



EAGLE EMS

OWNERS MANUAL

ENGINE TYPE _____
SERIAL NO _____
DATE OF PURCHASE _____
INSTALLATION DATE _____



14800 40th Avenue NE, Marysville, WA 98271
Telephone (360) 651-8282, Fax (360) 651-8080

GEN 5024 revision I0308
has been revised to incorporate
a new paragraph 11.0; creating
GEN5024 revision I0308 revised 01/09



Date: _____

**ENGINE CONTROL TROUBLESHOOTING
RUN-UP SHEET**

Aircraft Registration: _____ Fuel ECU S/N: _____
Aircraft Model: _____ Distribution Block S/N: _____
Engine Model: _____ Fuel Injector TSO: _____
Engine TSO: _____ #1 Fuel Injector S/N: _____
#2 Fuel Injector S/N: _____ #3 Fuel Injector S/N: _____
#4 Fuel Injector S/N: _____

Idle Speed	LEFT _____ RIGHT _____	Full Power RPM	BOTH _____
Left/Right ECU Drop	_____	Throttle Response	_____
Idle Lean Out Rise	_____	Static RPM Fuel Flow	_____
ECU Settings	<u>PRINT OUTS</u>	ECU Run Data	<u>PRINT OUTS</u>
CHT (If available)	#1 _____ #2 _____	#3 _____ #4 _____	
EGT (If available)	#1 _____ #2 _____	#3 _____ #4 _____	

It would be very helpful, if a print out or e-file is provided from the unit under test to aid in troubleshooting. Print the run data along with the calibration, configuration, RPM VE table, BAP/MAP VE table, OPS information and History Report.

Additional Comments _____

For technical assistance please contact Precision Airmotive LLC.

INSTALLATION: It is absolutely necessary to install ECU, PMU, Ignition Coils, Distribution Block, Eagle battery, Fuel Injectors and associated wiring per installation manual For Proper Operation.
Failure To Do So May Result In Unsatisfactory Operation.

REMOVAL: Before Removing EMS Components From Engine For Warranty Consideration, And After Verifying All Other Components Work Properly, Troubleshoot The Following Symptoms:

The enclosed Precision Airmotive LLC “Eagle” Electronic Engine Management System has been produced using the highest quality materials and components. This gives you the assurance that it has been designed, produced and tested under the strictest quality standards in the industry.

We take great pride in the reputation our products and services have earned through the years of performing safely and dependably under all flying conditions.

The Eagle EMS, non-certified Electronic Engine Management System is proven technology drawn from years of research, design and engineering by Precision Airmotive. Manufactured as experimental, this new Eagle EMS kit provides experimental aircraft with precise, dependable, and reliable spark control and fuel metering.

Only Precision Airmotive or authorized representative supplies the latest training manuals, technical, and engineering support.

If you have any questions, please call our product support department @ 360-651-8282, or visit our website: precisionairmotive.com

Thank you for choosing a Precision Airmotive product.

Sincerely,

Precision Airmotive LLC



PRECISION AIRMOTIVE LLC COMMERCIAL WARRANTY
Experimental EMS series

PRECISION AIRMOTIVE LLC (“Precision”) warrants that at the time of delivery each of its Factory New, experimental “Eagle EMS” to be free from defects in materials and manufacture and will conform to the applicable Precision specifications and drawings to which they were manufactured for a period of 2 years from the date of shipment from the factory or for 1000 engine operating hours, whichever shall occur first.

In certain applications, and due to various aircraft configurations, the “Eagle EMS” may need a flow modification for better performance. Fuel flow modifications are performed by changing constants in the software via laptop or through an authorized representative. There is a flow modification charge if custom calibration is requested.

This warranty applies only to Products that have received recommended maintenance and have not been subjected to (a) lack of proper maintenance or overhaul, (b) lack of proper filtration (where applicable), (c) repair by any party other than Precision, or (d) tampering, alteration, improper operation or storage, or other extraordinary or abnormal use, abuse, or neglect.

Written notice of any claimed defect or nonconformance must be received by Precision within thirty (30) days after the defect is first discovered. Provided said written notice is received, Precision shall, at its sole option:

- (a) Repair at its factory of the nonconforming Product or component part thereof
- (b) Replacement from its factory of the nonconforming Product or component part thereof,
- (c) Issuance of a credit to the first user in the amount of the then current applicable net price for the nonconforming Product or component part thereof.

Transportation charges

- (a) Return of product or component part thereof to Precision shall be prepaid by the customer
- (b) IF product or component part thereof is found to be defective, Precision will return item ground freight, at Precision’s expense. Any expedited freight charges will be at customer’s expense.
- (c) IF product or component part thereof is found to be free of defects all transportation charges will be at customer’s expense.

NOTE: If a returned unit is found to be free of defects, the customer’s returned unit may be subject to the current shop rate.

This warranty does not extend or apply to any product or component part thereof which has been determined by Precision examination to have been damaged or altered as a result of misuse, tampering, abuse, neglect, improper storage, lack of proper maintenance or overhaul, lace of filtration (where applicable), repair by any party other than Precision Airmotive, or other components of the aircraft engine which are not the products of Precision.

This warranty does not extend to any **labor** charges whatsoever, including labor charges for repair, replacement, disassembly, reassembly, inspection, reinspection, test or retest of the product or component part thereof, except for the labor provided at no charge to the first user by Precision in repairing a product or component part thereof.



STARTING, TAXING, INFLIGHT TROUBLESHOOTING GUIDE		
PROBLEM	PROBABLE CAUSE	REMEDY
	BACKFIRE).	RESTART
ROUGH ENGINE, NO INDICATORS ARE LITE.	MIXTURE TOO RICH OR TOO LEAN, CONFIRMED BY OXYGEN SENSOR, EGT’S OR RPM RISES	UPDATE VE TABLE OR AIR FUEL RATIO TABLE. IF FIRST RUN ON AIRFRAME. IF NOT FIRST RUN ON AIRFRAME REPLACE ECU AND INJECTORS
	CLOGGED FUEL LINE (S).	REMOVE AND REPLACE FUEL INJECTOR AND DISTRIBUTION BLOCK FILTER WITH LLC AUTHORIZED PARTS.
	IDLE SPEED LESS THAN 650 RPM	SET IDLE SCREW TO 650 RPM
	ENGINE MIXTURE CONTROL OPEN OR LEFT COUNTER CLOCK WISE	REPLACE MIXTURE CONTROL POTENIOMETER OR ROTATE LEAN CRUISE KNOB TO ZERO (FULLY CW)
ROUGH ENGINE, LEFT INDICATOR ON FOR 4 SECONDS THEN FLASHES	LEFT SIDE OF ENGINE IS NOT OPERATING WITHIN SPECIFIED PARAMETERS. (SYNC ERROR)	SIDE WITH FLASHING LIGHT IS NOT FUNCTIONING. VERIFY SIDE HAS CORRECT INPUT AND OUTPUT SIGNAL. REPLACE ECU, IF INPUT SIGNALS ARE CORRECT

SEE CALIBRATION AND INSTALLATION MANUAL FOR MORE TROUBLESHOOTING INFORMATION. MORE ADVANCED TROUBLESHOOTING INFORMATION AVAILABLE ON OUR WEBISTE, <http://www.precisionairmotive.com>

IF ALL THE ABOVE ITEMS HAVE BEEN ELIMINATED AND THE EAGLE SYSTEM IS UNDER WARRANTY, THE EAGLE SYSTEM COMPONENTS MUST BE SENT TO PRECISION AIRMOTIVE OR REPRESENTATIVE FOR REPLACEMENT AND/OR REPAIR.

- NOTE:**
- 1) THE USE OF NON-AVIATION GRADE FUEL VOIDS ALL WARRANTIES.
 - 2) SYSTEM COMPONENTS ARE NOT SEALED AND SHOULD NOT BE PRESSURE WASHED.

CAUTION

THIS ASSEMBLY IS NOT SEALED

DO NOT PRESSURE WASH



OPERATION AND TROUBLESHOOTING CHART



STARTING, TAXING, INFLIGHT TROUBLESHOOTING GUIDE		
PROBLEM	PROBABLE CAUSE	REMEDY
ENGINE WILL NOT START, LEFT AND RIGHT ECU LIGHTS ARE OFF, NOT PULSING OR FLASHING. CHARGE LIGHT IS ON	EAGLE BATTERY IS DISCHARGED	CHECK VOLTAGE CHARGE OR REPLACE EAGLE BATTERY
ENGINE WILL NOT START, LEFT AND RIGHT ECU LIGHTS ARE OFF, NOT PULSING OR FLASHING. CHARGE LIGHT IS OFF	THE SPEED SENSOR SIGNALS ARE NOT BEING PROCESSED BY THE ELECTRONIC CONTROL UNIT.	REMOVE AND REPLACE ELECTRONIC CONTROL UNIT, IF CONFIRMED BY TROUBLE SHOOTING.
	PMU NOT POWERING UP ECU.	REPLACE PMU AFTER CHECKING FOR 12 VOLTS TO ECU.
ENGINE WILL NOT START, LEFT AND RIGHT ECU LIGHTS ARE FLASHING	EAGLE BATTERY REQUIRES CHARGING (2 SECONDS ON 2 SECONDS OFF)	RECHARGE BATTERY AND TEST BATTERY LIFE
	NO FUEL TO DISTRIBUTION BLOCK (2 PULSES PER SECOND)	CHECK BOOST PUMP PRESSURE AND SELECTOR VALVE POSITION
ENGINE WILL NOT START, ANNUNCIATOR LIGHTS ARE OFF, EAGLE BATTERY IS CHARGED, FUSES ARE GOOD	ELECTRONIC CONTROL UNIT	REPLACE ECU AFTER CONFIRMING POWER SUPPLY VOLTAGE AND SENSOR SIGNALS ARE CORRECT
ENGINE WILL NOT START, LEFT OR RIGHT ECU LIGHT IS PULSING	INPUT SIGNALS ARE OUT OF RANGE FOR PROPER OPERATION	CHECK WIRING, SENSOR FUNCTION AND MIXTURE KNOB POSITION
ENGINE RUNS ROUGH, ECU LIGHTS ARE OFF	PLUG, COIL, IGNITION WIRE OR INJECTOR	REPLACE ASSOCIATED COMPONENT AFTER TROUBLE SHOOTING FOR SPARK OR FUEL
HARD STARTING, HAS SPARK AND FUEL	WON'T FIRE, NOT ENOUGH FUEL	CYCLE KEYSWITCH TO THE OFF POSITION FOR 1 SECOND TO PROVIDE EXTRA FUEL FOR STARTING. THEN RESTART.
	WON'T FIRE, FLOODED, TOO MUCH FUEL.	CLEAR EXCESS FUEL FROM ENGINE BY CRANKING WITH THROTTLE WIDE OPEN
	INSUFFICIENT PRIME (USUALLY ACCOMPANIED BY A	CYCLE KEYSWITCH TO THE OFF POSITION TO PROVIDE EXTRA FUEL FOR STARTING. THEN

WARRANTY AND LIABILITY INFORMATION:

The use of unauthorized parts in Precision Airmotive products constitutes an alteration or modification and voids all warranties. Precision Airmotive will accept no warranty or tort liability for products containing UNAUTHORIZED parts. The operator and/or overhaul facility responsible for installation of UNAUTHORIZED parts should expect to have the sole and full liability for property damage or injury including death, arising from any malfunction of the product in which such parts are installed.

The use of Non-Aviation grade fuel voids all Warranties.

THIS WARRANTY SPECIFIES THE SOLE WARRANTY OBLIGATION OF PRECISION WITH RESPECT TO THE PRODUCTS AND IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES, EXPRESS OR IMPLIED ARISING BY OPERATION OF LAW OR OTHERWISE, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND IN NO EVENT SHALL PRECISION BE LIABLE FOR ANY INCIDENTAL DAMAGES, OTHER THAN THE TRANSPORTATION CHARGES COVERED BY THIS WARRANTY, OR FOR ANY CONSEQUENTIAL OR SPECIAL DAMAGES OF ANY NATURE OR KIND.

WARNING:

The use of unauthorized parts in any system can cause product malfunctions, which could result in damage to, or destruction of, equipment and injury to and/or death of personnel. Use only Precision Airmotive replacement parts as specified in the Illustrated Parts List.

PRECISION
AIRMOTIVE LLC
 14800 40th Avenue NE, Marysville, WA 98271
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OPERATION AND DETAIL SPECIFICATIONS
EAGLE EMS SYSTEM

- 1.0 Purpose:** The purpose of this document is to provide the pilot with an overview of his interactions with the Eagle EMS. This includes error messages from the Annunciator panel and system information if connected to a laptop computer.
- 2.0 Description:** The EAGLE EMS is based on the principle of electrically measuring engine, airframe and environmental conditions to establish ignition and fuel flow. Two redundant computers are used to read sensors and vary the fuel injector pulse width and spark timing to ignite the fuel-air mixture. The computers also deliver RPM and Fuel Flow signals to some existing instrumentation. The electronic system detects engine over heating, and over speed. The system compensates for rapid throttle changes, altitude, engine temperature, fuel pressure and air temperature. There is an instrument panel mixture knob for leaner fuel-air adjustment.
- 3.0 General Specifications:**
- Electronic Control Unit: 2 Electronic Controllers, in one metal case
Throttle Body Bore Size: 2-5/16" inside diameter
Precision Airmotive Fuel Injectors: 30 lbs/hour/injector
Weight: Approximately 18 lbs.
- 4.0 Installation Requirements:**
- Dimensional: See installation manual for size of components.
Fuel Pressure: Fuel Pressure Range: 30-60 psi
- Fuel Filtration: The fuel supplied to the system shall be filtered to 32 micron nominal. This filtration may occur prior to the engine driven pump, but all other pumps and valves shall be upstream of the filter.
- Fuel Temp: 120°F recommended max at inlet to system. This minimizes vapor formation downstream. Fuel temperatures upstream of the distribution block shall be low enough to prevent vapor formation in the fuel lines. It is assumed that temperatures may exceed the above listed temperatures under some conditions, but these temperatures may result in degraded performance at low engine speeds.
- Inlet Air Temp: The induction air temperature measured at the inlet to the throttle body shall not exceed 400°F. The ECU operates normally when IAT is between -40°F and 212°. Out side that range the Annunciator Light will blink until IAT is with in range.

Note: Five fuel filters are present in the Eagle EMS system. There is a 10 micron filter in the fuel distribution block and a 41 micron filter in each fuel injector.



OPERATION AND DETAIL SPECIFICATIONS
EAGLE EMS SYSTEM

10.0 ENGINE START / RUN EAGLE CHECKLIST

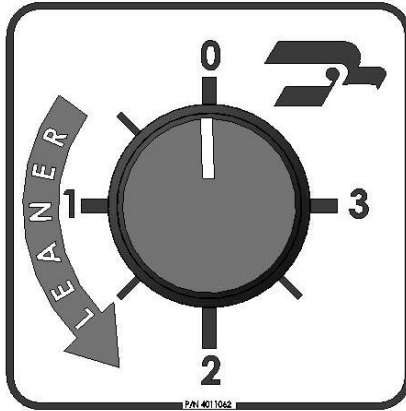
- Step 1. FUEL SELECTOR IN **BOTH** POSITION
Step 2. MASTER BUS **ON** (ECU POWER ON, IF INSTALLED)
Step 3. KEY SWITCH TO **BOTH**
Step 4. BOOST PUMP **ON**, 15 SECONDS PRIOR TO STARTING
Step 5. **SET** THROTTLE POSTION ¼" OPEN, FROM IDLE.
Step 6. **SET** MIXTURE CONTROL KNOB TO ZERO
Step 7. START ENGINE
Step 8. MASTER BUS POWER **OFF** (RUN ENGINE FOR 10 SEC MIN)
ECU STATUS L & R **OFF** (EAGLE BATTERY OK)
Step 10. MASTER BUS **ON**
Step 11. ALTERNATOR **ON**
Step 12. OBSERVE ECU STATUS L & R **OFF**
Step 13. PERFORM LEFT-RIGHT SYSTEM CHECK NOTE RPM DROP AND ECU STATUS LIGHTS. WHEN IN THE LEFT POSTION THE RIGHT ECU LIGHT WILL FLASH AFTER 4 SECONDS. WHEN IN THE RIGHT POSITION, THE LEFT ECU LIGHT WILL FLASH AFTER 4 SECONDS.
Step 14. KEY SWITCH TO **BOTH**
OBSERVE ECU STATUS L & R **OFF** (4 SEC DELAY AFTER SWITCHING TO BOTH)
Step 15. PERFORM NORMAL ENGINE WARM UP PROCEDURES

11.0 RECOMMENDED PERIODIC MAINTENANCE

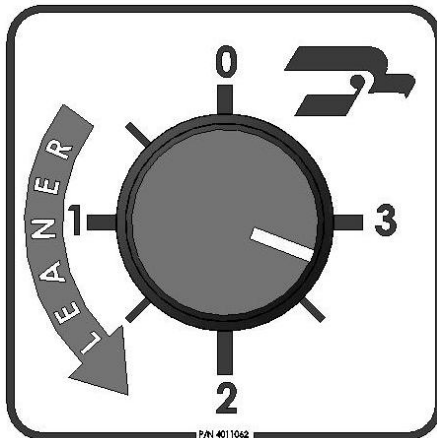
- Replace fuel filter in distribution block every 500 hours.
- Check torque on fuel injectors every 500 hours. Use tension in fuel line to pull injectors tight.
- Test the aircraft and Eagle battery every 500 hours for capacity.



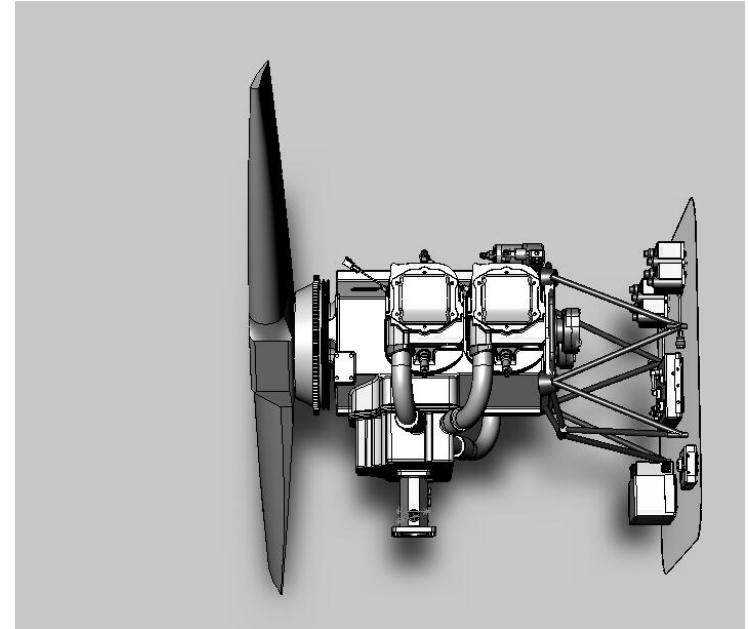
9.0 LEAN CRUISE ADJUSTMENT KNOB SETTINGS



SHOWN ABOVE IS THE RECOMMENDED MIXTURE CONTROL SETTING FOR TAXING AND TAKE OFF AND STARTING. IF THE MIXTURE CONTROL IS NOT SET TO ZERO BEFORE STARTING THE FUNCTION WILL FLASH 2 PULSES PER SECOND TO ALERT THE OPERATOR.



THIS CONTROL KNOB IS USED TO LEAN FUEL MIXTURE FOR LEAN CRUISE. KNOB POSITION WILL VARY DEPENDING ON THE ENGINE MANUFACTURER'S RECOMMENDATIONS. LEAN CRUISE IS TYPICALLY BASED ON EGT'S, RPM AND ETC.



5.0 Environmental Requirements:

Operating Temperatures

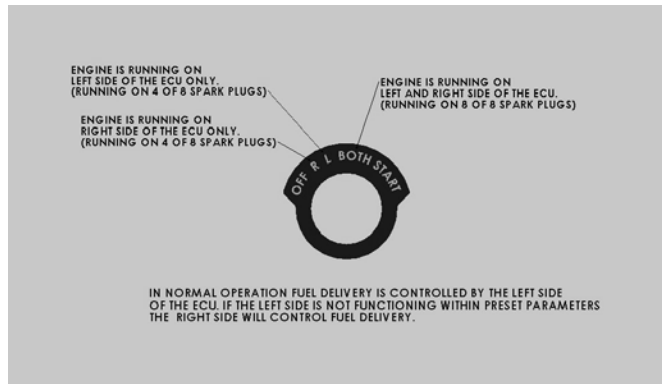
ECU and PMU:	-40°F to 212°F
Throttle Body, Distribution Block:	-65°F to 300°F
Ignition Coils, Speed Sensors	-65°F to 257°F
Harnesses:	-76°F to 392°F
Fuel Injectors	-65°F to 450°F
Injector wires	-76°F to 392°F

Temperature shall be measured on the metal exterior of the components.

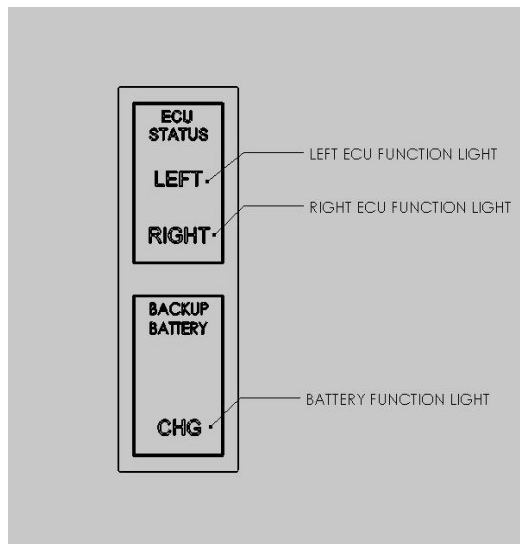


6.0 EMS KEY SWITCH OPERATION

REVERT TO LEFT SIDE OPERATION BY TURNING IGNITION KEY SWITCH TO RIGHT AND THEN BACK TO BOTH. THIS ALLOWS THE PILOT TO TEST THE ECU'S SEPARATELY.



7.0 EMS ANNUNCIATOR PANEL



8.0 MALFUNCTION INDICATOR LIGHT DEFINITIONS:

THERE ARE THREE LIGHTS IN THE ANNUNCIATOR PANEL:

- RED LEFT ECU FUNCTION LIGHT
- RED RIGHT ECU FUNCTION LIGHT
- YELLOW BATTERY FUNCTION LIGHT

8.1 LEFT AND RIGHT RED ECU FUNCTION LIGHT

- **4 SECONDS THEN FLASHES ONCE PER SECOND:** SPEED SENSOR SYNC ERROR
- **2 SEC ON - 2 SEC OFF:** LOW EAGLE BATTERY VOLTAGE
- **2 PULSES PER SEC:** INPUT SENSOR SIGNAL(S) OUT OF LIMITS OR MIXTURE CONTROL IS IN A POSITION OTHER THAN ZERO.
- **1 PULSE PER SEC:** OPERATING ON RIGHT ECU AND NO ERRORS WITH LEFT,

RECOMMENDED GROUND OPERATION CORRECTIVE ACTIONS

- IF ANY OF THE ABOVE CONDITIONS EXIST DO NOT TAKE OFF UNTIL FAULT IS CORRECTED

RECOMMENDED INFLIGHT CORRECTIVE ACTIONS

- IF A LEFT OR RIGHT SYNC ERROR OCCURS (**4 SECONDS THEN FLASHES ONCE PER SECOND**), PROCEED TO THE NEAREST AIRPORT FOR REPAIRS USING THE BOTH POSITION
- IF LEFT OR RIGHT ECU SHOWS (**2 SEC ON - 2 SEC OFF**) A LOW BATTERY CONDITION THE PLANE SHOULD PROCEED TO THE NEAREST AIRPORT.
- IF A LEFT OR RIGHT SENSOR SIGNAL ERROR OCCURS (**2 PULSES PER SEC**), PROCEED TO THE NEAREST AIRPORT FOR REPAIRS USING THE BOTH POSITION
- IF A LEFT AND RIGHT SENSOR SIGNAL ERROR OCCURS (**2 PULSE PER SEC**), PROCEED TO THE NEAREST AIRPORT FOR REPAIRS USING THE BOTH POSITION
- IF ENGINE IS RUNNING ON ONLY THE LEFT OR RIGHT ECU (**1 PULSE PER SEC**), PROCEED TO THE NEAREST AIRPORT FOR REPAIRS USING THE BOTH POSITION.

8.2 BATTERY FUNCTION LIGHT

- IF THE YELLOW BATTERY LIGHT IS ON THE EAGLE BATTERY IS BEING CHARGED.
- THE LIGHT WILL COME ON AFTER START AND THEN GO OFF, IN A FEW SECONDS, AFTER RECHARGING.
- PERIODICALLY DURING FLIGHT THE LIGHT WILL FLICKER INDICATING THE BATTERY IS BEING CHARGED.

RECOMMENDED GROUND OPERATION CORRECTIVE ACTIONS

- IF THE EAGLE BATTERY LIGHT DOES NOT COME ON AFTER STARTING DO NOT FLY, BATTERY IS NOT CHARGING.

RECOMMENDED INFLIGHT CORRECTIVE ACTIONS

- IF THE EAGLE BATTERY LIGHT DOESN'T COME ON IN FLIGHT AND ALTERNATOR IS SHOWING CHARGE FLY TO DESTINATION AIRPORT. IF ALTERNATOR IS NOT CHARGING, PROCEED TO THE NEAREST AIRPORT FOR REPAIRS USING THE BOTH POSITION. SWITCHING TO THE LEFT OR RIGHT ONLY WILL SAVE 40% ON BATTERY POWER.