** SOLUTION **

Title	Diagnostic Trouble Codes (DTC) P20EE And P103C, Diagnostic Procedure; REPLACES GUIDED DIAGNOSTICS IN PREMIUM TECH TOOL (PTT) - US17+OBD16 Through US17+OBD2018 Emissions, Model Years 2018 And 2019

Mack Models

Mack Model	LR , MRU - TerraPro , TE - TerraPro , AN - Anthem , CHU - Pinnacle, Axle back , CXU - Pinnacle, Axle front , GR - Granite , GU - Granite , PI - Pinnacle

Volvo Models

Volvo Model	VNL , VNM , VNR , VAH , VHD

Emission Standard

Emission Standard	US17+OBD16 , US17+OBD18

Engine family

Engine family	11L Engine , 13L Engine , MP7 , MP8

** SOLUTION **

Cause	Procedures and checks to follow for P20EE and P103C on US17+OBD2016 and US17+OBD2018 chassis.

Solution

5 JANUARY 2020 UPDATE

There is no longer an eService case required for ANY STEP of the process below. A case should ONLY BE OPENED if further assistance is required to complete diagnosis.

If test results determine an SCR replacement is required, A CASE IS NOT REQUIRED TO ORDER A REPLACEMENT.

Cases submitted solely to request approval to replace an SCR WILL BE REFUSED.

PRIOR TO PROCEEDING

Review open campaigns for the vehicle and ensure that it is NOT listed for Recalls EC0020a, EC0022a, EC0022b, or EC0022c.

IF THE CAMPAIGN APPLIES TO THE VEHICLE:

- **No diagnostics are necessary.**
- **No eService case is necessary.**

Follow the recall instructions if the vehicle is listed. This solution should only be utilized if the vehicle is not included in any of the recalls.

CASES AND DIAGNOSTIC TIME REQUESTS OPENED FOR CHASSIS AFFECTED BY ONE OF THE ABOVE RECALLS WILL BE REFUSED.

⚠ **WARNING**

If this solution is being reviewed for P225E-00, solution K15560422 must be utilized FIRST, and this solution should only be followed if the NOx sensors are determined to be functioning properly. The tests performed in K15560422 do not need to be duplicated for this solution.

The following checklist should be used for diagnosis of P20EE or P103C on GHG17 chassis instead of Guided Diagnostics.

DO NOT REPLACE ANY PARTS UNTIL ALL ACTIVITIES LISTED IN THIS CBR ARE COMPLETE.

NOTE: The Malfunction Indicator Lamp (MIL) may still be lit even if P20EE shows inactive on a DTC Readout.

I. Vehicle Emissions Level

Review the vehicle emissions level

• Details can be found in the Product Details box on the Product tab in PTT as seen below:

• **If the vehicle is US17+OBD16 or US17+OBD18:**

    - Perform Sections II and III below.

II. Vehicle History

- The following information should be obtained prior to beginning diagnosis.

• Is this the chassis's first visit to the dealer for either of these codes?

• Have there been any previous failures or problems that may have caused problems with the Exhaust Aftertreatment System (EATS)?

Examples:

- Turbocharger failure
- EGR Cooler failure
- Coolant passage through the exhaust
- Excessive fuel through the exhaust (Injector failure, AHI failure)
- DPF failure
- Contaminated DEF

III. Check the DTC Readout

- Are there any other NOx sensor DTCs present?

• P225E and P0422 are very similar to P20EE and should be checked with the same steps below.
• Any other NOx sensor codes may suggest intermittent NOx sensor failure.

- Are there any codes present for other engine components that would indicate an issue contributing to or causing either P20EE or P103C?

• Examples:

EGR System
Fuel System (Includes AHI)
Turbocharger/Boost
DPF
Exhaust temperature

IV. Check SCR Efficiency Evaluations

- SCR Efficiency values can be found in Premium Tech Tool (PTT) Operation 2589-08-03-05 Aftertreatment Selective Catalytic Reduction (SCR) System.
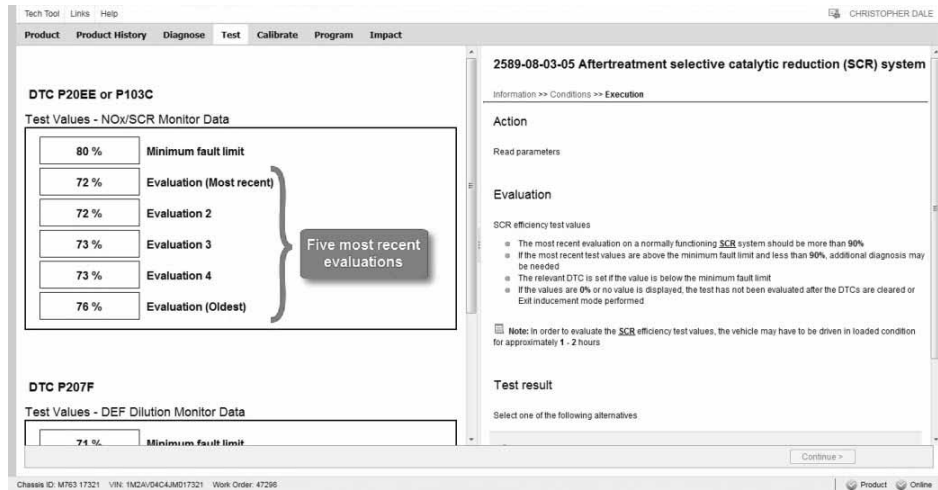
- The last five efficiency evaluations are displayed as shown in the screenshot above.

    If all five tests are below the fault limit, SCR conversion has been poor for an extended amount of time.
    If only one or two are below the fault limit, conversion is only intermittently poor.
      - Information on driving conditions when the poor conversion is occurring may provide insight into the cause of the codes.

V. SCR System Checks

All steps below should be performed to verify proper function of each component.

1. **Check DEF quality with a refractometer**

2. **Physically check for any contamination in the DEF tank**

    - Examples
      - Dirt or Debris
      - Coolant
      - Water
      - Fuel
      - Oil

3. **Physically inspect the DEF Dosing Valve, Diffuser Pipe, and SCR Inlet for crystallized DEF**

    - Ensure there is no significant/excessive crystal buildup in any component.
        NOTE: A small amount of crystal accumulation is normal.
    - **If significant accumulation is noted clean it as first step and then** ensure that the DEF dosing valve is correctly installed with all gaskets and clamps positioned properly.

4. **Perform DEF Dosing Test 2 to confirm proper function**

    - Located in Operation 2589-08-03-05 Aftertreatment Selective Catalytic Reduction (SCR) System.
        Test B from the first screen of the operation

- Test two is the **Small Dosing Test**

  The test should be run twice and results noted to an accuracy of 2 milliliters

  Nominal Volume is **55 mL**

  - Acceptable range is 55 mL ± 3 mL

5. **Check the Main Software part number for the Engine Control Module (EMS).**

   - **If vehicle has Turbo-compound system, then do not update EECU SW. Only EECU MSW 23470187 and older have capability to run NOx conversion test on Turbo-compound vehicles.**
   - **If vehicle has VGT system, then update EECU MSW to 23766686 or newer.**

6. **If vehicle has a Turbo-compound System run NOx Conversion, Operation 2549-08-03-03. (only possible if vehicle still has 23470187 and older EECU MSW).**

7. **If vehicle has a VGT System run Exhaust After-treatment System Analysis, Operation 2589-08-03-18. Make sure to evaluate only NOx sensors and SCR using this test (Please attach pictures emailed).**

VI. eService Case

If further assistance is required to complete diagnosis and an eService case is opened, the case <u>MUST INCLUDE</u>:

1. The vehicle history as described in Section I.

2. A complete DTC Readout from the time of the vehicle's arrival.

3. Screenshots of:

   - SCR Efficiency values as shown in Section III
   - The NOx Conversion Test as shown in the picture in Section IV.

   NOTE: Refer to CBR Solution <u>K52225504</u> - Methods For Taking A Screenshot

4. A description of findings for each item checked in Section IV, **including numerical values for the dosing tests** ("Good", "Okay", "In spec", etc. are not acceptable values).

Internal comments (BO)	**<u>For OBD2019 and Newer vehicles (Truck MY2020+), there is a new CBR.</u>** GHG2017 and OBD2018 vehicles have Exhaust Aftertreatment System Analysis Test (2589-08-03-18), which helps evaluate NOx sensors, DEF dosing valve and SCR in one ~30 minute test with wk1945+ EECU MSW (P/N 2376686 or newer) releases. We do not have capability to run either NOx conversion or EATS Diagnostics Test (2589-08-03-18) on Turbocompound Vehicles.
Solution visibility	Dealer distribution

Function(s)/component(s) affected

Function affected	Diagnostic tool , DEF Dosing , SCR

Function Group

Function Group	254 catalytic converter; exhaust emission control equipment , 258 emissions after-treatment

Customer effect

Main customer effect	regeneration , diagnostics/methodology , efficiency/abnormal behavior , fault code /display
Fluid implicated	Diesel Exhaust Fluid (DEF)

Fault Codes And Error Codes

OBDII Diagnostic Trouble Codes (P, U, B Format)	P0422-00 , P103C-00 , P20EE-00 , P225E-00

Conditions

Vehicle operating mode	when driving , when stationary
Frequency of occurrence of problem	random

Administration

Author	UT0031H
Dealer ID	UT0031H
Last modified by	A241298
Creation date	05-06-2018 17:06
Date of last update	27-04-2020 14:04
Review date	01-10-2018 00:10
Status	Published
Average score	3.75
Number of scores	4
NA_Reviewer	ut0031h
NA_Author_Group	GTT

** SOLUTION **

Title	Methods For Taking A Screenshot / Screen Capture For eService Cases Or Other Use; Premium Tech Tool (PTT) And Other Software

Mack Models

Mack Model	LEU , LR , MRU - TerraPro , TE - TerraPro , AN - Anthem , CHU - Pinnacle, Axle back , CXU - Pinnacle, Axle front , GR - Granite , GU - Granite , PI - Pinnacle , TD - Titan , CH , CHN , CL , CT , CTP713 , CTP713B , CV , CX , CXM , CXN , CXP 612 , CXP613 , CXU613 , DM , DM6 , DMM , FDM , LE , LE , MH , MR , MR6 , RB , RB6 , RD , RD6 , RD8 , RM6 , RW6 , RW7

Volvo Models

Volvo Model	VN , VAH , VHD , VT

Emission Standard

Emission Standard	US04 , US07 , US10 , US10+OBD13 , US14+OBD13 , US14+OBD15 , US14+OBD 16 , US17+OBD16 , US17+OBD18

Engine family

Engine family	11L Engine , 13L Engine , 16L Engine , MP7 , MP8 , MP10 , CU15 , CU12 CNG , CU9 CNG , CU9

** SOLUTION **

Cause	Many different situations, eService activities or otherwise, may necessitate taking screenshots, or screen captures, of operations or information in PTT or other programs
Solution	

Overview

There are a variety of reasons a screenshot may be needed for review. Diagnostic Trouble Code Readouts, PTT errors, product or control unit information, diagnostic test results, steps and messages, and oscilloscope readings name a few.

There are tools available to capture a screenshot, and Windows itself also has the ability to copy a screenshot to the clipboard without launching a program. This solution will cover the two methods that can be used on most every computer. If there is other imaging software installed on a computer that allows screen captures (Snagit, Jing, and FastStone Capture are a few examples), the software instructions will need to be followed.

Procedure

I. Using The Windows Snipping Tool

Computers running Windows XP or newer (Windows 7, Windows 8, Windows 10) have the Snipping Tool utility installed as part of the Windows software package. The Snipping Tool allows shots to be taken of specific parts of the screen, speeding the process of capturing and saving a
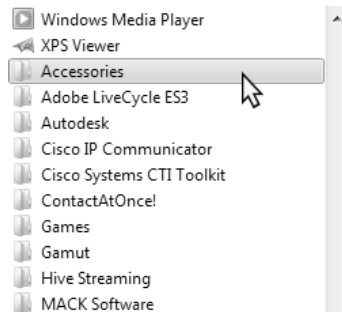
screenshot.

For Windows XP, Windows 7, and Windows 10:

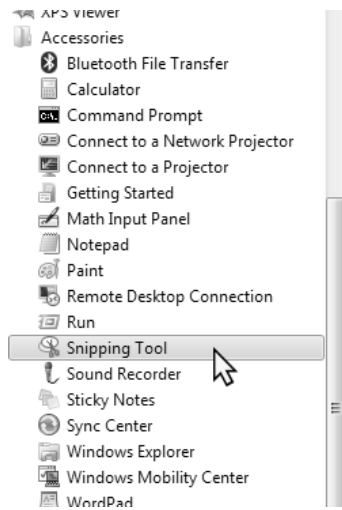1. Click on the Start Menu, then mouse over or click on All Programs:
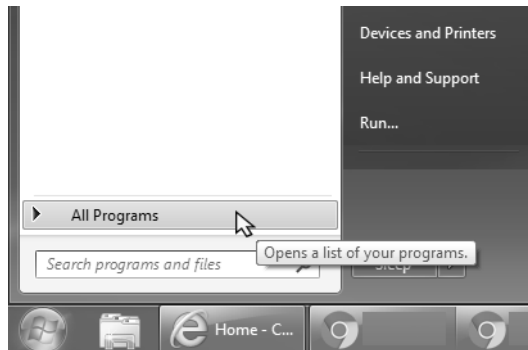
2. Scroll through the list of programs and find the Accessories folder:

3. Click on the Accessories folder, then find the Snipping Tool. Click to open the program.
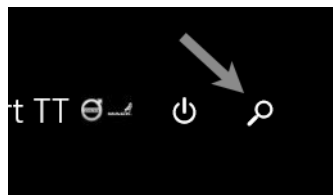

For Windows 8:

1. Click the Start button to bring up the Start Screen

2. Click the Search button (magnifying glass) in the upper right-hand corner of the screen

3. Type "Snipping" into the search bar. Click on Snipping Tool to open the program
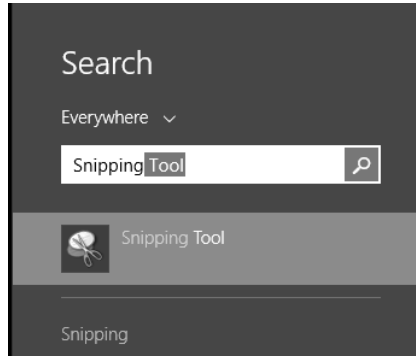
For all Windows versions:

4. The Snipping Tool will open ready to capture a shot. The cursor should change to a cross icon. If the capture doesn't start automatically, click the New button in the Snipping Tool Window.

4a. Move the cursor to where one corner of the screenshot should be. Click and hold the left mouse button, then drag the mouse to the opposite corner of the desired shot:
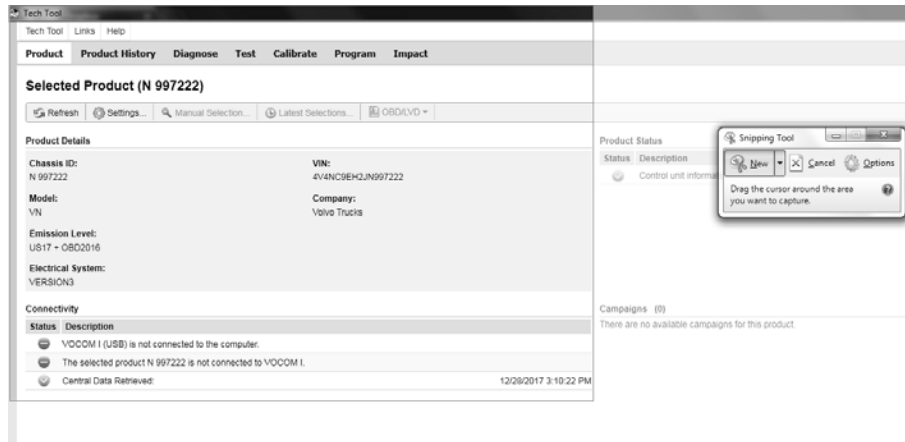
4b. When the left mouse button is released, Snipping Tool will capture the highlighted area and open it in a preview window:
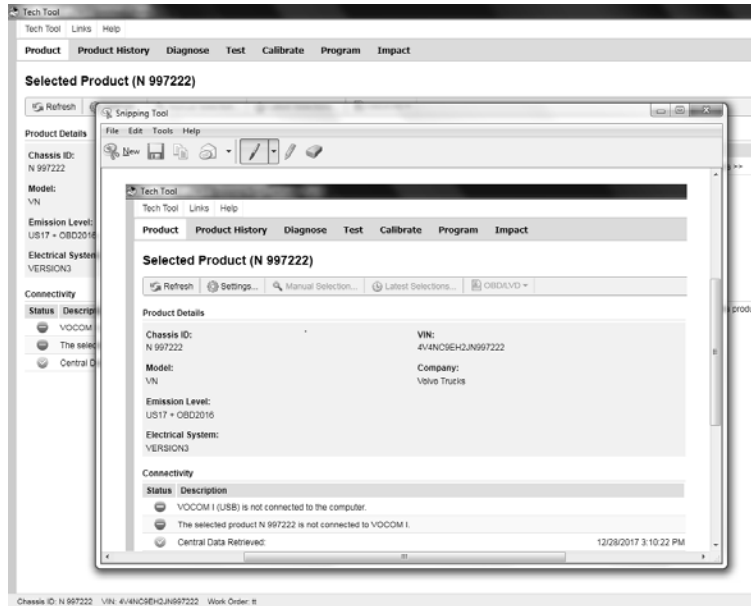
5. If a shot of a complete window is needed, click the dropdown icon (down arrow) next to the New button in the Snipping Tool and select Window Snip. Clicking once on the desired window to copy will open a screenshot of the full window in the preview pane:
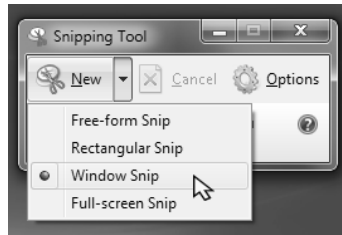
6. Click on the Save (Disk) icon in the preview window. Save the file to desktop or a folder where it can be located. Attach the file to the eService case as needed.

II. Using The Print Screen Key

1. If the screenshot will be of a specific window, make sure the window is maximized first.

2. To capture a screenshot of the full screen, press the Print Screen key on the keyboard. **NOTE:** M any laptops have Print Screen sharing a key with another function. It may be necessary to hold the Function key (Usually marked as Fn) as Print Screen is pressed

Wired keyboard

Laptop keyboard

2a. If taking a shot of a specific window, holding the Alt key and pressing Print Screen (Alt+Fn+Print Screen on a laptop) will only capture the contents of the currently selected window

Wired keyboard

Laptop keyboard

3. Open MS Paint
   • **For Windows XP and Windows 7** Paint is located in the Accessories folder of the Start menu, follow the above steps for locating Snipping Tool
   • **For Windows 8** Follow the steps for the Snipping Tool above to go to the Search box on the Start screen. Search for Paint

4. With Paint open, press either Ctrl+V on the keyboard to paste the screenshot, click the Paste button in the upper left-hand corner of the screen (Windows 7), or select Paste from the Edit menu at the top of the screen (Windows XP). The screenshot will appear in the drawing area.

5. Save the screenshot to Desktop or another folder where it can be easily located. Attach it to the eService case as needed.

Campaign code	Screencap, screen cap, screen shot
Solution visibility	Dealer distribution

Function(s)/component(s) affected

Function affected	MID 140 – IC04 / IC05 , Diagnostic tool , Impact

Function Group

Function Group	0 General , 1 standard parts, service and maintenance material , 2 engine with mounting and equipment , 3 electric power supply; lighting; instruments; software; warning and information system

Customer effect

Main customer effect	calibration/programming/pairing/missing operation , diagnostics/methodology , fault code/display , visual appearance

Conditions

Vehicle operating mode	on start-up , when driving , when stationary
Frequency of occurrence of problem	random

Administration

Author	RU4469V
Dealer ID	RU4469V

Last modified by	A241298
Creation date	28-12-2017 19:12
Date of last update	13-05-2019 15:05
Status	Published

Product   Product History   Diagnose   **Test**   Calibrate   Program

2549-08-03-03 NOx Conversion

☐ **Simulation**

Information >> Conditions >> Execution

Purpose

Check the SCR system's efficiency in reducing the amount of nitrogen oxides (NOx) in the exhaust gas

Components to be tested are:

- Aftertreatment selective catalytic reduction (SCR) system performance
- NOx sensor

Description

The test can be used when:

- Fault tracing - Confirmation of active DTCs
- Fault tracing - Complement to dosing test and DEF quality check
- Verification - To compare system behaviour before and after repair

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

▶ Information

Continue >

[Cancel]

Continue >

Chassis ID: N 890687   Work Order: 000

● Product   Offline

11:32 AM
4/27/2020

Tech Tool | Links | Help

Product | Product History | Diagnose | Test | Calibrate | Program

2549-08-03-03 NOx Conversion

[ ] Simulation

Tech Tool | Links | Help

Product | Product History | Diagnose | Test | Calibrate | Program

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

[ ] Confirmed

1 (P)

2 = Released

3 rpm > 600rpm

4

Product   Product History   Diagnose   Test   Calibrate   Program

2549-08-03-03 NOx Conversion

☐ Simulation

Product   Product History   Diagnose   Test   Calibrate   Program

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 until test has completed (Engine shut down)

▤ **Note:** Some of the data in the graph does not change until the evaluation phase is near the end of the test (Conversion efficiency and DEF dosing amount)

▼ **Engine speed, NOx-in and NOx-out levels, Conversion efficiency and DEF dosing amount**

▼ **Exhaust gas temperatures**

▼ **Other sensors**

NOx Conversion Test

▲

▲ **Engine speed, NOx-in and NOx-out levels, Conversion efficiency and DEF dosing amount**

Conversion Efficiency ― ― DEF Dosing

Tech Tool   Links   Help

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Product   Product History   Diagnose   **Test**   Calibrate   Program

2549-08-03-03 NOx Conversion

☐ Simulation

Tech Tool

Tech Tool   Links   Help

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Product   Product History   Diagnose   **Test**   Calibrate   Program

Test

Select an operation and click Start

[+]   [Sort by function]

🔍

⊞ 1 - Service and maintenance
⊟ 2 - Engine, Engine mounting and equipment
  ⊞ 20 - General
  ⊞ 21 - Engine
  ⊞ 22 - Lubrication and Oil System
  ⊞ 23 - Fuel system
  ⊟ 25 - Inlet and exhaust system
    2500-08-03-02 Boost Pressure, Test Drive
    2500-08-03-03 Response, Test Drive
    2500-08-03-05 Intake and Exhaust Systems, Checks
    2530-08-03-02 Engine Brake Function
    2530-08-03-03 Warm Hold Function
    2545-08-03-02 Exhaust Aftertreatment Diagnostics
    2589-08-03-02 Exhaust Aftertreatment System, Service Regeneration
    2545-08-03-04 Exhaust Aftertreatment System Logged Data
    2549-08-03-03 NOx Conversion

Product   Product History   Diagnose   **Test**   Calibrate   Program

2549-08-03-03 NOx Conversion

☐ **Simulation**

Purpose

Check the SCR system's efficiency in reducing the amount of nitrogen oxides (NOx) in the exhaust gas

Components to be tested are:

- Aftertreatment selective catalytic reduction (SCR) system performance
- NOx sensor

Description

The test can be used when:

- Fault tracing - Confirmation of active DTCs
- Fault tracing - Complement to dosing test and DEF quality check
- Verification - To compare system behaviour before and after repair

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

▶ **Information**

Continue >

Cancel

2549-08-03-03 NOx Conversion

☐ Simulation

2589-08-03-18 Exhaust Aftertreatment System Analysis

☐ Run the operation in simulation mode

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, P225C, P225E, P229F, P2201, P0422

Description

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

Available sub-test that can be performed individually:

1 Aftertreatment hydrocarbon injection (AHI) system
2 NOx sensors
3 DEF dosing system

Test

Select an operation and click Start

⊞   Sort by function

🔍

2589-08-03-02 Exhaust Aftertreatment System, Service Regeneration
2545-08-03-04 Exhaust Aftertreatment System Logged Data
2549-08-03-03 NOx Conversion
2551-08-03-02 Variable Geometry Turbo Function
2584-08-03-01 SCR System, forced heating
2589-08-03-05 Aftertreatment selective catalytic reduction (SCR) system
2589-08-03-06 SCR System Drain
2589-08-03-18 Exhaust Aftertreatment System Analysis

⊞ 26 - Cooling System
⊞ 27 - Engine controls
⊞ 28 - Ignition and control system
⊞ 29 - Miscellaneous
⊞ 3 - Electrical system and instruments
⊞ 4 - Transmission

2549-08-03-03 NOx Conversion

☐ Simulation

2589-08-03-18 Exhaust Aftertreatment System Analysis

☐ Simulation

Information >> Conditions >> Execution >> Result

Purpose

Comprehensive check of Exhaust Aftertreatment System (EATS)

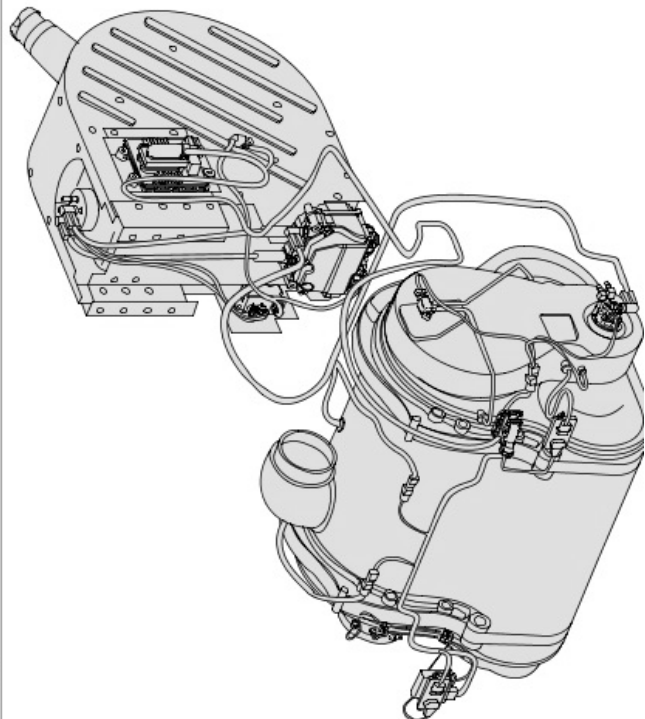🗒 **Note:** This operation should only be used in the following circumstances

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

Description

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Available sub-test that can be performed individually:

1   Aftertreatment hydrocarbon injection (AHI) system

Tech Tool   Links   Help

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Product   **Product History**   **Diagnose**   **Test**   **Calibrate**   **Program**

2549-08-03-03 NOx Conversion

☐ Simulation

Tech Tool   Links   Help

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Tech Tool   Links   Help

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Product   **Product History**   **Diagnose**   **Test**   **Calibrate**   **Program**

2589-08-03-18 Exhaust Aftertreatment System Analysis

☐ Simulation

Information >> Conditions >> **Execution** >> Result

▼ Information

④ **Action**

① It is highly recommended to run all the sub-tests at the same time in order to achieve an optimal system evaluation. However, each subtest can be selected individually based on recommendation from diagnostic/service information or Technical Support.

🗑 **Note:** All subtest are enabled by default

Deselect which subtest not to run

☑ Aftertreatment hydrocarbon injection (AHI) system

☑ NOx sensors

☑ DEF dosing system

☑ SCR efficiency

Start

▲ ■

DEF dosing status:
Waiting for start

Percentage completed (0 - 100%)

0%

▼ Primary Parameters

▼ Secondary Parameters

2549-08-03-03 NOx Conversion

Simulation

2589-08-03-18 Exhaust Aftertreatment System Analysis

Simulation

Information >> Conditions >> **Execution** >> Result

▶ Information

◀ Action

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

Note: All subtest are enabled by default

Deselect which subtest not to run

☑ Aftertreatment hydrocarbon injection (AHI) system

☑ NOx sensors

☑ DEF dosing system

☑ SCR efficiency

Start

DEF dosing status:
Waiting for start

Percentage completed (0 - 100%)

0%

▶ Primary Parameters

▶ Secondary Parameters

Product   Product History   Diagnose   Test   Calibrate   Program

2549-08-03-03 NOx Conversion

☐ Simulation

Product   Product History   Diagnose   Test   Calibrate   Program

2589-08-03-18 Exhaust Aftertreatment System Analysis

☐ Simulation

Information >> Conditions >> Execution >> Result

Result

◢ Recommended actions

AHI Response

　● Not tested

NOx inlet response

　● Restart the test

NOx outlet response

　● Replace the NOx outlet sensor (post-SCR)

Test result

AHI Response

NOx inlet response

NOx outlet response

DEF dosing system

SCR efficiency