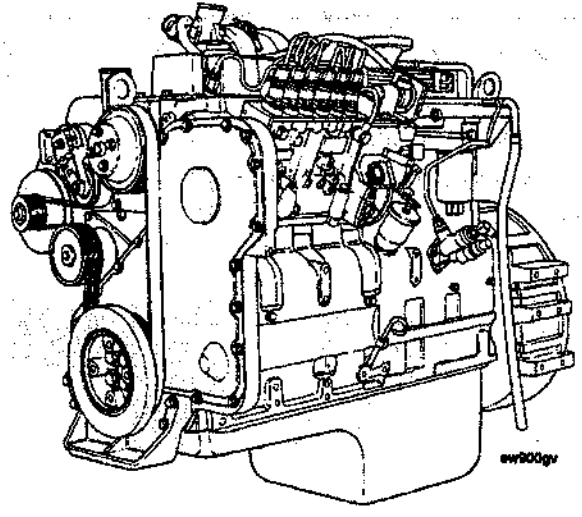
Operation and Maintenance Manual C Series Engines



Foreword

This manual contains information for the correct operation and maintenance of your Cummins engine. It also includes important safety information, engine and systems specifications, troubleshooting guidelines, and listings of Cummins Authorized Repair Locations and component manufacturers.

Keep this manual with the equipment. If the equipment is traded or sold, give the manual to the new owner.

The information, specifications, and recommended maintenance guidelines in this manual are based on information in effect at the time of printing. Cummins Engine Company, Inc.reserves the right to make changes at any time without obligation. If you find differences between your engine and the information in this manual, contact your local Cummins Authorized Repair Location.

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:

Note: Warranty information is located in Section W. Make sure you are familiar with the warranty or warranties applicable to your engine.

Table of Contents

Page No.

Important Reference Numbers

Fill in the part name and number in the blank spaces provided below. This will give you a reference whenever service or maintenance is required.

Engine Model	_____
Engine Serial Number	_____
Engine Specification Number	_____
Fuel Pump Part Number	_____
Filter Part Numbers:	
• Air Cleaner Element	_____
• Lubricating Oil	_____
• Fuel	_____
• Fuel Water separator	_____
Belt Part Numbers	_____
	_____
	_____
	_____
	_____

NOTES

Section i-Introduction

Section Contents

To The Owner and Operator

Preventative maintenance is the easiest and least expensive type of maintenance.Follow the maintenance schedule recommendations outlined in Maintenance Guidelines (Section 2).

Keep records of regularly scheduled maintenance.

Use the correct fuel, oil and coolant in your engine as specified in Engine Specifications (Section V).

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.

Personnel at Cummins Authorized Repair Locations have been trained to provide expert service and parts support. If there is a problem that cannot be resolved by a Cummins Authorized Repair Location, follow the steps outlined in the Service Assistance (Section S).

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-5 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 intervals at which maintenance on your engine is to be performed. A table which states the required intervals and the checks to be made is located in Section 2. Locate the interval at which you are performing maintenance then follow the steps given in that section for all the procedures to be performed. In addition, all the procedures done under previous maintenance intervals must be performed.

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

Refer to Section T for a guide to troubleshooting your engine. Follow the directions given on page T-3 to locate and correct 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.

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 simbolos siguientes son usados en este manual para clarificar el proceso de las instrucciones. Cuando aparece uno de estos simbolos, 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 especifico.

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. Zurvermeidung 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 instruction. Quand l'un de ces symboles apparait, 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.

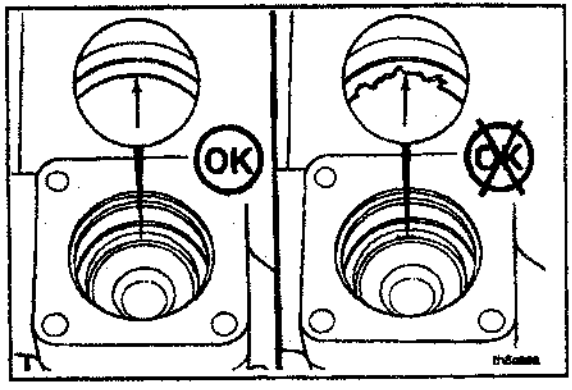
EFFECTUER une **MESURE** électrique.

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

Use the illustrations in this manual as a guide to perform the action or the repair described. Many illustrations are generic and will not look exactly like the engine or the parts used in your application. In order to provide clarity to illustrations, some illustrations show parts removed that are not related to the specific parts given in the text. Most of the illustrations contain symbols to indicate an action required or to indicate an **acceptable (OK)** or **unacceptable (not OK)** condition.



General Safety Instructions

Important Safety Notice

⚠ WARNING ⚠

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 safe. Be aware of hazardous conditions that can exist.
- **Always** wear protective glasses and protective shoes when working.
- Do **not** wear loose-fitting or torn clothing. Remove all jewelry when working.
- Disconnect the battery 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 engine 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 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.

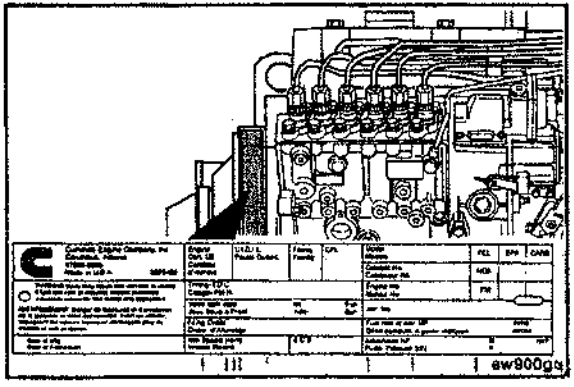
Definition of Terms

AFC	Air Fuel Control
API	American Petroleum Institute
ASA	Air Signal Attenuator
ASTM	American Society of Testing and Materials
C	Celsius
CARB	California Air Resources Board
C. I. D.	Cubic Inch Displacement
Cm	Centimeter
CPL	Control Parts List
cSt	Centistokes
DCA	Diesel Coolant Additive
ECM	Electronic Control Module
E. C. S.	Emission Control System
EPA	Environmental Protection Agency
EPS	Engine Position Sensor
F	Fahrenheit
ft-lb	Foot Pound
GVW	Gross Vehicle Weight
Hg	Mercury
HP	Horsepower
H_2O	Water
in-lb	Inch Pound
kg	Kilograms
km	Kilometers
km/l	Kilometers per Liter
kPa	Kilopascal
l	Liter
m	Meter
mm	Millimeter
MPa	Megapascal
MPH	Miles Per Hour
MPQ	Miles Per Quart
N · m	Newton-meter
OEM	Original Equipment Manufacturer
ppm	Parts Per Million
psi	Pounds Per Square Inch
PTO	Power Takeoff
RPM	Revolutions Per Minute
S. A. E.	Society of Automotive Engineers
STC	Step Timing Control
vs	Variable Speed
vss	Vehicle Speed Sensor

Section E-Engine and Component Identification

Section Contents

Engine Identification



Engine Dataplate

The engine dataplates show specific information about the engine. The engine serial number (1) and Control Parts List (CPL) (2) provide information for ordering parts and service needs.

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

Cummins Corporation Inc. Box 3005 Columbus, Indiana 47202-3005		C.I.D./L	CPL	Engine Serial No.	
		Family		Cust. Spec.	
				Engine Model	
Warning: Injury May Result And Warranty Is Voided If Fuel Rate RPM Or Altitudes Exceed Published Maximum Values For This Model And Application		Low idle RPM			
		Valve lash cold	Int. Exh.	Fuel rate at rated HP	mm^3 /st
Date of Mfg Made in China by Dong Feng Cummins Engine CO. Ltd. 3415519		Firing order		Shop Order No.	
		Gross kW	at RPM		

Cummins Engine Nomenclature

The model name for engines in automotive and 96 industrial applications provides the data shown in the example:

Example

C 8.3 - 275

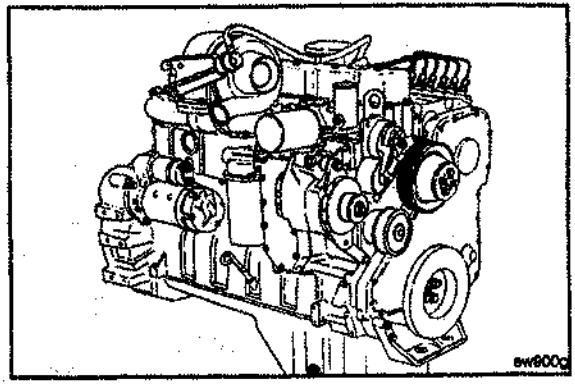
- 275 — Rated Horsepower
- 8.3 — Displacement in Liters
- C — Engine Series

The following example shows a model name of an engine for pre-96 industrial and non-automotive applications:

Example

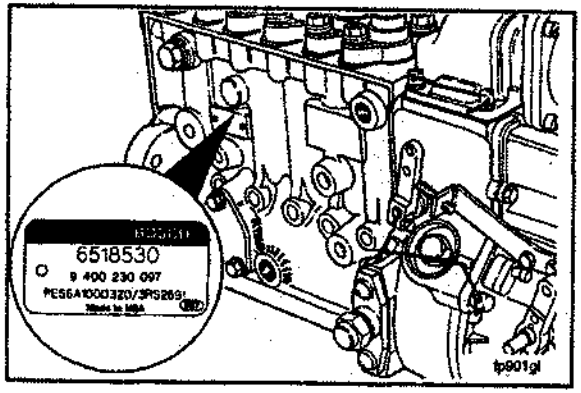
6 C T A 8.3

- 8.3 — Displacement in Liters
- A — Aftercooled
- T — Turbocharged
- C — Engine Series
- 6 — Number of Cylinders

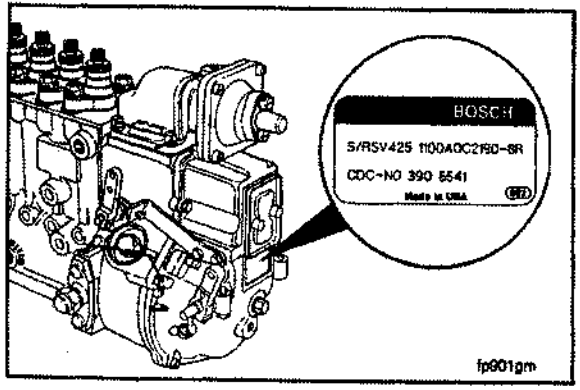


Injection Pump Dataplate

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



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



General Specifications

GENERAL ENGINE DATA	6C8.3	6CT8.3	6CTA8.3	C8.3
Bore-mm [in.]	114 [4.49]			
Strok-mm [in.]	135 [5.32]			
Displacement-liter [in. ^{3}]	8.27 [504.5]			
Engine Weight (Dry) With Standard Accessories	603-612Kg [1330-1350 lb]			
Wet Weight	635-658Kg [1400-1450 lb]			
Firing Order	1-5-3-6-2-4			
Valve Clearances				
-Intake-mm [in.]	0.30 [0.012]			
-Exhaust-mm [in.]	0.61 [0.024]			
Compression Ratio	16.4: 1	17.3: 1	16.5: 1	17.3: 1*/18: 1**
Rotation, viewed from the front of the engine	Clockwise			
Aspiration				
-Naturally Aspirated	×			
-Turbocharged		×		
-Aftercooled			×	
-Charge Air Cooled (CAC)				×
*High Torque				
*Low Torque				

LUBRICATION SYSTEM	6C8.3	6CT8.3	6CTA8.3	C8.3
Lubricating Oil Pressure at Idle-(Minimum Allowable) kPa [PSI]	**69 [10]**			
Lubricating Oil Pressure at Rated-(Minimum Allowable) kPa [PSI]	**207 [30]**			
Regulating Valve Opening Pressure-kPa [PSI]	**518 [75]**			
Differential Pressure to Open the Filter Bypass Valve -kPa [PSI]	**172 [25]**			
Lubricating Oil Capacity of Pan(High-Low) -Liter [U. S. Qts.]	**18.9 [20]** **15.1 [16]**			
COOLING SYSTEM				
Coolant capacity (Engine Only) -liter [U. S. Qts.]	9.9 [10.5]	9.9 [10.5]	10.9 [11.5]	9.9 [10.5]
Standard Modulating Thermostat Range-°C [°F]	**Start 81 [178]**		**Fully Open 95 [203]**	
Pressure Cap-kPa [PSI] Minimum	**50 [7]**			
Maximum Allowable Top Tank Temperature °C [°F]	**100 °C [212 °F]**			
Minimum Recommended Top Tank Temperature °C [°F]	**70 °C [158 °F]**			

INTAKE AIR, EXHAUST AND FUEL SYSTEM	6C8.3	6CT8.3	6CTA8.3	C8.3
Maximum Allowable Air Intake Restriction at Rated Speed and Load with Dirty Air Filter Element-mm H_2O [in. H_2O]	508 [20]	635 [25]	635 [25]	635 [25]
Maximum Allowable Exhaust Restriction at Rated Speed and Load-mm Hg			**76 [3]**	
[in. Hg]			**152 [6]**	
Maximum Fuel Filter Pressure Drop Across Filters kPa [psi]			**34 [5]**	
Maximum Allowable Return Line Restriction-mm Hg [in Hg]			**518 [20.4]**	
Maximum Inlet Restriction to Fuel Transfer Pump mm Hg [in Hg]			**100 [4]**	

*with catalyst

ELECTRICAL SYSTEM

Minimum Recommended Battery Capacity

Battery Size	Ambient Temperatures			
	-18 °C (0 °F)		0 °C (32 °F)	
	Cold Cranking Amperes	Reserve Capacity Amperes	Cold Cranking Amperes	Reserve Capacity Amperes
12 Volt	1800	640	1280	480
24Volt**	900	320	640	240

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

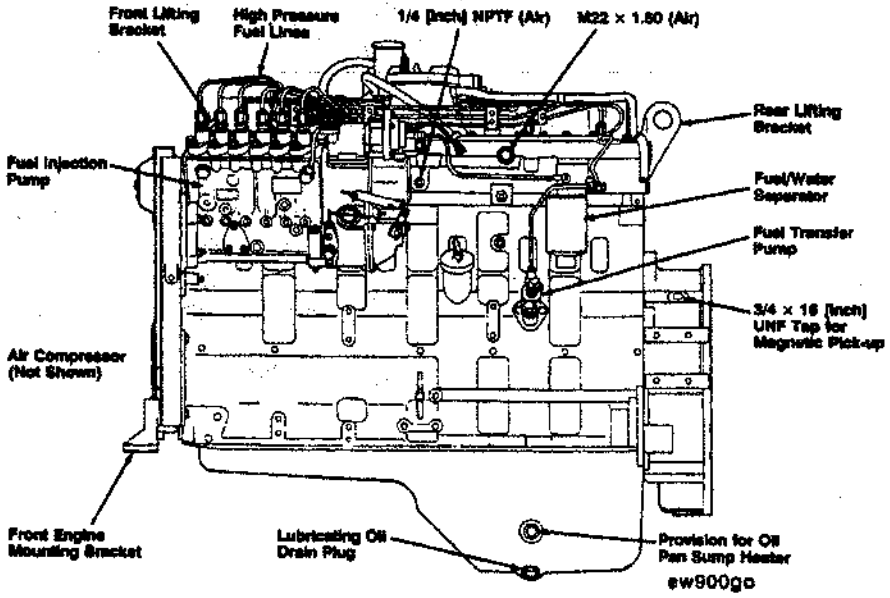
**Per Battery (two 12 volt batteries in series) CCA ratings are based on-18°C [0°F].

Batteries (Specific Gravity)

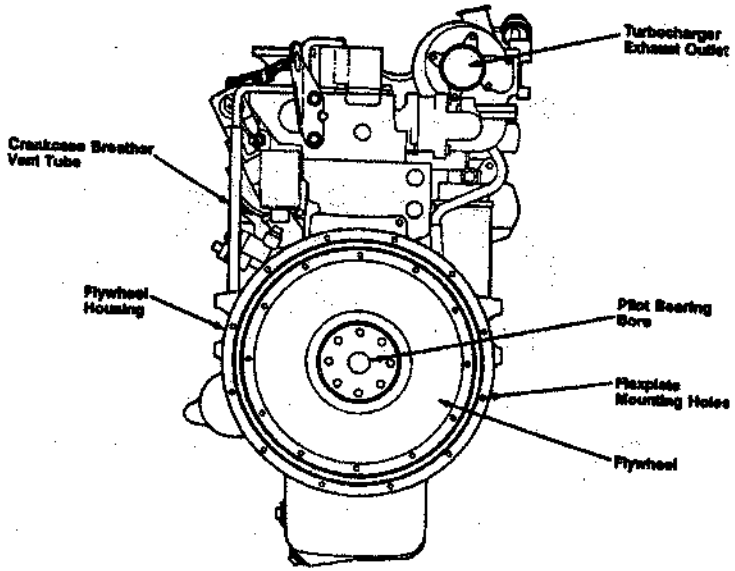
Specific Gravity at27 °C [80 °F]	State of Charge
1.260-1.280	100%
1.230-1.250	75%
1.200-1.220	50%
1.170-1.190	25%
1.110-1.130	Discharged

Engine Diagrams

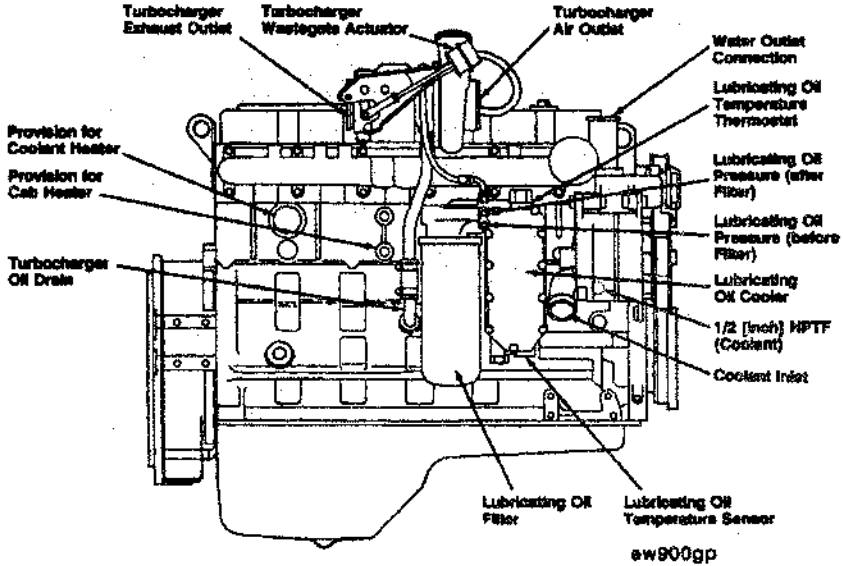
The illustrations which follow show the locations of the major external engine components, filters, and other service and maintenance points. Some external components will be at different locations for different engine models.



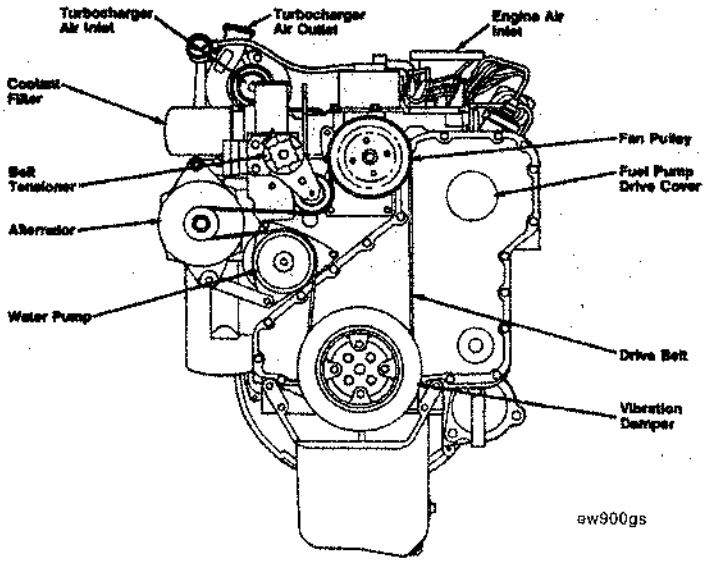
FUEL PUMP SIDE VIEW


Turbocharger Exhaust Outlet
Crankcase Breather Vent Tube
Flywheel Housing
Pilot Bearing Bore
Flexplate Mounting Holes
Flywheel

REAR VIEW



EXHAUST SIDE VIEW


Turbocharger Air Inlet
Turbocharger Air Outlet
Engine Air Inlet
Coolant Filter
Fan Pulley
Belt Tensioner
Fuel Pump Drive Cover
Alternator
Water Pump
Drive Belt
Vibration Damper
ew900gs

FRONT VIEW

Section 1-Operating Instructions

Section Contents

General Operating Instuctions

Proper care of the engine will result in longer life, better performance, and more economical operation.

- Follow the daily maintenance checks listed in Section 2.
- Check the oil pressure indicator (s), temperature indicator (s), warning light (s), and other gauges daily to make sure they are operational.

Warning: DO NOT OPERATE A DIESEL ENGINE WHERE THERE ARE OR CAN BE COMBUSTIBLE VAPORS. These vapors can be drawn through the air intake system and cause engine acceleration and over-speeding, which can result in a fire, an explosion and extensive property damage. Numerous safety devices are available, such as air intake shutoff devices, to minimize the risk of over-speeding where an engine, due to its application, might operate in a combustible environment, such as due to a fuel spill or gas leak. Rimember, Cummins has no way of knowing the use you have for your engine. THE EQUIPMENT OWNER AND OPERATOR ARE RESPONSIBLE FOR SAFE OPERATION IN A HOSTILE ENVIRONMENT. CONSULT YOUR CUMMINS AUTHORIZED REPAIR LOCATION FOR FURTHER INFORMATION.

Starting Procedure Matrix

	Idle Throttle	Full Throttle
Automotive/Industrial		
All pumps-above16 °C [60 °F]	X (5sec) (See Note)	
All pumps-below16 °C [60 °F]		X (See Note)

NOTE: Full throttle is applied after engaging the starter.

- Disengage the driven unit, or if equipped, put the transmission in neutral.
- Position the fuel shut-off, electrical switch or mechanism control to the RUN position.
- With Bosch in-line pumps, fully depress the throttle **AFTER** engaging the starter.

NOTE: Most Industrial engines are equipped with Robert Bosch RSV governors which automatically position the internal pump controls to the **START** position for maximum fuel delivery when the throttle is set at idle.

Caution: To prevent damage to the starter and fuel shutoff solenoid, do not engage the starting motor more than 30 seconds. Wait 2 minutes between each attempt to start (electrical starting motors only).

- If the engine does not start after three attempts, check the fuel supply system. Absence of blue or white exhaust smoke during cranking indicates no fuel is being delivered.
- Move the throttle position to idle as soon as the engine starts.

- Engine oil pressure must be indicated on the gauge within 15 seconds after starting.
- When starting a cold engine, increase the engine speed (RPM) slowly to be sure adequate lubrication is available to the bearings and to allow the oil pressure to stabilize.

Caution: Do not idle the engine for excessively long periods. Long periods of idling (more than 10 minutes) can damage an engine because combustion chamber temperatures drop so low the fuel will not burn completely. This will cause carbon to clog the injector spray holes and piston rings, and can cause the valves to stick. If the engine coolant temperature becomes too low (60℃ [140℉]), raw fuel will wash the lubricating oil off the cylinder walls and dilute the crankcase oil; therefore, all moving parts of the engine will not receive the correct amount of lubrication.

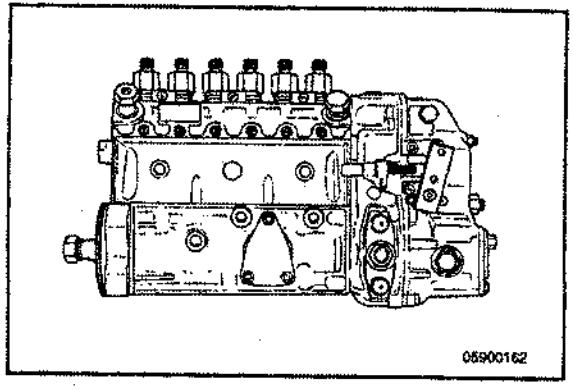
- Idle the engine 3 to 5 minutes before operating with a load.

Caution: When using jumper cables to start the engine, make sure to connect the jumper cables in parallel: positive (+) to positive (+) and negative (-) to negative (-). When using an external electrical source to start the engine, turn the disconnect switch to the "OFF"position. Remove the key before attaching the jumper cables to prevent unintentional starter engagement.

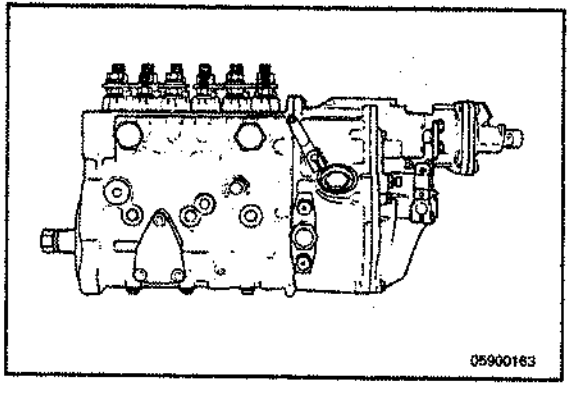
In-Line Pumps-General Information

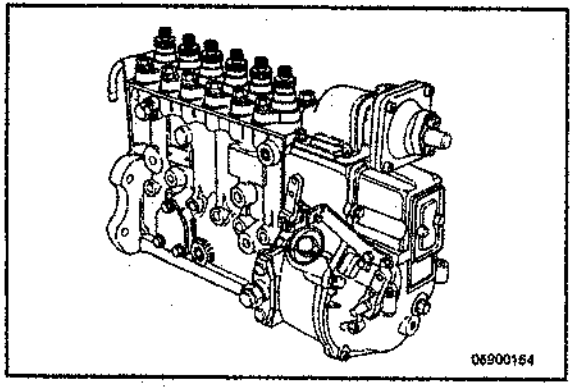
Bosch In-Line Pump Identification

Bosch Apump with RSV governor for an industrial application. The A pump will use the RQV governor for automotive engines. Some industrial engines will use RQV governors.

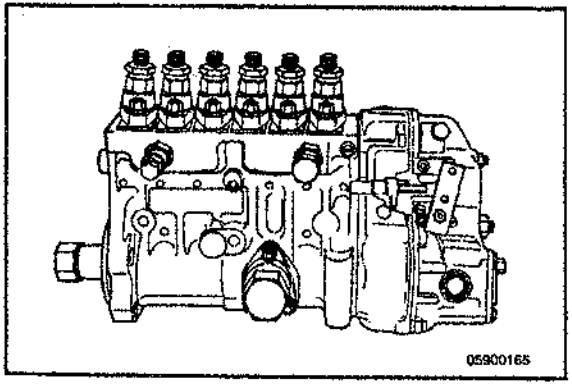


Bosch MWpump with RQV governor for an automotive engine. The MW pump will use the RSV governor for industrial applications. Some industrial engines will use RQV governors.





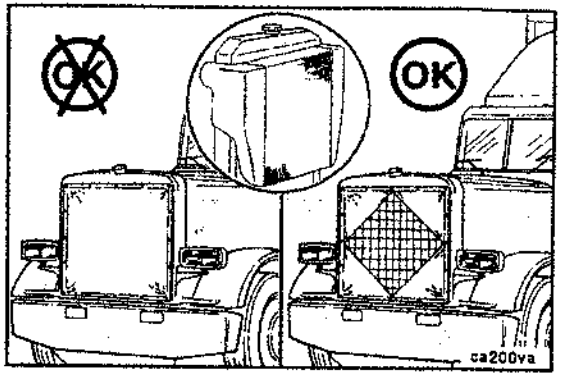
Bosch P7100 pump with RQV-Kgovernor for an automotive B or C Series engine.



Nippondenso EP-9 pump with RSV governor for marine and some industrial B-series ratings.

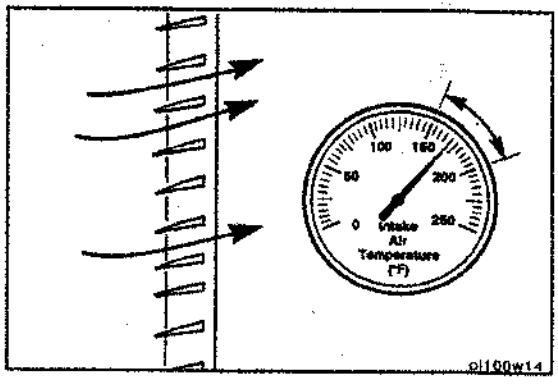
Winterfronts

Winterfronts can be used on a vehicle equipped with charge air cooling (CAC), but must be designed to partially cover the frontal area of the cooling system. A minimum of 120 square inches (11 in × 11 in) of frontal area must be left open to air flow for the CAC to function correctly.



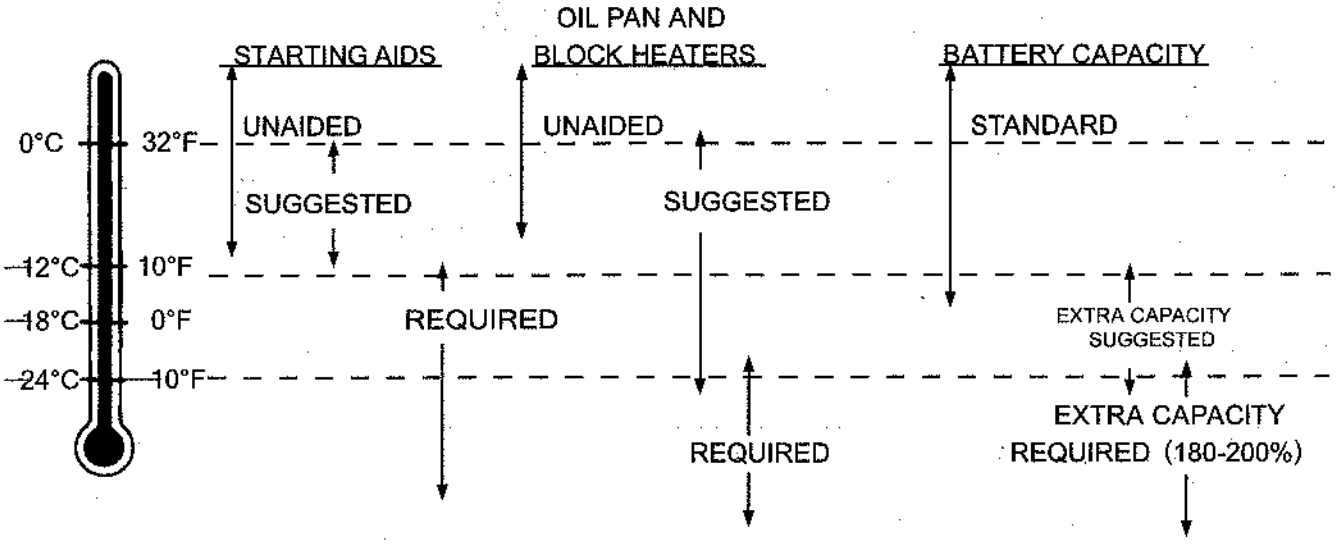
Shutters

Installations of CAC engines with shutters also requires an intake manifold air temperature switch to open the shutters at 65.5°C [150°F] to prevent excessive intake manifold temperatures. This prevents engine damage due to high intake manifold temperatures as a result of blocked air flow across the CAC.



Cold Weather Starting Aids

Use the following chart as a reference for required cold weather starting aids:



Cold Weather Starting With Starting Fluid

Starting Procedure With Mechanical Or Electrical Metering Equipment

Automotive/Industrial

All pumps-above 16°C [60°F].

Foot off throttle. If engine does not start within 5 seconds of cranking, follow cold start procedures below.

All pumps-below 16°C [60°F].

Fully depress the throttle after engaging the starter. Full throttle on the VE pump makes sure there is sufficient start fuel delivery and helps keep the engine operating once started. The inline pumps with RQV and RQV-K governors require full throttle to position and hold the rack in the start fuel position. The throttle must be depressed after engaging the starter to allow the shutoff lever to move to the run position before noving the throttle.

Using Starting Fluid Without Metering Equipment

Warning: Never use starting fluid near an open flame, or with a preheater or flame thrower equipment. This combination can cause an explosion.

Warning: Do not breathe starting fluid fumes. Starting fluid fumes can be harmful to your health.

Caution: Do not use excessive amounts of starting fluid when starting an engine. The use of too much starting fluid will cause engine damage.

- Spray starting fluid into the air cleaner intake while another person cranks the engine.

Warning: Do not use volatile cold starting aids in underground mine or tunnel operations due to the potential of an explosion. Check with the local U. S. Bureau of Mines Inspector for Instructions.

Cold Weather Starting with the Flame Start System

The following flame start system is available on the C Series Automotive engine ONLY with either a 12V or 24v electrical system.

The flame start system burns a small amount of diesel fuel in the intake manifold to aid starting in cold ambient temperature conditions. The system also operates in a post start mode to reduce white smoke.

The intake cold start control module monitors engine temperature. When the engine temperature is greater than 45 degrees F the flame start system will not be activated. Below 45 degrees F, the system will operate as follows:

Preheat Cycle:

1. When the engine temperature is below 45 degrees F turn the ignition key to the "run" position. When the key is in this position the "Wait to Start" light will be illuminated for approximately 25 seconds. The engine should not be cranked until the "Wait to Start" light shuts off. If the engine is cranked before the preheat cycle is complete the process is aborted. The controller is reset each time the ignition is turned off.

Engine Starting Cycle:

2. When the "Wait to Start" light goes out the preheat cycle is complete. Depress the accelerator pedal all the way to the floor and crank the engine. The engine must be cranked within 30 seconds. If the engine is not cranked within 30 seconds the preheat cycle needs to be repeated (Step 1).

Post Heat Cycle:

3. Post heating occurs as the flame plugs continue to burn for a period of time while the engine is running. Post heating helps warm the engine faster and eliminates white smoke. Post heating times are determined by the engine temperature upon start up.

Cold Weather Starting with the Electric Grid Heater

For industrial Jacket Water Aftercooled (JWAC) C Series engine with a Bosch in line injection pump only, a grid heater is available that improves cold weather starting characteristics by heating the intake air during cranking. It can also serve to reduce white smoke if it is enerzied during cold ambient temperatures while the engine is at idle. The electric grid heater operates in a preheat and post heat mode. The length Of heater on time is a function of the engine temperature. If the engine temperature is greater than 45 degrees F, the electric grid ait heater system will not be activated. Below 45 degrees **F**.the system will operate as follows:

Engine Staring Cycle:

1. Turn the ignition key to the 'run' position. When the key is in this position the "Wait to Start" light will be illuminated for appoximately 25 seconds.

The engine should not be cranked until the"Wait to Start"light shuts off.

NOTE: The controller is reset each time the ignition is turned off and the cycle will start over.

2. When the "Wait to Start" light goes out the preheat cycle is complete. Depress the accelerator pedal and crank the engine. The starter should be cranked as soon as the "Wait to Start" light goes out.

Post Heat Cycle:

3. Post heating occurs as the grid heater elements are cycled for a period of time while the engine is running. Post heating helps warm the engine up faster and eliminates white smoke. Post heating is determined by the engine temperature upon start up.

WARNING: ETHER MUST NOT BE USED IN CONJUCTION WITH THE FLAME START SYSTEM OR THE ELECTRIC GRID AIR HEATER.

Starting Procedure After Extended Shutdown or Oil Change

Complete the following steps after each lubricating oil change, or after the engine has been shut off for more than 30 days to make sure the engine receives the correct oil flow through the lubricating oil system:

- Disconnect the electrical wire from the fuel injection pump solenoid valve.
- Rotate the crankshaft, using the starting motor, until oil pressure appears on the gauge, or the warning light goes out.
- Connect the electrical wire to the fuel injection pump solenoid valve.
- Start the engine; refer to Normal Starting Procedures in this section.
- Refer to Fuel System-Bleeding, Section 5, for instructions to vent the fuel system.

NOTE: If the engine is allowed to run out of fuel.air is pulled into full lines. Refer to Fuel System—Bleeding, Section 5, for instructions to vent the fuel system.

Operating the Engine

- Do not operate the engine at full throttle below peak torque engine speed (RPM) for extended periods (more than a minute) of time.
- Allow the engine to idle 3 to 5 minutes before shutting the engine off after a full load operation.
- Monitor the lubricating oil pressure and coolant temperature gauges frequently, Refer to **Engine Specifications** (Section V) for recommended operating pressures and temperatures. Shut the engine off if any pressure or temperature does not meet the specifications.

Caution: Continuous operation with low coolant temperature (below 60 °C [140 °F]) or high coolant temperature (above 100 °C [212 °F]) can damage the engine.

- If an overheating condition starts to occur reduce engine speed or shift to a lower gear, Or both, until the temperature returns to normal operating range. If engine temperature does not return to normal, refer to **Troubleshooting** (Section T) or contact a Cummins Authorized Repair Location.
- Most failures give an early warning. Look and listen for changes in performance, sound, or engine appearance that can indicate service or engine repair is needed. Some changes to look for are:
  - Engine misfires
  - Vibration
  - Unusual engine noises
  - Fuel, oil or coolant leaks
  - Sudden changes in engine operating temperature or pressure
  - Exessive smoke
  - Loss of power
  - An increase in oil consumption
  - An increase in fuel consumption

Engine Operating Range

Cummins engines are designed to operate successfully at full throttle under transient conditions down to peak torque engine speed (RPM). This is consistent with recommended driving practices for good fuel economy.

Caution: Excessive full throttle operation below peak torque RPM (peak torque RPM varies from 1,100 RPM to 1,500 RPM, depending upon rated engine speed) will shorten engine life to overhaul, can cause serious engine damage, and is considered engine abuse.

Caution: Operation of the engine below peak torque RPM can occur during gear shifting due to the difference of ratios between transmission gears, but engine operation must not be sustained more than one minute at full throttle below peak torque RPM.

Caution: Operating the engine beyond high idle speed can cause severe engine damage. When descending a steep grade, use a combination of transmission gears and engine or service brakes to control the vehicle and engine speed.

Engine Shut-down Procedure

- Allow the engine to idle 3 to 5 minutes after a full load operation before shutting the engine off. This allows the engine to cool gradually and uniformly.
- Turn the ignition key switch to the OFF position.

Section 2-Maintenance Guidelines

Section Contents

General Information

Cummins Engine Company. Inc.recommend to obtain proper operation and preserve the warranty on engine; follow maintenance schedule in this seciton.

If the engine is operating in ambient temperatures consistently below-18°C [0°F] or above 38°C [100°F], perform maintenance at shorter intervals. Shorter maintenance intervals are also required if the engine is operated in a dusty environment or if frequent stops are made. See your Cummins Authorized Repair Location for recommended intervals.

Use the chart provided on page 2-9 as a convenient way to keep a record of maintenance performed.

*If the engine is equipped with a component or an accessory not manufactured by Cummins Engine Company. Inc, refer to the component manufacturer' s maintenance recommendations. A listing of suppliers' addresses and telephone numbers is provided in Component Manufacturers, Section C.

Tool Requirements

In the text, a symbol followed by the wrench size or tool description is used to identify the tooling required to perform each step. A list of wrench sizes and descriptions indicate more than one tool is needed.

Sockets	Wrenches	Other Tools
	19mm	
19mm	17mm	Filter Wrenches (75-80mm, 90-95mm and 118-131mm)
17mm	15mm	Ratchet (1/2 and 3/8 inch drive)
15mm	14mm	Torque Wrench
	13mm	Flat Blade Screwdriver
	10mm	5/16 Allen Wrench
		Feeler Gauges (0.30mm and 0.61mm)
		Engine Barring Gear Part No. 3377371
		DCA4 Test Kit, Fleetguard Part No. CC-2626
		3823276 Injector Puller

C Series Engine Maintenance Schedule

Daily or refueling	Every 10,000 Km (6,000Mi)Or 250 Hour, 3 Months	Every 19,000 Km (12,000Mi)Or 500 Hour, 6 Months	Every 38,000 Km (24,000Mi)Or 1000 Hour, 12 Months	Every77,000 Km (48,000Mi)Or 2000 Hour, 2 Years
Check	Change/Replace			
• Lubricating Oil Level • Coolant Level • Drive Belt • Fuel Water Trap	• Lubricating Oil[1] • Lubricating Filter • Coolant Filter	• Lubricating Oil • Lubricating Filter • Coolant Filter • Fuel Filter[3]	• Lubricating Oil • Lubricating Filter • Coolant Filter • Fuel Filter	• Lubricating Oil • Lubricating Filter • Coolant Filter • Fuel Filter • Antifreeze[3] • Fuel Strainer
	Adjust			
			• Valve Lash[2] Clearance	• Valve Lash Clearance
	Check/Inspect			
	• Air Cleaner • Intake System • Charge Air Cooler	• Air Cleaner • Intake System • Antifreeze • Charge Air Cooler	• Air Cleaner • Intake System • Antifreeze • Fan Hub • Belt Tensioner Bearing • Belt Tension • Charge Air Cooler	• Air Cleaner • Intake System • Air Compressor • Fan Hub • Belt Tensioner Bearing • Belt Tension • Vibration Damper • Charge Ail Cooler[4]

[1] Refer to the Lubricating Oil Change Interval chart given in Section 4 to find the correct lubricating oil change interval for the engine application.

[2] Initial valve lash clearance adjustment,subsequent adjustments to be performed at every 8th engine oil change for automotive engines or 77,000Km(48,000Mi),2000Hrs or 2years interval,whichever occurs first.

[3] Must use a heavy duty antifreeze that meets the chemical composition of GM6038-M.The change interval is 2 years or 385,000 Km [240,000Mi] for industrial engines.

[4] Service interval is 2 years,or 320,000 Km [200,000Mi],whichever occurs first.

[©]Service interval is every other engine oil change or 19,000 Km [12,000mi], 500 hours or 6 months.

Page References for Maintenance Instructions

For your convenience, listed below are the page numbers which contain specific instructions for performing the maintenance checks listed in the maintenance schedule:

Daily or Refueling

Every 10,000 Kilometers [6,000Miles], 250Hours or 3 Months

Every 19,000 Kilometers [12,000Miles], 500Hours or 6 Months

- Lubricating oil - change..... 4-3
- Lubricating oil filter - change..... 4-5
- Fuel filter - change..... 5-3
- Intake air system - check..... 4-11
- Coolant and Antifreeze - check..... 5-8
- Charge Air Cooler..... 4-11

Every 38,000 Kilometers [24,000Miles], 1000Hours or 12 Months

- Lubricating oil - change..... 4-3
- Lubricating oil filters - change..... 4-5
- Fuel filter - change..... 5-3
- Valve lash clearance - adjust..... 6-3
- Fan hub - check..... 6-11
- Belt tensioner bearing - check..... 6-11
- Belt tension - check..... 6-10
- Coolant and antifreeze - check..... 5-8

Every 77,000 Kilometers [48,000Miles], 2,000Hours or 2 Years

Every 385,000 Kilometers [240,000Miles], 6000Hours or 2 Years

Maintenance Record

Engine Serial No. _____ Engine Model _____

Owner's Name _____ Equipment Name/Number _____

Date	Km (Miles), Hours or Time Interval	Actual Km (Miles) or Hours	Maintenance Check Performed	Check Performed By	Comments

Date	Km (Miles), Hours or Time Interval	Actual Km (Miles) or Hours	Maintenance Check Performed	Check Performed By	Comments

Section 3-Daily Maintenance Procedures

Section Contents

General Information

Preventative maintenance begins with day-to-day awareness of the condition of the engine and its systems. Before starting the engine, check the lubricating oil and coolant levels, look for:

- Leaks
- Loose or damaged parts
- Worn or damaged belts
- Any change in engine appearance

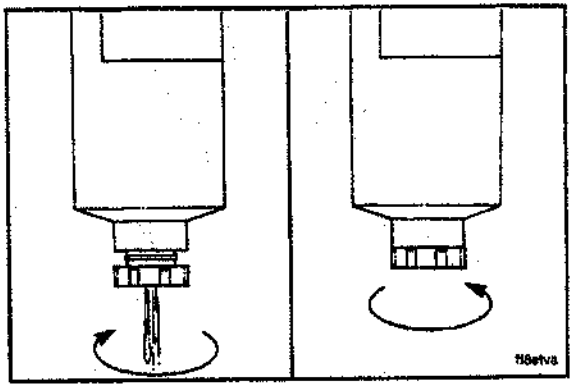
Fuel-Water Separator

Draining

Drain the water and sediment from the fuel-water separator daily.

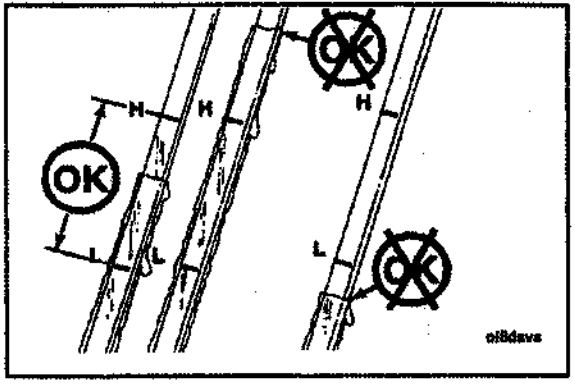
Shut off the engine. Open the drain valve. Turn the valve counterclockwise 4 complete turns until the valve drops down 1".Drain the fuel-water separator of water and sediment until clear fuel is visible.

Caution: Do not overtighten the valve. Overtightening can damage the threads.



Push the valve up and turn the valve clockwise to close the drain valve.

NOTE: If more than 2 oz.is drained, refill the filter to help prevent hard starting.



Lubricating Oil Level

Checking

Never operate the engine with the lubricating oil level below the "L"(Low)mark or above the "H"(High)mark. Wait at least 5 minutes after shutting off the engine to check the lubricating oil. This allows time for the lubricating oil to drain to the oil pan.

NOTE: The engine must be level when checking the lubricating oil level to make sure the measurement is correct.

Lubricating Oil Capacity: Low Mark To High Mark

3.8 Litres [4 U.S. Quarts]

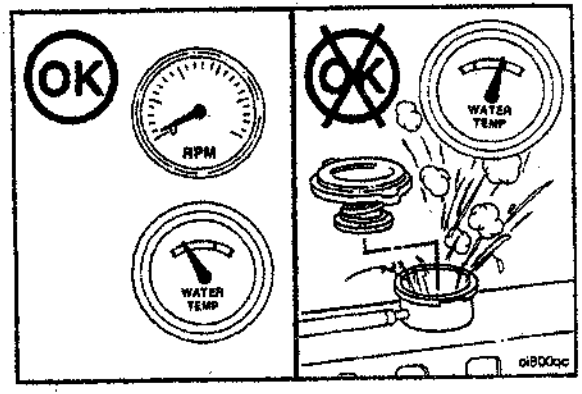
Coolant Level

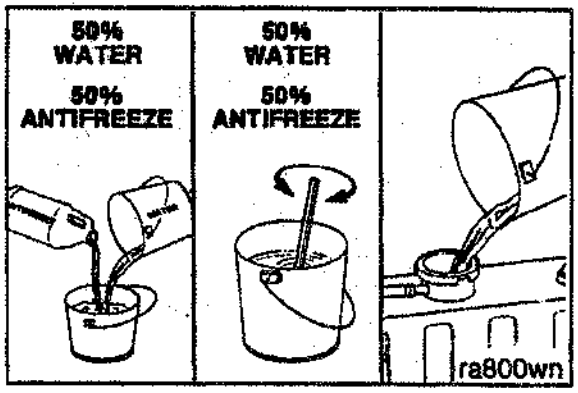
Checking

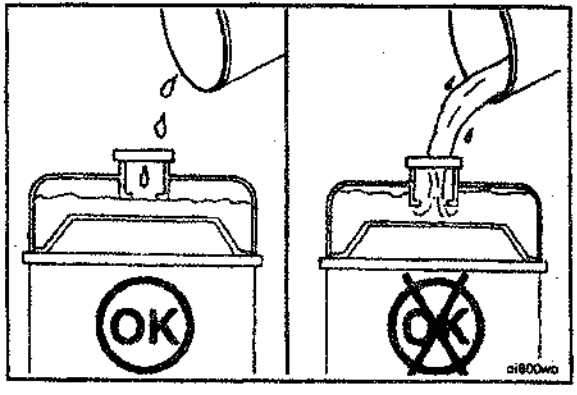
Warning: Do not remove the radiator cap from a hot engine . Wait until the temperature is below 50℃ [122℉] before removing the pressure cap . Failure to do so can result in personal injury from heated coolant spray or steam. Remove the filler cap slowly to relieve coolant system pressure.

NOTE: Never use a sealing additive to stop leaks in the coolant system. This can result in coolant system plugging and inadequate coolant flow causing the engine to overheat.

The coolant level must be checked daily.







Caution: Do not add cold coolant to a hot engine. Engine castings can be damaged. Allow the engine to cool to below 50 °C[122 °F]before adding coolant.

NOTE: If additional coolant is added to the cooling system a 50% mixture of water and antifreeze must be premixed before added to the system. Since the ability of antifreeze to remove heat from the engine is not as good as water, pouring antifreeze into the engine first could contribute to an over heated condition before the liquids are completely mixed.

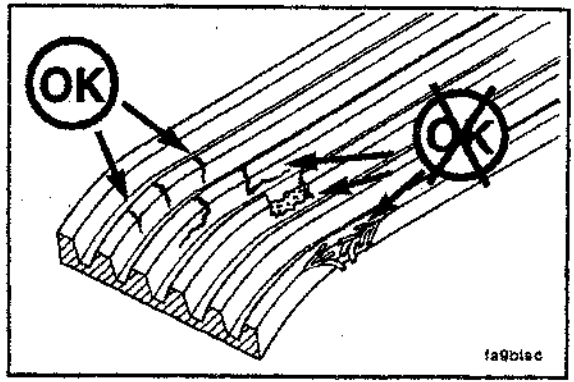
Fill the cooling system with coolant to the bottom of the fill neck in the radiator fill or expansion tank.

NOTE: Some radiators have two fill necks, both of which **must** be filled when the cooling system is drained.

Drive Belt

Inspection

Visually inspect the belt. Check the belt for intersecting cracks. Transverse (across the belt width) cracks are acceptable. Longitudinal (direction of belt length) cracks that intersect with transverse cracks are not acceptable. Replace the belt if it is frayed or has pieces of material missing. Refer to **Adjustment and Replacement** (Section A).



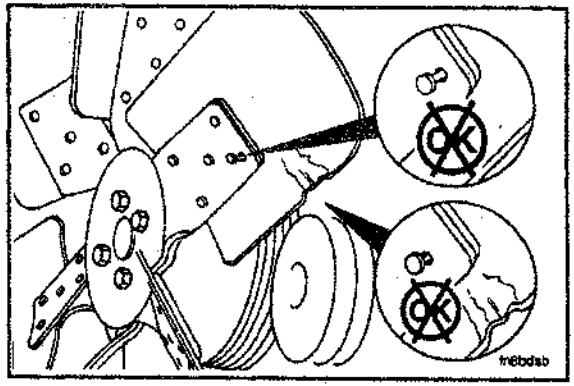
Cooling Fan

Inspection

Warning: Personal injury can result from a fan blade failure. Never pull or pry on the fan. This can damage the fan blade (s) and cause fan failure.

NOTE: Rotate the crankshaft by using the engine barring gear, Part No. 3824591.

A visual inspection of the cooling fan is required daily. Check for cracks, loose rivets, and bent or loose blades. Check the fan to make sure it is securely mounted. Tighten the capscrews if necessary. Replace any fan that is damaged.



NOTES

Section4-Maintenance Procedures at 10,000 Kilometers [6,000 Miles], 250 Hours or 3 Months

Section Contents

General Information

All checks or inspections listed under daily or previous maintenance intervals must also be performed at this time in addition to those listed under this maintenance interval.

Lubricating Oil and Filter Change Interval

Refer to the following charts to determine the maximum recommended lubricating oil and filter change interval in kilometers [miles], hours or months; whichever occurs first:

Is your vehicle an on Highway application? YES

Is your vehicle one of those below?
— Regional Haul Truck
— Coach Bus
— Vehicle accum. 8000 miles/mth. or. more

YES

Change Interval			
KM	MILES	HOURS	MOS
17,000	10,000	250	3

NO

Use the following oil drain intervals for your application (1):

VEH/EQUIP	KM	MILES	HRS	MOS
Refuse Trk	10,000	6,000	250	3
Mixer/Dumper	10,000	6,000	250	3
Del. Truck	10,000	6,000	250	6
Shuttle or Transit Bus	10,000	6,000	250	3
School Bus	10,000	6,000	250	6
Fire Truck	10,000	6,000	250	3
Recreational Vehicle	10,000	6,000	250	6

(1) Or whichever comes first. If your application accumulates high hours and low mileage, the change interval is determined by hours.

Example: Transit buses and refuse Trucks may average 16 Km/h [10 MPH] when used in all urban routes. Oil drain intervals in those applications are 4800 Km [3,000 mi], or less.

NO

Is your vehicle used in a Construction, Mining or Logging Application? YES

Use the following oil drain intervals for your application (1):

VEHICLE/EQUIP	KM	MILES	HRS	MOS
Truck Crane	10,000	6,000	250	3
Yard Spotter	10,000	6,000	250	3
Paver	N/A	N/A	250	6
Cranes	N/A	N/A	250	6
Backhoe	N/A	N/A	250	6
Dozer	N/A	N/A	250	6
Scraper	N/A	N/A	250	6
Skidder	N/A	N/A	250	6

NO

Is your vehicle used in an Agricultural or Stationary Power Application? YES

Use the following oil drain intervals for your application (1):

VEHICLE/EQUIP	HOURS	MONTHS
Farm Tractors	250	6
Combines	250	6
Irrigation Equip	250	6
Generator Set	250	6
Air Compressor	250	6
Fire Pump	250	6
Pleasure Boat	250	6
Work Boat	250	3

NO

Change Interval			
KM	MILES	HOURS	MOS
10,000	6,000	250	3

Lubricating Oil and Filter

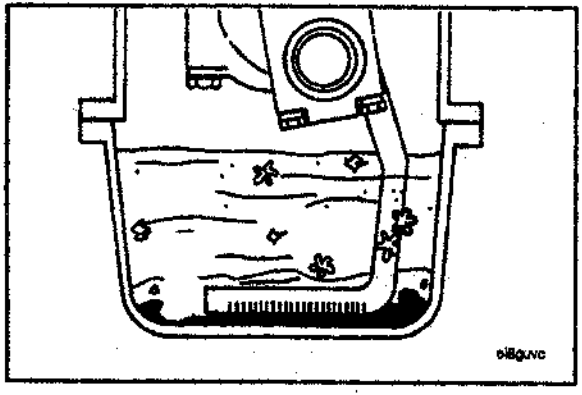
Changing

Caution: Avoid prolonged and repeated skin contact with used engine lubricating oils. Such prolonged and repeated contact may cause skin disorders or other bodily injury.

— Avoid excessive contact-wash thoroughly after contact.

— Keep out of reach of children.

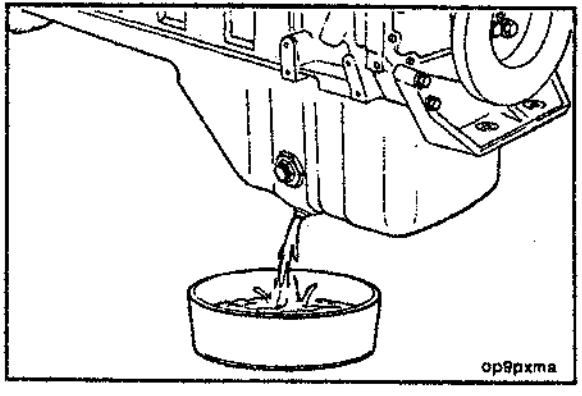
PROTECT THE ENVIRONMENT: Handling and disposal of used engine lubricating oil may be subject to federal, state and local law and regulation.Use authorized waste disposal facilities, including civic amenity sites and garages providing authorized facilities for receipt of used lubricating oil. If in doubt, contact your state and local environmental authorities or the Environmental Protection Agency for guidance as to proper handling and disposal of used engine lubricating oil.



NOTE: If the engine is in service,under no circumstances can the lubricating oil drain interval extend beyond the intervals given in the charts.

Change the lubricating oil and filters to remove the contaminants suspended in the lubricating oil.

NOTE: Drain the lubricating oil only when it is hot and the contaminants are in suspension.



17mm

Caution:Hot lubricating oil can cause personal injury.

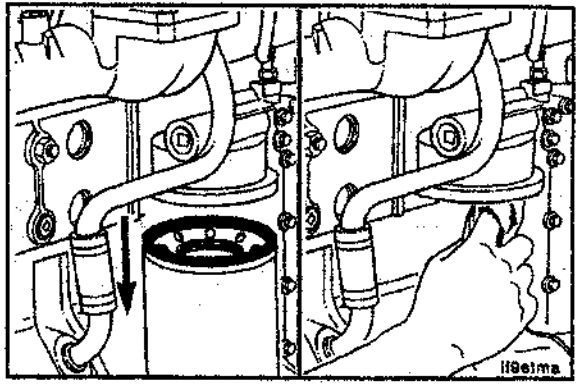
Operate the engine until the water temperature reaches 60° C [140° F]. Shut the engine off. Remove the lubricating oil drain plug.

NOTE: Use a container that can hold at least 25 liters [27U.S.qts.] of lubricating oil.

118 to 131 mm Filter Wrench

Clean the area around the lubricating oil filter head. Remove the filter. Clean the gasket surface of the filter head.

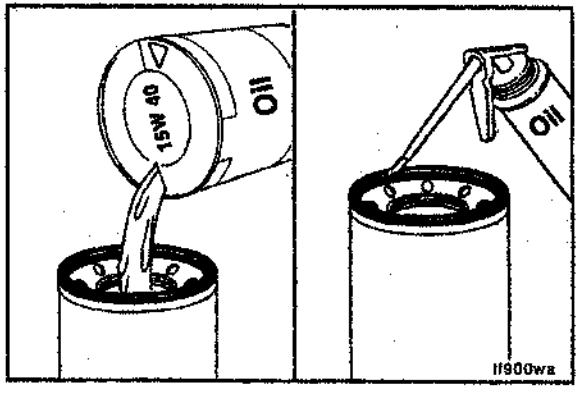
NOTE: The o-ring can stick on the filter head. Make sure it is removed.

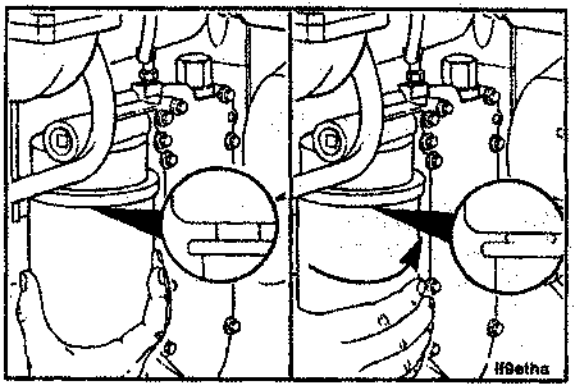


Caution: Fill the filters with clean lubricating oil before installation.

Apply a light film of lubricating oil to the gasket sealing surface before installing the filters.

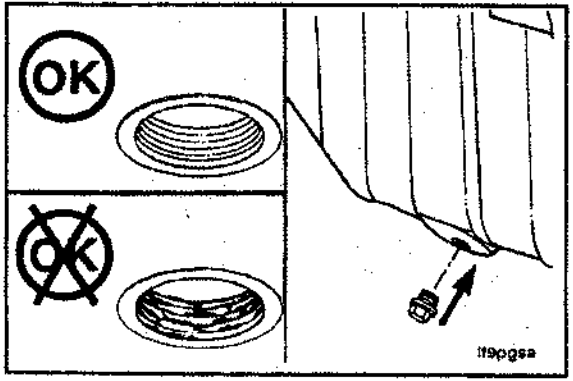
NOTE: The LF3000 lubricating oil filter has two gaskets. Lubricate both gaskets.





Caution: Mechanical over-tightening may distort the threads or damage the lubricating oil filter element seal.

Install the lubricating oil filter as specified by the filter manufacturer.

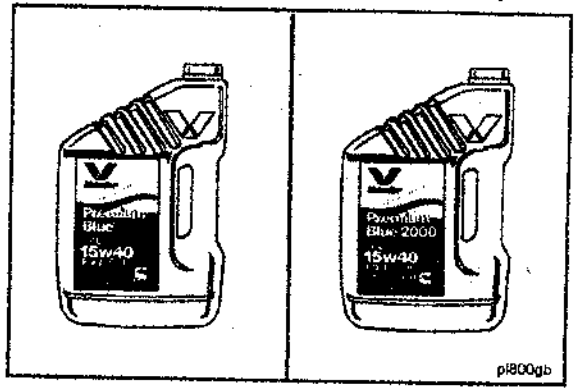


17mm

Check and clean the lubricating oil drain plug threads and sealing surface.
Install the lubricating oil pan drain plug.

Torque Value: 80 N·m [60ft-lb]

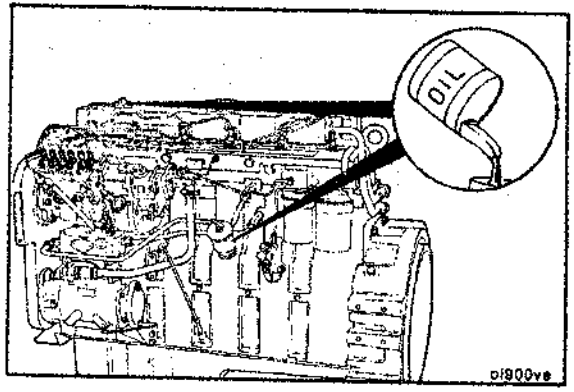
NOTE: Use a high quality 15W-40 multi-viscosity lubricating oil, such as Cummins Premium Blue, or its equivalent in Cummins engines. Choose the correct lubricating oil for your operating climate as outlined in Section V.

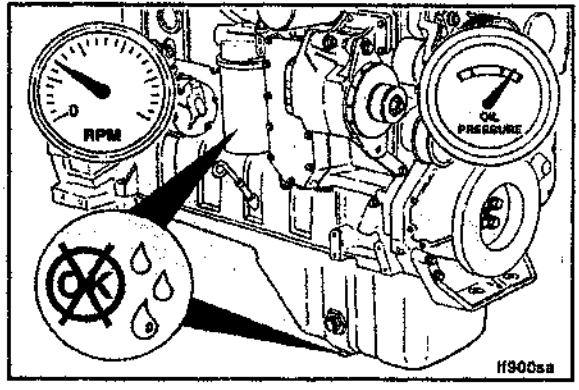


Fill the engine with clean lubricating oil to the proper level.

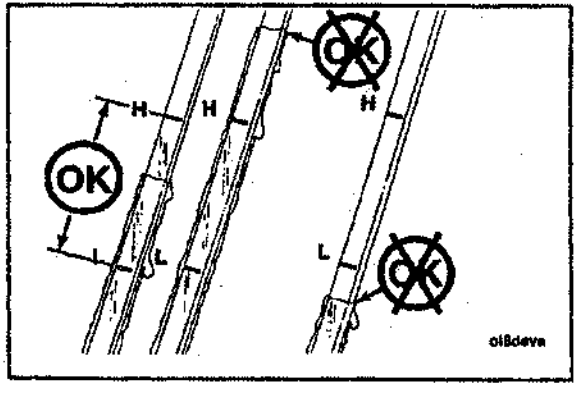
System Capacity

23.8 Liter [25.2 U.S. Quart]





Operate the engine at low idle to inspect for leaks at the lubricating oil filter and the drain plug.



Stop the engine. Wait approximately 15 minutes to let the lubricating oil drain from the upper parts of the engine Check the level again.

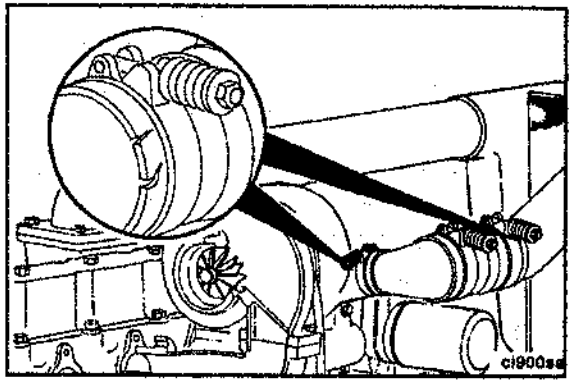
Add lubricating oil as necessary to bring the lubricating oil level to the "H" (High) mark on the dipstick.

Air Intake System

Inspection

Inspect the intake piping for cracked hoses, loose clamps, or punctures which may damage the engine.

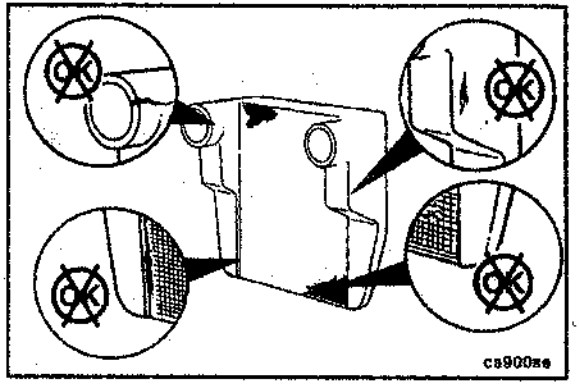
Tighten or replace parts as necessary to make sure the air intake system does not leak.

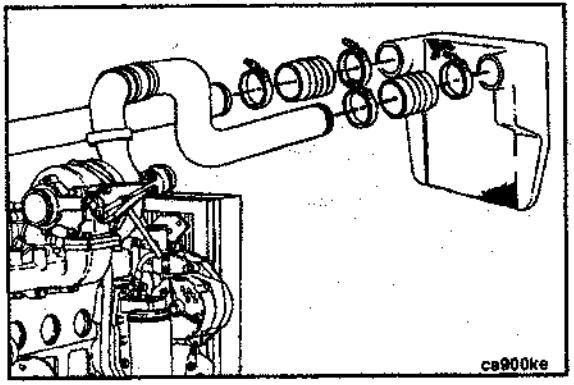


Charge Air Cooler

Visually inspect the CAC for cracks, holes or damage.

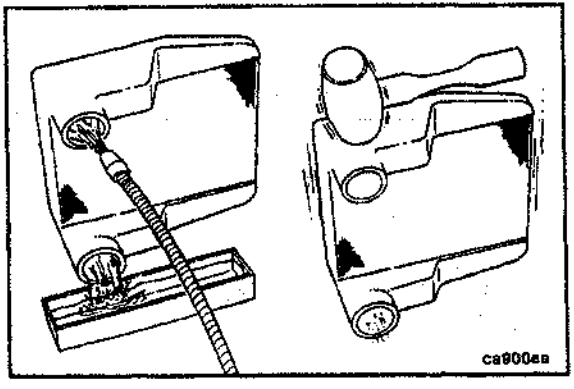
Inspect the tubes, fins and welds for tears, breaks or other damage.





If the engine experiences a turbocharger failure or any other occasion where oil or debris is put into the CAC, the CAC must be cleaned.

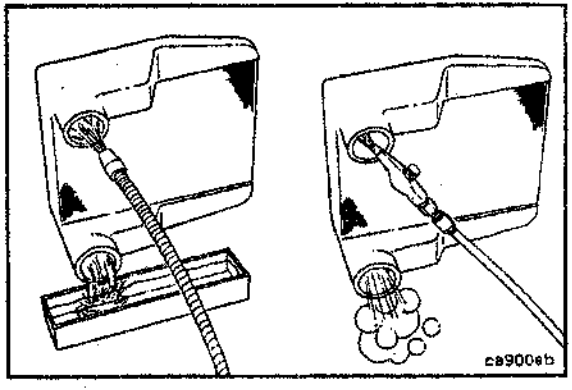
Remove the CAC from the vehicle.Refer to the vehicle manufacturer's instructions.



Caution: Do not use caustic cleaners to clean the CAC. Damage to the CAC will result.

Flush the CAC internally with solvent in the opposite direction of normal air flow.Shake the CAC and lightly tap on the end tanks with a rubber mallet to dislodge trapped debris, Comtinue flushing until all debris or oil is removed.

After the CAC has been thoroughly cleaned of all oil and debris with solvent, wash the CAC internally with hot soapy water to remove the remaining solvent. Rinse thoroughly with clean water.
Blow compressed air into the CAC in the opposite direction of normal air flow until the CAC is dry internally.
Refer to the vehicle manufacturer's instructions for installation.

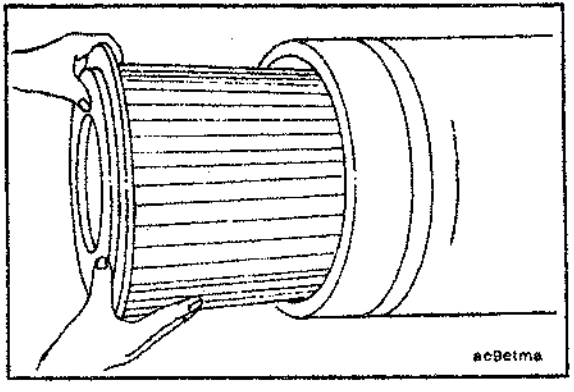


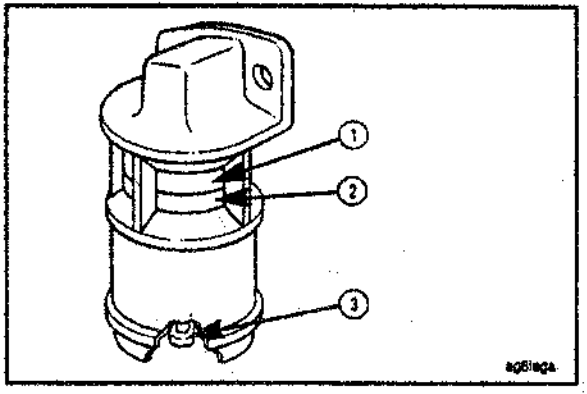
Air Cleaner

Restriction

Maximum intake air restriction is 635 mm [25.0 in.] of water for turbocharged engines. Naturally aspirated engines have a maximum restriction of 510 mm [20.0 in.] of water.

The engine must be operated at rated RPMand full load to chek maximum intake air restriction. Replace the air cleaner element when the restriction reaches the maximum allowable limit or clean according to the manufacturer's recommendations.





NOTE: Follow the manufacturer's instructions when cleaning or replacing the air cleaner element.

Change the air cleaner service indicator,if equipped.

Change the filter element when the red indicator flag (2) is at the raised position in the window (1).

After the air cleaner has been serviced, reset the button (3) in the end of the service indicator.

NOTE: Never operate the engine without an air cleaner.Intake air must be filtered to prevent dirt and debris from entering the engine and causing premature wear.

Section5-Maintenance Procedures at 19,000 Kilometers [12,000 Miles], 500 Hours or 6 Months

Section Contents

General Information

All checks or inspections listed under daily or previous maintenance intervals must also be performed at this time in addition to those listed under this maintenance interval.

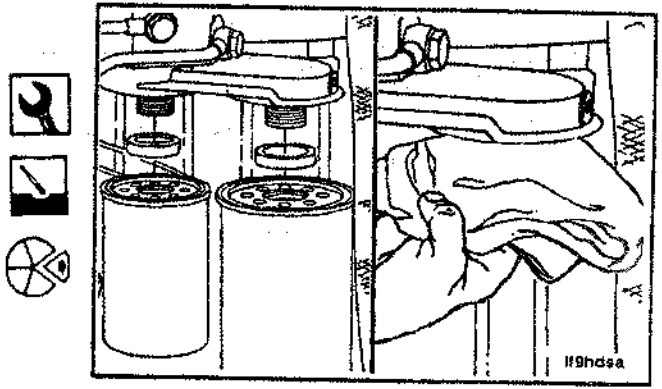
Fuel Filter

Replacement

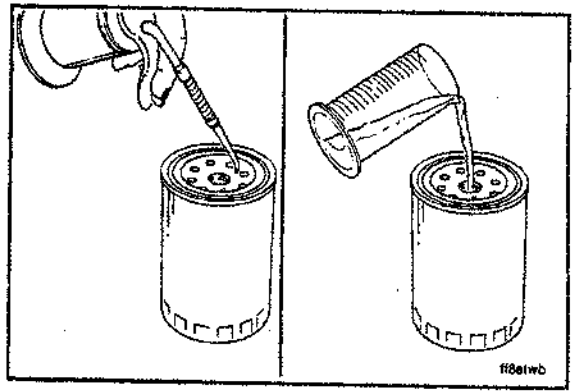
75-80 mm and 90-95 mm

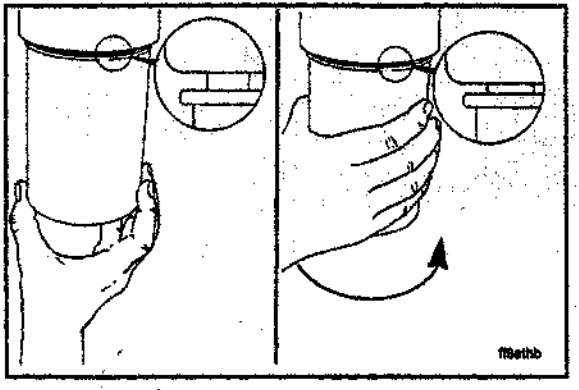
Clean the area around the fuel filter head, Remove the filters. Clean the gasket surface of the fuel filter head.

Replace the o-ring.



Fill the new fuel filter(s) with clean fuel and lubricate the o-ring seal with clean 15W-40 engine lubricating oil.





Caution: To prevent fuel leaks, make sure the fuel filter is installed tightly but not overtightened. Mechanical tightening will damage the fuel filter.

Install the fuel filter as specified by the filter manufacturer.

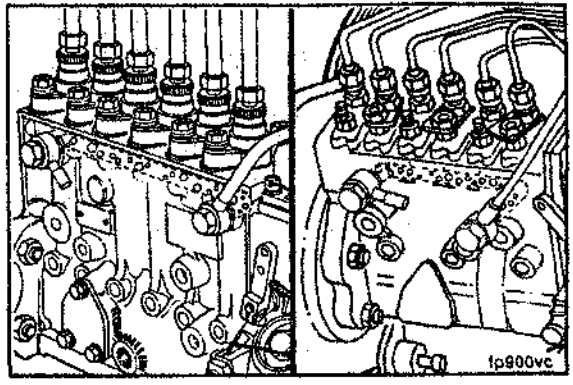
Fuel System

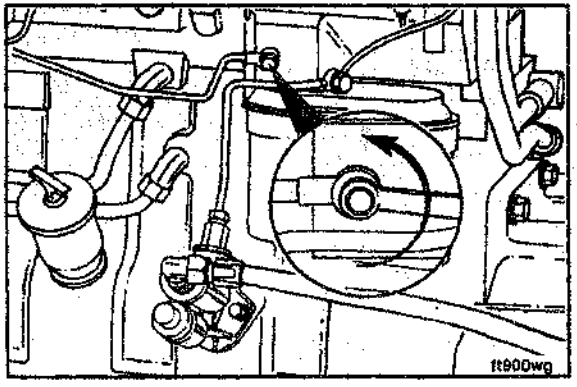
Bleeding

Controlled venting is provided at the injection pump through the fuel drain manifold. Small amounts of air introduced by changing the fuel filters or fuel injection pump supply line will be vented automatically.if the fuel filter is changed in accordance with the instructions.

NOTE: Manual bleeding is required if:

- The fuel filter is not filled prior to installation.
- Fuel injection pump is replaced.
- High Pressure fuel line connections are loosened or fuel lines replaced.
- Initial engine start up or start up after an extended period of no engine operation.
- Vehicle fuel tank has been run until empty.



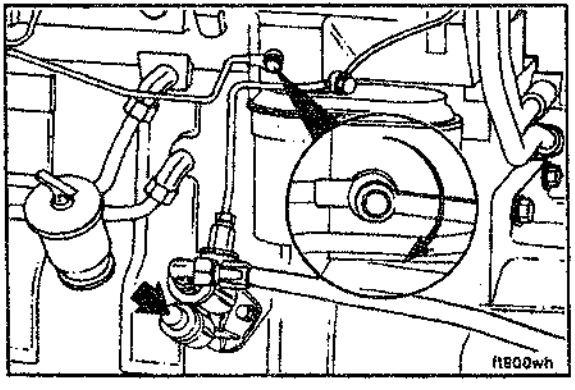


Low Pressure Lines and Fuel Filter (s)

Venting

10mm

Open the bleed screw.



10mm

Operate the plunger on the fuel transfer pump until the fuel flowing from the fitting is free of air.

Tighten the bleed screw .

Torque Value: 9N·m [80ft-lb]

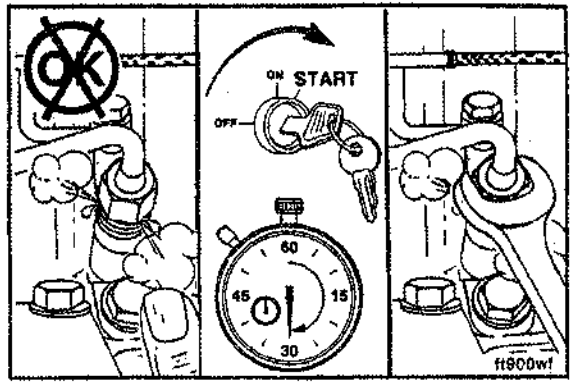
High Pressure Lines

Venting

17mm (PES. A, PES. MW), 19mm (PES. P)

Warning: The pressure of the fuel in the line is sufficient to penetrate the skin and cause serious bodily harm.

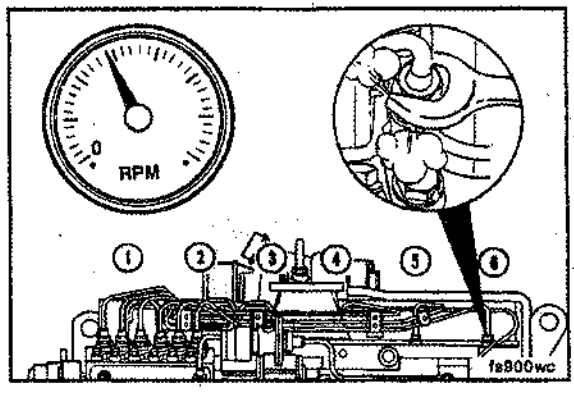
Loosen the fittings at the injectors, and crank the engine to allow entrapped air to bleed from the lines. Tighten the fittings.

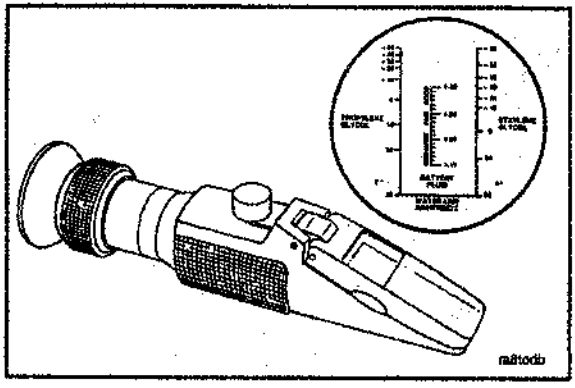


Warning: It is necessary to put the engine in the "RUN" position. Because the engine could start, be sure to follow all the safety precautions. Use the normal engine starting procedure.

Start the engine and vent one line at a time until the engine runs smoothly.

NOTE: Do not engage the starter for more than 30 seconds each time it is used to vent the system: wait 2 minutes between engagements.



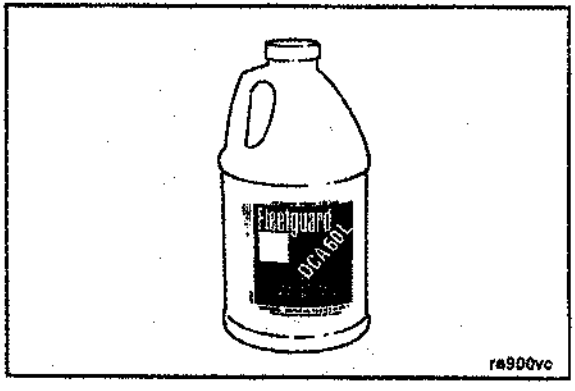


Antifreeze Concentration

Checking

Check the antifreeze concentration. Use ethylene-glycol base antifreeze to protect the engine to -37°C [-34°F] throughout the year.

Antifreeze is essential in all climates. It broadens the operating temperature range by lowering the coolant freezing point and by raising the coolant boiling point.



Coolant Additive Concentration

Checking

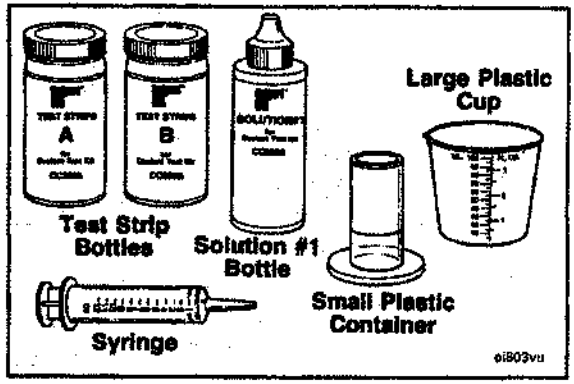
Caution:Inadequate concentration of the coolant additive can result in major corrosive damage to cooling system components. Over concentration can cause formation of "gel"that can cause restriction, plugging of coolant passages, and overheating.

NOTE: If the engine coolant is changed, the coolant filters must also be changed.

The cooling system must contain the proper coolant additive units to provide the best chemical protection.

Refer to the **Engine Specifications** (Section V).

DCA4 Test Kit: Use only DCA4 Coolant Test Kit, Fleetguard ® Part No. CC-2626 to check the coolant additive concentration in the cooling system.

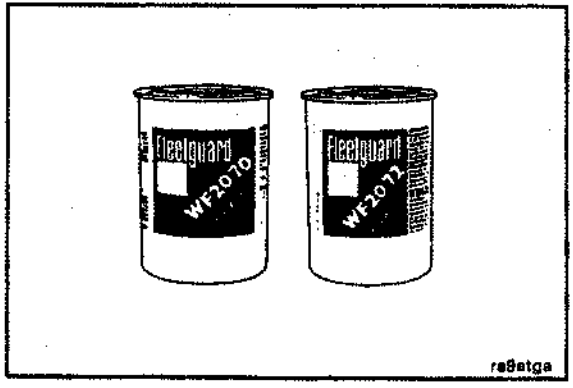


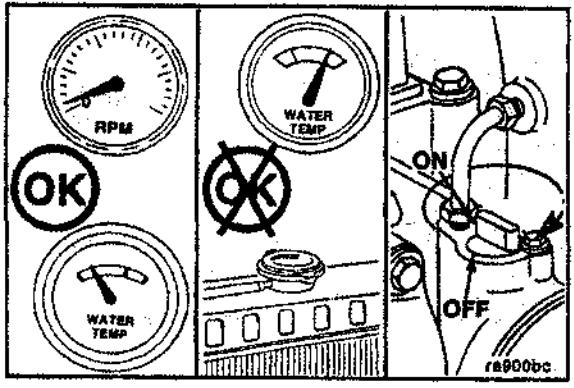
Coolant Filter/DCA4 Corrosion Resistor

Cartridge

The correct coolant filter to be used is determined by the total cooling system capacity and other operational factors.

Refer to the DCA4 Maintenance Guide in Engine Specifications (SectionV) for the correct selection of the filter.

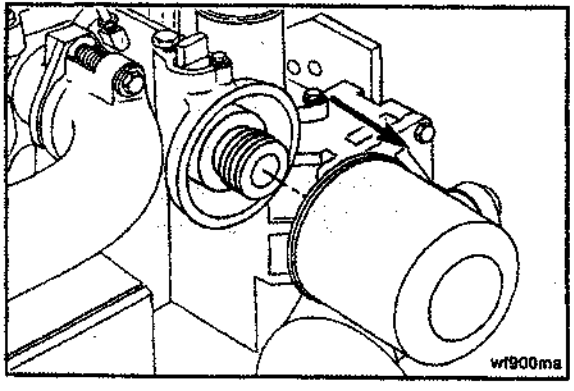




Coolant Filter

Replacement

Warning: Do not remove the radiator cap from a hot engine. Hot steam will cause serious personal injury. Wait until the coolant temperature is below 50 °C [122 °F] before removing the pressure cap. Remove the coolant system pressure cap and close the shutoff valve before removing the coolant filter. Failure to do so can result in personal injury from heated coolant spray.

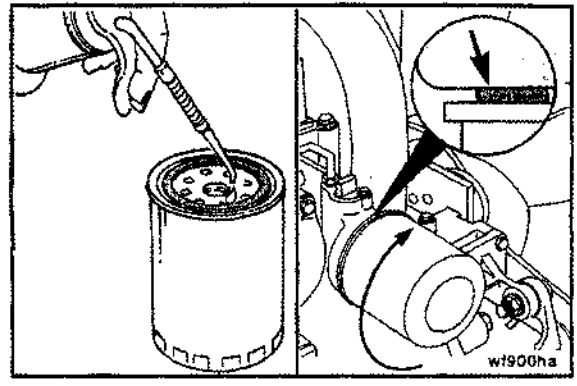


Remove and discard the coolant filter. Clean the coolant filter gasket surface.

Apply a light film of clean 15W-40lubricating oil to the gasket sealing surface before installing the coolant filter.

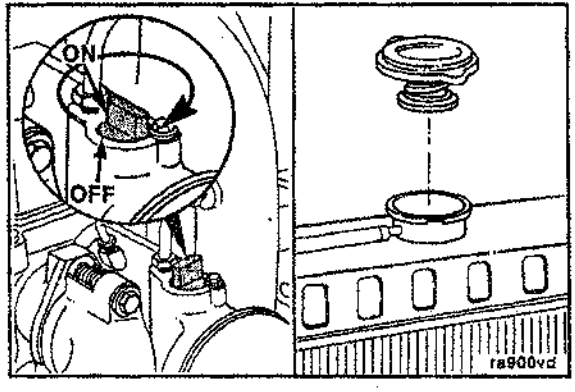
Caution: Mechanical over-tightening may distort the threads or damage the coolant filter head.

Install the filter as specified by the filter manufacturer.



Open the engine coolant shutoff valve and install the coolant system pressure cap.

NOTE: Failure to open the engine coolant shutoff valve can result in severe engine damage.



NOTES

Section 6 - Maintenance Procedures at 38,000 Kilometers [24,000 Miles], 1000 Hours or 1 Year

Section Contents

General Information

All checks or inspections listed under daily or previous maintenance intervals must also be performed at this time in addition to those listed under this maintenance interval.

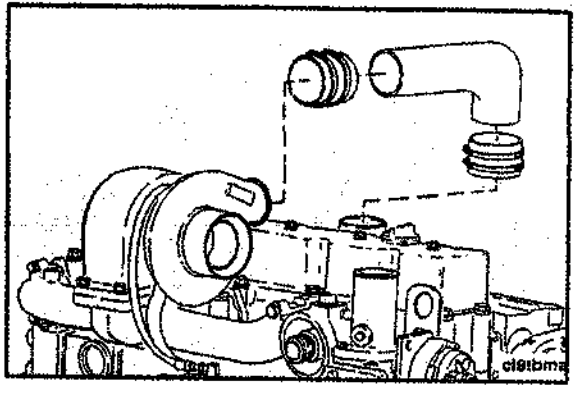
The procedures given in this section for valve lash adjustment are to be performed at the initial 38，000 Km [24，000 Mi] adjustment. Subsequent adjustments are to be performed at 77，000 Km [48，000 Mi] intervals.

Valve Clearance

Adjusting

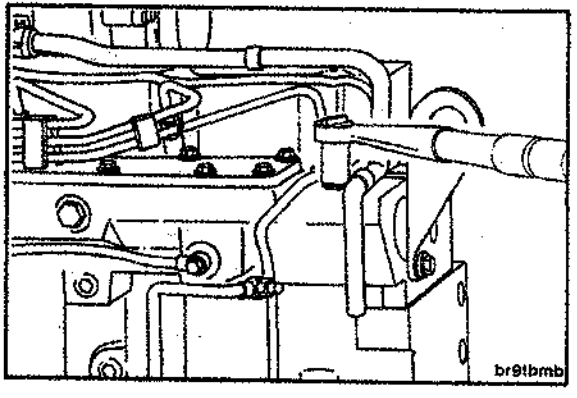
Screwdriver

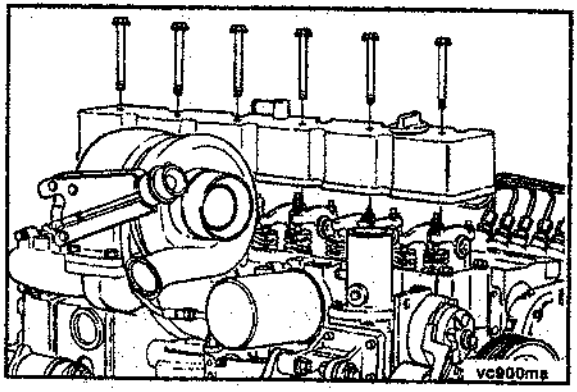
Remove the air crossover tube if the engine is so equipped.



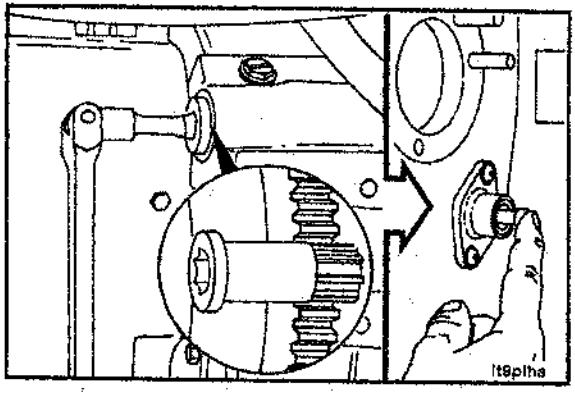
10 and 15mm

Disconnect the support clamps, hose clamp and wastegate sensing line. Remove the crankcase vent tube and any other parts that would prevent removal of the valve cover.



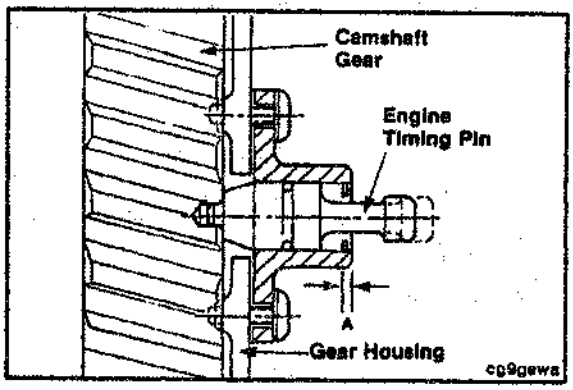


15mm
Remove the valve cover.

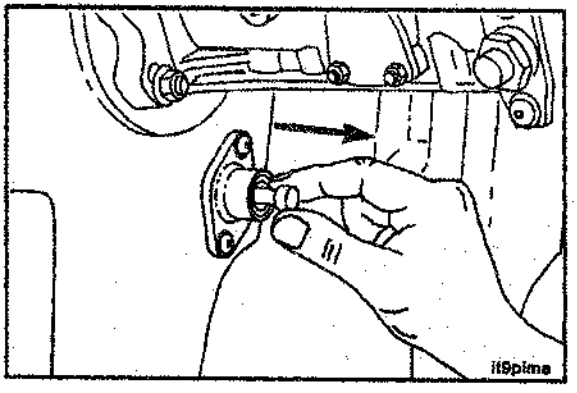


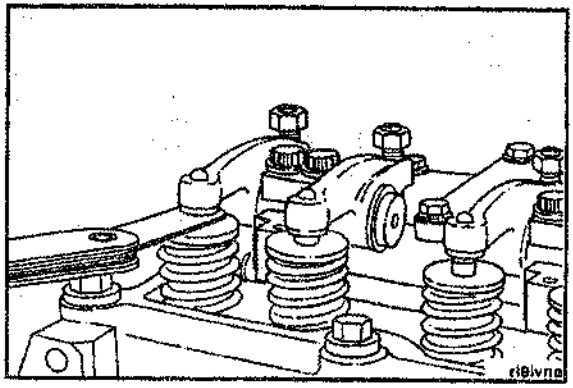
1/2 Inch Drive, 3824591 Barring Gear
Locate Top Dead Center (TDC) for Cylinder Number 1 by rotating the crankshaft slowly while pressing on the engine timing pin.
The barring gear inserts into the flywheel housing and engages the flywheel ring gear. The engine can then be rotated by hand using a 1/2 inch ratchet or breaker bar.

When the engine timing pin engages the hole in the camshaft gear, Cylinder Number 1 is at TDC on the compression stroke.



Caution: Be sure to disengage the engine timing pin after locating TDC to prevent damage to the engine timing pin.





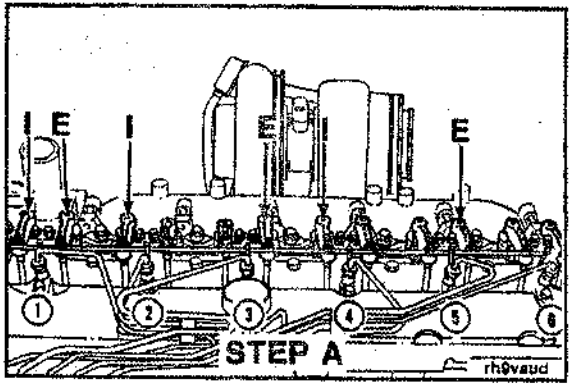
Feeler Gauge

Intake Clearance: 0.30 mm [0.012 inch]

Exhaust Clearance: 0.61 mm [0.024 inch]

Check/set valves with engine cold-below 60°C[140°F].

NOTE: The clearance is correct when some resistance is "felt" when the feeler gauge is slipped between the valve stem and the rocker lever.



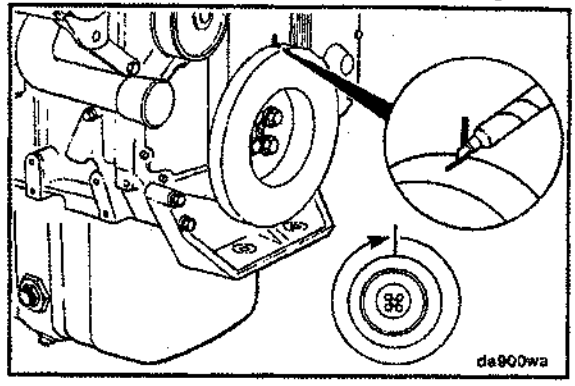
14mm, Flatblade Screwdriver

Locate Top Dead Center(TDC)for Cylinder Number1.
Check/adjust the valves indicated for STEP A (1= Intake; E=Exhaust).
After tightening the rocker lever lock nut, check the valve clearance to make sure the valve clearance has not changed.

Torque Value: 24 N·m [18ft-lb]

Mark the vibration damper and rotate the crankshaft 360 degrees.

Caution: Be sure the engine timing pin is disengaged to prevent damage to the engine timing pin.

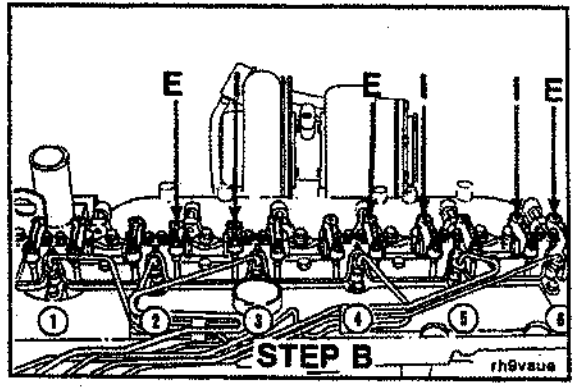


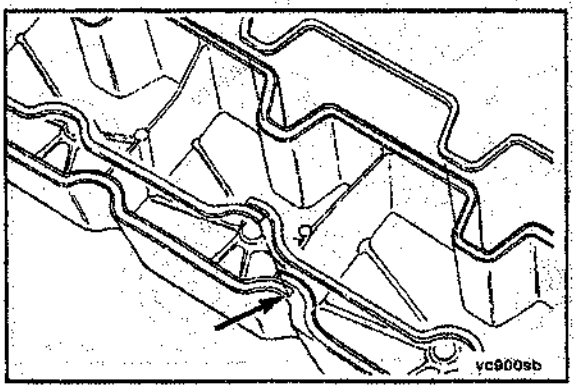
14mm, Flatblade Screwdriver

Set the valves indicated for STEP B.

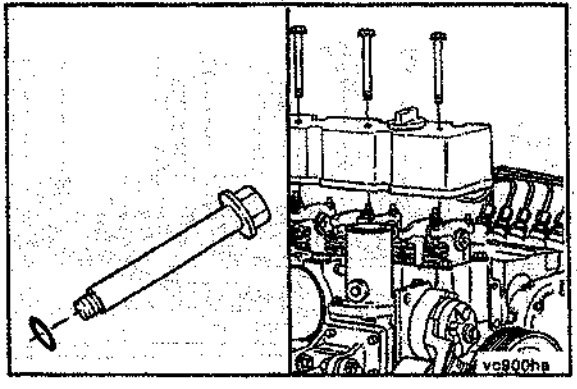
After tightening the rocker lever lock nut, check the valve clearance to make sure the valve clearance has not changed.

Torque Value: 24 N · m [18ft-lb]





NOTE: If the seal is not damaged, it can be used again. If the seal is damaged, install a new seal.
Install the rubber seal into the groove in the valve cover. Start the installation at the overlap area shown in the illustration. **Do not stretch the rubber seal.**
If the seal has more overlap than shown in the illustration,trim the length to provide the correct overlap.



15mm
Install new sealing o-rings on the capscrews.

Install the valve cover and wastegate sensing tube.

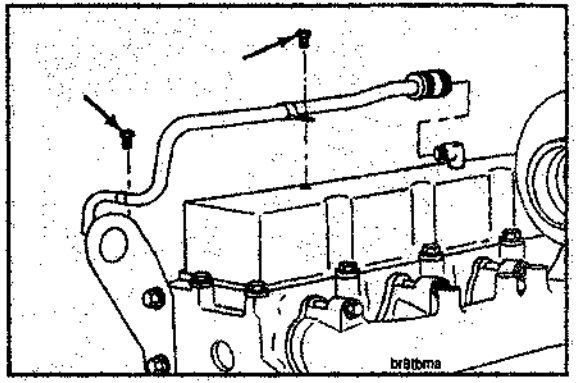
Torque Value: 24 N·m [18ft-lb]

10 and 15mm

Install the crankcase vent tube and secure with the support clamps and hose clamp.

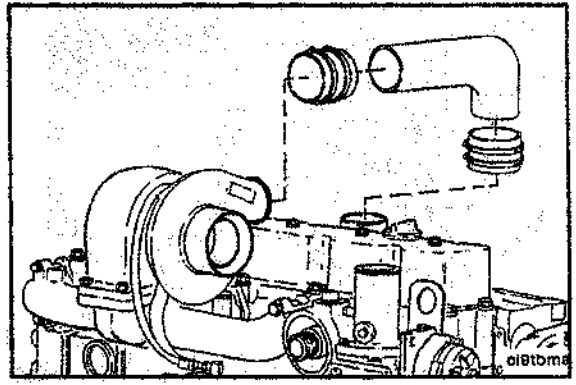
A=24 N · m [18ft-lb]

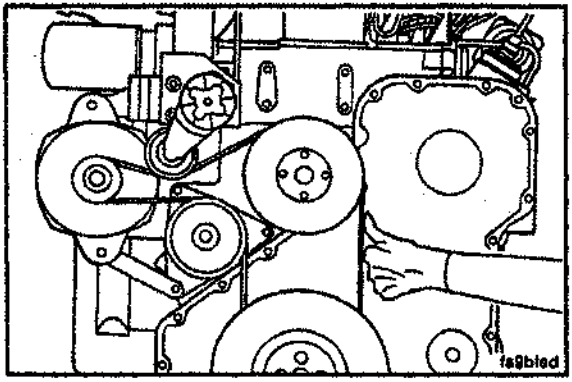
B=43 N · m [32ft-lb]



Screwdriver

Install the air crossover tube and any other parts previously removed to gain access to the valve cover.



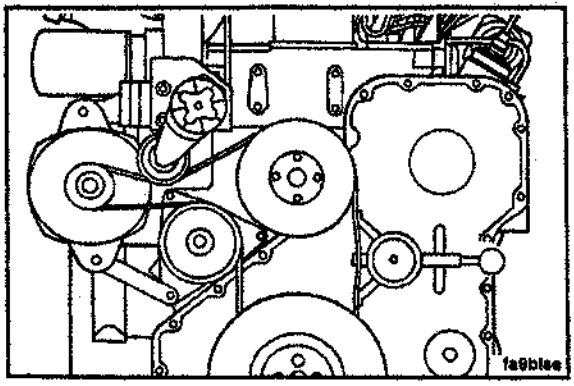


Drive Belt Tension

Checking

Measure the belt deflection at the longest span of the belt.

Maximum Deflection: 9.5 to 12.7 mm [3/8 to 1/2 inch]



NOTE: The Cummins belt tension gauge ST-1293 can be used.

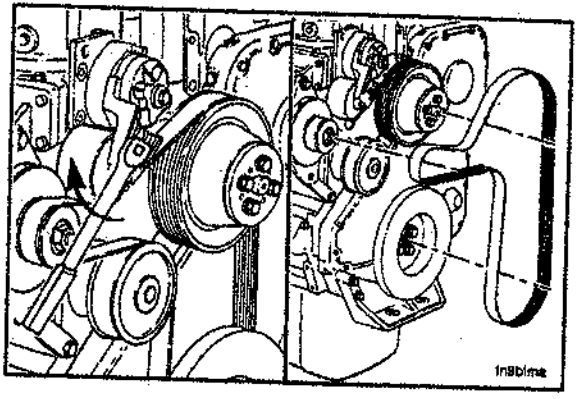
Tension Limit: 360 to 490 N [80 to 100 lbf]

Drive Belt, Tensioner Bearing and Fan Hub

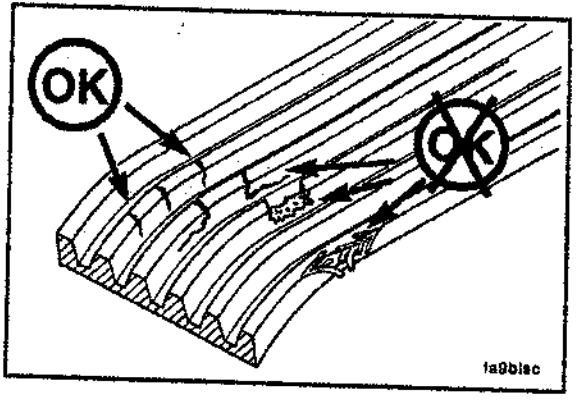
inspection

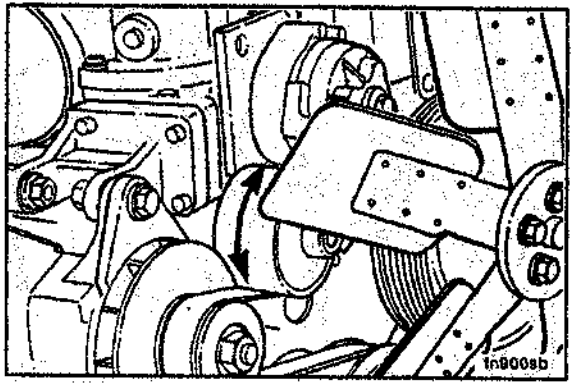
Wrench Size: 3/8 Inch Square Drive

Remove the drive belt and complete the following steps:



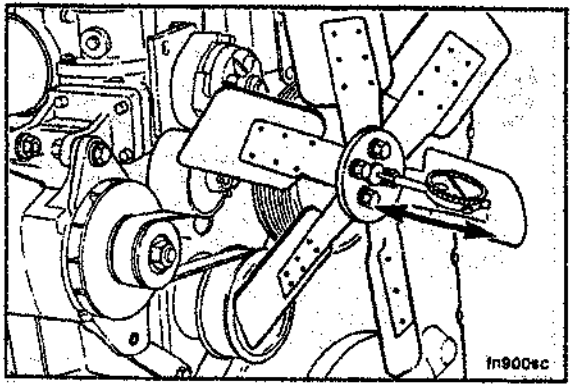
- Inspect the drive belt for damage.





NOTE: The tensioner pulley should rotate freely.

- Check the tensioner bearing.

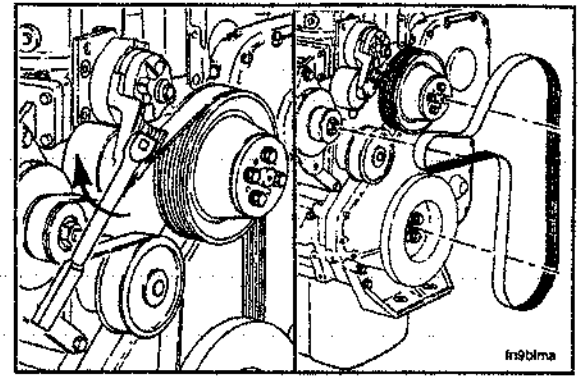


NOTE: The fan hub should rotate without any wobble or excessive end play.

- Check the fan hub bearing.

Maximum End Play: 0.15 mm [0.006 in.]

3/8 Inch Square Drive, 13mm



Install the drive belt.

Service Tip: If difficulty is experienced installing the drive belt (the belt seems too short), position the belt over the grooved pulleys first and then, while holding the tensioner up, slide the belt over the water pump pulley.

NOTE: After the tensioner arm has been raised, check the torque of the tensioner capscrew.

Torque Value: 43 N·m [32ft-lb]

NOTES

Section 7 - Maintenance Procedures at 77,000 Kilometers [48,000 Miles], 2000 Hours or 2 Years

Section Contents

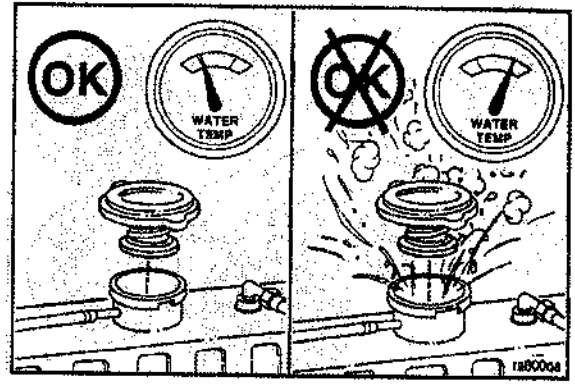
General Information

All checks or inspections listed under daily or previous maintenance intervals must also be performed at this time in addition to those listed under this maintenance interval.

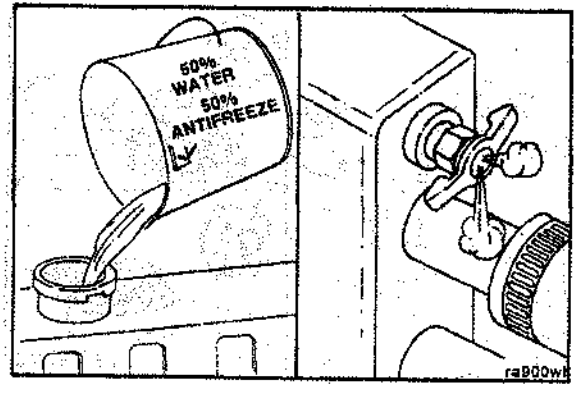
Cooling System Maintenance

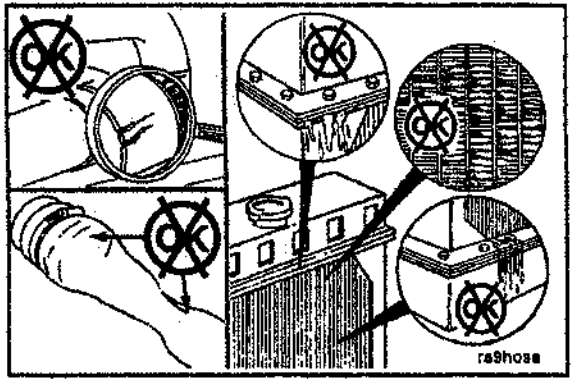
Coolant Draining

Warning: Wait until the temperature is below 50 °C [122 °F] before removing the coolant system pressure cap. Failure to do so can cause personal injury from heated coolant spray.

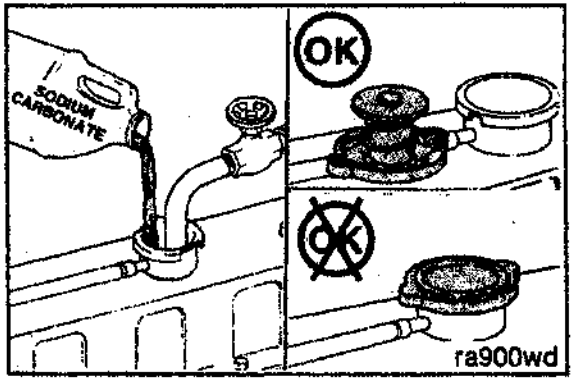


Drain the cooling system by opening the drain valve on the radiator and engine lubricating oil cooler. Adrain pan with a capacity of 25 liters [27 U. S.quarts] will be adequate in most applications.





Check for damaged hoses and loose or damaged hose clamps.Replace as required.Check the radiator for leaks, damage and build up of dirt. Clean and repair as required.



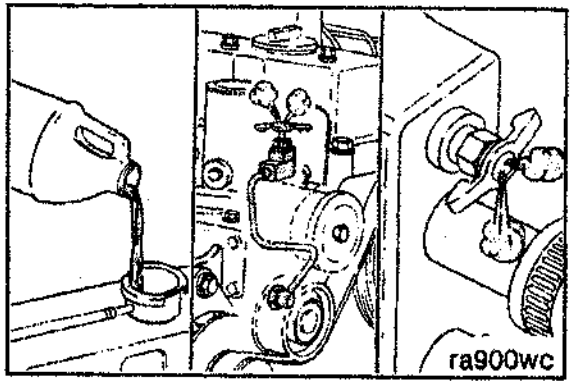
Coolant System Flushing

Fill the system with a mixture of sodium carbomate and water (or a commercially available equivalent).

NOTE: Use 0.5 kilogram [1.0 pound] of sodium carbonate for every 23 liters[6.0 U.S.gallons]of water.

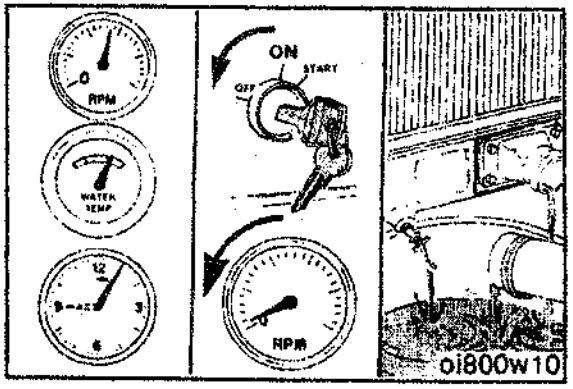
Caution: Do not install the radiator cap. The engine is to be operated without the radiator cap for the coolant system flushing process.

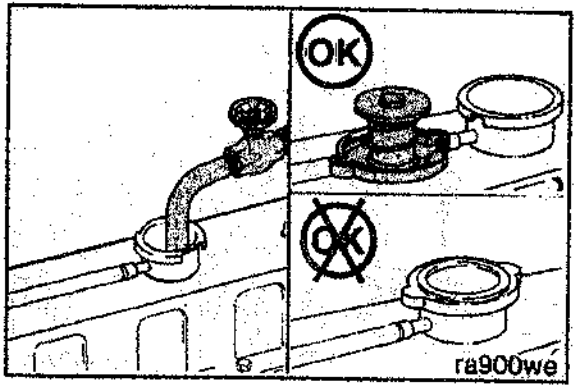
Caution: During filling, air must be vented from the engine coolant passages. Open the engine venting petcock and the petcock on the aftercooler for after-cooled engines. The system must be filled slowly to prevent air locks. Wait 2 to 3 minutes to allow air to be vented, then add mixture to bring the level to the bottom of the radiator filler neck.



Operate the engine for 5 minutes with the coolant temperature above 80°C [176°F].

Shut the engine off, and drain the cooling system.

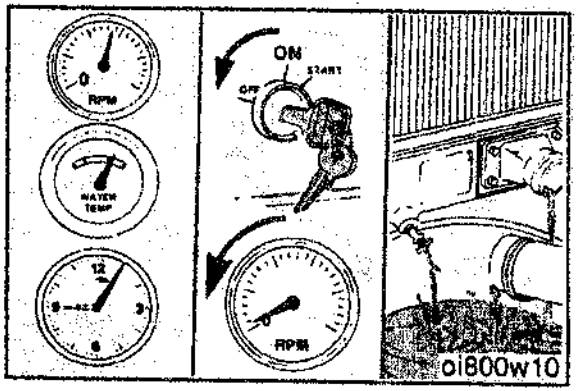




Fill the cooling system with clean water.

NOTE: Be sure to vent the engine and aftercooles for complete filling.

NOTE: Do not install the radiator cap or the new coolant filter.



Operate the engine for 5 minutes with the coolant temperature above 80°C [176°F].

Shut the engine off, and drain the cooling system.

NOTE: If the water being drained is still dirty, the system must be flushed again until the water is clean.

Coolant System Filling

Caution: Never use water alone for coolant. Damage from corrosion can be the resuit of using water alone for coolant.

NOTE: A 50 percent mixture of antifreeze and water must be premixed before filling the system. The ability of antifreeze to remove heat from the engine is not as good as water, so pouring antifreeze into the engine first could contribute to an over heated condition before the liquids are completely mixed.

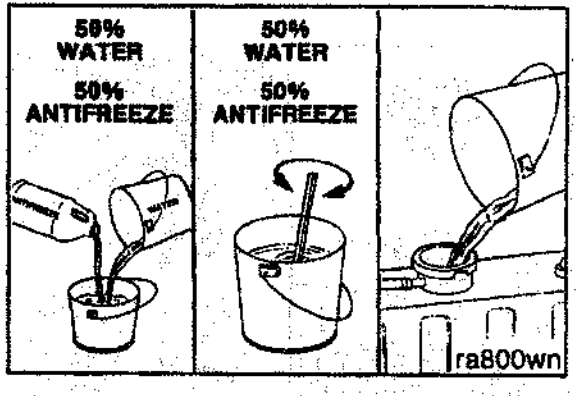
Close all drain valves and fill the system. Use a mixture of 50 percent water and 50 percent ethylene glycol antifreeze to provide freeze protection to -36°C [-34°F].

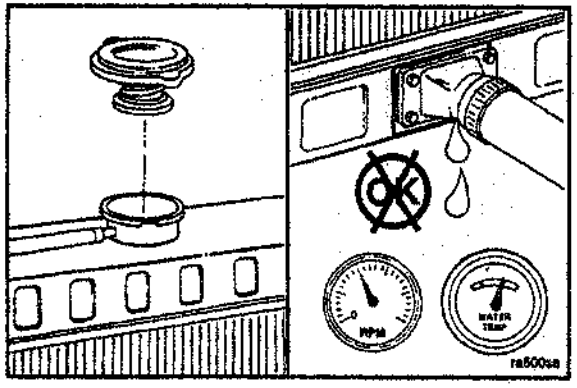
Coolant Capacity (Engine Only)

Liter		U.S. Quarts
10.1	6C8.3	10.5
10.1	6CT8.3*	10.5
12.3	6CTA8.3	13.0

* Same capacity for charge air cooled engines.

Use the amount of DCA4 corrosion inhibitor given in Section V to protect the cooling system.





Warning: Wait until the coolant temperature is below 50 °C[122 °F]before removing the pressure cap.Failure to do so can result in personal injury from heated coolant spray.

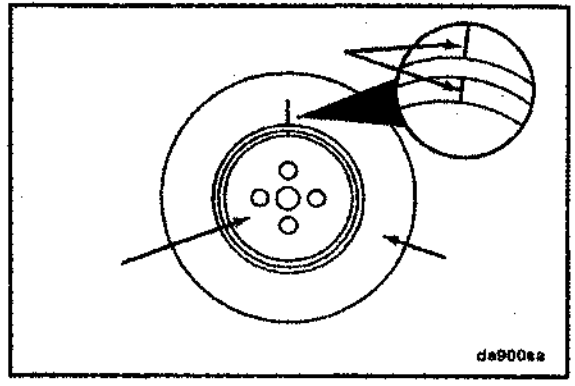
Caution: During Filling, air must be vented from the engine coolant passages. Open the engine venting petcock and the petcock on the aftercooler for after-cooled engines. The system must be filled slowly to prevent air locks. Wait 2 to 3 minutes to allow air to be vented, then add coolant to bring the level to the bottom of the radiator filler neck.

Install the pressure cap. Operate the engine until it reaches a temperature of 80°C [176°F], and check for coolant leaks and add coolant as necessary.

Vibration Damper

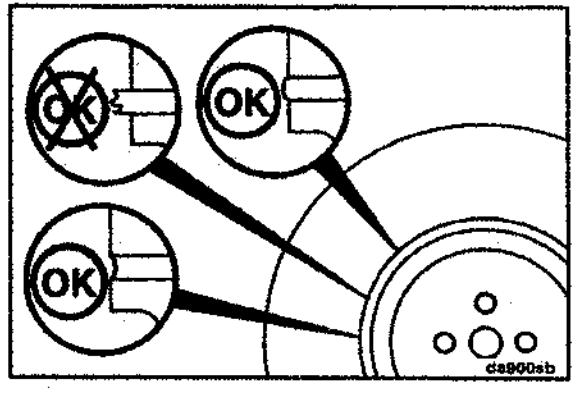
Inspection

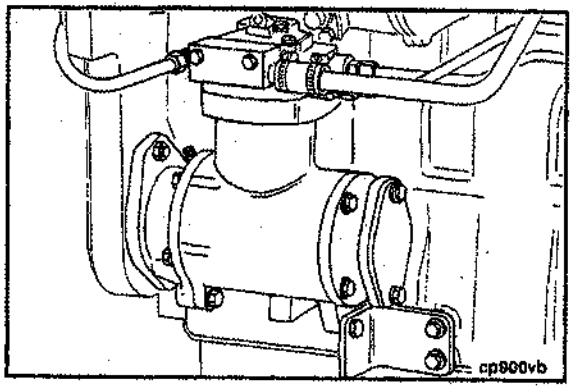
Check the index lines (A) on the damper hub (B) and the inertia member (C). If the lines are more than 1.59mm [1/16 inch] out of alignment, replace the damper.



Inspect the rubber member for deterioration. If pieces of rubber are missing or if the elastic member is more than 3.18mm [1/8 inch] below the metal surface, replace the damper.

NOTE: Also look for forward movement of the damper ring on the hub. Replace the damper if any movement is detected.

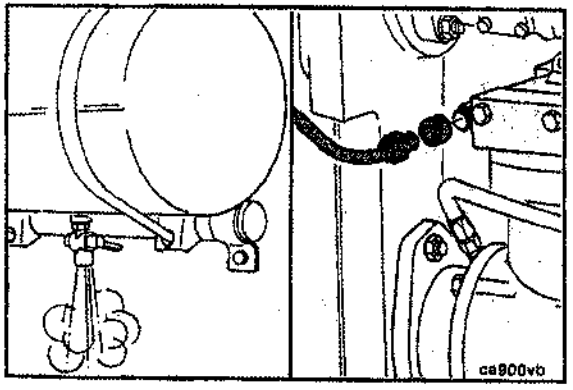




Air Compressor

Inspection

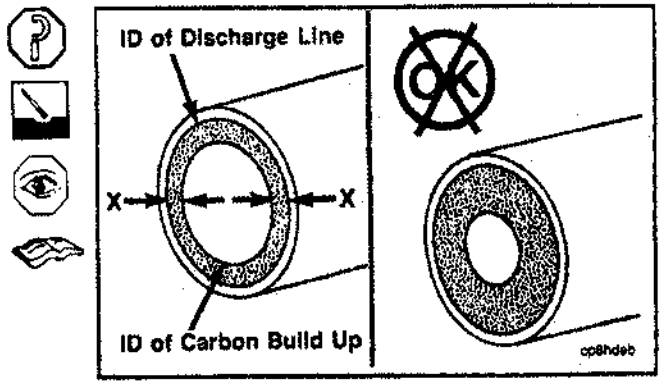
NOTE: All air compressors have a small amount of lubricating oil carry over which lubricates the piston rings and moving parts. When this lubricating oil is exposed to normal air compressor operating temperatures over a period of time, the lubricating oil will form varnish or carbon deposits. If the following inspections are **not** done, the air comperatures and pressures and will not seal correctly.



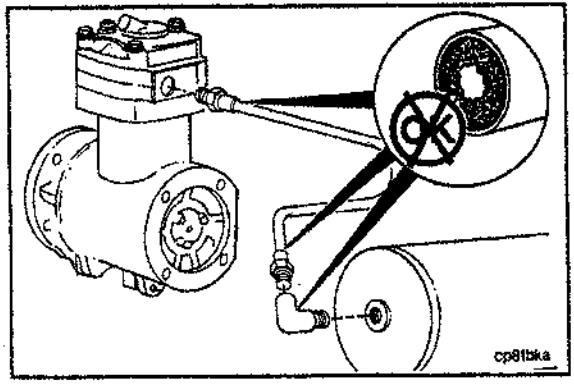
Air Compressor Discharge Inspection

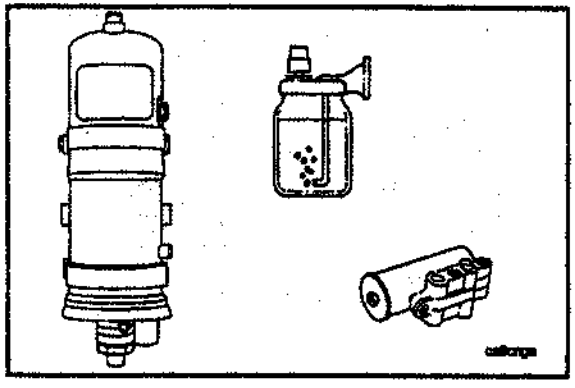
Drain the air system wet tank to release the system air pressure. Remove the air discharge line from the air compressor.

Measure the total carbon deposit thickness inside the air discharge line as shown. If the total carbon deposit (X+ X) exceeds 2 mm [1/16-inch], clean and inspect the cylinder head, the valve assembly, and the discharge line. Replace if necessary. Contact your Cummins Authorized Repair Location for procedures.



If the total carbon deposit exceeds specifications, continue checking the air discharge line connections up to the first tank until total carbon deposit is less than 2 mm [1/16-inch]. Clean or replace any lines or connections that exceed this specification.





Inspect any air driers, spitter valves, pressure relief valves, and alcohol injectors for carbon deposits or malfunctioning parts. Inspect for air leaks. Maintain and repair the parts according to the manufacturer's specification.

Section D-System Diagrams

Section Contents

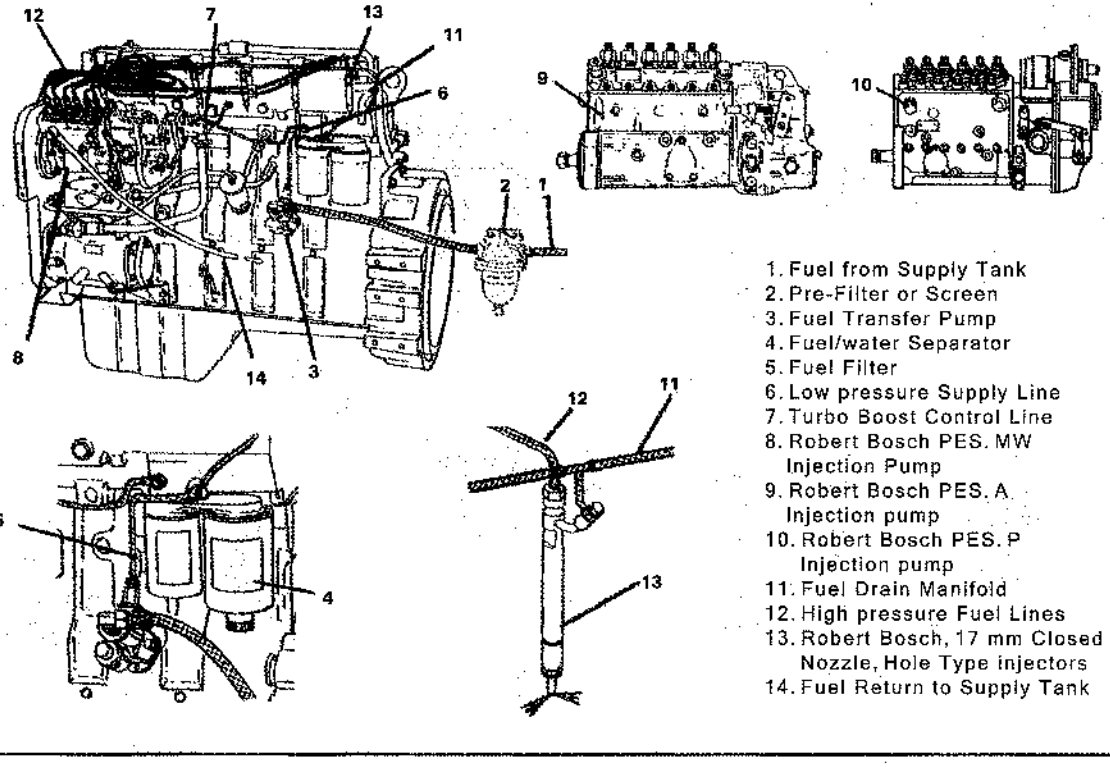
General Information

The following drawings show the flow through the engine systems. Although parts can change between different applications and installation, the flow remains the same. The systems shown are:

- Fuel System
- Lubricating Oil System
- Coolant System
- Intake Air System
- Exhaust System

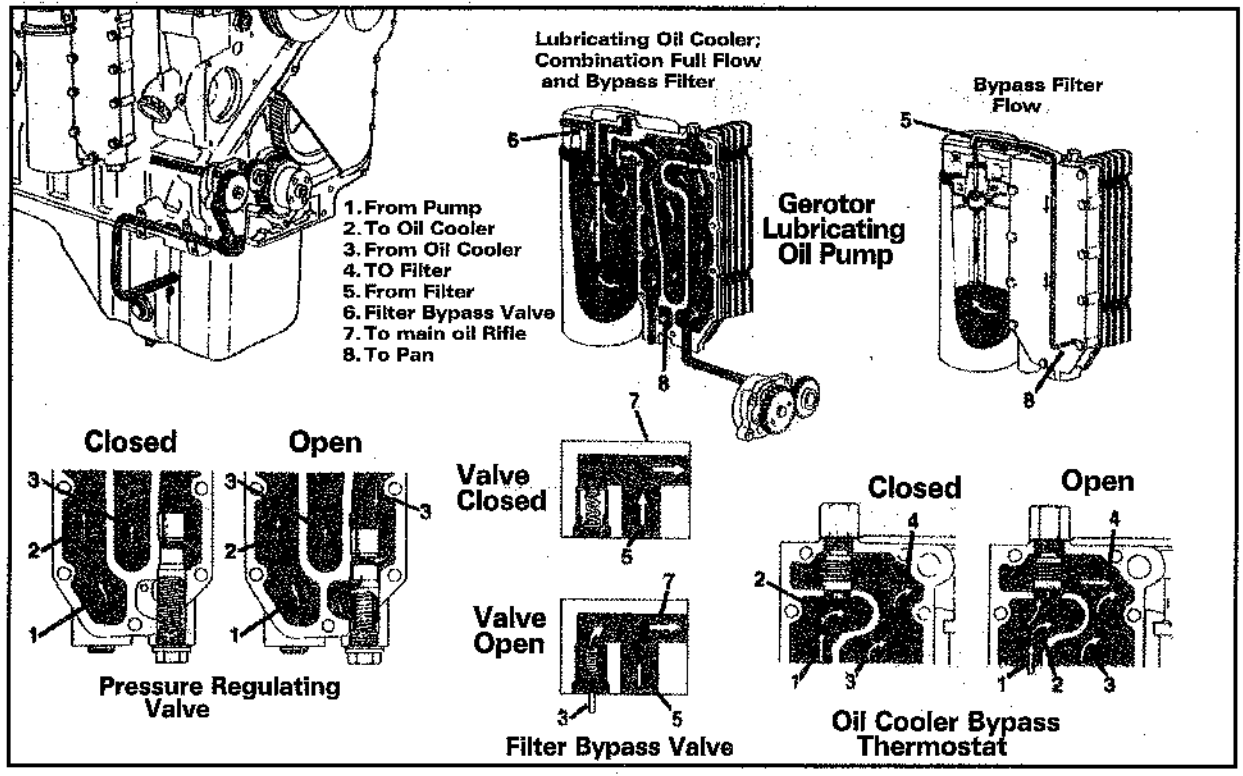
Knowledge of the engine systems can help you in troubleshooting, service and general maintenance of your engine.

Fuel System

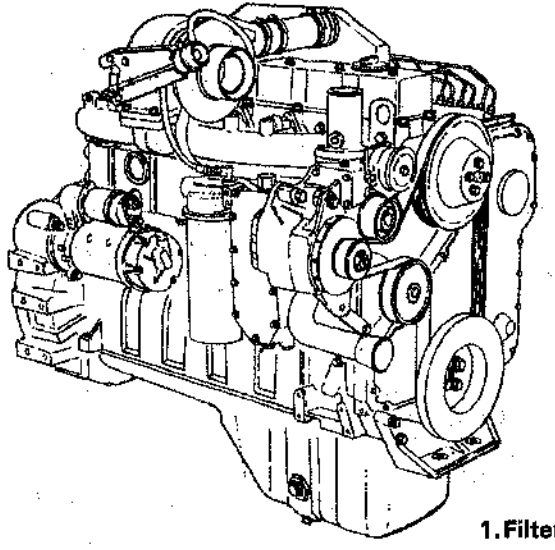


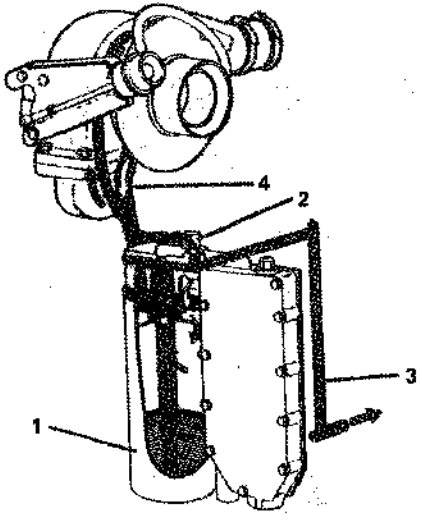
1. Fuel from Supply Tank
2. Pre-Filter or Screen
3. Fuel Transfer Pump
4. Fuel/water Separator
5. Fuel Filter
6. Low pressure Supply Line
7. Turbo Boost Control Line
8. Robert Bosch PES. MW Injection Pump
9. Robert Bosch PES. A Injection pump
10. Robert Bosch PES. P Injection pump
11. Fuel Drain Manifold
12. High pressure Fuel Lines
13. Robert Bosch, 17 mm Closed Nozzle, Hole Type injectors
14. Fuel Return to Supply Tank

Lubricating Oil System



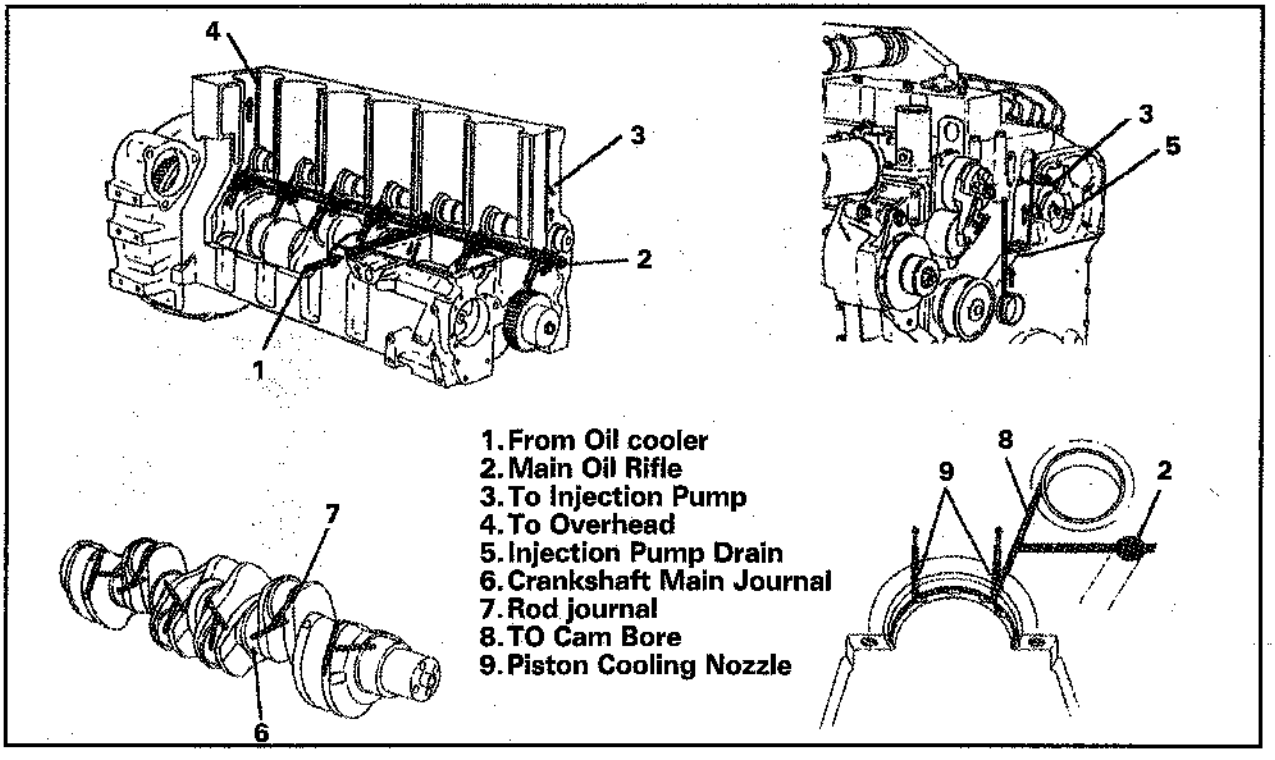
Lubricating for the Turbocharger



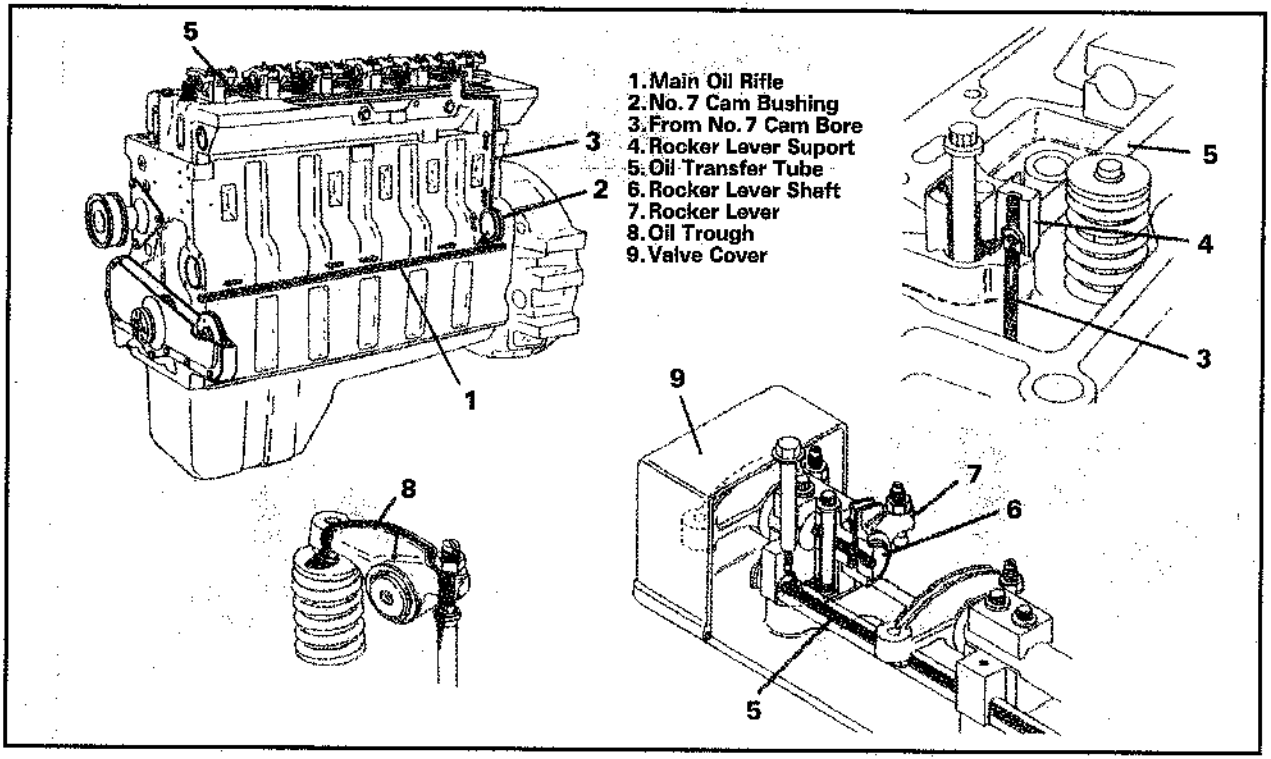


1. Filter
2. Turbocharger Supply
3. To Main Oil Rifle
4. To Pan

Lubricating for the power Components



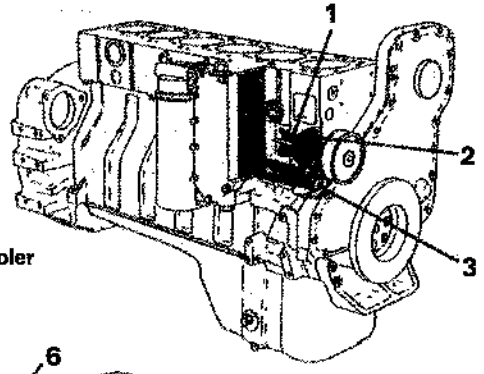
Lubricating for the Overhead

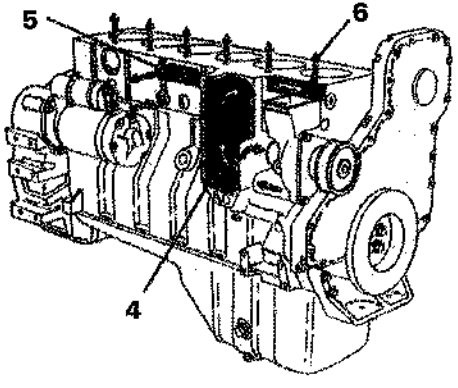


Coolant System

Cylinder Block

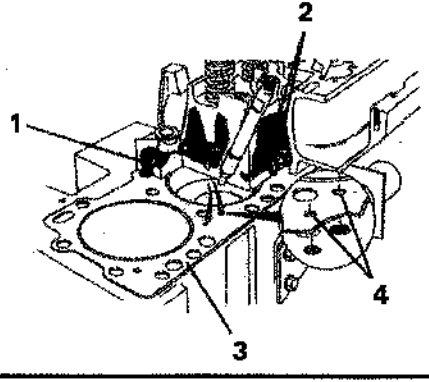
1. Coolant Inlet
2. Pump Impeller
3. Coolant Flow to Cooler
4. Coolant Flow Past Oil Cooler
5. Upper Coolant Manifold
6. Coolant to Cylinder Head



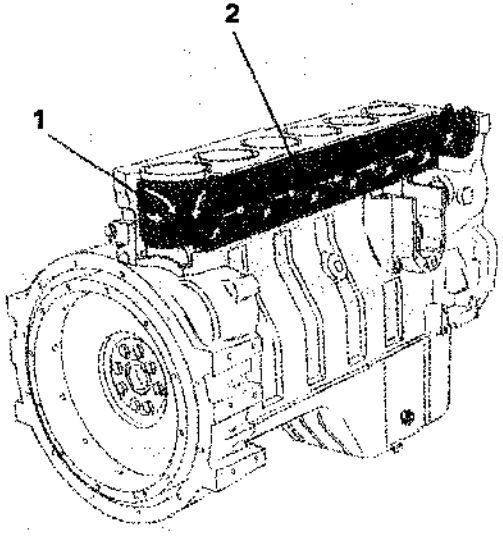


Cylinder Head

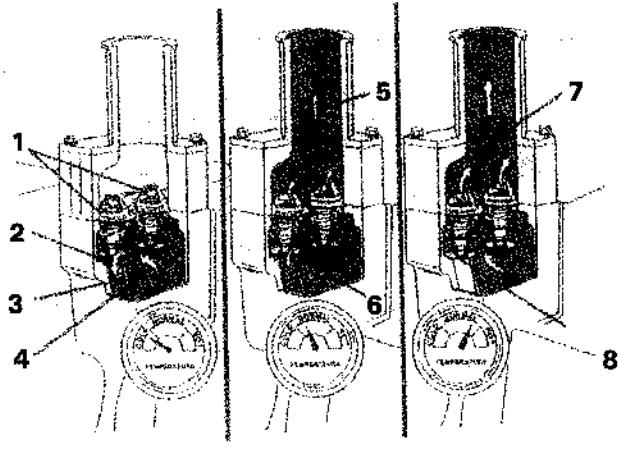
1. Coolant Flow from Upper Coolant Manifold
2. Coolant to Liner Cavity
3. Cylinder Head Gasket
4. Coolant Flow Orifice



Coolant System

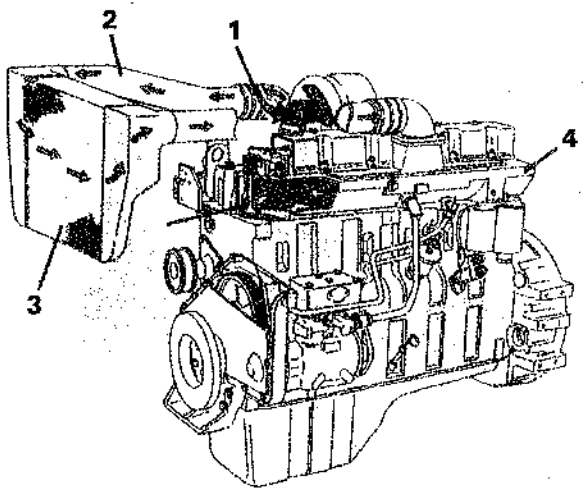


1. Coolant Flow Past Cylinder Liners
2. Lower Coolant Manifold



Closed	Intermediate	Open
1. Thermostats 2. Coolant to Pump Inlet 3. Bypass Passage 4. Coolant from Lower Coolant Manifold	5. Partial Coolant Flow to Radiator 6. Restricted Coolant Flow to Bypass	7. Coolant to Radiator 8. Bypass Closed

Air System

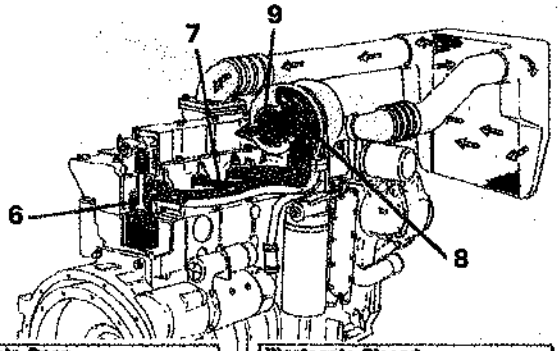


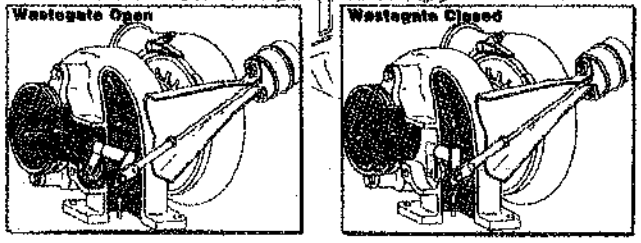
Intake System

1. Intake Air Inlet to Turbochanger
2. Turbocharger Air charge Air Cooler
3. Charge Air to Cooler
4. Intake Manifold
   (Integral Part of Cylinder Head)
5. Intake Valve

Exhaust System

6. Exhaust Valve
7. Exhaust Manifold (Pulse Type)
8. Dual Entry to Turbocharger
9. Turbocharger Exhaust Outlet





Section T-Troubleshooting

Section Contents

Troubleshooting Procedures and Techniques

This guide describes some typical engine operating problems, their causes, and some acceptable corrections to those problems. Unless noted otherwise, the problems listed are those which an operator can diagnose and repair. See a Cummins Authorized Repair Location for diagnosis and repair of problems not listed.

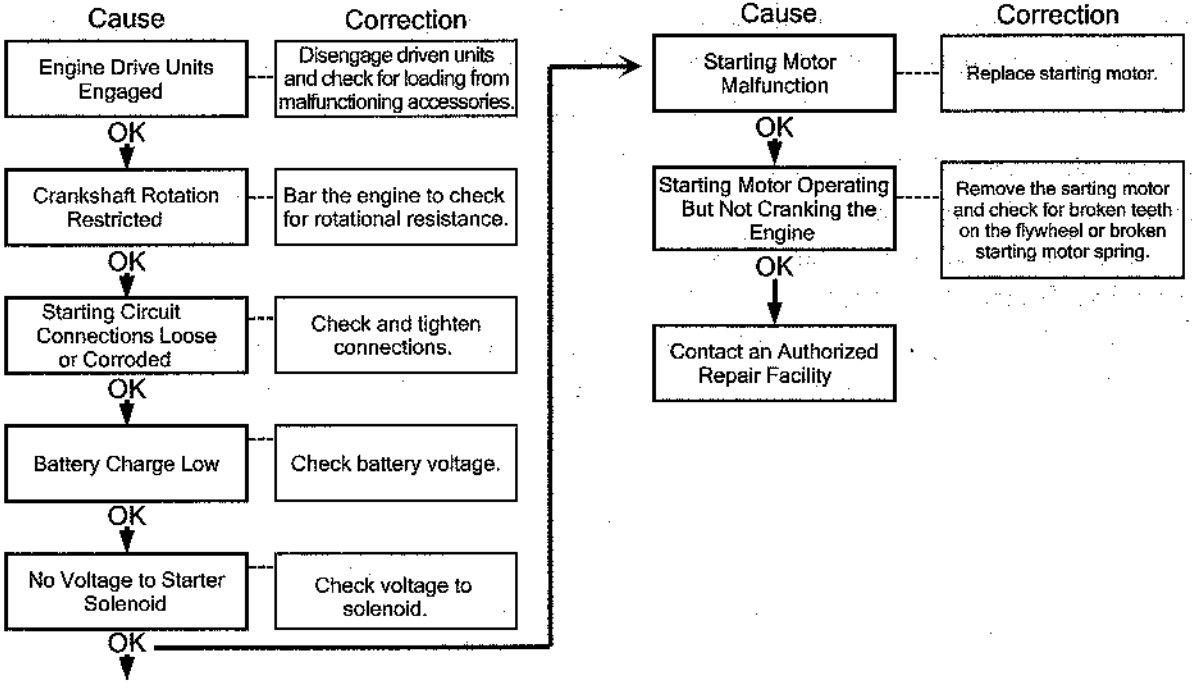
Follow the suggestions below to develop good troubleshooting procedures:

- Study the problem thoroughly before acting.
- Do the easiest and obvious things first.
- Find and correct the basic cause of the problem.

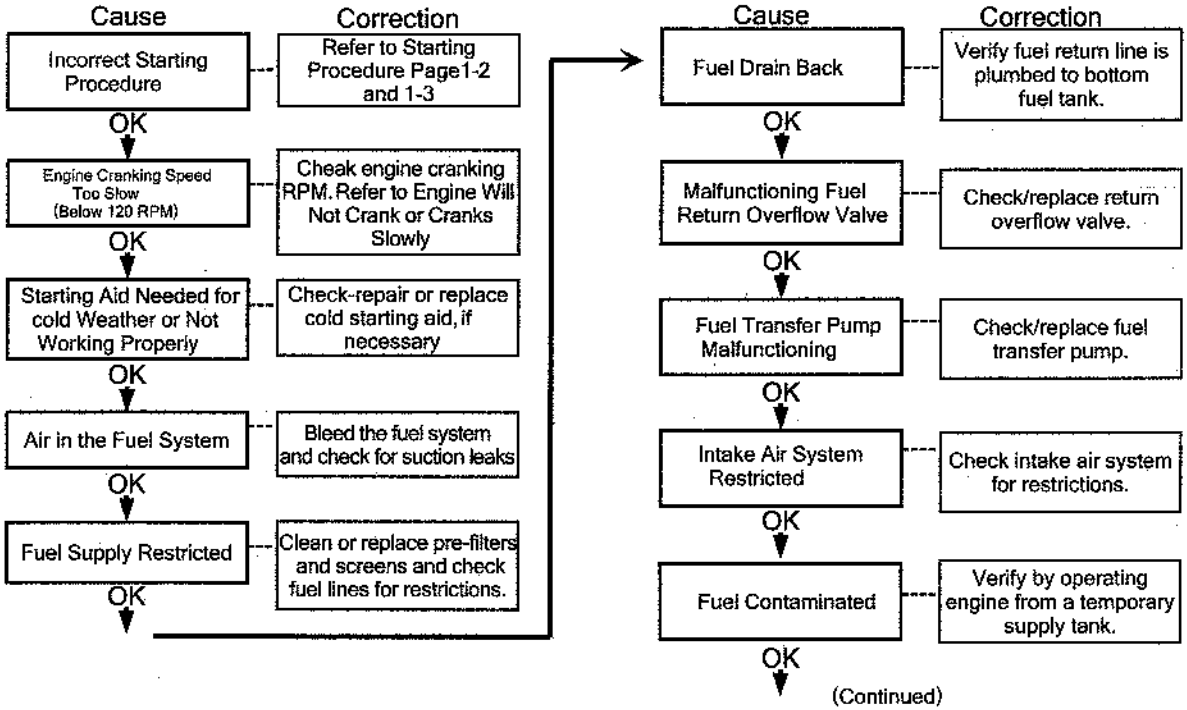
Troubleshooting Symptoms Charts

Use the charts on the following pages of this section to aid in diagnosing specific engine problems. Read each row of blocks from top to bottom. Follow the arrows through the chart to identify the corrective action.

Engine Will Not Crank or Cranks Slowly

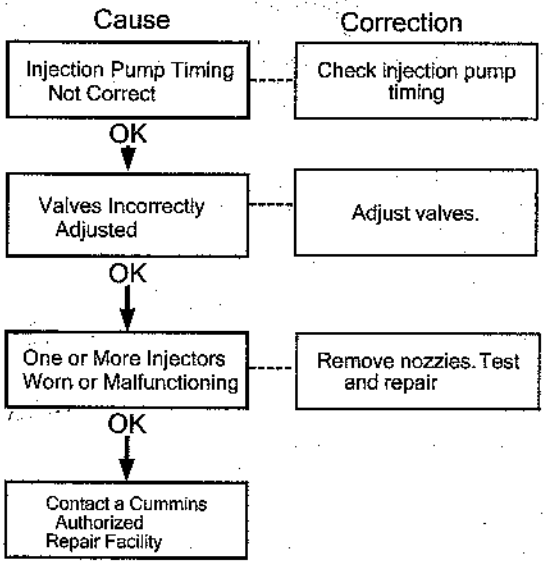


Engine Difficult to Start or Will Not Start (Exhaust Smoke Present)

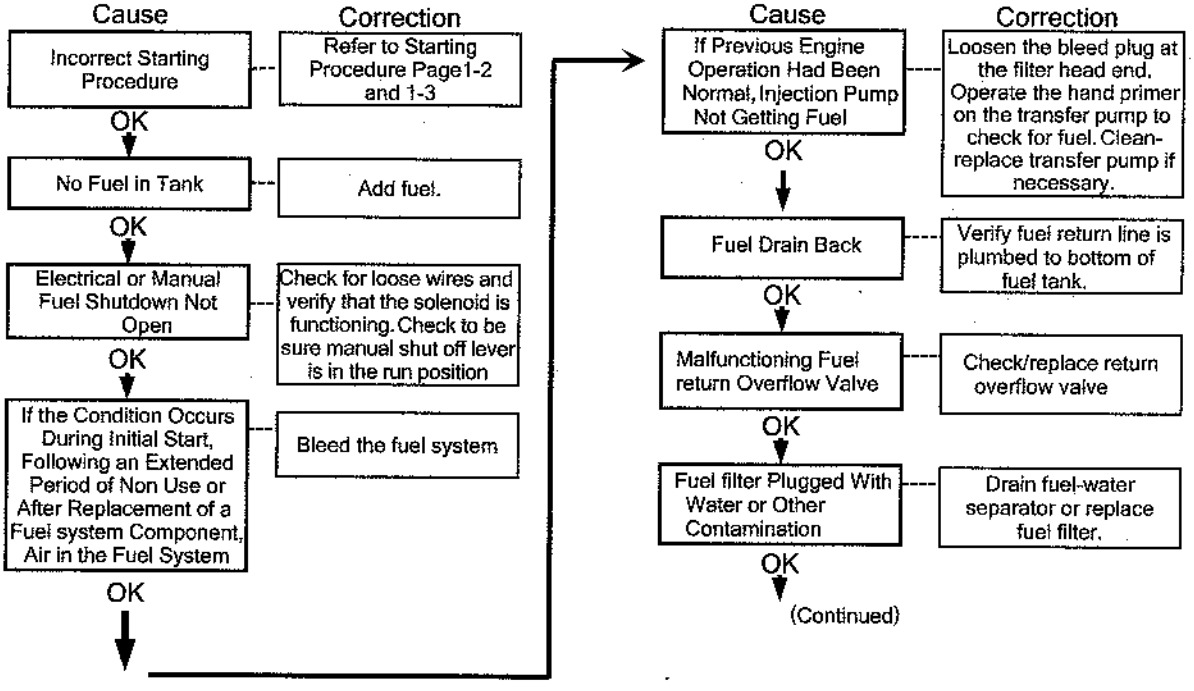


(Continued)

Engine Difficult to Start or Will Not Start (Exhaust Smoke Present) (Continued)

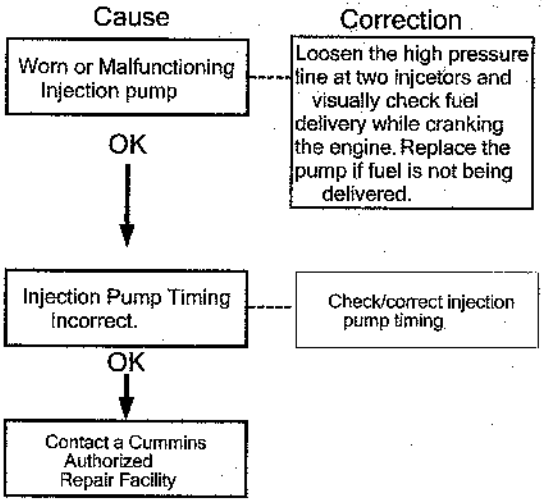


Engine Charts, But Will Not Start-No Smoke From Exhaust

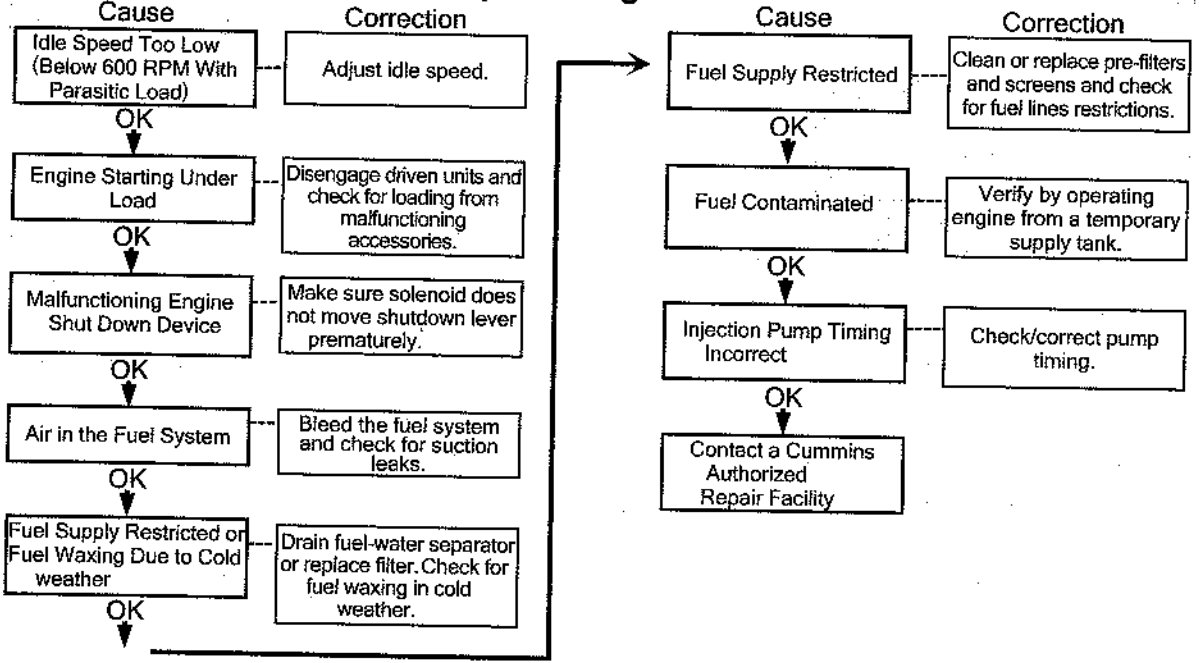


(Continued)

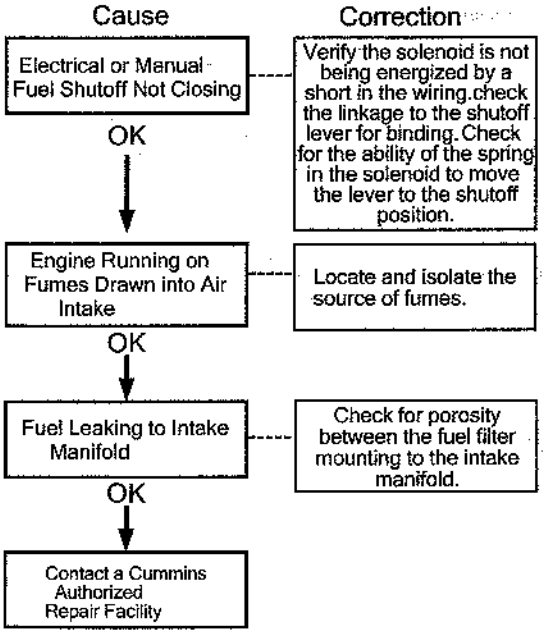
Engine Charts, But Will Not Start-No Smoke From Exhaust (Continued)



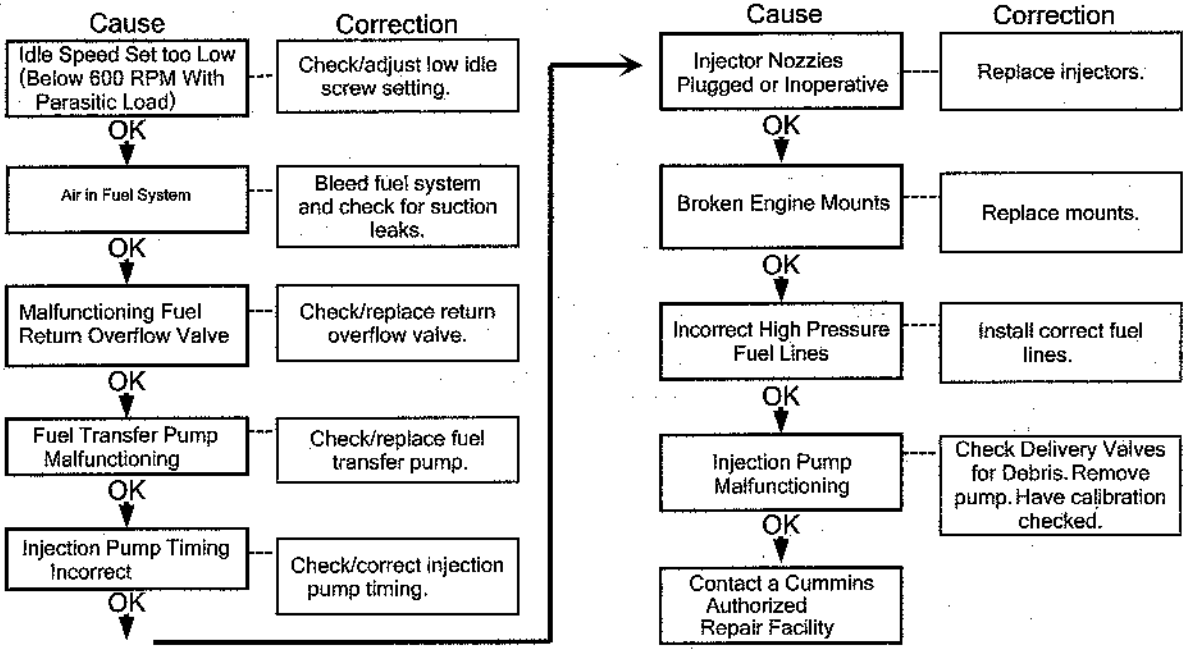
Engine Start But Will Not Keep Running



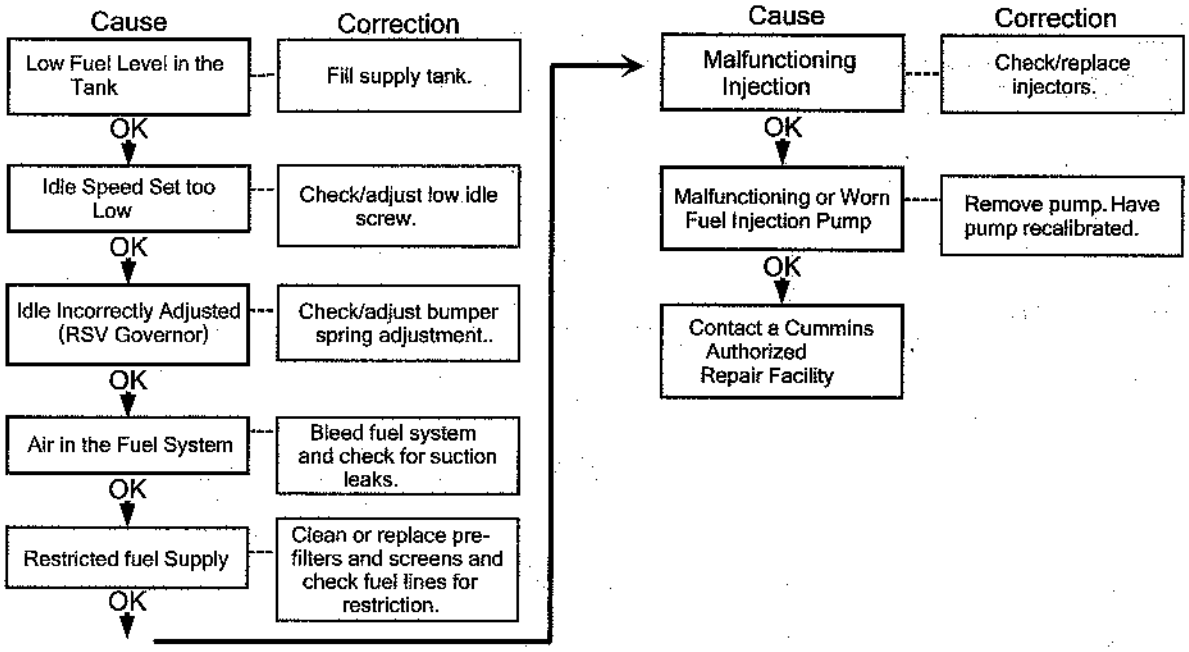
Engine Will Not Shut Off



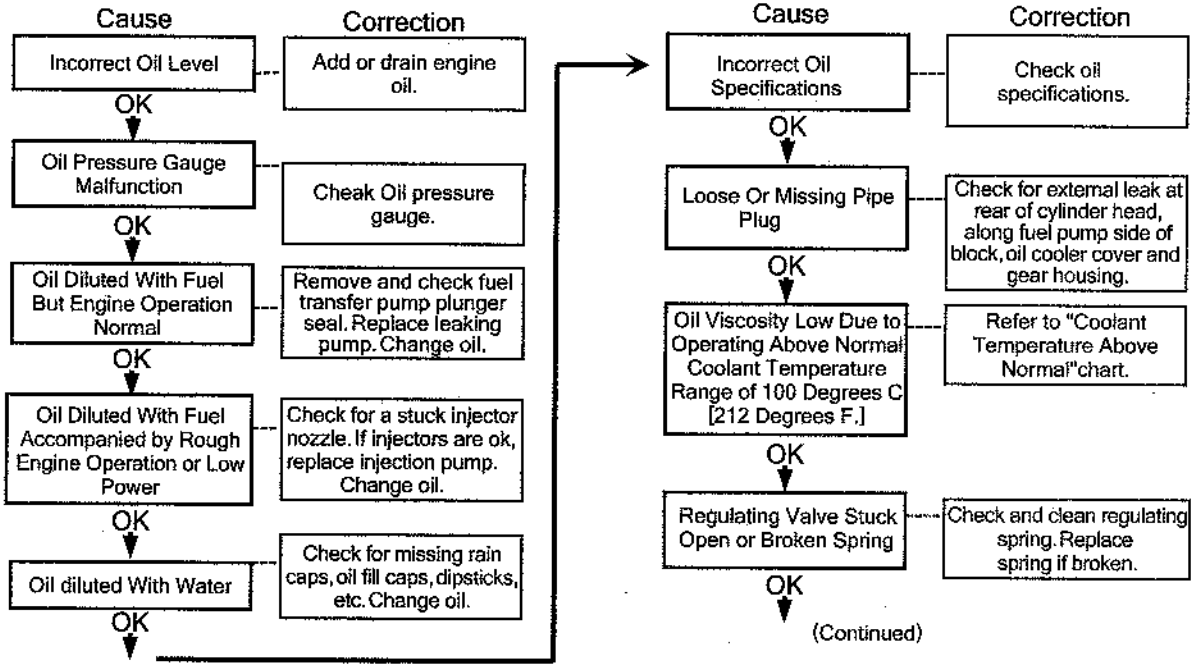
Rough Idle, Warm Engine



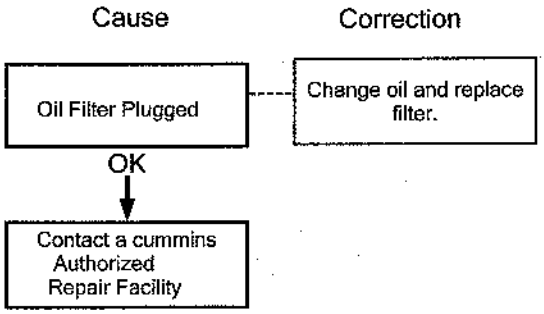
Engine Surges at Idle



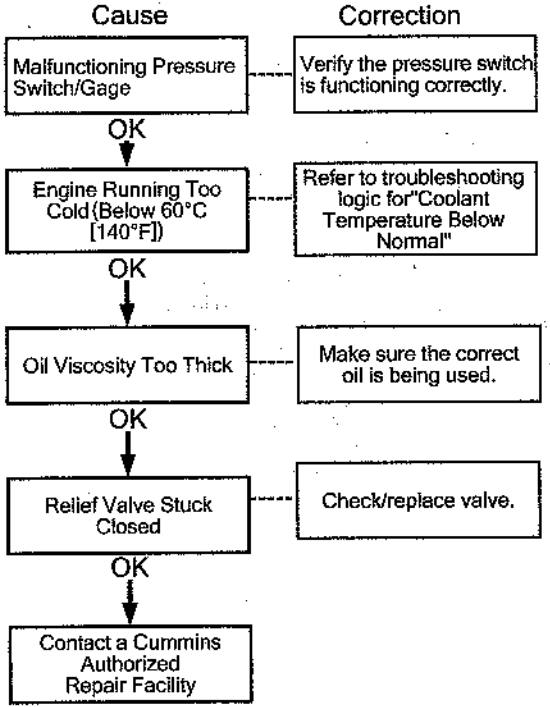
Lubricating Oil Pressure Low



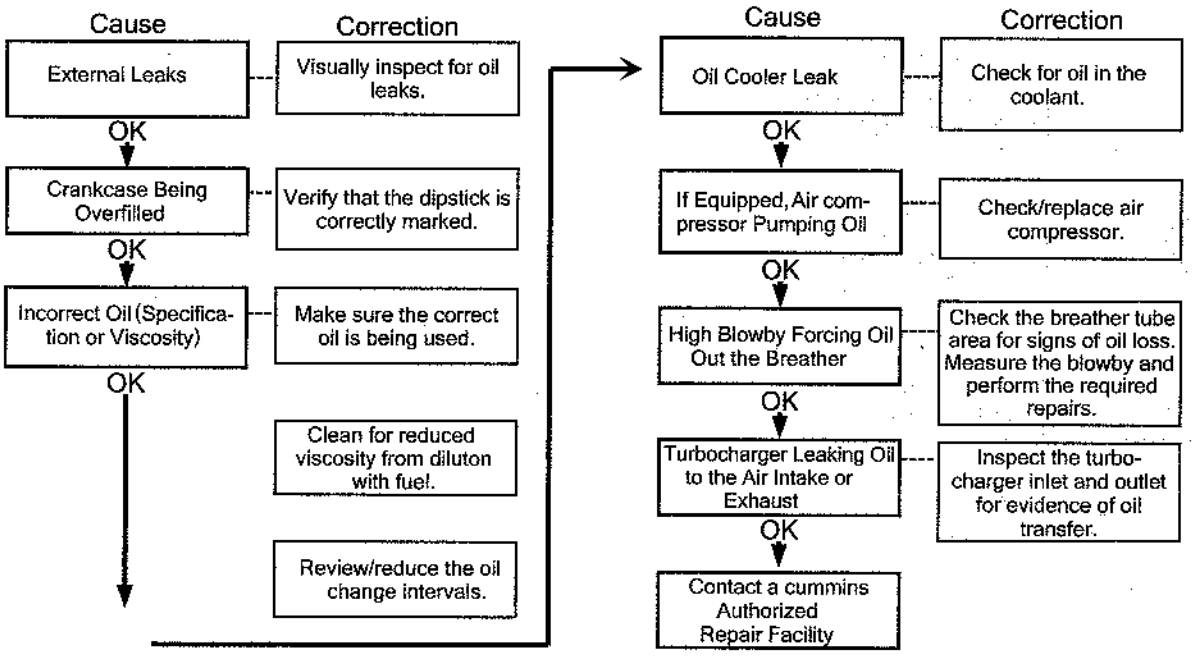
Lubricating Oil Pressure Low (Continued)



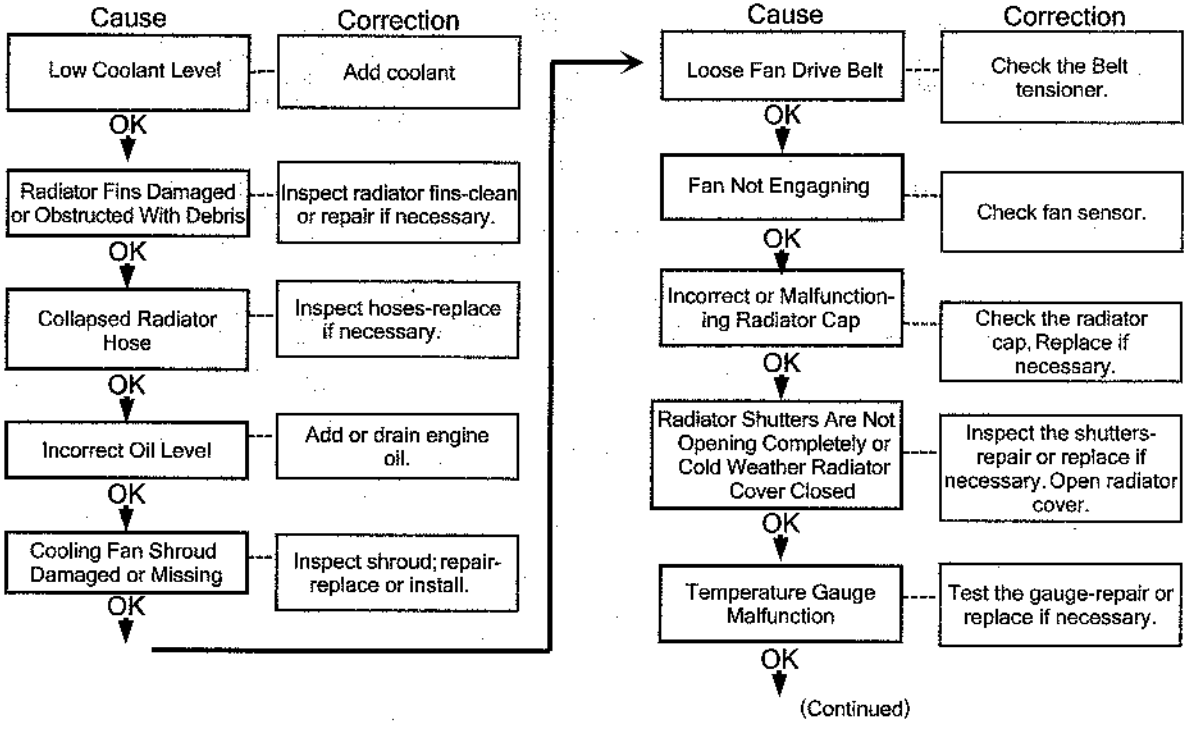
Lubricating Oil Pressure Too High



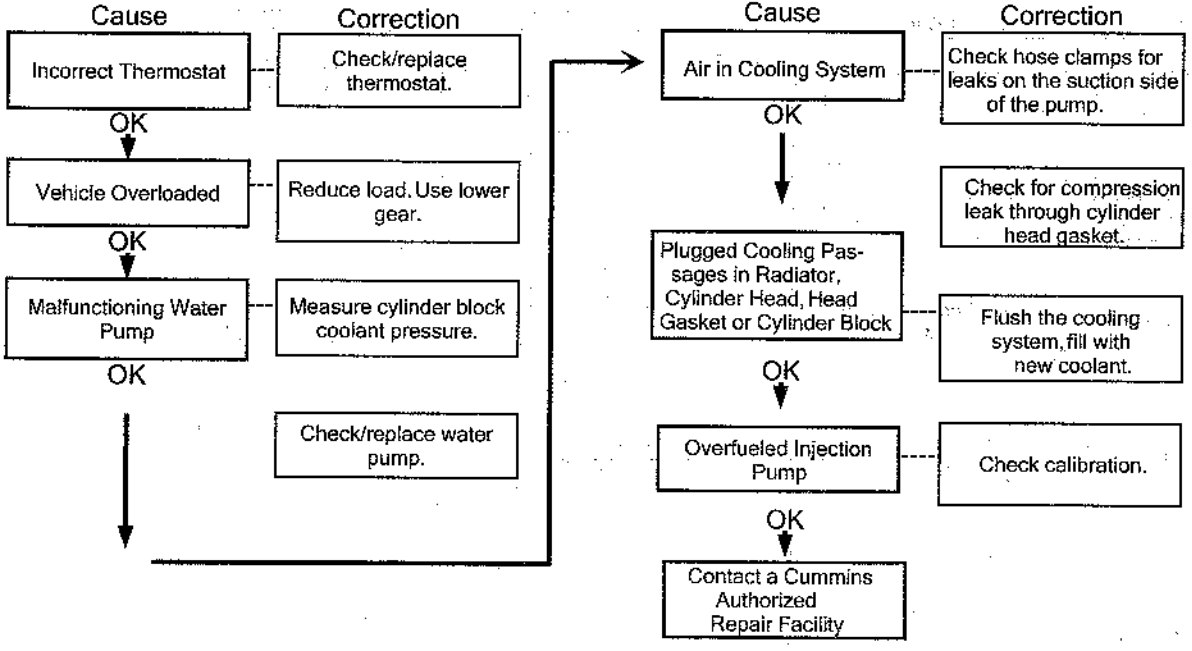
Lubricating Oil Loss



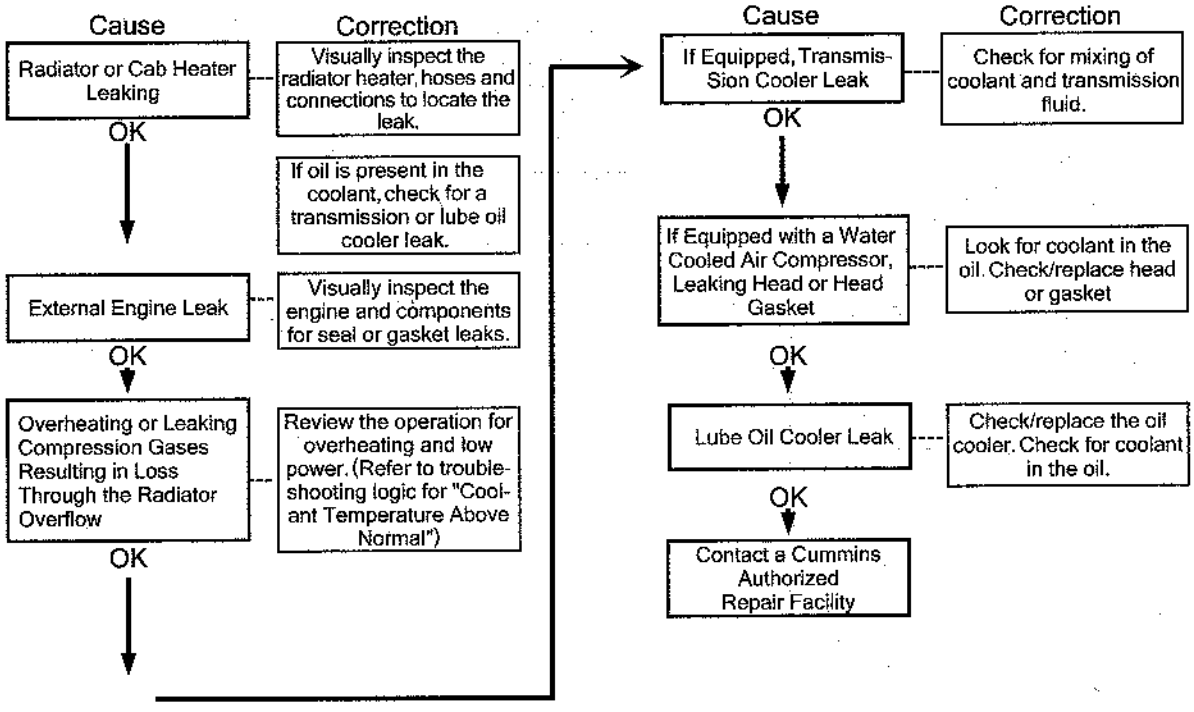
Coolant Temperature Above Normal



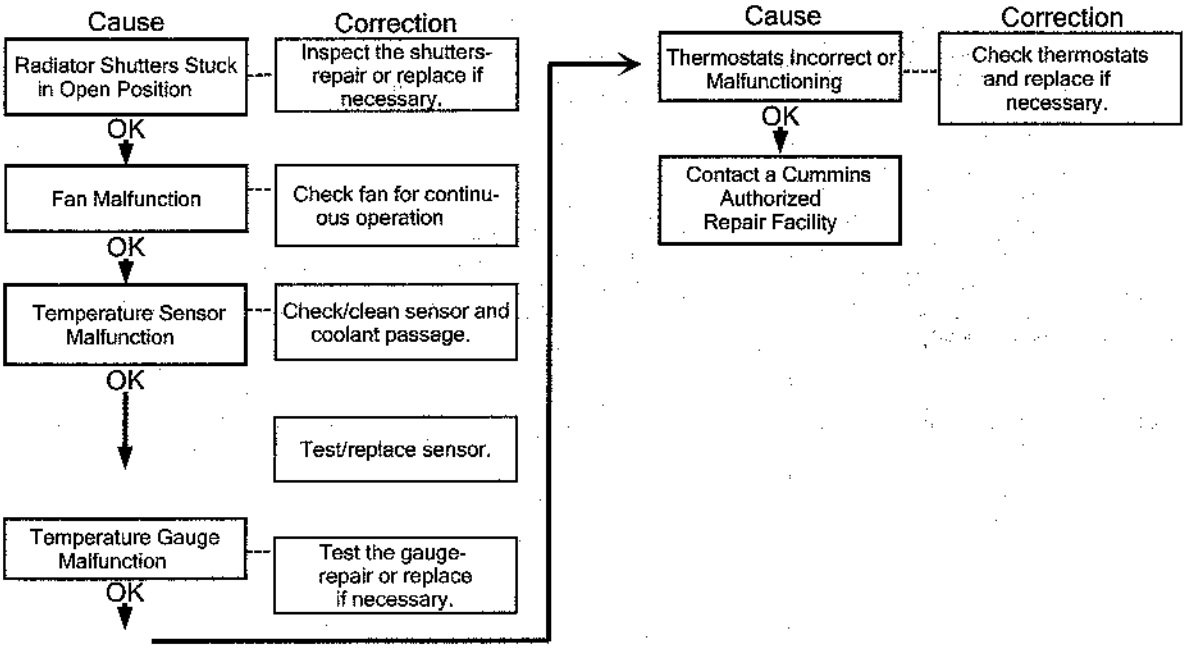
Coolant Temperature Above Normal (Continued)



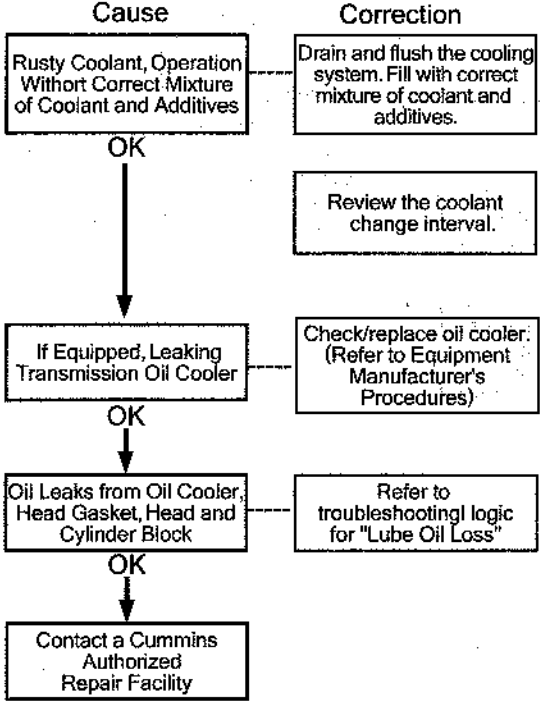
Coolant Loss



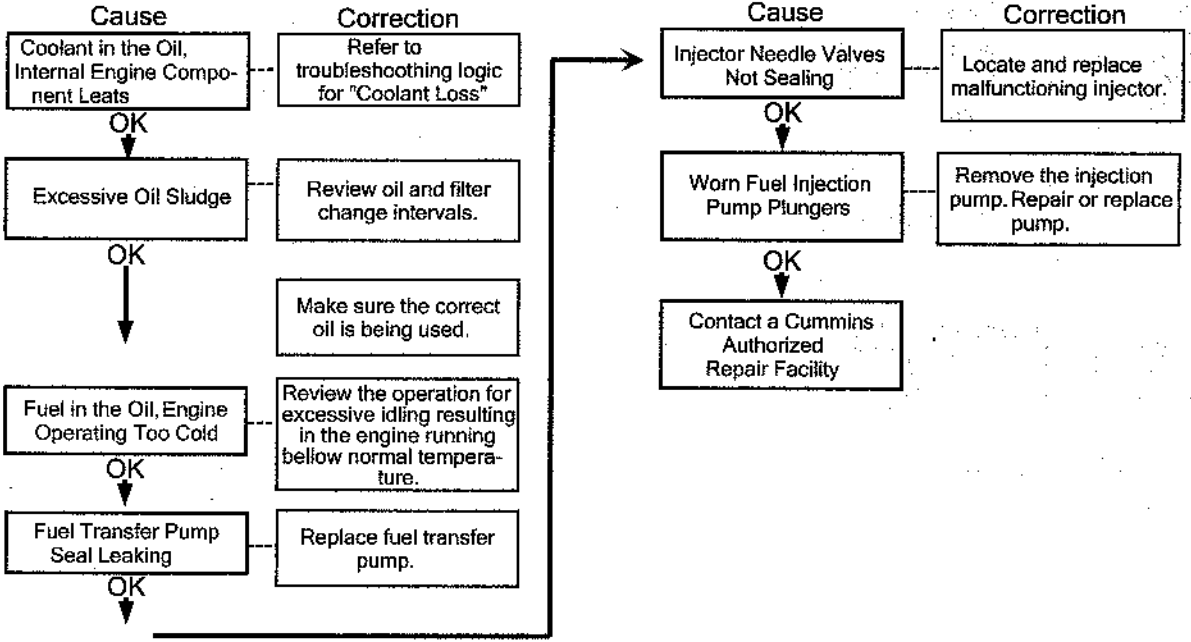
Coolant Temperature Below Normal



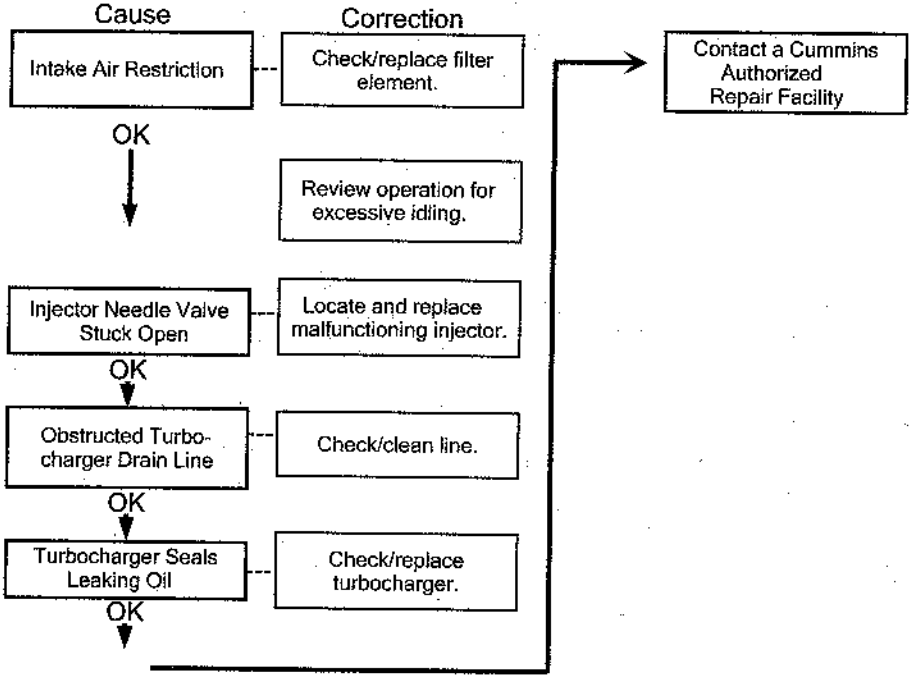
Contaminated Coolant



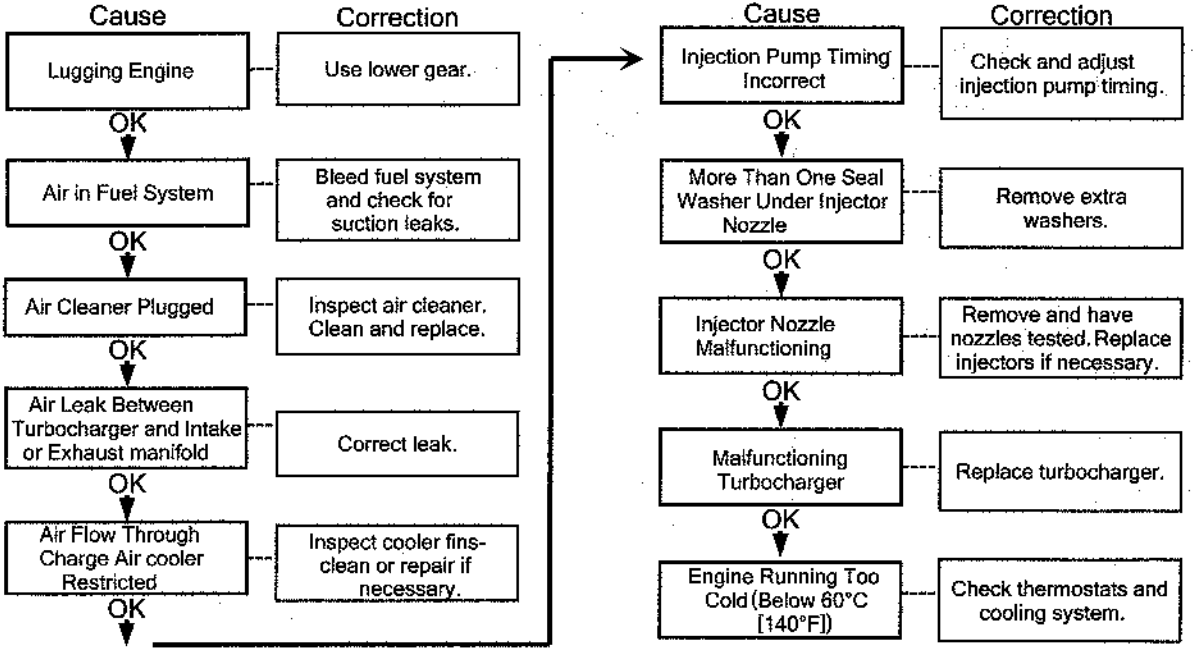
Contaminated Lubricating Oil



Fuel or Oil Leaking from Exhaust Manifold

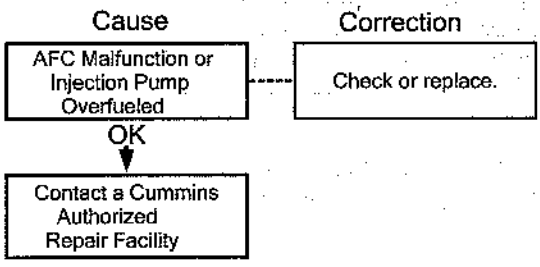


Exhaust Smoke Excessive Under Load

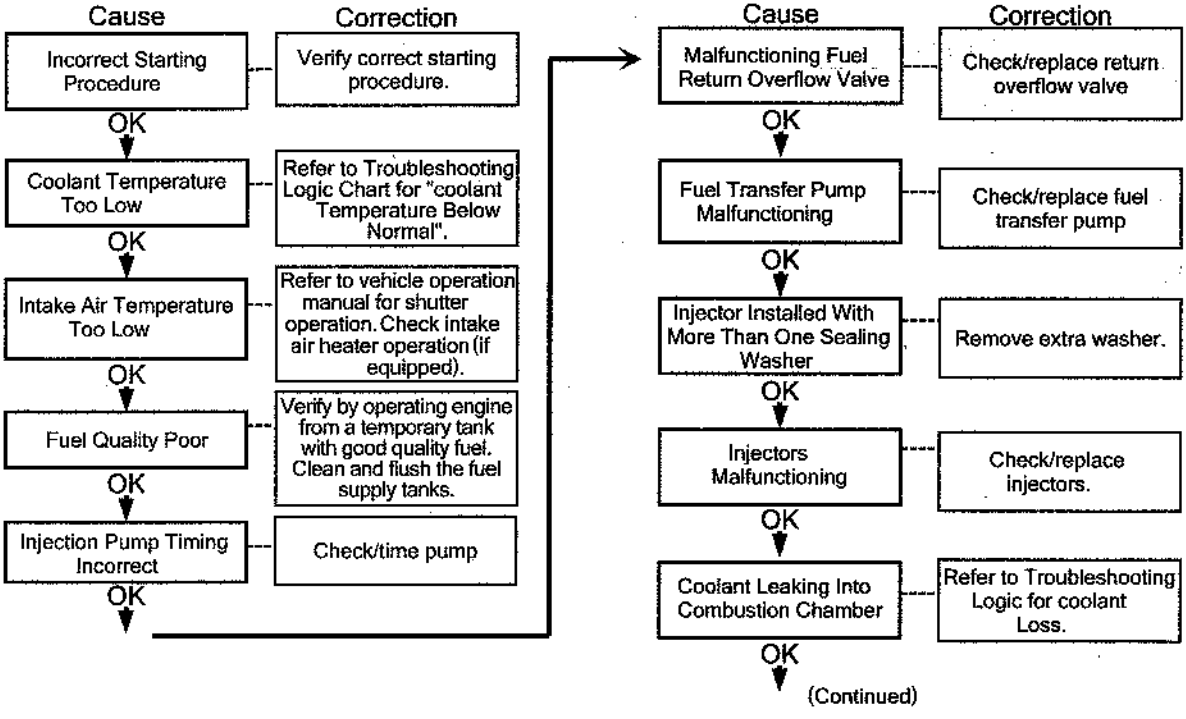


(Continued)

Exhaust Smoke Excessive Under Load (Continued)



Exhaust White Smoke Excessive



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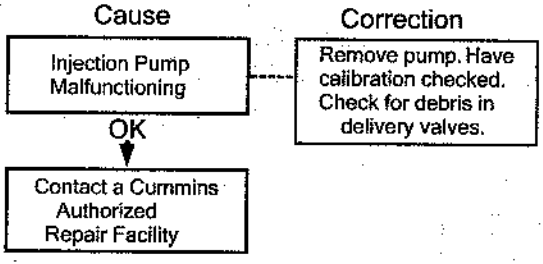
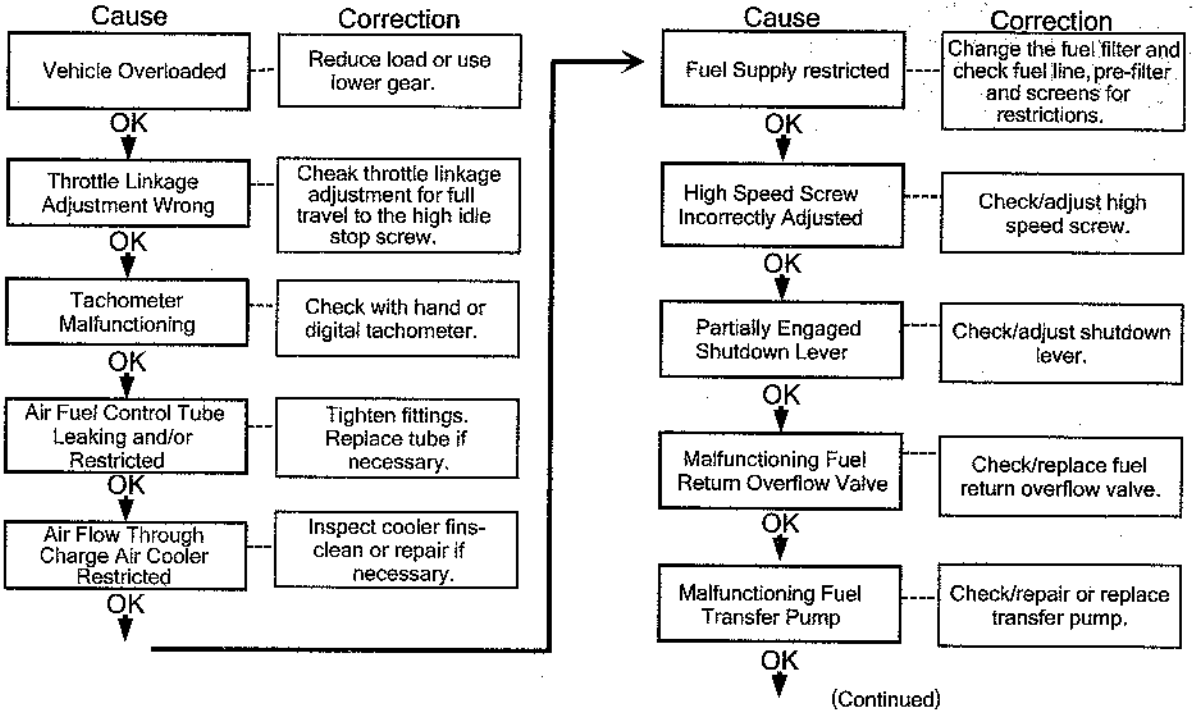
Exhaust White Smoke Excessive (Continued)



Engine Will Not Reach Rated Speed When Loaden



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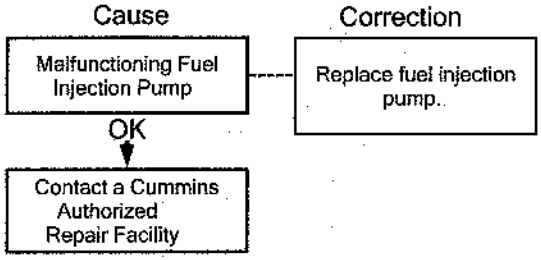
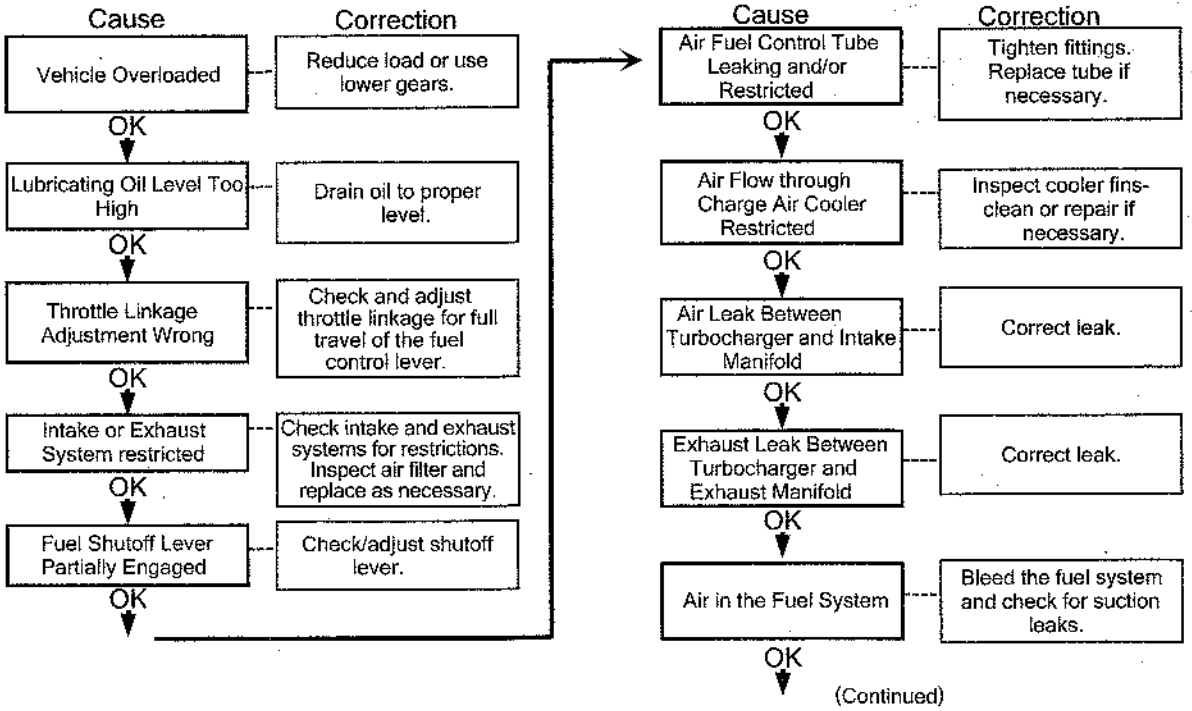
Engine Will Not Reach Rated Speed When Loaden (Continued)



Low Power



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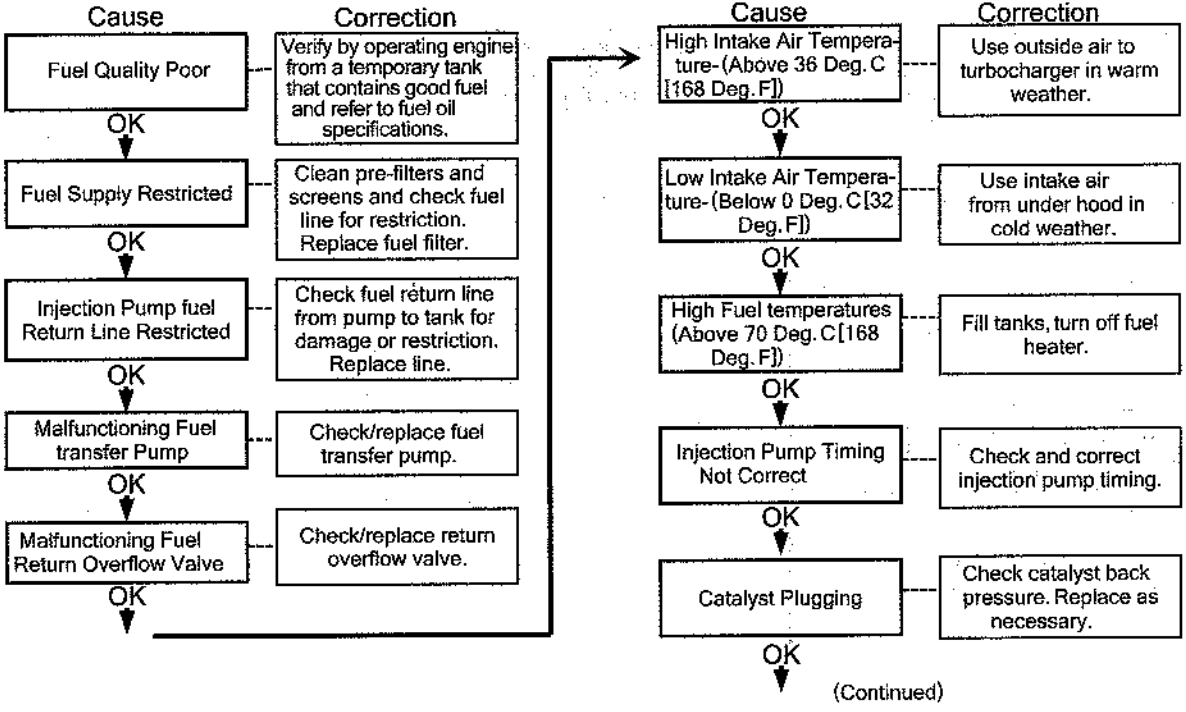
Low Power (Continued)



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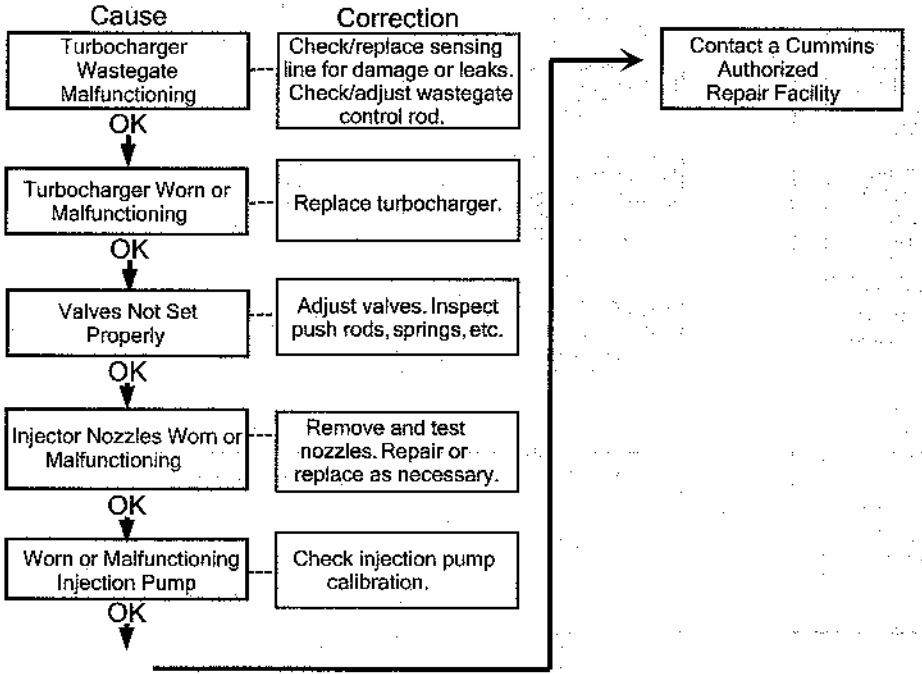
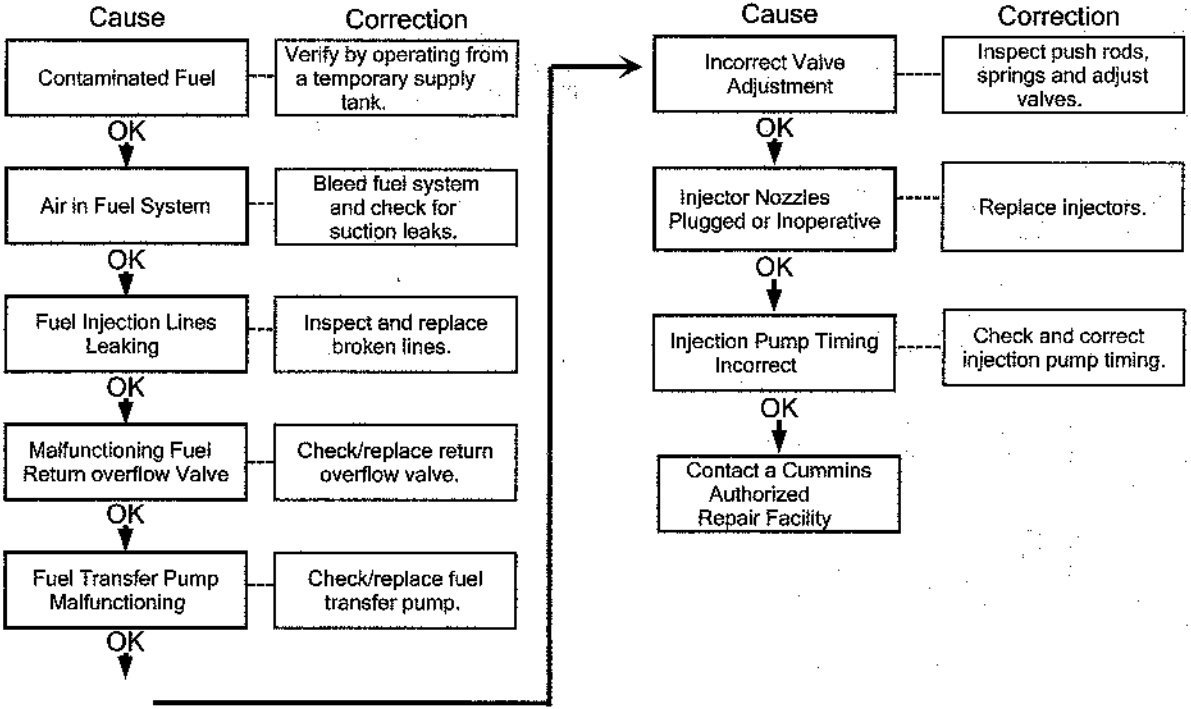
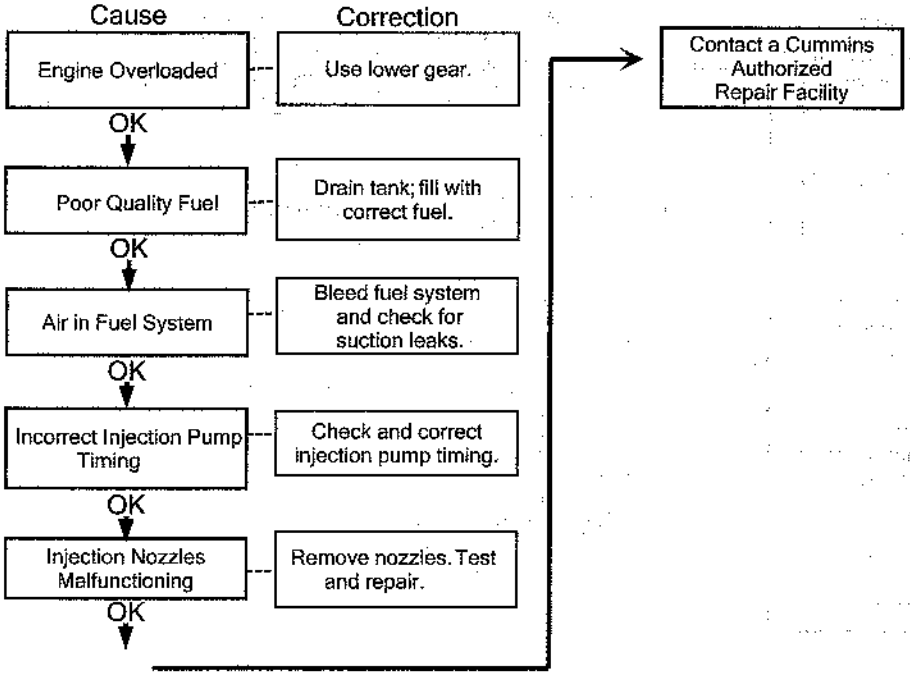
Low Power (Continued)



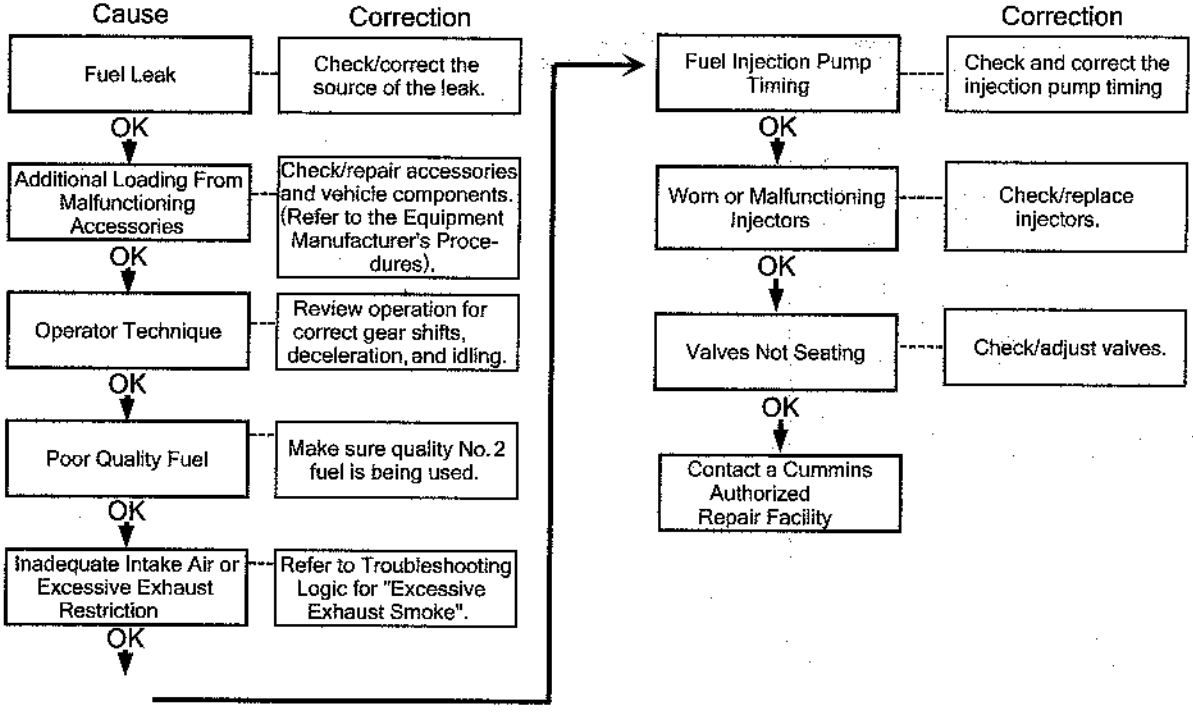
Engine Misfiring



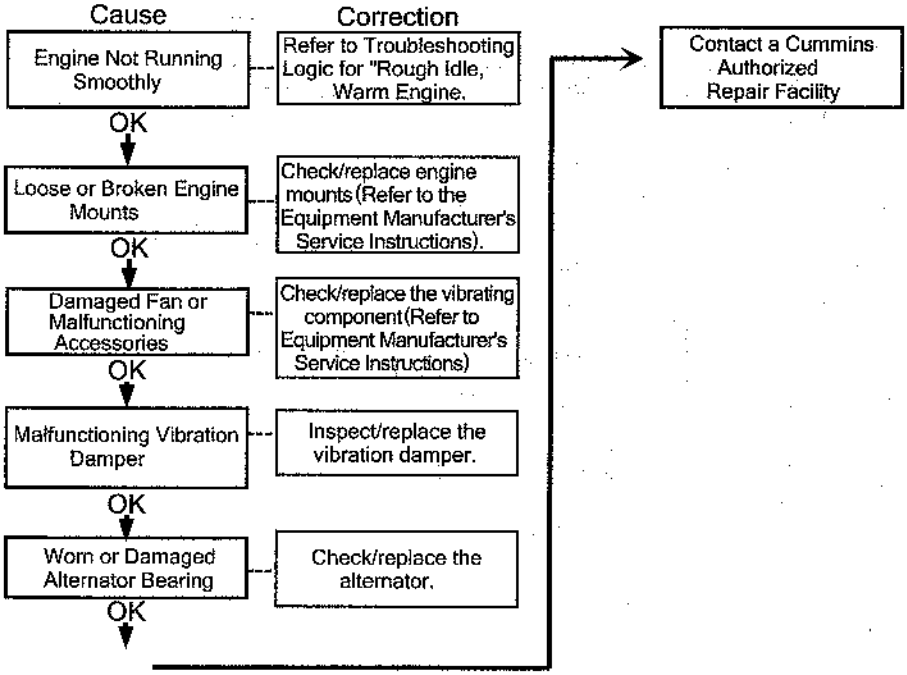
Fuel Knock


Cause
Correction
Engine Overloaded
Use lower gear.
OK
Poor Quality Fuel
Drain tank; fill with correct fuel.
OK
Air in Fuel System
Bleed fuel system and check for suction leaks.
OK
Incorrect Injection Pump Timing
Check and correct injection pump timing.
OK
Injection Nozzles Malfunctioning
Remove nozzles. Test and repair.
OK
Contact a Cummins Authorized Repair Facility

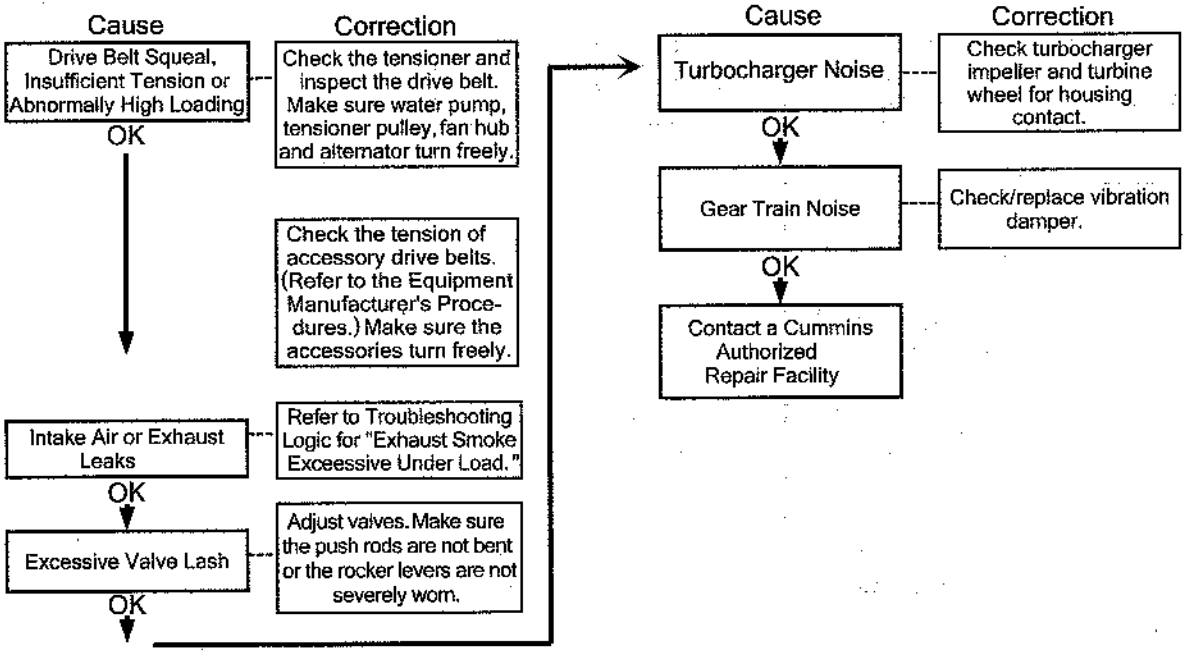
Excessive Fuel Consumption



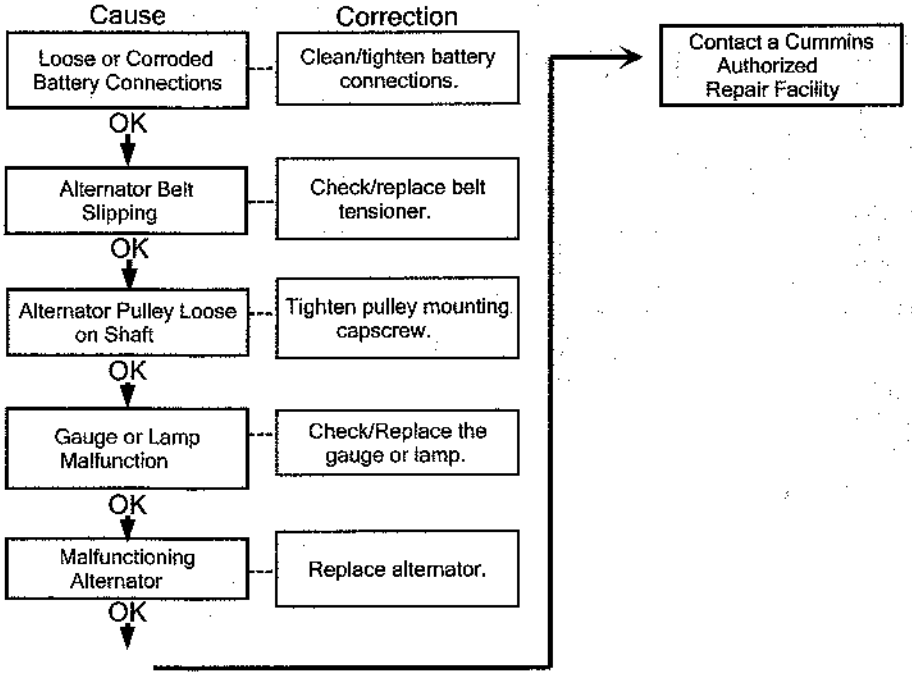
Excessive Vibration



Excessive Engine Noises



Alternator Not Charging or Insufficient Charging



Section A-Adjustment, Replacement and Repair

Section Contents

Repair Procedures

The various repair procedures in this section have been organized by engine system. The summary statement of the steps and the tools needed for the replacement of a component, provided at the beginning of each group, will allow you to quickly assess the size of the task.

Follow the appropriate, illustrated steps to complete the repairs.

Repair Tools Required

Sockets	Wrenches	Other
10mm		
12mm	8mm	Allen Wrench (8mm)
13mm	10mm	Breaker Bar (3/8 in.sq.drive)
15mm	13mm	Flat Screwdriver
17mm	15mm	Ratchet (3/8 in.sq.drive)
18mm	17mm (open end)	Ratchet (1/2 in.sq.drive)
19mm	19mm	Filter Wrenches (75-80mm, 90-95, and 118-131mm)
22mm	22mm	T-Bar Puller (75mm)
27mm	24mm	Torque Wrench
		Pliers
		Engine Barring Gear, Part No. 3377371

Cooling System Repair Summary

Component To Be Replaced	Tools	Preparatory Steps
Drive Belt	Breaker Bar (3/8 inch square drive)	
Belt Tensioner	Ratchet(3/8 inch drive) 15mm Socket and Torque Wrench)	Remove drive belt
FanHub	10mm Socket/Wrench	Remove drive belt and fan pulley
Water Pump	10mm Socket/Wrench	Drain coolant and remove drive belt
Thermostat	10mm 18mm and 19mm Socket/Wrench	Drain coolant, remove drive belt, Loosen alternator link, remove alternator mounting capscrew, remove thermostat housing

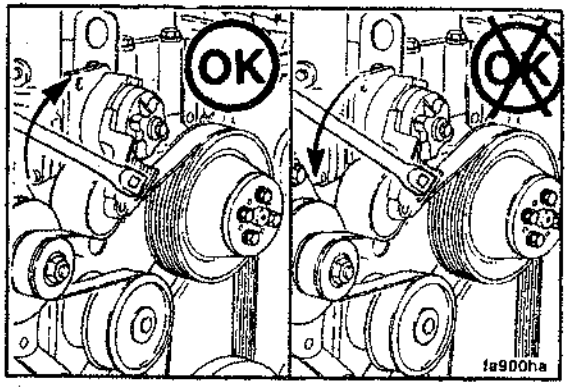
⚠ WARNING ⚠

Avoid prolonged and repeated skin contact with used antifreeze and wash thoroughly after contact. Keep out of reach of children. Such prolonged repeated contact can cause skin disorders or other bodily injury. Wait until the temperature is below 50℃ [120℉] before removing the coolant system pressure cap. Failure to do so can cause personal Injury from heated coolant spray.

Drive Belt

Replacement

3/8 Inch Square Drive



Lift the tensioner arm and pulley to remove and install the belt.

NOTE: The belt tensioner is spring loaded and must be pivoted away from the belt.

Caution: Pivoting in the wrong direction can result in damage to the belt tensioner.

NOTE: After raising the tensioner arm to remove/install the belt, check the torque on the tensioner capscrew.

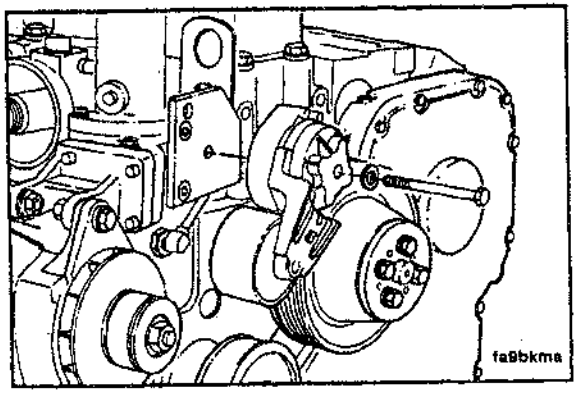
Torque Value: 43N · m [32ft-lb]

Belt Tensioner

Replacement

Preparatory step:

- Remove the drive belt.



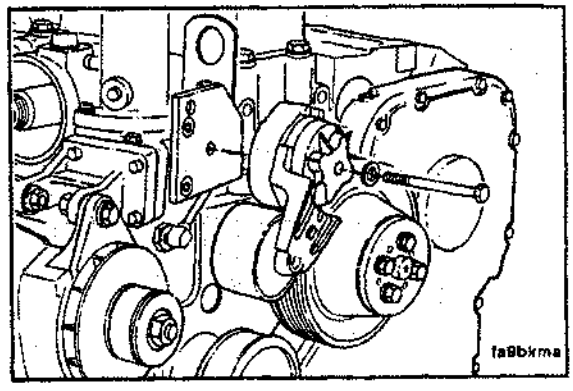
13mm

Remove the belt tensioner from the bracket.

13mm

Install the belt tensioner.

Torque Value: 43N · m [32ft-lb]



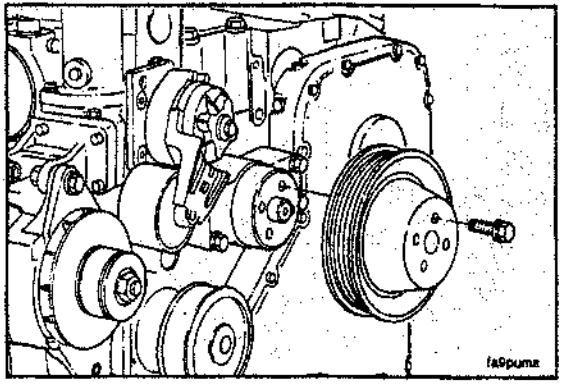
Fan Pulley

Replacement

Preparatory Steps:

- Remove the drive belt.

NOTE: Loosen the capscrews before removing the belt and torque the capscrews after the belt is installed.



13mm

Remove the four capscrews,fan and spacer.Replace the fan pulley.

Torque Value: 43N·m [32ft-lb]

Water Pump

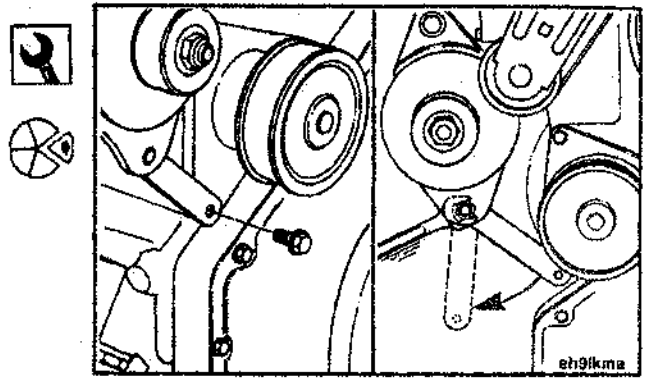
Replacement

Preparatory Steps:

- Drain the coolant.
- Remove the drive belt.

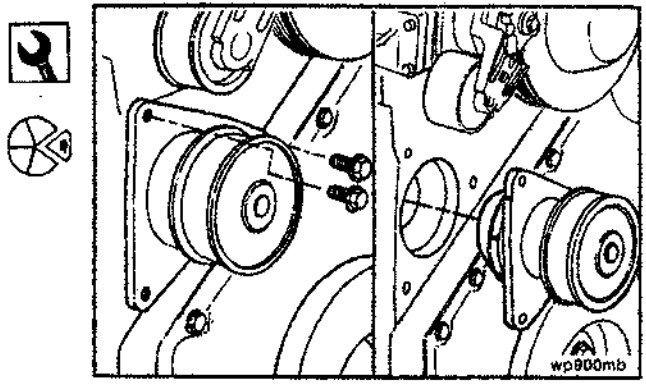
10mm, 19mm

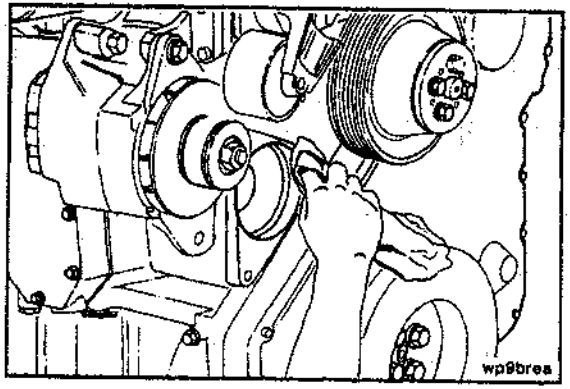
Remove the alternator link.



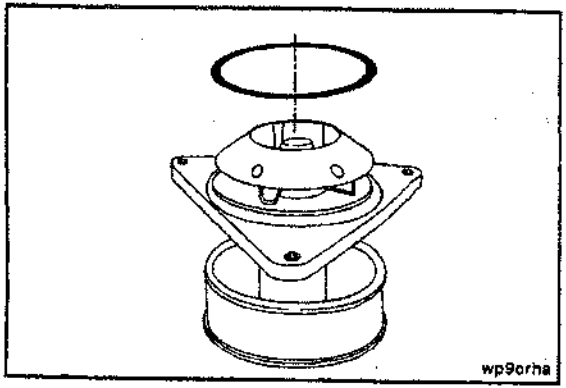
10mm, 19mm

Remove the water pump.





Clean the sealing surface on the cylinder block.



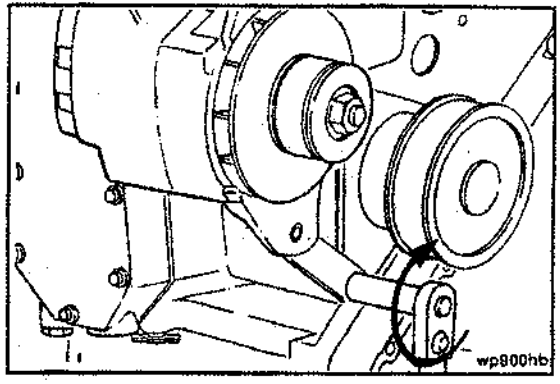
Install a new o-ring into the groove in the wather pump.

10mm, 19mm

Install the water pump and alternator link.

Torque Value:

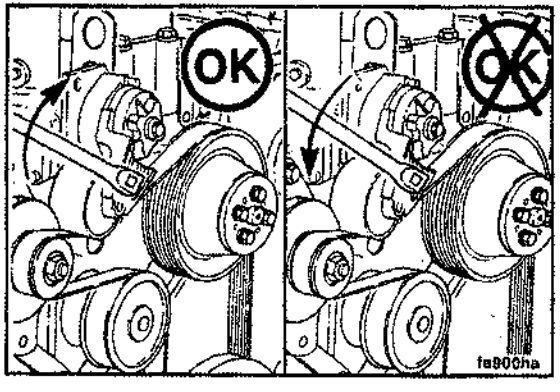
(Water Pump)	24N · m	[18 ft-lb]
(Alternator Link)	43N · m	[32 ft-lb]

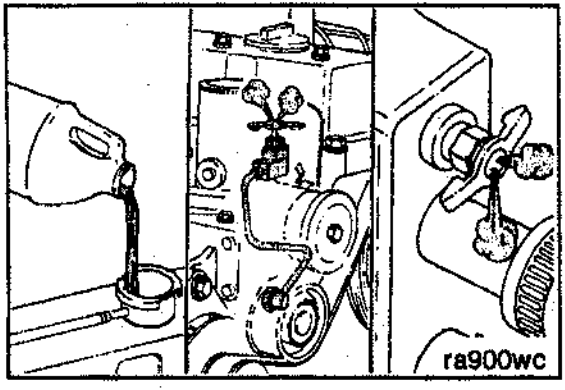


3/8 inch Square Drive

Lift the tensioner arm and pulley to install the drive belt.

NOTE: The belt tensioner is spring loaded and must be pivoted away from the belt. Pivoting in the wrong direction can result in damage to the belt tensioner.



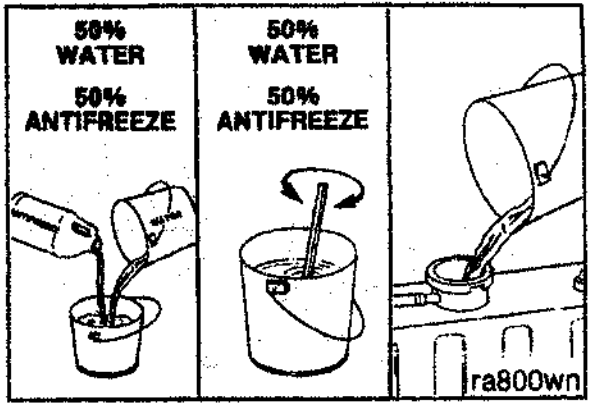


Caution: during filling, air must be vented from the engine coolant passages.Open the engine vent petcock. Also, be sure to open the petcock on the aftercooler for aftercooled engines. The system must be filled slowly to prevent air locks.wait 2 to 3 minutes to allow air to be vented, then add coolant to bring the level to the bottom of the radiator filler neck.

Caution: Never use water alone for coolant. Damage from corrosion can be the result of using water alone for coolant.

NOTE: A50 percent mixture of antifreeze and water must be premixed before filling the system. The ability of antifreeze to remove heat from the engine is not as good as water, so pouring antifreeze into the engine first could contribute to an over heated condition before the liquids are completely mixed.

Close all drain valves and fill the system. Use a mixture of 50percent water and 50 percent ethylene-glycol type antifreeze to provide freeze protection to -36°C [-34°F].

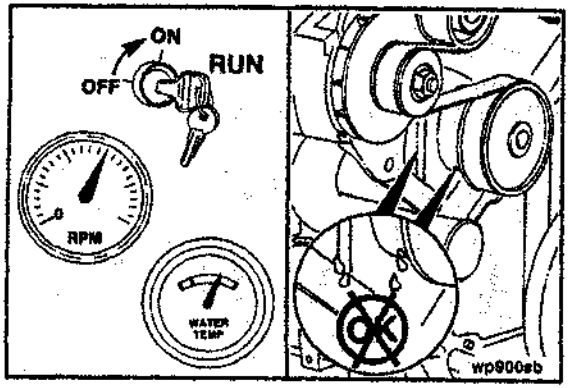


Coolant Capacity (Engine Only)

Liter		U. S. Quarts
10.1	6C8.3	10.5
10.1	6CT8.3*	10.5
12.3	6CTA8.2	13.0

*Same capacity for charge air cooled engines.

Use the amount of DCA4 corrosion inhibitor given in Section V to protect the cooling system.



Install the pressure cap. Operate the engine until it reaches a temperature of 80°C [176°F], and check for coolant leaks.

Coolant Thermostat

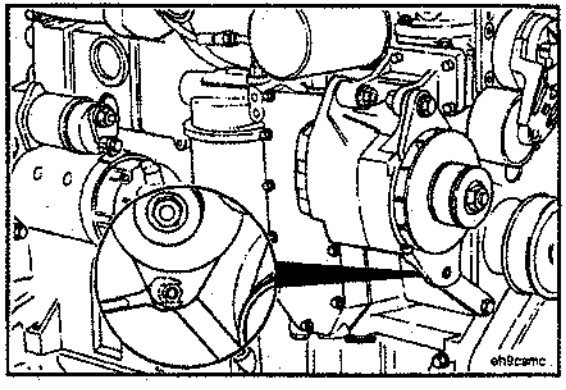
Replacement

Preparatory Step:

- Drain 2 litres (2.1 U.S. Quarts) of coolant.
- Remove the radiator hose from the outlet connection.
- Remove the drive belt.

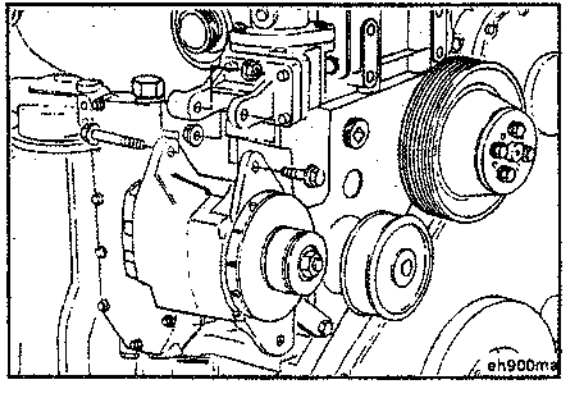
19 mm

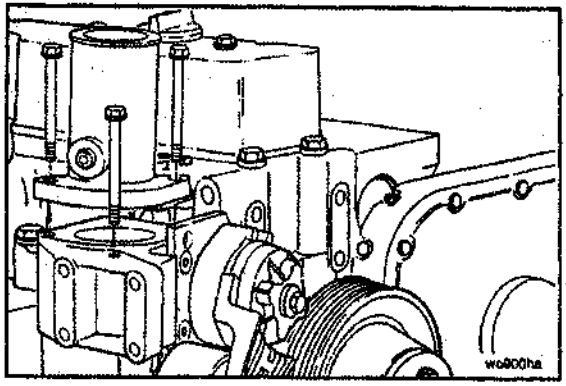
Loosen the alternator link capscrew.



18 mm, 19 mm

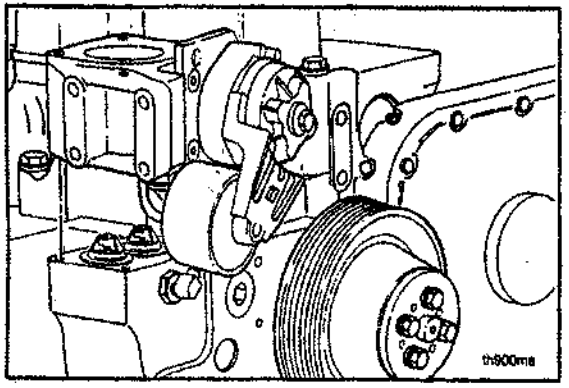
Remove the alternator mounting bolts and nuts. Lower the alternator.





10mm

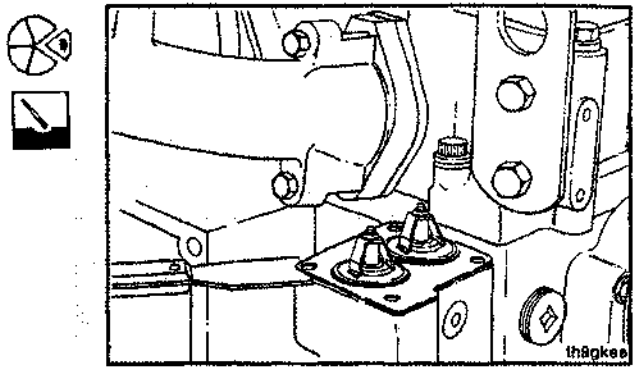
Remove the capscrews from the thermostat housing and water outlet connection.Remove the water outlet connection.



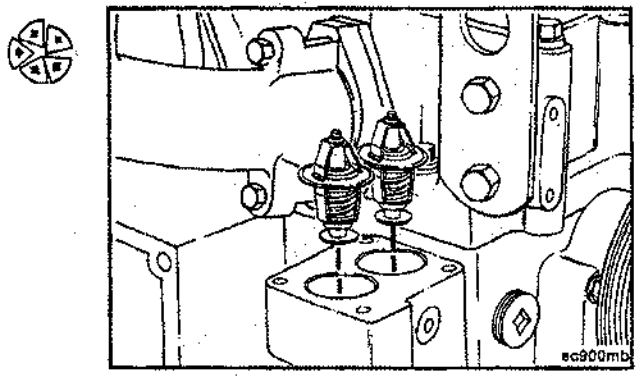
Remove the thermostat housing and belt tensioner assembly.

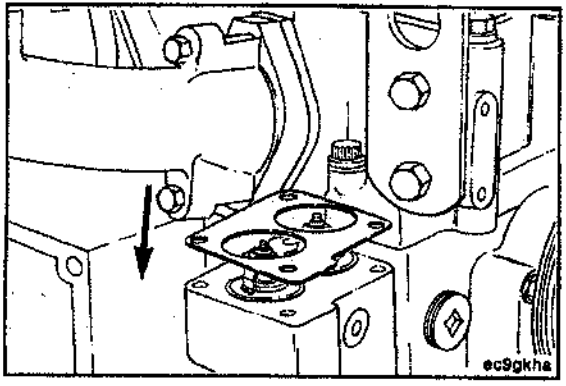
Remove the thermostats and clean the gasket surfaces.

NOTE: Do not let any debris fall into the thermostat cavity when cleaning gasket surfaces.

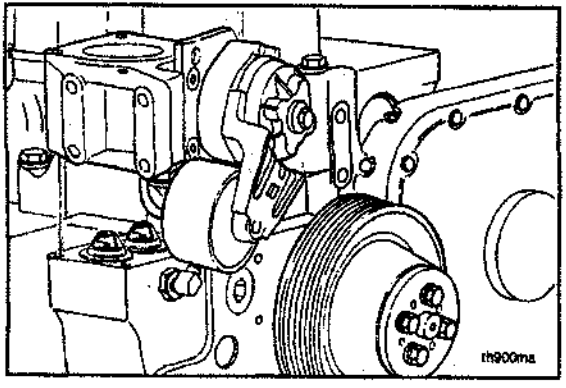


Install the new thermostats.





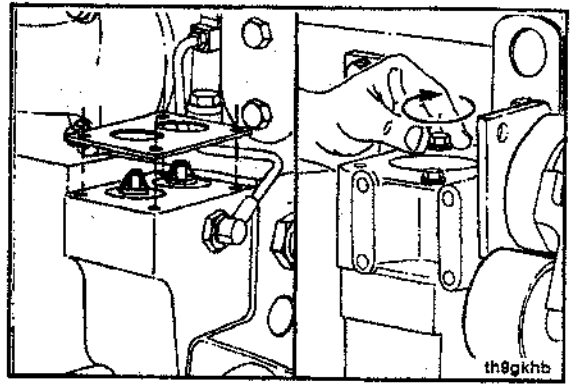
Position a new gasket over the thermostats.



Position the thermostat housing and belt tensioner over the thermostats and gasket.

Make sure the gasket is aligned with the capscrew holes.

Install the capscrews and use fingers to tighten.

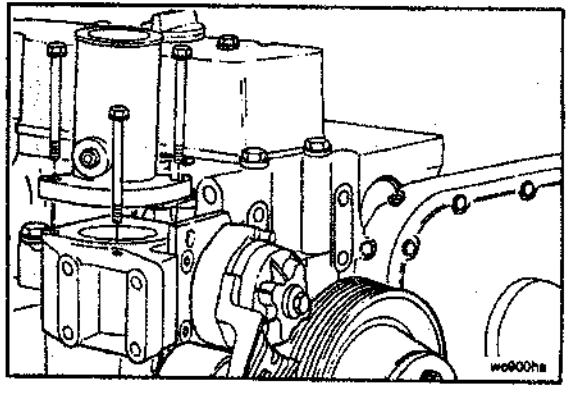


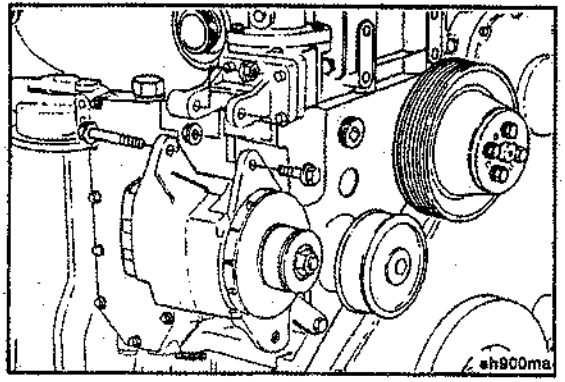
10mm

Install the water outlet connection.

Tighten all capscrews.

Torque Value: 24N·m [18ft-lb]



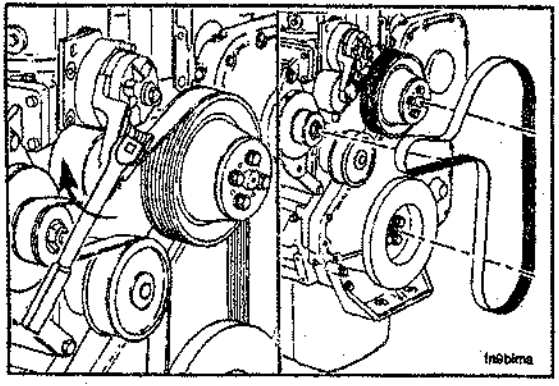


18 mm, 19 mm

Position the alternator and install the mounting bolts and nuts.

Torque Value:

(Alternator Mounting)	77N · m	[57ft-lb]
(Alternator Link)	43N · m	[32ft-lb]



3/8 inch Square Drive

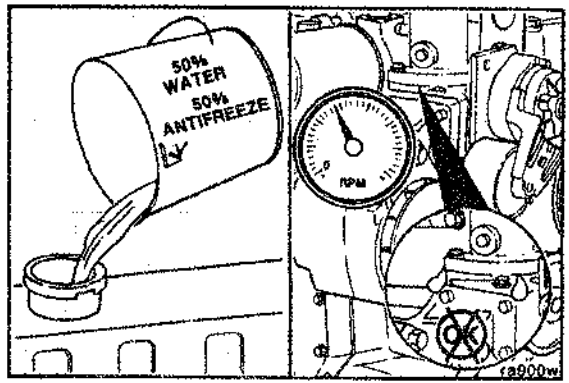
Install the drive belt.

NOTE: After raising the tensioner arm to remove/install the belt, check the torque on the tensioner capscrew.

Torque Value: 43N · m [32ft-lb]

Fill the cooling system and make sure air is vented from system. Operate the engine and check for leaks.

NOTE: Be sure to vent the engine and aftercooler during fill.



Fuel System Repair Summary

Component To Be Replaced	Tools	Preparatory Steps
Fuel Transfer Pump	10,14,17 and 20 mm Wrenches, 10 mm Socket	Clean debris.
High Pressure Lines	17 mm, 19 mm Open End Wrench, 10 mm Socket and a Torque Wrench	Clean debris.
Injector Fuel Drain Manifold	10 mm and 19 Wrenches, 10 mm and 19 mm Sockets, and a torque Wrench	Clean debris.
Injectors	17 mm, 19 mm, 10 mm, 13 mm and a Torque Wrench, 3823276 Injector Puller, Injector Bore cleaning Brush	Disconnect the high pressure lines and fuel drain manifold.
Injection Pump	Ratchet, 22 mm Socket, 27 mm Socket, 30 mm Socket, 75 mm T-Bar Puller (w/28 mm capscrews) 1/2in. open end Wrench 15 mm Socket, 17 mm, 19mm Wrench and a Torque Wrench	Remove high pressure lines, supply line, disconnect fuel return line, AFC air line and external oil line.
Fuel Solenoid	8mm, 10mm Wrench	Label and disconnect wiring.
Fuel Filter Head	24 mm, 75-80 mm and 90-95 mm Filter Wrench	clean debris.

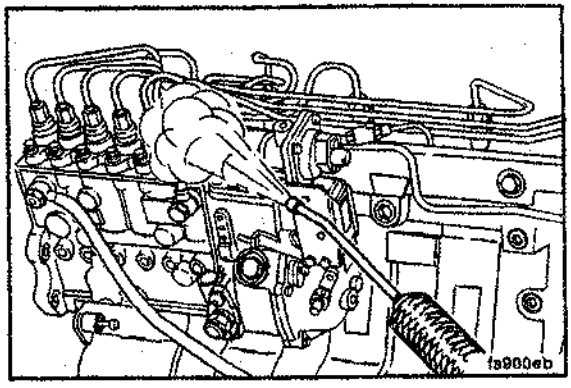
⚠ WARNING ⚠

Do not mix gasoline, alcohol, or gasohol with diesel fuel. This mixture content would be highly flammable and can cause an explosion. Avoid having any ignition source close to fuel mixture.

Fuel System Components

Cleaning

Thoroughly clean all fittings and components before removal. Make sure that the debris, water, steam or cleaning solution does not reach the inside of the fuel system.

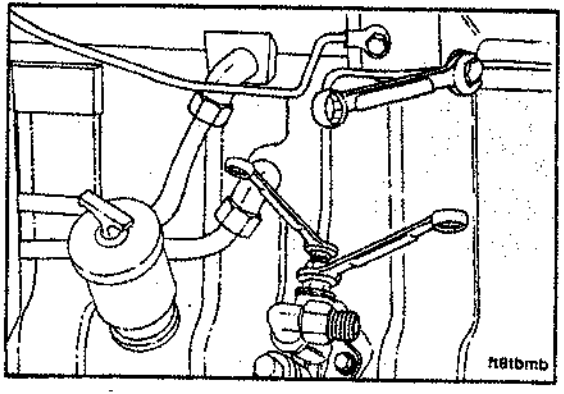


Low Pressure Fuel Line

Replacement

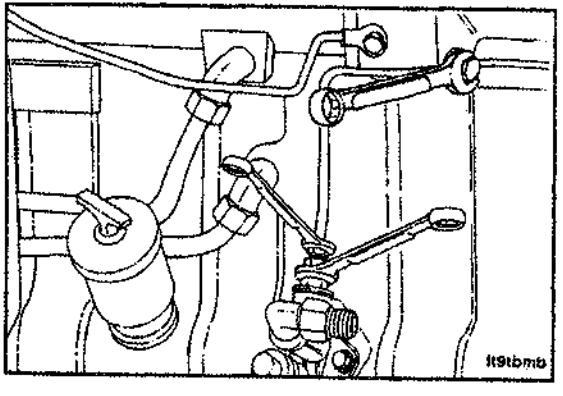
Preparatory Steps:

- Clean debris from fittings.



14 mm, 17 mm, 20 mm

Disconnect the fuel line from the fuel transfer pump and fuel filter head. Use two wrenches to disconnect the line from the fuel transfer pump.



14 mm, 17 mm, 20 mm

Install the fuel line to the fuel transfer pump and fuel filter head.Use two wrenches to tighten the connection to the fuel transfer pump. Do not overtighten. Fuel leak can result from overtightening.

Torque Value: 24N·m [18ft-lb]

Fuel Filter Head Adapter

Replacement

Preparatory Steps:

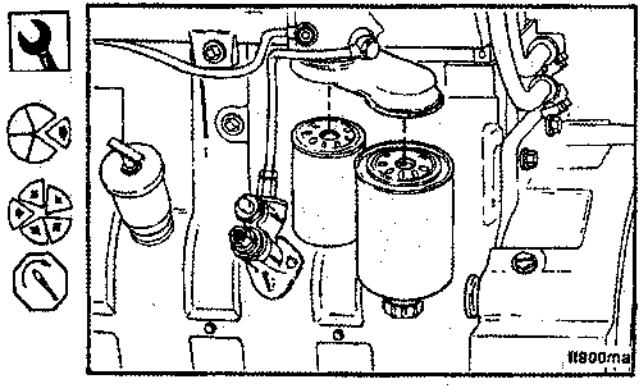
- Clean debris.
- Remove fuel filters

24 mm

Remove the retaining nut, fuel filter head adapter and sealing washers.

Install in the reverse order of removal.

Torque Value: 32N · m [24ft-lb]

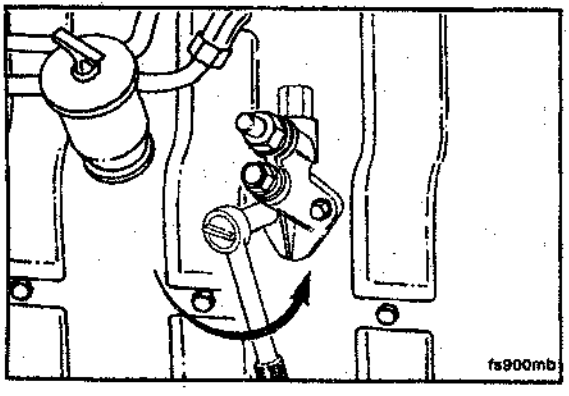


Fuel Transfer pump

Replacement

Preparatory step:

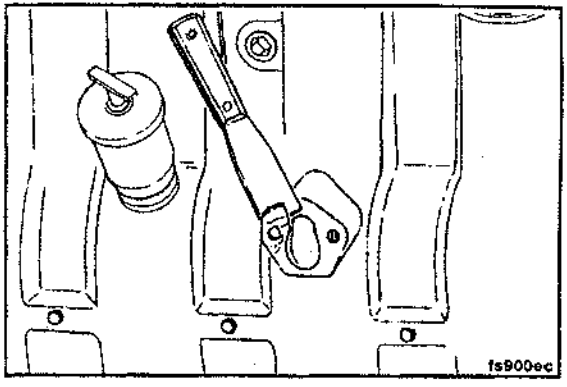
- Clean debris.
- Disconnect the fuel lines. 14 mm, 17 mm, 20mm wrench.



10mm

Remove the fuel transfer pump.

clean the fuel transfer pump mounting surface on the cylinder block.

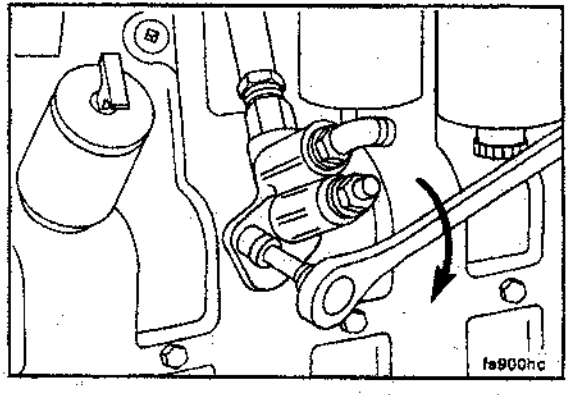


10mm

Install a new gasket and the fuel transfer pump.

Connect the fuel lines.

Torque Value: 24N · m [18ft-lb]

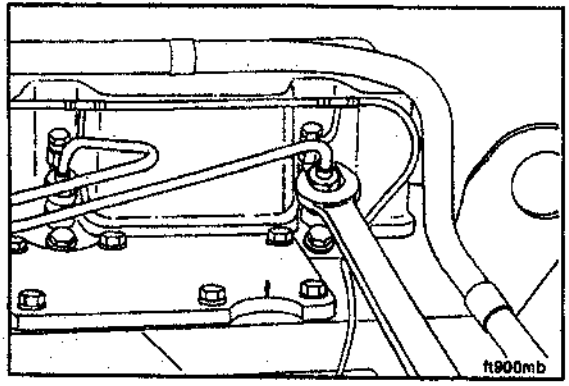


High Pressure Fuel Lines

Replacement

Preparatory step:

- Clean debris.



8 mm, 10 mm, 17 mm and 19 mm

NOTE: If individual high pressure fuel lines are to be replaced, remove the support clamp from the set of lines containing the line to be replaced.

Disconnect the high pressure fuel line (s) from the injectors.Be sure to protect the injector inlet from debris.

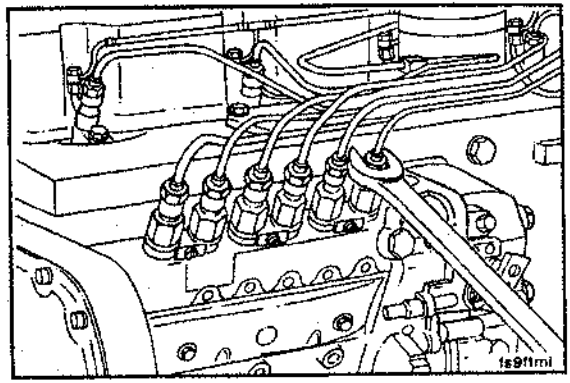
17mm (PES. A, PES. MW) 19 mm (PES. P)

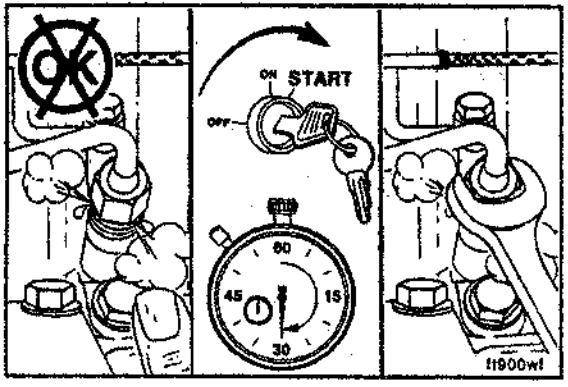
Disconnect the high pressure fuel line (s) from the fuel injection pump. Be sure to protect the delivery valves from debris.

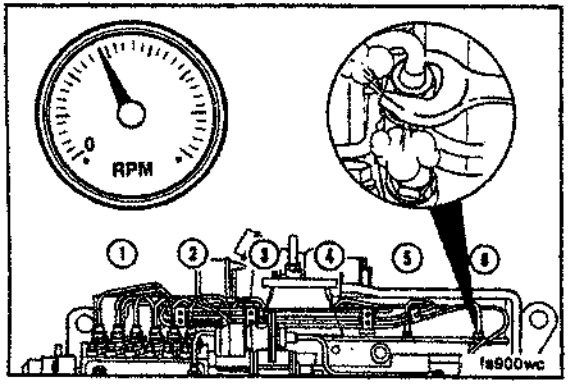
NOTE: reinstall the support clamp in the original position and make sure the high pressure fuel lines do not contact each other or another component. **Do not bend the fuel lines.**

Use your hand to install the high pressure fuel lines and support clamps in the reverse order of removal. Then, tighten the line fittings and clamps.

Torque Value:	(Line Fittings)	24N · m	[18ft-lb]
	(Line Fittings)	30N · m	[22ft-lb]
	(Support Clamp)	6N · m	[53in-lb]







Venting

17mm (PES. A, PES. MW) 19 mm (PES. P)

WARNING:Fuel pressure can penetrate skin and cause severe personal injury-Fuel is toxic, and keep proper distance away from venting lines.

Loosen the high pressure fuel line fittings at the injectors, and crank the engine to allow entrapped air to bleed from the fuel lines. Tighten the high pressure fuel line fittings to the torque value given above.

Start the engine and vent one high pressure fuel line at a time until the engine runs smoothly.

Fuel Drain Manifold

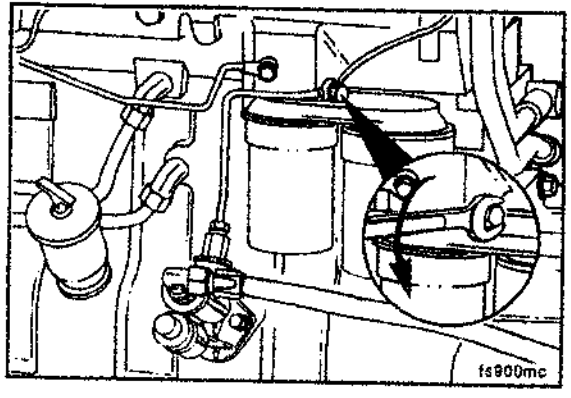
Replacement

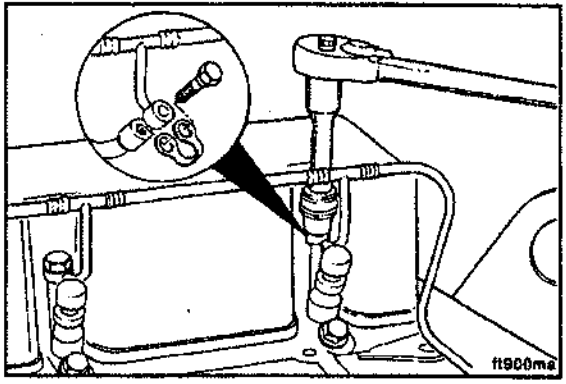
Preparatory Steps:

- Clean debris.

10 mm, 12 mm

Remove the drain line banjo capscrew from the fuel filter head.





10mm

Remove the drain line banjo capscrews from the injectors.

Install the manifold in the reverse order of removal.

Torque Value: 9N·m [80in-lb]

Injectors

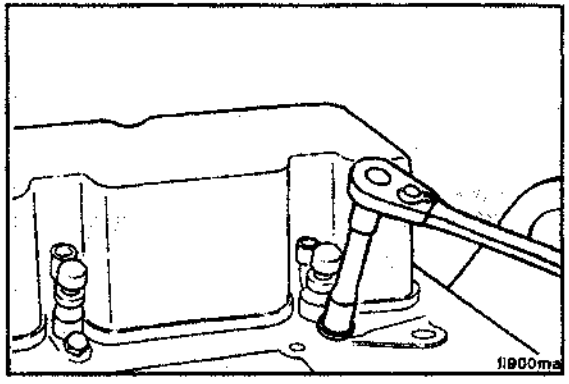
Replacement

Preparatory Step:

- Thoroughly clean around the injectors.
- Disconnect the high pressure fuel lines.
- Disconnect the fuel drain manifold.

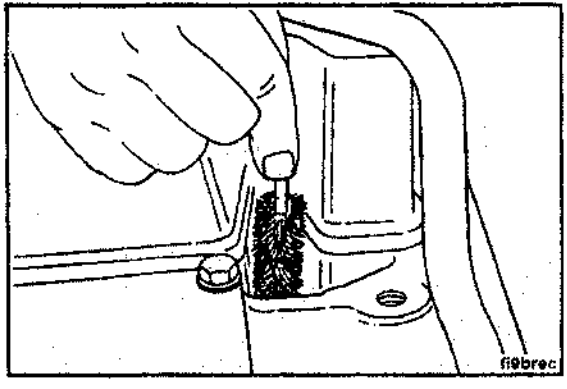
10mm (PES. A, PES. MW), (PES. P), Part No. 3823276 Injectors Puller

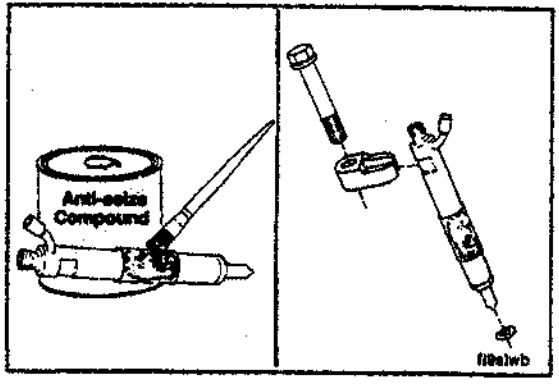
Remove the injectors.



Part No. 3822510, Injector Bore Brush

Clean the injector nozzle bore.

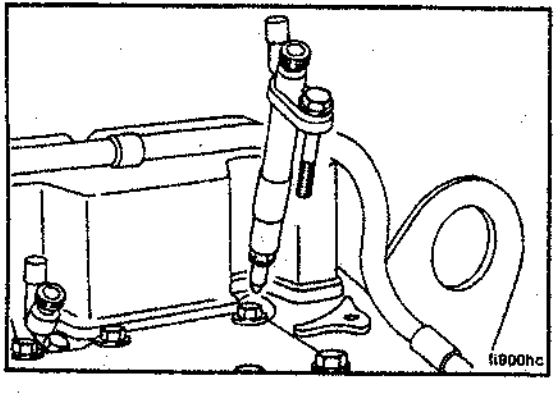




Lubricate the sealing surface of the injector sleeve with an anti-seize compound. Assemble the injector, injector sleeve, a new copper sealing washer and the holddown clamp.

Use only one washer.

Service Tip: A light coat of clean 15W40 engine oil between the washer and injector can help to keep the washer from falling during installation.

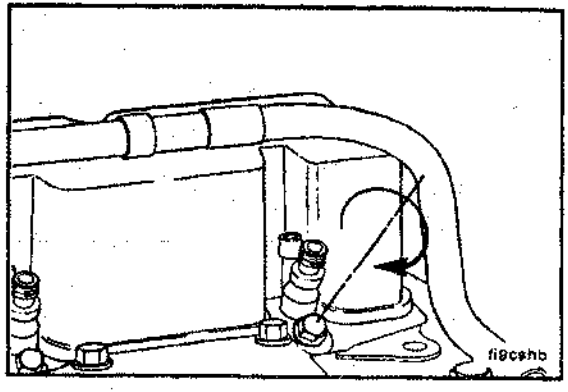


Install the injector,injector sleeve,copper sealing washer and hold down clamp into the injector bore. The injector fuel return connection must be toward the valve cover.

10mm (PES. A, PES. MW), (PES. P)

Install the injector holddown capscrew.

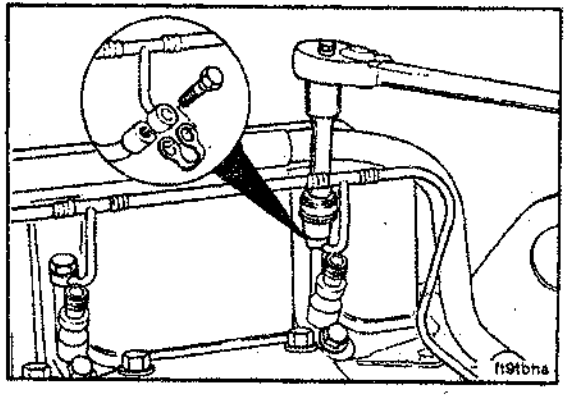
Torque Value: 24N · m [18ft-lb]

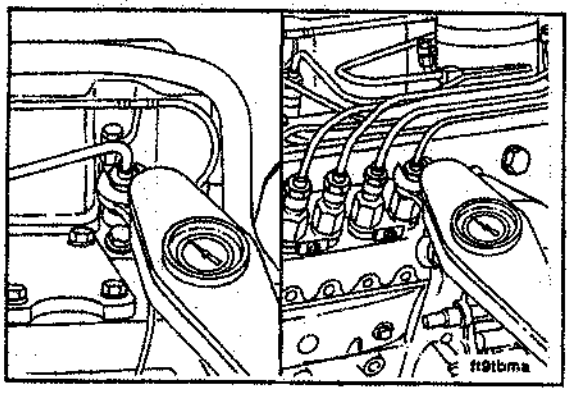


10mm

Install the fuel drain manifold.

Torque Value: 9N · m [80in-lb]





17 mm (PES. A, PES. MW), 19 mm (PES. P)

Install the high pressure fuel lines.

Torque Value:	17 mm	24N·m	[80ft-lb]
	19 mm	30N·m	[22ft-lb]

Fuel Shutoff Solenoid

Replacement

Preparatory Step:

- Label and disconnect the wiring.

RSV Governor fuel Shutoff Solenoid

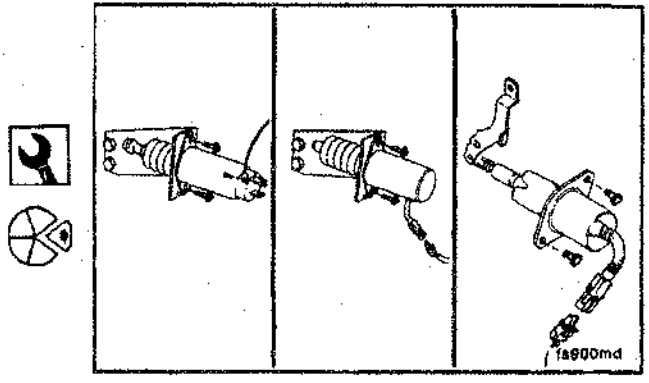
Removing

Cylinder Block Mounted

10mm

Remove the two mounting capscrews and remove the solenoid from the bracket.

1. Synchro-start
2. Trombetta
3. Direct Link



Installing

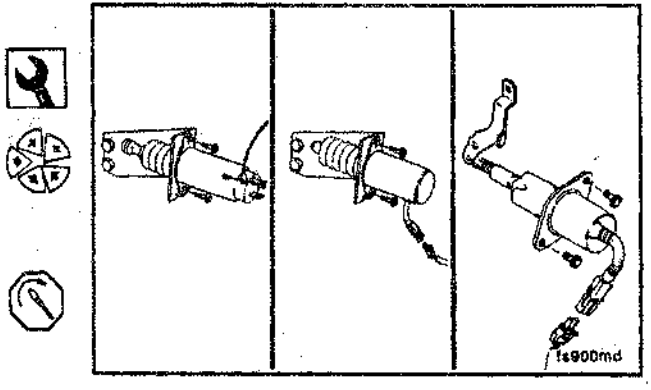
10mm

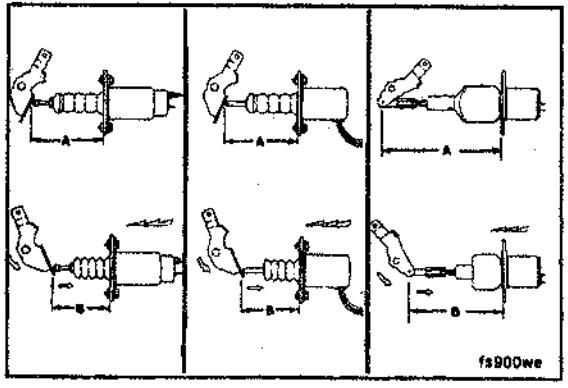
NOTE: Make sure the acorn nut is tightened to be snug on the fuel shutoff solenoid shaft (Synchro-start only).

Install the new fuel shutoff solenoid to the bracket and connect the wires. Make sure the wiring harness on the trombetta solenoid is installed in the 6: 00 o'clock position.

Torque Value: 10N · m [84 in-lb]

1. Synchro-start
2. Trombetta
3. Direct Link



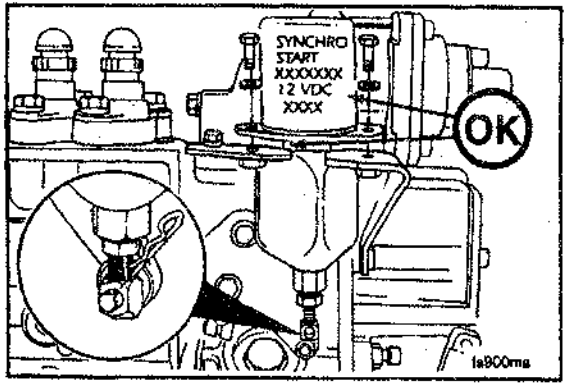


Activate the switch and check the plunger travel.

1. Synchro-start	2. Trombetta
A=86.6 mm [3.4 in]	A=91.4 mm [3.6 in]
B=60.2 mm [2.4 in]	B=63.5 mm [2.5 in]

3. direct Link
B=117.1 mm [4.61 in]

The plunger must be retracted when the fuel shutoff solenoid is activated to the RUN position"B". The fuel shutoff solenoid must operate without binding.



RQVK Governor Fuel Shutoff Solenoid

Removing and Installing

8 mm

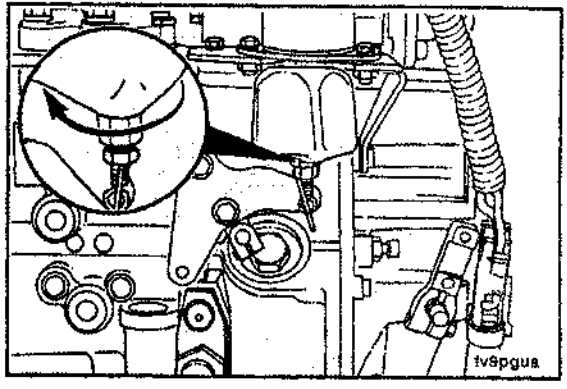
Remove the hitch pin clip, the mounting capscrews and the fuel shutoff solenoid.

Install the new solenoid in reverse order of removal and connect the wires.

Torque Value: 10N·m [84 in-lb]

10 mm, 16 mm

Adjust the solenoid linkage as necessary so that the plunger is magnetically held in with the shutoff lever in the absolute full run position. Turn the large hex nut on the end of the plunger to make adjustments and secure in place with lock nut.

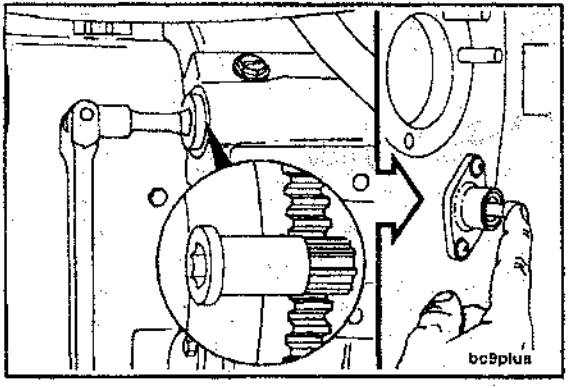


Fuel Injection Pump

Replacement

Preparatory Steps:

- Clean debris.
- Remove all fuel lines.
- Remove control linkage.
- Remove fuel shutoff solenoid.
- Remove the AFC air line.
- Remove the governor oil line.



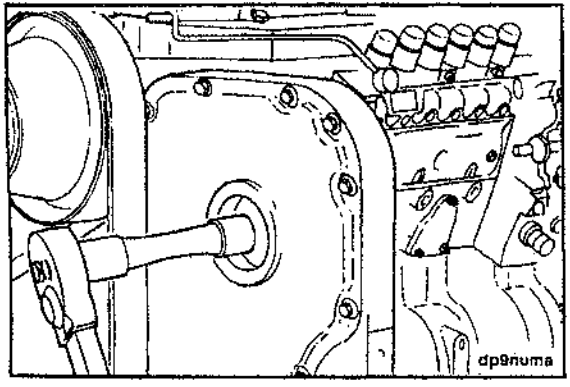
Removing

Part No. 3824591 Engine Barring Gear

Locate TDC for cylinder number 1. Push the timing pin into the hole in the camshaft gear while slowly rotating the crankshaft.

The barring gear inserts into the flywheel housing and engages the flywheel ring gear. The engine can then be rotated by hand using a 1/2 inch ratchet or breaker bar.

Caution: be sure to disengage the timing pin after locating TDC to prevent damage to the timing pin.



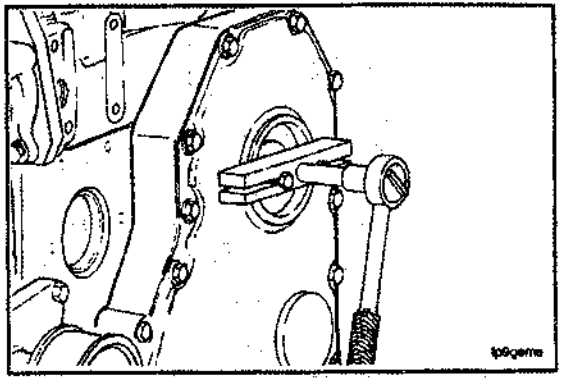
22 mm (PES. A Pump), 27 mm (PES. MW Pump), 30 mm (PES. P Pump)

Remove the gear cover access cap.

Remove the nut and washer from the fuel injection pump shaft.

75 mm T-Bar Puller

Pull the fuel injection pump drive gear loose from the shaft.

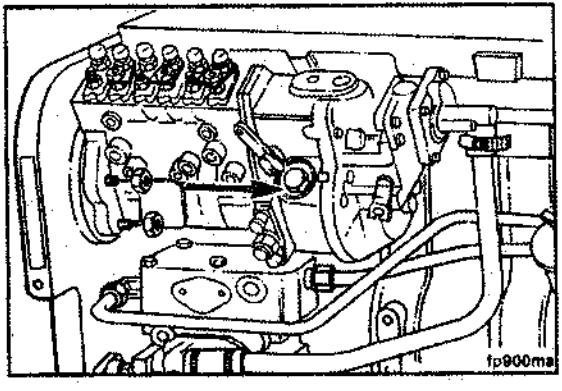


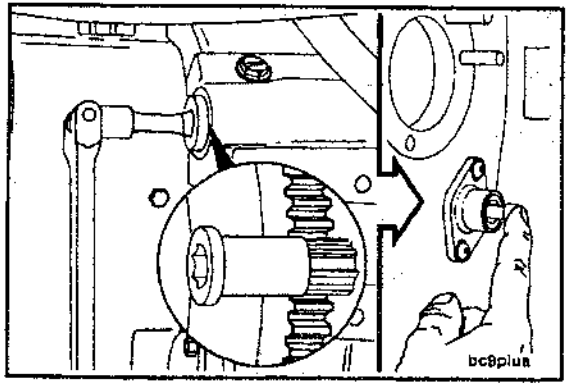
10 mm, 15 mm

Remove the four mounting nuts and the capscrews that fasten the fuel injection pump support to the cylinder block.

Remove the rear support bracket for the PES6P fuel injection pump.

Remove the fuel injection pump.

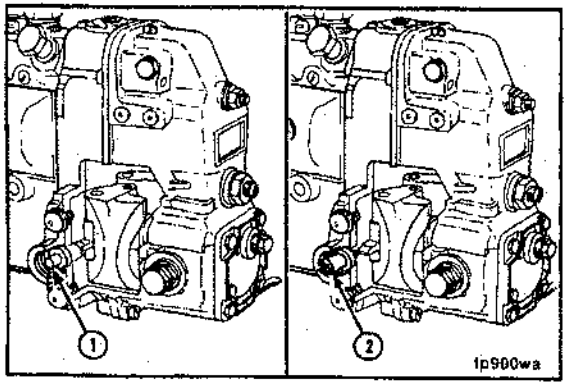




Installing

Part No. 3377371 Engine Barring Gear

Make sure the engine has cylinder number 1 at TDC.



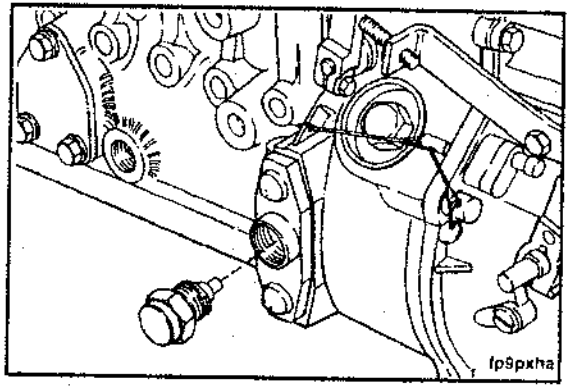
Fuel Injection Pump-Timing

The fuel injection pump also has a timing pin (1), located in the governor housing, to position the fuel injection pump shaft to correspond with TDC for cylinder number 1. After the fuel injection pump is installed, the timing pin is to be reversed and stored in the housing (2).

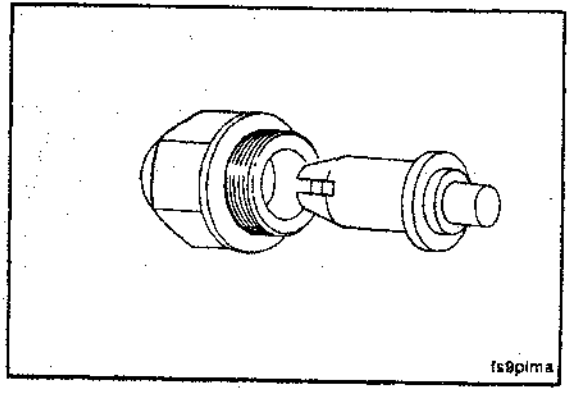
NOTE: The industrial governor is shown in the illustration. The procedure is the same for automotive governors.

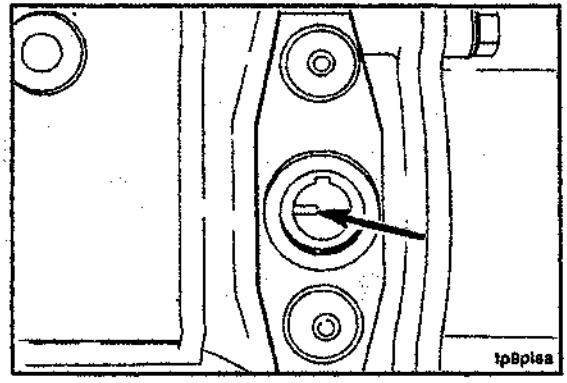
24 mm

Remove the timing pin access plug.

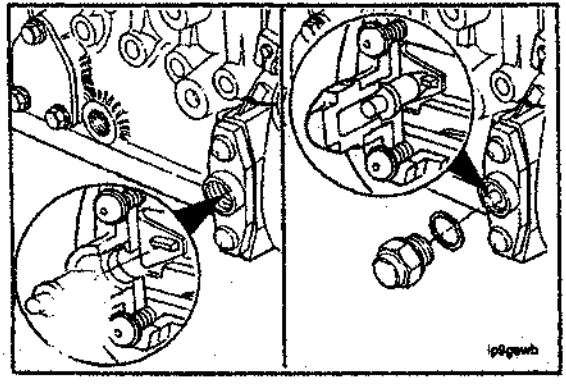


Remove the timing pin.





If the timing tooth is not aligned with the timing pin hole, rotate the pump shaft until the timing tooth aligns.



Reverse the position of the timing pin so the slot of the timing pin will fit over the timing tooth in the fuel injection pump.

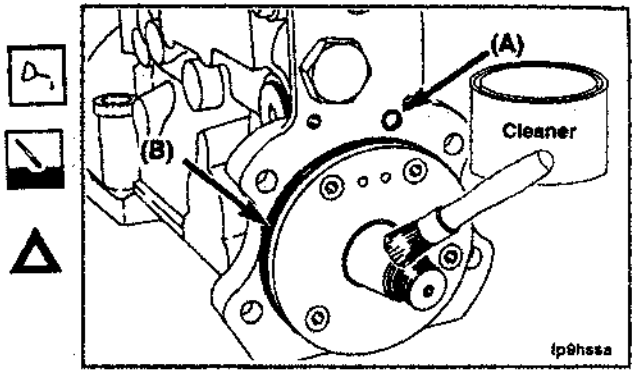
Install and secure the timing pin with the access plug.

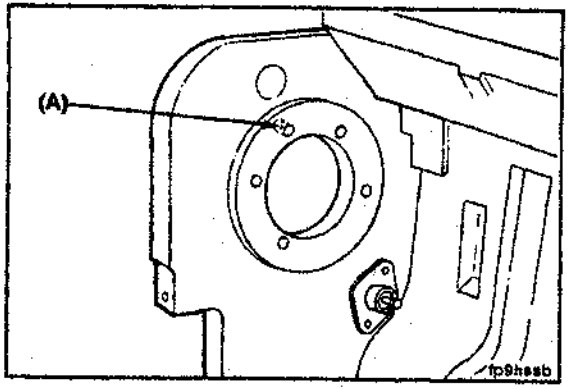
Make sure the o-ring seals for the fill orifice (A) and pilot (B) are correctly installed on the fuel injection pump and are not damaged.

Lubricate the mounting flange with clean 15W-40 engine lubricating oil.

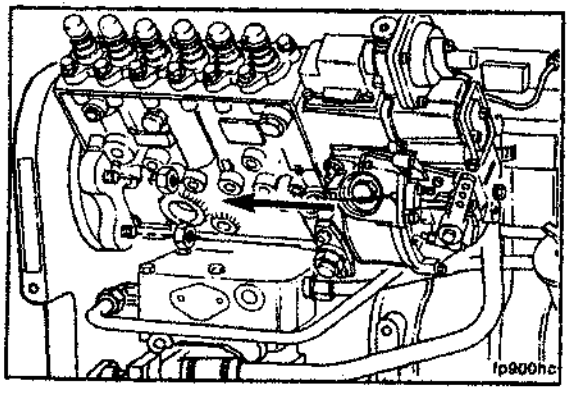
If the pilot o-ring (B) has a colored stripe, it cannot be reused. When installing a new striped o-ring, lubricate only the gear housing bore, not the o-ring.

Caution: The fuel pump drive gear inside diameter and the shaft outside diameter must be clean and dry before installing the pump. A non petrolium based cleaner should be used to clean the drive gear and shaft mounting surfaces. Failure to do so will result in gear slippage in the retarded direction.



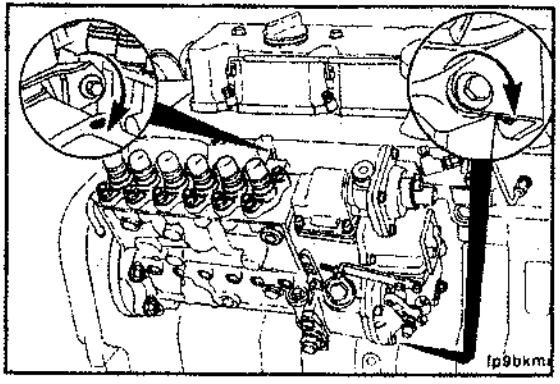


NOTE: The oil feed o-ring (A) for PES. P fuel injection pump will be located in the gear housing.



Slide the pump shaft through the drive gear and position the pump flange onto the mounting studs. Use your fingers to tighten the mounting nuts.

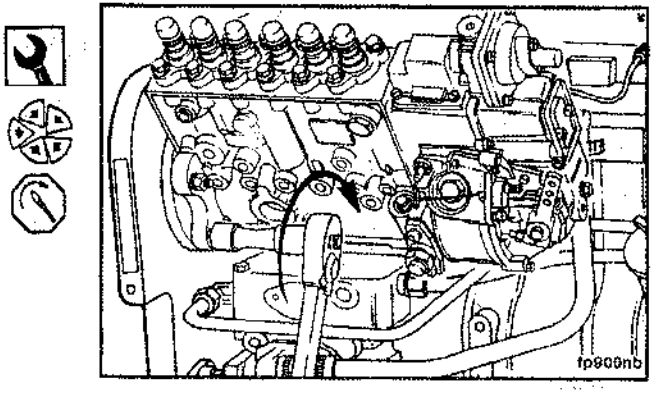
Use your fingers to tighten the capscrews for the support bracket.

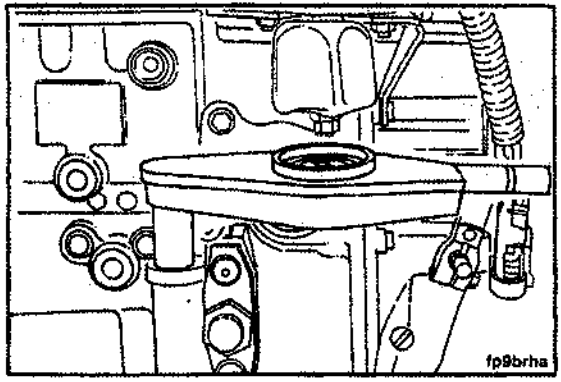


15 mm

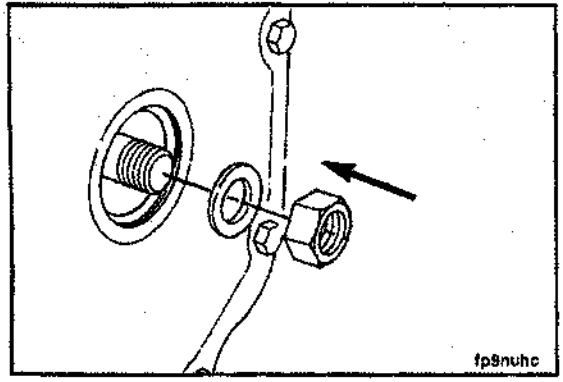
Tighten the mounting nuts.

Torque Value: 43N · m [32ft-lb]



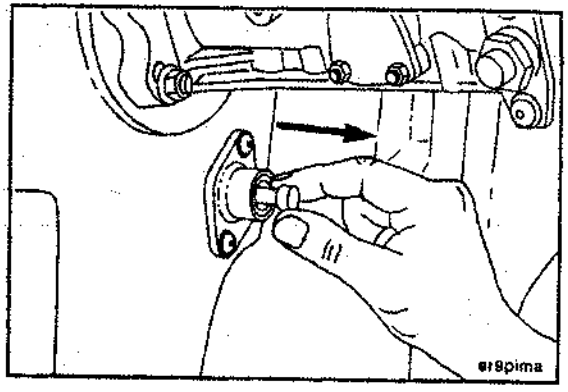


10 mm (PES6P Fuel Injection Pump)
Tighten the capscrews for the rear support bracket.
Torque Value: 24N·m [18ft-lb]



22 mm (PES. A Pump), 27 mm (PES. MW Pump), 30 mm (PES P Pump)
Install the fuel injection pump retaining nut and washer.
Initial Torque Value: 10-15N·m [7-11ft-lb]
NOTE: Do not exceed the torque value given. This is not the final torque value for the retaining nut.

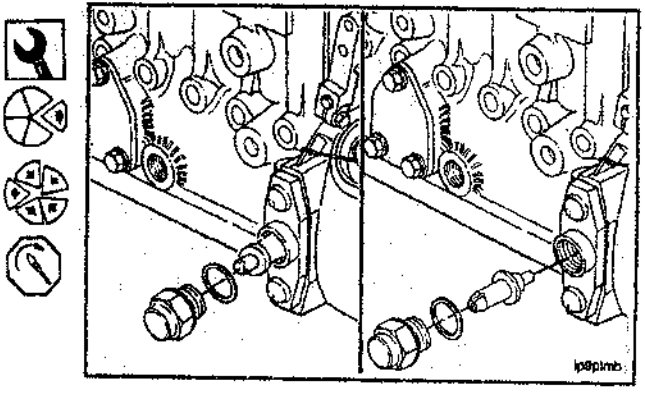
Disengage the engine timing pin.

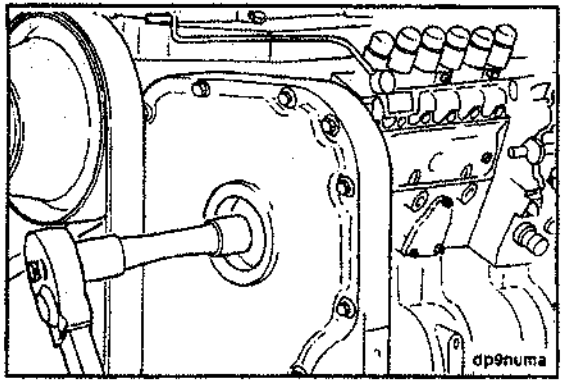


24 mm

Remove the pump timing pin plug. Reverse the position of the timing pin and install the pin, plug, and sealing washer.

Torque Value: 15N · m [11ft-lb]





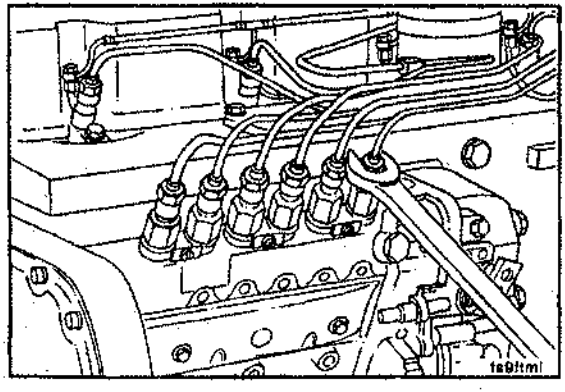
22 mm, 27 mm or 30 mm

Tighten the fuel pump drive nut.

Torque Value:

PES. A Pump, 95N·m [52 ft-lb]
PES. MW Pump, 105N·m [77 ft-lb]
PES. P Pump, 178N·m [144 ft-lb]

Install the gear cover access cap hand tight.



17 mm (PES. A , PES. MW), 19 mm (PES. P)

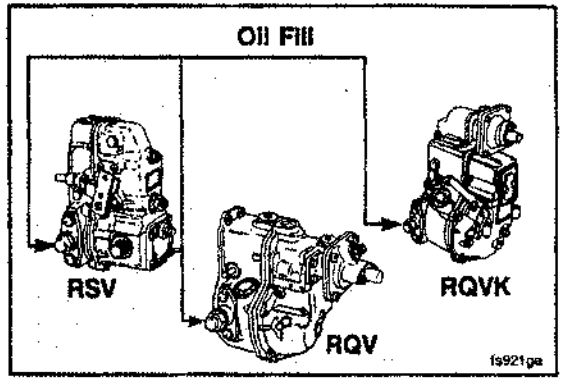
Install the high pressure lines to the fuel pump.
Install the fuel supply and fuel return lines.
NOTE: If removed , reinstall the support clamp in the original position and make sure the high pressure lines do not contact each other or another component.

Torque Value:

(Line Fittings)	30N·m [22 ft-lb]
(Support clamp)	6N·m [48 in-lb]
(Fuel Supply and Fuel Return Banjo)	24N·m [18 ft-lb]

Caution: If a replacement or repaired pump was inst alled, be sure to fill the governor housing with clean 15 W 40 engine lubricating oil before starting the engine. Failure to do so will result in damage to the fuel pump camshaft and governor fly weights.

Governor Housing Oil Capacity		
ml		**fl.oz.**
450	RSV	15.2
750	RQV, RQVK	25.4
500	RSV-H	16.9



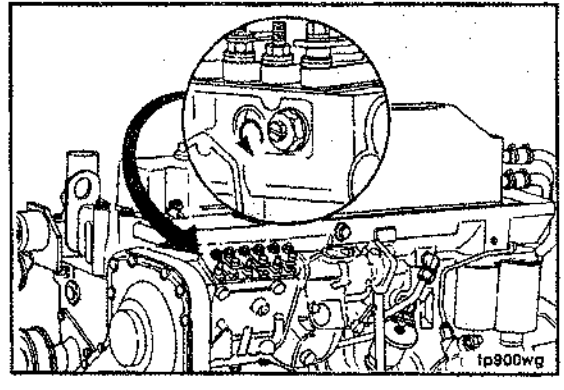
Fuel Injection Pump-Venting

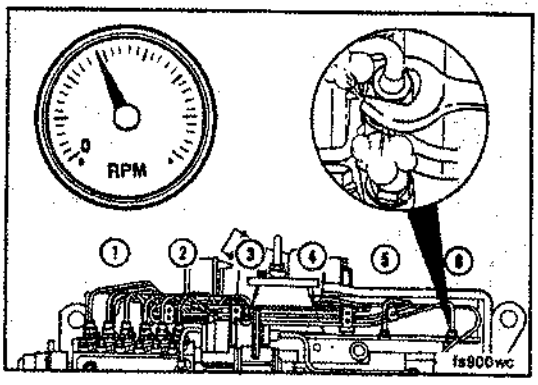
10 mm, 17 mm

The PES. MW pump must be vented after installation. Loosen the vent screw located near the front on the side nearest to the engine. Crank the engine so air can bleed from the fuel injection pump, then tighten the vent screw.

NOTE: Earlier PES. MW fuel injection pumps were not equipped with a vent screw. Remove the large plug from the location described above to vent the fuel injection pump. PES. A pumps are self venting.

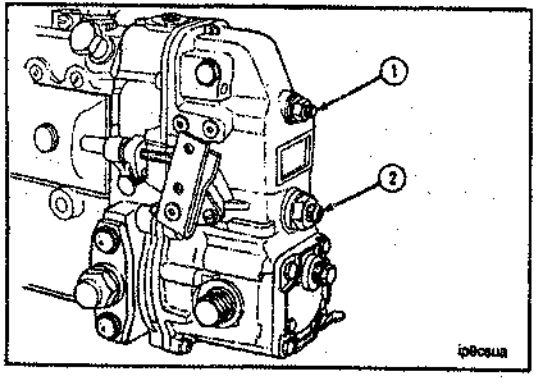
Torque Value: 9N · m [80 in-lb]





Vent each high pressure fuel line separately until the engine runs smoothly. Tighten the high pressure fuel lines.

Torque Value: 17 mm 24N·m [18 ft-lb]
19 mm 30N·m [22 ft-lb]



Injection Pump-Idle Speed Adjustment

RSV Governor

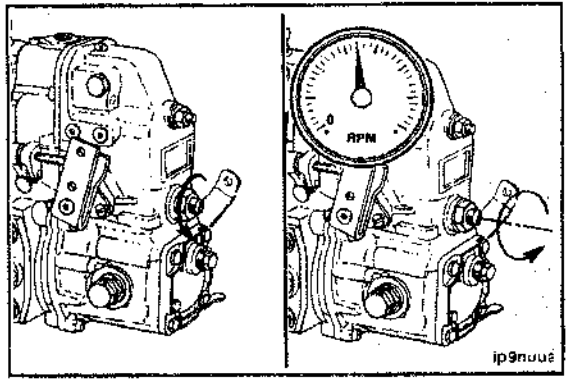
Idle adjustment for **industrial** engines requires the setting of both the low idle screw (1) and the bumper spring screw (2).

Caution: Failure to set low idle with bumper spring could result in an unstable governor(engine surge).

19 mm Screwdriver and Tachometer

First, loosen the locknut and back out the bumper spring screw until there is no change in engine speed.

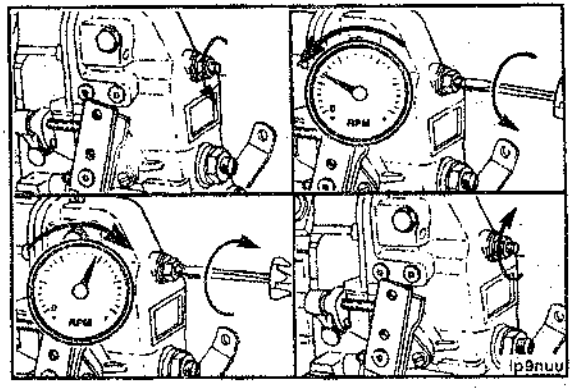
NOTE: The speed should drop 30-40 RPM as the bumper spring screw is backed out.

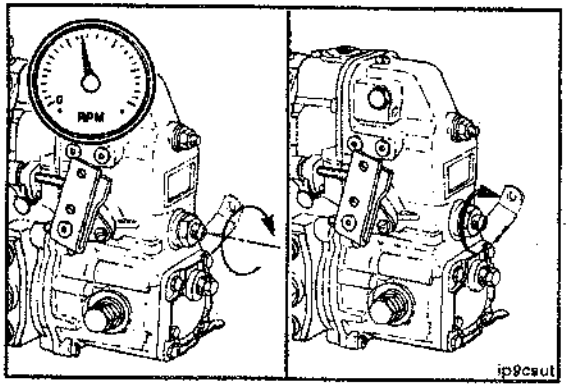


13 mm Screwdriver and Tachometer

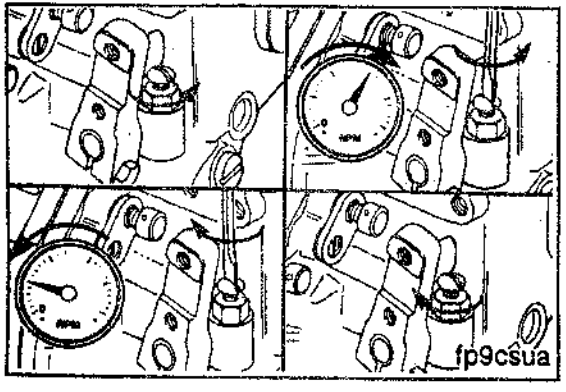
Loosen the locknut and adjust the idle screw to 30-40 RPM less than the desired speed. Turn the idle screw **counterclockwise** to decrease RPM; **clockwise** to increase RPM. Tighten the idle screw locknut.

Torque Value: 8N · m [72 in-lb]





Turn the bumper spring **clockwise** until the data plate specified idle speed is obtained with normal idle operation accessory loads (i.e, air conditioning, hydraulic loads, transmission). Tighten the locknut.
Torque Value: 8N·m [72 in-lb]



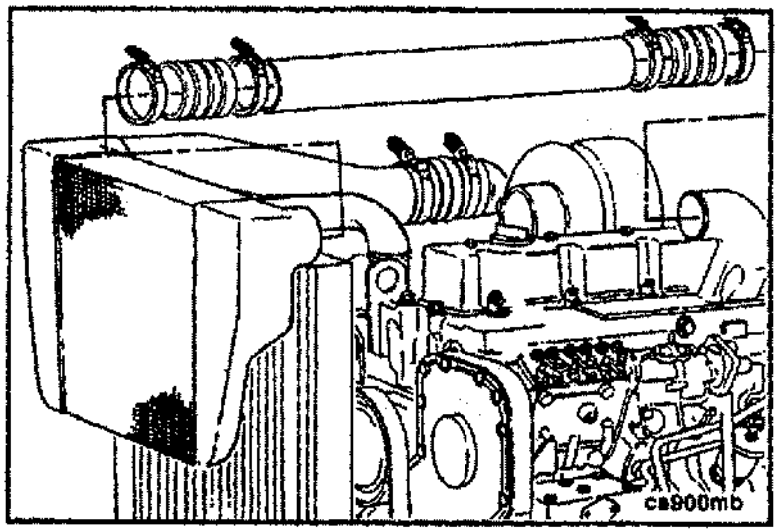
RQV and RQVK Governor

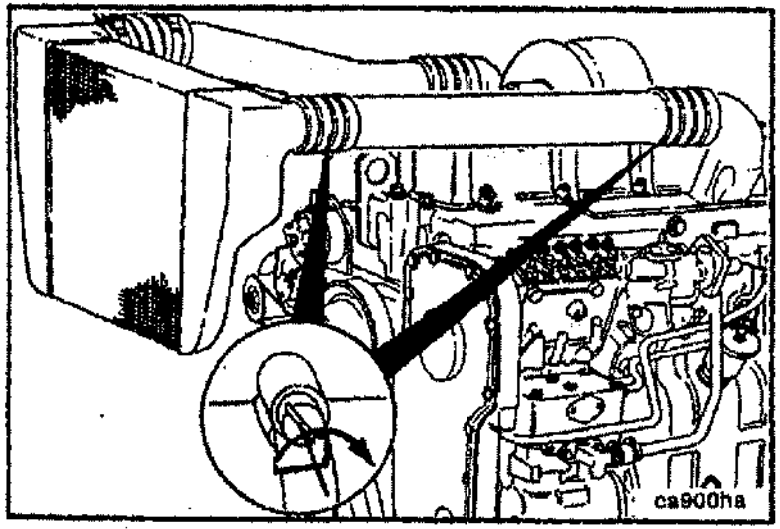
10 mm Screwdriver and Tachometer
Idle adjustment on fuel injection pumps with RQV and RQVK governors require setting of the idle adjustment screw.
Loosen the locknut and turn the idle adjustment screw **counterclockwise** to raise the RPM; **clockwise** to decrease the idle speed until the data plate specified idle speed is attained with normal idle operation accessory loads (i.e.transmission, hydraulic, air conditioning). Tighten the locknut.
Torque Value: 8N·m [72 in-lb]

Air System Repair Summary

Component To Be Replaced	Tools	Preparatory Steps*
Intake Air Piping	8 mm Socket, Common Screwdriver and Torque Wrench	
Intake Manifold Cover and Gasket	10mm Socket	Disconnect cold starting aid, if used, and air piping.
Aftercooler and Gasket	8mm, 10mm Socket	Disconnect cold starting aid if used, remove air crossover tube and drain coolant.
Turbocharger and/or Gasket	10mm, 15mm, 16mm, 7/16-Inch Wrenches	Disconnect intake and exhaust piping.
Exhaust Manifold and/or Gasket	15mm Socket	Disconnect intake and exhaust piping, and remove the turbocharger.

*Removal of some chassis parts may be necessary to gain access to some engine components. Follow the equipment manufacturer's procedures and precautions for removing chassis parts.





Intake Air Piping

Replacement

8 mm or Screwdriver

Loosen the hose clamps and remove the air piping.

8 mm or Screwdriver

Use new hose piping and clamps as required.

Tighten the hose clamps.

Refer to the manufacturers specifications for the correct torque value.

Intake Manifold Cover and Gasket

Replacement

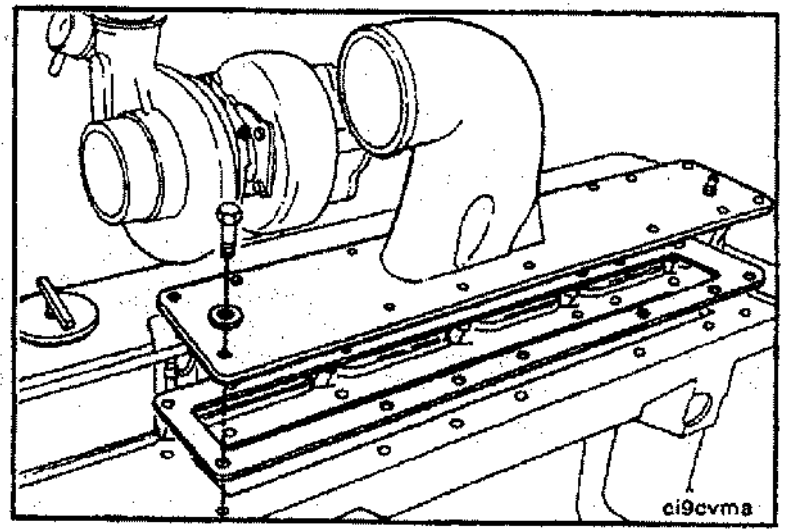
Preparatory Steps:

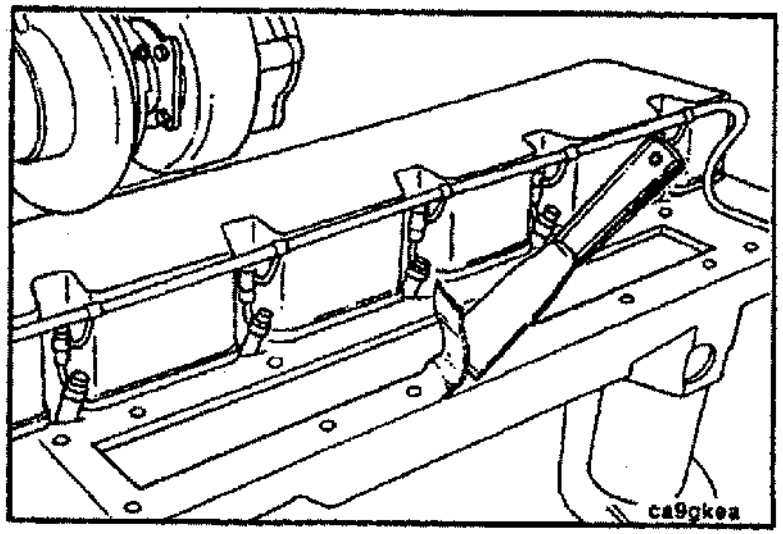
- Disconnect the cold starting aid, if used.
- Remove the air crossover tube.
- Remove the high pressure fuel lines.

10 mm

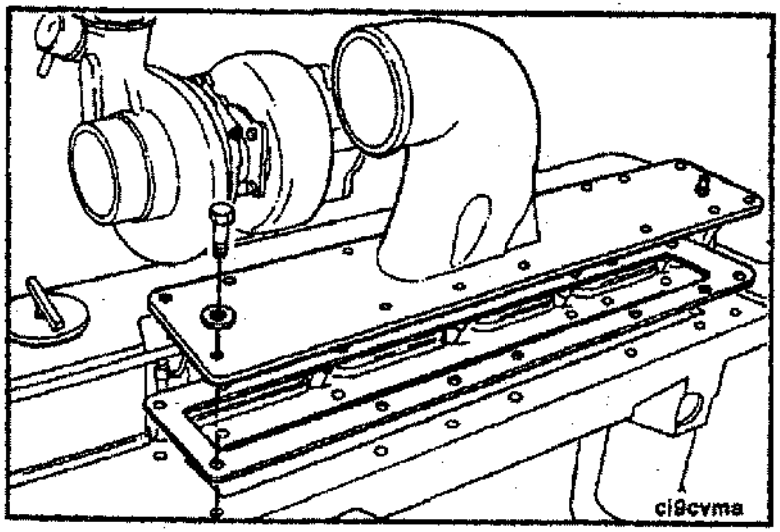
Remove the air intake manifold cover and gasket.

Plug intake with clean rag to prevent foreign material from entering intake system.



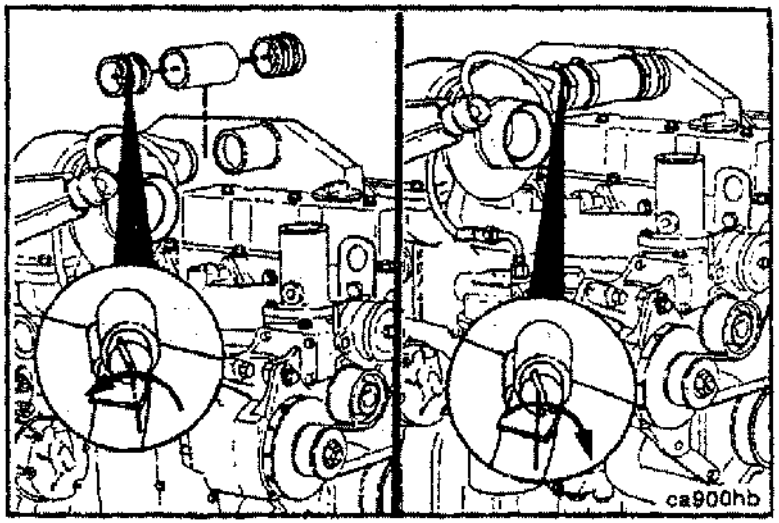


Clean the sealing surface.
NOTE: Keep the gasket material and any other material out of the air intake manifold.



10 mm, 19 mm
Install the air intake manifold cover and a new gasket.
Install the high pressure fuel lines.
Torque Value: 24N·m [18 ft-lb]

Assemble the intake piping and connect the cold starting aid if used. Vent the high pressure fuel lines.

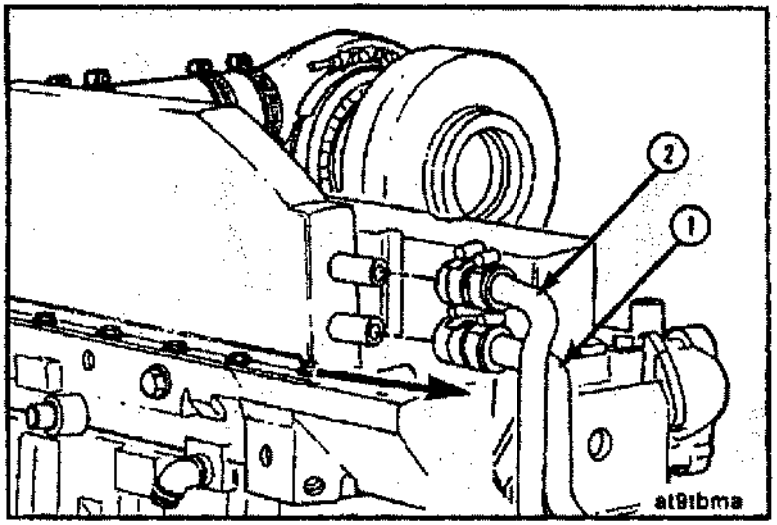


Aftercooler and Gasket

Replacement

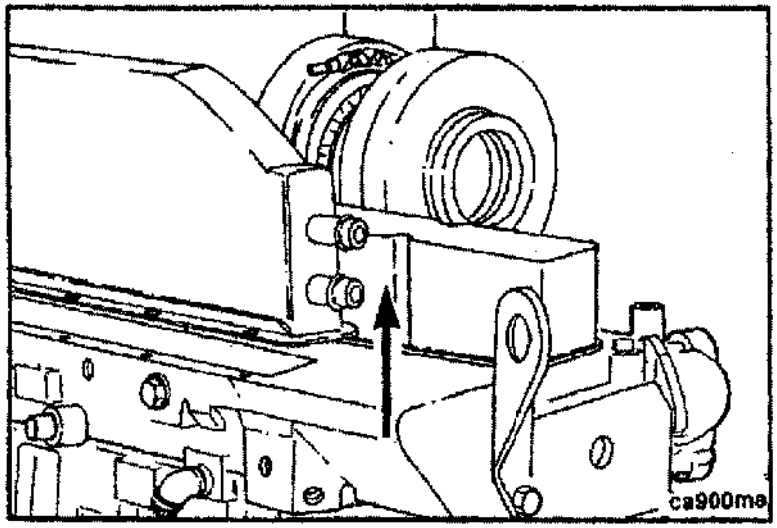
Preparatory Steps:

- Dis connect the cold starting aid, if used.
- Remove the air crossover tube.
- Drain 2 litres (2.1 U.S. Quarts) of coolant.
- Remove the high pressure fuel ines.



8 mm

Remove the coolant supply tube (1) and the coolant return tube (2) (off highway engines).



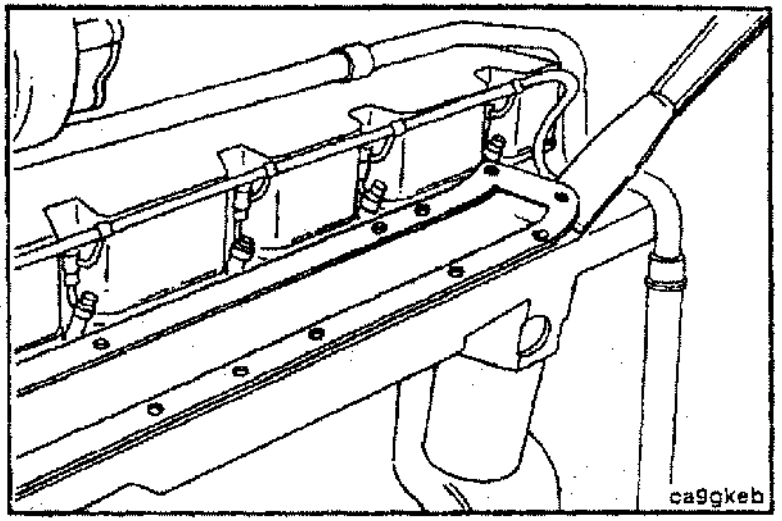
10 mm

Remove the aftercooler housing and gasket.

Plug opening with clean shop rag to prevent foreign material from entering air intake.

clean the sealing surface.

NOTE: Keep the gasket material and any other material out of the air intake.

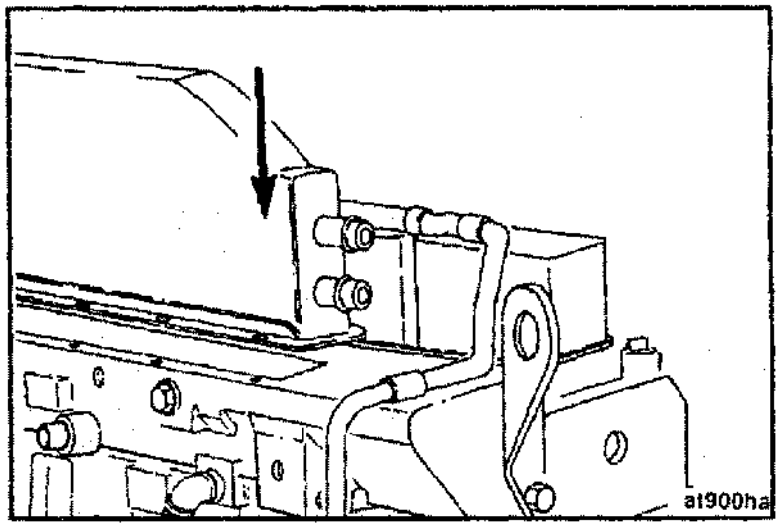


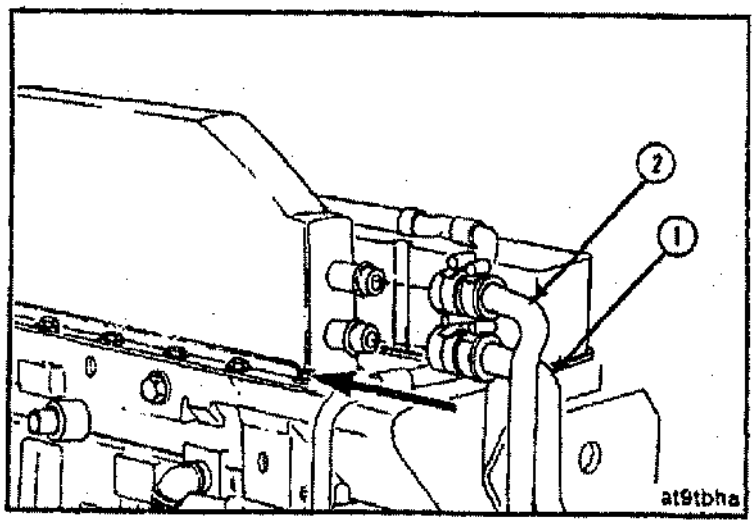
10mm, 19 mm

Install the aftercooler housing and a new gasket.

Install the high pressure fuel lines.

Torque Value: 24N · m [18 ft-lb]

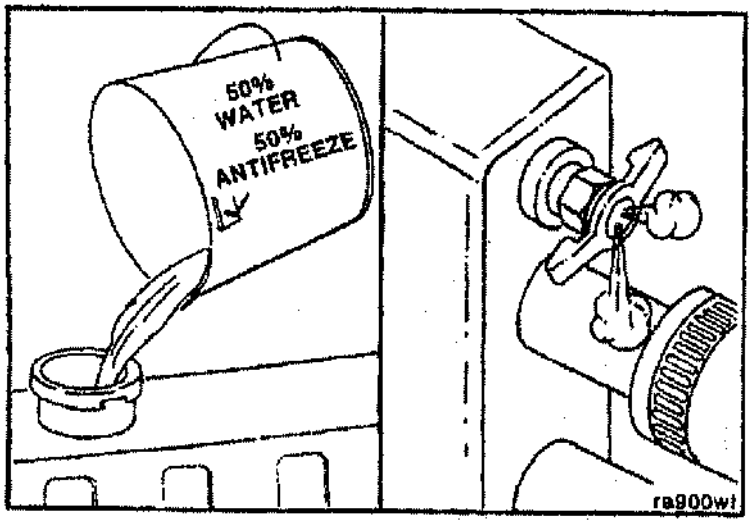




8 mm

Install the coolant supply tube (1) and coolant return tube (2). Install the air crossover tube.

Torque Value: 8N·m [72 in-lb]



Caution:Be sure to open the engine and aftercooler vents to allow air to escape as the system is filled. Refer to the procedure given on page 7-7. Vent the high pressure fuel lines.

Fill the coolant system with a mixture of 50% water and 50% ethylene-glycol type antifreeze.

Charge Air Cooler

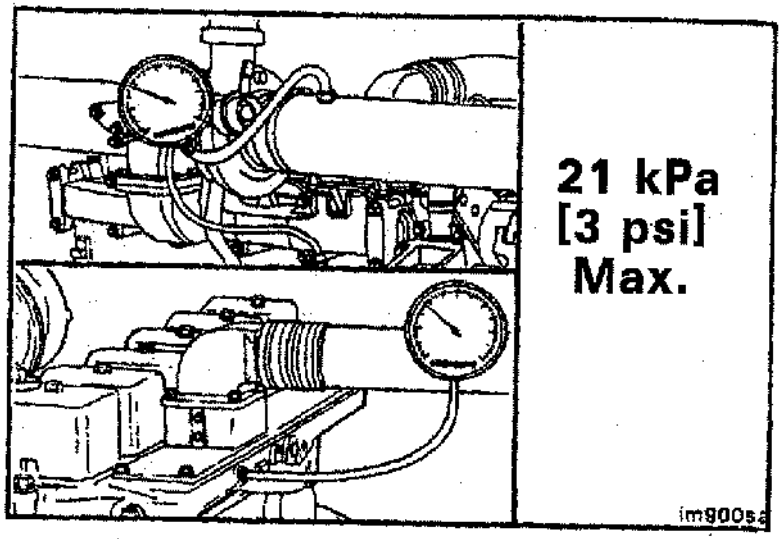
Intake Manifold Pressure-Check

Install pressure gauge, Part No. ST-1273, to the fitting in the turbocharger outlet.

Install another pressure gauge, Part No. ST-1273, in the intake manifold.

Operate the engine at rated RPM and load. Record the readings on the two gauges.

If the differential pressure is greater than 21 kPa [3 psi], check the charge air cooler for plugging. Clean or replace if necessary.

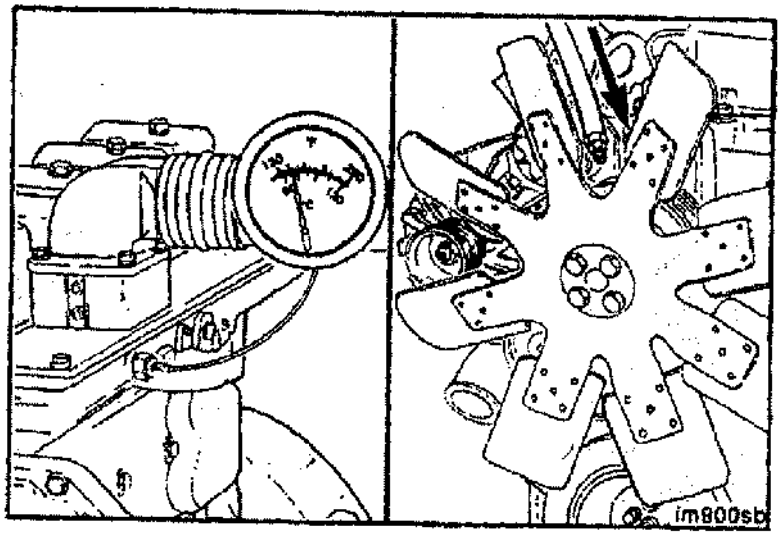


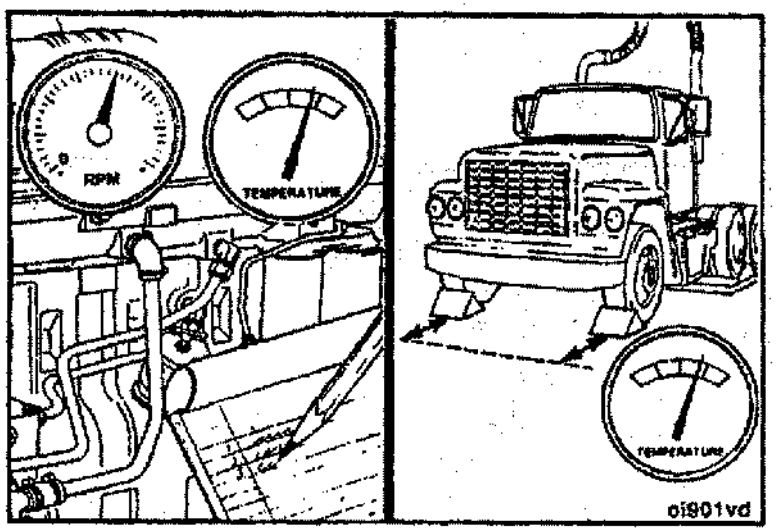
Intake Manifold Temperature-Checking

Install a temperature gauge in the intake manifold.

Lock the fan drive in the ON mode to prevent erratic test results, This can be done by installing a jumper across the temperature switch or supplying shop air to the fan. Refer to the fan drive manufacturer for lock-up procedure.

NOTE: Some trucks have a manual switch that will lock on the fan.



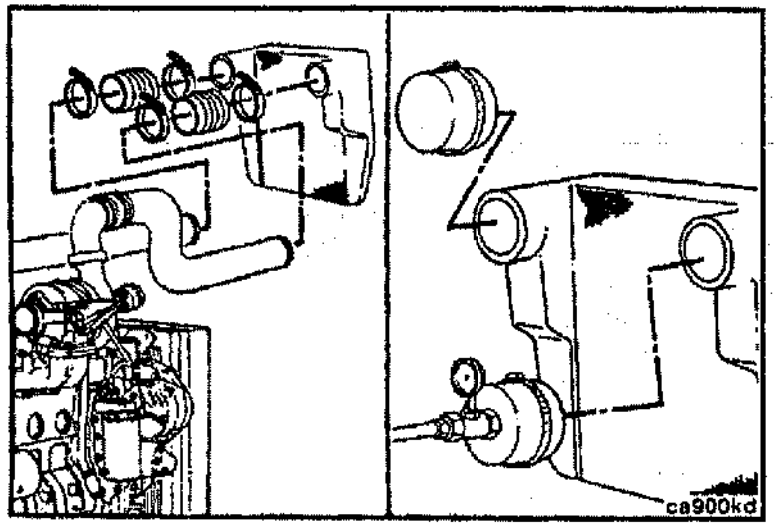


Operate the engine at rated RPM and load. Record the intake manifold temperature.

Measure the ambient temperature at least 60.96 cm [2.0 feet] in front of the vehicle.

The maximum temperature differential **must not** be greater than 7°C [45°F].

If the temperature differential is greater than 7°C [45°F], check the charge air cooler for dirt and debris on the fins, and clean as necessary. If the problem still exists, check the cooler for internal contamination or plugging.



To check the charge air cooler for cracked tubes or header,remove the inlet and outlet hoses from the cooler. Remove the charge air cooler.

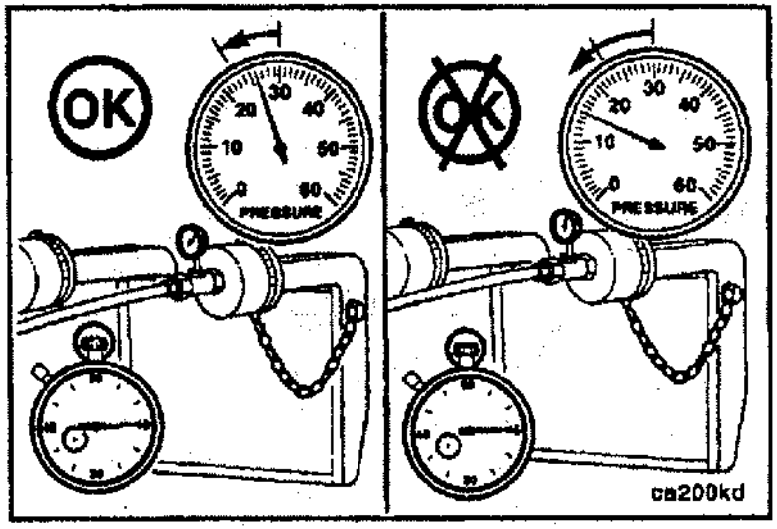
Install a cap over the outlet side of the cooler, Install a pressure gauge and a shop air supply line to the inlet side of the cooler.

Leak Check

Apply 276 kPa [40 psi] of air pressure to the cooler. If the pressure drop is 35kPa [5 psi] or less in 15 seconds, the cooler is okay.

If the pressure drop is greater than 35 kPa [5 psi] in 15 seconds, the charge air cooler must be repaired or replaced. Refer to the CAC manufacturer for repair instructions.

NOTE: A leak tank can be used to locate the air leak.

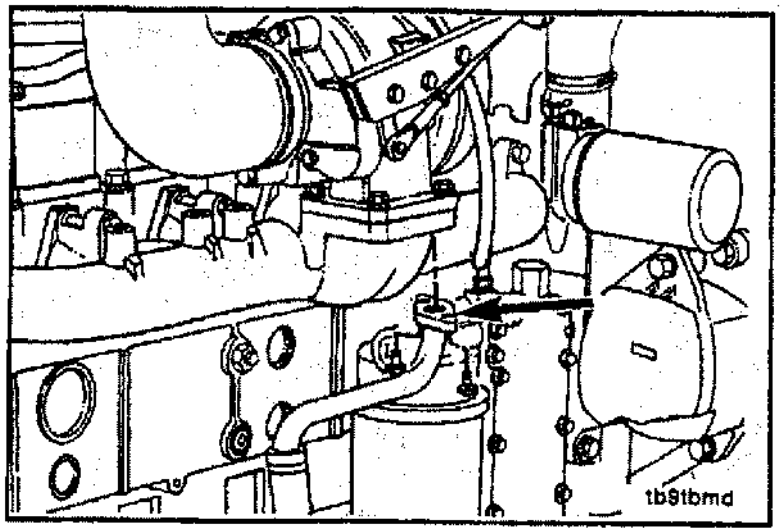


Turbocharger

Replacement

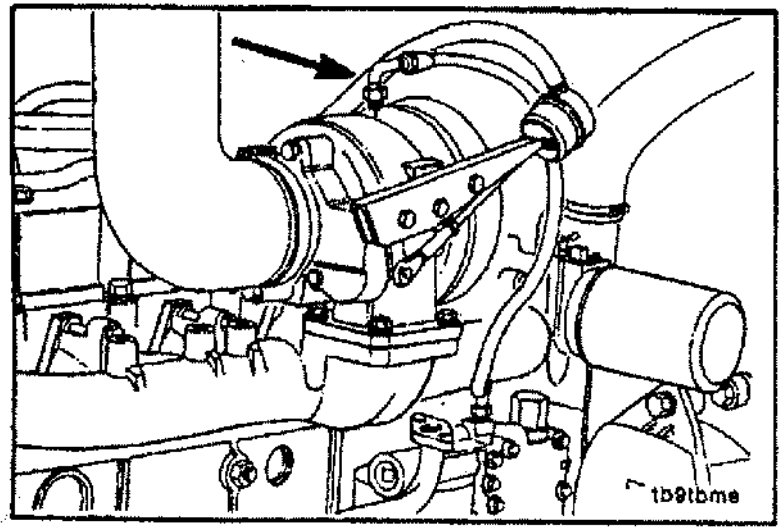
Preparatory Steps:

- Remove the air intake piping.
- Disconnect the intake and exhaust piping.
- Disconnect the wastegate actuator line.



10 mm

Remove the capscrews from the oil drain tube.



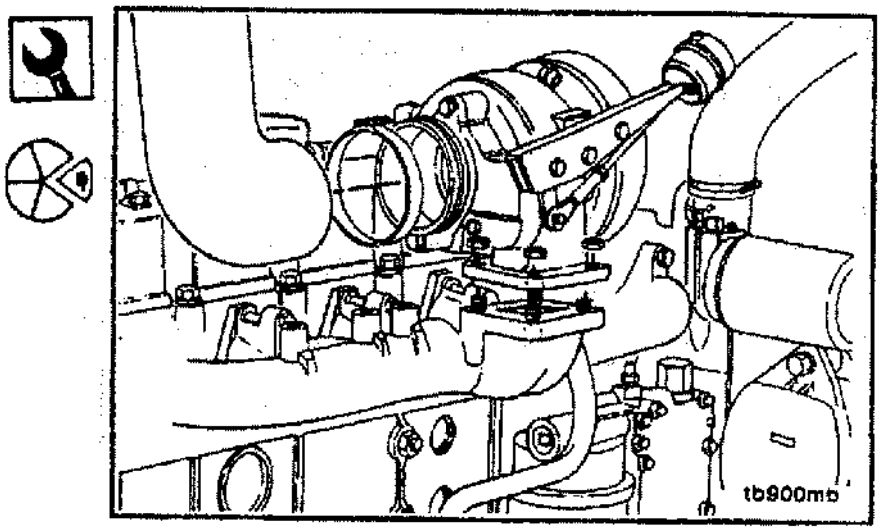
16 mm

Remove the oil supply line.

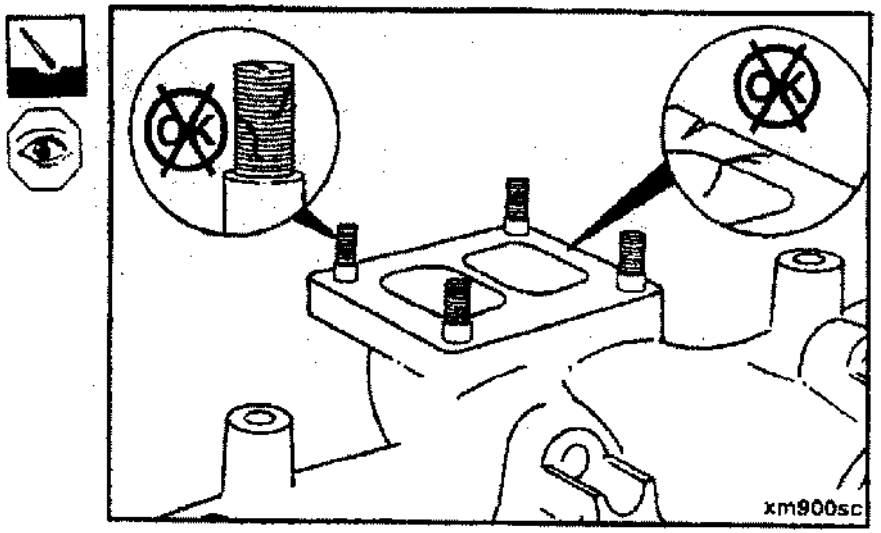
15 mm and 11 mm

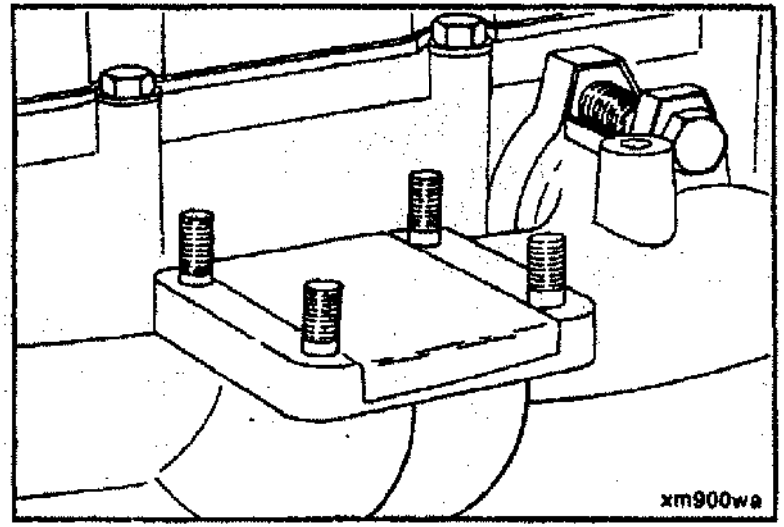
Remove the exhaust clamp, turbocharger, and gasket.

Plug exhaust flange with clean shop rag to prevent foreign material from entering manifold.

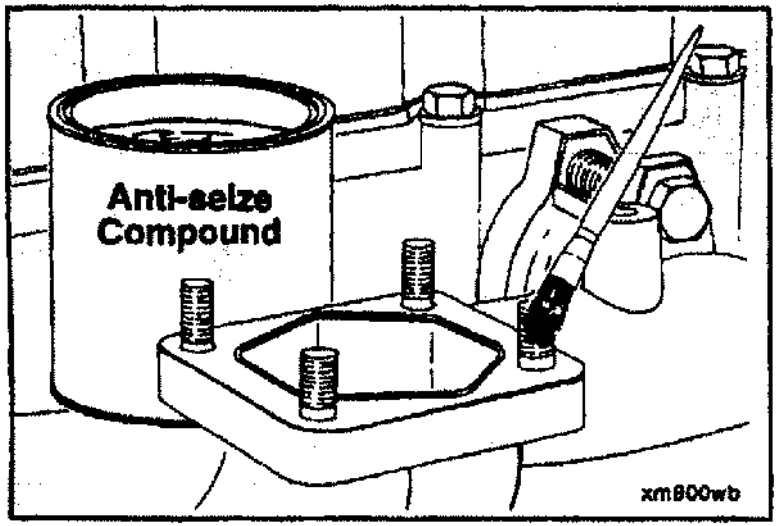


Clean the sealing surface. Inspect the sealing surface and mounting studs for damage.





Caution: If the turbocharger is not to be immediately replaced, cover the opening to prevent any material from falling into the manifold.

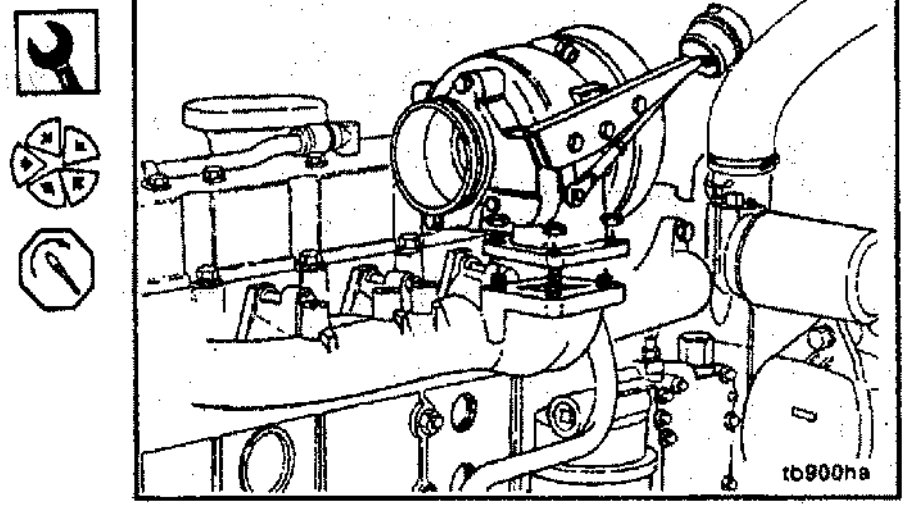


Install a new gasket and apply an anti-seize compound to the mounting studs.

15 mm

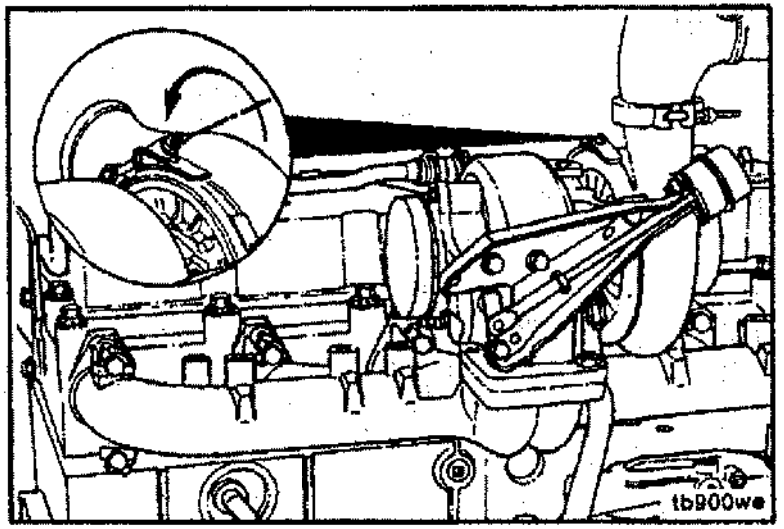
Install the turbocharger.

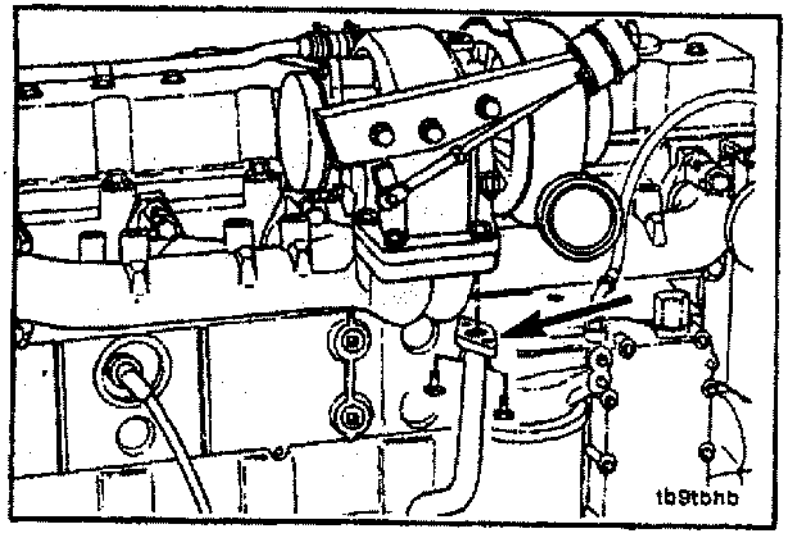
Torque Value: 45 N·m [33 ft-lb]



11 mm

If required, loosen the turbine housing capscrews and position the bearing housing to install the turbocharger drain tube.

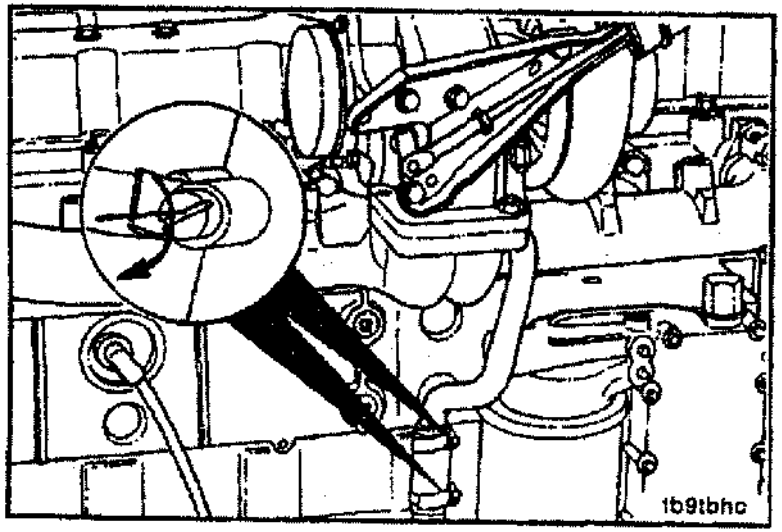




10 mm

Install the hose and clamps on the turbocharger drain tube loosely. Install the drain tube and gasket on the turbocharger.

Torque Value: 24 N·m [18 ft-lb]



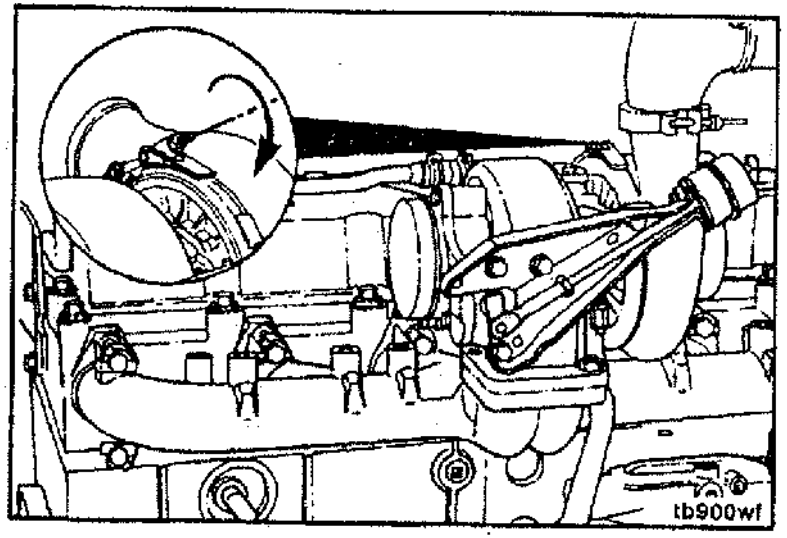
Position the turbocharger drain hose to connect the drain tubes; tighten the clamps.

Torque Value: 5 N·m [44 in-lb]

11 mm, Punch, Hammer

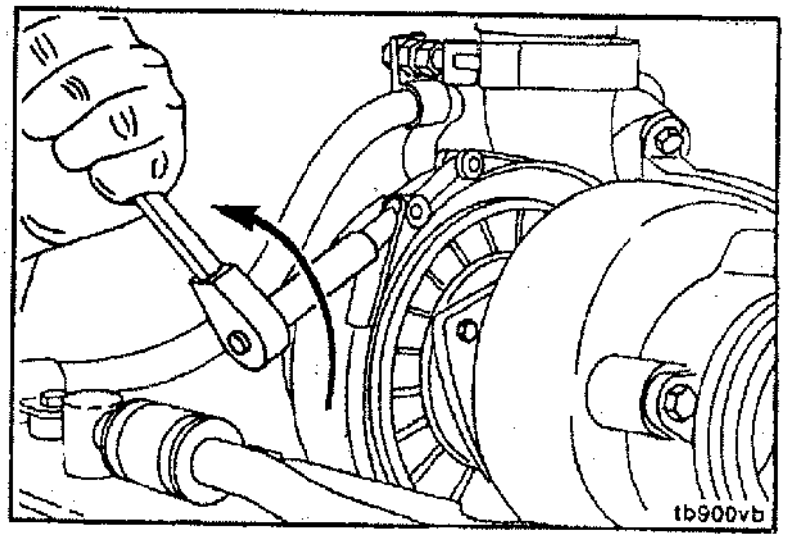
If loosened, tighten the turbine housing capscrews.

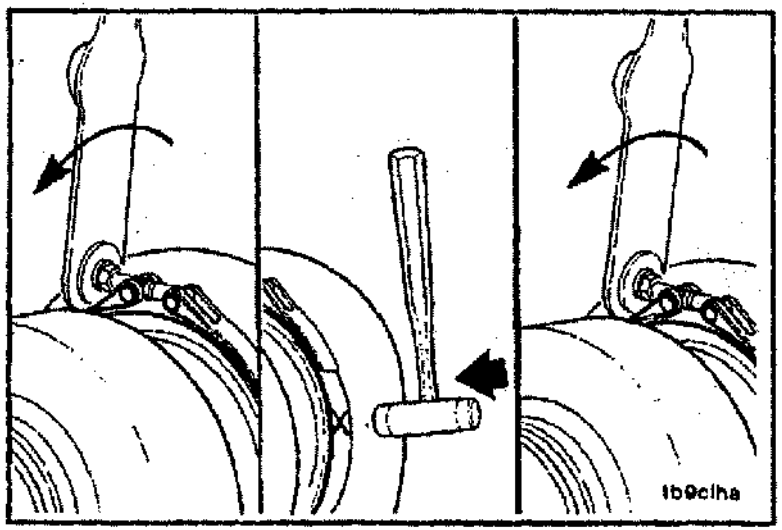
Torque Value: 11 N·m [100 in-lb]



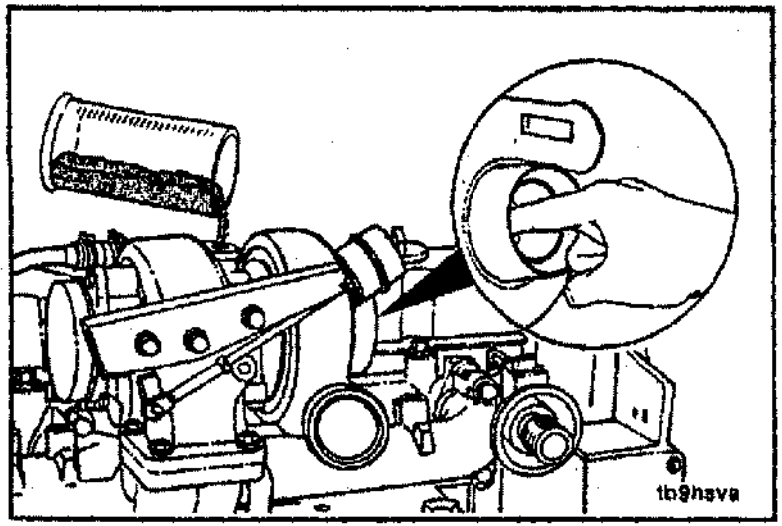
11 mm

If required, loosen the compressor housing position the housing to align with the air crossover tube.





11 mm, Plastic Hammer
Tighten the band clamp. Tap around the clamp with plastic hammer and tighten again.
Torque Value: 8N·m [71in-lb]
NOTE: Effective Oct.1,1990 all holset Turbochargers use silver plated nuts with the v-band clamp. The silver plated nuts require a **lower** torque than the stainless steel nut to provide the same v-band clamp load.

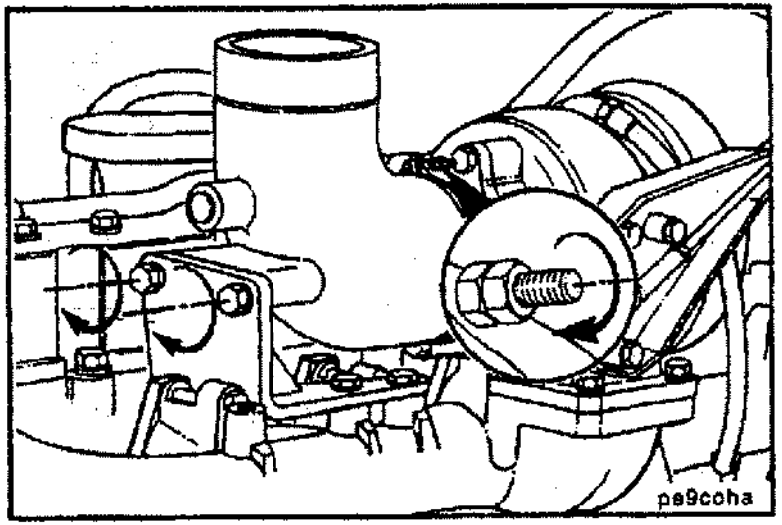


Caution: New turbochargers must be prelubricated before start-up to prevent internal damage.
Pour 50 to 60 cc [2 to 3 ounces] of clean 15W-40 engine lubricating oil into the oil supply fitting.Rotate the turbine wheel to allow the lubricating oil to enter the bearing housing.

Install the exhaust outlet connection.

Do not tighten the two mounting capscrews until the band clamp has been tightened.

Torque Value: Band Clamp - 8N · m [70 in-lb]
Capscrews - 43N · m [32 ft-lb]

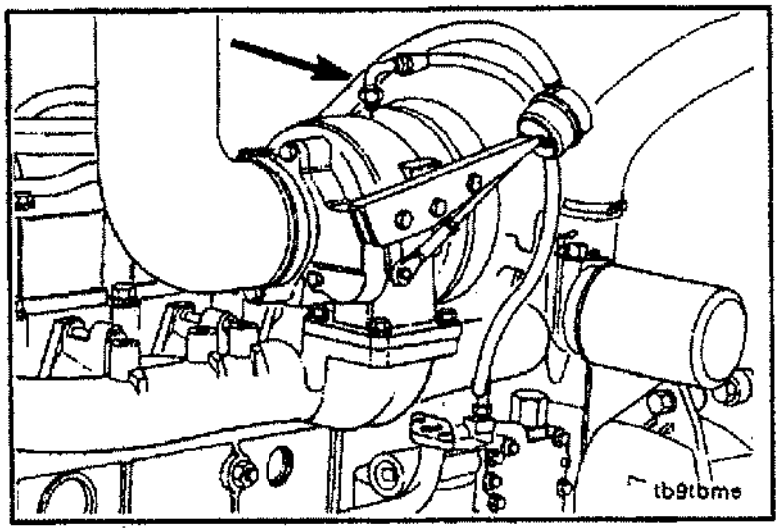


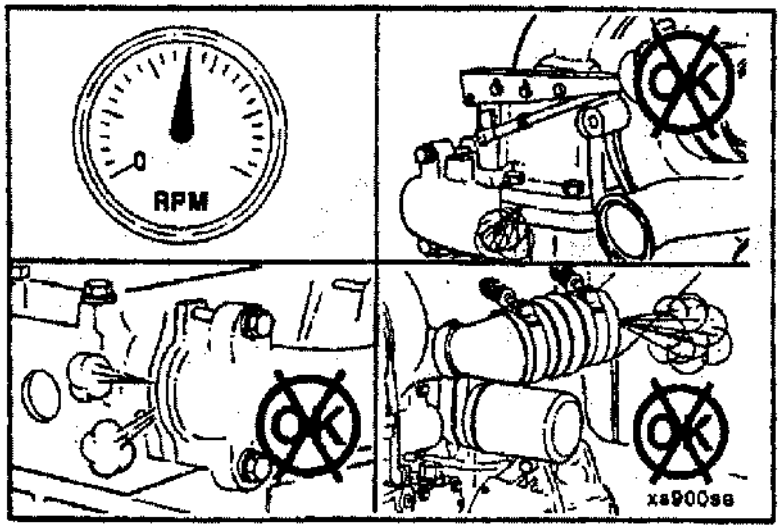
16 mm

Install the lubricating oil supply line.

Torque Value: 35N · m [26 ft-lb]

WARNING: The oil supply line must not contact turbine housing. The line can burn, causing equipment damage, and severe personal injury.





Install the air inlet and exhaust piping. Install the wastegate actuator line.

Operate the engine and check for leaks.

Exhaust Manifold and Gaskets

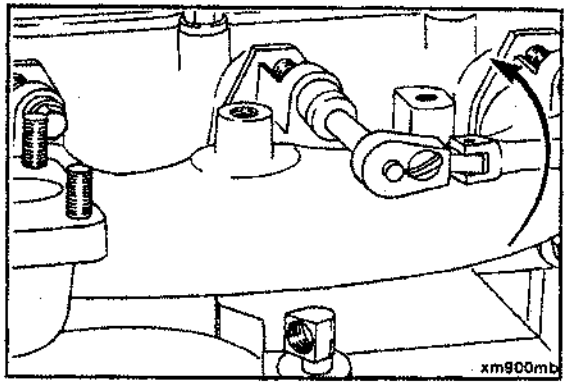
Replacement

Preparatory step:

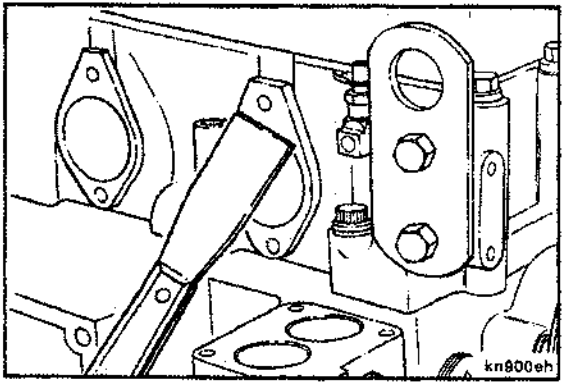
- Remove the air crossover tube.
- Disconnect the air intake and exhaust piping.
- Remove the turbocharger, if used.

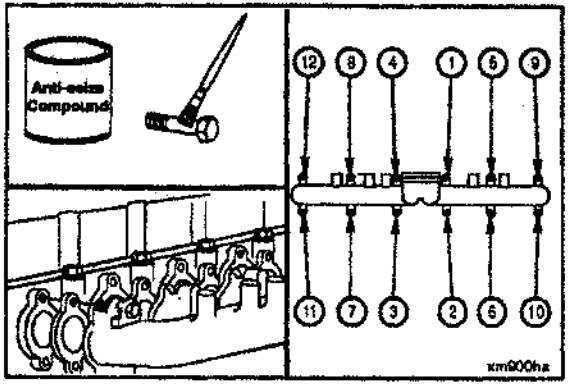
16 mm

Remove the exhaust manifold and gaskets.



Clean the exhaust manifold sealing surfaces.





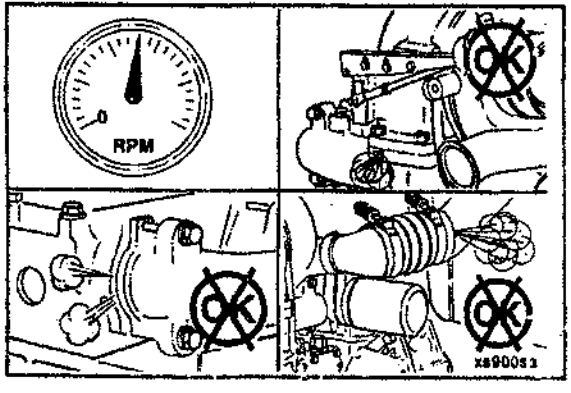
16 mm

Install the exhaust manifold,new gaskets and lock plates.

Torque Value: 43N·m [32 ft-lb]

Follow the tightening sequence shown in the illustration.

Apply an anti-seize compound to exhaust manifold bolts upon reassembly.



Install the parts previously removed, Operate the engine and check for leaks.

Lubricating Oil System Repair Summary

Component To Be Replaced	Tools	Preparatory Steps
Oil Pressure Regulator Valve and/or Spring	22 mm Socket, Ratchet and Torque Wrench	Clean debris.
Lubricating Oil Thermostat	32 mm Socket, Ratchet and Torque Wrench	Clean debris.
Oil Cooler Element and/or Gaskets	16 mm Wrench, Ratchet, 10 mm Socket and Torque Wrench	Drain coolant. Remove the oil filter.

⚠ WARNING ⚠

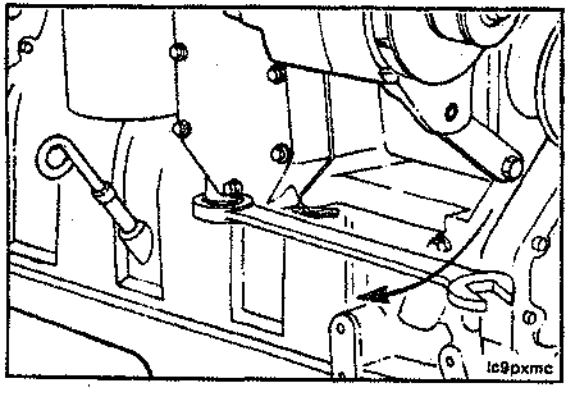
Used engine oil can be carcinogenic and cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil.

Lubricating Oil Pressure Regulator, Valve and Spring

Replacement

Preparatory step:

- Clean debris.



32mm

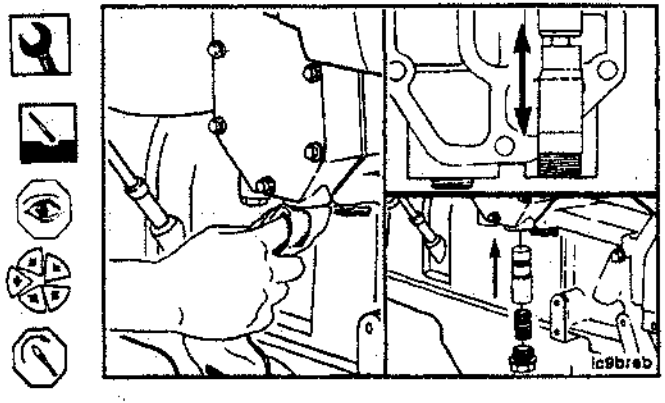
Remove the plug, spring and regulator valve.

32 mm

Clean and inspect the bore and regulator valve before assembly.

The valve must move freely in the bore.

Install the regulator, spring and plug.
Torque Value: 80N · m [60 ft-lb]

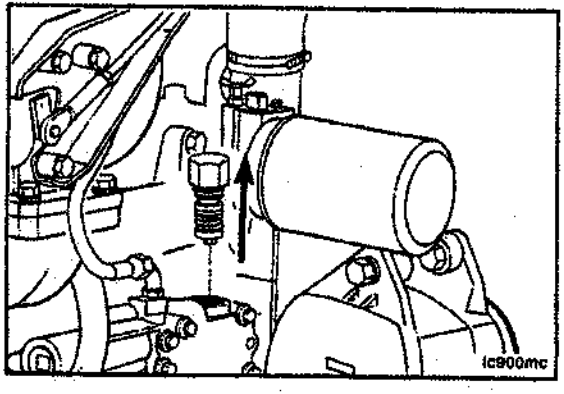


Lubricating Oil Thermostat

Replacement

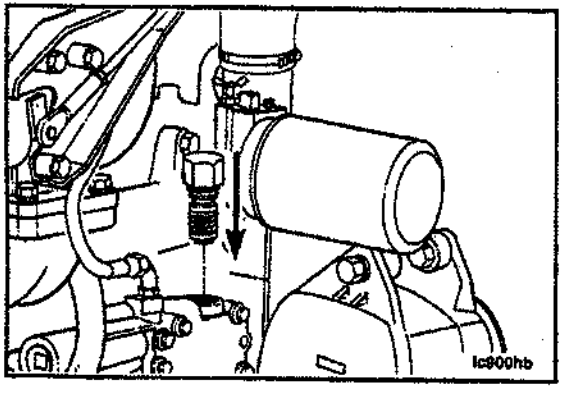
preparatory Steps:

- Clean debris



32 mm

Remove the lubricating oil thermostat.



32 mm

Clean and inspect the lubricating oil thermostat bore before assembly.

Install the lubricating oil thermostat.

Torque Value: 50N·m [37 ft-lb]

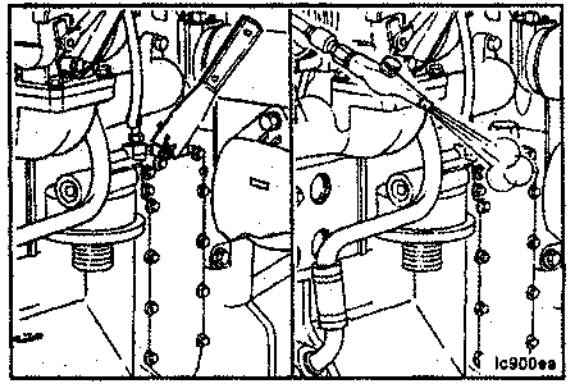
Lubricating Oil Cooler Element and Gasket

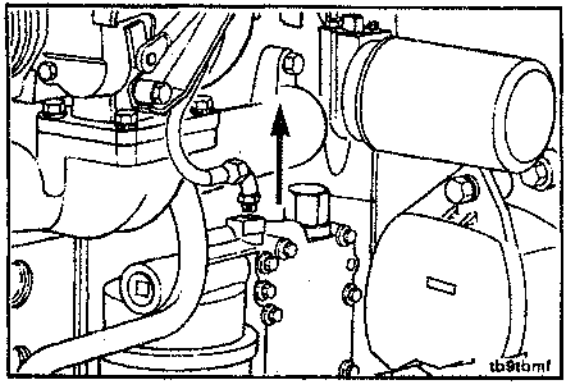
Replacement

Preparatory Steps:

- Drain the coolant.
- Remove the lubricating oil filter.

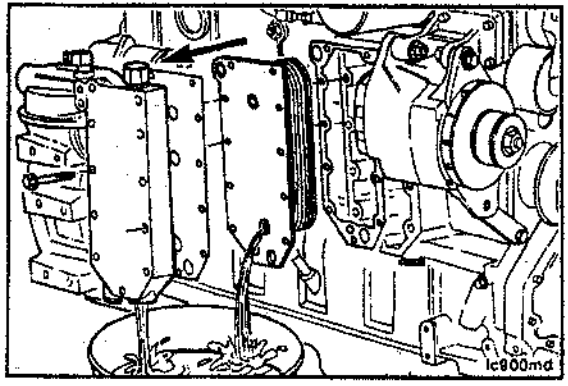
Clean all debris from around the lubricating oil cooler.





16 mm

Remove the turbocharger oil supply line from the oil filter head.

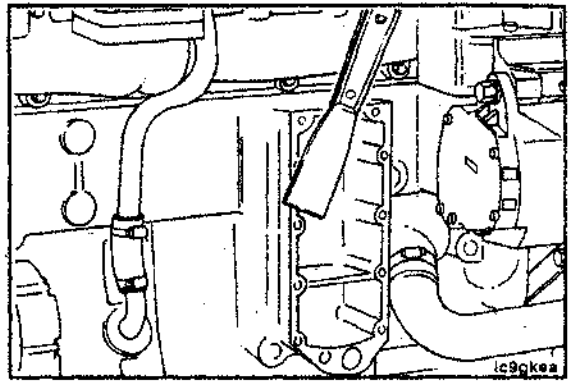


10 mm

Remove the oil cooler cover, element and gaskets.

NOTE: The element will contain approximately 0.7 Liters [0.75 U.S. Qts.] of lubricating oil which will drain when the cooler is removed from the engine.

Clean the oil cooler sealing surfaces.



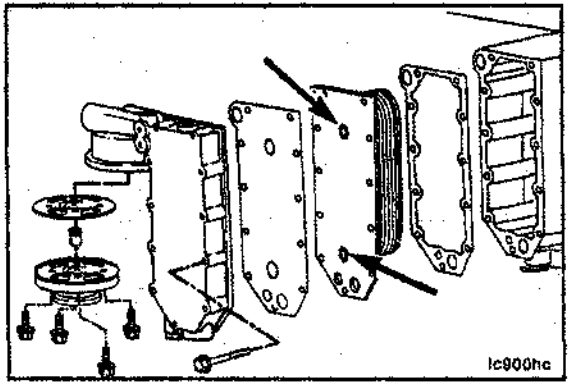
10 mm

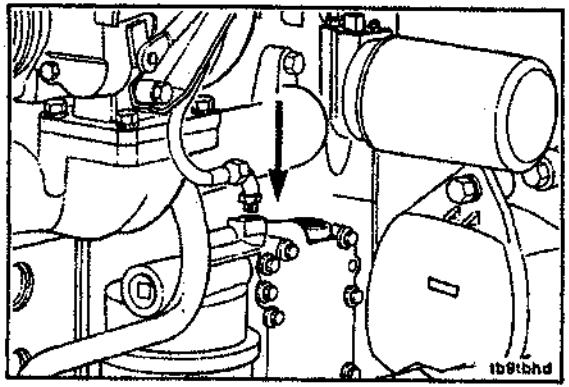
Assemble the lubricating oil cooler gasket, element, cooler cover gasket, lubricating oil thermostat and oil cooler cover to the cylinder block.

Install the filter head and gasket if removed.

NOTE: Be sure to remove the shipping plugs from the new cooler element.

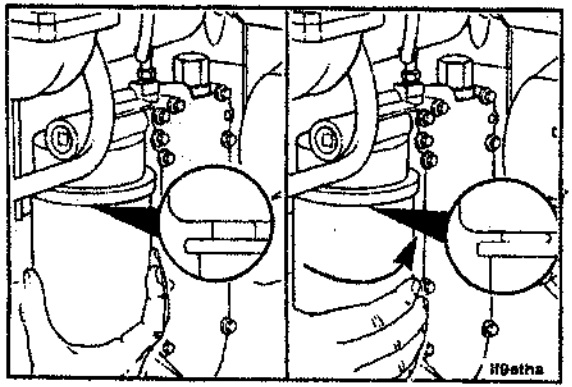
Lubricating Oil Cooler Cover Capscrews	24N · m	18 ft-lb
Lubricating Oil Filter Head capscrews	24N · m	18 ft-lb





16 mm
Connect the turbocharger oil supply line.

Torque Value: 15N·m [11 ft-lb]

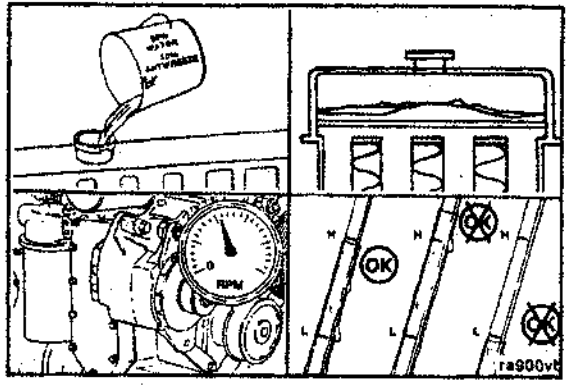


Install a new lubricating oil filter.
Follow the manufacturer's instructions for tightening.

NOTE: Be sure to open the engine and aftercooler vents to alow air to escape as the system is filled. Refer to Section 7.

Fill the coolant system and operate the engine to check for leaks.

Stop the engine and check the coolant and lubricating oil level.



Electrical System Repair Summary

Component To Be Replaced	Tools	Preparatory Steps
Starting Motor	Ratchet, 16 mm Socket, 19 mm Wrench,and Torque Wrench	Disconnect ground cable to battery.
Alternator	Ratchet, 8 mm, 13 mm and 17 mm Socket and Torque Wrench, 1/2 inch Square Drive Breaker Bar	Disconnect ground cable to battery and remove drive belt.

⚠ WARNING ⚠

Batteries can emit explosive gas. Ventilate area before working on around battery. Keep flame, cigarettes, pilot lights, sparks, wiring switches, equipment, and other ignition sources away. Remove negative (-) cable first and attach it last.

Starting Motor

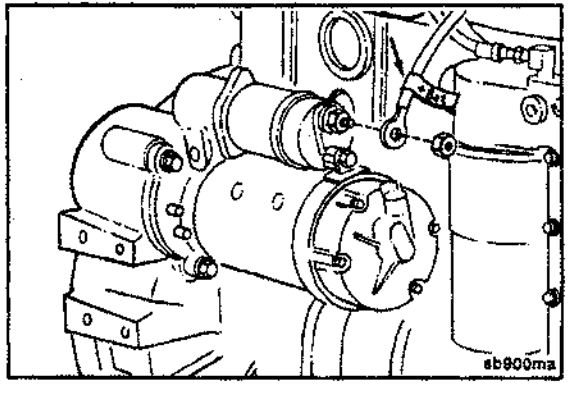
Replacement

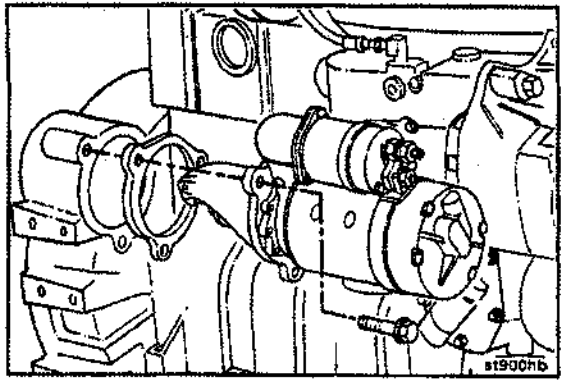
Preparatory Steps:

- Disconnect the ground cable from the battery.
- Identify each electrical wire with a tag indicating location.

19 mm

Remove the battery cable from the solenoid.





16mm

Remove the starting motor and spacer.

Install the starting motor in the reverse order of removal.

Torque Value: 43 N·m [32 ft-lb]

Alternator

Replacement

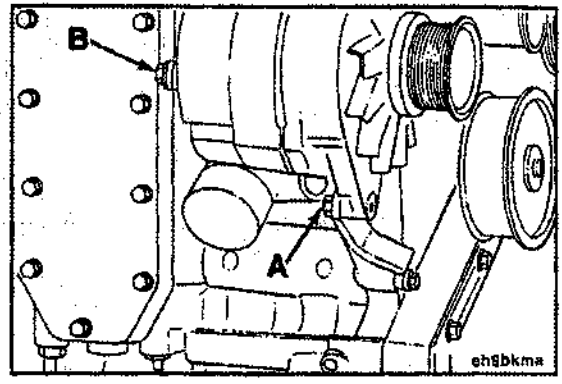
Preparatory Step:

- Disconnect the ground cable from the battery terminal.
- Identify each electrical wire with a tag indicating location.
- Remove the drive belt.

19 mm

Remove the capscrew (A) from the alternator link.

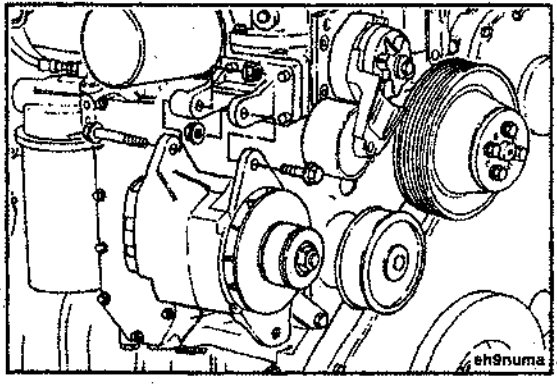
Remove the capscrew (B) from the support bracket.

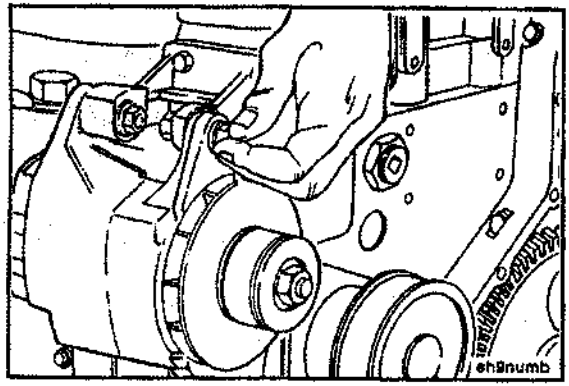


18 mm, 19 mm

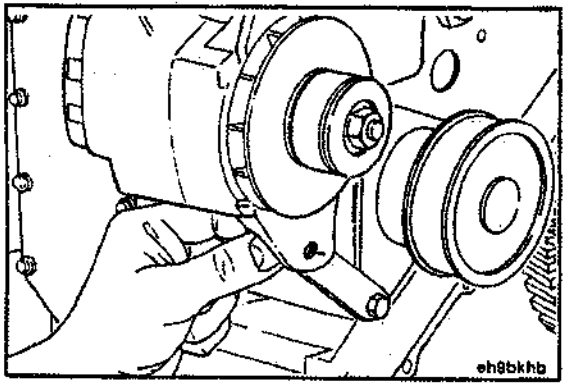
Remove the alternator mounting capscrews and nuts.

Remove the alternator.





Position the alternator on the bracket and secure it with the mounting capscrews.
Do not tighten at this time.



Connect the alternator link to the alternator. Finger tighten.
NOTE: Make sure the alternator link is properly positioned for correct belt alignment.

15 mm, 18 mm, 19 mm

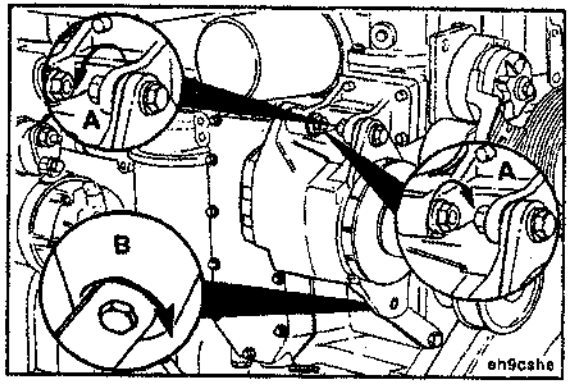
Tighten the alternator mounting capscrew.

Torque Value:

A=43N · m [32 ft-lb]

B=24N · m [18 ft-lb]

Install the drive belt.



NOTES

Section V -Specifications and Torque Values

Section Contents

General Specifications

GENERAL ENGINE DATA	6C8.3	6CT8.3	6CTA8.3	C8.3
Bore-mm [in.]			**114 [4.49]**	
Strok-mm [in.]			**135 [5.32]**	
Displacement-liter [in. ^{3}]			**8.27 [504.5]**	
Engine Weight (Dry Weight)			**603-612Kg [1330-1350 lb]**	
(Wet Weight)			**635-658Kg [1400-1450 lb]**	
Firing Order			**1-5-3-6-2-4**	
Valve Clearances				
-Intake-mm [in.]			**0.30 [0.012]**	
-Exhaust-mm [in.]			**0.61 [0.024]**	
Compression Ratio	16.4: 1	17.3: 1	16.5: 1	17.3: 1*/18: 1**
Rotation, viewed from the front of the Engine				
Aspiration			**Clockwise**	
-Naturally Aspirated	×			
-Turbocharged		×	×	×
-Aftercooled			×	
-Charge Air Cooled (CAC)				×

*High Torque (Peak Torque 700 ft/lbs and above)
**Low Torque (Peak Torque 700 ft/lbs and below)

LUBRICATION SYSTEM	**6C8.3**	**6CT8.3**	**6CTA8.3**	**C8.3**
Lubricating Oil Pressure at Idle- (Minimum Allowable) kPa [PSI]	**69 [10]**			
Lubricating Oil Pressure at Rated - (Minimum Allowable) kPa [PSI]	**207 [30]**			
Regulating Valve Opening Pressure kPa [PSI]	**518 [75]**			
Differential Pressure to Open the Filter Bypass Valve -kPa [PSI]	**172 [25]**			
Lubricating Oil Capacity of Pan (High-Low) -Liter [U.S. Qts.]	**18.9 [20]**			
	15.3 [16]			
COOLING SYSTEM				
Coolant capacity (Engine Only) -liter [U.S. Qts.]	9.9 [10.5]	9.9 [10.5]	10.9 [11.5]	9.9 [10.5]
Standard Modulating Thermostat -Range-°C [°F]	**Start 83 [181]**	**Fully Open 95 [203]**		
Pressure Cap-kPa [PSI] Min	**50 [7]**			
Maximum Allowable Top Tank Temperature°C [°F]	**100°C [212°F]**			
Minimum Recommended Top Tank Temp. °C [°F]	**70°C [158°F]**			

INTAKE AIR, EXHAUST AND FUEL SYSTEM	6C8.3	6CT8.3	6CTA8.3	C8.3
Maximum Allowable air Intake Restriction at Rated Speed and Load with Dirty Air Filter Element-mm H_2O [in. H_2O]	508 [20]	635 [25]	635 [25]	635 [25]
Maximum Allowable Exhaust Restriction at Rated Speed and Load-mm Hg [in. Hg]		**76 [3]**		
		152 [6]		
Maximum Fuel Filter Pressure Drop Across Filters kPa [PSI]		**34 [5]**		
Maximum Allowable Return Line Restriction-mm Hg [in Hg]		**518 [20.4]**		
Maximum Inlet Restriction to Fuel Transfer Pump mm Hg [in Hg]		**100 [4]**		

*with catalyst

Minimum Recommended Battery Capacity

Battery Size	Ambient Temperatures			
	-18°C (O°F)		O°C. (32°F)	
	Cold Cranking Amperes	Reserve Capacity Amperes	Cold Cranking Amperes	Reserve Capacity Amperes
12 Volt	1800	640	1280	480
24Volt**	900	320	640	240

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

**Per Battery (Two 12 volt batteries in series) CCA ratings are based on-18°C [0°F].

Batteries (Specific Gravity)

Specific Gravity at27℃ [80℉]	State of Charge
1.260-1.280	100%
1.230-1.250	75%
1.200-1.220	50%
1.170-1.190	25%
1.110-1.130	Discharged

Fuel Recommendations/Specifications

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

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

NOTE: The use of diesel fuel blended with lube oil is not acceptable for engines equipped with a catalytic convertor.

Automotive engines for model year 1 994 and beyond are equipped with a catalyst as a part of em ission control.

Use ASTM No. 2 D fuel with a minimum Cetane number of 40. No. 2 diesel fuel gives the best economy and performance under most operating conditions. Fuels with Cetane numbers higher than 40 may be needed In high altitudes or extremely low ambient temperatures to prevent misfires and excessive smoke.

At operating temperatures below 0°C [32°F], use a blend of No. 1 D and No. 2 D fuels, also known as "winterized" No. 2 D.

NOTE: No. 1 D fuel can be used, however, fuel economy and performance will decrease.

Use low sulfur content fuel having a cloud point that is at least 10 degrees below the lowest expected fuel temperature. Cloud point is the temperature at which wax crystals begin to form in diesel fuel.

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

For a more detailed description of fuel properties, refer to Fuel For Cummins Engines, Bulletin No. 3379001-04.

The following chart lists acceptable alternate fuels for MidRange engines.

Acceptable Alternate Fuels Component Wear/Durability

Fuel Type	Bosch Inline Pumps	Nippondenso EP-9
NO. 1-D Diesel	OK	OK
NO. 2 Fuel Oil	OK	OK
NO. 1-K Kerosene	OK	OK
NO. 2-K Kerosene	OK	OK
Jet-A	OK	OK
Jet A-1	OK	OK
JP-5	OK	OK
JP-8	OK	OK
Jet-B	Not ok	Not ok
JP-4	Not ok	Not ok
Cite	Not ok	Not ok

NOTE: Any adjustment to compensate for reduced performance with a fuel system using alternate fuel is not warrantable.

NOTE: Wear on any mid-range fuel injection pump component attributed to the lack of lubrication in the fuel is not a warrantable repair.

Engine Lubricating Oil Recommendations

The use of quailty engine lubricating oils combined with appropriate lubricating oil drain and filter change intervals is a critical factor in maintaining engine performance and durability.

Cummins Engine Company, Inc.recommends the use of a high quality SAE 1 5W-40 heavy duty engine lubricating oil (such as Cummins Premium Blue) which meets the American Petroleum institute (API) performance classi fication CF4/SG.

NO TE: CE/SG/SF engine lubricating oils can be used in areas where CF4 oil is not yet available, but the lubricating oil change interval must be reduced to one half the interval given in the maintenance shcedule.

A sulfated ash limit of 1.0 mass percent is suggested for optimum valve and piston deposit and lubricating oil consumption control. The sulfated ash must not exceed 1.85 mass percent.

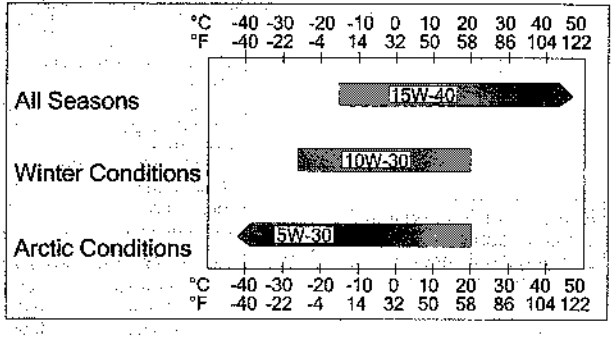
Lubricating Oil Viscosity Recommendations

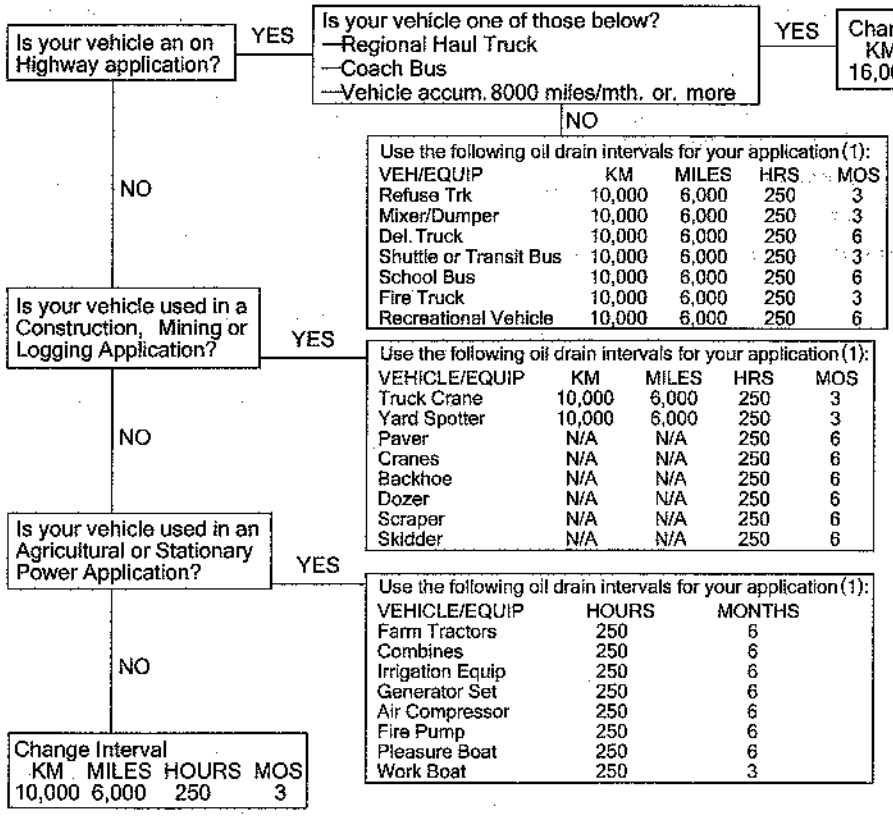
The use of multi-viscosity lubricating oil has been found to improve lubricating oil consumption control and improve engine cranking in cold temperatures while maintaining lubrication at high operating temperatures.

While 1 5W-40 lubricating oil is recommended for most climates。refer to the accompnaying table for lubricating oil viscosity recommendations for extreme climates.

For further details and discussion of engine lubricating oils for Cummins engines, refer to Bulletin No. 3810340, Cummins Engine Oil Recommendations.

Caution: Limited use of low viscosity lubricating oils, such as 10 W-30 may be used to aid in starting the engine and providing sufficient oil flow at ambient temperatures below -5 °C [23 °F]. However, continuous use of low viscosity lubricating oils can decrease engine life due to wear. Refer to the accompanying chart.





(1) Or whichever comes first. If your application accumulates high hours and low mileage, the change interval is determined by hours.

Example: Transit buses and refuse Trucks may average 16 Km/h [10 MPH] when used in an all urban route. Oil drain intervals in those applications are 4800 Km [3,000 mi], or less.

Arctic Operation

if an engine is operated in ambient temperatures consistently below-23°C [-10°F] and there are no provisions to keep the engine warm when It IS not in operation, use a synthetic CC/CE engine lubricating oil with adequate low temperature properties such as; 5W-20 or 5W-30.

The oil supplier must be responsible for meeting the performance service specifications.

Caution: The use of a synthetic base oil does not justify extended lubricating oil change intervals. Extended lubricating oil change intervals can decrease engine life due to factors such as; corrosion, deposits and wear

Special "break in" engine lubricating oils are not recommended for new or rebuilt Cummins engines. Use the same type lubricating oil during the "break in" as that which is used in normal operation.

Caution: A sulfated ash limit of 1.85%has been placed on all engine lubricating oils recommended for use in Cummins engines. Higher ash lubricating oils may cause valve and/or piston damage and lead to excessive lubricating oil consumption.

For natural gas engines, a sulfated ash range of. 03 to. 85 mass percent is recommended. Cummins Engine Company, Inc., does not recommend the use of ashless lubricating oils for natural gas engines.

Additional information regarding lubricating oil availability throughout the world is available in the"E.M.A.Lubricating Oils Data Book for Heavy Duty Automotive and Industrial Engines。' ' The data book may be ordered from the engine Manufacturers Association, One Illinois Center, 111 East Wacker Drive。Chicago, IL U.S. A. 60601. The telephone number is: (312) 644-6610.

Coolant Recommendations

Antifreeze

SPECIFICATIONS-Use low silicate antifreeze which meets ASTM 4985 test (GM6038 spec.) criteria.
CONCENTRATION-Antifreeze must be used in any climate for both freeze and boiling point protection, Cummins recommends a 50 percent concentration level (40 percent to 60 percent range) of ethylene glycol or propylene glycol in most climates. Antifreeze at 68 percent concentration provides the maximum freeze protection and must never be exceeded under any condition. Antifreeze protection decreases above 68 percent.

Ethylene Glycol	Propylene Glycol
40%=-23°C [-10°F]	40%= -21°C [-6°F]
50%=-37°C [-34°F]	50%= -33°C [-27°F]
60%=-54°C [-65°F]	60%= -49°C [-56°F]
68%=-71°C [-90°F]	68%= -63°C [-82°F]

CONCENTRATION TESTING-Antifreeze concentration must be checked using a refractometer (such as Fleetguard Part No. CC2800). "Floating ball"type density testers or hydrometers are not accurate enough for use with heavy duty diesel cooling systems.
COOLANT CHANGE RECOMMENDATION-The coolant must be drained and replaced every 385,000 km [240,000miles], 6,000 hours or 2 years (whichever occurs first) to eliminate buildup of harmful chemicals.

Supplemental Coolant Additives

SUPPLEMENTAL COOLANT ADDITIVES (SCA). Are recommended for all Cummins cooling systems. Antifreeze alone does not provide sufficient corrosion protection for heavy duty diesel engines.

DCA4 is the recommended SCA for all Cummins engines.Other brands can be used provided they provide adaquate engine protection and do not cause seal or gasket degredation or corrosion/fouling.

SCA CONCENTRATION-The recommended concentration level of DCA 4 is 1.5 units per 3.7 liter [1 U.S.gallon]. The DCA4 concentration must never exceed 3.0 units per 3.7 liter [1 U.S.gallon] nor fall below 1.2 units per 3.7 liter [1 U.S.gallon].

DCA4 FILTER CHANGE INTERVAL-Supplemental Coolant Addatives deplete during normal engine operation. Cummins recommends that the level be maintained by installation of a service coolant filter on the engine at every 10,000 km [6,000 miles] 250 hours or 3 months interval.

Coolant Test Kits

DCA4 CONCENTRATION TESTS-As noted above, the primary method is to maintain proper DCA4 concentration levels by changing the service coolant filter at every 10,000 [6,000 mi] 250 hours or 3 months. Fleetguard DCA4 "dip strip" test Kit Part No. CC 2626 or Fleetguard Monitor C Part No. CC2700 must be used if testing is deemed necessary due to:

- addition of untreated make up coolant in excess of 5.7 liters [6 U.S.quarts] between maintenance intervals.
- troubleshooting of cooling system problems in the fleet (such as corrosion or seal leakage)
- An optional program in some fleets to monitor SCA levels to determine if maintenance intervals are acceptable.

NOTE: The practice of using a test kit to determine when to add or change the coolant filter is specifically not recommended. No other test kit (such as the Fleetguard Titration Test Kit Part No. 3300846-S or the 3825379-S) can be used on Cummins engines with DCA4.

DCA4 Unit Maintenance Guide

Fleetguard® Part No.	Cummins Part No.	DCA4 Units
DCA4 Liquid		
DCA 60L	3315459	4*
DCA4 Filter		
WF-2070	3318157	2
WF-2071	3315116	4
WF-2072	3318201	6
WF-2073	3315115	8
WF-2074	3316053	12
WF-2077	None	0

*If **DCA 60L** is used, **do not** use a coolant filter that contains coolant additives. The combination of liquid and filter coolant additives will result in overconcentration.

DCA4 Maintenance Guide

Maintenance Invervals		
Total Cooling System Capacity Liters [U. S. Gallons] (A)	**Initial Charge (B)**	**3 Months 250 Hours 10,000 KM (6,000)**
30 to 57 [6-12]	WF-2074	WF-2070

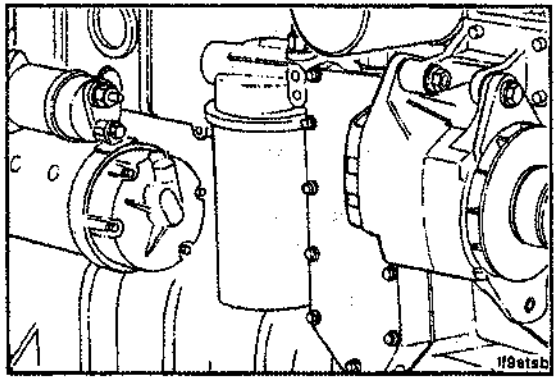
Notes:

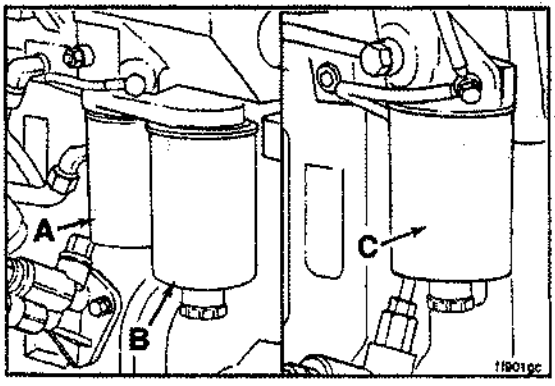
A. consult the vehicle equipment manufacturer's maintenance information for total cooling system capacity.

B. After draining and replacing the coolant, install the initial per charge coolant filter to provide the recommended level of DCA4 concentration.

C. Change coolant filters at regular intervals to protect the cooling system.

D. Check the coolant additive concentration regularly. Check cooling systems using DCA4 only with DCA4 Coolant Test Kit, Fleetguard® Part No. CC-2626.





Filter Selection

Lubricating Oil Filter

3825970 (LF3000) Standard Six Cylinder Aplications

Fuel Filters

A= Standard Filter used as secondary filter in dual filter applications.

B= Fuel Water Separator Primary filter for dual filter applications.

C= Fuel Water Separator used in single filter applications.

Engine Component Torque Values

Socket Or Wrench Size MM (Inch)		Torque N·m	[Ft-lb]
10	Aftercooler Mounting	24	[18]
8	Aftercooler Water Hose clamp	5	[48 in-lb]
13	Alternator Link	24	[18]
13	Alternator Mounting Bolt (10-15 SI)	43	[32]
10	Alternator Support (Upper)	24	[18]
13	Belt Tensioner to Bracket	43	[32]
5 Hex	Belt Tensioner Bracket to Block	24	[18]
18	Vibration Damper	200	[148]
8	Crossover Clamp	5	[48 in-lb]
15	Exhaust Manifold	43	[32]
16	Exhaust Outlet Pipe Mounting	43	[32]
11	Exh Outlet Pipe, "V" Band Clamp	5	[48 in-lb]
10	Fan Bracket Mounting	24	[18]
13	Fan Hub	43	[32]
16	Fan Hub (60 mm Bolt Circle)	43	[32]
24	Flame Start Aid	40	[30]
19	Flywheel	137	[101]

Engine Component Torque Values (Continued)

Socket Or Wrench Size MM (Inch)		Torque N·m	[Ft-lb]
18	Flywheel Housing	77	[57]
(1/2)	Flywheel Housing Drain Plug	43	[32]
-	Front Gear Cover Cap	Hand Tighten	
15	Front Engine Support Mounting	112	[82]
17	Fuel banjo Screw (in Filter Head)	24	[18]
10	Fuel Vent Screw in Banjo	9	[80 in-lb]
75 -80	Fuel Filter	3/4 Turn After Contact	
19	Fuel Low Pressure Supply and return at fuel Injection Pump	24	[18]
10	Fuel Low Pressure Return at Filter Head	9	[80 in-lb]
24	Fuel Filter Adapter Nut	32	[24]
17	Fuel Line Fitting (High Pressure)	24	[18]
19	Fuel Line Fitting (High Pressure)	30	[22]
22	Fuel Injection Pump Drive Gear (A)	70	[52]
27	Fuel Injection Pump Drive Gear (MW)	105	[77]
30	Fuel Injection Pump Drive Gear (P)	131	[144]
24	Fuel Injection Pump Lock	17	[11]
15	Fuel Injection Pump Mounting Nut	43	[32
10	Fuel Injection Pump to Bracket	24	[18]
10	Fuel Injection Pump Vent Screw (PES. MW)	5	[48 in-lb]
15	Fuel Solenoid Bracket	43	[32]
15	Fuel Injection Pump Support bracket to Cylinder Block	43	[32]

Engine Component Torque Values (Continued)

Socket Or Wrench Size MM (Inch)		Torque N·m	[Ft-lb]
8	Fuel Solenoid Mounting	10	[84 in-lb]
10	Fuel transfer Pump Mounting/Cover Plate	24	[18]
18	Engine Lifting Bracket	77	[57]
10	Gear Cover	24	[18]
10	Injector Fuel Drain Manifold	9	[80 in-lb]
10	Injector Retaining capscrew	24	[18]
10	Intake Manifold Cover	24	[18]
118-131	Lubricating Oil Filter	3/4 Turn After Contact	
10	Lubricating Oil Cooler Cover	24	[18]
17	Lubricating Oil Pan Drain Plug	80	[60]
17	Lubricating Oil Pan Heater Plug	80	[60]
32	Lubricating Oil Pressure Regulator Valve	80	[60]
32	Lubricating Oil Thermostat	50	[37]
15	PTO Adapter	77	[57]
13	PTO Adapter Cover Plate A Drive	43	[32]
15	PTO Adapter Cover Plate B Drive	77	[57]
(3/4)	PTO Gear Nut A Drive	100	[74]

Engine Component Torque Values (Continued)

Socket Or Wrench Size MM (Inch)		Torque N·m	[Ft-lb]
(15/16)	PTO Gear Nut B Drive	134	[100]
(11/16)	PTO Flange Companion	85	[63]
14	Rocker Lever Nut	24	[18]
15	Starter Mounting (12 Point)	77	[57]
10	Tachometer Drive Retainer	3	[24 in-lb]
10	Thermostat Housing	24	[18]
T-25 Torx	Timing Pin Flange Mounting	5	[48 in-lb]
13	Turbine Housing	11	[96 in-lb]
11	Turbocharger Compressor Housing Clamp	6	[50 in-lb]
15	Turbocharger Mounting Nut	32	[24]
10	Turbocharger Drain Tube	24	[18]
16	Turbocharger Oil Supply (Both Ends)	35	[26]
8	Water Hose Clamps	5	[48 in-lb]
(3/8)	Water Inlet Plugs	34	[25]
13	Water Pump Mounting	24	[18]
15	Valve Cover	24	[18]
-	Valve Cover Oil Fill		Hand Tighten

Lubricants and Sealants-Engine Assembly

Use the sealants listed below or sealants containing equivalent properties.

Description	Sealing Method
1. Pipe Plugs	Precoated teflon or pipe sealer.
2. Gaskets	No sealant required.
3. Cup Plugs	Loctite® 277 or Cummins Sealant 3375068
4. O-rings	No sealant required.
5. Rear Camshaft Expansion Plug	Loctite® 277 or Cummins Sealant 3375068
6. Fuel Pump Studs	Loctite® 242.
7. Turbocharger drain (in block)	Loctite® 277 or Cummins Sealant 3375068
8.dipstick Tube (in block)	Loctite® 277 or Cummins Sealant 3375068
9. Wet Flywheel Housing to Block	Three Bond Sealant 3823494
10. Rear Seal (in rear cover)	No Sealant
11. Timing Pin Housing Capscrews	No sealant
12. Side Oil Fill	Loctite® 277 or Cummins Sealant 3375068

Use the lubricants listed below or lubricants containing equivalent properties.

Parts	Lubricant Required
Connecting Rod Bearings	Lubriplate 105
Main Bearings	Lubriplate 105
Camshaft Lobes and Journals	Lubriplate 105
Tappets	Lubriplate 105
Pistons	15 W-40 Engine Lubricating Oil
Piston Rings	15 W-40 Engine Lubricating Oil
Piston Pin	15 W-40 Engine Lubricating Oil
Rocker Assemblies	15 W-40 Engine Lubricating Oil
Push Tubes	15 W-40 Engine Lubricating Oil + Lubriplate 105 in cup
Cylinder Liner O-Ring	15 W-40 Engine Lubricating Oil

Capscrews-under head and on threads, as follows:

• Main Bearing Capscrews	15 W-40 Engine Lubricating Oil
• Cylinder Head Capscrews	15 W-40 Engine Lubricating Oil
• Connecting Rod Capscrews	15 W-40 Engine Lubricating Oil
• Flywheel Mounting Capscrews	15 W-40 Engine Lubricating Oil
• Damper Mounting Capscrews	15 W-40 Engine Lubricating Oil
• All Other Capscrews	Preservative Lubricating Oil or 15 W-40 Engine Lubricating Oil
Valve Stems and Seals	15 W-40 Engine Lubricating Oil
Lubricating Oil Pressure Regulator	15 W-40 Engine Lubricating Oil

Capscrew Markings and Torque Values

Caution:When replacing capscrews,always use a capscrew of the same measurement and strength as the capscrew being replaced. Using the wrong capscrews can result in engine damage.

Metric capscrews and nuts are identified by the grade number stamped on the head of the capscrew or on the surface of the nuts. U. S. Customary capscrews are identified by radial lines stamped on the head of the capscrew. the following examples indicate how capscrews are identified:

Metric -M8-1.25x 25

M8	1.25	25
Major Thread Diameter in Millimeters	Distance Between Threads in	Length in Millimeters

U. S. Customary [5/16x8x1 1/2]

5/16	18	1-1/2
Major Thread Diameter in Inches	Number Threads per Inch	Length in Inches

NOTES:

1. **Always** use the torque values listed in the following tables when specific torque values are **not** available.
2. Do **not** use the torque values in place of those specified in other sections of this manual.
3. The torque values in the table are based on the use of lubricated threads.
4. When the ft-lb value is less than 10, give consideration to converting the ft-lb value to in-lb to obtain a better torque with an in-lb torque wrench. Example: 6 ft-lb equals 72 in-lb.

Millimeters

Capscrew Markings and Torque values-Metric

Commercial Steel Class

8.8	10.9	12.9

Capscrew Head Markings

Body Size	Torque				Torque				Torque			
Diam	Cast Iron		Aluminum		Cast Iron		Aluminum		Cast Iron		Aluminum	
mm	N·m	ft-lb	N·m	ft-lb	N·m	ft-lb	N·m	ft-lb	N·m	ft-lb	N·m	ft-lb
6	9	7	7	5	12	9	7	5	12	9	7	5
7	14	10	11	8	18	13	11	8	23	18	11	8
8	25	18	18	13	32	23	18	13	40	29	18	13
10	40	30	30	22	60	45	30	22	70	50	30	22
12	70	56	55	40	105	77	55	40	125	95	55	40
14	115	85	90	66	160	118	90	66	195	145	90	66
16	180	133	140	103	240	177	140	103	290	210	140	103
18	230	170	180	133	320	236	180	133	400	290	180	133

NOTES