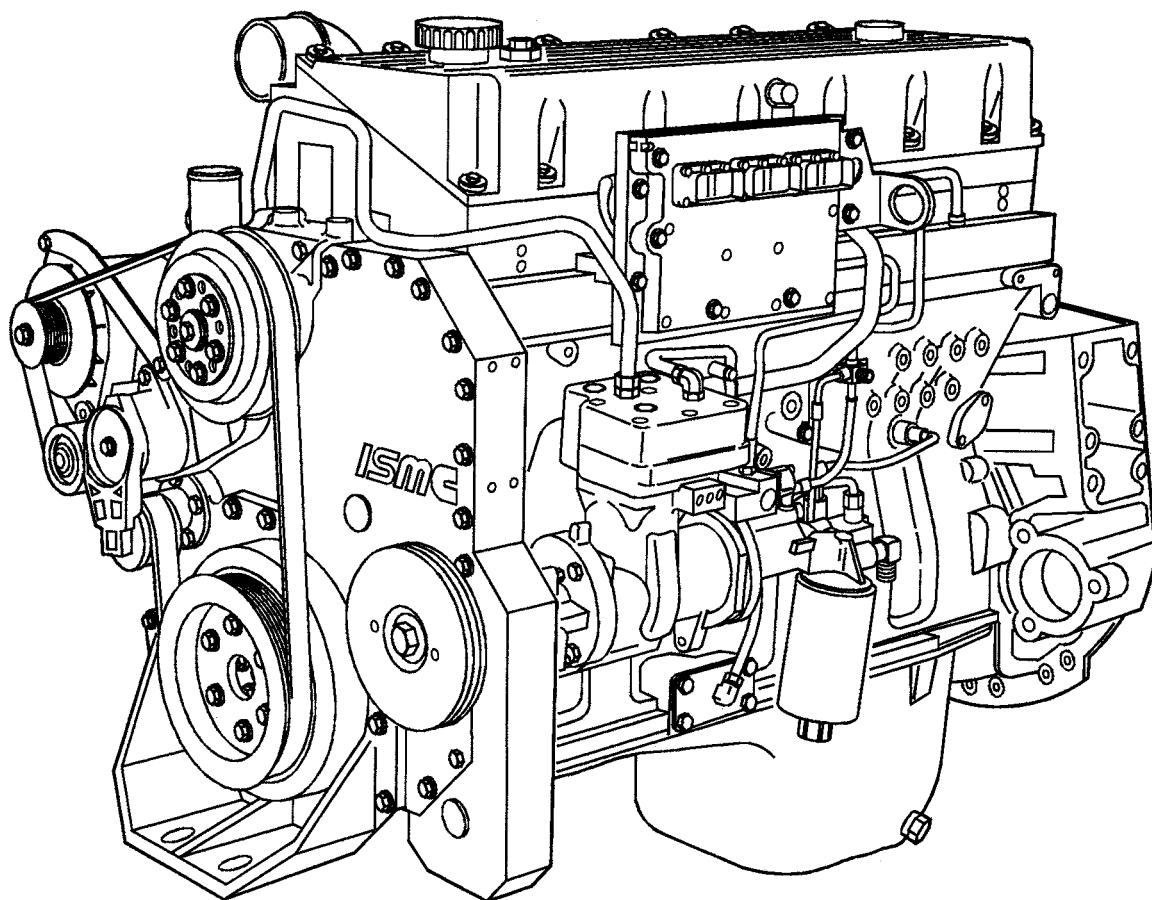




Troubleshooting and Repair Manual ISM/QSM11 Series Engines



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Bulletin No. 3666322-01
Printed 1/00

Foreword

This manual provides instructions for troubleshooting and repairing this engine in the chassis. Component and assembly rebuild procedures are provided in the engine shop manual. Refer to Section i - Introduction for instructions on how to use this manual.

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

The manual is organized to guide a service technician through the logical steps of identifying and correcting problems related to the engine. This manual does not cover vehicle or equipment problems. Consult the vehicle or equipment manufacturer for repair procedures.

A series of specific service manuals (for example: Shop, Specifications, and Alternative Repair) are available and can be ordered by filling out and mailing the Literature Order Form located in Section L - Service Literature.

The repair procedures used in this manual are recommended by Cummins Engine Co., Inc. Some service procedures require the use of special service tools. Use the correct tools as described.

Cummins Engine Company, Inc. encourages the user of this manual to report errors, omissions, and recommendations for improvement. Please use the postage paid, pre-addressed Literature Survey Form in the back of this manual for communicating your comments.

The specifications and rebuild information in this manual are based on the information in effect at the time of printing. Cummins Engine Company, Inc. reserves the right to make any changes at any time without obligation. If differences are found between your engine and the information in this manual, contact a 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 are used to manufacture Cummins engines. When replacement parts are needed, we recommend using only genuine Cummins or ReCon® exchange parts. These parts can be identified by the following trademarks:



Table of Contents

	Section	
Introduction	i	■
Engine Identification	E	■
Troubleshooting Symptoms	TS	■
Complete Engine – Group 00	0	■
Cylinder Block – Group 01	1	■
Cylinder Head – Group 02	2	■
Rocker Levers – Group 03	3	■
Cam Followers/Tappets – Group 04	4	■
Fuel System – Group 05	5	■
Injectors and Fuel Lines – Group 06	6	■
Lubricating Oil System – Group 07	7	■
Cooling System – Group 08	8	■
Drive Units – Group 09	9	■
Air Intake System – Group 10	10	■
Exhaust System – Group 11	11	■
Compressed Air System – Group 12	12	■
Electrical Equipment – Group 13	13	■
Engine Testing – Group 14	14	■
Mounting Adaptations – Group 16	16	■
Miscellaneous Hardware – Group 17	17	■
Vehicle Braking – Group 20	20	■
Service Literature	L	■
Component Manufacturers	M	■
Specifications	V	■
Index	X	■



Section i - Introduction

Section Contents

	Page
About the Manual	i-1
Acronyms and Abbreviations	i-7
General Cleaning Instructions	i-6
Glass or Plastic Bead Cleaning	i-6
Solvent and Acid Cleaning	i-6
Steam Cleaning	i-6
General Repair Instructions	i-5
Welding on a Vehicle with an Electronic Controlled Fuel System	i-5
General Safety Instructions	i-4
Important Safety Notice	i-4
How to Use the Manual	i-1
Illustrations	i-3
Symbols	i-2

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About the Manual

This 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. Each section is equivalent to a group used in Cummins film card system. Some sections contain **reference** numbers and **procedure** numbers. **Reference** numbers provide general information, specifications, diagrams, and service tools where applicable. **Procedure** numbers are used to identify and reference specific repair procedures for correcting the problem.

This manual is designed so the troubleshooting trees are used to locate the cause of an engine problem. The troubleshooting trees then direct the user to the correct repair procedure. The repair procedures within a section are in numerical order. However, the repair steps within a given procedure are organized in the order the repair **must** be performed regardless of the numerical order of the steps. The user **must** use the contents pages or the index at the back of the manual to locate specific topics when not using the troubleshooting trees.

This manual covers all base engine repair procedures and some fuel system repair procedures. Repair procedures and fault code diagnosis for the electronic fuel system is covered in the Fuel System Troubleshooting and Repair Manual listed in section L .

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). The manual is designed to use the Troubleshooting Symptoms as a guide to locating the problem and directing the end-user to the correct procedure for making the repair. Complete the following steps to locate and correct the problem.

- (Step 1) Locate the symptom on the Section Contents pages of Section TS.
- Reference to the page number where the Troubleshooting Symptom Tree is found is made to the right of the symptom tree title.
- (Step 2) 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.
- 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.
- (Step 3) Locate the probable cause in the left column then turn to the procedure referenced in the right column.
- (Step 4) The Troubleshooting Symptom Charts are based on the following assumptions:
1. The engine has been installed according to the manufacturer's specifications.
 2. The easiest repairs are done first.
 3. "Generic" solutions to cover problems with the most common applications and Original Equipment Manufacturer (OEM).

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.

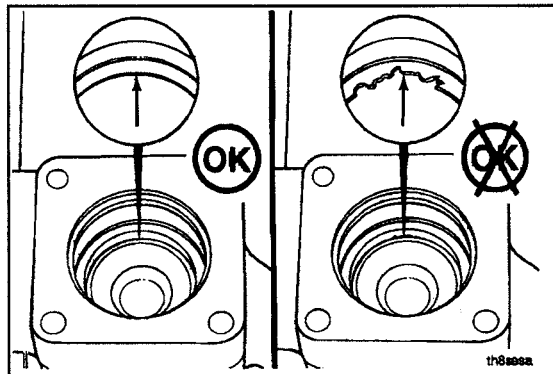


The component weighs 23 kg [50 lb] or more. To avoid personal injury, use a hoist or get assistance to lift the component.

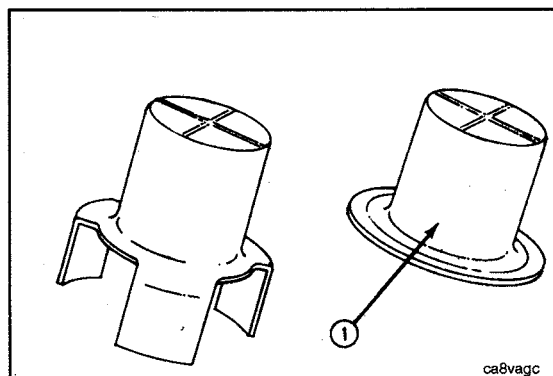
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Illustrations

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.

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.

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.

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 | 5. Belts and Hoses |
| 2. Wiring | 6. Bearings |
| 3. Injectors | 7. Electronic Control Module (ECM) |
| 4. Fuel Pump | 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.
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
Engine Diagrams	E-6
Engine Views	E-6
Engine Identification	E-1
Cummins Engine Nomenclature	E-2
ECM Dataplate	E-2
Engine Dataplate	E-1
Specifications	E-3
Air Intake System	E-5
Batteries (Specific Gravity)	E-5
Cooling System	E-4
Electrical System	E-5
Exhaust System	E-5
Fuel System	E-4
General Specifications	E-3
Lubricating Oil System	E-4

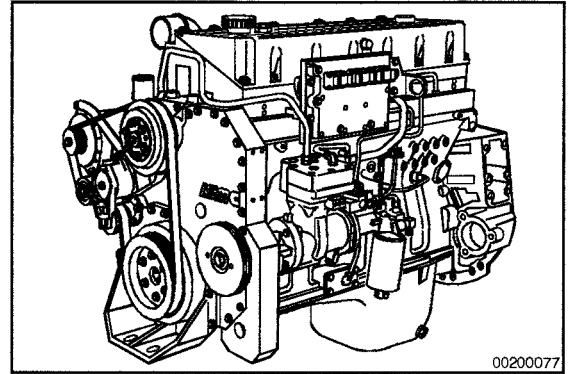
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Engine Identification

Engine Dataplate

The engine dataplate shows facts about your engine. The Engine Serial Number and CPL provide information for ordering parts and service needs. The engine dataplate **must not** be changed unless approved by Cummins Engine Company, Inc.

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

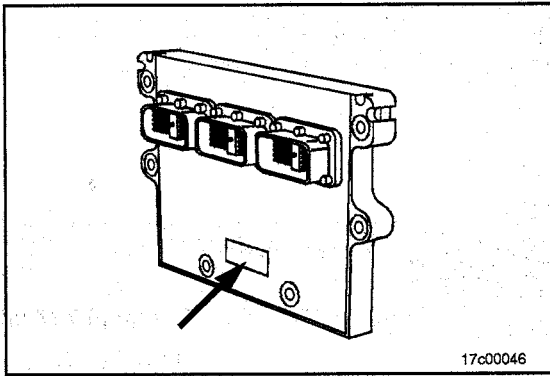


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Engine No. Motour No.	Advert. HP Puiss. Indiquée(ch)	at	RPM	E.C.B.	NO	IMPORTANT ENGINE INFORMATION: This engine conforms to U.S.EPA and California regulations applicable to 19 Model Year New Heavy Duty Engines. This engine has a primary standard service application as a heavy heavy-duty diesel engine. This engine is certified to operate on diesel fuel. The engine is not certified for use in an urban bus as defined in 40 CFR 92.009-2. Sales of this engine for use in an urban bus is a violation of Federal law under the Clean Air Act. WARNING: Injury may result and warranty is voided if fuel, oil, RPM or other rated published maximum values are exceeded and/or exceeded. AVERTISSEMENT: Danger de blessures et de dommages de la personne si vous ne respectez pas les valeurs maximums indiquées pour ce modèle et son utilisation.		
Family Famille	Peak Torque (F-TLB) Torque Cime	at	RPM	Inj. Timing Code Calage d'Injection	PM			
Model Modèle	Fuel rate at Advert. HP Débit Combust. à Puiss. Indiquée	Int. Adm.	mm 3 stroke	C.I.D.A. Pouce Cube	<table border="1"> <tr> <td>PEL</td> <td>EPA</td> <td>CARB</td> </tr> </table>	PEL	EPA	CARB
PEL	EPA	CARB						
Date of Mfg. Date Fabrication	Valve Lash Cold Jeux Soupapes à Froid		Exh. Eoh.	CPL				
Idle Speed RPM Vitesse de Ralent	Inj. Set Course Inj.		Governed Speed Vitesse Gouvernée					
Ref. No.								

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1. Engine serial number
2. CPL
3. Model
4. Horsepower and rpm rating.

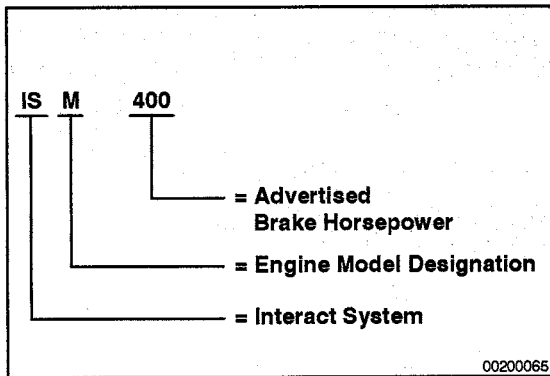


ECM Dataplate

The ECM dataplate is located on the front of the ECM.

The abbreviations on the dataplate are explained as follows:

- P/N = part number
- S/N = serial number
- D/C = date code.



Cummins Engine Nomenclature

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

Specifications

General Specifications

Horsepower (refer to engine dataplate)

Engine Speed @ Maximum Output:

Governed Speed (rpm)	
Automotive	1800
Vocational/Transit Bus	2100
Marine	2300

Bore and Stroke 125 mm [4.921 in] x 147 mm [5.787 in]

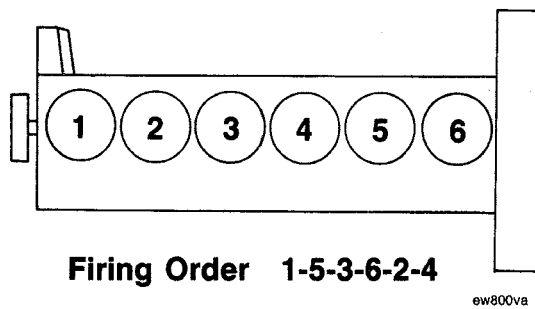
Displacement 10.8 liters [661 C.I.D.]

Firing Order 1-5-3-6-2-4

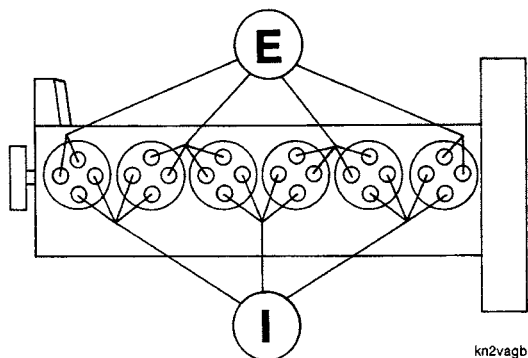
Engine Weight (with standard accessories):

Dry Weight	940 kg [2070 lb]
Wet Weight	996 kg [2193 lb]

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



Cylinder Location and Firing Order



Intake and Exhaust Valve Locations

Fuel System

For performance and fuel rate values, refer to the engine data sheet or the fuel pump code for the particular model involved.

Engine Idle Speed	600 to 800 rpm
Fuel Inlet Maximum Restriction:	
Clean Fuel Filter	152 mm Hg [6 in Hg]
Dirty Fuel Filter	254 mm Hg [10 in Hg]
Fuel Drain Line Maximum Restriction	89 mm Hg [3.5 in Hg]
Minimum Fuel Pressure:	
During Cranking	172 kPa [25 psi]
1200 rpm	827 kPa [120 psi]
Governed rpm	1034 to 1241 kPa [150 to 180 psi]
Fuel Inlet Maximum Temperature	71°C [160°F]
Engine Minimum Cranking Speed	150 rpm
Shutoff Valve Solenoid Coil Resistance	
12 VDC	7.0 to 8.0 ohms

Lubricating Oil System

Oil Pressure:	
Low Idle (minimum allowable)	70 kPa [10 psi]
At 1200 rpm or Torque Peak (minimum allowable)	207 kPa [30 psi]
Oil Capacity of Standard Engine:	
Combination Filter:	
LF9000	3.0 liters [0.8 gal]
LF9001	2.6 liters [0.7 gal]
Oil Pan (high-low)	34 to 26.5 liters [9 to 7 gal]
Transit Bus Oil Pan (high-low)	34 to 30.3 liters [9 to 8 gal]

Cooling System

Coolant Capacity (engine only)	9.5 liters [10 qt]
Standard Modulating Thermostat Range	82 to 93°C [180 to 200°F]
Cylinder Block Coolant Pressure (pressure cap removed):	
Minimum	
Closed Thermostat - 1800 rpm - No Load	138 kPa [20 psi]
Maximum	
Closed Thermostat	275 kPa [40 psi]
Maximum Allowable Operating Coolant Temperature	100°C [212°F]
Minimum Recommended Operating Coolant Temperature	70°C [160°F]
Minimum Recommended Pressure Cap	48 kPa [7 psi]
Maximum Allowable Coolant Flow to Accessories (liters/minute [gpm])	75.7 Liters [20 gal]
Coolant Sensing Fan Control:	
On	96°C [205°F]
Off	91°C [195°F]