

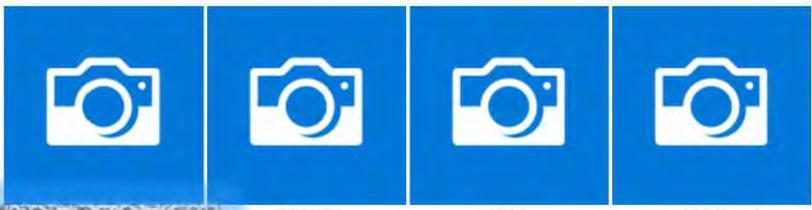
MISSOURI GATEWAY VEHICLE INSPECTION PROGRAM (GVIP) EMISSIONS INSPECTOR TRAINING GUIDEBOOK CLASSROOM STUDY GUIDE



6/19/2017 10:48:09 AM Station: CC02 Unit: MOTRAINING1 Version: 3.8.0.0 Network: No Connection Emissions Auths Safety Auths Battery
Offline Tests: 0 Inspector: BR1002200 - CHUCK GEE Status: ●

Using the built in camera, take photos of the the vehicle, including the Rear of the Vehicle, the Dashboard VIN, Odometer, and if required the Door GVWR label. Tap an icon to take a photo or an existing photo to retake. You can take additional photos as well.

100 10
Next Cancel



OBD Interface Module Self Test: Passed

Firmware: 1.05.8

Serial: WP001916

Voltage: 12.1 Pass

J1850PWM - Pass

J1850VPW - Pass

I9140808 - Pass

KWPS8FE9 - Pass

KWPF8FE9 - Pass

ICAN11bt500 - Pass

ICAN29bt500 - Pass

ICAN11bt250 - Pass

ICAN29bt250 - Pass



Dashboard VIN (Required)

Odometer (Required)

Door GVWR VIN Label (Required)

ERROR COMMUNICATING WITH VEHICLE.
CHECK CABLING FROM THE OBD DAD DEVICE LEAD TO THE VEHICLE'S OBD DIAGNOSTIC LINK CONNECTOR (DLC).
PUSH POWER BUTTON ON OBD DAD DEVICE IF NECESSARY.
[Close](#)



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Missouri GVIP Inspector Training Program

1. MO GVIP Inspector Training



Notes:



Gateway Vehicle Inspection Program Inspector Training



1.2 Course Outline

ABOUT THIS COURSE:

This training program provides the rules and regulations that need to be followed to correctly perform vehicle emissions inspections in accordance with the Code of State Regulations (CSR) that enact the provisions of 643.300 - 643.355 Revised Statutes of Missouri (RSMo).

This training program also details:

- Hardware components used in the GVIP;
- Test equipment operation, testing sequences, and equipment maintenance;
- The air pollution problem in the St. Louis nonattainment area, causes and effects;
- The purpose, function and goals of the GVIP;
- Inspection regulations and procedures;
- Technical details of the test procedures and the rationale for their design;
- Emission control device function, configuration, and inspection;
- Quality control procedures and their purpose;
- Public relations; and
- Safety and health issues related to the inspection process.

1.3 GVIP INSPECTOR TRAINING – IMPORTANT ACRONYMS

The acronyms/abbreviations listed below are frequently used in the emissions testing field and being familiar with these terms will aid the user in understanding the material presented in this training program.

APCP – Air Pollution Control Program
CAA – Clean Air Act
DLC – Data Link Connector
DOC – Diesel Oxidation Catalyst
DPF – Diesel Particulate Filter
DTC – Diagnostic Trouble Code
EGS – Exhaust Gas Sensor
EGR – Exhaust Gas Recirculation
GVIP – Gateway Vehicle Inspection Program
GVWR – Gross Vehicle Weight Rating
I/M – Inspector / Mechanic
IM – Inspection Maintenance
KOEO – Key On Engine Off
KOER – Key On Engine Running
MIL – Malfunction Indicator Light
MDAS – Missouri Decentralized Analyzer System
MDNR – Missouri Dept. of Natural Resources
MDOR – Missouri Dept. of Revenue
MSHP – Missouri State Highway Patrol
MVI – Motor Vehicle Inspection division
NAAQS – National Ambient Air Quality Standards
NMHC - Non-Methane HydroCarbon
NOx – Nitrogen Oxides
O2S – Oxygen Sensor
OBD – On-Board Diagnostics
PCM – Powertrain Control Module
SCR – Selective Catalyst Reduction
VID – Vehicle Inspection Database
VIPMS – Vehicle Inspection Program Management System
VIR – Vehicle Inspection Report

2. GVIP TESTING EQUIPMENT

2.1 MISSOURI DECENTRALIZED ANALYZER SYSTEM



Network nano-router

Sticker printer



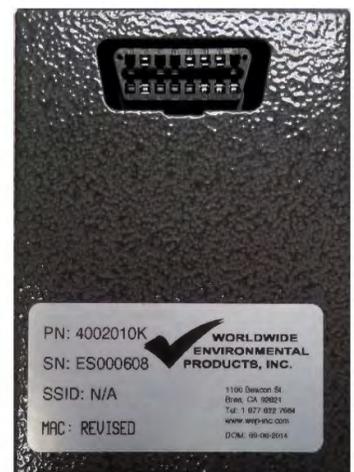
Data Acquisition Device (DAD)



Vehicle Inspection Report (VIR) laser printer

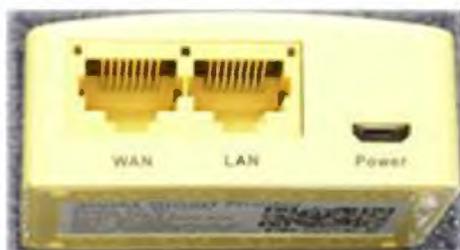


Self-Test Module



2.2 Network Nano-Router Overview

Network Nano-Router Overview



The nano-router serves as the connection point for all the hardware pieces and the shop's network.

The nano-router will be connected to the shop's network either wirelessly or with the existing network cable plugged in to the WAN port, completing the GVIP equipment connection to the Vehicle Inspection Program Management System (VIPMS).

The tablet, DAD and VIR printer will all connect together wirelessly through the nano-router.



The sticker printer must connect to the nano-router LAN port through a cabled LAN connection.

2.3 GVIP Ruggedized Computer Tablet Overview

Wireless Keyboard and Optional Docking Station

GVIP Ruggedized Computer Tablet Overview
Wireless Keyboard and Optional Docking Station



The ruggedized inspection tablet is specifically designed for use in a shop environment, using a shatter-resistant screen and a sealed, shock-absorbing case with reinforced corners for extra protection.

A wireless keyboard (connects via bluetooth) is also provided as a convenience.

An optional docking station is available and provides an efficient location to store the inspection tablet while keeping it charged.

2.4 Tablet On/Off and Power Port

Inspection Tablet Features
On/Off and Charging Port

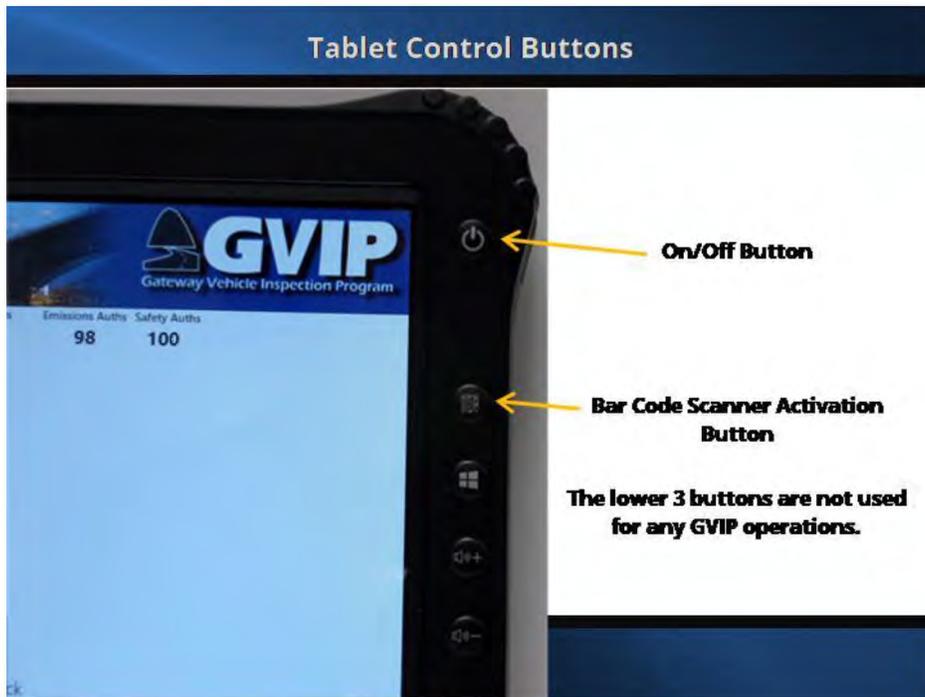


On/Off button
Press and hold for approximately 1-2 seconds to power up the inspection tablet.
To power down the tablet, press and hold the On/Off button for approximately 3 seconds to display the power down prompt.

The DC charging port is on the left side of the tablet under a sealed cover.
The tablet must be connected to the power supply or docking station each night to ensure the tablet is fully charged and ready for operation.

NOTE: An uncharged inspection tablet will prevent any inspection from occurring until the tablet is sufficiently charged (approximately an hour).

Zoomed In On Control Buttons



2.5 Rear Camera, Fingerprint Scanner



2.6 Bar Code Scanner

**Inspection Tablet Operation
Bar Code Scanner**

The 1D/2D Barcode laser emitter and receiver/reader is located on the top edge of the inspection tablet.



1D/2D Barcode reader

To use the bar code scanner, simply press the activation button located on the tablet's right side.




With the barcode scanner activated, direct the red dot to the center of the bar code being scanned.



2.7 Inspection Tablet Operation USB Ports

**Inspection Tablet Operation
USB Ports**

Inspection Tablet Left Side



There are two USB ports located on the left side of the inspection tablet, under a sealed cover.

Only the USB Type-A receptacle is used for GVIP purposes, which include connecting the tablet to the DAD Self-Test Module using the supplied USB cable.

Any use of inspection tablet ports other than for official GVIP purposes is not allowed.



2.8 Tablet Usage and Care

Inspection Tablet Usage and Care

Basic care for the tablet includes using a lint-free computer monitor cleaning cloth moistened with either water or a mild display cleaner. Do not use any harsh chemical or abrasive materials to clean the screen or enclosure. 

The same lint-free cloth and mild display cleaning solution can be used for both the barcode and fingerprint scanner lens.

Before cleaning the tablet, turn the unit off and disconnect any attached cables such as the power supply and USB cables.

Reconnect cables after cleaning is complete.

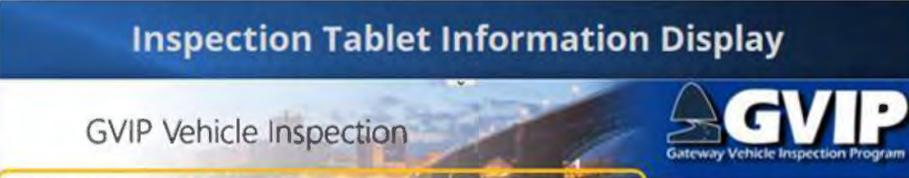
Although the inspection tablet is ruggedized and designed for use in shop environments, care should be taken in order to avoid dropping the equipment.



To clean the keyboard, use a can of compressed air to blow out any foreign matter. To clean the sides of the keys, use a cotton swab dipped in isopropyl alcohol and gently swab around each key.

2.9 Tablet Screen Information pg1

Inspection Tablet Information Display



GVIP Vehicle Inspection
 

6/14/2017 2:51:24 PM Station: CC02 Unit: MOTRARNING1 Version: 3.5.0.0 Network:  Internet Access

<p>Date available</p>	<p>The Station listed to help identify the</p>	<p>The Unit with the be listed in order to</p>	<p>Version the in versio always:</p>	<p>In order to help ensure the tablet user is always aware of network connectivity status, the current condition will be displayed.</p> <p>Network: Internet Access</p> <p>Indicates the tablet is connected to the nano-router and there is a connection to the shop's ISP (Internet Service Provider) network.</p> <p>Network: Local Access</p> <p>Indicates a disconnect from the shop's ISP, but a connection within the shop's network. Off-line testing and access to the printers is available.</p> <p>Network: No Connection</p> <p>Indicates a loss of connection between the inspection tablet and the nano-router.</p>
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2.10 Tablet Screen Information pg2

The screenshot shows the 'Inspection Tablet Information Display' interface. At the top, it says 'GVIP Vehicle Inspection' and 'Gateway Vehicle Inspection Program'. Below this, there is a status bar with the following information: '6/14/2017 2:51:24 PM Station: CCO2 Unit: MOTRAINRG1 Version: 3.5.0.0 Network: Internet Access Emissions Auths Safety Auths Battery'. Underneath the status bar, there are three columns of information: 'Offline Tests: 0', 'Emissions Auths', and 'Safety Auths'. Each column has a yellow arrow pointing to it from the explanatory text below. The explanatory text is as follows:

- Inspector information:** Inspector information will show "NONE" until an inspector logs in to do an official test. Once the login process is complete, inspector information is displayed and includes the inspector number and full name. If this information is not accurate, the test should be aborted and the inspector should log back in and ensure the correct inspector information is displayed.
- Emissions Authorizations:** The number of remaining Emissions Authorizations are continuously displayed after each test regardless of network status. Status indicates whether or not the tablet is locked out from doing official tests. Unlocked indicates there are no lockouts set and the equipment is not restricted from conducting official tests.
- Battery:** Charge state of the inspection tablet battery is displayed as a bar graph in the upper right corner of the screen and indicates the charge amount left.



2.11 Data Acquisition Device (DAD) Overview

WEP OBDII Data Acquisition Device (DAD) Overview

The OBDII Data Acquisition Device (DAD) has many features to enhance usage efficiency.

Features include:

- An internal power supply that supports full operation even if there is no power at the vehicle's DLC pin 16;

5' long heavy-duty cable to survive tough shop environments

4' cable section that is easily replaceable by shop personnel

Hanger to provide convenient positioning of DAD during testing

2.12 DAD Controls and Indicators

DAD Controls and Indicators

Operational indicators include:

- Status LED**
- Power LED**

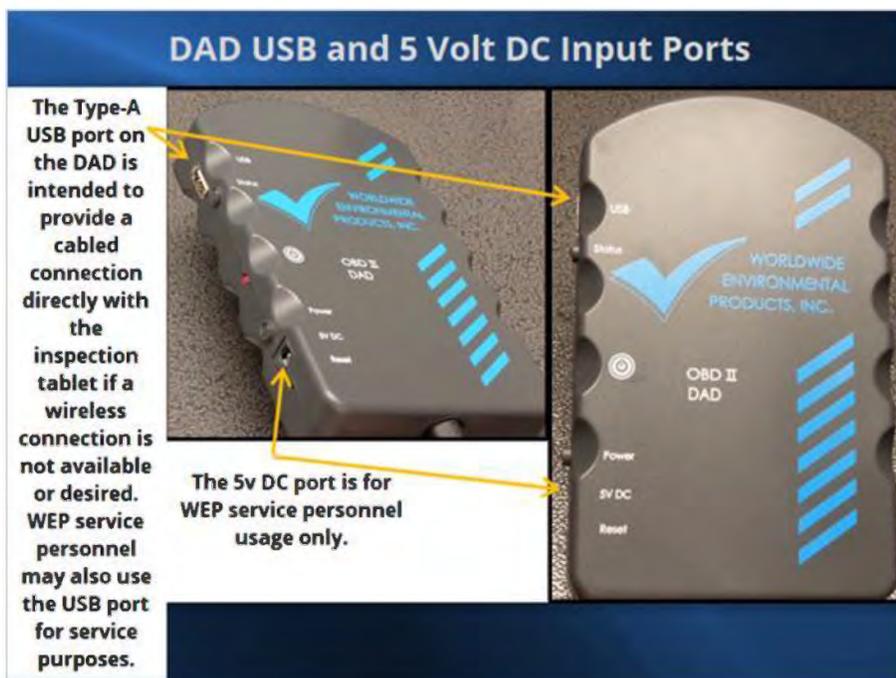
Controls include:

- Power Switch**
- Reset Switch**

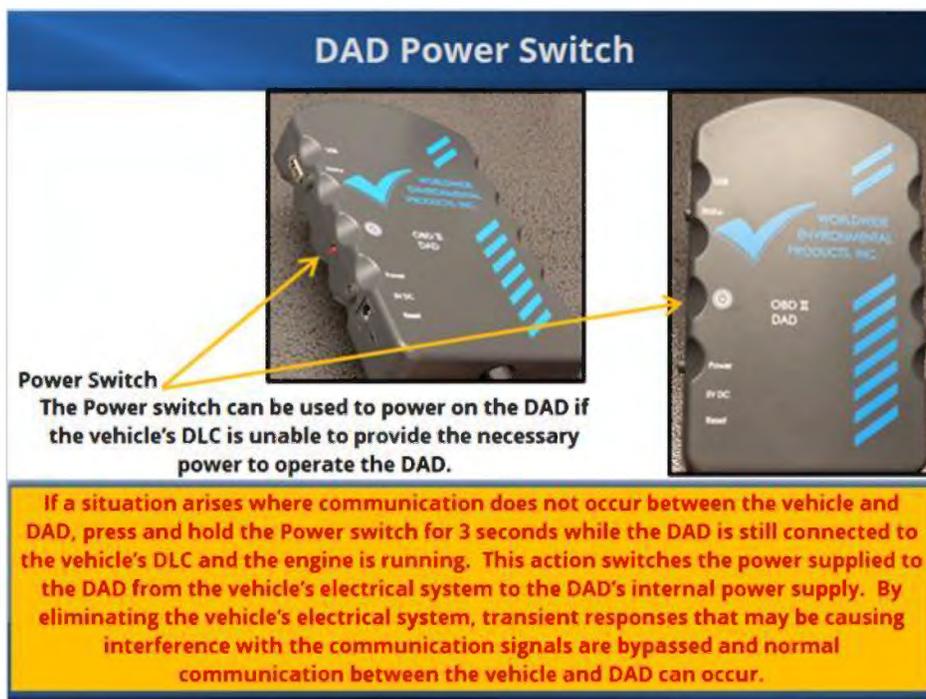
The Status LED will be green in color when connected wirelessly, red when connected via USB cable.

The Power LED uses red, blue, and green to indicate different power modes.

2.13 DAD USB and 5 Volt DC Input Ports



2.14 DAD Power Switch



2.15 DAD Reset Switch

DAD Reset Switch




Reset Switch

The Reset switch should be used if the DAD experiences communication difficulties with either the vehicle or the tablet, seems unresponsive, or is not passing the self-test.

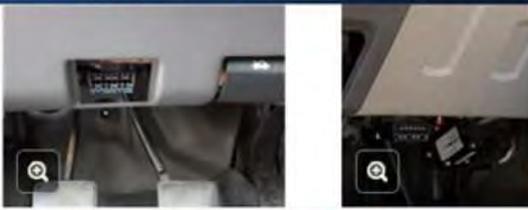
The switch is recessed into the DAD housing to prevent accidental activation. A small instrument, such as a paperclip can be used to access and depress the switch. Press and hold the switch in the closed position for at least 1 second and then release. The Status and Power LEDs will extinguish while the Reset button is closed and should resume normal operation when the button is released. Retry whatever process was unsuccessful prior to using the Reset button.

2.16 DAD Power LED Operation:

DAD Power LED Operation: DAD Powered On By Vehicle

DAD operation begins by powering up the DAD. For most tests, this will occur when the DAD's data link connector (DLC) is connected to the vehicle's DLC.

If the vehicle's DLC is able to provide power and ground, the DAD will respond by flashing the red and blue Power LEDs, indicating the DAD is powered on and charging the internal power supply, or the Power LEDs will flash blue and green indicating the DAD is powered on and the internal power supply is fully charged.




Vehicle DLC details are presented in Section 6.

[Click here for a summary of the Power LED displays](#)

DAD Operation: Power LED Operation Summary

DAD Operation: Power LED Operation Summary

Power LED	
DAD operating on internal power supply	Flashing Blue 
DAD connected to vehicle or emulator DLC with power available and the internal power supply is charging	Solid Red with Flashing Blue 
DAD connected to vehicle or emulator DLC with power available and the internal power supply fully charged	Solid Green with Flashing Blue 

2.17 DAD Powered by Internal Supply

DAD Power LED Operation: DAD Powered On By Internal Power Supply

If some type of malfunction exists with the vehicle's electrical system and there is an interruption to the power supply at DLC pin 16, the DAD can fully operate with the internal power supply. A lack of power from vehicle DLC will be evident by the DAD's Power LED not illuminating when the DAD is connected to the vehicle DLC.

To operate the DAD using the internal power supply, press and hold the red Power button for 3 seconds and then release.

While the DAD is operating on the internal power supply, the blue Power LED will flash on and off.

LOCATE THE VEHICLE'S OBD DIAGNOSTIC LINK CONNECTOR (DLC). ATTACH THE OBD DAD DEVICE LEAD TO THE VEHICLE CONNECTOR. PUSH POWER BUTTON ON OBD DAD DEVICE IF NECESSARY.



Vehicle DLC details are presented in Section 6.

[Click here for a summary of the Power LED displays](#)

2.18 DAD Status Indicator-Wireless Connection

DAD Status Indicator: Wireless Connection



When the DAD first connects with the inspection tablet, a notification tool-tip is displayed for a moment.

When the DAD is first powered on, the Status LED will flash at regular intervals for a moment while a wireless connection is being established with the inspection tablet. Once a connection has been established with the inspection tablet, the steady green illuminated Status LED indicates the DAD is connected to the inspection tablet but is not yet transmitting vehicle data.

Common states are:

- Initialization with inspection tablet begins,
- Successful and the DAD is connected to inspection tablet via the nano-transmitting vehicle data and,
- Connected to the inspection tablet but not yet transmitting vehicle data.



Click here for a summary of the Status LED displays

DAD Operation: Status LED Operation Summary

Wireless Connectivity with Inspection Tablet DAD Operation: Status LED Operation Summary

Status LED	
DAD connected to inspection tablet	Steady Green 
DAD connected to inspection tablet and vehicle, transmitting vehicle data to tablet	Rapid Short Flashing Green 
DAD not connected to inspection tablet	Steady Flashing Green with Pause Every 4 Seconds 

2.19 Wireless Connection: Status Indicator During Vehicle Data Transmission

DAD Status Indicator: Vehicle Data Transmission Using A Wireless Connection

While the DAD is transmitting data over a wireless connection with the inspection tablet, the Status LED will flash on and off rapidly.



Click here for a summary of the Status LED displays

2.20 Vehicle Communication Error

DAD Status Indicator: Error Communicating with Vehicle

If the DAD is wirelessly connected to the inspection tablet and the inspection software is attempting to communicate with the vehicle but some error exists which prevents vehicle communications from taking place as intended, the Status Indicator will be on steady.

The analyzer software will prompt the inspector to activate the DAD's internal power supply after the first failed attempt to communicate with the vehicle.



ERROR COMMUNICATING WITH VEHICLE.
 CHECK CABLING FROM THE OBD DAD DEVICE LEAD TO THE VEHICLE'S OBD DIAGNOSTIC LINK CONNECTOR (DLC).
 PUSH POWER BUTTON ON OBD DAD DEVICE IF NECESSARY.

[Close](#)

Click here for a summary of the Status LED displays

2.21 DAD No Wireless Connection To Tablet

DAD Status Indicator: No Wireless Connection to Tablet

If the DAD is unable to connect with the inspection tablet using a wireless connection, the Status LED will turn on and off at regular intervals.

The on/off times will vary as the DAD attempts different connection routines.

If the DAD indicates a wireless connection is not present, move the DAD so there is an unobstructed "line-of-site" between the DAD and nano-router. If a connection is still unavailable, move the DAD (and possibly the vehicle) closer to the nano-router location.

The DAD and nano-router must be within 30 feet (12.2 meters) of each other for a wireless connection to be possible.



[Click here for DAD specifications](#)

DAD Wireless Communication Specifications

DAD Wireless Communication Specifications

The DAD is designed to meet most shop conditions. The DAD meets the following wireless specifications:

- No loss of communication between the DAD and nano-router when they are within 30 feet (12.2 meters) of each other with a clear path for signal transmission (no walls or other obstructions).
- No loss of communication between the DAD and nano-router while either the DAD or nano-router is within 2 feet (0.6 meters) of a vehicle engine's Original Equipment Manufacturer (OEM) (not modified) electronic engine controls, while the vehicle's engine is running.
- No loss of communication between the DAD and nano-router, while either are within 5 feet (1.5 meters) of up to a five horsepower (5-hp.) properly operating Alternating Current (AC) electric motor.
- No loss of communication between the DAD and nano-router, while either are subjected to Citizen's Band (CB), Emergency Band, or other types of radio transmissions.

2.22 DAD USB Cable Connection To Tablet

DAD Status Indicator: USB Cable Connection Between DAD and Inspection Tablet

If the DAD is unable to connect with the inspection tablet using a wireless connection or a wireless connection is not desired, a USB cable can be used to directly connect the DAD to the inspection tablet.

To use the USB cable, first connect the USB cable to the Type-A USB port on the tablet.



Next, connect the other end of the USB cable to the Type-A USB port on the DAD.



With the USB cable connected on both ends, the Status LED should illuminate with a steady red color to indicate the DAD and inspection tablet are connected and communication is possible and the DAD assistant will indicate the DAD is connected via USB.




[Click here for DAD specifications](#)

2.23 DAD Self-Test Module Overview

WEP OBDII DAD SELF-TEST MODULE OVERVIEW

The WEP OBDII DAD Self-Test Module is designed to verify the proper functionality of the DAD hardware and software.



During an OBD test, the DAD must be able to communicate with the vehicle in order to retrieve the necessary information for vehicle Pass/Fail determination.

If communication is not possible, the malfunction should be identified as vehicle related, or DAD related. Before the vehicle is failed for the malfunction, the DAD and DLC cable must be validated for proper operation. In order to validate the DAD and cable, the emissions testing software will prompt the inspector through the process of a DAD self-test.

The Self-Test Module requires power and a USB cable connected to the computer tablet.



Self-Test Module DLC

Power Supply Port

USB Port

Module end view

2.24 DAD Self-Test

DAD SELF-TEST
Prompt From Analyzer Software

ERROR COMMUNICATING WITH VEHICLE.
YOU MUST PERFORM AN OBD SELF TEST.

[Close](#)

If the DAD is unable to communicate with the vehicle after a second attempt, the analyzer software will indicate a self-test must be performed in order to verify the hardware is functioning properly. After selecting the "Close" button, the inspector will be taken to the Self-Test instruction screen.

2.25 DAD Self-Test

DAD SELF-TEST
Manually Initiated

GVIP Vehicle Inspection

5/22/2017 11:31:38 AM Station: CC02 Unit: MOTRA#ING1 Version: 3.0.0.0 Status: Internet Access Emissions Auths: 98 Safety Auths: 99 Inspector: NONE



The self-test can also be manually initiated by the inspector in order to verify proper DAD operation if the inspector suspects there may be some type of fault with the DAD or DAD cable.

- Main Menu
- Inspector Menu
- Training
- Auditor Menu
- Station Manager Menu
- Service Personnel Menu
- Messages/Bulletins
- Documents
- View Test Authorization Stock
- OBID Interface Self Test
- Check for Updates

To manually initiate a self-test for the DAD, start from the Main Menu and then select OBID Interface Self Test.

2.26 Self-Test USB Tablet Connection

DAD SELF-TEST MODULE CONNECTIONS
USB Cable to Tablet

GVIP Vehicle Inspection
OBD Self Test

1/22/2017 9:28:52 AM Station: CCSE Unit: MDTTRAINING! Version: 3.0.0.0 Status: Internet Access Emissions Auth: Safety Auth: 98 99

Inspector: NONE



Exit Start Cancel

- Make sure the USB cable from the Self Test Module is plugged into either the Tablet USB port or Docking Station port.
- Connect the OBD Interface Connector to the OBD Self Test Module Connector.
- Click Start to begin Self test

After being directed to perform a self-test by the analyzer software, or by selecting the OBD Interface Self-Test from the Main Menu, on-screen instructions will be displayed directing the user to first connect the USB Type-A connector of the supplied cable to the tablet's mating USB Type-A port, or to one of the USB ports on the docking station with the tablet mounted in the docking station.



2.27 Self-Test Module USB Connection

DAD SELF-TEST MODULE CONNECTIONS
USB Cable to Self-Test Module

GVIP Vehicle Inspection
OBD Self Test

1/22/2017 9:28:52 AM Station: CCSE Unit: MDTTRAINING! Version: 3.0.0.0 Status: Internet Access Emissions Auth: Safety Auth: 98 99

Inspector: NONE



Exit Start Cancel

- Make sure the USB cable from the Self Test Module is plugged into either the Tablet USB port or Docking Station port.
- Connect the OBD Interface Connector to the OBD Self Test Module Connector.
- Click Start to begin Self test

Next, make sure the Type B connector of the USB cable is connected to the Self-Test Module's mating USB Type-B port.



2.28 Self-Test Module Power Connection

DAD SELF-TEST MODULE CONNECTIONS
Self-Test Module Power Supply

GVIP Vehicle Inspection
OBD Self Test

5/21/2017 9:28:52 AM Station: CCO2 Unit: MOTTRAINING1 Version: 3.0.0.0 Status: Internet Access Emissions Auths: 98 Safety Auths: 99

Inspector: NONE

Exit Start Cancel

- Make sure the USB cable from the Self Test Module is plugged into either the Tablet USB port or Docking Station port.
- Connect the OBD Interface Connector to the OBD Self Test Module Connector.

After the USB cable is connected to the tablet/docking station and Self-Test Module, connect the power supply to the Self-Test Module.

If the Self-Test Module is already powered up from previous usage, disconnect the power supply for a minimum of 5 seconds and then reconnect the power supply. This helps to ensure accurate results.



2.29 DAD Self-Test DLC Connection

DAD SELF-TEST MODULE CONNECTIONS
DAD DLC to Self-Test Module DLC

GVIP Vehicle Inspection
OBD Self Test

5/21/2017 5:49:54 PM Station: CCO2 Unit: MOTTRAINING1 Version: 3.0.0.0 Status: Internet Access Emissions Auths: 98 Safety Auths: 99

Inspector: NONE

Exit Start Cancel

- Make sure the USB cable from the Self Test Module is plugged into either the Tablet USB port or Docking Station port.
- Connect the OBD Interface Connector to the OBD Self Test Module Connector.
- Click Start to begin Self test

Once the USB and power cables are connected to the Self-Test Module, the DAD DLC should be connected to the Self-Test Module's DLC.

As soon as the DAD is powered up and connected to the wireless network, a DAD Wi-Fi tool-tip with a green indicator will be displayed.

After the DAD is connected to the wireless network, the Self-Test can be initiated by selecting the Start button.



Self-Test Sequence

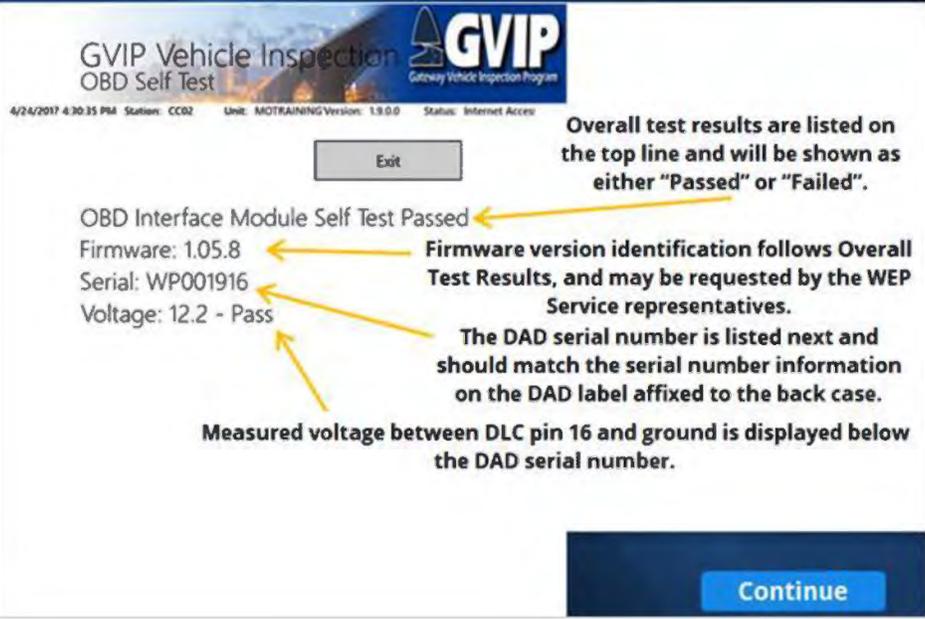
DAD Self-Test Module Connection Review & Self-Test Results




Once the self-test is complete, the overall results are displayed along with specific test results:

2.30 Self-Test Overall Results DAD info

DAD SELF-TEST RESULTS



Overall test results are listed on the top line and will be shown as either "Passed" or "Failed".

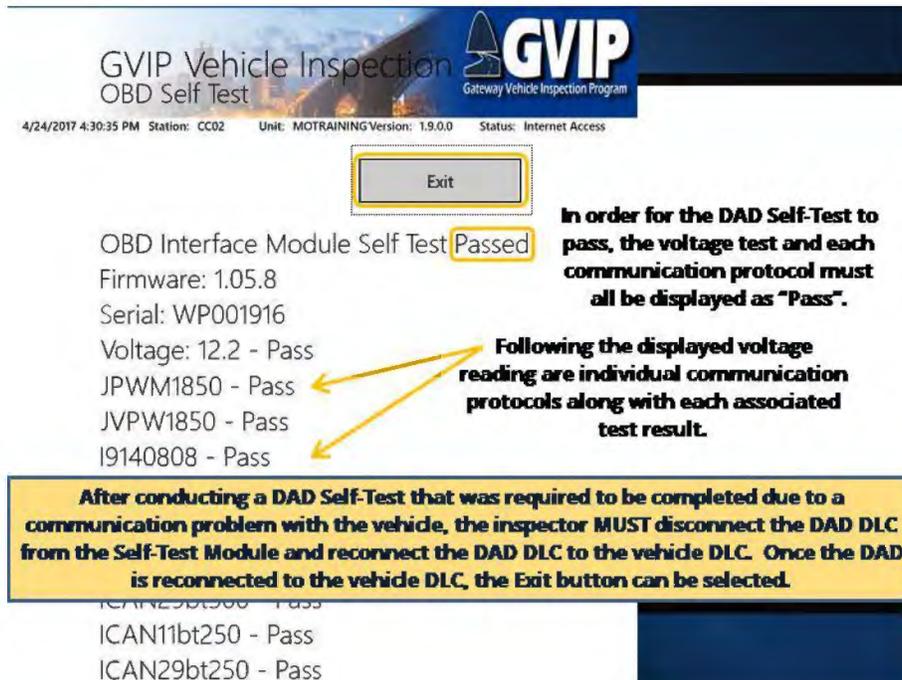
Firmware version identification follows Overall Test Results, and may be requested by the WEP Service representatives.

The DAD serial number is listed next and should match the serial number information on the DAD label affixed to the back case.

Measured voltage between DLC pin 16 and ground is displayed below the DAD serial number.

Continue

Self-Test Pass



GVIP Vehicle Inspection
OBID Self Test
4/24/2017 4:30:35 PM Station: CC02 Unit: MOTRAINING Version: 1.9.0.0 Status: Internet Access

OBID Interface Module Self Test Passed
 Firmware: 1.05.8
 Serial: WP001916
 Voltage: 12.2 - Pass
 JPWM1850 - Pass
 JVPW1850 - Pass
 I9140808 - Pass

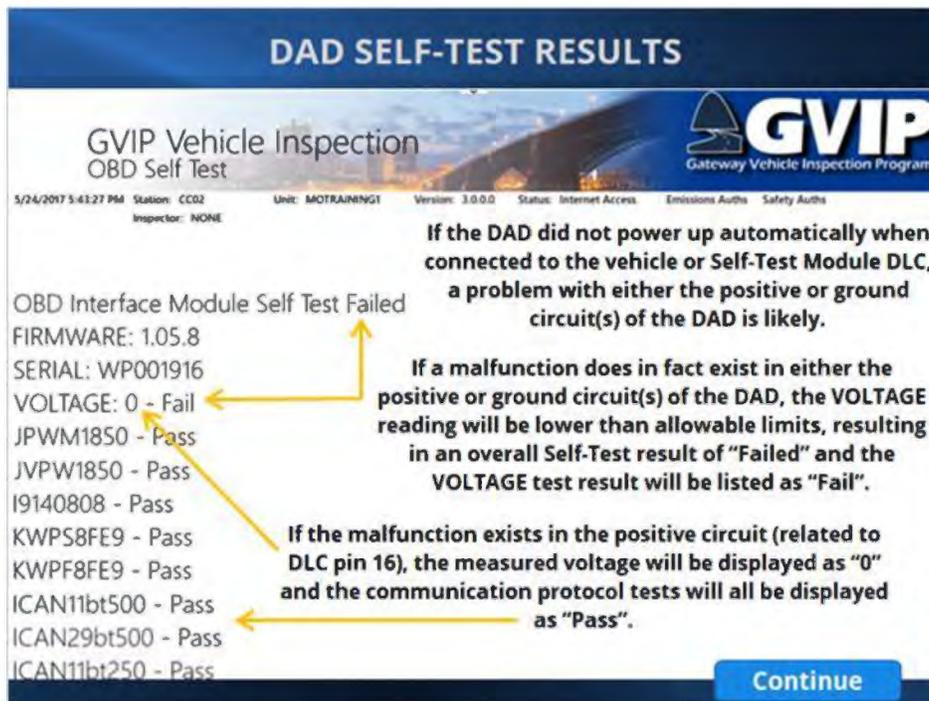
In order for the DAD Self-Test to pass, the voltage test and each communication protocol must all be displayed as "Pass".

Following the displayed voltage reading are individual communication protocols along with each associated test result.

After conducting a DAD Self-Test that was required to be completed due to a communication problem with the vehicle, the inspector MUST disconnect the DAD DLC from the Self-Test Module and reconnect the DAD DLC to the vehicle DLC. Once the DAD is reconnected to the vehicle DLC, the Exit button can be selected.

ICAN29bt500 - Pass
 ICAN11bt250 - Pass
 ICAN29bt250 - Pass

2.31 Self-Test Fail



DAD SELF-TEST RESULTS

GVIP Vehicle Inspection
OBID Self Test
5/24/2017 5:43:27 PM Station: CC02 Unit: MOTRAINING Version: 3.0.0.0 Status: Internet Access Emissions Authn Safety Authn
Inspector: NONE

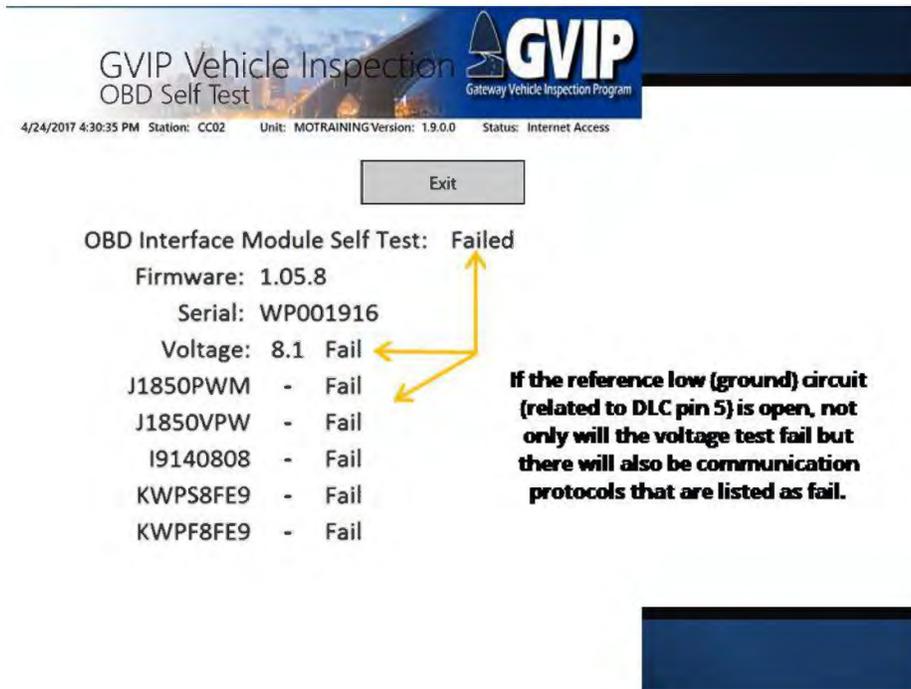
OBID Interface Module Self Test Failed
 FIRMWARE: 1.05.8
 SERIAL: WP001916
 VOLTAGE: 0 - Fail
 JPWM1850 - Pass
 JVPW1850 - Pass
 I9140808 - Pass
 KWPS8FE9 - Pass
 KWPF8FE9 - Pass
 ICAN11bt500 - Pass
 ICAN29bt500 - Pass
 ICAN11bt250 - Pass

If the DAD did not power up automatically when connected to the vehicle or Self-Test Module DLC, a problem with either the positive or ground circuit(s) of the DAD is likely.

If a malfunction does in fact exist in either the positive or ground circuit(s) of the DAD, the VOLTAGE reading will be lower than allowable limits, resulting in an overall Self-Test result of "Failed" and the VOLTAGE test result will be listed as "Fail".

If the malfunction exists in the positive circuit (related to DLC pin 16), the measured voltage will be displayed as "0" and the communication protocol tests will all be displayed as "Pass".

Self-Test Voltage Failed



GVIP Vehicle Inspection
 OBD Self Test
4/24/2017 4:30:35 PM Station: CC02 Unit: MOTRAINING Version: 1.9.0.0 Status: Internet Access

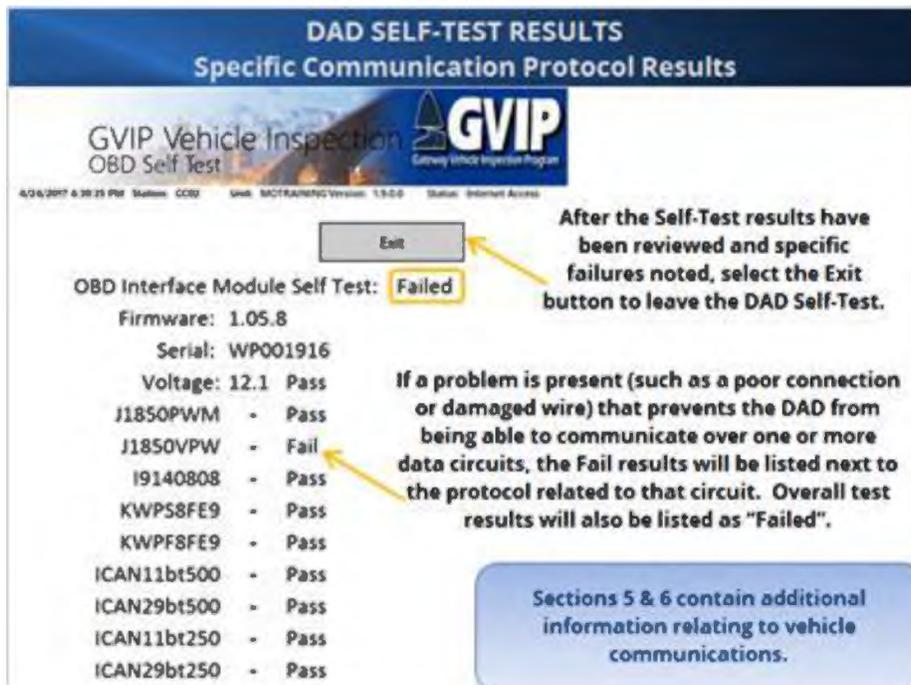
Exit

OBD Interface Module Self Test: **Failed**

Firmware: 1.05.8
 Serial: WP001916
 Voltage: 8.1 Fail
 J1850PWM - Fail
 J1850VPW - Fail
 I9140808 - Fail
 KWPS8FE9 - Fail
 KWPF8FE9 - Fail

If the reference low (ground) circuit (related to DLC pin 5) is open, not only will the voltage test fail but there will also be communication protocols that are listed as fail.

2.32 Self-Test Results: Specific Protocols



DAD SELF-TEST RESULTS
Specific Communication Protocol Results

GVIP Vehicle Inspection
 OBD Self Test
4/24/2017 4:30:35 PM Station: CC02 Unit: MOTRAINING Version: 1.9.0.0 Status: Internet Access

Exit

OBD Interface Module Self Test: **Failed**

Firmware: 1.05.8
 Serial: WP001916
 Voltage: 12.1 Pass
 J1850PWM - Pass
 J1850VPW - Fail
 I9140808 - Pass
 KWPS8FE9 - Pass
 KWPF8FE9 - Pass
 ICAN11bt500 - Pass
 ICAN29bt500 - Pass
 ICAN11bt250 - Pass
 ICAN29bt250 - Pass

After the Self-Test results have been reviewed and specific failures noted, select the Exit button to leave the DAD Self-Test.

If a problem is present (such as a poor connection or damaged wire) that prevents the DAD from being able to communicate over one or more data circuits, the Fail results will be listed next to the protocol related to that circuit. Overall test results will also be listed as "Failed".

Sections 5 & 6 contain additional information relating to vehicle communications.

2.33 DAD Cable Service

DAD & SELF-TESTER SERVICE



If the DAD unit fails a self-test, several possibilities exist:

- Faulty or damaged DLC cable section
- Faulty or damaged DAD cable section
- Faulty or damaged DAD unit

Due to usage, the DLC cable section is the most likely cause for a failed self-test.

The 4 foot DLC cable section is designed for easy replacement by station personnel.

If the DLC cable section has been replaced and the DAD still fails the self-test, the WEP service department should be contacted.

Simply loosen the 2 knurled screws, separate the DB9 serial connector and then attach the new DLC cable section.



The WEP part # and name for the 4 foot DLC cable section is:
512-1091 Cable, DAD DB9 Female to DLCM

WEP Service
1-800-832-7664

The WEP part # and name for the 4 foot DLC cable section is:
512-1091 Cable, DAD DB9 Female to DLCM

2.34 Inspection Sticker Printer

TSC TTP-244CE INSPECTION STICKER PRINTER

The TTP-244 sticker printer is the only hardware device that is connected to the nano-router via cable. A network cable is provided to facilitate this connection.



(1) Connect the printer to the nano-router via the provided network cable.

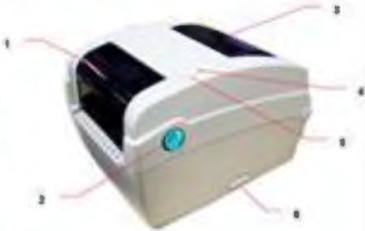
(2) Plug the power cable into the power jack at the rear of the printer.

(3) Plug the power cord into a properly grounded wall outlet.

Always switch OFF printer power switch prior to plugging in the power cord to printer power jack.

Select the Resources Link above to access the User Manual

IMPORTANT NOTE: Be sure to use the power supply unit (PSU) included with this printer. The 24 volt, 2.5 amp (60 watt) power requirement must be strictly observed, and of course tip polarity is critical to proper operation. Any other PSU used may cause permanent damage to the printer and void any applicable warranty coverage.



1. Ribbon access cover
2. Top cover open lever
3. Media view window
4. Paper output tray
5. Power button
6. Power cord socket



2.35 Sticker Printer General Usage

TSC TTP-244CE INSPECTION STICKER PRINTER
General Usage

The TTP-244 sticker printer is designed for long life and ease of use.



The network port has two LEDs to indicate network connectivity and data transmission activity.



Multi-colored LED indicates printer status.

The On/Off button is on the back side of the printer next to the power jack and may be cycled off and then back on in order to restore normal operations, if needed.

The Media Feed button is used to manually advance the print media one section (one label).

2.36 Opening Top Cover

STICKER PRINTER
Opening & Closing Top Cover



In order to open the sticker printer top cover, both the left and right top cover open levers must be moved forward simultaneously.



Click image to replay video



With the top cover open fully, a cover support engages with the lower inner cover.

To close the top cover, press the cover support to disengage from the lower inner cover.



Click image to replay video

2.37 Loading Stickers

Loading Stickers (Print Media) – Installing Media on Holders

STICKER PRINTER
Loading Stickers (Print Media) – Installing Media on Holders

Turn the printer off, open the top cover and unlock the left media holder lock.

Slide the media holders apart using the holder tabs.

Place the media roll on to the right holder. Make sure the media unrolls from the top of the spool.

Place the media roll on to the left holder. Make sure the media spool is able to rotate freely.

Lock the left media holder.

Loading Stickers (Print Media) – Adjusting Guides

STICKER PRINTER
Loading Stickers (Print Media) – Adjusting Guides

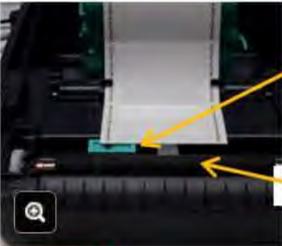
Locate the media between the two media guides

Using the guide adjuster knob, adjust the media guides to allow smooth and unrestricted movement of the media through the guides.



Loading Stickers (Print Media) – Final Steps

STICKER PRINTER
Loading Stickers (Print Media) – Final Steps



Media sensor (also referred to as the Black Mark Sensor)

Platen roller



Once the media guides have been properly adjusted, the media must be positioned across the Media sensor and platen roller. Note that the left side of the media should be in alignment with the Media sensor. To verify alignment, carefully bend back the media strip and note the alignment of a black mark and the sensor. Pull the media strip across the Media sensor and platen roller. The tape strip can be used to temporarily hold the media strip in place while closing the top cover.

Calibrate Sensor

STICKER PRINTER
Calibrate Sensor

After changing label stock, the Gap (also identified as the Black Mark) sensor should be calibrated, according to the printer manufacturer's recommendations.

Starting with the printer turned Off, press the Media Feed button down and hold while turning On the printer. Continue holding the Feed button until the multi-colored LED (located above the Feed button) begins to flash amber. Note that the LED will first be red when the power switch is turned on, then the LED will turn green for a moment, then red once more, indicating the Power On Utility has been activated. The LED will next flash red 5 times. Continue holding down the Feed button.

Calibration is accomplished by activating the Gap/Black Mark sensor calibration function through the Power On Utilities.



Following the 5 red flashes, the LED will begin to flash amber. Release the Feed button WHILE the LED is flashing amber and the sensor calibration, self-test and data dump mode will be activated and completed. Upon completion, the LED will be green, indicating the printer is ready for use.

Power on utilities		The LED color will be changed as following pattern:							
		LED color							
		Amber	Red	Amber	Green	Green/Amber	Red/Amber	Red/Amber	Red/Amber
1.	Ribbon Sensor Calibration and Gap sensor calibration	Release	(5 flashes)						
2.	Black mark sensor calibration, Self-test and error dump mode		Release						

2.38 Loading Ribbon

Removing Used Ribbon and Spool

STICKER PRINTER
Removing Used Ribbon and Spool



The old printer ribbon spool will be needed to collect the used ribbon from the new roll.



Open the ribbon access cover to gain access to the used ribbon roll.



Push the used roll to the right, against the spring-loaded rewind hub.



Disengage the used ribbon spool and remove.



Open the top cover fully to engage the top cover support. Remove old spool by pushing to the right and fully removing spool from supply hub.



STICKER PRINTER Installing Empty Spool

STICKER PRINTER
Installing Empty Spool and New Ribbon Roll



Take the empty spool removed in the previous step and install onto the ribbon rewind hub by pushing the spool against the hub spring and then positioning the spool onto the left hub.



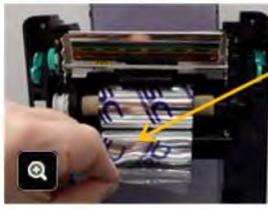
Note the slots in the empty spool must align with the hub splines.



Install the new printer ribbon roll onto the right supply hub, paying attention to align the slots in the spool with the hub splines, and then mount the spool on to the left hub with spool slots aligned with hub splines.

Loading New Ribbon – Final Steps

STICKER PRINTER
Loading New Ribbon – Final Steps



Pull the new ribbon leader out and up to the empty spool previously installed on the rewind hub. Use the adhesive strip on the new ribbon leader and attach to the empty rewind spool.





Turn the ribbon rewind gear until the ribbon leader is completely wound onto the rewind spool and the black section of the ribbon covers the print head.

Close the ribbon access cover and the top cover.

Turn the printer On and the LED should be green, indicating the printer is ready for use.

2.39 Brother Laser Printer

BROTHER HL-L2340DW LASER PRINTER



The Vehicle Inspection Report (VIR) printer is the Brother HL-L2340DW laser printer. This printer was selected for its reliability and ease of use. The VIR printer is connected via wireless networking in order to be able to easily place the printer in the most efficient location.

When not in use, the printer will be in a “deep sleep” mode which simply means a power-saving mode. When a print job is received, the printer will automatically come out of the power-saving mode and quickly heat the needed components for rapid printing.



Click the Resources link to access the Toner and Drum replacement instructions.



Click the image above to open the Brother printer support web page.

2.40 VIR Printer Normal Use and Maintenance

VIR PRINTER Normal Use and Maintenance

Normal use requires periodic cleaning of the paper pick-up rollers, replacement of the toner cartridge and after approximately 12,000 printed pages, replacement of the printer drum unit.

The most common maintenance needed on the VIR printer will be cleaning the paper pick-up rollers. Cleaning the paper pick-up rollers periodically will help prevent paper jams and paper mis-feeds.

Follow the recommended procedure as outlined in the printer's user guide.

Clean the Paper Pick-up Rollers

Cleaning the paper pick-up rollers periodically may prevent paper jams by ensuring the proper feeding of paper.

If you have paper feed problems, clean the pick-up rollers as follows:

1. Press and hold  to turn off the machine.
2. Pull the paper tray completely out of the machine.
3. If paper is loaded or something is stuck inside in the paper tray, remove it.
4. Tightly wring out a lint-free cloth soaked in lukewarm water, and then wipe the separator pad on the paper tray to remove dust.
5. Wipe the two pick-up rollers inside the machine to remove dust.
6. Insert the paper and pull the paper tray firmly back in the machine.
7. Press  to turn on the machine.



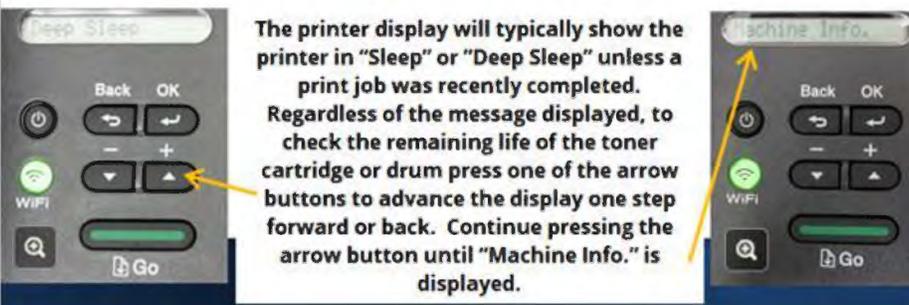
2.41 Control Panel Navigation

VIR PRINTER Control Panel Navigation

To check the current status of the toner cartridge and drum unit, follow the instructions detailed under "Check the Remaining Life of Parts", available through the online user's guide. Click on the image to open the Brother Online User's Guide.



The printer display will typically show the printer in "Sleep" or "Deep Sleep" unless a print job was recently completed. Regardless of the message displayed, to check the remaining life of the toner cartridge or drum press one of the arrow buttons to advance the display one step forward or back. Continue pressing the arrow button until "Machine Info." is displayed.



2.42 Toner Life

VIR PRINTER
Identifying Toner Life

With "Machine Info." displayed on the Operator's display panel, select the OK button and then press either arrow button until "Parts Life" is displayed. With "Parts Life" listed on the display panel, select the OK button and then press either arrow key until "Toner Life" is displayed.

Press the OK button and the remaining toner will be displayed as a series of blocks.

10 blocks represent 100% (as shown).

Press the Back button twice to return to the "Parts Life" display.

Blocks	% Toner Life Left
10	= 100
9	= 90
8	= 80
7	= 70
6	= 60
5	= 50
4	= 40
3	= 30
2	= 20
1	= 10

The standard toner cartridge will print approximately 1,200 pgs.

2.43 Drum Life

VIR PRINTER
Identifying Drum Life

With "Parts Life" listed on the display panel, select the OK button and then press either arrow key until "Drum Life" is displayed.

Press the OK button and the remaining drum life will be displayed in %.

To exit the "Machine Info." section, press the Back button until "Sleep" is displayed.

2.44 Removing Toner/Drum Assembly

VIR PRINTER
Removing the Toner/Drum Assembly

The toner cartridge is designed for easy replacement.

Follow the instructions to remove the toner/drum assembly from the printer.

Replace the Toner Cartridge

1. Make sure the machine is turned on.
2. Open the front cover.
3. Remove the toner cartridge and drum unit assembly from the machine.





The toner cartridge and drum unit function together as an assembly.

The WEP part # and name for the toner cartridge is:
180-2341 Toner Cartridge, Printer, Brother HL-2340

2.45 Separating Toner Cartridge from Drum Unit

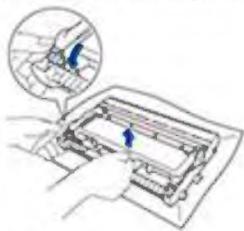
VIR PRINTER
Removing Toner Cartridge From Drum Unit



To release the toner cartridge from the drum unit, press down on the lock lever as described in the instructions. (Click the lever in the picture to get an idea of how much toner cartridge movement to expect. Click here to reset image.)

After being released from the drum unit, lift up and remove the toner cartridge.

4. Push down the green lock lever and take the toner cartridge out of the drum unit



5. Unpack the new toner cartridge

6. Remove the protective cover




2.46 Installing New Toner Cartridge

VIR PRINTER
Installing New Toner Cartridge and Cleaning Corona Wire



Install the new toner cartridge by aligning cartridge with drum unit and ensure the cartridge securely locks in to place.

[Click here to view video](#)

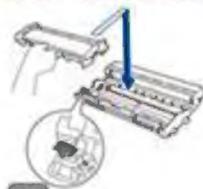


Cleaning the corona wire when replacing the toner cartridge helps to ensure best image quality.

[Click here to view video](#)

With the toner cartridge properly installed in to the drum unit, reinsert the drum/toner assembly into the printer.

7. Put the new toner cartridge firmly into the drum unit until you hear it lock into place.



8. Make sure you put the toner cartridge in correctly, or it may separate from the drum unit.

9. Clean the corona wire inside the drum unit by gently sliding the green tab from left to right and right to left several times.



10. Push the tab to return the tab to the Home position (H). This arrow on the tab must be aligned with the arrow on the drum unit. If it is not, printed pages may have a vertical edge.

2.47 Replacing Drum and Counter Reset

VIR PRINTER
Replacing Drum Unit and Resetting Counter

Replacing the drum unit uses the same procedures as outlined for replacing the toner cartridge, other than a new drum unit will be reinstalled with the toner cartridge. The existing toner cartridge can be used with a new drum unit, or a new toner cartridge can be installed with the new drum unit.

HL-L2305W/HL-L2315DW/HL-L2340DW/HL-L2360DW

After replacing the drum unit with a new drum unit, the drum counter should be reset. Follow the instructions as detailed in the User's Guide.

1. Leave the machine turned on for 10 minutes for the internal fan to cool the extremely hot parts inside the machine.
2. Open the front cover.



3. Press and hold OK for about two seconds to display the Erase Tn.L.c. option, and then press OK.
4. Press OK for Reset to reset the drum counter.

**The WEP part # and name for the drum is:
180-2342 Drum, Printer, Brother HL-2340**

2.48 GVIP Hardware Part # and Name List

GVIP Hardware Part # and Name List	
Part #:	Name:
792-1000	Rugged Tablet PC w/Barcode scanner
792-1000B	Battery, Rugged Tablet PC w/ Barcode Scanner
792-1000C	Charger, Rugged Table PC w/ Barcode Scanner
792-1000D	Docking Station, Rugged Table PC w/ Barcode Scanner
290-9055	WI Enhanced WEP OBDII, DAD
180-244CE	TSC TTP 244 CE Printer
790-6055	Roll, Thermal Transfer Label
790-6065	Thermal Transfer, Ribbon 76mm X 110m
180-2340	Printer, Brother HL-2340
180-2341	Toner Cartridge, Printer, Brother HL-2340
180-2342	Drum, Printer, Brother HL-2340
400-2011K	Standalone, ECU Simulator w/cables and power adapter
510-1528	Cat 5 Network Cable
510-1566	Wireless, Nano Router
160-0108	Mini Keyboard
160-0200	USB, Portable wall charger
510-1020	Cable, USB/Printer 6'
512-1091	Cable, DAD DB9 Female to DLCM
354-0950	Workstation Cabinet w/wheels

3. Air Pollution Problems, Causes, and Effects

3.1 VEHICLE EMISSIONS: AIR POLLUTION PROBLEMS, CAUSES & EFFECTS

VEHICLE EMISSIONS: AIR POLLUTION PROBLEMS, CAUSES & EFFECTS

Four of the six air pollutants required by the Clean Air Act (CAA) to be monitored for health and environmental concerns are either direct (primary) emissions from mobile sources, or are secondary pollutants created from primary vehicle emissions through complex chemical reactions in the atmosphere.

The Missouri Department of Natural Resources (DNR) maintains a system of air monitors across the state to track concentrations of ozone (O₃), particulate matter (PM), nitrogen dioxide (NO₂), and carbon monoxide (CO), as well as many other pollutants.



[Click here to open the MO State Implementation Plan web page](#)

3.2 MO Air Pollution Introduction

VEHICLE EMISSIONS: AIR POLLUTION PROBLEMS, CAUSES & EFFECTS

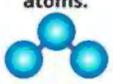


Motor vehicles are a leading source of air pollution in the St. Louis area due to the large number of vehicles on the road and amount of miles traveled daily.

Four pollutants emitted to the atmosphere from the exhaust of an internal combustion engine are:

- Hydrocarbons (HCs)
- Carbon monoxide (CO)
- Nitrogen oxides (NO_x)
- Particulate Matter (PM)

Ozone is a molecule composed of three oxygen atoms.



The U.S. EPA has designated the counties of St. Charles, St. Louis, Franklin, Jefferson and St. Louis City as an ozone nonattainment area. The area does not meet the federal health-based air quality standards for ground-level ozone. According to the Federal Clean Air Act, once an area is considered in violation of the NAAQS for ground-level ozone, a vehicle Inspection/ Maintenance (IM) program is mandatory. The reason for this requirement has to do with how ground-level ozone is formed and the severity of health and environmental damage caused.

[Internet Web Link to the Missouri Air Pollution Control Program](#)

[Internet Web Link to the Missouri GVIP Vehicle Owner Ozone Information](#)

Ozone: Health and Environmental Concerns

VEHICLE EMISSIONS: AIR POLLUTION PROBLEMS, CAUSES & EFFECTS
Ozone: Health and Environmental Concerns

In the upper atmosphere (stratosphere), ozone acts as a UltraViolet (UV) radiation filter and helps reduce the amount of harmful UV radiation that reaches the earth. At ground levels, however, ozone is a serious health problem, particularly for children, the elderly, and people of all ages who have lung diseases such as asthma.

Breathing ozone can trigger a variety of health problems including chest pain, coughing, throat irritation, and airway inflammation. It also can reduce lung function and harm lung tissue, including permanent scarring. Ozone can worsen bronchitis, emphysema, and asthma, leading to increased medical care.

Learn more about ozone here: [EPA - Ozone Pollution](#)

Ground-level ozone also damages vegetation and ecosystems. It leads to reduced agricultural crop and commercial forest yields, reduced growth and survivability of tree seedlings, and increased susceptibility to diseases, pests and other stresses such as harsh weather. In the United States alone, ground-level ozone is responsible for an estimated \$500 million in reduced crop production each year. Ground-level ozone also damages the foliage of trees and other plants, affecting the landscape of cities, national parks and forests, and recreation areas.




Images courtesy of EPA

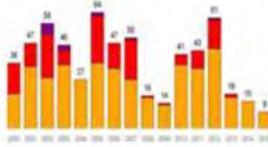
Ozone Monitoring

VEHICLE EMISSIONS: AIR POLLUTION PROBLEMS, CAUSES & EFFECTS
Ozone Monitoring

Typically, ozone pollution is a problem in the St. Louis area in the hot summer months (from late May to early September) when higher temperatures cause the chemical reaction to take place. Ozone levels tend to rise in mid-morning, several hours after the rush-hour and onset of emissions-generating business operations and peak in the late afternoon.

30 exceedances were reported during the 2016 ozone season.

St. Louis, MO-4
 Number of Ozone-Exceeding Alerts by Month (Based on Hourly Ozone Data for 2016)



Ozone Monitoring Data

30 Exceedances by Category:
 - Very Exceedance: 10
 - Exceedance: 15
 - Exceedance for Smaller Group: 5

Poor Visibility

Ozone 0.101 PPM
 Particulate 32 µg/m³



Good Visibility

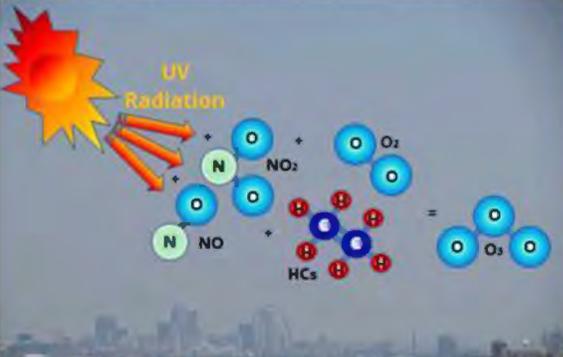


[Link to Missouri Skies Now and Then](#)
[Link to the St. Louis Visual Air Pollution Camera](#)

3.5 Ozone Formation

VEHICLE EMISSIONS: AIR POLLUTION PROBLEMS, CAUSES & EFFECTS
Ozone Formation

Ground level ozone is not emitted directly by an internal combustion engine, but is formed through complex chemical reactions, using the sun's UV radiation energy to power these processes. Along with UV radiation, oxides of nitrogen (NOx) and volatile organic compounds (VOCs - which include hydrocarbons and are sometimes also referred to as Reactive Organic Gases or ROG) play a key role in the formation of ground-level ozone, photochemical smog and small particulates.



Ozone, photochemical smog and small particulates formed from vehicle exhaust are all dangerous to our health and environment.

The MO GVIP program is an important part of the State Implementation Plan (SIP) that helps reduce the formation of these harmful pollutants.

NOx include NO (nitrogen monoxide) and NO₂ (nitrogen dioxide)
VOCs (volatile organic compounds) include hydrocarbons in gasoline and diesel fuels

3.6 CO

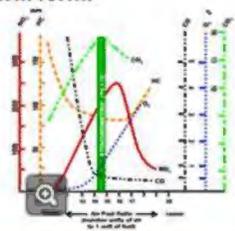
VEHICLE EMISSIONS: AIR POLLUTION PROBLEMS, CAUSES & EFFECTS
Carbon Monoxide (CO)

Carbon Monoxide (CO) is a colorless, odorless gas resulting from the incomplete combustion of hydrocarbon fuels.

Incomplete combustion occurs when there is not enough oxygen present during the combustion process and as a result, some CO is formed instead of the desired carbon dioxide (CO₂).

During combustion, the hydrogen and carbon atoms split apart and recombine with oxygen. Hydrogen will use whatever oxygen is necessary to form water (H₂O) and then whatever oxygen is left will combine with the carbon atoms. Ideally, a carbon atom will bond with 2 oxygen atoms to form CO₂, but if there is not enough oxygen, (incomplete combustion) CO molecules will form.

The air to fuel ratio (A:F) is very important for complete combustion to occur in gasoline and other spark-ignition engines. The fuel must also be well mixed with the air in the combustion chamber in order for complete combustion to occur. If the A:F is too rich, or the fuel is not well vaporized and properly distributed throughout the combustion chamber along with the needed oxygen, the combustion process will be adversely affected and CO emissions will increase.



[Click here to open the EPA's CO web page](#)

[Click here for more information on CO formation and the chemistry of hydrocarbon combustion](#)

Chemistry of combustion

Chemistry of Hydrocarbon Combustion

Each different hydrocarbon has a unique air to fuel ratio, due to the different number of carbon and hydrogen atoms. Since gasoline is a complex mixture of many different hydrocarbons, the overall best air to fuel ratio is 14.7 parts air to 1 part fuel. If the air to fuel ratio shifts rich (less than 14.7 parts air), CO starts to form instead of CO₂.

12.5:1 air to fuel ratio

Balanced equation, chemistry of complete combustion for an octane molecule.

$$\begin{array}{c}
 \text{H} & \text{H} \\
 | & | & | & | & | & | & | & | & | & | \\
 \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\
 | & | & | & | & | & | & | & | & | & | \\
 \text{H} & \text{H}
 \end{array}
 + 12 \text{H}_2\text{O} = 9 \text{H}_2\text{O} + 8 \text{CO}_2$$

Octane (8 carbon, 18 hydrogen atoms) + 12 Oxygen molecules (O₂) (total oxygen atoms) = 9 Water molecules (H₂O) (18 hydrogen atoms, 9 oxygen atoms) + 8 Carbon dioxide molecules (CO₂) (8 carbon atoms, 16 oxygen atoms)

10.5:1 air to fuel ratio

Balanced equation, chemistry of partial combustion for an octane molecule.

$$\begin{array}{c}
 \text{H} & \text{H} \\
 | & | & | & | & | & | & | & | & | & | \\
 \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\
 | & | & | & | & | & | & | & | & | & | \\
 \text{H} & \text{H}
 \end{array}
 + 10 \text{H}_2\text{O} = 9 \text{H}_2\text{O} + 4 \text{CO} + 4 \text{C-O}$$

Octane (8 carbon, 18 hydrogen atoms) + 10 Oxygen molecules (O₂) (total oxygen atoms) = 9 Water molecules (H₂O) (18 hydrogen atoms, 9 oxygen atoms) + 4 Carbon monoxide molecules (CO) (4 carbon atoms, 4 oxygen atoms) + 4 Carbon monoxide molecules (C-O) (4 carbon atoms, 4 oxygen atoms)

9.5:1 air to fuel ratio

Balanced equation, chemistry of partial combustion for an octane molecule.

$$\begin{array}{c}
 \text{H} & \text{H} \\
 | & | & | & | & | & | & | & | & | & | \\
 \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\
 | & | & | & | & | & | & | & | & | & | \\
 \text{H} & \text{H}
 \end{array}
 + 9 \text{H}_2\text{O} = 9 \text{H}_2\text{O} + 2 \text{CO} + 6 \text{C-O}$$

Octane (8 carbon, 18 hydrogen atoms) + 9 Oxygen molecules (O₂) (total oxygen atoms) = 9 Water molecules (H₂O) (18 hydrogen atoms, 9 oxygen atoms) + 2 Carbon monoxide molecules (CO) (2 carbon atoms, 2 oxygen atoms) + 6 Carbon monoxide molecules (C-O) (6 carbon atoms, 6 oxygen atoms)

The equations illustrate the increase in CO molecule formation as the amount of air is decreased while the hydrocarbon amount remains the same.

3.7 CO Health and Environmental Concerns

VEHICLE EMISSIONS: AIR POLLUTION PROBLEMS, CAUSES & EFFECTS

CO: Health and Environmental Concerns

CO is an odorless, colorless gas that is very harmful, even in low concentrations. CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues. At extremely high levels, CO can cause death.

Exposure to CO can reduce the oxygen-carrying capacity of the blood. People with several types of heart disease already have a reduced capacity for pumping oxygenated blood to the heart, which can cause them to experience myocardial ischemia (reduced oxygen to the heart), often accompanied by chest pain (angina), when exercising or under increased stress. For these people, short-term CO exposure further affects their body's already compromised ability to respond to the increased oxygen demands of exercise or exertion.

[Click here to open the EPA's CO web page](#)

[Click here for more information on CO formation and the chemistry of hydrocarbon combustion](#)

3.8 Summary-Air Pollution Problems

VEHICLE EMISSIONS: AIR POLLUTION PROBLEMS, CAUSES & EFFECTS
Summary

- The GVIP is necessary in order to help the St. Louis area combat the growing problems of ground-level ozone that is a result of VOCs and NOx emissions from mobile sources.
- Ozone is harmful to our health and environment and continuous effort must be made in order to continue the downward trend of ground-level ozone concentration.
- CO is a poison that directly reduces the oxygen-carrying capacity of our blood stream. In short-term, high concentration exposure conditions, CO can cause death. In long-term, low concentration exposure conditions, CO can cause brain and other internal organ damage.

Notes:

4. Inspection Program Purpose, Function and Goals

4.1 Introduction to the Emissions Inspection Program

INSPECTION PROGRAM PURPOSE, FUNCTION, & GOALS
The Missouri Gateway Vehicle Inspection Program

In 1965, Missouri put in to state statute the commission to control air pollution. The intent and purpose was to maintain purity of the air resources of the state in order to protect the health, general welfare and physical property of Missouri residents.



The Gateway Vehicle Inspection Program (GVIP), which began Oct. 1, 2007, is part of Missouri's continuing effort to improve air quality and bring the St. Louis area into attainment for the 8-hour ozone standard in the St. Louis region and includes St. Louis City, as well as the counties of Franklin, Jefferson, St. Louis and St. Charles.

[Click here to open the MO Air Pollution Control Program web page](#)
[Click here to open the MO GVIP web page](#)

INSPECTION PROGRAM PURPOSE, FUNCTION, & GOALS

Motor vehicles are a leading source¹ of air pollution in the St. Louis area due to the large number of vehicles on the road and amount of miles traveled daily. 

All 1996 and newer gas-powered vehicles and 1997 and newer diesel-powered vehicles 8,500 pounds or less Gross Vehicle Weight Rating (GVWR) registered in the St. Louis nonattainment area are subject to a combined emissions test and safety inspection.



The GVIP is Missouri's vehicle emissions Inspection/Maintenance (IM) program and is designed to ensure that poorly performing vehicles are identified through a state-of-the-art Inspection process, **(the I in IM)** and repaired/maintained **(the M in IM)** in a timely manner.

Because the St. Louis area is in nonattainment for ozone, the state is required to maintain an I/M program to be in compliance with the Federal Clean Air Act and applicable amendments. The Clean Air Act (CAA) is the comprehensive federal law that regulates air emissions from stationary and mobile sources. 

1 Motor vehicles produce up to 57% of the pollutants that contribute to the formation of ozone.

4.3 Summary

INSPECTION PROGRAM PURPOSE, FUNCTION, & GOALS Summary

- **The GVIP plays an important role in helping meet emissions reductions by identifying vehicles that have malfunctions which may cause an increase in tail-pipe or evaporative emissions,**
- **The GVIP has built-in features that help ensure vehicles are repaired properly before the vehicle is able to pass a re-test,**
- **The GVIP helps to ensure vehicles are tested using the best technology, and the inspector workforce has the latest and best information to ensure proper decisions are made and accurate information is shared with the driving public.**

5. Inspection Regulations and Procedures

5.1 Introduction to the Inspection Regulations

**EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
Vehicles That Are Required To Be Emissions Tested**

1996 and newer gasoline and 1997 and newer diesel-powered vehicles with a gross vehicle weight rating (GVWR) of 8,500 pounds or less registered and operated in the St. Louis nonattainment area, are subject to a combined OBD emissions test and safety inspection.

Vehicles that are subject to the emissions inspection are required to be tested every other year, based on the vehicle's model year (MY).

On-Cycle Vehicle Emissions Testing Schedule									
Calendar Years:	2017	2018	2019	2020	2021	2022	2023	2024	2025
Even-Numbered Vehicle Model Years: 1996, 1998, 2000, etc.		X		X		X		X	
Odd-Numbered Vehicle Model Years: 1997, 1999, 2001, etc.	X		X		X		X		X

When a vehicle registration is transferred, the vehicle is required to be inspected.

Prior to the sale of a vehicle, private sellers of vehicles are required to provide the purchaser with an emissions inspection compliance certificate or compliance waiver that is valid for registering the vehicle.

5.2 Emissions Inspection Periods

**EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
Emissions Inspection Periods**

- Safety Inspections are valid for 60 days
- Emission Inspections are valid for:
 - § 60 days for purposes of a registration renewal
 - § 90 days for transfer/sale by a private seller i
 - § 120 days for transfer/sale by a licensed motor vehicle dealer

Reinspections occurring less than 90 days after the initial emissions inspection are subject to the applicable reinspection requirements. i

Reinspections occurring more than 90 days after the initial emissions inspection are considered to be an initial inspection.

There are exemptions to the normal on-cycle emissions testing schedule that may be applicable to the vehicle being tested due to extenuating circumstances, such as being driven less than 12,000 miles between prior and currently required biennial emission inspections. To the extent possible, the analyzer software will automatically apply exemption criteria and print out the appropriate paper work. The inspector is expected to understand why a vehicle qualifies for a particular waiver or exemption.

5.3 Emissions Inspection Fees

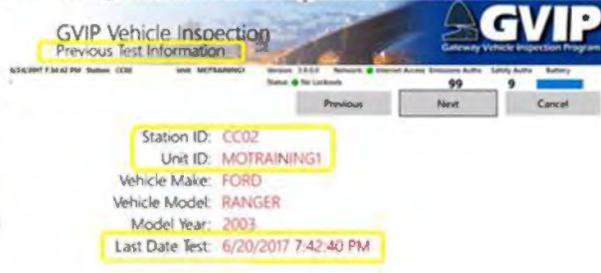
EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
Emissions Inspection Fees

The maximum fee a station is allowed to charge for an initial emissions inspection is \$24. The station is allowed to charge less than the maximum amount, if desired.

Each initial vehicle emissions inspection fee includes 1 free reinspection, provided that the reinspection is conducted within 20 business days of the paid initial emissions inspection and is conducted at the same inspection station that performed the initial inspection.

Following the vehicle and owner Information Review screen, the Previous Test Information screen is displayed. The Last Test Date will display the date and time of the most recent emissions test prior to the current test in progress. The station and analyzer that performed the previous test is also displayed.

As a note, fleet operations inspecting their own fleet vehicles at their own inspection facility do not need to charge themselves an inspection fee.



The screenshot shows the 'Previous Test Information' screen with the following details:

- Station ID: CC02
- Unit ID: MOTRAINING1
- Vehicle Make: FORD
- Vehicle Model: RANGER
- Model Year: 2003
- Last Date Test: 6/20/2017 7:42:40 PM

At the top of the screen, there are authorization counters: Emissions Auths: 99, Safety Auths: 9, and a Battery indicator.

5.4 Emissions Inspection Oversight Fees

EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
Emissions Inspection Oversight Fee

Licensed emissions inspection stations shall pre-pay the state two dollars and fifty cents (\$2.50) for each passing emissions inspection that they intend to perform. The fee is paid to the Director of Revenue and submitted to the Missouri State Highway Patrol (MSHP). Using the VID, the MSHP will credit the number of pre-paid emissions inspections to the licensed emissions inspection station's GVIP analyzer. The GVIP analyzer system will deduct 1 emissions credit authorization for each passing emissions inspection.

At the time that a licensed emissions inspection station discontinues operation or chooses not to renew its emissions inspection license, the department will issue the licensed emissions inspection station a full refund of \$2.50 for each paid emissions inspection credit authorization that remains on the licensed emissions inspection station's GVIP analyzer.

Remaining authorizations are easily identified by the Authorization counters. The counters are displayed in the header section of every screen.

Licensed inspection stations are required to maintain a sufficient positive quantity of emissions credits on their analyzer(s) to prevent having to turn away motorists who have requested an inspection.



The screenshot shows the header section of the GVIP interface with the following details:

- Station: CC02
- Unit: MOTRAINING1
- Version: 3.9.0.0
- Network: Internet Access
- Emissions Auths: 99
- Safety Auths: 9
- Battery: Full

5.5 Emissions Inspector Requirements (1-3)

EMISSIONS INSPECTION REGULATIONS & PROCEDURES: Emissions Inspector Requirements

Emissions Inspector Requirements:

- Every person requesting a vehicle emissions inspector license shall submit a completed vehicle emissions inspector application to the Missouri State Highway Patrol – Motor Vehicle Inspection Division. The emissions inspector application shall include a facial photograph with dimensions of two inches (2") in length and two inches (2") in width.
- All vehicle emissions inspectors must be at least eighteen (18) years of age and able to read and understand documents written in English. The emissions inspector written exam may include an oral component to evaluate the applicant's ability to read and understand documents written in English.
- Emissions inspectors must pass a written test that demonstrates their knowledge of the fundamentals of emissions testing and the procedures of the emissions inspection program. A minimum grade of eighty percent (80%) is required to pass the written examination or reexamination.
- Emissions inspectors must be thoroughly familiar with the emissions inspection equipment and demonstrate competency to either the department or the MSHP while performing an emissions inspection on a vehicle prior to the issuance of the inspector's license. A minimum grade of eighty percent (80%) is required to pass the practical examination or reexamination.

This is a screenshot of a Missouri State Highway Patrol application form. The form is titled 'MISSOURI STATE HIGHWAY PATROL' and 'APPLICATION TO MOTOR VEHICLE INSPECTION STATION'. It contains various fields for personal information, contact details, and checkboxes for different types of applications. A search icon is visible in the bottom left corner of the form area.

5.6 Emissions Inspector Requirements (4-6)

EMISSIONS INSPECTION REGULATIONS & PROCEDURES: Emissions Inspector Requirements

Emissions Inspector Requirements:

- If the applicant meets the applicable requirements, an emissions inspector license will be issued without charge. Licenses are valid for a period of three (3) years from the date of issuance, or until suspended or revoked by the department or the MSHP. An emissions inspector whose license has been suspended or revoked shall be required to successfully complete a recertification training program and pass the written and practical exams.
- If the emissions inspector leaves the employment of one licensed emissions inspection station and enters the employment of another licensed emissions inspection station, the emissions inspection station manager of the station that the inspector is transferring to shall complete an amendment form to inform DNR and MSHP of the personnel changes. The emissions inspector's license is transferable with the licensed emissions inspector, provided the emissions inspector's license has not expired.

This is a screenshot of a Missouri State Highway Patrol amendment form. The form is titled 'MISSOURI STATE HIGHWAY PATROL' and 'AMENDMENT TO MOTOR VEHICLE INSPECTION STATION APPLICATION'. It contains fields for station information, inspector details, and checkboxes for different types of amendments. A search icon is visible in the bottom left corner of the form area.

5.7 Emissions Inspector Requirements (7-8)

EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
Emissions Inspector Requirements

Emissions Inspector Requirements:

- An emissions inspector may be reexamined at any time, and if s/he fails the reexamination or refuses to be reexamined, the license issued to him/her shall be suspended. If a vehicle emissions inspector fails a reexamination, s/he cannot again be tested until a period of thirty (30) days has elapsed.
- An emissions inspector license may be renewed before the expiration date or within sixty (60) days after expiration without a reexamination. If the license has expired more than sixty (60) days before the license renewal application is submitted, a repeat of classroom training session and reexamination and the hands-on practical exam will be required. A vehicle emissions inspector does not have authority to conduct any inspections during the sixty (60)-day post-expiration grace period unless the license has been properly renewed.

5.8 Emissions Inspection Procedures

EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
Emissions Inspection Procedures

The emissions inspector is responsible to ensure that every emissions inspection is performed according to the procedures described in Title 10 of Missouri's code of state regulations (CSR) 10-5.381.

Once an emissions inspection has begun, it shall be completed and shall not be terminated. A vehicle may not be passed or failed based upon a partial inspection.

A proper and complete emissions inspection consists of entering the information requested, testing the vehicle in the condition presented, conducting the emissions test as detailed in this training program and the state regulations, and ensuring the test record information is uploaded.

As soon as an inspection is complete, the emissions inspection record is transmitted to the VID for the purpose of real time registration verification by the MDOR and program oversight by MDNR and MSHP.

10 CSR 10-5.381 On-Board Diagnostics Motor Vehicle Emissions Inspection

PURPOSE: This rule enacts the provisions of 643.300-643.355, RSMo, and meets the 1990 Federal Clean Air Act Amendments requirement that the ozone state implementation plan contains necessary enforceable measures to maintain the mandatory vehicle emissions inspection and maintenance program. The purpose of the inspection and maintenance program is to reduce vehicle emissions in the St. Louis nonattainment area.

The emissions analyzer must be connected to the shop's data network with access to the vehicle information database (VID) at all times.

5.9 Special Notes

EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
Emissions Inspection Procedures: Special Notes

Vehicles shall be inspected in as received condition including vehicles whose malfunction indicator lamp (MIL) is illuminated while the engine is running, or whose readiness monitors are unset.

The inspector shall connect the OBD DAD to the data link connector (DLC) of the actual vehicle submitted for emissions testing. The connection shall remain intact and functioning during the entire test procedure. Clean scanning as defined in 10 CSR 10-6.020 is prohibited and may result in jail time. **i**

An official inspection, once initiated, should be performed in its entirety regardless of immediate outcome, except in the case of an invalid test condition or determination by the emissions inspector. **i**

The initial emissions inspection shall be performed according to the test method described in this training program and the Code of State Regulations, without repair or adjustment at the emission inspection station prior to conducting the vehicle inspection. **i**

Inspecting Vehicles As Received

EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
Emissions Inspection Procedures: Special Notes

Vehicles shall be inspected in as received condition including vehicles whose malfunction indicator lamp (MIL) is illuminated while the engine is running, or whose readiness monitors are unset.

Inspecting Vehicles As Received

When a vehicle is presented for an inspection, the inspector should inspect the vehicle "as is", meaning that even though the MIL may be illuminated and the vehicle will obviously FAIL the emissions test, the inspector (or other station personnel) should NOT advise the vehicle operator to bring the vehicle back at a later time after repairs have been made, or other service work performed. By allowing the vehicle to be tested, even under obviously failing conditions such as the MIL ON while the engine is running, data from the vehicle is gathered that is useful in determining WHY the vehicle fails the emissions test. Testing the vehicle also documents important information such as mileage (for possible mileage based exemptions), and allows for other options to possibly be considered, such as Cost-Based Waivers.

the contact 10 CSR

less of nation

method repair

or adjustment at the emission inspection station prior to conducting the vehicle inspection. **i**

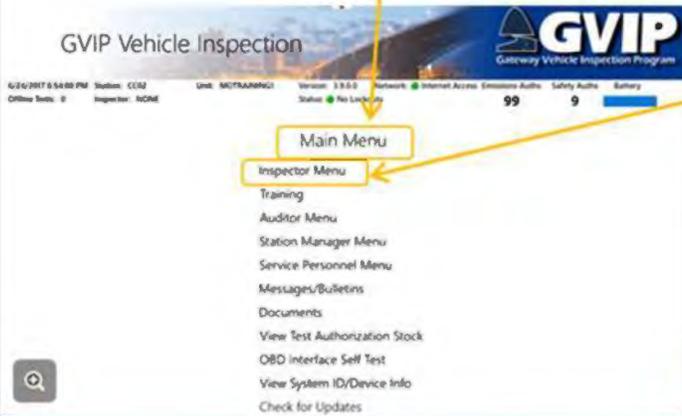
Continue

5.10 Beginning an Official Inspection

**EMISSIONS INSPECTION PROCEDURES:
Beginning an Official Inspection**

In order to begin an official inspection, the inspector must first be authorized to perform inspections.

Fingerprints must be registered for each inspector. Each inspector must also be assigned to the station at which they are currently employed. With all necessary authorizations in place, the inspector begins an official inspection from the Main Menu on the inspection tablet.

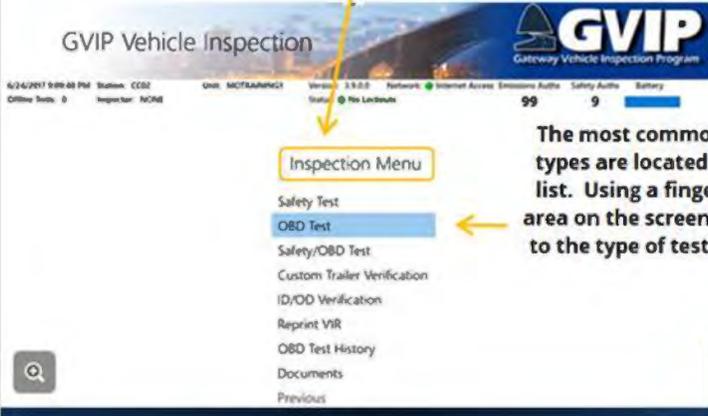


Selecting the Inspector Menu requires just a single tap with a finger on the touch-sensitive screen, on or near the Inspector Menu line.

5.11 Inspection Menu

**EMISSIONS INSPECTION PROCEDURES:
Inspection Menu**

The Inspection Menu provides all the different inspection options needed to conduct any type of test the GVIP offers, as well as being able to view previous test results.



The most commonly selected test types are located at the top of the list. Using a finger, gently tap the area on the screen that corresponds to the type of test to be performed.

5.12 Inspector Logon

EMISSIONS INSPECTION PROCEDURES: Inspector Logon Window



After the test type is selected, the analyzer software presents the Inspector Logon window. Ensure the correct number and name is selected from the list of available inspectors authorized for the station and tablet. With the correct inspector listed in the Inspector # field, the fingerprint associated with the inspector must be entered and authenticated in order to proceed. At this time, no passwords have been assigned to emissions inspectors and so are not an option for authentication purposes.



5.13 Inspector Logon via Fingerprint

EMISSIONS INSPECTION PROCEDURES: Inspector Logon via Fingerprint

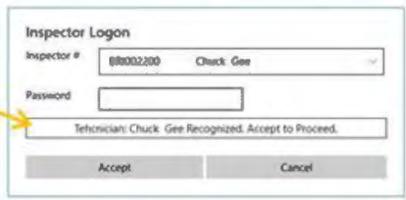


When the fingerprint scanner is used, pull back the sealed cover and place one of the previously registered fingers over the scanner plate.



Once the print is recognized, a message will appear indicating the technician has been recognized.

Press the Accept button to proceed to the next screen.



5.14 Inspector Logon Not Valid

**EMISSIONS INSPECTION PROCEDURES:
Inspector Logon Not Valid**



If a fingerprint is not recognized, a message will be displayed with a prompt to try the fingerprint again. Repeated recognition issues need to be brought to the attention of either DNR or Highway Patrol.

5.15 VIN Entry

**EMISSIONS INSPECTION PROCEDURES:
VIN Entry**

For each inspection, the following information is required to be properly and accurately entered and verified by the inspector:

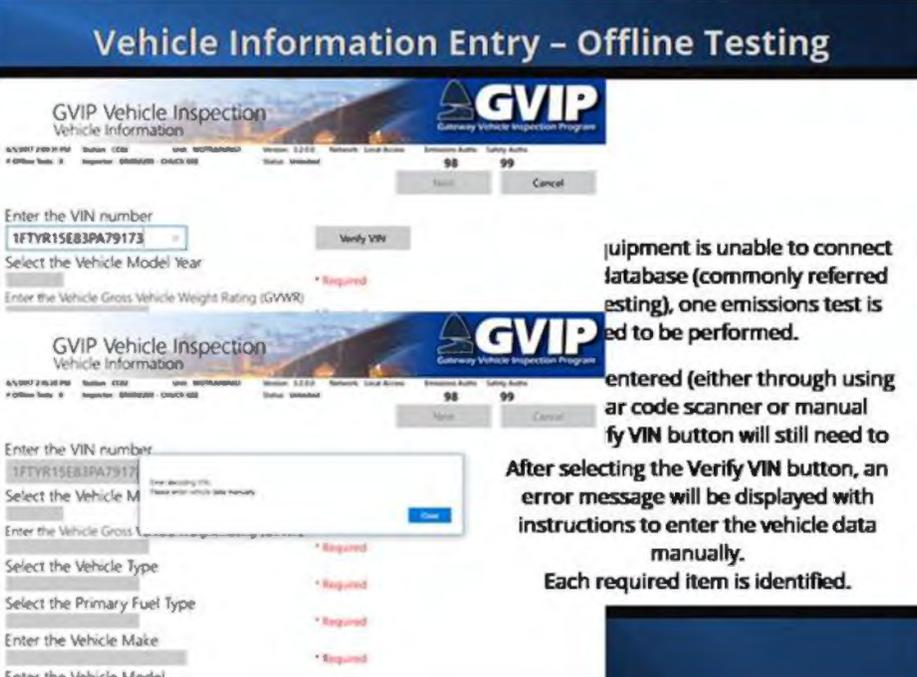
- Vehicle identification number (VIN),
- Vehicle model year, make, vehicle model, & body style,
- Gross Vehicle Weight Rating (GVWR),
- Fuel type,
- # of cylinders,
- Engine displacement in liters,
- Transmission type, and
- Odometer reading at the time of the emissions inspection.



To begin, enter the VIN of the vehicle being tested using the tablet's built-in bar code scanner (described in Section 2) or using the keyboard to manually input the VIN. When entered correctly, a VIN for a 1996 and newer vehicle will have 17 characters. Once the VIN has been entered, select the Verify VIN button.

Off-line Testing

VIN Entry-Offline Testing



Vehicle Information Entry - Offline Testing

GVIP Vehicle Inspection
Vehicle Information

Enter the VIN number
1FTYR15E83PA79173

Select the Vehicle Model Year

Enter the Vehicle Gross Vehicle Weight Rating (GVWR)

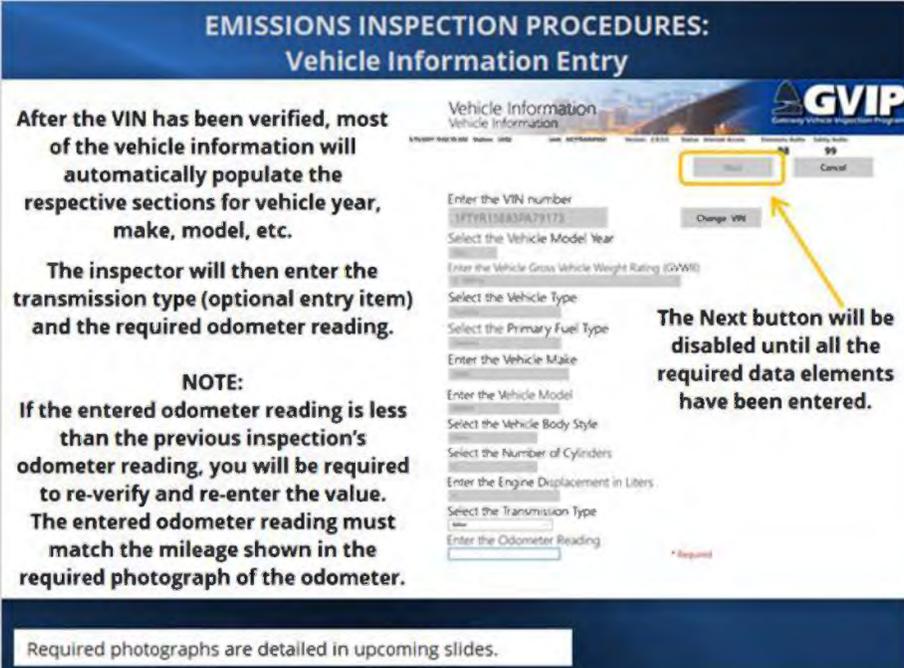
Verify VIN

Equipment is unable to connect to database (commonly referred to as offline testing), one emissions test is required to be performed.

After selecting the Verify VIN button, an error message will be displayed with instructions to enter the vehicle data manually.

Each required item is identified.

5.16 Vehicle Information Entry



**EMISSIONS INSPECTION PROCEDURES:
Vehicle Information Entry**

After the VIN has been verified, most of the vehicle information will automatically populate the respective sections for vehicle year, make, model, etc.

The inspector will then enter the transmission type (optional entry item) and the required odometer reading.

NOTE:
If the entered odometer reading is less than the previous inspection's odometer reading, you will be required to re-verify and re-enter the value. The entered odometer reading must match the mileage shown in the required photograph of the odometer.

Required photographs are detailed in upcoming slides.

The Next button will be disabled until all the required data elements have been entered.

5.17 Information Confirmation

EMISSIONS INSPECTION PROCEDURES: Vehicle and Owner Information Confirmation



After the vehicle information has been confirmed, the Owner Information screen will be displayed.

Enter the appropriate vehicle owner information and ensure the Transfer of Ownership is accurately indicated.

If a transfer of vehicle ownership is indicated, mileage-based exemptions and possibly other waivers are not applicable.



Once the plate, vehicle owner, and transfer of ownership information has been entered, an Information Review screen will be displayed.

If the information is accurate, select the Next button. If any modifications are needed, select the Previous button and make the necessary changes.

5.18 Previous Test Information

EMISSIONS INSPECTION REGULATIONS & PROCEDURES: Previous Test Information

Following the vehicle and owner information entry, Previous Test Information will be displayed if possible. Previous test information will be displayed if a vehicle has been tested at a GVIP station within the last 180 days.



After a review of the Previous Test Information is complete and all entered information is accurate, select the Yes button on the confirmation window.

If the vehicle has been tested previously and failed, the Current Test (OBD/Safety) counter(s) will indicate how many tests have been performed without a successful passing test or an approved waiver/exemption having been issued.

5.19 Required Vehicle Images

**EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
Required Vehicle Images**

The inspector is required to take three (3) legible pictures showing the current license plate, VIN, and odometer reading, using the inspection tablet's built-in camera. The picture of the license plate, VIN, and odometer must match the plate, VIN, and odometer reading input by the inspector. These pictures become part of the inspection record. Pictures of the rear license plate are to be of the entire rear portion of the vehicle from taillight to taillight. If the vehicle license plate is located only on the front of the vehicle, then the license plate picture needs to be of the entire front of the vehicle. All pictures must be clear and legible.



With the equipment operating on-line, 3 pictures will be required, with the Door GVWR/VIN label picture being optional.

If operating off-line, a picture of the door GVWR/VIN label will be required.

5.20 Taking Required Photos

**EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
Required Photographs Using Built-In Camera**

Instructions on how to use the built-in camera are included on the Vehicle Images screen. Tap one of the 4 sections to activate the camera.



After touching one of the 4 sections and activating the camera, the camera view will be shown on the screen along with a small camera icon.

When the camera view has the desired image properly framed and in focus, touch the small camera icon to capture the image.

Make sure to take a photograph of the correct area of the vehicle. If the incorrect area is photographed, or the photograph is poor quality, reselect the appropriate section on the screen and retake the photograph.

5.21 Non-Functional Camera

**EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
Vehicle Images; Non-Functional Camera**



If the camera is not operating properly and the required pictures cannot be taken, the inspector should select the Next button.



A message pop-up window will be displayed stating the vehicle images are required and the images should only be bypassed if the camera is non-functional. The inspector is required to select Yes or No in order to proceed.

Selecting No will allow the inspector another chance to take the required photos.

Selecting Yes indicates an agreement that WEP will be notified of the camera malfunction and the software will proceed to a second notification screen.



2nd notification screen

The second notification screen gives the inspector another opportunity to take the required photographs or to acknowledge that no further testing can be done after the current test is complete until the camera malfunction has been resolved. Selecting the "Continue Without Photos" button will allow the inspector to proceed with this one inspection.

If the "Take Photos" button is selected, the inspector will have another opportunity to take the required photographs.

5.22 MIL Visual Inspection - KOEO

**EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
Emissions Inspection Procedures: MIL Visual Inspection**

After the required photographs have been taken and image quality has been confirmed (or the images have been bypassed if necessary), the next step of the emissions test is to perform a visual inspection of the MIL.

Before beginning this step, make sure the ignition key has been in the off position for at least 12 seconds.



**GVIP Vehicle Inspection
Bulb Check Test**

6/19/2017 3:15:27 PM Station: CCO2 Unit: MOTTRAINING1 Version: 3.8.0.0 Network: Internet Access Emissions Auths: Safety Auths: Battery: 100 10
Offline Tests: 0 Inspector: BR002200 - CHUCK GEE Status: No Lockouts

With the engine OFF, turn the key to the ON position.

Does the MIL illuminate?

Yes No

The inspector is required conduct a visual inspection of the vehicle dashboard area and locate the MIL in order to determine if the MIL illuminates for a bulb test. The inspector indicates "Yes" the MIL did illuminate or "No", the MIL did not illuminate while the ignition key is in the "Run" position with the engine off. This vehicle operating condition is commonly referred to as KOEO, or Key On Engine Off.

5.23 MIL Visual Inspection - KOER

**EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
MIL Visual Inspection KOEO & KOER**

GVIP Vehicle Inspection
Bulb Check Test



6/19/2017 3:19:38 PM Station: CC02 Unit: MOTTRAINING1 Version: 3.8.0.0 Network: ● Internet Access Emissions Auths Safety Auths Battery
 Offline Tests: 0 Inspector: BR0002200 - CHUCK GEE Status: ● No Lockouts

100 10
 Next Cancel

With the engine OFF, turn the key to the ON position.
Does the MIL illuminate?

Yes No

Start the Engine and let idle.
Does the MIL illuminate?

Yes No

After performing the visual bulb check and indicating whether the MIL did or did not illuminate during KOEO, the inspector is prompted to start and idle the engine during the next steps of the test. This operating condition is referred to as KOER, or Key On Engine Running.

The inspector is required to conduct a second visual inspection of the MIL and indicate whether or not the MIL is illuminated during KOER.

5.24 MIL Visual Inspection - Complete

**EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
MIL Visual Inspection KOEO & KOER**

GVIP Vehicle Inspection
Bulb Check Test



6/19/2017 3:25:06 PM Station: CC02 Unit: MOTTRAINING1 Version: 3.8.0.0 Network: ● Internet Access Emissions Auths Safety Auths Battery
 Offline Tests: 0 Inspector: BR0002200 - CHUCK GEE Status: ● No Lockouts

100 10
 Next Cancel

With the engine OFF, turn the key to the ON position.
Does the MIL illuminate?

Yes No

Start the Engine and let idle.
Does the MIL illuminate?

Yes No

After indicating Yes or No at the KOER MIL prompt, select the Next button to proceed.

5.25 Connect DAD to Vehicle DLC

**EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
Connecting DAD To Vehicle DLC**

GVIP Vehicle Inspection
OBD Test

6/19/2017 3:52:27 PM Station: CC02 Unit: MOTTRAINING1 Version: 3.8.0.0 Network: Internet Access Emissions Auths Safety Auths Battery
Offline Tests: 0 Inspector: BR0002200 - CHUCK GEE Status: No Lockouts 100 10

DLC ERROR **Next** Cancel

Once a successful connection has been established between the DAD and inspection tablet, select the Next button to continue with the test procedure.

- CLICK NEXT TO PROCEED WITH OBD TEST.

Following the two visual inspections of the MIL, the inspector is prompted to connect the DAD to the vehicle's DLC. Note that the engine should still be running during this step. When the DAD is connected to the vehicle's DLC, both LEDs should illuminate on the DAD. If the LEDs do not illuminate, press the DAD Power button to activate the internal power supply. Refer to Section 2 for details.

DAD Wi-Fi
The OBD/ DAD is connected.

When the DAD powers up and connects to the inspection tablet, a window will be displayed briefly indicating a successful connection has been established. This indication will appear with either a wireless or USB connection.

5.26 Vehicle Communications

**EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
Vehicle Communications**

GVIP Vehicle Inspection
OBD Test

6/19/2017 5:19:23 PM Station: CC02 Unit: MOTTRAINING1 Version: 3.8.0.0 Network: Internet Access Emissions Auths Safety Auths Battery
Offline Tests: 0 Inspector: BR0002200 - CHUCK GEE Status: No Lockouts 100 10

After the inspector indicates the DAD is properly connected to the vehicle DLC, the DAD is powered on and a connection has been established with the inspection tablet, and the Next button has been selected, the DAD will initiate communications with the vehicle computer system that operates the on-board diagnostic system for emission controls.

Test in Progress

During the time that emissions-related data is being transmitted to the inspection tablet, an animated icon will be displayed indicating the test is in progress.

Total emissions data collection time may take up to 6 minutes in order to meet state requirements.

5.29 VIR-Passing Inspection

**EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
VIR: Passing Inspection**

The Emissions Inspection Result section of the VIR displays the overall results of the OBD test. Either Pass or Fail will be listed.

(Colors used in these examples are for emphasis only. The actual VIRs do not use color)

Emissions Inspection Result: Pass

The MIL Result section identifies the overall result of the 3 separate MIL inspections. MIL Results will be displayed as either Pass or Fail.

Results of the MIL visual inspection during Key On Engine Off (KOEO) and Key On Engine Running (KOER) are listed, as well as the OBD system's commanded state of the MIL.

If the inspector indicates the MIL illuminated during KOEO, a Pass will be displayed. If the MIL did not illuminate during KOEO, a Fail will be displayed.

If the inspector indicates the MIL extinguished during KOER, a Pass will be displayed. If the MIL is illuminated during KOER, a Fail will be displayed.

If no emissions related malfunctions are currently present, the OBD system will command the MIL OFF and MIL Command Status will show Pass. If the MIL is being commanded ON due to the presence of an emissions related malfunction, a Fail will be displayed.

5.30 VIR: Vehicle DLC, Communications Requirements and Results

**EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
VIR: Vehicle DLC, Communications Requirements and Results**

The Data Link Connector (DLC) section displays the results of the DLC test and will have either a Pass or Fail, depending on whether or not the DAD was able to be properly connected to the vehicle DLC. In order to pass the emissions test, the vehicle DLC must be accessible (cannot be blocked) and cannot be tampered or moved from the originally certified position.

Emissions Inspection Result: Pass		Protocol: ICAN11BT
Data Link Connector (DLC): Pass	DLC Fail Reason:	
OBD Communication: Pass	Comm. Fail Reason:	
Readiness Result: Pass	# of Not Com:	
O2 Sensor: Completed	Catalytic Converter:	
O2 Sensor Heater: Completed	Secondary Air:	
Diagnostic Trouble Code (DTC) Result: Pass		

In order to communicate with the vehicle's OBD system, the DAD must automatically determine which communication protocol the vehicle uses. There are 7 different protocols vehicle manufacturers have used since the 1996 vehicle model year. The identified protocol is listed on the VIR for reference and if necessary, will be used to help determine fraudulent testing activity.

[Click here for more information on DLC requirements](#)

[Click here for more information on communication protocols](#)

If the necessary information for vehicle Pass/Fail determination is properly transmitted during the Communications portion of the test, the OBD Communication section result will be listed as Pass.

Communication Protocols

Communication Protocols For Emissions Data

For 1996 and newer model year (MY) vehicles, emissions related data transmission and other diagnostic functions are all standardized. As part of new vehicle OBD certification, vehicle manufacturers are required to use certain communication protocols (data transmission languages). Since 1996, there have been 7* different protocols that have been considered OBD compliant:

- SAE J1850VPW (Society of Automotive Engineers J1850 Variable Pulse Width)
- SAE J1850PWM (Society of Automotive Engineers J1850 Pulse Width Modulation)
- ISO 9141 (International Standards Organization)
- ISO 14230 or KWP2000 (Keyword Protocol 2000)
 - o Fast Initialization
 - o 5-baud Wakeup
- ISO 11898 CAN 11-bit (Controller Area Network 11-bit header)
- ISO 11898 CAN 29-bit (Controller Area Network 29-bit header)

2008 MY and newer vehicles are required to use one or the other version of the CAN protocol. Vehicle manufacturers started phasing the CAN system in as early as 2003 MY. As the CAN system was being phased in, the older SAE and ISO protocols were being phased out.

* The number 7 is based on the different numbers of ISO and SAE standards, and variations within some of the standards.

Data Link Connector

Data Link Connector (DLC) Requirements



In order to achieve a "Pass" in the DLC Result section, the following must be met:

- The DLC must be unobstructed and readily accessible as per vehicle manufacturer design.
- The DLC cannot be modified or tampered with for any reason.
- The DLC must be in the original location.



The emissions inspector is required to determine and record any reason the DLC does not meet requirements.

GVIP Vehicle Inspection

If the DLC has been tampered with

After the DLC ERROR button is selected, a pop-up window is displayed with a list of DLC problems for the inspector to choose from. Once the appropriate DLC problem has been selected, click on the Accept button. The test ends and the Test Results screen will be displayed.

Select DLC problem below:

DLC is inaccessible

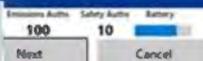
DLC is tampered with

DLC is blocked

DLC cannot be located

Accept

Cancel



OR (DLC).
CONNECTOR.
RY.

5.31 VIR-Monitors and Readiness Codes

**EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
VIR: OBD Monitors and Readiness Status**

Overall results of Readiness status evaluation is identified in the Readiness Result section. Pass/Fail determination takes in to account specific requirements for the vehicle being tested.

Emissions Inspection Result: Pass		Protocol: ICAN11BT	
# of Not Completed Monitors is a count of how many Monitors have not yet completed testing.			
Readiness Result: Pass	# of Not Completed Monitors: 1		
O2 Sensor: Completed	Catalytic Converter: Not Completed	EGR System: Unsupported	
O2 Sensor Heater: Completed	Secondary Air: Unsupported	Evap System: Completed	

Individual emissions control system monitors are listed with their current status shown for reference.

Completed = Monitor has completed testing
 Not Completed = Monitor has not completed testing
 Unsupported = Monitor is disabled either because the related emission control system is not used on the vehicle or is not required to be monitored. 

[Click here for more information on Monitor and Readiness Requirements](#)

Readiness Requirements

**EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
VIR: OBD Monitors and Readiness Status**

Overall results of Readiness status evaluation is identified in the Readiness Result section. Pass/Fail determination takes in to account specific requirements for the vehicle being tested.

Emissions Inspection Result: Pass	<p>In order to achieve a "Pass" in the Readiness Result section (Passing the Readiness monitor test), the following must be met:</p> <ul style="list-style-type: none"> • 1996-2000 MY gasoline-powered vehicles may have no more than 2 Readiness Indicators set to "Not Completed", • 2001 and newer MY gasoline-powered vehicles may have no more than 1 Readiness Indicator set to "Not Completed", • Gasoline-powered vehicles that fail the OBD test with a catalytic converter DTC (P0420-P0439) present must have the catalyst monitor Readiness Indicator set to "Complete" in order to pass the readiness monitor portion of the emissions retest. • Gasoline-powered vehicles will fail the OBD Communications portion of the emissions test if the following monitors are not supported; <ul style="list-style-type: none"> - Oxygen sensor, and - Catalyst.
Readiness Result: Pass	
O2 Sensor: Completed	
O2 Sensor Heater: Completed	

Individual emissions control system monitors are listed with their current status shown for reference.

Completed = Monitor has completed testing
 Not Completed = Monitor has not completed testing
 Unsupported = Monitor is disabled either because the related emission control system is not used on the vehicle or is not required to be monitored. 

[information on Monitor and Readiness Requirements](#)

[<Back](#)

5.32 VIR-Failure

**EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
VIR: Failing Test**

If a subject vehicle fails the emissions test, a failing VIR will be printed and is to be given to the vehicle operator.

Overall Emissions Inspection Result

The VIR will indicate in the Specific Section Results what part or parts of the OBD test the vehicle failed.

Specific Section Results:

- MIL
- DLC
- Communications
- Readiness

If a Fail is listed in any of the above sections, additional information will be available to identify the specifics as to why a failure is indicated.

Emissions Inspection Result: Fail		Protocol: 1914	
MIL Result: Pass	MIL KO2: Pass	MIL KO2R: Pass	MIL Command Status: Pass
Data Link Connector (DLC): Pass	DLC Fail Reason:	DLC Voltage: 14	
OBD Communication: Pass	Comm Fail Reason:	SPM: 726	
Readiness Result: Fail	# of Not Completed Monitors: 2	Prior Converter DTC Reported: No	Prior Evap DTC Reported: No
EVAP Monitor: Completed	Catalytic Converter: Completed	EGR System: Not Completed	EVAP System: Completed
O2 Sensor Heater: Not Completed	Secondary Air: Unsupported	Exhaust System: Completed	
Diagnostic Trouble Code (DTC) Result: Pass	Count of DT: 0	Count of Permanent DTCs: 0	

The most common emissions test failure will be due to too many monitors "Not Completed".

Readiness Result will indicate "Fail". The # of Not Completed Monitors will be displayed and individual monitor status is listed for reference.

5.33 VIR: MRRT

**EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
VIR: Missouri Recognized Repair Technician List**

A failing emissions test VIR will include a list of the ten (10) nearest repair facilities employing a Missouri Recognized Repair Technicians (MRRTs) to the licensed emissions inspection station that the failed test occurred at. This list is printed below the emissions details section of the VIR. A repair data sheet that is used to collect emissions repair data for the repair facility performance report will also be printed and given to the motorist, after development and approval.

The repair data sheet will be printed by the test equipment for each failing vehicle and provided by the inspection station to the motorist. The information on repair data sheets will be collected and entered by emissions inspectors into the emissions test equipment.

The information to be collected shall include, but not be limited to, the following:

1. The total cost of repairs, divided into parts and labor;
2. The name of the repair facility and, if applicable, the repair business's inspection station number and/or the MRRT facility's identification number; and
3. The inspection failure the vehicle was being repaired for and the emissions-related repairs performed.

The repair data and resulting emissions test outcome will be used to develop a Repair Effectiveness Index (REI) for any repair shop choosing to participate.

TBD in software

5.34 Emissions Inspection Procedures

**EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
Emissions Inspection and Reinspection Procedures**

If the emissions inspection is aborted by the emissions equipment software or the emissions inspector, the emissions inspection station shall provide the vehicle owner or driver with the emissions VIR that indicates that the OBD test was aborted.

Vehicles that fail an initial test are required to be repaired and then reinspected.

Vehicles that fail the emissions inspection shall be reinspected to determine if the repairs were effective at correcting failures on the previous inspection, thereby reducing or preventing an increase in present and future tailpipe or evaporative emissions.

The inspector shall enter the data from the repair data sheet into the emissions equipment prior to initiating the re-inspection, even if the vehicle receives multiple reinspections.

The inspector shall ensure that the VIN of the re-inspected vehicle matches the VIN of the originally inspected vehicle.

Repair Data Sheet still TBD in software



5.35 Emissions Reinspection Procedures

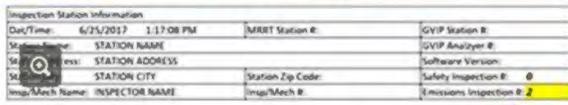
**EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
Emissions Re-Inspection Procedures**

Conducting an emissions re-inspection follows the procedures as an initial inspection, including taking new photographs. Upon passing a re-inspection, the emissions inspection station shall issue the vehicle owner or driver a passing VIR certifying that the vehicle has passed the emissions inspection, and provide a windshield sticker for the windshield of the subject vehicle.

If the subject vehicle fails a re-inspection, the vehicle owner may either:

- A. Have more repairs performed on the vehicle and have the vehicle re-inspected; or
- B. Apply for a cost-based waiver.

Test counter information is displayed on the VIR in the Inspection Station Information section. reinspections are identified by counter #'s 2 and above.



5.36 Exemptions and Waivers

**EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
Vehicle Exemptions And Waivers**

Vehicles that are exempt from emissions testing include:

- Vehicles above 8,500 GVWR and older than the listed model years are not subject to emissions testing;
- Motorcycles and motortricycles;
- Vehicles powered exclusively by electric or hydrogen power or by fuels other than gasoline, ethanol (E10 and E85), or diesel;
- Historic motor vehicles;
- School buses;
- Tactical military vehicles;
- Specially constructed vehicles;
- Plug-in hybrid electric vehicles (PHEVs).

Specific exemptions exist for the following:

- New and unused motor vehicles;
- Vehicles that qualify for mileage-based exemptions;
- Out-of-area exempted vehicles.

Other special circumstances may involve the vehicle owner working with the DNR and obtaining a:

- Cost-based repair waiver;
- Estimate based repair waiver;
- Out-of-area waiver;
- Reciprocity waiver.

Refer to the applicable sections of the CSR for more information.

6. Test Procedure Details and Design Rationale

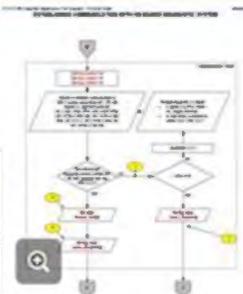
6.1 Intro Test Details

TEST PROCEDURE DETAILS & DESIGN RATIONAL

OBD Emissions Testing

The OBD test procedure has been designed with input from nearly every vehicle manufacturer in order to ensure proper functionality of each step and the necessary information is obtained to provide accurate emissions test results.

Emissions Inspection Result: Pass		Protocol: ICA118T	
MIL Result: Pass	MIL KOEO: Pass	MIL KOER: Pass	MIL Command Status: Pass
Data Link Connector (DLC): Pass	DLC Fail Reason:	DLC Voltage: 12	RPM: 0
OBD Communication: Pass	Comm. Fail Reason:	Prior Converter DTC Reported: No	Prior Evap DTC Reported: No
Readiness Result: Pass	# of Not Completed Monitors: 1	EGR System: Unsupported	Evap System: Completed
O2 Sensor: Completed	Catalytic Converter: Not Completed	Count of Permanent DTCs: 0	
SI Sensor Heater: Completed	Secondary Air: Unsupported		
Diagnostic Trouble Code (DTC) Result: Pass	Count of DTCs: 0	Count of Permanent DTCs: 0	



The vehicle's On-Board Diagnostic (OBD) system is actually doing the evaluation of the emissions control systems and making the determination whether or not the systems are functioning properly and are fault-free. The GVIP test equipment is designed to gather information from the vehicle's OBD system and based on the retrieved information, determines if the vehicle should Pass or Fail the emissions test.



Notes:

According to 10 CSR 10-5.381 (which is commonly referred to as "this rule") (5) (B):The OBD test shall follow the procedures described in 40 CFR 85.2222, which is incorporated by reference in this rule, as published by the EPA, Office of Transportation and Air Quality, 2000 Traverwood, Ann Arbor, MI 48105 on April 5, 2001. This rule does not incorporate any subsequent amendments or additions to 40 CFR 85.2222.

1. If the subject vehicle cannot be tested with the OBD test due to manufacturer design, then the subject vehicle shall be tested with only a bulb check test described in paragraph (5)(B)2. of this rule.
 2. Bulb check test.
 - A. Vehicles will fail the bulb check portion of the OBD test if the MIL is not illuminated while the key is in the on position and the engine is off (KOEO).
 - B. Vehicles will fail the bulb check portion of the OBD test if the MIL is illuminated while the key is in the on position and the engine is running (KOER).
 - C. Vehicles with keyless ignitions shall be subject to a bulb check test.
 - D. Vehicles that fail the KOEO bulb check portion of the OBD test described in subparagraph (5)(B)2.A. of this rule shall fail the OBD test. Repairs made to correct bulb check failures shall not be eligible for cost-based or estimate-based waivers.

6.2 MIL Visual Inspection

TEST PROCEDURE DETAILS & DESIGN RATIONAL
MIL Visual Inspection

An important part of the emissions test procedure is the visual inspection of the Malfunction Indicator Light (MIL).

The MIL is the critical link between the vehicle's OBD system and the vehicle operator. If an emissions related malfunction has been detected by the vehicle's OBD system, the MIL is illuminated to notify the vehicle operator that some type of emissions related problem has been detected and requires attention.



Due to the importance and purpose of the MIL, the inspector is required to visually inspect MIL operation under two vehicle operating conditions:

- Key On Engine Off (KOEO) and;
- Key On Engine Running (KOER).

In order to properly conduct the visual inspections of the MIL, the inspector must know the MIL appearance and behavior during both KOEO and KOER operating conditions.

6.3 MIL Appearance/Operation

TEST PROCEDURE DETAILS & DESIGN RATIONAL
MIL Appearance & Operation During KOEO

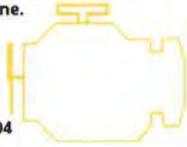
Vehicle manufacturers may use the phrase "Service Engine Soon" or equivalent (Check Engine, etc.)

The ISO engine symbol may be substituted for the word "Engine" or may be used alone.



Possible MIL colors:

- Amber
- Red
- Standardized to **AMBER** in 2004



In order to verify the MIL is able to illuminate properly, vehicle manufacturers are required to illuminate the MIL as a bulb check during the KOEO condition. For vehicles model year (MY) 1996 through 2004, MIL ON time during KOEO varies from approximately one-half second to being ON continuously.

For 2005 and subsequent MY vehicles, the MIL is required to be illuminated for a minimum of 15 seconds.

Generally, the MIL is located on the drivers side of the dashboard. However, the MIL may be in the instrument cluster, above the instrument cluster, or in a drivers information center.

Notes:

There are other indicators such as "Service Vehicle Soon" that may be easily confused with the emissions MIL. The inspector must be careful when completing the visual inspection process.

6.4 MIL-KOEO

TEST PROCEDURE DETAILS & DESIGN RATIONAL
KOEO MIL Visual Inspection

During the emissions test, the inspector is required to verify the MIL illuminates during the KOEO operating condition and enter the results of this visual MIL check at the appropriate analyzer software prompt.



GVIP Vehicle Inspection
 Bulb Check Test

If the inspector indicates the MIL DOES illuminate during KOEO, the vehicle passes this portion of the emissions test procedure.

With the engine OFF, turn the key to the ON position.
 Does the MIL illuminate?

Yes No

If the inspector indicates the MIL DOES NOT illuminate during KOEO, the vehicle fails this portion of the emissions test procedure and will ultimately fail the emissions test.

Internet Access: 100 Emissions Auths: 10 Safety Auths: 10 Battery: 10
 [Next] [Cancel]

6.5 MIL-KOEO_NOTES

TEST PROCEDURE DETAILS & DESIGN RATIONAL
KOEO MIL Visual Inspection Notes

IMPORTANT NOTES RELATED TO THE KOEO VISUAL MIL INSPECTION:

Due to variations in how the vehicle manufacturers interpreted OBD regulations relating to the MIL operation, the emissions inspector must be aware of the differences in how the MIL may behave during the KOEO operating condition.



Click here to display information relating to a short MIL ON time during KOEO



Click here to display information relating to a flashing MIL during KOEO

Short MIL ON Time

Test Procedure Details and Design Rational MIL Visual Inspection Notes: Short ON Time

If the inspector is unfamiliar with the exact location of the MIL, it is possible to miss the initial MIL bulb check during KOEO. If the inspector feels the bulb check was missed, the ignition should be turned OFF for at least 12 seconds and then back to KOEO in order to initiate the MIL bulb check again. This repeat of the bulb check does not disrupt the test sequence. Once MIL operation during the bulb check has been properly verified, the inspector should continue with the vehicle test by selecting the appropriate response on the inspection tablet screen.



Flashing MIL KOEO-Readiness

Test Procedure Details and Design Rational MIL Visual Inspection Notes: Flashing During KOEO

Beginning with the 2001 model year, some vehicle manufacturers use the MIL to indicate whether or not all Readiness Indicators are set to "Completed".

MIL operation during KOEO is as follows:

- KOEO operating state is initiated; - MIL comes on steady.
- After 20 seconds in this state the MIL will do one of two things:
 1. Cycle on and off to indicate that one or more Readiness Indicators are "Not Completed". Depending on manufacturer, the amount of time the MIL flashes varies from five to ten seconds.
 2. Remain on steady or extinguish (varies with manufacturer) for the duration of the KOEO period to indicate all Readiness Indicators are "Completed".



6.6 MIL-KOEO_NOTES pg2

TEST PROCEDURE DETAILS & DESIGN RATIONAL
KOEO MIL Visual Inspection Notes

Vehicles with keyless ignitions are subject to the visual MIL inspection during KOEO. Be aware that keyless ignition systems have been around since model year 2002. In order to properly conduct the KOEO visual inspection, inspectors are required to follow proper procedures to initiate the KOEO operating condition. For most keyless ignition system vehicles, initiating the KOEO operating condition requires the remote control being in the vehicle or inserted into the dash slot. With the engine off, press the "START-STOP" button once without depressing the brake pedal. To start the engine for KOER, depress the brake pedal and press the "START-STOP" button a second time.

Keyless Ignition Equipped Vehicles
Revised 2/16/2009 COURTESY OF THE NATIONAL OBD CLEARINGHOUSE AT WEBER STATE UNIVERSITY

YEAR	MAKE	MODEL	ENGINE	TRANSMISSION	DRIVE	TEST TYPE	KEYLESS IGNITION "KOEO" and "KOER" TEST PROCEDURES		
2004	Bentley	Bentley	Continental GT	1	12	3	A	1	To initiate a MIL bulb check: 1. Ensure the remote control is in the passenger compartment. 2. If the engine is running, stop it by pressing the "START-STOP" button in the lower centre console control panel. 3. Then, without touching the brake pedal, press the "START-STOP" button again. This is the "accessory on, bulb check" mode. The MIL and other warning lamps appear in the Instrument Warning Panel, located around the speedometer and tachometer.

The complete Keyless Ignition reference file, available from the National OBD Clearinghouse, is available through the Resources tab in the upper right corner of the screen.

Repairs made to correct bulb check failures are not eligible for cost-based or estimate-based waivers.

6.7 MIL-KOER

TEST PROCEDURE DETAILS & DESIGN RATIONAL
KOER MIL Visual Inspection

The second visual MIL inspection performed by the emissions inspector is during the Key On Engine Running (KOER) vehicle operating condition.

Start the Engine and let idle.
Does the MIL illuminate?

Yes No

The analyzer software will prompt the inspector to start the engine and note the MIL illumination status, whether the MIL is ON or OFF.

If the MIL is OFF during the KOER operating condition, the OBD system is indicating that no current emissions-related malfunctions exist.

If the MIL is ON during the KOER operating condition, the OBD system is indicating that one or more emissions-related malfunctions exist. If the MIL is flashing during KOER operating conditions, the MIL is considered ON. [Click here for more information.](#)

When the inspector indicates the MIL is ON during KOER, the vehicle will Fail the OBD test.

Inspector entered results for the MIL visual inspection during KOEO and KOER are listed on the VIR.

Reminder: Vehicles shall be inspected in as received condition, including vehicles whose MIL is lit.

Emissions Inspection Result: Fail		Protocol:	
MIL Result: Fail	MIL KOEO: Pass	MIL KOER: Fail	MIL Command Status: Fail
Data Link Connector (DLC):	DLC Fail Reason:		DLC Voltage: N/A
OBD Communication: N/A	Comm. Fail Reason: N/A		RPM: N/A
Readiness Result: N/A	# of Not Completed Monitors: N/A	Prior Converter DTC Reported: No	Prior Evap DTC Reported: No
O ₂ Sensor Heater: N/A	Catalytic Converter: N/A	EGR System: N/A	
	Secondary Air: N/A	Evap System: N/A	
Diagnostic Trouble Code (DTC) Result: N/A	Count of DTCs: 0	Count of Permanent DTCs:	



MIL Flashing during KOER

Test Procedure Details and Design Rational OBD I/M Testing: Flashing MIL During KOER

Under certain circumstances, the MIL may flash during KOER. If the MIL is flashing during KOER, the inspector should indicate that the MIL is illuminated.

If the MIL is flashing during KOER, a catalyst damaging misfire has been detected by the OBD system and is indicated by flashing the MIL while the engine is running.

The vehicle operator should be encouraged to get the vehicle repaired as soon as possible in order to avoid permanent damage to the catalytic converter.



When an engine misfire occurs, engine out HCs increase. When excess HCs pass into the catalytic converter(s), internal temperatures increase due to the excess heat energy that is released as the HCs are combusted and converted into H₂O and CO₂.

6.8 DLC Details

TEST PROCEDURE DETAILS & DESIGN RATIONAL Data Link Connector (DLC) Details

The Data Link Connector (DLC) provides both the physical and electrical connections necessary for data communications to occur between the vehicle's OBD system and an off-board computer system.



All 1996 and newer light-duty vehicles with spark-ignition engines and all 1997 and newer light-duty vehicles with compression-ignition engines have the required DLC.



If a DLC is located behind a panel or cover, be cautious when removing the panel or cover.

The shape, size, and 8 of the 16 cavities have been standardized in order to improve connection and communication efficiency between on-board and off-board computer systems such as the GVIP test equipment.

SAE J1962 is the Recommended Practice relating to the DLC. [Click here to link to a full copy of the SAE standard.](#)



6.9 DLC Location

TEST PROCEDURE DETAILS & DESIGN RATIONAL
Data Link Connector (DLC) Location

Locating the vehicle's DLC and connecting the emissions test equipment to the vehicle DLC is an essential step of the emissions test.

Information retrieved from the vehicle's OBD system is essential in order to determine whether or not the vehicle should Pass or Fail the GVIP emissions test. Vehicles will fail the DLC portion of the emissions test if the DLC is inaccessible due to manufacturer design, tampered with, blocked, or not located where the manufacturer originally located the DLC.

Image courtesy of OBDclearinghouse

6.10 DLC Connections

TEST PROCEDURE DETAILS & DESIGN RATIONAL
DLC Connections

When instructed to connect the DAD to the vehicle's DLC, the inspector must determine whether or not the DLC is able to provide a secure mechanical connection as well as good electrical connections for all terminals being used to facilitate the electronic transfer of vehicle data.

Before connecting the DAD to the vehicle's DLC, visually inspect the area around the DLC to ensure there is nothing that will block or prohibit the DAD's DLC from making a complete mechanical connection.

The vehicle DLC should be fastened and located so as to permit a one-handed/blind insertion of the mating test equipment connector.

The DLC alignment tab is designed to help ensure the test equipment connector is properly positioned as the connectors are pushed together.

Partial connection **Full connection**

When connecting the test equipment to the vehicle DLC, ensure the connector is fully seated.

Vehicle DLC **Test Equipment DLC**

6.11 Tampered or Damaged DLC

TEST PROCEDURE DETAILS & DESIGN RATIONAL
Tampered or Missing DLC

If the DLC is inaccessible, has been tampered with, is blocked with an aftermarket component, or cannot be located, select the **DLC ERROR** button.

Confirm there is an error with the vehicle DLC by selecting the **Yes** button in the pop-up window that appears after selecting the **DLC ERROR** button.

• LOCATE THE
• ATTACH THE
• PUSH POWER

Is there an error with the vehicle DLC?

Yes No

After selecting Yes, a list of possible problems will be displayed. Select the appropriate reason why the DAD cannot be connected to the vehicle DLC and then select the **Accept** button.

The test will end and the printed VIR will indicate the vehicle failed the emissions test, and will list the specific reason for failure.

Select DLC problem below:

- DLC is inaccessible
- DLC is tampered with**
- DLC is blocked
- DLC cannot be located

Accept Cancel

Emissions Inspection Result:	Fail	Protocol:		
MIL Result: Pass	MIL KOEO: Pass	MIL KOER: Pass	MIL Command Status: N/A	
Data Link Connector (DLC): Fail	DLC Fail Reason: DLC is tampered with	DLC Voltage: N/A		
OBD Communication: N/A	Comm. Fail Reason: N/A	RPM: N/A		

6.12 MIL Command

TEST PROCEDURE DETAILS & DESIGN RATIONAL
Vehicle Communications: MIL Command

Required information for emissions test Pass/Fail determination is transmitted over the data communications network from the vehicle's OBD system and includes:

- MIL Command Status (two possible states, either ON or OFF);
 - MIL Command ON due to the presence of confirmed emissions related malfunctions or;
 - MIL Command OFF as a result of no confirmed emissions related malfunctions currently detected.

MIL Command Status is included as part of the information listed on the VIR.

Emissions Inspection Result:	Fail			
MIL Result: Fail	MIL KOEO: Pass	MIL KOER: Fail	MIL Command Status: Fail	

IMPORTANT NOTE:
Before MIL Command data is transmitted from the vehicle to the GVIP test equipment, the engine must be running due to inconsistencies between vehicle manufacturer's MIL Command during KOEO. It is possible for a vehicle to have the MIL Command "ON" during KOEO and no emission related failures currently present. The GVIP equipment will prompt the inspector to start the engine at the appropriate time. The inspector must follow the instructions properly, as it is possible to cause a false failure of the vehicle.

Notes:

For 2005 MY and subsequent vehicles, during KOEO MIL COMMAND will be "OFF" unless a confirmed failure exists.

6.13 Initiate OBD Communications

TEST PROCEDURE DETAILS & DESIGN RATIONAL
Vehicle Communications: MIL Command

GVIP Vehicle Inspection
Built Check Test

During the visual inspection of the MIL, the inspector is instructed to start the engine prior to completing the KOER visual MIL inspection.

The engine is to remain running for the remainder of the test.

Start the Engine and let idle.

After results of the visual MIL inspection are entered, the Next button selected, the DAD successfully connected to the vehicle's DLC and the Next button selected on the connect DAD instruction screen, the DAD will automatically initiate communications with the vehicle's OBD computer system. Once communications have been established, the DAD will retrieve information needed to determine if the vehicle should Pass or Fail the emissions test. Information retrieved includes MIL Command, DTCs (if MIL Command = ON), and Monitor status.

GVIP Vehicle Inspection
OBD Test

Test in Progress

Notes:

For 2005 MY and subsequent vehicles, during KOEO MIL COMMAND will be "OFF" unless a confirmed failure exists.

6.14 Monitor Readiness

TEST PROCEDURE DETAILS & DESIGN RATIONAL
Vehicle Communications: Monitor Readiness

Emissions Inspection Result:		Protocol:	
MIL Result:	MIL KOED:	MIL KOER:	MIL Command Status:
Data Link Connector (DLC):	DLC Fail Reason:		DLC Voltage:
OBD Communication:	Comm. Fail Reason:		RPM:
Readiness Results:	# of Not-Completed Monitors:		Prior Converter DTC Reported:
O2 Sensor:	Catalytic Converter:		EGR System:
O2 Sensor Heater:	Secondary Air:		Evap System:
Diagnostic Trouble Code (DTC) Result:	Count of DTCs:		Count of Permanent DTCs:

Monitor readiness conveys important information regarding the emissions control systems on the vehicle and whether or not the OBD system has been able to determine if each specific emission control system is functioning properly or not (operational status).

In order to determine if any malfunctions exist that may cause vehicle emissions to exceed applicable standards, the OBD system is programmed to monitor all aspects of each emission control system along with engine management, which includes the fuel delivery and spark control systems.

Monitoring each system for any type of malfunction that might cause vehicle emissions to exceed standards requires sophisticated testing and evaluation of system performance. Monitoring must also occur during vehicle operating conditions that will ensure an accurate determination of the system's operational status.

6.15 VIR and Readiness Codes

TEST PROCEDURE DETAILS & DESIGN RATIONAL
VIR and Readiness Indicators

Emissions Inspection Result: Pass		Protocol: ICAN11BT	
MIL Result: Pass	MIL KOEO: Pass	MIL KOER: Pass	MIL Command Status: Pass
Data Link Connector (DLC): Pass	DLC Fail Reason:		DLC Voltage: 12
OBD Communication: Pass	Comm. Fail Reason: N/A		RPM: 963
Readiness Result: Pass	# of Not Completed Monitors: 0	Prior Converter DTC Reported: No	Prior Evap DTC Reported: No
O2 Sensor: Completed	Catalytic Converter: Completed	EGR System: Unsupported	
O2 Sensor Heater: Completed	Secondary Air: Unsupported	Evap System: Completed	
Diagnostic Trouble Code (DTC) Result: Pass		Count of DTCs: 0	Count of Permanent DTCs: 0

Each emission control system that is monitored for proper operation has a Readiness Indicator. The Readiness Indicator shows when monitoring of the related system is complete (indicated as "Completed") or has not yet accomplished the system evaluations (indicated as "Not Completed"). If a Readiness Indicator is "Completed", the operational status of that emission control system has been determined. If no Diagnostic Trouble Codes (DTCs) are stored and the MIL is not commanded ON, the emission control system is functional and fault-free.

If a Readiness Indicator shows "Not Completed" for a specific emission control system, the operational status has not been determined and further evaluation is needed to determine if a malfunction exists that might cause emissions to exceed applicable standards, or the system is functional and fault-free.

Readiness Indicators do not indicate Pass/Fail status of the emissions control systems.

6.16 VIR-Monitors and Readiness Codes

EMISSIONS INSPECTION REGULATIONS & PROCEDURES:
VIR: Monitors and Readiness Indicators

Overall results of Monitor Readiness evaluation are identified in the Readiness Result section. Pass/Fail determination takes in to account specific requirements for the vehicle being tested.

Emissions Inspection Result: Fail		Protocol: ICAN11BT	
MIL Result: Pass	MIL KOEO: Pass	MIL KOER: Pass	MIL Command Status: Pass
Data Link Connector (DLC): Pass	DLC Fail Reason:		DLC Voltage: 12
OBD Communication: Pass	Comm. Fail Reason: N/A		RPM: 963
Readiness Result: Fail	# of Not Completed Monitors: 2	Prior Converter DTC Reported: No	Prior Evap DTC Reported: No
O2 Sensor: Completed	Catalytic Converter: Not Completed	EGR System: Unsupported	
O2 Sensor Heater: Completed	Secondary Air: Unsupported	Evap System: Not Completed	
Diagnostic Trouble Code (DTC) Result: Pass		Count of DTCs: 0	Count of Permanent DTCs: 0

Individual Readiness Indicators are listed with their current status shown for reference.

Completed = Monitor has completed testing
 Not Completed = Monitor has not completed testing
 Unsupported = Monitor is disabled either because the related emission control system is not used on the vehicle or is not required to be monitored. 

Count of Not Ready Monitors show how many Monitors have not been able to complete testing.

[Click here for more information on unsupported emission control systems](#)

Monitor Unsupported But Emission Control System Present On Vehicle

Monitor Unsupported But Emission Control System Present On Vehicle

There are instances where an engine may have an EGR system present on the engine but the OBD system shows the EGR monitor as Unsupported, or the EGR monitor is supported but there is no external EGR system on the engine. The reasons these combinations may be present include:

- The EGR system being used as a fuel economy system but does not cause emissions to exceed applicable standards if a malfunction is present.
- The engine uses a Variable Valve Timing (VVT) system to accomplish exhaust gas recirculation (internal EGR) and does not need an external EGR system.

There are engines manufactured by GM and Land Rover that were originally certified with AIR systems, but later were re-certified without AIR. With the new certification, the engine computer can be reprogrammed and the AIR system is rendered non-functional. With the AIR non-functional, the AIR monitor is turned off and the AIR Readiness Code displays Unsupported. In this case, the inspector would indicate that the AIR appears to be present, but the OBD system will show the AIR system as not supported.

6.17 Monitors and Readiness Code Requirements

TEST PROCEDURE DETAILS & DESIGN RATIONAL			
Readiness Indicator Requirements for Emissions Testing - Gasoline			
There are different requirements for vehicles to pass the Readiness Indicator portion of the OBD test, depending on vehicle model year and fuel type.			
Emissions Inspection Result: Fail		Protocol: ICAN11BT	
MIL Result: Pass	MIL KOEO: Pass	MIL KOER: Pass	MIL Command Status: Pass
Data Link Connector (DLC): Pass	DLC Fail Reason:	DLC Voltage: 12	
OBD Communication: Pass	Comm. Fail Reason: N/A	RPM: 963	
Readiness Result: Fail	# of Not Completed Monitors: 2	Prior Converter DTC Reported: No	Prior Evap DTC Reported: No
O2 Sensor: Completed	Catalytic Converter: Not Completed	EGR System: Unsupported	Evap System: Not Completed
O2 Sensor Heater: Completed	Secondary Air: Unsupported	Diagnostic Trouble Code (DTC) Result: Pass	
Count of DTCs: 0		Count of Permanent DTCs: 0	
<p>1996 – 2000 model year gasoline-powered vehicles may pass the Readiness portion of the test if they have no more than 2 Not Completed Monitors.</p>		<p>2001 and newer model year gasoline-powered vehicles may pass the Readiness portion of the test if they have no more than 1 Not Completed Monitor.</p>	
Vehicles must pass the Readiness portion of the OBD test to be eligible for a cost-based or estimate-based waiver	Monitor Readiness Requirements For Diesel-Powered Vehicles	Gasoline-powered vehicles that fail due to a catalytic converter DTC P0420 through P0439 commanding the MIL ON, must have the catalyst Readiness Indicator set to "Completed" in order to pass the Readiness portion of the emission retest .	

Diesel Vehicle Readiness Requirements

Readiness Indicator Requirements for Emissions Testing - Diesel

Emissions Inspection Result: Pass		Protocol: ICAN11BT	
MIL Result: Pass	MIL KOEO: Pass	MIL KOER: Pass	MIL Command Status: Pass
Data Link Connector (DLC): Pass	DLC Fail Reason:		DLC Voltage: 12
OBD Communication: Pass	Comm. Fail Reason: N/A		RPM: 963
Readiness Result: Pass		# of Not Completed Monitors: 1	Prior Converter DTC Reported: No
Exhaust Gas Sen: Completed	NMHC Catalyst: Completed	PM Filter: Not Completed	Prior Evap DTC Reported: No
PM Filter: Not Completed	Boost Pressure: Completed	NOX/SCR: Completed	GR/VVT System: Completed
Diagnostic Trouble Code (DTC) Result: Pass		Count of DTCs: 0	Count of Permanent DTCs: 0

1997 – 2009 model year diesel-powered vehicles may pass the Readiness portion of the test only if all monitors are Completed.

2010 and newer model year diesel-powered vehicles may pass the Readiness portion of the test if they have no more than 1 Not Completed Monitor.

If a vehicle reports 6 supported monitors, 1 monitor is allowed to be set to Not Ready.

6.18 CAT/O2 Monitor Requirement

TEST PROCEDURE DETAILS & DESIGN RATIONAL Specific Requirements for O2S and Catalytic Converter Monitors

Gasoline -powered vehicles will fail the readiness monitor portion of the OBD test if the Catalytic Converter and/or O2 Sensor monitors show "Unsupported".

Emissions Inspection Result: Fail		Protocol: ICAN11BT	
MIL Result: Pass	MIL KOEO: Pass	MIL KOER: Pass	MIL Command Status: Pass
Data Link Connector (DLC): Pass	DLC Fail Reason:		DLC Voltage: 12
OBD Communication: Pass	Comm. Fail Reason: N/A		RPM: 963
Readiness Result: Fail		# of Not Completed Monitors: 1	Prior Converter DTC Reported: No
O2 Sensor: Unsupported	Catalytic Converter: Unsupported	O2 Sensor Heater: Not Completed	Prior Evap DTC Reported: No
O2 Sensor Heater: Not Completed	Secondary Air: Unsupported	Evap System: Completed	EGR System: Unsupported
Diagnostic Trouble Code (DTC) Result: Pass		Count of DTCs: 0	Count of Permanent DTCs: 0

Vehicles that are known to legitimately have either or both of these two monitors not supported are automatically recognized in the analyzer software and will not fail for this reason.

Repairs made to correct for Monitor Readiness tampering caused by unauthorized electronic modifications to the OBD system programming or the installation of aftermarket components shall not be eligible for cost-based or estimate-based waivers.

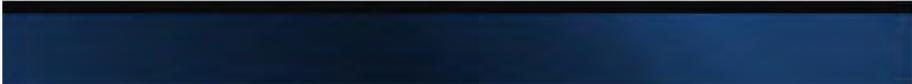
Monitor Unsupported But Emission Control System Present On Vehicle

Test Procedure Details and Design Rational Monitor Unsupported But Emission Control System Present On Vehicle

There are instances where an engine may have an EGR system present on the engine but the OBD system shows the EGR monitor as Unsupported, or the EGR monitor is supported but there is no external EGR system on the engine. The reasons these combinations may be present include:

- The EGR system being used as a fuel economy system but does not cause emissions to exceed applicable standards if a malfunction is present,
- The engine uses a Variable Valve Timing (VVT) system to accomplish exhaust gas recirculation (internal EGR) and does not need an external EGR system.

There are engines manufactured by GM and Land Rover that were originally certified with AIR systems, but later were re-certified without AIR. With the new certification, the engine computer can be reprogrammed and the AIR system is rendered non-functional. With the AIR non-functional, the AIR monitor is turned off and the AIR Readiness Indicator displays Unsupported. In this case, the inspector would indicate that the AIR appears to be present, but the OBD system will show the AIR system as not supported.



6.19 Readiness Code Information for Drivers

TEST PROCEDURE DETAILS & DESIGN RATIONAL Monitor Readiness Failures and Information to Provide the Vehicle Owner

Vehicles that fail the emissions test due to too many Readiness Indicators in the “Not Completed” state need to be operated in a way that meets the enable criteria related to the monitors that have not run to completion. Vehicle operators/owners should be encouraged to operate their vehicle following these general guidelines that are known to help meet non-continuous monitor enable criteria:

- Fuel tank level should be between 1/4 and 3/4 full
- Cold start - engine coolant and ambient air temperatures should be between 40° F and 90° F and within 10° F of each other at engine start-up 
- Start the engine and idle normally for 2 minutes with A/C system turned off
- Drive vehicle until normal engine temperature has been reached and is stable
- Achieve a stable cruise speed at approximately 40mph for 5 minutes. This stable cruise DOES NOT have to occur uninterrupted. Testing will resume when the cruise condition resumes. 
- Accelerate to 60mph and then decelerate gradually to 30mph
Repeat this acceleration/deceleration process 3 times.
- Stop the vehicle and allow the engine to idle for 2 minutes
- Turn the engine off for at least 2 minutes
- The stable cruise and acceleration/deceleration conditions may need to be repeated a second time.

Emissions Inspection Result:		Pass	Protocol: ICA11187				
Ins. Result:	State	Ins. O2SD	Pass	Ins. O2SD	Pass	Ins. Comment Status:	Pass
Data Link Connector (DLC)	Pass	DLC Fuel Reason		DLC Voltage	12		
OBD Communication	Pass	Comm. Fail Reason	N/A	IRMS	98.9		
	Pass	# of Not Completed Monitors	0	Prior Emission DTC Reported	No		
	Completed	Catalytic Converter	Completed	Prior Prep DTC Reported	No		
	Completed	Secondary Air	Unsupported	EVAP System	Completed		
	Completed			Loop System	Completed		
Diagnostic Trouble Code (DTC) Result:		Pass	Count of DTCs	0	Count of Persistent DTCs	0	

Startup Temperature Information

Temperature Requirements for Cold Start-up

Most vehicle manufacturers do not use a fuel temperature sensor to measure fuel temperature directly, so in order to determine fuel temperature, the engine coolant and ambient air temperatures are used. When the engine and ambient air temperatures are within 10° F of each other, fuel temperature is calculated to be at the same temperature as well.

Fuel temperature information is needed by the Evaporative Emissions Control System monitor in order to calculate expected (predetermined) fuel vapor pressure changes based on operating conditions. Predetermined fuel vapor pressures are compared to actual fuel vapor pressures to identify the presence of leaks in the vapor and liquid fuel storage system.

Parking a vehicle outside for many hours in order to allow the engine temperature to equalize to ambient air will typically satisfy the start-up temperature requirements, however, be aware that if the vehicle has been parked outside over night and is started during the early dawn hours, the ambient air temperature may have dropped several degrees and the engine temperature won't be able to change as rapidly. As a result, both the engine coolant and ambient air temperatures may be within the 40° F - 90° F range, but may not necessarily be within 10° F of each other, even though the vehicle has been parked over night.

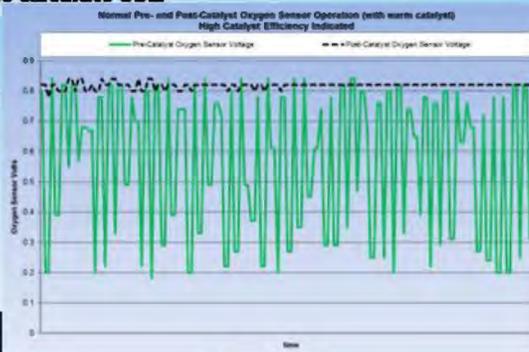
Cruise Information

Low-Speed Cruise

The low-speed cruise operating condition is important for several monitors, such as the catalyst efficiency and oxygen sensor monitors, and for some vehicles, the EGR system.

Catalytic converter efficiency determination is based on oxygen storage capacity (OSC). High OSC translates to high converter efficiency, and low OSC indicates a catalytic converter malfunction. OSC is calculated from exhaust oxygen sensors (O2Ss) located in front (pre-catalyst) and in back (post-catalyst) of the catalytic converter(s). In order to use O2S signals for catalyst efficiency determination, the catalyst must be at normal operating temperatures and engine load conditions need to be stable long enough to gather the amount of information to calculate OSC.

The most common strategy for catalytic converter efficiency determination includes monitoring pre- and post-catalyst O2S signals during a low-speed (approximately 40mph) cruise with engine load conditions steady, which results in steady exhaust flow rates. To help ensure steady exhaust flow, the A/C compressor should be off.



6.20 Readiness Codes Reset

TEST PROCEDURE DETAILS & DESIGN RATIONAL
OBD Readiness Indicator Reset

Once a Readiness Indicator indicates a system as having been monitored, the Readiness Indicator remains "Ready" until a reset occurs. A reset will occur if any of the following events take place, and result in all* Readiness Indicators for the non-continuous monitors resetting to "Not Ready":

- (1) If the PCM loses connection to the battery positive or negative circuit(s).
- (2) If battery voltage goes below a minimum value.
- (3) When DTC information is cleared from PCM memory with a scan tool.
- (4) If the PCM uses EEPROM technology and is able to be reprogrammed, Readiness Indicators will be reset during the reprogramming procedure.

*Some PCM's store Readiness Indicator information in non-volatile memory and are only reset during the scan tool DTC information clear process. These systems also store MIL status in non-volatile memory and MIL status is only reset with the DTC information clear process.

6.21 DTCs

TEST PROCEDURE DETAILS & DESIGN RATIONAL
MIL Command ON & DTCs

Diagnostic Trouble Codes (DTCs) are 5-digit alpha-numeric codes with which the OBD system uses to specify the type and general location of malfunctions. P0420

Each DTC has an associated test that is designed to detect a failure with an emissions control system/component, or system/component that is used for monitoring an emission control system.



Vehicles will fail the emissions test if the OBD system has stored one or more DTCs that cause the MIL to illuminate.

Vehicles will not fail the emissions test due to the presence of DTCs only.

When an emissions related problem has been detected and confirmed to be an actual component or system malfunction that may cause emissions to exceed applicable standards, the OBD system will command the MIL ON to alert the driver that the vehicle is in need of service, and will store the applicable DTC information.

Vehicles will fail the emissions test if the OBD system commands the MIL ON even though there may be no DTCs stored in the system.

[Click here for information related to DTC Service Modes](#)

[Click here for information related to DTC operation](#)

[Click here for examples of DTCs](#)

[Click here for more information on DTC structure](#)

DTC Details

Test Procedure Details and Design Rational DTC Structure

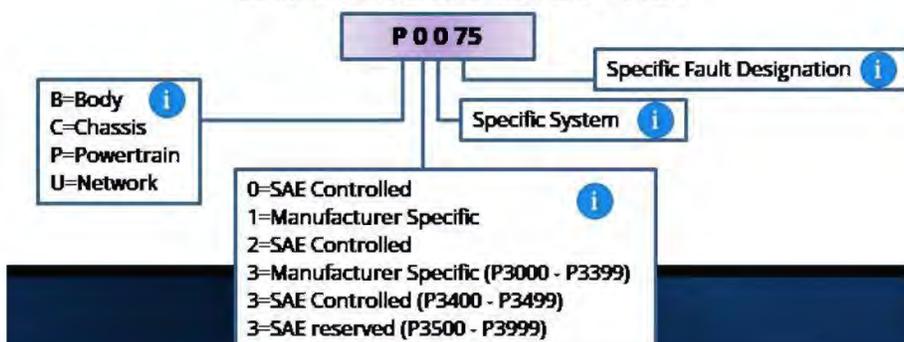
DTCs are intended to indicate the type and general location of emission related faults.

With OBD standardization, DTC structure, types and general operation are similar between vehicle manufacturers.

The uniform DTC numbering system used by OBD systems follows the SAE J2012 Recommended Practice for Diagnostic Trouble Code Definitions. DTCs are required to be displayed in a five-digit alpha/numeric format.

DTC Structure Example:

Intake Valve Control Solenoid Circuit Bank 1



Specific DTCs-Examples

DTC Examples

DTC	NAME/DESCRIPTION
P0170	Fuel Trim Malfunction (Bank 1)
P0171	System too lean (Bank 1)
P0172	System too rich (Bank 1)
P0300	Random or multiple cylinder misfire detected
P0301*	Cylinder #1* misfire detected
P0420	Catalyst System Efficiency Below Threshold Bank 1
P0430	Catalyst System Efficiency Below Threshold Bank 2
P0439	Catalyst Heater Control Circuit Bank 2
P0600	Serial Communication Link
P0650	MIL Control Circuit/Open
P202A	Reductant Tank Heater Control Circuit/Open
P34A3	Cylinder 12 Deactivation/Intake Valve Performance

*DTCs P0301 - P0312 are related to misfire in specific cylinders

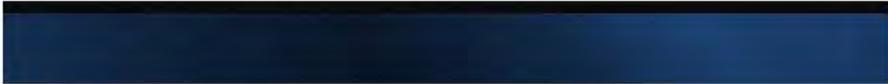
DTC and MIL Illumination

Test Procedure Details and Design Rational DTCs and MIL Illumination

A vehicle does not fail an emissions test due to the presence of DTCs alone. This is because of the operational rules of DTCs that have been standardized for all light-duty gasoline powered vehicles since 1996 MY.

If a malfunction that caused the MIL to illuminate is not present for 3 consecutive operating events where the test(s) related to the MIL illuminating malfunction runs and passes, the MIL is allowed to extinguish, but the DTC(s) will remain in memory for a duration of 40 warm-up cycles. 

Because of this allowance, a vehicle does not, and should not, fail the emissions test based solely upon the presence of DTCs.



DTC Related Service Modes

Test Procedure Details and Design Rational MIL Command ON & DTCs

During the emissions test, communications between the vehicle OBD system and the off-board testing equipment is facilitated through the use of several different service modes. There are 3 different service modes related to retrieving DTCs:

- **Service Mode \$03** retrieves DTCs that identify confirmed emissions-related malfunctions and will cause the MIL to be commanded ON when the malfunction is first confirmed. Mode \$03 DTCs will be printed on the VIR if the MIL is currently commanded ON.
- **Service Mode \$07** retrieves DTCs that identify emissions-related malfunctions which have not yet been confirmed and consequently have not yet caused the MIL to illuminate. Mode \$07 DTCs are not printed on the VIR.
- **Service Mode \$0A** retrieves DTCs that can only be cleared by the vehicle OBD system after the malfunction has been determined to be no longer present and the MIL is no longer being commanded ON. A permanent DTC is stored when a confirmed (Mode \$03) DTC is stored and is commanding the MIL to illuminate.

Emissions Inspection Result:		Fail		Pass		Protocol: ICAN29BT	
MIL Result:	Fail	MIL ADED:	Pass	MIL ADR:	Fail	MIL Command Status:	Fail
Data Link Connector (DLC):	Pass	DLC Fail Reason:		DLC Voltage:	14.2		
OBD Communication:	Pass	Comm. Fail Reason:	None	SPN:	989		
Readiness Result:	Pass	# of Not Completed Monitors:		Prior Complete DTC Reported:	No		
O2 Sensor:	Completed	Catalytic Converter:	Not Completed	EVAP System:	Completed		
O2 Sensor Heater:	Completed	Secondary Air:	Unsupported	EVAP System:	Completed		
Diagnostic Trouble Code (DTC) Result:	Fail	Count of DTCs:	0	Count of Permanent DTCs:	0		
DTC Features: P0136 O2 Sensor Circuit Bank 1 Sensor 2							
P0131 O2 Sensor Heater Circuit Bank 1 Sensor 2							
P0131 System Too Lean Bank 1							
P0401 EGR "A" Flow Insufficient Detected							
P0442 EVAP System Leak Detected (small leak)							
P1333							

Only Mode \$03 DTCs will be printed on the VIR.

*The \$ identifies a hexadecimal value

6.22 Vehicle Communications

TEST PROCEDURE DETAILS & DESIGN RATIONAL Vehicle Communications Summary

Vehicles will fail the communications portion of the emissions test if the vehicle does not maintain sufficient voltage to the DLC during OBD communication or if the OBD system does not transmit the necessary information to the inspection equipment.

If the vehicle does not communicate after the second communication attempt, inspectors shall verify that a valid communications failure exists by using the MDAS OBD verification tool to verify the communication failure according to the lane software procedures.

If the OBD verification tool determines that the DAD is not capable of communicating with the vehicle, the MDAS will automatically abort the OBD test and generate an emissions VIR to describe the failure.

If the OBD verification tool determines that the DAD is capable of communicating with the vehicle, inspectors are required to make one additional communication attempt. If the vehicle does not communicate with the MDAS, the MDAS shall determine and record the reason for this failure and print this reason on the emissions VIR.

6.23 Emissions Testing Summary

TEST PROCEDURE DETAILS & DESIGN RATIONAL Emissions Testing Summary

To accurately conduct an emissions test, the inspector must know:

- The various appearances of the MIL and range of behaviors during KOEO;
- Normal MIL operation and possible variations during KOER;
- The appearance and location of the DLC;
- Proper on- and off-board DLC connection and disconnection procedures;
- Proper vehicle operating conditions during each step of the emissions test;
- How to properly conduct a self-test during a non-communication event to identify whether the vehicle or the equipment is at fault;
- How to accurately interpret VIR information.

7. Emission Control Devices and Systems

7.1 Control Systems Introduction

EMISSION CONTROL DEVICE FUNCTION, CONFIGURATION, & INSPECTION

Hydrocarbons (HC), Carbon Monoxide (CO), Nitrogen Oxides (NOx), and Particulate Matter (PM) are the principle pollutants emitted to the atmosphere from the exhaust of an internal combustion engine. HC emissions are also a result of evaporating fuel and crankcase vapors.

The Clean Air Act of 1977, and subsequent amendments to the Clean Air Act, sets limits to the amounts of these pollutants that can be emitted from a vehicle. Over time, these standards have evolved and have continued to drive technological advancements in order to meet the newer and more stringent standards.

To address these challenges, fuels have improved, vehicle and engine manufacturers have created self-adjusting fuel and ignition control systems, made improvements in basic engine design as well as significant advancements in managing intake and exhaust valve opening/closing events, and added pollution control devices such as catalytic converters that reduce emissions by over 90% when operating properly.

The slide includes a graph titled 'HC Emissions Standards' showing hydrocarbon emissions in grams per mile (g/mi) for various vehicle types and standards. The y-axis ranges from 0 to 0.4 g/mi. Standards shown include Tier 1 (0.4 g/mi), TLEV (0.3 g/mi), LEV (0.2 g/mi), ULEV (0.1 g/mi), and SULEV and Tier 2 (0.05 g/mi). A legend indicates that 0.4 g/mi is the 1990 Standard, 0.3 g/mi is LEV, 0.2 g/mi is TLEV, 0.1 g/mi is ULEV, and 0.05 g/mi is SULEV and Tier 2. Two diagrams illustrate engine components: one shows a fuel injection system with labels for Fuel Injector, Fuel Rail, Fuel Filter, Fuel Pump, and Fuel Line; the other shows a catalytic converter with labels for Inlet, Outlet, and various internal components.

7.2 Control Systems pg 2

EMISSION CONTROL DEVICE FUNCTION, CONFIGURATION, & INSPECTION
OBD Systems

Modern OBD systems represents major advancements in the detection and identification of emissions-related malfunctions. OBD requirements not only improve fault detection, OBD regulations also standardize:

- Emissions-related terminology,
- Data communications between on-board and off-board computer systems,
- Diagnostic Link Connector (DLC),
- Malfunction Indicator Light (MIL),
- Readiness Indicator operation,
- Stored diagnostic information, including diagnostic trouble codes (DTCs) and stored engine conditions (Freeze Frame).

OBD conducts the monitoring and fault detection/notification processes related to the vehicle's emission control system and powertrain operation. Monitoring and evaluation for proper operation of the powertrain, emission control systems, and any other component or system that is part of a diagnostic strategy used in emissions controls or fault detection, occurs as often as vehicle operating conditions will allow.

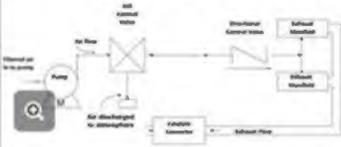
Diagnostic information stored in on-board computer memory is designed to aide diagnosticians more efficiently identify, repair, and verify repairs of emissions-related malfunctions.



7.3 AIR Systems

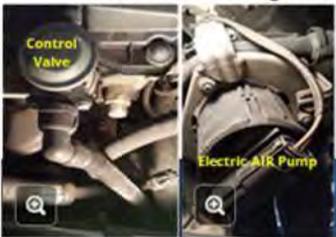
EMISSION CONTROL DEVICE FUNCTION, CONFIGURATION, & INSPECTION
Secondary Air Injection Reaction (AIR) Systems

Secondary Air Injection Reaction (AIR) Systems have been used on spark ignition engines since the 1970's. The main purpose of AIR systems is to reduce HC emissions during cold engine operating conditions. Due to the rich air/fuel ratio needed for good engine performance during cold conditions, HC emissions are much higher.



AIR systems are designed to direct fresh air under pressure into the exhaust stream immediately after the exhaust ports. The fresh air mixes with hot exhaust gases and continues the combustion of fuel (HCs) not burned in the combustion chamber. As an additional benefit, CO molecules may combine with oxygen to form CO₂, reducing CO emissions during cold start as well.

Electronically controlled AIR systems typically consist of an electrically driven pump and a solenoid operated directional control valve to either allow air to flow from the pump to the exhaust system or to be diverted away from the exhaust system, depending on engine operating conditions.

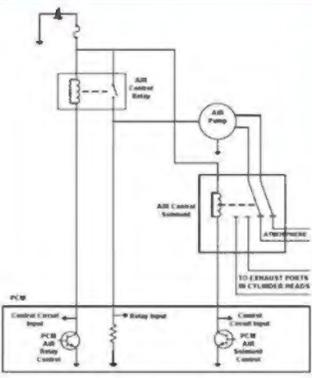


Control Valve
Electric AIR Pump

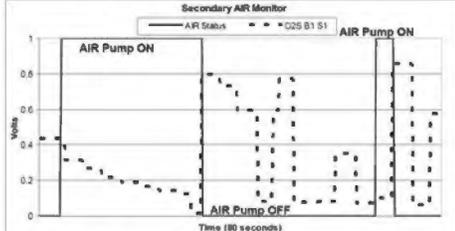
[Click here for information related to AIR System OBD Monitoring](#)

AIR OBD Monitoring

Emission Control Devices and Systems:
AIR System Monitoring



OBID monitoring of AIR systems not only identifies electrical circuit failures but also identifies system performance malfunctions such as air flow to the wrong position, physically inoperative switching valves or pumps that have restricted or no flow.



Although there are several methods used by the vehicle manufacturers to verify proper AIR system performance, a common approach includes monitoring the pre-catalyst exhaust oxygen sensor (O2S1) and comparing the change in the signal to the commanded change of the AIR pump's ON/OFF state. If the pump and related flow controls are operating properly, there will be a direct correlation.

7.4 A/C Systems

EMISSION CONTROL DEVICE FUNCTION, CONFIGURATION, & INSPECTION Air Conditioning (A/C) Systems

Typically, the A/C system is not included in emissions inspections, however, due to OBD monitoring requirements there may be vehicles that may have the A/C system monitor supported.

1996 through 2005 model year vehicle monitoring requirements for the Air Conditioning (A/C) system is limited to refrigerant compounds that can harm the stratospheric ozone layer or are reactive in forming atmospheric ozone. Any loss of refrigerant must be detected. Monitoring of the A/C system includes detection of any faults with the sensors for the A/C system. Once a leak has been detected, the MIL must remain illuminated until the leak has been repaired. Manufacturers using federally approved refrigerants (i.e., R-134A for automobiles) need not comply with this monitoring requirement.

According to the OBD requirements from EPA and the California Air Resources Board (CARB), beginning model year 2006, vehicle manufacturers using "... an engine control strategy that alters off idle fuel and/or spark control when the A/C system is on, the OBD II system shall monitor all electronic air conditioning system components for malfunctions that cause the system to fail to invoke the alternate control while the A/C system is on or cause the system to invoke the alternate control while the A/C system is off. Additionally, the OBD II system shall monitor for malfunction all electronic air conditioning system components that are used as part of the diagnostic strategy for any other monitored system or component. . .If no single electronic component failure or deterioration causes emissions to exceed 1.5 times any of the appropriate applicable emission standards. . .nor is used as part of the diagnostic strategy for any other monitored system or component, manufacturers are not required to monitor any air conditioning system component. . ." CARB 1968.2

7.5 Catalytic Converter Systems

EMISSION CONTROL DEVICE FUNCTION, CONFIGURATION, & INSPECTION Catalytic Converter Systems Used With Spark Ignition Engines

In the U.S.A., catalytic converters have been used with spark-ignition engines (engines fueled with gasoline, natural gas and propane) since the 1970's. As catalytic converters became more common, leaded fuel was phased out of use due to the lead contamination that occurred inside the catalytic converters. 

Modern catalytic converters are typically referred to as 3-Way Converters (TWCs) because they are designed to split NOx (NO and NO₂) into nitrogen (N₂) and oxygen (O and O₂), as well as combine oxygen with HCs to produce water (H₂O) and carbon dioxide (CO₂) and combine oxygen with carbon monoxide (CO) to produce carbon dioxide (CO₂).



A catalyst helps promote chemical reactions under conditions the reaction wouldn't normally occur, and is not consumed in the reaction. As a result, a catalytic converter is designed to last the lifetime of the vehicle and will not "wear out" through normal use. Certain malfunctions, such as engine misfire, create conditions that can permanently damage a catalytic converter.



click for more information

[Click here for information related to TWC System OBD Monitoring](#)

[Back to Section 3: HC's](#)

Because of the importance of the Catalytic Converter, the GVIP program requires the TWC Monitor to be supported by the vehicle's OBD system. 

Damaged TWC

Emission Control Devices and Systems: TWC Damage



TWC internal damage as shown in the photograph, is caused by excessive heat resulting from excessive amounts of unburned fuel passing through the engine. As the unburned fuel (HCs) come in contact with the catalyst sites, the hydrogen and carbon atoms separate, releasing a large amount of heat energy. If too much heat energy is released in a short amount of time, the metal and ceramic materials will melt.

Chemicals such as lead, glycol-based engine coolants, carbon (soot), silicon additives in fuels and sealants, and phosphorus from engine oils can poison the catalytic converter by accumulating on the surface of the catalyst sites.

Poison accumulations restrict exhaust emissions from contacting the catalyst sites, lowering catalytic converter efficiency.

Most¹ poisons will not permanently damage the catalytic converter, but if the source of the poison is not removed in time, the buildup will prohibit normal operating temperatures from being reached and the poison will not eventually burn off.

¹ Lead is a permanent poison for catalytic converters

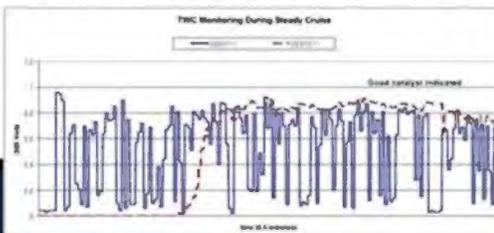
TWC OBD Monitoring

Emission Control Devices and Systems: TWC OBD Monitoring

Three Way Catalyst (TWC) operation is monitored for efficiency once the TWC(s) have reached normal operating temperatures and a steady operating state has been achieved. TWC temperatures are determined by:

- Calculations based on operating conditions since engine start and/or
- A TWC temperature sensor providing input to the PCM

Currently vehicle manufacturers have used monitoring strategies that include HO2S's in front and back of the TWC(s). By monitoring the HO2S signals, oxygen storage capacity (OSC) of the TWC is determined and TWC efficiency can be calculated. Currently for many systems, monitoring takes place during a steady cruise while engine loads are fairly stable. For this monitoring strategy, the front and rear HO2S signals are compared over a sample period to determine TWC OSC and calculate TWC efficiency.

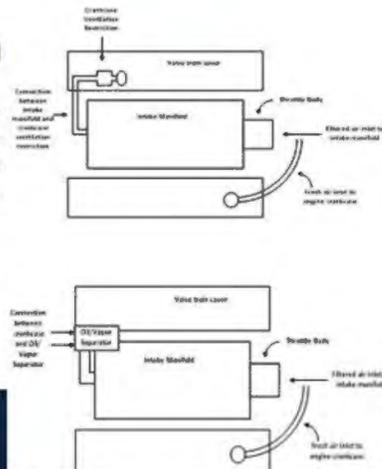


7.6 Crankcase Ventilation Systems - Spark Ignition Engines

EMISSION CONTROL DEVICE FUNCTION, CONFIGURATION, & INSPECTION Spark-Ignition Engine Crankcase Vapor Control Systems

Crankcase vapors consist mostly of HCs from hot oil vapor and blow-by gases, which are easily combustible. The purpose of the positive crankcase ventilation (PCV) system is to draw crankcase vapors into the intake system instead of allowing the vapors out into the atmosphere.

Controlling crankcase vapor flow is accomplished several different ways by the various vehicle manufacturers. Spark-ignition engine crankcase ventilation systems have a filtered fresh air inlet to allow filtered air into the crankcase where the fresh air mixes with the crankcase vapors. From the crankcase, vapors are drawn through the flow control valve/restriction or an oil/vapor separator, into the intake manifold and then into the combustion chamber.



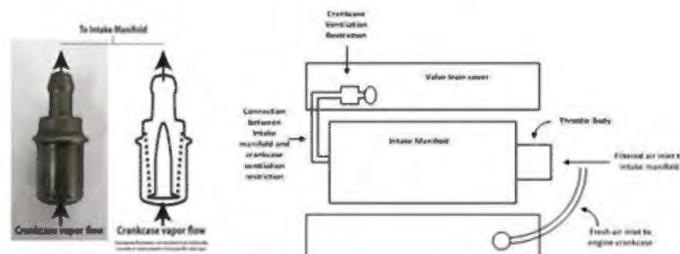
[Click here for information related to PCV Valve](#)

[Click here for information related to PCV System OBD Monitoring](#)

PCV Valve Details

Emission Control Devices and Systems: Positive Crankcase Ventilation (PCV) Valve

The most common method of crankcase vapor flow control uses a variable orifice valve (Positive Crankcase Ventilation or PCV valve) along with a calibrated spring that works with intake manifold pressure to determine the exact placement of the tapered valve relative to the orifice. As the tapered valve is moved against spring pressure, the valve regulates the amount of vapor flow, preventing too much flow during low intake manifold pressure conditions, but helping to ensure adequate flow is possible during high pressure conditions in the intake manifold. The valve also helps to prevent any back-fire in the intake manifold from being transmitted to the crankcase.



PCV System OBD Monitoring

Emission Control Devices and Systems: OBD Monitoring Requirements for PCV Systems

PCV system monitoring requirements began with vehicle model year 2002 and were phased in through 2004. Monitoring of the PCV system is part of the Comprehensive Component Monitor and is required to identify if a disconnect occurs between the PCV valve and the engine crankcase or between the PCV valve and intake manifold. Exceptions to the monitoring requirement include the following engine design features:

- PCV systems designed such that the PCV valve is fastened directly to the crankcase in a manner which makes it significantly more difficult to remove the valve from the crankcase rather than disconnect the line between the valve and the intake manifold (taking aging effects into consideration)
- Connections between the PCV valve and crankcase are resistant to deterioration or accidental disconnection, are significantly more difficult to disconnect than the line between the valve and the intake manifold, and are not subject to disconnection per manufacturer's repair procedures for non-PCV system repair work.
- If a disconnect between the PCV valve and the intake manifold (1) causes the vehicle to stall immediately during idle operation; or (2) is unlikely due to a PCV system design that is integral to the induction system (e.g., machined passages rather than tubing or hoses).

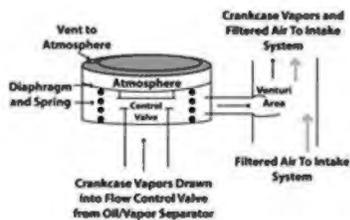
To accommodate these exceptions so PCV system monitoring is not required, manufacturers have taken different approaches to redesigning PCV systems such as using a threaded connection between the PCV valve and engine crankcase or valvetrain cover or incorporating an integrated fixed size orifice into a fitting at the crankcase or valve cover.

7.7 Crankcase Ventilation Systems - Compression Ignition Engines

EMISSION CONTROL DEVICE FUNCTION, CONFIGURATION, & INSPECTION Compression-Ignition Engine Crankcase Vapor Control Systems

Modern compression-ignition (diesel fuel powered) engines also use a closed-crankcase ventilation (crankcase emissions control) system in order to prevent HC-rich crankcase vapors from escaping into the atmosphere.

Due to higher combustion chamber pressures and resulting blow-by gas volumes, diesel-powered engines typically do not require a filtered fresh air inlet to the crankcase area as do spark-ignition engines. Through the use of a pressure control valve (or valves), crankcase pressures are maintained at a constant level.



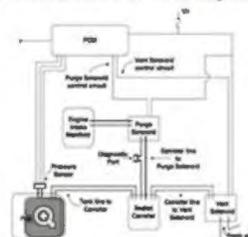
7.8 EECS

EMISSION CONTROL DEVICE FUNCTION, CONFIGURATION, & INSPECTION Evaporative Emissions Control Systems (EECS)

Evaporative Emissions Control Systems (EECS) are designed to reduce HC emissions on gasoline powered vehicles.

HC evaporative emissions come from any area where fuel is stored on the vehicle, such as fuel tanks. In an effort to reduce fuel vapors from escaping to the atmosphere during refueling events, vehicle manufacturers have incorporated on-board fuel vapor recovery into the EECS.

The EECS is designed to store fuel vapors at times when the engine is not able to use (combust) the vapors, but release (purge) the fuel vapors during operating conditions when the engine can combust the fuel vapors. There are many different system designs, but all systems have a storage canister with a source of fresh air into the canister, some type of sealing system on the fuel refill side (fuel cap or other), control valves/ solenoids, and vacuum hoses connecting the various components together.



Examples of different EECS storage canisters



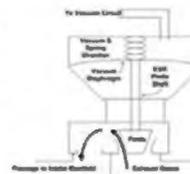
7.9 EGR Systems

EMISSION CONTROL DEVICE FUNCTION, CONFIGURATION, & INSPECTION Exhaust Gas Recirculation (EGR) Systems

Exhaust Gas Recirculation (EGR) systems are designed specifically to help reduce NOx emissions in both spark (gasoline, CNG, etc.) and compression ignition (diesel) engines. Since NOx emissions are formed under high temperature conditions, the function of the EGR system is to reduce overall combustion chamber temperatures.

Temperature reductions are achieved by introducing a small, metered amount of exhaust gas back into the intake system. The exhaust gas partially fills the combustion chamber, reducing the amount of room for air, and as a result, less fuel is needed. With less air and fuel in the combustion chamber, less heat energy is released during the combustion process, and NOx emissions are reduced. Some vehicle manufacturers also list the EGR system as a fuel economy system due to the reduced fuel used while the EGR system is operational.

EGR systems use either an external valve to meter exhaust gas flow from the exhaust system to the intake manifold, or a variable timing camshaft system that varies the amount of exhaust and intake valve overlap.



Electronic EGR

7.10 EGR Systems pg 2

EMISSION CONTROL DEVICE FUNCTION, CONFIGURATION, & INSPECTION
Exhaust Gas Recirculation (EGR) Systems

EGR systems that are used on modern compression ignition (diesel fueled) engines typically include some type of cooling system to help stabilize and control exhaust gas temperatures before being directed back into the induction system.

If EGR flow is not adequate, NOx emissions increase, while too much EGR flow will cause rough running (misfire), raising HC emissions.



Diesel EGR Cooler

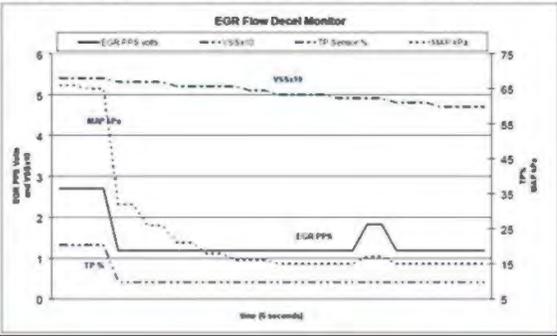
[Click here for information related to EGR System variations](#)

[Click here for information related to EGR System OBD Monitoring](#)

EGR OBD Monitor

Emission Control Devices and Systems: EGR OBD System Monitor

The EGR system can be monitored several different ways, but one of the most common methods to verify proper EGR functionality is to open the EGR valve during an extended deceleration event and monitor both the EGR pintle position, as well as the change in intake manifold pressure. As the EGR valve opens, exhaust gas flows into the intake manifold and causes an increase in the intake manifold pressure. The rate of pressure change should match predetermined values based on the position of the EGR valve's pintle.



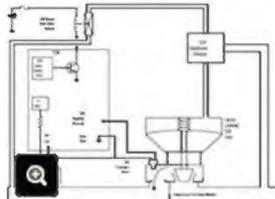
EGR Flow Decel Monitor

Time (seconds)	EGR PPS (voh)	VSS (v/h)	TP Sensor (%)	IMAP (Pa)
0	1.5	60	15	35
1	1.5	60	15	35
2	1.5	60	15	35
3	1.5	60	15	35
4	1.5	60	15	35
5	1.5	60	15	35
6	1.5	60	15	35
7	1.5	60	15	35
8	1.5	60	15	35
9	1.5	60	15	35
10	1.5	60	15	35
11	1.5	60	15	35
12	1.5	60	15	35
13	1.5	60	15	35
14	1.5	60	15	35
15	1.5	60	15	35
16	1.5	60	15	35
17	1.5	60	15	35
18	1.5	60	15	35
19	1.5	60	15	35
20	1.5	60	15	35
21	1.5	60	15	35
22	1.5	60	15	35
23	1.5	60	15	35
24	1.5	60	15	35
25	1.5	60	15	35
26	1.5	60	15	35
27	1.5	60	15	35
28	1.5	60	15	35
29	1.5	60	15	35
30	1.5	60	15	35
31	1.5	60	15	35
32	1.5	60	15	35
33	1.5	60	15	35
34	1.5	60	15	35
35	1.5	60	15	35
36	1.5	60	15	35
37	1.5	60	15	35
38	1.5	60	15	35
39	1.5	60	15	35
40	1.5	60	15	35
41	1.5	60	15	35
42	1.5	60	15	35
43	1.5	60	15	35
44	1.5	60	15	35
45	1.5	60	15	35
46	1.5	60	15	35
47	1.5	60	15	35
48	1.5	60	15	35
49	1.5	60	15	35
50	1.5	60	15	35

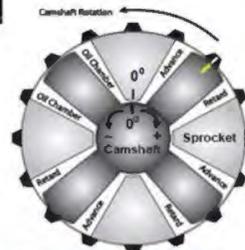
EGR System Variations

Emission Control Devices and Systems: EGR System Variations

Some vacuum controlled EGR systems use an external Backpressure Transducer in order to better regulate the vacuum signal to the EGR valve. The Backpressure Transducer is a critical component to the EGR system and must have all the necessary vacuum and exhaust fittings/connections in place and secured for proper operation.



Many engines now use some type of variable valve timing (VVT) system which varies camshaft timing relative to the crankshaft on either the intake, exhaust or both camshafts. Variable valve timing provides many benefits including reduced pumping losses, increased volumetric efficiency, removal of the external exhaust gas recirculation system with improved exhaust gas recirculation distribution among cylinders which all add up to improved torque across a wider engine RPM range.



Variable Valve Timing Actuator

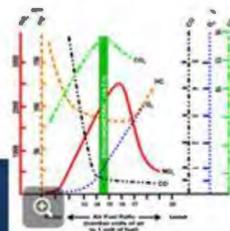
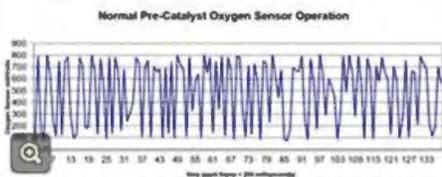
7.11 O2S Systems

EMISSION CONTROL DEVICE FUNCTION, CONFIGURATION, & INSPECTION Exhaust Oxygen Sensor (O2S) Systems

One of the significant advancements in vehicle emissions controls is the electronic spark and fuel injection engine management system with feedback information to more closely control the spark timing and fuel being delivered based on the amount of oxygen available in each combustion event.

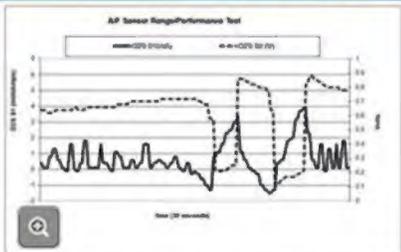
With the intake air mass known, a base fuel injection pulse can be calculated for the current vehicle operating conditions. To further adjust or "trim" injector pulse width, exhaust oxygen must be determined. Conventional exhaust oxygen sensors (O2S) are able to detect oxygen in the exhaust stream and provide a signal that represents oxygen amounts above (lean) and below (rich) the target 14.7:1 air to fuel ratio.

Intake air volume and density can be calculated or measured through the use of sensors that are able to provide input data that represents critical engine operating conditions such as Mass Air Flow (MAF), Manifold Absolute Pressure (MAP), Throttle Position (TP), Engine Coolant Temperature (ECT) and Engine RPM.



7.12 O2S Systems

EMISSION CONTROL DEVICE FUNCTION, CONFIGURATION, & INSPECTION
Exhaust Oxygen Sensor (O2S) Systems



Wide-band oxygen sensors (commonly referred to as A/F sensors) provide a more accurate signal relating to the actual air to fuel ratio. A/F sensors are able to accurately indicate exhaust oxygen levels from 10:1 up to atmospheric oxygen in the exhaust.

Regardless of the exhaust oxygen sensor system type used, the Readiness Monitor section of the VIR will indicate O2 Sensor.

On vehicles that use A/F sensor(s), the A/F sensor(s) will be located in front of the TWC system and a conventional O2S located behind the TWC system. All O2Ss used for fuel trim calculations (pre- and post-TWC) are included in the O2S Monitor.



Click here for information related to O2S System OBD Monitoring

Because of the important feedback information the O2S(s) provide, the GVIP program requires the O2S Monitor to be supported by the vehicle's OBD system.

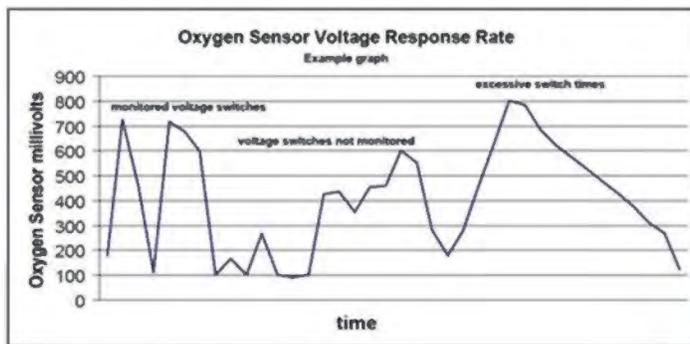
O2S System OBD Monitoring

Emission Control Devices and Systems:
O2S System OBD Monitoring

Oxygen sensors (O2S) or Heated O2S (HO2S) used for fuel control are required to be monitored for proper response rate, output voltage, and any other operating characteristic that affect emissions.

Response rate of an HO2S is the time required for the signal to switch from below/above and above/below calibrated levels, indicating the variations in exhaust oxygen content. The switching must occur within a predetermined amount of time.

The ability of the HO2S to accurately respond to the changes in exhaust oxygen content is critical for accurate feedback to the PCM for proper air/fuel control.



O2S signal circuits are also monitored for shorts to positive voltage, ground, and open circuit conditions.

7.13 Heated O2S Systems

EMISSION CONTROL DEVICE FUNCTION, CONFIGURATION, & INSPECTION
Heated Exhaust Oxygen Sensor (O2S) Systems

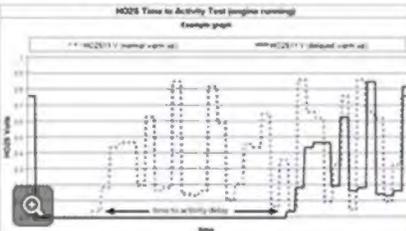
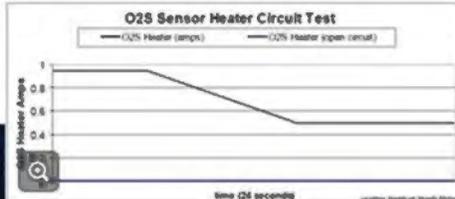
In order to provide important exhaust oxygen information as soon as possible after engine start, most exhaust oxygen sensors use some type of a heater system in order to bring the sensor element up to operating temperature quickly without causing thermal shock or other damage to the sensing element.

O2S heaters are built in to the sensor and are not serviced separately from the sensor itself.

The O2S Heater monitor is separate from the O2S monitor in order to allow unique Monitor Readiness display. Separate Monitor Readiness more clearly indicates monitoring progress of the complex exhaust oxygen sensing system.

O2S heater monitoring includes heater circuit continuity and performance. Performance can be determined through time-to-activity or by measuring heater amperage.

Inspection Item	Result	Pass	Protocol	Comments
Exhaust Oxygen Sensor (O2S) Heater	Pass	Pass	Exhaust Oxygen Sensor (O2S) Heater	

7.14 Diesel Exhaust Catalyst Systems

EMISSION CONTROL DEVICE FUNCTION, CONFIGURATION, & INSPECTION
Diesel Exhaust Catalyst Systems

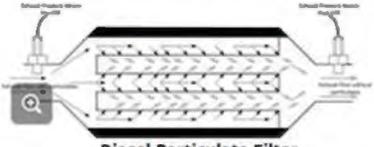
Diesel Oxidation Catalysts (DOCs) use the same catalyst metals (platinum/palladium) as spark ignition engines in order to convert HC's and CO into H₂O and CO₂. DOCs are also known to help reduce particulate matter in diesel exhaust. As a result of the multiple benefits derived from the use of DOCs, some vehicle manufacturers will combine a DOC with a Diesel Particulate Filter (DPF) in order to increase the amount of particulates removed from the exhaust.

Particulate filters are designed specifically to reduce harmful particulates from the exhaust.

Selective Catalyst Reduction (SCR) systems are also used on some diesel engines in order to reduce NOx emissions by injecting diesel emissions fluid (DEF) into the exhaust in front of a specialized catalyst designed to promote reactions between NOx emissions and the ammonia based DEF, which results in the formation of H₂O (water), and N₂ (nitrogen).



Diesel Oxidation Catalyst



Diesel Particulate Filter



Selective Catalyst Reduction System

7.15 Emission Control Devices and Systems Summary

EMISSION CONTROL DEVICE FUNCTION, CONFIGURATION, & INSPECTION Summary

A visual inspection of the vehicle emission control systems and components should include verifying all related electrical connections are securely connected to the related device and free from corrosion, and that the wiring is properly routed away from any moving components or other abrasive surfaces.

Exhaust system plumbing should be free from corrosion and/or leaks. Post-TWC O2Ss should not be threaded in to any type of spacer or extension.

All vacuum components and hoses should be properly connected and routed properly away from heat sources or abrasive surfaces.

8. Quality Control Procedures and Purpose

8.1 Quality Control

QUALITY CONTROL PROCEDURES & PURPOSE

The GVIP has many features that address all aspects of a successful IM program. Program management and enforcement involves the Missouri Department of Natural Resources (DNR) and Missouri State Highway Patrol (MSHP).

MISSOURI NATURAL RESOURCES



The mission of the DNR is to protect our air, land and water; to preserve our unique natural and historic places; and to provide recreational and learning opportunities for everyone.



MISSOURI STATE HIGHWAY PATROL

The mission of the MSHP is to serve and protect all people by enforcing laws and providing services to ensure a safe and secure environment.

DNR and MSHP work together to develop and prosecute cases of inspection fraud, which sometimes involves working with the Federal EPA. License suspension, revocation, fines and even inspector jail time are potential consequences of emissions inspection fraud.

8.2 Enforcement Actions

QUALITY CONTROL PROCEDURES & PURPOSE
Quality Control for Emissions Inspection Stations

Failure to comply with the emissions inspection law or the emissions inspection rule will subject the emissions inspection station manager and emissions inspector(s) to one (1) or more of the following procedural penalties: i

- * Warning;
- * Lockouts from being able to conduct official inspections; [List Of Lockouts >](#)
- * Fines that will not be less than five (5) times the amount of the fee described in paragraph (3)(D)1. of the emissions rule;
- * Suspension or revocation of emissions inspection station and/or inspector licenses;
- * Department or MSHP requests for investigation and/or criminal and civil penalties by the U.S. Environmental Protection Agency.

Fraudulent emissions inspections or repairs are a violation of the GVIP program rules and will subject the emissions inspection station manager and emissions inspector(s) to procedural penalties that may include fines and/or license suspension or revocation.

GRAVITY-BASED ASSESSMENT MATRIX

		B. EXTENT OF DEVIATION FROM REQUIREMENT		
		MAJOR	MODERATE	MINOR
POTENTIAL FOR HARM	MAJOR	\$10,000 TO \$1,750	\$1,750 TO \$7,500	\$7,500 TO \$1,250
	MODERATE	\$1,250 TO \$1,000	\$1,000 TO \$1,750	\$1,750 TO \$2,500
	MINOR	\$2,500 TO \$1,250	\$1,250 TO \$500	\$0

Lockouts pg1

Quality Control Procedures and Purpose Quality Control for Emissions Inspection Stations: Lockouts

The department or MSHP may electronically lockout any emissions inspector, station, MRRT, or equipment if the department or MSHP identifies any irregularities within the emissions inspection database or any irregularities identified during either overt or covert audits. The lockout may precede warnings, license suspensions or revocations, or arrests. A lockout warning will be displayed on the monitor of any inspection equipment that is locked out by the department or MSHP. Lockouts shall prevent the performing of emissions inspections by the locked out party. Lockouts shall be cleared when the department or MSHP is satisfied that there is no longer a need for the lockout. Irregularities include, but are not limited to:

- * Failure to enter all required information properly and accurately;
- * Uploading unclear pictures, uploading license plate pictures that do not match the license plate recorded on the VIR, or failing to upload pictures ;
- * Clean scanning;
- * Performing more inspections than are physically possible for a given time duration;
- * Performing emissions inspections using another emissions inspector's fingerprint or password;
- * Conducting off-line inspections while the emissions equipment is not connected to the VID, unless the VID is off-line;
- * Conducting improper safety inspection of the air pollution control devices;

Lockouts pg2

Quality Control Procedures and Purpose Quality Control for Emissions Inspection Stations: Lockouts

- * Bad faith or fraudulent repairs performed at the emissions inspection station or MRRT repair facility where:
 - (I) Vehicles repeatedly fail reinspections for the same reasons that they initially failed the OBD test;
 - (II) Vehicle repairs are not qualifying repairs; or
 - (III) Physical visual inspection of the repaired vehicles determines that the repairs were not performed as described on the submitted repair receipts;
- * Installing or assisting motorists with the installation of aftermarket catalytic converters that do not conform to EPA's AMCC enforcement policy;
- * Installing or assisting motorists with the installation of aftermarket components that disable or compromise the capabilities of the vehicle manufacturer's EPA-certified emissions control system;
- * Failure to maintain a positive balance of emissions inspection credit authorizations;
- * Failure to upload the emissions inspection results to the VID immediately upon completion of the inspection ;
- * Failure to properly re-inspect vehicles that failed an initial emissions test;
- * Failure to pay the VID Service Fees according to the terms of the contract between the contractor and licensed emissions inspection;
- * Failure to download and install the latest version of lane software to the MDAS; and
- * Failure to maintain dedicated data transmission capabilities for the emissions inspection equipment to stay online with the contractor's VID.

8.3 Covert Vehicle Program

QUALITY CONTROL PROCEDURES & PURPOSE
Quality Control for Emissions Inspection Stations

All mandatory emissions testing programs such as the GVIP are required by EPA to include covert performance audits as part of the ongoing quality assurance program. The purpose of the covert program is to determine whether or not proper procedures are being followed by the inspector.

The department shall cause unannounced tests of facilities that inspect, repair, service, or maintain motor vehicle emissions components and equipment. This includes submitting vehicles for testing that have known defects for inspection and repair without prior disclosure to the facility.



8.4 Quality Control for Inspection Stations

QUALITY CONTROL PROCEDURES & PURPOSE
Quality Control for Emissions Inspection Stations – Page 1

Emissions inspection windshield stickers will be issued to an emissions inspection station by the MSHP and can be printed by only that station. Emissions inspection windshield stickers shall be kept secure to prevent them from being lost, damaged, or stolen. If windshield stickers are lost, damaged, or stolen, the incident shall be reported immediately to the MSHP at (314) 416-2180 extension 4358.

The inspection of a vehicle shall be made only by an individual who has a current, valid emissions inspector license. No person without a current, valid emissions inspector license shall issue an emissions VIR or a windshield sticker. No owner, operator, or employee of an inspection station shall furnish, loan, give, or sell an emissions VIR or windshield sticker to any person except those entitled to receive it because their vehicle has passed the emissions inspection.

All emissions inspections must be conducted at the licensed emissions inspection station in the approved inspection area.

8.5 Section Summary

QUALITY CONTROL PROCEDURES & PURPOSE Summary		
		
<p>The best quality control for the GVIP program comes from the inspector group performing the vehicle inspections in the manner outlined in the Missouri Code of State Regulations and as detailed in this training program.</p>		
<p>Remember that as a certified inspector, the quality of the vehicle inspection is directly under your control.</p>		
<p>The overall integrity of the program relies on you and your fellow inspectors. The officials at the DNR, MSHP and WEP will help in any way they can if you have questions or concerns.</p>		
Dept. Natural Resources (314) 416-2115	Highway Patrol (314) 416-2180	WEP (800) 832-7664 main (714) 990-3100 fax

9. Public Relations

9.1 Public Relations

PUBLIC RELATIONS

The GVIP Information Center contains a great deal of information that is designed for the driving public, as well as station inspectors.

Each tab across the top of the page has a drop-down list that appears when the mouse cursor hovers above each tab.



**Department of Natural Resources
Inspection and Maintenance Section**

7545 S. Lindbergh, Suite 210
St. Louis, MO 63125
314-416-2115 or 800-361-6627
Email: imsunit@dnr.mo.gov

Opus Inspection

6681 South Cottonwood, Suite 1
Murray, UT 84107
Toll-free 866-623-8378
Telephone 801-265-0099
Fax: 801-265-1199

**Missouri State Highway Patrol
Motor Vehicle Inspections Division**

3180 Koch Road
St. Louis, MO 63125
Telephone 314-416-2180
www.mshp.dps.missouri.gov

**Department of Revenue Central Office
Harry S Truman State Office Building**

301 West High Street
Jefferson City, MO 65101
Motor Vehicle: 573-526-3669
Email: dormail@dor.mo.gov
DOR License/Registration Offices

9.2 Operating Hours-Customer Wait Times

PUBLIC RELATIONS

In order to maintain a high level of satisfaction within the driving public community, an official inspection station will be open for business at least eight continuous hours per day, five days per week, excluding all state holidays.

An official inspection station is also expected to prevent customer wait times from exceeding a two hour period after being presented unless other vehicles are already being emissions inspected. Also, a re-inspection must begin within one hour when a vehicle is presented during the twenty consecutive-day period for re inspections excluding Saturdays, Sundays, and state holidays.

An officially licensed inspection station and officially licensed inspector will be provided with a license certificate. These certificates are to be framed under clean glass or plastic and displayed in a conspicuous location discernible to those presenting vehicles for emissions inspections.

9.3 Station Signs and Poster Display

PUBLIC RELATIONS

The official sign designating the station as an emissions inspection station is required to be displayed in a location visible to motorists driving past the inspection station.

Each station will also be provided with a poster that informs the public that required repairs or corrections need not be made at that inspection station. Waiver and exemption options are also described. The poster is required to be displayed in a conspicuous location discernible to those presenting vehicles for emissions inspections.

Additional signs and posters may be purchased using a purchase requisition form found in the document section of the inspection tablet for a fee equal to the cost to the state for each. The signs/posters will be delivered by a DNR Air Pollution Control Program Inspection Maintenance auditor.

9.4 Public Relations - Summary

PUBLIC RELATIONS
Summary

<p>The GVIP is designed for maximum efficiency for the motoring public while still maintaining the oversight and enforcement to ensure integrity of the program and testing outcomes.</p>	<p>All stakeholders in the GVIP share responsibility to help ensure a good vehicle testing experience is had by the motoring public.</p>
<p>The testing station management is responsible to provide a safe and proper location for tests to be performed, as well as ensuring the inspectors are properly trained.</p>	<p>The inspector needs to ensure an accurate test is performed and correct information is conveyed to the vehicle operator.</p>

DNR is responsible for providing the necessary training and support to the stations and inspectors to ensure the driving public is receiving the proper level of service. DNR is also responsible for enforcement actions in cases where tests are done improperly. DNR also is responsible to help vehicle owners on a case-by-case basis when vehicles are not able to be tested, or repairs are not able to be performed as needed for the vehicle to pass during a normal test cycle.

DPS is responsible for ensuring fair and consistent enforcement of the program, authorities assignment to analyzers and conflict resolution regarding authorities for emissions and safety testing.

10. Vehicle Inspection Safety and Health Issues

10.1 Inspection Safety

VEHICLE INSPECTION SAFETY & HEALTH ISSUES

There are several safety items to be aware of when conducting the vehicle inspection.

As part of the station requirements to be licensed in the GVIP, the emissions test area is to be properly lighted, adequately heated and cooled, and properly ventilated in order to conduct an emissions test safely.

As part of the emissions test, the vehicle engine must be running. As a result of this requirement, vehicle exhaust must be properly evacuated or vented. As discussed in Section 3, CO poisoning is a serious health concern and a very real possibility when working with running vehicles in an enclosed area such as an inspection facility.

When an engine is first started and the catalytic converter is cold (not operating at peak efficiency), CO emissions may be as high as 7% - 10%. As an inspector working around vehicles that have their engine running in an enclosed area, you need to ensure that the vehicle's exhaust is not contaminating the breathable air in your work area.



10.2 Course Summary

SUMMARY

As a certified inspector in the GVIP, you are acting as a representative of the Department of Natural Resources and Highway Patrol. Every vehicle inspection you perform needs to be done with the utmost care and attention to detail.

A vehicle that is in proper operating condition should pass the vehicle inspection and a vehicle that is not operating according to vehicle manufacturer specifications for emissions controls or safety related functions should not pass the test, and as the inspector, you need to ensure that vehicle does not pass the vehicle inspection.

The GVIP has detailed instructions for each inspector to follow that help ensure consistent, repeatable, and accurate test results. At the completion of this training program, the detailed instructions will have been thoroughly covered with review questions being used to help ensure the most important points are understood. The Missouri Code of State Regulations, Title 10 - Department of Natural Resources, Division 10 - Air Conservation Commission, Chapter 5 - Air Quality Standards and Air Pollution Control Rules Specific to the St. Louis Metropolitan Area, part .381 - Onboard Diagnostics Motor Vehicle Emissions Inspection contain the specific regulations and allowances for the current GVIP.

If you have any questions, please review this training program. Also for convenience, 10 CSR 10-5.381 is available in the Resources section. If there are questions or concerns that are not addressed in the training or CSR, please call:
 Department of Natural Resources (314) 416-2115