONIC HARDWARE/FIRMWARE

BEACON ASIC LOAD FILE: V1.01

BEACON ASIC FIRMWARE: V1.0

DO-254 LEVEL E

E-04 ELT MAJOR PARTS



SECTION 17 DO-160F/ED-14F ENVIRONMENTAL CATEGORIES

CONDITIONS	SECTION	DESCRIPTION OF TESTS CONDUCTED
Temperature and Altitude	4.0	Qualifies To Category D1
Temperature Variation	5.0	Qualifies To Category A
Humidity	6.0	Qualifies To Category C
Shock and Crash DO-204 Par. 2.3.4.1 DO-204 Par. 2.4.2.4	7.0	Not Tested Category Identified as X Shock Crash Safety
Vibration	8.0	Qualifies To Category R
Explosive Atmosphere	9.0	Not Tested Category Identified as X
Waterproofness	10.0	Qualifies To Category S
Fluids Susceptibility	11.0	Not Tested Category Identified as X
Sand and Dust	12.0	Not Tested Category Identified as X
Fungus	13.0	Not Tested Category Identified as X
Salt Spray	14.0	Qualifies To Category S
Magnetic Effect	15.0	Qualifies To Category Z
Power Input	16.0	Qualifies To Category B Additional Testing to 16.6.1.3 (b)
Voltage Spike	17.0	Qualifies to Category B
Audio Frequency Conducted Susceptibility	18.0	Qualifies To Category B
Induced Signal Susceptibility	19.0	Qualifies To Category BC
Radio Frequency Susceptibility	20.0	Not Tested Category Identified as X
Radio Frequency Emissions	21.0	Qualifies To Category H
Lightning Induced Transient susceptibility	22.0	Not Tested Category Identified as X
Lightning Direct Effects	23.0	Not Tested Category Identified as X
Icing	24.0	Not Tested Category Identified as X
Electro-Static Discharge	25.0	Not Tested Category Identified as X
Fire, Flammability DO-204 Par. 2.3.7.1	26.0	Not Tested Category Identified as X Flame Test

Additional DO-204 Testing

DO-204	Par 2.3.2.1	Low Temperature Battery Life
DO-204	Par 2.3.2.2	High Temperature Battery Life
DO-204	Par 2.3.2.3	Frequency Stability With Temperature Gradient
DO-204	Par 2.3.2.4	Thermal Shock
DO-204	Par 2.3.2.5	VSWR
DO-204	Par 2.3.2.6	Self Test
DO-204	Par 2.3.1.1	Low Temperature Activation
DO-204	Par 2.3.1.2	High Temperature Activation
DO-204	Par 2.3.1.3	Altitude
DO-204	Par 2.3.1.4	Decompression
DO-204	Par 2.3.1.5	Overpressure

SECTION 18 RS 232 DATA FORMATS / INSTALLATION NOTES

The following data messages are recognized by the model E-04 RS 232 GPS interface:

Electrical per EIA RS 232C

Baud Rate Selectable, 8 bits, 1 stop bit, no parity

<STX> ASCII start of text character (hex02)

<id> item designator

<dddd> item data

<it> item terminator

<ETX> ASCII end of text character (hex03)

Typical message: <STX><id><dddd><it><id><dddd><it>...<id><dddd><it><ETX>

Bendix/King Format these id's and data fields must be the first data fields in the message

id	Data Format	Field Width	Description
A	s dd mmhh	9	s dd mmhh 9 present latitude s=sign: N for North, S for South dd=degrees mm=minutes hh=hundreths of minutes
B	s ddd mmhh	10	s ddd mmhh 10 present longitude s=sign: E for East, W for West ddd=degrees mm=minutes hh=hundreths of minutes

Garmin Format these id's and data fields must be the first data fields in the message

id	Data Format	Field Width	Description
Z	aaaaa	5	Current GPS Altitude in Feet
A	s dd mmhh	9	s dd mmhh 9 present latitude s=sign: N for North, S for South dd=degrees mm=minutes hh=hundreths of minutes
B	s ddd mmhh	10	s ddd mmhh 10 present longitude s=sign: E for East, W for West ddd=degrees mm=minutes hh=hundreths of minutes

NMEA 0183 format the \$GPGGA message must be present in the string.

Example: \$GPGGA,123519,4807.038,N,01131.000,E,

Where:

GGA Global Positioning System Fix Data

123519 Fix taken at 12:35:19 UTC

4807.038,N Latitude 48 deg 07.038' N

01131.000,E Longitude 11 deg 31.000' E

GPS installation notes:

- 1.) Garmin portable x96 series (i.e. 469, 596 etc.) GPS: the output should be set to TIS In/ NMEA & VHF Out, this sets the baud rate to 9600 which is the default baud rate of the E-04. NEMA In/NMEA Out may also be used at a different baud rate. Under advanced NEMA settings the data rate should be set to "normal" not "fast" and Garmin priority should be set to "Off".
- 2.) Bendix/King, and Garmin panel mount receivers use RS 232 aviation format out @9600 baud.
- 3.) Avidyne IFD540 Revision 9.3 and above, use RS 232 aviation message out @ 9600 baud.
- 4.) The ELT is also compatible with most ARNAV, II Morrow, and Trimble Navigation GPS receivers. Please contact the GPS manufacture for the proper RS 232 configuration that conforms to our data input requirements above.

SECTION 19 TROUBLE SHOOTING / MISCELLANEOUS NOTES

<i>The Remote Control and Audio Alert Indicator do not work</i>	<i>Make sure you have installed batteries in the Remote Control and Audio Alert Indicator. Make sure you are using a CR 2 battery in the Audio Alert Indicator. See Section 4 and 5 of this manual.</i>
<i>Remote flashes constantly and Audio Alert makes a clicking sound with ELT off or armed</i>	<i>The remote cable is crossed. Remove one of the male RJ 11 plugs and reverse the plug 180 degrees and re-crimp new plug. This can occur if you make your cables and do not use the factory supplied cables.</i>
<i>No GPS data is being received the ELT test light does not flash or LED stays on</i>	<i>Check that the data being sent to the ELT meets the data protocol in Section 17 of this manual. Connect test LED to pin 4 and ground of the cable providing GPS data and power (page 8 Fig 13) test light should flash if not reverse test LED and if flashing retry test lead on ELT.</i>
<i>There are no GPS coordinates when the message is decoded on a beacon tester.</i>	<i>COSPAS/SARSAT requirements do not allow GPS position information to be transmitted during the self test message. The coordinates are only sent during a live distress transmission.</i>
<i>Beacon tester can not decode the 406 MHz message</i>	<i>Check with the beacon tester manufacturer to make sure the tester will recognize our 406.037 MHz transmission. Many of the early testers will not decode the newer COSPAS/SARSAT assigned frequencies.</i>
<i>ELT transmits when switched from the "Off" to "Armed" position</i>	<i>The ELT does a self test when you switch from the "off" to the "armed" position. It transmits on 121.5 MHz for one second followed by a 406 MHz test burst. See section 9 of this manual.</i>
<i>ELT continues to transmit when the "Reset/Test" button is pressed</i>	<i>Make sure the Placard is positioned so that the "Reset/Test" is over the black pushbutton switch. See Section 4 Figure 5 of this manual.</i>
<i>Audio Alert gives a trouble code of 5 beeps (High VSWR or high current)</i>	<i>Check to make sure the ELT is connected to one of our two approved antennas. Check the coax cable from the ELT to antenna. Make sure the antenna has a proper ground plane and is not in close proximity of metal surfaces. Check ELT battery condition.</i>
<i>Audio Alert gives a trouble code of 4 beeps (Frequency not locked)</i>	<i>Frequency synthesizer is not locked. Retest 2 times if trouble code does not clear return ELT to our facility for service. If code clears retest during the next 3 flights. If trouble code again appears return ELT to our facility for service.</i>
<i>Audio Alert gives a trouble code of 3 beeps (Low RF power)</i>	<i>Check battery</i>
<i>Audio Alert gives a trouble code of 2 beeps (Low battery)</i>	<i>Replace battery</i>

Battery testing procedure:

At an ambient temperature of 25C +/- 5C, remove the battery from the ELT and measure the open circuit voltage. This should be above 11.5 volts. Connect a 15 watt 12 volt automotive bulb across the battery contacts while monitoring the voltage it will initially be below 10 volts after 15-25 seconds it should increase to above 10 volts.

An alternate method to test the battery is to separate the battery and transmitter section, and use jumpers to connect the negative contact of the battery, to the negative contact of the transmitter. Connect an amp meter capable of measuring a minimum of 3 amps across the positive battery terminals, and the transmitter terminals. Place a second volt meter across the terminals. Place a 50 Ohm load on the antenna BNC connector, and perform a self test by switching the ELT from the "Off" position to the "Armed" position. During the test current should be in the range of 1.5 to 2.2 amps voltage should stay above 9.5 volts.

See Section 14 Canadian Maintenance Procedures "caution" before performing this test.

LIMITED WARRANTY

THIS MODEL E-04 EMERGENCY LOCATOR TRANSMITTER IS GUARANTEED BY ACK TECHNOLOGIES, INC. AGAINST DEFECTS IN MATERIALS AND WORKMANSHIP FOR A PERIOD OF TWO YEARS FROM THE INSTALLATION DATE OR TWO YEARS THREE MONTHS FROM THE DATE IT WAS MANUFACTURED WHICHEVER OCCURS FIRST. ACTIVATE YOUR WARRANTY BY REGISTERING ON LINE AT OUR WEBSITE WWW.ACKAVIONICS.COM THIS WARRANTY IS LIMITED EXCLUSIVELY TO REPAIR OR REPLACEMENT OF THE E-04 ELT AND ASSOCIATED PARTS WHICH WERE MANUFACTURED BY ACK TECHNOLOGIES, INC. THE DEFECTIVE PARTS MUST BE RETURNED FREIGHT PREPAID TO OUR MANUFACTURING FACILITY. THIS WARRANTY DOES NOT INCLUDE REPAIR OR REPLACEMENT OF ANY PART THAT HAS BEEN IMPROPERLY USED, INSTALLED OR PHYSICALLY DAMAGED. THIS WARRANTY DOES NOT COVER ANY DAMAGE CAUSED BY CHEMICAL EXPOSURE TO THE ELT. DISCHARGE OF THE LITHIUM BATTERY IS NOT COVERED BY THIS OR ANY OTHER WARRANTY. EXCEPT AS PROVIDED HEREIN ACK TECHNOLOGIES, INC. MAKES NO EXPRESS WARRANTIES, AND ANY IMPLIED WARRANTY OF MERCHANTABILITY OF FITNESS FOR A PARTICULAR PURPOSE IS LIMITED IN ITS DURATION TO THE DURATION OF THE WRITTEN LIMITED WARRANTIES SET FORTH HEREIN. ACK TECHNOLOGIES, INC. SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING FROM THE USE OR MISUSE OF THIS PRODUCT. EXCEPT AS PROVIDED HEREIN NO EMPLOYEE, AGENT, DEALER, OR OTHER PERSON IS AUTHORIZED TO GIVE ANY WARRANTIES OF ANY NATURE ON BEHALF OF ACK TECHNOLOGIES, INC.

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E-MAIL: INFO@ACKAVIONICS.COM

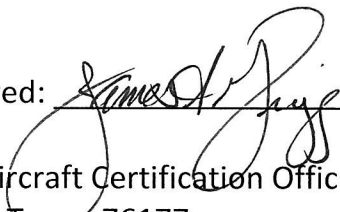
FAA APPROVED AIRPLANE FLIGHT MANUAL SUPPLEMENT

For Cessna Model 172F through M, 182E
through K 205,205A, 206, P206 through
P206B, TP206A and B, U206 through U206B,
TU206A and B, 210 210D through F and T210F
airplanes.

Registration Number _____

Serial Number _____

This supplement must be attached in the FAA approved Airplane Flight Manual (AFM) when the airplane is modified with the Visual Instruments Flap Position Indicator in Accordance with STC _____. The information contained herein, supplements, or supersedes the basic manual only in those areas listed in this supplement. For limitations, procedures and performance not contained in this supplement, consult the Basic AFM.

FAA Approved: 
Jim Grigg
Manager, Aircraft Certification Office
Fort Worth Texas 76177

Dated: 22 JUN 2017

Visual Instruments, LLC
48 Aviation Drive – Suite 1
Gilmer Texas 75645

General

The Visual Instrument Flap Position Indicator is an electronic indicator utilizing an LED bar graph display to show the position of the wing flaps. The indicator replaces the original flap indicator and is located in the same position on the instrument panel. The LED bar graph on the display instrument is comprised of 9 LED's arranged vertically. The top LED is illuminated when power is supplied to the instrument from the main bus. The second LED is illuminated as the flaps move to the 5 degree position and each succeeding LED illuminates with each additional 5 degrees of flap position, until all 9 LED s are illuminated at the 40 degree position.

The indicator incorporates an auto dimmer circuit which reduces the brightness of the LED display when the natural light in the cockpit is reduced during night or IFR operations.

FAA APPROVED _____

Date: _____

FAA APPROVED
AIRPLANE FLIGHT MANUAL SUPPLEMENT

For Cessna Model 172F through M, 182E through K 205,205A, 206, P206 through P206B, TP206A and B, U206 through U206B, TU206A and B, 210 210D through F and T210F airplanes.

Registration Number _____

Serial Number _____

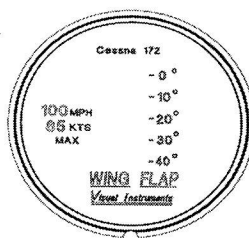
This supplement must be attached in the FAA approved Airplane Flight Manual (AFM) when the airplane is modified with the Visual Instruments Flap Position Indicator in Accordance with STC SA00819SE. The information contained herein, supplements, or supersedes the basic manual only in those areas listed in this supplement. For limitations, procedures and performance not contained in this supplement, consult the Basic AFM.

FAA Approved:  _____
Jim Grigg
Manager, Aircraft Certification Office
Fort Worth Texas 76177

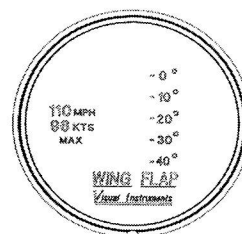
Dated: 22 JUN 2017

The Visual Instrument Flap Position Indicator is an electronic indicator utilizing an LED bar graph display to show the position of the wing flaps. The indicator replaces the original flap indicator and is located in the same position on the instrument panel. The LED bar graph on the display instrument is comprised of 9 LED's arranged vertically. The top LED is illuminated when power is supplied to the instrument from the main bus. The second LED is illuminated as the flaps move to the 5 degree position and each succeeding LED illuminates with each additional 5 degrees of flap position, until all 9 LED s are illuminated at the 40 degree position.

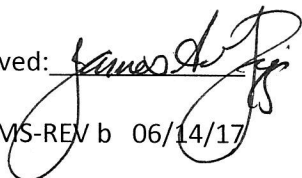
LIMITATIONS



Placard
CESSNA 172



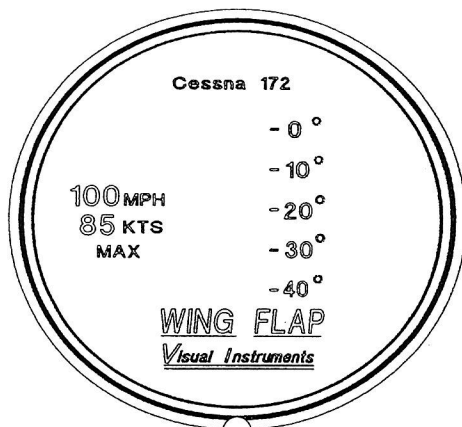
Placard
CESSNA 182, 205, 206, 210

FAA Approved:  Dated: 22 JUN 2017

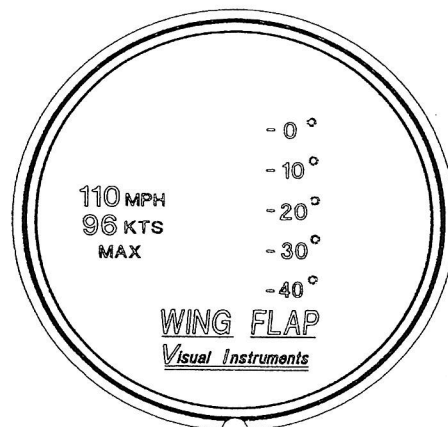
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Gilmer, Texas 75645

LIMITATIONS



Placard
CESSNA 172



Placard
CESSNA 182, 205, 206, 210

FAA APPROVED _____

Jim Grigg

Manager, Aircraft Certification Office
Fort Worth, Texas 76177

Date: 22 Jun 2017

**Visual Instruments Flap Position Indicator
Installation Instructions
Instructions for Continued Airworthiness**

STC SA00819SE

- a. DESCRIPTION**
- b. INSTALLATION AND RIGGING**
- c. INSTRUCTIONS FOR CONTINUED AIRWORTHINESS**
- d. TROUBLESHOOTING**

a. Description

The Visual Instrument Flap Position Indicator is an electronic indicator utilizing an LED bar graph display to show the position of the wing flaps. The display instrument is similar in size to the OEM instrument and uses the original mounting position and hardware. The flap position transmitter is also similar to the OEM transmitter and is mounted in the right wing using the same mounting bracket and hardware. The electrical wiring for the unit uses existing wiring in the airframe. The LED bar graph on the display instrument is comprised of 9 LED's arranged vertically. The top LED is illuminated when power is supplied to the instrument from the main bus. The second LED is illuminated as the flaps move to the 5 degree position and each succeeding LED illuminates with each additional 5 degrees of flap application, until all 9 LED's are illuminated at the 40 degree position.

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b. Installation and Rigging

Please read before installing and wiring your new flap indicating system.

Cessna used two different flap indicating systems during the manufacture of aircraft to which this STC is applicable. One system used two wires from the position transmitter to the indicator the other used only one. Even if the system you removed used only one wire there may be two wires installed in the airframe. It is preferred that two wires be used with the Visual Instrument system but if only one is available the airframe can be used as a ground between the transmitter and indicator. Check your airframe to determine if one or two wires are available then check continuity of the wires with an ohmmeter. Refer to figure 1 while performing the transmitter Installation.

Installation of Transmitter

1. Disconnect aircraft battery.
2. Remove flap transmitter access panel from right wing.
3. Remove courtesy light, on aircraft so equipped.
4. Remove cotter pin from clevis pin and remove clevis pin from transmitter arm.
5. Remove two 3/16 bolts holding transmitter to bracket on wing rib. Disconnect wire(s) and remove transmitter from wing.
6. Install the new transmitter assembly to the wing rib bracket using the 3/16 bolts just removed. If your installation is only using one wire from the transmitter to the indicator leave one bolt finger tight.
7. Attach the new transmitter arm to flap pulley arm using the clevis pin removed in step 3 and a new cotter pin.
8. Attach the large end of the transmitter arm and retaining washer to the potentiometer spindle using 6-32 socket head cap screws and lock washers (supplied). Do not tighten screws at this time.
9. If using two wires, remove factory terminals from airframe wires and install a male blade terminal on one wire and a female blade terminal on the other wire. Connect airframe wires to transmitter lead wires.

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10. If using one wire, remove factory terminal from the airframe wire and install a male (Scotch Lok) terminal on the wire. Connect airframe wire to the transmitter lead wire. Remove the other Scotch Lok connector from the transmitter and install a #10 ring terminal. Install this ring terminal under the mounting bolt left finger tight in step 6. Tighten bolt.

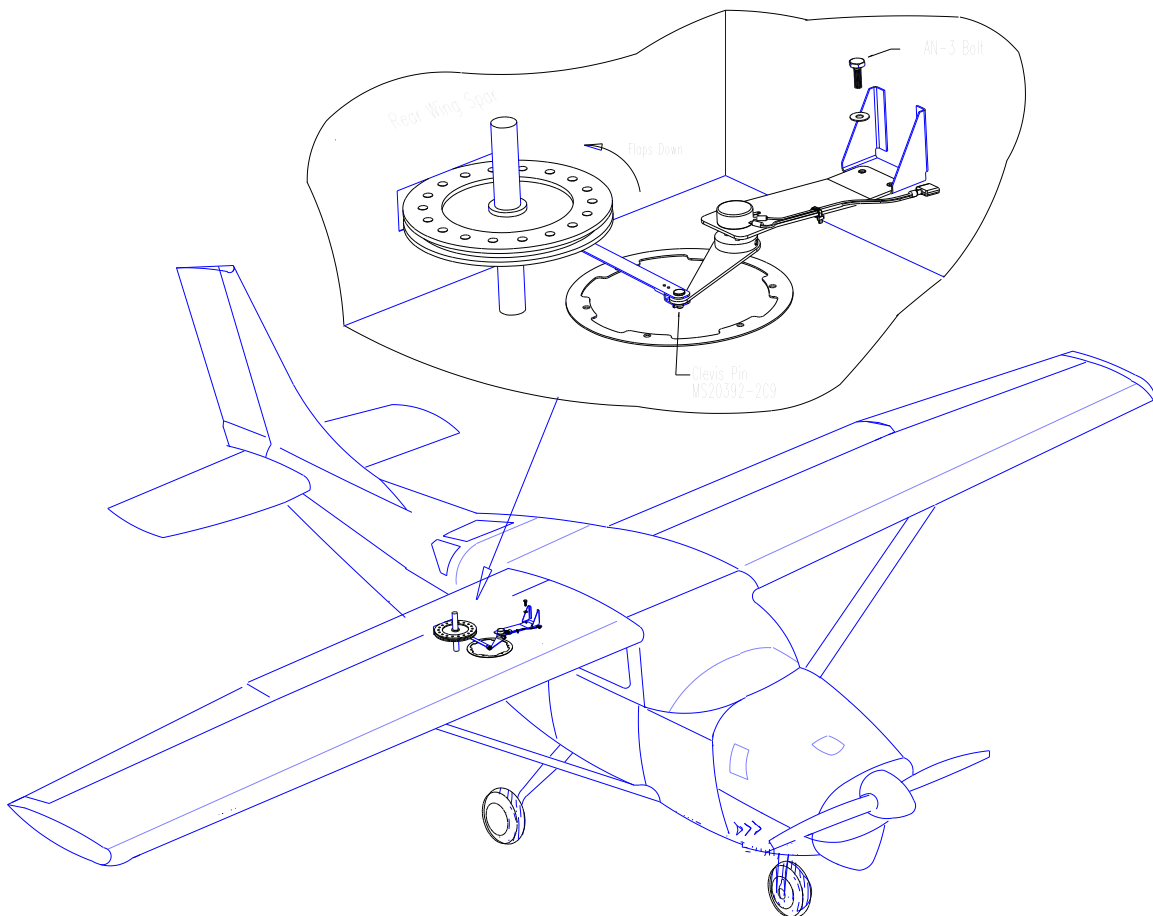


Figure 1

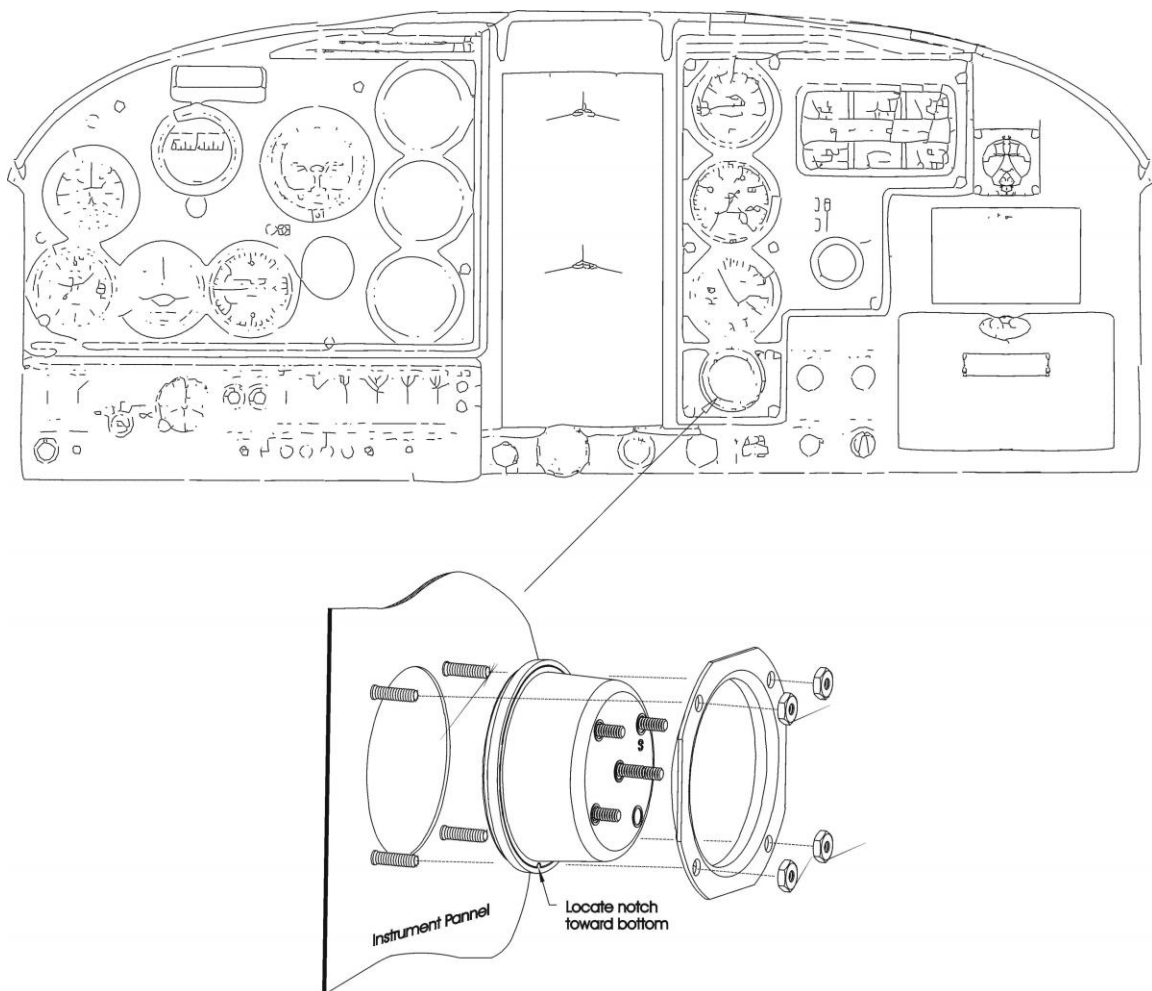


Figure 2

Refer to Figure 2 while performing the indicator installation on 200 series Cessna's

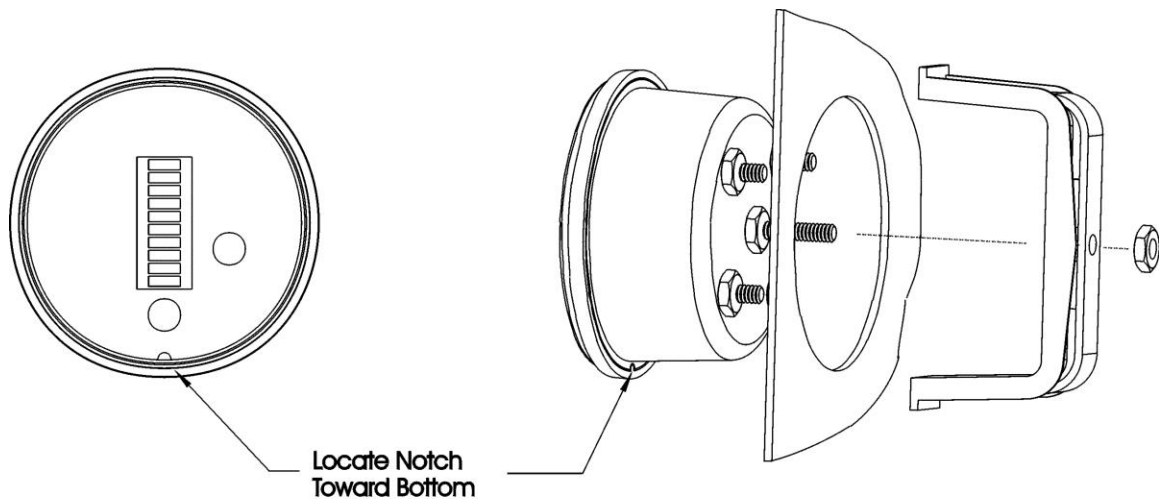


Figure 3

Refer to Figure 3 while performing the indicator installation on 100 series Cessna's

Installation of Indicator

11. Gain access to rear of indicator and remove wires.
12. Remove 4 nuts holding retaining ring and indicator (Cessna 200 series)
- 12a. Remove one or two nuts from the back of the indicator and remove the retaining bracket (Cessna 100 series)
13. Remove indicator.
14. Position the new indicator using retaining ring and nuts just removed. Do not tighten nuts. (Cessna 200 series) see figure 2
- 14a. position the new indicator using the 3000-2300 Retaining Bracket and nylon insert stop nut supplied with the unit. Do not tighten the nut. (Cessna 100 series) see figure 3

NOTE: indicator will have to be removed after rigging to apply label

15. Using voltmeter, locate and verify airframe power wire. Wire may be marked DB1, DB7 or DB11. Attach this wire to + terminal on new indicator.

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16. Using ohmmeter, locate and verify airframe ground wire. Wire may be marked DB6 or DB10. Attach this wire to - terminal on new indicator.
17. To the **S** terminal of the new indicator, attach airframe signal wire DB5. On aircraft having a two wire system, connect the DB2 wire to the – terminal of indicator. On these aircraft there will be two wires connected to the – terminal. Refer to Drawings B-6000-0700 and B-6000-0800.

Rigging

18. Reconnect battery and turn master switch on. Verify that at least the top LED is lit. If no LED's are lit, turn master off and recheck wiring.
19. Extend flaps to flaps to the 5 degrees position. Use a protractor confirm flap position.
20. At transmitter, rotate retaining washer until only the top LED is lit. Rotate the washer the opposite direction until the second LED is lit. Tighten 3 sender assembly retaining screws.
21. Extend flaps to the full-down position, then retract 1 degree.
22. Using a small screwdriver inserted in the bottom hole in the indicator face, adjust trim pot until the second from bottom LED just lights up. Note the bottom LED is not used.

Note. For Cessna 172 with 180hp conversion and 30-degree max travel on flaps.

Adjust trim pot until the forth from bottom LED just lights up. Note the bottom 3 LED's will not be used.

23. Retract flaps fully. Verify only top LED is lit. Extend flaps to full-down position and verify that 9 LED's are lit. If 9 are not lit repeat steps 18 through 23.
24. Remove indicator from panel, and apply applicable self-adhesive label to front. Reinstall indicator, tighten nuts and secure wires. On 100 series Cessna's use the nylon insert stop nut to install the retaining bracket.
25. Reinstall the courtesy light on aircraft so equipped. Reinstall wing access cover.

26. Make appropriate entry in aircraft maintenance log. Complete enclosed FAA Form 337 and file with your local FSDO. Insert flight manual supplement in aircraft POH.

c. Instructions for Continued Airworthiness

This product requires no maintenance other than that specified in the Cessna maintenance manual for this system.

d Troubleshooting

1. No LED's lit in any flap position.
 - Check circuit breaker and reset if necessary.
 - Check for power to the back of the instrument.
 - Check ground wire on back of the instrument.
2. LED's do not correspond to actual flap position.
 - Check mechanical connection between transmitter and flap control arm or pulley.
 - Check security of transmitter on bracket.
 - Check rigging of transmitter (see installation and rigging instructions).
 - Check signal wire from indicator to transmitter for a short to ground.
3. One or more LED's do not illuminate.
 - If lower LED's do not illuminate check rigging of transmitter
 - If one or more LED's are not lit with others lit below it, replace indicator.
 - Check signal wire from indicator to transmitter for open circuit.

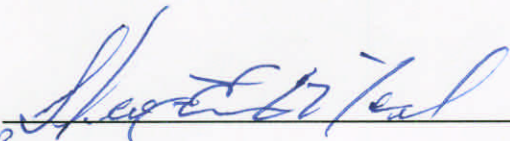
FAA APPROVED

**AIRCRAFT FLIGHT
MANUAL SUPPLEMENT**

**MaxPulse
Model 9200-000-A/B
Landing Light Controller**

Aircraft: Cessna 172
Model: M
R/N: 17263767 / 17264078
S/N: N1840V / N22905

FAA Approved :


for Manager, Seattle Aircraft Certification Office

Date: JUL 18 2008

Revised: FEB - 5 2010



Seaton Engineering Corp.
Spokane, WA 99208

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Aircraft Flight Manual Supplement

DESCRIPTION

The MaxPulse Landing Light Controller gives the pilot complete control of two landing or clearance light circuits. The light circuits, referenced as Port and Starboard in this document, may not necessarily be located in those positions. This is dependent upon the model of the aircraft and will have been predetermined during the installation of the MaxPulse controller.

The landing lights may be located on the Port and Starboard ends of the wings, in the middle of both wings, a single light in the nose wheel cowling, one light on either wing or one in the nose cowling and a wing. The pilot should locate these lights and familiarize him/her self with their location during ground inspection and establish that they are not defective and are functional with this procedure.

For future reference, this MaxPulse Aircraft Flight Manual Supplement should be retained in the basic aircraft manual.

Limitations: Do not operate MaxPulse Landing Light Controller in IMC conditions.

FUNCTIONAL OPERATION

To begin a functional checkout, place the MaxPulse rotary switch in the FIRST position. This sets the MaxPulse to its off position.	X
MaxPulse in SECOND position The Starboard light should come on and remain on.	S
MaxPulse in THIRD position The Port light should come on and remain on.	P
MaxPulse in FORTH position. The Port and Starboard lights should come on and remain on.	P+S
MaxPulse in FIFTH position The Port and Starboard lights should alternate on and off 44 times per minute.	A44
MaxPulse in SIXTH position Both Port and Starboard lights should turn on and off 44 times per minute	B44
MaxPulse in SEVENTH position The Port and Starboard lights should alternate on and off 88 times per minute.	A88
MaxPulse in EIGHTH position The Port and Starboard lights should alternate on and off 120 times per minute.	A120

- X** OFF
- S** Starboard Circuit On
- P** Port Circuit On
- P+S** Port and Starboard Circuits Both On
- A44** Alternate Circuits 44 Times/Minute
- B44** Both Circuits turn on and off 44 Times/Minute
- A88** Alternate Circuits 88 Times/Minute
- A120** Alternate Circuits 120 Times/Minute



Seaton Engineering Corp.
Spokane, WA 99208

FAA Approved, Date: FEB - 5 2010

Document	Rev.	Date	Page
9150-009	C	7-10-2009	2 of 2

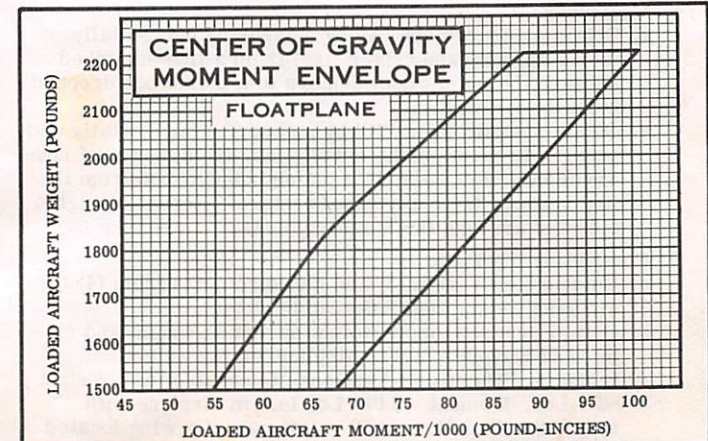
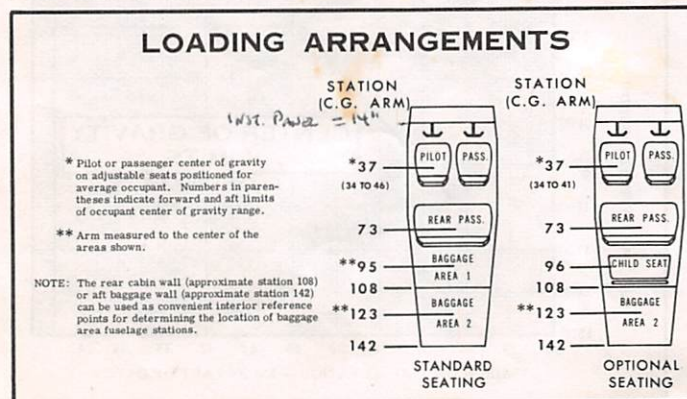
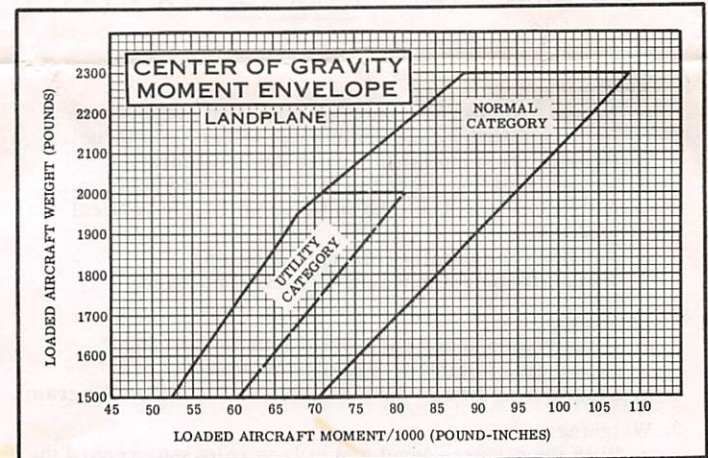
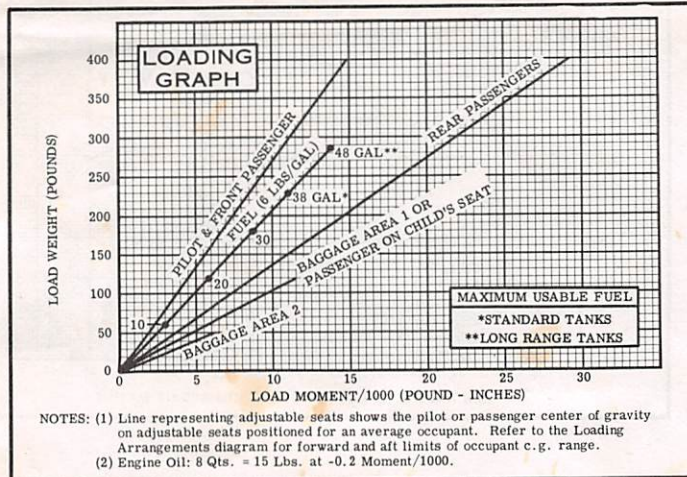
Loading and Center of Gravity Charts

IT IS THE RESPONSIBILITY OF THE PILOT AND AIRCRAFT OWNER TO ENSURE THAT THE AIRCRAFT IS LOADED PROPERLY.

When computing aircraft loading requirements, refer to the Weight and Balance and Installed Equipment Data sheet in the aircraft file for the licensed empty weight, arm and moment of the aircraft as delivered from the factory. (If alterations have been made to the aircraft, refer to Aircraft Records for the latest empty weight, arm and moment.) The aircraft weight and balance may then be determined using the Loading Graph and Center of Gravity Moment Envelope as indicated in the Sample Loading Problems below.

SAMPLE LOADING PROBLEM (NORMAL CATEGORY)	SAMPLE AIRPLANE		YOUR AIRPLANE	
	Weight (lbs.)	Moment (lb.-ins./1000)	Weight (lbs.)	Moment (lb.-ins./1000)
1. Licensed Empty Weight (Use the data pertaining to your airplane as it is presently equipped. Includes unusable fuel.)	1366	53.8		
2. Oil (8 Qts. - The weight of full oil may be used for all calculations. 8 Qts. = 15 Lbs. at -0.2 Moment/1000).	15	-0.2	15	-0.2
3. Usable Fuel (At 6 Lbs./Gal.)				
Standard Tanks (38 Gal. Maximum)	228	10.9		
Long Range Tanks (48 Gal. Maximum)				
4. Pilot and Front Passenger (Station 34 to 46)	340	12.6		
5. Rear Passengers	340	24.8		
6.* Baggage Area 1 or Passenger on Child's Seat (Station 82 to 108) 120 Lbs. Max.	11	1.0		
7.* Baggage Area 2 (Station 108 to 142) 50 Lbs. Max.				
8. TOTAL WEIGHT AND MOMENT	2300	102.9		
9. Locate this point (2300 at 102.9) on the Center of Gravity Moment Envelope, and since this point falls within the envelope, the loading is acceptable.				
NOTE * The maximum allowable combined weight capacity for baggage areas 1 and 2 is 120 lbs.				

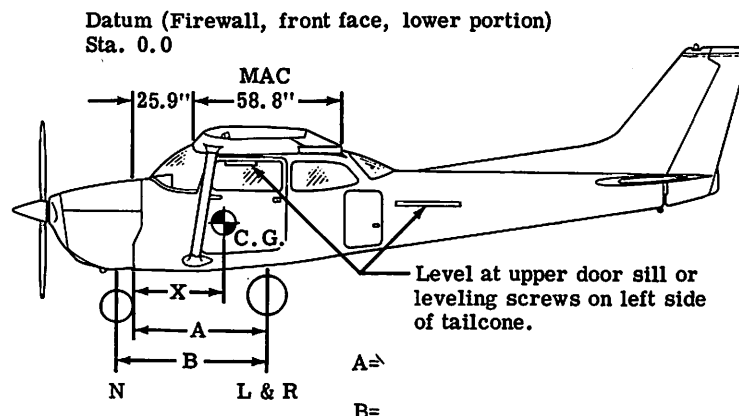
SAMPLE LOADING PROBLEM (UTILITY CATEGORY)	SAMPLE AIRPLANE		YOUR AIRPLANE	
	Weight (lbs.)	Moment (lb.-ins./1000)	Weight (lbs.)	Moment (lb.-ins./1000)
1. Licensed Empty Weight (Use the data pertaining to your airplane as it is presently equipped. Includes unusable fuel.)	1366	53.8		
2. Oil (8 Qts. - The weight of full oil may be used for all calculations. 8 Qts. = 15 Lbs. at -0.2 Moment/1000).	15	-0.2	15	-0.2
3. Usable Fuel (At 6 Lbs./Gal.)				
Standard Tanks (38 Gal. Maximum)	228	10.9		
Long Range Tanks (48 Gal. Maximum)				
4. Pilot and Front Passenger (Station 34 to 46)	340	12.6		
5. TOTAL WEIGHT AND MOMENT	1949	77.1		
6. Locate this point (1949 at 77.1) on the Center of Gravity Moment Envelope, and since this point falls within the envelope, the loading is acceptable.				



Weighing Procedure

MODEL 172M

1975



Scale Position	Scale Reading	Tare	Symbol	Net Weight
Left Wheel			L	
Right Wheel			R	
Nose Wheel			N	
Aircraft Empty Weight (As Weighed)			W	

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

- Preparation:
 - Inflate tires to recommended operating pressures.
 - Remove all wing tank drain plugs to remove all fuel.
 - Remove oil sump drain plug to drain all oil.
 - Move all sliding seats to the most forward position. All seat backs should be in the most nearly vertical position.
 - Put flaps in the fully retracted position.
 - Place all control surfaces in neutral position.
- Leveling:
 - Place scales under each wheel (500# nose, 1000# each main, minimum capacity for scales).
 - Deflate nose tire to center bubble on level (See Diagram).
- Weighing:
 - With the airplane level and brakes released, record the weight shown on each scale. Deduct the tare, if any, from each reading.
- Measuring:
 - Obtain measurement "A" by measuring horizontally (along the airplane center line) from a line stretched between the main wheel centers to a plumb bob dropped from the firewall.
 - Obtain measurement "B" by measuring horizontally and parallel to the airplane center line, from center of nose-wheel axle, left side, to a plumb bob dropped from the line between the main wheel centers. Repeat on right side and average the measurements.
- Completing the Form:
 - Using weights from (3) and measurements from (4) the airplane weight and C.G. can be determined.
 - Obtain licensed empty weight by adding weight and moment of unusable fuel to airplane empty weight and moment. There are 4 gallons of unusable fuel (Weight = 24 Lbs, Moment = 1104 Lb. In.) in airplane with either the 42 gallon or 52 gallon capacity wing located fuel systems.

