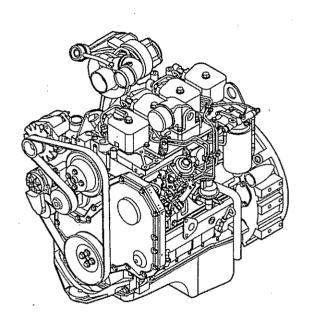
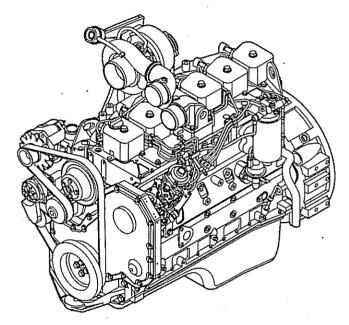


Operation and Maintenance Manual Industrial B3.9, B4.5, and B5.9 Series Engines







B5.9

Foreword

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

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

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

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

The latest technology and the highest quality components were used to produce this engine. When replacement parts are needed, we recommend using only genuine Cummins or ReCon® exchange parts. These parts can be identified by the following trademarks:



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

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Important Reference Numbers

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

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:		• 0.00000000000000000000000000000000000
Air Cleaner Element		
Lubricating Oil		
• Fuel		•
Fuel-Water Separator		
Coolant		,
Crankcase Ventilation		
Governor Control Module (GCM) (if applicable)		
Belt Part Numbers:		
•		
0		
Clutch or Marine Gear (if applicable):		
o Model		
Serial Number		
Part Number		
Sea Water Pump		
Model		
- Part Number		

Section i - Introduction

Section Contents

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To the Owner and Operator

General Information

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

Keep records of regularly scheduled maintenance.

Use the correct fuel, lubricating oil, and coolant in your engine as specified in Maintenance Specifications (Section V).

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

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

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

△ CAUTION △

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

About the Manual

General Information

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

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

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

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

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

How to Use the Manual

General Information

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

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

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

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



Symbols

General Information

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



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



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



Indicates a REMOVAL or DISASSEMBLY step.



Indicates an INSTALLATION or ASSEMBLY step.



INSPECTION is required.



CLEAN the part or assembly.



PERFORM a mechanical or time MEASUREMENT.



LUBRICATE the part or assembly.



Indicates that a WRENCH or TOOL SIZE will be given.



TIGHTEN to a specific torque.



PERFORM an electrical MEASUREMENT.



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



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

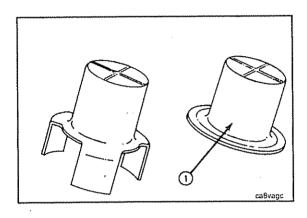
Illustrations

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.

OK) OK) Itsiasa

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

A WARNING A

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

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

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

General Repair Instructions

General Information

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

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

Air Compressor
Air Controls
Air Shutoff Assemblies
Balance Weights
Cooling Fan
Fan Hub Assembly
Fan Mounting Bracket(s)
Fan Mounting Capscrews
Fan Hub Spindle
Flywheel
Flywheel Crankshaft Adapter

Flywheel Mounting Capscrews
Fuel Shutoff Assemblies
Fuel Supply Tubes
Lifting Brackets
Throttle Controls
Turbocharger Compressor Casing
Turbocharger Oil Drain Line(s)
Turbocharger Oil Supply Line(s)
Turbocharger Turbine Casing
Vibration Damper Mounting Capscrews

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

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

Welding on a Vehicle with an Electronic Controlled Fuel System

△ CAUTION △

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

General Cleaning Instructions

Solvent and Acid Cleaning

Several solvent and acid-type cleaners can be used to clean the engine parts. Experience has shown that the best results can be obtained using a cleaner that can be heated to 90 to 95 degrees Celsius [180 to 200 degrees Fahrenheit]. A cleaning tank that provides a constant mixing and filtering of the cleaning solution will give the best results. **Cummins Inc. does not recommend any specific cleaners.** Always follow the cleaner manufacturer's instructions.



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

MARNING A

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

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

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

Steam Cleaning

Steam cleaning can be used to remove all types of dirt that can contaminate the cleaning tank. It is a good way to clean the oil drillings.

MARNING A

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

Do not steam clean the following parts:

- 1. Electrical Components
- 2. Wiring
- 3. Injectors
- 4. Fuel Pump

- 5. Belts and Hoses
- 6. Bearings
- 7. Electronic Control Module (ECM)
- 8. ECM Connectors

Glass or Plastic Bead Cleaning

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

△ CAUTION △

Do not use glass or plastic bead cleaning on aluminum piston skirts. Do not use glass bead cleaning on aluminum ring grooves. Small particles of glass or plastic will embed in the aluminum and result in premature wear. Valves, turbocharger shafts, etc., can also be damaged. Follow the cleaning directions listed in the procedures.

NOTE: Plastic bead blasting media, Part No. 3822735, can be used to clean aluminum ring grooves. Do **not** use any bead blasting media on pin bores or aluminum skirts.

Follow the equipment manufacturer's cleaning instructions. The following guidelines can be used to adapt to manufacturer's instructions:

- 1. Bead size:
 - a. Use U.S. size No. 16-20 for piston cleaning with plastic bead media, Part No. 3822735,
 - b. Use U.S. size No. 70 for piston domes with glass media.
 - c. Use U.S. size No. 60 for general purpose cleaning with glass media.
- Operating Pressure:
 - a. Glass: Use 620 kPa [90 psi] for general purpose cleaning.
 - b. Plastic: Use 270 kPa [40 psi] for piston cleaning.
- 3. Steam clean or wash the parts with solvent to remove all of the foreign material and glass or plastic beads after cleaning. Rinse with hot water. Dry with compressed air.
- Do not contaminate the wash tanks with glass or plastic beads.

Acronyms and Abbreviations

General Information

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

American Petroleum Institute API

American Society of Testing and Materials **ASTM**

°C Celsius

California Air Resources Board **CARB** Cubic Inch Displacement C.I.D. Compressed Natural Gas CNG Control Parts List CPL

cSt Centistokes

Electronic Control Module **ECM EGR** Exhaust Gas Recirculation Environmental Protection Agency **EPA**

Fahrenheit o۳

Failure Mode Indentifier FMI Gross Vehicle Weight **GVW** LPG Liquified Petroleum Gas

Hg Mercury Horsepower hp

 H_2O Water

Ignition Control Module ICM Kilometers per Liter km/l

kPa Kilopascal LNG Liquid Natural Gas

Low Temperature Aftercooling LTA

MPa Megapascal Miles Per Hour mph Miles Per Quart mpq Nem Newton-meter

Natural Gas NG

Original Equipment Manufacturer **OEM** Parameter Identification Descriptions PID

ppm Parts Per Million Pounds Per Square Inch psi Power Takeoff PTO

Revolutions Per Minute rpm

Society of Automotive Engineers SAE Supplemental Coolant Additive SCA

Step Timing Control STC

Subsystem Identification Descriptions SID

٧S Variable Speed Vehicle Speed Sensor VSS

NOTES

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Section E - Engine and System Identification Section Contents

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Stanadyne Rotary	E-4

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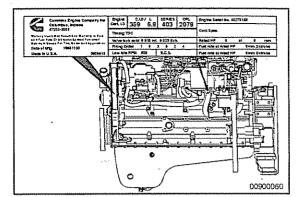
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B3.9, B4.5, B5.9 Industrial Section E - Engine and System Identification

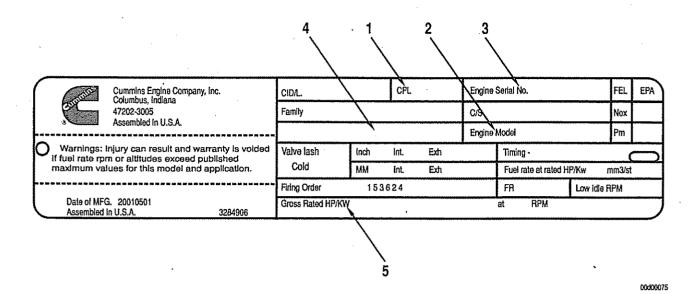
Engine Identification

Engine Dataplate

The engine dataplate shows specific facts about your engine. The engine serial number and CPL provide information for ordering parts and for service. The engine dataplate **must not** be changed unless approved by Cummins Inc.







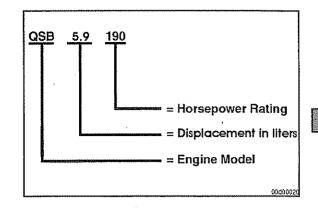
Have the following engine data available when communicating with a Cummins Authorized Repair Location. The information on the dataplate is **mandatory** when sourcing service parts.

- 1. Control parts list (CPL)
- 2. Model
- 3. Engine serial number
- | Common Engine Company Inc. | Col. |
- 4. Emissions certification
- 5. Horsepower and rpm rating.

NOTE: If the engine dataplate (1) is **not** readable, the engine serial number (2) can be identified on the engine block near the top of the gear housing.

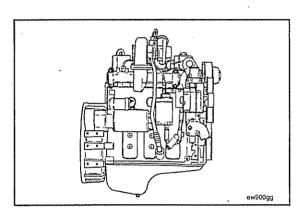
Cummins Engine Nomenclature

The Cummins engine nomenclature provides the data as illustrated in the graphic.



The model name for engines in industrial applications provides the data shown below For example:

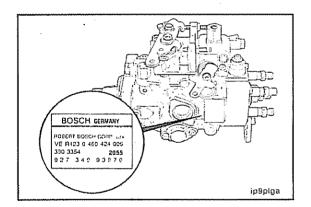
- 4 (1) B (2) T (3) AA (4) 3.9 (5)
- 1. Number of cylinders
- 2. Engine series
- 3. Turbocharged
- 4. Charge air cooled
- 5. Displacement in liters.



Fuel Injection Pump Dataplate

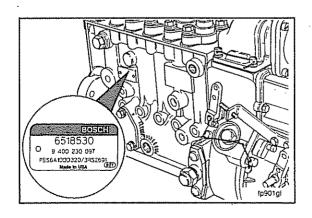
Bosch® Rotary

The injection pump dataplate for the Bosch® VE pump is located on the side of the injection pump. The dataplate provides information for fuel pump calibration.



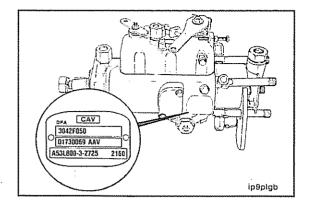
Bosch® In-line

The injection pump dataplate for the Bosch® in-line pump is located on the side of the injection pump. The data plate provides information for fuel pump calibration.



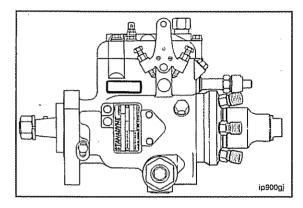
Engine Identification Page E-4

B3.9, B4.5, B5.9 Industrial Section E - Engine and System Identification



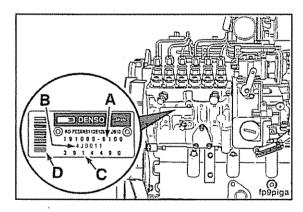
CAV Rotary

The injection pump dataplate for the Lucas DPA pump is located on the side of the injection pump. The dataplate provides information for fuel pump calibration.



Stanadyne Rotary

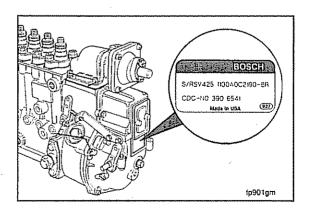
The injection pump dataplate for the Stanadyne DB4 is located on the side of the injection pump. The dataplate provides information for the fuel pump calibration.



Denso In-line

The Denso fuel injection pump dataplate contains the following information:

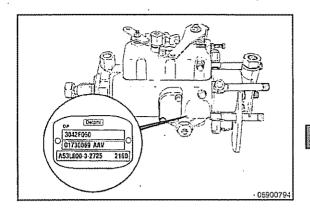
- (A) Fuel injection pump part number
- (B) Denso serial number
- (C) Cummins part number
- (D) Fuel injection pump bar code.



The Cummins part number for the fuel pump-governor combination is located on the governor dataplate.

Delphi Rotary

The injection pump dataplate for the Delphi DP pump is located on the side of the injection pump. The dataplate provides information for fuel pump calibration.

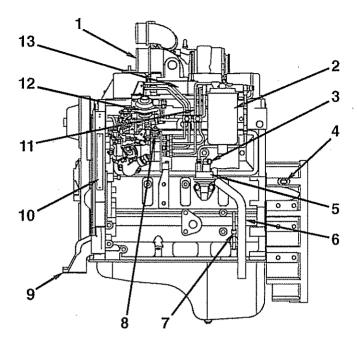


Engine Diagrams

Engine Views

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

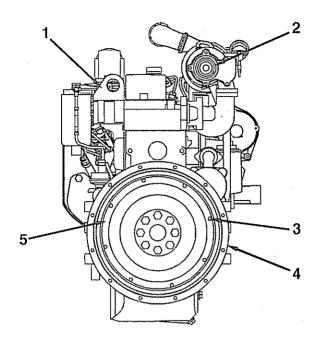
NOTE: The illustrations are only a reference to show a typical engine.



B3.9 Industrial - Air Intake Side View

- 1. Engine air inlet
- 2. Fuel filter/water separator
- 3. Fuel inlet connection
- 4. Magnetic pickup location (3/4-16 UNF)
- 5. Fuel lift pump
- 6. Crankcase breather tube
- 7. Lubricating oil dipstick

- 8. Fuel drain connection
- 9. Front engine mounting bracket
- 10. Engine dataplate
- 11. High pressure fuel lines
- 12. Fuel injection pump
- 13. Intake air preheater (optional).

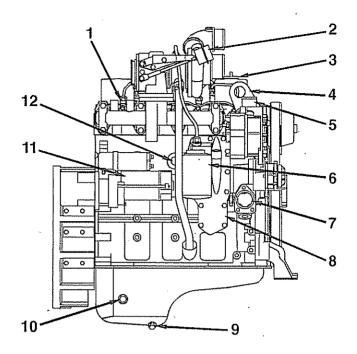


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B3.9 Industrial - Rear View

- 1. Rear engine lifting bracket
- 2. Turbocharger exhaust outlet
- 3. Flexplate mounting holes

- 4. Flywheel housing
- 5. Flywheel/flexplate.

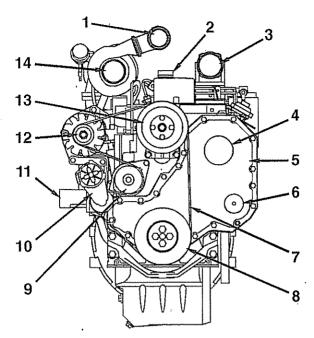


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B3.9 Industrial - Exhaust Side View

- 1. Fuel injection nozzles
- 2. Turbocharger wastegate actuator
- 3. Lubricating oil fill
- 4. Front engine lifting bracket
- 5. Water outlet
- 6. Lubricating oil filter
- 7. Water inlet

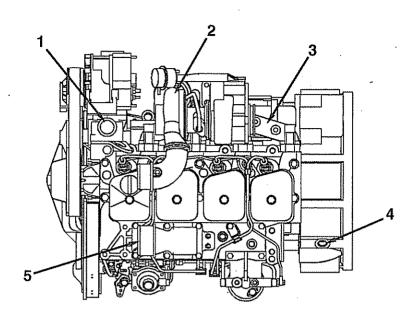
- 8. Lubricating oil cooler
- 9. Lubricating oil drain
- 10. Provision for lubricating oil immersion heater
- 11. Starter motor and solenoid
- 12. Provision for coolant heater.



B3.9 Industrial - Front View

- 1. Turbocharger air outlet
- 2. Lubricating oil fill
- 3. Engine air inlet
- 4. Fuel pump drive cover
- 5. Front gear cover
- 6. Accessory drive cover (optional)
- 7. Fan drive belt
- 8. Front Pulley

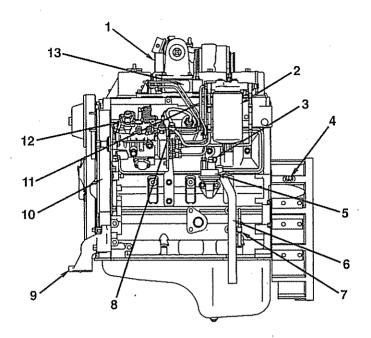
- 9. Water pump
- 10. Automatic belt tensioner
- 11. Water inlet
- 12. Alternator
- 13. Fan pulley
- 14. Turbocharger air inlet.



B3.9 Industrial - Top View

- 1. Water outlet
- 2. Turbocharger
- 3. Exhaust manifold

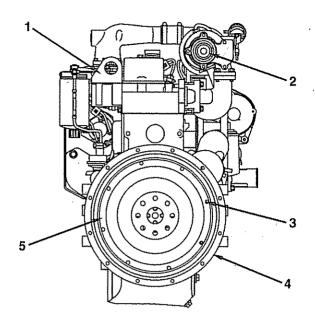
- 4. Magnetic pickup location (3/4-16 UNF)
- 5. Engine air inlet.



B4.5 Industrial - Air Intake Side View

- 1. Engine air inlet
- 2. Fuel filter/water separator
- 3. Fuel inlet connection
- 4. Magnetic pickup location (3/4-16 UNF)
- 5. Fuel lift pump
- 6. Crankcase breather tube
- 7. Lubricating oil dipstick

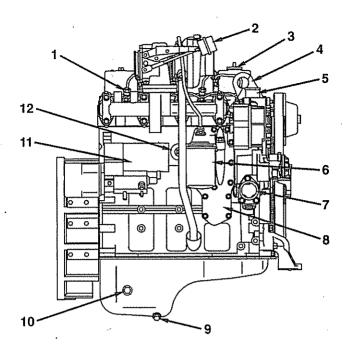
- 8. Fuel drain connection
- 9. Front engine mounting bracket
- 10. Engine dataplate
- 11. High pressure fuel lines
- 12. Fuel injection pump
- 13. Intake air preheater (optional).



B4.5 Industrial - Rear View

- 1. Rear engine lifting bracket
- 2. Turbocharger exhaust outlet
- 3. Flexplate mounting holes

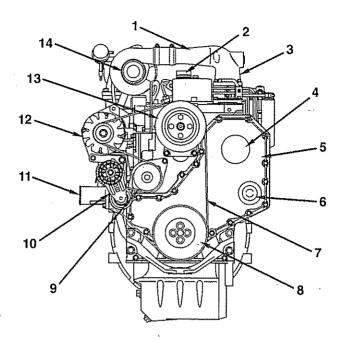
- 4. Flywheel housing
- 5. Flywheel/flexplate.



B4.5 Industrial - Exhaust Side View

- 1. Fuel injection nozzles
- 2. Turbocharger wastegate actuator
- 3. Lubricating oil fill
- 4. Front engine lifting bracket
- 5. Water outlet
- 6. Lubricating oil filter
- 7. Water inlet

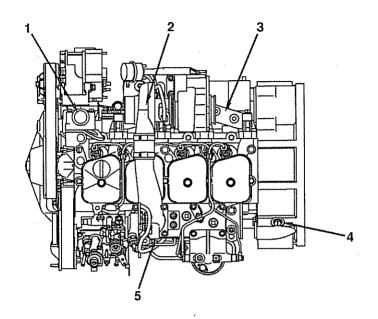
- 8. Lubricating oil cooler
- 9. Lubricating oil drain
- 10. Provision for lubricating oil immersion heater
- 11. Starter motor and solenoid
- 12. Provision for coolant heater.



B4.5 Industrial - Front View

- 1. Turbocharger air outlet
- 2. Lubricating oil fill
- 3. Engine air inlet
- 4. Fuel pump drive cover
- 5. Front gear cover
- 6. Accessory drive cover (optional)
- 7. Fan drive belt
- 8. Front Pulley

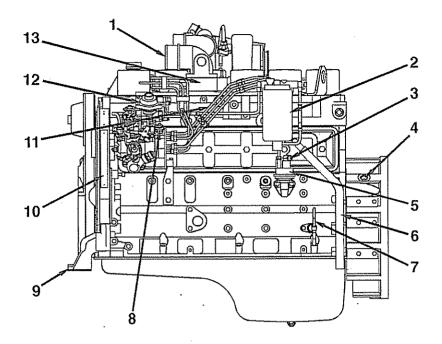
- 9. Water pump
- 10. Automatic belt tensioner
- 11. Water inlet
- 12. Alternator
- 13. Fan pulley
- 14. Turbocharger air inlet.



B4.5 Industrial - Top View

- 1. Water outlet
- 2. Turbocharger
- 3. Exhaust manifold

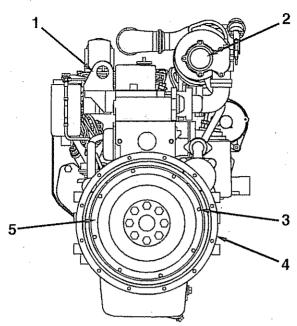
- 4. Magnetic pickup location (3/4-16 UNF)
- 5. Engine air inlet.



B5.9 Industrial - Air Intake Side View

- 1. Engine air inlet
- 2. Fuel filter/water separator
- 3. Fuel inlet connection
- 4. Magnetic pickup location (3/4-16 UNF)
- 5. Fuel lift pump
- 6. Crankcase breather tube
- 7. Lubricating oil dipstick

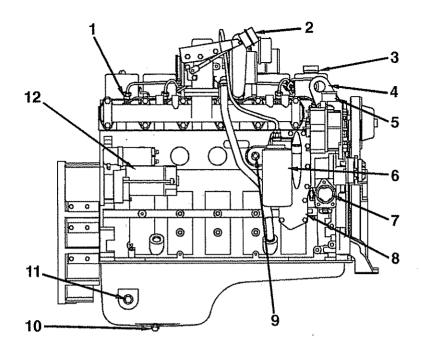
- 8. Fuel drain connection
- 9. Front engine mounting bracket
- 10. Engine dataplate
- 11. High pressure fuel lines
- 12. Fuel injection pump
- 13. Intake air preheater (optional).



B5.9 Industrial - Rear View

- 1. Rear engine lifting bracket
- 2. Turbocharger exhaust outlet
- 3. Flexplate mounting holes

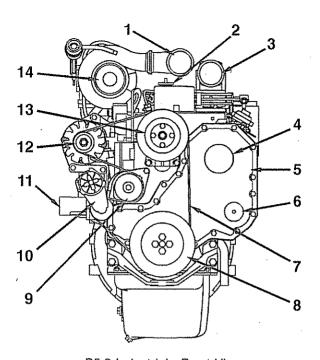
- 4. Flywheel housing
- 5. Flywheel/flexplate.



B5.9 Industrial - Exhaust Side View

- 1. Fuel injection nozzles
- 2. Turbocharger wastegate actuator
- 3. Lubricating oil fill
- 4. Front engine lifting bracket
- 5. Water outlet
- 6. Lubricating oil filter
- 7. Water inlet

- 8. Lubricating oil cooler
- 9. Provision for coolant heater
- 10. Lubricating oil drain
- 11. Provision for lubricating oil immersion heater
- 12. Starter motor and solenoid.

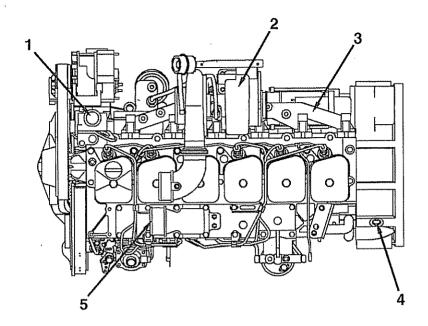


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B5.9 Industrial - Front View

- 1. Turbocharger air outlet
- 2. Lubricating oil fill
- 3. Engine air inlet
- 4. Fuel pump drive cover
- 5. Front gear cover
- 6. Accessory drive cover (optional)
- 7. Fan drive belt
- 8. Vibration damper

- 9. Water pump
- 10. Automatic belt tensioner
- 11. Water inlet
- 12. Alternator
- 13. Fan pulley
- 14. Turbocharger air inlet.



00900352

B5.9 Industrial - Top View

- 1. Water outlet
- 2. Turbocharger
- 3. Exhaust manifold

- 4. Magnetic pickup location (3/4-16 UNF)
- 5. Engine air inlet.

NOTES
-

Section 1 - Operating Instructions Section Contents

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Operating Instructions - Overview



General Information

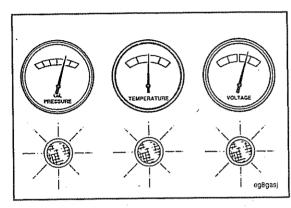
Correct care of your engine will result in longer life, better performance, and more economical operation.

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.

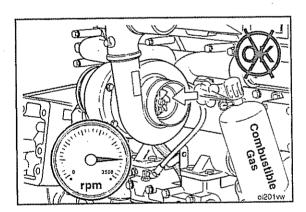


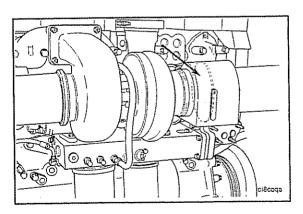


MARNING A

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

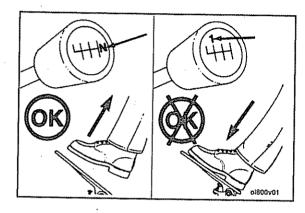
Cummins recommends the installation of an air intake shutoff device or a similar safety device to minimize the risk of overspeeding where an engine, due to the vehicle, vessel or equipment being operated in a combustible environment, such as due to a fuel spill or gas leak.





A CAUTION A

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



Normal Starting Procedure

General Information

MARNING A

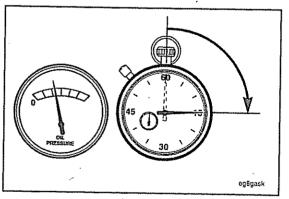
Do not depress the accelerator pedal or move the accelerator lever from the idle position while cranking the engine. This can result in engine overspeed and severe damage to the engine.

▲ CAUTION ▲

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

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

- Disengage the driven unit, or if equipped, put the transmission in neutral.
- 2. With the accelerator pedal or lever in the idle position, turn the keyswitch to the ON position, and wait for the WAIT-TO-START lamp to go out; then, turn the key to the START position.
- If the engine does not start after three attempts, check the fuel supply system. Absence of blue or white exhaust smoke during cranking indicates no fuel is being delivered.





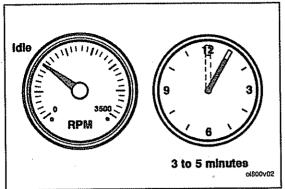
A CAUTION A

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

Refer to Lubricating Oil Pressure Low symptom tree in Section TS if no oil pressure is indicated.

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

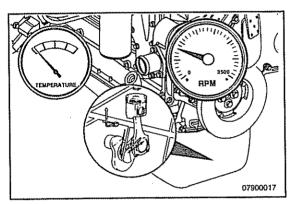






After starting a cold engine, increase the engine speed (rpm) slowly to provide adequate lubrication to the bearings and to allow the oil pressure to stabilize.





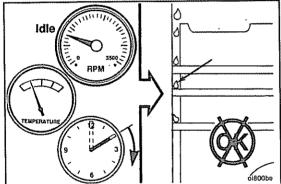
Do **not** operate the engine at low idle for long periods with the engine coolant temperature below the minimum specification. Refer to Engine Specifications in Section V.

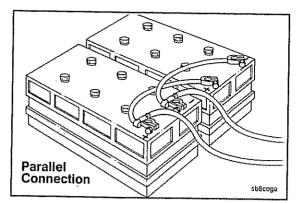
This can result in the following:

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











Jump Starting

MARNING A

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.

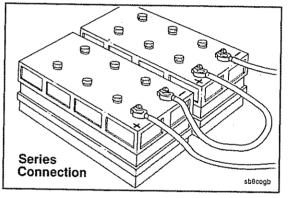
▲ CAUTION ▲

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

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



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



Starting Procedure Matrix					
Automotive and industrial	Idle throttle				
All pumps above 16°C [60°F]	X (after 5 seconds, see note)				
Automotive and industrial Full throttle					
All numps below 16°C [60°F]	X (see note)				
(1) Full throttle on the VE pump makes sure there is sufficient start-fuel delivery and helps keep the engine operating once started. The in-line pumps with RQV and RQV-K governors require full throttle to position and hold the rack in the start-fuel position.					

NOTE: Full throttle is applied after engaging the starter.

- 1. Disengage the driven unit, or if equipped, put the transmission in neutral.
- 2. Position the fuel shutoff, electrical switch, or mechanism control to the RUN position.

NOTE: Full throttle procedure not required on Tier II B3.9, B4.5, and B5.9 engines.

Cold Weather Starting

General Information

Follow the Normal Starting Procedures in this section in cold weather. The Wait-To-Start lamp will stay on longer

With Mechanical or Electrical Metering Equipment (Ether)

- Disengage the driven unit, or if equipped, put the transmission in neutral
- · While cranking the engine, inject metered amounts of starting fluid
- Engine oil pressure must be indicated on the gauge within 15 seconds after starting.

Ether Starting Aids

M WARNING A

Because of the potential for an explosion, do not use volatile cold starting aids in underground mine or tunnel operations. Ask the local U.S. Bureau of Mines inspector for instructions.

▲ WARNING ▲

Starting fluid is highly flammable and explosive. Keep flames, sparks, and arcing switches away from starting fluid.

A WARNING A

Do not breathe starting fluid fumes. Starting fluid fumes can be hazardous to your health.

△ CAUTION △

Do not use excessive amounts of starting fluid when starting an engine. The use of too much starting fluid will cause damage to the engine.

· Spray starting fluid into the air cleaner intake while another person cranks the engine.

Grid Heater

MARNING M

To reduce the possibility of personal injury and property damage, never use starting fluid if the grid heater option is used. Starting fluid, which contains ether, can cause an explosion.

A grid heater is available that improves cold weather starting characteristics by heating the intake air. It can also serve to reduce white smoke if it is energized during cold ambient temperatures while the engine is at idle.

The electric grid heater operates in a preheat and postheat mode. The length of heater on-time is a function of the engine temperature.

If the intake manifold air temperature is greater than 19°C [66°F], the electric grid air heater system will **not** be activated. If the intake manifold air temperature is below 19°C [66°F], the system will operate as follows:

Engine Starting Cycle

1. Turn the ignition key to the RUN position. When the key is in this position, the WAIT-TO-START lamp will be illuminated for approximately 25 seconds. Do **not** crank the engine until the WAIT-TO-START lamp shuts off.



NOTE: The controller is reset each time the ignition is turned off and the cycle will start over.

2. When the WAIT-TO-START lamp goes out, the preheat cycle is complete. Crank the engine.

Postheat Cycle

3. Postheating occurs as the grid heater elements are cycled for a while with the engine running. Postheating helps warm the engine up faster and eliminates white smoke. Postheating is determined by the intake manifold air temperature upon start-up.

Starting Procedure After Extended Shutdown or Oil Change

General Information

Complete the following steps after each oil change, or after the engine has been shut down for more than 30 days to make sure the engine receives the correct oil flow through the lubricating oil system.

- 1. Disconnect the electrical wire from the fuel pump solenoid.
- 2. Rotate the crankshaft, using the starting motor, until oil pressure appears on the gauge or the warning lamp goes out.
- 3. Connect the electrical wire to the fuel pump solenoid valve.
- 4. Start the engine; refer to normal starting procedures in this section.

Operating the Engine

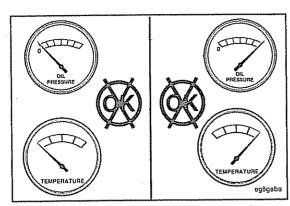
Normal

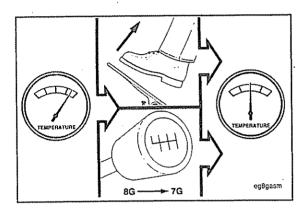
If equipped, monitor the oil pressure and coolant temperature gauges frequently. Refer to Lubricating Oil System specifications and Cooling System specifications, in Maintenance Specifications (Section V) for recommended operating pressures and temperatures. Shut off the engine if any pressure or temperature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

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

If an overheating condition starts to occur, reduce the power output of the engine by releasing the accelerator pedal or lever or shifting the transmission to a lower gear, or both, until the temperature returns to the normal operating range. If the engine temperature does **not** return to normal, shut off the engine, and refer to Troubleshooting Symptoms (Section TS), or contact a Cummins Authorized Repair Location.



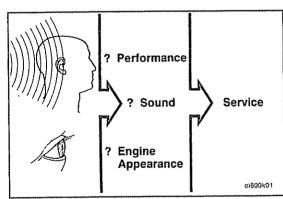




Most failures give an early warning. Look and listen for changes in performance, sound, or engine appearance that can indicate service or engine repair is needed. Some changes to look for are:

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





Cold Weather

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

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

Ambient Temperature

0 to -32°C [32 to -25°F]

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

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

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

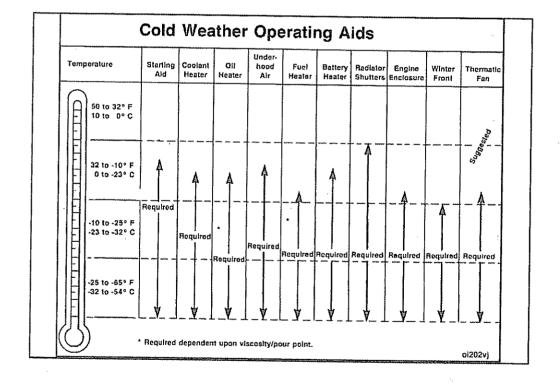
-32 to -54°C [-25 to -65°F]

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

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

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

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



Winterfronts and Shutters

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

Engine Operating Range

General Information

A CAUTION A

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

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

A CAUTION A

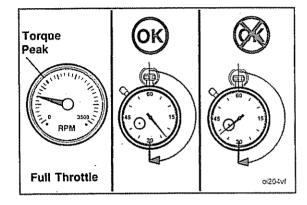
Do not operate the engine beyond the maximum engine speed. Operating the engine beyond the maximum engine speed can cause severe engine damage. Use proper operating techniques for the vehicle, vessel, or equipment to prevent engine overspeed. The maximum engine speed specification is listed in Maintenance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

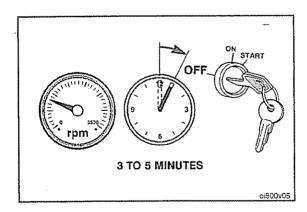
Engine Shutdown

General Information

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

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





Electromagnetic Interference (EMI)

General Information

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

System EMI Susceptibility

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

System EMI Radiation Levels

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

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

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

Section 2 - Maintenance Guidelines Section Contents

	rage
Maintenance Guidelines - Overview	2-1 2-1
Maintenance Record Form	2-3
Maintenance Schedule General Information Oil Drain Intervals	2-1
Tool Requirements	2-1 2-1



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Maintenance Guidelines - Overview

General Information

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

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

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

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

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

Tool Requirements

General Information

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

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

Tool Part Number	Description
ST-1273	Pressure gauge
3375045	Torque wrench (0 to 175 ft-lb)
3375049	Oil filter wrench
3376807	Engine coolant and fuel filter wrench
3824556	Charge air cooler (CAC) pressure kit
3824591	Engine barring gear
3824783	Torque wrench (0 to 300 in-lb)
CC-2800	Refractometer
CC-2802	Coolant test kit
3824842	M10 Compucheck® fitting
3377161	Digital multimeter
3164488	Digital multimeter

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

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

previous maintenance checks that are due to	r scheduled maintenance.
Daily or Refueling - Maintenance Check ⁽⁴⁾	
 Air Intake Piping - Inspect 	
Air Tank and Reservoirs - Drain	
 Cooling Fan - Check/Correct 	
 Crankcase Breather Tube - Inspect 	

- Drive Belts Check/Correct
- Engine Coolant Level Check/Correct
- Engine Lubricating Oil Level Check/Correct
- Fuel-Water Separator Drain

Every 250 Hours or 3 Months - Maintenance Check (1, 4)

- Air Cleaner Restriction Check/Correct
- Air Compressor Mounting Hardware Check/Correct
- Charge Air Cooler Check/Correct
- · Charge Air Piping Check/Correct

- · Fuel Injection Pump Mounting Hardware Check/Correct
- · Lubricating Oil and Filters Change
- Radiator Hoses Check

- Engine Coolant Antifreeze Check
- · Fuel Filter, Canister-Type Replace
- Fuel Filter, Spin-on-Type Replace
- · Lubricating Oil and Filters Change

- · Cooling Fan Belt Tensioner Check/Correct
- Fan Hub, Belt-Driven Check/Correct
- · Overhead Set Adjust

- · Air Compressor Discharge Line Check/Correct
- · Cooling System Drain, Flush, and Fill
- Vibration Damper, Rubber Check
- · Vibration Damper, Viscous Check

Notes:

- The lubricating oil and lubricating oil filter interval can be adjusted based on application, fuel consumption, gross vehicle weight, and idle time. For engines whose aspiration is jacket water-cooled, turbocharged only, or natural, refer to Table 1 in the Oil Drain Intervals section.
- The lubricating oil and lubricating oil filter interval can be adjusted based on application, fuel consumption, gross vehicle weight, and idle time. For engines whose aspiration is charge air cooled, refer to Table 2 in the Oil Drain Intervals section.
- 3. Antifreeze check interval is every oil change or 500 hours or 6 months, whichever occurs first. The operator must use a heavy-duty year-round antifreeze that meets the chemical composition of GM6038M. The antifreeze change interval is 2 years, 2000 hours, or whichever occurs first. Antifreeze is essential for freeze, overheat, and corrosion protection.
- 4. Follow the manufacturer's recommended maintenance procedures for the starter, alternator, generator, batteries, electrical components, charge air cooler, radiator, air compressor, air cleaner, refrigerant compressor, and fan clutch. Refer to the Component Manufacturers in Section M.

Oil Drain Intervals

Refer to Table 1 or Table 2 to determine the maximum recommended oil change and filter change intervals engine operating in hours or months, whichever comes first.

Cummins Engine Stan- dard Classification	American Petroleum Institute Classification	International Classifica- tions	All Engine Ratings	
(CES)	(API)			
CES-20078, CES-20077, CES-20076, CES-20072, CES-20071	API CI-4/SK, API CI-4, API CH-4, API CH-4/SJ	ACEA E-5, Global DHD-1	250 Hours or 3 Months	
CES-20075 - API CF-4/SG		ACEA E-3, ACEA E-2, JAMA DH-1	150 Hours or 6 Weeks	
	API CG-4/SH, API CD, API CE	ACEA E-1	OBSOLETE. DO NOT USE.	

Table 2: Charge Air Cooled Engines						
Cummins Engine Stan- dard Classification	American Petroleum In- stitute Classification	International Classifica- tions	All Engine Ratings			
(CES)	(API)					
CES-20078, CES-20077, CES-20076, CES-20072, CES-20071	API CI-4/SK, API CI-4, API CH-4, API CH-4/SJ	ACEA E-5, Global DHD-1	500 Hours or 6 Months			

(Continued)

Table 2: Charge Air Cooled Engines						
Cummins Engine Stan- dard Classification	American Petroleum Institute Classification	International Classifica- tions	All Engine Ratings			
CES-20075	API CF-4/SG	ACEA E-3, ACEA E-2, JAMA DH-1	250 Hours or 3 Weeks			
	API CG-4/SH, API CD, API CE	ACEA E-1	OBSOLETE. DO NOT USE.			

Maintenance Record Form

Maintenance Data

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

Key to table headings:

A = Date

B = km [Miles], Hours or Time Interval

C = Actual km [Miles] or Hours

D = Maintenance Check Performed

E = Check Performed By

F = Comments

Α	В	С	D	E	F
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B3.9, B4.5, B5.9 Industrial Section 2 - Maintenance Guidelines

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Section 3 - Maintenance Procedures at Daily Interval Section Contents

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Daily Maintenance Procedures - Overview

General Information

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

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

Engine Operation Report

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

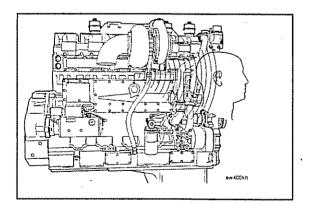
Comparison and intelligent interpretation of the daily report, along with a practical follow-up action, will eliminate most failures and emergency repairs.

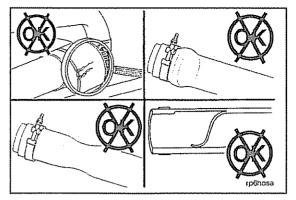
Report to the maintenance department any of the following conditions:

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

Unusual Engine Noise

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







Air Intake Piping

Maintenance Check

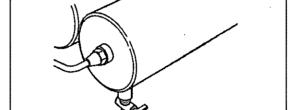


Visually inspect the intake piping daily for wear points and damage to piping, loose clamps, or punctures that can damage the engine.

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

Torque Value: 8 Nom [72 in-lb]

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

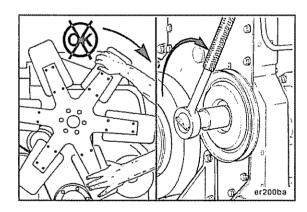




Air Tanks and Reservoirs

Drain

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



Fan, Cooling

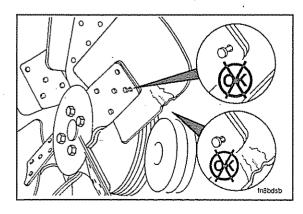
Inspect for Reuse







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

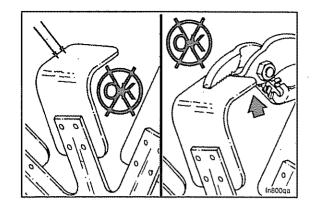




A visual inspection of the cooling fan is required daily. Check for cracks, loose rivets, and bent or loose blades. Check the fan to make sure it is securely mounted. Tighten the capscrews, if necessary.

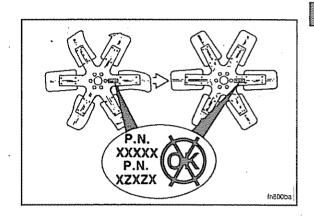
WARNING

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



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

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



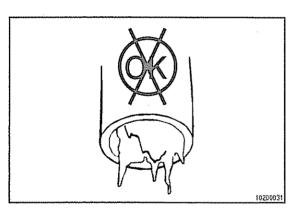
Crankcase Breather Tube

Maintenance Check

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

Inspect the tube more frequently in icy conditions.





Coolant Level

Maintenance Check



WARNING



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



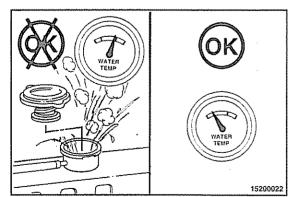
▲ CAUTION ▲

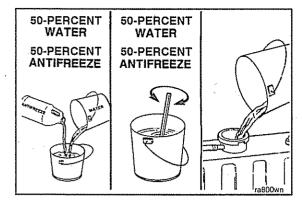


Never use a sealing additive to stop leaks in the cooling system. This can result in cooling system plugging and inadequate coolant flow, causing the engine to overheat.

The coolant level must be checked daily.







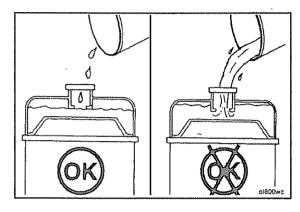


A CAUTION A

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

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

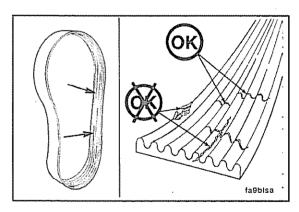
Coolant recommendations and specification details on correct mixing of coolant can be found in Maintenance Specifications (Section V).





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

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





Drive Belts

Maintenance Check



Poly-Vee Belt

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

Belt damage can be caused by:

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

Cogged Belt

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

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

Belt damage can be caused by:

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

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

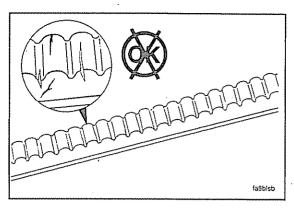
Refer to the Belt Tension Chart in Section V for the correct gauge and tension value for the belt width used.

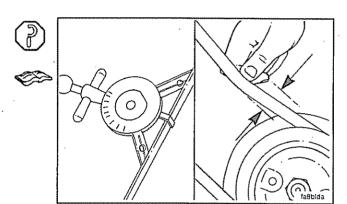
An alternate method (deflection method) can be used to check belt tension by applying 110 N [25 lbf] force between the pulleys on v-belts. If the deflection is more than one belt thickness per foot of pulley center distance, the belt tension must be adjusted.

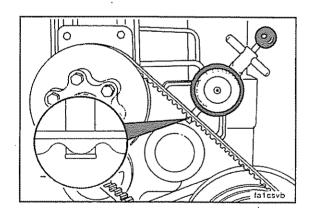
Refer to Section A for adjustment procedures.

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









Fuel-Water Separator

Drain



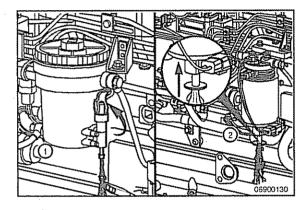
WARNING



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

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

Drain the water and sediment from the separator daily.

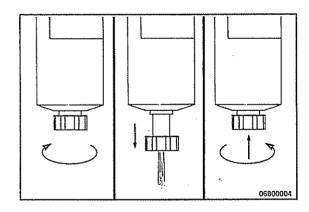


Canister Type

Shut off the engine.

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

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



Spin-on Type

Shut off the engine.

Use your hand to open the drain valve. Turn the valve counterclockwise approximately 31/2 turns until the valve drops down 25.4mm [1 in] and draining occurs.

Drain the filter sump until clear fuel is visible.



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

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

Lubricating Oil Level

Maintenance Check

▲ CAUTION **▲**

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

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

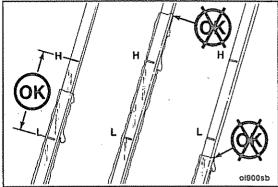
Shut off the engine for an accurate reading.

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

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









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Maintenance Procedures at 250 Hours or 3 Months Section Contents

Pa	age
Air Cleaner Restriction	4-1 4-1
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Charge-Air Piping	4-2 4-2
Closed Crankcase Ventilation Hoses	4-3 4-3
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Radiator Hoses	4-3 4-3



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B3.9, B4.5, B5.9 Industrial Maintenance Procedures at 250 Hours or 3 Months

Maintenance Procedures - Overview General Information

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

Air Cleaner Restriction

Maintenance Check

Mechanical Indicator

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

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

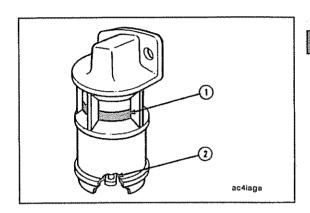
Restriction or vacuum indicators need to be installed as close as possible to the turbocharger air inlet in order to obtain a true indication of restrictions.

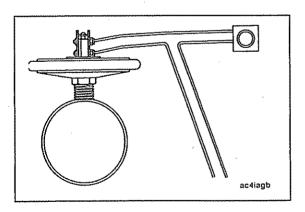
A CAUTION A

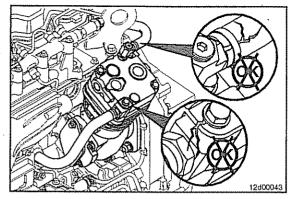
Never operate the engine without an air cleaner. Intake air must be filtered to prevent dirt and debris from entering the engine and causing premature wear.

Vacuum Indicator

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









Air Compressor

Maintenance Check



NOTE: Depending on application, it is possible engines will **not** be equipped with an air compressor.

Inspect compressor housing for cracks and damage.

Inspect hydraulic pump couplings for cracks, wear, or damage (if equipped).

Inspect air plumbing for splits or cracks.

Inspect the air compressor mounting nuts, including support bracket, for loose or damaged hardware.

Operate the engine and check for correct compressor operation and air, oil, and coolant leaks.

Torque Value:

Mounting

mm

77 N•m

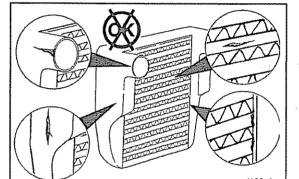
[57 ft-lb]

Torque Value:

Bracket 10 mm

45 Nom

[33 ft-lb]



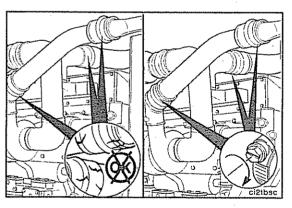


Charge-Air Cooler

Maintenance Check



Inspect the charge-air cooler (CAC) for dirt and debris blocking the fins. Check for cracks, holes, or other damage. If damage is found, refer to the vehicle, vessel, or equipment manufacturer.





Charge-Air Piping Maintenance Check



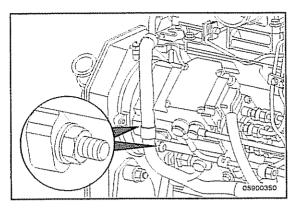
Inspect the charge-air piping and hoses for leaks, holes, cracks, or loose connections. Tighten the hose clamps if necessary. Refer to the vehicle or equipment manufacturer's specifications for the correct torque value.

Fuel Pump

Maintenance Check

Inspect the fuel injection pump mounting nuts, including the tail support bracket, for loose or damaged hardware.



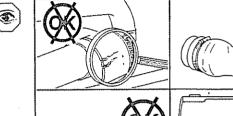


Radiator Hoses

Maintenance Check

Check all hoses for cracks, cuts, or collapsing.

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





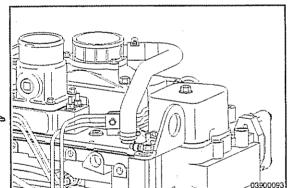
Closed Crankcase Ventilation Hoses Maintenance Check

Inspect the closed-crankcase ventilation piping and hoses for leaks, holes, cracks, or loose connections. Tighten the hose clamps, if necessary to proper torque. Refer to Section V for torque specification. The illustration shown is one of two options available for the closed-crankcase ventilation system.

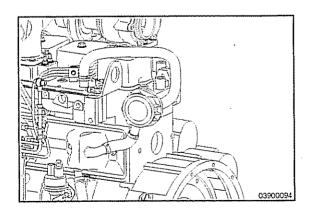








The illustration shown is the second of two options available for the closed-crankcase ventilation system.



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Maintenance Procedures at 500 Hours or 6 Months Section Contents

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Engine Coolant Antifreeze	٠,
Fuel Filter (Canister Type) Install Preparatory Steps Prime Remove	5-1 5-2 5-2
Fuel Filter (Spin-On Type) Drain Install Prime Remove	5-4 5-5 5-4
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B3.9, B4.5, B5.9 Industrial Maintenance Procedures at 500 Hours or 6 Months

Maintenance Procedures - Overview

General Information

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

Engine Coolant Antifreeze

Maintenance Check

A CAUTION A

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

Check the antifreeze concentration. Use a mixture of 50-percent water and 50-percent ethylene glycol or propylene glycol-base antifreeze to protect the engine to -32°C [-25°F] year-around.

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

Antifreeze is essential in every climate.

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

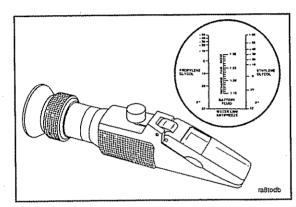
The corrosion inhibitors also protect the cooling system components from corrosion and provides longer component life.

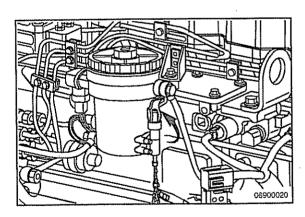
Fuel Filter (Canister Type) Preparatory Steps

MARNING A

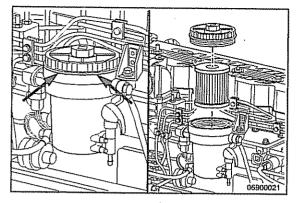
Drain the fuel-water separator into a container, and dispose of contents in accordance with local environmental regulations.

Lift up on the filter drain lever to drain fuel out of the filter for approximately 5 seconds. This will eliminate fuel from running over the top of the filter upon removal.











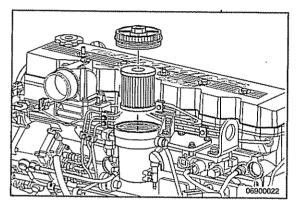
Remove

Clean all debris from around the canister lid.



Remove the filter lid and filter element. A crescent wrench can be used if the lid can **not** be removed by hand.

NOTE: Remove the filter element by twisting the element sideways from the filter lid. The filter element is incinerable.





Install

Install the new element in the canister lid, and place back in the canister by twisting **clockwise**.

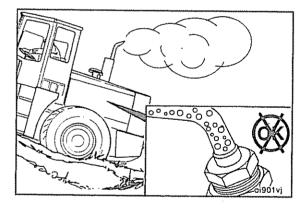


Refer to Section V for fuel filter part numbers.

NOTE: The replacement filter element comes with a new o-ring for the canister lid. The o-ring must be replaced with the filter element.

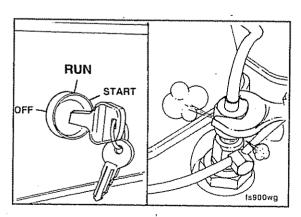
Lubricate the o-ring with clean engine oil.

Hand-tighten the canister lid.



Prime

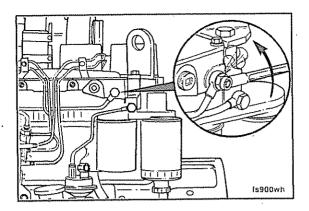
Controlled venting is provided at the injection pump through the fuel drain manifold. Small amounts of air introduced by changing the filters or injection pump supply line will be vented automatically if the fuel filter is changed in accordance with the instructions.



However, manual bleeding will be required if one of the following conditions exists:

- The fuel filter is not filled prior to installation
- · The fuel injection pump is replaced
- The high-pressure fuel line connections are loosened or the lines are replaced
- It is an initial engine start-up or start-up after an extended period of no engine operation.

Open the bleed screw.

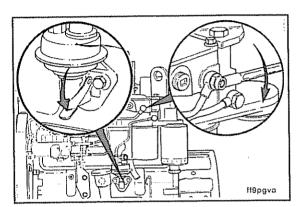


Operate the hand lever until the fuel flowing from the fitting is free of air.

Tighten the bleed screw.

Torque Value: 9 Nom [80 in-lb]





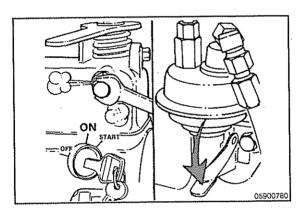
Air and fuel can be vented from the illustrated vent locations on the Bosch® VE fuel injection pumps.

Loosen the vent screw and operate the priming lever on the fuel transfer pump until the fuel injection pump is primed.

Tighten the vent screw.

Torque Value: 9 Nom [80 in-lb]





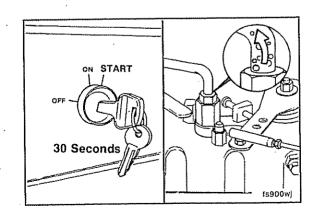
A CAUTION A

It is necessary to turn the keyswitch to the ON position. Because the engine can start, be sure to follow all safety precautions. Use the normal engine starting procedure.

A CAUTION A

When using the starting motor to vent the system, do not engage it for more than 30 seconds, or starter damage will occur. Wait 2 minutes before starting the engine again.

Air can also be vented through the fuel drain manifold line by operating the starting motor.



Fuel Filter (Spin-On Type) Page 5-4

B3.9, B4.5, B5.9 Industrial Maintenance Procedures at 500 Hours or 6 Months



Drain

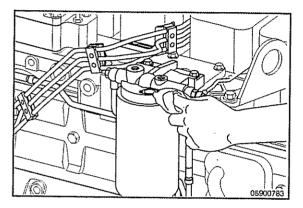


WARNING



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

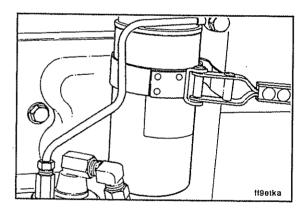
Use the filter drain valve to drain fuel out of the filter for approximately 5 seconds. This will eliminate fuel from running over the top of the filter upon removal.





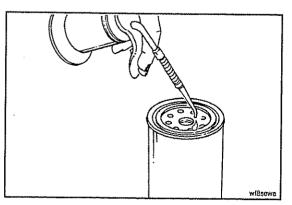
Remove

Clean the area around the fuel filter head.





Remove the fuel filter.





Refer to Section V for fuel-water separator filter part number(s).



Lubricate the o-ring seal with clean lubricating oil.

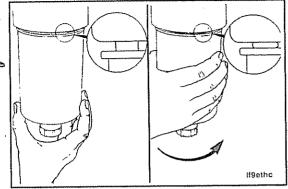
△ CAUTION **△**

Mechanical overtightening will distort threads, filter element seal, or filter can.

Install the filter as specified by the filter manufacturer.

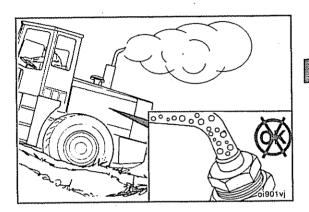






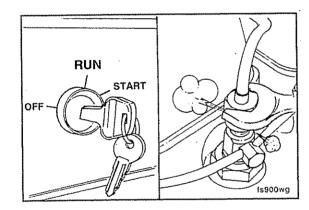
Prime

Controlled venting is provided at the injection pump through the fuel drain manifold. Small amounts of air introduced by changing the filters or injection pump supply line will be vented automatically if the fuel filter is changed in accordance with the instructions.

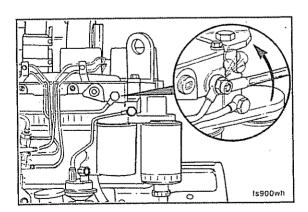


However, manual bleeding will be required if one of the following conditions exists:

- · The fuel filter is not filled prior to installation
- · The fuel injection pump is replaced
- The high-pressure fuel line connections are loosened or the lines are replaced
- It is an initial engine start-up or start-up after an extended period of no engine operation.

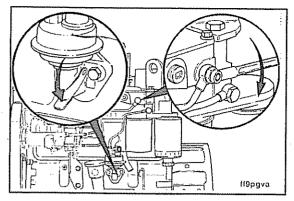


Open the bleed screw.



Fuel Filter (Spin-On Type) Page 5-6

B3.9, B4.5, B5.9 Industrial Maintenance Procedures at 500 Hours or 6 Months

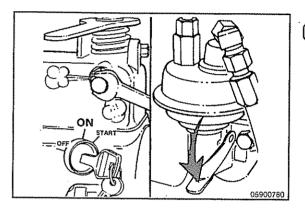




Operate the hand lever until the fuel flowing from the fitting is free of air.

Tighten the bleed screw.

Torque Value: 9 Nom [80 in-lb]



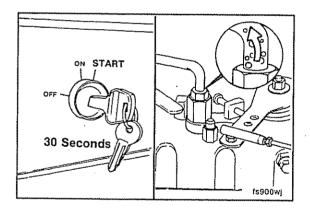


Air and fuel can be vented from the illustrated vent locations on the Bosch® VE fuel injection pumps.

Loosen the vent screw and operate the priming lever on the fuel transfer pump until the fuel injection pump is primed.

Tighten the vent screw.

Torque Value: 9 Nom [80 in-lb]



A CAUTION A

It is necessary to turn the keyswitch to the ON position. Because the engine can start, be sure to follow all safety precautions. Use the normal engine starting procedure.

A CAUTION A

When using the starting motor to vent the system, do not engage it for more than 30 seconds, or starter damage will occur. Wait 2 minutes before starting the engine again.

Air can also be vented through the fuel drain manifold line by operating the starting motor.

Lubricating Oil and Filters

Drain

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.

WARNING

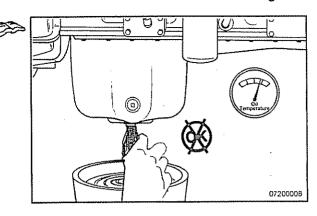
To reduce the possibility of personal injury, avoid direct contact of hot oil with your skin.

Change the lubricating oil and filter(s) at the specified oil change interval. Refer to Oil Drain Intervals (Section 2) to find the correct change interval for your application.

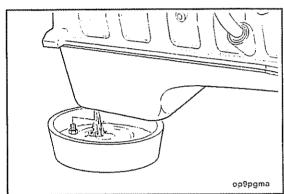
Operate the engine until the water temperature reaches 60°C [140°F]. Shut off the engine.

NOTE: Use a container that can hold at least 26 liters [27 at] of lubricating oil.

Remove the oil drain plug from the bottom of the lubricating oil pan.







Remove

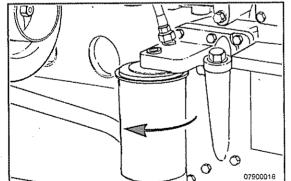
Clean the area around the lubricating oil filter head.

Remove the oil filter.

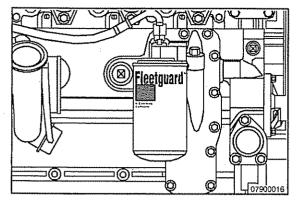
Clean the gasket surface of the filter head.

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





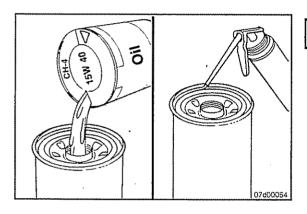






Use the correct oil filter.

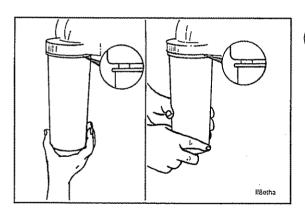
Refer to Section V for oil filter part number(s).





Fill the filter with clean lubricating oil before installation.

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

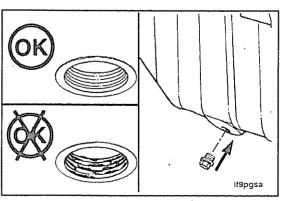




lack CAUTION lack

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

Install the filter as specified by the filter manufacturer.





Clean the sealing surface.

Check the oil drain plug threads.

Install the drain plug.





Steel Pan

80 Nom

[59 ft-lb]

Aluminum Pan

55 N•m

[41 ft-lb]





B3.9, B4.5, B5.9 Industrial Maintenance Procedures at 500 Hours or 6 Months

Fill

Use a high-quality 15W-40 multiviscosity lubricating oil, such as Valvoline® Premium Blue® or its equivalent, in Cummins engines. Choose the correct lubricating oil for your operating climate as outlined in Section V.



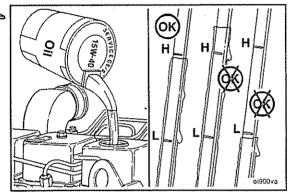


Fill the engine with clean lubricating oil to the proper level. Refer to Lubricating Oil Specifications in Section V for lubricating oil capacity.

NOTE: Total system capacity assumes lubricating oil pan plus lubricating oil filter.

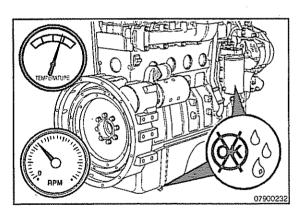
Some applications use a slightly different lubricating oil pan capacity. All lubricating oil quantities **must** be adjusted accordingly. Contact your local Cummins Distributor if you have any questions.





Operate the engine and check for leaks at the filters and oil drain plug.





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Maintenance Procedures at 1000 Hours or 1 Year Section Contents

	raye
Cooling Fan Belt Tensioner	6-1
Maintenance Check	6-1
Fan Hub, Belt Driven	6-2
Maintenance Check	6-2
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Finishing Steps General Information Preparatory Steps	6-3
Preparatory Steps	6-3

Page 6-b

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Maintenance Procedures - Overview

General Information

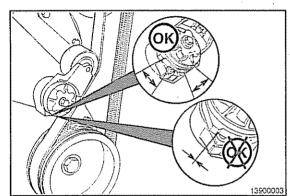
All maintenance checks and inspections listed in previous maintenance intervals must also be performed at this time, in addition to those listed under this maintenance interval.

Cooling Fan Belt Tensioner

Maintenance Check

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







WARNING



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



MARNING M



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

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

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

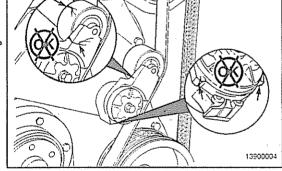
With the cooling fan belt removed, check that the bottom tensioner arm stop is in contact with the bottom tensioner arm stop boss on the tensioner body. If these two are not touching, the tensioner must be replaced.



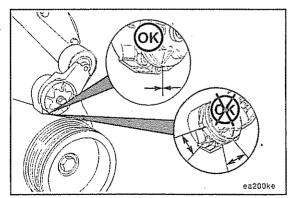




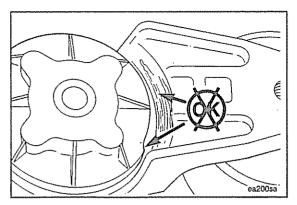






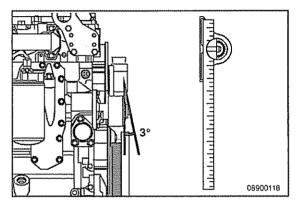


B3.9, B4.5, B5.9 Industrial Maintenance Procedures at 1000 Hours or 1 Year





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





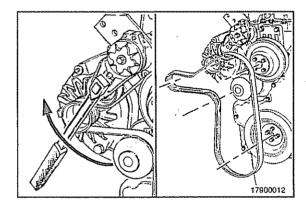
The worn tensioner that has play in it or a belt that "walks" off its pulley possibly indicates pulley misalignment.

NOTE: Maximum pulley misalignment is 3 degrees.



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

Install the belt.

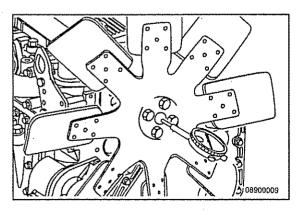




Fan Hub, Belt Driven

Maintenance Check

Remove the drive belt.





NOTE: The fan hub must rotate without any wobble or excessive end play.

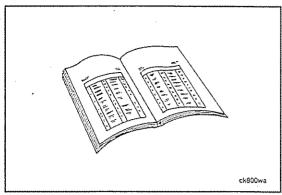
		Fan Hub End	l Play	
mm	•			in
0.15	-	MAX		0.006

Overhead Set

General Information

Refer to Engine Identification in Section E.





Preparatory Steps

Remove the rocker lever covers.

Locate top dead center (TDC) for cylinder number 1.

Use a 1/2-inch drive and Engine Barring Tool, Part Number 3824591, to rotate the engine (clockwise when facing the damper) until cylinder number 4 (for 4-cylinder) or cylinder number 6 (for 6-cylinder) intake rocker arm starts to open the intake valve.

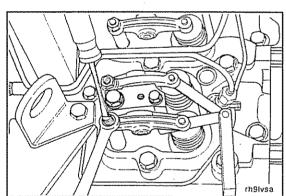
NOTE: Wiggle the rocker arm while barring the engine; when the rocker arm gets tight, stop barring.

Adjust

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

Intake Clearance: 0.254 mm [0.010 in]
Exhaust Clearance: 0.508 mm [0.020 in]





Four-Cylinder Engine Adjustment

Make sure the engine is at top dead center (TDC) for cylinder number 1.

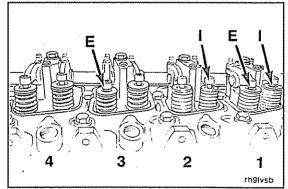
Set **only** valves indicated by the arrows (E = exhaust, I = intake). Do **not** set valves that are **not** indicated.

Holding the locknut steady with the wrench, adjust the valve clearance with the screwdriver or Allen wrench.

Tighten the locknut and measure the valve lash again.

Torque Value: 24 Nom [18 ft-lb]



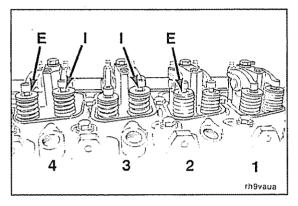


Overhead Set Page 6-4

B3.9, B4.5, B5.9 Industrial Maintenance Procedures at 1000 Hours or 1 Year

dagshwa :

Mark the vibration damper and rotate the crankshaft 360 degrees.

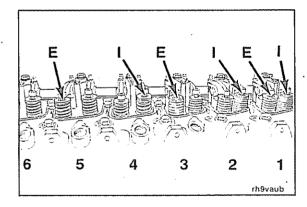


Adjust the valves as indicated in the illustration.

Torque Value: 24 Nom [18 ft-lb]



Set **only** valves indicated by the arrows (E = exhaust, I = intake). Do **not** set valves that are **not** indicated.



(7)

Six-Cylinder Engine Valve Adjustment

Make sure the engine is at top dead center (TDC) for cylinder number 1.

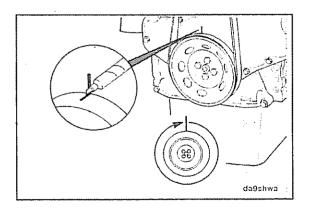


Set **only** the valves indicated by the arrows in the illustration (E = exhaust, I = intake).

Holding the locknut steady with the wrench, adjust the valve clearance with the screwdriver or Allen wrench.

Tighten the locknut, and measure the valve lash again.

Torque Value: 24 Nom [18 ft-lb]



Mark the pulley, and rotate the crankshaft 360 degrees.

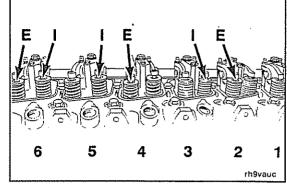
Adjust the valves as indicated in the illustration.

Set **only** the valves indicated by the arrows in the illustration (E= exhaust, I= intake). Do **not** set valves that are **not** indicated.

Torque Value: 24 Nom [18 ft-lb]







Finishing Steps

Check the rocker lever covers for cracks.

Install the rocker lever covers.

Tighten the capscrews. Refer to Section V for torque value.



NOTES

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Maintenance Procedures at 2000 Hours or 2 Years Section Contents

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Maintenance Procedures - Overview	7-1 7-1
Vibration Damper, Rubber	
Vibration Damper, Viscous	7-6 7-6

Page 7-b

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Maintenance Procedures - Overview General Information

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

Air Compressor Discharge Lines General Information

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

Maintenance Check



WARNING



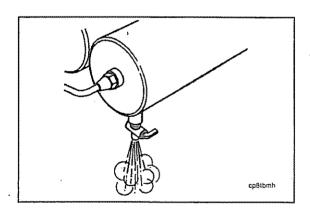
Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

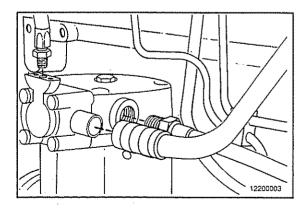
Shut off the engine.

System Diagrams (Section D).

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

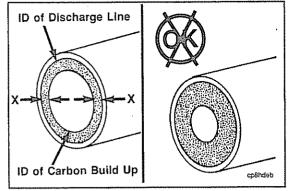
Remove the air compressor discharge line from the air compressor. Location of the air compressor discharge line can be found in Flow Diagram, Compressed Air System in





Cooling System Page 7-2

B3.9, B4.5, B5.9 Industrial Maintenance Procedures at 2000 Hours or 2 Years

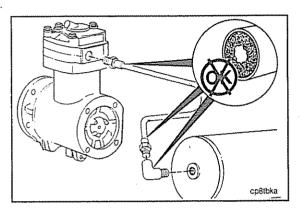




Measure the total carbon deposit thickness inside the air discharge line as shown. If the total carbon deposit (X + X) exceeds 2 mm [1/16 in], clean and inspect the cylinder head, the valve assembly, and the discharge line. Replace if necessary, Contact the Cummins Authorized Repair Location for procedures.



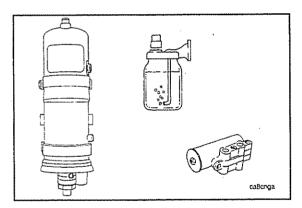








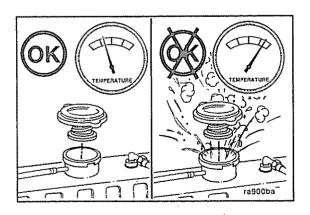
If the total carbon deposit exceeds specifications, continue checking the air discharge line connections up to the first tank until total carbon deposit is less than 2 mm [1/16 in]. Clean or replace any lines or connections that exceed this specification.





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





Cooling System

Drain



WARNING



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

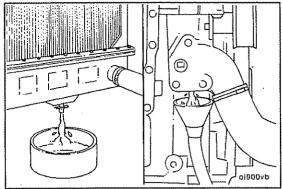
MARNING



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

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



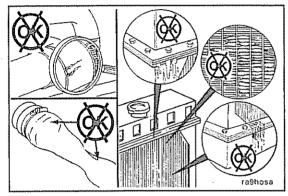


Check for damaged hoses and loose or damaged hose clamps. Replace as required.

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





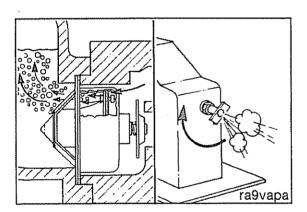


Flush

▲ CAUTION ▲

The system must be filled properly to prevent air locks. During filling, air must be vented from the engine coolant passages. Wait 2 to 3 minutes to allow air to be vented then add mixture to bring the level to the top.

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

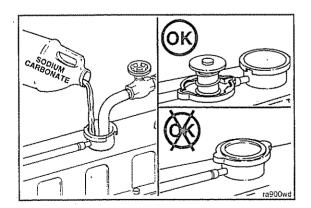


▲ CAUTION ▲

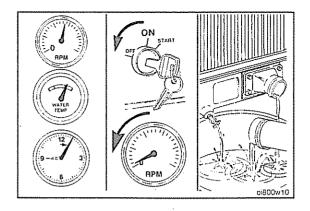
Do not install the radiator cap. The engine is to be operated without the cap for this process.

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

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



Cooling System Page 7-4





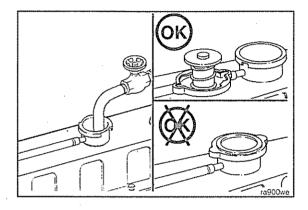
WARNING



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

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

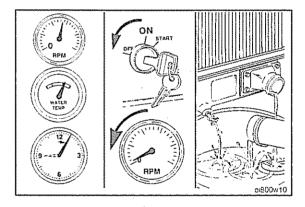
Shut the engine off, and drain the cooling system.



Fill the cooling system with clean water.

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

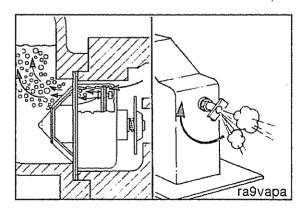
NOTE: Do not install the radiator cap or the new coolant filter.



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

Shut the engine off, and drain the cooling system.

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



Fill

▲ CAUTION ▲

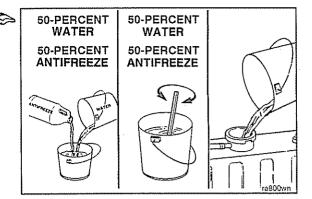
The system must be filled properly to prevent air locks. During filling, air must be vented from the engine coolant passages. Be sure to open the petcock on the aftercooler for aftercooled engines. Wait 2 to 3 minutes to allow air to be vented; then add mixture to bring the level to the top.

The system has a design fill rate of 19 liters per minute [5 U.S. gallons per minute].

A CAUTION A

Never use water alone for coolant. Damage from corrosion can be the result of using water alone for coolant.

Use a mixture of 50-percent water and 50-percent ethylene glycol or propylene glycol antifreeze to fill the cooling system. Refer to the cooling system specifications in Section V for system capacity.



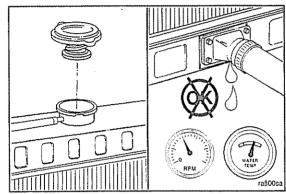
Install the pressure cap.

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

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



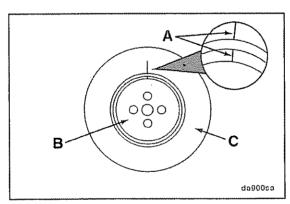




Vibration Damper, Rubber Inspect

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



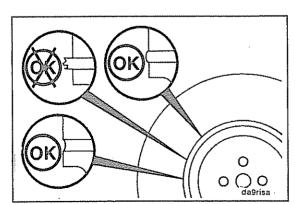


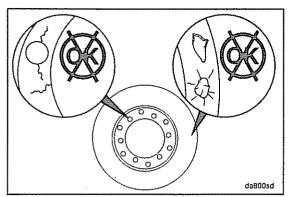
Inspect the rubber member for deterioration. If pieces of rubber are missing or if the elastic member is more than 3.18 mm [1/8 in] below the metal surface, replace the damper.

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

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









Vibration Damper, Viscous Inspect

▲ CAUTION ▲

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

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

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

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

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

Section A - Adjustment, Repair, and Replacement Section Contents

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Starting Motor	A-15 A-14



Page A-b

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Air in Fuel

General Information

MARNING A

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

▲ WARNING **▲**

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

The low-pressure fuel system for a Cummins diesel installed in the vehicle consists of the fuel tank, lines between the tank and the engine, transfer pump and lines, and fuel filter and lines. Air or bubbles at the injection pump can cause the engine **not** to operate or erratic engine operation and/or subsequent malfunction of the fuel injection pump. Air can be introduced by leaks in the fuel system prior to the transfer pump since the fuel in the lines is under a vacuum and can draw air into the system. Bubbles can result from any number of restrictions in the system:

- · Plugged fuel filter
- Crimped fuel line
- · Stopped-up tank module
- · Inoperative transfer pump.

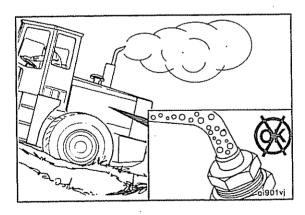
If sufficient fuel reaches the injection pump from the lowpressure system then solutions to engine operational problems are elsewhere. The following steps will aid in evaluating low-pressure fuel system performance.

NOTE: For cold-start or performance problems, perform the following steps:

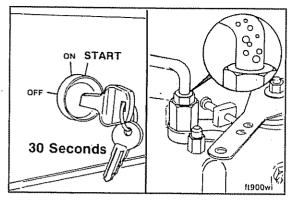
- Leave vehicle outside in cold environment for at least 12 hours
- · Perform outlined test
- If the system fails to meet test criteria, replace the fuel lift pump.

Test

A replacement of fuel supply lines, fuel filters, fuel injection pump, high-pressure fuel lines, and injectors will let air enter the fuel system. Air in the fuel system will make the engine hard to start, run rough, misfire, produce low power, and can cause excessive smoke and a fuel knock.

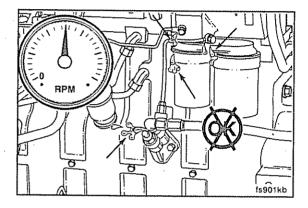




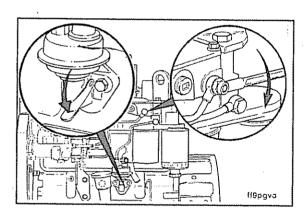




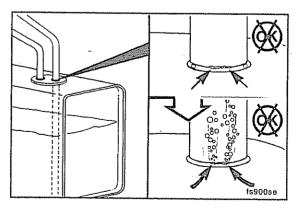
Replacing the fuel supply lines, fuel filters, fuel injection pump, high-pressure fuel lines, and injectors will let air enter into the fuel system. Follow the specified procedure to bleed the air from the system.



Since the fuel transfer pump provides positive pressure through the fuel filter and supply line to the fuel injection pump, loose connections or defective seals show as a fuel leak and **not** as an air leak.



For faster air purge, small amounts of air can be bled from the fuel injection pump by operating the hand primer located on the fuel transfer pump or by cranking the engine.





A source that is often overlooked for air to enter the fuel system is between the inlet of the prefilter and the suction tube in the tank. Fuel tanks that have the outlet fitting at the top have a suction tube that extends to the bottom of the tank. Cracks or pin holes in the weld that join the tube to the fitting can let air enter the fuel system.

B3.9, B4.5, B5.9 Industrial Section A - Adjustment, Repair, and Replacement

A stuck-open injector can also blow combustion gas back into the pump and cause air to be present in the overflow. If the engine seems to be misfiring or running rough, break all the injector supply lines loose at the pump end.

NOTE: Use two wrenches when loosening the lines at the fuel pump, one to hold the delivery valve and one to loosen the fuel line.

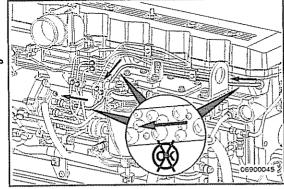
Tighten the fuel lines.

Torque Value: 24 Nom [212 in-lb]









M WARNING M



Keep hands and body parts away from the high-pressure fuel lines. Fuel coming from the high-pressure fuel lines are under extreme pressure and can cause serious injury by penetrating the skin.



M WARNING M



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

Check for air in the high-pressure lines by loosening the fittings at the head. Crank the engine to allow entrapped air to bleed from the line. Tighten the fittings.

Torque Value: 38 Nom [28 ft-lb]

Operate the engine and vent one line at a time until the engine runs smoothly.

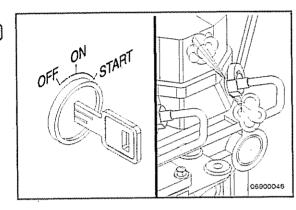
If air continues to bubble out of the system for several minutes then an air leak is present.

An often overlooked source from which air can enter the fuel system is between the inlet of the fuel transfer pump and the suction tube in the tank. Fuel tanks that have the outlet fitting at the top will have a suction tube that extends to the bottom of the tank. Cracks or pin holes in the weld that join the tube to the fitting can let air enter the fuel system.

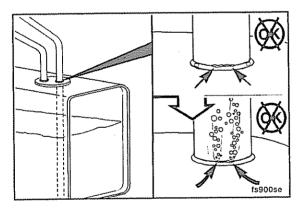
Also, check to make sure all the fittings from the fuel supply line on the tank to the inlet of the fuel transfer pump are tight.

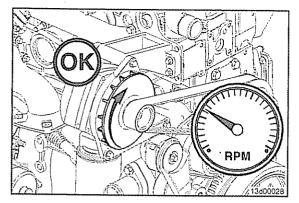
Use a sight glass at the fuel lift pump inlet to check for air in the fuel supply lines.









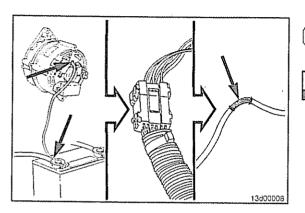




Alternator

Initial Check

Check the drive belt and alternator pulley to be sure the alternator is rotating.





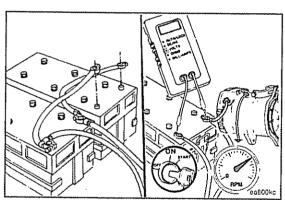
M WARNING A



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.

Check the battery and all wiring connections.

Inspect the wiring for defects. Check all connections for tightness and cleanliness, including the slip connectors at the alternator and engine compartment bulkhead, and connections at the battery.





Test







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



WARNING



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

Disconnect any cables that lead to any other battery boxes in the circuit, negative (-) cables first.

Operate the engine at high idle, and measure the alternator voltage output to the batteries with digital multimeter. Part Number 3377161. Refer to the alternator manufacturer's specifications.

warning 🛕

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

▲ WARNING ▲

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

Shut off the engine and remove the test equipment.

Connect all battery cables, negative (-) cable last.

Preparatory Steps

WARNING A

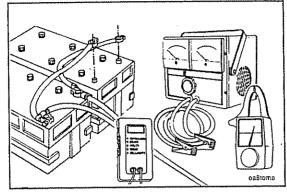
Batteries can emit explosive gases. To avoid personal injury, always ventilate the compartment before servicing the batteries. To avoid arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

Disconnect the ground cable from the battery terminal.

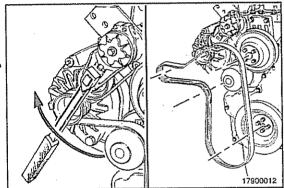
Remove the drive belt from the alternator pulley.









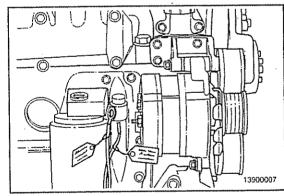


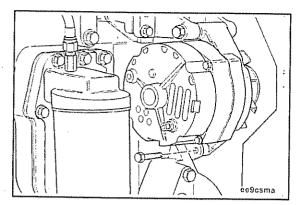
Remove

Remove and tag all wires.

Complete the following steps.

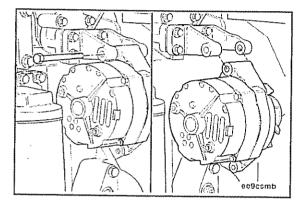






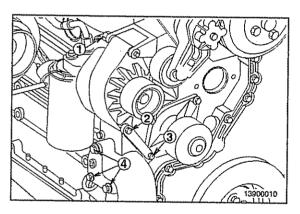


Remove the alternator link capscrew.





Remove the alternator mounting capscrew. Remove the alternator.





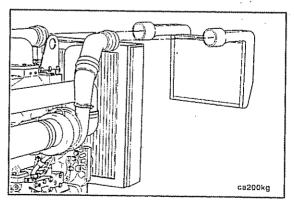
Install

To assemble the alternator, the alternator mounting components **must** be tightened in the following sequence:



- 1. Alternator-to-alternator bracket capscrew
- 2. Lower brace-to-alternator capscrew
- 3. Lower alternator brace-to-water pump capscrew
- 4. Water inlet-to-block capscrews.

NOTE: Wrench size and torque value are determined by the make and model of alternator. Refer to the Engine Component Torque Values.





Charge-Air Cooler

Clean



NOTE: If the engine experiences a turbocharger failure or any other occasion where oil or debris is put into the charge air cooler, the charge air cooler **must** be cleaned.

Remove the charge air cooler piping and charge air cooler from the vehicle. Refer to the equipment manufacturer's instructions.

A CAUTION A

Do not use caustic cleaners to clean the charge air cooler. Damage to the charge air cooler will result.

Flush the charge air cooler internally with solvent in the opposite direction of normal airflow. Shake the charge air cooler and lightly tap on the end tanks with a rubber mallet to dislodge trapped debris. Continue flushing until all debris or oil is removed (i.e., the water runs clear).

NOTE: Make sure that the tubes are in the vertical direction when flushing.

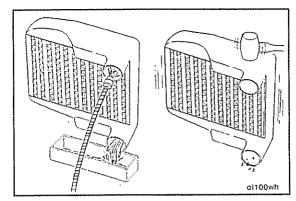
If the debris can **not** be totally removed from the charge air cooler, the charge air cooler **must** be replaced.

▲ CAUTION ▲

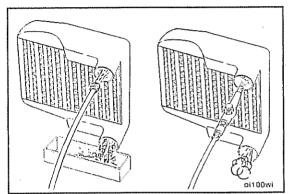
The charge air cooler must be rinsed, dried, and freed of solvent, oil, and debris, or engine damage will result.

After the charge air cooler has been thoroughly cleaned of all oil and debris with solvent, wash the charge air cooler internally with hot, soapy water to remove the remaining solvent. Rinse thoroughly with clean water.

Blow compressed air through the inside of the charge air cooler in the opposite direction of normal airflow until the charge air cooler is dry internally.







Inspect for Reuse

Inspect the charge air cooler for cracks, holes, and damage.

Inspect the tubes, fins, and welds for tears, breaks, or other damage. If any damage causes the charge air cooler to fail the air leak check mentioned earlier in this publication, the charge air cooler **must** be replaced.

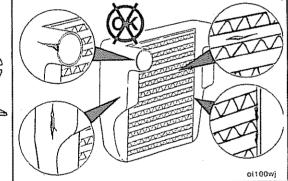
Install the charge air cooler and charge air cooler piping on the vehicle. Refer to the vehicle manufacturer's instructions.

NOTE: Always clean and inspect the charge air cooler piping and hoses prior to installation.









Leak Test

M WARNING M

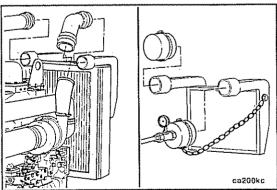
To prevent possible injury if either plug blows off during the test, secure safety chains on the test plugs to any convenient capscrew on the radiator assembly. This test must not be performed without securely fastened safety chains.

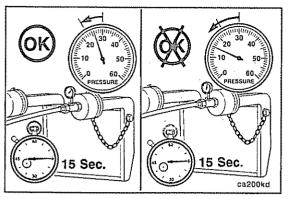
To check the charge air cooler for cracked tubes or header, remove the inlet and outlet hoses from the cooler. The charge air cooler does **not** have to be removed from the chassis.

Install a plug or cap over the outlet side of the cooler. Install a pressure gauge and a regulated shop air supply line with a shutoff valve to the inlet side of the cooler.









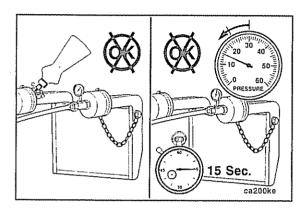


Apply air pressure to the cooler until the pressure gauge reads a steady 207 kPa [30 psi] of air pressure.

Shut off the airflow to the cooler and start a stopwatch at the same time. Record the leakage at 15 seconds.

If the pressure drop is 34 kPa [5 psi] or less in 15 seconds, the cooler is operational.

If the pressure drop is greater than 34 kPa [5 psi] in 15 seconds, check all connections again.

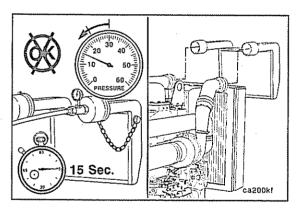




Determine if the pressure drop is caused by a leak in the charge air cooler or from a leaky connection. Use a spray bottle filled with soapy water applied to all hose connections, and watch for bubbles to appear at the location of the leak.

If the pressure drop is caused by a leaky connection, repair the connection and repeat the test. If the leak is within the charge air cooler, repeat the test to verify the accuracy of the pressure drop measurement. Similar pressure drop readings **must** be obtained in at least three consecutive tests before the reading can be considered accurate.

NOTE: If a charge air cooler leaks more than 34 kPa [5 psi] in 15 seconds, it will appear as a major leak in a leak tank.

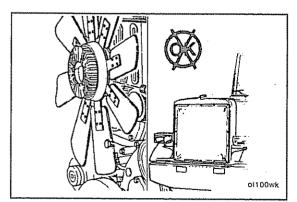




If the pressure drop is greater than 34 kPa [5 psi] in 15 seconds, the charge air cooler **must** be replaced.

Refer to the equipment manufacturer's service manual for replacement instructions.

NOTE: Charge air coolers are **not** designed to be 100-percent leak free. If the pressure drop is less than 34 kPa [5 psi] in 15 seconds, then the charge air cooler does **not** need to be replaced.





Temperature Differential Test

Inspect the charge air cooler fins for obstructions to airflow. Remove obstructions such as a winterfront or debris. Manually lock shutters in the open position, if equipped.

Lock the fan drive in the ON mode to prevent erratic test results. This can be done by installing a jumper wire across the temperature switch.

ca200ki

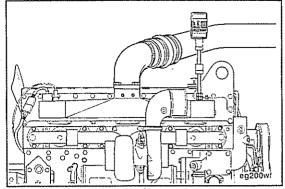
B3.9, B4.5, B5.9 Industrial Section A - Adjustment, Repair, and Replacement

Install fluke digital thermometer, Part Number 3822666, and thermocouple wire kit, Part Number 3822988, into the intake manifold at the 1/8-inch NPT tap near the air horn connection with the intake manifold.

Install another thermocouple at the air cleaner inlet to measure ambient air temperature.





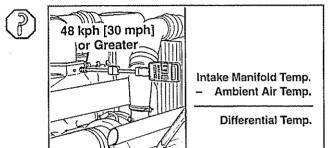


Perform a road test with the engine at peak power and a vehicle speed of 48 kph [30 mph] or greater.

Record the intake manifold temperature and the ambient air temperature.

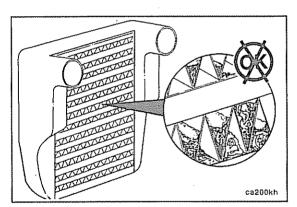
Calculate the differential temperature:

Intake manifold temperature - ambient air temperature = differential temperature. Maximum differential temperature = 28°C [50°F].



If the temperature differential is greater than the specifications, check the charge air cooler for dirt and debris on the fins and clean as necessary. If the problem still exists, check the charge air cooler for debris in the fins or between the charge air cooler and radiator. Confirm full-fan engagement.





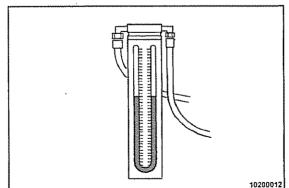
Pressure Differential Test

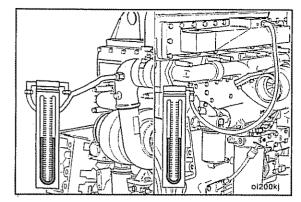
Preferred Method

Measure the charge air cooler system pressure drop with a mercury manometer, Part Number ST-1111-3.







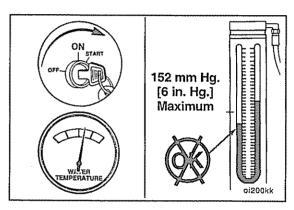




Install one end of a mercury manometer, Part Number ST-1111-3, to the fitting in the turbocharger compressor outlet elbow.



Install the other end of the mercury manometer in the intake manifold.



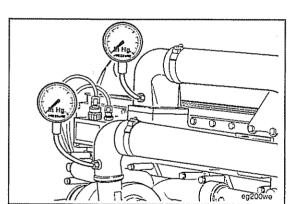


Operate the engine at rated rpm and load. Record the readings on the manometer.



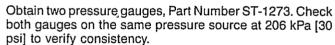
If the differential pressure is greater than 152 mm Hg [6 in Hg], check the charge air cooler and associated piping for plugging, restrictions, or damage.







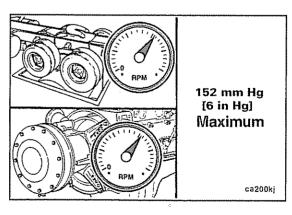
Optional Method





Install pressure gauge, Part Number ST-1273, to the 1/8-inch fitting in the turbocharger compressor outlet elbow.

Install the other pressure gauge in the intake manifold.





Operate the engine at rated rpm and load. Record the readings on the two gauges.



If the differential pressure is greater than 152 mm Hg [6 in Hg], check the charge air cooler and associated piping for plugging, restrictions, or damage.





Clean or replace, if necessary.

Cooling Fan Belt Tensioner

Remove

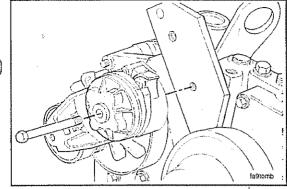
15 mm

Remove the belt tensioner mounting capscrew.

Remove the belt tensioner from the bracket.





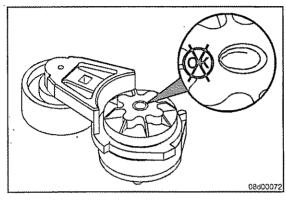


Inspect for Reuse

Inspect the tensioner bushing between the arm and the spring case.







Install

15 mm

Install the belt tensioner.

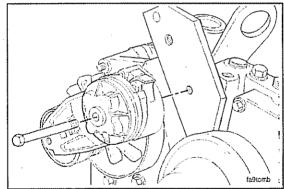
Install and tighten the belt tensioner capscrew.

Torque Value: 43 Nom [32 ft-lb]









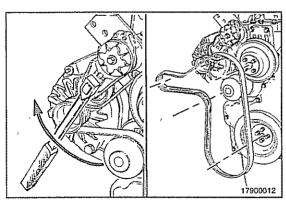
3/8-Inch Square Drive

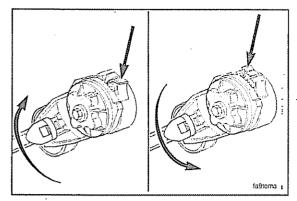
Lift and hold the tensioner. Install the drive belt and release the tensioner.

Service Tip: If difficulty is experienced installing the drive belt, for example, the belt seems too short, position the belt over the grooved pulleys first; then, while holding the tensioner up, slide the belt over the water pump pulley.











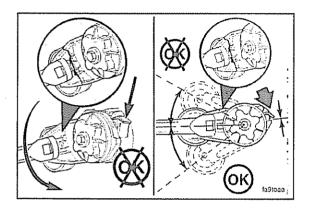
Drive Belt, Cooling Fan

Remove



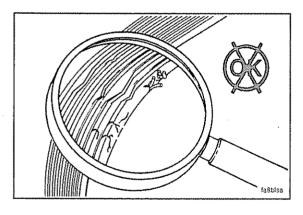
Lift the tensioner to remove the drive belt.

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





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

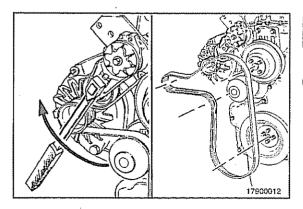




Inspect for Reuse

Inspect the drive belt for:

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





install



▲ CAUTION ▲

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

Lift the tensioner to install the drive belt.

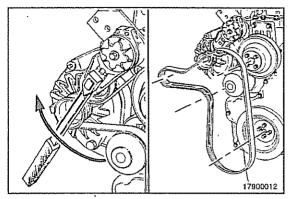
Fan Spacer and Pulley

Preparatory Steps

· Remove the drive belt.

NOTE: Loosen the capscrews before removing the belt, and tighten the capscrews after the belt is installed.

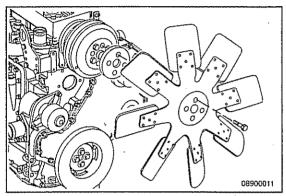




Remove

Remove the four capscrews, fan, and spacer.



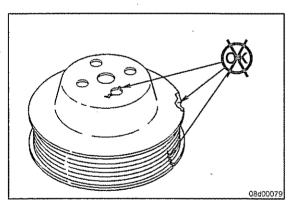


Inspect for Reuse

Inspect the fan pulley for cracks near bolt holes.

Check for cracks, loose rivets, and bent or loose blades.



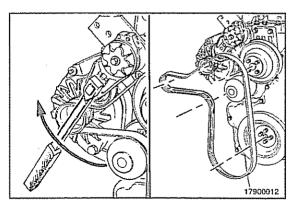


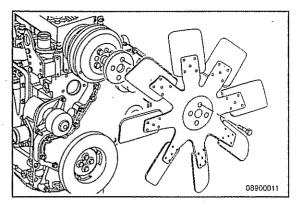
Install

Lift the tensioner, and install the belt.

Service Tip: If difficulty is experienced installing the drive belt (the belt seems too short), position the belt over the grooved pulleys first; then, while holding the tensioner up, slide the belt over the water pump pulley.



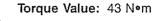




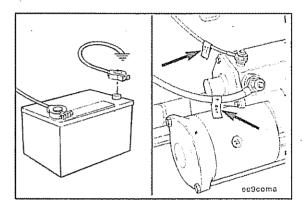


Install the four capscrews, fan, and spacer.

Torque Value: 24 Nom [212 in-lb] [32 ft-lb]





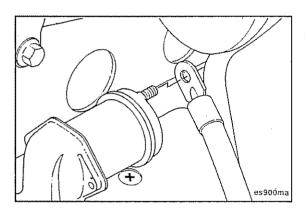




Starting Motor

Preparatory Steps

- · Disconnect the ground cable from the battery ter-
- · Identify each electrical wire with a tag indicating location.

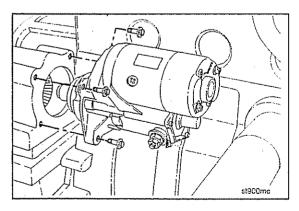




Remove

Remove the battery cable from the solenoid.

Remove all other wires connected to the starter.





Remove the starter motor.

Install

WARNING A



Always connect the ground or negative (-) cable last to avoid arcing that can ignite explosive battery gases.

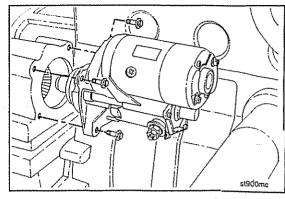
Install the starter motor.

Connect all cables, connecting ground (-) last.

Torque Value: 43 Nom [32 ft-lb]







NOTES

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Section D - System Diagrams

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System Diagrams - Overview

General Information

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

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

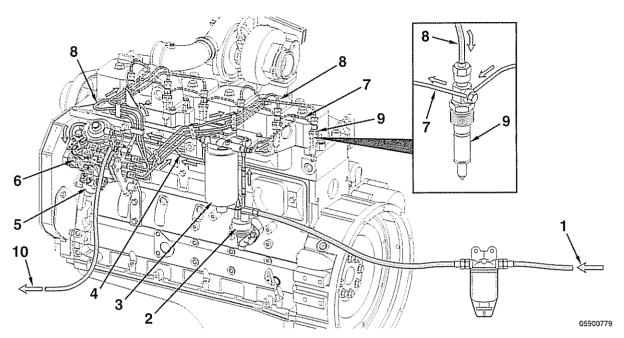
Knowledge of the engine systems can help you in troubleshooting, service, and general maintenance of your engine.



Flow Diagram, Fuel System

Flow Diagram

Industrial Applications

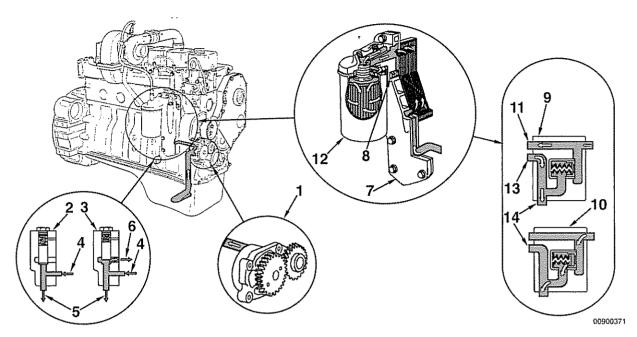


- 1. Fuel from supply tank
- 2. Fuel lift pump
- 3. Fuel filter/water separator
- 4. Low-pressure fuel supply lines
- 5. Bosch® KKSB cold start injection advance
- 6. Bosch® VE injection pump

- 7. Fuel drain manifold
- 8. High-pressure fuel supply lines
- 9. Bosch® closed nozzle injectors
- 10. Fuel return to supply tanks.

Flow Diagram, Lubricating Oil System

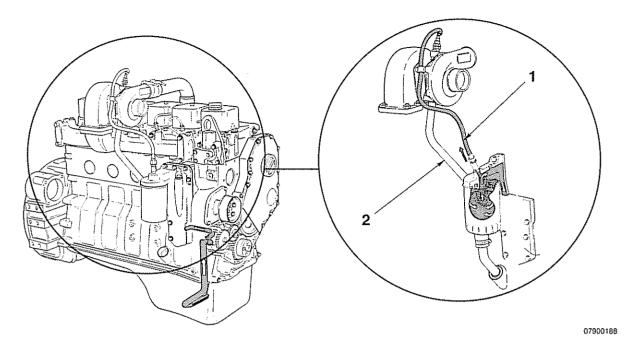
Flow Diagram



- 1. Lubricating Oil Pump
- 2. Pressure Regulating Valve Closed
- 3. Pressure Regulating Valve Open
- 4. From Lubricating Oil Pump
- 5. To Lubricating Oil Cooler
- 6. To Lubricating Oil Pan
- 7. Lubricating Oil Cooler
- 8. Filter Bypass Valve

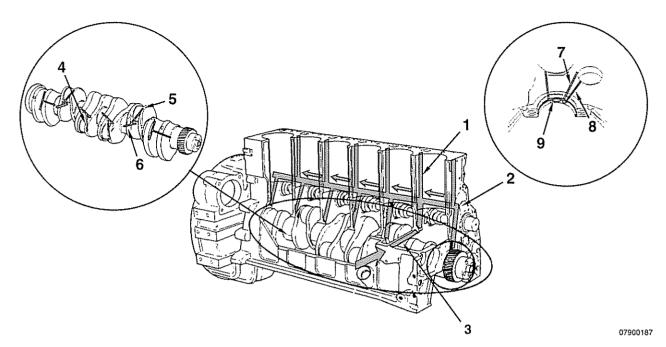
- 9. Filter Bypass Valve Closed
- 10. Filter Bypass Valve Open
- 11. To Lubricating Oil Filter
- 12. Lubricating Oil Filter
- 13. From Lubricating Oil Filter
- 14. Main Lubricating Oil Rifle.

Lubrication for the Turbocharger



- 1. Lubricating Oil Supply
- 2. Lubricating Oil Drain.

Lubrication for the Power Components

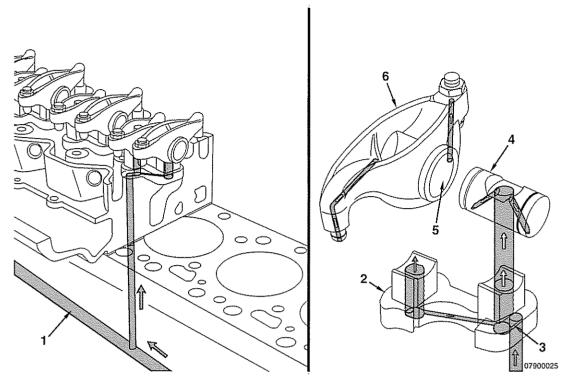


- 1. To Valve Train
- 2. Main Lubricating Oil Rifle
- 3. From Lubricating Oil Cooler
- 4. Connecting Rod Journal
- 5. To Connecting Rod Bearing

- 6. Crankshaft Main Journal
- 7. From Main Lubricating Oil Rifle
- 8. To Camshaft
- 9. To Piston Cooling Nozzle.



Lubrication for the Overhead

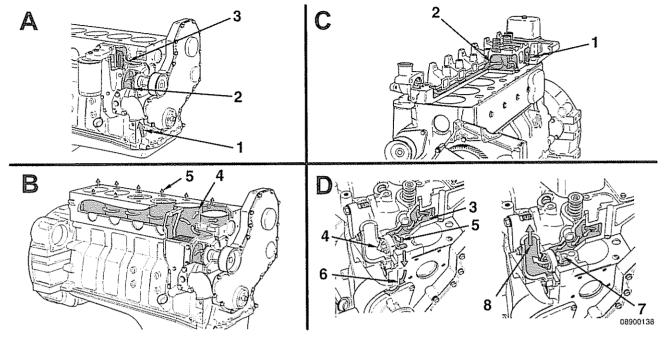


- 1. Main Lubricating Oil Rifle
- 2. Rocker Lever Support
- 3. Transfer Slot
- 4. Rocker Lever Shaft

- 5. Rocker Lever Bore
- 6. Rocker Lever.

Flow Diagram, Cooling System

Flow Diagram



- Views A and B
- 1. Coolant inlet
- 2. Pump Impeller
- 3. Coolant Flow Past Lubricating Oil Cooler
- 4. Coolant Flow Past Cylinders
- 5. Coolant Flow to Cylinder Head.

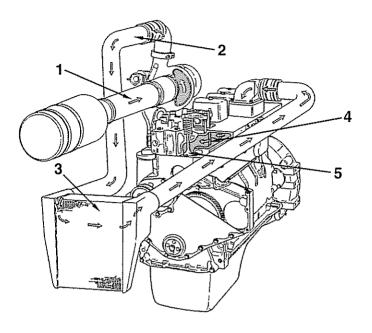
Views C and D

1. Coolant Flow From the Cylinder Head

- 2. Coolant Flow to Thermostat Housing
- 3. Coolant Flow Past Injector
- 4. Thermostat
- 5. Coolant Bypass Passage
- 6. Coolant Flow to Water Pump Inlet
- 7. Coolant Bypass Closed
- 8. Coolant Flow Back to Radiator.

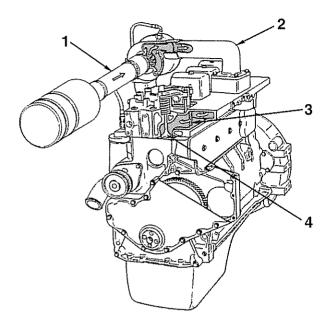
Flow Diagram, Air Intake System

Flow Diagram



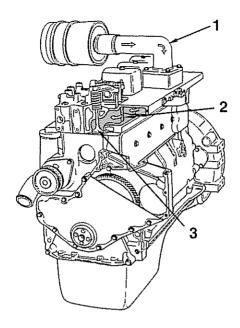
Turbocharged-Charge-Air-Cooled Engine

- 1. Intake air inlet to turbocharger
- 2. Turbocharger air to charge air cooler
- 3. Charge air cooler
- 4. Intake manifold
- 5. Intake valve.



Turbocharged-Aftercooled (Water Jacket) Engine

- 1. Intake air inlet to turbocharger
- 2. Air to intake manifold
- 3. Intake manifold
- 4. Intake valve.

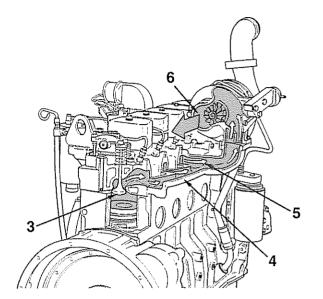


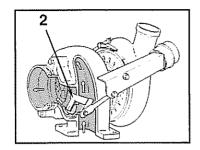
Naturally Aspirated Engine

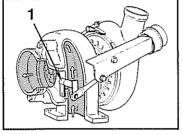
- 1. Intake air inlet
- 2. Intake manifold
- 3. Intake valve.

Flow Diagram, Exhaust System

Flow Diagram

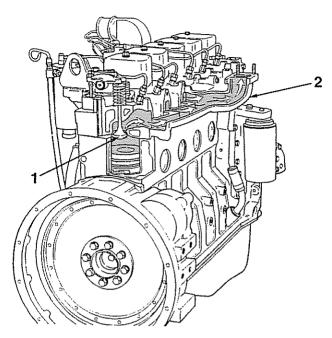






Turbocharged with Wastegate

- 1. Wastegate closed
- 2. Wastegate open
- 3. Exhaust valve
- 4. Exhaust manifold
- 5. Turbocharger exhaust inlet
- 6. Turbocharger exhaust outlet.

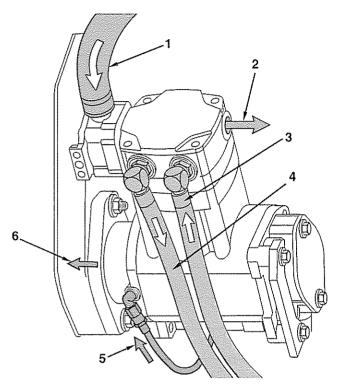


Naturally Aspirated Engine

- 1. Exhaust valve
- 2. Exhaust manifold.

Flow Diagram, Compressed Air System

Flow Diagram



- 1. Air In
- 2. Air Out
- 3. Coolant In
- 4. Coolant Out

- 5. Lubricating Oil In
- 6. Lubricating Oil Out Is Internal to the Gear Housing.

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Section L - Service Literature

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Additional Service Literature

General Information

The following publications can be purchased by contacting your Cummins distributor:

Bulletin	Title of Publication
3666087	Troubleshooting and Repair Manual, B3.9 and B5.9 Series Engines
3666017	B Series Shop Manual
3666109	Alternative Repair Manual, B and C Series Engines
3379000	Air For Your Engine .
3666132	Coolant Requirements and Maintenance
3810340	Cummins Engine Oil Recommendations
3379001	Fuels for Cummins Engines
3379009	Operation - Cold Weather

Service Literature Ordering Location

Contact Information

Region

United States and Canada

U.K., Europe, Mid-East, Africa, and Eastern European Countries

South and Central America (excluding Brazil and Mexico)

Brazil and Mexico

Far East (excluding Australia and New Zealand)

Australia and New Zealand

Ordering Location

Cummins Distributors

or

Credit Cards at 1-800-646-5609

or

Order online at www.powerstore.cummins.com

Cummins Engine Co., Ltd. Royal Oak Way South

Daventry

Northants, NN11 5NU, England

Cummins Americas, Inc. 16085 N.W. 52nd Avenue Hialeah, FL 33104

Cummins Inc.

International Parts Order Dept., MC 40931

Box 3005

Columbus, IN 47202-3005

Cummins Diesel Sales Corp.

Literature Center 8 Tanjong Penjuru Jurong Industrial Estate

Singapore

Cummins Diesel Australia

Maroondah Highway, P.O.B. 139

Ringwood 3134 Victoria, Australia

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Component Manufacturers' Addresses

General Information

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

Air Compressors

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

Holset Engineering Co., Inc. 1320 Kemper Meadow Drive Suite 500

Cincinnati, OH 45240 Telephone: (513) 825-9600

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

Air Cylinders

Bendix Ltd. Douglas Road Kingswood Bristol England

Telephone: 0117-671881

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

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

Air Heaters

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

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

Air Starting Motors

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

Ingersoll-Rand Engine Starting Systems 888 Industrial Drive Elmhurst, IL 60126

Telephone: (708) 530-3875

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

Alternators

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

Prestolite Electrics Cleveland Road Levland PR₅ 1XB England

Telephone: (0)1772-421663

C. E. Niehoff & Co. 2021 Lee Street Evanston, IL 60202 Telephone: (708) 866-6030 Delco-Remy America 2401 Columbus Avenue P.O. Box 2439 Anderson, IN 46018 Telephone: (317) 646-3528

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

Auxiliary Brakes

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

Belts

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

Dayco Mfg. Belt Technical Center 1955 Enterprize Rochester Hills, MI 48309 Telephone: (810) 853-8300 Gates Rubber Company 900 S. Broadway Denver, CO 80217

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

Catalytic Converters

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

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

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

Coolant Level Switches

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

Clutches

Twin Disc International S.A. Chaussee de Namur Nivelles Belguim

Telephone: 067-224941 Twin Disc Incorporated 1328 Racine Street Racine, WI 53403 Telephone: (414) 634-1981

Coolant Heaters

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

Drive Plates

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



Electric Starting Motors

Prestolite Electrics Cleveland Road Leyland PR5 1XB England

Telephone: 01772-421663

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

Leece-Neville Corp. 400 Main Street Arcade, NY 14009

Telephone: (716) 492-1700

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

Electronic Switches

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

Engine Protection Controls

Flight Systems Headquarters Hempt Road P.O. Box 25

Mechanicsburg, PA 17055 Telephone: (717) 697-0333

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

Teddington Industrial Equipment Windmill Road Sunbury on Thames Middlesex **TW167HF**

England

Telephone: (0)9327-85500

Fan Clutches

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

Holset Engineering Co. Ltd. ST Andrews Road Huddersfield, West Yorkshire England HD1 6RA

Telephone: (0)1484-22244

Horton Industries, Inc. P.O. Box 9455 Minneapolis, MN 55440 Telephone: (612) 378-6410 Rockford Clutch Company 1200 Windsor Road P.O. Box 2908 Rockford, IL'61132-2908 Telephone: (815) 633-7460

Fans

Truflo Ltd. Westwood Road Birmingham B6 7JF England

Telephone: (0)121-3283041

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

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

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

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

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

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

Fault Lamps

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

Filters

Fleetguard International Corp. Cavalry Hill Industrial Park Weedon

Northampton NN7 4TD

England

Telephone: 01327-341313

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

(1-800-223-4583)

Flexplates

Corrugated Packing and Sheet Metal Hamsterlev Newcastle Upon Tyne England

Telephone: (0)1207-560-505 Allison Transmission

Division of General Motors Corporation P.O. Box 894 Indianapolis, IN 46206-0894

Telephone: (317) 242-5000 Midwest Mfa. Co.

29500 Southfield Road, Suite 122 Southfield, MI 48076 Telephone: (313) 642-5355 Wohlert Corporation

708 East Grand River Avenue P.O. Box 20217 Lansing, MI 48901

Telephone: (517) 485-3750

Fuel Coolers

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

Fuel Pumps

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

Fuel Warmers

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

Gauges

Grasslin U.K. Ltd. Vale Rise Tonbridge Kent TN9 1TB England

Telephone: (0)1732-359888

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

Rochester Gauges, Inc. 11616 Harry Hines Blvd. P.O. Box 29242 Dallas, TX 75229

Telephone: (214) 241-2161

Governors

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

B3.9, B4.5, B5.9 Industrial Section M - Component Manufacturers

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

United Technologies Diesel Systems 1000 Jorie Blvd. Suite 111 Oak Brook, IL 69521

Oak Brook, IL 69521 Telephone: (312) 325-2020

Heat Sleeves

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

Hydraulic and Power Steering Pumps

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

Sperry Vickers P.O. Box 302 Troy, MI 48084

Telephone: (313) 280-3000

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

In-Line Connectors

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

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

Oil Heaters

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

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

Prelubrication Systems

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

Radiators

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

The G&O Manufacturing Company 100 Gando Drive P.O. Box 1204 New Haven, CT 06505–1204 Telephone: (203) 562–5121 Young Radiator Company 2825 Four Mile Road Racine, WI 53404 Telephone: (910) 271–2397

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

Throttle Assemblies

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

Torque Converters

Twin Disc International S.A. Chaussee de Namur Nivelles Belgium

Telephone: 067-224941
Twin-Disc Incorporated
1328 Racine Street
Racine, WI 53403-1758
Telephone: (414) 634-1981

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

Modine Mfg. Co. 1500 DeKoven Avenue Racine, WI 53401

Telephone: (414) 636-1640

		NOTES

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Section S - Service Assistance

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Routine Service and Parts

General Information

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

Emergency and Technical Service

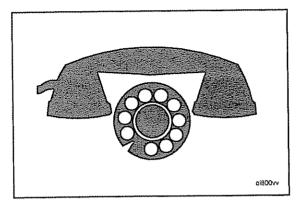
General Information

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

If additional assistance is required, call Toll-Free:

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

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



Problem Solving

General Information

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

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

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



Division and Regional Offices Locations

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

United States

Southern Division Office

Cummins Engine Company, Inc. 425 Franklin Road S.W. Suite 500 Marietta, GA 30067 Telephone: (770) 423-1108 FAX: (770) 499-8240

Plains Regional Office

Cummins Engine Company, Inc. 1901 Central Drive Suite 356 Bedford, TX 76021 Telephone: (817) 267-3172 FAX: N/A

Canada

Canadian Division Office

Cummins Diesel of Canada, Ltd. 5575 North Service Road Burlington, Ontario L726M1 Telephone: (905) 331-5944 FAX: (905) 331-0276

Western Canada Regional Office

Cummins Diesel of Canada, Ltd. 18452 - 96th Avenue Surrey, B.C. V3T 4W2 Telephone: (604) 882-5727 FAX: (604) 882-9110

Eastern Canada Regional Office

Cummins Diesel of Canada Ltd. 7200 Trans Canada Hwy. Pt. Cuaire, Quebec H9R 1C0 Telephone: (514) 695-2402 FAX: (514) 695-8917

Central Canada Regional Office

Cummins Diesel of Canada Ltd. 4887 – 35th Street SE Calgary, Alberta T2B 3C6 FAX: (403) 569-9974

Australia Regional Office

Cummins Engine Company Pty. Ltd.

2 Caribbean Drive Scoresby, Victoria 3179 Australia Telephone: (61-3) 9765-3222 FAX: (61-3) 9763-0079

NOTE: This office also serves New Zealand.

Cummins Americas Regional Office

Cummins Latin America

3088 N. Commerce Parkway MPC #14, Building A Miramar, FL 33025 Telephone: (305) 621-1300

NOTE: This office serves Puerto Rico and South America excluding Brazil.

Distributors and Branches United States

Alabama

Birmingham Distributor

Cummins Alabama, Inc. 2200 Pinson Highway P.O. Box 1147 Birmingham, AL 35201 Telephone: (205) 841-0421 FAX: (205) 849-5926

Mobile Branch

Cummins Alabama, Inc. 1924 N. Beltline Hwy. Mobile, AL 36601–1598 Telephone: (334) 456-2236 FAX: (334) 452-6419

Mobile Onan/Marine Branch

Cummins Alabama, Inc. 3422 Georgia Pacific Avenue Mobile, AL 36617 Telephone: (334) 452-6426 FAX: (334) 473-6657

Montgomery Branch

Cummins Alabama, Inc. 2325 West Fairview Avenue Montgomery, AL 36108 Telephone: (205) 263-2594 FAX: (205) 263-2594

Alaska

Anchorage - (Branch of Seattle)

Cummins Northwest, Inc. 2618 Commercial Drive Anchorage, AK 99501-3095 Telephone: (907) 279-7594 FAX: (907) 276-6340

Arizona

Phoenix Distributor and Branch

Cummins Southwest, Inc. 2239 N. Black Canyon Hgwy Phoenix, AZ 85009 Telephone: (602) 252-8021 FAX: (602) 253-6725

Tucson Branch

Cummins Southwest, Inc. 1912 West Prince Road Tucson, AZ 85705 Telephone: (520) 887-7440 FAX: (520) 887-4173

Arkansas

Little Rock - (Branch of Memphis)

Cummins Mid-South, Inc. 6600 Interstate 30 Little Rock, AR 72209 Telephone:

Sales: (501) 569-5600 Service: (501) 569-5656 Parts: (501) 569-5613 FAX: (501) 565-2199

California

San Leandro Distributor

Cummins West, Inc. 14775 Wicks Blvd. San Leandro, CA 94577-6779 Telephone: (510) 351-6101 FAX: (510) 352-3925

Arcata Branch

Cummins West, Inc. 4801 West End Road Arcata, CA 95521 Telephone: (707) 822–7392 FAX: (707) 822–7585

Bakersfield Branch

Cummins West, Inc. 4601 East Brundage Lane Bakersfield, CA 93307 Telephone: (805) 325-9404 FAX: (805) 861-8719

Fresno Branch

Cummins West, Inc. 2740 Church Avenue Fresno, CA 93706 Telephone: (209) 495–4745 FAX: (209) 486–7402

Redding Branch

Cummins West, Inc. 20247 Charlanne Drive Redding, CA 96001 Telephone: (916) 222–4070 FAX: (916) 224–4075

Stockton Branch

Cummins West, Inc. 41 West Yokuts Avenue Suite 131 Stockton, CA 95207 Telephone: (209) 473-0386 FAX: (209) 478-2454

West Sacramento Branch

Cummins West, Inc. 2661 Evergreen Avenue West Sacramento, CA 95691 Telephone: (916) 371-0630 FAX: (916) 371-2849

Los Angeles Distributor

Cummins Cal Pacific Inc. 1939 Deere Avenue (Irvine) Irvine, CA 92606 Telephone: (949) 253-6000 FAX: (949) 253-6080

Montebello Branch

Cummins Cal Pacific Inc. 1105 South Greenwood Avenue Montebello, CA 90640 Telephone: (323) 728-8111 FAX: (323) 889-7422

Bloomington Branch

Cummins Cal Pacific Inc. 3061 S. Riverside Avenue Bloomington, CA 92377 Telephone: (909) 877-0433 FAX: (909) 877-3787

San Diego Branch

Cummins Cal Pacific Inc. 310 N. Johnson Avenue El Cajon, CA 92020 Telephone: (619) 593-3093 FAX: (619) 593-0600

Ventura Branch

Cummins Cal-Pacific Inc. 3958 Transport St. Ventura, CA 93003 Telephone: (805) 644–7281 FAX: (805) 644–7284

Colorado

Denver Distributor

Cummins Rocky Mountain, Inc. 5100 East 58th Avenue Commerce City, CO 80022 Telephone: (303) 287-0201 FAX: (303) 288-7080

Denver Onan/Industrial Branch

Cummins Rocky Mountain, Inc. 5100 East 58th Ave. Commerce City, CO 80022 Telephone: (303) 286-7697 FAX: (303) 287-4837

Durango Branch

Cummins Rocky Mountain, Inc. 13595 County Road 213 Durango, CO 81301 Telephone: (970) 259–7470 FAX: (970) 259–7482

Grand Junction Branch

Cummins Rocky Mountain, Inc. 2380 U.S. Highway 6 & 50 P.O. Box 339 Grand Junction, CO 81501 Telephone: (303) 242-5776 FAX: (303) 243-5495

Connecticut

Rocky Hill - (Branch of Bronx)

Cummins Metropower, Inc. 914 Cromwell Ave. Rocky Hill, CT 06067 Telephone: (860) 529-7474 FAX: (860) 529-7524

Distributors and Branches Page S-4

Florida

Tampa Distributor

Cummins Southeastern Power, Inc. Corporate Office 5421 N. 59th Street Tampa, FL 33610 Telephone: (813) 621-7202 FAX: (813) 621-8250

Ft. Myers Branch

Cummins Southeastern Power, Inc. 2671 Edison Avenue Ft. Myers, FL 33902 Telephone: (941) 337–1211 FAX: (941) 337-5374

Jacksonville Branch

Cummins Southeastern Power, Inc. 755 Pickettville Rd. Jacksonville, FL 32220 Telephone: (904) 378-1902 FAX: (904) 378-1904

Hialeah (Miami) Branch

Cummins Southeastern Power, Inc. 9900 N.W. 77th Avenue Hialeah Gardens, FL 33016 Telephone: (305) 821-4200 FAX: (305) 557-2992

Ocala Branch

Cummins Southeastern Power 321 Southwest 52nd Ave. Ocala, FL 34474-1892 Telephone: (352) 861-1122 FAX: (352) 861-1130

Orlando Branch

Cummins Southeastern Power, Inc. 4020 North Orange Blossom Trail Orlando, FL 32810 Telephone: (407) 298-2080 FAX: (407) 290-8727

Tampa Branch

Cummins Southeastern Power, Inc. 5912 E. Hillsborough Avenue Tampa, FL 33610 Telephone: (813) 626-1101 FAX: (813) 628-4183

Georgia

Atlanta Distributor

Cummins South, Inc. 5125 Georgia Highway 85 College Park, GA 30349 Telephone: (404) 763-0151 FAX: (404) 766-2132

Albany Branch

Cummins South, Inc. 1915 W. Oakridge Drive Albany, GA 31707–4938 Telephone: (912) 888-6210 FAX: (912) 883–1670

Atlanta Branch

Cummins South, Inc. 100 University Avenue, S.W. Atlanta, GA 30315-2202 Telephone: (404) 527-7800 FAX: (404) 527-7832

Augusta Branch

Cummins South, Inc. 1255 New Savannah Road Augusta, GA 30901-3891 Telephone: (706) 722-8825 FAX: (706) 722-7553

Savannah Branch

Cummins South, Inc. 8 Interchange Court Savannah, GA 31401-1627 Telephone: (912) 232-5565 FAX: (912) 232-5145

Hawaii

Kapolei Distributor

Cummins Hawaii Diesel Power, Inc. 91–230 Kalaeloa Blvd. Kapolei, HI 96707 Telephone: (808) 682–8110 FAX: (808) 682–8477

Idaho

Boise - (Branch of Salt Lake City)

Cummins Intermountain, Inc. 2851 Federal Way City Boise, ID 83705 Telephone: (208) 336-5000 FAX: (208) 338-5436

Pocatello - (Branch of Salt Lake City)

Cummins Intermountain, Inc. 14299 Highway 30 West Pocatello, ID 83201 Telephone: (208) 234-1661 FAX: (208) 234-1662

Illinois

Chicago Distributor

Cummins Northern Illinois, Inc. 7145 Santa Fe Drive Hodgkins, IL 60525 Telephone: (708) 579-9222 FAX: (708) 352-7547

Bloomington-Normal – (Branch of Indianapolis)

Cummins Mid-States Power, Inc. (at U.S. 51 N and I-55) 414 W. Northtown Road Bloomington-Normal, IL 61761 Telephone: (309) 452-4454 FAX: (309) 452-1642

Onan Branch

Cummins/Onan Northern Illinois 8745 W. 82nd Place Justin, IL 60458 Telephone: (708) 563-7070 FAX: (708) 563-7095

B3.9, B4.5, B5.9 Industrial Section S - Service Assistance

Harrisburg (Branch of St. Louis)

Cummins Gateway, Inc. Highway 45 North Harrisburg, IL 62946 Telephone: (618) 273-4138 FAX: (618) 273-4531

Rock Island - (Branch of Omaha)

Cummins Great Plains Diesel, Inc. 7820 - 42nd Street West Rock Island, IL 61204 Telephone: (309) 787-4300 FAX: (309) 787-4397

Onan Branch

Cummins Gateway, Inc. #1 Extra Mile Drive Collinsville, IL 62234 Telephone: (618) 345-0123 FAX: (314) 531-6604

Indiana

Indianapolis Distributor

Cummins Mid-States Power, Inc. P.O. Box 42917 3762 West Morris Street Indianapolis, IN 46242-0917 Telephone: (317) 243-7979 FAX: (317) 240-1925

Evansville - (Branch of Louisville)

Cummins Cumberland, Inc. 7901 Highway 41 North Evansville, IN 47711 Telephone: (812) 867-4400 FAX: (812) 421-3282

Ft. Wayne Branch

Cummins Mid-States Power, Inc. 3415 Coliseum Blvd. West (At Jct. I-69 & 30/33) Ft. Wayne, IN 46808 Telephone: (219) 482-3691 FAX: (219) 484-8930

Gary - (Branch of Chicago)

Cummins Northern Illinois, Inc. 1440 Texas Street Gary, IN 46402 Telephone: (219) 885-5591 FAX: (219) 883-4817

Indianapolis Branch

Cummins Mid-States Power, Inc. P. O. Box 42917 3621 West Morris Street Indianapolis, IN 46242-0917 Telephone: (317) 244-7251 FAX: (317) 240-1215

Onan Branch

Mid-States Power, Inc. 4301 W. Morris Street P.O. Box 42917 Indianapolis, IN 46240-0917 Telephone: (317) 240-1967 FAX: (317) 240-1975

lowa

Cedar Rapids - (Branch of Omaha)

Cummins Great Plains Diesel, Inc. 625 - 33rd Avenue SW Cedar Rapids, IA 52406

Telephone: (319) 366-7537 (24 hours)

FAX: (319) 366-7562

Des Moines - (Branch of Omaha)

Cummins Great Plains Diesel, Inc. 1680 N.E. 51st Avenue P.O. Box B Des Moines, IA 50313 Telephone: (515) 262-9591 Parts: (515) 262-9744

FAX: (515) 262-0626

Des Moines - (Branch of Omaha)

Midwestern Power Products Division of Cummins Great Plains Diesel. Inc.

5194 N.E. 17th Street Des Moines, IA 50313 Telephone: (515) 264-1650 FAX: (515) 264-1651

Kansas

Colby - (Branch of Kansas City, Missouri)

Cummins Mid-America, LLC. 1880 South Range Colby, KS 67701 Telephone: (785) 462-3945 FAX: (785) 462-3970

Garden City - (Branch of Kansas City, Missouri)

Cummins Mid-America, Inc. 1285 Acraway Garden City, KS 67846 Telephone: (316) 275-2277 FAX: (316) 275-2533

Wichita - (Branch of Kansas City, Missouri)

Cummins Mid-America, Inc. 5101 North Broadway Wichita, KS 67201 Telephone: (316) 838-0875 FAX: (316) 838-0704

Kentucky

Louisville Distributor

Cummins Cumberland, Inc. (Corporate Office) 2301 Nelsonville Parkway Louisville, KY 40223 Telephone: (502) 254-3363 FAX: (502) 254-9272

Hazard Branch

Cummins Cumberland, Inc. Highway 15 South P.O. Box 510 Hazard, KY 41701 Telephone: (606) 436-5718 FAX: (606) 436-5038

Louisville Branch

Cummins Cumberland, Inc. 9820 Bluegrass Parkway Louisville, KY 40299 Telephone: (502) 491-4263 FAX: (502) 499-0896

Louisiana

Morgan City - (Branch of Memphis)

Cummins Mid-South, Inc. Hwy. 90 East P.O. Box 1229 Amelia, LA 70340 Telephone: (504) 631-0576 FAX: (504) 631-0081

New Orleans - (Branch of Memphis)

Cummins Mid-South, Inc. 110 E. Airline Highway Kenner, LA 70062 Telephone: (504) 468-3535 FAX: (504) 465-3408

Maine

Bangor (Branch of Boston)

Cummins Northeast, Inc. 221 Hammond Street Bangor, ME 04401 Telephone: (207) 941-1061 FAX: (207) 945-3170

Scarborough - (Branch of Boston)

Cummins Northeast, Inc. 10 Gibson Road Scarborough, ME 04074 Telephone: (207) 883-8155 FAX: (207) 883-5526

Maryland

Baltimore Distributor

Cummins Power Systems, Inc. 1907 Parkwood Drive MD 21061 Telephone: (410) 590–8700

FAX: (410) 590-8723

Massachusetts

Boston Distributor

Cummins Northeast, Inc. 100 Allied Drive Dedham, MA 02026 Telephone: (781) 329-1750 FAX: (781) 329-4428

Springfield Branch

Cummins Northeast, Inc. 177 Rocus Street Springfield, MA 01104 Telephone: (413) 737-2659 FAX: (413) 731-1082

Mexico

Tijuana - (Branch of Los Angeles)

Distribuidora Cummins De Baja Blvd. 3ra. Oeste No. 17523 Fracc. Industrial Garita de Otay C.P. 22400 Tijuana, Baja California Mexico Telephone: 011–52–66–238433 FAX: 011–52–66–238649

Michigan

Detroit (Novi) Distributor

Cummins Michigan, Inc. 41216 Vincenti Court Novi, MI 48375 Telephone: (248) 478-9700 FAX: (248) 478-1570

Blissfield, Michigan

Diesel Fuel Systems, Inc. Subsidiary of Cummins Michigan Inc. 211 N. Jipson Street Blissfield, MI 49228 Telephone: (517) 486-4324 FAX: (517) 486-3614

Dearborn Branch

Cummins Michigan, Inc. 3760 Wyoming Avenue Dearborn, MI 48120 Telephone: (313) 843-6200 FAX: (313) 843-6070

Grand Rapids Branch

Cummins Michigan, Inc. 3715 Clay Avenue, S.W. Grand Rapids, MI 49508 Telephone: (616) 538-2250 FAX: (616) 538-3830

Grand Rapids Branch

Standby Power, Inc. 7580 Expressway Drive S.W. Grand Rapids, MI 49548 Telephone: (616) 281-2211 FAX: (616) 281-3177

Iron Mountain - (Branch of De Pere)

Cummins Great Lakes, Inc. 1901 Stevenson Avenue Iron Mountain, MI 49801 Telephone: (906) 774-2424 (800) 236-2424

FAX: (906) 774-1190

Novi Branch

Cummins Michigan, Inc. 25100 Novi Road Novi, MI 48375 Telephone: (248) 380-4300 FAX: (248) 380-0910

Power Products (Branch of Detroit)

Cummins Michigan, Inc. 41326 Vincenti Ct. Novi, MI 48375 Telephone: (248) 426-9300

FAX: (248) 473-8560

Saginaw Branch

Cummins Michigan, Inc. 722 N. Outer Drive Saginaw, MI 48605 Telephone: (517) 752-5200

FAX: (517) 752-4194

Standby Power - (Branch of Detroit)

Cummins Michigan, Inc. 12130 Dixie Redford, MI 48239 Telephone: (313) 538-0200 FAX: (313) 538-3966

Minnesota

St. Paul Distributor

Cummins North Central, Inc. 3030 Centre Pointe Drive Suite 500 Roseville, MN 55113 Telephone: (651) 636-1000 FAX: (651) 638-2442

Duluth Branch

Cummins Diesel Sales, Inc. 3115 Truck Center Drive Duluth, MN 55806-1786 Telephone: (218) 628-3641 FAX: (218) 628-0488

St. Paul Branch

Cummins North Central, Inc. 2690 Cleveland Ave. North St. Paul, MN 55113 Telephone: (651) 636-1000 FAX: (651) 638-2497

Mississippi

Jackson - (Branch of Memphis)

Cummins Mid-South, Inc. 325 New Highway 49 South Jackson, MS 39288-4224 Telephone:

Admin.: (601) 932-7016 Parts: (601) 932-2720 Service: (601) 939-1800 FAX: (601) 932-7399

Missouri

Kansas City Distributor and Branch

Cummins Mid-America, Inc. 8201 NE Parvin Road Kansas City, MO 64161 Telephone: (816) 414-8200 FAX: (816) 414-8299

Joplin Branch

Cummins Mid-America, Inc. 3507 East 20th Street Joplin, MO 64801 Telephone: (417) 623-1661 FAX: (417) 623-1817

Springfield Branch

Cummins Mid-America, Inc. 3637 East Kearney Springfield, MO 65803 Telephone: (417) 862-0777 FAX: (417) 862-4429

St. Louis Distributor

Cummins Gateway, Inc. 7210 Hall Street St. Louis, MO 63147 Telephone: (314) 389-5400 FAX: (314) 389-9671

Columbia Branch

Cummins Gateway, Inc. 5221 Highway 763 North Columbia, MO 65202 Telephone: (314) 449-3711 FAX: (314) 449-3712

Sikeston Branch

Cummins Gateway, Inc. 101 Keystone Drive Sikeston, MO 63801 Telephone: (314) 472-0303 FAX: (314) 472-0306

Industrial Power Branch

Cummins Gateway, Inc. 3256 E. Outer Road Scott City, MO 63788 Telephone: (573) 335-9399 FAX: (573) 335-7062

Montana

Billings - (Branch of Denver)

Cummins Rocky Mountain, Inc. 5151 Midland Road Billings, MT 59101 Telephone: (406) 245-4194 FAX: (406) 245-7923

Great Falls - (Branch of Denver)

Cummins Rocky Mountain, Inc. 415 Vaughn Road Great Falls, MT 59404 Telephone: (406) 452-8561 FAX: (406) 452-9911

Missoula - (Branch of Seattle)

Cummins Northwest, Inc. 4950 North Reserve Street Missoula, MT 59802-1498 Telephone: (406) 728-1300 FAX: (406) 728-8523

Nebraska

Omaha Distributor and Branch

Cummins Great Plains Diesel, Inc. 5515 Center Street P.O. Box 6068 Omaha, NE 68106 Telephone: (402) 551-7678 (24 Hours) FAX: (402) 551-1952

Kearney Branch

Cummins Great Plains Diesel, Inc. 515 Central Avenue Kearney, NE 68847 Telephone: (308) 234-1994 FAX: (308) 234-5776

Nevada

Elko - (Branch of Salt Lake City)

Cummins Intermountain, Inc. 5370 East Idaho Street Elko, NV 89801 Telephone: (775) 738-6405 FAX: (775) 738-1719

Las Vegas - (Branch of Salt Lake City)

Cummins Intermountain, Inc. 2750 Losee Road North Las Vegas, NV 89030 Telephone: (702) 399-2339 FAX: (702) 399-7457

Sparks - (Branch of Salt Lake City)

Cummins Intermountain, Inc. 150 Glendale Avenue Sparks, NV 89431 Telephone: (775) 331-4983 FAX: (775) 331-7429

New Jersey

Newark - (Branch of Bronx)

Cummins Metropower, Inc. 41-85 Doremus Ave. Newark, NJ 07105 Telephone: (973) 491–0100 FAX: (973) 578–8873

New Mexico

Albuquerque - (Branch of Phoenix)

Cummins Southwest, Inc. 1921 Broadway N.E. Albuquerque, NM 87102 Telephone: (505) 247-2441 FAX: (505) 842-0436

Farmington - (Branch of Phoenix)

Cummins Southwest, Inc. 1101 North Troy King Road Farmington, NM 87401 Telephone: (505) 327-7331 FAX: (505) 326-2948

New York

Bronx Distributor

Cummins Metropower, Inc. 890 Zerega Avenue Bronx, NY 10473 Telephone: (718) 892-2400 FAX: (718) 892-0055

Albany - (Branch of Boston)

Cummins Northeast, Inc. 101 Railroad Avenue Albany, NY 12205 Telephone: (518) 459-1710 FAX: (518) 459-7815

Buffalo - (Branch of Boston)

Cummins Northeast, Inc. 480 Lawrence Bell Dr. Williamsville, NY 14221-7090 Telephone: (716) 631-3211 FAX: (716) 626-0799

B3.9, B4.5, B5.9 Industrial Section S - Service Assistance

Syracuse - (Branch of Boston)

Cummins Northeast, Inc. 29 Eastern Avenue Syracuse, NY 13211 Telephone: (315) 437-2751 FAX: (315) 437-8141

North Carolina

Charlotte Distributor

Cummins Atlantic, Inc. 11101 Nations Ford Road (28273) P.O. Box 240729 Charlotte, NC 28224-0729 Telephone: (704) 588-1240 FAX: (704) 587-4870

Charlotte Branch

Cummins Atlantic, Inc. 3700 North Interstate 85 Charlotte, NC 28206 Telephone: (704) 596-7690 FAX: (704) 596-3038

Greensboro Branch

Cummins Atlantic, Inc. 513 Preddy Boulevard (27406) P.O. Box 22066 Greensboro, NC 27420-2066 Telephone: (336) 275-4531 FAX: (336) 275-8304

Wilson Branch

Cummins Atlantic, Inc. 1514 Cargill Avenue (27893) P.O. Box 1177 Wilson, NC 27894-1117 Telephone: (252) 237-9111 FAX: (252) 237-9132

North Dakota

Fargo - (Branch of St. Paul)

Cummins North Central, Inc. 3801 - 34th Ave. SW Fargo, ND 58104 Telephone: (701) 282-2466 FAX: (701) 277-5399

Grand Forks - (Branch of St. Paul)

Cummins North Central, Inc. 4728 Gateway Drive Grand Forks, ND 58201 Telephone: (701) 775-8197 FAX: (701) 775-4833

Minot - (Branch of St. Paul)

Cummins North Central, Inc. 1501 - 20th Avenue, S.E. Minot, ND 58702 Telephone: (701) 852-3585 FAX: (701) 852-3588

Ohio

Columbus Distributor and Branch

Cummins Interstate Power, Inc. 4000 Lyman Drive Hilliard (Columbus), OH 43026 Telephone: (614) 771-1000 FAX: (614) 771~0769

Columbus Distributor

Cummins Interstate Power, Inc. 2297 Southwest Bldv., Suite K Grove City, OH 43123 Telephone: (614) 771-1000 FAX: (614) 527-2576

Cincinnati Branch

Cummins Interstate Power, Inc. 10470 Evendale Drive Cincinnati, OH 45241 Telephone: (513) 563-6670 FAX: (513) 563-0594

Cleveland Branch

Cummins Interstate Power, Inc. 7585 Northfield Road Cleveland, OH 44146 Telephone: (440) 439-6800 FAX: (440) 439-7390

Strasburg Branch

Cummins Interstate Power, Inc. 777 South Wooster Avenue Strasburg, OH 44680 Telephone: (216) 878-5511 FAX: (216) 878-7666

Toledo Branch

Cummins Interstate Power, Inc. 801 Illinois Avenue Maumee (Toledo), OH 43537 Telephone: (419) 893-8711 FAX: (419) 893-5362

Youngstown Branch

Cummins Interstate Power, Inc. 7145 Masury Road Hubbard (Youngstown), OH 44425 Telephone: (216) 534-1935 FAX: (216) 534-5606

Oklahoma

Oklahoma City - (Branch of Arlington)

Cummins Southern Plains, Inc. 5800 West Reno Oklahoma City, OK 73127 Telephone: (405) 946-4481 (24 hours) FAX: (405) 946-3336

Tulsa - (Branch of Arlington)

Cummins Southern Plains, Inc. 16525 East Skelly Drive Tulsa, OK 74116 Telephone: (918) 234–3240 FAX: (918) 234–2342

Oregon

Bend - (Branch of Seattle)

Cummins Northwest, Inc. 3500 N. Highway 97 (97701-5729) P.O. Box 309 Bend, OR 97709-0309 Telephone: (541) 389-1900 FAX: (541) 389-1909

Coburg/Eugene - (Branch of Seattle)

Cummins Northwest, Inc. 91201 Industrial Parkway Coburg, OR 97401 (Mailing Address) P.O. Box 10877 Eugene, OR 97440-2887 Telephone: (541) 687-0000 FAX: (541) 687-1977

Medford - (Branch of Seattle)

Cummins Northwest, Inc. 4045 Crater Lake Highway Medford, OR 97504-9796 Telephone: (541) 779-0151 FAX: (541) 772-2395

Pendleton - (Branch of Seattle)

Cummins Northwest, Inc. 223 S.W. 23rd Street Pendleton, OR 97801-1810 Telephone: (541) 276-2561 FAX: (541) 276-2564

Portland - (Branch of Seattle)

Cummins Northwest, Inc. 4711 N. Basin Avenue P. O. Box 2710 (97208-2710) Portland, OR 97217-3557 Telephone: (503) 289-0900 FAX: (503) 286-5938

Pennsylvania

Philadelphia Distributor

Cummins Power Systems, Inc. 2727 Ford Road Bristol, PA 19007 Telephone: (215) 785-6005 and (609) 563-0005 FAX: (215) 785-4085

Bristol Branch

Cummins Power Systems, Inc. 2727 Ford Road Bristol, PA 19007 Telephone: (215) 785-6005 and (609) 563-0005 FAX: (215) 785-4728

Pittsburgh Branch

Cummins Power Systems, Inc. 3 Alpha Drive Pittsburgh, PA 15238–2901 Telephone: (412) 820–8300 FAX: (412) 820–8308

Harrisburg Branch

Cummins Power Systems, Inc. 4499 Lewis Road Harrisburg, PA 17111-2541 Telephone: (717) 564-1344 FAX: (717) 558-8217

Puerto Rico

Puerto Nuevo - (Branch of Tampa)

Cummins Diesel Power, Inc. #31 Calle "C" El Matadero Puerto Nuevo, Puerto Rico 00920 Telephone: (787) 793-0300 FAX: (787) 793-1072

South Carolina

Charleston - (Branch of Charlotte)

Cummins Atlantic, Inc. 3028 West Montague Avenue Charleston, SC 29418-5593 Telephone: (843) 554-5112 FAX: (843) 745-0745

Charleston - (Branch of Charlotte)

Cummins Atlantic Inc. 231 Farmington Road Charleston, SC 29483 Telephone: (843) 851-9819 FAX: (843) 875-4338

Columbia - (Branch of Charlotte)

Cummins Atlantic, Inc. 1233 Bluff Road (29201) P.O. Box 13543 Columbia, SC 29201-3543 Telephone: (803) 799-2410 FAX: (803) 779-3427

South Dakota

Sioux Falls - (Branch of Omaha)

Cummins Great Plains Diesel, Inc. 701 East 54th Street North Sioux Falls, SD 57104 Telephone: (605) 336-1715 FAX: (605) 336-1748

Tennessee

Memphis Distributor & Distribution Center

Cummins Mid-South, Inc. 666 Riverside Drive Memphis, TN 38703 Telephone: (901) 577-0666 FAX: (901) 522-8758

Chattanooga - (Branch of Atlanta)

Cummins South, Inc. 1509 East 26th Street Chattanooga, TN 37407-1095 Telephone: (615) 629-1447 FAX: (615) 629-1494

Knoxville - (Branch of Louisville)

Cummins Cumberland, Inc. 1211 Ault Road Knoxville, TN 37914 Telephone: (423) 523-0446 FAX: (423) 523-0343

Memphis Branch

Cummins Mid-South, Inc. 1784 E. Brooks Road Memphis, TN 38116 Telephone:

Sales/Admin.: (901) 345-7424 Parts: (901) 345-1784 Service: (901) 345-6185 FAX: (901) 346-4735

Nashville - (Branch of Louisville)

Cummins Cumberland, Inc. 706 Spence Lane Nashville, TN 37217 Telephone: (615) 366-4341 FAX: (615) 366-5693

Texas

Arlington Distributor

Cummins Southern Plains, Inc. 600 N Watson Road Arlington, TX 76004-3027 Telephone: (817) 640-6801 FAX: (817) 640-6852

Amarillo Branch

Cummins Southern Plains, Inc. 5224 Interstate 40 -Expressway East P.O. Box 31570 Amarillo, TX 79120-1570 Telephone: (806) 373-3793 (24 hours) FAX: (806) 372-8547

Dallas Branch

Cummins Southern Plains, Inc. 3707 Irving Boulevard Dallas, TX 75247 Telephone: (214) 631-6400 (24 hours) FAX: (214) 631-2322

El Paso - (Branch of Phoenix)

Cummins Southwest, Inc. 14333 Gateway West El Paso, TX 79927 Telephone: (915) 852-4200 FAX: (915) 852-3295

Fort Worth Branch

Cummins Southern Plains, Inc. 3250 North Freeway Fort Worth, TX 76111 Telephone: (817) 624-2107 (24 hours) FAX: (817) 624-3296

Houston Branch

Cummins Southern Plains, Inc. 4750 Homestead Road P.O. Box 1367 Houston, TX 77251-1367 Telephone: (713) 675-7421 (24 hours) FAX: (713) 675-1515

Mesquite Branch

Cummins Southern Plains, Inc. 2615 Big Town Blvd. Mesquite, TX 75150 Telephone: (214) 321-5555 (24 hours) FAX: (214) 328-2732

Odessa Branch

Cummins Southern Plains, Inc. 1210 South Grandview P.O. Box 633 Odessa, TX 79760-0633 Telephone: (915) 332-9121 (24 hours) FAX: (915) 333-4655

San Antonio Branch

Cummins Southern Plains, Inc. 6226 Pan Am Expressway North P.O. Box 18385 San Antonio, TX 78218-0385 Telephone: (512) 655-5420 (24 hours) FAX: (512) 655-3865

Houston Onan Branch

Southern Plains Power A Division of Cummins Southern Plains 1155 West Loop North Houston, TX 77055 Telephone: (713) 956-0020 FAX: (713) 956-0266

Utah

Salt Lake City Distributor

Cummins Intermountain, Inc. 1030 South 300 West Salt Lake City, UT 84101 Telephone: (801) 355-6500 FAX: (801) 524-1351

Vernal Branch

Cummins Intermountain, Inc. 1435 East 335 South Vernal, UT 84078 Telephone: (435) 789-5732 FAX: (435) 789-2853

Virginia

Cloverdale - (Branch of Charlotte)

Cummins Atlantic, Inc. 263 Simmons Drive Cloverdale, VA 24077 Telephone: (540) 966-3169 FAX: (540) 966-3749

Richmond - (Branch of Charlotte)

Cummins Atlantic, Inc. 3900 Deepwater Terminal Road Richmond, VA 23234 Telephone: (804) 232-7891 FAX: (804) 232-7428

Tidewater - (Branch of Charlotte)

Cummins Atlantic, Inc. Atlantic Power Generation 3729 Holland Blvd. Chesapeake, VA 23323 Telephone: (757) 485-4848 FAX: (757) 485-5085

Washington

Seattle Distributor

Cummins Northwest, Inc. 811 S.W. Grady Way (98055-2944) P.O. Box 9811 Renton, WA 98057-9811 Telephone: (425) 235-3400 FAX: (425) 235-8202

Chehalis Branch

Cummins Northwest, Inc. 926 N.W. Maryland Chehalis, WA 98532-0339 Telephone: (360) 748-8841 FAX: (360) 748-8843

Spokane Branch

Cummins Northwest, Inc. 11134 W. Westbow Blvd. Spokane, WA 99204 Telephone: (509) 455-4411 FAX: (509) 624-4681

Tacoma Branch

Cummins Northwest, Inc. 3701 Pacific Highway East Tacoma, WA 98424-1135 Telephone: (253) 922-2191 FAX: (253) 922-2379

Yakima Branch

Cummins Northwest, Inc. 1905 East Central Avenue (98901-3609) P.O. Box 9129 Yakima, WA 98909-0129 Telephone: (509) 248-9033

West Virginia

FAX: (509) 248-9035

Charleston - (Branch of Louisville)

Cummins Cumberland, Inc. 3100 MacCorkle Ave. SW P.O. Box 8456 South Charleston, WV 25303 Telephone: (304) 744-6373 FAX: (304) 744-8605

Fairmont - (Branch of Louisville)

Cummins Cumberland, Inc. South Fairmount Exit, I-79 145 Middletown Road Fairmont, WV 26554 Telephone: (304) 367-0196 FAX: (304) 367-1077

Wisconsin

DePere Distributor

Cummins Great Lakes, Inc. Corporate Office 875 Lawrence Drive P.O. Box 5070 DePere, WI 54115–5070 Telephone: (920) 337-1991 FAX: (920) 337-9746

Chippewa Falls Branch

Cummins Great Lakes, Inc. 2030 St. Highway 53 Chippewa Falls, WI 54729 Telephone: (715) 720-0680 FAX: (715) 720-0685

DePere Branch

Cummins Great Lakes, Inc. 939 Lawrence Drive P. O. Box 5070 DePere, WI 54115-5070 Telephone: (920) 336-9631 (800) 236-1191 FAX: (920) 336-8984

Milwaukee Branch

Cummins Great Lakes, Inc. 9401 South 13th Street P.O. Box D Oak Creek, WI 53154 Telephone: (414) 768-7400 (800) 472-8283 FAX: (414) 768-9441

Wausau Branch

Cummins Great Lakes, Inc. 4703 Rib Mountain Drive Wausau, WI 54401 Telephone: (715) 359-6888 (800) 236-3744 FAX: (715) 359-3744

Wyoming

Gillette - (Branch of Denver)

Cummins Rocky Mountain, Inc. 2700 Hwy, 14 & 16 North P.O. Box 1207 (82717) Gillette, WY 82716 Telephone: (307) 682-9611 FAX: (307) 682-8242

Rock Springs - (Branch of Salt Lake City)

Cummins Intermountain, Inc. 2000 Foothill Blvd. P.O. Box 1634 Rock Springs, WY 82901 Telephone: (307) 362-5168 FAX: (307) 362-5171



Canada

Alberta

Edmonton Distributor and Branch

Cummins Alberta 11751 - 181 Street Edmonton, AB T5S 2K5 Telephone: (780) 455-2151 FAX: (780) 454-9512

Calgary Branch

Cummins Alberta 4887 - 35th Street S.E. Calgary, Alberta T2B 3H6, Canada Telephone: (403) 569-1122 FAX: (403) 569-0027

Grande Prairie

Cummins Alberta - Grande Praire RR2, Site 9, Box 22 Sexsmith, AB CN T0H 3C0 Telephone: (780) 568-3359 FAX: (780) 568-2263

Hinton Branch

Cummins Alberta 135 Veats Avenue Hinton, Alberta T7V 1S8, Canada Telephone: (780) 865-5111 FAX: (780) 865-5714

Lethbridge Branch

Cummins Alberta 240 - 24th Street North Lethbridge, Alberta T1H 3T8, Canada Telephone: (403) 329-6144 FAX: (403) 320-5383

British Columbia

Vancouver Distributor

Cummins British Columbia 18452 - 96th Avenue Surrey, B.C., Canada V4N 3P8 Telephone: (604) 882-5000

FAX: (604) 882-5080

Kamloops Branch

Cummins British Columbia 976 Laval Crescent Kamloops, B.C. Canada V2C 5P5 Telephone: (250) 828-2388 FAX: (250) 828-6713

Prince George Branch

Cummins British Columbia 102-3851-18th Avenue Prince George, B.C. V2N 1B1 Telephone: (250) 564-9111 FAX: (250) 564-5853

Sparwood Branch

Cummins British Columbia 731 Douglas Fir Road Sparwood, B.C. VOB 2GO, Canada Telephone: (250) 425-0522 FAX: (250) 425-0323

Tumbler Ridge Branch

Cummins British Columbia Industrial Site, Box 226 Tumbler Ridge, B.C. Canada VOC 2WO Telephone: (250) 242-4217 FAX: (250) 242-4906

Manitoba

Winnipeg Distributor

Cummins Mid-Canada Ltd. 489 Oak Point Road P.O. Box 1860 Winnipeg, MB R3C 3R1, Canada Telephone: (204) 632-5470 FAX: (204) 697-0267

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Fredericton - (Branch of Montreal)

Cummins Eastern Canada, Inc. R.R.#1 Doak Road P.O. Box 1178, Station 'A' Fredericton. New Brunswick E3B 4X2, Canada Telephone: (506) 451-1929 FAX: (506) 451-1921

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Cummins Eastern Canada, Inc. 122 Clyde Avenue Donovans Industrial Park Mount Pearl, Newfoundland A1N 2C2 Telephone: (709) 747-0176 FAX: (709) 747-2283

Wabush - (Branch of Montreal)

Cummins Eastern Canada, Inc. Wabush Industrial Park Wabush, Newfoundland A0R 1B0 Telephone: (709) 282-3626 FAX: (709) 282-3108

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Halifax - (Branch of Montreal)

Cummins Eastern Canada, Inc. 50 Simmonds Drive Dartmouth, Nova Scotia B3B 1R3 Telephone: (902) 468-7938 FAX: (902) 468-5177 Parts: (902) 468-6560

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Toronto Distributor

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Kenora - (Branch of Winnipeg)

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Thunder Bay Branch

Cummins Ontario Inc. 1400 W, Walsh Street Thunder Bay Ontario P7É 4X4 Telephone: (807) 577-7561 FAX: (807) 577-1727

Whitby Branch

Cummins Ontario Inc. 1311 Hopkins Street Whitby, Ontario L1N 2C2, Canada Telephone: (905) 668-6886 FAX: (905) 668-1375

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Montreal Distributor

Cummins Eastern Canada, Inc. 7200 Trans Canada Highway Pointe Claire, Quebec H9R 1C2. Telephone: (514) 695-8410 FAX: (514) 695-8917

Montreal Branch

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B3.9, B4.5, B5.9 Industrial Section S - Service Assistance

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Cummins Engine Company, Pty. Ltd. P.O. Box 124 Darra, 4076 Queensland, Australia Location: 33 Kimberley Street Darra, 4076, Australia Telephone: (61-7) 3375-3277

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Cummins Engine Company, Ptv. Ltd. P.O. Box 1751 Bunbury, WA 6230 Australia Location: 11 Dryanda Court Picton, WA 6230 Telephone: (61-8) 9725-6777 FAX: (61-8) 9725-6444

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Cummins Engine Company, Pty. Ltd. P.O. Box 18 South Grafton, 2461 New South Wales, Australia Location: 18-20 Induna Street South Grafton, 2461

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B3.9, B4.5, B5.9 Industrial Section S - Service Assistance

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Cummins Engine Company, Pty. Ltd. P.O. Box 1264 Swan Hill, 3585 Victoria, Australia Location: 5 McAllister Road Swan Hill, 3585 Telephone: (61-3) 5032-1511

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Cummins Engine Company, Pty. Ltd. P.O. Box 677 Tamworth, 2320 New South Wales, Australia Location: Lot 65 Gunnedah Road Tamworth, 2340 Telephone: (61-2) 6765-5455

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Cummins Engine Company, Pty. Ltd. P.O. Box 16-149
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Cummins Engine Company, Pty. Ltd. P.O. Box 9024 Palmerston North, New Zealand Location: 852-860 Tremaine Avenue Telephone: (64-6) 356-2209

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Country

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Beijing Regional Office - China

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Countries

Covered:

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Countries

Covered:

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Gross-Gerau Regional Office - Germany

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Countries

Covered:

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Macedonia

Hong Kong Regional Office - Hong Kong

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Fax: (852) 2691-1641, 2687-3552

Country

Covered: Hong Kong, Macau

Pune Kirloskar Regional Office - India

Kirloskar Cummins Limited Kothrud

Pune - 411 029, India

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Countries

Covered:

Bhutan India Nepal

Milan Regional Office - Italy

Cummins Diesel Italia S.P.A.

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Country

Covered: Italy

North Asia Regional Office - Japan

Cummins Diesel Sales Corporation

1-12-10 Shintomi Chuo-ku, Tokyo 104

Japan

Telephone: (81-3) 3555-3131/2/3/4/5

Country

Covered:

Japan

Seoul Regional Office - Korea

Cummins Korea Ltd.

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35-26 Sam Sung Dong, Kang Nam Ku

Seoul, South Korea

Telephone: (82-2) 516-0431/2/3, 517-3370/1

Country

Covered:

South Korea

Cummsa Regional Office - Mexico

Cummins, S.A. de C.V. Arquimedes No. 209

Col. Polanco

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Mexico

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Mailing/Shipping Address: Gonzalez de Castilla Inc.

P.O. Box 1391

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Telephone: (512) 722-5207

Country

Covered:

Mexico

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Cummins Engine Co., Inc.

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Countries

Covered:

Armenia

Azerbaijan

Moldova

Belarus Tajikistan Russia

Georgia :

Turkmenistan Ukranie

Kyrgyzstan Kazakhstar

Uzbekistan

South And East Asia Area Office -Singapore

Cummins Diesel Sales Corporation

8 Tanjong Penjuru

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Countries

Covered:

Bangladesh

Brunei Burma/Mynamar Malaysia Mongolia Philippines

Cambodia

Singapore

Indonesia

Laos

Sri Lanka Thailand Vietnam

Taipei Regional Office - Taiwan

Cummins Corporation - Taiwan

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Country

Covered: Taiwan

Middle East Regional Office

Cummins Diesel FZE

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Afghanistan

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Countries Covered:

MIDEAST

Jordan Kuwait Lebanon

Saudi Arabia Sudan Syria

Djibouti Oman Egypt Pakistan U.A.E. United Kingdom Yemen

Iraq Qatar Iran Turkey

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

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Countries Covered:

NORTH/WEST/EAST AND CENTRAL AFRICA Gabon

Benin (from Togo)

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Chad

Burundi Cameroon Cape Verde

Ghana

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Bissau Ivory Coast

Liberia

Congo (D.R.) Congo (P.R.)

Malta

Siera Leone

Libya Djibouti Equatorial Mali

Somalia Togo

Tunisia Uganda

Senegal

Seychelies

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

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Countries

Covered:

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

Eucador

Caracas Regional Office - Venezuela

Cummins Engine Company Oficina de Delegado Torre La Primera, Oficina 5-D Av. Francisco de Miranda Chacao, Caracas 1060

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Dominican Nicaragua
Republic Panama
El Salvador Venezuela

Guatemala

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Covered:

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Botswana South Africa
Comoros Island ST. Helena
Lesotho Tanzania
Madagascar
Malawi Zambia
Mauritius Zimbabwe

Mozambique Nambia

Distributors - International

Locations

ABU DHABI

- See United Arab Emirates

AFGHANISTAN

- See Middle East Regional Office

ALBANIA

- See Germany Regional Office - Gross-Gerau

ALGERIA

- See Cummins Diesel S.A. - Lyon

AMERICAN SAMOA

- See South Pacific Regional Office

ANDORRA

- See European Regional Office - Mechelen

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BENIN

- See Togo

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- See Netherlands Antilles

BOTSWANA

- See Southern Africa Regional Office -Kelvin

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BRITISH VIRGIN ISLANDS

- See Puerto Rico

BRUNEI

- See Malaysia

BURKINA - FASO

- See North/West/East and Central Africa Regional Office - Daventry

BULGARIA

-See Germany Regional Office - Gross-Gerau

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- Singapore

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CAPE VERDE

- See ECV Portugal

CENTRAL AFRICAN REPUBLIC

- See North/West Africa Regional Office - Daventry

CEYLON

- See Sri Lanka

- See North/West/East and Central Africa Regional Office - Daventry

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Troubleshooting Procedures and Techniques

General Information

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

▲ WARNING **▲**

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

Follow the suggestions below for troubleshooting:

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

Troubleshooting Symptoms Charts

General Information

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



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

Air Compressor Air Pressure Rises Slowly

Cause

Air intake system restriction to air compressor is excessive

Replace the air compressor air cleaner (if installed). Check the air intake piping. Check engine air intake restriction if the air compressor inlet is plumbed to the vehicle or equipment intake system. Refer to Section 3 and Section 4.

Correction

OK

Air system leaks

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

OK

Carbon buildup is excessive in the air discharge line, downstream air valves, or cylinder head

Check for carbon buildup. Replace the air compressor discharge line and cylinder head assembly if necessary. Refer to Section 7.

OK

Contact a Cummins Authorized Repair Facility Contact a Cummins Authorized Repair Facility

Air Compressor Cycles Frequently

Correction Cause Block the vehicle wheels and check the air system for leaks with spring brakes applied and released. Check for leaks from the air Air system leaks compressor gaskets and the air system hoses, fittings, tanks, and valves. Refer to the OEM service manuals. OK -Check for carbon buildup. Replace the air Carbon buildup is excessive in the air discompressor discharge line, if necessary. Refer charge line, check valve, or cylinder head to Section 7. OK Replace the desiccant cartridge on the Turbo/CR 2000 air dryer. Refer to the OEM service manual. Check the air compressor duty Air compressor pumping time is excessive cycle. Install a larger air compressor, if necessary. Refer to a Cummins Authorized Repair Facility. OK

Air Compressor Noise is Excessive

Cause

Carbon buildup is excessive in the air discharge line, downstream air valves, or cylinder head

> OK **O**K

Air compressor is sending air pulses into the air tanks

OK **⊅**

Ice buildup in the air system components

OK **⊅**

Contact a Cummins Authorized Repair Facility

Correction

Check for carbon buildup. Replace the air compressor discharge line and cylinder head assembly if necessary. Refer to Section 7.

Install a ping tank between the air dryer and the wet tank. Refer to the manufacturer's instructions.

For all models, check for ice in low spots of the air discharge line, dryer inlet, and elbow fittings. On Holset® models, also check the Econ valve (if equipped). Refer to the OEM service manual.

Air Compressor Pumping Excess Lubricating Oil into the Air System

Cause		Correction
Lubricating oil drain interval is excessive		Verify the correct lubricating oil drain interval. Refer to Section 2.
OK •		
Air intake system restriction to air compressor is excessive		Replace the air compressor air cleaner (if installed). Check the air intake piping. Check engine air intake restriction if the air compressor inlet is plumbed to the vehicle or equipment intake system. Refer to Section 3.
OK -	_j L	
Air compressor pumping time is excessive		Replace the desiccant cartridge on the Turbo/CR 2000 air dryer. Refer to the OEM service manual. Check the air compressor duty cycle. Install a larger air compressor, if necessary. Refer to a Cummins Authorized Repair Facility.
OK 🕶	٠ . ا	
Carbon buildup is excessive in the air dis- charge line, check valve, or cylinder head		Check for carbon buildup. Replace the air compressor discharge line, if necessary. Refer to Section 7.
OK 🗢		
Contact a Cummins Authorized Repair Facility		

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

•	 (incompany)
Cause	 Correction
Air system leaks	Block the vehicle wheels and check the air system for leaks with spring brakes applied and released. Check for leaks from the air compressor gaskets and the air system hoses, fittings, tanks, and valves. Refer to the OEM service manual.
OK •	
Contact a Cummins Authorized Repair Facility	

B3.9, B4.5, B5.9 Industrial Section TS - Troubleshooting Symptoms

Air Compressor Will Not Stop Pumping

All Con I	
 Cause	
Air system leaks	
OK OK	
Contact a Cummins Authorized Repair Facility	

Correction

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

Alternator Not Charging or Insufficient Charging Correction Tighten the pulley. Refer to OEM service Cause ey is loose on the shaft manual. OK Check the condition of the batteries. Replace the batteries, if necessary. Refer to OEM have malfunctioned service manual. ΟK Check the battery cables and connections. s or connections are loose, roded (excessive resistance) OK Install an alternator with a higher capacity. Refer to the OEM service manual. arloaded, or alternator capacity pelow specification ŌΚ Test the alternator output. Replace the alternator or voltage regulator if necessary. Refer to ***** 'oltage regulator is malfunctionthe OEM service manual. OK Position the batteries away from heat sources. Refer to the OEM service manual. perature is above specification OK Check the fuses, wires, and connections. Refer to the OEM service manual and the manufac-system is "open" (blown fuses, turer's wiring diagram. wires, or loose connections)

Check the vehicle gauge. Refer to the OE

service manual.

ŌΚ

Φ

cle gauge is malfunctioning

ntact a Cummins Authorized Repair Facility

ΟK

Alternator Overcharging

Cause Correction Check the condition of the batteries. Replace the batteries, if necessary. Refer to the OEM service manual. OK Voltage regulator is malfunctioning OK Check the voltage regulator. Replace the voltage regulator, if necessary. Refer to a Cummins Authorized Repair Facility. OK Contact a Cummins Authorized Repair Facility

,_{nohqələ}r uelsixed Karachi 753

/Yoeley

Coolant Contamination

Cause

Correction

Coolant is rusty and has debris

Drain and flush the cooling system. Fill with correct mixture of antifreeze and water. Refer to Section 7.

ОК 4

Transmission oil cooler or torque converter cooler is leaking

Check the transmission oil cooler and torque converter cooler for coolant leaks. Refer to the OEM service manual.

OK ₩

Lubricating oil cooler is leaking

Check the lubricating oil cooler for coolant leaks and cracks. Refer to a Cummins Authorized Repair Facility.

Cylinder head gasket is leaking

OK

Check the cylinder head gasket. Refer to a Cummins Authorized Repair Facility.

OK ₩

Contact a Cummins Authorized Repair Facility

Coolant Loss - External

Correction Cause Inspect the engine and cooling system for external coolant leaks. Repair if necessary. Coolant level is below specification Add coolant. Refer to the OEM service manual. ОК 4 Inspect the engine for coolant leaking from hoses, draincocks, water manifold, jumper tubes, expansion and pipe plugs, fittings, radiator core, air compressor and cylinder head External coolant leak gaskets, lubricating oil cooler, water pump seal, cylinder block, and OEM-mounted components that have coolant flow. Refer to the OEM service manual. OK **₽** Check the radiator pressure cap. Refer to the Radiator cap is not correct, is malfunctioning, OEM service manual. or has low-pressure rating OK 4 Cooling system hose is collapsed, restricted, or Inspect the hoses. Refer to Section 4. leaking OK Check the coolant fill line for restrictions or Coolant fill line is restricted or obstructed obstructions. Refer to Section 7. OK Drain and flush the cooling system. Fill with correct mixture of antifreeze and water. Refer Goolant is rusty and has debris to Section 7. OK 0 Refer to the Coolant Temperature Above Engine is overheating Normal symptom tree. OK -63-Contact a Cummins Authorized Repair Facility

Coolant Temperature Above Normal - Gradual Overheat

Correction Cause Inspect the charge air cooler, air conditioner Charge air cooler fins, radiator fins, or air condenser, and radiator fins. Clean, if necesconditioner condenser fins are damaged or sary. Refer to Section 4 and the OEM service obstructed with debris manual. OK • Open the cold weather radiator cover or the winterfront. Maintain a minimum of 387 cm2 Cold weather radiator cover or winterfront is [60 in²] of opening at all times. Refer to closed Section 1. OK Inspect the engine and cooling system for external coolant leaks. Repair if necessary. Coolant level is below specification Add coolant. Refer to Section 7. OK Inspect the shroud and the recirculation Fan shroud is damaged or missing or the air baffles. Repair, replace, or install, if necessary. recirculation baffles are damaged or missing Refer to the OEM service manual. OK 0 Refer to the Lubricating Oil Contaminated Lubricating oil is contaminated with coolant or symptom tree. fuel OK. 4 Cooling system hose is collapsed, restricted, or Inspect the hoses. Refer to Section 4. leaking ОК 0 Verify the concentration of antifreeze in the coolant. Add antifreeze or water to correct the Coolant mixture of antifreeze and water is not concentration. Refer to Section 5 and Section correct OK Check the oil level. Add or drain oil, if neces-Lubricating oil level is above or below specifisary. Refer to Section 3. Use the oil recomcation mended in Section V. OK

(Continued)

Coolant Temperature Above Normal - Gradual Overheat (Continued)

Correction Cause Test the temperature gauge. Repair or replace Coolant temperature gauge is malfunctioning the gauge, if necessary. OK -Fan drive belt is loose, tight, or not in align-Check the fan drive belt. Refer to Section 3. ment OK -67 Verify that the engine and vehicle cooling Vehicle cooling system is not adequate systems are using the correct components. Refer to the OEM specifications. ОК Contact a Cummins Authorized Repair Facility

Coolant Temperature Above Normal - Sudden Overheat

Cause Correction Inspect the engine and cooling system for Coolant level is below specification external coolant leaks. Repair if necessary. Add coolant, Refer to Section 3. OK Inspect and vent the cooling system. Refer to Air in the cooling system Section 7. OK -Check the fan drive belt. Replace the belt, if Fan drive belt is broken necessary. Refer to Section A. OK Radiator cap is **not** correct, is malfunctioning, Check the radiator pressure cap. Refer to the or has low-pressure rating OEM service manual. OK • Cooling system hose is collapsed, restricted, or Inspect the hoses. Refer to Section 4. leaking OK Test the temperature gauge. Repair or replace Coolant temperature gauge is malfunctioning the gauge, if necessary. OK Inspect the charge air cooler, air conditioner condenser, and radiator fins. Clean, if neces-Charge air cooler fins, radiator fins, or air conditioner condenser fins are damaged or sary. Refer to Section 4 and the OEM service obstructed with debris manual. OK • Open the cold weather radiator cover or the Cold weather radiator cover or winterfront is winterfront. Maintain a minimum of 387 cm² [60 in²] of opening at all times. Refer to closed Section 1. OK Contact a Cummins Authorized Repair Facility

Contact a Cummins Authorized Repair Facility

Coolant Temperature Below Normal

Correction Cause Test the gauge and the sensor. Repair or replace, if necessary. Refer to OEM service Coolant temperature gauge or sensor is malfunctioning . manual. OK Check the winterfront, shutters, and under-thehood air. Use under-the-hood intake air in cold Engine is operating at low ambient temperature weather. Refer to Cold Weather Operation, Bulletin 3387266, and Section 1. OK Check the fan drive and controls. Refer to the Fan drive or fan controls are malfunctioning OEM service manual. OK . Test the temperature gauge. Repair or replace Coolant temperature gauge is malfunctioning the gauge, if necessary. OK • Check the thermostat for the correct part number and for correct operation. Contact a Thermostat is **not** correct or is malfunctioning Cummins Authorized Repair Facility. OK .

Cause

Correction

Engine Acceleration or Response Poor

Operator technique is not correct		Refer to Section 1, Operating Instructions.
OK ,	(
Fuel level is low in the tank		Fill the supply tank. Refer to the OEM service manual.
OK •	L.	· · · · · · · · · · · · · · · · · · ·
Vehicle parasitics are excessive		Check the vehicle brakes for dragging, transmission malfunction, cooling fan operation cycle time, and engine-driven units. Refer to the OEM service manual.
OK ₹	[.	
Clutch is malfunctioning or is not correct		Compare the drivetrain specifications to Cummins recommendations. Check the clutch for correct operation. Refer to the OEM service manual.
OK ◆		
Drivetrain is not correctly matched to the engine		Check for correct gearing and drivetrain components. Refer to the OEM vehicle specifications.
OK ♥	_ [
Fuel leak		Check the fuel lines, fuel connections, and fuel filters for leaks. Check the fuel lines to the supply tanks. Refer to the OEM service manual.
OK . ♥		
Intake manifold air temperature is above specification		Refer to the Intake Manifold Air Temperature Above Specification symptom tree.
OK •		
Charge air cooler is restricted or leaking		Inspect the charge air cooler for air restrictions or leaks. Refer to Section 4.
OK ♥		
(Continued)		

Engine Acceleration or Response Poor (Continued)

Correction Cause Check for air in the fuel system. Tighten or replace the fuel connections, fuel lines, fuel Air in the fuel system tank standpipe and fuel filters as necessary. Vent air from the system. Refer to Section 5. OK • Check for loose or damaged piping connections and missing pipe plugs. Check the Air intake or exhaust leaks turbocharger and exhaust manifold mounting. Refer to Section 3. OK Check the air intake system for restriction. Air intake system restriction is above specifica-Clean or replace the air filter and inlet piping as necessary. Refer to Section 4. OK Operate the engine from a tank of high-quality Fuel grade is not correct for the application or fuel. Refer to Fuel Recommendations and the fuel quality is poor Specifications in Section V. OK 4 Measure the fuel pressure before and after the Fuel filter is plugged fuel filter. Refer to Section 5. **OK** 4 Check the flow through the filter to locate the Fuel supply is not adequate source of the restriction. Refer to Section 5. OK 4 Check the fuel lift pump for correct operation. Check the pump output pressure. Replace the Fuel lift pump is malfunctioning fuel lift pump if necessary. Refer to a Cummins Authorized Repair Facility. OK Contact a Cummins Authorized Repair Facility

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

Cause Correction Verify the correct starting procedure. Refer to Starting procedure is not correct Section 1. ОК Fill the supply tank. Refer to the OEM service Fuel level is low in the tank manual. OK Check for correct operation of the cold weather Starting aid, if necessary for cold weather, is starting aid. Refer to Cold Weather Starting Aids in Section 1. Refer to the manufacturer's malfunctioning instructions. OK Check the electrical sources and wiring to the Engine block heater is malfunctioning (if cylinder block heater. Replace the block heater, equipped) if necessary. Refer to the OEM service manual. OK * Check the fuel heater and replace, if neces-Fuel heater is malfunctioning (if equipped) sary. Refer to the manufacturer's instructions. OK --Check the batteries and the unswitched battery Battery voltage is low supply circuit. Refer to the OEM service manual. OK **5** Check the vehicle keyswitch circuit. Refer to Keyswitch circuit is malfunctioning the OEM service manual. OK 4 If the cranking speed is slower than 150 rpm, refer to the Engine Will Not Crank or Cranks Engine cranking speed is too slow Slowly symptom tree. OK Check the vehicle brakes for dragging, transmission malfunction, cooling fan operation Vehicle parasitics are excessive cycle time, and engine-driven units. Refer to the OEM service manual. OK (Continued)

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

Cause		Correction		
Fuel leak		Check the fuel lines, fuel connections, and fuel filters for leaks. Check the fuel lines to the supply tanks. Refer to the OEM service manual.		
OK T	_			
Air in the fuel system		Check for air in the fuel system. Tighten or replace the fuel connections, fuel lines, fuel tank standpipe and fuel filters as necessary. Vent air from the system. Refer to Section 5.		
OK ▼				
Air intake system restriction is above specification		Check the air intake system for restriction. Clean or replace the air filter and inlet piping as necessary. Refer to Section 4.		
OK ▼				
Fuel grade is not correct for the application or the fuel quality is poor		Operate the engine from a tank of high-quality fuel. Refer to Fuel Recommendations and Specifications in Section V.		
OK .	(,			
Fuel filter is plugged		Measure the fuel pressure before and after the fuel filter. Refer to Section 5.		
OK ♥	L			
Fuel supply is not adequate		Check the flow through the filter to locate the source of the restriction. Refer to Section 5.		
OK ♥	J L			
Fuel pump overflow valve is malfunctioning		Check the overflow valve. Replace if necessary. Refer to a Cummins Authorized Repair Facility.		
OK →				
Fuel lift pump is malfunctioning		Check the fuel lift pump for correct operation. Check the pump output pressure. Replace the fuel lift pump if necessary. Refer to a Cummins Authorized Repair Facility.		
OK ♥	\			
(Continued)		•		

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

Check the fuel pump throttle linkage adjustment. Refer to the OEM service manual. OK Contact a Cummins Authorized Repair Facility

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

Cause	, ,	Correction
Starting procedure is not correct		Verify the correct starting procedure. Refer to Section 1.
OK.		
Fuel level is low in the tank		Fill the supply tank. Refer to the OEM service manual.
OK ◆	!	
Fuel grade is not correct for the application or the fuel quality is poor		Operate the engine from a tank of high-quality fuel. Refer to Fuel Recommendations and Specifications in Section V.
OK ♥		v
Fuel shutoff is malfunctioning		Check for loose wires and verify that the fuel shutoff valve is functioning. Refer to the OEM service manual.
OK ➡	ا ل	
OEM engine protection system is malfunction- ing		Isolate the OEM engine protection system. Follow the OEM service manuals to check for a malfunction.
OK ♥	J L	
Battery voltage is low		Check the batteries and the unswitched battery supply circuit. Refer to the OEM service manual.
OK ♥		
Keyswitch circuit is malfunctioning		Check the vehicle, equipment, or vessel keyswitch circuit. Refer to a Cummins Authorized Repair Facility.
OK ₩	!	
Air in the fuel system		Check for air in the fuel system. Tighten or replace the fuel connections, fuel lines, fuel tank standpipe and fuel filters as necessary. Vent air from the system. Refer to Section 5.
OK ▼	i '	
Fuel filter is plugged	,	Measure the fuel pressure before and after the fuel filter. Refer to Section 5.
OK		
(Continued)		

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

—) _[-	Correction
	Check the flow through the filter to locate the source of the restriction. Refer to Section 5.
} L	
• • • • • •	Check or replace the return overflow valve. Refer to the OEM service manual.
L	
	Inspect the fuel transfer pump. Replace if necessary. Refer to a Cummins Authorized Repair Facility.
J L	
• • • • • •	Verify the fuel return line is plumbed to the bottom of the fuel tank.
	Adjust or repair the linkage. Refer to the OEM service manual.

Engine Noise Excessive

	Correction
	Check the fan drive belt. Refer to Section 3.
J L	
	Refer to the Lubricating Oil Specifications in Section V.
l	
	Inspect the vibration damper. Refer to Section 7.
	Check for loose or damaged piping connections and missing pipe plugs. Check the turbocharger and exhaust manifold mounting. Refer to Section 3.
	Inspect the air piping, chassis, and cab for contact points. Refer to the OEM service manual.
	•
	Check the air intake system for restriction. Clean or replace the air filter and inlet piping as necessary. Refer to Section 4.
	Refer to the Coolant Temperature is Above Normal - Sudden Overheat or the Coolant Temperature is Above Normal - Gradual Overheat symptom tree.
	Check the engine mounts. Refer to the OEM service manual.
	Isolate each component and check for noise. Refer to the OEM service manual.

Engine Noise Excessive (Continued)

Cause

Fan is loose, damaged, or has excessive hub bearing end play

OK **Φ**

Contact a Cummins Authorized Repair Facility

Correction

Check the fan. Refer to Section 3.

Contact a Cummins Authorized Repair Facility

Engine Noise Excessive — Combustion Knocks

Cause Check the winterfront, shutters, and under-thehood air. Use under-the-hood intake air in cold Engine is operating at low ambient temperature weather. Refer to Cold Weather Operation, Bulletin 3387266, and Section 1. OK 43-Repair or replace the ether starting aids. Refer Ether starting aid is malfunctioning to the manufacturer's instructions. OK Operate the engine from a tank of high-quality Fuel grade is not correct for the application or fuel. Refer to Fuel Recommendations and the fuel quality is poor Specifications in Section V. OK • Check for air in the fuel system. Tighten or replace the fuel connections, fuel lines, fuel Air in the fuel system tank standpipe and fuel filters as necessary. Vent air from the system. Refer to Section 5. OK 47 Refer to the Coolant Temperature Below Coolant temperature is below specification Normal symptom tree. OK

Engine Power Output Low

Cause Correction Operate the engine from a tank of high-quality Fuel grade is not correct for the application or fuel. Refer to Fuel Recommendations and the fuel quality is poor Specifications in Section V. ОК Engine power decreases above recommended Engine is operating above recommended altitude. Refer to the Engine Data Sheet for altitude specifications. OK 9 Compare the tachometer reading with a Tachometer is not calibrated or is malfunctionhandheld tachometer. Replace the tachometer ing as necessary. Refer to the OEM service manual. OK Check the intake and exhaust systems for Intake and exhaust system restricted restrictions. Inspect the intake air filter and replace as necessary. OK • Check the air intake system for restriction. Air intake system restriction is above specifica-Clean or replace the air filter and inlet piping tion as necessary. Refer to Section 4. OK 7 Check for loose or damaged piping connections and missing pipe plugs. Check the turbocharger and exhaust manifold mounting. Air intake or exhaust leaks Refer to Section 3. OK Check for leaks in the air crossover tube, charge air cooler connections, hoses, or Air leak between the turbocharger and the through holes in the manifold cover and repair intake manifold or replace if necessary. Refer to the OEM service manual. OK . Inspect the charge air cooler for air restrictions Charge air cooler is restricted or leaking or leaks. Refer to Section 4. OK (Continued)

Engine Power Output Low (Continued)

Cause		Correction
Fuel leak		Check the fuel lines, fuel connections, and fuel filters for leaks. Check the fuel lines to the supply tanks. Refer to the OEM service manual.
OK **		
Air in the fuel system		Check for air in the fuel system. Tighten or replace the fuel connections, fuel lines, fuel tank standpipe and fuel filters as necessary. Vent air from the system. Refer to Section 5.
OK ▼	_ -	
Fuel supply is not adequate		Check the flow through the filter to locate the source of the restriction. Refer to the OEM service manual.
OK •		
Fuel return restriction excessive		Inspect the fuel return lines for restrictions. Refer to the OEM service manual.
OK .	l	
Fuel filter is plugged		Measure the fuel pressure before and after the fuel filter. Refer to Section 5.
• OK	J L	·
Fuel pump overflow valve is malfunctioning		Check the overflow valve. Replace if necessary. Refer to a Cummins Authorized Repair Facility.
OK ♥		
Fuel lift pump is malfunctioning		Check the fuel lift pump for correct operation. Check the pump output pressure. Replace the fuel lift pump if necessary. Refer to a Cummin Authorized Repair Facility.
OK ♥	!	
Vehicle parasitics are excessive		Check the vehicle brakes for dragging, transmission malfunction, cooling fan operation cycle time, and engine-driven units. Refer to the OEM service manual.
OK		

Engine Power Output Low (Continued)

Cause

Lubricating oil level above specification

ОК

Contact a Cummins Authorized Repair Facility

Correction

Check the oil level. Verify the oil pan capacity. Fill the system to the specified level. Refer to Section V.

Engine Runs Rough at Idle

Correction Cause Allow the engine to warm to operating temperature. If the engine will not reach operating Engine is cold temperature, refer to the Coolant Temperature Below Normal symptom tree. OK • Check and adjust the low-idle screw. Refer to a Idle speed is set too low for accessories Cummins Authorized Repair Facility. OK Check for air in the fuel system. Tighten or replace the fuel connections, fuel lines, fuel Air in the fuel system tank standpipe and fuel filters as necessary. Vent air from the system. Refer to Section 5. OK * Measure the fuel pressure before and after the Fuel filter is plugged fuel filter. Refer to Section 5. OK ➾ Check the flow through the filter to locate the Fuel supply is not adequate source of the restriction. Refer to Section 5. OK ₩ Check the fuel lift pump for correct operation. Check the pump output pressure. Replace the Fuel lift pump is malfunctioning fuel lift pump if necessary. Refer to a Cummins Authorized Repair Facility. ОК Check the engine mounts. Refer to the OEM Engine mounts are worn, damaged, or not service manual. correct OK -Operate the engine from a tank of high-quality Fuel grade is not correct for the application or fuel. Refer to Fuel Recommendations and the fuel quality is poor Specifications in Section V. OK . Contact a Cummins Authorized Repair Facility

Engine Runs Rough or Misfires

Cause		Correction
Engine is cold		Allow the engine to warm to operating temperature. If the engine will not reach operating temperature, refer to the Coolant Temperature Below Normal symptom tree.
OK •		L
Air in the fuel system		Check for air in the fuel system. Tighten or replace the fuel connections, fuel lines, fuel tank standpipe and fuel filters as necessary. Vent air from the system. Refer to Section 5.
OK •		
Fuel grade is not correct for the application or the fuel quality is poor		Operate the engine from a tank of high-quality fuel. Refer to Fuel Recommendations and Specifications in Section V.
. OK		
Fuel leak		Check the fuel lines, fuel connections, and fuel filters for leaks. Refer to the OEM service manual.
OK ◆		
Fuel filter is plugged		Measure the fuel pressure before and after the fuel filter. Refer to Section 5.
OK ₹	_J L	
Fuel supply is not adequate		Check the flow through the filter to locate the source of the restriction. Refer to Section 5.
OK ♥		
Fuel lift pump is malfunctioning		Check the fuel lift pump for correct operation. Check the pump output pressure. Replace the fuel lift pump if necessary. Refer to a Cummins Authorized Repair Facility.
OK •	_}	
Engine mounts are worn, damaged, or not correct		Check the engine mounts. Refer to the OEM service manual.
OK •	.J L	,
Contact a Cummins Authorized Repair Facility].	

Engine Shuts Off Unexpectedly or Dies During Deceleration

Correction Cause Refer to the Engine Difficult to Start or Will Not Engine will not restart Start symptom tree. OK 40 Fill the supply tank. Refer to the OEM service Fuel level is low in the tank manual. ΟK Check for loose wires and verify that the fuel shutoff valve is functioning. Refer to the OEM Fuel shutoff is malfunctioning service manual. OK ₽ Isolate the OEM engine protection system. OEM engine protection system is malfunction-Follow the OEM service manuals to check for a ing malfunction. OK 4 Check for air in the fuel system. Tighten or replace the fuel connections, fuel lines, fuel Air in the fuel system tank standpipe, and fuel filters as necessary. Refer to Section 5. OK -Contact a Cummins Authorized Repair Facility

Engine Speed Surges at Low or High Idle

Cause		Correction
Fuel level is low in the tank		Fill the supply tank. Refer to the OEM service manual.
OK ▼		
Engine idle speed is set too low		Adjust the idle speed. Refer to a Cummins Authorized Repair Facility.
OK ♥		
Air in the fuel system		Check for air in the fuel system. Tighten or replace the fuel connections, fuel lines, fuel tank standpipe and fuel filters as necessary. Vent air from the system. Refer to Section 5.
OK ₩	J	
Fuel filter is plugged		Measure the fuel pressure before and after the fuel filter. Refer to Section 5.
OK ♥	J	
Fuel supply is not adequate		Check the flow through the filter to locate the source of the restriction. Refer to Section 5.
OK •		
Fuel lift pump is malfunctioning		Check the fuel lift pump for correct operation. Check the pump output pressure. Replace the fuel lift pump if necessary. Refer to a Cummins Authorized Repair Facility.
OK ▼	J L	
Fuel grade is not correct for the application or the fuel quality is poor		Operate the engine from a tank of high-quality fuel. Refer to Fuel Recommendations and Specifications in Section V.
OK ❤	L	
Contact a Cummins Authorized Repair Facility		

Engine Speed Surges Under Load or in Operating Range

Cause		Correction
Fuel level is low in the tank	· · · · · ·	Fill the supply tank. Refer to the OEM service manual.
OK ♥		
Air in the fuel system		Check for air in the fuel system. Tighten or replace the fuel connections, fuel lines, fuel tank standpipe and fuel filters as necessary. Vent air from the system. Refer to Section 5.
OK OK	J	
Fuel filter is plugged		Measure the fuel pressure before and after the fuel filter. Refer to Section 5.
OK ▼	l	
Fuel supply is not adequate		Check the flow through the filter to locate the source of the restriction. Refer to Section 5.
OK		
Idling with excessive load		Use the PTO feature for loaded conditions at low engine speeds. Refer to Section 1.
OK	.	
Vehicle parasitics are excessive		Check the vehicle brakes for dragging, transmission malfunction, cooling fan operatior cycle time, and engine-driven units. Refer to the OEM service manual.
OK ♥		
Clutch is malfunctioning or is not correct		Compare the drivetrain specifications to Cummins recommendations. Check the clutch for correct operation. Refer to the OEM service manual.
OK ❖	l	
Fuel grade is not correct for the application or the fuel quality is poor		Operate the engine from a tank of high-quality fuel. Refer to Fuel Recommendations and Specifications in Section V.
OK ♣		
Contact a Cummins Authorized Repair Facility		

Engine Starts But Will Not Keep Running

Cause Correction Fill the supply tank. Refer to the OEM service Fuel level is low in the tank manual. OK ➾ Check and adjust the low-idle screw. Refer to a Idle speed is set too low for accessories Cummins Authorized Repair Facility. OK Engine-driven units are engaged Disengage engine-driven units. Refer to the OEM service manual. OK Check for loose wires and verify that the fuel shutoff valve is functioning. Check to be sure Fuel shutoff is malfunctioning manual shutoff lever is in the run position. Refer to the OEM service manual. OK 4 Check for air in the fuel system. Tighten or replace the fuel connections, fuel lines, fuel Air in the fuel system tank standpipe and fuel filters as necessary. Vent air from the system. Refer to Section 5. OK Fuel filter or fuel suction line is restricted Replace the fuel filter. Refer to Section 5. OK -Operate the engine from a tank of high-quality Fuel grade is not correct for the application or fuel. Refer to Fuel Recommendations and the fuel quality is poor Specifications in Section V. OK Contact a Cummins Authorized Repair Facility

Engine Vibration Excessive

Cause		Correction
Belt-driven accessories are malfunctioning		Check the fan hub, alternator, refrigerant compressor, and hydraulic pump for interference. Isolate belt-driven accessories and check for vibration. Refer to Section 3 and Section 4.
OK ▼		
Air compressor pumping time is excessive		Refer to the Air Compressor Cycles Frequently symptom tree.
OK •	L	
Engine idle speed is set too low		Adjust the idle speed. Refer to a Cummins Authorized Repair Facility.
OK •		
Engine mounts are worn, damaged, or not correct		Check the engine mounts. Refer to the OEM service manual.
OK ▼		
Fan is loose, damaged, or has excessive hub bearing end play		Check the fan. Refer to Section 3.
OK ♥		
Engine is misfiring		Refer to the Engine Runs Rough or Misfires symptom tree.
OK ▼	L	
Vibration damper is damaged		Inspect the vibration damper. Refer to Section 7.
OK ₹		
Alternator bearing worn or damaged		Clean and replace the alternator. Refer to the OEM service manual.
OK •		
Contact a Cummins Authorized Repair Facility		

Engine Will Not Crank or Cranks Slowly (Air Starter)

Cause Correction Increase air pressure with an external air Air pressure is low in the air tanks source. Refer to the OEM service manual, OK Disengage engine-driven units. Refer to the Engine-driven units are engaged OEM Šervice Manual. OK Check the oil level. Verify the oil pan capacity. Lubricating oil level above specification Fill the system to the specified level. Refer to Section V. OK Lubricating oil does not meet specifications for Change the oil and filters. Refer to Section 5. operating conditions Use the oil recommended in Section V. OK Electrical system is "open" (blown fuses, broken wires, or loose connections) Check the fuses, wires, and connections. Refer to the OEM service manual and manufacturer's wiring diagram. OK -Check battery. If the battery is low, check the alternator for proper charging. Charge the Battery charge is low battery, and replace if necessary. Refer to the OEM service manual. OK **50** Check the vehicle, equipment, or vessel Keyswitch circuit is malfunctioning keyswitch circuit. Refer to the OEM service manual. OK Check the battery supply to the starter sole-Starter solenoid is not receiving voltage noid. Refer to the OEM service manual. OK (Continued)

Engine Will Not Crank or Cranks Slowly (Air Starter) (Continued)

Cause

Starting motor is malfunctioning or starting motor is **not** correct

OK **⊘**K

Contact a Cummins Authorized Repair Facility

Correction

Check the starting motor operation. Compare the starting motor with the engine and vehicle specifications. Refer to the manufacturer's instructions.

Engine Will Not Crank or Cranks Slowly (Electric Starter)

Cause Check the battery heater. Refer to the manu-Batteries are cold facturer's instructions. OK Battery cables or connections are loose. Check the battery cables and connections. broken, or corroded (excessive resistance) OK • Check the fuses, wires, and connections. Refer Electrical system is "open" (blown fuses, to the OEM service manual and manufacturbroken wires, or loose connections) er's wiring diagram. OK Check battery. If the battery is low, check the alternator for proper charging. Charge the Battery charge is low battery, and replace if necessary. Refer to the OEM service manual. OK <₽ Check the vehicle, equipment, or vessel Keyswitch circuit is malfunctioning keyswitch circuit. Refer to the OEM service manual. OK • Check the battery supply to the starter sole-Starter solenoid is not receiving voltage noid. Refer to the OEM service manual. OK <₽ Disengage engine-driven units. Refer to the Engine-driven units are engaged OEM Service Manual. OK -€9-Check the oil level. Verify the oil pan capacity. Lubricating oil level above specification Fill the system to the specified level. Refer to Section V. OK (Continued)

Engine Will Not Crank or Cranks Slowly (Electric Starter) (Continued)

Cause

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

OK

Contact a Cummins Authorized Repair Facility

Correction

Change the oil and filters. Refer to Section 5. Use the oil recommended in Section V.

Engine Will Not Reach Rated Speed (RPM)

Cause		Correction
Vehicle speed is too low for adequate cooling with high engine load		Reduce the engine load. Increase the engine (fan) rpm by downshifting.
OK •	<u>.</u>	
Tachometer is not calibrated or is malfunction- ing		Compare the tachometer reading with a handheld tachometer. Replace the tachometer as necessary. Refer to the OEM service manual.
OK	. [
Air-fuel tube leaking, wastegate diaphragm ruptured, or wastegate plumbing damaged		Tighten the fittings, repair plumbing, replace wastegate diaphragm. Refer to the OEM service manual or a Cummins Authorized Repair Facility.
OK .		
Charge air cooler restricted (if equipped)		Inspect the air cooler for internal and external restrictions. Replace the restricted cooler if necessary. Refer to the OEM service manual.
OK	_	
Fuel supply is not adequate		Check the flow through the filter to locate the source of the restriction. Refer to the OEM service manual.
OK ♥	ـا لـ	
Exhaust back pressure too high		Measure and correct if above specification. Refer to a Cummins Authorized Repair Facility.
. OK ❖	f L	
Fuel lift pump is malfunctioning		Check the fuel lift pump for correct operation. Check the pump output pressure. Replace the fuel lift pump if necessary. Refer to a Cummins Authorized Repair Facility.
OK •		
Vehicle parasitics are excessive		Check the vehicle brakes for dragging, transmission malfunction, cooling fan operation cycle time, and engine-driven units. Refer to the OEM service manual.
OK ♥	لـ	
(Continued)		

Engine Will Not Reach Rated Speed (RPM) (Continued)

Cause Correction Engine power output is low Refer to the Engine Power Outlet Low symptom tree. OK Contact a Cummins Authorized Repair Facility

Engine Will Not Shut Off .

Cause Correction Check for loose wires and verify that the fuel shutoff valve is functioning. Refer to the OEM Fuel shutoff is malfunctioning service manual. OK Inspect the air intake ducts. Locate and isolate Engine running on fumes drawn into the air the source of the fumes. Make repairs as needed. Refer to the OEM service manual. intake OK Check the fuel lines, fuel connections, and fuel filters for leaks using the combustible gas Fuel leak detector service tool. Refer to the OEM service manual. OK Contact a Cummins Authorized Repair Facility

Exhaust Smoke Excessive Under Load

Cause		Correction
Engine is being lugged down		Use lower gear.
OK •		
Air in the fuel system		Check for air in the fuel system. Tighten or replace the fuel connections, fuel lines, fuel tank standpipe and fuel filters as necessary. Vent air from the system. Refer to Section 5.
OK •		-
Air filter is restricted	, ,	Check the air filter for restrictions. Refer to Section 4.
OK •		
Intake or exhaust leak		Check intake and exhaust systems for loose or damaged piping connections and/or missing pipe plugs. Check turbocharger and exhaust manifold mounting. Refer to Section 4.
OK •	<u>.</u>	· ·
Engine is cold		Allow the engine to warm to operating temperature. If the engine will not reach operating temperature, refer to the Coolant Temperature Below Normal symptom tree.
OK ♥		
Air-fuel (AFC) control is leaking or obstructed		Check the AFC for leaks. Repair any leaks found, if necessary. Check and clean AFC tubing and fittings for obstructions. Refer to the OEM service manual or a Cummins Authorized Repair Facility.
OK .	J [
Contact a Cummins Authorized Repair Facility		
	. L.	•

Fuel Consumption Excessive

Cause		Correction
Operator technique is not correct .		Refer to Section 1, Operating Instructions.
OK ₹		
Fuel leak		Check the fuel lines, fuel connections, and fuel filters for leaks. Check the fuel lines to the supply tanks. Refer to the OEM service manual.
OK **	(-	-
Hubometer or odometer is miscalibrated	. ,	Check the hubometer and odometer calibrations. Calibrate or replace the hubometer or odometer, if necessary. Calculate fuel consumption with new mileage figures.
OK . ₹		
Hour meter is miscalibrated	.,	Check the hour meter. Calibrate or replace the hour meter if necessary. Calculate fuel consumption with new figures.
OK ▼		
Air intake or exhaust leaks		Check for loose or damaged piping connections and missing pipe plugs. Check the turbocharger and exhaust manifold mounting. Refer to Section 3.
OK ◆		
Air intake system restriction is above specifica- tion		Check the air intake system for restriction. Clean or replace the air filter and inlet piping as necessary. Refer to Section 4.
OK •	_	
Equipment and environmental factors are affecting fuel consumption		Consider ambient temperatures, wind, tire size, axle alignment, routes, and use of aerodynamic aids when evaluating fuel consumption.
OK •	L	
(Continued)		

Fuel Consumption Excessive (Continued)

Cause

Lubricating oil level above specification

OK

Contact a Cummins Authorized Repair Facility

Correction

Check the oil level. Verify the oil pan capacity. Fill the system to the specified level. Refer to Section V.

Fuel in Coolant

Cause

Bulk coolant supply is contaminated

OK •

Contact a Cummins Authorized Repair Facility

Correction

Check the bulk coolant supply. Drain the coolant and replace with noncontaminated coolant. Replace the coolant filters. Refer to Section 5.

Fuel in the Lubricating Oil

Cause Correction Low oil and coolant temperatures can be caused by long idle time (greater than 10 minutes). Shut off the engine rather than idle for long periods. If idle time is necessary, raise the idle speed. OK Bulk oil supply is contaminated Check the bulk oil supply. Drain the oil and replace with noncontaminated oil. Replace the oil filter(s). Refer to Section 5. OK Contact a Cummins Authorized Repair Facility

Fuel or Lubricating Oil Leaking From Exhaust Manifold

Cause	 Correction
Intake air restriction is high	 Check the air intake system for restriction. Refer to the OEM service manual.
OK ❖	 ` .
Turbocharger drain line is restricted .	 Remove the turbocharger drain line and check for restriction. Clean or replace the drain line. Refer to the OEM service manual or an Authorized Cummins Repair Facility.
OK •	
Turbocharger oil seal is leaking	 Check the turbocharger for oil seals and for leaks. Refer to the Turbocharger Leaks Engine Oil or Fuel Symptom tree.
OK 😝	
Contact a Cummins Authorized Repair Facility	

OK

(Continued)

Intake Manifold Air Temperature Above Specification

Correction Inspect the charge air cooler, air conditioner Charge air cooler fins, radiator fins, or air condenser, and radiator fins. Clean, if necesconditioner condenser fins are damaged or sary. Refer to Section 4 and the OEM service obstructed with debris manual. OK 4 Open the cold weather radiator cover or the Cold weather radiator cover or winterfront is winterfront. Maintain a minimum of 387 cm² [60 in²] of opening at all times. Refer to closed Section 1. OK . Check the fan drive belt and water pump belt. Fan drive belt or water pump belt is broken Replace the belts if necessary. Refer to Section A. OK -Inspect the shroud and the recirculation Fan shroud is damaged or missing or the air baffles. Repair, replace, or install, if necessary. recirculation baffles are damaged or missing Refer to the OEM service manual. OK 0 Inspect the radiator shutters. Repair or replace Radiator shutters are not opening completely if necessary. Refer to the manufacturer's or the shutterstat setting is wrong instructions. Check the shutterstat setting. Refer to the OEM service manual. OK Vehicle speed is too low for adequate cooling Reduce the engine load. Increase the engine with high engine load (fan) rpm by downshifting. OK ₩. Verify that the engine and vehicle cooling Vehicle cooling system is not adequate systems are using the correct components. Refer to the OEM vehicle specifications. OK Intake manifold temperature gauge is malfunc-Test the temperature gauge. Refer to the OEM service manual. tioning, if equipped

Intake Manifold Air Temperature Above Specification (Continued)

Cause

Fan is **not** an adequate size for the application

Correction

Verify that the fan is the correct size. Refer to the engine and OEM vehicle specifications.

OK

Contact a Cummins Authorized Repair Facility

Intake Manifold Pressure (Boost) is Below Normal

Cause Correction Check for loose or damaged piping connections and missing pipe plugs. Check the turbocharger and exhaust manifold mounting. Air intake or exhaust leaks Refer to Section 4. OK Check the air intake system for restriction. Clean or replace the air filter and inlet piping as necessary. Refer to Section 4 and Section Air intake system restriction is above specifica-ОК Inspect the charge air cooler for air restrictions Charge air cooler is restricted or leaking or leaks. Refer to Section 4. ОК 0 Refer to the Engine Power Output Low symp-Engine power output is low tom tree. OK Contact a Cummins Authorized Repair Facility



Lubricating Oil Consumption Excessive

Cause Correction Check and clean the crankcase breather and Crankcase ventilation system is plugged vent tube. Refer to Section 3. OK • Lubricating oil does not meet specifications for Change the oil and filters. Refer to Section 5. Use the oil recommended in Section V. operating conditions ОК **-**Verify the correct lubricating oil drain interval. Lubricating oil drain interval is excessive Refer to Section 2. OK Inspect the engine for external oil leaks. Tighten the capscrews, pipe plugs, and fittings. Lubricating oil leak (external) Replace gaskets, if necessary. Refer to Section V for specifications. ОК 0 Check the amount of oil added versus the Verify the oil consumption rate hours of operation. OK **₹** Check the air lines for carbon buildup and Air compressor is pumping lubricating oil into lubricating oil. Refer to a Cummins Authorized the air system Repair Facility. OK Contact a Cummins Authorized Repair Facility

Lubricating Oil Contaminated

Correction Cause Change the oil and filters. Refer to the Lubricating Oil Sludge in the Crankcase Excessive Lubricating oil sludge is excessive symptom tree. OK Change the oil and filters. Refer to Section 5. Lubricating oil is contaminated with coolant or Use the oil recommended in Section V. OK Check the fuel lift pump for correct operation. Check the pump output pressure. Replace the Fuel lift pump is malfunctioning fuel lift pump if necessary. Refer to a Cummins Authorized Repair Facility. OΚ 4 Check the bulk oil supply. Drain the oil and replace with noncontaminated oil. Replace the Bulk oil supply is contaminated oil filter(s). Refer to Section 5. OK 4 Contact a Cummins Authorized Repair Facility

Lubricating Oil Loss

Cause Correction Inspect the engine for external oil leaks. Tighten the capscrews, pipe plugs, and fittings. Replace gaskets, if necessary. Refer to the Lubricating oil leak (external) OEM service manual. OK • Check the oil level. Verify the oil pan capacity. Lubricating oil level below specification Fill the system to the specified level. Refer to Section V. OK Lubricating oil does not meet specifications for Change the oil and filters. Refer to Section 5. operating conditions Use the oil recommended in Section V. OK Check the oil pressure switch, gauge, or sensor for correct operation and location. Refer Lubricating oil pressure switch, gauge, or sensor is malfunctioning or is not in the correct location toa Cummins Authorized Repair Facility. OK ₽ Check the lubricating oil cooler for coolant leaks and cracks. Refer to the OEM service Lubricating oil cooler is leaking manual or a Cummins Authorized Repair Facility. ОК 4 Check the air lines for carbon buildup and Air compressor is pumping lubricating oil into lubricating oil. Refer to the OEM service the air system manual or a Cummins Authorized Repair Facility. OK Check for excessive blowby. Refer to the OEM Blowby excessive service manual or a Cummins Authorized Repair Facility. OK (Continued)

Lubricating Oil Loss (Continued)

Cause	 Correction
Turbocharger oil seal is leaking	 Check the turbocharger for oil seals and for leaks. Refer to the Turbocharger Leaks Engine Oil or Fuel symptom tree.
OK ▼	
Contact a Cummins Authorized Repair Facility	

Lubricating Oil Pressure High

Cause Correction Refer to the Coolant Temperature Below Coolant temperature is below specification Normal symptom tree. OK • Lubricating oil does not meet specifications for Change the oil and filters. Refer to Section 5. operating conditions Use the oil recommended in Section V. OK Lubricating oil pressure switch, gauge, or sensor is malfunctioning or is **not** in the Check the oil pressure switch, gauge, or sensor for correct operation and location. Refer correct location tothe OEM service manual. ОК 43-Contact a Cummins Authorized Repair Facility



Lubricating Oil Pressure Low

Correction Cause Change the oil and filters. Refer to Section 5. Lubricating oil does not meet specifications for Use the oil recommended in Section V. operating conditions ОК Check for a missing dipstick, rain caps, or oil fill caps. Change the oil. Refer to the OEM Lubricating oil is diluted with water service manual. OK Change the oil and filter. Refer to Section 5. Lubricating oil filter is plugged Use the oil recommended in Section V. OK Refer to the Lubricating Oil Contaminated Lubricating oil is contaminated with coolant or symptom tree. fuel OK -Inspect the engine for external oil leaks. Tighten the capscrews, pipe plugs, and fittings. Lubricating oil leak (external) Replace gaskets, if necessary. Refer to Section V for specifications. OK -€5-Check the oil level. Add or drain oil, if neces-Lubricating oil level is above or below specifisary. Refer to Section 5. Use the oil recommended in Section V. OK -Refer to the Engine Data Sheet, the OEM Engine angularity during operation exceeds service manual, or a Cummins Authorized specification Repair Facility. OK ₽ Check the oil pressure switch, gauge, or Lubricating oil pressure switch, gauge, or sensor for correct operation and location. Refer sensor is malfunctioning or is not in the correct location to the OEM service manual. OK Contact a Cummins Authorized Repair Facility

Repair Facility

Lubricating Oil Sludge in the Crankcase Excessive

Cause Correction Check the bulk oil supply. Drain the oil and replace with noncontaminated oil. Replace the Bulk oil supply is contaminated oil filter(s). Refer to Section 5. Use the oil recommended in Section V. OK 4 Refer to the Coolant Temperature Below Coolant temperature is below specification Normal symptom tree. OK -Check and clean the crankcase breather and Crankcase ventilation system is plugged vent tube. Refer to Section 3. OK Operate the engine from a tank of high-quality Fuel grade is not correct for the application or fuel. Refer to Fuel Recommendations and the fuel quality is poor Specifications in Section V. ОК ₽ Lubricating oil does not meet specifications for Change the oil and filters. Refer to Section 5. operating conditions Use the oil recommended in Section V. OK 43 Contact a Cummins Authorized

Smoke, Black — Excessive

Correction Cause Check the air intake system for restriction. Air intake system restriction is above specifica-Clean or replace the air filter and inlet piping as necessary. Refer to Section 4. OK 4 Check for loose or damaged piping connections and missing pipe plugs. Check the turbocharger and exhaust manifold mounting. Air intake or exhaust leaks Refer to Section 4. OK Inspect the charge air cooler for air restrictions Charge air cooler is restricted or leaking or leaks. Refer to Section 4. OK Contact a Cummins Authorized Repair Facility

Smoke, White — Excessive

Cause Correction Verify the correct starting procedure. Refer to Starting procedure is not correct Section 1. ОК ₽ Allow the engine to warm to operating temperature. If the engine will not reach operating Engine is cold temperature, refer to the Coolant Temperature Below Normal symptom tree. OK Check the winterfront, shutters, and under-thehood air. Use under-the-hood intake air in cold Engine is operating at low ambient temperature weather. Refer to Cold Weather Operation, Bulletin 3387266, and Section 1. OK Check for correct operation of cold-starting aid. Starting aid is malfunctioning Refer to Cold Weather Starting Aids in Section 1. Refer to the manufacturer's instructions. OK Refer to the Coolant Temperature is Below Coolant temperature is below specification Normal symptom tree. OK 0 Operate the engine from a tank of high-quality Fuel grade is not correct for the application or fuel. Refer to Fuel Recommendations and the fuel quality is poor Specifications in Section V. OK -Check for loose or damaged piping connections and missing pipe plugs. Check the Air intake or exhaust leaks turbocharger and exhaust manifold mounting. Refer to Section 4. OK Check the air intake system for restriction. Air intake system restriction is above specifica-Clean or replace the air filter and inlet piping tion as necessary. Refer to Section 3. OK (Continued)

Smoke, White — Excessive (Continued)

Cause Charge air cooler is restricted or leaking OK Contact a Cummins Authorized Repair Facility Correction Correction Inspect the charge air cooler for air restrictions or leaks. Refer to Section 4.

Turbocharger Leaks Engine Oil or Fuel

Cause Correction Engine is operating for extended periods under Review the engine operating instructions. light or no-load conditions (slobbering) Refer to Section 1. OΚ Lubricating oil or fuel is entering the turbo-Remove the intake and exhaust piping, and check for oil or fuel. Refer to Section 3. charger OK Remove the turbocharger drain line and check Turbocharger drain line is restricted for restriction. Clean or replace the drain line. Refer to a Cummins Authorized Repair Facility. OK -Check and tighten oil supply line fitting(s), if necessary. Refer to a Cummins Authorized Turbocharger oil supply line loose or leaking Repair Fácility. OK • Contact a Cummins Authorized Repair Facility

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General Engine

Specifications	
Horsepower	efer to engine dataplate
Engine Weight (Dry) Less Flywheel and Electronics B4.5 (naturally aspirated) B4.5 and B3.9 (turbocharged) B5.9	
Compression Ratio	18:1
Bore B3.9, B4.5, and B5.9	102 mm [4.02 in]
Stroke B4.5	138 mm [5.42 in] 120 mm [4.72 in]
Displacement	4.5 liters [2/5 U.I.D.]
Firing Order B3.9 and B4.5 B5.9	1-3-4-2 1-5-3-6-2-4
Valve Clearance IntakeExhaust	0.51 חווו נס.טבט ווון
Crankshaft Rotation (viewed from the front of the engine)	Clockwise
Fuel System	
Specifications	
For performance and fuel rate values, refer to the Engine Data Sheet or the fuel injection pum involved.	p for the particular model
Distributor-Type and In-Line-Type Fuel Injection Pumps Engine Idle Speed Maximum Fuel Inlet Restriction to Lift Pump Maximum Allowable Return Line Restriction Fuel Pressure Range at Fuel Filter Outlet (engine cranking) Fuel Pressure Range at Fuel Filter Inlet (engine running at idle) Maximum Pressure Drop across Fuel Filter Fuel Drain Line Maximum Restriction Fuel Transfer Pump Minimum Output Pressure (low flow) Fuel Transfer Pump Minimum Output Pressure (high flow) Minimum Fuel Injection Pump Gallery Pressure (low flow fuel transfer pump) Minimum Fuel Injection Pump Gallery Pressure (high flow fuel transfer pump) Fuel Inlet Maximum Temperature	69 kPa [20 in Hg] 21 to 28 kPa [3 to 4 psi] 34 to 48 kPa [5 to 7 psi] 34 kPa [5 psi] 70 kPa [10 psi] 172 kPa [25 psi] 82.7 kPa [12 psi] 140 kPa [20 psi]
Engine Minimum Cranking Speed	110 rpm
Lubricating Oil System	•
Specifications	
Oil Pressure Low Idle (minimum allowed) At Rated Speed (minimum allowed)	בטי או מ ניט ף און
Regulated Pressure (B3.9, B4.5, and B5.9)	345 kPa [50 psi]
Oil Capacity of Standard Engine Standard Pan Only	

B3.9 and B4.5 B5.9	9.5 liters [10 qt]
IUIdi Oysieiii	
B3.9 and B4.5	
Deep Sump	10.0 жого (17.2 чц
Pan Only B3.9 and B4.5	14.5 liters [15.3 at]
B5.9	24.0 liters [25.4 qt]
B3.9 and B4.5	15.9 liters [16.8 at]
B5.9 Oil Pan Low - High	26.1 liters [27.6 qt]
Standard Pan	•
B3.9 and B4.5	
B5.9 Deep Sump	
B3.9 and B4.5 B5.9	
NOTE: Some applications use a slightly different lubricating oil pan capacit	Contact your local Cumming Authorized
Repair Facility if you have questions.	y. Contact your local Cullimins Authorized
Cooling System	
Specifications	
Coolant Capacity (engine only)	
B3.9 and B4.5 B5.9	
Standard Modulating Thermostat - Range	
Maximum Allowed Operating Temperature	
Minimum Recommended Operating Temperature	7 4
Minimum Recommended Pressure Cap	
Maximum Recommended Pressure Cap	
Air Intake System	
Specifications	
Maximum Intake Restriction	
Clean Air Filter Element Dirty Air Filter Element	
Recommended Intake Piping Size (inner diameter)	
B3.9 and B4.5	
	101.6 mm [4 in]
Exhaust System	
Specifications	
Maximum Back Pressure from Piping and Silencer (combined)	76 mm Hg 13 in Hg1
H ₂ O	1016 mm H ₂ O [40 in H ₂ O]
Recommended Exhaust Piping Size (inner diameter)	
B3.9 and B4.5	
Electrical System	
· · · · · · · · · · · · · · · · · · ·	

Specifications

Minimum Recommended Battery Capacity @ -18°C [0°F]

12–VDC Starter	
With Light Accessories ⁽¹⁾	COE CCA
B3.9 B5.9	020 CCA
	600 CCA
With Heavy Accessories ⁽²⁾	የሰባ ድርለ
B3.9	000 CCA
	950 CCA
24–VDC Starter	
With Light Accessories ⁽¹⁾	400.004
B3.9	400 CCA
B5.9	400 CCA
With Heavy Accessories ⁽²⁾ B3.9	400 CCA
B3.9	475 CCA
B5.9	475 CCA
Maximum Allowable Starting Circuit Resistance	•
12-VDC	0.001 ohm
12-VDC	0.002 ohms
1. Typical light accessories include alternator, small steering pump, and disengaged clutch.	
2. Typical heavy accessories include hydraulic pump and torque converter.	

Cummins/Fleetguard® Filter Specifications

General Information

Fleetguard® is a subsidiary of Cummins Inc. Fleetguard® filters are developed through joint testing at Cummins and Fleetguard®. Fleetguard® filters 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 should insist on products that the supplier has tested to meet Cummins high-quality standards.

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

		Fi	lter Part Numbe	rs		
	Lubricating Oil Filter B3.9	Lubricating Oil Filter B4.5	Lubricating Oil Filter B5.9	Fuel Filter B3.9	Fuel Filter B4.5	Fuel Filter B5.9
Cummins Part Number	3934429	3934429	3934430	3966139	3991350	3900632
Fleetguard® Part Number	LF9100	LF9100	LF9098	FF9413	FS19608	FF9417

Fuel Recommendations and Specifications

Fuel Recommendations



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

△ CAUTION △

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

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

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

NOTE: Lighter fuels can reduce fuel economy.

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

The following chart lists acceptable substitute fuels for this engine.

Acceptable Substitute Fuels									
Number 1D Diesel ^{(1) (2)}	Number 2D Diesel ⁽³⁾	Number 1K Kerosene	Jet-A	Jet-A1	JP-5	JP-8	Jet-B	JP-4	CITE
А	OK	Not OK	Α	Α	А	А	Not OK	Not OK	Not OK

- An "A" means OK only if fuel lubricity is adequate. This means the BOCLE number is 3100 or greater as measured with the U.S. Army scuffing BOCLE test. The limits for acceptable lubricity are specified as a wear scar diameter ≤ 400 micrometers using the highfrequency reciprocating rig test method.
- 2. Any adjustment to compensate for reduced performance with a fuel system using alternate fuel is not warrantable.
- Winter blend fuels, such as found at commercial fuel-dispensing outlets, are combinations of number 1D and 2D diesel fuels and are acceptable.

Additional information for fuel recommendations and specifications can be found in Fuel for Cummins Engines, Bulletin 3379001. See ordering information in the back of this manual.

Lubricating Oil Recommendations and Specifications

General Information

△ CAUTION △

A sulfated ash limit of 1.85 percent has been placed on all engine lubricating oils recommended for use in Cummins engines. Higher ash oils can cause valve and/or piston damage and lead to excessive oil consumption.

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.

Cummins Inc. recommends the use of high-quality SAE 15W-40 heavy-duty engine oil, such as Valvoline® Premium Blue®, which meets performance specifications as listed below.

NOTE: In areas where CH-4/SJ or CG-4/SH oils are not available, refer to Oil Drain Intervals in Section 2.

Cummins Engineering Standard Classification (CES)	American Petro- leum Institute Classification (API)	International Clas- sifications	Comments
·	API CD API CE API CG-4/SH	ACEA E-1	OBSOLETE. DO NOT USE.
CES-20075	API CF-4/SG	ACEA E-2 ACEA E-3 JAMA DH-1	Minimum acceptable oil classification for midrange engines.
CES-20071 CES-20076	API CH-4/SJ API CH-4	Global DHD-1	Acceptable oil classification for midrange engines.
CES-20072 CES-20077	API CH-4	ACEA E-5 Global DHD-1	Similar in performance to CES-20071 but validated under European test stan- dards. Excellent oil for midrange en- gines.
CES-20078	API CI-4/SK API CI-4		Excellent oil for midrange engines.

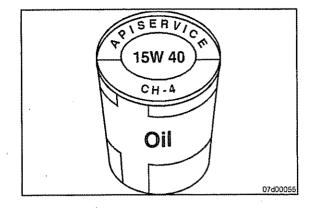
A sulfated ash limit of 1.0 mass percent is suggested for optimum valve and piston deposit and oil consumption control.

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

The API service symbols are shown in the accompanying illustration. The upper half of the symbols displays the appropriate oil categories.

The lower half can contain words to describe oil energyconserving features.

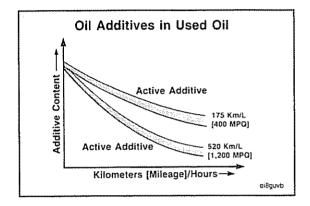
The center section identifies the SAE oil viscosity grade.



As the engine oil becomes contaminated, essential oil additives are depleted. Lubricating oils protect the engine as long as these additives are functioning properly. Progressive contamination of the oil between oil and filter change intervals is normal. The amount of contamination will vary depending on the operation of the engine, kilometers or miles on the oil, fuel consumed, and new oil added.

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

Refer to the oil drain chart in this section to determine which oil drain interval to use for your application.



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 as is used in normal operation.

Additional information regarding lubricating oil availability throughout the world is available in the EMA Lubricating Oils Data Book for Heavy-Duty Automotive and Industrial Engines. The data book can be ordered from the Engine Manufacturers Association, Two North LaSalle Street - Suite 2200, Chicago, IL, U.S.A. 60602. The telephone number is (312) 827-8733.

Arctic Operation

▲ CAUTION ▲

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

The use of low-viscosity oils, such as 10W or 10W-30, can be used to aid in starting the engine and in providing sufficient oil flow at ambient temperatures below -5°C [23°F]. However, continuous use of low-viscosity oils can decrease engine life due to wear. Refer to the accompanying chart.

If an engine is operated in ambient temperatures consistently below -23°C [-9°F] and there are no provisions to keep the engine warm when it is **not** in operation, use a synthetic CH/SI or CH/SK or higher API classification engine oil with adequate low-temperature properties such as 5W-20 or 5W-30.

The oil supplier is responsible for meeting the performance service specifications represented with its product.

Coolant Recommendations and Specifications

Fully Formulated Coolant/Antifreeze

Use low-silicate antifreeze that meets ASTM4985 (GM6038M specification) criteria.

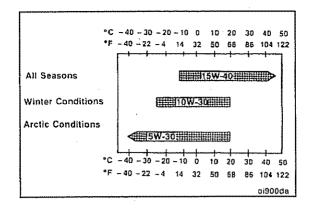
Fully formulated coolant must meet ASTM D-6210/D-6211.

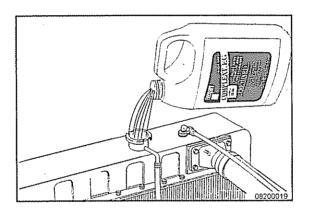
Cummins Inc. recommends using either a 50/50 mixture of good-quality water and fully formulated antifreeze, or fully formulated coolant when filling the cooling system.

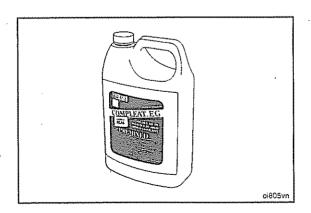
Good-quality water is important for cooling system performance. Excessive levels of calcium and magnesium contribute to scaling problems, and excessive levels of chlorides and sulfates cause cooling system corrosion.

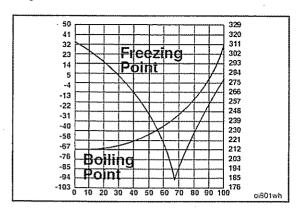
Water Quality				
Calcium Magnesium Maximum 170 ppm as $(CaCO_3 + MgCO^3)$				
Chloride	40 ppm as (CI)			
Sulfur	100 ppm as (SO₄)			

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

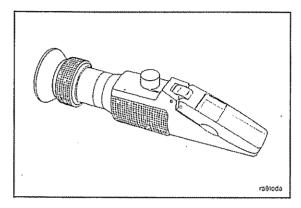






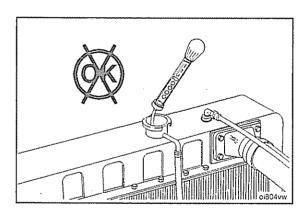


Fully formulated antifreeze must be mixed with good-quality water at a 50/50 ratio (40- to 60-percent working range). A 50/50 mixture of antifreeze and water gives a -36°C [-33°F] freezing point and a 108°C [226°F] boiling point, which is adequate for locations in North America. The actual lowest freezing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

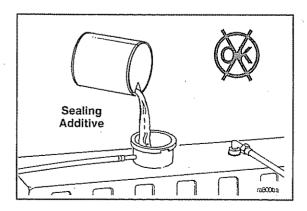




A refractometer **must** be used to measure the freezing point of the coolant **accurately**. Use Fleetguard® refractometer, Part Number CC2800 or CC2806.



Do **not** use a floating ball hydrometer. Using 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.

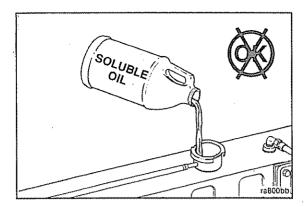
B3.9, B4.5, B5.9 Industrial Section V - Maintenance Specifications

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.

Coolant Recommendations and Specifications Page V-9



Drive Belt Tension

Tension Chart

SAE Belt Size	Belt Tension G	Belt Tens	sion New	Belt Tension Range Used*			
	Click-type	-type Burroughs		lbf	N	lbf	
0.380 in	3822524		620	140	270 to 490	60 to 110	
0.440 in	3822524		620	140	270 to 490	60 to 110	
1/2 in	3822524	ST-1138	620	140	270 to 490	60 to 110	
11/16 in	3822524	ST-1138	620	140	270 to 490	60 to 110	
3/4 in	3822524	ST-1138	620	140	270 to 490	60 to 110	
7/8 in	3822524	ST-1138	620	140	270 to 490	60 to 110	
4 rib	3822524	ST-1138	620	140	270 to 490	60 to 110	
5 rib	3822524	ST-1138	670	150	270 to 530	60 to 120	
6 rib	3822525	ST-1293	710	160	290 to 580	65 to 130	
8 rib	3822525	ST-1293	890	200	360 to 710	80 to 160	
10 rib	3822525	3823138	1110	250	440 to 890	100 to 200	
12 rib	3822525	3823138	1330	300	530 to 1070	120 to 240	
12 rib K section	3822525	3823138	1330	300	890 to 1070	200 to 240	

NOTE: This chart does not apply to automatic belt tensioners.

Engine Component Torque Values

General Information

Component	Wrench Size	N∘m	ft-lb or in-lb	
Aftercooler Mounting	10 mm	24	18 ft-lb	
Aftercooler Water Hose Clamp	8 mm	5	44 in-lb	
Alternator Link (Delco 10-15 SI)	13 mm	24	18 ft-lb	
Alternator Link (Delco 20-27 SI)	3/4 in	43	32 ft-lb	
Alternator Mtg. Bolt 10-15 SI	15 mm	43	32 ft-lb	
Alternator Mtg. 27 SI	18 mm	77	57 ft-lb	
Alternator Support (Upper)	10 mm	24	18 ft-lb	
Belt Tensioner Flat Bracket	Allen 5 mm	24	18 ft-lb	
Belt Tensioner Mounting	15 mm	43	32 ft-lb	
Crankshaft Damper and Pulley	15 mm	137	101 ft-lb	
Crossover Clamp	5/16 in	5	44 in-lb	
Tee Bolt Type Clamp	11 mm	11 mm 8		
Exhaust Outlet Pipe, V Band Clamp	7/16 in	8	71 in-lb	
Fan Bracket Mounting	10 mm	24	18 ft-lb	
Fan Pulley	10 mm	. 24	18 ft-lb	
Fan Pulley	13 mm	13 mm 43		
Fuel Filter	75 to 85 mm	Install as specified by fi manufacturer		
Fuel Filter Adapter Nut	24 mm	32	24 ft-lb	
Lubricating Oil Filter	75 to 85 mm	3/4 Turn	after Contact	
Lubricating Oil Cooler Assembly	10 mm	24	18 ft-lb	
Lubricating Oil Pan Drain Plug (steel)	17 mm	17 mm 80		
Lubricating Oil Pan Drain Plug (aluminum)	17 mm	55	41 ft-lb	
(Continued)				

(Continued)

^{*} A belt is considered used if it has been in service for ten minutes or longer.

^{*} If used belt tension is less than the minimum value, tighten the belt to the maximum used belt value.

Component	Wrench Size	N∘m	ft-lb or in-lb	
Lubricating Oil Pan Heater Plug	27 mm	80	59 ft-lb	
Lubricating Oil Pressure Regulator Plug	19 mm	80	59 ft-lb	
Starter Mounting	10 mm	43	32 ft-lb	
Thermostat Housing	10 mm	24	18 ft-lb	
Water Inlet Connection	15 mm	43	32 ft-lb	
Water Pump Mounting	13 mm	24	18 ft-lb	
Rocker Lever Cover	15 mm	24	18 ft-lb	
Water-in-Fuel Sensor	19 mm	Har	nd-Tighten	
Top - Load Filter Lid	10 mm	Har	nd-Tighten	

Sealants

General Information

Use the sealants listed below or sealants containing equivalent properties.

Item Description	Sealing Method
Pipe Plugs	Precoated teflon or pipe sealer
Cup Plugs	Loctite 277 or 11,264
O-Rings	Lubriplate™ 105
Rear Camshaft Expansion Plug	Precoated or Loctite 59,241 liquid teflon
Fuel Block Mounting Studs	Loctite 609
Turbocharger Drain in Block	Loctite 277 or 11,264
Front Seal in Gear Cover	Loctite 277 or 11,264
Rear Seal in Rear Cover	No sealant
Oil Pan at T-Joint	Three-Bond™ 1207C (Cummins Part Number 3823494)

Capscrew Markings and Torque Values

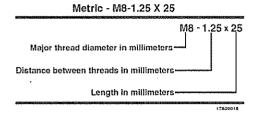
General Information

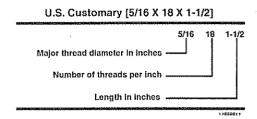
△ CAUTION **△**

When replacing capscrews, always use a capscrew of the same measurement and strength as the capscrew being replaced. Using the wrong capscrews can result in engine damage.

Metric capscrews and nuts are identified by the grade number stamped on the head of the capscrew or on the surface of the nuts. U.S. Customary capscrews are identified by radial lines stamped on the head of the capscrew.

The following examples indicate how capscrews are identified:





NOTES:

- 1. Always use the torque values listed in the following tables when specific torque values are not available.
- 2. Do not use the torque values in place of those specified in other sections of this manual.
- 3. The torque values in the table are based on the use of lubricated threads.
- 4. When the ft-lb value is less than 10, convert the ft-lb value to in-lb to obtain a better torque with an in-lb torque wrench. Example: 6 ft-lb equals 72 in-lb.

Capscrew Markings and Torque Values - Metric

Commercial Steel Class
8.8 10.9 12.9

Capscrew Head Markings













Body Size	Size Torque			Torque				Torque				
Diameter	Cast	Iron	Alum	inum	Cast	Iron	Alum	inum	Cast	Iron	Alum	inum
mm	Nom	ft-lb	N∘m	ft-lb	N∘m	ft-lb	N∘m	ft-lb	N∘m	ft-lb	N∘m	ft-lb
6	9	5	7	4	13	10	7	4	14	9	7	4
7	14	9	11	7	18	14	11	7	23	18	11	7
8	23	17	18	14	33	25	18	14	40	29	18	14
10	45	33	30	25	65	50	30	25	70	50	30	25
12	80	60	55	40	115	85	55	40	125	95	55	40 🗇
14	125	90	90	65	180	133	90	65	195	145	90	65
16	195	140	140	100	280	200	140	100	290	210	140	100
18	280	200	180	135	390	285	180	135	400	290	180	135
20 .	400	290		*******	550	400						

Capscrew Markings and Torque Values - U.S. Customary

·		-
SAE Grade Number	5	8
Capscrew Head Markings	\sim	
These are all SAE Grade 5 (3 line)	
		HA
	~~	
~ ~ ~	Concerny Torque Crode & Concerny	Concerny Torque - Grade 9 Concerny

Capscrew Body Size	UBI	screw lorqu	e - Grade 5 C	apscrew	Capaci	ew jorque -	Grade & Caps	Crew
	Cast Iron		Aluminum		Cast Iron		Aluminum	
	. N•m	ft-lb	N∙m	ft-lb	N∘m	ft-lb	N∙m	ft-lb
1/4 - 20	9	7	8	6	15	11	8	6
1/4 - 28	12	9	9	7	18	13	9	7
5/16 - 18	20	15	16	12	30	22	16	12
5/16 - 24	23	17	19	14	33	24	19	14
3/8 - 16	40	30 .	25	20	55	40	25	20
3/8 - 24	40	30	35	25	60	45	35	25
7/16 - 14	60	45	45	35	90	65	45	35
7/16 - 20	65	50	55	40	· 95	70	55	40
1/2 - 13	95	70	_. 75	55	130	95	75	55
1/2 - 20	100	75	80	60	150	110	80	60
9/16 - 12	135	100	110	80	190	140	110	80
9/16 - 18	150	110	115	85	210	155	115	85
5/8 - 11	180	135	150	110	255	190	150	110
5/8 - 18	. 210	155	160	120	290	215	160	120
3/4 - 10	325	240	255	190	460	340	255	190
3/4 - 16	365	270	285	210	515	380	285	210
7/8 - 9	490	360	380	280	745	550	380	280
7/8 - 14	530	390	420	310	825	610	420	310
1 - 8	720	530	570	420	1100	820	570	420
1 - 14	800	590	. 650	480	1200	890	650	480

Section W - Warranty Section Contents

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Off-Highway Engines United States and Canada	W.1

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Off-Highway Engines United States and Canada

Coverage

Products Warranted

This warranty applies to new Engines sold by Cummins and delivered to the first user on or after April 1, 1999, that are used in industrial (off-highway) applications in the United States* and Canada, except for Engines used in marine, generator drive and certain defense applications, for which different warranty coverage is provided.

Base Engine Warranty

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

Coverage begins with the sale of the Engine by Cummins. Coverage continues for two years or 2,000 hours of operation, whichever occurs first, from the date of delivery of the Engine to the first user, or from the date the unit is first leased, rented or loaned, or when the Engine has been operated for 50 hours, whichever occurs first. If the 2,000 hour limit is exceeded during the first year, Coverage continues until the end of the first year.

Extended Major Components Warranty

The Extended Major Components Warranty covers Warrantable Failures of the Engine cylinder block, camshaft, crankshaft and connecting rods (Covered Parts).

Bushing and bearing failures are not covered.

This Coverage begins with the expiration of the Base Engine Warranty and ends three years or 10,000* hours of operation from the date of delivery of the Engine to the first user, or from the date the unit is first leased, rented or loaned, or from when the Engine has been operated for 50 hours, whichever occurs first.

*3,000 hours for A series engines.

Consumer Products

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

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

Cummins' Responsibilities

During The Base Engine Warranty

Cummins will pay for all parts and labor needed to repair the damage to the Engine resulting from a Warrantable Failure.

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

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

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

During The Extended Major Components Warranty

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

Owner's Responsibilities

During The Base Engine Warranty

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

During The Extended Major Components Warranty

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

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

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

During The Base Engine and Extended Major Components Warranties

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

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

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

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

Limitations

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

For power units and fire pumps (package units), this warranty applies to accessories, except for clutches and filters, supplied by Cummins which bear the name of another company.

Except for power units and fire pumps, this warranty does not apply to accessories which bear the name of another company. Such non-warranted accessories include, but are not limited to: alternators, starters, fans**, air conditioning compressors, clutches, filters, transmissions, torque converters, steering pumps, and non-Cummins fan drives, engine compression brakes and air compressors.

Cummins Compusave units are covered by a separate warranty.

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

Failures of belts and hoses supplied by Cummins are not covered beyond the first 500 hours or one year of operation, whichever occurs first.

Parts used to repair a Warrantable Failure may be new Cummins parts, Cummins-approved rebuilt parts, or repaired parts. Cummins is not responsible for failures resulting from the use of parts not approved by Cummins.

A new Cummins or Cummins-approved rebuilt part used to repair a Warrantable Failure assumes the identity of the part it replaced and is entitled to the remaining coverage hereunder.

CUMMINS DOES NOT COVER WEAR OR WEAROUT OF COVERED PARTS.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

THESE WARRANTIES SET FORTH HEREIN ARE THE SOLE WARRANTIES MADE BY CUMMINS IN REGARD TO THESE ENGINES. CUMMINS MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Emission Warranty

Products Warranted

This emission warranty applies to new Engines marketed by Cummins that are used in the United States* in vehicles designed for Industrial off-highway use. This warranty applies to Engines delivered to the ultimate purchaser on or after April 1, 1999 for engines up to 750 horsepower, on or after January 1, 2000 for engines 751 horsepower and over.

Coverage

Cummins warrants to the ultimate purchaser and each subsequent purchaser that the Engine is designed, built and equipped so as to conform at the time of sale by Cummins with all U.S. Federal emission regulations applicable at the time of manufacture and that it is free from defects in workmanship or material which would cause it not to meet these regulations within the longer of the following periods: (A) Five years or 3,000 hours of operation, whichever occurs first, as measured from the date of delivery of the Engine to the ultimate purchaser, or (B) The Base Engine Warranty.

If the vehicle in which the Engine is installed is registered in the state of California, a separate California Emission Warranty also applies.

Limitations

Failures, other than those resulting from defects in materials, or workmanship, are not covered by this warranty.

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

Cummins is not responsible for non-Engine repairs, "downtime" expenses, cargo damage, fines, all business costs or other losses resulting from a Warrantable Failure.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

- * Includes American Samoa, the Commonwealth of Northern Mariana Islands, Guam, Puerto Rico, and the U.S. Virgin Islands.
- ** Alternators, starters, and fans ARE covered for the duration of the base engine warranty on A series and B3.3 engines.

Off-Highway Engines International

Coverage

PRODUCTS WARRANTED

This warranty applies to new Engines sold by Cummins and delivered to the first user on or after April 1, 1999, that are used in industrial (off-highway) applications anywhere in the world where Cummins-approved service is available, except the United States* and Canada. Different warranty coverage is provided for Engines used in marine, generator drive and certain defense applications.

BASE ENGINE WARRANTY

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

Coverage begins with the sale of the Engine by Cummins. Coverage continues for two years or 2,000 hours of operation, whichever occurs first, from the date of delivery of the Engine to the first user, or from the date the unit is first leased, rented or loaned, or when the Engine has been operated for 50 hours, whichever occurs first. If the 2,000 hour limit is exceeded during the first year, coverage continues until the end of the first year.

EXTENDED MAJOR COMPONENTS WARRANTY

The Extended Major Components Warranty covers Warrantable Failures of the Engine cylinder block, camshaft, crankshaft and connecting rods (Covered Parts).

Bushing and bearing failures are not covered.

This coverage begins with the expiration of the Base Engine Warranty and ends three years or 10,000* hours of operation, from the date of delivery of the Engine to the first user, or from the date the unit is first leased, rented or loaned, or from when the Engine has been operated for 50 hours, whichever occurs first.

*3,000 hours for A series engines.

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

Cummins' Responsibilities

DURING THE BASE ENGINE WARRANTY

Cummins will pay for all parts and labor needed to repair the damage to the Engine resulting from a Warrantable Failure.

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

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

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

DURING THE EXTENDED MAJOR COMPONENTS WARRANTY

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

Owner's Responsibilities

DURING THE BASE ENGINE WARRANTY

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

DURING THE EXTENDED MAJOR COMPONENTS WARRANTY

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

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

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

DURING THE BASE ENGINE AND EXTENDED MAJOR COMPONENTS WARRANTIES

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

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

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

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

Limitations

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

For power units and fire pumps (package units) the warranty applies to accessories, except for clutches and filters supplied by Cummins which bear the name of another company.

Starters, alternators, power steering pumps and non-Cummins air compressors supplied by Cummins on B or C Series Engines that are not supplied as part of a package unit are covered for six months* from the date of delivery of the Engine to the first user, or the date the Engine is first leased, rented or loaned, or from when the Engine has been operated for 50 hours, whichever occurs first.

Except for the accessories noted previously, Cummins does not warrant accessories which bear the name of another company. Such non-warranted accessories include, but are not limited to: alternators, starters, fans*, air conditioning compressors, clutches, filters, transmissions, torque converters, steering pumps, non-Cummins fan drives, and air cleaners

Cummins Compusave units are covered by a separate warranty.

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

Failures of belts and hoses supplied by Cummins are not covered beyond the first 500 hours or one year of operation, whichever occurs first.

Parts used to repair a Warrantable Failure may be new Cummins parts, Cummins-approved rebuilt parts, or repaired parts. Cummins is not responsible for failures resulting from the use of parts not approved by Cummins.

A new Cummins or Cummins-approved rebuilt part used to repair a Warrantable Failure assumes the identity of the part it replaced and is entitled to the remaining coverage hereunder.

CUMMINS DOES NOT COVER WEAR OR WEAROUT OF COVERED PARTS.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

THESE WARRANTIES SET FORTH HEREIN ARE THE SOLE WARRANTIES MADE BY CUMMINS IN REGARD TO THESE ENGINES. CUMMINS MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

In case of consumer sales, in some countries, the Owner has statutory rights which cannot be affected or limited by the terms of this warranty.

Nothing in this warranty excludes or restricts any contractual rights the Owner may have against third parties.

* Alternators, starters, and fans ARE covered for the duration of the base engine warranty on A series and B3.3 engines.



California Emission Control System Warranty, Off-Highway

Products Warranted

This Emission Control System Warranty applies to off-road diesel engines certified with the California Air Resources Board beginning with the year 1996 for engines up to 750 horsepower, beginning with the year 2000 for 751 horsepower and over, marketed by Cummins, and registered in California for use in industrial off-highway applications.

Your Warranty Rights and Obligations

The California Air Resources Board and Cummins Engine Company, Inc., are pleased to explain the emission control system warranty on your engine. In California, new off-road diesel engines must be designed, built and equipped to meet the State's stringent anti-smog standards. Cummins must warrant the emission control system on your engine for the periods of time listed below provided there has been no abuse, neglect or improper maintenance of your engine.

Your emission control system may include parts such as the fuel injection system and the air induction system. Also included may be hoses, belts, connectors and other emission-related assemblies.

Where a warrantable condition exists, Cummins will repair your off-road diesel engine at no cost to you including diagnosis, parts and labor.

Manufacturer's Warranty Coverage

This warranty coverage is provided for 5 years or 3,000 hours of engine operation, whichever first occurs from the date of delivery of the engine to the first user. If any emission-related part on your engine is defective, the part will be repaired or replaced by Cummins.

Coverage

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

Fuel Pump

Static Timing Delivery Valve

Injection Control Valve Module

Injectors

Spring

Calibration Needle Nozzle

Turbocharger

Compressor Wheel Turbine Wheel Turbine Oil Seal Wastegate Valve

Intake Manifold

Charge Air Cooler Aftercooler

Exhaust Manifold

Oxidation Catalyst

Electronic Control System

Control Module Boost Pressure Sensor Coolant Temperature Sensor Fuel Pressure Sensor

Owner's Warranty Responsibilities

As the off-road diesel engine owner, you are responsible for the performance of the required maintenance listed in your Cummins Operation and Maintenance Manual. Cummins recommends that you retain all receipts covering maintenance on your off-road diesel engine, but Cummins cannot deny warranty solely for the lack of receipts or for your failure to ensure the performance of all scheduled maintenance.

You are responsible for presenting your off-road diesel engine to a Cummins dealer as soon as a problem exists. The warranty repairs should be completed in a reasonable amount of time, not to exceed 30 days.

As the off-road diesel engine owner, you should also be aware that Cummins may deny you warranty coverage if your off-road diesel engine or a part has failed due to abuse, neglect, improper maintenance or unapproved modifications.

Your engine is designed to operate on diesel fuel only. Use of any other fuel may result in your engine no longer operating in compliance with California's emissions requirements.

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

Prior to the expiration of the applicable warranty, Owner must give notice of any warranted emission control failure to a Cummins distributor, authorized dealer or other repair location approved by Cummins and deliver the engine to such facility for repair. Repair locations are listed in Cummins United States and Canada Service Directory.

Owner is responsible for incidental costs such as: communication expenses, meals, lodging incurred by Owner or employees of Owner as a result of a warrantable failure.

Owner is responsible for business costs and losses, "downtime" expenses, and cargo damage resulting from a warrantable failure. CUMMINS IS NOT RESPONSIBLE FOR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDE BUT ARE NOT LIMITED TO FINES, THEFT, VANDALISM OR COLLISIONS.

Replacement Parts

Cummins recommends that any service parts used for maintenance, repair or replacement of emission control systems be new, genuine Cummins or Cummins approved rebuilt parts and assemblies, and that the engine be serviced by a Cummins distributor, authorized dealer or the repair location approved by Cummins. The owner may elect to have maintenance, replacement or repair of the emission control parts performed by a facility other than a Cummins distributor, an authorized dealer or a repair location approved by Cummins, and may elect to use parts other than new genuine Cummins or Cummins approved rebuilt parts and assemblies for such maintenance, replacement or repair; however, the cost of such service or parts will not be covered under this emission control system warranty.

Cummins Responsibilities

Repairs and service will be performed by any Cummins distributor, authorized dealer or other repair location approved by Cummins using new, genuine Cummins or Cummins approved rebuilt parts and assemblies. Cummins will repair any of the emission control parts found by Cummins to be defective without charge for parts or labor (including diagnosis which results in determination that there has been a failure of a warranted emission control part).

Emergency Repairs

In the case of an emergency where a Cummins distributor, authorized dealer, or other repair location approved by Cummins is not available, repairs may be performed by any available repair location using any replacement parts. Cummins will reimburse the Owner for expenses (including diagnosis), not to exceed the manufacturer's suggested retail price for all warranted parts replaced and labor charges based on the manufacturer's recommended time allowance for the warranty repair and the geographically appropriate hourly labor rate. A part not being available within 30 days or a repair not being complete within 30 days constitutes an emergency. Replaced parts and paid invoices must be presented at a Cummins authorized repair facility as a condition of reimbursement for emergency repairs not performed by a Cummins distributor, authorized dealer, or other repair location approved by Cummins.

Warranty Limitations

Cummins is not responsible for failures resulting from Owner or operator abuse or neglect, such as: operation without adequate coolant, fuel or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or air intake systems; improper storage, starting, warm-up, run-in or shutdown practices.

The manufacturer warrants to the ultimate purchaser and each subsequent purchaser that the engine is designed, built, and equipped so as to conform with all applicable regulations adopted by the Air Resources Board, and that it is free from defects in materials and workmanship which cause the failure of a warranted part.

Any warranted part which is not scheduled for replacement as required maintenance, or which is scheduled only for regular inspection to the effect of "repair or replace as necessary" is warranted for the warranty period.

Any warranted part which is scheduled for replacement as required maintenance is warranted for the period of time prior to the first scheduled replacement point for that part.

The owner will not be charged for diagnostic labor which leads to the determination that a warranted part is defective, if the diagnostic work is performed at a warranty station.

The manufacturer is liable for damages to other engine components caused by the failure under warranty of any warranted part.

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

These warranties, together with the express commercial warranties and emission warranty are the sole warranties of Cummins. There are no other warranties, express or implied, or of merchantability or fitness for a particular purpose.

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Cummins Customized Parts Catalog

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. Your name and engine model identification even appears on the catalog spine. Everybody will know that Cummins created a catalog specifically for you.

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

Additional Features of the Customized Catalog include:

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

ORDERING THE CUSTOMIZED PARTS CATALOG

Ordering by Telephone:

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

Ordering On-Line

The Customized Parts Catalog can be ordered On-Line from the Cummins Powerstore by credit card. Contact the Powerstore at WWW.CUMMINS.powerstorecom

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

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

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

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

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

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Name: Company: Street Address: City: Country:	State/Province:		

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