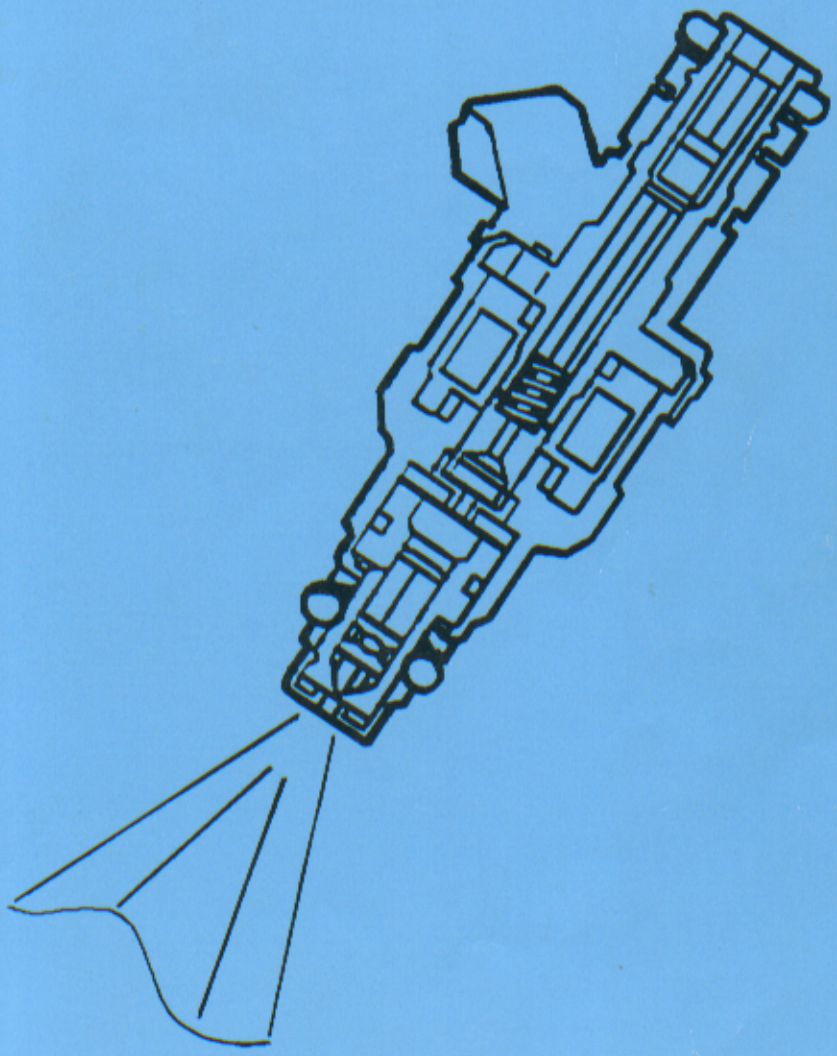
P/N 7796458-3
4-1994

Workshop Manual

1994 "MD" Models

EFI Diagnostic - Ford



VOLVO PENTA

⚠ Safety Warning

This Workshop Manual will alert you to certain procedures that must be done very carefully. If you ignore this information, you could...

- **Injure yourself or people around you**
- **Injure the boat operator, boat passengers, or people around the boat**
- **Damage the Volvo Penta product or its systems**

Understand the following symbols before proceeding:

⚠ **Safety Warning**	Alerts you to the possibility of danger and identifies information that will help prevent injuries.
Note	Identifies information that will help prevent damage to machinery.
Important	Appears next to information that controls correct assembly and operation of the product.

This Workshop Manual is written for qualified, factory trained service technicians familiar with the use of Volvo Penta special tools.

This Workshop Manual tells you how to correctly maintain and service Volvo Penta products and systems. When correctly serviced, the Volvo Penta product will be reliable and safe to operate.

When Volvo Penta special tools are called for, use them. Where mentioned, the tools are required to perform the service procedure.

If you use service procedures or service tools that are not recommended in this manual, YOU ALONE must decided if your actions might injure people or damage the Volvo Penta product.

Contents

Contents

This workshop manual is one of a set of seven that covers *Volvo Penta* stern drive models. All seven books can be ordered as a set from *Volvo Penta Parts*. Order P/N 7796741-2.

Individual workshop manuals covering these models are also available. Order the following part numbers from *Volvo Penta Parts*.

- **P/N 7796484-9 Drive Unit and Transom Shield - *SX* models**

Includes information on Transom Shield, Upper Gear Unit and Lower Gear Unit service; Drive Unit removal and installation; Propellers; and Trim/Tilt hydraulic operation.

- **P/N 7796485-6 Engines**

Includes information on Engine service and troubleshooting; Engine removal and installation; Steering systems; Throttle and Shift Control systems; and Cooling systems.

- **P/N 7796456-7 Electrical/Ignition Systems - all models**

Includes service and troubleshooting information on Cranking systems; Charging systems; Trim/Tilt electrical systems; Ignition systems; and Engine and Instrument wiring diagrams.

- **P/N 7796457-5 Fuel Systems - all models**

Includes service and troubleshooting information on all carbureted and EFI fuel systems and related components.

- **P/N 7796458-3 Diagnostic Manual *Ford* - Fi Models Only**

Includes step by step troubleshooting procedures for all EFI related components and wiring.

- **P/N 7796431-0 Diagnostic Manual *GM* - Gi Models Only**

Contains troubleshooting procedures for all Gi models and related components.

- **P/N 7731624-8 SP and DP Workshop Manual**

Includes Upper Gear Unit and Lower Gear Unit overhaul procedures, installation and removal.

Important Information

The *Ford* EFI Diagnostic Manual structure and content parallel, as far as possible, *Ford's* Powertrain Control / Emissions Diagnosis manual. Because of the differences between marine EFI engines and automotive EFI engines, procedures are not identical. Information has been removed that pertains to automotive systems, and for this reason the diagnostic procedures appear to have gaps in their numerical sequence. No information pertinent to troubleshooting *Ford* marine EFI engines is missing.

Before attempting any troubleshooting procedures, read the **Glossary.** The Diagnostic Manual's text makes extensive use of acronyms (letter abbreviations for words). Diagnostic procedures may be difficult and confusing if you are not familiar with, or know where to find, these terms.

Necessary Diagnostic Instruments

Ford's EFI engines feature an Electronic Engine Control (EEC-IV) system. Specialized instruments are required to diagnose EEC-related fuel, electrical, and ignition problems. Without these devices, problem solving will be time consuming and will have little chance of successfully diagnosing problems. Use of certain diagnostic instruments, other than those recommended, can damage components of the EEC system. **This damage will not be covered under Warranty.**

- [EFI TESTER, P/N 3851324-8] - Available in the EFI Service Tool Package, or individually from *Volvo Penta Parts.* Required to put the ECA into a Self-Test mode and to call up service codes. See **Section 2: Quick Tests** for a complete description of the EFI Tester's capabilities.

- [BREAKOUT BOX] - Installs between the ECA and the engine wiring harness, and is used in conjunction with a DVOM. Required for volt, ohm and Hertz signal checks of all EEC system components and circuits, both with power on or off.

- [Digital Volt-Ohm Meter] - It's used in conjunction with a Breakout Box, and must have Hertz reading capability in order to check the MAP sensor.

  [Note] Any digital volt-ohm meter used to test the EEC system must have a minimum impedance rating of 10 Megohms per Volt. **Any other type DVOM will damage the ECA.**

- FUEL PRESSURE TESTER AND ADAPTER - Available from *Owatonna* Tool Co.; order OTC-7211 (Pressure Gauge and Bleeder) and OTC-7272 (Adapter). Required to check fuel system operating pressure to determine if problem is fuel system related. The Pressure Tester you choose must be able to screw on to a Schraeder Valve, and must have a device that will allow you to slowly bleed off fuel under pressure. **A fuel pressure tester should be one of the first diagnostic devices used when checking for suspected EFI problems.**

- VARIABLE ADVANCE TIMING LIGHT - Available from several manufacturers. Required to perform EEC timing control test.

- KILOVOLT TESTER - Required to check spark output of the TFI-IV ignition system in both open and closed circuit situations. Available from Snap-on Tools and other quality manufacturers.

  ⚠ **Any device used to check ignition system spark output MUST NOT allow an open spark. Use of such a device will create a hazardous condition due to the possible presence of fuel vapors in a boat's engine compartment.**

All of the above are considered the minimum equipment necessary to troubleshoot *Ford's* marine EFI engines. Other useful instruments will be noted at the start of the Ignition and Fuel sections, and in the Appendix of the **Quick Test section.**

How to Use the *Ford* EFI Diagnostic Manual

The *Ford* EFI Diagnostic Manual is divided into the following sections:

- Section 1: Diagnostic Routines
- Section 2: Quick Test
- Section 3: Pinpoint Tests
- Section 4: TFI-IV Ignition System
- Section 5: Fuel System Diagnostics
- Section 6: Electronic Engine Control System
- Section 7: Glossary
- Section 8: Diagrams
- Section 9: Safety

Gather as much information as possible from the owner about the problem, then run the engine to verify it exists as described. If problem is said to occur at 3200 RPM with a warm engine, check it the same way. Valuable time can be wasted if you fail to verify the condition.

Whenever a *Ford* EFI engine has a suspected fuel or electrical problem that requires you to use this Manual, **always start with Section 1, Diagnostic Routines.** This section lists problems by symptom. Each Symptom Chart will offer several possibilities, and will direct you to the specific sections in this manual most likely to resolve the problem. **Do not begin troubleshooting without first starting in the Diagnostic Routines section.**

- **Example:** the engine stalls or quits at idle. The Diagnostic Routines Index directs you to a Symptom Chart. The Chart shows the EEC system as one possibility and directs you to **Section 2, Quick Test.**

The Quick Test procedures may direct you to other Manual sections, usually **Section 3, Pinpoint Tests.** Once you reach the appropriate Test or section, there may be Special Notes at the start of it. **Read these before beginning any troubleshooting tests or procedures. They contain important information, some possibly safety-related, pertaining to that section.**

- **Example:** the Quick Tests identify a service code which directs you to a Pinpoint Test.

Do not immediately start at the specific Pinpoint Test you were directed to (i.e. DH12). Instead, go to the front of that section (i.e. DH) and read the introductory information and any safety warnings. Then turn to the appropriate Pinpoint Test. While performing the tests required, you may be further directed to another section of this manual. Continue to follow all troubleshooting steps as directed; do not guess, randomly substitute parts or jump from section to section. This will only waste time, and delay or prevent resolution of the problem.

Remember; all troubleshooting steps must begin with the Diagnostic Routines section. If you require service assistance, contact your factory Service Department.

SECTION 1

DIAGNOSTIC ROUTINES

Table of Contents

⚠ Safety Warning

Before performing any tests or checks recommended in this chapter, read the section called Safety at the end of this manual.

Diagnostic Routines

Preface

The Diagnostic Routines list the components and systems that can contribute to a particular operational problem in the order of probability, ease of accomplishment, and accessibility. These routines can be used as check lists for reference in the event of unusual or infrequent causes of malfunction.

It's not necessary that any given order be followed, but it makes good sense for the technician to visually inspect everything that his experience tells him could be the source of the condition before beginning a more involved diagnosis. The effectiveness of every service procedure must be validated.

All references, under the REFERENCE column in each Diagnostic Routine chart, are as follows:

- Titles refer to specific *Volvo Penta* Workshop Manuals – Engine, Electrical/Ignition, Fuel, etc.
- Section numbers refer to sections in this *Ford* EFI Diagnostic Manual.

If a particular system / component is determined to be operating normally, return to the Diagnostic Routine Chart in this section for other possible causes of the symptom.

Note **Whenever diagnostic procedures refer you to Pinpoint Tests (Section 3), always read the Special Notes and Test Equipment information found at the start of each Pinpoint Test section. This data will aid diagnosing problems outlined in that Test.**

Diagnostic Routines Index

* Determine whether problem is in fuel system or ignition system. Conduct a fuel pressure test at fuel rail before proceeding to Diagnostic Routines Charts. The fuel pressure test results will help you determine your troubleshooting direction.

Diagnostic Routines Index (Cont.)

Chart 1

Symptom

Starting - No Crank

System	Component	Reference
Starting	Battery, Starter Motor, Assist Solenoid, Neutral Safety Switch, Ignition Switch or Fuse, Circuit Breaker	Cranking System Electrical / Ignition Workshop Manual
Engine	Flywheel, Engine Seized	Engine Workshop Manual
Fuel	Injectors (hydro-lock)	Section 5

Chart 2

Symptom

Starting - Hard Start / Long Crank

Note: It is good practice to confirm that the correct starting procedure was used by the operator before proceeding with diagnosis.

System	Component	Reference
Ignition	Spark Plugs, Coil, Secondary Ignition Wires, Distributor Cap and Rotor, Hall Sensor, TFI-IV Module	Visual Check; Section 4 Electrical / Ignition Workshop Manual
EEC	EEC-IV Quick Test	Section 2
Fuel / Throttle Body	Fuel Filter, Fuel Pumps, Water / Dirt / Rust in Fuel, Fuel Lines, Fuel Pressure Regulator, Injectors, Improper Fuel, Idle Airflow, PCV Valve	Visual Check; Section 5 Fuel System Workshop Manual
Exhaust	Hoses, components restricted	Engine Workshop Manual
Air Intake and Vacuum Distribution	Vacuum Leaks, Flame Arrestor Restricted	Visual Check; Audible Check

Chart 3

Symptom

Starting - Stalls After Start
Idle - Stalls / Quits

System	Component	Reference
EEC	EEC-IV Quick Test	Section 2
Fuel / Throttle Body	Idle Airflow, Electrical Connections, Vacuum Connections, Fuel Filter, Fuel Pumps or Relay, Water / Dirt / Rust in Fuel, Fuel Lines, Tank (Fuel Supply), Fuel Pressure Regulator, Injectors, Improper Fuel, Fuel Reservoir	Visual Check; Section 5 Fuel System Workshop Manual
Vacuum Distribution	Hoses, vacuum Leaks	Visual Check; Audible Check
Ignition	Electrical Connections, Secondary Ignition Wires, Ignition Switch or Fuse, Coil, TFI-IV Module, Distributor Cap and Rotor, Circuit Breaker, Hall Sensor	Section 4 Electrical / Ignition Workshop Manual
Exhaust	Hoses, components restricted	Engine Workshop Manual
Air Intake	Intake Manifold, Throttle Body, Flame Arrestor, Plenum	Fuel System Workshop Manual
Engine	Camshaft and Valve Train	Engine Workshop Manual

Chart 4

Symptom

Starting - No Start / Normal Crank

⚠ **Safety Warning: Extended cranking, because of a "No Start" condition, can load the engine cylinders with raw fuel. After the condition has been corrected, verify cylinders are not hydraulically locked before attempting to start engine.**

System	Component	Reference
EEC	EEC-IV Quick Test	Section 2
Ignition	Electrical Connections, Secondary Wires, Spark Plugs, Ignition Switch, Coil, TFI-IV Module, Distributor Cap and Rotor, Loss of ECA Ground, Circuit Breaker, Hall Sensor, EEC Power Relay, Loss of ECA VPWR	Section 4 Electrical / Ignition Workshop Manual
Fuel / Throttle Body	Fuel Filter, Fuel Pumps or Relay, Water / Dirt / Rust in Fuel, Fuel Lines, Tank (Fuel Supply), Fuel Pressure Regulator, Injectors, Fuel Reservoir	Visual Check; Section 5 Fuel System Workshop Manual
Engine	Compression, Timing	Engine Workshop Manual
Exhaust	Hoses, components restricted	Visual Check Engine Workshop Manual
Air Intake	Intake Manifold, Plenum, Flame Arrestor, Throttle Body	Fuel System Workshop Manual

Chart 5

Symptom

Idle - Slow Return to Idle

System	Component	Reference
EEC	EEC-IV Quick Test	Section 2
Fuel / Throttle Body	Contamination, Throttle Plate and Linkage	Section 5
Vacuum Distribution	Hoses, vacuum Leaks	Visual Check; Audible Check
Air Intake	Air Leak	Fuel System Workshop Manual
Remote Control	Throttle Cable Adjustment	Engine Workshop Manual

Chart 6

Symptom

Idle - Rolling Idle / Runs Rough / Misses

System	Component	Reference
Ignition	Secondary Wires, Spark Plugs, Coil, Distributor Cap and Rotor, Timing	Section 4 Electrical / Ignition Workshop Manual
EEC	EEC-IV Quick Test	Section 2
Fuel / Throttle Body	Idle Airflow, Electrical Connections, Vacuum Connections, Fuel Pressure Regulator, Fuel Reservoir, Injectors, Fuel Rail, Fuel Lines, Fuel Pumps	Section 5 Fuel System Workshop Manual
Vacuum Distribution	Hoses, vacuum Leaks	Visual Check; Audible Check
Engine	Compression, Valve Train, Camshaft, Intake Manifold Gaskets	Engine Workshop Manual
Air Intake	Intake Manifold, Throttle Body, Plenum	Fuel System Workshop Manual
Charging	Components, wiring	Electrical / Ignition Workshop Manual
Exhaust	Hoses, components restricted	Engine Workshop Manual
PCV	Component restricted / defective, vacuum leak	Section 3

Chart 7

Symptom

Idle - Fast Idle
Diesels / Runs On

System	Component	Reference
Fuel / Throttle Body	Idle Airflow, Throttle Plate and Linkage	Visual Check; Section 5
Vacuum Distribution	Hoses, vacuum Leaks	Visual Check; Audible Check
EEC	EEC-IV Quick Test	Section 2
Air Intake	Intake Manifold Gaskets, Plenum Gasket	Engine Workshop Manual
Cooling	Overheating	Engine Workshop Manual

Chart 8

Symptom

Idle - Low / Slow Idle
Stalls / Quits - Cruise, Deceleration

System	Component	Reference
Fuel / Throttle Body	Idle Airflow, Electrical Connections	Visual Check; Section 5
Vacuum Distribution	Hoses, vacuum Leaks	Visual Check; Audible Check
EEC	EEC-IV Quick Test	Section 2

Chart 9

Symptom

Stalls / Quits - Acceleration
Buck / Jerk - Acceleration, Cruise, Deceleration
Hesitation / Stumble - Acceleration
Surge - Acceleration

System	Component	Reference
EEC	EEC-IV Quick Test	Section 2
Ignition	Secondary Wires, Spark Plugs, Coil, Distributor Cap and Rotor, Crossed Wires, Timing	Section 4 Electrical / Ignition Workshop Manual
Fuel / Throttle Body	Idle Airflow, Fuel Filter, Fuel Pumps, Water / Dirt / Rust in Fuel, Fuel Lines, Fuel Pressure Regulator, Fuel Reservoir, Injectors	Visual Check; Section 5 Fuel System Workshop Manual
Vacuum Distribution	Hoses, vacuum Leaks	Visual Check; Audible Check
Air Intake	Flame Arrestor	Fuel System Workshop Manual
Exhaust	Hoses, components restricted	Engine Workshop Manual

Chart 10

Symptom

Runs Rough - Acceleration, Cruise
Misses - Acceleration, Cruise
RPM Limited to 2700 and Below

System	Component	Reference
Ignition	Secondary Wires, Spark Plugs, Coil, Distributor Cap and Rotor, Timing, Crossed Wires	Section 4 Electrical / Ignition Workshop Manual
EEC	EEC-IV Quick Test	Section 2
Fuel / Throttle Body	Fuel Filter, Fuel Pumps, Fuel Lines, Fuel Pressure Regulator, Injectors	Visual Check; Section 5 Fuel System Workshop Manual
Vacuum Distribution	Hoses, vacuum Leaks	Visual Check; Audible Check
Engine	Components	Engine Workshop Manual
S.L.O.W.	Water temperature or oil pressure switch, associated wiring, ECA	Electrical / Ignition Workshop Manual Section 3

Chart 11

Symptom

Surge - Cruise

System	Component	Reference
EEC	EEC-IV Quick Test	Section 2
Fuel/Throttle Body	Fuel Filter, Fuel Pumps, Fuel Lines, Fuel Pressure Regulator, Fuel Octane, Idle Airflow, Fuel Reservoir	Visual Check; Section 5 Fuel System Workshop Manual
Ignition	Spark Plugs, Secondary Wires, Coil, Timing	Section 4
Vacuum Distribution	Hoses, vacuum Leaks	Visual Check; Audible Check
Air Intake	Air Intake Components	Visual Check Fuel System Workshop Manual
Engine	Valve Train and Camshaft, Intake Manifold and Gaskets	Engine Workshop Manual

Chart 12

Symptom

Backfires - Idle, Acceleration, Deceleration

System	Component	Reference
Ignition	Spark Plugs, Secondary Wires, Coil, Crossed Wires, Timing	Section 4
Vacuum Distribution	Hoses, vacuum leaks	Visual Check; Audible Check
EEC	EEC-IV Quick Test	Section 2
Engine	Intake Manifold Gaskets, Compression Check, Camshaft, Valves	Engine Workshop Manual
Exhaust	Hoses, components restricted	Engine Workshop Manual
Fuel/Throttle Body	Fuel Filter, Fuel Pumps, Water/Dirt/Rust in Fuel, Fuel Lines, Fuel Pressure Regulator, Injectors, Fuel Octane	Visual Check; Section 5 Fuel System Workshop Manual

Chart 13

Symptom

Lack / Loss of Power - Acceleration, Cruise

System	Component	Reference
Ignition	Spark Plugs, Secondary Wires, Coil, Timing	Section 4 Electrical / Ignition Workshop Manual
EEC	EEC-IV Quick Test	Section 2
Fuel / Throttle Body	Fuel Filter, Fuel Pumps, Fuel Lines, Fuel Pressure Regulator, Injectors, Idle Airflow, Fuel Reservoir	Visual Check; Section 5 Fuel System Workshop Manual
Exhaust	Hoses, components restricted	Engine Workshop Manual
Cooling	Thermostat	Visual Check; Audible Check Engine Workshop Manual
Vacuum Distribution	Hoses, vacuum Leaks	Engine Workshop Manual
Air Intake	Flame Arrestor	Fuel System Workshop Manual
Engine	Compression Check, Camshaft, Valves	Engine Workshop Manual
Drive Unit	Assembly, Lubrication, Propeller	Drive Unit / Transom Shield Workshop Manual

Chart 14

Symptom

Spark Knock - Acceleration, Cruise

System	Component	Reference
Ignition	Timing, Knock Sensor	Section 4
EEC	EEC-IV Quick Test	Section 2
Cooling	Overheating	Visual Check Engine Workshop Manual
Engine	Oil Level, Compression Check, Intake Manifold Gaskets	Engine Workshop Manual
Fuel / Throttle Body	Fuel Octane, Fuel Pumps and Filter, Fuel Lines, Fuel Pressure Regulator, Injectors	Visual Check; Section 5 Fuel System Workshop Manual
Air Intake	Flame Arrestor	Fuel System Workshop Manual

Chart 15

Symptom

Poor Fuel Economy

Note **Since fuel consumption is drastically increased for short-run operation, stop and go operation, etc., as opposed to normal cruising, an attempt should be made to determine these factors when confronted with "poor fuel economy" conditions. However, since the operator is not always at fault, consider the following:**

System	Component	Reference
Fuel / Throttle Body	Fuel Pressure Regulator	Section 5 Fuel System Workshop Manual
Air Intake	Flame Arrestor	Visual Check Fuel System Workshop Manual
Ignition	Spark Plugs, Coil, Secondary Wires, Distributor Cap and Rotor, Timing	Section 4 Electrical / Ignition Workshop Manual
EEC	EEC-IV Quick Test	Section 2
Cooling	Thermostat	Engine Workshop Manual
Factors External to the Engine	Condition of Boat Bottom, Drive Unit, Propeller	Visual Check

Chart 16

Symptom

Fuel System Odor

System	Component	Reference
Fuel / Throttle Body	Fuel Filter Leaks, Injector Leak, Fuel Pumps Leak, Fuel Lines, Fuel Pressure Regulator Leaks, Fuel Tank Leaks, Fuel Tank Filler Neck Leaks, Fuel Tank Sender Leaks, Fuel Reservoir	Visual Check; Section 5 Fuel System Workshop Manual
EEC	EEC-IV Quick Test	Section 2