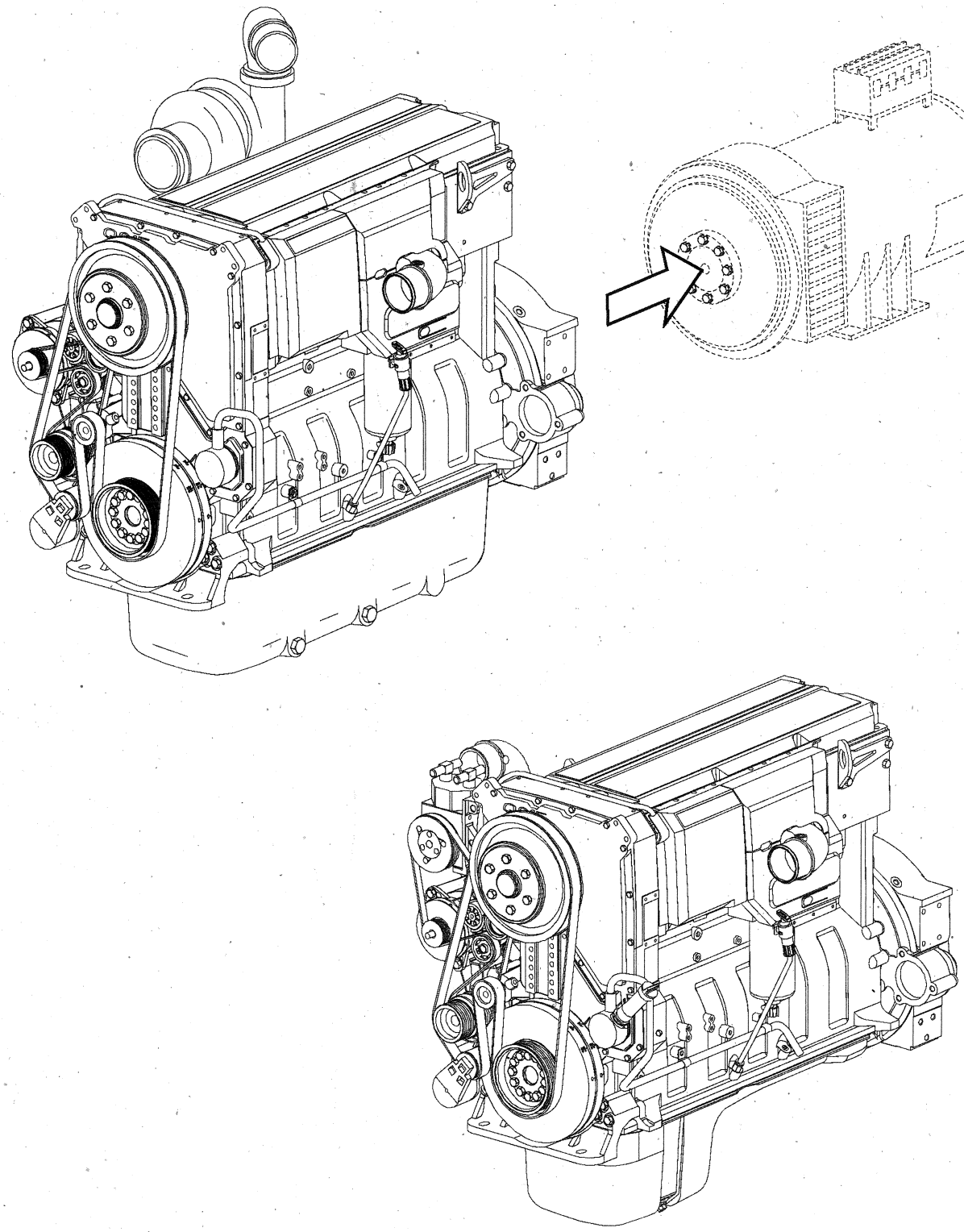
Operation and Maintenance Manual Industrial and Power Generation QSX15 Engines



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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. These parts can be identified by the following trademarks:

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.

Part Name	Part Number	Part 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 Filter		
• Fuel		
• Fuel-Water Separator		
• Coolant		
• Remote Gas		
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

Section Contents

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General Information i-1

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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).

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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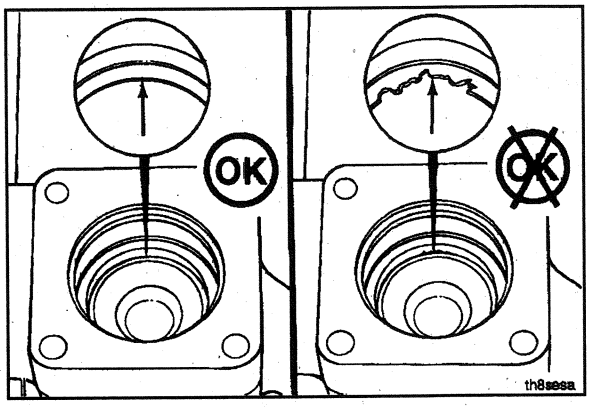
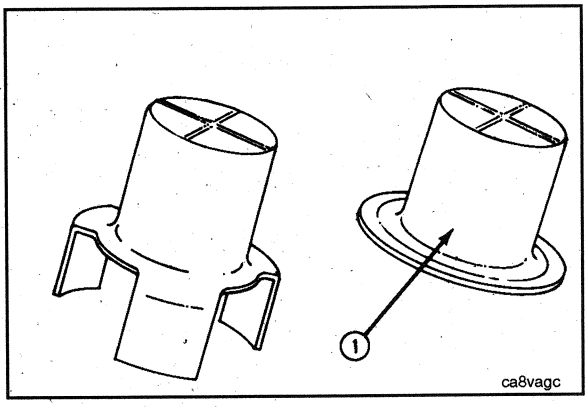
Illustrations

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

⚠ WARNING ⚠

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, 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.
- Liquified 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.
- To reduce the possibility of suffocation and frostbite, wear protective clothing and ONLY disconnect natural gas and liquified petroleum gas lines in a well ventilated area.
- 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.

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

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

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

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.

⚠WARNING⚠

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 particulary 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

⚠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.

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

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.

⚠CAUTION⚠

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.

⚠CAUTION⚠

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** sure 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 psd) 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.

⚠CAUTION⚠

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.

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
°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 Indentifier
GVW	Gross Vehicle Weight
LPG	Liquified Petroleum Gas
Hg	Mercury
hp	Horsepower
H_2O	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
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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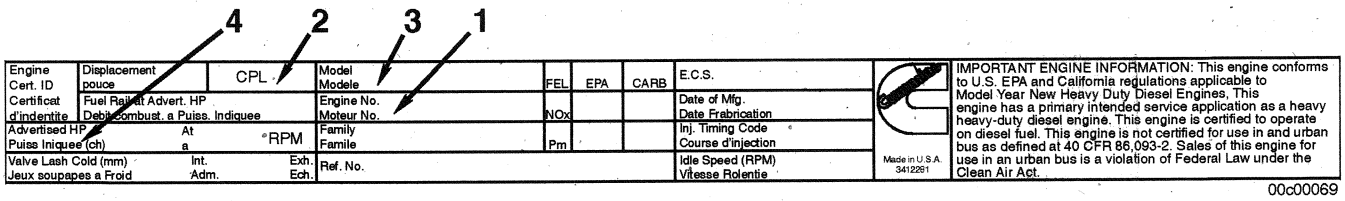
Engine Identification

Engine Dataplate



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The engine dataplate, located on top of the rocker lever cover, provides the model identification and other important data about the engine.

Have the following engine data available when communicating with a Cummins Authorized Repair Location. The data on the dataplate are **mandatory** when sourcing service parts:

1. Engine serial number (ESN)
2. Control parts list
3. Model
4. Advertised horsepower and rpm.

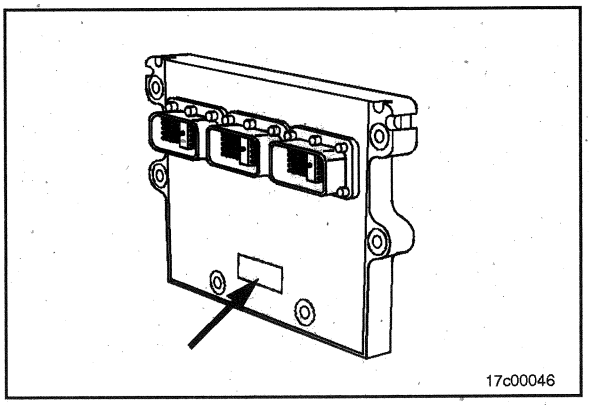
ECM Dataplate

Industrial Applications

The electronic control module (ECM) dataplate is located on the front of the ECM.

The abbreviations on the dataplate are explained as follows:

- P/N = Part number
- S/N = Serial number
- D/C = Data code.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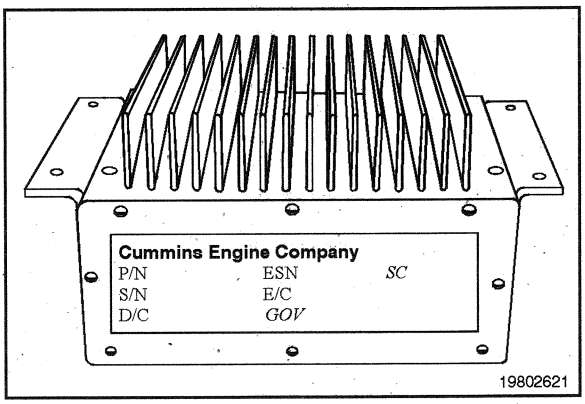
Power Generation

The electronic control module (ECM) dataplate is located on the front of the ECM.

The abbreviations on the dataplate are explained as follows:

- P/N = Part number
- S/N = Serial number
- D/C = Date code.



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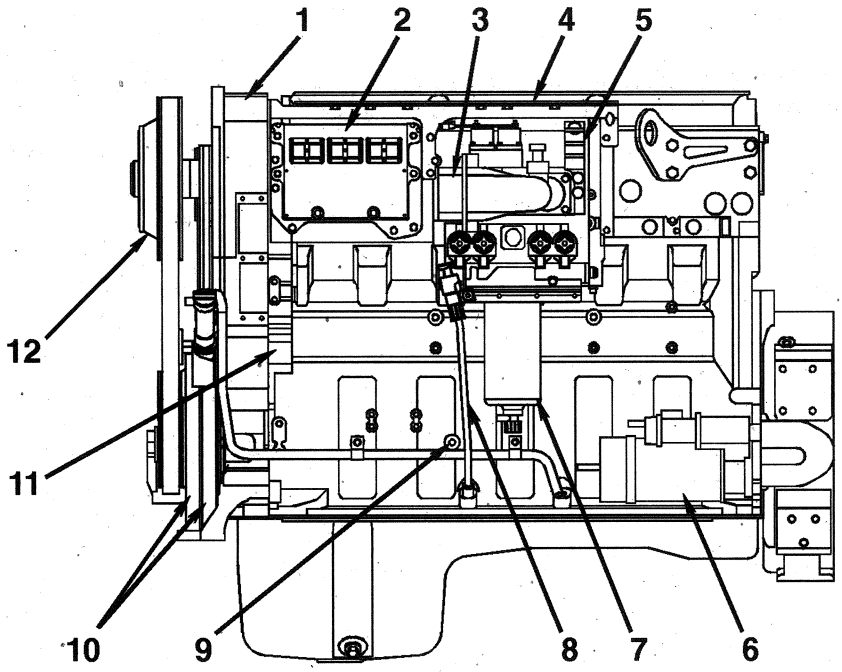
Engine Diagrams

Engine Views

The following illustrations show the location 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.

Without CM870



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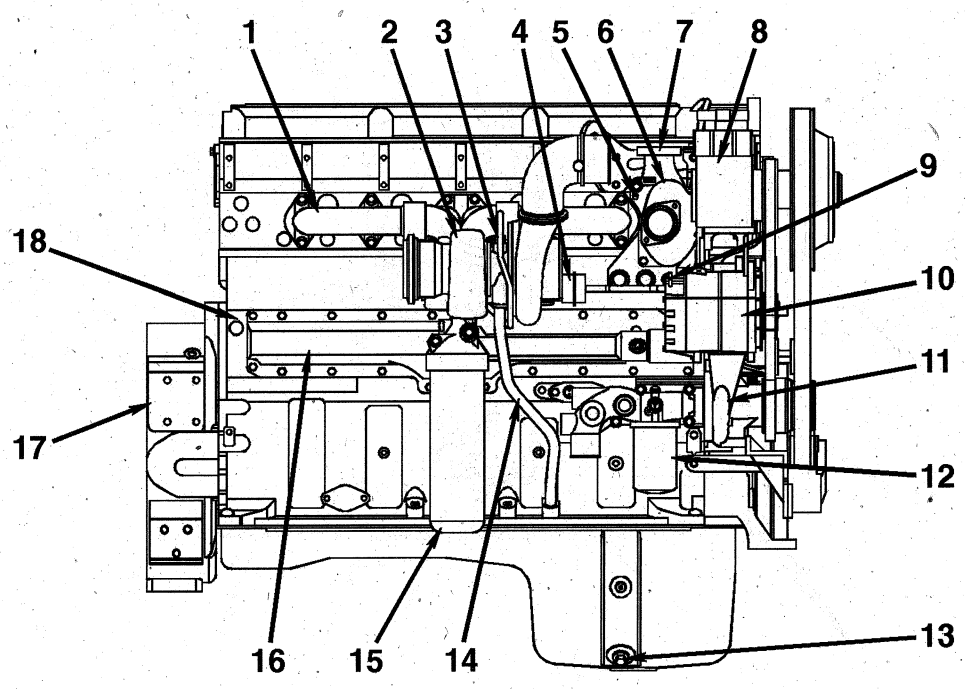
Industrial - Intake Side

1. Gear Housing
2. Electronic Control Module (ECM)
3. Air Intake
4. Engine Dataplate
5. Fuel Pump
6. Starter
7. Fuel Filter
8. Lubricating Oil Dipstick
9. Crankshaft Timing Pin Port
10. Vibration Dampers
11. Barring Device/Air Compressor
12. Fan Hub.

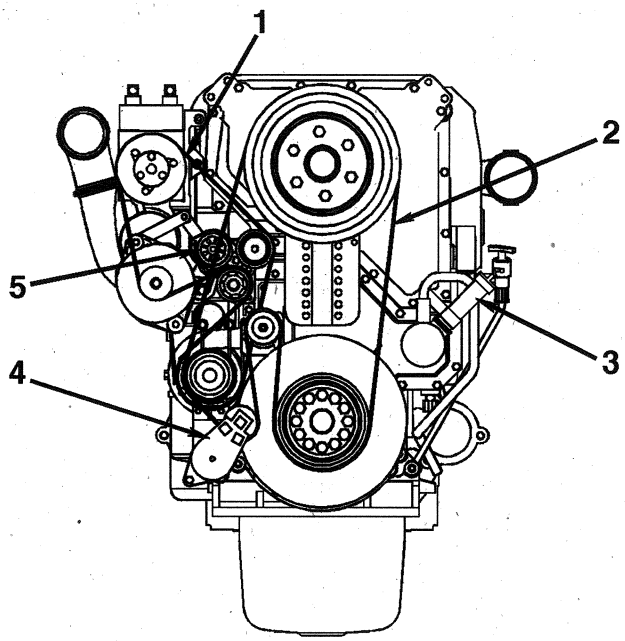
Without CM870



Industrial - Exhaust Side

1. Exhaust Manifold
2. Turbocharger
3. Oil Inlet to Turbocharger
4. Wastegate Actuator
5. Thermostat Housing Vent
6. Thermostat Housing
7. Engine Coolant Outlet (to radiator)
8. Freon Compressor
9. Coolant Temperature Sensor
10. Alternator
11. Water Pump
12. Coolant Filter
13. Lubricating Oil Drain
14. Turbocharger Oil Drain
15. Combination Full-Flow/Bypass Lubricating Oil Filter
16. Lubricating Oil Cooler Assembly
17. Flywheel Housing
18. Engine Serial Number.

Without CM870



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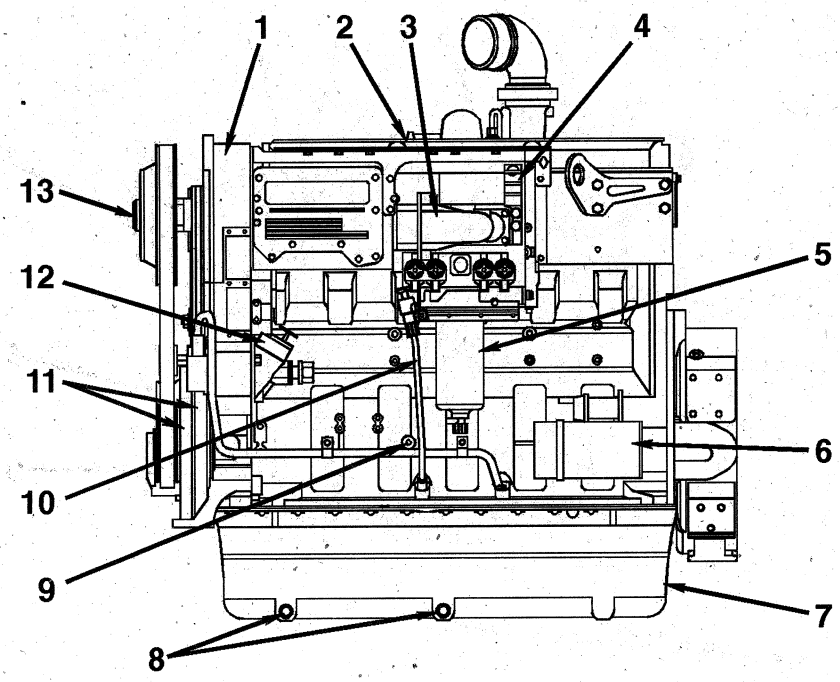
Industrial - Front

1. Accessory Drive Belt
2. Water Pump/Fan Drive Belt
3. Lubricating Oil Fill
4. Water Pump/Fan Drive Belt Tensioner
5. Accessory Drive Belt Tensioner.

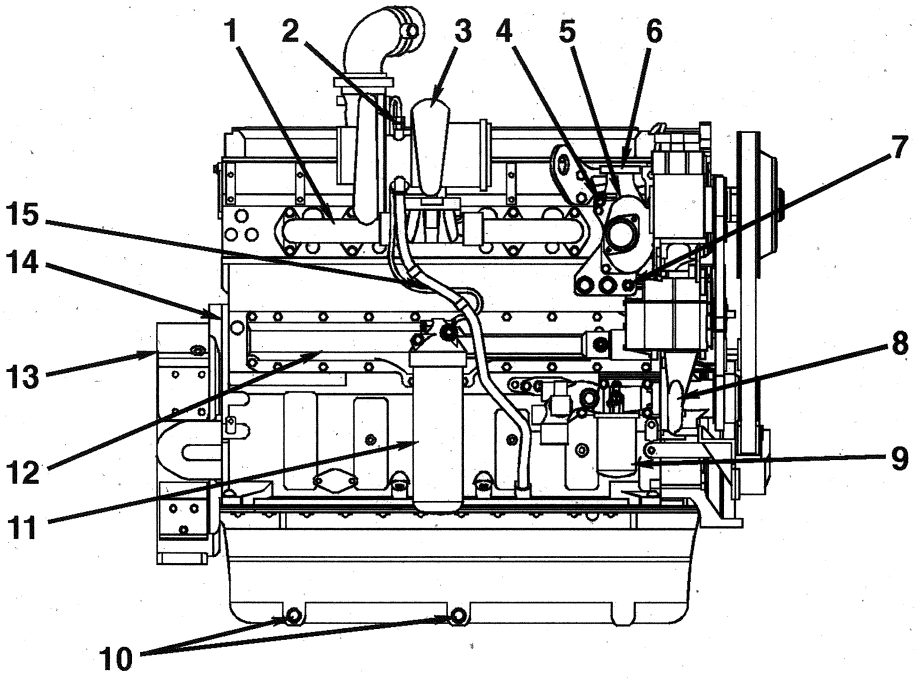
Without CM870



Power Generation - Intake Side

1. Gear Cover
2. Engine Dataplate
3. Air Intake
4. Fuel Pump
5. Fuel Filter
6. Starter
7. Lubricating Oil Pan
8. Lubricating Oil Drains
9. Crankshaft Timing Pin Port
10. Lubricating Oil Dipstick
11. Vibration Dampers
12. Lubricating Oil Fill/Barring Device
13. Fan Hub.

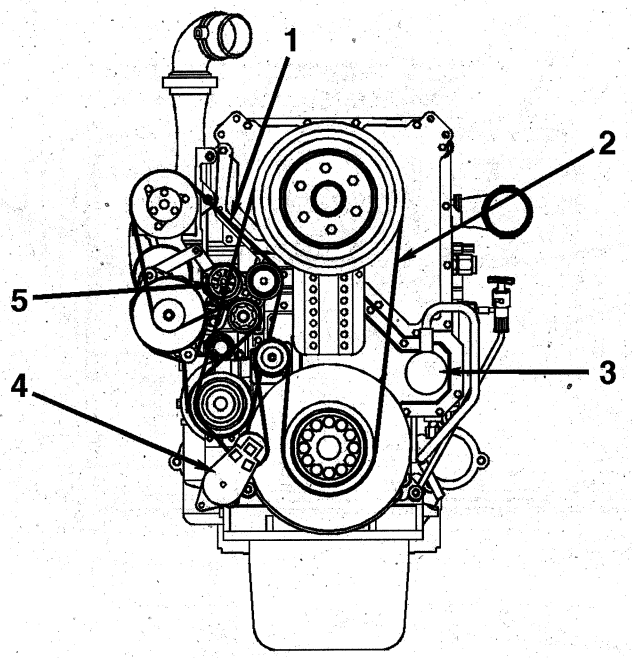
Without CM870



Power Generation - Exhaust Side

1. Exhaust Manifold
2. Lubricating Oil Inlet to Turbocharger
3. Turbocharger
4. Thermostat Housing Vent
5. Thermostat Housing
6. Engine Coolant Outlet (to radiator)
7. Coolant Temperature Sensor
8. Water Pump
9. Coolant Filter
10. Lubricating Oil Drains
11. Combination Full-Flow/Bypass Lubricating Oil Filter
12. Lubricating Oil Cooler Assembly
13. Flywheel Housing
14. Engine Serial Number
15. Turbocharger Lubricating Oil Drain.

Without CM870



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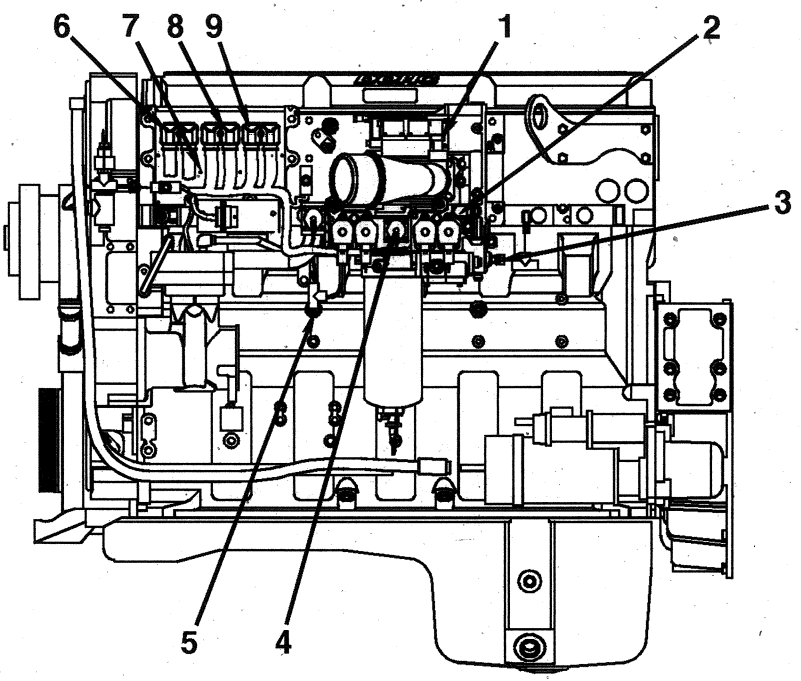
Power Generation - Front

1. Accessory Drive Belt
2. Water Pump/Fan Drive Belt
3. Oil Fill/Crankcase Breather
4. Water Pump/Fan Drive Belt Tensioner
5. Accessory Drive Belt Tensioner.

Without CM870



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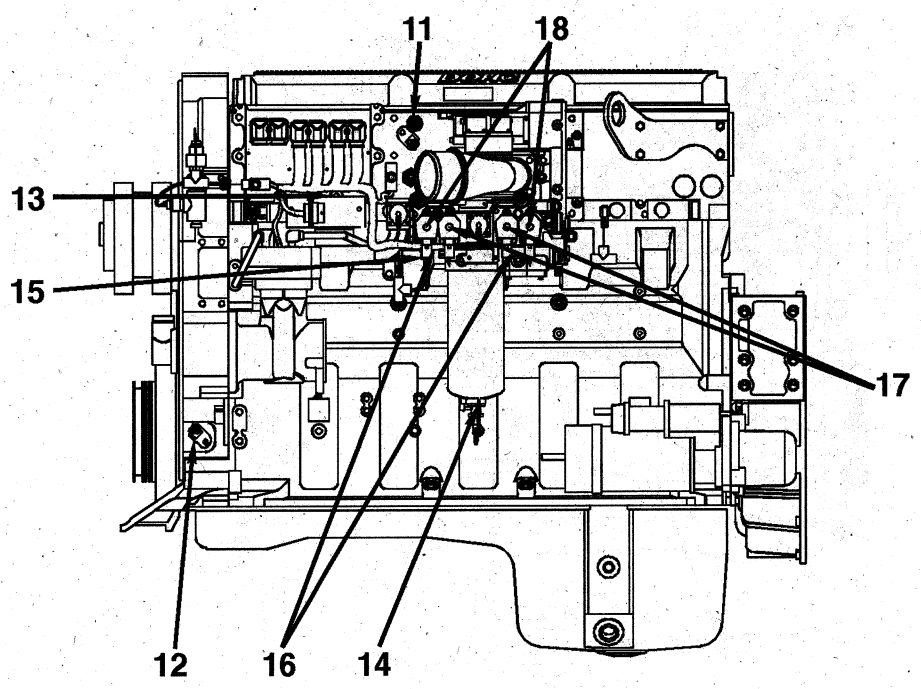
Intake Side (Fuel System)

1. Fuel Shutoff Valve
2. Oil Pressure/Temperature Sensor
3. Intake Manifold Pressure/Temperature Sensor
4. Cooling Plate (behind ECM)
5. Electronic Control Module (ECM)

1. ECM/Engine Harness Port (Actuator)
2. ECM/Engine Harness Port (OEM)
3. Fuel Inlet
4. Fuel Outlet
5. ECM/Sensor Port.

Without CM870

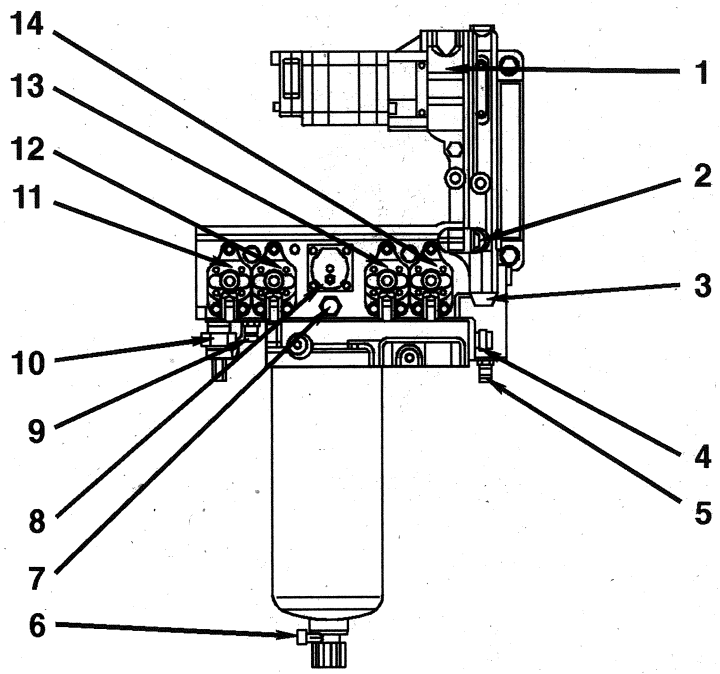


Intake Side (Fuel System) continued

11. Camshaft Position Sensor
12. Crankshaft Position Sensor
13. Ambient Air Pressure Sensor
14. Water-in-Fuel Sensor
15. Fuel Pressure Sensor
16. Front and Rear Rail Sensors*
17. Timing Actuators
18. Fueling Actuators

* Eliminated on most engines

Without CM870



Fuel Delivery Housing (front view)

1. Priming Bypass Valve (internal)
2. 320-psi Pressure Regulator
3. 36-mc Filter Screen
4. Fuel Inlet
5. Quick Disconnect Pressure Tap - Suction Side
6. WIF Sensor
7. 250-psi Pressure Regulator
8. Fuel Shutoff Valve
9. Quick Disconnect Pressure Tap - Pressure Side
10. Fuel Pressure Sensor
11. Front Rail Actuator
12. Front Timing Actuator
13. Rear Timing Actuator
14. Rear Rail Actuator.

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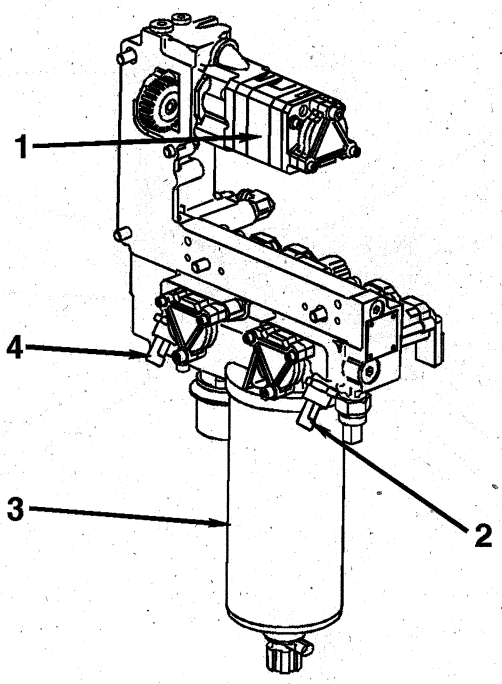

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Fuel Delivery Housing (rear view)

1. Fuel Pump Assembly
2. Front Rail Pressure Sensor*
3. Fuel Filter
4. Rear Rail Pressure Sensor*.

* Eliminated on most engines.

Section 1 - Operating Instructions

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Operating Instructions - Overview

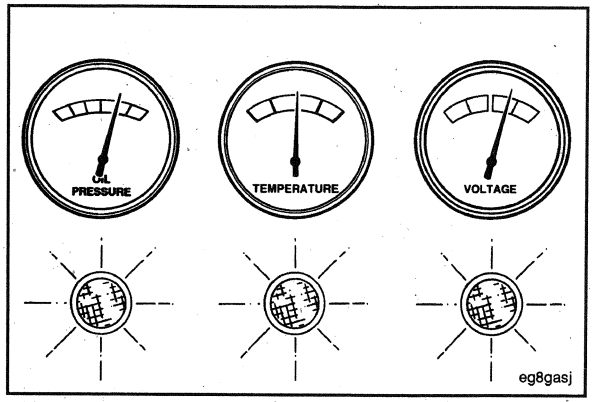
General Information

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).

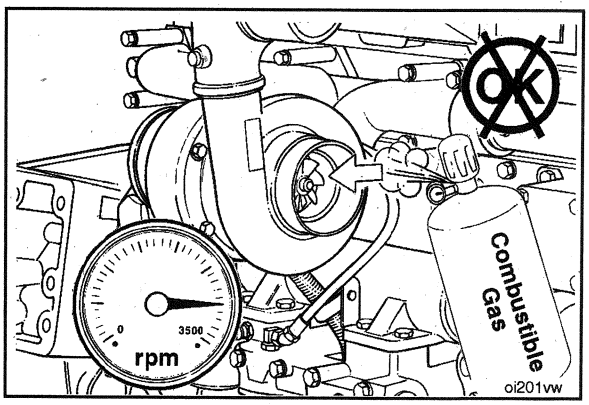
The **new** Cummins engine associated with this manual does **not** require a "break-in" procedure. This section of the manual provides all of the necessary information required for proper engine operation.

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

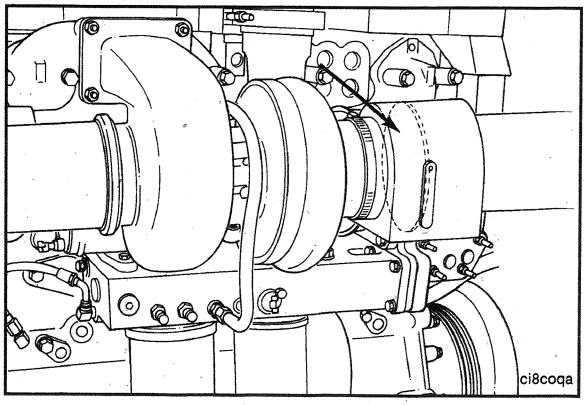


⚠ WARNING ⚠

DO NOT OPERATE A DIESEL ENGINE WHERE THERE ARE OR CAN BE COMBUSTIBLE VAPORS. The vapors can be sucked through the air intake system and cause engine acceleration and overspeeding that can result in a fire, an explosion, and extensive property damage. Numerous safety devices are available, such as air intake shutoff devices, to minimize the risk of overspeeding where an engine, due to its application, due to a fuel spill or gas leak. Remember, Cummins has no way of knowing the use you have for your engine. THE EQUIPMENT OWNER AND OPERATOR ARE RESPONSIBLE FOR SAFE OPERATION IN A HOSTILE ENVIRONMENT. CONSULT YOUR CUMMINS AUTHORIZED REPAIR LOCATION FOR FURTHER INFORMATION.



Cummins recommends the installation of an air intake shutoff device or a similar safety device to minimize the risk of overspeeding where an engine, due to the vehicle, vessel or equipment being operated in a combustible environment, such as due to a fuel spill or gas leak.

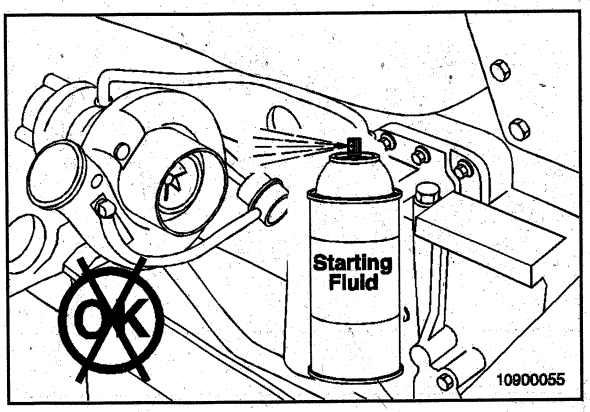


⚠CAUTION⚠
Do not expose the engine to corrosive chemicals. Corrosive chemicals can damage the engine.

Cold Weather Starting

General Information

Follow the Normal Starting Procedures in this section. In cold weather, the engine can run at idle **only** longer.



Using Starting Aids

Cold weather starting aids are available for your engine. Contact the local Cummins Authorized Repair Location for more information.

Starting Procedure After Extended Shutdown or Oil Change

General Information

Follow the Normal Starting Procedure in this section. The engine will run at idle **only** until the minimum oil pressure is detected by the ECM.

Normal Starting Procedure

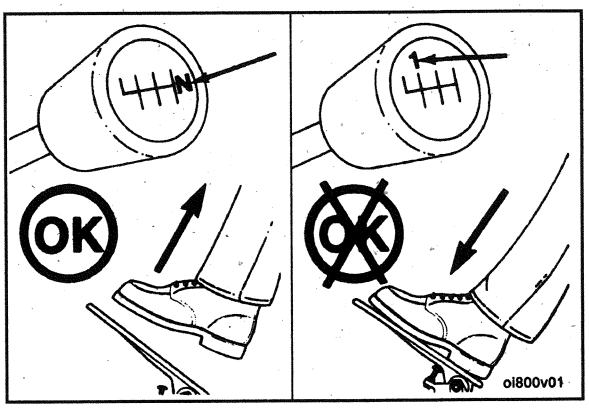
General Information

⚠WARNING⚠

Do not depress the accelerator pedal or move the accelerator lever from the idle position while cranking the engine. This can result in engine overspeed and severe damage to the engine.

△CAUTION△

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

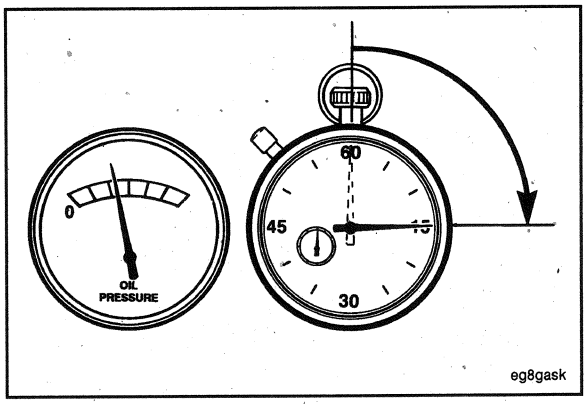


NOTE: Engines equipped with air starting motors require a minimum of 480 kPa [70 PSI].

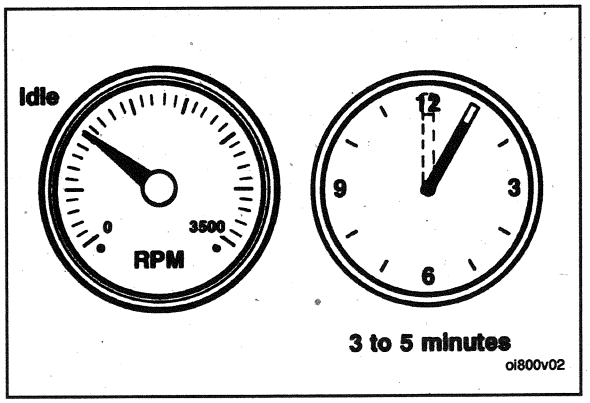
- Disengage the driven unit, or if equipped, put the transmission in neutral.
- With the accelerator pedal or lever in the idle position, turn the key switch to the ON position, then turn the key to the START position.
- If the engine does **not** start after three attempts, check the fuel supply system. Absence of blue or white exhaust smoke during cranking indicates no fuel is being delivered.

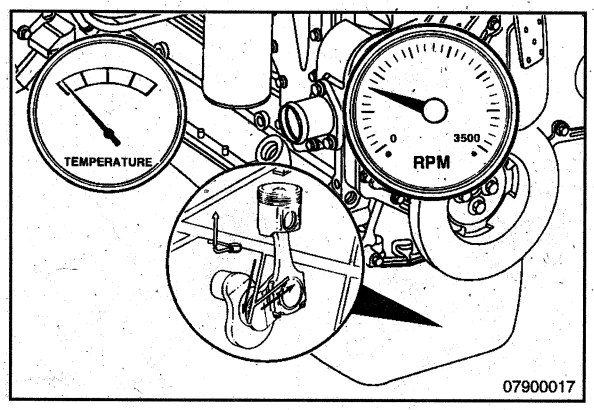
△CAUTION△

The engine must have adequate oil pressure within 15 seconds after starting. If the WARNING lamp indicating low oil pressure has not gone out or there is no oil pressure indicated on a gauge within 15 seconds, shut off the engine immediately to avoid engine damage. The low oil pressure troubleshooting procedure is located in Troubleshooting Symptoms (Section TS).

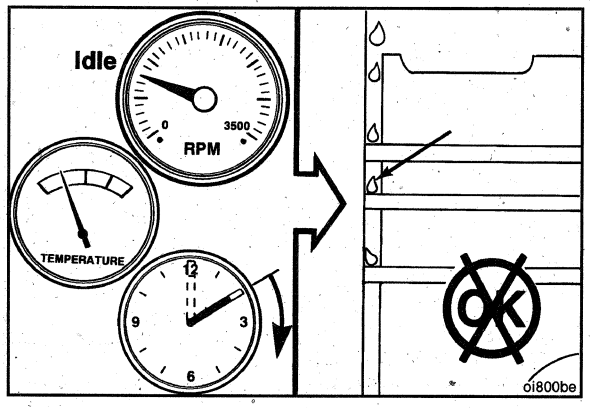


Idle the engine 3 to 5 minutes before operating with a load.





After starting a cold engine, increase the engine speed (rpm) slowly to provide adequate lubrication to the bearings and to allow the oil pressure to stabilize.



⚠CAUTION⚠

Do not operate engine at low idle for long periods with engine coolant temperature below the minimum specification in Maintenance Specifications (Section V). This can result in the following:

- Fuel Dilution of the lubricating oil
- Carbon build up in the cylinder
- Cylinder head valve sticking
- Reduced performance

Jump Starting

⚠WARNING⚠

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

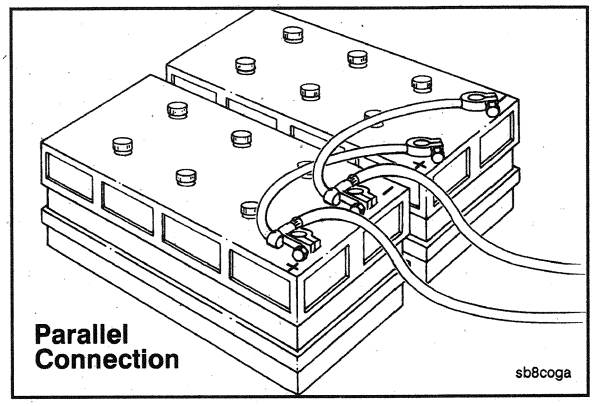
⚠CAUTION⚠

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 cables.

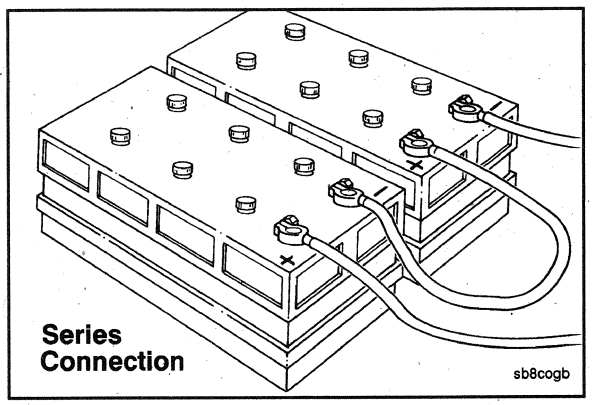
⚠CAUTION⚠

To avoid damage to engine parts, do not connect jumper starting or battery charging cable to any fuel system or electronic component.

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.

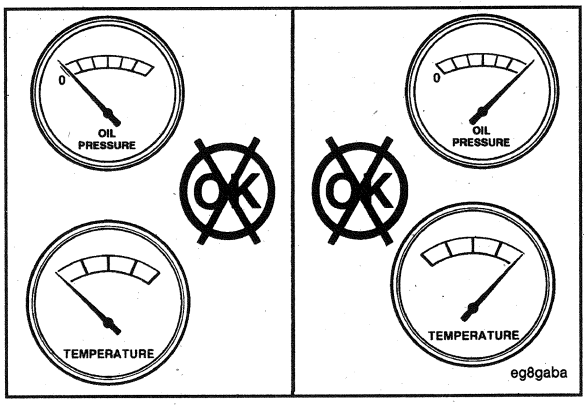


Operating the Engine

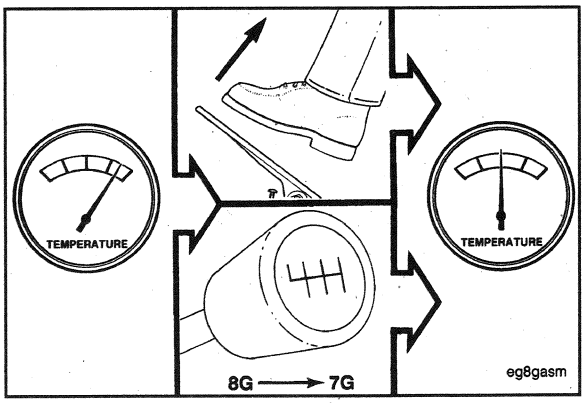
Normal

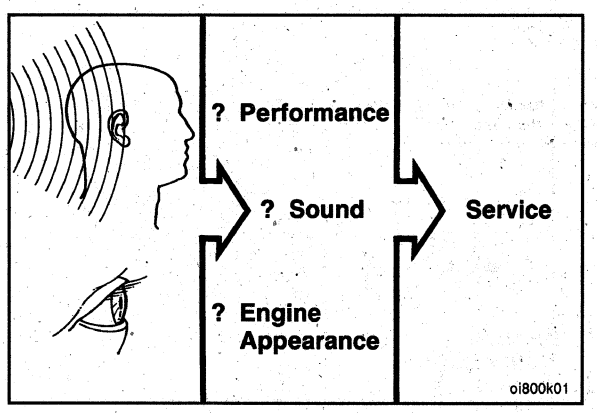
If equipped, monitor the oil pressure and coolant temperature gauges frequently. Refer to Lubricating Oil System specifications and Cooling System specifications, in Maintenance Specifications (Section V) for recommended operating pressures and temperatures. Shut off the engine if any pressure or temperature 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 releasing the accelerator pedal or lever or shifting the transmission to a lower gear, or both, until the temperature returns to the normal operating range. If the engine temperature does **not** return to normal, shut off the engine, and refer to Troubleshooting Symptoms (Section TS), or 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.

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.

The Diesel fuel must have maximum cloud and pour points 6°C [10°F] lower than the ambient temperature in which the engine operates.

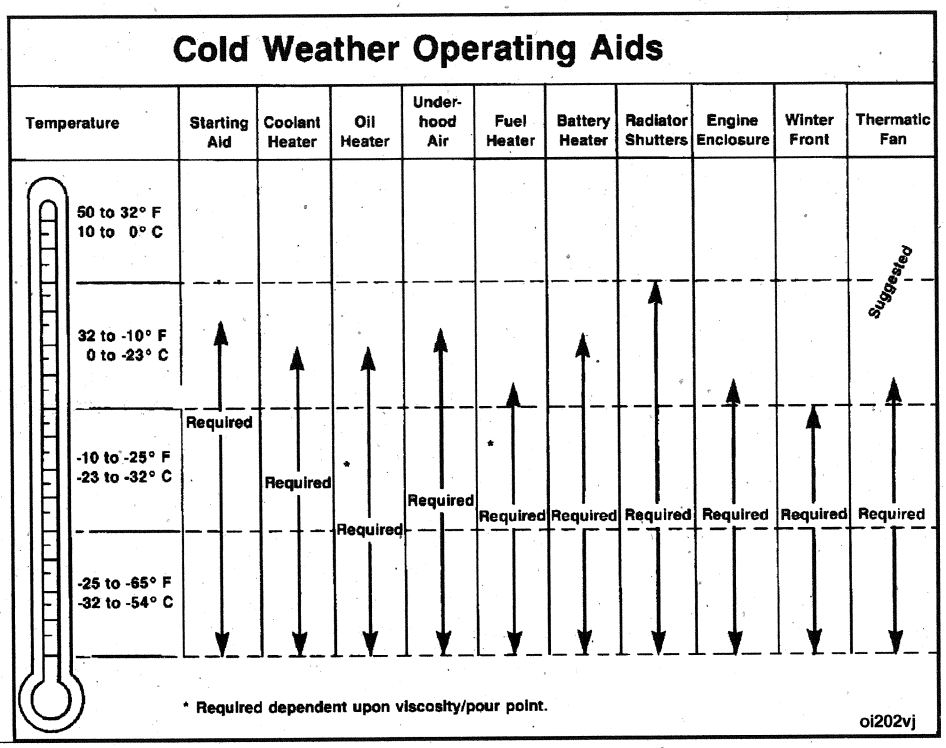
-32 to -54°C [-25 to -65°F]

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.

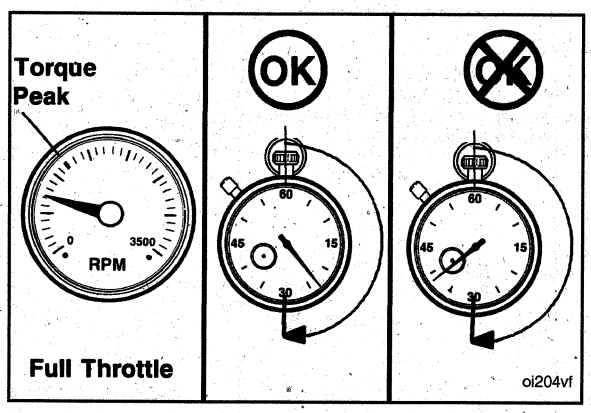
The Diesel fuel must have maximum cloud and pour points 6°C [10°F] lower than the ambient temperature in which the engine operates.

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



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

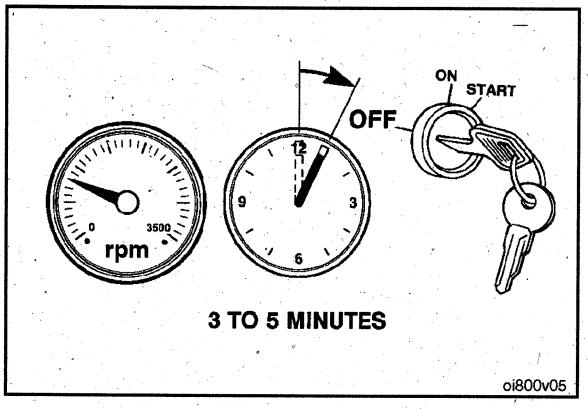
⚠CAUTION⚠

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.

⚠CAUTION⚠

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).

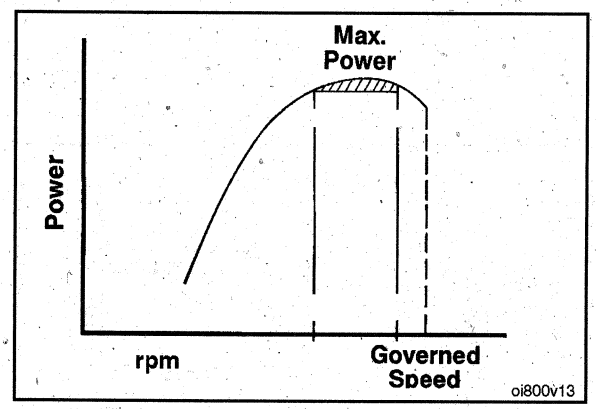


Engine Shutdown

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 ignition switch to the OFF position. If the engine does not shut down, refer to Troubleshooting Symptom (Section TS).



Electronic Controlled Fuel System

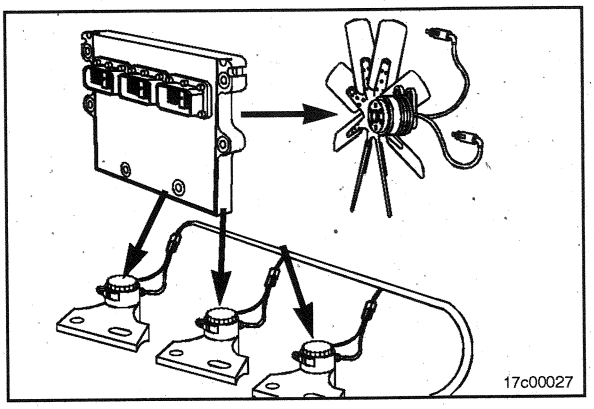
General Information

The Signature/ISX fuel system is an electronically controlled fuel injection system that optimizes fuel economy and reduces exhaust emissions. It does this by controlling the torque and horsepower curve, engine high speed, low idle, and road speed.

Signature/ISX has the capability of controlling the fan clutch actuator if an electronically controlled fan clutch is used.

Signature/ISX also allows the engine brakes to be activated by controlling the engine brake solenoids.

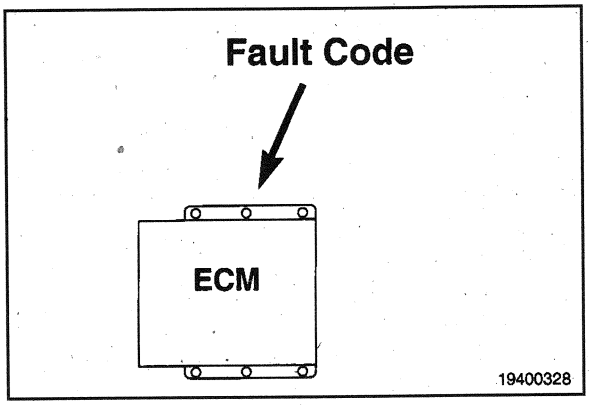
The electronic feature, fan control engine braking can be enabled to activate the fan clutch during engine braking. This increases the load on the engine during engine braking.



Diagnostic Fault Codes

Industrial Applications

The QSX15 fuel system can display and record certain detectable fault conditions. These failures are displayed as fault codes, which make troubleshooting easier. The fault codes are retained in the electronic control module (ECM).

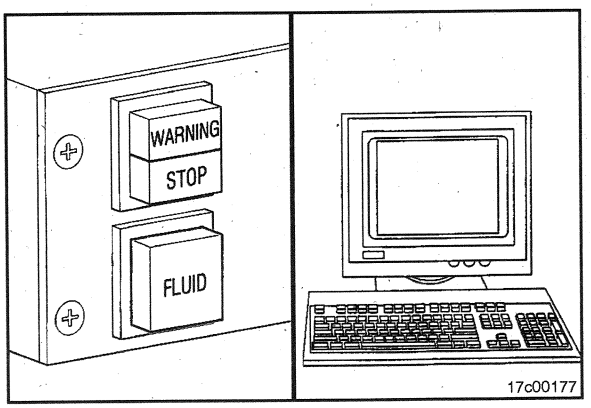


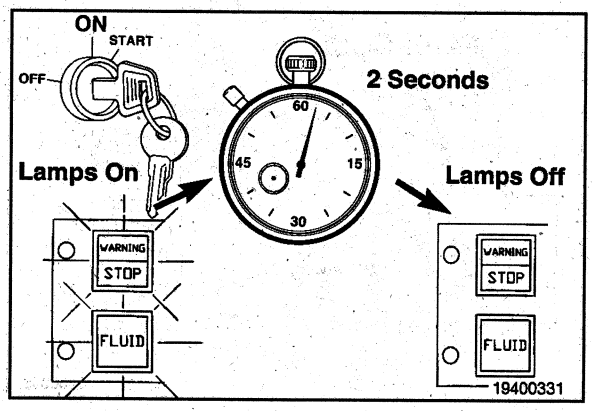
There are two types of fault codes. There are engine electronic fuel system fault codes and engine protection system fault codes.

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

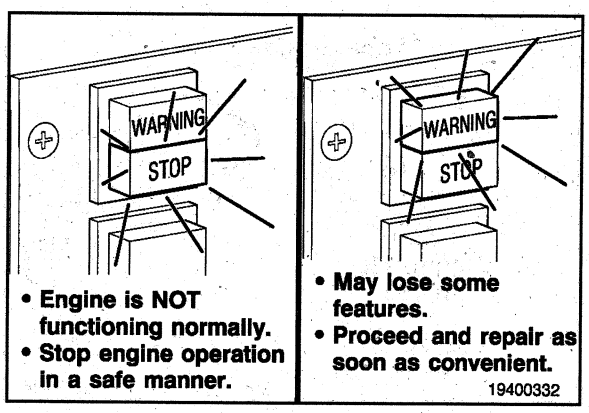
Diagnostic Fault Codes
•Engine Electronic Fuel System Fault Codes
•Engine Protection System Fault Codes.

Active fault codes can be read using the warning (amber) and stop lamps (red) in the cab panel or electronic service tool. Inactive fault codes can **only** be viewed with an electronic service tool.





When the vehicle keyswitch is turned on and the diagnostic switch is off, the fault code lamps (red, yellow, and maintenance) will illuminate for approximately 2 seconds, one after the other, to check their operation.

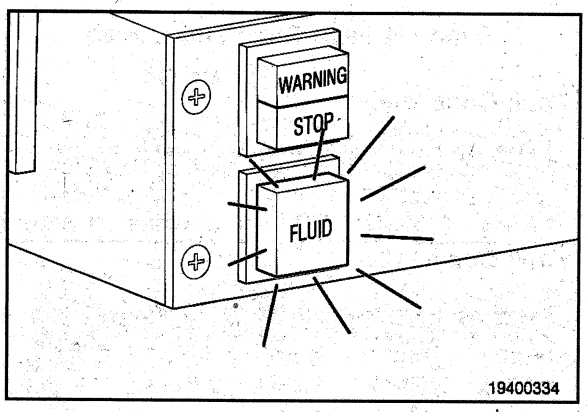


The lights will remain off until a fault code is recorded. If a stop (red) light comes on while the engine is in operation, the fault can be engine-disabling. Stop the engine in a safe manner as soon as possible.

If the warning (amber) light illuminates, the engine can still be operated, but it can lose some system features that can sometimes result in a power loss. The failure **must** be repaired as soon as is convenient.

The engine protection system records separate fault codes when an out-of-range condition is found for any of the sensors in the engine protection system. Engine protection is **only** available when the engine protection feature is enabled.

- Coolant Temperature
- Coolant Level
- Intake Manifold Temperature
- Oil Pressure.

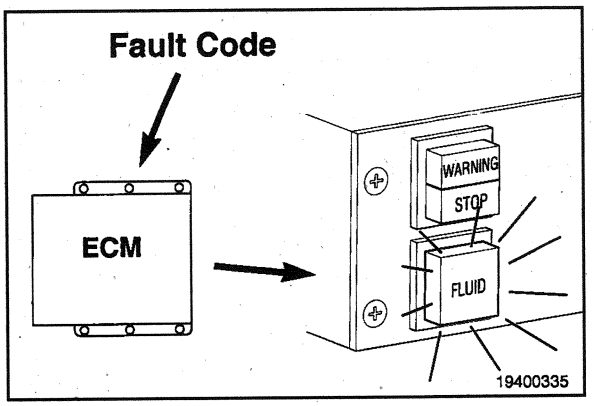


The engine protection system will light the maintenance lamp (orange) when an out-of-range condition occurs.

NOTE: Lamp colors and labels will vary by OEM.

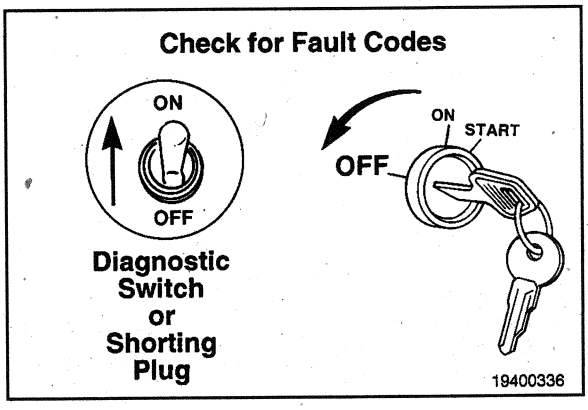
If the engine protection maintenance lamp comes on while driving, it means that a fault code has been recorded. The light will remain on as long as the fault is occurring.

The light will begin to flash if the condition continues to get worse. The engine power and/or speed will be gradually reduced. If the engine protection shutdown feature is enabled, the engine will shut down to prevent engine damage.

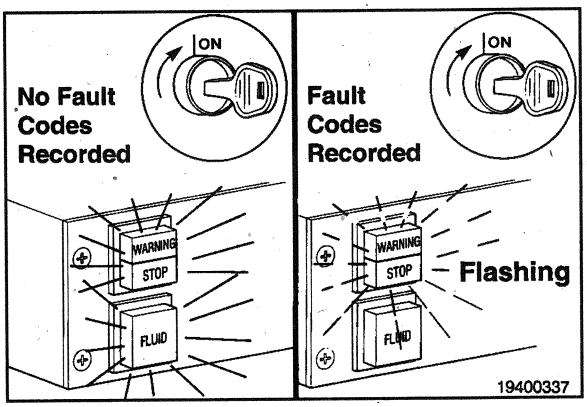


To check for active fault codes, first turn the vehicle keyswitch to the OFF position. Move the diagnostic switch to the ON position.

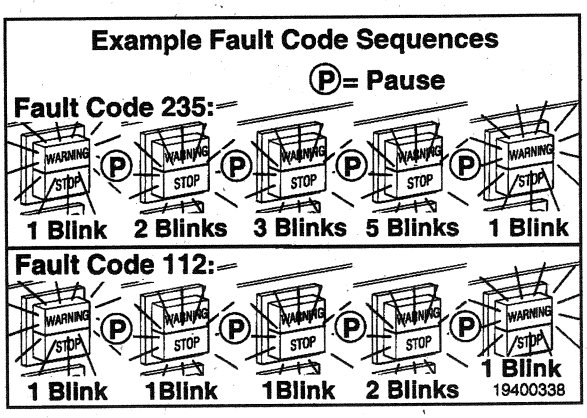
NOTE: Some OEMs use a shorting plug.

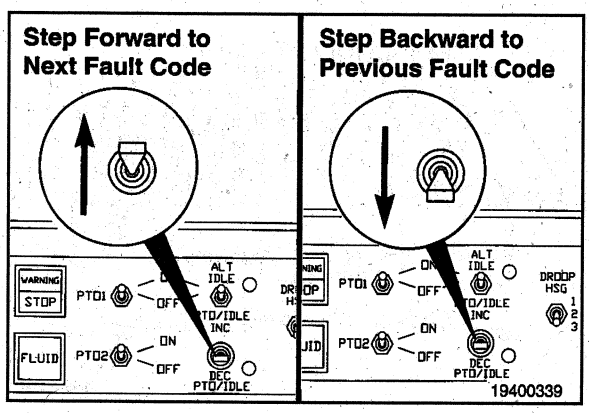


Turn the vehicle keyswitch to the ON position. If no active fault codes are recorded, all three lights will come on and stay on. If active fault codes are recorded, all three lights will come on momentarily. The amber (warning) and red (stop) lights will begin to flash the code of the recorded fault.



The fault code will flash in the following sequence. First, the amber (warning) lamp will flash. Then there will be a short 1-second pause when both the amber and red lights are off. Then the numbers of the recorded fault code will flash in red. There will be a 1-second pause between each number. When the number has stopped flashing, an amber light will appear again. The number will repeat in the same sequence.

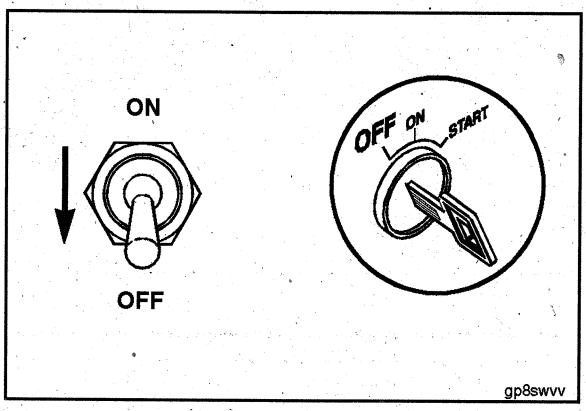




The lights will continue to flash the same fault code until the system has advanced to the next active fault code. To go to the second fault code, move the idle-speed adjust switch to "+," then release it. You can also go back to the previous fault code by moving the switch to "-," then releasing it. To check the third or fourth fault code, move the switch to "+," then release it when all active fault codes have been viewed. Moving the switch to "+" will go back to the first fault code.

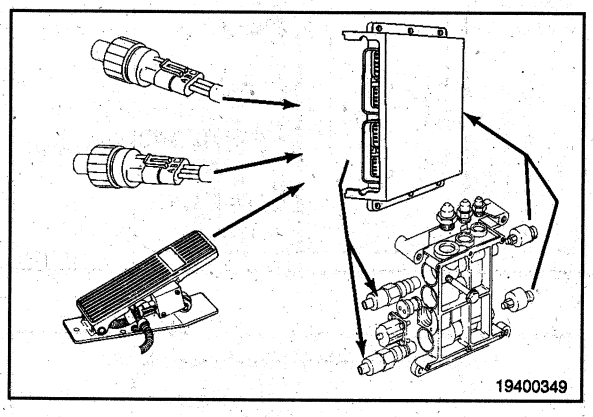
The explanation and correction of all fault codes is in the troubleshooting charts of the QSX15 fuel manual. Refer to Troubleshooting and Repair Manual, Electronic Control System, Signature, ISX and QSX15 Engines, Bulletin No. 3666259.

Electronic fault code troubleshooting trees are in ascending numerical order. An index is located at the beginning of the section.



To stop the diagnostic system, move the diagnostic switch to the OFF position, or remove the shorting plug. Turn the vehicle keyswitch to the OFF position.

NOTE: Some OEMs use a shorting plug.



Fault Code Snapshot Data

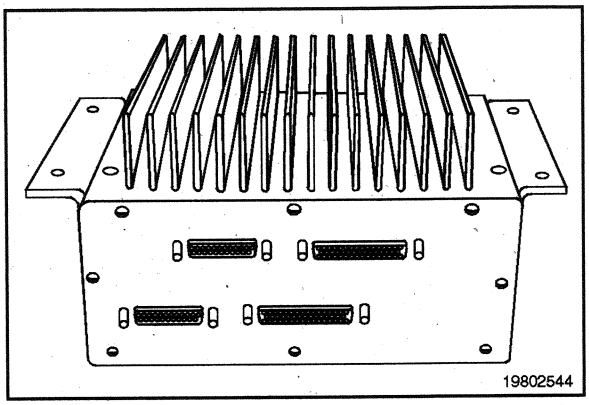
When a diagnostic fault code is recorded in the ECM, ECM input and output data are recorded from all sensors and switches. Snapshot data allow the relationships between ECM inputs and outputs to be viewed and used during troubleshooting.

Power Generation

The QSX15 fuel system can display and record certain detectable fault conditions. These failures are displayed as fault codes, which make troubleshooting easier. The fault codes are retained in the ECM.

There are two types of diagnostic codes:

Information codes are to inform the operator and electronic system (paralleling controllers, smart switch gear) that an event has occurred.
Fault codes are to report to the operator and the electronic system that there is a problem or potential problem with the engine or fuel system.



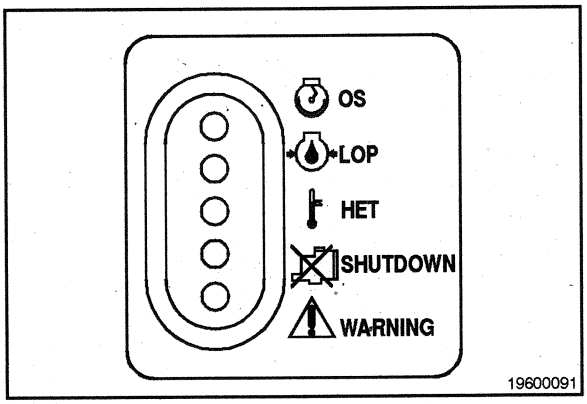
Fault codes can be accessed in three different ways:

1. . Flash Out
2. . Electronic Service Tool
3. . Operator Interface Panel.

Generator-Drive Control System ECM Diagnostic Lamps

The generator-drive control system ECM has five LEDs for diagnostics. Typical lights will include:

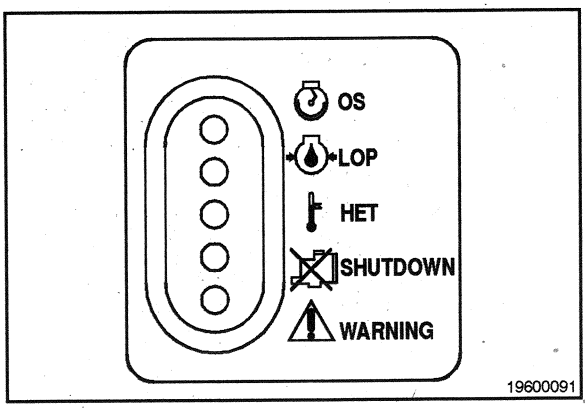
1. . OS - Overspeed
2. . LOP - Low Oil Pressure
3. . HET - High Engine Temperature
4. . Shutdown - Engine Protection Shutdown Has Occurred
5. . Warning - Engine Protection Warning Condition Exists.

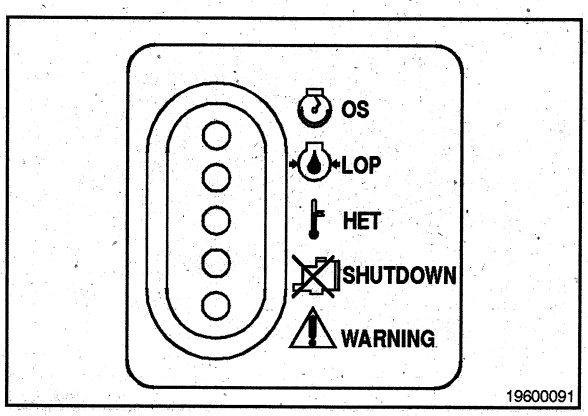


Generator-Drive Control System Relay Drivers

The generator-drive control system has seven relay drivers for customer-supplied relays.

- Overspeed
- Low Oil Pressure
- High Engine Temperature
- Engine Protection Shutdown Has Occurred
- Engine Protection Warning Condition Exists
- Prelow Oil Pressure
- Prehigh Engine Temperature.

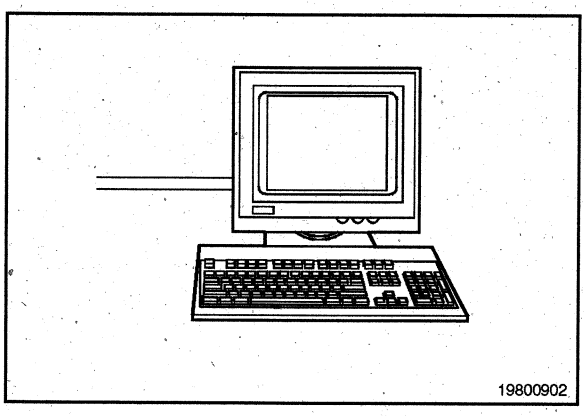




Fault Code Flash-out

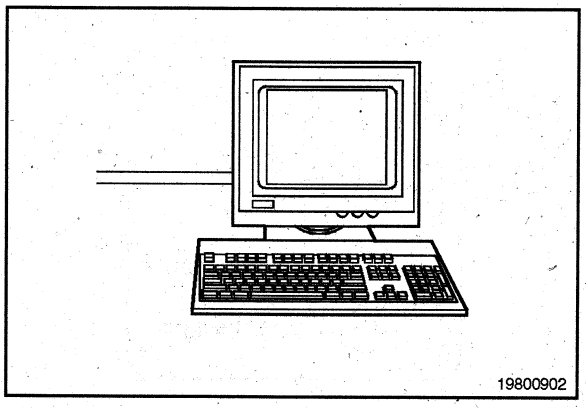
To "flash out" a fault code, the ECM **must** be put into the diagnostic mode. Enter the diagnostic mode by removing the diagnostic connector shorting the plug from the engine harness, turning the plug, and reinserting it, or using the diagnostic mode switch.

The warning lamp will flash (signifying the start of a new fault code), and then the fault code will flash out on the shutdown lamp.



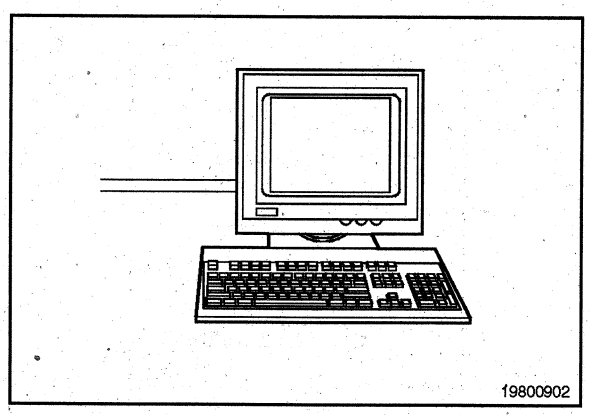
Fault Codes - Electronic Service Tool

The electronic service tool can be used to read the fault codes. Connect a personal computer, with the electronic service tool installed, to the engine using the service harness, Part No. 3163156. Refer to the electronic service tool manual for specifics about how to use the tool to read the fault codes.



Fault Code - Operator Interface Panel

If the customer supplied an operator interface panel, it has been integrated with the generator-drive control system using the RS485 datalink. The ability to display fault codes is one plus of this panel; refer to the manuals supplied with the unit for more details.



Fault Code Snapshot Data\

When a diagnostic fault code is recorded in the ECM, the ECM input and output data are recorded from all sensors and switches. Snapshot data allow the relationships between ECM inputs and outputs to be viewed and used during troubleshooting.

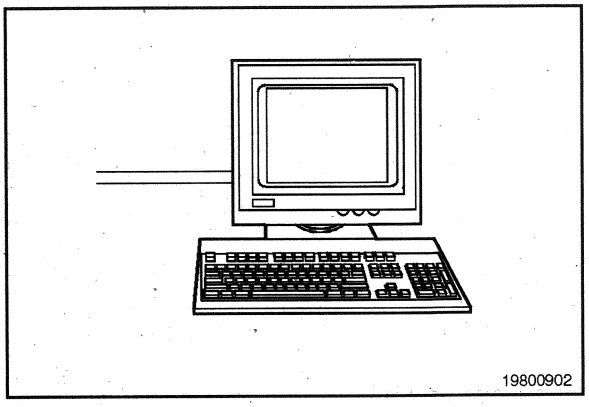
To Clear a Fault Code

Only inactive fault codes can be cleared. There are two ways to clear an inactive fault code:

1. . The reset switch on the operator interface panel
2. . The electronic service tool.

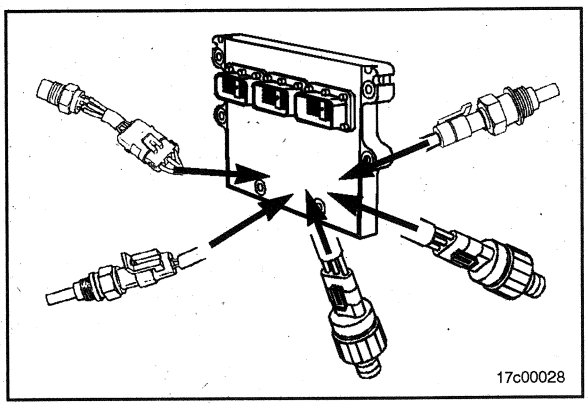
NOTE: The engine **must** be shut down to clear inactive shutdown faults.

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



Engine Protection System

QSX15 engines are equipped with an engine protection system. The system monitors critical engine temperatures and pressures and will log diagnostic faults when an abnormal operating condition occurs. If an out-of-range condition exists and engine derate action is to be initiated, the operator will be alerted by an in-cab warning light. The warning light will blink or flash when out-of-range conditions continue to worsen. The driver **must** pull to the side of the road, when it is safe to do so, to reduce the possibility of engine damage.

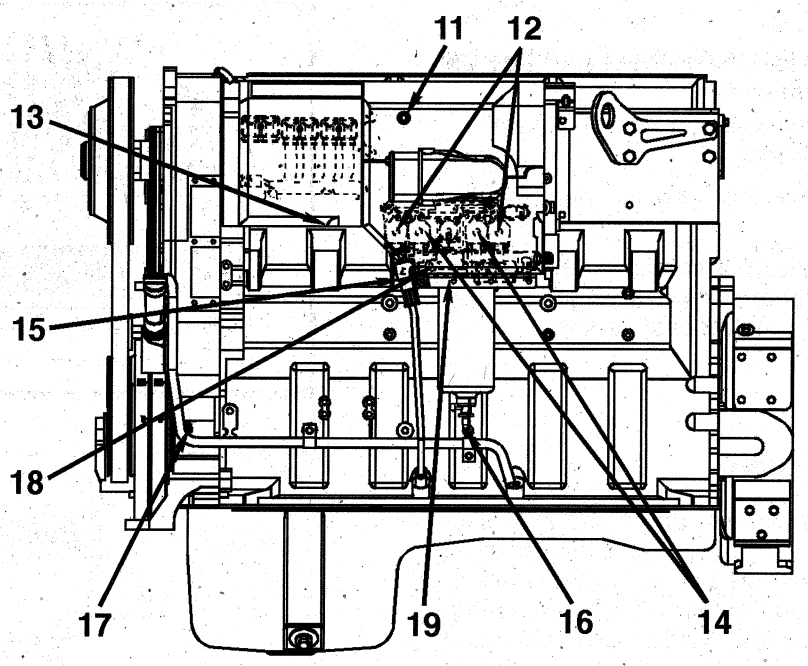


NOTE: Engine power and speed will be gradually reduced, depending on the level of severity of the observed condition. The engine protection system will **not** shut down the engine unless the engine protection shutdown feature has been selected. If the feature has been selected and the engine does shut down, the engine can be started again by turning off the keyswitch and then turning it back on.

Fuel System Description

The QSX15 electronically controlled fuel system consists of:

1. Fuel shutoff valve
2. Oil pressure/temperature sensor
3. Intake manifold pressure/temperature sensor
4. Cooling plate (behind ECM)
5. Electronic control module
6. Fuel in
7. Fuel out
8. ECM actuator harness port (industrial only)
9. ECM OEM harness port (industrial only).



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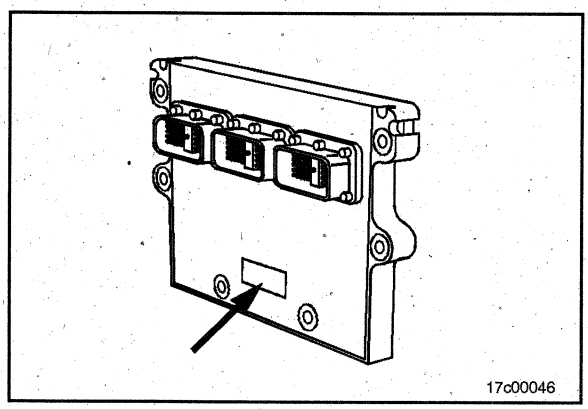
The QSX15 electronically controlled fuel system consists of:

1. Camshaft Position Sensor
2. Fueling Actuators
3. Ambient Air Pressure Sensor
4. Timing Actuators
5. Fuel Pressure Sensor
6. Water-in-Fuel Separator
7. Crankshaft Position Sensor
8. Front and Rear Rail Pressure Sensor
9. Fuel Inlet Restriction Sensor
10. Coolant Level Sensor (In Radiator) - Optional*.

* Not in this view.

Electronic Control Module (ECM) Dataplate



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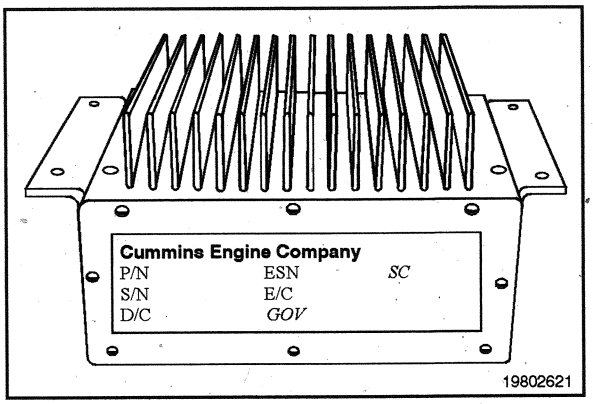
Industrial

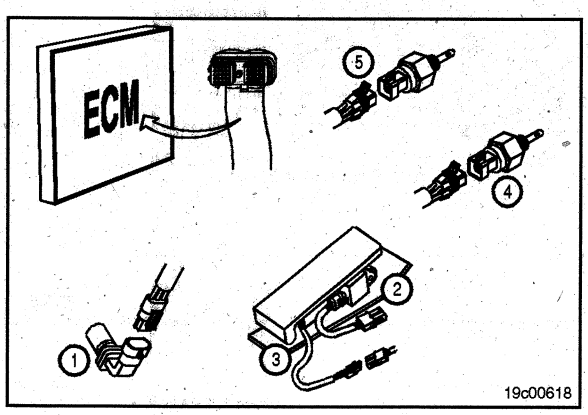
The data tag for the ECM is located on the front of the module housing.

Power Generation

The data tag for the ECM is located on the side of the ECM opposite the ECM connectors.

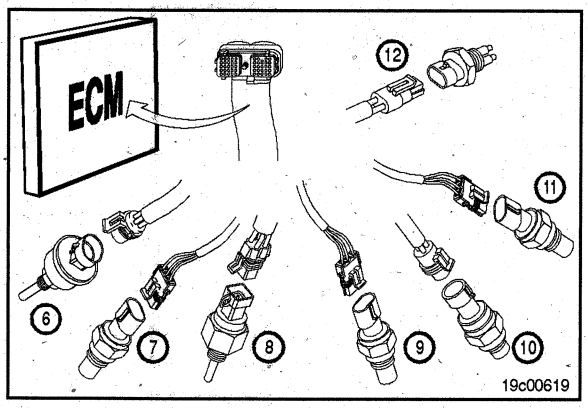


Electronic Control Module Inputs



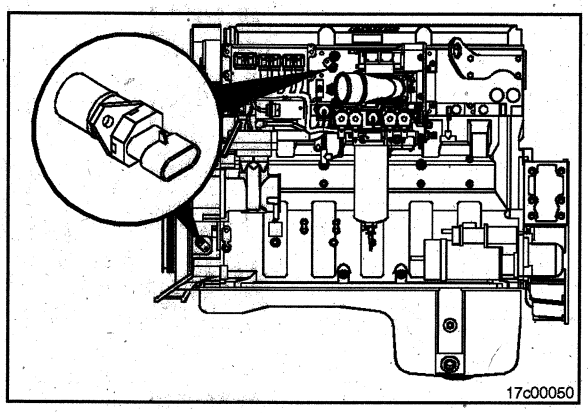
Electronic Control Module (ECM) Inputs:

1. . Engine Camshaft or Crankshaft Position Sensor
2. . Throttle Position Sensor (industrial **only**)*
3. . Idle Validation Switch*



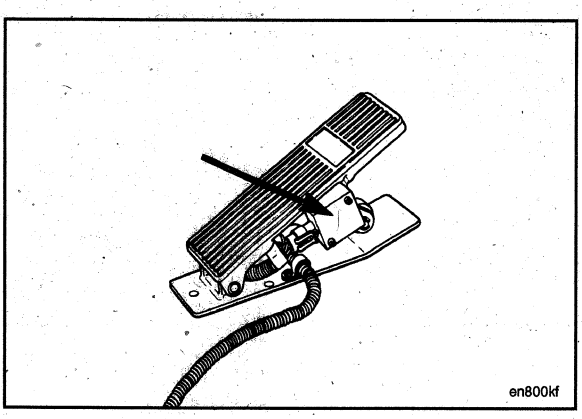
6. Coolant Level Sensor*
7. Ambient Air Pressure Sensor
8. Oil Pressure/Temperature Sensor
9. Wet Tank Pressure Sensor*
10. Unintended Fuel Diagnostic Sensor (industrial **only**)
11. Fuel Pressure Sensor
12. Water-in-Fuel Sensor (industrial **only**).

*These are OEM sensors that are **not** installed on the engine.



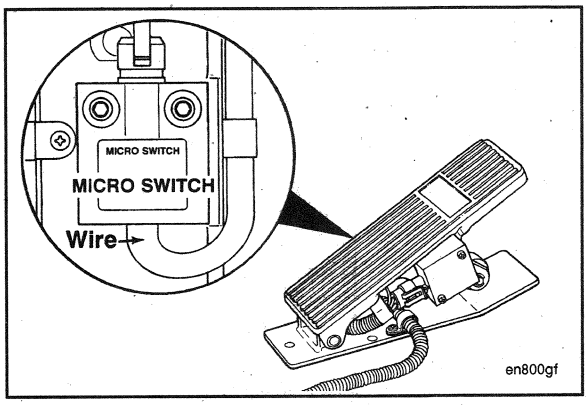
The engine cam and crank position sensors provide engine speed and position information.

The cam position sensor is located between the ECM and fuel pump. The crank position sensor is located below the air compressor drive or the barring device.

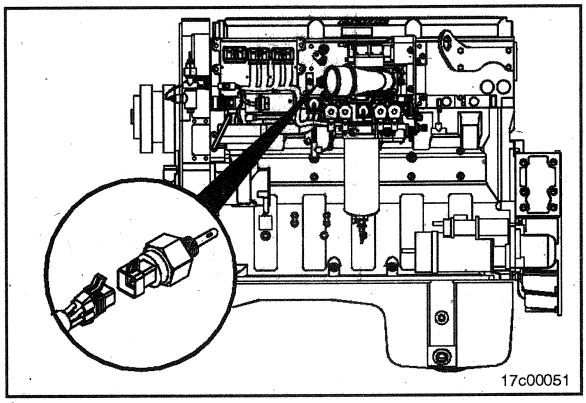


The throttle position sensor (industrial **only**) is located in the throttle foot pedal assembly. When the foot pedal is at idle, the engine brakes can be activated. When the throttle pedal is depressed, the sensor deactivates the engine brakes and the PTO. The accelerator pedal can override the cruise control and PTO (if the throttle override in PTO is enabled).

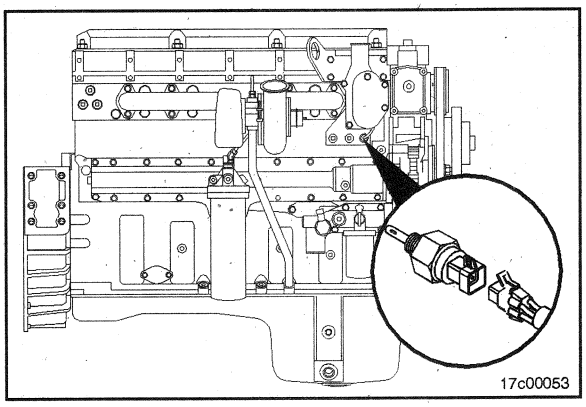
The idle validation switch is added to the throttle pedal assembly and will verify that the throttle pedal is in the low-idle position.



The intake air pressure/temperature sensor, located in the front of the intake air connection, monitors positive manifold pressure and turbocharged intake air temperature. Both are used in the fuel control function. The intake air pressure/temperature sensor is also used in the engine protection system.

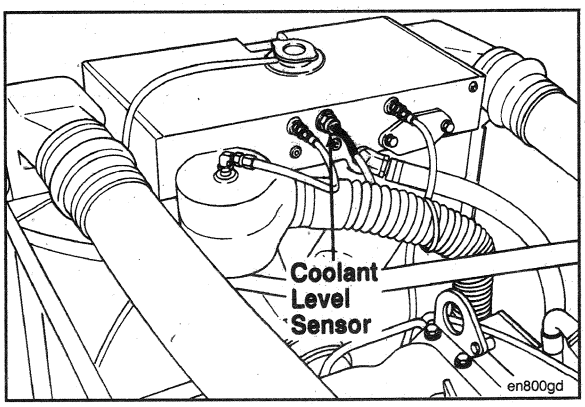


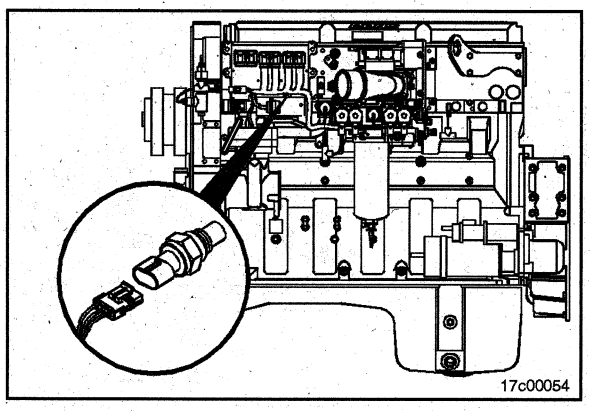
The engine coolant temperature sensor , located in the thermostat housing, monitors engine coolant temperature used in the fuel control function and engine protection system.



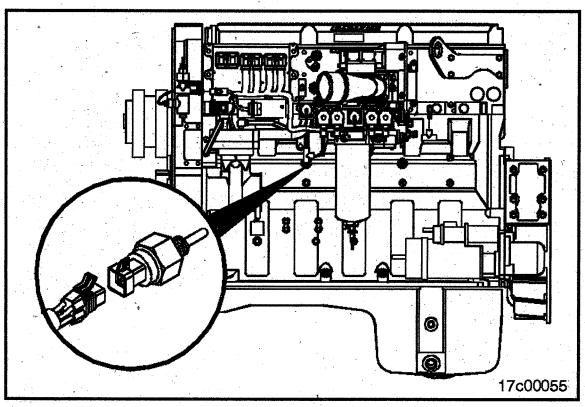
The coolant level sensor is mounted in the radiator top tank or surge tank, depending on the OEM. It is a fluid-level-actuated switch required for the engine protection system.

NOTE: This is an optional sensor that will or will **not** be on all vehicles.

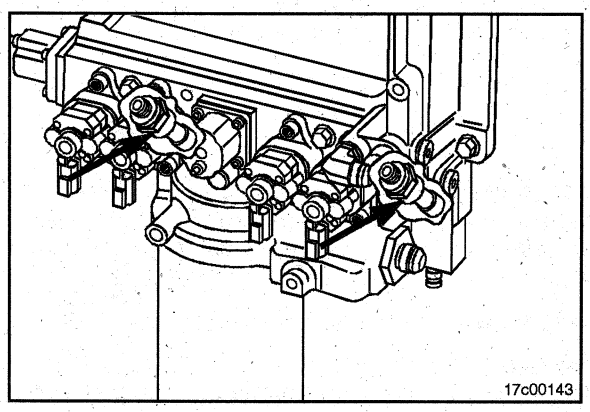




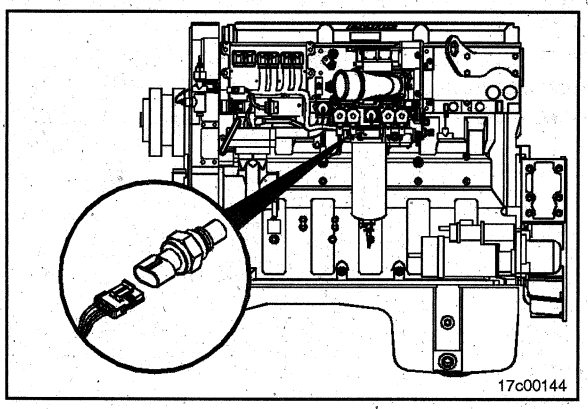
The ambient air pressure sensor is located on the fuel pump side of the engine, just below the ECM. It is used to control fueling.



The oil pressure/temperature sensor , located on the fuel pump side of the engine, monitors lubricating oil pressure and temperature for the engine protection system.

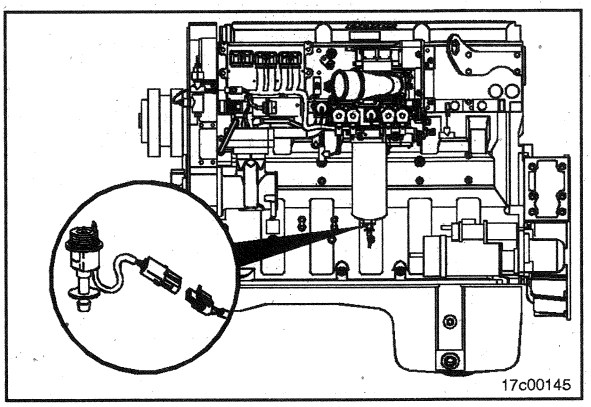


The unintended fuel diagnostic sensors , located behind the fuel actuators on the integrated fuel system module, monitor the fuel actuator's passage pressure.



The fuel pressure sensor , located on the integrated fuel system module, monitors actuator supply rail pressure.

The water-in-fuel sensor , located on the fuel filter, monitors water in fuel.



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.

Notes

Section 2 - Maintenance Guidelines

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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

Automotive Applications

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

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

3376807	Coolant Filter Wrench
3375049	Oil and Fuel Filter Wrench
3397929	Oil and Fuel Filter Wrench
3400157	Oil and Fuel Filter Wrench
3375044	Torque Wrench
3163530	Brake Feeler Gauge - 7.00 mm [0.276 in]

Refer to the appropriate sections for a description of the tools and how to use them.

Contact your nearest Cummins Authorized Repair Location for the required service tools.

Maintenance Schedule

General Information

Daily or Refueling - Maintenance Check (1)

Section 3

- Air Intake Piping - check
- Air Tanks and Reservoirs - drain
- Charge Air Piping - check
- Coolant Level - check
- Cooling Fan - check
- Crankcase Breather Tube - check
- Drive Belts - check
- Fuel-Water Separator - drain
- Lubricating Oil Level - check

Every 250 Hours, or 6 Months(1), (4)

Section 4

- Lubricating Oil - change
- Lubricating Oil Filter - replace
- Supplemental Coolant Additive (SCA) and Antifreeze Concentration - check

Every 1500 Hours, or 1 Year (2), (3)

Section 5

- Air Cleaner Restriction - check
- Air Leaks, Air Intake and Exhaust Systems - check
- Cooling Fan Belt Tensioner - inspect
- Coolant Filter - replace
- Engine Wiring Harness - check
- Fuel Filter (Spin-on) - remove and install

Every 3000 Hours, or 2 Years (3)

Section 6

- Cold Weather Starting Aids - check
- Crankcase Breather Tube - inspect
- Engine Hoses - check
- Engine Mounting Bolts - check
- Engine Steam Cleaning
- Vibration Damper - check
- Overhead Set - adjust

Every 10,000 Hours, or 5 Years(3)

Section 7

- Air Compressor Discharge Lines - check
- Fan Hub, Belt Driven - check

Oil Drain Intervals

All Others Without EGR

Select oil drain interval based on oil classification for RV, Refuse, Mixer, Dump, Delivery, Logging, Fire Truck or Crane vehicle applications.

Oil Classification	Kilometers	Miles	Hours	Months
CF-4	3000	2000	100	6
CG-4	6500	4000	200	6
CES 20071 (equivalent to CH-4 and CES 20072)	11,500	7000	300	6
CES 20076/CH-4 and CES 20078 (CI-4)	14,500	9000	400	6

If your application is **not** one of the above select the oil drain interval severe, normal, or light based on how you use your engine. See Oil Drain Intervals by Severity km [mi] located in this section.

- Follow oil drain interval Severe if your vehicle operates under either of the conditions listed in interval Severe.
- Follow oil drain interval Normal if your vehicle operates under either of the conditions listed in interval Normal and does **not** meet any conditions in interval Severe.
- Follow oil drain interval Light if your vehicle operates under both of the conditions listed in interval Light and does **not** meet any conditions in interval Severe or interval Normal.

Oil Classification	Severe-Duty	Normal Duty	Light Duty
	< 2.3 km/liter [5.5 mpg] or 36,287 kg [80,000 lb] GVW	**2.3 to 2.8 km/liter [5.5 to 6.5 mpg] or 36,287 kg [80,000 lb] GVW**	**2.9 km/liter [6.7 mpg] or < 31,751 kg [70,000 lb] GVW**
CF-4	8000 km [5000 mi]	16,000 km [10,000 mi]	20,000 km [12,500 mi]
CG-4	16,000 km [10,000 mi]	32,000 km [20,000 mi]	40,000 km [25,000 mi]
CES 20071 (CH-4)	24,000 km [15,000 mi]	56,500 km [35,000 mi]	72,500 km [45,000 mi]
CES 20076/CH-4 and CES 20078 (CI-4)	32,000 km [20,000 mi]	64,500 km [40,000 mi]	80,500 km [50,000 mi]

NOTE: Extending the oil and filter change interval beyond the recommendation will decrease engine life due to factors such as corrosion, deposits, and wear.

NOTE: If the sulfur content of the fuel is greater than 0.50 percent, the oil change interval **must** be reduced by 20 percent.

For industrial engines, the oil drain intervals are based on the duty cycle (as reflected by fuel consumption) and lubricating oil quality. The table below specifies the maximum oil drain interval for the listed lubricating oil classifications based on the three different duty cycles: heavy, medium, and light.

- Follow oil drain interval heavy if your equipment uses more than 57 liter [15 gal] of fuel per hour.
- Follow oil drain interval medium if your equipment uses between 42 to 57 liter [11 to 15 gal] of fuel per hour.
- Follow oil drain interval light if your equipment uses less than 42 liter [11 gal] of fuel per hour.

NOTE: Extending the oil and filter change interval beyond the recommendation will decrease engine life due to factors such as corrosion, deposits, and wear.

Duty Cycle (Fuel Consumption)			
Oil Classification	**Heavy >57 liters/hour [14 gallons/hour]**	**Medium 42 to 57 liters/ hour [11 to 15 gallons/ hour]**	**Light < 42 liters/hour] [11 gallons/hour]**
API CD-4, CE-4, CF-4[1, 3]	125	250	375
API CG-4[3]	250	375	500
API CH-4[3]	400	525	650
CES 20076/CH-4[2, 3]	500	625	750

NOTE:

1. The oil classifications CD, CE, and CF have been obsolete by API and **must not** be used, as their specifications are no longer controlled.
2. Valvoline Premium Blue and Premium Blue 2000 meet CES 20076 standards.
3. Refer to the lubricating oil filter specification table in Section V.

The table below list typical duty cycles by application.

NOTE: The actual duty cycle can vary from the below chart. In those cases, it is necessary to change the lubricating oil as a function of average fuel consumption. Therefore, select a column based on the representative fuel consumption range.

Typical Duty Cycles by Applications		
Heavy	**Medium**	**Light**
Air Compressor	Articulated Dump Truck	Crane
Combine	Irrigation Equipment	Rear Dump Truck
Dozer	Scraper	
Dragline	Skidder	
Excavator		
Farm Tractors		
Forage Harvester		
Rock Drill		
Tub Grinder		

For Generator Drive engines, this service interval is based on load factor (as reflected by fuel usage), lubricating oil quality, lubricating system capacity, and operating speed 1500 rpm (50 Hz) or 1800 rpm (60 Hz). Premium grade oils (API CG-4, CH-4, and CES 20076) are recommended for the QSX15 engine. The oil grades CD, CE, and CF have been obsoleted by API and **must not** be used, as their specifications are no longer controlled. There are two recommended methods for determining the proper oil change interval:

- Fixed hour method; based on fixed hours of operation or months of service, whichever occurs first.
- Chart method; based on known fuel consumption rates.

If the chart method is **not** used or, for all stand-by power applications, the oil **must** be changed at a regular interval or 12 months, whichever occurs first:

Operating Speed	Sump Size	Change Interval
1500 rpm (50 Hz)	45 liters [12 gal]	125 Hours or 12 Months

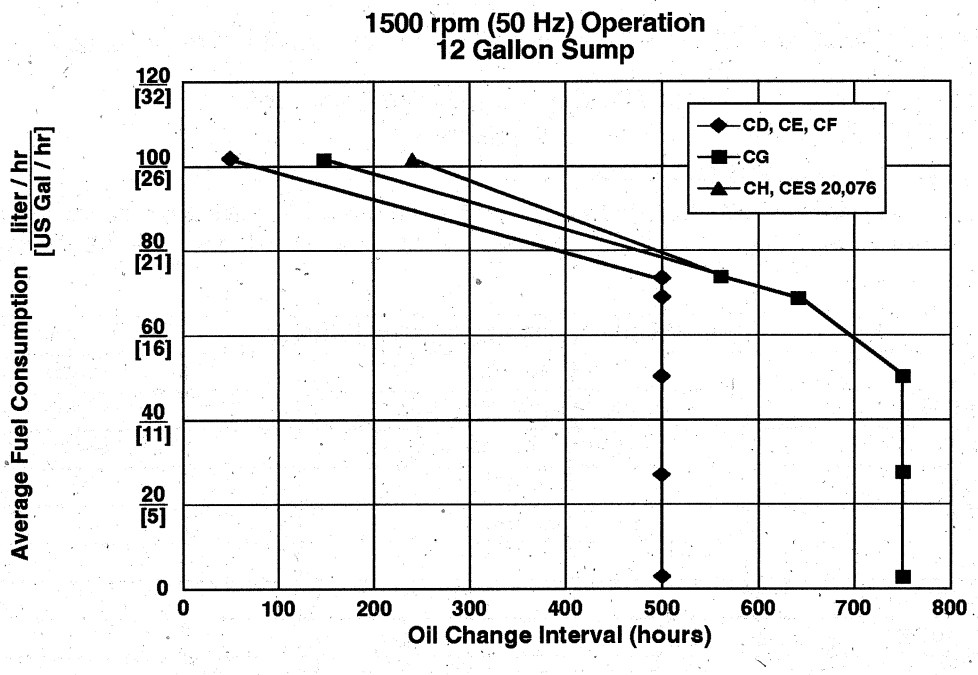
Operating Speed	Sump Size	Change Interval
	45 liters [12 gal]	250 Hours or 12 Months
1800 rpm (60 Hz)	95 liters [25 gal]	250 Hours or 12 Months
	95 liters [25 gal]	500 Hours or 12 Months

The chart method is recommended to provide the lowest total cost of operation while still protecting the engine. Due to differing availability outside North America, lower grade oil (CD, CE, and CF) are also depicted, however their classifications have been obsoleted by API, and oil change intervals are greatly reduced.

The charts **must** be used as guidelines because actual oil drain intervals will also depend on operation and maintenance practices. It is suggested that oil analysis **must** be used periodically for prime power applications (every 100 hours) to make sure the proper oil change interval is being applied.

To use the charts, locate the chart for the appropriate sump size and operating speed. Find the fuel consumption rate in U.S. gallons per hour or liters per hour on the left vertical axis. Draw a horizontal line from left to right across the char, parallel with the bottom of the chart, until it intersects the curve.

From the intersection point on the curve, draw a line perpendicular to the bottom of the chart. The number the line intersects across the bottom of the chart represents the recommend oil change interval in hours.



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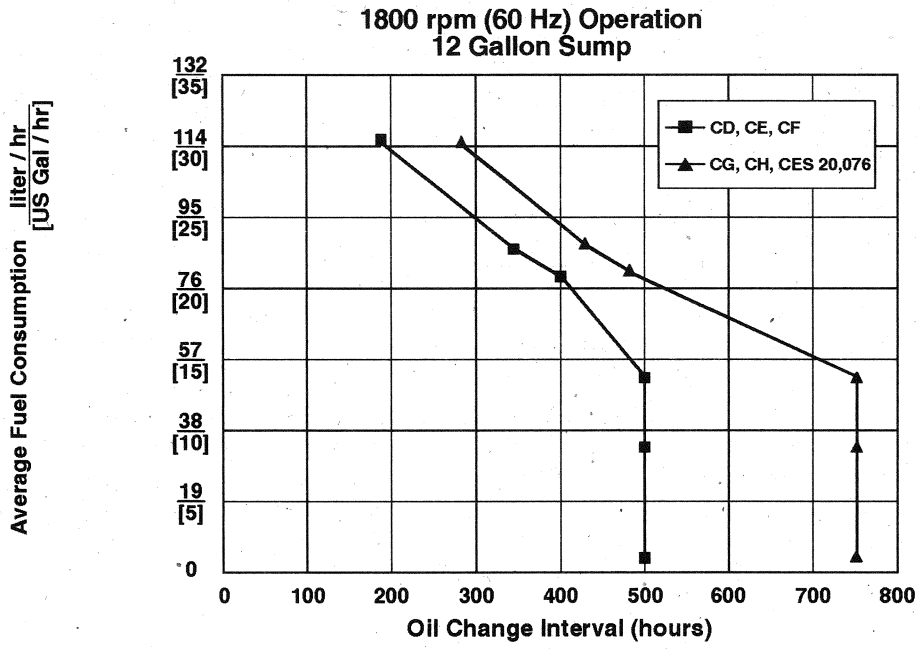

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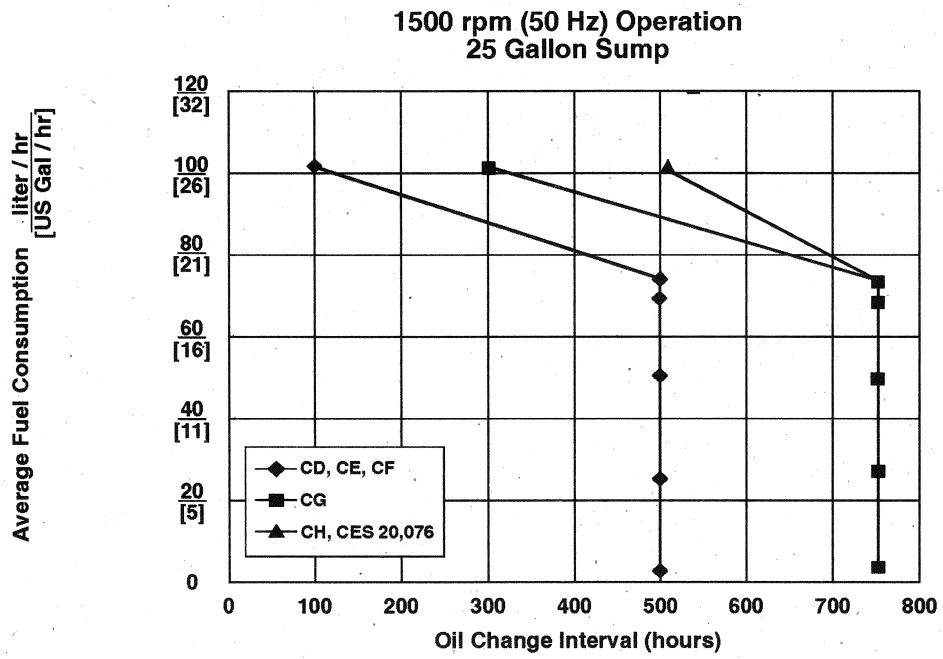

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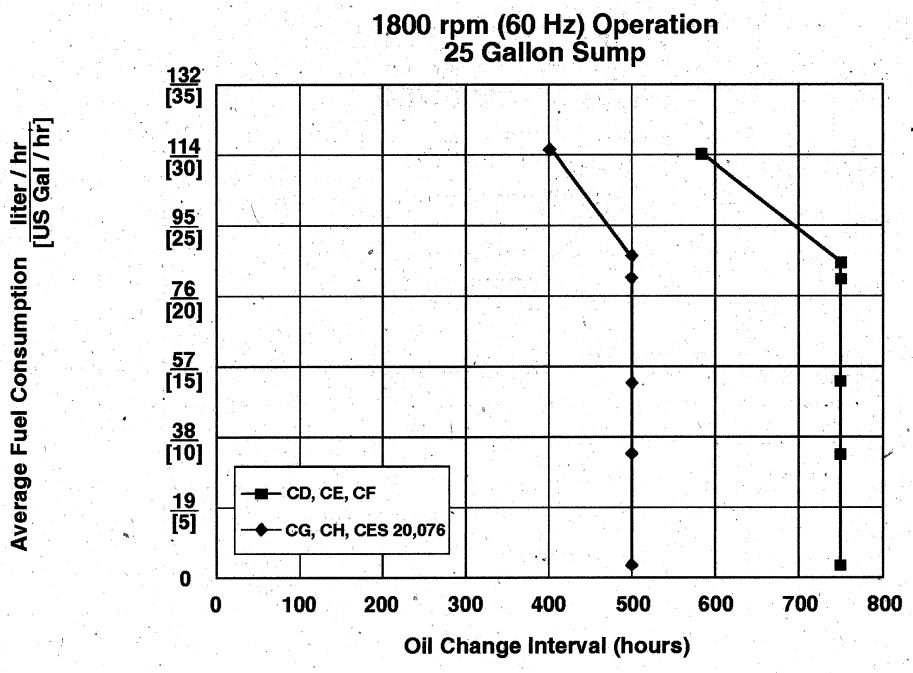

Maintenance Record Form

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

A	B	C	D	E	F

Notes

Section 3 - Maintenance Procedures at Daily Interval

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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.

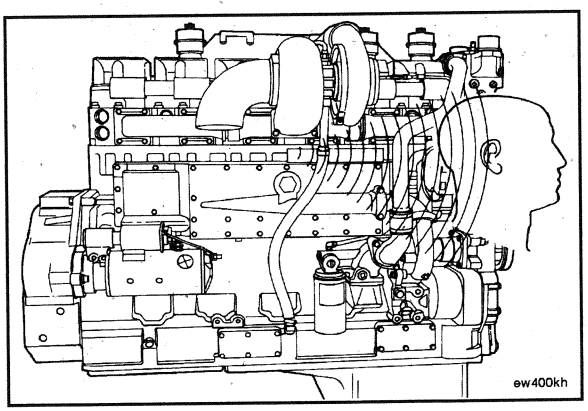
Comparison and intelligent interpretation of the daily report, along with a practical follow-up action, will eliminate most failures and emergency repairs.

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.



Fuel-Water Separator

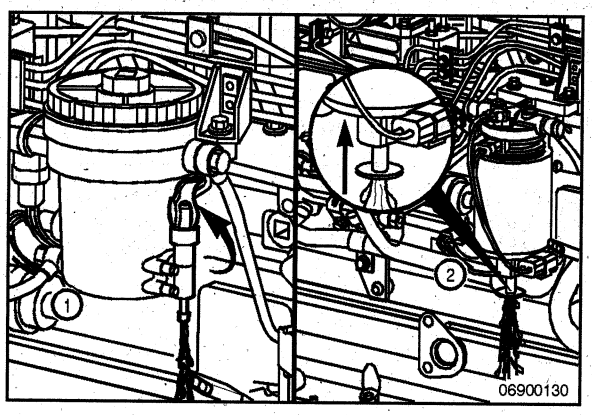
Drain

⚠WARNING⚠

Drain the water-fuel separator into a container and dispose of in accordance with local environmental regulations.

Cummins Inc. requires a fuel-water separator or fuel filter be installed in the fuel supply system.

Drain the water and sediment from the separator daily.

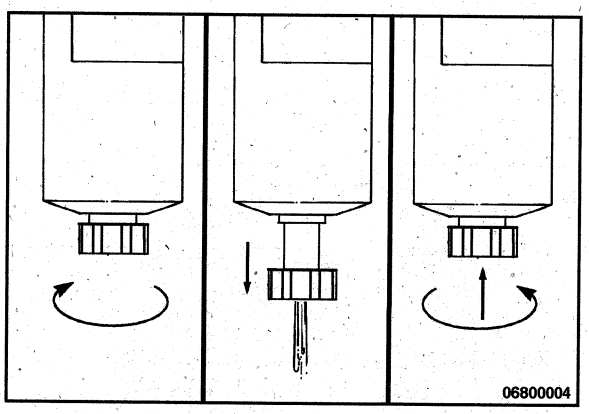


Canister Type

Shut off the engine.

Pull up on the drain valve lever until fluid drains out of the drain tube. Drain the filter sump until clear fuel is visible.

Push up on the drain valve until fluid drains out of the drain tube.



Spin-on Type

Shut off the engine.

Use your hand to open the drain valve. Turn the valve **counterclockwise** approximately 3½ turns until the valve drops down 25.4mm [1 in] and draining occurs.

Drain the filter sump until clear fuel is visible.

△CAUTION△

When closing the drain valve, do not overtighten the valve. Overtightening can damage the threads.

To close the valve, lift the valve and turn **clockwise** until it is hand-tight.

Lubricating Oil Level

Maintenance Check

⚠CAUTION⚠

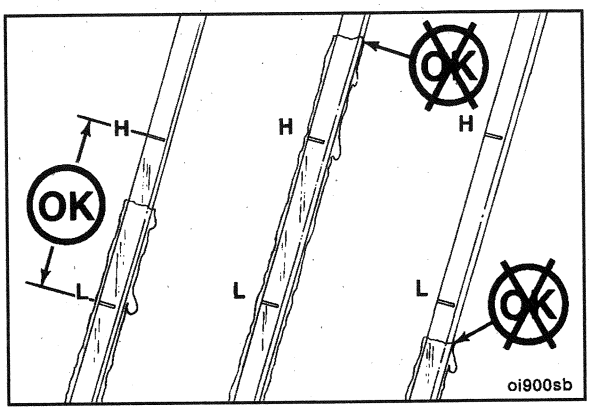
Never operate the engine with oil level below the L (low) mark or above the H (high) mark. Poor engine performance or engine damage can occur.

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).



Coolant Level

Maintenance Check

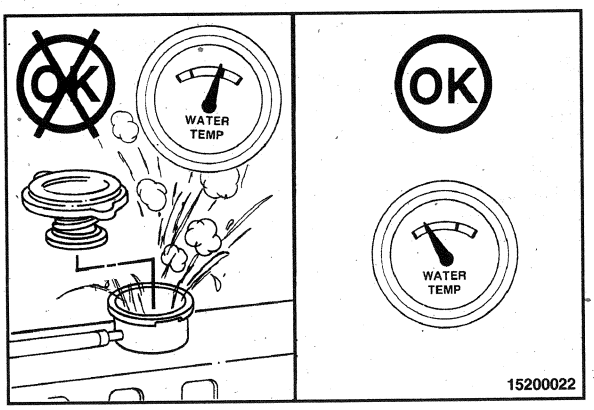
⚠WARNING⚠

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.

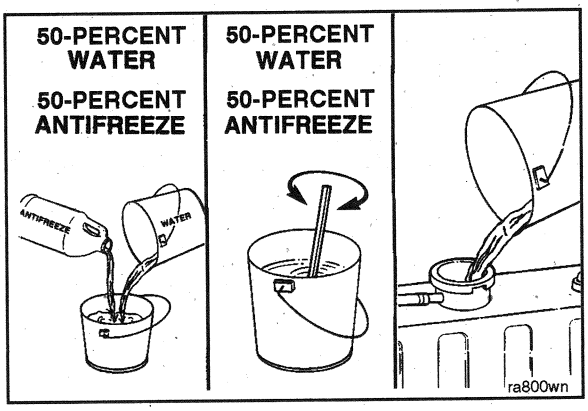


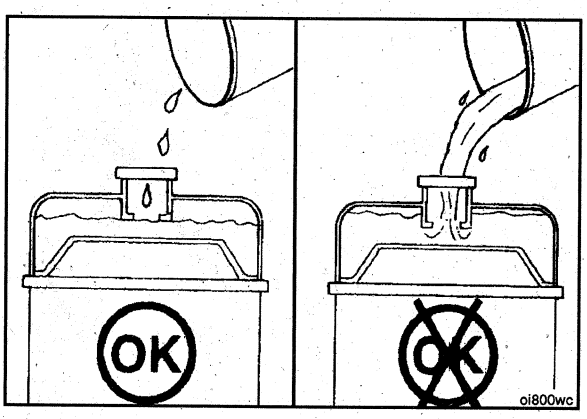
⚠CAUTION⚠

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.

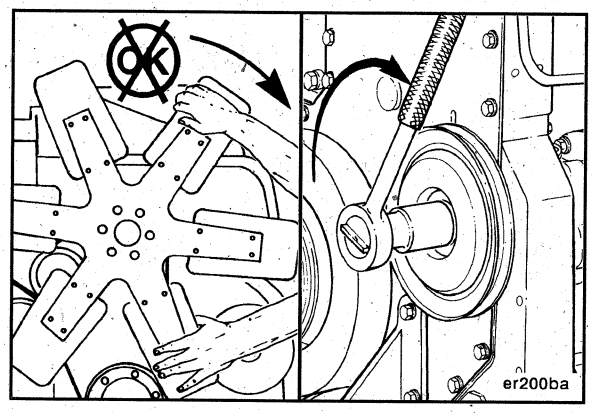
Coolant recommendations and specification details on correct mixing of coolant can be found in Maintenance Specifications (Section V).





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.

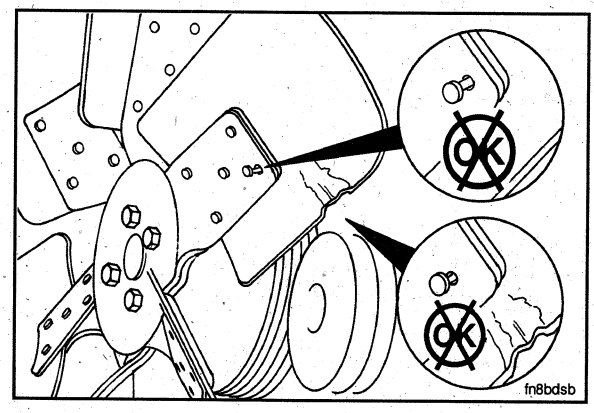


Fan, Cooling

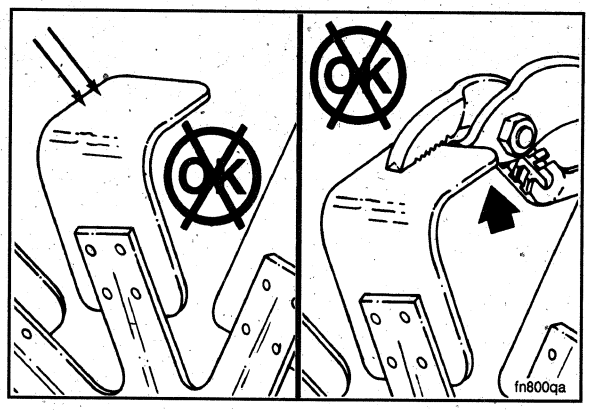
Inspect for Reuse

⚠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.

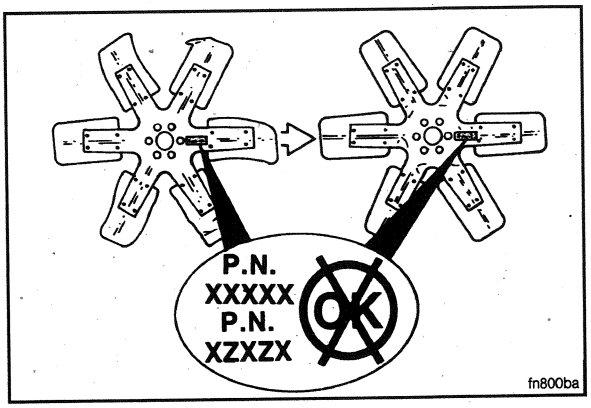


⚠WARNING⚠

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.

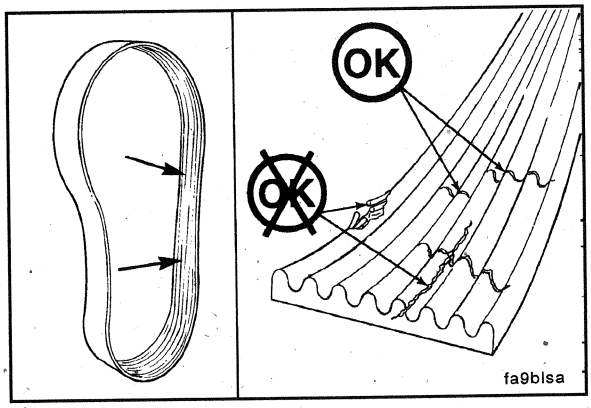
Refer to the vehicle or equipment manufacturer's specifications for capscrew torque.



Drive Belts

Maintenance Check

Poly-Vee Belt

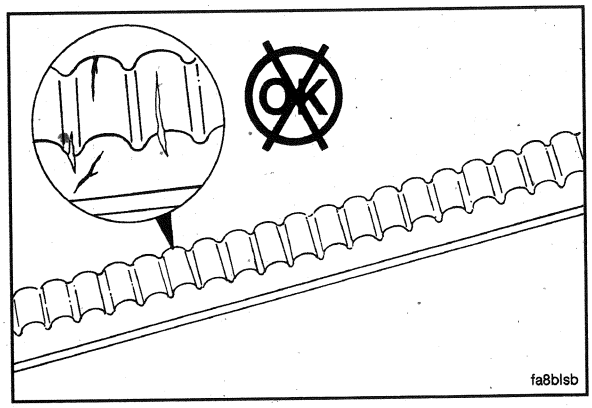


Inspect the belts daily. Check the belt for intersecting cracks. Traverse (across the belt width) cracks are acceptable. Longitudinal (direction of belt length) cracks that intersect with transverse cracks are **not** acceptable. Replace the belt if it is frayed or has pieces of material missing. Refer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

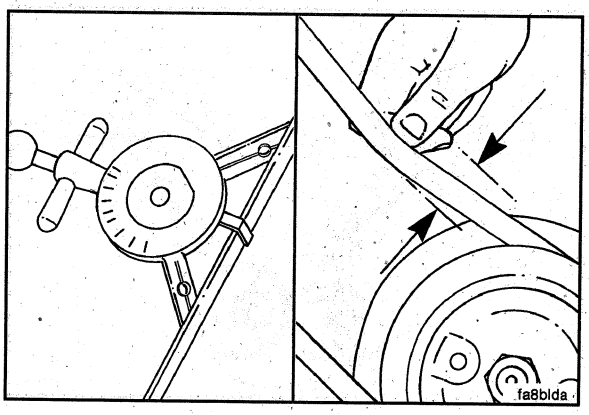


Inspect the belts daily. Replace the belts if they are cracked, frayed, or have chunks of material missing. Small cracks are acceptable.

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

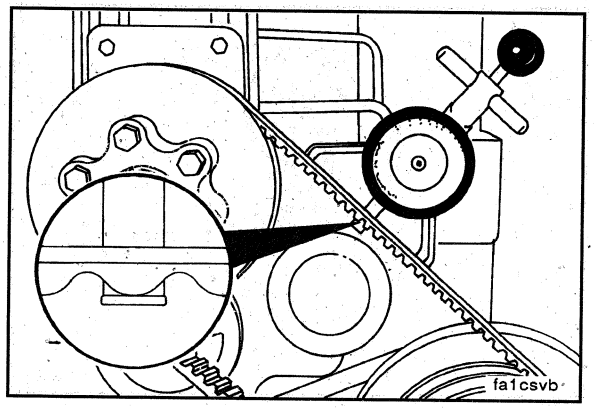


Measure the belt tension in the center span of the pulleys.

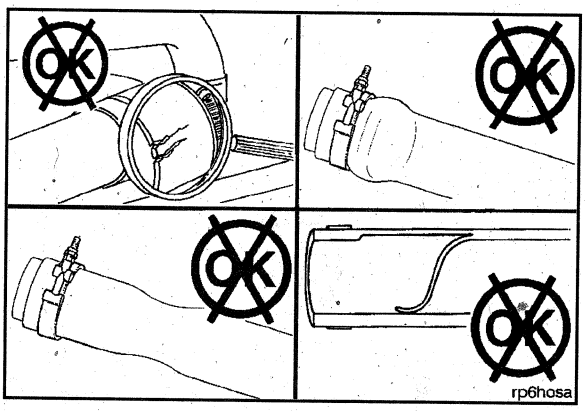
Refer to the Belt Tension Chart in Section V for the correct gauge and tension value for the belt width used.

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.



Air Intake Piping

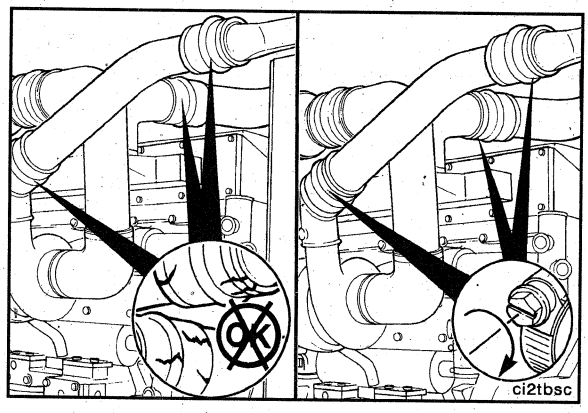
Maintenance Check

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

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

Torque Value: 8 N•m [72 in-lb]

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



Charge-Air Piping

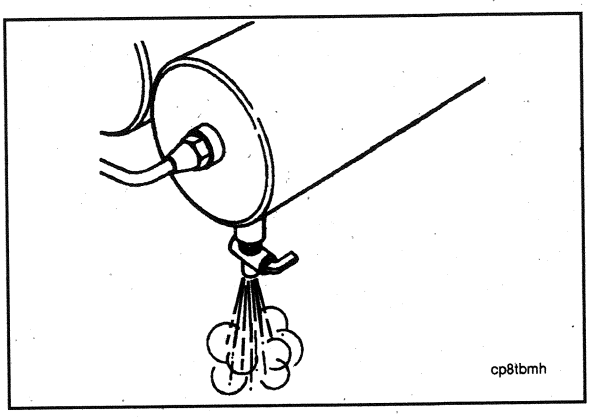
Maintenance Check

Inspect the charge-air piping and hoses for leaks, holes, cracks, or loose connections. Tighten the hose clamps if necessary. Refer to the vehicle or equipment manufacturer's specifications for the correct torque value.

Air Tanks and Reservoirs

Drain

If automatic purging or spitter valves are used, confirm the valves are operating correctly. If a manual drain valve is used on the wet tank, open the draincock on the wet tank to drain any moisture accumulated in the air system. If oil is present, the air compressor system **must** be checked. Contact your Cummins Authorized Repair Location.

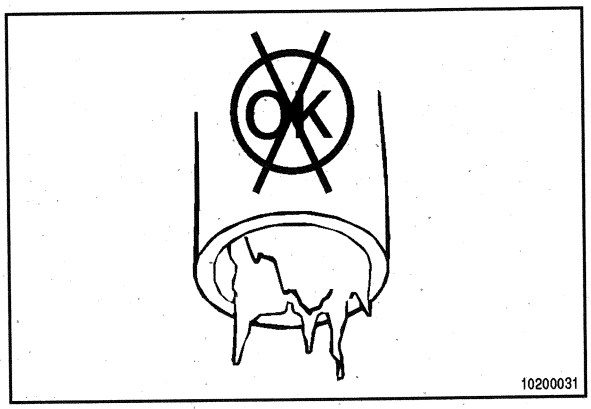


Crankcase Breather Tube

Maintenance Check

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

Inspect the tube more frequently in icy conditions.



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Section 4 - Maintenance Procedures at 250 Hours or 6 Months

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Supplemental Coolant Additive (SCA) 4-3
Antifreeze 4-3

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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.

Lubricating Oil and Filters

Drain

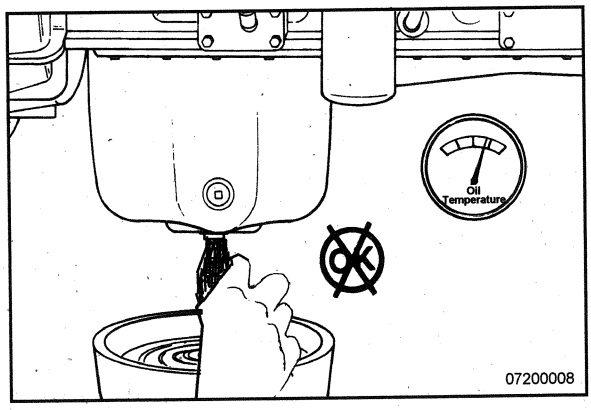
⚠WARNING⚠

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.

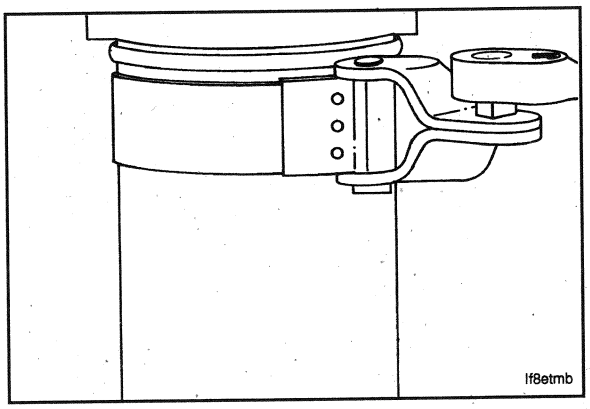
Operate the engine until the water temperature reaches 60°C [140°F]. Shut off the engine. Remove the oil drain plug. Drain the oil immediately to make sure all the oil and suspended contaminants are removed from the engine.

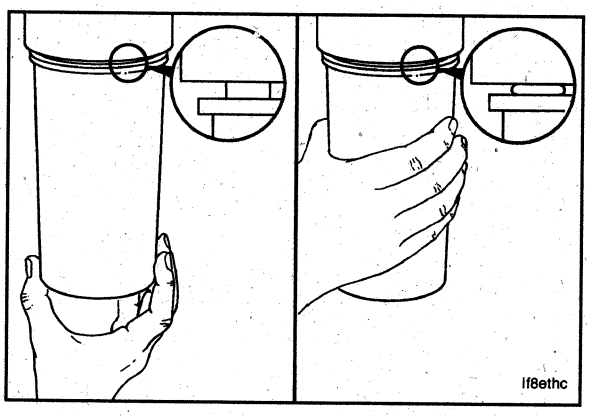


Remove

Remove the lubricating oil filter. Refer to Procedure 007-013.

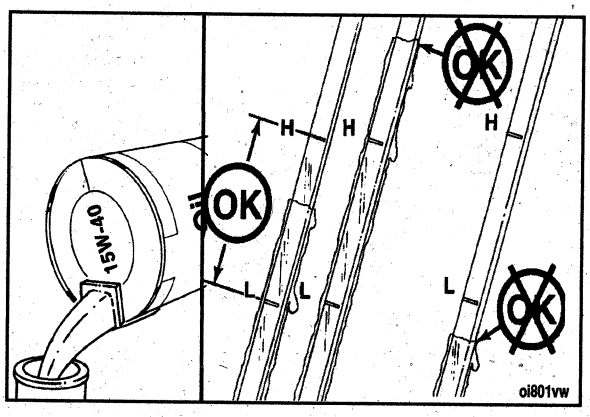
NOTE: Dispose of used oil in accordance with federal, state, and local laws and regulations.





Install

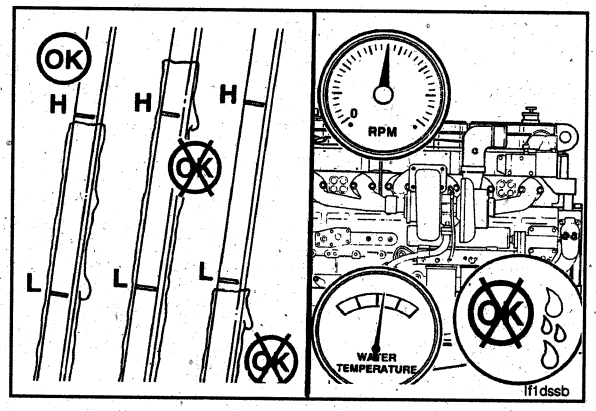
Fill and install the lubricating oil filter. Refer to Procedure 007-013.



Fill

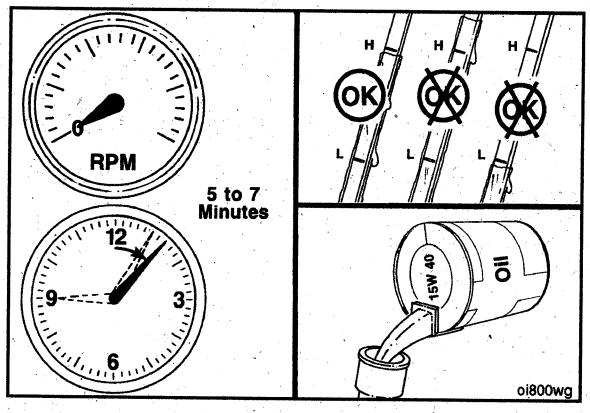
Add the specified amount of clean 15W-40 oil to fill the oil pan.

Oil Pan Capacity	
Automotive and Industrial	41.6 liters [11 gal]
Power Generation	83.3 liters [22 gal]



Check the oil level on the dipstick. It **must** be filled to the H (high) mark. Refer to Procedure 007-009 for dipstick calibration.

Operate the engine until the water temperature reaches 82°C [180°F], and check for leaks.



Shut off the engine. Wait 15 minutes for the oil to drain back to the oil pan.

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

Supplemental Coolant Additive (SCA) and Antifreeze Concentration

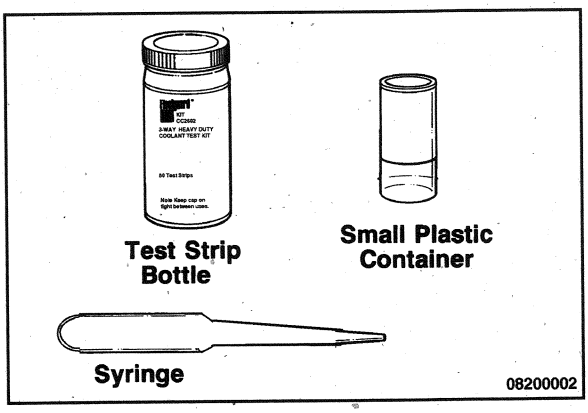
Maintenance Check

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

⚠CAUTION⚠

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

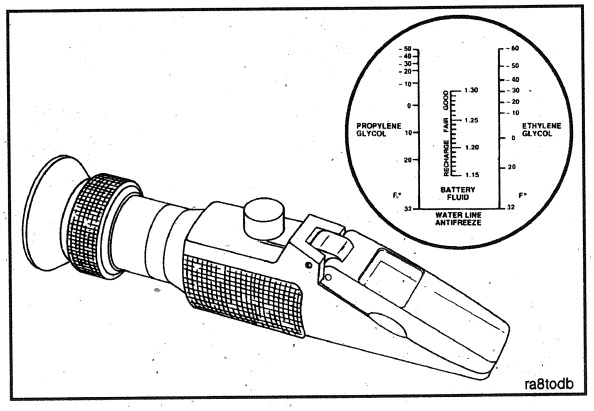
Check the antifreeze concentration. Use a mixture of 50-percent water and 50-percent ethylene glycol or propylene glycol-based antifreeze to protect the engine to -32°C [-26°F] year-around.

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.



Notes

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Maintenance Procedures - Overview

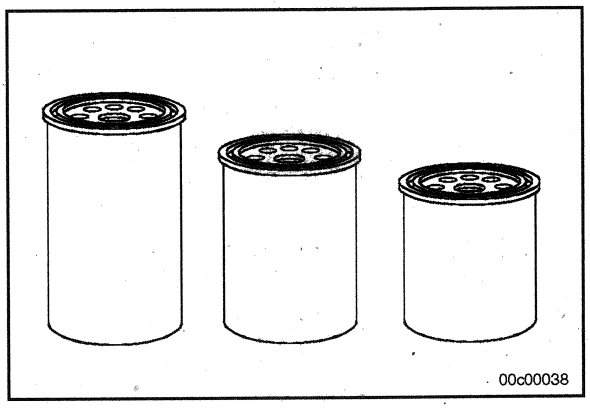
General Information

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.

Coolant Filter

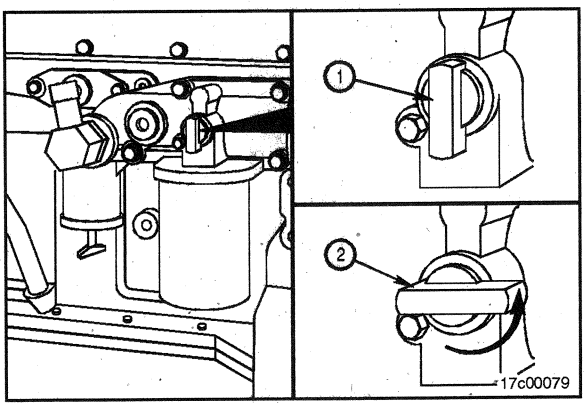
General Information

Refer to Procedure Coolant Recommendations and Specifications at the beginning of this section.



An on/off valve is provided to prevent coolant leakage while changing the coolant filter.

With the valve in the ON position (1), the coolant flows to and from the coolant filter. In the OFF position (2), the coolant flow is cut off to and from the coolant filter.

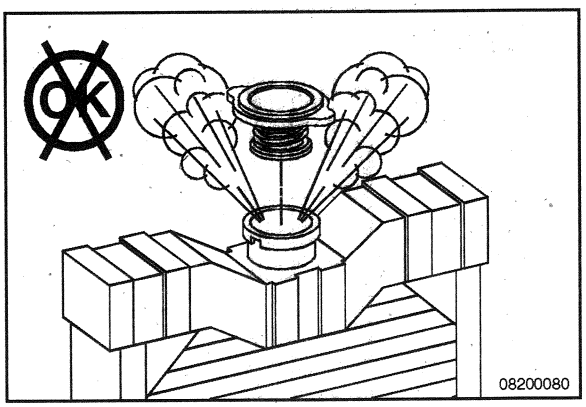


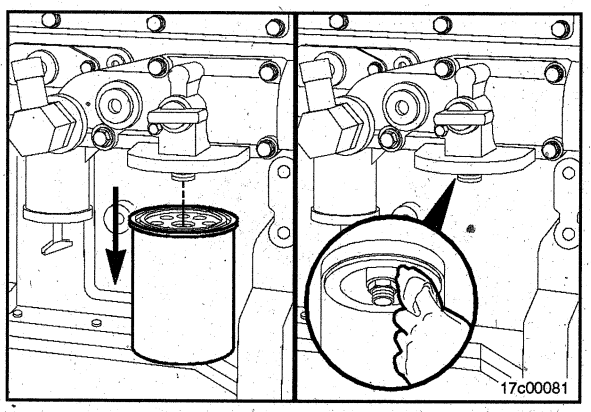
Remove

⚠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.

Remove the cooling system pressure cap.





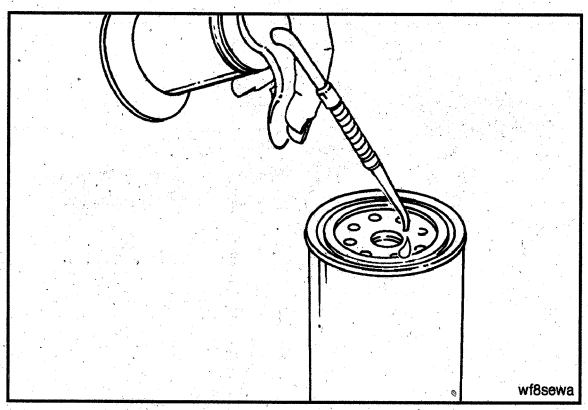
⚠WARNING⚠

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

Turn the coolant on/off valve to the OFF position.

NOTE: Do **not** use force to open or close the on/off valve. If the valve does **not** turn freely, refer to procedure 008-082.

Remove and discard the coolant filter. Clean the gasket surface on the filter head.



Install

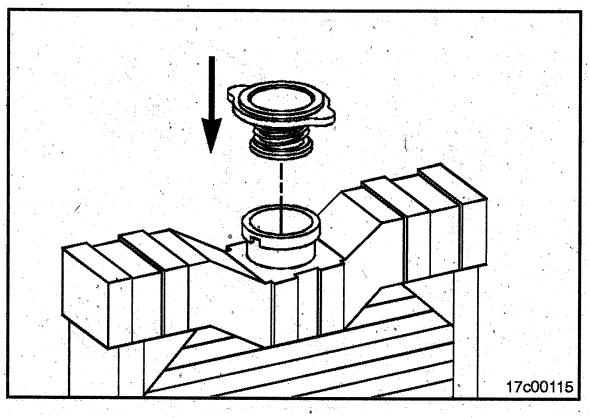
△CAUTION△

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

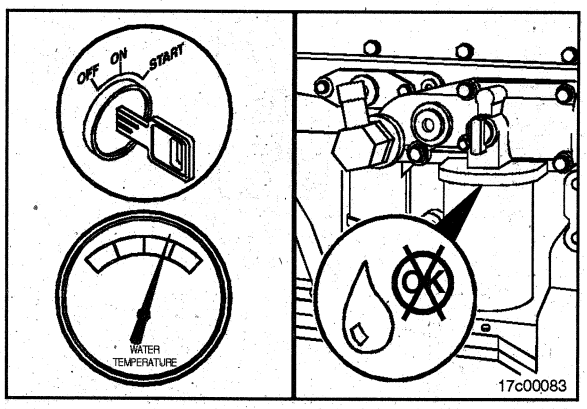
Apply a thin film of clean engine oil, or its equivalent, to the coolant filter gasket sealing surface before installing the coolant filter.

Tighten the coolant filter 1/2 to 3/4 of a turn after initial gasket contact, or as specified by the manufacturer.

Turn the coolant on/off valve to the ON position.



Install the radiator pressure cap.



⚠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.

Operate the engine until the coolant temperature is above 82°C [180°F], and check for coolant leaks.

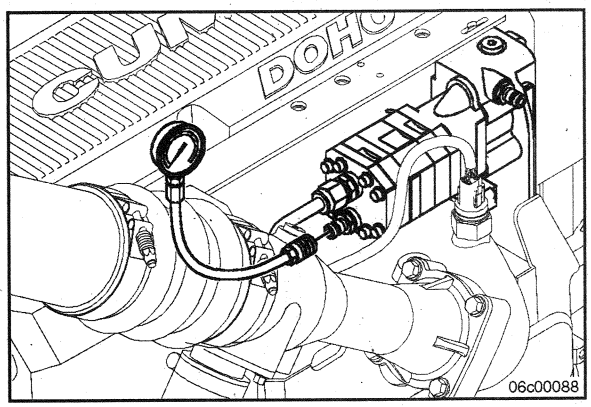
After the air has been purged from the system, check the coolant level again.

Fuel Filter (Spin-On Type)

Initial Check

With Pressurized Fuel Filtering

Install a pressure gauge, Part Number 3824877 (2758 kPa [400 psi]), on the fuel pump Compuchek® fitting to measure the fuel pressure before the fuel filter.

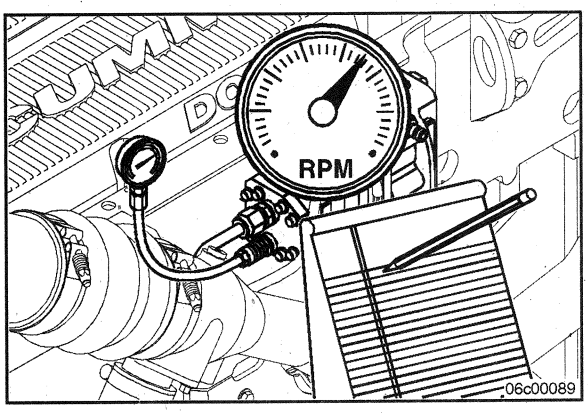


Start the engine and run at high idle and no load.

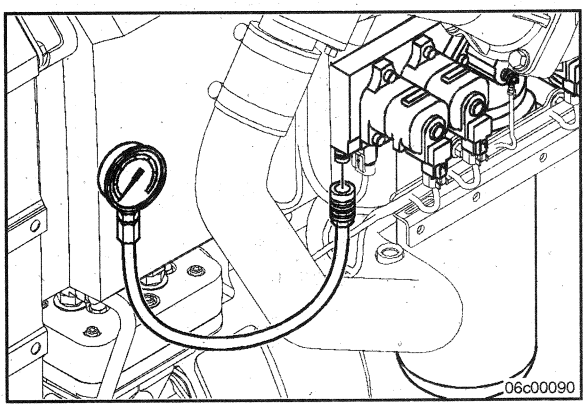
Measure and record the fuel pressure.

Shut the engine off.

Remove the pressure gauge from the fuel pump.



Install a pressure gauge, Part Number 3824877 (275 kPa [400 psi]), on the rail fuel pressure Compuchek® fitting located on the integrated fuel system module to measure fuel pressure after the filter.



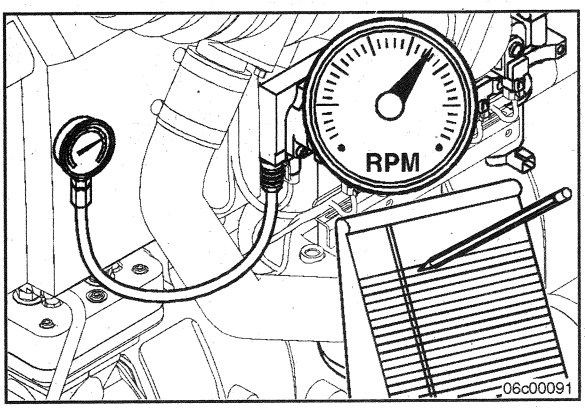
Start the engine and operate at high idle and no load.

Measure and record the fuel pressure.

Shut the engine off.

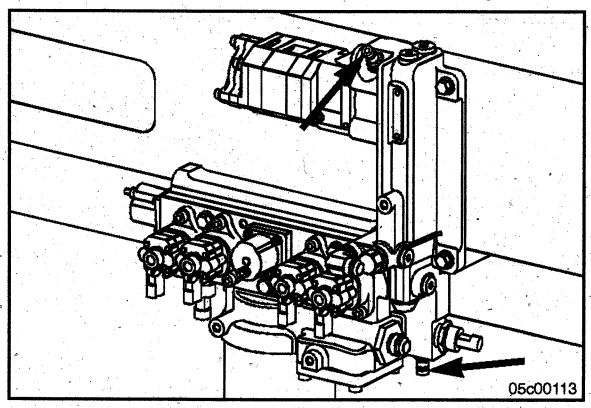
Remove the pressure gauge from the rail fuel pressure Compuchek® fitting.

The pressure difference between the rail fuel pressure and fuel pump pressure is the differential pressure.



Fuel Filter Restriction		
kPa		psi
517	MAX	75

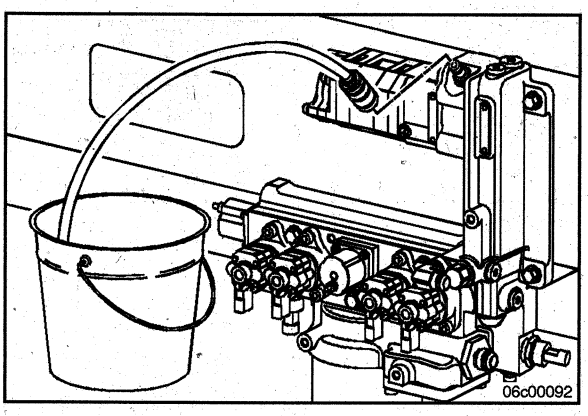
If the fuel filter restriction is above specifications, replace the filter.



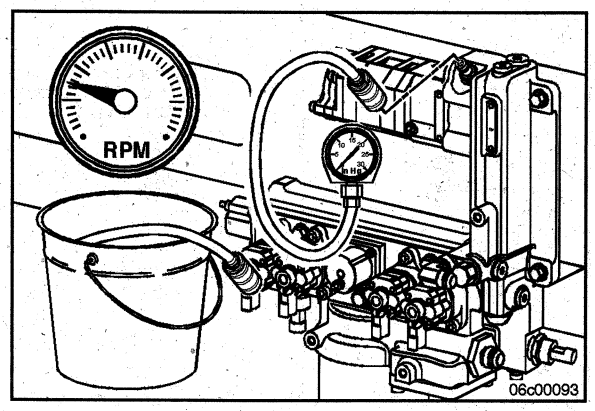
With Vacuum Fuel Filtering

Connect a vacuum gauge to either suction-side Compuchek® fitting.

NOTE: Some engines equipped with priming pumps do **not** have a lower Compuchek® fitting and have an air vent line plumbed into the upper location. Refer to the following procedure for measuring inlet restriction.



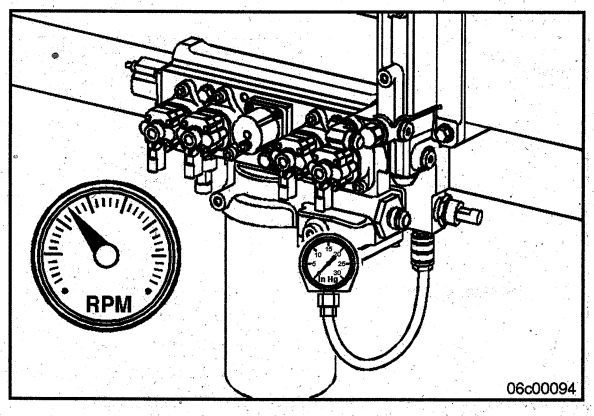
Disconnect the air bleed line from the upper location on the IFSM. Insert a Compuchek® fitting in this location and run a line to a catch container.



Start the engine.

After the fuel lift pump stops running and with the engine operating at idle, disconnect the hose to the catch container.

Connect the vacuum gauge to the Compuchek® fitting and measure the fuel inlet restriction.



Operate the engine at high idle and no load.

Fuel Inlet Restriction			
	mm Hg		in Hg
Upper Location	356	MAX	14
Lower Location	305	MAX	12

An inlet restriction greater than specification indicates either a dirty fuel filter or a restriction in the OEM fuel supply plumbing. Inlet restriction at the fuel supply connection should be checked to identify the correct source of the restriction.

Remove

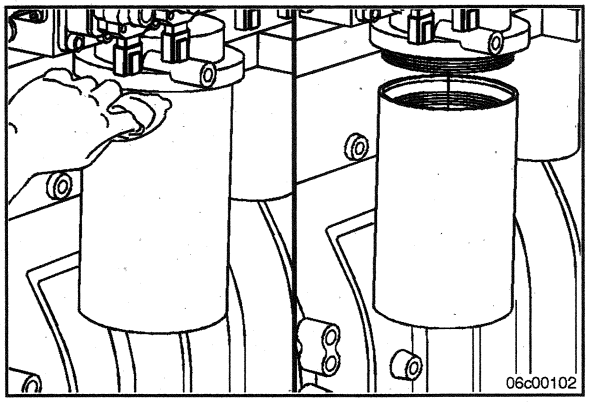
With Pressurized Fuel Filtering

⚠WARNING⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing 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 the fuel system.

Clean the area around the fuel filter head and filter.

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



With Vacuum Fuel Filtering

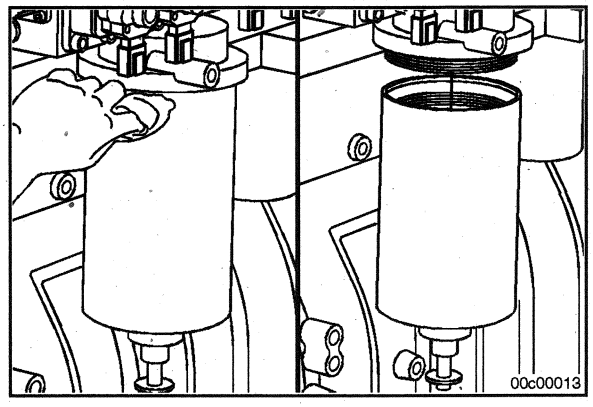
⚠WARNING⚠

Fuel is flammable. Keep all cigarettes, flames, pilot lights, arcing 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 the fuel system.

Clean the area around the fuel filter head and filter.

Disconnect the wiring harness from the water-in-fuel sensor if equipped.

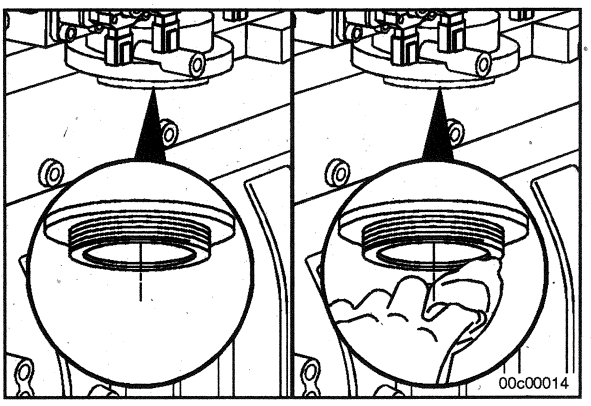
Remove the fuel filter with filter wrench, Part Number 3376807.



Clean and Inspect for Reuse

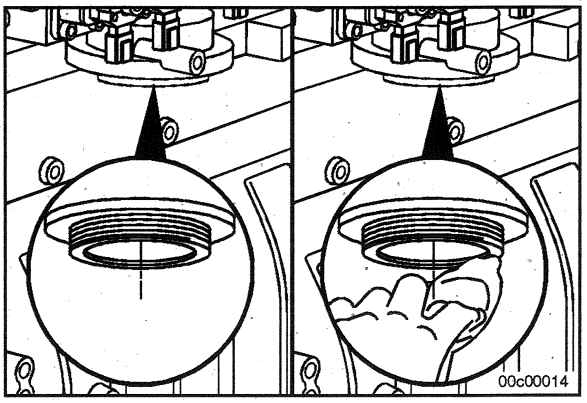
With Pressurized Fuel Filtering

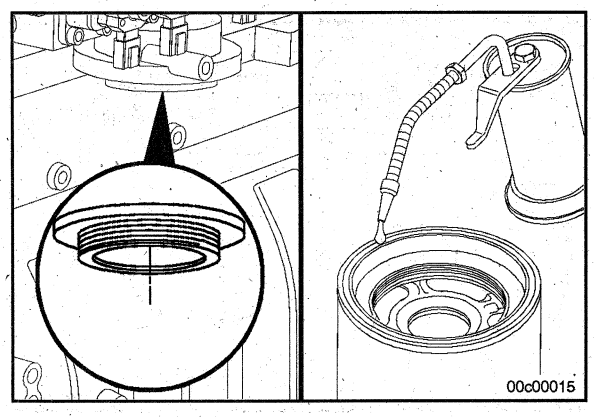
Use a clean, lint-free cloth to clean the filter head gasket surface.



With Vacuum Fuel Filtering

Use a clean, lint-free cloth to clean the filter head gasket surface.





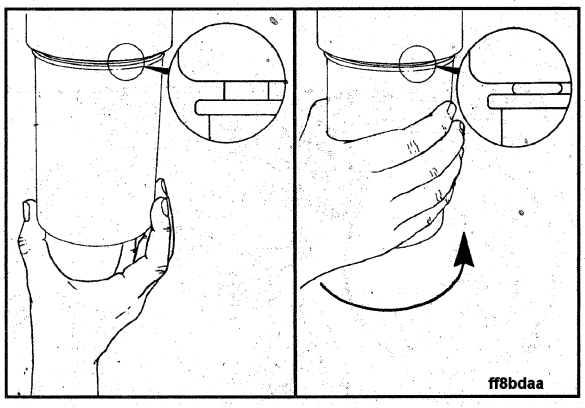
Install

With Pressurized Fuel Filtering

Use the correct filter(s) for your engine. It **must** remove a minimum of 95 percent of free and emulsified water. It **must** also have a minimum of 98.7 percent 15-micron particle-removal efficiency.

Cummins, Part Number 3101546
Fleetguard® Nelson®, Part Number FF2200

Apply a thin coating of clean engine oil to the filter gasket surface.

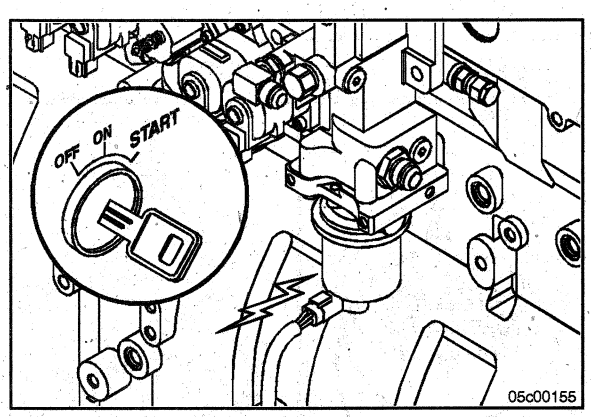


⚠CAUTION⚠
Mechanical overtightening of the filter can distort the threads or damage the filter element seal.

NOTE: Engines equipped with priming pumps do **not** require the fuel filter to be filled prior to installation if the following filling procedure is followed.

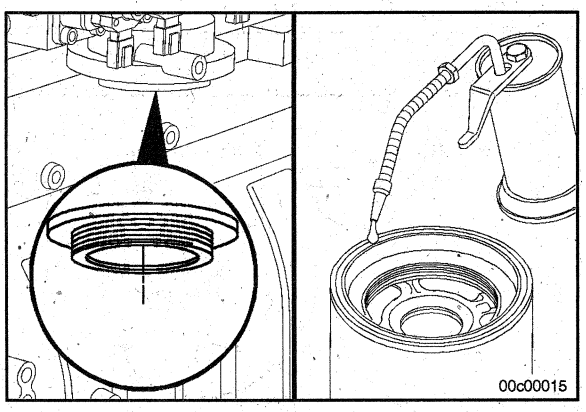
Install the filter onto the filter head. Turn the filter until the gasket contacts the filter head surface.

Tighten the filter an additional 3/4 of a turn after the gasket contacts the filter head surface, or as specified by the filter manufacturer.



Fill the fuel filter by turning the ignition switch to the ON position. The priming pump will run for two minutes which will adequately fill the fuel filter. The engine can then be started.

NOTE: The engine will, perhaps, run rough for several minutes until the air is out of the system.



With Priming Pump

Use the correct filter(s) for your engine. It **must** remove a minimum of 95 percent of free and emulsified water. It **must** also have a minimum of 98.7 percent at 25-micron particle-removal efficiency.

Cummins, Part Number 4010651
Fleetguard® Nelson®, Part Number FS1040

Apply a thin coating of clean engine oil to the filter gasket surface and the center seal.

⚠CAUTION⚠

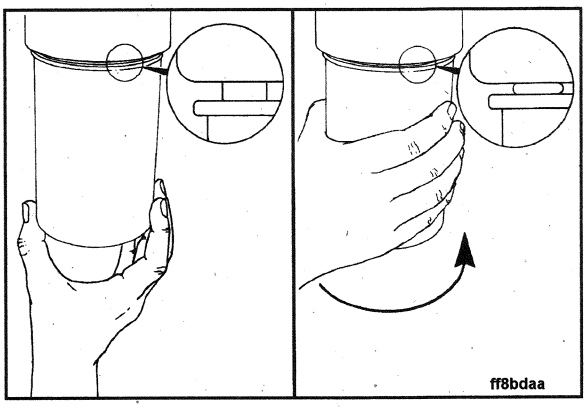
Mechanical overtightening of the filter can distort the threads or damage the filter element seal.

NOTE: Engines equipped with priming pumps do **not** require the fuel filter to be filled prior to installation if the following filling procedure is followed.

Install the filter onto the filter head. Turn the filter until the gasket contacts the filter head surface.

Tighten the filter an additional 3/4 of a turn after the gasket contacts the filter head surface, or as specified by the filter manufacturer.

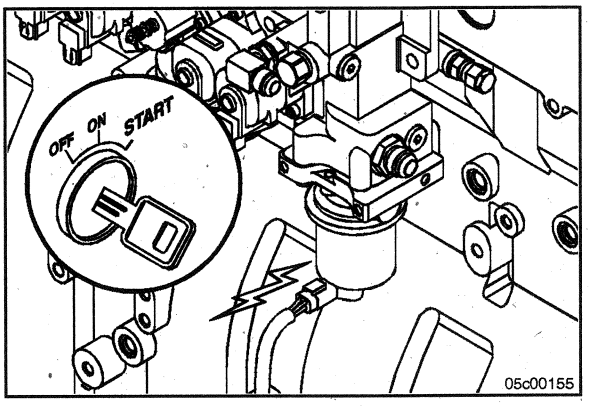
NOTE: If the filter is equipped with a water-in-fuel sensor, rotate the sensor to the desired location and connect the wiring harness.



Fill the fuel filter by turning the ignition switch to the ON position. The priming pump will run for two minutes which will adequately fill the filter. The engine can then be started.

Some engines utilize a manual, remote mount priming pump. Flip the priming pump mounted toggle switch to the ON position. Run the pump for two minutes and shut it off. The engine can then be started.

NOTE: The engine will, perhaps, run rough for several minutes until the air is out of the system.

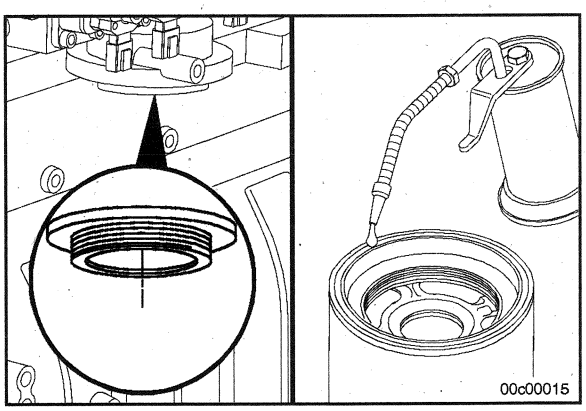


Without Priming Pump

Use the correct filter(s) for your engine. It **must** remove a minimum of 95 percent of free and emulsified water. It **must** also have a minimum of 98.7 percent at 25-micron particle-removal efficiency.

Cummins, Part Number 4010651
Fleetguard® Nelson®, Part Number FS1040

Apply a thin coating of clean engine oil to the filter gasket surface and the center seal.



⚠CAUTION⚠

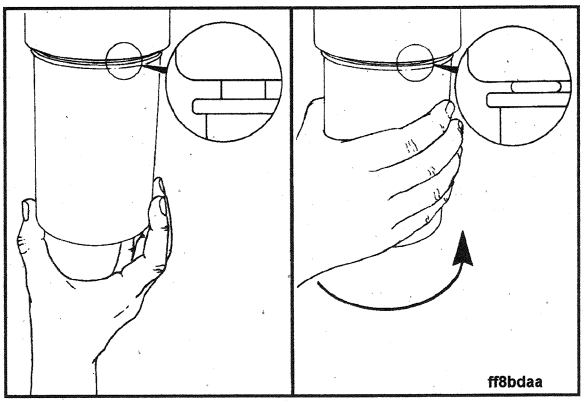
Mechanical overtightening of the filter can distort the threads or damage the filter element seal.

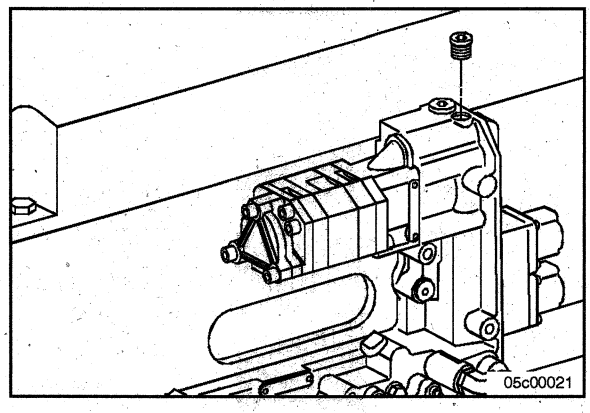
NOTE: Fill the filter with clean fuel prior to installation.

Install the filter onto the filter head. Turn the filter until the gasket contacts the filter head surface.

Tighten the filter an additional 3/4 of a turn after the gasket contacts the filter head surface, or as specified by the filter manufacturer.

NOTE: If the filter is equipped with a water-in-fuel sensor, rotate the sensor on the filter to the desired location and connect the wiring harness.





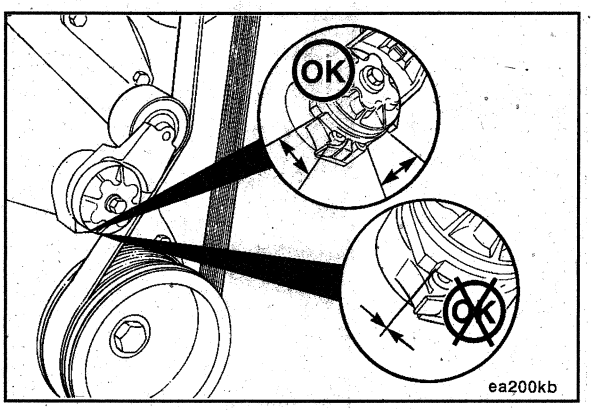
Remove the external hex plug on the top of the integrated fuel system module. Crank the engine until a solid stream of fuel comes out of the port.

Install the hex plug.

Crank the engine for 20 seconds. If the engine does **not** start within 20 seconds, wait two minutes. It will probably be necessary to remove the filter, fill the filter with clean fuel, and install the filter.

Repeat these steps until the engine starts.

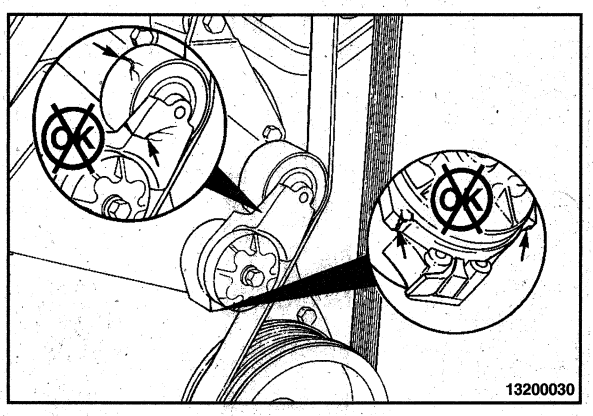
NOTE: The engine will, perhaps, run rough for several minutes until the air is out of the system.



Cooling Fan Belt Tensioner

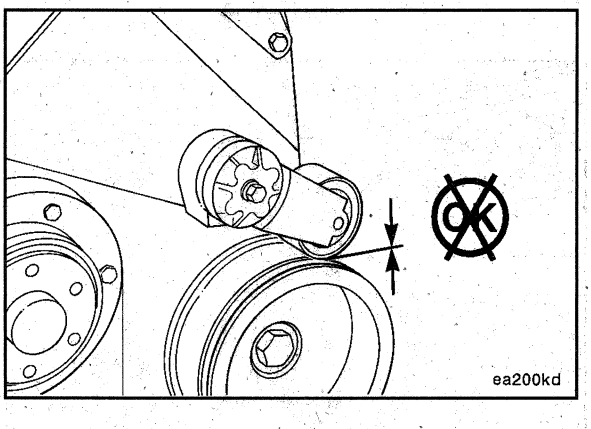
Inspect for Reuse

With the engine turned off, verify 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 sure the correct belt part number is being used if either condition exists.



Check the tensioner pulley and body for cracks. If any cracks are noticed, the tensioner **must** be replaced.

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

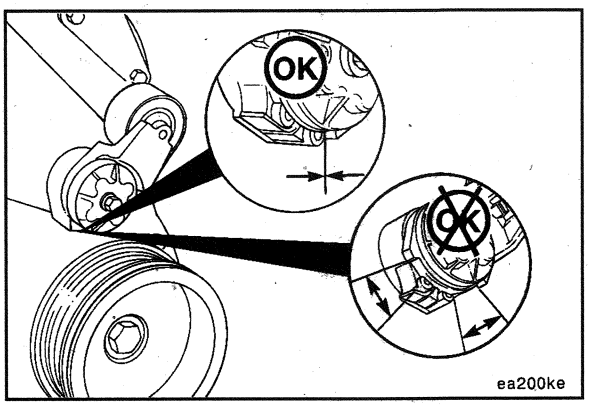


Remove the alternator belt.

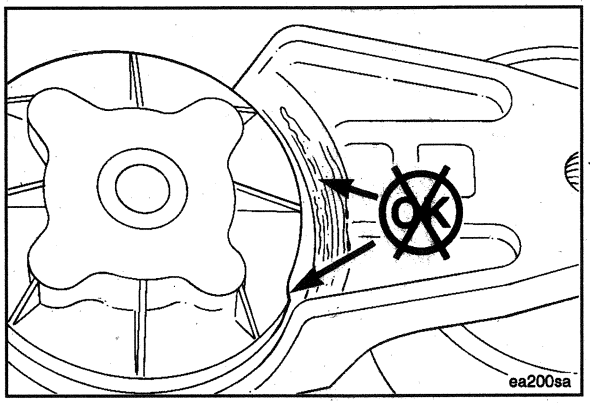
If the tensioner pulley touches the accessory drive pulley after the tensioner has been fully relaxed, the bottom tensioner arm stop boss has broken and the tensioner **must** be replaced.

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** contacting, the tensioner **must** be replaced.

Install the alternator belt.



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



Air Leaks, Air Intake and Exhaust Systems

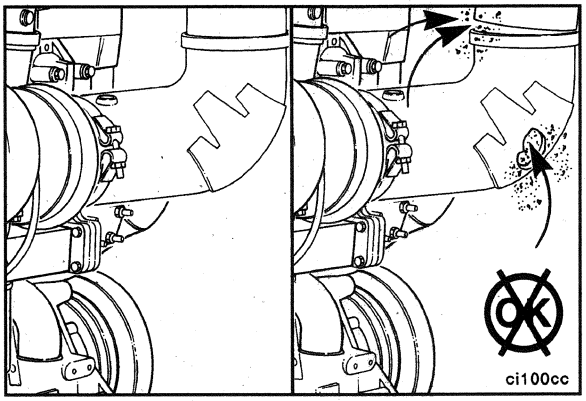
Maintenance Check

⚠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.

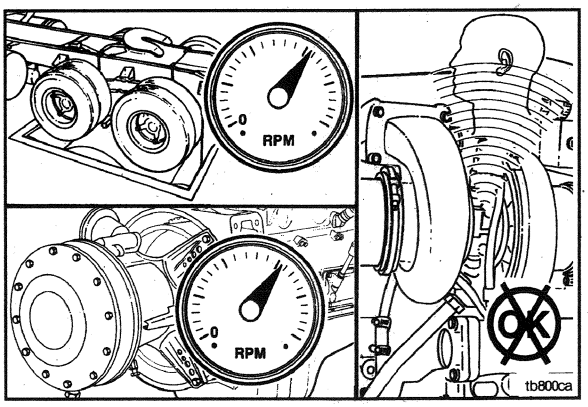
Inspect for loose clamps or damage between the intake air piping, air cleaner, turbocharger, charge-air cooler, and intake manifold.

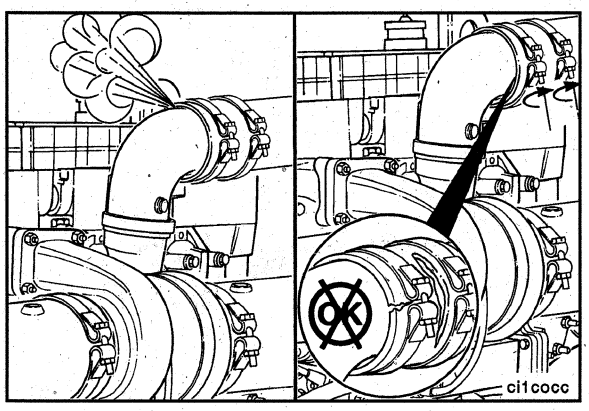
Replace damaged pipes, and tighten loose clamps.



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

Operate the engine at full throttle and maximum load, and check for air leaks. Listen for whistling noise caused by high-pressure air leaks.



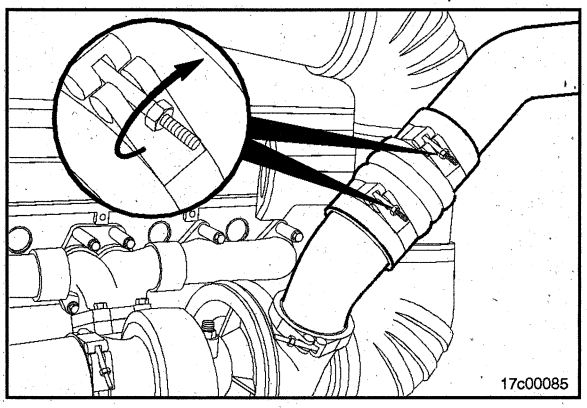


The noise can be caused by an air leak from the following:

Turbocharger-to-charge-air cooler elbow connection.

- Inspect the connection and o-ring seal for damage.
- Tighten the v-band clamps.

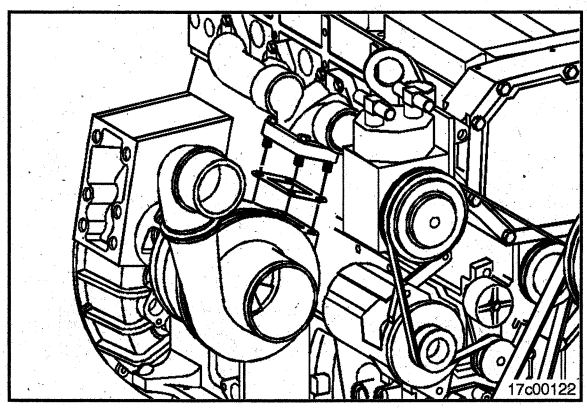
Torque Value: 9 N•m [80 in-lb]



Any charge-air cooler piping or connecting hose.

- Inspect the hose and piping for damage.
- Tighten the hose clamps.

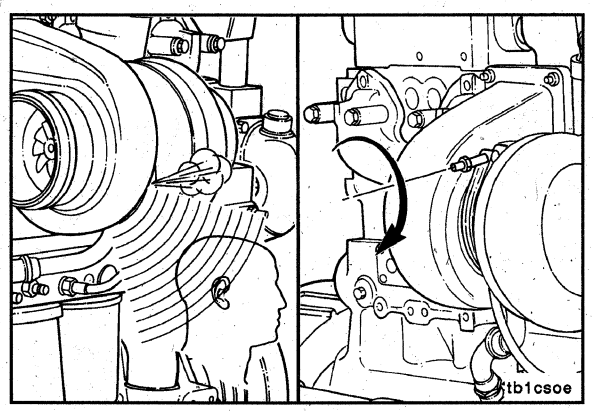
Torque Value: 9 N•m [80 in-lb]



Turbocharger-to-exhaust-manifold mounting gasket.

- Replace the gasket.

Refer to Procedure 010-033 in the Troubleshooting and Repair Manual, Signature, ISX and QSX15 Engines, Bulletin 3666239, for turbocharger removal and installation.



Turbine housing sealing surface air leak.

- Tighten the v-band clamp.

Torque Value: 14 N•m [120 in-lb]

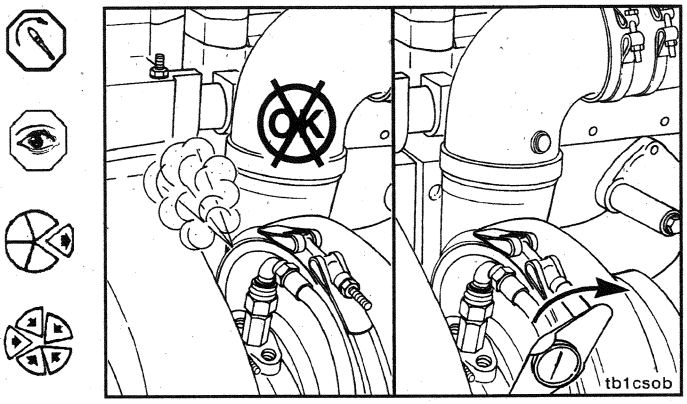
- Check for an air leak.
- If an air leak is still present, remove and replace the turbocharger.

Compressor housing sealing surface air leak.

- Tighten the v-band.

Torque Value: 9 N•m [80 in-lb]

- Check for an air leak.
- If an air leak is still present, remove and replace the turbocharger.



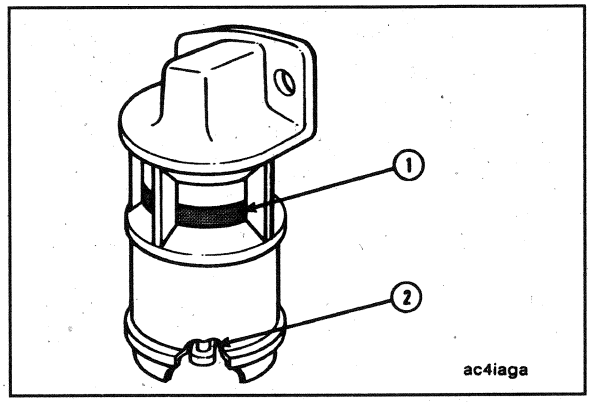
Air Cleaner Restriction

Maintenance Check

Mechanical Indicator

NOTE: Do **not** remove the felt washer from the indicator. The felt washer absorbs moisture.

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).



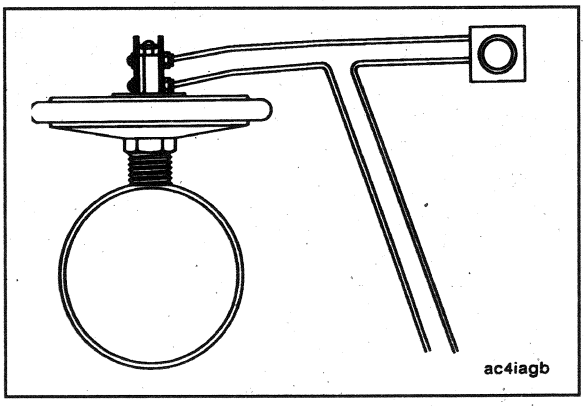
Restriction or vacuum indicators need to be installed as close as possible to the turbocharger air inlet in order to obtain a true indication of restrictions.

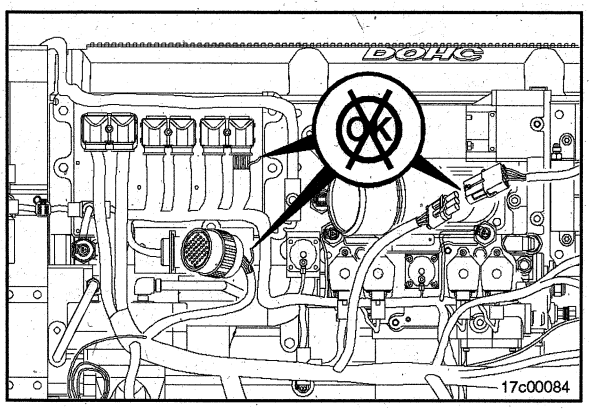
⚠CAUTION⚠

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.

Vacuum Indicator

Vacuum switches actuate a warning light on the instrument panel when the air restriction becomes excessive.





Engine Wiring Harness

Maintenance Check

⚠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.

Check all wire connections and the wiring harness for damage. Faulty wiring can cause improper engine operation and poor performance.

Section 6 - Maintenance Procedures at 6000 Hours or 2 Years

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Maintenance Procedures - Overview

General Information

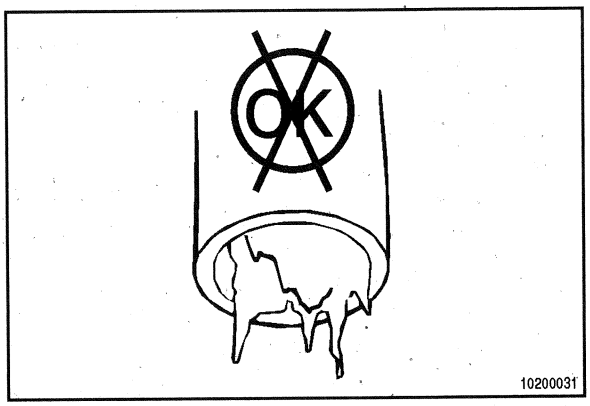
All maintenance checks and inspections listed in previous maintenance intervals **must** also be performed at this time, in addition to those listed under this maintenance interval.

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.

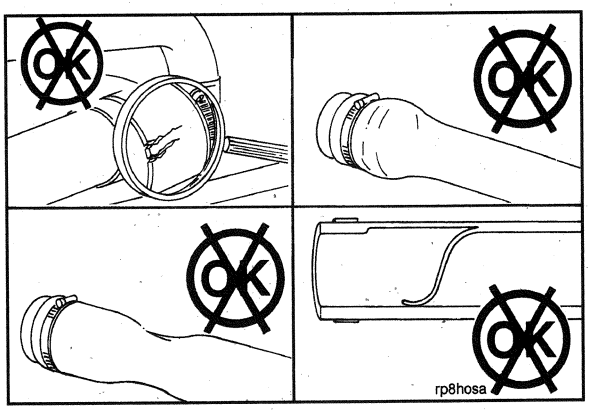


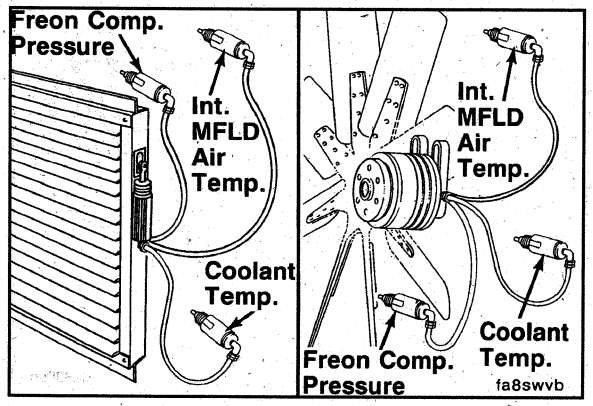
Radiator Hoses

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.





Cold Weather Starting Aids

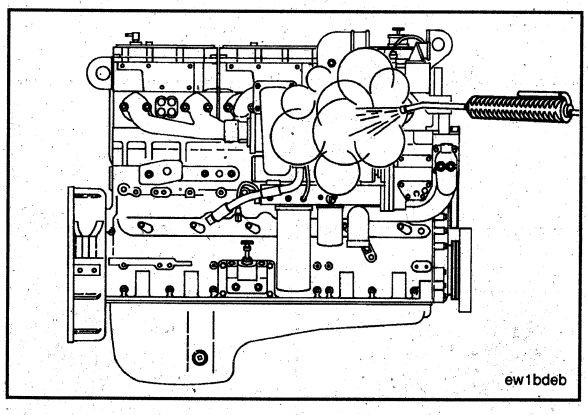
Maintenance Check

Check the shutterstats and the thermatic fan.

NOTE: Parallel control systems are required for automatic radiator **shutters** and **thermatic fans**. Shutters **must** open and fans turn on whenever the intake manifold air temperature, the engine coolant outlet temperature, or the freon compressor pressure rises above their sensor set points. Any one of the following conditions **must** activate the shutters and/or fan:

- High coolant temperature
- High intake manifold temperature
- High freon compressor pressure.

Shutterstat and thermatic fan controls **must** operate in the same temperature range as the thermostat with which they are used. Refer to the Thermal Control Settings Graph in this section.



Engine Steam Cleaning

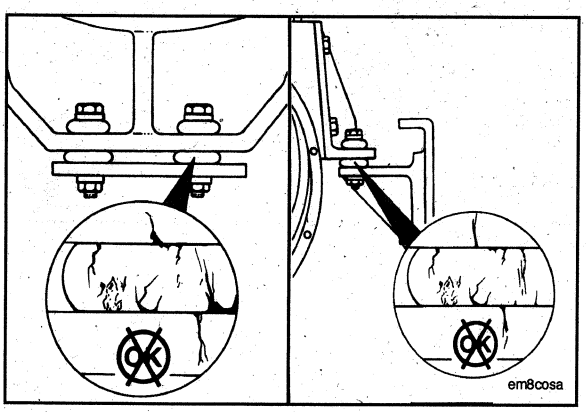
Clean

⚠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.



Engine Mounts

Inspect

Check the torque on the engine-mounting nuts and bolts. Tighten any that are loose. Refer to the OEM service manual or manufacturer for torque specifications.

Inspect the rubber for deterioration and age hardening. Replace any broken or lost bolts, capscrews, or damaged rubber.

Vibration Damper, Viscous

Inspect

⚠CAUTION⚠

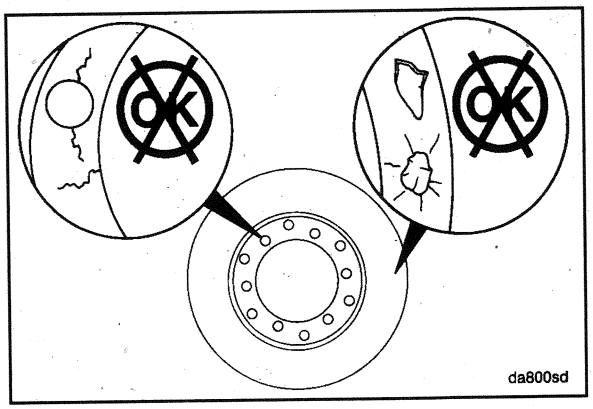
The silicone fluid in the vibration damper will become solid after extended service and will make the damper inoperative. An inoperative vibration damper can cause major engine or drivetrain failures.

Check the vibration damper for evidence of fluid loss, dents, and wobble. Inspect the vibration damper thickness for any deformation or raising of the damper cover plate.

If any of these conditions are identified, contact your local Cummins Authorized Repair Location to replace the vibration damper.

Viscous dampers have a limited life. The maximum damper life specifications are located in Maintenance Specifications (Section V).

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



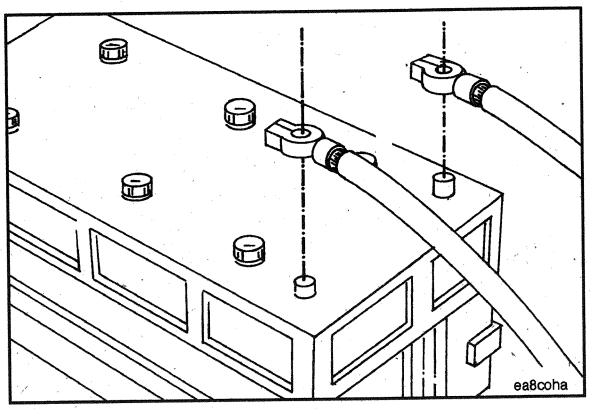
Overhead Set

General Information

⚠WARNING⚠

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

Disconnect the battery.

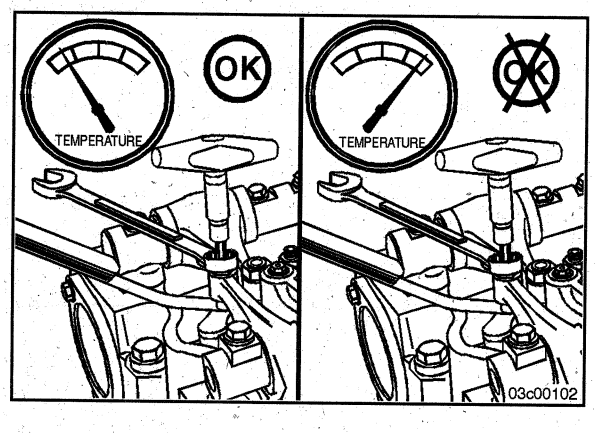


NOTE: Read the entire procedure for overhead adjustment before attempting to perform this operation.

Valves, injectors, and engine brakes (if equipped) **must** be correctly adjusted for the engine to operate efficiently. Valve, injector, and engine brake adjustment **must** be performed using the values listed in this section.

Adjust the valves, injectors, and engine brakes every 800,000 km [500,000 mi], 10,000 hours, or 5 years (whichever occurs first). Adjustment must be made after any major repair. After a major repair, the adjustment interval again becomes every 800,000 km [500,000 mi], 10,000 hours, or 5 years (whichever occurs first).

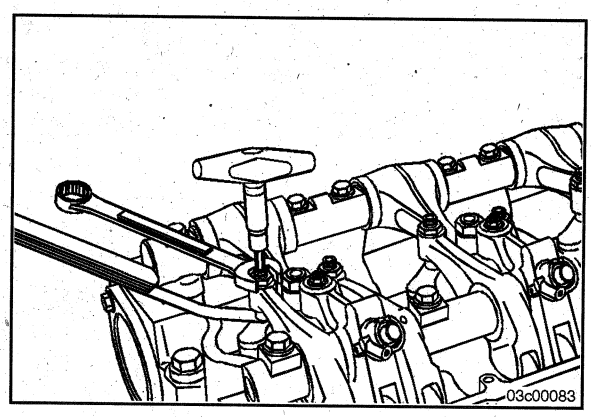
Signature, ISX, and QSX15 Valve, Brake, and Injector Adjustment Values		
Signature, ISX, and QSX15 Injector Adjustment is 8 N•m [70 in-lb]		
	mm	in
Intake Valve	0.35	0.014
Exhaust Valve	0.68	0.027
Engine Brake	7.00	0.276



Adjust

NOTE: Make sure the engine base timing is properly set before attempting to adjust/set the overhead. Refer to Procedure 001-088.

All overhead valve, injector, and brake adjustments **must** be made when the engine is cold (any stabilized coolant temperature at 60°C [140°F] or below).

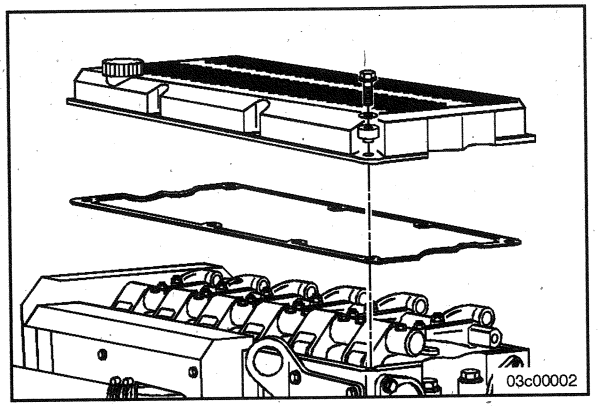


NOTE: After an engine rebuild or any major repair where the injector and valve setting **must** be disturbed, set all the valves and injectors and brakes.

⚠CAUTION⚠

Do not use solvent to clean the rocker cover gasket. Solvent can damage the gasket material and cause it to swell.

Remove the rocker lever cover and gasket. Refer to Procedure 003-011.



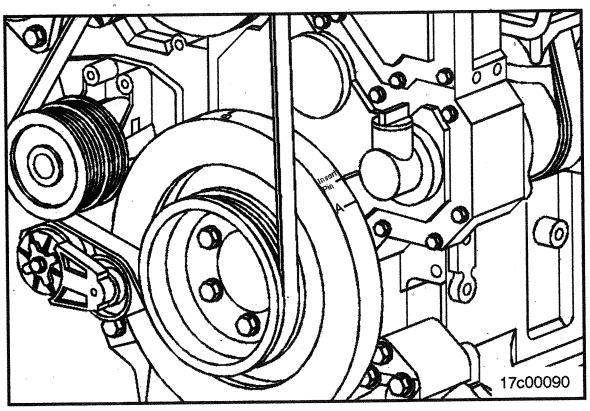
NOTE: Early engine vibration dampers are marked with BRAKE SET 1-6, BRAKE SET 2-5, or BRAKE SET 3-4. The engine brakes **must** be set at the appropriate mark on these engines. Newer engine vibration dampers are marked with **only** A, B, or C, and are adjusted with the valves and injector on the same cylinder.

Locate the valve set marks on the outside of the vibration damper.

The set marks are A, B, and C:

Set to mark A to adjust cylinder 1 or 6.
Set to mark B to adjust cylinder 2 or 5.
Set to mark C to adjust cylinder 3 or 4.

NOTE: Two complete revolutions are required to set all valves, engine brakes, and injectors.

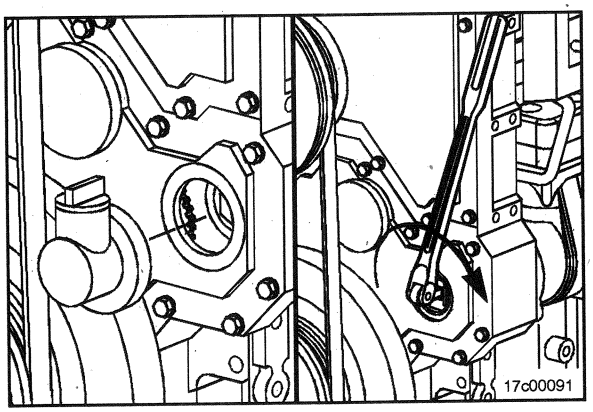


With Air Compressor:

Remove the oil fill connector from the lower gear case cover.

Insert a 3/4-inch drive ratchet and extension into the air compressor drive.

Rotate the air compressor drive **clockwise** as viewed from the front of the engine.



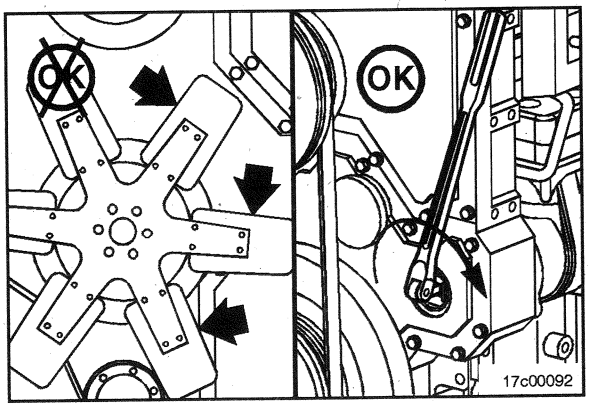
⚠WARNING⚠

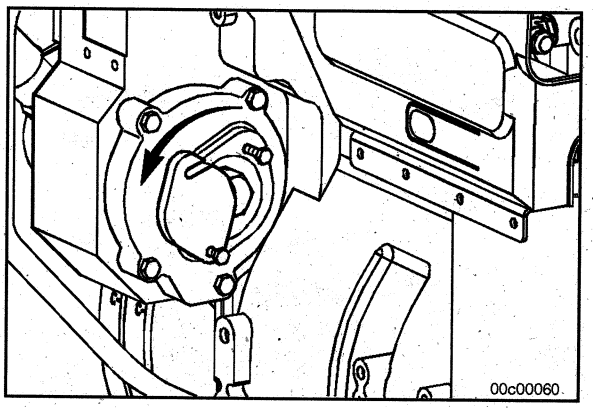
Do not pull or pry on the fan to manually rotate the engine. To do so can damage the fan blades. Damaged fan blades can cause premature fan failures which can result in serious personal injury or property damage.

The crankshaft rotation is **clockwise** as viewed from the front of the engine.

The cylinders are numbered from the front of the engine (1-2-3-4-5-6).

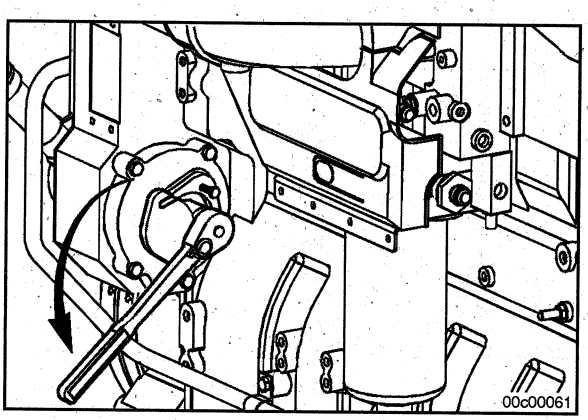
The engine firing order is 1-5-3-6-2-4.





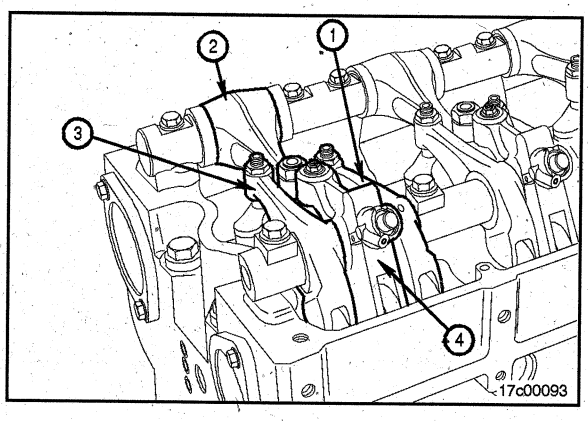
Without Air Compressor:

Loosen the capscrews and rotate the cover or remove oil fill tube, if equipped.



Using a 1 1/2-inch socket, push the barring gear into the gear mesh and rotate the barring adapter **counterclockwise** to bar the engine.

NOTE: Rock the barring device back and forth until it disengages.



Each cylinder has four rocker levers:

- The exhaust valve rocker lever (1)
- The injector rocker lever (2)
- The intake valve rocker lever (3)
- The engine brake rocker lever (4).

NOTE: The intake valve rocker lever is **always** the long lever on valve rocker lever shaft.

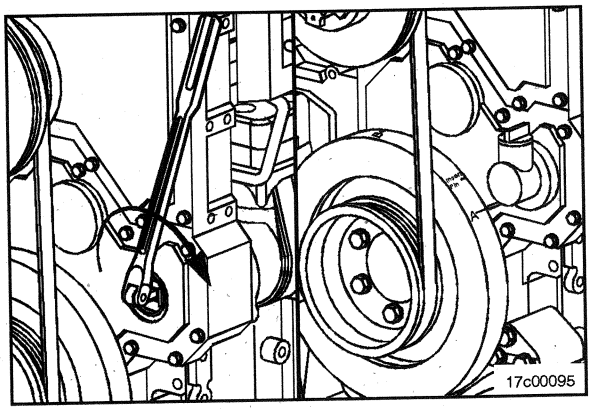
NOTE: Early engine vibration dampers are marked with BRAKE SET 1-6, BRAKE SET 2-5, or BRAKE SET 3-4. The engine brakes **must** be set at the appropriate mark on these engines. Newer engine vibration dampers are marked with **only** A, B, or C, and are adjusted with the valves and injector on the same cylinder.

The valves, brakes, and the injectors on the same cylinder are adjusted at the same index mark on the vibration damper.

Signature, ISX and QSX15				
Injector and Valve Adjustment Sequence				
		Set Cylinder		
Bar Engine in Direction of Rotation	Pulley Position	Injector	Valve	Brake
Start	A	1	1	1
Advance to	B	5	5	5
Advance to	C	3	3	3
Advance to	A	6	6	6
Advance to	B	2	2	2
Advance to	C	4	4	4
Firing Order: 1-5-3-6-2-4				

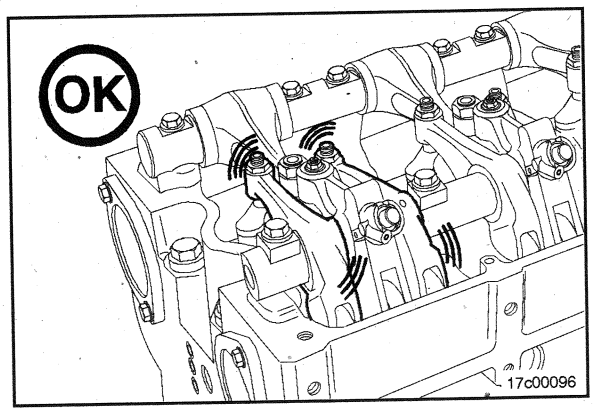
Use the compressor drive or barring device to bar the engine over in the direction of engine rotation, **clockwise** as viewed from the front of the engine. Align the A mark on the vibration damper with the pointer on the gear cover.

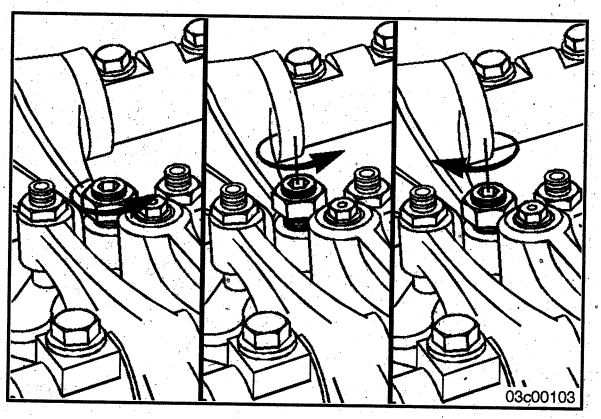
NOTE: For illustrative purposes, position A is shown as the first step. It is **not** necessary to start with position A, as long as the proper sequence is followed.



Check the valve rocker levers on the given cylinder to see if both intake and exhaust valves are closed.

NOTE: Both sets of valves are closed when the rocker levers and the brake lever are loose. If both sets of valves are **not** closed, rotate the compressor drive gear one complete revolution, and align the A mark on the front damper with the pointer again.





Loosen the injector adjusting screw locknut on the cylinder.

Use a dial-type torque wrench with a range of 0 to 150 in-lb to tighten the injector rocker lever adjusting screw. If the screw chatters during setting, repair the screw and lever as required.

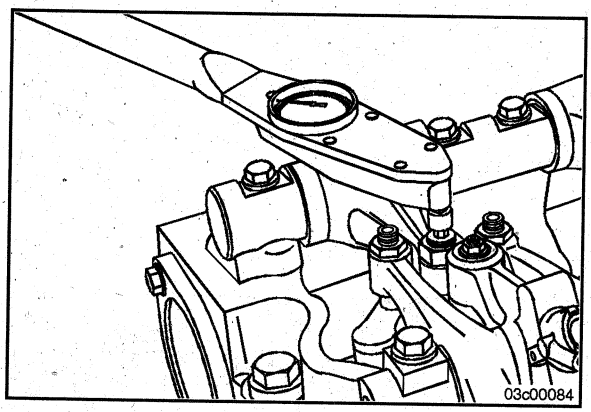
NOTE: Do **not** use a click-type torque wrench.

Back out the adjusting screw one or two turns.

Hold the torque wrench in a position that allows you to look in a direct line at the dial. This is to make sure the dial will be read accurately.

Make sure the parts are aligned, and squeeze the oil out of the valve and injector train by tightening the adjusting screw.

NOTE: Use this initial adjustment to preload the valve train and injector.



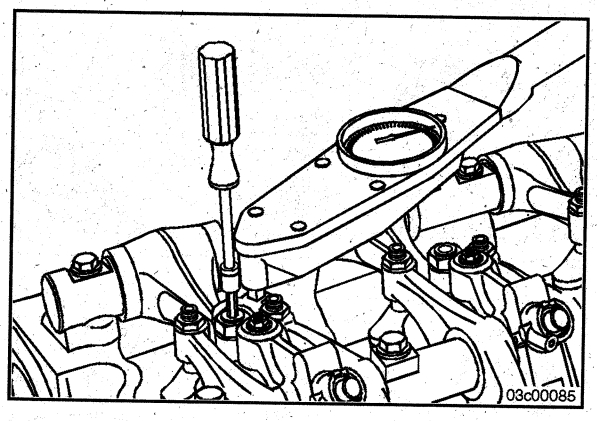
Tighten the injector lever adjusting screw.

Torque Value: 8 N•m [71 in-lb]

Back the adjusting lever screw out 1 or 2 turns.

Retighten the injector lever adjusting screw.

Torque Value: 8 N•m [71 in-lb]

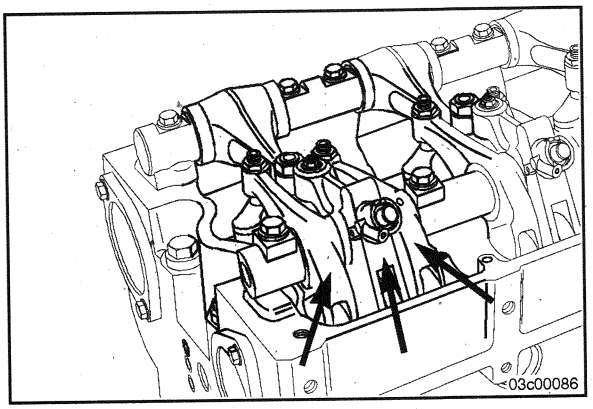


Hold the injector lever adjusting screw, and tighten the adjusting screw locknut.

Torque Value: 75 N•m [55 ft-lb]

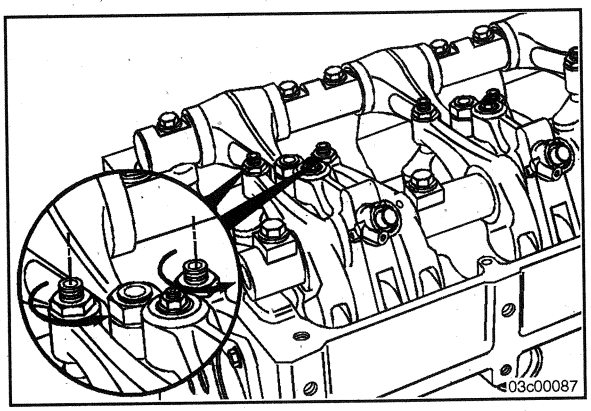
After setting the injector on a cylinder, set the valves, and engine brakes on the same cylinder.

NOTE: Early engine vibration dampers are marked with BRAKE SET 1-6, BRAKE SET 2-5, or BRAKE SET 3-4. The engine brakes **must** be set at the appropriate mark on these engines. Newer engine vibration dampers are marked with **only** A, B, or C, and are adjusted with the valve and injector on the same cylinder.



With the set mark aligned with the pointer on the gear cover and both sets of valves closed on the cylinder, loosen the locknuts on the intake and exhaust valve adjusting screws.

Back out the adjusting screws one or two turns.

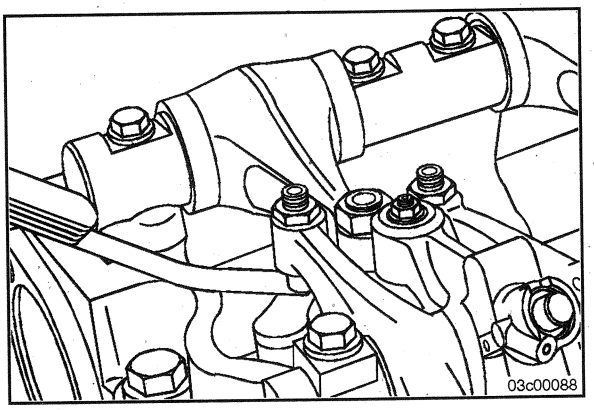


Select a feeler gauge for the correct valve lash specification.

Valve Lash Specification			
	mm		in
Intake	0.36	NOM	0.014
Exhaust	0.69	NOM	0.027

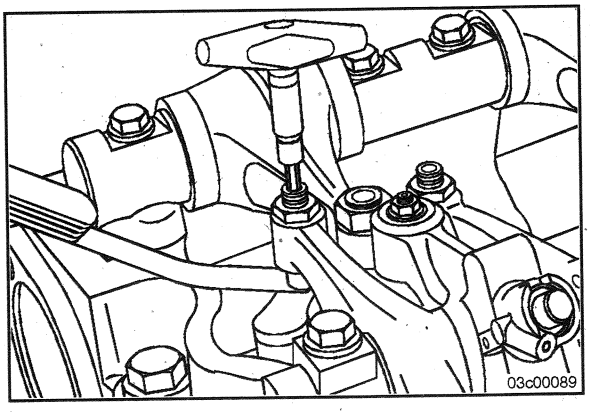
Insert the feeler gauge between the top of the crosshead and the rocker lever nose pad.

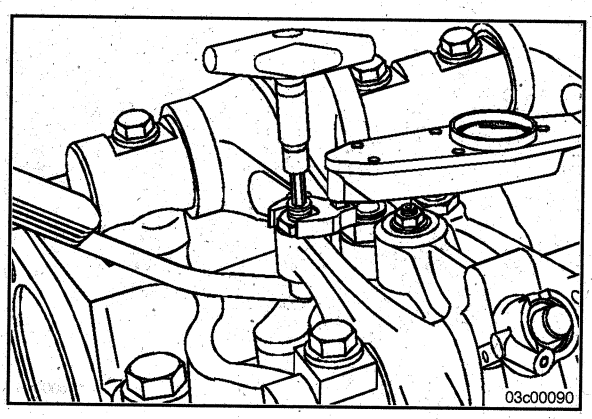
Make sure the feeler gauge is completely under the pivoting rocker lever nose pad.



Tighten the adjusting screw.

Torque Value: 0.6 N•m [5 in-lb]

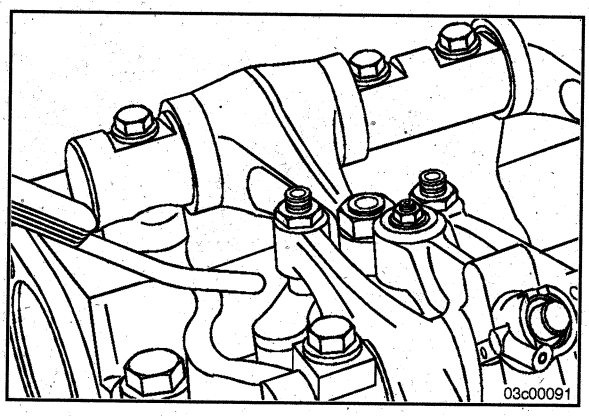




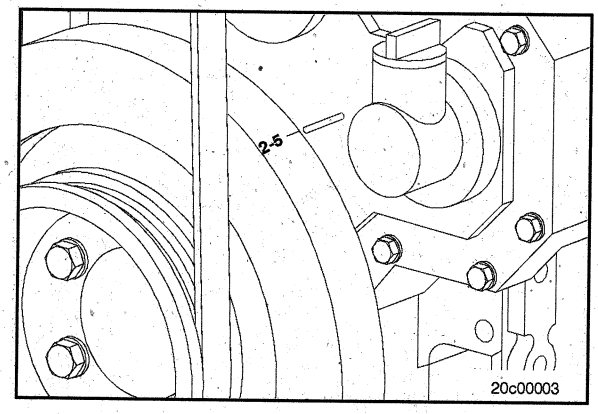
NOTE: Use a torque wrench and crows foot adapter to tighten the locknut.

Hold the adjusting screw in this position. The adjusting screw **must not** turn when the locknut is tightened.

Torque Value: 45 N•m [33 ft-lb]



After tightening the locknut to the correct torque value, remove the feeler gauge.



⚠CAUTION⚠

To get maximum brake operating efficiency and to prevent engine damage, the brake adjustment instructions must be followed.

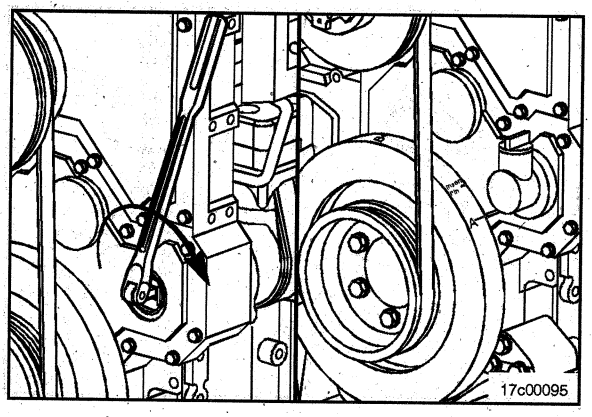
For older engines, locate the engine brake set marks on the outside of the vibration damper.

The set marks are BRAKE SET 1-6, and BRAKE SET 2-5, and BRAKE SET 3-4.

BRAKE SET 1-6: Cylinder 1 or 6 adjust

BRAKE SET 2-5: Cylinder 2 or 5 adjust

BRAKE SET 3-4: Cylinder 3 or 4 adjust

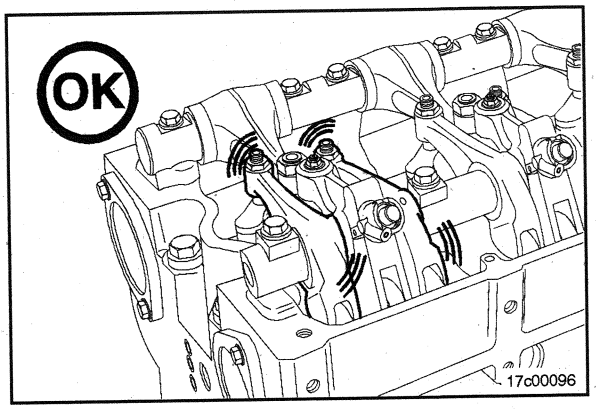


Use the compressor drive or barring device to bar the engine over in the direction of rotation, **clockwise** as viewed from the front of the engine. Align the A mark on the vibration damper with the pointer on the gear cover.

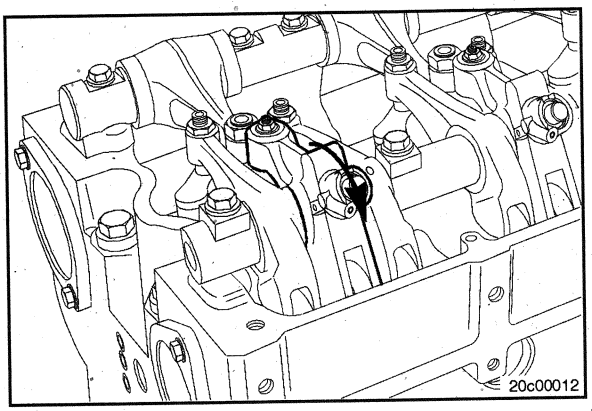
NOTE: For illustrative purposes, position A is shown as the first step. It is **not** necessary to start with position A, as long as the proper sequence is followed.

Check the valve rocker levers on the given cylinder to see if both intake and exhaust valves are closed.

NOTE: Both sets of valves are closed when the rocker levers and the brake lever are loose. If both sets of valves are **not** closed, rotate the compressor drive gear one complete revolution, and align the A mark on the front damper with the pointer again.



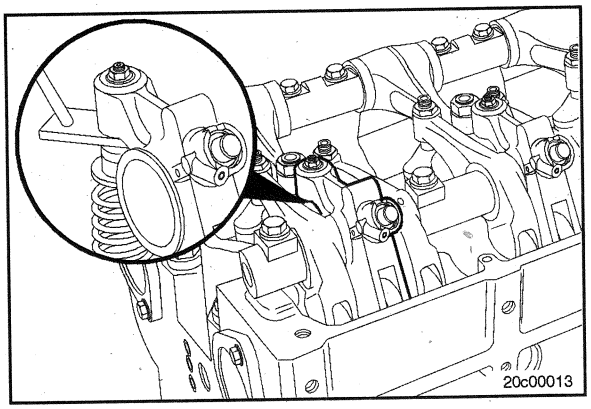
Press the engine brake lever down to verify that the camshaft follower is in contact with the camshaft.



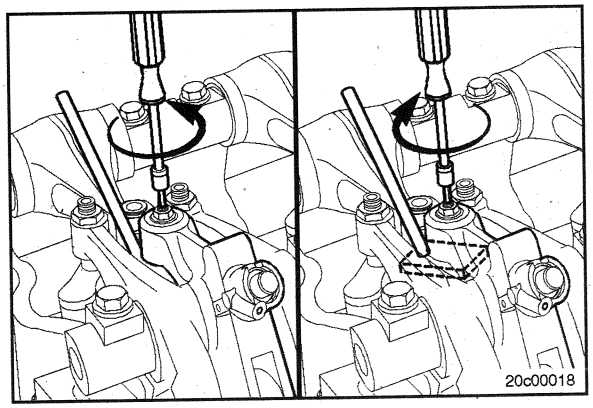
Loosen the locknut on the brake lever adjusting screw, and back out the adjusting screw one turn.

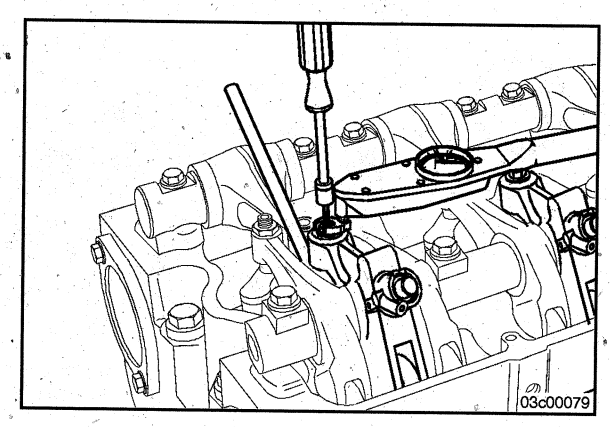
Insert the feeler gauge, Part Number 3163530, between the bottom of the engine brake piston and top of exhaust valve pin on exhaust valve crosshead.

Brake Lever Lash Specification		
mm		in
7.00	NOM	0.276



Tighten adjusting screw until drag on feeler gauge is felt. Proper drag means that there is no motion of the brake lever camshaft follower against the cam lobe.

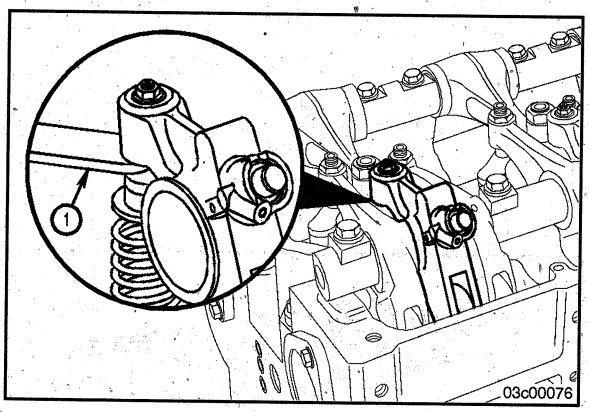




Hold the engine brake lever adjusting screw, and tighten the locknut.

Torque Value: 20 N•m [177 in-lb]

Remove the feeler gauge.



⚠CAUTION⚠

Engine damage can occur if running clearance is not within specifications.

Check the running clearance:

1. . Rotate the engine brake rocker lever to the detente (neutral) position.
2. . Check the clearance (1) between the engine brake lever actuator piston and the crosshead guide pin.

Engine Brake Rocker Lever Running Clearance		
mm		in
0.508	MIN	0.020
2.790	MAX	0.110

If the running clearance does **not** fall in the given specifications, loosen the rocker lever shaft and rotate the rocker lever shaft, slightly, in the direction required to bring the running clearance within specifications.

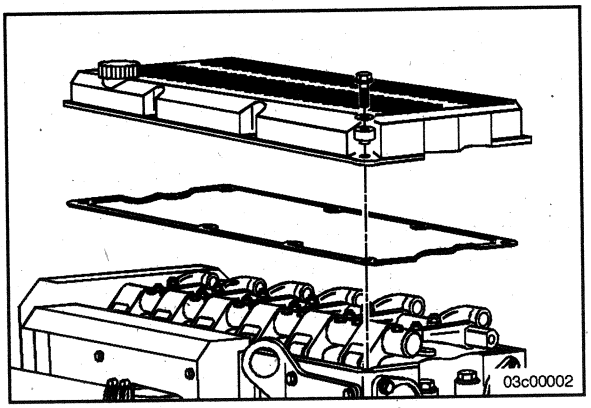
Recheck the brake running clearance.

NOTE: The rocker lever shafts **must** be adjusted so that all three engine brake levers fall within the given running clearance specification.

Repeat the process to adjust all injectors, engine brakes, and valves according to the chart shown earlier in this procedure.

Signature, ISX and QSX15				
Injector and Valve Adjustment Sequence				
		Set Cylinder		
Bar Engine in Direction of Rotation	Pulley Position	Injector	Valve	Brake
Start	A	1	1	1
Advance to	B	5	5	5
Advance to	C	3	3	3
Advance to	A	6	6	6
Advance to	B	2	2	2
Advance to	C	4	4	4
Firing Order: 1-5-3-6-2-4				

Install the rocker lever cover and gasket. Refer to Procedure 003-011.



Notes

Section 7 - Maintenance Procedures at 10,000 Hours or 5 Years

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General Information 7-1
Maintenance Check 7-2
Fan Hub, Belt Driven 7-1
Maintenance Check 7-1
Maintenance Procedures - Overview 7-1
General Information 7-1

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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.

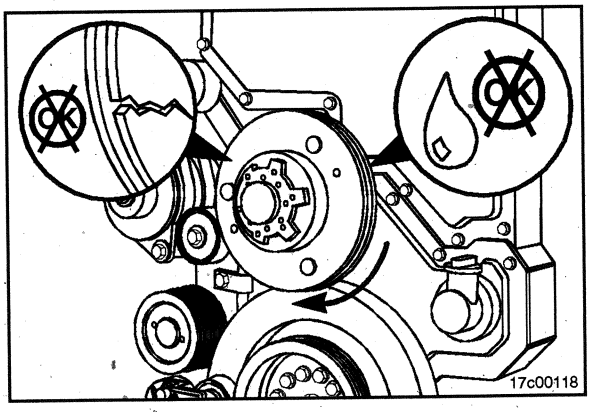
Fan Hub, Belt Driven

Maintenance Check

Inspect the fan hub for the following:

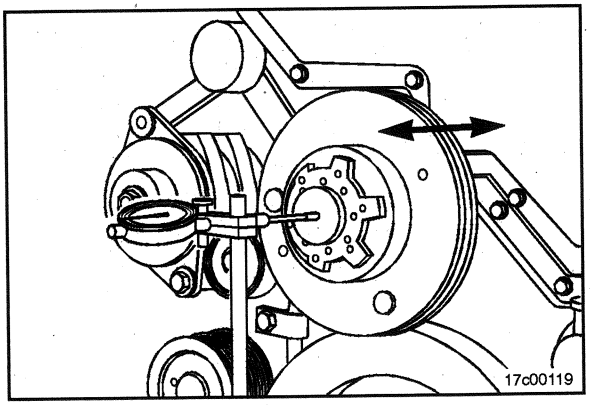
- Freedom of rotation
- Cracks
- Grease seal leakage.

Repair or replace the fan hub if the fan hub does **not** rotate freely or if there is evidence of cracks or grease seal leakage.



Measure the fan hub end clearance. Fan hubs with "step-bore" shafts and **not** bearing spacers **must** be 0.08 to 0.25 mm [0.003 to 0.010 in] end clearance.

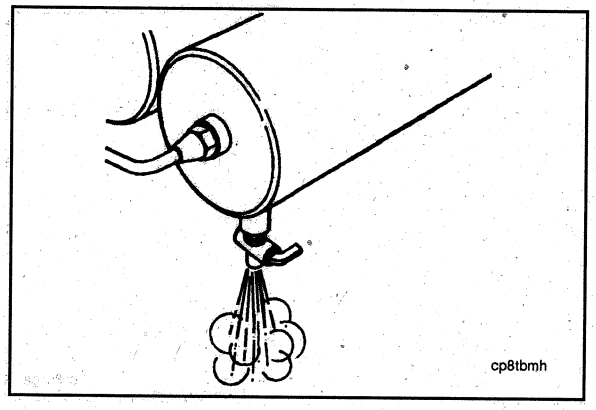
Fan hubs with "through-bore" shafts with inner and outer bearing spacers **must** be 0.08 to 0.41 mm [0.003 to 0.016 in] end clearance.



Air Compressor Discharge Lines

General Information

All air compressors have a small amount of lubricating oil carryover that lubricates the piston rings and moving parts. When this lubricating oil is exposed to normal air compressor operating temperatures over time, the lubricating oil will form varnish or carbon deposits. If the following maintenance check are not performed, the air compressor piston rings will wear and not seal correctly.



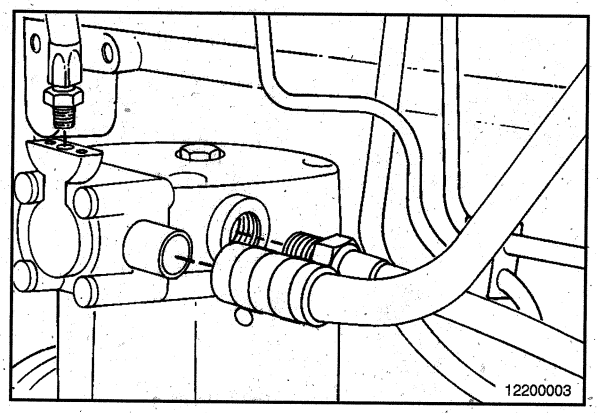
Maintenance Check

⚠ WARNING ⚠

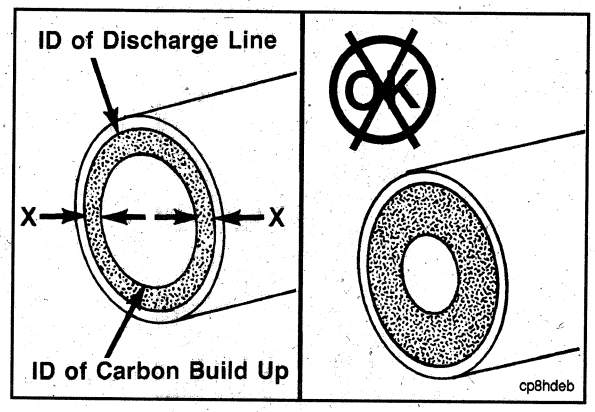
Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

Shut off the engine.

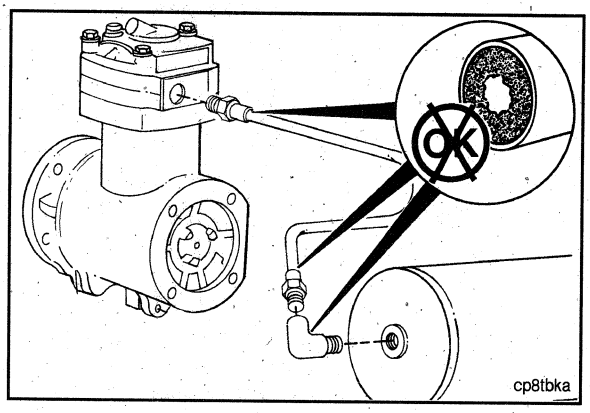
Open the drain valve on the wet tank to release the system air pressure.



Remove the air compressor discharge line from the air compressor. Location of the air compressor discharge line can be found in Flow Diagram, Compressed Air System in System Diagrams (Section D).

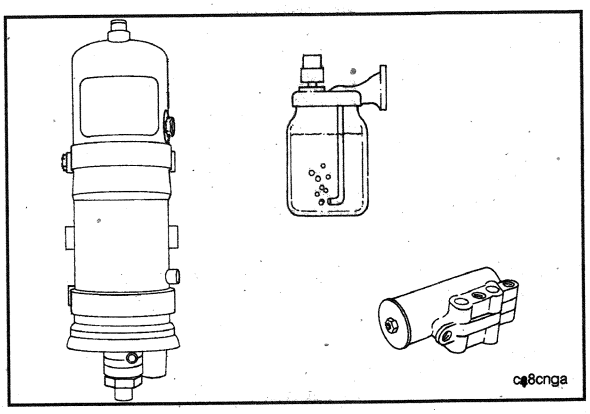


Measure the total carbon deposit thickness inside the air discharge line as shown. If the total carbon deposit (X + X) exceeds 2 mm [1/16 in], clean and inspect the cylinder head, the valve assembly, and the discharge line. Replace if necessary. Contact the Cummins Authorized Repair Location for procedures.



If the total carbon deposit exceeds specifications, continue checking the air discharge line connections up to the first tank until total carbon deposit is less than 2 mm [1/16 in]. Clean or replace any lines or connections that exceed this specification.

Inspect any air driers, splitter valves, pressure relief valves, and alcohol injectors for carbon deposits or malfunctioning parts. Inspect for air leaks. Maintain and repair the parts according to the manufacturer's specifications.



Notes

Section A - Adjustment, Repair, and Replacement

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Air Starting Motor

General Information

The air starting motor system (tanks, line sizes, and valves) is designed and installed by the original equipment manufacturers and the starting motor suppliers. Reference any questions about the air starting systems to the manufacturer.

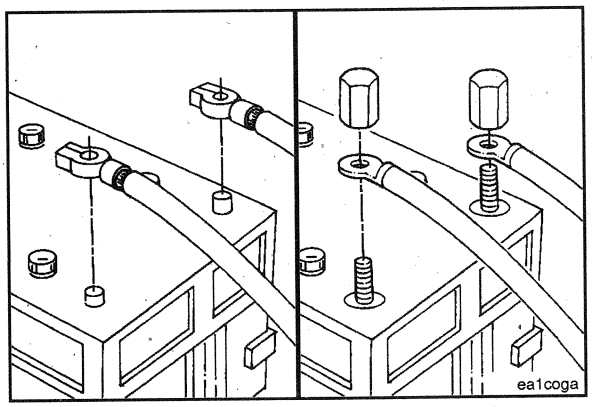
- Do **not** operate the air starting motor with air pressure lower than 480 kPa [70 psi].
- Maintain the air starting motor according to the manufacturer's recommendations.
- For maximum efficiency, the hoses, tubes, and lines **must not** leak.
- Refer to the OEM service manual and manufacturer manuals for specific information regarding the starting motors, valves, and systems.

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).

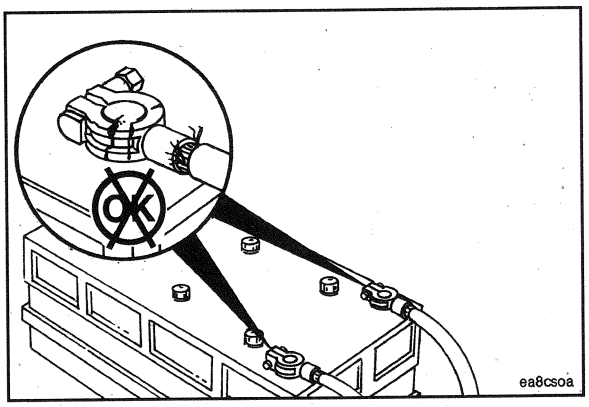


⚠ WARNING ⚠

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.

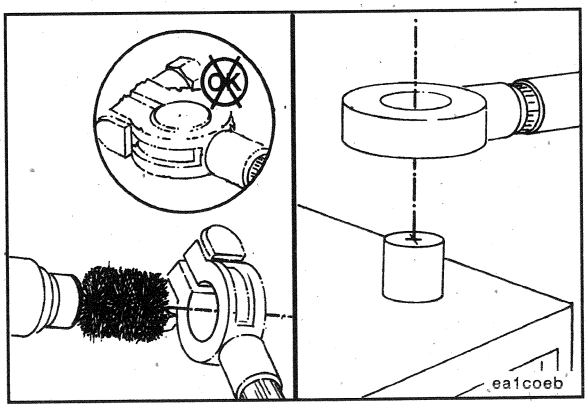
Remove and inspect the battery cables and connections for cracks or corrosion.

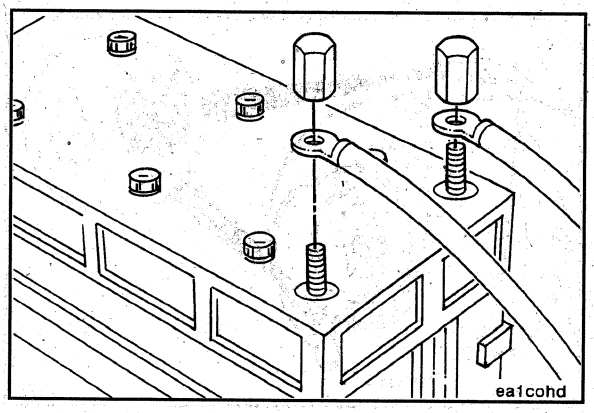
Replace broken terminals, connectors, or cables.



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.



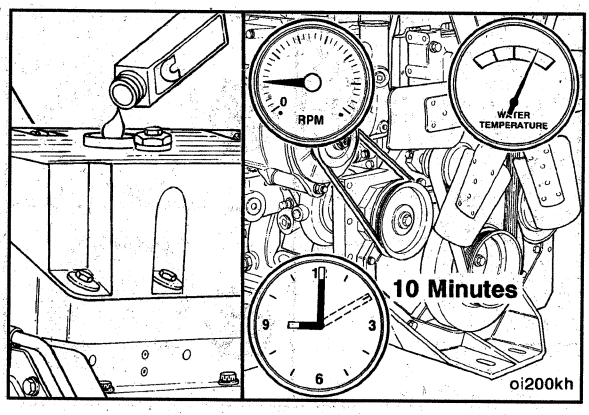


⚠WARNING⚠

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.



Turbocharger

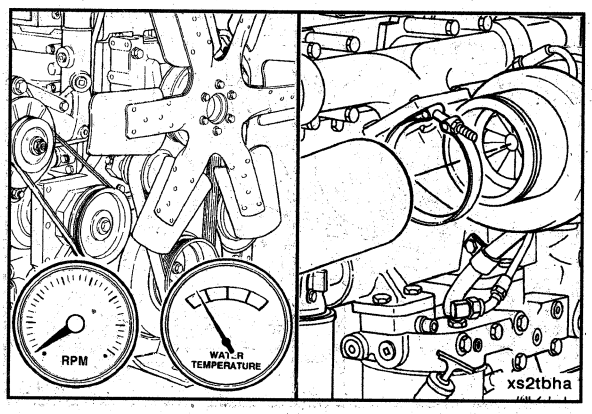
Initial Check

Without EGR

Add one unit of fluorescent tracer, Part Number 3376891, to each 38 liters [10 gal] of engine lubricating oil.

NOTE: If bearing housing coolant leak is suspected, use turbocharger waterjacket leak test kit, Part Number 3164682. Refer to the Turbocharger Coolant Leak Test Kit, Bulletin 3377919.

Operate the engine at low idle for 10 minutes.

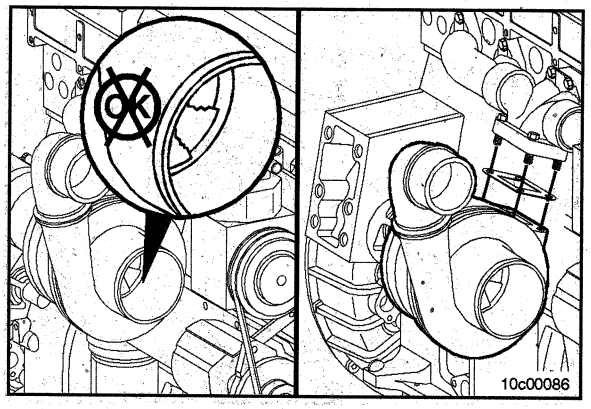


Shut off the engine.

Allow the turbocharger to cool.

Remove the intake and the exhaust pipe from the turbocharger.

Remove the intake piping and compressor discharge piping.



Inspect the turbocharger compressor impeller blades for damage.

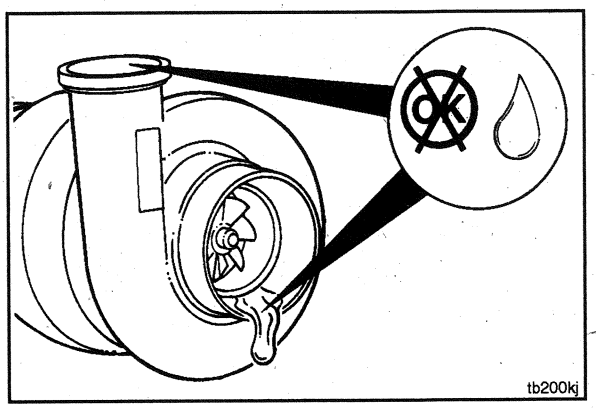
Replace the turbocharger if damage is found.

Inspect the compressor intake and discharge for signs of oil.

If oil is present in the compressor intake as well as the discharge, check upstream of the turbocharger for the source of the oil.

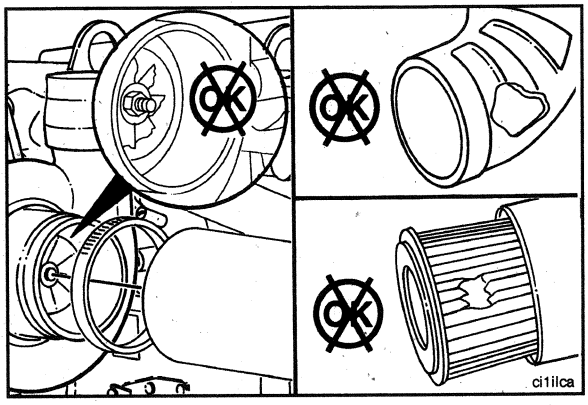
If oil is present only in the discharge side, check for intake restriction.

If no intake restriction is found, replace the turbocharger.



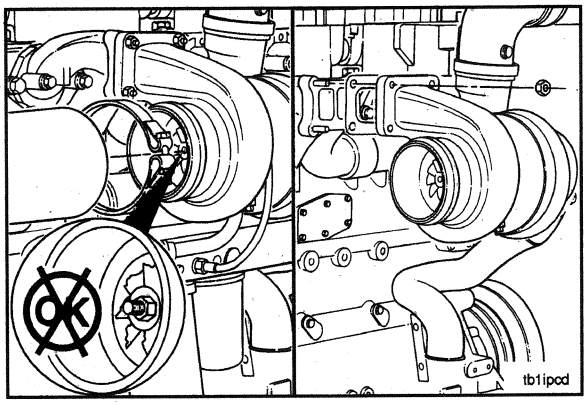
If the compressor impeller is damaged, inspect the intake air piping and the filter element for damage.

Repair any damage before operating the engine.



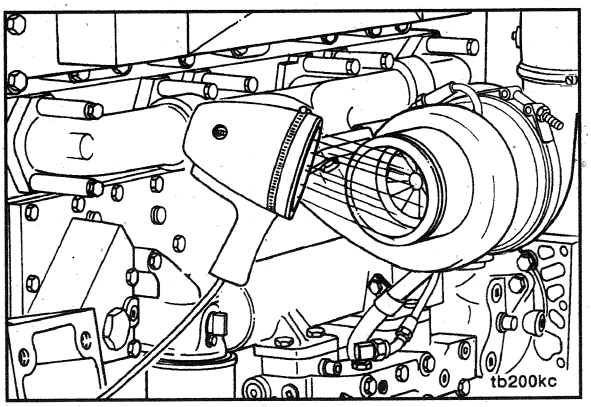
Inspect the turbine wheel for damage.

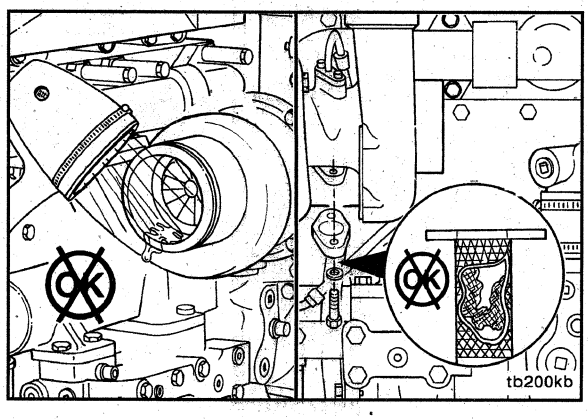
Replace the turbocharger if damage is found.



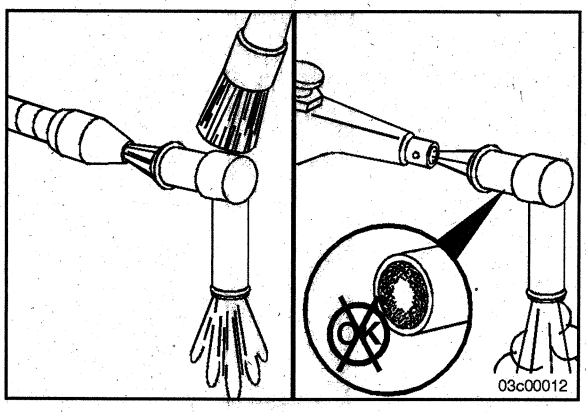
Use a high-intensity black light, Part Number 3163337 (100 watt) or 3163338 (50 watt) to inspect the turbine outlet for leaks.

A dark blue glow indicates a fuel leak. A yellow glow indicates an oil leak.

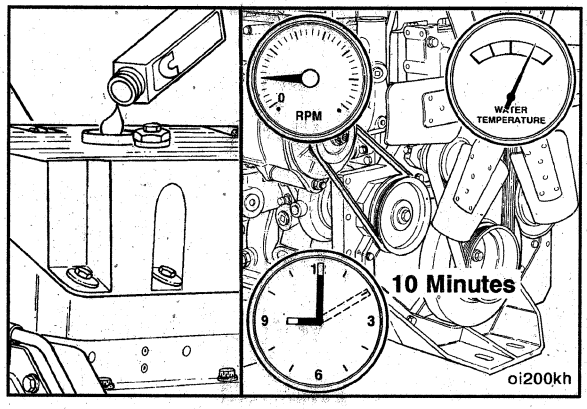




If oil is found in the exhaust outlet of the turbine housing, remove the oil drain line and check for restrictions. Clear any restrictions found, or replace damaged components as required.



Check engine breather or the breather tube for restriction. Clear any restrictions or replace damaged components. Refer to Procedure 003-001.

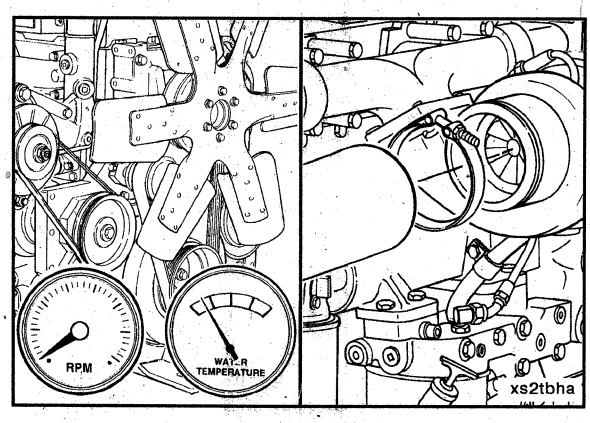


Variable Geometry

Add one unit of fluorescent tracer, Part Number 3376891, to each 38 liters [10 gal] of engine lubricating oil.

NOTE: If bearing housing coolant leak is suspected, use turbocharger waterjacket leak test kit, Part Number 3164682. Refer to the Turbocharger Coolant Leak Test Kit, Bulletin 3377919.

Operate the engine at low idle for 10 minutes.



Shut off the engine.

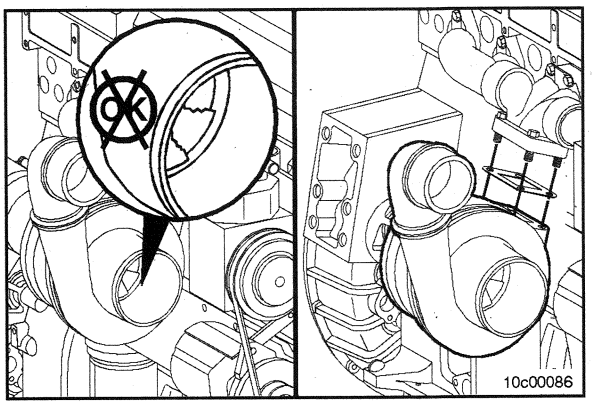
Allow the turbocharger to cool.

Remove the intake and the exhaust pipe from the turbocharger.

Remove the intake piping and compressor discharge piping.

Inspect the turbocharger compressor impeller blades for damage.

Replace the turbocharger if damage is found.

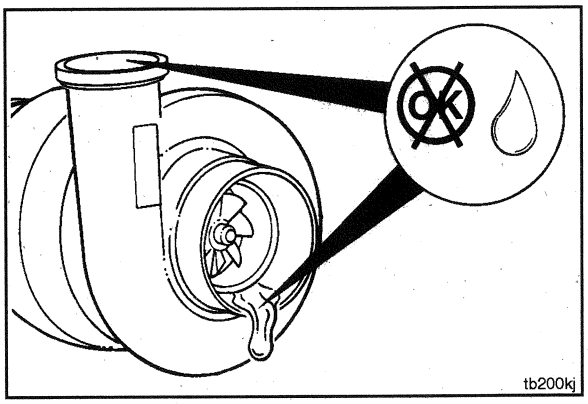


Inspect the compressor intake and discharge for signs of oil.

If oil is present in the compressor intake as well as the discharge, check upstream of the turbocharger for the source of the oil.

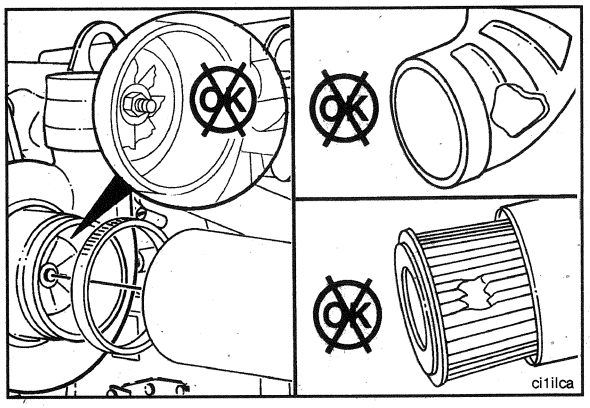
If oil is present only in the discharge side, check for intake restriction.

If no intake restriction is found, replace the turbocharger.



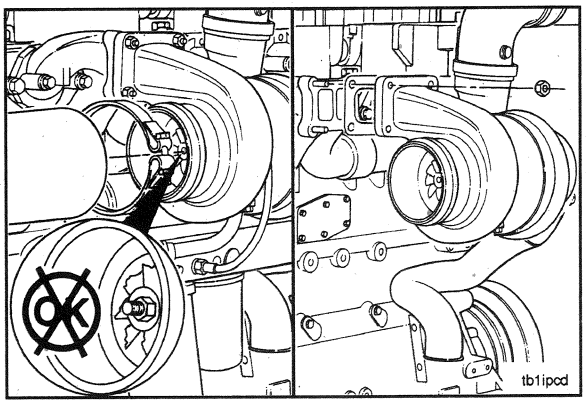
If the compressor impeller is damaged, inspect the intake air piping and the filter element for damage.

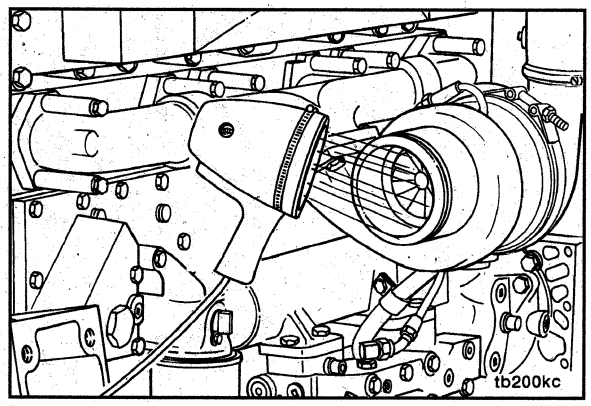
NOTE: Repair any damage before operating the engine.



Inspect the turbine wheel for damage.

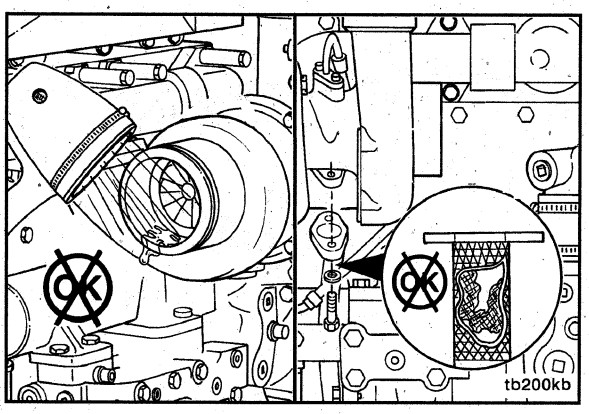
Replace the turbocharger if damage is found.



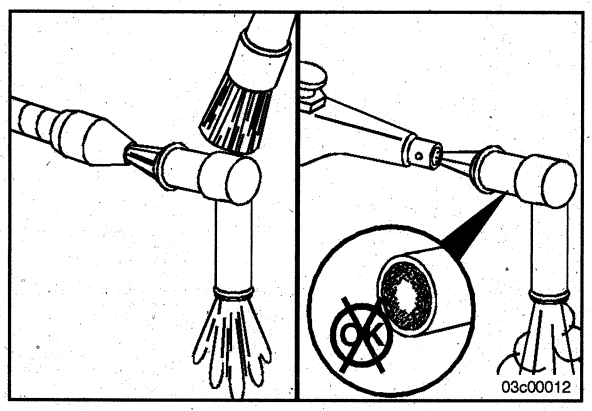


Use a high-intensity black light, Part Number 3163337 (100 watt) or 3163338 (50 watt) to inspect the turbine outlet for leaks.

A dark blue glow indicates a fuel leak. A yellow glow indicates an oil leak.



If oil is found in the exhaust outlet of the turbine housing, remove the oil drain line and check for restrictions. Clear any restrictions found, or replace damaged components as required.



Check engine breather or the breather tube for restriction. Clear any restrictions or replace damaged components. Refer to Procedure 003-001.

⚠ WARNING ⚠

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

⚠ 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.

Drain the cooling system. Refer to Procedure 008-018.

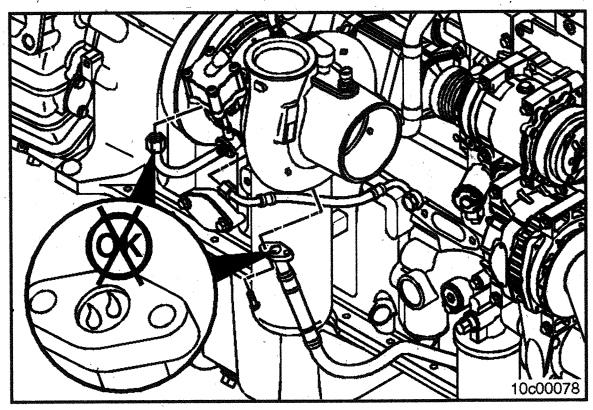
Inspect the bearing housing for external oil or coolant leaks.

Remove the oil supply, oil drain, coolant inlet, and coolant outlet tubes from the turbocharger.

Disconnect the variable geometry turbocharger actuator air supply line.

Discard the oil drain tube gasket.

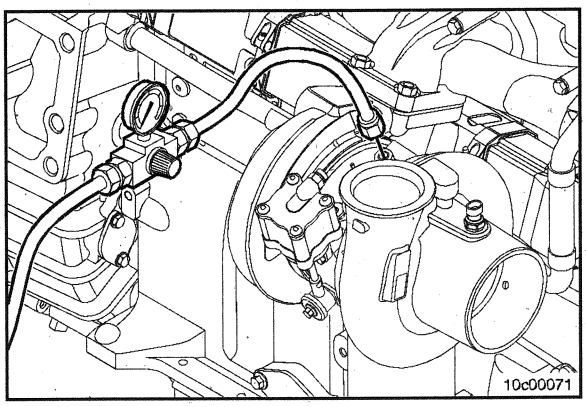
Check for evidence of coolant in the oil supply and oil drain fittings.



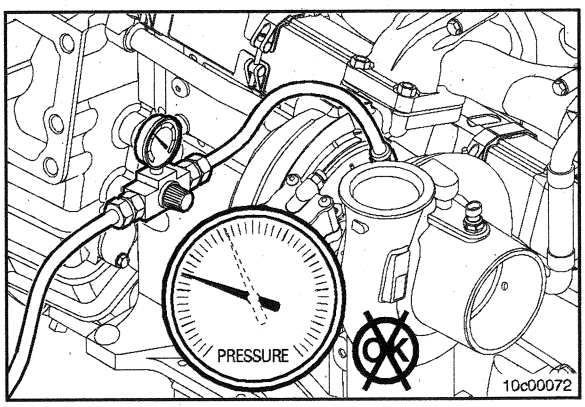
Connect a turbocharger coolant leak test kit, Part Number 3164682, to the coolant inlet and outlet.

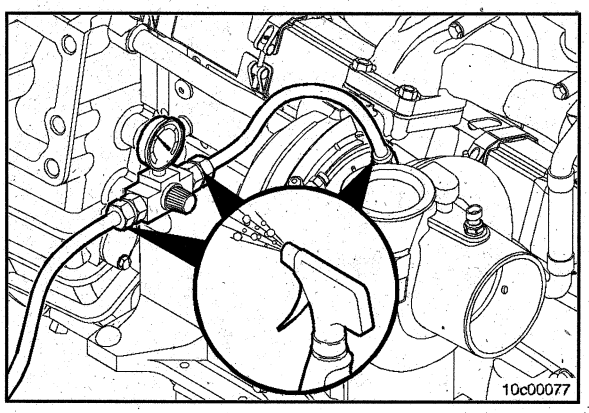
Using shop air supply, pressurize the turbocharger to 276 kPa [40 psi].

Close the air pressure regulator.



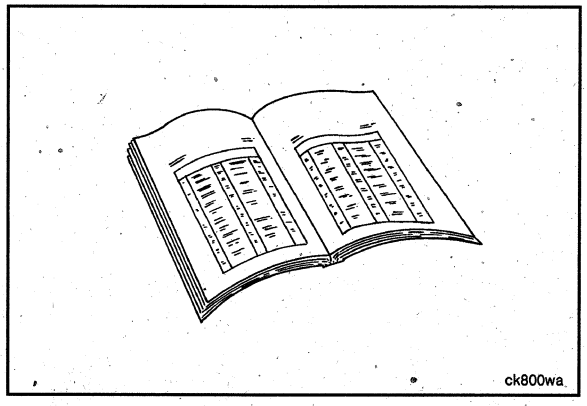
Watch for the pressure to decrease. Pressure **must not** decrease more than 49 kPa [5 psi] in one minute.





If the pressure decreases greater than 49 kPa [5 psi] in one minute, use a spray bottle of soapy water to wet all hose connections. Bubbles will appear if the connections are leaking.

If the pressure does decrease and the hose connections are **not** leaking, replace the turbocharger.



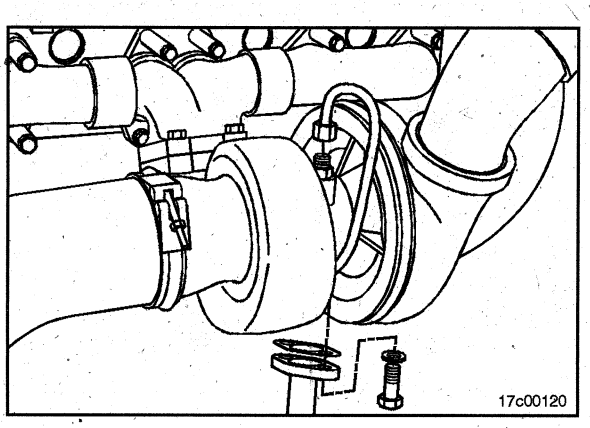
Preparatory Steps

Variable Geometry

Drain the coolant. Refer to Procedure 008-018.

Remove or disconnect the following:

- Charge air cooler piping. Refer to Procedure 010-027.
- V-band clamp from the discharge elbow and the turbocharger compressor outlet.
- Discharge elbow. Refer to the OEM service manual.
- Air intake and exhaust piping. Refer to the OEM service manual.
- Electrical connectors on the turbocharger speed sensor and the turbocharger compressor air inlet temperature sensor. Refer to Procedure 019-390 in the Fuel System Troubleshooting and Repair Manual, Bulletin 4021334.
- Actuator air supply line. Refer to Procedure 010-113.
- Coolant outlet on the top of turbocharger bearing housing.
- Oil supply, drain, and coolant inlet from the bottom of the turbocharger bearing housing.
- Oil drain tube gasket.



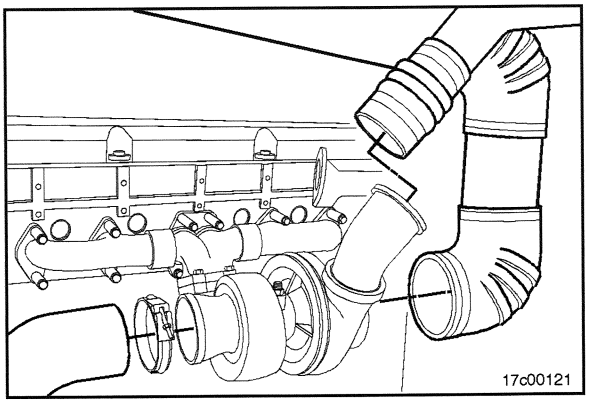
Without EGR

If **not** already removed, remove the oil supply, the oil drain tube, and brace (if equipped) from the turbocharger.

Remove the wastegate actuator hose.

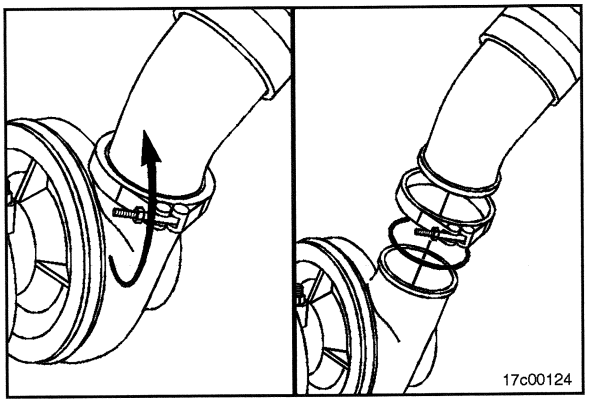
If **not** already removed, remove the intake and the exhaust pipes from the turbocharger.

If **not** already removed, remove the charge-air cooler piping from the discharge elbow.



Remove clamp, o-ring seal, and discharge elbow to turbocharger.

Discard o-ring seal.



Remove

Variable Geometry

⚠WARNING⚠

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

⚠CAUTION⚠

When installing lifting eye, ensure that shoulder of lifting eye is bottomed against bearing housing. Failure to do so can result in failure of lifting eye and personal injury.

⚠CAUTION⚠

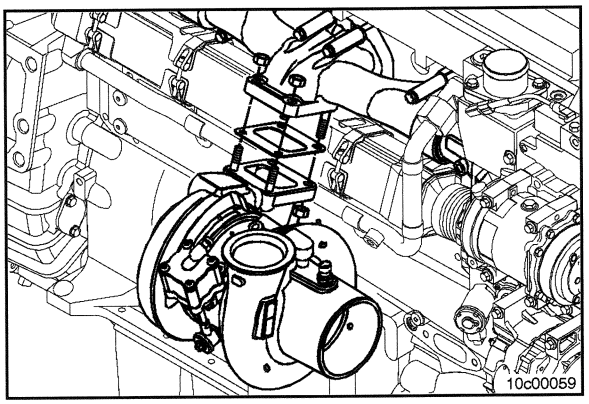
If the lifting eye is installed in the turbocharger bearing housing, it is to be used exclusively for turbocharger removal and installation. It is not to be used in removal of the exhaust manifold, or engine. Doing so will cause damage to the turbocharger.

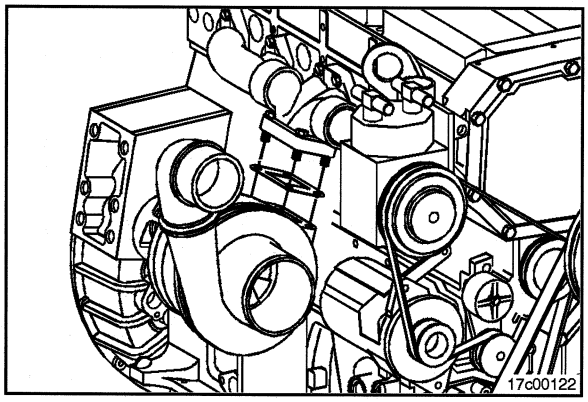
NOTE: The capscrew in top of the turbocharger bearing housing can be removed and replaced with a lifting eye to aid in removal of turbocharger.

Remove the four turbocharger mounting nuts.

NOTE: If the turbocharger mounting nuts do **not** loosen freely, split the nuts to avoid breaking a mounting stud.

Remove the turbocharger and discard the gasket.





Without EGR

⚠WARNING⚠

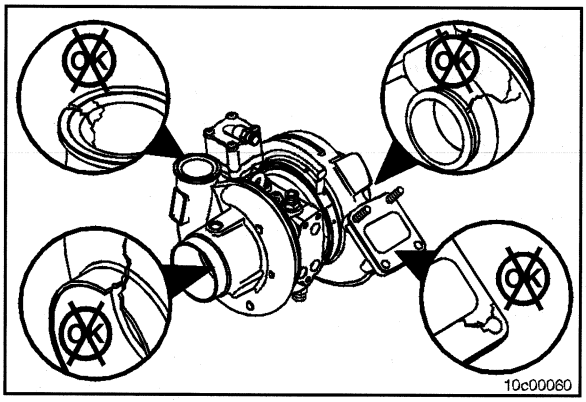
This component weighs 23 kg [50 lb] or more. To avoid personal injury, use a hoist or get assistance to lift this component.

NOTE: In some applications the turbocharger will **not** clear the lubricating oil cooler assembly during removal and installation. It will, perhaps, be necessary to remove the exhaust manifold and turbocharger together, and then separate the two components. If the two components **must** be removed together, refer to Procedure 011-007 for removal and installation of the exhaust manifold.

Remove the four turbocharger mounting nuts.

Remove the turbocharger, and discard the gasket.

NOTE: If the turbocharger mounting nuts do **not** loosen freely, split the nuts to avoid breaking a mounting stud.



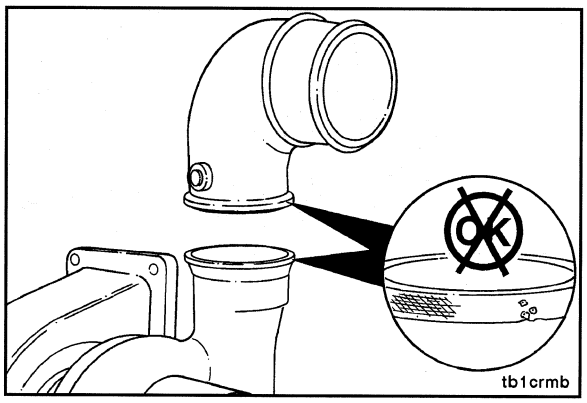
Clean and Inspect for Reuse

Variable Geometry

Inspect for cracks on the turbocharger and compressor casings.

Replace if through cracks in the outer walls are found.

Inspect for cracks on the turbine inlet and exhaust mounting flanges. Replace if any cracks are found.



Inspect the turbocharger compressor v-band outlet and the discharge elbow v-band connection for dents or fretting.

Replace the turbocharger or discharge elbow, if damaged, to prevent compressed air leaks.

Inspect the compressor wheel for signs of rubbing against the compressor cover. Replace the turbocharger if rubbing is seen.

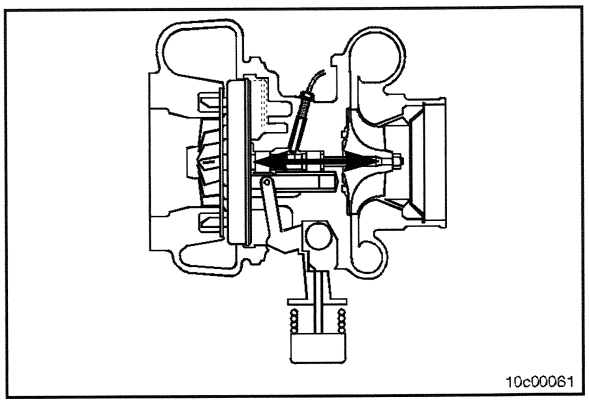
Use light finger pressure to push the compressor wheel. If the compressor wheel contacts the cover, replace turbocharger.

NOTE: If the engine experiences a turbocharger failure or any other occasion where oil or debris is put into the charge air system, that charge air system **must** be inspected and cleaned. Refer to Procedure010-027.

Check the axial movement of the turbocharger wheels and shaft.

Turbocharger Wheel Axial Movement		
mm		in
0.025	MIN	0.001
0.127	MAX	0.005

Replace the turbocharger if out of specifications.

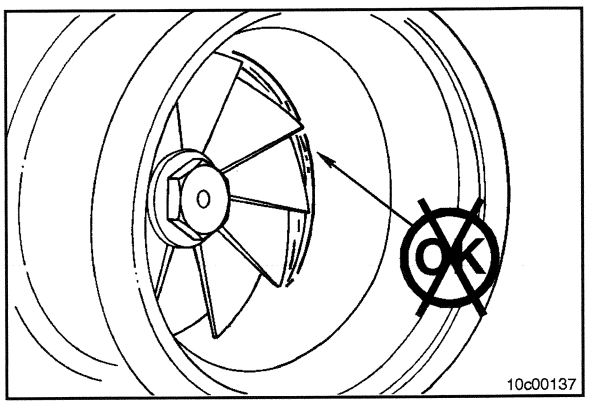


Check the radial movement of the turbocharger wheels and shaft.

Use light finger pressure to push the compressor wheel toward side of the compressor housing.

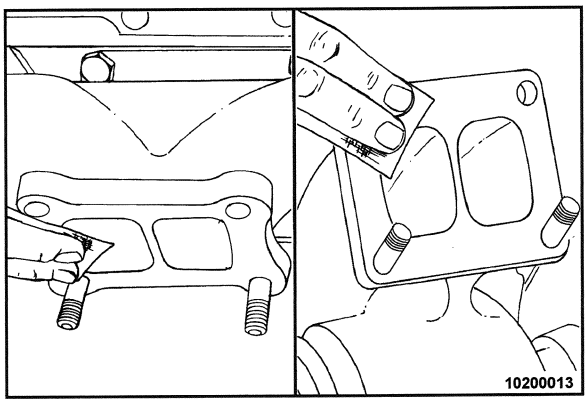
Repeat the procedure for the turbine wheel and housing.

Replace the turbocharger if either wheel contacts the housing.



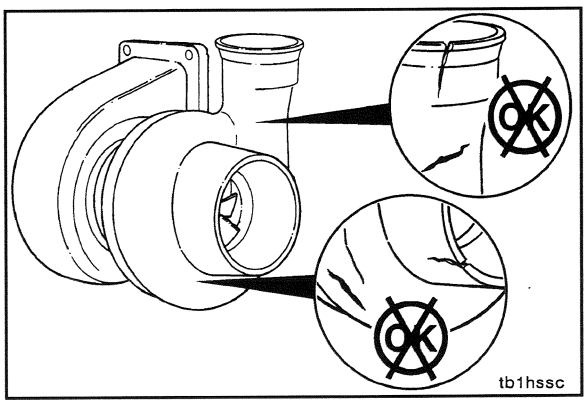
Without EGR

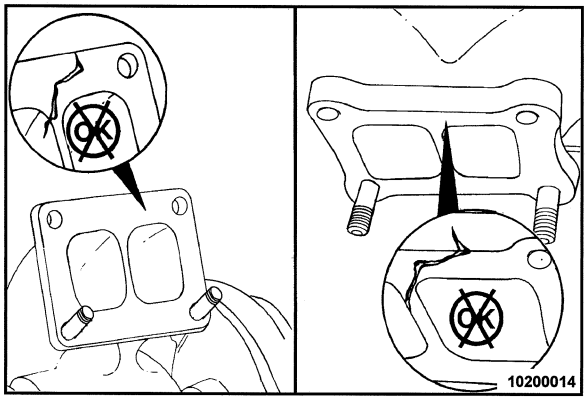
Clean the turbocharger and exhaust manifold gasket surfaces.



Inspect the wastegate actuator. Refer to Procedure 010-050.

Inspect the turbocharger casings and replace if through cracks are found in the outer walls.

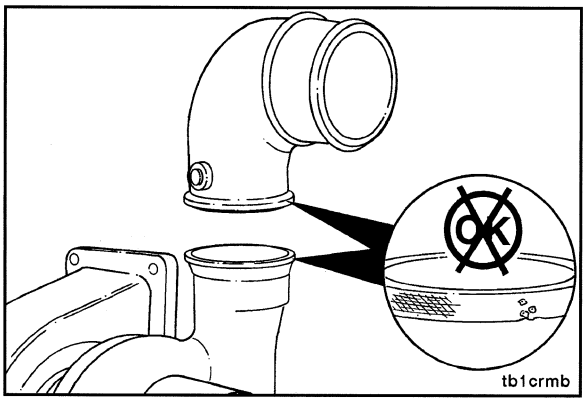




Cracks on the turbocharger mounting flange or the exhaust flange are **not** acceptable.

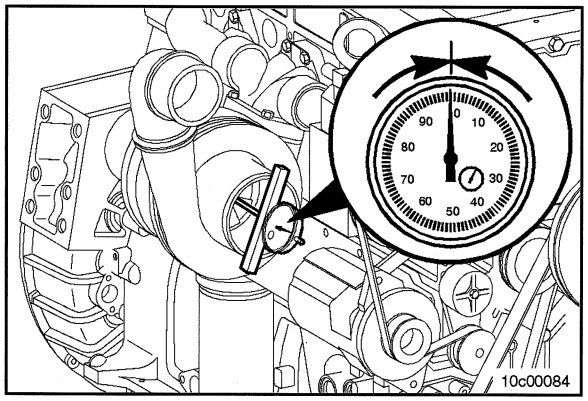
Inspect the turbocharger mounting studs for damage. Replace the studs if necessary.

Replace any cracked manifolds or turbocharger.



Inspect the turbocharger compressor v-band outlet and the discharge elbow v-band connection for dents or fretting.

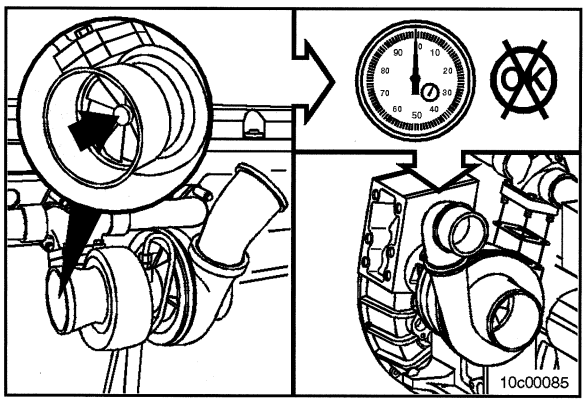
Replace the turbocharger or discharge elbow, if damaged, so that the compressed air will **not** leak.



Use dial depth gauge, Part Number ST-537.

Push the rotor assembly away from the gauge.

Set the gauge to zero (0).



Push the rotor assembly toward the gauge and record the reading.

Turbocharger Axial Clearance		
mm		**in**
0.025	MIN	0.001
0.127	MAX	0.005

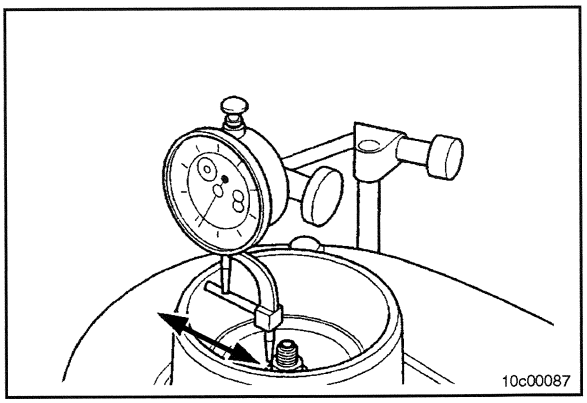
Replace the turbocharger if the clearance does **not** meet the specifications.

Use a dial indicator to check radial movement at the compressor impeller nose.

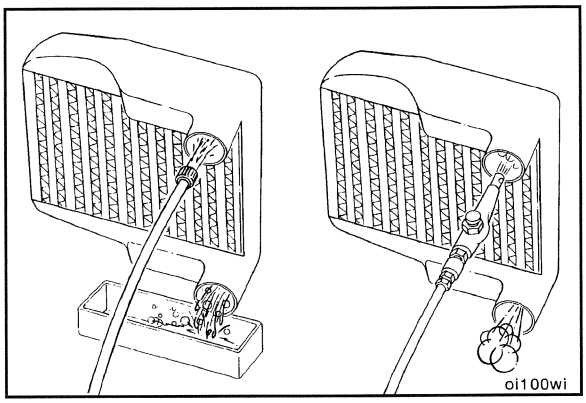
Push the impeller away from the gauge and set the indicator to zero. Push the impeller toward the gauge and record the reading.

Turbocharger Radial Bearing Clearance		
mm		in
0.406	MIN	0.016
0.610	MAX	0.024

If radial movement exceeds specifications, replace the turbocharger.



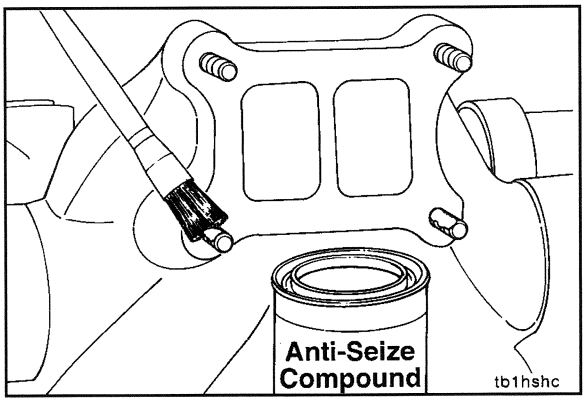
If the engine experiences a turbocharger failure or any other occasion where oil or debris is put into the charge-air system, the charge-air system **must** be inspected and cleaned. Refer to Procedure 010-027.

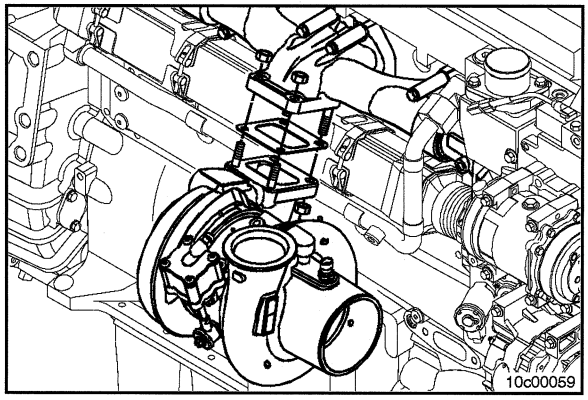


Install

Variable Geometry

Apply a film of high-temperature anti-seize compound, to the turbocharger mounting studs.





⚠WARNING⚠

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

⚠CAUTION⚠

When installing lifting eye, ensure that shoulder of lifting eye is bottomed against bearing housing. Failure to do so can result in failure of lifting eye and personal injury.

⚠CAUTION⚠

If lifting eye is installed in turbocharger bearing housing, it is to be used exclusively for turbocharger removal and installation. It is not to be used in removal of the exhaust manifold, or engine. Doing so will cause damage to the turbocharger.

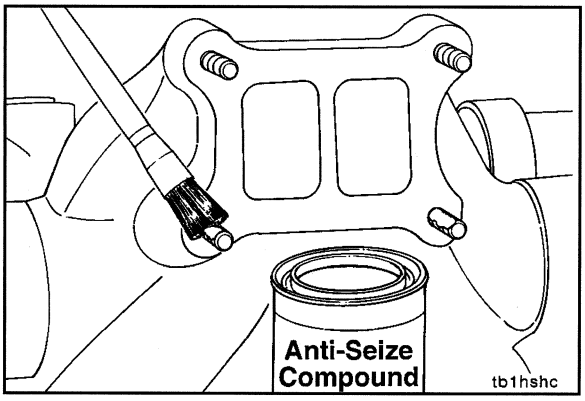
⚠CAUTION⚠

Do not rotate turbocharger turbine housing. Loosening turbine v-band and rotating turbine housing can cause damage to internal variable geometry mechanism.

NOTE: The capscrew in top of the turbocharger bearing housing can be removed and replaced with a lifting eye to aid in removal of turbocharger.

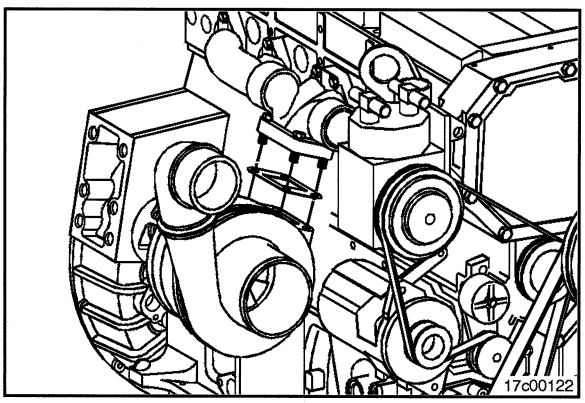
Install a new gasket, the turbocharger, and the four mounting nuts. Tighten the mounting nuts.

Torque Value: 88 N•m [65 ft-lb]



Without EGR

Apply a film of high-temperature anti-seize compound, Part Number 3823097, to the turbocharger mounting studs.



⚠WARNING⚠

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

NOTE: If the exhaust manifold and turbocharger were removed together in order for the turbocharger to clear the lubricating oil cooler assembly, refer to Procedure 011-007 for installation of the exhaust manifold.

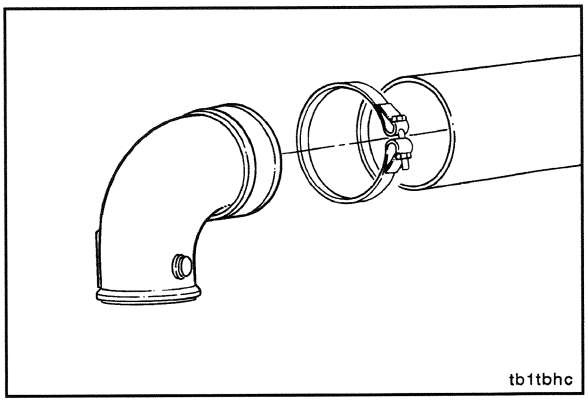
Install a new mounting gasket, the turbocharger, and the four mounting nuts.

Tighten the mounting nuts.

Torque Value: 60 N•m [45 ft-lb]

Install the discharge elbow and clamp onto the charge-air cooler pipe connection.

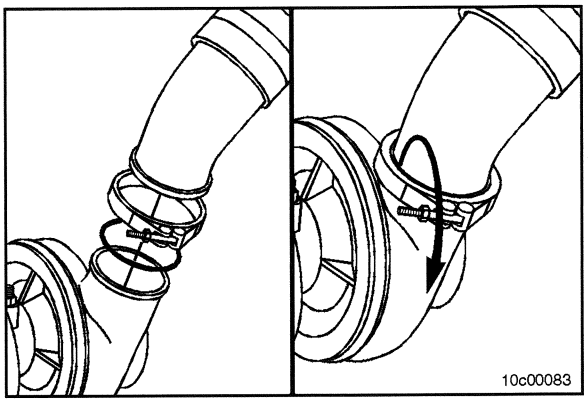
NOTE: Do **not** tighten the clamp until the elbow is installed on the turbocharger.



Install a new o-ring seal, the clamp, and the discharge elbow to the turbocharger.

Tighten the clamps.

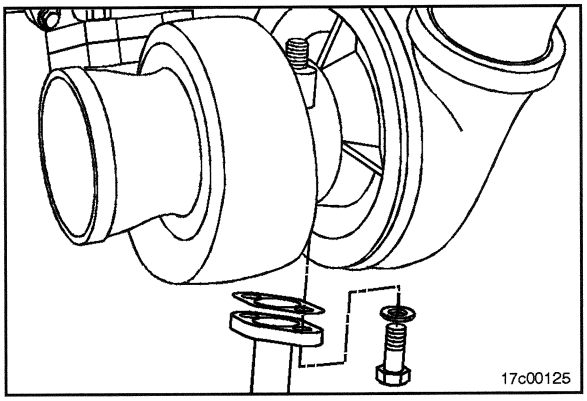
Torque Value: 9 N•m [80 in-lb]



Install a new gasket, oil drain tube, and capscrews.

Tighten the capscrews.

Torque Value: 25 N•m [18 ft-lb]

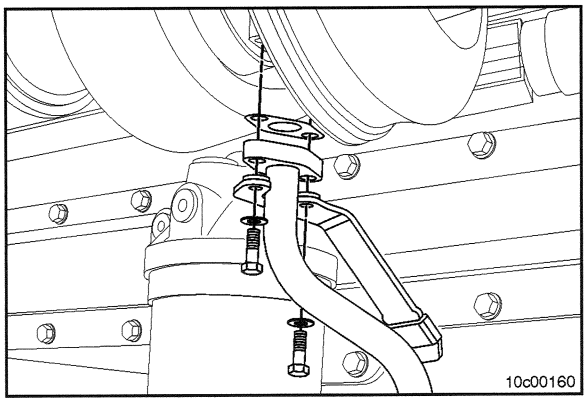


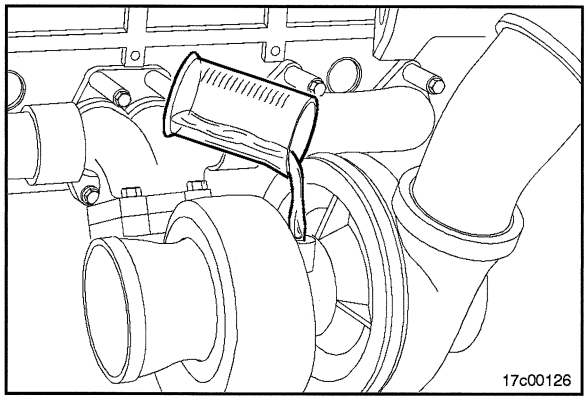
Install the turbocharger anti-rotation brace (if equipped) . The end rests on the oil cooler housing.

NOTE: This brace requires longer, 1.25 mm [0.049 in], capscrews.

Tighten the capscrews.

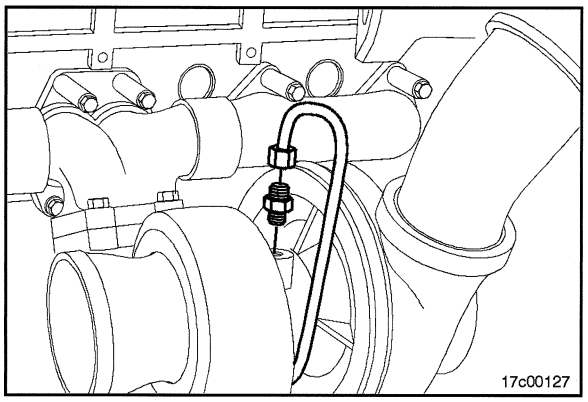
Torque Value: 25 N•m [18 ft-lb]





Install the wastegate actuator hose.

Pour 50 to 60 cc [2 to 3 oz] of clean engine oil into the turbocharger oil supply opening.



⚠CAUTION⚠

Proper routing of the turbocharger oil supply tube is critical to prevent failure. Avoid any tube-to-metal contact. (The inlet supply fitting must be oriented slightly off vertical to allow proper alignment.)

If installing a new turbocharger, make sure the turbocharger is aligned, loosen the compressor and turbine V-bands, and adjust as needed. Tighten the V-bands.

Torque Value: 9 N•m [80 in-lb]

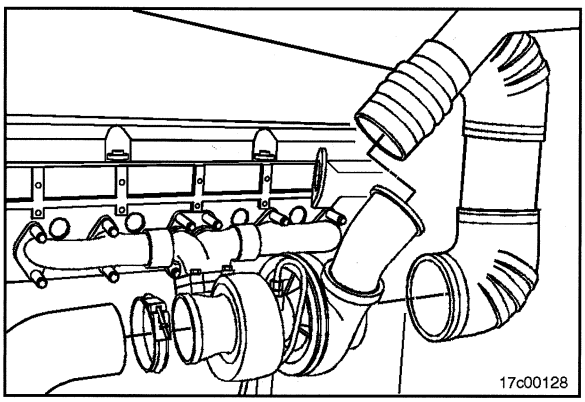
Torque Value: 12 N•m [106 in-lb]

If installing a new turbocharger, install the male union elbow.

Torque Value: 30 N•m [22 ft-lb]

Install the turbocharger oil supply tube on the elbow.

Torque Value: 30 N•m [22 ft-lb]



Install the intake and exhaust pipes to the turbocharger, and tighten the clamps.

Torque Value: 9 N•m [80 in-lb]

Operate the engine, and check for air and oil leaks.

Finishing Steps

Variable Geometry

⚠CAUTION⚠

Turbocharger speed sensor harness and turbocharger compressor inlet air temperature sensor harnesses must be tied securely and away from heat sources, such as the exhaust manifold and exhaust pressure sensor tube. Failure to do so can cause damage to the sensor harness.

⚠CAUTION⚠

The turbocharger compressor inlet air temperature sensor must be positioned so the sensor body is pointing up and away from the exhaust manifold. Failure to do so can cause sensor damage.

⚠CAUTION⚠

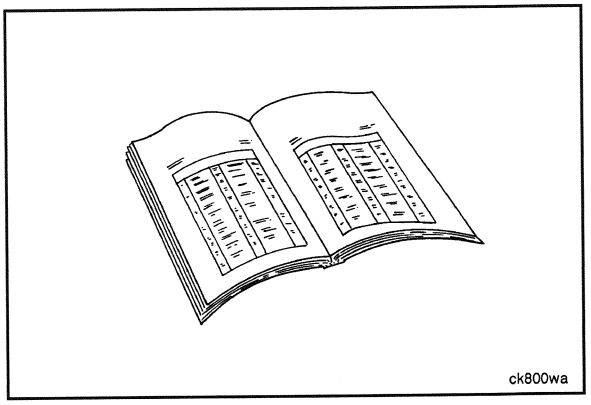
Do not twist coolant lines while tightening. Failure to do so will damage coolant lines.

Install or connect the following:

- Coolant inlet and outlet lines to the turbocharger bearing housing.
- New oil drain tube gasket.
- Drain tube.
- Turbocharger oil supply line.
- Turbocharger actuator air supply line. Refer to Procedure 010-113.
- Turbocharger speed sensor harness. Refer to Procedure 019-390 in the Fuel System Troubleshooting and Repair Manual, Bulletin 4021334.
- Compressor inlet air temperature sensor harness.
- Air intake and exhaust piping. Refer to the OEM service manual.
- New o-ring seal, clamp, and the discharge elbow to the turbocharger.
- Discharge elbow and clamp onto the charge air cooler connection. Refer to Procedure 010-027.

Fill the cooling system. Refer to Procedure 008-018.

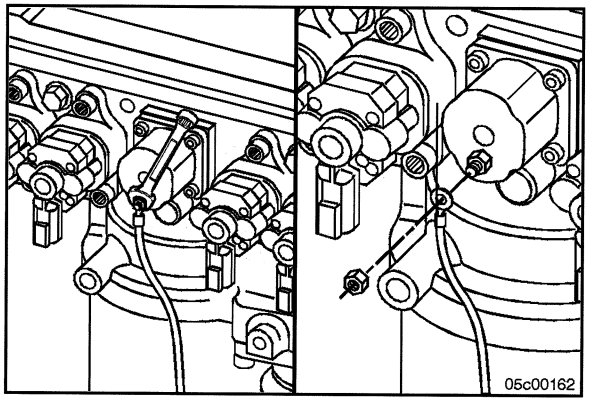
Start and operate the engine until the coolant temperature reaches 82°C [180°F] and check for air, coolant and oil leaks.



Engine Storage - Long Term

General Information

If the engine will be out of service longer than 6 months, take special precautions to prevent rust. Contact the nearest Cummins Authorized Repair Location for information concerning engine storage procedures.



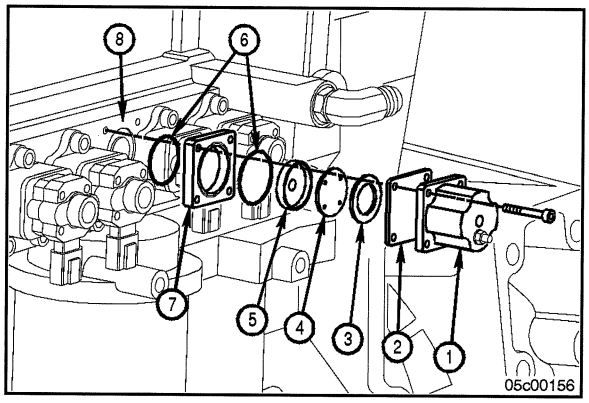
Fuel Shutoff Valve

Remove

Use a wrench to hold the nut at the base of the post.

Use a 3/8-inch wrench to remove the nut holding the electrical connection of the fuel shutoff valve coil.

Remove the connection.

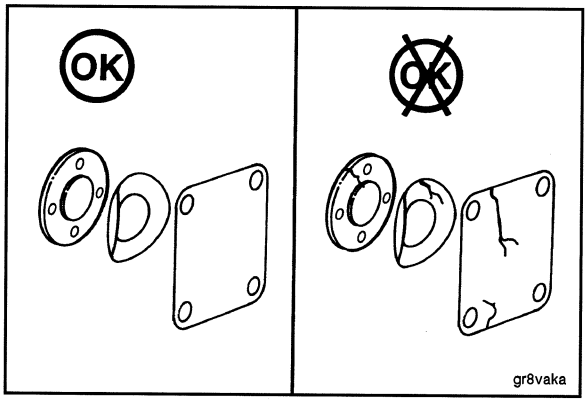


Remove the four Allen head capscrews.

Remove the coil (1) and the fuel shield (2).

Remove the valve spring washer (3), valve disc (4), and actuator disc (5) from the actuator housing (7) from the IFSM (8).

Discard the o-rings (6).



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 ⚠

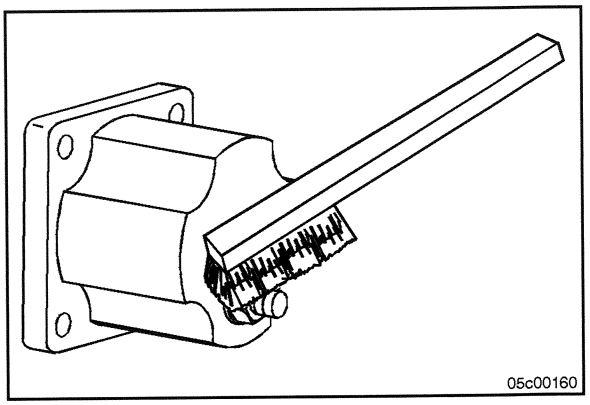
Some solvents are flammable and toxic. Read the manufacturer's instructions before using.

Use mineral spirits. Clean all of the parts **except** the coil assembly.

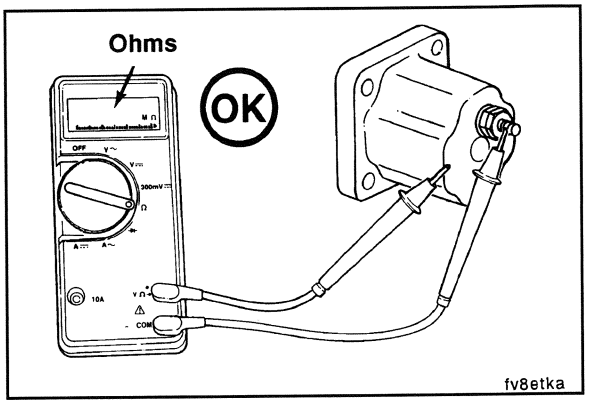
NOTE: Do **not** get solvent on the coil. Clean the coil with a dry cloth. Use a 200-grit emery cloth and a flat surface to polish the coil surface.

Check the valve disc, valve seat, and actuator disc for dirt, metal parts, bonding separation, corrosion, cracks, or wear. Replace if necessary.

Use a wire brush to clean any corrosion from the coil terminal.



Check the coil assembly with a multimeter. Replace the solenoid if the resistance is **not** to specification.



Fuel System Shutoff Valve Solenoid Specifications		
Voltage	**Resistance Minimum (Ohms)**	**Resistance Maximum (Ohms)**
6 VDC	1	5
12 VDC	6	15
24 VDC	24	50
32 VDC	42	80
36 VDC	46	87
48 VDC	92	145
74 VDC	315	375
115 VAC	645	735

NOTE: If the coil assembly shows 0 ohm, there is an electrical short in the coil.

Install

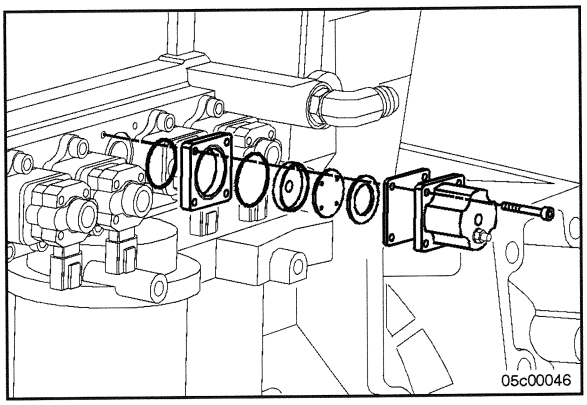
Assemble the shutoff valve as shown. Install these parts as follows.

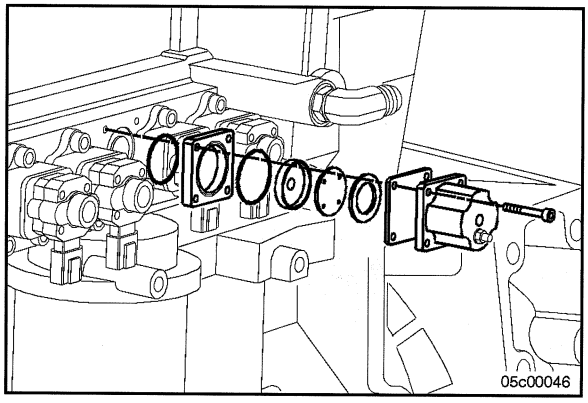
Install a new o-ring between the spacer and the electronic control valve body.

Install the spacer o-ring groove toward the coil.

Install the actuator disc with the cup side toward the coil.

Install the spring washer with the cup side toward the coil.





Align the actuator disc, spacer, and valve disc on the electronic control valve body.

Install a new o-ring.

Put the spring washer on the valve disc with the cavity side positioned upward.

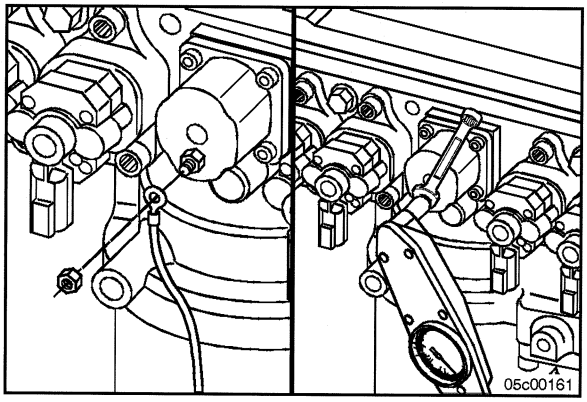
NOTE: The coil **must** be oriented with the electrical connection post on the bottom.

NOTE: Make sure the shutoff valve coil is the correct voltage (12 VDC). The coil voltage and part number are cast into the terminal connection end of the coil.

Install the fuel shield and coil onto the front cover.

Install a new o-ring and tighten the Allen head capscrews.

Torque Value: 3.4 N•m [30 in-lb]



Install the electrical connection on the fuel shutoff valve.

Install the nut onto the threaded post of the coil.

Use a wrench to hold the nut at the base of the post firmly while tightening the connection nut.

Torque Value: 3 N•m [25 in-lb]

Section D - System Diagrams

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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:

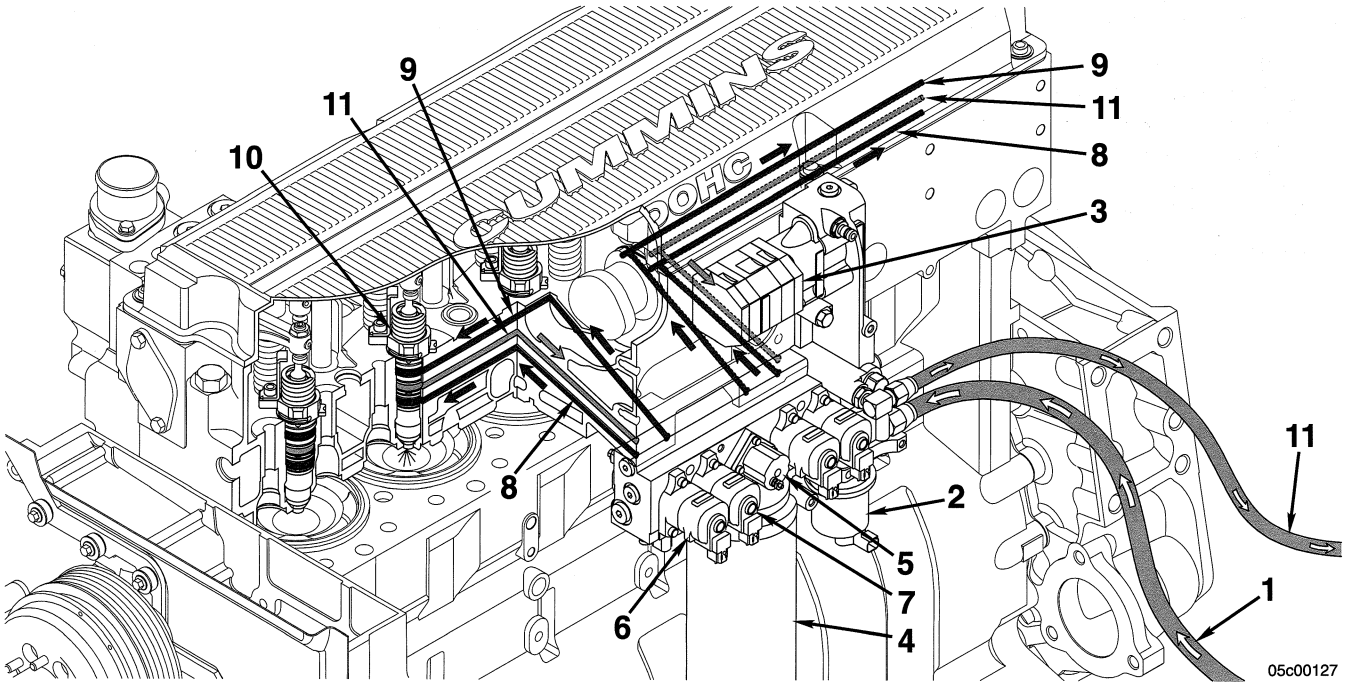
- Fuel System
- Lubricating Oil System
- Coolant System
- Intake Air System
- Exhaust System
- Compressed Air System.

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

Flow Diagram, Fuel System

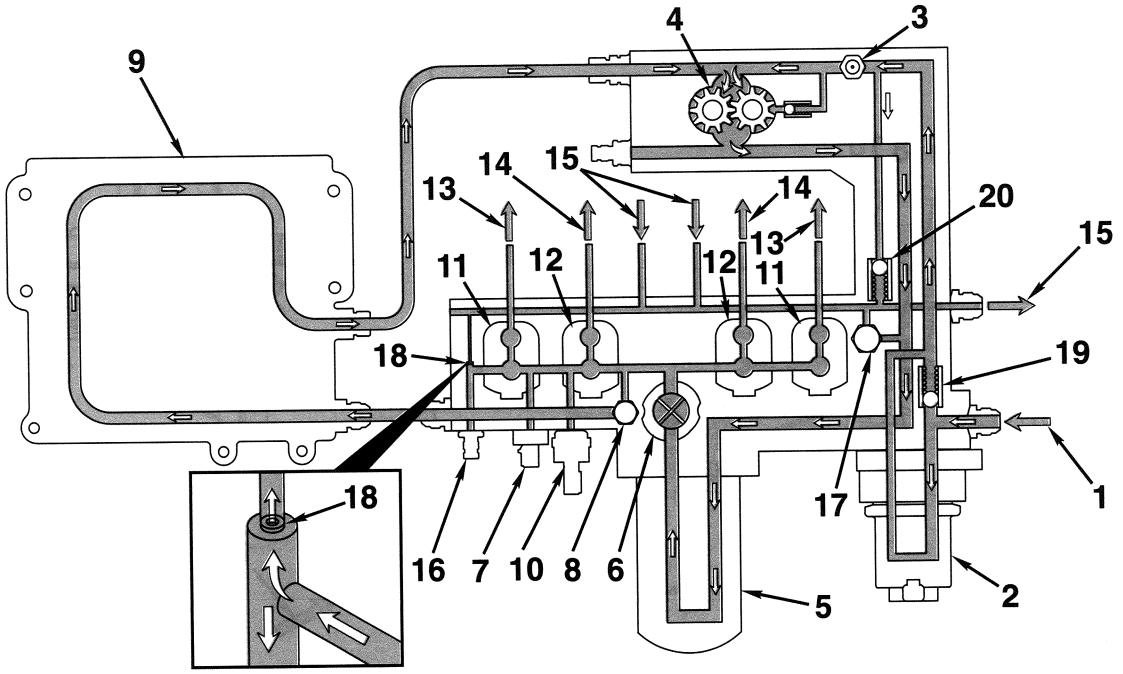
Flow Diagram

With Lift Pump



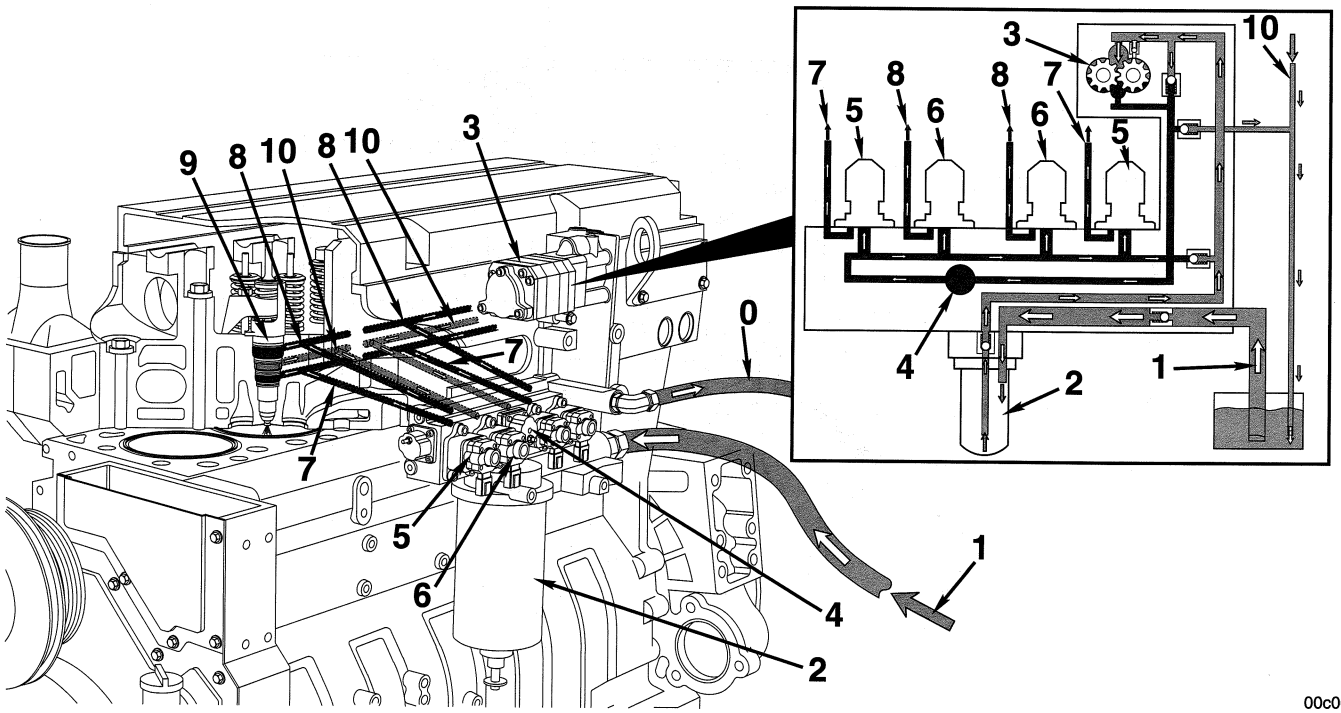
1. Fuel supply from tank
2. Fuel lift pump
3. Fuel pump
4. Pressure fuel filter
5. Fuel shutoff valve
6. Fueling actuator
7. Timing actuator
8. Fueling supply to injector
9. Timing fuel supply to injector
10. Injector
11. Fuel drain to tank.

With Lift Pump and ECM Cooling Plate



1. Fuel supply from tank
2. Fuel lift pump
3. Compuchek™ fitting (fuel inlet restriction)
4. Fuel pump
5. Pressure fuel filter
6. Fuel shutoff valve
7. Engine fuel temperature sensor
8. 250-psi regulator
9. ECM cooling plate
10. Rail fuel pressure sensor
11. Fueling actuator
12. Timing actuator
13. Fueling supply to injector
14. Timing fuel supply to injector
15. Fuel drain to tank
16. Compuchek™ fitting (rail fuel pressure)
17. 380-psi regulator
18. Hot start and stall orifice
19. Check valve
20. Fuel lift pump bypass valve.

Without EGR



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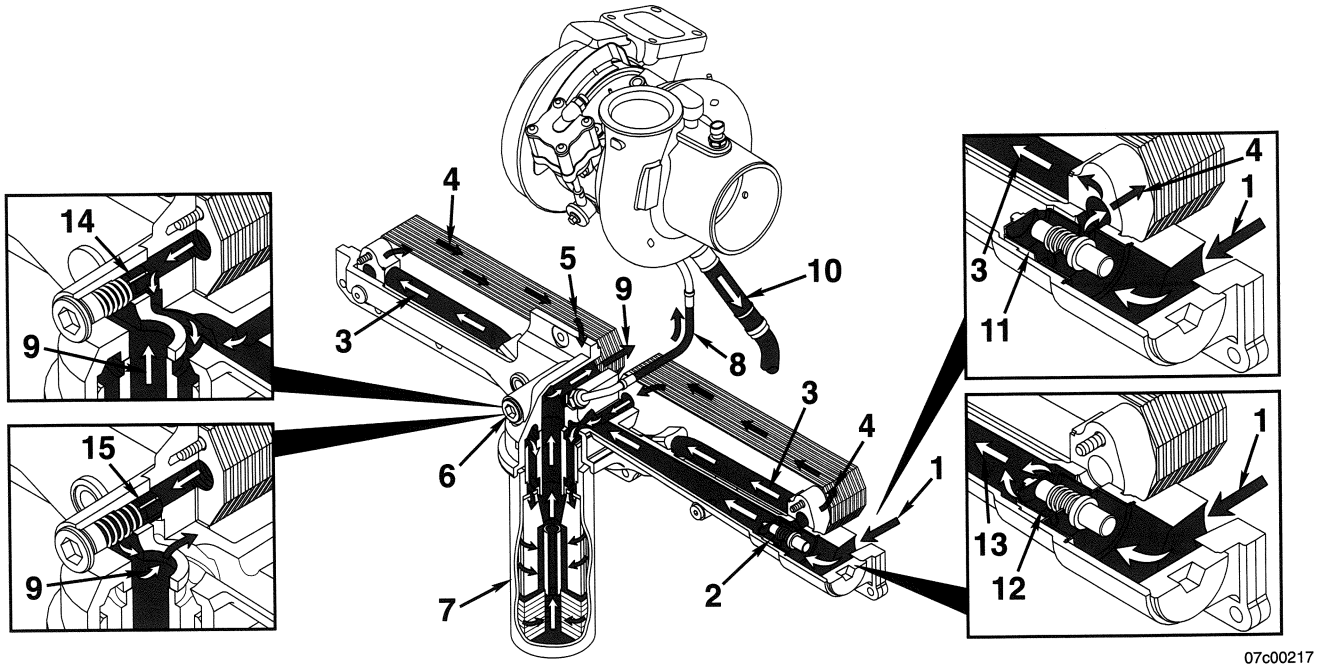
1. Fuel supply from tank
2. Fuel filter
3. Gear pump
4. Fuel shutoff valve
5. Rail metering actuator
6. Timing actuator
7. Rail metering supply to injector
8. Timing fuel supply to injector
9. Injector
10. Fuel drain to tank.

Flow Diagram, Lubricating Oil System

Flow Diagram

With EGR



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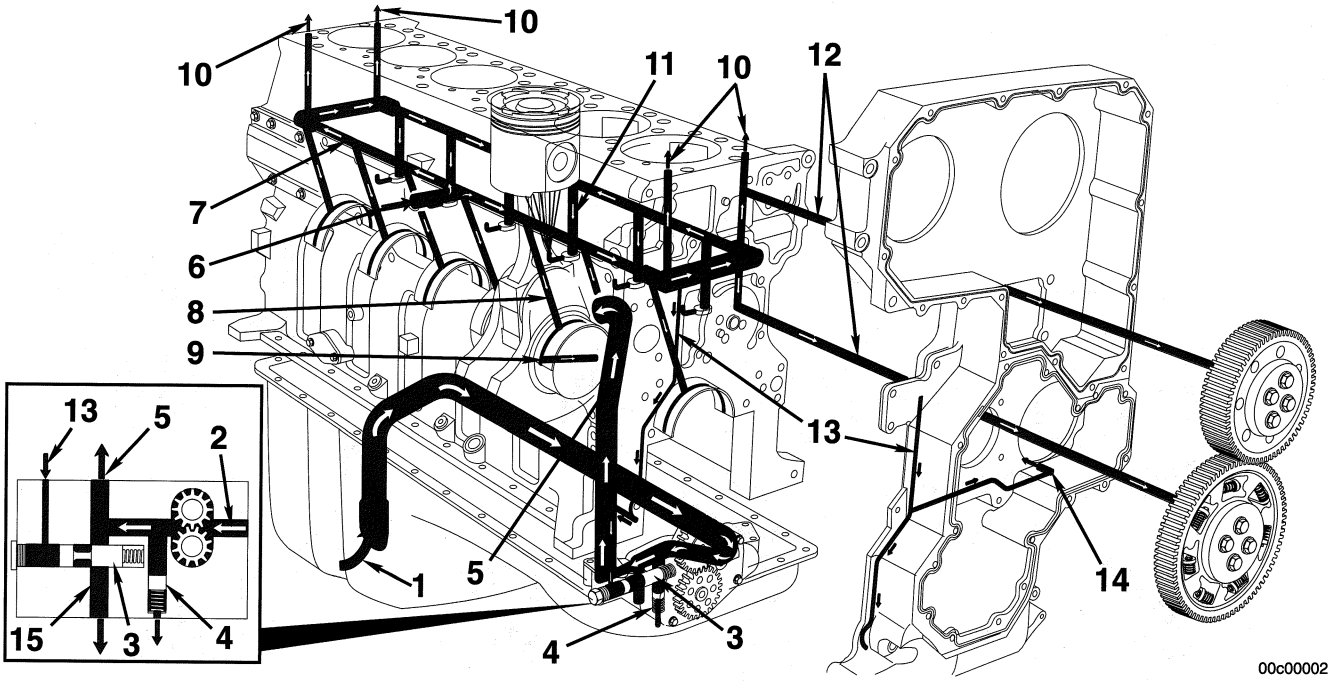
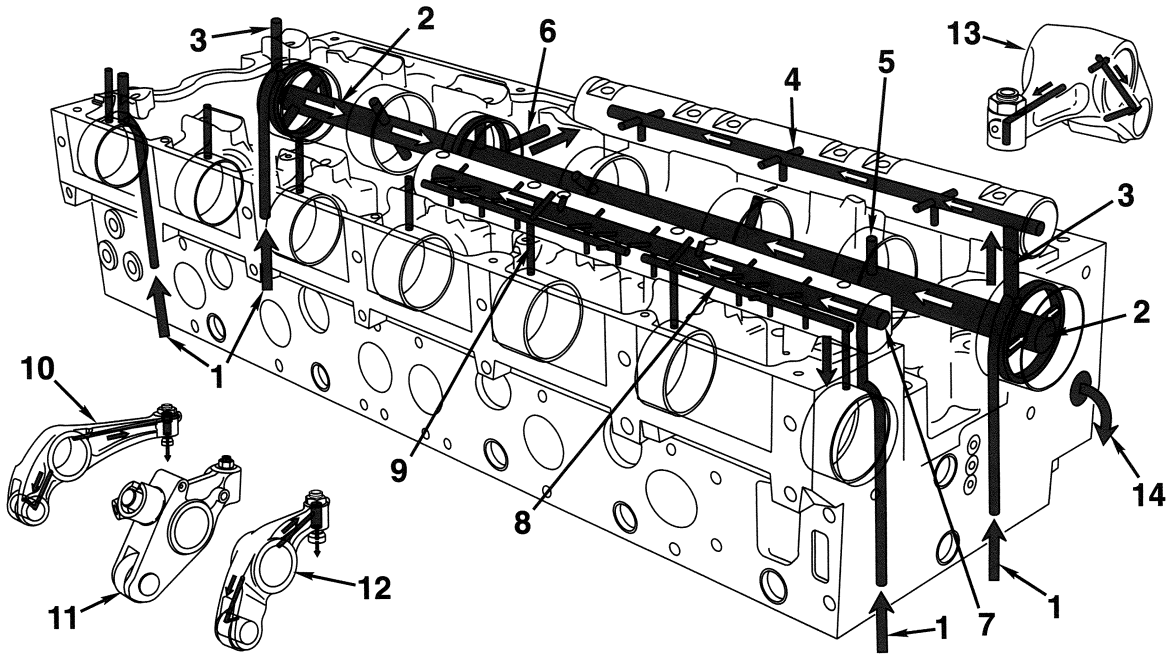
1. Lubricating Oil Flow from Oil Pump
2. Thermostat
3. Oil Transfer to Rear Oil Cooler
4. Flow through Oil Coolers
5. Oil Cooler Flow Return to Filter Head
6. Filter Bypass Valve
7. Oil Filter
8. Flow to Turbocharger
9. Flow to Main Oil Rifle
10. Oil Drain from Turbocharger
11. Thermostat Open - Oil Flows through Oil Coolers
12. Thermostat Closed - Oil Flows Directly to Oil Filter
13. Flow to Oil Filter
14. Bypass Valve Closed - Oil Flows to Oil Filter
15. Bypass Valve Open - Oil Flows Directly to Main Oil Rifle

Without EGR



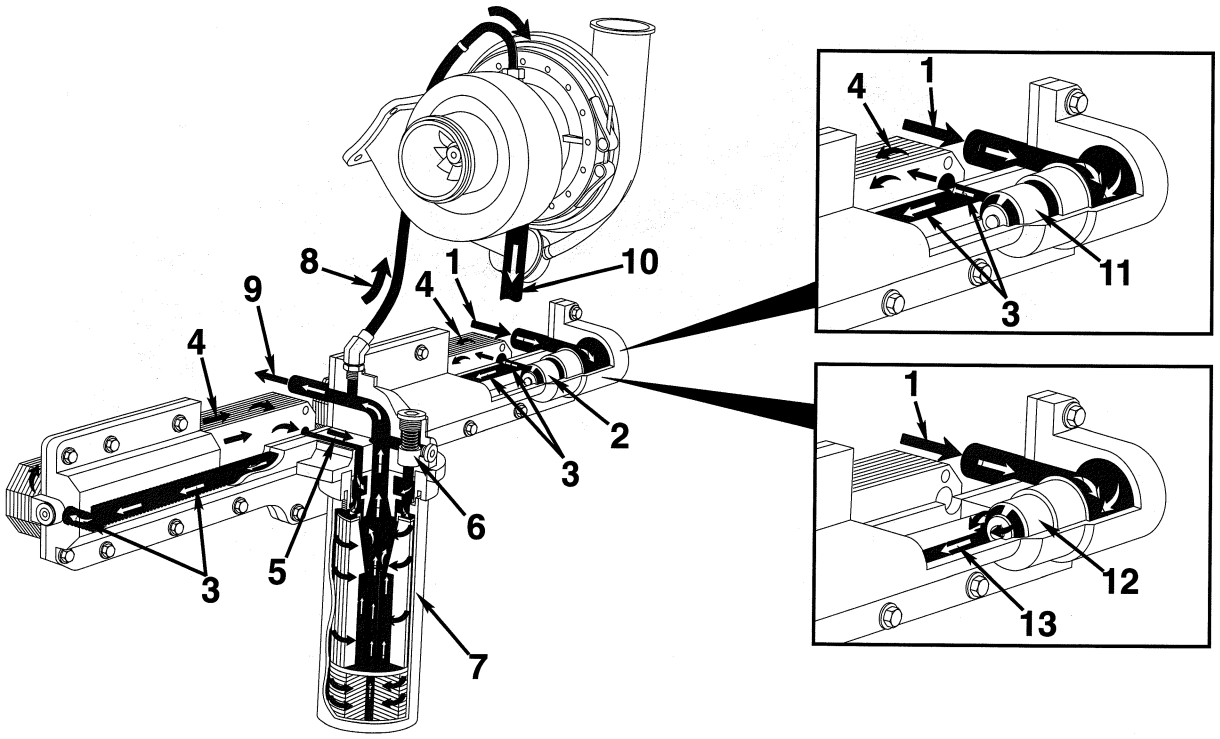
1. Lubricating Oil Flow from Oil Pan through Suction Tube
2. Flow from Suction Tube to Oil Pump
3. Pressure Regulator
4. High-Pressure Relief Valve
5. Flow from Oil Pump to Oil Cooler/Filter Head Housing
6. Oil Return from Oil Cooler/Filter Head Housing to Main Oil Rifle
7. Main Oil Rifle
8. Flow to Main Bearing
9. Flow from Main Bearing to Crankshaft
10. Flow to Cylinder Head
11. Flow to Piston Cooling Nozzle
12. Flow to Idler Gears
13. Oil Transfer from Main Oil Rifle
14. Flow to Air Compressor
15. Rifle Sensing Regulator Dump to Inlet.

Without EGR



1. Lubricating Oil Flow from Cylinder Block to Cylinder Head
2. Flow around Grooved Head to Drilled Camshaft and Rocker Lever Shafts
3. Flow to Injector Rocker Lever Shafts
4. Flow to Injector Rocker Levers
5. Flow to Injector Camshaft Journal Bearings
6. Flow to Fuel Pump
7. Flow to Valve Rocker Lever Shaft
8. Flow to Valve Rocker Levers
9. Flow to Valve Camshaft Journal Bearings
10. Intake Valve Rocker Lever
11. Engine Brake Lever
12. Exhaust Valve Rocker Lever
13. Injector Rocker Lever
14. Oil Drain from Overhead (Front and Rear).

Without EGR



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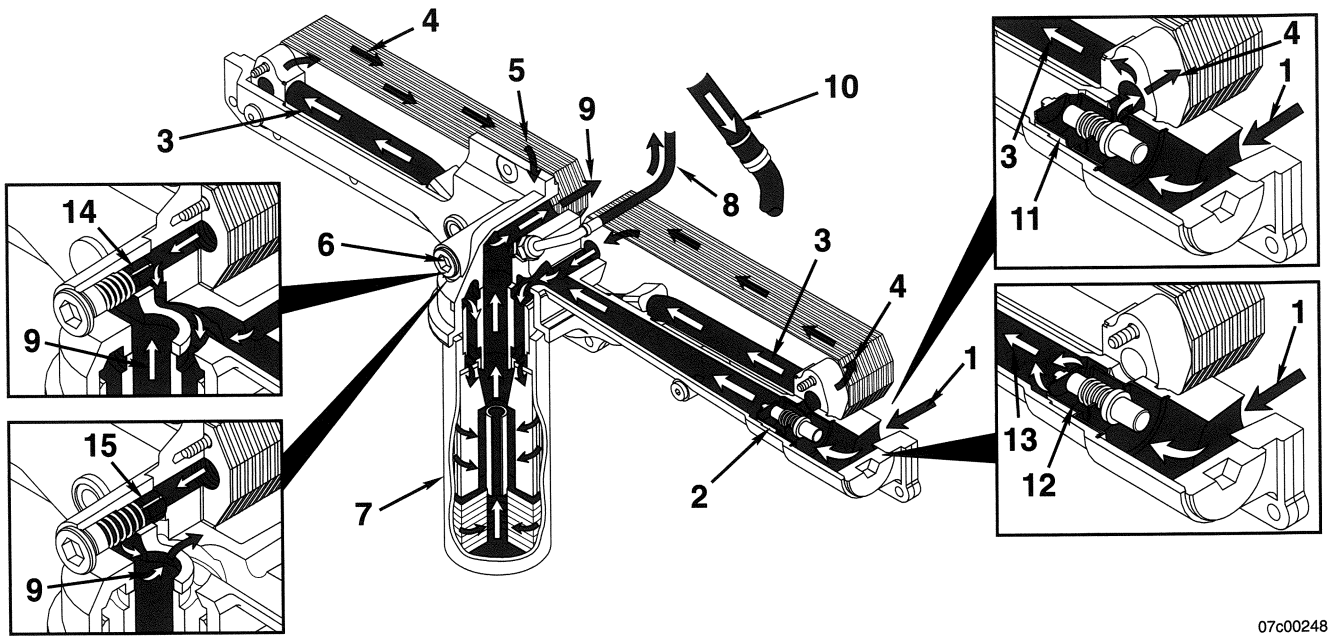
1. Lubricating Oil Flow from Oil Pump
2. Thermostat
3. Oil Cooler Bypass Flow
4. Flow through Oil Coolers
5. Flow Return to Filter Head
6. Filter Bypass Valve
7. Oil Filter
8. Flow to Turbocharger
9. Flow to Main Oil Rifle
10. Oil Drain from Turbocharger
11. Thermostat Open - Oil Flows through Oil Coolers
12. Thermostat Closed - Oil Flows Directly to Oil Filter
13. Flow to Oil Filter.

Without EGR

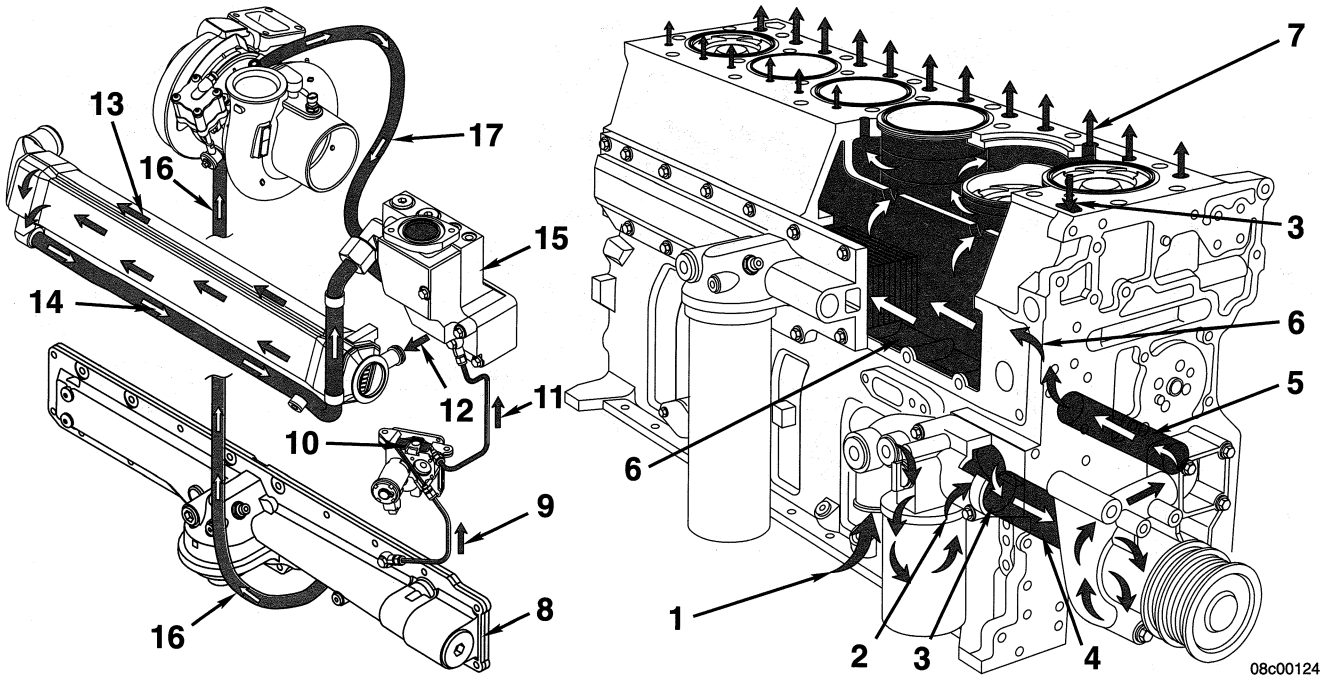


1. Lubricating Oil Flow from Oil Pump
2. Thermostat
3. Oil Cooler Bypass Flow
4. Flow through Oil Coolers
5. Oil Cooler Flow Return to Filter Head
6. Filter Bypass Valve
7. Oil Filter
8. Flow to Turbocharger
9. Flow to Main Oil Rifle
10. Oil Drain from Turbocharger
11. Thermostat Open - Oil Flows through Oil Coolers
12. Thermostat Closed - Oil Flows Directly to Oil Filter
13. Flow to Oil Filter
14. Bypass Valve Open - Oil Flows to Oil Filter
15. Bypass Valve Closed - Oil Flows Directly to Main Oil Rifle

Flow Diagram, Cooling System

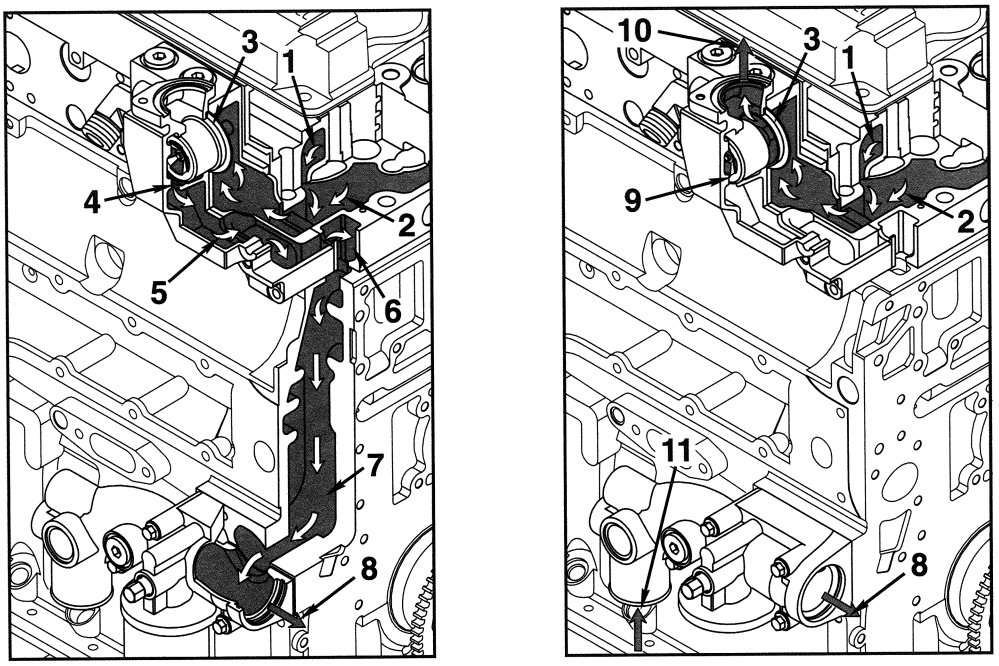
Flow Diagram

With EGR



1. Coolant Inlet
2. Coolant Flow from Coolant Filter
3. Coolant Bypass Flow from Thermostat
4. Coolant Flow to Water Pump
5. Coolant Flow from Water Pump
6. Coolant Flow past Oil Cooler
7. Coolant Flow to Cylinder Head.
8. Lubricating Oil Cooler
9. Coolant Supply to EGR Valve Body
10. Coolant Flow around EGR Valve
11. EGR Valve Coolant Return to Thermostat Housing
12. EGR Cooler Coolant Supply from Cylinder Block
13. Coolant Flow through EGR Cooler
14. EGR Cooler Coolant Return to Thermostat Housing
15. Thermostat Housing
16. Coolant Supply to Turbocharger
17. Coolant Return from Turbocharger.

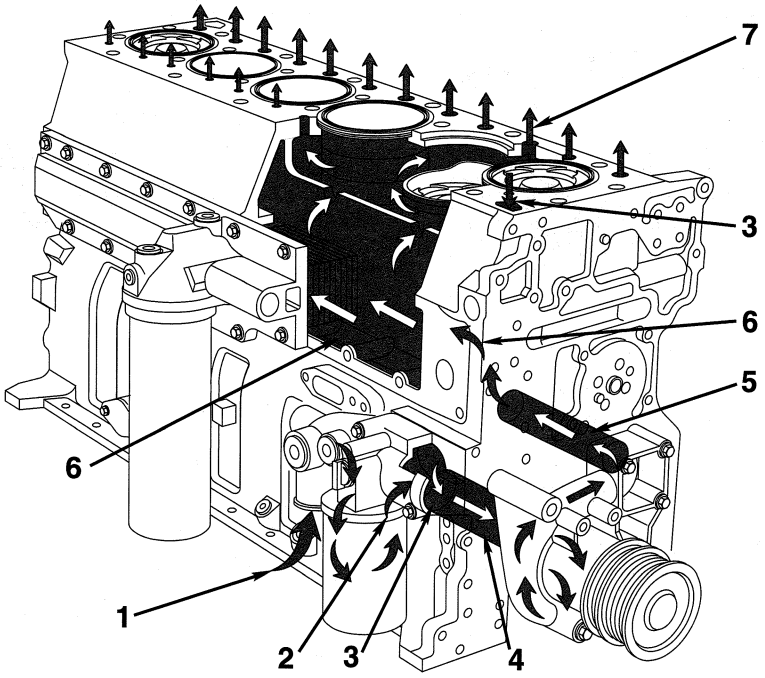
Single Thermostat



08c00125

1. Coolant Flow through Cylinder Head
2. Coolant Flow from Cylinder Head to Thermostat Housing
3. Thermostat
4. Bypass Open
5. Coolant Flow through Thermostat Housing to Bypass Passage
6. Coolant Bypass Passage
7. Coolant Bypass Flow to Water Pump
8. Coolant Flow to Water Pump
9. Bypass Closed
10. Coolant Flow to Radiator
11. Coolant Flow from Radiator.

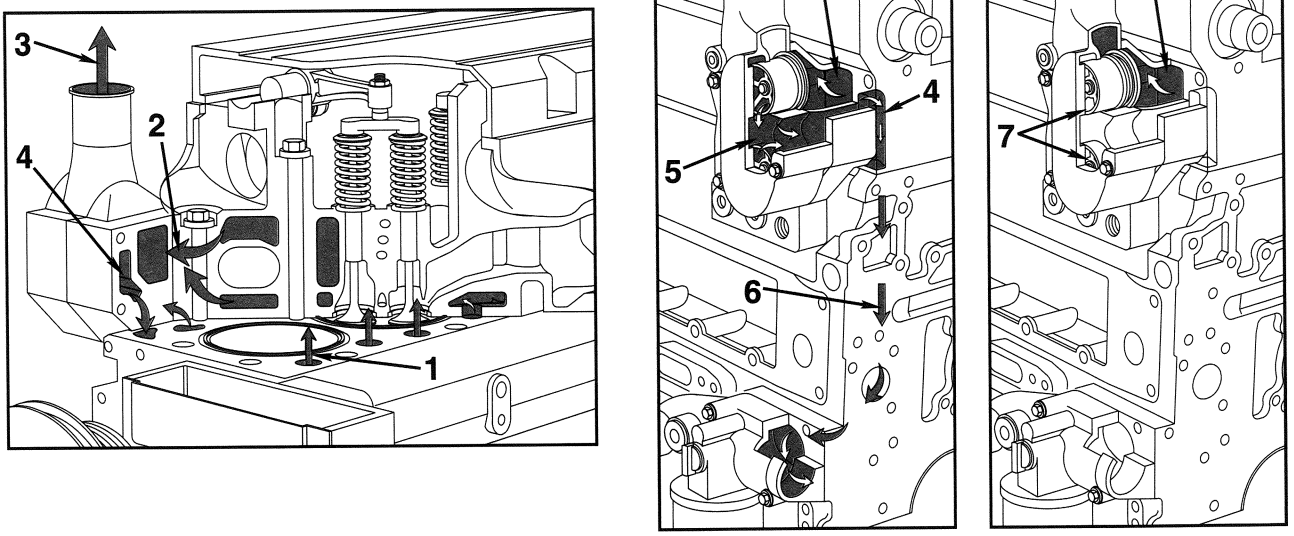
Without EGR



00c00041

1. Coolant Inlet
2. Coolant Flow from Coolant Filter
3. Coolant Bypass Flow from Thermostat
4. Coolant Flow to Water Pump
5. Coolant Flow from Water Pump
6. Coolant Flow past Oil Cooler
7. Coolant Flow to Cylinder Head.

Dual Thermostat



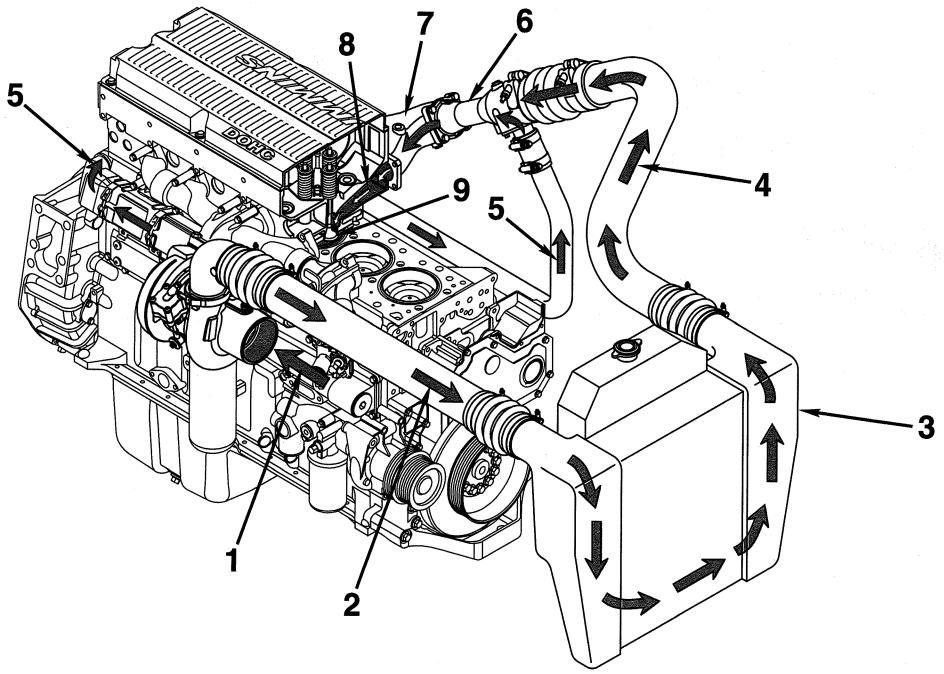
00c00042

1. Coolant Flow from Cylinder Block to Cylinder Head
2. Coolant Flow from Cylinder Head to Thermostat Housing
3. Coolant Flow to Radiator
4. Coolant Bypass Passage
5. Coolant Bypass Flow to Water Pump
6. Coolant Bypass Closed
7. Thermostats.

Flow Diagram, Air Intake System

Flow Diagram

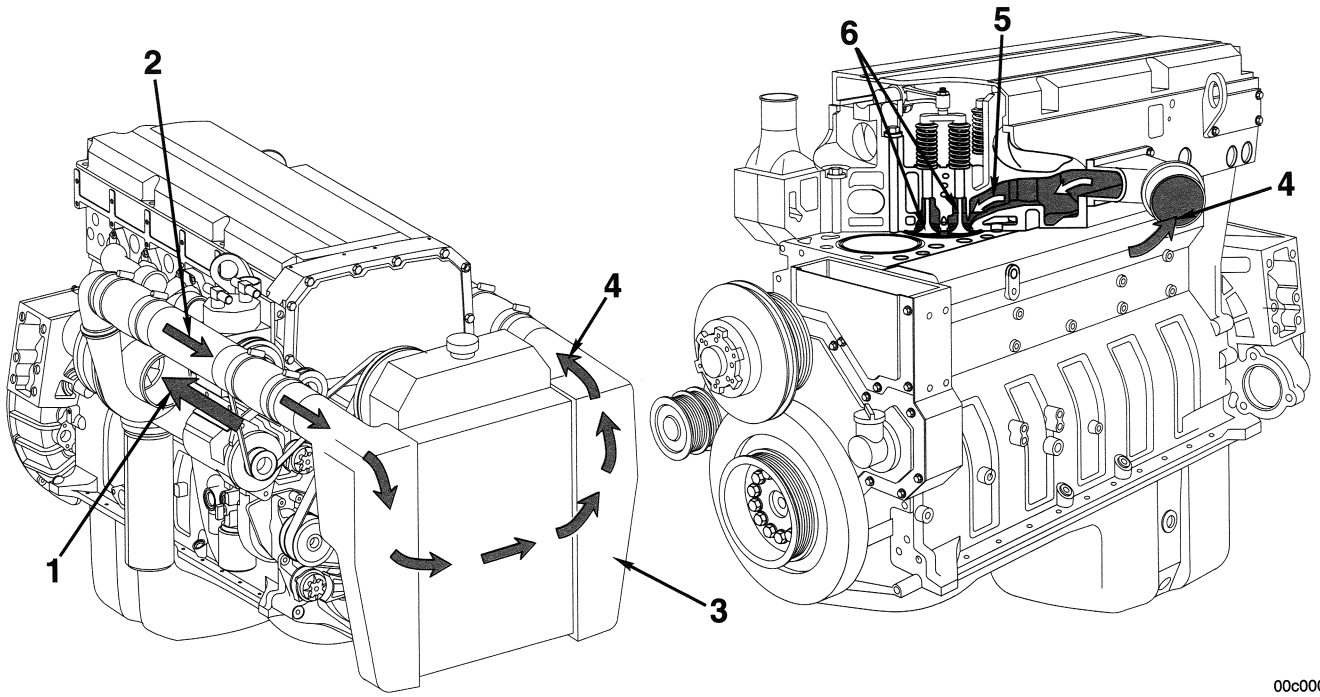
With EGR



10c00126

1. Intake Air Inlet to Turbocharger
2. Turbocharger Air to Charge Air Cooler
3. Charge Air Cooler
4. From Charge Air Cooler to Intake Manifold
5. Exhaust Gas to EGR Mixer
6. EGR Mixer
7. Air Intake Connection
8. Intake Valve Port
9. Intake Valves

Without EGR



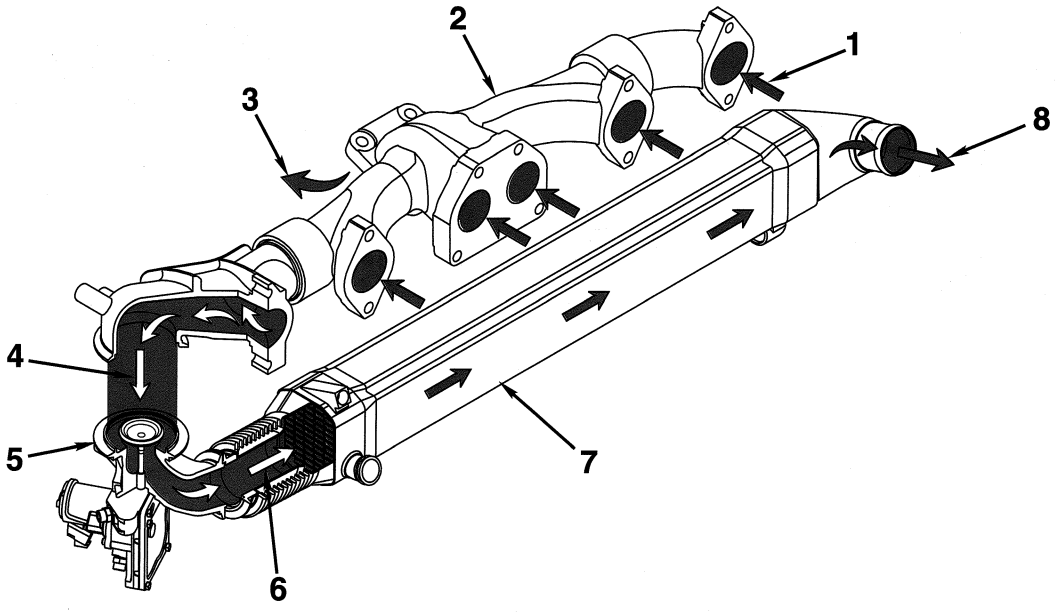
00c00005

1. Intake Air Inlet to Turbocharger
2. Turbocharger Air to Charge Air Cooler
3. Charge Air Cooler
4. From Charge Air Cooler to Intake Manifold
5. Intake Valve Port
6. Intake Valves

Flow Diagram, Exhaust System

Flow Diagram

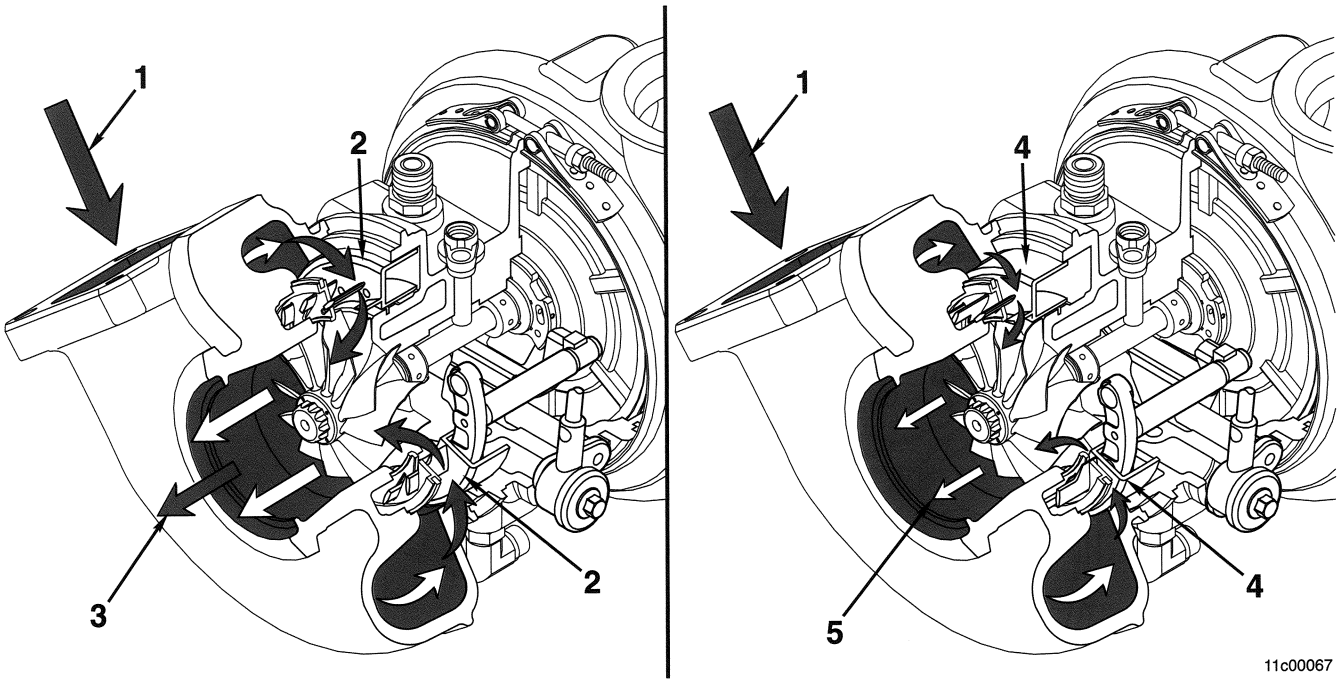
With EGR



11c00066

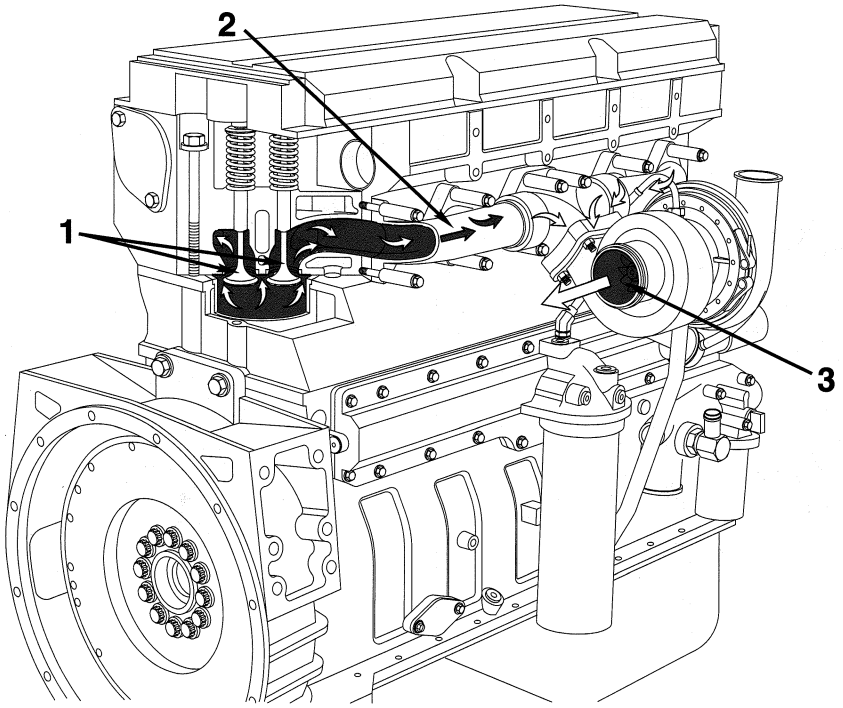
1. Exhaust Gas to Manifold
2. Exhaust Manifold
3. Exhaust Gas to Turbocharger
4. Exhaust Gas to EGR Valve
5. EGR Valve
6. Exhaust Gas to EGR Cooler Connection
7. EGR Cooler
8. Cooled Exhaust Gas to EGR Connection Tube and EGR Mixer.

Variable Geometry



1. Exhaust In
2. Sliding Nozzle Open
3. Exhaust Gas Low Velocity Flow
4. Sliding Nozzle Closed
5. Exhaust Gas High Velocity Flow.

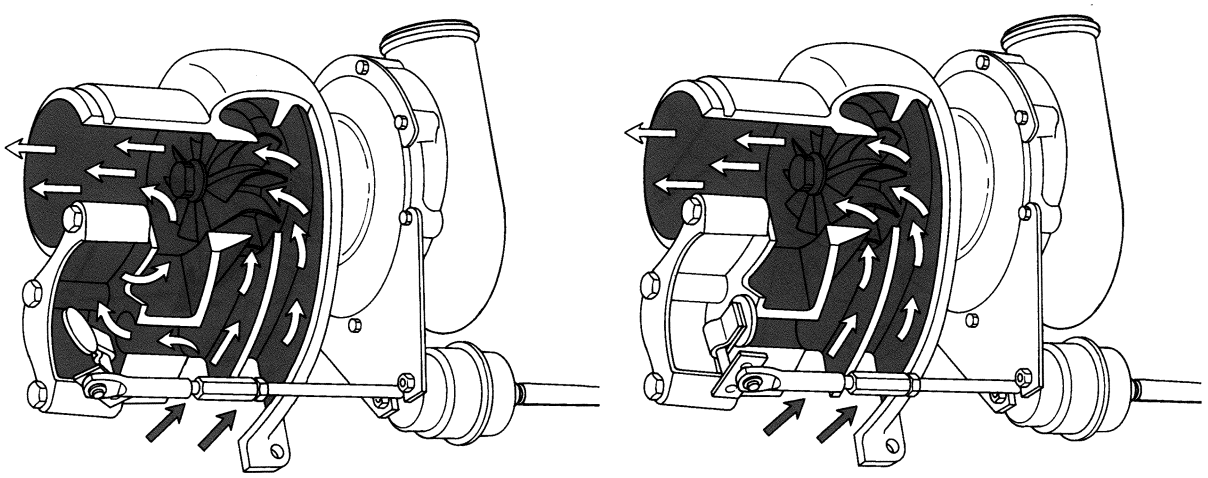
Without EGR



00c00006

1. Exhaust Valve Ports
2. Exhaust Manifold
3. Turbocharger Turbine.

Without EGR

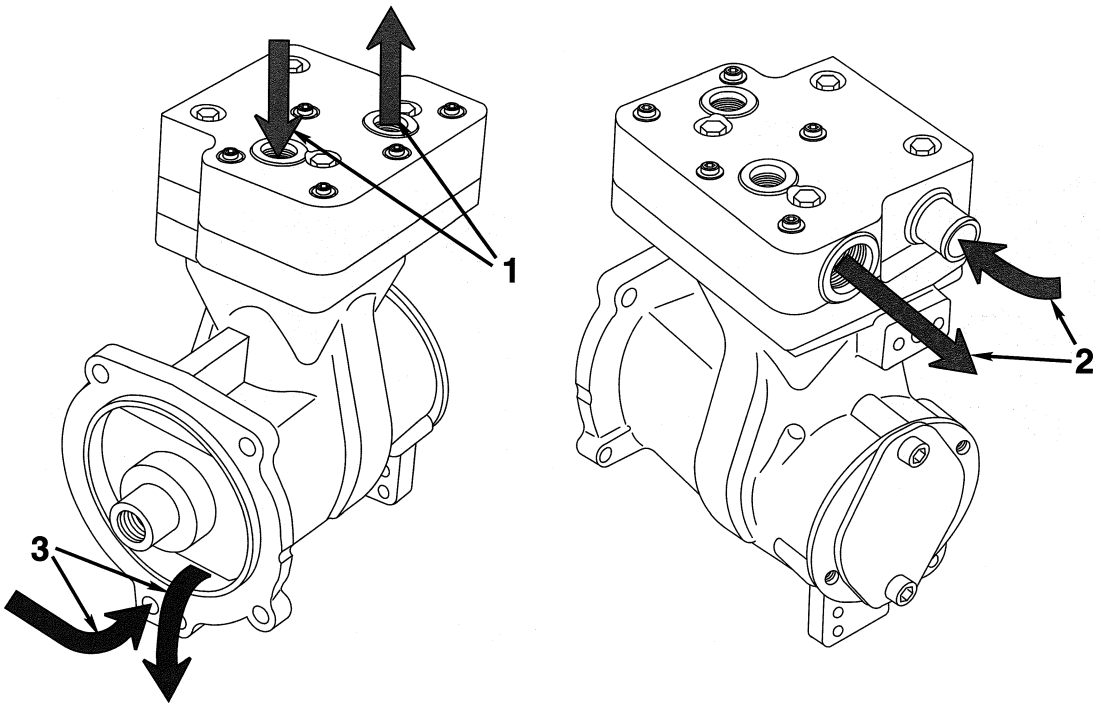


12200016

Wastegate OPEN; Wastegate CLOSED

Flow Diagram, Compressed Air System

Flow Diagram

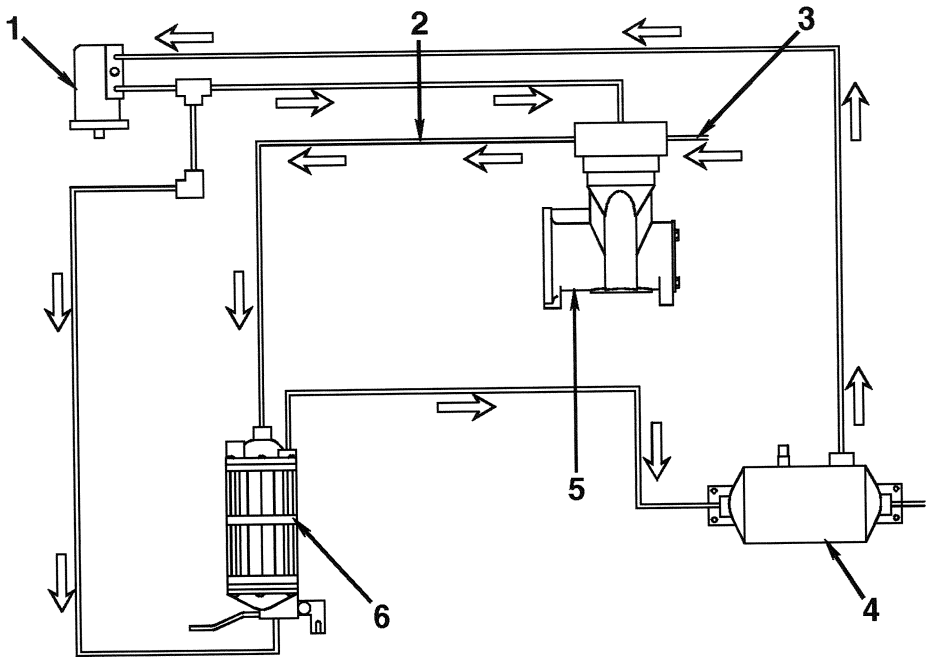


00c00007

1. Coolant
2. Air
3. Lubricant.

Flow Diagram, Compressed Air System

Flow Diagram



00c00008

WABCO - Type System with Air Dryer

1. Governor
2. Discharge
3. Intake
4. Reservior (wet tank)
5. Air Compressor
6. Air Dryer.

Notes

Cummins Service Publications Electronic Books on CD-ROM

Enclosed, we've included on CD-ROM, an electronic copy of this publication in Adobe® Acrobat® format (PDF) for your personal use and reference. **Before you begin to use the CD-ROM, please read the "Cummins Service Publications Electronic Books on CD-ROM Information" printed section, beginning on the next page.** This section includes information about this CD-ROM including System Requirements, Local Administrative Rights requirements, How to Use, Helpful Support Tips and other information.

Cummins Service Publications Electronic Books on CD-ROM Information

The enclosed CD-ROM provides you with the capability to view this publication electronically as well as perform searches. This CD-ROM is copy protected and will not allow Printing, Changing of Content, Extracting Content or Commenting / Annotating of the PDF file.

This CD-ROM is read only, and you will not be able to copy files from the CD-ROM and have them open or function in any manner. The only method to view the electronic publication is from the original CD-ROM.

This CD-ROM is intended for use by the owner of the printed publication only. Copying or distribution of content from this CD-ROM is expressly prohibited. This CD-ROM will not function from a network server CD-ROM drive. It will function only in a CD-ROM drive directly connected to your computer.

For Microsoft Windows NT 4.0, Microsoft Windows 2000 or Microsoft Windows XP, this CD-ROM requires that you have Local Administrative rights in order to use. See the System requirements section for additional details.

System Requirements:

Use of the Cummins Service Publications Electronic Books on CD-ROM requires Adobe Acrobat, Adobe Acrobat Reader, or Adobe Reader software to be pre-installed on your computer. This product has been tested for compatibility with Adobe Acrobat software versions 5.0, 6.0 and 7.0. It may function properly with versions later than Adobe Acrobat 7.0, but testing has not been performed. Acrobat Reader is available as a free download from www.adobe.com.

The Cummins Service Publications Electronic Books on CD-ROM product requires the following system components:

- Microsoft Windows Auto-Play must be enabled on your computer (it is enabled by default when Windows is installed)
- CD-ROM Drive
- Color Monitor with at least 800x600 resolution graphics
- Microsoft Windows XP Professional or Microsoft Windows 2000 Professional. This CD-ROM may be compatible with Microsoft Windows 98 SE, Microsoft Windows NT 4.0, or Microsoft Windows XP Home Edition, but testing has not been performed.
- Recommended memory, processor speed and available hard-disk space is in accordance with respective Microsoft Operating System Guidelines, as well as Adobe Acrobat system requirements listed later in these instructions.

Note: The Cummins Service Publications Electronic Books on CD-ROM product is not Macintosh compatible.

About required Local Administrative Rights:

The copy protection system used on this product requires direct access to CD-ROM drives in order to authenticate copy protected discs.

In order to allow the software to enable direct access to CD-ROM drives rights under Microsoft Windows, if you are using Microsoft Windows NT 4.0, Microsoft Windows 2000 or Microsoft Windows XP, your logon account/profile must have Local Administrative Rights on the computer you will be using your Cummins Service Publications Electronic Book on CD-ROM with. If this computer is set up in Restricted Mode, and your logon account/profile does not have Local Administrative Rights, then, with approval of your I.T. department or the owner of your computer, you can choose from the following options to allow the Cummins Service Publications Electronic Book on CD-ROM to function properly:

- Have your computer account enabled to have Local Administrative rights and then you can run the Cummins Service Publications Electronic Book on CD-ROM - OR -
- Have a user with Local Administrative Rights logon to your computer and run the CD-ROM one time. By doing this, the necessary files will be loaded to your computer and your computer will be enabled to have direct access to CD-ROM drives. Then restart this computer. It is very important to restart the computer after you have done this. For all future needs, you can run the Cummins Service Publications Electronic Book on CD-ROM under your own account, without requiring your logon account/profile to have Local Administrative Rights. (Note: This needs to be done only once for any Cummins Service Publications Electronic Book on CD-ROM and then does not need to be done again for other Cummins Service Publications Electronic Book on CD-ROM titles you may own.)

Cummins Service Publications Electronic Books on CD-ROM Information (continued)

About the Copy Protection Software:

- This product may upgrade the proprietary copy protection software files it uses that are placed on your computer system to a new version, if an older version exists on your computer. If you have CD-ROM copy protected items from other companies and they use older versions of the same HexaLock copy protection software that the Cummins Service Publications Electronic Books on CD-ROM uses, it may render them incompatible for use on your computer.

Adobe Acrobat Reader 5.0 system requirements:

- PC Compatible computer w/ Intel® Pentium® processor
- One of the following Microsoft® Windows Operating Systems:
  - Microsoft Windows 98 SE
  - Microsoft Windows Millennium Edition
  - Microsoft Windows NT® 4.0 with Service Pack 5
  - Microsoft Windows 2000
  - Microsoft Windows XP
- 64MB of RAM
- 24MB of available hard-disk space
- Additional 70MB of hard-disk space for Asian fonts (optional)

(Asian fonts are not required for Cummins Service Publications Electronic Books on CD-ROM product.)

Adobe Reader 6.0.1 system requirements:

- PC Compatible computer w/ Intel Pentium processor
- One of the following Microsoft Windows Operating Systems:
  - Microsoft Windows 98 SE
  - Microsoft Windows Millennium Edition
  - Microsoft Windows NT 4.0 with Service Pack 6
  - Microsoft Windows 2000 with Service Pack 2
  - Microsoft Windows XP Professional or Home Edition
  - Microsoft Windows XP Tablet PC Edition
- 32MB of RAM (64MB recommended)
- 60MB of available hard-disk space
- Microsoft Internet Explorer 5.0.1, 5.5, 6.0, or 6.1

Adobe Reader 7.0 system requirements:

- PC Compatible computer w/ Intel Pentium processor
- One of the following Microsoft Windows Operating Systems:
  - Microsoft Windows 2000 with Service Pack 2
  - Microsoft Windows XP Professional or Home Edition
  - Microsoft Windows XP Tablet PC Edition
- 128MB of RAM
- Up to 90MB of available hard-disk space
- Microsoft Internet Explorer 5.5 or higher

How to Use the Cummins Service Publications Electronic Book on CD-ROM:

To use the CD-ROM, simply insert the CD-ROM into your computer and it should automatically run, open Adobe Acrobat and open the Electronic Book. (This happens with Microsoft Windows Auto-Play functionality, and Adobe Acrobat pre-loaded by you on your computer).

Cummins Service Publications Electronic Books on CD-ROM Information (continued)

Helpful Support Tips:

- If Windows Auto-Play is not enabled, try re-enabling it, or navigate with Windows Explorer to your CD-ROM drive and double click on the CD-ROM drive letter to open it. Then double-click on the program named "clickhere". (Do not attempt to directly open the PDF file by clicking on the PDF document.)
- In rare occasions, after inserting the CD-ROM you may receive a notice from Adobe Acrobat that it "could not open the PDF because it is either not a supported file type or the file has been corrupted". This can occur in rare occasions due to application timing issues. If this occurs there are several options to remedy the situation: 1) Simply click OK on the notice, eject the CD-ROM and re-insert it to have it restart the program, or 2) Click OK on the notice and navigate with Windows Explorer to your CD-ROM drive and double click on the CD-ROM drive letter to open it. Then double-click on the program named "clickhere". (Do not attempt to directly open the PDF file by clicking on the PDF document) or 3) Click OK on the notice, eject the CD-ROM, restart your computer and after the system has restarted, re-insert the CD-ROM and have it automatically run.
- If the Cummins Service Publications Electronic Books on CD-ROM does not function, see the prior section on "About required Local Administrative Rights:" in this documentation and verify you have Local Administrative Rights on your computer in order to run the CD-ROM.

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Support for this product is available from Monday through Friday weekly, excluding Holidays, from 8 a.m. to 5 p.m. You may call (502) 540-4981 for telephone support. For e-mail support, please e-mail ebooksupport@merrickind.com.

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Up to 90 days from date of purchase:

Within the first 90 days from your date of purchase, if your copy of an Electronic Book on CD-ROM does not function, and after a Cummins Electronic Book Technical Support Technician has confirmed the situation and authorized its replacement by providing you an RMA#, you may send back the CD-ROM for a free replacement. To do so, you must package the CD-ROM and ship/mail, with postage pre-paid by you, to the below address. You must also include a photocopy of the original invoice for proof of purchase of the publication clearly indicating the bulletin # and the purchase date. The RMA# must be on the address information of the package. If the proof of purchase copy of the invoice is not enclosed, your request will not be able to be processed and will not be returned. Delivery of the replacement will be shipped to you at no charge. Allow 3 to 4 weeks for your receipt of replacement copy. Note: Return only the non-functional CD-ROM, do not return the entire printed publication. The replacement CD-ROM maintains the original purchase/invoice date for the purposes of this replacement policy. This policy is subject to change at any time, without notice. For a copy of the most current replacement options policy, please e-mail ebooksupport@merrickind.com with your request.

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RMA#: XXXXXX (where XXXXXX is the RMA#)
808 E. Liberty Street
Louisville, KY 40204 U.S.A.

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Section L - Service Literature

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Additional Service Literature

General Information

The following publications can be purchased:

Bulletin No.	Title of Publication
3379001	Fuel for Cummins Engines
3810340	Cummins Engine Oil Recommendations
3387251	Coolant Additives and Filtration
3387266	Cold Weather Operation
3666209	Cooling System Maintenance Extended Interval
3666239	Troubleshooting and Repair Manual, Signature, ISX, and QSX15 Engines
3666259	Troubleshooting and Repair Manual, Electronic Control System, Signature ISX, and QSX15 Engines
3666393	Troubleshooting and Repair Manual Generator-Drive Control System QSX15, QSK45, and QSK60 Engines
3666394	Troubleshooting and Repair Manual PowerCommand Control QSX15, QSK45, and QSK60 Generator Sets
3666414	QSX15 Industrial Wiring Diagram
3666349	QSX15 Generator Drive Wiring Diagram
3666466	QSX15 PowerCommand Control Wiring Diagram

Service Literature Ordering Location
Contact Information

Region	Ordering Location
United States and Canada	Cummins Distributors or Credit Cards at 1-800-646-5609 or Order online at www.powerstore.cummins.com
U.K., Europe, Mid-East, Africa, and Eastern European Countries	Cummins Engine Co., Ltd. Royal Oak Way South Daventry Northants, NN11 5NU, England
South and Central America (excluding Brazil and Mexico)	Cummins Americas, Inc. 16085 N.W. 52nd Avenue Hialeah, FL 33104
Brazil and Mexico	Cummins Inc. International Parts Order Dept., MC 40931 Box 3005 Columbus, IN 47202-3005
Far East (excluding Australia and New Zealand)	Cummins Diesel Sales Corp. Literature Center 8 Tanjong Penjuru Jurong Industrial Estate Singapore
Australia and New Zealand	Cummins Diesel Australia Maroondah Highway, P.O.B. 139 Ringwood 3134 Victoria, Australia

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

Section M - Component Manufacturers

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Auxiliary Brakes M-1
Belts M-1
Catalytic Converters M-1
Coolant Level Switches M-1
Clutches M-1
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Prelubrication Systems M-3
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Torque Converters M-3

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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

Truflo 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

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

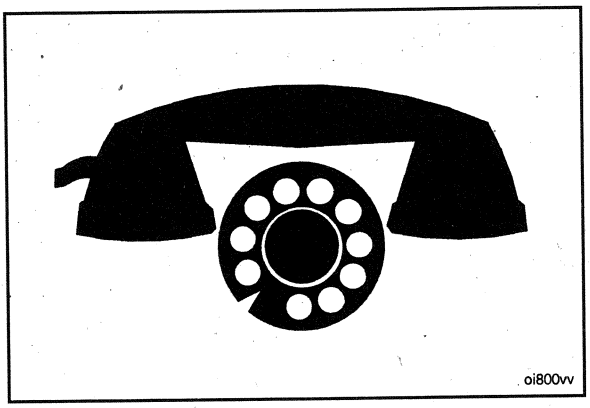
General Information

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

NOTE: The following list contains offices in U.S., Canada, Australia, New Zealand, and Puerto Rico.

United States	**Southern Division Office**	Cummins Engine Company, Inc. 425 Franklin Road S.W. Suite 500 Marietta, GA 30067 Telephone: (770) 423-1108 FAX: (770) 499-8240
United States	**Plains Regional Office**	Cummins Engine Company, Inc. 1901 Central Drive Suite 356 Bedford, TX 76021 Telephone: (817) 267-3172 FAX: N/A
Canada	**Canadian Division Office**	Cummins Diesel of Canada, Ltd. 5575 North Service Road Burlington, Ontario L726M1 Telephone: (905) 331-5944 FAX: (905) 331-0276
Canada	**Western Canada Regional Office**	Cummins Diesel of Canada, Ltd. 18452 - 96th Avenue Surrey, B.C. V3T 4W2 Telephone: (604) 882-5727 FAX: (604) 882-9110
Canada	**Eastern Canada Regional Office**	Cummins Diesel of Canada Ltd. 7200 Trans Canada Hwy. Pt. Cuaire, Quebec H9R 1C0 Telephone: (514) 695-2402 FAX: (514) 695-8917
Canada	**Central Canada Regional Office**	Cummins Diesel of Canada Ltd. 4887 - 35th Street SE Calgary, Alberta T2B 3C6 FAX: (403) 569-9974
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 Latin America**	3088 N. Commerce Parkway MPC #14, Building A Miramar, FL 33025 Telephone: (305) 621-1300 **NOTE:** This office serves Puerto Rico and South America excluding Brazil.

Distributors and Branches - United States

Alabama	**Birmingham Distributor**	Cummins Alabama, Inc. 2200 Pinson Highway P.O. Box 1147 Birmingham, AL 35201 Telephone: (205) 841-0421 FAX: (205) 849-5926
Alabama	**Mobile Branch**	Cummins Alabama, Inc. 1924 N. Beltline Hwy. Mobile, AL 36601-1598 Telephone: (334) 456-2236 FAX: (334) 452-6419
Alabama	**Mobile Onan/Marine Branch**	Cummins Alabama, Inc. 3422 Georgia Pacific Avenue Mobile, AL 36617 Telephone: (334) 452-6426 FAX: (334) 473-6657
Alabama	**Montgomery Branch**	Cummins Alabama, Inc. 2325 West Fairview Avenue Montgomery, AL 36108 Telephone: (205) 263-2594 FAX: (205) 263-2594
Alaska	**Anchorage - (Branch of Seattle)**	Cummins Northwest, Inc. 2618 Commercial Drive Anchorage, AK 99501-3095 Telephone: (907) 279-7594 FAX: (907) 276-6340
Arizona	**Phoenix Distributor and Branch**	Cummins Southwest, Inc. 2239 N. Black Canyon Hgwy Phoenix, AZ 85009 Telephone: (602) 252-8021 FAX: (602) 253-6725
Arizona	**Tucson Branch**	Cummins Southwest, Inc. 1912 West Prince Road Tucson, AZ 85705 Telephone: (520) 887-7440 FAX: (520) 887-4173
Arkansas	**Little Rock - (Branch of Memphis)**	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 Distributor**	Cummins West, Inc. 14775 Wicks Blvd. San Leandro, CA 94577-6779 Telephone: (510) 351-6101 FAX: (510) 352-3925

California	**Arcata Branch**	Cummins West, Inc. 4801 West End Road Arcata, CA 95521 Telephone: (707) 822-7392 FAX: (707) 822-7585
California	**Bakersfield Branch**	Cummins West, Inc. 4601 East Brundage Lane Bakersfield, CA 93307 Telephone: (805) 325-9404 FAX: (805) 861-8719
California	**Fresno Branch**	Cummins West, Inc. 2740 Church Avenue Fresno, CA 93706 Telephone: (209) 495-4745 FAX: (209) 486-7402
California	**Redding Branch**	Cummins West, Inc. 20247 Charlanne Drive Redding, CA 96001 Telephone: (916) 222-4070 FAX: (916) 224-4075
California	**Stockton Branch**	Cummins West, Inc. 41 West Yokuts Avenue Suite 131 Stockton, CA 95207 Telephone: (209) 473-0386 FAX: (209) 478-2454
California	**West Sacramento Branch**	Cummins West, Inc. 2661 Evergreen Avenue West Sacramento, CA 95691 Telephone: (916) 371-0630 FAX: (916) 371-2849
California	**Los Angeles Distributor**	Cummins Cal Pacific Inc. 1939 Deere Avenue (Irvine) Irvine, CA 92606 Telephone: (949) 253-6000 FAX: (949) 253-6080
California	**Montebello Branch**	Cummins Cal Pacific Inc. 1105 South Greenwood Avenue Montebello, CA 90640 Telephone: (323) 728-8111 FAX: (323) 889-7422
California	**Bloomington Branch**	Cummins Cal Pacific Inc. 3061 S. Riverside Avenue Bloomington, CA 92377 Telephone: (909) 877-0433 FAX: (909) 877-3787
California	**San Diego Branch**	Cummins Cal Pacific Inc. 310 N. Johnson Avenue El Cajon, CA 92020 Telephone: (619) 593-3093 FAX: (619) 593-0600

California	**Ventura Branch**	Cummins Cal-Pacific Inc. 3958 Transport St. Ventura, CA 93003 Telephone: (805) 644-7281 FAX: (805) 644-7284
Colorado	**Denver Distributor**	Cummins Rocky Mountain, Inc. 5100 East 58th Avenue Commerce City, CO 80022 Telephone: (303) 287-0201 FAX: (303) 288-7080
Colorado	**Denver Onan/Industrial Branch**	Cummins Rocky Mountain, Inc. 5100 East 58th Ave. Commerce City, CO 80022 Telephone: (303) 286-7697 FAX: (303) 287-4837
Colorado	**Durango Branch**	Cummins Rocky Mountain, Inc. 13595 County Road 213 Durango, CO 81301 Telephone: (970) 259-7470 FAX: (970) 259-7482
Colorado	**Grand Junction Branch**	Cummins Rocky Mountain, Inc. 2380 U.S. Highway 6 & 50 P.O. Box 339 Grand Junction, CO 81501 Telephone: (303) 242-5776 FAX: (303) 243-5495
Connecticut	**Rocky Hill - (Branch of Bronx)**	Cummins Metropower, Inc. 914 Cromwell Ave. Rocky Hill, CT 06067 Telephone: (860) 529-7474 FAX: (860) 529-7524
Florida	**Tampa Distributor**	Cummins Southeastern Power, Inc. Corporate Office 5421 N. 59th Street Tampa, FL 33610 Telephone: (813) 621-7202 FAX: (813) 621-8250
Florida	**Ft. Myers Branch**	Cummins Southeastern Power, Inc. 2671 Edison Avenue Ft. Myers, FL 33902 Telephone: (941) 337-1211 FAX: (941) 337-5374
Florida	**Jacksonville Branch**	Cummins Southeastern Power, Inc. 755 Pickettville Rd. Jacksonville, FL 32220 Telephone: (904) 378-1902 FAX: (904) 378-1904
Florida	**Hialeah (Miami) Branch**	Cummins Southeastern Power, Inc. 9900 N.W. 77th Avenue Hialeah Gardens, FL 33016 Telephone: (305) 821-4200 FAX: (305) 557-2992

Florida	**Ocala Branch**	Cummins Southeastern Power 321 Southwest 52nd Ave. Ocala, FL 34474-1892 Telephone: (352) 861-1122 FAX: (352) 861-1130
Florida	**Orlando Branch**	Cummins Southeastern Power, Inc. 4020 North Orange Blossom Trail Orlando, FL 32810 Telephone: (407) 298-2080 FAX: (407) 290-8727
Florida	**Tampa Branch**	Cummins Southeastern Power, Inc. 5912 E. Hillsborough Avenue Tampa, FL 33610 Telephone: (813) 626-1101 FAX: (813) 628-4183
Georgia	**Atlanta Distributor**	Cummins South, Inc. 5125 Georgia Highway 85 College Park, GA 30349 Telephone: (404) 763-0151 FAX: (404) 766-2132
Georgia	**Albany Branch**	Cummins South, Inc. 1915 W. Oakridge Drive Albany, GA 31707-4938 Telephone: (912) 888-6210 FAX: (912) 883-1670
Georgia	**Atlanta Branch**	Cummins South, Inc. 100 University Avenue, S.W. Atlanta, GA 30315-2202 Telephone: (404) 527-7800 FAX: (404) 527-7832
Georgia	**Augusta Branch**	Cummins South, Inc. 1255 New Savannah Road Augusta, GA 30901-3891 Telephone: (706) 722-8825 FAX: (706) 722-7553
Georgia	**Savannah Branch**	Cummins South, Inc. 8 Interchange Court Savannah, GA 31401-1627 Telephone: (912) 232-5565 FAX: (912) 232-5145
Hawaii	**Kapolei Distributor**	Cummins Hawaii Diesel Power, Inc. 91-230 Kalaeloa Blvd. Kapolei, HI 96707 Telephone: (808) 682-8110 FAX: (808) 682-8477
Idaho	**Boise - (Branch of Salt Lake City)**	Cummins Intermountain, Inc. 2851 Federal Way City Boise, ID 83705 Telephone: (208) 336-5000 FAX: (208) 338-5436

Idaho	**Pocatello - (Branch of Salt Lake City)**	Cummins Intermountain, Inc. 14299 Highway 30 West Pocatello, ID 83201 Telephone: (208) 234-1661 FAX: (208) 234-1662
Illinois	**Chicago Distributor**	Cummins Northern Illinois, Inc. 7145 Santa Fe Drive Hodgkins, IL 60525 Telephone: (708) 579-9222 FAX: (708) 352-7547
Illinois	**Bloomington-Normal - (Branch of Indianapolis)**	Cummins Mid-States Power, Inc. (at U.S. 51 N and I-55) 414 W. Northtown Road Bloomington-Normal, IL 61761 Telephone: (309) 452-4454 FAX: (309) 452-1642
Illinois	**Onan Branch**	Cummins/Onan Northern Illinois 8745 W. 82nd Place Justin, IL 60458 Telephone: (708) 563-7070 FAX: (708) 563-7095
Illinois	**Harrisburg (Branch of St. Louis)**	Cummins Gateway, Inc. Highway 45 North Harrisburg, IL 62946 Telephone: (618) 273-4138 FAX: (618) 273-4531
Illinois	**Rock Island - (Branch of Omaha)**	Cummins Great Plains Diesel, Inc. 7820 - 42nd Street West Rock Island, IL 61204 Telephone: (309) 787-4300 FAX: (309) 787-4397
Illinois	**Onan Branch**	Cummins Gateway, Inc. #1 Extra Mile Drive Collinsville, IL 62234 Telephone: (618) 345-0123 FAX: (314) 531-6604
Indiana	**Indianapolis Distributor**	Cummins Mid-States Power, Inc. P.O. Box 42917 3762 West Morris Street Indianapolis, IN 46242-0917 Telephone: (317) 243-7979 FAX: (317) 240-1925
Indiana	**Evansville - (Branch of Louisville)**	Cummins Cumberland, Inc. 7901 Highway 41 North Evansville, IN 47711 Telephone: (812) 867-4400 FAX: (812) 421-3282
Indiana	**Ft. Wayne Branch**	Cummins Mid-States Power, Inc. 3415 Coliseum Blvd. West (At Jct. I-69 & 30/33) Ft. Wayne, IN 46808 Telephone: (219) 482-3691 FAX: (219) 484-8930

Indiana	**Gary - (Branch of Chicago)**	Cummins Northern Illinois, Inc. 1440 Texas Street Gary, IN 46402 Telephone: (219) 885-5591 FAX: (219) 883-4817
Indiana	**Indianapolis Branch**	Cummins Mid-States Power, Inc. P. O. Box 42917 3621 West Morris Street Indianapolis, IN 46242-0917 Telephone: (317) 244-7251 FAX: (317) 240-1215
Indiana	**Onan Branch**	Mid-States Power, Inc. 4301 W. Morris Street P.O. Box 42917 Indianapolis, IN 46240-0917 Telephone: (317) 240-1967 FAX: (317) 240-1975
Iowa	**Cedar Rapids - (Branch of Omaha)**	Cummins Great Plains Diesel, Inc. 625 - 33rd Avenue SW Cedar Rapids, IA 52406 Telephone: (319) 366-7537 (24 hours) FAX: (319) 366-7562
Iowa	**Des Moines - (Branch of Omaha)**	Cummins Great Plains Diesel, Inc. 1680 N.E. 51st Avenue P.O. Box B Des Moines, IA 50313 Telephone: (515) 262-9591 Parts: (515) 262-9744 FAX: (515) 262-0626
Iowa	**Des Moines - (Branch of Omaha)**	Midwestern Power Products Division of Cummins Great Plains Diesel, Inc. 5194 N.E. 17th Street Des Moines, IA 50313 Telephone: (515) 264-1650 FAX: (515) 264-1651
Kansas	**Colby - (Branch of Kansas City, Missouri)**	Cummins Mid-America, LLC. 1880 South Range Colby, KS 67701 Telephone: (785) 462-3945 FAX: (785) 462-3970
Kansas	**Garden City - (Branch of Kansas City, Missouri)**	Cummins Mid-America, Inc. 1285 Acraway Garden City, KS 67846 Telephone: (316) 275-2277 FAX: (316) 275-2533
Kansas	**Wichita - (Branch of Kansas City, Missouri)**	Cummins Mid-America, Inc. 5101 North Broadway Wichita, KS 67201 Telephone: (316) 838-0875 FAX: (316) 838-0704

Kentucky	**Louisville Distributor**	Cummins Cumberland, Inc. (Corporate Office) 2301 Nelsonville Parkway Louisville, KY 40223 Telephone: (502) 254-3363 FAX: (502) 254-9272
Kentucky	**Hazard Branch**	Cummins Cumberland, Inc. Highway 15 South P.O. Box 510 Hazard, KY 41701 Telephone: (606) 436-5718 FAX: (606) 436-5038
Kentucky	**Louisville Branch**	Cummins Cumberland, Inc. 9820 Bluegrass Parkway Louisville, KY 40299 Telephone: (502) 491-4263 FAX: (502) 499-0896
Louisiana	**Morgan City - (Branch of Memphis)**	Cummins Mid-South, Inc. Hwy. 90 East P.O. Box 1229 Amelia, LA 70340 Telephone: (504) 631-0576 FAX: (504) 631-0081
Louisiana	**New Orleans - (Branch of Memphis)**	Cummins Mid-South, Inc. 110 E. Airline Highway Kenner, LA 70062 Telephone: (504) 468-3535 FAX: (504) 465-3408
Maine	**Bangor (Branch of Boston)**	Cummins Northeast, Inc. 221 Hammond Street Bangor, ME 04401 Telephone: (207) 941-1061 FAX: (207) 945-3170
Maine	**Scarborough - (Branch of Boston)**	Cummins Northeast, Inc. 10 Gibson Road Scarborough, ME 04074 Telephone: (207) 883-8155 FAX: (207) 883-5526
Maryland	**Baltimore Distributor**	Cummins Power Systems, Inc. 1907 Parkwood Drive MD 21061 Telephone: (410) 590-8700 FAX: (410) 590-8723
Massachusetts	**Boston Distributor**	Cummins Northeast, Inc. 100 Allied Drive Dedham, MA 02026 Telephone: (781) 329-1750 FAX: (781) 329-4428
Massachusetts	**Springfield Branch**	Cummins Northeast, Inc. 177 Rocus Street Springfield, MA 01104 Telephone: (413) 737-2659 FAX: (413) 731-1082

Mexico	**Tijuana - (Branch of Los Angeles)**	Distribuidora Cummins De Baja Blvd. 3ra. Oeste No. 17523 Fracc. Industrial Garita de Otay C.P. 22400 Tijuana, Baja California Mexico Telephone: 011-52-66-238433 FAX: 011-52-66-238649
Michigan	**Detroit (Novi) Distributor**	Cummins Michigan, Inc. 41216 Vincenti Court Novi, MI 48375 Telephone: (248) 478-9700 FAX: (248) 478-1570
Michigan	**Blissfield, Michigan**	Diesel Fuel Systems, Inc. Subsidiary of Cummins Michigan Inc. 211 N. Jipson Street Blissfield, MI 49228 Telephone: (517) 486-4324 FAX: (517) 486-3614
Michigan	**Dearborn Branch**	Cummins Michigan, Inc. 3760 Wyoming Avenue Dearborn, MI 48120 Telephone: (313) 843-6200 FAX: (313) 843-6070
Michigan	**Grand Rapids Branch**	Cummins Michigan, Inc. 3715 Clay Avenue, S.W. Grand Rapids, MI 49508 Telephone: (616) 538-2250 FAX: (616) 538-3830
Michigan	**Grand Rapids Branch**	Standby Power, Inc. 7580 Expressway Drive S.W. Grand Rapids, MI 49548 Telephone: (616) 281-2211 FAX: (616) 281-3177
Michigan	**Iron Mountain - (Branch of De Pere)**	Cummins Great Lakes, Inc. 1901 Stevenson Avenue Iron Mountain, MI 49801 Telephone: (906) 774-2424 (800) 236-2424 FAX: (906) 774-1190
Michigan	**Novi Branch**	Cummins Michigan, Inc. 25100 Novi Road Novi, MI 48375 Telephone: (248) 380-4300 FAX: (248) 380-0910
Michigan	**Power Products (Branch of Detroit)**	Cummins Michigan, Inc. 41326 Vincenti Ct. Novi, MI 48375 Telephone: (248) 426-9300 FAX: (248) 473-8560
Michigan	**Saginaw Branch**	Cummins Michigan, Inc. 722 N. Outer Drive Saginaw, MI 48605 Telephone: (517) 752-5200 FAX: (517) 752-4194

Michigan	**Standby Power - (Branch of Detroit)**	Cummins Michigan, Inc. 12130 Dixie Redford, MI 48239 Telephone: (313) 538-0200 FAX: (313) 538-3966
Minnesota	**St. Paul Distributor**	Cummins North Central, Inc. 3030 Centre Pointe Drive Suite 500 Roseville, MN 55113 Telephone: (651) 636-1000 FAX: (651) 638-2442
Minnesota	**Duluth Branch**	Cummins Diesel Sales, Inc. 3115 Truck Center Drive Duluth, MN 55806-1786 Telephone: (218) 628-3641 FAX: (218) 628-0488
Minnesota	**St. Paul Branch**	Cummins North Central, Inc. 2690 Cleveland Ave. North St. Paul, MN 55113 Telephone: (651) 636-1000 FAX: (651) 638-2497
Mississippi	**Jackson - (Branch of Memphis)**	Cummins Mid-South, Inc. 325 New Highway 49 South Jackson, MS 39288-4224 Telephone: Admin.: (601) 932-7016 Parts: (601) 932-2720 Service: (601) 939-1800 FAX: (601) 932-7399
Missouri	**Kansas City Distributor and Branch**	Cummins Mid-America, Inc. 8201 NE Parvin Road Kansas City, MO 64161 Telephone: (816) 414-8200 FAX: (816) 414-8299
Missouri	**Joplin Branch**	Cummins Mid-America, Inc. 3507 East 20th Street Joplin, MO 64801 Telephone: (417) 623-1661 FAX: (417) 623-1817
Missouri	**Springfield Branch**	Cummins Mid-America, Inc. 3637 East Kearney Springfield, MO 65803 Telephone: (417) 862-0777 FAX: (417) 862-4429
Missouri	**St. Louis Distributor**	Cummins Gateway, Inc. 7210 Hall Street St. Louis, MO 63147 Telephone: (314) 389-5400 FAX: (314) 389-9671
Missouri	**Columbia Branch**	Cummins Gateway, Inc. 5221 Highway 763 North Columbia, MO 65202 Telephone: (314) 449-3711 FAX: (314) 449-3712

Missouri	**Sikeston Branch**	Cummins Gateway, Inc. 101 Keystone Drive Sikeston, MO 63801 Telephone: (314) 472-0303 FAX: (314) 472-0306
Missouri	**Industrial Power Branch**	Cummins Gateway, Inc. 3256 E. Outer Road Scott City, MO 63788 Telephone: (573) 335-9399 FAX: (573) 335-7062
Montana	**Billings - (Branch of Denver)**	Cummins Rocky Mountain, Inc. 5151 Midland Road Billings, MT 59101 Telephone: (406) 245-4194 FAX: (406) 245-7923
Montana	**Great Falls - (Branch of Denver)**	Cummins Rocky Mountain, Inc. 415 Vaughn Road Great Falls, MT 59404 Telephone: (406) 452-8561 FAX: (406) 452-9911
Montana	**Missoula - (Branch of Seattle)**	Cummins Northwest, Inc. 4950 North Reserve Street Missoula, MT 59802-1498 Telephone: (406) 728-1300 FAX: (406) 728-8523
Nebraska	**Omaha Distributor and Branch**	Cummins Great Plains Diesel, Inc. 5515 Center Street P.O. Box 6068 Omaha, NE 68106 Telephone: (402) 551-7678 (24 Hours) FAX: (402) 551-1952
Nebraska	**Kearney Branch**	Cummins Great Plains Diesel, Inc. 515 Central Avenue Kearney, NE 68847 Telephone: (308) 234-1994 FAX: (308) 234-5776
Nevada	**Elko - (Branch of Salt Lake City)**	Cummins Intermountain, Inc. 5370 East Idaho Street Elko, NV 89801 Telephone: (775) 738-6405 FAX: (775) 738-1719
Nevada	**Las Vegas - (Branch of Salt Lake City)**	Cummins Intermountain, Inc. 2750 Losee Road North Las Vegas, NV 89030 Telephone: (702) 399-2339 FAX: (702) 399-7457
Nevada	**Sparks - (Branch of Salt Lake City)**	Cummins Intermountain, Inc. 150 Glendale Avenue Sparks, NV 89431 Telephone: (775) 331-4983 FAX: (775) 331-7429

New Jersey	**Newark - (Branch of Bronx)**	Cummins Metropower, Inc. 41-85 Doremus Ave. Newark, NJ 07105 Telephone: (973) 491-0100 FAX: (973) 578-8873
New Mexico	**Albuquerque - (Branch of Phoenix)**	Cummins Southwest, Inc. 1921 Broadway N.E. Albuquerque, NM 87102 Telephone: (505) 247-2441 FAX: (505) 842-0436
New Mexico	**Farmington - (Branch of Phoenix)**	Cummins Southwest, Inc. 1101 North Troy King Road Farmington, NM 87401 Telephone: (505) 327-7331 FAX: (505) 326-2948
New York	**Bronx Distributor**	Cummins Metropower, Inc. 890 Zerega Avenue Bronx, NY 10473 Telephone: (718) 892-2400 FAX: (718) 892-0055
New York	**Albany - (Branch of Boston)**	Cummins Northeast, Inc. 101 Railroad Avenue Albany, NY 12205 Telephone: (518) 459-1710 FAX: (518) 459-7815
New York	**Buffalo - (Branch of Boston)**	Cummins Northeast, Inc. 480 Lawrence Bell Dr. Williamsville, NY 14221-7090 Telephone: (716) 631-3211 FAX: (716) 626-0799
New York	**Syracuse - (Branch of Boston)**	Cummins Northeast, Inc. 29 Eastern Avenue Syracuse, NY 13211 Telephone: (315) 437-2751 FAX: (315) 437-8141
North Carolina	**Charlotte Distributor**	Cummins Atlantic, Inc. 11101 Nations Ford Road (28273) P.O. Box 240729 Charlotte, NC 28224-0729 Telephone: (704) 588-1240 FAX: (704) 587-4870
North Carolina	**Charlotte Branch**	Cummins Atlantic, Inc. 3700 North Interstate 85 Charlotte, NC 28206 Telephone: (704) 596-7690 FAX: (704) 596-3038
North Carolina	**Greensboro Branch**	Cummins Atlantic, Inc. 513 Preddy Boulevard (27406) P.O. Box 22066 Greensboro, NC 27420-2066 Telephone: (336) 275-4531 FAX: (336) 275-8304

North Carolina	**Wilson Branch**	Cummins Atlantic, Inc. 1514 Cargill Avenue (27893) P.O. Box 1177 Wilson, NC 27894-1117 Telephone: (252) 237-9111 FAX: (252) 237-9132
North Dakota	**Fargo - (Branch of St. Paul)**	Cummins North Central, Inc. 3801 - 34th Ave. SW Fargo, ND 58104 Telephone: (701) 282-2466 FAX: (701) 277-5399
North Dakota	**Grand Forks - (Branch of St. Paul)**	Cummins North Central, Inc. 4728 Gateway Drive Grand Forks, ND 58201 Telephone: (701) 775-8197 FAX: (701) 775-4833
North Dakota	**Minot - (Branch of St. Paul)**	Cummins North Central, Inc. 1501 - 20th Avenue, S.E. Minot, ND 58702 Telephone: (701) 852-3585 FAX: (701) 852-3588
Ohio	**Columbus Distributor and Branch**	Cummins Interstate Power, Inc. 4000 Lyman Drive Hilliard (Columbus), OH 43026 Telephone: (614) 771-1000 FAX: (614) 771-0769
Ohio	**Columbus Distributor**	Cummins Interstate Power, Inc. 2297 Southwest Bldv., Suite K Grove City, OH 43123 Telephone: (614) 771-1000 FAX: (614) 527-2576
Ohio	**Cincinnati Branch**	Cummins Interstate Power, Inc. 10470 Evendale Drive Cincinnati, OH 45241 Telephone: (513) 563-6670 FAX: (513) 563-0594
Ohio	**Cleveland Branch**	Cummins Interstate Power, Inc. 7585 Northfield Road Cleveland, OH 44146 Telephone: (440) 439-6800 FAX: (440) 439-7390
Ohio	**Strasburg Branch**	Cummins Interstate Power, Inc. 777 South Wooster Avenue Strasburg, OH 44680 Telephone: (216) 878-5511 FAX: (216) 878-7666
Ohio	**Toledo Branch**	Cummins Interstate Power, Inc. 801 Illinois Avenue Maumee (Toledo), OH 43537 Telephone: (419) 893-8711 FAX: (419) 893-5362

Ohio	**Youngstown Branch**	Cummins Interstate Power, Inc. 7145 Masury Road Hubbard (Youngstown), OH 44425 Telephone: (216) 534-1935 FAX: (216) 534-5606
Oklahoma	**Oklahoma City - (Branch of Arlington)**	Cummins Southern Plains, Inc. 5800 West Reno Oklahoma City, OK 73127 Telephone: (405) 946-4481 (24 hours) FAX: (405) 946-3336
Oklahoma	**Tulsa - (Branch of Arlington)**	Cummins Southern Plains, Inc. 16525 East Skelly Drive Tulsa, OK 74116 Telephone: (918) 234-3240 FAX: (918) 234-2342
Oregon	**Bend - (Branch of Seattle)**	Cummins Northwest, Inc. 3500 N. Highway 97 (97701-5729) P.O. Box 309 Bend, OR 97709-0309 Telephone: (541) 389-1900 FAX: (541) 389-1909
Oregon	**Coburg/Eugene - (Branch of Seattle)**	Cummins Northwest, Inc. 91201 Industrial Parkway Coburg, OR 97401 (Mailing Address) P.O. Box 10877 Eugene, OR 97440-2887 Telephone: (541) 687-0000 FAX: (541) 687-1977
Oregon	**Medford - (Branch of Seattle)**	Cummins Northwest, Inc. 4045 Crater Lake Highway Medford, OR 97504-9796 Telephone: (541) 779-0151 FAX: (541) 772-2395
Oregon	**Pendleton - (Branch of Seattle)**	Cummins Northwest, Inc. 223 S.W. 23rd Street Pendleton, OR 97801-1810 Telephone: (541) 276-2561 FAX: (541) 276-2564
Oregon	**Portland - (Branch of Seattle)**	Cummins Northwest, Inc. 4711 N. Basin Avenue P. O. Box 2710 (97208-2710) Portland, OR 97217-3557 Telephone: (503) 289-0900 FAX: (503) 286-5938
Pennsylvania	**Philadelphia Distributor**	Cummins Power Systems, Inc. 2727 Ford Road Bristol, PA 19007 Telephone: (215) 785-6005 and (609) 563-0005 FAX: (215) 785-4085

Pennsylvania	**Bristol Branch**	Cummins Power Systems, Inc. 2727 Ford Road Bristol, PA 19007 Telephone: (215) 785-6005 and (609) 563-0005 FAX: (215) 785-4728
Pennsylvania	**Pittsburgh Branch**	Cummins Power Systems, Inc. 3 Alpha Drive Pittsburgh, PA 15238-2901 Telephone: (412) 820-8300 FAX: (412) 820-8308
Pennsylvania	**Harrisburg Branch**	Cummins Power Systems, Inc. 4499 Lewis Road Harrisburg, PA 17111-2541 Telephone: (717) 564-1344 FAX: (717) 558-8217
Puerto Rico	**Puerto Nuevo - (Branch of Tampa)**	Cummins Diesel Power, Inc. #31 Calle "C" El Matadero Puerto Nuevo, Puerto Rico 00920 Telephone: (787) 793-0300 FAX: (787) 793-1072
South Carolina	**Charleston - (Branch of Charlotte)**	Cummins Atlantic, Inc. 3028 West Montague Avenue Charleston, SC 29418-5593 Telephone: (843) 554-5112 FAX: (843) 745-0745
South Carolina	**Charleston - (Branch of Charlotte)**	Cummins Atlantic Inc. 231 Farmington Road Charleston, SC 29483 Telephone: (843) 851-9819 FAX: (843) 875-4338
South Carolina	**Columbia - (Branch of Charlotte)**	Cummins Atlantic, Inc. 1233 Bluff Road (29201) P.O. Box 13543 Columbia, SC 29201-3543 Telephone: (803) 799-2410 FAX: (803) 779-3427
South Dakota	**Sioux Falls - (Branch of Omaha)**	Cummins Great Plains Diesel, Inc. 701 East 54th Street North Sioux Falls, SD 57104 Telephone: (605) 336-1715 FAX: (605) 336-1748
Tennessee	**Memphis Distributor & Distribution Center**	Cummins Mid-South, Inc. 666 Riverside Drive Memphis, TN 38703 Telephone: (901) 577-0666 FAX: (901) 522-8758
Tennessee	**Chattanooga - (Branch of Atlanta)**	Cummins South, Inc. 1509 East 26th Street Chattanooga, TN 37407-1095 Telephone: (615) 629-1447 FAX: (615) 629-1494

Tennessee	**Knoxville - (Branch of Louisville)**	Cummins Cumberland, Inc. 1211 Ault Road Knoxville, TN 37914 Telephone: (423) 523-0446 FAX: (423) 523-0343
Tennessee	**Memphis Branch**	Cummins Mid-South, Inc. 1784 E. Brooks Road Memphis, TN 38116 Telephone: Sales/Admin.: (901) 345-7424 Parts: (901) 345-1784 Service: (901) 345-6185 FAX: (901) 346-4735
Tennessee	**Nashville - (Branch of Louisville)**	Cummins Cumberland, Inc. 706 Spence Lane Nashville, TN 37217 Telephone: (615) 366-4341 FAX: (615) 366-5693
Texas	**Arlington Distributor**	Cummins Southern Plains, Inc. 600 N Watson Road Arlington, TX 76004-3027 Telephone: (817) 640-6801 FAX: (817) 640-6852
Texas	**Amarillo Branch**	Cummins Southern Plains, Inc. 5224 Interstate 40 - Expressway East P.O. Box 31570 Amarillo, TX 79120-1570 Telephone: (806) 373-3793 (24 hours) FAX: (806) 372-8547
Texas	**Dallas Branch**	Cummins Southern Plains, Inc. 3707 Irving Boulevard Dallas, TX 75247 Telephone: (214) 631-6400 (24 hours) FAX: (214) 631-2322
Texas	**El Paso - (Branch of Phoenix)**	Cummins Southwest, Inc. 14333 Gateway West El Paso, TX 79927 Telephone: (915) 852-4200 FAX: (915) 852-3295
Texas	**Fort Worth Branch**	Cummins Southern Plains, Inc. 3250 North Freeway Fort Worth, TX 76111 Telephone: (817) 624-2107 (24 hours) FAX: (817) 624-3296
Texas	**Houston Branch**	Cummins Southern Plains, Inc. 4750 Homestead Road P.O. Box 1367 Houston, TX 77251-1367 Telephone: (713) 675-7421 (24 hours) FAX: (713) 675-1515

Texas	**Mesquite Branch**	Cummins Southern Plains, Inc. 2615 Big Town Blvd. Mesquite, TX 75150 Telephone: (214) 321-5555 (24 hours) FAX: (214) 328-2732
Texas	**Odessa Branch**	Cummins Southern Plains, Inc. 1210 South Grandview P.O. Box 633 Odessa, TX 79760-0633 Telephone: (915) 332-9121 (24 hours) FAX: (915) 333-4655
Texas	**San Antonio Branch**	Cummins Southern Plains, Inc. 6226 Pan Am Expressway North P.O. Box 18385 San Antonio, TX 78218-0385 Telephone: (512) 655-5420 (24 hours) FAX: (512) 655-3865
Texas	**Houston Onan Branch**	Southern Plains Power A Division of Cummins Southern Plains 1155 West Loop North Houston, TX 77055 Telephone: (713) 956-0020 FAX: (713) 956-0266
Utah	**Salt Lake City Distributor**	Cummins Intermountain, Inc. 1030 South 300 West Salt Lake City, UT 84101 Telephone: (801) 355-6500 FAX: (801) 524-1351
Utah	**Vernal Branch**	Cummins Intermountain, Inc. 1435 East 335 South Vernal, UT 84078 Telephone: (435) 789-5732 FAX: (435) 789-2853
Virginia	**Cloverdale - (Branch of Charlotte)**	Cummins Atlantic, Inc. 263 Simmons Drive Cloverdale, VA 24077 Telephone: (540) 966-3169 FAX: (540) 966-3749
Virginia	**Richmond - (Branch of Charlotte)**	Cummins Atlantic, Inc. 3900 Deepwater Terminal Road Richmond, VA 23234 Telephone: (804) 232-7891 FAX: (804) 232-7428
Virginia	**Tidewater - (Branch of Charlotte)**	Cummins Atlantic, Inc. Atlantic Power Generation 3729 Holland Blvd. Chesapeake, VA 23323 Telephone: (757) 485-4848 FAX: (757) 485-5085
Washington	**Seattle Distributor**	Cummins Northwest, Inc. 811 S.W. Grady Way (98055-2944) P.O. Box 9811 Renton, WA 98057-9811 Telephone: (425) 235-3400 FAX: (425) 235-8202

Washington	**Chehalis Branch**	Cummins Northwest, Inc. 926 N.W. Maryland Chehalis, WA 98532-0339 Telephone: (360) 748-8841 FAX: (360) 748-8843
Washington	**Spokane Branch**	Cummins Northwest, Inc. 11134 W. Westbow Blvd. Spokane, WA 99204 Telephone: (509) 455-4411 FAX: (509) 624-4681
Washington	**Tacoma Branch**	Cummins Northwest, Inc. 3701 Pacific Highway East Tacoma, WA 98424-1135 Telephone: (253) 922-2191 FAX: (253) 922-2379
Washington	**Yakima Branch**	Cummins Northwest, Inc. 1905 East Central Avenue (98901-3609) P.O. Box 9129 Yakima, WA 98909-0129 Telephone: (509) 248-9033 FAX: (509) 248-9035
West Virginia	**Charleston - (Branch of Louisville)**	Cummins Cumberland, Inc. 3100 MacCorkle Ave. SW P.O. Box 8456 South Charleston, WV 25303 Telephone: (304) 744-6373 FAX: (304) 744-8605
West Virginia	**Fairmont - (Branch of Louisville)**	Cummins Cumberland, Inc. South Fairmount Exit, I-79 145 Middletown Road Fairmont, WV 26554 Telephone: (304) 367-0196 FAX: (304) 367-1077
Wisconsin	**DePere Distributor**	Cummins Great Lakes, Inc. Corporate Office 875 Lawrence Drive P.O. Box 5070 DePere, WI 54115-5070 Telephone: (920) 337-1991 FAX: (920) 337-9746
Wisconsin	**Chippewa Falls Branch**	Cummins Great Lakes, Inc. 2030 St. Highway 53 Chippewa Falls, WI 54729 Telephone: (715) 720-0680 FAX: (715) 720-0685
Wisconsin	**DePere Branch**	Cummins Great Lakes, Inc. 939 Lawrence Drive P. O. Box 5070 DePere, WI 54115-5070 Telephone: (920) 336-9631 (800) 236-1191 FAX: (920) 336-8984

Wisconsin	**Milwaukee Branch**	Cummins Great Lakes, Inc. 9401 South 13th Street P.O. Box D Oak Creek, WI 53154 Telephone: (414) 768-7400 (800) 472-8283 FAX: (414) 768-9441
Wisconsin	**Wausau Branch**	Cummins Great Lakes, Inc. 4703 Rib Mountain Drive Wausau, WI 54401 Telephone: (715) 359-6888 (800) 236-3744 FAX: (715) 359-3744
Wyoming	**Gillette - (Branch of Denver)**	Cummins Rocky Mountain, Inc. 2700 Hwy. 14 & 16 North P.O. Box 1207 (82717) Gillette, WY 82716 Telephone: (307) 682-9611 FAX: (307) 682-8242
Wyoming	**Rock Springs - (Branch of Salt Lake City)**	Cummins Intermountain, Inc. 2000 Foothill Blvd. P.O. Box 1634 Rock Springs, WY 82901 Telephone: (307) 362-5168 FAX: (307) 362-5171

Distributors and Branches - Canada

Alberta	**Edmonton Distributor and Branch**	Cummins Alberta 11751 - 181 Street Edmonton, AB T5S 2K5 Telephone: (780) 455-2151 FAX: (780) 454-9512
Alberta	**Calgary Branch**	Cummins Alberta 4887 - 35th Street S.E. Calgary, Alberta T2B 3H6, Canada Telephone: (403) 569-1122 FAX: (403) 569-0027
Alberta	**Grande Prairie**	Cummins Alberta - Grande Praire RR2, Site 9, Box 22 Sexsmith, AB CN T0H 3C0 Telephone: (780) 568-3359 FAX: (780) 568-2263
Alberta	**Hinton Branch**	Cummins Alberta 135 Veats Avenue Hinton, Alberta T7V 1S8, Canada Telephone: (780) 865-5111 FAX: (780) 865-5714
Alberta	**Lethbridge Branch**	Cummins Alberta 240 - 24th Street North Lethbridge, Alberta T1H 3T8, Canada Telephone: (403) 329-6144 FAX: (403) 320-5383
British Columbia	**Vancouver Distributor**	Cummins British Columbia 18452 - 96th Avenue Surrey, B.C., Canada V4N 3P8 Telephone: (604) 882-5000 FAX: (604) 882-5080
British Columbia	**Kamloops Branch**	Cummins British Columbia 976 Laval Crescent Kamloops, B.C. Canada V2C 5P5 Telephone: (250) 828-2388 FAX: (250) 828-6713
British Columbia	**Prince George Branch**	Cummins British Columbia 102- 3851- 18th Avenue Prince George, B.C. V2N 1B1 Telephone: (250) 564-9111 FAX: (250) 564-5853
British Columbia	**Sparwood Branch**	Cummins British Columbia 731 Douglas Fir Road Sparwood, B.C. VOB 2GO, Canada Telephone: (250) 425-0522 FAX: (250) 425-0323
British Columbia	**Tumbler Ridge Branch**	Cummins British Columbia Industrial Site, Box 226 Tumbler Ridge, B.C. Canada VOC 2WO Telephone: (250) 242-4217 FAX: (250) 242-4906

Manitoba	**Winnipeg Distributor**	Cummins Mid-Canada Ltd. 489 Oak Point Road P.O. Box 1860 Winnipeg, MB R3C 3R1, Canada Telephone: (204) 632-5470 FAX: (204) 697-0267
New Brunswick	**Fredericton - (Branch of Montreal)**	Cummins Eastern Canada, Inc. R.R.#1 Doak Road P.O. Box 1178, Station 'A' Fredericton, New Brunswick E3B 4X2, Canada Telephone: (506) 451-1929 FAX: (506) 451-1921
Newfoundland	**St. John's - (Branch of Montreal)**	Cummins Eastern Canada, Inc. 122 Clyde Avenue Donovans Industrial Park Mount Pearl, Newfoundland A1N 2C2 Canada Telephone: (709) 747-0176 FAX: (709) 747-2283
Newfoundland	**Wabush - (Branch of Montreal)**	Cummins Eastern Canada, Inc. Wabush Industrial Park Wabush, Newfoundland A0R 1B0 Telephone: (709) 282-3626 FAX: (709) 282-3108
Nova Scotia	**Halifax - (Branch of Montreal)**	Cummins Eastern Canada, Inc. 50 Simmonds Drive Dartmouth, Nova Scotia B3B 1R3 Telephone: (902) 468-7938 FAX: (902) 468-5177 Parts: (902) 468-6560
Ontario	**Toronto Distributor**	Cummins Ontario, Inc. 7175 Pacific Circle Mississauga, ON L5T 2A5 Telephone: (905) 795-0050 FAX: (905) 795-0021
Ontario	**Kenora - (Branch of Winnipeg)**	Cummins Mid-Canada Ltd. Highway 17 East P.O. Box 8 Kenora, Ontario P9N 3X1 Telephone: (807) 548-1941 FAX: (807) 548-8302
Ontario	**Ottawa Branch**	Cummins Ontario Inc. 3189 Swansea Crescent Ottawa, Ontario K1G 3W5, Telephone: (613) 736-1146 FAX: (613) 736-1202
Ontario	**Thunder Bay Branch**	Cummins Ontario Inc. 1400 W. Walsh Street Thunder Bay Ontario P7E 4X4 Telephone: (807) 577-7561 FAX: (807) 577-1727

Ontario	**Whitby Branch**	Cummins Ontario Inc. 1311 Hopkins Street Whitby, Ontario L1N 2C2, Canada Telephone: (905) 668-6886 FAX: (905) 668-1375
Quebec	**Montreal Distributor**	Cummins Eastern Canada, Inc. 7200 Trans Canada Highway Pointe Claire, Quebec H9R 1C2, Telephone: (514) 695-8410 FAX: (514) 695-8917
Quebec	**Montreal Branch**	Cummins Eastern Canada, Inc. 7200 Trans Canada Highway Pointe Claire, Quebec H9R 1C2, Canada Telephone: (514) 695-8410 Sales: (514) 695-4555 Parts: (514) 694-5880 FAX: (514) 695-8917
Quebec	**Dorval Onan Branch**	Cummins, Eastern Canada, Inc. 580 Lepihe Dorval, Quebec H9H 1G2 Telephone: (514) 631-5000 FAX: (514) 631-0104
Quebec	**Quebec City Branch**	Cummins Diesel Branch of Cummins Americas, Inc. 2575 Dalton Street Ste. Foy, Quebec G1P 3S7 Telephone: (418) 653-6411 FAX: (418) 653-5844
Quebec	**Val D'Or Branch**	Cummins, Eastern Canada, Inc. 1025 Rue Del Val D'Or, Quebec 59P 4P6 Telephone: (819) 825-0993 FAX: (819) 825-8488
Saskatchewan	**Lloydminster - (Branch of Winnipeg)**	Cummins Mid-Canada Ltd. 4005 52nd Lloydminster, SK S9V 0Y9 Telephone: (305) 825-2062 FAX: (305) 825-6702
Saskatchewan	**Regina - (Branch of Winnipeg)**	Cummins Mid-Canada Ltd. 110 Kress Street P.O. Box 98 Regina, SK S4P 2Z5 Telephone: (306) 721-9710 FAX: (306) 721-2962
Saskatchewan	**Saskatoon - (Branch of Winnipeg)**	Cummins Mid-Canada, Ltd. 3001 Faithful Avenue P.O. Box 7679 Saskatoon, SK S7K 4R4, Canada Telephone: (306) 933-4022 FAX: (306) 242-1722

Distributors and Branches - Australia

Branches:	**Gepps Cross**	Cummins Engine Company, Pty. Ltd. P.O. Box 108 Blair Athol, 5084 South Australia, Australia Location: 45-49 Cavan Road Gepps Cross, 5094 Telephone: (61-8) 8262-5211
Branches:	**Dosra**	Cummins Engine Company, Pty. Ltd. P.O. Box 124 Darra, 4076 Queensland, Australia Location: 33 Kimberley Street Darra, 4076, Australia Telephone: (61-7) 3375-3277
Branches:	**Bunbury**	Cummins Engine Company, Pty. Ltd. P.O. Box 1751 Bunbury, WA 6230 Australia Location: 11 Dryanda Court Picton, WA 6230 Telephone: (61-8) 9725-6777 FAX: (61-8) 9725-6444
Branches:	**Cairns**	Cummins Engine Company, Pty. Ltd. P.O. Box 7189 Cairns Mail Centre, 4870 Queensland, Australia Location: Liberty Street Cairns, 4870 Telephone: (61-7) 935-2999
Branches:	**Campbellfield**	Cummins Engine Company, Pty. Ltd. Private Bag 9 Campbellfield, 3061 Victoria, Australia Location: 1788-1800 Hume Highway Campbellfield, 3061 Telephone: (613) 9357-9200
Branches:	**Dandenong**	Cummins Engine Company, Pty. Ltd. Lot 7 Greens Road Dandenong, 3175 Victoria, Australia Telephone: (613) 9706-8088
Branches:	**Darwin**	Cummins Engine Company, Pty. Ltd. P.O. Box 37587 Winnellie, 0821 Northern Territory, Australia Location: Lot 1758 Graffin Crescent Winnellie, 0821 Telephone: (61-8) 8947-0766

Branches:	**Devonport**	Cummins Engine Company, Pty. Ltd. P.O. Box 72E Tasmania, Australia Location: 2 Matthews Way Devonport, 7310 Telephone: (61-3) 6424-8800
Branches:	**Emerald**	Cummins Engine Company, Pty. Ltd. P.O. Box 668 Emerald, 4720 Queensland, Australia Location: Capricorn Highway Emerald, 4720 Telephone: (61-7) 4982-4022
Branches:	**Grafton**	Cummins Engine Company, Pty. Ltd. P.O. Box 18 South Grafton, 2461 New South Wales, Australia Location: 18-20 Induna Street South Grafton, 2461 Telephone: (61-2) 6642-3655
Branches:	**Hexham**	Cummins Engine Company, Pty. Ltd. 21 Galleghan Street Hexham New South Wales, Australia Telephone: (61-2) 4964-8466 FAX: (61-2) 4964-8616
Branches:	**Kalgoorlie**	Cummins Engine Company, Pty. Ltd. P.O. Box 706 Kalgoorlie, 6430 Western Australia, Australia Location: 16 Atbara Street Kalgoorlie, 6430 Telephone: (61-8) 9021-2588
Branches:	**Karratha**	Cummins Engine Company, Pty. Ltd. P.O. Box 377 Karratha, WA 6714 Australia Location: 1490 Lambert Road Karratha, WA 6714 Australia Telephone: (61-8) 9144-4646 FAX: (61-8) 9143-1507
Branches:	**Laverton**	Cummins Engine Company, Pty. Ltd. Locked Bag 1 Laverton, Victoria 3028 Australia Location: 195 Boundary Road Laverton North, Victoria 3028 Australia Telephone: (61-3) 9360-0800 FAX: (61-3) 9360-0438

Branches:	**Leeton**	Cummins Engine Company, Pty. Ltd. P.O. Box 775 Leeton, NSW 2705 Australia Location: 29 Brady Way Leeton, NSW 2705 Australia Telephone: (61-2) 6953-3077 FAX: (61-2) 6953-3109
Branches:	**Mackay**	Cummins Engine Company, Pty. Ltd. P.O. Box 842 Mackay, 4740 Queensland, Australia Location: 4 Presto Avenue Mackay, 4746 Telephone: (61-7) 4955-1222
Branches:	**Mount Gambier**	Cummins Engine Company, Pty. Ltd. P.O. Box 2219 Mount Gambier, 5290 South Australia, Australia Location: 2 Avey Road Mount Gambier, 5290 Telephone: (61-87) 25-6422
Branches:	**Penrith**	Cummins Engine Company, Pty. Ltd. P.O. Box 132 Cambridge Park, 2747 New South Wales, Australia Location: 7 Andrews Road Penrith, 2750 Telephone: (61-2) 4729-1313
Branches:	**Queanbeyan**	Cummins Engine Company, Pty. Ltd. P.O. Box 527 Queanbeyan, 2620 New South Wales, Australia Location: 15-27 Bayldon Road Queanbeyan, 2620 Telephone: (61-2) 6297-3433 FAX: (61-2) 6297-6709
Branches:	**Regency Park**	Cummins Engine Company, Pty. Ltd. P.O. Box 2147 Regency Park, SA 5942 Australia Location: 11 Manton Street Hindmarsh, SA 5942 Australia Telephone: (61-8) 8346-3832 FAX: (61-8) 8340-2045

Branches:	**Swan Hill**	Cummins Engine Company, Pty. Ltd. P.O. Box 1264 Swan Hill, 3585 Victoria, Australia Location: 5 McAllister Road Swan Hill, 3585 Telephone: (61-3) 5032-1511
Branches:	**Tamworth**	Cummins Engine Company, Pty. Ltd. P.O. Box 677 Tamworth, 2320 New South Wales, Australia Location: Lot 65 Gunnedah Road Tamworth, 2340 Telephone: (61-2) 6765-5455
Branches:	**Townsville**	Cummins Engine Company, Pty. Ltd. P.O. Box 7339 Garbutt Business Centre, QLD4814 Australia Location: 704-710 Ingham Road Townsville, QLD 4814 Telephone: (61-7) 4774-7733 FAX: (61-7) 4774-7640
Branches:	**Welshpool**	Cummins Engine Company, Pty. Ltd. P. O. Box 52 Welshpool, 6986 Western Australia, Australia Location: 50 Kewdale Road Welshpool, 6106 Telephone: (61-8) 9458-5911
Branches:	**Wetherill Park**	Cummins Engine Company, Pty. Ltd. Private Bag 150 Wetherill Park, NSW 2164 Australia Location: 492-494 Victoria Street Wetherill Park, NSW 2164 Australia Telephone: (61-2) 9616-5300 FAX: (61-2) 9616-5399
Branches:	**Wodonga**	Cummins Engine Company, Pty. Ltd. P.O. Box 174 Wodonga, 3690 Victoria, Australia Location: 9-11 McKoy Street Wodonga, 3690 Telephone: (61-2) 6024-3655

Distributors and Branches - New Zealand

Auckland		Cummins Engine Company, Pty. Ltd. Private Bag 92804 Penrose, Auckland, New Zealand Location: 440 Church Street Penrose Telephone: (64-9) 579-0085
Branches:	**Auckland**	Cummins Engine Company, Pty. Ltd. Private Bag 92804 Penrose, Auckland, New Zealand Location: 440 Church Street Penrose Telephone: (64-9) 579-0085
Branches:	**Christchurch**	Cummins Engine Company, Pty. Ltd. P.O. Box 16-149 Hornby, Christchurch, New Zealand Location: 35 Parkhouse Road Sockburn, Christchurch Telephone: (64-3) 348-8170
Branches:	**Dunedin**	Cummins Engine Company, Pty. Ltd. P.O. Box 2333 South Dunedin, New Zealand Location: 8 Devon Street Dunedin Telephone: (643) 477-8818
Branches:	**Palmerston North**	Cummins Engine Company, Pty. Ltd. P.O. Box 9024 Palmerston North, New Zealand Location: 852-860 Tremaine Avenue Telephone: (64-6) 356-2209
Branches:	**Rotorua**	Cummins Engine Company, Pty. Ltd. P.O. Box 934 Rotorua, New Zealand Location: 328 Te Ngae Road Rotorua Telephone: (647) 345-6699

Regional Offices - International - Locations

European Regional Office - Mechelen

Cummins Diesel N.V.
Blarenberglaan 4
Industriepark Noord 2
2800 Mechelen
Brussels
Telephone: (32-15) 89000

Countries Covered:

- Austria
- Belgium
- Czech Republic
- Denmark
- Finland
- Greece
- Hungary
- Iceland
- Israel
- Luxembourg
- Netherlands
- Norway
- Portugal
- Slovakia
- Spain
- Sweden
- Switzerland

Cumbrasa Regional Office - Brazil

Cummins Brasil S.A.
Rua Jati, 266
07180-900 Guarulhos
Sao Paulo, Brazil

Mailing Address:
P.O. Box 13
07180-900 Guarulhos
Sao Paulo, Brazil
Telephone: (55-11) 945-9811

Country Covered:

- Brazil

Beijing Regional Office - China

Cummins Corporation
China World Tower, Suite 917
China World Trade Center
No. 1 Jian Guo Men Wai
Beijing 100004
People's Republic of China
Telephone: (86-1) 6505-1658
Fax: (88-10) 6505-4211

Countries Covered:

- China
- Mongolia

Bogota Regional Office - Columbia	
Cummins Engine Co. de Colombia S.A. Carrera 11A No. 90-15 Of. 601/602 Bogota, D.E., Colombia Telephone: (57-1) 610-4849	Mailing Address: Apartado Aereo 90988 Bogota D.E., Colombia

Countries Covered:		
	Argentina	Ecuador
	Bolivia	Paraguay
	Chile	Peru
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Gross-Gerau Regional Office - Germany	
Cummins Diesel Deutschland GmbH Odenwaldstr. 23 D-4521 Gross-Gerau Germany Telephone: (49-6152) 174-0	

Countries Covered:		
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	Latvia	Lithuania
	Germany	Estonia
	Luxembourg	Croatia
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Hong Kong Regional Office - Hong Kong	
Cummins Engine H.K. Ltd. Unison Industrial Centre 15th Floor, Units C & D 27-31 Au Pui Wan Street P. O. Box 840 Shatin Fo Tan, Shatin, N.T. Hong Kong Telephone: (852) 2606-5678 Fax: (852) 2691-1641, 2687-3552	

Country Covered:	
	Hong Kong, Macau

Pune Kirloskar Regional Office - India	
Kirloskar Cummins Limited Kothrud Pune - 411 029, India Telephone: (91-212) 33-0240, 33-5435, 33-1105	
Countries Covered:	Bhutan India Nepal

Milan Regional Office - Italy	
Cummins Diesel Italia S.P.A. Piazza Locatelli 8 Zona Industriale 20098 San Giuliano Milanese Milan, Italy Telephone: (+39-02) 98-83-111	
Country Covered:	Italy

North Asia Regional Office - Japan	
Cummins Diesel Sales Corporation 1-12-10 Shintomi Chuo-ku, Tokyo 104 Japan Telephone: (81-3) 3555-3131/2/3/4/5	
Country Covered:	Japan

Seoul Regional Office - Korea	
Cummins Korea Ltd. 5th Floor, Hye Sung Building 35-26 Sam Sung Dong, Kang Nam Ku Seoul, South Korea Telephone: (82-2) 516-0431/2/3, 517-3370/1	
Country Covered:	South Korea

Cummsa Regional Office - Mexico	
Cummins, S.A. de C.V. Arquimedes No. 209 Col. Polanco 11560 Mexico, D.F. Mexico Telephone: (52-5) 254-3822/3783/3622	Mailing/Shipping Address: Gonzalez de Castilla Inc. P.O. Box 1391 4605 Modern Lane Modern Industrial Park Laredo, TX 78040 Telephone: (512) 722-5207
Country Covered: Mexico	

Moscow Regional Office - Russia	
Cummins Engine Co., Inc. Park Place Office E708 Leninsky Prospect 113 Russia 117198 Telephone: (7-502) 256-5122 or 256-5123	

Countries Covered:

- Armenia
- Azerbaijan
- Belarus
- Tajikistan
- Georgia
- Kyrgyzstan
- Kazakhstar
- Moldova
- Russia
- Turkmenistan
- Ukranie
- Uzbekistan

South And East Asia Area Office - Singapore	
Cummins Diesel Sales Corporation 8 Tanjong Penjuru Jurong Industrial Estate Singapore 2260 Telephone: (65) 265-0155	

Countries Covered:

- Bangladesh
- Brunei
- Burma/Mynamar
- Cambodia
- Indonesia
- Laos
- Malaysia
- Mongolia
- Philippines
- Singapore
- Sri Lanka
- Thailand
- Vietnam

Taipei Regional Office - Taiwan	
Cummins Corporation - Taiwan 12th Floor, No. 149 Min-Sheng E. Road Section 2 Taipei, Taiwan R.O.C. 104 Telephone: (886-2) 2503-8441	
Country Covered: Taiwan	

Middle East Regional Office	
Cummins Diesel FZE Units ZF 5 & 6, Jebel Ali Free Zone Dubai United Arab Emirates Telephone: (971) 4 883-8998 Fax: (971) 4 883-8997 E-mail: cdfze@emirates.net.ae)	

Countries Covered:

MIDEAST

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Djibouti	Oman	U.A.E.
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Iraq	Qatar	Yemen
Iran	Turkey	

North/West/East and Central Africa Regional Office - Daventry (U.K.)

Cummins Engine Company Ltd.
Royal Oak Way South
Daventry, Northants NN11 5NU
England
Telephone: (44-1327) 886000

Countries Covered:

NORTH/WEST/EAST AND CENTRAL AFRICA

Benin (from Togo)
Burkina-Paso
Burundi
Cameroon
Cape Verde
Central African Republic
Chad
Congo (D.R.)
Congo (P.R.)
Djibouti
Equatorial Guinea
Gabon
Gambia
Ghana
Guinea
Guinea-Bissau
Ivory Coast
Liberia
Libya
Mali
Malta
Mauritania
Morocco
Niger
Nigeria
Sao Tome & Principe
Senegal
Seychelles
Siera Leone
Somalia
Togo
Tunisia
Uganda

Latin America Regional Office - Miramar (U.S.A.)

Cummins Americas, Inc.
Miramar Park of Commerce
3450 Executive Way
Miramar, FL 33025
Telephone: (305) 431-5511

Countries Covered:

Argentina
Bolivia
Chile
Colombia
Costa Rica
Dominican Republic
El Salvador
Eucador
Guatemala
Honduras
Nicaragua
Panama
Paraguay
Peru
Uruguay
Venezuela

Caracas Regional Office - Venezuela	
Cummins Engine Company Oficina de Delegado Torre La Primera, Oficina 5-D Av. Francisco de Miranda Chacao, Caracas 1060	Mailing Address: Cummins Engine Company M-227 c/o Jet Cargo International P.O. Box 020010 Miami, FL 33102-0010 U.S.A. Telephone: (58-2) 32-0563, 32-718

Counties Covered:

- Costa Rica
- Dominican Republic
- El Salvador
- Guatemala
- Honduras
- Nicaragua
- Panama
- Venezuela

Southern Africa Regional Office	
Cummins Diesel South Africa (Pty) Ltd 13 Eastern Service Road Kelvin View 2054 South Africa Telephone: (00 27 11) 321 8700 (from U.K.) Fax: (00 27 11 444 1899)	Mailing Address: Wendywood 2144 Gauteng South Africa

Countries Covered:

- Angola
- Botswana
- Comoros Island
- Lesotho
- Madagascar
- Malawi
- Mauritius
- Mozambique
- Nambia
- Swaziland
- South Africa
- ST. Helena
- Tanzania
- Zambia
- Zimbabwe

Distributors - International - Locations

ABU DHABI		- See United Arab Emirates
AFGHANISTAN		- See Middle East Regional Office
ALBANIA		- See Germany Regional Office - Gross-Gerau
ALGERIA		- See Cummins Diesel S.A. - Lyon
AMERICAN SAMOA		- See South Pacific Regional Office
ANDORRA		- See European Regional Office - Mechelen
ANGOLA	**Luanda**	Hull Blyth (Angola) Ltd Casa Inglesa Rua Major Kahangulo, 134/140 Luanda Republic of Angola Telephone: (244-2) 331817/337184/310026 Fax: (244-2) 335602
ANTIGUA		Miami (Office In U.S.A.) Cummins Southeastern Power, Inc. 9900 N.W. 77 Court Hialeah Gardens, FL 33016 Telephone: (305) 821-4200
ARGENTINA	**Buenos Aires**	Distribuidora Cummins, S.A. (DICUMAR) Av. Del Libertador 602 Piso 5 Buenos Aires, Argentina Telephone: (54-1)814-1895/1395/1393
ARUBA, ISLAND OF		- See Netherlands Antilles
AUSTRIA	**Neudoerfl**	Cummins Diesel Motorenvertriebsges m.b.H. Trenner & Co. Bickfordstr. 25 A-7201 Neudoerfl Austria Telephone: (43-2622) 77418/77625
BAHAMAS	**Miami (Office in U.S.A.)**	Cummins Southeastern Power, Inc. 9900 N.W. 77 Court Hialeah Gardens, FL 33016 Telephone: (305) 821-4200
BAHRAIN	**Bahrain**	Yusuf Bin Ahmed Kanoo W.L.L. P.O. Box 45, Manama Bahrain Telephone: (973) 738200
BALEARIC ISLANDS	**Madrid (Office in Spain)**	Cummins Ventas y Servicio, S.A. Torrelaguna, 56 28027 Madrid, Spain Telephone: (34-91) 367-2000 376-2404

BANGLADESH	**Dhaka**	Equipment & Engineering Co., Ltd. G.P.O. Box 2339 Dhaka 1000, Bangladesh Location: 56, Dilkusha Commercial Area 2nd Floor/Eastern Block Telephone: (880-2) 234357, 234060
BARBADOS	**Miami (Office in U.S.A.)**	Cummins Southeastern Power, Inc. 9900 N.W. 77 Court Hialeah Gardens, FL 33016 Telephone: (305) 821-4200
BELGIUM	**Brussels**	Cummins Distributor Belgium S.A. 623/629 Chaussee de Haecht B-1030 Brussels, Belgium Telephone: (24 hr.) (32-2) 216-81-10
BELIZE	**Tampa (Office in U.S.A.)**	Cummins Southeastern Power, Inc. 5421 N. 59th Street Tampa, FL 33610 Telephone: (813) 621-7202
BENIN		- See Togo
BERMUDA	**Bronx (Office in U.S.A.)**	Cummins Metropower, Inc. 890 Zerega Avenue Bronx, NY 10473 Telephone: (718) 892-2400
BHUTAN	**Pune (Office in India)**	Cummins Diesel Sales & Service (India) Ltd. 35A/1/2, Erandawana Pune - 411 038, India (State of Maharashtra) India Telephone: (91-212) 331234/331554/ 331635/330066/ 330166/330356/ 31703
BOLIVIA	**La Paz**	Machinery & Auto Service Casilla 4042 La Paz, Bolivia Location: Av. 20 de Octubre Esq. Rosendo Gutierrez Telephone: (591-2) 379650, 366394
BONAIRE, ISLAND OF		- See Netherlands Antilles
BOTSWANA		- See Southern Africa Regional Office - Kelvin
BRAZIL	**Ananindeua**	Marcos Marcelino & Companhia Ltda. Rodovia BR-316, Km 9 67020-010 Ananindeua, Para, Brazil Telephone: (55-91) 235-4100/4132/ 4143/4012

BRAZIL	**Belo Horizonte**	Distribuidora Cummins Minas S.A. 31950-640 Olhos D'Agua Norte Belo Horizonte, MG Brazil Telephone: (55-31) 288-1344
BRAZIL	**Campo Grande**	Distribuidora Cummins Mato Grosso Ltda. Rodovia BR 163 Km 01 79060-000 Campo Grande Mato Grosso do Sul, Brazil Telephone: (55-67) 787-1166
BRAZIL	**Curitiba**	Distribuidora Cummins Parana S.A. Rua Brasilio Itibere, 2195 80230 Curitiba, Parana Brazil Telephone: (55-41) 222-4036
BRAZIL	**Fortaleza**	Distribuidora Cummins Diesel Do Nordeste Ltda. Av. da Abolicao, 3882, Mucuripe 60165-081 Fortaleza, Ceara Brazil Telephone: (55-85) 263-1212
BRAZIL	**Goianian**	Distribuidora de Motores Cummins Centro Oeste Ltda. Av. Caiapo 777 - Setor Sta. Genoveva 74672-400 Goiania, Goias Brazil Telephone: (55-62) 207-1010
BRAZIL	**Manaus**	Distribuidora Cummins Amazonas Ltda. Estrada da Ponta Negra, 6080 - Sao Jorge 69037 Manaus, Amazonas, Brazil Telephone: (55-92) 656-5444
BRAZIL	**Porto Alegre**	Distribuidora Cummins Meridional S.A. Rua Dona Alzira, 98, Sarandi 91110-010 Porto Alegre, Rio Grande do Sul, Brazil Telephone: (55-51) 340-8222
BRAZIL	**Rio de Janeiro**	Distribuidora Cummins Leste Ltda. Rua Sariema, 138-Olaria 21030-550 Rio de Janeiro, Rio de Janeiro, Brazil Telephone: (55-21) 290-7899
BRAZIL	**Sao Paulo**	Companhia Distribuidora de Motores Cummins Rua Martin Burchard, 291 - Bras 03043-020 Sao Paulo, Sao Paulo, Brazil Telephone: (55-11) 270-2311

BRITISH VIRGIN ISLANDS		- See Puerto Rico
BRUNEI		- See Malaysia
BURKINA - FASO		- See North/West/East and Central Africa Regional Office - Daventry
BULGARIA		-See Germany Regional Office - Gross-Gerau
BURMA	**Kuala Lumpur (Office In Malaysia)**	Contact: Scott & English (M) Sdn Bhd P.O. Box 10324 50710 Kuala Lumpur West Malaysia Location: 16 Jalan Chan Sow Lin 55200 Kuala Lumpur West Malaysia Telephone: (60-3) 2211033
BURUNDI	**Brussels (Office in Belgium)**	Bia, S.A. Rameistraat, 123 B-3090 - Overijse, Belgium Telephone: (32-2) 6892811
CAMBODIA		- See South & East Asia Regional Office - Singapore
CANARY ISLANDS	**Madrid (Office in Spain)**	Cummins Ventas y Servicio, S.A. Torrelaquna, 56 28027 Madrid, Spain Telephone: (34-91) 3672000/3672404
CAPE VERDE		- See ECV Portugal
CENTRAL AFRICAN REPUBLIC		- See North/West Africa Regional Office - Daventry
CEYLON		- See Sri Lanka
CHAD		- See North/West/East and Central Africa Regional Office - Daventry
CHILE	**Santiago**	Distribuidora Cummins Diesel S.A.C.I. Casilla Postal 1230 Calle Bulnes 1203 Santiago, Chile Corporate Office: Av. Providencia 2653, Office 1901 Santiago, Chile Telephone: (56-2) 698-2113/4/5, 697-3566/7/8, 697-2709
CHINA, PEOPLE'S REPUBLIC	**Beijing**	Cummins Engine (Beijing) Co., Ltd. No. 8, Wan Yuan Street Beijing Economic and Technology Development Zone Beijing, 100176 People's Republic of China Telephone: (86-10) 67882258 Fax: (86-10) 67882285

CHINA, PEOPLE'S REPUBLIC	**Shenyang**	Cummins Engine (China) Investment Co., Ltd. - Shenyang No. 198, Lianhe Rd., Dadong District Shenyang, 110044 People's Republic of China Telephone: (86-24) 88094014, 88905794 Fax: (86-24) 88905970
CHINA, PEOPLE'S REPUBLIC	**Kunming**	Cummins Engine (China) Investment Co., Ltd. - Kunming Suite A4, A5 No. 114 East 2nd Ring Rd. Kunming, 650224 People's Republic of China Telephone: (86-871) 5629579, 5630958 Fax: (86-871) 5632210
CHINA, PEOPLE'S REPUBLIC	**Urumqi**	Cummins Engine (China) Investment Co., Ltd. - Urumqi No. 275, A Le Tai Rd., Urumqi, 830011 Xinjiang, People's Republic of China Telephone: (86-991) 3844712, 3844723 Fax: (86-991) 3849232
CHINA, PEOPLE'S REPUBLIC	**Shanghai**	Cummins Engine (China) Investment Co., Ltd. - Shanghai 1st Floor, 555 Zhong Shan Nan Er Rd., Shanghai, 200032 People's Republic of China Telephone: (86-21) 64033999 Fax: (86-21) 64033111
CHINA, PEOPLE'S REPUBLIC	**Wuhan**	Cummins Engine (China) Investment Co., Ltd. - Wuhan No. 198, Jianshe Rd., Jianghan District Wuhan, 430030 People's Republic of China Telephone: (86-27) 83330180, 83330182 Fax: (86-27) 83330180 ext. 812
CHINA, PEOPLE'S REPUBLIC	**Guangzhou - South China Regional Office**	Cummins Engine (China) Investment Co., Ltd. - Guangzhou Rm. 211, Bai Yun Hotel, 367 Huan Shi Dong Rd. Guangzhou, 510065 People's Republic of China Telephone: (86-20) 83313136, 83313137 Fax: (86-20) 83313135
CHINA, PEOPLE'S REPUBLIC	**Shenzhen (JV)**	Shenzhen Chongfa Cummins Engine Co., Ltd. Unit D2-F2.6 Tian An Che Gong Miao Industrial Estate Shen Nan Rd., Shenzhen, 518040 People's Republic of China Telephone: (86-755) 3415479 Fax: (86-755) 3415480
COLOMBIA	**Barranquilla**	Cummins de Colombia S.A. Apartado Aereo 5347 Barranquilla, Colombia Location: Calle 30, No. 19 - 21 Telephone: (57-58) 40-02-06/40-13-46

COLOMBIA	**Bogota**	Cummins Colombiana Ltda. Apartado Aereo No. 7431 Bogota, D.E. Colombia Location: Av. Americas X Carrera 42C No. 19-45 Telephone: (57-1) 244-5688/5882
COLOMBIA	**Bucaramanga**	Cummins API, Ltda. Apartado Aereo 352 Bucaramanga, Colombia Location: Autopista a Giron, Km 7 Telephone: (57-76) 468060
COLOMBIA	**Cali**	Distribuidora Cummins del Valle, Ltda. Apartado Aereo No. 6398 Cali, Colombia Location: Av. 3a. # 39-35 - Vipasa Telephone: (57-3) 65-4343
COLOMBIA	**Medellin**	Equipos Tecnicos Ltda. Apartado Aereo No. 2046 Medellin, Colombia Location: Carrera 52 No. 10-184 Telephone: (57-4) 255-4200
COLOMBIA	**Pereira**	Equipos Tecnicos Ltda. C.Q.R. Apartado Aereo No. 1240 Pereira, Colombia Location: Carrera 8a. No. 45-39 Telephone: (57-63) 366341
COMOROS		- See Southern Africa Regional Office - Kelvin
CONGO, PEOPLE'S REPUBLIC	**Brussels (Office in Belgium)**	Bia, S.A. Rameistraat, 123 B-3090 Overijse, Belgium Telephone: (32-2) 6892811
CORSICA		- See France
COSTA RICA	**San Jose**	Servicios Unidos, S.A. P.O. Box 559 San Jose, Costa Rica Location: 100 metros al este de Excelsior Antiguo Curridabat, San Jose Telephone Office: (506) 53-93-93 Telephone Service Shop: (506) 26-00-76
CUBA	**Miami (Office in U.S.A.)**	Cummins Southeastern Power, Inc. 9900 N.W. 77 Court Hialeah Gardens, FL 33016 Telephone: (305) 821-4200

CYPRUS	**Nicosia**	Alexander Dimitriou & Sons Ltd. P.O. Box 21932 Nicosia, Cyprus CY-1515 Location: 4 Salamis Avenue Telephone: (357-2) 349450
CZECH REPUBLIC		- See Austrian Distributor
DENMARK	**Glostrup**	Cummins Diesel Salg & Service A/S Hovedvejen 233B Osted DK-4000 Roskilde Denmark Telephone: (45-46) 423 552
DJIBOUTI		- See North/West/East and Central Africa
DOMINICA	**Miami (Office in U.S.A.)**	Cummins Southeastern Power, Inc. 9900 N.W. 77 Court Hialeah Gardens, FL 33016 Telephone: (305) 821-4200
DOMINICAN REPUBLIC	**Santo Domingo**	Argico C. Por A. P.O. Box 292-2 Feria Santo Domingo Dominican Republic, ZP-6 Location: Calle Jose A. Soler No. 3, ESQ. Avenida Lope de Vega Telephone: (809) 562-6281
DUBAI		- See United Arab Emirates
ECUADOR	**Guayaquil**	Motores Cummins (MOTCUM) S.A. P.O. Box 1062 Guayaquil, Ecuador Location: Avenida Carlos Julio Arosemena Km. 4 Telephone: (593-4) 203995/201177
ECUADOR	**Quito**	Rectificadora Botar S.A. P.O. Box 17-01-3344 Quito, Ecuador Location: Av. 10 de Agosto No. 5980 Telephone: (593-2) 465-176/177/ 178/195/197
EGYPT	**Cairo**	ADAT P.O. Box 1572 Cairo, Egypt Sales and Service Location: 25, Pyramid Road Giza, Cairo, Egypt Telephone: (20-2) 385-4001/2/4/5/6/8/9

EL SALVADOR	**San Salvador**	Salvador Machinery Company, S.A. de C.V. P.O. Box 125 San Salvador, El Salvador Location: Blvd. Ejercito Nacional Telephone: (503) 711022, 228388
ENGLAND		- See United Kingdom
EQUATORIAL GUINEA		- See North/West/East and Central Africa Regional Office - Daventry
ESTONIA		- See Gross Gerau Regional Office - Germany
FAROE ISLANDS	**Wellingborough (Office in United Kingdom)**	Cummins Diesel Rutherford Drive Park Farm South Wellingborough Northants NN8 2QH, England Telephone: (44-1933) 334200
FERNANDO PO		- See Spain
FIJI		- See Cummins Diesel Sales & Service New Zealand Ltd.
FINLAND	**Helsinki**	Machinery OY P.O. Box 560 FIN 01741 Varta Finland Telephone: Int: (358-9) 8955 2215
FRANCE	**Lyon**	Cummins Diesel S.A. Sales Corporation 39, rue Ampere Z.I. 69680 Chassieu, France Telephone: (33) 72-22-92-72 Parts and Service Telephone: (33) 72-22-92-69
GABON		- See North/West/East and Central Africa Regional Office - Daventry
GAMBIA		- See Matforce Senegal
GEORGIA		- See Moscow Regional Office - Moscow
GERMANY	**Gross-Gerau**	Cummins Diesel Deutschland GmbH P.O. Box 1134 D-6080 Gross-Gerau, Germany Location: Odenwaldstr. 23 Telephone: (49-6152) 174-0
GHANA	**Accra**	J&D Diesels and Systems P.O. Box c2381 Cantonments Accra, Ghana Telephone: (233-21) 30-14-51

GREECE	**Athens**	Ergotrak Box 51528 14 Km. National Rd. Athens-Lamia 14510 Kifissia, Greece Telephone: (30-1) 6293400/41
GREENLAND		- See Denmark
GRENADA	**Miami (Office in U.S.A.)**	Cummins Southeastern Power, Inc. 9900 N.W. 77 Court Hialeah Gardens, FL 33016 Telephone: (305) 821-4200
GUADELOUPE	**Miami (Office in U.S.A.)**	Cummins Southeastern Power, Inc. 9900 N.W. 77 Court Hialeah Gardens, FL 33016 Telephone: (305) 821-4200
GUAM	**Barrigada**	Mid-Pac Far East, Inc. Airport Industrial Park 825 Tiyan Parkway Barrigada, Guam 96921 Telephone: (671) 632-5160
GUATEMALA	**Guatemala City**	Maquinaria y Equipos, S.A. P.O. Box 2304 Guatemala City, Guatemala Location: Carretera Amatitlan Km 12 zona 12 Telephone: (502-2) 773334/7/9
GUINEA	**Brussels (Office in Belgium)**	BIA s.a. Rameistraat, 123 B-3090 - Overijse, Belgium Telephone: (32-2) 6892811
GUINEA BISSAU		- See North/West/East and Central Africa Regional Office - Daventry
GUYANA	**Miami (Office in U.S.A.)**	Cummins Southeastern Power, Inc. 9900 N.W. 77 Court Hialeah Gardens, FL 33016 Telephone: (305) 821-4200
GUYANA, FRENCH	**Miami (Office in U.S.A.)**	Cummins Southeastern Power, Inc. 9900 N.W. 77 Court Hialeah Gardens, FL 33016 Telephone: (305) 821-4200
HAITI	**Miami (Office in U.S.A.)**	Cummins Southeastern Power, Inc. 9900 N.W. 77 Court Hialeah Gardens, FL 33016 Telephone: (305) 821-4200
HOLLAND		- See Netherlands

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IRAQ		- See Middle East Regional Office or United Arab Emirates
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NEW GUINEA		- See Papua New Guinea
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REUNION		- See Lyon Regional Office - Lyon
RIO DE ORO		- See Spain
ROMANIA		- See Germany Regional Office - Gross-Gerau
RUSSIA		- See Moscow Regional Office - Moscow
RWANDA	**Brussels (Office in Belgium)**	Bia, S.A. Rameistraat, 123 B-3090 - Overijse, Belgium Telephone: (32-2) 6892811
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SAUDI ARABIA	**Al-Khobar**	GCC Olayan P.O. Box 356 Al-Khobar 31952 Saudi Arabia Telephone: (966-3) 882-0888
SCOTLAND		- See United Kingdom
SENEGAL	**Dakar**	Matforce B.P. 397 Dakar, Senegal Location: 10 Avenue Faidherbe Telephone: (221-8) 399500 Fax: (221-8) 399531/399550 Equipements et Services (Mining Only) BP 15372-Fann Dakar Senegal Contacts: Mr. Jean Smets Tel: (221-8) 60 77 76 & 24 73 62 Fax: (221-8) 60 95 98
SEYCHELLES		- See North/West/East & Central Regional Office - Daventry
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SOLOMON ISLANDS		- See South Pacific Regional Office - Melbourne
SOMALIA		- See East and Southern Africa Regional Office - Harare
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SOUTHWEST AFRICA		- See Namibia
SPAIN	**Madrid**	Cummins Ventas y Servicio S.A. Torrelaguna, 56 28027 Madrid, Spain Telephone: (34-91) 367-2000/3672404
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SRI LANKA	**Colombo**	Trade Promoters Ltd P.O. Box 321 69, Walukarama Road Colombo 3 Sri Lanka Telephone: (94-1) 573927, 574651, 575005
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SWAZILAND		- See South Africa
SWEDEN	**Stockholm**	SMA Maskin AB Aggelundavagen 7 S-17562 Jarfalla Sweden Telephone: (46-8) 56-222-500
SWITZERLAND	**Regensdorf**	Robert Aebi S.A. Riedhofstrasse 100 8105 Regensdorf Switzerland Telephone: (41-1) 842-5111
SYRIA	**Damascus**	Puzant Yacoubian & Sons P.O. Box 3617 Damascus, Syria Location: Abou Baker El Saddik Street Kafar Sousse Square Telephone: (963-11) 212-8600
TAHITI, ISLAND OF		- See French Polynesia
TAIWAN	**Taipei (JV)**	Cummins Power Service & Parts Corp. No. 115, Wu Ko 1st Rd., Wu Ku, Industrial District Taipei, Taiwan, R.O.C. Telephone: (886-2) 2290-0331 Fax: (886-2) 2290-0393
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THAILAND	**Bangkok**	Diethelm & Company Ltd. 1696 New Petchburi Road Bangkok 10310, Thailand Telephone: (66-2) 254-4900
TOGO (and BENIN)	**Lome**	Togomat B.P. 1641 Lome, Togo Location: Zone Industrielle CNPPME Telephone: (228) 27-23-95
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VATICAN CITY		- See Italy
VENEZUELA	**Caracas**	Sudimat Apartado Postal 1322 Carmelitas Caracas 1010 Venezuela Location: Final Avenida San Martin Urb. la Quebradita Caracas 1061 Telephone: (58-2) 442-6161/2647
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WESTERN SAMOA		- See South Pacific Regional Office - Melbourne

YEMEN	**Sana'a**	Zubieri Trading Co. P.O. Box 535 Sana'a, Yemen Arab Republic Telephone: (967) 1-223943/224051
YUGOSLAVIA		Cummins Dizel Motori Doo Prodaja I Servis Autoput 22 11080 Zemun Beograd F.R. Yugoslavia Telephone: (381-11) 314 9071
ZAMBIA	**Ndola**	Cummins Diesel Services (Zambia) Ltd. P.O. Box 71501 Ndola, Zambia Telephone: (260-2) 610729
ZIMBABWE	**Harare**	Cummins Zimbabwe (Pvt) Ltd. P.O. Box ST363 Southerton Harare, Zimbabwe Location: 72 Birmingham Road Southerton, Harare Telephones: (263-4) 621871/2/3/4/5

Notes

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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.

⚠ WARNING ⚠

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

Air Compressor Air Pressure Rises Slowly

This is symtom tree t004

Cause	Correction
STEP 1 Air intake system restriction to air compressor is excessive	Replace the air compressor air cleaner (if installed). Check the air intake piping. Check engine air intake restriction if the air compressor inlet is plumbed to the vehicle or equipment intake system. Refer to Procedure 010-059 (Air Cleaner Restriction) in Section 5.
OK Go To Next Step	
STEP 2 Air system leaks	Block the vehicle wheels and check the air system for leaks with spring brakes applied and released. Check for leaks from the air compressor gaskets and the air system hoses, fittings, tanks, and valves. Refer to the OEM service manual.
OK Go To Next Step	
STEP 3 Air governor is malfunctioning or **not** set correctly	Check the air governor for correct operation. Refer to the OEM service manual.
OK Go To Next Step	
STEP 4 Carbon buildup is excessive in the air discharge line, downstream air valves, or cylinder head	Check for carbon buildup. Replace the air compressor discharge line and cylinder head assembly if necessary. Refer to Procedure 012-015 (Air Compressor Discharge Lines) in Section 7.
OK Go To Next Step	
STEP 5 Air system component is malfunctioning	Check the operation of air system valves, air dryers, and other OEM-installed air system components. Refer to the manufacturer's instructions.

Air Compressor Noise is Excessive

This is symtom tree t006

Cause	Correction
STEP 1 Carbon buildup is excessive in the air discharge line, downstream air valves, or cylinder head	Check for carbon buildup. Replace the air compressor discharge line and cylinder head assembly if necessary. Refer to Procedure 012-015 (Air Compressor Discharge Lines) in Section 7.
OK Go To Next Step	
STEP 2 Ice buildup in the air system components	For all models, check for ice in low spots of the air discharge line, dryer inlet, and elbow fittings. On Holset® models, also check the Econ valve (if equipped). Refer to the OEM service manual..
OK Go To Next Step	
STEP 3 Air compressor is sending air pulses into the air tanks	Install a ping tank between the air dryer and the wet tank and check discharge line size for the application. Refer to the manufacturer's instructions.

Air Compressor Pumping Excess Lubricating Oil into the Air System

This is symtom tree t007

Cause	Correction
STEP 1 Lubricating oil drain interval is excessive	Verify the correct lubricating oil drain interval. Refer to Procedure 018-003 (Lubricating Oil Recommendations and Specifications) in Section V.
OK Go To Next Step	
STEP 2 Air intake system restriction to air compressor is excessive	Replace the air compressor air cleaner (if installed). Check the air intake piping. Check engine air intake restriction if the air compressor inlet is plumbed to the vehicle or equipment intake system. Refer to Procedure 010-059 (Air Cleaner Restriction) in Section 5.
OK Go To Next Step	
STEP 3 Contaminants are building up in the system reservoirs	Drain the reservoirs daily. Refer to Procedure 012-021 in Section 3.
OK Go To Next Step	
STEP 4 Carbon buildup is excessive in the air discharge line, air system valves, or cylinder head	Check for carbon buildup. Replace the air compressor discharge line, cylinder head, or air compressor. Check the turbocharger for oil leaks. Check the intake tube for oil. Refer to Procedure 012-015 (Air Compressor Discharge Lines) in Section 7.
OK Go To Next Step	
STEP 5 Engine angularity during operation exceeds specification	Refer to the Engine Specification data sheet.
OK Go To Next Step	
STEP 6 Air compressor runs hot	If coolant temperature is above normal, refer to the Coolant Temperature Above Normal - Gradual Overheat Symptom Tree.

Air Compressor Will Not Maintain Adequate Air Pressure (Not Pumping Continuously)

This is symtom tree t008

Cause	Correction
STEP 1 Air system leaks	Block the vehicle wheels and check the air system for leaks with spring brakes applied and released. Check for leaks from the air compressor gaskets and the air system hoses, fittings, tanks, and valves. Refer to the OEM service manual.

Air Compressor Will Not Stop Pumping

This is symtom tree t010

Cause	Correction
STEP 1 Air governor is malfunctioning or **not** set correctly	Check the air governor for correct operation. Refer to the OEM service manual.
OK Go To Next Step	
STEP 2 Air system leaks	Block the vehicle wheels and check the air system for leaks with spring brakes applied and released. Check for leaks from the air compressor gaskets and the air system hoses, fittings, tanks, and valves. Refer to the OEM service manual.
OK Go To Next Step	
STEP 3 Air system component is malfunctioning	Check the operation of air system valves, air dryers, and other OEM-installed air system components. Refer to the manufacturer's instructions.

Alternator Not Charging or Insufficient Charging

This is symtom tree t013

Cause	Correction
STEP 1 Alternator belt is loose	Check the alternator belt tension. Adjust as necessary. Refer to Procedure 018-005 (Drive Belt Tension) in Section V.
OK Go To Next Step	
STEP 2 Alternator drive pulley is loose on the water pump shaft	Make sure the drive pulley is tight on the shaft. Refer to the manufacturer's specifications.
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 Vehicle gauge is malfunctioning	Check the vehicle gauge. Refer to the OEM service manual.
OK Go To Next Step	
STEP 6 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 7 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 8 Alternator is overloaded or alternator capacity is below specification	Install an alternator with a higher capacity. Refer to the OEM service manual.
OK Go To Next Step	
STEP 9 Battery temperature is above specification	Position the batteries away from heat sources. Refer to the OEM service manual.

Coolant Loss - External

This is symtom tree t020

Cause	Correction
STEP 1 Coolant level is above specification	Check the coolant level. Refer to the OEM service manual.

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 restriction. Refer to the OEM service manual.

OK
Go To Next Step

STEP 5 Cooling system hose is collapsed, restricted, or leaking	Inspect the hoses. Refer to Procedure 008-045 (Radiator Hoses) in Section 6.

Coolant Loss - Internal

This is symtom tree t021

Cause	Correction
STEP 1 Fuel heater is leaking coolant	Check the fuel heater for coolant leaks. Refer to the manufacturer's instructions.

OK
Go To Next Step

STEP 2 Transmission oil cooler or torque converter cooler is leaking	Check the transmission oil cooler and torque converter cooler for coolant leaks. Refer to the manufacturer's instructions.

Coolant Temperature Above Normal - Gradual Overheat

This is symtom tree t022

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronic Controlled Fuel System) in Section 1.
OK Go To Next Step	
STEP 2 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.
OK Go To Next Step	
STEP 3 Charge air cooler fins, radiator fins, or air conditioner condenser fins are damaged or obstructed with debris	Inspect the charge air cooler, air conditioner condenser, and radiator fins. Clean, if necessary. Refer to the OEM service manual.
OK Go To Next Step	
STEP 4 Cold weather radiator cover or winterfront is closed	Open the cold weather radiator cover or the winterfront. Maintain a minimum of 784 cm^2 [122 in^2] or approximately 28 x 28 cm [11 x 11 in] of opening at all times. Refer to Procedure 101-015 (Operating the Engine) in Section 1.
OK Go To Next Step	
STEP 5 Cooling system hose is collapsed, restricted, or leaking	Inspect the hoses. Refer to Procedure 008-045 (Radiator Hoses) in Section 6.
OK Go To Next Step	
STEP 6 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.
OK Go To Next Step	
STEP 7 Fan shroud is damaged or missing, or the air recirculation baffles are damaged or missing	Inspect the shroud and the recirculation baffles. Repair, replace, or install if necessary. Refer to the OEM service manual.
OK Go To Next Step	
STEP 8 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	

Coolant Temperature Above Normal - Gradual Overheat

This is symtom tree t022

Cause	Correction
STEP 9 Intake manifold air temperature is above specification	Refer to the Intake Manifold Air Temperature Above Specification symptom tree.
OK Go To Next Step	
STEP 10 Coolant temperature gauge is malfunctioning	Test the temperature gauge. Repair or replace the gauge if necessary. Refer to the OEM service manual.
OK Go To Next Step	
STEP 11 Thermostat is **not** correct or is malfunctioning	Check the thermostat for the correct part number and for correct operation. Contact a Cummins Authorized Repair Facility.
OK Go To Next Step	
STEP 12 Radiator shutters are **not** opening completely, or the shutterstat setting is wrong	Inspect the radiator shutters. Repair or replace if necessary. Check the shutterstat setting. Refer to the manufacturer's instructions.
OK Go To Next Step	
STEP 13 Radiator swing check valve is malfunctioning (if equipped)	Check the swing check valve for correct operation. Refer to the OEM service manual.
OK Go To Next Step	
STEP 14 Vehicle cooling system is **not** adequate	Verify that the engine and vehicle cooling systems are using the correct components. Refer to the OEM service manual.
OK Go To Next Step	
STEP 15 Torque converter is malfunctioning	Check the torque converter. Refer to the OEM service manual.

Coolant Temperature Above Normal - Sudden Overheat

This is symtom tree t023

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronic Controlled Fuel System) in Section 1.
OK Go To Next Step	
STEP 2 Fan drive belt is broken	Check the fan drive belt. Replace the belt, if necessary. Refer to 103-002 (Drive Belts) in Section 3.
OK Go To Next Step	
STEP 3 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.
OK Go To Next Step	
STEP 4 Charge air cooler fins, radiator fins, or air conditioner condenser fins are damaged or obstructed with debris	Inspect the charge air cooler, air conditioner condenser, and radiator fins. Clean, if necessary. Refer to the OEM service manual.
OK Go To Next Step	
STEP 5 Cooling system hose is collapsed, restricted, or leaking	Inspect the hoses. Refer to Procedure 008-045 (Radiator Hoses) in Section 6.
OK Go To Next Step	
STEP 6 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 7 Radiator shutters are **not** opening completely, or the shutterstat setting is wrong	Inspect the radiator shutters. Repair or replace if necessary. Check the shutterstat setting. Refer to the manufacturer's instructions.
OK Go To Next Step	
STEP 8 Cold weather radiator cover or winterfront is closed	Open the cold weather radiator cover or the winterfront. Maintain a minimum of 784 cm^2 [122 in^2] or approximately 28 x 28 cm [11 x 11 in] of opening at all times. Refer to Procedure 101-015 (Operating the Engine) in Section 1.
OK Go To Next Step	

Coolant Temperature Above Normal - Sudden Overheat

This is symtom tree t023

Cause	Correction
STEP 9 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. Procedure 101-015 (Operating the Engine) in Section 1

OK
Go To Next Step

STEP 10 Radiator swing check valve is malfunctioning (if equipped)	Check the swing check valve for correct operation. Refer to the OEM service manual.

OK
Go To Next Step

STEP 11 Fan drive or fan controls are malfunctioning	Check the fan drive and controls. Refer to the OEM service manual.

Coolant Temperature Below Normal

This is symtom tree t024

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronic Controlled Fuel System) in Section 1.
OK Go To Next Step	
STEP 2 Engine is operating at low ambient temperature	Check the winterfront, shutters, and under-the-hood air. Use under-the-hood intake air in cold weather. Refer to Procedure 101-015 (Operating the Engine) in Section 1.
OK Go To Next Step	
STEP 3 Coolant fill line is **not** routed correctly	Check the routing of the coolant fill line. Refer to the OEM service manual.
OK Go To Next Step	
STEP 4 Coolant temperature gauge is malfunctioning	Refer to the OEM service manual.
OK Go To Next Step	
STEP 5 Radiator shutters are stuck open or opening early	Check the shutter operation. Repair or replace the shutters if necessary. Refer to the OEM service manual.
OK Go To Next Step	
STEP 6 Radiator swing check valve is malfunctioning (if equipped)	Check the swing check valve for correct operation. Refer to the OEM service manual.
OK Go To Next Step	
STEP 7 Fan drive or fan controls are malfunctioning	Check the fan drive and controls. 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 Facility.
OK Go To Next Step	
STEP 9 Coolant flow through the radiator is **not** correct	Refer to the OEM service manual.

Crankcase Gases (Blowby) Excessive

This is symtom tree t027

Cause	Correction
STEP 1 Crankcase ventilation system is plugged	Check and clean the crankcase breather and vent tube. Refer to Procedure 101-007 (Electronic Controlled Fuel System) in Section 1.

OK
Go To Next Step

STEP 2 Turbocharger oil seal is leaking	Check the turbocharger compressor and turbine seals. Contact a Cummins Authorized Repair Facility.

Engine Brake Does Not Operate

This is symtom tree t036

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronic Controlled Fuel System) in Section 1.

OK
Go To Next Step

STEP 2 Engine brakes disabled	Enable the engine brake feature using an electronic service tool. Refer to a Cummins Authorized Repair Facility.

OK
Go To Next Step

STEP 3 Programmable parameters or selected features are **not** correct	Check the programmable parameters and the selected features with an electronic service tool. Set the parameters and features again if necessary. Refer to a Cummins Authorized Repair Facility.

OK
Go To Next Step

STEP 4 Service brake pressure switch or circuit is malfunctioning	Check the service brake pressure switch and circuit. Refer to a Cummins Authorized Repair Facility.

OK
Go To Next Step

STEP 5 Clutch switch or circuit is malfunctioning	Check the clutch switch adjustment, switch, and circuit. Refer to a Cummins Authorized Repair Facility.

OK
Go To Next Step

STEP 6 Accelerator pedal or lever position sensor or circuit is malfunctioning	Check for foot pedal restriction. Check the accelerator pedal or lever position sensor and circuit. Refer to the OEM service manual.

OK
Go To Next Step

STEP 7 Engine electrical ground is malfunctioning	Check engine ground to chassis and chassis ground to battery negative (-) post. Refer to the OEM service manual.

OK
Go To Next Step

STEP 8 Engine brake adjustment is **not** correct	Adjust the engine brakes. Refer to a Cummins Authorized Repair Facility.

Engine Brake - Low Retarding Power or Slow to Activate

This is symtom tree t037

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronic Controlled Fuel System) in Section 1.
OK Go To Next Step	
STEP 2 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 3 Programmable parameters or selected features are **not** correct	Check the programmable parameters and the selected features with an electronic service tool. Set the parameters and features again if necessary. Refer to a Cummins Authorized Repair Facility.
OK Go To Next Step	
STEP 4 Lubricating oil pressure is below specification	Check the oil pressure. If the pressure is low, refer to the Lubricating Oil Pressure Low symptom tree.
OK Go To Next Step	
STEP 5 Air in the lubricating oil system	Check the oil level. If level is high, contact a Cummins Authorized Repair Facility.
OK Go To Next Step	
STEP 6 Engine brake adjustment is **not** correct	Adjust the engine brakes. Refer to a Cummins Authorized Repair Facility.

Engine Brake — One or More Cylinders Braking with Power Switch Off

This is symtom tree t038

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronic Controlled Fuel System) in Section 1.

OK
Go To Next Step

STEP 2 Engine brake adjustment is **not** correct	Adjust the engine brakes. Refer to a Cummins Authorized Repair Facility.

Engine Decelerates Slowly

This is symtom tree t041

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronic Controlled Fuel System) in Section 1.
OK Go To Next Step	
STEP 2 Accelerator pedal or lever is sticking	Check for a sticking accelerator pedal. Refer to the OEM service manual.
OK Go To Next Step	
STEP 3 Air in the fuel system	Prime the fuel pump. Refer to the OEM service manual.

Engine Difficult to Start or Will Not Start (Exhaust Smoke)

This is symtom tree t043

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronic Controlled Fuel System) in Section 1.
OK Go To Next Step	
STEP 2 Fuel level is low in the tank	Fill the supply tank. Refer to the OEM service manual.
OK Go To Next Step	
STEP 3 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 4 Battery voltage is low	Check the batteries and the unswitched battery supply circuit. Refer to the OEM service manual.
OK Go To Next Step	
STEP 5 Fuel grade is **not** correct for the application or the fuel quality is poor	Operate the engine from a tank of high-quality fuel. Refer to Procedure 018-002 (Fuel Recommendations and Specifications) in Section V.
OK Go To Next Step	
STEP 6 Engine is operating at low ambient temperature	Check the winterfront, shutters, and under-the-hood air. Use under-the-hood intake air in cold weather. Refer to Procedure 101-015 (Operating the Engine) in Section 1.
OK Go To Next Step	
STEP 7 Fuel inlet restriction	Check the fuel filter. Refer to Procedure 006-015 (Fuel Filter) in Section 5.
OK Go To Next Step	
STEP 8 Air in the fuel system	Prime the fuel pump. Refer to the OEM service manual.
OK Go To Next Step	
STEP 9 Vehicle parasitics are excessive	Refer to the OEM service manual.
OK Go To Next Step	

Engine Difficult to Start or Will Not Start (Exhaust Smoke)

This is symtom tree t043

Cause	Correction
STEP 10 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 in Section 5.

OK
Go To Next Step

STEP 11 Overhead adjustments are **not** correct	Measure and adjust the overhead settings. Refer to a Cummins Authorized Repair Facility.

OK
Go To Next Step

STEP 12 Engine brakes are malfunctioning	Check the engine brake operation, adjustment, and solenoid resistance. Repair or adjust as necessary. Refer to a Cummins Authorized Repair Facility.

OK
Go To Next Step

STEP 13 Exhaust system restriction	Check the exhaust system for any restrictions. Refer to a Cummins Authorized Repair Facility.

Engine Difficult to Start or Will Not Start (No Exhaust Smoke)

This is symtom tree t044

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronic Controlled Fuel System) in Section 1.

OK
Go To Next Step

STEP 2 Vehicle antitheft feature active	Enter the correct "PIN" or verify the antitheft feature is disabled using electronic service tool Contact a Cummins Authorized Repair Facility.

OK
Go To Next Step

STEP 3 Keyswitch circuit is malfunctioning	Check the vehicle keyswitch circuit. Refer to the OEM service manual.

OK
Go To Next Step

STEP 4 Fuel level is low in the tank	Fill the supply tank. Refer to the OEM service manual.

OK
Go To Next Step

STEP 5 Air in the fuel system	Prime the fuel pump. Refer to the OEM service manual.

OK
Go To Next Step

STEP 6 Battery voltage is low	Check the batteries and the unswitched battery supply circuit. Refer to the OEM service manual.

OK
Go To Next Step

STEP 7 Fuel inlet restriction	Check the fuel filter. Refer to Procedure 006-015 (Fuel Filter) in Section 5.

OK
Go To Next Step

STEP 8 Electronic control module (ECM) is locked up	Disconnect the battery cables for 30 seconds. Connect the battery cables, and start the engine.

OK
Go To Next Step

STEP 9 Moisture in the wiring harness connectors	Dry the connectors with Cummins electronic cleaner, Part Number 3824510.

Engine Noise Excessive

This is symtom tree t047

Cause	Correction
STEP 1 Lubricating oil pressure is below specification	Check the oil pressure. If the pressure is low, refer to Lubricating Oil Pressure Low symptom tree.
OK Go To Next Step	
STEP 2 Lubricating oil level is below specification	Check the oil level. Refer to Procedure 007-043 (Lubricating Oil Level) in Section 3.
OK Go To Next Step	
STEP 3 Coolant temperature is above specification	Refer to the Coolant Temperature is Above Normal - Sudden Overheat or the Coolant Temperature is Above Normal - Gradual Overheat symptom tree.
OK Go To Next Step	
STEP 4 Lubricating oil is thin or diluted	Refer to Procedure 018-003 (Lubricating Oil Recommendations and Specifications) in Section V.
OK Go To Next Step	
STEP 5 Fan drive belt is loose, tight, or **not** in alignment	Check the fan drive belt. Refer to Section 3, Procedure 103-002 (Drive Belts).
OK Go To Next Step	
STEP 6 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 7 Engine mounts are worn, damaged, or **not** correct	Inspect the engine mounts. Refer to the OEM service manual.
OK Go To Next Step	
STEP 8 Air intake or exhaust piping is contacting the chassis or cab	Inspect the air piping, chassis, and cab for contact points. Refer to the OEM installation instructions.
OK Go To Next Step	
STEP 9 Air intake or exhaust leaks	Check for loose or damaged piping connections and missing pipe plugs. Check the turbocharger and exhaust manifold mounting. Refer to Procedure 010-024 (Air Leaks, Air Intake and Exhaust Systems) in Section 5.
OK Go To Next Step	

Engine Noise Excessive

This is symtom tree t047

Cause	Correction
STEP 10 Turbocharger noise	Turbocharger fluttering noises can be heard during deceleration or quick throttle closing. This noise is normal.
OK Go To Next Step	
STEP 11 Overhead adjustments are **not** correct	Measure and adjust the overhead settings. Refer to a Cummins Authorized Repair Facility.
OK Go To Next Step	
STEP 12 Vibration damper is damaged	Inspect the vibration damper. Refer to a Cummins Authorized Repair Facility.
OK Go To Next Step	
STEP 13 Air compressor noise is excessive	Refer to the Air Compressor Noise Is Excessive - Air Compressor symptom tree.
OK Go To Next Step	
STEP 14 Fan clutch, hydraulic pump, or refrigerant compressor noise is excessive	Isolate each component and check for noise. Refer to the OEM service manual.
OK Go To Next Step	
STEP 15 Drivetrain noise is excessive	Disconnect the drivetrain. Check for engine noise. Refer to the OEM service manual.

Engine Noise Excessive — Combustion Knocks

This is symtom tree t048

Cause	Correction
STEP 1 Engine is operating at low ambient temperature	Check the winterfront, shutters, and under-the-hood air. Use under-the-hood intake air in cold weather. Refer to Procedure 101-015 (Operating the Engine) in Section 1.
OK Go To Next Step	
STEP 2 Ether starting aid is malfunctioning	Repair or replace the ether starting aids. Refer to the manufacturer's instructions.
OK Go To Next Step	
STEP 3 Fuel grade is **not** correct for the application or the fuel quality is poor	Operate the engine from a tank of high-quality fuel. Refer to Procedure 018-002 (Fuel Recommendations and Specifications) in Section V.
OK Go To Next Step	
STEP 4 Air in the fuel system	Prime the fuel pump. Refer to the OEM service manual.
OK Go To Next Step	
STEP 5 Coolant temperature is below specification	Refer to the Coolant Temperature Below Normal symptom tree.
OK Go To Next Step	
STEP 6 Overhead adjustments are **not** correct	Measure and adjust the overhead settings. Refer to a Cummins Authorized Repair Facility.

Engine Power Output Low

This is symtom tree t057

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronically Controlled Fuel System) in Section 1.
OK Go To Next Step	
STEP 2 Accelerator pedal or lever is sticking	Check for a sticking accelerator pedal. Refer to the OEM service manual.
OK Go To Next Step	
STEP 3 Tachometer or speedometer is **not** calibrated or is malfunctioning	Compare the vehicle tachometer and speedometer readings with an electronic service tool reading. Check the calibration values for the flywheel teeth, rear axle ratio, and tire revolutions. Adjust the values if necessary. Refer to the OEM service manual.
OK Go To Next Step	
STEP 4 Programmable parameters or selected features are **not** correct	Check the programmable parameters and the selected features with an electronic service tool. Set the parameters and features again if necessary. Refer to a Cummins Authorized Repair Location.
OK Go To Next Step	
STEP 5 Fuel grade is **not** correct for the application or the fuel quality is poor	Operate the engine from a tank of high-quality fuel. Refer to Procedure 018-002 (Fuel Recommendations and Specifications) in Section V.
OK Go To Next Step	
STEP 6 Fuel inlet restriction	Check the fuel filter. Refer to Procedure 006-015 (Fuel Filter Spin-on) in Section 5.
OK Go To Next Step	
STEP 7 Air in the fuel system	Prime the fuel pump. Refer to the OEM service manual.
OK Go To Next Step	
STEP 8 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 010-058 (Air Intake Piping) in Section 3.
OK Go To Next Step	

Engine Power Output Low

This is symtom tree t057

Cause	Correction
STEP 9 Air intake or exhaust leaks	Check for loose or damaged piping connections and missing pipe plugs. Check the turbocharger and exhaust manifold mounting. Refer to Procedure 010-024 (Air Leaks, Air Intake and Exhaust System) in Section 5.
OK Go To Next Step	
STEP 10 Charge air cooler is restricted or leaking	Inspect the charge air cooler for air restrictions or leaks. Refer to Procedure 010-028 (Charge Air Piping) in Section 3.
OK Go To Next Step	
STEP 11 Drivetrain is **not** correctly matched to the engine	Check for correct gearing and drivetrain components. Refer to the OEM vehicle specifications..
OK Go To Next Step	
STEP 12 Exhaust system restriction is above specification	Check the exhaust system for restrictions. Refer to the OEM service manual.
OK Go To Next Step	
STEP 13 Vehicle parasitics are excessive	Refer to the OEM service manual.
OK Go To Next Step	
STEP 14 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. Refer to Procedure 007-043 (Lubricating Oil Level) in Section 3.
OK Go To Next Step	
STEP 15 Overhead adjustments are **not** correct	Measure and adjust the overhead settings. Refer to Procedure 003-004 (Overhead Set) in Section 6.
OK Go To Next Step	
STEP 16 Engine brake adjustment is **not** correct	Adjust the engine brakes. Refer to a Cummins Authorized Repair Location.

Engine Runs Rough at Idle

This is symtom tree t061

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronically Controlled Fuel System) in Section 1.
OK Go To Next Step	
STEP 2 Engine is operating at low ambient temperature	Check the winterfront, shutters, and under-the-hood air. Use under-the-hood intake air in cold weather. Refer to Procedure 101-015 (Operating the Engine) in Section 1.
OK Go To Next Step	
STEP 3 Engine mounts are worn, damaged, or **not** correct	Check the engine mounts. Refer to the OEM service manual.
OK Go To Next Step	
STEP 4 Fuel grade is **not** correct for the application or the fuel quality is poor	Operate the engine from a tank of high-quality fuel. Refer to Procedure 018-002 (Fuel Recommendations and Specifications) in Section V.
OK Go To Next Step	
STEP 5 Air in the fuel system	Prime the fuel pump. Refer to the OEM service manual.
OK Go To Next Step	
STEP 6 Fuel inlet restriction	Check the fuel filter. Refer to Procedure 006-015 (Fuel Filter Spin-on) in Section 5.
OK Go To Next Step	
STEP 7 Overhead adjustments are **not** correct	Measure and adjust the overhead settings. Refer to Procedure 003-004 (Overhead Set) in Section 6.
OK Go To Next Step	
STEP 8 Vibration damper is damaged	Inspect the vibration damper. Refer to Procedure 001-052 (Vibration Damper, Viscous) in Section 6.

Engine Runs Rough or Misfires

This is symtom tree t062

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronically Controlled Fuel System) in Section 1.
OK Go To Next Step	
STEP 2 Engine is operating at low ambient temperature	Check the winterfront, shutters, and under-the-hood air. Use under-the-hood intake air in cold weather. Refer to Procedure 101-015 (Operating the Engine) in Section 1.
OK Go To Next Step	
STEP 3 Fuel grade is **not** correct for the application or the fuel quality is poor	Operate the engine from a tank of high-quality fuel. Refer to Procedure 018-002 (Fuel Recommendations and Specifications) in Section V.
OK Go To Next Step	
STEP 4 Air in the fuel system	Prime the fuel pump. Refer to the OEM service manual.
OK Go To Next Step	
STEP 5 Fuel inlet restriction	Check the fuel filter. Refer to Procedure 006-015 (Fuel Filter Spin-on) in Section 3.
OK Go To Next Step	
STEP 6 Engine brake adjustment is **not** correct	Adjust the engine brakes. Refer to a Cummins Authorized Repair Location.
OK Go To Next Step	
STEP 7 Overhead adjustments are **not** correct	Measure and adjust the overhead settings. Refer to Procedure 003-004 (Overhead Set) in Section 6.
OK Go To Next Step	
STEP 8 Vibration damper is damaged	Inspect the vibration damper. Refer to Procedure 001-052 (Vibration Damper, Viscous) in Section 6.

Engine Shuts Off Unexpectedly or Dies During Deceleration

This is symtom tree t064

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronically Controlled Fuel System) in Section 1.
OK Go To Next Step	
STEP 2 Engine will **not** restart	Refer to the Engine Difficult to Start or Will Not Start symptom tree.
OK Go To Next Step	
STEP 3 Keyswitch circuit is malfunctioning	Check the vehicle keyswitch circuit. Refer to the OEM service manual.
OK Go To Next Step	
STEP 4 Battery voltage is low	Check the batteries and the unswitched battery supply circuit. Refer to the OEM service manual.
OK Go To Next Step	
STEP 5 Fuel inlet restriction	Check the fuel filter. Refer to Procedure 006-015 (Fuel Filter Spin-on) in Section 3.
OK Go To Next Step	
STEP 6 Air in the fuel system	Prime the fuel pump. Refer to the OEM service manual.

Engine Speed Surges at Low or High Idle

This is symtom tree t066

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronically Controlled Fuel System) in Section 1.
OK Go To Next Step	
STEP 2 Fuel level is low in the tank	Fill the supply tank. Refer to the OEM service manual.
OK Go To Next Step	
STEP 3 Fuel inlet restriction	Check the fuel filter. Refer to Procedure 006-015 (Fuel Filter Spin-on) in Section 5.
OK Go To Next Step	
STEP 4 Air in the fuel system	Prime the fuel pump. Refer to the OEM service manual.
OK Go To Next Step	
STEP 5 Idling with excessive load	Use the PTO feature for loaded conditions at low engine speeds. Refer to a Cummins Authorized Repair Location.
OK Go To Next Step	
STEP 6 Alternator is malfunctioning	Temporarily disconnect the alternator and run the engine. Replace the alternator if necessary. Refer to the OEM service manual.

Engine Speed Surges Under Load or in Operating Range

This is symtom tree t067

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronically Controlled Fuel System) in Section 1.
OK Go To Next Step	
STEP 2 Engine speed also surges at idle	Refer to the Engine Speed Surges at Low or High Idle symptom tree..
OK Go To Next Step	
STEP 3 Air in the fuel system	Prime the fuel pump. Refer to the OEM service manual.
OK Go To Next Step	
STEP 4 Fuel drain line restriction	Check the fuel drain lines for restriction. Refer to the OEM service manual.
OK Go To Next Step	
STEP 5 Fuel inlet restriction	Check the fuel filter. Refer to Procedure 006-015 (Fuel Filter Spin-on) in Section 5.
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 010-058 (Air Intake Piping) in Section 3.
OK Go To Next Step	
STEP 7 Exhaust system restriction is **not** within specification	Check the exhaust system for restrictions. Contact a Cummins Authorized Repair Facility.

Engine Starts But Will Not Keep Running

This is symtom tree t072

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronically Controlled Fuel System) in Section 1.
OK Go To Next Step	
STEP 2 Idle shutdown or PTO shutdown features are activated	Turn the keyswitch to the OFF position for 30 seconds. Turn the keyswitch to the ON position and check fault code operation.
OK Go To Next Step	
STEP 3 Fuel level is low in the tank	Fill the supply tank. Refer to the OEM service manual.
OK Go To Next Step	
STEP 4 Battery voltage is low	Check the batteries and the unswitched battery supply circuit. Refer to the OEM service manual.
OK Go To Next Step	
STEP 5 Fuel inlet restriction	Check the fuel filter. Refer to Procedure 006-015 (Fuel Filter Spin-on) in Section 5.
OK Go To Next Step	
STEP 6 Keyswitch circuit is malfunctioning	Check the vehicle keyswitch circuit. Refer to the OEM service manual.
OK Go To Next Step	
STEP 7 Vehicle parasitics are excessive	Check for transmission malfunctioning, cooling fan operation cycle time, and engine-driven units. Refer to the OEM service manual.
OK Go To Next Step	
STEP 8 Fuel grade is **not** correct for the application or the fuel quality is poor	Operate the engine from a tank of high-quality fuel. Refer to Procedure 018-002 (Fuel Recommendations and Specifications) in Section V.

Engine Vibration Excessive

This is symtom tree t075

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronically Controlled Fuel System) in Section 1.
OK Go To Next Step	
STEP 2 Engine is misfiring	Refer to the Engine Runs Rough or Misfires symptom tree.
OK Go To Next Step	
STEP 3 Engine idle speed is set too low (electronically controlled fuel systems)	Verify the correct idle speed setting. Increase the idle speed with the idle increment switch or an electronic service tool.
OK Go To Next Step	
STEP 4 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 5 Engine mounts are worn, damaged, or **not** correct	Check the engine mounts. Refer to the OEM service manual.
OK Go To Next Step	
STEP 6 Vibration damper is damaged	Inspect the vibration damper. Refer to Procedure 001-052 (Vibration Damper, Viscous) in Section 6.
OK Go To Next Step	
STEP 7 Drivetrain components are malfunctioning or are **not** correct	Compare the drivetrain components to the engine and equipment specifications. Isolate the drivetrain components and check for vibrations. Refer to the OEM specifications.
OK Go To Next Step	
STEP 8 Power take-off (PTO) is damaged	Check the PTO for damage and correct installation. Refer to the manufacturer's instructions.

Engine Will Not Crank or Cranks Slowly

This is symtom tree t077

Cause	Correction
STEP 1 Starting motor is malfunctioning or starting motor is **not** correct	Check the starting motor operation. Compare the starting motor with the engine and vehicle specifications. Refer to a Cummins Authorized Repair Location.
OK Go To Next Step	
STEP 2 Starting motor pinion or ring gear is damaged	Remove the starting motor, and inspect the gear.
OK Go To Next Step	
STEP 3 Engine-driven units are engaged	Disengage engine-driven units.
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 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. Refer to Procedure 007-043 (Lubricating Oil Level) in Section 3.
OK Go To Next Step	
STEP 6 Crankshaft rotation is impaired	Check the crankshaft for ease of rotation. Refer to a Cummins Authorized Repair Location.

Engine Will Not Shut Off

This is symtom tree t081

Cause	Correction
STEP 1 Keyswitch circuit is malfunctioning	Check the vehicle keyswitch 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 Turbocharger oil seal is leaking	Check the turbocharger compressor and turbine seals. Contact a Cummins Authorized Repair Facility.

Fuel Consumption Excessive

This is symtom tree t087

Cause	Correction
STEP 1 Fuel leak	Check the fuel lines, fuel connections, and fuel filters for leaks. Check the fuel lines to the supply tanks. Refer to the OEM service manual.
OK Go To Next Step	
STEP 2 Hubometer or odometer is miscalibrated	Check the hubometer and odometer calibrations. Calibrate or replace the hubometer or odometer, if necessary. Calculate fuel consumption with new mileage figures.
OK Go To Next Step	
STEP 3 Operator technique is **not** correct	Refer to Procedure 101-015 (Operating the Engine) in Section 1.
OK Go To Next Step	
STEP 4 Equipment and environmental factors are affecting fuel consumption	Consider ambient temperatures, wind, tire size, axle alignment, routes, and use of aerodynamic aids when evaluating fuel consumption.
OK Go To Next Step	
STEP 5 Drivetrain is **not** correctly matched to the engine	Check for correct gearing and drivetrain components. Refer to the OEM service manual.
OK Go To Next Step	
STEP 6 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronically Controlled Fuel System) in Section 1.
OK Go To Next Step	
STEP 7 Fuel grade is **not** correct for the application or the fuel quality is poor	Operate the engine from a tank of high-quality fuel. Refer to Procedure 018-002 (Fuel Recommendations and Specifications) in Section V.
OK Go To Next Step	
STEP 8 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. Refer to Procedure 007-043 (Lubricating Oil Level) in Section 3.
OK Go To Next Step	

Fuel Consumption Excessive

This is symtom tree t087

Cause	Correction
STEP 9 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 010-058 (Air Intake Piping) in Section 3.

OK
Go To Next Step

STEP 10 Exhaust system restriction is above specification	Check the exhaust system for restrictions. Refer to the OEM service manual.

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 6.

Fuel in Coolant

This is symtom tree t091

Cause	Correction
STEP 1 Bulk coolant supply is contaminated	Check the bulk coolant supply. Drain the coolant and replace with noncontaminated coolant. Replace the coolant filters. Refer to Procedure 008-006 (Coolant Filter) in Section 5
OK Go To Next Step	
STEP 2 Fuel heater is malfunctioning (if equipped)	Check the fuel heater and replace, if necessary. Refer to the manufacturer's instructions.

Fuel in the Lubricating Oil

This is symtom tree t092

Cause	Correction
STEP 1 Bulk oil supply is contaminated	Check the bulk oil supply. Drain the oil and replace with noncontaminated oil. Replace the oil filters.
OK Go To Next Step	
STEP 2 Engine idle time is excessive	Low oil and coolant temperatures can be caused by long idle time (greater than 10 minutes). Shut off the engine rather than idle for long periods. If idle time is necessary, raise the idle speed.
OK Go To Next Step	
STEP 3 Fuel drain line is restricted	Inspect the fuel drain lines for restrictions. Remove any restrictions found. Refer to the OEM service manual.

Intake Manifold Air Temperature Above Specification

This is symtom tree t096

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronically Controlled Fuel System) in Section 1.
OK Go To Next Step	
STEP 2 Intake manifold temperature gauge is malfunctioning, if equipped	Test the temperature gauge. Refer to the OEM service manual.
OK Go To Next Step	
STEP 3 Radiator shutters are **not** opening completely, or the shutterstat setting is wrong	Inspect the radiator shutters. Repair or replace if necessary. Check the shutterstat setting. Refer to the manufacturer's instructions.
OK Go To Next Step	
STEP 4 Cold weather radiator cover or winterfront is closed	Open the cold weather radiator cover or the winterfront. Maintain a minimum of 784 cm^2 [122 in^2] or approximately 28 x 28 cm [11 x 11 in] of opening at all times. Refer to Procedure 101-015 (Operating the Engine) in Section 1.
OK Go To Next Step	
STEP 5 Charge air cooler fins, radiator fins, or air conditioner condenser fins are damaged or obstructed with debris	Inspect the charge air cooler, air conditioner condenser, and radiator fins. Clean, if necessary. Refer to Procedure 010-028 (Charge Air Piping) in Section 3.
OK Go To Next Step	
STEP 6 Fan shroud is damaged or missing, or the air recirculation baffles are damaged or missing	Inspect the shroud and the recirculation baffles. Repair, replace, or install if necessary. Refer to the OEM service manual.
OK Go To Next Step	
STEP 7 Fan drive or fan controls are malfunctioning	Check the fan drive and controls. Refer to the OEM service manual.
OK Go To Next Step	
STEP 8 Fan is **not** an adequate size for the application	Verify that the fan is the correct size. Refer to the OEM specifications and Engine Data Sheet.

Lubricating Oil Consumption Excessive

This is symtom tree t102

Cause	Correction
STEP 1 Verify the oil consumption rate	Check the amount of oil added versus the mileage.
OK Go To Next Step	
STEP 2 Lubricating oil leak (external)	Inspect the engine for external oil leaks. Tighten the capscrews, pipe plugs, and fittings. Replace gaskets, if necessary. Refer to Procedure 018-006 (Engine Component Torque Values) in Section V.
OK Go To Next Step	
STEP 3 Crankcase ventilation system is plugged	Check and clean the crankcase breather and vent tube. Refer to Procedure 003-018 (Crankcase Breather Tube) in Section 3.
OK Go To Next Step	
STEP 4 Air compressor is pumping lubricating oil into the air system	Check the air lines for carbon buildup and lubricating oil. Refer to Procedure 012-015 (Air Compressor Discharge Lines) in Section 7.
OK Go To Next Step	
STEP 5 Turbocharger oil seal is leaking	Check the turbocharger compressor and turbine seals. Contact a Cummins Authorized Repair Facility.
OK Go To Next Step	
STEP 6 Lubricating oil temperature is above specification	Contact a Cummins Authorized Repair Facility.
OK Go To Next Step	
STEP 7 Lubricating oil is contaminated with coolant or fuel	Contact a Cummins Authorized Repair Facility.
OK Go To Next Step	
STEP 8 Lubricating oil dipstick calibration is **not** correct	Check the dipstick calibration. Refer to a Cummins Authorized Repair Location.
OK Go To Next Step	
STEP 9 Lubricating oil does **not** meet specifications for operating conditions	Change the oil and filters. Refer to Procedure 018-003 (Lubricating Oil Recommendations and Specifications) in Section V. Use the oil type recommended in Section V.
OK Go To Next Step	

Lubricating Oil Consumption Excessive

This is symtom tree t102

Cause	Correction
STEP 10 Lubricating oil drain interval is excessive	Verify the correct lubricating oil drain interval. Refer to Procedure 102-002 (Maintenance Schedule) in Section 2.

Lubricating Oil Contaminated

This is symtom tree t103

Cause	Correction
STEP 1 Bulk oil supply is contaminated	Check the bulk oil supply. Drain the oil and replace with noncontaminated oil. Replace the oil filters.
OK Go To Next Step	
STEP 2 Internal coolant leaks	Refer to the Coolant Loss - Internal symptom tree.
OK Go To Next Step	
STEP 3 Lubricating oil sludge is excessive	Refer to the Lubricating Oil Sludge in the Crankcase Is Excessive symptom tree.
OK Go To Next Step	
STEP 4 Fuel in the lubricating oil	Refer to the Fuel in the Lubricating oil symptom tree.

Lubricating Oil Pressure High

This is symtom tree t104

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronically Controlled Fuel System) in Section 1.
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. Refer to the OEM service manual.
OK Go To Next Step	
STEP 3 Coolant temperature is below specification	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 type recommended in Section V.

Lubricating Oil Pressure Low

This is symtom tree t105

Cause	Correction
STEP 1	
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.
OK Go To Next Step	
STEP 3 Lubricating oil leak (external)	Inspect the engine for external oil leaks. Tighten the capscrews, pipe plugs, and fittings. Replace gaskets, if necessary. Refer to Procedure 018-006 (Engine Component Torque Values) in Section V for specifications.
OK Go To Next Step	
STEP 4 Engine angularity during operation exceeds specification	Refer to the Engine Data Sheet.
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. Refer to the OEM service manual.
OK Go To Next Step	
STEP 6 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 type recommended in Section V.
OK Go To Next Step	
STEP 7 Lubricating oil is contaminated with coolant or fuel	Contact a Cummins Authorized Repair Facility.
OK Go To Next Step	
STEP 8 Lubricating oil filter is plugged	Change the oil and filter. Refer to Procedure 007-002 (Lubricating Oil and Filters) in Section 4. Review the oil change interval.
OK Go To Next Step	
STEP 9 Lubricating oil temperature is above specification	Contact a Cummins Authorized Repair Facility.

Lubricating Oil Sludge in the Crankcase Excessive

This is symtom tree t106

Cause	Correction
STEP 1 Bulk oil supply is contaminated	Check the bulk oil supply. Drain the oil and replace with noncontaminated oil. Replace the oil filters.
OK Go To Next Step	
STEP 2 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 3 Lubricating oil drain interval is excessive	Verify the correct lubricating oil drain interval. Refer to Procedure 102-002 (Maintenance Schedule) in Section 2.
OK Go To Next Step	
STEP 4 Fuel grade is **not** correct for the application or the fuel quality is poor	Operate the engine from a tank of high-quality fuel. Refer to Procedure 018-002 (Fuel Recommendations and Specifications) in Section V.
OK Go To Next Step	
STEP 5 Coolant temperature is below specification	Refer to the Coolant Temperature Below Normal symptom tree.
OK Go To Next Step	
STEP 6 Lubricating oil is contaminated with coolant or fuel	Contact a Cummins Authorized Repair Facility.
OK Go To Next Step	
STEP 7 Crankcase ventilation system is plugged	Check and clean the crankcase breather and vent tube. Refer to Procedure 003-018 (Crankcase Breather Tube) in Section 3.

Lubricating Oil Temperature Above Specification

This is symtom tree t107

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronically Controlled Fuel System) in Section 1.
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.
OK Go To Next Step	
STEP 3 Coolant temperature is above specification	Refer to the Coolant Temperature is Above Normal - Sudden Overheat or the Coolant Temperature is Above Normal - Gradual Overheat symptom tree.

Lubricating or Transmission Oil in the Coolant

This is symtom tree t108

Cause	Correction
STEP 1 Bulk coolant supply is contaminated	Check the bulk coolant supply. Drain the coolant and replace with noncontaminated coolant. Replace the coolant filters. Refer to Procedure 008-006 (Coolant Filter) in Section 5
OK Go To Next Step	
STEP 2 Torque converter cooler or hydraulic oil cooler is malfunctioning	Remove and inspect the cooler cores and o-rings. Refer to the OEM service manual.

Operating Fuel Pressure is Low

This is symtom tree t109

Cause	Correction
STEP 1 Air in the fuel system	Prime the fuel pump. Refer to a Cummins Authorized Repair Location.
OK Go To Next Step	
STEP 2 Fuel inlet restriction	Check the fuel filter. Refer to Procedure 006-015 (Fuel Filter Spin-on) in Section 5.

Smoke, Black — Excessive

This is symtom tree t116

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronically Controlled Fuel System) in Section 1.
OK Go To Next Step	
STEP 2 Fuel grade is **not** correct for the application or the fuel quality is poor	Operate the engine from a tank of high-quality fuel. Refer to Procedure 018-002 (Fuel Recommendations and Specifications) in Section V.
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 Procedure 010-024 (Air Leaks, Air Intake and Exhaust Systems) in Section 5.
OK Go To Next Step	
STEP 4 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 010-058 (Air Intake Piping) in Section 3.
OK Go To Next Step	
STEP 5 Exhaust system restriction is above specification	Check the exhaust system for restrictions. Refer to the OEM service manual.
OK Go To Next Step	
STEP 6 Charge air cooler is restricted or leaking	Inspect the charge air cooler for air restrictions or leaks. Refer to Procedure 010-028 (Charge Air Cooler) in Section 3.
OK Go To Next Step	
STEP 7 Overhead adjustments are **not** correct	Measure and adjust the overhead settings. Refer to Procedure 003-004 (Overhead Set) in Section 6.
OK Go To Next Step	
STEP 8 Turbocharger oil seal is leaking	Check the turbocharger compressor and turbine seals. Contact a Cummins Authorized Repair Facility.

Smoke, White — Excessive

This is symtom tree t118

Cause	Correction
STEP 1 Electronic fault codes active or high counts of inactive fault codes	Refer to Procedure 101-007 (Electronically Controlled Fuel System) in Section 1.
OK Go To Next Step	
STEP 2 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 3 Engine is operating at low ambient temperature	Check the winterfront, shutters, and under-the-hood air. Use under-the-hood intake air in cold weather. Refer to Procedure 101-015 (Operating the Engine) in Section 1.
OK Go To Next Step	
STEP 4 Fuel inlet restriction	Check for fuel inlet restriction. Contact a Cummins Authorized Repair Facility.
OK Go To Next Step	
STEP 5 Fuel grade is **not** correct for the application or the fuel quality is poor	Operate the engine from a tank of high-quality fuel. Refer to Procedure 018-002 (Fuel Recommendations and Specifications) in Section V.
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 6.

Turbocharger Boost Pressure Low

This is symtom tree t121

Cause	Correction
STEP 1 Intake and exhaust system restricted	Check the intake and exhaust systems for restrictions. Inspect the intake air filter and replace as necessary.

OK
Go To Next Step

STEP 2 Air intake or exhaust leaks	Check for loose or damaged piping connections and missing pipe plugs. Check the turbocharger and exhaust manifold mounting. Refer to Procedure 010-024 (Air Leaks, Air Intake and Exhaust Systems) in Section 5.

Turbocharger Leaks Engine Oil or Fuel

This is symtom tree t122

Cause	Correction
STEP 1 Engine is operating for extended periods under light or no-load conditions (slobbering)	Review the engine operating instructions. Refer to Procedure 101-015 (Operating the Engine) in Section 1.
OK Go To Next Step	
STEP 2 Turbocharger oil seal is leaking	Check the turbocharger compressor and turbine seals. Contact a Cummins Authorized Repair Facility.

Notes

Section V - Maintenance Specifications

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General Engine

Specifications

Listed below are general specifications for this engine.

Horsepower	Refer to the engine dataplate.
Engine Speed	Refer to the engine dataplate
Engine Speed	
400 to 450 hp	1800 rpm
500 to 600 hp	2000 rpm
Displacement	15 liters [912 C.I.D.]
Bore and Stroke	137 mm [5.40 in] x 169 mm [6.65 in]
Wet Engine Weight	1266 kg [2790 lb]
Dry Engine Weight:	
Power Generation	1370 kg [3020 lb]
Industrial	1524 kg [3360 lb]
Wet Engine Weight:	
Power Generation	1475 kg [3250 lb]
Industrial	1628 kg [3590 lb]
Firing Order	1-5-3-6-2-4
Crankshaft Rotation (viewed from front of engine)	**Clockwise**

Fuel System

Specifications

With EGR

Maximum Allowable Restriction to Pump with or without Fuel Cooler:
- With Clean Filter....203 mm Hg [8 in Hg]
- With Dirty Filter....305 mm Hg [12 in Hg]

Maximum Allowable Fuel Return Line Restriction....229 mm Hg [9 in Hg]
Minimum Allowable Fuel Tank Vent Capability....2.0 m ^{3}/hr [70 ft ^{3}/hr]
Maximum Allowable Fuel Inlet Temperature....71°C [160°F]
Fuel Shutoff Solenoids' Resistance....6 to 10 ohms
Maximum Allowable Pressure Drop Across Pressure Fuel Filter....517 kPa [75 psi]

Without EGR

Maximum Allowable Fuel Return Line Restriction....229 mm Hg [9 in Hg]
Minimum Allowable Fuel Tank Vent Capability....2.0 m ^{3}/hr [70 ft ^{3}/hr]
Maximum Allowable Fuel Inlet Temperature....71°C [160°F]
Fuel Shutoff Solenoids' Resistance....6 to 10 ohms
Maximum Allowable Inlet Restriction at the IFSM - high idle, no load:
- Upper Location....355 mm Hg [14 in Hg]
- Lower Location....305 mm Hg [12 in Hg]

Maximum Allowable Inlet Restriction at OEM Fuel Inlet:
- Without Remote Mount Filter....76 mm Hg [3 in Hg]
- With Remote Mount Filter....254 mm Hg [10 in Hg]

Lubricating Oil System

Specifications

Oil Pressure at Idle (minimum allowable at 93°C [200°F] oil temperature).....103 kPa [15 psi]
Oil Pressure at No-Load Governed Speed (automotive and industrial **only**).....241 to 276 kPa [35 to 40 psi]
Oil Capacity of Standard Engine:
  Combination Full-Flow/Bypass Filter Capacity.....3.78 liters [1 gal]
Oil Pan Capacity:
Automotive and Industrial
  High.....41.6 liters [11 gal]
  Low.....34.1 liters [9 gal]
Power Generation (for oil pan option OP1493)
  High.....83.3 liters [22 gal]
  Low.....72.0 liters [19 gal]
Oil Change Capacity (oil pan and filter filled to capacity):
  Automotive and Industrial.....45.4 liters [12 gal]
  Power Generation (for oil pan option OP1493).....87.0 liters [23 gal]
Total Lubricating Oil System Capacity Including Filter:
  Automotive and Industrial.....45.4 liters [12 gal]
  Power Generation (for oil pan option OP1493).....98.4 liters [26 gal]
Oil Pressure Range:
  Cold Engine.....Up to 900 kPa [130 psi]
  Warm Engine.....241 to 276 kPa [35 to 40 psi]

Cooling System

Specifications

With EGR

Coolant Capacity (engine **only**).....26.5 liters [28 qt]
Standard Modulating Thermostat Range.....82 to 93°C [180 to 200°F]
Maximum Coolant Pressure
(exclusive of pressure cap - closed thermostat at the maximum no-load governed speed).....262 kPa [38 psi]
Coolant Alarm Activation Temperature:
Ratings Below 565 Horsepower.....107°C [225°F]
Ratings of 565/600 Horsepower.....110°C [230°F]
Maximum Allowable Top Tank Temperature:
Automotive and Industrial
Ratings Below 565 Horsepower.....107°C [225°F]
Ratings of 565/600 Horsepower.....110°C [230°F]
Minimum Recommended Top Tank Temperature.....70°C [160°F]
Minimum Allowable Draw Down Percent.....11
Minimum Recommended Pressure Cap:
Automotive and Industrial.....103 kPa [15 psi]
Minimum Fill Rate (without low-level alarm).....19 liters/min [5 gpm]
Maximum Dearation Time.....25 minutes
Fan-on Coolant Temperature.....99°C [210°F]
Fan-on Intake Air Temperature.....190°C [230°F]
Shutter Opening Temperature
Coolant.....96°C [205°F]
Intake Air.....104°C [220°F]
Winterfronts (air passage area).....774 cm ^{2} [120 in ^{2}]

Without EGR

Coolant Capacity (engine **only**).....24 liters [25 qt]
Standard Modulating Thermostat Range.....82 to 93°C [180 to 200°F]
Maximum Coolant Pressure
(exclusive of pressure cap - closed thermostat at the maximum no-load governed speed).....227 kPa [33 psi]
Coolant Alarm Activation Temperature (automotive and industrial **only**).....110°C [230°F]
Maximum Allowable Top Tank Temperature
Automotive and Industrial.....107°C [225°F]
Power Generation
Standby.....110°C [230°F]
Prime.....104°C [220°F]
Minimum Recommended Top Tank Temperature.....70°C [158°F]
Minimum Allowable Drawdown or 10 Percent of System Capacity (whichever is greater).....2.4 liters [2.5 qt]
Minimum Recommended Pressure Cap
Automotive and Industrial.....50 kPa [7 psi]
Power Generation.....69 kPa [10 psi]
Minimum Fill Rate (without low-level alarm).....19 liters/min [5 gpm]
Maximum Deaeration Time.....25 minutes
Fan On Coolant Temperature
Automotive.....99°C [210°F]
Industrial.....95°C [203°F]
Fan On Intake Air Temperature (automotive and industrial **only**).....88°C [190°F]
Shutter Opening Temperature (automotive and industrial **only**)
Coolant.....
Intake Air.....
Winterfronts - Automotive Only.....Air passage area 775 cm ^{2} [120 in ^{2}]

General Information

Cummins Inc. recommends the use of fully formulated antifreeze or coolant containing a precharge of supplemental coolant additive (SCA). The antifreeze or coolant **must** meet the specifications outlined in The Maintenance Council (TMC) Recommended Practice (RP) 329 (ethylene glycol) or RP 330 (propylene glycol). The use of fully formulated antifreeze or coolant significantly simplifies cooling system maintenance.

Copies of TMC specifications can be obtained through Cummins Inc., or by contacting:

The Maintenance Council

American Trucking Association
2200 Mill Road
Alexandria, VA 33314-5388
Phone: (703) 838-1763
Fax (703) 836-6070

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 50/50 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.

This section also contains information on cooling system maintenance and a coolant treatment chart that is used to determine the correct SCA service filter.

Alternative maintenance practices for cooling systems can be found in Cummins Coolant Requirements and Maintenance, Bulletin 3666132.

Air Intake System

Specifications

⚠CAUTION⚠

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

Exhaust System

Specifications

Maximum Allowable Exhaust Back Pressure Created by Piping and Silencer:
Automotive and Industrial:
Power Generation:
Hg (mercury).....51 mm Hg [2 in Hg]
H_2O (water).....682 mm H_2O [27 in H_2O]
Exhaust Pipe Size (normally acceptable inside diameter):
Automotive and Industrial.....
Power Generation.....152 mm [6 in]

Electrical System

Specifications

Minimum Recommended Battery Capacity:

System Voltage	Ambient Temperatures	
	-18°C [0°F]	
	Cold Cranking Amperes	**Reserve Capacity* Amperes**
12 VDC		
Automotive and Power Generation	1800	540
Industrial	2700	360
24 VDC**		
Automotive and Power Generation	900	270
Industrial	1350	360

* The number of plates within a given battery size determines reserve capacity. Reserve capacity determines the length of time that sustained cranking can occur.

**CCA ratings are based on two 12-VDC batteries in series.

A minimum of 6 VDC at the OEM connector is required to power up the ECM.

Minimum Battery Capacity:
12-VDC Starter.....
24-VDC Starter.....200 ampere-hours to 900 cold cranking amps @ -18°C [0°F]
Maximum Starting Circuit Resistance:
12-VDC Starter.....
24-VDC Starter.....0.00200 ohm
Battery Cable Sizes - American Wire Gauge (maximum length in cranking motor circuit):
12-VDC:
No. 0000 or Two No. 0*.....6.1 m [20 ft]
Two No. 00.....7.6 m [25 ft]
12-VDC High Output:
No. 00..... 2.1 m [7 ft]
No. 000.....2.7 m [9 ft]
No. 0000 or Two No. 0*.....3.7 m [12 ft]
Two No. 00.....4.3 m [14 ft]
24 to 32 VDC:
No. 00..... 6.1 m [20 ft]
No. 000.....8.2 m [27 ft]
No. 0000 or Two No. 0*.....10.7 m [35 ft]
Two No. 00.....13.7 m [45 ft]
Minimum Ambient Air Temperature without Starting Aid.....-1°C [30°F]
Minimum Cranking Speed without Starting Aid.....130 rpm
* Two strands of No. 0 cable can be used in place of one No. 0000 cable, provided that connections are carefully made to make sure equal current flow exists in each parallel cable.....

Cummins/Fleetguard® Filter Specifications

Specifications

Fleetguard® is a subsidiary of Cummins Inc. Fleetguard® filters are developed through joint testing at Cummins Inc. and Fleetguard®. Fleetguard® filters are standard on new Cummins Inc. engines. Cummins Inc. recommends their use.

Fleetguard® products met 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 **must** insist on products that the supplier has tested to meet Cummins Inc. high quality standards.

Cummins can **not** be responsible for problems caused by; nongenuine filters that do **not** meet Cummins' performance or durability requirements.

Cummins Inc. requires a lubricating oil filter be used that meets Cummins Source Approval Method 10,765.

Filter Type	
Lubricating Oil Filter	
Cummins Part Number	3406810 and 3406809
Fleetguard® Part Number	LF9000 and LF9001
Fuel-Water Separator	
Cummins Part Number	4010650 and 4010651
Fleetguard® Part Number	FS1007 and FS1040
Coolant Filter	
Fleetguard® Part Number	WF2125[1] WF2126[2] WF2127[3]

1. This filter is designed for use with Fleetguard®'s extended service cooling system, which extends cooling system service to 1 year, 150,000 miles, or 4000 hours, whichever comes first. This filter is used for cooling systems up to 20 gallons. Refer to Coolant Requirements and Maintenance, Bulletin 3666132. Fleetguard® ES coolant **must** be used for all fill and top-off, which is critical for extended cooling system maintenance intervals.
2. This filter is designed for extended service intervals up to 50,000 miles when using TMC RP329 or RP330 coolants and is used for cooling systems up to 20 gallons. Refer to Coolant Requirements and Maintenance, Bulletin 3666132.
3. This filter has been designed for extended service intervals of 50,000 to 150,000 miles. It has no chemical additives and can be used in the following systems:
   - Cooling systems above 20 gallons in capacity.
   - See maintenance chart below.

When using WF2127 filter, the following volumes of treatment **must** be added at the designated mileages:

Cooling System Capacity	50,000-Mile Service Interval with RP329/330 Coolant or Treated Water (Fleetcool or DCA4)	150,000-Mile Service Interval with ES Coolant (ES Liquid)
0 to 20 gallons	1 qt (10 units)	1 qt (15 units)
20 to 40 gallons	2 qt (20 units)	2 qt (30 units)
40 to 60 gallons	3 qt (30 units)	3 qt (45 units)
60 to 80 gallons	4 qt (40 units)	4 qt (60 units)
80 to 100 gallons	5 qt (50 units)	5 qt (75 units)

NOTE: Filters **must** meet Cummins SAM 10,769. Fleetguard® filters meet Cummins SAM 10,769. The standard filter for the Signature engine is Fleetguard® WF2126. For systems larger than 100 gallons, use 1 quart per 15 gallons. Consult vehicle manufacturer for total cooling system capacity.

Fuel Recommendations and Specifications

Fuel Recommendations

⚠ WARNING ⚠

Do not bleed the fuel system on a hot engine; this can cause fuel to spill onto a hot exhaust manifold, which can cause a fire.

△ CAUTION △

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

△ CAUTION △

Do not use diesel fuel blended with lubricating oil in engines equipped with a catalytic converter. Damage to the converter will result.

Cummins Inc. recommends the use of ASTM No. 2 D fuel. The use of No. 2 diesel fuel will result in optimum engine performance.

At operating temperatures below 0°C [32°F], acceptable performance can be obtained by using blends of No. 2D and No. 1D.

NOTE: Lighter fuels can reduce fuel economy.

The viscosity of the fuel **must** be kept above 1.3 cSt at 40°C [104°F] to provide adequate fuel system lubrication.

The following chart lists acceptable alternate fuels.

Acceptable Substitute Fuels									
No. 1D Diesel	No. 2D Diesel	No. 1K Kerosene	Jet-A	Jet-A1	JP-5	JP-8	Jet-B	JP-4	CITE
1	OK	1	1	1	OK	OK	NOT OK	NOT OK	NOT OK

1. Additional information for fuel recommendations and specifications can be found in Fuel for Cummins Engines, Bulletin No. 3379001. See ordering information in the back of this manual.

Cummins diesel engines are designed to operate on No. 2 diesel fuel. These engines will also operate satisfactorily on fuels that meet the following specifications:

Property	Recommended Specifications
Viscosity (ASTM D445)	1.3 to 5.8 centistokes [1.3 to 5.8 mm per second] at 40°C [104°F].
Cetane Number (ASTM D613)	40 Minimum above 0°C [32°F]. 45 Minimum below 0°C [32° F].
Sulfur Content (ASTMD129 or 1552)	**Not** to exceed 0.05 mass percent*.
Active Sulfur (ASTM D130)	Copper Strip Corrosion **not** to exceed No. 2 rating after three hours at 49°C [122°F].
Water and Sediment (ASTM D1796)	**Not** to exceed 0.1 volume percent.
Carbon Residue (Rams-bottom, ASTM D524 or Conradson, ASTM D189)	**Not** to exceed 0.35 mass percent on 10 volume percent residuum.
Density (ASTM D287)	42 to 30° API gravity at 0.816 to 0.876 g/cc at 15°C [60°F].
Cloud Point (ASTM D97)	6°C [10°F] below lowest ambient temperature at which the fuel is expected to operate.

As h (ASTM D482)	**Not** to exceed 0.02 mass percent (0.05 mass percent with lubricating oil blending).
Distillation (ASTM D86)	The distillation curve **must** be smooth and continuous.
Acid Number (ASTM D664)	**Not** to exceed 0.1 mg KOA per 100 ml.

NOTE: * Effective October 1, 1993, the Environmental Protection Agency requires maximum sulfur content **not** to exceed 0.05 mass percent.

Lubricating Oil Recommendations and Specifications

General Information

Industrial Applications

The use of high-quality engine lubricating oils and appropriate oil drain and filter change intervals are critical factors in maintaining engine performance and durability.

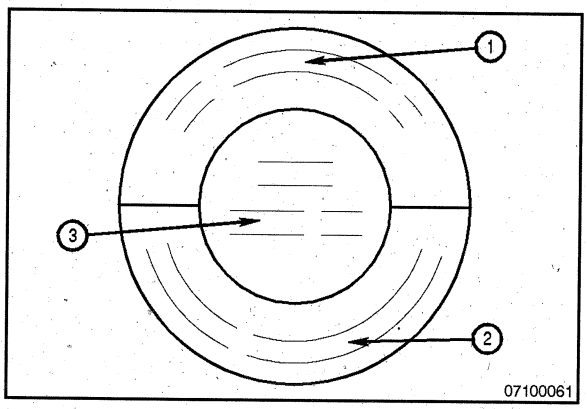
Cummins Inc. recommends the use of a high-quality 15W-40 multiviscosity heavy-duty engine oil that meets the requirements of Cummins Engineering Specification CES 20071 or CES 20076 (such as Valvoline® Premium Blue® or Premium Blue® 2000). American Petroleum Institute (API) specification CH-4 can be used as an alternative to CES 20071. Oils that meet API specification CG-4 can be used, but at a reduced drain interval according to the Oil Drain Intervals chart listed in Section 2. The oil grades CC, CD, CE, and CF have been obsoleted by API and **must not** be used.

Shortened drain intervals can be required with monograde oils as determined by close monitoring of the oil condition with scheduled oil sampling. Use of single-grade oils can affect engine oil control.

Synthetic engine oils, API category III, are recommended for use in Cummins engines operating in ambient temperature conditions consistently below -25°C [-13°F]. Above this temperature, petroleum-based multigrade lubricants are recommended. Synthetic 0W-30 oils that meet API category III can be used in operations where the ambient temperature **never** exceeds 0°C [32°F]. Multiviscosity oils rated 0W-30 do **not** offer the same level of protection against fuel dilution as do higher multigrade oils. Higher cylinder wear can be experienced when using 0W-30 oils in high-load situations.

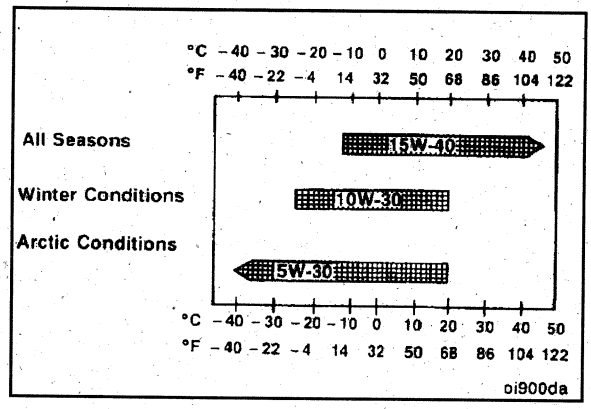
For further details and an explanation of engine lubricating oils for Cummins engines, refer to Cummins Engine Oil Recommendations, Bulletin 3810340.

Additional information regarding lubricating oil availability throughout the world is available in the Engine Manufacturing Association (EMA) Lubricating Oils Data Book for Heavy-Duty Automotive and Industrial Engines. The data book can be ordered from Engine Manufacturers Association, Two North LaSalle Street, Chicago, IL 60602; (312) 827-8733, (321) 827-8700, (www.engine-manufacturers.org).



The API service symbols are shown in the accompanying illustration.

1. . The upper half of the symbols displays the appropriate oil categories.
2. . The lower half contains words to describe oil energy-conserving features.
3. . The center section identifies the SAE oil viscosity grade.



Oil viscosity should be chosen according to the typical climate conditions experienced by the user. Use of 15W-40 is recommended for the best engine durability at higher ambient temperature. For temperate or cold conditions, 10W-30 or 5W-30 viscosity can be used for easier starting, improved oil flow, and improved fuel economy.

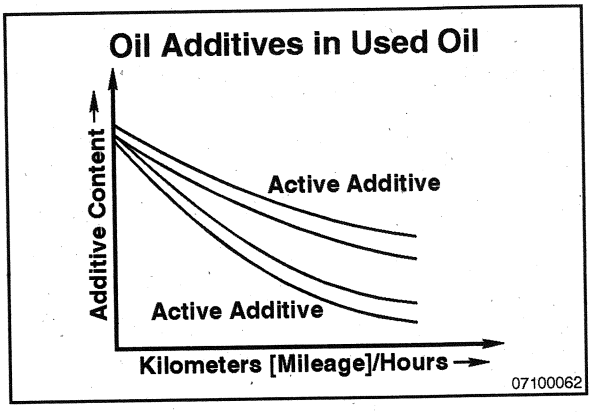
Oil Drain Intervals

Industrial Applications

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, kilometers or miles on the oil, fuel consumed, and new oil added.

Extending the oil and filter change interval beyond the recommendation will decrease engine life due to factors such as corrosion, deposits, and wear.

Reference the oil drain chart in Section 2 of the appropriate Operations and Maintenance Manual to determine which oil drain interval to use for your application.



⚠CAUTION⚠

The use of synthetic-based oil does not justify extended oil change intervals. Extended oil change intervals can decrease engine life due to factors such as corrosion, deposits, and wear.

Maximum oil drain intervals are based upon the use of fuel with 0.05 percent sulfur. Refer to Cummins Engine Oil Recommendations, Bulletin 3810340, for further details. For questions regarding fuel sulfur content, ask the fuel supplier to provide a written analysis of the fuel.

The lubricating oil filter is to be replaced at each oil drain with a high-quality filter that meets the Cummins Source Approval Method 10,765 specification including the cold flow specifications.

AfterMarket Oil Additive Usage

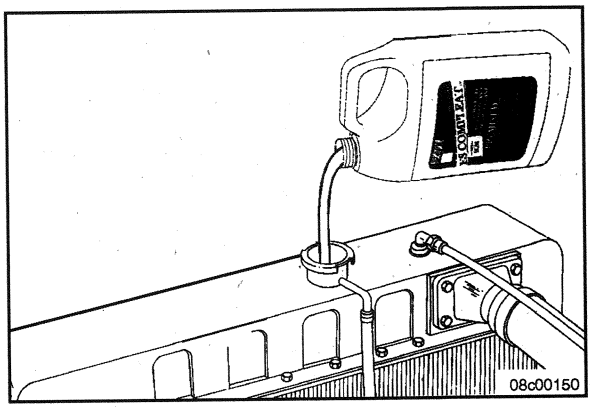
Cummins Inc. does **not** recommend the use of aftermarket oil additives. Current high-quality fully additive engine lubricating oils are very sophisticated, with precise amounts of additives blended into the lubricating oil to meet stringent requirements defined by Cummins Engineering Specification CES 20076 that is similar to API CH-4 and in CES 20078 that is similar to API CI-4. These furnished oils meet performance characteristics that conform to the lubricant industry standards. Aftermarket lubricating oil additives are **not** necessary to enhance engine oil performance and in some cases can reduce the finished oil's capability to protect the engine.

New Engine Break-in Oils

Special "break-in" engine lubricating oils are **not** recommended for new or rebuilt Cummins® engines. Use the same lubricating oil that will be used during normal operation.

Coolant Recommendations and Specifications

Fully Formulated Coolant/Antifreeze



Cummins Inc. recommends using either a 50/50 mixture of good-quality water and fully formulated antifreeze, or fully formulated coolant when filling the cooling system. The fully formulated antifreeze or coolant **must** meet TMC RP329 or TMC RP330 specifications.

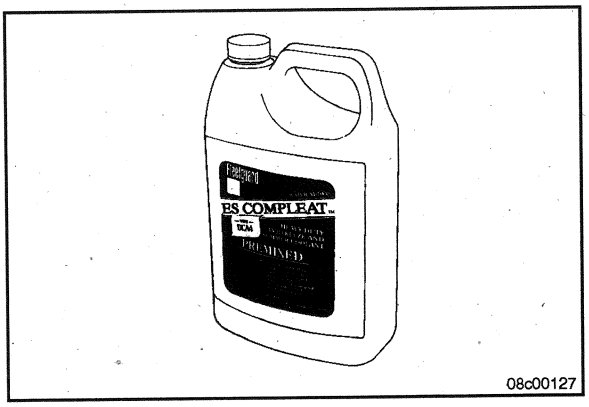
NOTE: Use of products meeting TMC RP329 or RP330 is necessary for 50,000-mile and 150,000-mile service intervals.

NOTE: Low-silicate antifreeze meeting ASTM D4985 is inadequate for these extended service intervals.

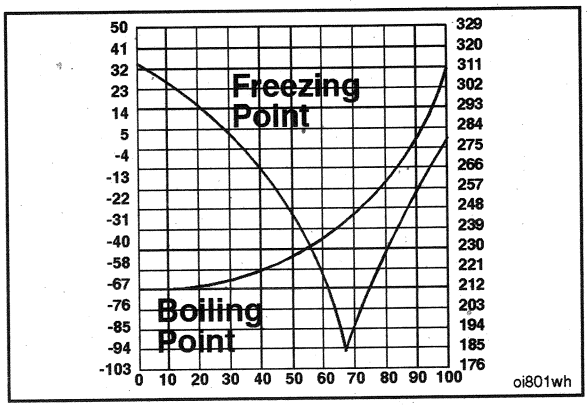
Good-quality water is important for cooling system performance. Excessive levels of calcium and magnesium contribute to scaling problems, and excessive levels of chlorides and sulfates cause cooling system corrosion.

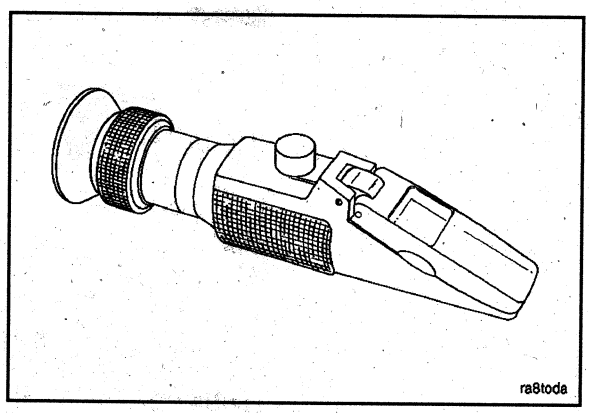
Water Quality	
Calcium Magnesium (Hardness)	Maximum 170 ppm as ($CaCO_3$ + $MgCO_3$)
Chloride	40 ppm as (Cl)
Sulfate	100 ppm as (SO_4)

Cummins Inc. recommends using Fleetguard® COMPLEAT ES. It is available in glycol forms (ethylene and propylene) and complies with TMC RP329 and RP330 standards.

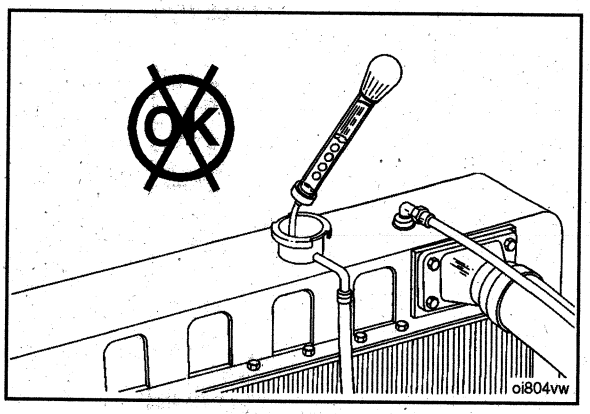


Fully formulated antifreeze **must** be mixed with quality water at a 50/50 ratio (40-percent to 60-percent working range). A 50/50 mixture of antifreeze and water gives a -36°C [-34°F] freezing point and a 110°C [228°F] boiling point, which is adequate for locations in North America. The actual lowest freezing point of ethylene glycol antifreeze is 68 percent. Using higher concentrations of antifreeze will raise the freezing point of the solution and increase the possibility of a silica gel problem.

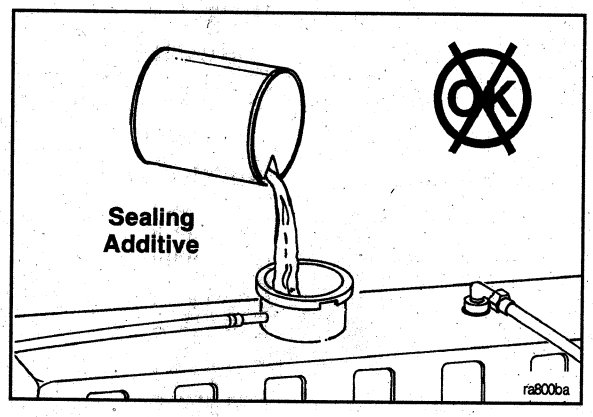




A refractometer **must** be used to measure the freezing point of the coolant **accurately**.



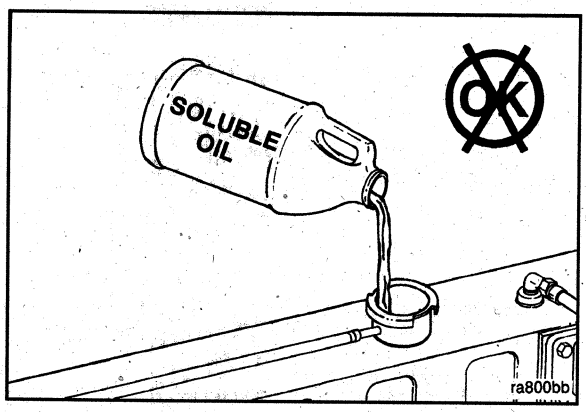
Do **not** use a floating ball hydrometer. Using a floating ball hydrometer can give an incorrect reading.



Cooling System Sealing Additives

Do **not** use sealing additives in the cooling systems. The use of sealing additives can:

- Build up in coolant low-flow areas
- Clog coolant filters
- Plug radiator and oil cooler.



Cooling System Soluble Oils

Do **not** use soluble oils in the cooling system. The use of soluble oils can:

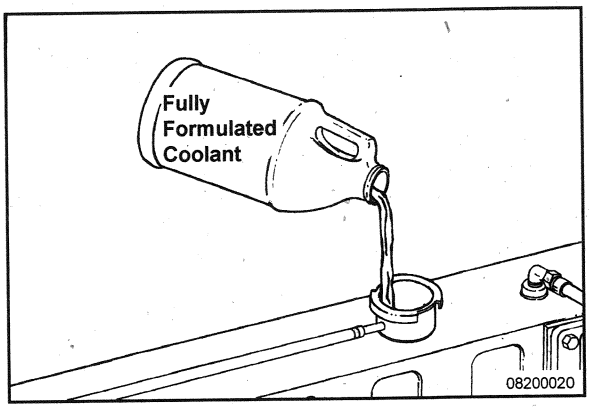
- Allow cylinder liner pitting
- Corrode brass, aluminum, and copper
- Damage heat transfer surfaces
- Damage seals and hoses.

Supplemental Coolant Additive (SCA)

⚠CAUTION⚠

The Signature, ISX, and QSX15 engines use aluminum parts that are in contact with the coolant. Improper coolant, coolant filter selection, and maintenance will likely result in perforation of one of these parts. Insufficient concentration of the coolant additives will result in liner pitting and engine failure.

Fully formulated products contain SCAs and are required to protect the cooling system from scale and fouling, solder corrosion, and general corrosion. The coolant filter is required to protect the cooling system from abrasive materials, debris, and precipitated coolant additives.



Fleetguard® DCA4 Service Filters and Liquid Precharge

WF2125 - This filter is designed for use with Fleetguard®'s extended service cooling system, which extends cooling system service to 1 year, 150,000 miles, or 4000 hours, whichever comes first. This filter is used for cooling systems up to 20 gallons. Refer to Coolant Requirements and Maintenance, Bulletin 3666132. Fleetguard® ES coolant **must** be used for all fill and top-off, which is critical for extended cooling system maintenance intervals.

WF2126 - This filter is designed for extended service intervals up to 50,000 miles when using TMC RP329 or RP330 coolants and is used for cooling systems up to 20 gallons. Refer to Coolant Requirements and Maintenance, Bulletin 3666132.

WF2127 - This filter has been designed for extended service intervals of 50,000 to 150,000 miles. It has no chemical additives and can be used in the following systems:

- Cooling systems above 20 gallons in capacity.
- See maintenance chart below.

When using WF2127 filter, the following volumes of treatment **must** be added at the designated mileages:

Cooling System Capacity	50,000-Mile Service Interval with RP329/330 Coolant or Treated Water (Fleetcool or DCA4)	150,000-Mile Service Interval with ES Coolant (ES Liquid)
0 to 20 gallons	1 qt (10 units)	1 qt (15 units)
20 to 40 gallons	2 qt (20 units)	2 qt (30 units)
40 to 60 gallons	3 qt (30 units)	3 qt (45 units)
60 to 80 gallons	4 qt (40 units)	4 qt (60 units)
80 to 100 gallons	5 qt (50 units)	5 qt (75 units)

NOTE: Filters **must** meet Cummins SAM 10,769. Fleetguard® filters meet Cummins SAM 10,769. The standard filter for the Signature engine is Fleetguard® WF2126. For systems larger than 100 gallons, use 1 quart per 15 gallons. Consult vehicle manufacturer for total cooling system capacity.

Testing SCA Concentration Level CC-2602 Test Kit

Precautions and Instructions for Proper Kit Use

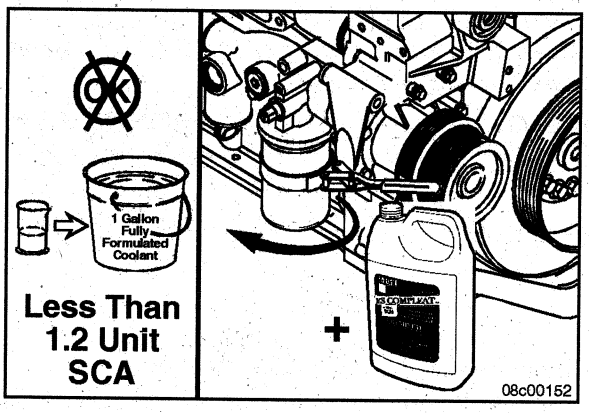
Carefully follow the instructions to test the coolant. Take the appropriate action recommended by the kit.

- 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, you will get incorrect results.
- 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 does fall between two colors on the color chart, choose the lower numbered (or lettered) block. It is safer to underestimate your results than to overestimate.
- The test strips do 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 cap tightly sealed on the test 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 the top pad on the unused strips have turned light brown.
- Use one strip at a time and take care **not** to touch any of the pads on the strip. Doing so will contaminate the pads and skew the test results.
- If the strip container is left uncapped for 24 hours, moisture in the air will render the strips useless, even though no discoloration will be evident.
- **Only** use the color chart supplied with the kit.
- Following the correct test times is very important. Use a clock or stopwatch.
- Do **not** utilize the test kit to maintain minimum SCA concentration levels (i.e., 1.5 units).
- When performing service that requires draining the cooling system, take special precautions to collect coolant in a clean non-galvanized container, seal coolant to prevent contamination, and save for reuse.

- Probablizer:
  - 3318169S Plug - Installs on the engine for easy coolant sampling
  - 3318168S Cap - Use with Monitor C bottle to sample coolant
  - CC2700 Monitor C™ - Use lab analysis of coolant samples for more detailed analysis.

- Works with any SCA formulation. Call 1-800-22FILTER (800-223-4583) if you have this test kit and the color chart does **not** show the number of units of SCA gallon of coolant.)



Test Intervals

⚠ WARNING ⚠

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

Testing is recommended if the operator is **not** sure of his cooling system condition due to leaks, uncontrolled topping off of the system, or major coolant loss.

If the concentration is below 1.2 units per gallon, replace the filter and precharge with liquid.

Check the SCA concentration level at least every 6 months, and anytime the coolant condition is unknown or corrosion is apparent within the cooling system.

Use Fleetguard® coolant test kit, CC2602, to check the concentration level. Instructions are included with the test kit.

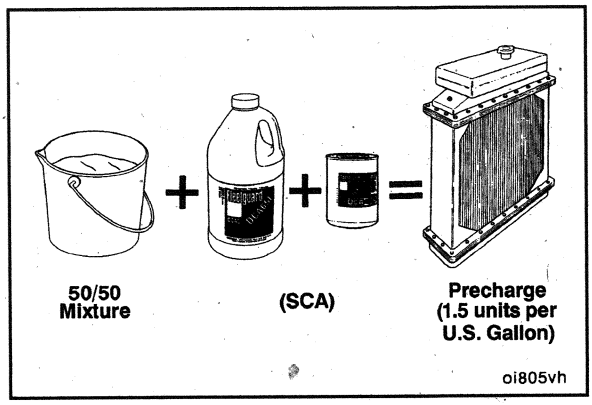
Call the following numbers to get answers to any questions you have about cooling system maintenance:

Cummins	Fleetguard®
1-800-DIESELS	**1-800-22FILTER**
1-800-343-7357	**1-800-223-4583**

Coolant Replacement Requirements

Drain and flush the cooling system after 6000 hours or 3 years of service. However, if Fleetguard®'s ES coolant and ES filters are used, check chloride, sulfate, and pH levels according to Coolant Requirements and Maintenance, Bulletin 3666132, to determine whether the coolant **must** be replaced. Refill with either new fully formulated coolant or ES coolant.

NOTE: Dispose of used coolant/antifreeze in accordance with federal, state, and local laws and regulations.



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

General Information

Component	Wrench Size	Torque Value	
		N•m	ft-lb
Oil Pan Drain Plug		47	35
Rocker Cover Capscrews	10 mm	25	16
Air Intake Piping V-Band Clamps	7/16	8.5	75 in-lb
Injector Adjusting Screw Locknut	24 mm	75	55
Injector Adjusting Screw	8 mm	8	70 in-lb
Valve Adjusting Screw	6 mm	0.6	5 in-lb
Valve Adjusting Screw Locknut	19 mm	45	33
Engine Brake Adjusting Screw	3 mm	N/A	N/A
Engine Brake Adjusting Screw Locknut	13 mm	20	15
Turbocharger Oil Drain Capscrews	13 mm	25	16
Turbocharger Male Union Elbow	22 mm	30	22
Turbocharger Oil Supply Line Fitting	21 mm	30	22
Turbocharger V-Band Clamps	7/16	8.5	75 in-lb
Turbocharger Mounting Nuts	15 mm	60	45

Capscrew Markings and Torque Values

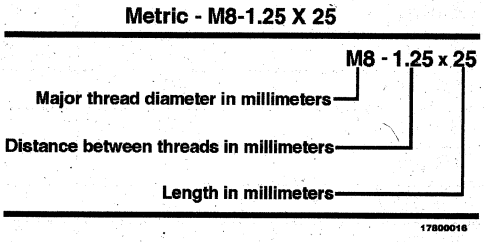
General Information

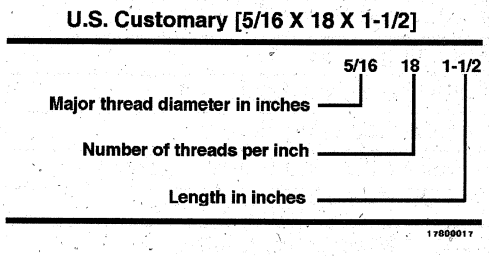
⚠CAUTION⚠

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:

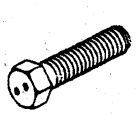
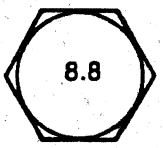
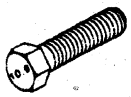
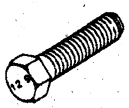




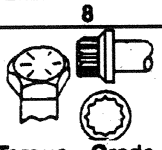
NOTES:

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	Torque				Torque				Torque			
Diameter	**Cast Iron**		**Aluminum**		**Cast Iron**		**Aluminum**		**Cast Iron**		**Aluminum**	
mm	**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 Body Size	Capscrew Torque - Grade 5 Capscrew				Capscrew Torque - Grade 8 Capscrew			
	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

Notes

Section W - Warranty

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All Diesel EnginesWorldwideGenerator Drive

Engines Warranted

This warranty applies to new Engines sold by Cummins and delivered to the first user on or after April 1, 1999 that are used in generator drive application anywhere in the world where Cummins approved service is available. These Engines will have the following rating designations:

Standby Power Rating

Engines of this rating are applicable for supplying emergency power for the duration of the utility power outage. No overload capability is available for this rating. Under no condition is an Engine allowed to operate in parallel with the public utility at the Standby Power rating. This rating should be applied where reliable utility power is available. A standby rated engine is to be sized for a maximum of an 80 percent average load factor and 200 hours of operation per year. This includes less than 25 hours per year at the Standby Power rating. Standby rating should never be applied except in true emergency power outages. Negotiated power outages contracted with a utility company are not considered an emergency.

Unlimited Time Running Prime Power Rating

Engines with this rating are available for an unlimited number of hours per year in a variable load application. Variable load is not to exceed a 70 percent average of the Prime Power Rating during any operating period of 250 hours. Total operating time at 100 percent Prime Power shall not exceed 500 hours per year.

A 10 percent overload capability is available for a period of one hour within a twelve hour period of operation. Total operating time at the 10 percent overload power shall not exceed 25 hours per year.

Limited Time Running Prime Power Rating

Engines of this rating are available for a limited number of hours in a non-variable load application. It is intended for use in situations where power outages are contracted, such as in utility power curtailment. Engines may be operated in parallel to the public utility up to 750 hours per year at power levels never to exceed the Prime Power rating.

Limited Time Running Prime Power ratings differ from Unlimited Time Running in that even though the maximum power output of the engines are the same, the Limited Time Running allows the Engine to be parallel to Public Utility and run at the full Prime Power rating and must never exceed the Prime Power rating.

Continuous/Base Power Rating

Engines with this rating are available for supplying utility power at a constant 100 percent load for an unlimited number of hours per year. No overload capability is available for this rating.

Continuous/Base Power ratings differ from Unlimited Time Running Prime Power ratings in that the Continuous/Base Load ratings are significantly reduced from the Prime Power ratings. Continuous/Base Load ratings have no load factor or application restrictions.

Coverage

Base Engine Warranty

This warranty covers any failures of the Engine, under normal use and service, which result from a defect in material or factory workmanship (Warrantable Failure).

Coverage begins with the sale of the Engine by Cummins and continues for the Duration stated below. The Duration commences either on the date of delivery of the Engine to the first user, or on the date the Engine is first leased, rented or loaned, or when the Engine has been operated for 50 hours, whichever occurs first.

Base Engine Warranty

	Duration Whichever Occurs First	
Rating	**Months**	**Hours**
Standby Power	24	400
Unlimited Prime Power	12	Unlimited
Limited Prime Power	12	750
Continuous/Base Power	12	Unlimited

Extended Major Components Warranty

The Extended Major Components Warranty applies to Engines other than B and C series and covers Warrantable Failures of the Engine cylinder block, camshaft, crankshaft and connecting rods (Covered Parts). Bushing and bearing failures are not covered. This coverage begins with the expiration of the Base Engine Warranty and continues for the following stated Duration. The Duration commences either on the date of delivery of the Engine to the first user, or on the date the Engine is first leased, rented or loaned, or when the Engine has been operated for 50 hours, whichever occurs first.

Extended Major Components Warranty

	Duration Whichever Occurs First	
Rating	**Months**	**Hours**
Standby Power	36	600
Unlimited Prime Power	36	10,000
Limited Prime Power	36	2,250
Continuous/Base Power	36	10,000

Consumer Products

This warranty on Consumer Products in the United States is a LIMITED warranty. **CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.** Any implied warranties applicable to Consumer Products terminate concurrently with the expiration of the express warranties applicable to the product. In the United States, some states do not allow the exclusion of incidental or consequential damages, or limitations on how long an implied warranty lasts, so the limitations or exclusions herein may not apply to you.

These warranties are made to all Owners in the chain of distribution, and Coverage continues to all subsequent Owners until the end of the periods of Coverage.

Cummins Responsibilities

During Base Engine Warranty

Cummins will pay for all parts and labor needed to repair the damage to the Engine resulting from a Warrantable Failure when performed during normal business hours. All labor costs will be paid in accordance with Cummins published Standard Repair Time guidelines.

Cummins will pay for the lubricating oil, antifreeze, filter elements, and other maintenance items that are not reusable due to the Warrantable Failure.

Cummins will pay reasonable travel expenses for mechanics to travel to and from the Engine site, including meals, mileage, and lodging when the repair is performed at the site of the failure.

Cummins will pay reasonable labor costs for Engine removal and reinstallation when necessary to repair a Warrantable Failure.

During the Extended Major Components Warranty

Cummins will pay for the repair or, at its option, replacement of the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner's Responsibilities

During the Base Engine Warranty

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during warranty repairs unless such items are not reusable due to the Warrantable Failure.

During the Extended Major Components Warranty

Owner is responsible for the cost of all labor needed to repair the Engine, including the labor cost for Engine removal and reinstallation. When Cummins elects to repair a part instead of replacing it, the Owner is not responsible for the labor needed to repair the part.

Owner is responsible for the cost of all parts required for the repair except for the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during repair of a Warrantable Failure.

During the Base Engine and Extended Major Components Warranties

Owner is responsible for the operation and maintenance of the Engine as specified in the applicable Cummins Operation and Maintenance Manual. Owner is also responsible for providing proof that all recommended maintenance has been performed.

Before the expiration of the applicable warranty, Owner must notify a Cummins distributor, authorized dealer or other repair location approved by Cummins of any Warrantable Failure and make the Engine available for repair by such facility. Locations in the United States* and Canada are listed in the Cummins United States and Canada Sales and Service Directory; other locations are listed in the Cummins International Sales and Service Directory.

Owner is responsible for communication expenses, meals, lodging and similar costs incurred as a result of a Warrantable Failure.

Owner is responsible for non-Engine repairs, "downtime" expenses, fines, all applicable taxes, all business costs and other losses resulting from a Warrantable Failure.

Owner is responsible for providing sufficient access to and reasonable ability to remove the Engine from the installation in the event of a Warrantable Failure.

Owner is responsible for maintaining an operating Engine hourmeter. If the hourmeter is not operational, engine usage will be estimated at 400 hours per month.

Limitations

Cummins is not responsible for failures or damage resulting from what Cummins determines to be abuse or neglect, including, but not limited to: operation without adequate coolants or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or intake systems; improper storage, starting, warm-up, run-in or shutdown practices; unauthorized modifications to the Engine. Cummins is also not responsible for Engine performance problems or failures caused by incorrect oil or fuel, or by water, dirt or other contaminants in the fuel or oil.

This warranty does not apply to accessories supplied by Cummins which bear the name of another company. Such non-warranted accessories include, but are not limited to: alternators, starters, fans**, air conditioning compressors, clutches, filters, transmissions, air cleaners and safety shutdown switches.

Before a claim for excessive oil consumption will be considered, Owner must submit adequate documentation to show that consumption exceeds Cummins published standards.

Failure of belts and hoses supplied by Cummins are not covered beyond the first 500 hours or one year of operation, whichever occurs first after the warranty start date.

Parts used to repair a Warrantable Failure may be new Cummins parts, Cummins approved rebuilt parts, or repaired parts. Cummins is not responsible for failures resulting from the use of parts not approved by Cummins.

A new Cummins or Cummins-approved rebuilt part used to repair a Warrantable Failure assumes the identity of the part it replaced and is entitled to the remaining coverage hereunder.

Cummins is not responsible for Engine performance problems or failures resulting from:

1. . Use or application of the Engine inconsistent with its rating designation as set forth above.
2. . Inadequate or incorrect installations deviating from Cummins Generator Drive Installation Guidelines.

CUMMINS IS NOT RESPONSIBLE FOR WEAR OR WEAROUT OF COVERED PARTS.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

THE WARRANTIES SET FORTH HEREIN ARE THE SOLE WARRANTIES MADE BY CUMMINS IN REGARD TO THESE ENGINES. CUMMINS MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

In the United States* and Canada, this warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Outside the United States* and Canada, in case of consumer sales, in some countries, the Owner has statutory rights which cannot be affected or limited by the terms of this warranty.

Nothing in this warranty excludes or restricts any contractual rights the owner may have against third parties.

* Includes American Samoa, the Commonwealth of Northern Mariana Islands, Guam, Puerto Rico, and the U.S. Virgin Islands.

** Alternators, starters, and fans ARE covered for the duration of the base engine warranty on B3.3 engines.

All Engines United States and CanadaIndustrial (Off-Highway)

Coverage

Products Warranted

This warranty applies to new Engines sold by Cummins and delivered to the first user on or after April 1, 1999, that are used in industrial (off-highway) applications in the United States* and Canada, except for Engines used in marine, generator drive and certain defense applications, for which different warranty coverage is provided.

Base Engine Warranty

This warranty covers any failures of the Engine, under normal use and service, which result from a defect in material or factory workmanship (Warrantable Failures).

Coverage begins with the sale of the Engine by Cummins. Coverage continues for two years or 2,000 hours of operation, whichever occurs first, from the date of delivery of the Engine to the first user, or from the date the unit is first leased, rented or loaned, or when the Engine has been operated for 50 hours, whichever occurs first. If the 2,000 hour limit is exceeded during the first year, Coverage continues until the end of the first year.

Extended Major Components Warranty

The Extended Major Components Warranty covers Warrantable Failures of the Engine cylinder block, camshaft, crankshaft and connecting rods (Covered Parts).

Bushing and bearing failures are not covered.

This Coverage begins with the expiration of the Base Engine Warranty and ends three years or 10,000* hours of operation from the date of delivery of the Engine to the first user, or from the date the unit is first leased, rented or loaned, or from when the Engine has been operated for 50 hours, whichever occurs first.

*3,000 hours for A series engines.

Consumer Products

The warranty on Consumer Products in the United States is a LIMITED warranty. **CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.** Any implied warranties applicable to Consumer Products in the United States terminate concurrently with the expiration of the express warranties applicable to the product. In the United States, some states do not allow the exclusion of incidental or consequential damages, or limitations on how long an implied warranty lasts, so the limitations or exclusions herein may not apply to you.

These warranties are made to all Owners in the chain of distribution, and Coverage continues to all subsequent Owners until the end of the periods of Coverage.

Cummins' Responsibilities

During The Base Engine Warranty

Cummins will pay for all parts and labor needed to repair the damage to the Engine resulting from a Warrantable Failure.

Cummins will pay for the lubricating oil, antifreeze, filter elements, and other maintenance items that are not reusable due to the Warrantable Failure.

Cummins will pay reasonable costs for mechanics to travel to and from the equipment site, including meals, mileage and lodging, when the repair is performed at the site of the failure.

Cummins will pay reasonable labor costs for Engine removal and reinstallation when necessary to repair a Warrantable Failure.

During The Extended Major Components Warranty

Cummins will pay for the repair or, at its option, replacement of the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered part.

Owner's Responsibilities

During The Base Engine Warranty

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items provided during warranty repairs unless such items are not reusable due to the Warrantable Failure.

During The Extended Major Components Warranty

Owner is responsible for the cost of all labor needed to repair the Engine, including the labor to remove and reinstall the Engine. When Cummins elects to repair a part instead of replacing it, Owner is not responsible for the labor needed to repair the part.

Owner is responsible for the cost of all parts required for the repair except for the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during repair of a Warrantable Failure.

During The Base Engine and Extended Major Components Warranties

Owner is responsible for the operation and maintenance of the Engine as specified in the applicable Cummins Operation and Maintenance Manual. Owner is also responsible for providing proof that all recommended maintenance has been performed.

Before the expiration of the applicable warranty, Owner must notify a Cummins distributor, authorized dealer or other repair location approved by Cummins of any Warrantable Failure and make the Engine available for repair by such facility. Locations in the United States and Canada are listed in the Cummins Off Highway Authorized Dealer Directory.

Owner is responsible for communication expenses, meals, lodging and similar costs incurred as a result of a Warrantable Failure.

Owner is responsible for non-Engine repairs, "downtime" expenses, cargo damage, fines, all applicable taxes, all business costs and other losses resulting from a Warrantable Failure.

Limitations

Cummins is not responsible for failures or damage resulting from what Cummins determines to be abuse or neglect, including, but not limited to: operation without adequate coolants or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or intake systems; improper storage, starting, warm-up, run-in or shutdown practices; unauthorized modifications of the Engine. Cummins is also not responsible for failures caused by incorrect oil or fuel or by water, dirt or other contaminants in the fuel or oil.

For power units and fire pumps (package units), this warranty applies to accessories, except for clutches and filters, supplied by Cummins which bear the name of another company.

Except for power units and fire pumps, this warranty does not apply to accessories which bear the name of another company. Such non-warranted accessories include, but are not limited to: alternators, starters, fans**, air conditioning compressors, clutches, filters, transmissions, torque converters, steering pumps, and non-Cummins fan drives, engine compression brakes and air compressors.

Cummins Compusave units are covered by a separate warranty.

Before a claim for excessive oil consumption will be considered, Owner must submit adequate documentation to show that consumption exceeds Cummins published standards.

Failures of belts and hoses supplied by Cummins are not covered beyond the first 500 hours or one year of operation, whichever occurs first.

Parts used to repair a Warrantable Failure may be new Cummins parts, Cummins-approved rebuilt parts, or repaired parts. Cummins is not responsible for failures resulting from the use of parts not approved by Cummins.

A new Cummins or Cummins-approved rebuilt part used to repair a Warrantable Failure assumes the identity of the part it replaced and is entitled to the remaining coverage hereunder.

CUMMINS DOES NOT COVER WEAR OR WEAROUT OF COVERED PARTS.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

THESE WARRANTIES SET FORTH HEREIN ARE THE SOLE WARRANTIES MADE BY CUMMINS IN REGARD TO THESE ENGINES. CUMMINS MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Emission Warranty

Products Warranted

This emission warranty applies to new Engines marketed by Cummins that are used in the United States* in vehicles designed for Industrial off-highway use. This warranty applies to Engines delivered to the ultimate purchaser on or after April 1, 1999 for engines up to 750 horsepower, on or after January 1, 2000 for engines 751 horsepower and over.

Coverage

Cummins warrants to the ultimate purchaser and each subsequent purchaser that the Engine is designed, built and equipped so as to conform at the time of sale by Cummins with all U.S. Federal emission regulations applicable at the time of manufacture and that it is free from defects in workmanship or material which would cause it not to meet these regulations within the longer of the following periods: (A) Five years or 3,000 hours of operation, whichever occurs first, as measured from the date of delivery of the Engine to the ultimate purchaser, or (B) The Base Engine Warranty.

If the vehicle in which the Engine is installed is registered in the state of California, a separate California Emission Warranty also applies.

Limitations

Failures, other than those resulting from defects in materials, or workmanship, are not covered by this warranty.

Cummins is not responsible for failures or damage resulting from what Cummins determines to be abuse or neglect, including, but not limited to: operation without adequate coolant or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or intake systems; improper storage, starting, warm-up, run-in or shutdown practices; unauthorized modifications of the Engine. Cummins is also not responsible for failures caused by incorrect fuel or by water, dirt or other contaminants in the fuel.

Cummins is not responsible for non-Engine repairs, "downtime" expenses, cargo damage, fines, all business costs or other losses resulting from a Warrantable Failure.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

* Includes American Samoa, the Commonwealth of Northern Mariana Islands, Guam, Puerto Rico, and the U.S. Virgin Islands.

** Alternators, starters, and fans ARE covered for the duration of the base engine warranty on A series and B3.3 engines.

All Engines InternationalIndustrial (Off-Highway)

Coverage

PRODUCTS WARRANTED

This warranty applies to new Engines sold by Cummins and delivered to the first user on or after April 1, 1999, that are used in industrial (off-highway) applications anywhere in the world where Cummins-approved service is available, except the United States* and Canada. Different warranty coverage is provided for Engines used in marine, generator drive and certain defense applications.

BASE ENGINE WARRANTY

This warranty covers any failures of the Engine, under normal use and service, which result from a defect in material or factory workmanship (Warrantable Failure).

Coverage begins with the sale of the Engine by Cummins. Coverage continues for two years or 2,000 hours of operation, whichever occurs first, from the date of delivery of the Engine to the first user, or from the date the unit is first leased, rented or loaned, or when the Engine has been operated for 50 hours, whichever occurs first. If the 2,000 hour limit is exceeded during the first year, coverage continues until the end of the first year.

EXTENDED MAJOR COMPONENTS WARRANTY

The Extended Major Components Warranty covers Warrantable Failures of the Engine cylinder block, camshaft, crankshaft and connecting rods (Covered Parts).

Bushing and bearing failures are not covered.

This coverage begins with the expiration of the Base Engine Warranty and ends three years or 10,000* hours of operation, from the date of delivery of the Engine to the first user, or from the date the unit is first leased, rented or loaned, or from when the Engine has been operated for 50 hours, whichever occurs first.

*3,000 hours for A series engines.

These warranties are made to all Owners in the chain of distribution, and Coverage continues to all subsequent Owners until the end of the periods of Coverage.

Cummins' Responsibilities

DURING THE BASE ENGINE WARRANTY

Cummins will pay for all parts and labor needed to repair the damage to the Engine resulting from a Warrantable Failure.

Cummins will pay for the lubricating oil, antifreeze, filter elements, and other maintenance items that are not reusable due to a Warrantable Failure.

Cummins will pay reasonable costs for mechanics to travel to and from the equipment site, including meals, mileage and lodging, when the repair is performed at the site of the failure.

Cummins will pay reasonable labor costs for Engine removal and reinstallation when necessary to repair a Warrantable Failure.

DURING THE EXTENDED MAJOR COMPONENTS WARRANTY

Cummins will pay for the repair or, at its option, replacement of the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered part.

Owner's Responsibilities

DURING THE BASE ENGINE WARRANTY

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during warranty repairs unless such items are not reusable due to the Warrantable Failure.

DURING THE EXTENDED MAJOR COMPONENTS WARRANTY

Owner is responsible for the cost of all labor needed to repair the Engine, including the labor to remove and reinstall the Engine. When Cummins elects to repair a part instead of replacing it, Owner is not responsible for the labor needed to repair the part.

Owner is responsible for the cost of all parts required for the repair except for the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during repair of a Warrantable Failure.

DURING THE BASE ENGINE AND EXTENDED MAJOR COMPONENTS WARRANTIES

Owner is responsible for the operation and maintenance of the Engine as specified in the applicable Cummins Operation and Maintenance Manual. Owner is also responsible for providing proof that all recommended maintenance has been performed.

Before the expiration of the applicable warranty, Owner must notify a Cummins distributor, authorized dealer or other repair location approved by Cummins of any Warrantable Failure and make the product available for repair by such facility. Locations are listed in the Cummins International Sales and Service Directory.

Owner is responsible for communication expenses, meals, lodging and similar costs incurred as a result of a Warrantable Failure.

Owner is responsible for non-Engine repairs, "downtime" expenses, cargo damage, fines, all applicable taxes, all business costs and other losses resulting from a Warrantable Failure.

Limitations

Cummins is not responsible for failures or damage resulting from what Cummins determines to be abuse or neglect, including, but not limited to: operation without adequate coolants or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or intake systems; improper storage, starting, warm-up, run-in or shutdown practices; unauthorized modifications of the Engine. Cummins is also not responsible for failures caused by incorrect oil or fuel or by water, dirt or other contaminants in the fuel or oil.

For power units and fire pumps (package units) the warranty applies to accessories, except for clutches and filters supplied by Cummins which bear the name of another company.

Starters, alternators, power steering pumps and non-Cummins air compressors supplied by Cummins on B or C Series Engines that are not supplied as part of a package unit are covered for six months* from the date of delivery of the Engine to the first user, or the date the Engine is first leased, rented or loaned, or from when the Engine has been operated for 50 hours, whichever occurs first.

Except for the accessories noted previously, Cummins does not warrant accessories which bear the name of another company. Such non-warranted accessories include, but are not limited to: alternators, starters, fans*, air conditioning compressors, clutches, filters, transmissions, torque converters, steering pumps, non-Cummins fan drives, and air cleaners.

Cummins Compusave units are covered by a separate warranty.

Before a claim for excessive oil consumption will be considered, Owner must submit adequate documentation to show that consumption exceeds Cummins published standards.

Failures of belts and hoses supplied by Cummins are not covered beyond the first 500 hours or one year of operation, whichever occurs first.

Parts used to repair a Warrantable Failure may be new Cummins parts, Cummins-approved rebuilt parts, or repaired parts. Cummins is not responsible for failures resulting from the use of parts not approved by Cummins.

A new Cummins or Cummins-approved rebuilt part used to repair a Warrantable Failure assumes the identity of the part it replaced and is entitled to the remaining coverage hereunder.

CUMMINS DOES NOT COVER WEAR OR WEAROUT OF COVERED PARTS.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

THESE WARRANTIES SET FORTH HEREIN ARE THE SOLE WARRANTIES MADE BY CUMMINS IN REGARD TO THESE ENGINES. CUMMINS MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

In case of consumer sales, in some countries, the Owner has statutory rights which cannot be affected or limited by the terms of this warranty.

Nothing in this warranty excludes or restricts any contractual rights the Owner may have against third parties.

* Alternators, starters, and fans ARE covered for the duration of the base engine warranty on A series and B3.3 engines.

All Engines Worldwide Marine/Commercial Propulsion and Auxiliary Products Coverage

Engines Included in this Coverage

Marine Propulsion	Marine Generator Drive
NT855-M	4B3.9-D(M)
NTA855-M	4BT3.9-D(M)
KT19-M	6B5.9-D(M)
KTA19-M	6BT5.9-D(M)
KTA19-M3	6CT8.3-D(M)
KTA19-M4	6CTA8.3-D(M)
QSK19-M	NT855-D(M)
VTA28-M	NTA855-D(M)
KTA38-M0	KTA19-D(M)
KTA38-M1	KTA19-D(M1)
KTA38-M2	VTA28-D(M)
KTA50-M2	KTA38-D(M)
QSK60-M	KTA38-D(M1)
	KTA50-D(M)
	QSK60-D(M)

Products Warranted

This warranty applies to new Engines sold by Cummins Inc., herein after "Cummins", that are branded as Cummins Marine products and used in Marine propulsion and marine auxiliary applications anywhere in the world where Cummins approved service is available and delivered to the first user on or after July 1, 2002. This warranty excludes all engines branded and sold as Cummins Mercruiser Diesel products. The `Product' consists of a new Cummins Engine, as well as accessories, which are approved and supplied by Cummins and which are either installed by Cummins or a Cummins authorized distributor. These Products have the following designation:

MARINE PROPULSION AND MARINE AUXILIARY (EXCLUDING GENERATOR DRIVE ENGINES)

Intermittent Rating

This power rating is intended for intermittent use in variable load applications where full power is limited to two hours out of every eight hours of operation. Also, reduced power operations must be at or below 200 RPM of the maximum rated RPM. This rating is an ISO3046 Fuel Stop Power Rating and is for applications that operate less than 1500 hours per year.

Medium Continuous Rating

This power rating is intended for continuous use in variable load applications where full power is limited to six hours out of every twelve hours of operation. Also, reduced power operations must be at or below 200 RPM of the maximum rated RPM. This rating is an ISO3046 Fuel Stop Power Rating and is for applications that operate less than 3000 hours per year.

Heavy Duty Rating

This power rating is intended for continuous use in variable load applications where full power is limited to eight hours out of every ten hours of operation. Also, reduced power must be at least 200 RPM below the maximum rated RPM. This rating is an ISO3046 Fuel Stop Power Rating and is for applications that operate less than 5,000 hours per year.

Continuous Rating

This power rating is intended for continuous use in applications requiring uninterrupted service at full power. This rating is an ISO3046 Standard Power Rating.

MARINE GENERATOR DRIVE

Prime Power

Engines with this rating are available for an unlimited number of hours per year in variable load applications. Variable load is not to exceed a 70 percent average of the Prime Power rating during any operating period of 250 hours. Total operating time at 100 percent Prime Power shall not exceed 500 hours per year.

A 10 percent overload capability is available for a period of one hour within a twelve hour period of operation. Total operating time at the 10 percent overload power shall not exceed 25 hours per year. This power rating conforms to ISO 8528 guidelines.

Continuous Power

Engines with this rating are available for supplying utility power at a constant 100 percent load for an unlimited number of hours per year. No overload capability is available for this rating.

Continuous Power ratings differ from Prime Power ratings in that the Continuous Load ratings are significantly reduced from the Prime Power ratings. Continuous Load ratings have no load factor or application restrictions. This power rating conforms to ISO 8528 guidelines.

Base Engine Warranty

This warranty covers any failures of the Product, under normal use and service, which result from a defect in Cummins material or factory workmanship (Warrantable Failure). Coverage begins with the sale of the Engine by Cummins and ends at the time and hours stated in the following table. The Duration commences on either the date of delivery of the Product to the first end-user, or the date the unit is first leased, rented or loaned, or when the Product has been operated for 50 hours, whichever occurs first.

	Duration Whichever Occurs First	
Rating	Years	Hours
Intermittent	1	1500
Medium Continuous	1	3000
Heavy Duty	1	5000
Continuous	1	Unlimited
Prime Power	1	Unlimited
Continuous Power	1	Unlimited

Extended Major Components Warranty

The Extended Major Components Warranty applies to engines other than B and C Series. It covers Warrantable Failures of the engine cylinder block, camshaft, crankshaft and connecting rods (Covered Parts). Bushing and bearing failures are not covered. This coverage begins with the expiration of the Base Engine Warranty and ends at three years or 10,800 hours of operation, whichever occurs first, after the date of delivery to the first end-user, or the date the unit is first leased, rented, or loaned, or when the Product has been operated for 50 hours, whichever occurs first.

These warranties are made to all Owners in the chain of distribution and Coverage continues to all subsequent Owners until the end of the periods of Coverage.

Cummins Responsibilities

During Base Engine Warranty

Cummins will pay for all parts and labor needed to repair the damage to the Product resulting from a Warrantable Failure when performed during normal business hours. All labor costs will be paid in accordance with Cummins published Standard Repair Time guidelines.

When it is necessary for mechanics to make on-site warranty repairs, Cummins will pay reasonable travel expenses, including meals, mileage and lodging, for mechanics to travel to and from the repair dock.

Cummins will pay for the lubricating oil, antifreeze, filter elements, and other maintenance items that are not reusable due to the Warrantable Failure.

Cummins will pay for reasonable labor costs for Engine removal and reinstallation when necessary to repair a Warrantable Failure.

During the Extended Major Components Warranty

Cummins will pay for the repair or, at its option, replacement of the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner Responsibilities

During the Base Engine Warranty

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements, and other maintenance items replaced during warranty repairs unless such items are not reusable due to the Warrantable Failure.

During the Extended Major Components Warranty

Owner is responsible for the cost of all labor needed to repair the Engine, including the labor cost for Engine removal and reinstallation. When Cummins elects to repair a part instead of replacing it, the Owner is not responsible for the labor needed to repair the part.

Owner is responsible for the cost of all parts required for the repair except for the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during repair of a Warrantable Failure.

During the Base Engine and Extended Major Components Warranties

Owner is responsible for the operation and maintenance of the Product as specified in the applicable Cummins Operation and Maintenance Manual. Owner is also responsible for providing proof that all recommended maintenance has been performed.

Before the expiration of the applicable warranty, Owner must notify a Cummins distributor, authorized dealer, or other repair location approved by Cummins of any Warrantable Failure and make the Engine available for repair by such facility. Locations in the United States and Canada are listed in the Cummins U.S. and Canada Sales and Service Directory; other locations are listed in the Cummins International Sales and Service Directory.

In the event of any Product failure, Owner is responsible for the cost of towing the boat to the repair dock and for all associated docking and harbor charges.

Owner is responsible for communication expenses, meals, lodging, and similar costs incurred as a result of a Warrantable Failure.

Owner is responsible for maintaining the Engine hourmeter in good working order at all times and to ensure that the hourmeter accurately reflects the total hours of operation of the Product.

Owner is responsible for the costs to investigate complaints, unless the problem is caused by a defect in Cummins material or factory workmanship.

Owner is responsible for non-Engine repairs, "downtime" expenses, cargo damage, fines, all applicable taxes, all business costs, and other losses resulting from a Warrantable Failure.

Limitations

Cummins is not responsible for failures or damage resulting from what Cummins determines to be abuse or neglect, including, but not limited to: operation without adequate coolants or lubricants; overfueling; overspeeding; lack of maintenance of cooling, lubricating or intake systems; improper storage, starting, warm-up, run-in or shutdown practices; unauthorized modifications to the Engine. Cummins is also not responsible for failures caused by incorrect oil or fuel or by water, dirt or other contaminants in the fuel or oil.

Cummins is not responsible for failures resulting from:

1. . Use or application of the Product inconsistent with its rating designation set forth above.
2. . Incorrect installation.

Before a claim for excessive oil consumption will be considered, Owner must submit adequate documentation to show that oil consumption exceeds Cummins published standards.

Cummins is not responsible for failures of marine maintenance components supplied by Cummins beyond ninety days after the coverage start date. Marine maintenance components include, but are not limited to: sea water pump impellers; zinc plugs; oil filters; fuel filters; air filters; water filters; fuel/water separator filters; expansion tank pressure caps.

Failure of belts and hoses supplied by Cummins are not covered beyond 90 days after the date of delivery of the Product to the first user, or the date the unit is first leased, rented or loaned, or when the Product has been operated for 50 hours, whichever occurs first.

Except for the accessories noted previously, Cummins does not warrant accessories which bear the name of another company.

Parts used in warranty repairs may be new Cummins parts, Cummins approved rebuilt parts, or repaired parts. Cummins is not responsible for failures resulting from the use of parts not supplied by Cummins.

Parts used to repair a Warrantable Failure may be new Cummins parts, Cummins approved rebuilt parts, or repaired parts. Cummins is not responsible for failures resulting from the use of parts not approved by Cummins.

A new Cummins or Cummins-approved rebuilt part used to replace a Warranted Part assumes the identity of the Warranted Part it replaced and is entitled to the remaining coverage hereunder.

Cummins Inc. reserves the right to interrogate Electronic Control Module (ECM) data for purposes of failure analysis.

CUMMINS DOES NOT COVER WEAR OR WEAROUT OF COVERED PARTS.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

THIS WARRANTY AND THE EMISSION WARRANTY SET FORTH HEREIN ARE THE SOLE WARRANTIES MADE BY CUMMINS IN REGARD TO THESE ENGINES. CUMMINS MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

In the United States** and Canada, this warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Outside the United States** and Canada, in case of consumer sales, in some countries the Owner has statutory rights which cannot be affected or limited by the terms of this warranty.

Nothing in this warranty excludes or restricts any contractual rights the Owner may have against third parties.

Emission Warranty

Products Warranted

This Emission Warranty applies to new Engines certified to United States EPA 40 CFR 94 sold by Cummins that are installed on vessels flagged or registered in the United States**.

Coverage

Cummins warrants to the first user and each subsequent purchaser that the Engine is designed, built and equipped so as to conform at the time of sale by Cummins with all United Stated Federal emission regulations applicable at the time of manufacture and that it is free from defects in material or factory workmanship which would cause it not to meet these regulations within the longer of the following periods. (A) Five years or 5,000 hours of operation, whichever occurs first, as measured from the date of delivery of the engine to the first user, or the date the unit is first leased, rented or loaned, or when the Engine has been operated for 50 hours, whichever occurs first, or (B) The Base Engine Warranty.

Limitations

An owner may elect to have maintenance, replacement or repair of the emission control parts performed by a facility other than a Cummins distributor, an authorized dealer or a repair location approved by Cummins, and may elect to use parts other than new genuine Cummins or Cummins approved rebuilt parts and assemblies for such maintenance, replacement or repair; however, the cost of such service or parts and subsequent failures resulting from such service or parts will not be covered under this emission control system warranty.

Failures, other than those resulting from defects in materials or factory workmanship, are not covered by this warranty.

Cummins is not responsible for failures or damage resulting from what Cummins determines to be abuse or neglect, including, but not limited to: operation without adequate coolants or lubricants; overfueling; overspeeding, lack of maintenance of lubricating, cooling or intake systems; improper storage, starting, warm-up, run-in or shutdown practices; unauthorized modifications of the Engine. Cummins is also not responsible for failures caused by incorrect oil or fuel or by water, dirt or other contaminants in the fuel or oil.

Cummins is not responsible for non-Engine repairs, "downtime" expenses, cargo damage, fines, all applicable taxes, all business costs or other losses resulting from a Warrantable Failure.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

** United States incudes American Samoa, the Commonwealth of Northern Mariana Islands, Guam, Puerto Rico, and the U.S. Virgin Islands.

California Emission Control System Warranty, Off-Highway

Products Warranted

This Emission Control System Warranty applies to off-road diesel engines certified with the California Air Resources Board beginning with the year 1996 for engines up to 750 horsepower, beginning with the year 2000 for 751 horsepower and over, marketed by Cummins, and registered in California for use in industrial off-highway applications.

Your Warranty Rights and Obligations

The California Air Resources Board and Cummins Engine Company, Inc., are pleased to explain the emission control system warranty on your engine. In California, new off-road diesel engines must be designed, built and equipped to meet the State's stringent anti-smog standards. Cummins must warrant the emission control system on your engine for the periods of time listed below provided there has been no abuse, neglect or improper maintenance of your engine.

Your emission control system may include parts such as the fuel injection system and the air induction system. Also included may be hoses, belts, connectors and other emission-related assemblies.

Where a warrantable condition exists, Cummins will repair your off-road diesel engine at no cost to you including diagnosis, parts and labor.

Manufacturer's Warranty Coverage

This warranty coverage is provided for 5 years or 3,000 hours of engine operation, whichever first occurs from the date of delivery of the engine to the first user. If any emission-related part on your engine is defective, the part will be repaired or replaced by Cummins.

Coverage

This emission control system warranty applies to the following emission control parts:

Turbocharger
Compressor Wheel
Turbine Wheel
Turbine Oil Seal
Wastegate Valve
Wastegate Actuator/Controller

Intake Manifold
Charge Air Cooler

Exhaust Manifold

Fuel System
Actuators (Fueling & Timing)
Fuel Pressure Sensor
Injectors (TP)

Electronic Control System
Control Module
Intake Manifold Pressure Sensor
Coolant Temperature Sensor

Owner's Warranty Responsibilities

As the off-road diesel engine owner, you are responsible for the performance of the required maintenance listed in your Cummins Operation and Maintenance Manual. Cummins recommends that you retain all receipts covering maintenance on your off-road diesel engine, but Cummins cannot deny warranty solely for the lack of receipts or for your failure to ensure the performance of all scheduled maintenance.

You are responsible for presenting your off-road diesel engine to a Cummins dealer as soon as a problem exists. The warranty repairs should be completed in a reasonable amount of time, not to exceed 30 days.

As the off-road diesel engine owner, you should also be aware that Cummins may deny you warranty coverage if your off-road diesel engine or a part has failed due to abuse, neglect, improper maintenance or unapproved modifications.

Your engine is designed to operate on diesel fuel only. Use of any other fuel may result in your engine no longer operating in compliance with California's emissions requirements.

If you have any questions regarding your warranty rights and responsibilities, you should contact Cummins Customer Assistance Department at 1-800-343-7357 (1-800-DIESELS) or the California Air Resources Board at 9528 Telstar Avenue, El Monte, CA 91731.

Prior to the expiration of the applicable warranty, Owner must give notice of any warranted emission control failure to a Cummins distributor, authorized dealer or other repair location approved by Cummins and deliver the engine to such facility for repair. Repair locations are listed in Cummins United States and Canada Service Directory.

Owner is responsible for incidental costs such as: communication expenses, meals, lodging incurred by Owner or employees of Owner as a result of a warrantable failure.

Owner is responsible for business costs and losses, "downtime" expenses, and cargo damage resulting from a warrantable failure. CUMMINS IS NOT RESPONSIBLE FOR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDE BUT ARE NOT LIMITED TO FINES, THEFT, VANDALISM OR COLLISIONS.

Replacement Parts

Cummins recommends that any service parts used for maintenance, repair or replacement of emission control systems be new, genuine Cummins or Cummins approved rebuilt parts and assemblies, and that the engine be serviced by a Cummins distributor, authorized dealer or the repair location approved by Cummins. The owner may elect to have maintenance, replacement or repair of the emission control parts performed by a facility other than a Cummins distributor, an authorized dealer or a repair location approved by Cummins, and may elect to use parts other than new genuine Cummins or Cummins approved rebuilt parts and assemblies for such maintenance, replacement or repair; however, the cost of such service or parts will not be covered under this emission control system warranty.

Cummins Responsibilities

Repairs and service will be performed by any Cummins distributor, authorized dealer or other repair location approved by Cummins using new, genuine Cummins or Cummins approved rebuilt parts and assemblies. Cummins will repair any of the emission control parts found by Cummins to be defective without charge for parts or labor (including diagnosis which results in determination that there has been a failure of a warranted emission control part).

Emergency Repairs

In the case of an emergency where a Cummins distributor, authorized dealer, or other repair location approved by Cummins is not available, repairs may be performed by any available repair location using any replacement parts. Cummins will reimburse the Owner for expenses (including diagnosis), not to exceed the manufacturer's suggested retail price for all warranted parts replaced and labor charges based on the manufacturer's recommended time allowance for the warranty repair and the geographically appropriate hourly labor rate. A part not being available within 30 days or a repair not being complete within 30 days constitutes an emergency. Replaced parts and paid invoices must be presented at a Cummins authorized repair facility as a condition of reimbursement for emergency repairs not performed by a Cummins distributor, authorized dealer, or other repair location approved by Cummins.

Warranty Limitations

Cummins is not responsible for failures resulting from Owner or operator abuse or neglect, such as: operation without adequate coolant, fuel or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or air intake systems; improper storage, starting, warm-up, run-in or shutdown practices.

The manufacturer warrants to the ultimate purchaser and each subsequent purchaser that the engine is designed, built, and equipped so as to conform with all applicable regulations adopted by the Air Resources Board, and that it is free from defects in materials and workmanship which cause the failure of a warranted part.

Any warranted part which is not scheduled for replacement as required maintenance, or which is scheduled only for regular inspection to the effect of "repair or replace as necessary" is warranted for the warranty period.

Any warranted part which is scheduled for replacement as required maintenance is warranted for the period of time prior to the first scheduled replacement point for that part.

The owner will not be charged for diagnostic labor which leads to the determination that a warranted part is defective, if the diagnostic work is performed at a warranty station.

The manufacturer is liable for damages to other engine components caused by the failure under warranty of any warranted part.

Cummins is not responsible for failures resulting from improper repair or the use of parts which are not genuine Cummins or Cummins approved parts.

These warranties, together with the express commercial warranties and emission warranty are the sole warranties of Cummins. There are no other warranties, express or implied, or of merchantability or fitness for a particular purpose.

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