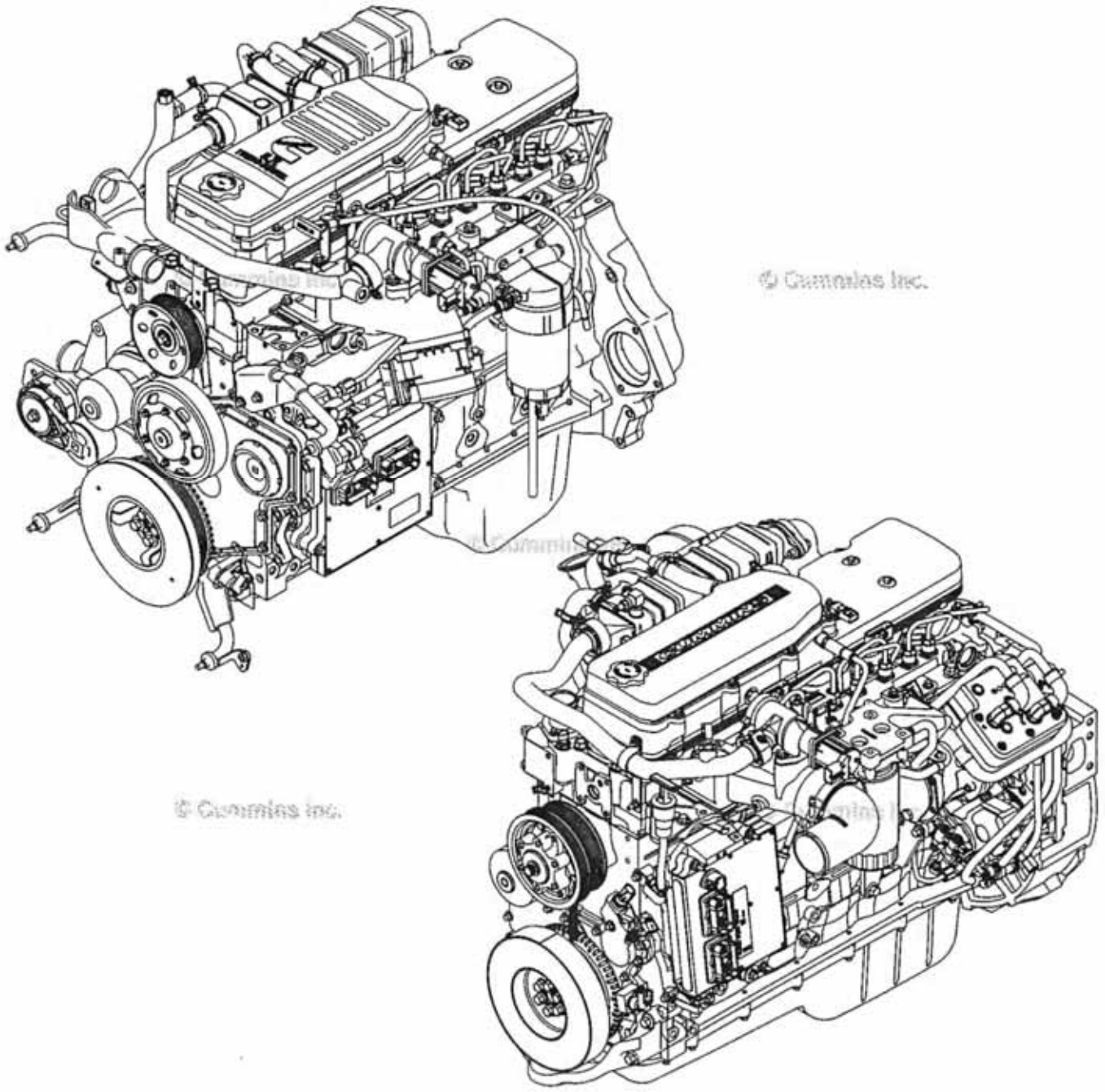
Service Manual
ISB CM2100 and CM2150



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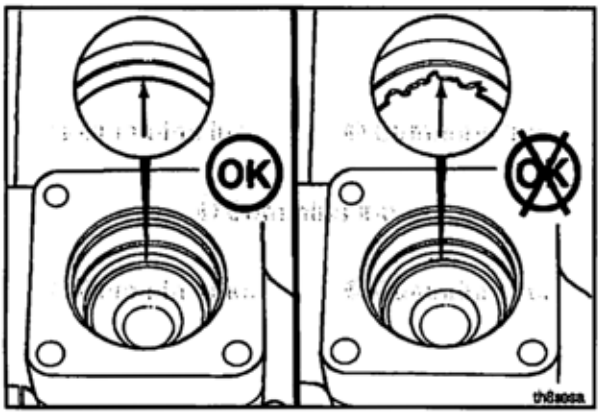
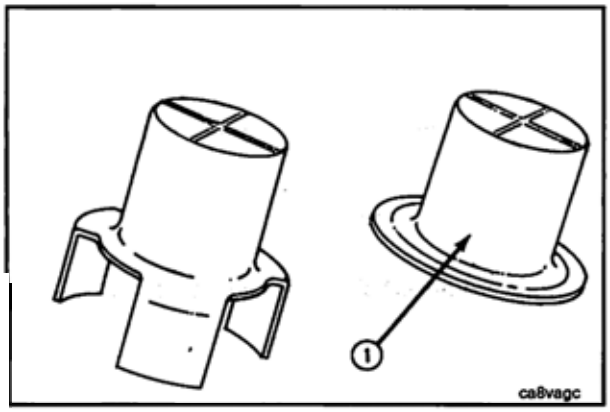


Illustrations

General Information

Some of the illustrations throughout this manual are generic and will **not** look exactly like the engine or parts used in your application. The illustrations can contain symbols to indicate an action required and an acceptable or **not** acceptable condition.



The illustrations are intended to show repair or replacement procedures. The procedure will be the same for all applications, although the illustration can differ.

General Repair Instructions

General Information

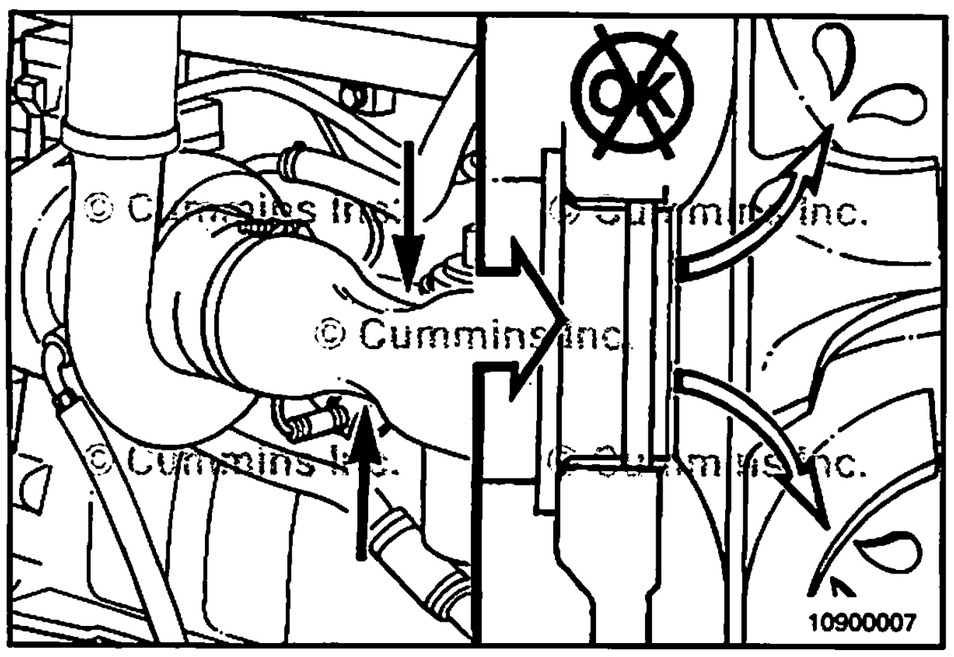
This engine incorporates the latest technology at the time it was manufactured; yet, it is designed to be repaired using normal repair practices performed to quality standards.

⚠CAUTION⚠

Cummins Inc. does not recommend or authorize any modifications or repairs to engines or components except for those detailed in Cummins Service Information. In particular, unauthorized repair to safety-related components can cause personal injury or death. Below is a partial listing of components classified as safety-related:

1 **Air Compressor**
2 **Air Controls**
3 **Air Shutoff Assemblies**
4 **Balance Weights**
5 **Cooling Fan**
6 **Fan Hub Assembly**
7 **Fan Mounting Bracket(s)**
8 **Fan Mounting Capscrews**
9 **Fan Hub Spindle**
10 **Flywheel**
11 **Flywheel Crankshaft Adapter**
12 **Flywheel Mounting Capscrews**
13 **Fuel Shutoff Assemblies**
14 **Fuel Supply Tubes**
15 **Lifting Brackets**
16 **Throttle Controls**
17 **Turbocharger Compressor Casing**
18 **Turbocharger Oil Drain Line(s)**
19 **Turbocharger Oil Supply Line(s)**
20 **Turbocharger Turbine Casing**
21 **Vibration Damper Mounting Capscrews**

- Follow all safety instructions noted in the procedures
- Follow the manufacturer's recommendations for cleaning solvents and other substances used during the repair of the engine. Some solvents and used engine oil have been identified by government agencies as toxic or carcinogenic. Avoid excessive breathing, ingestion and contact with such substances. **Always** use good safety practices with tools and equipment.
- Provide a clean environment and follow the cleaning instructions specified in the procedures
- The engine and its components **must** be kept clean during any repair. Contamination of the engine or components will cause premature wear.
- Perform the inspections specified in the procedures
- Replace all components or assemblies which are damaged or worn beyond the specifications
- Use genuine Cummins new or ReCon® service parts and assemblies
- The assembly instructions have been written to use again as many components and assemblies as possible. When it is necessary to replace a component or assembly, the procedure is based on the use of new Cummins or Cummins ReCon® components. All of the repair services described in this manual are available from all Cummins Distributors and most Dealer locations.
- Follow the specified disassembly and assembly procedures to reduce the possibility of damage to the components

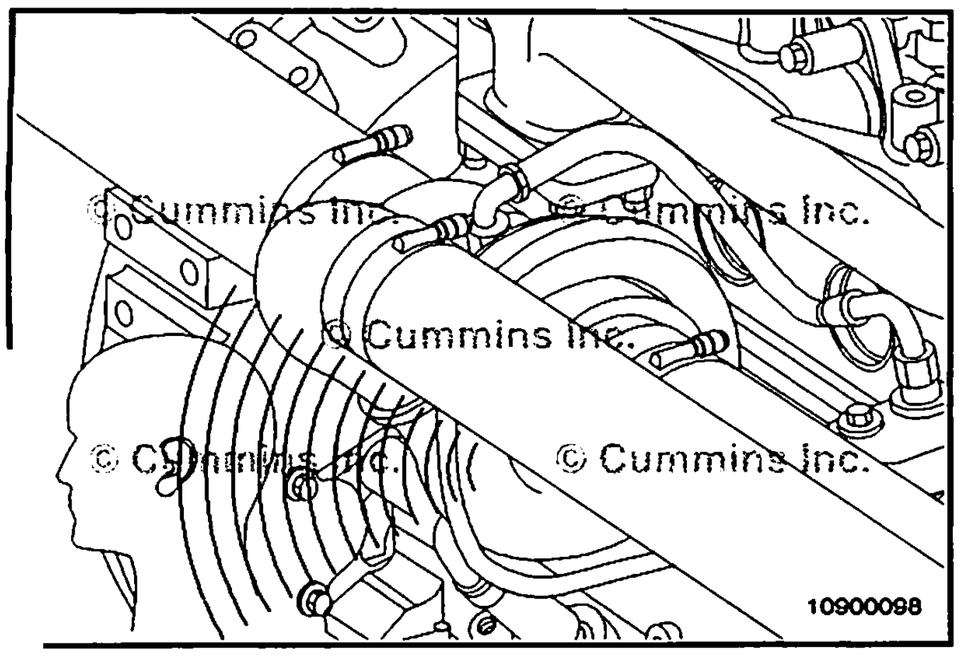


Additionally, high intake or exhaust restrictions can cause a vacuum between the compressor and the turbocharger housing, resulting in lubricating oil leaking past the seal rings at the compressor (intake) side.

NOTE: If this occurs, it is necessary to flush the charge-air cooler to clean oil from the intake system. Flush the charge-air cooler. Refer to Procedure 010-027 in Section 10. Clean the air intake manifold. Refer to Procedure 010-023 in Section 10.

Clean the EGR differential pressure sensor ports. Refer to Procedure 010-080 in Section 10.

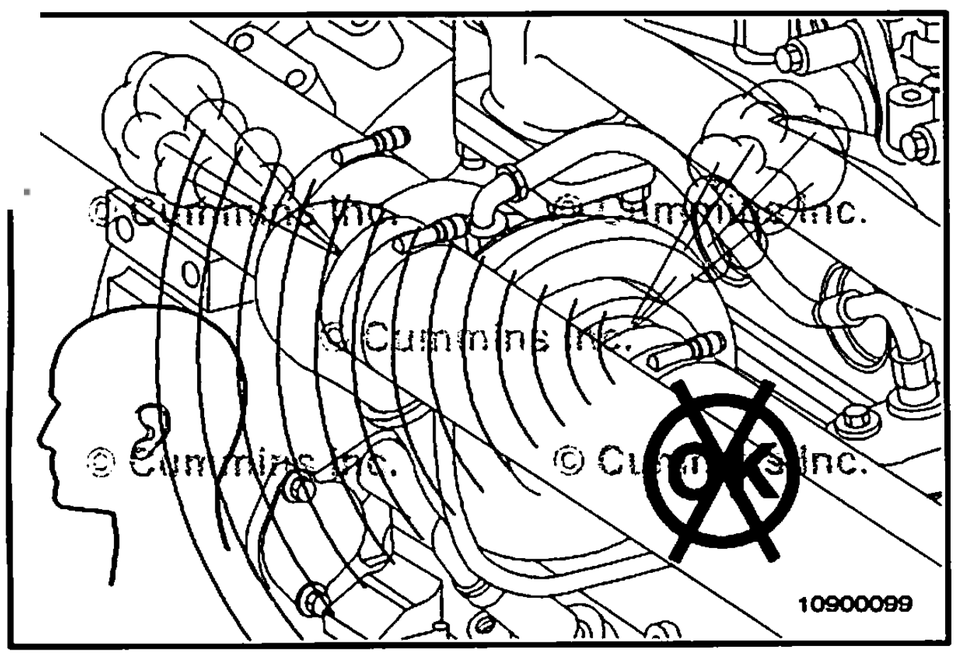
Clean the intake manifold and cold starting aid. Refer to Procedure 010-023 in Section 10.



Turbocharger Noise

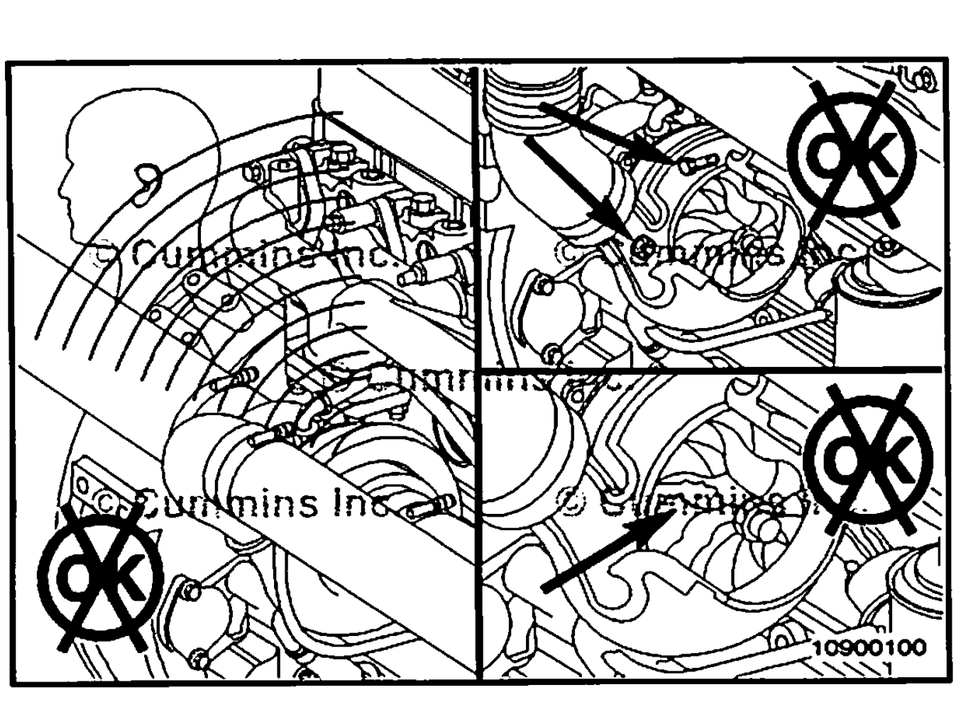
It is normal for the turbocharger to emit a “whining” sound that varies in the intensity depending on turbine wheel speed. The sound is caused by the very high rotational speed of the rotor assembly and the method used to balance the rotor assembly during manufacturing.

Because the engine uses a variable geometry turbocharger, which allows for control of the turbine wheel speed independent of engine load and speed, the sound may **not** be the loudest at rated engine speed and load. Depending on engine and aftertreatment requirements for exhaust temperatures and exhaust pressure, the sound may be most noticeable around idle speed conditions or slightly above.



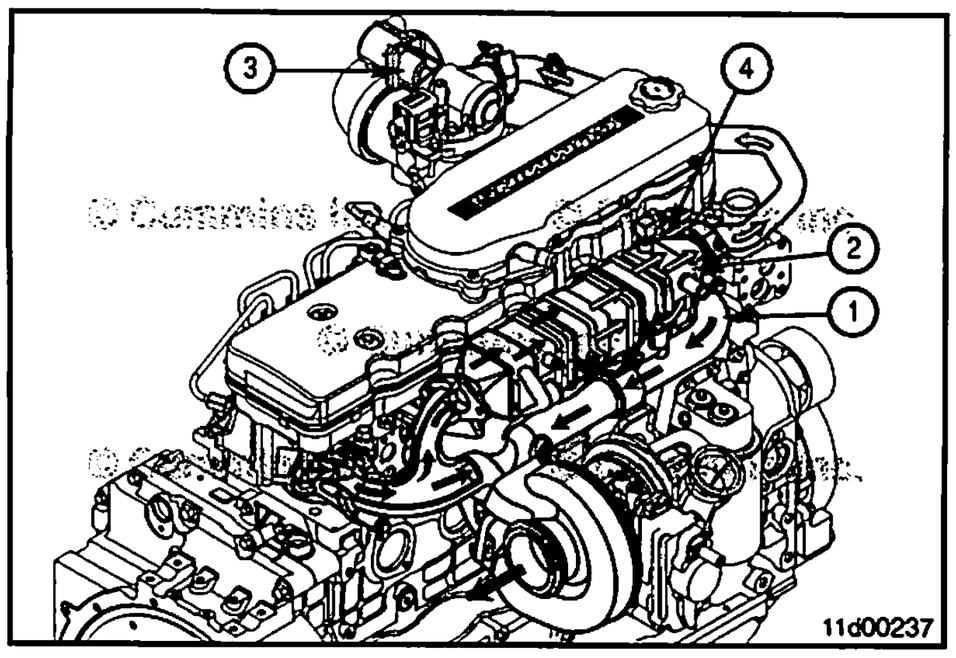
Leaks in the air system intake and/or exhaust components can produce excessive engine noise. A leaking noise usually sounds like high-pitched whining or sucking.

Check for leaks in the intake and exhaust system. Check to make sure all hose clamps are tight. Refer to Procedure 010-024 in Section 10.



Lower pitched sounds or rattles, at slower engine speeds, can indicate that debris is in the system or that the rotor assembly is touching the housings.

Remove the turbocharger inlet and check for foreign objects. If suspect, check for turbocharger blade damage and bearing clearance. Refer to Procedure 010-033 in Section 10.



Exhaust System - Overview (011-999)

General Information

On an engine with exhaust gas recirculation (EGR), the air intake system and exhaust system components work together to provide the correct amount of intake charge flow into the engine. This overview covers the major components of the exhaust system.

1 Exhaust manifold

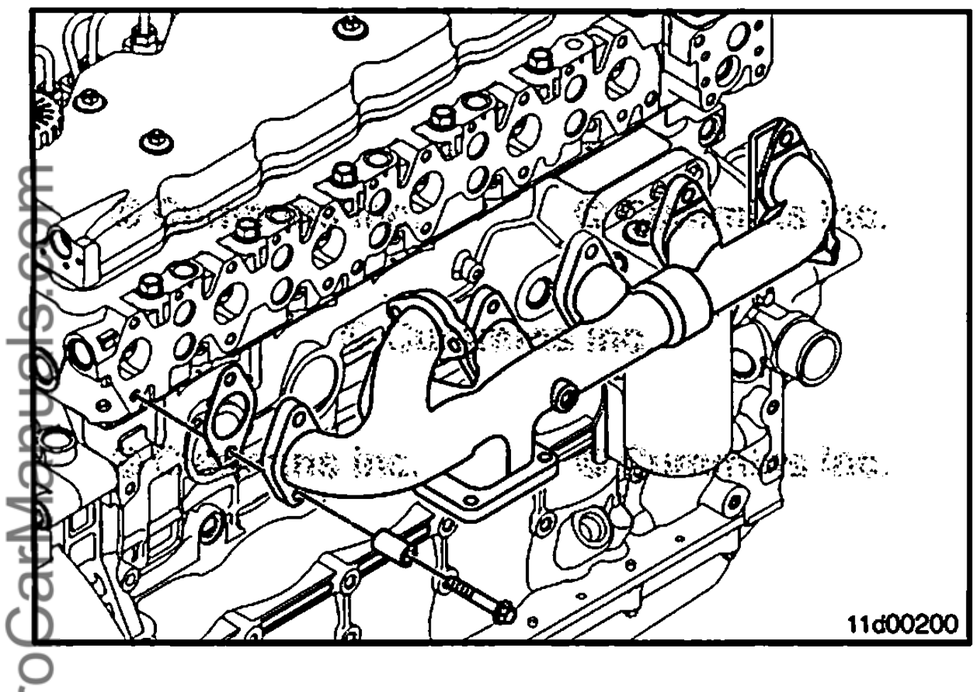
2 EGR cooler

3 EGR valve

4 Exhaust pressure sensor and mounting.

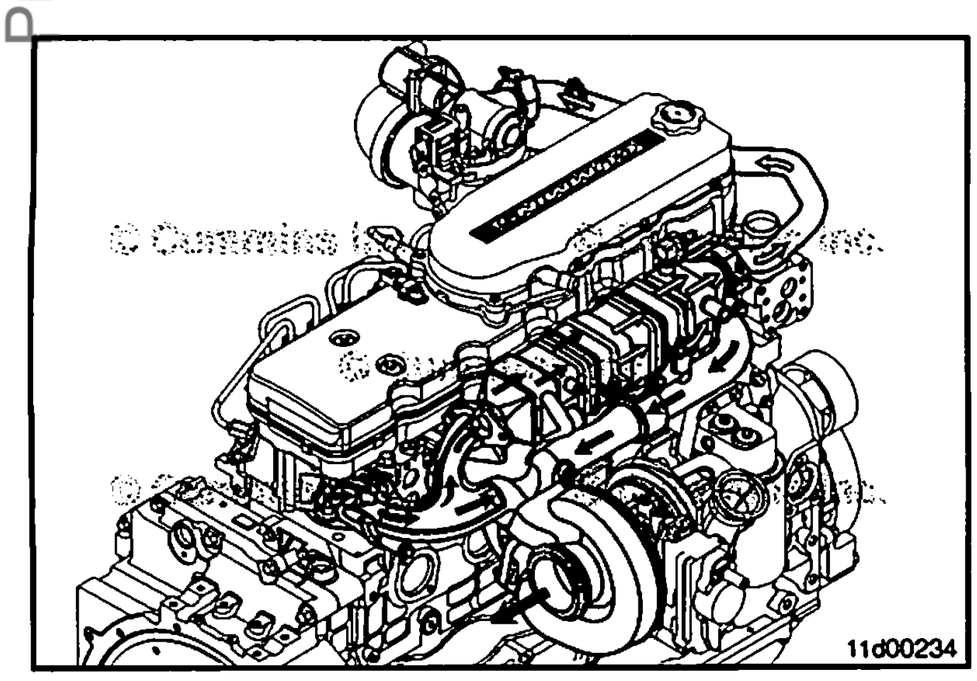
NOTE: The intake air system components are covered in Section 10 - Intake Air System - Overview.

This overview also covers the aftertreatment system components located off the engine in the exhaust system.



The exhaust manifold is a two-piece design with a slip-joint to allow for thermal expansion. Depending on the application, the exhaust manifold used can vary to locate the turbocharger in various positions. The exhaust manifold has an additional port that connects to the EGR cooler inlet.

NOTE: For front gear train engines, the exhaust manifold is a single piece design.



The EGR cooler cools the exhaust gases flowing to the EGR valve. The EGR cooler is mounted above the exhaust manifold and is supported by an EGR cooler mounting bracket attached to the cylinder head. Because the EGR valve is mounted after the EGR cooler, the EGR cooler is subject to the same exhaust temperatures and pressures as the exhaust manifold.

On rear gear train engines, the EGR cooler has a coolant vent near the exhaust outlet of the EGR cooler. This vent prevents air from being trapped in the cooler during coolant filling and engine operation by continuously flowing coolant to the top tank of the vehicle cooling system.

Intake Manifold Air Temperature Above Specification

This is symptom tree t096

Cause	Correction
STEP 8 Programmable parameters or selected features are **not** correct	Check the programmable parameters and the selected features with an electronic service tool. Set the parameters and features again if necessary. Refer to Procedure 019-078 in the Troubleshooting and Repair Manual, CM2100 and CM2150 Electronic Control System, Bulletin 4021570.

OK
Go To Next Step

STEP 9 Fan drive or fan controls are malfunctioning	Check the fan drive and controls. Refer to Procedure 008-026 if electronically controlled by the engines's ECM. If OEM controlled see the OEM service manual.

OK
Go To Next Step

STEP 10 Fan is **not** correct	Check the fan part number and compare it to the OEM-specified part number. Replace fan if necessary. Refer to the OEM service manual.

OK
Go To Next Step

STEP 11 Fan shroud is damaged or missing or the air recirculation baffles are damaged or missing	Inspect the shroud and the recirculation baffles. Repair, replace, or install, if necessary. Refer to Procedure 008-038.

OK
Go To Next Step

STEP 12 Vehicle speed is too low for adequate cooling with high engine load	Reduce the engine load. Increase the engine (fan) rpm by downshifting.

OK
Go To Next Step

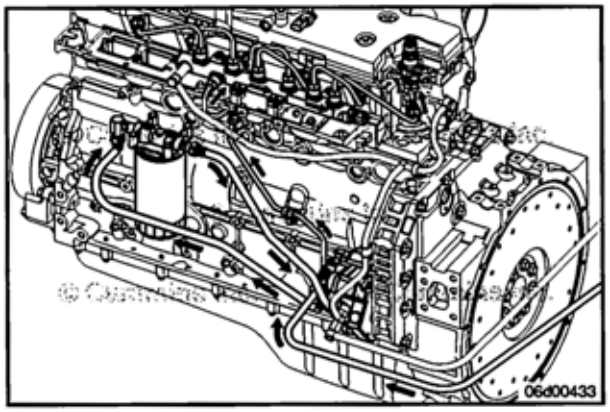
STEP 13 Exhaust system leaking hot air into engine compartment	Check the exhaust plumbing for leaks or broken components. Refer to Procedure 010-024.

OK
Go To Next Step

STEP 14 Intake manifold pressure (boost) sensor or circuit is malfunctioning	Check the boost sensor and circuit. Compare the intake manifold pressure sensor reading in the monitor mode using INSITE™ to a manual pressure gauge. Refer to Procedure 019-159 in the Troubleshooting and Repair Manual, CM2100 and CM2150 Electronic Control System, Bulletin 4021570.

OK
Go To Next Step

The arrows indicate the fuel supply flow for rear gear train engines.



Install

Front Gear Train

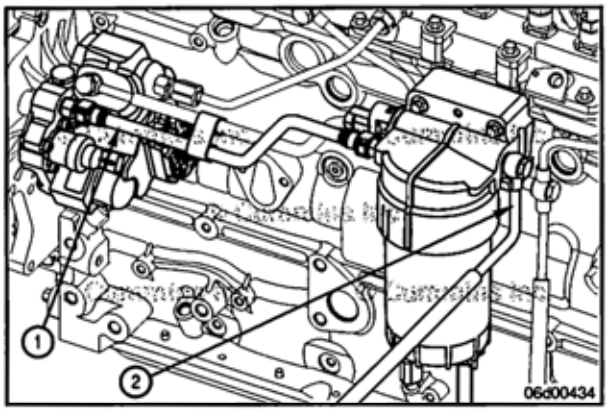
Install the p-clips and p-clip mounting capscrews in the locations noted during removal.

Torque Value: 24 N•m [212 in-lb]

Do **not** bend, pry, or kink the fuel supply lines during installation.

- Install the fuel supply line connecting the fuel filter head outlet to the gear pump inlet.
- Install the fuel supply line located on the right side of the filter head.

Torque Value: 24 N•m [212 in-lb]



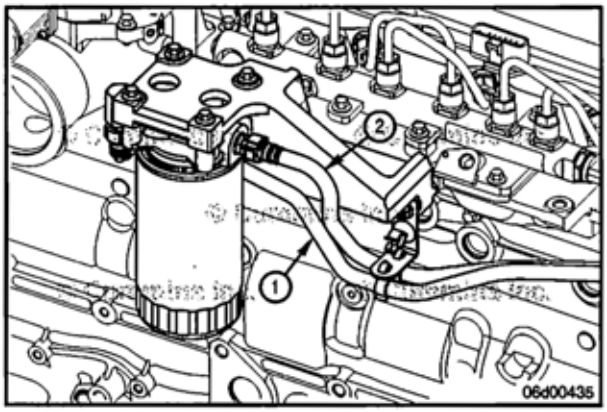
Rear Gear Train

Install the p-clips and p-clip mounting capscrews in the locations noted during removal.

Torque Value: 24 N•m [212 in-lb]

Do **not** bend, pry, or kink the fuel supply lines during installation.

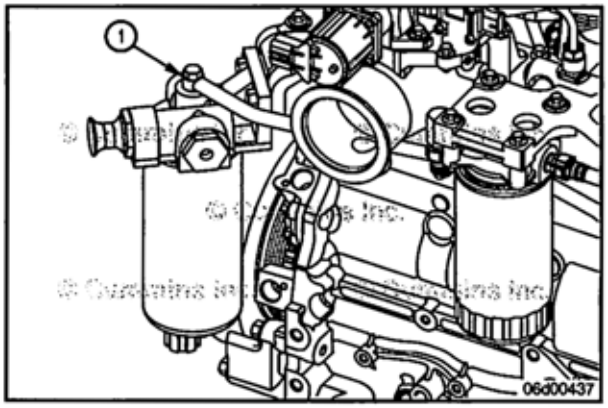
- Install the fuel supply line connecting the gear pump outlet to the pressure-side fuel filter head inlet.
- Install the fuel supply line connecting the fuel filter head outlet to the fuel pump inlet.



For engine-mounted suction side fuel filter applications:

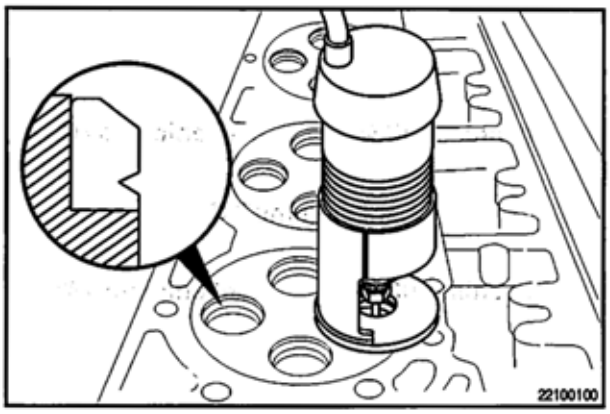
Install the fuel supply line (1) from the priming pump filter head outlet to the fuel pump inlet.

Torque Value: 24 N•m [212 in-lb]



NOTE: Prior to the removal of the valve seat inserts, see the Initial Check and Clean and Inspect for Reuse sections of this procedure. The condition of the valve, the amount of recess, and the sealing of the valve on the seat insert all help determine whether or **not** a seat insert needs to be replaced.

- If required, remove the valve seat inserts.
- Inspect the valve-insert-to-cylinder-head contact area. A sufficient groove for the remover **must** exist.
- If there is sufficient valve insert groove area, proceed to the next step.
- If the valve insert groove area is **not** sufficient, use the valve seat insert cutting kit, Part Number 3376405, to create a sufficient groove.



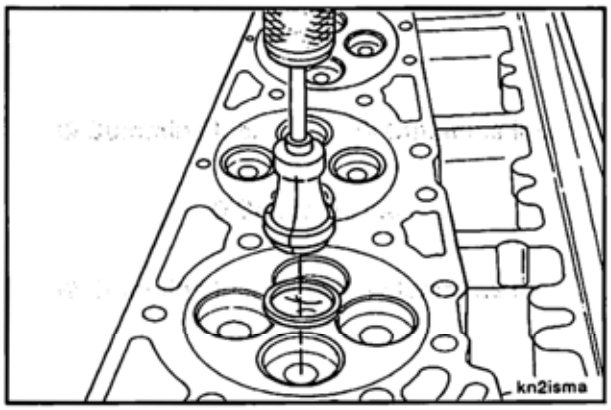
Use the slide hammer remover, Part Number 3376617, with valve insert remover, Part Number 3165170, to remove the valve seats.

NOTE: Make certain the valve insert remover assembly is perpendicular to the cylinder head when installed.

Insert the valve insert remover assembly into the valve insert and rotate the T-handle **clockwise** until the remover loosely grips the valve insert.

Position the valve insert remover assembly into the valve insert groove area. Tighten the T-handle firmly, allowing the remover to expand under the valve insert or into the cut groove.

Strike the slide hammer remover against the top nut until the valve insert is removed. Turn the T-handle **counterclockwise** to release the valve insert from the remover.

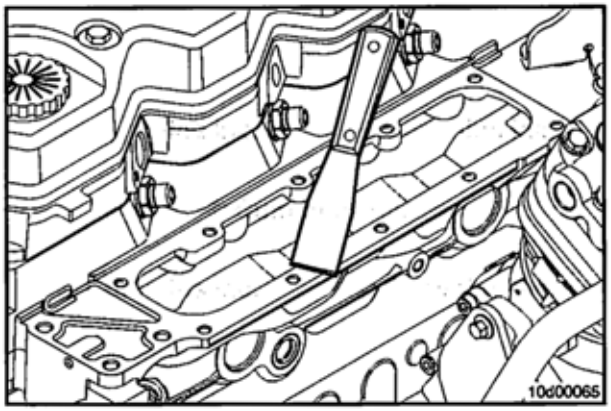


Clean and Inspect for Reuse

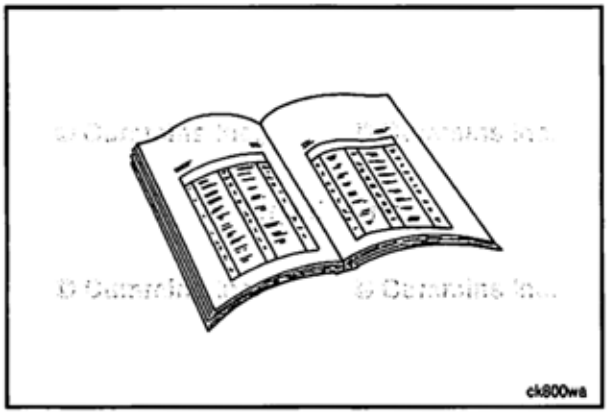
Keep the gasket material, and any other foreign materials out of the air intake.

If removed, clean the cylinder head sealing surfaces where the air intake manifold seals.

NOTE: On engines equipped with EGR, it is common to have soot buildup in the air intake section of the cylinder head. If the cylinder head is removed as part of another repair, it is **not** necessary to clean the soot from the air intake.



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.

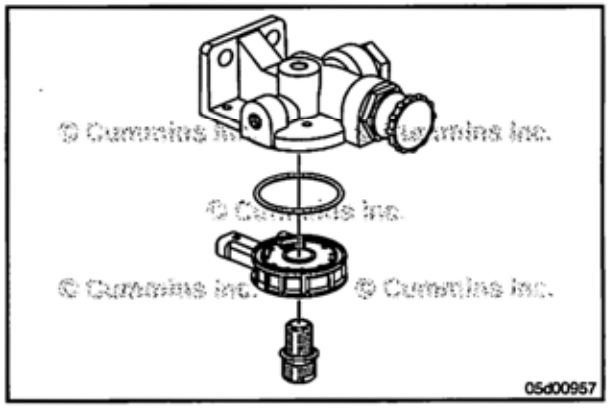
⚠WARNING⚠

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

- Steam clean the fuel heater and area around the fuel heater. Dry with compressed air.
- Disconnect the batteries. Refer to the OEM service manual.
- Disconnect all electrical connections.
- For rear gear train engines, remove the fuel filter. Refer to Procedure 006-015 in Section 6.

Remove

Rear Gear Train



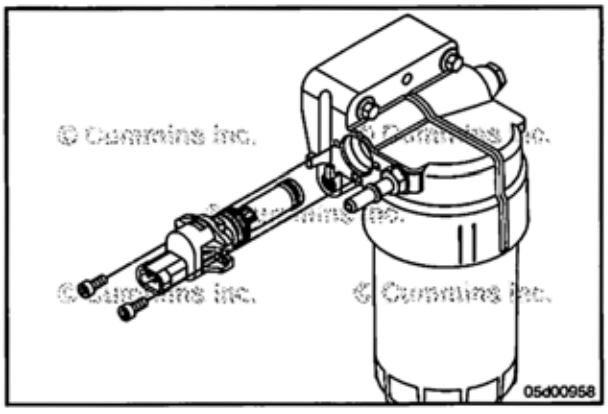
NOTE: Make sure the fuel filter seal ring is **not** stuck to the bottom of the fuel heater when the filter is removed.

Remove the fuel filter spud from the filter head.

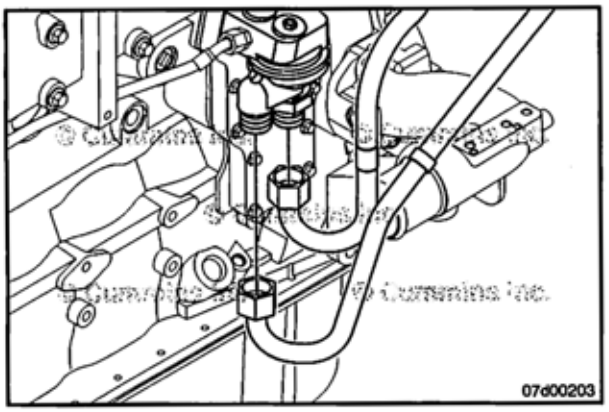
Remove the fuel heater. The heater will be able to be pulled off the filter head.

NOTE: Make sure the heater seal ring is **not** stuck to the bottom of the fuel filter when the heater is removed.

Front Gear Train



Remove the fuel heater from the fuel filter head by removing the mounting fasteners.



Remove

⚠WARNING⚠

To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.

⚠WARNING⚠

Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

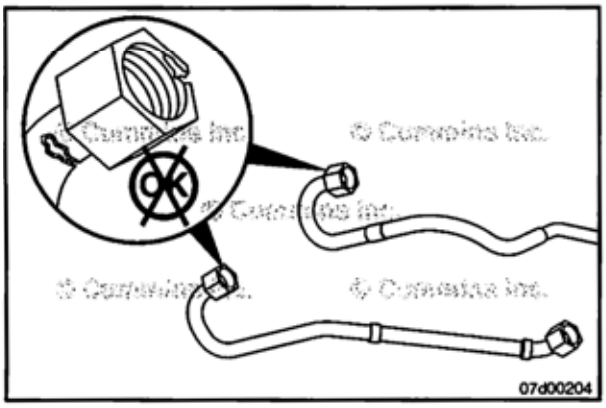
△CAUTION△

Use caution when draining oil that oil is not spilled or drained into the bilge area. The oil must be disposed in accordance with local environmental regulations.

Label the lubricating oil lines before removal. The labels will help ensure a correct installation.

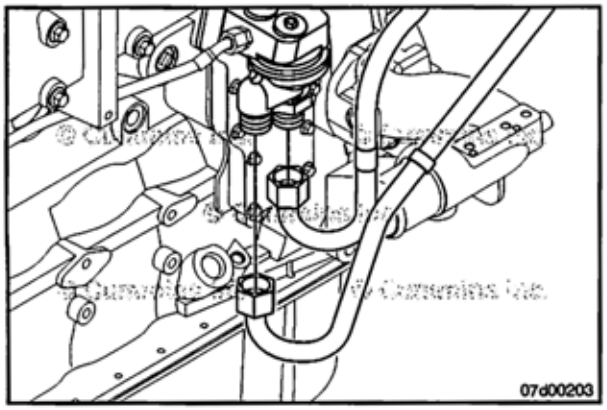
Disconnect the lubricating oil lines from the lubricating oil filter head adapter.

Disconnect the oil lines from the remote-mounted lubricating oil filter head.



Inspect for Reuse

Inspect the hoses and o-ring sealing surfaces for damage.



Install

△CAUTION△

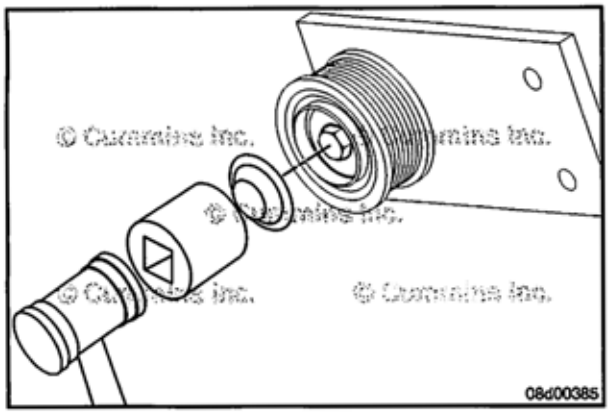
When installing the lubricating oil lines, make sure the oil lines are not touching or rubbing each other or any other engine parts. Damage to the lines can result in a loss of engine lubricating oil pressure.

Use the labels applied in the remove step to align the lubricating oil lines. Install the lubricating oil filter lines to the filter head adapter and tighten finger tight.

If labels were not applied, the supply line is the outer connection and the return line is the inner connection.

Tighten the lubricating oil lines on the filter head adapter.

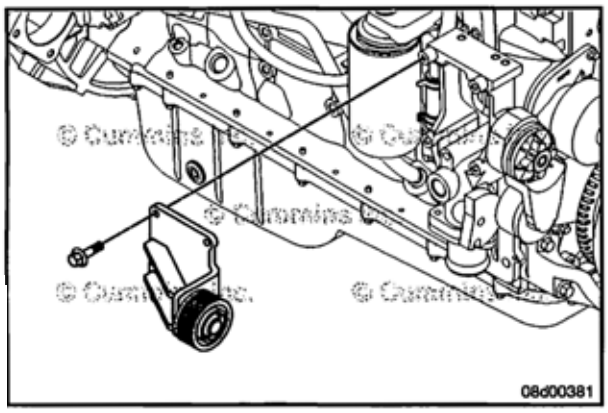
Torque Value: 76 N•m [56 ft-lb]



If the idler pulley mounting capscrew was covered by a dust shield, install a new dust shield.

The preferred method of installation is to use a press and socket that match the outside diameter of the dust shield.

If a press is **not** available, use a socket that matches the outside diameter of the dust shield and drive the dust shield into the idler pulley with a hammer.



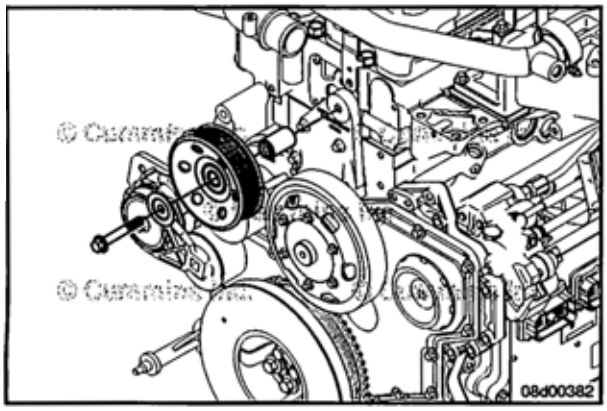
Install

Rear Gear Train

Install the idler pulley assembly and idler pulley support bracket mounting capscrews

Tighten the capscrews.

Torque Value: 18 N•m [159 in-lb]

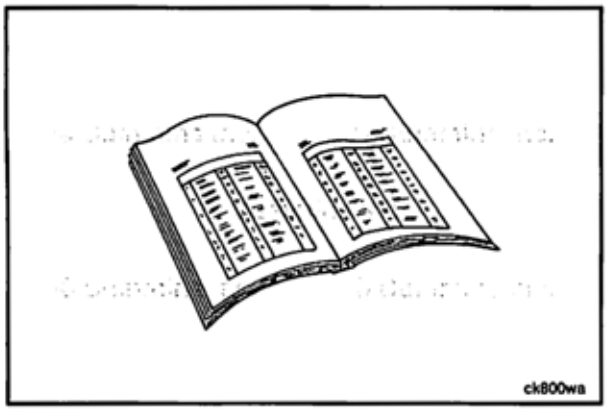


Front Gear Train

Install the idler pulley and the idler pulley mounting capscrew.

Tighten the idler pulley mounting capscrew.

Torque Value:
Idler Pulley Mounting Capscrews 18 N•m [159 in-lb]



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.

- Install the fan drive belt. Refer to Procedure 008-002 in Section 8.
- If removed, install the fan shroud assembly. Refer to Procedure 008-038 in Section 8.
- Connect the batteries. Refer to the OEM service manual.

Clean and Inspect for Reuse

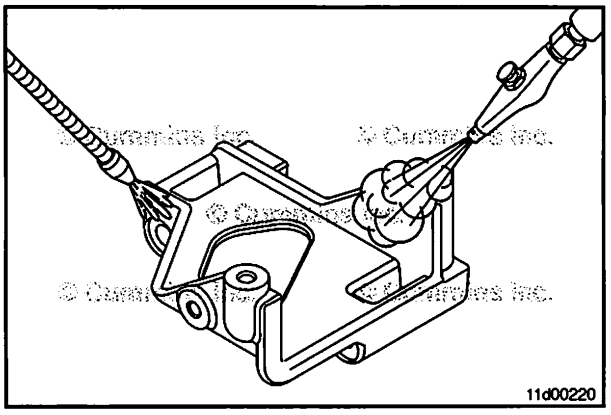
⚠WARNING⚠

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

⚠WARNING⚠

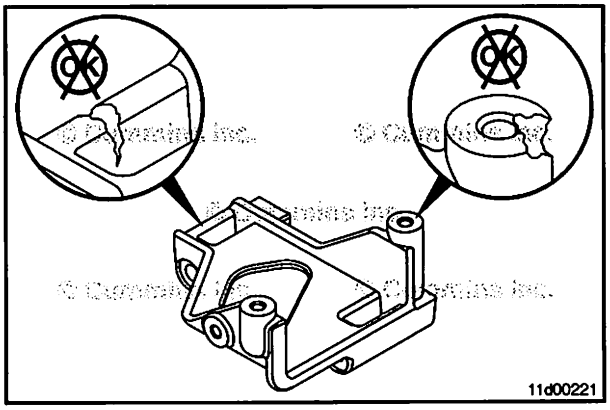
When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

Clean the EGR cooler bracket with solvent and dry with compressed air.



Inspect the EGR cooler bracket for cracks or other damage.

Replace the EGR cooler bracket if damaged.



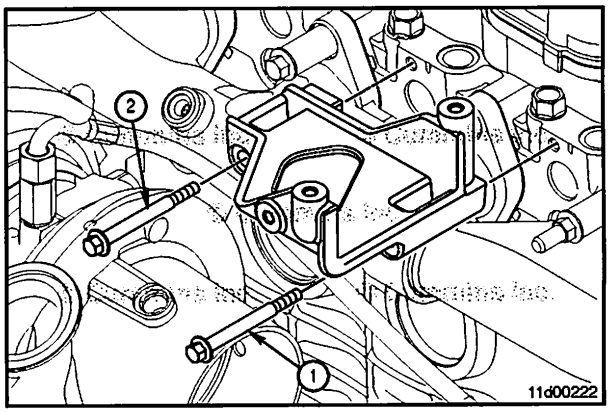
Install

Install the EGR cooler bracket and capscrew to the cylinder head.

Tighten the capscrews in the order shown.

Torque Value: 24 N•m [212 in-lb]

NOTE: It is important to tighten the capscrews in the proper sequence, or the EGR cooler will align incorrectly with the exhaust manifold potentially causing premature EGR cooler malfunction.

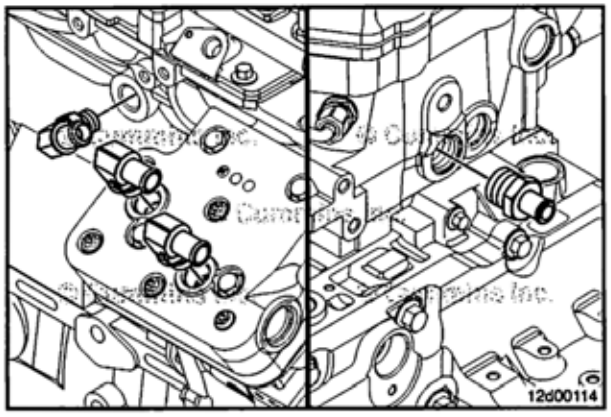


Disassemble

NOTE: Note the location of all fitting(s) before removal to aid in assembly.

Remove the coolant supply fitting(s) from the following:

- Cylinder block
- Cylinder head
- Air compressor cylinder head.



Clean and Inspect for Reuse

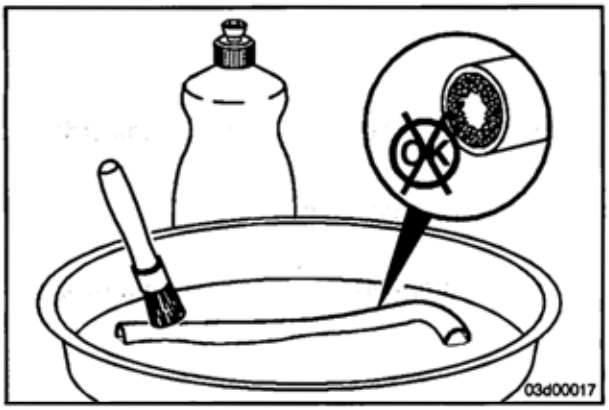
⚠WARNING⚠

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

Clean the air compressor coolant lines with a strong detergent solution.

Dry the air compressor coolant lines with compressed air.

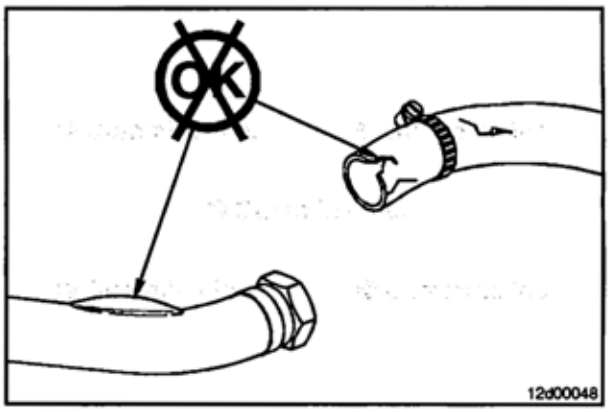
Inspect the air compressor coolant lines for any internal restrictions. Replace the coolant lines if any restrictions are found.

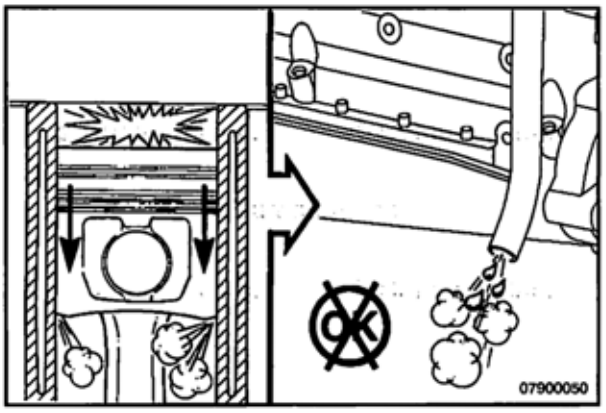


Inspect the coolant hoses for splits, cracks, hardening, or other damage.

Inspect metal coolant lines for kinks, corrosion, or cracks.

Replace the component if any damage is found.





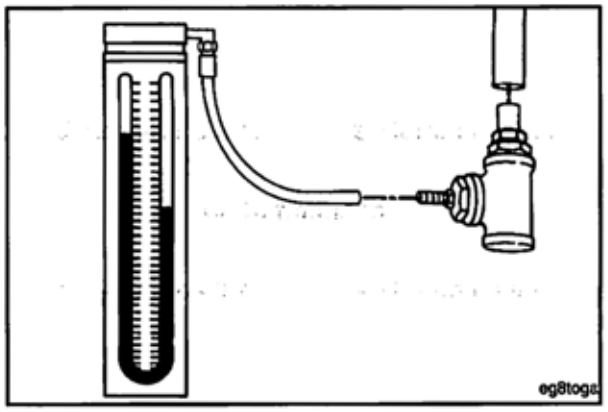
It is important to note that commonly the terms blowby and carryover (oil out of the breather tube) are used interchangeably.

When measuring blowby and there is an excessive amount of oil coming out of the breather tube, the quantity of oil can affect the blowby measurement.

The blowby measurement is affected by the oil collecting on the orifice of the blowby measurement service tool. This reduces the size of the orifice, which results in higher than actual blowby measurements.

If this occurs it will be necessary to:

- Find a different location on the engine to measure blowby (oil fill, oil fill cap, unused turbocharger drain location, etc.)
- Clean any oil residue from the breather and dry thoroughly before measuring blowby
- Determine if there is an issue causing the breather to be flooded with oil, for example
- Incorrect oil level
- Vehicle operation (excessive angularity, excessive engine side-to-side movement)
- Internal engine components are deflecting oil toward the breather cavity (piston cooling nozzles, accessory oil drains, etc.)
- Determine if another breather option is available for the engine being serviced.



The tools used to measure blowby are similar in design. The difference between the tools is in the size of the orifice. Different size orifices are available to more accurately measure blowby and to accommodate the wide variety of engine configurations and ratings. This is due to the fact that engine blowby is dependent on the volume of intake airflow.

For example:

If measuring blowby on two identically configured and size engines, but the horsepower ratings and rated speed are different, the maximum blowby values measured will be different.

The engine with the higher horsepower rating and rated speed will have a higher volume of intake airflow, which will result in higher blowby. This means that if the smaller orifice blowby tool was used on the engine with a higher horsepower rating and rated speed, the measurement can exceed the limits of the pressure measuring tool.

Blowby Tool Part Number	Orifice Size mm [in]
3822476	5.61 mm [0.221 in]
3822566	7.67 mm [0.302 in]

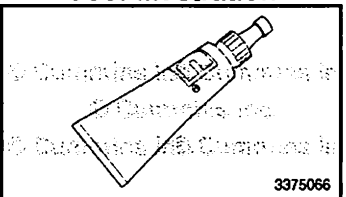
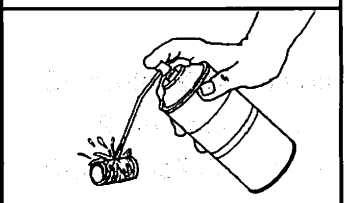
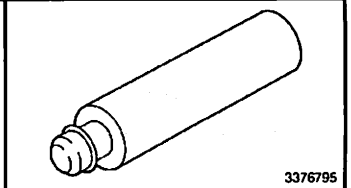
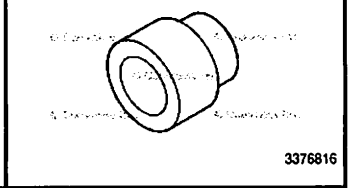
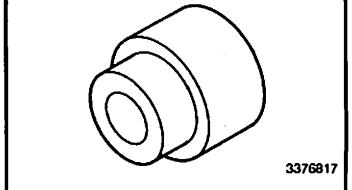
To measure the crankcase blowby pressure, connect a water manometer, Part Number ST1111-3, or equivalent, pressure gauge or transducer to the blowby tool.

NOTE: Water manometer, Part Number ST1111-3, can measure a maximum of 944 mm [36 in] of water.

Service Tools

Miscellaneous

The following special tools are recommended to perform procedures in this section. The use of these tools is shown in the appropriate procedure. These tools can be purchased from a local Cummins® Authorized Repair Location.

Tool No.	Tool Description	Tool Illustration
3375066	**Pipe Plug Sealant** Used when installing pipe plugs to reduce the possibility of leaks.	 3375066
3375068	**Cup Plug Sealant** Used when installing cup plugs to reduce the possibility of leaks.	 3375068
3824510	**Quick Dry Spray Cleaner** Used to clean cup plug opening.	
3164085	**Cup Plug Driving Tools (universal handle)** Required use with driver heads to install new cup plugs to their proper depth, plus avoiding damage to the cup plug and the surrounding area.	 3376795
3376816	**Cup Plug Driving Tools (driver head, 1-inch nominal)** Required to install new cup plugs to their proper depth, plus avoiding damage to the cup plug and the surrounding area.	 3376816
3376817	**Cup Plug Driving Tools (driver head, 1-1/4-inch nominal)** Required to install new cup plugs to their proper depth, plus avoiding damage to the cup plug and the surrounding area.	 3376817