Selective Catalytic Reduction (SCR) Muffler Troubleshooting Guide - US10+OBD13 And Newer Emissions

Component Overview

The SCR contains a coated substrate that, with the input of heat and DEF, changes NOx into nitrogen and water vapor. The SCR's job in the Emissions After-Treatment System (EATS) is to lower the NOx level emitted into the atmosphere.

The performance of the SCR is evaluated by the NOx sensors. There are NOx sensors that are located on upstream (inlet) and downstream (outlet) ends of the SCR.

Important: the SCR is the last component in the EATS which makes it susceptible to any upstream failures.

Primary failure mode of the Muffler (SCR) is:

- Coating of the substrate being compromised
- Indigestions of foreign objects such as oil, coolant, fuel, etc.

Diagnosis and Repair

Prior to proceeding with any of the information below, any codes, symptoms or failures of upstream components must be diagnosed and corrected first.

Upstream components include:

- Base Engine (Starting or operation issues)
- EGR System
- Fuel System (Engine supply and aftertreatment hydrocarbon injector supply)
- Turbocharger/Boost
- Diesel Oxidation Catalyst (DOC)
- Diesel Particulate Filter (DPF)
- Aftertreatment sensors (Exhaust temperature)

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The three DTCs below indicate problems with SCR function. These DTCs

should only be diagnosed if they are active or if the DTC Confirmed status is True in the Detailed status information section.

Fault Code	Descriptions
P20EE	SCR NOx Catalyst Efficiency Below Threshold (Bank 1)
P103C	NOx Catalyst Efficiency Inducement, Selective Catalytic Reduction (SCR) Unit
P207F	SCR NOx Catalyst Efficiency Below Threshold (Bank 1)

Evaluations for SCR Muffler Replacement

The following systems need to be evaluated in progressive order to determine the state of the SCR.

1. **DEF System -** Test the Urea/DEF Systems functionality for proper:

- Quality
  - Check DEF Quality using Refractometer (88890105)
  - Litmus Test paper (88890110)
- Quantity
  - SCR Dosing Test in PTT, Operation 2589-08-03-05 subsection 1-3.
  - With the dosing nozzle removed, inspect for crystal build up.

If any of the above tests fail: Correct the issue, clear fault codes, and release the truck.

2. **NOx Sensor Condition -** Evaluate the condition of both NOx Sensors.

- Look for the following:
  - Non-OEM (3rd party) sensors, use CBR-2114 for guidance.
  - Any/All NOx sensor fault codes. See CBR-2116 for a list of these faults and recommendations.

If Non-OEM or faulty Nox Sensor(s) is found: Replace the sensor(s), clear faults and release the truck.

3. **NOx Sensor Function and SCR Assessment-** Evaluate NOx sensor function using the appropriate test for the vehicle's emission level, indicated below. Follow the directions in the Action column for Nox or eplacements.

Emission Level	**PTT Operation**	**Action**
OBD 13-16	2549-08-03-03 Nox Conversion Test	Follow test recommendation, if no fault found replace the SCR in accordance with Impact procedures.
OBD 17-18 **VGT Only**	2589-08-03-18 Exhaust Aftertreatment System Analysts **(make sure Nox and SCR Subtest are selected)**	Follow test recommendation and release truck.
OBD 17-18 **TC Only**	No test…	Replace Both Nox Sensors if not replaced within past 3 months and release truck. If truck has received both Nox sensors within past 3 months replace the SCR in accordance to impact procedures.
OBD 19 and Newer **VGT Only**	2549-08-03-03 Nox Conversion Test **OR** (whichever is available) 2589-08-03-18 Exhaust Aftertreatment System Analysts **(only Nox Subtest available)**	Follow test recommendation, if no fault found replace the SCR in accordance to Impact procedure.
OBD 19 and Newer **TC Only**	2549-08-03-03 Nox Conversion Test	Follow test recommendation, if no fault found replace the SCR in accordance to Impact procedures.

Rules for Replacement

Standard Diagnostic time is 3 hours.

Note that Warranty will only cover replacement of the SCR if one of the codes in the section above is present. If the SCR is suspected to have failed due to upstream contamination with no codes present, an

eService case is required for further evaluation.

Review the applicable video link below.

MACK	SCR MUFFLER
VOLVO	SCR MUFFLER

Tags

p103c00 p207f00 volvo mack scr

p20ee00 unlocking uptime

Related links and attachments

No links or attachments available

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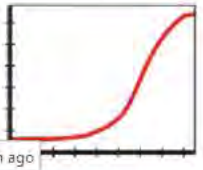
A



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B

C

Exit inducement mode

D

SCR efficiency test values

2589-08-03-05 Aftertreatment selective catalytic reduction (SCR) system

Simulation

Information >> Conditions >> Execution

Purpose

Check that a newly installed, repaired, overhauled or replaced SCR system works correctly

Selections

Select the illustration corresponding to the method or test to be performed

A - System pressure build up

Check function/leakage of pump and hoses

B - Dosing test

- Check function/leakage of dosing valve
- Perform the Dosing test after the dosing valve has been replaced in order to exit inducement and clear **DTC P208E** or **P103B**

C - Exit inducement mode

- This should only be performed to exit inducement mode in order to find the root cause of **DTC P207F** or **P103C**
- Reset SCR system inducement timers

D - SCR efficiency test values

The following diagnostic trouble codes (DTCs) are concerned: **P207F** or **P20EE**

Continue > Cancel

Tech Tool

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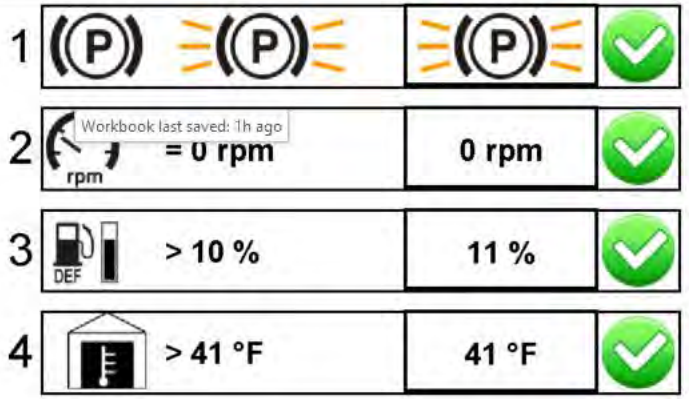
Product Product History Diagnose Test Calibrate Program Impact



2589-08-03-05 Aftertreatment selective catalytic reduction (SCR) system

Simulation

Information >> **Conditions** >> Execution

Automatically checked conditions

1 Parking brake applied
2 Engine not running
3 DEF tank level above 10 %
4 Ambient temperature above 41 °F

Continue > Cancel

Chassis ID: M744 41340 VIN: 1M1AW07Y9EM041340 Work Order: 9999

Product Online

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Tech Tool

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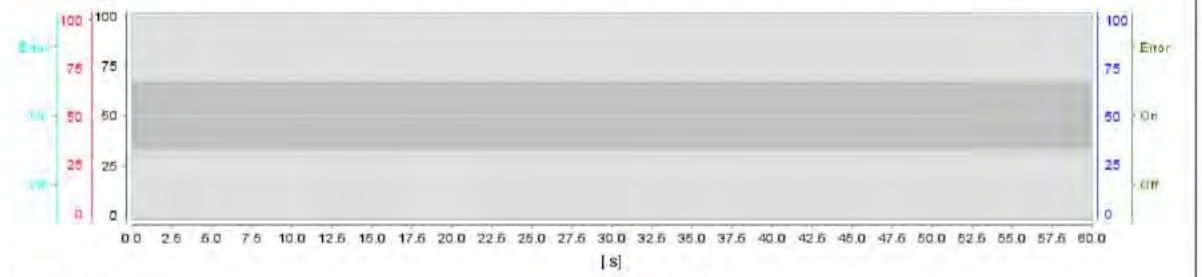
Product Product History Diagnose Test Calibrate Program Impact

SCR Start-up Test (Pressure build up)

DEF System Status:
Waiting for start

Graph



2589-08-03-05 Aftertreatment selective catalytic reduction (SCR) system

Simulation

Information >> Conditions >> **Execution**

Information

This test gives the possibility to start up / build up the pressure without starting the engine

The test can be used to check that the repaired, serviced or replaced dosing system is working correctly

Action

- Before starting the test, monitor the signals and make sure the DEF pressure is near **0 kPa (0 psi)** without a large deviation
- Start the test

Note: The SCR Start-up test should be run for several minutes to verify that the system can hold pressure over time

Parameter values

14.5038 psi	DEF pressure
0 %	DEF pump rate in percent
0	Aftertreatment DEF dosing valve
	DEF tank heating valve
	DEF direction valve
60 %	DEF concentration

Evaluation

The pressure should build up to approximately **900 kPa (130 psi)**

Test result

Continue >

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Non-OEM (3rd Party) NOx Sensor Identification

› **Internal Content**

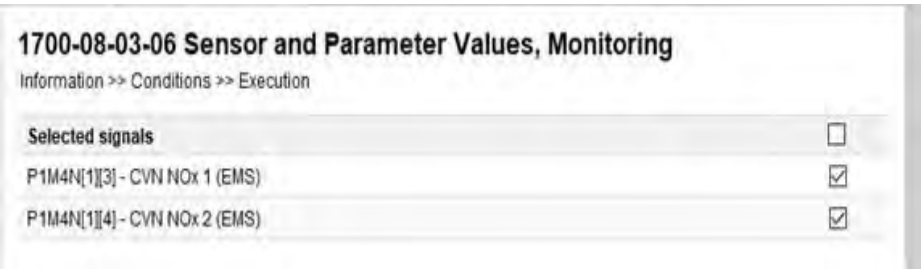
If one or more of the codes below are present it is recommended to inspect for 3rd party NOx sensors.
P103C-00
P207F-00
P026D-00

3rd party NOx sensors have been found to induce erroneous faults and cause various system failures. If 3rd party NOx sensors are found they should be removed and replaced with a genuine OEM sensor. Clear faults and verify the repair.

Use the below information to identify 3rd party NOx sensors.

How To Verify An OEM Sensor

For Trucks MY 2017 and newer products run **Premium Tech Tool Test 1700-08-03-06 Sensor and Parameter Values.** All genuine OEM NOx sensors will display the expected values as seen below. All other values are components from a 3rd party.



Expected Values	
NOx1	NOx2
791293237	541003308

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Refer to the illustrations below to help identify 3rd party NOx sensor.

OEM sensor with markings and part number for reference


3rd party NOx Sensor in bag

3rd party sensors with and with out markings

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OEM sensor tip design for reference	3rd party sensor with incorrect sensor tip
	

The table below illustrates how difficult it can be to identify 3rd party sensors when compared to an OEM sensor

	
Sticker says “Warranty void”	No such sticker
Marking text: “PreSCR”	Marking text: “Pre SCR”
Marking text: “CONTINENT AL”	Marking text: “CONTINENTAL”
Marking text font: different from Volvo part	
Conclusion: The sensor on the left is not a Genuine Volvo NOx Sensor	

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Tags

Tags

3rd party nox sensor p103c p207f p026d

volvo mack spn 1231 fmi 2

Related links and attachments

No links or attachments available

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NOx Sensor Troubleshooting Guide - US10+OBD13 And Newer Emissions

Component Overview

There are two Nitrogen Oxide (NOx) sensors in the Exhaust Aftertreatment System, an INLET and OUTLET. They are smart sensors reporting on the DL7 (J1939-7) data link and they measure the INLET (Pre SCR) and OUTLET (Post SCR) of NOx. The NOx sensors have unique CAN identification numbers and cannot be swapped. Additionally these sensors are not operational until the exhaust is up to operating temperature and free of moisture. The Engine Control Module compares the INLET and OUTLET NOx readings to evaluate the efficiency of the SCR.

The primary failure mode the NOx Sensors is internal failure, which will generate a sensor specific fault code.

Diagnosis and Repair

Review the tables below to determine which category the Fault Code currently being diagnosed falls under. Proceed according to the instructions for the appropriate section.

INLET NOx Sensor (NOx 1) Diagnostic Trouble Codes - Sensor Failure
REPLACE the sensor if any codes in red below are active and/or confirmed. Do not replace for inactive codes.

Fault Code	Fault Description
P22FB-92	NOx Sensor Performance - Sensing Element Bank 1 Sensor 1, Performance or Incorrect Operation
P220E-93	NOx Sensor Heater Control Circuit Range/Performance (Bank 1 Sensor 1), No operation
P2200-13	NOx Sensor Bank 1 Sensor 1, Circuit Open
P2203-00	NOx Sensor Circuit High Bank 1 Sensor 1
P2205-13	NOx Sensor Gas Outlet Open Circuit, Circuit open
P2206-00	NOx sensor heater control circuit low, bank 1 sensor 1
P2208-00	NOx sensor heater sense circuit, bank 1 sensor 1

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Direction/Repair: Replace the sensor in accordance with Impact

instructions.

Do NOT Cut the sensor wiring harness, all NOX sensors are currently on mandatory return.

Inlet NOx Sensor (NOx 1) Diagnostic Trouble Codes - Potential Sensor Failure

These codes in yellow below indicate that the inlet NOx sensor is potentially damaged, but further investigation is required to verify sensor condition.

Fault Code	Fault Description
P026C-00	Fuel Injection Quantity Lower Than Expected
P026D-00	Fuel Injection Quantity Higher Than Expected
P2201-64	NOx Sensor Bank 1 Sensor 1, Signal plausibility failure
P225C-00	NOx Sensor Performance - Signal Stuck High Bank 1 Sensor 1

Direction: Run the applicable PTT Operation per OBD Level.

Emission Level	PTT Operation
OBD 13-16	2549-08-03-03 Nox Conversion Test
OBD 17-18 VGT Only	2589-08-03-18 Exhaust Aftertreatment System Analysts (make sure Nox Subtest is selected)
OBD 17-18 TC Only	No test… Replace INLET (Nox 1) Nox Sensors if not replaced within past 3 months and release truck. If Nox sensor has been replaced within past 3 months open an E-Service Case.
OBD 19 and Newer VGT Only	2549-08-03-03 Nox Conversion Test OR (whichever is available) 2589-08-03-18 Exhaust Aftertreatment System Analysts (only Nox Subtest available)
OBD 19 and Newer TC	2549-08-03-03 Nox Conversion Test

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Repair:

• If the INLET (NOx1) sensor fails the evaluation, replace the Inlet NOx Sensor ONLY.

• If the NOx2 sensor (Outlet NOx Sensor) fails the test, disregard the results.

OUTLET NOx Sensor (NOx 2) Diagnostic Trouble Codes - Sensor Failure

REPLACE the sensor if any codes in red table below are active and/or confirmed. Do not replace for inactive codes.

Fault Code	Fault Description
P220F-93	NOx Sensor Incorrect Value at Startup, No operation
P229E-13	NOx Sensor Bank 1 Sensor 2, Circuit open
P22A6-00	NOx sensor heater sense circuit, bank 1 sensor 2
P22A1-00	NOx Sensor Circuit High Bank 1 Sensor 2
P22A3-13	NOx Sensor Heater Control Bank 1 Sensor 2, Circuit open
P22A4-00	NOx sensor heater control circuit low, bank 1 sensor 2
P22FE-00	NOx Sensor Performance - Sensing Element Bank 1 Sensor 2

Direction/Repair: Replace the sensor in accordance with Impact instructions.

Do NOT Cut the sensor wiring harness, all NOX sensors are currently on mandatory return.

Outlet NOx Sensor (NOx 2) Diagnostic Trouble Codes - Potential Sensor Failure

Fault Code	Fault Description
P225E-00	NOx Sensor Performance - Signal Stuck High Bank 1 Sensor 2

Direction: Run the applicable PTT Operation per OBD Level.

Emission Level	PTT Operation
OBD 13-16	2549-08-03-03 NOx Conversion Test
OBD 17-18 VGT Only	2589-08-03-18 Exhaust Aftertreatment System Analysts (make sure NOx and SCR Subtest are selected)
OBD 17-C Only	No test… Replace Outlet (NOx 2) NOx Sensors if not replaced within past 3 months and release truck. If NOx sensor has been replaced within past 3 months open an E-Service Case

Only	replaced within past 3 months open an E-Service Case.
OBD 19 and Newer VGT Only	2549-08-03-03 NOx Conversion Test OR (whichever is available) 2589-08-03-18 Exhaust Aftertreatment System Analysts **(only Nox Subtest available)**
OBD 19 and Newer TC Only	2549-08-03-03 NOx Conversion Test

Repair:

• If the Outlet (NOx 2) sensor fails the evaluation, replace the Outlet NOx Sensor ONLY.

• If the NOx 1 sensor (Inlet NOx Sensor) fails the test, disregard the results.

Diagnostic Trouble Codes With NOx Sensor in the Description

Direction/Repair: **DO NOT REPLACE** the NOx sensor(s) for these codes. Diagnostics should be performed using PTT Diagnostics and the comment section in the table below.

Fault Code	Fault Description	Comments
P220A-1C	NOx Sensor Supply Voltage Circuit (Bank 1 Sensor 1), Circuit voltage out of range	Power supply
P220B-1C	NOx Sensor Gas Outlet High Voltage, Circuit voltage out of range	Power supply
P225D-00	NOx Sensor Performance - Signal Stuck Low Bank 1 Sensor 1	Sensor reading fresh air
P225F-00	NOx Sensor Performance - Signal Stuck Low Bank 1 Sensor 2	Sensor reading fresh air
U029D-00	Lost Communication With NOx Sensor "A"	Most likely Harness Issue
-00	Lost Communication with NOx Sensor B	Most likely Harness Issue

P229F-64	NOx Sensor Gas Outlet Removed, Signal plausibility failure	Nuisance code, most likely “Confirmed = False”

Although the codes above have the term "NOx sensor" in their descriptions, it is highly unlikely that the sensor is the cause of any of these codes. The table above specifies the likely cause of each code.

Rules for Replacement

Warranty will only cover replacement of the NOx Sensors if one of the codes in Red or Yellow listed above is active or confirmed. If the NOx Sensor is suspected to have failed with no active or confirmed codes, an eService case is required for further evaluation.

Review the video link below.

MACK	NOx Sensor
VOLVO	NOx Sensor

Standard Diagnostic Time for a NOx Sensor is 1.0 hr.

Tags

p2200-13 p2203-00 p2205-13 p2206-00

p2208-00 p026c-00 p026d-00 p2201-64

p225c-00 p220f-93 p229e-13 p220a-1c

Live UI b-1c p225d-00 p225f-00 u029d-00

u029e-00 p229f-64 p22fb-92 p220e-93

p22a6-00 p22a1-00 p22a3-13 p22a4-00

p22fe-00 p225e-00 p20ee-00 p103c-00

p207f-00 volvo mack unlocking uptime

Related links and attachments

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