

Section 21

Electrical System

Procedures covered in this section:

Install instrument panel and instruments; install rotor tach senders, wiring harness, ignition modules, FADEC electrical components, spark plug wires, and overhead switch panel; fabricate inertia switch bracket and install inertia switches; install Enigma, electronics panel and components.

Cards used in this section:

| | | |
|-----------------------------------|-------------------------------|---------------------------|
| E25 CARD 4T (fuel) | E35 CARD 1T (wiring) | E36 CARD 1T (instruments) |
| E32 CARD 1T (body/seat/floor pan) | E35 CARD 2T (electrical sys.) | E36 CARD 2T (instruments) |
| E24 CARD 2F (spark plug wires) | G Box | |

Prints used in this section:

| | |
|------------------------------------|---------------------------|
| E23-2000 (rotor tach sender mount) | E35-2001 (wiring diagram) |
| E49-2002 (rotor system) | |

Templates used in this section:

| | | |
|---------------------------|-------------------------|----------------------------------|
| E25-2 (inertia switch) | E35-1 (ignition module) | E36-3431 Rev C (compass/horizon) |
| E01-1280 (ecu's/ignition) | | |

Tools required for this section

| | | | |
|-----------------------|----------|----------------|----------------|
| Air or electric drill | Files | Pop rivet gun | Wire strippers |
| Band saw or hacksaw | Heat gun | Screwdrivers | |
| Crimpers | Pliers | Soldering iron | |

Drill bits of the following sizes: 1/8", 3/16", 13/64", 1/4", 19/64", 5/16", 25/64"

Ratchet with sockets of the following sizes: 3/8", 7/16", 1/2"

Wrenches of the following sizes: 3/8", 7/16", 1/2"

Notes:

1. **BEFORE WIRING:** See next section (Section 22) for installation of seat bulkhead, floor pan and tub, which is required at this point for routing of electrical wires.
2. **SECURE WIRES:** Wiring should be secured with wire ties as necessary. Do not stretch the wires tight, but allow some flexibility between components. Wires that are under tension may pull out of the connector.
3. **CONNECTORS:** Before plugging in connectors, inspect for any debris or foreign material inside the plug and remove if necessary. Check to make sure the pins are straight. NEVER force a plug into the matching socket or connector. Make sure the weather-tight seals are in place on the plugs that are equipped with them.
4. **STARTER RELAY:** Mount the starter relay to the pilot's side fuel tank bracket.
5. The FADEC wiring harness connects to the **NEGATIVE** terminal on the battery. **DO NOT** connect this to the positive battery terminal.

6. BATTERY: When installing the wiring, do not connect the cables to the battery until all other wiring has been completed.
7. FUEL PUMPS: The pumps should be mounted so that the black (negative) terminals are facing towards each other (see Section 20). Attach the negative wires to the black terminals, and the positive wires to the yellow terminals.
8. INSTRUMENTS: Connect wires to the instruments as shown on print E35-2001 and E35-2100.
9. **IMPORTANT: SECURE ALL WIRING AWAY FROM THE MAIN ROTOR SHAFT.**
10. DUAL ENGINE/ROTOR TACH: See Section 26 for testing procedures before installation.
11. To remove injector or TPS connectors push in on wire clip as pulling connector off. It is not necessary to remove wire clip from connector.

INSTRUMENT PANEL

Photo #1

Fit the instrument panel into the opening of the pod, trimming the panel for close fit is necessary. Wax the back of the instrument panel (to prevent the fiberglass resin from sticking) and clamp it in the pod in the desired location.

Note: The instrument panel should be recessed about 1/2" into the pod, from the edge of the opening to the face of the panel. This provides room for the rubber molding to be mounted around the edge of the pod.

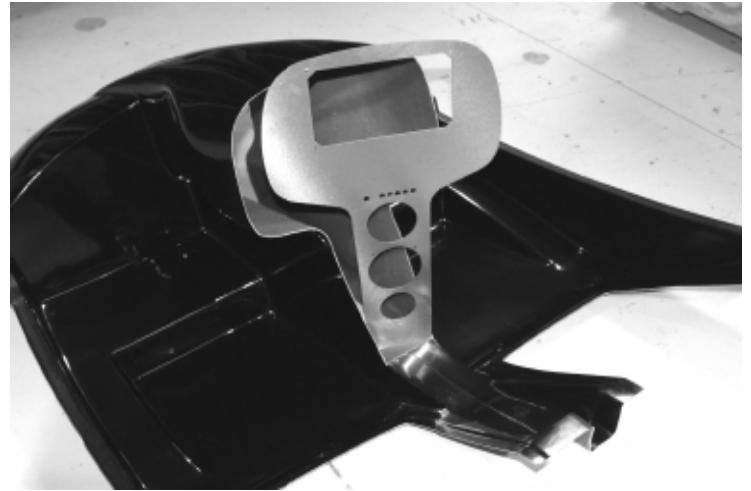


Photo #2

Cut the fiberglass angle material into 1-1/4" lengths. Position them on the back of the panel and the inside wall of the pod. (Refer to the instrument panel diagram on the next page for mounting hole locations.) Fiberglass the angles to the walls of the pod using the resin and mat supplied. A layer of fiberglass cloth (E09 CARD 3T) over the top for extra strength.

Note: Any excess angle material that interferes with instrument mounting may be trimmed off.

When fiberglass has cured, drill the mounting holes through the instrument panel and the angle brackets. Install nut plates on the fiberglass angles.

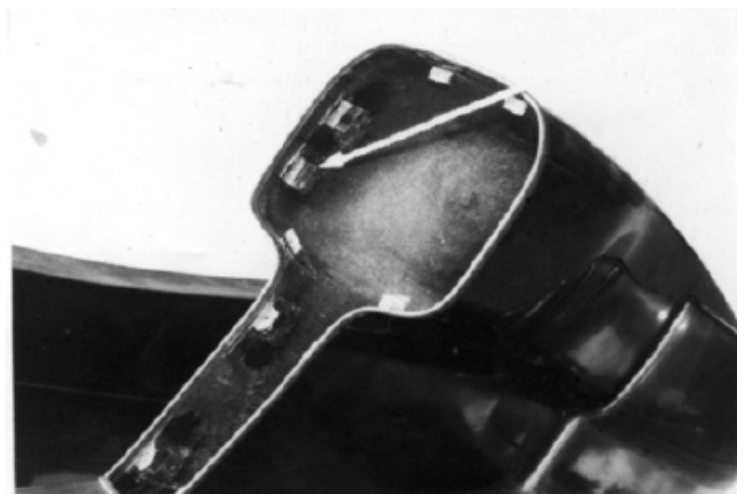


Photo #3

Install hinge on bottom of instrument panel. The hinge will allow the panel to come forward for service. E45 CARD 2T, E32-7290. Bend the bottom of the instrument panel forward to make a lip. Pop rivet one side of the hinge to the lip. The other side of the hinge will be nut plated.

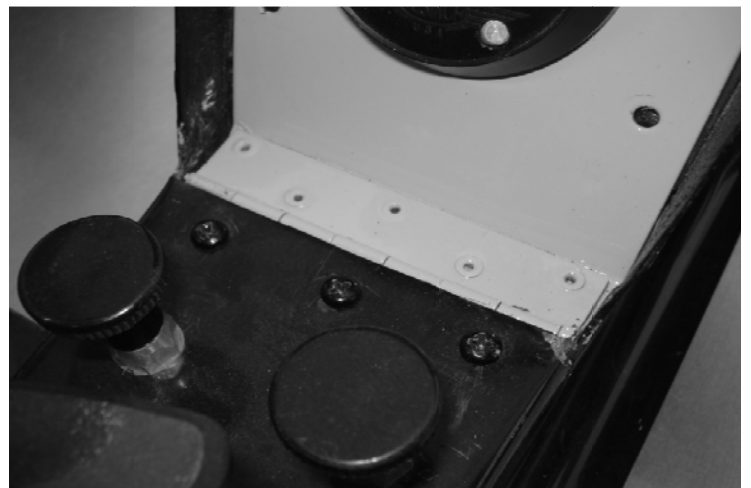




Photo #4

Cover the instrument panel with the black panel fabric (E32-3100) Trim the fabric as required, then install the instruments. Painting or powder coating can be done instead of using black panel fabric. Mount the instrument panel in the pod. Glue the rubber molding around the edge of the pod opening.

Note: The rubber molding is the same as used for the skid pants, and is found on E45 CARD 1.

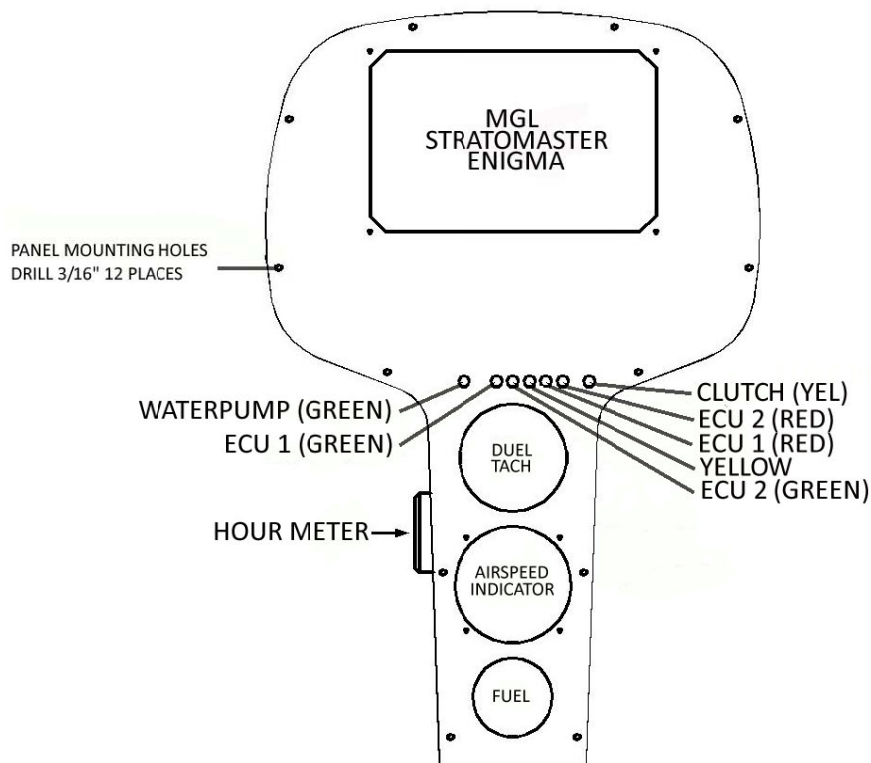


Photo #5

Install airframe harness on airframe.
Part E35-9003. Wire for electric clutch can be added to
or run with airframe harness. See drawing section 21,
page 31.



Wiring Harness

Photo #6

Route the wiring harness down the passenger side of
the airframe.

Note: Hold the wiring in place with a few wire ties until
final position is determined, then use as many ties as
needed.

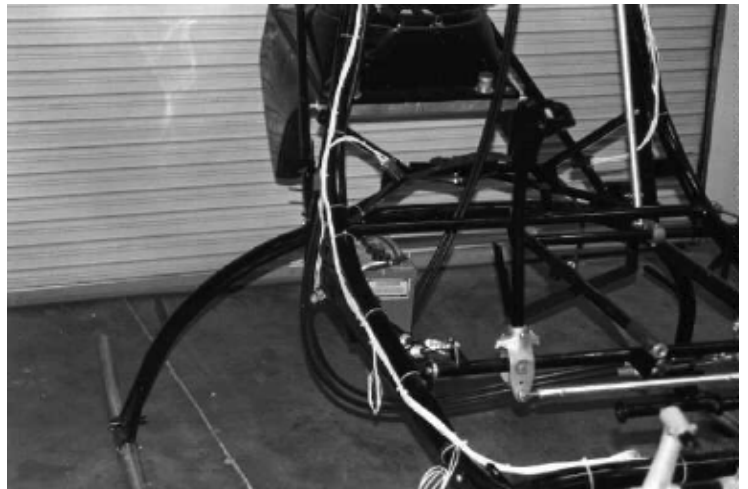
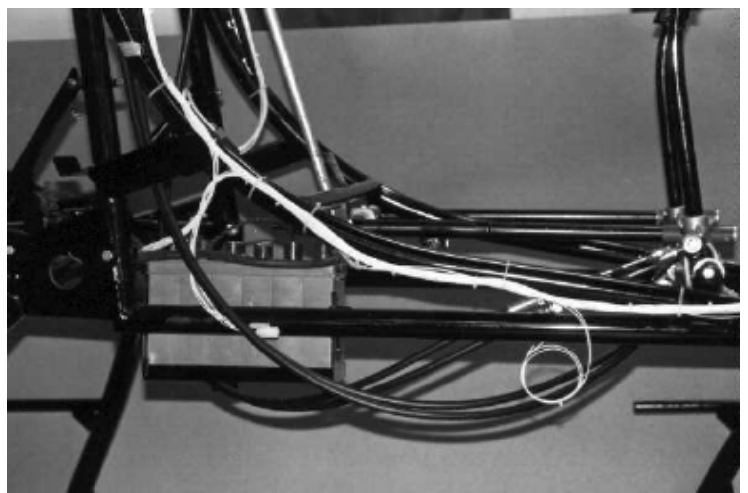


Photo #7

Another view of the harness on airframe. Route the
wires along the outside of the airframe tube to prevent
interference with the fiberglass seat bulkhead.



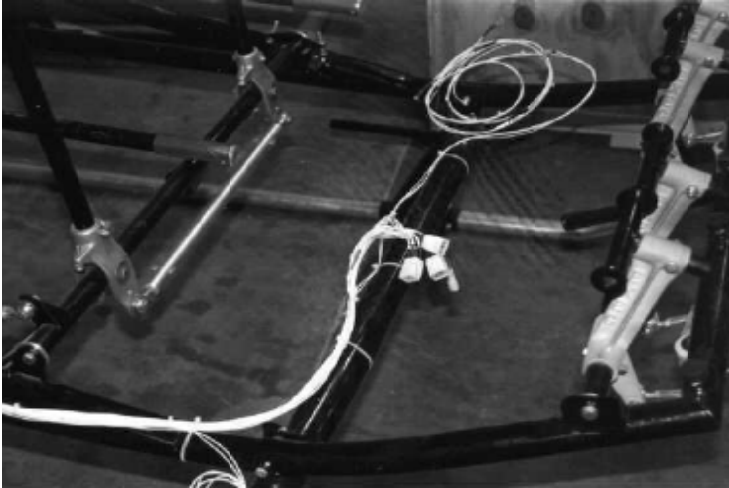


Photo #8

Route the wires to the instrument panel along the front landing gear tube.

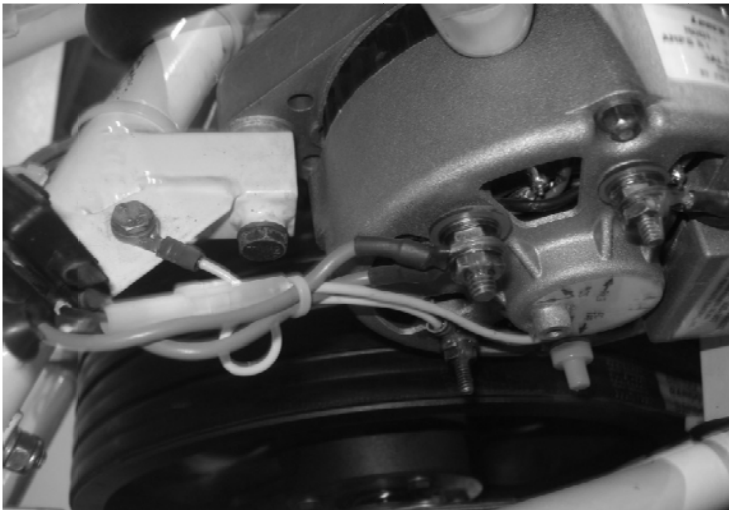
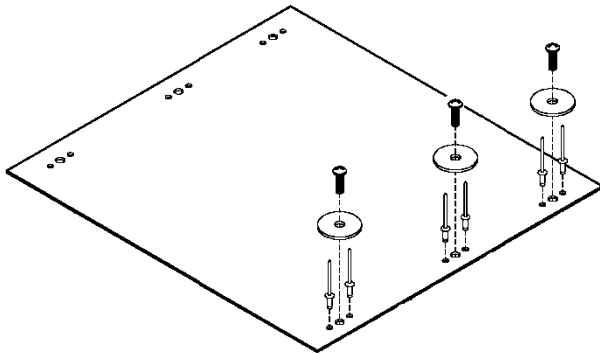


Photo #9

Connect the wires to the alternator see print #E35-2001. Make a ground wire to go from the alternator ground terminal, to the airframe gusset on the alternator mount. Drill a 3/16" hole in the gusset and remove paint if necessary for a good ground. Two #10 x 14ga. Ring terminals, wire and hardware are on E42 CARD 1T.

Note: The inline fuse holders and alternator on your helicopter may be different than shown in this photo.



ENGINE CONTROL UNITS (ECUs)

Photo #10

Fabricate the ECU mounting plate from .050 aluminum using template E32-1. Attach nut plates as shown. The tray will be attached to the underside of the fiberglass seat bulkhead with six screws and fender washers. Hardware found on E35 CARD 2T.

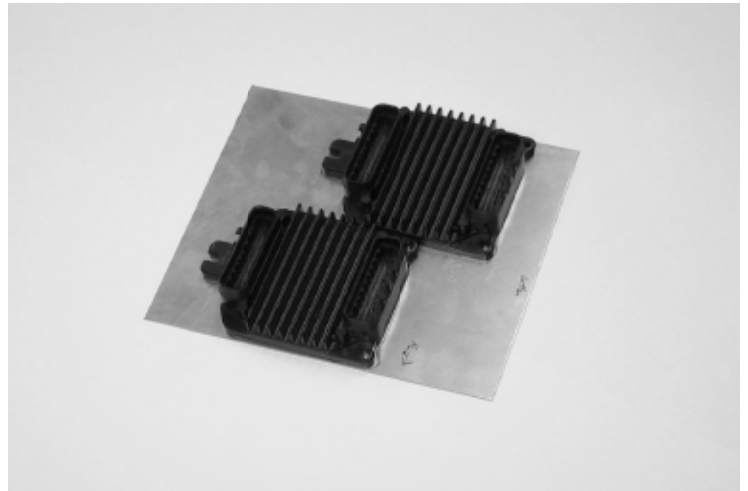
Note: Nut plates not shown on bottom side of mounting plate.

Photo #11

Install ECUs on the mounting plate (Ecu's found in engine crate).

Note: Both ECUs look the same but have been programmed differently. The labels indicate primary and secondary. The primary ECU should be mounted towards the front. Hardware found on E35 CARD 1T.

Template E01-1280



FENDER WASHERS AND SCREWS

Photo #12

Install the ECU mounting plate on the underside of the seat bulkhead, using 8-32 screws with fender washers. Mount ECU plate towards the rear of the seat. Do not allow sheet metal to hang over fiberglass. Parts on E35 CARD 1T and E35 CARD 2T.

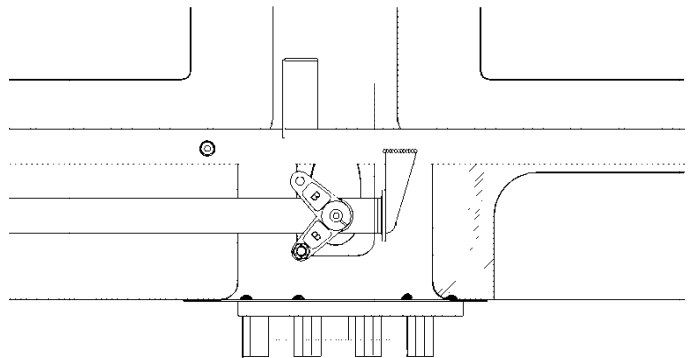


Photo #13

Plug in the connectors to the ECUs as shown here. No ground strap is required for the Ecu mounting plate.

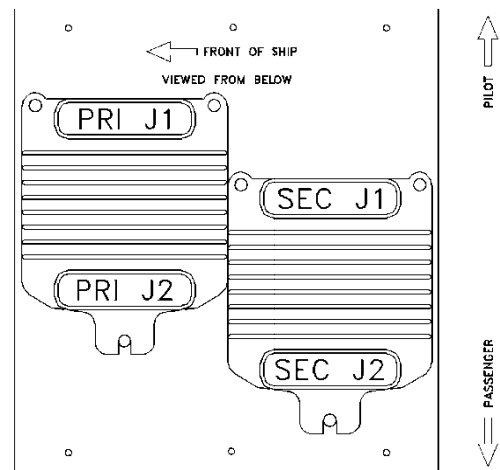




Photo #14

External battery posts shown. First assemble connectors and battery cables before locating battery post panel fiberglass on tub.

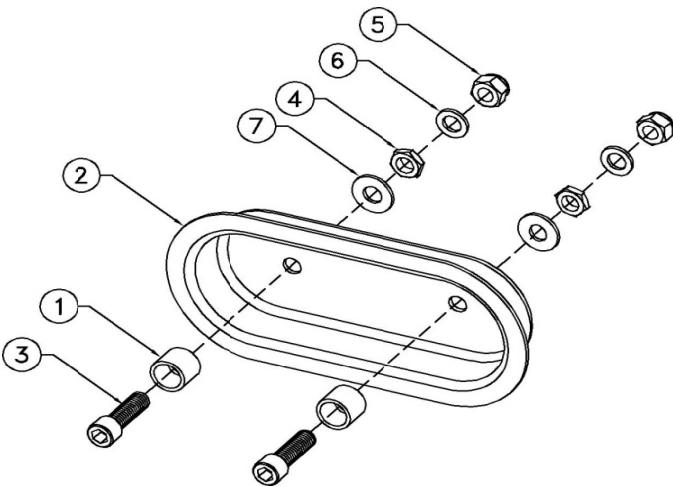


Photo #15

Connect short lengths of battery cables from the positive and negative terminals of the battery to the back of the posts. Positive and negative terminals should be clearly marked on the outside of the panel. Parts on E35 CARD 2T.

ITEM PART NO. QTY DESCRIPTION

- 1. E35-4910 2 Battery Post External
- 2. E35-4920 1 Battery Post Panel, Fiberglass
- 3. E00-2535 2 Bolt 5/16-18 x 1-1/4 SHCS
- 4. E00-3503 2 Nut 5/16-18 Jam AN340-518
- 5. E00-3504 2 Nut 5/16-18 Fiberlock AN365-518
- 6. E00-4501 2 Washer 5/16 Regular AN960-516
- 7. E00-4502 2 Washer 5/16 Large MS15795-11



Photo #16

Finished view of battery post panel. Nut plates and 8-32 screws are used to mount battery post panel to the fiberglass tub. Parts are found on E35 CARD 2T.

IGNITION MODULES

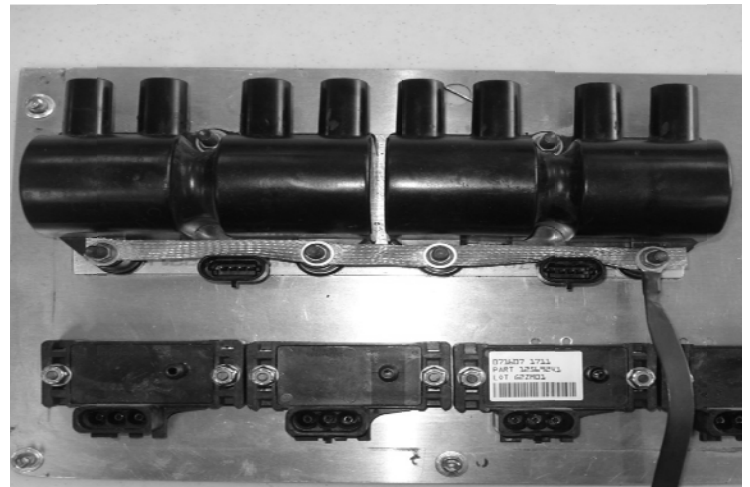
Photo #17

Using template E35-1, cut out and drill the ignition module backing plate (E35 CARD 2T part number E25-4036). The holes must be loose enough so that the bolts do not bind. The ignition modules must sit flat against the backing plate without binding or twisting. When they fit properly on the backing plate, drill the matching holes in the seat back inspection panel according to template E01-1280.



Photo #18

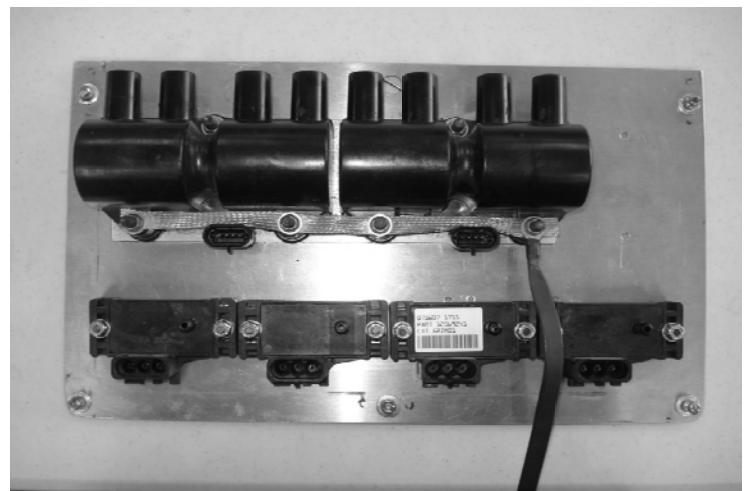
Apply a thin coat of dielectric grease E35-4190 (E35 CARD 1T) to the backside of the ignition module backing plate. Bolt the ignition modules to the seat back panel using 8 button head bolts. Insert the bolts from the cabin side of the panel, using no washers under the heads. Install the braided grounding strap across the four lower bolts as shown. Install the long insulated ground strap from the lower right bolt to the engine mount bolt on the airframe. Use a thin washer and small hex locknut on each bolt. Gradually tighten the bolts, alternating from one to another, until snug. Tighten the bolts to 75 inch pounds. Hardware found on E35 CARD 1T.



ELECTRICAL CONNECTIONS AND SENSORS

Photo #19

Mount the man/baro sensors on the inspection panel according to template E01-1280, using the long 10-32 button head bolts. All four man/baro sensors are the same. Hardware found on E35 CARD 1T



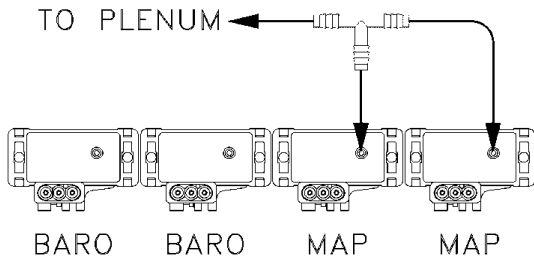


Photo #20

Using the plastic tee, connect the manifold pressure sensors (MAP) to the 1/4" 90 degree hose barb on the plenum (the one in the middle) and secure it with plastic hose clamps.

Plastic "T" E35 CARD 2T, E35-4710.
Hose E35 CARD 1T, E35-4071
Small Hose E25 CARD 2T, E25-4130

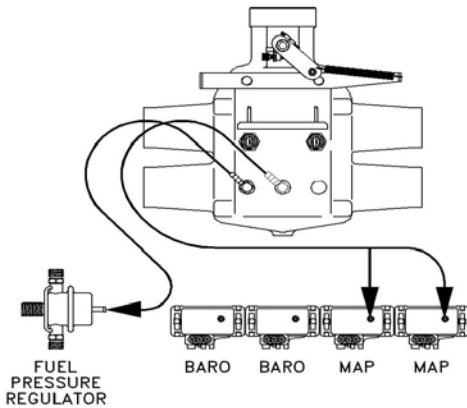


Photo #21

Connect hoses from the fittings on the plenum. Attach the smaller hose at left to the fuel pressure regulator, the middle hose to the MAP sensors (using the "T" provided). The baro sensors are identical; it does not matter which one is primary

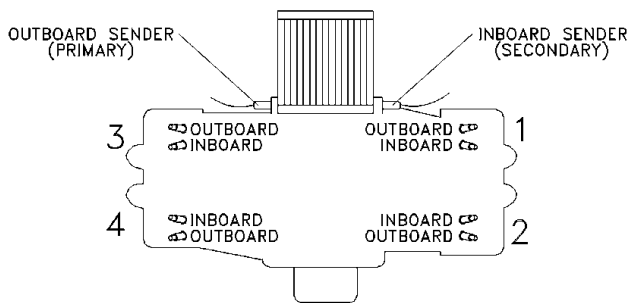


Photo #22

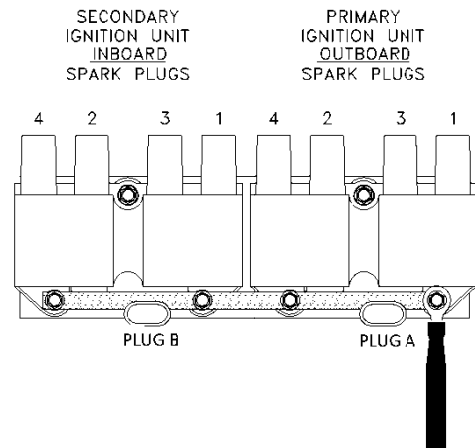
Overview of spark plug locations on engine (viewed from front).

Install the spark plugs and spark plug wires (E24 CARD 2T). Route wires from cylinders 1 and 2 (pilot's side) under the intake runners and plenum to the ignition modules. Route the wires from cylinders 3 and 4 (passenger side) over the runners. Use wire separators as necessary. The wires should not be allowed to touch each other or any other components. Cylinder numbers are found between spark plugs. Note: Use anti-seize on the spark plug threads torque to 10 ft.lbs. Anti-seize (E23-1180) found on E23 CARD 1T.

Photo #23

Connect the spark plug wires to the ignition modules in the order shown here. When packs are installed on seatback, inboard (pilot side) outboard (passenger side).

Note: Use a thin coat of dielectric grease on the inside of the spark plug boots, this will help when installing wires into ignition packs. Dielectric grease (E35-4190) Found on E35 CARD1T.



FADEC HARNESS

Photo #24

Install FADEC harness (E35-4220). First connect ECU connectors, route harness aft and tie harness to frame away from collective controls. ECU connectors, viewed from under the passenger seat towards the pilots side. Secure the FADEC harness with wire ties as needed.



Photo #25

Plug in the connectors to the air temp sensors. **Primary sensor should be on the 3-4 side** (senders in this picture are hidden behind fuel hose).

Note: On the Faded Harness all Primary sensor wires should be hooked up on the 3-4 cylinder side and all Secondary sensor wires should be hooked up on the 1-2 cylinder side.

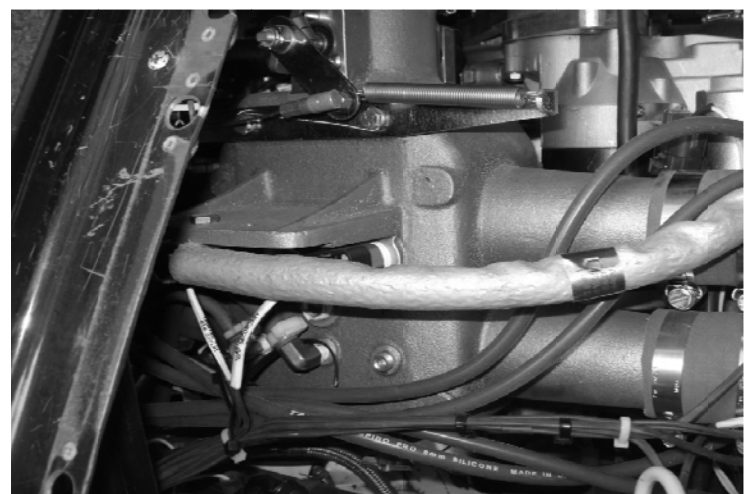




Photo #26

Plug in the connectors to the throttle position sensors. **The primary sensor is aft, and the secondary sensor should be forward.**

Note: Before installing a connector, inspect for any debris or foreign material inside the plug and make sure the pins are straight. Make sure the weather-tight seals are in place on the plugs that are equipped with them.

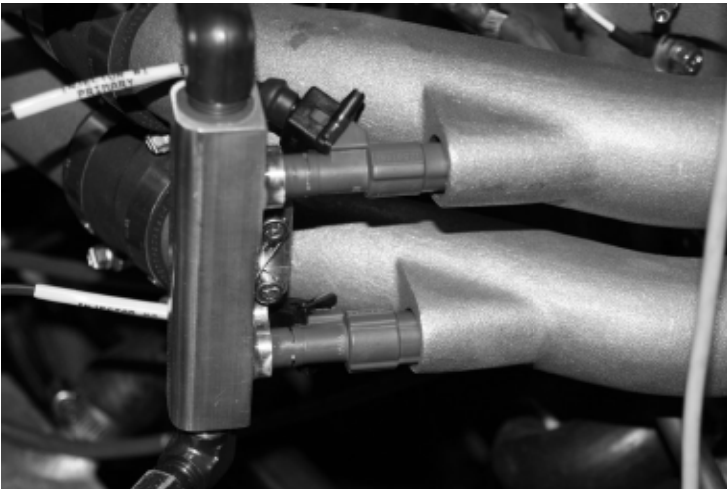


Photo #27

Plug in the connectors to the fuel injectors. It will be necessary to rotate the injectors slightly to install the connectors. The injector wires are marked with a cylinder number. You can find the cylinder numbers marked on the engine heads between the spark plugs.

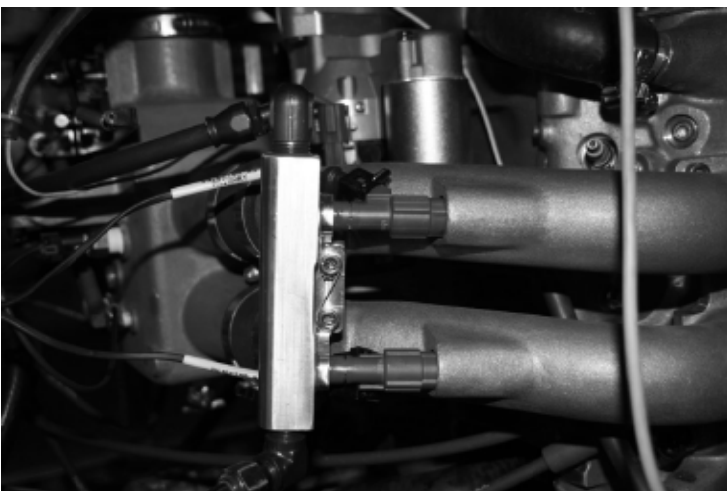


Photo #28

Another view of the connectors to the primary fuel injectors.

Note the final position of the connector on the inboard side of the fuel rail. The connectors must not bind against the intake manifold runners on the engine.

Photo #30

Plug in the connector to the water temp sensors. **The Primary water temp sender is on the head by cylinder #3. The Secondary water temp sender is by cylinder #2** (sender by cylinder #2 shown in picture).

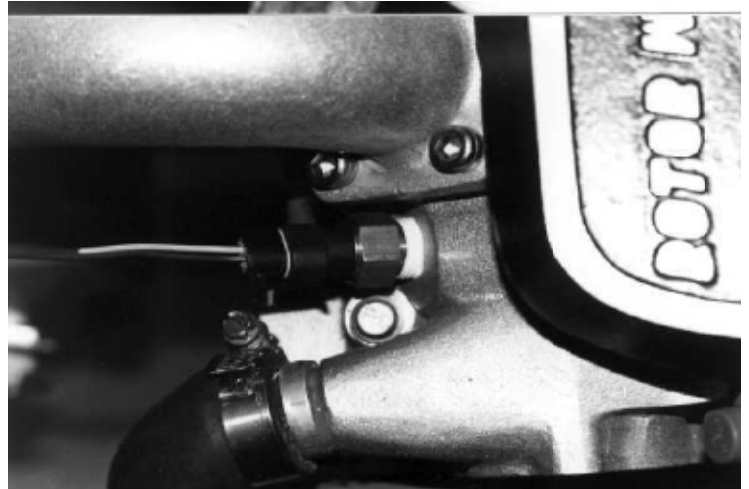


Photo #31

The ignition sensor wires must be plugged into the correct sensor. **The Primary sensor** (shown here) **is on the 3-4 side, or passenger side.**

Note: Keep ignition sensor wires as far away as possible from the spark plug wires.



Photo #32

Secondary ignition sender (shown here) **is on the 1-2 side, or pilot side.**





Photo #33

Both knock sensors are the same. When making electrical connections. **Primary sensor on the 3-4 side, Secondary on the 1-2 side of engine.** Sensors are on the back side of motor located on heads.

Note: Keep the knock sensor wires as far away as possible from the spark plug wires.

Note: Once all the harness connectors are installed you can go back and reroute wires to clean harness installation. Tie straps can be used from E35 CARD 2T.



OVERHEAD SWITCH PANEL

Photo #34

Cut an opening in the cabin roof panel 3/4 inch smaller than the overhead switch panel on all sides. Hold the switch panel and fiberglass cover in place on the roof panel, then drill holes for the mounting screws through all three pieces.

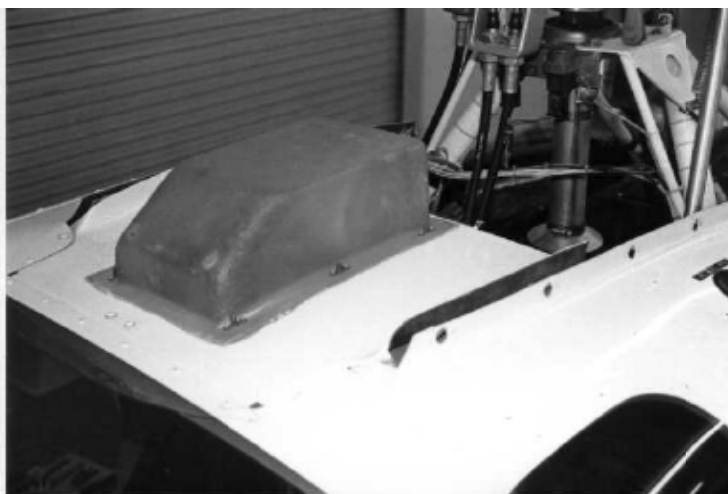


Photo #35

Attach nut plates to the fiberglass cover. Route the wires through the rear of the cover and plug in the connectors to the airframe wiring harness. On final installation, seal the cover to the roof panel with silicone, then install the screws.

Photo #36

Important: Secure all wiring away from the main rotor shaft.

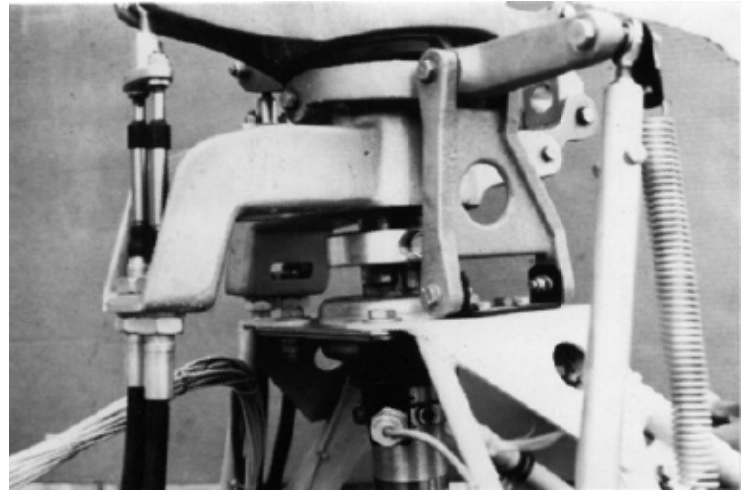


Photo #37

Attach the negative battery cables from the battery and engine to the lower engine mount bolt on the passenger side (print E13-2000). The FADEC wiring harness connects to the negative battery terminal.

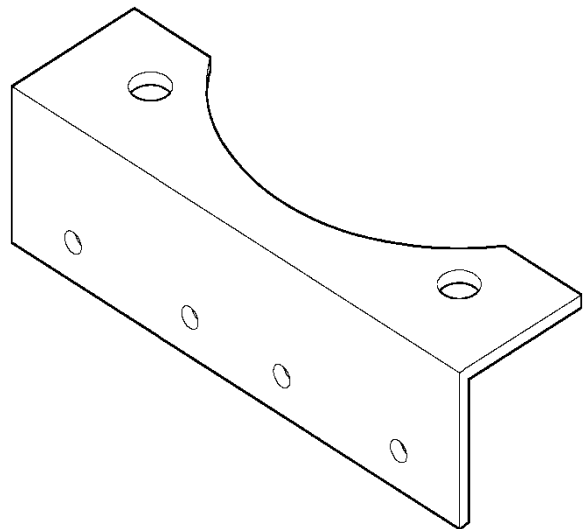
CAUTION: DO NOT connect the FADEC wiring harness to the positive battery terminal. Do not connect the cables to the battery until all wiring is completed. Print (E35-2001).



FUEL PUMP INERTIA SWITCHES

Photo #38

Using template E25-2, cut out and drill the inertia switch bracket



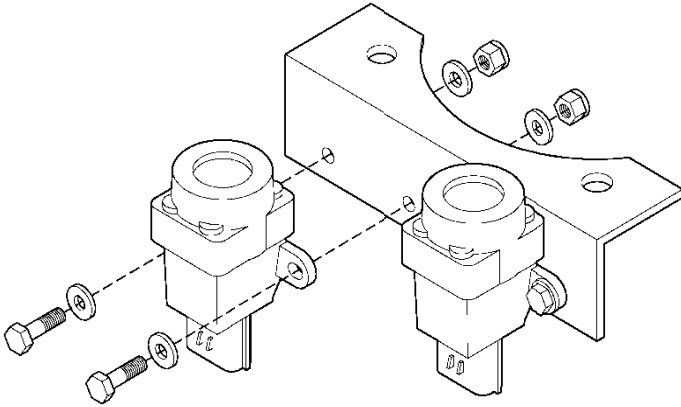


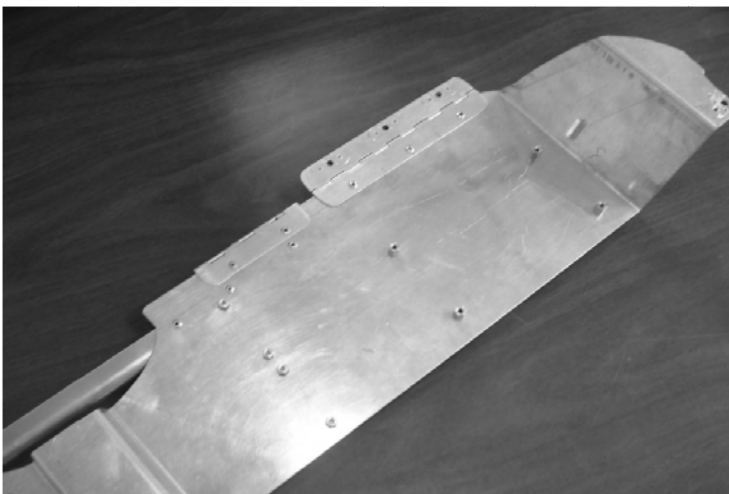
Photo #39

Mount the inertia switches on the bracket. E25 CARD 4T, bolts part number E00-2301.



Photo #40

Install the bracket underneath the main bearing flange, using the two front 3/8" bolts that hold the flange to the hood bracket. Plug in the connectors from the switches to the wiring harness.



ELECTRONICS PANEL

Photo #41

Fit the electronics panel (E35-5000) to the bottom of the seatback. Trimming the panel may be necessary for mounting and harness clearance. Hinges will allow front of panel to lower for service.

Photo #42

Rivet hinge (E35-5010) and brace (E35-5020) on electronics panel. Nut plate hinge to seatback (E35-CARD 1T).

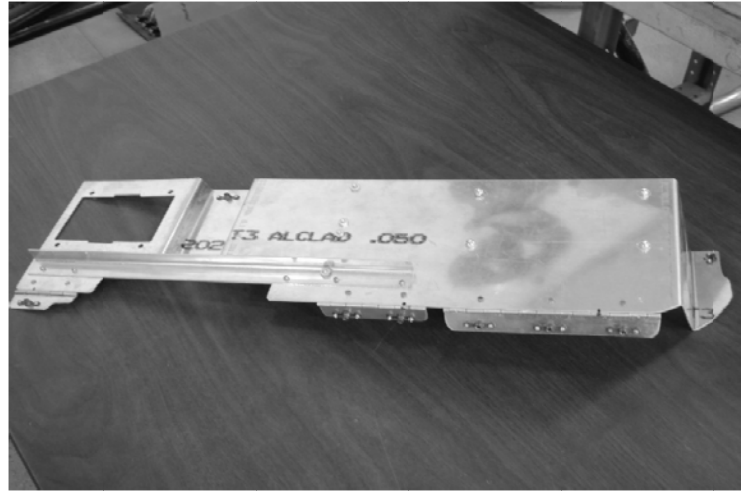


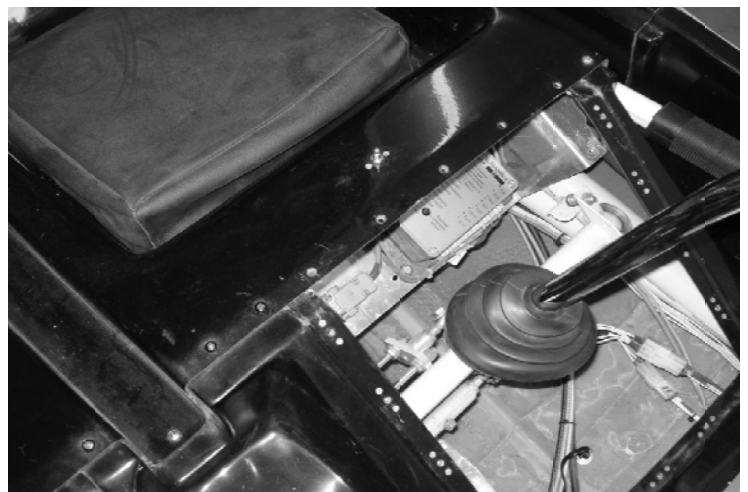
Photo #43

On forward side of panel two nut plates will be installed to hold electronics panel in up position. Nutplates will be located thru holes in seatback.



Photo #44

Top view.



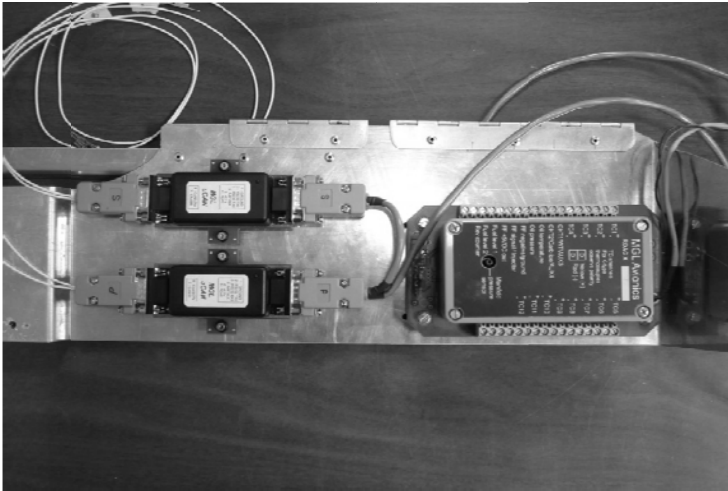


Photo #45

Mount U-cans (E36-8200) and RDAC XF box (E36-8100) to electronics panel. U-can to ALDL harness (E36-8700) and U-can to Enigma harness (E36-8710) also shown. Parts are in G-Box.

Note: The RDAC X box shown on the right side of This picture has changed. See photo 77 on Page 29 of this section.



Photo #46

Hardware for U-cans:

- 4ea. Standoffs E36-8260
 - 4ea. Aluminum nut E36-8261
 - 4ea. Aluminum screw SHCS E36-8262.
- Use Locktite 222 A24-1648.
Standoff location is in G-Box.

Hardware for RDAC:

- 4ea. 6-32 x 1/2" screws E00-1100
- 4ea. 6-32 fiberlock nut E00-3100
- 8ea. 6-32 regular washer E00-4101

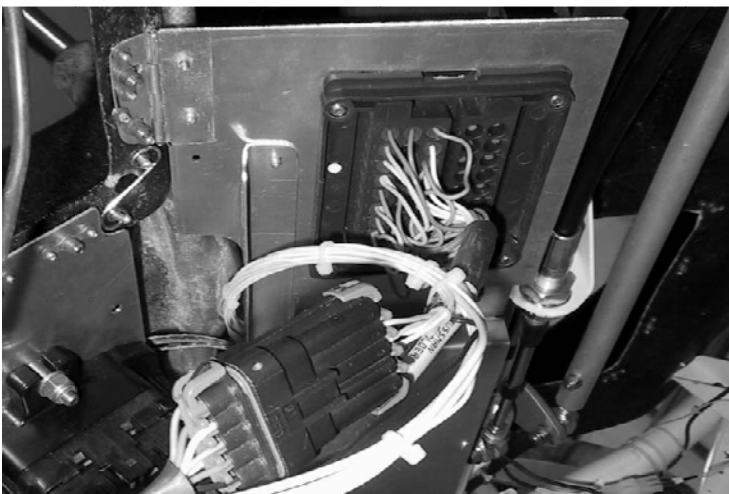


Photo #47

FADEC harness relay box and ALDL connector shown. Screws for relay box, E00-2310, E35 CARD 1T.

Photo #48

Top view of electronics panel in lowered position
(view from pilots side).

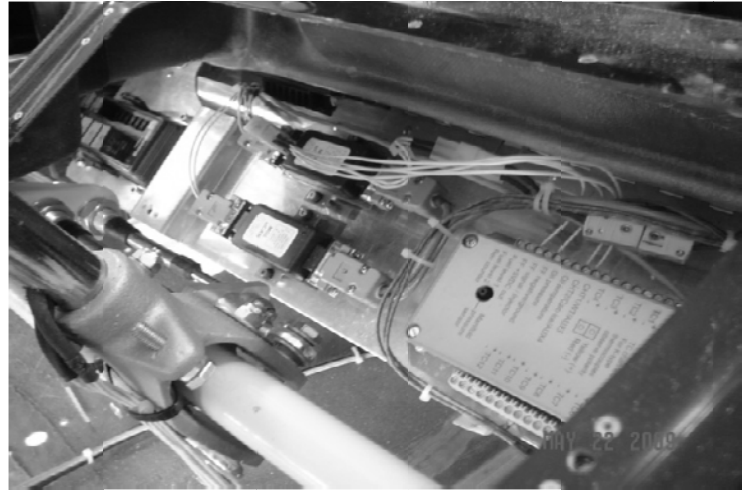


Photo #49

Top view from passenger side in lowered position.

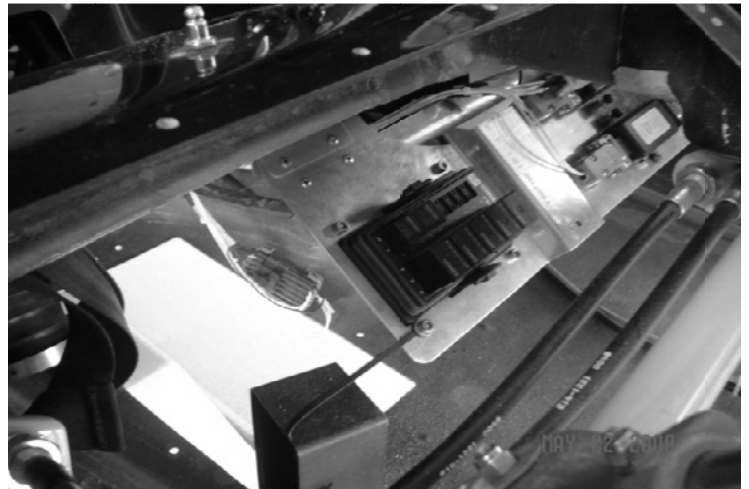


Photo #50

Bottom view of electronics panel installed in up position.





Photo #51

View of panel in lowered position.



ENIGMA

Photo #52

Dash panel forward for view of Enigma and wiring.

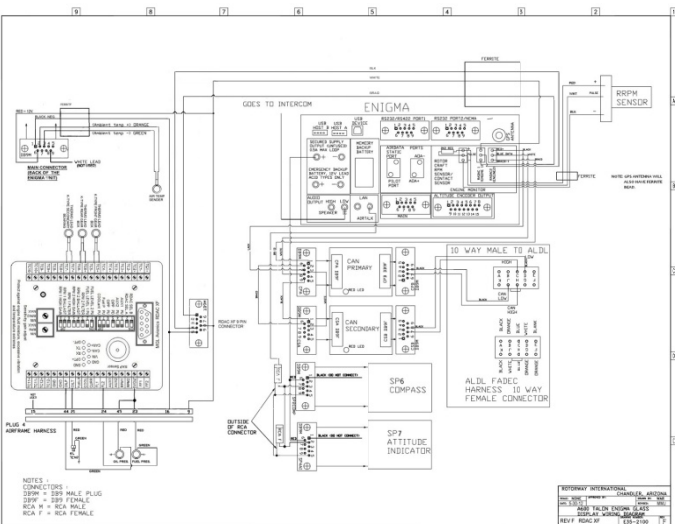


Photo #53

Refer to EFIS construction prints E35-2100 Rev F and E35-2001 Rev C for glass display wiring.

Photo #54

Mounting location in instrument panel for the horizon and compass panel. Two 8-32 screws shown holding panel on the inside. Mounting point for GPS antenna also shown in photo.



Photo #55

Use template E36-3431 Rev C to make shelf for compass and horizon indicators, Compass and Horizon found in G Box.



Photo #56

Top view with compass and horizon installed on shelf. Compass installed on bottom side. Shelf panel for horizon and compass made out of material E32-3122 (.050 aluminum).





Photo #57

Compass and horizon when installed should be level and mounted straight forward. The Enigma has a vertical adjustment for the horizon for fine adjustment.

SP6 Compass E36-8411
SP7 Attitude heading E36-8421

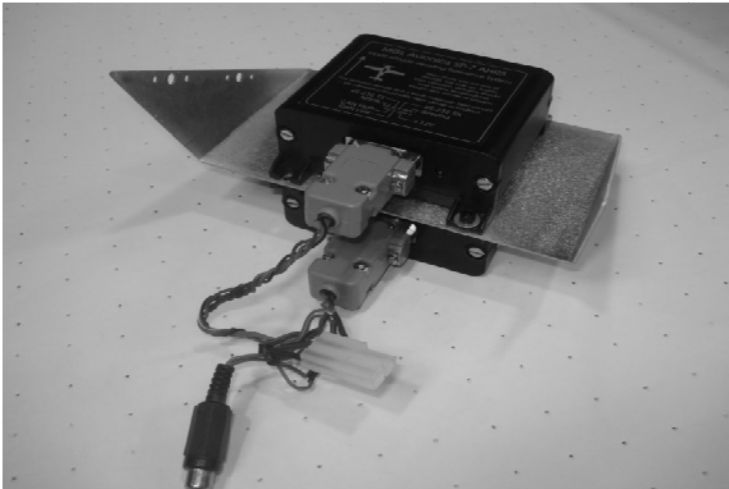
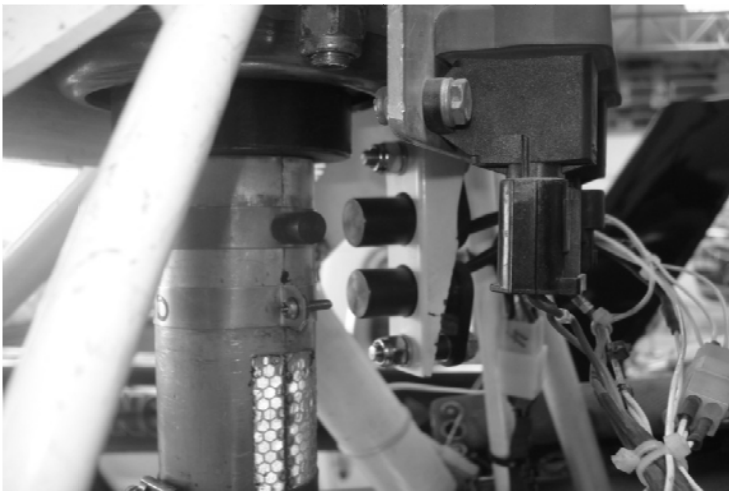


Photo #58

Hardware found in Box G

- 4ea. E00-1112 SHCS 6-32 x 5/8" screws
- 8ea. E00-4101 6-32 washers
- 4ea. E00-3100 6-32 fiber lock nut
- 4ea. E00-7000 Nut plates
- 4ea. E00-1200 8-32 x 7/16" Phillips screws



ROTOR TACH SENDERS

Photo #59

Mount the rotor tach senders and bracket under airframe bracket as shown (E36 CARD 1T) You will be using one of the 3/8" bolts for the main bearing flange. One sender and bracelet is for the dual rotor tach in the Enigma and the other sender is for the back up rotor tach. The air gap for senders should be 3/16". The senders spacers can be trimmed to get correct air gap. To minimize interference from the electrical system and to get a steady reading on the tach, route the wires from the sensors to the tach down the pilot's side of the airframe.

Photo #60

Rotor Tach Senders E36-8650, Rotor Tach Bracelets E36-8669. Use Molex 4-pin connectors to connect senders to the harness.

- 2EA Molex Female E35-8200
- 2EA Molex Male E35-8201
- 6EA Female Pin E35-8570
- 6EA Male Pin E35-8490
- .020 Gauge Wire E36-8650
- Hardware E35 CARD 1T
- E36- CARD 1T
- Wire E35-8393

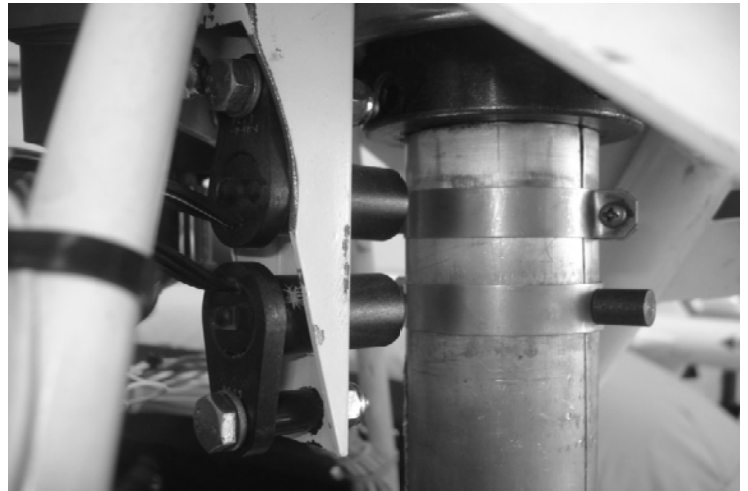
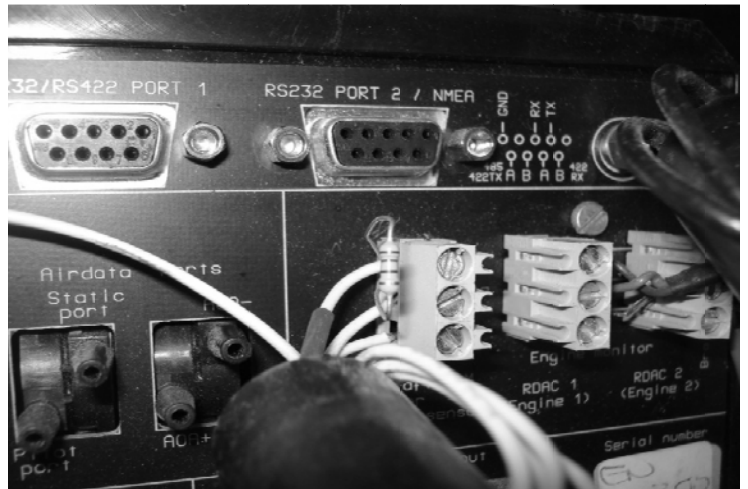


Photo #61

Photo shows the back of Enigma, a 2K2 resistor (E36-8655) shown in center of picture. The resistor is hooked to rotor craft RPM sensor terminal (drawing E35 2100) On. E36 CARD 1T there is .020 gauge wire (E35-8393) used for both rotor tach senders.

Note: Both rotor tach senders will have a 2K2 resistor. Resistors can both be installed on the sender end at the 4-pin molex connectors (Print E35-2001).

Note: Rotor Tach Sender wire colors
Red Stripe - positive
White Stripe - pulse
Black - negative



THERMOCOUPLES

Photo #62

Thermocouple for front gearbox E36-8515 90".
Box G

Note: All thermocouple wires will be ran to the RDAC XF Box on the pilot's side of the airframe.

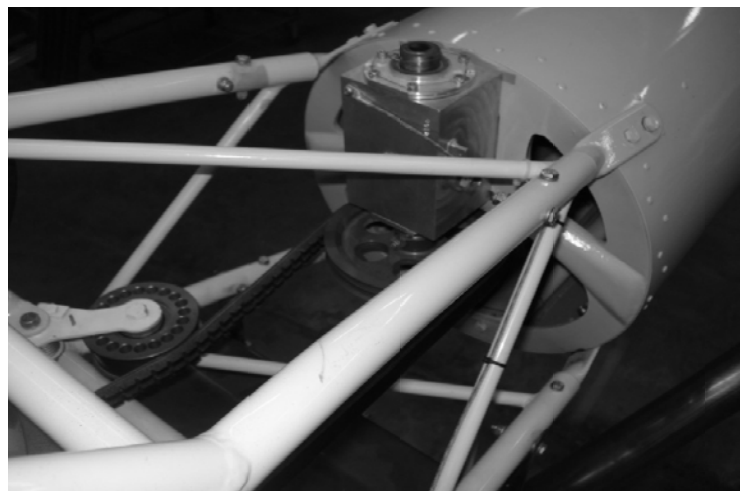




Photo #63

Thermocouple for secondary upper bearing. E36-8525 108".
Mount behind zert fitting.

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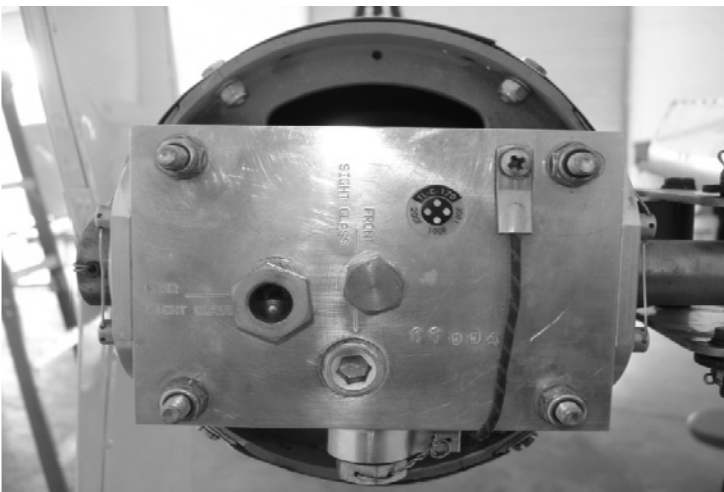


Photo #64

Thermocouple for Rear Gearbox E36-8535 240". Run all three thermocouple wires along left side of airframe to RDAC XF box.

Photo #65

Ferrite beads should be close as possible to Enigma plug. Two loops around the bead is recommended. GPS antenna needs to have its own ferrite bead. Rotortach, RDAC and U-cans can share a ferrite bead. E36-8720. The third ferrite bead should be used for main power plug wires. Ferrite beads found in the G-Box. Drawing E35-2100 Rev E.

Note: A fourth Ferrite bead will be provided in the Enigma Box.

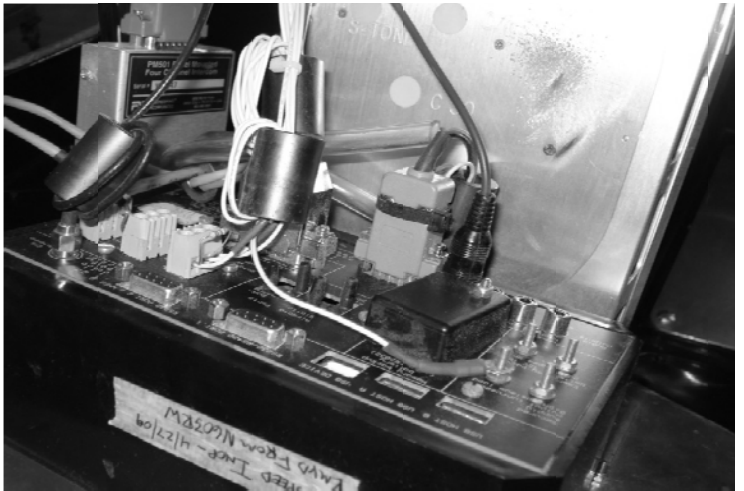


Photo #66

ECU's viewed from bottom, airframe harness #4 plug (white wires) are going into electronics panel.



Photo #67

Back of EFIS showing altitude encoder, main connector and GPS antenna installed. The left lower single audio cable is from the air talk port going to the compass and attitude indicator.



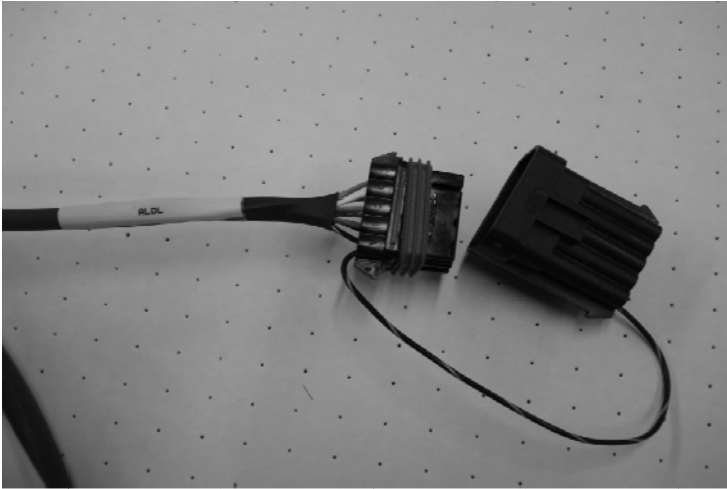


Photo #68

ALDL connector shown on the Fadec wiring harness. See print E35-2001 and E35-2100. Harnesses E36-8700 and E36-8710 (found in G Box) will run from U-cans and will plug into ALDL female connector.



Photo #69

Another view of the back of the Enigma display.

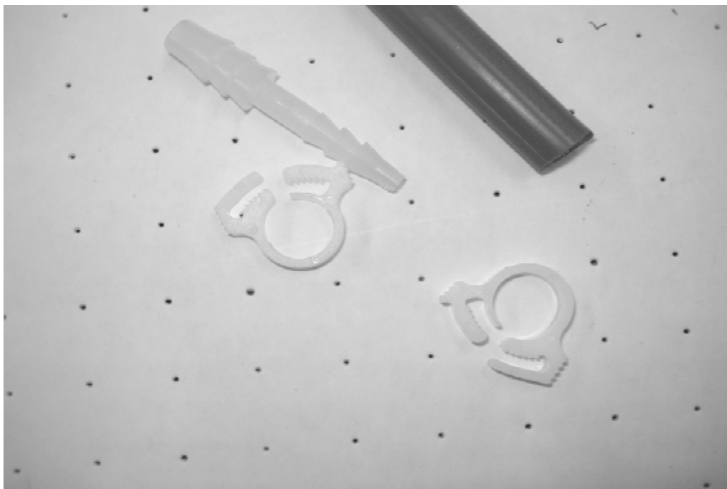


Photo #70

Reducer and clamps for airspeed to Enigma.
Small clamp E00-9160
Large clamp E00-9170
1/8" to 1/4" reducer E35-4070
Small Hose E25-4130
Large Hose E36-4070, E36 CARD 2T

Photo #71

Airspeed hose and reducer. Installed in pitot port in center of unit.



Photo #72

Air Temp Sender and hardware E36-8620 found in Stratomaster Enigma box E36-8000.



Photo #73

Air Temp Sender installed on bottom side of tub. If tub is split (two pieces) it is recommended to mount sender in aft section. This will make removal of front section easier. Sensor may vary from instillation pictures.





Photo #74

Oil Temp Sender E36-857, located on passenger side of ship. Wire will be ran to airframe harness plug #4.

Note: red wire to RDAC
green wire to ground
Switching wires will change the resistance of the sender.



Photo #75

Oil Pressure Sender E36-3120.



Photo #76

Fuel Pressure Sender E36-3120 same part number as Oil Pressure Sender. E36 CARD 1T.

Photo #77

When turning on instrument switch you should power Enigma and RDAC box. The RDAC box has green LED light on top of box.

Note: The harness for the RDAC is # E36-8110 (Found in Box G). The harness will be ran to the Enigma display.

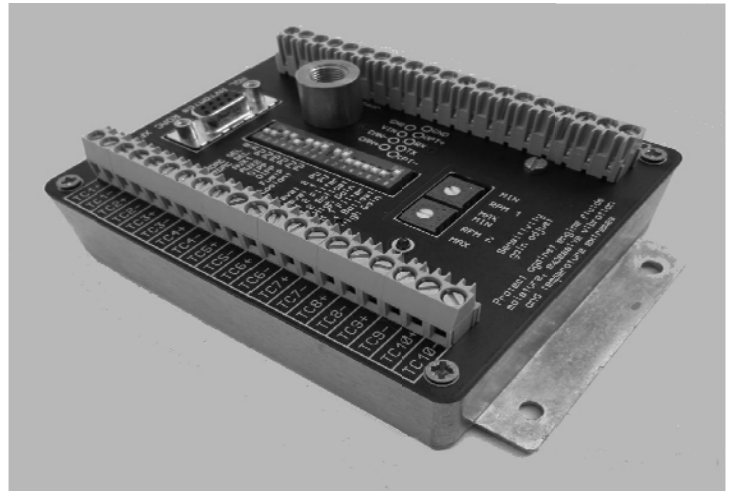


Photo #78

To get engine values you must turn on FADEC 1 and FADEC 2. Values also shown here on screen #6 of Enigma.

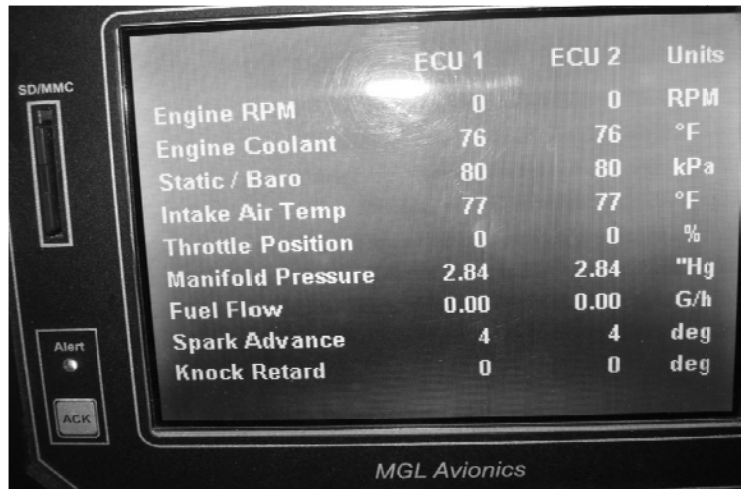


Photo #79

When FADEC 1 and 2 are turned on you should see a blinking red LED light on primary and secondary U-can.



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