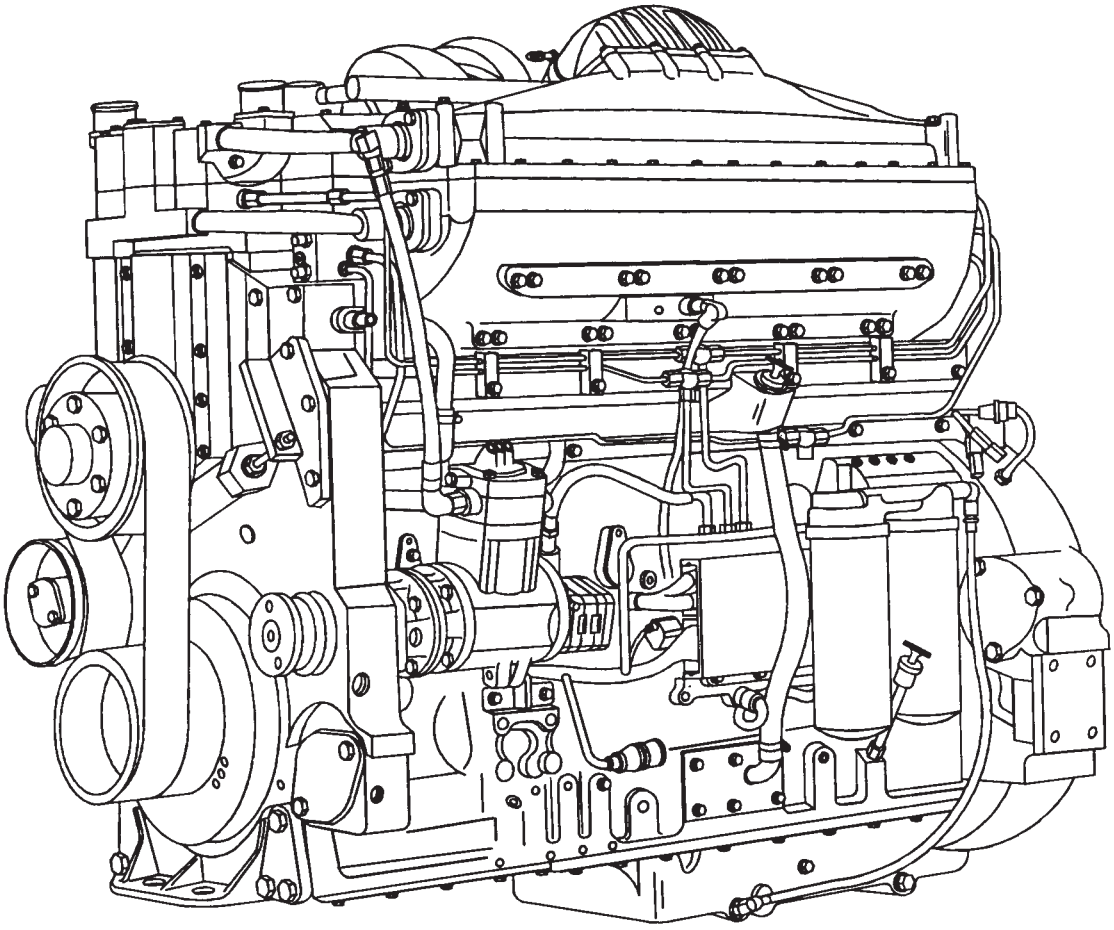
Shop Manual
QSK19 Series
Engines



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Bulletin No. 3666232
Printed 12/97

Foreword

This manual contains complete rebuild procedures and specifications. Disassembly, cleaning, inspection, and assembly instructions are included. A listing of accessory and component suppliers is located in Section M - Component Manufacturers. Suppliers can be contacted directly for any information not covered in this manual.

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

The repair procedures in this manual are based on the engine or component removed from chassis. Some rebuild procedures require the use of special service tools. Make sure the correct tools are used as described in the procedures.

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: Troubleshooting and Repair, 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.

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:

Table of Contents

Section i - Introduction

Section Contents

About the Manual

This manual contains information needed to correctly operate and maintain your engine as recommended by Cummins Engine Company, Inc. Additional service literature (Shop Manual, Troubleshooting and Repair Manual, etc.) can be ordered by filling out and mailing the Literature Order Form located in Service Literature, Section L.

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

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

Numerous illustrations and symbols are used to aid in understanding the meaning of the text. Refer to page i-3 through i-6 for a complete listing of symbols and their definitions.

Each section is preceded by a Section Contents to aid in locating information more quickly.

How to Use the Manual

This manual is organized according to the maintenance intervals that are to be performed. A table that states the required intervals and the checks to be made is located in Section 2. Locate the maintenance interval that you are performing and follow all the procedure steps given in that section. In addition, all the previous maintenance interval procedures **must** also be performed.

Keep a record of all the checks and inspections made. A record form for recording date, mileage/kilometer or hours, and what maintenance checks were performed is located in Section 2.

Refer to Section T for a troubleshooting guide to your engine. Follow the Troubleshooting Section Contents for locating and correcting engine problems.

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 that section.

NOTE: Discharge of oil or oily water into or upon the water is a direct violation of today's laws. Violators are subject to a penalty of various monetary charges. Dispose of these substances in accordance with standards set by the EPA.

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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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.

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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.

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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.

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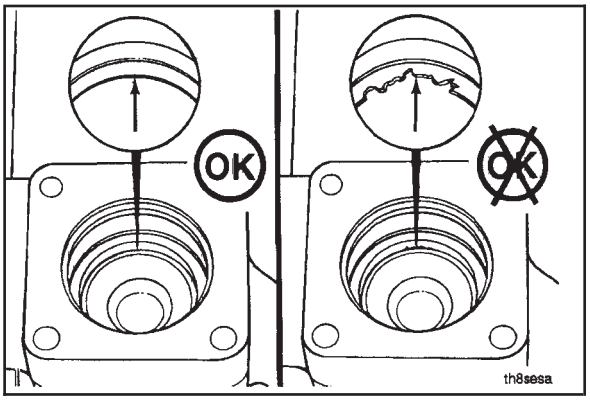
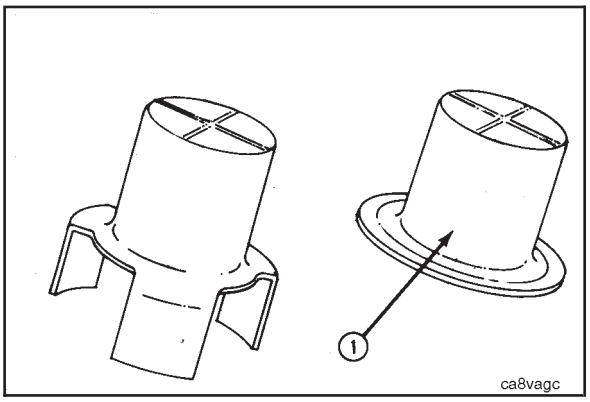


Illustrations

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, 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 L — Service Literature for ordering instructions.

Welding on a Vehicle with Electronic Components

⚠ CAUTION ⚠

Improper welding can destroy the vehicle's electronic components. Before welding, disconnect the negative (-) and then positive (+) battery cables. Attach the welder ground cable within 0.61 meters [2 feet] of the part being welded. Do NOT connect the welder ground cable to any electronic component or component mounting location. Do NOT weld on the engine or engine-mounted components.

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
2. Wiring
3. Injectors
4. Fuel Pump
5. Belts and Hoses
6. Bearings
7. Electronic Control Module (ECM)
8. ECM Connectors

Glass or Plastic Bead Cleaning

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

△ CAUTION △

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

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

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

1. Bead size:
   - 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.

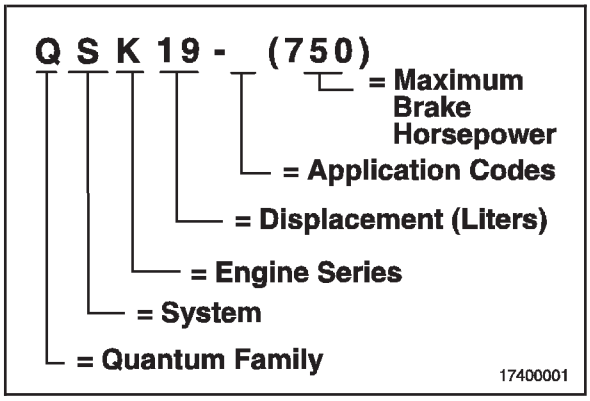
NOTES

Section E - Engine Identification

Section Contents

Engine Identification

Cummins Engine Nomenclature



The model name provides identification data for the engine. Refer to the illustration for the model name identification.

The application codes are:

A = Agricultural

C = Construction

D = Generator Drive

F = Fire Pump

G = Generator Set

L = Locomotive

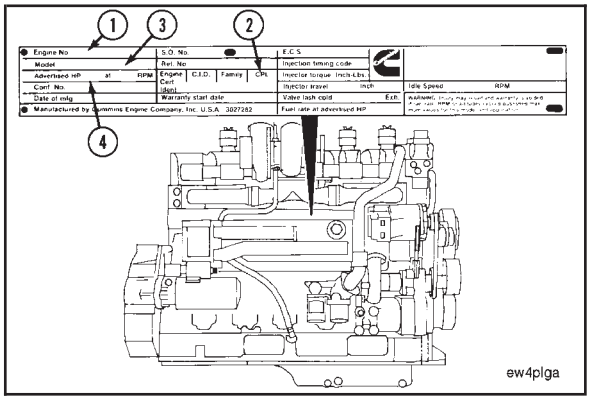
M = Marine

P = Power Unit

R = Railcar

T = Tactical Military

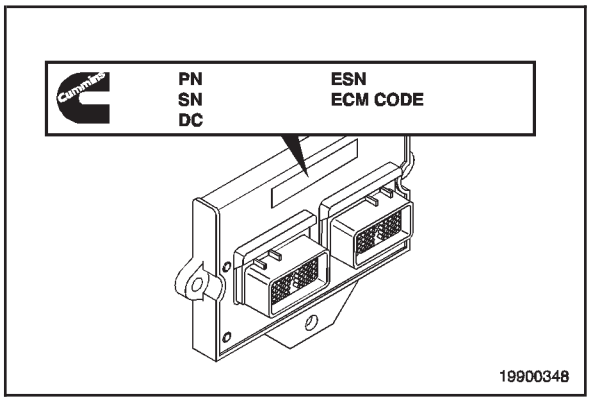
Engine Dataplate



The engine dataplate shows specific information about the engine. The engine serial number (ESN) (1), Control Parts List (CPL) (2), Model (3), and Horsepower and rpm rating (4) provide information for ordering parts and service needs.

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

ECM Dataplate



The external ECM dataplate is located on top on the ECM.

The dataplate contains the following:

- ECM part number (P/N)
- ECM serial number (S/N)
- Manufacturer date code (D/C)
- Engine serial number (ESN)
- ECM code identifying the software in the ECM

Specifications

General Specifications

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

Engine Speed ..... Refer to the fuel pump calibration data for optional speed rating.

Displacement ..... 19 liters [1150 C.I.D.]

Bore and Stroke ..... 158.75 mm x 158.75 mm [6.25 in x 6.25 in]

Engine Weight:
- Dry ..... 1720 kg [3800 lb]
- Wet ..... 2045 kg [4504 lb]

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

Valve and injector settings:
- Intake valve adjustment ..... 0.36 mm [0.014 in]
- Intake valve limits ..... 0.28 to 0.43 mm [0.011 to 0.017 in]
- Exhaust valve adjustment ..... 0.81 mm [0.032 in]
- Exhaust valve limits ..... 0.74 to 0.89 mm [0.029 to 0.035 in]
- Injector OBC Method adjustment (in engine) ..... 19 N•m [165 in-lb]

Compression Ratio:
- 525 HP to 600 HP-Jacket Water Aftercooled (JWAC) 17.0:1
- 600 HP to 750 HP-Low Temperature Aftercooled (LTA) 15.0:1

Crankshaft Rotation (Viewed from the front of the engine) ..... Clockwise

Air Intake System

Maximum Allowable Intake Restriction (at rated speed and load)
- With Clean Filter Element ..... 380 mm H_2O [15 in H_2O]
- With Dirty Filter Element ..... 635 mm H_2O [25 in H_2O]

Electrical System

Maximum Starting Circuit Resistance
- 24 - volt starter ..... 0.00200 Ohms

Battery Cable Sizes - American Wire Gauge (Maximum length in cranking motor circuit)

24 to 32 - volt
- No. 00 ..... 6.1 m [20 ft]
- No. 000 ..... 8.2 m [27 ft]
- No. 0000 or two No. 0* ..... 10.7 m [35 ft]
- Two No. 00 ..... 13.7 m [45 ft]

Minimum Cranking Speed Without Starting Aid ..... 150 rpm

* Two strands of No. 0 cable can be used instead of one No. 0000 cable, providing all connections are carefully made to provide equal current flow in each parallel cable.

NOTE: Starting aids, such as block heaters, lubricating oil pan heaters, etc., are available to aid in cold weather starting.

System Voltage	Ambient Temperatures			
	-18°C (0°F)		0°C (32°F)	
	Cold Cranking Amperes	Reserve Capacity* Amperes	Cold Cranking Amperes	Reserve Capacity* Amperes
24 Volt**	900	320	640	240

* The number of plates within a given battery size determines reserve capacity. Reserve capacity is the length of time sustained cranking can occur.

** CCA ratings are based on two 12-volt batteries in series.

Fuel System

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

Basic Application Requirements

Engine Idle Speed ..... 600 to 1400 rpm

Fuel Inlet Maximum Restriction:
- Clean Fuel Filter ..... 100 mm Hg [4.0 in-Hg]
- Dirty Fuel Filter ..... 203 mm Hg [8.0 in-Hg]

Fuel Drain Line Restriction:
- With Check Valves ..... 0 to 21 kPa [0 to 3 psi]
- With Check Valves Removed* ..... 14 to 34 kPa [2 to 5 psi]

*All QSK19 engines are built with a check valve.

Fuel Check Valve Between Fuel Pump and Cylinder Head (Integral to Fuel Pump):
- Opening Pressure ..... 21 to 35 kPa [3 to 5 psi]

Engine Minimum Cranking Speed ..... 150 rpm

Fuel Check Valve in Fuel Drain Line:
- Opening Pressure ..... 13 to 25 mm Hg [1/4 to 1/2 psi]

Derate Engine Fuel Rate for High Altitude ..... 4% per 300 m [1000 ft] above 3600 m [12,000 ft]

Derate Engine Fuel Rate for Hot Weather ..... 2% per 11°C above 38°C [1% per 10°F above 100°F]

Shutoff Valve Solenoid Coil Resistance in Ohms 24VDC ..... 28 to 32 Ohms

Fuel Pump Cranking Pressure - Minimum: ..... 172 kPa [25 psi] @ 150 rpm

Fuel Pump Pressure - Minimum:
- 1500 rpm: ..... 1448 kPa [210 psi]
- 1800 rpm: ..... 1655 kPa [240 psi]
- 2100 rpm: ..... 1861 kPa [270 psi]
- 2350 rpm: ..... 1999 kPa [290 psi]

Fuel Filter Specifications (Cummins Engine Company, Inc. Standard No. 14,223)
Efficiency: ..... 98.7% at 10 microns
96.0% at 8 microns
86.0% at 5 microns
Water Removal: ..... Free = 95%
Emulsified = 95%

Lubricating Oil System

Oil Pressure (With 15W-40 Oil at 107° C [225° F])
At Idle (Minimum Allowable) ..... 138 kPa [20 psi]
At No Load Governed Speed ..... 345 to 483 kPa [50 to 70 psi]

Oil Temperature
Maximum ..... 120°C [250° F]

Oil Filter Capacity
Bypass Filter (Spin-On)(LF777 Fleetguard) ..... 2.3 Liters [0.6 U.S. Gallons]
Full-Flow Filter (Spin-On)(LF670 Fleetguard) ..... 2.7 Liters [0.7 U.S. Gallons]
Combination Filter (Two LF3000 Fleetguard) ..... 5.7 Liters [1.5 U.S. Gallons]

	Oil Pan Capacity (Liters)		[U.S. Gallons]	
Oil Pan Part No.	**High**	**Low**	**High**	**Low**
3096460	72	64	19	17
3086096	61	49	16	13
3086097	61	49	16	13
3331695	61	49	16	13
3331568	114	102	30	27

NOTE: When the rear gear train option is specified, add 7.6 liters [2 U.S. gallons] to the oil pan capacity listed above.

Cooling System

Coolant Capacity (Engine Only) ..... 32.2 liters [34 U.S. Quarts]

Standard Modulating Thermostat Range ..... 82°C to 94°C [180°F to 202°F]

Standard LTA Thermostat Range ..... 69°C to 78°C [157°F to 172°F]

Maximum Coolant Pressure (Exclusive of Pressure Cap) ..... 241 kPa [35 psi]

Maximum Allowable Top Tank Temperature ..... 100°C [212°F]

Minimum Recommended Top Tank Temperature ..... 70°C [160°F]

Maximum Allowable Deaeration Time ..... 25 Minutes

Minimum Allowable Drawdown or 20% of System Capacity (whichever is greater) ..... 11 liters [12 U.S. Quarts]

Minimum Allowable Pressure Cap ..... 50 kPa [7 psi]

Exhaust System

Back Pressure - Maximum (at rated speed and load): ..... 75 mm Hg [3.0 in Hg]

Exhaust Pipe Size (Normally Acceptable Inside Diameter):

- All Ratings ..... 152 mm [6.0 in]

Batteries (Specific Gravity)

Battery State of Charge	Specific Gravity @ 27°C [80°F]
100%	1.260-1.280
75%	1.230-1.250
50%	1.200-1.220
25%	1.170-1.190
Discharged	1.110-1.130

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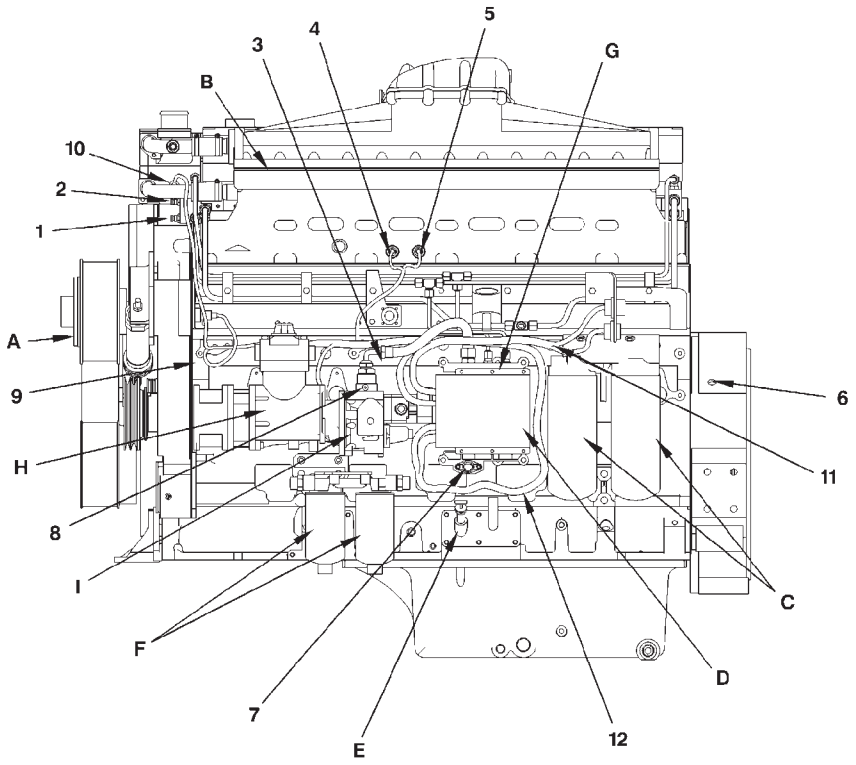
Engine Diagrams

Engine Views

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



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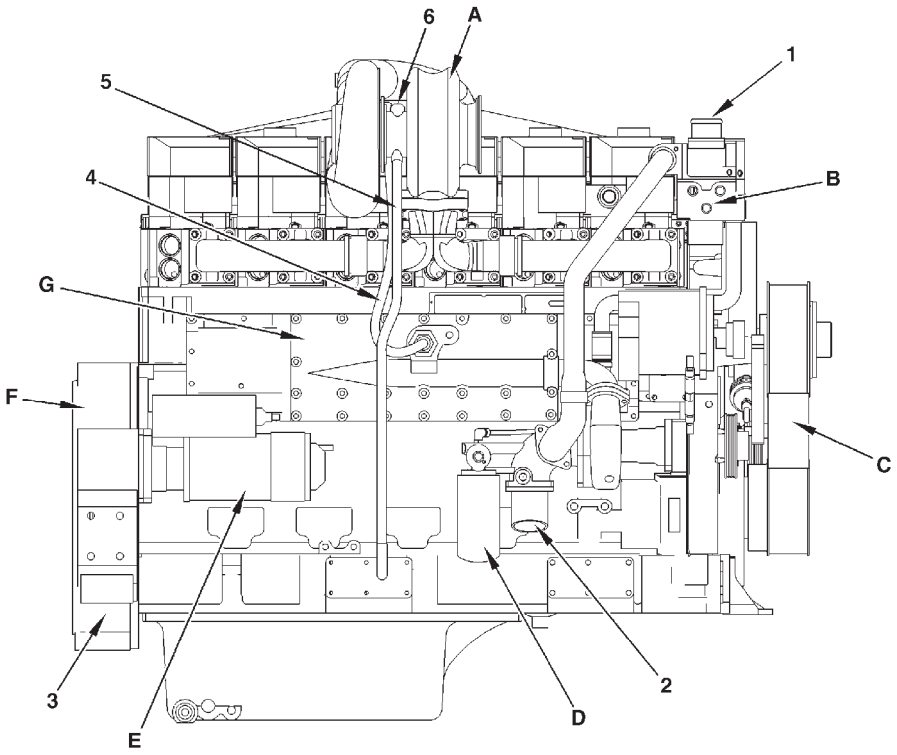
1. Fuel Rail Quick-Disconnect Fitting
2. Timing Rail Quick-Disconnect Fitting
3. Oil Pressure Sensor (OPS)
4. Intake Manifold Temperature Sensor (IMTS)
5. Intake Manifold Pressure Sensor (IMPS)
6. Engine Speed Sensor (ESS)(Generator Drive)
7. Ambient Air Pressure Sensor (AAPS)
8. Fuel Pump Outlet Quick-Disconnect Fitting
9. Engine Speed Sensor (**NOT** Generator Drive)
10. Coolant Temperature Sensor (CTS)
11. OEM Interface Harness
12. Engine Harness

A. Fan Hub
B. Aftercooler Assembly
C. Combination Full Flow/ Bypass Oil Filters
D. Electronic Control Module (ECM)
E. Dipstick
F. Fuel Filters
G. Control Valve Body
H. Air Compressor
I. Fuel Pump



EXHAUST SIDE - QSK19

1. Coolant Outlet
2. Coolant Inlet
3. Alternate Location for Engine Speed Sensor (ESS)(G-Drive ONLY)
4. Coolant Supply to Turbocharger
5. Turbocharger Oil Drain
6. Oil Inlet to Turbocharger

A. Turbocharger
B. Thermostat Housing
C. Fan Idler and Assembly
D. Coolant Filter
E. Starting Motor
F. Flywheel Housing
G. Oil Cooler

NOTES

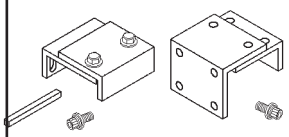
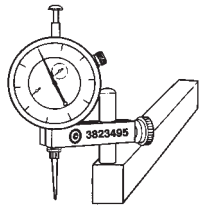
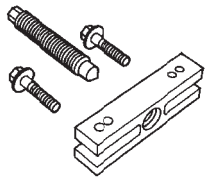
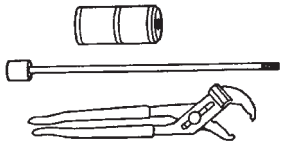
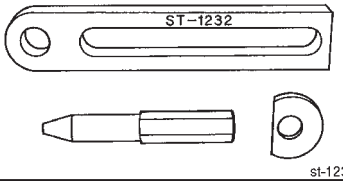
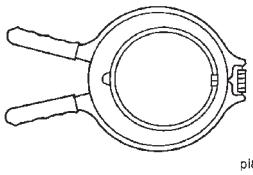
Section 0 - Complete Engine - Group 00

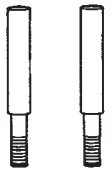
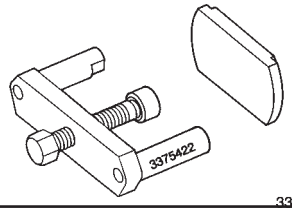
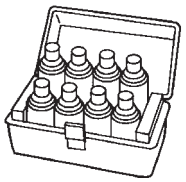
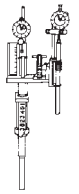
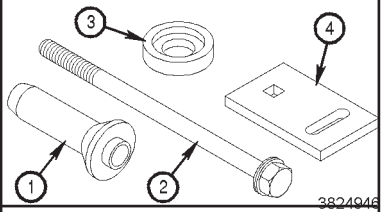
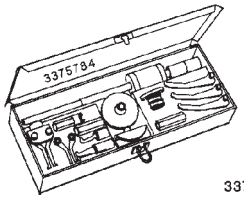
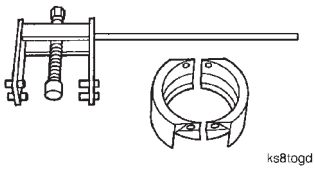
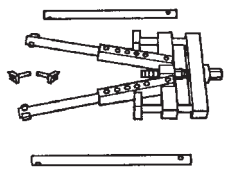
Section Contents

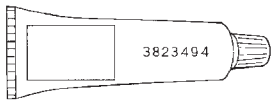
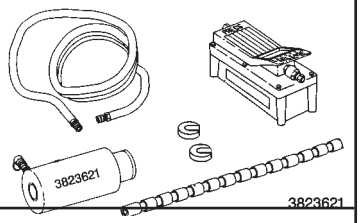
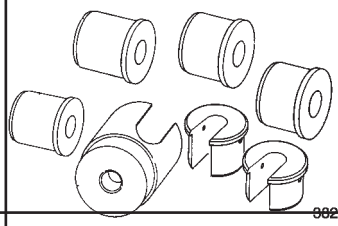
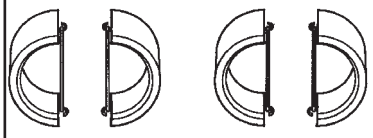
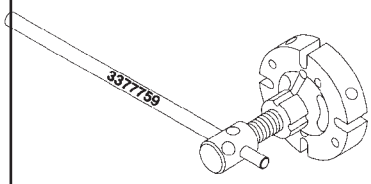
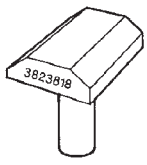
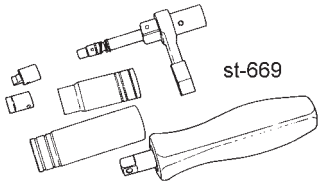
Service Tools

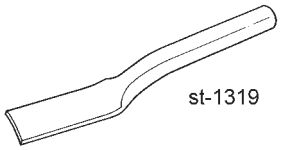
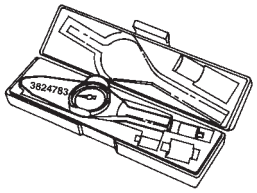
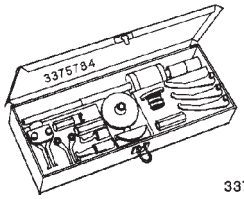
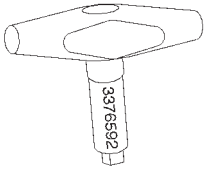
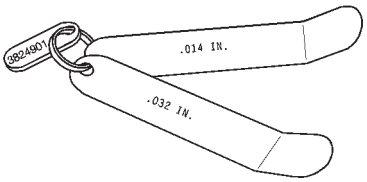
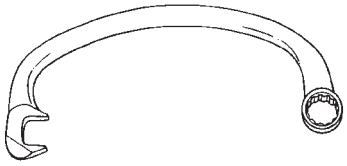
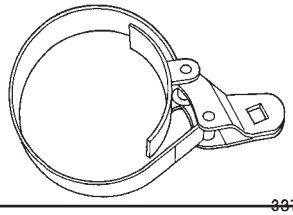
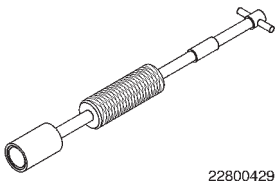
Engine Disassembly and Assembly

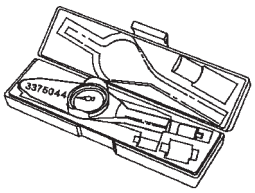
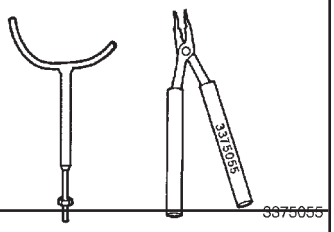
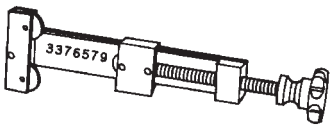
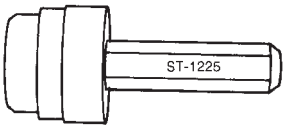
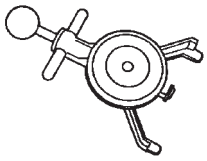
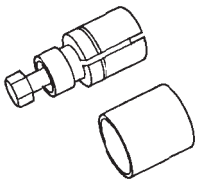
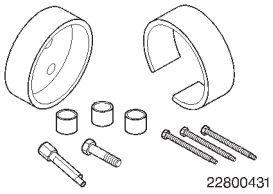
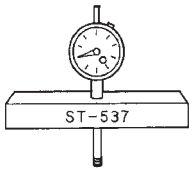
The following special tools are recommended to perform procedures in this section. The use of these tools is shown in the appropriate procedure. These tools can be purchased from your local Cummins Authorized Repair Location.

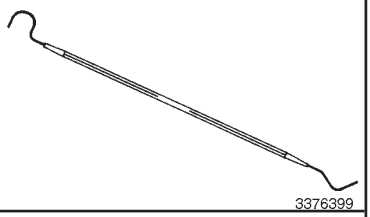
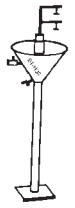
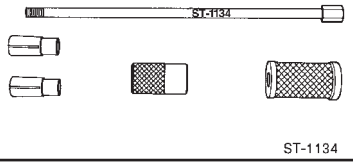
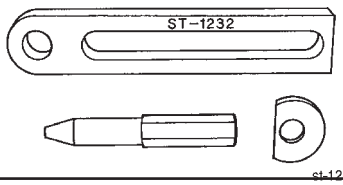
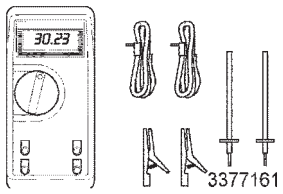
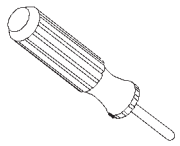
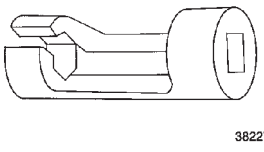
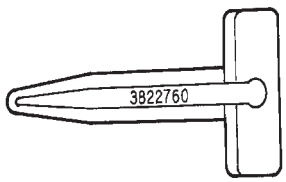
Tool No.	Tool Description	Tool Illustration
3375252	**Engine Support Bracket Kit** Support the front of the engine to allow the front support or oil pan adapter to be removed.	 22800428
3823495	**Depth Gauge Assembly** Measure cylinder liner protrusion and cylinder liner counterbore ledge angle.	 3823495
ST-647	**Puller** Remove the alternator and accessory drive pulleys.	 ad8toga
ST-1178	**Main Bearing Cap Pulley** Used to remove the main bearing caps from the cylinder block.	 mb8toga
ST-1232	**Drill Ream Fixture** Machine dowel hole to install oversize dowels in cylinder block and flywheel housing. Use with a drill, reamer, and the appropriate drill/ream bushing set.	 st-1232
ST-1269	**Piston Ring Expander** Designed to install piston rings on the piston without damaging or distorting the rings.	 pi8togd

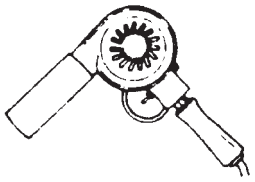
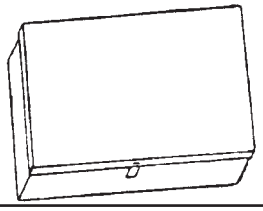
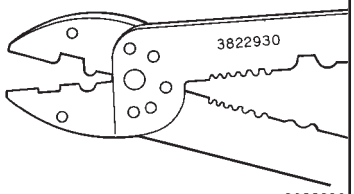
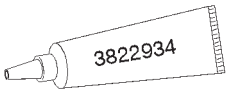
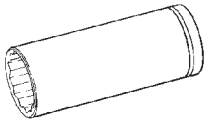
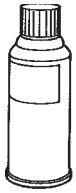
Tool No.	Tool Description	Tool Illustration
3375098	**Connecting Rod Guide Pins** Special nylon pins used to protect the crankshaft journal by guiding the connecting rod during installation or removal.	 cx8togg
3375422	**Liner Installation Tool** Install cylinder liner in engine.	 3375422
3375432	**Crack Detection Kit** Check for cracks in any engine component. Contains cleaner, developer, and penetrant.	 bp8togj
3824942	**Injection Timing Tool** Check injection timing. The timing fixture is designed to determine the push tube travel in relation to the piston travel.	 3823451
3824946	**Universal Injector Timing Tool Fixture Kit Update** Up-Date Kit for the previous Universal Injection Timing Tool, 3823451, to include QSK 19 hardware.	 3824946
3375784	**Light Duty Puller Kit** Remove small bushings, oil seals, and bearings.	 3375784
3375834	**Puller Assembly** Remove the crankshaft front gear from the crankshaft. Use with Part No. 3375835 Puller Jaw.	 ks8togd
3376015	**Universal Liner Puller** Remove cylinder liner from engine.	 ck8togr

Tool No.	Tool Description	Tool Illustration
3376326	**Pulley Installation Tool** Install the alternator and accessory drive pulleys.	 ad8togb
3823494	**Cummins Sealant** Used to prevent coolant or oil leaks. This is one part Room Temperature Vulcanizing (RTV) silicone rubber, adhesive, and sealant material having high heat and oil resistance, and low compression rate.	 3823494
3823621	**Camshaft Bushing Tool Hydraulic Actuator Kit** Hydraulic ram provides the force to install/remove cam bushings when used with installation/removal kit.	 3823621
3824863	**Camshaft Bushing Installation/Removal Kit** Used with the Part No. 3823621 Camshaft Bushing Hydraulic Actuator Kit to remove the camshaft bushing.	 3824842
3825150	**Camshaft Pilot** Install camshaft without damaging the camshaft bushings or camshaft.	 cg8togc
3824900	**Camshaft Gear Puller Kit** Remove camshaft gear from camshaft without removing camshaft from engine.	
3823818	**Main Bearing Roll-out Tool** Used to remove and install main bearing shell.	 3823818
ST-669	**Torque Wrench Adapter** Secures the rocker lever adjusting screw while tightening the lock nut.	

Tool No.	Tool Description	Tool Illustration
ST-1319	**Water Tube Driver** Used to install or remove the water transfer tubes from the rocker housings.	
3824783	**Torque Wrench** A dial-type torque wrench used to accurately adjust injectors in inch-pounds. Use of a clicker-type torque wrench is **not** recommended. 0-35 N•m [0-300 in-lb]	 3824783
3375784	**Light Duty Puller Kit** Used to remove small bushings, oil seals, and bearings.	 3375784
3376592	**Torque Wrench** Inch-pound torque wrench used to tighten the valve lever adjusting screw. Does **not** require screwdriver attachment.	 3376592
3824901	**Valve Setting Gauge Kit** Kit contains two 25.4 mm [1 in] wide feeler gauges for centering under the swivel foot of the rocker lever when setting the valves. The kit contains an intake valve gauge at 0.36 mm [0.014 in] and an exhaust valve gauge at 0.081 mm [0.032 in].	 3824901
3376845	**Fuel Pump/Air Compressor Wrench** Used to reach nuts when removing or installing the fuel pump or air compressor.	 3376845
3375049	**Filter Wrench** Remove spin-on filter.	 3375049
3823580 3824830	**Injector Removal / Installation Tool** Used to remove and install the QSK injector.	

Tool No.	Tool Description	Tool Illustration
3824783	**Torque Wrench** This is a [3/8 inch] drive, [300 in-lb], torque wrench used to set injector preload adjustments on engines with the high pressure fuel injection systems such as the QUANTUM™ Series K19.	
3375055	**Pressure Regulator Removal Tool** Remove retaining ring from lubricating oil pump regulator (on engine).	
3376579	**Filter Cutter** Open spin-on full-flow filter for inspection.	
ST-1225	**Thermostat Seal Mandrel** Install the thermostat seal in the thermostat housing.	
ST-1293	**Belt Tension Gauge** Measure the accessory drive belt tension.	
3376663	**Coupling Puller** Used to remove accessory drive coupling and spline coupling hub.	
3824760	**Oil Seal Remover/Installer** Used to remove small bushings, oil seals, and bearings.	
ST-537	**Dial depth gauge** This gauge is used to check for proper nozzle ring crush or end clearance checks on turbochargers.	

Tool No.	Tool Description	Tool Illustration
3376399	**O-Ring Pick** Use to remove and install o-rings.	
ST-1135	**Lubricating Oil Sampling Filter** Used to monitor oil contamination.	
ST-1134	**Dowel Pin Extractor** Remove dowel pins.	
ST-1232	**Drill Ream Fixture** Machine dowel hole to install oversize dowels in cylinder block and flywheel housing. Use with a drill, reamer, and the appropriate drill/ream bushing set.	
3377161	**Digital Volt-Ohm Meter** Measure electrical circuits; voltage (volts), resistance (ohms), and current (amps).	
3822608	**Weather-Pack Terminal Removal Tool** Used to repair Weather-Pack connectors.	
3822747	**Engine Position Sensor Installation Tool** Used to remove and install the engine position sensor.	
3822760	**Deutsch Terminal Removal Tool** Used to repair Deutsch connectors.	

Tool No.	Tool Description	Tool Illustration
3822860	**Heat Gun** Used to repair connector wires.	
3822926	**Wiring Repair Kit** Contains a variety of connectors, pins, seals, terminals, test leads, and other tools used to repair connectors.	
3284903	**Wire Crimping Pliers** Used when repairing connector wires.	 3822930
3822934	**Lubricant DS-ES** Dielectric lithium grease used to lubricate the pins in the electrical connectors before installation.	 3822934
3823843	**Deep Well Socket (1–1/4 inch)** Used to remove and install sensors and actuators.	 3823843
3824510	**Electrical Contact Cleaner** A non-petroleum cleaner used to clean electrical contacts and connectors.	 oi8togt

Engine Disassembly (000-003)

General Information

General Information

These procedures apply to all QSK19 engines. The differences between engine model due to the application, the optional equipment on an engine, and the year an engine was built are included in the instructions. Omit the steps that do **not** apply to the engine being rebuilt.

⚠ WARNING ⚠

A Warning statement is included for any component or assembly that weighs more than 23 kg [50 lb]. To avoid personal injury, use a hoist or get assistance from more than one person when removing or installing these parts.

⚠ CAUTION ⚠

All fasteners are given in U.S. Customary measurements. All fasteners have right-handed threads unless a Caution states that a fastener has left-handed threads.

Disassembly

The instructions in this procedure are organized in a logical sequence to **disassemble** an engine. This is **not** the **only** sequence to **disassemble** an engine. Certain parts **must** be removed in the sequence indicated. Use this sequence until you become familiar with the engine.

Discard all gaskets, seals, hoses, filters, and o-rings. Keep these parts if they are needed for a failure analysis.

Label, tag, or mark the parts for location as the parts are removed. This will help find all the parts that can be involved in a failure, and simplify the **assembly** procedure.

Label, tag, or mark the wiring harness and all components and sensors as they are removed from the engine.

Label, tag, mark, or photograph all special equipment prior to removal from an engine. This engine **assembly** procedure does **not** include the installation of special optional equipment.

Force **must** be used to remove certain parts. A mallet **must** be used when force is required.

Avoid as much dirt as possible during **disassembly**. The accumulation of additional dirt will make it more difficult to clean the components.

Assembly

This procedure assumes that all of the components and assemblies have been cleaned, replaced, or rebuilt and are ready to be installed on the engine.

Torque values are listed in each step. If a torque value is not specified, use the chart listed in the Specifications (Section V) to determine the correct torque value.

Many of the gaskets and o-rings are manufactured from a material designed to absorb oil. These gaskets will enlarge and provide a tight seal after coming in contact with oil. Use ONLY a recommended contact adhesive or a vegetable based oil to install these parts.

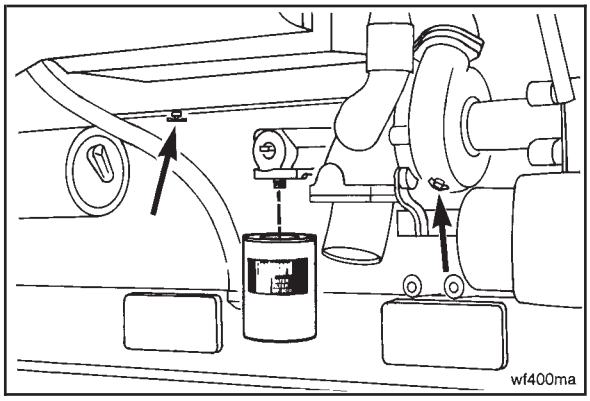
If the capscrew length is not specified, use the formula in the Specifications (Section V) to determine the correct capscrew length. The use of a longer capscrew than the capscrew that is listed can result in damage to the engine.

Disassemble

Remove the Water Filter

Open the draincock on the oil cooler housing and on the water pump.

Remove and discard the coolant filter.



Prepare Engine to be Mounted on Rebuild Stand

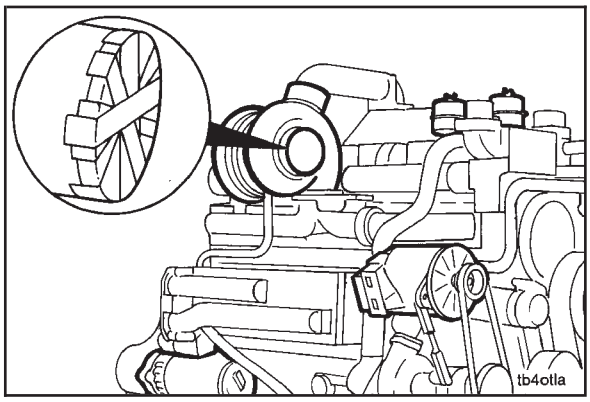
WARNING

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

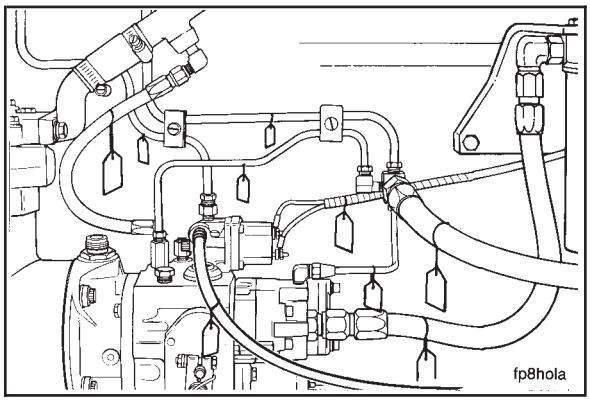
CAUTION

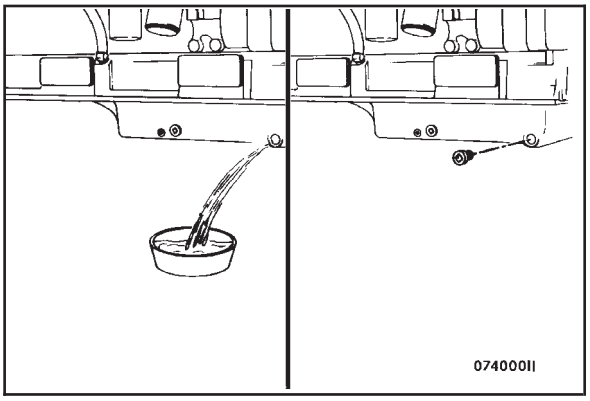
Cover all engine openings and electrical components. This will prevent water damage.

Use steam to clean the heavy dirt from the exterior of the engine.



NOTE: Put a tag on **all** hoses, lines, linkage, and electrical connections as they are removed to identify location and aid during the installation process.





⚠ WARNING ⚠

Hot oil can cause serious personal injury. Drain the oil when the oil temperature is approximately 60°C [140°F].

⚠ WARNING ⚠

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. Always use the proper procedures to dispose of the oil.

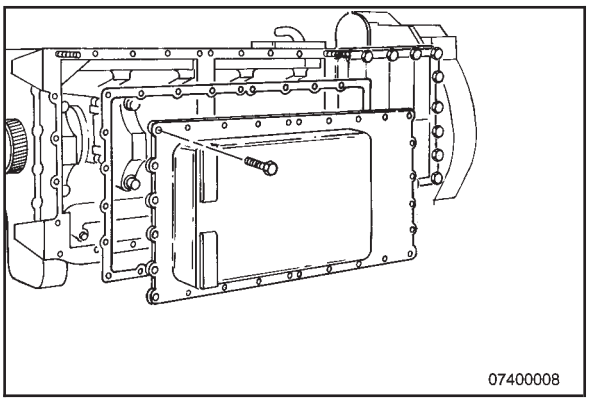
Remove the oil drain plug from the bottom of the oil sump.

Drain the oil.

Install the drain plug.

Tighten the drain plug.

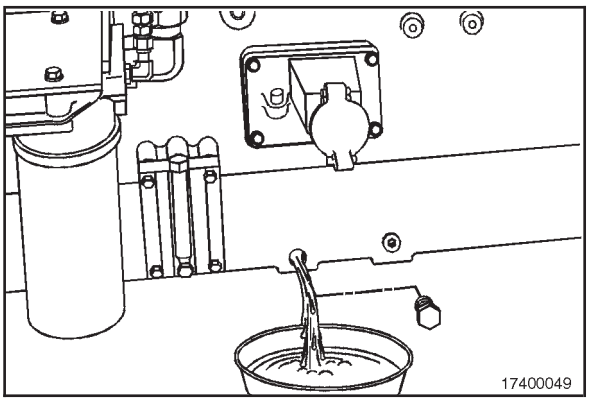
Torque Value: 100 N•m [75 ft-lb]



Remove the 28 capscrews.

Remove the oil pan.

Remove and discard the gasket.



Rail Applications

Remove the lubricating oil drain plug.

Drain the lubricating oil.

Replace the drain plug and tighten.

Torque Value: 100 N•m [75 ft-lb]

Rail Applications

Remove the lubricating oil filters and filter head.

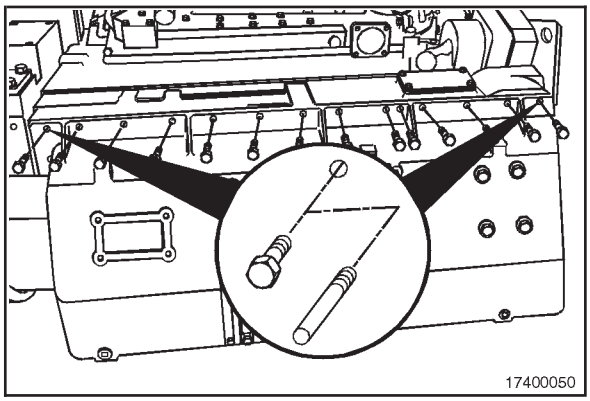
Remove the fuel filter and filter head.

Remove the coolant filter and filter head.

Rail Applications

Remove 15 capscrews on the top of the oil pan.

Install two 3/8 - 16 guide studs in the capscrew holes.

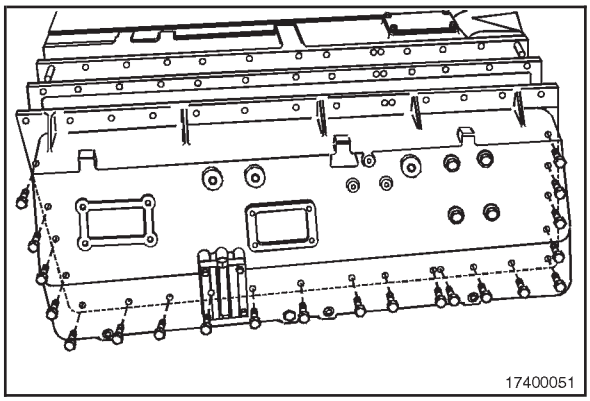


Rail Applications

Remove the remaining 23 capscrews.

Remove the lubricating oil pan.

Remove and discard the gasket.



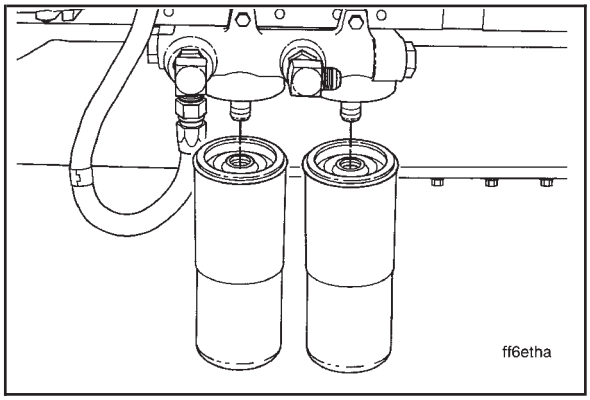
Remove the Fuel Filters

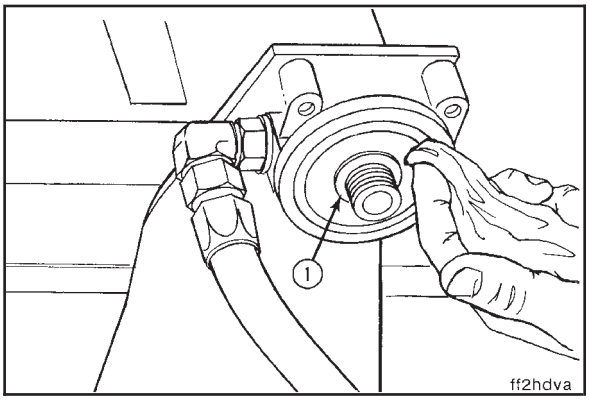
WARNING

Fuel is flammable. Do not allow cigarettes, flames, sparks, arcing switches or equipment, pilot lights, or other ignition sources near the fuel system.

Close the fuel line shutoff valve before changing the fuel filters, or the overhead tank can drain, causing a fuel leak.

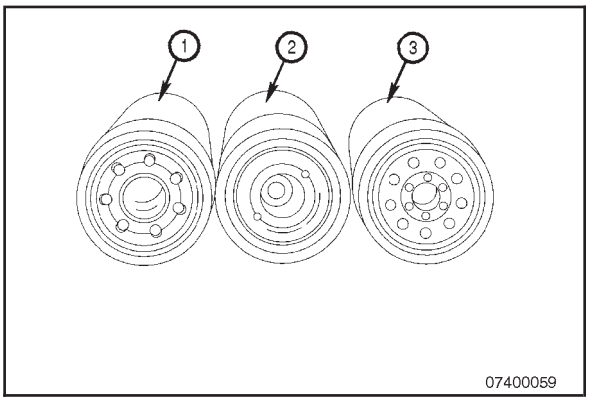
Remove the fuel filter with filter wrench, Part No. 3376807.





Remove the thread adapter sealing ring (1).

Use a clean, lint-free towel to clean the surface of the filter head gasket.



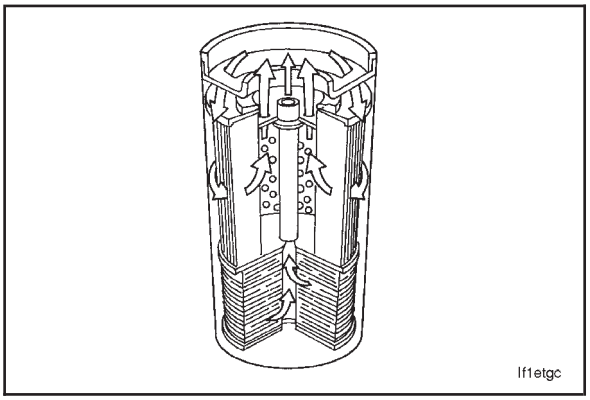
Remove the Oil Filters

The external appearance of the full-flow (1) the bypass (2) and the combination (3) filters are the same. The accompanying picture identifies the differences among the three filters.

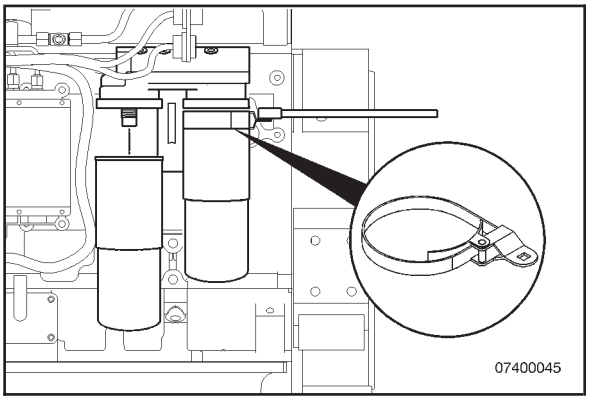
⚠ CAUTION ⚠

The bypass and combination filters both have the same threads. Verify correct filter is used for replacement to avoid damage to the engine.

NOTE: The full-flow filter contains [1 1/2-16 inch] threads. The bypass and combination filters contain [2 1/4-12 inch] threads.



A combination oil filter is used on most engines. The upper section of the filter contains the full-flow filter element while the lower section contain the bypass element.



NOTE: The following illustrations show the combination oil filter. Use the same procedure when changing the remote bypass oil filters.

Use an oil filter wrench, Part No. 3375049, or equivalent. Remove the oil filters.

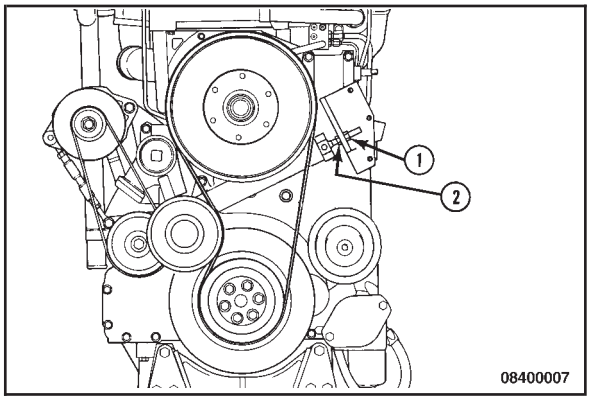
Discard the filters if they are **not** needed for a failure analysis.

Remove the Cooling Fan Drive Belt

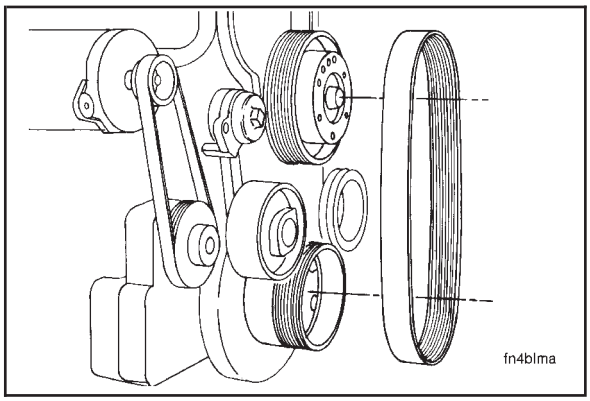
⚠ CAUTION ⚠

The fan belt idler is under tension. Do NOT allow your hands to get between the idler and the belt, or the fan hub. Personal injury can result.

Loosen nuts (1) and (2). Turn nut (1) **counterclockwise** to end of threaded rod to relieve tension on the belt.

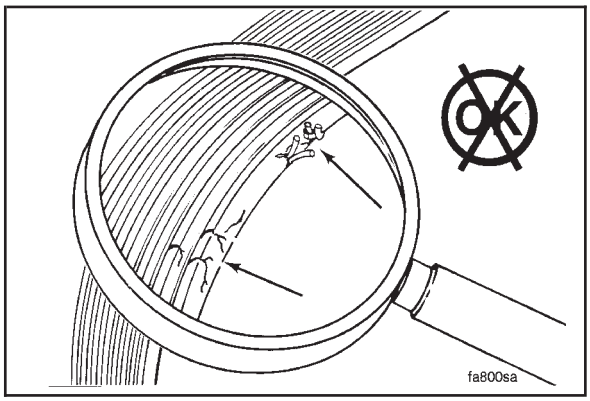


Remove the fan belt.



Check the belt for wear.

If the belt indicates any wear, it **must** be replaced.



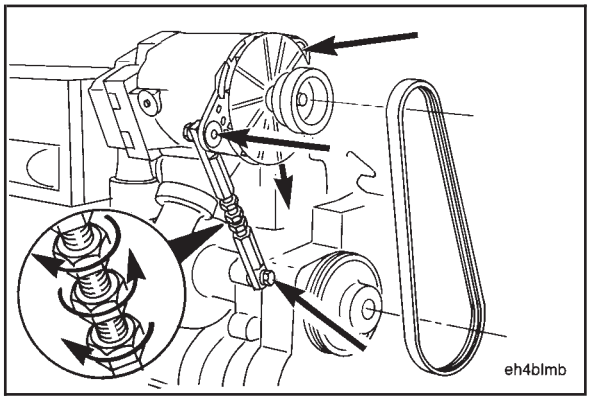
Remove the Alternator Drive Belt

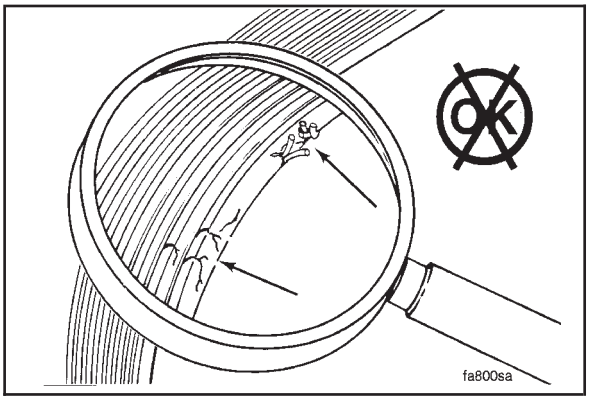
Loosen the adjusting link and the alternator mounting capscrews.

NOTE: The lower jam nut has **left-hand** threads.

Loosen both of the jam nuts. Turn the adjusting screw to relieve the belt tension.

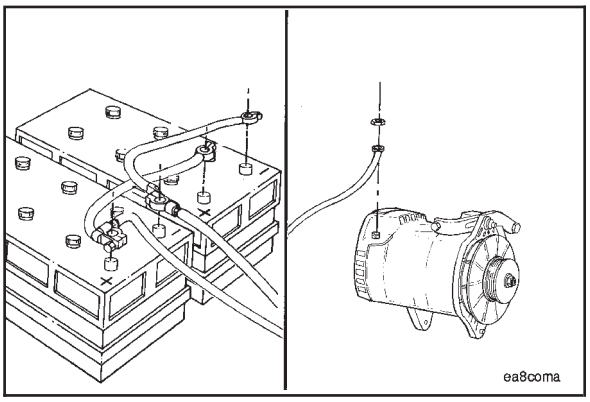
Remove the belt.





Check the belt for wear.

If the belt indicates any wear, it **must** be replaced.



Remove the Alternator

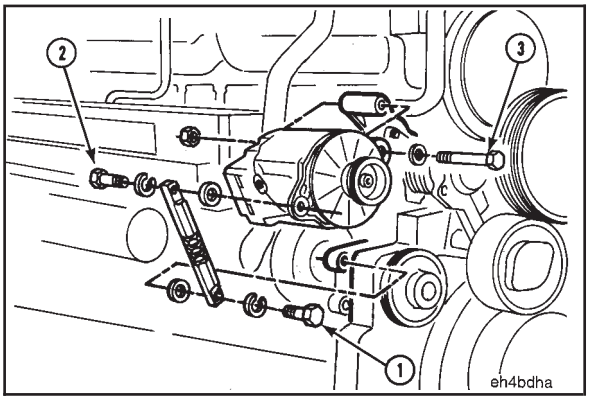
WARNING

Always disconnect the negative (-) cable first to avoid sparks that can ignite explosive battery gases.

WARNING

Batteries emit hydrogen gas. To avoid explosion and personal injury, do not smoke or allow ignition source in area when servicing batteries.

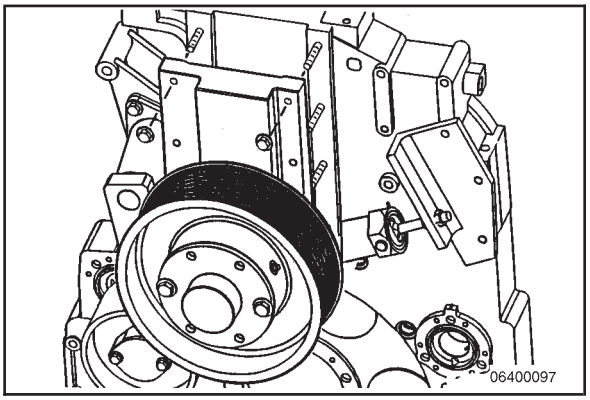
Disconnect the wiring and ground strap from the alternator.



Remove capscrews (1) and (2) and the adjusting link.

Remove capscrew (3) and nut.

Remove the alternator.



Remove the Belt Driven Fan Hub

CAUTION

This assembly weighs more than 23 kg [50 lb]. To avoid personal injury, use a hoist or get personal assistance.

Remove the eight nuts and washers, and the fan hub.

Remove the Fan Drive Idler Arm Assembly

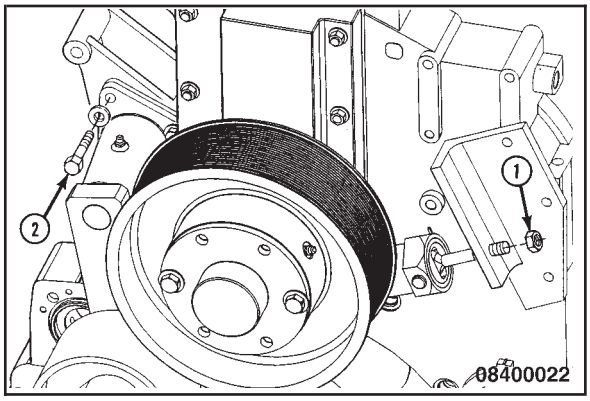
⚠ CAUTION ⚠

The belt tensioner and the pivot arm assembly will rotate during removal. Personal injury can result. To avoid personal injury, use a hoist or get personal assistance to lift the component.

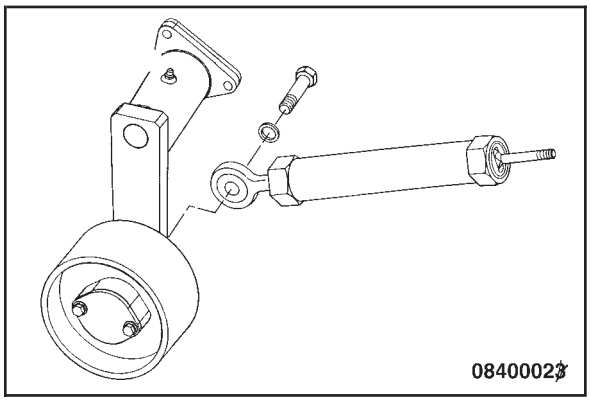
Remove the belt adjusting nut (1) from the tensioner assembly.

Remove the three capscrews (2) from the pivot arm assembly.

Remove the pivot arm and the belt tensioner as an assembly.



Remove the belt tensioner from the idler arm assembly.

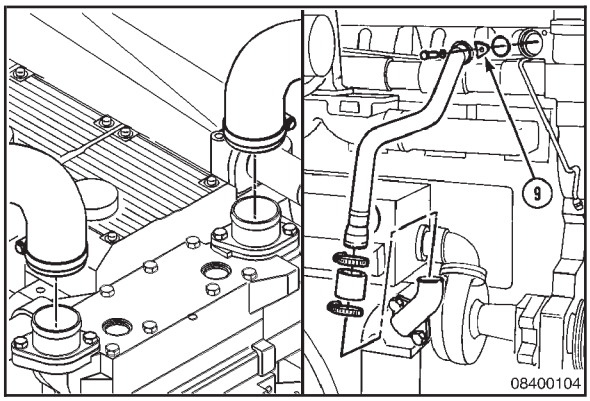


Remove the Coolant Tubes and Hoses - Conventional Aftercooling

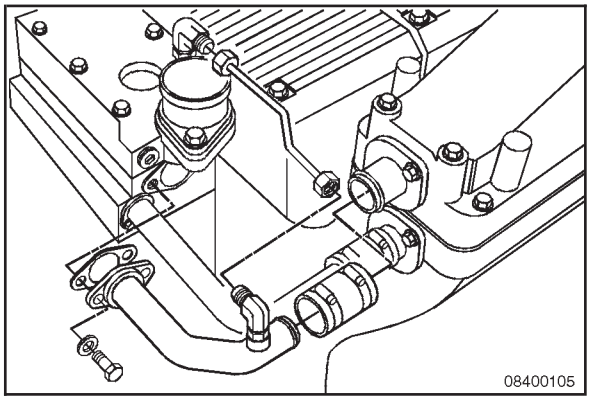
Remove the bypass tube clip (9).

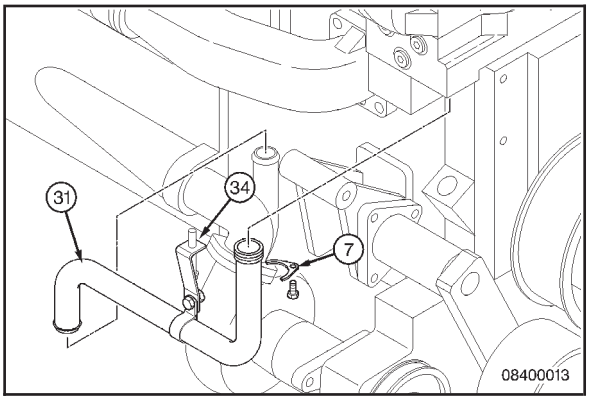
Loosen both hose clamps.

Remove the bypass tube.



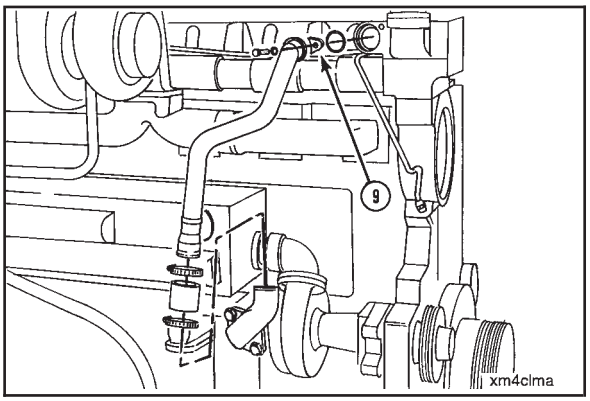
Remove the aftercooler coolant return tube aftercooler coolant supply tube, gaskets and hoses from the thermostat housing support.





Remove the aftercooler water supply tube clip (7). Loosen the hose clamps. Remove the support bracket (34).

Remove the tube (31). Remove and discard the o-ring.

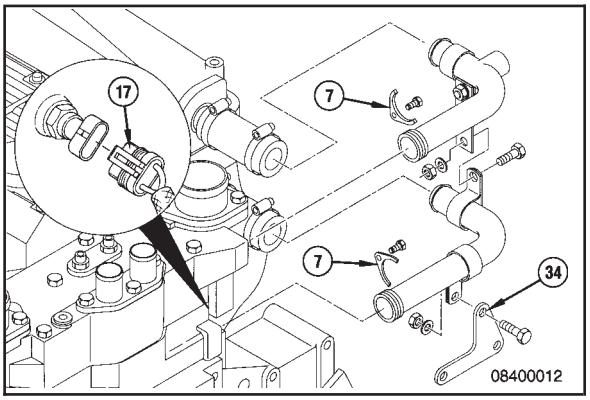


Remove the Coolant Tubes and Hoses - Low Temperature Aftercooling

Remove the bypass tube clamp (9).

Loosen both hose clamps.

Remove the bypass tube, hose, and water connection.



Remove the water inlet and outlet tube clips (7).

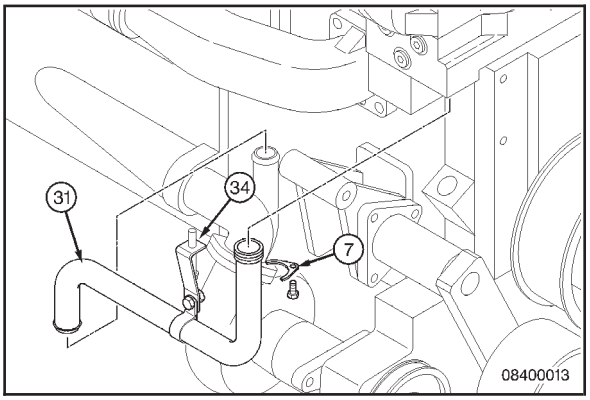
Loosen the hose clamps.

Remove the aftercooler water tube support bracket (34).

Remove the aftercooler water tubes.

Remove and discard the o-rings.

Disconnect the coolant temperature sensor wire (17).



Remove the aftercooler water supply tube clip (7).

Loosen the hose clamps.

Remove the support bracket (34).

Remove the tube (31).

Remove and discard the o-ring.