SERVICE MANUAL INFORMATION

Group:	SERVICE MANUAL UPDATE
Bulletin No:	SB-15-041
Issue Date:	11-17-2015

Subject: CORRECTION OF WORKSHOP MANUAL FOR HINO CONVENTIONAL
Revision of Troubleshooting Procedure for P20EE

RELEVANT MODEL: 15MY-16MY Conventional Trucks

The following is to inform you of the above caption. This service data should be attached to the relevant pages of the workshop manuals for maintenance and to use for servicing.

OVERVIEW:

In the event that a vehicle exhibits a P20EE, an update is available to the current published diagnostic troubleshooting work procedure.

*All changes will be reflected in the 17MY Conventional Workshop Manual as well.

REVISED DIAGNOSTIC PROCEDURE

Inspect the NOx Sensor

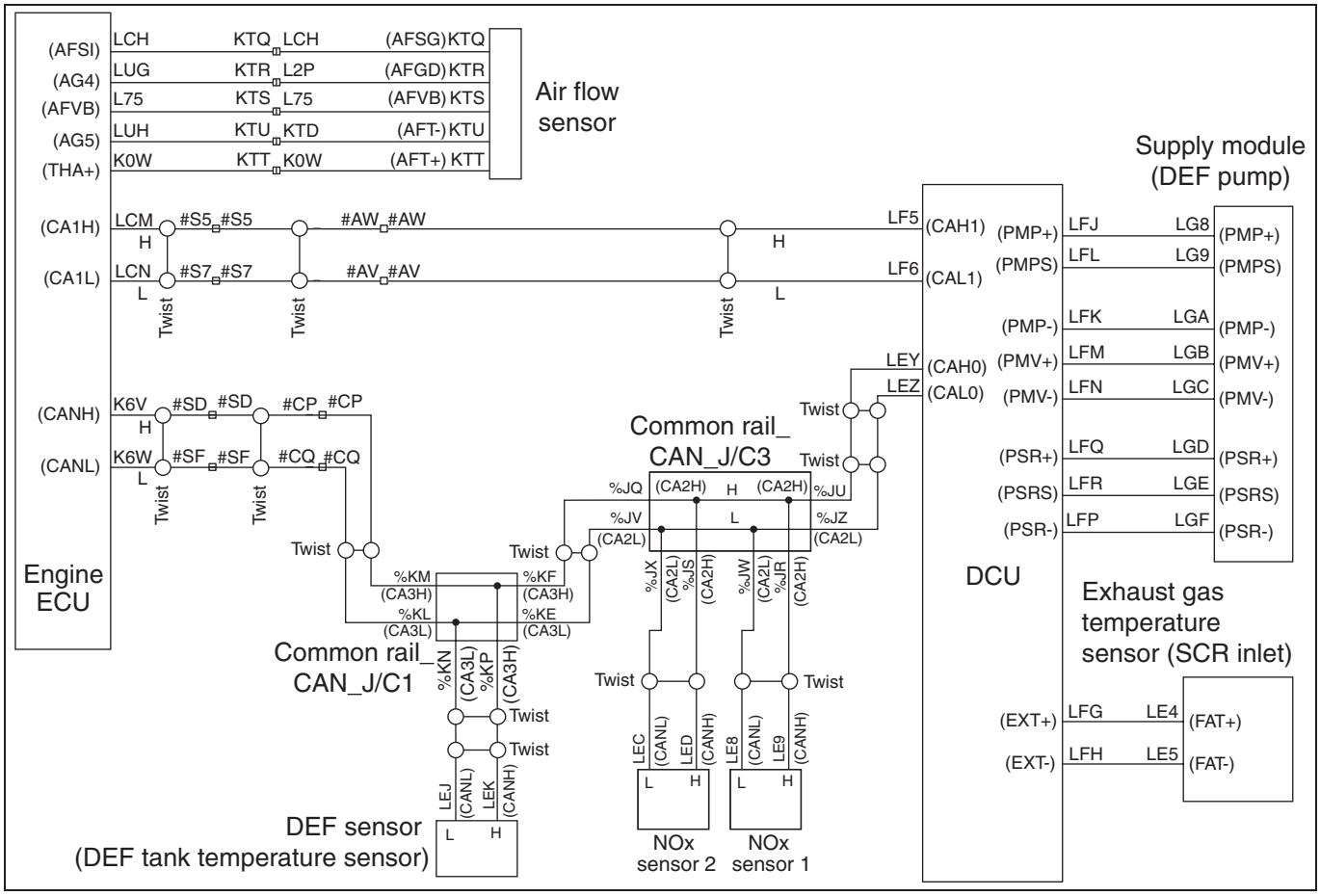
Step 3(upstream) and Step 4(downstream) P20EE

DTC: P20EE

EN01H16F01030F03001141

P20EE: NOx converting catalyst conversion efficiency

INFORMATION



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1. Technical description

- Deterioration of SCR catalyst is determined by a decision of a drop in the NOx conversion efficiency and the DEF concentration.
- Conversion efficiency is calculated by upstream and downstream NOx sensors.
- Besides other factors, conversion efficiency may drop due to the increase or decrease of DEF amount supplied to the sensing unit.
- DEF SCR catalyst concentration is measured by a DEF quality sensor.

<Description of malfunction>

- Deterioration of DEF SCR catalyst is detected.

2. DTC set condition

(1) DTC detection condition

a. Conditions below continue for 5 seconds.
1,000 r/min ≤ Engine speed ≤ 2,500 r/min
Engine speed ≥ 300 r/min for 3 seconds.
30 mm^3/st. cyl. ≤ Fuel injection quantity < 150 mm^3/st. cyl.
300 kg/h ≤ Exhaust gas mass flow < 1,000 kg/h
210 °C {410 °F} ≤ SCR catalyst temperature < 260 °C {500 °F}
50 ppm ≤ NOx (SCR upstream) < 1,000 ppm
Intake air temperature > -20 °C {-4 °F}
60 % ≤ Ratio of actual NH_3 load < 120 %

Calculated HC load < 0.1 g
NOx sensor 1 (SCR upstream) and NOx sensor 2 (SCR downstream) are valid for 121 seconds.
DPF active regeneration not in process

b. Conditions below continue for 10 seconds
DEF defrosting completed (DEF take temperature) ≥ -5 °C {23 °F}
Exhaust gas temperature (SCR inlet) > 150 °C {302 °F}
Engine speed ≥ 350 r/min
Vehicle speed > 6.2 mph
11 V < Battery voltage < 32 V
DEF quality sensor is valid.

(2) Judgement criteria
The conditions described below are formed.

a. Calculate Average NOx conversion efficiency from NOx sensor 1 (upstream) and 2 (downstream).
Target NOx conversion efficiency (from DCU) - Average NOx conversion efficiency ≥ 0.99

b. Average DEF concentration > 16 %

3. Reset condition

- Immediately after normal operation is restored and SCR-related memory is reset.

4. Indication, warning or system control regulation when the DTC is set.

- MIL: ON
- SVS Light: OFF
- Engine output is restricted.
- Vehicle speed is restricted.

5. Symptoms on the vehicle when the DTC is set

<Symptoms on the vehicle due to backup control (fail safe function)>

- –

<Symptoms on the vehicle due to malfunction>

- –

6. Pre-inspection work

- Check that the battery voltage is in the normal range.

7. After-inspection work

- Clear all past DTCs.
- Form the DTC detection condition.
- Check that no DTC is detected after test drive.

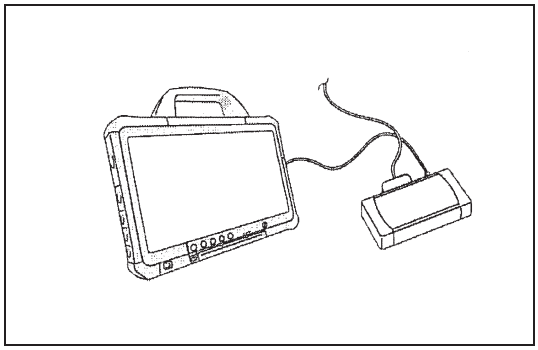
8. Estimated failure factors

- Faulty DEF solution reduction
- Harness disconnection or short-circuit
- NOx sensor failure
- Air flow sensor failure
- Exhaust gas temperature sensor (SCR inlet) failure
- DEF quality sensor failure
- SCR catalyst: miscalculation of adsorption amount or HC poisoning

NOTICE
If no trouble causes are found , it can be suspected that the respective DTC was issued because of a temporary fault condition caused by the freezing of the DEF.

INSPECTION PROCEDURE: P20EE

1	Check the DTC detected [HINO DX II]



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1. Set the starter switch to the "LOCK" position.
2. Connect the diagnostic system (HINO DX II) to the vehicle.
3. Set the starter switch to the "ON" position.
4. Select [Engine] on the screen of HINO DX II and check it the DTC P20EE has been detected.

Has any DTC related to P20EE been detected?

YES

Go to diagnosis procedure of the related DTC.
After repair, go to step 2.

NO

Go to step 2.

2	Check the DEF solution

1. Check the DEF solution concentration.

Standard values
32.5 ± 2.5 %

Do the measurements meet the standard value?

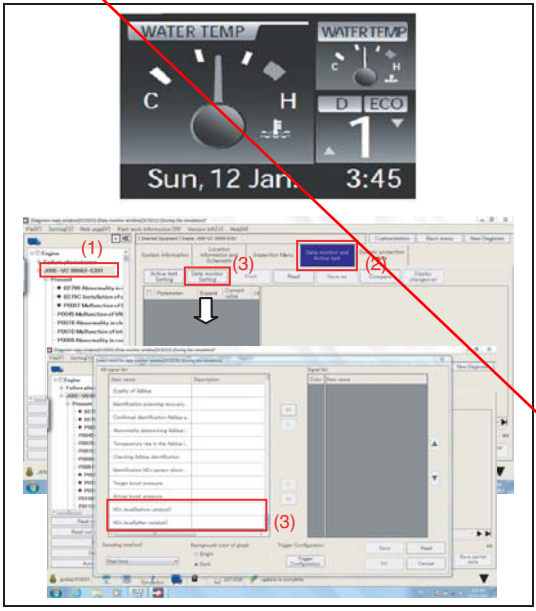
YES

Go to step 3.

NO

Replace the DEF solution.
If the DEF concentration is below the standard, drain the DEF solution through the tank drain with the starter switch ON, and then refill the tank with at least 5 liters {1.3 gallons} of DEF. Afterward, drive the vehicle and confirm that the problem does not recur under driving conditions.
Perform "After-inspection work" of INFORMATION section.

3	Inspect the NOx sensor 1 (SCR upstream) [HINO DX II]



SAPH16F010300792

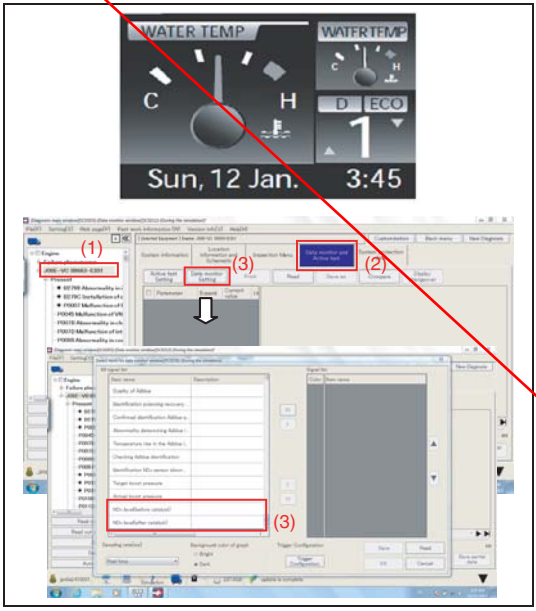
1. Set the starter switch to the "ON" position.
2. Connect the vehicle to HINO DX II .
3. Set the starter switch to the "ON" position.
4. Start the engine. Begin warm-up operation while turning on the exhaust brake. Wait until the indicator on water temperature meter goes up to the middle, as shown in the left picture.
5. Confirm that the output waveform of NOx sensor is being read out, using [Data monitor Setting] function in DX II screen.
   <Inspection procedure>
   (1) Select [Engine].
   (2) Select [Data monitor Setting and Active test Setting].
   (3) Select the [NOx level (before catalyst)] and [NOx level (after catalyst)] on [Data monitor Setting] screen, and start data monitor.
   5-1. If the level of NOx sensor is being read out, wait for three minutes, then turn off the exhaust brake while continued idling.
   5-2. If the level of NOx sensor is not being read out, keep the exhaust brake turned on until the level of NOx sensor begins to be read out, wait for three minutes, then turn off the exhaust brake while continued idling.
6. Check the level of NOx sensor 5 minutes after having the exhaust brake turned off, and determine the condition based on Failure Judgment Manual for NOx sensor.

NOx controller operates properly?

YES	NO
Go to step 4.	**Replace NOx sensor 1 (SCR upstream) that does not operate properly.**

SEE APPENDIX A

4	Inspect the NOx sensor 2 (SCR downstream) [HINO DX II]



SAPH16F010300793

1. Set the starter switch to the "ON" position.
2. Connect the vehicle to HINO DX II .
3. Set the starter switch to the "ON" position.
4. Start the engine. Begin warm-up operation while turning on the exhaust brake. Wait until the indicator on water temperature meter goes up to the middle, as shown in the left picture.
5. Confirm that the output waveform of NOx sensor is being read out, using [Data monitor Setting] function in DX II screen.
   <Inspection procedure>
   (1) Select [Engine].
   (2) Select [Data monitor Setting and Active test Setting].
   (3) Select the [NOx level (before catalyst)] and [NOx level (after catalyst)] on [Data monitor Setting] screen, and start data monitor.
   5-1. If the level of NOx sensor is being read out, wait for three minutes, then turn off the exhaust brake while continued idling.
   5-2. If the level of NOx sensor is not being read out, keep the exhaust brake turned on until the level of NOx sensor begins to be read out, wait for three minutes, then turn off the exhaust brake while continued idling.
6. Check the level of NOx sensor 5 minutes after having the exhaust brake turned off, and determine the condition based on Failure Judgment Manual for NOx sensor.

NOx controller operates properly?

YES	NO
Go to step 5.	**Replace NOx sensor 2 (SCR downstream) that does not operate properly.**

5	Inspect the DEF tank

1. Remove the DEF tank from the vehicle.
2. Remove the DEF quality sensor from the DEF tank.
3. Drain the DEF solution from the DEF tank and check the tank interior for the presence of foreign substances.

Was any failure found?

YES

Remove the foreign substances and clean the DEF tank interior.

⚠ CAUTION
Use fresh water or a diluted DEF solution to clean the DEF tank interior.

Perform "After-inspection work" of INFORMATION section.

NO

Go to step 6.

6	Check the DEF quality sensor

1. Make sure there is no dirt or damage to the DEF quality sensor.

Was any failure found?

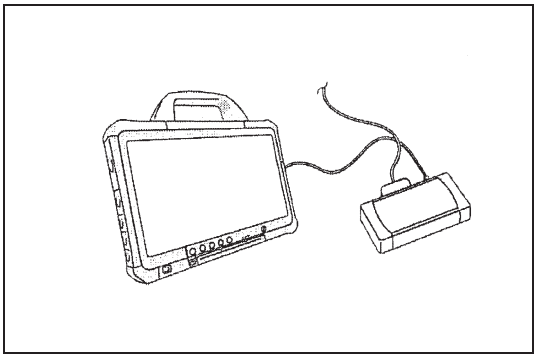
YES

Clean the DEF quality sensor.
Go to step 6.

NO

Go to step 7.

7	Check the DTC detected (Engine ECU) [HINO DX II]



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1. Temporarily install the DEF quality sensor in the DEF tank and mount the tank on the vehicle. (This makes it possible to connect the DEF quality sensor connector.)
2. Fill the tank with the standard concentration of DEF solution.
3. Perform "After-inspection work" of INFORMATION section.
4. Connect the vehicle to HINO DX II .
5. Set the starter switch to the "ON" position.
6. Select [Engine] and check if DTC P20EE has been detected.

Has DTC P20EE been detected?

YES	NO
Replace the DEF quality sensor. Perform "After-inspection work" of INFORMATION section.	**Go to step 8.**

8	Inspect the exhaust gas temperature sensor (SCR inlet) connector

1. Check the connection of the exhaust gas temperature sensor (SCR inlet) connector (Looseness and poor contact).

Was any failure found?

YES	NO
Connect securely, repair if needed. Go to step 9.	**Go to step 9.**

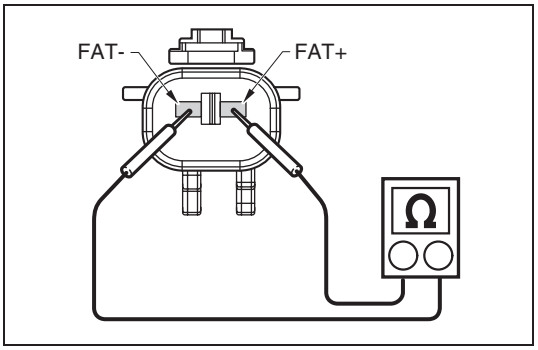
9	Inspect the exhaust gas temperature sensor (SCR inlet)

1. Check the installation of the exhaust gas temperature sensor (SCR inlet).
2. Make sure there is no dirt or damage to the exhaust gas temperature sensor (SCR inlet).

Was any failure found?

YES	NO
Clean the exhaust gas temperature sensor (SCR inlet) and install it properly. If damaged, replace the exhaust gas temperature sensor (SCR inlet). Go to step 10.	**Go to step 10.**

10	Inspect the exhaust gas temperature sensor (SCR inlet) unit



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1. Set the starter switch to the "LOCK" position.
2. Disconnect the exhaust gas temperature sensor (SCR inlet) connector.
3. Use the electrical tester to measure the resistance between the terminals of the exhaust gas temperature sensor (SCR inlet).

Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	Exhaust gas temperature sensor (SCR inlet) FAT+ – FAT-	20 °C {68 °F}: 220 Ω

Do the measurements meet the standard value?

YES

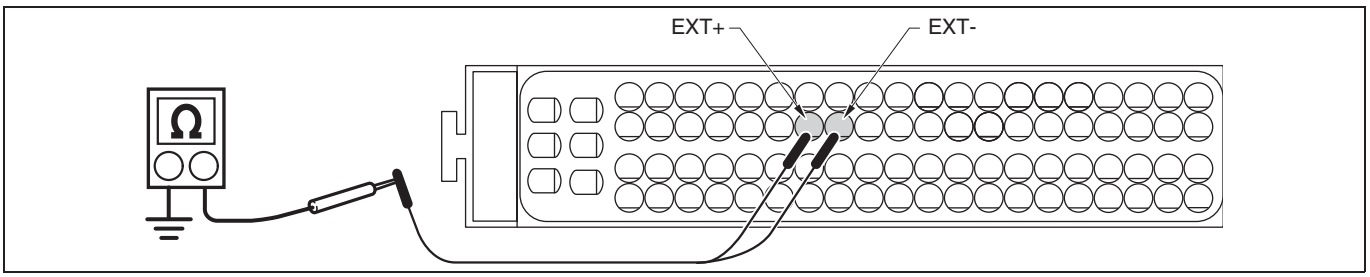
Go to step 11.

NO

Replace the exhaust gas temperature sensor (SCR inlet).
Go to step 11.

11	Inspect for short-circuit in the exhaust gas temperature sensor (SCR inlet) harness

1. Disconnect the DCU 86P connector.
2. Connect the signal check harness and use the electrical tester to measure the resistance between the terminals of the DCU 86P vehicle-side connector and the ground.



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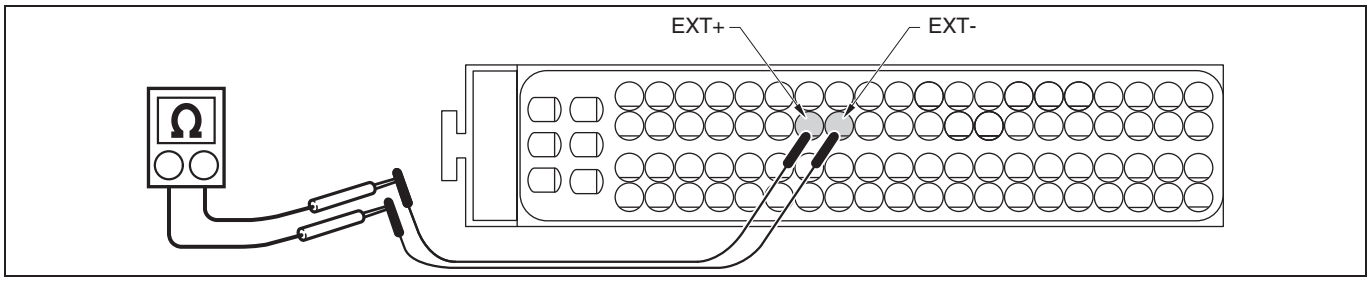
Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	DCU 86P vehicle-side connector EXT+ – Ground EXT- – Ground	∞ Ω

Do the measurements meet the standard value?

YES	NO
Go to step 12.	**Repair or replace the harness. Go to step 12.**

12	Inspect disconnection of the exhaust gas temperature sensor (SCR inlet) harness

1. Connect the exhaust gas temperature sensor (SCR inlet) connector.
2. Connect the signal check harness and use the electrical tester to measure the resistance between the terminals of the DCU 86P vehicle-side connector.



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Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	**DCU 86P vehicle-side connector EXT+ – EXT-**	**20 °C {68 °F}: 220 Ω**

Do the measurements meet the standard value?

YES	NO
Go to step 13. If any failure was found at the step 8 - 11, perform "After-inspection work" of INFORMATION section.	**Repair or replace the harness. Perform "After-inspection work" of INFORMATION section.**

13	Check the DEF pipe (pump ↔ injector)

1. Check the DEF pipe (pressure line) and verify that there are no disconnections, clogging, corrosion, or cracks.

Was any failure found?

YES

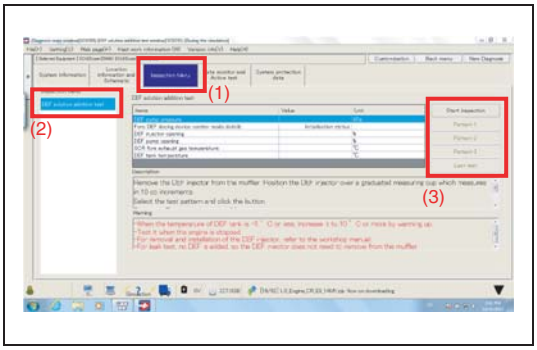
Repair or replace the faulty part.
Perform "After-inspection work" of INFORMATION section.

NO

Go to step 14.

14	Inspect the DEF injector 1 [HINO DX II]

NOTICE
Prepare a beaker or similar, plus a larger measuring vessel for measuring the DEF to be injected, before perform this inspection. (If the vessel is small, there is dispersion at the time of injection from the injector, and the measuring quantity decreases.)



SAPH16F010300798

1. Set the starter switch to the "LOCK" position.
2. Remove the DEF injector from the muffler.

HINT
Refer to the section "SELECTIVE CATALYTIC REDUCTION (SCR)" in the chapter "EMISSION CONTROL (J08E)" (S5-CJ08E12* or S5-UJ08E12*) for removal and installation of the DEF injector.

3. Connect the vehicle to HINO DX II .
4. Set the starter switch to the "ON" position.
5. Select [DCU].
6. Select [Inspection Menu] on HINO DX II menu and check the operation of the DEF injector.

NOTICE
When the DEF tank temperature is -5 °C (23 °F) or lower, perform warm-up to raise it to 10 °C (50 °F) or higher.

<Inspection procedure>
(1) Select [Inspection Menu].
(2) Select [DEF solution addition test].
(3) Perform addition test as instructed on the HINO DX II screen. (Perform all three patterns)

Is operation normal?

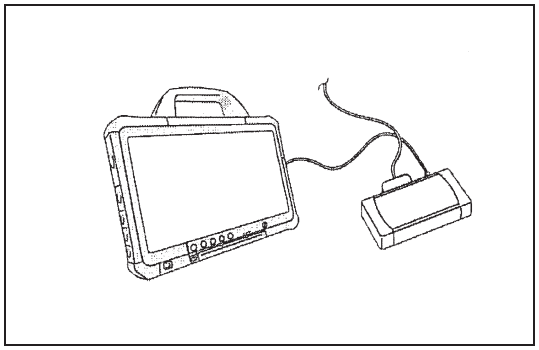
YES

Re-install the DEF injector on the muffler.
Go to step 16.

NO

Go to step 15.

15	Inspect the DEF injector 2 [HINO DX II]



SAPH16F010300799

1. Set the starter switch to the "LOCK" position.
2. Replace the DEF injector with a new one. (Do not install it on the muffler.)
3. Set the starter switch to the "ON" position.
4. Perform DEF addition test as same as step 14.

Is operation normal?

YES

Install the new injector on the muffler and complete the check.
After installing the injector, idle the engine (for about 10 min.) and on HINO DX II (Data Monitor) verify that the DEF solution is stable between 800 kPa {116 psi} and 1,051 kPa {152 psi}.
Perform "After-inspection work" of INFORMATION section.

NO

Re-install the DEF injector and replace the DEF pipe (pressure line).
After replacing the pipe, idle the engine (for about 10 min.) and on HINO DX II (Data Monitor) verify that the DEF solution is stable between 800 kPa {116 psi} and 1,051 kPa {152 psi}.
Perform "After-inspection work" of INFORMATION section.

16	Inspect the air flow sensor connector

1. Check the connection of the air flow sensor connector (Looseness and poor contact).

Was any failure found?

YES

Connect securely, repair if needed.
Go to step 17.

NO

Go to step 17.

17	Inspect the air flow sensor

1. Check the installation of the air flow sensor.
2. Make sure there is no dirt or damage to the air flow sensor.

Was any failure found?

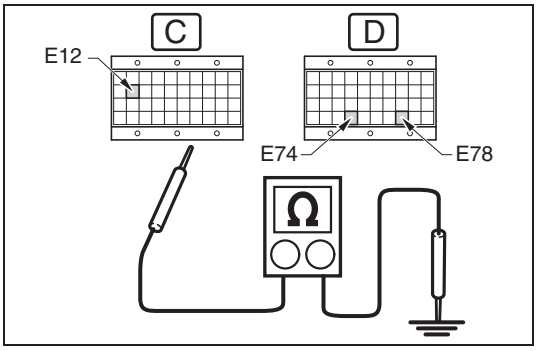
YES

If dirt, clogging or damage was found in sensing unit, replace the air flow sensor.
Go to step 18.

NO

Go to step 18.

18 Inspect for short-circuit of the air flow sensor harness



SAPH16F010300800

1. Set the starter switch to the "LOCK" position.
2. Connect the signal check harness to the engine ECU vehicle-side harness. (Do not connect the harness to the ECU.)
3. Disconnect the air flow sensor connector.
4. Use the electrical tester to measure the resistance between the terminals of the engine ECU (signal check harness) and ground.

Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	**Engine ECU (signal check harness) AFSI(E74) – Ground AG4(E78) –Ground AFVB(E12) –Ground**	**∞ Ω**

Do the measurements meet the standard value?

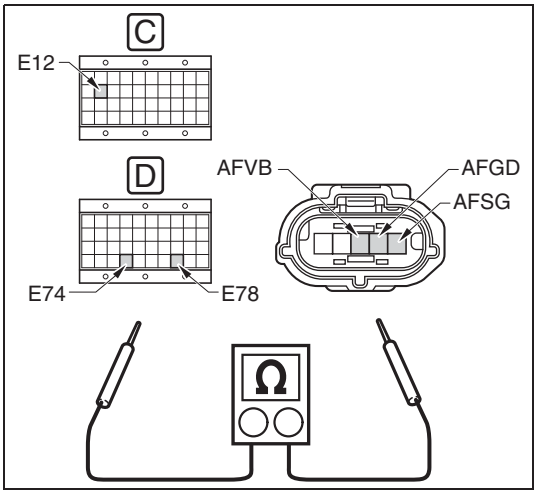
YES

Go to step 19.

NO

Repair or replace the harness.
Go to step 19.

19 Inspect disconnection of the air flow sensor harness



SAPH16F010300801

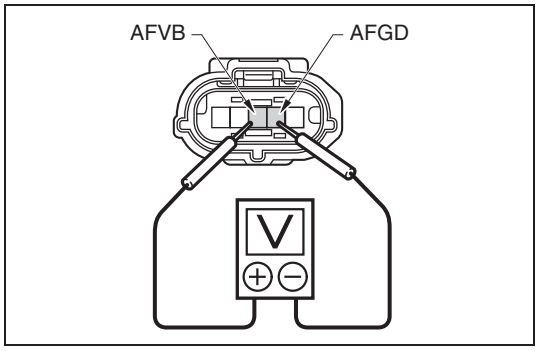
1. Use the electrical tester to measure the resistance between the terminals of the engine ECU (signal check harness) and air flow sensor vehicle-side connector.

Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	**Engine ECU (signal check harness) – Air flow sensor vehicle-side connector AFSI(E74) – AFSG AG4(E78) – AFGD AFVB(E12) – AFVB**	**1 Ω or less**

Do the measurements meet the standard value?

YES	NO
Go to step 20.	**Repair or replace the harness. Go to step 20.**

20 Inspect the air flow sensor power supply



SAPH16F010300802

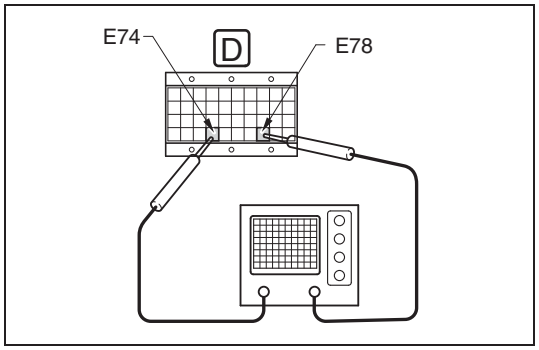
1. Connect the signal check harness to the engine ECU.
2. Set the starter switch to the "ON" position.
3. Use the electrical tester to measure the voltage between the terminals of the air flow sensor vehicle-side connector.

Measurement conditions	Tester connections	Standard values
Starter switch: ON	**Air flow sensor vehicle-side connector AFVB – AFGD**	**4.5 – 5.5 V**

Do the measurements meet the standard value?

YES	NO
Go to step 21.	**Replace the engine ECU. Go to step 21.**

21 Inspect the air flow sensor signal



SAPH16F010300803

1. Set the starter switch to the "LOCK" position.
2. Connect the air flow sensor connector.
3. Start the engine.
4. Use the oscilloscope to measure the signal voltage between the terminals in the engine ECU (signal check harness).

Measurement conditions	Tester connections	Standard values
After engine warm-up, with engine idling	**Engine ECU (signal check harness) AFSI(E74) – AG4(E78)**	**5 – 6 kHz**

Do the measurements meet the standard value?

YES

Go to step 22.
If any failure was found at the step 16 - 20, perform "After-inspection work" of INFORMATION section.

NO

Replace the air flow sensor.
Perform "After-inspection work" of INFORMATION section.

22	Perform a basic engine check

1. Perform a basic engine check using the ENGINE BASIC INSPECTION SHEET (ENGINE INSPECTION CHECK SHEET).

Was any failure found?

YES

Repair or replace the faulty part.
Perform "After-inspection work" of INFORMATION section.

NO

Go to step 23.

23	Inspect the exhaust pipe

1. Make sure there is no soot leakage from the exhaust pipe outlet.

Was any failure found?

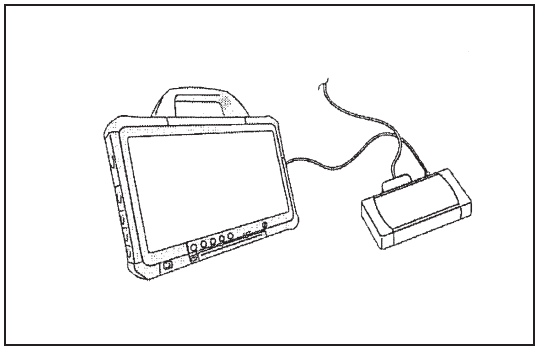
YES

Replace the DPR filter
After replacing the filter, execute a DPR manual regeneration and check if no DTC (P20EE) is detected.
Perform "After-inspection work" of INFORMATION section.

NO

Go to step 24.

24	Inspect the SCR catalyst [HINO DX II]



SAPH16F010300804

1. Set the starter switch to the "LOCK" position.
2. Replace the SCR catalyst.
3. Set the starter switch to the "ON" position.
4. Erase the trouble history.
5. Form the DTC detection condition.
6. Select [Engine] and check if P20EE has been detected.

Has DTC P20EE been detected?

YES

Replace the engine ECU.
Perform "After-inspection work" of INFORMATION section.

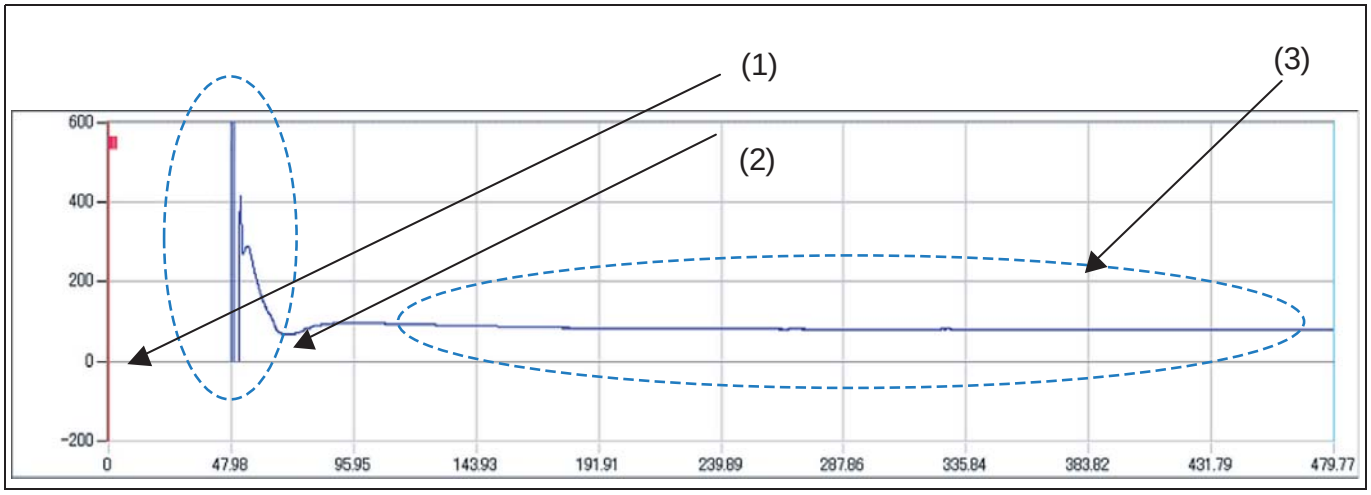
NO

Procedure completed. (SCR catalyst is faulty.)
Perform "After-inspection work" of INFORMATION section.

Manual for the Verification of the Condition of NOx Sensor

Verify the condition of NOx sensor based on the waveforms illustrated below when checking the level of NOx sensor using DX II .

Quality Product Example



SAPH16F010300805

Judgmental Standard
The data of the level of NOx sensor is below "1" and becomes stable in 5 minutes after the initiation of NOx transmission.

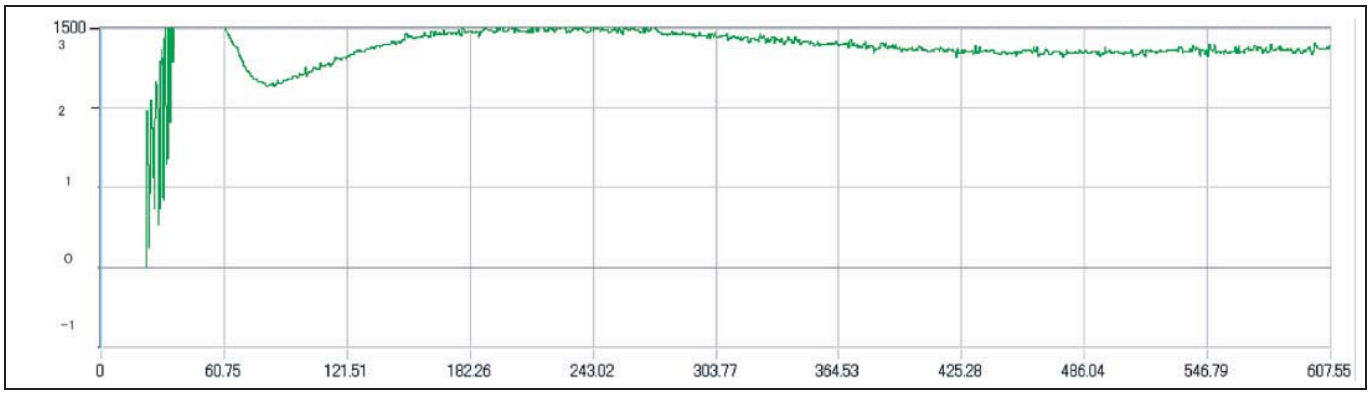
Characteristics

1. The level of NOx sensor stays around "0" until the indicator on the water temperature meter on the vehicle goes up to the middle, as its data is not being transmitted.
2. It is not a problem if the meter shows a high level of NOx sensor for an instant moment when the data of the level of NOx sensor begins to be transmitted.
3. The data of the level of NOx sensor becomes stable at below "1" in about 5 minutes after the initiation of NOx transmission. (Make sure to set the exhaust brake to "OFF")

Failed Product Examples

The level of NOx sensor staying at a elevated level.
The condition in which the level of NOx sensor stays above "1" for longer than 5 minutes after the initiation of NOx transmission is called "elevated NOx level" and NOx sensors with this condition is considered as defective.

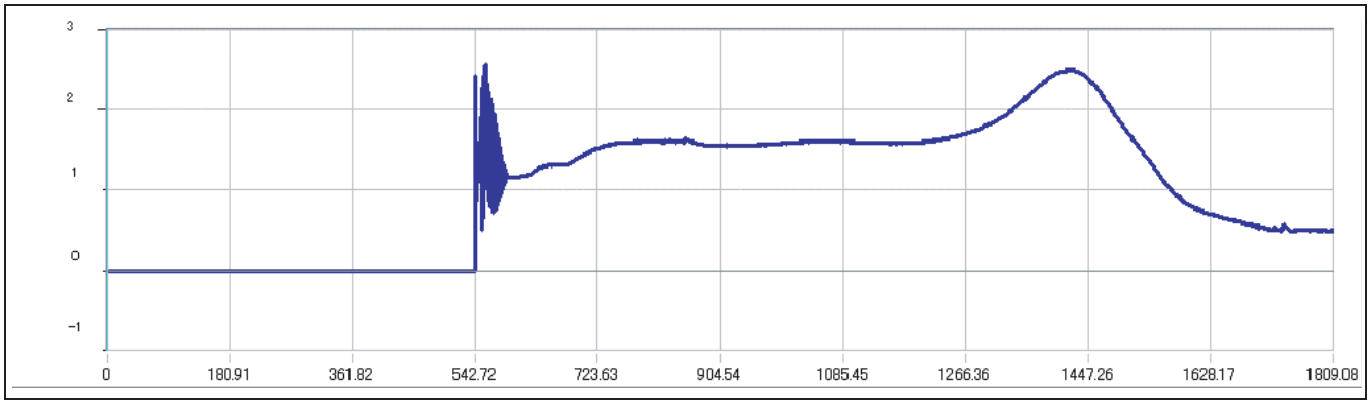
<Elevated NOx Level CASE1>



SAPH16F010300806

Considered defective as the level of NOx sensor is above "1"

<Elevated NOx Level CASE2>



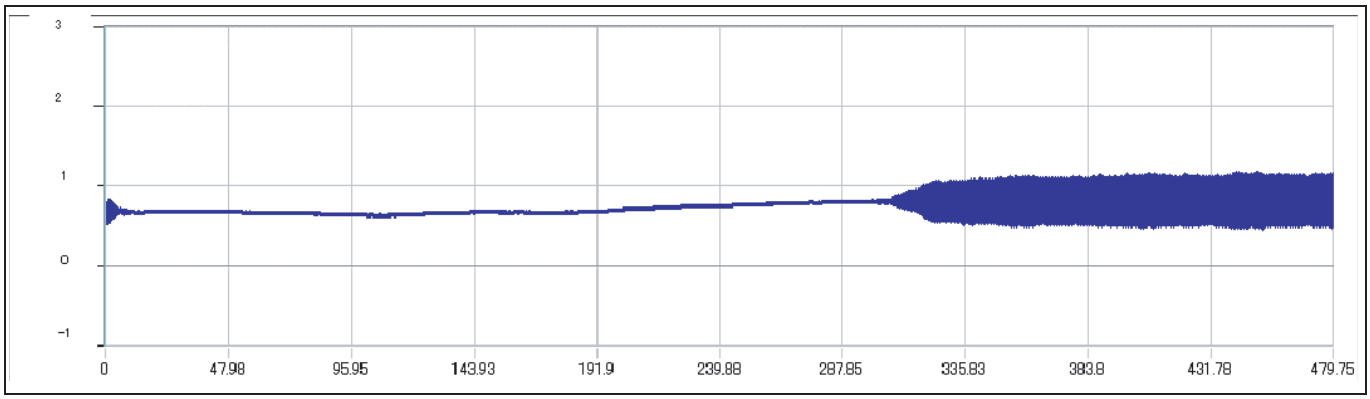
SAPH16F010300807

Considered defective as the level of NOx sensor mostly stays above "1" for longer than 5 minutes after the initiation of NOx transmission, although it goes down to below "1" at the end of the graph.

Oscillation

The condition in which the level of NOx sensor is unstable is called "Oscillation" and considered as defective.

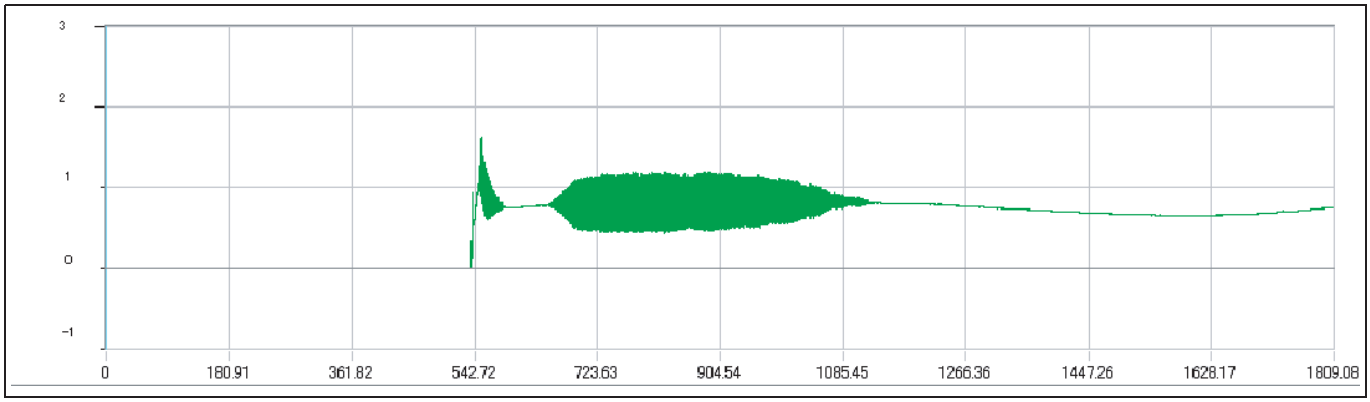
<Oscillation CASE1>



SAPH16F010300808

Considered defective as the level of NOx sensor is not stable all the way through, although it stays below "1".

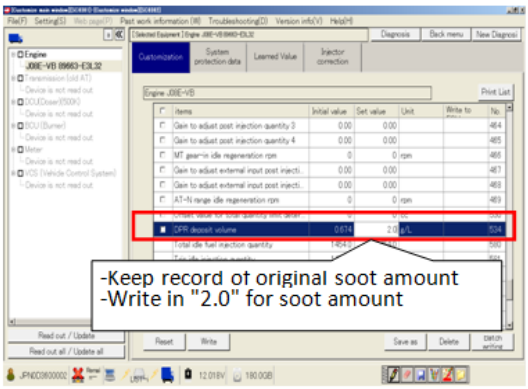
<Oscillation CASE2>



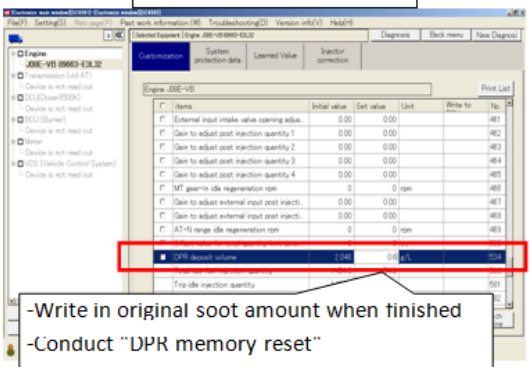
SAPH16F010300809

Considered defective as the level of NOx sensor is not stable all the way through, although it stays below level "1".

APPENDIX A



CAUTION



Check the output waveform of the NOx sensor in the Data Monitor in HINO DXII.

NOTICE: Update the engine ECU control software to the latest version using Auto-repro function of DXII before conducting this procedure.

a. Turn the ignition key to "ON".
b. Select [Engine] in the main screen of DX.
c. Write in "2.0" for the soot amount in the "Customization" function of DX. (Keep the record of the original value)
d. Select [NOx level (before catalyst], [NOx level (after catalyst)] and the SCR catalyst temperature in the Data Monitor function of DX and start the monitoring.
DXII: [Data monitor Setting and Active test setting] [Data monitor Setting] [NOx level (before catalyst)] and [NOx level (after catalyst)]
e. Start the engine.
f. Press the DPR manual regeneration switch and start the regeneration.

HINT: Perform DPR regeneration to increase the exhaust gas temperature as the waveform of the NOx sensor can only be detected when the exhaust gas temperature exceeds the specified value.

h. Monitor the SCR temperature and the NOx levels (before and after catalyst) in the DX Data Monitor.
i. Press the DPR button when the SCR catalyst temperature reaches 250°C, and cancel the regeneration process.
j. Determine whether the NOx sensor is functioning properly based on the NOx sensor waveform recorded during monitoring as per the Performance Verification Manual.

<CAUTION>
1. Rewrite the soot amount back to the original upon completion of the troubleshooting.
2. Conduct DPR memory reset (DTC for abnormal DPR regeneration frequency will come on if not conducted)

Was any failure found?

YES

Replace the effected NOx sensor (1 or 2). Perform the "After-inspection work" of the Information section

NO

Go to step 5.