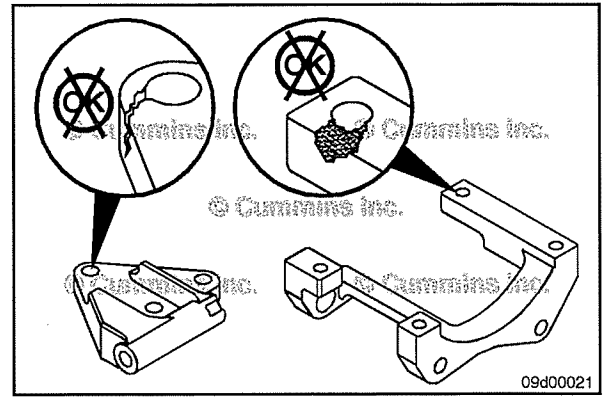


Table of Contents

	Section	
Introduction	i	■
Cooling System - Group 08	8	■
Drive Units - Group 09	9	■
Air Intake System - Group 10	10	■
Exhaust System - Group 11	11	■
Compressed Air System - Group 12	12	■
Electrical Equipment - Group 13	13	■
Engine Testing - Group 14	14	■
Mounting Adaptations - Group 16	16	■
Miscellaneous - Group 17	17	■
Electronic Controls - Group 19	19	■
Service Literature	L	■
Specifications	V	■
Back	back	■

NOx	Mono-Nitrogen Oxides
NG	Natural Gas
O2	Oxygen
OBD	On-Board Diagnostics
OEM	Original Equipment Manufacturer
OSHA	Occupational Safety and Health Administration
PID	Parameter Identification Descriptions
ppm	Parts Per Million
psi	Pounds Per Square Inch
PTO	Power Takeoff
REPTO	Rear Power Take Off
RGT	Rear Gear Train
rpm	Revolutions Per Minute
SAE	Society of Automotive Engineers
SCA	Supplemental Coolant Additive
SCR	Selective Catalytic Reduction
STC	Step Timing Control
SID	Subsystem Identification Descriptions
TDC	Top Dead Center
VDC	Volts of Direct Current
VGT	Variable Geometry Turbocharger
VS	Variable Speed
VSS	Vehicle Speed Sensor

Inspect the refrigerant compressor mounting brackets.
Replace the refrigerant compressor mounting brackets, if cracked or otherwise damaged.

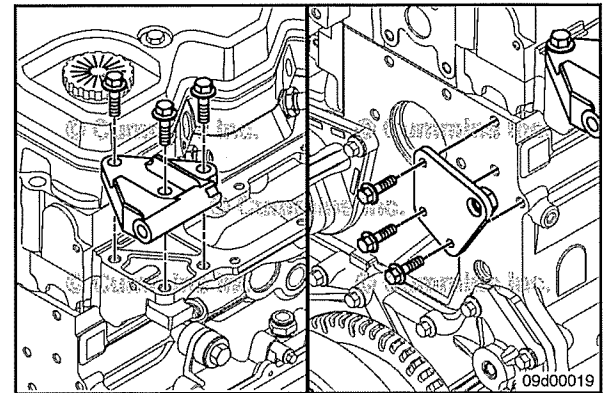


Install

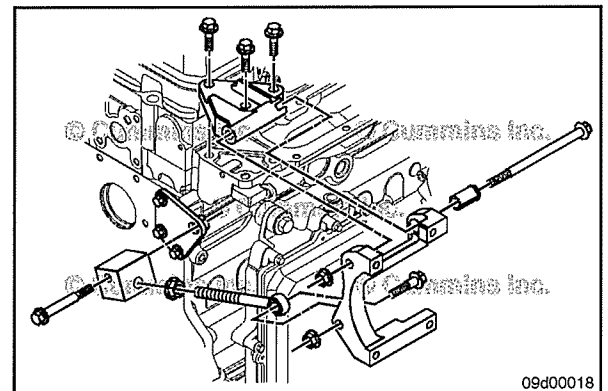
Install the two mounting brackets and capscrews.
Tighten the capscrews.

Torque Value:
M8 23 N•m [204 in-lb]

Torque Value:
M10 43 N•m [32 ft-lb]

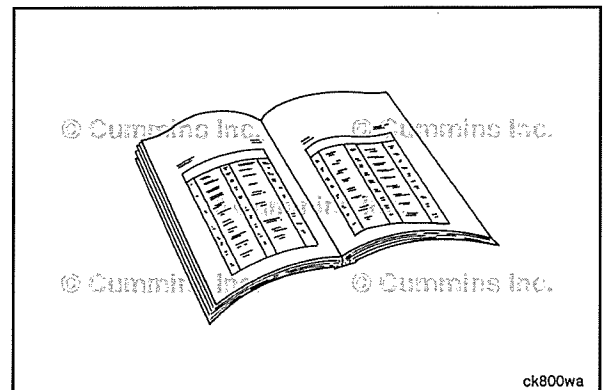


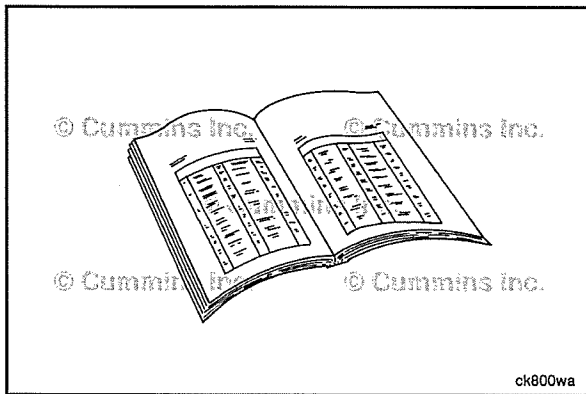
Install the refrigerant compressor support.
Install the pivot bolt hand-tight.
Install the adjusting link.
Install the adjusting link bolts hand-tight.
Tighten the adjusting link bolts and the pivot bolt after the refrigerant compressor is installed and the drive belt has been tensioned.



Finishing Steps

- Install the refrigerant compressor. Refer to the OEM service manual.
- Install the refrigerant compressor belt. Refer to Procedure 009-052 in Section 9.
- Operate the engine and check for leaks.





Finishing Steps

⚠ WARNING ⚠



Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

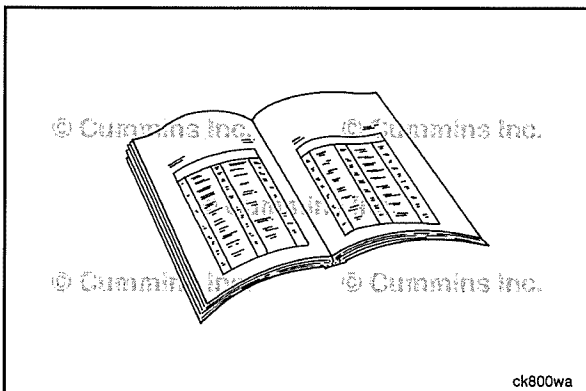


- If removed, install the air intake connection adapter. Refer to Procedure 010-131 in Section 10.
- If removed, install the EGR valve to the air intake connection. Refer to Procedure 011-022 in Section 11.
- If removed, install the EGR differential pressure sensor. Refer to Procedure 019-370 in Section 19.
- Connect the electrical connection to the EGR differential pressure sensor. Refer to Procedure 019-370 in Section 19.
- Connect the electrical connection to the EGR valve and EGR temperature sensor. Refer to Procedure 019-378 in Section 19.
- Install the two wiring harness p-clips to the air intake connection.
- Connect the air crossover tube to the air intake connection adapter. Refer to Procedure 010-019 in Section 10.
- Connect the batteries. Refer to the OEM service manual.
- Operate the engine and check for leaks.

Air Intake Connection Adapter (010-131)

General Information

The air intake connection adapter refers to the part of the air intake system upstream of the air intake connection. The Cummins® engines covered in this manual use an air intake connection adapter attached to the air intake connection by a v-band clamp.



Preparatory Steps

⚠ WARNING ⚠

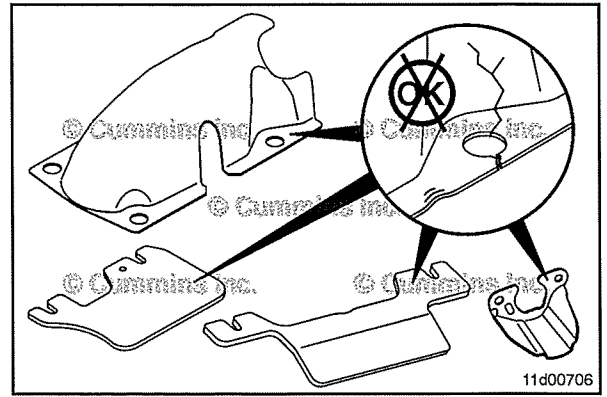


Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Disconnect the battery cables. Refer to the original equipment manufacturer (OEM) service manual.
- Remove the charge air piping between the air intake connection adapter and the outlet of the charge air cooler. Refer to Procedure 010-019 in Section 10.

Clean and Inspect for Reuse

Inspect the heat shield for cracks or other damage.
Replace the heat shield if any damage is found.

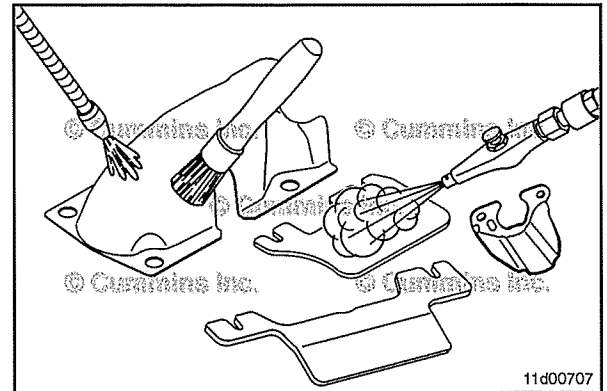


⚠ WARNING ⚠

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Wash the heat shield in a hot, soapy water solution or steam clean if desired.

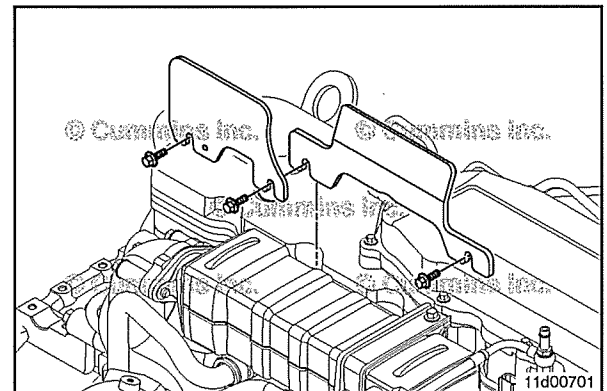
Dry with compressed air.



Install

Install all applicable heat shields.

Use the following procedure for torque values. Refer to Procedure 018-009 in section V.

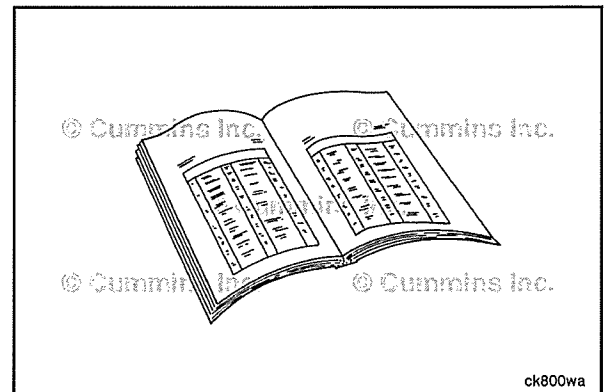


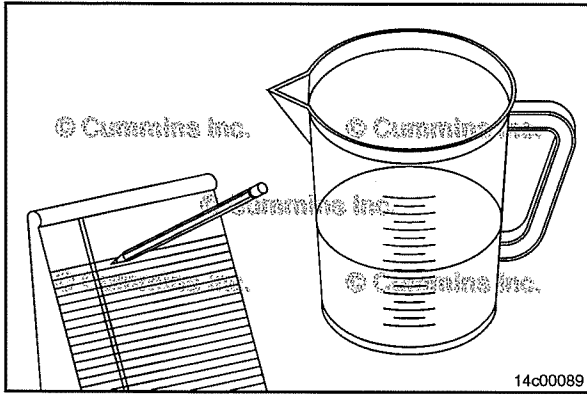
Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

- Connect the battery cables. Refer to the OEM service manual.





After the test is complete (test runs for 6 minutes), measure the amount of DEF sprayed into the container. Pour the DEF into the graduated beaker, Part Number 4919139, or equivalent.

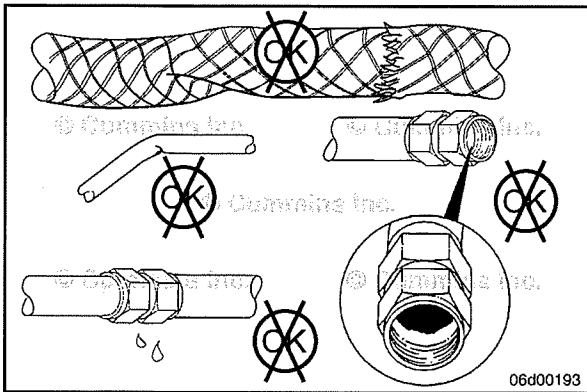
Perform the test three times. The amount of DEF measured for each test **must** be within specification.

Aftertreatment DEF Dosing Valve Volume Specifications

ml		fl-oz
85	MIN	2.9
115	MAX	3.9

NOTE: Do **not** pour the DEF back into the DEF tank. Dispose of the DEF in accordance with local environmental regulations.

NOTE: Inspect the collected sample of DEF for signs of debris or contamination.



NOTE: Low battery voltage can cause the dosing volume to be low. Check the batteries. Refer to the OEM service manual. View and troubleshoot any fault codes with INSITE™ electronic service tool. Reference the QSB6.7 CM2350 B105 Troubleshooting Fault Code Manual, Bulletin 4332777.



If the amount of DEF is **not** within specification, check for leaks, blockages, or restrictions in the DEF line between the aftertreatment DEF dosing unit and the aftertreatment DEF dosing valve. Use the following as a guide if the amount of DEF is still **not** within specification for one or more of the three tests:

- Clean the DEF dosing valve if one or more of the test results is below 85 ml [2.9 oz]
- Replace the DEF dosing valve if one or more of the test results is above 115 ml [3.9 oz]
- Replace the DEF dosing valve if the test results vary with both below-specification and above-specification conditions. This could be an erratic valve with intermittent malfunction and **must** be replaced. Refer to Procedure 011-059 in Section 11.

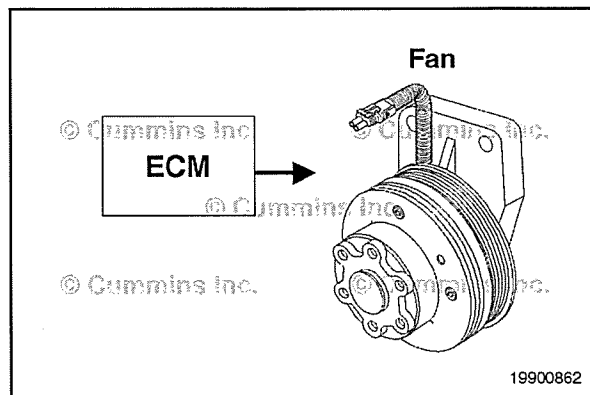
NOTE: The aftertreatment DEF dosing valve may have been plugged by debris. Inspect the aftertreatment DEF dosing unit filter for signs of contamination and debris prior to installing the new aftertreatment DEF dosing valve. Refer to Procedure 011-060 in Section 11.

If the vehicle is equipped with a clutched fan, make sure the fan is locked in the ON position when operating an engine on a chassis dynamometer for the best results.



If the engine control module (ECM) controls the ON/OFF function of the fan, use INSITE™ electronic service tool to lock the fan ON if the unit does not have a manual fan switch.

If the ECM does not control the ON/OFF function of the fan, refer to the manufacturers instructions.



19900862

⚠ CAUTION ⚠

Do not operate the engine at idle speed longer than specified during engine run-in. Excessive carbon formation can damage the engine.

⚠ CAUTION ⚠

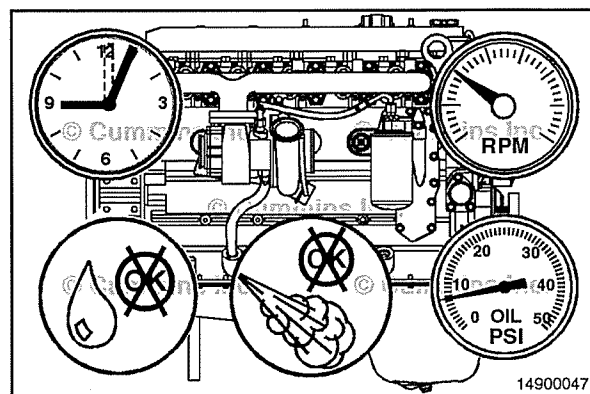
Do not allow the engine speed to exceed 1000 rpm before run-in. The internal engine components can be damaged.

⚠ CAUTION ⚠

Do not shut off the engine immediately after the last step of the run-in is completed. Allow the engine to cool by operating at low idle for minimum of 3 minutes to avoid internal engine component damage.

If performing an engine run-in, avoid long idle periods. Operate the engine at low idle **only** long enough (3 to 5 minutes) to check for correct lubricating oil pressure and any fuel, lubricating oil, water, or air leaks.

If a sudden increase in blowby occurs or if blowby exceeds the maximum allowable limit during any run-in step, return to the previous step and continue the run-in. If blowby does **not** reach an acceptable level, discontinue the run-in and determine the cause.



14900047

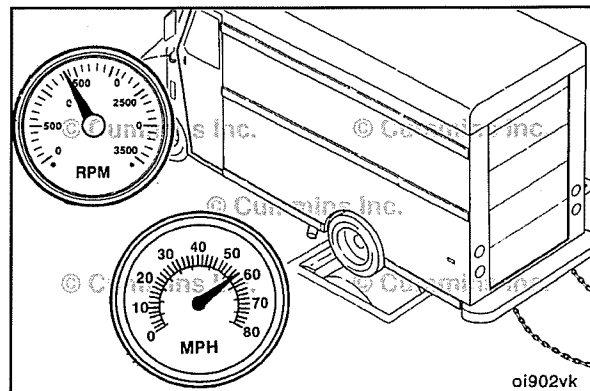
Engine Run-in (Chassis Dynamometer) (014-003)

General Information

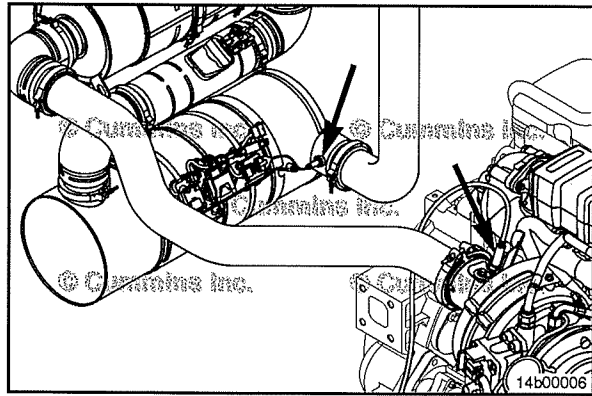
See the following procedure for general chassis dynamometer, operating/testing procedures, and safety precautions. Refer to Procedure 014-002 in Section 14.

Test

Operate the vehicle in a gear that produces a road speed of 90 to 95 km/h [56 to 59 mph].



oi902vk



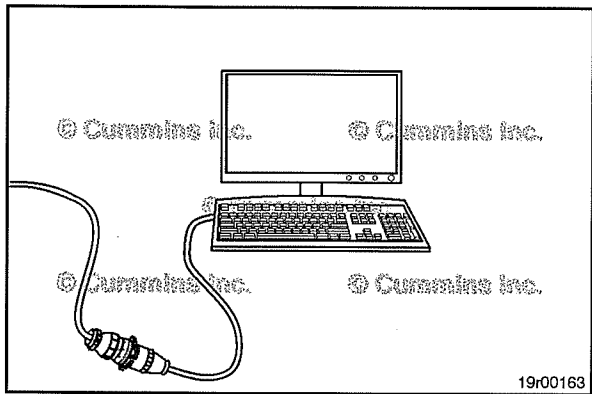
Aftertreatment Selective Catalytic Reduction (SCR) Performance Test (014-015)

General Information

Use the following procedure for additional information on the aftertreatment system. Refer to Procedure 011-999 in Section F.

The following procedure contains information on how to perform an SCR Performance Test using INSITE™ electronic service tool.

The INSITE™ electronic service tool SCR Performance Test uses the Aftertreatment Intake NOx sensor and Aftertreatment Outlet NOx sensor readings to test the efficiency of the SCR catalyst.



Initial Check

Use INSITE™ electronic service tool to check for fault codes. If any fault codes are present, follow the corresponding troubleshooting tree before performing any part of this procedure.

The fault code troubleshooting tree, in some cases, will refer back to this procedure to complete the diagnostics.

Test

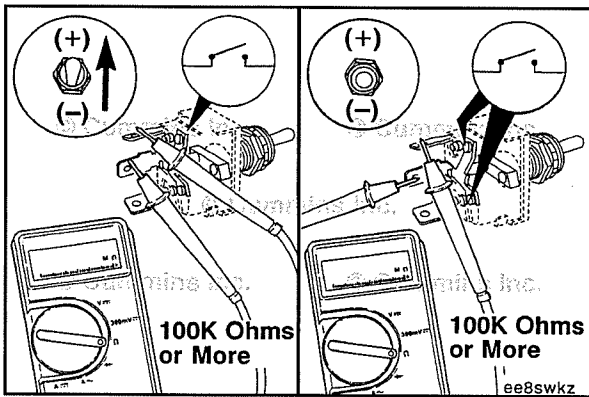


WARNING

During testing, exhaust gas temperature could reach 800°C [1500°F] and exhaust system surface temperature can exceed 700°C [1300°F], which is hot enough to ignite or melt common materials, and to burn people. The exhaust and exhaust components can remain hot after the vehicle stops moving. To avoid the risk of fire, property damage, burns or other serious personal injury, allow the exhaust system to cool before beginning this procedure or repair and make sure that no combustible materials are located where they are likely to come in contact with hot exhaust or exhaust components.

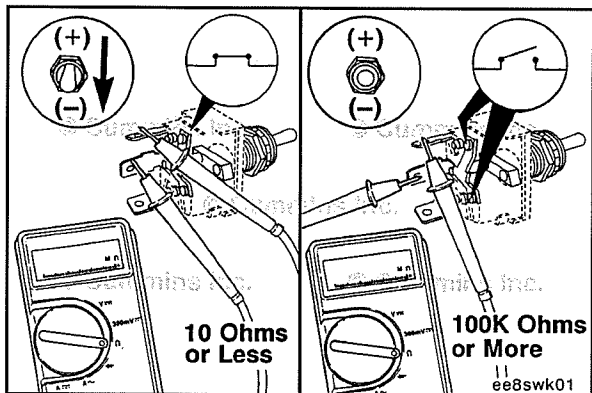
Before performing an SCR Performance Test, follow the steps listed below:

- 1 Select an appropriate location to park the vehicle.
a On a surface that will not burn or melt under high temperatures (such as clean concrete or gravel, not grass or asphalt)
b Away from anything that can burn, melt, or explode
• Nothing within 0.6 m [2 ft] of the exhaust outlet
• Nothing that can burn, melt, or explode within 1.5 m [5 ft] (such as gasoline, wood, paper, plastics, fabric, compressed gas containers, and hydraulic lines)
- No gas or vapors nearby that could burn, explode, or contribute to a fire (such as liquid petroleum gas, gasoline vapors, oxygen, and nitrous oxide).
2 Park the truck securely.
a Set the parking brake.
b Place the transmission in Park, if provided. Otherwise, place the transmission in Neutral.
c Set the wheel chocks at the front and rear of at least one tire.



Hold the idle adjust switch in the positive (+) increment position. The multimeter **must** show an open circuit (100k ohms or more) when the switch is held in the positive (+) increment position and after it is released. If the circuit is **not** open, the switch has failed.

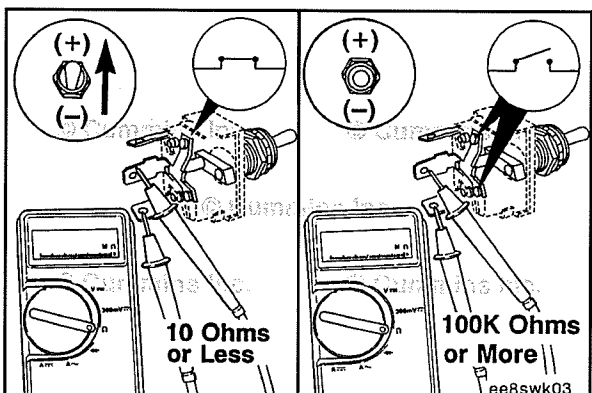
Refer to the OEM troubleshooting and repair manual for the replacement procedures.



Hold the switch in the negative (-) decrement position. The multimeter **must** show a closed circuit (10 ohms or less) when the switch is held in the negative (-) decrement position.

When the switch is released, it **must** show an open circuit (100k ohms or more). If the multimeter does **not** show the correct values, the switch has failed.

Refer to the OEM troubleshooting and repair manual for the replacement procedures.

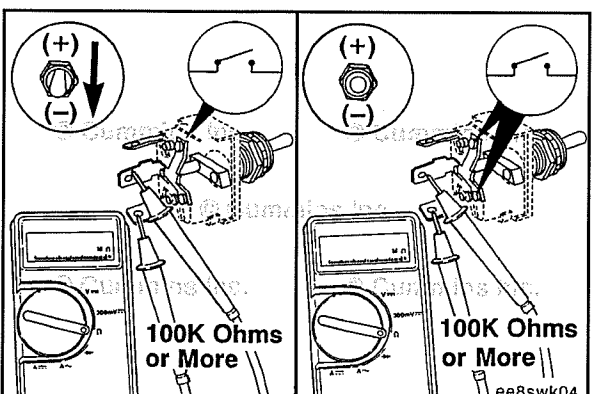


Move the electrical lead from the cruise control/PTO resume/accelerate switch signal terminal to the cruise control/PTO set/coast switch signal terminal.

Hold the idle adjust switch in the positive (+) increment position. The multimeter **must** show a closed circuit (10 ohms or less) while the switch is held in the positive (+) increment position.

When the switch is released, the multimeter **must** show an open circuit (100k ohms or more). If the multimeter does **not** show the correct values, the switch has failed.

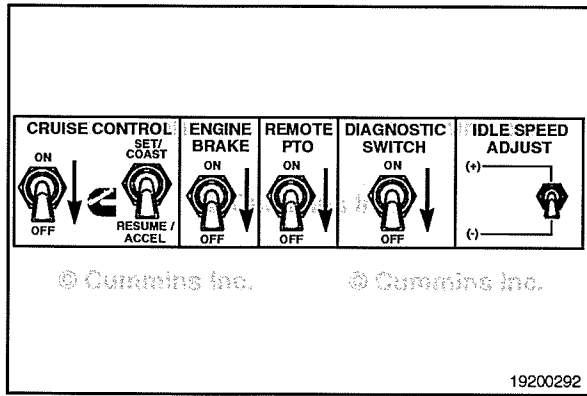
Refer to the OEM troubleshooting and repair manual for the replacement procedures.



Move the idle adjust switch to the negative (-) decrement position. The multimeter **must** show an open circuit (100k ohms or more) when the switch is held in the negative (-) decrement position and when it is released. If the circuit is **not** open, the switch has failed.

Refer to the OEM troubleshooting and repair manual for the replacement procedures.

If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.



Check for Short Circuit to Ground

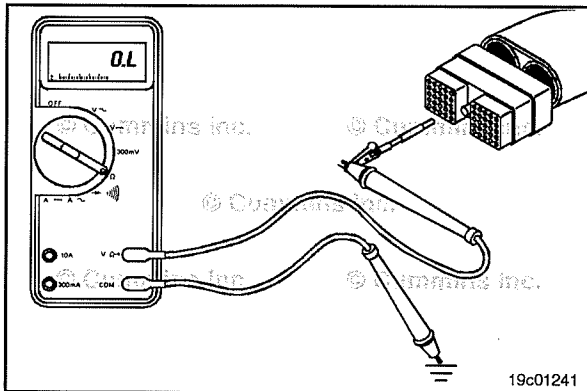
To isolate the brake pedal position switch circuit when checking for a short circuit, turn all cab panel switches to the OFF or neutral position.



Disconnect the OEM harness connector from the ECM and the OEM harness from the brake pedal position switch.

Set the service brake using the trailer brake hand valve.

Disconnect the clutch pedal position switch, accelerator position switch and the idle validation on/off switch.

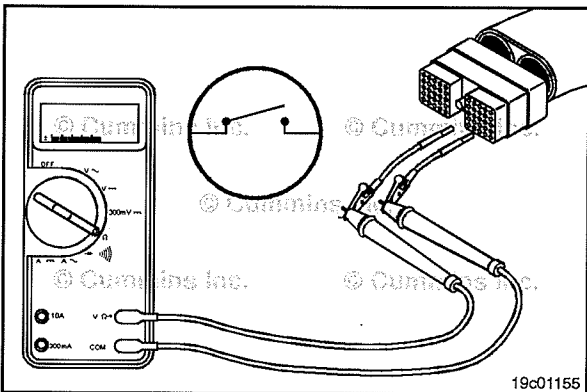


Insert a test lead into the brake pedal position switch signal pin of the OEM harness connector. Connect the lead to the multimeter probe. Remove the alligator clip from the other multimeter probe and touch the probe to the engine block.

The multimeter **must** show an open circuit (100k ohms or more). If the circuit is **not** open, there is a short circuit to ground in the brake pedal position switch signal wire, provided that the switch has been previously checked.

Repair or replace the wire connected to the brake pedal position switch signal pin in the OEM harness according to the vehicle manufacturer's procedures.

Measure the resistance.

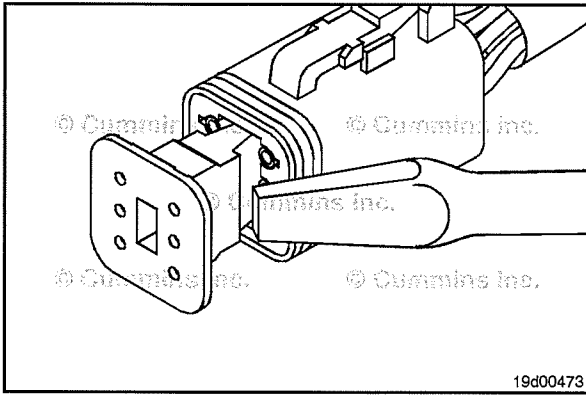


Check for Short Circuit from Pin to Pin

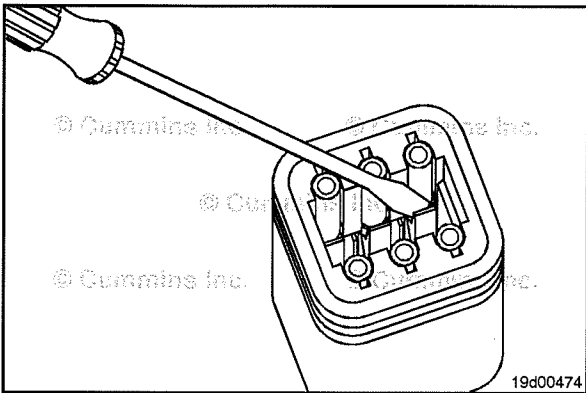
Isolate the brake pedal position switch circuit by disconnecting the brake pedal position switch connector and the OEM harness connector at the ECM. Insert a test lead into the brake pedal position switch signal pin of the OEM harness connector. Insert the other test lead into the switch return pin of the OEM harness connector. Connect the alligator clips to the multimeter probes. Measure the resistance. The multimeter **must** show an open circuit (100k ohms or more).

Remove the lead from the switch return pin and test all other pins in the connector. The multimeter **must** show an open circuit (100k ohms or more) at all pins. If the circuit is **not** open, there is a short circuit between the wire connected to the service brake switch signal pin and any pin that did **not** show an open circuit.

Repair or replace the wires in the OEM harness according to the vehicle manufacturer's procedures.



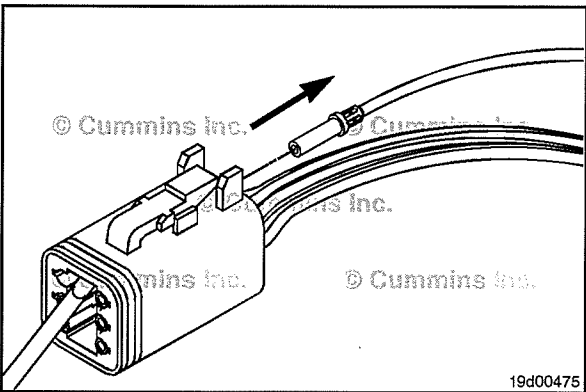
To replace the pin in the plug connector, grasp the orange wedge and pull the wedge straight out.



⚠CAUTION⚠

Locking finger can be easily broken. Care must be taken when using this tool. Do not force the tool into place.

To remove the contact out of the connector body, gently pull wire backward, while at the same time releasing the locking finger by moving it away from the contact with a screwdriver.

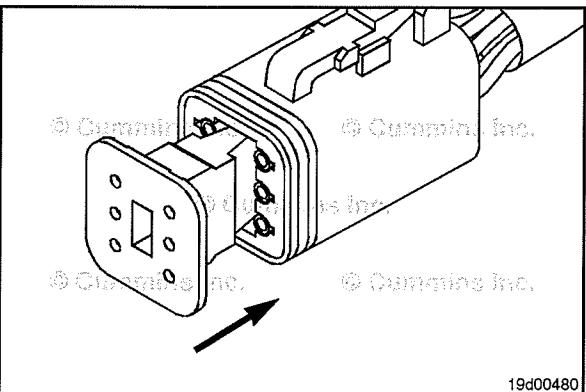


⚠CAUTION⚠

If more than one wire is repaired or if the connector body is replaced, be sure to insert the wires into the same location as they were in the original connector. If wires are not in the original location electrical damage can occur.



Replace the connector and install the wire and terminal into the seal at the back of the connector. Push the wires straight in until a click is felt. A slight tug will confirm that it is properly locked in place.



Once the wires are in place, insert the orange wedge with arrow pointing toward the exterior locking mechanism. Push the orange wedge in until it snaps in place.



Make sure both seals are in place at the back of the connector plug and receptacle. Make sure the rubber seal has been installed on the connector plug.

Check for Short Circuit to Ground

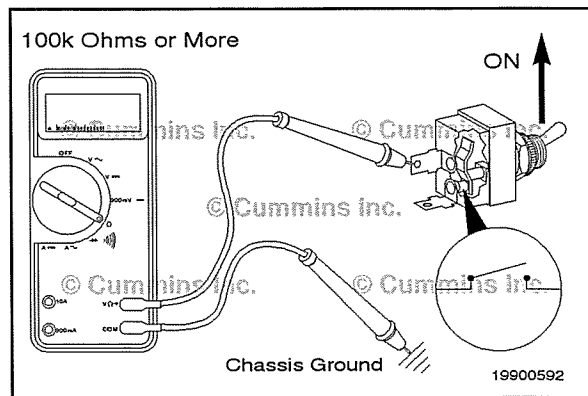
Touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground.

Move the switch to the ON position, and measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, the switch is damaged and **must** be replaced.

Refer to the OEM repair manual for replacement procedures.



Two-Speed Axle Switch Circuit (019-256)

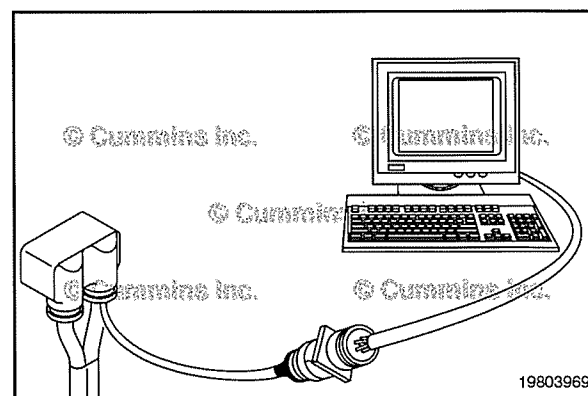
Resistance Check

⚠ CAUTION ⚠

Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.

If INSITE™ electronic service tool is available, monitor the 2-speed axle switch circuit for proper operation.

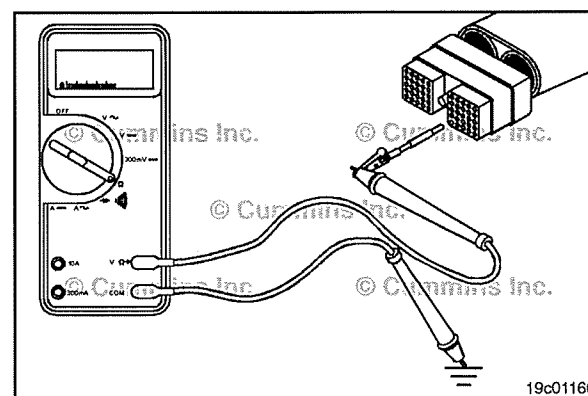
If **not**, follow the troubleshooting procedures in this section.



Disconnect the OEM harness from the ECM connector.

Insert a test lead into the 2-speed axle switch signal pin of the OEM harness connector, and attach it to a multimeter probe.

Touch the other multimeter probe to the engine block ground.

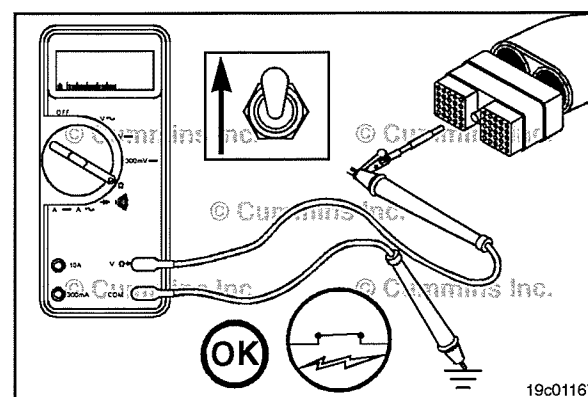


Move the 2-speed axle switch to the ON position.

The multimeter **must** show a closed circuit (10 ohms or less).

If the circuit is **not** closed, inspect the 2-speed-axle-switch signal wire for an open circuit. Refer to the OEM troubleshooting and repair manual.

If the resistance is within specification, the 2-speed axle switch signal pin **must** be checked for a short circuit to ground, a short circuit from pin-to-pin, and a short circuit to an external voltage source.



Clean and Inspect for Reuse

Inspect the camshaft position sensor for debris, cracks, or damage from contact with the tone wheel.

If there is debris on the camshaft position sensor, clean the sensor.

Inspect the engine harness connector and sensor for the following:

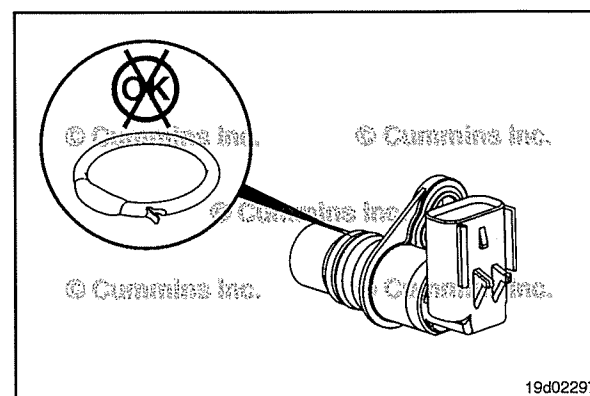
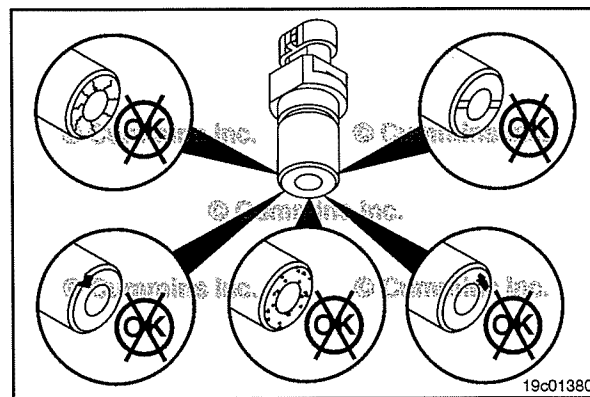
- Cracked or broken connector shell
- Missing or damaged connector seals
- Dirt, debris, or moisture in or on the connector pins
- Corroded, bent, broken, pushed back, or expanded pins
- Chipped, cracked, extruded or damaged sensor.

Repair or replace parts as necessary.

Inspect the camshaft position sensor o-ring for the following:

- Swollen o-ring
- Nicks or cuts in or on the o-ring.

Replace the o-ring if any damage is found.



Test

Connect the camshaft position sensor to the engine harness.

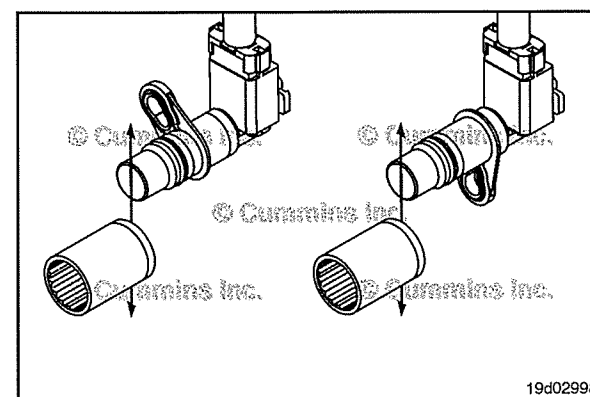
Use an electronic service tool to monitor the value of the camshaft position sensor with the key in the ON position and the engine off.

Place the ratchet drive side of the socket tool that was used to remove the sensor from the engine, flush on the sensor so the edge of the socket is on the edge of the sensor. Slowly slide the socket along the edge of the sensor as shown.

NOTE: The tool or part used for this **must** be of a ferrous material (a magnet would stick to it).

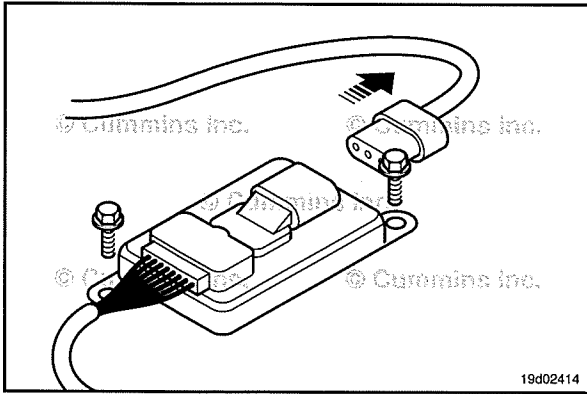
Monitor the sensor state while passing the socket over the sensor. Verify that the state changes from high to low or low to high.

If the sensor state does **not** change, replace the camshaft position sensor.

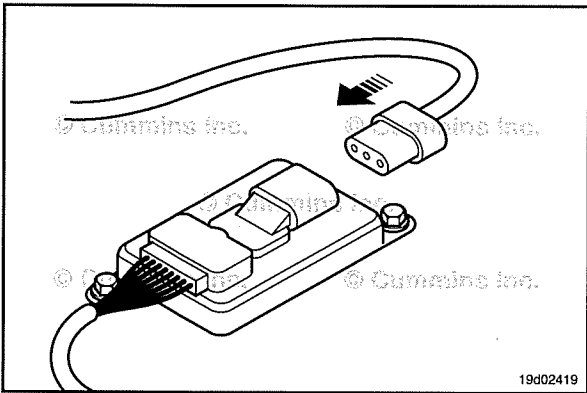


Test

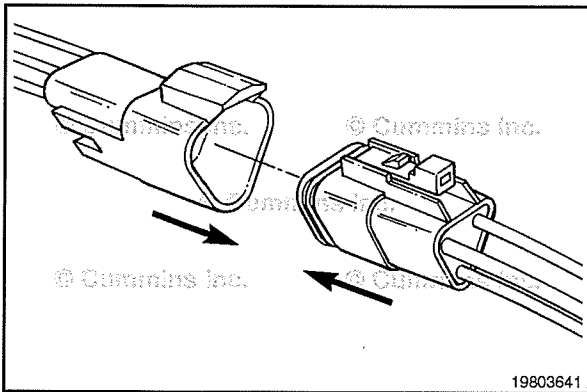
Unplug the NOx sensor from the vehicle harness.

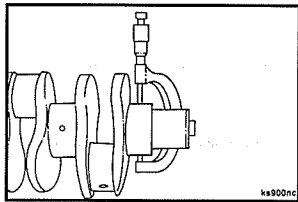
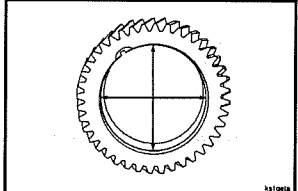
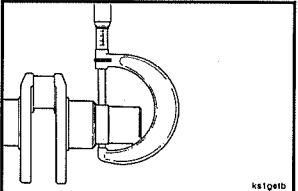
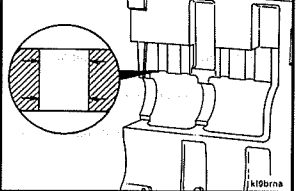
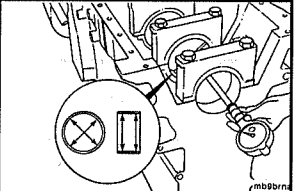


Connect the service tool, Part Number 2892467, to the NOx sensor module.



Connect the service tool data link (3-pin Deutsch™) to the engine SAE J1939 data link connection, located on the driver's side of the engine.



Component or Assembly (Procedure)	Ref.No./ Steps	Metric	U.S.		
Standard Crankshaft Main Bearing Journal Diameter		82.962 mm	MIN 3.2662 in		
		83.013 mm	MAX 3.2682 in		
0.25 mm [0.010 in]		82.712 mm	MIN 3.2564 in		
		82.763 mm	MAX 3.2584 in		
0.50 mm [0.020 in]		82.462 mm	MIN 3.2465 in		
		82.513 mm	MAX 3.2485 in		
0.75 mm [0.030 in]		82.212 mm	MIN 3.2367 in		
		82.263 mm	MAX 3.2387 in		
1.00 mm [0.040 in]		81.962 mm	MIN 3.2268 in		
		82.013 mm	MAX 3.2289 in		
Crankshaft Gear, Front (Crankshaft Removed) (001-019)					
Crankshaft Gear Bore Inside Diameter		70.51 mm	MIN 2.776 in		
		70.55 mm	MAX 2.779 in		
Crankshaft Gear Journal Outside Diameter		70.59 mm	MIN 2.779 in		
		70.61 mm	MAX 2.780 in		
Cylinder Block (001-026)					
Tappet Bore Diameter		16.000 mm	MIN 0.630 in		
		16.055 mm	MAX 0.632 in		
Main Bearing Bore Diameter with Bearings Removed		87.983 mm	MIN 3.4639 in		
		88.019 mm	MAX 3.4653 in		