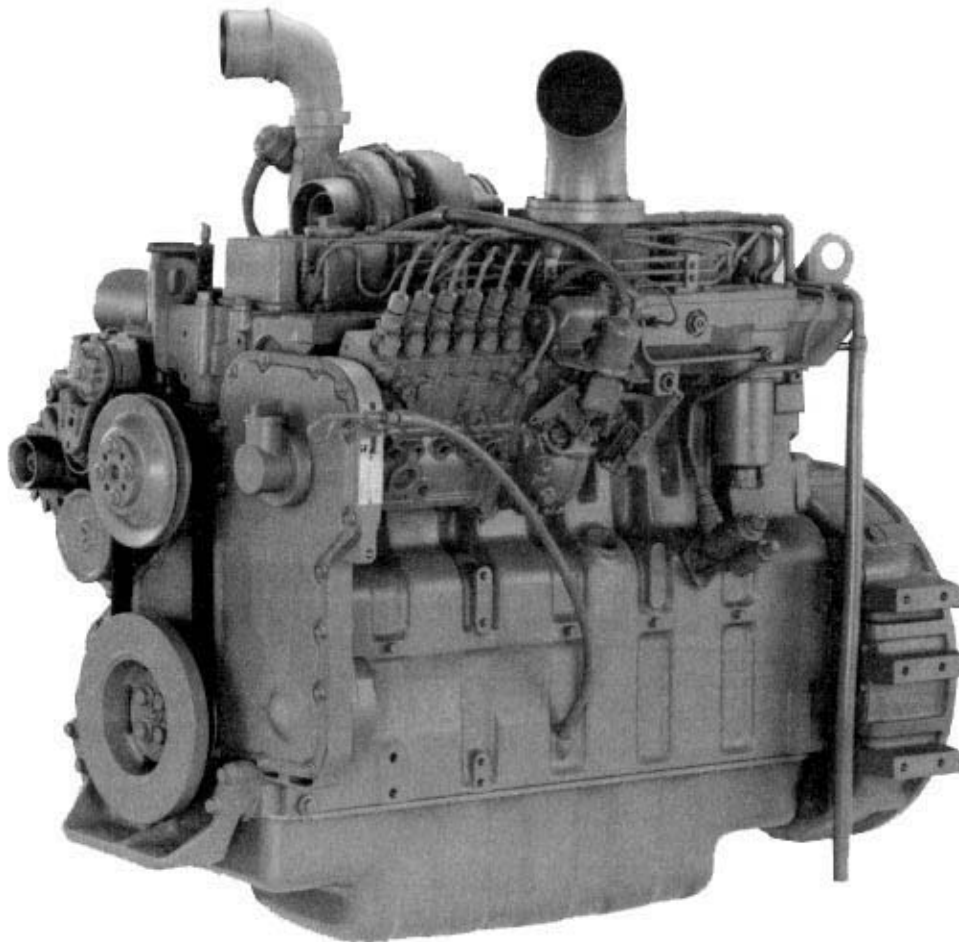

WORKSHOP MANUAL SERIE C CUMMINS ENGINES

Workshop manual integration of the following models:

EX255 - EX285 - FH270

G170 - G200 - FG75A - FG85A + FG105A

W170 - W190 - W230

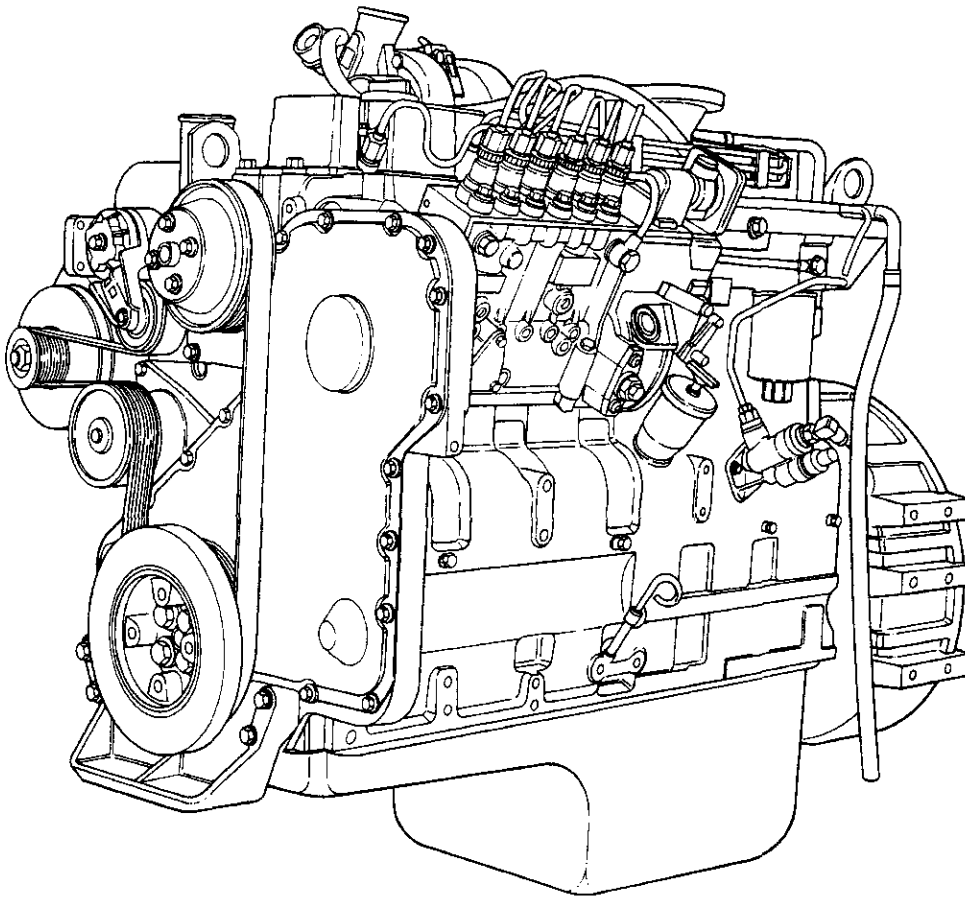


All information, illustrations and specifications in this manual are based on the latest product information available at the time of publication.

The right is reserved to make changes at any time without notice.



Troubleshooting and Repair Manual C Series Engines



ew900gu

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Section i - Introduction

Section Contents

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About the Manual

This C Series Engine Troubleshooting and Repair Manual is intended to aid in determining the cause of engine-related problems and to provide recommended repair procedures. The manual is divided into sections by system. Each section provides general information, specifications, diagrams, and service tools, where applicable. The specific repair procedures are referenced in the Troubleshooting Symptoms Charts.

How to Use the Manual

This manual is organized to provide an easy flow from problem identification to problem correction. A list of troubleshooting symptoms containing the most common engine problems is in the Troubleshooting Symptoms, Section TS. This manual is designed to use the Troubleshooting Symptoms as a guide in locating the problem and directing the end user to the correct procedure for making the necessary repairs to the engine. Complete the following steps to locate and correct any problems:

1. Locate the symptom on the Section Contents page of Section TS.
2. Reference to the page number where the Troubleshooting Symptom Tree is found is made to the right of the symptom tree title.
3. The left column of boxes in the Troubleshooting Symptom Charts indicates a probable cause of the problem, starting at the top with the simplest and easiest to repair, and continuing downward to the most difficult.
4. The right column of boxes provides a brief description of the corrective action with a reference number to the correct procedure used to make the repair.
5. Locate the probable cause in the left column then turn to the procedure referenced in the right column.

The Trouble shooting Symptom Charts are based on the following assumptions:

- The engine has been installed according to the OEM's specifications.
- The easiest repairs are done first.
- "Generic" solutions to cover problems with the most common applications and OEM.

Refer to Section V for specifications recommended by Cummins Engine Company, Inc. for your engine. Specifications and torque values for each engine system are given in Section V.

Symbols

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



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



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



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



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



INSPECTION is required.



CLEAN the part or assembly.



PERFORM a mechanical or time **MEASUREMENT**.



LUBRICATE the part or assembly.



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



TIGHTEN to a specific torque.



PERFORM an electrical **MEASUREMENT**.



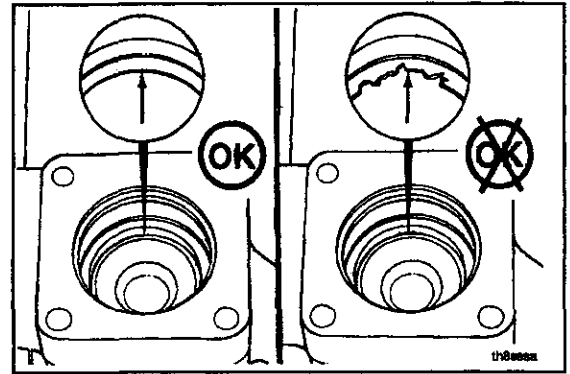
Refer to another location in this manual or another publication for additional information.



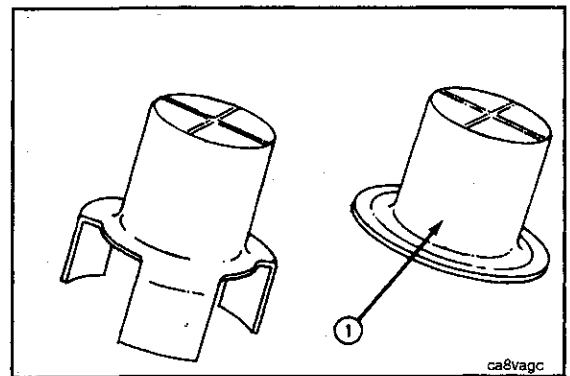
The component weighs 23 kg [50 lb] or more. To avoid personal injury, use a hoist or get assistance to lift the component.

Illustrations

Some of the illustrations throughout this manual are generic and will **not** look exactly like the engine or parts used in your application. The illustrations can contain symbols to indicate an action required and an acceptable or **not** acceptable condition.



The illustrations are intended to show repair or replacement procedures. The procedure will be the same for all applications, although the illustration can differ.



General Safety Instructions

Important Safety Notice

▲ WARNING ▲

Improper practices or carelessness can cause burns, cuts, mutilation, asphyxiation or other bodily 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.

- Make sure the work area surrounding the product 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 you slowly loosen the filler cap and relieve the pressure from the cooling system.
- Do **not** work on anything that is supported **ONLY** by lifting jacks or a hoist. **Always** use blocks or proper stands to support the product before performing any service work.
- Relieve all pressure in the air, oil, fuel and the 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 prevent suffocation and frostbite, wear protective clothing and **ONLY** disconnect fuel and 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 avoid 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 your 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 avoid 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 them 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.
- Coolant is toxic. If **not** reused, dispose of in accordance with local environmental regulations.

General Repair Instructions

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

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 avoid 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.

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 Engine Company, Inc. does not recommend any specific cleaners. Always follow the cleaner manufacturer's instructions.**

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

▲ WARNING ▲

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.

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.

▲ WARNING ▲

Wear protective clothing to prevent personal injury from the high pressure and extreme heat.

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

- | | |
|--------------------------|--------------------|
| 1. Electrical Components | 4. Fuel Pump |
| 2. Wiring | 5. Belts and Hoses |
| 3. Injectors | 6. Bearings |

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.
2. 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.
4. Do **not** contaminate the wash tanks with glass or plastic beads.

Acronyms and Abbreviations

AFC	Air Fuel Control	kPa	Kilopascal
API	American Petroleum Institute	LNG	Liquid Natural Gas
ASA	Air Signal Attenuator	LTA	Low Temperature Aftercooling
ASTM	American Society of Testing and Materials	MIP	Mixer Inlet Pressure
°C	Celsius	MPa	Megapascal
CARB	California Air Resources Board	mph	Miles Per Hour
C.I.D.	Cubic Inch Displacement	mpq	Miles Per Quart
CNG	Compressed Natural Gas	N•m	Newton-meter
CPL	Control Parts List	NG	Natural Gas
cSt	Centistokes	OEM	Original Equipment Manufacturer
ECM	Electronic Control Module	ppm	Parts Per Million
ECS	Emission Control System	psi	Pounds Per Square Inch
EPA	Environmental Protection Agency	PTO	Power Takeoff
EPS	Engine Position Sensor	rpm	Revolutions Per Minute
°F	Fahrenheit	SAE	Society of Automotive Engineers
GVW	Gross Vehicle Weight	SCA	Supplemental Coolant Additive
Hg	Mercury	STC	Step Timing Control
hp	Horsepower	VS	Variable Speed
H₂O	Water	VSS	Vehicle Speed Sensor
ICM	Ignition Control Module		
km/l	Kilometers per Liter		

Section E - Engine Identification

Section Contents

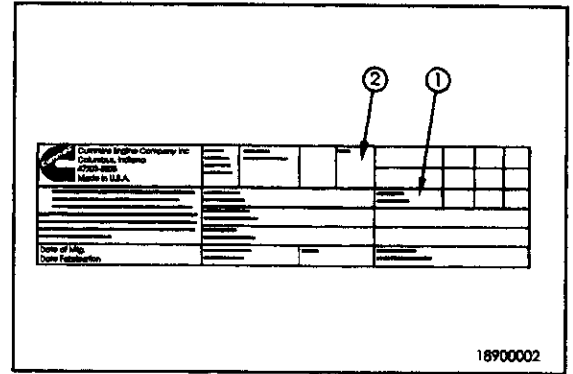
	Page
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Engine Identification	E-1
Cummins Engine Nomenclature	E-1
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Fuel Injection Pump Dataplate	E-1
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Engine Identification

Engine Dataplate

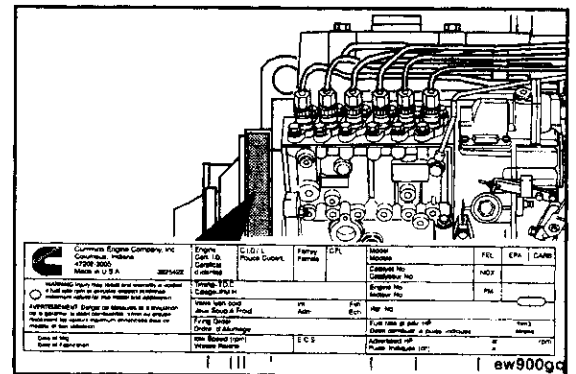
The engine dataplates show specific information about your engine. The engine serial number and control parts list (CPL) provide information for ordering parts and service needs.

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



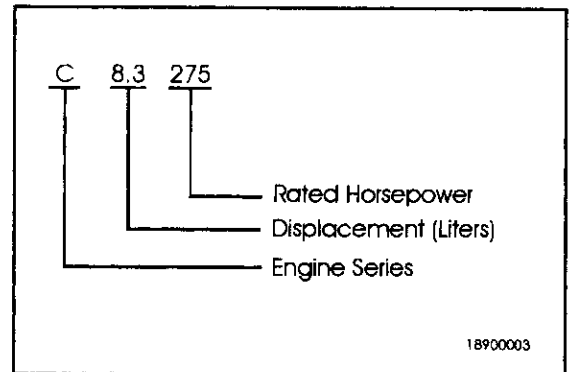
The dataplate is located on the top side of gear cover. Have the following engine data available when communicating with a Cummins Authorized Repair Location. The information on the dataplate is **mandatory** when sourcing service parts.

1. Engine Serial Number (ESN)
2. Control Parts List (CPL).



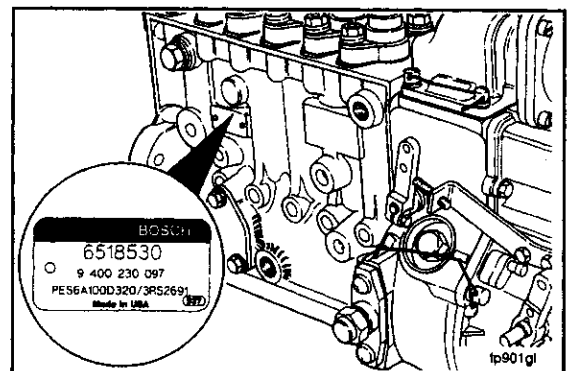
Cummins Engine Nomenclature

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

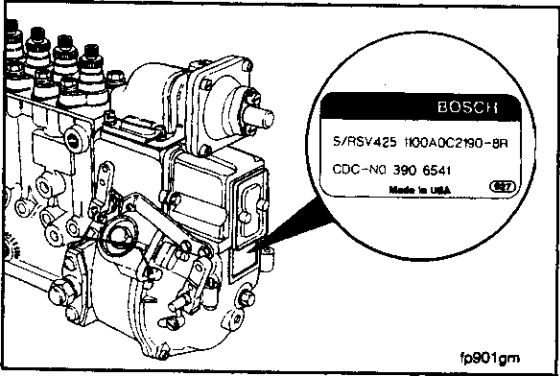


Fuel Injection Pump Dataplate

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



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





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Specifications

General Specifications

Bore and Stroke	114 mm [4.49 in] x 135 mm [5.32 in]
Displacement	8.27 liters [504.5 C.I.D.]
Compression Ratio	17.3:1
Firing Order	1-5-3-6-2-4
Engine Weight (with standard accessories):	
Dry Weight	612 kg [1350 lb]
Wet Weight	658 kg [1450 lb]
Crankshaft Rotation (viewed from the front of the engine)	Clockwise

Fuel System

Fuel Transfer Pump	
Inlet Restriction	100 mm Hg [4 in Hg]
Fuel Transfer Pump Output Pressure	
Minimum @ Rated Speed	
High Flow	172 kPa [25 psi]
Low Flow	83 kPa [12 psi]
Fuel Filter Restriction	
Maximum Pressure Drop across Filters	35 kPa [5 psi]
Fuel Return Restriction (maximum)	518 mm Hg [20.4 in Hg]

Fuel Recommendations



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



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

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

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

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

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

The following chart lists acceptable alternate fuels for C Series engines.

Acceptable Substitute Fuels - Cummins C Series Fuel System						
No. 1 D Diesel ^{(1) (2)}	No. 2 D Diesel ⁽³⁾	No. 1 K Kerosene	Jet-A	Jet-A1	JP-5	JP-8
A	OK	A	A	A	A	A
<p>1. An "A" means OK, only if the fuel lubricity is adequate. Wear scar diameter (WSD) must be less than 0.3 mm @ 25°C or 0.4 mm @ 60°C [0.012 in @ 77°F or 0.016 in @ 140°F] as measured with the high-frequency reciprocating rig (HFRR) method.</p> <p>2. Any adjustment to compensate for reduced performance with a fuel system using alternate fuel is not warrantable.</p> <p>3. Winter blend fuels, such as found at commercial fuel dispensing outlets, are combinations of No. 1 D and No. 2 D diesel fuel, and are acceptable.</p>						

Additional information for fuel recommendations and specifications can be found in Fuel for Cummins Engines, Bulletin No. 3379001.

Cooling System

Coolant Capacity (engine only)	9.9 liter [10.5 qt]
Standard Modulating Thermostat Range	81 to 95°C [181 to 203°F]
Pressure Cap for:	
99°C [210°F] System	50 kPa [7 psi]
104°C [220°F] System	103 kPa [15 psi]
Operating Temperatures	
Minimum Recommended	70°C [158°F]
Maximum Allowable	100°C [212°F]

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