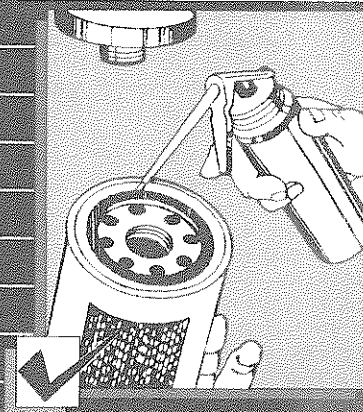
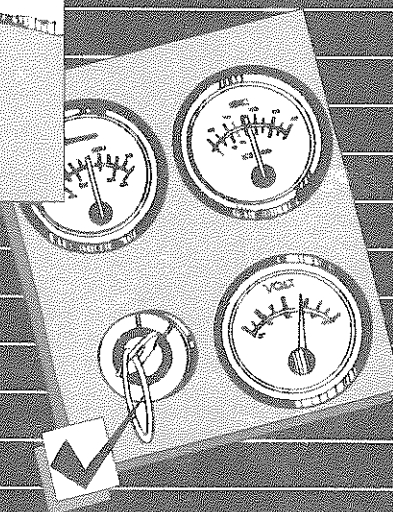
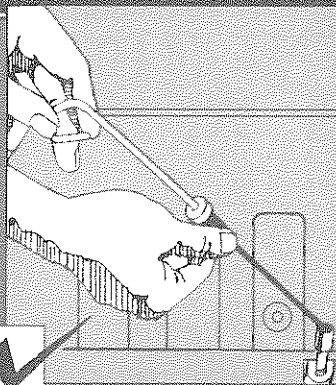
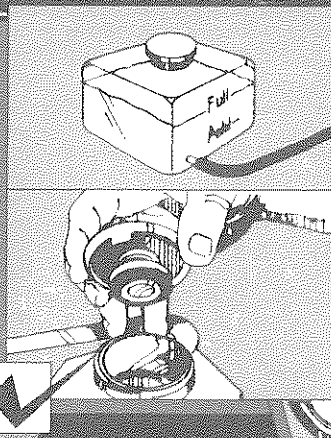


Operation and Maintenance Manual G8.3 CM558

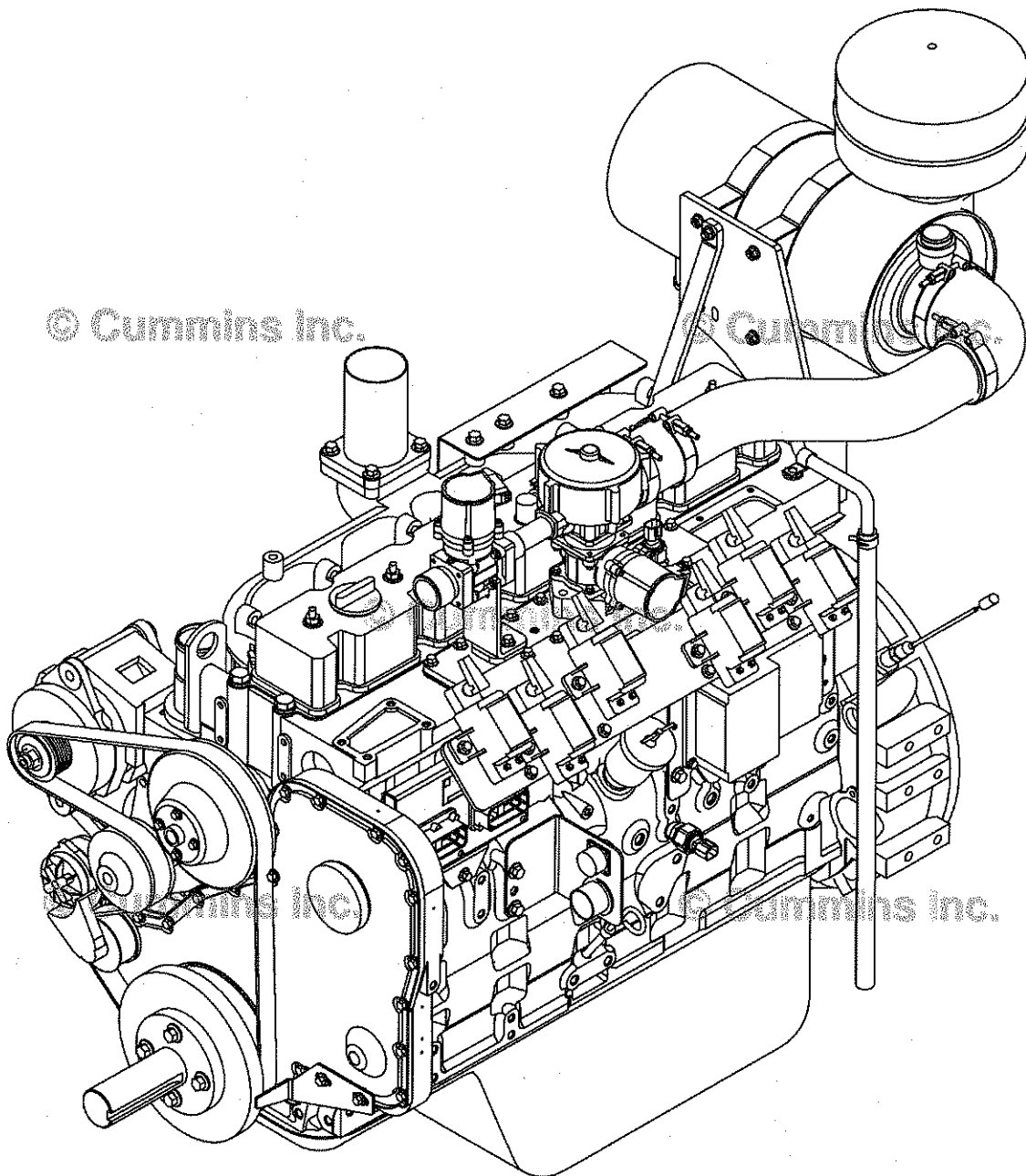
**THIS
PRINTED
CUMMINS MANUAL
INCLUDES
A COMPANION
CD-ROM
VERSION**



**Cummins Customer Assistance Center
1-800-DIESELS (1-800-343-7357)
APPLICABLE ONLY IN U.S.A. AND CANADA**



Operation and Maintenance Manual G8.3 CM558



Foreword

This manual contains information for the correct operation and maintenance of your Cummins engine. It also includes important safety information, engine and systems specifications, troubleshooting guidelines, and listings of Cummins Authorized Repair Locations and component manufacturers.

Read and follow all safety instructions. Refer to the WARNING in the General Safety Instructions in Section I - Introduction.

Keep this manual with the equipment. If the equipment is traded or sold, give the manual to the new owner.

The information, specifications, and recommended maintenance guidelines in this manual are based on information in effect at the time of printing. Cummins Inc. reserves the right to make changes at any time without obligation. If you find differences between your engine and the information in this manual, contact your local Cummins Authorized Repair Location or call 1-800-DIESELS (1-800-343-7357) toll free in the U.S. and Canada.

The latest technology and the highest quality components were used to produce this engine. When replacement parts are needed, we recommend using only genuine Cummins or ReCon® exchange parts.

NOTE: Note: Warranty information is located in Section W. Make sure you are familiar with the warranty or warranties applicable to your engine.

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Important Reference Numbers

Fill in the part name and number in the blank spaces provided below. This will give you a reference whenever service or maintenance is required.

Name	Number	Number
Engine Model		
Engine Serial Number (ESN)		
Control Parts List (CPL)		
Fuel Pump Part Number		
Electronic Control Module (ECM)		
Electronic Control Module Serial Numbers (ECM)		
Filter Part Numbers:		
• Air Cleaner Element		
• Lubricating Oil		
• Fuel		
• Fuel-Water Separator		
• Coolant		
• Crankcase Ventilation		
• Cummins Particulate Filter		
Governor Control Module (GCM) (if applicable)		
Belt Part Numbers:		
•		
•		
•		
Clutch or Marine Gear (if applicable):		
• Model		
• Serial Number		
• Part Number		
• Oil Type		
• Sea Water Pump		
- Model		
- Part Number		

Section i — Introduction

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To the Owner and Operator

General Information

Preventive maintenance is the easiest and least expensive type of maintenance. Follow the maintenance schedule recommendations outlined in Maintenance Guidelines (Section 2).

Keep records of regularly scheduled maintenance.

Use the correct fuel, lubricating oil, and coolant in your engine as specified in Maintenance Specifications (Section V). Blending engine oil with fuel is prohibited for engines with an aftertreatment system.

Cummins Inc. uses the latest technology and the highest quality components to produce its engines. Cummins Inc. recommends using genuine Cummins new parts and ReCon® exchange parts.

Personnel at Cummins Authorized Repair Locations have been trained to provide expert service and parts support. If you have a problem that can **not** be resolved by a Cummins Authorized Repair Location, follow the steps outlined in the Service Assistance (Section S).

Product coverage, warranty limitations and owner responsibilities are available in Warranty (Section W).

CAUTION

Disconnect both the positive (+) and negative (-) battery cables from the battery before welding on the vehicle. Attach the welder ground cable no more than 0.61 meters [2 feet] from the part being welded. Do not connect the ground cable of the welder to the ECM cooling plate or ECM. Welding on the engine or engine mounted components is not recommended.

About the Manual

General Information

This manual contains information needed to correctly operate and maintain your engine as recommended by Cummins Inc. For additional service literature and ordering locations, refer to Service Literature (Section L).

This manual does **not** cover vehicle, vessel, or equipment maintenance procedures. Consult the original vehicle, vessel, or equipment manufacturer for specific maintenance recommendations.

Both metric and U.S. customary values are listed in this manual. The metric value is listed first, followed by the U.S. customary in brackets.

Numerous illustrations and symbols are used to aid in understanding the meaning of the text. Refer to Symbols in this section for a complete listing of symbols and their definitions.

Each section of the manual is preceded by a Section Contents to aid in locating information.

How to Use the Manual

General Information

This manual is organized according to intervals at which maintenance on your engine is to be performed. A maintenance schedule, that states the required intervals and maintenance checks, is located in Maintenance Guidelines (Section 2). Locate the interval at which you are performing maintenance; then follow the steps given in that section for all the procedures to be performed.

Keep a record of all the checks and inspections made. A maintenance record form is located in Maintenance Guidelines (Section 2).

Engine troubleshooting procedures for your engine are located in Troubleshooting Symptoms (Section TS).

Specifications for your engine are located in Maintenance Specifications (Section V).

Symbols

General Information

The following symbols have been used in this manual to help communicate the intent of the instructions. When one of the symbols appears, it conveys the meaning defined below:



WARNING - Serious personal injury or extensive property damage can result if the warning instructions are not followed.



CAUTION - Minor personal injury can result or a part, an assembly, or the engine can be damaged if the caution instructions are not followed.



Indicates a **REMOVAL** or **DISASSEMBLY** step.



Indicates an **INSTALLATION** or **ASSEMBLY** step.



INSPECTION is required.



CLEAN the part or assembly.



PERFORM a mechanical or time **MEASUREMENT**.



LUBRICATE the part or assembly.



Indicates that a **WRENCH** or **TOOL SIZE** will be given.



TIGHTEN to a specific torque.



PERFORM an electrical **MEASUREMENT**.



Refer to another location in this manual or another publication for additional information.



The component weighs 23 kg [50 lb] or more. To avoid personal injury, use a hoist or get assistance to lift the component.

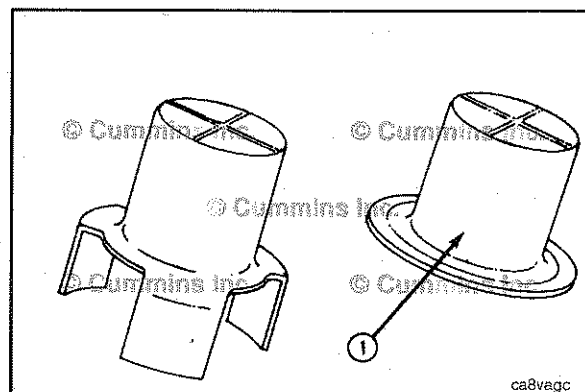
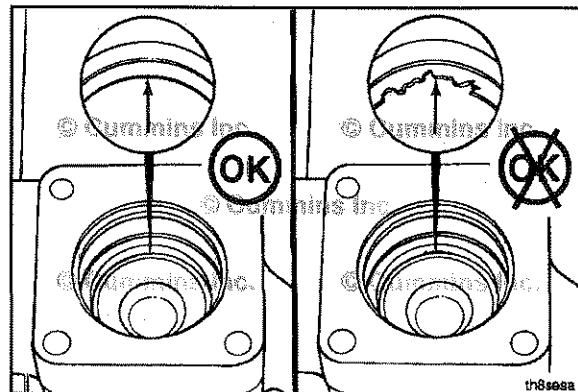
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Illustrations

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 Safety Instructions

Important Safety Notice



Improper practices, carelessness, or ignoring the warnings can cause burns, cuts, mutilation, asphyxiation or other personal injury or death.

Read and understand all of the safety precautions and warnings before performing any repair. This list contains the general safety precautions that **must** be followed to provide personal safety. Special safety precautions are included in the procedures when they apply.

- Work in an area surrounding the product that is dry, well lit, ventilated, free from clutter, loose tools, parts, ignition sources and hazardous substances. Be aware of hazardous conditions that can exist.
- **Always** wear protective glasses and protective shoes when working.
- Rotating parts can cause cuts, mutilation or strangulation.
- Do **not** wear loose-fitting or torn clothing. Remove all jewelry when working.
- Disconnect the battery (negative [-] cable first) and discharge any capacitors before beginning any repair work. Disconnect the air starting motor if equipped to prevent accidental engine starting. Put a "Do **Not** Operate" tag in the operator's compartment or on the controls.
- Use **ONLY** the proper engine barring techniques for manually rotating the engine. Do **not** attempt to rotate the crankshaft by pulling or prying on the fan. This practice can cause serious personal injury, property damage, or damage to the fan blade(s) causing premature fan failure.
- If an engine has been operating and the coolant is hot, allow the engine to cool before slowly loosening the filler cap to relieve the pressure from the cooling system.
- **Always** use blocks or proper stands to support the product before performing any service work. Do **not** work on anything that is supported **ONLY** by lifting jacks or a hoist.
- Relieve all pressure in the air, oil, fuel, and cooling systems before any lines, fittings, or related items are removed or disconnected. Be alert for possible pressure when disconnecting any device from a system that utilizes pressure. Do **not** check for pressure leaks with your hand. High pressure oil or fuel can cause personal injury.
- To reduce the possibility of suffocation and frostbite, wear protective clothing and **ONLY** disconnect liquid refrigerant (Freon) lines in a well ventilated area. To protect the environment, liquid refrigerant systems **must** be properly emptied and filled using equipment that prevents the release of refrigerant gas (fluorocarbons) into the atmosphere. Federal law requires capturing and recycling refrigerant.
- To reduce the possibility of personal injury, use a hoist or get assistance when lifting components that weigh 23 kg [50 lb] or more. Make sure all lifting devices such as chains, hooks, or slings are in good condition and are of the correct capacity. Make sure hooks are positioned correctly. **Always** use a spreader bar when necessary. The lifting hooks **must not** be side-loaded.
- Corrosion inhibitor, a component of SCA and lubricating oil, contains alkali. Do **not** get the substance in eyes. Avoid prolonged or repeated contact with skin. Do **not** swallow internally. In case of contact, immediately wash skin with soap and water. In case of contact, immediately flood eyes with large amounts of water for a minimum of 15 minutes. **IMMEDIATELY CALL A PHYSICIAN. KEEP OUT OF REACH OF CHILDREN.**
- Naptha and Methyl Ethyl Ketone (MEK) are flammable materials and **must** be used with caution. Follow the manufacturer's instructions to provide complete safety when using these materials. **KEEP OUT OF REACH OF CHILDREN.**
- To reduce the possibility of burns, be alert for hot parts on products that have just been turned off, exhaust gas flow, and hot fluids in lines, tubes, and compartments.
- **Always** use tools that are in good condition. Make sure you understand how to use the tools before performing any service work. Use **ONLY** genuine Cummins® or Cummins ReCon® replacement parts.
- **Always** use the same fastener part number (or equivalent) when replacing fasteners. Do **not** use a fastener of lesser quality if replacements are necessary.
- Do **not** perform any repair when fatigued or after consuming alcohol or drugs that can impair your functioning.
- Some state and federal agencies in the United States of America have determined that used engine oil can be carcinogenic and can cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil.
- The Cummins® natural gas liquefied and petroleum gas engine ignition systems produces high voltage when the engine is operating. Do **not touch** any ignition wiring or components while the engine is operating unless you use suitably insulated tools. Failure to comply with this warning can cause serious shock.
- Do **not** connect the jumper starting or battery charging cables to any ignition or governor control wiring. This can cause electrical damage to the ignition or governor.
- The natural gas and liquefied petroleum gas exhaust system normally operates at a higher temperature than similar diesel exhaust systems. To reduce the possibility of burns, do **not touch** exhaust components. Do **not** route lines or hoses which can deteriorate from heat near the natural gas exhaust.
- Liquefied petroleum gas is heavier than air and can accumulate near the floor, in sumps, and low-lying areas.

- Natural gas is lighter than air and can accumulate under hood and awnings.
- Compressed natural gas and liquefied petroleum gas is normally treated with an odor producing chemical, so that users will be able to smell gas leaks. **Always** be alert for the smell of gas. If you enter a room or approach a vehicle and a smell of gas is present, immediately shut off all engines and ignition sources, avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition in the area and in areas with common ventilation. Provide extra ventilation to the area and do **not** start the equipment or nearby equipment until the leak is corrected and the area is ventilated. Avoid leaving natural gas and liquefied petroleum gas fueled equipment in unvented rooms overnight or for extended periods. Store and service natural gas fueled equipment in large well ventilated areas or outside. **Note: Liquid natural gas does not have an odor.**
- To reduce the possibility of suffocation and frostbite, wear protective clothing and **ONLY** disconnect natural gas and liquefied petroleum gas lines in a well ventilated area.
- Do **not** troubleshoot or repair gas leaks while the engine is running.
- **Always** torque fasteners and fuel connections to the required specifications. Overtightening or undertightening can allow leakage. This is critical to the natural gas and liquefied petroleum gas fuel and air systems.
- **Always** test for fuel leaks as instructed, as odorant can fade.
- Close the manual fuel valves prior to performing maintenance and repairs, and when storing the vehicle inside.
- Coolant is toxic. If **not** reused, dispose of in accordance with local environmental regulations.

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

- 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

Complete rebuild instructions are available in the shop manual which can be ordered or purchased from a Cummins Authorized Repair Location. Refer to Section L — Service Literature for ordering instructions.

Welding on a Vehicle with an Electronic Controlled Fuel System

CAUTION

Disconnect both the positive (+) and negative (-) battery cables from the battery before welding on the vehicle. Attach the welder ground cable no more than 0.61 meters [2 feet] from the part being welded. Do not connect the ground cable of the welder to the ECM cooling plate or ECM. Welding on the engine or engine mounted components is not recommended or damage to the engine or components can result.

General Cleaning Instructions

Definition of Clean

Parts **must** be free of debris that can contaminate any engine system. This does **not** necessarily mean they have to appear as new.

Sanding gasket surfaces until the factory machining marks are disturbed adds no value and is often harmful to forming a seal. It is important to maintain surface finish and flatness tolerances to form a quality sealing surface. Gaskets are designed to fill small voids in the specified surface finish.

Sanding gasket surfaces where edge-molded gaskets are used is most often unnecessary. Edge-molded gaskets are those metal carriers with sealing material bonded to the edges of the gasket to seal while the metal portion forms a metal to metal joint for stability. Any of the small amounts of sealing material that can stick to the parts are better removed with a blunt-edged scraper on the spots rather than spending time polishing the whole surface with an air sander or disc.

For those gaskets that do **not** have the edge molding, nearly all have a material that contains release agents to prevent sticking. Certainly this is **not** to say that some gaskets are **not** difficult to remove because the gasket has been in place a long time, has been overheated or the purpose of the release agent has been defeated by the application of some sealant. The object however is just to remove the gasket without damaging the surfaces of the mating parts without contaminating the engine (don't let the little bits fall where they can not be removed).

Bead blasting piston crowns until the dark stain is removed is unnecessary. All that is required is to remove the carbon build-up above the top ring and in the ring grooves. There is more information on bead blasting and piston cleaning later in this document.

Cummins Inc. does **not** recommend sanding or grinding the carbon ring at the top of cylinder liners until clean metal is visible. The liner will be ruined and any signs of a problem at the top ring reversal point (like a dust-out) will be destroyed. It is necessary to remove the carbon ring to provide for easier removal of the piston assembly. A medium bristle, high quality, steel wire wheel that is rated above the rpm of the power tool being used will be just as quick and there will be less damage. Yes, one **must** look carefully for broken wires after the piston is removed but the wires are more visible and can be attracted by a magnet.

Oil on parts that have been removed from the engine will attract dirt in the air. The dirt will adhere to the oil. If possible, leave the old oil on the part until it is ready to be cleaned, inspected and installed, and then clean it off along with any attracted dirt. If the part is cleaned then left exposed it can have to be cleaned again before installation. Make sure parts are lubricated with clean oil before installation. They do **not** need to be oiled all over but do need oil between moving parts (or a good lube system priming process conducted before cranking the engine).

Bead blasting parts to remove exterior paint is also usually unnecessary. The part will most likely be painted again so all that needs happen is remove any loose paint.

Abrasive Pads and Abrasive Paper

The keyword here is "abrasive". There is no part of an engine designed to withstand abrasion. That is they are all supposed to lock together or slide across each other. Abrasives and dirt particles will degrade both functions.



Abrasive material must be kept out of or removed from oil passages and parts wear points. Abrasive material in oil passages can cause bearing and bushing failures that can progress to major component damage beyond reuse. This is particularly true of main and rod bearings.

Cummins Inc. does **not** recommend the use of emery cloth or sand paper on any part of an **assembled** engine or component including but **not** limited to removing the carbon ridge from cylinder liners or to clean block decks or counterbores.

Great care **must** be taken when using abrasive products to clean engine parts, particularly on partially assembled engines. Abrasive cleaning products come in many forms and sizes. All of them contain aluminum oxide particles, silicon carbide, or sand or some other similar hard material. These particles are harder than most of the parts in the engine. Since they are harder, if they are pressed against softer material they will either damage the material or become embedded in it. These materials fall off the holding media as the product is used. If the products are used with power equipment the particles are thrown about the engine. If the particles fall between two moving parts, damage to the moving parts is likely.

If particles that are smaller than the clearance between the parts while they are at rest (engine stopped), but larger than the running clearance then damage will occur when the parts move relative to each other (engine started). While the engine is running and there is oil pressure, particles that are smaller than the bearing clearance are likely to pass between the parts without damage and be trapped in the oil filter. However, particles larger than the bearing clearance will remove material from one part and can become embedded in one of the parts. Once embedded in one part it will

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

pressure water or steam clean the parts before putting them in the cleaning tank. Removing the heaviest dirt before placing in the tank will allow the cleaner to work more effectively and the cleaning agent will last longer.

Rinse all the parts in hot water after cleaning. Dry completely with compressed air. Blow the rinse water from all the capscrew holes and the oil drillings.

If the parts are **not** to be used immediately after cleaning, dip them in a suitable rust proofing compound. The rust proofing compound **must** be removed from the parts before assembly or installation on the engine.

Steam Cleaning

Steam cleaning can be used to remove all types of dirt that can contaminate the cleaning tank. It is a good method for cleaning the oil drillings and coolant passages



When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

Do **not** steam clean the following components:

- Electrical Components
- Wiring Harnesses
- Injectors
- Fuel Pump
- Belts and Hoses
- Bearings (ball or taper roller)
- Electronic Control Module (ECM)
- ECM Connectors
- Dosing Control Unit
- NOx Sensor.

Plastic Bead Cleaning

Cummins Inc. does **not** recommend the use of glass bead blast or walnut shell media on **any** engine part. Cummins Inc. recommends using **only** plastic bead media, Part Number 3822735 or equivalent on any engine part. **Never** use sand as a blast media to clean engine parts. Glass and walnut shell media when **not** used to the media manufacturer's recommendations can cause excess dust and can embed in engine parts that can result in premature failure of components through abrasive wear.

Plastic bead cleaning can be used on many engine components to remove carbon deposits. The cleaning process is controlled by the use of plastic beads, the operating pressure and cleaning time.



Do not use bead blasting cleaning methods on aluminum pistons skirts or the pin bores in any piston, piston skirt or piston crown. Small particles of the media will embed in the aluminum or other soft metal and result in premature wear of the cylinder liner, piston rings, pins and pin bores. Valves, turbocharger shafts, etc., can also be damaged. Follow the cleaning directions listed in the procedures.



Do not contaminate wash tanks and tank type solvent cleaners with the foreign material and plastic beads. Remove the foreign material and plastic beads with compressed air, hot high pressure water or steam before placing them in tanks or cleaners. The foreign material and plastic beads can contaminate the tank and any other engine parts cleaned in the tank. Contaminated parts may cause failures from abrasive wear.

Plastic bead blasting media, Part Number 3822735, can be used to clean all piston ring grooves. Do **not** use any bead blasting media on piston pin bores or aluminum skirts.

Follow the equipment manufacturer's cleaning instructions. Make sure to adjust the air pressure in the blasting machine to the bead manufacturer's recommendations. Turning up the pressure can move material on the part and cause the plastic bead media to wear out more quickly. The following guidelines can be used to adapt to manufacturer's instructions:

1. Bead size: U.S. size Number 16 — 20 for piston cleaning with plastic bead media, Part Number 3822735
2. Operating Pressure — 270 kPa (40 psi) for piston cleaning. Pressure should not cause beads to break.
3. Steam clean or wash the parts with solvent to remove all of the foreign material and plastic beads after cleaning. Rinse with hot water. Dry with compressed air.



The bead blasting operation must not disturb the metal surface. If the metal surface is disturbed the engine can be damaged due to increased parts clearance or inadequate surface finish on parts that move against other parts.

When cleaning pistons, it is **not** necessary to remove all the dark stain from the piston. All that is necessary is to remove the carbon on the rim and in the ring grooves. This is best done by directing the blast across the part as opposed to straight at the part. If the machining marks are disturbed by the blasting process, then the pressure is too high or the blast is being held on one spot too long. The blast operation **must not** disturb the metal surface.

Walnut shell bead blast material is sometimes used to clean ferrous metals (iron and steel). Walnut shell blasting produces a great amount of dust particularly when the pressure if the air pressure on the blasting machine is increased above media manufacturer's recommendation. Cummins Inc. recommends **not** using walnut shell media to clean engine parts due to the risk media embedment and subsequent contamination of the engine.

Cummins Inc. now recommends glass bead media **NOT** used to clean any engine parts. Glass media is too easily embedded into the material particularly in soft materials and when air pressures greater than media manufacturer's recommend are used. The glass is an abrasive so when it is in a moving part, that part is abrading all the parts in contact with it. When higher pressures are used the media is broken and forms a dust of a very small size that floats easily in the air. This dust is very hard to control in the shop, particularly if **only** compressed air (and not hot water) is used to blow the media after it is removed from the blasting cabinet (blowing the part off inside the cabinet may remove large accumulations but never removes all the media).

Bead blasting is best used on stubborn dirt/carbon build-up that has **not** been removed by first steam/higher pressure washing then washing in a heated wash tank. This is particularly true of pistons. Steam and soak the pistons first then use the plastic bead method to safely remove the carbon remaining in the grooves (instead of running the risk of damaging the surface finish of the groove with a wire wheel or end of a broken piston ring. Make sure the parts are dry and oil free before bead blasting to prevent clogging the return on the blasting machine.

Always direct the bead blaster nozzle "across" rather than directly at the part. This allows the bead to get under the unwanted material. Keep the nozzle moving rather than hold on one place. Keeping the nozzle directed at one-place too long causes the metal to heat up and be moved around. Remember that the spray is **not** just hitting the dirt or carbon. If the machining marks on the piston groove or rim have been disturbed then there has **not** been enough movement of the nozzle and/or the air pressure is too high.

Never bead blast valve stems. Tape or use a sleeve to protect the stems during bead blasting. Direct the nozzle across the seat surface and radius rather than straight at them. The object is to remove any carbon build up and continuing to blast to remove the stain is a waste of time.

Fuel System

When servicing any fuel system components, which can be exposed to potential contaminants, prior to disassembly, clean the fittings, mounting hardware, and the area around the component to be removed. If the surrounding areas are **not** cleaned, dirt or contaminants can be introduced into the fuel system.

The internal drillings of some injectors are extremely small and susceptible to plugging from contamination. Some fuel injection systems can operate at very high pressures. High pressure fuel can convert simple particles of dirt and rust into a highly abrasive contaminant that can damage the high pressure pumping components and fuel injectors.

Electrical contact cleaner can be used if steam cleaning tools are **not** available. Use electrical contact cleaner rather than compressed air, to wash dirt and debris away from fuel system fittings. Diesel fuel on exposed fuel system parts attracts airborne contaminants.

Choose lint free towels for fuel system work.

Cap and plug fuel lines, fittings, and ports whenever the fuel system is opened. Rust, dirt, and paint can enter the fuel system whenever a fuel line or other component is loosened or removed from the engine. In many instances, a good practice is to loosen a line or fitting to break the rust and paint loose, and then clean off the loosened material.

When removing fuel lines or fittings from a new or newly-painted engine, make sure to remove loose paint flakes/chips that can be created when a wrench contacts painted line nuts or fittings, or when quick disconnect fittings are removed.

Fuel filters are rated in microns. The word micron is the abbreviation for a micrometer, or one millionth of a meter. The micron rating is the size of the smallest particles that will be captured by the filter media. As a reference, a human hair is 0.003 mm [3/1000 in] in diameter. One micron measures 0.00004 mm [4/100,000 in]. The contaminants being filtered out are smaller than can be seen with the human eye, a magnifying glass, or a low powered microscope.

The tools used for fuel system troubleshooting and repair are to be cleaned regularly to avoid contamination. Like fuel system parts, tools that are coated with oil or fuel attract airborne contaminants. Remember the following points regarding your fuel system tools:

- Fuel system tools are to be kept as clean as possible.
- Clean and dry the tools before returning them to the tool box.
- If possible, store fuel system tools in sealed containers.
- Make sure fuel system tools are clean before use.

Acronyms and Abbreviations

General Information

The following list contains some of the acronyms and abbreviations used in this manual.

API	American Petroleum Institute
ASTM	American Society of Testing and Materials
BTU	British Thermal Unit
°C	Celsius
CARB	California Air Resources Board
C.I.D.	Cubic Inch Displacement
CNG	Compressed Natural Gas
CPL	Control Parts List
cSt	Centistokes
ECM	Electronic Control Module
EGR	Exhaust Gas Recirculation
EPA	Environmental Protection Agency
°F	Fahrenheit
FMI	Failure Mode Identifier
GVW	Gross Vehicle Weight
LPG	Liquefied Petroleum Gas
Hg	Mercury
hp	Horsepower
H₂O	Water
ICM	Ignition Control Module
km/l	Kilometers per Liter
kPa	Kilopascal
LNG	Liquid Natural Gas
LTA	Low Temperature Aftercooling
MPa	Megapascal
mph	Miles Per Hour
mpq	Miles Per Quart
N•m	Newton-meter
NG	Natural Gas
OEM	Original Equipment Manufacturer
PID	Parameter Identification Descriptions
ppm	Parts Per Million
psi	Pounds Per Square Inch
PTO	Power Takeoff
RGT	Rear Gear Train
rpm	Revolutions Per Minute
SAE	Society of Automotive Engineers
SCA	Supplemental Coolant Additive
STC	Step Timing Control
SID	Subsystem Identification Descriptions
VS	Variable Speed
VSS	Vehicle Speed Sensor

Section E — Engine Identification

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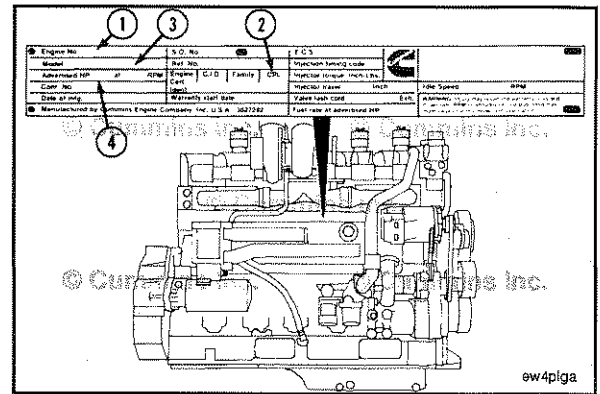
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Engine Identification

Engine Dataplate

The engine dataplates show specific information about the engine. The engine serial number (ESN) (1), Control Parts List (CPL) (2), model (3), and horsepower and rpm ratings (4) provide information for ordering parts and for service needs.

NOTE: The engine dataplate **must not** be changed unless approved by Cummins Inc.



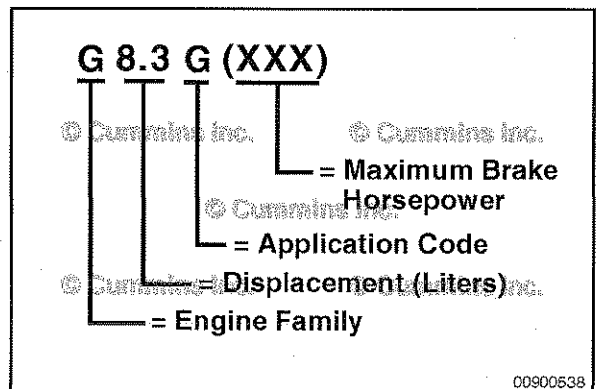
Cummins® Engine Nomenclature

The model name provides identification data for the engine.

See the illustration for the model name identification.

The application codes are:

- A = Agricultural
- C = Construction
- D = Generator Drive
- F = Fire Pump
- G = Gas
- L = Locomotive
- M = Marine
- P = Power Unit
- R = Railcar
- T = Tactical Military.

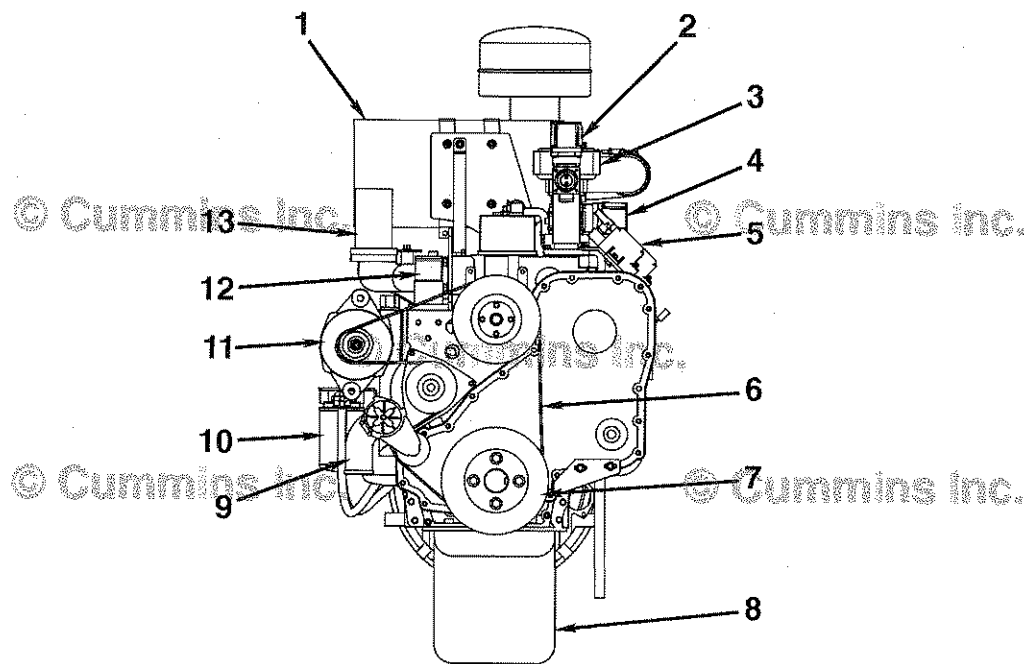


Engine Diagrams

Engine Views

The following illustrations show the locations of the major external engine components, filters, and other service and maintenance points. Some external components will be at different locations for different engine models.

NOTE: The illustrations are **only** a reference to show a typical engine.



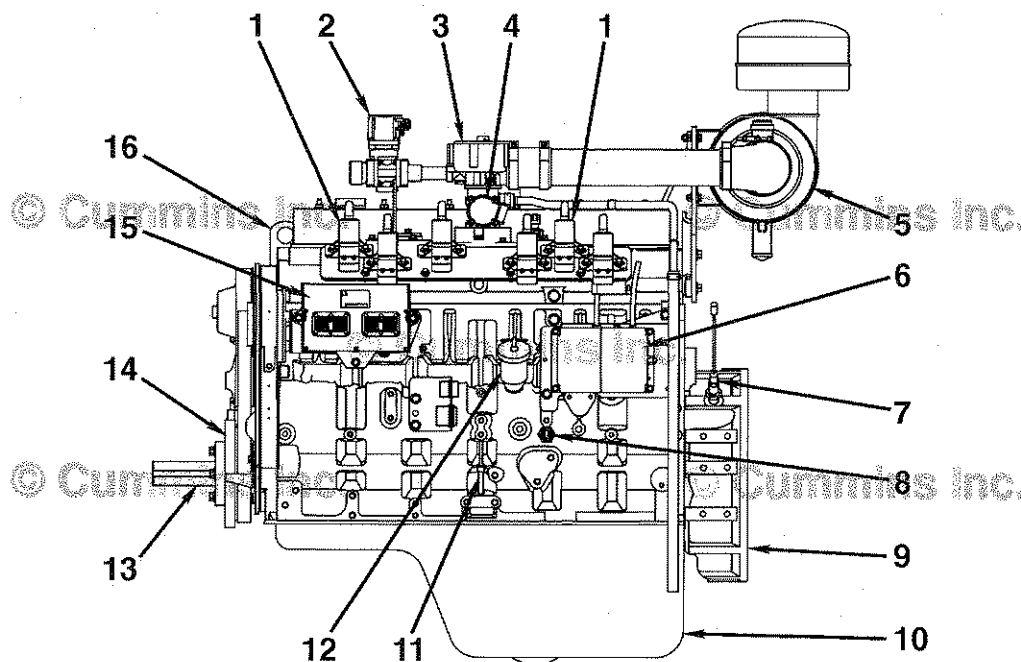
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Front View - G8.3 CM558

1. Air cleaner assembly
2. Fuel control valve
3. Air/Fuel mixer
4. Throttle actuator
5. Ignition coil(s) (6)
6. Fan drive belt
7. Vibration damper
8. Lubricating oil pan
9. Coolant inlet
10. Coolant filter
11. Alternator
12. Coolant outlet
13. Exhaust outlet.

Engine Diagrams

Engine Views



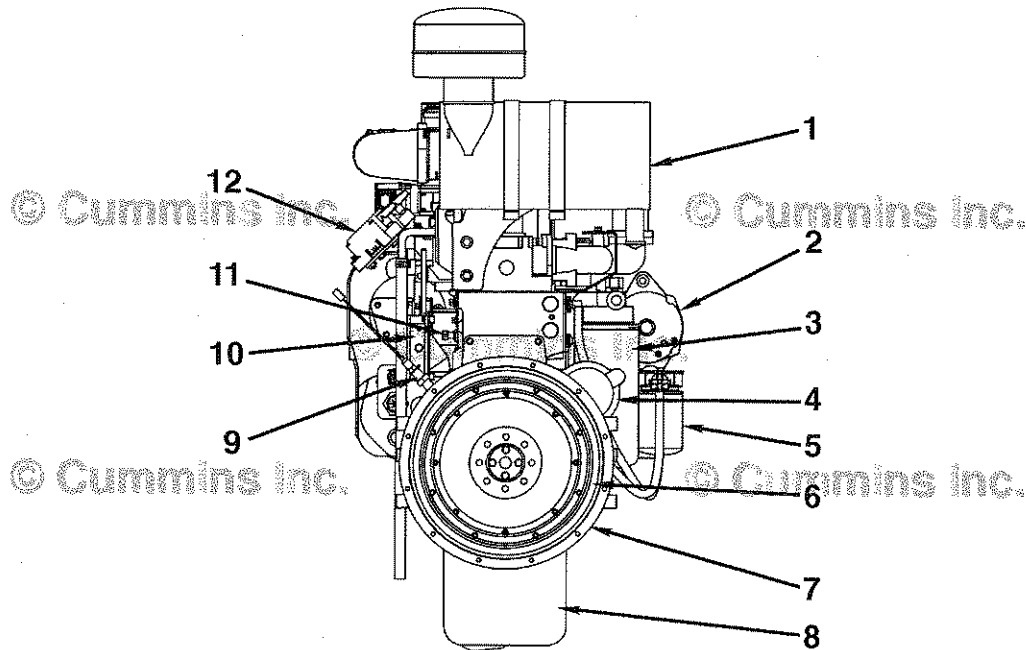
Left View - G8.3 CM558

00900560

1. Ignition coil(s) (6)
2. Fuel control valve
3. Air/Fuel mixer
4. Throttle actuator
5. Air cleaner assembly
6. Ignition control module
7. Engine speed magnetic pickup
8. Lubricating oil pressure sensor
9. Flywheel housing
10. Lubricating oil pan
11. Engine lubricating oil dipstick
12. Lubricating oil fill tube
13. Front engine power output shaft
14. Vibration damper
15. Electronic control module (ECM)
16. Front lifting bracket.

Engine Diagrams

Engine Views



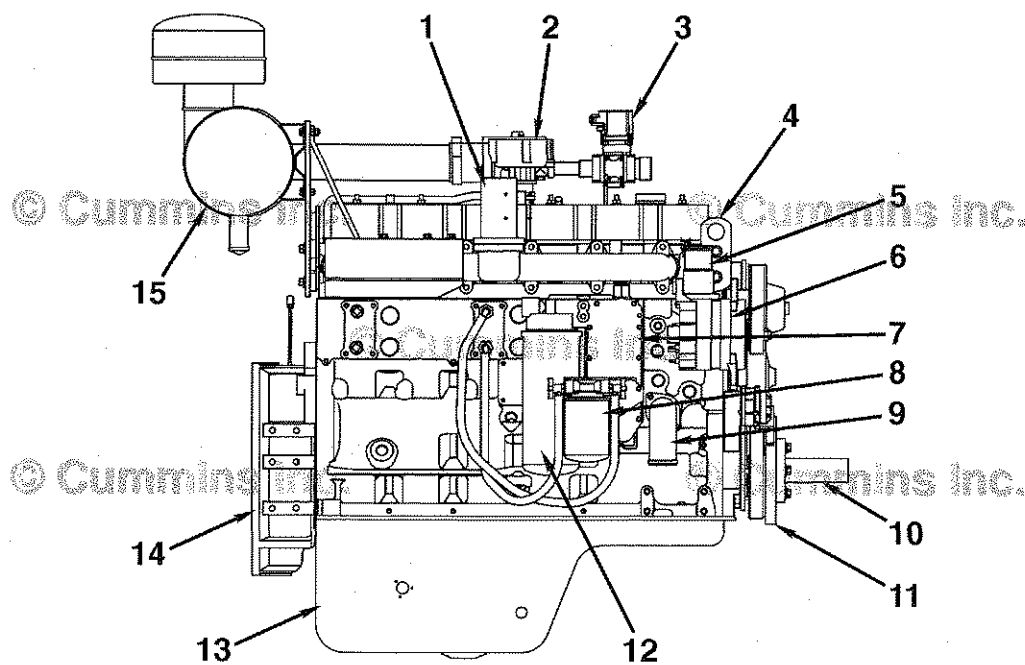
Rear View - G8.3 CM558

00900542

1. Air cleaner assembly
2. Alternator
3. Lubricating oil filter
4. Starter
5. Coolant filter
6. Flywheel
7. Flywheel housing
8. Lubricating oil pan
9. Engine speed magnetic pickup
10. Ignition control module
11. Lubricating oil pressure sensor
12. Ignition coil(s) (6).

Engine Diagrams

Engine Views



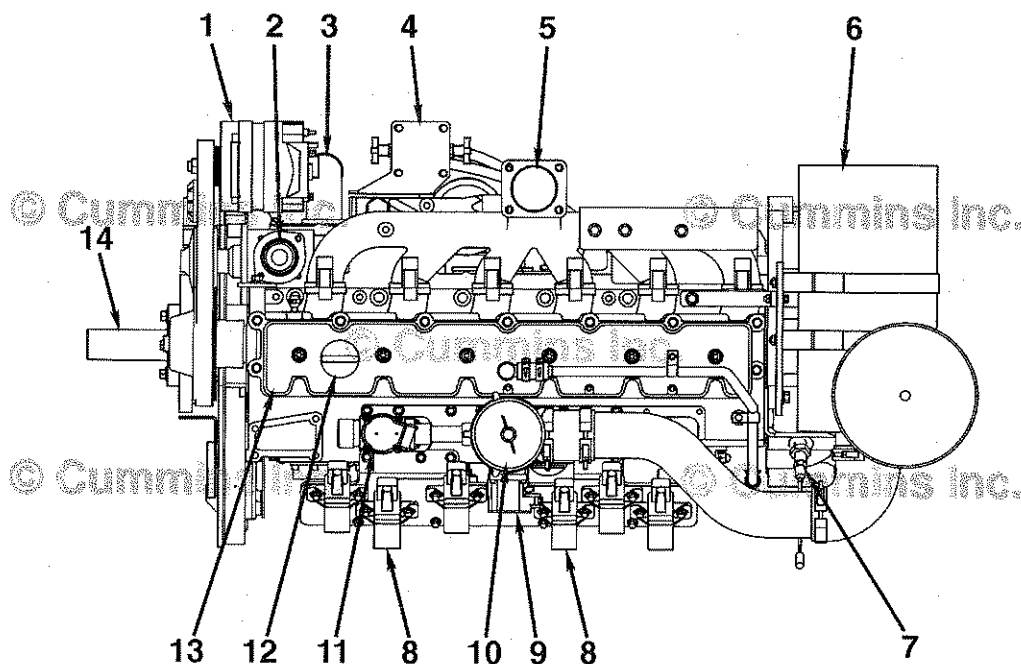
Right View - CM558

1. Exhaust outlet
2. Air/Fuel mixer
3. Fuel control valve
4. Engine lifting bracket
5. Coolant outlet
6. Alternator
7. Lubricating oil cooler
8. Coolant filter
9. Coolant inlet
10. Front power output shaft
11. Vibration damper
12. Lubricating oil filter
13. Lubricating oil pan
14. Flywheel housing
15. Air cleaner assembly.

00900543

Engine Diagrams

Engine Views



Top View - G8.3 CM558

00900544

1. Alternator
2. Coolant outlet
3. Coolant inlet
4. Coolant filter
5. Exhaust outlet
6. Air cleaner assembly
7. Engine speed magnetic pickup
8. Ignition coil(s) (6)
9. Throttle actuator
10. Air/Fuel mixer
11. Fuel control valve
12. Lubricating oil fill
13. Rocker lever cover
14. Front power output shaft.

Section 1 — Operating Instructions

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Operating Instructions - Overview

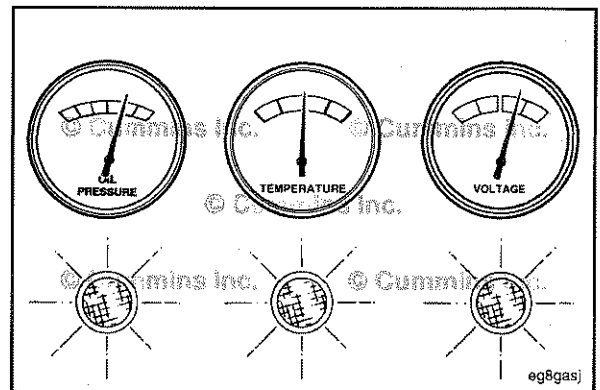
General Information

Correct care of your engine will result in longer life, better performance, and more economical operation.

Follow the daily maintenance checks listed in Maintenance Guidelines (Section 2).

The new Cummins® engine associated with this manual does not require a "break-in" procedure. This section of the manual provides all of the necessary information required for proper engine operation.

Check the oil pressure indicators, temperature indicators, warning lights, and other gauges daily to make sure they are operational.



⚠CAUTION⚠

Do not expose the engine to corrosive chemicals. Corrosive chemicals can damage the engine.

Normal Starting Procedure

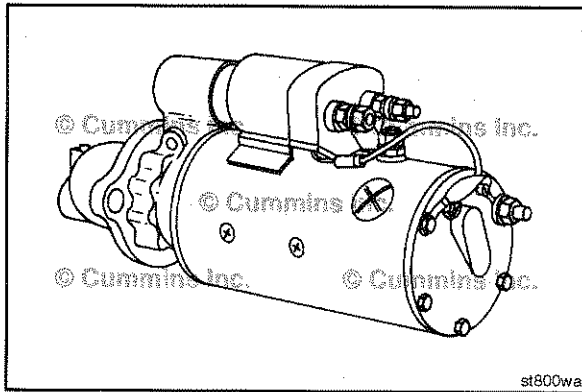
Starting

NOTE: This startup procedure assumes that a Murphy® Switchgag™ Instrument Panel or similar is installed and operational. Changes in this procedure can possibly be required to accommodate variations in instrument panel controls.

NOTE: Perform the Daily Maintenance checks before initiating the engine start process.

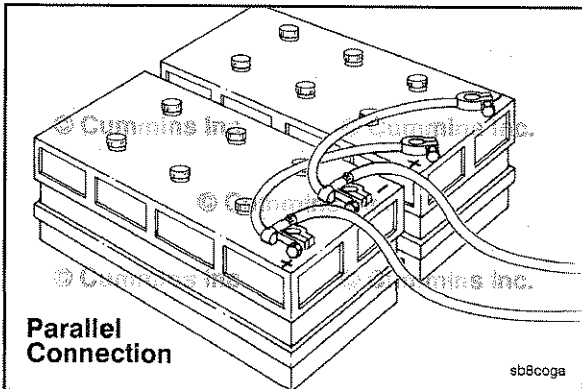
Engine Maintenance Schedule (1, 2)				
Daily or Refueling	Every 16,000 km (10,000 mi), 250 hours or 6 months (3)	Every 32,000 km (20,000 mi), 500 hours or 1 year (3)	Every 48,000 km (30,000 mi), 750 hours or 1.5 years (3)	Every 64,000 km (40,000 mi), 1,000 hours or 2 years (3)
- Check operator's report - Check and bring to correct level: - Engine Oil - Coolant - Visually inspect for: - loose or missing bolts, nuts or other fasteners - oil leaks - water leaks - damaged or loose wiring - Check fuel filter - Check engine coolant (ECW) concentration level. Add if necessary. - Check air intake system for leaks, damage, and loose connections. - Check air cleaner restriction. - Check engine oil level.	- Adjust valves and injectors. - Check torque on sub-charger mounting nuts. - Check torque on engine mounting bolts. - Reduce noise as required. - Check skidsteers and hydraulic tank of eq/ports.	- Adjust valves and injectors. - Check torque on sub-charger mounting nuts. - Check torque on engine mounting bolts. - Reduce noise as required. - Check skidsteers and hydraulic tank of eq/ports.	- Adjust valves and injectors. - Check torque on sub-charger mounting nuts. - Check torque on engine mounting bolts. - Reduce noise as required. - Check skidsteers and hydraulic tank of eq/ports.	- Adjust valves and injectors. - Check torque on sub-charger mounting nuts. - Check torque on engine mounting bolts. - Reduce noise as required. - Check skidsteers and hydraulic tank of eq/ports.

NOTES: Refer to the applicable sections for corrective procedures and maintenance procedures.
(1) The lubricating oil and lubricating oil filter interval can be adjusted based on the fuel and oil consumption rates of the engine. See Section 2 for the Oil Filter.
(2) Follow the manufacturer's recommended maintenance procedures for the starter, alternator, generator, batteries, electrical components, engine brake, exhaust brake, air compressor, front compressor, and fan clutch. Refer to Section C for addresses and telephone numbers.
(3) At each scheduled maintenance interval, perform all previous checks in addition to the ones specified.



⚠CAUTION⚠

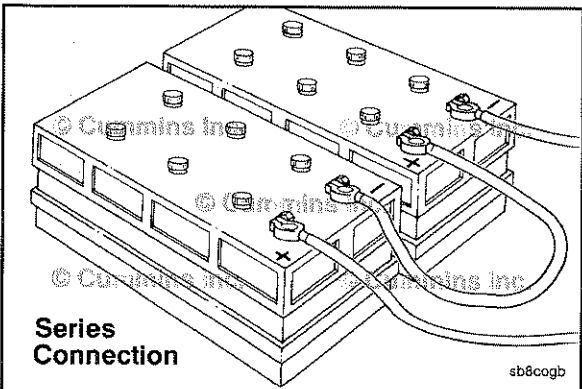
To prevent damage to the electric starting motor, do not engage the starting motor for more than 30 seconds. Wait a minimum of 2 minutes between each attempt to start (only electrical starting motors).



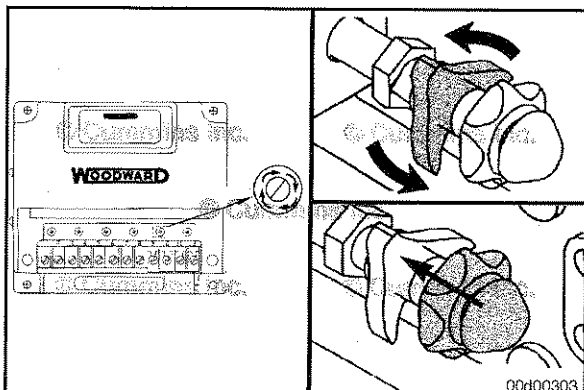
⚠CAUTION⚠

When using jumper cables to start the engine, make sure to connect the cables in parallel: positive (+) to positive (+) and negative (-) to negative (-). When using an external electrical source to start the engine, turn the disconnect switch to the OFF position. Remove the key before attaching the jumper cable.

The accompanying illustration shows a typical parallel battery connection. This arrangement doubles the cranking amperage.



This illustration shows a typical series battery connection. This arrangement, positive (+) to negative (-), doubles the voltage.

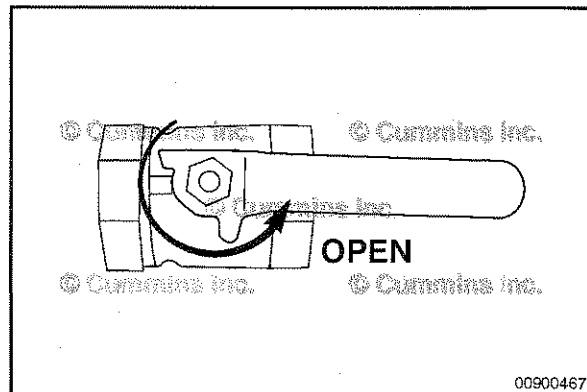


Set the engine for idle speed.

Be sure the engine is **not** under load.

Open the gas supply shut-off valve.

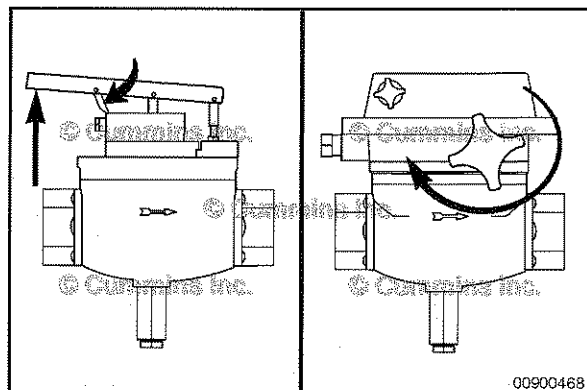
NOTE: If the engine fails to start for any reason, the engine **must** be purged of excess fuel. To purge the engine, close the shut-off valve and crank the engine for 15 seconds. Once the engine is purged, startup can be attempted again.



If equipped with a fuel shut-off valve with a manual reset, return the manual reset to the OPEN position before cranking the engine.

The lever will lock in the OPEN position.

After the engine starts and oil pressure begins to rise, the shut-off valve will return to its normal operating position.

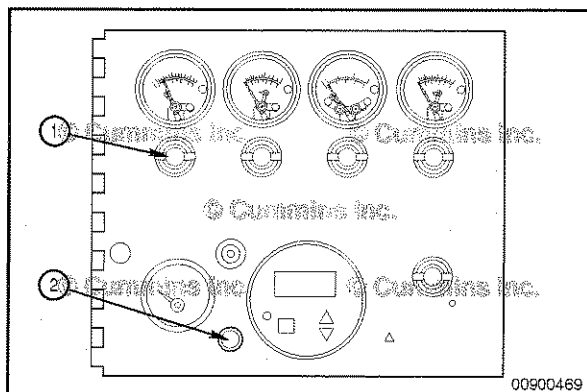


⚠CAUTION⚠

If the engine fails to start for any reason, the engine **must** be purged of excess fuel. To purge the engine, close the shut-off valve and crank the engine for 15 seconds. Once the engine is purged, startup can be attempted again.

Push in any Tattletale™ buttons that may be out except for the Oil Pressure Tattletale™.

Press and hold in the Oil Pressure Tattletale™ button (1) and push the Start button (2).

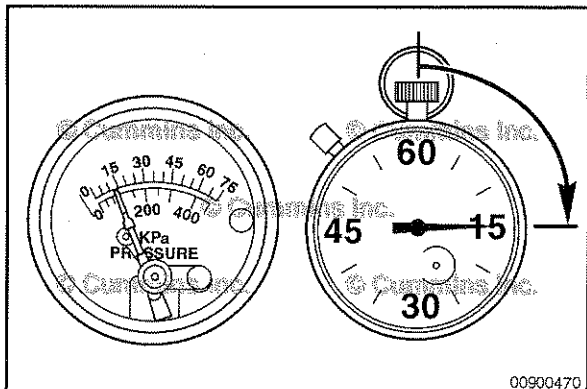


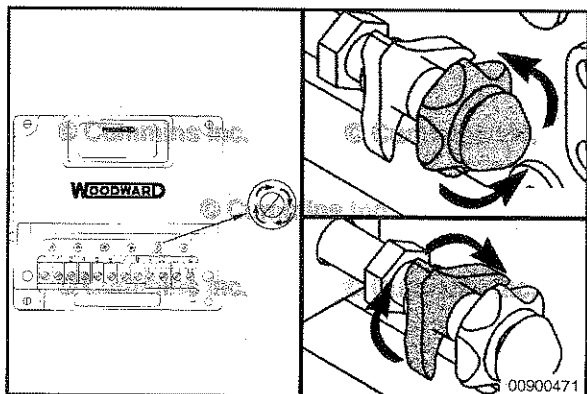
Release the Start button when the engine starts.

Release the Oil Pressure Tattletale™ when the oil pressure gauge shows an increase in oil pressure.

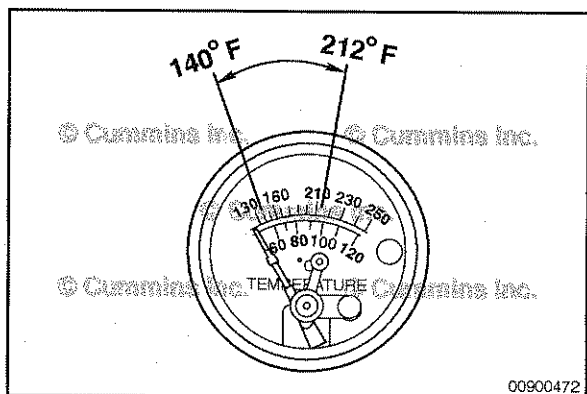
Oil pressure **must** be indicated within 15 seconds after starting.

If oil pressure has **not** registered within 15 seconds, shut off the engine immediately to avoid engine damage. Refer to Section TS of the GTA8.3 CM558 Operation and Maintenance Manual, Bulletin 4021640, to troubleshoot low oil pressure.

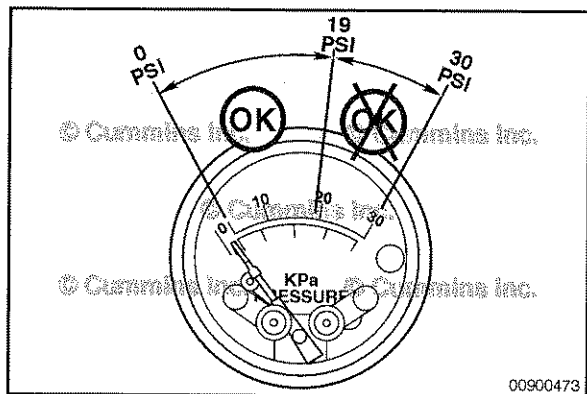




Adjust the engine speed to rated speed.



If the application permits, operate the engine at reduced load for the next 10 to 15 minutes or until the water temperature reaches 71 to 73.9°C [160 to 165°F], before applying full load.



Adjust the engine load to rated load. As the load is increased, the manifold boost pressure will rise.

Cold Weather Starting Using Starting Aids

⚠CAUTION⚠

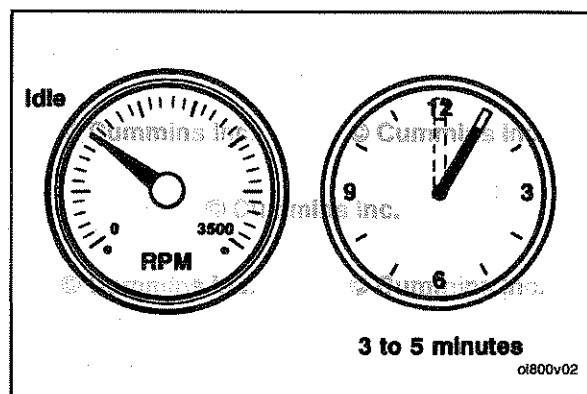
In extreme temperatures, below -12°C [10°F], the only starting aids recommended for use are the coolant pre-heating system, and the oil pre-lube system. These systems are designed to keep the coolant and oil temperatures close to normal operating temperatures while the engine is not in operation.

⚠CAUTION⚠

Do not operate the engine unloaded for long periods. Periods of running unloaded for longer than 30 minutes can damage the engine. Increased oil consumption will result.

Follow the Normal Starting Procedures in this section.

Operate the engine 3 to 5 minutes at rated rpm before operating with a load.



Starting Procedure After Extended Shutdown or Oil Change

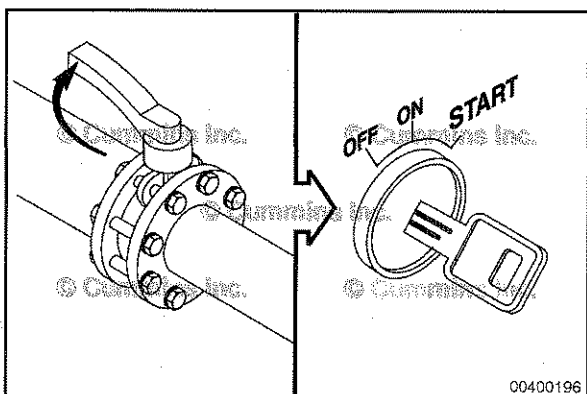
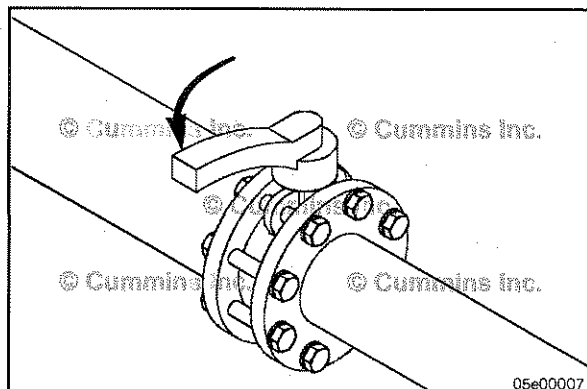
General Information

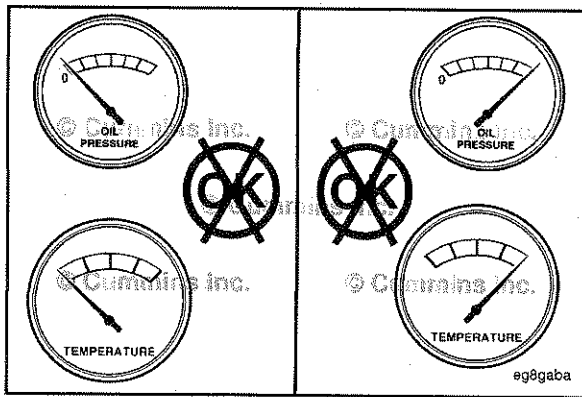
Complete the following steps after each oil change, or after the engine has been shut off for more than five days, to be sure that the engine receives oil flow through the lubrication system.

Verify that all sensors are functioning properly prior to engine start. Reset control and clear any inactive faults (using a service tool).

If no pre-lubricating oil pump is fitted, complete the following steps.

- Check that the manual gas supply shutoff valve is closed so that no fuel can reach the engine.
- Rotate the crankshaft using the starter motor until oil pressure appears on the gauge or the warning light goes out.
- Open the manual gas supply valve to allow fuel to flow.
- Start the engine. Follow the Normal Starting Procedures in this section.



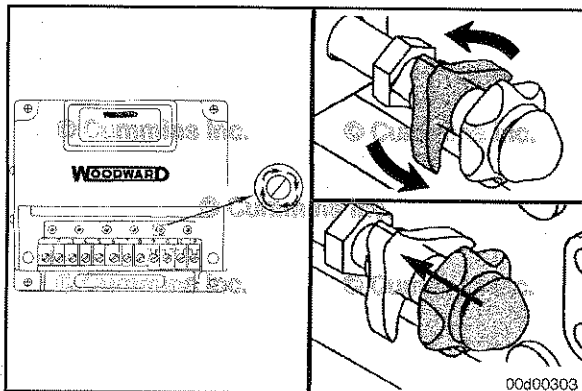


Operating the Engine

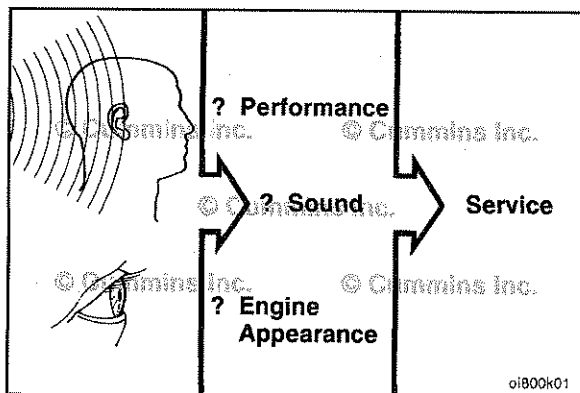
Normal

If equipped, monitor the oil pressure and coolant temperature gauges frequently. Refer to Lubricating Oil System specifications and Cooling System specifications, in Maintenance Specifications (Section V) for recommended operating pressures and temperatures. Shut off the engine if any pressure or temperature does **not** meet the specifications.

Continuous operation with engine coolant temperature above or below the engine coolant temperature specifications listed in Maintenance Specifications (Section V) can damage the engine.



If an overheating condition starts to occur, reduce the power output of the engine by reducing the throttle setting until the temperature returns to normal operating range. If the engine temperature does **not** return to normal, further reduce the engine speed and contact a Cummins Authorized Repair Location.



Most failures give an early warning. Look and listen for changes in performance, sound, or engine appearance that can indicate service or engine repair is needed. Some changes to look for are:

- Engine misfires
- Vibration
- Unusual engine noises
- Sudden changes in engine operating temperatures or pressures
- Excessive smoke
- Loss of power
- An increase in oil consumption
- An increase in fuel consumption
- Fuel, oil, or coolant leaks.

⚠CAUTION⚠

Do not idle for extended periods of time. Excessive idle time can cause poor engine performance.

Internal combustion engines **must not** operate at low idle speed for extended periods of time. This operating condition may lead to poor engine performance. The idle shutdown feature, available on most Cummins® engines, can be programmed to shut the engine down after a period of low idle speed operation with no driver activity. A flashing warning lamp will inform the driver of an impending shutdown. If an engine **must** idle for an extended period of time, it should be done at fast idle (1000 rpm or greater). The Power Take-Off (PTO) feature, available on most Cummins® engines, can be programmed to adjust engine speed with the use of OEM switches to pre-programmed set points.

Cold Weather

It is possible to operate engines in extremely cold environments if they are properly prepared and maintained. Satisfactory performance of an engine in low ambient temperature conditions requires modification of the engine, surrounding equipment, operating practices and maintenance procedures.

The correct engine coolant lubricating oil and fuels **must** be used for the cold weather range in which the engine is being operated. Below are the recommendations for these critical engine fluids:

Ambient Temperature

0 to -32°C [32 to -25°F]

Use 50-percent ethylene glycol antifreeze and 50-percent water for the engine coolant mixture.

Refer to Maintenance Specifications (Section V) Lubricating Oil recommendations for the correct specifications.

-32 to -54°C [-25 to -65°F]

Use 60-percent ethylene glycol antifreeze and 40-percent water for the engine coolant mixture.

Refer to Maintenance Specifications (Section V) Lubricating Oil recommendations for the correct specifications.

The following cold weather operating aids are required for cold weather situations:

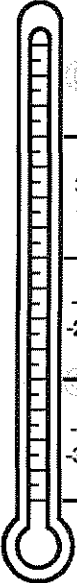
Cold Weather Operating Aids

Temperature	Starting Aid	Coolant Heater	Oil Heater	Under-hood Air	Fuel Heater	Battery Heater	Radiator Shutters	Engine Enclosure	Winter Front	Thermostatic Fan
50 to 32° F 10 to 0° C										
32 to -10° F 0 to -23° C	↑	↑	↑	↑	↑	↑	↑			↑
-10 to -25° F -23 to -32° C	Required	Required	Required	Required	Required	Required	Required	Required	Required	Required
-25 to -65° F -32 to -54° C	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓

* Required dependent upon viscosity/pour point.

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Cold Weather Operating Aids

Temperature	Coolant Heater	Oil Heater	Under-hood Air	Battery Heater	Radiator Shutters	Engine Enclosure	Thermatic Fan
 50 to 32°F 10 to 0° C							
32 to -10°F 0 to -23° C	-12°C [11°F] ↑	-12°C [11°F] ↑	-9°C [15°F] ↑	-9°C [15°F] ↑	-0°C [32°F] ↑	-19°C [-2°F] ↑	-19°C [-2°F] ↑
-10 to -25°F -23 to -32° C	Required	Required*	Required	Required	Required	Required	Required
-25 to -65°F -32 to -54° C	↓	↓	↓	↓	↓	↓	↓

* Required dependent upon viscosity/pour point.

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Winterfronts and Shutters

Winterfronts and shutters can be used on a vehicle or equipment to reduce air flow through the radiator core into the engine compartment. This can reduce the time required to warm the engine and help maintain the engine coolant temperature. The engine coolant temperature specifications are in the Maintenance Specification (Section V).

Engine Operating Range

General Information



Do not operate the engine at full throttle operation below peak torque rpm (refer to engine dataplate for peak torque rpm) for more than 30 seconds. Operating the engine at full throttle below peak torque will shorten engine life to overhaul, can cause serious engine damage, and is considered engine abuse.

Cummins® engines are designed to operate successfully at full throttle under transient conditions down to peak torque engine speed. This is consistent with recommended operating practices.



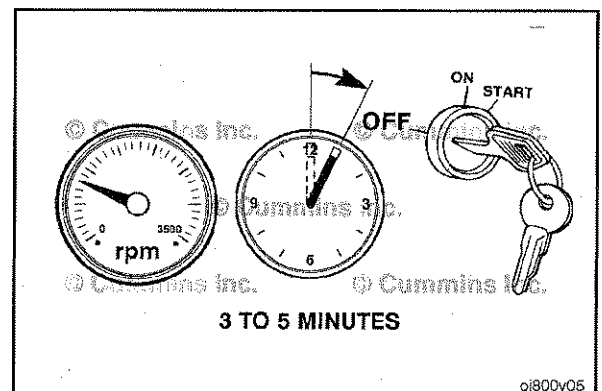
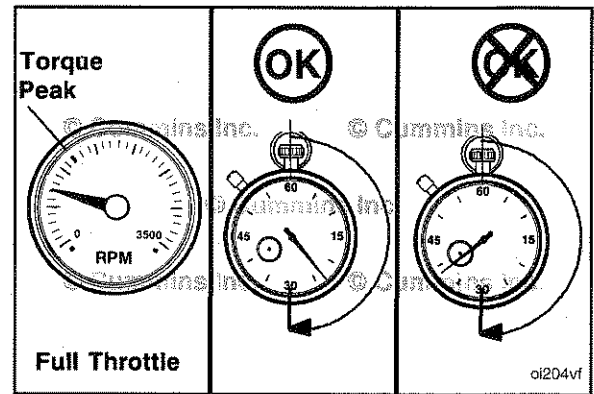
Do not operate the engine beyond the maximum engine speed. Operating the engine beyond the maximum engine speed can cause severe engine damage. Use proper operating techniques for the vehicle, vessel, or equipment to prevent engine overspeed. The maximum engine speed specification is listed in Maintenance Specifications (Section V).

Engine Shutdown

General Information

Allow the engine to idle 3 to 5 minutes before shutting it off after a full-load operation. This allows adequate cool down of pistons, cylinders, bearings, and turbocharger components.

Turn the keyswitch or Run/Off/Auto switch to the OFF position. If the engine does **not** shut down, refer to Troubleshooting Symptom (Section TS) in appropriate Operation and Maintenance manual.



Electronic Controlled Fuel System

Fuel System Description

Fuel Flow

This section provides an overview of how fuel and air flow through the engine.

For a detailed description of the individual components, reference the ECM Inputs and ECM Outputs sections under Electronic Engine Controls.

The engine receives gaseous fuel that is regulated to a certain pressure by the primary regulator. The primary regulator is an OEM-installed component.

The fuel passes through a fuel shutoff valve. The fuel shutoff valve is a mechanical valve that is powered by a solenoid that is either on or off, and is an OEM-installed component. The solenoid is controlled by a relay on the OEM control panel.

The fuel then enters the engine mounted secondary fuel pressure regulator, which lowers the fuel pressure to a value specific to the engine.

The fuel then proceeds through the fuel control valve, which is an electronically actuated butterfly valve controlled by the ECM. It is the fuel control valve which maintains the proper air/fuel ratio by constantly regulating the fuel flow into the carburetor.

G5.9, G8.3, G855 CM558

The carburetor meters fuel into the airstream. After the air and fuel are combined, the mixture then flows down a single tube and passes through the governor/throttle. The fuel/air mixture then enters the intake manifold and then into the cylinders for combustion. Afterwards, it then enters the exhaust manifold and then the exhaust tubing.

There is an intake manifold pressure/temperature sensor located in the intake manifold. The information from this sensor is used to adjust the air-to fuel ratio to meet the desired engine performance.

GTA855 CM558

The carburetor meters fuel into the airstream. After the air and fuel are combined, the mixture is compressed by the turbocharger. The compressed mixture then flows down a single tube and passes through the engine governor/throttle. After passing through the throttle valve, the fuel/air mixture enters the water-to-air aftercooler, and then enters the intake manifold. From here, it enters the cylinders for combustion.

There is an intake manifold pressure/temperature sensor located in the intake manifold. The information from this sensor is used to adjust the air-to fuel ratio to meet the desired engine performance. As the exhaust exits the turbocharger turbine, it flows through the exhaust outlet elbow and into the exhaust tubing.

Aftertreatment

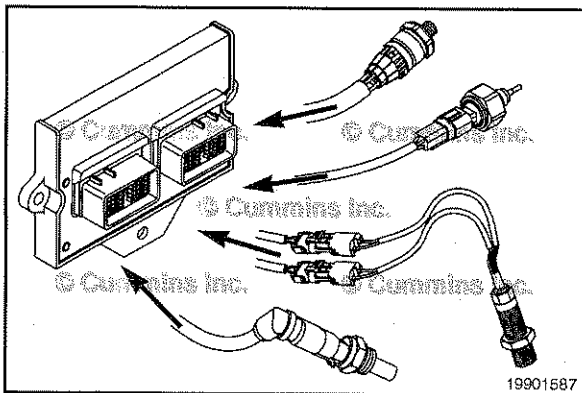
The exhaust gases now flow past two sensors, the aftertreatment inlet temperature sensor and the aftertreatment inlet oxygen concentration sensor. This temperature sensor is used to make sure that damage will not occur to the three-way catalyst. This oxygen sensor is used to measure the amount of the oxygen in the exhaust. The ECM can calculate the engine's actual air/fuel ratio based on the amount of oxygen left from combustion.

The gases then pass through the three-way catalyst which causes reactions to occur to reduce emissions. The aftertreatment outlet temperature sensor and the aftertreatment outlet oxygen concentration sensor are located after the three-way catalyst. The aftertreatment outlet oxygen concentration is used by the ECM to help optimize the fueling of the engine.

Electronic Engine Controls

Ignition System

The ignition system is controlled solely by the Programmable Cummins Ignition Module (PCIM) and is separate from the ECM. Refer to G8.3, G5.9, G855, and GTA855 CM558, Master Repair Manual Bulletin 4021701 , or equivalent.



ECM Inputs

The ECM receives signals from the following sources:

- Engine speed sensor
- Throttle position sensor (internal to throttle actuator)
- Intake manifold pressure/temperature sensor
- Speed Bias input (4-20 ampere, 0-5 V)
- Engine oil pressure/temperature sensor
- Coolant temperature sensor
- Fuel control valve position sensor (internal to valve actuator).
- Aftertreatment inlet and outlet temperature sensors
- Aftertreatment inlet and outlet oxygen concentration sensors
- Switch inputs- Keyswitch, Idle/rated, Run/stop, Diagnostic test, Diagnostic increment, decrement

These engines have one magnetic sensor on the flywheel which is used by the ECM. The ECM magnetic pickup measures engine speed by counting teeth on the engine flywheel. This allows the ECM to accurately measure engine speed.

The throttle position sensor is internal to the throttle actuator and measures the position of the throttle plate.

The intake manifold air pressure/temperature sensor is a combination sensor. The absolute air pressure side determines the pressure of the air/fuel mixture in the intake manifold by measuring the capacitance of two circular plates in the sensor. As the manifold pressure changes, the distance between the plates changes, causing a change in the capacitance of the plates. The sensor has a built-in printed circuit board that converts the capacitance measurement to a signal the ECM can use. The temperature side determines the temperature of the air/fuel mixture in the manifold. This is done by measuring the resistance of the sensor. The ECM receives this signal and measures the voltage drop across a known resistance in the ECM that is in series with the sensor.

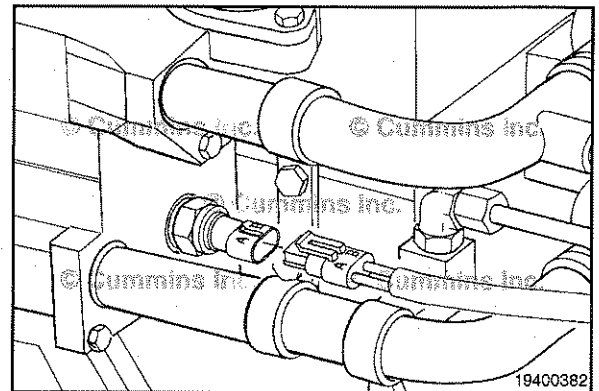
NOTE: This is an absolute pressure sensor.

The speed bias input is used by the ECM to control the governor from a signal sent by the OEM panel. This allows the OEM to dictate the speed of the engine. The lubricating oil temperature/pressure sensor determines the oil temperature and pressure in the engine's oil rifle. The temperature is found by measuring the resistance of the sensor along with a known resistance that is built into the engine wiring harness. The pressure is found in a similar method as to how the intake manifold air pressure sensor works.

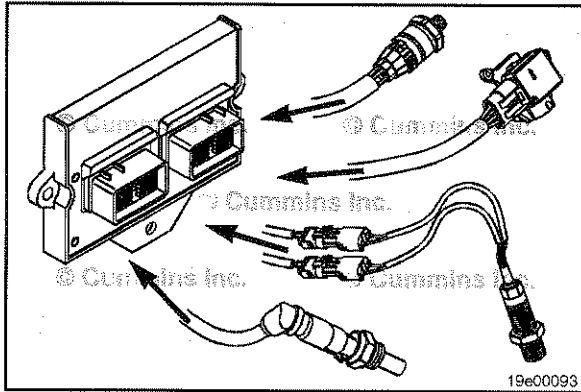
The fuel control valve position sensor is internal to the valve actuator and measures the position of the valve plate.

The aftertreatment inlet and outlet temperature sensors are used to measure the temperature of the exhaust gases before and after the three-way catalyst. These values are then used by the ECM to protect the catalyst. The aftertreatment inlet and outlet oxygen concentration sensors are used by the ECM to control fueling if the engine is running too rich or too lean.

The location and use of the switch inputs may vary based on the OEM. The keyswitch is **not** on/off switch for power. In this application, it's used as an ECM reset switch. If the battery is **not** an on/off switch for power. In this application, it's used as an ECM reset switch. If the battery power must be disconnected for maintenance the keyswitch must be turned off before doing this. The ECM will then recognize this shutdown as a commanded shutdown.



The idle/rated switch is used when one lower rpm is set for idle and then another higher rpm is set for rated. When this switch is toggled, the engine will change rpm to the other preset value. The run/stop switch is used as a means to start or stop the engine. Another switch, the diagnostic test switch will allow the operator to perform tests on the engine. The diagnostic increment and decrement switches allow the operator to view fault flashouts on the fault lamps. Pressing the increment switch up with the go on to the next fault in the system.



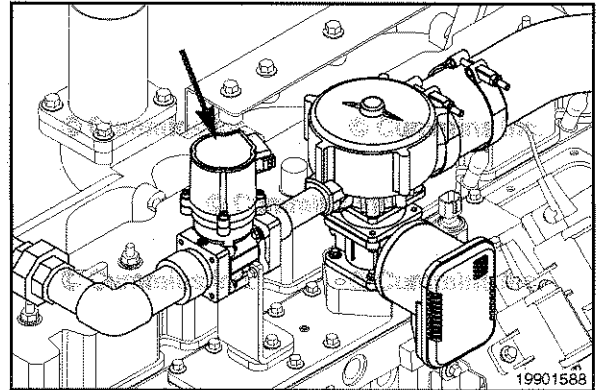
ECM Outputs

The ECM controls the following outputs:

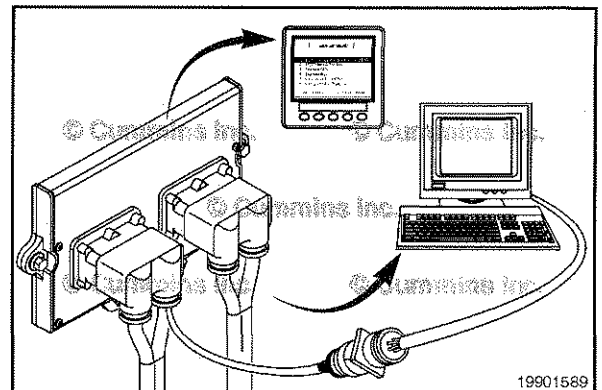
- Fuel shutoff valve relay
- Fuel control valve
- J1939 data link
- Electronic engine display.
- Throttle actuator
- Aftertreatment system power relays
- Battery conservation relay
- Engine shutdown indication (red lamp) relay
- Engine warning indication (yellow lamp) relay.

The fuel shutoff valve is commanded by the CM558. The ECM outputs a signal that powers one or more relays in the customer panel. The fuel shutoff valve is operated by a solenoid that gets a signal from one of these relays.

The fuel control valve is used to control the amount of fuel delivered to the carburetor. The ECM precisely determines the amount the valve should be open under operating conditions, using inputs from the heated oxygen sensor, engine speed sensor, and the intake manifold pressure sensor.



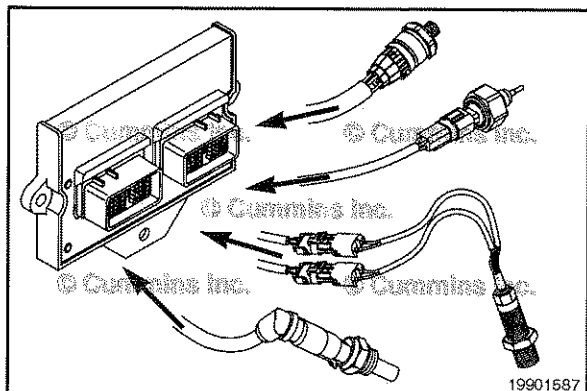
The data link ECM broadcasts information over the data link which can be used by both the INSITE™ electronic service tool and industry standard diagnostic tools. Start/Stop control SAE J1939 protocol is the only one used for these electronically controlled gas engine.



These electronically controlled gas engines use an electronic throttle actuator that is electronically controlled by the ECM.

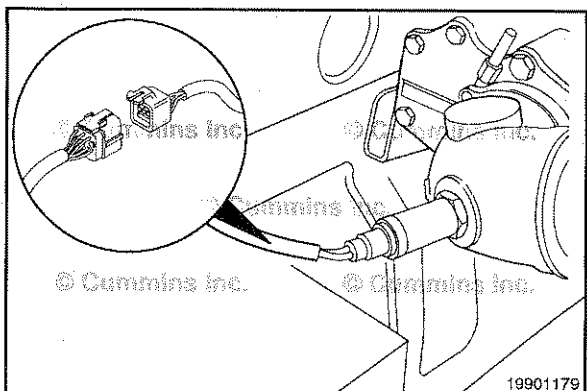
The throttle actuator controls the position of the throttle plate. The ECM sends a signal to the actuator, which in turn opens or closes the throttle plate.

These engines use an electronic engine display to allow the operator to see important engine information, engine faults, and to also provide the ability to change basic engine settings. For more information and troubleshooting steps, Refer to G8.3, G5.9, G855, and GTA855 CM558, Master Repair Manual Bulletin 4021701, or equivalent.



The ECM is responsible for the following functions:

- Air/fuel ratio control
- Start/stop control
- Engine speed governing
- Engine protection and diagnostics.



The optimal engine air/fuel ratio is determined by the engine control module (ECM) through engine sensor inputs. The ECM's fueling control strategy is composed of several parts:

Intake manifold air pressure and engine speed are used to find the desired lambda for operation at the present operating point. This is then compared with the measured lambda.

The ECM computes a fuel control valve position command and the engine runs at this value until a change is calculated.

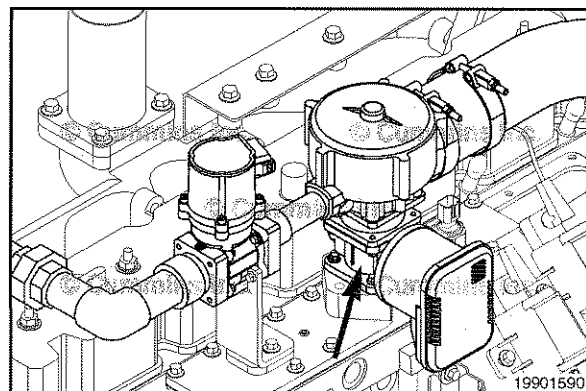
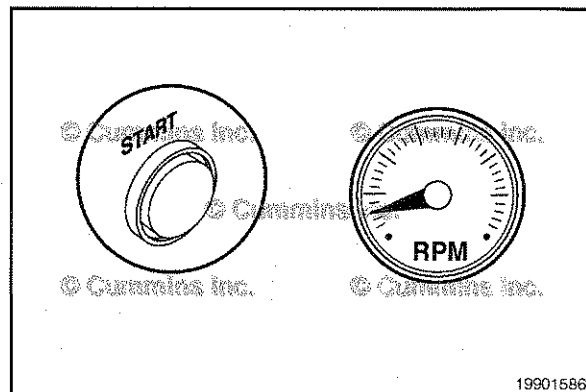
The closed loop fueling control adjusts the default fueling command after the heated oxygen sensor has warmed up to the proper operating temperature (90 seconds).

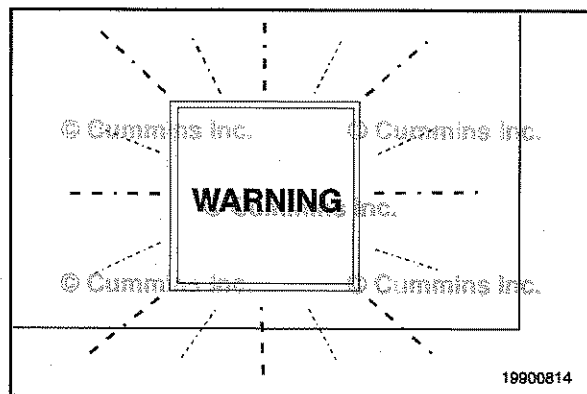
Heated oxygen sensor measures exhaust oxygen content and is used to inform the ECM if the engine is operating too lean or too rich, and will adjust the fueling accordingly. At start up the fuel control valve position is fixed; this can also happen at certain fault conditions.

The engine starting sequence is initiated by opening the manual gas valve and allowing gas to flow to the engine and allowing gas to flow to the engine and moving the Run/stop toggle to RUN. This may vary based on the OEM. The electric or air starter will then crank over the engine to at least the minimum starting rpm. The fuel shutoff valve relay will be delayed in opening the fuel shutoff valve for 2 seconds to allow for purging gas from the engine. After the fuel shutoff valve is opened to allow gas to flow, the engine will begin firing after 1-2 seconds. An automatic feature on these engine, the engine will hold idle rpm, until oil temperature reaches the operating range. If the engine is cold, the engine will idle at 1200 rpm.

NOTE: The keyswitch is the ECM reset switch in this case. If the batteries are to be disconnected for maintenance, the keyswitch should be switched on and off first.

The engine speed governing controls the position of the throttle plate. The ECM sends a signal to the actuator which in turn opens or closes the throttle plate.





These engines are equipped with an engine protection system which is integrated in the ECM. The system monitors critical engine temperatures and pressures and will log diagnostic faults when an over or under normal operating condition occurs. Depending on the type and severity of the fault, the ECM will either initiate a **WARNING**, which allows the engine to continue to operate at a derated setting and is displayed as an amber lamp for the operator, or a **SHUTDOWN**, which immediately shuts the engine down for protection reasons and is displayed as a red lamp.

The engine protection system monitors the following inputs:

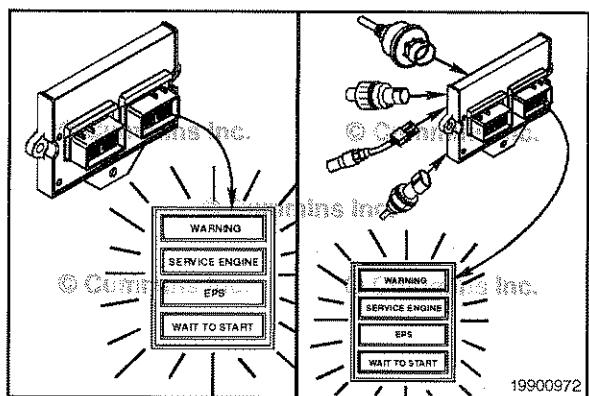
- Intake manifold pressure
- Intake manifold temperature
- Fuel control valve position
- Engine coolant temperature
- Engine overspeed
- Exhaust gas temperature
- Battery voltage
- Throttle actuator position
- Engine oil rifle temperature/pressure
- ECM internal temperature.

NOTE: The engine ignition system uses its own fault monitoring and protection diagnostics. For more information and troubleshooting steps, refer to G8.3, G5.9, G855, and GTA855 CM558, Master Repair Manual Bulletin 4021701.

Diagnostic Fault Codes

The CM558 engine control system can show and record operation anomalies that present themselves as fault codes. These codes will make troubleshooting easier. The fault codes are recorded in the electronic control module (ECM) and the electronic engine display. Fault Codes are also available via lamp flashouts. The fault codes can be read with the electronic engine display on the OEM control panel or with the INSITE™ electronic service tool.

NOTE: Not all engine control system anomalies are shown as fault codes.



There are two types of system codes:

- Engine electronic control system fault codes
- Engine protection system fault codes.

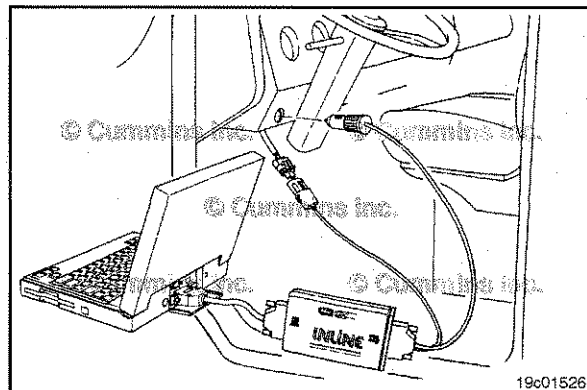
All fault codes recorded will be either active (fault code is currently active on the engine) or inactive (fault code was active at some time, but at the moment, is **not** active).

Most, but **not** all, of the electronic fault codes will light a lamp when they are active. There are two possible lamps that can be illuminated when a fault code is active:

- The WARNING lamp is amber and indicates the need to repair the fault at the first available opportunity. This lamp will also illuminate when an engine maintenance function needs to be performed.
- The STOP lamp is red and indicates that the engine is shut down for protection reasons. The engine **must** remain shut down until the fault can be repaired.

Fault Code Snapshot Data

Additional fault code information can be obtained by using the INSITE™ electronic service tool. The snapshot data records the value or state of the control system sensors and switches at the time a fault code occurred. Either set of data is stored for the first occurrence of the fault, since it was last cleared, and for the most recent occurrence. This data can be very valuable when trying to recreate or determine engine operating conditions at the time of the fault.



INSITE™ Description

INSITE™ electronic service tool is the **only** Cummins Inc. supplied electronic service tool for the GTA8.3 CM558. Standard J1939 scan tools can be used to read fault codes and monitor some parameters, but INSITE™ electronic service tool is required to adjust parameters and monitor all parameters, among other things. For more information, reference the INSITE™ Electronic Service Tool User Manual, Bulletin 3666203.

On-line Help and the INSITE™ Electronic Service Tool User Manual - This part of INSITE™ electronic service tool contains information on how to use the INSITE™ electronic service tool application. All of the information in the user's manual can be found in the on-line help system. This system provides context specific help through the help button in the INSITE™ electronic service tool application dialog boxes.

INSITE™ electronic service tool Security - To communicate with an engine, INSITE™ electronic service tool **must** have security installed. This can be installed when INSITE™ electronic service tool is installed or later. For more information on security, reference the INSITE™ electronic service tool System Administrator's Manual, Bulletin 3885787.

INSITE™ electronic service tool Parameter Explanations:

These parameter descriptions are for GTA8.3 CM558 engines **only**.

Battery Voltage - Actual voltage supplied to the ECM.

Closed Loop Operation - After the first 90 seconds of operation (after the engine is started), the system **must** go to and remain in closed loop mode.

Coolant Temperature - The temperature of the engine coolant.

Engine Fuel Shutoff Command - Open/Closed. This is the commanded position of the fuel shutoff (**not** necessarily the actual mechanical position). When the engine is started the valve will remain closed for 2 seconds to purge and then it will open.

Engine Oil Pressure - Pressure measured in the oil rifle.

Engine Speed - This is the speed of the engine as sensed by the ECM. The ECM uses the speed read from the flywheel by the engine speed sensor (Magnetic pickup).

Fuel Control Valve - Percent open (**not** percent duty cycle) commanded to the fuel control valve. Zero percent open means the valve is closed for conditions such as overspeed shutoff.

Intake Manifold Air Temperature - This is the temperature of the air in the intake manifold.

Intake Manifold Pressure - This is the pressure read by the intake manifold pressure sensor in the intake manifold. Please note, the sensor measures the pressure in an absolute value. With no pressure applied to the sensor, it will read atmospheric pressure (101.4 kPa [14.7 psi] at sea level).

Throttle Position - Position of the throttle plate. Measured in percentage travel, 0 to 100.

Electromagnetic Interference (EMI)

General Information

Some engine applications utilize accessories (CB radios, mobile transmitters, etc.) that generate and use radio frequency energy that, if **not** installed and used properly, can cause electromagnetic interference (EMI) conditions to exist between the accessory and Cummins electronic controlled fuel system. Cummins is **not** liable for any performance problems with either the fuel system or the accessory due to EMI. EMI is **not** considered by Cummins to be an engine failure and therefore is **not** warrantable.

System EMI Susceptibility

Your Cummins product has been designed and tested for minimum sensitivity to incoming electromagnetic energy. Testing has shown that there is no engine performance degradation at relatively high energy levels; however, if very high energy levels are encountered, then some noncritical diagnostic fault code logging can occur. The fuel system EMI susceptibility level will protect your engine from most, if **not** all, electromagnetic energy-emitting devices that meet the Federal Communications Commission legal requirements.

System EMI Radiation Levels

Your Cummins product has been designed to emit minimum electromagnetic energy. Electronic components are required to pass various Cummins and industry EMI specifications. Testing has shown that when the engine is properly installed, it will not interfere with onboard communication equipment or with the vehicle's, equipment's, or vessel's ability to meet any applicable EMI standards and regulated specifications.

If an interference condition is observed, follow the suggestions below to reduce the amount of interference:

1. Locate the receiving antenna as far away from the engine and as high as possible.
2. Locate the receiving antenna as far away as possible from all metal obstructions (e.g., exhaust stacks)
3. Consult a representative of the accessory supplier in your area to:
 - Calibrate accurately the device for proper frequency, power output, and sensitivity (both base and remote site devices **must** be properly calibrated)
 - Obtain antenna reflective energy data measurements to determine the optimum antenna location
 - Obtain optimum antenna type and mounting arrangement for your application
 - Make sure your accessory equipment model is built for maximum filtering to reject incoming electromagnetic noise.

Section 2 — Maintenance Guidelines

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Maintenance Record Form	2-4
Maintenance Data.....	2-4
Maintenance Schedule	2-3
General Information.....	2-3
Gas Compression.....	2-3
Tool Requirements	2-2
General Information.....	2-2

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Maintenance Guidelines - Overview

General Information

Cummins Inc. recommends that the engine be maintained according to the Maintenance Schedule in this section.

If the engine is operating in ambient temperatures below -18°C [0°F] or above 38°C [100°F], perform maintenance at shorter intervals. Shorter maintenance intervals are also required if the engine is operated in a dusty environment or if frequent stops are made. Contact your local Cummins Authorized Repair Location for recommended maintenance intervals.

Some of these maintenance procedures require special tools or must be completed by qualified personnel. Contact your local Cummins Authorized Repair Location for detailed information.

If your engine is equipped with a component or accessory not manufactured by Cummins Inc., refer to the component manufacturer's maintenance recommendations.

Use the chart provided in this section as a convenient way to record maintenance performed.

Tool Requirements

General Information

Most of the maintenance operations described in this manual can be performed with common hand tools (metric and S.A.E. wrenches, sockets, and screwdrivers).

The following is a list of special service tools required for some maintenance operations:

Tool Part Number	Description
3375049	Oil filter wrench
3376592	Torque wrench (valve adjustment)
ST-1138	Belt tension gauge
3163099	INLINE™ data link adapter kit
3163196	Torque wrench adapter (used with 3163099 torque wrench)
ST-1273	Pressure gauge 0 to 1900 mm Hg [0 to 75 in Hg]
3824510	Electronic contact cleaner
3164486	Ignition coil tester kit
3164499	Digital thermometer
3376589	Female Compuchek™ quick connect
3823983	Compression gauge/adapter kit
3165179	Combustible gas detector
3824876	Spark plug socket
3164491	Pressure vacuum module
3164498	Bead probe (used with digital thermometer, Part Number 3164499)
3823921	Cylinder head capscrew length gauge
3163292	Valve spring compressor

NOTE: Contact a Cummins® Authorized Repair Location for information on hardware requirements.

Maintenance Schedule

General Information

Gas Compression

All maintenance procedures listed for previous intervals **must** also be performed.

NOTE: When hours and month/year(s) are listed, please use whichever comes **FIRST**.

For convenience, listed below are the section numbers that contain specific instructions for performing the maintenance.

Maintenance Procedures at Daily IntervalSection 3

- Drive Belts - Check
- Crankcase Breather Tube - Check
- Lubricating Oil Level - Check
- Fan, Cooling - Check
- Coolant Level - Check
- Air Cleaner Restriction - Check

Maintenance Procedures at 250 Hours or 3 MonthsSection 4

- Overhead Set ¹ - Adjust
- Air/Fuel Mixer - Check
- Lubricating Oil and Filters - Change
- Air Cleaner Restriction - Check
- Exhaust Gas Analysis - Check

Maintenance Procedures at 750 Hours or 6 MonthsSection 5

- Supplemental Coolant Additives (SCA) and Antifreeze Concentration ² - Check
- Cooling Fan Belt Tensioner - Check
- Air Intake Piping - Check
- Spark Plugs (Non Shielded) - Check
- Heated Oxygen Sensor - Check

Maintenance Procedures at 1500 Hours or 1 YearSection 6

- Engine Steam Cleaning - Clean
- Overhead Set - Adjust
- Coolant Filter - Change
- Radiator Hoses - Check
- Air Cleaner Element, Paper Type - Change
- Batteries - Check
- Battery Cables and Connections - Check
- Spark Plug Wire (Non Shielded) - Check
- Ignition Timing - Adjust
- Engine Mounts - Check

Maintenance Procedures at 9000 Hours or 2 YearsSection 7

- Vibration Damper, Rubber - Check
- Cooling System - Flush
- Water Pump - Check
- Fan Hub, Belt Driven - Check

1. Adjust the valves at the first oil change period of 250 operating hours, and then at the interval of every 750 hours or 1 year, whichever comes first.
2. Check the coolant additive concentration every 6 months unless the concentration is over 3.0 units. Then, check at every oil change interval until the concentration is below 3.0 units.

Maintenance Data

Maintenance Record	
Engine Serial No.:	Engine Model:
Owner's Name:	Equipment Name/Number:

Key to table headings:

- A = Date
- B = km [Miles], Hours or Time Interval
- C = Actual km [Miles] or Hours
- D = Maintenance Check Performed
- E = Check Performed By
- F = Comments

[illegible]

Section 3 — Maintenance Procedure at Daily Interval

Section Contents

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Air Cleaner Restriction	3-6
Maintenance Check.....	3-6
Coolant Level	3-5
Maintenance Check.....	3-5
Crankcase Breather Tube	3-3
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Daily Maintenance Procedures - Overview	3-1
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Maintenance Check.....	3-2
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Lubricating Oil Level	3-3
Maintenance Check.....	3-3

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Daily Maintenance Procedures - Overview

General Information

Preventative maintenance begins with day-to-day awareness of the engine and its system. Before starting the engine, check the oil and coolant levels. Look for:

- Leaks
- Loose or damaged parts
- Worn or damaged belts
- Any change in engine appearance.
- Odor of fuel

Engine Operation Report

The engine **must** be maintained in top mechanical condition if the operator is to get optimum satisfaction from its use. The maintenance department needs daily running reports from the operator to make necessary adjustments in the time allocated. The daily running report also helps to make provisions for more extensive maintenance work as the reports indicate the necessity.

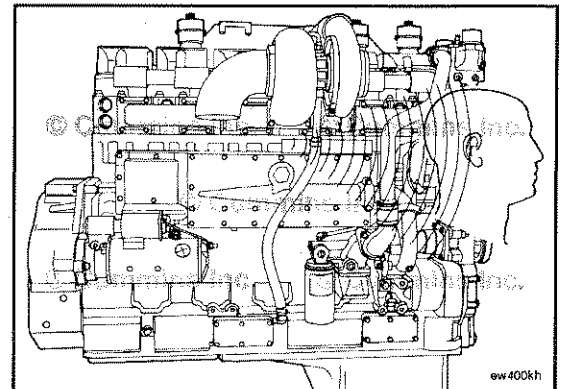
Comparison and intelligent interpretation of the daily report, along with a practical follow-up action, will eliminate most failures and emergency repairs.

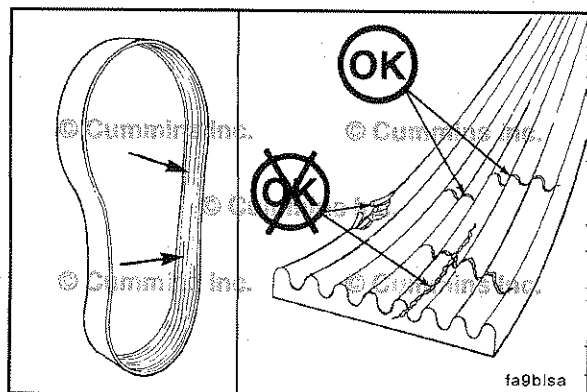
Report to the maintenance department any of the following conditions:

- Low lubricating oil pressure
- Low power
- Power increases or engine surge
- Erratic or no accelerator control or response
- Any warning lights flashing or staying on
- Abnormal water or oil temperature
- Unusual engine noise
- Excessive smoke
- Excessive use of coolant, fuel, or lubricating oil
- Any fuel, coolant, or lubricating oil leaks
- Loose or damaged parts
- Worn or damaged belts

Unusual Engine Noise

During daily maintenance checks, listen for any unusual engine noise that can indicate that service is required.





Drive Belts

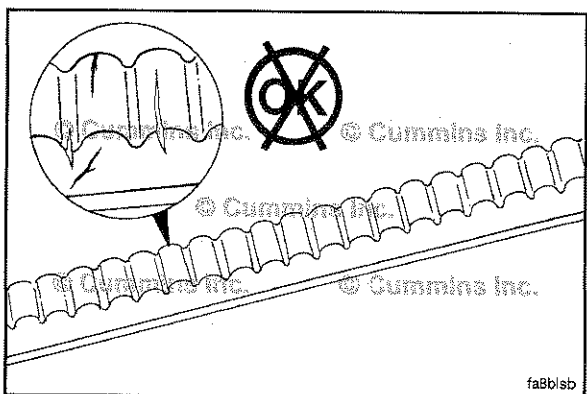
Maintenance Check

Poly-Vee Belt

Inspect the belts daily. Check the belt for intersecting cracks. Traverse (across the belt width) cracks are acceptable. Longitudinal (direction of belt length) cracks that intersect with transverse cracks are **not** acceptable. Replace the belt if it is frayed or has pieces of material missing. Refer to Section A for belt adjustment and replacement procedures.

Belt damage can be caused by:

- Incorrect tension
- Incorrect size or length
- Pulley misalignment
- Incorrect installation
- Severe operating environment
- Oil or grease on the side of belts.



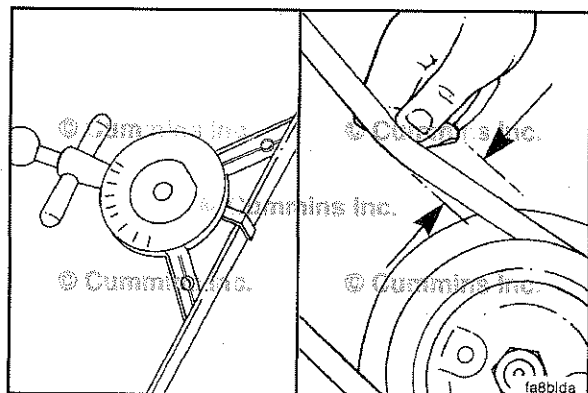
Cogged Belt

Inspect the belts daily. Replace the belts if they are cracked, frayed, or have chunks of material missing. Small cracks are acceptable.

Adjust the belts that have a glazed or shiny surface, which indicates belt slippage. Correctly installed and tensioned belts will show even pulley and belt wear. Refer to Section A for belt adjustment and replacement procedures.

Belt damage can be caused by:

- Incorrect tension
- Incorrect size or length
- Pulley misalignment
- Incorrect installation
- Severe operating environment
- Oil or grease on the belts



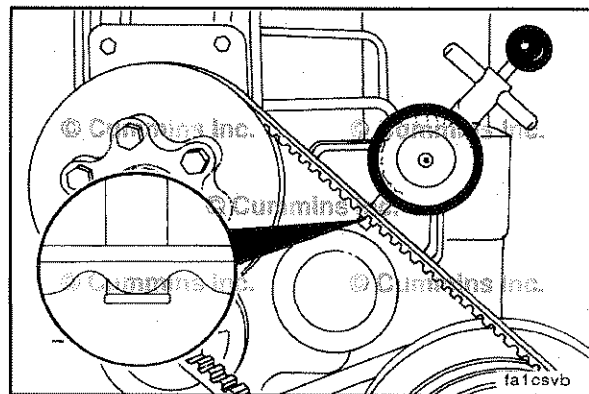
Measure the belt tension in the center span of the pulleys. Refer to the Belt Tension Chart in Section V for the correct gauge and tension value for the belt width used.



An alternate method (deflection method) can be used to check belt tension by applying 110 N [25 lbf] force between the pulleys on v-belts. If the deflection is more than one belt thickness per foot of pulley center distance, the belt tension **must** be adjusted.

Refer to Section A for adjustment procedures.

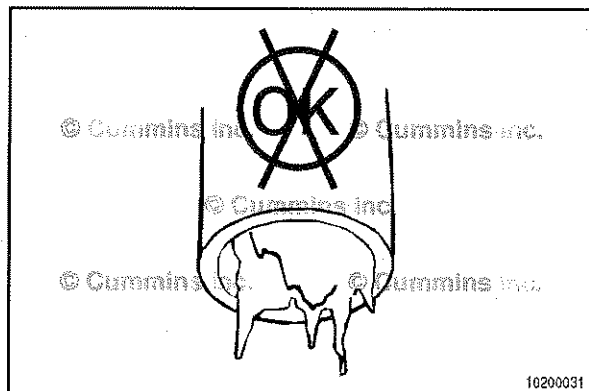
For cogged belts, **make sure** that the belt tension gauge is positioned so that the center tensioning leg is placed directly over the high point (hump) of a cog. Other positioning will result in incorrect measurement.



Crankcase Breather Tube Maintenance Check

Inspect the breather tube for sludge, debris, or ice in the tube.

Inspect the tube more frequently in icy conditions.



Lubricating Oil Level Maintenance Check



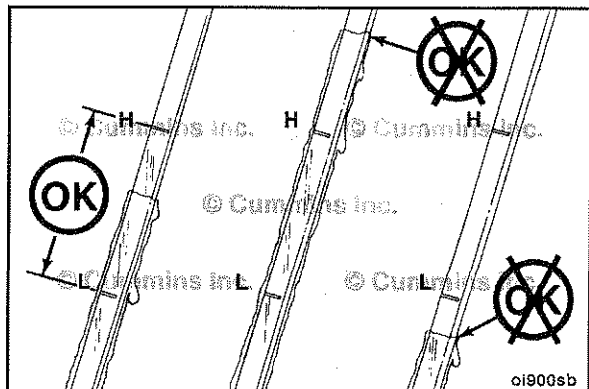
Never operate the engine with oil level below the L (low) mark or above the H (high) mark. Poor engine performance or engine damage can occur.

The engine **must** be level when checking the oil level to make sure the measurement is correct.

Shut off the engine for an accurate reading.

Wait at least 15 minutes after shutting off the engine to check the oil level. This allows time for the oil to drain into the oil pan.

For additional lubricating oil recommendations and oil pan capacity information, refer to Maintenance Specifications (Section V).

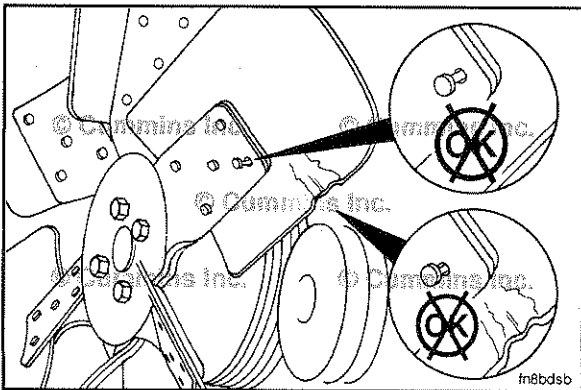
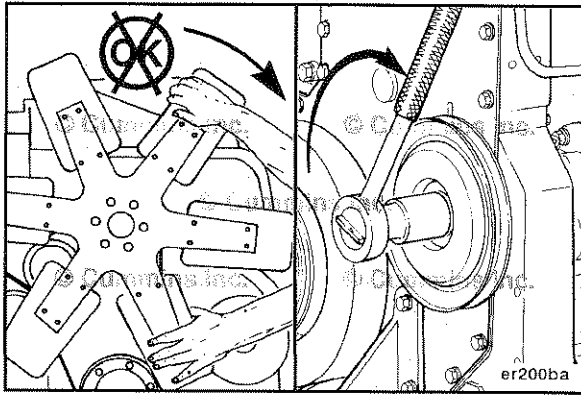


Fan, Cooling

Inspect for Reuse

⚠ WARNING ⚠

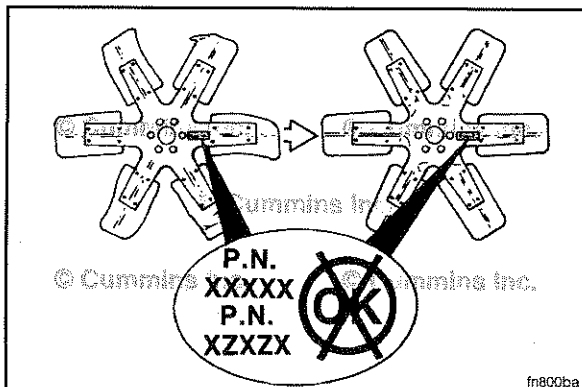
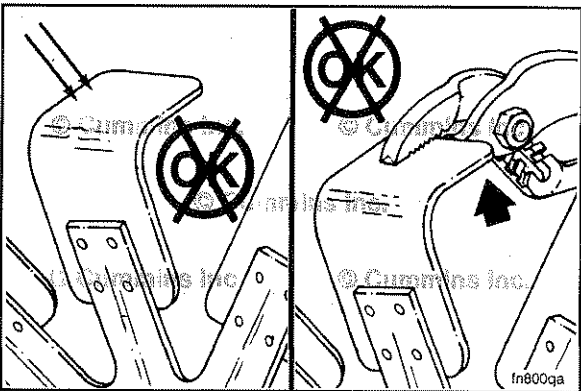
Do not rotate the engine by pulling or prying on the fan. The fan blade(s) can be damaged and cause the fan to fail and cause personal injury or property damage. Use the accessory drive shaft or the crankshaft barring tool to rotate the crankshaft.



A visual inspection of the cooling fan is required daily. Check for cracks, loose rivets, and bent or loose blades. Check the fan to make sure it is securely mounted. Tighten the capscrews, if necessary.

⚠ WARNING ⚠

Do not straighten a bent fan blade or continue to use a damaged fan. A bent or damaged fan blade can fail during operation and cause personal injury or property damage.



Replace original equipment fan that is damaged with a fan of the identical part number. Cummins Inc. **must** approve any other fan changes to be covered under warranty.

Refer to the vehicle or equipment manufacturer's specifications for capscrew torque.

Coolant Level Maintenance Check

⚠ WARNING ⚠

Do not remove a 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.

⚠ CAUTION ⚠

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

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

⚠ CAUTION ⚠

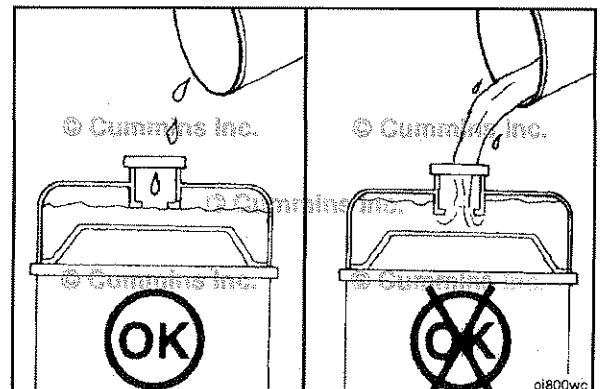
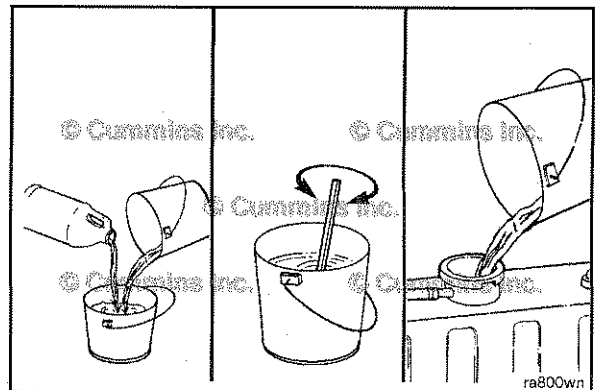
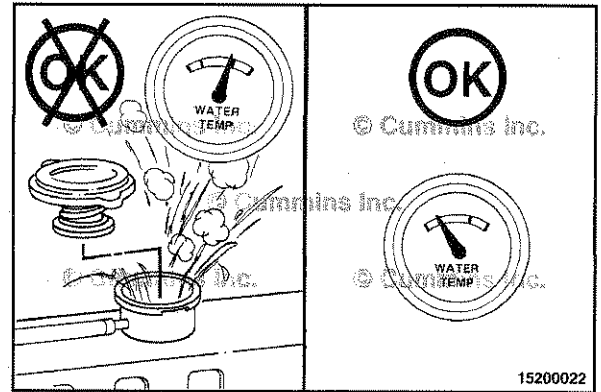
Do not add cold coolant to a hot engine. Engine castings can be damaged. Allow the engine to cool to below 50°C [120°F] before adding coolant.

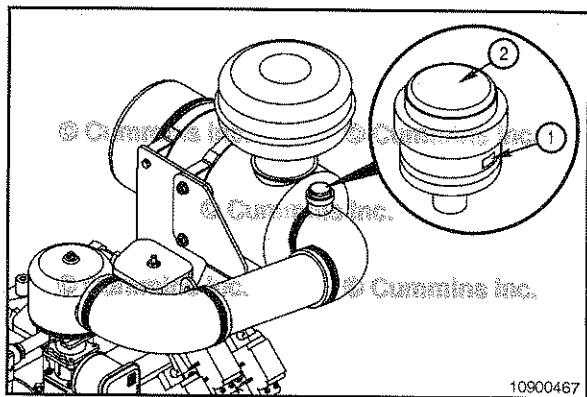
Make up coolant added to the engine **must** be mixed with the correct proportions of antifreeze, supplemental coolant additive, and water to avoid engine damage.

Coolant recommendations and specification details on correct mixing of coolant can be found in Maintenance Specifications (Section V).

Fill the cooling system with coolant to the bottom of the fill neck in the radiator fill or expansion tank.

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





Air Cleaner Restriction Maintenance Check

⚠CAUTION⚠

Never operate the engine without an air cleaner. Intake air must be filtered to prevent dirt and debris from entering the engine and causing premature wear.

A mechanical restriction indicator is available to indicate excessive air restriction through a dry-type air cleaner. This instrument can be mounted in the air cleaner outlet or on the instrument panel. The red flag (1) in the window gradually rises as the cartridge loads with dirt. After changing or replacing the cartridge, reset the indicator by pushing the reset button (2).

Restriction or vacuum indicators need to be installed as close as possible to the turbocharger air inlet in order to obtain a true indication of restriction.

Section 4 — Maintenance Procedures at 250 Hours or 3 Months

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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.

Overhead Set Preparatory Steps



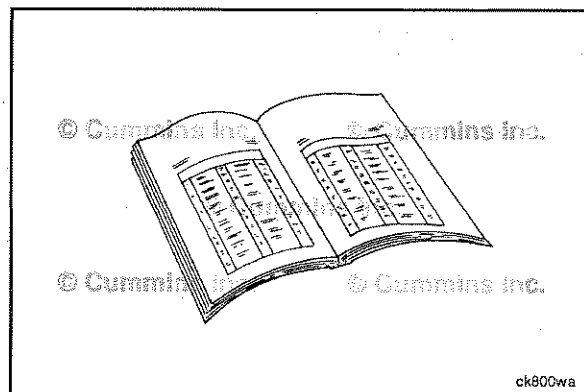
WARNING

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.

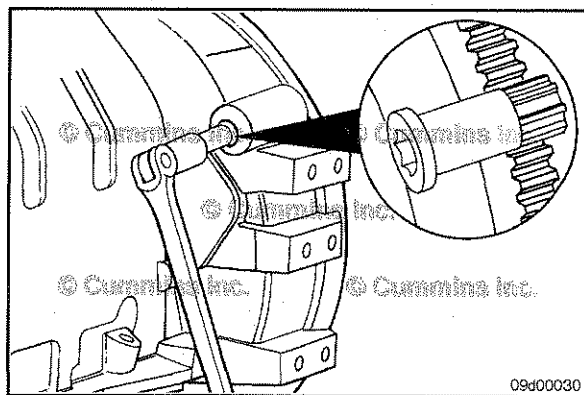
- Close the fuel supply valve. Refer to the OEM instructions.
- Disconnect the batteries. Refer to Procedure 013-009 (Battery Cables and Connections) in Section 5.
- Remove the rocker lever cover. Refer to Procedure 003-011 (Rocker Lever Cover) in Section A.

Adjust

The engine is at top dead center (TDC) if both cylinder number 1 intake and exhaust valves are closed. If **not**, use engine barring tool, Part Number 3377371, to rotate the crankshaft until the exhaust valve and intake valve are both open on cylinder number 6. Watch for the exhaust valve to begin to close. Once it is almost closed, the intake will start to open. At this point, the engine will be at top dead center (TDC) on cylinder number 1.

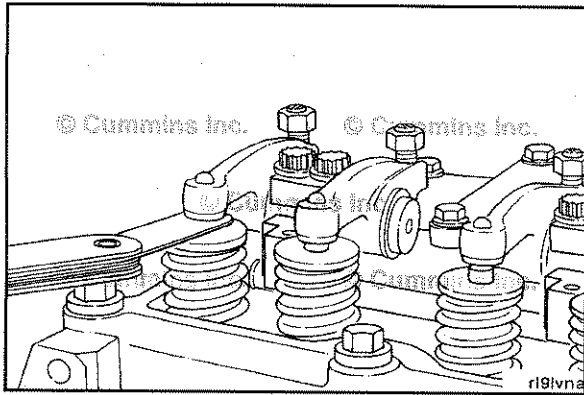


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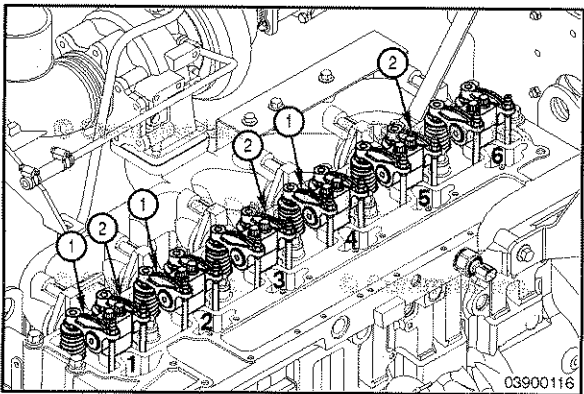
Section 4 — Maintenance Procedures at 250 Hours or 3 Months



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

	Valve Lash		
	mm		in
Intake	0.305	NOM	0.012
Exhaust	0.610	NOM	0.024

Check and set the valves when the engine is cold, below 60°C [140°F].

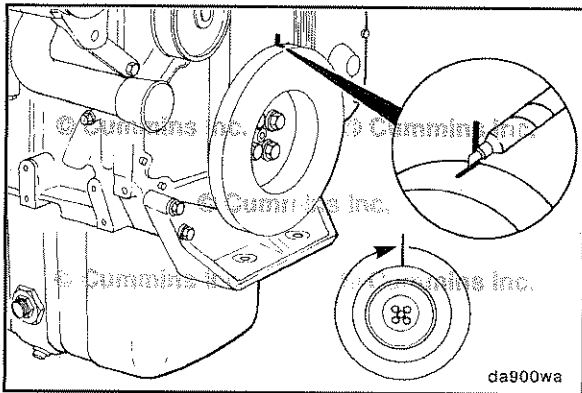


Check and adjust the valves indicated for STEP A (1 = intake; 2 = exhaust).

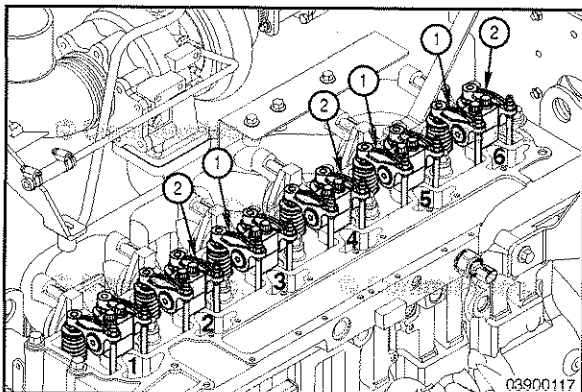


After tightening the rocker lever locknut, check the valve clearance to make sure the valve clearance has **not** changed.

Torque Value: 24 N•m [212 in-lb]



Mark the vibration damper and rotate the crankshaft 360 degrees.



Set the valves indicated for Step B.

After tightening the rocker lever locknut, check the valve clearance to make sure the valve clearance has **not** changed.

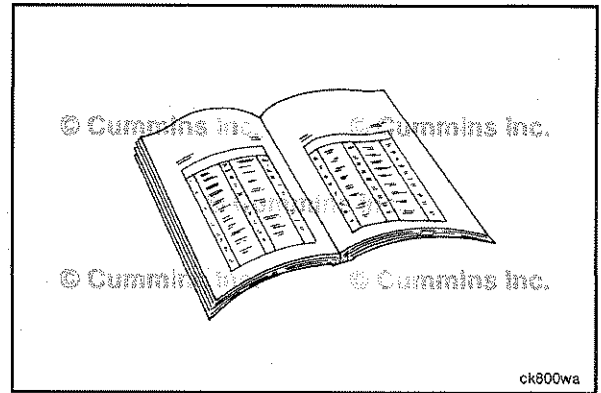
Torque Value: 24 N•m [212 in-lb]

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 rocker lever cover. Refer to Procedure 003-011 (Rocker Lever Cover) in Section A.
- Connect the batteries. Refer to Procedure 013-009 (Battery Cables and Connections) in Section 6.
- Open the fuel supply valve. Refer to the OEM instructions.
- Operate the engine and check for leaks.

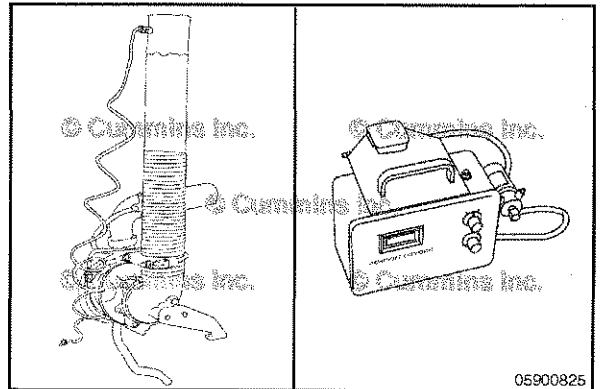


Air/Fuel Mixer General Information

The proper adjustment of the air/fuel mixer has a direct relationship with the exhaust oxygen (O_2) content.

Exhaust oxygen (O_2) is an indication of the air/fuel ratio. A low exhaust oxygen (O_2) reading indicates a rich air/fuel ratio while a high exhaust oxygen (O_2) indicates a lean condition.

The exhaust oxygen (O_2) is measured by taking a sample of the exhaust gas after the turbocharger, usually at a fitting location in the exhaust stack.

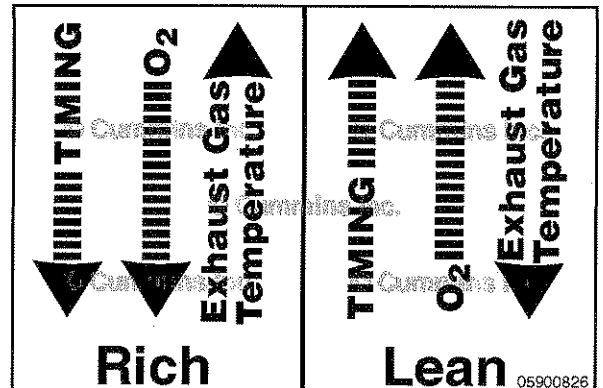


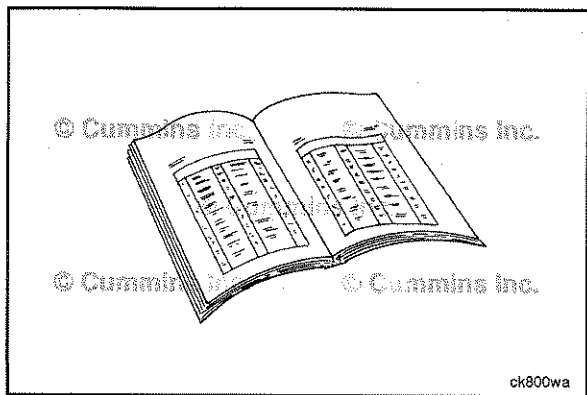
The exhaust gas temperature is an indicator of a rich or lean condition.

At the rated load and speed of the engine, the exhaust temperature is affected by ignition timing, exhaust oxygen (O_2) air/fuel ratio, fuel type, fuel quality, altitude, and ambient temperature. The **only** two of these that are adjustable are timing and exhaust oxygen (O_2).

Both ignition timing and exhaust oxygen (O_2) are inversely related to exhaust temperature. When ignition timing is advanced, exhaust temperature decreases, and when ignition timing is retarded, exhaust inlet temperature increases.

The same is true for exhaust oxygen (O_2). Increasing exhaust oxygen (O_2) indicates a leaner air/fuel mixture and results in decreasing exhaust temperature.





Preparatory Steps

⚠ WARNING ⚠

Natural gas is explosive and flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas with shared ventilation to reduce the possibility of severe personal injury or death when working on a natural gas system.

⚠ WARNING ⚠

Natural gas is lighter than air. Check the ceiling of the area where work is to be done for any possible ignition sources.

⚠ WARNING ⚠

Always have proper ventilation when working on a natural gas system.

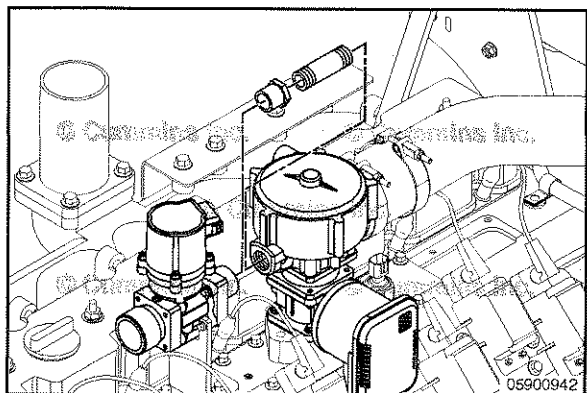
⚠ WARNING ⚠

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.

⚠ CAUTION ⚠

To reduce the possibility of shock loading of components downstream of the supply valve, opening and closing of the gas supply valve must be done slowly.

- Disconnect the batteries. Refer to Procedure 013-009 (Battery Cables and Connections) in Section 6.
- Slowly close the manual gas supply valve. Refer to the OEM installation instructions.



Remove

Remove the fuel supply line connecting the fuel regulator to the air/fuel mixer power valve.

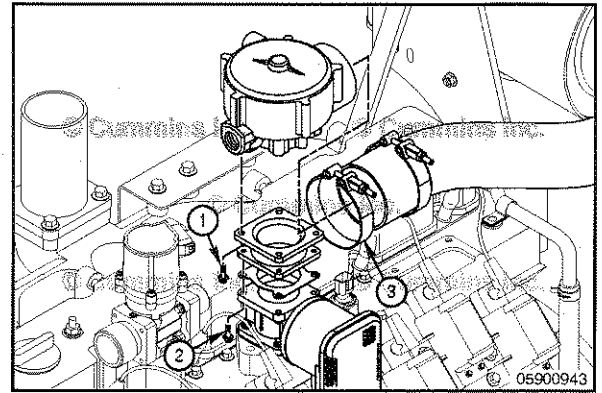
Remove the following capscrews and hose clamps:

1. Air/fuel mixer to the air/fuel mixer power valve (7/16 capscrews).
2. Air/fuel mixer power valve to the throttle (7/16 capscrews).
3. Hose clamp connecting air cleaner tube to air/fuel mixer inlet.



Remove and separate the air/fuel mixer from the air/fuel mixer power valve.

Discard the gaskets.



Clean and Inspect for Reuse

▲ WARNING ▲

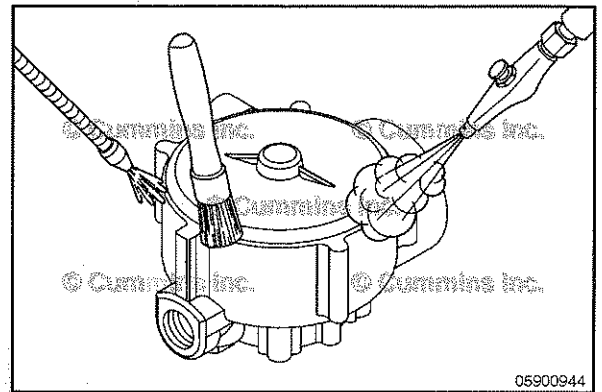
When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

▲ WARNING ▲

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

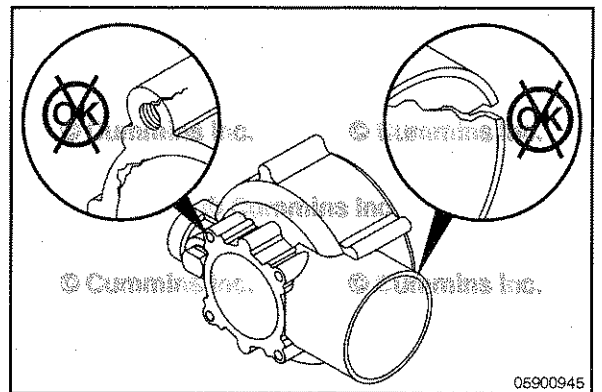
Use solvent to clean the air/mixer valve. Use a soft bristle brush for heavy deposits.

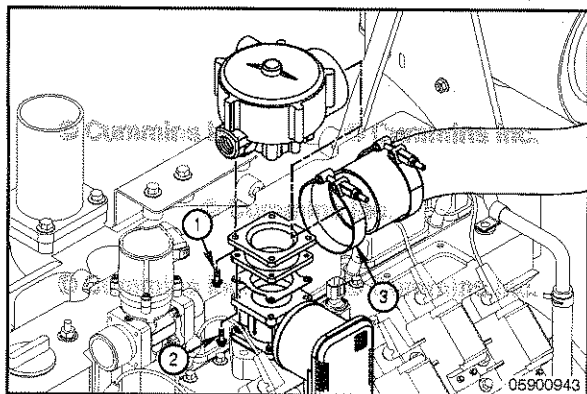
Dry using compressed air.



Inspect the air/fuel mixer body for any signs of damage.

Inspect the flange areas for cracks or damaged capscrew holes.





Install

Use new gaskets, assemble the air/fuel mixer and the air/fuel mixer power valve, use four 7/16 capscrews. Hand tighten **only**.

Install the air/fuel mixer onto the engine. Install the following capscrews and hose clamps hand tight:

- Four 7/16 capscrews connecting the throttle to the air/fuel mixer power valve.
- Four 7/16 capscrews connecting the air/fuel mixer to the air cleaner tube.
- Hose clamp connecting air cleaner tube to air/fuel mixer inlet.

Tighten the capscrews

Torque Value:

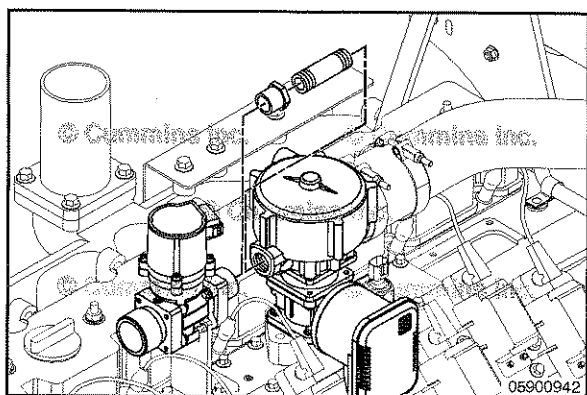
7/16 capscrews 27 N•m [240 in-lb]

Torque Value:

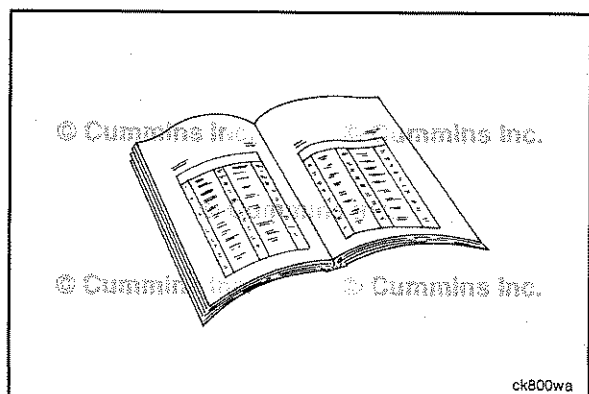
3/8 capscrews 61 N•m [45 ft-lb]

Torque Value:

Hose clamps 7 N•m [62 in-lb]



Install the fuel supply line connecting the fuel regulator to the air/fuel mixer power valve.



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.

⚠ CAUTION ⚠

To reduce the possibility of shock loading of components downstream of the supply valve, opening and closing of the gas supply valve must be done slowly.

- Slowly open the fuel supply valve. Refer to OEM installation instructions.
- Connect the batteries. Refer to Procedure 013-009 (Battery Cables and Connections) in Section 6.

Adjust

Determine the correct exhaust oxygen (O_2) specifications from the Fuel System Operating Specifications and Derates table in Section V of this manual.

Install the Exhaust Oxygen (O_2) meter. Refer to the manufacturer's operating instructions.

Start the engine. Refer to Procedure 101-014 (Normal Starting Procedure) in Section 1. Operate the engine until the coolant temperature reaches 60°C [140°F].

Once to operating temperature, raise the engine rpm to rated speed and load.

Measure the Exhaust Oxygen (O_2), use an oxygen meter. Contact a Cummins® Authorized Repair Location.

Adjust the exhaust oxygen (O_2) by turning the power valve on the carburetor.

NOTE: Shown is a hex head adjustment screw. Allen adjustment screws are also used on some models.

Turn the valve **clockwise** to lean the air/fuel mixture, which will cause the exhaust oxygen (O_2) reading to increase.

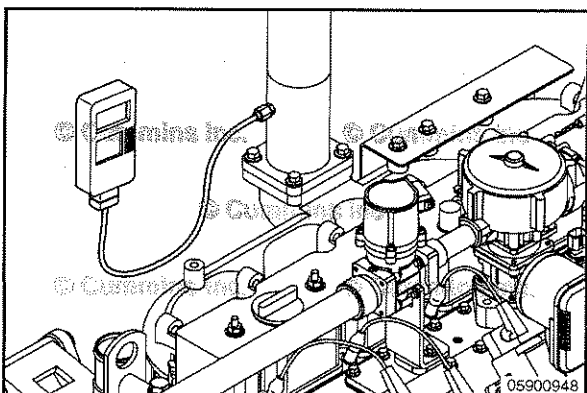
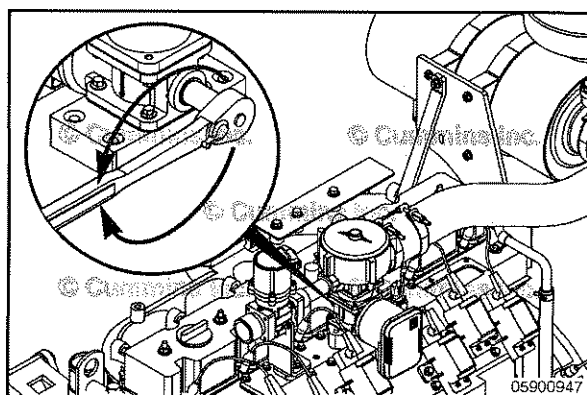
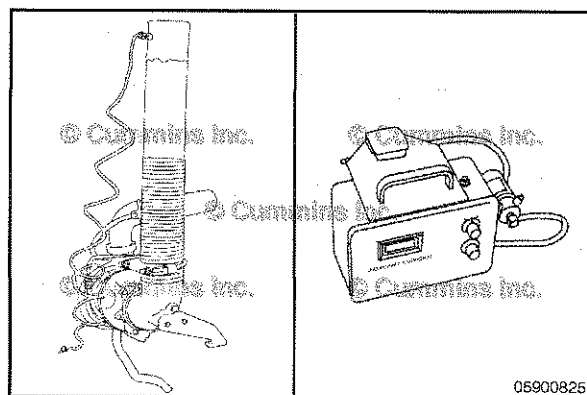
Turn the valve **counterclockwise** to richen the air/fuel mixture, which will cause the exhaust oxygen (O_2) reading to decrease.

Allow adequate time between adjustments for the oxygen meter to react to the new condition. This can take up to 30 seconds.

Adjustment is complete when the meter displays the correct specifications for 30 seconds at the rated engine conditions.

Measure the exhaust temperature.

It will be necessary to adjust (advance) the ignition timing to reduce the exhaust temperature. Contact a Cummins® Authorized Repair Location.



Lubricating Oil and Filters

General Information

⚠ WARNING ⚠

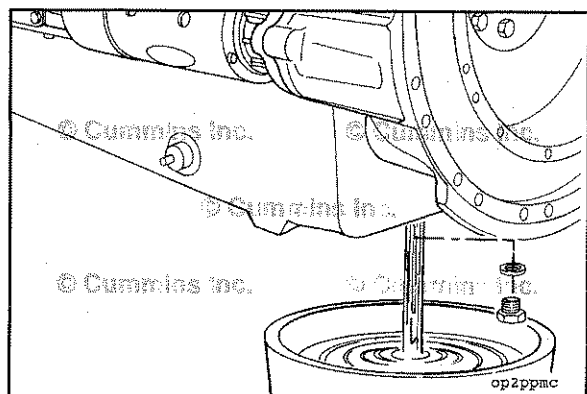
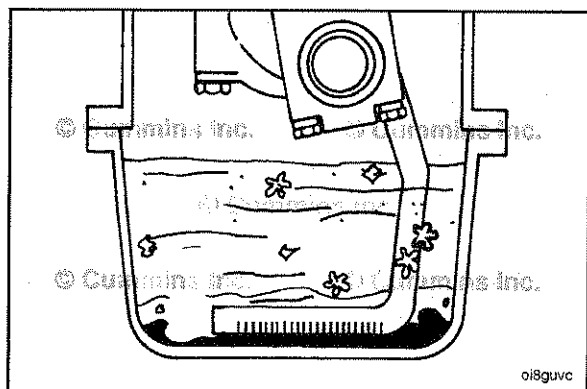
Some state and federal agencies have determined that used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

NOTE: Oil for natural gas engines does **not** darken and look dirty as diesel oil does. Use the recommended maintenance intervals to determine oil change requirements, **not** the oil's appearance.

Change the lubricating oil and filter(s) at the specified oil change intervals. Refer to Procedure 102-002 (Maintenance Schedule) in Section 2 to find the correct change interval for your application.

Change the oil and filter to remove the contaminants suspended in the oil.

NOTE: Drain the oil only when it is warm and the contaminants are in suspension.



Drain

⚠ 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.

Operate the engine until the water temperature reaches 70°C [158°F]. Shut the engine off.

NOTE: Use a container that can hold at least 25 liters [27 qt] of oil.

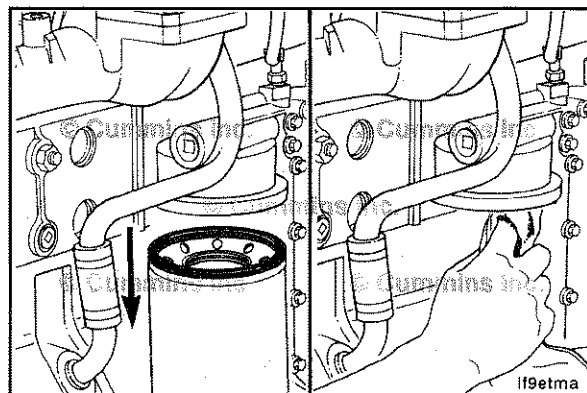
Remove the drain plug.

Remove

Remove the oil filter with filter wrench, Part Number 3375049.

Clean the area around the lubricating oil filter. Clean the gasket surface of the filter head.

NOTE: The o-ring can stick on the filter head. Make sure it is removed before installing the new filter.

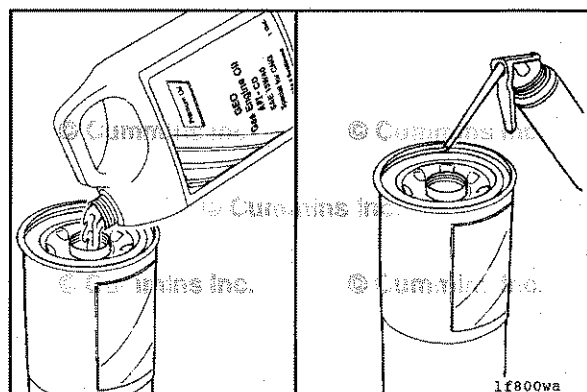


Install

Use the correct oil filter. Refer to Procedure 018-024 (Cummins/Fleetguard™ Filter Specifications) in Section V for the correct part number.

NOTE: Fill the filter with clean lubricating oil before installation. The lack of lubrication during the delay until the filter is pumped full of oil is harmful to the engine.

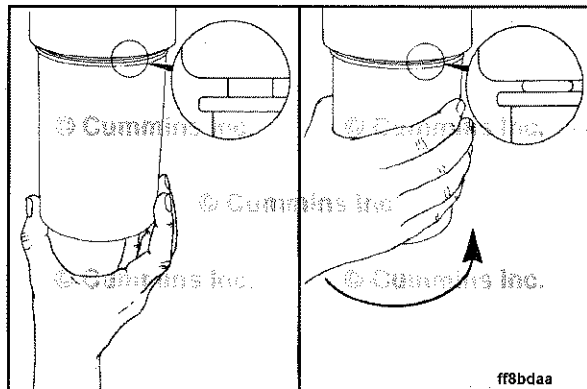
Apply a light film of lubricating oil to the gasket sealing surface before installing the new filter.



⚠CAUTION⚠

Mechanical overtightening can distort the threads or damage the lubricating oil filter element seal.

Install the oil filter. Turn the filter until the gasket contacts the filter head surface. Tighten the filter by hand an additional 1/2 to 3/4 of a turn after the gasket contacts the filter head surface, or as specified by the oil filter manufacturer.

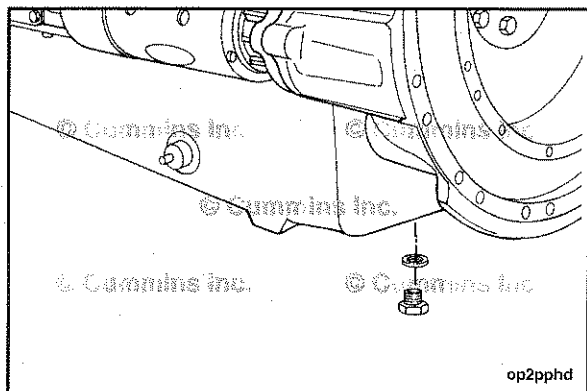


Check and clean the lubricating oil drain plug threads and sealing surface.

Install the oil pan drain plug.

Torque Value:

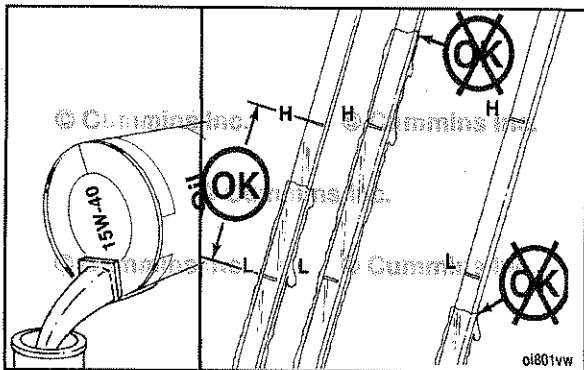
For steel stamp oil pans 80 N•m [59 ft-lb]





Fill

Use a high quality oil blend that meets Cummins specifications for natural gas engines. Refer to Procedure 018-003 (Lubricating Oil Recommendations and Specifications) in Section V.

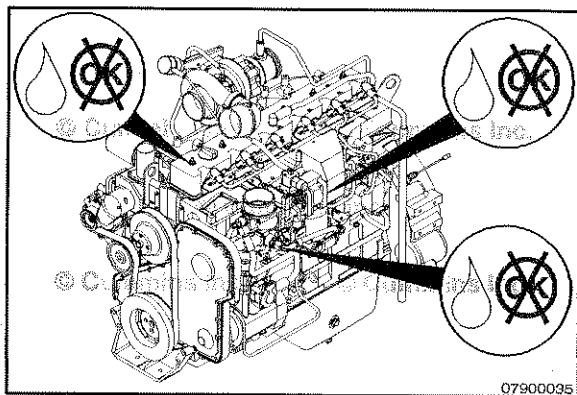


Fill the engine with clean lubricating oil to the proper level.

Oil Pan Capacity

Pan Capacity	18.9 Liters [20 U.S. qts.]
Total System Capacity	20.8 Liters [22 U.S. qts.]

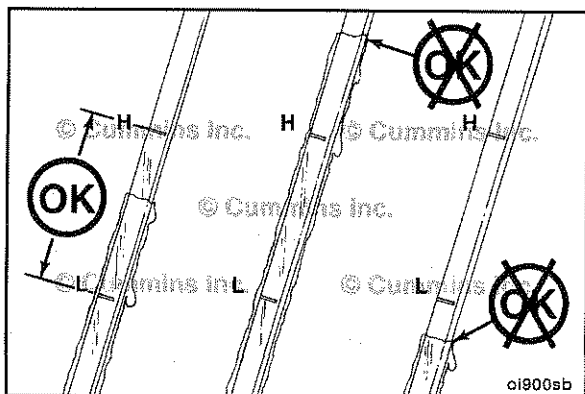
NOTE: Total system capacity includes lubricating oil pan plus lubricating oil filter(s). Some applications use a slightly different lubricating oil pan capacity, and all lubricating oil quantities **must** be adjusted accordingly. Contact your Local Cummins Distributor if there is any questions.



⚠ WARNING ⚠

If no oil pressure is noted within 15 seconds after the engine is started, shut down the engine to reduce the possibility of internal damage.

Operate the engine at idle to inspect for leaks at the lubricating oil filter and the drain plug.



Stop the engine. Wait approximately 5 minutes to let the lubricating oil drain from the upper parts of the engine. Check the oil level again.

Add oil as necessary to bring the oil level to the H (high) mark on the dipstick.

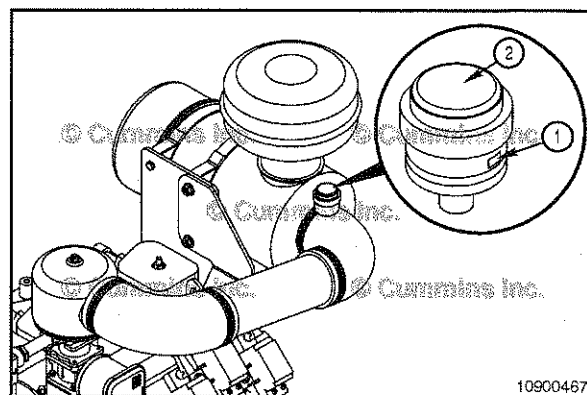
Air Cleaner Restriction Maintenance Check



Never operate the engine without an air cleaner. Intake air must be filtered to prevent dirt and debris from entering the engine and causing premature wear.

A mechanical restriction indicator is available to indicate excessive air restriction through a dry-type air cleaner. This instrument can be mounted in the air cleaner outlet or on the instrument panel. The red flag (1) in the window gradually rises as the cartridge loads with dirt. After changing or replacing the cartridge, reset the indicator by pushing the reset button (2).

Restriction or vacuum indicators need to be installed as close as possible to the turbocharger air inlet in order to obtain a true indication of restriction.



Exhaust Gas Analysis General Information

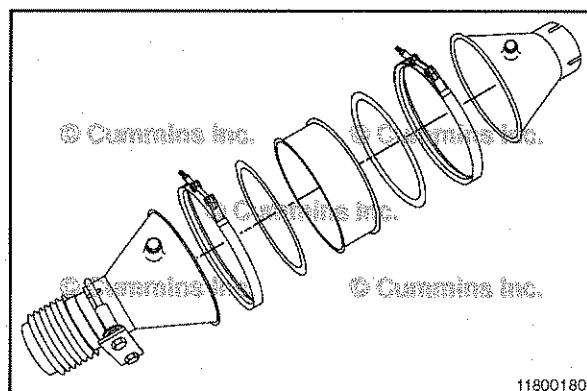
The proper adjustment of the air/fuel mixer has a direct relationship with the exhaust gas content. The three-way catalyst also has an effect on the concentration of these gases leaving the exhaust system.

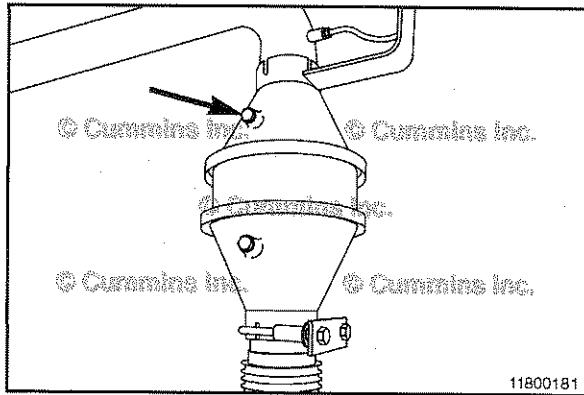
These engines operate around a stoichiometric condition, and run both slightly lean and slightly rich. The control system handles this switching from an ideal air-to-fuel ratio.

The exhaust gases that are usually measured are:

- Oxides of nitrogen (NOx)
- Carbon monoxide (CO)
- Non-Methane hydrocarbons (NMHC)
- Volatile organic compounds (VOC).

Total hydrocarbons (THC) may also be used. This combines the NMHC concentration with that of the methane in the mixture.





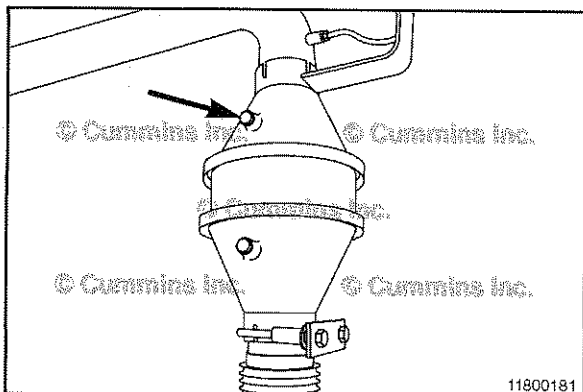
Measure

⚠ WARNING ⚠

The exhaust and exhaust components can remain hot after the engine has shut down. To reduce 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.

If needed, remove a fitting in the exhaust tubing downstream from the engine and catalyst of the catalyst. Calibrate or purge gas analyzer according to manufacturer specifications, if necessary. The exhaust gases are measured after the catalyst by taking a sample, usually at a fitting in the exhaust tubing or catalyst housing. A gas analyzer is needed to perform this procedure. A four gas analyzer capable of measuring the following concentrations shall be used:

Compound	Upper Range Limit (PPM)	Accuracy (percentage of reading)
NO _x	100	± 5%
CO	1000	± 5%
THC (Methane)	2000	± 5%
NMHC	100	± 5%



Initial Check

⚠ WARNING ⚠



The exhaust and exhaust components can remain hot after the engine has shut down. To reduce 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.

With the engine running, place the exhaust gas probe in the exhaust stream.

Take a sample, for approximately 30 seconds.

Do **not** leave exhaust probe in place for an extended amount of time.

Compare the values to the regulations. Reference Procedure 018-020 (Exhaust System Specifications) in Section V in the Operations and Maintenance Manual, G5.9 CM558, Bulletin 4021690, or Operation and Maintenance Manual, G8.3 CM558, Bulletin 4021689, or Operation and Maintenance Manual, GTA855 CM558, Bulletin 4021929. If the engine is providing exhaust gas concentrations greater than those given in the specifications, Contact a Cummins® Authorized Repair Location.

Install any fittings that were removed in the previous steps.

Section 5 — Maintenance Procedures at 750 Hours or 6 Months

Section Contents

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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.

Supplemental Coolant Additive (SCA) and Antifreeze Concentration

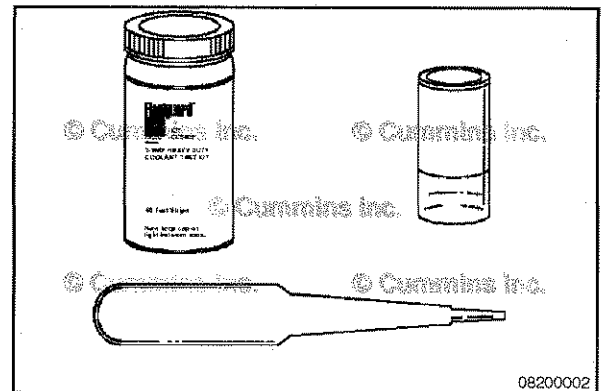
Maintenance Check

Supplemental Coolant Additive (SCA)

Check the SCA concentration level:

- At least twice a year
- At every subsequent oil drain interval if the concentration is above 3 units
- Whenever coolant is added to the cooling system between filter changes.

Use Fleetguard® coolant test kit, Part No. CC2602, to check the SCA concentration level. Instructions are included with the test kit. Refer to Coolant Recommendations and Specifications in Maintenance Specifications (Section V) for the correct SCA and antifreeze level.



Antifreeze



Overconcentration of antifreeze or use of high-silicate antifreeze can damage the engine.

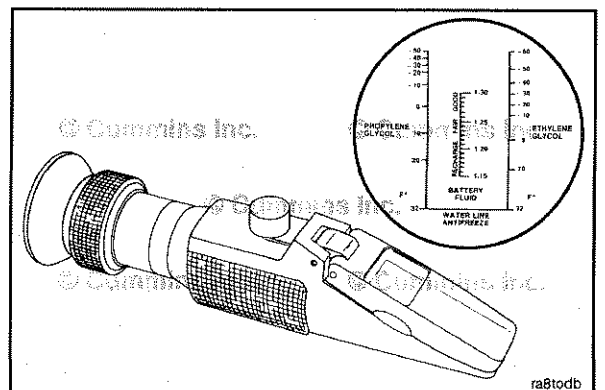
Check the antifreeze concentration. Use a mixture of 50-percent water and 50-percent ethylene glycol or propylene glycol-based antifreeze to protect the engine to -32°C [-26°F] year-around.

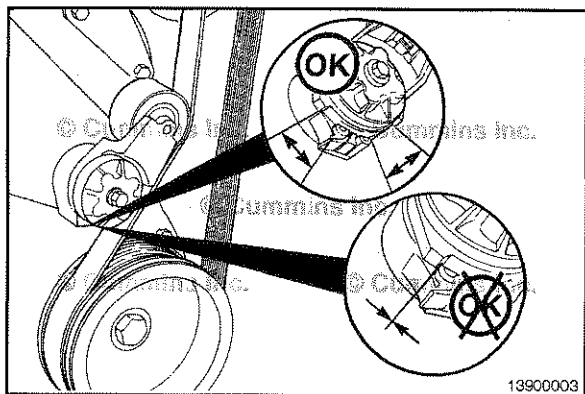
The Fleetguard® refractometer, Part Number C2800, provides a reliable, easy-to-read, and accurate measurement of freezing point protection and glycol (antifreeze) concentration.

Antifreeze is essential in every climate.

Antifreeze broadens the operating temperature range by lowering the coolant freezing point and by raising its boiling point.

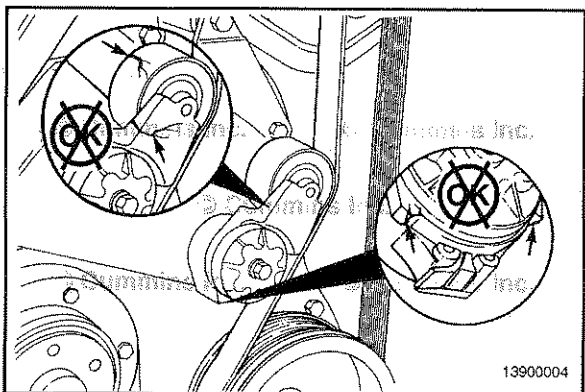
The corrosion inhibitors also protect the cooling system components from corrosion and prolong component life.





Cooling Fan Belt Tensioner Maintenance Check

With the engine turned off, check that neither the top nor bottom tensioner arm stop is touching the cast boss on the tensioner body. If either of the stops is touching a boss, the alternator belt **must** be replaced. Check to make certain the correct belt part number is being used if either condition exists.



⚠ WARNING ⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.



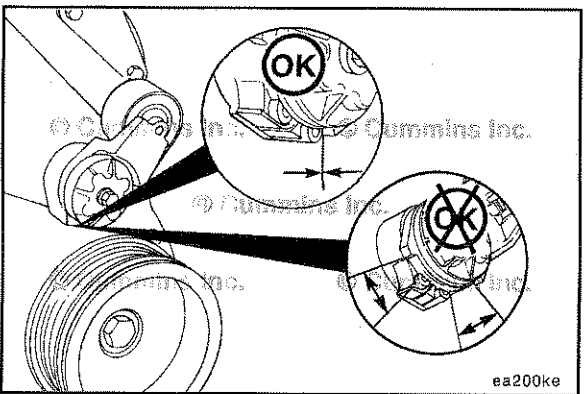
⚠ WARNING ⚠

Wear safety glasses or a face shield, as well as protective clothing, to prevent personal injury when using a steam cleaner or high-pressure water.

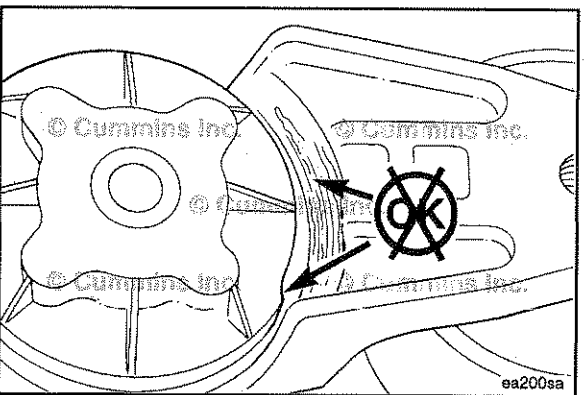


Check the tensioner pulley and body for cracks. If any cracks are noticed, the tensioner **must** be replaced. Refer to a Cummins® Authorized Repair Facility.

Check the tensioner for dirt buildup. If this condition exists, the tensioner **must** be removed and steam-cleaned.



With the cooling fan belt removed, check that the bottom tensioner arm stop is in contact with the bottom tensioner arm stop boss on the tensioner body. If these two are **not** touching, the tensioner **must** be replaced.



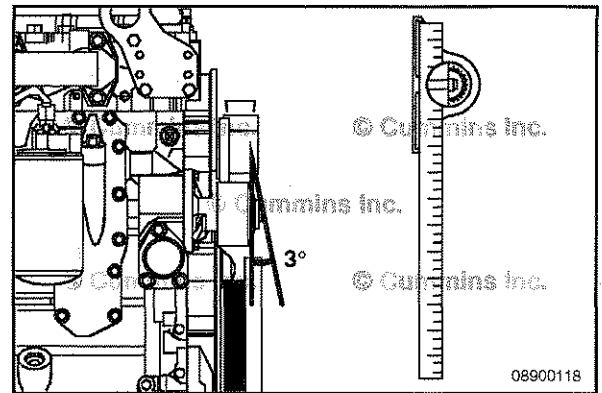
Inspect the tensioner for evidence of the pivoting tensioner arm contacting the stationary circular base. If there is evidence of these two areas touching, the pivot tube bushing has failed and the tensioner **must** be replaced.

The worn tensioner that has play in it or a belt that “walks” off its pulley possibly indicates pulley misalignment.

NOTE: Maximum pulley misalignment is 3 degrees.

This measurement can be taken with a straightedge and an inclinometer.

Install the belt.



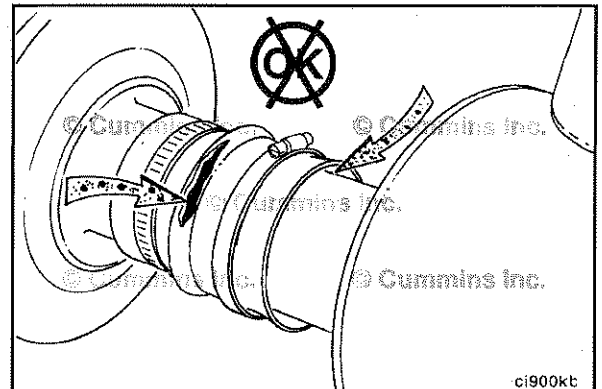
Air Intake Piping Maintenance Check

⚠CAUTION⚠

Engine intake air must be filtered to prevent dirt and debris from entering the engine. If intake air piping is damaged or loose, unfiltered air will enter the engine and cause premature wear.

Inspect the intake air piping for cracked hoses, damage, or loose clamps.

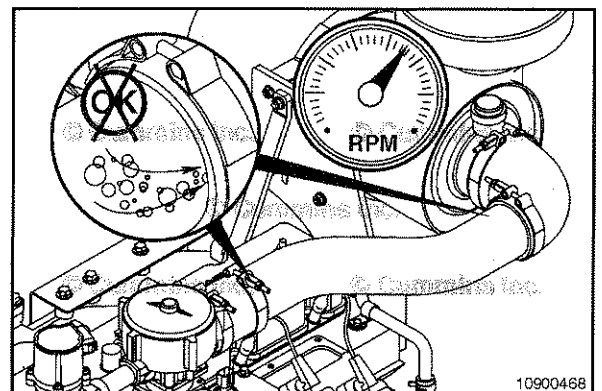
Replace damaged pipes and tighten loose clamps as necessary to make sure the air intake system does **not** leak.



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

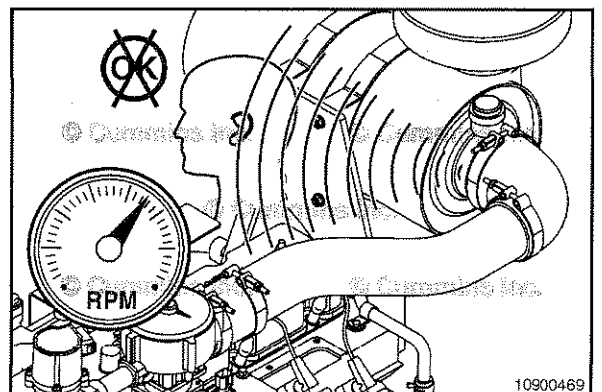
Operate the engine at high idle and use a solution of soapy water to spot intake air leaks.

NOTE: If an air leak exists, the soap bubbles will be drawn in with the air.

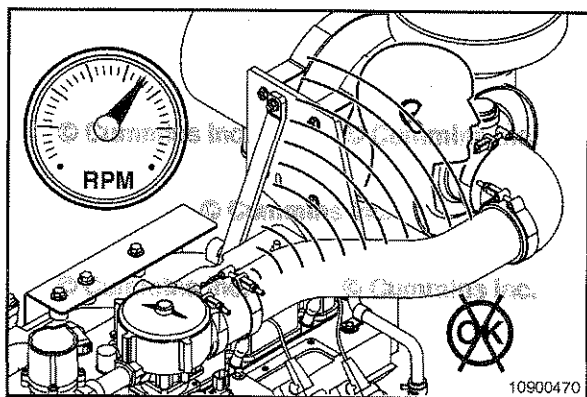


Operate the engine at full throttle and rated rpm under maximum load conditions.

Listen for a high-pitched whistling noise from the air cleaner, nearby piping, and connections.

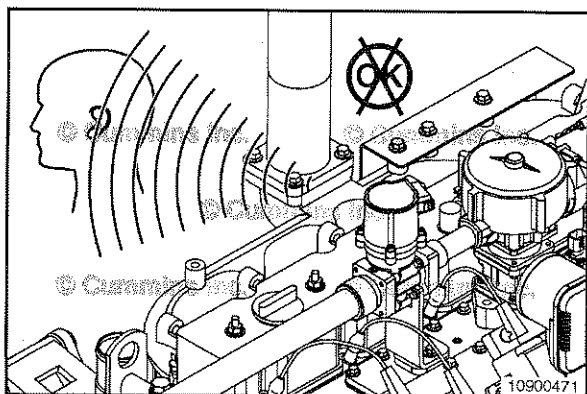


Section 5 — Maintenance Procedures at 750 Hours or 6 Months

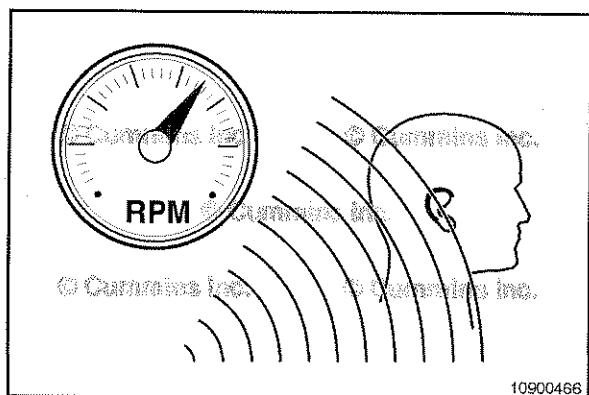


The noise can be caused by an air leak from the:

- Air cleaner-to-air/fuel mixer elbow connection
- Inspect for damage and tighten loose clamps.



- Exhaust manifold-to-exhaust-manifold mounting gasket
- Replace the gasket. Contact a Cummins® Authorized Repair Location.

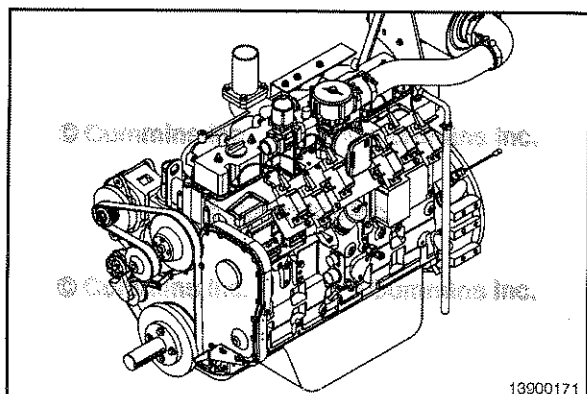


Operate the engine at full throttle and rated rpm under maximum load conditions.

Listen for leaks.



If the air piping is **not** damaged and the noise can still be heard. Contact a Cummins® Authorized Repair Location.



Spark Plugs (Non Shielded)

General Information

Every 750 hours or 6 months, check the spark plugs for fouling and carbon buildup.

Do **not** regap the spark plugs.

Replace the spark plugs, if necessary.

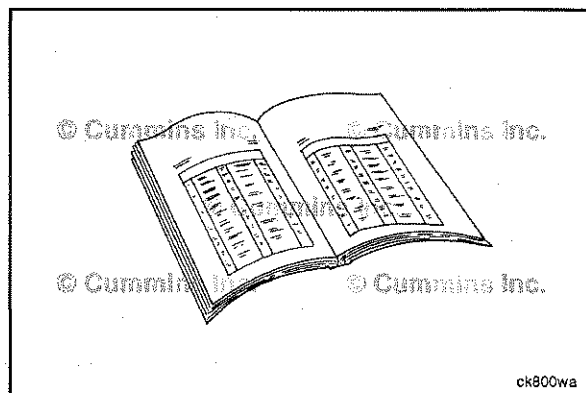
Every 1500 hours or 1 year, replace the spark plugs. Use **only** Cummins® recommended spark plugs. Use of non-recommended spark plugs can result in hard starting, misfire, or degraded engine performance.

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. Refer to Procedure 013-009 (Battery Cables and Connections) in Section 6.

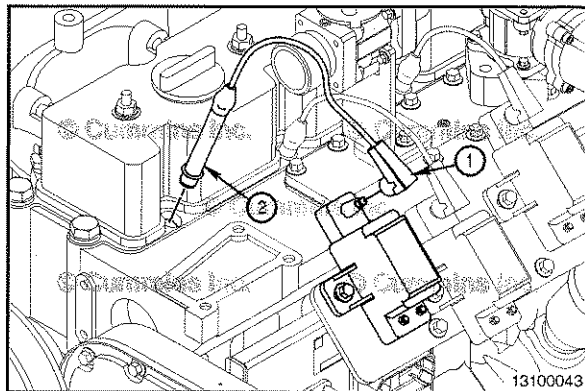


Remove

⚠ CAUTION ⚠

Do not pull on the spark plug wire during removal. Damage to the spark plug wire can result. To remove the spark plug wire, pull on the coil boot and on the spark plug adapter.

Disconnect the spark plug wire from the ignition coil and remove the spark plug adapter by pulling on the adapter.

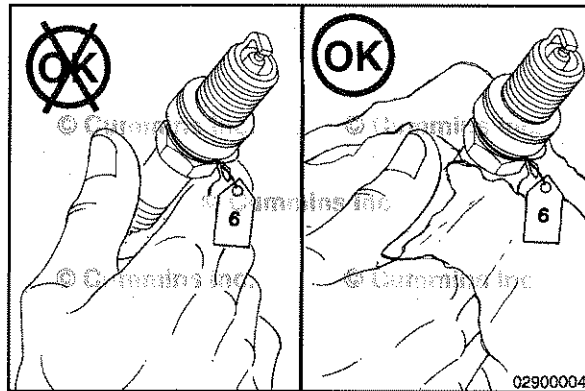


Clean and Inspect for Reuse

⚠ 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.

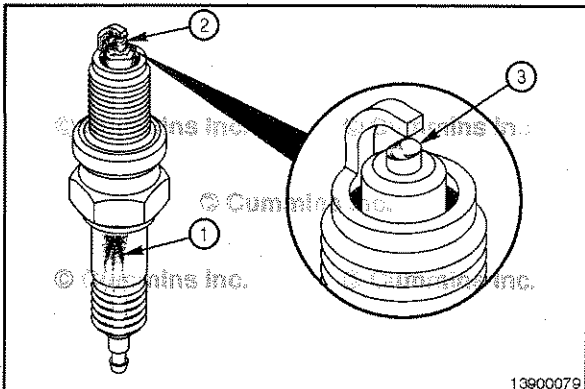
Spark plugs **must always** be kept clean. Never touch the porcelain area of the spark plug. If the porcelain becomes dirty, it **must** be cleaned before installation. Cleaning can be done with rubbing alcohol and a clean cloth.

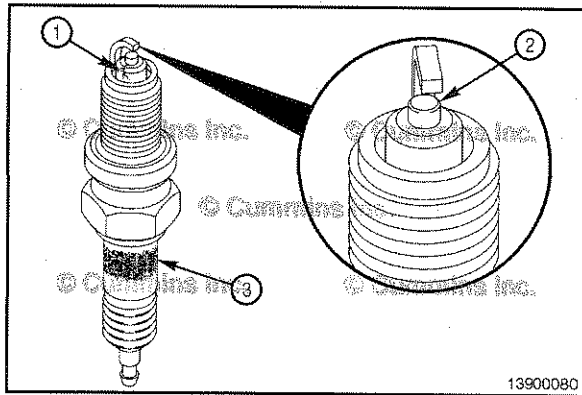


Inspect the spark plug for the following:

1. Insulator flashover
2. Electrode deposits or fouling
3. Worn or missing electrode.

If a spark plug exhibits any of these conditions, the spark plug **must** be replaced.

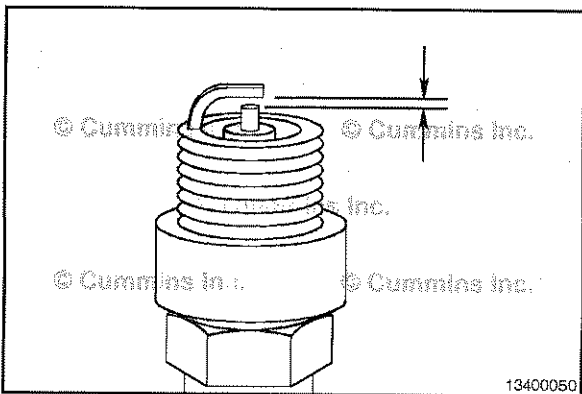




Inspect the spark plug for the following:

4. Cracked insulator
5. Electrode misalignment
6. Corona marks.

If a spark plug exhibits any of these conditions, the spark plug **must** be replaced.



Install

CAUTION

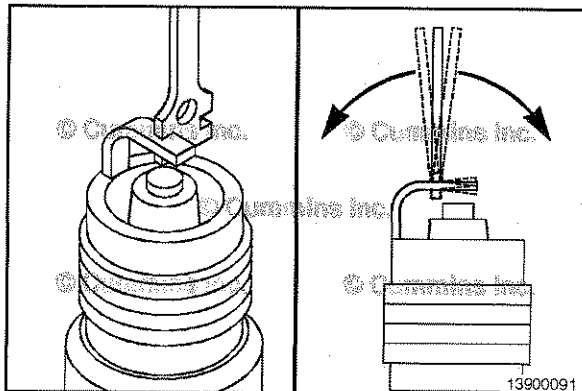


Do not force a feeler gauge into the spark plug gap. This will damage the precious metal electrodes and shorten the spark plug life.

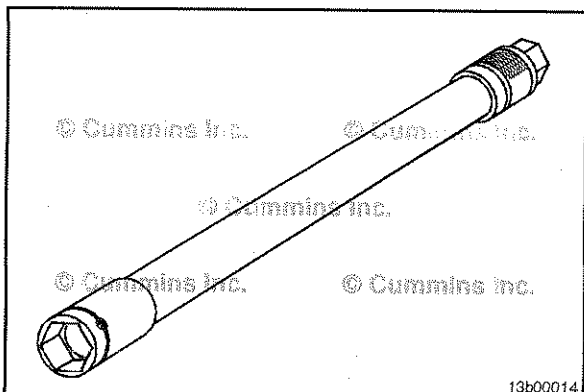
The spark plug can be serviced up to a maximum of three times.

Always replace the gasket, Part Number 3075639, whenever the spark plug is removed from the cylinder head.

Always inspect the gap of new spark plugs. The gap **must** be set to 0.508 mm [0.020 in].



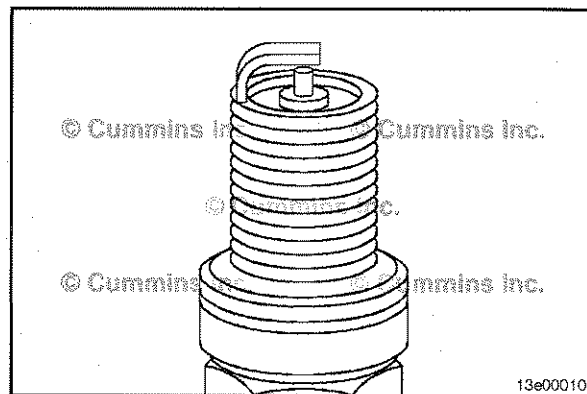
Adjust the gap by bending the ground (side) electrode using the slots on the gap tool. Align the center and ground electrode. The ground electrode **must** be parallel and centered over the middle of the electrode.



A magnetic spark plug socket can be used to install the spark plug.

The spark plug socket used for installation **must** also be kept clean. Do **not** use a spark plug socket with a rubber insert. Rubber inserts can contaminate the spark plugs that you have just cleaned.

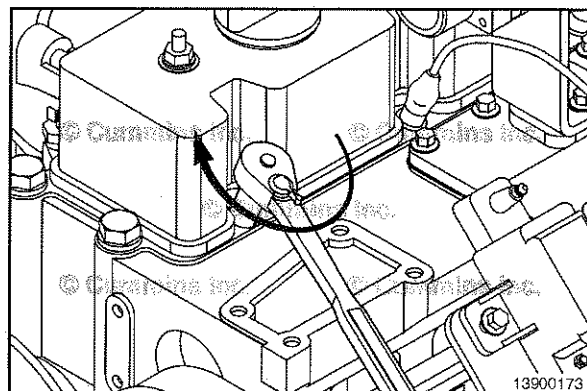
Spark plug threads have anti-seize plating. Anti-seize compound is generally conductive and **must not** be used on spark plugs.



Install the spark plugs.

Spark plugs **must always** be tightened to the correct torque value. On a hot engine, tighten all of the spark plugs hand tight before tightening the first spark plug with a torque wrench. This will allow all of the spark plugs to warm up to the cylinder head temperature prior to tightening.

Spark Plug Torque		
N•m		ft-lb
35	MIN	26
41	MAX	30



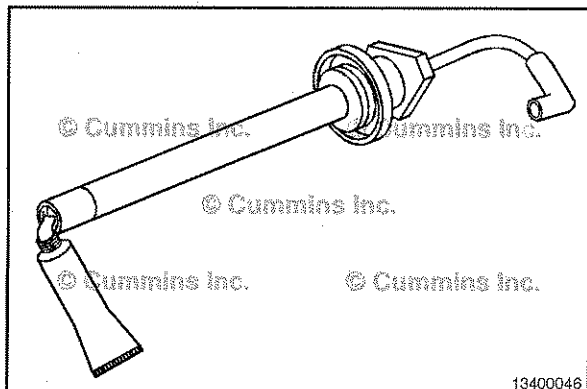
⚠CAUTION⚠

Never use Lubriplate™ in or on a spark plug adapter boot. Lubriplate™ is a conductor and its use can lead to spark plug flashover, resulting in engine damage.

Cummins Inc. recommends the following dielectric grease:

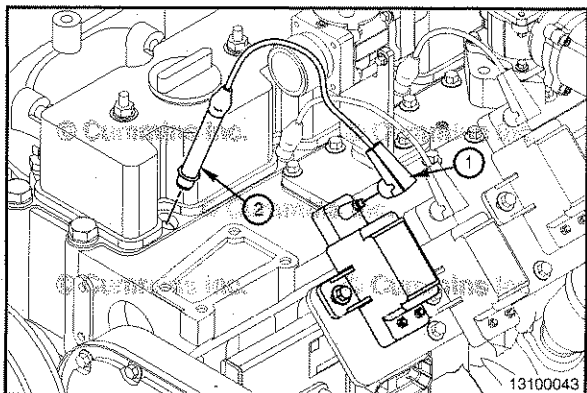
- Dupont™ Krytox® 205, Cummins® Part Number 3164956.

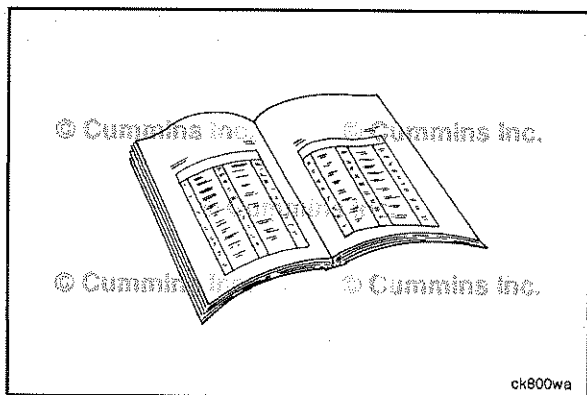
Always apply a pea-sized amount of dielectric lubricant to the spark plug adapter boot prior to installation. The approved dielectric grease is Cummins® Part Number 3164956 or Dupont™ Krytox® 205. This adds to the dielectric seal of the rubber boot and reduces the possibility of the boot melting onto the spark plug.



Install the spark plug adapter.

Install the spark plug wire onto the ignition coil.





Finishing Steps

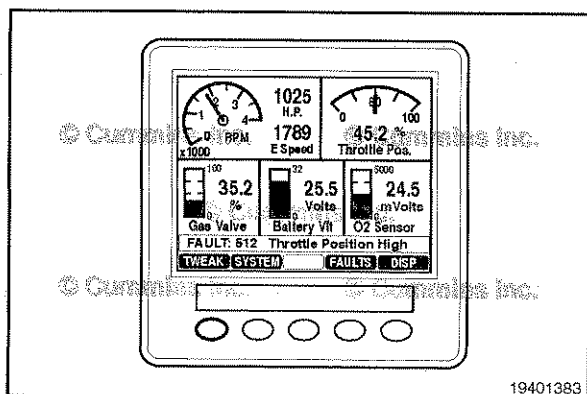


WARNING



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. Refer to Procedure 013-009 (Battery Cables and Connections) in Section 6.



Heated Oxygen Sensor Maintenance Check



The heated oxygen sensor parameters settings **must** be checked every 3 months. If the oxygen sensor is replaced, the settings **must** be calibrated.

If it is determined that the heated oxygen sensor is malfunctioning or damaged, the heated oxygen sensor **must** be replaced. Contact a Cummins® Authorized Repair Location for replacement of the heated oxygen sensor.

The heated oxygen sensor **must** be inspected for reuse every three months and replaced every six months. If it is determined that the sensor is properly operating at the 3 month interval, it **must** be replaced at the 6 month interval.

If the heated oxygen sensor is replaced, the control system settings **must** be recalibrated.

Contact a Cummins® Authorized Repair Location for checking and calibrating the control system settings.

Section 6 — Maintenance Procedures at 1500 Hours or 1 Year

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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.

Engine Steam Cleaning Clean

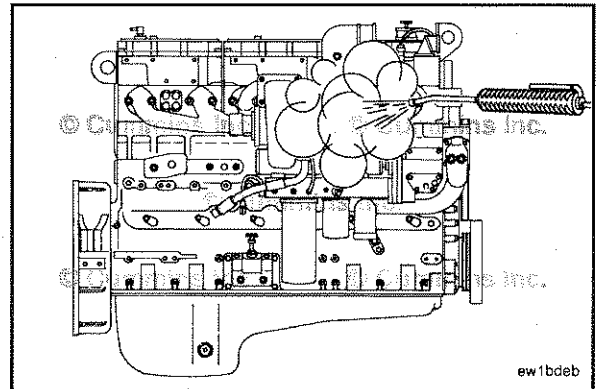


WARNING

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

Steam is the best method of cleaning a dirty engine or a piece of equipment. If steam is **not** available, use a solvent to wash the engine.

Protect all electrical components, openings, and wiring from the full force of the cleaner spray nozzle.



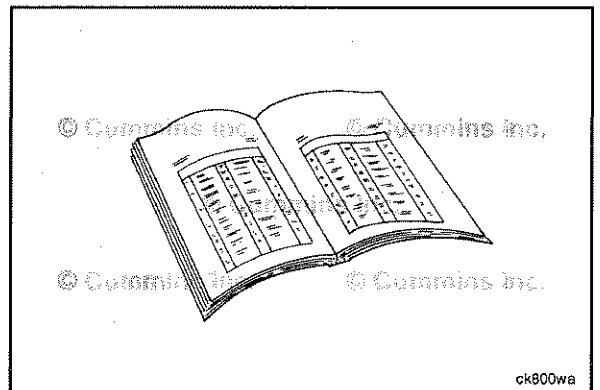
Overhead Set Preparatory Steps

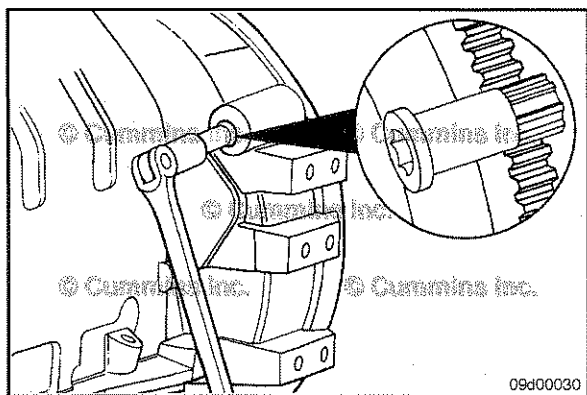


WARNING

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.

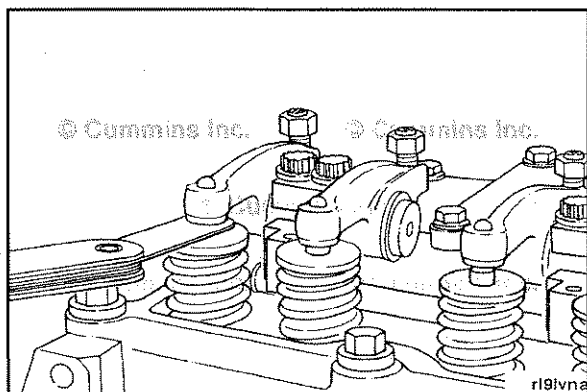
- Close the fuel supply valve. Refer to the OEM instructions.
- Disconnect the batteries. Refer to Procedure 013-009 (Battery Cables and Connections) in Section 5.
- Remove the rocker lever cover. Refer to Procedure 003-011 (Rocker Lever Cover) in Section A.





Adjust

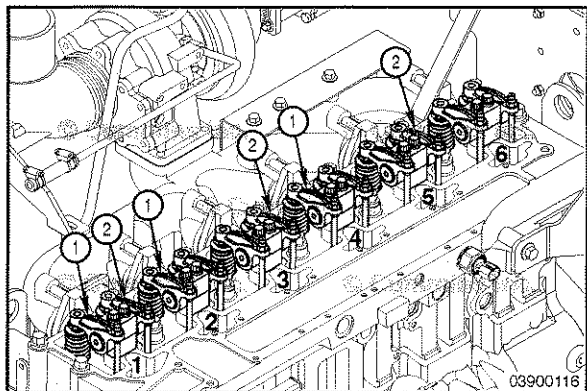
The engine is at top dead center (TDC) if both cylinder number 1 intake and exhaust valves are closed. If **not**, use engine barring tool, Part Number 3377371, to rotate the crankshaft until the exhaust valve and intake valve are both open on cylinder number 6. Watch for the exhaust valve to begin to close. Once it is almost closed, the intake will start to open. At this point, the engine will be at top dead center (TDC) on cylinder number 1.



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

	Valve Lash		
	mm		in
Intake	0.305	NOM	0.012
Exhaust	0.610	NOM	0.024

Check and set the valves when the engine is cold, below 60°C [140°F].

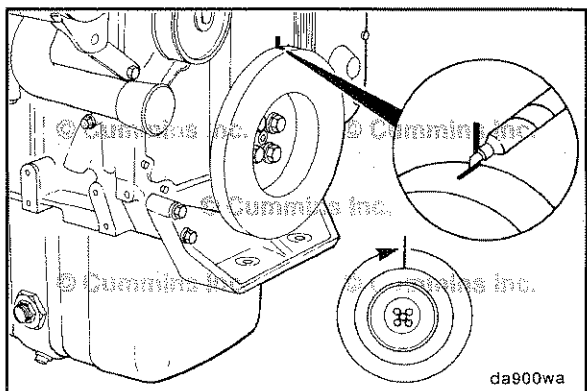


Check and adjust the valves indicated for STEP A (1 = intake; 2 = exhaust).



After tightening the rocker lever locknut, check the valve clearance to make sure the valve clearance has **not** changed.

Torque Value: 24 N•m [212 in-lb]

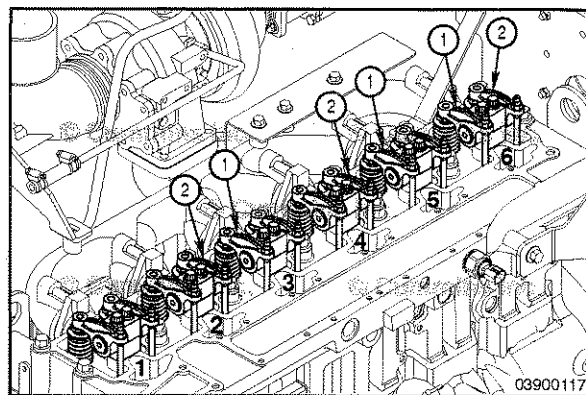


Mark the vibration damper and rotate the crankshaft 360 degrees.

Set the valves indicated for Step B.

After tightening the rocker lever locknut, check the valve clearance to make sure the valve clearance has **not** changed.

Torque Value: 24 N•m [212 in-lb]

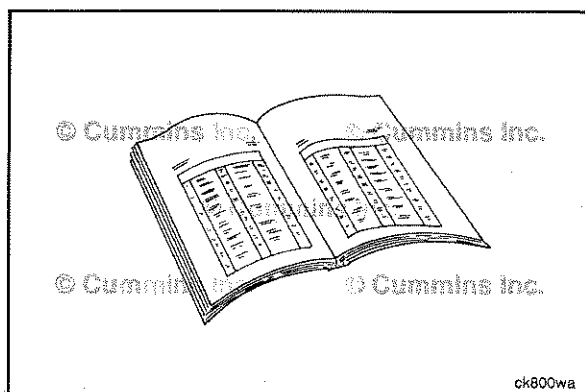


Finishing Steps

⚠ 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 rocker lever cover. Refer to Procedure 003-011 (Rocker Lever Cover) in Section A.
- Connect the batteries. Refer to Procedure 013-009 (Battery Cables and Connections) in Section 6.
- Open the fuel supply valve. Refer to the OEM instructions.
- Operate the engine and check for leaks.



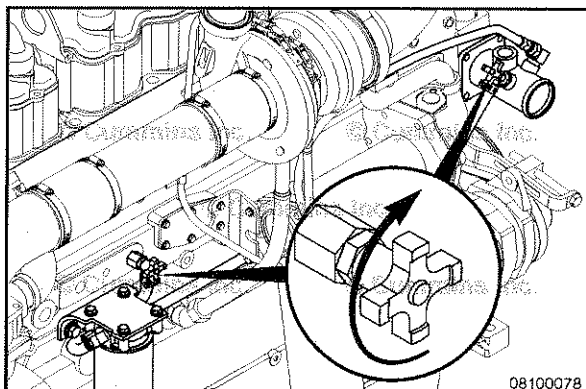
Coolant Filter

Remove

⚠ 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.

Turn the shutoff valve to the OFF position by rotating the knobs in a **clockwise** direction until the valves are fully closed.



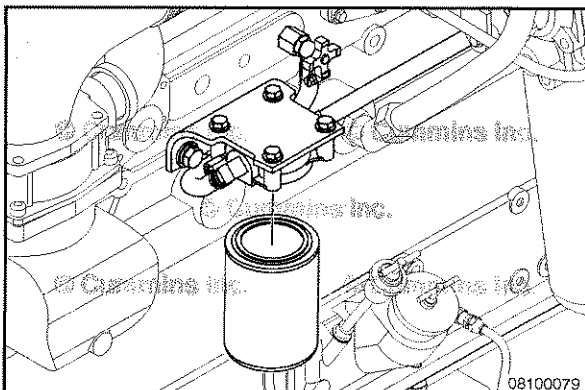
⚠ WARNING ⚠

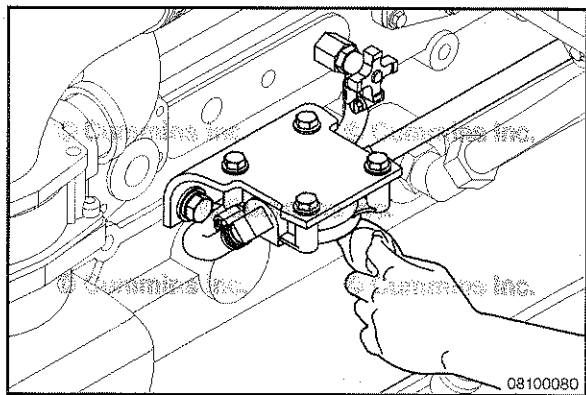
A small amount of coolant can leak when servicing the coolant filter with the shutoff valve in the OFF position. To reduce the possibility of personal injury, avoid contact with hot coolant.

⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

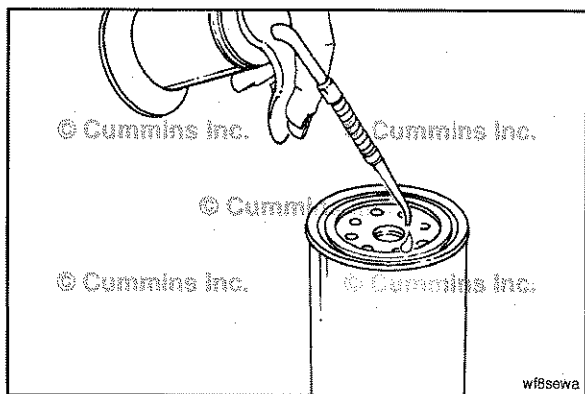
Remove and discard the coolant filter.





Clean

Clean the gasket surface.



Install

⚠CAUTION⚠

Do not allow oil to get into the filter. Oil will damage the DCA.

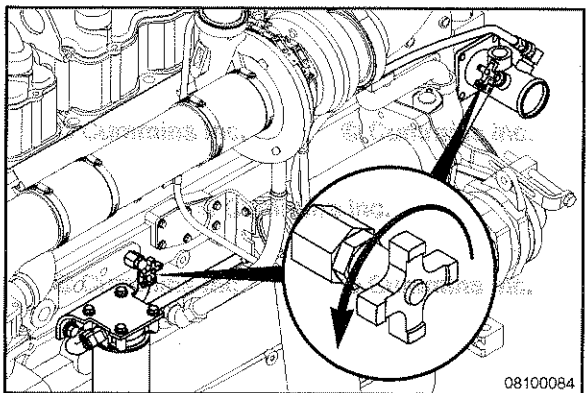
⚠CAUTION⚠

Mechanical overtightening can distort the threads of damage the filter head.

Apply a thin film of lubricating oil to the gasket sealing surface before installing the new coolant filter.

Install the coolant filter on the filter head. Tighten the filter until the gasket contacts the filter head surface.

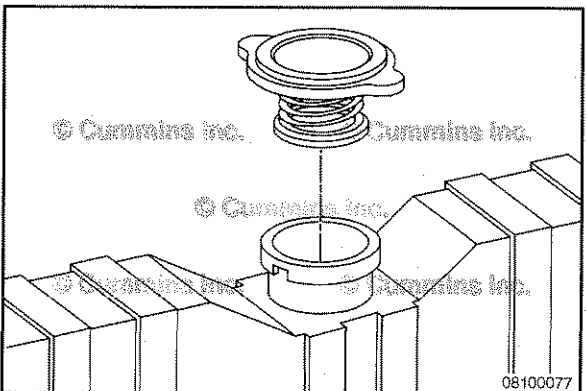
Tighten the coolant filter an additional 1/2 to 3/4 of a turn, or as specified by the filter manufacturer.



⚠CAUTION⚠

The valve must be in the ON position to prevent engine damage.

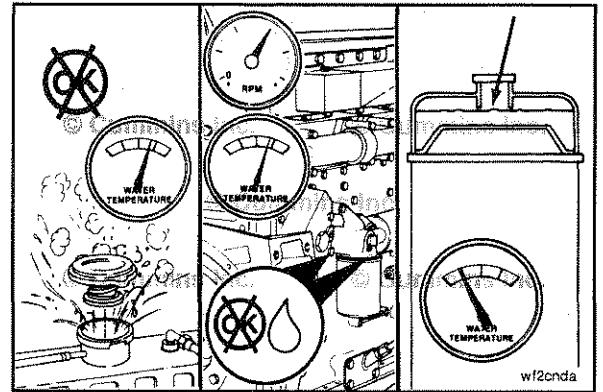
Turn the shutoff to the ON position by rotating the knobs in the **counter-clockwise** direction until the valves are fully open.



Install the coolant system pressure cap.

Operate the engine and check for coolant leaks.

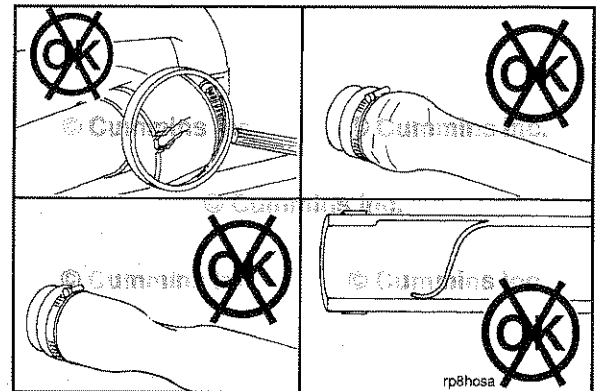
After the air has been purged from the system, check the coolant level again.



Radiator Hoses Maintenance Check

Check all hoses for cracks, cuts, or collapsing.

NOTE: The silicone engine coolant hose will exhibit swelling due to the elasticity of the hose.



Air Cleaner Element, Paper Type Replace

The illustrations in this section show typical dry type air cleaner parts. The particular engine parts can vary.

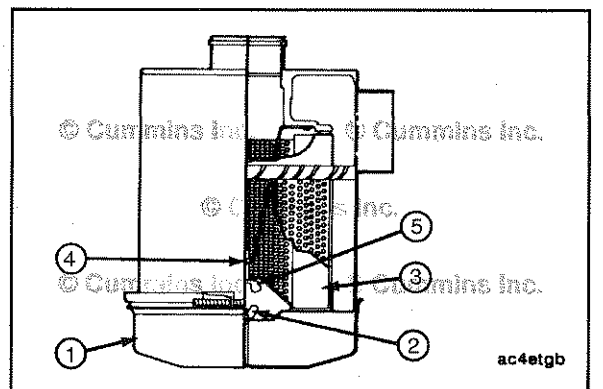
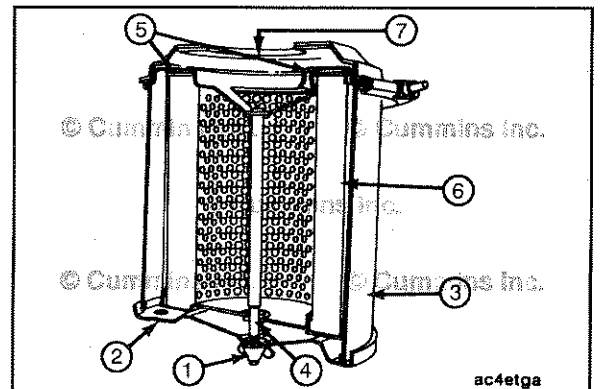
Replace the element if the inlet restriction or vacuum at full power is found to exceed 3.5 kPa [15 in H₂O]. Changing filters or breaking the seal on the intake system more than necessary will result in excess dirt in the engine and **must** be avoided.

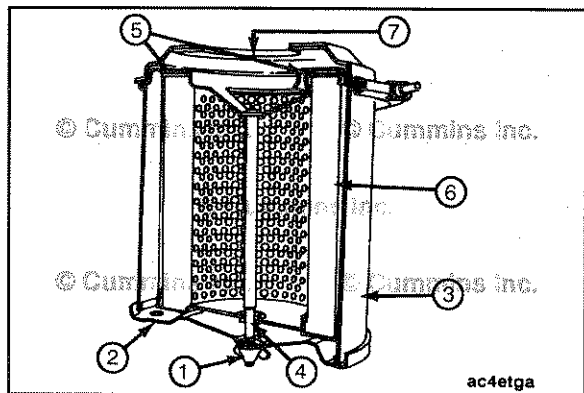
⚠CAUTION⚠

Holes, loose end seals, dented sealing surfaces and other forms of damage render the cleaner inoperative and require immediate element replacement.

Cummins Inc. does **not** recommend cleaning paper type air cleaner elements.

Elements that have been cleaned will clog and air flow to the engine will be restricted.





CAUTION

Pull the cover and the element straight out when removing them from the housing to reduce the possibility of damage to the element.



Remove the wing nut (1) that secures the bottom cover (2) to the cleaner housing (3). Remove the cover.

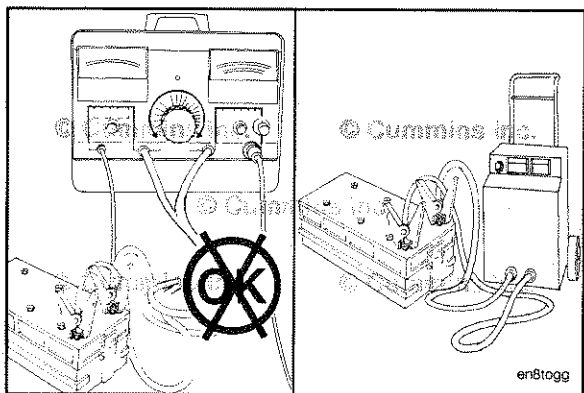


Pull the element (6) down from the center bolt (4).

Remove the gasket (5) from the outlet end (7) of the housing.

Inspect the gasket. Replace the gasket if necessary.

Assemble the bottom cover to the cleaner housing.



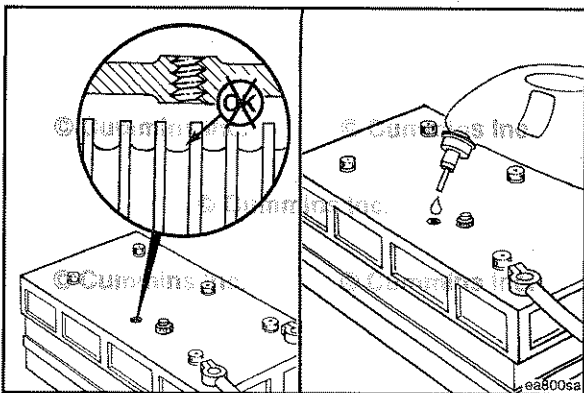
Batteries

Inspect



Use an inductive charging and cranking system analyzer to load-test the state of charge of maintenance-free batteries. If the state of charge is low, use a battery charger to charge the battery. Refer to the manufacturer's instructions.

Replace the battery if it will **not** charge to the manufacturer's specifications or the battery will **not** maintain a charge.



If conventional batteries are used, remove the cell caps or covers and check the electrolyte (water and sulfuric acid solution) level.



WARNING

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

NOTE: Maintenance-free batteries are sealed and do not require the addition of water.

Fill each battery cell with water. Refer to the manufacturer's specifications.

Refer to the accompanying table to determine the battery state of charge based on the specific-gravity readings.

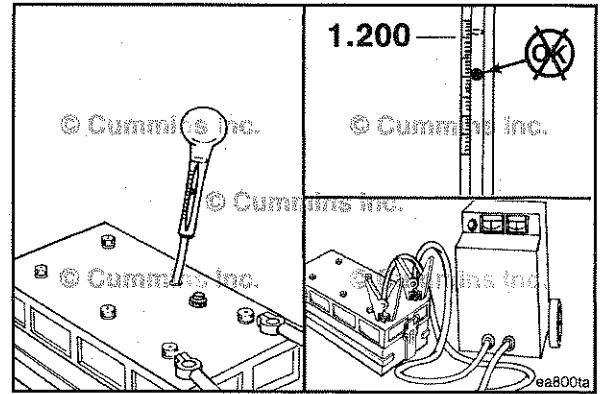
Battery State of Charge	Specific Gravity @ 27°C [80°F]
100%	1.260 to 1.280
75%	1.230 to 1.250
50%	1.200 to 1.220
25%	1.170 to 1.190
Discharged	1.110 to 1.130

Use a hydrometer to measure the specific gravity of each cell.



NOTE: If the specific gravity of any cell is below 1.200, the battery **must** be charged.

NOTE: Do **not** attempt to check the specific gravity of a battery immediately after adding water. If it is necessary to add water to allow use of the hydrometer, charge the battery several minutes at a high rate to mix the electrolyte.

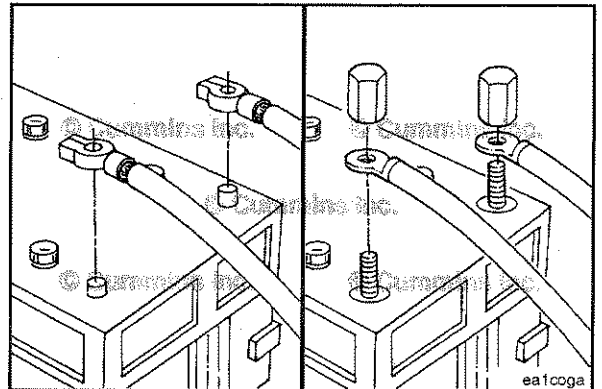


Battery Cables and Connections

Initial Check

There are two possible heavy-duty battery connections:

- Battery terminal and clamp (1)
- Threaded battery terminal and nut (2).



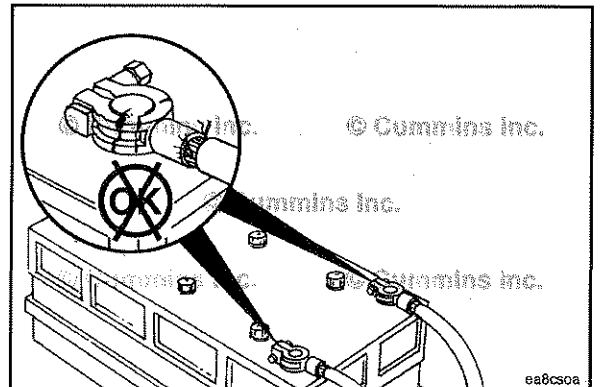
⚠ WARNING ⚠

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.



Remove and inspect the battery cables and connections for cracks or corrosion.

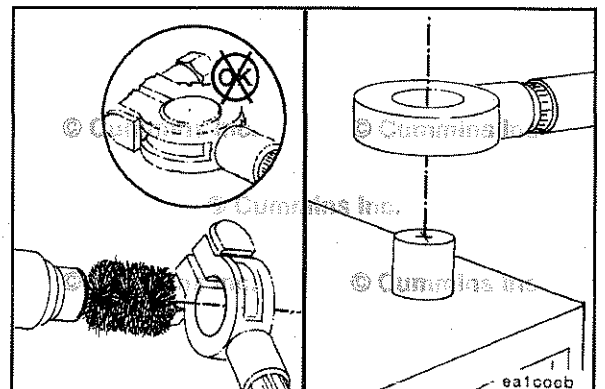
Replace broken terminals, connectors, or cables.

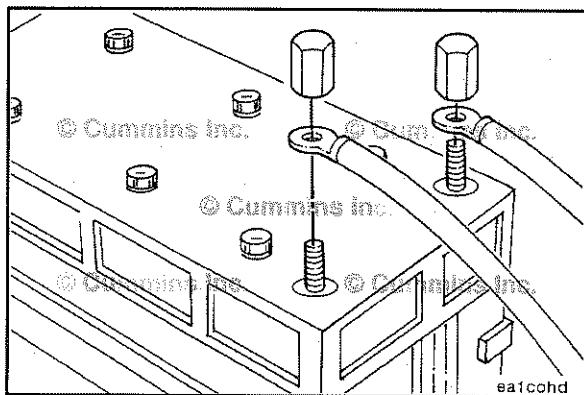


If the connections are corroded, use a battery brush or wire brush to clean the connections until shiny.



Make sure all debris is removed from the connecting surfaces.



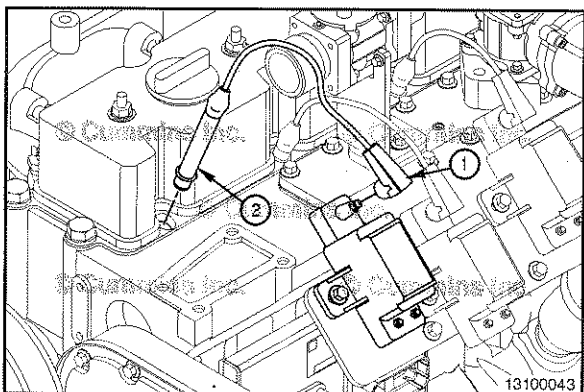


⚠ WARNING ⚠

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 cables and tighten the battery connections.
Coat the terminals with grease to prevent corrosion.



Spark Plug Wire (Non Shielded)

Remove

⚠ WARNING ⚠

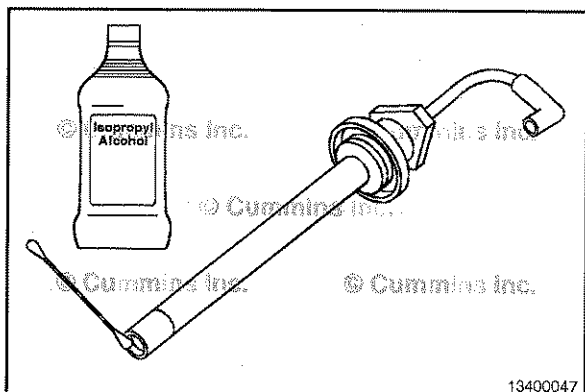
To reduce the possibility of personal injury, do not touch any ignition wires or components while the engine is operating, unless using suitably insulated tools.

⚠ CAUTION ⚠

To reduce the possibility of damage to the spark plug wires, do not pull on the wires. Pull only on the plug boots during removal.

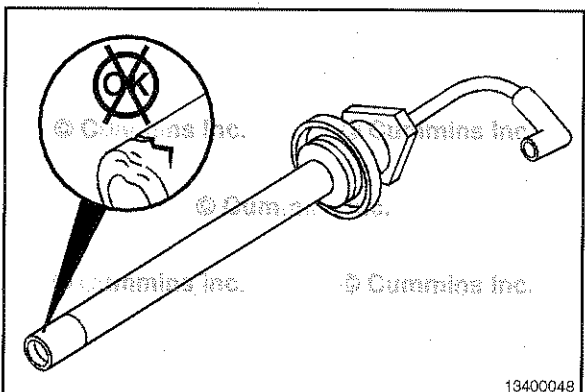
Disconnect the spark plug wire from the ignition coil.

Remove the spark plug adapter.



Clean and Inspect for Reuse

Use a lint free cloth or cotton swab and isopropyl alcohol to clean any excess residue of dielectric lubricant from the spark plug adapter boot.



Inspect the spark plug adapter boot for melting and cracks.

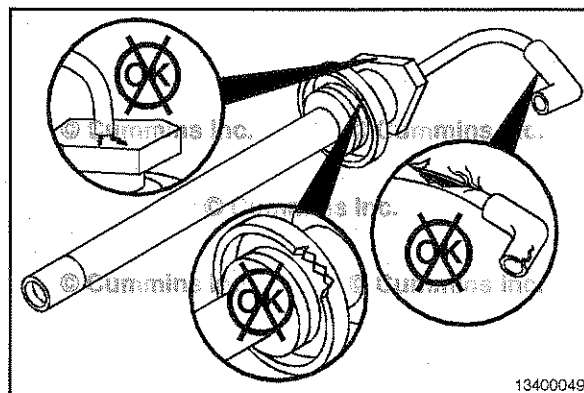
Inspect the spark plug adapter for any cracks and spark carryover.

If any damage is found, replace the spark plug adapter and spark plug wire.

Check the spark plug wire for breaks or fraying.

Check the spark plug adapter rubber boot for damage.

If any damage is found, replace the spark plug adapter and spark plug wire.



Install

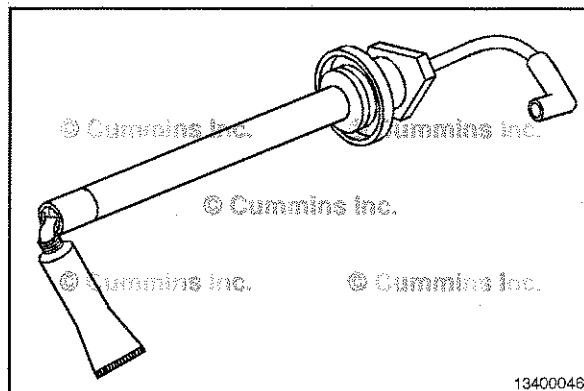
⚠CAUTION⚠

Avoid contact with the boot to prevent contamination of the grease. Dirt can lead to shortened plug life.

NOTE: Replace the spark plug wires one at a time to prevent crossing the wires across cylinders.

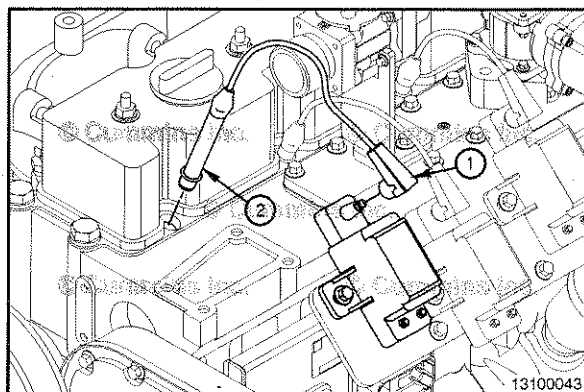
NOTE: Do not apply excessive grease.

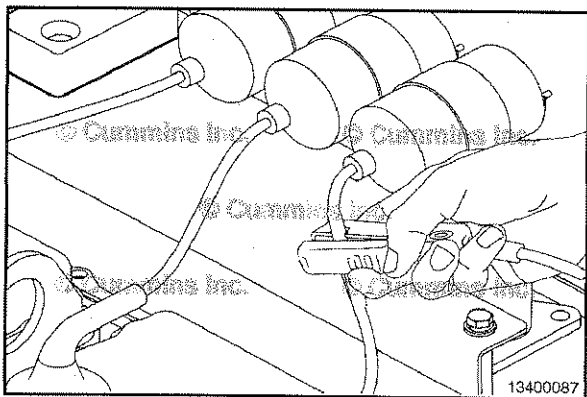
Always apply a small amount of dielectric lubricant to the spark plug adapter boot prior to installation. Dow Corning® Number 4 insulating compound or General Electric® G624 can be used. Outside the United States, if Dow Corning® Number 4 or General Electric® G624 is **not** available, use sealant. This adds to the dielectric seal of the rubber boot and reduces the possibility of the boot melting onto the spark plug.



Install the spark plug wire adapter.

Install the spark plug wire onto the ignition coil.



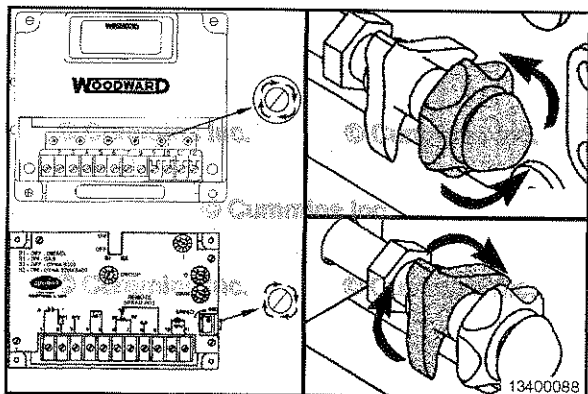


Ignition Timing Adjust

⚠ CAUTION ⚠

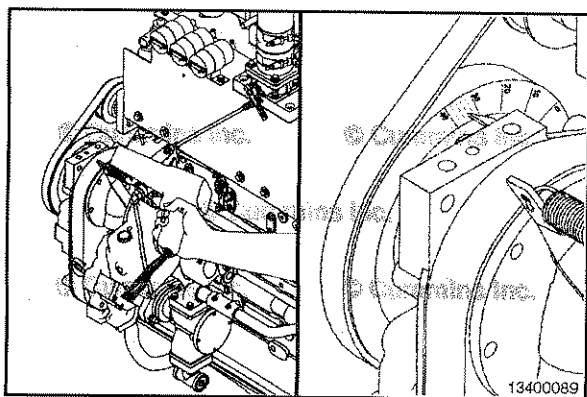
Check that the voltage of the timing light has the same voltage as the battery source, damage to the timing light can occur.

Connect the timing light induction pick up clamp around the spark plug secondary wire for number 1 cylinder and connect the leads to the battery.



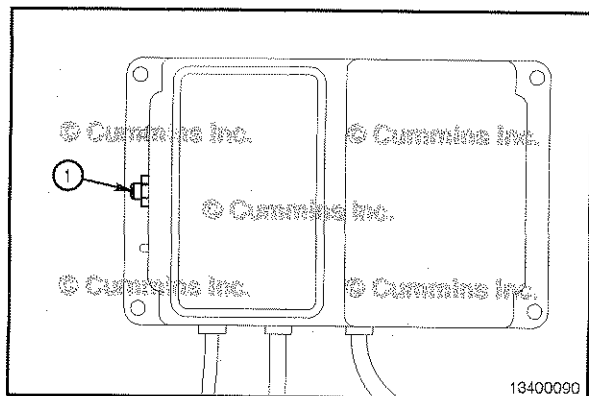
Start the engine and allow it to reach 60°C [140°F] coolant temperature.

Once up to temperature, set the rpm to rated speed.



Point the timing light toward the ignition timing marks on the accessory drive pulley. The timing mark will be illuminated showing the number of degrees before top dead center (BTDC) that the spark is occurring on the cylinder which the timing light is connected to.

Compare the measured timing to the specification for the engine.



Electronic Type

If the ignition timing requires adjustment, use the timing switch (1) located under the plastic white cap at one end of the ignition generator.

⚠CAUTION⚠

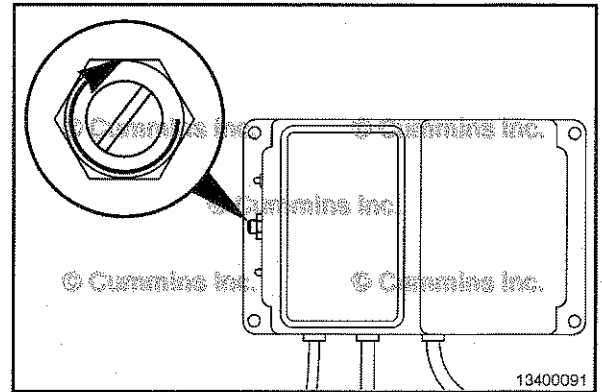
To reduce the possibility of shutting down or damage to the engine, do not switch from position 7 to 0 or 0 to 7 while the engine is running.

NOTE: Switch position 7 gives the most advanced timing, position 0 is full retard timing.

Turn the timing switch one position at a time while observing the timing marks with the timing light until the desired timing is obtained.

To advance the timing, rotate the switch **clockwise**.

To retard the timing, rotate the switch **counterclockwise**.



Engine Mounts

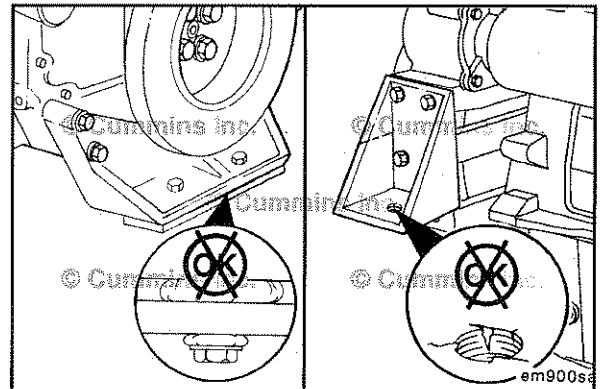
Inspect for Reuse

⚠CAUTION⚠

Damaged engine mounts and brackets can cause engine misalignment. Drivetrain component damage will possibly result in vibration complaints.

Inspect all rubber-cushioned mounts for cracks or damage.

Inspect all mounting brackets for cracks or damaged bolt holes.



This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Section 7 — Maintenance Procedures at 9000 Hours or 2 Years

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Vibration Damper, Rubber	7-1
Inspect.....	7-1
Water Pump	7-5
Maintenance Check.....	7-5

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Maintenance Procedures - Overview

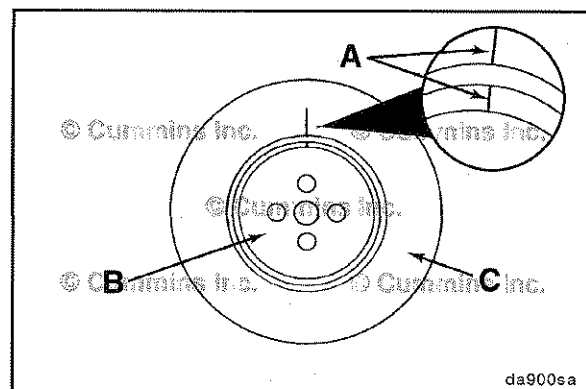
General Information

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.

Vibration Damper, Rubber

Inspect

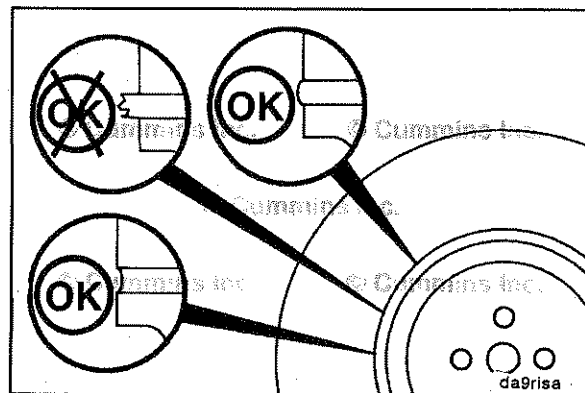
Check the index lines (A) in the vibration damper hub (B) and the inertia member (C). If the lines are more than 1.59 mm [1/16 in] out of alignment, replace the vibration damper.

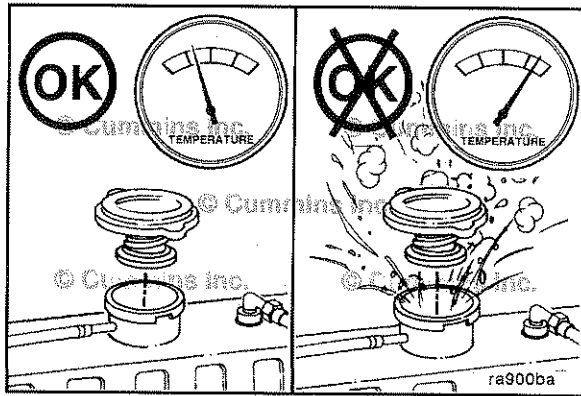


Inspect the rubber member for deterioration. If pieces of rubber are missing or if the elastic member is more than 3.18 mm [1/8 in] below the metal surface, replace the damper.

Look for forward movement on the damper ring on the hub. Replace the vibration damper if any movement is detected.

For vibration damper location, refer to Engine Diagrams in Engine Identification (Section E).





Cooling System Drain

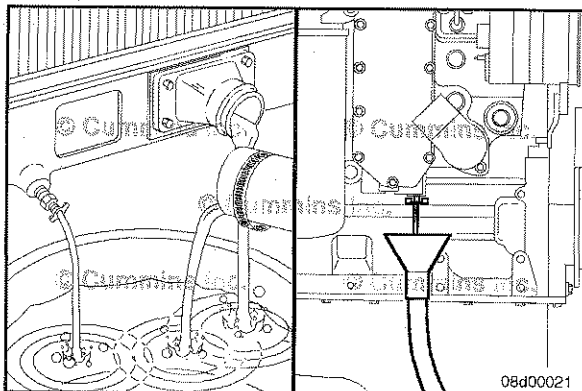
⚠ WARNING ⚠

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.

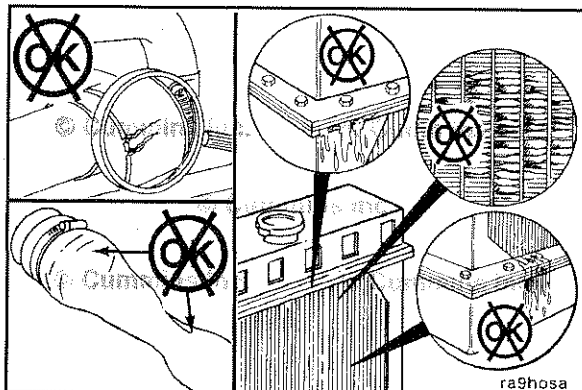
⚠ WARNING ⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

- Avoid excessive contact, and wash thoroughly after contact.
- Keep out of reach of children.



Drain the cooling system by opening the drain valve on the radiator and removing the plug in the bottom of the water inlet hose. A drain pan with a capacity of 19 liters [5 gal] will be adequate for most applications.



Check for damaged hoses and loose or damaged hose clamps. Replace as required.



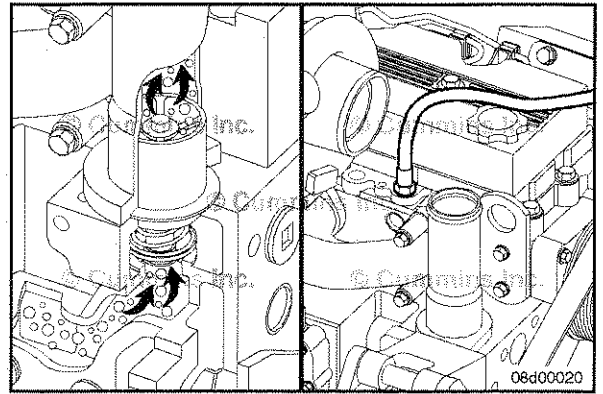
Check the radiator for leaks, damage, and buildup of dirt. Clean and replace as required.

Flush

⚠CAUTION⚠

The system must be filled properly to prevent air locks. During filling, air must be purged from the engine coolant passages. Be sure to open the petcock on the aftercooler for aftercooled engines. Wait 2 to 3 minutes to allow air to be vented; then add mixture to bring the level to the top.

NOTE: Adequate venting is provided for a fill rate of 19 liters [5 gal] per minute.

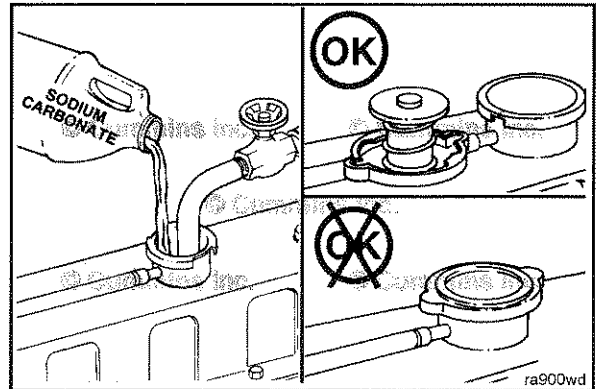


⚠CAUTION⚠

Do not install the radiator cap. The engine is to be operated without the cap for this process.

Fill the system with a mixture of sodium carbonate and water (or a commercially available equivalent).

NOTE: Use 0.5 kg [1 lb] of sodium carbonate for every 23 liters [6 gal] of water.

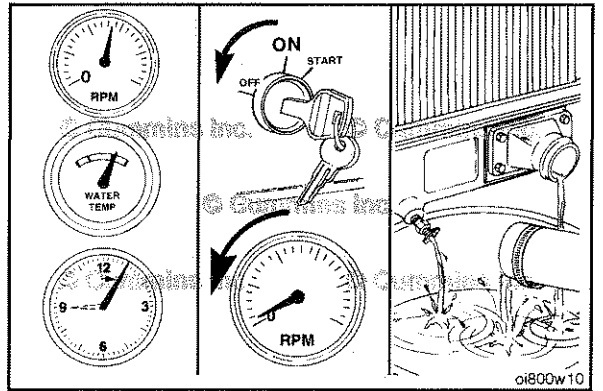


⚠WARNING⚠

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

Operate the engine for 5 minutes with the coolant temperature above 80°C [176°F].

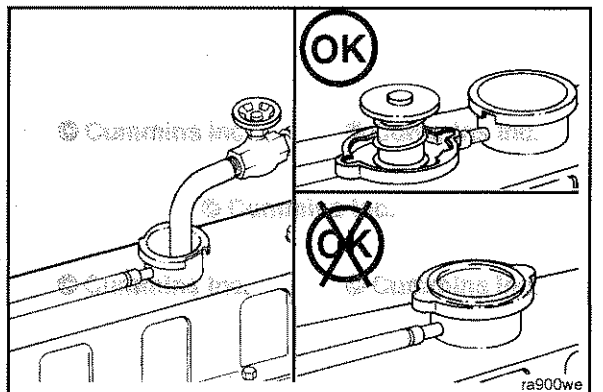
Shut the engine off, and drain the cooling system.

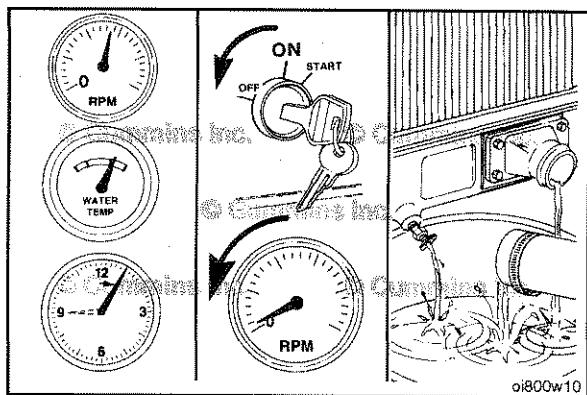


Fill the cooling system with high-quality water.

NOTE: Be sure to vent the engine and aftercooler for complete filling.

NOTE: Do not install the radiator cap or the new coolant filter.

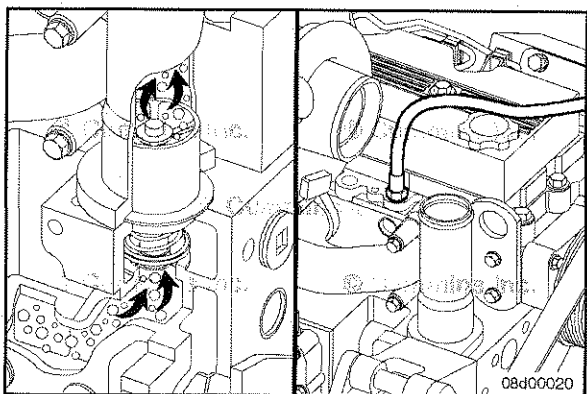




Operate the engine for 5 minutes with the coolant temperature above 80°C [176°F].

Shut the engine off, and drain the cooling system.

NOTE: If the water being drained is still dirty, the system must be flushed again until the water is clean.



Fill

⚠CAUTION⚠

The system must be filled properly to prevent air locks. During filling, air must be purged from the engine coolant passages. Be sure to open the petcock on the aftercooler for aftercooled engines. Wait 2 to 3 minutes to allow air to be vented; then add mixture to bring the level to the top.

The system is designed to use a specific quantity of coolant. If the coolant level is low, the engine will run hot.

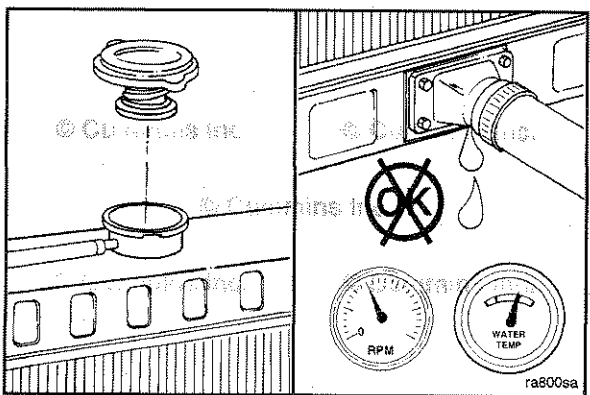
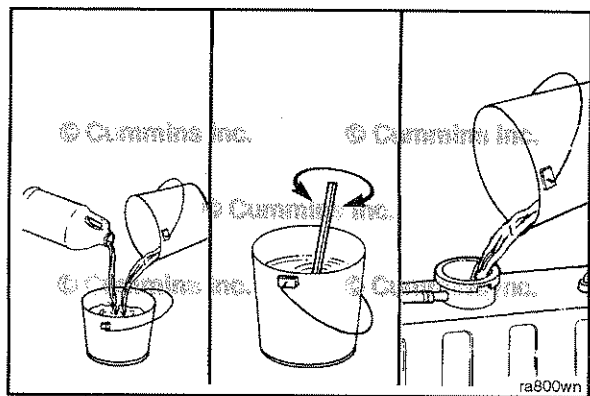
If frequent addition of coolant is necessary, the engine or system has a leak. Find and repair the leak.

The system has a designed fill rate of 19 liters [5 gal] per minute.

⚠CAUTION⚠

Never use water alone for coolant. This can result in damage from corrosion.

Use a mixture of 50-percent water and 50-percent ethylene glycol or propylene glycol antifreeze to fill the cooling system.



⚠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.

Install the pressure cap. Operate the engine until the coolant reaches a temperature of 80°C [180°F], and check for coolant leaks.

Check the coolant level again to make sure the system is full of coolant or that the coolant level has risen to the hot level in the recovery bottle on the system, if so equipped.

Fan Hub, Belt Driven Maintenance Check



Remove the fan drive belt.

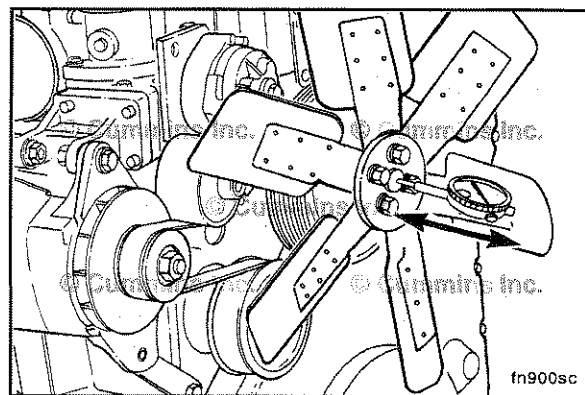
Inspect the fan hub for the following:

- Freedom of rotation
- Cracks
- Grease seal leakage.

Measure the fan hub end clearance.

Fan Hub End Clearance		
mm		in
0.15	MAX	0.006

Replace or rebuild the fan hub if the clearance does **not** meet this specification. See a Cummins® Authorized Repair Location.



Water Pump Maintenance Check

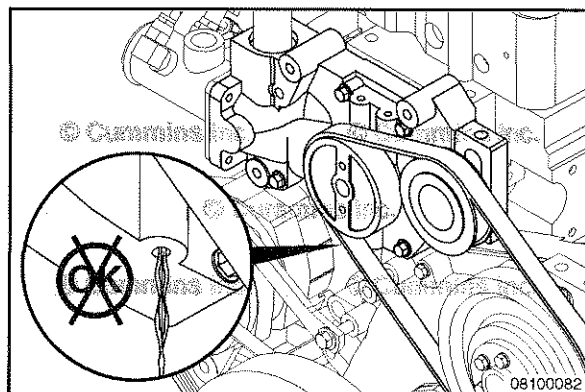


Check the water pump body for indications of water leakage at the weep hole.

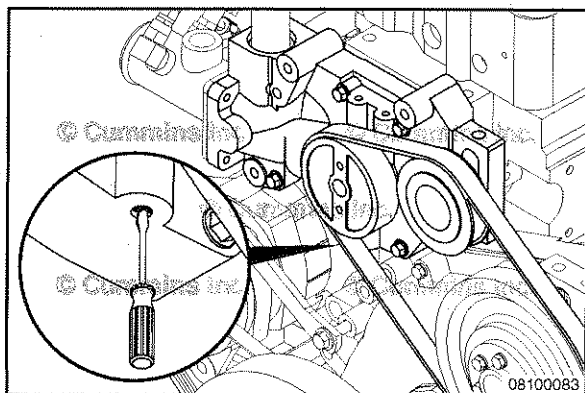


A chemical streak or chemical buildup at the weep hole is **not** justification for water pump replacement. If a steady flow of coolant is observed, replace the water pump with a new or rebuilt unit.

Contact a Cummins® Authorized Repair Location.



Make sure the weep hole is open. A small screwdriver or similar tool can be used to remove any debris.



Notes

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Section A — Adjustment, Repair and Replacement

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Rocker Lever Cover

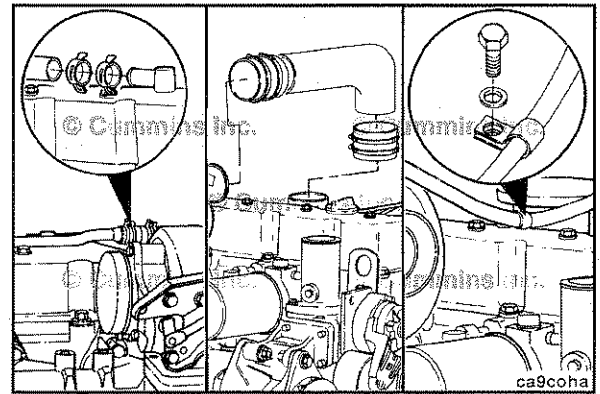
Preparatory Steps

NOTE: Shown throughout this procedure is the C8.3 diesel engine. Although different the procedure remains the same.

Remove the crankcase breather tube and hose. Refer to Procedure 003-018 (Crankcase Breather Tube) in Section 3.

Remove the air crossover tube (if installed). Contact a Cummins® Authorized Repair Location.

Remove the capscrew from the support bracket for the turbocharger wastegate actuator hose (if installed).

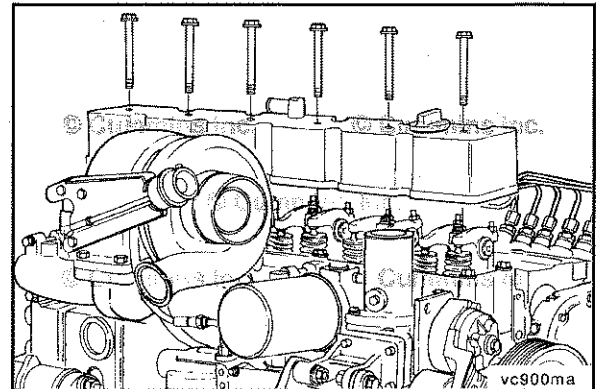


Remove

Remove the six valve cover mounting capscrews.

Discard the sealing o-rings.

Remove the rocker lever cover.



Clean and Inspect for Reuse



WARNING

When using a steam cleaner, wear protective clothing and safety glasses or a face shield. Hot steam can cause serious personal injury.

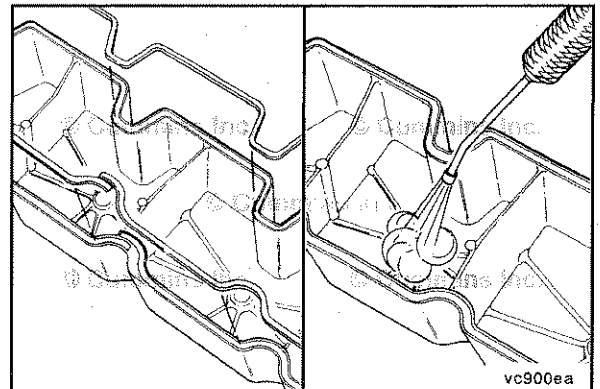


WARNING

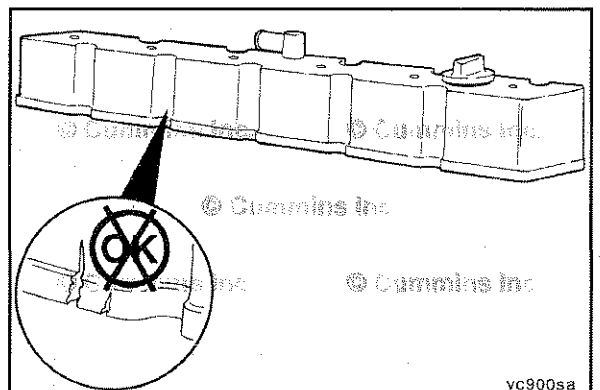
Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

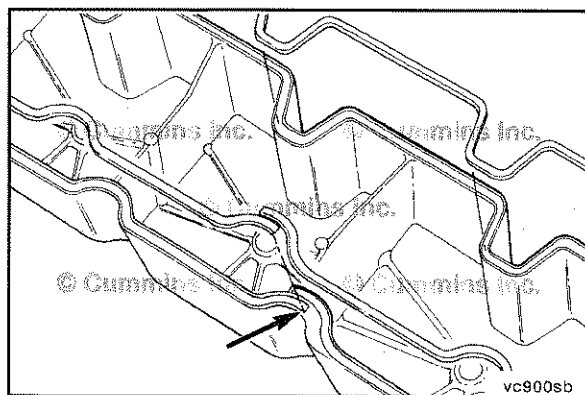
Inspect the seal for damage. Discard the gasket.

Steam-clean and dry with compressed air.



Inspect the cover for cracks or damage and replace if necessary.

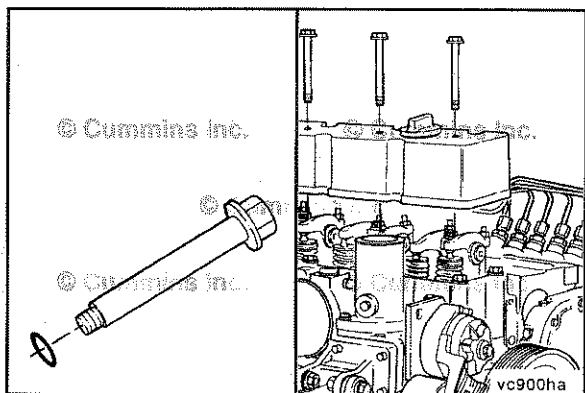




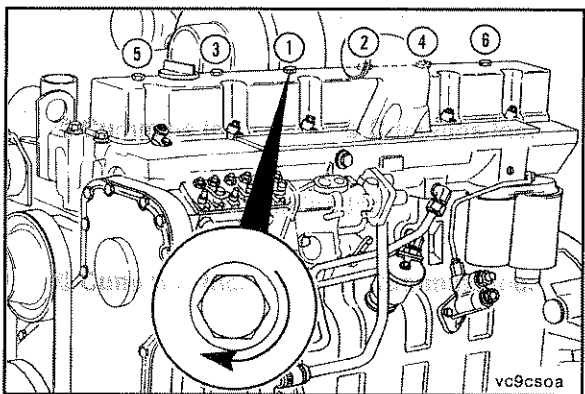
Install

Install the rocker lever gasket into the groove in the rocker lever cover. Start the installation at the overlap area shown in the illustration. Do **not** stretch the rubber rocker lever gasket.

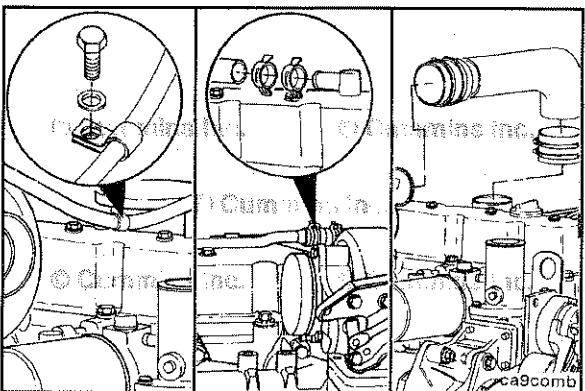
If the rocker lever gasket has more overlap than shown in the illustration, trim the length to provide the correct overlap.



Install new sealing o-rings on the capscrews.
Install the six capscrews into the cover.



Tighten the capscrews in the sequence shown.
Torque Value: 24 N•m [18 ft-lb]



Finishing Steps

Install the cap screw into the support bracket for the turbocharger wastegate actuator hose (if installed).

Install the crankcase breather tube and hose. Refer to Procedure 003-018.

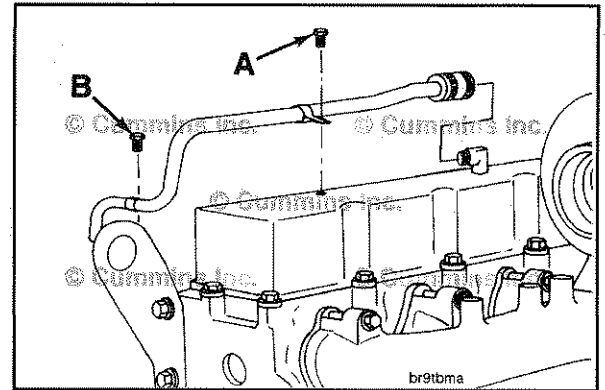
Install the air crossover tube (if installed). Contact a Cummins® Authorized Repair Location.

Crankcase Breather Tube

Remove

Remove the two hose clamps from the crankcase breather.

Remove the two breather tube support bracket capscrews (A and B).



Clean and Inspect for Reuse

⚠ 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.

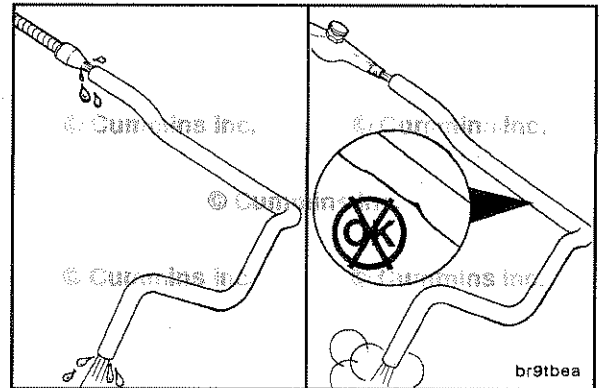
⚠ WARNING ⚠

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

Clean the crankcase breather tube with solvent.

Inspect the hose and tube for restrictions, cracks, or other damage.

Replace the hose and tube if damaged.

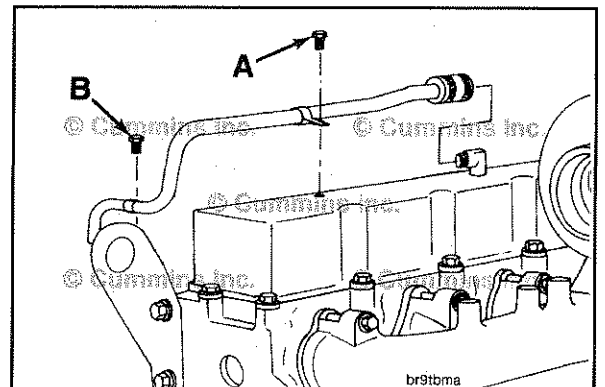


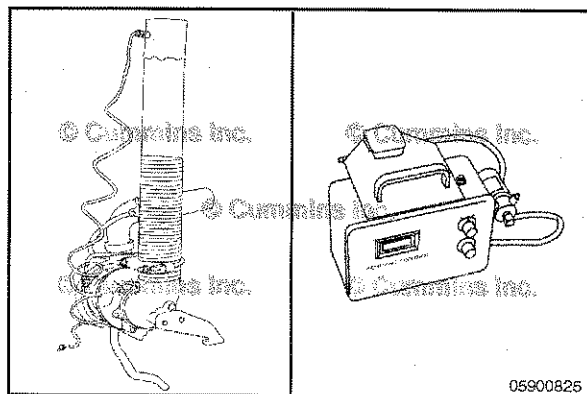
Install

Install the breather tube and hose clamps with the outlet oriented to allow the best routing of a 2.54 cm [1 in] diameter breather hose to the oil pan flange.

Tighten the capscrews for the breather tube support brackets.

Torque Value: Step1	24 N•m	[212 in-lb]
Step2	43 N•m	[381 in-lb]





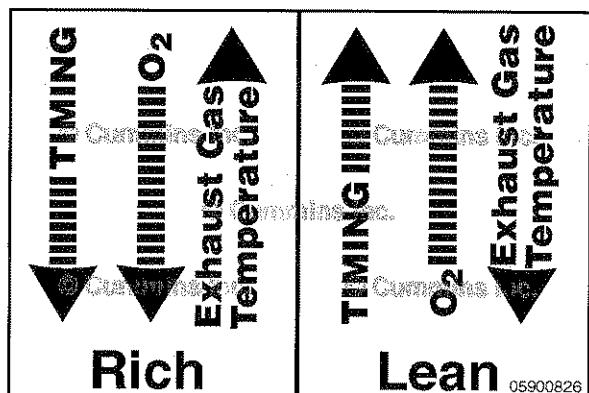
Air/Fuel Mixer

General Information

The proper adjustment of the air/fuel mixer has a direct relationship with the exhaust oxygen (O_2) content.

Exhaust oxygen (O_2) is an indication of the air/fuel ratio. A low exhaust oxygen (O_2) reading indicates a rich air/fuel ratio while a high exhaust oxygen (O_2) indicates a lean condition.

The exhaust oxygen (O_2) is measured by taking a sample of the exhaust gas after the turbocharger, usually at a fitting location in the exhaust stack.



The exhaust gas temperature is an indicator of a rich or lean condition.

At the rated load and speed of the engine, the exhaust temperature is affected by ignition timing, exhaust oxygen (O_2) air/fuel ratio, fuel type, fuel quality, altitude, and ambient temperature. The **only** two of these that are adjustable are timing and exhaust oxygen (O_2).

Both ignition timing and exhaust oxygen (O_2) are inversely related to exhaust temperature. When ignition timing is advanced, exhaust temperature decreases, and when ignition timing is retarded, exhaust inlet temperature increases.

The same is true for exhaust oxygen (O_2). Increasing exhaust oxygen (O_2) indicates a leaner air/fuel mixture and results in decreasing exhaust temperature.

Preparatory Steps

⚠ WARNING ⚠

Natural gas is explosive and flammable. Keep all cigarettes, flames, pilot lights, arcing equipment, and switches out of the work area and areas with shared ventilation to reduce the possibility of severe personal injury or death when working on a natural gas system.

⚠ WARNING ⚠

Natural gas is lighter than air. Check the ceiling of the area where work is to be done for any possible ignition sources.

⚠ WARNING ⚠

Always have proper ventilation when working on a natural gas system.

⚠ 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.

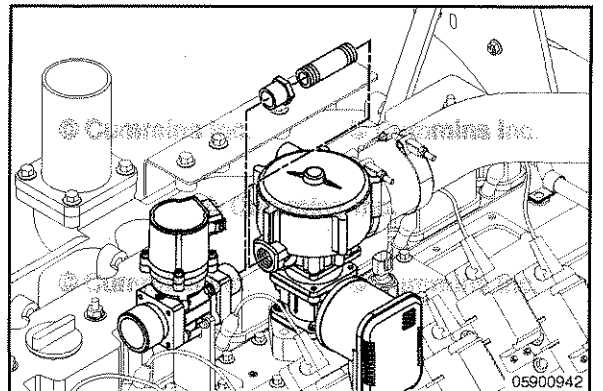
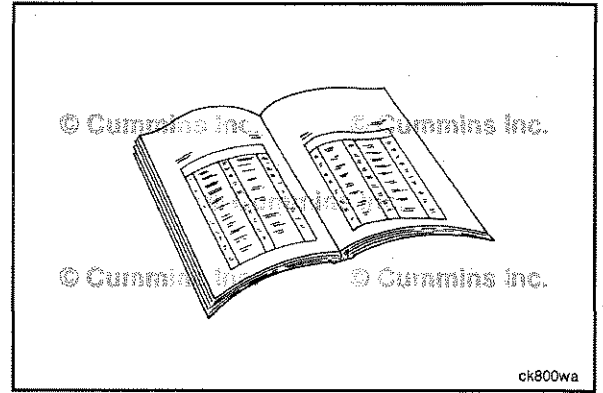
⚠ CAUTION ⚠

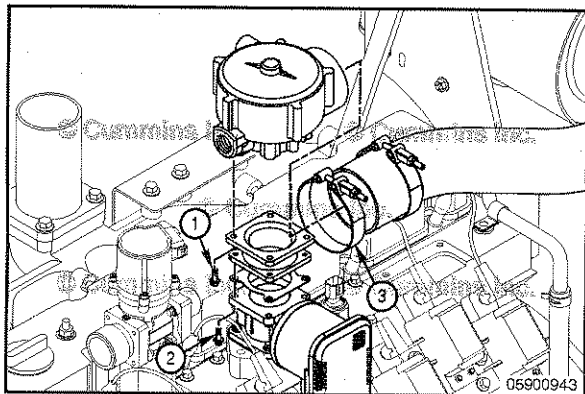
To reduce the possibility of shock loading of components downstream of the supply valve, opening and closing of the gas supply valve must be done slowly.

- Disconnect the batteries. Refer to Procedure 013-009 (Battery Cables and Connections) in Section 6.
- Slowly close the manual gas supply valve. Refer to the OEM installation instructions.

Remove

Remove the fuel supply line connecting the fuel regulator to the air/fuel mixer power valve.



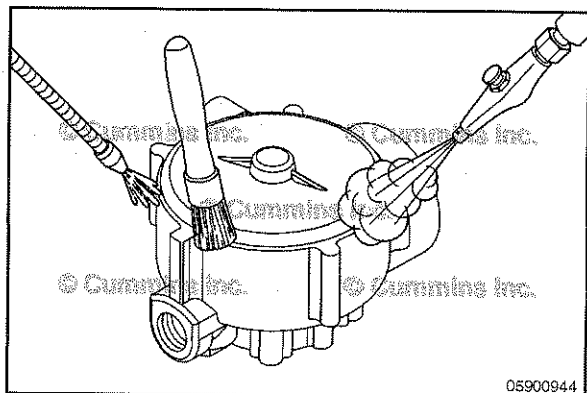


Remove the following capscrews and hose clamps:

1. Air/fuel mixer to the air/fuel mixer power valve (7/16 capscrews).
2. Air/fuel mixer power valve to the throttle (7/16 capscrews).
3. Hose clamp connecting air cleaner tube to air/fuel mixer inlet.

Remove and separate the air/fuel mixer from the air/fuel mixer power valve.

Discard the gaskets.



Clean and Inspect for Reuse

▲ WARNING ▲

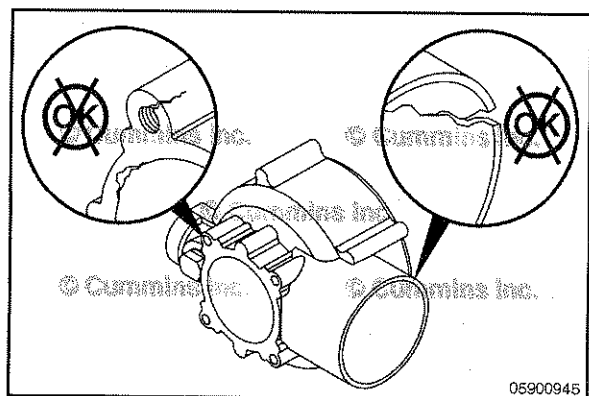
When using solvents, acids, or alkaline materials for cleaning, follow the manufacturer's recommendations for use. Wear goggles and protective clothing to reduce the possibility of personal injury.

▲ WARNING ▲

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

Use solvent to clean the air/mixer valve. Use a soft bristle brush for heavy deposits.

Dry using compressed air.



Inspect the air/fuel mixer body for any signs of damage.

Inspect the flange areas for cracks or damaged capscrew holes.

Install

Use new gaskets, assemble the air/fuel mixer and the air/fuel mixer power valve, use four 7/16 capscrews. Hand tighten **only**.

Install the air/fuel mixer onto the engine. Install the following capscrews and hose clamps hand tight:

- Four 7/16 capscrews connecting the throttle to the air/fuel mixer power valve.
- Four 7/16 capscrews connecting the air/fuel mixer to the air cleaner tube.
- Hose clamp connecting air cleaner tube to air/fuel mixer inlet.

Tighten the capscrews

Torque Value:

7/16 capscrews 27 N•m [240 in-lb]

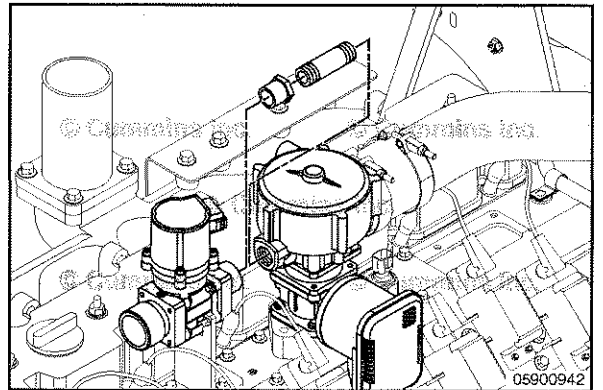
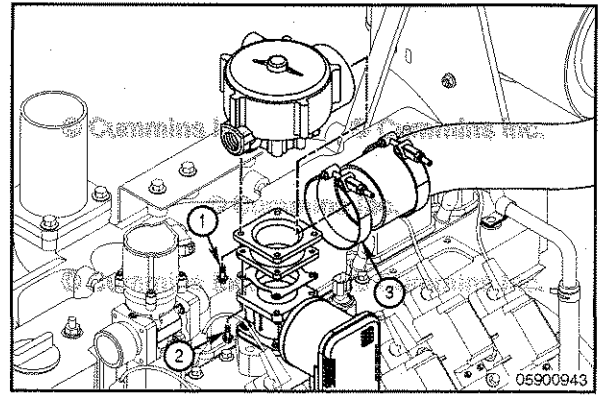
Torque Value:

3/8 capscrews 61 N•m [45 ft-lb]

Torque Value:

Hose clamps 7 N•m [62 in-lb]

Install the fuel supply line connecting the fuel regulator to the air/fuel mixer power valve.



Finishing Steps



WARNING

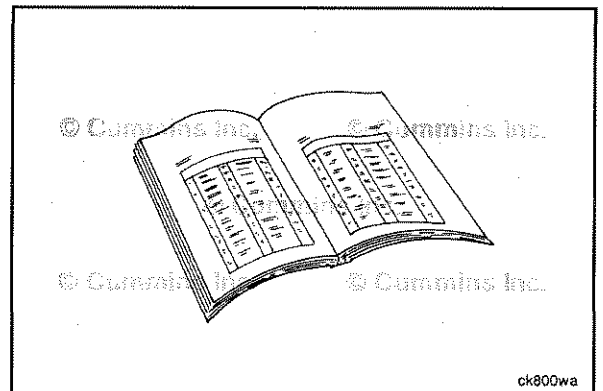
Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

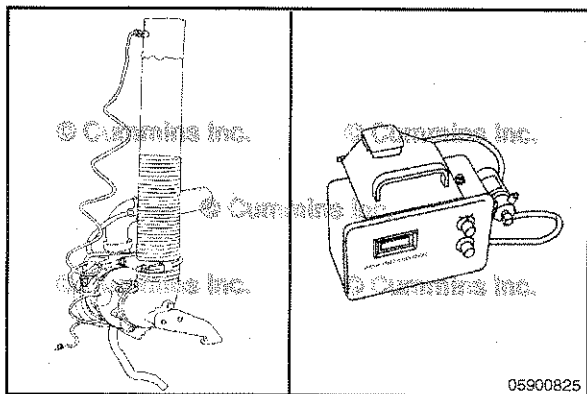


CAUTION

To reduce the possibility of shock loading of components downstream of the supply valve, opening and closing of the gas supply valve must be done slowly.

- Slowly open the fuel supply valve. Refer to OEM installation instructions.
- Connect the batteries. Refer to Procedure 013-009 (Battery Cables and Connections) in Section 6.





Adjust

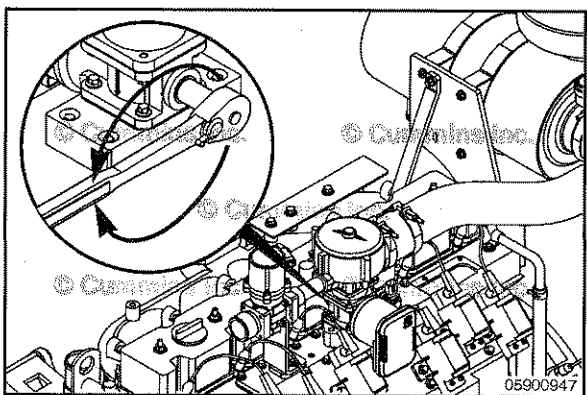
Determine the correct exhaust oxygen (O_2) specifications from the Fuel System Operating Specifications and Derates table in Section V of this manual.

Install the Exhaust Oxygen (O_2) meter. Refer to the manufacturer's operating instructions.

Start the engine. Refer to Procedure 101-014 (Normal Starting Procedure) in Section 1. Operate the engine until the coolant temperature reaches 60°C [140°F].

Once to operating temperature, raise the engine rpm to rated speed and load.

Measure the Exhaust Oxygen (O_2), use an oxygen meter. Contact a Cummins® Authorized Repair Location.



Adjust the exhaust oxygen (O_2) by turning the power valve on the carburetor.

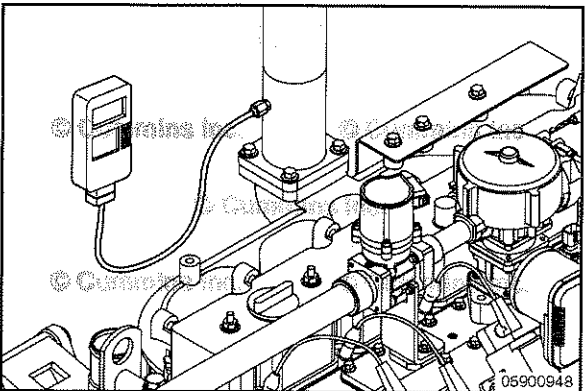
NOTE: Shown is a hex head adjustment screw. Allen adjustment screws are also used on some models.

Turn the valve **clockwise** to lean the air/fuel mixture, which will cause the exhaust oxygen (O_2) reading to increase.

Turn the valve **counterclockwise** to richen the air/fuel mixture, which will cause the exhaust oxygen (O_2) reading to decrease.

Allow adequate time between adjustments for the oxygen meter to react to the new condition. This can take up to 30 seconds.

Adjustment is complete when the meter displays the correct specifications for 30 seconds at the rated engine conditions.



Measure the exhaust temperature.

It will be necessary to adjust (advance) the ignition timing to reduce the exhaust temperature. Contact a Cummins® Authorized Repair Location.

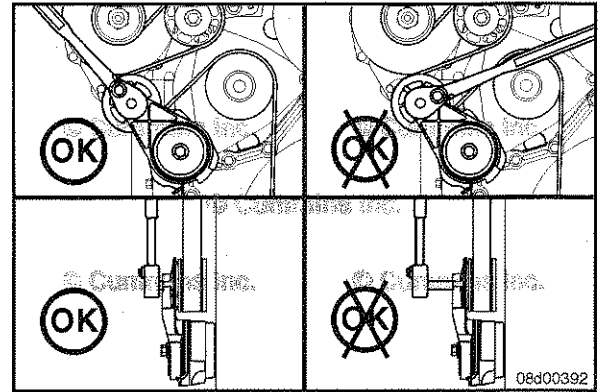
Drive Belt, Cooling Fan

Remove

⚠CAUTION⚠

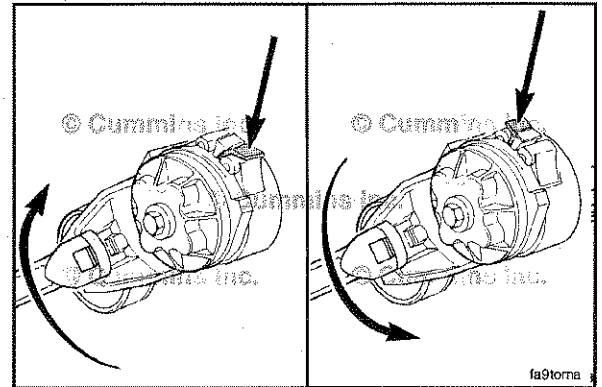
Using a socket extension is not recommended because it can cause axial twisting damage to the belt tensioner.

NOTE: If a socket extension is necessary, support the head of the ratchet with one hand to prevent the belt tensioner arm from being subjected to unintended loading.



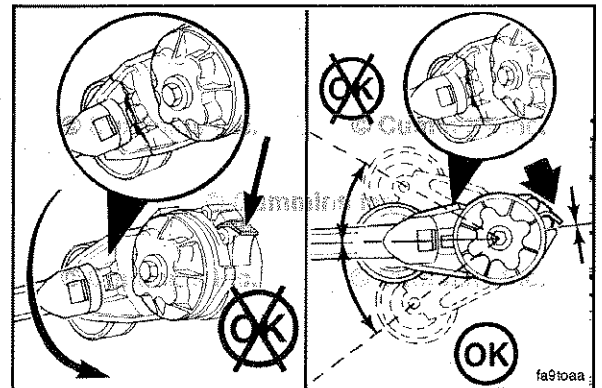
Lift the tensioner to remove the drive belt.

NOTE: The belt tensioner winds in the direction that the spring tang is bent over the tensioner body. To loosen the tension on the belt, rotate the tensioner to wind the spring tighter.



⚠CAUTION⚠

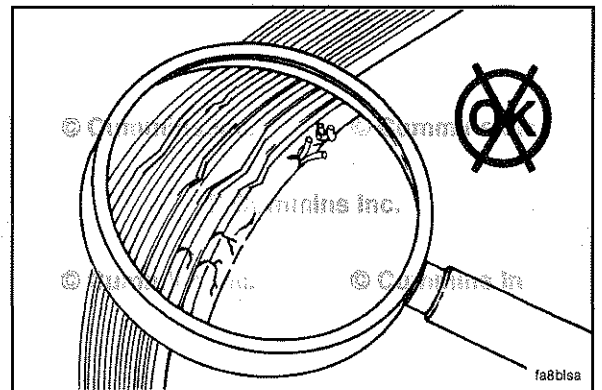
Applying excessive force in the opposite direction of windup or after the tensioner has been wound up to the positive stop can cause the tensioner arm to break.

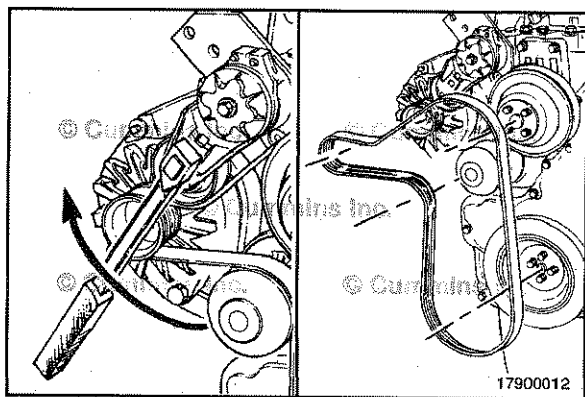


Inspect for Reuse

Inspect the drive belt for:

- Cracks
- Glazing
- Tears or cuts
- Hardening
- Excessive wear.





Install

⚠CAUTION⚠

The belt tensioner is spring-loaded and must be pivoted away from the drive belt. Pivoting in the wrong direction can result in damage to the belt tensioner.

Lift the tensioner to install the drive belt.

Exhaust Catalyst 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 ⚠

Acid is extremely dangerous and can damage the machinery and can also cause serious burns. Always provide a tank of strong soda water as a neutralizing agent when servicing the batteries. Wear goggles and protective clothing to reduce the possibility of serious personal injury.

⚠ WARNING ⚠

Not all types of Natural Gas are treated with an odorant. Gas leaks from a non-refined source, such as Landfill Gas, Biogas, Coal Bed Gas or Wellhead Gas, can not always be detected by smell.

⚠ WARNING ⚠

Natural gas is explosive and flammable. Keep all cigarettes, flames, pilot lights, arching equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on a natural gas fuel system.

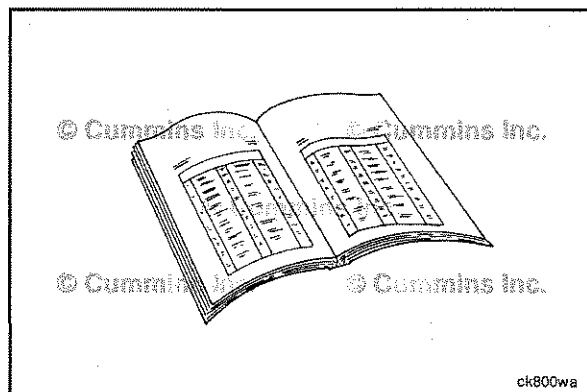
⚠ WARNING ⚠

When working on a natural gas system, always have proper ventilation.

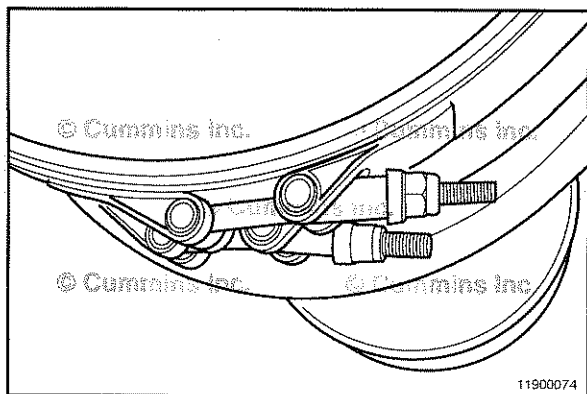
⚠ WARNING ⚠

The exhaust and exhaust components can remain hot after the engine has shut down. To reduce 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.

- Shut down the engine. Refer to the OEM installation instructions.
- Disconnect the batteries. Refer to Procedure 013-009 (Battery Cables and Connections) in Section 6.
- Shut off the fuel supply to the engine. Refer to the OEM installation instructions.



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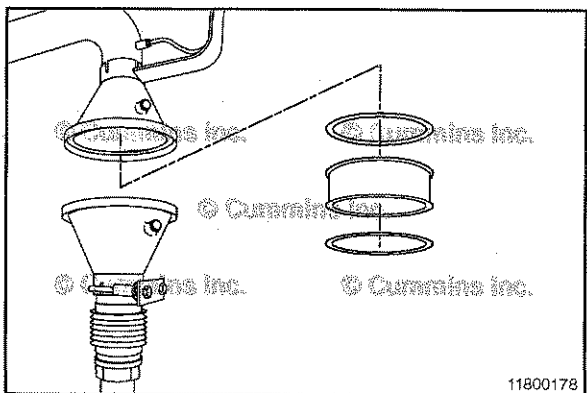
Remove



WARNING

This component or assembly weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.

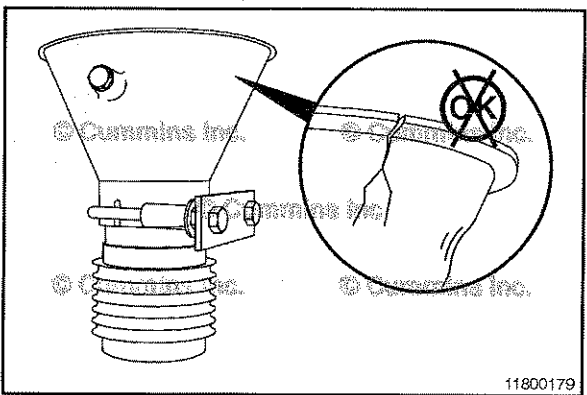
Remove the V-band clamps.



Remove the catalyst module.

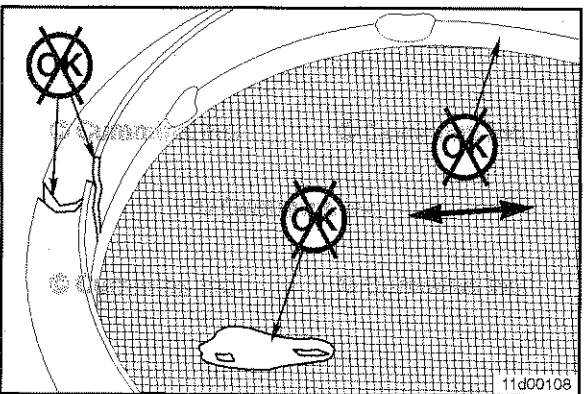
Remove all gasket material from the inlet and outlet sections.

Discard the gaskets.



Inspect for Reuse

Check the inlet and outlet sections for any cracks or other damage. Replace if necessary.



Check the inlet and outlet face of the catalyst section for oil or coolant buildup.

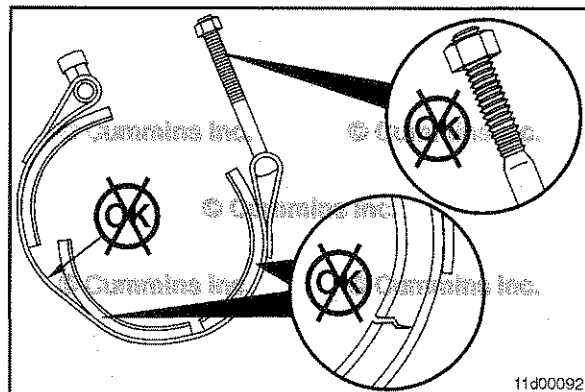


Refer to Service Bulletin, Catalyst Muffler for Service Use Only, Bulletin 3666243 for more information in determining if the catalyst needs to be replaced.

Inspect the V-band clamps for signs of over-extension. The band **must not** be bent or damaged.

Inspect the V-band clamp threads for damage.

Replace the V-band clamp if damage is found.



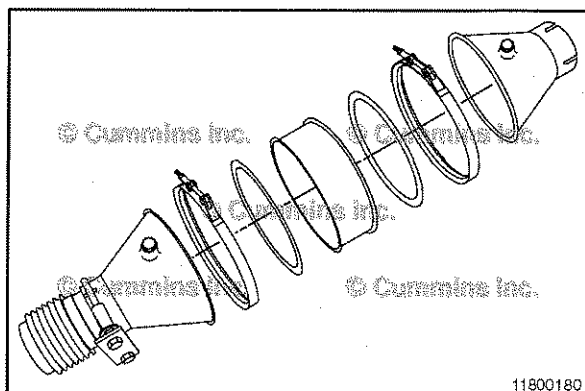
Install

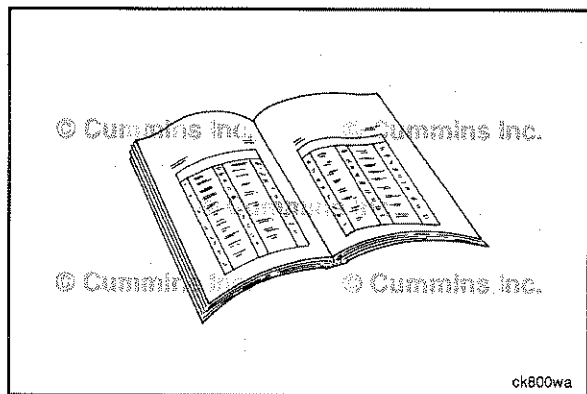
NOTE: Some applications can use a dual catalyst module.

Use the V-band clamps and new gaskets to assemble the sections of the catalyst assembly.

Tighten the V-band clamps.

Torque Value: 20 N•m [177 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.

⚠ WARNING ⚠

Acid is extremely dangerous and can damage the machinery and can also cause serious burns. Always provide a tank of strong soda water as a neutralizing agent when servicing the batteries. Wear goggles and protective clothing to reduce the possibility of serious personal injury.

⚠ WARNING ⚠

Not all types of Natural Gas are treated with an odorant. Gas leaks from a non-refined source, such as Landfill Gas, Biogas, Coal Bed Gas or Wellhead Gas, can not always be detected by smell.

⚠ WARNING ⚠

Natural gas is explosive and flammable. Keep all cigarettes, flames, pilot lights, arching equipment, and switches out of the work area and areas sharing ventilation to reduce the possibility of severe personal injury or death when working on a natural gas fuel system.

⚠ WARNING ⚠

When working on a natural gas system, always have proper ventilation.

⚠ WARNING ⚠

The exhaust and exhaust components can remain hot after the engine has shut down. To reduce 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.

- Connect the batteries. Refer to Procedure 013-009 (Battery Cables and Connections) in Section 6.
- Turn on the fuel supply to the engine. Refer to the OEM installation instructions.
- Start the engine and check for leaks. Refer to the OEM installation instructions.

Starting Motor 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 ground cable from the battery terminal.
- Identify each electrical wire with a tag indicating location.

Remove

Remove the battery cable from the solenoid.
Remove all other wires connected to the starter.

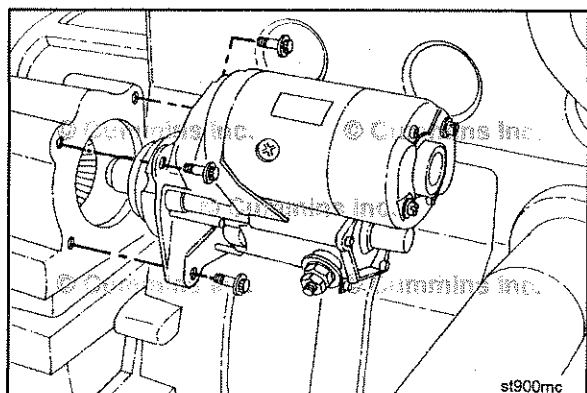
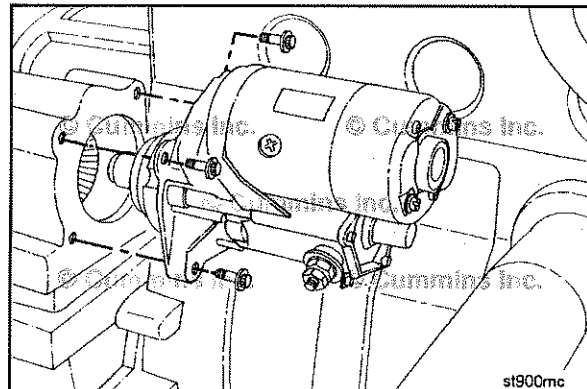
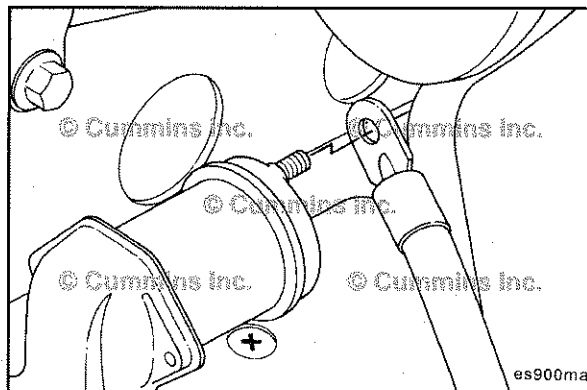
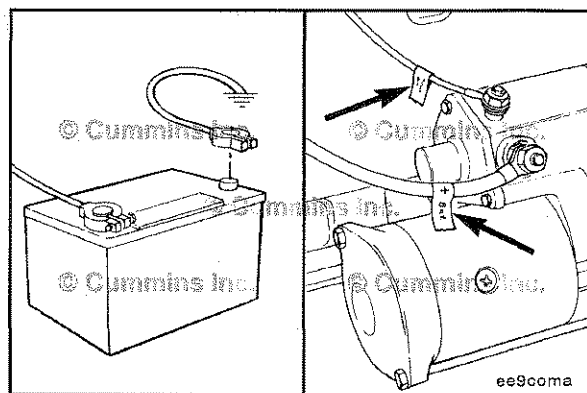
Remove the starter motor.

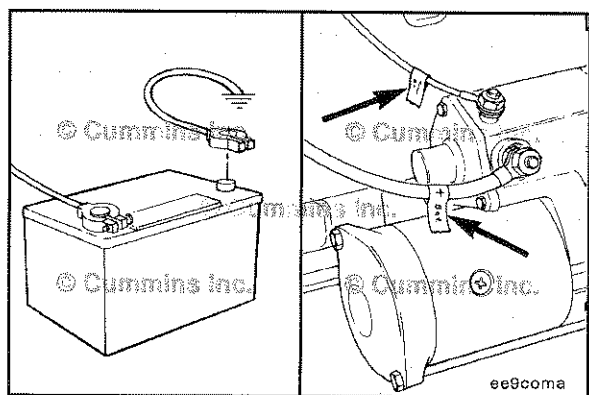
Install

Install the starter motor.

Torque Value: 43 N•m [32 ft-lb]

Connect all cables and all other wires connected to the starter.





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 ground cable from the battery terminal.

Section D — System Diagrams

Section Contents

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Flow Diagram.....	D-11
Flow Diagram, Fuel System	D-2
Flow Diagram.....	D-2
Flow Diagram, Lubricating Oil System	D-3
Flow Diagram.....	D-3
System Diagrams - Overview	D-1
General Information.....	D-1

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System Diagrams - Overview

General Information

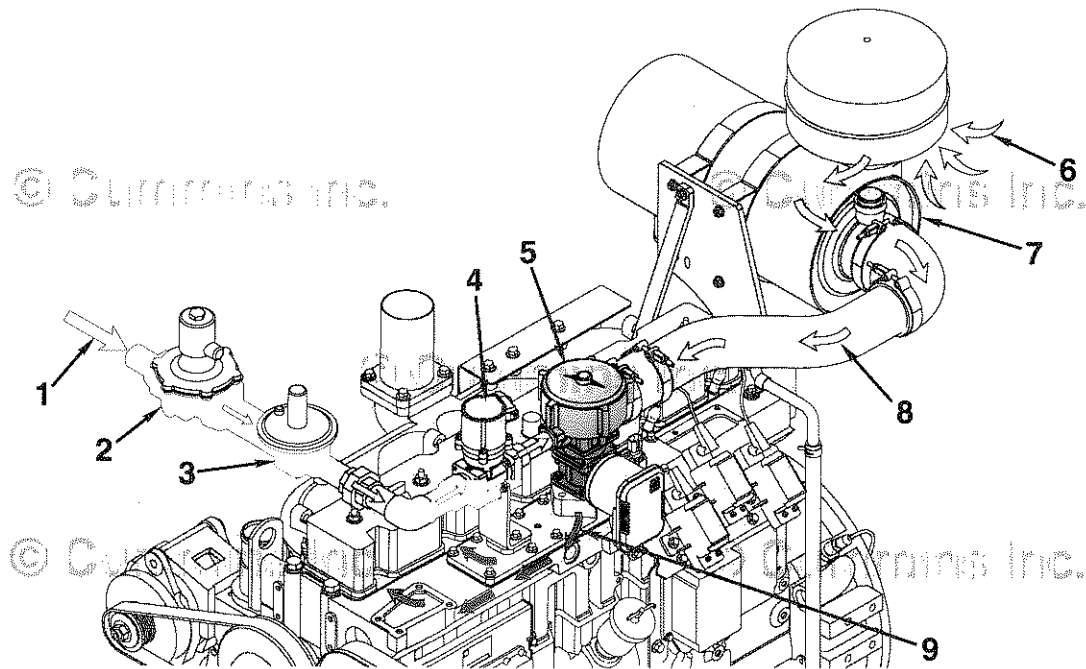
The following drawings show the flow through the engine systems. Although parts can change between different applications and installations, the flow remains the same. The systems shown are:

- Fuel System
- Lubricating Oil System
- Coolant System
- Intake Air System
- Exhaust System
- Compressed Air System.

Knowledge of the engine systems can help you in troubleshooting, service, and general maintenance of your engine.

Flow Diagram, Fuel System

Flow Diagram



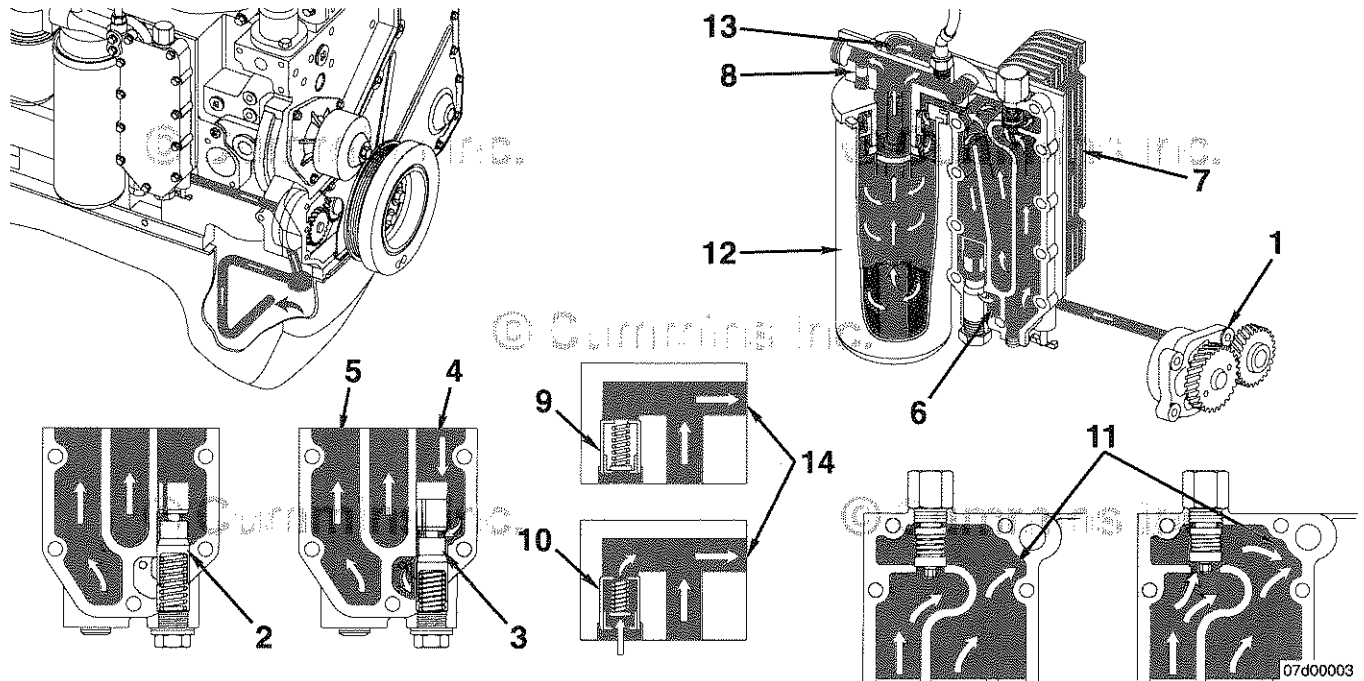
G8.3 CM558

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1. Fuel inlet
2. Fuel shutoff valve
3. Pressure regulator valve
4. Fuel control valve
5. Air/fuel mixer
6. Air inlet to air cleaner
7. Air cleaner
8. Air inlet to air/fuel mixer
9. Air/fuel flow to intake manifold.

Flow Diagram, Lubricating Oil System

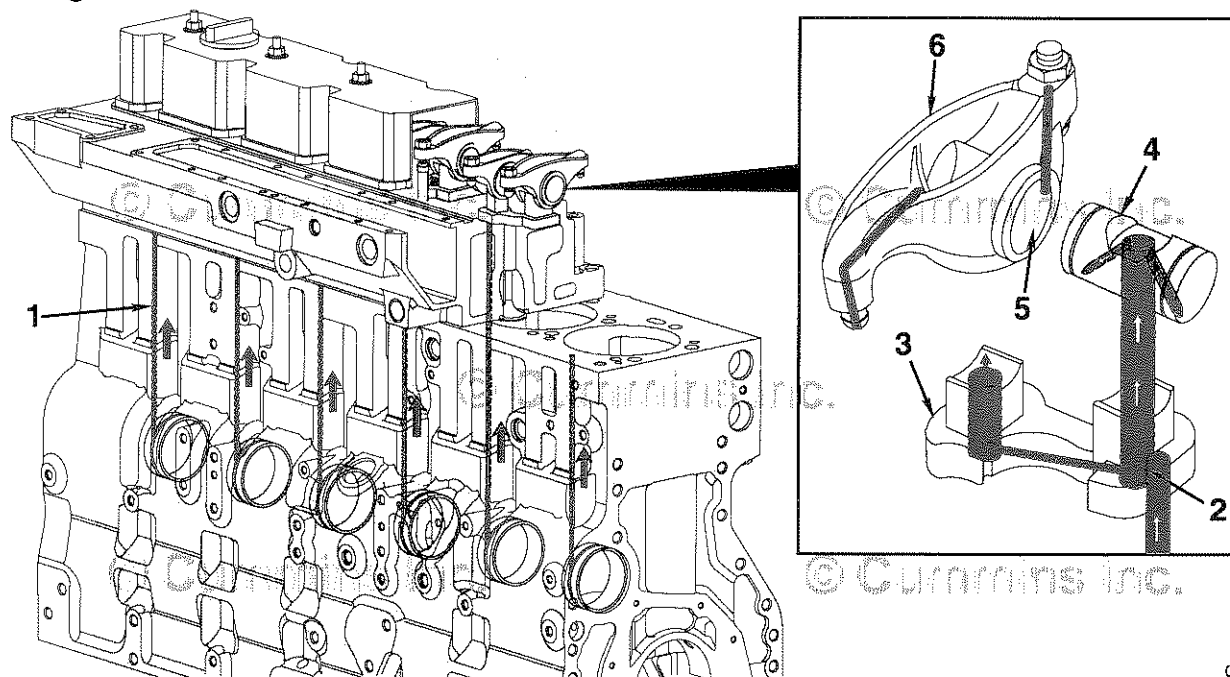
Flow Diagram



1. Gerotor lubricating oil pump
2. Pressure regulating valve closed
3. Pressure regulating valve open
4. From lubricating oil pump
5. To lubricating oil cooler
6. To lubricating oil pump oil pan
7. Lubricating oil cooler
8. Filter bypass valve
9. Filter bypass valve closed
10. Filter bypass valve open
11. To lubricating oil filter
12. Full-flow lubricating oil filter
13. From lubricating oil filter
14. Main lubricating oil rifle.

Flow Diagram, Lubricating Oil System

Flow Diagram

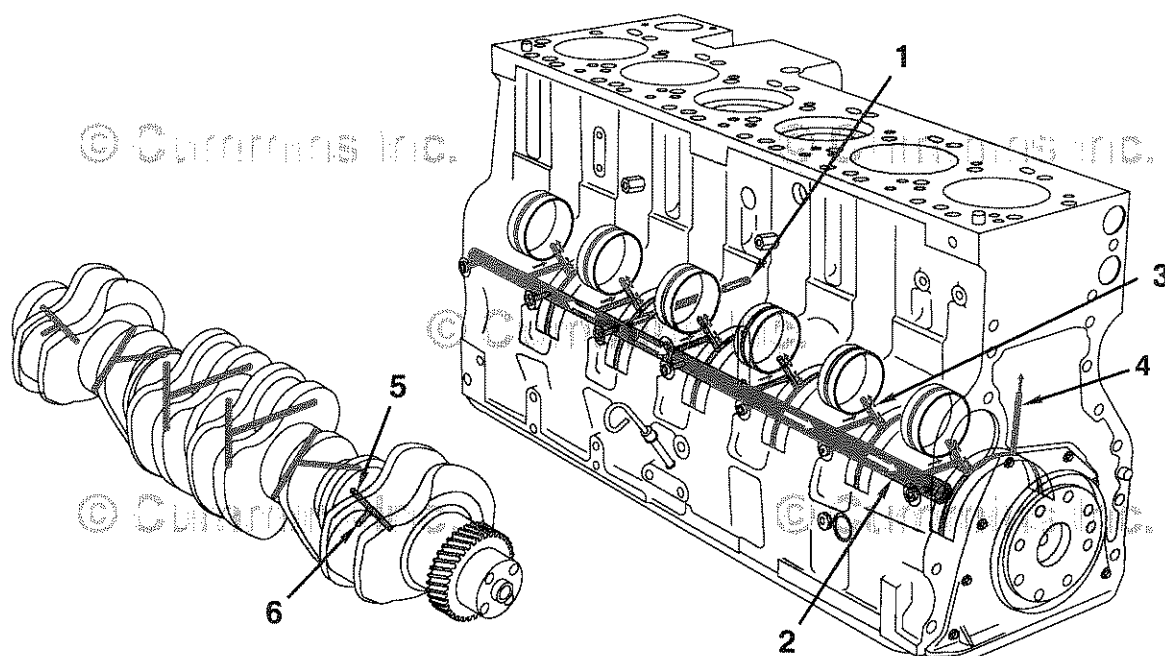


1. From cam bushings
2. Transfer slot
3. Rocker lever support
4. Rocker lever shaft
5. Rocker lever bore
6. Rocker lever.

07900335

Flow Diagram, Lubricating Oil System

Flow Diagram

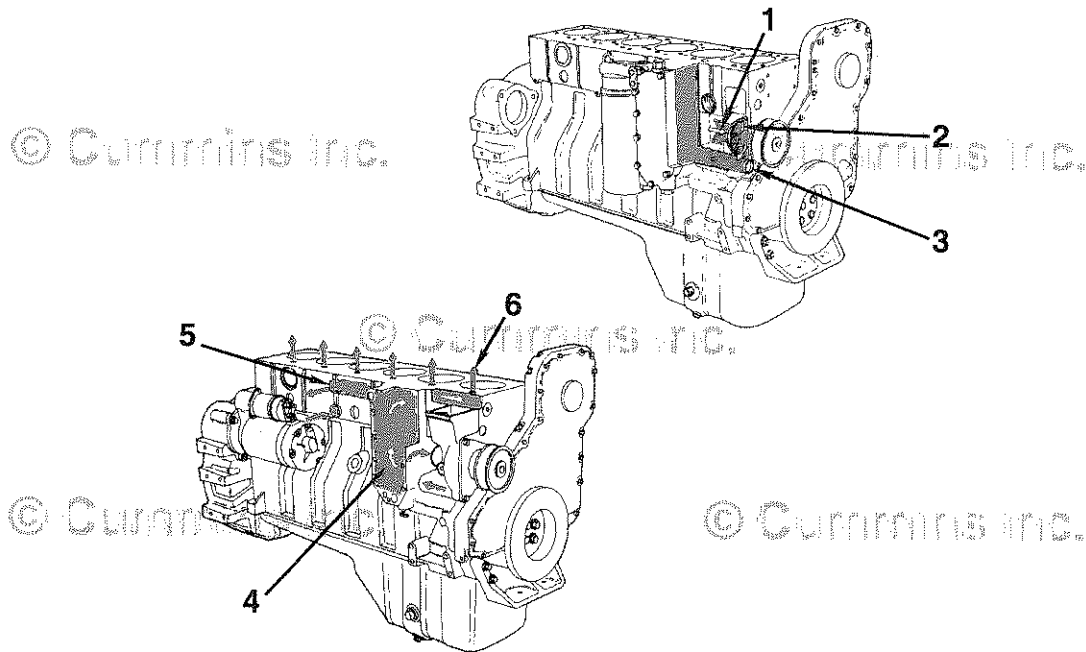


07d00001

1. From lubricating oil cooler
2. Main lubricating oil rifle
3. To camshaft
4. To piston cooling nozzle
5. From main lubricating oil rifle
6. To connecting rod bearing.

Flow Diagram, Cooling System

Flow Diagram



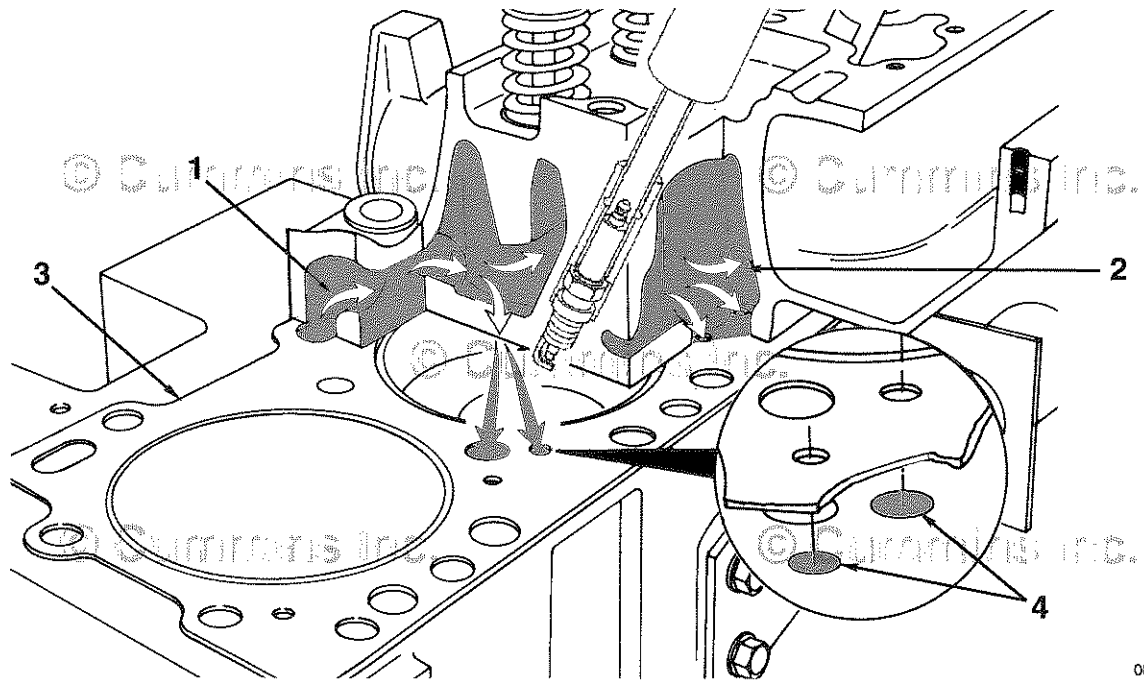
Engine Coolant Flow through Cylinder Block

08900201

1. Coolant inlet
2. Water pump impeller
3. Coolant flow to oil cooler
4. Coolant flow past oil cooler
5. Upper coolant manifold
6. Coolant flow to cylinder head.

Flow Diagram, Cooling System

Flow Diagram



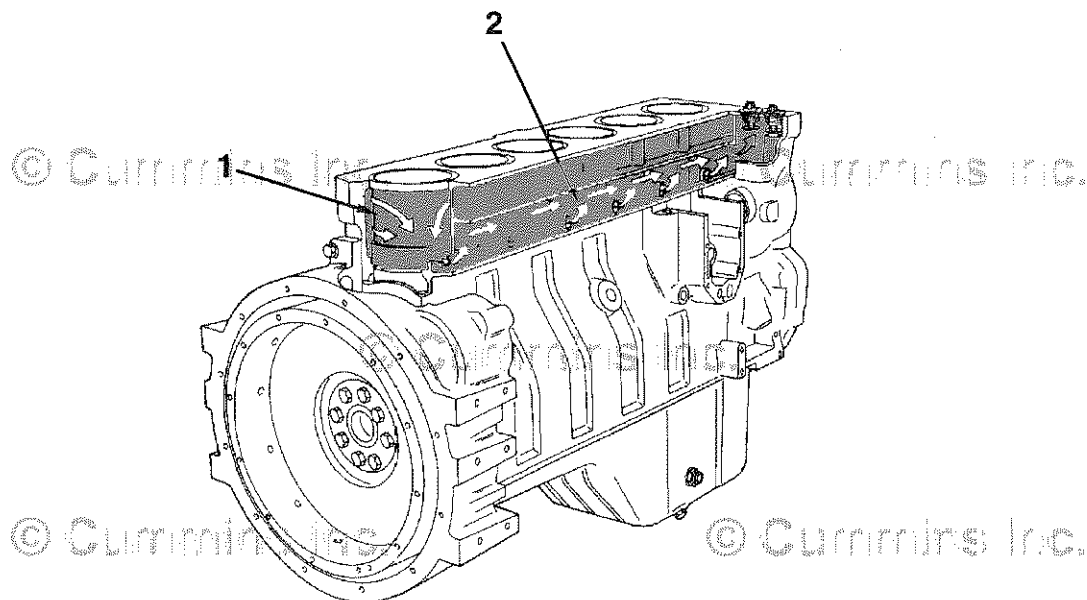
Engine Coolant Flow through cylinder heads

1. Flow from upper coolant manifold
2. Flow to liner cavity
3. Cylinder head gasket
4. Coolant flow orifice in gasket.

08900275

Flow Diagram, Cooling System

Flow Diagram



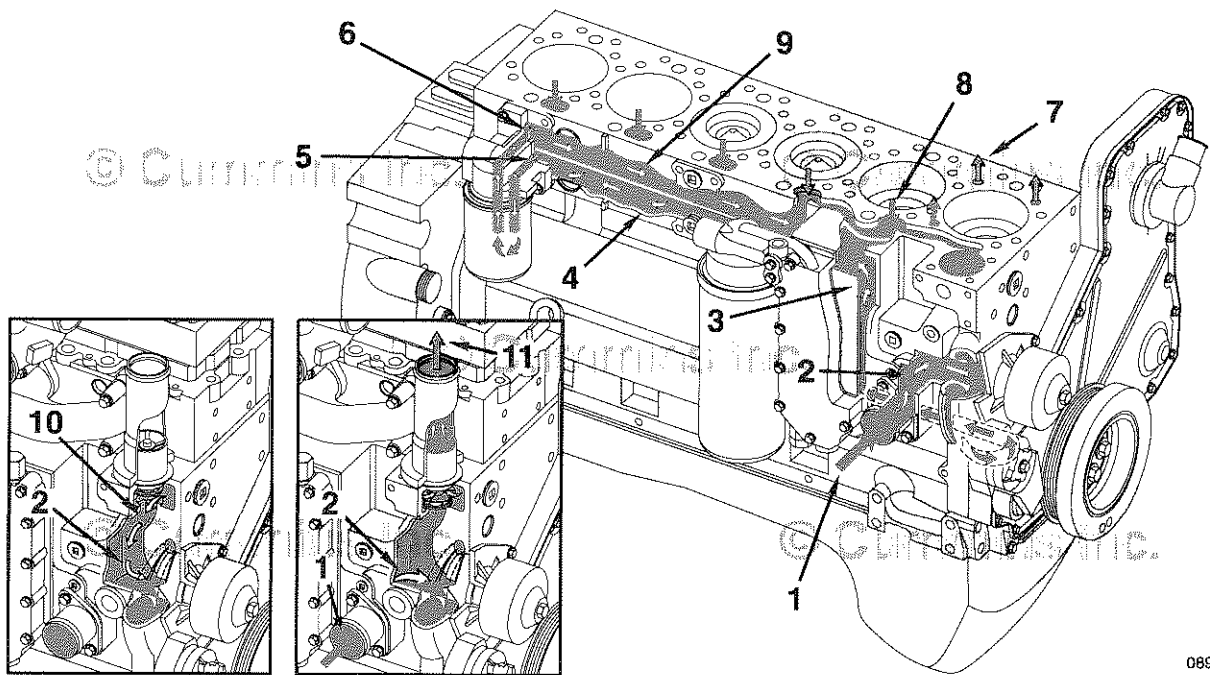
08900200

Engine Coolant Flow past Cylinder Liners

1. Flow past cylinder liners
2. Lower coolant manifold.

Flow Diagram, Cooling System

Flow Diagram

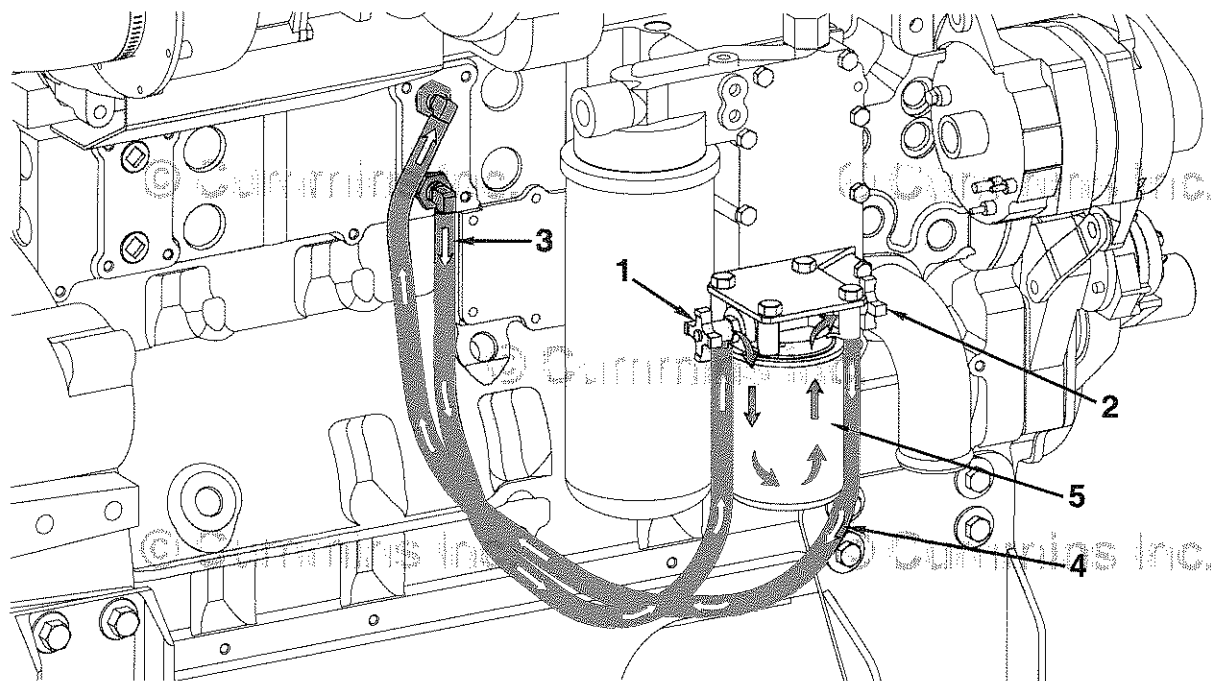


Single Thermostat

08900119

Flow Diagram, Cooling System

Flow Diagram

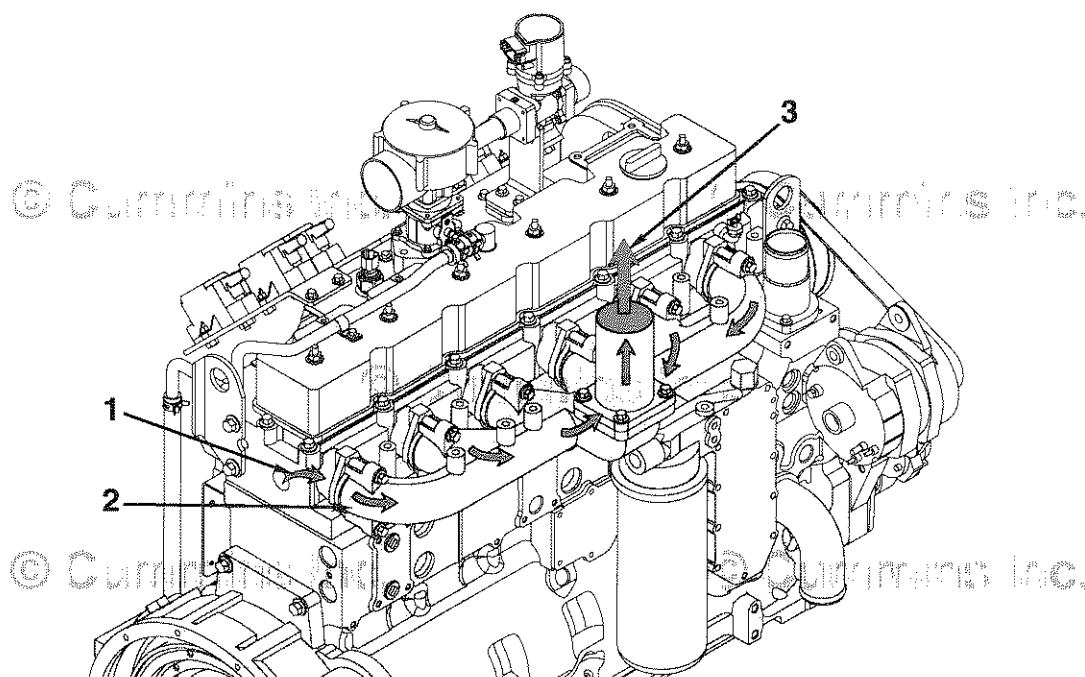


Coolant Filter Plumbing and Vent Configuration - Rationalized Block

1. Inlet shutoff
2. Outlet shutoff
3. Coolant flow from cylinder block (high pressure)
4. Coolant return to cylinder block (low pressure)
5. Coolant filter.

Flow Diagram, Exhaust System

Flow Diagram



G8.3 CM558

1100100

1. Exhaust flow from cylinder
2. Exhaust manifold
3. Exhaust outlet.

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Section L — Service Literature

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Additional Service Literature

General Information

The following publications can be purchased by contacting a Cummins® Authorized Repair Location.

Bulletin	Title of Publication
4021701	Master Repair Manual, G5.9, G8.3, G855, and GTA855 CM558
4021702	Troubleshooting and Repair Manual, Electronic Control System, G5.9, G8.3, G855, and GTA855 CM558
4021693	Owners Manual, G8.3 CM558
4021703	G8.3 Wiring Diagram
3379000	Air for Cummins® Engines
3379001	Fuels for Cummins® Engines
3379009	Operation - Cold Weather Bulletin
3666132	Cummins® Coolant Requirements and Maintenance
3666286	Cummins® Requirements for Cooling System Extended Service Intervals
3810340	Cummins® Engine Oil and Oil Analysis Recommendations

Service Literature Ordering Location Contact Information

Region

United States and Canada

All Other Countries

Ordering Location

Cummins Distributors

or

Credit Cards at 1-800-646-5609

or

Order online at www.powerstore.cummins.com

Cummins Distributors or Dealers

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 the Powerstore at WWW.POWERSTORE.CUMMINS.COM

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.

Notes

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Section M — Component Manufacturers

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Component Manufacturers' Addresses

NOTE: The following list contains addresses and telephone numbers of suppliers of accessories used on Cummins engines. Suppliers can be contacted directly for any specifications **not** covered in this manual.

Air Compressors

Bendix Heavy Vehicles Systems
Div. of Allied Automotive
901 Cleveland Street
Elyria, OH 44036
Telephone: (216) 329-9000

Holset Engineering Co., Inc.
1320 Kemper Meadow Drive
Suite 500
Cincinnati, OH 45240
Telephone: (513) 825-9600

Midland-Grau
Heavy Duty Systems
Heavy Duty Group Headquarters
10930 N. Pamona Avenue
Kansas City, MO 64153
Telephone: (816) 891-2470

Air Cylinders

Bendix Ltd.
Douglas Road
Kingswood
Bristol
England
Telephone: 0117-671881

Catching Engineering
1733 North 25th Avenue
Melrose Park, IL 60160
Telephone: (708) 344-2334

TEC - Hackett Inc.
8909 Rawles Avenue
Indianapolis, IN 46219
Telephone: (317) 895-3670

Air Heaters

Fleetguard, Inc.
1200 Fleetguard Road
Cookeville, TN 38502
Telephone: (615) 526-9551

Kim Hotstart Co.
P.O. Box 11245
Spokane, WA 99211-0245
Telephone: (509) 534-6171

Air Starting Motors

Ingersoll Rand
Chorley New Road
Horwich
Bolton
Lancashire
England
BL6 6JN
Telephone: 01204-65544

Ingersoll-Rand Engine
Starting Systems
888 Industrial Drive
Elmhurst, IL 60126
Telephone: (708) 530-3875

StartMaster
Air Starting Systems
A Division of Sycon Corporation
9595 Cheney Avenue
P. O. Box 491
Marion, OH 43302
Telephone: (614) 382-5771

Alternators

Robert Bosch Ltd.
P.O. Box 98
Broadwater Park
North Orbital Road
Denham
Uxbridge
Middlesex UD9 5HG
England
Telephone: (0)1895-838383

Prestolite Electrics
Cleveland Road
Leyland
PR5 1XB
England
Telephone: (0)1772-421663

C. E. Niehoff & Co.
2021 Lee Street
Evanston, IL 60202
Telephone: (708) 866-6030

Delco-Remy America
2401 Columbus Avenue
P.O. Box 2439
Anderson, IN 46018
Telephone: (317) 646-3528

Leece-Neville Corp.
400 Main Street
Arcade, NY 14009
Telephone: (716) 492-1700

Auxiliary Brakes

The Jacobs Manufacturing Company
Vehicle Equipment Division
22 East Dudley Town Road
Bloomfield, CT 06002
Telephone: (203) 243-1441

Belts

T.B.A. Belting Ltd.
P.O. Box 77
Wigan
Lancashire
WN2 4XQ
England
Telephone: (0)1942-259221

Dayco Mfg.
Belt Technical Center
1955 Enterprize
Rochester Hills, MI 48309
Telephone: (810) 853-8300

Gates Rubber Company
900 S. Broadway
Denver, CO 80217

Goodyear Tire and
Rubber Company
Industrial Products Div.
2601 Fortune Circle East
Indianapolis, IN 46241
Telephone: (317) 898-4170

Catalytic Converters

Donaldson Company, Inc.
1400 West 94th Street
P.O. Box 1299
Minneapolis, MN 55440
Telephone: (612) 887-3835

Nelson Division
Exhaust and Filtration Systems
1801 U.S. Highway 51 P.O. Box 428
Stoughton, WI 53589
Telephone: (608) 873-4200

Walker Manufacturing
3901 Willis Road
P.O. Box 157
Grass Lake, MI 49240
Telephone: (517) 522-5500

Coolant Level Switches

Robertshaw Controls Company
P.O. Box 400
Knoxville, TN 37901
Telephone: (216) 885-1773

Clutches

Twin Disc International S.A.
Chaussee de Namur
Nivelles
Belguim
Telephone: 067-224941

Twin Disc Incorporated
1328 Racine Street
Racine, WI 53403
Telephone: (414) 634-1981

Coolant Heaters

Fleetguard, Inc.
1200 Fleetguard Road
Cookeville, TN 38502
Telephone: (615) 526-9551

Drive Plates

Detroit Diesel Allison
Division of General Motors
Corporation
P.O. Box 894
Indianapolis, IN 46206-0894
Telephone: (317) 242-5000

Electric Starting Motors

Prestolite Electrics
Cleveland Road
Leyland
PR5 1XB
England
Telephone: 01772-421663

Delco-Remy America
2401 Columbus Avenue
P.O. Box 2439
Anderson, IN 46018
Telephone: (317) 646-3528

Leece-Neville Corp.
400 Main Street
Arcade, NY 14009
Telephone: (716) 492-1700

Nippondenso Inc.
2477 Denso Drive
P.O. Box 5133
Southfield, MI 48086
Telephone: (313) 350-7500

Electronic Switches

Cutler-Hammer Products
Eaton Corporation
4201 N. 27th Street
Milwaukee, WI 53216
Telephone: (414) 449-6600

Engine Protection Controls

Flight Systems Headquarters
Hempt Road
P.O. Box 25
Mechanicsburg, PA 17055
Telephone: (717) 697-0333

The Nason Company
2810 Blue Ridge Blvd.
West Union, SC 29696
Telephone: (803) 638-9521

Teddington Industrial
Equipment
Windmill Road
Sunbury on Thames
Middlesex
TW16 7HF
England
Telephone: (0)9327-85500

Fan Clutches

Kysor Cooling Systems N.A.
6040 West 62nd Street
Indianapolis, IN 46278
Telephone: (317) 328-3330

Holset Engineering Co. Ltd.
ST Andrews Road
Huddersfield, West Yorkshire
England HD1 6RA
Telephone: (0)1484-22244

Horton Industries, Inc.
P.O. Box 9455
Minneapolis, MN 55440
Telephone: (612) 378-6410

Rockford Clutch Company
1200 Windsor Road
P.O. Box 2908
Rockford, IL 61132-2908
Telephone: (815) 633-7460

Fans

Trufflo Ltd.
Westwood Road
Birmingham
B6 7JF
England
Telephone: (0)121-3283041

Hayes-Albion Corporation
Jackson Manufacturing Plant
1999 Wildwood Avenue
Jackson, MI 49202
Telephone: (517) 782-9421

Engineered Cooling Systems, Inc.
201 W. Carmel Drive
Carmel, IN 46032
Telephone: (317) 846-3438

Brookside Corporation
P.O. Box 30
McCordsville, IN 46055
Telephone: (317) 335-2014

TCF Aerovent Company
9100 Purdue Rd., Suite 101
Indianapolis, IN 46268-1190
Telephone: (317) 872-0030

Kysor-Cadillac
1100 Wright Street
Cadillac, MI 49601
Telephone: (616) 775-4681

Schwitzer
6040 West 62nd Street
P.O. Box 80-B
Indianapolis, IN 46206
Telephone: (317) 328-3010

Fault Lamps

Cutler-Hammer Products
Eaton Corporation
4201 N. 27th Street
Milwaukee, WI 53216
Telephone: (414) 449-6600

Filters

Fleetguard International Corp.
Cavalry Hill Industrial Park
Weedon
Northampton NN7 4TD
England
Telephone: 01327-341313

Fleetguard, Inc.
1200 Fleetguard Road
Cookeville, TN 38502
Telephone: 1-800-22-Filters
(1-800-223-4583)

Flexplates

Corrugated Packing and
Sheet Metal
Hamsterley
Newcastle Upon Tyne
England
Telephone: (0)1207-560-505

Allison Transmission
Division of General Motors
Corporation
P.O. Box 894
Indianapolis, IN 46206-0894
Telephone: (317) 242-5000

Midwest Mfg. Co.
29500 Southfield Road, Suite 122
Southfield, MI 48076
Telephone: (313) 642-5355

Wohlert Corporation
708 East Grand River Avenue
P.O. Box 20217
Lansing, MI 48901
Telephone: (517) 485-3750

Fuel Coolers

Hayden, Inc.
1531 Pomona Road
P.O. Box 848
Corona, CA 91718-0848
Telephone: (909) 736-2665

Fuel Pumps

Robert Bosch Corp.
Automotive Group
2800 South 25th Ave.
Broadview, IL 60153

Fuel Warmers

Fleetguard, Inc.
1200 Fleetguard Road
Cookeville, TN 38502
Telephone: (615) 526-9551

Gauges

Grasslin U.K. Ltd.
Vale Rise
Tonbridge
Kent
TN9 1TB
England
Telephone: (0)1732-359888

Datcon Instruments
P.O. Box 128
East Petersburg, PA 17520
Telephone: (717) 569-5713

Rochester Gauges, Inc.
11616 Harry Hines Blvd.
P.O. Box 29242
Dallas, TX 75229
Telephone: (214) 241-2161

Governors

Woodward Governor Co.
P.O. Box 1519
Fort Collins, CO 80522
Telephone: (303) 482-5811
(800) 523-2831

Barber Colman Co.
1354 Clifford Avenue
Loves Park, IL 61132
Telephone: (815) 637-3000

United Technologies
Diesel Systems
1000 Jorie Blvd.
Suite 111
Oak Brook, IL 69521
Telephone: (312) 325-2020

Heat Sleeves

Bentley Harris Manufacturing Co.
100 Bentley Harris Way
Gordonville, TN 38563
Telephone: (313) 348-5779

Hydraulic and Power Steering Pumps

Honeywell Control Systems Ltd.
Honeywell House
Arlington Business Place
Bracknell
Berks RG12 1EB
Telephone: (0)1344-656000

Sperry Vickers
P.O. Box 302
Troy, MI 48084
Telephone: (313) 280-3000

Z.F.
P.O. Box 1340
Grafvonsoden Strasse
5-9 D7070
Schwaebisch Gmuend
Germany
Telephone: 7070-7171-31510

In-Line Connectors

Pioneer-Standard Electronics, Inc.
5440 Neiman Parkway
Solon, OH 44139
Telephone: (216) 349-1300

Deutsch
Industrial Products Division
37140 Industrial Avenue
Hemet, CA 92343
Telephone: (714) 929-1200

Oil Heaters

Fleetguard, Inc.
1200 Fleetguard Road
Cookeville, TN 38502
Telephone: (615) 526-9551

Kim Hotstart Co.
P.O. Box 11245
Spokane, WA 99211-0245
Telephone: (509) 534-6171

Prelubrication Systems

RPM Industries, Inc.
Suite 109
55 Hickory Street
Washington, PA 15301
Telephone: (412) 228-5130

Radiators

JB Radiator Specialties, Inc.
P.O. Box 292087
Sacramento, CA 95829-2087
Telephone: (916) 381-4791

The G&O Manufacturing Company
100 Gando Drive
P.O. Box 1204
New Haven, CT 06505-1204
Telephone: (203) 562-5121

Young Radiator Company
2825 Four Mile Road
Racine, WI 53404
Telephone: (910) 271-2397

L and M Radiator, Inc.
1414 East 37th Street
Hibbing, MN 55746
Telephone: (218) 263-8993

Throttle Assemblies

Williams Controls, Inc.
14100 SW 72nd Avenue
Portland, OR 97224
Telephone: (503) 684-8600

Torque Converters

Twin Disc International S.A.
Chaussee de Namur
Nivelles
Belgium
Telephone: 067-224941

Twin Disc Incorporated
1328 Racine Street
Racine, WI 53403-1758
Telephone: (414) 634-1981

Rockford Powertrain, Inc.
Off-Highway Systems
1200 Windsor Road
P.O. Box 2908
Rockford, IL 61132-2908
Telephone: (815) 633-7460

Modine Mfg. Co.
1500 DeKoven Avenue
Racine, WI 53401
Telephone: (414) 636-1640

Notes

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Section S — Service Assistance

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Routine Service and Parts

General Information

Personnel at Cummins Authorized Repair Locations can assist you with the correct operation and service of your engine. Cummins has a worldwide service network of more than 5,000 Distributors and Dealers who have been trained to provide sound advice, expert service, and complete parts support. Check the telephone directory yellow pages or refer to the directory in this section for the nearest Cummins Authorized Repair Location.

Emergency and Technical Service

General Information

The Cummins Customer Assistance Center provides a 24-hour, toll free telephone number to aid in technical and emergency service when a Cummins Authorized Repair Location can **not** be reached or is unable to resolve an issue with a Cummins product.

If additional assistance is required, call Toll-Free:

1-800-DIESELS
(1-800-343-7357)

- Includes all 50 states, Bermuda, Puerto Rico, Virgin Islands, and the Bahamas.
- Outside of North America contact your Regional Office. Telephone numbers and addresses are listed in the International Directory.



Problem Solving

General Information

Normally, any problem that arises with the sale, service, or repair of your engine can be handled by a Cummins Authorized Repair Location in your area. Refer to the telephone directory yellow pages for the one nearest you. If the problem has **not** been handled satisfactorily, follow the steps outlined below:

1. If the disagreement is with a Dealer, talk to the Cummins Distributor with whom he has his service agreement.
2. If the disagreement is with a Distributor, call the nearest Cummins Division or Regional Office; however, most problems are solved below the Division or Regional office level. Telephone numbers and addresses are listed in this section. Before calling, write down the following information:
 - a. Engine model and serial number
 - b. Type and make of equipment
 - c. Total kilometers [miles] or hours of operation
 - d. Warranty start date
 - e. Nature of problem
 - f. Summary of the current problem arranged in the order of occurrence
 - g. Name and location of the Cummins Distributor or Dealer
12. If a problem can **not** be resolved satisfactorily through your Cummins Authorized Repair Location or Division Office, write to:

Cummins Customer Assistance Center - 41403, Cummins Inc., Box 3005, Columbus, IN 47202-3005

Division and Regional Offices - Locations

Australia Regional Office	Cummins Engine Company Pty. Ltd.	2 Caribbean Drive Scoresby, Victoria 3179 Australia Telephone: (61-3) 9765-3222 FAX: (61-3) 9763-0079 NOTE: This office also serves New Zealand.
Cummins Americas Regional Office	Cummins Americas Inc.	3350 SW 148 Avenue Suite 205 Miramar, FL 33027 Telephone: [1-954] 431-5511 Fax: [1-954] 433-5797 NOTE: This office serves Puerto Rico and South America excluding Brazil.
China Beijing	Cummins (China) Investment Co. Ltd	28F, Tower A, GATEWAY, No.18, Xiaguangli North Road, East Third Ring, Chaoyang District Beijing, Beijing ZIP / Postal Code: 100027 China Telephone: [86-10] 84548888 Telefax: [86-10] 67876347
Brazil	Cummins Brasil Ltda.	Rua Jati, 266 07180-900 Guarulhos Sao Paulo Brazil Phone: [55-11] 6465-9811 Fax: [55-11] 6412-1483
Daventry	Cummins Engine Company Ltd (Africa)	Royal Oak Way South Daventry, Northants ZIP / Postal Code: NN11 5NU United Kingdom Telephone: [44-1327] 886000 Telefax: [44-1327] 886106
Daventry	Cummins Engine Co. Ltd (Serving Czech Republic)	Royal Oak Way South Daventry, Northants ZIP / Postal Code: NN11 5NU United Kingdom Telephone: [44-1327] 886000 Telefax: [44-1327] 886106
Daventry	Cummins Engine Company Ltd (Middle East)	Royal Oak Way South Daventry, Northants ZIP / Postal Code: NN11 5NU United Kingdom Telephone: [44-1327] 886000 Telefax: [44-1327] 886106
Dubai United Arab Emirates	Cummins Middle East FZE	Units ZF 5/6 Jebel Ali Free Zone P.O.Box No 17636 Dubai United Arab Emirates Phone: [971-4] 883 8998 Fax: [971-4] 883 7971

India Pune	Cummins India Ltd.	Kothrud Pune, Maharashtra ZIP / Postal Code: 411029 India Telephone: [91-20] 2538-5435 / 0240 / 1105 Telefax: [91-20] 2538-0125
Korea Seoul	Cummins Korea Ltd.	25th floor, ASEM tower, 159-1, Samsung-Dong Kangnam-ku, Seoul ZIP / Postal Code: 135-798 South Korea Telephone: [82-2] 3420-0901 Telefax: [82-2] 3452-4113 / 539-6569
SLP Mexico	Cummins, S. de R.L. de C.V.	Arquimedes No. 209 Col. Polanco Mexico, Distrito Federal ZIP / Postal Code: 11560 Mexico Telephone: [52-5] 254-3822 / 3783 / 3622 Telefax: [52-5] 254-3645
Russia Moscow	Cummins Engine Company, Inc.	Park Place Office E708, 113/1 Leninskiy Prospect Moscow ZIP / Postal Code: 117198 Russia Telephone: [7-495] 956-51-22 / 23 Telefax: [7-495] 956-53-62
Singapore	Cummins Diesel Sales Corporation	8 Tanjong Penjuru Singapore ZIP / Postal Code: 609019 Singapore Telephone: [65] 6265-0155

Distributors and Branches - United States

Alabama	Birmingham	Cummins Mid-South, LLC 2200 Pinson Highway P.O. Box 1147 Birmingham, AL 35217 Telephone: (205) 841-0421 FAX: (205) 849-5926
Alabama	Mobile	Cummins Mid-South, LLC 1924 N. Beltline Hwy. Mobile, AL 36617 Telephone: (334) 456-2236 FAX: (334) 452-6419
Alaska	Anchorage	Cummins Northwest, Inc. 2618 Commercial Drive Anchorage, AK 99501-3095 Telephone: (907) 279-7594 FAX: (907) 276-6340
Arizona	Phoenix	Cummins Rocky Mountain, LLC 2239 N. Black Canyon Hgwy Phoenix, AZ 85009 Telephone: (602) 252-8021 FAX: (602) 253-6725
Arkansas	Little Rock	Cummins Mid-South, Inc. 6600 Interstate 30 Little Rock, AR 72209 Telephone: Sales: (501) 569-5600 Service: (501) 569-5656 Parts: (501) 569-5613 FAX: (501) 565-2199
California	San Leandro	Cummins West, Inc. 14775 Wicks Blvd. San Leandro, CA 94577-6779 Telephone: (510) 351-6101 FAX: (510) 352-3925
California	Arcata	Cummins West, Inc. 4751 West End Road Arcata, CA 95521 Telephone: (707) 822-7392 FAX: (707) 822-7585
California	Bakersfield	Cummins West, Inc. 4601 East Brundage Lane Bakersfield, CA 93307 Telephone: (805) 325-9404 FAX: (805) 861-8719
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Section TS — Troubleshooting Symptoms

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Troubleshooting Procedures and Techniques

General Information

This guide describes some typical engine operating problems, their causes, and some acceptable corrections to those problems. Unless noted otherwise, the problems listed are those which an operator can diagnose and repair.

WARNING

Performing troubleshooting procedures **NOT** outlined in this section can result in equipment damage or personal injury or death. Troubleshooting must be performed by trained, experienced technicians. Consult a Cummins Authorized Repair Location for diagnosis and repair beyond that which is outlined, and for symptoms not listed in this section. Before beginning any troubleshooting, refer to General Safety Instructions in Section i of this manual.

Follow the suggestions below for troubleshooting:

- Study the complaint thoroughly before acting
- Refer to the engine system diagrams
- Do the easiest and most logical things first
- Find and correct the cause of the complaint

Troubleshooting Symptoms Charts

General Information

Use the charts on the following pages of this section to aid in diagnosing specific engine symptoms. Read each row of blocks from top to bottom. Follow through the chart to identify the corrective action.



Troubleshooting presents the risk of equipment damage, personal injury or death. Troubleshooting must be performed by trained, experienced technicians.

Alternator Not Charging or Insufficient Charging

Cause

Correction

STEP 1

Drive belt is loose, tight, or **not** in alignment

Check and adjust the drive belt as needed. Refer to Procedure 008-002 (Drive Belt, Cooling Fan) in Section A .

OK

Go To Next Step

STEP 2

Electrical system is "open" (blown fuses, broken wires, or loose connections)

Check the fuses, wires, and connections. Refer to the OEM service manual and the manufacturer's wiring diagrams .

OK

Go To Next Step

STEP 3

Battery cables or connections are loose, broken, or corroded (excessive resistance)

Check the battery cables and connections.

OK

Go To Next Step

STEP 4

Batteries have malfunctioned

Check the condition of the batteries. Replace the batteries, if necessary. Refer to the OEM service manual .

OK

Go To Next Step

STEP 5

Alternator or voltage regulator is malfunctioning

Test the alternator output. Replace the alternator or voltage regulator if necessary. Refer to the OEM service manual .

OK

Go To Next Step

STEP 6

Contact a Cummins Authorized Repair Facility

Alternator Overcharging

Cause	Correction
STEP 1 Voltmeter is malfunctioning	Inspect the voltmeter. Replace as needed. Refer to the OEM service manual .
OK Go To Next Step	
STEP 2 Battery cables or connections are loose, broken, or corroded (excessive resistance)	Check the battery cables and connections.
OK Go To Next Step	
STEP 3 Battery cell is damaged (open circuit)	Check the condition of the batteries. Replace the batteries, if necessary. Refer to the OEM service manual .
OK Go To Next Step	
STEP 4 Voltage regulator is malfunctioning	Check the voltage regulator. Replace the voltage regulator, if necessary. Refer to the OEM service manual .
OK Go To Next Step	
STEP 5 Contact a Cummins Authorized Repair Facility	

Coolant Loss - External

Cause	Correction
STEP 1 Coolant level is above specification	Check the coolant level. Refer to Procedure 008-066 (Coolant Level) in Section 3 .
OK Go To Next Step	
STEP 2 External coolant leak	Inspect the engine for coolant leaking from hoses, draincocks, water manifold, expansion and pipe plugs, fittings, radiator core, exhaust heat shield, heat exchanger, air compressor and cylinder head gaskets, lubricating oil cooler, water pump seal, and OEM-mounted components that have coolant flow.
OK Go To Next Step	
STEP 3 Radiator cap is not correct, is malfunctioning, or has low-pressure rating	Check the radiator pressure cap. Refer to the OEM service manual .
OK Go To Next Step	
STEP 4 Fill line or vent lines are restricted, obstructed, or not routed correctly	Check the vent lines and the fill line for correct routing and for restrictions. Refer to OEM specifications .
OK Go To Next Step	
STEP 5 Coolant fill line is restricted or obstructed	Check the coolant fill line for restrictions or obstructions. Refer to the OEM installation instructions .
OK Go To Next Step	
STEP 6 Engine is overheating	Refer to Coolant Temperature Above Normal symptom tree .
OK Go To Next Step	
STEP 7 Contact a Cummins Authorized Repair Facility	

Coolant Temperature Above Normal - Gradual Overheat
Cause

Correction

STEP 1

Coolant level is below specification

Check the coolant level. Check for an external leak. Refer to Procedure 018-018 (Cooling System Specification) in Section V. Sample the lubricating oil and have a laboratory check for coolant in the oil (internal leak).

OK

Go To Next Step

STEP 2

Coolant mixture of antifreeze and water is **not** correct

Verify the concentration of antifreeze in the coolant. Add antifreeze or water to correct the concentration. Refer to the Cummins® Coolant Recommendations and Maintenance, Bulletin 3666132.

OK

Go To Next Step

STEP 3

Lubricating oil level is above or below specification

Check the oil level. Add or drain oil, if necessary. Refer to Procedure 007-043 (Lubricating Oil Level) in Section 3 and Procedure 007-002 (Lubricating Oil and Filters) in Section 4.

OK

Go To Next Step

STEP 4

Load is excessive for engine horsepower rating

Reduce the load on the engine. Refer to OEM specifications.

OK

Go To Next Step

STEP 5

Coolant temperature gauge is malfunctioning

Test the temperature gauge. Repair or replace the gauge, if necessary. Contact a Cummins® Authorized Repair Location.

OK

Go To Next Step

STEP 6

Radiator fins are damaged or obstructed with debris

Inspect the radiator fins. Clean and repair the fins as necessary. Contact a Cummins® Authorized Repair Location.

OK

Go To Next Step

STEP 7

Radiator cap is **not** correct, is malfunctioning, or has low-pressure rating

Check the radiator pressure cap. Refer to the OEM service manual.

OK

Go To Next Step

STEP 8

Thermostat is **not** correct or is malfunctioning

Check the thermostat for the correct part number and for correct operation. Contact a Cummins® Authorized Repair Location.

OK

Go To Next Step

Coolant Temperature Above Normal - Gradual Overheat

Cause

Correction

STEP 9

Cooling system hose is collapsed, restricted, or leaking

Inspect the hoses. Refer to OEM installation instructions .

OK

Go To Next Step

STEP 10

Fill line or vent lines are restricted, obstructed, or **not** routed correctly

Check the vent lines and the fill line for correct routing and for restriction. OEM installation instructions

OK

Go To Next Step

STEP 11

Cooling system is contaminated with dirt, scale, or sludge

Clean the cooling system. Refer to Procedure 008-018 (Cooling System) in Section 6 .

OK

Go To Next Step

STEP 12

Water pump is malfunctioning

Check the water pump for correct operation. Replace the water pump if necessary.

OK

Go To Next Step

STEP 13

Air or combustion gases are entering the cooling system

Check for air or combustion gases in the cooling system.

OK

Go To Next Step

STEP 14

Contact a Cummins Authorized Repair Facility

Coolant Temperature Above Normal - Sudden Overheat

Cause

Correction

STEP 1

Coolant level is below specification

Inspect the engine and cooling system for external coolant leaks. Repair if necessary. Add coolant. Refer to Procedure 008-066 (Coolant Level) in Section 3 and the Coolant Leak External symptom tree .

OK

Go To Next Step

STEP 2

Water pump belt is broken

Check the water pump belt. Replace the belt if necessary. Refer to Procedure 008-002 (Drive Belt, Cooling Fan) in Section A .

OK

Go To Next Step

STEP 3

Thermostat is **not** correct or is malfunctioning

Check the thermostat for the correct part number and for correct operation. Contact a Cummins® Authorized Repair Location.

OK

Go To Next Step

STEP 4

Coolant temperature gauge is malfunctioning

Test the temperature gauge. Repair or replace the gauge, if necessary. Contact a Cummins® Authorized Repair Location.

OK

Go To Next Step

STEP 5

Cooling system hose(s) collapsed, restricted, or leaking

Inspect the cooling system hose(s) for restrictions or obstructions. Refer to the OEM service manual .

OK

Go To Next Step

STEP 6

Fill line or vent lines are restricted, obstructed, or **not** routed correctly

Check the vent lines and the fill line for correct routing and for restriction. Refer to the OEM service manual .

OK

Go To Next Step

STEP 7

Water pump is malfunctioning

Check the water pump for correct operation. Replace the water pump if necessary.

OK

Go To Next Step

STEP 8

Cooling system pressure cap is **not** correct, is malfunctioning, or has a low-pressure rating

Inspect the pressure cap. Refer to the OEM service manual .

OK

Go To Next Step

STEP 9

Contact a Cummins Authorized Repair Facility

Coolant Temperature Below Normal

Cause

Correction

STEP 1

Engine is operating at low ambient temperature

Check the shutters and engine compartment air. Refer to Operation of Diesel Engines in Cold Climates, Bulletin 3379009 .

OK

Go To Next Step

STEP 2

Temperature gauge malfunction

Check or replace the temperature gauge. Refer to the OEM service manual .

OK

Go To Next Step

STEP 3

Thermostat is **not** operating properly.

Check the thermostat for correct operation. Refer to a Cummins® Authorized Repair Location .

OK

Go To Next Step

STEP 4

Contact a Cummins Authorized Repair Facility

Engine Acceleration or Response Poor

Cause	Correction
STEP 1 Verify the complaint OK Go To Next Step	Refer to the Human Machine Interface, if available, or an electronic service tool to verify system faults and system status. Contact a Cummins® Authorized Repair Location if an electronic service tool is required. .
STEP 2 Fuel leak OK Go To Next Step	Check the fuel lines, fuel connections, and fuel filters for leaks, use the combustible gas detector service tool. Contact a Cummins® Authorized Repair Location.
STEP 3 Load is excessive OK Go To Next Step	Check and reduce the load.
STEP 4 Air intake or exhaust leaks OK Go To Next Step	Inspect the air intake and exhaust systems for air leaks. Contact a Cummins® Authorized Repair Location
STEP 5 Air intake system restriction is above specification OK Go To Next Step	Inspect the air intake system for restriction. Clean or replace filter and inlet piping as necessary. Refer to Procedure 010-059 (Air Cleaner Restriction) in Section 3 and Procedure 010-060 (Air Cleaner Element, Paper Type) in Section 6 .
STEP 6 Exhaust system restriction is not within specification OK Go To Next Step	Check the exhaust system for restrictions. Contact a Cummins® Authorized Repair Location.
STEP 7 Ignition system is malfunctioning or misfiring OK Go To Next Step	Check the ignition system. Refer to Procedure 013-016 (Spark Plug (Non Shielded)) in Section 5 and Procedure 013-014 (Spark Plug Wire (Non Shielded)) in Section 6 . If the problem persists, contact a Cummins® Authorized Repair Location.
STEP 8 Contact a Cummins Authorized Repair Facility	

Engine Decelerates Slowly

Cause

Correction

STEP 1

Electronic control module system calibration is **not** correct

Compare the calibration in the electronic control system with the engine rating and the Control Parts List (CPL), Bulletin 3379133 or 4021327. If necessary, calibrate the system. Contact a Cummins® Authorized Repair Location.

OK

Go To Next Step

STEP 2

Engine is running on fumes drawn into the air intake

Check the air intake ducts. Locate and isolate the source of the fumes. Repair as necessary. Refer to Procedure 010-058 (Air Intake Piping) in Section 5.

OK

Go To Next Step

STEP 3

Engine governor settings are incorrect

Adjust engine governor until acceptable stability and response are achieved. Contact a Cummins® Authorized Repair Location.

OK

Go To Next Step

STEP 4

Throttle plate is malfunctioning

Check the throttle plate for sticking or hysteresis. Contact a Cummins® Authorized Repair Location.

OK

Go To Next Step

STEP 5

Contact a Cummins Authorized Repair Facility

Engine Difficult to Start or Will Not Start

Cause

Correction

STEP 1

OEM manual fuel shutoff valve is closed

Check the OEM fuel shutoff valves. Verify that the shutoff valves are open. Refer to the OEM service manual .

OK

Go To Next Step

STEP 2

Engine cranking speed is too slow

If the cranking speed is slower than 150 rpm, refer to the Engine Will **Not** Crank or Cranks Slowly symptom tree .

OK

Go To Next Step

STEP 3

Air intake system restriction is above specification

Inspect the air intake system for restriction. Replace the air filter. Refer to Procedure 010-059 (Air Cleaner Restriction) in Section 3 and Procedure 010-060 (Air Cleaner Element, Paper Type) in Section 6 .

OK

Go To Next Step

STEP 4

Engine-driven units are engaged

Disengage engine-driven units.

OK

Go To Next Step

STEP 5

Starting procedure is **not** correct

Verify the correct starting procedure. Refer to Procedure 101-014 (Normal Starting Procedure) in Section 1 .

OK

Go To Next Step

STEP 6

Engine speed sensor or circuit is malfunctioning

Check the engine speed sensor for correct adjustment and for debris on the sensor. Check the engine speed sensor circuit. Refer to a Cummins® Authorized Repair Location .

OK

Go To Next Step

STEP 7

Contact a Cummins Authorized Repair Facility

Engine Noise Excessive

Cause	Correction
STEP 1 Lubricating oil pressure is below specification OK Go To Next Step	Check the oil pressure. If the pressure is low, refer to the Lubricating Oil Pressure Low symptom tree . Contact a Cummins® Authorized Repair Location
STEP 2 Coolant temperature is above specification OK Go To Next Step	Refer to the Coolant Temperature is Above Normal symptom tree .
STEP 3 Fan drive belt is loose, tight, or not in alignment OK Go To Next Step	Check the fan drive belt. Refer to Procedure 008-087 (Belt Tensioner, Automatic (Water Pump)) in Section 6 and Procedure 008-036 (Fan Hub, Belt Driven) in Section 7 .
STEP 4 Alternator noise is excessive OK Go To Next Step	Refer to a Cummins® Authorized Repair Location .
STEP 5 Engine mounts are worn, damaged, or not correct OK Go To Next Step	Check the engine mounts. Refer to the OEM service manual .
STEP 6 Ignition system is malfunctioning or misfiring OK Go To Next Step	Check the ignition system. Contact a Cummins® Authorized Repair Location .
STEP 7 Overhead adjustments are not correct OK Go To Next Step	Measure and adjust the overhead settings. Refer to Procedure 003-004 (Overhead Set) in Section 4 .
STEP 8 Main bearing or connecting rod bearing noise OK Go To Next Step	Refer to a Cummins® Authorized Repair Location .
STEP 9 Contact a Cummins Authorized Repair Facility	

Engine Power Output Low

Cause	Correction
STEP 1 Verify the complaint	Test the engine operation while under load. Perform an engine acceleration test. Perform an engine load/install test. Refer to the OEM installation instructions .
OK Go To Next Step	
STEP 2 Load is excessive for engine horsepower rating	Reduce the load on the engine. Refer to OEM specifications .
OK Go To Next Step	
STEP 3 Engine is misfiring	Refer to the Engine Runs Rough or Misfires symptom tree .
OK Go To Next Step	
STEP 4 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 the OEM service manual .
OK Go To Next Step	
STEP 5 Air intake system restriction is above specification	Check the air intake system for restriction. Clean or replace the air filter and inlet piping as necessary. Refer to Procedure 010-059 (Air Cleaner Restriction) in Section 3 and Procedure 010-060 (Air Cleaner Element, Paper Type) in Section 6 .
OK Go To Next Step	
STEP 6 Low or no fuel pressure at the fuel filter (primary pressure)	Increase output pressure from the primary regulator. Contact a Cummins® Authorized Repair Location.
OK Go To Next Step	
STEP 7 Low or no fuel pressure at the fuel filter (secondary pressure)	Increase output pressure from the secondary regulator. Contact a Cummins® Authorized Repair Location.
OK Go To Next Step	
STEP 8 Air/fuel ratio is set incorrectly.	Check exhaust excess oxygen against specifications. Adjust if necessary. Refer to Procedure 019-100 (Heated Oxygen Sensor) in Section 6 and Procedure 005-003 (Air/Fuel Mixer) in Section A .
OK Go To Next Step	

Engine Power Output Low

Cause

Correction

STEP 9

Contact a Cummins Authorized Repair Facility

Engine Runs Rough at Idle

Cause

Correction

STEP 1

Engine mounts are worn, damaged, or **not** correct

Inspect the engine mounts. Replace as needed.
Contact a Cummins® Authorized Repair Location.

OK

Go To Next Step

STEP 2

Ignition system is malfunctioning or misfiring

Check the ignition system. Refer to Procedure 013-016 (Spark Plugs (Non Shielded)) in Section 5 and Procedure 013-014 (Spark Plug Wire (Non Shielded)) in Section 6 . If the problem persists, contact a Cummins® Authorized Repair Location.

OK

Go To Next Step

STEP 3

Intake air restricted

Inspect and change air cleaner. Look for other restrictions. Refer to Procedure 010-059 (Air Cleaner Restriction) in Section 3 and Procedure 010-060 (Air Cleaner Element, Paper Type) in Section 6 .

OK

Go To Next Step

STEP 4

Air/fuel ratio is set incorrectly.

Check exhaust excess oxygen against specifications. Adjust if necessary. Refer to Procedure 019-100 (Heated Oxygen Sensor) in Section 6 and Procedure 005-003 (Air/Fuel Mixer) in Section A .

OK

Go To Next Step

STEP 5

Overhead adjustments are **not** correct

Measure and adjust the overhead settings. Refer to Procedure 003-004 (Overhead Set) Section 4 .

OK

Go To Next Step

STEP 6

Contact a Cummins Authorized Repair Facility

Engine Runs Rough or Misfires

Cause

Correction

STEP 1
Fuel leak

Check the fuel lines, fuel connections, and fuel filters for leaks, use the combustible gas detector service tool. Contact a Cummins® Authorized Repair Location.

OK
Go To Next Step

STEP 2
Air/fuel ratio is set incorrectly.

Check exhaust excess oxygen against specifications. Adjust if necessary. Refer to Procedure 019-100 (Heated Oxygen Sensor) in Section 6 and Procedure 005-003 (Air/Fuel Mixer) in Section A .

OK
Go To Next Step

STEP 3
Ignition system is malfunctioning or misfiring

Check the ignition system. Contact a Cummins® Authorized Repair Location .

OK
Go To Next Step

STEP 4
Intake air restricted

Inspect and change air cleaner. Look for other restrictions. Refer to Procedure 010-059 (Air Cleaner Restriction) in Section 3 and Procedure 010-060 (Air Cleaner Element, Paper Type) in Section 6 .

OK
Go To Next Step

STEP 5
Overhead adjustments are **not** correct

Measure and adjust the overhead settings. Refer to Procedure 003-004 (Overhead Set) in Section 4 .

OK
Go To Next Step

STEP 6
Contact a Cummins Authorized Repair Facility

Engine Speed Surges at Low or High Idle

Cause	Correction
STEP 1 Engine is cold	Allow the engine to warm up for approximately 1 to 3 minutes. Refer to Procedure 101-999 (Operating Instructions - Overview) in Section 1 .
OK Go To Next Step	
STEP 2 Fuel leak	Check the fuel lines, fuel connections, and fuel filters for leaks, use the combustible gas detector service tool. Contact a Cummins® Authorized Repair Location.
OK Go To Next Step	
STEP 3 Air/fuel ratio is set incorrectly.	Check exhaust excess oxygen against specifications. Adjust if necessary. Refer to Procedure 019-100 (Heated Oxygen Sensor) in Section 4 and Procedure 005-003 (Air/Fuel Mixer) in Section A .
OK Go To Next Step	
STEP 4 Ignition system is malfunctioning or misfiring	Check the ignition system. Contact a Cummins® Authorized Repair Location .
OK Go To Next Step	
STEP 5 Intake air restricted	Inspect and change air cleaner. Look for other restrictions. Refer to Procedure 010-059 (Air Cleaner Restriction) in Section 3 and Procedure 010-060 (Air Cleaner Element, Paper Type) in Section 4 .
OK Go To Next Step	
STEP 6 Overhead adjustments are not correct	Measure and adjust the overhead settings. Refer to Procedure 003-004 (Overhead Set) in Section 4 .
OK Go To Next Step	
STEP 7 Contact a Cummins Authorized Repair Facility	

Engine Starts But Will Not Keep Running

Cause	Correction
STEP 1 Manual fuel valve closed	Open manual fuel valve.
OK Go To Next Step	
STEP 2 Engine-driven units are engaged	Disengage engine-driven units.
OK Go To Next Step	
STEP 3 Load is excessive for engine horsepower rating	Reduce the load on the engine. Refer to OEM specifications .
OK Go To Next Step	
STEP 4 Air intake system restriction is above specification	Inspect the air intake system for restriction. Replace the air filter. Refer to Procedure 010-059 (Air Cleaner Restriction) in Section 3 and Procedure 010-060 (Air Cleaner Element, Paper Type) in Section 6 .
OK Go To Next Step	
STEP 5 Exhaust system restriction is not within specification	Check the exhaust system for restrictions. Contact a Cummins® Authorized Repair Location.
OK Go To Next Step	
STEP 6 Fuel supply pressure is below specification	Measure the fuel supply pressure. Contact a Cummins® Authorized Repair Location.
OK Go To Next Step	
STEP 7 Low or no fuel pressure at the mixer (secondary pressure)	Contact a Cummins® Authorized Repair Location.
OK Go To Next Step	
STEP 8 Air/fuel ratio is set incorrectly.	Check exhaust excess oxygen against specifications. Adjust if necessary. Refer to Procedure 005-003 (Air/Fuel Mixer) in Section A and Procedure 019-100 (Heated Oxygen Sensor) in Section 6 .
OK Go To Next Step	
STEP 9 Ignition system is malfunctioning or misfiring	Check the ignition system. Contact a Cummins® Authorized Repair Location .
OK Go To Next Step	

Engine Starts But Will Not Keep Running

Cause

Correction

STEP 10

Contact a Cummins Authorized Repair Facility

Engine Transient Response Poor

Cause	Correction
STEP 1 Fuel leak	Check the fuel lines, fuel connections, and fuel filters for leaks, use the combustible gas detector service tool. Contact a Cummins® Authorized Repair Location.
OK Go To Next Step	
STEP 2 Engine-driven units are engaged	Disengage engine-driven units.
OK Go To Next Step	
STEP 3 Load is excessive for engine horsepower rating	Reduce the load on the engine. Refer to OEM specifications .
OK Go To Next Step	
STEP 4 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 the OEM service manual .
OK Go To Next Step	
STEP 5 Air intake system restriction is above specification	Inspect the air intake system for restriction. Replace the air filter. Refer to Procedure 010-059 (Air Cleaner Restriction) in Section 3 and Procedure 010-060 (Air Cleaner Element, Paper Type) in Section 6 .
OK Go To Next Step	
STEP 6 Exhaust system restriction is not within specification	Check the exhaust system for restrictions. Contact a Cummins® Authorized Repair Location.
OK Go To Next Step	
STEP 7 Ignition system is malfunctioning or misfiring	Check the ignition system. Contact a Cummins® Authorized Repair Location .
OK Go To Next Step	
STEP 8 Low or no fuel pressure at the fuel filter (primary pressure)	Increase output pressure from the primary regulator. Contact a Cummins® Authorized Repair Location.
OK Go To Next Step	

Engine Transient Response Poor

Cause	Correction
STEP 9 Low or no fuel pressure at the fuel filter (secondary pressure)	Increase output pressure from the secondary regulator. Contact a Cummins® Authorized Repair Location.
OK Go To Next Step	
STEP 10 Air/fuel ratio is set incorrectly.	Check exhaust excess oxygen against specifications. Adjust if necessary. Refer to Procedure 005-003 (Air/Fuel Mixer) in Section A and Procedure 019-100 (Heated Oxygen Sensor) in Section 6 .
OK Go To Next Step	
STEP 11 Ignition system is malfunctioning or misfiring	Check the ignition system. Contact a Cummins® Authorized Repair Location .
OK Go To Next Step	
STEP 12 Contact a Cummins Authorized Repair Facility	

Engine Vibration Excessive

Cause	Correction
STEP 1 Engine is misfiring	Refer to the Engine Runs Rough or Misfires symptom tree .
OK Go To Next Step	
STEP 2 Fan is loose, damaged, or not balanced	Check the fan. Refer to Procedure 008-040 (Fan, Cooling) in Section 3 .
OK Go To Next Step	
STEP 3 Vibration damper is damaged	Inspect the vibration damper. Contact a Cummins® Authorized Repair Location.
OK Go To Next Step	
STEP 4 Overhead adjustments are not correct	Measure and adjust the overhead settings. Refer to Procedure 003-004 (Overhead Set) in Section 4 .
OK Go To Next Step	
STEP 5 Engine mounts are worn, damaged, or not correct	Check the engine mounts. Refer to Procedure 016-010 (Engine Mounts) in Section 6 .
OK Go To Next Step	
STEP 6 Contact a Cummins Authorized Repair Facility	

Engine Will Not Crank or Cranks Slowly (Air Starter)

Cause

Correction

STEP 1

Starting procedure is **not** correct

Verify the correct starting procedure. Refer to Procedure 101-014 (Normal Starting Procedure) in Section 1 .

OK

Go To Next Step

STEP 2

Engine-driven units are engaged

Disengage engine-driven units.

OK

Go To Next Step

STEP 3

Crankshaft rotation is impaired

Check the crankshaft for ease of rotation. Contact a Cummins® Authorized Repair Location .

OK

Go To Next Step

STEP 4

Starting air pressure low

Check that the air supply valve is open completely. Check the air compressor for proper operation.

OK

Go To Next Step

STEP 5

Lubricating oil pressure switch, gauge, or sensor is malfunctioning or is **not** in the correct location

Check the oil pressure switch, gauge, or sensor for correct operation and location. Contact a Cummins® Authorized Repair Location.

OK

Go To Next Step

STEP 6

Lubricating oil level is above specification

Check the oil level. Verify the dipstick calibration and oil pan capacity. Fill the system to the specified level. Contact a Cummins® Authorized Repair Location.

OK

Go To Next Step

STEP 7

Lubricating oil does **not** meet specifications for operating conditions

Change the oil and filters. Refer to Procedure 007-002 (Lubricating Oil and Filters) in Section 4 and Procedure 018-024 (Cummins®/Fleetguard® Filter Specifications) in Section V .

OK

Go To Next Step

STEP 8

OEM starter interlock devices engaged

Check the starter interlock devices. Refer to the OEM service manual .

OK

Go To Next Step

STEP 9

Starting circuit component is malfunctioning

Check the starting circuit components. Refer to the OEM service manual .

OK

Go To Next Step

STEP 10

Contact a Cummins Authorized Repair Facility

Engine Will Not Reach Rated Speed (RPM)

Cause

Correction

STEP 1

Load is excessive for engine horsepower rating

Reduce the load on the engine. Refer to OEM specifications .

OK

Go To Next Step

STEP 2

Tachometer is **not** calibrated or is malfunctioning

Compare the tachometer reading with a handheld tachometer or an electronic service tool reading. Calibrate or replace the tachometer as necessary. Refer to the OEM service manual .

OK

Go To Next Step

STEP 3

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 the OEM service manual .

OK

Go To Next Step

STEP 4

Air intake system restriction is above specification

Inspect the air intake system for restriction. Replace the air filter. Refer to Procedure 010-059 (Air Cleaner Restriction) in Section 3 and Procedure 010-060 (Air Cleaner Element, Paper Type) in Section 4 .

OK

Go To Next Step

STEP 5

Engine power output is low

Refer to the Engine Power Output Low symptom tree .

OK

Go To Next Step

STEP 6

Fuel leak

Check the fuel lines, fuel connections, and fuel filters for leaks, use the combustible gas detector service tool. Contact a Cummins® Authorized Repair Location.

OK

Go To Next Step

STEP 7

Ignition system is malfunctioning or misfiring

Check the ignition system. Contact a Cummins® Authorized Repair Location .

OK

Go To Next Step

STEP 8

Fuel supply pressure is below specification

Measure the fuel supply pressure. Contact a Cummins® Authorized Repair Location.

OK

Go To Next Step

Engine Will Not Reach Rated Speed (RPM)

Cause	Correction
STEP 9 Low or no fuel pressure at the mixer (secondary pressure)	Contact a Cummins® Authorized Repair Location.
OK Go To Next Step	
STEP 10 Air/fuel ratio is set incorrectly.	Check exhaust excess oxygen against specifications. Adjust if necessary. Refer to Procedure 019-100 (Heated Oxygen Sensor) in Section 6 and Procedure 005-003 (Air/Fuel Mixer) in Section A .
OK Go To Next Step	
STEP 11 Overhead adjustments are not correct	Measure and adjust the overhead settings. Refer to Procedure 003-004 (Overhead Set) in Section 4 .
OK Go To Next Step	
STEP 12 Engine governor settings are incorrect	Adjust engine governor until acceptable stability and response are achieved. Contact a Cummins® Authorized Repair Location.
OK Go To Next Step	
STEP 13 Overhead adjustments are not correct	Measure and adjust the overhead settings. Refer to Procedure 003-004 (Overhead Set) in Section 4 .
OK Go To Next Step	
STEP 14 Engine governor settings are incorrect	Adjust engine governor until acceptable stability and response are achieved. Contact a Cummins® Authorized Repair Location.
OK Go To Next Step	
STEP 15 Contact a Cummins Authorized Repair Facility	

Engine Will Not Shut Off

Cause

Correction

STEP 1

Stop/Run switch circuit is malfunctioning

Check the Stop/Run switch circuit. Refer to the OEM service manual .

OK

Go To Next Step

STEP 2

Engine is running on fumes drawn into the air intake

Check the air intake ducts. Locate and isolate the source of the fumes. Repair as necessary. Refer to the OEM service manual .

OK

Go To Next Step

STEP 3

Fuel shutoff is malfunctioning

Check for loose wires and verify that the fuel shutoff valve is functioning. Refer to the OEM service manual .

OK

Go To Next Step

STEP 4

Contact a Cummins Authorized Repair Facility

Fuel Consumption Excessive

Cause	Correction
STEP 1 Verify the complaint	Refer to the engine datasheet. Compare the fuel usage records with the engine datasheet .
OK Go To Next Step	
STEP 2 Fuel leak	Check the fuel lines, fuel connections, and fuel filters for leaks, use the combustible gas detector service tool. Contact a Cummins® Authorized Repair Location.
OK Go To Next Step	
STEP 3 Load is excessive for engine horsepower rating	Reduce the load on the engine. Refer to OEM specifications .
OK Go To Next Step	
STEP 4 Fuel consumption has increased after an engine repair	Evaluate the engine repair to determine its effect on fuel consumption. Check part numbers to make sure the correct parts were used. Refer to the Control Parts List (CPL), Bulletin Number 4021326 .
OK Go To Next Step	
STEP 5 Exhaust system restriction is not within specification	Check the exhaust system for restrictions. Contact a Cummins® Authorized Repair Location.
OK Go To Next Step	
STEP 6 Air intake system restriction is above specification	Check the air intake system for restriction. Clean or replace the air filter and inlet piping as necessary. Refer to Procedure 010-059 (Air Cleaner Restriction) in Section 3 and Procedure 010-060 (Air Cleaner Element, Paper Type) in Section 6 .
OK Go To Next Step	
STEP 7 Ignition system is malfunctioning or misfiring	Check the ignition system. Contact a Cummins® Authorized Repair Location .
OK Go To Next Step	
STEP 8 Contact a Cummins Authorized Repair Facility	

Lubricating Oil Consumption Excessive

Cause

Correction

STEP 1

Lubricating oil leak (external)

Inspect the engine for external oil leaks. Tighten the capscrews, pipe plugs, and fittings. Replace gaskets, if necessary. Contact a Cummins® Authorized Repair Location.

OK

Go To Next Step

STEP 2

Lubricating oil level is above or below specification

Check the oil level. Add or drain oil, if necessary. Refer to Procedure 007-043 (Lubricating Oil Level) in Section 3 and Procedure 007-002 (Lubricating Oil and Filters) in Section 4 .

OK

Go To Next Step

STEP 3

Engine is cold

Allow the engine to warm to operating temperature. If the engine will **not** reach operating temperature, refer to the Coolant Temperature Below Normal symptom tree .

OK

Go To Next Step

STEP 4

Lubricating oil does **not** meet specifications for operating conditions

Change the oil and filters. Refer to Procedure 007-002 (Lubricating Oil and Filters) in Section 4 . Use the oil recommended in Section V.

OK

Go To Next Step

STEP 5

Contact a Cummins Authorized Repair Facility

Lubricating Oil Pressure High

Cause

STEP 1

Lubricating oil pressure switch, gauge, or sensor is malfunctioning or is **not** in the correct location

OK

Go To Next Step

STEP 2

Coolant temperature is below specification

OK

Go To Next Step

STEP 3

Lubricating oil does **not** meet specifications for operating conditions

OK

Go To Next Step

STEP 4

Contact a Cummins Authorized Repair Facility

Correction

Check the oil pressure switch, gauge, or sensor for correct operation and location. Contact a Cummins® Authorized Repair Location.

Refer to the Coolant Temperature Below Normal symptom tree .

Change the oil and filters. Refer to Procedure 007-002 (Lubricating Oil and Filters) in Section 4 . Use the oil type recommended in Section V .

Lubricating Oil Pressure Low

Cause

Correction

STEP 1

Lubricating oil level is above or below specification

Check the oil level. Add or drain oil if necessary. Refer to Procedure 007-043 (Lubricating Oil Level) in Section 3 and Procedure 007-002 (Lubricating Oil and Filters) in Section 4 . Check the dipstick calibration.

OK

Go To Next Step

STEP 2

Lubricating oil pressure switch, gauge, or sensor is malfunctioning or is **not** in the correct location

Check the oil pressure switch, gauge, or sensor for correct operation and location. Contact a Cummins® Authorized Repair Location.

OK

Go To Next Step

STEP 3

Lubricating oil does **not** meet specifications for operating conditions

Change the oil and filters. Refer to Procedure 007-002 (Lubricating Oil and Filters) in Section 4 .

OK

Go To Next Step

STEP 4

Lubricating oil temperature is above normal (120° C [248°F])

Refer to the Coolant Temperature Above Normal symptom tree .

OK

Go To Next Step

STEP 5

Contact a Cummins Authorized Repair Facility

Cause	Correction
STEP 1 Lubricating oil drain interval is excessive OK Go To Next Step	Verify the correct lubricating oil drain interval. Refer to Procedure 102-002 (Maintenance Schedule) in Section 2 .
STEP 2 Engine is cold OK Go To Next Step	Allow the engine to warm to operating temperature. If the engine will not reach operating temperature, refer to the Coolant Temperature Below Normal symptom tree .
STEP 3 Lubricating oil does not meet specifications for operating conditions OK Go To Next Step	Change the oil and filters. Refer to Procedure 007-002 (Lubricating Oil and Filters) in Section 4 . Use the oil type recommended in Section V .
STEP 4 Bulk oil supply is contaminated OK Go To Next Step	Check the bulk oil supply. Drain the oil and replace with noncontaminated oil. Replace the oil filter(s).
STEP 5 Contact a Cummins Authorized Repair Facility	

Lubricating Oil Temperature Above Specification

Cause

Correction

STEP 1

Coolant temperature is above specification

Refer to the Coolant Temperature Above Normal symptom tree .

OK

Go To Next Step

STEP 2

Lubricating oil level is above or below specification

Check the oil level. Add or drain oil, if necessary. Refer to Procedure 007-043 (Lubricating Oil Level) in Section 3 and Procedure 007-002 (Lubricating Oil and Filters) in Section 4 .

OK

Go To Next Step

STEP 3

Lubricating oil pressure sensor or gauge is malfunctioning or is **not** in the correct location

Check the oil pressure switch or gauge for correct operation and location. Refer to the OEM service manual for proper operation and the OEM installation instructions for proper location of pressure gauge or sensor .

OK

Go To Next Step

STEP 4

Contact a Cummins Authorized Repair Facility

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Section V — Maintenance Specifications

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General Engine

Specifications

For performance and fuel rate values, see the engine data sheet.

Bore and Stroke.....	114 mm [4.49 in] x 135 mm [5.32 in]
Displacement.....	8.3 liters [505 in ³]
Compression Ratio.....	8.5:1
Firing Order.....	1-5-3-6-2-4
Horsepower.....	175 hp
Governed Engine Speed.....	1800 rpm
Idle Speed.....	900 rpm

Engine Weight

Wet.....	748 kg [1,650 lb]
Crankshaft Rotation (viewed from the front of the engine).....	Clockwise
Maximum allowable installed engine power angle.....	6 degrees
Maximum allowable installed engine tilt angle.....	6 degrees
Maximum Overspeed Capacity.....	1980 rpm

Fuel System

Specifications

Fuel Inlet Pressue to the Regulator:

Minimum.....83 kPa [12 psi]
Maximum.....172 kPa [25 psi]

Gas Pressure to Engine-mounted Regulator (at full load):

Minimum.....41 kPa [64 psi]
Maximum.....206 kPa [30 psi]

Gas Pressure to Carburetor (water column at full load):.....102 to 152 mm H₂O [4 to 6 in H₂O]

Ignition Timing and Exhaust Oxygen Content:

Degrees Before Top Dead Center (TDC).....26
Excess O₂ Percent (Prime - Continuous).....0.4 to 0.6 percent

Application Derates:

Application(s): Industrial, Generator

Power Rating:.....Continuous, Prime

Application Derates:

Maximum Altitude without Derate:

Continuous, Prime (High Compression Ratio).....457 m [1500 ft]

Application Derates:

Maximum Ambient - Intake Manifold Temperature, without Derate:

Continuous, Prime (High Compression Ratio).....25°C [77°F]

Lubricating Oil System

Specifications

Oil Pressure:

Low Idle (minimum allowable).....70 kPa [10 psi]
At 1400 rpm or Torque Peak (minimum allowable).....207 kPa [30 psi]

Oil Capacity:

Standard Oil Pan.....15 to 19 liter [4.0 to 5.0 gal]
High Capacity Oil Pan:.....22.7 to 35 liter [6.0 to 9.25 gal]

Total System Capacity Including Filters:

Standard Oil Pan:.....23.8 liter [6.3 gal]
High Capacity Oil Pan:.....39.9 liter [10.55 gal]

Maximum Allowable Oil Temperature:.....127°C [260°F]

Cooling System

Specifications

Coolant Capacity (engine only).....	11.6 liter [11 qt]
Engine Coolant Thermostat Operating Temperature	
Operating Temperature.....	82°C [180°F]
Fully Open Temperature.....	88°C [190°F]
Operating Temperature	
Minimum Recommended.....	71°C [160°F]
Maximum Allowable.....	102°C [215°F]
Maximum Recommended External Coolant Flow Restriction in Engine Circuit.....	34 kPa [5 psi]
Coolant Pressure Cap Rating	
Minimum Pressure cap Rating at Sea Level.....	48 kPa [7 psi]
Maximum Pressure cap Rating at Sea Level.....	103 kPa [15 psi]
Maximum Deration Time.....	25 minutes
Low Temperature Aftercooler (LTA) Circuit	
Maximum Recommended External Coolant Restriction.....	48.3 kPa [7 psi]
LTA Radiator Coolant Flow with 34.5 kPa [5 psi] External Restriction at 25°C [77°F] and Rated Speed...58 L/min [15 gpm]	
Coolant Capacity - Low Temperature Aftercooler.....	5.3 liters [5.6 qt]

Air Intake System

Specifications

All measurements are while engine is under rated conditions.

Maximum Intake Air Restriction:

With Dirty Filter Element.....	6 kPa [25 in H ₂ O]
With Normal-Duty Air Cleaner and Clean Air Filter Element.....	2 kPa [10 in H ₂ O]
With Heavy-Duty Air Cleaner and Clean Air Filter Element.....	4 kPa [15 in H ₂ O]

Exhaust System

Specifications

Maximum Exhaust Back Pressure:.....50 mm Hg [2 in Hg]
Exhaust Outlet Tubing Size:.....102 mm [4 in]
Exhaust Gas Temperature Limit (dry manifold):.....738°C [1360°F]

Exhaust Gas Limits

NOTE: These values are in terms of gas concentration in PPM (parts per million) at rated speed and load. These are the Environmental Protection Agency (EPA) certification limits starting in 2008, giving the maximum numbers. Some local regulatory commissions could possibly have specifications that are different from these. Please check with a Cummins® Authorized Repair Location for assistance.

NOx (oxides of nitrogen).....418 PPM
CO (carbon monoxide).....1283 PPM
NMHC (non-methane hydrocarbons).....451 PPM

Electrical System

Specifications

Minimum Recommended Battery Capacity (Cold soak -18°C [0°F] or above).....24-VDC

Engine Only:

Cold Cranking Amps.....900

Reserve Capacity (minimum).....320

Engine Loaded:

Cold Cranking Amps.....900

Reserve Capacity (minimum).....320

Maximum Allowable Resistance to Starting Circuit (Ohms).....0.002 Ohms

Starting Circuit

Maximum Resistance

12-VDC Starter.....0.0012 ohms

24-VDC Starter.....0.0040 ohms

Minimum Recommended Battery Capacity				
System Voltage	Ambient Temperature: -18°C [0°F]		Ambient Temperature: 0°C [32°F]	
	Cold Cranking Amperes	Reserve Capacity ¹ Amperes	Cold Cranking Amperes	Reserve Capacity ¹ Amperes
12-VDC	1800	640	1280	480
24-VDC ²	900	320	640	240

1. The number of plates within a given battery size determines reserve capacity. Reserve capacity determines the length of time that sustained cranking can occur.
2. CCA ratings are based on two 12-VDC batteries in series.

Cummins/Fleetguard® Filter Specifications

General Information

Cummins Filtration Solutions is a subsidiary of Cummins Inc. Cummins Filtration Solutions filters are developed through joint testing at Cummins Inc. and Cummins Filtration Solutions.

Cummins Filtration Solutions products meet all Cummins Inc. Source Approval Test standards to provide the quality filtration necessary to achieve the engine's design life. If other brands are substituted, the purchaser should insist on products that the supplier has tested to meet Cummins Inc. high-quality standards.

Cummins Inc. can **not** be responsible for problems caused by non-genuine filters that do **not** meet Cummins Inc. performance or durability requirements.

Filter Part Numbers

Lubricating Oil Filter Part Numbers

Cummins Filtration Solutions

LF3000

Cummins Inc.

3401544

Lubricating Oil Recommendations and Specifications

General Information



07900244

⚠ CAUTION ⚠

Do not use L10G engine oil in G8.3 CM558 engines. If L10G engine lubricating oil is used, failure of the tappets and camshaft will occur.

⚠ CAUTION ⚠

Do not use diesel engine oil in a natural gas engine. If diesel engine oil is used, valve torching, piston scuffing, and reduction of spark plug life will occur.

⚠ CAUTION ⚠

A sulfated ash limit of 0.6 percent has been placed on all engine lubricating oil recommended for use in Cummins® natural gas engines. Higher ash oils can cause valve and/or piston damage and lead to excessive oil consumption and degradation of the catalyst.

Cummins® natural gas engines require a special oil that is available from major oil suppliers. Careful attention **must** be paid to engine oil specifications, because natural gas engine oil has different properties than diesel engine oil.

The oil specification for G8.3 CM558 engines is **not** the same as the L10G engine lubricating oil specification.

GTA8.3 Simple Lean Burn engines **must** use oil that conforms to Cummins® Engineering Standard (CES) 20074. This standard will be identified on the supplier's oil packaging. If in doubt as to whether the oil meets the Cummins Inc. specification, contact the supplier to obtain a copy of the Cummins Inc. registration letter that certifies the oil meets specifications.

For easy identification, the packaging of the oil will show CES20074 upon it.

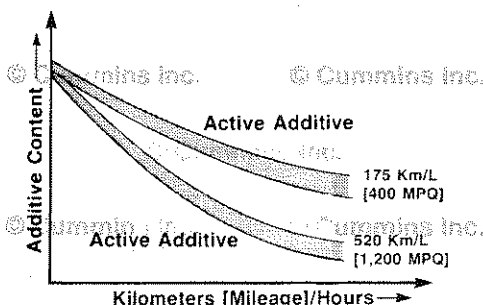
For further assistance, contact a Cummins® Authorized Repair Location, which can supply information regarding oil brands that comply with Cummins Inc. specifications.

Correct engine lubricating oil and filter change intervals **must** be maintained for each specific Cummins® engine model. A sharp increase in component wear and damage can occur if lubricating oil and filter maintenance intervals are **not** followed, as outlined in the maintenance schedule in Section 2.

Quality engine lubricating oils combined with appropriate oil and filter change intervals are critical factors in maintaining engine performance and durability.

Special "break-in" engine lubricating oils are **not** recommended for new or rebuilt Cummins® natural gas engines. During "break-in", use the same lubricating oil that will be used in normal engine operation.

Oil Additives in Used Oil



oil8guvb

As the engine oil becomes contaminated, essential oil additives are depleted. Lubricating oils protect the engine as long as these additives are functioning properly.

Progressive contamination of the oil between oil and filter change intervals is normal. The amount of contamination will vary, depending on the operation of the engine, distance on the oil, fuel consumed, and new oil added.

NOTE: Oil for natural gas engines does **not** darken and look dirty as diesel oil does. Use the maintenance schedule in Section 2 to determine the oil change interval requirement, **not** the oil's appearance.

Additional information regarding lubricating oil availability throughout the world is available in the E.M.A. Lubricating Oils Data Book for Heavy-Duty Automotive and Industrial Engines. The data book can be ordered from the following:

Engine Manufacturers Association
2 North LaSalle Street
Suite 2200
Chicago, IL, U.S.A. 60602
Phone 1-312-827-8700

For further details and discussion of engine lubricating oils for Cummins® engines, refer to Cummins® Engine Oil and Oil Analysis Recommendations, Bulletin 3810340.

Coolant Recommendations and Specifications

General Information

Cummins recommends the use of fully-formulated antifreeze or coolant containing a pre-charge of Supplemental Coolant Additive (SCA). The use of fully formulated antifreeze or coolant significantly simplifies cooling system maintenance.

Fully-formulated antifreeze contains balanced amounts of antifreeze, SCA, and buffering compounds, but does **not** contain 50 percent water.

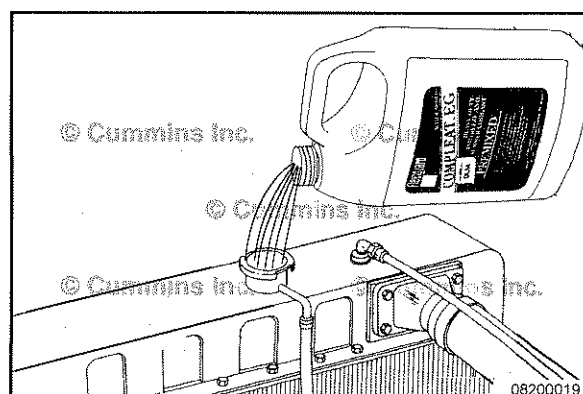
Fully-formulated coolant contains balanced amounts of antifreeze, SCA, and buffering compounds already premixed 50 to 50 with deionized water.

The following pages will give an explanation of water, antifreeze, and SCA's. They will also explain how to test antifreeze and SCA levels.

Alternative maintenance practices for cooling systems can be found in Cummins Coolant Requirements and Maintenance, Bulletin 3666132.

Fully Formulated Coolant/Antifreeze

Cummins recommends using either a 50 to 50 mixture of high quality water and fully formulated antifreeze, or fully formulated coolant when filling the cooling system.



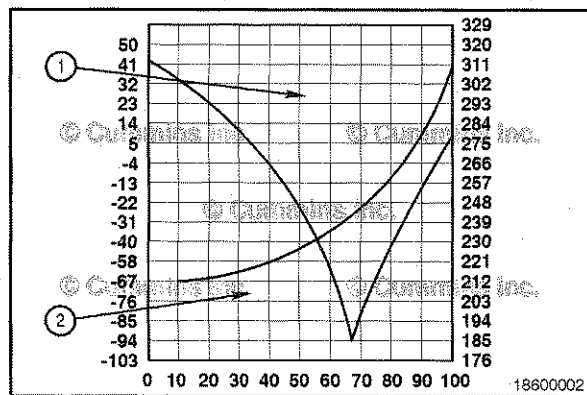
High quality water is important for cooling system performance. Excessive levels of calcium and magnesium contribute to scaling problems, and excessive levels of chlorides and sulfates cause cooling system corrosion.

Water Quality	
Calcium Magnesium (Hardness)	Maximum 170 ppm as (CaCO ₃ + MgCO ₃)
Chloride	40 ppm as (Cl)
Sulfur	100 ppm as (SO ₄)

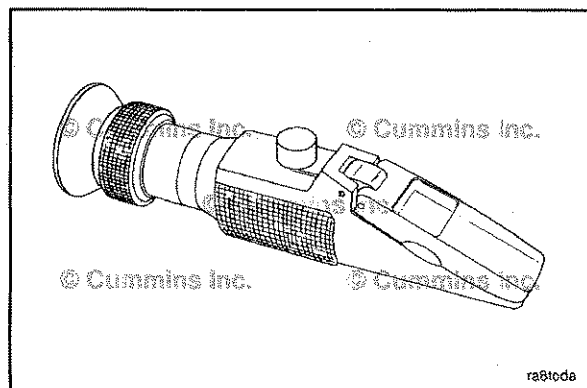
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Cummins recommends using Fleetguard® Complete. It is available in both glycol forms (ethylene and propylene).

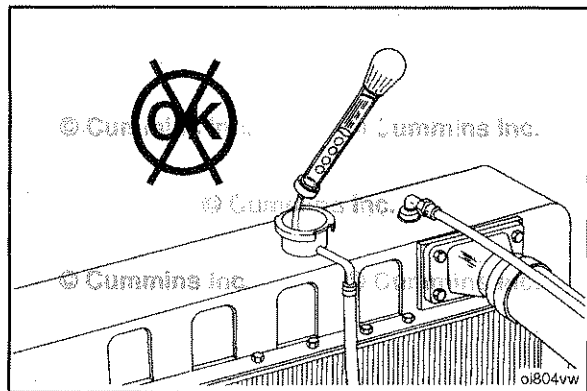




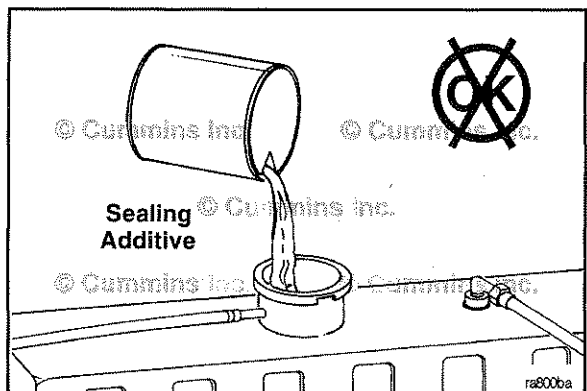
Fully formulated antifreeze **must** be mixed with a good quality water at a 50 to 50 ratio (40% to 60% working range). A 50 to 50 mixture of antifreeze and water gives a (1) -36°C [-34°F] freeze point and (2) a boiling point of 110°C [228°F], which is adequate for all locations. The actual lowest freeze point of ethylene glycol antifreeze is at 69%. Using higher concentrations of antifreeze will raise the freeze point of the solution and increase the possibility of a silicate gel problem.



A refractometer, Part Number CC-2800, **must** be used to accurately measure the freeze point of the coolant.



Do **not** use a floating ball hydrometer, as it can give incorrect readings.



Cooling System Sealing Additives

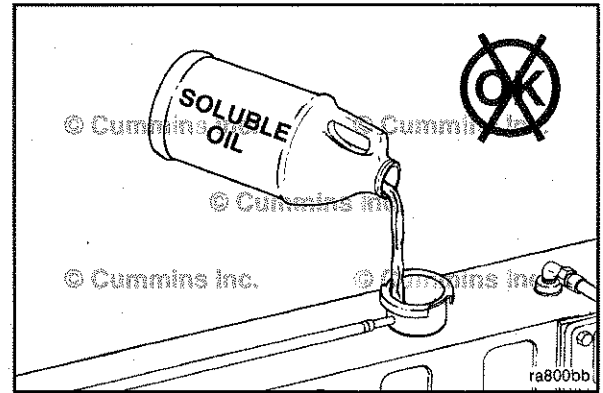
Do **not** use sealing additives in the cooling systems. The use of sealing additives will:

- Build up in coolant low flow areas
- Plug the radiator and oil cooler.

Cooling System Soluble Oils

Do **not** use soluble oils in the cooling system. The use of soluble oils will:

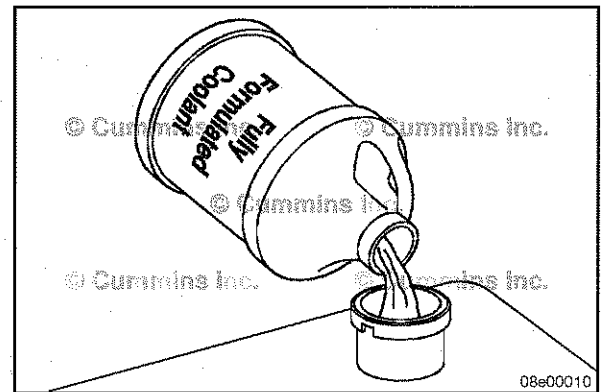
- Allow cylinder liner pitting
- Corrode brass and copper
- Damage heat transfer surfaces
- Damage seals and hoses.



Supplemental Coolant Additive (SCA)

Fully-formulated products contain SCA's and are required to protect the cooling system from fouling, solder blooming, and general corrosion.

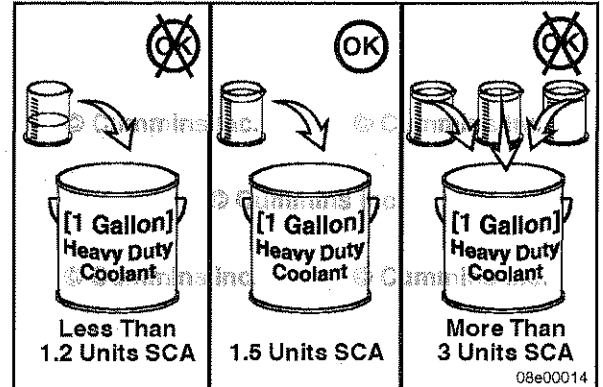
Supplemental coolant additives, or equivalent, are used to prevent pitting, corrosion, and scale deposits in the cooling system.



⚠CAUTION⚠

Insufficient concentration of the coolant additives will result in cylinder liner pitting, corrosion, solder blooming, and scale deposits which will lead to engine failure.

The SCA concentration **must not** fall below 1.5 units or exceed 3 units per gallon of cooling system capacity.

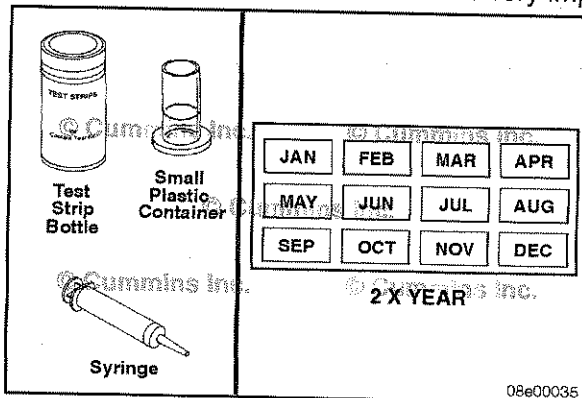


Testing SCA Concentration Level CC-2602 Test Kit

Carefully follow the instructions to test the coolant and take the appropriate action recommended by the kit.

- The coolant sample to be tested **must** be between 10 and 54°C [50 and 130°F]. If the sample is too cold or too hot, the results will be incorrect.
- To get the best color match results, compare test strip pads to the color chart in daylight or under cool white fluorescent lighting. If unsure about a specific color match when a test falls between two colors on the color chart, choose the lower numbered block. It is safer to underestimate results than to overestimate.
- The test strips have a limited shelf life and are sensitive to humidity and extreme heat. Proper handling and storage is necessary to protect the life of the strips.
- Keep the lid tightly sealed on the strip bottle except when removing a strip. Store away from direct sunlight and in an area where the temperature will generally stay below 32°C [90°F].
- Do **not** use the test strips after the expiration date stamped on the bottle.
- Discard the kit if any of the pads on the unused strips have turned light brown or pink.
- Use one strip at a time and take care **not** to touch and pads on the strip. Doing so will contaminate the pads and affect the test results.

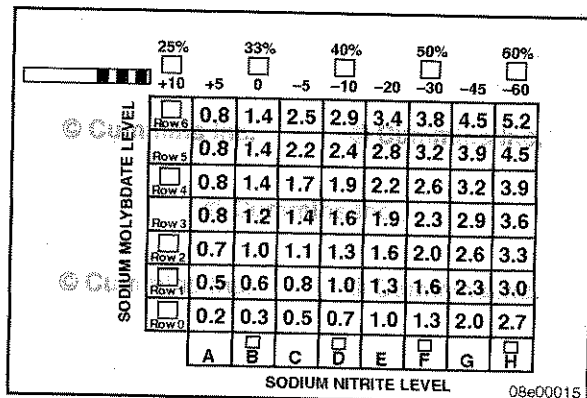
- If the strip container is left uncapped for 24 hours, moisture in the air will render the strips useless, although no discoloration will be evident.
- Only use the color chart supplied with the kit.
- Clean and dry the sample cup and syringe after each use. This will prevent contaminating future samples.
- Following the correct test times is very important, use a clock or stopwatch.



Test Intervals

Testing is recommended if the operator is **not** sure of the cooling system condition due to leaks, uncontrolled topping off of the system, or major coolant loss.

Test the cooling system at a minimum of twice a year to monitor the SCA level. If the SCA level is above 3 units, test at subsequent oil drain intervals until the concentration is back under 3 units.



Do **not** use the test kit to maintain minimum SCA concentration levels (i.e. 1.5 units). The recommended SCA level is 1.5 units per gallon.

In some instances the A or B reading can be high. However, it is the combined reading that is important. Therefore, **always** follow the chart.

Part Number	Description
CC2602 Coolant Test Kit	Works with any SCA formulation (Call 1-800-521-4005) if the color chart does not show the number of units of SCA per gallon of coolant.
Probablizer:	
3318169S Plug	Installs on the engine for easy coolant sampling
3318168S Cap	Use with Monitor C bottle to sample coolant
CC2700 Monitor C	Lab analysis of coolant sample

To get answers to any questions regarding cooling system maintenance, contact a local Cummins Authorized Repair Location.

Cummins: 1-800-DIESELS
1-800-521-4005

1-800-22-FILTERS Inc.
1 - 800 - 223 - 4583

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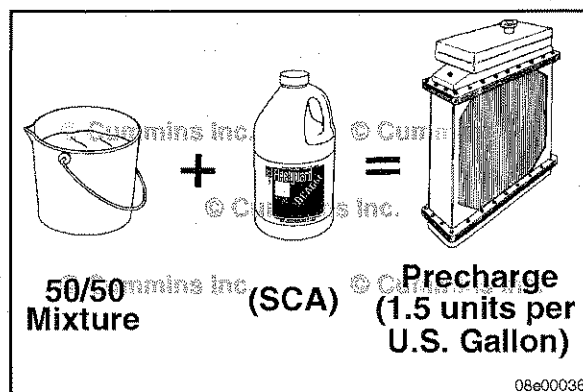
Coolant Replacement Requirements



WARNING

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

Drain and flush the cooling system after 15,000 hours or 30 months of service. Refill with either new fully-formulated coolant or a 50 to 50 mixture of high quality water and fully-formulated antifreeze.



08e00036

Drive Belt Tension

Tension Chart

SAE Belt Size	Belt Tension Gauge Part No.		Belt Tension New		Belt Tension Range Used*	
	Click-type	Burroughs	N	lbf	N	lbf
0.380 in	3822524		620	140	270 to 490	60 to 110
0.440 in	3822524		620	140	270 to 490	60 to 110
1/2 in	3822524	ST-1138	620	140	270 to 490	60 to 110
11/16 in	3822524	ST-1138	620	140	270 to 490	60 to 110
3/4 in	3822524	ST-1138	620	140	270 to 490	60 to 110
7/8 in	3822524	ST-1138	620	140	270 to 490	60 to 110
4 rib	3822524	ST-1138	620	140	270 to 490	60 to 110
5 rib	3822524	ST-1138	670	150	270 to 530	60 to 120
6 rib	3822525	ST-1293	710	160	290 to 580	65 to 130
8 rib	3822525	ST-1293	890	200	360 to 710	80 to 160
10 rib	3822525	3823138	1110	250	440 to 890	100 to 200
12 rib	3822525	3823138	1330	300	530 to 1070	120 to 240
12 rib K section	3822525	3823138	1330	300	890 to 1070	200 to 240

NOTE: This chart does not apply to automatic belt tensioners.

* A belt is considered used if it has been in service for ten minutes or longer.

* If used belt tension is less than the minimum value, tighten the belt to the maximum used belt value.

Engine Component Torque Values

Component List

Engine Component Torque List		Torque Values	
Component		N•m	ft-lb
Oil Pan Drain Plug		80	59
Rocker Lever Cover Capscrews		15	130 in-lb
Air Intake Hose Clamps		8	72 in-lb
Spark Plugs		35 to 41	26 to 30
Starter Motor		43	32
Turbocharger exhaust and Intake Piping Hose Clamps		8	72 in-lb
Coils to Coil Bracket		9	80 in-lb
Belt Tensioner		43	32
Fan Pulley		24	18
Thermostat Housing / Water Outlet Connection		24	18
Alternator Mounting		Refer to the OEM Service Literature	
Alternator Link		Refer to the OEM Service Literature	
Filters		Contact plus ½ to ¾ turn	

Sealants

General Information

Use the sealants listed below or sealants containing equivalent properties.

Item Description	Sealing Method
Pipe Plugs	Precoated teflon or pipe sealer
Cup Plugs	Loctite 277 or 11,264
O-Rings	Lubriplate™ 105
Rear Camshaft Expansion Plug	Precoated or Loctite 59,241 liquid teflon
Fuel Block Mounting Studs	Loctite 609
Turbocharger Drain in Block	Loctite 277 or 11,264
Front Seal in Gear Cover	Loctite 277 or 11,264
Rear Seal in Rear Cover	No sealant
Oil Pan at T-Joint	Three-Bond™ 1207C (Cummins Part Number 3823494)

Capscrew Markings and Torque Values

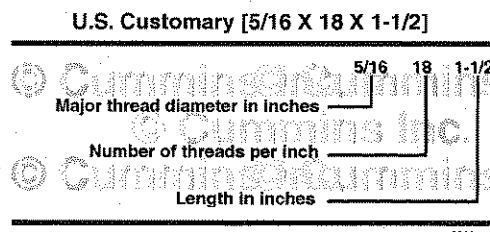
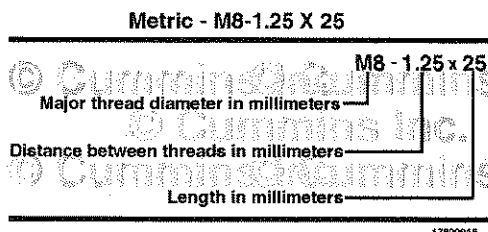
General Information



When replacing capscrews, always use a capscrew of the same measurement and strength as the capscrew being replaced. Using the wrong capscrews can result in engine damage.

Metric capscrews and nuts are identified by the grade number stamped on the head of the capscrew or on the surface of the nuts. U.S. Customary capscrews are identified by radial lines stamped on the head of the capscrew.

The following examples indicate how capscrews are identified:



NOTES:

1. Always use the torque values listed in the following tables when specific torque values are **not** available.
2. Do **not** use the torque values in place of those specified in other sections of this manual.
3. The torque values in the table are based on the use of lubricated threads.
4. When the ft-lb value is less than 10, convert the ft-lb value to in-lb to obtain a better torque with an in-lb torque wrench. Example: 6 ft-lb equals 72 in-lb.

Capscrew Markings and Torque Values - Metric

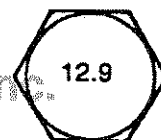
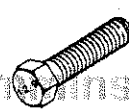
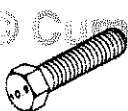
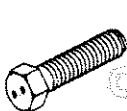
Commercial Steel Class

8.8

10.9

12.9

Capscrew Head Markings



Body Size Diameter mm	Torque				Torque				Torque			
	Cast Iron		Aluminum		Cast Iron		Aluminum		Cast Iron		Aluminum	
	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb
6	9	5	7	4	13	10	7	4	14	9	7	4
7	14	9	11	7	18	14	11	7	23	18	11	7
8	23	17	18	14	33	25	18	14	40	29	18	14
10	45	33	30	25	65	50	30	25	70	50	30	25
12	80	60	55	40	115	85	55	40	125	95	55	40
14	125	90	90	65	180	133	90	65	195	145	90	65
16	195	140	140	100	280	200	140	100	290	210	140	100
18	280	200	180	135	390	285	180	135	400	290	180	135
20	400	290	—	—	550	400	—	—	—	—	—	—

Capscrew Markings and Torque Values - U.S. Customary

SAE Grade Number		5				8			
Capscrew Head Markings									
These are all SAE Grade 5 (3 line)									
		Capscrew Torque - Grade 5 Capscrew				Capscrew Torque - Grade 8 Capscrew			
Capscrew Body Size	Cast Iron		Aluminum		Cast Iron		Aluminum		
	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	
1/4 - 20	9	7	8	6	15	11	8	6	
1/4 - 28	12	9	9	7	18	13	9	7	
5/16 - 18	20	15	16	12	30	22	16	12	
5/16 - 24	23	17	19	14	33	24	19	14	
3/8 - 16	40	30	25	20	55	40	25	20	
3/8 - 24	40	30	35	25	60	45	35	25	
7/16 - 14	60	45	45	35	90	65	45	35	
7/16 - 20	65	50	55	40	95	70	55	40	
1/2 - 13	95	70	75	55	130	95	75	55	
1/2 - 20	100	75	80	60	150	110	80	60	
9/16 - 12	135	100	110	80	190	140	110	80	
9/16 - 18	150	110	115	85	210	155	115	85	
5/8 - 11	180	135	150	110	255	190	150	110	
5/8 - 18	210	155	160	120	290	215	160	120	
3/4 - 10	325	240	255	190	460	340	255	190	
3/4 - 16	365	270	285	210	515	380	285	210	
7/8 - 9	490	360	380	280	745	550	380	280	
7/8 - 14	530	390	420	310	825	610	420	310	
1 - 8	720	530	570	420	1100	820	570	420	
1 - 14	800	590	650	480	1200	890	650	480	

Fraction, Decimal, Millimeter Conversions

Conversion Chart

Fraction	inch	mm	Fraction	inch	mm
1/64	0.0156	0.397	33/64	0.5156	13.097
1/32	0.0313	0.794	17/32	0.5313	13.494
3/64	0.0469	1.191	35/64	0.5469	13.891
1/16	0.0625	1.588	9/16	0.5625	14.288
5/64	0.0781	1.984	37/64	0.5781	14.684
3/32	0.0938	2.381	19/32	0.5938	15.081
7/64	0.1094	2.778	39/64	0.6094	15.478
1/8	0.1250	3.175	5/8	0.6250	15.875
9/64	0.1406	3.572	41/64	0.6406	16.272
5/32	0.1563	3.969	21/32	0.6563	16.669
11/64	0.1719	4.366	43/64	0.6719	17.066
3/16	0.1875	4.763	11/16	0.6875	17.463
13/64	0.2031	5.159	45/64	0.7031	17.859
7/32	0.2188	5.556	23/32	0.7188	18.256
15/64	0.2344	5.953	47/64	0.7344	18.653
1/4	0.2500	6.350	3/4	0.7500	19.050
17/64	0.2656	6.747	49/64	0.7656	19.447
9/32	0.2813	7.144	25/32	0.7813	19.844
19/64	0.2969	7.541	51/64	0.7969	20.241
5/16	0.3125	7.938	13/16	0.8125	20.638
21/64	0.3281	8.334	53/64	0.8281	21.034
11/32	0.3438	8.731	27/32	0.8438	21.431
23/64	0.3594	9.128	55/64	0.8594	21.828
3/8	0.3750	9.525	7/8	0.8750	22.225
25/64	0.3906	9.922	57/64	0.8906	22.622
13/32	0.4063	10.319	29/32	0.9063	23.019
27/64	0.4219	10.716	59/64	0.9219	23.416
7/16	0.4375	11.113	15/16	0.9375	23.813
29/64	0.4531	11.509	61/64	0.9531	24.209
15/32	0.4688	11.906	31/32	0.9688	24.606
31/64	0.4844	12.303	63/64	0.9844	25.003
1/2	0.5000	12.700	1	1.0000	25.400

Conversion Factor: 1 inch = 25.4 mm

Newton-Meter to Foot-Pound Conversions

Conversion Chart

N•m	ft-lb	N•m	ft-lb	N•m	ft-lb
1	9 in-lb	55	41	155	114
5	44 in-lb	60	44	160	118
6	53 in-lb	65	48	165	122
7	62 in-lb	70	52	170	125
8	71 in-lb	75	55	175	129
9	80 in-lb	80	59	180	133
10	89 in-lb	85	63	185	136
11	97 in-lb	90	66	190	140
12	106 in-lb	95	70	195	144
14	124 in-lb	100	74	200	148
15	133 in-lb	105	77	205	151
16	142 in-lb	110	81	210	155
18	159 in-lb	115	85	215	159
20	15 ft-lb	120	89	220	162
25	18	125	92	225	165
30	22	130	96	230	170
35	26	135	100	235	173
40	30	140	103	240	177
45	33	145	107	245	180
50	37	150	111	250	184

NOTE: To convert from Newton-Meters to Kilogram-Meters divide Newton-Meters by 9.803.

Pipe Plug Torque Values

Torque Table

Size		Torque		Torque	
Thread	Actual Thread O.D.	In Aluminum Components		In Cast Iron or Steel Components	
in	in	N•m	ft-lb	N•m	ft-lb
1/16	0.32	5	45 in-lb	15	10
1/8	0.41	15	10	20	15
1/4	0.54	20	15	25	20
3/8	0.68	25	20	35	25
1/2	0.85	35	25	55	40
3/4	1.05	45	35	75	55
1	1.32	60	45	95	70
1-1/4	1.66	75	55	115	85
1-1/2	1.90	85	65	135	100

Tap-Drill Chart - U.S. Customary and Metric

General Information

NOTE ON SELECTING TAP-DRILL SIZES: The tap drill sizes shown on this card give the theoretical tap drill size for approximately 60% and 75% of full thread depth. Generally, it is recommended that drill sizes be selected in the 60% range as these sizes will provide about 90% of the potential holding power. Drill sizes in the 75% range are recommended for shallow hole tapping (less than 1 1/2 times the hole diameter) in soft metals and mild steel.

丝锥规格		钻孔尺寸	丝锥规格		钻孔尺寸	丝锥规格		钻孔尺寸	丝锥规格		钻孔尺寸
60%	75%		60%	75%		60%	75%		60%	75%	
		48			4.40mm			7.50mm			13.25mm
		1.95mm			16			19/64			17/32
		5/64			4.50mm			7.60mm			13.50mm
		47			15			N			13.75mm
		2.00mm			4.60mm			7.70mm			35/64
		2.05mm			14			7.75mm			14.00mm
		46			13			7.80mm			14.25mm
		45			4.70mm			7.90mm			9/16
		2.10mm			4.75mm			5/16			14.50mm
		2.15mm			3/16			8.00mm			37/64
		44			12			O			14.75mm
		2.20mm			4.80mm			8.10mm			15.00mm
		2.25mm			11			8.20mm			19.32
		43			4.90mm			P			15.25mm
		2.30mm			10			8.25mm			39/64
		2.35mm			9			8.30mm			15.50mm
		42			5.00mm			21/64			15.75mm
		3/32			8			8.40mm			5/8
		2.40mm			5.10mm			Q			16.00mm
		41			7			8.50mm			16.25mm
		2.45mm			13/64			8.60mm			41/64
		40			6			R			16.50mm
		2.50mm			5.20mm			8.70mm			21/32
		39			5			11/32			16.75mm
		38			5.25mm			8.75mm			17.00mm
		2.60mm			5.30mm			8.80mm			43/64
		37			4			S			17.25mm
		2.70mm			5.40mm			8.90mm			11/16
		36			3			9.00mm			17.50mm
		2.75mm			5.50mm			T			17.75mm
		7/64			7/32			9.10mm			45/64
		35			5.60mm			23/64			18.00mm
		2.80mm			2			9.20mm			18.25mm
		34			5.70mm			9.30mm			23/32
		33			5.75mm			U			18.50mm
		2.90mm			1			9.40mm			47/64
		32			5.80mm			9.50mm			18.75mm
		3.00mm			5.90mm			3/8			19.00mm
		31			A			V			3/4
		3.10mm			15/64			9.60mm			19.25mm
		1/8			6.00mm			9.70mm			49/64
		3.20mm			B			9.75mm			19.50mm
		3.25mm			6.10mm			9.80mm			25/32
		30			C			W			19.75mm
		3.30mm			6.20mm			9.90mm			20.00mm
		3.40mm			D			25/64			51/64
		29			6.25mm			10.00mm			20.25mm
		3.50mm			6.30mm			X			20.50mm
		28			E			10.20mm			13/16
		9/64			1/4			Y			20.75mm
		3.60mm			6.40mm			13/32			21.00mm
		27			6.50mm			Z			53/64
		3.70mm			F			10.50mm			21/25mm
		26			6.60mm			27/64			27/32
		3.75mm			G			10.75mm			21.50mm
		25			6.70mm			11.00mm			21.75mm
		3.80mm			17/64			7/16			55/64
		24			6.75mm						22.00mm
		3.90mm			H			11.25mm			7/8
		23			6.80mm			11.50mm			22.25mm
		5/32			6.90mm			29/64			22.50mm
		22			I			11.75mm			57/64
		4.00mm			7.00mm			11.50mm			22.75mm
		21			J			29/64			23.00mm
		20			7.10mm			15/32			29/32
		4.10mm			K			12.00mm			23.25mm
		4.20mm			9/32			12.25mm			59/64
		19			7.20mm			31/64			23.50mm
		4.25mm			7.25mm			12.50mm			23.75mm
		4.30mm			7.30mm			1/2			15/16
		18			L			12.75mm			
		11/64			7.40mm			13.00mm			
		17			M			33/64			

Weights and Measures - Conversion Factors

Conversion Chart

Quantity	U.S. Customary		Metric		From U.S. Customary To Metric Multiply By	From Metric To U.S. Customary Multiply By
	Unit Name	Abbreviation	Unit Name	Abbreviation		
Area	sq. inch	in ²	sq. millimeters	mm ²	645.16	0.001550
			sq. centimeters	cm ²	6.452	0.155
	sq. foot	ft ²	sq. meter	m ²	0.0929	10.764
Fuel Consumption	pounds per horsepower hour	lb/hp-hr	grams per kilowatt hour	g/kW-hr	608.277	0.001645
Fuel Performance	miles per gallon	mpg	kilometers per liter	km/l	0.4251	2.352
	gallons per mile	gpm	liters per kilometer	l/km	2.352	0.4251
Force	pounds force	lbf	Newton	N	4.4482	0.224809
Length	inch	in	millimeters	mm	25.40	0.039370
	foot	ft	millimeters	mm	304.801	0.00328
Power	horsepower	hp	kilowatt	kW	0.746	1.341
Pressure	pounds force per sq. inch	psi	kilopascal	kPa	6.8948	0.145037
	inches of mercury	in Hg	kilopascal	kPa	3.3769	0.29613
	inches of water	in H ₂ O	kilopascal	kPa	0.2488	4.019299
	inches of mercury	in Hg	millimeters of mercury	mm Hg	25.40	0.039370
	inches of water	in H ₂ O	millimeters of water	mm H ₂ O	25.40	0.039370
	bars	bars	kilopascals	kPa	100.001	0.00999
	bars	bars	millimeters of mercury	mm Hg	750.06	0.001333
Temperature	fahrenheit	°F	centigrade	°C	(°F-32) ÷ 1.8	(1.8 x °C) + 32
Torque	pound force per foot	ft-lb	Newton-meter	N•m	1.35582	0.737562
	pound force per inch	in-lb	Newton-meter	N•m	0.113	8.850756
Velocity	miles/hour	mph	kilometers/hour	kph	1.6093	0.6214
Volume: liquid displacement	gallon (U.S.)	gal.	liter	l	3.7853	0.264179
	gallon (Imp*)	gal.	liter	l	4.546	0.219976
	cubic inch	in ³	liter	l	0.01639	61.02545
	cubic inch	in ³	cubic centimeter	cm ³	16.387	0.06102
Weight (mass)	pounds (avoir.)	lb	kilograms	kg	0.4536	2.204623
Work	British Thermal Unit	BTU	joules	J	1054.5	0.000948
	British Thermal Unit	BTU	kilowatt-hour	kW-hr	0.000293	3414
	horsepower hours	hp-hr	kilowatt-hour	kW-hr	0.746	1.341

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Section W — Warranty
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Gaseous Fueled EnginesWorldwideIndustrial (Off Highway)Consumer PRODUCTS COVERED

Cummins Inc. (Cummins) warrants to the purchaser (and any subsequent owner) for personal, family or household use (the "Owner") that the following products or components are free from defects in materials and workmanship appearing within the time and/or mileage indicated.

PRODUCT WARRANTY	DURATION of WARRANTY
Base Engine Warranty: New Cummins Gaseous Off-Highway Engines sold by Cummins and delivered to the first user on or after October 1, 2004.	Two years or 2,000 hours of operation, whichever comes first, from the date of delivery to the first end-user; provided, however, that if 2,000 hours of operation are met within the first year, coverage will last until the end of that year.
Accessories Warranty: Cummins branded accessories, excluding clutches and filters.	The duration of the Base Engine Warranty.
Belts Warranty: Belts supplied by Cummins.	One year or 500 hours of operation, whichever comes first, from the date of delivery to the first end-user.

THERE ARE NO EXPRESS WARRANTIES OTHER THAN THE ABOVE LIMITED WARRANTIES.

IN NO EVENT SHALL ANY IMPLIED WARRANTIES, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE, EXTEND BEYOND THE DURATION OF THESE WARRANTIES.

Some states do not allow limitations on how long an implied warranty lasts.

PRODUCTS NOT COVERED

The following products are not covered by any of the limited warranties described above:

Any accessories bearing the name or brand of another company, even if supplied by Cummins.

OTHER EXCLUSIONS

These limited warranties do not apply to the following:

1. Engines used commercially, industrially, for competition.
2. Normal wear and tear.
3. Damage caused by accidents, abuse, alteration, modification, misuse, neglect or improper care or maintenance, including, but not limited to, the following: operation without adequate coolants or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or intake systems; improper storage; and starting, warm-up, run-in or shutdown practices.
4. Damage or failures caused by repair or replacement using parts not supplied, rebuilt or repaired by Cummins.
5. Damage caused by operation of the engine outside of the recommended specifications for timing and/or fueling.
6. Damage or failures caused by incorrect oil or fuel or by the presence of water, dirt or other contaminants in the fuel, oil and/or coolant.
7. Claims for excessive oil consumption where the Owner cannot provide adequate documentation to show that consumption met or exceeded published standards.
8. Damage due to the failure to follow all instructions specified in the Cummins Operation and Maintenance Manual. Proof of proper maintenance is the Owner's responsibility. Keep all receipts and be prepared to make them available if questions arise about maintenance.
9. The cost of normal maintenance or replacement of parts which are not defective. These are the sole responsibility of the Owner.

REMEDIES

Cummins will repair or replace, free of charge, the defective part or product.

Cummins will pay for all labor costs to remove and/or reinstall the Engine or to repair parts, and will also pay for any additional replacement parts needed for the repair (even if such parts are not defective in material or workmanship).

Any repair or replacement must be done by Cummins or a Cummins distributor.

If Cummins replaces maintenance items, including, but not limited to, lubricating oil, antifreeze and filter elements, because they have been damaged by a warranted failure, Cummins will repair or replace these maintenance items free of charge; if such items are replaced at the Owner's request in the course of repair, and not because they have been damaged by a warranted failure, the cost of such replacement is the sole responsibility of the Owner.

Any part repaired or replaced by Cummins or a Cummins distributor under this Warranty will be covered by the remainder of the applicable warranty.

CUMMINS' ONLY RESPONSIBILITY, AND THE OWNER'S ONLY REMEDY, IS REPAIR OR REPLACEMENT AS DESCRIBED IN THIS WARRANTY.

CUMMINS SHALL NOT BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other legal rights which vary from state to state.

HOW TO OBTAIN SERVICE

To obtain warranty service in the United States, the Engine or part believed to be defective, and proof of the date of delivery to the first end-user must be presented to a Cummins distributor. Any charges incurred for service calls, meals, lodging, transportation to/from the Cummins distributor and other similar costs are the responsibility of the Owner. If you have any questions regarding this limited warranty, please visit our website at <http://www.cummins.com>.

Gaseous Fueled EnginesWorldwideIndustrial (Off Highway)Commercial PRODUCTS COVERED

Cummins Inc. (Cummins) warrants to the purchaser (and any subsequent owner) for industrial and commercial use (the "Owner") that the following products or components are free from defects in materials and workmanship appearing within the time and/or mileage indicated.

PRODUCT WARRANTY	DURATION of WARRANTY
Base Engine Warranty: New Cummins Gaseous Off-Highway Engines sold by Cummins and delivered to the first user on or after October 1, 2004, for industrial and commercial use.	Two years or 2,000 hours of operation, whichever comes first, from the date of delivery to the first end-user; provided, however, that if 2,000 hours of operation are met within the first year, coverage will last until the end of that year.
Accessories Warranty: (1) Cummins Branded Accessories, excluding clutches and filters.	The duration of the Base Engine Warranty.
Belts Warranty: Belts supplied by Cummins.	One year or 500 hours of operation, whichever comes first, from the date of delivery to the first user.

THERE ARE NO EXPRESS WARRANTIES OTHER THAN THE ABOVE WARRANTIES, WHICH ARE IN LIEU OF ANY IMPLIED WARRANTIES, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE.

PRODUCTS NOT COVERED

The following products are not covered by any of the limited warranties described above:

Any accessories bearing the name or brand of another company, even if supplied by Cummins.

OTHER EXCLUSIONS

These limited warranties do not apply to the following:

1. Engines used for personal, family or household purposes, or for competition.
2. Normal wear and tear.
3. Damage caused by accidents, abuse, alteration, modification, misuse, neglect or improper care or maintenance, including, but not limited to, the following: operation without adequate coolants or lubricants; overfueling; overspending; lack of maintenance of lubricating, cooling or intake systems; improper storage; and starting, warm-up, run-in or shutdown practices.
4. Damage or failures caused by repair or replacement using parts not supplied, rebuilt or repaired by Cummins.
5. Damage caused by operation of the engine outside of the recommended specifications for timing and/or fueling.
6. Damage or failures caused by incorrect oil or fuel or by the presence of water, dirt or other contaminants in the fuel, oil, air and/or coolant.
7. Claims for excessive oil consumption where the Owner cannot provide adequate documentation to show that consumption met or exceeded published standards.
8. Damage due to the failure to follow all instructions specified in the Cummins Operation and Maintenance Manual. Proof of proper maintenance is the Owner's responsibility. Keep all receipts and be prepared to make them available if questions arise about maintenance.
9. The cost of normal maintenance or replacement of parts which are not defective. These are the sole responsibility of the Owner.

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Cummins will repair or replace, free of charge, the defective part or product.

Cummins will pay for all labor costs to remove and/or reinstall the Engine or to repair parts, and will also pay for any additional replacement parts needed for the repair (even if such parts are not defective in material or workmanship).

Any repair or replacement must be done by Cummins or a Cummins distributor.

If Cummins replaces maintenance items, including, but not limited to, lubricating oil, antifreeze and filter elements, because they have been damaged by a warranted failure, Cummins will repair or replace these maintenance items free of charge; if such items are replaced at the Owner's request in the course of repair, and not because they have been damaged by a warranted failure, the cost of such replacement is the sole responsibility of the Owner.

Any part repaired or replaced by Cummins or a Cummins distributor under this Warranty will be covered by the remainder of the applicable warranty.

CUMMINS' ONLY RESPONSIBILITY, AND THE OWNER'S ONLY REMEDY, IS REPAIR OR REPLACEMENT AS DESCRIBED IN THIS WARRANTY.

CUMMINS SHALL NOT BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES.

HOW TO OBTAIN SERVICE

To obtain warranty service in the United States, the Engine or part believed to be defective, and proof of the date of delivery to the first end-user must be presented to a Cummins distributor. Any charges incurred for service calls, meals, lodging, transportation to/from the Cummins distributor and other similar costs are the responsibility of the Owner.

Gaseous Fueled EnginesWorldwideGenerator DriveConsumer

PRODUCTS COVERED

Cummins Inc. warrants to the purchaser (and any subsequent owner) for personal, family or household use solely in generator drive applications (the "Owner") that the following products or components are free from defects in materials and workmanship appearing within the time or hours or actual operation indicated:

PRODUCT WARRANTY	DURATION of WARRANTY
Base Engine Warranty: New Cummins engines sold by Cummins and delivered to the first user on or after October 1, 2004. The duration of the warranty depends on the power rating assigned to the engine which can be found stamped on the engine data plate.	
Standby Power Rating	24 months or 400 hours of actual operation, whichever comes first, from the date of delivery to the first end-user.
Unlimited Time Running Prime Power Rating	12 months from the date of delivery to the first end-user
Limited Time Running Prime Power Rating	12 months or 750 hours of actual operation, whichever comes first, from the date of delivery to the first end-user.
Continuous/Base Power Rating	12 months from the date of delivery to the first end-user
Accessories Warranty: Cummins branded accessories, excluding clutches and filters.	The duration of the Base Engine Warranty.
Belts Warranty: Belts supplied by Cummins.	One year or 500 hours of actual operation, whichever comes first, from the date of delivery to the first end-user.

THERE ARE NO EXPRESS WARRANTIES OTHER THAN THE ABOVE LIMITED WARRANTIES.

IN NO EVENT SHALL ANY IMPLIED WARRANTIES, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE, EXTEND BEYOND THE DURATION OF THESE WRITTEN WARRANTIES.

Some states do not allow limitations on how long an implied warranty lasts.

PRODUCTS NOT COVERED

The following products are not covered by any of the limited warranties described above:

Any accessories bearing the name or brand of another company, even if supplied by Cummins.

OTHER EXCLUSIONS

These limited warranties do not apply to the following:

1. Engines used commercially, industrially, for competition or in applications other than generator drive applications.
2. Normal wear and tear.
3. Damage caused by accidents, abuse, alteration, modification, misuse, neglect or improper care or maintenance, including, but not limited to, the following: operation without adequate coolants or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or intake systems; improper storage; and starting, warm-up, run-in or shutdown practices.
4. Damage caused by operation of the engine outside of the recommended specifications for timing and/or fueling.
5. Damage or failures caused by repair or replacement using parts not supplied, rebuilt or repaired by Cummins.
6. Damage or failures caused by incorrect oil or fuel or by the presence of water, dirt or other contaminants in the fuel, oil, air and/or coolant.
7. Claims for excessive oil consumption where the Owner cannot provide adequate documentation to show that consumption met or exceeded published standards.
8. Damage due to the failure to follow all instructions specified in the Cummins Operation and Maintenance Manual. Proof of proper maintenance is the Owner's responsibility. Keep all receipts and be prepared to make them available if questions arise about maintenance.
9. The cost of normal maintenance or replacement of parts which are not defective. These are the sole responsibility of the Owner.

10. Any engine on which the hourmeter has been disconnected or damaged by causes other than warranted defects, except to the extent that, after presuming 400 hours of actual operation for each month since delivery to the first end-user, the applicable warranty remains in force.
11. Use of an engine that is inconsistent with its applicable rating as described in the Cummins Operation and Maintenance Manual.
12. Failure to make installations adequately or correctly in accordance with the Cummins Generator Drive Installation Guidelines.

REMEDIES

Cummins will repair or replace, free of charge, the defective part or product during normal business hours.

Cummins will pay for all labor costs to remove and/or reinstall the engine or to repair parts, and will also pay for any additional replacement parts needed for the repair (even if such parts are not defective in material or workmanship).

Any repair or replacement must be done by Cummins or a Cummins distributor. (The Owner is responsible for providing sufficient access to enable the servicing entity to remove the engine from the installation.)

If Cummins replaces maintenance items, including, but not limited to, lubricating oil, antifreeze and filter elements, because they have been damaged by a warranted failure, Cummins will repair or replace these maintenance items free of charge; if such items are replaced at the Owner's request in the course of repair, and not because they have been damaged by a warranted failure, the cost of such replacement is the sole responsibility of the Owner.

Any part repaired or replaced by Cummins or a Cummins distributor under this Warranty will be covered by the remainder of the applicable warranty.

CUMMINS' ONLY RESPONSIBILITY, AND THE OWNER'S ONLY REMEDY, IS REPAIR OR REPLACEMENT AS DESCRIBED IN THIS WARRANTY.

CUMMINS SHALL NOT BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other legal rights which vary from state to state.

HOW TO OBTAIN SERVICE

To obtain warranty service, contact a Cummins distributor and provide proof of the date of delivery to the first end-user. If you have any questions regarding this limited warranty, please visit our website at <http://www.cummins.com>.

Gaseous Fueled EnginesWorldwideGenerator DriveCommercial

PRODUCTS COVERED

Cummins Inc. warrants to the purchaser (and any subsequent owner) for industrial and commercial use solely in generator drive applications (the "Owner") that the following products or components are free from defects in materials and workmanship appearing within the time or hours or actual operation indicated:

PRODUCT WARRANTY	DURATION of WARRANTY
Base Engine Warranty: New Cummins engines sold by Cummins and delivered to the first user on or after October 1, 2004. The duration of the warranty depends on the power rating assigned to the engine which can be found stamped on the engine data plate.	
Standby Power Rating	24 months or 400 hours of actual operation, whichever comes first, from the date of delivery to the first end-user.
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Belts Warranty: Belts supplied by Cummins.	One year or 500 hours of actual operation, whichever comes first, from the date of delivery to the first end-user.

THERE ARE NO EXPRESS WARRANTIES OTHER THAN THE ABOVE WARRANTIES, WHICH ARE IN LIEU OF ALL IMPLIED WARRANTIES, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE.

PRODUCTS NOT COVERED

The following products are not covered by any of the limited warranties described above:

Any accessories bearing the name or brand of another company, even if supplied by Cummins.

OTHER EXCLUSIONS

These limited warranties do not apply to the following:

1. Engines used for personal, family or household purposes, for competition or in applications other than generator drive applications.
2. Normal wear and tear.
3. Damage caused by accidents, abuse, alteration, modification, misuse, neglect or improper care or maintenance, including, but not limited to, the following: operation without adequate coolants or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or intake systems; improper storage; and starting, warm-up, run-in or shutdown practices.
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Any part repaired or replaced by Cummins or a Cummins distributor under this Warranty will be covered by the remainder of the applicable warranty.

CUMMINS' ONLY RESPONSIBILITY, AND THE OWNER'S ONLY REMEDY, IS REPAIR OR REPLACEMENT AS DESCRIBED IN THIS WARRANTY.

CUMMINS SHALL NOT BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES.

HOW TO OBTAIN SERVICE

To obtain warranty service, contact a Cummins distributor and provide proof of the date of delivery to the first end-user.

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CALIFORNIA
Proposition 65 Warning

Natural Gas engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

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