

OBD Communications Compliance Test Cases for Heavy Duty Components and Vehicles

RATIONALE

Not applicable.

FOREWORD

SAE members have generated this document to serve as a guide for testing vehicles for compliance with, CARB, requirements for emissions-related on-board diagnostic (OBD) functions for heavy duty trucks and truck engines.

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1. SCOPE

The purpose of this Recommended Practice is to verify that vehicles and/or components are capable of communicating a minimum subset of information, in accordance with the diagnostic test modes specified in SAE J1939-73: Diagnostic Services.

This document describes the tests, test methods, and results for verifying diagnostics communication from an off board device to a vehicle and/or component.

2. REFERENCES

This specification takes precedence over all conflicts in the documents cited in this section.

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein. Unless otherwise specified, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J1939 Recommended Practice for a Serial Control and Communications Vehicle Network

SAE J1939-03 On Board Diagnostics Implementation Guide

SAE J1939-13 Off-Board Diagnostic Connector

SAE J1939-21 Data Link Layer

SAE J1939-71 Vehicle Application Layer (Through February 2007)

SAE J1939-73 Application Layer—Diagnostics

SAE J2403 Medium/Heavy-Duty E/E Systems Diagnosis Nomenclature—Truck and Bus

2.2 Related Publications

The following publications are for information purposes only and are not a required part of this document.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J1699[®]-3 OBD II Compliance Test Cases

2.2.2 ISO Publications

Available from American National Standards Institute (ANSI), 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

2.2.3 Other Publications

CARB Regulations

Available from California Air Resources Board, 1001 "I" Street, P.O. Box 2815, Sacramento, CA 95812, Tel: 916-322-2990, <<http://www.arb.ca.gov/msprog/obdprog/obdregs.htm>>.

Title 13, California Code Regulations, Section 1968.2, Malfunction and Diagnostic System Requirements for 2004 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines (OBD II)

Title 13, California Code Regulations, Section 1971.1, On-Board Diagnostic System Requirements for 2010 and Subsequent Model-Year Heavy-Duty Engines (HD OBD)

3. DEFINITIONS

The definitions provided in SAE J2403 apply to this document as applicable.

3.1 Definition of Terms

Failure – Results from running a test are flagged as a failed by the Test Unit.

Test Unit or Test Tool – Equipment used to generate or monitor tests and messages.

Warning – Results from running a test are flagged for further analysis by the Test Unit operator.

Additional definitions of terms that are related to the use of this document may be found in the publications listed under Section 2.1, Applicable Publications.

3.2 Acronyms

The following are common acronyms used in this document:

A/C	Air Conditioning
CAN	Controller Area Network
CALID	Calibration Identification
CID	Component ID
CVN	Calibration Verification Number
DLC	Data Length Code
DTC	Diagnostic Trouble Code
DTM	Diagnostic Test Mode
ECU	Electronic Control Unit
HEV	Hybrid Electric Vehicle
HSC	High Speed CAN
ID	Identification (number)
I/M	Inspection and Maintenance
ISO	International Standards Organization
Kbps	Kilobits per second
MIL	Malfunction Indicator Lamp
OBD-II	On Board Diagnostics (level 2)
OBDM	On Board Diagnostic Monitor
PCM	Powertrain Control ECU
PWM	Pulse Width Modulation
PID	Parameter Identification (number)
RPM	Revolutions Per Minute (engine speed)
SAE	Society of Automotive Engineers
SID	Service ID
TID	Test ID
VIN	Vehicle Identification Number

4. OVERVIEW

The purpose of the testing is to gain confidence that communications with the vehicle and/or component can be established and maintained according to the protocol SAE J1939. And further that the emission regulated diagnostic services defined in SAE J1939-73 and implemented on the vehicle adhere to the defined structure and return data which can be interpreted using the information contained in the SAE J1939-73 document.

This SAE J1939-84 document is structured in the following manner:

Section 4 – Provides an overview and specifies general conditions for testing.

Section 5 – Defines the required message structure and required timing.

Sections 6 through 7 – These sections are divided according to the conditions that are applied to the vehicle.

Within each subsection, the Request and Response message data for each of the allowed protocols and test mode (service) that need to be conducted are defined. Evaluation criteria to judge success or failure are defined.

Table 1 shows which services are tested under each operating condition.

TABLE 1 - CONDITIONS AND SERVICES TESTED

Section	Condition	Diagnostic Messages (DM)	Purpose
6	No Malfunctions	DM5, DM6, DM4, DM10, DM11, DM12, DM19, DM23	Basic test Service support
7.1 to 7.6	Pending Trouble Codes	DM4, DM6, DM24, DM25	DTC and status properly reported
7.7	Active Trouble Codes	DM12	Emission related DTCs

It is expected that formal testing will be conducted on a production vehicle containing no faults with the Test Unit connected via the SAE J1939-13 diagnostic connector. Formal testing will follow the order defined in this document.

The following notes are applicable to the component or vehicle testing described in this document:

- a. Battery voltage at the SAE J1939 connector pin must be between 11.0 and 32.0 volts (i.e., nominal 12- or 24-volt system with the engine off or the engine running).
- b. Multiple ECUs can respond to SAE J1939 request messages that are sent to the Global address.
- c. All data specified within messages are hexadecimal unless otherwise specified.
- d. XX = valid reported hexadecimal data (data not checked/specified in this document).
- e. x = valid reported data (data not checked/specified in this document).
- f. Each OBD ECU will respond within the time defined in Section 5.2.
- g. Test Unit will use the preferred addresses defined in SAE J1939 for a Diagnostic Tool.
- h. Procedure to determine when the link drops out – Send SAE J1939 request for DM 5. The proper response from all OBD ECUs will be verified or the diagnostic link will be flagged as being “down” and the test aborted.
- i. It is assumed that all OBD emission or diagnostic-critical ECUs support DM 5. Also, the number of emissions related ECUs are specified for the vehicle each with their CALIDs and CVNs.
- j. Multiple responses from a given ECU for a given request message shall be flagged as a warning. If a defined periodic message is received it should not be considered as a warning.

5. TEST UNIT DIAGNOSTIC MESSAGE FORMAT AND TIMING ACCURACY

5.1 Message Format

The message format is defined in SAE J1939-21, SAE J1939-73, and SAE J1939-71.

5.2 Message Timing

The Test Unit must be capable of measuring the response time to an accuracy of at least 1 ms.

The message response time is specified in SAE J1939-21.

6. COMPLIANCE TEST – NO MALFUNCTIONS

This Section consists of a series of tests for evaluating the OBD compliance of the system under test. The purpose of these tests are to verify proper response behaviors of the OBD ECUs when there are no OBD, or emissions related failure conditions present.

6.1 Perform MIL Bulb Check, Engine Off

Purpose: This test determines that the MIL behaves as required by OBD legislation.

Procedure:

6.1.1 Ignition off for at least 60 seconds. Connect Test Unit to the SAE J1939-13 connector.

6.1.2 Turn ignition on. Do not crank engine.

Evaluation:

6.1.3 Visually verify that the MIL is on for a minimum of 15 seconds.

6.2 Verify Communication, Ignition On, Engine Off

Purpose: To verify that the allowed protocol is supported and that at least one ECU on the vehicle sends a response message of the correct format. Also, to verify the number of responses match the number of emissions related components.

Procedure:

6.2.1 Test Unit sends SAE J1939 request message for DM5.

FIGURE 1 - DIAGNOSTIC READINESS 1 (DM5) REQUEST MESSAGE

Message PGN:		59904 (Request)
Source Addr:		SA of Test Unit
Destination Addr:		255 (Global destination)
Data:	Data Description	Byte Value (Hex)
Byte 1	PGN of requested message (i.e. DM5 - PGN = 65230 ₁₀ , 00FECE ₁₆)	CE ₁₆
Byte 2		FE ₁₆
Byte 3		00 ₁₆

FIGURE 2 - ECU#X RESPONSE: DIAGNOSTIC READINESS 1 (DM5) RESPONSE MESSAGE

Message PGN:		65230 (DM5)
Source Addr:		SA of Responding ECU
Destination Addr:		N/A (PGN does not support Destination Addressing)
Data:	Data Description	Byte Value (Hex)
Byte 1-8	As defined for DM5 in SAE J1939-73 (Use OBD Type as defined.)	See DM5 definition

Evaluation criteria:

Operator prompt 1 asks for the number of emission-related ECUs in the vehicle.

The Engine ECU must be one of the responders to the DM5 request.

The Test Unit shall record the different Source Addresses that provide the DM5 responses.

If all of the specified number of emissions-related ECUs do not positively respond to the requested DM5 message, this shall be flagged as a failure.

6.3 Clear DTCs (DM11), Engine Off

Purpose: To verify that, with the ignition on and engine off, all ECUs provide the correct response to a SAE J1939 request for DM11.

Procedure:

- 6.3.1 Transmit SAE J1939 request message for DM11 to each OBD compliant ECU and observe response message. The Test Unit will send a SAE J1939 Request message for DM11 to the devices that responded to DM5 as an OBD compliant device.

Any Test Unit meeting these specifications must wait 2 seconds before proceeding to next step to allow for NVRAM read/write times.

FIGURE 3 - CLEAR ACTIVE DIAGNOSTIC CODES (DM11) REQUEST MESSAGE

Message PGN:		59904 (Request)
Source Addr:		SA of Test Unit
Destination Addr:		0 (Engine), other OBD compliant ECUs
Data:	Data Description	Byte Value (Hex)
Byte 1	PGN of requested message	D3 ₁₆
Byte 2	(i.e. DM11 - PGN = 65235 ₁₀ , 00FED3 ₁₆)	FE ₁₆
Byte 3		00 ₁₆

FIGURE 4 - ECU#X RESPONSE: ACKNOWLEDGE MESSAGE

Message PGN:		59392 (ACK)
Source Addr:		SA of Responding ECU
Destination Addr:		255 (Global)
Data:	Data Description	Byte Value (Hex)
Byte 1	0 for Faults Cleared (As defined for ACK in SAE J1939-21)	See ACK definition
Byte 2		FF ₁₆
Byte 3		FF ₁₆
Byte 4		FF ₁₆
Byte 5	Source address of test unit	XX
Byte 6	PGN of requested message	D3 ₁₆
Byte 7	(i.e. DM11 - PGN = 65235 ₁₀ , 00FED3 ₁₆)	FE ₁₆
Byte 8		00 ₁₆

Evaluation criteria:

For each DM11 message sent to an OBD ECU, only that OBD ECU must respond with message as shown in the response in Figure 4 above. If any other OBD ECU responds to this diagnostic message, it shall be flagged as a failure.

6.4 Verify MIL Status Bit, Engine Off

Purpose: To verify the correct response to a SAE J1939 request for DM12, and that DTCs and the MIL status bit are not set.

Note to manufacturers: During bulb testing, MIL status bit must indicate whether the MIL will be illuminated after engine is started. It should not reflect the status of the MIL bulb driver circuit, which will be turning the bulb on for the bulb prove out.

Procedure:

- 6.4.1 Test Unit sends SAE J1939 request message for DM12 to all OBD compliant ECUs. (Separate requests should be sent to each ECU by the Test Unit.)

FIGURE 5 - ACTIVE EMISSIONS- RELATED FAULTS (DM12) REQUEST MESSAGE

Message PGN:		59904 (Request)
Source Addr:		SA of Test Unit
Destination Addr:		0 (Engine), other OBD compliant ECUs
Data:	Data Description	Byte Value (Hex)
Byte 1	PGN of requested message	D4 ₁₆
Byte 2	(i.e. DM12 - PGN = 65236 ₁₀ , 00FED4 ₁₆)	FE ₁₆
Byte 3		00 ₁₆

FIGURE 6 - ECU#X RESPONSE: ACTIVE EMISSIONS- RELATED FAULTS (DM12) RESPONSE MESSAGE

Message PGN:		65236 (DM12)
Source Addr:		SA of Responding ECU
Destination Addr:		N/A (PGN does not support Destination Addressing)
Data:	Data Description	Byte Value (Hex)
Byte 1-8	As defined for DM12 in SAE J1939-73 (should be Zero in bytes 3-6 to indicate no faults)	See DM12 definition

Evaluation criteria:

All OBD compliant ECUs must respond with a message as shown in the response in Figure 6 above. Responses are expected from all other OBD compliant ECUs on the vehicle. If the MIL status bit is not "off", a failure shall be flagged.

6.5 Check for Pending Diagnostic Codes (DM6) – Request On-Board Monitoring Test Results, Engine Off

Purpose: To verify that each ECU responds correctly to a DM6 request, and that the data in the responses are correct. Verify that there are no Pending Diagnostic Trouble Codes set since the clearing of Active Codes in the previous step.

Procedure:

- 6.5.1 The Test Unit transmits the SAE J1939 Request message for DM6 to each OBD compliant ECU on the vehicle and confirm that there are no pending codes.

FIGURE 7 - PENDING EMISSIONS- RELATED FAULTS (DM6) REQUEST MESSAGE

Message PGN:		59904 (Request)
Source Addr:		SA of Test Unit
Destination Addr:		0 (Engine), other OBD compliant ECUs
Data:	Data Description	Byte Value (Hex)
Byte 1	PGN of requested message (i.e. DM6 - PGN = 65231 ₁₀ , 00FECF ₁₆)	CF ₁₆
Byte 2		FE ₁₆
Byte 3		00 ₁₆

FIGURE 8 - ECU#X RESPONSE: PENDING EMISSIONS- RELATED FAULTS (DM6) RESPONSE MESSAGE

Message PGN:		65231 (DM6)
Source Addr:		SA of Responding ECU
Destination Addr:		N/A (PGN does not support Destination Addressing)
Data:	Data Description	Byte Value (Hex)
Byte 1-8	As defined for DM6 in SAE J1939-73 (should be Zero in bytes 3-6 to indicate no faults)	See DM6 definition

Evaluation criteria:

Verify that DM6 response received from all OBD compliant ECUs.

Verify that emission-related faults have been cleared. Any fault code reported in this message indicates a current problem and should be flagged as a failure.

6.6 Verify Data Stream Information – Monitor Current Powertrain Diagnostic Data, Engine Off

NOTE: Hybrid Electric Vehicles (HEVs) have engine controls that can start and stop the engine without regard to ignition setting. The operator must ensure that the engine is off when performing the test.

Purpose: To verify that all OBD Compliant ECUs transmit appropriate diagnostic DM24 response to determine which SPNs are supported by each ECU and to check that the returned data is valid for engine-off conditions.

Procedure:

- 6.6.1 Test Unit transmits SAE J1939 Request for DM24 (SPN support for Freeze Frame and Data Stream) to each OBD compliant ECU on the vehicle. The DM24 responses will use the SAE J1939 Transport Protocol. Note the SPNs reported by each ECU as being supported.

FIGURE 9 - SPN SUPPORTED FOR FREEZE FRAME AND DATA STREAM (DM24) REQUEST MESSAGE

Message PGN:		59904 (Request)
Source Addr:		SA of Test Unit
Destination Addr:		0 (Engine), other OBD compliant ECUs
Data:	Data Description	Byte Value (Hex)
Byte 1	PGN of requested message (i.e. DM24 - PGN = 64950 ₁₀ , 00FCB6 ₁₆)	B6 ₁₆
Byte 2		FD ₁₆
Byte 3		00 ₁₆

FIGURE 10 - ECU#X RESPONSE: SPN SUPPORTED (DM24) RESPONSE MESSAGE

Message PGN:		64950 (DM24)
Source Addr:		SA of Responding ECU
Destination Addr:		N/A (PGN does not support Destination Addressing)
Data:	Data Description	Byte Value (Hex)
Byte 1-n	As defined for DM24 in SAE J1939-73. Note: n > 8 so Transport Protocol is used.	See DM24 definition

Evaluation criteria:

If no DM24 response is received from each OBD ECU, a failure shall be flagged.

If a DM24 response is received from at least one ECU, then the test unit should verify that the SPNs 92, 110, 190, and 84 are reported at least once as Data Stream parameters among all the Data Stream parameter responses. If all four SPNs are not supported, a failure will be flagged.

Monitor the SAE J1939 Data Link for the presence of these SPNs, noting that the appropriate values for 190 and 84 should be zero for the vehicle at rest and the engine off. If these two SPNs are not reported, or reported with non-zero value, a failure will be flagged.

Note that a lack of support for DM24 is not necessarily a failure, depending on the level of OBD support that the ECUs have reported. DM24 (and DM25) are required for ECUs supporting the California CCR 1971.1 regulation, but not for previous regulations such as CCR 1968.1.

6.7 Verify Communication with Engine Running

Purpose: Verify that the allowed protocol is supported and that a response message of the correct format is sent by the vehicle with engine running.

Procedure:

6.7.1 Move ignition to crank position and start engine. Let engine idle for 1 minute.

NOTE: Some powertrain control systems have engine controls that can start and stop the engine without regard to ignition position or setting. The operator must ensure that the engine is running when performing the test, e.g., turn on A/C.

6.7.2 Repeat the tests in Sections 6.2 – 6.6 above, but with engine running. Note that the evaluation criteria for test 6.6.1 this time is SPN 84 (vehicle speed) should be zero and SPN 190 (engine speed) should not be zero.

6.8 Verify DM4 – Request Powertrain Freeze Frame Data, Engine Running

Purpose: To verify that all ECUs respond correctly to requests for DM4 when there is no DTC stored, that at least one ECU supports Freeze Frames, and that the current Freeze Frame is empty (since faults have been cleared.)

Procedure:

6.8.1 Test Unit transmits SAE J1939 request message for DM4 to determine which ECUs support Freeze Frames.

FIGURE 11 - FREEZE FRAME (DM4) REQUEST MESSAGE

Message PGN:		59904 (Request)
Source Addr:		SA of Test Unit
Destination Addr:		255 (Global)
Data:	Data Description	Byte Value (Hex)
Byte 1	PGN of requested message (i.e. DM4 - PGN = 65229 ₁₀ , 00FECD ₁₆)	CD ₁₆
Byte 2		FE ₁₆
Byte 3		00 ₁₆

FIGURE 12 - ECU#X RESPONSE: FREEZE FRAME (DM4) RESPONSE MESSAGE

Message PGN:		65229 (DM4)
Source Addr:		SA of Responding ECU
Destination Addr:		N/A (PGN does not support Destination Addressing)
Data:	Data Description	Byte Value (Hex)
Byte 1-8	As defined for DM4 in SAE J1939-73 (should be Zero in byte 1 to indicate no faults)	See DM4 definition

Evaluation criteria:

Verify at least one OBD compliant ECU must support Freeze Frames, else this shall be flagged as a failure. This support may be provided by DM4 or DM25, depending on the compliance level (if no ECU supports DM4, request DM25 to assure support.)

Verify each ECU that returns a Freeze Frame (DM4) message must have bytes 1-5 of the data portion of the message set to zero, since faults have been cleared and there is thus no Freeze Frame data available.

6.9 Verify Vehicle Information, Engine Running

Purpose: To verify that all ECUs respond correctly to SAE J1939 requests with the engine running and to verify that VIN and DM19 (CALIDs, and CVNs) are supported in the returned responses for reprogrammable ECUs.

Procedure:

6.9.1 Test Unit sends SAE J1939 request message for VIN PGN to the Global Address. Test Unit sends DM19 to each OBD compliant ECU to get CALID and CVN.

FIGURE 13 - VIN REQUEST MESSAGE

Message PGN:		59904 (Request)
Source Addr:		SA of Test Unit
Destination Addr:		255 (Global)
Data:	Data Description	Byte Value (Hex)
Byte 1	PGN of requested message (i.e. Vehicle ID - PGN = 65260 ₁₀ , 00FEEC ₁₆)	EC ₁₆
Byte 2		FE ₁₆
Byte 3		00 ₁₆

FIGURE 14 - ECU#X RESPONSE: VIN MESSAGE

Message PGN:		65260 (Vehicle Identification)
Source Addr:		SA of Responding ECU
Destination Addr:		N/A (PGN does not support Destination Addressing)
Data:	Data Description	Byte Value (Hex)
Byte 1-n	As defined for Vehicle Identification in SAE J1939-71 (Data will be the ASCII values for the characters that make up the VIN: 17 letters and numbers)	See definition in SAE J1939-71, VIN assigned by Mfgr.

FIGURE 15 - CALIBRATION INFORMATION (DM19) REQUEST MESSAGE

Message PGN:		59904 (Request)
Source Addr:		SA of Test Unit
Destination Addr:		0 (Engine), other OBD compliant ECUs
Data:	Data Description	Byte Value (Hex)
Byte 1	PGN of requested message	00 ₁₆
Byte 2	(i.e. DM19 - PGN = 54016 ₁₀ , 00D300 ₁₆)	D3 ₁₆
Byte 3		00 ₁₆

FIGURE 16 - ECU#X RESPONSE: CALIBRATION INFORMATION (DM19) RESPONSE MESSAGE

Message PGN:		54016 (DM19)
Source Addr:		SA of Responding ECU
Destination Addr:		SA of Test Unit
Data:	Data Description	Byte Value (Hex)
Byte 1-8	As defined for DM19 in SAE J1939-73 (CVN, CALID pairs)	See DM19 definition

Evaluation criteria:

Verify that all ECUs respond correctly to SAE J1939 requests.

If more than one VIN is reported for the vehicle, a failure will be flagged. If multiple ECUs report VIN, all must be identical.

The VIN year character (position 10) must correspond to the model year entered by the operator in the Test Unit and must be in accordance with the appropriate specification for the format of the VIN.

FIGURE 17 - VIN REFERENCE

VIN Character	SAE J272	ISO 3779
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All CALIDs must contain 1 to 16 printable ASCII characters.

Test Unit operator prompt asks for the number of emission-related ECUs in the vehicle. Verify that CALIDs and CVNs are supported by the expected number of ECUs, and agree with the expected response.

Test Unit operator prompt asks for the number of emission-related ECUs in the vehicle. Each emission-related ECU shall output one or more CALIDs (every OBD ECU must report its own CALID, however, some ECUs may report multiple CALIDs). If CALIDs do not match expected value, then flag as a warning.

7. TEST VEHICLE WITH A FAULT CODE BY INDUCING A FAULT

Purpose: This group of tests will establish that under normal operating conditions communication can be established and that all supported test services behave correctly in the presence of an induced fault.

7.1 Induce Circuit Fault

Purpose: Induce a circuit fault that will generate a MIL light and a single DTC with the engine idling in preparation for the services tests in the remainder of the tests in this section.

Procedure:

7.1.1 With ignition off and engine off, disconnect a sensor that is tested continuously (e.g. Engine coolant temperature, Intake Manifold Pressure, Atmospheric Pressure, Fuel Pressure, etc.).

Fault selection criteria:

- The selected fault should generate a MIL light and a single DTC with the engine idling in a short period of time (i.e. < 10 seconds) for only one ECU.
- The selected fault shall illuminate the MIL during the first driving cycle to allow proper testing in a manufacturing setting. In this case, a pending DTC a confirmed DTC and MIL will be set on the first driving cycle.

NOTE: This will not completely test the functions of the Pending DTC or Freeze Frame capture for Pending DTCs, but this is not needed to test the communication capabilities of the system.

7.1.2 Start engine, let idle for one minute or whatever time it takes to set a pending DTC. Note: Some powertrain control systems have engine controls that can start and stop the engine without regard to ignition position. The operator must ensure that the engine is on when performing the test, e.g. turn on A/C or defroster.

7.2 Establish Communication (J1939), Engine Running

Purpose: To verify that the SAE J1939 protocol is supported and that the response message of the correct format is sent by the vehicle.

Procedure:

7.2.1 Test Unit sends SAE J1939 request message for the DM5 (Diagnostic Readiness 1) message to the Global Destination address.

FIGURE 18 - DIAGNOSTIC READINESS 1 (DM5) REQUEST MESSAGE

Message PGN:		59904 (Request)
Source Addr:		SA of Test Unit
Destination Addr:		255 (Global destination)
Data:	Data Description	Byte Value (Hex)
Byte 1	PGN of requested message (i.e. DM5 - PGN = 65230 ₁₀ , 00FECE ₁₆)	CE ₁₆
Byte 2		FE ₁₆
Byte 3		00 ₁₆

FIGURE 19 - ECU#X RESPONSE: DIAGNOSTIC READINESS 1 (DM5) RESPONSE MESSAGE

Message PGN:	65230 (DM5)	
Source Addr:	SA of Responding ECU	
Destination Addr:	N/A (PGN does not support Destination Addressing)	
Data:	Data Description	Byte Value (Hex)
Byte 1-8	As defined for DM5 in SAE J1939-73	See DM5 definition

Evaluation criteria:

If the specified number of emissions-related modules do not positively respond to an OBD diagnostic message, this shall be flagged as a failure.

7.3 Verify DM6 – Request Pending Emission-Related DTCs, Engine Running

Purpose: To verify that all modules respond correctly to a DM6 (Pending DTCs) request and there is at least one pending emission-related DTC reported.

Procedure:

- 7.3.1 Every 0.500 seconds, Test Unit will send a SAE J1939 Request message for DM6 to Global Address to get pending DTCs. If DTC is set, Test Unit will prompt user that DTC has been set and to continue. If no pending DTC is set, after 30 seconds the Test Unit will prompt the user to continue without a pending DTC (logged as a failure).

FIGURE 20 - PENDING EMISSION RELATED DTCs (DM6) REQUEST MESSAGE

Message PGN:	59904 (Request)	
Source Addr:	SA of Test Unit	
Destination Addr:	255 (Global destination)	
Data:	Data Description	Byte Value (Hex)
Byte 1	PGN of requested message (i.e. DM6 - PGN = 65231 ₁₀ , 00FECF ₁₆)	CF ₁₆
Byte 2		FE ₁₆
Byte 3		00 ₁₆

FIGURE 21 - ECU#X RESPONSE: PENDING EMISSION RELATED DTCs (DM6) RESPONSE MESSAGE

Message PGN:	65231 (DM6)	
Source Addr:	SA of Responding ECU	
Destination Addr:	N/A (PGN does not support Destination Addressing)	
Data:	Data Description	Byte Value (Hex)
Byte 1	Lamp Status (See DM6 for specifics)	XX
Byte 2	Lamp Status (See DM6 for specifics)	XX
Byte 3	1st Pending DTC=[SPN Low 8 bits, SPN Mid 8 bits, SPN Upper 3 bits and FMI, SPN Method and Occurrence Cnt]	XX
Byte 4		XX
Byte 5		XX
Byte 6		XX
:	:	:
Byte n*4-1	nth Pending DTC=[SPN Low 8 bits, SPN Mid 8 bits, SPN Upper 3 bits and FMI, SPN Method and Occurrence Cnt]	XX
Byte n*4		XX
Byte n*4+1		XX
Byte n*4+2		XX

Evaluation criteria:

Verify at least one DM6 pending DTC response with a non-zero DTC should be received. If at least one is not received it shall be flagged as a failure.

7.4 Verify DM25 – Request Expanded Freeze Frame (DM25) Data

Purpose: To verify that all modules respond correctly to DM25 (Expanded Freeze Frame) requests if a freeze frame is stored and expanded freeze frame support is required by the regulations.

Procedure:

7.4.1 The Test Unit will send a SAE J1939 Request message for DM25 to the Global destination address to read freeze frame data (DTC).

FIGURE 22 - FREEZE FRAME DATA (DM25) REQUEST MESSAGE

Message PGN:		59904 (Request)
Source Addr:		SA of Test Unit
Destination Addr:		255 (Global destination)
Data:	Data Description	Byte Value (Hex)
Byte 1	PGN of requested message (i.e. DM25 - PGN = 64951 ₁₀ , 00FDB7 ₁₆)	B7 ₁₆
Byte 2		FD ₁₆
Byte 3		00 ₁₆

FIGURE 23 - ECU#X RESPONSE: FREEZE FRAME (DM25) RESPONSE MESSAGE

Message PGN:		64951 (DM25)
Source Addr:		SA of Responding ECU
Destination Addr:		N/A (PGN does not support Destination Addressing)
Data:	Data Description	Byte Value (Hex)
Byte 1	1st Freeze Frame Length	XX
Byte 2	1st FF DTC = [SPN Low 8 bits, SPN Mid 8 bits, SPN Upper 3 bits and FMI, SPN Method and Occurrence Cnt]	XX
Byte 3		XX
Byte 4		XX
Byte 5		XX
Byte 6	Parameter Data for 1st Freeze Frame	XX
:	:	:
Byte m	:	XX
:	:	:
Byte (n-1)*m + 1	nth Freeze Frame Length	XX
Byte (n-1)*m + 2	nth FF DTC = [SPN Low 8 bits, SPN Mid 8 bits, SPN Upper 3 bits and FMI, SPN Method and Occurrence Cnt]	XX
Byte (n-1)*m + 3		XX
Byte (n-1)*m + 4		XX
Byte (n-1)*m + 5		XX
Byte (n-1)*m + 6	Parameter Data for nth Freeze Frame	XX
:	:	:
Byte m*n	:	XX

Evaluation criteria:

If at least one ECU complying with OBD level of CCR1971.1 does not support DM25, this shall be flagged as a failure.

For each ECM that supports DM25, verify the Freeze Frame length(s) correctly correspond with the length of the Data field. If the Freeze Frame length and Data field length do not correspond correctly, then this shall be flagged as a failure.

7.5 Verify DM4 – Request Freeze Frame Data, Engine Running

Purpose: To verify that all modules respond correctly to DM4 (Freeze Frame) requests if a freeze frame is stored.

Procedure:

- 7.5.1 The Test Unit will send a SAE J1939 Request message for DM4 to the devices that responded to DM5 as an OBD compliant device.

FIGURE 24 - FREEZE FRAME DATA (DM4) REQUEST MESSAGE

Message PGN:		59904 (Request)
Source Addr:		SA of Test Unit
Destination Addr:		0 (Engine), other OBD compliant ECUs
Data:	Data Description	Byte Value (Hex)
Byte 1	PGN of requested message (i.e. DM4 - PGN = 65229 ₁₀ , 00FEC ₁₆)	CD ₁₆
Byte 2		FE ₁₆
Byte 3		00 ₁₆

FIGURE 25 - ECU#X RESPONSE: FREEZE FRAME (DM4) RESPONSE MESSAGE

Message PGN:		65229 (DM4)
Source Addr:		SA of Responding ECU
Destination Addr:		N/A (PGN does not support Destination Addressing)
Data:	Data Description	Byte Value (Hex)
Byte 1	1st Freeze Frame Length	XX
Byte 2	1st FF DTC = [SPN Low 8 bits, SPN Mid 8 bits, SPN Upper 3 bits and FMI, SPN Method and Occurrence Cnt]	XX
Byte 3		XX
Byte 4		XX
Byte 5		XX
Byte 6	1st FF Required Parameters Data	XX
:	:	:
Byte 13	1st FF Optional Parameters Data	XX
Byte 14		XX
:		:
Byte m		XX
:	:	:
Byte 1	nth Freeze Frame Length	XX
Byte 2	nth FF DTC = [SPN Low 8 bits, SPN Mid 8 bits, SPN Upper 3 bits and FMI, SPN Method and Occurrence Cnt]	XX
Byte 3		XX
Byte 4		XX
Byte 5		XX
Byte 6	nth FF Required Parameters Data	XX
:	:	:
Byte 13	nth FF Optional Parameters Data	XX
Byte 14		XX
:		:
Byte m		XX

Evaluation criteria:

If an ECU does not support DM4, it shall respond with a NACK to a DM4 request instead of the Figure 25 data bytes.

If an ECU supports DM4 but has no accumulated freeze frames to report, it shall respond with a DM4 message with \$00 in byte 1, \$00 in bytes 2 through 5 and \$FF in bytes 6 through 8.