
Introduction

Note: The descriptions and specifications contained in this manual were in effect at the time this manual was approved for publication. Ford Motor Company reserves the right to discontinue models at any time, or change specifications or design without notice and without incurring obligation.

REPAIR TECHNIQUES

Appropriate service methods and procedures are essential for the safe, reliable operation of all motor vehicles as well as the personal safety of the individual doing the work. This manual provides general directions for performing service with tested, effective techniques. Following them will help assure reliability.

There are numerous variations in procedure, techniques, tools and parts for servicing vehicles, as well as in the skill of the individual doing the work. This manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in this manual must first establish that they compromise neither their personal safety nor the vehicle integrity by their choice of methods, tools or parts.

NOTE, NOTICE, CAUTION AND WARNING

As you read through this manual, you may come across a NOTE, NOTICE, CAUTION or WARNING. Each one is there for a specific purpose. A NOTE calls attention to unique, additional or essential information related to the subject procedure. A NOTICE identifies a hazard that could damage the vehicle or property. A CAUTION identifies a hazard that could result in minor personal injury to yourself or others. A WARNING identifies a hazard that could result in severe personal injury or death to yourself or others. Some general WARNINGS that you should follow when you work on a vehicle are listed below.

- ALWAYS WEAR SAFETY GLASSES FOR EYE PROTECTION.
- KEEP SOLVENTS AWAY FROM IGNITION SOURCES. SOLVENTS MAY BE FLAMMABLE AND COULD IGNITE OR EXPLODE IF NOT HANDLED CORRECTLY.
- USE SAFETY STANDS WHENEVER A PROCEDURE REQUIRES YOU TO BE UNDER THE VEHICLE.
- MAKE SURE THAT THE IGNITION SWITCH IS ALWAYS IN THE OFF POSITION, UNLESS OTHERWISE REQUIRED BY THE PROCEDURE.
- SET THE PARKING BRAKE WHEN WORKING ON THE VEHICLE. IF YOU HAVE AN AUTOMATIC TRANSMISSION, SET IN PARK UNLESS INSTRUCTED OTHERWISE FOR A SPECIFIC OPERATION. IF YOU HAVE A MANUAL TRANSMISSION, IT SHOULD BE IN REVERSE (ENGINE OFF) OR NEUTRAL (ENGINE ON) UNLESS INSTRUCTED OTHERWISE FOR A SPECIFIC OPERATION. PLACE WOOD BLOCKS (4" X 4" OR LARGER) OR WHEEL CHOCKS AGAINST THE FRONT AND REAR SURFACES OF THE TIRES TO HELP PREVENT THE VEHICLE FROM MOVING.
- OPERATE THE ENGINE ONLY IN A WELL-VENTILATED AREA TO AVOID THE DANGER OF CARBON MONOXIDE POISONING.
- KEEP YOURSELF AND YOUR CLOTHING AWAY FROM MOVING PARTS WHEN THE ENGINE IS RUNNING, ESPECIALLY THE DRIVE BELTS.
- TO PREVENT SERIOUS BURNS, AVOID CONTACT WITH HOT METAL PARTS SUCH AS THE RADIATOR, EXHAUST MANIFOLD, TAIL PIPE, THREE WAY CATALYTIC CONVERTER AND MUFFLER.
- DO NOT SMOKE WHILE WORKING ON A VEHICLE.
- TO AVOID INJURY, ALWAYS REMOVE RINGS, WATCHES, LOOSE HANGING JEWELRY AND LOOSE CLOTHING BEFORE BEGINNING TO WORK ON A VEHICLE.
- WHEN IT IS NECESSARY TO WORK UNDER THE HOOD, KEEP HANDS AND OTHER OBJECTS CLEAR OF THE COOLING FAN BLADES!

Preface

This manual provides a step-by-step approach for diagnosing driveability, emission, and powertrain control system symptoms. Before beginning diagnosis, it may be helpful to refer to any Technical Service Bulletins (TSBs) or On-line Automotive Service Information System (OASIS) information when this is available. The TSB and OASIS information is available on either the Professional Technician Society (PTS) or Motorcraft® website.

This manual is used in conjunction with the Workshop and Wiring Diagrams Manuals. The Workshop Manuals provide additional diagnostic or component removal and installation information. The Wiring Diagrams Manuals provide vehicle specific wiring information, component, connector, and splice locations.

The following is a description of the information contained in each section of this manual.

Section 1: Description and Operation

This section contains description and operation information on powertrain control systems and components and provides the technician with a general knowledge of the powertrain control system. Use this section when general information about the powertrain control system is desired.

Section 2: Diagnostic Methods

This section contains information on specific diagnostic tasks that are used during diagnosis. Descriptions of specific diagnostic methods are included, as well as detailed instructions on how to access or carry out the task.

Section 3: Symptom Charts

All diagnosis begins in Section 3 with QT Powertrain Control Module (PCM) Quick Test. If the PCM Quick Test is completed and no diagnostic trouble codes (DTCs) have been retrieved, the technician is directed to the [No Diagnostic Trouble Codes \(DTCs\) Present Symptom Chart Index](#) in Section 3. The No Diagnostic Trouble Codes (DTCs) Present Symptom Chart Index contains the list of symptoms addressed in this manual, and directs the technician to the appropriate chart in the [No Diagnostic Trouble Codes \(DTCs\) Present Symptom Charts](#). If no PCM DTCs are present and the vehicle symptom is not listed in the No Diagnostic Trouble Codes (DTCs) Present Symptom Chart Index, the technician should go to the appropriate Workshop Manual section to continue diagnosis.

Section 4: Powertrain Diagnostic Trouble Code (DTC) Charts and Descriptions

This section contains the Diagnostic Trouble Code (DTC) Charts and Descriptions. These charts and descriptions are referenced if a DTC is retrieved in Section 3. Also included in this section is the list of possible causes and diagnostic aids.

Section 5: Pinpoint Tests

All pinpoint tests are included in this section. Never enter a pinpoint test unless directed there. When directed to a pinpoint test, always read the information included at the beginning of the pinpoint test.

Section 6: Reference Values

This section contains the Typical Diagnostic Reference Values charts. The technician is directed to these charts from Pinpoint Test Z in Section 5.

How to Use the Diagnostic Procedures

- Use the information about the vehicle driveability or emission concerns to attempt to verify/recreate the symptom. Look for any vehicle modifications or aftermarket items that may contribute to the symptom. A check of any applicable TSBs or OASIS messages may be useful if this information is available.
- Go to Section 3, GO to [QT1](#) Powertrain Control Module (PCM) Quick Test. Carry out the PCM quick test steps. Follow any notes as directed.
- If the PCM quick test is completed, no DTCs were retrieved, and no special notes applied, go to the [No Diagnostic Trouble Codes \(DTCs\) Present Symptom Chart Index](#).
- Select the symptom that best describes the vehicle symptom (for multiple symptoms select the one that is most evident). Go to the [No Diagnostic Trouble Codes \(DTCs\) Present Symptom Charts](#) as indicated. If no PCM DTCs are present and the vehicle symptom is not listed in the No Diagnostic Trouble Codes (DTCs) Present Symptom Chart Index, go to the appropriate Workshop Manual section to continue diagnosis.
- The No Diagnostic Trouble Codes (DTCs) Present Symptom Charts contain areas to be tested for diagnosis of the vehicle symptom. The chart is arranged to place the higher probability or easiest to test items toward the top of the chart. However, the technician is not required to follow this order due to reasons such as variations in vehicle type, vehicle repair history, or technician experience.
 - The System/Component column indicates the areas that are tested. This column may also contain a quick system/component test.
 - The Reference column indicates where to go for the System/Component testing. All references are to the beginning of a pinpoint test in Section 5 of this manual unless noted otherwise. If referred to a pinpoint test in this manual or a Workshop Manual section, go to the procedures. Follow the directions given in those procedures, including directions to other tests or sections. If a damaged part is found, repair as directed. If no concern is found, and diagnosis in that area is complete, return to the [No Diagnostic Trouble Codes \(DTCs\) Present Symptom Charts](#) to continue to the next item.
 - If a quick system/component test is in the System/Component column, the Reference column indicates where to go if the test failed.
- During diagnosis, if directed to test a system/component that is not contained on that vehicle, go to the next step.
- If the No Diagnostic Trouble Codes (DTCs) Present Symptom Chart for the vehicle symptom is completed and no concern is found, return to the [No Diagnostic Trouble Codes \(DTCs\) Present Symptom Chart Index](#) to address the

next most prominent symptom. If all diagnosis is complete and no concern is found, it may be helpful to GO to Pinpoint Test [Z](#) in Section 5 to continue diagnosis.

- The installation of any new component that affects the PCM adaptive learning strategies (adaptive airflow, idle speed, refueling event, or fuel trim) requires the reset of keep alive memory (KAM). Refer to Section 2, [Resetting The Keep Alive Memory \(KAM\)](#) to reset the KAM.
- After any repair, reconnect any components and remove any test equipment. Verify the vehicle is operating correctly and the original complaint is no longer present. If a DTC was present, clear the DTCs and repeat the self-test to verify the repair.
- If a symptom is determined to be intermittent, a careful visual and physical underhood inspection of connectors, wiring harnesses, vacuum lines, and components is required. The Customer Information Worksheet may contain more detailed symptom information. Before an in-depth diagnosis begins, start the engine and wiggle wires, tap on components while listening for an indication of a concern (such as a RPM change or a relay clicking).

Information about engine conditions is stored when a DTC that illuminates the malfunction indicator lamp (MIL) is set. This information is called freeze frame data and may be helpful in diagnosing intermittent concerns. Refer to Section 2, [Freeze Frame Data](#) for additional information.

What's New In This Manual

The following is a list of changes to this manual for 2020:

- The Aviator with a new 3.0L GTDI engine.
 - The new Corsair with a new 2.0L GTDI engine, a new 2.3L GTDI engine, and a new 2.5L hybrid engine.
 - The new Escape with a new 1.5L GTDI engine, a new 2.0L GTDI engine, and a new 2.5L hybrid engine.
 - The Explorer with a new 2.3L GTDI engine, a new 3.0L GTDI engine, and a new 3.3L TIVCT engine.
 - The F-Series Super Duty with a new 7.3L engine.
 - The Motorhome with a new 7.3L engine.
 - The Mustang with a 5.2L supercharged engine.
 - The Transit with a new 3.5L TIVCT engine.
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