Attachment D: 2012 Quality Control Report
Audits of OBD Test Equipment

40 CFR section 51.366(c)

Massachusetts Vehicle Check
Inspection and Maintenance Program

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1.0 Background

1.1 Types of Emissions Tests in Massachusetts

Since October 1, 2008, the Massachusetts Vehicle Check program has employed only OBD testing for all vehicles required to receive an emissions test, with the exception of diesel vehicles with a Gross Vehicle Weight Rating (GVWR) greater than or equal to 10,000 pounds that are not equipped with OBD. These diesel vehicles receive an opacity test.

1.2 Overview of Test Equipment Audits and Self Checks

The Massachusetts Vehicle Check program uses three methods to ensure that the emissions test equipment is operating properly:

1. The workstations have been designed to run daily "self-checks" so that equipment with significant issues is identified (and repaired) as quickly as possible,
2. Workstations check OBD cable and connector continuity before allowing a vehicle to fail the OBD test for lack of communication, and
3. RMV field investigators audit equipment performance in the field.

Every 24 hours, the workstation is programmed to require the inspector to perform equipment checks that ensure the functionality of the OBD scan tool, printer, barcode scanner, and, if equipped, diesel opacity meter. These self-checks include:

- A daily "loopback" check that tests the continuity of the OBD scan tool cable and pins in the Diagnostic Link Connector (DLC). If a loopback test fails, the workstation is locked out from performing OBD tests until a loopback check can be passed. Inspectors are also required to perform a loopback check prior to a vehicle failing its emissions test for failure to communicate with the workstation. This is to verify that the emissions test failure is not related to an equipment-related problem.
- A daily printer/barcode scanner check that tests print quality and the proper function of the barcode scanner. The workstation prints sample 1D and 2D barcodes and sample Vehicle Inspection Report (VIR) text. The inspector examines the quality of the printed sample and records a failure if the text is not legible. If the print quality is good, the inspector is then prompted to scan the 1D and 2D barcodes. If the workstation cannot read the barcodes, the workstation records a failure. Failure to read the barcodes can be caused by a faulty barcode scanner or poor print quality. If the printer/barcode scanner check fails, the workstation is locked out from performing all inspections until it can pass the check.
- For workstations equipped with diesel opacity meters, the three daily self-checks are electronic zero and span; accuracy at 37.5% opacity; and current draw of the sample fan. All three checks have tolerances which must be met to pass. If any of the three checks fails, the workstation is locked out from performing diesel opacity tests until all three checks pass.

2.0 Procedure for OBD Test Equipment Audits

Sierra Research (Sierra) of Sacramento, CA developed general equipment audit guidelines for EPA for ASM-type equipment used in transient test I&M programs[1]. The guidelines include auditing procedures for OBD test equipment, and MassDEP's OBD audit procedures were developed to be consistent with EPA's guidance. The three OBD audit parts are listed in Table 1.

Table 1: Audit Parts in the Massachusetts OBD Test Equipment Audit

Audit Part	Description	Included in EPA's Audit Guidance?
Communications Check	Automated check of the OBD test equipment's ability to communicate with the OBD vehicle simulator.	√
Accuracy Check	Accuracy check of the OBD test equipment's ability to retrieve specific diagnostic trouble codes (DTCs), readiness monitor status, and other data, including engine RPM.	√ Modified
Visual Cable and Connector Check	Visual check of the cables and connector condition.	√

In 2009, MassDEP revised its OBD test equipment audit procedures by modifying the RPM portion of the accuracy check, and by adding to the items to be checked during the accuracy check. The RPM check was modified to test only one RPM setting (5,000 RPM) instead of the two RPMs recommended in EPA's audit guidance (700 and 2500), and to require that workstations must read exactly 5,000 RPM instead of within the range of ± 3% that was recommended in EPA's guidance. The results of MassDEP's prior OBD auditing experience supported the Massachusetts' decision to simplify the OBD RPM audit (and to deviate from EPA's recommendations on this point). In auditing OBD equipment from 2002 through 2008, MassDEP found that the RPM reading always exactly matched the standard as long as the OBD vehicle simulator communicated with the workstation OBD test equipment. Since 2009 we have found that if the RPM is reported, it is always correct, confirming that checking multiple RPMs is not an effective use of the field investigators' time.

For the accuracy check, Massachusetts uses custom-built OBD vehicle simulators to generate signals for the OBD emissions testing equipment to read. There are six different configurations for the OBD vehicle simulators, covering six different OBD communication protocols: CAN (11 bit), CAN (29 bit), KWP (ISO 14230-4), ISO

[1] "U.S. EPA Steady State and Transient Testing Equipment Audit Guidance," July 2001

(ISO9141), VPW and PWM. The items listed in Table 2 are included in the OBD test equipment audit accuracy check.

Table 2: Items Included in the Accuracy Check

Item	Included in EPA's Audit Guidance?
OBDII RPM	√
MIL status	√
Misfire monitor status	√
Fuel System monitor status	√
Comprehensive Components monitor status	√
Catalyst monitor status	√
Heated Catalyst monitor status	√
Evaporative System monitor status	√
Secondary Air monitor status	√
A/C System monitor status	√
O2 Sensor monitor status	√
O2 Sensor Heater monitor status	√
EGR monitor status	√
DTC 1	√
DTC 2	√
DTC 3	√
DTC 4	√
DTC 5	√
DTC 6	√
Communication Protocol	
PCM Module ID 1	
PID Count 1	
PID $1C Response	
OBD VIN	

3.0 Workstation Selection for OBD Equipment Audits

The OBD equipment audits are conducted as one component of routine station site visits performed by RMV field investigators. Workstations are not selected to receive OBD audits based on data analysis or other information that may indicate the equipment may be broken. However, the workstations may be selected for an audit based on consumer complaints or data analysis that indicates the inspector(s) may be conducting improper inspections. Other methods of selecting the workstations to audit may include, but are not limited to, the length of time since the last audit, a high volume of inspections and the location of the station (to minimize field investigators' travel distance). Workstations may also be selected for follow-up audits following a previous audit failure.

4.0 OBD Test Equipment Audits

> 40 CFR 51.366 (c) Quality control report. …Basic statistics on the quality control program for January through December of the previous year, including:
>
> (1) The number of emission testing sites and lanes in use in the program;
>
> (2) The number of equipment audits by station and lane; . . .
>
> (3) The number and percentage of stations that have failed equipment audits; and
>
> (4) Number and percentage of stations and lanes shut down as a result of equipment audits.

In Massachusetts' decentralized program, the number of workstations is equivalent to the number of lanes in a centralized testing program. Most Massachusetts stations have only one workstation.

In 2012, 1,654 stations and 1,715 workstations (lanes) conducted emissions inspections throughout the period. A station or workstation must have conducted at least one emissions inspection in each month in 2012 to be counted as "testing throughout the period." A total of 1,834 stations and 1,868 workstations conducted at least one emissions test during 2012.

Thirty-three RMV field investigators performed a total of 5,180 OBD test equipment audits in 2012. This covered 1,666 different workstations (lanes) and 1,625 different inspection stations, with 1,448 workstations being audited more than once.

In 2012, forty-three stations failed at least one OBD audit. Four of these stations failed two audits.

In 2012, six stations failed OBD functional checks. These stations represent 0.4% (6/1,625) of all audited inspection stations and 0.4% (6/1,654) of stations that conducted emissions inspections throughout the year.

Forty-three stations failed OBD functional checks or the visual cable or connector check. These stations represent 2.6% (43/1,625) of all audited inspection stations and 2.6% (43/1,654) of stations that conducted emissions inspections throughout the year.

No stations or workstations were shut down by the field investigators as a result of the OBD equipment audits. For two audits that failed for communication, at the time of the audit the workstation software locked out the workstation from performing OBD inspections. For six audits that failed for the cable and connector condition, at the time of the audit the workstation software locked out the workstation from performing OBD inspections.

5.0 Detailed OBD Test Equipment Audit Results

Table 3 presents a breakdown of the results of the Workstation OBD test equipment audits conducted in 2012, including individual audit parts and overall audit results. To pass the overall audit, the workstation cannot fail any individual audit part.

Table 3: OBD Test Equipment Audit Results

	2012 Audit Results			
Audit Part	**Pass**	**Fail**	**Tested**	**Failure Rate**
Functional Checks				
Communications Check	5,175	5	5,180	0.1%
Accuracy Check, (Including RPM)	5,174	1	5,175[2]	0.0%
Audits Failing One or More Functional Checks	5,174	6	5,180	0.1%
Visual Cable and Connector Check	5,134	41	5,175[3]	0.8%
Overall Audit Results (Audits that failed one or more audit parts)	5,133	47	5,180	0.9%

Six workstation audits failed a functional check: five failed the communication check and one failed the accuracy check.

For the five workstation audits that failed the communications check:

- Two of the workstations that failed to communicate had already been automatically locked out from performing inspections by the workstation software prior to the audit being conducted.

[2] The accuracy check could not be done for the five workstation audits that had failed for communication.
[3] Due to a bug with the current audit software, the visual cable and connector check results were not recorded in the database for the five workstation audits that failed for communication.

- One workstation was communicating with after-market cables, but failed to communicate with the approved cables, and therefore required repair.
- One of the communication failures was at a new car dealership. The communication protocol of the simulator used on the audit is not typically seen by the dealership because the protocol is not associated with the line of vehicles it sells. Because the workstation appeared to be communicating during inspections, an audit was required to detect the communication failure for the particular communication protocol.

The workstation that failed the accuracy check was not displaying or recording results for the RPM The repair record for this failure indicated that the connection was intermittent and you had to "play with" the connection in order to communicate. The OBD interface and cables were replaced.

Forty-one workstation audits failed the visual cable and connector check. While all forty-one of these workstation audits passed for both communication and accuracy, six had already been automatically locked out from performing inspections by the workstation software prior to the audit being conducted.

Inspection stations are required to open service request tickets for all audit failures. Field investigators continue to monitor the cable and connector conditions for all stations and issue station violations if the stations are unresponsive to repair requirements.

No workstations were manually shut down as a result of the equipment audit failures. Eight workstations were automatically locked out from performing inspections by the workstation software prior to the audits, preventing improper inspections from occurring.