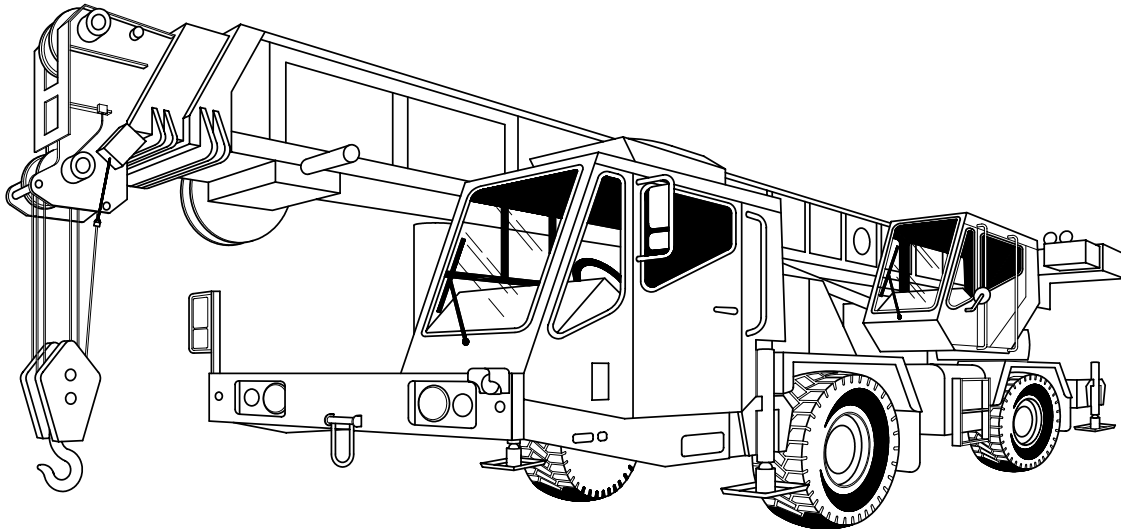


TM 5-3810-307-24-2-1

TECHNICAL MANUAL

**MAINTENANCE MANUAL FOR
DIESEL ENGINE
ALL-TERRAIN CRANE (ATEC) AT422T
DIESEL ENGINE DRIVEN, 22 TON CAPACITY
TRUCK MOUNTED WITH CAB**

NSN 3810-01-448-2619



DISTRIBUTION STATEMENT A - Approved for public release; distribution is unlimited.

**HEADQUARTERS, DEPARTMENT OF THE ARMY
AUGUST 2000**

WARNING

OPERATIONS ADJACENT TO OVERHEAD LINES ARE PROHIBITED UNLESS ONE OF THE FOLLOWING CONDITIONS ARE SATISFIED.

1	POWER HAS BEEN SHUT OFF AND POSITIVE MEANS TAKEN TO PREVENT LINES FROM BEING ENERGIZED.	
2	POSITION AND BLOCK EQUIPMENT INSURING NO PARTS, INCLUDING CABLE, CAN COME WITHIN THE FOLLOWING CLEARANCES:	<u>VOLTAGE REQD CLEARANCE</u> UNDER 50 KV - 10 FEET 69 KV - 12 FEET 115-161 KV - 15 FEET 230-285 KV - 20 FEET 345 KV - 25 FEET 500 KV - 35 FEET

CHECK WITH YOUR LOCAL POWER SUPPLIER FOR CORRECT LINE VOLTAGE

NOTE

READ AND UNDERSTAND ALL OF THE SAFETY WARNINGS AND CAUTIONS CONTAINED IN SECTION 2 OF THE OPERATOR'S MANUAL BEFORE OPERATING OR MAINTAINING THE CRANE, DIRECT ANY QUESTIONS THAT YOU MAY HAVE TO YOUR SUPERVISOR FOR CLARIFICATION.

TM 5-3810-307-24-2-1

CHANGE
NO. 1

HEADQUARTERS, DEPARTMENT OF THE ARMY
WASHINGTON D.C., 30 NOVEMBER 2006

TECHNICAL MANUAL

VOLUME 1 MAINTENANCE MANUAL FOR
DIESEL ENGINE

All-Terrain Crane (ATEC)
Diesel Engine Driven, 22 Ton Capacity
Truck Mounted With Cab
NSN 3810-01-448-2619

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TM 5-3810-307-24-2-1, 1 August 2000, is updated as follows:

1. File this sheet in front of the manual for reference.
2. This change is a result of miscellaneous changes documented against the diesel engine configuration. The most significant change involves the replacement of Holset air compressor with a Cummins/Wabco air compressor.
3. New or updated test is indicated by a vertical bar in the outer margin of the page.
4. Added illustrations are indicated by a vertical bar adjacent to the figure number. Changed illustrations are indicated by change bars in the outside margin adjacent to the updated area and a change bar adjacent to the figure number.
5. Remove old pages and insert new pages as indicated below:

Remove Pages

List of Effective Pages
Title Page, Foreword, Table of Contents,
and Important Reference Numbers
i-1 through i-14
E-1 through E-18
1-1 and 1-2
1-5 through 1-12
2-1 and 2-2
2-5 and 2-6
3-1 through 3-8
4-1 thru 4-6
4-13 and 4-14
5-1 and 5-2
5-5 through 5-10
6-1 through 6-10
T-19 and T-20
T-29 and T-30
A-1 through A-104
V-1 through V-24

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2-5 and 2-6
3-1 through 3-6
4-1 thru 4-6
None
5-1 and 5-2
5-5 through 5-8
6-1 through 6-10
T-19 and T-20
T-29 and T-30
A-1 through A-86
V-1 through V-20

Remove Pages
1 through 4

Insert Pages
Index 1 through Index 4

By Order of the Secretary of the Army:

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PETER J. SCHOOMAKER
*General, United States Army
Chief of Staff*

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TM 5-3810-307-24-2-1

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LIST OF EFFECTIVE PAGES

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Dates of issue for original and changed pages are:

Original ..0..1 August 2000

Change ..1..30 November 2006

**TOTAL NUMBER OF PAGES FOR THIS MANUAL IS 266
CONSISTING OF THE FOLLOWING:**

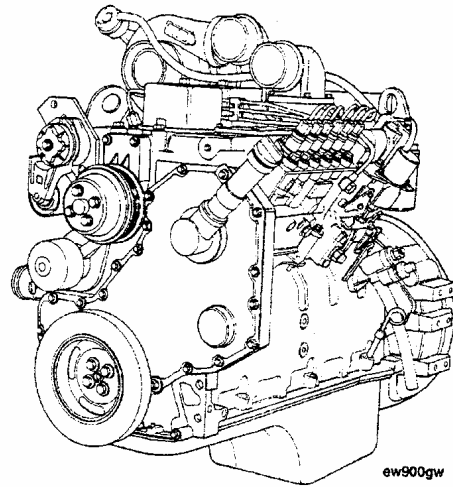
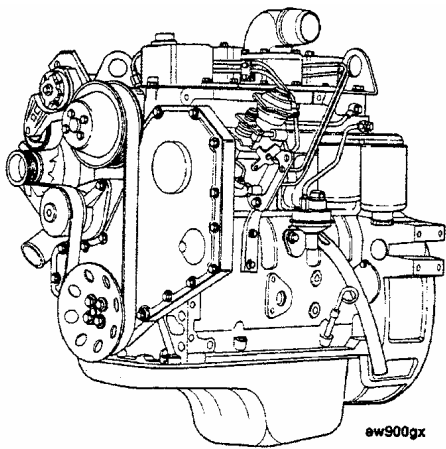
Page No.	*Change No.	Page No.	*Change No.	Page No.	*Change No.
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Blank	0	5-6 – 5-8	1		
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i-2 – i-3	0	6-3 – 6-10	1		
i-4	1	7-1 – 7-12	0		
i-5	0	T-1 – T-18	0		
i-6 – i-10	1	T-19 – T-20	1		
i-11/ (i-12 blank)	1	T-21 – T-28	0		
E-1	1	T-29 – T-30	1		
E-2	0	T-31 – T-38	0		
E-3 – E-12	1	A-1 – A-86	1		
1-1 – 1-2	1	V-1 – V-20	1		
1-3 – 1-5	0	S-1 – S-4	0		
1-6 – 1-8	1	C-1 – C-8	0		
2-1	0	W-1/ (W-2 blank)	0		
2-2	1	L-1 – L-6	0		
2-3 – 2-4	0	Index-1 –	1		
2-5 – 2-6	1	Index-4			
2-7 – 2-10	0				
3-1	1				
3-2	0				
3-3 – 3-6	1				
4-1 – 4-2	1				
4-3	0				
4-4 – 4-6	1				
4-7 – 4-12	0				
5-1	1				

* Zero in this column indicates an original page.

TM 5-3810-307-24-2-1
30 September 2006

Operation and Maintenance Manual B Series Engines

U.S.A., Canada, Australia,
New Zealand, and Puerto Rico



TM 5-3810-307-24-2-1

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.

Read and follow all safety instructions. Refer to the WARNING in the General Safety Instructions in this section.

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 their trademarks:

NOTE

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

MAINTENANCE MANUAL FOR
DIESEL ENGINE
ALL-TERRAIN CRANE (ATEC) AT422T
DIESEL ENGINE DRIVEN, 22 TON CAPACITY
TRUCK MOUNTED WITH CAB
NSN 3810-01-448-2619

TM 5-3810-307-24-2-1

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this publication. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Submit your DA Form 2028 (Recommended Changes to Equipment Technical Publications), through the Internet, on the Army Electronic Product Support (AEPS) website. The Internet address is <http://aeeps.ria.army.mil>. The DA Form 2028 is located under the Public Applications section in the AEPS Public Home Page. Fill out the form and click on SUBMIT. Using this form on the AEPS will enable us to respond quicker to your comments and better manage the DA Form 2028 program. You may also mail, fax or E-mail your letter or DA Form 2028 direct to: AMSTA-LC-LMIT / TECH PUBS, TACOM-RI, 1 Rock Island Arsenal, Rock Island, IL 61299-7630. The email address is TACOM-TECH-PUBS@ria.army.mil. The fax number is DSN 793-0726 or Commercial (309) 782-0726.

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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

Section i - Introduction

Section Contents

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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).

Cummins Engine Company, Inc. uses the latest technology and the highest quality components to produce its engines. Cummins recommends using only genuine Cummins parts and ReCon exchange parts.

Personnel at Cummins Authorized Repair Locations have been trained to provide expert service and parts support. If you have 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.

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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 also.

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.



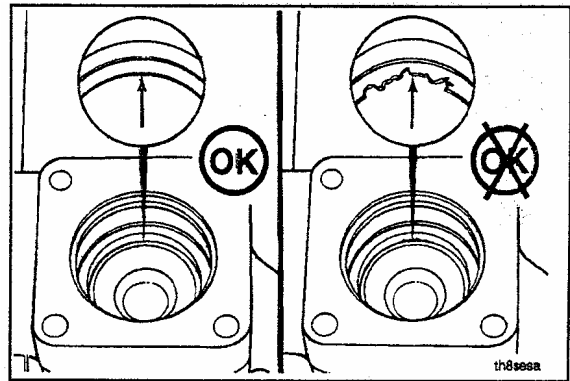
The component weighs 23 kg [50 lb] or more. To avoid personal injury, use a hoist or get assistance to lift the component.

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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**

Improper practices or carelessness can cause burns, cuts, mutilation, asphyxiation or other bodily injury or death.

Read and understand all of the safety precautions and warnings before performing any repair. This list contains the general safety precautions that **must** be followed to provide personal safety. Special safety precautions are included in the procedures when they apply.

- Make sure the work area surrounding the product is dry, well lit, ventilated; free from clutter, loose tools, parts, ignition sources and hazardous substances. Be aware of hazardous conditions that can exist.
- **Always** wear protective glasses and protective shoes when working.
- Rotating parts can cause cuts, mutilation or strangulation.
- Do **not** wear loose-fitting or torn clothing. Remove all jewelry when working.
- Disconnect the battery (negative [-] cable first) and discharge any capacitors before beginning any repair work. Disconnect the air starting motor if equipped to prevent accidental engine starting. Put a “Do **Not** Operate” tag in the operator’s compartment or on the controls.
- Use **ONLY** the proper engine barring techniques for manually rotating the engine. Do **not** attempt to rotate the crankshaft by pulling or prying on the fan. This practice can cause serious personal injury, property damage, or damage to the fan blade(s) causing premature fan failure.
- If an engine has been operating and the coolant is hot, allow the engine to cool before you slowly loosen the filler cap and relieve the pressure from the cooling system.

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WARNING Continued

- Do **not** work on anything that is supported **ONLY** by lifting jacks or a hoist. Always use blocks or proper stands to support the product before performing any service work.
- Relieve all pressure in the air, oil, and the cooling systems before any lines, fittings, or related items are removed or disconnected. Be alert for possible pressure when disconnecting any device from a system that utilizes pressure. Do **not** check for pressure leaks with your hand. High pressure oil or fuel can cause personal injury.
- To prevent suffocation and frostbite, wear protective clothing and **ONLY** disconnect liquid refrigerant (freon) lines in a well ventilated area. To protect the environment, liquid refrigerant systems must be properly emptied and filled using equipment that prevents the release of refrigerant gas (fluorocarbons) into the atmosphere. Federal law requires capture and recycling refrigerant.
- To avoid personal injury, use a hoist or get assistance when lifting components that weigh 23 kg [50 lb] or more. Make sure all lifting devices such as chains, hooks, or slings are in good condition and are of the correct capacity. Make sure hooks are positioned correctly. **Always** use a spreader bar when necessary. The lifting hooks **must not** be side-loaded.
- Corrosion inhibitor contains alkali. Do **not** get the substance in your eyes. Avoid prolonged or repeated contact with skin. Do **not swallow** internally. In case of contact, immediately wash skin with soap and water. In case of contact, immediately flood eyes with large amounts of water for a minimum of 15 minutes. IMMEDIATELY CALL A PHYSICIAN. KEEP OUT OF REACH OF CHILDREN.
- Naptha and Methyl Ethyl Ketone (MEK) are flammable materials and **must be** used with caution. Follow the manufacturer's instructions to provide complete safety when using these materials. KEEP OUT OF REACH OF CHILDREN.

WARNING Continued

- To avoid burns, be alert for hot parts on products that have just been turned OFF, and hot fluids in lines, tubes, and compartments.
- **Always** use tools that are in good condition. Make sure you understand how to use them before performing any service work. Use **ONLY** genuine Cummins or Cummins Recon® replacement parts.
- **Always** use the same fastener part number (or equivalent) when replacing fasteners. Do **not** use a fastener of lesser quality if replacements are necessary.
- Do **not** perform any repair when fatigued or after consuming alcohol or drugs that can impair your functioning.
- Some state and federal agencies in the United States of America have determined that used engine oil can be carcinogenic and can cause reproductive toxicity. Avoid inhalation of vapor, ingestion, and prolonged contact with used engine oil.

Definition of Terms

AFC	Air Fuel Control	H₂O	Water
API	American Petroleum Institute		
ASA	Air Signal Attenuator	in-lb	Inch Pound
ASTM	American Society of Testing and Materials	kg	Kilograms
		km	Kilometers
C	Celsius	km/l	Kilometers per Liter
CARB	California Air Resources Board	kPa	Kilopascal
C.I.D.	Cubic Inch Displacement	l	Liter
Cm	Centimeter	m	Meter
CPL	Control Parts List	mm	Millimeter
cSt	Centistokes	Mpa	Megapascal
DCA	Diesel Coolant Additive	MPH	Miles Per Hour
ECM	Electronic Control Module	MPQ	Miles Per Quart
E.C.S.	Emission Control System	N•m	Newton-meter
EPA	Environmental Protection Agency	OEM	Original Equipment Manufacturer
EPS	Engine Position Sensor	ppm	Parts Per Million
F	Fahrenheit	psi	Pounds Per Square Inch
ft-lb	Foot Pound	PTO	Power Takeoff
GVW	Gross Vehicle Weight	RPM	Revolutions Per Minute
Hg	Mercury	S.A.E.	Society of Automotive Engineers
HP	Horsepower	STC	Step Timing Control

Definition of Terms - Continued

VS	Variable Speed
VSS	Vehicle Speed Sensor

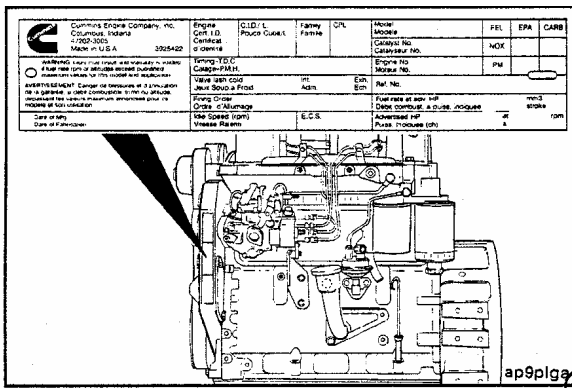
Section E – Engine and Component Identification

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Robert Bosch In-Line Dataplate Location	E-3

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Engine Identification



Engine Dataplate

The engine dataplates show specific information about your 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.

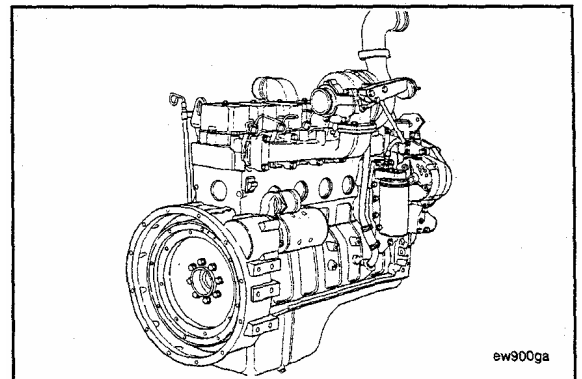
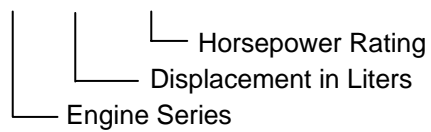
<p>Cummins Engine Company, Inc. Columbus, Indiana 47202-3005 Made in U.S.A.</p> <p>3925422</p> <p>WARNING: Injury may result and warranty is voided if fuel rate rpm or altitudes exceed published maximum values for this model and application. AVERTISSEMENT: Danger de blessures et d'annulation de la garantie, si débit combustible, tr/mn ou altitude, dépassent les valeurs maximum annoncées pour ce modèle et son utilisation.</p> <p>Date of Mfg. Date de Fabrication</p>	Engine Cert. I.D. Certificat d'identité	C.I.D./L. Pouce Cube/L.	Family Famille	CPL	Model Modèle	FEL	EPA	CARB
	Timing-T.D.C. Calage-PM.H.	Int. Adm.	Ext. Ech.	Ref. No.				
	Valve lash cold Jeux Soup.à Froid							
	Firing Order Ordre d'Allumage	E.C.S.			Fuel rate at adv. HP Débit combust. à pleine charge	mm3 stroke		
	Idle Speed (rpm) Vitesse Régime				Advertised HP Puiss. Indiquée (ch)	at a	rpm	

ap9plga

Automotive/Industrial Engine Nomenclature

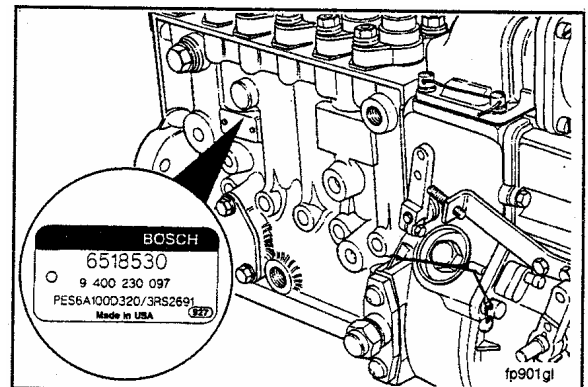
The model name for Automotive/Industrial engines provides the following engine data:

B 5.9 - 190

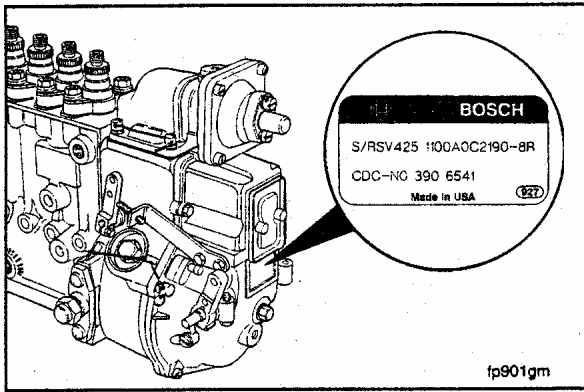


Injection Pump Dataplate

Robert Bosch In-Line Dataplate Location



TM 5-3810-307-24-2-1



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

General Specifications (Automotive Engines)

Lubricating System kPa [psi]					B5.9-190		
Bore - mm [in.].....					102 [4.02]		
Stroke - mm [in.].....					120 [4.72]		
Displacement - liter [in. ³]					5.9 [359]		
Engine Weight (Dry) Less Flywheel and Electrics – kg [lbs.].....					428 [942]		
Firing Order					1-5-3- 6-2-4		
Valve Clearances:							
- Intake - mm [in.].....					0.25 [0.010]		
- Exhaust - mm [in.]					0.51 [0.020]		
Compression Ratio.....					17.1:1		
Rotation, viewed from the Front of the Engine.....					Clockwise		
Aspiration:							
- Naturally Aspirated							
- Turbocharged					X		
- Aftercooled							
- Charge Air Cooled					X		

General Specifications (Automotive Engines)

Lubricating System kPa [psi]					B5.9-190		
Min. Allowable Press. @ Idle.....					69 [10]		
Min. Allowable Press. @ Rated Regulated Pressure @ Oil Rifle.....					207 [30] 449 [65]		
Filter Bypass Diff. Pressure					172 [25]		
Oil Capacity L [QT]:							
- Standard Pan Only.....					14.2 [15]		
- Total System					16.4 [17.3]		
QTS From "L" to "H"					[2]		
Cooling System L [QT]							
Engine Coolant Capacity					9.0 [9.5]		
Thermostat Modulating Range:							
C					83-95		
[F]					[181-203]		
Pressure Cap kPa [psi]:							
- 104C° [220°F].....					103[15]		
- 99C° [210°F].....					48[7]		

General Specifications (Automotive Engines)

Intake Air, Exhaust, And Fuel System					B5.9-190		
Maximum Allowable Intake Restriction at Rated Speed and Load with Dirty Air Filter Element – mm H ₂ O [in. H ₂ O].....					635 [25]		
Maximum Allowable Exhaust Restriction at Rated Speed and Load – mm Hg [in. Hg]					152.4 [6]*		
Maximum Allowable Restriction to fuel transfer Pump mm Hg [in. Hg]					100 [4]		
Maximum Allowable Return Line Restriction – mm Hg [in. Hg]					518 [20.4]		
Maximum Fuel Pressure Drop Across Filters kPa [psi]					34 [5]		

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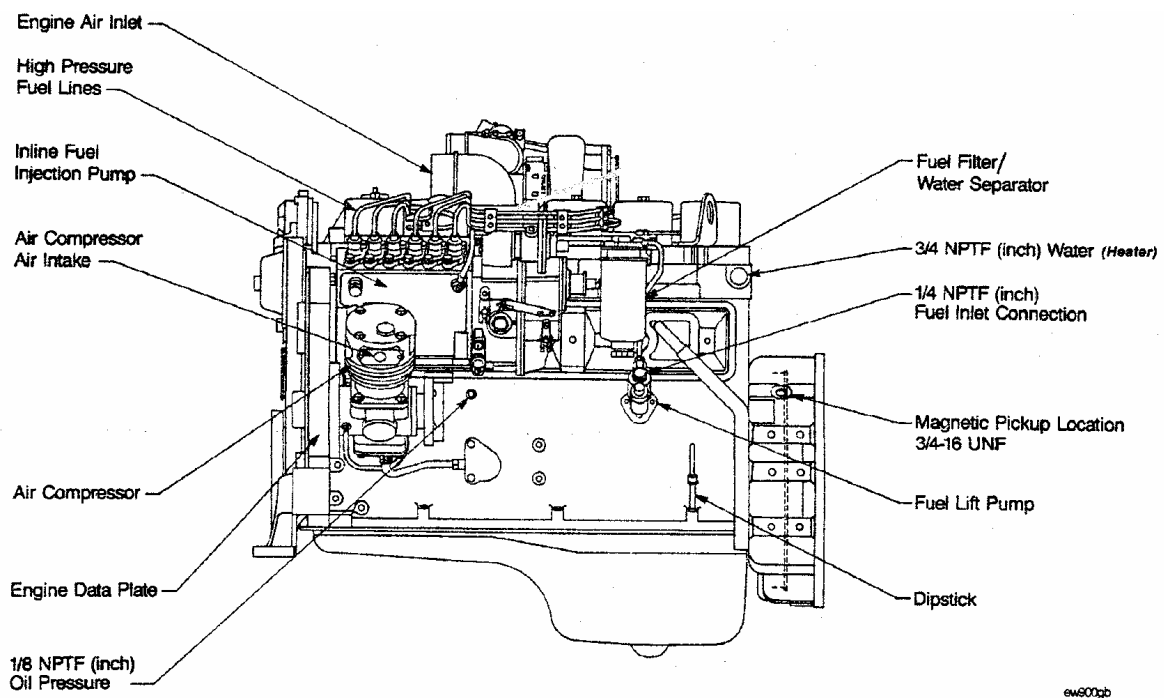
General Specifications (Automotive Engines)

For General Electrical System Information Refer to TM 5-3810-307-24-1, Volume 1.

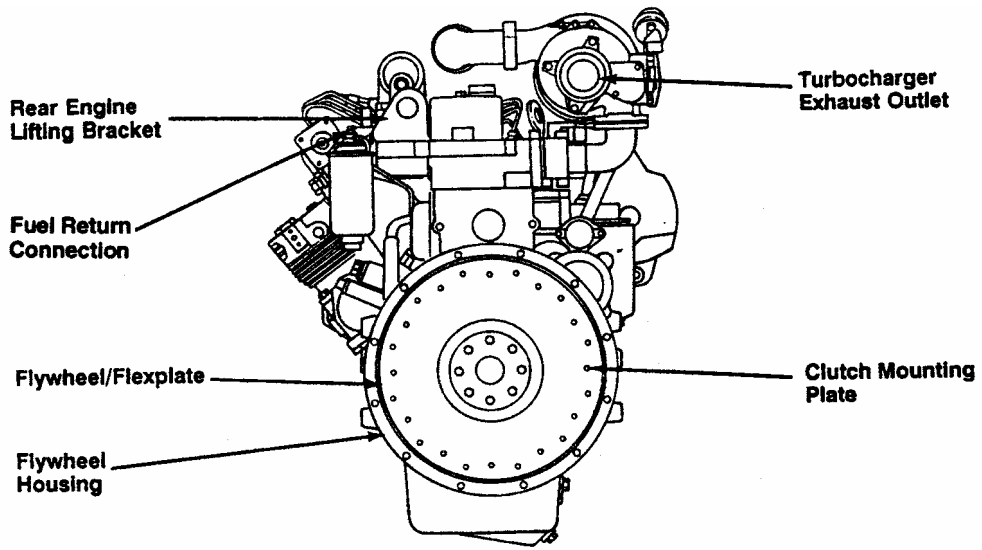
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External Engine Components

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



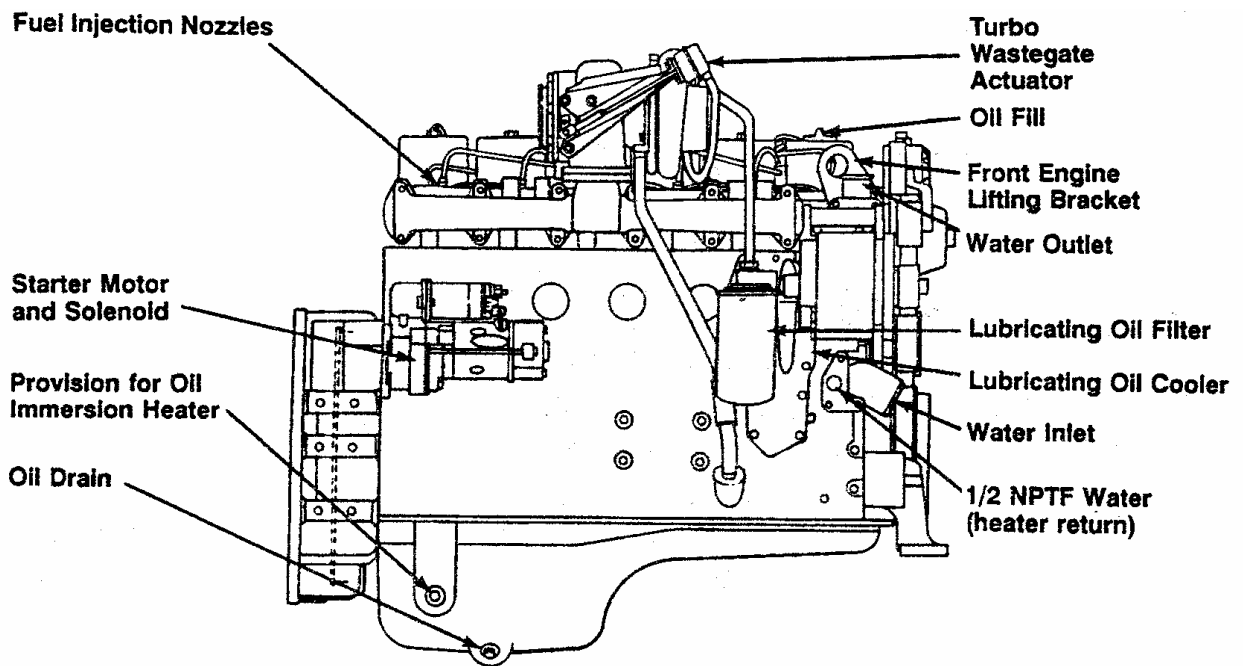
TM 5-3810-307-24-2-1



Rear View

Rear View

aw900gd

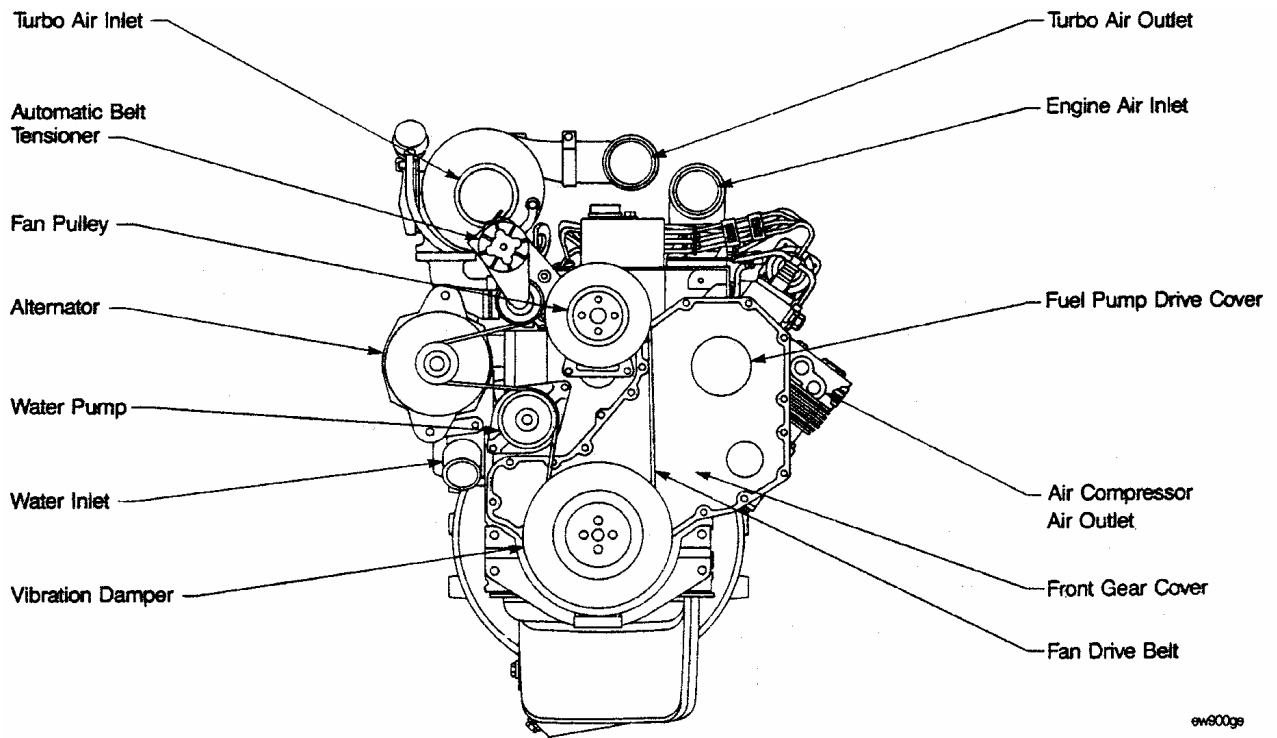


Turbocharger Side View

aw900nc

Turbocharger Side View

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ew900ge

Front View

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General Information

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

- Follow the daily maintenance checks listed in Maintenance Guidelines, Section 2.
- Check the oil pressure indicators, temperature indicators, warning lights, 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/or extensive property damage. Numerous safety devices are available, such as air intake shut-off 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. The equipment owner and operator are responsible for safe operation in a hostile environment. Consult your authorized repair location for further information.

Starting Procedure

Automotive/Industrial

All pumps - above 16°C [60°F].

Foot off throttle. If engine does not start within five 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 moving the throttle.

1-2 C-1

Starting Procedure Matrix

Automotive/Industrial	Idle Throttle	Full Throttle
All pumps – above 16°C [60°F].....	X (after 5 sec, see Note)	
All pumps – below 16°C [60°F].....		X Note

NOTE

Full throttle is applied after engaging 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.



CAUTION

To prevent damage to the starter, 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 make sure adequate lubrication is available to the bearings.



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°C [140°F]), 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 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.

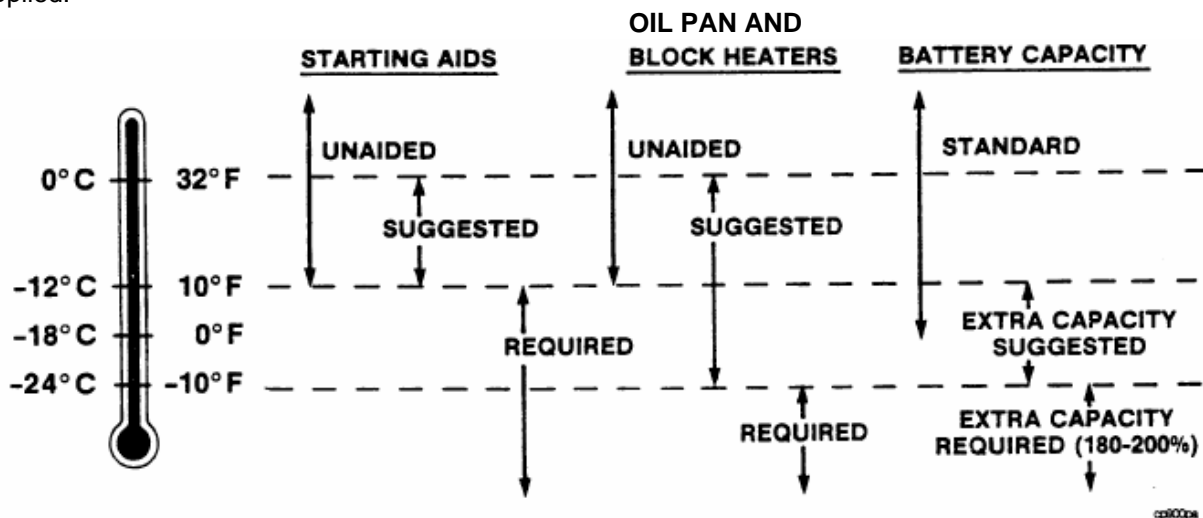
Cold Weather Operation

Starting Aid Requirements

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

Operation in ambient temperatures below 0°C [32°F] can require special consideration be given to engine starting.

At temperatures below 0°C [32°F], operate the engine at **moderate** speeds for five minutes before full loads are applied.



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Starting Procedure – After Extended Shutdown or Oil Change

Complete the following steps after each 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 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 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.

Operating the Engine

- Do **not** operate the engine at full throttle below peak torque engine speed (1100 to 1600 RPM, dependent on engine rating) for extended periods (more than 1 minute) of time.
- Allow the engine to idle 3 to 5 minutes before shutting it off after a full load operation.



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.

- Monitor the oil pressure and coolant temperature gauges frequently. Refer to Lubricating Oil System or Cooling System, Section V, for recommended operating pressures and temperatures. Shut off the engine if any pressure or temperature does **not** meet the specifications.
- If an overheating condition starts to occur, reduce the power output of the engine by releasing the throttle pressure or shifting the transmission to a lower gear, or both, until the temperature returns to normal operating range. If engine temperature does **not** return to normal, shut off the engine and refer to Troubleshooting, Section T, or contact an 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 as follows:

— Engine misfires	— Excessive smoke
— Vibration	— Loss of power
— Unusual engine noises	— An increase in oil consumption
— Fuel, oil, or coolant leaks	— An increase in fuel consumption
— Sudden changes in engine operating temperature or oil pressure	

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 1,600 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 1 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

- Allow the engine to idle 3 to 5 minutes after a full load operation before shutting it 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

	Page
General Information	2-2
Maintenance Record Form	2-8
Maintenance Schedule	2-4
Page References for Maintenance Instructions	2-5
Tool Requirements	2-3

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General Information

Follow the maintenance schedule in this section in order to obtain proper operation and preserve the warranty on the engine.

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 Authorized Repair Location for recommended intervals.

Use the chart provided at the end of this section as a convenient way to keep a record of maintenance performed.

If your 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.

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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	Filter Wrenches (75-80mm and 90-95mm)
17mm	17mm	Ratchet (1/2 inch drive)
15mm	15mm	Torque Wrench
	14mm	Flat Blade Screwdriver
	13mm	5/16 Allen Wrench
	10mm	Feeler Gauges (0.25 mm and 0.51 mm)
		Engine Barring Gear Part No. 3824591

Maintenance Schedule

Daily or Refueling	Every 10,000 Km [6,000 Mi], 250 Hours or 3 Months	Every 19,000 Km [12,000 Mi], 500 Hours or 6 Months	Every 38,000 Km [24,000 Mi] 1000 Hours or 12 Months	Every 77,000 Km [48,000 Mi], 2000 Hours or 2 Years
Check	-----Change/Replace-----			
• Oil Level	• Lube Oil ^①	• Lube Oil	• Lube Oil	• Lube Oil
• Coolant Level	• Lube Filter	• Lube Filter	• Lube Filter	• Lube Filter
• Fan – Inspection		• Fuel Filter ^⑤	• Fuel Filter	• Fuel Filter
• Drive Belt – Inspection				• Antifreeze ^③
• Fuel Water Trap				
	-----Adjust-----			
			• Valve Lash ^② Clearance	
	-----Check/Inspect-----			
	• Air Cleaner	• Air Cleaner	• Air Cleaner	• Air Cleaner
	• Intake System	• Intake System	• Intake System	• Charge Air Cooler ^④
	• Charge Air Cooler	• Antifreeze ^③	• Charge Air Cooler	• Intake System
		• Charge Air Cooler	• Antifreeze	• Fan Hub
			• Fan Hub	• Belt Tensioner
			• Belt Tensioner	• Bearing
			• Bearing	• Belt Tension
			• Belt Tension	• Damper

- ① Refer to the Oil change Interval chart given in Section 4 to find the specific oil change interval for your application.
- ② Initial valve lash clearance adjustment, subsequent adjustments to be performed at 77,000 Km [48,000 mile] intervals or every 8th oil change for automotive engines or, 2000 hours, 2 year intervals for industrial engines.
- ③ Must use a heavy duty year around antifreeze that meets the chemical composition of GM6038M. The change interval is 2 years or 320,000 Km [200,000 Mi], whichever occurs first. Antifreeze is essential for freeze, overheat and corrosion protection.
- ④ Service interval is 2 years or 320,000 Km [200,000 Mi], whichever occurs first.
- ⑤ Service interval is every other oil change or 19,000 Km [12,000 miles], 500 hours or 6 months, whichever comes first.

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

- Belts - inspect 3-5
- Engine oil level - check 3-3
- Engine coolant level - check 3-4
- Fan - inspect 3-6
- Fuel-water separator - drain 3-3

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

- Lubricating oil - change 4-5
- Lubricating oil filters - change 4-5
- Air intake system - check 4-11
- Air cleaner restriction - check 4-12
- Charge Air Cooler 4-11

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

- Lubricating oil – change..... 4-5
- Lubricating Oil filter – change 4-5
- Fuel filter - change 5-3
- Intake air system – check 4-11
- Charge Air Cooler 4-11
- Coolant and Antifreeze – check..... 5-9

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

- Lubricating oil - change..... 4-5
- Lubricating oil filters - change..... 4-5
- Fuel filter – change 5-3
- Intake air system – check 4-11
- Charge Air Cooler 4-11
- Valve lash clearance – adjust (first time only, thereafter every 77,000 KM) 6-3
- Fan hub - check 6-11
- Belt tensioner bearing - check 6-11
- Belt tension – check..... 6-9
- Coolant and antifreeze – check 5-9

(Text Deleted)

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

- Lubricating oil - change..... 4-5
- Lubricating oil filter - change..... 4-5
- Fuel filter - change 5-3
- Intake air system - check..... 5-3
- Valve lash clearance - adjust 6-3
- Fan hub - check 6-11
- Belt tensioner bearing - check 6-9
- Belt tension - check 6-11
- Vibration damper - inspect 7-7
- Charge Air Cooler - leak check (320,000 Km/200,000 Mi) A-87

Every 320,000 Kilometers [200,000 Miles], 6,000 Hours or 2 Years

- Coolant and antifreeze - change..... 7-3

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Maintenance Record Form

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

Section 3 – Daily Maintenance Procedures

Section Contents

	Page
Coolant Level	3-4
Check	3-4
Cooling Fan	3-6
Inspection.....	3-6
Drive Belt	3-6
Inspection.....	3-6
General Information	3-2
Oil Level	3-3
Check	3-3

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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 oil and coolant levels. Look for:

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

Oil Level

Check

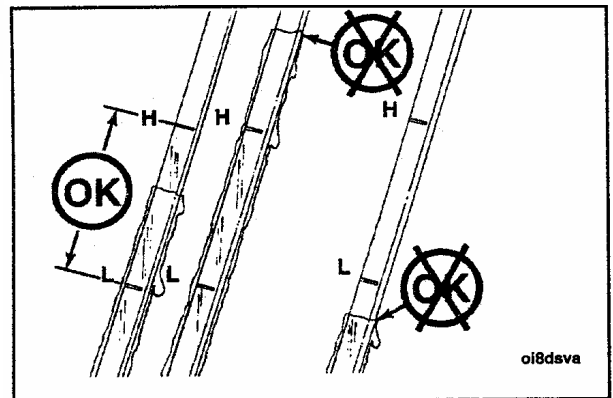
Never operate the engine with the oil level below the "L" (Low) mark or above the "H" (High) mark. Wait at least 15 minutes after shutting off the engine to check the oil. This allows time for the oil to drain to the oil pan.

NOTE

The vehicle must be level when checking the oil level to make sure the measurement is correct.

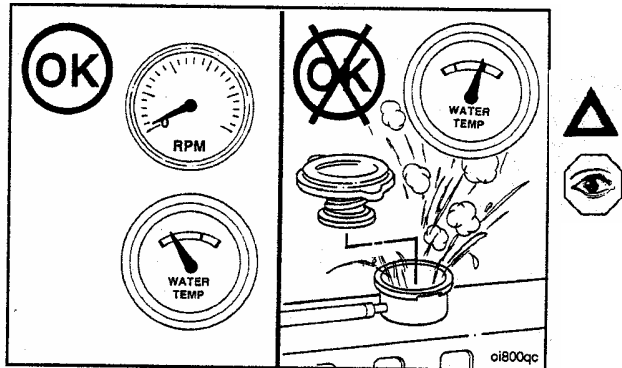
Low Mark To High Mark Oil Capacity

6 Cylinder - 1.89 Liter [2.0 U.S. Quart]



oi8dsva

TM 5-3810-307-24-2-1



Coolant Level

Check

WARNING

Do not remove the radiator cap from a hot engine. Wait until the temperature is below 50 C [120 F] 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 over-heat.

The coolant level **must** be checked daily, refer to TM 5-3810-307-10 for correct procedures for checking coolant level.

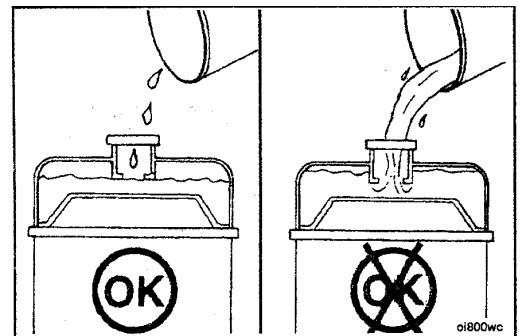
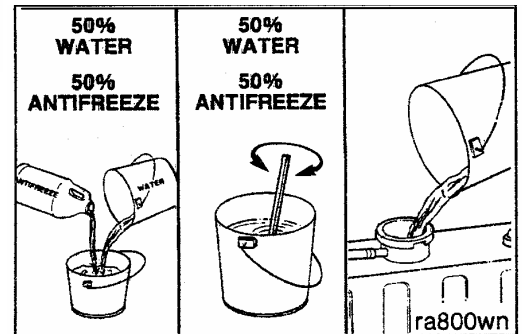
CAUTION

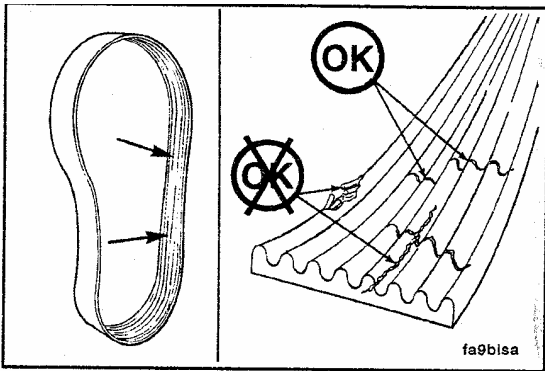
Do not add cold coolant to a hot engine. Engine castings can be damaged. Allow the engine to cool to below 50°C [120°F] before adding coolant.

NOTE

On applications that use a coolant recovery system, check to make sure the coolant is at the appropriate level on the coolant recovery tank depending on engine temperature.

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

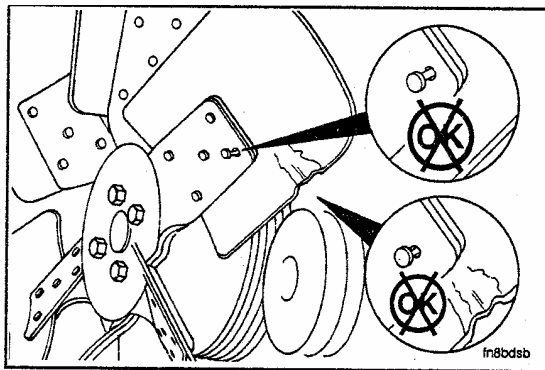




Drive Belt

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.

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.

Section 4 – Maintenance Procedures at 10,000 Kilometers [6,000 Miles], 250 Hours or 3 Months

Section Contents

	Page
Air Intake System	4-10
Inspection	4-10
Charge Air Cooler	4-11
Cleaning	4-12
Inspection	4-11
General Information	4-2
Lubricating Oil and Filter	4-4
Changing	4-4
Lubricating Oil and Filter Change Interval	4-2

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General Information

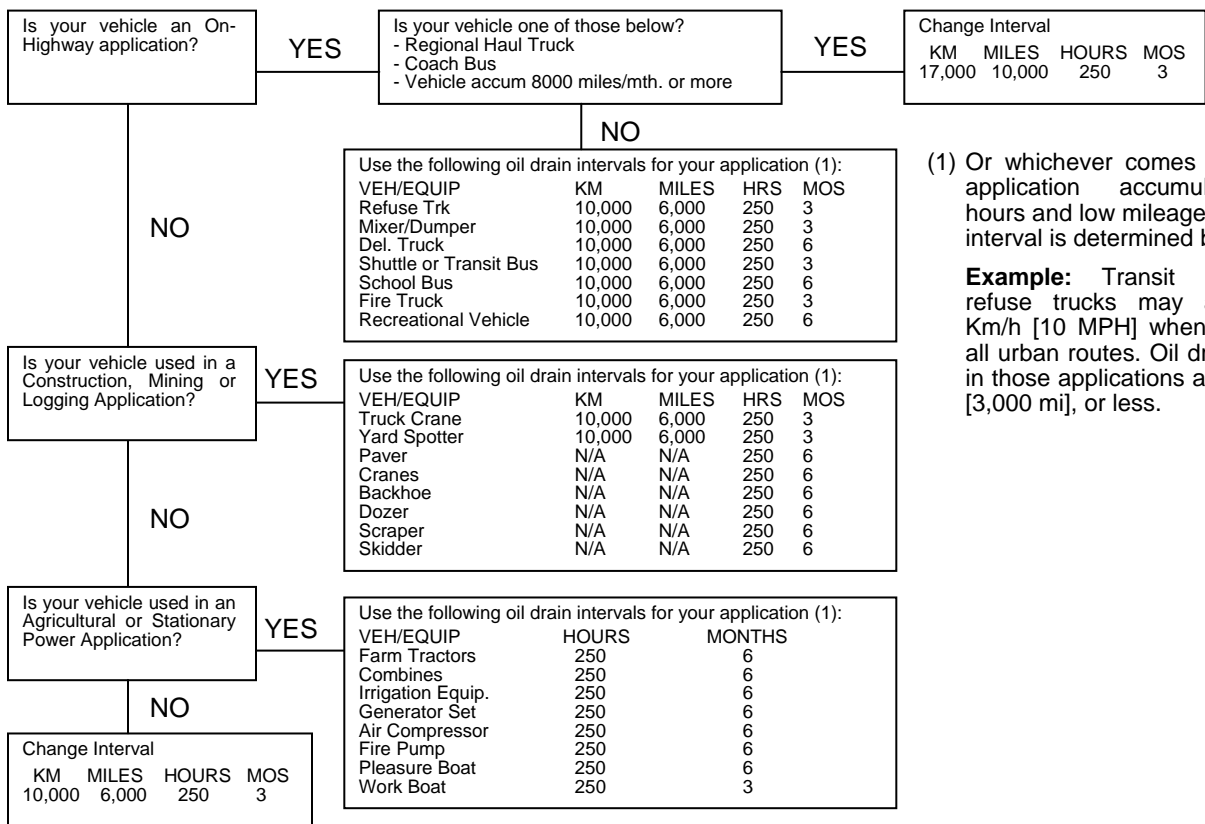
All checks or inspections listed under daily or previous maintenance intervals **must** also be performed at this time in addition to those listed under this maintenance interval.

Lubricating Oil and Filter Change Interval

Refer to the following flow chart to determine the **maximum** recommended oil and filter change intervals in kilometers, miles, hours or months; whichever comes first.

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(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 routes. Oil drain intervals in those applications are 4,800 Km [3,000 mi], or less.

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Lubricating Oil and Filter

Changing



WARNING

Avoid prolonged and repeated skin contact with used engine 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 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 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 oil.

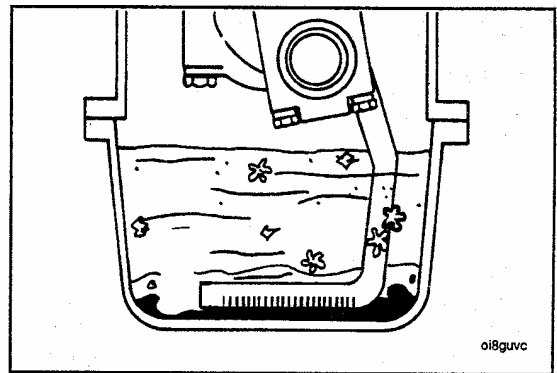
NOTE

If the engine is in service, the oil drain interval of 10,000 Km [6,000 miles] 250 hours or 3 months (or approved extended interval from the Chart on Page 4-3) **must** be observed.

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

NOTE

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



17 mm

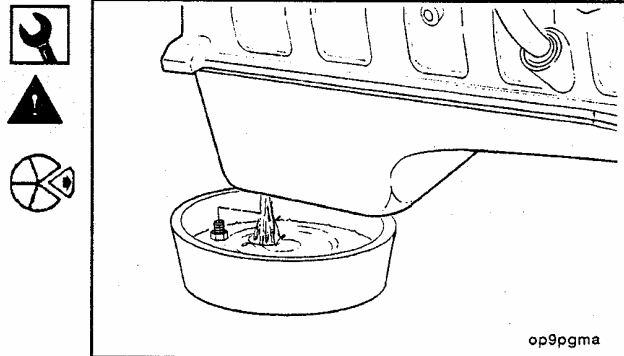
WARNING

Hot oil can cause personal injury.

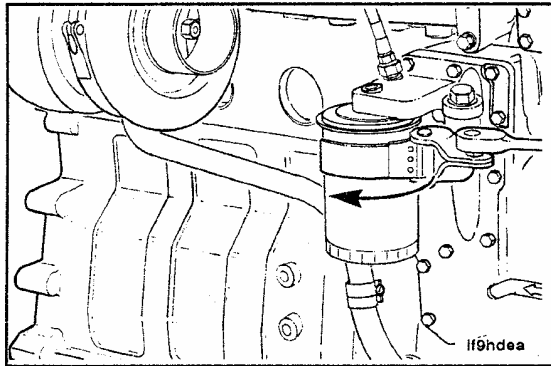
Operate the engine until the water temperature reaches 60° C [140° F]. Shut the engine off. Remove the oil drain plug.

NOTE

Use a container that can hold at least 20 liters [15 U.S. qts.] of oil.



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90 to 95 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 before installing the new filter.

Make sure the correct oil filter is used.

The filter for the six-cylinder engine is longer than the filter for four-cylinder engines.

B = Standard for six-cylinder applications.



CAUTION

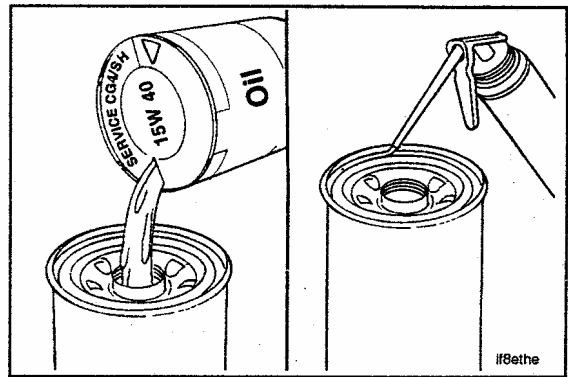
A 6 cylinder oil filter can be used on a 4 cylinder engine. Do not use a 4 cylinder oil filter on a 6 cylinder engine. Use of a 4 cylinder oil filter on a 6 cylinder engine will result in engine damage.



NOTE

Fill the filters with clean lubricating oil before installation.

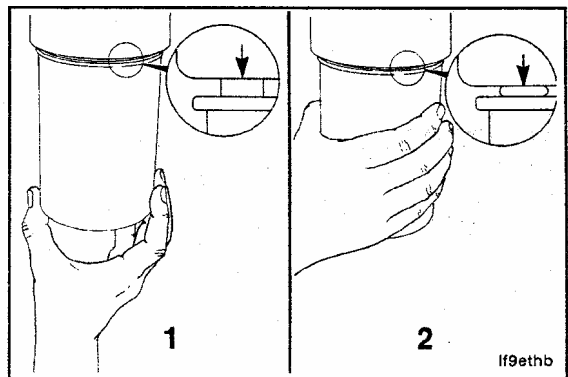
Apply a light film of lubricating oil to the gasket sealing surface before installing the filters.



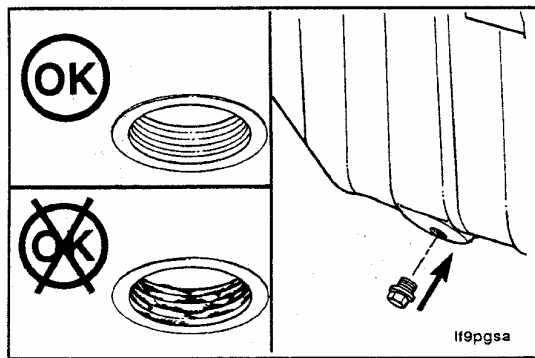
CAUTION

Mechanical over-tightening can distort the threads or damage the filter element seal.

Install the filter as specified by the filter manufacturer.



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17 mm

Check and clean the oil drain plug threads and sealing surface.

Install the oil drain plug.

Torque Value: 80 N•m

[60 ft-lb]

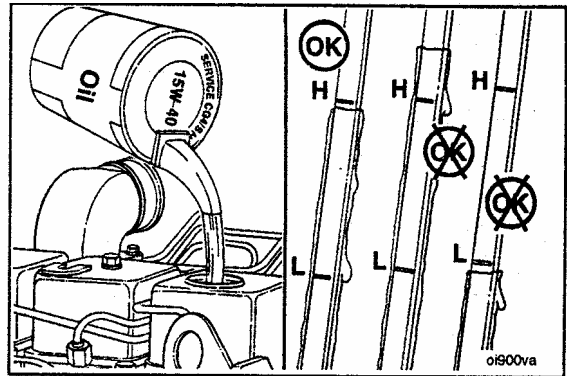


NOTE

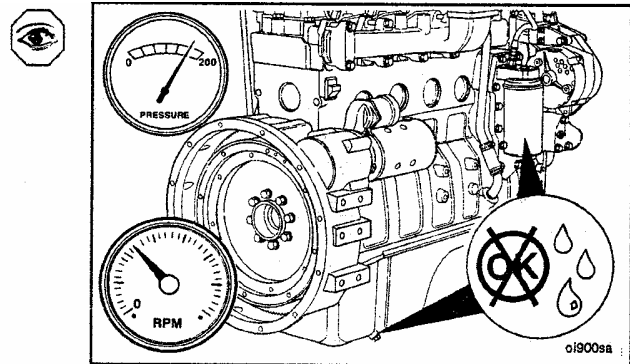
Use high quality 15W-40 multi-viscosity lubricating oil or its equivalent in Cummins engines. Choose the correct lubricating oil for your operating climate as outlined in Section V.

TM 5-3810-307-24-2-1

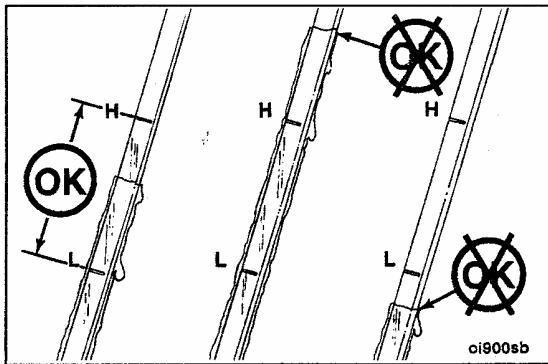
Fill the engine with clean oil to the proper level. Engine capacity is 17.3 qts (16.4 l).



Operate the engine at idle to inspect for leaks at the filters and the drain plug.

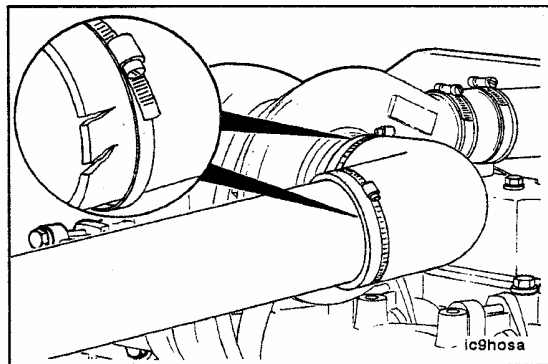


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Stop the engine. Wait approximately 15 minutes to let the oil drain from the upper parts of the engine. Check the oil level again.

Add oil as necessary to bring the 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 can allow dirt and debris to enter the engine.

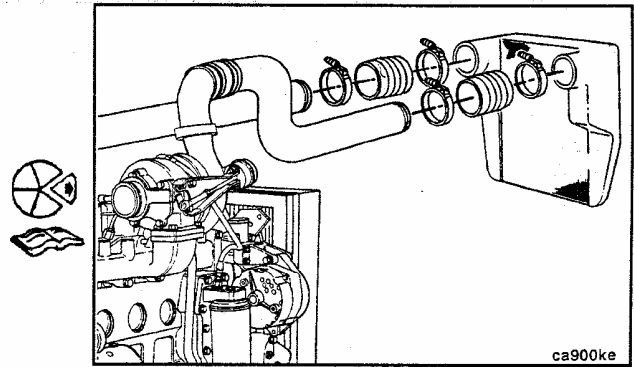
Tighten or replace parts as necessary to make sure the air intake system does not leak.

Charge Air Cooler

Inspection

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.

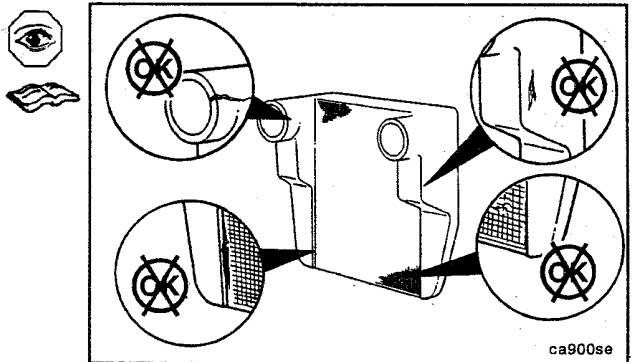
Remove the CAC from the vehicle. Refer to the vehicle manufacturer's instructions.



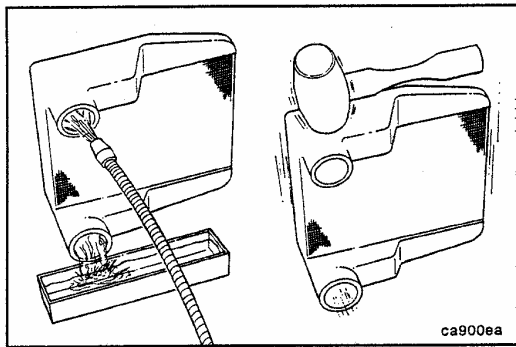
Visually inspect the CAC for cracks, holes or damage.

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

Refer to Section A to find the leak check procedure.



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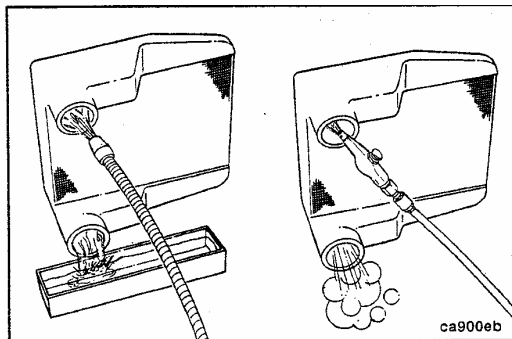


Cleaning

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. Continue flushing until all debris or oil is removed.

CAUTION

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



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 procedures.

Section 5 – Maintenance Procedures at 19,000 Kilometers [12,000 Miles], 500 Hours or 6 Months

Section Contents

	Page
Fuel Filter	5-3
Replacement.....	5-3
Fuel System	5-4
Bleeding.....	5-4
General Information	5-2
High Pressure Lines	5-6
Re-Tighten Line Fittings.....	5-7
Venting.....	5-6
Low Pressure Lines and Fuel Filter(s)	5-5
Venting.....	5-5

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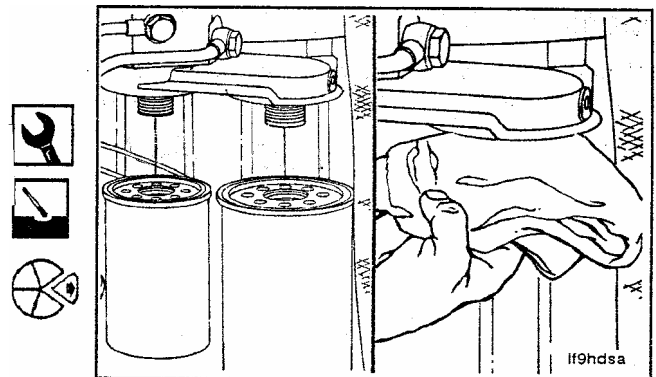
General Information

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.

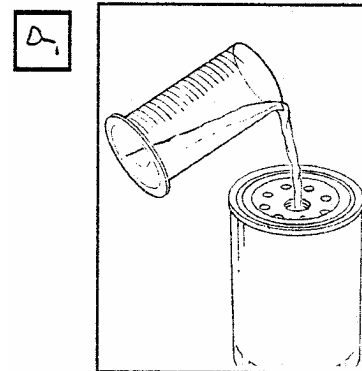
Fuel Filter Replacement

75-80 mm and 90-95 mm

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



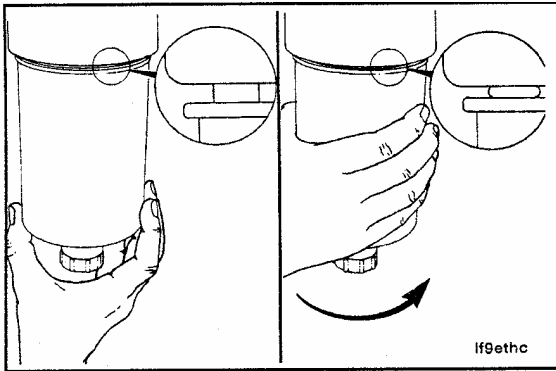
Fill the new filter with clean fuel and lubricate the filter gasket with clean lubricating oil.



NOTE

The ATEC is similar but not identical to the configuration shown.

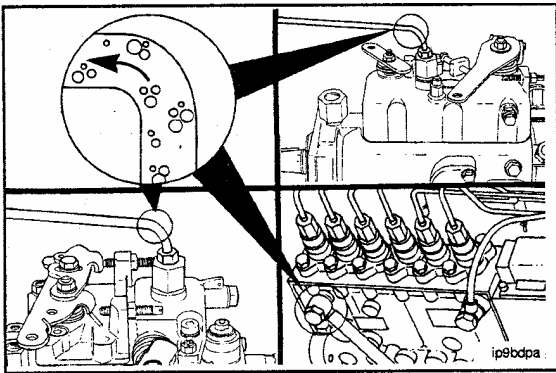
TM 5-3810-307-24-2-1



CAUTION

Mechanical tightening will distort the threads, filter element seal or filter can.

Install the 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 filters or injection pump supply line will be vented automatically, if the fuel filter is changed in accordance with the instructions. No manual bleeding of fuel lines is required.

NOTE

Manual bleeding is required if:

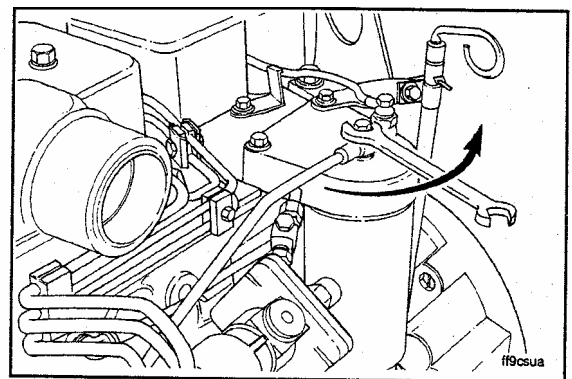
- The fuel filter is not filled prior to installation.
- Injection pump is replaced.
- High pressure fuel line connections are loosened or lines replaced.
- Initial engine start up or start up after an extended period of no engine operation.
- Vehicle fuel tank has run empty.

Low Pressure Lines and Fuel Filter(s)

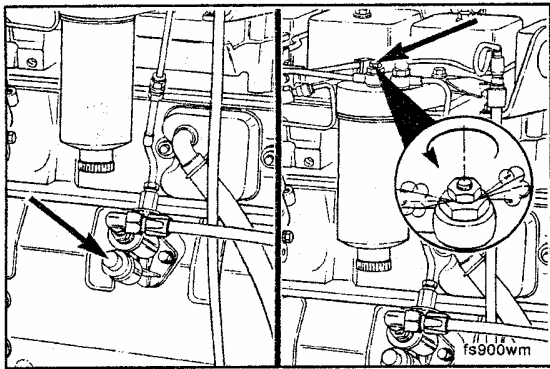
Venting

8 mm

Open the vent screw.



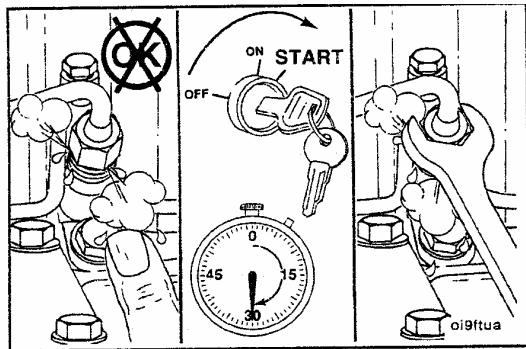
TM 5-3810-307-24-2-1



Operate the priming button on the lift pump until the fuel flowing from the fitting is free of air.

Tighten the bleed screw.

Torque Value: 9 N•m [7 ft-lb]



High Pressure Lines

Venting

17 mm, 19 mm

WARNING

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

Venting is accomplished by loosening one or more fittings at the injectors and cranking the engine to allow entrapped air to bleed from the lines.

Re-Tighten Line Fittings

Torque Value: 30 N•m [22 ft-lb]

WARNING

Do not bleed a hot engine as this could cause fuel to spill onto a hot exhaust manifold creating a danger of fire.

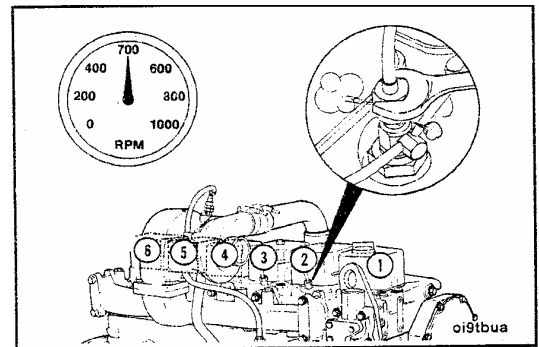
Start the engine and vent one line at a time until the engine runs smoothly.

CAUTION

When using the starting motor to vent the system, do not engage it for more than 30 seconds at a time. Wait two (2) minutes between engagements.

WARNING

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



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

Section Contents

	Page
Drive Belt	6-9
Inspection.....	6-9
Drive Belt Tension	6-8
Check	6-8
General Information	6-2
Valves	6-3
Adjustment	6-3
Six-Cylinder Engine Adjustment	6-6

TM 5-3810-307-24-2-1

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.

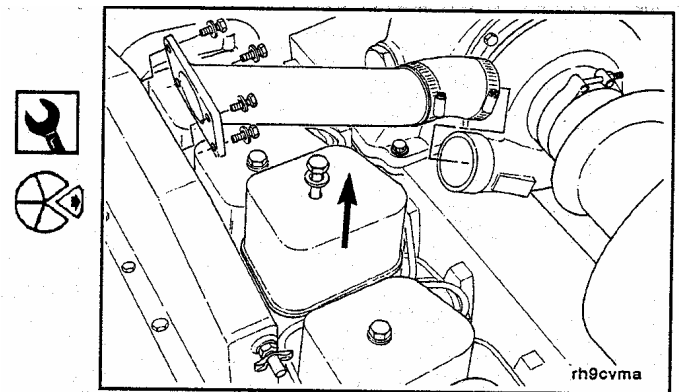
The procedures given in this section for valve lash adjustment are to be performed at the initial 38,000 km [24,000 mi] adjustment. Subsequent adjustments are to be performed at 77,000 km [48,000 mi] intervals.

Valves

Adjustment

15 mm

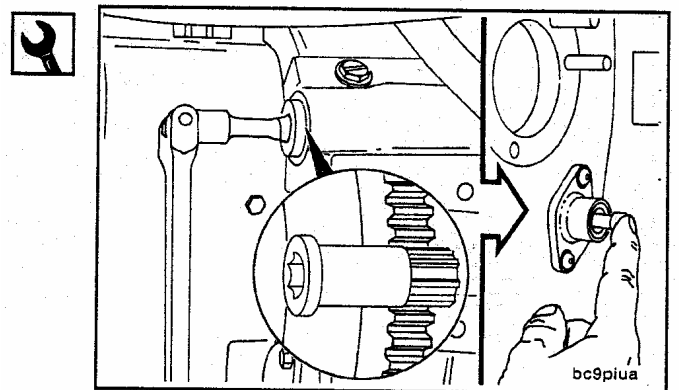
Remove the valve cover.



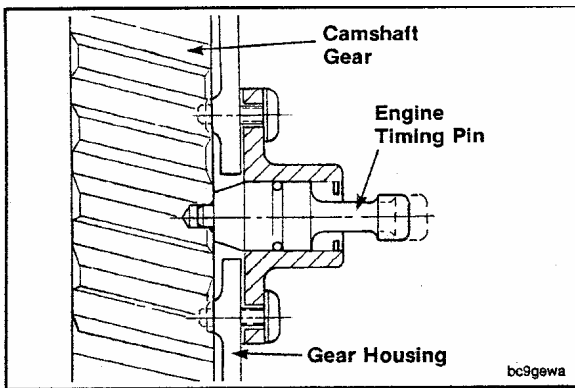
1/2 Inch Drive, 3824591 Engine Barring Gear

Locate Top Dead Center (TDC) for Cylinder Number 1 by barring engine slowly while pressing on the engine timing pin.

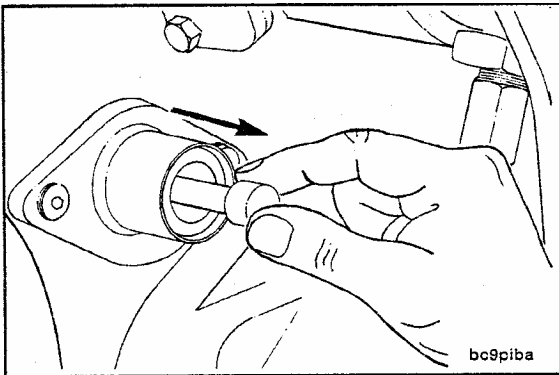
The barring gear inserts into the flywheel housing and engages the flywheel ring gear. The engine can then be rotated by hand using a 1/2 inch ratchet or breaker bar.



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



CAUTION

To prevent damage to the engine or pin, be sure to disengage the pin after locating TDC.

Feeler Gauge

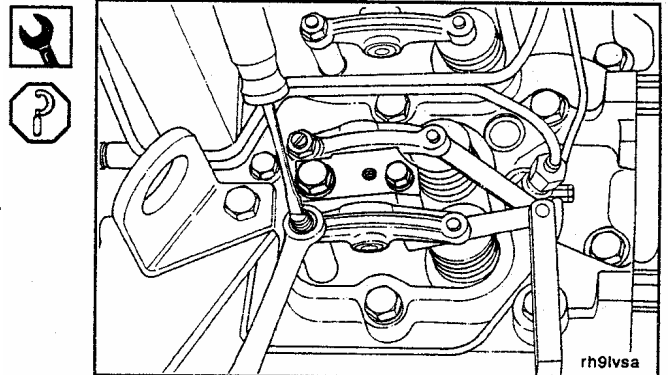
Intake Clearance: 0.254 mm [0.010 IN]

Exhaust Clearance: 0.508 mm [0.020 IN]

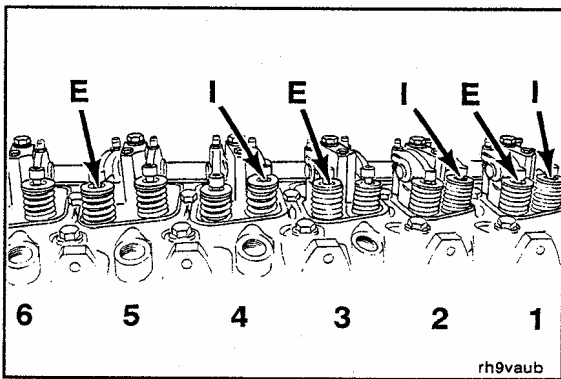
Check/set valves with engine cold - **below** 60° C [140° F].

NOTE

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



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Six-Cylinder Engine Adjustment

14 mm, Flatblade Screwdriver

Locate Top Dead Center (TDC) for Cylinder Number 1

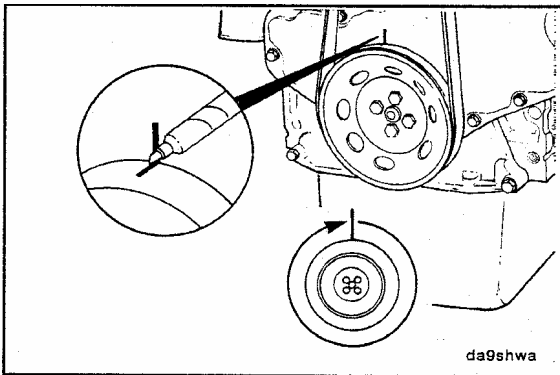
Check/adjust the valves as indicated in the illustration

(I = Intake, E = Exhaust).

Tighten the lock nut and measure the valve lash again.

Torque Value: 24 N•m [18 ft-lb]

Mark the pulley/vibration damper and rotate the crank-shaft 360 degrees.



CAUTION

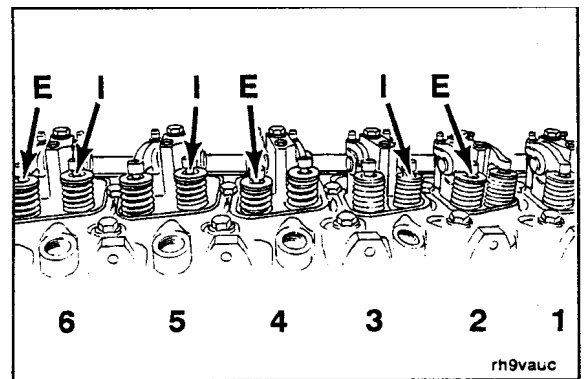
To prevent engine or pin damage, be sure timing pin is disengaged.

TM 5-3810-307-24-2-1

Adjust the valves as indicated in the illustration.

Tighten the lock nut and measure the valve lash again.

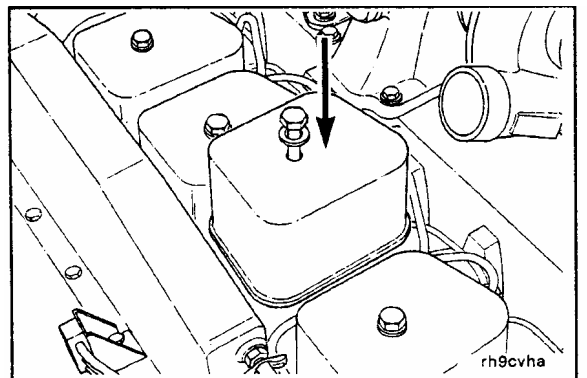
Torque Value: 24 N•m [18 ft-lb]



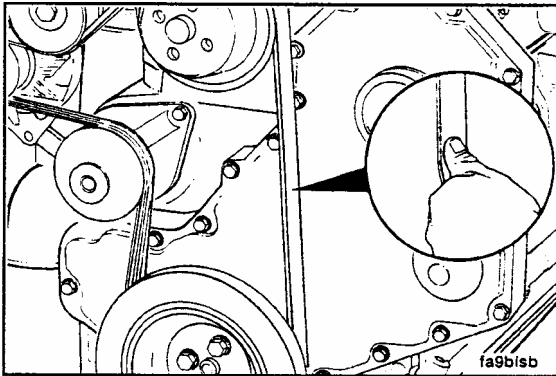
15 mm

Install the valve covers and tighten capscrews.

Torque Value: 24 N•m [18 ft-lb]



TM 5-3810-307-24-2-1

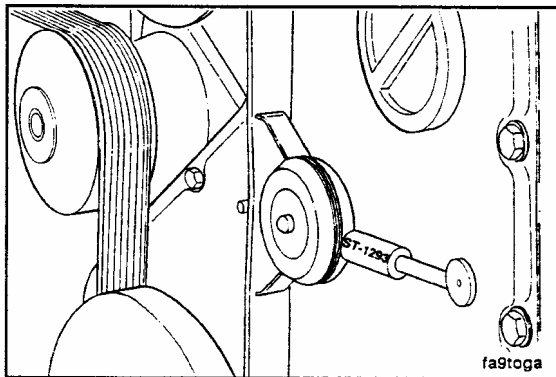


Drive Belt Tension

Check

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, Part No. ST-1293 can be used.

Gauge Value: 267 to 578 N [60 to 130 Lbf]

Drive Belt

Inspection

3/8 Inch Square Drive, 13 mm

Remove the drive belt.

Lift the tensioner to remove and install the belt.

NOTE

After the tensioner has been raised to remove/ install the belt, check the torque of the tensioner capscrew.

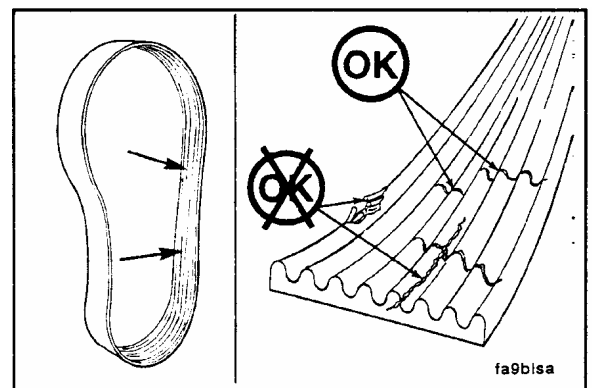
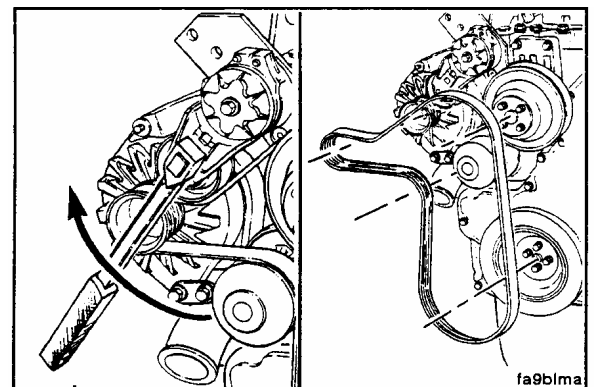
Torque Value: 43 N•m [32 ft-lb]

Inspect the belt for damage.

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 has unacceptable cracks, is frayed or has pieces of material missing.



Section 7 – Maintenance Procedures at 77,000 Kilometers [48,000 Mi.], 2000 Hours or 2 Years

Section Contents

	Page
Air Compressor	7-10
Air Compressor Discharge Inspection	7-11
Inspection	7-10
Cooling System Maintenance	7-3
Coolant Draining	7-3
Coolant System Filling	7-7
Cooling System Flushing	7-5
General Information	7-2
Vibration Damper (Rubber)	7-9
Inspection	7-9

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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

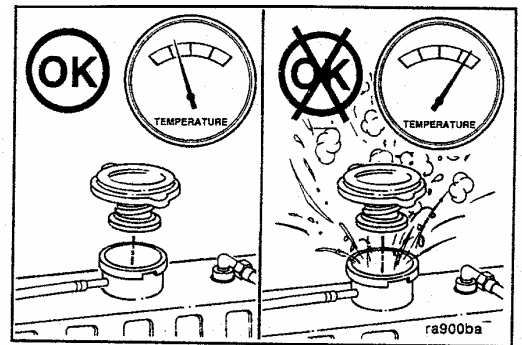
Avoid prolonged and repeated skin contact with used antifreeze. Such prolonged repeated contact can cause skin disorders or other bodily injury.

- Avoid excessive contact - wash thoroughly after contact.
- Keep out of reach of children.

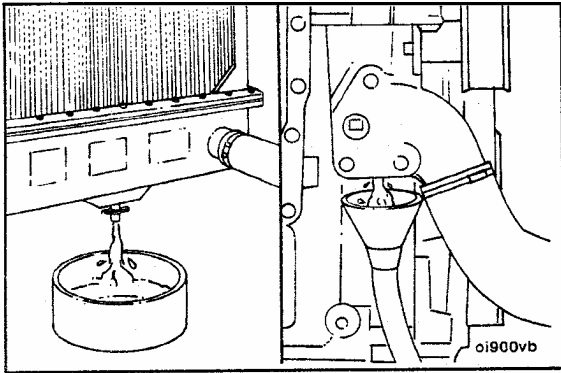
Protect the environment: Handling and disposal of used antifreeze can be subject to federal, state, and local law regulation. Use authorized waste disposal facilities, including civic amenity sites and garages providing authorized facilities for the receipt of used antifreeze. If in doubt, contact your local authorities or the EPA for guidance as to proper handling of used antifreeze.

WARNING

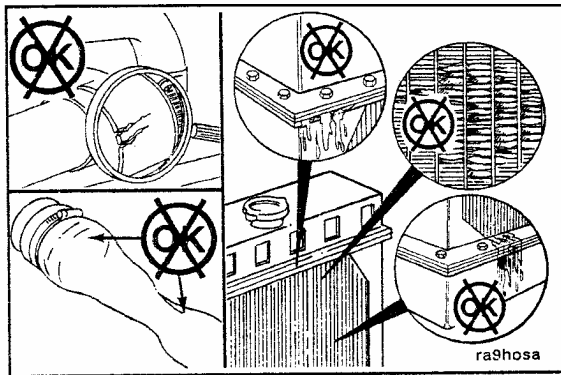
Wait until the temperature is below 50°C [120°F] before removing the coolant system pressure cap. Failure to do so can cause personal injury from heated coolant spray.



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Drain the cooling system by opening the drain valve on the radiator and removing the plug in the bottom of the water inlet. A drain pan with a capacity of 20 liters [5 U.S. gallons] 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.

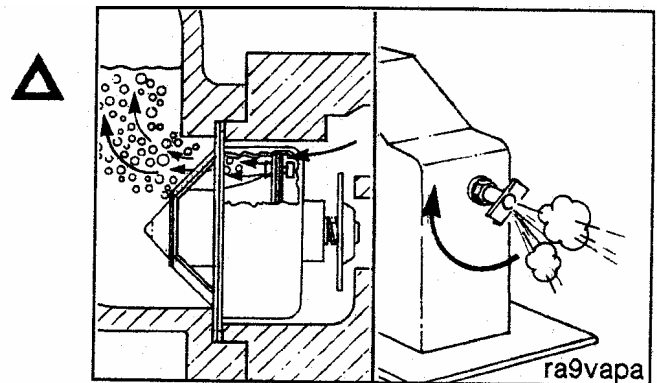
Cooling System Flushing

CAUTION

During filling, air must be vented from the engine coolant passages. The air vents through the "jiggle pin" openings to the top radiator hose and out the fill opening. Additional venting is provided for engines equipped with an aftercooler. Open the petcock during filling.

NOTE

Adequate venting is provided for a fill rate of 19 liters/minute [5 U.S. Gallon/minute].



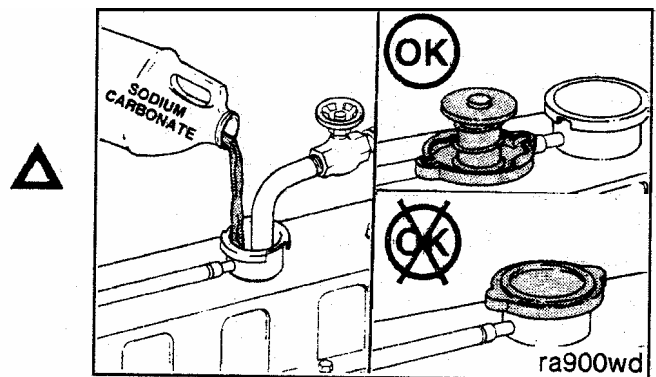
Fill the system with a mixture of sodium carbonate and water (or a commercially available equivalent).

NOTE

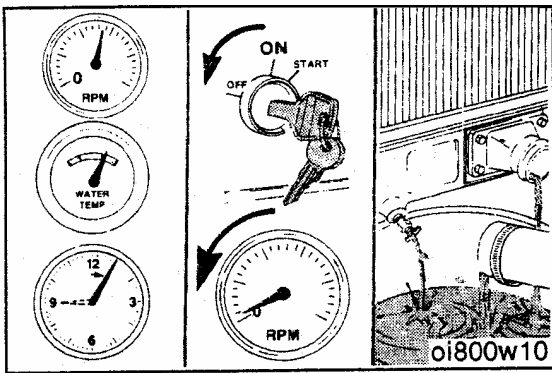
Use 0.5 kilogram [1.0 pound] of sodium carbonate for every 23 liters [6.0 U.S. gallons] of water.

CAUTION

Do not install the radiator cap. The engine is to be operated without the cap for this process.

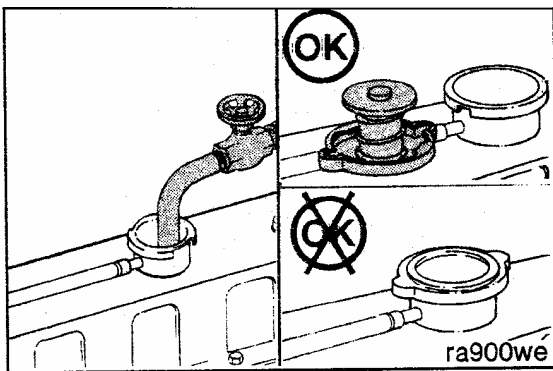


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Operate the engine for five minutes with the coolant temperature above 80°C [176°F].

Shut the engine off and drain the cooling system.



Fill the cooling system with clean water.

NOTE

Be sure to vent the engine and aftercooler for complete filling.

NOTE

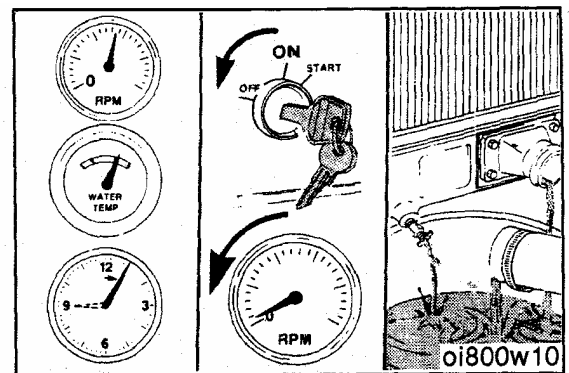
Do not install the radiator cap or the new coolant filter.

Operate the engine for five 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.

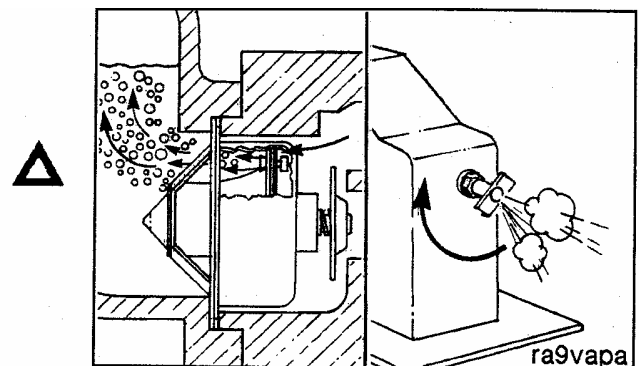


Coolant System Filling

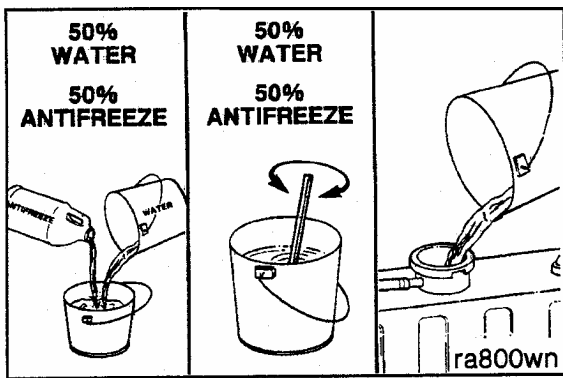
The system has a design fill rate of 19 liters per minute [5 U.S. Gallons per minute].

CAUTION

The system must be filled properly to prevent air locks. During filling, air must be vented from the engine coolant passages. Be sure to open the petcock on the aftercooler for aftercooled engines. Wait 2 to 3 minutes to allow air to be vented, then add mixture to bring the level to the top.



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Use a mixture of 50 percent water and 50 percent ethylene glycol antifreeze to fill the cooling system.

Coolant Capacity (Engine Only)		Liter [U.S. Quarts]	
4B3.9	6B5.9		
4BT3.9	4BTA3.9*	6BT5.9	6BTA5.9*
7.0 [7.4]	7.9 [8.4]	9 [9.5]	9.9 [10.5]

* 4BTA and 6BTA engines use a jacket-water aftercooler. If a Charge Air Cooler is used, the coolant capacity is the same as the naturally aspirated or turbocharged only engines.

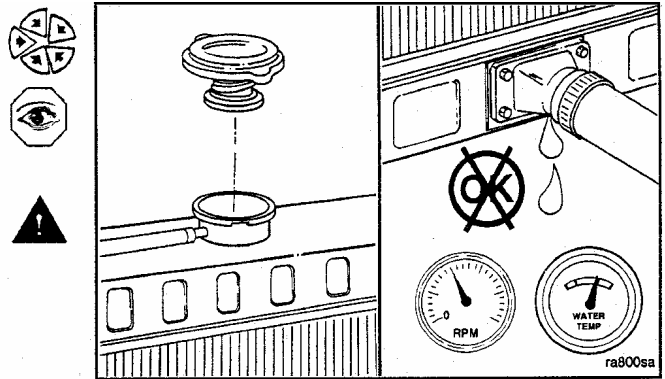


CAUTION

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

Install the pressure cap. Operate the engine until it reaches a temperature of 80°C [180°F], and check for coolant leaks.

Check the coolant level again to make sure the system is full of coolant, or that the coolant level has risen to the hot level in the recovery bottle on the system, if so equipped.



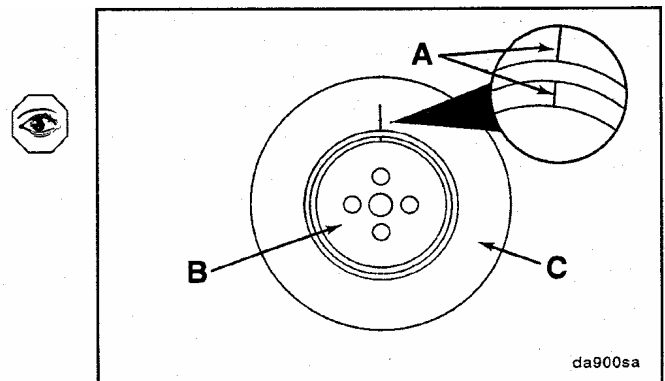
Vibration Damper (Rubber)

Inspection

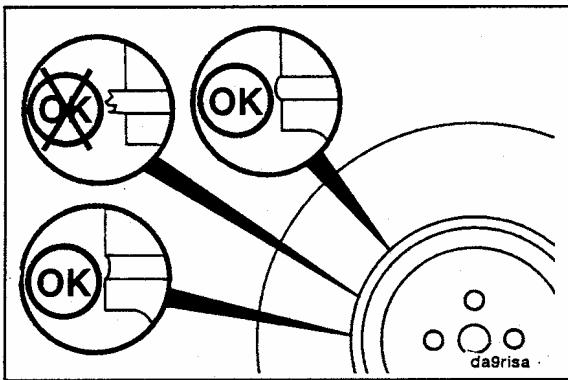
Check the index lines (A) on the damper hub (B) and the inertia member (C). If the lines are more than 1.59 mm [1/16 inch] out of alignment, replace the damper.

WARNING

Before removing the pressure cap, wait until the coolant temperature is below 50°C [120°F]. Failure to do so can cause personal injury from heated coolant spray.



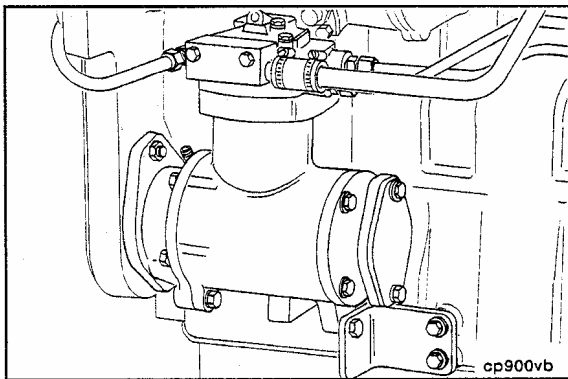
TM 5-3810-307-24-2-1



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.



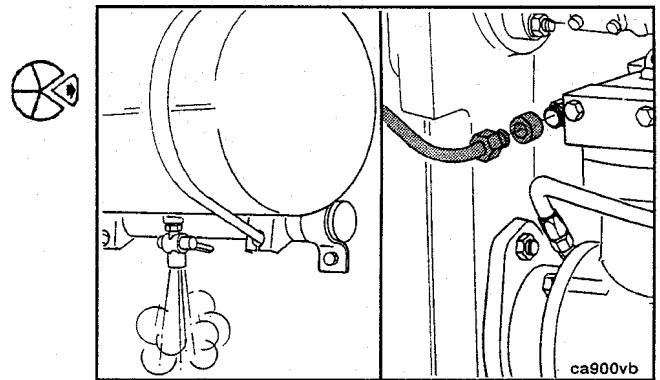
**Air Compressor
Inspection**

CAUTION

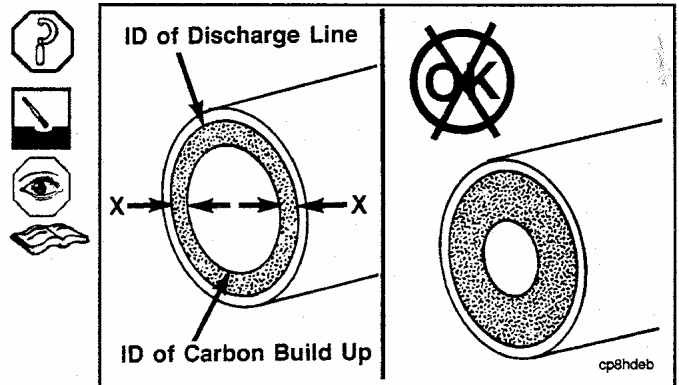
All air compressors have a small amount of lubricating oil carry over which lubricates the piston rings and moving parts. When this lubricating oil is exposed to normal air compressor operating temperatures over a period of time, the lubricating oil will form varnish or carbon deposits. If the following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

Air Compressor Discharge Inspection

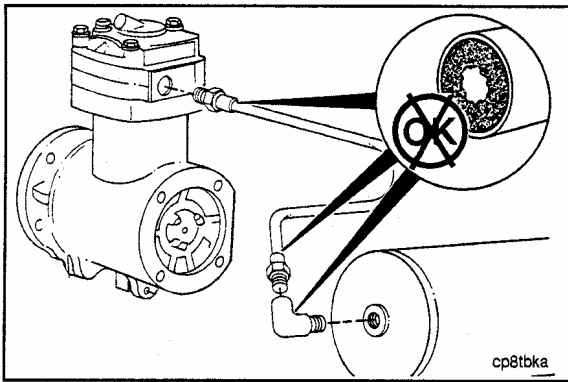
Drain the air system wet tank to release the system air pressure. Remove the air discharge line from the air compressor.



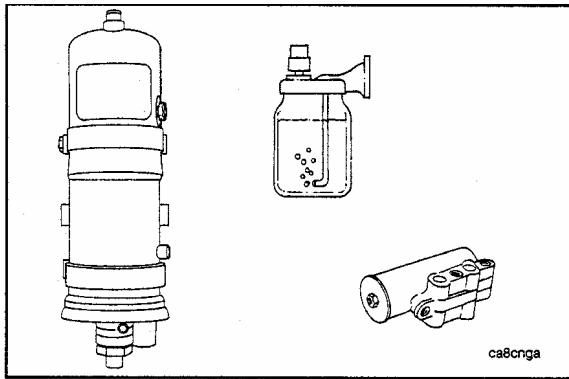
Measure the total carbon deposit thickness inside the air discharge line as shown. If the total carbon deposit ($X + X$) exceeds 2 mm [1/16-inch], clean and inspect the cylinder head, the valve assembly, and the discharge line. Replace if necessary. Contact your Authorized Repair Location for procedures.



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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 specifications.

Section T – Troubleshooting

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	Page
Troubleshooting Symptoms - Continued	
Vibration Excessive	T-34
White Smoke Excessive During Cold Start	T-37

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 an Authorized Repair Location for diagnosis and repair of problems **not** listed.

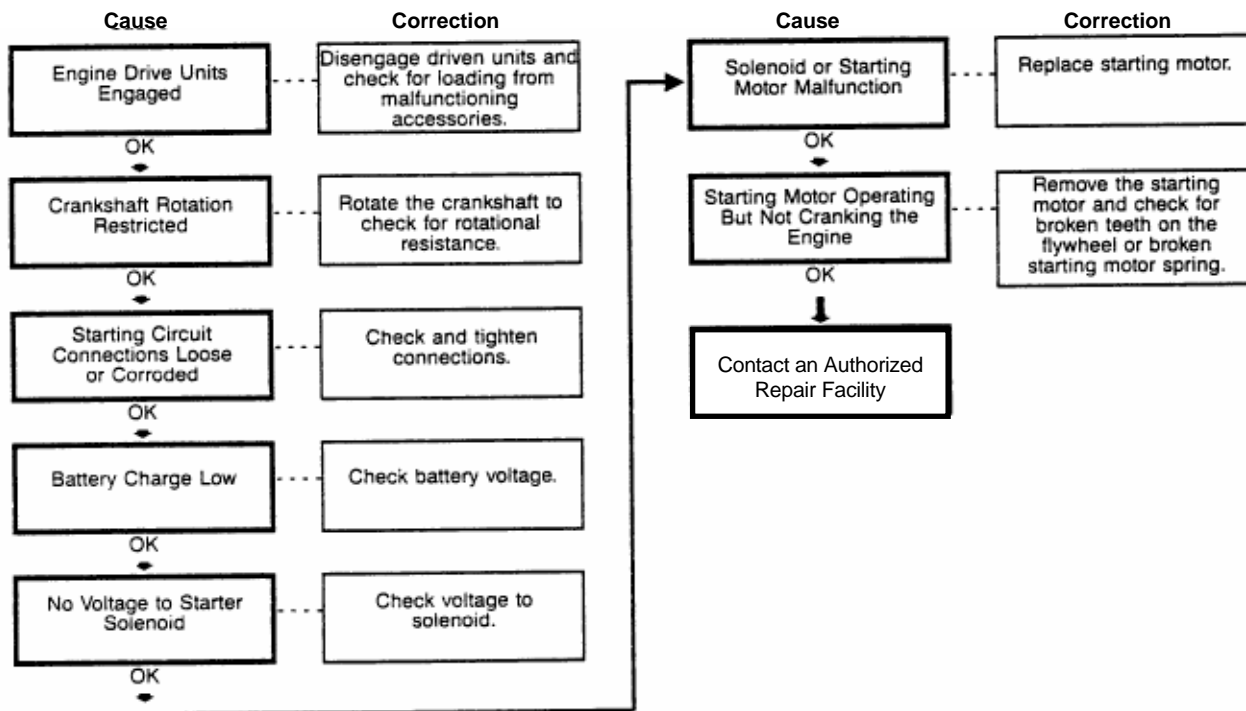
Follow the suggestions below to develop good troubleshooting procedures:

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

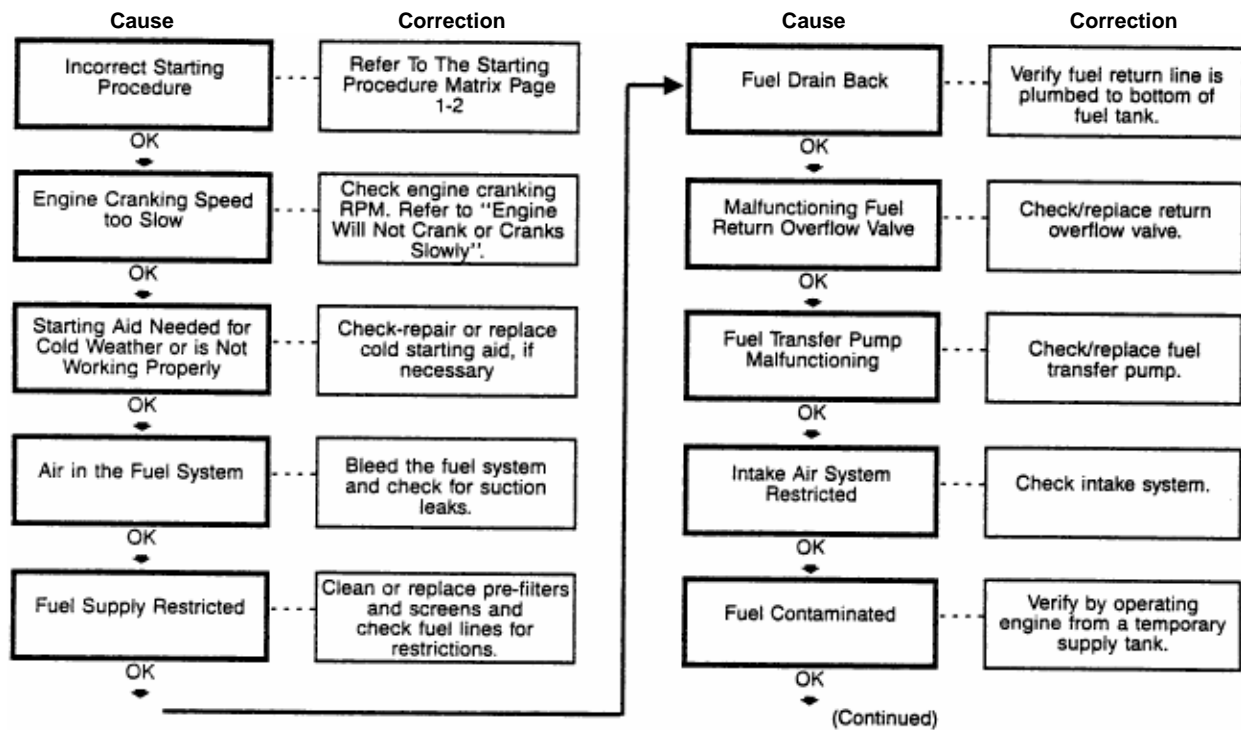
Troubleshooting Symptoms

Use the charts given on the following pages to help find the cause and correction of a malfunction. Read each row of blocks from top to bottom. Follow the arrows through the chart to identify corrective action.

Engine Will Not Crank or Cranks Slowly

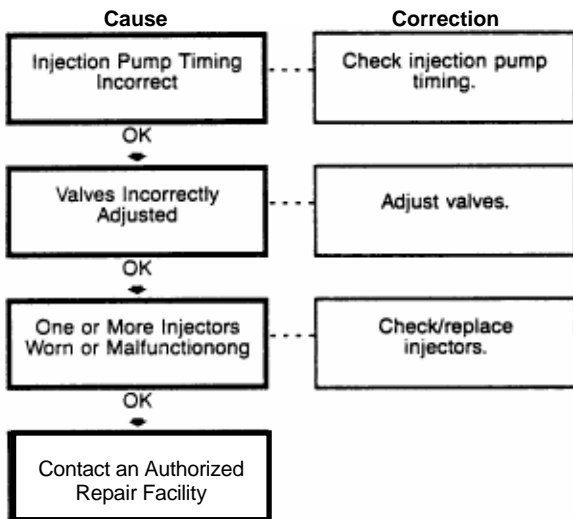


Engine Hard to Start or Will Not Start (Exhaust Smoke Present)

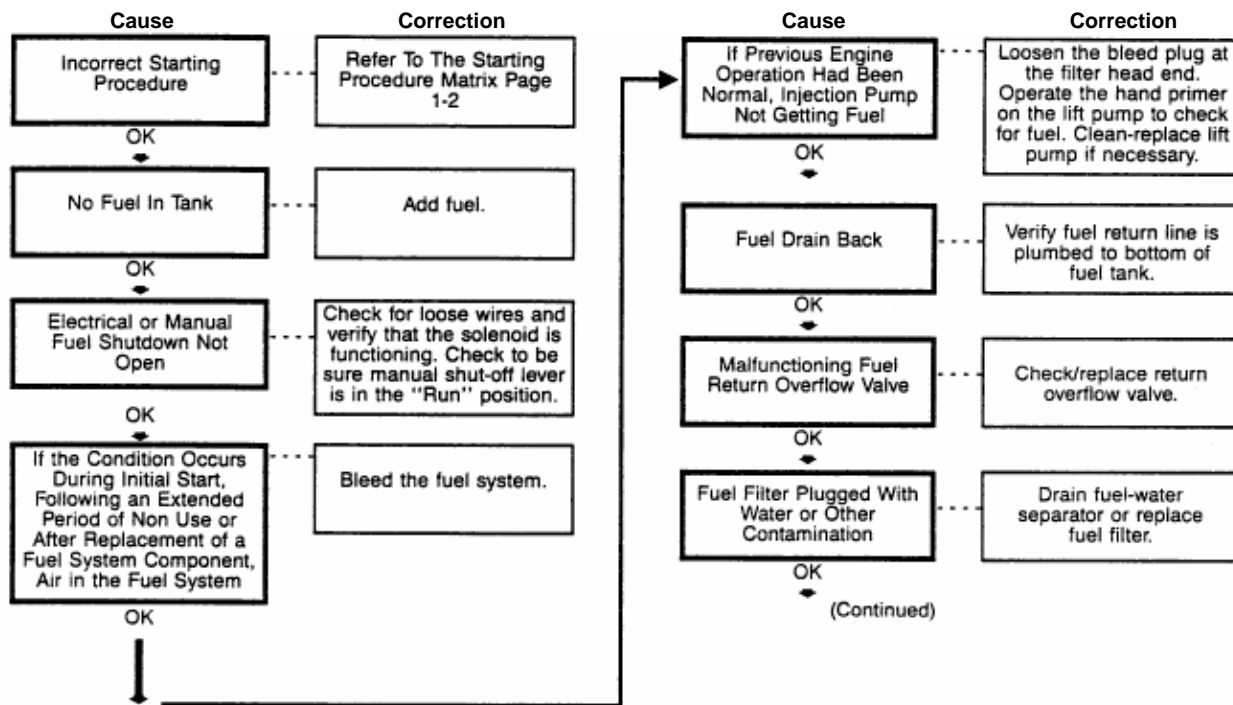


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Engine Hard to Start or Will Not Start (Exhaust Smoke Present) (Continued)

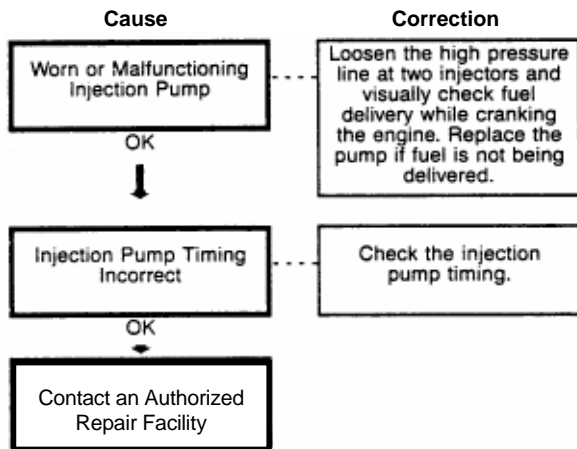


Engine Cranks But Will Not Start (No Smoke From Exhaust)

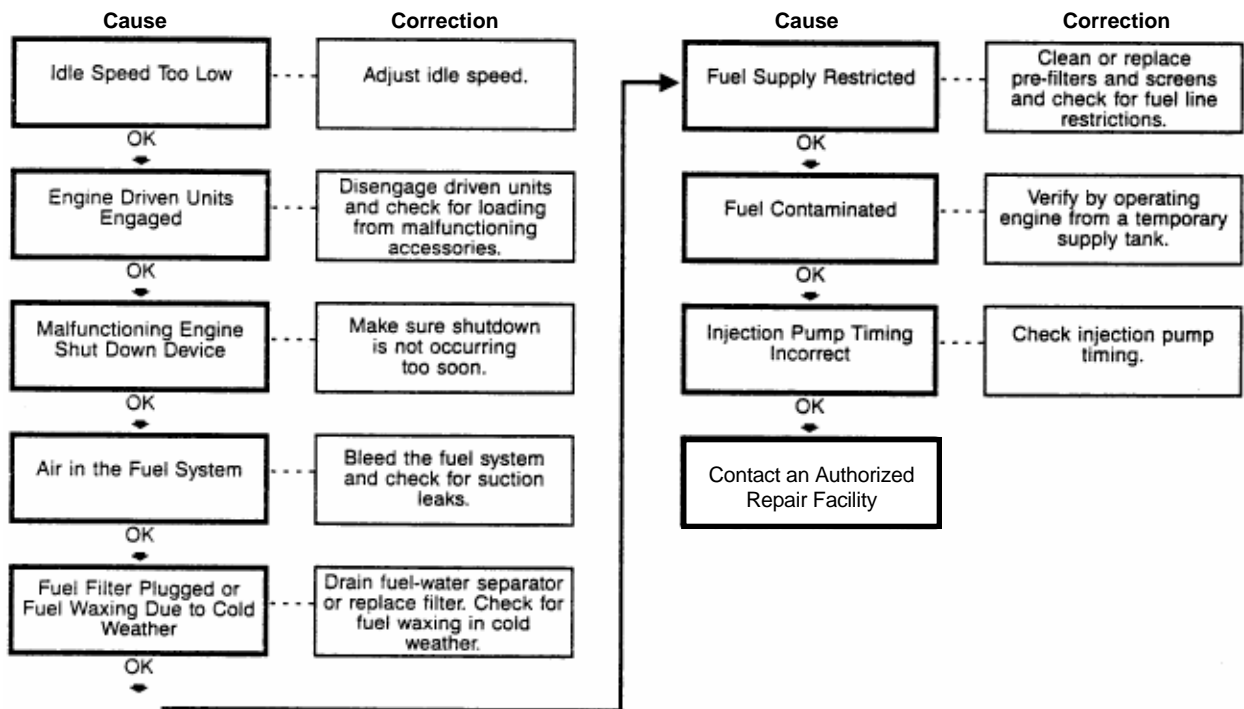


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Engine Cranks But Will Not Start (No Smoke From Exhaust) (Continued)

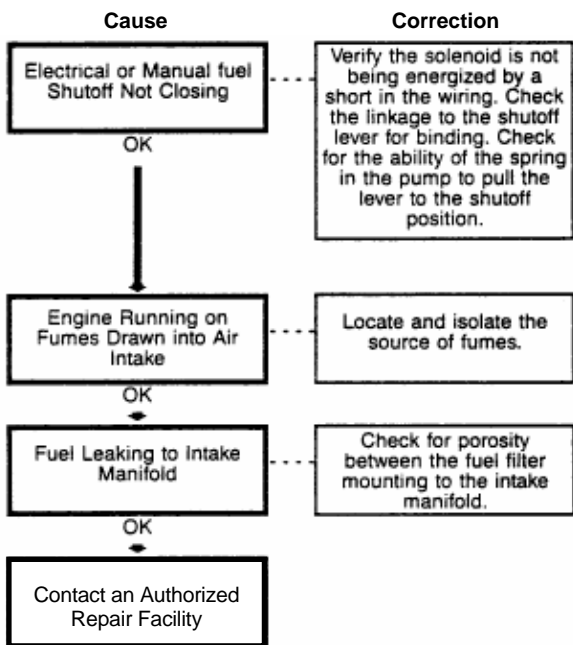


Engine Starts But Will Not Keep Running

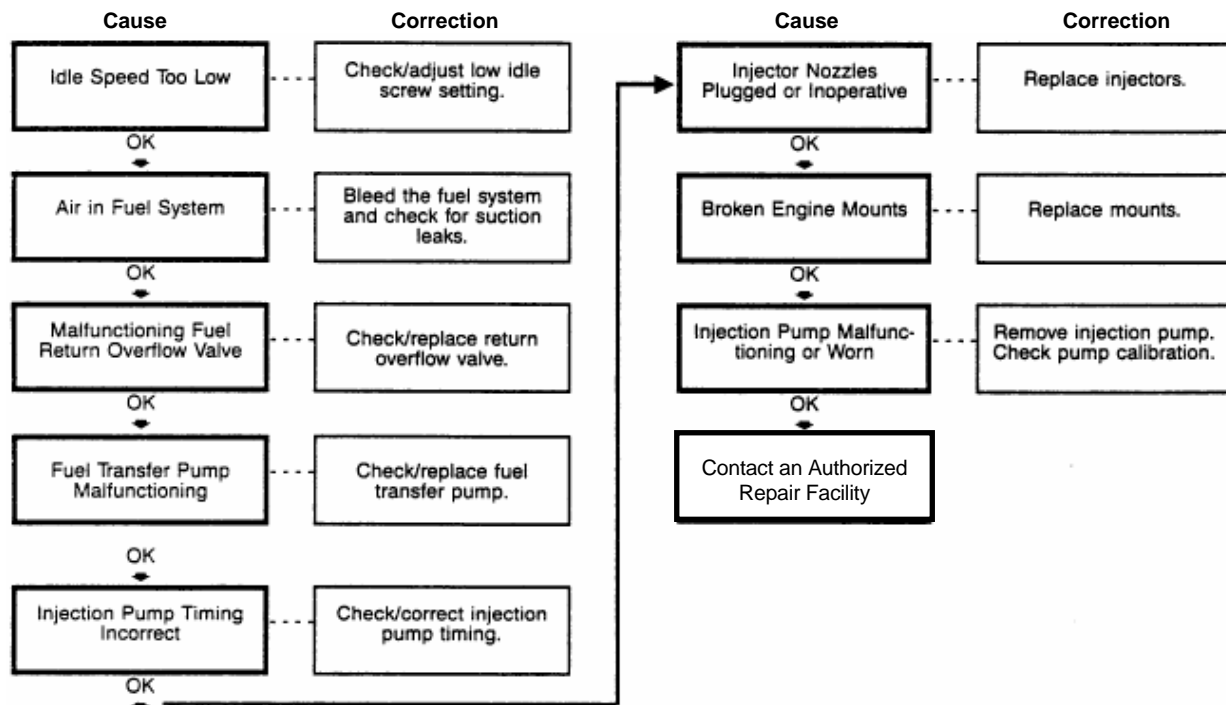


TM 5-3810-307-24-2-1

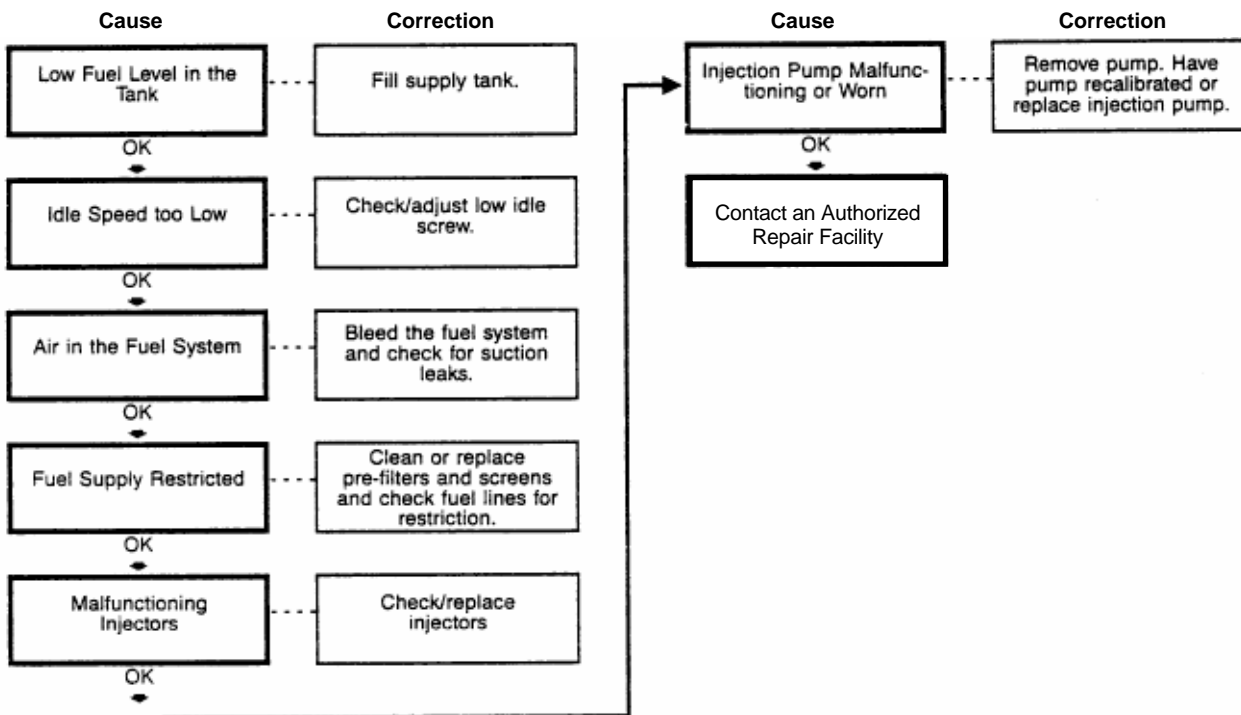
Engine Will Not Shut Off



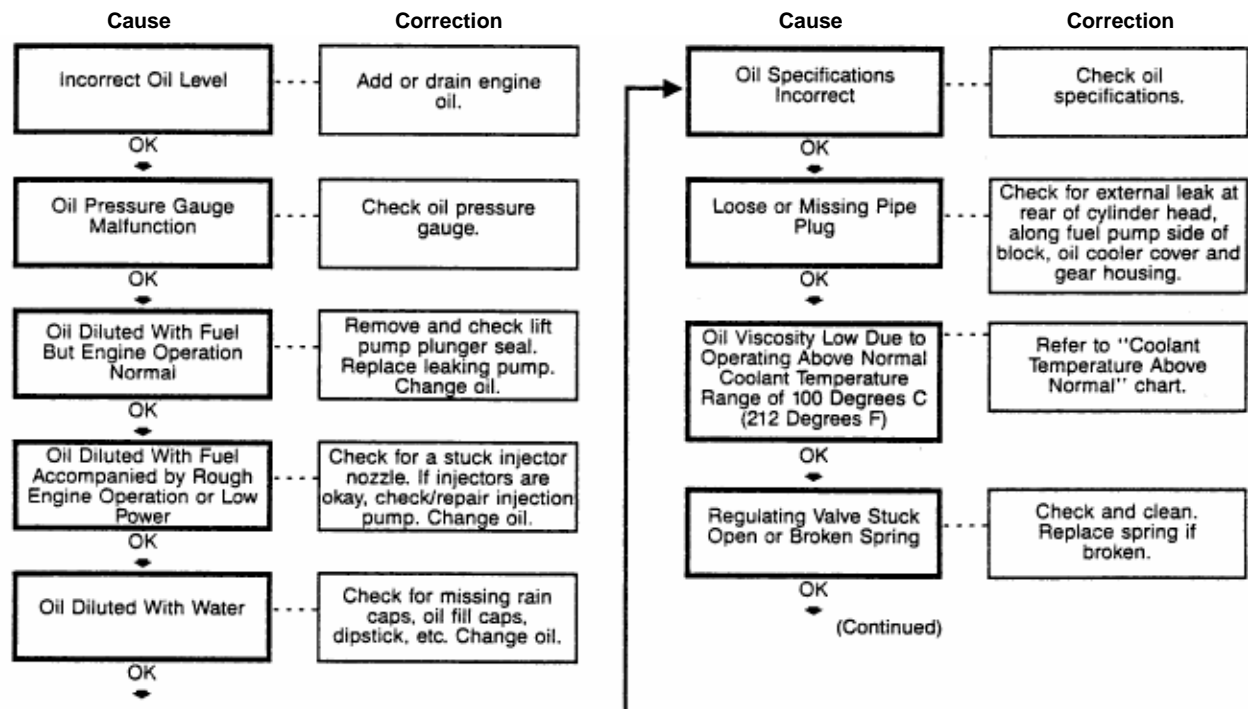
Rough Idle, Warm Engine



Engine Surges at Idle

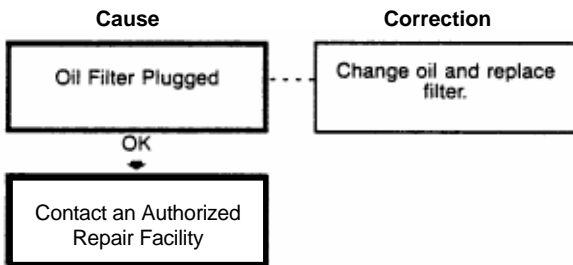


Lubricating Oil Pressure Low

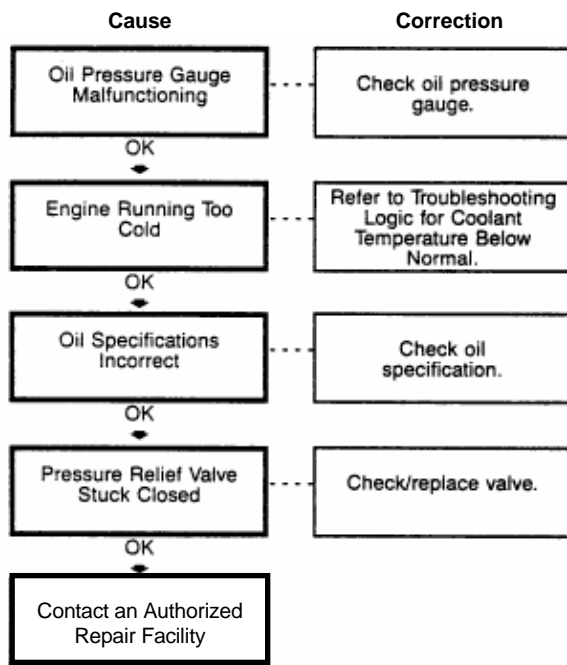


TM 5-3810-307-24-2-1

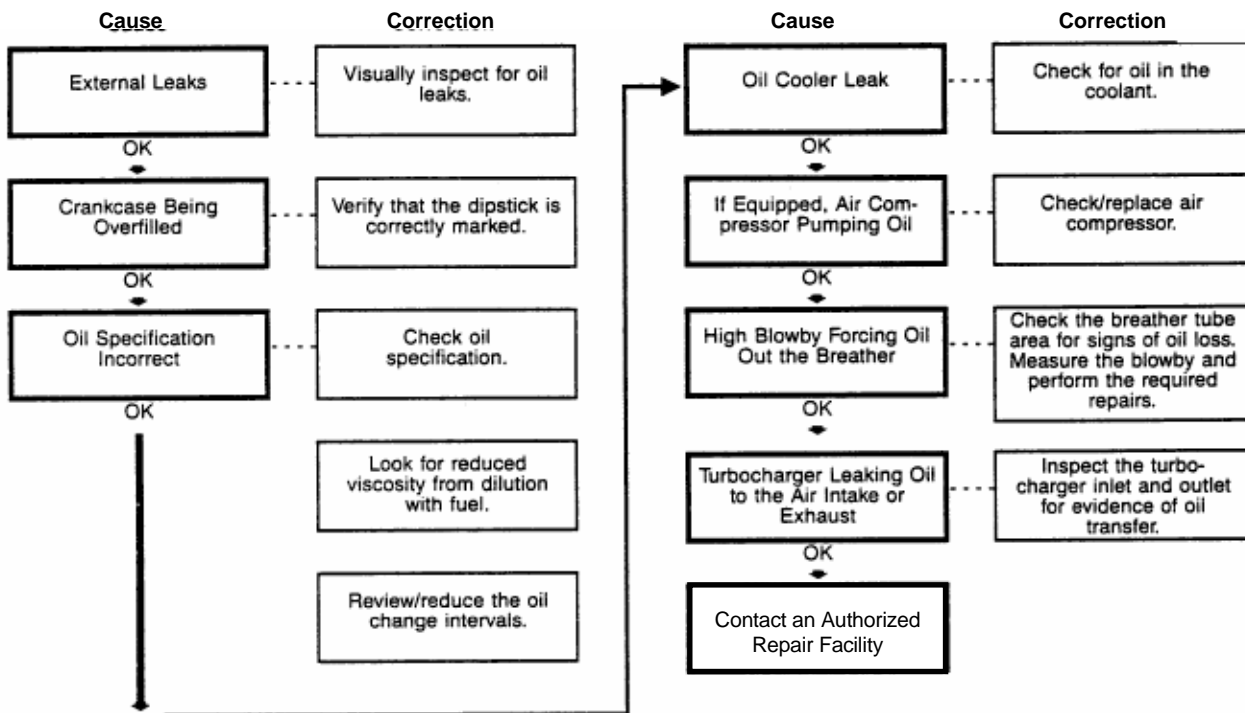
Lubricating oil Pressure Low (Continued)



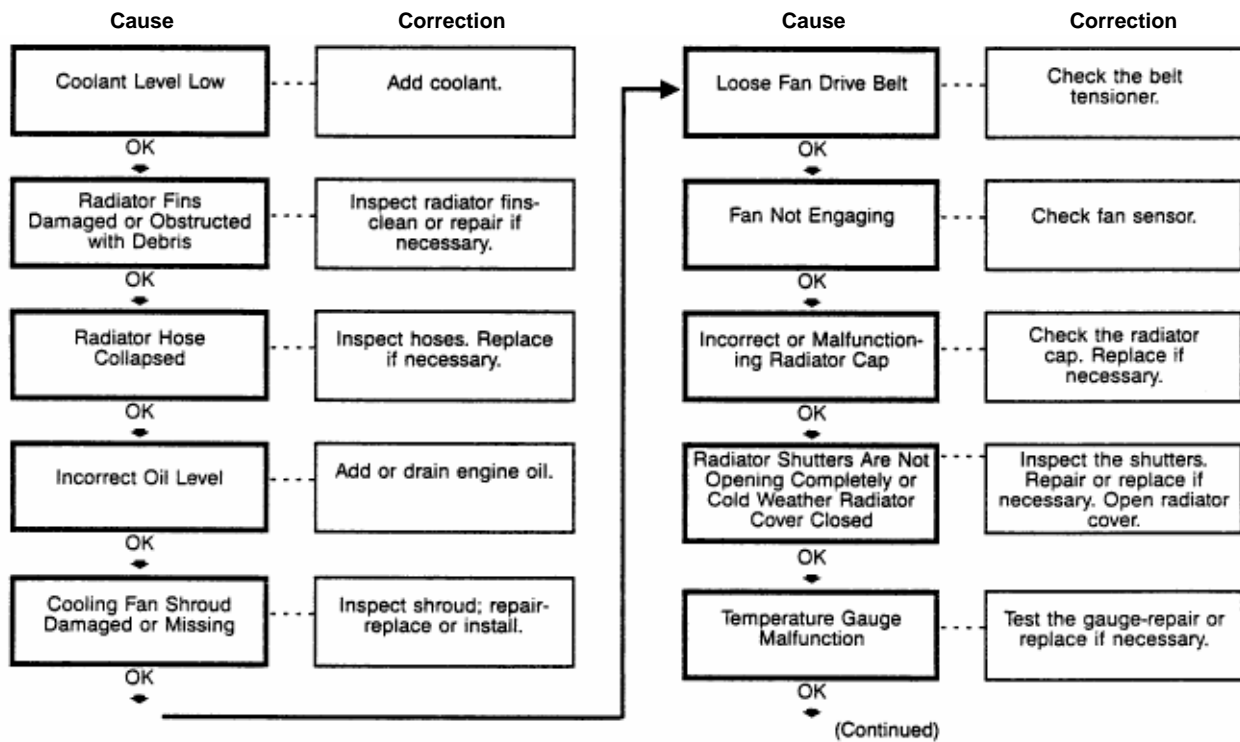
Lubricating Oil Pressure Too High



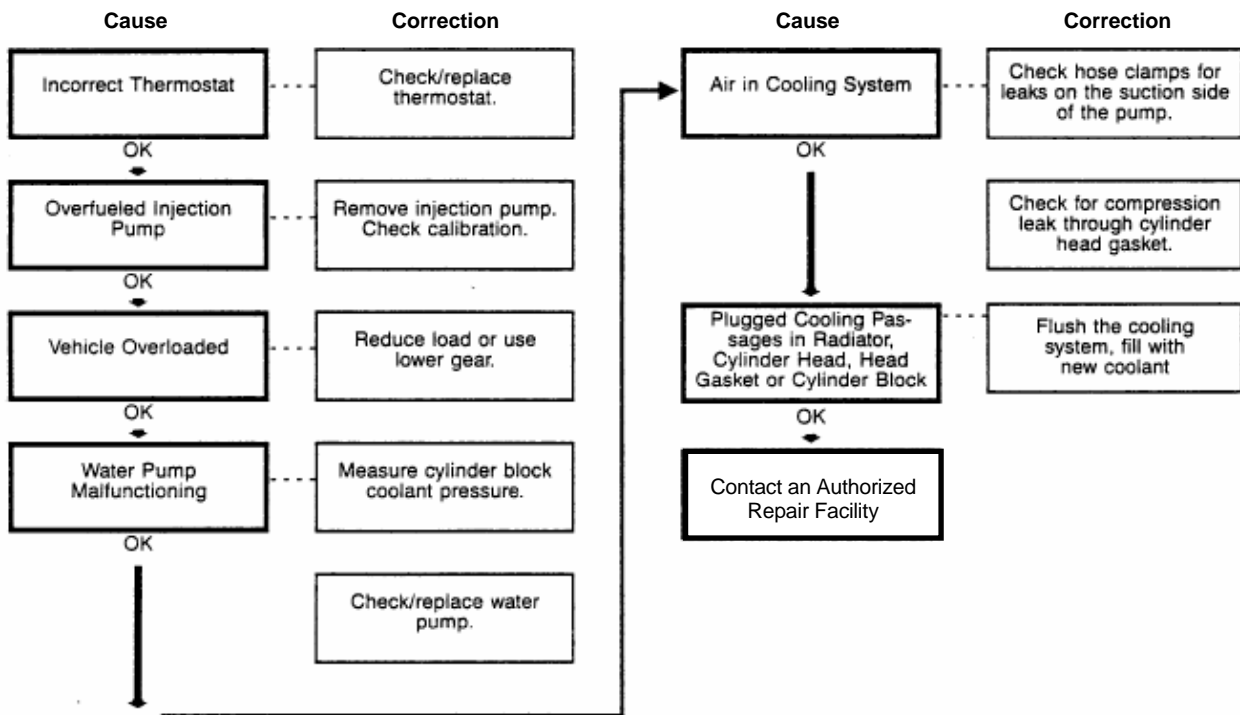
Lubricating Oil Loss



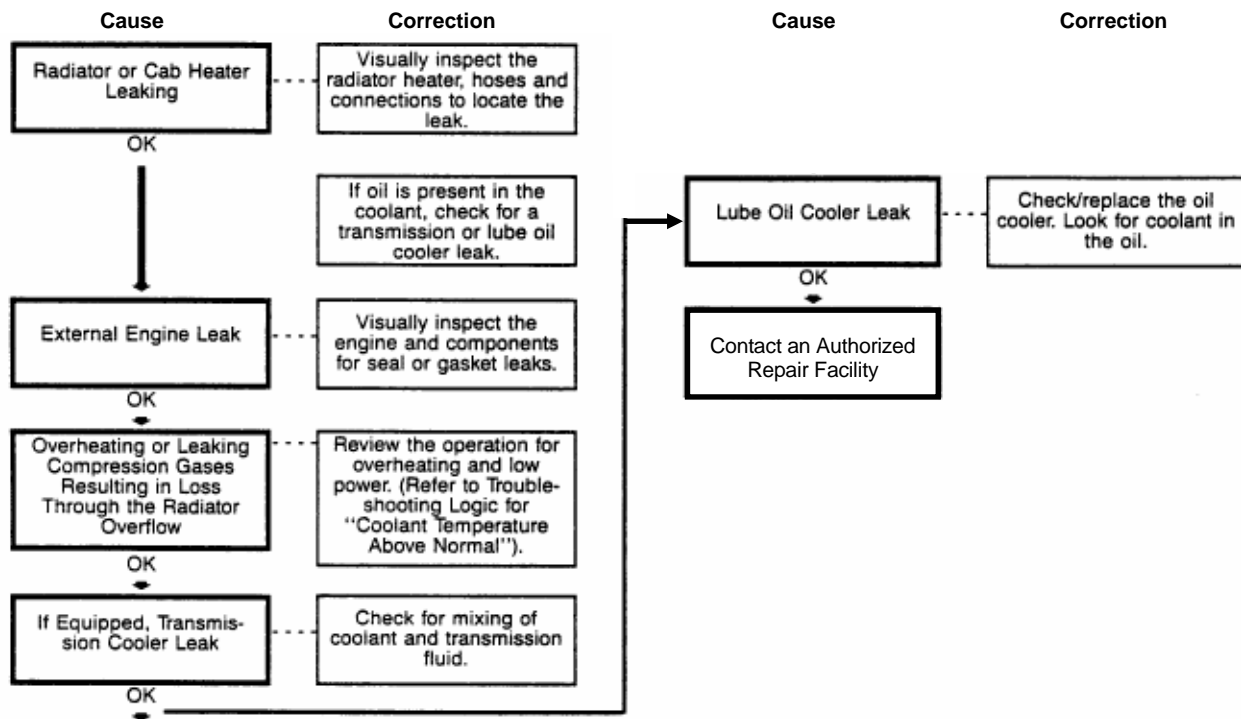
Coolant Temperature Above Normal



Coolant Temperature Above Normal (Continued)

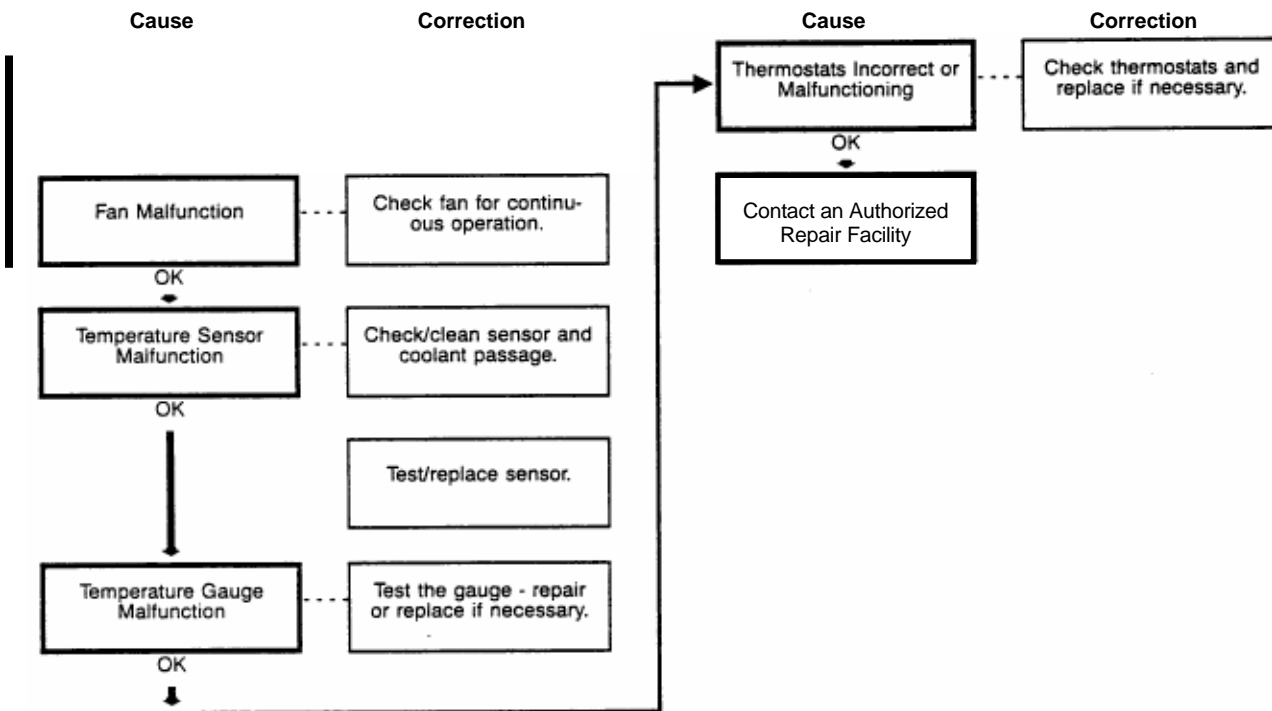


Coolant Loss



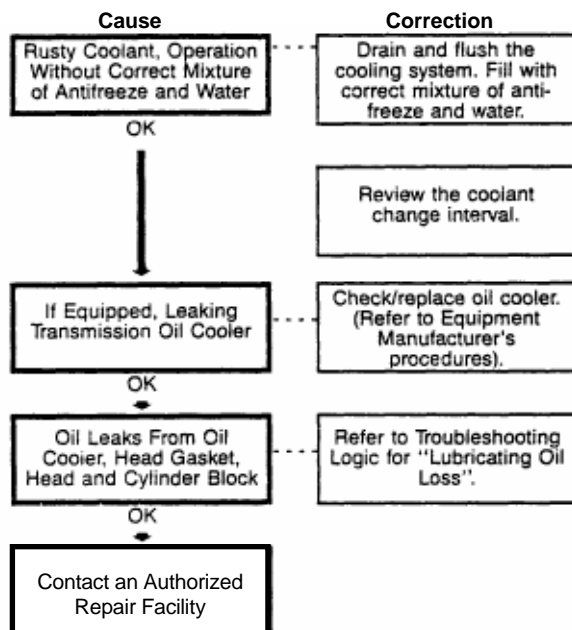
TM 5-3810-307-24-2-1

Coolant Temperature Below Normal

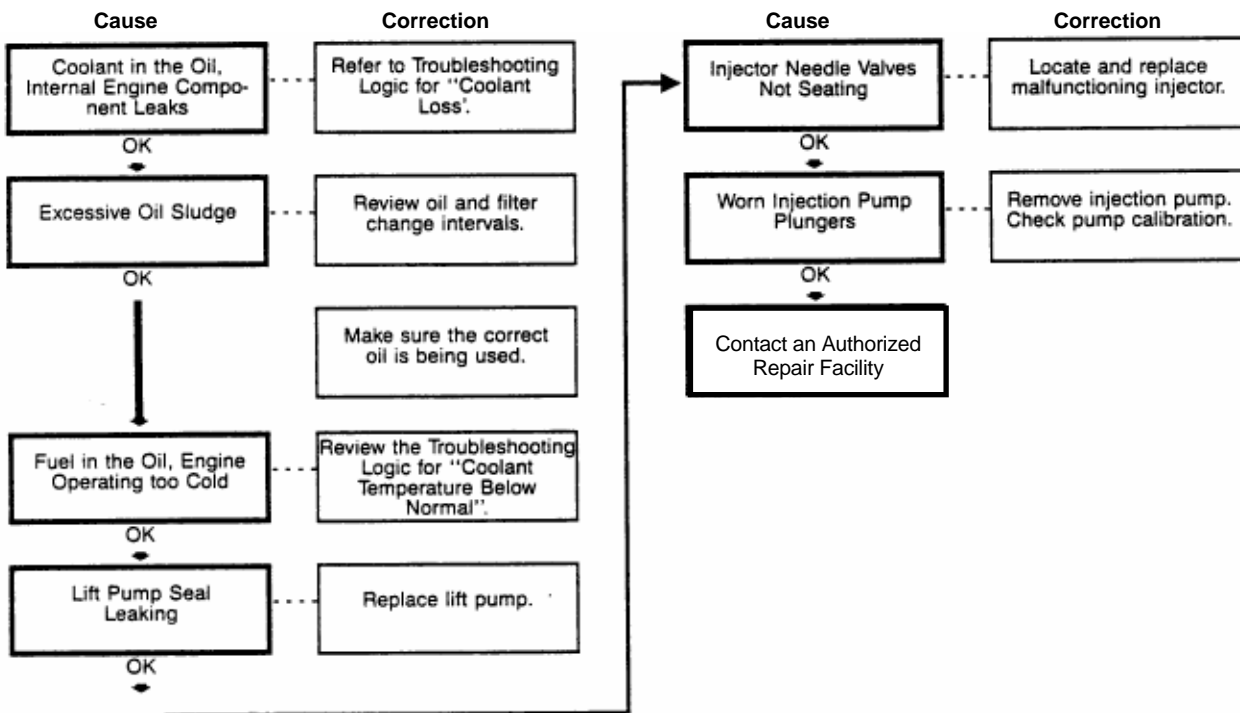


T-20 C-1

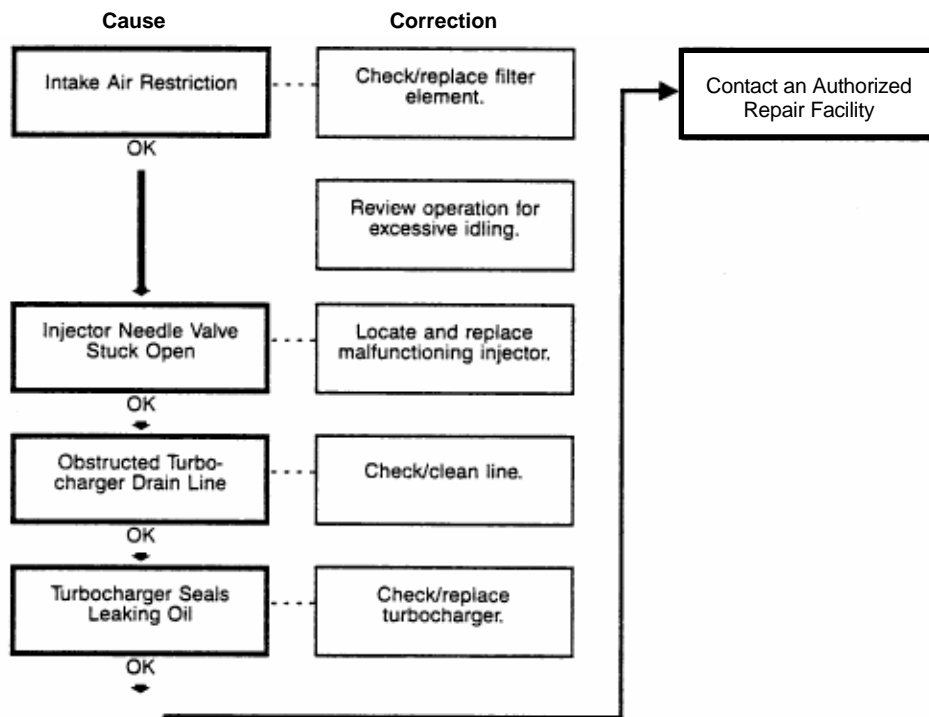
Coolant Contaminated



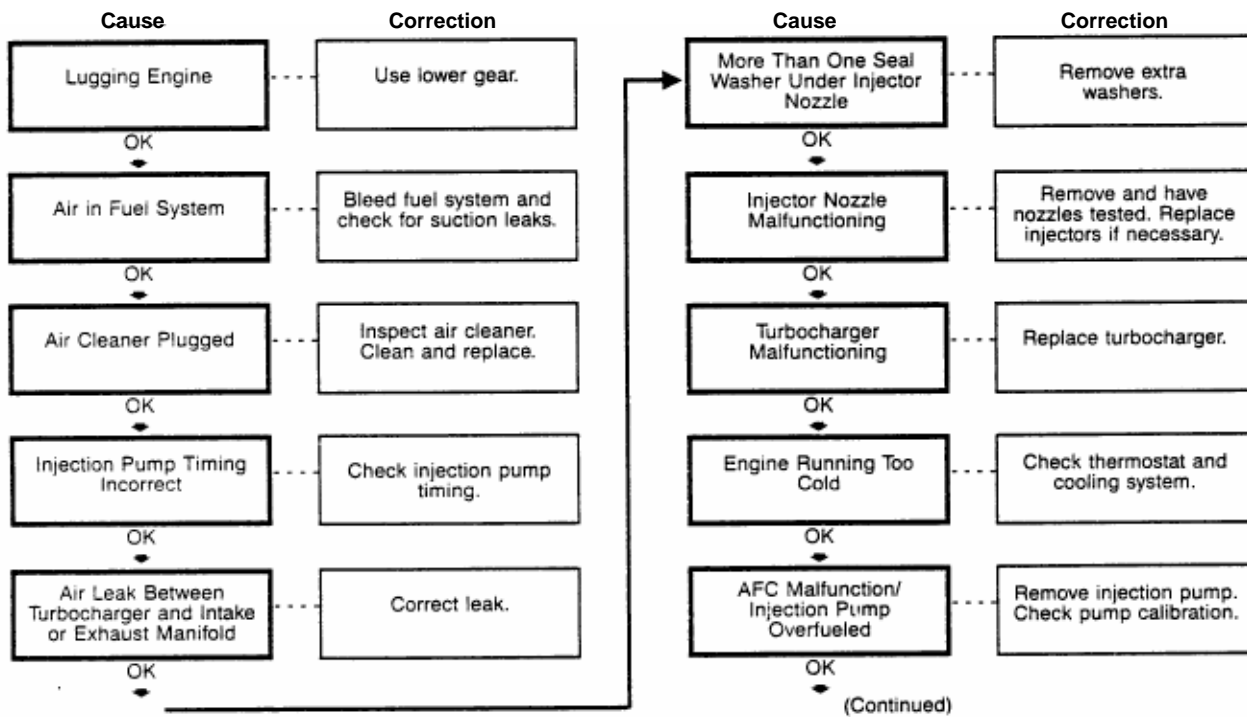
Lubricating Oil Contaminated



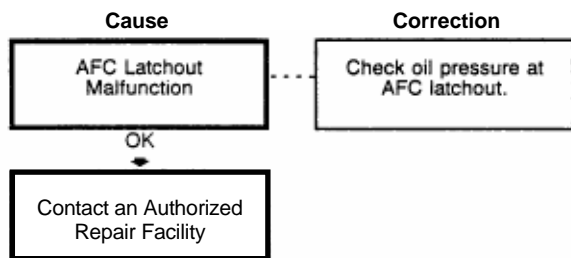
Fuel or Oil Leaking from Exhaust Manifold



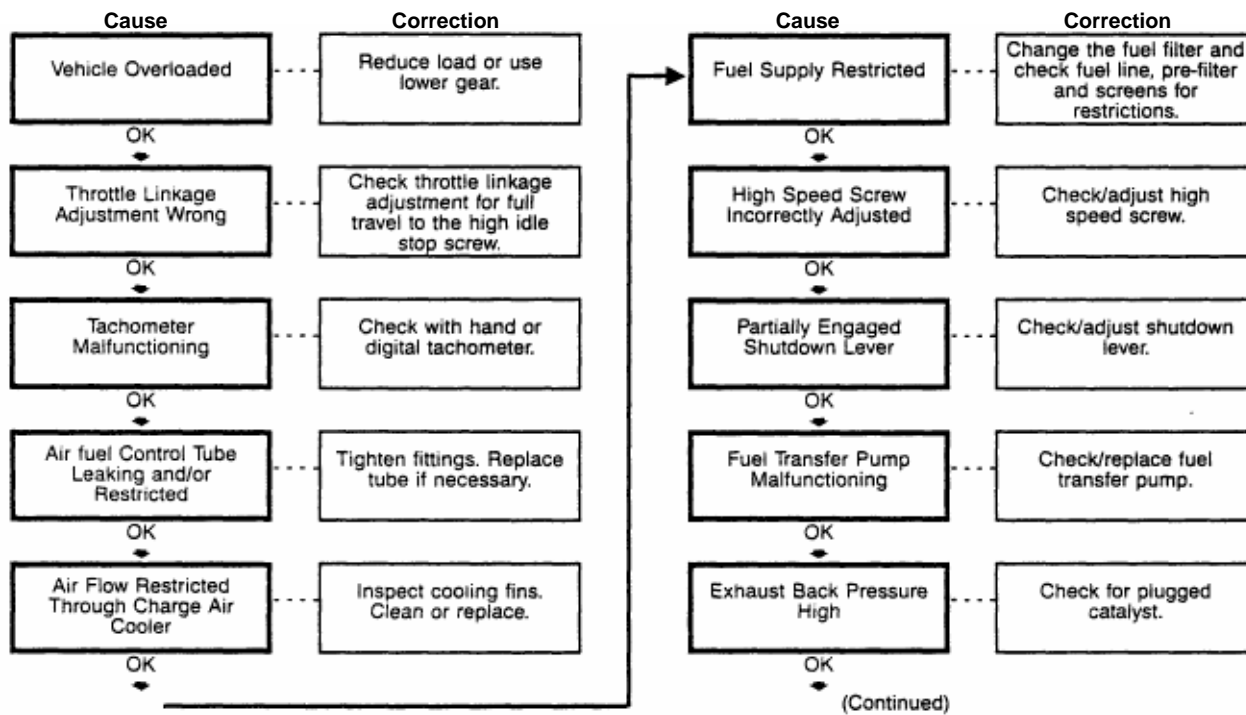
Exhaust Smoke Excessive Under Load



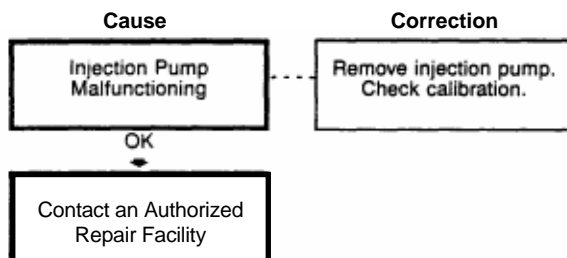
Exhaust Smoke Excessive Under Load (Continued)



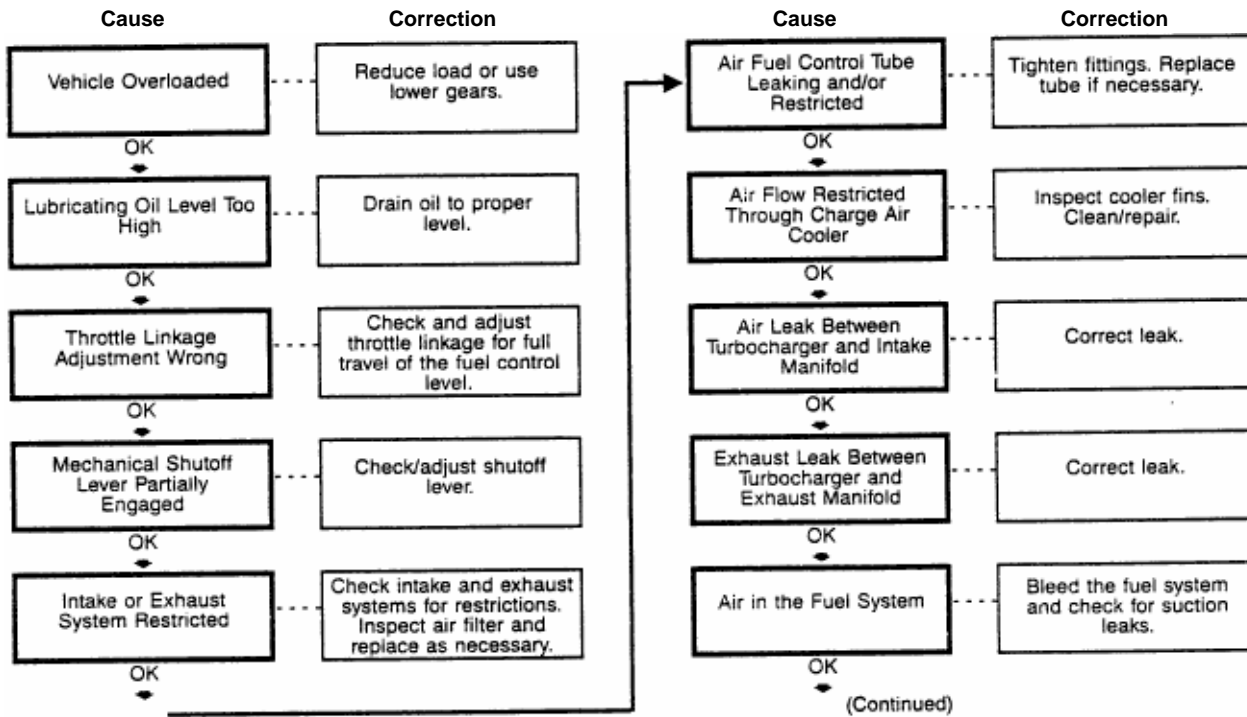
Engine Will Not Reach Rated Speed When Loaded



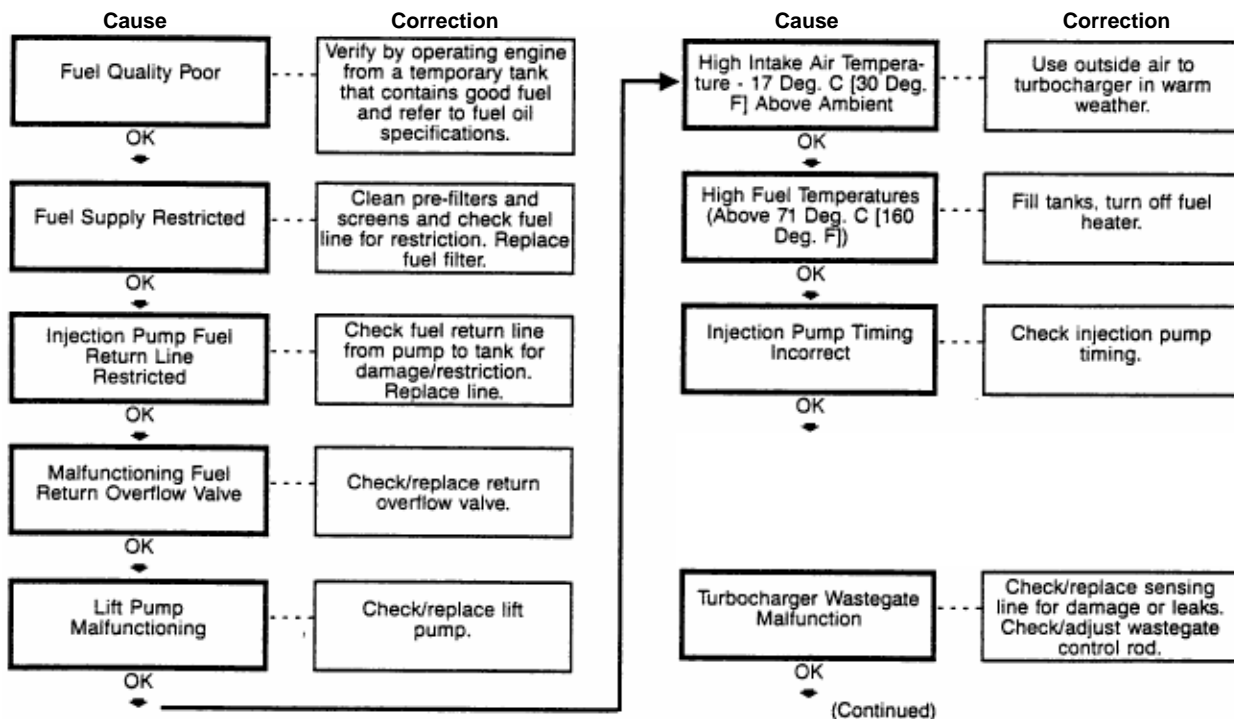
Engine Will Not Reach Rated Speed When Loaded (Continued)



Power Output Low

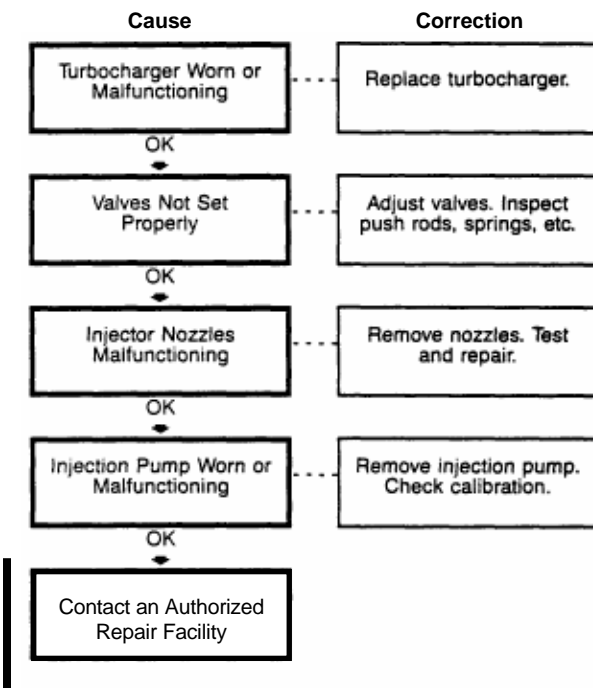


Power Output Low (Continued)



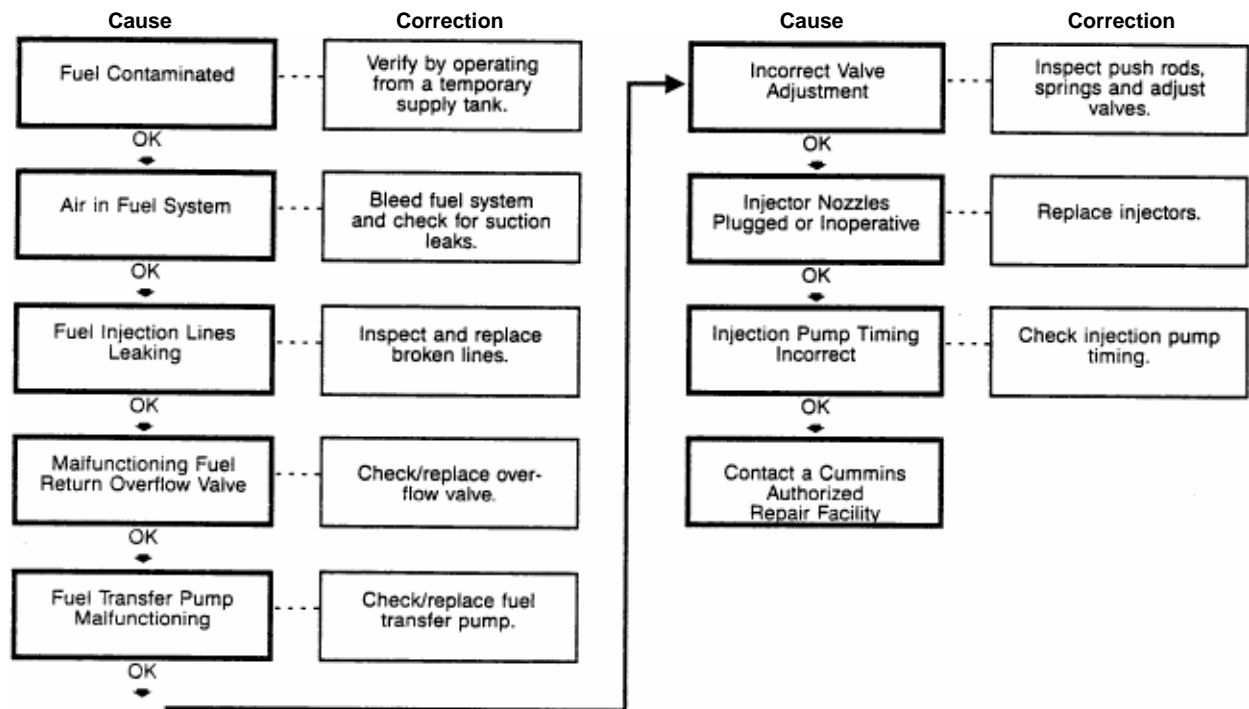
TM 5-3810-307-24-2-1

Power Output Low (Continued)

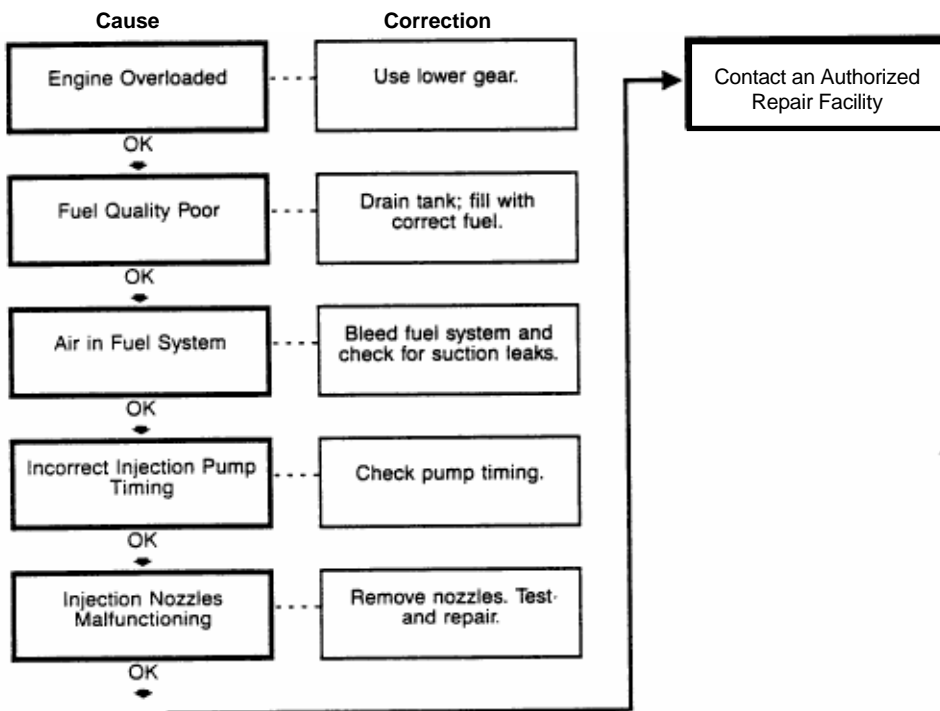


T-30 C-1

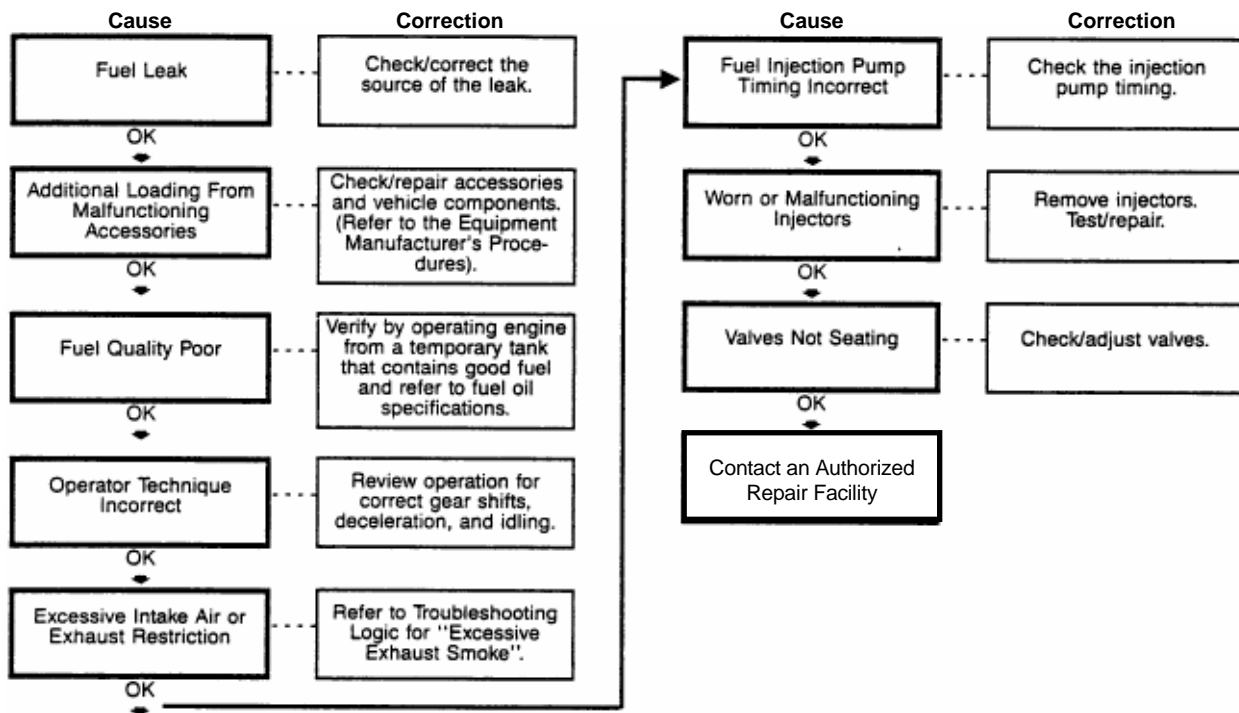
Engine Misfiring



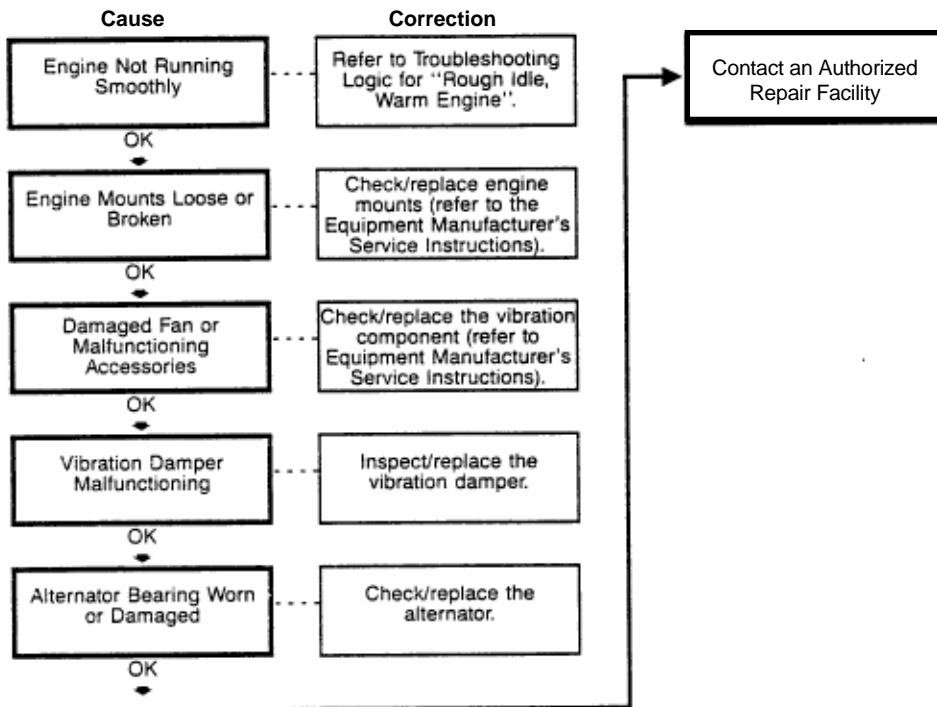
Fuel Knock



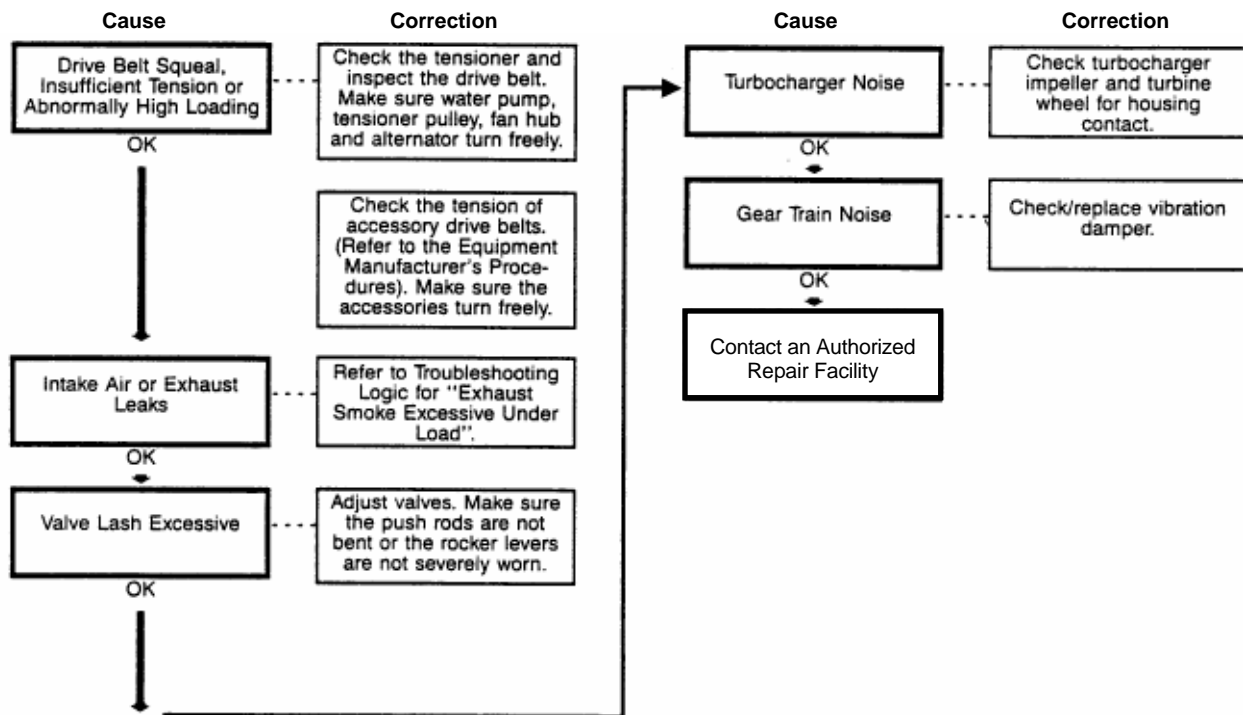
Fuel Consumption Excessive



Vibration Excessive

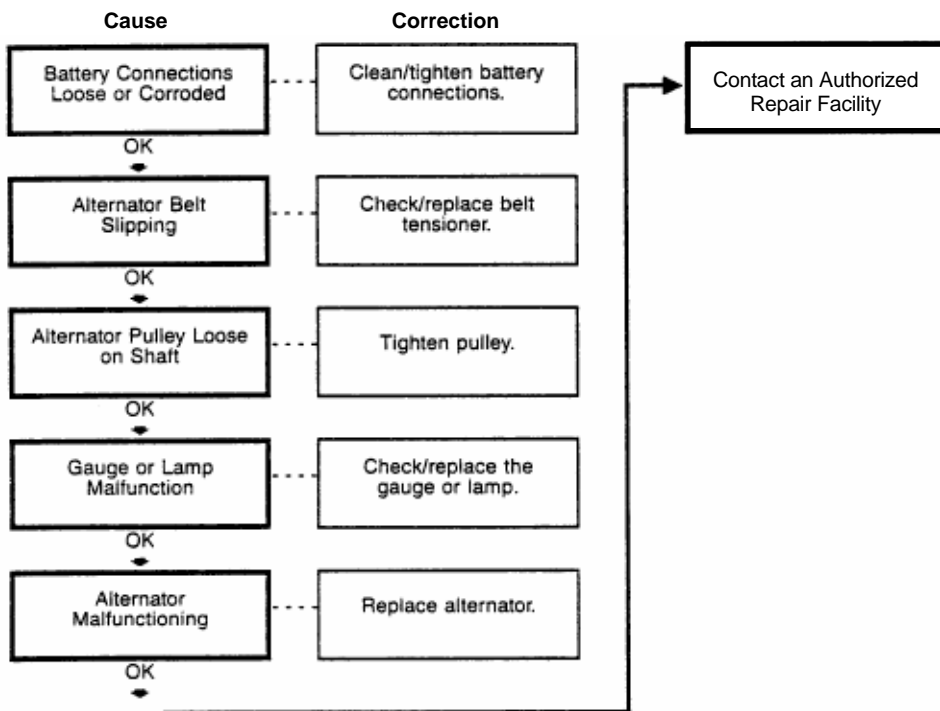


Engine Noises Excessive

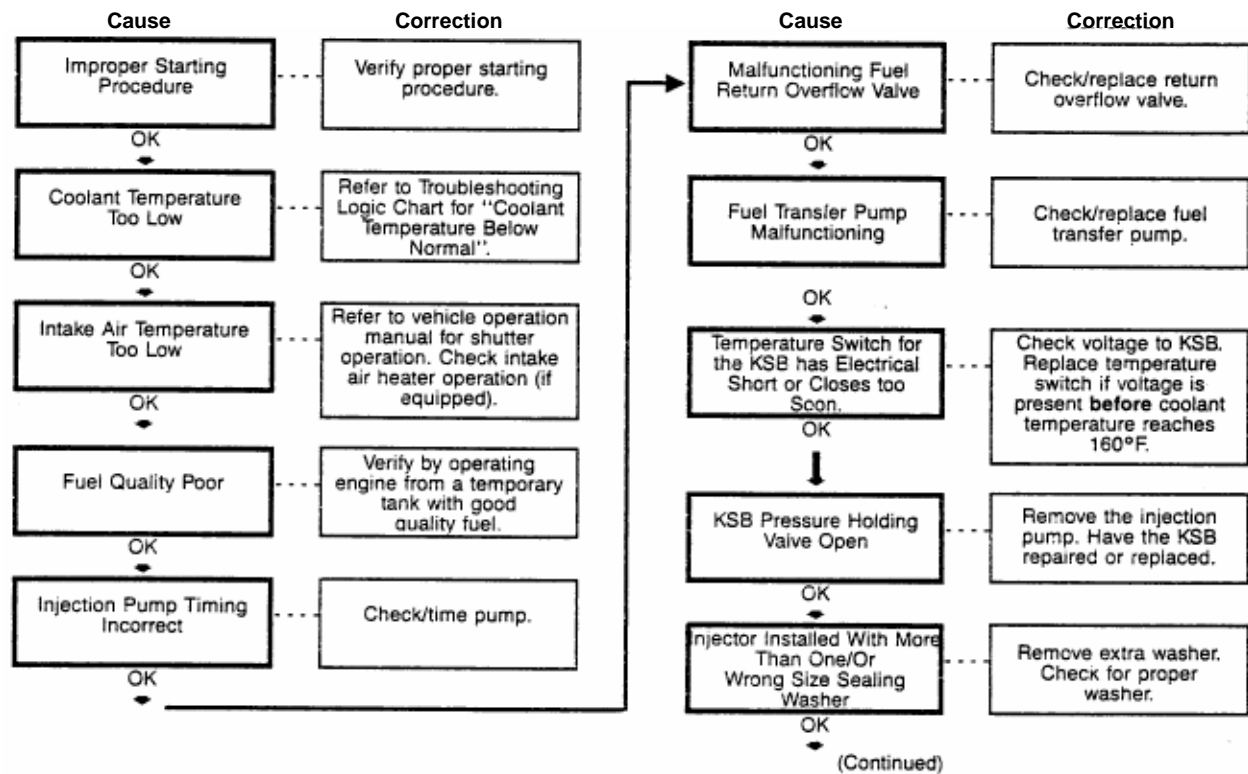


TM 5-3810-307-24-2-1

Alternator Not Charging or Insufficient Charging



White Smoke Excessive During Cold Start



TM 5-3810-307-24-2-1

White Smoke Excessive During Cold Start (Continued)

Cause	Correction	Cause	Correction
Injectors Malfunctioning	Remove nozzles. Test and repair.		
OK ↓			
Coolant Leaking Into Combustion Chamber	Refer to Troubleshooting Logic for Coolant Loss.		
OK ↓			
Injection Pump Malfunctioning	Remove pump. Have calibration checked.		
OK ↓			
Contact an Authorized Repair Facility			

Section A – Adjustment, Replacement and Repair

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Repair Tools Required

Sockets	Wrenches	Other
10 mm		
12 mm	8 mm	Allen Wrench (8 mm)
13mm	10 mm	Breaker Bar (1/2 in. Sq. Drive)
15 mm	13 mm	Flat Screwdriver
17 mm	15 mm	Ratchet (3/8 in. Sq. Drive)
18 mm	17 mm (open end)	Ratchet (1/2 in. Sq. Drive)
19 mm	19 mm	Filter Wrenches (75-80 mm and 90-95 mm)
22 mm	22 mm	Drill Motor (1/4 inch)
27 mm	24 mm	Drill Bit (3 mm)
		Slide Hammer
		Flat Chisel
		T-Bar Puller (75 mm)
		Sheet Metal Screw (#10)
		Torque Wrench
		Pliers
		Engine Barring Gear 3824591

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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) 13 mm Socket and Torque Wrench	Remove Drive Belt
Fan Hub	13 mm Socket/Wrench	Remove Drive Belt and Fan Pulley
Water Pump	10 mm Socket/Wrench	Drain Coolant and Remove Drive Belt
Thermostat	10 mm, 18 mm and 19 mm Socket/Wrench	Drain Coolant, Remove Drive Belt, Loosen Alternator Link, Remove Alternator Mounting Capscrew, Remove Thermostat



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° C [120° F] before removing the coolant system pressure cap. Failure to do so can cause personal injury from heated coolant spray.

Cooling System Repair

Drive Belt - Replacement

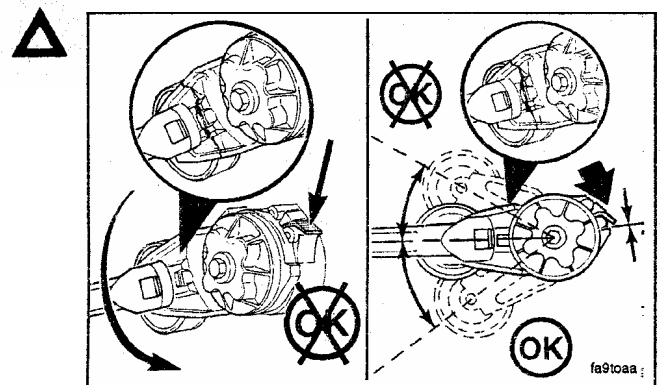
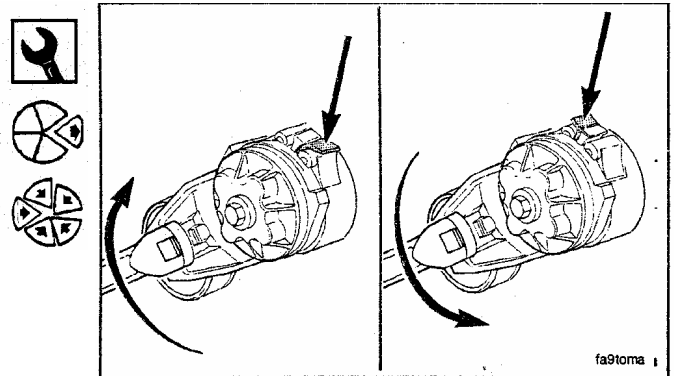
3/8 Inch Square Drive

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

The belt tensioner winds in the direction that the spring tang is bent over the tensioner body. To loosen the tension on the belt, rotate the tensioner to wind the spring tighter.

CAUTION

Applying excessive force in the opposite direction of wind-up or after the tensioner has been wound-up to the positive stop can cause the tensioner arm to break.

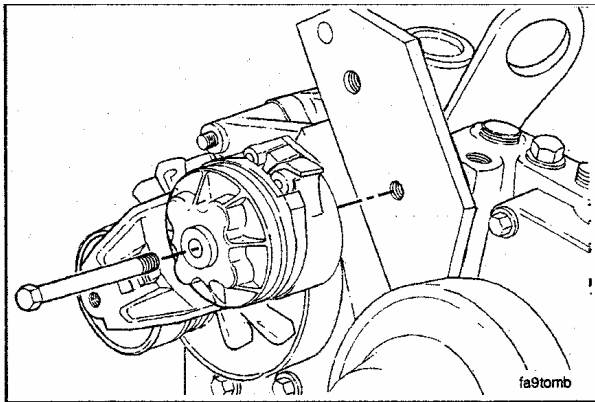


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Belt Tensioner - Replacement

Preparatory Step:

- Remove the drive belt.



13 mm



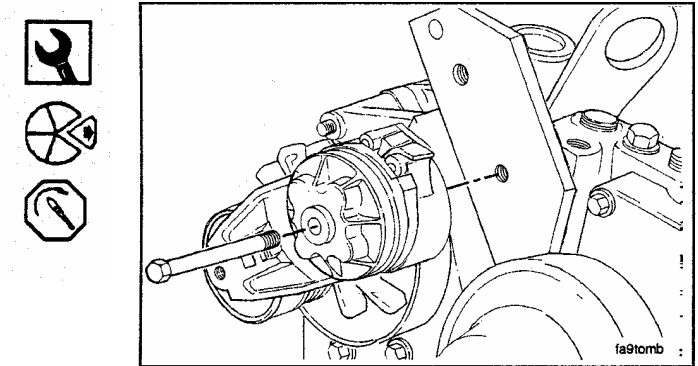
Remove the belt tensioner from the bracket.

13 mm

Install the belt tensioner.

Torque Value: 43 N•m

[32 ft-lb]



Fan Pulley – Replacement

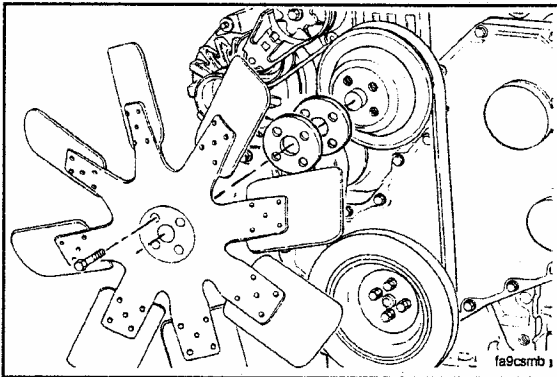
Preparatory Steps:

- Remove the drive belt.

NOTE

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

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10 mm and 13 mm

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

Torque Values:

- 8 mm Capscrews - 24 N•m [18 ft-lb]
- 10 mm Capscrews - 43 N•m [32 ft-lb]

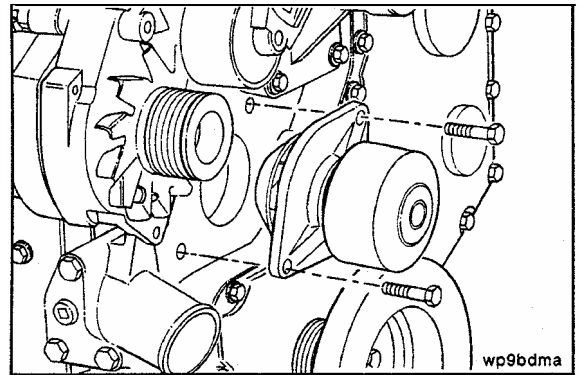
Water Pump – Replacement

Preparatory Steps:

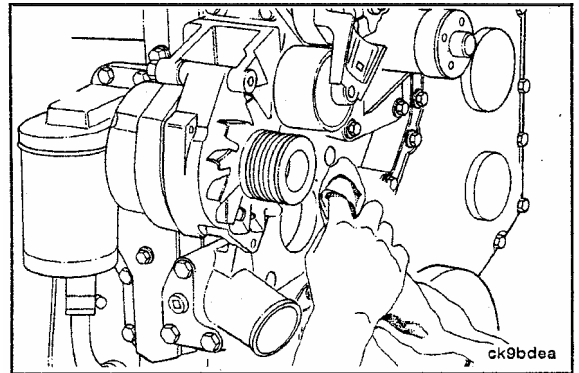
- Drain the coolant.
- Remove the drive belt.

10 mm

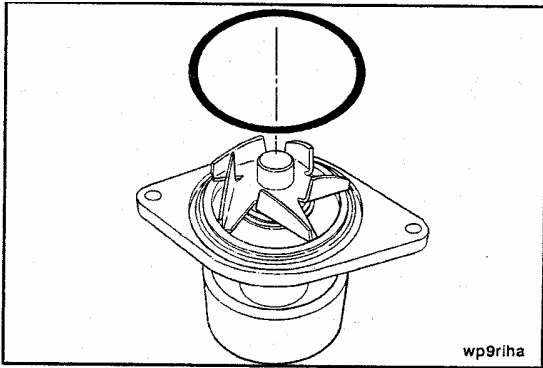
Remove the water pump.



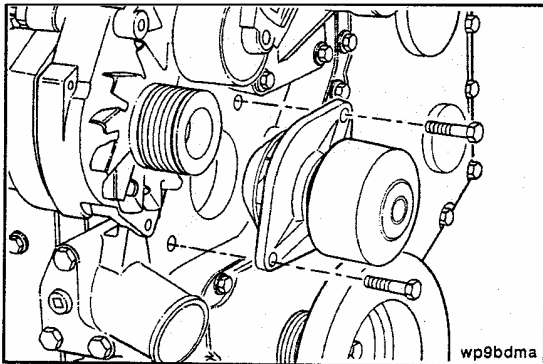
Clean the sealing surface on the cylinder block.



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Install a new O-ring into the groove in the water pump.



10 mm
Install the water pump.

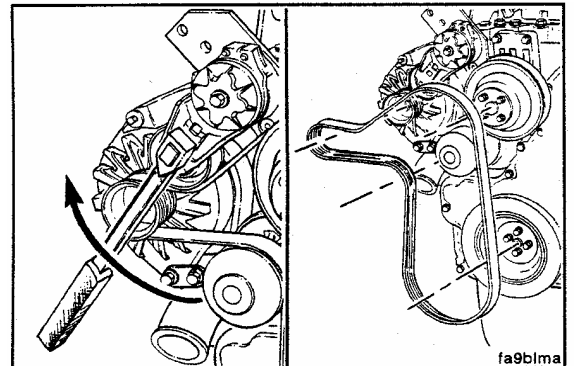


Torque Value: 24 N•m

[18 ft-lb]



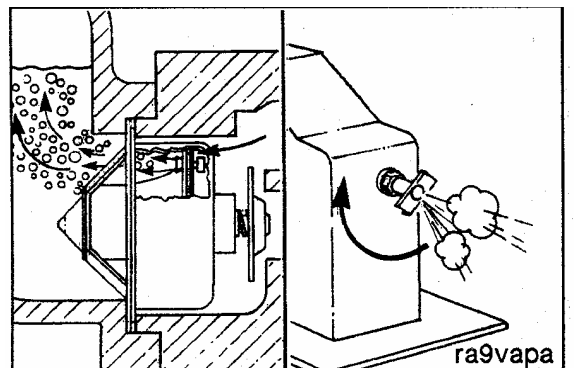
Lift the tensioner arm and pulley to install the drive belt.



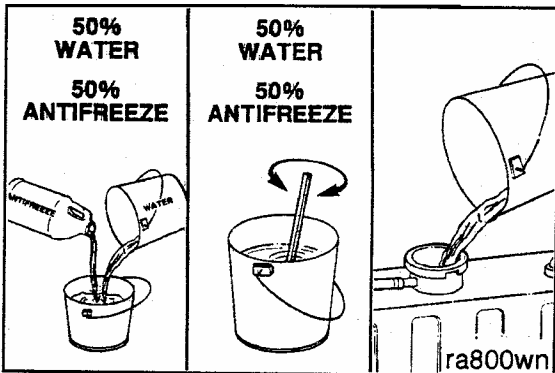
CAUTION

The system must be filled properly to prevent air locks. During filling, air must be vented from the engine coolant passages. Be sure to open the petcock on the aftercooler for aftercooled engines.

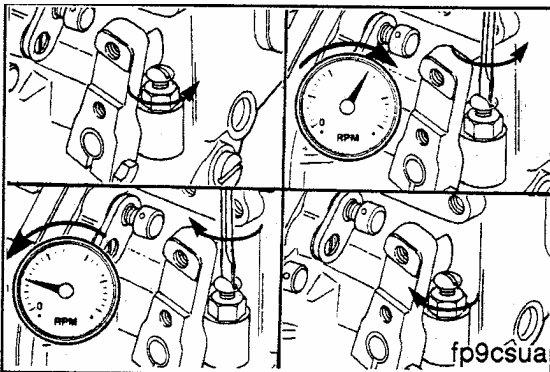
The system has a design fill rate of 19 liters per minute [5 U.S. gallons per minute]. Do not exceed this fill rate. Wait 2 to 3 minutes to allow air to be vented. Then add coolant to bring the level to the top.



TM 5-3810-307-24-2-1

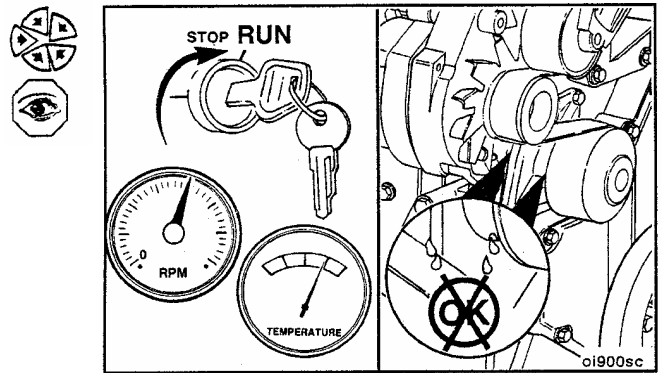


Close the drain valves. Fill the cooling system with a mixture of 50% water and 50% ethylene-glycol type antifreeze. This will provide freeze protection to -36.7° C [-34° F].



Coolant Capacity (Engine Only)	Liters [U.S. Quarts]
B5.9-190	
9.0 [9.5]	

Install the pressure cap. Operate the engine until it reaches a temperature of 80° C [180° F], and check for coolant leaks

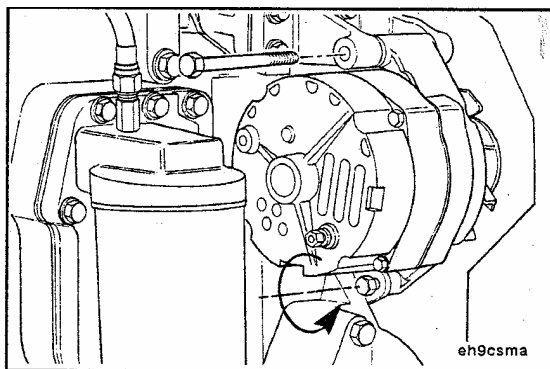


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Thermostat – Replacement

Preparatory Steps:

- Disconnect the negative battery cable.
- Drain 2 liters (2.1 U.S. Quarts) of coolant.
- Remove the radiator hose from the outlet connection.
- Remove the drive belt.

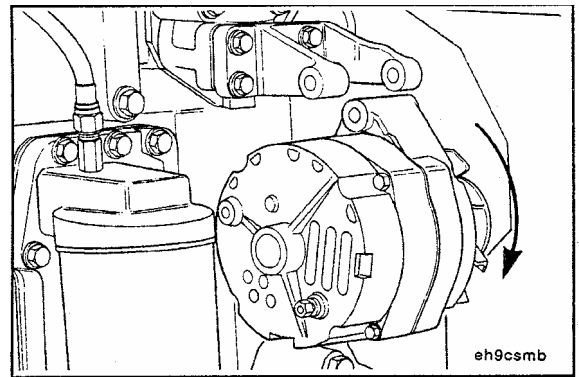


14 mm, 16 mm

Loosen the lower alternator link cap screw.

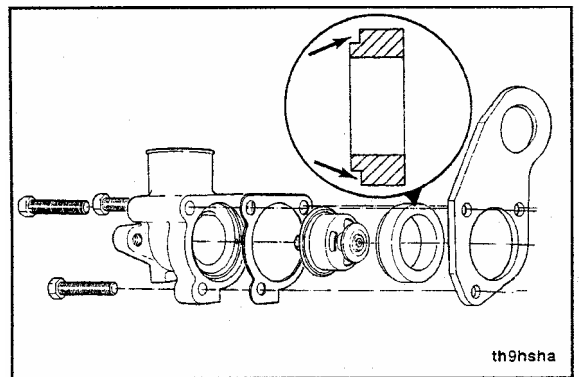
Remove the upper alternator mounting cap screw.

Lower the alternator.

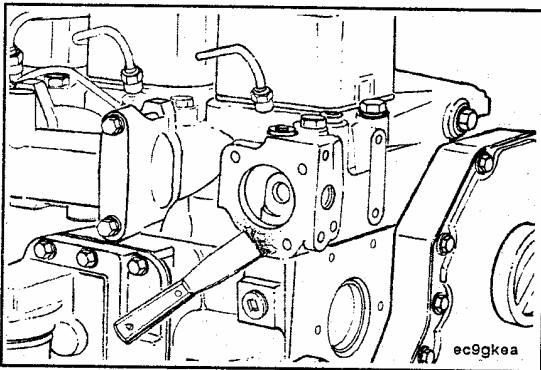


10 mm

Remove the thermostat housing, lifting bracket, thermostat and thermostat seal.



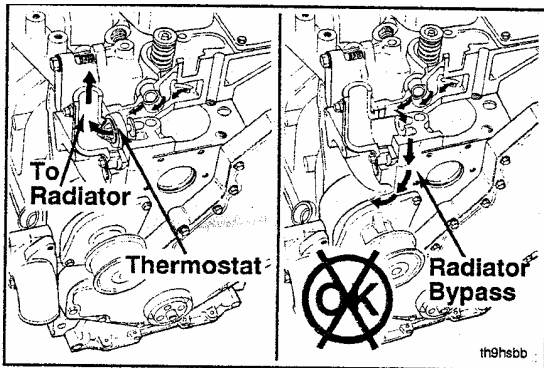
TM 5-3810-307-24-2-1



Clean the gasket surfaces.

NOTE

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



CAUTION

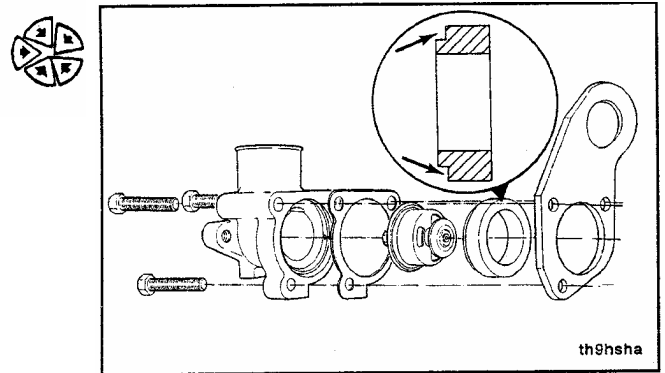
Always use the correct thermostat and never operate the engine without a thermostat. An incorrect thermostat can cause the engine to overheat or run too cold. The engine will overheat if operated without a thermostat because the coolant flows back to the inlet of the water pump instead of through the radiator for cooling.

TM 5-3810-307-24-2-1

Assemble the removed parts in the reverse order of removal.

Make sure the gasket is aligned with the capscrew holes. Install the capscrews and use your fingers at first to tighten.

The notched end of the rubber thermostat seal points away from the cylinder head.

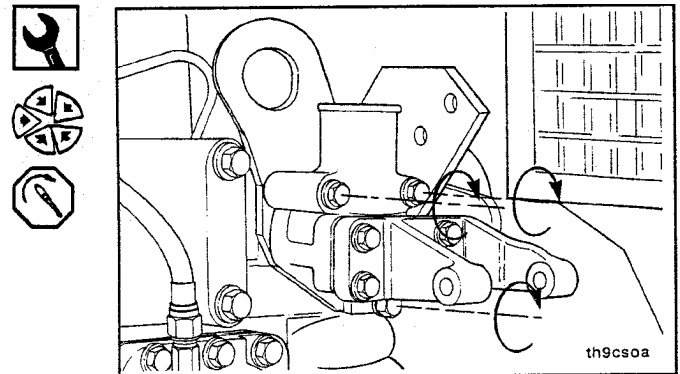


10 mm

Tighten all capscrews.

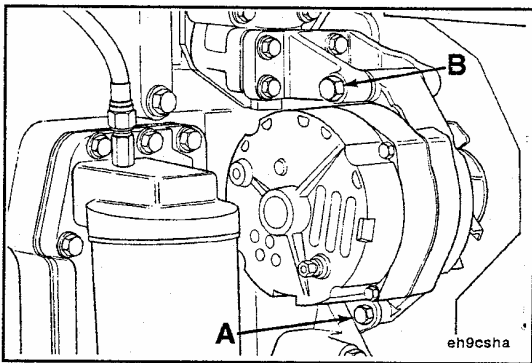
Torque Value: 24 N•m

[18 ft-lb]



A-17 C-1

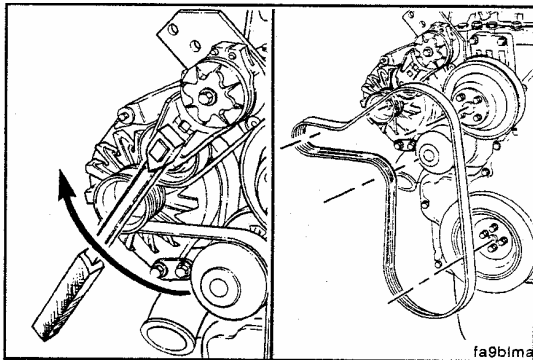
TM 5-3810-307-24-2-1



14 mm, 16 mm

Position the alternator and install the mounting capscrew.

Torque Value: (A) 24 N•m [18 ft-lb]
(B) 43 N•m [32 ft-lb]



13 mm

Install the drive belt.

NOTE

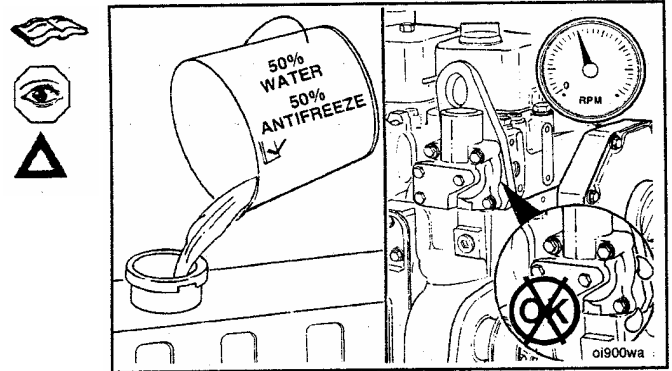
After the tensioner has been raised to remove/ install the belt, check the torque of the tensioner capscrew.

Torque Value: 43 N•m [32 ft-lb]

Fill the cooling system. Operate the engine and check for leaks.

CAUTION

Be sure to vent the engine and aftercooler during filling, to remove air from the coolant system or overheating will result.



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Fuel System Repair Summary

Component To Be Replaced	Tools	Preparatory Steps
Lift Pump	13, 14 and 17 mm Wrenches	Clean debris.
High Pressure Lines	10 mm Socket, 14, 17, and 19 mm Open End Wrenches and a Torque Wrench	Clean debris.
Injector Fuel Drain Manifold	10 mm and 19 mm Open End Wrenches, 10 mm and 13 mm Sockets, and a Torque Wrench	
Injectors	Ratchet, 24 mm Socket (deep well), and a Torque Wrench Injector bore cleaning brush.	Disconnect the high pressure lines and fuel drain manifold.
Injection Pump	10 mm Wrench, Ratchet, 22 mm Socket, 75 mm T-Bar Puller (w/2 8 mm capscrews) 1/2 in. open end wrench flat Screwdriver 13 mm Socket, 13 mm Wrench, Hammer, flat Chisel and a Torque Wrench.	Remove high pressure lines, supply line and return line. Remove the AFC air line, oil line(s), fuel shutoff solenoid and control linkage.
Fuel Solenoid (Rotary Pump)	Robert Bosch 24 mm Wrench, Lucas CAV 22 mm Wrench	Label and disconnect wiring
Fuel Filter Head	24 mm, 75-80 mm and 90-95 mm Filter Wrench	Clean debris.

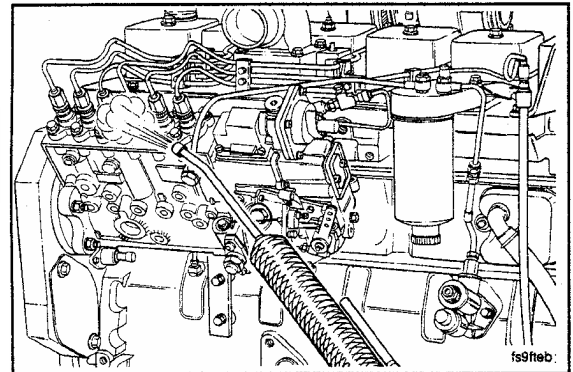


Do not mix gasoline, alcohol, or gasohol with diesel fuel. This mixture content would be highly flammable and can cause an explosion. Avoid having any ignition source close to fuel mixture.

Fuel System Repair - In-Line Pump

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.



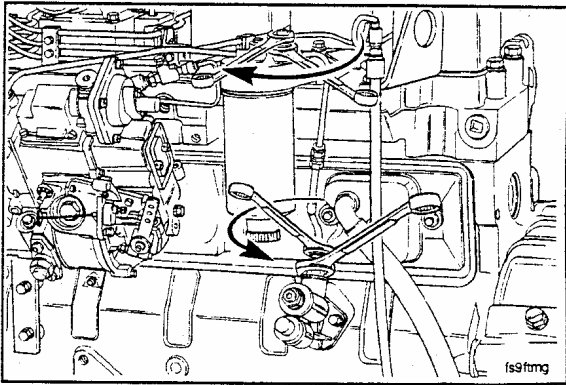
Low Pressure Fuel Line Replacement -

Preparatory Step

- Clean debris from fittings.



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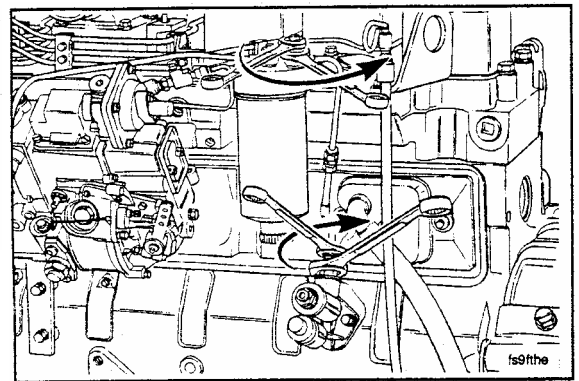
14 mm, 17 mm, 20 mm

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

14 mm, 17 mm, 20 mm

Install the fuel line to the lift pump and filter head. Use two wrenches to tighten the connection to the lift pump.

Torque Value: 24 N•m [18 ft-lb]



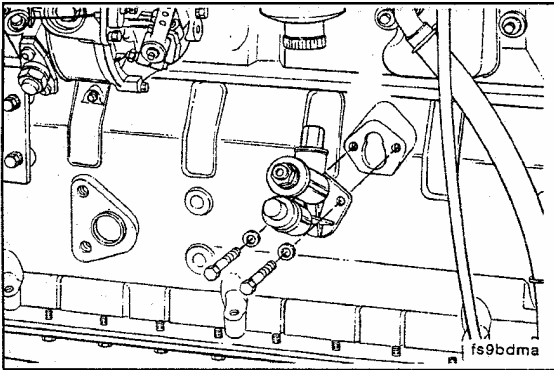
Lift Pump – Replacement

Preparatory Steps:

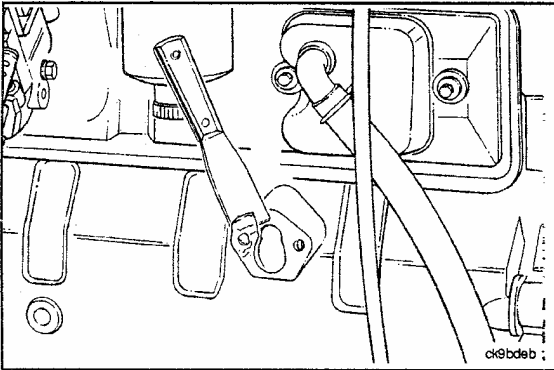
- Clean debris
- Disconnect the fuel lines



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10 mm
Remove the lift pump.



Clean the mounting surface on the cylinder block and spacer.

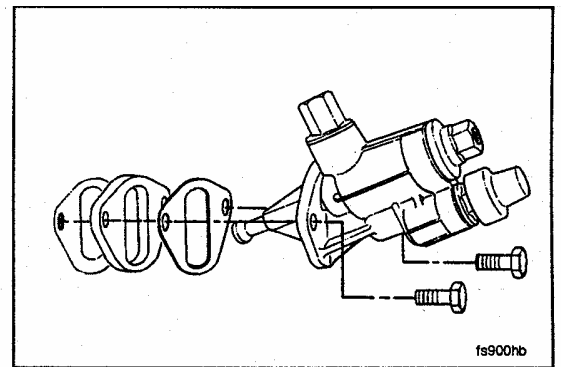
10 mm

CAUTION

Alternately tighten the mounting capscrews. As the capscrews are tightened, the fuel transfer pump plunger is pushed into the pump. Failure to tighten the capscrews in an even manner can result in the plunger being bent or broken.

Install the pump.

Torque Value: 24 N•m [18 ft-lb]



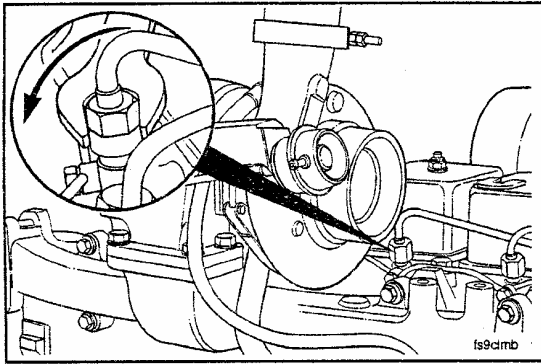
High Pressure Fuel Lines - Replacement

Preparatory Steps:

- Clean debris.



TM 5-3810-307-24-2-1

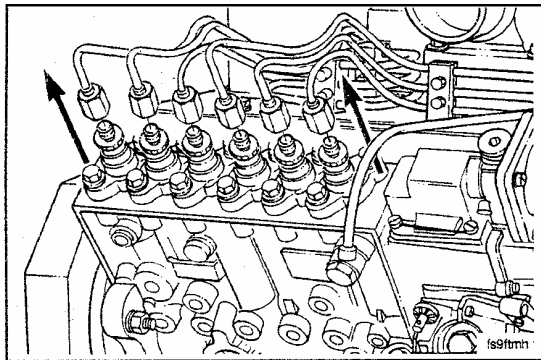


8 mm, 17 mm, and 19 mm

NOTE

If individual lines are to be replaced, remove the support clamp from the set of lines containing the line to be replaced.

Disconnect the line(s) from the injectors.



19 mm

Disconnect the line(s) from the fuel pump.

NOTE

If removed, reinstall the support clamp in the original position and make sure the lines do not contact each other or another component. Install a protective cover on the injectors and fuel delivery valves to prevent the entry of dirt into the system.

Install the lines in the reverse order of removal.

Torque Value: (Line Fittings) 24 N•m [18 ft-lb]
(Support Clamp) 6 N•m [52 in-lb]
(Support Bracket) 24 N•m [18 ft-lb]

Fuel Drain Manifold - Replacement

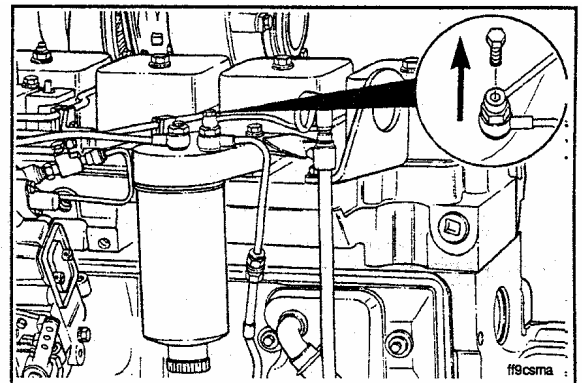
Preparatory Steps:

- Clean debris.

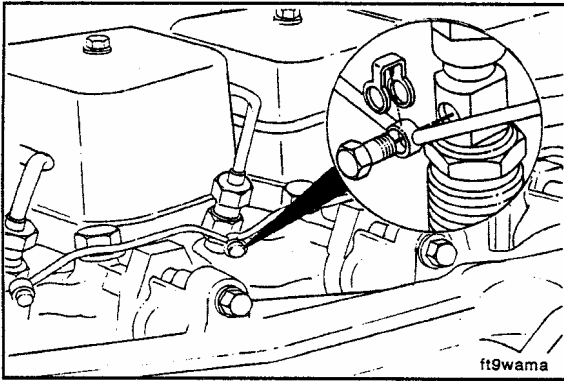


10 mm

Remove the drain line banjo capscrew from the fuel filter head. Remove the capscrew from the bracket on the intake cover.

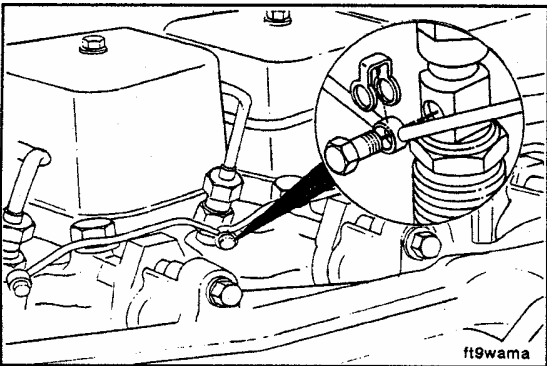


TM 5-3810-307-24-2-1



10 mm

Remove the banjo capscrews from the injectors.



NOTE

Use new seals and sealing washers.

Assemble the drain line and fuel drain manifold in the reverse order of removal.

Torque Value:

(Banjo fitting screw)	15 N•m [11 ft-lb]
(Banjo fitting)	9 N•m [80 in-lb]
(Bracket Capscrew)	24 N•m [18 ft-lb]

Injectors - Replacement

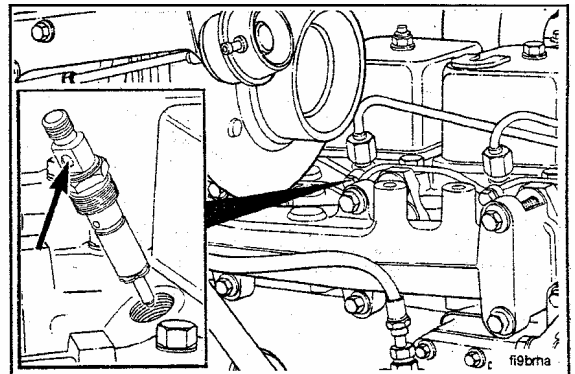
Preparatory Steps:

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

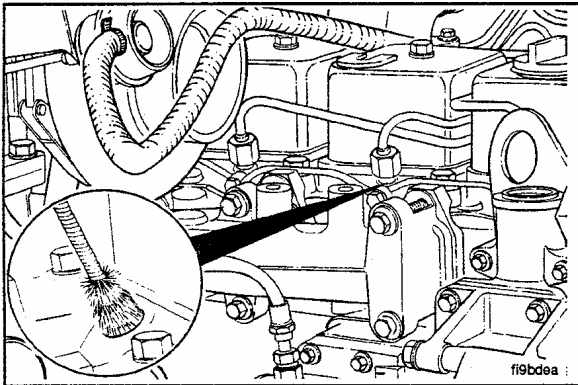


24 mm

Remove the injectors.

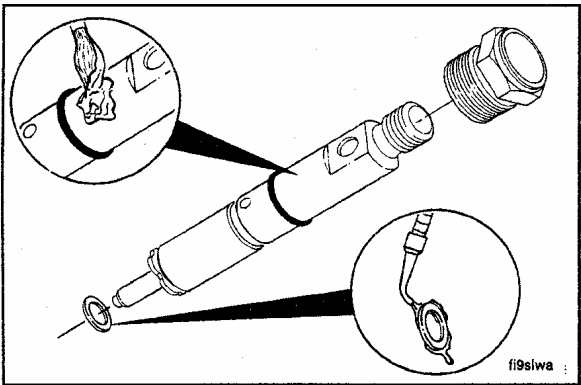


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Injector Bore Brush

Clean the injector nozzle bore, using Service Tool No. 3822509.



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

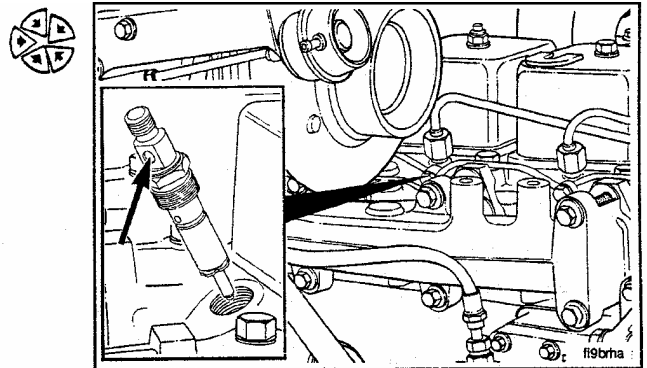


Use only one washer.

NOTE

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

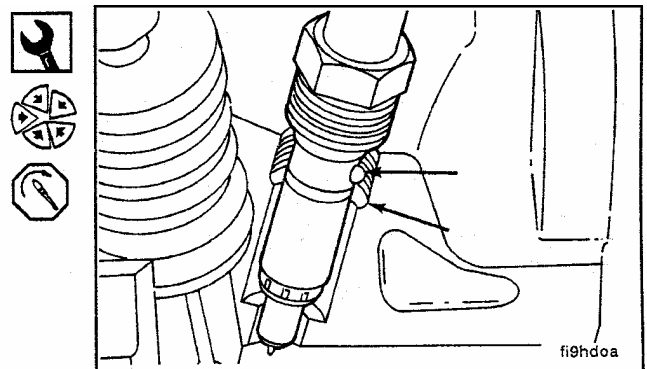
Install the injector package into the injector bore. The injector leak off connection **must** be away from the valve cover.



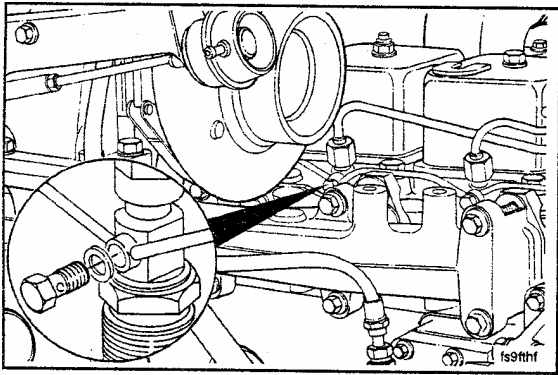
24 mm

Tighten the injector nozzle nut. The protrusion on the side of the nozzle fits into a notch in the head to orient the injector.

Torque Value: 60 N•m [44 ft-lb]



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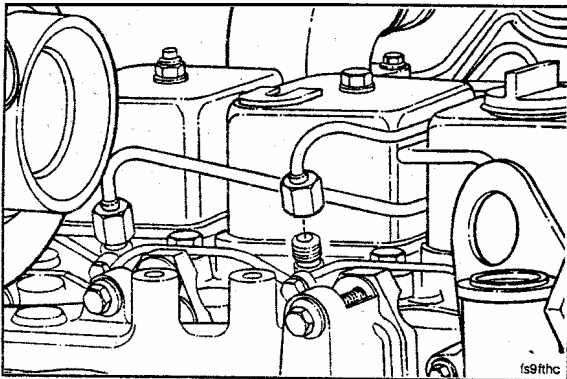


10 mm

Install the fuel drain manifold.



Torque Value: 9 N•m [80 in-lb]



17 mm, 19 mm

Install the high pressure fuel lines.



Torque Value: 24 N•m [18 ft-lb]



Fuel Shutoff Solenoid - Replacement

Preparatory Steps:

- Label and disconnect the wiring.

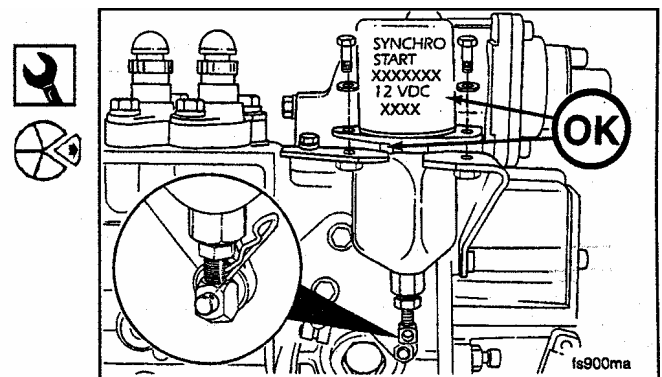
RQVK Governor Shutoff Solenoid

10 mm

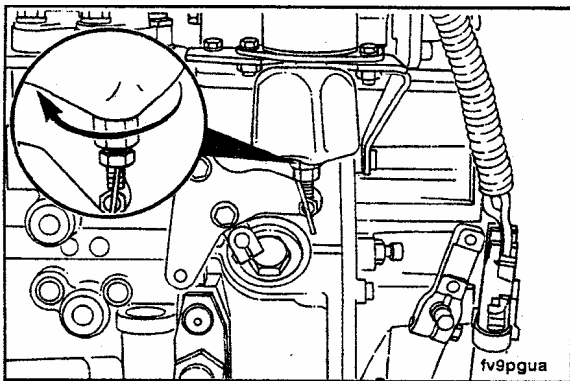
Remove the hitch pin clip, mounting capscrews and the fuel shutoff solenoid.

Install the new solenoid in reverse order of removal and connect the wires. Make sure the part number and cable tie block is facing away from the engine.

Torque Value: 10 N•m [89 in-lb]



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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 on the end of the plunger to make adjustments.

Injection Pump - Replacement

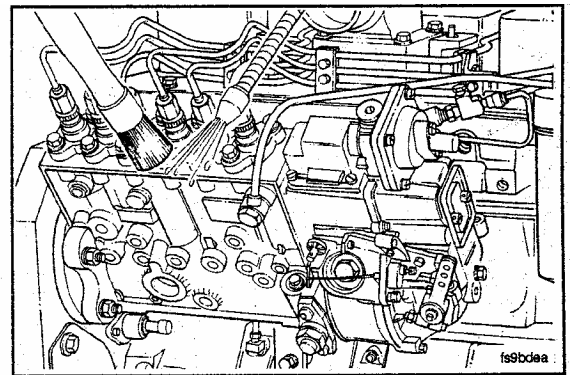
Preparatory Steps:

- Clean debris.
- Remove all fuel lines.
- Remove control linkage.
- Remove fuel shutoff solenoid.
- Remove AFC air line
- Remove oil line(s)

NOTE

A diesel engine can **not** tolerate dirt or water in the fuel system. A tiny piece of dirt or a few drops of water in the injection system may stop your units.

Clean all external surfaces of the injection pump, including all line connections and fittings that are to be disconnected. Clean the area around the injection pump gear cover to prevent dirt from entering the crankcase.



Injection Pump - Removal

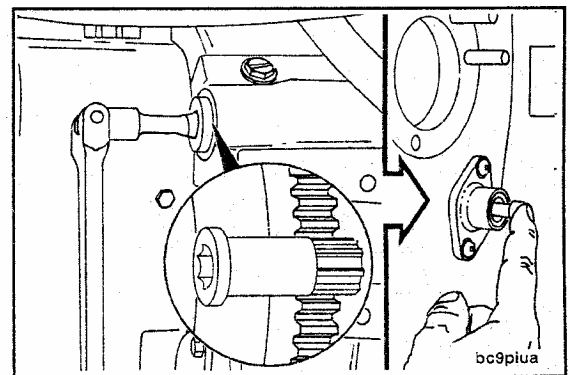
3824591 Engine Barring Gear

Locate TDC for cylinder No. 1. Push the TDC pin into the hole in the camshaft gear while slowly barring the engine.

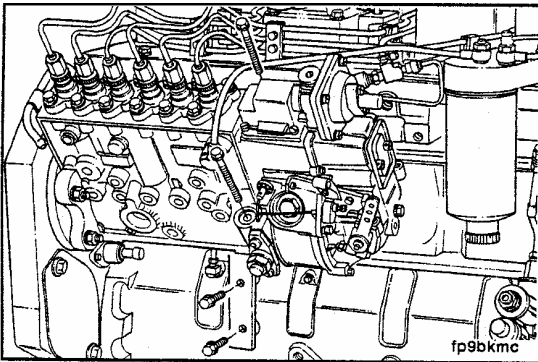
NOTE

Be sure to disengage the pin after locating TDC.

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.

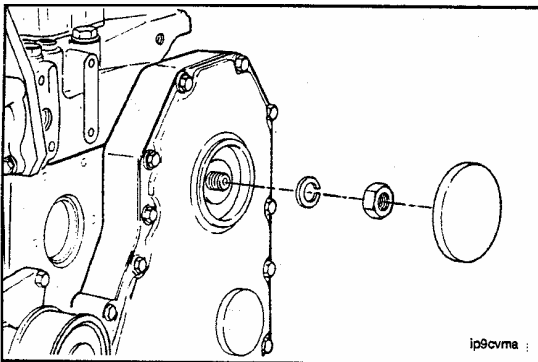


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10 mm

Remove the fuel pump mounting bracket.



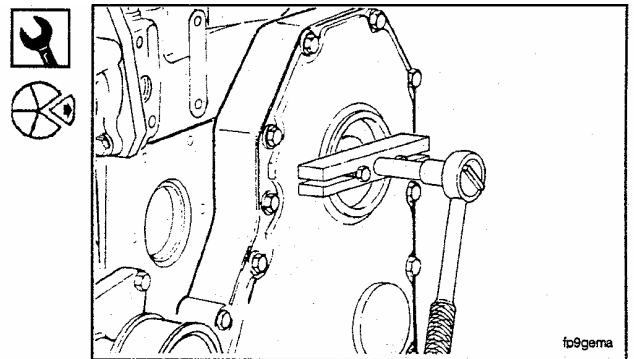
30 mm (P Pump)

Remove the gear cover access cap.

Remove the nut and washer from the fuel pump shaft.

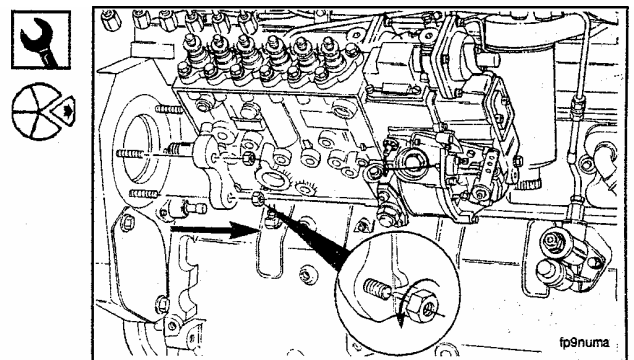
75 mm T-Bar Puller

Pull the fuel pump drive gear loose from the shaft.

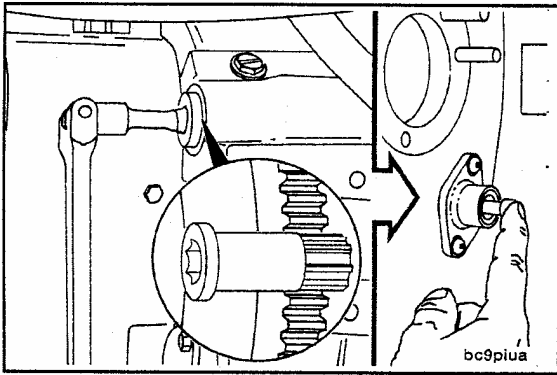


15 mm

Remove the four mounting nuts.
Remove the fuel pump.



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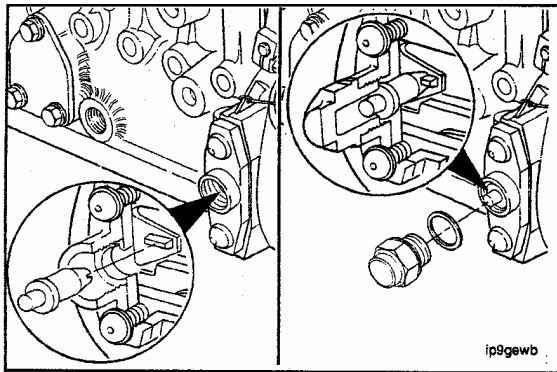


Injection Pump - Installation

3824591 Engine Barring Gear

Make sure the engine has cylinder No. 1 at TDC.

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.

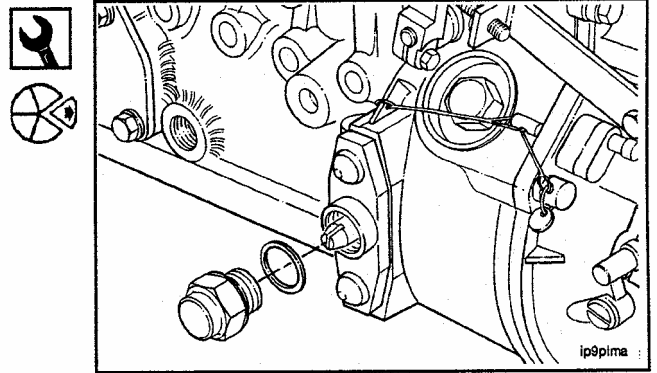


Injection Pump - Timing

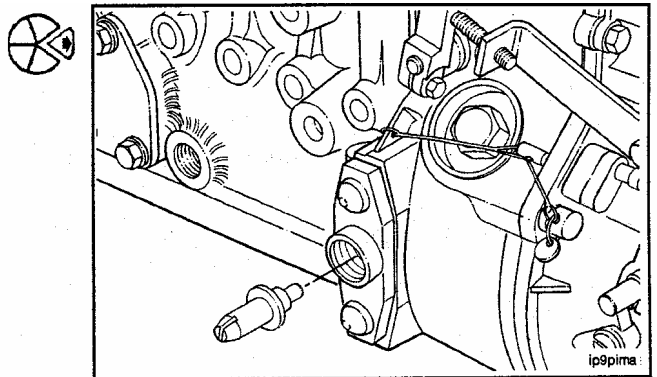
The injection pump also has a timing pin, located in the governor housing, to position the pump shaft to correspond with TDC for cylinder No. 1.

24 mm

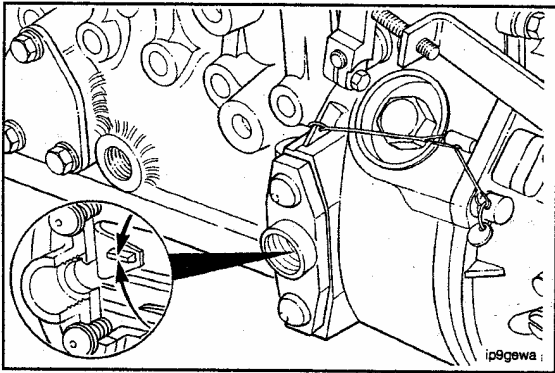
Remove the access plug.



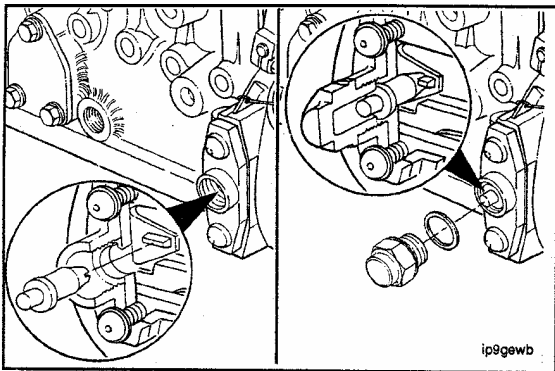
Remove the timing pin.



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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 pin so the slot of the pin will fit over the timing tooth in the pump.

Install and secure the pin with the access plug.



NOTE

If the mounting flange O-ring has a colored stripe, it can **not** be reused. Replace with a new O-ring. Furthermore, do **not** lubricate the new type O-ring. Instead, lubricate the seating area of the gear housing.

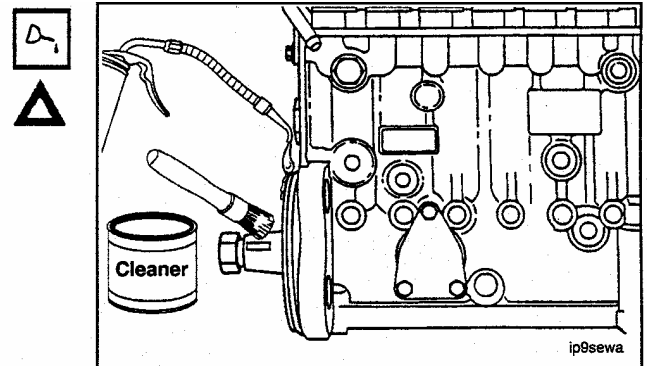
Lubricate the mounting flange of the fuel injection pump with clean engine oil.

CAUTION

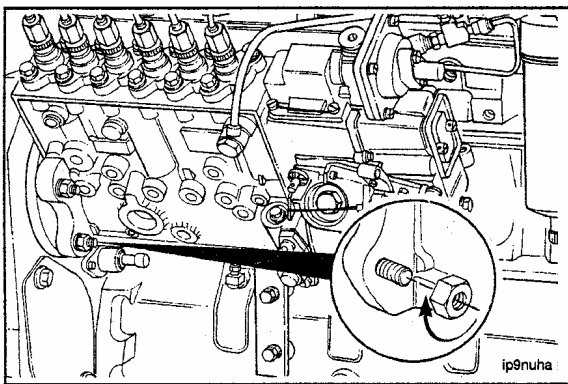
The fuel pump drive gear inside diameter and the shaft outside diameter must be clean and dry before installing the shaft into the gear. A non-petroleum based cleaner should be used to clean the drive gear and shaft mounting surfaces. Failure to do so will result in gear slippage in the retarded direction.

NOTE

The P7100 fuel injection pump driveshaft has a provision for a Woodruff key, however, it is not required. Timing mark alignment is not required for the P7100 drive gear.



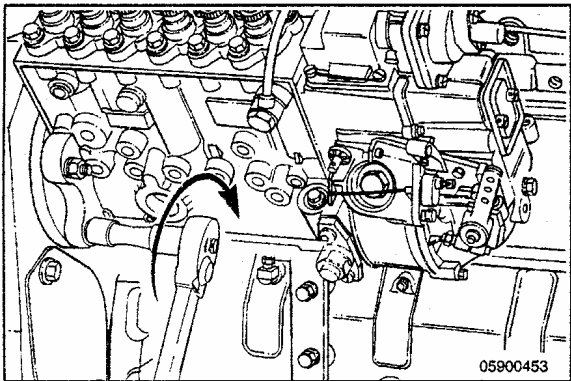
TM 5-3810-307-24-2-1



Slide the pump shaft through the drive gear and position the pump flange onto the mounting studs.

Push the pump forward until the mounting flange and o-ring are properly fitted into the gear housing bore.

Use your fingers to tighten the capscrews for the support bracket, if so equipped.



15 mm

Tighten the mounting nuts.



Tighten the capscrews for the rear support bracket.



Torque Value:

Mounting Nuts	44 N•m [32 ft-lb]
Support Bracket	24 N•m [18 ft-lb]

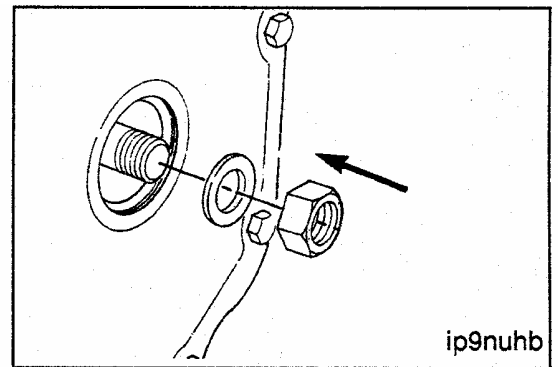
22 mm (A Pump), 30 mm (P Pump)

Install the fuel injection pump retaining nut and washer.

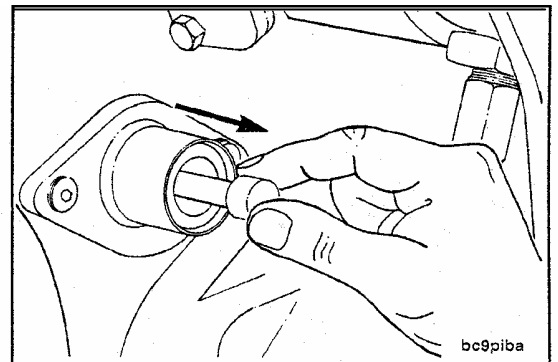
Torque Value: 10 to 15 N•m [89 in-lb to 11 ft-lb]

CAUTION

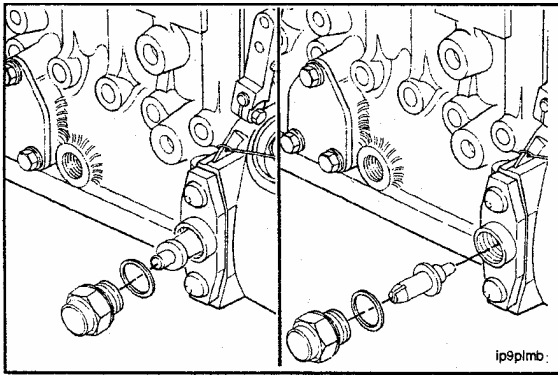
Do not exceed the torque value given. This is not the final torque value for the retaining nut.



Disengage the engine timing pin.



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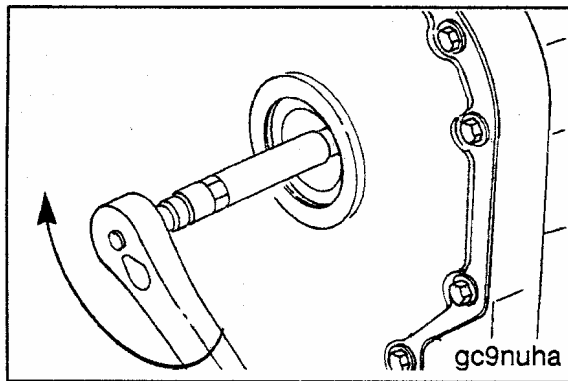


24 mm

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



Torque Value: 24 N•m [18 ft-lb]



22 mm or 27 mm

Tighten the fuel pump drive nut.



Torque Value: P7100 Pump, 178 N•m [132 ft-lb]



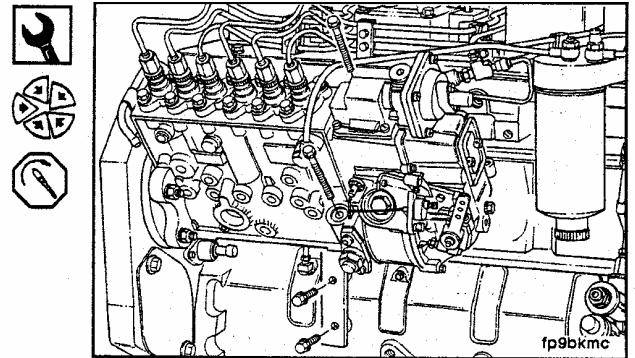
Install the gear cover access cap hand tight.

10 mm

Install the fuel pump mounting bracket capscrews finger tight.

To make sure the alignment is correct, tighten the support mounting capscrews.

Torque Value: 24 N•m [18 ft-lb]



10 mm Hex Drive

CAUTION

If a replacement or repaired pump was installed, be sure to fill the governor housing with engine oil before starting the engine. Failure to do so will result in damage to the governor fly weights.

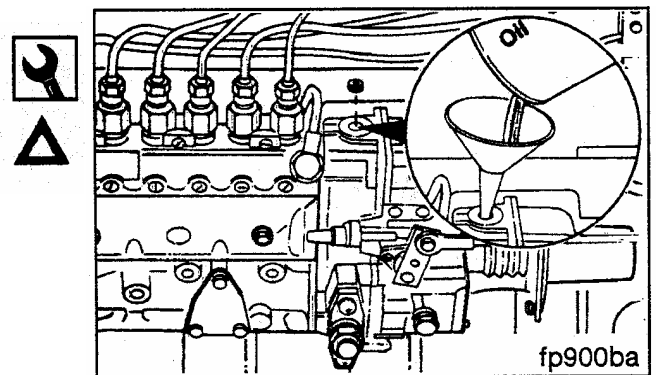
Remove the access plug.

Oil Capacity

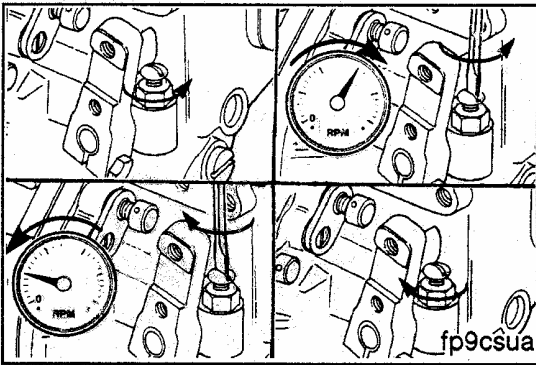
RQVK Governor	750 ML [0.8 Qt]
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Install the access plug.

Torque Value: 28 N•m [21 ft-lb]



TM 5-3810-307-24-2-1



Injection Pump - Idle Speed Adjustment

RQVK Governor

10 mm Screwdriver and Tachometer



Idle adjustment for the RQVK governor requires setting of the idle adjustment screw.

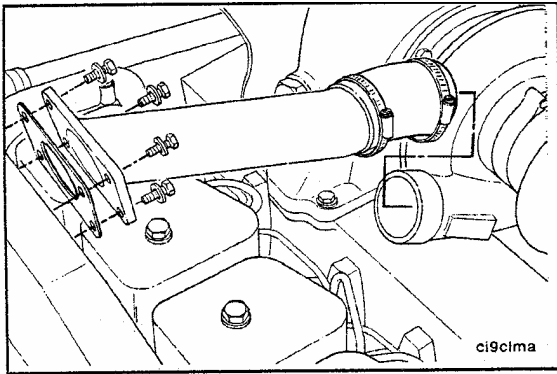
Loosen the locknut and turn the screw **counterclockwise** to raise the RPM; **clockwise** to decrease the idle speed until the data plate specified idle speed is attained with normal idle operation accessory loads (i.e. transmission, hydraulic, air conditioning). Tighten the locknut.

Air System Repair Summary

Component To Be Replaced	Tools	Preparatory Steps*
Air Crossover Tubing	8 mm and Common Screwdriver and Torque Wrench	
Intake Manifold Cover and Gasket	10 mm Socket	Remove high pressure fuel lines, disconnect cold starting aid, if used, and air crossover tubing.
Aftercooler and Gasket	8 mm, 10 mm Socket	Disconnect Cold Starting aid if used, remove air crossover tube and drain coolant.
Turbocharger and/or Gasket	10 mm, 15 mm, 16 mm, 7/16-Inch Wrenches	Disconnect intake and exhaust piping and remove crossover tubing.
Exhaust Manifold and/or Gasket	15 mm Socket	Disconnect intake and exhaust piping, remove air crossover tube 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.

TM 5-3810-307-24-2-1

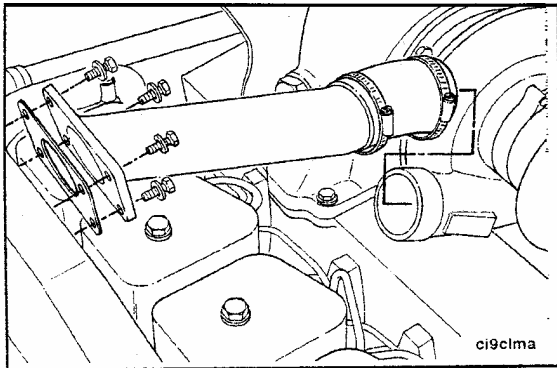


Air System Repair

Air Crossover Tube - Replacement

8 mm or Screwdriver

Loosen the hose clamps and position the hose so the crossover tube can be removed.



8 mm or Screwdriver

Use new hose and clamps as required to install the crossover tube.

Torque Value: 8 N•m

[71 in-lb]

Intake Manifold Cover and Gasket – Replacement

Preparatory Steps:

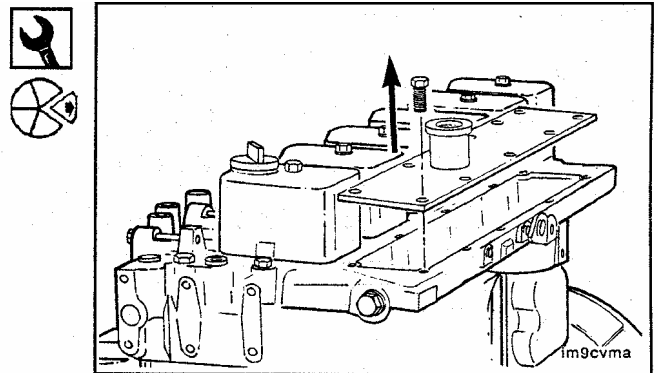
- Remove the high pressure fuel lines.
- Disconnect the cold starting aid, if used.
- Remove the air crossover tube (Industrial).

10 mm

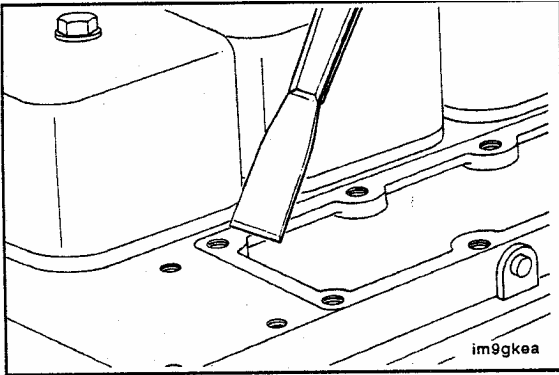
Remove the manifold cover and gasket.

NOTE

Plug the opening of air intake with a clean shop rag to prevent foreign material from entering combustion chamber.



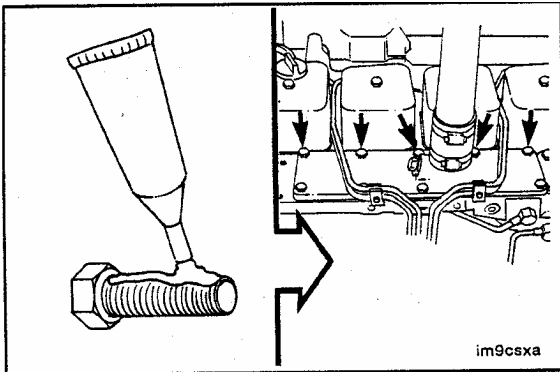
TM 5-3810-307-24-2-1



Clean the sealing surface.

NOTE

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



NOTE

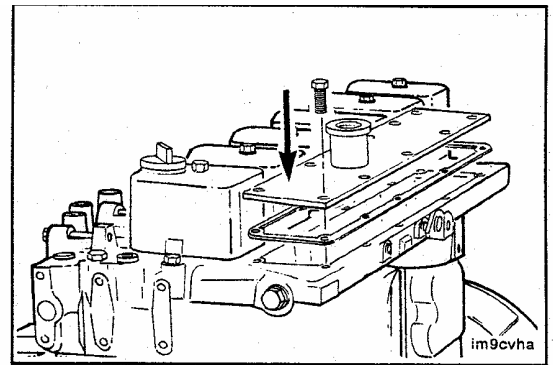
The holes shown in the illustration are drilled through and must be sealed by applying liquid teflon sealant to the capscrews.

TM 5-3810-307-24-2-1

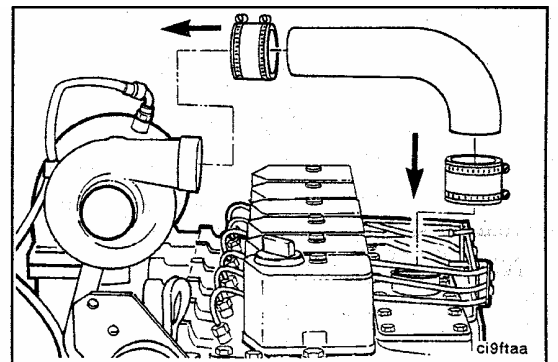
10 mm

Install the cover and a new Gasket.

Torque Value: 24 N•m [18 ft-lb]

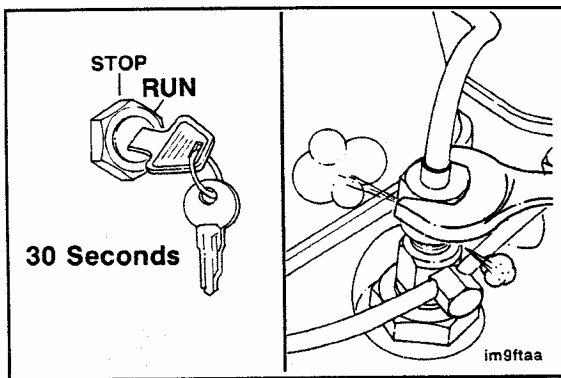


Assemble the intake piping and connect the cold starting aid if used.



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TM 5-3810-307-24-2-1



Install and bleed the high pressure fuel lines.



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.

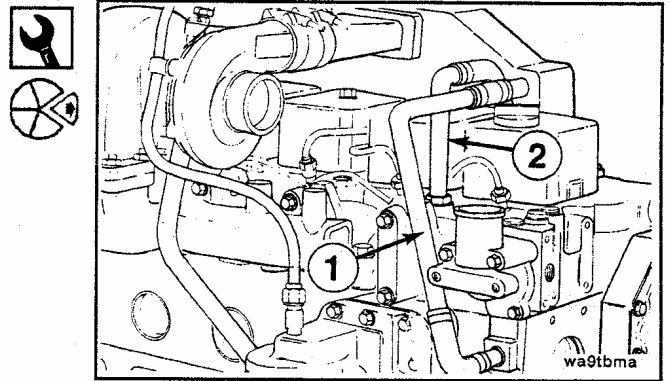
Jacket-Water Aftercooler and Gasket - Replacement

Preparatory Steps:

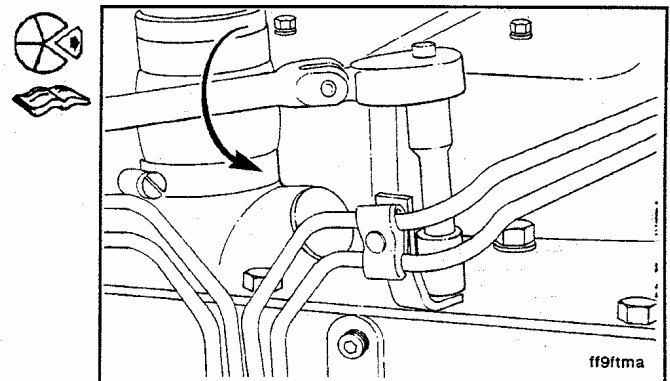
- Disconnect the cold starting aid, if used.
- Remove the air crossover tube.
- Remove high pressure fuel lines.
- Drain 2 liters (2.1 U.S. Quarts) of coolant.

8 mm

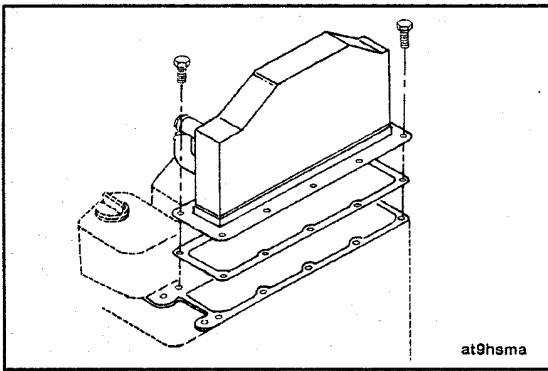
Remove the coolant supply tube (1) and the coolant return tube (2).



Remove the high pressure fuel lines. (Refer to High Pressure Fuel Lines Section A.)



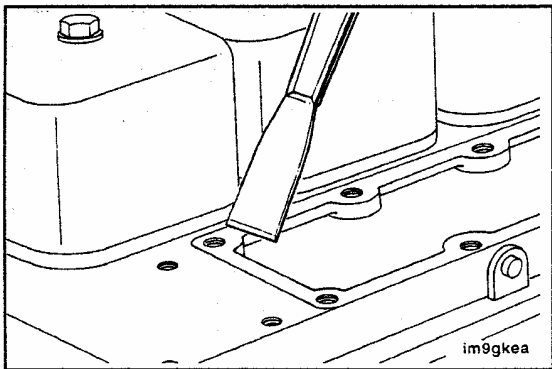
TM 5-3810-307-24-2-1



10 mm

Remove the aftercooler housing and gasket.

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



Clean the sealing surface.

NOTE

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

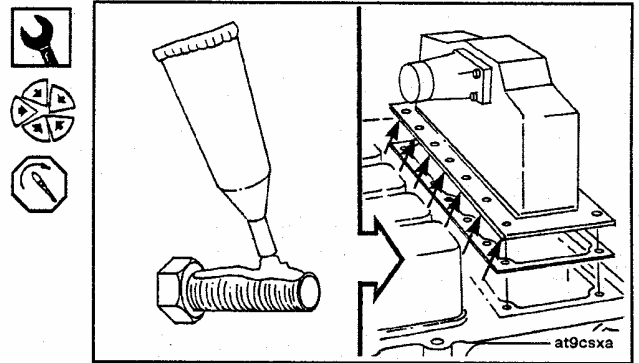
10 mm

NOTE

The holes shown in the illustration are drilled through. Apply liquid teflon sealant to the capscrews.

Install the aftercooler housing and a new gasket.

Torque Value: 24 N•m [18 ft-lb]

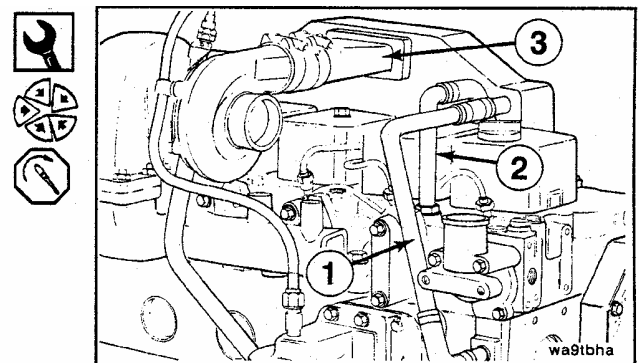


8 mm

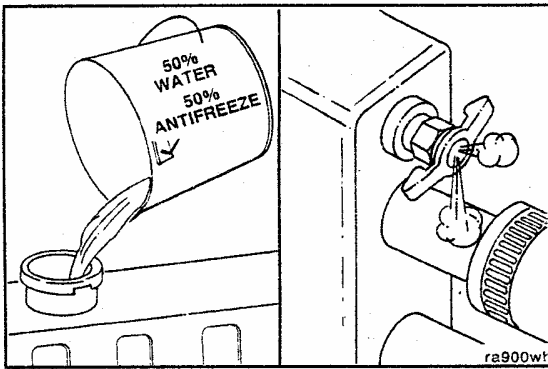
Install the coolant supply tube (1) and coolant return tube (2). Install the air crossover tube (3).

Reinstall and bleed the high pressure fuel lines.

Torque Value: 8 N•m [6 ft-lb]



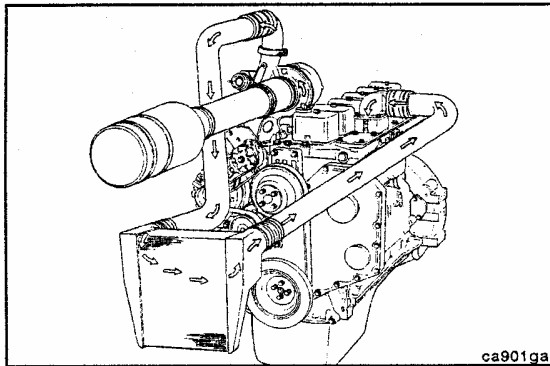
TM 5-3810-307-24-2-1



CAUTION

The system must be filled slowly to prevent air locks. Be sure to open the engine and aftercooler vents to allow air to escape as the system is filled.

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



Charge Air Cooler - Leak Check

NOTE

The long term integrity of the charge air cooler system is the responsibility of the vehicle and component manufacturers; however, the following symptoms can be checked by any Authorized Repair Location:

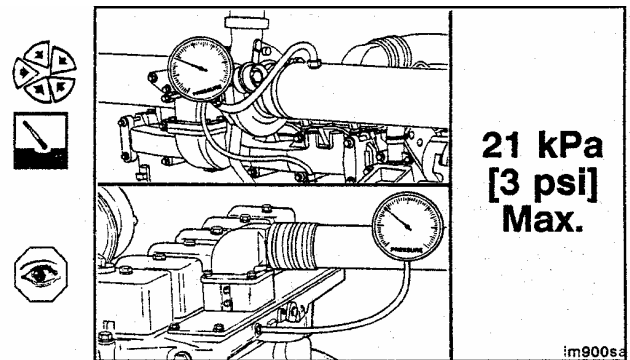
Intake Manifold Pressure - Check

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.



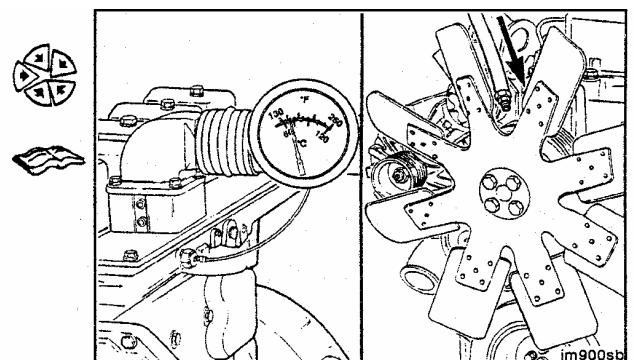
Intake Manifold Temperature - Check

Install a temperature gauge in the intake manifold.

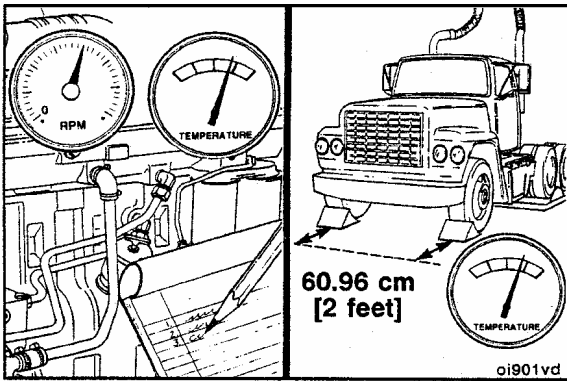
Lock the fan drive in the ON mode to prevent erratic test results. This can be done by installing a jumper across the temperature switch or supplying shop air to the fan. Refer to the fan drive manufacturer for lock-up procedure.

NOTE

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



TM 5-3810-307-24-2-1



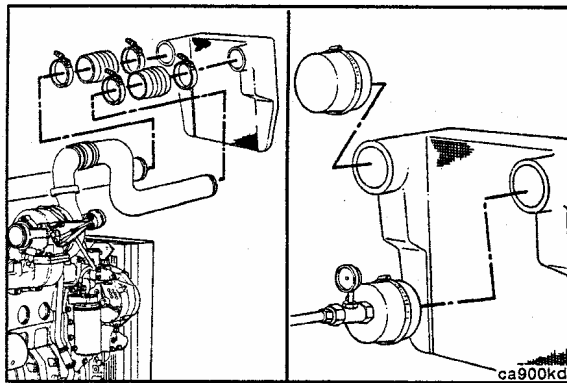
Operate the engine at rated RPM and load. Record the intake manifold temperature.

Measure the ambient temperature at least two feet in front of the vehicle.

The maximum temperature differential must **not be** greater than 25°C [45°F].



If the temperature differential is greater than 25° 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.



3824556

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.

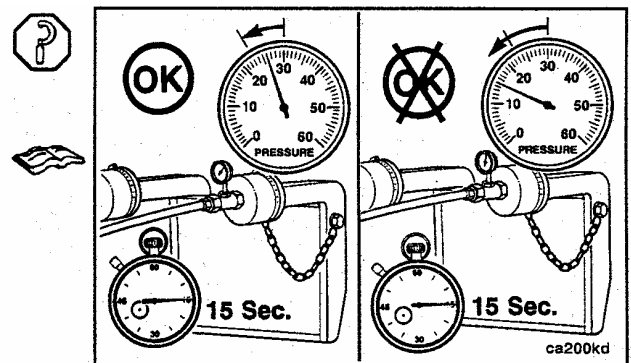
Using service Tool No. 3824556, install a cap over the outlet side of the cooler. Install a pressure gauge and a shop air supply line to the inlet side of the cooler.

Apply 276 kPa [40 psi] of air pressure to the cooler. If the pressure drop is 35 kPa [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.

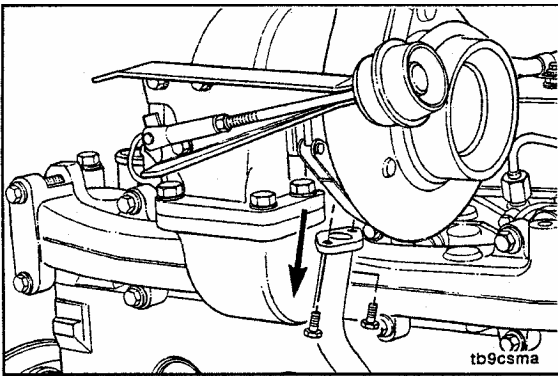


Turbocharger - Replacement

Preparatory Steps:

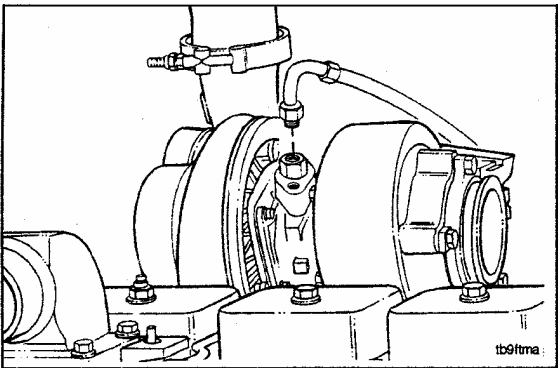
- Remove the air crossover tube.
- Disconnect the intake and exhaust piping.

TM 5-3810-307-24-2-1



10 mm

Remove the capscrews from the oil drain tube.

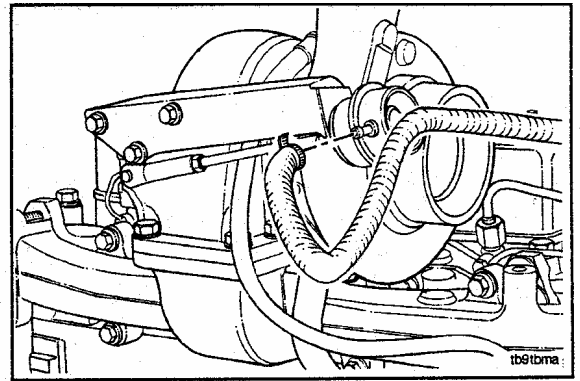


16 mm

Remove the oil supply line.

TM 5-3810-307-24-2-1

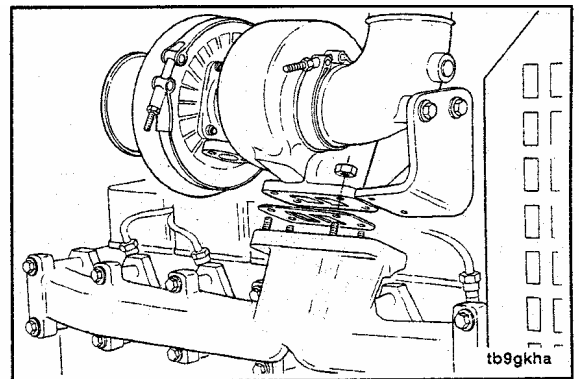
If equipped with a wastegate turbocharger, remove the intake manifold pressure supply line from the boost capsule.



15 mm and 11 mm

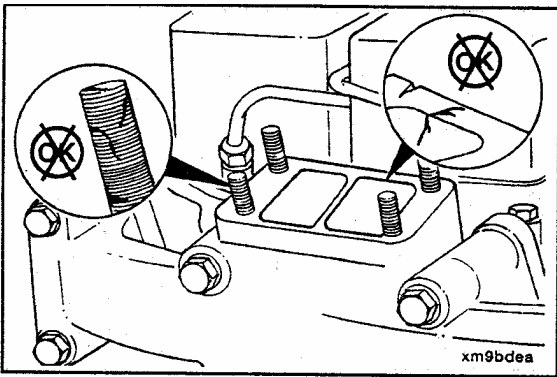
Remove the exhaust clamp, turbocharger, and gasket.

Plug the opening with a clean shop rag to prevent foreign material from entering exhaust system.

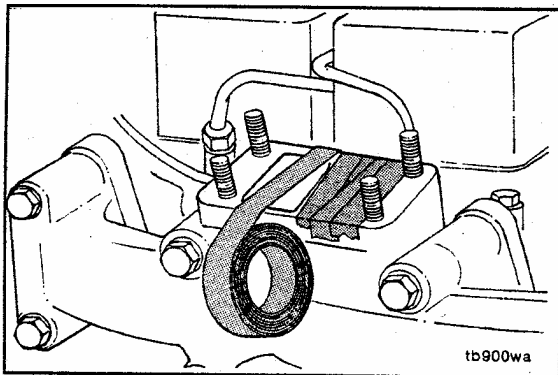


A-61 C-1

TM 5-3810-307-24-2-1



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

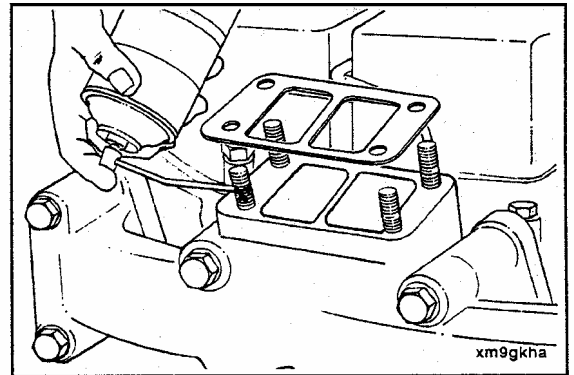


NOTE

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

TM 5-3810-307-24-2-1

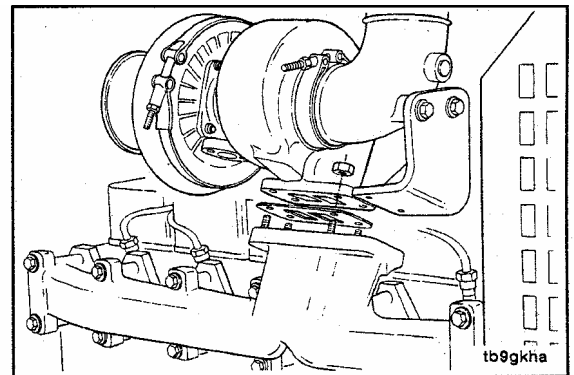
Install a new gasket and apply anti-seize compound to the mounting studs.



15 mm

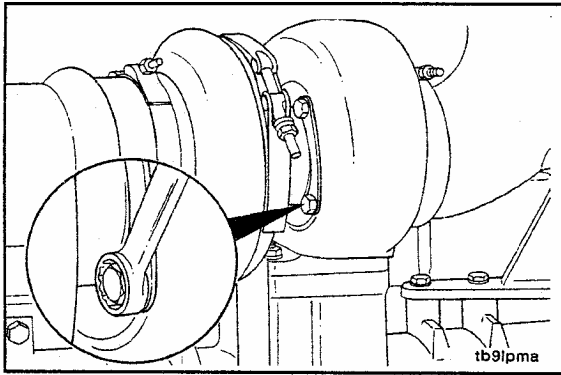
Install the turbocharger and a new gasket.

Torque Value: 43 N•m [32 ft-lb]



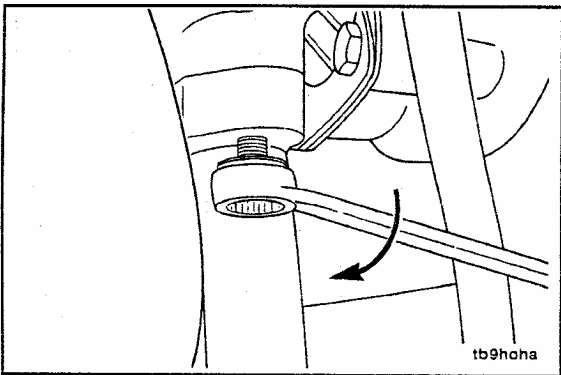
A-63 C-1

TM 5-3810-307-24-2-1



13 mm

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



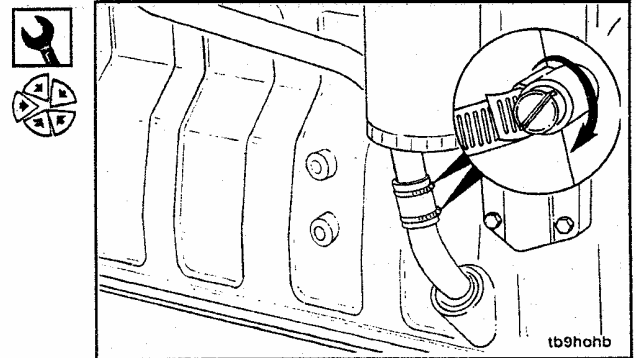
13 mm

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]

Screwdriver

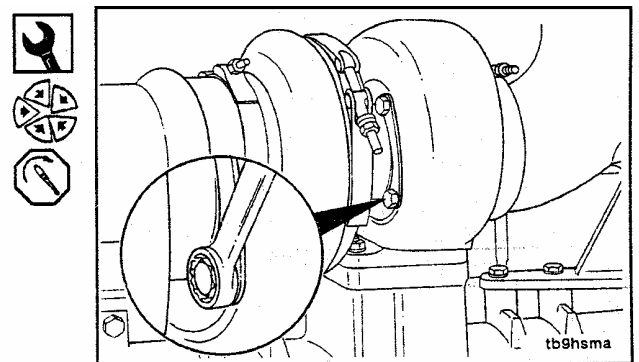
Position the turbocharger drain hose to connect the drain tubes; tighten the clamps.



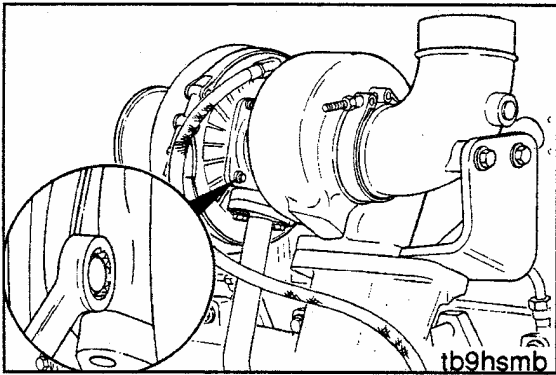
13 mm, Punch, Hammer

If loosened, tighten the turbine housing capscrews. Press the lockplates onto the flats to prevent loosening.

Torque Value: 20 N•m [15 ft-lb]



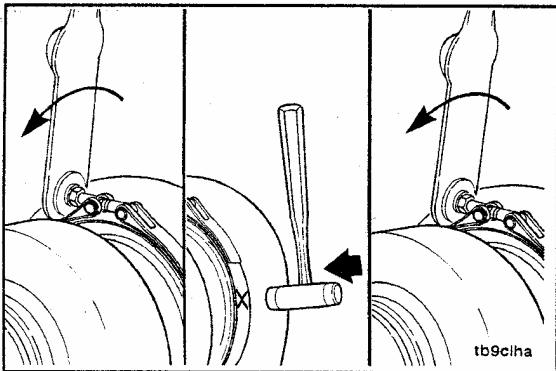
TM 5-3810-307-24-2-1



10 mm

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

Torque Value: 8.5 N•m [75 in-lb]



11 mm, Plastic Hammer

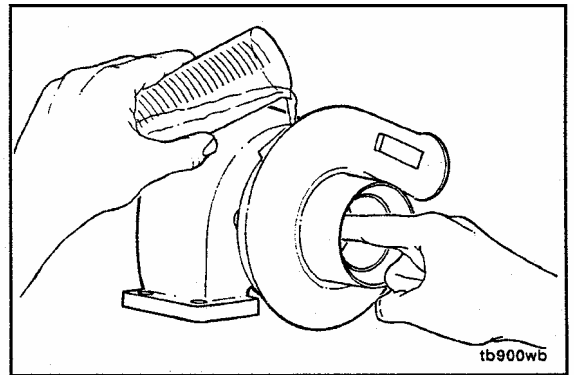
Tighten the band clamp. Tap around the clamp with a plastic hammer and tighten again.

Torque Value: 8.5 N•m [75 in-lb]

CAUTION

To prevent bearing damage new turbochargers must be prelubricated before start-up.

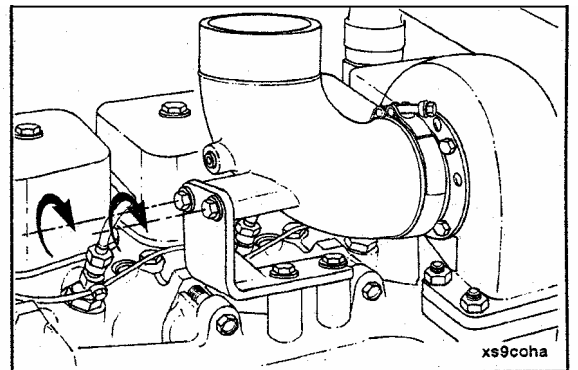
Pour 50 to 60 cc [2 to 3 ounces] of clean engine oil into the oil supply fitting. Rotate the turbine wheel to allow the oil to enter the bearing housing.



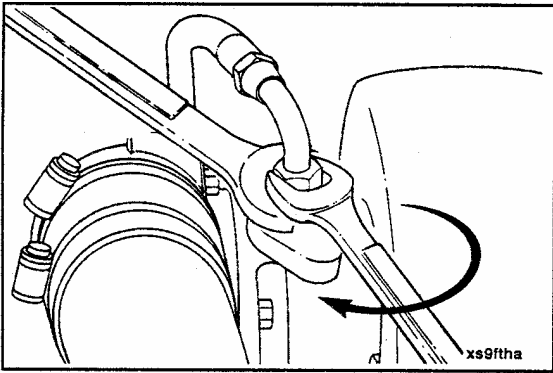
Install the exhaust outlet connection.

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

Torque Value: Band Clamp - 8 N•m [6 ft-lb]
Capscrews - 43 N•m [32 ft-lb]



TM 5-3810-307-24-2-1



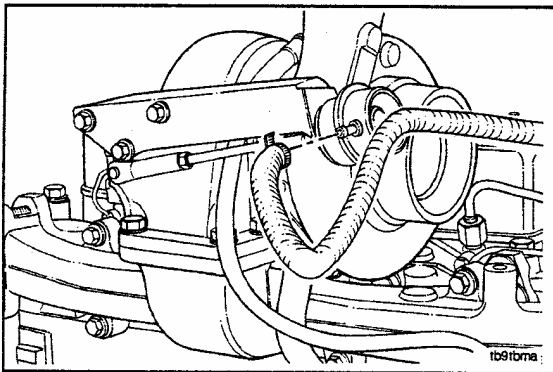
16 mm

Install the oil supply line.

Torque Value: 35 N•m [26 ft-lb]

CAUTION

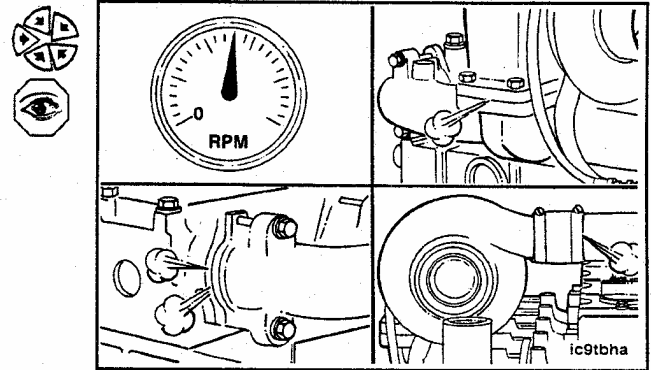
When installing oil supply line, be sure line is not in direct contact with turbine housing or line will burn during operation.



If equipped with a wastegate turbocharger, install the intake manifold pressure supply line from the boost capsule

Install the air crossover tube, inlet and exhaust piping.

Operate the engine and check for leaks.

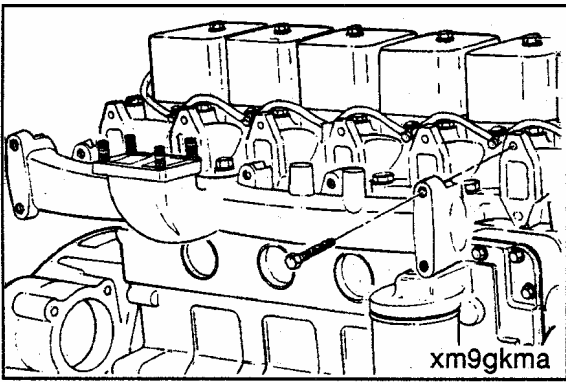


Exhaust Manifold and Gaskets – Replacement

Preparatory Steps:

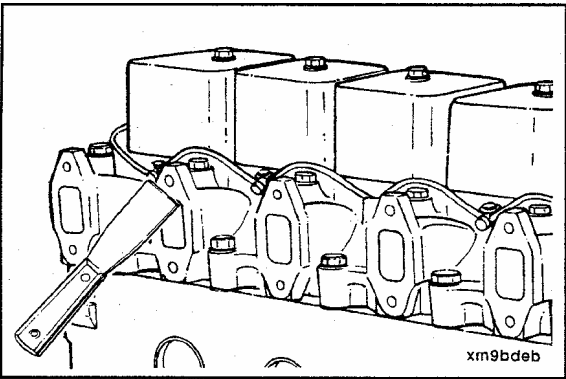
- Remove the air crossover tube.
- Disconnect the air intake and exhaust piping.
- Remove the turbocharger, if used.

TM 5-3810-307-24-2-1



15 mm, 13 mm

Remove the exhaust manifold and gaskets.



Clean the sealing surfaces.

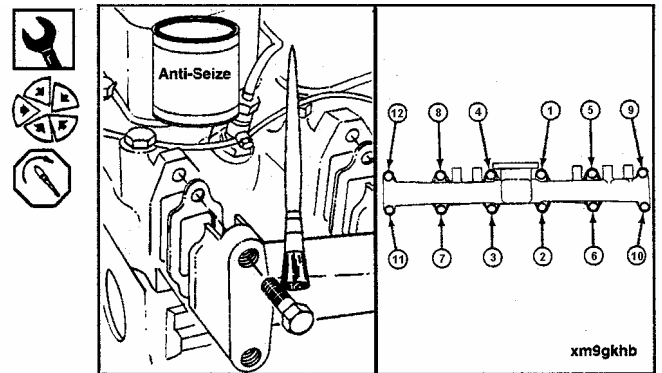
15 mm, 13 mm

Install the exhaust manifold and new gaskets.

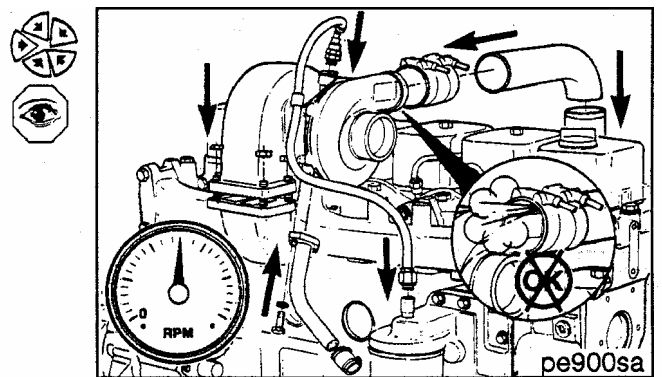
Torque Value: 43 N•m [32 ft-lb]

Follow the tightening sequence shown in the illustration. Then, follow the same sequence and tighten the capscrews again to the same torque values.

Apply an anti-seize compound on exhaust manifold bolt threads upon reassembly.



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



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Lubricating System Repair Summary

Component To Be Replaced	Tools	Preparatory Steps
Oil Pressure Regulator Valve and/or Spring	Ratchet, 19 mm Socket 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.



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

Lubricating System Repair

Oil Pressure Regulator, Valve and Spring – Replacement

Preparatory Steps:

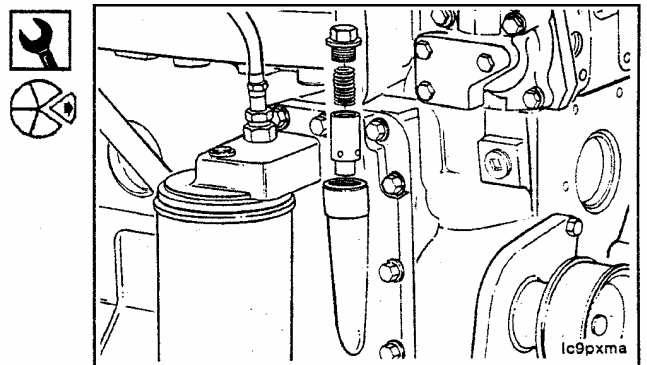
- Clean debris.

NOTE

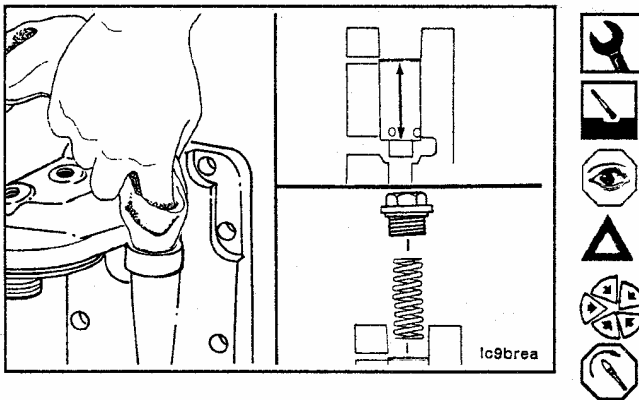
The ATEC is similar but not identical to the configuration shown.

19 mm

Remove the plug and regulator valve



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19 mm

Clean and inspect the bore and regulator valve before assembly.

CAUTION

In order to regulate the oil pressure, the valve must move freely in the bore.

Install the regulator and spring.

Torque Value: 80 N•m [60 ft-lb]

Oil Cooler Element and Gasket – Replacement

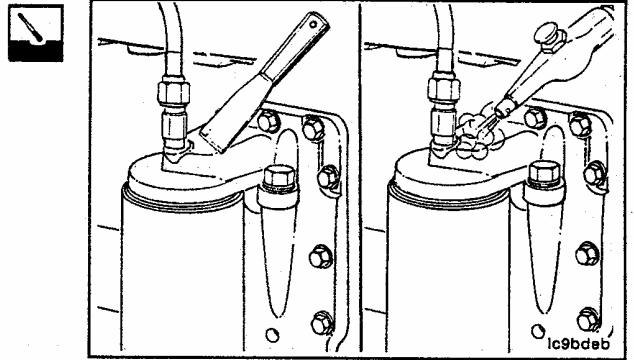
Preparatory Steps:

- Drain the coolant.
- Remove the oil filter.

NOTE

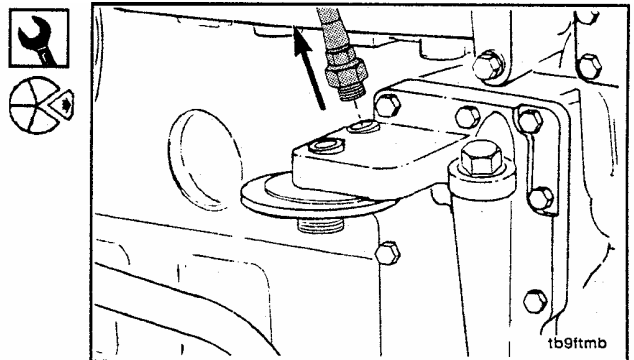
The ATEC is similar but not identical to the configuration shown.

Clean all debris from around the oil cooler.



16 mm

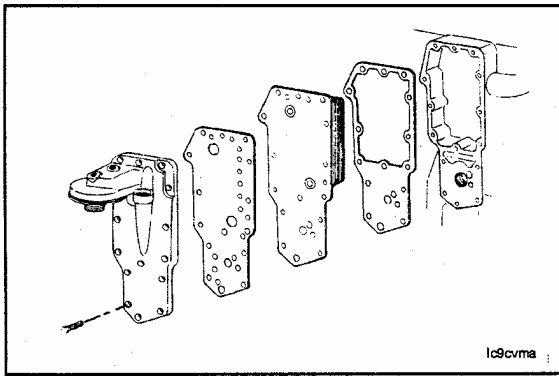
Remove the turbocharger oil supply line from the oil filter head.



NOTE

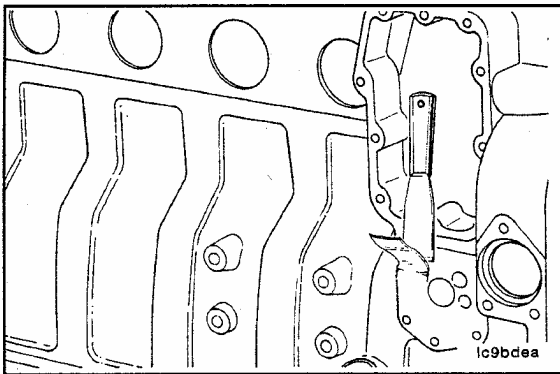
The ATEC is similar but not identical to the configuration shown.

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10 mm

Remove the oil cooler cover, element and gaskets.

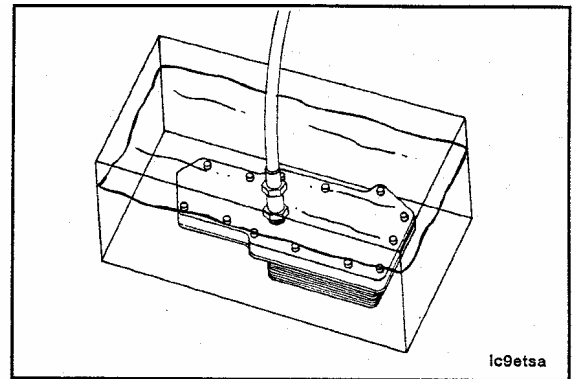


Clean the sealing surfaces.

NOTE

The ATEC is similar but not identical to the configuration shown.

Pressurize the element to 483 kPa [70 psi] to check it for leaks.



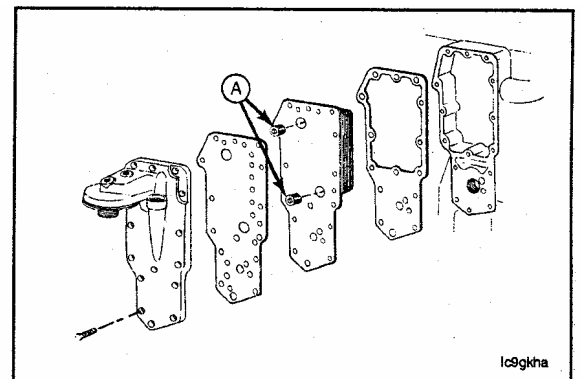
10 mm

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

NOTE

Be sure to remove the shipping plugs (A) from the new cooler element.

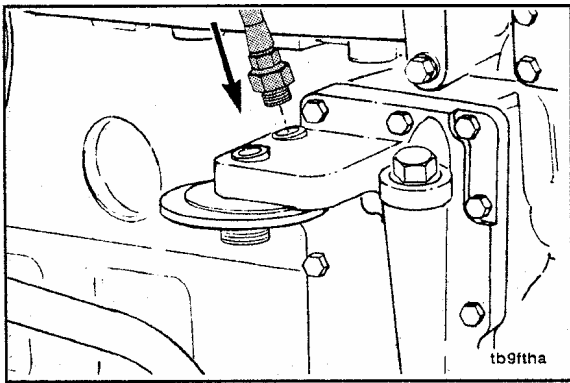
Torque Value: 24 N•m [18 ft-lb]



NOTE

The ATEC is similar but not identical to the configuration shown.

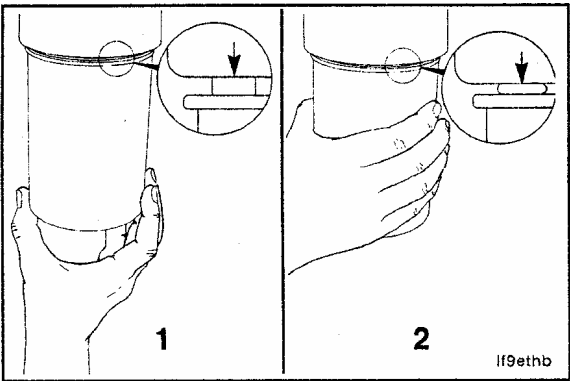
TM 5-3810-307-24-2-1



16 mm

Connect the turbocharger oil supply line.

Torque Value: 35 N•m [26 ft-lb]



Install a new oil filter.

Follow the manufacturer's instructions for tightening.

NOTE

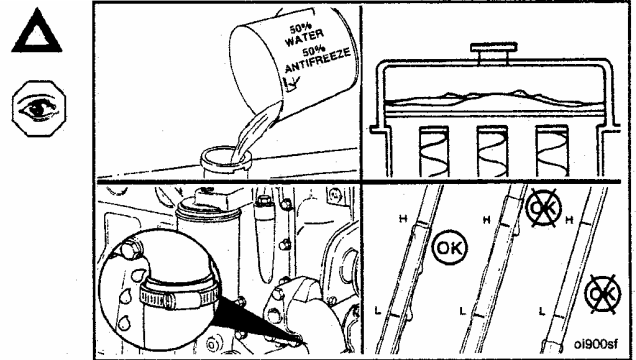
The ATEC is similar but not identical to the configuration shown.

CAUTION

The system must be filled slowly to prevent air locks. Be sure to open the aftercooler vents to allow air to escape as the system is filled.

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

Stop the engine and check the coolant and oil level.



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Electrical System Repair Summary

Component To Be Replaced	Tools	Preparatory Steps
Starting Motor	Ratchet, 17 mm Socket, 14 mm Wrench, and Torque Wrench	Disconnect ground cable to battery.
Alternator	Ratchet, 8 mm, 14 mm and 16 mm Socket and Torque Wrench, 1/2 inch Square Drive Breaker Bar	Disconnect ground cable to battery and remove drive belt.



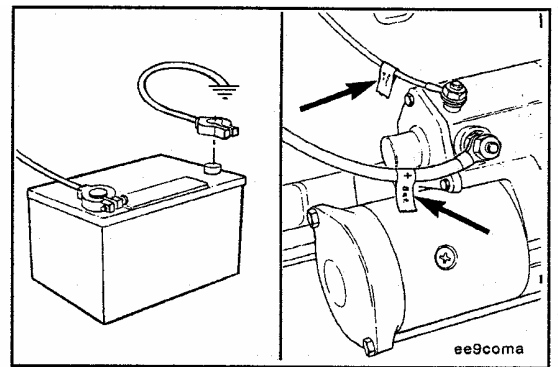
Batteries can emit explosive gas. Ventilate area before working on or around battery. Keep flame, cigarettes, pilot lights, sparks, wiring switches, equipment, and other ignition sources away. Remove negative (-) cable first and attach it last.

Electrical System Repair

Starting Motor - Replacement

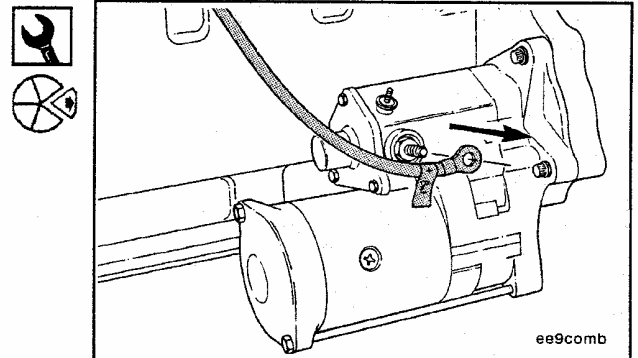
Disconnect the ground cable from the battery.

Identify each electrical wire with a tag indicating location.

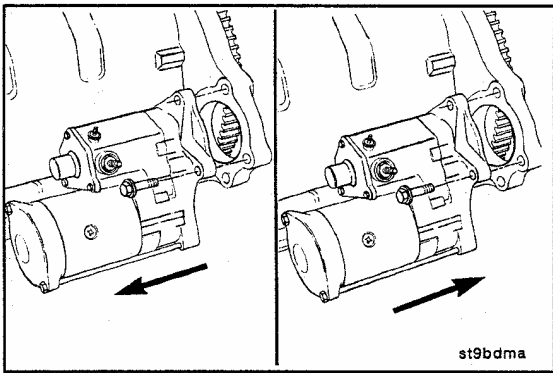


14 mm

Remove the battery cable from the solenoid.



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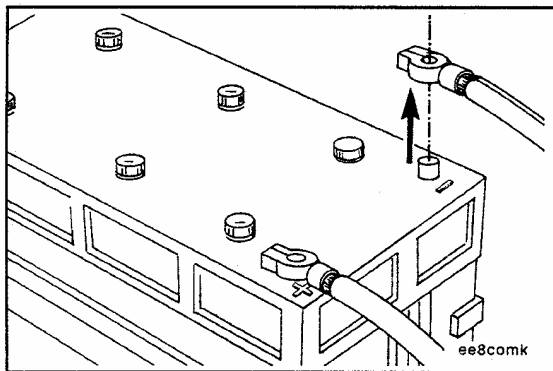


10 mm

Remove the starting motor.

Install the starting motor in the reverse order of removal.

Torque Value: 43 N•m [32 ft-lb]



Alternator - Replacement

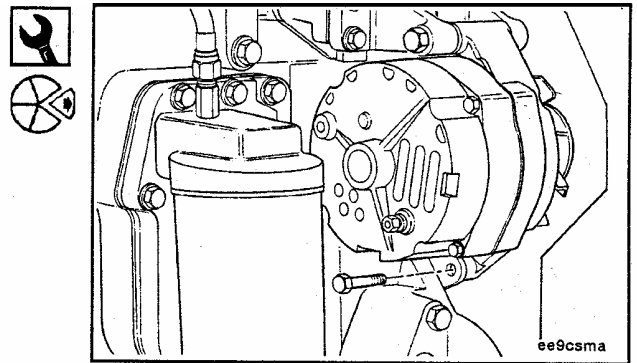
Disconnect the ground cable from the battery terminal.

Identify each electrical wire with a tag indicating location.

Remove the drive belt.

14 mm

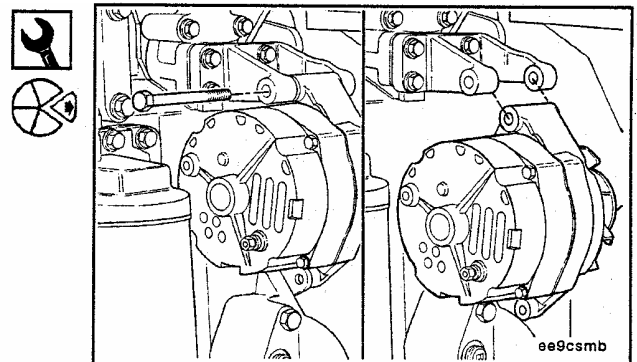
Remove the capscrew from the alternator link.



16 mm

Remove the alternator mounting capscrews.

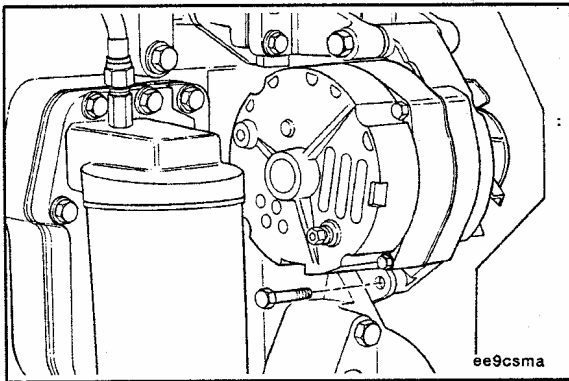
Remove the alternator.



NOTE

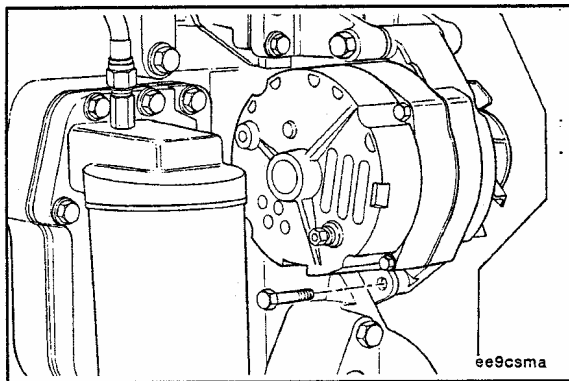
The ATEC is similar but not identical to the configuration shown.

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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.

NOTE

The ATEC is similar but not identical to the configuration shown.

14, 16 mm

Tighten the alternator mounting capscrew.

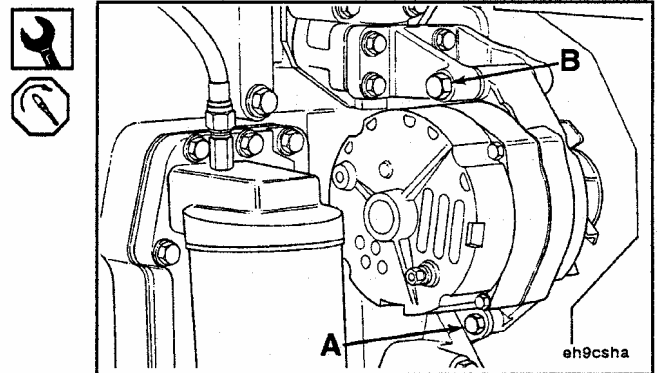
Torque Value:

A = 24 N•m [18 ft-lb]

B = 43 N•m [32 ft-lb]

NOTE

The ATEC is similar but not identical to the configuration shown.



Section V – Specifications and Torque Values

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General Specifications (Automotive Engines)

Lubricating System kPa [psi]				B5.9-190		
Bore – mm [in.].....				102 [4.02]		
Stroke – mm [in.].....				120 [4.72]		
Displacement – liter [in. ³].....				5.9 [359]		
Engine Weight (Dry) Less Flywheel and Electrics – kg [lbs.]				428 [942]		
Firing Order.....				1-5-3-6-2-4		
Valve Clearances:						
- Intake – mm [in.]				0.25 [0.010]		
- Exhaust – mm [in.].....				0.51 [0.020]		
Compression Ratio				17.1:1		
Rotation, viewed from the Front of the Engine				Clockwise		
Aspiration:						
- Naturally Aspirated						
- Turbocharged				X		
- Aftercooled.....						
- Charge Air Cooled				X		

General Specifications (Automotive Engines)

Lubricating System kPa [psi]				B5.9-190		
Min. Allowable Press. @ Idle ..				69 [10]		
Min. Allowable Press. @ Rated				207 [30]		
Regulated Pressure				449 [65]		
Filter Bypass Diff. Pressure				172 [25]		
Oil Capacity L [QT]:						
- Standard Pan Only.....				14.2 [15]		
- Total System				16.4 [17.3]		
QTS From "L" to "H"				[2]		
COOLING SYSTEM L [QT]				B5.9-190		
Engine Coolant Capacity.....				9.0 [9.5]		
Thermostat Modulating Range:						
C				83-95		
[F]				[181-203]		
Pressure Cap kPa [psi]:						
- 104C° [220°F]				103 [15]		
- 99C° [210°F]				48 [7]		

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General Specifications (Automotive Engines)

Intake, Air, Exhaust, And Fuel System				B5.9-190		
Maximum Allowable Intake Restriction at Rated Speed and Load with Dirty Air Filter Element – mm H ₂ O [in. H ₂ O]				635 [25]		
Maximum Allowable Exhaust Restriction at Rated Speed and Load – mm Hg [in. Hg].....				152.4 [6]*		
Maximum Allowable Restriction to fuel transfer Pump – With Dirty Filter – mm Hg [in. Hg].....				100 [4]		
Maximum Allowable Return Line Restriction – mm Hg [in. Hg].....				518 [20.4]		
Maximum Fuel Pressure Drop Across Filters kPa [psi]				34 [5]		

* with catalyst

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General Specifications (Automotive Engines)

For General Electrical System Information Refer to TM 5-3810-307-24-1, Volume 1.

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Fuel Recommendations/Specifications

WARNING

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

CAUTION

Any adjustment to compensate for reduced performance with a fuel system alternate fuel is not warrantable. Cummins, the diesel engine manufacturer, advises that certain fuels, listed below, can not provide adequate lubrication to the Bosch fuel injection pump internal parts and must not be used. If these fuels are used, it will result in internal parts failure in the Bosch fuel injection pump, due to lack of lubrication, and any warranty repair will be voided.

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 32° F (0° C), use a blend of No. 1-D and No. 2-D fuels, also known as "winterized" No. 2-D.

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 crystals begin to form in diesel fuel. The viscosity of the fuel must be kept above 1.3 centistokes to provide adequate fuel system lubrication at 104° F (40° C).

Acceptable Alternate Fuel Types:

*No. 1-D Diesel and No. 2 Fuel Oil,
No. 1-K Kerosene, No. 2-K Kerosene,
Jet-A, Jet A-1, JP-5, and JP-8**

Unacceptable Fuel Types:

Jet-B, JP-4, and Cite

**JP-8 (MIL-T-83133) is acceptable if its lubricity is 3100 grams or greater as measured with the US Army scuffing BOCLE test or Wear Scuff Diameter less than 0.45 mm at 60° C (less than 0.38 mm at 25° C) as measured with the HFRR method.*

Acceptable Alternate Fuels - Component Wear/Durability				
Fuel Type	Bosch P Pump			
NO. 1-D Diesel	OK			
NO. 2 Fuel Oil	OK			
NO. 1-K Kerosene	OK			
NO. 2-K Kerosene	OK			
Jet-A	OK			
Jet A-1	OK			
JP-5	OK			
JP-8	*			
Jet-B	Not ok			
JP-4	Not ok			
Cite	Not ok			

**JP-8 (MIL-T-83133) is acceptable if its lubricity is 3100 grams or greater as measured with the US Army scuffing BOCLE test or Wear Scuff Diameter less than 0.45 mm at 60° C (less than 0.38 mm at 25° C) as measured with the HFRR method.*

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Lubricating Oil Recommendations/Specifications

Oil Performance Recommendations

The use of quality engine lubricating oils combined with appropriate oil drain and filter change intervals are critical factors in maintaining engine performance and durability.

Cummins Engine Company, Inc. recommends the use of a high quality SAE 15W-40 heavy duty engine oil (such as Cummins Premium Blue) which meets the American Petroleum Institute (API) performance classification CE/SG.

NOTE: CC/CD or CD/SF engine oils can be used in areas where CE oil is not yet available, but the oil change interval must be reduced to one half the interval given in the maintenance schedule.

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

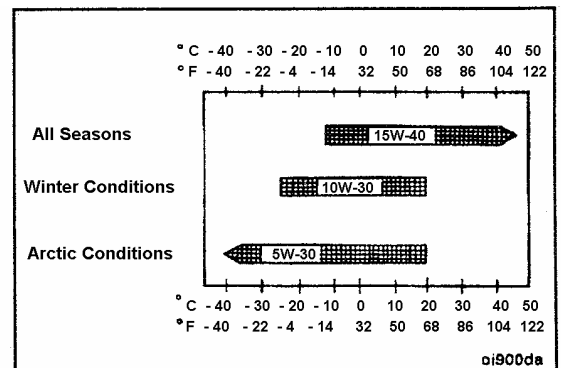
Oil Viscosity Recommendations

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

While 15W-40 oil is recommended for most climates, refer to the accompanying table for oil viscosity recommendations for extreme climates.

NOTE

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



New Engine Break-In Oils

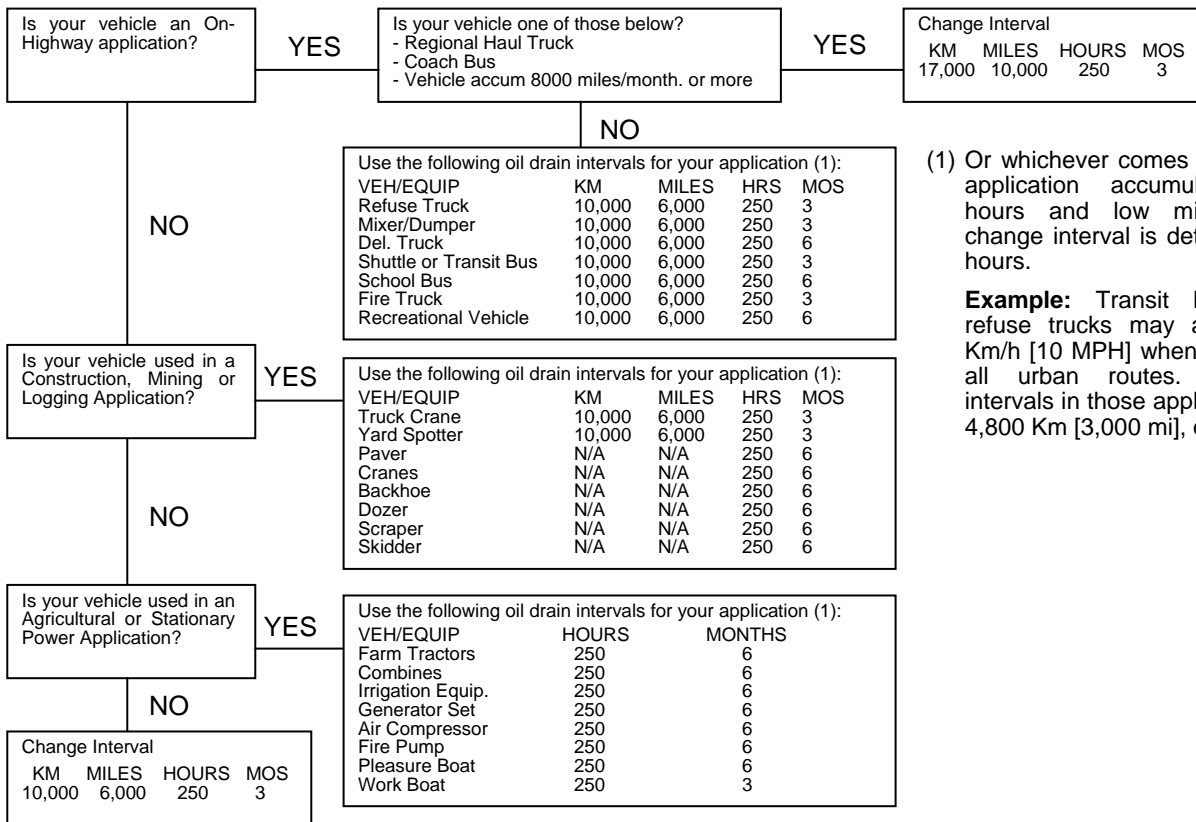
Do not use special “break-in” lubricating oils for new or rebuilt Cummins engines. Use the same type of oil during the “break-in” as that which is used in normal operation.

Recommended Oil Change Intervals

Refer to the following flowchart for the recommended oil change interval based on engine application.

(Text Deleted)

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(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 routes. Oil drain intervals in those applications are 4,800 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 CE/SG engine oil with adequate low temperature properties such as; 5W-30.

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



CAUTION

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

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/Specifications

Heavy duty diesel-engines require a balanced coolant mixture of water and antifreeze. Drain and replace the mixture every 2 years, 320,000 KM [200,000 miles] or 6,000 hours of operation (whichever occurs first) to eliminate buildup of harmful chemicals.

- **Antifreeze is essential in any climate.** it broadens the operating temperature range by lowering the coolant freezing point and by raising its boiling point. Do **not** use more than 50 percent antifreeze in the mixture unless additional freeze protection is required. **Never** use more than 68 percent antifreeze under any condition.
- Use soft water in the coolant mixture. Contaminants in hard water neutralize the corrosion inhibitor components. Water **must not** exceed 300 ppm hardness, or contain more than 100 ppm of either chloride or sulfate.
- **Specifications - Use low silicate antifreeze which meets ASTM4985 test (GM6038M 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
40% = -23° C [-10° F]
50% = -37° C [-34° F]
60% = -54° C [-65° F]
68% = -71° C [-90° F]

Propylene Glycol
40% = -21° C [-6° F]
50% = -33° C [-27° F]
60% = -49° C [-56° 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.

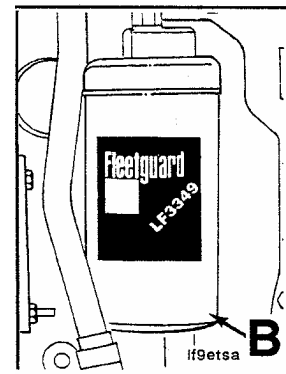
Filter Selection

Oil Filters

LF 3349 Standard Six Cylinder Applications

CAUTION

A 6 cylinder oil filter can be used on a 4 cylinder engine. Do not use a 4 cylinder oil filter on a 6 cylinder engine. Use of a 4 cylinder oil filter on a 6 cylinder engine will result in engine damage.

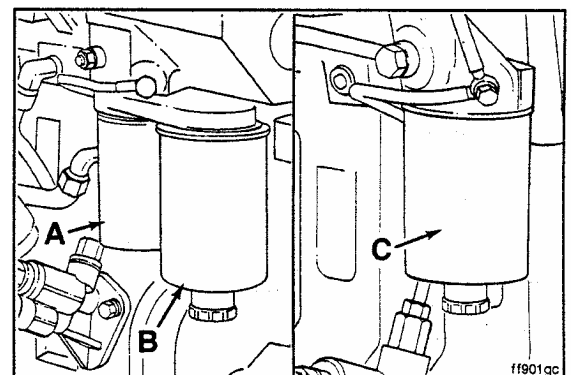


Fuel Filters

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 Value

Socket or Wrench Size		Torque	
MM (Inch)		N•m	(Ft-lb)
10	Aftercooler Mounting	24	[18]
8	Aftercooler Water Hose Clamp	5	[4]
13	Alternator Link (Delco 10-15 SI).....	24	[18]
[3/4]	Alternator Link (Delco 20-27 SI).....	43	[32]
15	Alternator Mtg. Bolt 10-15 SI.....	43	[32]
18	Alternator Mtg. Bolt 27 SI	77	[57]
10	Alternator Support (Upper).....	24	[18]
Allen 5 mm	Belt Tensioner Flat Bracket.....	24	[18]
15	Belt Tensioner Mounting	43	[32]
15	Crankshaft Damper & Pulley.....	137	[101]
[5/16]	Crossover Clamp	5	[4]
11	Tee Bolt Type Clamp	8	[6]
15	Exhaust Manifold.....	43	[32]
15	Exhaust Outlet Pipe Mtg Bracket	43	[32]
(7/16)	Exhaust Outlet Pipe, V Band Clamp	8	[6]
10	Fan Bracket Mounting.....	24	[18]
10	Fan Pulley	24	[18]
13	Fan Pulley	43	[32]
19	Flywheel	137	[101]
--	Front Cover Clamp Access Cap.....	-----Hand Tighten-----	
17	Fuel Drain Line Banjo Screw (Rotary Pump).....	15	[11]

Engine Component Torque Value (Continued)

Socket or Wrench Size MM (Inch)		Torque N•m	(Ft-lb)
17	Fuel Banjo Screw (in Filter Head)	24	[18]
10	Fuel Vent Screw (in Banjo).....	9	[7]
10	Fuel Banjo Screw (Injector)	9	[7]
75-85	Fuel Filter.....	3/4 Turn After Contact	
24	Fuel Filter Adapter Nut	32	[24]
17 or 19	Fuel Line Fitting (High Pressure).....	24	[18]
22	Fuel Pump Drive Gear (with Pump Unlocked) Rotary.....	65	[48]
22	Fuel Pump Drive Gear (Pump Unlocked) Nippondenso	123	[92]
30	Fuel Pump Drive Gear (Pump Unlocked) Bosch Inline "P"	195	[144]
30	Fuel Pump Drive Gear (Pump Unlocked) Bosch Inline "A"	70	[52]
10	Fuel Pump Lock (Bosch) Rotary	30	[22]
	Fuel Pump Unlock (Bosch) Rotary	13	[10]
14	Fuel Pump Lock (CAV).....	7	[5]
	Fuel Pump Unlock (CAV)	20	[15]
13	Fuel Pump Mounting Nuts (Bosch Rotary).....	24	[18]
15	Fuel Pump Mounting Nuts (Bosch In-Line, Nippondenso)	43	[32]
13	Fuel Pump Mounting Nuts (CAV)	30	[22]
13	Fuel Pump Support Bracket	24	[18]
24	Injector Retaining Nut	60	[44]
13	Intake Manifold Cover.....	24	[18]
10	Lift Pump/Cover Plate.....	24	[18]

Engine Component Torque Value (Continued)

Socket or Wrench Size MM (Inch)		Torque N•m	(Ft-lb)
18	Lifting Bracket (Rear)	77	[57]
75-85	Oil Filter	3/4 Turn After Contact	
10	Oil Cooler Assembly.....	24	[18]
17	Oil Pan Drain Plug.....	80	[60]
27	Oil Pan Heater Plug	80	[60]
19	Oil Pressure Regulator Plug.....	80	[60]
10	Rear Seal Housing	9	[7]
14	Rocker Lever Nut	24	[18]
10	Starter Mounting.....	43	[32]
10	Tappet Cover/Fuel Drain Line Supports	24	[18]
10	Thermostat Housing	24	[18]
13	Turbine Housing.....	20	[15]
10	Turbo Compressor Housing Clamp	8.5	[6]
15	Turbo Mounting Nuts.....	43	[32]
13	Turbo Drain Tube	24	[18]
16	Turbo Oil Supply (Both Ends)	35	[26]
15	Water Inlet Connection.....	43	[32]
13	Water Pump Mounting	24	[18]
15	Valve Cover.....	24	[18]
--	Valve Cover Oil Fill.....	Hand Tighten	

Sealants

Use the sealants listed below or sealants containing equivalent properties.

Description	Sealing Method
1. Pipe Plugs	Precoated teflon or pipe sealer.
2. Cup Plugs	Loctite 277 or 11,264.
3. O-Rings	No sealant required.
4. Rear Camshaft Expansion Plug	Precoated or Loctite 59,241 liquid teflon.
5. Fuel Pump Studs	Loctite 609.
6. Turbo Drain in Block	Loctite 277 (P/N 24231), 11,264, or NSN 8030-01-014-5869.
7. Front Seal in Gear Cover	Loctite 277 or 11,264.
8. Rear Seal in Rear Cover	No sealant required.
9. Oil Pan at T-Joint	3-Bond 1207C® (Cummins P/N 3823494).
10. Aftercooler Capscrews	Loctite (P/N 59231) or NSN 8030-01-054-0740.
11. Aftercooler Sealing Surface	3-Bond 1207C® (Cummins P/N 3823494).
12. Dipstick Tube at Block	Loctite 277 (P/N 24231), 11,264, or NSN 8030-01-014-5869.

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.

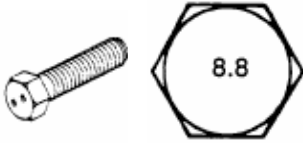
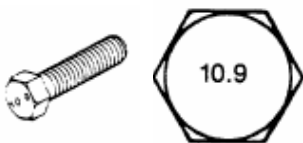
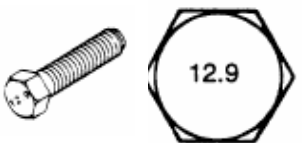
The following examples indicate how capscrews are identified:

Metric – M8-1.25 X 25			U.S. Customary [5/16 X 18 X 1-1/2]		
M8	1.25	25	5/16	18	1-1/2
Major	Distance	Length	Major	Number	Length
Thread	Between	In	Thread	Threads	in
Diameter in	Threads in	Millimeters	Diameter	per Inch	Inches
Millimeters	Millimeters		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.




Capscrew Markings and Torque Values - Metric

Commercial Steel Class		8.8	10.9	12.9
Capscrew Head Markings				
				

Body Size	Torque				Torque				Torque			
	Cast Iron		Aluminum		Cast Iron		Aluminum		Cast Iron		Aluminum	
Diam. 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	5	7	4	12	9	7	4	14	9	7	4
7	14	9	11	7	18	14	11	7	23	18	11	7
8	25	18	18	14	33	25	18	14	40	29	18	14
10	45	33	30	25	60	45	30	25	70	50	30	25
12	80	60	55	40	105	75	55	40	125	95	55	40
14	125	90	90	65	165	122	90	65	195	145	90	65
16	180	130	140	100	240	175	140	100	290	210	140	100
18	230	170	180	135	320	240	180	135	400	290	180	135

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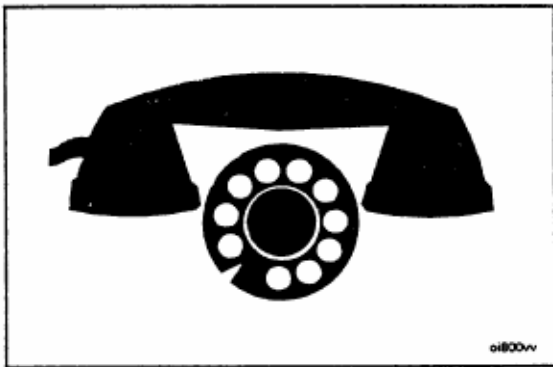
Capscrew Markings and Torque Values – U.S. Customary

SAE Grade Number	5				8			
Capscrew Head Markings								
These are all SAE Grade 5 (3) line								
								
	Capscrew Torque – Grade 5 Capscrew				Capscrew Torque – Grade 8 Capscrew			
Capscrew Body Size	Cast Iron		Aluminum		Cast Iron		Aluminum	
	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb
1/4 – 20	9	7	8	6	15	11	8	6
– 28	12	9	9	7	18	13	9	7
5/16 – 18	20	15	16	12	30	22	16	12
– 24	23	17	19	14	33	24	19	14
3/8 – 16	40	30	25	20	55	40	25	20
– 24	40	30	35	25	60	45	35	25
7/16 – 14	60	45	45	35	90	65	45	35
– 20	65	50	55	40	95	70	55	40
1/2 – 13	95	70	75	55	130	95	75	55
– 20	100	75	80	60	150	110	80	60
9/16 – 12	135	100	110	80	190	140	110	80
– 18	150	110	115	85	210	155	115	85
5/8 – 11	180	135	150	110	255	190	150	110
– 18	210	155	160	120	290	215	160	120
3/4 – 10	325	240	255	190	460	340	255	190
– 16	365	270	285	210	515	380	285	210
7/8 – 9	490	360	380	280	745	550	380	280
– 14	530	390	420	310	825	610	420	310
1 – 8	720	530	570	420	1100	820	570	420
– 14	800	590	650	480	1200	890	650	480

Section S – Service Assistance

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Routine Service	S-2



Service Assistance

Routine Service

Personnel at a Cummins Authorized Repair Location can assist you with the correct operation or service of your engine. We have a worldwide service network of more than 5,000 Cummins Distributors and Dealers who have been trained to provide sound advice, expert service, and complete parts support. Check the telephone directory yellow pages or go to the internet address: WWW.cummins.com/partsserv/intro.html, for the nearest Cummins Authorized Repair Location.

Emergency Service

The Cummins Customer Assistance Center provides a 24-hour, toll free telephone number to aid in locating emergency service when a local Cummins Authorized Repair Location can **not** be reached. The emergency service telephone numbers are:

- United States and Canada (excluding Alaska and Hawaii)
 - (800) D-I-E-S-E-L-S
 - (800) 343-7357
- Outside of North America contact your Regional Office, telephone numbers and addresses are listed on page S-4 of this section.

Problem Solving

Normally, any problem that arises with the sale, service, or repair of your engine can be handled by a Cummins Authorized Repair Location in your area. Refer to the telephone directory yellow pages or go to the internet address: WWW.cummins.com/partserv/intro.html, for the one nearest you. If the problem has **not** been handled satisfactorily, follow the steps outlined below:

1. If the disagreement is with a Dealer, talk to the Cummins Distributor with whom he has his service agreement.
2. If the disagreement is with a distributor, call the nearest Cummins Division or Regional Office; however, most problems are solved below the Division or Regional Office level. Telephone numbers and addresses for Division and Regional Offices are listed on page S-4. Before calling, write down the following information:
 - a. Engine model and serial number
 - b. Type and make of equipment
 - c. Total kilometers [miles] or hours of operation
 - d. Warranty start date
 - e. Nature of problem
 - f. Summary of the current problem arranged in the order of occurrence
 - g. Name and location of the Cummins Distributor or Dealer
3. If a problem can **not** be resolved satisfactorily through your Cummins Authorized Repair Location or Division Office, write to:

Customer Relations - 41403, Cummins Engine Company, Inc., Box 3005, Columbus, IN 47202-3005

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Division and Regional Offices

The following offices are in U.S., Canada, Australia, New Zealand, and Puerto Rico.

United States

Northern Division Office

Cummins Engine Company, Inc.
21 Southpark Blvd.
Greenwood, IN 46143
Telephone: (317) 885-4400

Southern Division Office

Cummins Engine Company, Inc.
425 Franklin Road
Suite 500
Marietta, GA 30067
Telephone: (404) 423-1108

Western Division Office

Cummins Engine Company, Inc.
5660 Greenwood Plaza Blvd.
Englewood, CO 80111
Telephone: (303) 773-2866

Western Regional Office

Cummins Engine Company, Inc.
569 First Street West
Sonoma, CA 95476
Telephone: (707) 935-3842

Plains Regional Office

Cummins Engine Company, Inc.
1901 Central Drive
Suite 356
Bedford, TX 76021
Telephone: (817) 267-3172

Canada

Canadian Division Office

Cummins Diesel of Canada, Ltd.
700 Dorval Drive
Suite 600
Oakville, Ontario L6K 3V3
Telephone: (416) 842-8070

Western Canada Regional Office

Cummins Diesel of Canada, Ltd.
18452 – 96th Avenue
Surrey, B.C. V4N 3P8
Telephone: (604) 882-5727

Eastern Canada Regional Office

Cummins Diesel of Canada, Ltd.
800 Montee DeLiesse
Saint Laurent, Quebec H4T 1P3
Telephone: (514) 342-4042

Central Canada Regional Office

Cummins Diesel of Canada, Ltd.
14755 – 121 A Avenue
Edmonton, Alberta T5L 2T2
Telephone: (403) 455-2151

Australia Regional Office

Cummins Diesel Australia

2 Caribbean Drive
Scoresby, Victoria 3179
Australia
Telephone: (61) 3-765-3222

This office also serves New Zealand.

Cummins Americas Regional Office

Cummins Caribbean

16085 N. W. 52nd Avenue
Hialeah, FL 33014
Telephone: (305) 621-1300

This office also serves Puerto Rico and South America excluding Brazil.

Section C – Component Manufacturers

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Component Manufacturers' Addresses

NOTE: The following list contains addresses and telephone numbers of suppliers of accessories used on Cummins engines. Suppliers may be contacted directly for any specifications **not** covered in this manual.

Air Compressors

Bendix Heavy Vehicles Systems
Div. of Allied Automotive
901 Cleveland Street
Elyria, OH 44036
Telephone: (216) 329-9000

Holset Engineering Co., Inc.
1320 Kemper Meadow Drive
Suite 500
Cincinnati, OH 45240
Telephone: (513) 825-9600

Midland-Grau
Heavy Duty Systems
Heavy Duty Group Headquarters
10930 N. Pomona Avenue
Kansas City, MO 64153
Telephone: (816) 891-2470

Air Cylinders

Bendix Ltd.
Douglas Road
Kingswood
Bristol
England
Telephone: 0272-671 881

Catching Engineering
2101 Roberts Drive
Broadview, IL 60153
Telephone: (312) 344-2334

Air Heaters

Fleetguard, Inc.
Cookeville, TN 38502
P.O. Box 6001
Telephone: (615) 526-9551

Kim Hotstart Co.
West 917 Broadway
Spokane, WA 99210
Telephone: (509) 534-6171

Air Starting Motors

Ingersoll Rand
Chorley New Road
Horwich
Bolton
Lancashire
England
BL6 6JN
Telephone: 0204-65544

Ingersoll-Rand Engine
Starting Systems
888 Industrial Drive
Elmhurst, IL 60126
Telephone: (312) 530-3800

StartMaster
Air Starting Systems
A Division of Sycon Corporation
P O. Box 491
Marion, OH 43302
Telephone: (614) 382-5771

Alternators

Robert Bosch Ltd.
P.O. Box 98
Broadwater Park
North Orbital Road
Denham
Uxbridge
Middlesex UD9 5HG
England
Telephone: 0895-833633

Butec Electrics
Cleveland Road
Leyland
PR5 1XB
England
Telephone: 0744-21 663

C.A.V. Electrical Equipment
P.O. Box 36
Warple Way
London
W3 7SS
England
Telephone: 01-743-3111

A.C. Delco Components Group
Civic Offices
Central Milton Keynes
MK9 3EL
England
Telephone: 0908-66001

C. E. Niehoff
2021 Lee Street
Evanston, IL 60202
Telephone: (708) 866-6030

Delco-Remy
P.O. Box 2439
Anderson, IN 46018
Telephone: (317) 646-7838

Leece-Neville Corp.
1374 E. 51st St.
Cleveland, OH 44013
Telephone: (216) 431-0740

Auxiliary Brakes

The Jacobs Manufacturing Company
Vehicle Equipment Division
22 East Dudley Town Road
Bloomfield, CT 06002
Telephone: (203) 243-1441

Belts

Dayco Rubber U.K.
Sheffield Street
Stockport
Cheshire
SK4 1RV
England
Telephone: 061-432-5163

T.B.A. Ind. Products
P.O. Box 77
wigan
Lancashire
WN2 4XQ
England
Telephone: 0942-59221

Dayco Corp.
Belt Technical Center
P.O. Box 3258
Springfield, MO 65804
Telephone: (417) 881-7440

Gates Rubber Company
5610 Crawfordsville Road
Suite 2002
Speedway, IN 46224
Telephone: (317) 248-0386

Goodyear Tire and
Rubber Company
49 South Franklin Road
Indianapolis, IN 46219
Telephone: (317) 898-4170

Catalytic Convertors

Donaldson Company, Inc.
1400 West 94th Street
P.O. Box 1299
Minneapolis, MN 55440
Telephone: (612) 887-3131

Nelson Industries, Inc.
Exhaust and Filtration Systems
Highway 51 West, P.O. Box 428
Stoughton, WI 53589
Telephone: (608) 873-4373

Walker Manufacturing
3901 Willis Road
P.O. Box 157
Grass Lake, MI 49240
Telephone: (517) 522-5500

Clutches

Twin Disc International S.A.
Chaussee de Namur
Nivelles
Belguim
Telephone: 067-224941

Twin Disc Clutch Co.
Racine, WI 53403
Telephone: (414) 634-1981

Coolant Heaters

Fleetguard, Inc.
P.O. Box 6001
Cookeville, TN 38502
Telephone: (615) 526-9551

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Drive Plates

Detroit Diesel Allison
Division of General Motors
Corporation
P.O. Box 894
Indianapolis, IN 46206
Telephone: (317) 244-1511

Electric Starting Motors

Butec Electrics
Cleveland Road
Leyland
PR5 1XB
England
Telephone: 0744-21663

C.A.V. Electrical Equipment
P.O. Box 36
Warple Way
London
W3 7SS
England
Telephone: 01-743-3111

A.C. Delco Components Group
Civic Offices
Central Milton Keynes
MK9 3EL
England
Telephone: 0908-66001

Delco-Remy
P.O. Box 2439
Anderson, IN 46018
Telephone: (317) 646-7838

Leece-Neville Corp.
1374 E. 51st Street
Cleveland, OH 44013
Telephone: (216) 431-0740

Nippondenso Sales, Inc.
24777 Denso Drive
P.O. Box 5133
Southfield, MI 48086-5133
Telephone: (313) 350-7500

Nippondenso of Los Angeles, Inc.
3900 Via Oro Avenue
Long Beach, CA 90810
Telephone: (310) 834-6352

Engine Protection Controls

Teddington Industrial
Equipment
Windmill Road
Sunburn on Thames
Middlesex
TW167HF
England
Telephone: 09327-85500

The Nason Company
10388 Enterprise Drive
Davisburg, MI 48019
Telephone: (313) 625-5381

Fan Clutches

Holset Engineering Co. Ltd.
P.O. Box 9
Turnbridge
Huddersfield
England
Telephone: 0484-22244

Horton Industries, Inc.
P.O. Box 9455
Minneapolis, MN 55440
Telephone: (612) 378-6410

Rockford Division
Borg-Warner Corporation
1200 Windsor Road
P.O. Box 7007
Rockford, IL 61125-7007
Telephone: (815) 633-7460

Transportation Components Group
Facet Enterprises, Inc.
Elmira, NY 14903
Telephone: (607) 737-8212

Fans

Trufflo Ltd.
Westwood Road
Birmingham
B6 7JF
England
Telephone: 021 -557-4101

Hayes-Albion
1999 Wildwood Avenue
Jackson, MI 49202
Telephone: (517) 782-9421

Engineering Cooling Systems
201 W. Carmel Drive
Carmel, IN 46032
Telephone: (317) 846-3438

Brookside
McCordsville, IN 46055
Telephone: (317) 335-2014

Aerovent
8777 Purdue Rd.
Indianapolis, IN 46268
Telephone: (317) 872-0030

Kysor
1100 Wright Street
Cadillac, MI 49601
Telephone: (616) 775-4681

Schwitzer
1125 Brookside Avenue
P.O. Box 80-B
Indianapolis, IN 46206
Telephone: (317) 269-3100

Filters

Fleetguard International Corp.
Cavalry Hill Industrial Park
Weedon
Northampton NN7 4TD
England
Telephone: 0327-41 313

Fleetguard, Inc.
P.O. Box 6001
Cookeville, TN 38502
Telephone: (615) 526-9551

Flexplates

Corrugated Packing and
Sheet Metal
Hamsterley
Newcastle Upon Tyne
Telephone: 0207-560-505

Allison Transmission
Division of General Motors
Corporation
P.O. Box 894
Indianapolis, IN 46206
Telephone: (317) 244-1511

Allison Transmission
Division of General Motors
36501 Van Born Road
Romulus, MI 48174
Telephone: (313) 595-5711

Midwest Mfg. Co.
30161 Southfield Road
Southfield, MI 48076
Telephone: (313) 642-5355

Wohlert Corporation
708 East Grand River Avenue
Lansing, MI 48906
Telephone: (517) 485-3750

Fuel Warmers

Fleetguard, Inc.
P.O. Box 6001
Cookeville, TN 38502
Telephone: (615) 526-9551

Gauges

A.I.S.
Dyffon Industrial Estate
Ystrad Mynach
Hengoed
Mid Glamorgan
CF8 7XD
England
Telephone: 0443-812791

Grasslin U.K. Ltd.
Vale Rise
Tonbridge
Kent
TN9 1TB
England
Telephone: 0732-359888

Icknield Instruments Ltd.
Jubilee Road
Letchworth
Herts
England
Telephone: 04626-5551

Superb Tool and Gauge Co.
21 Princip Street
Birmingham
B4 61 E
England
Telephone: 021-359-4876

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Kabi Electrical and Plastics
Cranborne Road
Potters Bar
Herts
EN6 3JP
England
Telephone: 0707-53444

Datcon Instrument Co.
P.O. Box 128
East Petersburg, PA 17520
Telephone: (717) 569-5713

Rochester Gauge of Texas
11637 Denton Drive
Dallas, TX 75229
Telephone: (214) 241-2161

Governors

Woodward Governors Ltd.
p.o. Box 15
663/664 Ajax Avenue
Slough
Bucks
SLi 4DD
England
Telephone: 0753-26835

Woodward Governor Co.
1000 E. Drake Road
Fort Collins, CO 80522
Telephone: (303) 482-5811

Barber Colman Co.
1300 Rock Street
Rockford, IL 61101
Telephone: (815) 877-0241

United Technologies
Diesel Systems
1000 Jorie Blvd.
Oak Brook, IL 60521
Telephone: (312) 325-2020

Heat Sleeves

Bentley Harris Manufacturing Co.
100 Bentley Harris Way
Gordonville, TN 38563
Telephone: (313) 348-5779

Hydraulic and Power Steering Pumps

Hoburn Eaton Ltd.
Priory Road
Strood
Rochester
Kent
ME2 2BD
Telephone: 0634-71773

Honeywell Control Systems Ltd.
Honeywell House
Charles Square
Bracknell
Berks RG12 1EB
Telephone: 0344-424555

Sundstrand Hydratec Ltd.
Cheney Manor Trading Estate
Swindon
Wiltshire
SN2 2PZ
England
Telephone: 0793-30101

Sperry Vickers
1401 Crooks Road
Troy, MI 48084
Telephone: (313) 280-3000

Z.F.
P.O. Box 1340
Grafvonsoden Strasse
5-9 D7070
Schwaebisch Gmuend
West Germany
Telephone: 7070-7171 -31510

Oil Heaters

Fleetguard, Inc.
P.O. Box 6001
Cookeville, TN 38502
Telephone: (615) 526-9551

Kim Hotstart Co.
West 917 Broadway
Spokane, WA 99210
Telephone: (509) 534-6171

Torque Converters

Twin Disc International S.A.
Chaussee de Namur
Nivelles
Belgium
Telephone: 067-224941

Twin Disc Clutch Co.
Racine, WI 53403
Telephone: (414) 634-1981

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Rockford Division
Borg-Warner Corporation
1200 Windsor Road
P.O. Box 7007
Rockford, IL 61125-7007
Telephone: (815) 633-7460

Modine
1500 DeKoven Avenue
Racine, WI 53401
Telephone: (414) 636-1640

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Section W – Warranty

All warranty information and directions for taking warranty actions are addressed in TB 5-3810-307-14.

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Section L – Service Literature

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Additional Service Literature

The following publications can be purchased by filling in and mailing the Service Literature Order Form:

Bulletin No.	Title Of Publication
3666087	Troubleshooting and Repair Manual
3666017	B Series Engine Shop Manual
3810234	B Series Alternative Repair
3810326	4B Series Standard Repair Times
3810350	6B Series Standard Repair Times
3666025	Specifications Manual

Service Literature Ordering Location

Region

United States and Canada

South and Central America
(excluding Brazil and Mexico)

Australia and New Zealand

Ordering Location

Cummins Distributors

or

Cummins Engine Co., Inc.
Publishing Services CMC 95030
Box 3005
Columbus, IN 47202-3005

Cummins Americas, Inc.
16085 N.W. 52nd Avenue
Hialeah, FL 33104

Cummins Diesel Australia
Maroondah Highway, P.O.B. 139
Ringwood 3134
Victoria, Australia

Obtain current price information from your local Cummins Distributor or (for U.S.A.) by calling Cummins Toll Free Number 1-800-DIESELS (1-800-343-7357).

Literature Order Form

Use this form for prompt handling of your literature order.

Item	Bulletin Number	Title of Publication	Quantity	U.S. Price Each	Amount
1				\$	\$
2					
3					
4					
5					
6					
Order Total					\$

Contact your Cummins distributor for prices and availability.

For problems with literature orders, contact 1-800-DIESELS (1-800-343-7357) (for U.S.A. and Canada).

Prices subject to change without notice.

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Mail the Literature Order Form along with your ship-to address to your nearest Cummins distributor.

FROM:

Name: _____

Street Address: _____

City: _____ State: _____ Zip Code: _____

Country: _____

SHIP TO: (Name and address where literature is to be shipped)

Name: _____

Street Address: _____

City: _____ State: _____ Zip Code: _____

Country: _____

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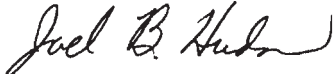
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By Order of the Secretary of the Army:

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