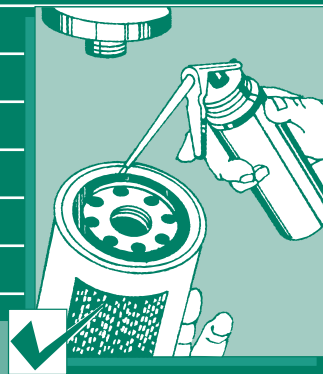
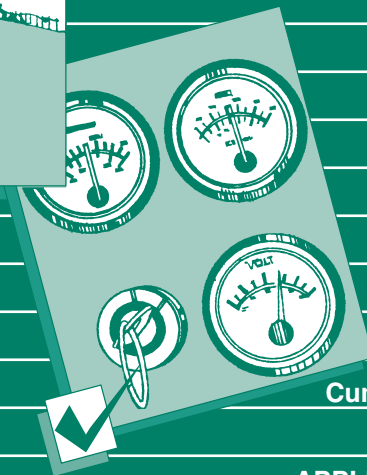
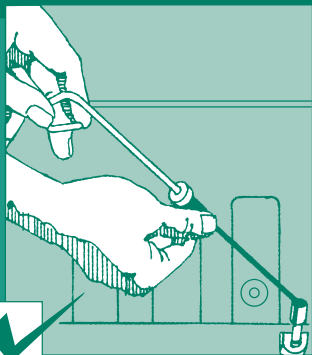
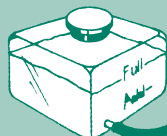




# Owners Manual QSB4.5 CM2250 EC



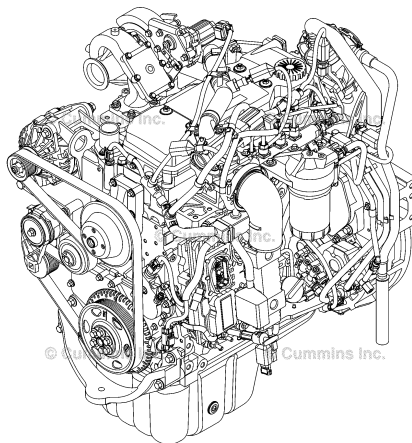
Cummins Customer Assistance Center

1-800-DIESELS™ (1-800-343-7357)

APPLICABLE ONLY IN U.S.A. AND CANADA



# Owners Manual QSB4.5 CM2250 EC



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Bulletin 4310577  
Printed 25-AUGUST-2015

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# Foreword

This manual contains information for the correct operation and maintenance of your Cummins® Product.

**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 product 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 product. When replacement parts are needed, we recommend using only genuine Cummins® or ReCon® exchange parts.

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

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# Important Reference Numbers

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

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

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•		
•		
•		
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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## Symbols

### General Information

The 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.

**NOTE:** It is possible to have four symbols for each text and graphic combination.



**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, and assembly, or the engine can be damaged if the caution instructions are not followed.



Indicates a **REMOVAL** or **Dissassembly** 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**.

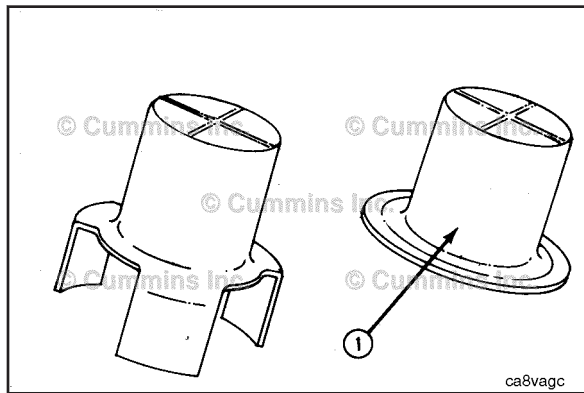
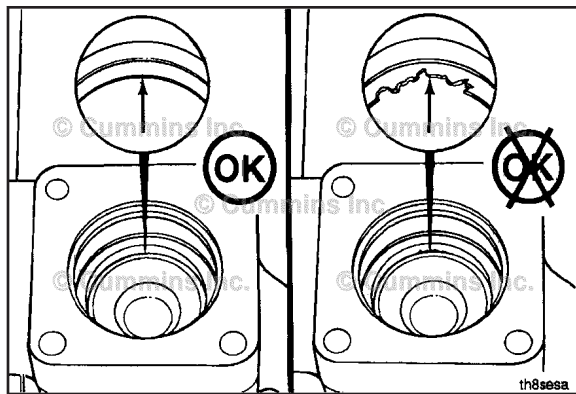
Refer to another location in this manual or another publication for additional information.



The component weighs 23kg [50 lbs] or more. To reduce the possibility of personal injury, use a hoist or get assistance to lift the component.







## 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

Read and understand the safety information and precautions before performing any repair or operating equipment. This procedure contains general safety precautions that **must** be followed to provide personal safety. **Always** follow procedures to mitigate safety concerns.

### Work Environment

Follow these recommended practices when servicing products.

- **Always** follow on-site safety requirements.
- **Always** follow local training, certification, authorization, and specific customer requirements. Do **not** work on products unless proper training has been completed to allow safe repair completion. Do **not** operate equipment unless proper training has been completed to allow safe operation..
- Work in a well-ventilated area away from ignition sources.
- If adverse weather conditions are present, take appropriate safety precautions when performing work.
- **Always** be aware of hazardous conditions that may exist in the work environment.

### Best Practices

Follow these recommended practices when servicing or operating equipment.

- **Always** wear protective glasses and protective shoes.
- Remove rings, watches, long jewelry, or metallic items.
- Do **not** wear loose fitting or torn clothing, jewelry, long hair, etc.. These increase the risk for personal injury.

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- Do **not** perform any repairs, or operate equipment, when fatigued or impaired due to drugs or alcohol.
- **Always** use tools that are in good condition.
- Do **not** work on equipment that is running unless otherwise directed by troubleshooting procedures.
- If any work **must** be performed while the unit is running, use extreme caution around hot components, moving parts, etc..
- Exercise caution when working on products that have just been turned off. Hot parts may cause burns or ignite or melt common materials.
- Do **not** bleed the fuel system of a hot engine. Contact with hot manifolds or other components can cause a fire.
- Do **not** attempt to rotate the crankshaft by pulling or prying on the fan. **Only** use proper engine barring techniques.
- Do **not** lift components that weigh 23 kg [ 50 lb ] or more. Use mechanical help or seek assistance.
- Exercise caution when working around rotating parts. Rotating parts can cause cuts, mutilation, or strangulation.
- Exercise caution when working on electrical components. High voltages can cause serious injury or death.
- Relieve system pressure as instructed before removing or disconnecting lines, fittings, or related items.
- **Always** test for pressure leaks as instructed.
- **Always** torque fittings and connections to the required specifications. Over or under tightening can damage threads and create leaks.
- **Always** use the same fastener part number, or equivalent, when replacing fasteners.

Perform the following prior to beginning work on any products.

- Shutdown the equipment unless otherwise directed by troubleshooting procedures.
- **Always** allow the product to cool.

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- **Always** ensure the product is properly supported by blocks or stands. Do **not** work on a product supported **only** by lifting jacks or hoists.
- Disconnect the battery unless otherwise directed by troubleshooting procedures.
- Disconnect the starting motor, if equipped, unless otherwise directed by troubleshooting procedures.
- Place a "Do NOT Operate" tag in the operator area or near the product controls.
- Become familiar with the tools required for performing the task at hand and how to use those tools correctly.
- Use only genuine Cummins or Cummins Recon replacement parts as instructed.

## Personal Protective Equipment (PPE)

To reduce the possibility of personal injury, personal protective equipment (PPE) should be utilized. Various types of PPE are listed below. Use proper judgment to determine which types of PPE are required for a given task. **Always** meet on-site safety regulations for required PPE. Proper maintenance of safety equipment **must** be practiced. Integrity of safety equipment **must** be checked to ensure equipment functionality is maintained.

### Eye Protection

Eye protection **must always** be worn. Wear appropriate eye protection based on the task being completed. Types of eye protection to consider are listed below.

- Safety glasses. Exposure to flying particles or debris, chemicals or caustic liquids, gases or vapors.
- Polarized safety glasses. Working in outdoor or bright lighting environments.
- Over-the-glass safety glasses. Add protection to prescription glasses.
- Safety goggles. Handling caustic liquids or chemicals.
- Shade or arc rated eyewear. Exposure to welding. Use appropriate filter ratings.

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## Foot Protection

Protective shoes **must always** be worn. Wear appropriate foot protection based on the task being completed. Types of protective footwear to consider are listed below.

- Steel toed shoes. Exposure to falling or rolling objects. Working with or around parts, tools, and equipment.
- Chemical resistant. Exposure to chemicals and other fluids.
- Overshoes and overboots. Add protection to everyday work shoes.
- Foot, toe, and metatarsal guards. Add protection to everyday work shoes.
- Electrical hazard safety toe shoes. Exposure to electrical hazards.
- Leather footwear or shoe protectors. Exposure to welding or arc flash.
- Cold protection. Exposure to cold weather.

## Head and Face Protection

Wear appropriate face protection based on the task being completed. Types of head and face protection to consider are listed below.

- Hard hats. Exposure varies. Consider welding, heat, or arc-rated.
- Visors. Exposure varies. Consider welding, heat, or arc-rated.
- Face liners. Exposure to cold weather.
- Face shields. Exposure to liquid splash. Handling caustic liquids or chemicals.

## Hand Protection

Wear appropriate type and fit of gloves based on the task being completed. Types of protective gloves to consider are listed below.

- Heat resistant or insulated. Exposure to hot items.
- Flame resistant. Exposure to welding or arc flash.
- Impact resistant. Performing repetitive impact and vibration work. Using pneumatic tools.
- Impervious. Exposure to high pressure fluids.
- Chemical resistant. Exposure to chemicals, fluids, or batteries.
- Cut resistant. Handling sharp objects or tools.
- Cold weather. Exposure to cold weather.

### **Hearing Protection**

When working around operating equipment, appropriately rated hearing protection should be worn. Types of hearing protection to consider are listed below.

- Single use ear plugs.
- Pre-formed ear plugs.
- Ear muffs.

### **Protective Clothing**

Wear appropriate protective clothing based on the task being completed. Types of protective clothing to consider are listed below.

- Flame resistant. Exposure to electrical hazards. Exposure to oil and gas or generator set applications. Performing welding.
- Chemical resistant. Exposure to chemicals.

- High visibility. Exposure to reduced visibility working environments. Working on mining, oil and gas, or sites with large equipment.

### **Respiratory Protection**

Wear appropriate respiratory protection based on the task being completed. Types of respiratory protection to consider are listed below.

- Disposable respirators. Exposure to dust and particles, welding fumes, nuisance odors, nuisance level acid gas.
- Reusable respirators. Exposure to cleaning, machining, welding, sanding, grinding, etc.

### **Fall Protection**

Utilize fall protection if a task is being completed more than 1.2 m [ 4 ft ] above a solid surface. Types of fall protection to consider are listed below.

- Fall harness and lanyard combinations.
- Safety nets.
- Guardrails.

### **Fuels**

Follow these recommended practices when interacting with equipment that uses different fuel types. For information regarding proper handling of various substances, refer to the manufacturer's safety data sheet.

#### **Diesel Fuel**

- Protect eyes.
- Protect skin.

- **Always** test for fuel leaks as instructed.
- Do **not** dilute.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Provide extra ventilation to the work area.
- Do **not** troubleshoot or repair fuel leaks while the engine is running.
- If material is spilled, avoid contact and dispersal with runoff, soil, waterways, drains, and sewers. Absorb with sand, clay, or commercial absorbent. Transfer to containers and neutralize the material. Flush spill area with soap and excess water.
- Report spills effecting water source contamination to local authorities immediately.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.
- **Always** torque fittings and connections to the required specifications. over or under tightening can damage threads and create leaks.

### Gasoline

- Protect eyes.
- Protect skin.
- **Always** be alert for the smell of gas.
- **Always** test for fuel leaks as instructed.
- Do **not** dilute.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.



- Vapors accumulate near the floor. Check the work floor, sumps, and low lying areas for ignition sources before servicing equipment..
- Provide extra ventilation to the work area.
- Do **not** troubleshoot or repair fuel leaks while the engine is running.
- If material is spilled, avoid contact and dispersal with runoff, soil, waterways, drains, and sewers. Absorb with sand, clay, or commercial absorbent. Transfer to containers and neutralize the material. Flush spill area with soap and excess water.
- Report spills effecting water source contamination to local authorities immediately.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.
- **Always** torque fittings and connections to the required specifications. over or under tightening can damage threads and create leaks.

### Biodiesel

- Protect eyes.
- Protect skin.
- **Always** test for fuel leaks as instructed.
- Do **not** dilute.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Vapors accumulate near the floor. Check the work floor, sumps, and low lying areas for ignition sources before servicing equipment..
- Provide extra ventilation to the work area.
- Do **not** troubleshoot or repair fuel leaks while the engine is running.

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- If material is spilled, avoid contact and dispersal with runoff, soil, waterways, drains, and sewers. Absorb with sand, clay, or commercial absorbent. Transfer to containers and neutralize the material. Flush spill area with soap and excess water.
- Report spills effecting water source contamination to local authorities immediately.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.
- **Always** torque fittings and connections to the required specifications. over or under tightening can damage threads and create leaks.

### Compressed Natural Gas

- Protect eyes.
- Protect skin.
- **Always** be alert for the smell of gas. Compressed natural gas is typically treated with an odor producing chemical for leak detection. Non-refined sources of natural gas (landfill gas, biogas, coal bed gas, wellhead gas, etc.) can **not always** be detected by smell.
- **Always** test for fuel leaks as instructed. Odorant can fade.
- Upon entering a room or approaching a vehicle where the smell of gas is present, immediately shutoff all engines and ignition sources.
- Natural gas ignites when there is a 5% - 15% mixture in the air. Asphyxiation can occur when concentration reaches 21% or more.
- Do **not** start equipment or nearby equipment until a suspected gas leak is corrected and the area is ventilated.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Work in areas that do **not** share common ventilation with areas containing ignition sources.

- Store and service natural gas fueled equipment in large, well-ventilated areas, or outside.
- Provide extra ventilation to the work area.
- Natural gas accumulates near the ceiling. Check the ceiling of the work area for ignition sources before servicing equipment.
- **Only** disconnect gas lines in a well-ventilated area.
- Do **not** troubleshoot or repair gas leaks while the engine is running.
- Natural gas ignition systems produce high voltage during operation. Do **not** touch ignition wiring or components while the engine is operating. If necessary, use **only** insulated tools.
- Natural gas exhaust systems operate at higher temperatures than similar diesel exhaust systems. Do **not** touch exhaust components. Do **not** route lines or hoses which deteriorate from heat exposure near exhaust components or in the flow path of the exhaust.
- **Always** torque fittings and connections to the required specifications. over or under tightening can damage threads and create leaks.

### Liquefied Natural Gas

- Protect eyes.
- Protect skin.
- **Always** be alert for the smell of gas. Liquefied natural gas may **not** have an odor. Non-refined sources of natural gas (landfill gas, biogas, coal bed gas, wellhead gas, etc.) can **not always** be detected by smell.
- **Always** test for fuel leaks as instructed. Odorant can fade.
- Upon entering a room or approaching a vehicle where the smell of gas is present, immediately shutoff all engines and ignition sources.

- Natural gas ignites when there is a 5% - 15% mixture in the air. Asphyxiation can occur when concentration reaches 21% or more.
- Do **not** start equipment or nearby equipment until a suspected gas leak is corrected and the area is ventilated.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Work in areas that do **not** share common ventilation with areas containing ignition sources.
- Store and service natural gas fueled equipment in large, well-ventilated areas, or outside.
- Provide extra ventilation to the work area.
- Natural gas accumulates near the ceiling. Check the ceiling of the work area for ignition sources before servicing equipment.
- **Only** disconnect gas lines in a well-ventilated area.
- Do **not** troubleshoot or repair gas leaks while the engine is running.
- Natural gas ignition systems produce high voltage during operation. Do **not** touch ignition wiring or components while the engine is operating. If necessary, use **only** insulated tools.
- Natural gas exhaust systems operate at higher temperatures than similar diesel exhaust systems. Do **not** touch exhaust components. Do **not** route lines or hoses which deteriorate from heat exposure near exhaust components or in the flow path of the exhaust..
- Liquefied natural gas is stored in vehicle tanks at extremely cold temperatures. If there is a liquefied natural gas spill, evacuate the area immediately and do not attempt to make contact with the liquid.
- **Always** torque fittings and connections to the required specifications. over or under tightening can damage threads and create leaks.
- Vapors accumulate near the floor. Check the work floor, sumps, and low lying areas for ignition sources before servicing equipment.

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## Liquefied Petroleum Gas

- Protect eyes.
- Protect skin.
- **Always** be alert for the smell of gas. Liquefied petroleum gas is typically treated with an odor producing chemical for leak detection.
- **Always** test for fuel leaks as instructed. Odorant can fade.
- Upon entering a room or approaching a vehicle where the smell of gas is present, immediately shutoff all engines and ignition sources.
- Do **not** start equipment or nearby equipment until a suspected gas leak is corrected and the area is ventilated.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Work in areas that do **not** share common ventilation with areas containing ignition sources.
- Store and service natural gas fueled equipment in large, well-ventilated areas, or outside.
- Provide extra ventilation to the work area.
- Liquefied petroleum gas accumulates near the floor. Check the work floor, sumps, and low lying areas for ignition sources before servicing equipment.
- **Only** disconnect gas lines in a well-ventilated area.
- Do **not** troubleshoot or repair gas leaks while the engine is running.
- Liquefied petroleum gas ignition systems produce high voltage during operation. Do **not** touch ignition wiring or components while the engine is operating. If necessary, use **only** insulated tools.

- Liquefied petroleum gas exhaust systems operate at higher temperatures than similar diesel exhaust systems. Do **not** touch exhaust components. Do **not** route lines or hoses which deteriorate from heat exposure near exhaust components or in the flow path of the exhaust..
- Liquefied natural gas is stored in vehicle tanks at extremely cold temperatures. If there is a liquefied natural gas spill, evacuate the area immediately and do not attempt to make contact with the liquid.
- **Always** torque fittings and connections to the required specifications. over or under tightening can damage threads and create leaks.

## Power Generation Applications

Follow these recommended practices when interacting with equipment in generator set applications.

Power generation applications produce high voltage during operation. When servicing a generator set, the following safety precautions **must** be taken.

- Remove any debris from the generator set.
- Keep the floor clean and dry throughout servicing
- Service access doors **must** be secured in the "open" position before working on enclosed generator sets.
- Use insulated or non-conducting tools.
- Prevent accidental or remote starting. Disconnect the starting battery cables. Disconnect the negative ( - ) terminal first.
- Isolate all auxiliary supplies.
- Switch the generator set control panel "off."
- Place a "Do **Not** Operate" tag on the control panel.

- Lock the generator set circuit breaker in the "Open" position.
- Activate the manual "Emergency Stop" device.
- Do **not** step on the generator set when servicing, entering, or leaving the generator room.

## **Aftertreatment**

Follow these recommended practices when interacting with equipment that utilize aftertreatment systems. For information regarding proper handling of various substances, refer to the manufacturer's safety data sheet.

### **Diesel Exhaust Fluid**

- Avoid breathing vapor or mist.
- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes.
- Protect skin. In case of contact with skin, wash with soap and water.
- Do **not** ingest. If ingested, contact a physician immediately.

### **Diesel Particulate Filter**

- Protect eyes.
- Protect skin.
- Avoid stirring up exhaust particulate dust.
- Avoid inhalation of exhaust particulate dust. Wear a dust mask. If respiratory irritation or discomfort occurs, leave the dusty area. Utilize breathing assistance or oxygen if necessary.
- Elevated concentrations of metals in the form of dust, soot, and contaminants are contained in these filters. Health regulations may exist for the materials found in these filters such as Zinc, Molybdenum, polynuclear aromatic

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hydrocarbons. Potentially toxic materials found in these filters are oxides of calcium, zinc, phosphorous, silicon, sulfur, and iron.

- Proper disposal of the exhaust dust and filter are required. Dispose of in accordance with local and environmental regulations.
- Diesel particulate filter maintenance **must** be completed by appropriately trained personnel.

### **Selective Catalytic Reduction (SCR) Catalyst**

- Protect eyes.
- Protect skin.
- Avoid stirring up exhaust catalyst dust.
- Avoid inhalation of exhaust catalyst dust. Wear a dust mask. If respiratory irritation or discomfort occurs, leave the dusty area. Utilize breathing assistance or oxygen if necessary.
- Do **not** cut open exhaust catalyst assemblies.
- Proper disposal of the exhaust catalyst is required. Dispose of in accordance with local and environmental regulations.

### **Oxidation Catalysts**

Types of Oxidation Catalysts may include, but are not limited to the following.

- Diesel Oxidation Catalyst (DOC)
- 3-way Oxidation Catalyst

When working with oxidation catalysts, perform the following.

- Protect eyes.



- Protect skin.
- Avoid stirring up exhaust catalyst dust.
- Avoid inhalation of exhaust catalyst dust. Wear a dust mask. If respiratory irritation or discomfort occurs, leave the dusty area. Utilize breathing assistance or oxygen if necessary.
- Do **not** cut open exhaust catalyst assemblies.

## Common Substances

Follow these recommended practices when interacting with the following substances. For information regarding proper handling of various substances, refer to the manufacturer's safety data sheet.

### Coolant

- Coolant is also referred to as antifreeze.
- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes. Receive medical attention immediately.
- Protect skin. In case of contact with skin, wash with soap and water. Remove contaminated clothing. If injection occurs, it is a medical emergency. Receive medical attention immediately.
- Do **not** ingest. If ingested, drink excess water for dilution and seek medical attention.
- Do **not** pour used antifreeze into containers that have been used to store other chemicals or products, such as oil or gasoline, unless they have been thoroughly cleaned.
- If material is spilled, avoid contact and dispersal with runoff, soil, waterways, drains, and sewers. Provide adequate ventilation to the area. Absorb with sand, clay, or commercial absorbent. Transfer to containers and neutralize the material. Flush spill area with soap and excess water.

- Report spills effecting water source contamination to local authorities immediately.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.

### **Liquid Nitrogen**

- Work in a well-ventilated area.
- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes. Receive medical attention immediately.
- Protect skin. In case of contact with skin, receive medical attention immediately.
- Wear protective clothing and gloves that insulate.
- Handle items with tongs or wire hooks.
- Avoid prolonged breathing of liquid nitrogen vapors. Utilize breathing assistance or oxygen if necessary.

### **Lubricating Oil**

See Lubricating Oil in the "Hazardous Substances" step.

### **Refrigerant**

- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes. In case of frostbite, use lukewarm water, not hot. Seek medical attention if irritation continues.
- Protect skin. Wear leather or insulated gloves. In case of contact with skin, wash with soap and water. Seek medical attention if irritation continues.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.
- **Only** disconnect liquid refrigerant lines in a well-ventilated area. liquid refrigerant systems **must** be properly emptied and filled using equipment that prevents the release of refrigerant gas into the atmosphere. Federal law requires capturing and recycling refrigerant in the United States of America.

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## Solvents

- Follow the manufacturer's instructions for safe handling practices.
- Follow the manufacturer's recommendations for use.
- Some solvents are flammable and toxic..
- Protect eyes. In case of contact with eyes, follow manufacturer's recommendations.
- Protect skin. In case of contact with skin, follow manufacturer's recommendations.
- Dispose of in accordance with manufacturer's recommendations.

## Starting Aids (Starting Fluid)

- Do **not** use starting fluid if the intake air heater option is used.
- Do **not** use volatile cold starting aids in underground mine or tunnel operations. The local United States Bureau of Mines inspector can provide more information and instructions.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Work in a well-ventilated area.
- Avoid inhalation.

## Hazardous Substances

Hazardous substances are known to some state and federal agencies to be carcinogenic and cause reproductive harm. Hazardous substances that may be encountered during service events are listed below.

## Diesel Engine Exhaust

- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes.

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- Protect skin. In case of contact with skin, wash with soap and water.
- Avoid inhalation.

### **Lubricating Oil**

- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes.
- Protect skin. In case of contact with skin, wash with soap and water.
- Do **not** ingest. If ingested, contact a physician immediately..
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.
- Do **not** allow water droplets to enter a container of hot oil. A violent reaction can result.

### **Mercury**

- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes.
- Protect skin. In case of contact with skin, wash with soap and water.
- Do **not** ingest. If ingested, contact a physician immediately.
- Proper disposal is required. Dispose of in accordance with local and environmental regulations.

### **Vanadium Pentoxide**

- Can be found in some selective catalytic reduction (SCR) catalysts.
- Protect eyes. In case of contact with eyes, flush with water for a minimum of 15 minutes.
- Protect skin. In case of contact with skin, wash with soap and water.
- Do **not** ingest. If ingested, contact a physician immediately.
- Avoid inhalation of vapors or airborne particles.

- Proper disposal is required. Dispose of in accordance with local and environmental regulations.

## Electrical Components

Follow these recommended practices when interacting with electrical components.

### Batteries

- Protect eyes. Wear safety glasses or goggles. In case of battery acid contact with eyes, flush with water for a minimum of 15 minutes. Receive medical attention immediately.
- Protect skin. Wear rubber gloves and a chemical apron. In case of battery acid contact with skin or clothing, rinse with water for several minutes. Avoid spreading the acid. Receive medical attention immediately.
- Do **not** open the battery caps with your face over or near the battery.
- Remove rings, watches, long jewelry, or metallic items when working with or near batteries.
- Ventilate the battery compartment before servicing the battery.
- Work in a well-ventilated area.
- Avoid sparks, arcing switches and equipment, cigarettes, pilot lights, flames, and other sources of ignition.
- Use insulated or non-conducting tools.
- Neutralize static buildup by contacting the nearest ground surface before working on a battery.
- Do **not** lift batteries by the posts.
- Do **not** touch both battery terminals with your bare hands at the same time.
- Disconnect the negative ( - ) battery cable first.
- Attach the negative ( - ) battery cable last.

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## Common Hazards

Follow these recommended practices when interacting with equipment as the following hazards may exist.

### High Temperature Area

Be alert for high temperature areas which may cause severe burns. High temperature areas may be encountered in the following situations.

- On products that have just been turned off.
- On or around exhaust related components (turbocharger, aftertreatment systems, etc).
- In exhaust gas flow paths.
- Contacting hot fluid lines, tubes, or compartments.

### Recommended Practices:

- Allow components to cool before servicing. Verify the temperature of the component. Utilize an infrared gun, temperature sensor, temperature gauge, or other reliable method to determine component temperature. Take appropriate precautions before starting work.
- Protect eyes.
- Protect skin. Wear insulated gloves.
- Ensure surrounding items do not come in contact with hot components or exhaust. Contact may ignite or melt those materials.

### Heavy Objects

Be alert when working with heavy objects.

- Do **not** lift components that weigh 23 kg [ 50 lb ] or more. Use mechanical help or seek assistance.

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- Use mechanical help to move items whenever possible. Make sure the load is securely fastened to the equipment.
- Make sure lifting devices, like chains, hooks, slings, etc., are in good condition and are rated for the correct capacity before use.
- Make sure lifting devices are positioned correctly before use.
- Use a spreader bar when necessary.
- If the item can be lifted manually, squat to lift and lower the item. Do **not** bend at the waist.
- Maintain balance when lifting items by keeping feet apart or staggered if possible.
- If the item must be carried, make sure the path is clear when carrying the item to, and placing the item in, the desired location.

### **Pressurized Areas**

Be alert for pressurized areas. Pressurized areas may be encountered in the following situations.

- Air, Oil, Fuel, and Cooling systems.
- When disconnecting or removing lines, fittings, or related items.
- When disconnecting a device from a pressurized system.
- When removing or loosening caps on tanks or pressurized systems.

Injuries that may result when interacting with pressurized areas are listed below.

- High pressure spray can penetrate the skin. Serious injury or death may result.
- Hot fluid spray can cause burns. See "High Temperature Area."

### **Recommended Practices:**

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- Protect skin. Wear impervious gloves. If skin penetration from high pressure spray occurs, it is a medical emergency. Receive medical attention immediately.
- Check for pressure leaks as instructed. **Never** check for pressure leaks with your hand.
- Allow product to cool before accessing pressurized areas.
- Relieve system pressure as instructed.
- Slowly loosen fill caps to relieve pressure before servicing.

## Job Safety Assessment

Completing a Job Safety Assessment (JSA) prior to performing work helps identify job safety hazards and prevent incidents. Use the guidelines below to assess if a situation is safe or at risk prior to performing designated work. If determined to be at risk, take appropriate precautions to prepare for, or eliminate, the hazard. If the risks are uncontrollable, consult a knowledgeable resource to find a safe practice solution. A knowledgeable resource may include, but is not limited to, one of the following:

- Site supervisor
- Customer
- Work supervisor

**Always** check with the site where work is being performed to determine if safety assessment documentation is required.

## Work Practices

Job Safety Analysis.

- Assess the job to identify safety hazards that may occur during the repair event.



### Ascending or Descending

- Maintain 3 points of contact when using steps, ladders, or entering and exiting a unit.

### Communication

- When working with others, make sure you understand what each other is doing to safely complete the task.

### Eyes On Hands and Work.

- Confirm if you will be able to maintain an unobstructed view of your hands at all times while performing the task.

### Eyes On Path

- Watch for hazards in your path to avoid trip or slip hazards. Examples are pits, platform edges, etc.

### Line Of Fire

- Position yourself so that you avoid striking against, or being struck by, anything that can swing, fall, or roll.

### Pinch Point

- Prevent exposure of all parts of your body to a nip hazard or pinch point.

### Rushing

- Take adequate time to safely perform the job. Do **not** rush or take short cuts.

### Follow Procedures

- Utilize QuickServe® Online or other standard procedures when available.
- Make sure the procedures are correct and safe.

## Ergonomics

### Back-Bending and Twisting

- Avoid bending forward more than 45 at your waist.
- Avoid working with your back twisted with loads over 23 kg [ 50 lb ].

#### **Knee**

- Avoid bending your knee more than 90.
- Avoid kneeling for more than 4 hours per day.

#### **Lifting and Lowering**

- Squat to pick up parts.
- Keep loads close to the body when lifting or carrying.
- Use a team lift or a lifting device if the object is more than 23 kg [ 50 lb ].

#### **Pulling or Pushing**

- Pull with your arms.
- Push with your legs.
- Avoid exerting more force than necessary.
- Avoid moving heavy load(s) too quickly.

### **Tools and Equipment**

#### **Selection**

- Select the correct tool or equipment to perform the task.

#### **Condition**

- Confirm the tool or equipment is free of defects before use.

- Confirm that safety devices are in place before use.

#### Use

- Use the tool or equipment as directed.
- Follow the manufacturer's instructions.

### **Personal Protective Equipment (PPE)**

#### Eye, Face, and Head Protection

- Confirm the eye, face, or head protection you plan to use are adequate for performing the task at hand.

#### Foot Protection

- Confirm the foot protection you plan to use is adequate for performing the task at hand in the current environment.

#### Fall Protection

- Fall protection should be used if you are working more than 1.2 m [ 4 ft ] above the floor.
- Use fall protection if you have been properly trained to do so. If you are not trained to use fall protection, allow someone who has received proper training to perform the task.

#### Hand Protection

- Avoid exposing hands to cuts or burns while completing the task.
- Confirm the proper glove type is being used for the task at hand. Examples are cut-resistant, chemical-resistant, electric shock-resistant, electric arc flash, welding, etc.

#### Hearing Protection

- Hearing protection should be worn when required or recommended.

#### Body Protection

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- Body parts should be protected from work hazards.
- Avoid contact with sharp edges, hot surfaces, etc.

### **Work Procedures**

#### Training

- Confirm if you have received task and safety training for the job being performed.

#### Working Alone

- Avoid working alone.
- Avoid working where you are **not** able to be seen or heard by another person.
- If you **must** work alone, notify others of your location and schedule check-in times.

#### Lockout and Tagout

- Lock out or tag out energy sources before work. Examples are electrical, mechanical, hydraulic, and pneumatic.

#### Barricades and Warnings

- Mark overhead work areas with barricade tape or signs.
- Mark open floor hazards with barricade tape, signs, or cones.

#### Confined Space

- Confirm if a confined space entry permit is required.
- If required, confirm the permit is posted, signed, and dated correctly.

#### Hot Work

- Confirm a functional fire extinguisher is readily available.

- Maintain separation between ignition sources and fuel sources.

**Place Wheel Chocks**

- Place wheel chocks at either the front or back tire of the unit prior to starting the task.

**Spotter**

- Use a spotter when moving a customer's unit.
- Confirm the driver can see and hear the spotter when moving.

**Housekeeping (The 5 S's - Scrap or Segregate, Set to Order, Spotless, Standardize, and Sustain)**

- Remove parts, extension cords, air hoses, and liquids from the work area that may cause trip, slip, or fall hazards.

## Acronyms and Abbreviations

### General Information

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

<b>ANSI</b>	American National Standards Institute
<b>API</b>	American Petroleum Institute
<b>ASTM</b>	American Society of Testing and Materials
<b>ATDC</b>	After Top Dead Center
<b>BTU</b>	British Thermal Unit
<b>BTDC</b>	Before Top Dead Center
<b>°C</b>	Celsius
<b>CAN</b>	Controller Area Network
<b>CO</b>	Carbon Monoxide
<b>CCA</b>	Cold Cranking Amperes
<b>CARB</b>	California Air Resources Board
<b>CES</b>	Cummins Engineering Standard
<b>C.I.B.</b>	Customer Interface Box
<b>C.I.D.</b>	Cubic Inch Displacement
<b>CNG</b>	Compressed Natural Gas
<b>CPL</b>	Control Parts List
<b>cSt</b>	Centistokes

<b>DEF</b>	Diesel Exhaust Fluid
<b>DOC</b>	Diesel Oxidation Catalyst
<b>DPF</b>	Diesel Particulate Filter
<b>ECM</b>	Engine Control Module
<b>EFC</b>	Electronic Fuel Control
<b>EGR</b>	Exhaust Gas Recirculation
<b>EPA</b>	Environmental Protection Agency
<b>ESN</b>	Engine Serial Number
<b>°F</b>	Fahrenheit
<b>ft-lb</b>	Foot-Pound Force
<b>FMI</b>	Failure Mode Identifier
<b>GVW</b>	Gross Vehicle Weight
<b>Hg</b>	Mercury
<b>hp</b>	Horsepower
<b>H<sub>2</sub>O</b>	Water
<b>inHg</b>	Inches of Mercury
<b>in H<sub>2</sub>O</b>	Inches of Water
<b>ICM</b>	Ignition Control Module
<b>IEC</b>	International Electrotechnical Commission
<b>km/l</b>	Kilometers per Liter
<b>kPa</b>	Kilopascal

<b>LNG</b>	Liquefied Natural Gas
<b>LPG</b>	Liquefied Petroleum Gas
<b>LTA</b>	Low Temperature Aftercooler
<b>MCRS</b>	Modular Common Rail System
<b>MIL</b>	Malfunction Indicator Lamp
<b>MPa</b>	Megapascal
<b>mph</b>	Miles Per Hour
<b>mpq</b>	Miles Per Quart
<b>N•m</b>	Newton-meter
<b>NOx</b>	Nitrogen Oxides
<b>NG</b>	Natural Gas
<b>O2</b>	Oxygen
<b>OBD</b>	On-Board Diagnostics
<b>OEM</b>	Original Equipment Manufacturer
<b>OSHA</b>	Occupational Safety and Health Administration
<b>PID</b>	Parameter Identification Descriptions
<b>PPE</b>	Personal Protective Equipment
<b>ppm</b>	Parts Per Million
<b>psi</b>	Pounds Per Square Inch
<b>PTO</b>	Power Takeoff
<b>REPTO</b>	Rear Engine Power Takeoff



<b>RGT</b>	Rear Gear Train
<b>rpm</b>	Revolutions Per Minute
<b>SAE</b>	Society of Automotive Engineers
<b>SCA</b>	Supplemental Coolant Additive
<b>SCR</b>	Selective Catalytic Reduction
<b>STC</b>	Step Timing Control
<b>SID</b>	Subsystem Identification Descriptions
<b>TDC</b>	Top Dead Center
<b>TSB</b>	Technical Service Bulletin
<b>VDC</b>	Volts of Direct Current
<b>VGT</b>	Variable Geometry Turbocharger
<b>VS</b>	Variable Speed
<b>VSS</b>	Vehicle Speed Sensor

# Section E - Engine and System Identification

## Section Contents

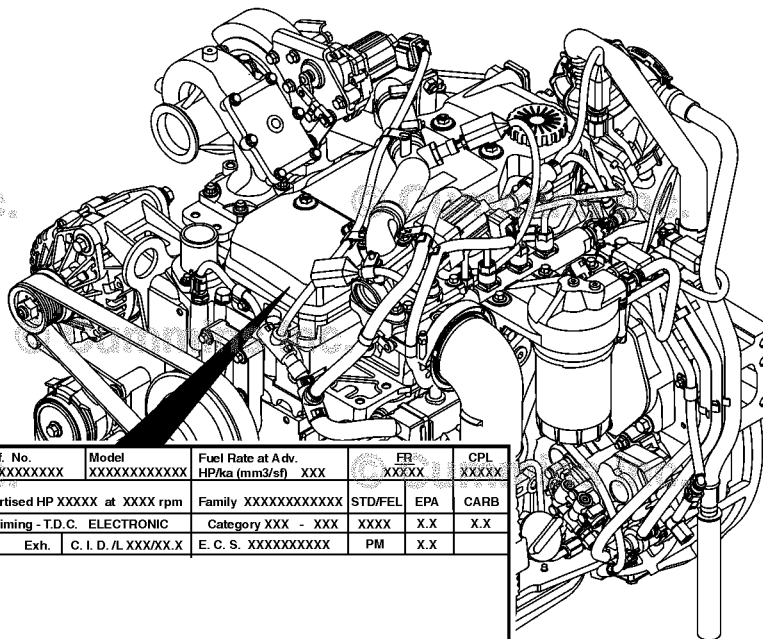
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## Engine Identification

### Engine Dataplate

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 <b>CUMMINS INC.</b> Assembled in the USA Date of Mfg xx-xx-xx	Engine No. XXXXXXXX	Ref. No. XXXXXXXXXX	Model XXXXXXXXXXXXX	Fuel Rate at Adv. HP/ka (mm3/sf) XXX	FR XXXX	CPL XXXXX
	Idle Speed (rpm) XXXX	Advertised HP XXXXX at XXXX rpm	Family XXXXXXXXXXXXX	STD/FEL	EPA	CARB
 XXXX XXXXXX XXXX XXXXXX XXX XXXX	Firing Order XXXXXX	Timing - T.D.C. ELECTRONIC	Category XXX - XXX	XXXX	X.X	X.X
	Valve lash cold X.XXX int.	Exh.	C. I. D. /L XXX/XX.X	E. C. S. XXXXXXXXXXXX	PM	X.X
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX <b>WARNING:</b> Injury may result and warranty is voided if fuel rate, rpm or altitudes exceed published maximum values for this model and application.						

00v00016

The engine dataplate provides important information about the engine. The engine serial number (ESN) and control part list (CPL) provide information for service and for ordering parts. The engine dataplate **must not** be changed unless approved by Cummins Inc.

Have the following engine data available when communicating with a Cummins® Authorized Repair Location. The information on the dataplate is mandatory when sourcing service parts.

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	<b>CUMMINS INC.</b> Assembled in the USA Date of Mfg xx-xx-xx				Engine No. XXXXXXXX	Ref. No. XXXXXXXXXX	Model XXXXXXXXXXXXX	Fuel Rate at Adv. HP/ka (mm3/sf) XXX	FR XXXXX		CPL XXXXX
					Idle Speed (rpm) XXXX	Advertised HP XXXXX at XXXX rpm	Family XXXXXXXXXXXXX	STD/FEL	EPA	CARB	
	XXXX	XXXXXX	X.XX	XXXX	Firing Order XXXXXX	Timing - T.D.C. ELECTRONIC	Category XXX - XXX	XXXX	X.X	X.X	
	XXXX	XXXXXX			Valve lash cold X.XXX" int.	Exh. C.I. D. /L XXX/XX.X	E. C. S. XXXXXXXXXXXX	PM	X.X		
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX											
WARNING: Injury may result and warranty is voided if fuel rate, rpm or altitudes exceed published maximum values for this model and application.											

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1      2      3      4      5

00100001

- Engine serial number
- Engine model information
- Valve lash (overhead) setting

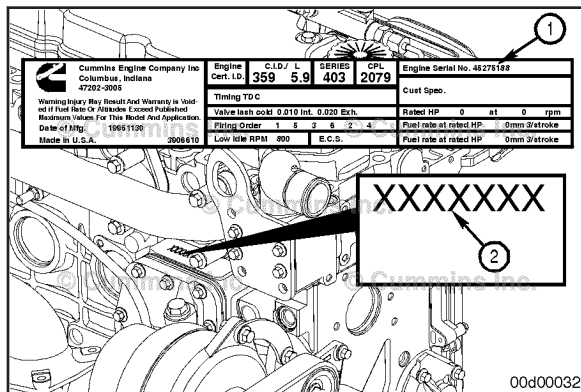
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## Engine Identification Page E-4

## QSB4.5 CM2250 EC Section E - Engine and System Identification

- Horsepower and rpm rating
- Emission control system (E.C.S.).

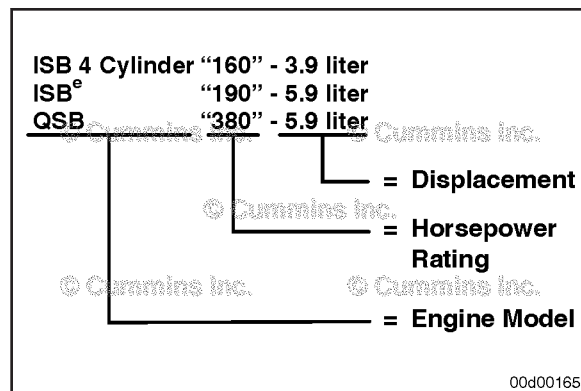
**NOTE:** Engine dataplates vary by manufacturing plant. The dataplate may **not** contain all of the emission control systems for the engine.



**NOTE:** If the engine dataplate (1) is **not** legible, the engine serial number (2) can be found on the engine block, on top of the lubricating oil cooler housing. Additional engine information is available by reading the ECM dataplate.

## Cummins® Engine Nomenclature

The Cummins® engine nomenclature provides the data as shown in the illustration.

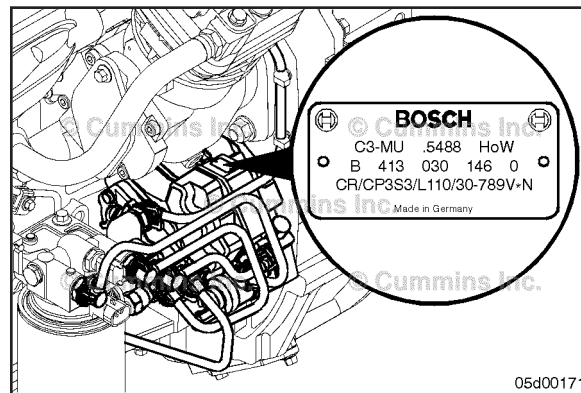


## Fuel Injection Pump Dataplate

The Bosch™ fuel injection pump dataplate is located on the fuel pump.

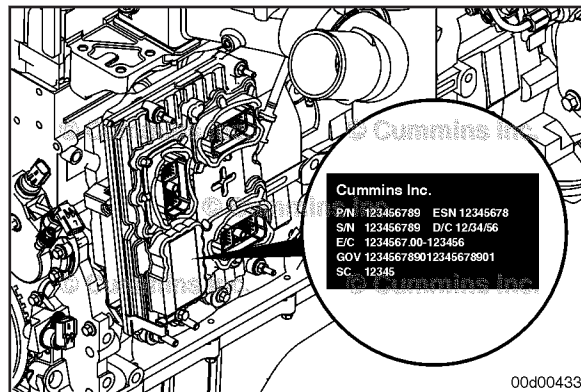
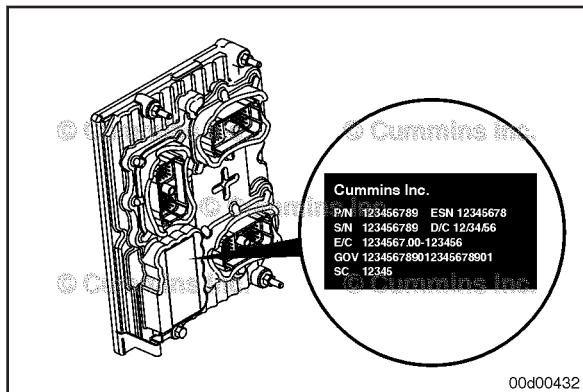
The dataplate contains the following information to assist in servicing or replacement:

- Pump serial number
- Cummins® part number
- Factory code
- Bosch™ part number
- Date code.





## ECM Dataplate



**NOTE:** Not all engines will have ECM dataplates.

Engines covered by this manual are equipped with a CM2250 Electronic Control Module (ECM). A CM2250 ECM has three 60-pin connectors and an additional 14-pin connector. Two ECM 60-pin connectors are for inputs and outputs **only**, and the third 60-pin and 14-pin connectors are for aftertreatment and vehicle inputs and outputs.

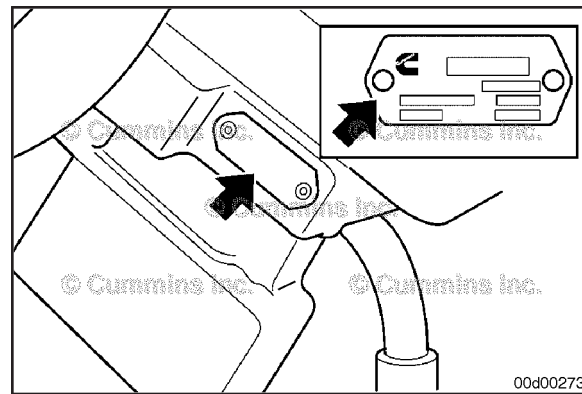
The engine harness uses a 24-pin breakout connector for vehicle inputs and outputs.

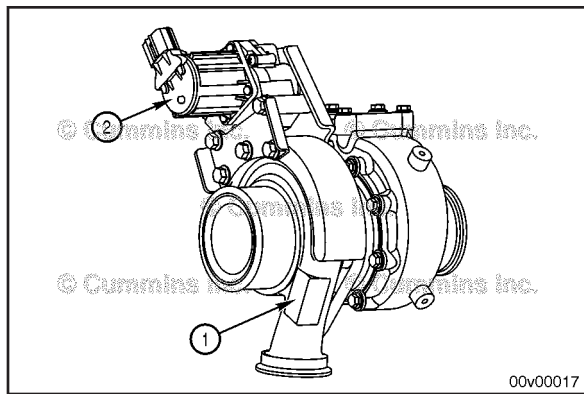
## Air Compressor

**NOTE:** Not all engines are equipped with an air compressor.

The Cummins® branded air compressor dataplate, identified by the Cummins Inc. logo, is typically located on the side of the air compressor. The dataplate contains the following information to assist in servicing or replacement:

- Cummins® part number
- Serial number
- Date code.





## Turbocharger Dataplate

The variable flow turbocharger (VFT) dataplate (1) is located on the turbocharger inlet compressor housing.

The dataplate contains the following information to assist in servicing or replacement:

- Cummins® assembly part number
- Serial number
- Customer number
- Model number.

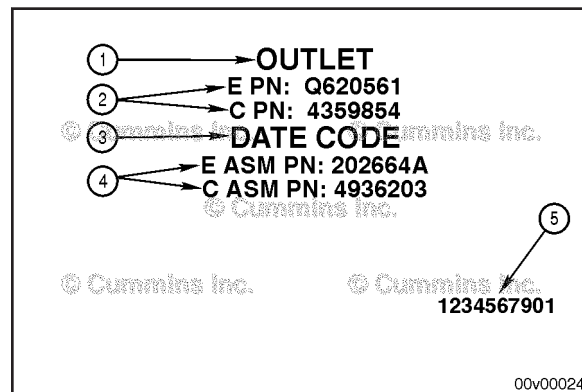
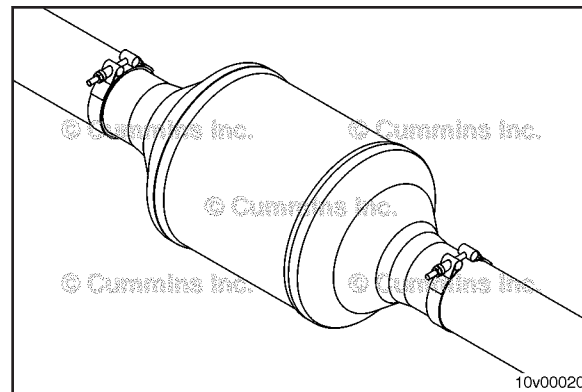
**NOTE:** The electronic actuator (2) on the VFT is a serviceable component and has a separate part number that contains information to assist in servicing or replacement.

## Exhaust System

The exhaust aftertreatment assembly has information stamped into the canister. This information is important for servicing or replacement.

A typical aftertreatment assembly stamping provides the following information, as shown in the illustration:

- 1 Section name
- 2 Part numbers
- 3 Date code
- 4 Aftertreatment system assembly part numbers
- 5 Serial number.

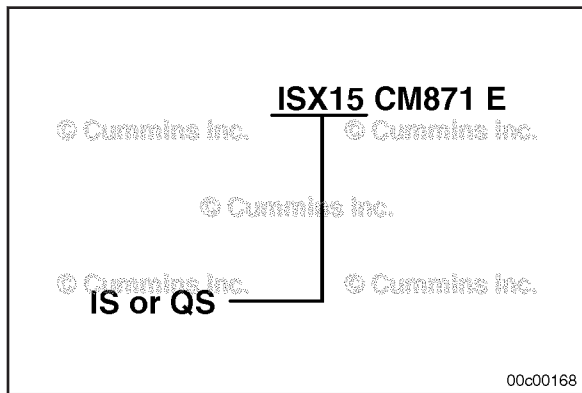


## Cummins® Service Engine Model Product Identification

### General Information

The Cummins® Service Engine Model Nomenclature procedure describes how engines are identified within Cummins service organization. This method was introduced for models after and including manufacture year 2007.

Electronic engines are identified by the first two letters, either an "IS" for On-Highway automotive or "QS" for Off-Highway industrial market applications.

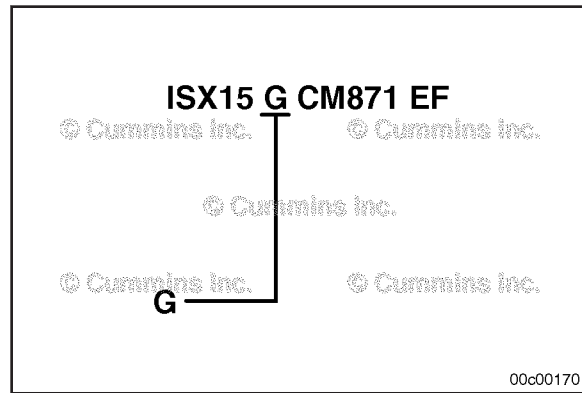
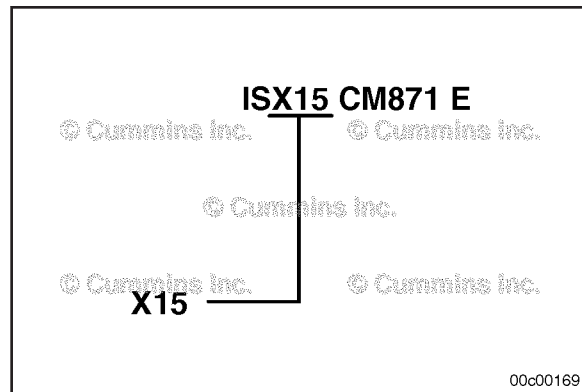


**QSB4.5 CM2250 EC**  
**Section E - Engine and System Identification**

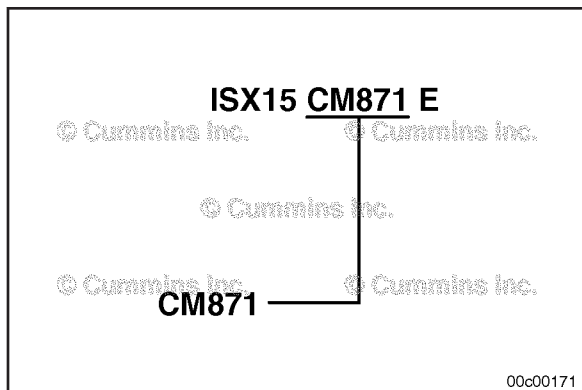
The third letter is the engine platform designation followed by the engine liter size.

**Cummins® Service Engine Model Product Identification**  
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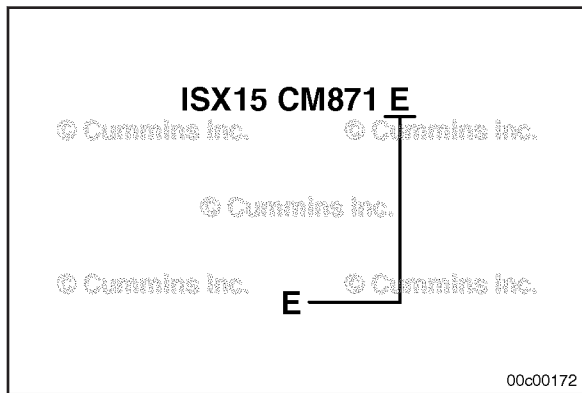
If the engine operates on a fuel type other than diesel, the type will be identified after the liter size.



The control system is identified with the letters "CM" followed by the control system model number.



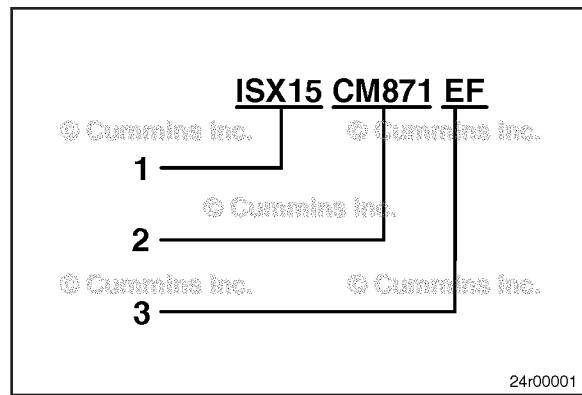
The technology identifier after the control system designates the prevailing technology used with the engine. (See table in this procedure for letter designations.)



**QSB4.5 CM2250 EC**  
**Section E - Engine and System Identification**

Example:

- 1 On-Highway automotive "X" 15 liter engine
- 2 Control system number 871
- 3 Technology supported; Electric EGR and Diesel Particulate Filter





Technology	Name	Suffix
Exhaust Gas Recirculation	Not used	None
	Pneumatic	P
	Electric	E
Diesel Particulate Filter (DPF)	Not used	None
	Full Flow DPF	F
	Partial Flow DPF	F2
Diesel Oxidation Catalyst	Not used	None
	DOC	C
3-Way Oxidation Catalytic Converter	Not used	None
	3-Way Catalyst	J
Selective Catalytic Reduction System	Not used	None
	Air Driven	S
	Airless	A
Nox Sensor	Not used	None
	Nox Sensor	N
Modular Common Rail System	Used only on QSK19, 38, 50 , 60 HHP Engines	MCRS
Integrated Dosing Control Unit	Not Used	None
	Integrated	I

# 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.

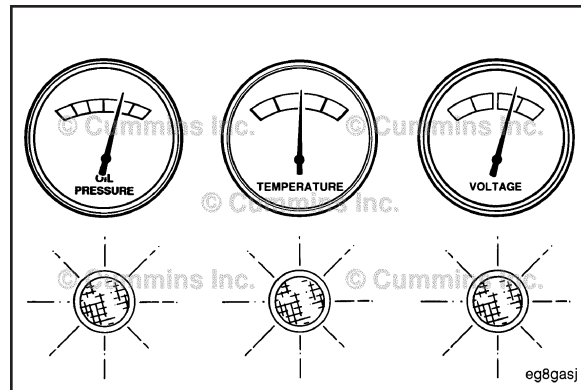
Follow the daily maintenance checks listed in Maintenance Guidelines (Section 2).

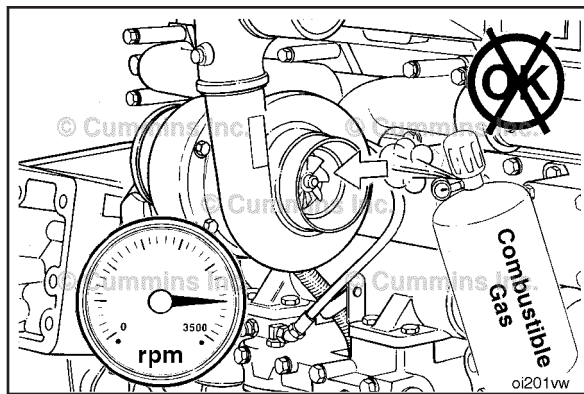
The new Cummins® engine associated with this manual does **not** require a "break-in" procedure. This section of the manual provides all of the necessary information required for proper engine operation.

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



Check the oil pressure, coolant temperatures DEF level, and other engine parameters daily via the OEM front panel to make sure they are operational. Check the panel regularly for any alarm messages. Take appropriate action to rectify the alarm condition or contact your nearest Authorized Cummins® Distributor.





**⚠ WARNING ⚠**

Do not operate a diesel engine where there are or can **BE COMBUSTIBLE** vapors. These vapors can be sucked through the air intake system and cause engine acceleration and over speeding 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 over speeding where an engine, due to its application, is operating in a combustible environment, such as due to a fuel spill or gas leak. Remember, Cummins Inc. 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 A Cummins® Authorized Repair Location for further information.

**⚠ CAUTION ⚠**

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

Cummins recommends the installation of an air intake shutoff device or a similar safety device to minimize the risk of overspeeding when an engine is operating in a combustible environment, such as due to a fuel spill or gas leak.

## Normal Starting Procedure

### Starting

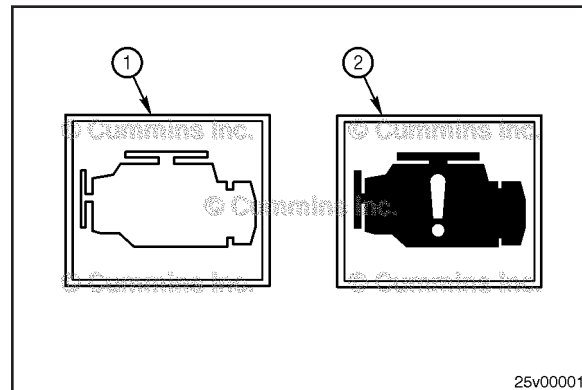
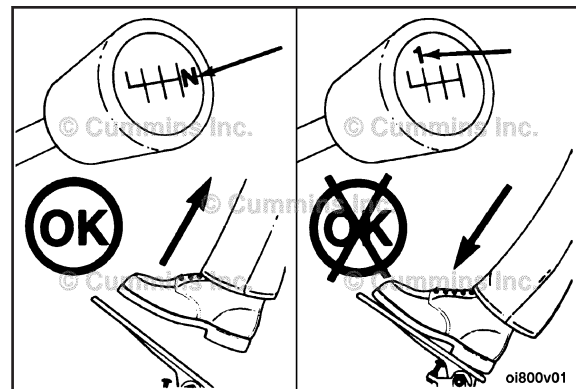
Disengage the driven unit, or if equipped, put the transmission in neutral.

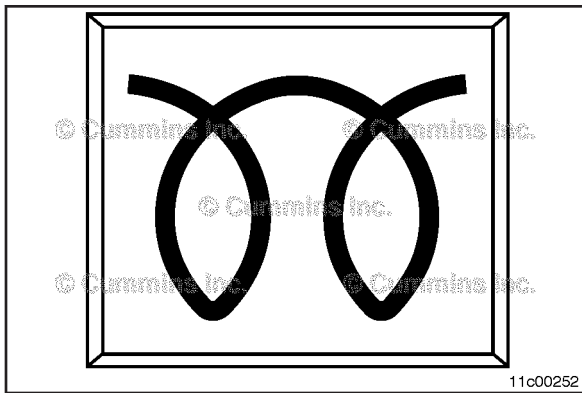
With the accelerator pedal or lever in the idle position, turn the keyswitch to the ON position.

With the keyswitch in the ON position, the engine indicator lamps will come on momentarily and then go out. The engine indicator lamps include:

- 1 WARNING (or CHECK ENGINE) lamp, amber in color
- 2 STOP (or STOP ENGINE) lamp, red in color.

If any of the lamps remain on or begin to flash, refer to the Engine Indicator Lamps procedure for additional information. Refer to Procedure 101-048 in Section 1.





**⚠CAUTION⚠**

Do not engage the starting motor for more than 30 seconds or damage to the starting motor can result. Wait 2 minutes between each attempt to start (electrical starting motors only).

Under cold conditions, the Wait-to-Start lamp (generally a yellow lamp using a symbol similar to the graphic, or the words WAIT TO START) will also illuminate at key ON, and will stay on for a period of up to 30 seconds.

**NOTE:** The length of time the Wait-to-Start lamp remains illuminated depends on the ambient temperature. The lower the ambient temperature, the longer the lamp will be illuminated.

Once the Wait-to-Start lamp turns off, turn the key to the start position to start the engine.

**NOTE:** Some engines are equipped with an engine starting motor protection feature. If the starting motor is engaged for 30 or more seconds, without the engine starting, the starter will be locked out from operating, allowing for proper cooling of the starting motor. During this time, the WAIT TO START lamp will flash for 2 minutes. Once the lamp discontinues flashing, the starting motor will be allowed to function.

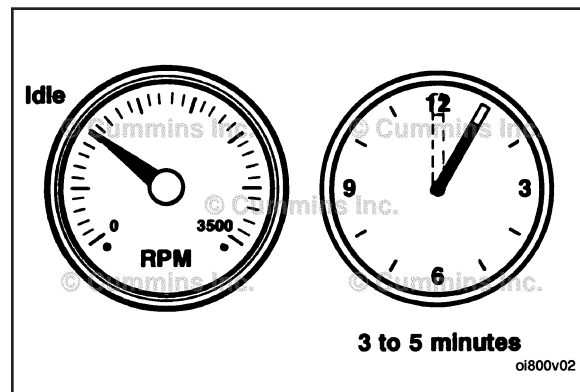
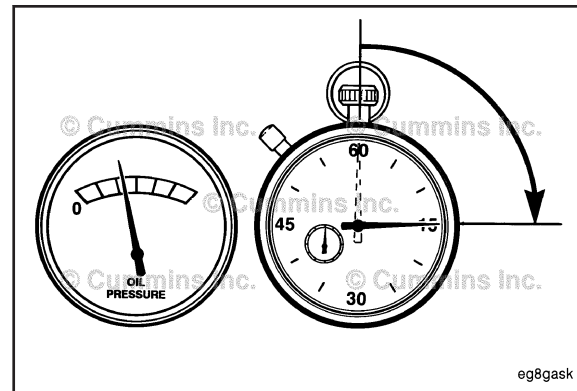
**NOTE:** Engines equipped with air starting motors require a minimum of 480 kPa [70 psi].

### ⚠CAUTION⚠

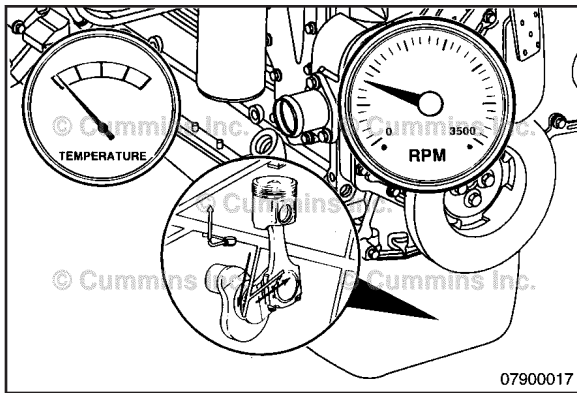
The engine must have adequate oil pressure within 15 seconds after starting. If the **WARNING** lamp indicating low oil pressure has not gone out or there is no oil pressure indicated on a gauge within 15 seconds, shut the engine **OFF** immediately to reduce the possibility of engine damage.

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

**NOTE:** After the engine is started, the voltmeter, if equipped, may show a gauge fluctuation under certain engine temperature conditions (both warm and cold). This cycling operation is caused by the post-heat cycle of the intake manifold heater system. The number of cycles and the length of the cycling operation is controlled by the engine control module. The cycling action will cause temporary dimming of the headlamps, interior lamps, and other vehicle electrical accessories.







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.

Some engines are equipped with a Fast Idle Warm Up feature. When enabled, this feature elevates the idle speed of the engine in cold ambient conditions in order to shorten the time necessary to warm up the engine. When the idle speed is elevated, the engine noise may change. This is normal. To bring the engine back to low idle speed:

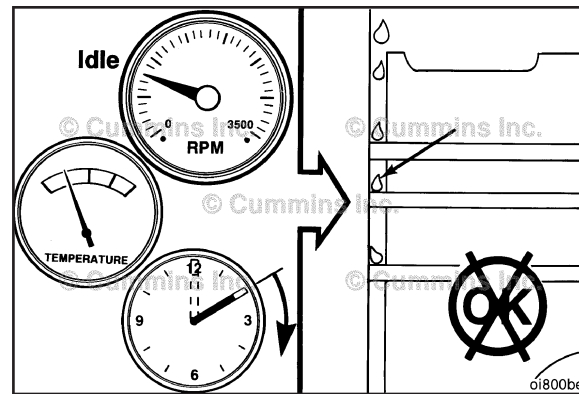
- For vehicles equipped with a manual transmission and clutch switch: Depress the clutch pedal.
- For vehicles equipped with a brake switch: Depress the service brake pedal.
- Depress the accelerator pedal.

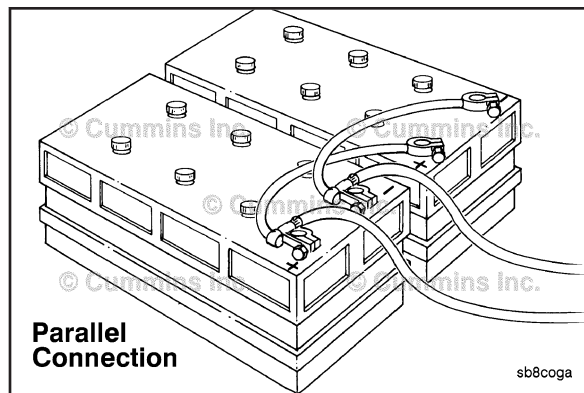
For more information on the Fast Idle Warm Up feature, contact a Cummins® Authorized Repair Location.

**⚠CAUTION⚠**

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

- Fuel dilution of the lubricating oil
- Carbon buildup in the cylinder
- Cylinder head valve sticking
- Reduced performance.





## Jump Starting

### ⚠ WARNING ⚠

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

### ⚠ CAUTION ⚠

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 ⚠

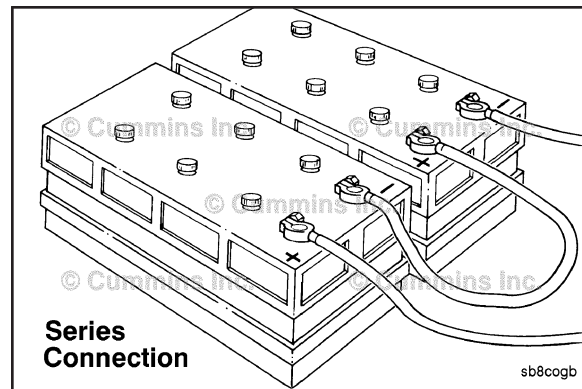
To reduce the possibility of damage to engine parts, do not connect the jumper starting or battery charging cable to any fuel system or electronic component.

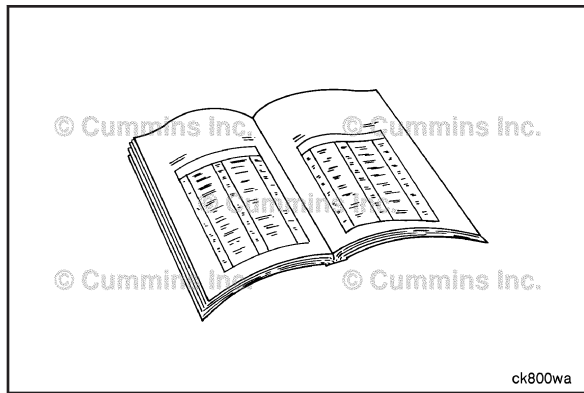
This illustration shows a typical parallel battery connection. This arrangement doubles the cranking amperage.

**NOTE:** Always reference the relevant OEM literature for jump starting procedures. Failure to follow correct procedures can result in damage to the ECM and other electrical equipment.

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

**NOTE: Always** reference the relevant OEM literature for jump starting procedures. Failure to follow correct procedures can result in damage to the ECM and other electrical equipment.





## Cold Weather Starting

### General Information

#### ⚠CAUTION⚠

To reduce the possibility of damage to the lubricating oil pan, due to the composite materials used in the manufacture of the lubricating oil pan, under no circumstances should an external heat source be applied directly or indirectly to the lubricating oil pan.

Follow the Normal Starting Procedure in this section. If equipped with an intake air heater, the Wait-To-Start lamp will stay on longer.

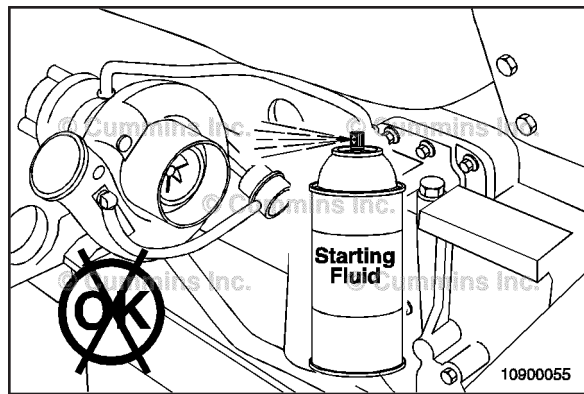
Refer to the OEM service manual for any additional cold weather starting procedures.

## Using Starting Aids

### ⚠ WARNING ⚠

Do not use starting fluids with this engine. This engine is equipped with an intake air heater; use of starting fluid can cause an explosion, fire, personal injury, severe damage to the engine, and property damage.

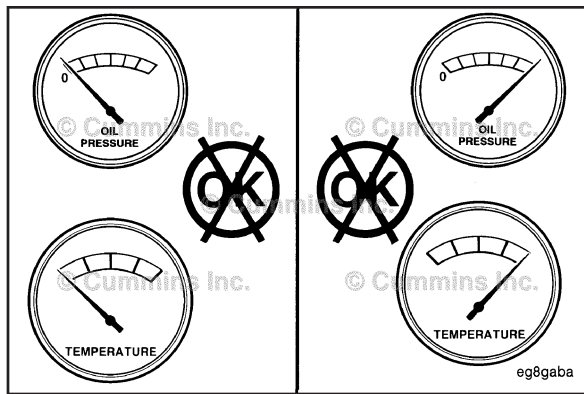
Cold weather starting aids are available for this engine. Contact a Cummins® Authorized Repair Location for more information.



## Starting Procedure After Extended Shutdown or Oil Change

### General Information

Follow the Normal Starting Procedure in this section. Refer to Procedure 101-014 in Section 1. The engine will run at idle **only** until the minimum oil pressure is detected by the ECM.

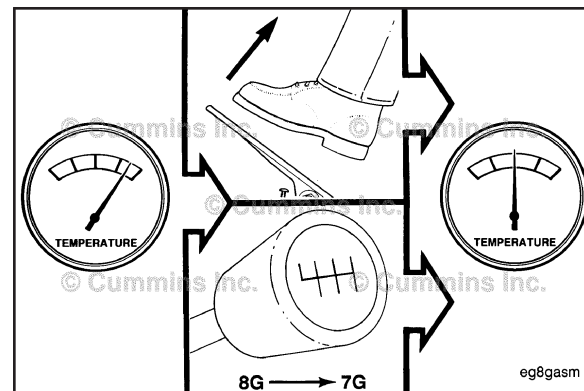


## Operating the Engine Normal

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.



## 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 Indicator Lamps

### General Information

The following engine indicator lamps cover **only** the lamps controlled by the engine ECM. The equipment manufacturer can provide additional indicator lamps. Please refer to the equipment owners manual for additional lamp information.

### Wait to Start Lamp

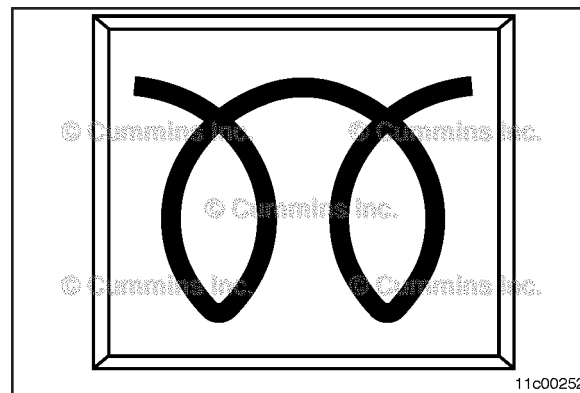
The WAIT TO START lamp illuminates when the intake air heater needs to warm the intake air prior to starting the engine.

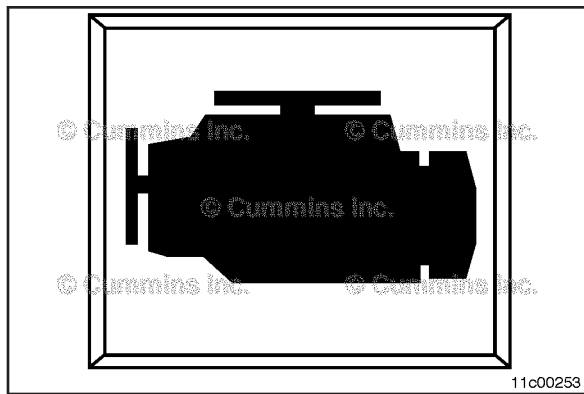
The WAIT TO START lamp on time will vary, depending on the ambient air temperature. See Normal Starting Procedure. Refer to Procedure 101-014 in Section 1.

The WAIT TO START lamp can appear as:

- the words WAIT TO START spelled out
- a symbol similar to the graphic illustrated.

**NOTE:** The color of the symbol or words can vary, based on the manufacturer of the vehicle, but will typically be red or amber.





### Check Engine Lamp

The CHECK ENGINE lamp illuminates when the engine needs to be serviced at the first available opportunity.

The CHECK ENGINE lamp is amber, and can appear as:

- the words WARNING or CHECK ENGINE spelled out
- a symbol of an engine, similar to the graphic illustrated.

Another function of the CHECK ENGINE lamp is to flash for 30 seconds at keyswitch ON when one of the following occurs. This flashing function is referred to as the MAINTENANCE lamp. The MAINTENANCE lamp could flash for any of the following reasons:

- Maintenance is required (if the Maintenance Monitor is enabled).
- Water-in-fuel is detected.
- The engine lubricating oil level is low (if equipped with an engine lubricating oil level sensor).
- The coolant level is low.

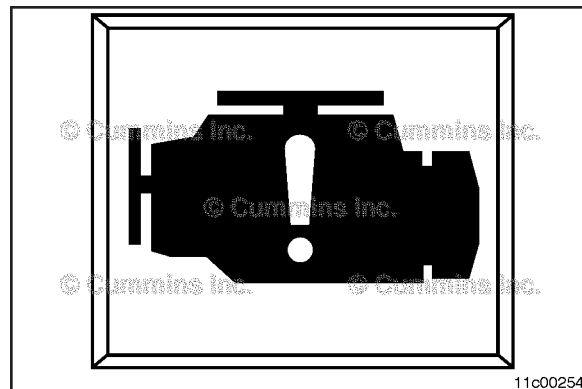
## Stop Engine Lamp

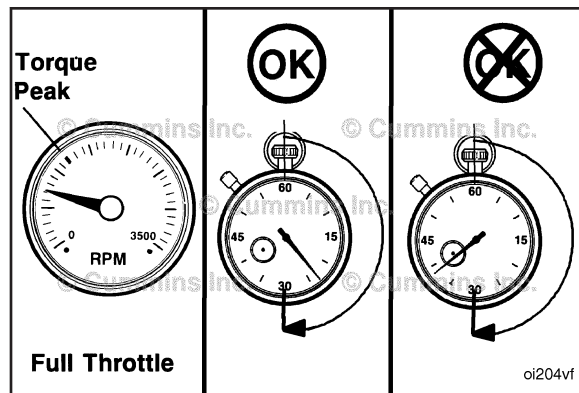
When illuminated, the STOP ENGINE lamp indicates the need to stop the engine as soon as it can be safely done. The engine **must** remain shut down until the engine can be repaired.

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

The STOP ENGINE lamp is red in color, and can appear as:

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





## Engine Operating Range

### General Information

#### ⚠CAUTION⚠

Do not operate the engine at full throttle 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.

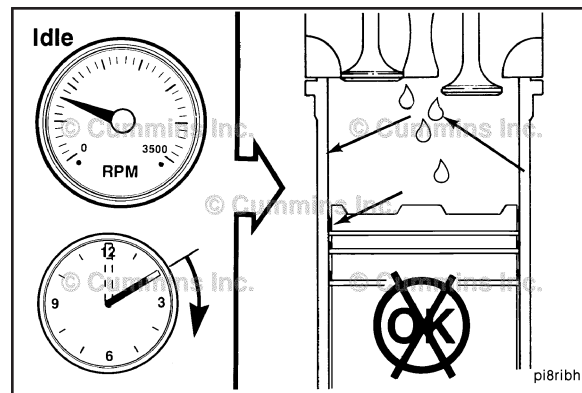
#### ⚠CAUTION⚠

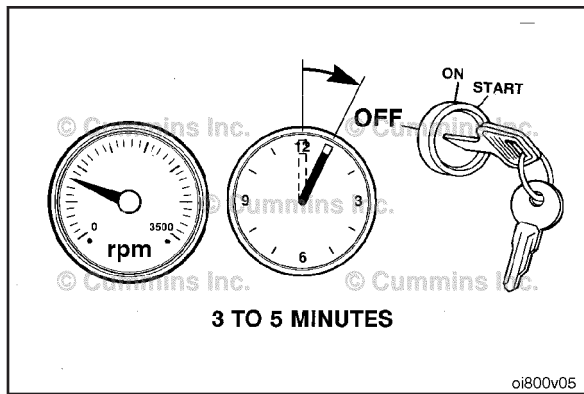
Do not operate the engine beyond the maximum engine speed. Operating the engine beyond the maximum engine speed can cause severe engine damage. Use proper operating techniques for the vehicle, vessel, or equipment to prevent engine overspeed. The maximum engine speed specification is listed in Maintenance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

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 idle the engine for excessively long periods. Long periods of idling, more than 10 minutes, can cause poor engine performance.





## Engine Shutdown

### General Information

#### ⚠CAUTION⚠

Failure to follow the correct shutdown procedure may result in damage to the turbocharger and shorten the turbocharger life.

**NOTE:** For engines equipped with an electronic control module (ECM) ensure the keyswitch is turned off for a minimum of 100 seconds prior to disconnecting the continuous (unswitched) battery power supply. If the unswitched battery power supply is disconnected in less than 100 seconds after the keyswitch is turned off active fault codes and incorrect ECM information can occur.

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

## Electronic Controlled Fuel System

### General Information

The engine addressed by this manual has an electronically controlled fuel system that provides many operator and vehicle/equipment features.

The base functions of the control system include fueling and timing control, limiting the engine speed operating range between the low- and the high-idle set points, and optimizing engine performance while maintaining emissions compliance. The system also controls the engine brakes.

The control system uses inputs from the operator and its sensors to determine the fueling and timing required to operate at the desired engine speed at the required emissions level.

### **Engine Control Module Inputs**

The engine control module (ECM) is the control center of the system. It processes all of the inputs and sends commands to the fuel system, vehicle/equipment and engine control devices.

The ECM performs diagnostic tests on most of its circuits and will activate a fault code if a problem is detected in one of these circuits. Along with the fault code identifying the problem, a snapshot of engine operating parameters at the time of fault activation is also stored in the memory.

Active fault codes will cause a diagnostic lamp to activate as a signal to the operator.

The ECM can communicate with service tools and some other vehicle/equipment controllers (such as transmissions, ABS, ASR, electronic dash displays, and so on) through the SAE J1939 data link.

Some vehicles and equipment will have SAE J1939 networks on them that link many of the "smart" controllers together. The vehicle/equipment control device can temporarily command engine speed or torque to perform one of its functions (that is, transmission shifting, anti-lock braking, and so on).

The control system uses a number of sensors to provide information on engine operating parameters. These sensors include:

- Engine coolant temperature sensor
- Intake manifold temperature/pressure sensor
- Engine oil pressure switch



- Engine speed (crankshaft position) sensor
- Camshaft position sensor
- Ambient air pressure/temperature sensor
- Fuel rail pressure sensor
- Water-in-fuel sensor
- Turbocharger speed sensor
- Variable geometry turbocharger actuator
- EGR valve
- Exhaust pressure sensor
- EGR temperature sensor
- EGR differential pressure sensor
- Crankcase pressure sensor
- Aftertreatment temperatures sensor(s)
- Aftertreatment diesel particulate filter differential pressure sensor
- Oil level sensor
- Accelerator pedal/lever position sensor
- Exhaust brake selector switches
- Engine coolant level sensor
- Vehicle speed sensors

- Feature control switches (i.e. cruise control switches)
- Fan control switch
- Air conditioner pressure switch
- Remote accelerator
- Remote PTO.

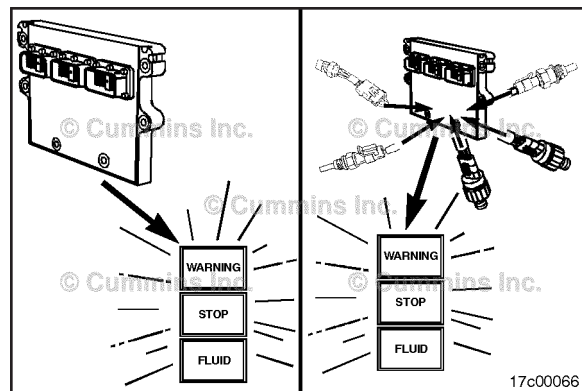
**NOTE:** These inputs are application dependent. Some applications will **not** use all of these inputs.

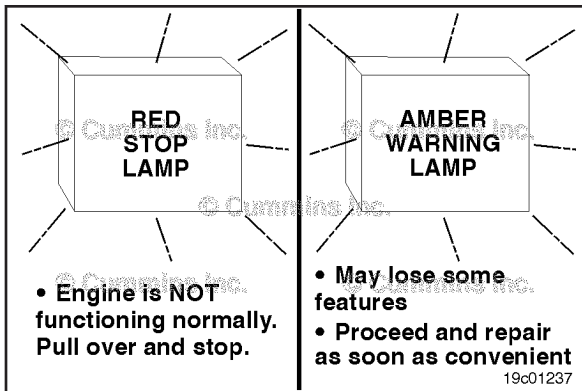
## Diagnostic Fault Codes

The electronic engine control system can display and record certain detectable fault conditions. These malfunctions are displayed as fault codes, which make troubleshooting easier. The fault codes are retained in the ECM.

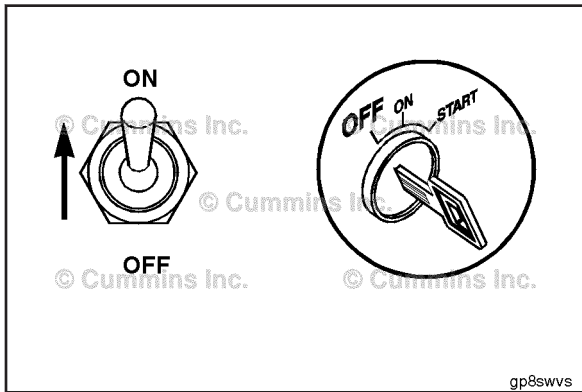
There are two types of diagnostic codes:

- Engine electronic control system fault codes are to inform the operator that there is a problem with the control system that will require troubleshooting.
- Information and engine protection fault codes inform the operator that the control system has detected an engine condition outside of the normal operating range.





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).



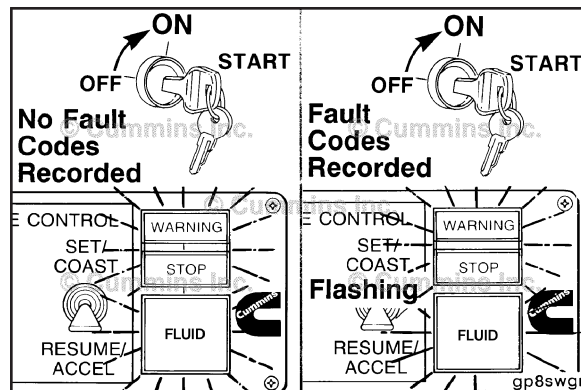
Fault codes can be accessed in at least two different ways; using the electronic service tool, or through fault code flash out.

To check for active engine electronic fuel system and engine protection system fault codes, turn the keyswitch OFF and move the diagnostic switch to the ON position.

Turn the vehicle keyswitch to the ON position.

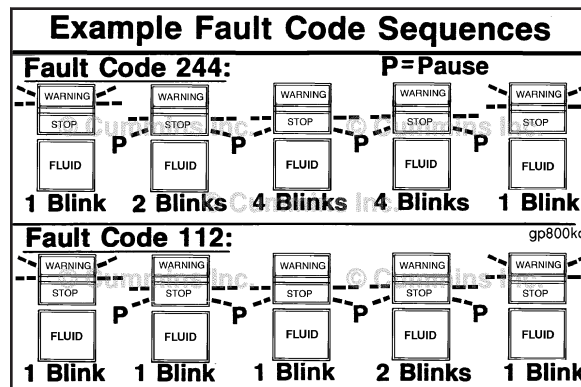
If no active fault codes are recorded, both lights will come on and stay on.

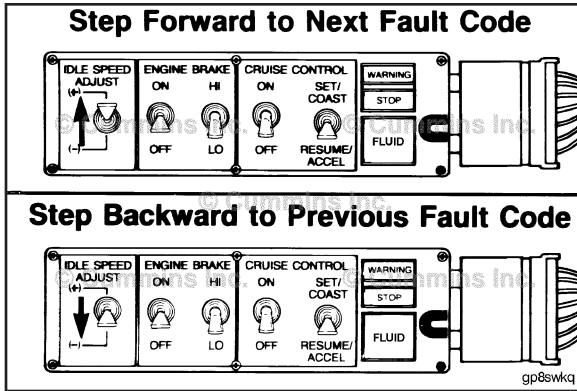
If active fault codes are recorded, both lights will come on momentarily, then begin to flash the code of the recorded faults.



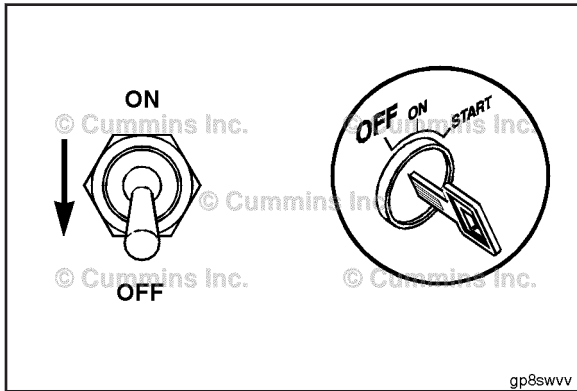
The fault code will flash in the following sequence:

- First, a WARNING (amber) light will flash.
- Then there will be a short 1 or 2 second pause after which the number of the recorded fault code will flash in STOP (red).
- There will be a 1 or 2 second pause between each number.
- When the number has finished flashing in red, an amber light will appear again.





The lights flash each fault code out three times before advancing to the next code. To skip to the next fault code, move the Increment/Decrement switch, if equipped, momentarily to the increment (+) position. You can go back to the previous fault code by momentarily moving the Increment/Decrement switch, if equipped, to the decrement (-) position. If only one active fault is recorded, the same fault code will continuously be displayed when either (+) or (-) switch is depressed.



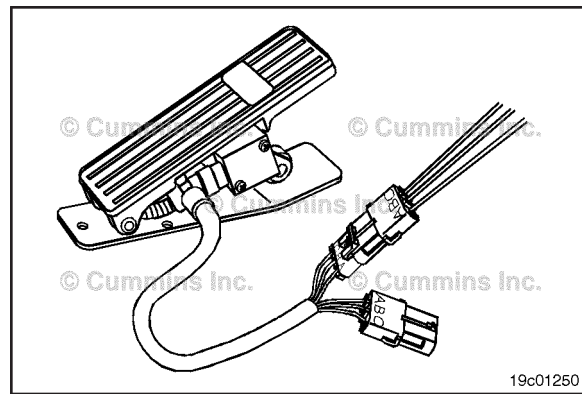
When **not** using the diagnostic system, turn off the diagnostic switch.

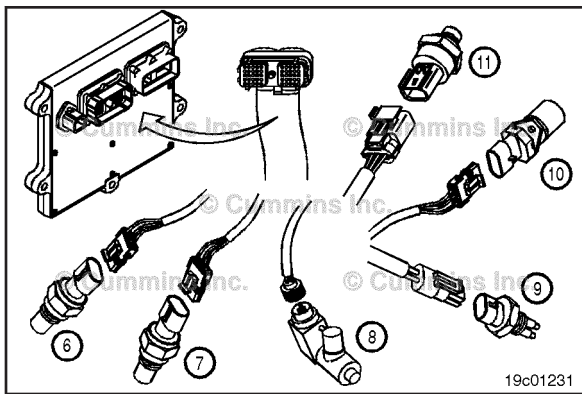
### Throttle Activated Diagnostic Switch

The throttle-activated diagnostic switch feature is intended to eliminate the need for a dash-mounted diagnostic switch, which is used to activate the fault code flashout on the lamps. The fault code flashout will be activated through a simple sequence of throttle movements. When this feature is enabled, the engine is in stop state and the keyswitch is turned ON. Every successive cycle of the throttle will lead to the next fault code to be flashed on the lamps, in the same manner as if the increment switch were depressed.

To activate this feature, the engine **must** be stopped and the keyswitch turned to the ON position. Then depress the accelerator pedal completely three times. The feature should then be enabled. Transitioning to the next fault code will happen automatically after the first fault code is flashed out twice or if the throttle pedal is cycled.

**NOTE:** There is an optional, error sensitive mode for this feature. If any of the throttle-related errors occur, this feature will turn on the diagnostic switch automatically when the engine is stopped and the keyswitch is ON. During this mode, **only** the increment switch can be used to flash out the next fault code.





## Engine Protection System

### ⚠CAUTION⚠

When the red STOP lamp is illuminated, the operator must stop the vehicle/equipment when it is safe to do so, to reduce the possibility of engine damage.

The engines addressed by this manual are equipped with an engine protection system. The system monitors critical engine temperatures and pressures, and will log diagnostic faults when an over or under normal 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 lamp. The STOP lamp will blink or flash when out-of-range conditions continue to worsen. The operator **must** stop the vehicle/equipment, when it is safe to do so, to reduce the possibility of engine damage.

**NOTE:** Engine power and speed will gradually be 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 enabled.

## Fault Code Snapshot Data

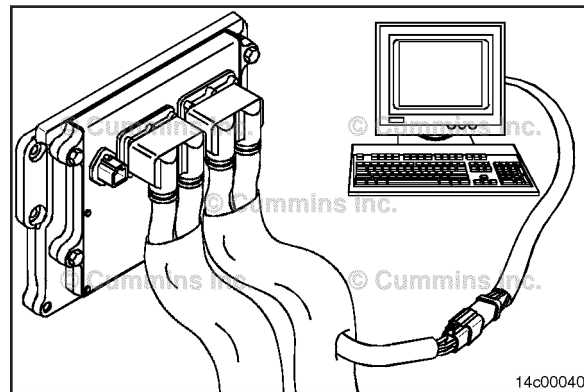
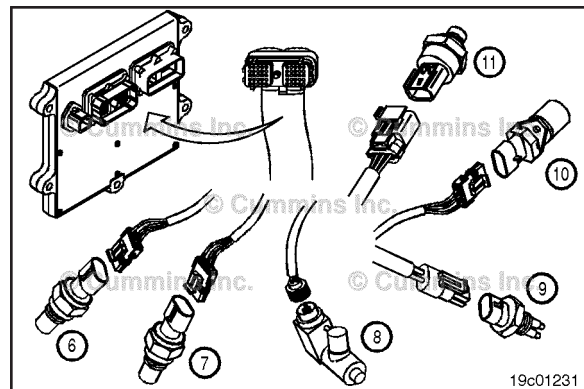
When a diagnostic fault code is recorded in the ECM, the ECM input and output data is recorded from all sensors and switches. Snapshot data allows the relationships between ECM inputs and outputs to be viewed and used during troubleshooting.

Fault code snapshot data can **only** be viewed using INSITE™ electronic service tool.

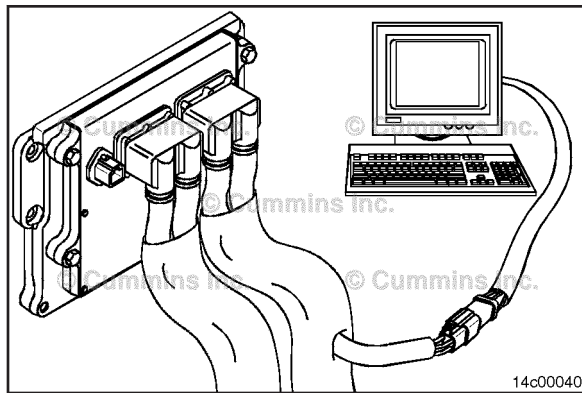
## INSITE™ Electronic Service Tool Description

INSITE™ electronic service tool is a service tool for the electronic engine control system. Use INSITE™ electronic service tool to:

- Program customer specified information into the ECM (parameter and features)
- Aid in troubleshooting the engine
- Change the engine power or rated speed calibration
- Transfer new or update calibration files to the ECM
- Create and view trip reports, etc.







## INSITE™ Electronic Service Tool Monitor Mode

The INSITE™ electronic service tool monitor mode is a useful troubleshooting aid that displays the key ECM inputs and outputs. This feature can be used to spot constant or intermittent out-of-range values.

## Electromagnetic Interference (EMI)

### General Information

Some applications utilize accessories such as (CB radios, mobile transmitters, etc.) if not installed and used correctly the radio frequency energy generated by these accessories can cause electromagnetic interference (EMI) conditions to exist between the accessory and the Cummins electronically controlled systems. Cummins is **not** liable for any performance problems with either the electronically controlled systems or the accessory due to EMI. EMI is **not** considered by Cummins to be a system 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 performance degradation at relatively high energy levels; however, if very high

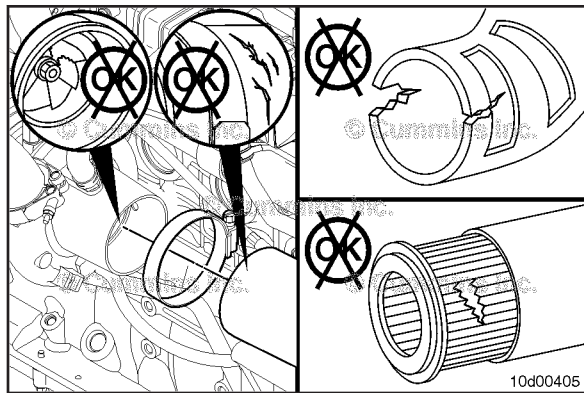
energy levels are encountered, then some noncritical diagnostic fault code logging can occur. The electronically controlled systems EMI susceptibility level will protect your systems from most, if **not** all, electromagnetic energy-emitting devices that meet the legal requirements.

## 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 systems are properly installed, they 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 transmitting antenna as far away from the electronically controlled systems and as high as possible.
- 2 Locate the transmitting 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:
  - Accurately calibrate 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.



## Turbocharger, Variable Flow

### Initial Check



**Do not operate the engine with the charge-air piping removed. The lack of boost pressure on the outlet side of the compressor outlet can cause progressive damage to the turbocharger.**

Inspect the linkage from the variable flow turbocharger (VFT) valve to the VFT actuator motor.

Replace the turbocharger if the linkage is cracked or corroded.

Check for excessive movement between the bushings and linkage arms. Replace the turbocharger if the linkage arms are seized or have excessive movement.

Inspect the turbocharger housing for damage.

Remove the intake pipe from the turbocharger. See the Remove section in this procedure.

Install protective caps from the Air Handling Clean Care Kit, Part Number 4919498, on all open connection points.

Inspect the turbocharger compressor impeller blades for damage.

Replace the turbocharger if damage is found. See the Remove and Install sections of this procedure.

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

Repair any damage before operating the engine.

**QSB4.5 CM2250 EC**  
**Section 1 - Operating Instructions**

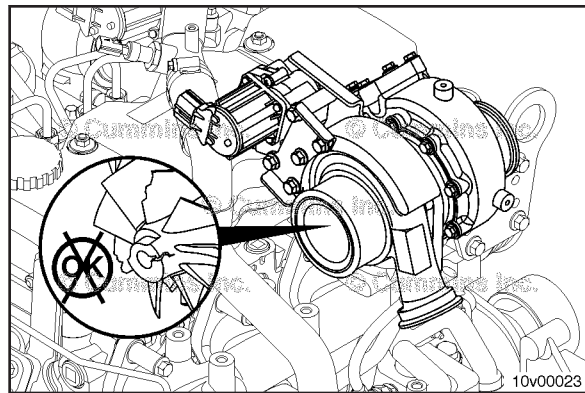
**Turbocharger, Variable Flow**  
**Page 1-33**

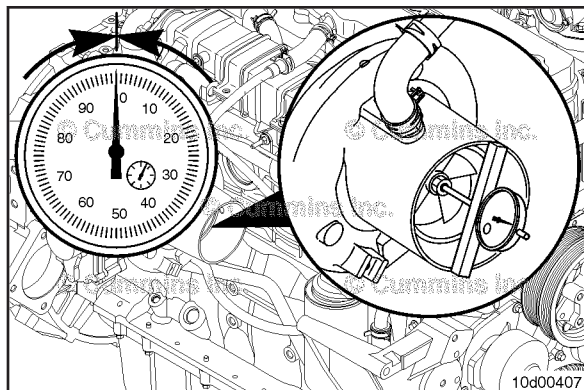
Remove the exhaust pipe from the turbocharger. See the Remove section in this procedure.

Install protective caps from the Air Handling Clean Care Kit, Part Number 4919498, on all open connection points.

Inspect the turbine wheel for damage.

Replace the turbocharger if damage is found. See the Remove and Install sections of this procedure.





#### Axial Clearance Check

Use a dial depth gauge, Part Number ST-537.

Push the rotor assembly away from the gauge.

Set the gauge to zero.

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

#### Axial Clearance (TD04 and TD04H Variable Flow Turbocharger) - Compressor Side

mm		in
0.39	MIN	0.015
0.67	MAX	0.026

#### Axial Clearance (TD04 and TD04H Variable Flow Turbocharger) - Turbine Side

mm		in
0.37	MIN	0.015
0.48	MAX	0.019

Replace the turbocharger if the clearance does **not** meet specifications. See the Remove and Install sections of this procedure.

#### Radial Clearance Check

Radial measurement specifications do not apply due to close blade to housing tolerances.

Check the radial movement of the rotor system by pushing the turbocharger compressor wheel toward the wall of the turbocharger compressor cover with light finger pressure. The turbocharger passes inspection if the wheel does **not** contact the compressor cover wall.

Repeat the procedure on the turbine wheel.

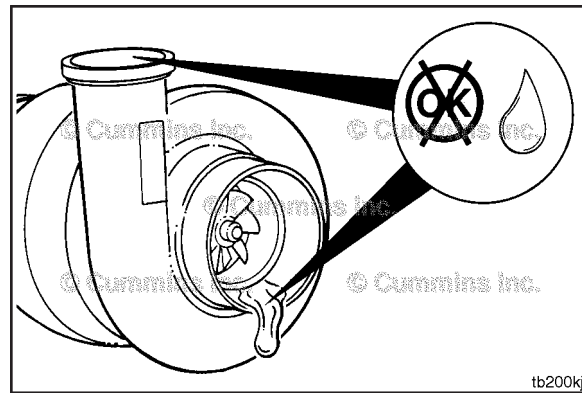
Replace the turbocharger if there is contact between the turbine wheel and turbine housing or compressor wheel and compressor housing. See the Remove and Install sections of this procedure.

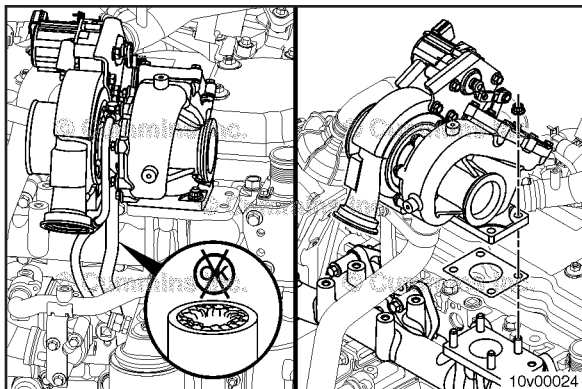
## Leak Test

Inspect the turbocharger compressor inlet and discharge for oil.

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

Engines equipped with a closed crankcase ventilation system can exhibit some oil misting of the compressor blades. This is normal and does **not** signify turbocharger damage. If oil is pooling in the turbocharger cavities or the charge-air cooler cavities, inspect the closed crankcase ventilation system for leaks, filter element damage, or plugging.





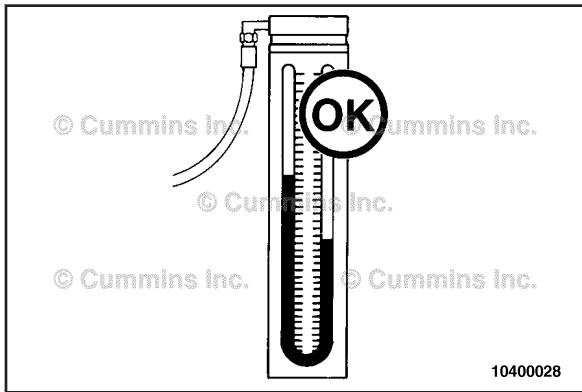
If oil is present **only** in the discharge side, install the air intake and charge-air piping.

Check for intake restrictions.



If the intake restriction is within specifications, remove the oil drain line and check for restrictions.

Clear any restrictions found. Install the drain line and new o-ring seals into the engine block.



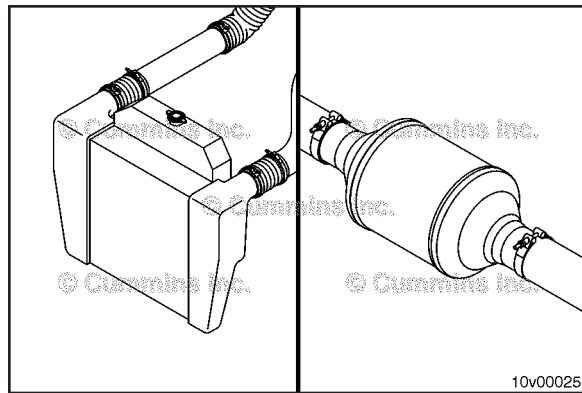
If the oil drain line was **not** restricted, measure the crankcase pressure (blowby).



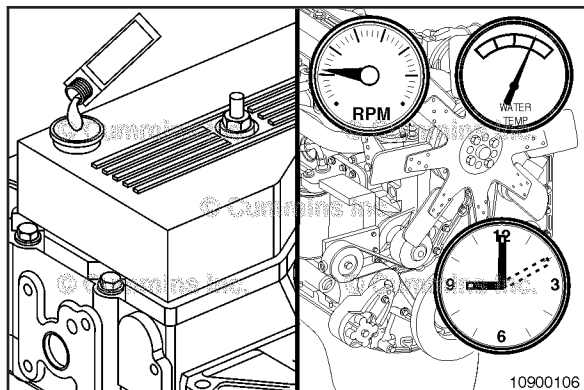
If the crankcase pressure is within specifications, replace the turbocharger. See the Remove and Install sections of this procedure.

**NOTE:** If the engine experiences a turbocharger malfunction that resulted in coolant or oil entering the intake, the charge-air cooler system and the EGR should be inspected and cleaned. Clean and inspect the charge-air cooler. Clean and inspect the EGR.

**NOTE:** If the engine experiences a turbocharger malfunction or any other occasion where oil is put into the Cummins® diesel oxidation catalyst, the Cummins® diesel oxidation catalyst **must** be inspected. Refer to the Aftertreatment Diesel Oxidation Catalyst and Aftertreatment Diesel Particulate Filter Reuse Guidelines Service Bulletin, 4021600.



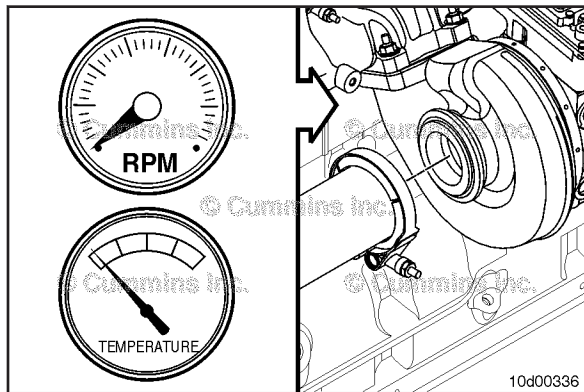




If oil is found **only** in the turbine outlet housing, perform the fluorescent tracer test.

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

Operate the engine at low idle for 10 minutes.



Shut the engine OFF.

Allow the turbocharger to cool.

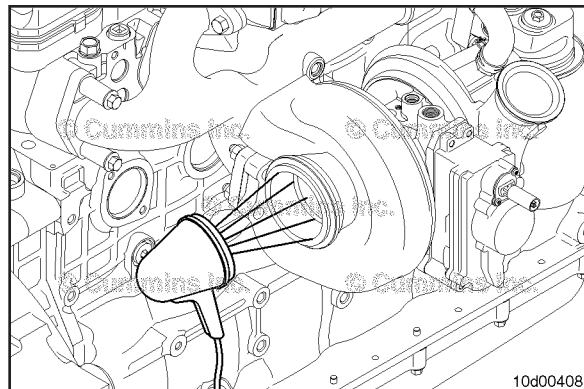
Remove the exhaust pipe from the turbine housing. See the Remove section of this procedure.

**QSB4.5 CM2250 EC**  
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**Turbocharger, Variable Flow**  
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Use a high-intensity black light, Part Number 3163339, to inspect the turbine outlet for leaks.

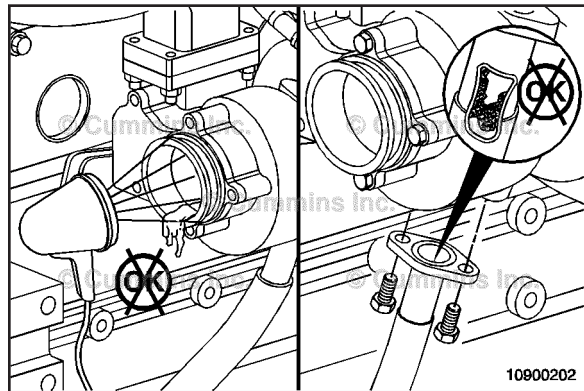
A yellow glow indicates an oil leak.

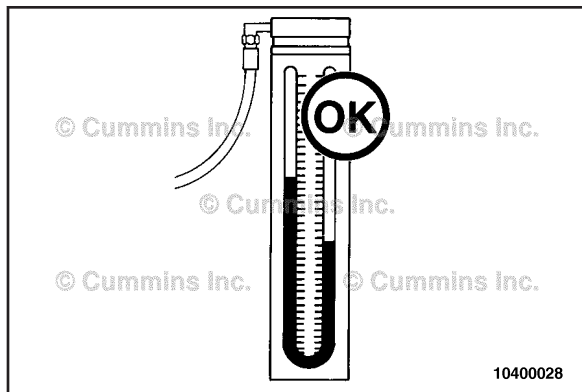


If oil is found in the turbine housing, remove the oil drain line and check for restrictions.

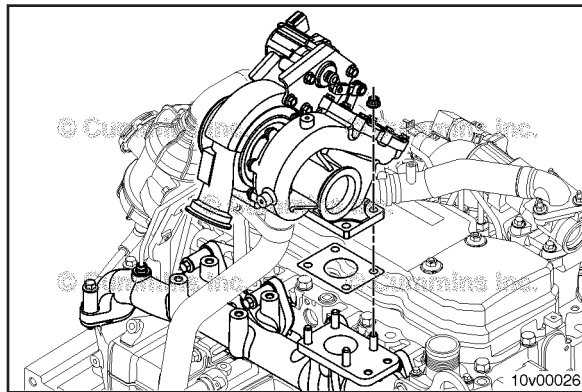
Clear any restrictions found.

Install the drain line and new o-ring seals into the engine block.





If the oil drain line was **not** restricted, measure the crankcase pressure (blowby).



If these checks do **not** reveal the problem, remove the turbocharger. See the Remove and Install sections of this procedure.



Once the turbocharger is removed, inspect the inside of the exhaust manifold for oil. If oil is **not** found, replace the turbocharger.

If oil is found in the exhaust manifold, proceed to the following check.

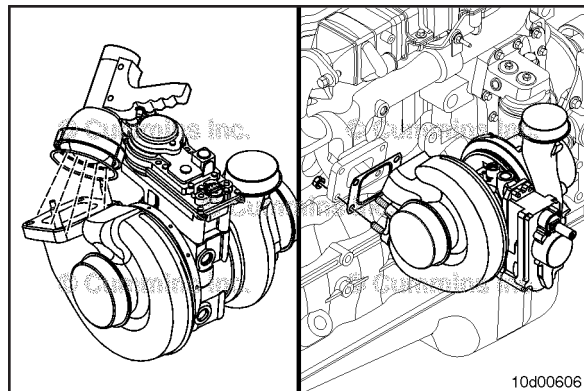
Use a high-intensity black light, Part Number 3163339, to inspect the turbine inlet for leaks.



A yellow glow indicates an oil leak from the engine.

If a yellow glow is **not** seen in the turbine inlet, replace the turbocharger. See the Remove and Install sections of this procedure.

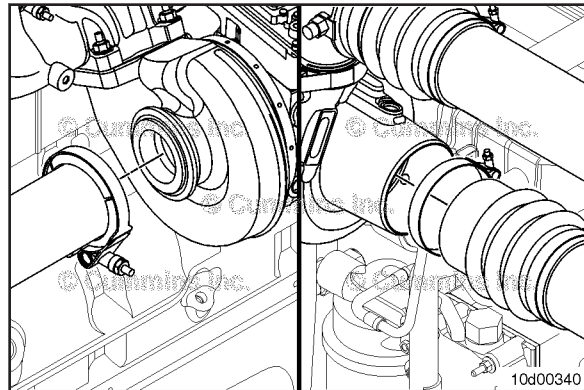
If a yellow glow is seen, reference the Lubricating Oil Consumption Excessive troubleshooting symptom tree in Section TS.

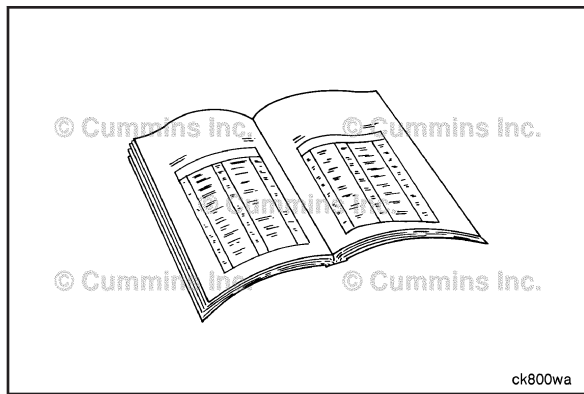


Install the exhaust pipe to the turbocharger turbine outlet and tighten the clamp. See the Install section of this procedure.



Install the intake pipe to the turbocharger compressor inlet and tighten the clamp. See the Install section of this procedure.





## Preparatory Steps



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



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



**WARNING**  
To reduce the possibility of personal injury, avoid direct contact with hot oil.



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

**NOTE:** Brush away all loose dirt from around the area of the air handling connections to avoid contamination of the interior of the engine.

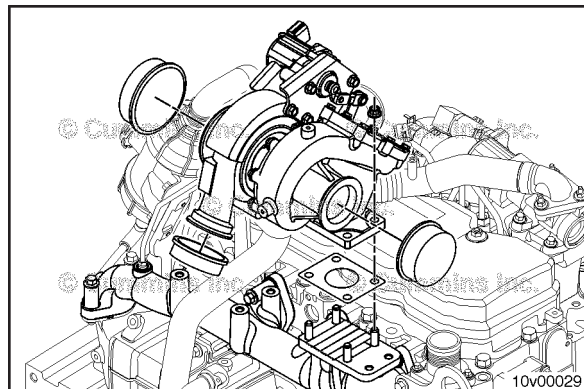
- Disconnect the batteries. Refer to the OEM service manual.
- Remove the oil supply line from the turbocharger.
- Remove the oil drain line from the turbocharger.
- Disconnect the turbocharger actuator wiring harness by unlocking the tang and pushing down to release the tab.
- Disconnect the crankcase ventilation hose.
- Remove the exhaust piping. Refer to the OEM service manual.
- Remove the turbocharger compressor air inlet and outlet connections. Refer to the OEM service manual.
- If equipped, remove the turbocharger compressor outlet connection.
- Remove the turbocharger compressor outlet connection.

## Remove

Remove the four turbocharger mounting nuts.

Remove the turbocharger and gasket.

Cover the turbocharger exhaust inlet port with a protective cap from the Air Handling Clean Care Kit, Part Number 4919498. Cover the opening on the exhaust manifold with heavy tape.



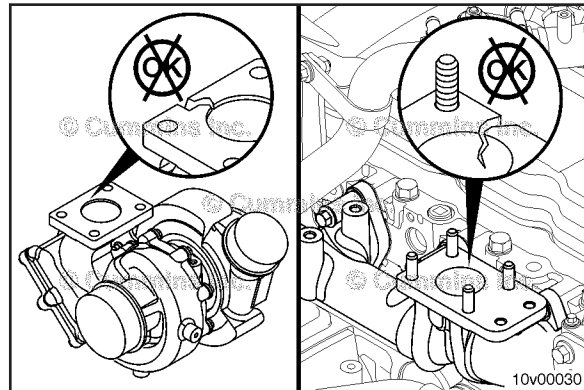
## Clean and Inspect for Reuse

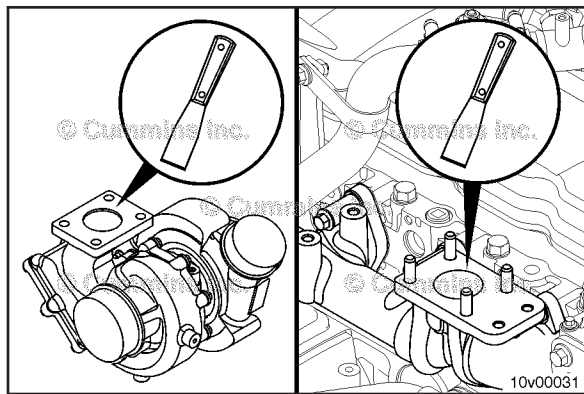
Clean the turbocharger and exhaust manifold gasket surfaces.

Inspect the turbocharger and exhaust manifold gasket surfaces and mounting studs for cracks and other damage.

Replace the turbocharger if any cracks or other damage is found in the mounting flange surfaces.

Replace the exhaust manifold if any cracks or other damage is found in the mounting flange surfaces.





**⚠ 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 ⚠**

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

**⚠ WARNING ⚠**

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

Remove all carbon deposits and gasket material from the surfaces indicated in the illustration.

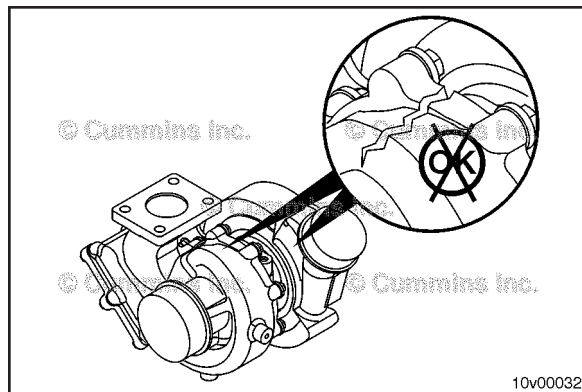
Use solvent or steam to clean the exterior of the turbocharger.

Dry with compressed air.

Inspect the turbine and compressor housings.

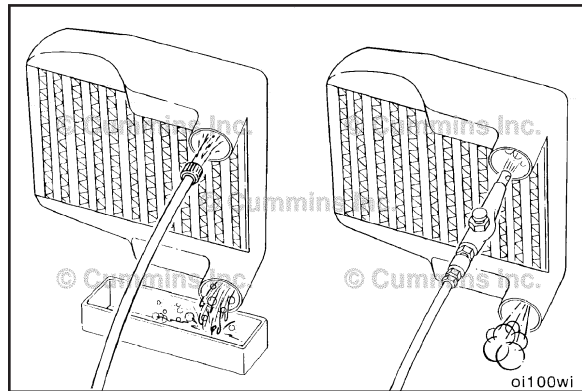
If cracks which go all the way through the outer walls are found, the turbocharger **must** be replaced.

**NOTE:** A charge-air cooler malfunction can cause progressive damage to the turbine housing. If the turbine housing is damaged, check the charge-air cooler.

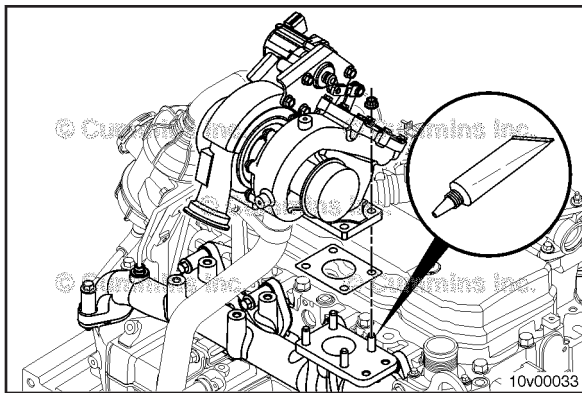


**NOTE:** If the engine experiences a turbocharger malfunction or any other occasion in which oil or debris is put into the charge-air system, the charge-air system **must** be inspected and cleaned.

**NOTE:** If the engine experiences a turbocharger malfunction that resulted in coolant or oil entering the intake, the charge-air cooler system, as well as the EGR should be inspected and cleaned.







## Install

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



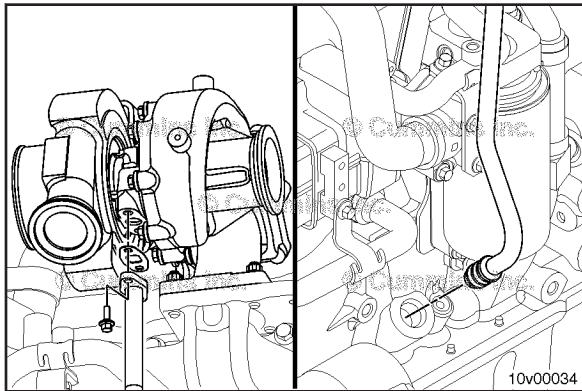
**Only** remove Clean Care caps as the connections are being made.

Use a new gasket and install the turbocharger.

Install and tighten the four mounting nuts.

**NOTE:** The torque values given have been established using anti-seize compound as a lubricant.

**Torque Value:** 24 N•m [ 212 in-lb ]



## Prime

Install and tighten the turbocharger oil drain line.



**Torque Value:** 10 N•m [ 89 in-lb ]



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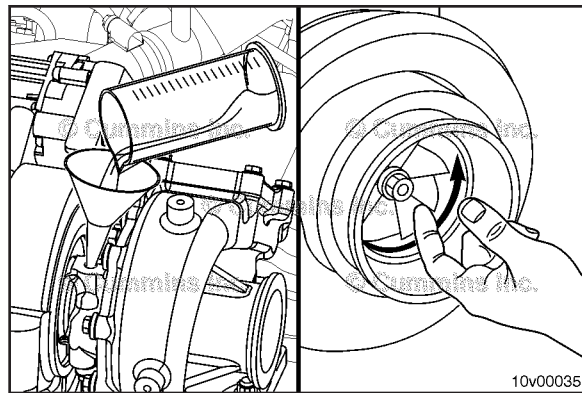
Lubricate the bearings by pouring 59 to 89 cc [2 to 3 oz] of clean 15W-40 engine oil in the turbocharger oil supply line fitting.

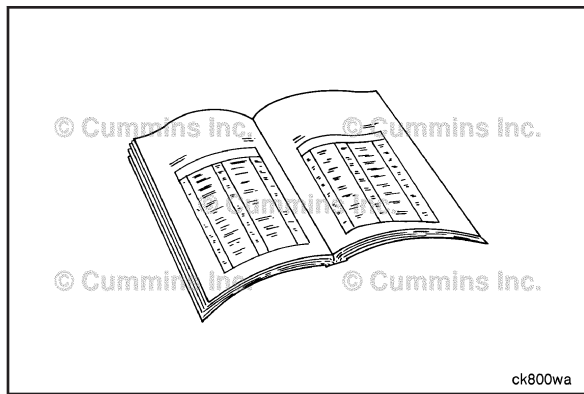
Rotate the turbine wheel to allow oil to enter the bearing housing.

**NOTE:** If too much oil is poured into the bearing housing, the oil may leak past the seals. This is **not** a malfunction since the seals are **not** dynamic and rely on exhaust gas and boost pressure to provide a proper seal.

Install the turbocharger oil supply line.

**Torque Value:** 15 N•m [ 133 in-lb ]





## Finishing Steps

### ⚠ WARNING ⚠

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

- If equipped, install the turbocharger compressor outlet connection.
- Install the exhaust piping. Refer to the OEM service manual.
- Install the turbocharger air inlet and outlet connections. Refer to the OEM service manual.
- Connect the turbocharger actuator wiring harness.
- Connect the crankcase ventilation hose.
- If damage resulted in oil, excessive fuel, or excessive black smoke entering the exhaust system, the aftertreatment system **must** be inspected.

If damage resulted in coolant or oil entering the intake, the charge-air cooler system, as well as the EGR, should be inspected and cleaned.

- Inspect the charge-air cooler.
- Connect the batteries. Refer to the OEM service manual.
- Operate the engine and check for leaks.

## Section 2 - Maintenance Guidelines

### Section Contents

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<b>Maintenance Guidelines - Overview</b> .....	2-1
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<b>Maintenance Record Form</b> .....	2-7
Maintenance Data.....	2-7
<b>Maintenance Schedule</b> .....	2-2
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Oil Drain Intervals.....	2-5

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## **Maintenance Guidelines - Overview**

### **General Information**

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

If the system 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 system is operated in a dusty environment or if frequent stops are made. For gas fueled generator sets, shorter maintenance intervals are also required, if operating at loads below 70% for prolonged periods. 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 system is equipped with a component or accessory not manufactured or supplied by Cummins Inc., refer to the component manufacturer's maintenance recommendations.

OEM supplied equipment and components can impact on the performance and reliability of the engine if they are not correctly maintained.

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

## **Maintenance Schedule**

### **General Information**

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

Perform maintenance at whichever interval occurs first. At each scheduled maintenance interval, perform all previous maintenance checks that are due for scheduled maintenance.

#### **Maintenance Procedures at Daily Interval<sup>(7)</sup>**

- Air Tank and Reservoirs - Drain
- Crankcase Breather Tube - Check
- Fuel-Water Separator - Drain
- Air Cleaner Restriction - Check<sup>(7)</sup>
- Lubricating Oil Level - Check
- Fan, Cooling - Check
- Coolant Level - Check
- Aftertreatment Exhaust Piping - Check
- Air Intake Piping - Check

#### **Maintenance Procedures at 250 Hours or 3 Months**

- Radiator Hoses - Check
- Air Intake Piping - Check

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- Radiator - Check
- Charge-Air Cooler - Check
- Charge-Air Piping - Check

**Maintenance Procedures at 500 Hours or 6 Months**

- Fuel Filter (Spin-On Type) - Change<sup>1</sup>
- Lubricating Oil and Filters - Change<sup>2, 4</sup>
- Engine Coolant Antifreeze - Check
- Batteries - Check
- Battery Cables and Connections - Check
- Radiator Pressure Cap - Check

**Maintenance Procedures 1000 Hours or 1 Year**

- Cooling Fan Belt Tensioner - Inspect for Reuse
- Drive Belt, Cooling Fan - Check
- Air Compressor Discharge Lines - Check
- Fan Hub, Belt Driven - Check

**Maintenance Procedures at 2000 Hours or 2 Years**

- Vibration Damper, Viscous - Check
- Vibration Damper, Rubber - Check
- Engine Steam Cleaning - Clean



- Crankcase Breather (External) - Check
- Cooling System - Flush<sup>3, 5</sup>

**Maintenance Procedures at 2000 Hours**

- Crankcase Ventilation Filter - Change<sup>6</sup>

**Maintenance Procedures at 5000 Hours or 4 Years**

- Overhead Set - Adjust

**NOTES:**

- 1 If the oil drain interval being used is greater than 500 hours, as determined by the Oil Drain Intervals section below, the fuel filter change can be extended until the oil drain interval.
- 2 The oil drain intervals are based on an engine equipped with a 14.2 liter [15 qt] capacity lubricating oil pan and a normal duty cycle. For detailed information on oil drain intervals based on oil pan capacity, see the Oil Drain Intervals Section of this procedure. Cummins Inc. requires the use of a high-quality, heavy-duty engine oil. Use the following procedure for lubricating oil recommendations and specifications. Refer to Procedure 018-003 in Section V.
- 3 Extended coolant drain/flush/fill intervals may be followed when certain requirements are met. For information on these requirements, refer to the Cummins® Coolant Requirements and Maintenance, Service Bulletin 3666132.
- 4 For standby generator sets, the recommended lubricating oil change interval is 250 hours or yearly, whichever occurs first. For prime or continuous rated generator sets, the lubricating oil change interval is 500 hours or yearly, whichever occurs first.
- 5 This cooling system requirement to flush at this scheduled maintenance includes: Drain, Flush, and Fill.
- 6 Remote mounting of the breather assembly can cause added restriction to the breather system. This reduces the filter service intervals. Consult a local Cummins® distributor for assistance.

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- 7 If a separate air filter is used for the air compressor air supply, please reference the original equipment manufacturer (OEM) Manual for Maintenance Guidelines and Schedule.
- The direct air cleaner uses both a primary and secondary filter element for industrial applications. The direct flow cleaner has been designed for a maximum restriction at 635 mmH<sub>2</sub>O [25 in H<sub>2</sub>O], at which point the filter element(s) **must** be changed. The secondary element **must** be changed every third time that the primary element is changed. If the primary element has been breached, then an inspection of the secondary filter **must** be performed and changed, if necessary. Refer to Procedure 010-014 in the Associated Procedures Table.

If the engine is equipped with a component or accessory that is **not** manufactured by Cummins Inc., reference the component manufacturer's maintenance recommendations.

Use the following procedure for fuel recommendations and specifications. Refer to Procedure 018-002 in Section V.

## Oil Drain Intervals

The lubricating oil and lubricating oil filter interval can be adjusted, based on the oil pan capacity.

Table 1: Lubricating Oil Drain Interval	
Lubricating Oil Pan Capacity	Lubricating Oil Change Interval
14.2 liters [15 qt]	500 Hours or 6 Months
Greater than 14.2 liters [15 qt]	550 Hours or 6 Months

### If the type/oil capacity of the oil pan is not known:

- a Contact a Cummins® Distributor/Dealer
- b Determine the capacity of the oil pan option for the engine being serviced. Use QuickServe™ Online and the engine serial number.

- c For the first oil drain interval, use the 14.2 liter [15 qt] oil drain interval. When filling the engine with oil, determine the capacity of the oil pan.

## Maintenance Record Form

### Maintenance Data

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

<b>Key to table headings:</b>
A = Date
B = Schedule km [Miles], Hours or Time Interval
C = Actual km [Miles] Hour or Time
D = Maintenance Check Performed
E = Check Performed By
F = Comments

A	B	C	D	E	F


# Section L - Service Literature

## Section Contents

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## Additional Service Literature

### General Information

The following publications can be purchased:

Bulletin	Title of Publication
4310575	Service Manual, QSB4.5 CM2250 EC
4310594	Fault Code Troubleshooting Manual, QSB4.5 CM2250 EC
2883643	Wiring Diagram, QSB4.5 CM2250 EC
4310576	Operation and Maintenance Manual, QSB4.5 CM2250 EC
4310577	Owners Manual, QSB4.5 CM2250 EC
3379000	Air for Your Engine
3379001	Fuels for Cummins® Engines
3379009	Operation of Diesel Engines in Cold Climates
3666132	Cummins® Coolant Requirements and Maintenance
3810340	Cummins® Engine Oil and Oil Analysis Recommendations



## Service Literature Ordering Location Contact Information

Region	Ordering Location
United States and Canada	Cummins Distributors or Credit Cards at <a href="https://store.cummins.com">https://store.cummins.com</a>
All Other Countries	Cummins Distributors or Dealers

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## **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 contain 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.

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 Cummins QuickServe Online.

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 Distributors, Original Equipment Manufacturers and Cummins Factory personnel order by calling Iron Mountain Fulfillment Services (IMFS) at 1-800-646-5609.

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- International Distributors and Original Equipment Manufacturers order the CPC from their regional Cummins Parts Distribution Centers (PDC).
- International PDC orders are called into Iron Mountain at (++) 630-283-2420.
- Retail Credit Card Orders require a 2 step ordering process.

### **Ordering On-Line**

Access the Cummins QSOL store at <https://store.cummins.com>

- Find the Customized Parts Catalog button located on the left of the homepage
- Select format. Your Price is also shown here
- Finalize Shopping Cart and Check Process as described on the website

North America call Iron Mountain Fulfillment Services (IMFS) at 800-646-5609, International customers call (++) 630-283-2420. Provide IMFS the catalog detail as described on the website. This step is required until we have our On Line form available.

Required information needed for your Customized Parts Catalog Order.

- Customer Name
- Street Address
- Company Name (optional)
- Telephone no.
- Credit Card No.
- Cummins Engine Serial Number (located on the engine data plate)

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

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

## Notes

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# Section V - Maintenance Specifications

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## General Engine

### Specifications

#### Industrial Applications

Listed below are the general specifications for the QSB4.5 liter engines covered by this manual.

Horsepower.....Refer to the engine dataplate.

Compression ratio.....17.2:1

Crankshaft rotation (viewed from the front of the engine)..... **Clockwise**

#### Bore and Stroke

For 4.5 liters [272 C.I.D.] engines.....107 mm [4.21 in] X 124 mm [4.88 in]

Displacement (four-cylinder engine).....4.5 liters [272 C.I.D.]

Firing order (four-cylinder engine).....1-3-4-2

#### Approximate Engine Weight Wet:

Wet weight for 4.5 liters (272 C.I.D.).....390 kg [860 lb]

Crankshaft Rotation (viewed from the front of the engine)..... **Clockwise**

#### Valve Clearance:

Intake.....0.254 mm [0.010 in]

Exhaust.....0.508 mm [0.020 in]

Maximum overspeed capability (15 seconds maximum).....3750 rpm

Minimum ambient air temperature for unaided cold start.....-12.2°C [10°F]

Minimum engine cranking speed.....120 rpm

Engine idle speed.....Minimum 700 to maximum 1200 rpm

#### Oil Carryover:

Open-crankcase ventilation system.....Less than 2 grams/hour [0.07 oz/hour]

#### Engine Blowby:

New.....1 kPa [4 in H<sub>2</sub>O]



Used.....2.49 kPa [10 in H<sub>2</sub>O]

**Altitude Maximum Before Derate Occurs**

163 bhp at 2500 rpm.....	518.6 m [1700 ft]
130 bhp at 2500 rpm.....	1829 m [6000 ft]
115 bhp at 2500 rpm.....	2438 m [8000 ft]
163 bhp at 2300 rpm.....	762 m [2500 ft]
130 bhp at 2300 rpm.....	1829 m [6000 ft]
160 bhp at 2200 rpm.....	457 m [1500 ft]
130 bhp at 2200 rpm.....	1829 m [6000 ft]
121 bhp at 2200 rpm.....	2438 m [8000 ft]
110 bhp at 2200 rpm.....	2743 m [9000 ft]
155 bhp at 2000 rpm.....	609.6 m [2000 ft]
140 bhp at 2000 rpm.....	1527 m [5000 ft]

**NOTE:** The engine features a no-adjust overhead. The valve train is designed such that adjustment of the valve lash is **not** required for normal service during the first 241,402 km [150,000 mi]. The valve train operates acceptably within the limits of 0.152- to 0.381-mm [0.006- to 0.015-in] intake valve lash and 0.381- to 0.762-mm [0.015- to 0.030-in] exhaust valve lash. It is recommended that the valve lash be checked around 241,402 km [150,000 mi] and every 81,000 km [50,000 mi] thereafter.

## Lubricating Oil System

### Specifications

#### Oil Pressure:

Low Idle (minimum allowed).....	69 kPa [10 psi]
At Rated (minimum allowed).....	207 kPa [30 psi]
Oil-regulating Valve-opening Pressure Range.....	448 kPa [65 psi] to 517 kPa [75 psi]
Oil Filter Differential Pressure to Open Bypass.....	345 kPa [50 psi]
Lubricating Oil Filter Capacity.....	0.95 liters [1 qt]

#### Oil Capacity of Standard Engine (Four-cylinder):

##### 4.5 liters [275 C.I.D.] Engines (Suspended Oil Pan)

Pan only .....	11 liters [11.6 qt]
Total system.....	13 liters [13.7 qt]
High to Low (on dipstick).....	1.9 liters [2.0 qt]

#### Oil Capacity of Standard Engine (Four-cylinder):

##### 4.5 liters [275 C.I.D.] Engines (Aluminum Oil Pan)

Pan Only .....	13 liters [13.7 qt]
Total System.....	15 liters [15.9 qt]
High to Low (on dipstick).....	3.0 liters [3.2 qt]

#### Oil Capacity of Standard Engine (Four-cylinder):

##### 4.5 liters [275 C.I.D.] Engines (High Capacity Oil Pan)

Pan Only .....	16 liters [16.9 qt]
Total System.....	18 liters [19.0 qt]
High to Low (on dipstick).....	6.0 liters [6.3 qt]

#### Maximum Oil Temperature:

##### With EGR

For 4.5 Liter [275 C.I.D.] Engines.....	135°C [275°F]
---	---------------

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**NOTE:** If the type or oil capacity of the oil pan is **not** known:

- 1 Contact a Cummins® Distributor/Dealer.
- 2 Determine the capacity of the oil pan option for the engine being serviced by using QuickServe™ Online and the engine serial number.
- 3 Fill the lubricating oil pan to the lowest oil pan capacity listed for the engine being serviced. Then add 0.95 liters [1 qt] of oil at a time until it reaches the high mark on the dipstick. Record the number of quarts added so the capacity is known the next time the oil is drained.

## Cooling System

### Specifications

Coolant Capacity (includes block, cylinder head, water pump volute, EGR cooler, and EGR plumbing)....11.5 liters [3.0 gal]

Standard Modulating Thermostat - Range.....86 to 97°C [186 to 207°F]

Maximum Allowed Operating Temperature.....107°C [225°F]

Minimum Recommended Operating Temperature.....71°C [160°F]

Minimum Recommended Pressure Cap.....90 kPa [13 psi]

Maximum Recommended Pressure Cap.....276 kPa [40 psi]

## Cummins®/Fleetguard® Filter Specifications

### General Information

Cummins Filtration™, which produces Fleetguard® products, is a division of Cummins Inc. Fleetguard® filters are developed through joint testing at Cummins Inc. and are standard on new Cummins® engines. Cummins Inc. recommends their use.

Fleetguard® products meet all Cummins® 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 Inc. can **not** be responsible for problems caused by non-genuine filters that do **not** meet Cummins Inc. performance or durability requirements.

#### Filter Part Numbers

Lubricating Oil Filter	
Cummins® Part Number	3937736
Fleetguard® Part Number	LF3970
Fuel Filter (Primary)	
Cummins® Part Number	5289121
Fleetguard® Part Number	FF63004
Fuel Filter (Prefilter with WIF Sensor) <sup>1</sup>	
Cummins® Part Number	3954904
Fleetguard® Part Number	FS19596

1. The fuel filter (Prefilter with WIF Sensor) could be OEM-supplied.

<b>Crankcase Ventilation Filter (Rear Engine Mounted)</b>	
Cummins® Part Number	5288839
Fleetguard® Part Number	A035P943

<b>Air Filter (Primary)</b>	
178 x 178 x 203 mm [7 x 7x 8 in]	
Cummins® Part Number	5283826
Fleetguard® Part Number	AF55020
178 x 178 x 305 mm [7 x 7 x 12 in]	
Cummins® Part Number	5288553
Fleetguard® Part Number	AF55021

<b>Air Filter (Secondary)</b>	
178 x 178 x 203 mm [7 x 7 x 8 in]	
Cummins® Part Number	5283827
Fleetguard® Part Number	AF55312
178 x 178 x 305 mm [7 x 7 x 12 in]	
Cummins® Part Number	5283827
Fleetguard® Part Number	AF55312

## Fuel Recommendations and Specifications

### Fuel Recommendations



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



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



Lighter fuels can reduce fuel economy or possibly damage the fuel injection pump.



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



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

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

The engine has been optimized for use with an exhaust aftertreatment system to meet the Tier 4 Interim/Stage IIIB off-highway emissions regulations. It **must** operate on ultra-low sulfur diesel (ULSD) with a maximum sulfur content of 15

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ppm in the United States and 10 ppm in the European Union. Failure to do so can permanently damage engine and aftertreatment systems within a short period of time. This damage could cause the engine to become inoperable and affect the warranty coverage on the engine.

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

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

The following chart lists acceptable alternative fuels.

Acceptable Substitute Fuels - Cummins® Fuel System									
Number 1D Diesel <sup>(1)</sup> (2)	Number 2D Diesel <sup>(2)</sup>	Number 1K Kerosene	Jet-A	Jet-A1	JP-5	JP-8	Jet-B	JP-4	CITE
OK	OK	<b>NOT OK</b>	<b>NOT OK</b>	<b>NOT OK</b>	<b>NOT OK</b>	<b>NOT OK</b>	<b>NOT OK</b>	<b>NOT OK</b>	<b>NOT OK</b>
48-34 <sup>(3)</sup>	40-24 <sup>(3)</sup>	50-35 <sup>(3)</sup>	51-37 <sup>(3)</sup>	51-37 <sup>(3)</sup>	48-36 <sup>(3)</sup>	51-37 <sup>(3)</sup>	57-45 <sup>(3)</sup>	57-45 <sup>(3)</sup>	57-45 <sup>(3)</sup>

**NOTE:** Cummins Inc. recommends that the cetane number of diesel fuel be a minimum of 45 for engines that are expected to operate at temperatures below 0°C [32°F] and a minimum of 40 for engines that are operated at temperatures above 0°C [32°F].

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



**NOTE:** Cummins Inc. requires all permissible fuels to have adequate fuel lubricity. This means the BOCLE number is 3100 or greater as measured by ASTM specification D6078, Scuffing Load Ball On Cylinder Lubricity Evaluator (SLBOCLE). Lubricity can also be measured by ASTM specification D6079, ISO 12156, High Frequency Reciprocating Rig (HFRR), in which the fuel **must** have a wear scar diameter of 0.45 mm [0.02 in] or less.

The equipment OEM is required to display readily visible labels on the dashboard (or instrument panel), and near all fuel fill inlets that states "Use Ultra Low-Sulfur Diesel Fuel Only" or "Ultra Low-Sulfur Diesel Fuel Only".

ULSD/Biodiesel blends up to B20 (20 percent biodiesel) supplied by a BQ9000 certified supplier are acceptable.

Reference the following bulletin for information on alternative fuels, such as biodiesel, and additional information for fuel recommendations and specifications. Refer to Fuels for Cummins® Engines, Bulletin 3379001.

## Lubricating Oil Recommendations and Specifications

### General Information



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

The use of quality engine lubricating oils, combined with appropriate oil drain and filter change intervals, is a critical factor in maintaining engine performance and durability. Extending the oil and filter change interval beyond the recommendations will decrease engine life due to factors such as corrosion, deposits, and wear. Use the following procedure to determine which oil drain interval to use for an application. Refer to Procedure 102-002 in Section 2.

**NOTE:** The responsibility is with the owner. If recommendations are ignored, warranty could be affected.

API: American Petroleum Institute

CES: Cummins® Engineering Standard

Cummins Inc. allows, for midrange applications, the use of lubricating oils that meet or exceed CES 20078 or CES 20081 with no change in oil drain interval. But, if a non-low ash lubricating oil meeting the Cummins® Engineering Standard (CES) classification CEA 20078 is used, the service interval(s) for the aftertreatment system will be reduced. Refer to Procedure 102-002 in Section 2.

Cummins Inc. requires the use of a high-quality SAE 15W-40 heavy-duty engine oil, such as Valvoline Premium Blue™ (USA) or Valvoline Premium Blue™ Extra (International), which meets or exceeds CES 20081 and the American Petroleum Institute (API) performance classification CJ-4.



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To determine if the lubricating oil meets CES 20081, review the label on the back of the lubricating oil bottle for the CES 20081 reference. If acquiring the lubricating oil in bulk, contact the supplier for the lubricating oil specifications and confirm that the oil meets CES 20081.

Also located on the lubricating oil bottle is the API service symbol, which is shown in the accompanying illustration. The upper half of the symbol displays the appropriate oil categories. The center section identifies the SAE oil viscosity grade. The table below shows how the Cummins® Engineering Standard (CES) compares to the American Petroleum Institute (API) classification.

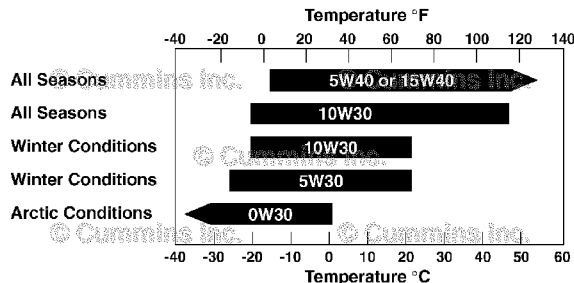
Cummins® Engineering Standard Classifications (CES)	American Petroleum Institute Classification (API)	Comments
CES-20081	CJ-4/SL	Minimum oil classification required.

**NOTE:** A lubricating oil that meets the American Petroleum Institute (API) performance classification CJ-4/SL may **not** meet the CES 20081 requirement. Always make sure that the lubricating oil used meets the CES 20081 requirement, in addition to the API performance classification CJ-4/SL.

The primary Cummins Inc. recommendation is for the use of 15W-40 multigrade lubricating oil for normal operation at ambient temperatures above -15°C [5°F]. The use of multigrade oil reduces deposit formation, improves engine cranking in low temperature conditions, and increases engine durability by maintaining lubrication during high temperature operating conditions. Since multigrade oils have been shown to provide approximately 30 percent lower oil consumption than monograde oils, it is important to use multigrade oils, to be certain the engine will meet applicable emissions requirements.

Use of "synthetic engine oils" (those made with API group 3 or group 4 base stocks) is permitted, subject to the same performance and viscosity limitations of petroleum (mineral) based engine oils. The same oil change intervals that are applied to petroleum (mineral) based engine oils **must** be applied to synthetic oils.

For further details and discussion of engine lubricating oils for Cummins® engines, reference the following bulletin. Refer to Cummins® Engine Oil Recommendations, Bulletin 3810340.



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While the preferred viscosity grade is 15W-40, lower viscosity multigrade oils can be used in colder climates. See the accompanying chart. Any viscosity grade lower than 15W-40 **must** still meet CES 20081.

Synthetic engine oils, API Group III and Group IV basestocks, are recommended for use in Cummins® engines operating in ambient temperature conditions consistently below -25°C [-13°F]. Synthetic 0W-30 oils that meet the requirements of API Group III or Group IV basestocks, 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.

As these oils have directionally thinner oil films than 15W-40 oils, top-quality Fleetguard® filters **must** be used above 20°C [70°F]. Some oil suppliers might claim better fuel economy for these oils. Cummins Inc. can neither approve nor disapprove any product **not** manufactured by Cummins Inc. These claims are between the customer and the oil supplier. Obtain a commitment from the oil supplier that the oil will give satisfactory performance in Cummins® engines, or do **not** use the oil.

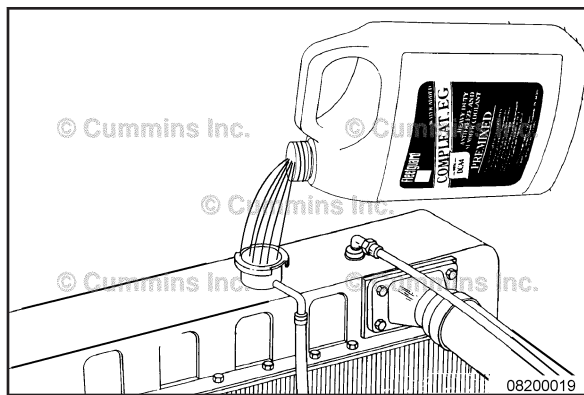
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## New Engine Break-in Oils

Special break-in engine lubricating oils are **not** recommended for new or rebuilt Cummins® engines. Use the same type of oil during the break-in period as is to be used in normal operation.

## AfterMarket Oil Additive Usage

Cummins Inc. does **not** recommend the use of aftermarket oil additives. Present high-quality fully additive engine lubricating oils are very sophisticated, with precise amounts of additives blended into the lubricating oil to meet stringent requirements. These 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 ability to protect the engine.



## Coolant Recommendations and Specifications

### Fully Formulated Coolant/Antifreeze

Cummins Inc. recommends the use of fully formulated antifreeze/coolant meeting Cummins Engineering Standards (C.E.S.) 14603. For further details and discussion of coolant for Cummins® engines, refer to Coolant Requirements and Maintenance, Bulletin 3666132.

Typically, antifreeze/coolants meeting ASTM4985 (GM6038M specification) or ASTM D6210 criteria are acceptable antifreeze/coolants for engines covered by the manual.

Low-silicate antifreeze/coolants meeting ASTM D4985 (GM6038M specification) are **not** adequate for extended service intervals.

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.

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 <sub>3</sub> + MgCO <sub>3</sub> )
Chloride	40 ppm as (Cl)
Sulfur	100 ppm as (SO <sub>4</sub> )

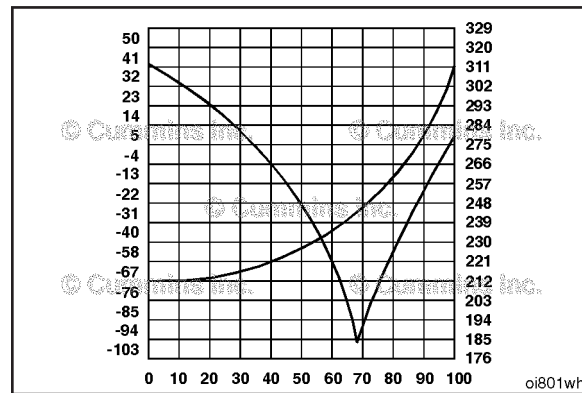
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**Section V - Maintenance Specifications**

Cummins Inc. recommends using Fleetguard® Compleat. It is available in both glycol forms (ethylene and propylene).

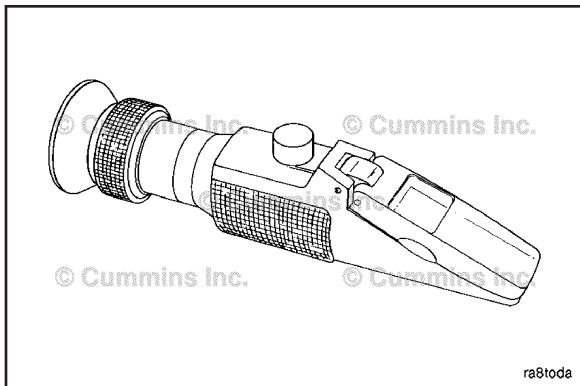
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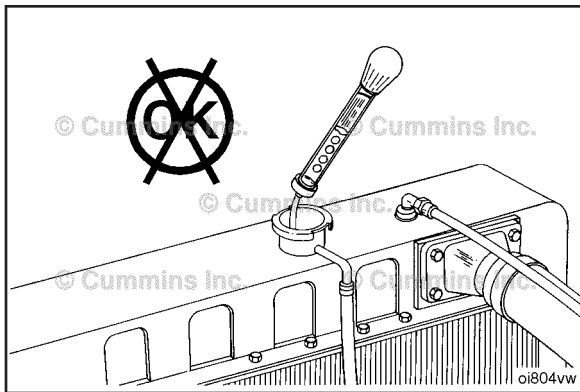
Fully formulated antifreeze **must** be mixed with good-quality water at a 50/50 ratio (40- to 60-percent working range). A 50/50 mixture of antifreeze and water gives a -36°C [-33°F] freezing point and a 108°C [226°F] boiling point, which is adequate for locations in North America. The actual lowest freezing point of ethylene glycol antifreeze is at 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**. Use Fleetguard® refractometer, Part Number C2800.

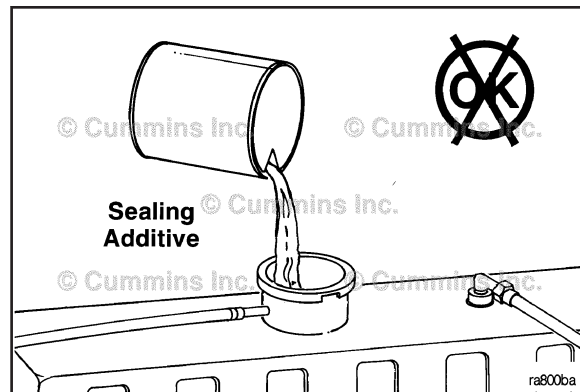


Do **not** use a floating ball hydrometer. The use of floating ball hydrometers can give an incorrect reading.

## Cooling System Sealing Additives

Do **not** use sealing additives in the cooling system. The use of sealing additives will:

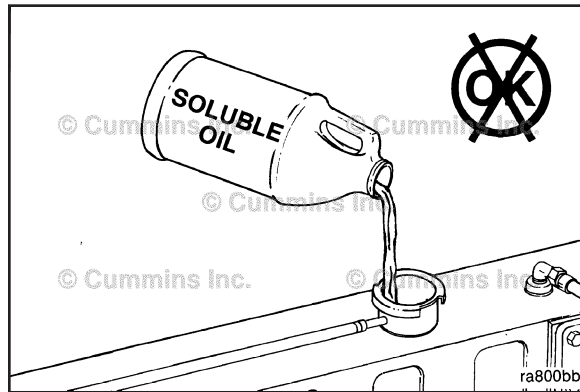
- Buildup in coolant low-flow areas
- Plug the radiator and oil cooler
- Possibly damage the water pump seal.



## Cooling System Soluble Oils

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

- Corrode brass and copper
- Damage heat transfer surfaces
- Damage seals and hoses.



## Notes

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# Section W - Warranty

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## **All Engines United States And Canada Industrial (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.

Engine aftertreatment components included in the Cummins Critical Parts List (CPL) and marked with a Cummins part number are covered under Base Engine Warranty.

Additional Coverage is outlined in the Emission Warranty section.

### **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 (3,000 hours for A Series Engines) 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.

### **Consumer Products**

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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 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. Service locations are listed on the Cummins Worldwide Service Locator at [cummins.com](https://cummins.com).

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**

Engines with an emissions certification listed below must be operated using only diesel fuel having no more than the corresponding maximum sulfur content. Failure to use the specified fuel as listed in the Cummins Fuel Bulletin



#3379001 Table 1 (Cummins Inc. Required Diesel Fuel Specifications) can damage the Engine and aftertreatment system within a short period of time. This damage could cause the Engine to become inoperable and failures attributable to the use of incorrect fuels will be denied Warranty Coverage. Fuel specifications also need to comply with local fuel regulations (EN590 for Europe and ASTM D975 for North America) for Warranty eligibility.

**Maximum sulfur levels by emissions certification level as listed on the Engine's dataplate are:**

EPA 2007/2010/2013	max. 15 parts per million
EPA Tier 4 Interim / Final	max. 15 parts per million
EU Stage IIIB 2011	max. 15 parts per million
Euro 4/5	max. 50 parts per million
Euro 6	max. 10 parts per million

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, fuel or diesel exhaust fluid or by water, dirt or other contaminants in the fuel, oil or diesel exhaust fluid.

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.

For all other Industrial engines (except those previously mentioned), 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.

For all A Series Applications, including Industrial, travel reimbursement for non-transportable equipment will be limited to 4.0 hours, \$0.25/mile and 250 miles maximum. Any costs beyond this limit are the customer's responsibility.

**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\* and Canada 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 and on or after January 1, 2000, for Engines 751 horsepower and over.

### **Coverage**

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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 for industrial applications, five years or 3,500 hours of operation for industrial spark-ignited Engines (GTA855, G855, G5.9C, G8.3-C, GTA8.9E, QSK19G) and five years or 2,500 hours of operation for industrial spark-ignited Engines (GKTA19-GC), 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**

Engines with an emissions certification listed below must be operated using only diesel fuel having no more than the corresponding maximum sulfur content. Failure to use the specified fuel as listed in the Cummins Fuel Bulletin #3379001 Table 1 (Cummins Inc. Required Diesel Fuel Specifications) can damage the Engine and aftertreatment system within a short period of time. This damage could cause the Engine to become inoperable and failures attributable to the use of incorrect fuels will be denied Warranty Coverage. Fuel specifications also need to comply with local fuel regulations (EN590 for Europe and ASTM D975 for North America) for Warranty eligibility.

### **Maximum sulfur levels by emissions certification level as listed on the Engine's dataplate are:**

EPA 2007/2010/2013	max. 15 parts per million
EPA Tier 4 Interim / Final	max. 15 parts per million
EU Stage IIIB 2011	max. 15 parts per million
Euro 4/5	max. 50 parts per million
Euro 6	max. 10 parts per million

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 oil, fuel or diesel exhaust fluid or by water, dirt or other contaminants in the fuel, oil or diesel exhaust fluid.

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.**

\* United States 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.

\*\* Alternators and starters are covered for the duration of the Base Engine Warranty on QSK23 Engines.

\*\*\* Emissions Warranty for BLPG Industrial Off-Highway Engines is 5 years / 3,500 hours.

## **All Engines International Industrial (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.

Engine aftertreatment components included in the Cummins Critical Parts List (CPL) and marked with a Cummins part number are covered under Base Engine Warranty.

### **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 (3,000 hours for A Series Engines) 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 when the Engine 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 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 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 Warranty 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. Service locations are listed in the Cummins Worldwide Service Locator at [cummins.com](http://cummins.com).

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**

Engines with an emissions certification listed below must be operated using only diesel fuel having no more than the corresponding maximum sulfur content. Failure to use the specified fuel as listed in the Cummins Fuel Bulletin #3379001 Table 1 (Cummins Inc. Required Diesel Fuel Specifications) can damage the Engine and aftertreatment system within a short period of time. This damage could cause the Engine to become inoperable and failures attributable to the use of incorrect fuels will be denied Warranty Coverage. Fuel specifications also need to comply with local fuel regulations (EN590 for Europe and ASTM D975 for North America) for Warranty eligibility.

**Maximum sulfur levels by emissions certification level as listed on the Engine's dataplate are:**

EPA 2007/2010/2013	max. 15 parts per million
EPA Tier 4 Interim / Final	max. 15 parts per million
EU Stage IIIB 2011	max. 15 parts per million
Euro 4/5	max. 50 parts per million
Euro 6	max. 10 parts per million

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, fuel or diesel exhaust fluid or by water, dirt or other contaminants in the fuel, oil or diesel exhaust fluid.

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.

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.

For all A Series Applications, including Industrial, travel reimbursement for non-transportable equipment will be limited to 4.0 hours, \$0.25/mile and 250 miles maximum. Any costs beyond this limit are the customer's responsibility.

**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 the 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.

\* Alternators and starters are covered for the duration of the Base Engine Warranty on QSK23 Engines.

## **California Emission Control Warranty Statement, Off-Highway**

### **Your Warranty Rights and Obligations**

The California Air Resources Board and Cummins Inc., are pleased to explain the emission control system warranty on your 2015 and 2016 model year engine. In California, new heavy-duty off-road diesel engines must be designed, built and equipped to meet the State's stringent anti-smog standards. Cummins Inc. 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 Inc. will repair your heavy-duty off-road diesel engine at no cost to you including diagnosis, parts and labor.

#### **Manufacturer's Warranty Coverage**

This warranty coverage for 2015 and 2016 model year heavy-duty off-road engines 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 Inc.

#### **Owner's Warranty Responsibilities**

As the engine owner, you are responsible for the performance of the required maintenance listed in your Cummins® Owners and/or Operation and Maintenance Manual. Cummins Inc. recommends that you retain all receipts covering maintenance on your engine, but Cummins Inc. cannot deny warranty solely for the lack of receipts or for your failure to substantiate the performance of all scheduled maintenance.

You are responsible for presenting your 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 an engine owner, you should also be aware that Cummins Inc. may deny you warranty coverage if your engine or a part has failed due to abuse, neglect, improper maintenance or unapproved modifications.

If you have any questions regarding your warranty rights and responsibilities, you should contact Cummins® Customer Relation Department at 1-800-343-7357 or the California Air Resources Board at 9528 Telstar Avenue, El Monte, CA 91731.

A warranted part which is scheduled for replacement as required maintenance is warranted up to the first schedule replacement point.

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 Inc. 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 Condition.

Owner is responsible for "downtime" expenses, cargo damage, fines, all applicable taxes, all business costs, and other losses resulting from a Warrantable Condition.

## Coverage

This emission control system warranty applies only to the following A series, B3.3, B3.9, B4.5s, B5.9, B6.7s, QSB3.9-30, QSB4.5-30, QSB5.9-30, QSB5.9-44, C8.3, QSC8.3, QSF2.8, QSF3.8, and QSL9 emission control parts:

### EPA Diesel

#### **Aftertreatment System Component**

Aftertreatment Electrical Connections  
Aftertreatment Fuel Drain Valve  
Aftertreatment Fuel Injector/Regulator  
Aftertreatment Fuel Pressure Sensor  
Aftertreatment Fuel Shut-Off Valve  
Aftertreatment Injector Manifold  
Aftertreatment Inlet and Outlet Modules  
Aftertreatment Temperature Interface Module  
Aftertreatment Temperature Sensors

#### **Aftertreatment System (cont') Component**

Decomposition Tube

#### **Base Engine System Component**

Camshaft  
Camshaft Injector Lobe  
Camshaft Valve Lobe  
Coolant Temperature Sensor  
Crankcase Breather  
Engine Oil Pressure Sensor  
Engine Speed, Position Sensor, Cam Position Sensor  
Exhaust Valve  
Static Cam Timing

#### **EGR System Component**

EGR Cooler

### **EPA Diesel**

DEF Dosing Controller (DCU)

DEF Dosing Unit (Pump)

DEF Dosing Valve

Diesel Oxidation Catalyst

Diesel Particulate Filter (except for ash maintenance)

Diesel Particulate Filter Differential Pressure Sensor

NH3 Sensor

NOx Sensors

SCR Catalyst

#### **Air Handling Component**

Barometric Air Pressure Sensor

Exhaust Gas Pressure Sensor

Exhaust Manifold

Grid Heater

Humidity Sensor

Intake Air Throttle Actuator

EGR Differential Pressure Sensor

EGR Mixer/Venturi

EGR Temperature Sensor

EGR Valve

#### **Electronic Control System Component**

Engine Control Module

Wiring Harness Circuits Connected at Both Ends to  
Emissions Warrantable Components

Engine Control Module Calibration

Engine Control Module Calibration

## EPA Diesel

Intake Manifold

Intake Manifold Air Temperature Sensor

### **Air Handling (cont')**

#### **Component**

Intake Manifold Temperature/Pressure Sensor

Turbocharger Actuator

Turbocharger Assembly

Turbocharger Compressor Inlet Air Temperature Sensor

Turbocharger Speed Sensor

### **Ignition System**

#### **Component**

Ignition Coils

Ignition Control Module

### **Fuel System**

#### **Component**

Fuel Control Valve

Fuel Lines

Fuel Pressure Sensor

Fuel Pump

Fueling/Timing Actuators

### **Fuel System (cont')**

#### **Component**

Injector

Secondary Fuel Pressure/Temperature Sensor

## **California Emission Control System Warranty Replacement Parts**

Cummins Inc. 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 Inc. 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 Inc., 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, except for Emergency Repairs as described below.

## **Cummins Responsibilities**

The warranty coverage begins when the engine is delivered to the ultimate purchaser.

Repairs and service will be performed by any Cummins® distributor, authorized dealer or other repair locations approved by Cummins Inc. using new, genuine Cummins® or Cummins® approved rebuilt parts and assemblies. Cummins Inc. will repair any of the emission control parts found by Cummins Inc. 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 Inc. is not available, repairs may be performed by any available repair location or by any individual using any replacement parts. A part not being available within 30 days or a repair not being complete within 30 days constitutes an emergency. Cummins Inc. 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

**To buy Cummins Parts and Service Manuals, Training Guides, or Tools go to our website at <https://store.cummins.com>**

rate. 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 Inc.

## **Warranty Limitations**

Cummins Inc. is not responsible for failures or damage resulting from what Cummins Inc. 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 Inc. is also not responsible for failures caused by incorrect oil, fuel, or coolant or by water, dirt or other contaminants in the fuel or oil or contaminants in the coolant.

Cummins Inc. is not responsible for failures resulting from improper repair or the use of parts which are not genuine Cummins® or Cummins® approved parts.

Cummins Inc. is not responsible for the material and labor costs of emission control parts and assemblies replaced during Scheduled Maintenance of the engine as specified in Cummins® Owners and/or Operation and Maintenance Manuals.

**THIS WARRANTY, TOGETHER WITH THE EXPRESS COMMERCIAL WARRANTIES ARE THE SOLE WARRANTIES MADE BY CUMMINS INC. THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.**



## Notes

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**CALIFORNIA**  
**Proposition 65 Warning**

**Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.**

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Bulletin 4310577

Printed in U.S.A. 25-AUGUST-2015

