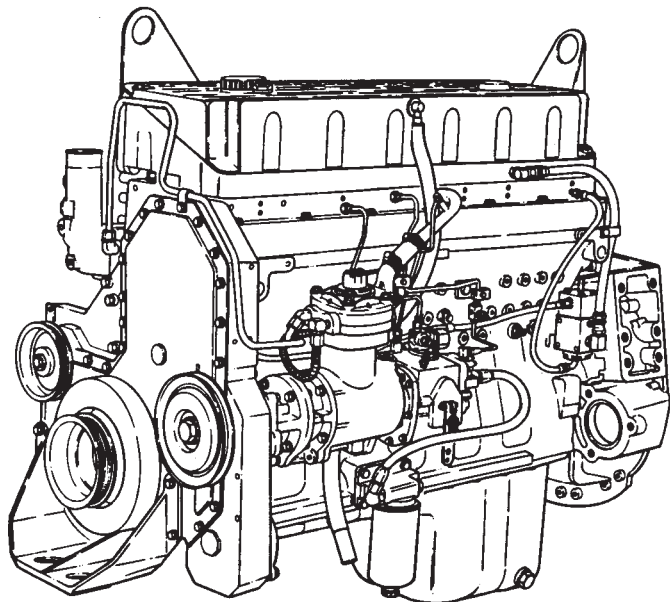
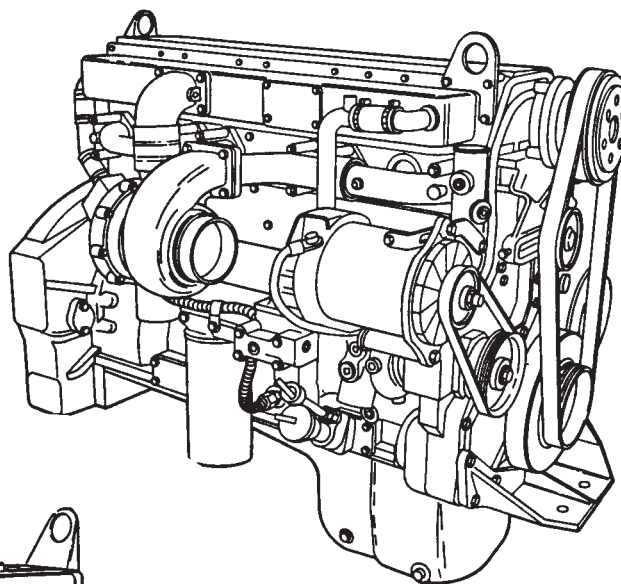




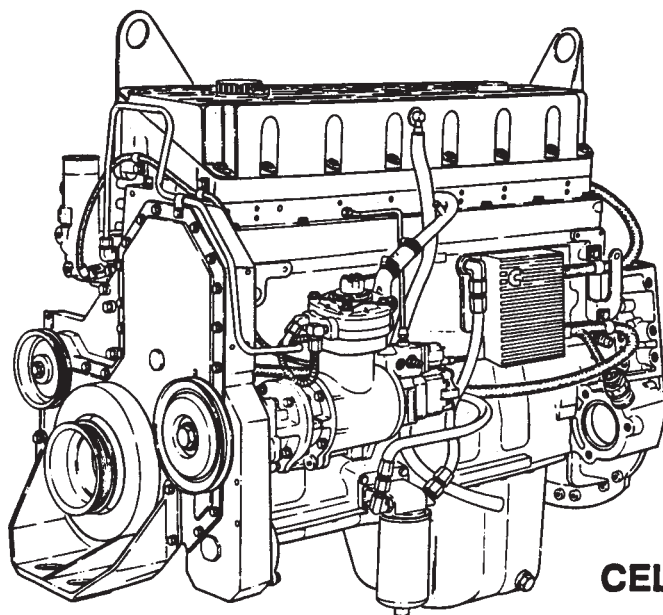
Alternative Repair Manual L10 and M11 Series Engines



STC



Fixed Time



CELECT

0020009

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Foreword

This alternative repair manual contains specifications and instructions for repairing damaged or worn components. The repair procedures are based on the engine being repaired with approved machining and grinding equipment. Some procedures require the use of special service tools. Make sure the correct tools and equipment are used as described in the procedures.

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

When a specific brand name, number, or special tool is referenced in this manual, an equivalent product can be used in place of the recommended item.

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

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 is 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).

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:



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Section i - Introduction

Section Contents

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About The Manual

The procedures in this manual were developed for a shop environment. A Group System has been used to subdivide the instructions by major components and systems. Refer to the Section Contents for the various groups. Wrench sizes and shop tooling are identified in the procedure when needed.

This publication provides general repair information, cylinder block repair, and cylinder head repair. Subsequent versions of the manual will include alternative repairs for additional components as they are developed.

The contents of this manual are based on information in effect at the time of publication and are subject to change without notice.

How to Use the Manual

This manual is divided in the same group system used for Cummins' engine shop manual. Each group is organized in a way that all mechanics, both those who are and are not familiar with the L10 or M11 engine models can reference the manual. Refer to the Table of Contents at the front of the manual to determine the group that details the desired information.

Each group contains the following in sequence:

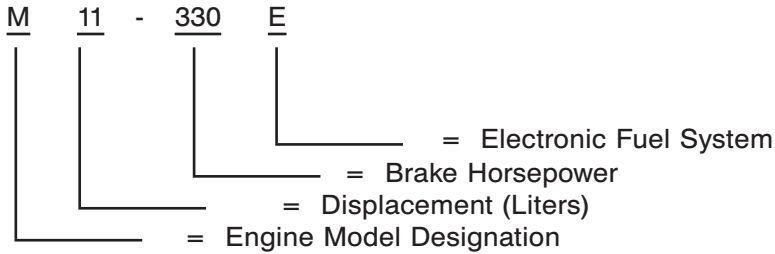
- Section contents at the beginning of each group to quickly aid in locating the information desired.
- Service tools list with recommended tools needed to rebuild the components.
- General information to aid in repairing the component.
- Step-by-step rebuild instructions for cleaning, inspection and salvage of the component.
- Symbols which represent the action outlined in the instructions. The definitions of the symbols, listed in four languages (English, Spanish, French and German), appear on pages i-4 through i-7.

Topics will be listed alphabetically on the Section Contents page. All procedures are described using the text-symbol-picture (TSP) format.

Both metric and U.S. customary values are used in this manual. The metric value is listed first, followed by the U.S. customary in brackets. An example is 60°C [140°F].

Engine Identification

The model name provides the following data:



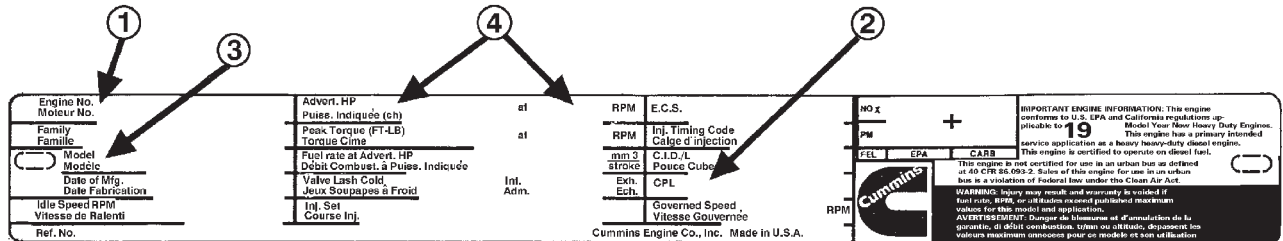
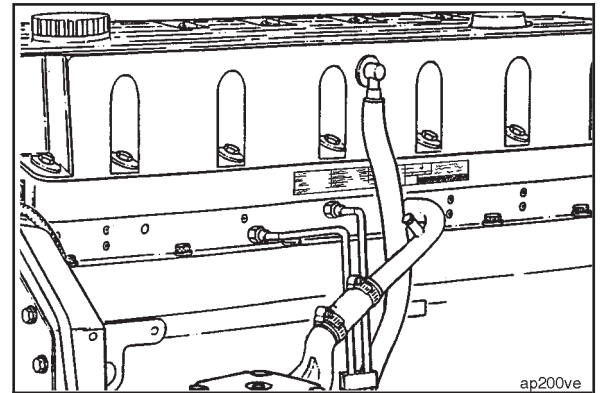
Engine Dataplate

The engine dataplate is located on the fuel pump side of the rocker housing.

The engine dataplate provides model identification as well as other important information about the engine.

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 (E.S.N.)
2. Control Parts List (CPL)
3. Model
4. Horsepower and RPM Rating

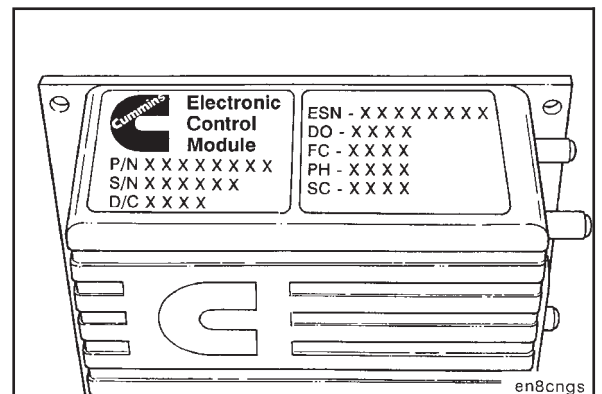


Electronic Control Module (ECM) Dataplate

On SELECT™ engines, there are two dataplates on the top of the electronic control module (ECM).

The dataplate on the left contains the part number (P/N), serial number (S/N) and the date code (D/C) of the ECM.

The dataplate on the right contains the engine serial number, fuel code and engine calibration information.



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.

Simbolos

Los símbolos siguientes son usados en este manual para clarificar el proceso de las instrucciones. Cuando aparece uno de estos símbolos, su significado se especifica en la parte inferior.



ADVERTENCIA - Serios daños personales o daño a la propiedad puede resultar si las instrucciones de Advertencia **no** se consideran.



PRECAUCION - Daños menores pueden resultar, o de piezas del conjunto o el motor puede averiarse si las instrucciones de Precaución **no** se siguen.



Indica un paso de **REMOCION** o **DESMONTAJE**.



Indica un paso de **INSTALACION** o **MONTAJE**.



Se requiere **INSPECCION**.



LIMPIESE la pieza o el montaje.



EJECUTESE una **MEDICION** mecánica o del tiempo.



LUBRIQUESE la pieza o el montaje.



Indica que se dará una **LLAVE DE TUERCAS** o el **TAMAÑO DE HERRAMIENTA**.



APRIETESE hasta un par torsor específico.



EJECUTESE una **MEDICION** eléctrica.



Para información adicional refiérase a otro emplazamiento de este manual o a otra publicación anterior.



El componente pesa 23 kg [50 lb] o mas. Para evitar dano corporal empleen una cabria u obtengan ayuda para elevar el componente.

Symbole

In diesem Handbuch werden die folgenden Symbole verwendet, die wesentliche Funktionen hervorheben. Die Symbole haben folgende Bedeutung:



WARNUNG - Wird die Warnung **nicht** beachtet, dann besteht erhöhte Unfall- und Beschädigungsgefahr.



VORSICHT - Werden die Vorsichtsmassnahmen **nicht** beachtet, dann besteht Unfall- und Beschädigungsgefahr.



AUSBAU bzw. **ZERLEGEN**.



EINBAU bzw. **ZUSAMMENBAU**.



INSPEKTION erforderlich.



Teil oder Baugruppe **REINIGEN**.



DIMENSION - oder **ZEITMESSUNG**.



Teil oder Baugruppe **ÖLEN**.



WERKZEUGGRÖSSE wird angegeben.



ANZUG auf vorgeschriebenes Drehmoment erforderlich.



Elektrische **MESSUNG DURCHFÜHREN**.



Weitere Informationen an anderer Stelle bzw. in anderen Handbüchern.



Das teil wiegt 23 kg [50 lb] oder mehr. Zur vermeidung von koerperverletzung winde benutzen oder hilfe beim heben des teils in anspruch nehmen.

Symboles

Les symboles suivants sont utilisés dans ce manuel pour aider à communiquer le but des instructions. Quand l'un de ces symboles apparaît, il évoque le sens défini ci-dessous:



AVERTISSEMENT - De graves lésions corporelles ou des dommages matériels considérables peuvent survenir si les instructions données sous les rubriques "Avertissement" **ne sont pas** suivies.



ATTENTION - De petites lésions corporelles peuvent survenir, ou bien une pièce, un ensemble ou le moteur peuvent être endommagés si les instructions données sous les rubriques "Attention" **ne sont pas** suivies.



Indique une opération de **DEPOSE**.



Indique une opération de **MONTAGE**.



L'INSPECTION est nécessaire.



NETTOYER la pièce ou l'ensemble.



EFFECTUER une **MESURE** mécanique ou de temps.



GRAISSER la pièce ou l'ensemble.



Indique qu'une **DIMENSION DE CLE** ou **D'OUTIL** sera donnée.



SERRER à un couple spécifique.



EFFECTUER une **MESURE** électrique.



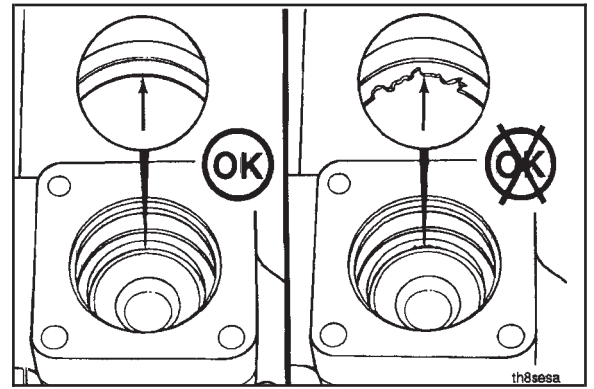
Se reporter à un autre endroit dans ce manuel ou à une autre publication pour obtenir des informations plus complètes.



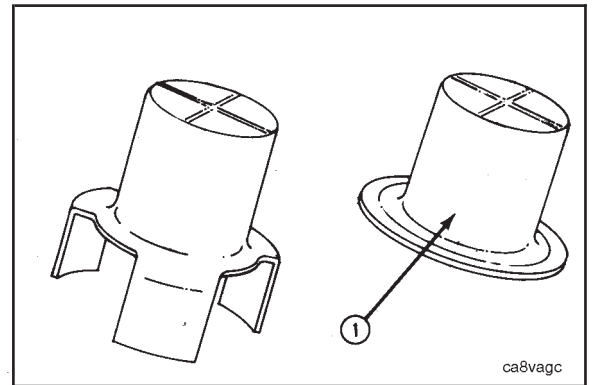
Le composant pèse 23 kg [50 lb] ou davantage. Pour éviter toute blessure, employer un appareil de levage ou demander de l'aide pour le soulever.

Illustrations

The illustrations used in the "Repair Sections" of this manual are intended to give an example of a problem, and to show what to look for and where the problem can be found. Some of the illustrations are generic and might **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 illustration can differ from your application, but the procedure given will be the same.



General Safety Instructions

Important Safety Notice



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, 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 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 capture 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 diesel 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, 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 0.610 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.

Welding on a PT Pacer™ Controlled Vehicle



Caution: When welding on a PT Pacer™ controlled vehicle, to protect the PCU computer circuits, the procedure below MUST be followed:

1. Remove the plus (+) 12 volt supply wire from the fuel shutoff solenoid or wherever the + 12 volt power supply is connected.
2. Remove the harness ground wire from the engine block.
3. Disconnect the positive (+) and negative (-) battery cables from the battery.
4. Do **NOT** connect the welder ground cable to the PCU.

Welding on a PACE™ Controlled Vehicle



Caution: When welding on a PACE™ controlled vehicle, to protect the PTCM computer circuits, the procedure below MUST be followed:

1. Remove both connectors going to the PTCM.
2. Disconnect the positive (+) and negative (-) battery cables from the battery.
3. Do **NOT** connect the welder ground cable to any part of the PACE™ control system.

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 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: - Use U.S. size No. 16-20 for piston cleaning with plastic bead media, Part No. 3822735.
- Use U.S. size No. 70 for piston domes with glass media.
- Use U.S. size No. 60 for general purpose cleaning with glass media.
2. Operating Pressure: - Glass: Use 620 kPa [90 psi] for general purpose cleaning.
- 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	km	Kilometers
API	American Petroleum Institute	km/l	Kilometers per Liter
ASA	Air Signal Attenuator	kPa	Kilopascal
ASTM	American Society of Testing and Materials	l	Liter
°C	Celsius	LTA	Low Temperature Aftercooling
CARB	California Air Resources Board	m	Meter
C.I.D.	Cubic Inch Displacement	mm	Millimeter
cm	Centimeter	MPa	Megapascal
CPL	Control Parts List	mph	Miles Per Hour
cSt	Centistokes	mpq	Miles Per Quart
ECM	Electronic Control Module	N•m	Newton-meter
ECS	Emission Control System	OEM	Original Equipment Manufacturer
EPA	Environmental Protection Agency	ppm	Parts Per Million
EPS	Engine Position Sensor	psi	Pounds Per Square Inch
°F	Fahrenheit	PTO	Power Takeoff
ft-lb	Foot Pound	RPM	Revolutions Per Minute
GVW	Gross Vehicle Weight	SAE	Society of Automotive Engineers
Hg	Mercury	SCA	Supplemental Coolant Additive
hp	Horsepower	STC	Step Timing Control
H₂O	Water	VS	Variable Speed
in-lb	Inch Pound	VSS	Vehicle Speed Sensor
kg	Kilograms		


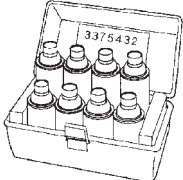
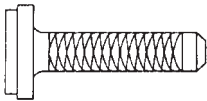
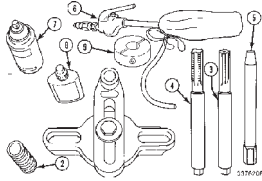
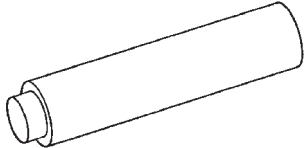
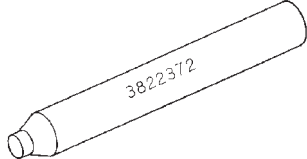
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Service Tools — General Repairs

The following special tools are recommended to perform procedures in Group 00. The use of these tools is shown in the appropriate procedure. These tools can be purchased from your local Cummins Authorized Repair Location.

Tool No.	Tool Description	Tool Illustration
3375021	<p>Threaded Insert Kit</p> <p>The kit contains the installation tools and associated thread inserts.</p>	 <p>3822709</p>
3375432	<p>Crack Detection Kit</p> <p>Inspect components for cracks. The kit consists of spray cleaner, Part No. 3375433, developer, Part No. 3375434, and penetrant, Part No. 3375435.</p>	 <p>3375432</p>
3376058	<p>Expansion Plug Driver</p> <p>Install the 2.263 inch diameter plugs in the cylinder head.</p>	 <p>3376058</p>
3376208	<p>Thread Repair Tool Kit</p> <p>Repair damaged capscrew threads. The kit contains the service tools required to salvage capscrew thread holes.</p>	 <p>3376208</p>
3376816	<p>Expansion Plug Driver</p> <p>Install the 1.010 inch diameter plugs in the cylinder block. Used with handle, Part No. 3376795.</p>	 <p>ck8to9c</p>
3822372	<p>Expansion Plug Driver</p> <p>Install the 0.380 inch diameter expansion plugs in the cylinder block.</p>	 <p>3822372</p>