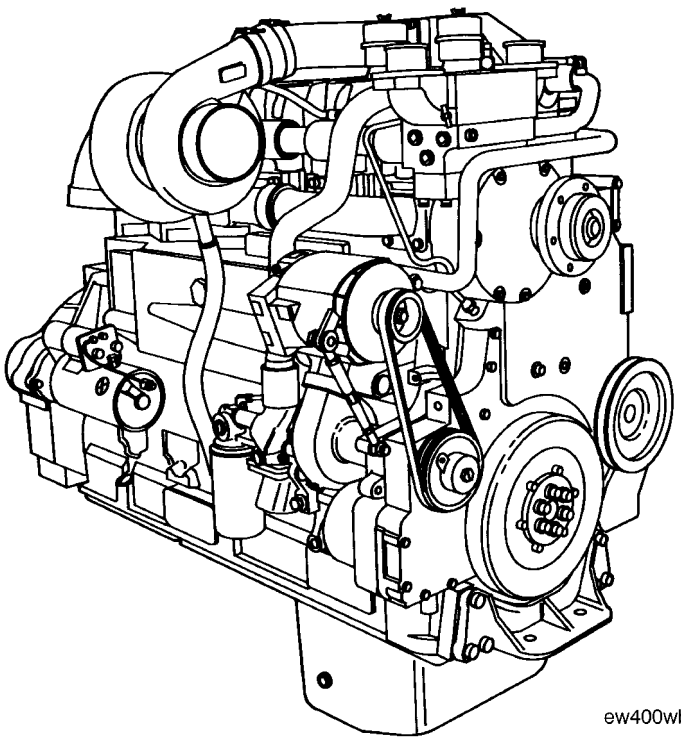
# Troubleshooting and Repair Manual K19 Engines



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# NOTES

# Foreword

T This manual provides instructions for troubleshooting and repairing the K19 Engine in the chassis. Component and assembly rebuild procedure are provided in the K19 Engine Shop Manual.

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 (Shop, Specifications, Alternative Repair, and so on.) are available and can be ordered by filling out and mailing the Literature Order Form located in the Service Literature Section 14.

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.

Reporting of errors, omissions, and recommendations for improving this publication by the user is encouraged. Please use the postage paid, self 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, A Cummins Division Office, or the factory

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:





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# Section i - Introduction

## Section Contents

# 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. Some sections contain reference numbers and procedure numbers. The reference numbers provide general information, specifications, diagrams, and service tools, where applicable. The procedure numbers describe specific repair procedures and are referred to in the Troubleshooting Logic Charts.

# How to Use the Manual

The 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 on Page T-2 in the Troubleshooting Section. Complete the following steps to locate and correct the problem:

(STEP 1.) Locate the symptom on the list.

Reference is made to the page number where the″Troubleshooting Logic Chart″ is found.

(STEP 2.) The left column of the ″Troubleshooting Logic Chart″ indicates a probable cause, starting at the top with the simplest and easiest to repair or most likely to occur, and continuing downward to the most difficult and least likely to occur.

The right column provides a brief description of the corrective action with a procedure number or bulletin number reference for the repair procedure.

(STEP 3.) Locate the probable cause in the left column, and then turn to the procedure referenced in the right column or consult the bulletin number specificed.

The repair procedures are listed by system (cooling, lubricating oil, combustion air, compressed air, fuel, electrical, and base engine components).

(STEP 4.) The Troubleshooting Logic 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 OEM's (Original Equipment Manufacturer).

# 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 weigt 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.

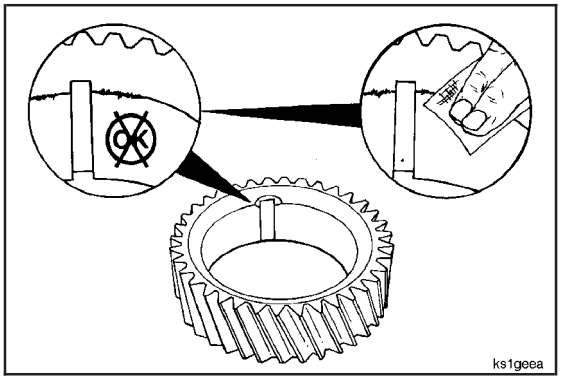
**EFFECTUER** une **MESURE** électrique.

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

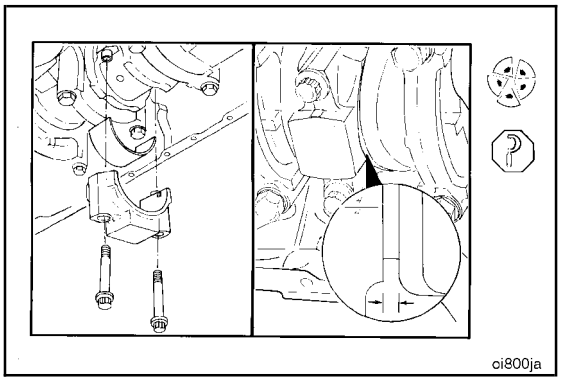
Le composant pese 23 kg [50 lb] ou davantage. Pour eviter toute blessure, employer un appariel de levage ou demander de l'aide pour le soulever.

## 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 may contain symbols to indicate an action required and an acceptable or **not** acceptable condition.




The illustrations are intended to show repair or replacement procedures with the engine ″in-chassis.″ The illustration can differ from your application, but the procedure given will be the same.



# 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 crankshaft. 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 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 lessor quality if replacements are necessary.
- Do **not** perform any repair when fatigued or after consuming alcohol or drugs that can impair your functioning.

# 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, injestion 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 14, 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. **Cummins Engine Company, Inc. does not recommend any specific cleaners. Always** follow the cleaner manufacturer's instructions.

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.

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
2. Wiring
3. Injectors
4. Fuel Pump
5. Belts and Hoses
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:
   - 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.

# Definition Of Terms

| | |
|---|---|
| A.C.: | Alternating Current |
| ACT Harness: | The wiring harness used to connect the actuators to the ECM |
| Alligator Clip: | An electrical test clip attached to the end of a wire |
| API: | American Petroleum Institute |
| ASA: | Air Signal Attenuator |
| ASTM: | American Society of Testing and Materials |
| ATDC: | After Top Dead Center; refers to the position of the piston or the crankshaft rod journal. The piston is moving downward on the power stroke or intake stroke. |
| BDC: | Bottom Dead Center; refers to the position of the piston or the crankshaft rod journal. The piston is at its lowest position in the cylinder. |
| BTDC: | Before Top Dead Center; refers to the position of the piston or the crankshaft rod journal. The piston is moving upward on the power stroke or exhaust stroke. |
| C: | Celsius |
| CAC: | Charge Air Cooler |
| CARB: | California Air Resources Board |
| CELECT™: | A fuel control system that electronically controls the fuel injection to improve fuel economy and to reduce the exhaust emissions. The system does this by controlling the torque and horsepower curve, AFC (smoke) function, engine high speed, engine low idle speed and the road speed.<br><br>The CELECT™ system also can control fan clutch operation, engine brake enabling and turbocharger wastegating.<br><br>Additional electronic features include cruise control, PTO, gear down protection, progressive shifting, automotive or VS governor and idle shutoff. |
| C.I.D.: | Cubic Inch Displacement |
| Circumferential Direction: | In the direction of a circle in respect to the centerline of a round part or a bore. |
| Cm: | Centimeter |
| Compulink™: | A Cummins service tool used for electronic system analysis and to reprogram the system |
| Concentricity: | A measurement of the **difference** between the centers of **either** two or more parts, **or** the bores in one part. |
| CPL: | Control Parts List; this listing identifies the specific parts that **must** be installed on the engine to meet agency certification. |
| cSt: | Centistokes |
| Cummins Sealant: | This is a one part Room Temperature Vulcanizing (RTV) silicone rubber, adhesive and sealant material having **high** heat and oil resistance, and **low** compression set.<br><br>Some of the equivalent products are Marston Lubricants, Hylosil, Dow Corning, Silastic 732, Loctite Superflex, General Electric 1473, and General Electric 1470. |
| DCA: | Diesel Coolant Additive |

| | |
|---|---|
| D.C.: | Direct Current |
| Deutsch Connector: | An electrical connector |
| Dye Penetrant Method: | A method used to check for cracks in a part by using a dye penetrant and a developer. Use Part No. 3375432 Crack Detection Kit, or equivalent. |
| End Clearance: | The clearance in an assembly determined by pushing the shaft in an axial direction **one way,** and then pushing the shaft the **other way.** |
| Echek™ | A Cummins hand held service tool used for electronic system analysis, adjusting features and programmable parameters. |
| ECM: | Electronic Control Module. |
| E.C.S.: | Emission Control System |
| EPA: | Environmental Protection Agency |
| EPS: | Engine Position Sensor |
| E.S.N.: | Engine Serial Number |
| ESS: | Engine Speed Sensor |
| F: | Fahrenheit |
| ft-lb: | Foot Pound |
| GVW: | Gross Vehicle Weight |
| Hammer: | A hand tool consisting of a hard steel head on a handle. |
| Hg: | Mercury |
| HP: | Horsepower |
| $H_20$: | Water |
| ID: | Inside Diameter |
| in-lb: | Inch Pound |
| kg: | Kilograms |
| km: | Kilometers |
| km/l: | Kilometers per Liter |
| kPa: | Kilopascal |
| l: | Liter |
| Loctite 290: | A single component, anaerobic, polyester resin, liquid sealant compound that hardens between closely fitted metal surfaces producing a tough, hard bond with good characteristics. An equivalent product is Perma-Lok HL 126. |
| Loctite 609: | A single component anaerobic, liquid adhesive that meets or exceeds the requirements of MIL-R-46082A (MR) TYPE 1.<br><br>Some of the equivalent products are Loctite 601 and Permabond HL 138. |
| Lubriplate 105: | A mineral oil base grease with calcium soap (2 percent to 6 percent), and zinc oxide (2 percent to 4 percent) additives. |
| m: | Meter |
| Magnetic Particle Inspection: | A method of checking for cracks in **either** steel **or** iron parts. This method requires a Magnaflux machine, or an equivalent machine that imparts a magnetic field on the part being checked. |

| | |
|---|---|
| Mallet: | A hand tool consisting of a soft head; **either** wood, plastic, lead, brass, **or** rawhide on a handle. |
| MAX: | Maximum allowed |
| MIN: | Minimum allowed |
| Mini-Gen: | Speed Sensor |
| mm: | Millimeter |
| MPa: | Megapascal |
| MPH: | Miles Per Hour |
| MPQ: | Miles Per Quart |
| N•m: | Newton-meter |
| No.: | Number |
| OD: | Outside Diameter |
| OEM: | Original Equipment Manufacturer |
| OEM Harness: | The wiring harness used to connect the ECM to the vehicle |
| OS: | Oversize |
| ppm: | Parts Per Million |
| Protrusion: | The **difference** in the height between two parts in the assembled state. |
| psi: | Pounds Per Square Inch |
| PTO: | Power Takeoff |
| RPM: | Revolutions Per Minute |
| S.A.E:. | Society of Automotive Engineers |
| SEN Harness: | The wiring harness used to connect the engine system sensors to the ECM |
| STD: | Standard |
| TC: | Torque Converter; used when referring to the torque converter cooler. |
| TDC: | Top Dead Center; refers to the position of the piston or the crankshaft rod journal. The piston is at its highest position in the cylinder. The rod journal is pointing straight up toward the piston. |
| TIR: | Total Indicator Reading; used when measuring the concentricity or the run out. The TIR refers to the total movement of the needle on a dial indicator, from the most **negative** reading to the most **positive** reading. |
| VOM: | Volt Ohm Meter |
| VS: | Variable Speed |
| VSS: | Vehicle Speed Sensor |

Water Pump Grease:

A premium high temperature grease that will lubricate antifriction bearings continually from **minus** 40 C [**minus** 40 F] to **plus** 150 C [**plus** 350 F].

Some of the greases meeting this requirement are Aeroshell No. 5, Chevron SRI, Amoco Rykon Premium No. 2, Texaco Premium RB, and Shell Dolium R.

Aeroshell No. 5 is **not** compatible with the other greases and **must not** be mixed. Cummins Engine Co., Inc., uses Aeroshell No. 5 on new engines and components.

# Section E - Engine and Component Identification

## Section Contents