Table of Contents

abrade the other part until contact is no longer being made between the two parts. If the damage sufficiently degrades the oil film, the two parts will come into contact resulting in early wear-out or failure from lack of effective lubrication.

Abrasive particles can fly about during cleaning it is **very** important to block these particles from entering the engine as much as possible. This is particularly true of lubricating oil ports and oil drilling holes, especially those located downstream of the lubricating oil filters. Plug the holes instead of trying to blow the abrasive particles and debris with compressed air because the debris is often simply blown further into the oil drilling.

All old gasket material **must** be removed from the parts gasket surfaces. However, it is **not** necessary to clean and polish the gasket surface until the machining marks are erased. Excessive sanding or buffing can damage the gasket surface. Many newer gaskets are of the edge molded type (a steel carrier with a sealing member bonded to the steel). What little sealing material that can adhere is best removed with a blunt-edged scraper or putty knife. Cleaning gasket surfaces where an edge-molded gasket is used with abrasive pads or paper is usually a waste of time.

⚠WARNING⚠

Excessive sanding or grinding the carbon ring from the top of the cylinder liners can damage the liner beyond reuse. The surface finish will be damaged and abrasive particles can be forced into the liner material which can cause early cylinder wear-out or piston ring failures.

Tape off or plug all openings to any component interior before using abrasive pads or wire brushes. If really necessary because of time to use a power tool with abrasive pads, tape the oil drillings closed or use plug and clean as much of the surface as possible with the tool but clean around the oil hole/opening by hand so as to prevent contamination of the drilling. Then remove the tape or plug and clean the remaining area carefully and without the tool. DO NOT use compressed air to blow the debris out of oil drilling on an assembled engine! More likely than **not**, the debris can be blown further into the drilling. Using compressed air is fine if both ends of the drilling are open but that is rarely the case when dealing with an assembled engine.

Gasket Surfaces

The object of cleaning gasket surfaces is to remove any gasket material, not refinish the gasket surface of the part.

Cummins Inc. does **not** recommend any specific brand of liquid gasket remover. If a liquid gasket remover is used, check the directions to make sure the material being cleaned will **not** be harmed.

Air powered gasket scrapers can save time but care must be taken to **not** damage the surface. The angled part of the scraper must be against the gasket surface to prevent the blade from digging into the surface. Using air powered gasket scrapers on parts made of soft materials takes skill and care to prevent damage.

Do **not** scrape or brush across the gasket surface if at all possible.

Solvent and Acid Cleaning

Several solvent and acid-type cleaners can be used to clean the disassembled engine parts (other than pistons. See Below). Experience has shown that the best results can be obtained using a cleaner that can be heated to 90° to 95° Celsius (180° to 200° Fahrenheit). Kerosene emulsion based cleaners have different temperature specifications, see below. A cleaning tank that provides a constant mixing and filtering of the cleaning solution will give the best results. Cummins Inc. does not recommend any specific cleaners. Always follow the cleaner manufacturer's instructions. Remove all the gasket material, o-rings, and the deposits of sludge, carbon, etc., with a wire brush or scraper before putting the parts in a cleaning tank. Be careful not to damage any gasket surfaces. When possible, steam clean the parts before putting them in the cleaning tank.

⚠WARNING⚠

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

Experience has shown that kerosene emulsion based cleaners perform the best to clean pistons. These cleaners should **not** be heated to temperature in excess of 77°C (170°F). The solution begins to break down at temperatures in excess of 82°C (180°F) and will be less effective.

Do **not** use solutions composed mainly of chlorinated hydrocarbons with cresols, phenols and/or cresylic components. They often do **not** do a good job of removing deposits from the ring groove and are costly to dispose of properly.

Solutions with a pH above approximately 9.5 will cause aluminum to turn black; therefore do **not** use high alkaline solutions.

Chemicals with a pH above 7.0 are considered alkaline and those below 7.0 are acidic. As you move further away from the neutral 7.0, the chemicals become highly alkaline or highly acidic.

Remove all the gasket material, o-rings, and the deposits of sludge, carbon, etc., with a wire brush or scraper before putting the parts in a cleaning tank. Be careful to **not** damage any gasket surfaces. When possible use hot high

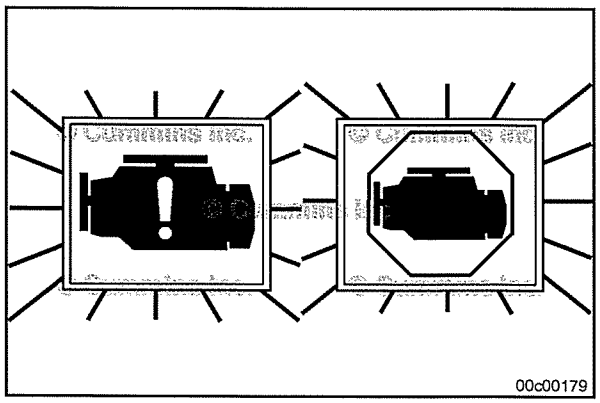
Stop Engine Lamp

The STOP ENGINE lamp indicates, when illuminated, the need to stop the engine as soon as it can be safely done. The engine **must** remain shut down until the engine can be repaired.

For engines with the Engine Protection Shutdown feature enabled, if the STOP ENGINE lamp begins to flash, the engine will automatically shut down after 30 seconds. The flashing STOP engine lamp alerts the operator to the impending shutdown.

The STOP ENGINE lamp is red in color, and can look like:

- The words STOP or STOP ENGINE spelled out
- A symbol of an engine with an exclamation point in the center, similar to the graphic.



SCR System Cleaning Lamp

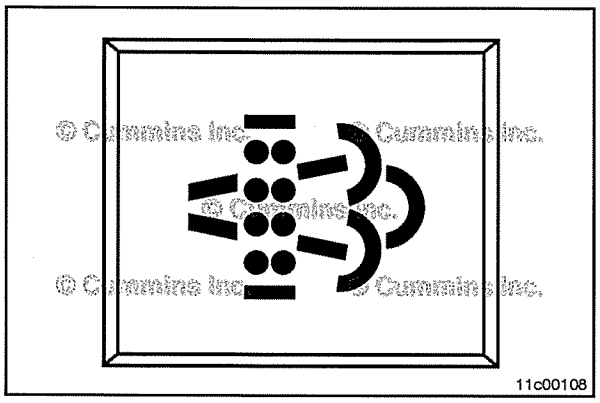
The SCR SYSTEM CLEANING lamp indicates the status of the aftertreatment SCR system cleaning events.

An illuminated SCR SYSTEM CLEANING lamp indicates that the aftertreatment SCR system needs to be cleaned at the next opportunity. This can be accomplished by:

1 Changing to a more challenging duty cycle, such as highway driving, for at least 20 minutes

2 Performing a stationary SCR/exhaust system cleaning. Refer to Procedure 101-050 in Section 1.

NOTE: Stationary SCR/exhaust system cleaning is considered a normal practice and is **not** covered by Cummins Inc. warranty.



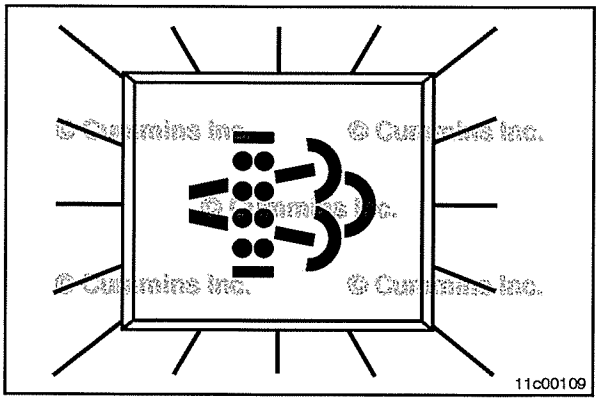
A flashing SCR SYSTEM CLEANING lamp indicates the status of a non-mission (stationary) SCR/ exhaust system cleaning when the SCR System Cleaning Start switch has been activated. See the following procedure for more information on the Start Conditioning switch. Refer to Procedure 101-050 in Section 1. When this lamp is flashing, the operator should:

1 Keep the exhaust outlet away from people and anything that can burn, melt, or explode.

2 Nothing within 0.6 m [2 ft] of the exhaust outlet.

3 Nothing that can burn, melt, or explode within 1.5 m [5 ft] (such as gasoline, wood, paper, plastics, fabric, compressed gas containers, or hydraulic lines).

4 In an emergency, turn the engine off to stop the flow of exhaust.



Air Intake Piping

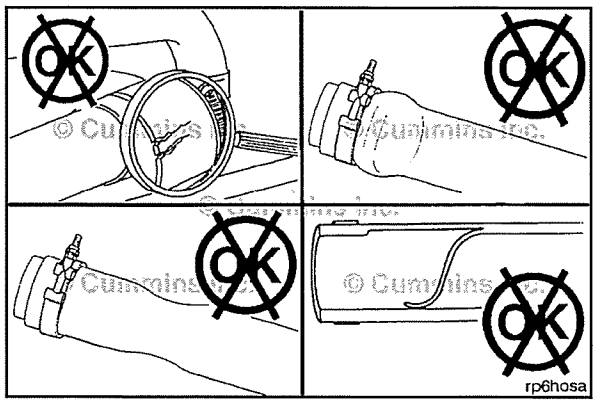
Maintenance Check

Inspect the intake piping daily for wear points and damage to piping, loose clamps, and punctures that can damage the engine.

Replace damaged pipes and tighten loose clamps, as necessary, to prevent the air system from leaking.

Torque Value: 8 N•m [71 in-lb]

Check for corrosion under the clamps and hoses of the intake system piping. Corrosion can allow corrosive products and dirt to enter the intake system. Disassemble and clean, as required.

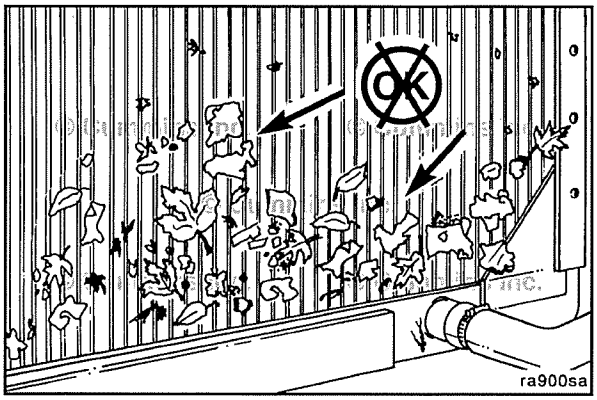


Radiator

General Information

Air forced through the fins of the radiator by a fan cools the coolant pumped through the radiator. Environmental debris (such as paper, straw, lint, and dust) can obstruct the fins and stop the flow of air, which will reduce the cooling effect of the radiator.

NOTE: For removal or installation of the radiator, refer to the original equipment manufacturer (OEM) service manual.



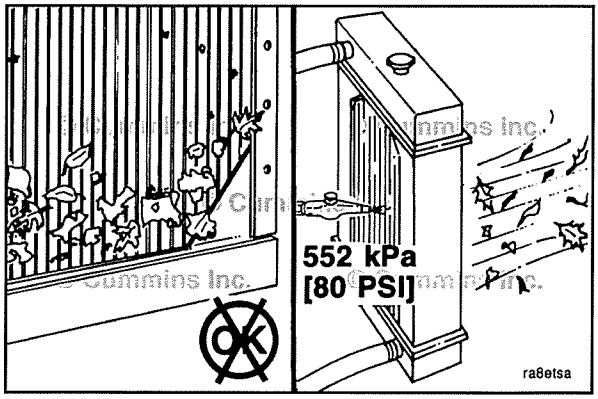
Initial Check

⚠CAUTION⚠
Wear appropriate eye and face protection when using compressed air. Improper use can cause bodily injury from flying debris and dirt.

Inspect for plugged radiator fins.

Use compressed air to blow out the dirt and debris.

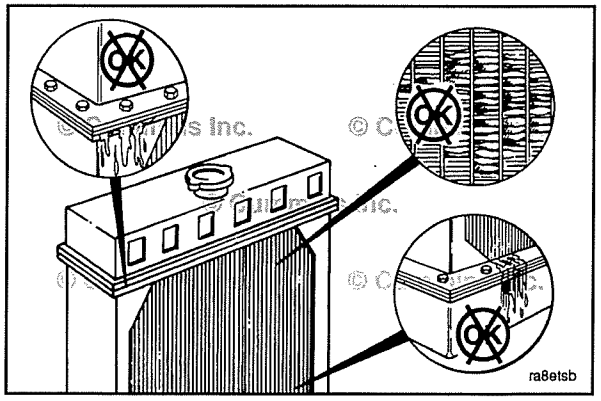
Air Pressure: 552 kPa [80 psi]



Inspect for bent or broken fins.

Inspect for radiator core and gasket leaks.

If the radiator **must** be replaced, refer to the equipment manufacturer's replacement procedures.



Maintenance Procedures - Overview

General Information

All maintenance checks and inspections listed in previous maintenance intervals **must** also be performed at this time, in addition to those listed under this maintenance interval.

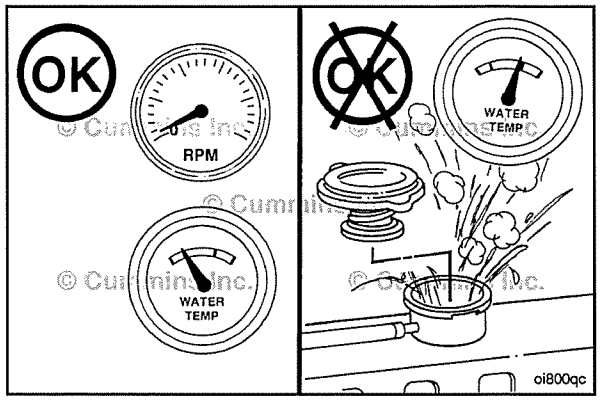
Cooling System

General Information

⚠WARNING⚠
Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50°C [120°F] before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

NOTE: Never use a sealing additive to stop leaks in the coolant system. This can result in coolant system plugging and inadequate coolant flow, causing the engine to overheat.

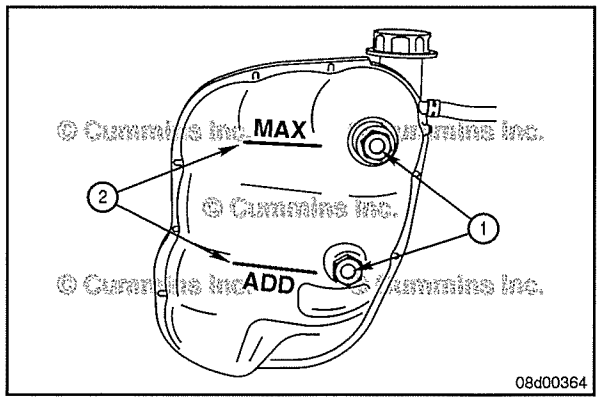
The engine coolant level **must** be checked daily.



△CAUTION△
Do not add cold coolant to a hot engine. Engine castings can be damaged. Allow the engine to cool below 50°C [120°F] before adding coolant.

On applications that use a coolant recovery system, check to make sure the coolant is at the appropriate level on the coolant recovery tank for the engine temperature.

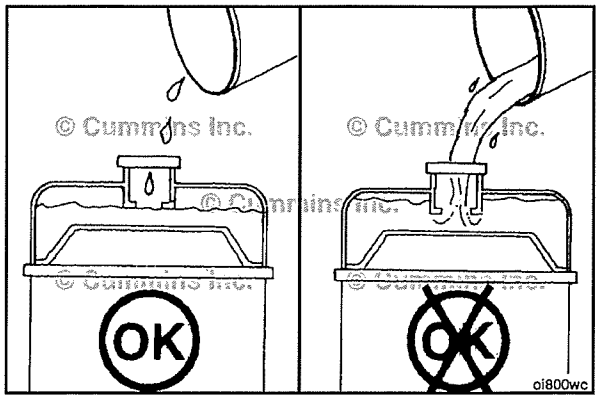
Many coolant recovery/expansion tanks, or are made of a semi-clear material (**not** shown) to aid in checking the coolant level without removing the radiator cap.



NOTE: Some radiators have two fill necks, both of which **must** be filled when the cooling system is drained.

On applications that do **not** use a coolant recovery system, the top tank of the radiator is used to check and top off the coolant level. **Never** remove the radiator cap when the cooling system is hot.

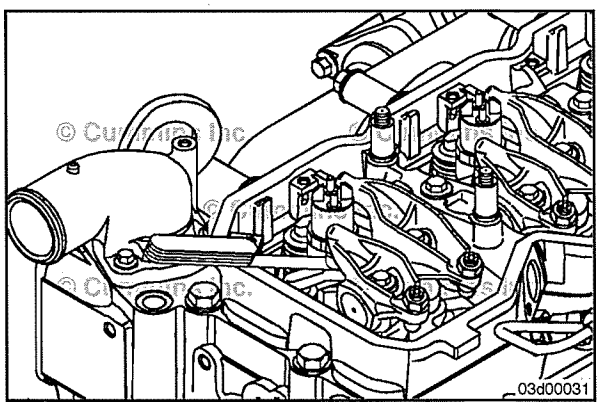
Check and refill when the cooling system is cool enough to touch (below 49°C [120°F]). Coolant level should be maintained at the bottom of the filler neck. Refill only with a pre-mixed, fully formulated coolant compliant with Cummins Inc. coolant recommendations.



If the number 1 cylinder is at TDC and both rocker levers are loose, the valve lash (overhead set) can be checked on the following rocker levers:

(E= exhaust, I= Intake)

1I, 1E, 2I, 3E, 4I, and 5E.



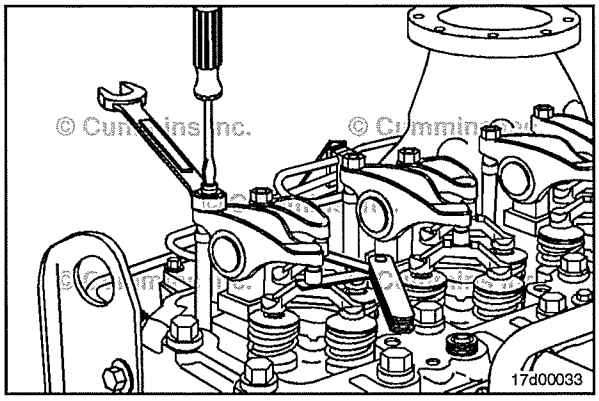
Overhead Set Check Limits

	mm		in
Intake	0.152	MIN	0.006
	0.381	MAX	0.015
Exhaust	0.533	MIN	0.021
	0.863	MAX	0.034

Checking the overhead setting is usually performed as part of a troubleshooting procedure, and resetting is **not** required during checks, as long as the lash measurements are within the specifications shown above.

The clearance is correct when some resistance is felt when the feeler gauge is slipped between the crosshead and the rocker lever socket.

Measure the valve lash (overhead set) by inserting a feeler gauge between the crosshead and the rocker lever socket. If the measurement is out of specification, loosen the locknut and adjust the lash to nominal specifications.



Valve Lash (Overhead Set)

	mm		in
Intake	0.254	NOM	0.010
Exhaust	0.508	NOM	0.020

Tighten the locknut and measure the clearance again.

Torque Value: 24 N•m [212 in-lb]

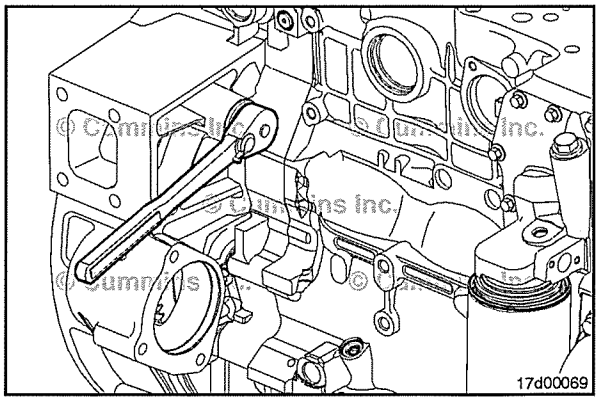
Use the barring tool, Part Number 3824591, to rotate the crankshaft 360 degrees.

Use the previous steps and specifications to set the valve lash on the following rocker levers:

(E= exhaust, I= Intake)

2E, 3I, 4E, 5I, 6I, and 6E.

If the measurements are out of specification, set the valve lash.

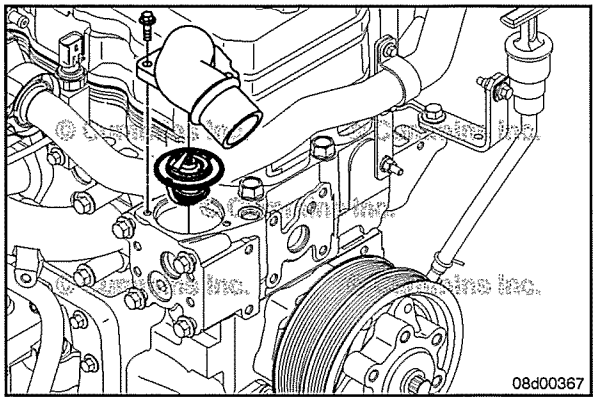


Remove

Remove the water outlet connection capscrews.

Remove the water outlet connection.

Remove the thermostat.

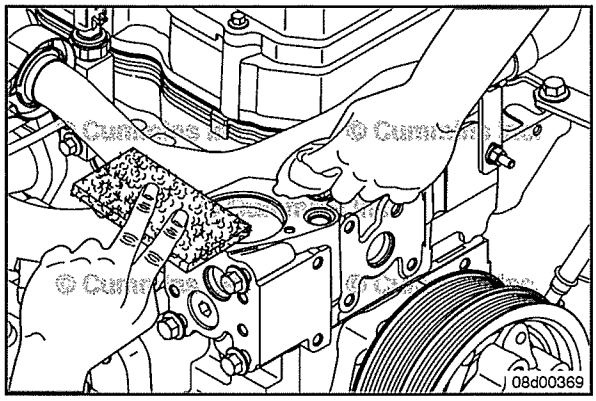


Clean and Inspect for Reuse

⚠CAUTION⚠

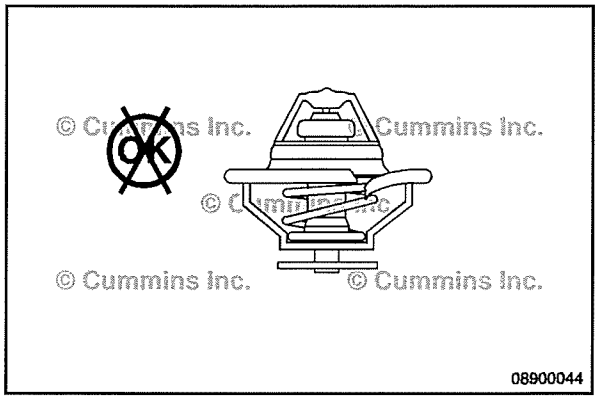
Do not let any debris fall into the thermostat cavity when cleaning the gasket surfaces. Damage to the cooling system and engine can occur.

Clean the mating surfaces with an abrasive pad, Part Number 3823258, or equivalent, and a clean cloth.



Inspect the thermostat for external damage. Also inspect for cracks, embedded debris, missing check balls, damaged seat, and other damage.

Replace the thermostat if any damage is found.

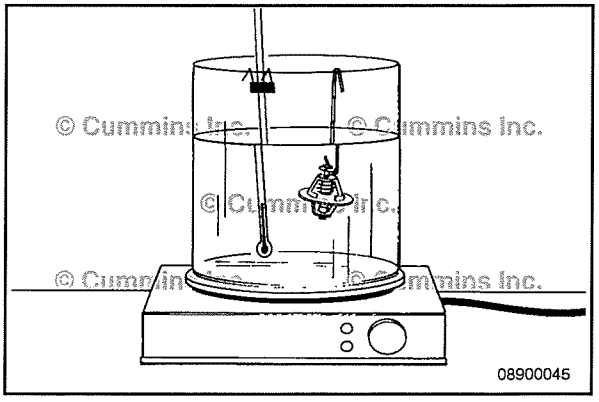


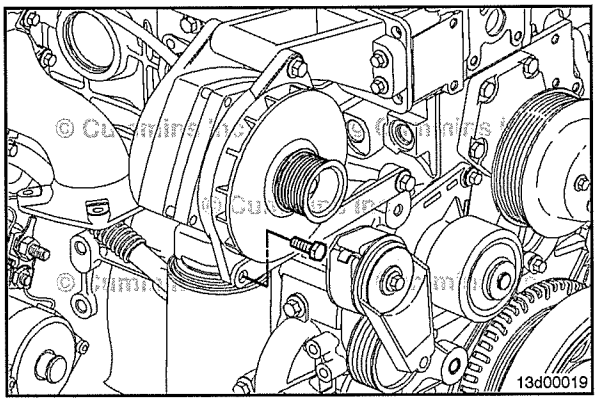
Measure

If the thermostat is suspected to be malfunctioning, the opening temperature of the thermostat should be measured to determine if the thermostat is functioning correctly.

NOTE: Do **not** allow the thermostat or thermometer to touch the container.

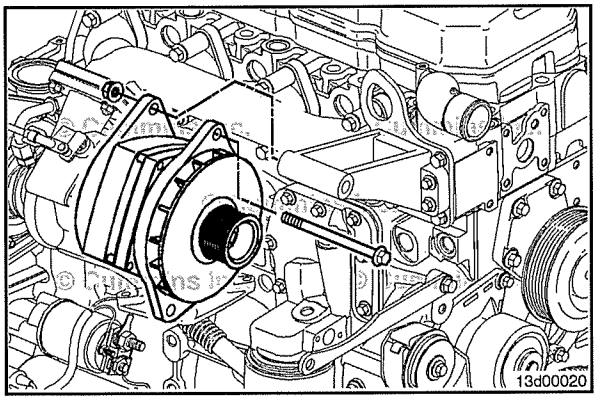
Suspend the thermostat and a 100°C [212°F] thermometer in a container of water.





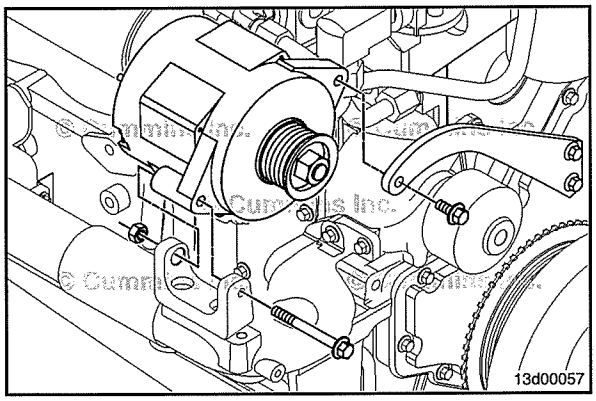
Hinge Mount

- Remove the alternator link capscrew.



Remove the alternator mounting capscrew.

Remove the alternator.



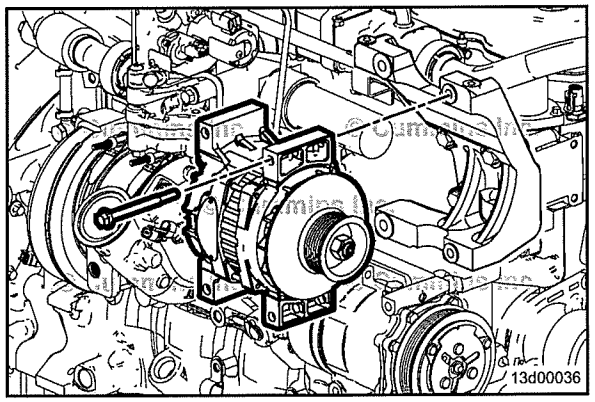
Install

Spool Mount

- Install the alternator and the bottom alternator mounting capscrew and nut.
- Tighten the capscrews.

Torque Value:
Lower Mounting Capscrew 40 N•m [30 ft-lb]

Torque Value:
Upper Link Mounting Capscrew 24 N•m [212 in-lb]



Pad Mount

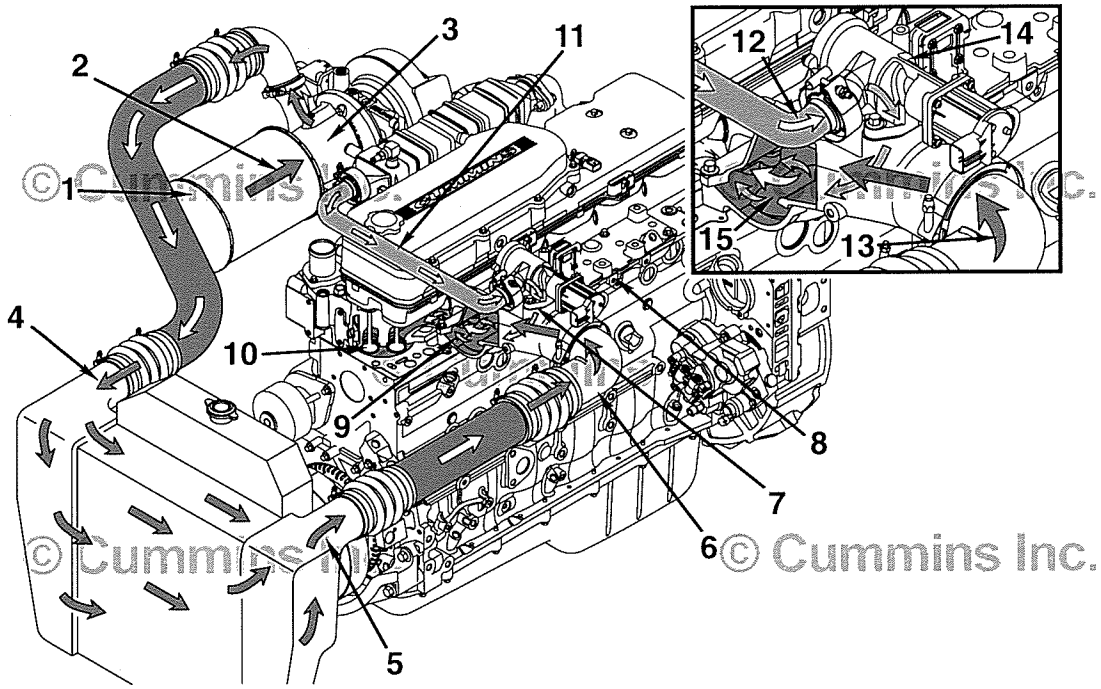
- Install the alternator.
- Install and tighten the alternator mounting capscrews.

Torque Value:
M10 Capscrew 36 N•m [27 ft-lb]

Torque Value:
M12 Capscrew 64 N•m [47 ft-lb]

Flow Diagram, Air Intake System

Flow Diagram



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10d00372

1 Air cleaner
2 Turbocharger compressor inlet
3 Turbocharger compressor outlet
4 Charge-air cooler inlet
5 Charge-air cooler outlet
6 Air intake connection adapter
7 Air intake connection
8 Intake manifold
9 Intake port
10 Intake valves
11 Exhaust gas recirculation (EGR) connection tube
12 EGR cooled exhaust gases
13 Charge air cooled intake air
14 EGR valve
15 Air mixture to combustion cylinder.

Cummins Customized Parts Catalog

General Information

Cummins is pleased to announce the availability of a parts catalog compiled specifically for you. Unlike the generic versions of parts catalogs that support general high volume parts content; Cummins Customized catalogs contains only the new factory parts that were used to build your engine.

The catalog cover, as well as the content, is customized with you in mind. You can use it in your shop, at your worksite, or as a coffee table book in your RV or boat. The cover contains your name, company name, address, and telephone number. Your name and engine model identification even appears on the catalog spine. Everybody will know that Cummins created a catalog specifically for you.

This new catalog was designed to provide you with the exact information you need to order parts for your engine. This will be valuable for customers that do not have easy access to the Cummins Electronic Parts Catalog or the Cummins Parts Microfilm System.

Additional Features of the Customized Catalog include:

- Engine Configuration Data
- Table of Contents
- Separate Option and Parts Indexes
- Service Kits (when applicable)
- ReCon Part Numbers (when applicable)

Ordering the Customized Parts Catalog

Ordering by Telephone

North American customers can contact their Cummins Distributor or call Gannett Direct Marketing Services at 1-800-646-5609 and order by credit card. Outside North America order on-line or make an International call to Gannett at (++)502-454-6660.

Ordering On-Line

The Customized Parts Catalog can be ordered On-Line from the Cummins Powerstore by credit card.

Contact GDMS or the CUMMINS POWERSTORE for the current price; Freight may be an additional expense.

Information we need to take your Customized Parts Catalog Order. This information drives the cover content of the CPC.

- Customer Name
- Street Address
- Company Name (optional)
- Telephone no.
- Credit Card No.
- Cummins Engine Serial Number (located on the engine data plate)
- Please identify the required media: Printed Catalog, CD-ROM, or PDF File

Unfortunately not all Cummins Engines can be supported by this parts catalog. Engines older than 1984 or newer than 3 months may not have the necessary parts information to compile a catalog. We will contact you if this occurs and explain why we are unable to fill your order.

Customized Parts Catalogs are produced specifically for a single customer. This means they are not returnable for a refund. If we make an error and your catalog is not useable, we will correct that error by sending you a new catalog.

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Engine Acceleration or Response Poor

Cause	Correction
STEP 1 Operator technique is **not** correct	Refer to Procedure 101-999 in Section 1.
OK Go To Next Step	
STEP 2 Fuel level is low in the tank	Fill the supply tank. Refer to the OEM service manual.
OK Go To Next Step	
STEP 3 Fuel leak	Check the fuel lines, fuel connections, and fuel filters for leaks. Check the fuel lines to the supply tanks. Refer to the OEM service manual.
OK Go To Next Step	
STEP 4 Engine indicator lamps illuminated	Refer to Procedure 101-048 in Section 1.
OK Go To Next Step	
STEP 5 Fuel supply line restriction between the fuel pump and the injectors	Check the fuel supply line from the fuel pump to the cylinder head for sharp bends that can cause restrictions. Refer to a Cummins® Authorized Repair Location.
OK Go To Next Step	
STEP 6 Charge-air cooler is restricted or leaking	Inspect the charge-air cooler for air restrictions or leaks. Refer to Procedure 010-027 in Section 4.
OK Go To Next Step	
STEP 7 Air intake or exhaust leaks	Check for loose or damaged piping connections and missing pipe plugs. Check the turbocharger and exhaust manifold mounting. Refer to Procedure 010-058 in Section 3.
OK Go To Next Step	
STEP 8 Air intake system restriction is above specification	Check the air intake system for restrictions. Clean or replace the air filter and inlet piping as necessary. Refer to Procedure 010-059 in Section 4.
OK Go To Next Step	
STEP 9 Fuel grade is **not** correct for the application or the fuel quality is poor	Operate the engine from a tank of known high quality fuel. Refer to Procedure 018-002 in Section V.
OK Go To Next Step	

Engine Starts But Will Not Keep Running

Cause	Correction
STEP 1 Fuel level is low in the tank	Fill the supply tank. Refer to the original equipment manufacturer (OEM) service manual.
OK Go To Next Step	
STEP 2 Battery voltage supply to the engine control module (ECM) is low, interrupted, or open	Check the battery connections, the fuses, and the unswitched battery supply circuit. Refer to the OEM service manual.
OK Go To Next Step	
STEP 3 Engine indicator lamps illuminated	Refer to Procedure 101-048 in Section 1.
OK Go To Next Step	
STEP 4 Fuel supply is **not** adequate	Check the flow through the filter to locate the source of the restriction. Refer to the OEM service manual.
OK Go To Next Step	
STEP 5 Air in the fuel system	Check for air in the fuel system. Tighten or replace the fuel connections, fuel lines, fuel tank standpipe, and fuel filters as necessary.
OK Go To Next Step	
STEP 6 Fuel grade is **not** correct for the application, or the fuel quality is poor	Operate the engine from a tank of known high quality fuel. Refer to Procedure 018-002 in Section V.
OK Go To Next Step	
STEP 7 Contact a Cummins® Authorized Repair Facility	

Fuel Recommendations and Specifications

Fuel Recommendations

⚠WARNING⚠

Do not mix gasoline, alcohol, or gasohol with diesel fuel. This mixture can cause an explosion.

△CAUTION△

Due to the precise tolerances of diesel injection systems, it is extremely important that the fuel be kept clean and free of dirt or water. Dirt or water in the system can cause severe damage to both the fuel pump and the fuel injectors.

△CAUTION△

Lighter fuels can reduce fuel economy or possibly damage fuel system components.

△CAUTION△

Do not use diesel fuel blended with lubricating oil in engines equipped with an aftertreatment system. Service intervals for aftertreatment systems will be reduced.

△CAUTION△

Ultra-low sulfur diesel fuel is required for correct operation of the aftertreatment system. If ultra-low sulfur diesel fuel is not used, the aftertreatment system could possibly be damaged.

Cummins Inc. recommends the use of ASTM number 2D fuel. The use of number 2D diesel fuel will result in optimum engine performance.

The engine has been optimized for use with an exhaust aftertreatment to meet the Tier 4 Final/Stage IV off-highway emissions regulations. It **must** operate on ultra-low sulfur diesel (ULSD) with a maximum sulfur content of 15 ppm in the United States and 10 ppm in the European Union. Failure to do so can permanently damage engine and aftertreatment systems within a short period of time. This damage could cause the engine to become inoperable and affect the warranty coverage on the engine.

Ultra-low sulfur diesel fuel, also defined by ASTM S-15, is defined as diesel fuel **not** exceeding 0.0015 (15 ppm) mass percent sulfur content. There is **no** acceptable substitute.

At operating temperatures below 0°C [32°F], acceptable performance can be obtained by using blends of number 2D and number 1D.

The following chart lists acceptable fuel types for this engine.

Acceptable Fuels - Cummins® Fuel System									
Number 1D Diesel[1] [2]	Number 2D Diesel[2]	Number 1K Kerosene	Jet-A	Jet-A1	JP-5	JP-8	Jet-B	JP-4	CITE
OK	OK	**NOT** OK	**NOT** OK	**NOT** OK	**NOT** OK	**NOT** OK	**NOT** OK	**NOT** OK	**NOT** OK
48-34[3]	40-24[3]	50-35[3]	51-37[3]	51-37[3]	48-36[3]	51-37[3]	57-45[3]	57-45[3]	57-45[3]

1 Any adjustment to compensate for reduced performance with a fuel system using alternate fuel is **not** warrantable.

2 Winter blend fuels, such as those found at commercial fuel dispensing outlets, are combinations of number 1D and number 2D diesel fuel, and are acceptable.

3 BTU Content/Degree API Gravity - Low API gravity fuels have a higher thermal energy content (BTU). As a general rule, there is a 3 to 5 percent decrease in BTU content for every 10 degree increase in API gravity; there is also a 0.7 degree API gravity increase with an increase in fuel temperature. This decrease in energy content equates roughly to the same percentage of power loss. Use of fuels with higher API gravity will cause higher than normal fuel consumption.

NOTE: Cummins Inc. recommends that the cetane number of diesel fuel be a minimum of 45 for engines that are expected to operate at temperatures below 0°C [32°F] and a minimum of 42 for engines that are operated at temperatures above 0°C [32°F].

NOTE: The use of diesel fuel with a lower than recommended cetane number can cause hard starting, instability, and excessive white smoke. To maintain satisfactory operation at low ambient temperatures, it is important to specify diesel fuel of the correct cetane number.