6. Diagnostic Overview

6.1. Malfunction Indicator Lamp (MIL) Diagnosis

6.1.1. Diagnostic Instructions

- Perform the Diagnostic System Check Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic **Procedure** Instructions provides an overview of each diagnostic category.

6.1.2. Circuit/System Description

The malfunction indicator lamp (MIL) illuminates to inform the driver that an emission system fault has occurred and the powertrain control system requires service. Ignition voltage is supplied directly to the MIL. The engine control module (ECM) turns the MIL ON by grounding the MIL control circuit when the emission system fault occurs. Under normal operating conditions, the MIL should be ON only when the ignition is ON and the engine is OFF.

6.1.3. Diagnostic Aids

If the condition is intermittent, move the related harnesses and connectors while monitoring the scan tool MIL control circuit status parameters. Perform this test with the ignition ON and the engine OFF, and with the engine running. The MIL control circuit status parameters change from OK or Not Run to Malfunction if there is a condition with a circuit or a connection.

6.1.4. Reference Information

Schematic Reference
Engine Controls Schematics
Instrument Cluster Schematics
Connector End View Reference
Component Connector End Views
Electrical Information Reference
Circuit Testing
Connector Repairs
Testing for Intermittent Conditions and Poor Connections
Wiring Repairs
Scan Tool Reference
Control Module References for scan tool information

6.1.5. Circuit/System Verification

Note:
Any MIL requesting DTCs that may be set should be diagnosed first.

1. Ignition ON.
2. Verify the parameters listed below do not display Malfunction when commanding the Malfunction Indicator Lamp On and Off with a scan tool.
   - The MIL Control Circuit Low Voltage Test Status
   - The MIL Control Circuit Open Test Status
   - The MIL Control Circuit High Voltage Test Status

⇒ If Malfunction is displayed
Refer to Circuit/System Testing
⇓ If Malfunction is not displayed
3. Engine running.
4. Verify the parameters listed below do not display Malfunction when commanding the Malfunction Indicator Lamp On and Off with a scan tool.
   - The MIL Control Circuit Low Voltage Test Status
   - The MIL Control Circuit Open Test Status
   - The MIL Control Circuit High Voltage Test Status

⇒ If Malfunction is displayed
Refer to Circuit/System Testing
⇓ If Malfunction is not displayed

5. Verify the malfunction indicator lamp turns ON and OFF when commanding the Malfunction Indicator Lamp On and Off with a scan tool.
⇒ If the malfunction indicator lamp does not turn ON and OFF
Refer to Circuit/System Testing
⇓ If the malfunction indicator lamp turns ON and OFF
6. All OK.

6.1.6. Circuit/System Testing

1. Ignition OFF.
2. Disconnect the X1 harness connector at the K20 Engine Control Module.
3. Ignition ON, verify the malfunction indicator lamp does not illuminate.
⇒ If the malfunction indicator lamp illuminates
3.1. Test for infinite resistance between the control circuit terminal X1 52 and ground.
⇒ If less than infinite resistance, repair the short to ground in the circuit.
⇒ If infinite resistance, replace the P16 Instrument Cluster.
⇓ If the malfunction indicator lamp does not illuminate
4. Connect a 3 A fused jumper wire between the control circuit terminal X1 52 and ground.
5. Verify the malfunction indicator lamp illuminates.
⇒ If the malfunction indicator lamp illuminates
Replace the K20 Engine Control Module.
⇒ If the malfunction indicator lamp does not illuminate
5.1. Test for less than 1 V between the control circuit terminal X1 52 and ground.
⇒ If 1 V or greater, repair the short to voltage on the circuit.
⇓ If less than 1 V
5.2. Ignition OFF.
5.3. Test for less than 2 Ω in the control circuit end to end.
⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.
⇓ If less than 2 Ω.
6. Ignition OFF, disconnect the harness connector at the instrument cluster.
7. Ignition ON, verify a test lamp illuminates between the ignition voltage circuit terminal 31 and ground.
⇒ If the test lamp does not illuminate and the circuit fuse is open
7.1. Ignition OFF.
7.2. Test for infinite resistance between the ignition voltage circuit and ground.
⇒ If less than infinite resistance, repair the short to ground on the circuit.
⇒ If the test lamp does not illuminate and the circuit fuse is good
7.1. Ignition OFF.
7.2. Test for less than 2 Ω in the ignition voltage circuit end to end.
⇒ If 2 Ω or greater, repair the open/high resistance in the circuit.
⇓ If the test lamp illuminates
8. Replace the P16 Instrument Cluster.

6.1.7. Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Instrument Cluster Replacement
- Control Module References for control module replacement, programming, and setup

6.2. Diagnostic System Check Vehicle

6.2.1. Diagnostic Instructions

- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic System Check Instructions provides an overview of each diagnostic step.
- Continue through the Diagnostic System Check until you are directed to follow a particular diagnostic or repair procedure. Once a repair has been completed, perform the Diagnostic Repair Verification and verify the customer concern has been corrected.

The diagnostic procedures within this manual are developed on the assumption that the following areas function as designed:

- The 12 V battery is fully charged and cables are clean and tight. Refer to Battery Inspection/Test.
- Fuses are not open
- Ground circuits for the area of customer concern are clean, tight, and in the correct location.
- All connectors/terminals fully seated in the area of concern..
- There are no aftermarket devices that affect the operation of the system.
- The scan tool powers up.

6.2.2. Diagnostic System Check

1. VERIFY CUSTOMER CONCERN—Understand and validate the customer concern. Inspect the visible system components for obvious damage or conditions that may cause the concern.
2. BULLETIN SEARCH—Check for related bulletins, recall/field actions and preliminary information.
3. MECHANICAL CONCERNS—Verify the symptom is not exclusively a mechanical concern.
   ⇒ If the symptom is exclusively a mechanical concern
   Refer to Symptoms Vehicle.
   ⇓ If the symptom is not a mechanical concern

Note:
Do not clear any DTCs unless instructed to do so by a diagnostic procedure. If any DTC is Powertrain related, store DTC and Freeze Frame/Failure Records to the scan tool.

4. VEHICLE POWER UP VERIFICATION—Ignition ON, verify the vehicle powers up.
   ⇒ If the vehicle does not power up
   Refer to Power Mode Mismatch.
   ⇓ If the vehicle powers up

6.3. Strategy Based Diagnosis

The goal of Strategy Based Diagnosis is to provide guidance when you create a plan of action for each specific diagnostic situation. Following a similar plan for each diagnostic situation, you will achieve maximum efficiency when you diagnose and repair vehicles. Although each of the Strategy Based Diagnosis steps are numbered, you are not required to complete every step in order to successfully diagnose a customer concern. The first step of your diagnostic process should always be Understand and Verify the Customer's Concern. The final step of your diagnostic process should be to Repair and verify the Fix. Refer to the steps listed below for the correct Strategy Based Diagnosis.

Note:
For additional information on the following steps refer to the corresponding numbered paragraphs listed below.

1. Understand and verify the customers concern.
2. Verify the vehicle is not operating as designed:
   - ⇒ If the vehicle is operating as designed review the suggestions listed below:
     - Check Identical Vehicle
     - Customer Misunderstanding of System – Explain operation to customer or refer to owners or service manual
     - Customer dissatisfaction – Notify Vanderhall
   - ⇓ If the vehicle is not operating as designed
3. Perform preliminary checks – Visual inspections and operational
   - ⇒ If the customers concern is found, refer to step 7
   - ⇓ If the customers concern is not found
4. Perform the Diagnostic System Check – Vehicle, determine the diagnostic service category to perform.
   - ⇒ If the customers concern is found, refer to step 7
   - ⇓ If the customers concern is not found
5. Check for related Bulletins, Recalls and Preliminary Information.
   - ⇒ If the customers concern is found, refer to step 7
   - ⇓ If the customers concern is not found
6. Follow the diagnostic path listed below:
   - 6.1. Current DTC – Follow DTC Diagnostics
   - 6.2. Symptom no DTC – Follow Symptom Diagnostics
   - 6.3. No published diagnostic – Analyze and develop diagnostics or call Technical Assistance
   - 6.4. Intermittent/History DTC – See diagnostic details below
7. Isolate the root cause then repair and verify the fix.
8. Re-examine the concern.
   - ⇒ If the vehicle is not repaired, refer to step 1
   - ⇓ If the vehicle is repaired
9. All OK.

6.3.1. Additional Information

1. Understand and Verify the Customer's Concern: The first part of this step is to obtain as much information as possible from the customer. Are there aftermarket accessories on the vehicle? When does the condition occur? Where does the condition occur? How long does the condition last? How often does the condition occur? In order to verify the concern, the technician should be familiar with the normal operation of the system and refer to the owner or service manual for any information needed.
2. Vehicle Operating as Designed: This condition exists when the vehicle is found to operate normally. The condition described by the customer may be normal. Compare with another like vehicle that is operating normally under the same conditions described by the customer. Explain your findings and the operation of the system to the customer. If the customer is dissatisfied Notify Vanderhall
3. Preliminary Checks: Conduct a thorough visual inspection. Detect unusual sounds or odors. Gather diagnostic trouble code (DTC) information in order to achieve an effective repair.
4. Perform Published Diagnostic System Check-Vehicle:
   - 4.1. The Diagnostic System Check Vehicle verifies the proper operation of the system. This will lead the technician in an organized approach to diagnostics and identify what category of diagnostic to perform.
5. Check for related Bulletins
6. Diagnostic categories:

6.1. Current DTC: Follow the designated DTC diagnostic in order to make an effective repair. Refer to Diagnostic Trouble Code (DTC) List Vehicle.

6.2. Symptom No DTC: Select the appropriate symptom diagnostic. Follow the diagnostic steps or suggestions in order to complete the repair. Refer to Symptoms Vehicle.

6.3. No Published Diagnostics: Analyze the Concern. Develop a plan for the diagnostics. Look at component locations to see if components, connectors or harnesses may be exposed to extreme temperature, moisture, or corrosives (road salt, battery acid, oil or other fluids). Utilize the wiring diagrams, system description and operation, and system circuit description.

6.4. Intermittent/History DTC: An intermittent condition is one that does not occur continuously, may be difficult to duplicate, and will only occur when certain conditions are met. Generally, an intermittent is caused by faulty electrical connections and wiring, malfunctioning components, electromagnetic/radio frequency interference, driving conditions, or aftermarket equipment. The following approaches/tools may prove to be beneficial in locating and repairing an intermittent condition or history DTC. Combining technicians knowledge with the available service information. Evaluate the symptoms and conditions described by the customer. Follow the suggestions on Testing for Intermittent Conditions and Poor Connections. Use a tool with data capturing capabilities like scan tool, digital multi-meter, or (if available) a vehicle data recorder.

7. Isolate the Root Cause then Repair and Verify Fix: After isolating the root cause, make the repairs and validate for the correct operation by performing the Diagnostic Repair Verification. Verifying that the DTC or symptom has been corrected may involve road testing the vehicle.
8. Reexamine the Concern: If a technician cannot successfully find or isolate the concern, a reevaluation is necessary. Re-verify The concern. The concern could be an intermittent or normal condition.