



NOx Sensor Replacement Guide - US10+OBD13 And Newer Emissions



Component Overview

There are two Nitrogen Oxides (NOx) sensors in the Exhaust After-Treatment 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
P2208-13	NOx sensor heater control circuit low, bank 1 sensor 1



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	2549-08-03-03 Nox Conversion Test

Live UI

and	
Newer TC Only	

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-	2549-08-03-03 NOx Conversion Test
OBD 17-	2589-08-03-18 Exhaust Aftertreatment System Analysts (make

 Live UI

18 VGT Only	sure NOx and SCR Subtest are selected)
OBD 17-18 TC 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.
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-	Lost Communication With NOx Sensor "A"	Most likely Harness Issue
U029E-	Lost Communication with NOx Sensor B	Most likely Harness

 Live UI

00		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.

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](#)
[p220b-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](#)

 Live UI

Related links and attachments

No links or attachments available



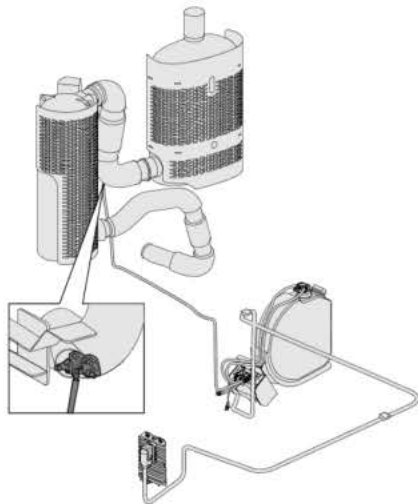
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Aftertreatment selective catalytic reduction (SCR) system



Illustrations are used for reference only, may differ slightly from the actual vehicle

2549-08-03-03 NOx Conversion

Simulation

Information >> Conditions >> Execution

Purpose

Check NOx sensor offset

Components to be tested are:

- NOx sensor

Note: This operation should only be used in the following circumstances

- Reference from diagnostic/service information or Technical support
- Relevant DTCs: P207F, P20EE, P225E, P225C

Description







The test can be used when:

- Verification - To compare system behaviour before and after repair

Note: Operation may take approximately 20 - 30 minute(s) to complete

Information



- 1 
- 2  = Released
- 3  > 600rpm
- 4  
- 5 

2549-08-03-03 NOx Conversion

Simulation

Information >> **Conditions** >> Execution

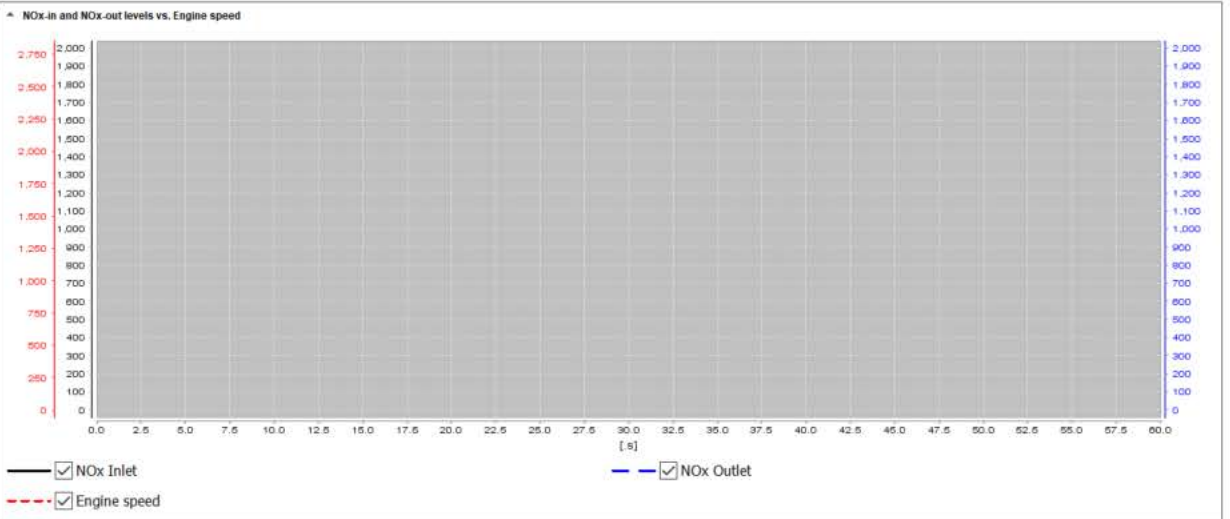
Manual conditions

- 1 Parking brake applied
- 2 Accelerator pedal (AP) released
- 3 Engine running
- 4 Vehicle outdoors in a suitable area
- 5 Reference from diagnostic/service information or Technical support (DTCs: P207F, P20EE, P225E, P225C)

Confirmed

NOx Conversion Test

▶



Exhaust gas temperatures

Other sensors

2549-08-03-03 NOx Conversion

Simulation

Information >> Conditions >> Execution

Information

Action

In order for the test to make a proper evaluation, the engine must shut down once the test is completed. If the engine does not shut down, the test did not complete correctly.

- 1 Start the test
- 2 Wait for the engine to shut down
- 3 Once the engine shuts down wait until message "Engine cranking needed" appears (next to Start/Stop button)
- 4 Crank the engine continuously until the pop-up message appears (10 - 15 seconds)

"After engine cranking has been completed, the key must NOT be turned to the OFF position until the operation has completely finished"

Note: "The engine must be cranked within 1 minute(s) after the engine shuts down. If engine cranking is not done within this time period, the test may have to be restarted."

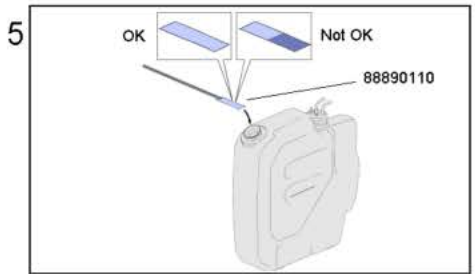
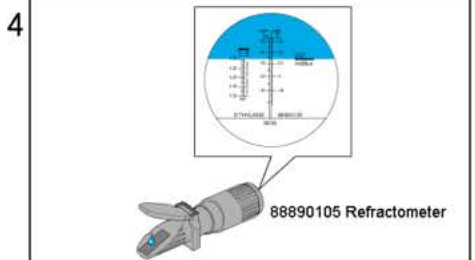
NOx-in and NOx-out levels vs. Engine speed

Exhaust gas temperatures

Other sensors

Result

Continue >



2589-08-03-18 Exhaust Aftertreatment System Analysis

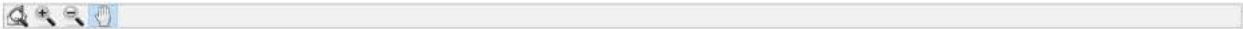
Simulation

Information >> Conditions >> Execution >> Result



Manual conditions

- 1 Reference from diagnostic/service information or Technical support (DTCs: P103C, P20EE, P225E, P225C, P229F, P2201, P0422)
- 2 Parking brake applied
- 3 Vehicle outdoors in a suitable area
- 4 DEF concentration within specifications
- 5 DEF free from contamination

Confirmed



Start

DEF System Status:
Waiting for start



- ▼ Primary Parameters
- ▼ Secondary Parameters

2589-08-03-18 Exhaust Aftertreatment System Analysis

Simulation

Information >> Conditions >> Execution >> Result

▼ Information

▲ Action

It is highly recommended to run all the subtests at the same time in order to achieve an optimal system evaluation. However, each subtest can be selected individually on recommendation from diagnostic/service information or Technical Support.

Note: All subtests are enabled by default

Deselect which subtests are not to run

- NOx sensors
- DEF dosing system
- SCR efficiency

Ignition Key ON and Engine OFF

- 1 Read out the status of the operating conditions
- 2 Check that all signals and values are stable and without abnormal deviations
- 3 Check that all signals are displaying realistic values according to the actual conditions

Start the engine and let it idle

- 1 Start the test
- 2 Wait until test has completed
- 3 Continue to the Result step



- ▼ Primary Parameters
- ▼ Secondary Parameters
- ▼ Static parameters, initial readout



Continue >

Test result

NOx inlet response



NOx outlet response



DEF dosing system



SCR efficiency



Reference

Icon	Description
	Test Completed, no errors detected
	Test Completed, error detected
	Test not completed
	Not tested
	Sensor signal out of expected range

2589-08-03-18 Exhaust Aftertreatment System Analysis

Simulation

Information >> Conditions >> Execution >> Result

Result

Recommended actions	
NOx inlet response	Not tested
NOx outlet response	Not tested
DEF dosing system	Not tested
SCR efficiency	Not tested

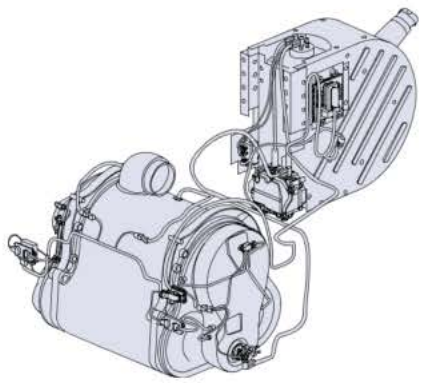
Detailed information



NOx sensor values
DEF dosing system values
SCR efficiency test values



Continue >



2589-08-03-18 Exhaust Aftertreatment System Analysis

Simulation

Information >> Conditions >> Execution >> Result

Purpose

Comprehensive check of Exhaust Aftertreatment System (EATS)

Note: This operation should only be used in the following circumstances

- Reference from diagnostic/service information or Technical support
- Relevant DTCs: P103C, P20EE, P225E, P225C, P229F, P2201, P0422

Description

- The ECM routine will perform a self-evaluating system test on the Exhaust Aftertreatment System (EATS)
- All tests can be performed in sequential order, or specific sub-tests can be individually selected

Available sub-tests that can be performed individually

- NOx sensors
- DEF dosing system
- SCR efficiency

Operation may take approximately 15 - 45 minute(s) to complete

Continue Cancel