CHAPTER 71
POWER PLANT
# Table of Contents

**SECTION 71-00** GENERAL  
- **SECTION 00-01** ENGINE MODEL DESCRIPTION 5  
- **SECTION 00-02** ENGINE PROCEDURES 6  
- ENGINE REMOVAL 7  
- ENGINE INSTALLATION 14  
- ENGINE OPERATIONAL CHECK 21  
- ENGINE LEVEL I DIAGNOSTIC 24  
- **SECTION 00-03** ENGINE TROUBLESHOOTING GUIDE 25

**SECTION 71-10** COWLING  
- **SECTION 10-01** COWLING PROCEDURES 28  
- COWLING REMOVAL 29  
- COWLING INSTALLATION 30  
- COWLING INSPECTION 31  
- **SECTION 10-02** COWLING TROUBLESHOOTING GUIDE 32

**SECTION 71-20** ENGINE MOUNTS  
- **SECTION 20-01** ENGINE MOUNT PROCEDURES 33  
- ENGINE MOUNT REMOVAL 34  
- ENGINE MOUNT INSTALLATION 35  
- ENGINE MOUNT FRAME REMOVAL 36  
- ENGINE MOUNT FRAME INSTALLATION 37  
- ENGINE MOUNT AND FRAME INSPECTION 38  
- **SECTION 20-02** ENGINE MOUNT TROUBLESHOOTING GUIDE 39

**SECTION 71-30** FIREWALL BLANKET  
- **SECTION 30-01** FIREWALL BLANKET PROCEDURES 41  
- FIREWALL BLANKET REMOVAL 42  
- FIREWALL BLANKET INSTALLATION 43  
- FIREWALL BLANKET INSPECTION 46  
- **SECTION 30-02** FIREWALL BLANKET TROUBLESHOOTING GUIDE 50

**SECTION 71-50** ENGINE ELECTRICAL HARNESS  
- **SECTION 50-01** FADEC LOW VOLTAGE HARNESS DESCRIPTION 53  
- **SECTION 50-02** FADEC IGNITION SYSTEM HARNESS 54  
- **SECTION 50-03** FADEC HARNESS ASSEMBLY PROCEDURES 55  
- IGNITION SYSTEM HARNESS REMOVAL 56  
- IGNITION SYSTEM HARNESS INSTALLATION 57  
- IGNITION SYSTEM HARNESS INSPECTION PROCEDURE 59  
- LOW VOLTAGE HARNESS REMOVAL 60  
- LOW VOLTAGE HARNESS INSTALLATION 61  
- LOW VOLTAGE HARNESS INSPECTION 62  
- **SECTION 50-04** ENGINE ELECTRICAL HARNESS TROUBLESHOOTING GUIDE 64

**SECTION 71-60** AIR INTAKES  
- **SECTION 60-01** AIR INTAKE PROCEDURES 65  
- AIR INTAKE REMOVAL 66  
- AIR INTAKE INSTALLATION 68  
- ALTERNATE AIR FLAPPER VALVE ARM REMOVAL 69  
- ALTERNATE AIR FLAPPER VALVE ARM PROCEDURE 70  
- AIR INTAKE INSPECTION 72  
- **SECTION 60-02** AIR INTAKE TROUBLESHOOTING GUIDE 76
Section 71-00 General

This chapter provides a descriptive overview of the IOF-240-B engine installed on the airplane. Detailed information for routine line maintenance for each engine subsection or system is provided in the appropriate chapter. More detailed information for repairs and maintenance on systems and components specific to the IOF-240-B engine (in particular, the FADEC system) are provided in the current release of the Teledyne Continental Motors Maintenance Manual for IOF-240-B series engines, TCM p/n: M-22.

Section 00-01 Engine Model Description

A Teledyne Continental Motors IOF-240-B engine rated at 125 bhp maximum continuous power powers the airplane. Recommended cruise power is 90 BHP. The engine drives a two-blade wooden fixed pitch propeller.

The IOF-240-B-X is a four-cylinder air-cooled engine. Its type designation reflects the following:

I – the engine is fuel injected

O – Cylinder layout - horizontally opposed

F– The engine uses a Full Authority Digital Engine Control system (FADEC)

240 – Engine displacement is 240 cubic inches

B – Model designation indicating that the engine is designed for use with a fixed-pitch propeller, with a doweled six bolt hole propeller flange and no provision for a hydraulic propeller governor

X – Specific configuration of accessories as supplied to Liberty Aerospace, Inc., for use on the airplane.

Figure 71-1 Engine Assembly
Because of the nature and complexity of the FADEC system, procedures covered in this maintenance manual include routine line servicing, replenishment of operating fluids, and replacement of “consumable” components such as spark plugs only. Detailed information and procedures covering maintenance and troubleshooting of the FADEC system and related components are provided in the Teledyne Continental Motors Maintenance Manual for IOF-240-B series engines.

A cylinder head temperature (CHT) sensor is installed in each cylinder head to provide required data to the FADEC system computers. An exhaust gas temperature (EGT) sensor is installed in each cylinder’s exhaust pipe, approximately two inches from its attachment to the cylinder exhaust port, to provide required data to the FADEC system computers.

Section 00-02 Engine Procedures
The following sections provide procedures for removal, installation, and operational check of the engine. Operational checks are performed in accordance with Chapter 05 – Time Limits/Maintenance Checks/Inspection Intervals.
ENGINE REMOVAL

Perform this procedure to remove the engine.

**CAUTION**

_Engine removal requires use of an engine hoisting system of sufficient capacity to suspend the full weight of the engine and attached accessories. Using a hoist of insufficient capacity may result in personal injury, engine damage or both._

**CAUTION**

_Before starting these procedures, the tail of the airplane requires support. Failure to support the airplane’s tail may cause damage to the airplane’s tail section while accessing any area aft of the passenger compartment._

1. Position the ALT and BAT master switches, the FADEC PWR A and B switches, and the ignition switch to OFF.
2. Pull the BAT1 (CB001) circuit breaker to OPEN.
3. Install a tail stand underneath the tail section of the airplane.
4. Remove the cabin aft bulkhead access panel, by removing securing screw hardware.
5. Disconnect the negative then the positive leads from the primary battery. Isolate the negative terminals on the batteries to prevent accidental connection.

**CAUTION**

_Failure to disconnect the batteries can cause damage to the electrical circuitry of the airplane._

6. Turn cockpit fuel selector OFF.
7. Remove upper and lower cowlings in accordance with the Cowling Removal procedures on page 29 of this chapter.
8. Remove propeller and spinner in accordance with Chapter 61 - _Propellers_.
9. Disconnect alternate air operating linkages referring to Page 66 of this Chapter for linkage details.
10. Disconnect throttle linkage referring to Chapter 76 – _Engine Controls_ for linkage removal details.
The aircraft can be equipped with one of two types of crankcase breather systems: a direct breather line and an air/oil separator Breather system. Refer to step 11 for the air/oil separator system or step 13 for the direct breather system.

11. If so equipped, disconnect the crankcase breather line from the air/oil separator at the location shown in Figure 71-2. The case breather line will be removed with the engine.

12. If so equipped, disconnect the air/oil separator oil sump return line from the engine fitting as shown in Figure 71-2. Cap the line and engine fitting after disconnection.

13. If so equipped, remove crankcase direct breather line clamp assemblies from the lower engine mount frame assembly as shown in Figure 71-3. The crankcase breather line is removed with the engine.
In the following steps wire harnesses and ignition leads from the engine to the airframe will be disconnected. Harness routing is secured by means of clamps and wire ties. Remove all securing clamps and hardware required to free harnesses permitting engine removal. Refer to Figure 71-4 for location of components to be disconnected.

- Remove harness clamps and wire ties securing Low Voltage Harness (LVH) to engine mount structure
- Remove clamps and wire ties securing ignition leads to the engine mount structure

Figure 71-3 Crankcase Direct Breather Line Clamp Removal

Figure 71-4 Engine Disconnections
14. Disconnect ignition leads from each spark plug. Cap and stow the leads aft of the engine mounts. Remove ignition lead clamps and insulated baffle plates as required to permit lead removal from the engine. Ignition leads will remain with the aircraft connected to ECU-1 and ECU-2. Ignition lead clamps aft of the engine mounts are to remain in place.

15. Disconnect power lead P04A4 from starter. This lead remains with the airframe.

16. Disconnect ground strap from the engine as shown in Figure 71-5. Do not disconnect strap from the engine mount frame grounding tab.

![Ground Strap Disconnection](image)

**Figure 71-5 Engine Ground Strap Disconnection**

17. Remove clamps and wire ties securing low voltage wire harnesses to the engine mount frame. Ignition lead clamps are to remain in place.

18. Disconnect cabin heat duct from Cabin heat box assembly and muffler shroud assembly. Remove duct and set aside for engine installation.

19. Disconnect P5 From P32 on the tunnel firewall assembly as shown in Figure 71-6.

20. Disconnect P6 From P32 on the tunnel firewall assembly as shown in Figure 71-6.

21. Disconnect J33 from P33 on the tunnel firewall assembly as shown in Figure 71-6.
22. Disconnect Low Voltage Harness connector P1 from ECU-1.
23. Disconnect Low Voltage Harness connector P2 from ECU-2.
24. Disconnect J34 from the oil pressure transducer located as shown in Figure 71-7.

**NOTE**

Minor fuel spillage may occur; position containers and/or absorbent material below firewall connections before disconnecting.

25. Disconnect fuel supply and fuel return lines at firewall location shown in Figure 71-7. Cap lines and fittings after disconnection.
26. Disconnect oil pressure line from the Oil Cooler Adapter mounted Oil Restrictor as shown in Figure 71-7. Cap open connections.

![Figure 71-8 Oil Pressure Line Disconnection](image)

**Figure 71-8 Oil Pressure Line Disconnection**

27. Remove clamp assemblies connecting fuel drain lines to the lower engine mount frame assembly as shown in Figure 71-9. Fuel drain lines are removed with the engine.

![Figure 71-9 Fuel Drain Line Clamp Assemblies](image)

**Figure 71-9 Fuel Drain Line Clamp Assemblies**

28. Disconnect oil cooler from firewall Oil Cooler Bracket Assembly as shown in Figure 71-10. The Oil Cooler Assembly is removed with the engine. Secure the assembly to engine structure with temporary support relieving oil line strain.
29. Attach hoist to lifting eye at top of crankcase.

**WARNING**

*IF ENGINE HOIST IS MOVABLE, THE POWER-PLANT PACKAGE CAN BE MOVED AWAY FROM AIRPLANE. PRIOR TO ANY MOVEMENT, VERIFY A TAIL STAND HAS BEEN INSTALLED. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY, DAMAGE TO THE AIRCRAFT OR BOTH.*

30. Raise hoist until load on engine mounts is relieved.

31. Remove four (4) engine mounts in accordance with Page 34 of this Chapter.

32. Remove entire power-plant package including exhaust system, oil cooler, baffles, etc. as one assembly.

This completes the Engine Removal procedure.
ENGINE INSTALLATION

Perform this procedure to install the engine.

1. Verify electrical power is removed from the aircraft and that primary and secondary batteries have been disconnected at their terminals.

2. Using hoist, place dressed engine assembly in correct position to allow (4) engine mount bolts to be inserted.

3. Install (4) engine mounts in accordance with Page 35 of this Chapter.

4. Connect oil cooler to oil cooler bracket assembly as shown in Figure 71-11. Torque ¼-28 mounting bolts in accordance with torque tables provided in Chapter 20 Standard Practices Airframe.

5. Install clamp assemblies connecting fuel drain lines to the lower engine mount frame assembly as shown in Figure 71-12. Fuel drain lines are removed with the engine.

Figure 71-11 Oil Cooler Installation

Figure 71-12 Fuel Drain Line Clamp Assembly Installation
6. Connect oil pressure line from the Oil Cooler Adapter mounted Oil Restrictor as shown in Figure 71-13. Cap open connections.

![Figure 71-13 Oil Pressure Line Connection](image)

**Figure 71-13 Oil Pressure Line Connection**

7. Connect fuel supply and fuel return lines at firewall location shown in Figure 71-14.

![Figure 71-14 Tunnel Firewall Fuel Line Connections](image)

**Figure 71-14 Tunnel Firewall Fuel Line Connections**

**NOTE**

In the following steps wire harnesses and ignition leads from the engine to the airframe will be connected. Harness routing is to be secured by means of clamps and wire ties. Install harness securing clamps and hardware removed previously. Refer to Figure 71-15 for the location of components to be connected.
8. Connect ignition leads to respective ECU-1 and ECU-2 ignition towers in accordance with Teledyne Continental Motors Installation and Operations manual OI-22 Chapter 5.

9. Connect Low Voltage Harness connector P1 from ECU-1 in accordance with Teledyne Continental Motors Installation and Operations manual OI-22 Chapter 4.

10. Connect Low Voltage Harness connector P2 from ECU-2 in accordance with Teledyne Continental Motors Installation and Operations manual OI-22 Chapter 4.

11. Connect J34 to the oil pressure transducer located as shown in Figure 71-14.

12. Connect P5 To P32 on the tunnel firewall assembly as shown in Figure 71-16.

13. Connect P6 To P32 on the tunnel firewall assembly as shown in Figure 71-16.

14. Connect J33 To P33 on the tunnel firewall assembly as shown in Figure 71-16.

Figure 71-15 Engine Connections
15. Connect Low Voltage Harness connectors P5 and P6 at firewall (Cannon plugs) in accordance with Teledyne Continental Motors Installation and Operations manual OI-22 Chapter 4.

16. Connect cabin heat duct to Cabin heat box assembly and muffler shroud assembly as shown in Figure 71-17.

17. Connect ground strap between engine and airframe as shown in Figure 71-18. Torque strap nuts in accordance with Teledyne Continental Motors Installation and Operations manual OI-22 Appendix B.

18. Perform ground strap bond check in accordance with Teledyne Continental Motors Installation and Operations manual OI-22 Chapter 4.
19. Connect power lead P04A4 to the starter. Torque terminal nut to 100 +/- 5 in/lbs.

NOTE

The aircraft can be equipped with one of two types of crankcase breather systems a direct breather line and an air/oil separator Breather system. Refer to step 11 for the air/oil separator system or step 13 for the direct breather system.

20. If so equipped, Connect the crankcase breather line from the air/oil separator at the location shown in Figure 71-19. The case breather line will be removed with the engine.

21. If so equipped, disconnect the air/oil separator oil sump return line from the engine fitting as shown in Figure 71-2. Cap the line and engine fitting after disconnection.
22. If so equipped, Install crankcase direct breather line clamp assemblies to the lower engine mount frame assembly as shown in Figure 71-20. Breather line is installed on the engine prior to airframe installation.

23. Connect throttle linkage referring to chapter to Chapter 76 – Engine Controls for linkage installation detail.

24. Install air intake ducts and alternate air operating linkages referring to Page 68 of this Chapter for installation details.

25. Install propeller and spinner in accordance with Chapter 61 - Propellers.

26. Install upper and lower cowlings in accordance with the Cowling Installation procedures on page 29 of this chapter.
27. Perform Engine Operational Check in accordance with TCM Installation and Operation Manual OI-22, Chapter 5.

This completes the Engine Installation procedure.
ENGINE OPERATIONAL CHECK

Perform this procedure to run an operational check of the engine prior to 50 and 100-hour engine inspections as called out in Chapter 5 of this manual or at any time an engine suspect condition exists.

For the following conditions perform engine operational checks in accordance with Teledyne Continental Motors Installation and Operations Manual OI-22 Chapter 5:

- 50-Hour Inspection
- 100-Hour inspection
- Engine Installation
- Maintenance and Troubleshooting
- Engine Overhaul
- Return From Storage

The following step will start the engine. Monitor oil pressure indication. In the event oil pressure does not rise within 30 seconds shut down the engine and proceed to Engine Troubleshooting Guide at the end of this section.

1. Start the engine following POH/AFM procedures. Allow engine to warm up until oil temperature is 75 deg. F or higher.

2. Check and record the following engine status data on start:

<table>
<thead>
<tr>
<th>Check</th>
<th>Result</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine Hours</td>
<td>HOBBS:</td>
<td>• Record Hobbs</td>
</tr>
<tr>
<td></td>
<td>Tach:</td>
<td>• Record Tachometer</td>
</tr>
<tr>
<td>Fuel Boost Pump</td>
<td>Auto:</td>
<td>• Runs in Auto mode</td>
</tr>
<tr>
<td></td>
<td>Manual:</td>
<td>• Runs in Manual mode</td>
</tr>
<tr>
<td></td>
<td>PSI:</td>
<td>• 30 psi minimum</td>
</tr>
<tr>
<td>Starter Operation</td>
<td>Starter:</td>
<td>• Verify starter operates</td>
</tr>
<tr>
<td></td>
<td>Indicator:</td>
<td>• Verify indicator lights</td>
</tr>
<tr>
<td>Oil Pressure</td>
<td>PSI:</td>
<td>• Idle 850-900 RPM</td>
</tr>
<tr>
<td></td>
<td>Rise Time:</td>
<td>• Pressure rise &lt; 30 sec.</td>
</tr>
<tr>
<td>Oil Temperature</td>
<td>F:</td>
<td>• 75 – 220 Normal</td>
</tr>
<tr>
<td>FADEC Both RPM</td>
<td>RPM:</td>
<td>• Record RPM drop for each FADEC channel</td>
</tr>
<tr>
<td>FADEC Left RPM</td>
<td>RPM:</td>
<td>• Check at 1700 RPM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Maximum allowable drop is 150 RPM</td>
</tr>
</tbody>
</table>
### Check Results Table

<table>
<thead>
<tr>
<th>Check</th>
<th>Result</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FADEC Right RPM</strong></td>
<td>RPM:</td>
<td>• Maximum allowable difference is 75 rpm.</td>
</tr>
<tr>
<td><strong>FADEC Power B OFF</strong></td>
<td>EBAT FAIL: _____</td>
<td></td>
</tr>
<tr>
<td><strong>FADEC Power A ON</strong></td>
<td>Engine Op: _____</td>
<td></td>
</tr>
<tr>
<td><strong>FADEC Power B ON</strong></td>
<td>PPWR FAIL: _____</td>
<td>• Verify PPWR FAIL is ON</td>
</tr>
<tr>
<td><strong>FADEC Power A OFF</strong></td>
<td>EBAT FAIL: _____</td>
<td>• Verify EBAT FAIL is ON</td>
</tr>
<tr>
<td><strong>FADEC Power B ON</strong></td>
<td>PPWR FAIL: _____</td>
<td>• Verify PPWR FAIL is OFF</td>
</tr>
<tr>
<td><strong>FADEC Power A ON</strong></td>
<td>EBAT FAIL: _____</td>
<td>• Verify EBAT FAIL is OFF</td>
</tr>
<tr>
<td><strong>FADEC Power B ON</strong></td>
<td>PPWR FAIL: _____</td>
<td>• Verify engine operation is normal</td>
</tr>
<tr>
<td><strong>FADEC Power A ON</strong></td>
<td>EBAT FAIL: _____</td>
<td>• Verify engine operation is normal</td>
</tr>
</tbody>
</table>

3. Increase engine to full throttle and record:

<table>
<thead>
<tr>
<th>Check</th>
<th>Result</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WOT Light</strong></td>
<td>WOT:</td>
<td>• On at full throttle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Off below full throttle</td>
</tr>
<tr>
<td><strong>Manifold Pressure</strong></td>
<td>InHg:</td>
<td>• 15 – 29.5 Normal</td>
</tr>
<tr>
<td><strong>RPM at Full Throttle</strong></td>
<td>RPM:</td>
<td>•</td>
</tr>
<tr>
<td><strong>Fuel Pressure</strong></td>
<td>PSI:</td>
<td>• 25 – 98 PSI – Normal</td>
</tr>
<tr>
<td><strong>Fuel Boost Pump</strong></td>
<td></td>
<td>• Verify boost pump cycles off above 1200 RPM.</td>
</tr>
<tr>
<td><strong>Oil Pressure</strong></td>
<td>PSI:</td>
<td>• 30 – 60 PSI Normal</td>
</tr>
<tr>
<td><strong>Oil Temperature</strong></td>
<td>F:</td>
<td>• 75 – 220 Normal</td>
</tr>
<tr>
<td><strong>Cylinder Head Temperature (CHT)</strong></td>
<td>CY1: _____ CY2: _____ CY3: _____ CY4: _____</td>
<td>• 240 – 420 F Normal</td>
</tr>
<tr>
<td><strong>Exhaust Gas Temperature (EGT)</strong></td>
<td>CY1: _____ CY2: _____ CY3: _____ CY4: _____</td>
<td>• 1000 – 1675 F Normal</td>
</tr>
<tr>
<td><strong>Alternator Output</strong></td>
<td>Volts: _____ Amps: _____ VM1000 Volts: _____ OAT</td>
<td>• 12.0 – 14.3 Normal, 14.1 +/- 0.1 Optimum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Expect current &lt; 60A</td>
</tr>
<tr>
<td>Check</td>
<td>Result</td>
<td>Notes</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-----------------------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>HSA Status</td>
<td>FADEC WARN: ______</td>
<td>• Verify all HSA indicators are OFF.</td>
</tr>
<tr>
<td></td>
<td>FADEC CAUTION: ______</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PPWR FAIL: ______</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EBAT FAIL: ______</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FUEL PUMP: ______</td>
<td></td>
</tr>
</tbody>
</table>

4. Reduce engine to idle and record:

<table>
<thead>
<tr>
<th>Check</th>
<th>Result</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manifold Pressure</td>
<td>InHg:</td>
<td>• 15 – 29.5 Normal</td>
</tr>
<tr>
<td>RPM</td>
<td></td>
<td>• Idle 850-900 RPM</td>
</tr>
<tr>
<td>Oil Pressure</td>
<td>PSI:</td>
<td>• Idle 850-900 RPM</td>
</tr>
<tr>
<td>Oil Temperature</td>
<td>F:</td>
<td>• 75 – 220 Normal</td>
</tr>
<tr>
<td>Cylinder Head Temperature (CHT)</td>
<td>CY1:</td>
<td>• 240 – 420 F Normal</td>
</tr>
<tr>
<td></td>
<td>CY2:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CY3:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CY4:</td>
<td></td>
</tr>
<tr>
<td>Exhaust Gas Temperature (EGT)</td>
<td>CY1:</td>
<td>• 1000 – 1675 F Normal</td>
</tr>
<tr>
<td></td>
<td>CY2:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CY3:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CY4:</td>
<td></td>
</tr>
<tr>
<td>Fuel Pressure</td>
<td>PSI:</td>
<td>• 25 – 98 PSI – Normal</td>
</tr>
<tr>
<td></td>
<td>Boost Pump:</td>
<td>• Verify boost pump runs at 1200 and below with switch in Auto</td>
</tr>
</tbody>
</table>

5. Shut down the engine following Liberty POH/AFM procedures.

This completes the Engine Operational Check procedure.
ENGINE LEVEL I DIAGNOSTIC

The following procedure performs a Engine Level I Diagnostic procedure. A test computer loaded with the latest revision of Teledyne Continental Motors PowerLink™ Maintenance Manual Suite MMS-22 diagnostic software is required. Data cables delivered with the aircraft are also required. This procedure may be performed at any time on condition as well as during 50 and 100-hour inspections called out in Chapter 5 of this manual.

1. Verify aircraft split master switch is in the off position.

2. Locate the Engine Data Interface (EDI-200) unit beneath the circuit breaker panel and connect data cables as shown in Figure 71-21 with the test computer.

4. Following instructions in the user guide and instructions provide by the application complete a Level I diagnostic and print the results for aircraft records. Perform engine start and shutdown procedures in accordance with Liberty POH/AFM procedures.

5. On completion, remove data cables and test computer.

This completes the Engine Level I Diagnostic procedure

**Section 00-03 Engine Troubleshooting Guide**

Use this troubleshooting guide to resolve issues with the engine. This guide provides initial troubleshooting guidance. Detailed procedure may be required in other chapters of this manual and in Teledyne Continental Motors maintenance manual M-22. Contact TCM for current manual information.

<table>
<thead>
<tr>
<th>Complaint</th>
<th>Possible Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine will not start</td>
<td>• Primary battery</td>
<td>• Inspect battery in accordance with chapter 24</td>
</tr>
<tr>
<td></td>
<td>• Secondary battery</td>
<td>• Inspect battery in accordance with chapter 24</td>
</tr>
<tr>
<td></td>
<td>• FADEC fault</td>
<td>• Perform troubleshooting procedure in accordance with TCM Maintenance Manual M-22 Chapter 8</td>
</tr>
<tr>
<td></td>
<td>• Fuel fault</td>
<td>• Inspect fuel system in accordance with chapter 73</td>
</tr>
<tr>
<td>Oil pressure does not rise on start</td>
<td>• No oil in the engine</td>
<td>• Add oil</td>
</tr>
<tr>
<td></td>
<td>• Oil pressure relief valve fault</td>
<td>• Refer to TCM Overhaul Manual M-22 Chapter 8 for corrective action</td>
</tr>
<tr>
<td></td>
<td>• Oil pump failure</td>
<td>• Refer to TCM Overhaul Manual M-22 Chapter 8 for corrective action</td>
</tr>
<tr>
<td>Engine runs rough</td>
<td>• Induction system obstruction</td>
<td>• Inspect and clear induction system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Replace air filter</td>
</tr>
</tbody>
</table>

**Figure 71-22 PowerLink™ Level I Diagnostic Display**

Figure 71-22 shows the PowerLink™ Level I Diagnostic Display.
<table>
<thead>
<tr>
<th>Complaint</th>
<th>Possible Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• FADEC fault</td>
<td>• Perform troubleshooting procedure in accordance with TCM Maintenance Manual M-22 Chapter 8</td>
</tr>
<tr>
<td></td>
<td>• Propeller imbalance</td>
<td>• Check propeller torque in accordance with chapter 61</td>
</tr>
<tr>
<td></td>
<td>• Engine mounts</td>
<td>• Inspect engine mounts in accordance with chapter 71</td>
</tr>
<tr>
<td>Poor engine performance</td>
<td>• Induction system obstruction</td>
<td>• Inspect and clear induction system</td>
</tr>
<tr>
<td></td>
<td>• FADEC fault</td>
<td>• Perform troubleshooting procedure in accordance with TCM Maintenance Manual M-22 Chapter 8</td>
</tr>
<tr>
<td></td>
<td>• Throttle rigging</td>
<td>• Inspect and adjust throttle rigging in accordance with chapter 76</td>
</tr>
<tr>
<td>Level I diagnostic Fault</td>
<td>• Refer to diagnostic generated report for probable cause</td>
<td>• Take corrective action in accordance with diagnostic report guidance.</td>
</tr>
</tbody>
</table>

Table 71-1 Engine Troubleshooting Guide
Section 71-10 Cowling

The airplane uses a two-piece (upper and lower) cowling of composite construction. The upper cowling incorporates a small door to allow oil level checks and oil replenishment without the need to remove the cowling.

Air exits from the engine compartment via an opening at the rear of the lower cowling.

Both cowlings are secured to the airframe and to each other with cam lock fasteners.

Section 10-01 Cowling Procedures

This section contains the procedures to remove, install, and inspect upper and lower engine cowl assemblies.

Figure 71-23 Guidance for Re-attaching Cowling
COWLING REMOVAL

Perform this procedure to remove the upper and lower cowling.

**CAUTION**

*When working around the cowling and engine exhaust areas, allow time for cooling of components to avoid maintenance personnel burning themselves.*

1. Ensure all electrical switches are OFF, and the engine has had adequate cool down time and the exhaust is cool.
2. Unfasten all Camloc® fasteners securing upper cowling to fuselage and upper cowling to lower cowling.
3. Lift off upper cowling.
4. Disconnect landing light connector P62 located near L/H engine baffle as shown in Figure 71-23.
5. Unfasten all Camloc® fasteners securing lower cowling except top rear fasteners on left and right side.
6. Support lower cowling while removing remaining fasteners.
7. Remove lower cowling taking care to remove cowl around exhaust.

This completes the upper and lower Cowling Removal procedure.
COWLING INSTALLATION

Perform this procedure to install the upper and lower cowling.

CAUTION

When re-installing cowling, it is important to place cowling properly and secure it loosely with (4) Camloc® fasteners at corners. Loosely insert remaining Cam-Locks. Tighten each Camloc® fasteners, insuring cowling is seating properly. Failure to re-install cowling properly can result in improper bending or “scooping”:

1. With engine cool, raise lower cowling into position and fasten top rear Camloc on left and right side, taking care to maneuver cowl around exhaust.
2. Fasten remaining Camloc fasteners to secure lower cowling to fuselage.
3. Reconnect landing light connector P62 as shown in Figure 71-23.
4. Place upper cowling into position.

CAUTION

Operate engine only with both upper and lower cowling installed and secured, or with both upper and lower cowling removed (do not operate with either upper or lower cowling installed alone). Do not operate engine at high power unless both upper and lower cowling are installed and secured.

5. Fasten all cam locks securing upper cowling to fuselage and upper cowling to lower cowling.

This completes Cowling Installation procedure.
COWLING INSPECTION

Perform the following Cowling Inspection in accordance with Chapter 05 – *Time Limits/Maintenance Checks/Inspection Intervals* any time cowling is removed for maintenance operations.

1. Inspect clearance/interference between propeller hub and cowl
2. Remove upper and lower cowling in accordance with the Cowling Removal procedure on page 29 of this chapter.
3. Inspect the cowling for cracks
4. Inspect for overheated areas, deformation or delamination
5. Inspect for loose or missing fasteners
6. Inspect for chafing or abnormal condition and oil,
7. If a hard landing is suspected, inspect the lower cowl for scratches or local dents from the nose leg hitting the clearance hole.
8. Inspect any paint removal.
9. Install lower and upper cowl in accordance with the Cowling Installation procedure on page 30 of this chapter.

This completes the Cowling Inspection procedure.
**Section 10-02  Cowling Troubleshooting Guide**

Use this troubleshooting guide to resolve issues with the engine.

<table>
<thead>
<tr>
<th>Complaint</th>
<th>Possible Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Missing or damaged Cam Lock</td>
<td>• In service Wear</td>
<td>• Replace</td>
</tr>
<tr>
<td></td>
<td>• Hard landing</td>
<td></td>
</tr>
<tr>
<td>Cracks</td>
<td>• Hard Landing</td>
<td>• Repair/replace in accordance with Chapter 51</td>
</tr>
<tr>
<td></td>
<td>• In service wear</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Impact damage</td>
<td></td>
</tr>
<tr>
<td>Scratched Paint</td>
<td>• Impact damage</td>
<td>• Inspect for subsurface damage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Repaint</td>
</tr>
<tr>
<td>Delamination</td>
<td>• Excess heat exposure</td>
<td>• Inspect for heat source and correct</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Repair/replace in accordance with Chapter 51</td>
</tr>
</tbody>
</table>

Table 71-2 Cowling Troubleshooting Guide
**Section 71-20  Engine Mounts**

A welded steel tube structure secures the engine to the fuselage center section space frame. It is attached to the space frame by four bolts with nuts and washers. If necessary, the engine mount can be removed from the space frame.

Four vibration-absorbing rubber mounts, with washers and bushings, are located at the rear of the engine crankcase. They are secured to the airplane engine mount by bolts, washers, and castellated nuts with cotter pins.

Adequate clearance to replace individual engine mount components, such as vibration absorbers, can be gained by withdrawing the engine mount bolts and moving the engine slightly forward (approximately one inch). The airplane tail must be supported and the engine must be raised with an engine hoist sufficiently to relieve loads on the engine mounts, but sufficient slack is available in most engine connections to minimize the amount of disconnection and disassembly required.

**Section 20-01  Engine Mount Procedures**

The following procedures perform engine mount removal, installation and inspection. Inspection is performed in accordance with the maintenance schedules in . Removal and replacement procedures are performed on condition.

![Figure 71-24 Exploded View of Engine Mount Installation](image)

*Figure 71-24 Exploded View of Engine Mount Installation*
ENGINE MOUNT REMOVAL

Perform this procedure to remove the engine mount.

CAUTION

Before starting these procedures, the tail of the airplane requires support. Failure to support the airplane’s tail may cause damage to the airplane’s tail section.

1. Position the ALT and BAT master switches, the FADEC PWR A and B switches, and the ignition switch to OFF.

2. Pull the BAT1 (CB001) circuit breaker to OPEN.

3. Install a tail stand underneath the tail section of the airplane.

4. Remove the cabin aft bulkhead access panel, by removing securing screw hardware.

5. Disconnect the negative then the positive leads from the primary battery. Isolate the negative terminals on the batteries to prevent accidental connection.

CAUTION

Failure to disconnect the batteries can cause damage to the electrical circuitry of the airplane.

6. Remove upper and lower engine cowling in accordance with the Cowling Removal procedure on page 29 of this chapter.

7. With an engine hoist raise engine, enough to relieve loading, but leaving sufficient slack to not bind mount bolts.

8. Loosen engine mount bolt and remove engine mount, noting sequence of parts, refer to engine mount exploded view for correct positioning of parts.

This completes the Engine Mount Removal procedure.
ENGINE MOUNT INSTALLATION

Perform this procedure to install the engine mount. Procedure applies to one or all four installations.

1. Ensure all isolators are flexible and not damaged.
2. Visually inspect all engine attachments and ensure they are not damaged.
3. Install engine mount(s) by reversing the above removal procedure.
4. Torque engine mount bolts to 175 ±15 in-lbs.

This completes the Engine Mount Installation procedure.
ENGINE MOUNT FRAME REMOVAL

Perform this procedure to remove the engine mount frame.

1. Refer to Figure 71-25. Remove engine in accordance with the Engine Removal procedure on page 7 of this chapter.

2. Remove harness clamps securing ignition leads to the engine mount frame assembly. Retain for installation procedure.

3. Remove ground straps shown in Figure 71-26 connecting the engine mount frame to ECU-1 and ECU-2

4. Remove four bolts, washers, and nuts securing engine mount frame to rolling frame and remove engine mount frame.

5. Remove engine isolators from engine mount frame in accordance with the Engine Mount Removal procedure on page 7 of this chapter.

This completes the Engine Mount Frame Removal procedure.

Figure 71-25 Engine Mount Frame Removal and Installation

Figure 71-26 Engine Mount Frame Ground Straps
ENGINE MOUNT FRAME INSTALLATION

Perform this procedure to install the engine mount frame.

1. Refer to Figure 71-4. Install engine mount frame to rolling frame using 4 bolts, washers, and nuts. Torque the nuts in accordance with Chapter 20 – Standard Practices.

2. Back the nuts off to first castellated slot for split pins. Install new split pins.

3. Install engine mounts to engine mount frame in accordance with the Engine Mount Installation procedure on page 35 of this chapter.

4. Install engine in accordance with the Engine Installation procedure on page 7 of this chapter.

This completes the Engine Mount Frame Installation
ENGINE MOUNT AND FRAME INSPECTION

Perform Engine Mount and Frame Inspection in accordance with chapter 05 and on condition.

1. Visually inspect engine mount frame for any damage, bent tubes, bubbled paint, or damaged mounting hardware.
2. Visually inspect engine mounts for any bent or damaged isolators and attachments.
3. Ensure engine mounts are free of cracks, corrosion, or damage.
4. Check for proper alignment and fastening of the engine and airframe mounting points.
5. Sufficient clearance exists between engine and aircraft/engine mount.
6. All engine-to-airframe connections are flexible and correctly supported to prevent vibration transmission, chafing, and breakage.

This completes the Engine Mount and Frame Inspection procedure.
## Section 20-02  Engine Mount Troubleshooting Guide

Use this troubleshooting guide to resolve issues with the engine.

<table>
<thead>
<tr>
<th>Complaint</th>
<th>Possible Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolator damage</td>
<td>• In service wear, age</td>
<td>• Remove and replace isolator</td>
</tr>
<tr>
<td></td>
<td>• Hard landing</td>
<td></td>
</tr>
<tr>
<td>Mount frame tube cracks</td>
<td>• Hard landing</td>
<td>• Removal and replace frame</td>
</tr>
<tr>
<td>Paint scratched</td>
<td>• In service wear</td>
<td>• Refinish</td>
</tr>
<tr>
<td>Frame corrosion</td>
<td>• Surface finish deterioration</td>
<td>• Inspect, repair or replace in accordance with chapter 51</td>
</tr>
<tr>
<td>Engine mount misaligned</td>
<td>• Hard landing</td>
<td>• Inspect for damage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Reinstall IWA chapter 71 if serviceable.</td>
</tr>
</tbody>
</table>

Table 71-3 Engine Mount Troubleshooting Guide
Section 71-30 Firewall Blanket

The removable engine firewall blanket is a fireproof barrier made specifically for the XL2 airplane. The blanket is constructed of silicone coated, aluminized, glass cloth. The layers are sealed on the edges with high temperature red RTV.

![Typical blanket lay-up](image)

**Figure 71-27 Firewall Cutaway**

![Engine Firewall Blanket Installation](image)

**Figure 71-28 Engine Firewall Blanket Installation**

**NOTE**

The firewall blanket is to be inspected for general condition. Any abnormalities such as tears, discoloration, or evidence of damage will be referred to Liberty Aerospace Customer Service for the corrective action procedure applicable to the condition.
Section 30-01  Firewall Blanket Procedures

This section contains the procedures to remove, install, and inspect the firewall blanket. Inspection is performed in accordance with the maintenance schedules in Chapter 05 – Time Limits/Maintenance Checks/Inspection Intervals.

Figure 71-29 Firewall Blanket Installation
FIREWALL BLANKET REMOVAL

Perform this procedure to remove the firewall blanket.

1. Remove upper and lower cowlings in accordance with the Cowling Removal procedure on page 29 of this chapter.

2. Remove engine in accordance with the Engine Removal procedure on page 7 of this chapter.

3. Disconnect ignition leads from ECU-1 and ECU-2. Cap exposed lead ends and ECU terminal towers.

4. Perform Engine Mount Removal in accordance with the procedure on Page 34 of this chapter.

5. Disconnect the following from the Tunnel Firewall Assembly engine side as shown in Figure 71-30.

6. Remove two bolts (1) and two washers (2) from cabin heat box assembly.

7. Disconnect cabin heat control cable from cabin heat box assembly, and remove heat box from firewall.
Figure 71-31 Cabin Heat Box Assembly Removal and Installation
8. Disconnect the Tunnel Firewall Assembly fuselage side components as shown in Figure 71-32.

Figure 71-32 Tunnel Firewall Assembly Disconnects - Fuselage
9. Remove the Tunnel firewall Assembly from the Space Frame mounting lugs (4)
10. Remove oil cooler Bracket Assembly.

12. Loosen and remove firewall-retaining bolts as shown in Figure 71-29. Note bolt and washer stack-up.

13. Remove firewall from fuselage.

This completes the Firewall Blanket Removal procedure.
**Firewall Blanket Installation**

Perform this procedure to install the firewall blanket.

**NOTE**

Ensure all washers placed in contact with surface of firewall blanket are coated with thin layer of high temperature RTV; P/N GE 106, Red High Temperature RTV.

1. Position the Firewall Blanket as shown in Figure 71-33 and secure with through bolts. Torque bolts in accordance with Chapter 20 – *Standard Practices.*

![Figure 71-33 Firewall Blanket Installation](image)

2. Install oil cooler bracket assembly. Torque bolts in accordance with Chapter 20 – *Standard Practices.*

3. Install FADEC ECU-1 and ECU-2 as shown in Figure 71-34. Torque bolts in accordance with Chapter 20 – *Standard Practices.*
Caulk all fuel lines with high temperature RTV; P/N GE106, Red High Temperature RTV.

4. Connect the Tunnel Firewall Assembly fuselage side components as shown in Figure 71-35.
5. Connect cabin heat control cable to cabin heat box assembly.

Figure 71-35 Tunnel Firewall Assembly Connects - Fuselage

Figure 71-36 Cabin Heat Box Assembly Installation

6. Install two bolts and two washers as shown in Figure 71-36 to secure cabin heat box assembly.

7. Perform Engine Mount Installation in accordance with the procedure on Page 35 of this chapter.
In the following step Tunnel Firewall Assembly connection on the engine facing side will take place. Connect only those components that do not require an installed engine to accomplish. Remaining connections will be made at engine installation.

8. Connect the following from the Tunnel Firewall Assembly engine side as shown in Figure 71-37. Torque all bolts to specifications for individual component installations. See Chapter 20 – Standard Practices.

![Diagram of Tunnel Firewall Assembly](image)

**Figure 71-37 Tunnel Firewall Assembly Connects - Engine**

9. Install engine in accordance with the Engine Installation procedure on page 14 of this chapter.

10. Install upper and lower cowlings in accordance with the Cowling Installation procedure on page 30 of this chapter.

This completes the Firewall Blanket Installation procedure.
**FIREWALL BLANKET INSPECTION**

Perform Firewall Blanket Inspection in accordance with Chapter 05 intervals or as required by condition.

1. Remove upper and lower cowlings in accordance with the Cowling Removal procedure on page 29 of this chapter.

2. Visually inspect condition of firewall blanket for tears or discoloration indicating excess heat exposure of the facing sheet materials or surrounding sealant materials as shown in Figure 71-38. Tears or discoloration is unacceptable.

3. Inspect firewall blanket around cabin heat valve box for tight fit or any blanket settling, reference Chapter 21 – Environmental Systems for additional information.

4. Inspect all Firewall Blanket penetrations for damage or loss of high temperature caulk insulation.

5. Inspect Firewall Blanket cowl contacting edges for damage. Edges

6. Install lower and upper cowl in accordance with the Cowling Inspection procedure on page 7 of this chapter.

This completes the Firewall Blanket Inspection procedure.
Section 30-02  Firewall Blanket Troubleshooting Guide

Use this troubleshooting guide to resolve issues with the engine.

<table>
<thead>
<tr>
<th>Complaint</th>
<th>Possible Cause</th>
<th>Remedy</th>
</tr>
</thead>
</table>
| Tears or discoloration     | • In service wear  
                             | • Excess heat exposure                    | • Replace blanket                          |
| Heat box fit loose         | • Loss of sealant                 | • Reseal heat box                           |
|                            | • In service blanket wear         | • Replace blanket                           |
| Worn edge sealing RTV      | • Cowl chafe                      | • Redress RTV material with GE406, Red High Temp. |

Table 71-4 Firewall Blanket Troubleshooting Guide
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Section 71-50 Engine Electrical Harness

Many of the sensor and control functions of the FADEC system are linked to airframe components by an electrical harness called the Low Voltage Harness. This harness is connected to airframe systems and components through two “Cannon plug” bulkhead connectors. These connectors are located on the firewall.

Additional circuits including starter and alternator wires, oil pressure and temperature sensors, etc., are connected through individual wires on the engine and connectors on the firewall.

Section 50-01 FADEC Low Voltage Harness Description

The low voltage harness connects all essential components of the FADEC System. This harness acts as a signal transfer buss interconnecting the two Electronic Control Units (ECUs) with aircraft power sources, the Ignition Switch, Speed Sensor Assembly (SSA), Health Status Annunciator (HSA) or two-light indicator panel.

Temperature and pressure sensors, the fuel injector coils and all sensors, except the SSA and Fuel Pressure and Manifold Pressure Sensors, are hardwired to the low voltage harness.

This harness transmits sensor input to the ECUs via a 50-pin connector. The harness connects to the engine mounted pressure sensors via cannon connectors. The 25-pin connectors connect the harness to the speed sensor signal conditioning unit. The low voltage harness attaches to the cabin harness by firewall-mounted bulkhead fittings or connectors. Information from the ECUs is conveyed to the HSA and the cockpit-mounted data port through the same cabin harness/bulkhead connector assembly.
Figure 71-40 shows the low voltage harness installed on an IOF-240-B series engine.

Section 50-02  FADEC Ignition System Harness

The Ignition System consists of the high voltage harness and spark plugs. Figure 71-41 shows the high voltage harness for a four-cylinder engine.

Since there are two spark plugs per cylinder on all engines, a four-cylinder engine has eight leads and eight spark plugs.

One end of each lead on the high voltage harness attaches to a spark plug and the other end of the lead wire attaches to the spark towers on each ECU. The spark tower pair is connected to opposite ends of one of the ECU's coil packs. Two coil packs are located in the upper portion of the ECU.

The high voltage harness carries energy from the ECU spark towers to the spark plugs on the engine.

Electronic Control Unit 1 fires the top and bottom spark plugs for Cylinders 1 & 2; ECU 2 fires the top & bottom spark plugs for Cylinders 3 & 4.
Section 50-03  FADEC Harness Assembly Procedures

This section contains the procedures for the FADEC harness assemblies. As described previously, there are two principle FADEC harnesses, the ignition system harness and the low voltage harness. Procedures to follow provide remove, replace, test and inspection procedures for each harness system. Selected procedures may be performed in accordance with schedules described in Chapter 05 or on condition.
IGNITION SYSTEM HARNESS REMOVAL

Perform the following procedure to remove ignition harness leads from the engine. Procedure applies to any one or all eight leads.

1. Locate and remove all “P” clamps securing the ignition lead to engine baffle and structure. Inspect each clamp location for evidence of damage.

2. Restrain the lead wire ferrule to prevent kinking of the lead.

3. Rotate the B-nut until is free of the barrel.

4. Extract the lead by pulling straight back from the barrel.

   CAUTION

   *Do not side load or twist the lead while removing it from the barrel damage to the silicone insulator may result. A gentle rocking force will be sufficient to free the lead end.*

5. Route the lead out of the engine installation taking care not to disturb adjacent leads and harnesses.

6. Repeat the above steps for all other ignition leads to be removed.

This completes the Ignition System Harness Removal Procedure.
IGNITION SYSTEM HARNESS INSTALLATION

Perform the following procedure to install ignition harness leads to the engine. Procedure applies to any one or all eight leads.

1. Route the ECU end of the ignition lead wires to the appropriate ECU. Each ignition lead wire has a metal identification (ID) tag that designates the cylinder and spark plug assignment. For example, 2T designates the lead is for Cylinder 2 top spark plug and 2B is for Cylinder 2 bottom spark plug.

2. Spray a small amount of MS 122 DF Spray in each ECU spark tower.

3. Connect each high voltage harness lead wire to the appropriate ECU spark tower. Each spark tower is identified with a two-digit code of the same format as the ignition lead wire ID tags (Figure 71-43).

4. To prevent the ignition lead wire sleeves from sticking and to minimize twisting of the ferrule, coat the insulating sleeves with MS 122 DF Spray (Figure 71-44).
5. Connect the lead wires as follows:
   - Insert the spring-end of the lead into the spark tower.
   - While holding the ferrule, firmly push the rubber insulator into the tower.
   - When the B-nut thread makes contact with the spark tower threads, turn the B-nut clockwise.
   - Restrain the lead wire ferrule to prevent kinking of the lead.
   - Continue rotating the B-nut until it seats.
   - Torque the B-nut per Teledyne Continental Motors M-22 Maintenance Manual, Appendix B.

   **CAUTION**

   Do not allow the ignition lead wire ferrule to twist while tightening the B-nut. If twisting is observed, hold the knurled portion of the B-nut shoulder with a wrench while tightening the B-nut.

6. Using “P” clamps removed previously, route leads as far away as possible from exhaust pipes to ensure they are not exposed to temperatures in excess of 400°F (204°C).

7. Route leads so as to prevent chafing and damage due to vibration. Refer to Appendix C of Teledyne Continental Motors M-22 Maintenance Manual for guide lines.

This completes the Ignition System Harness Installation procedure.
IGNITION SYSTEM HARNESS INSPECTION PROCEDURE

Perform this procedure to inspect the ignition system.

1. Perform the FADEC Level I Diagnostic in accordance with Teledyne Continental Motors M-22 Maintenance Manual.

2. Visually inspect the ignition leads for chafing, deterioration, and insulation breakdown. Worn or frayed ignition wire must be replaced.

3. Verify high voltage leads are securely fastened to the ECU spark towers.

4. Verify high voltage leads are securely fastened to the spark plugs

5. Inspect engine ignition lead “P: clamps for damage or chafing of ignition leads.

This completes the Ignition System Harness Inspection Procedure
**LOW VOLTAGE HARNESS REMOVAL**

Perform this procedure to remove the low voltage harness.

1. Position split master switch – OFF
2. Position BAT1 circuit breaker – OPEN
3. Position FADEC A and B power switches - OFF

Power is to remain OFF while the low voltage harness is removed.

4. Remove upper and lower cowl in accordance with the Cowling Removal procedure on page 29 of this chapter.
5. Remove engine baffle system in accordance with Chapter 75 – *Air Inductions*.

This completes the Low Voltage Harness Removal procedure.
LOW VOLTAGE HARNESS INSTALLATION

Perform this procedure to install the low voltage harness.

NOTE

Additional detailed information on this subject may be found in Teledyne Continental Motors IOF-240 Overhaul Manual OH-22, Chapter 11.

The engine low voltage harness (Figure 71-40) connects essential components of the FADEC System to the ECUs. Sensors are hardwired to the harness, except for the speed sensor array (SSA) and pressure sensors. When all connectors are properly routed connected, refer to “Harness Routing” in Appendix C of the Teledyne Continental Motors Overhaul manual OH-22 to complete the harness installation.

CAUTION

The engine low voltage harness is shipped with protective covers installed on all connectors to prevent damage and contamination. Remove the covers at the time of installation.

1. Position split master switch – OFF
2. Position BAT1 circuit breaker – OPEN
3. Position FADEC A and B power switches - OFF
4. If not already performed, remove engine baffle in accordance with Chapter 75 – Air Induction procedures.
5. Install low voltage wire harness in accordance with Teledyne Continental Motors IOF-240 Overhaul Manual OH-22, Chapter 11.
6. Install engine baffle system in accordance with Chapter 75 – Air Induction procedures.
7. Install upper and lower cowl in accordance with the Cowling Installation procedure on page 30 of this chapter.
8. Position BAT (CB001) circuit breaker – CLOSED.
9. Perform Inspection and engine functional check in accordance with the Engine Removal procedure on page 21 of this chapter.

This completes the Low Voltage Harness Installation procedure.
LOW VOLTAGE HARNESS INSPECTION

Perform this procedure to inspect the low voltage harness.

1. Inspect each low voltage path for indications of insulation abrasion or other physical damage. Refer to Figure 71-45.

2. Inspect speed sensor connectors for security and indication of contamination.

3. Inspect ECU connectors for security and indication of contamination.

4. Inspect CHT probe connections (4) for security, indications or wear or contamination.

5. Inspect EGT probes (4) for damage, excess bending or contamination.

6. Inspect MAP probes (2) for connector security or evidence of contamination.

7. Inspect fuel pressure sensor connectors for security or evidence of contamination.

8. Inspect injector solenoids for security, damage, or evidence of contamination.

Figure 71-45 Low Voltage Harness Inspection
9. Inspect WOT switch installation for follower wear, cam corrosion or connector damage.

10. Perform engine function test in accordance with the Engine Operational Check procedure on page 21 of this chapter.

This completes the Low Voltage Harness Inspection procedure.
## Section 50-04  Engine Electrical Harness Troubleshooting Guide

Use this troubleshooting guide to resolve issues with the engine.

<table>
<thead>
<tr>
<th>Complaint</th>
<th>Possible Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormal RPM or Performance Drop</td>
<td>• Ignition Lead Fault</td>
<td>• Perform diagnostics in accordance with TCM Maintenance Manual M-22 Chapter 8</td>
</tr>
<tr>
<td></td>
<td>• Spark plug fault</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• ECU fault</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• ECU fault</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Faulty “P” clamp</td>
<td>• Replace ignition lead</td>
</tr>
<tr>
<td></td>
<td>• Abrading on adjacent structure</td>
<td>• Replace faulty “P” Clamp</td>
</tr>
<tr>
<td></td>
<td>• Abrading on adjacent structure</td>
<td>• Replace ignition lead</td>
</tr>
<tr>
<td></td>
<td>• FADEC system failure</td>
<td>• Replace ignition lead</td>
</tr>
<tr>
<td></td>
<td>• Primary battery failure</td>
<td>• Replace primary battery</td>
</tr>
<tr>
<td></td>
<td>• Secondary battery failure</td>
<td>• Replace secondary battery</td>
</tr>
<tr>
<td></td>
<td>• Alternator failure</td>
<td>• Replace alternator</td>
</tr>
<tr>
<td></td>
<td>• Low Voltage harness fault</td>
<td>• Repair or replace low voltage harness</td>
</tr>
<tr>
<td></td>
<td>as a result of routing fault</td>
<td>• Correct harness routing</td>
</tr>
</tbody>
</table>

Table 71-5 Engine Electrical Harness Troubleshooting Guide
Section 71-60 Air Intakes

Two openings in the engine cowling, on either side of the propeller, admit air to the engine compartment. Baffles secured to the engine, and sealing against the interior of the cowling, direct the majority of this air past the cylinder cooling fins.

The normal intake for engine combustion air is through an air filter located on the top of the engine (on the high pressure / low temperature side of the engine baffles). Alternate air, when selected by the pilot, enters the engine from below the engine (on the high temperature / low pressure side of the engine baffles).

A duct on the left side of the firewall supplies high pressure / low temperature air to the oil cooler. Air leaving the oil cooler will exit through the aft opening in the lower cowling.

Figure 71-46 Air Induction System

Section 60-01 Air Intake Procedures

This section contains the procedures to remove and install the air intake system.
AIR INTAKE REMOVAL

Perform this procedure to remove the air intake.

11. Position the aircraft split master switch – OFF
12. Position BAT1 circuit breaker – OPEN
13. Position SYSTEM, START circuit breaker – OPEN
14. Remove upper cowl in accordance with the Cowling Removal procedures on page 29 of this chapter.
15. Remove air filter by removal of .010 safety wire and the loosening of securing band clamp as shown in Figure 71-46.
16. Disconnect alternate air cable by removal of alternate air arm bolt and nut hardware as shown in Figure 71-47.

Figure 71-47 Alternate Air Control Installation
17. Remove alternate air cable “P” clamp bolt, nut, washer and spacer
hardware as shown in Figure 71-47 and position cable clear of assembly.

18. Loosen three (3) band clamps securing the alternate air box assembly to
the forward baffle and to the engine induction manifold.

19. Slide scat tube clear of induction manifold

20. With a gentle upward motion slide the air box assembly off of the forward
baffle flange and clear of the engine installation.

This completes the Air Intake Removal procedure.
AIR INTAKE INSTALLATION

Perform this procedure to install the air intake.

1. Inspect the alternate air box for debris, flapper valve freedom of movement and return spring function.

2. Slide scat tube over alternate air box in the location indicated in Figure 71-47.

3. Position band clamp over the air box end of the scat tube and secure.

4. Pre-position three (2) band clamps on the alternate air box assembly as shown in Figure 71-47. One to secure scat tube to the engine induction manifold and one to secure the alternate air box to the forward engine baffle.

5. Slide the alternate air box assembly over the forward baffle flange and position inlet tube to align with engine induction manifold.

6. Slide lower band clamp down over the alternate air box tube split to appoint half way down the split. Tighten the band clamp in this position.

7. Slide the scat tube over the manifold inlet and secure with band clamp.

8. Connect the alternate air control cable end to the flapper valve arm with bolt, nut and washer removed previously. Do not install a new split pin at this time.

9. Install alternate air cable “P” clamp as shown in Figure 71-47 using bolt, nut, washer, and spacer removed previously.

10. From the cabin control, exercise the alternate air flapper valve and verify full range of motion. Adjust the alternate air arm cable as required to achieve full range of motion.

11. Secure the connection for the alternate air arm cable with a new split pin.

12. Install the air filter by sliding the band clamp loosely over the filter opening. Slide the filter into the alternate air box assembly in let tube. Secure the filter band clamp by tightening.

13. Install .020 in safety wire between the filter base and alternate air arm-mounting bracket.

14. Install upper cowl in accordance with the Cowling Installation procedure on page 30 of this chapter.

This completes the Air Intake Removal procedure.
**ALTERNATE AIR FLAPPER VALVE ARM REMOVAL**

Perform this procedure to remove the arm for the alternate air flapper valve.

1. Position the aircraft split master switch – OFF
2. Position BAT1 circuit breaker – OPEN
3. Position SYSTEM, START circuit breaker – OPEN
4. Remove upper cowl in accordance with the Cowling Removal procedures on page 29 of this chapter.
5. Cut and discard the safety wire securing the air induction filter.
6. Loosen the clamp securing the filter to the alternate air valve assembly. Remove the filter.
7. Remove and discard the split pin securing the nut that holds the cable of the alternate air valve cable to the valve arm.
8. Loosen the nut sufficiently to allow the cable to be disconnected from the valve arm.
9. Remove and discard the split pin securing the valve arm to the alternate air assembly.
10. Loosen and remove the nut and washer from the valve arm.
11. Slide the arm out of the alternate air assembly.

This completes the Alternate Air Flapper Valve Arm Removal procedure.
ALTERNATE AIR FLAPPER VALVE ARM INSTALLATION

Perform this procedure to install the arm for the alternate air flapper valve.

1. Position the aircraft split master switch – OFF
2. Position BAT1 circuit breaker – OPEN
3. Position SYSTEM, START circuit breaker – OPEN
4. Remove upper cowl in accordance with the Cowling Removal procedures on page 29 of this chapter.
5. If the filter is mounted on the alternate air assembly, loosen the clamp securing the filter to the alternate air valve assembly. Remove the filter.
6. Before inserting the valve arm, inspect the threads for any damage.
7. Align the valve arm as shown in the Figure 71-49. Insert the valve arm into the alternate air assembly. The arm must go through the flapper valve.

![Figure 71-49 Install The Flapper Arm With The Control Tab Pointing Forward](image)

8. Install the flat washer and castle nut.
9. Apply torque to the castle nut in accordance with Chapter 20 – Standard Practices.
10. Install a new split pin in accordance with Chapter 20 – Standard Practices.
11. Rotate the valve arm through the entire range. Movement should be smooth and without binding. The valve flapper should seat over both openings.
12. Connect the alternate air control cable end to the flapper valve arm with bolt, nut and washer removed previously. Do not install a new split pin at this time.
13. Install alternate air cable “P” clamp as shown in Figure 71-47 using bolt, nut, washer, and spacer removed previously.
14. From the cabin control, exercise the alternate air flapper valve and verify full range of motion. Adjust the alternate air arm cable as required to achieve full range of motion.
15. Secure the connection for the alternate air arm cable with a new split pin.

16. Install the air filter by sliding the band clamp loosely over the filter opening. Slide the filter into the alternate air box assembly in let tube. Secure the filter band clamp by tightening.

17. Install .020 in safety wire between the filter base and alternate air arm-mounting bracket.

18. Install upper cowl in accordance with the Cowling Installation procedure on page 30 of this chapter.

This completes the Air Intake Removal procedure
**AIR INTAKE INSPECTION**

Perform this procedure to inspect the air intake.

1. Inspect air filter for condition and time in service in accordance with Chapter 05 - Time Limits/Maintenance Checks/Inspection Intervals and Chapter 04 - Airworthiness Limitations or this manual.

2. Inspect alternate air assembly for corrosion or damage.

3. Remove the alternate air valve arm in accordance with the Alternate Air Flapper Valve Arm Removal procedure on page 69 of this chapter.

4. Inspect the threads on the shaft to insure there is no damage to the threads on the valve arm.

5. Install the valve are in accordance with the Alternate Air Flapper Valve Arm Installation on page 70 of this chapter.

6. Cycle alternate air flapper valve and verify full range of motion.

7. Inspect alternate air cable for binding

8. Inspect scat tube for damage and clamp security

9. Inspect baffle band clamp for security.

10. Inspect air filter safety wire for security.

This completes the Alternate Air Flapper Valve Arm Removal

Perform this procedure to remove the arm for the alternate air flapper valve.

**Figure 71-50 Alternate Air Valve Assembly**

11. Position the aircraft split master switch – OFF

12. Position BAT1 circuit breaker – OPEN

13. Position SYSTEM, START circuit breaker – OPEN
14. Remove upper cowl in accordance with the Cowling Removal procedures on page 29 of this chapter.

15. Cut and discard the safety wire securing the air induction filter.

16. Loosen the clamp securing the filter to the alternate air valve assembly. Remove the filter.

17. Remove and discard the split pin securing the nut that holds the cable of the alternate air valve cable to the valve arm.

18. Loosen the nut sufficiently to allow the cable to be disconnected from the valve arm.

19. Remove and discard the split pin securing the valve arm to the alternate air assembly.

20. Loosen and remove the nut and washer from the valve arm.

21. Slide the arm out of the alternate air assembly.

This completes the Alternate Air Flapper Valve Arm Removal procedure.
**ALTERNATE AIR FLAPPER VALVE ARM INSTALLATION**

Perform this procedure to install the arm for the alternate air flapper valve.

22. Position the aircraft split master switch – OFF
23. Position BAT1 circuit breaker – OPEN
24. Position SYSTEM, START circuit breaker – OPEN
25. Remove upper cowl in accordance with the Cowling Removal procedures on page 29 of this chapter.

26. If the filter is mounted on the alternate air assembly, loosen the clamp securing the filter to the alternate air valve assembly. Remove the filter.

27. Before inserting the valve arm, inspect the threads for any damage.

28. Align the valve arm as shown in the Figure 71-49. Insert the valve arm into the alternate air assembly. The arm must go through the flapper valve.

![Figure 71-51: Install The Flapper Arm With The Control Tab Pointing Forward](image)

29. Install the flat washer and castle nut.

30. Apply torque to the castle nut in accordance with Chapter 20 – *Standard Practices*.

31. Install a new split pin in accordance with Chapter 20 – *Standard Practices*.

32. Rotate the valve arm through the entire range. Movement should be smooth and without binding. The valve flapper should seat over both openings.

33. Connect the alternate air control cable end to the flapper valve arm with bolt, nut and washer removed previously. Do not install a new split pin at this time.

34. Install alternate air cable “P” clamp as shown in Figure 71-47 using bolt, nut, washer, and spacer removed previously.

35. From the cabin control, exercise the alternate air flapper valve and verify full range of motion. Adjust the alternate air arm cable as required to achieve full range of motion.
36. Secure the connection for the alternate air arm cable with a new split pin.

37. Install the air filter by sliding the band clamp loosely over the filter opening. Slide the filter into the alternate air box assembly in let tube. Secure the filter band clamp by tightening.

38. Install .020 in safety wire between the filter base and alternate air arm-mounting bracket.

39. Install upper cowl in accordance with the Cowling Installation procedure on page 30 of this chapter.

This completes the Air Intake Removal procedure.

Air Intake Inspection procedure.
# Section 60-02 Air Intake Troubleshooting Guide

Use this troubleshooting guide to resolve issues with the air intakes.

<table>
<thead>
<tr>
<th>Complaint</th>
<th>Possible Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter damaged</td>
<td>- Time in service</td>
<td>- Replace</td>
</tr>
<tr>
<td></td>
<td>- Impact damage</td>
<td></td>
</tr>
<tr>
<td>Filter time in service expired</td>
<td>- End of service life in accordance with Chapter 04</td>
<td>- Replace</td>
</tr>
<tr>
<td>Alternate air flapper valve will not move full travel</td>
<td>- Control cable out of adjustment</td>
<td>- Adjust cable</td>
</tr>
<tr>
<td></td>
<td>- Cable “P” clamp loose</td>
<td>- Tighten “P” clamp</td>
</tr>
<tr>
<td>Stiff alternate air control</td>
<td>- Cable corrosion</td>
<td>- Lubricate cable</td>
</tr>
<tr>
<td></td>
<td>- Alternate air arm mechanism damage</td>
<td>- Replace cable if damaged</td>
</tr>
<tr>
<td></td>
<td>- Cable pinched</td>
<td>- Replace cable if damage found</td>
</tr>
<tr>
<td>Leaking inlet scat tube</td>
<td>- Loose band clamp</td>
<td>- Tighten band clamp</td>
</tr>
<tr>
<td></td>
<td>- Damaged scat tube</td>
<td>- Replace scat tube</td>
</tr>
<tr>
<td>Corrosion</td>
<td>- In service wear</td>
<td>- Repair superficial surface</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Replace alternate air box</td>
</tr>
<tr>
<td></td>
<td></td>
<td>assembly for penetrating</td>
</tr>
<tr>
<td></td>
<td></td>
<td>corrosion.</td>
</tr>
<tr>
<td>Loose filter safety wire</td>
<td>- Faulty installation</td>
<td>- Replace safety wire</td>
</tr>
<tr>
<td></td>
<td>- Damage to filter base</td>
<td>- Replace filter</td>
</tr>
</tbody>
</table>

Table 71-6 Air Intakes Troubleshooting Guide
Section 71-70 Engine Drains

A small-diameter drain tube exits the intake area of each cylinder head to allow excess (liquid) fuel to drain. The four cylinder drains are combined to form a single engine fuel drain.

Check valves are provided to prevent backflow of ambient air into the intake manifold through the drains. At each scheduled maintenance interval, check to insure that the drains function properly.

Section 70-01  Manifold Fuel Drain Procedures

The section contains the procedure to perform in accordance with Chapter 05 – Time Limits/Maintenance Checks/Inspection Intervals scheduled maintenance.
MANIFOLD FUEL DRAIN CHECK PROCEDURE

Perform the Manifold Fuel Drain Procedure in accordance with Chapter 05 – Time Limits/Maintenance Checks/Inspection Intervals and on condition.

1. Apply light vacuum source to airframe fuel drain outlet.
2. Monitor fuel drain to ensure free airflow.
3. Apply slight positive air pressure to airframe fuel drain outlet.
4. Monitor fuel drain to ensure cylinder drain check valve closes (no airflow).
5. An additional drain is installed on dry bay of engine-mounted fuel pump. If fuel is present at drain indicates current (or impending) failure of fuel pump drive seals or internal components.

This completes the Manifold Fuel Drain Procedure.
Section 70-02  Engine Drains Troubleshooting Guide
Use this troubleshooting guide to resolve issues with the engine.

<table>
<thead>
<tr>
<th>Complaint</th>
<th>Possible Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain blockage</td>
<td>• Residue build up</td>
<td>• Repair tube damage</td>
</tr>
<tr>
<td></td>
<td>• Tube damage</td>
<td>• Perform drain check</td>
</tr>
<tr>
<td>Fuel present</td>
<td>• Engine driven fuel pump failure is pending or has occurred.</td>
<td>• Inspect engine pump and replace in accordance with TCM Maintenance Manual M-22</td>
</tr>
</tbody>
</table>

Table 71-7 Engine Drains Troubleshooting Guide