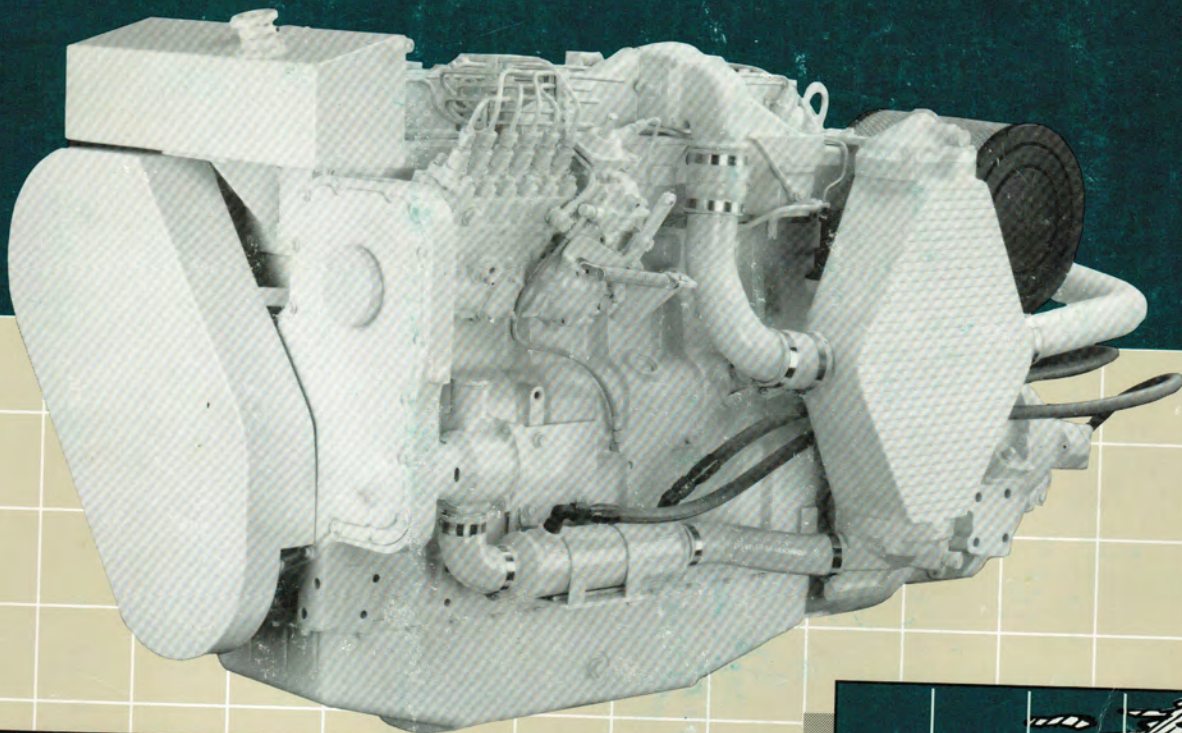


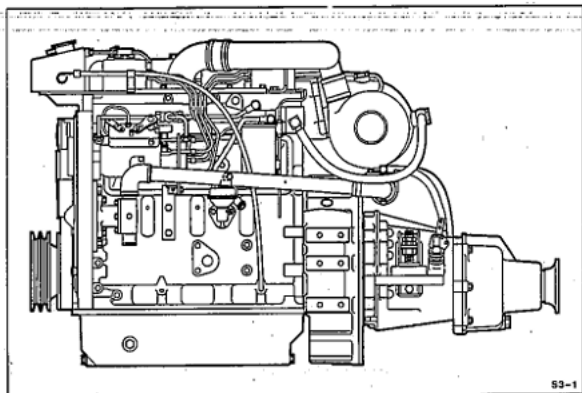


Operation and Maintenance Manual B and C Series Marine Propulsion Units Worldwide

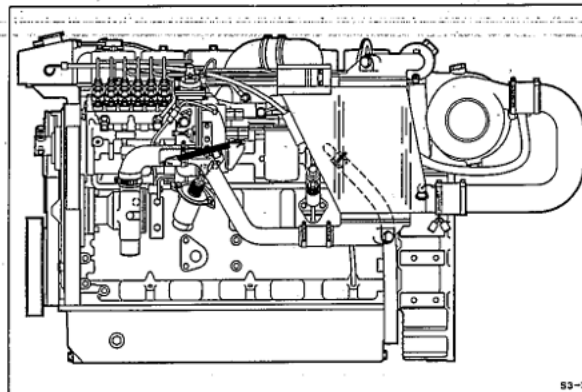




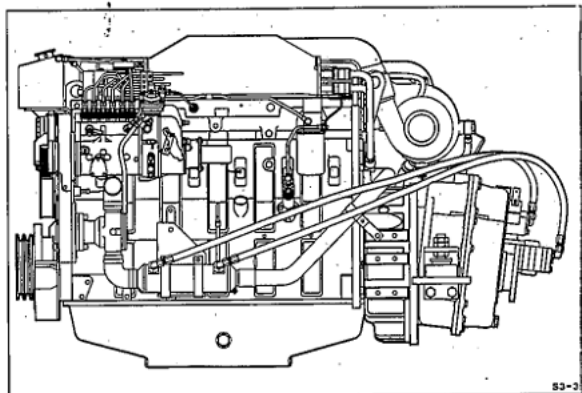
Operation and Maintenance Manual B and C Series Marine Propulsion Units Worldwide



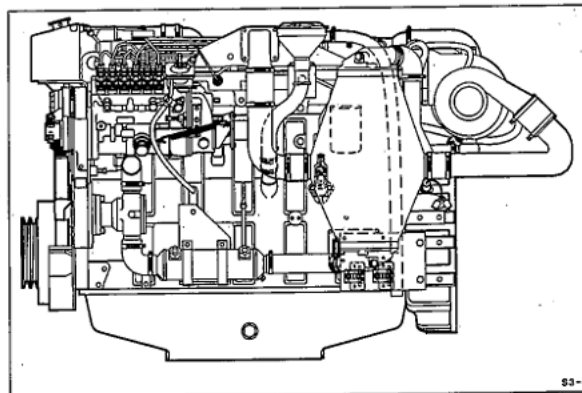
4BT 3.9M



6BTA 5.9M



6CTA 8.3M



6CTA 8.3M

Foreword

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

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

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

The latest technology and the highest quality components were used to produce this engine. When replacement parts are needed, we recommend using only genuine Cummins or ReCon® exchange parts. These parts can be identified by the following trademarks:



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

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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 Control Parts List (CPL) Number	_____
Engine Oil Type and Viscosity	_____
Engine Specification Number	_____
Fuel Pump Part Number	_____
Filter Part Numbers:	
• Air Cleaner Element	_____
• Coolant (C-Series)	_____
• Lubricating Oil	_____
• Fuel	_____
• Fuel Water Separator	_____
Belt Part Numbers	_____
Marine Gear Manufacturer	_____
Marine Gear Model	_____
Marine Gear Serial No.	_____
Marine Gear Part Number	_____
Marine Gear Oil Type	_____
Raw Water Pump Manufacturer	_____
Raw Water Pump Model	_____
Raw Water Pump Part Number	_____

Models Included in this manual are:

<u>Model</u>	<u>KW</u> <u>[BHP]</u>	<u>RPM</u>	<u>*Rating (Duty Cycle)</u>
4B	48 [64]	2200	Continuous
4B	57 [76]	2500	Medium Continuous
4B	60 [80]	2800	Recreation/Light Duty
4BT	97 [130]	2500	Medium Continuous
4BT	112 [150]	2800	Recreation/Light Duty
6B	73 [98]	2200	Continuous
6B	86 [115]	2500	Medium Continuous
6B	90 [120]	2800	Recreation/Light Duty
6BT	113 [152]	2500	Medium Continuous
6BT	134 [180]	2500	Medium Continuous
6BT	157 [210]	2600	Recreation/Light Duty
6BTA	164 [220]	2500	Medium Continuous
6BTA	186 [250]	2600	Recreation/Light Duty
6BTA	186 [250]	2600	Medium Continuous
6BTA	224 [300]	2800	Recreation/Light Duty
6CTA	186 [250]	2100	Continuous
6CTA	224 [300]	2500	Medium Continuous
6CTA	298 [400]	2600	Recreation/Light Duty

*Note: Detailed definitions of the Rating Terminology is covered in Section E.

NOTES

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Section i - Introduction

Section Contents

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General Repair Instructions	i-9
General Safety Instructions	i-8
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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 Specifications and Torque Values (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).

Review the Owners Responsibilities in (Section W).

NOTE: Discharge of oil or oily waste into or upon the water is a direct violation of today's laws. Violators are subject to a penalty of various monetary charges. Dispose of these substances properly.

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) can be ordered by filling out and mailing the Literature Order Form located in Service Literature, (Section L).

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

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

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

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

How to Use the Manual

This manual is organized according to 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 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-2 to locate and correct engine problems.

Refer to (Section V) for specifications recommended by Cummins Engine Company, Inc., for your engine. Specifications and torque values for each engine system are given in that section.

Symbols

The following symbols have been used in this manual to help communicate the intent of the instructions. When one of the symbols appears, it conveys the meaning defined below:



WARNING - Serious personal injury or extensive property damage can result if the warning instructions are **not** followed.



CAUTION - Minor personal injury can result or a part, an assembly, or the engine can be damaged if the caution instructions are **not** followed.



Indicates a **REMOVAL** or **DISASSEMBLY** step.



Indicates an **INSTALLATION** or **ASSEMBLY** step.



INSPECTION is required.



CLEAN the part or assembly.



PERFORM a mechanical or time **MEASUREMENT**.



LUBRICATE the part or assembly.



Indicates that a **WRENCH** or **TOOL SIZE** will be given.



TIGHTEN to a specific torque.



PERFORM an electrical **MEASUREMENT**.



Refer to another location in this manual or another publication for additional information.



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

Simbolos

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



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



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



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



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



Se requiere **INSPECCION**.



LIMPIESE la pieza o el montaje.



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



LUBRIQUESE la pieza o el montaje.



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



APRIETESE hasta un par torsor específico.



EJECUTESE una **MEDICION** eléctrica.



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



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

Symbole

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



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



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



AUSBAU bzw. **ZERLEGEN**.



EINBAU bzw. **ZUSAMMENBAU**.



INSPEKTION erforderlich.



Teil oder Baugruppe **REINIGEN**.



DIMENSION - oder **ZEITMESSUNG**.



Teil oder Baugruppe **ÖLEN**.



WERKZEUGGRÖSSE wird angegeben.



ANZUG auf vorgeschriebenes Drehmoment erforderlich.



Elektrische **MESSUNG DURCHFÜHREN**.



Weitere Informationen an anderer Stelle bzw. in anderen Handbüchern.



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

Symboles

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



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



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



Indique une opération de **DEPOSE**.



Indique une opération de **MONTAGE**.



L'INSPECTION est nécessaire.



NETTOYER la pièce ou l'ensemble.



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



GRAISSER la pièce ou l'ensemble.



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



SERRER à un couple spécifique.



EFFECTUER une **MESURE** électrique.



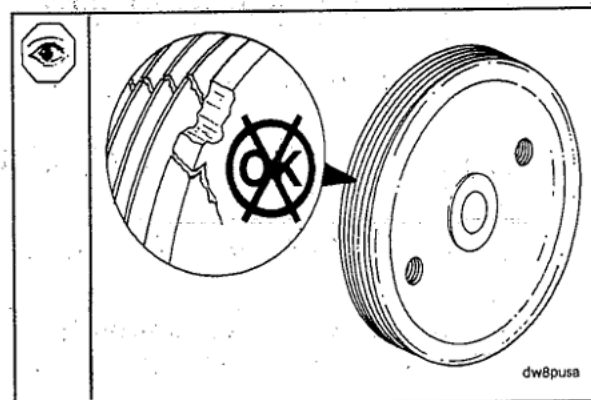
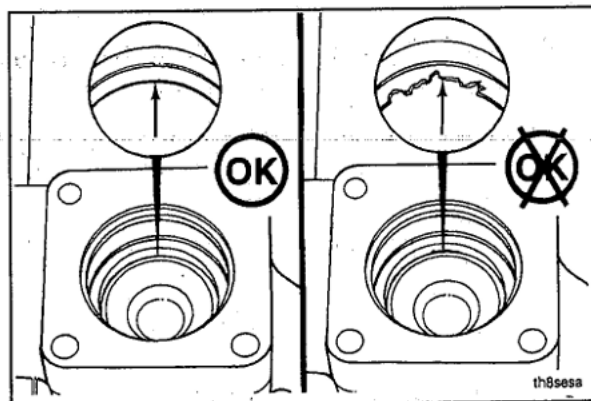
Se reporter à un autre endroit dans ce manuel ou à une autre publication pour obtenir des informations plus complètes.



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

Illustrations

The illustrations in this manual are intended to give an example of how to perform the action or the repair being described. Many of the illustrations are common and will **not** look exactly like the parts used in your 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



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

- Make sure the work area surrounding the product is safe. Be aware of hazardous conditions that can exist.
- **Always** wear protective glasses and protective shoes when working.
- Do **not** wear loose-fitting or torn clothing. Remove all jewelry when working.
- Disconnect the battery and discharge any capacitors before beginning any repair work. Disconnect the air starting motor if equipped to prevent accidental engine starting. Put a "Do **Not** Operate" tag in the operator's compartment or on the controls.
- Use **ONLY** the proper engine barring techniques for manually rotating the crankshaft. Do **not** attempt to rotate the crankshaft by pulling or prying on the fan. This practice can cause serious personal injury, property damage, or damage to the fan blade(s) causing premature fan failure.
- If an engine has been operating and the coolant is hot, allow the engine to cool before you slowly loosen the filler cap and relieve the pressure from the cooling system.
- Do **not** work on anything that is supported **ONLY** by lifting jacks or a hoist. **Always** use blocks or proper stands to support the product before performing any service work.
- Relieve all pressure in the air, oil, and the cooling systems before any lines, fittings, or related items are removed or disconnected. Be alert for possible pressure when disconnecting any device from a system that utilizes pressure. Do **not** check for pressure leaks with your hand. High pressure oil or fuel can cause personal injury.
- To prevent suffocation and frostbite, wear protective clothing and **ONLY** disconnect liquid refrigerant (freon) lines in a well ventilated area.
- To avoid personal injury, use a hoist or get assistance when lifting components that weigh 23 kg [50 lb] or more. Make sure all lifting devices such as chains, hooks, or slings are in good condition and are of the correct capacity. Make sure hooks are positioned correctly. **Always** use a spreader bar when necessary. The lifting hooks **must not** be side-loaded.
- Corrosion inhibitor contains alkali. Do **not** get the substance in your eyes. Avoid prolonged or repeated contact with skin. Do **not** swallow internally. In case of contact, immediately wash skin with soap and water. In case of contact, immediately flood eyes with large amounts of water for a minimum of 15 minutes. **IMMEDIATELY CALL A PHYSICIAN. KEEP OUT OF REACH OF CHILDREN.**
- Naptha and Methyl Ethyl Ketone (MEK) are flammable materials and **must** be used with caution. Follow the manufacturer's instructions to provide complete safety when using these materials. **KEEP OUT OF REACH OF CHILDREN.**
- To avoid burns, be alert for hot parts on products that have just been turned OFF, and hot fluids in lines, tubes, and compartments.
- **Always** use tools that are in good condition. Make sure you understand how to use them before performing any service work. Use **ONLY** genuine Cummins or Cummins Recon® replacement parts.
- **Always** use the same fastener part number (or equivalent) when replacing fasteners. Do **not** use a fastener of lesser quality if replacements are necessary.

General Repair Instructions

This engine incorporates the latest diesel technology; yet, it is designed to be repaired using normal repair practices performed to quality standards.

- **Cummins Engine Company, Inc. does not recommend or authorize any modifications or repairs to engines or components except for those detailed in Cummins Service Information. In particular, unauthorized repair to safety-related components can cause personal injury. Below is a partial listing of components classified as safety-related:**

- **Air Compressor**
- **Air Controls**
- **Air Shutoff Assemblies**
- **Balance Weights**
- **Cooling Fan**
- **Fan Hub Assembly**
- **Fan Mounting Bracket(s)**
- **Fan Mounting Capscrews**
- **Fan Hub Spindle**
- **Flywheel**
- **Flywheel Crankshaft Adapter**
- **Flywheel Mounting Capscrews**
- **Fuel Shutoff Assemblies**
- **Fuel Supply Tubes**
- **Lifting Brackets**
- **Throttle Controls**
- **Turbocharger Compressor Casing**
- **Turbocharger Oil Drain Line(s)**
- **Turbocharger Oil Supply Line(s)**
- **Turbocharger Turbine Casing**
- **Vibration Damper Mounting Capscrews**

- **Follow All Safety Instructions Noted in the Procedures.**
 - Follow the manufacturer's recommendations for cleaning solvents and other substances used during the repair of the engine. **Always** use good safety practices with tools and equipment.
- **Provide A Clean Environment and Follow the Cleaning Instructions Specified in the Procedures**
 - The engine and its components **must** be kept clean during any repair. Contamination of the engine and components will cause premature wear.
- **Perform the Inspections Specified in the Procedures.**
- **Replace all Components or Assemblies Which are Damaged or Worn Beyond the Specifications**
- **Use Genuine Cummins New or ReCon® Service Parts and Assemblies**
 - The assembly instructions have been written to use again as many components and assemblies as possible. When it is necessary to replace a component or assembly, the procedure is based on the use of new Cummins or Cummins ReCon® components. All of the repair services described in this manual are available from all Cummins Distributors and most Dealer locations.
- **Follow The Specified Disassembly and Assembly Procedures to Avoid Damage to the Components.**

Complete rebuild instructions are available in the shop manual which can be ordered or purchased from a Cummins Authorized Repair Location. Refer to Section L, Literature, for ordering instructions.

General Cleaning Instructions

Solvent and Acid Cleaning

Several solvent and acid-type cleaners can be used to clean the engine parts. **Cummins Engine Company, Inc. does not recommend any specific cleaners. Always** follow the cleaner manufacturer's instructions.

Experience has shown that the best results can be obtained using a cleaner that can be heated to 90 to 95 degrees Celsius [180 to 200 degrees Fahrenheit]. A cleaning tank that provides a constant mixing and filtering of the cleaning solution will give the best results.



Remove all the gasket material, o-rings, and the deposits of sludge, carbon, etc., with a wire brush or scraper before putting the parts in a cleaning tank. Be careful **not** to damage any gasket surfaces. When possible, steam clean the parts before putting them in the cleaning tank.



Warning: The use of acid can be extremely dangerous to personnel, and can damage the machinery. Always provide a tank of strong soda water as a neutralizing agent.

Rinse all of the parts in hot water after cleaning. Dry completely with compressed air. Blow the rinse water from all of the capscrew holes and the oil drillings.

If the parts are **not** to be used immediately after cleaning, dip them in a suitable rustproofing compound. The rustproofing compound **must** be removed from the parts before installation on the engine.

Steam Cleaning

Steam cleaning can be used to remove all types of dirt that can contaminate the cleaning tank. It is a good way to clean the oil drillings.



Warning: Wear protective clothing to prevent personal injury from the high pressure and extreme heat.

Do **not** steam clean the following parts:



1. Electrical Components
2. Wiring
3. Injectors
4. Fuel Pump
5. Belts and Hoses
6. Bearings

Glass or Plastic Bead Cleaning

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



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



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

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

1. Bead size: - Use U.S. size No. 16-20 for piston cleaning with plastic bead media, Part No. 3822735.
- Use U.S. size No. 70 for piston domes with glass media.
- Use U.S. size No. 60 for general purpose cleaning with glass media.
2. Operating Pressure: - Glass: Use 620 kPa [90 psi] for general purpose cleaning.
- Plastic: Use 270 kPa [40 psi] for piston groove cleaning.
3. Steam clean or wash the parts with solvent to remove all of the foreign material and glass or plastic beads after cleaning. Rinse with hot water. Dry with compressed air.
4. Do **not** contaminate the wash tanks with glass or plastic beads.

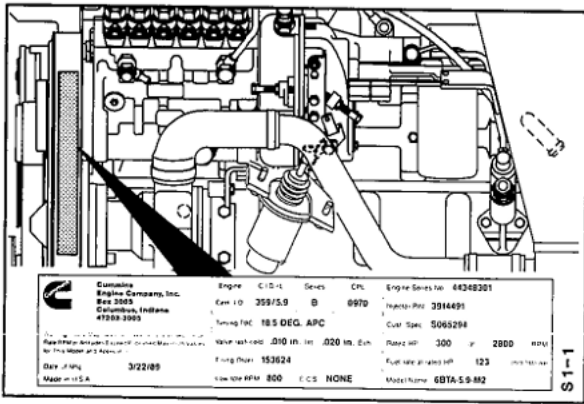
Definition of Terms

A.C.	Alternating Current	kg	Kilograms
AFC	Air Fuel Control	km	Kilometers
AMI	Advanced Marine Instrumentation	kPa	Kilopascal
AMS	Auxiliary Magnetic Switch	KW	Kilowatts
API	American Petroleum Institute	l	Liter
ASA	Air Signal Attenuator	lb	Pound
ASTM	American Society of Testing and Materials	lbf	Pounds of Force
C	Celsius	LCD	Liquid Crystal Display
cfm	Cubic Feet Per Minute	LDA	Air fuel Control
C.G.	Center of Gravity	m	Meter
C.I.D.	Cubic Inch Displacement	Max.	Maximum
cm	Centimeter	mm	Millimeter
CPL	Control Parts List	Min.	Minimum
cSt	Centistokes	MPa	Megapascal
D.C.	Direct Current	N	Newton
DCA	Diesel Coolant Additive	No.	Number
db	Noise Level Measurement	N·m	Newton-meter
E.C.S.	Emission Control System	O.D.	Outside Diameter
ECM	Electronic Control Module (Air Heater)	OEM	Original Equipment Manufacturer
EPA	Environmental Protection Agency	ppm	Parts Per Million
ESN	Engine Serial Number	psi	Pounds Per Square Inch
F	Fahrenheit	PTO	Power Takeoff
ft-lb	Foot Pound	qt	Quart
Hg	Mercury	RPM	Revolutions Per Minute
HP	Horsepower	S.A.E.	Society of Automotive Engineers
hr	Hour	ST	Service Tools
H₂O	Water	TDC	Top Dead Center
in	Inch	V	Volts
I.D.	Inside Diameter	VDC	Volts Direct Current
in-lb	Inch Pound	AT	Difference in Temperature

Section E - Engine Identification

Section Contents


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Bosch VE Distributor.....	E-3
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Engine Identification

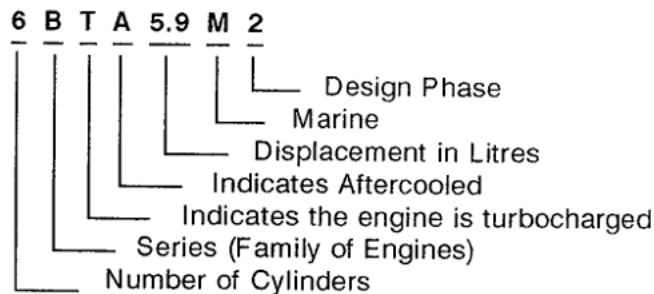
Engine Dataplate Location

Use the information from the engine dataplate when discussing service or sourcing parts for your engine. The location shown is for the B-Series but is also the same for the C-Series too.

 Cummins Engine Company, Inc. Box 3005 Columbus, Indiana 47202-3005	Engine	C.I.D./L.	Series	CPL	Engine Serial No. 44348301
	Cert. I.D.	359/5.9	B	0970	Injector P/N 3914491
	Timing - TDC 18.5 DEG. APC				Cust. Spec. S065294
	Valve lash cold .020 in. Int. .020 in. Exh.				Rated HP 300 at 2800 RPM
	Firing Order 153624				Fuel rate at rated HP 123 mm ³ /stroke
Date of Mfg. 3/22/89	Low Idle RPM 800		E.C.S. NONE		Model Name 6BTA-5.9-M2
Warning: Injury May Result and Warranty is Voided if Fuel Rate RPM or Altitudes Exceed Published Maximum Values for This Model and Application.					
Made in U.S.A.					

Si-77

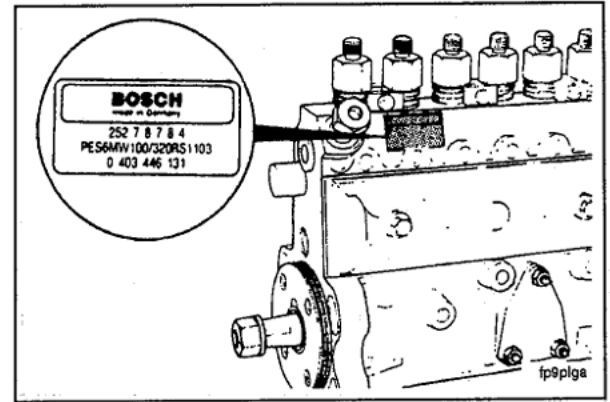
The engine model name provides the following engine data:



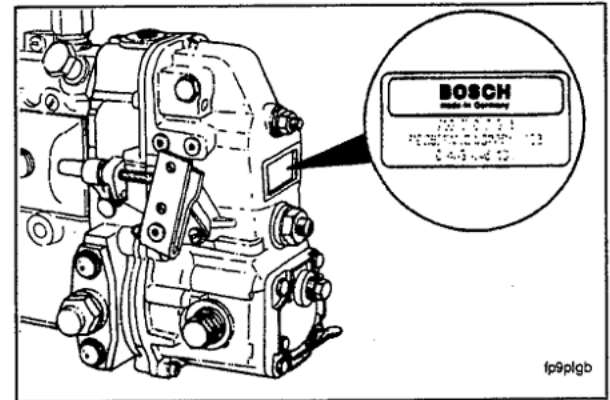
Injection Pump Dataplates

Bosch Inline

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

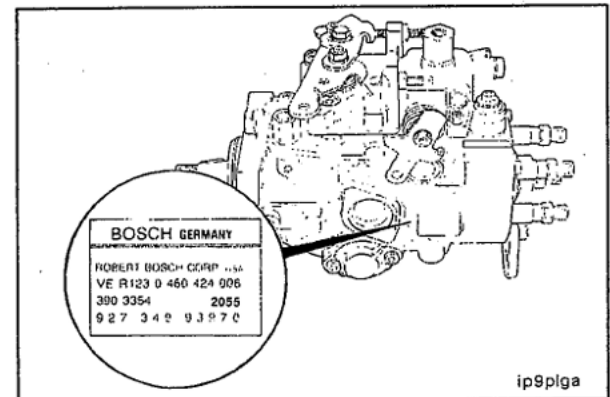


The Cummins part number for the fuel pump-governor combination is located on the governor dataplate.



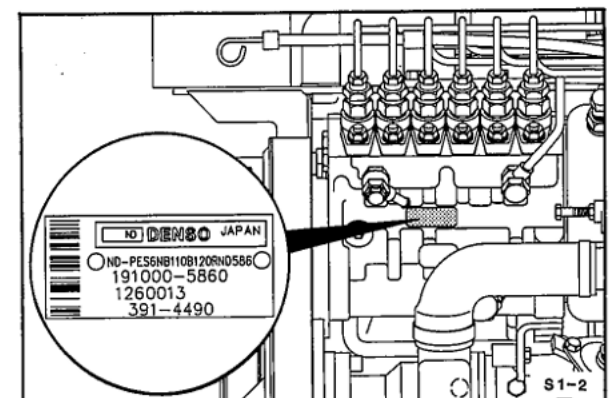
Bosch VE Distributor

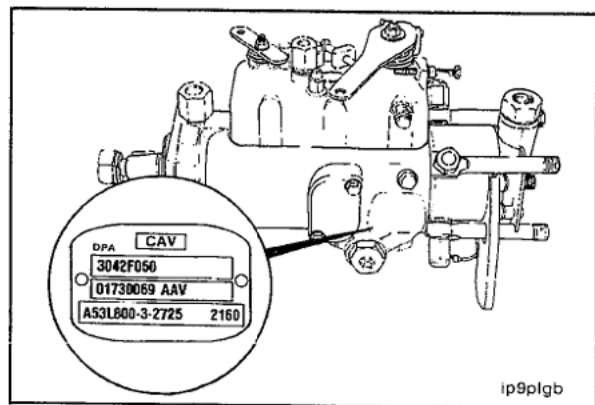
The injection pump dataplate is located on the side of the injection pump. The dataplate provides information for fuel pump calibration.



Nippondenso

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

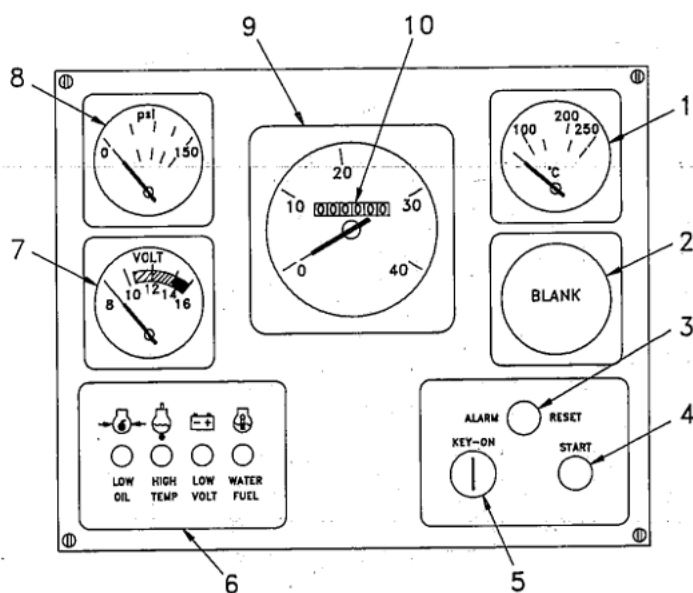




Lucas CAV DPA

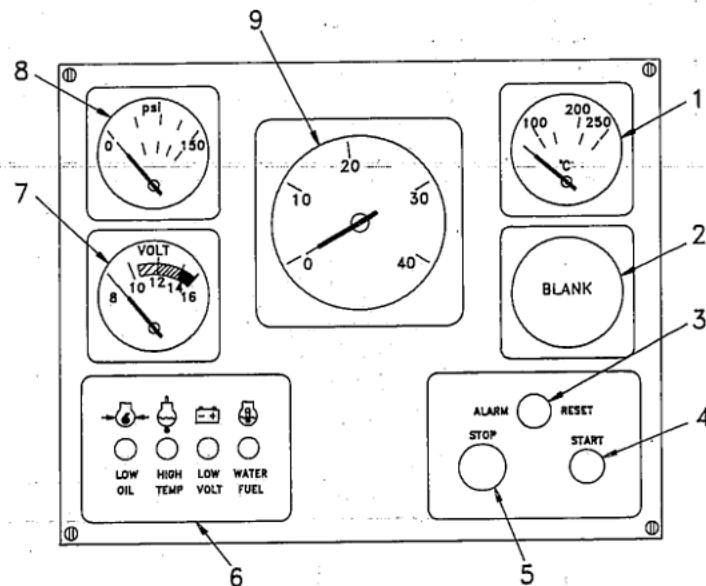
The injection pump dataplate is located on the side of the injection pump. It provides information for fuel pump calibration.

Premium Instrument Panels - Identification



Main Station Panel

1. Engine Coolant Temperature Gauge
2. Blank
3. Alarm Reset Pushbutton
4. Crank Pushbutton
5. Keyswitch
6. Alarm Panel
7. Battery Voltmeter
8. Engine Oil Pressure Gauge
9. Tachometer - Indicates Engine RPM
10. Hourmeter - Indicates Running Time



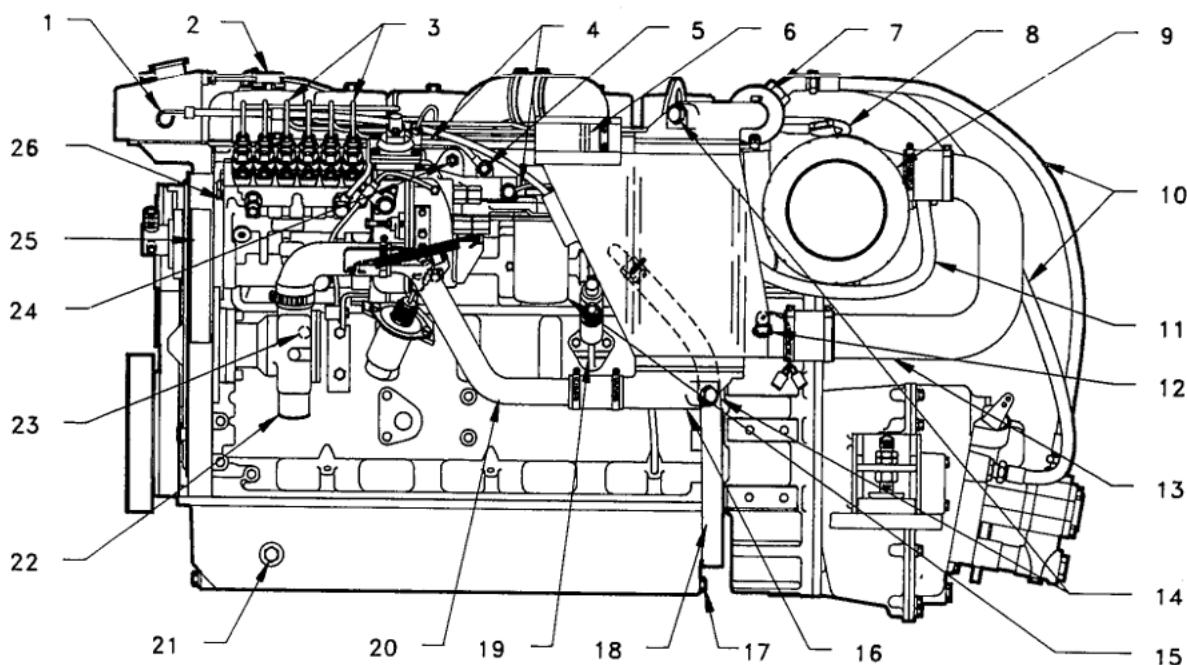
Second Station Panel

1. Engine Coolant Temperature Gauge
2. Blank
3. Alarm Reset Pushbutton
4. Crank Pushbutton
5. Stop Pushbutton
6. Alarm Panel
7. Battery Voltmeter
8. Engine Oil Pressure Gauge
9. Tachometer - Indicates Engine RPM

Engine Components - Identification

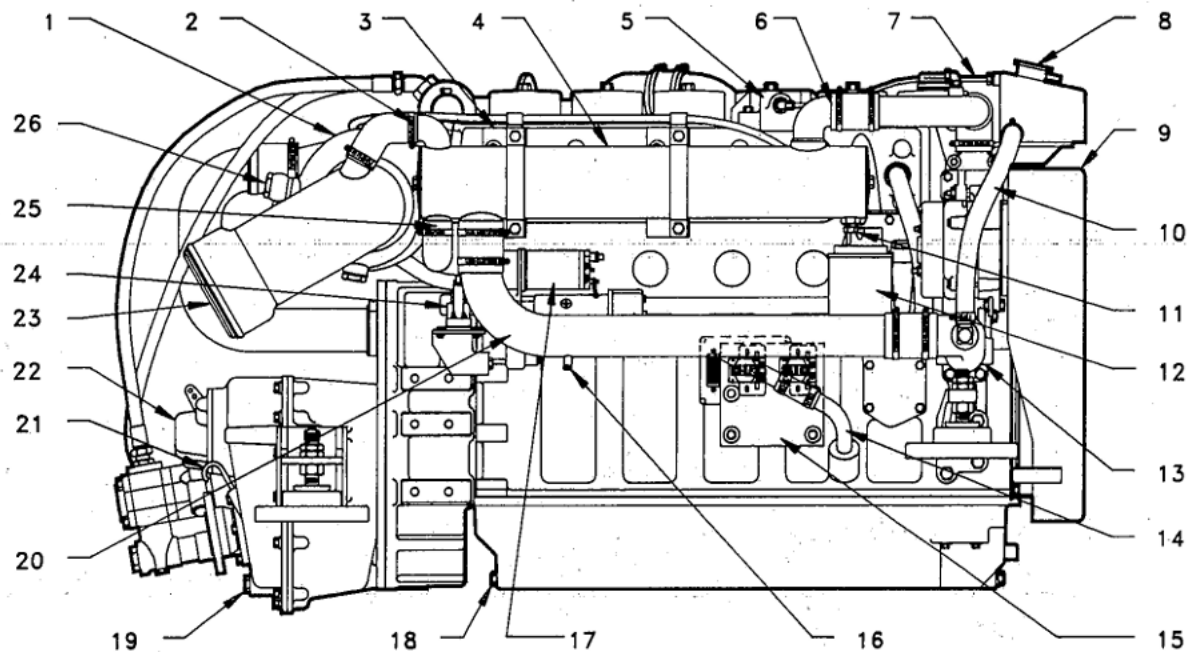
The following drawings illustrate the major components. You **must** be familiar with each component in order to conduct the maintenance and repairs discussed in this manual.

Fuel Pump Side View of 6BTA5.9M 300 HP



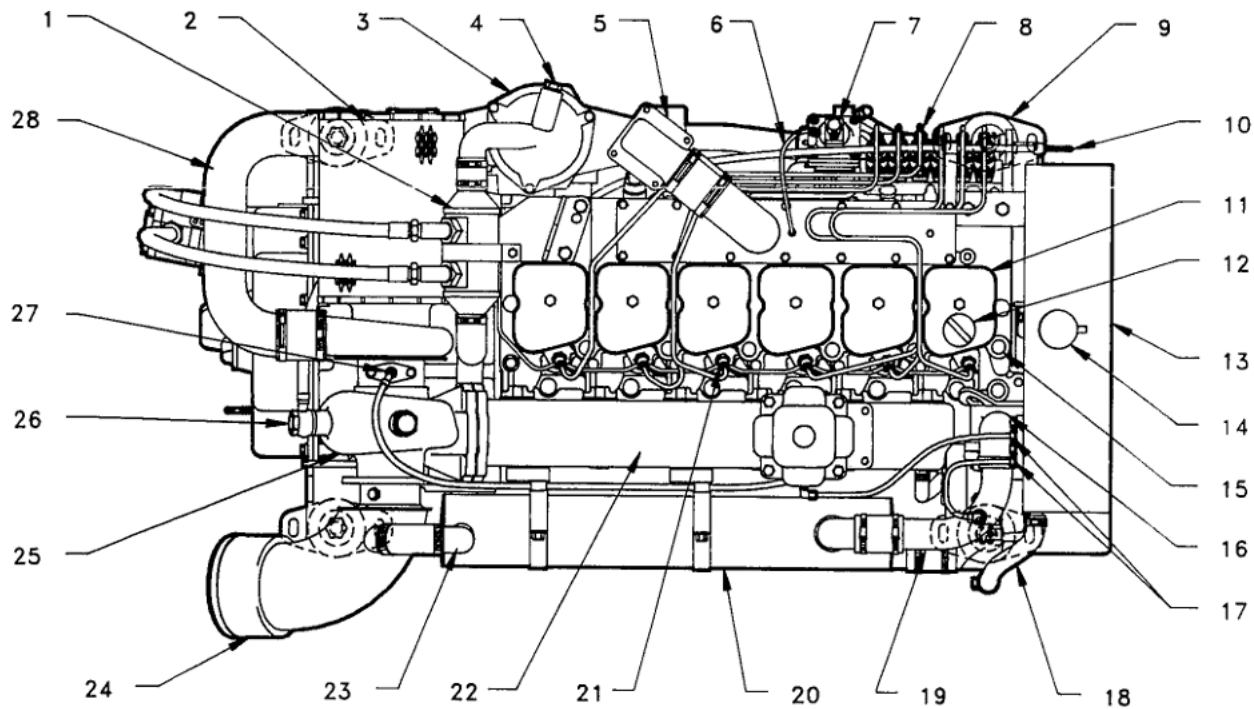
- | | |
|---------------------------------|---|
| 1. Dipstick (Engine Oil) | 15. Fuel Filter |
| 2. Engine Oil Fill Cap | 16. Aftercooler (Raw Water Type) |
| 3. High Pressure Fuel Lines | 17. Drain Plug (Engine Oil) |
| 4. Low Pressure Fuel Lines | 18. Breather Hose (Crankcase Ventilation) |
| 5. Fuel Vent Screw | 19. Fuel Lift Pump |
| 6. Air Heater Element | 20. Raw Water Transfer Tube |
| 7. Marine Gear Oil Cooler | 21. Oil Pan Heater Location |
| 8. Turbocharger Oil Inlet | 22. Raw Water Pump |
| 9. Air Filter | 23. Oil Pressure Sending Unit (Behind Raw Water Pump) |
| 10. Marine Gear Oil Lines | 24. Air Heater Thermistor |
| 11. Turbocharger Coolant Supply | 25. Engine Dataplate Location |
| 12. Magnetic Pickup | 26. Fuel Injection Pump |
| 13. Air Crossover Tube | |
| 14. Zinc Plugs (2 Shown) | |

Exhaust Side View of 6BTA5.9M 300 HP



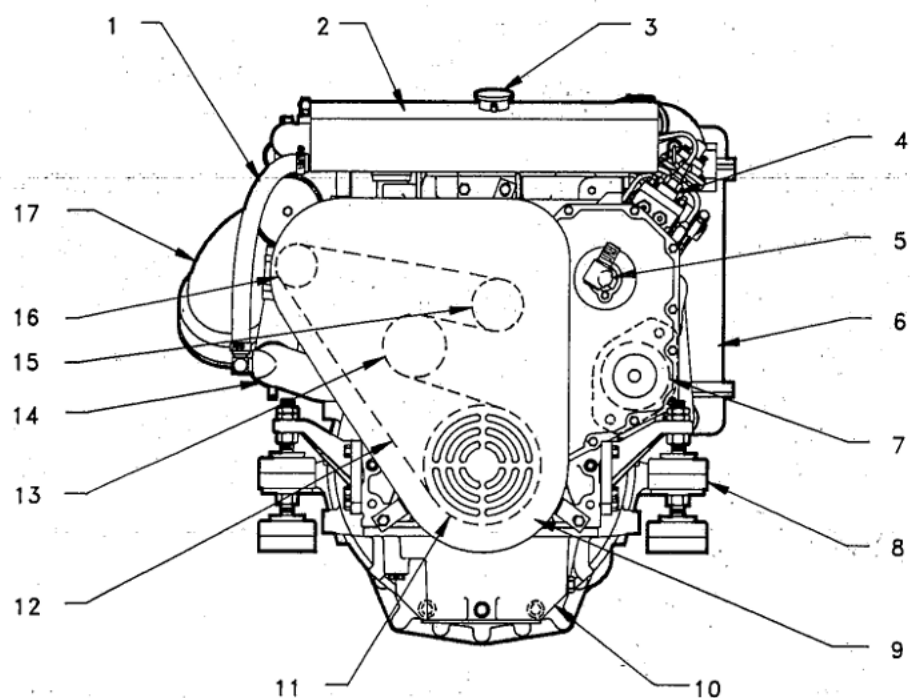
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|--|--|
| 1. Water Cooled Turbocharger | 15. Air Heater Control |
| 2. Raw Water Outlet Connection
(From Engine Heat Exchanger) | 16. Engine Coolant Drain Plug |
| 3. Exhaust Manifold (Water Cooled) | 17. Starter |
| 4. Engine Heat Exchanger | 18. Drain Plug (Engine Oil) |
| 5. Water Header Plate (Exhaust Manifold) | 19. Drain Plug (Marine Gear Oil) |
| 6. Engine Heat Exchanger Water Inlet | 20. Engine Heat Exchanger
Coolant Outlet Tube |
| 7. Coolant Vent Lines | 21. Dipstick (Marine Gear Oil) |
| 8. Coolant Expansion Tank
Fill Pressure Cap | 22. Marine Gear |
| 9. Belt Protective Cover | 23. Exhaust Elbow |
| 10. Coolant Fill Line | 24. Starter AMS (Auxiliary Magnetic
Switch) |
| 11. Zinc Plug (Heat Exchanger) | 25. Raw Water Inlet Connection To
Engine Heat Exchanger |
| 12. Oil Filter | 26. Turbocharger Coolant Inlet |
| 13. Engine Water Inlet Connection | |
| 14. Turbocharger Oil Drain | |

Top View of 6BTA5.9M 300 HP



- | | |
|---------------------------------|-------------------------------------|
| 1. Marine Gear Oil Cooler | 15. Coolant Temperature Sensor |
| 2. Air Filter | 16. Coolant Thermostat Location |
| 3. Aftercooler (Raw Water Type) | 17. Coolant Vent Line Connections |
| 4. Zinc Plug (Aftercooler) | 18. Coolant Fill Line |
| 5. Air Heater Element | 19. Heat Exchanger Coolant Inlet |
| 6. AFC Line | 20. Heat Exchanger |
| 7. Fuel Pump Boost Control | 21. Fuel Injector |
| 8. Fuel Pump | 22. Exhaust Manifold (Water Cooled) |
| 9. Engine Mount (2 Shown) | 23. Heat Exchanger Raw Water Outlet |
| 10. Dipstick (Engine Oil) | 24. Exhaust Elbow |
| 11. Valve Cover | 25. Turbocharger (Water Cooled) |
| 12. Engine Oil Fill Cap | 26. Turbocharger Coolant Inlet |
| 13. Coolant Expansion Tank | 27. Turbocharger Oil Inlet |
| 14. Coolant Pressure Cap | 28. Inlet Air Crossover Tube |

Front View of 6BTA5.9M 300 HP

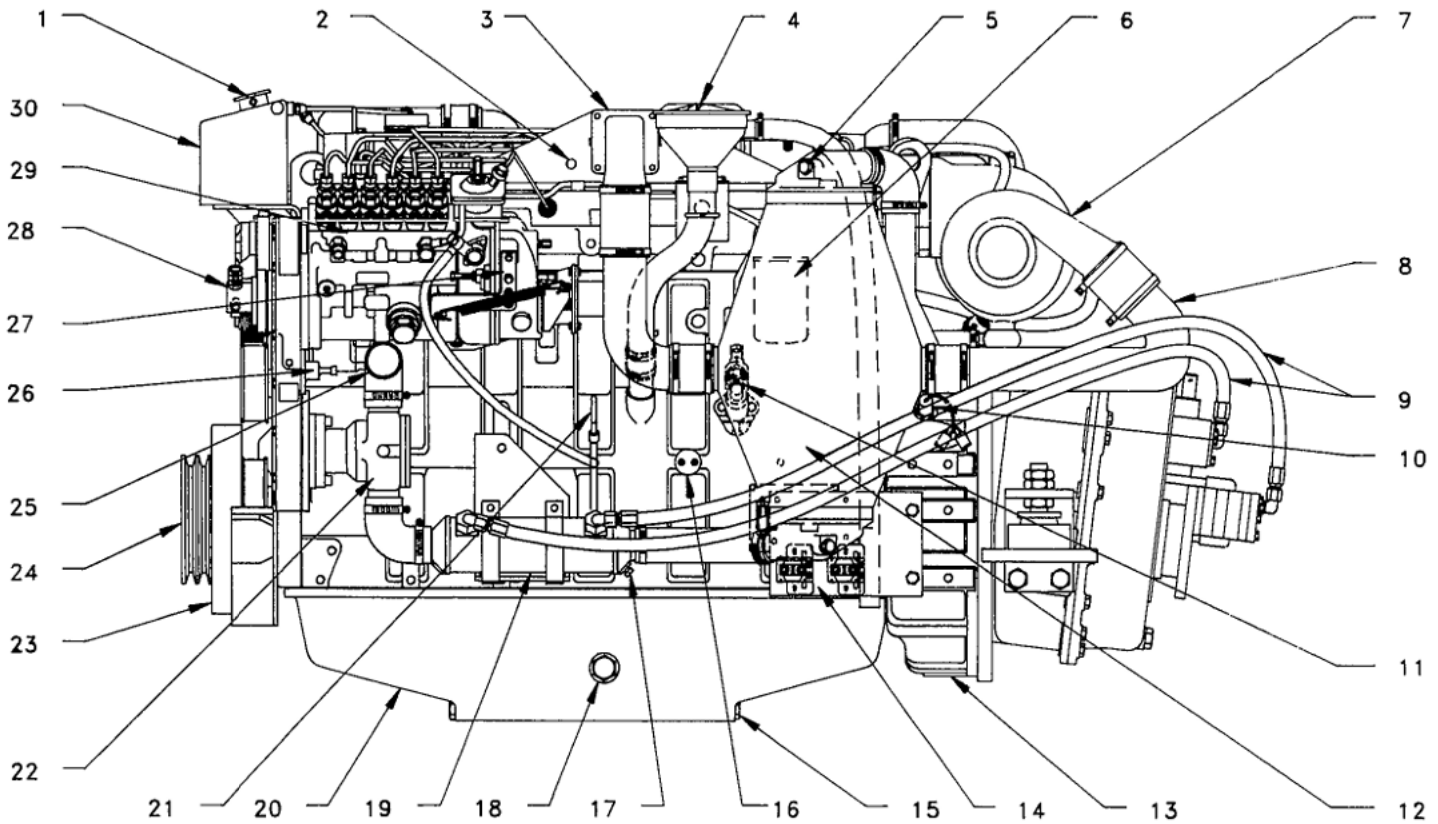


- 1. Coolant Fill Line
- 2. Coolant Expansion Tank
- 3. Coolant Pressure Cap
- 4. Fuel Pump
- 5. Mechanical Tachometer Drive
- 6. Aftercooler (Raw Water Type)
- 7. Raw Water Pump
- 8. Engine Mount
- 9. Belt Protective Cover

- 10. Oil Pan
- 11. Vibration Damper
- 12. Drive Belt
- 13. Coolant Water Pump
- 14. Engine Water Inlet
- 15. Belt Tensioner
- 16. Alternator
- 17. Exhaust Elbow

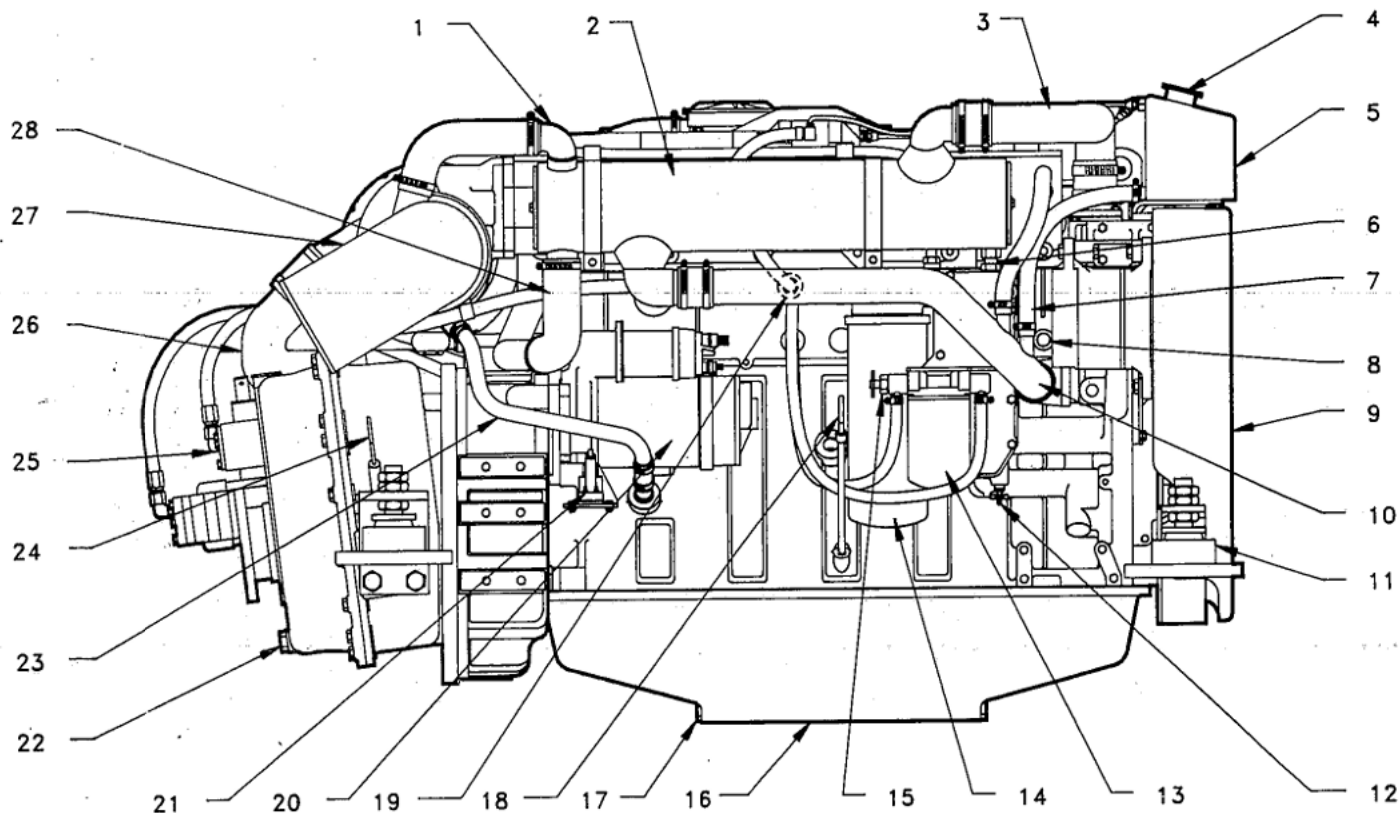
S3-52

Fuel Pump Side View of 6CTA8.3M 400 HP



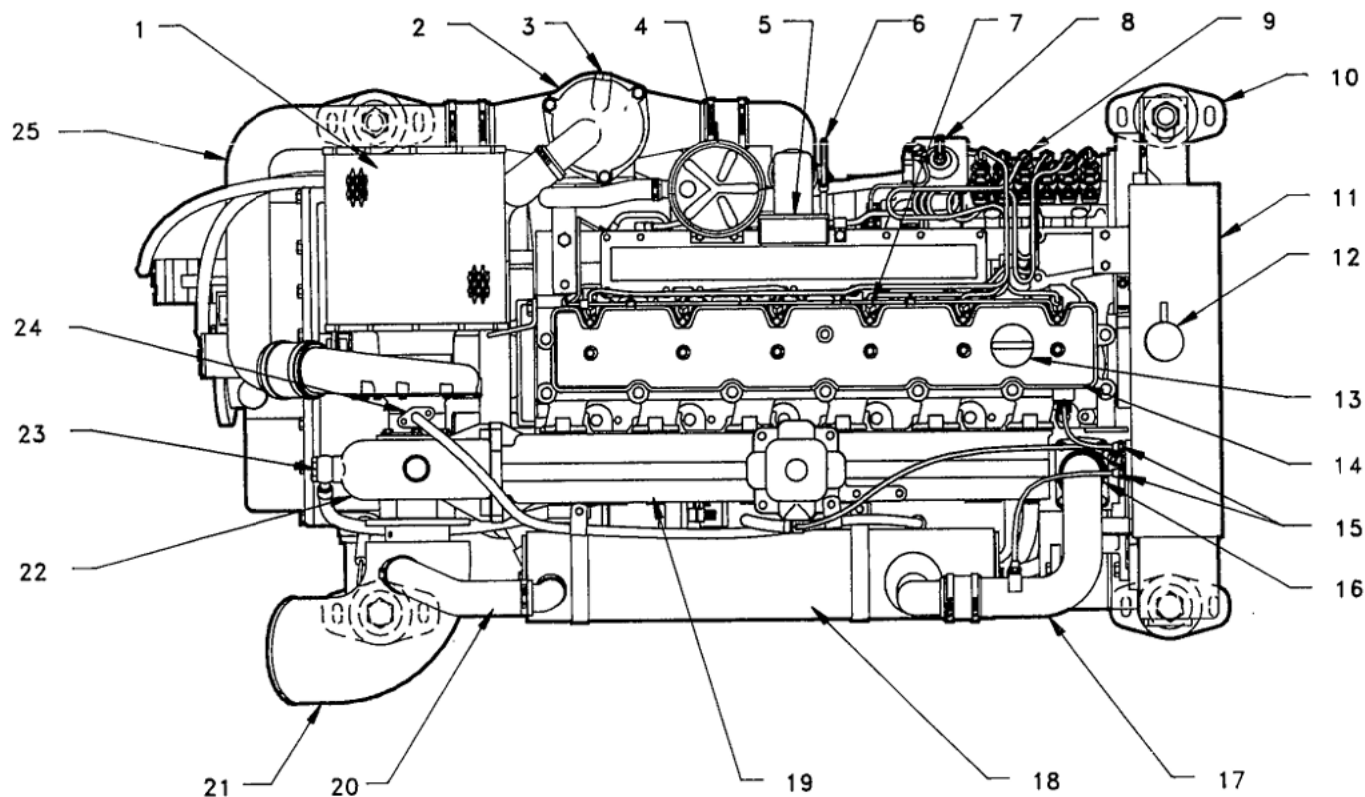
- | | |
|---------------------------------------|---------------------------------|
| 1. Coolant Expansion Tank | 16. Oil Pressure Sending Unit |
| 2. Air Heater Thermistor | 17. Raw Water Drain Plug |
| 3. Air Heater | 18. Oil Pan Heater Location |
| 4. Blowby Separator | 19. Marine Gear Oil Cooler |
| 5. Zinc Plug (2 Shown In Aftercooler) | 20. Oil Pan |
| 6. Fuel Filter | 21. Dipstick (Engine Oil) |
| 7. Turbocharger | 22. Raw Water Pump |
| 8. Inlet Air Crossover Tube | 23. Vibration Damper |
| 9. Marine Gear Oil Lines | 24. Accessory Drive Pulleys |
| 10. Magnetic Pickup | 25. Raw Water Pump Inlet |
| 11. Fuel Lift Pump | 26. Engine Timing Pin |
| 12. Aftercooler (Raw Water Type) | 27. Throttle Lever |
| 13. Flywheel Housing | 28. Mechanical Tachometer Drive |
| 14. Air Heater Control | 29. Fuel Pump |
| 15. Oil Drain Plug | 30. Coolant Expansion Tank |

Exhaust Side View of 6CTA8.3M 400 HP



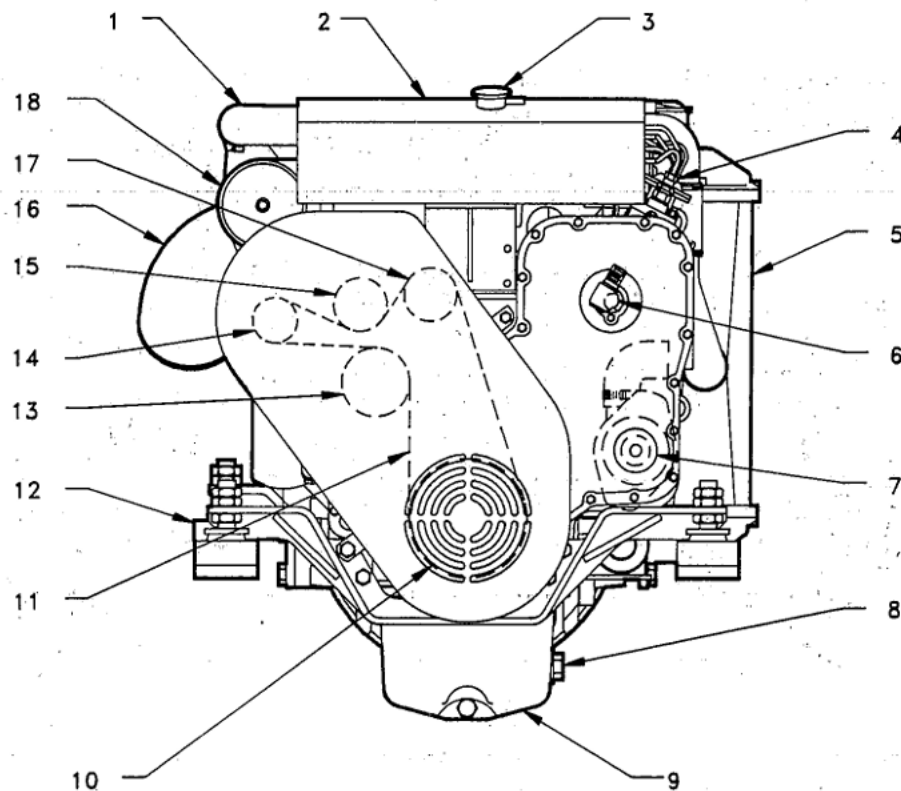
- | | |
|--|---|
| 1. Heat Exchanger Raw Water Outlet | 15. Coolant Filter Shutoff Valve (Return) |
| 2. Heat Exchanger | 16. Oil Pan |
| 3. Heat Exchanger Coolant Inlet | 17. Drain Plug (Engine Oil) |
| 4. Coolant Pressure Cap | 18. Dipstick (Engine Oil) |
| 5. Coolant Expansion Tank | 19. Coolant Filter Shutoff Valve (Supply) |
| 6. Zinc Plug (Heat Exchanger) | 20. Starter |
| 7. Coolant Fill Line | 21. Starter AMS (Auxiliary Magnetic Switch) |
| 8. Coolant Temperature Sensor | 22. Drain Plug (Marine Gear Oil) |
| 9. Belt Protective Cover | 23. Turbocharger Oil Drain |
| 10. Heat Exchanger Coolant Outlet Tube | 24. Dipstick (Marine Gear Oil) |
| 11. Engine Mount | 25. Marine Gear |
| 12. Coolant Drain Petcock | 26. Inlet Air Crossover Tube |
| 13. Coolant Filter | 27. Exhaust Elbow |
| 14. Engine Oil Filter | 28. Heat Exchanger Raw Water Inlet |

Top View of 6CTA8.3M 400 HP



- | | |
|---------------------------------|-------------------------------------|
| 1. Air Filter | 14. Valve Cover |
| 2. Aftercooler (Raw Water Type) | 15. Coolant Vent Line Connections |
| 3. Zinc Plug (Aftercooler) | 16. Coolant Thermostat Location |
| 4. Blowby Separator | 17. Heat Exchanger Coolant Inlet |
| 5. Air Heater | 18. Heat Exchanger |
| 6. Dipstick (Engine Oil) | 19. Exhaust Manifold (Water Cooled) |
| 7. Fuel Injector | 20. Heat Exchanger Raw Water Outlet |
| 8. Fuel Pump Boost Control | 21. Exhaust Elbow |
| 9. Fuel Pump | 22. Turbocharger (Water Cooled) |
| 10. Engine Mount | 23. Turbocharger Coolant Inlet |
| 11. Coolant Expansion Tank | 24. Turbocharger Oil Inlet |
| 12. Coolant Pressure Cap | 25. Inlet Air Crossover Tube |
| 13. Engine Oil Fill Cap | |

Front View of 6CTA8.3M 400 HP



- | | |
|---------------------------------|------------------------|
| 1. Heat Exchanger Coolant Inlet | 10. Vibration Damper |
| 2. Coolant Expansion Tank | 11. Drive Belt |
| 3. Coolant Pressure Cap | 12. Engine Mount |
| 4. Fuel Pump | 13. Coolant Water Pump |
| 5. Aftercooler (Raw Water Type) | 14. Alternator |
| 6. Mechanical Tachometer Drive | 15. Belt Tensioner |
| 7. Raw Water Pump | 16. Exhaust Elbow |
| 8. Oil Pan Heater Location | 17. Idler Pulley |
| 9. Oil Pan | 18. Heat Exchanger |

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NOTES

Section 1 - Operating Instructions


Section Contents

	Page
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General Information

Correct 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 sucked through the air intake system and cause engine acceleration and over-speeding, which can result in a fire, an explosion and extensive property damage. Numerous safety devices are available, such as air intake shutoff devices, to minimize the risk of over-speeding where an engine, due to its application, might operate in a combustible environment, such as due to a fuel spill or gas leak. Remember, Cummins has no way of knowing the service you have for your engine. THE EQUIPMENT OWNER AND OPERATOR ARE RESPONSIBLE FOR SAFE OPERATION IN A HOSTILE ENVIRONMENT. CONSULT YOUR CUMMINS AUTHORIZED REPAIR LOCATION FOR FURTHER INFORMATION.

Before Starting Engine

CHECK FLUID LEVELS. Check engine coolant level. Check engine oil level. Check marine gear oil level. Refill coolant to its normal cold level and oil to its high or "H" level if necessary. Check for signs of leakage. Engine coolant is a mixture of 50 percent anti-freeze and water. Engine oil should be 15W-40 SG for normal ambient temperatures. Consult the Marine Gear Operations Manual for recommendations for the marine gear oil.

CHECK FUEL SYSTEM. Open fuel valves and drain fuel/water separator. If a large quantity of water is drained from the system, check secondary filters and fuel tanks for water. **DO NOT START ENGINE UNTIL ALL WATER IS REMOVED FROM SYSTEM.**


CHECK RAW WATER SYSTEM. Open Raw water inlet valves. Clean debris from Raw water strainer.

CHECK AIR SYSTEM. All air inlets into engine room should be open and clean of obstructions.


CHECK ELECTRICAL SYSTEM. Check batteries for water level. Turn main electrical power switch to "ON". Start bilge blowers and bilge pump if necessary.

Normal Starting Procedure (Above 0°C [32°F])


- Disengage the marine gear.
- Position the fuel shutoff, electrical switch or mechanism control to the "RUN" position. If you have an engine equipped with the optional Electrical Intake Air Manifold heater System wait 15 seconds before engaging the starter motor. This will allow the air heater to perform its pre-heat cycle. If below 0°C [32°F] wait 20 seconds.
- Start the engine with the throttle at the idle speed.

 **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).**

- 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 provide adequate lubrication to the bearings, and to allow the oil pressure to stabilize.

 **Caution: Do not idle the engine for excessively long periods. Long periods of idling (more than 10 minutes) can damage an engine because combustion chamber temperatures drop so low the fuel will not burn completely. This will cause carbon to clog the injector spray holes and piston rings, and can cause the valves to stick. If the engine coolant temperature becomes too low (60°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.

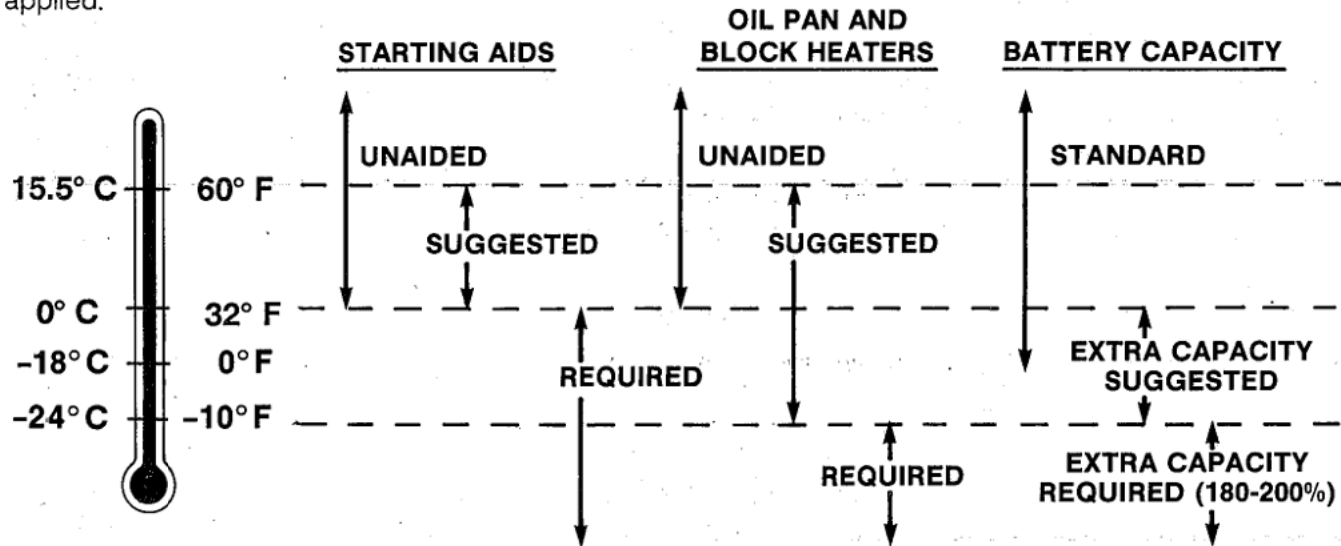
 **Caution: When using jumper cables to start the engine, make sure to connect the cables in parallel: positive (+) to positive (+) and negative (-) to negative (-).**

Cold Weather Starting Aids

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

Operation in ambient temperatures below 15.5°C [60°F] can require special consideration be given to engine starting.

At temperatures below 0°C [32°F], operate the engine at **moderate** speeds for 5 minutes before full loads are applied.



Using Starting Fluid With Mechanical or Electrical Metering Equipment

Warning: Starting fluid systems can not be used on engines equipped with the optional Electrical Intake Air Manifold Heater Systems as covered in Section A.

Starting fluids can be used, but **must** comply with the applicable Marine Regulations in your area. Cummins does **not** provide a starting fluid system for marine use.

- Set the throttle at half speed.
- Disengage the driven unit, or if equipped, put the transmission in neutral.
- Activate the switch to open the fuel pump shutoff valve.
- While cranking the engine, inject metered amounts of starting fluid.
- Engine oil pressure **must** be indicated on the gauge within 30 seconds after starting.

Using Starting Fluid Without Metering Equipment

Hand held fluid starting aids are **not** recommended for marine use.

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 7 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 - Venting, Section 5, for instructions to vent the fuel system.

Operating the Engine

- Allow the engine to idle 3 to 5 minutes before shutting it off after full throttle operation.
- Monitor the oil pressure and coolant temperature gauges frequently. Refer to Specifications and Torque Values, Section V, for recommended operating pressures and temperatures. Shut off the engine if any pressure or temperature does **not** meet the specifications.



Caution: Continuous operation with low coolant temperature (below 60°C [140°F]) or high coolant temperature (above 96°C [205°F]) can damage the engine.

- If an overheating condition starts to occur, reduce the power output of the engine by reducing the throttle setting until the temperature returns to normal operating range. If engine temperature does **not** return to normal, further reduce the engine speed and refer to Troubleshooting Section T. Contact an Authorized Repair Location at the earliest opportunity.
- 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 pressure

Engine Operating Range

Recreational/Light Duty Commercial

Engines with this rating are intended for powering Marine pleasure craft used for personal use, and for powering some marine commercial boats, such as gillnetters, bowpickers, skiffs, oil skimmers, and small fishing craft.

This power rating is intended for use in variable load applications where full power is limited to 1 hour out of every 8 hours of operation. Reduced power operation **must** be at or below cruise RPM (which is 200 RPM below rated RPM). This rating is an ISO 3046 Fuel Stop Power Rating and is for applications that operate less than 750 hours per year.

Medium Continuous

Engines with this rating are intended for powering commercial boats such as lobster boats, crew boats, party fishing boats, charter fishing boats, long range cruisers, harbor and coastal patrol boats, search and rescue boats, fire boats, bay shrimpers, clam boats, crab boats and seine skiffs.

This power rating is intended for continuous use in variable load applications where full power is limited to 6 hours out of every 12 hours of operation. Reduced power operations **must** be at or below cruise RPM (which is 200 RPM below rated RPM). This is an ISO 3046 Fuel Stop Power Rating and is for applications that operate less than 3000 hours per year.

Continuous

Engines with this rating are intended for powering commercial boats such as buoy tenders, research vessels, offshore supply boats, fishing trawlers, purse seiners, tugs, tow boats, and car/passenger ferries.

This power rating is intended for continuous use in applications requiring uninterrupted service at full power. This rating is the ISO 3046 Standard Power Rating and the SAE J1228 Continuous Crankshaft Power Rating.

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.

PROCEDURES FOR SEASONAL STORAGE

The following general recommendations **must** be used to prepare only your engine for winter storage. **Not** all of the recommendations will apply to your application. Always follow the manufacturer's recommendations on components supplied, but **not** manufactured, by Cummins Engine Company. This does **not** cover boat storage.

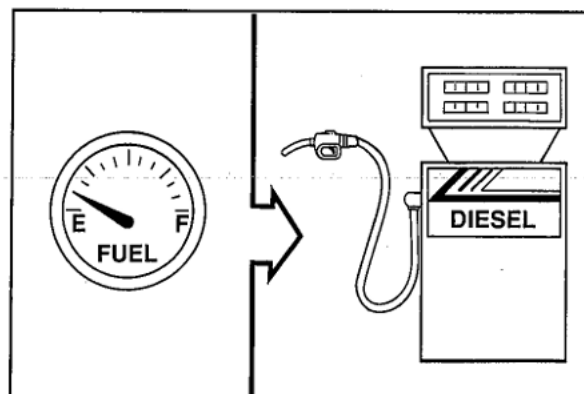
Fill the fuel tank.

Use only good quality ASTM No. 2D climatized diesel fuel.

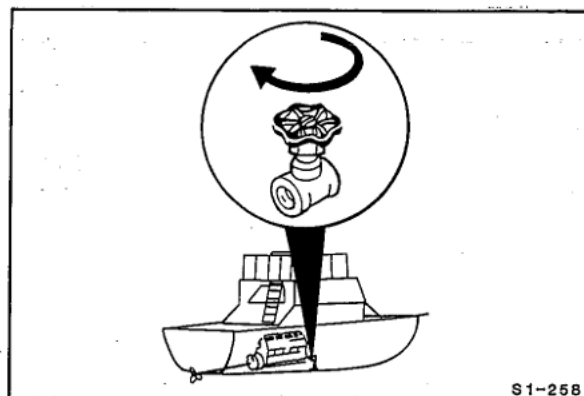
Change the engine fuel filter. Refer to Section 5.

Change the boat fuel water separator element. Refer to Section 5.

Change engine lubricating oil and filter. Refer to Section 4.

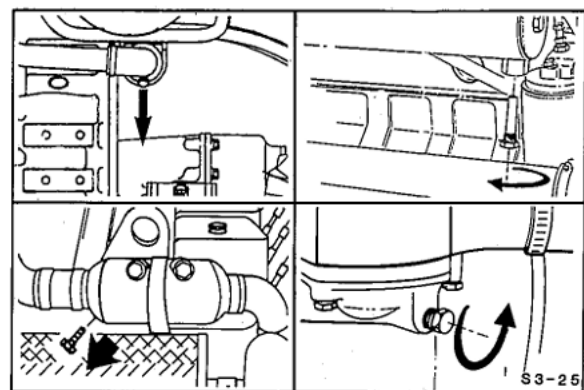


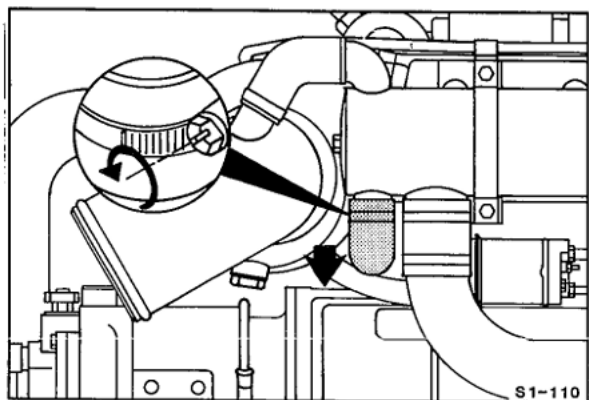
Shut off the raw water valve on the vessel hull.



Drain the raw water system.

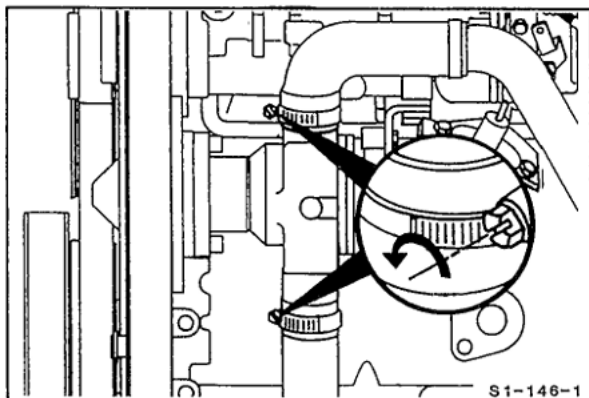
- Remove the drain plug on the marine gear oil cooler.
- Remove the zinc plug from the heat exchanger if applicable, and from the aftercoolers on the B-300 and C-400 horsepower ratings.



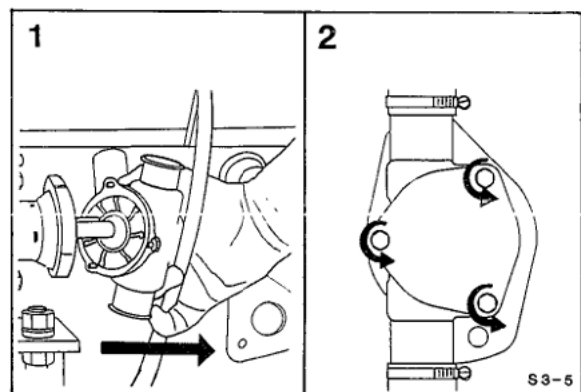


Remove the raw water inlet hose from the heat exchanger if applicable.

NOTE: All raw water **must** be drained from pipes and hoses that are part of the engine raw water system.



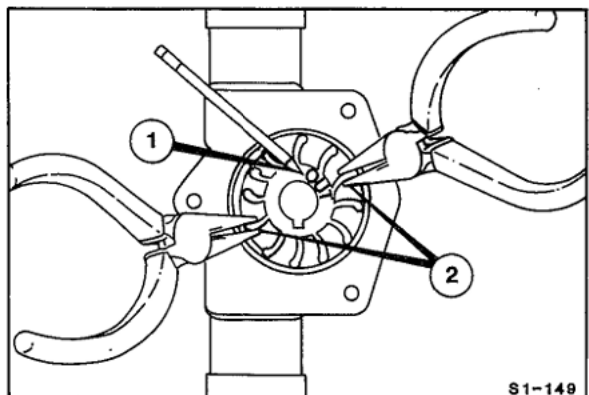
On engine models 4B-64 through 6B-210 horsepower, remove the rubber inlet and outlet hoses from the raw water pump.



Remove the raw water pump impeller. Refer to Section A.



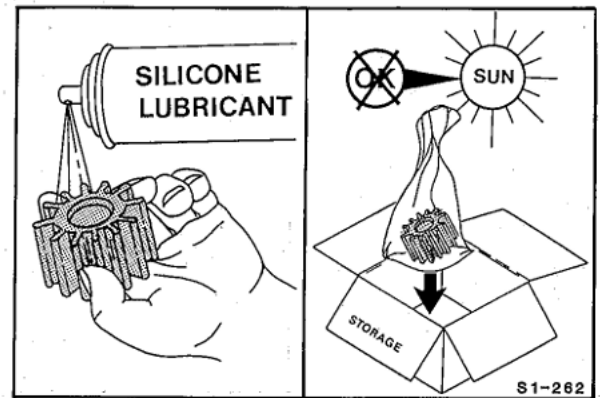
1. Used on B-Series ratings 64 to 250 horsepower.
2. Used on B-300 horsepower and all C-Series engines.



On models B-300 through C-400, remove the impeller from the raw water pump shaft. Mark the impeller to indicate which side is out if you intend to use it again. Use a pair of pliers at the top and another pair at the bottom of the impeller. Grasp the root of the impeller vanes. Pull the impeller from the shaft.

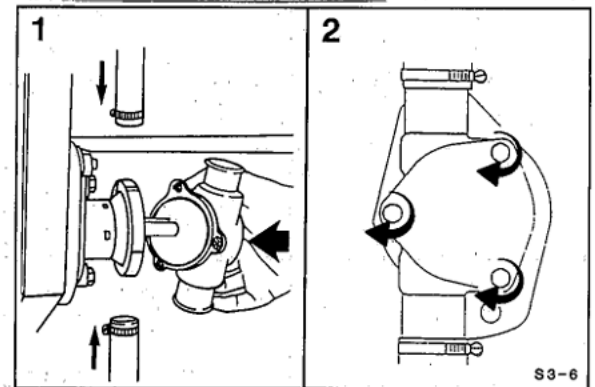
The impeller **must** be lubricated with glycerin or a **non-petroleum** based lubricant such as silicone spray. Do NOT use WD-40 or Vaseline!

Store the impeller for the winter season in a polyethylene bag, preferably in a dark location. Avoid exposure of the impeller to sunlight or any other source of ultra-violet light such as fluorescent lighting.

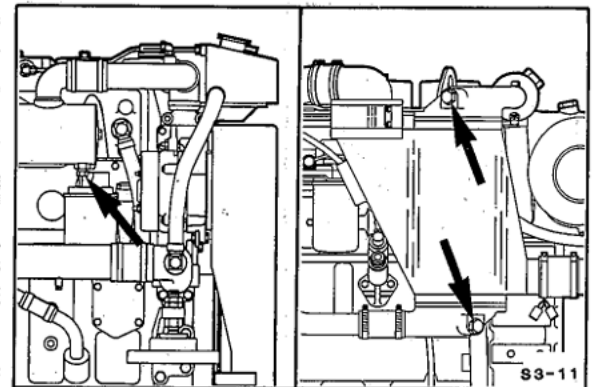


Install the raw water pump housing and the raw water pump inlet and outlet connections or the cover plate, depending on the model that you have.

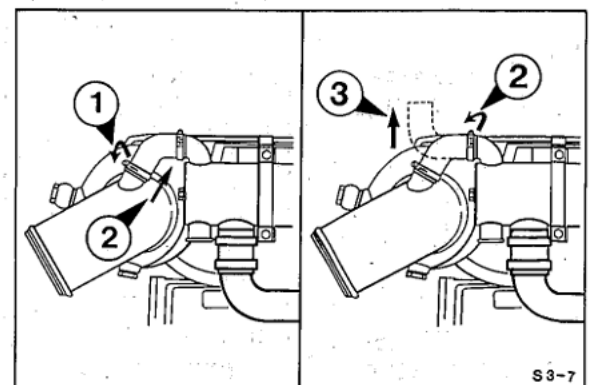
1. Used on B-Series ratings 64 through 250 horsepower.
2. Used on B-300 horsepower and all C-Series engines.

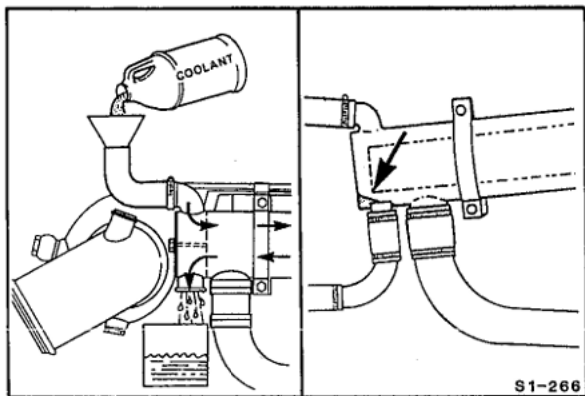


Install the zinc plugs.

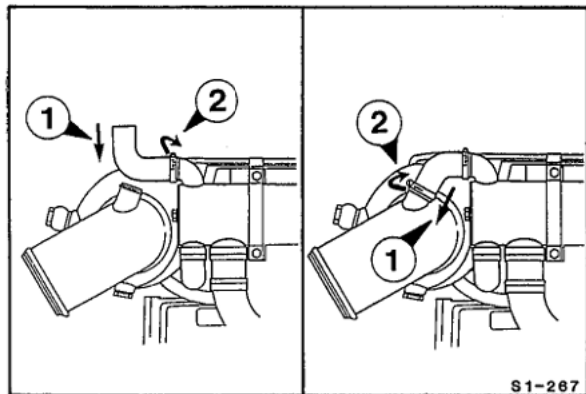


Remove the raw water connection to the exhaust elbow
 (1). Loosen the heat exchanger raw water outlet clamp
 (2). Turn the connection one-half of a turn (3).





Place a container under the heat exchanger raw water inlet. Pour a 50/50 mixture of ethylene-glycol and water through the heat exchanger. This procedure will allow any heat exchanger water pockets to be filled with the antifreeze mixture.

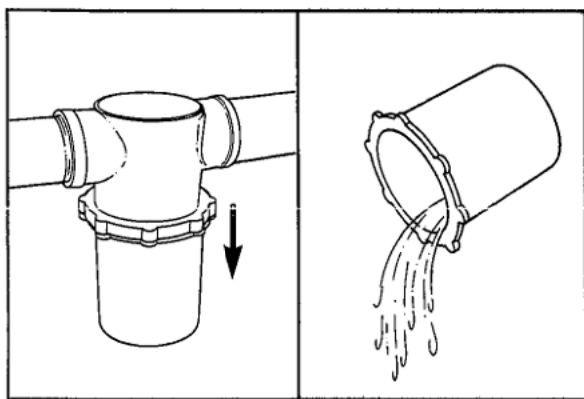


Install the raw water elbow hose to the exhaust elbow (1).

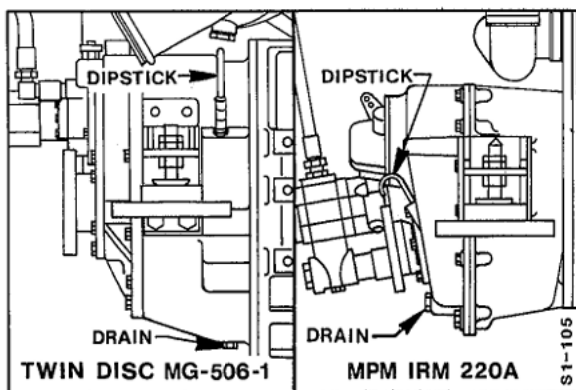
Tighten the hose clamps (2).



Torque Value: 5 N•m [44 in-lb]



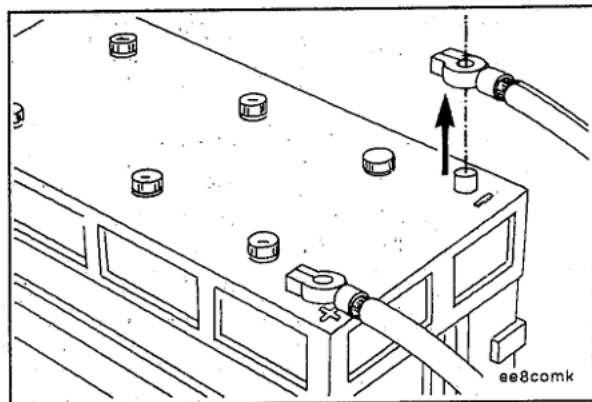
Empty the raw water strainer.



Change the marine gear oil. See Section 6 for additional instructions.

Disconnect and remove the battery. Store the battery in a cool and dry place.

NOTE: The battery should be fully charged, before placing in storage.



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Section 2 - Maintenance Guidelines

Section Contents

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Maintenance Tools.....	2-2
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Every 3 Months or 250 Hours.....	2-4
Every 6 Months or 500 Hours.....	2-4
Every 12 Months or 1000 Hours.....	2-4
Every 24 Months or 2000 Hours.....	2-4

General Information

The following guide **must** be used for routine and periodic maintenance. Perform each function at the indicated time interval. The intervals stated are for normal operating conditions. Service the unit more frequently under severe conditions. Neglecting maintenance can result in failures or permanent damage to 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.

Maintenance Tools

Sockets

1/2 Inch Drive

17 mm

15 mm

19 mm

3/8 Inch Drive

14 mm

13 mm

10 mm

8 mm

7/16 Deep Socket

5/16 Inch

Wrenches

28 mm

18 mm

17 mm

15 mm

14 mm

13 mm

10 mm

8 mm

7/8 Inch

11/16 Inch

9/16 Inch

1/2 Inch

7/16 Inch

3/8 Inch

1/4 Inch

Other Tools

Filter Wrenches (75 to 80, 90 to 95 and 118 to 131 mm)

Ratchets, 1/2 and 3/8 Inch Drive

Socket Extensions, 1/2 and 3/8 Inch, Long and Short

Socket Universal Joint, 3/8 Inch Drive

Adapter 1/2 Inch Female-to-3/8 Inch Male Socket

Torque Wrench, 1/2 Inch Drive, 100 lb-ft Capacity

Breaker Bar, 1/2 Inch Drive

Plastic Hammer

5/16 Allen Hex Key

Spray Can of Silicone Lubricant

Flat Screwdriver

Feeler Gauges, 0.254 and 0.508 mm

[0.010 and 0.020 inch]

Brass Rod, 4.76 mm [3/16 inch] Diameter

DCA4 Test Kit, Fleetguard Part No. CC-2626

Engine Barring Gear Part No. 3377371

Maintenance Schedule

B/C Series Engine Maintenance Schedule ^① ^②				
Section 3	4	5	6	7
Daily or Every 20 Hrs.	Every 3 Months or 250 Hrs	Every 6 Months or 500 Hrs	Every 12 Months or 1000 Hrs	Every 24 Months or 2000 Hrs
Check <ul style="list-style-type: none"> ● Marine Gear Oil Level^① ● Engine Oil level ● Fuel Level ● Coolant Level Drain <ul style="list-style-type: none"> ● Fuel/Water Separator Inspect <ul style="list-style-type: none"> ● Cooling Systems ● For Fuel, Oil or Water Leaks ● Belt and Hoses Clean <ul style="list-style-type: none"> ● Raw Water Strainer Record <ul style="list-style-type: none"> ● Coolant Operating Temperature ● Oil Pressure 	Check <ul style="list-style-type: none"> ● Battery ● Electrical Connections ● Mounting Bolts for Tightness ● Hoses and Clamps for Condition and Tightness Change <ul style="list-style-type: none"> ● Engine Oil ● Engine Oil Filter Inspect <ul style="list-style-type: none"> ● Air System ● Wiring ● Zinc Plug(s) 	Check <ul style="list-style-type: none"> ● Antifreeze Concentration^② ● Coolant Additive Concentration Change <ul style="list-style-type: none"> ● Fuel Filter ● Fuel/Water Separator Element ● Coolant Filter Inspect <ul style="list-style-type: none"> ● Air Cleaner 	Check <ul style="list-style-type: none"> ● Belt Tension ● Belt ● Tensioner Bearing ● Turbocharger ● Coolant Heater Change <ul style="list-style-type: none"> ● Marine Gear Oil^① Inspect <ul style="list-style-type: none"> ● Raw Water Pump Flush <ul style="list-style-type: none"> ● Marine Gear Oil Cooler ● Heat Exchanger Adjust <ul style="list-style-type: none"> ● Engine Valve Lash Clearance 	Inspect <ul style="list-style-type: none"> ● Vibration Damper Clean/Flush <ul style="list-style-type: none"> ● Cooling System Replace <ul style="list-style-type: none"> ● Coolant^②
^① Change the marine gear oil for the first time after 50 hours of operation, then at 1 year intervals. The oil must also be changed if the gear has not been used for over 6 months. Consult the marine gear manufacturer's operators manual for specifications and recommendations.				
^② Must use a heavy duty antifreeze that meets the chemical composition of GM6038M.				

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 Every 20 Hours

• Marine gear oil level - checking	3-2
• Engine oil level - checking	3-2
• Fuel level - checking	3-3
• Coolant level - checking	3-3
• Fuel/water separator - draining	3-4
• Cooling System - inspection	3-4
• Fuel, oil or water leaks - inspection	3-4
• Raw water strainer - cleaning	3-5
• Operating temperature and oil pressure - record	3-5

Every 3 Months or 250 Hours

• Battery - checking	4-2
• Mounting bolts for tightness - checking	4-5
• Hoses and clamps for condition and tightness - checking	4-6
• Engine oil - change	4-2
• Engine oil filter - change	4-2
• Air system - inspection	4-5
• Wiring - inspection	4-5
• Zinc plug - inspection	4-6

Every 6 Months or 500 Hours

• Antifreeze concentration - checking	5-9
• Fuel filter - change	5-2
• Air cleaner - inspection	5-9
• Coolant additive concentration - checking	5-8
• Coolant Filter - change	5-9

Every 12 Months or 1000 Hours

• Belt tension - checking	6-5
• Belt - checking	6-5
• Tensioner bearing - checking	6-5
• Turbocharger - checking	6-7
• Safety alarms - checking	6-9
• Marine gear oil - change	6-15
• Marine gear oil cooler - flushing	6-16
• Heat exchanger - flushing	6-17
• Engine valve lash clearance - adjustment	6-2

Every 24 Months or 2000 Hours

• Cooling system - flushing	7-2
• Coolant - replacement	7-3
• Vibration damper - inspection	7-4

Maintenance Record

Owner's Name _____ Equipment Name/Number _____

[illegible]

Section 3 - Daily or Every 20 Hours Maintenance Procedures

Section Contents

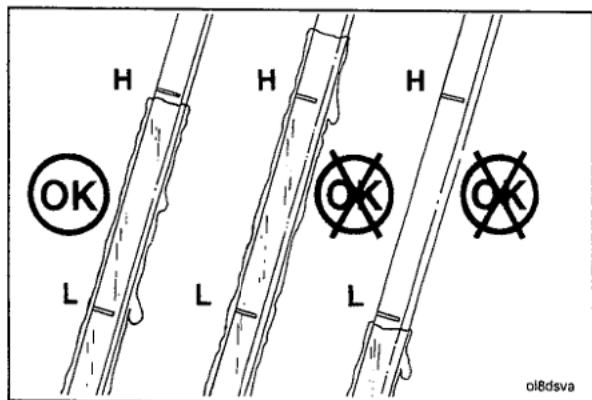
	Page
Coolant Level - Checking.....	3-3
Cooling System - Inspection.....	3-5
Fuel Level - Checking.....	3-4
Fuel, Oil and Water Leaks - Inspection.....	3-4
Fuel/Water Separator - Draining.....	3-4
General Information.....	3-2
Lubricating Oil Level - Checking.....	3-2
Marine Gear Oil Level - Checking.....	3-2
Operating - Record.....	3-6
Raw Water Strainer - Cleaning.....	3-5

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

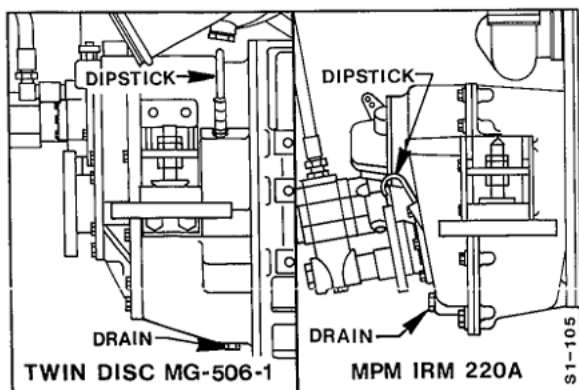


Lubricating Oil Level - Checking

Caution: Never operate the engine with the oil level below the "L" (low) mark or above the "H" (high) mark.

- Low to High

4B Series - 0.9 litre [1 U.S. quart]
6B Series - 1.8 litre [2 U.S. quarts]
6C Series - 3.8 litre [4 U.S. quarts]



Marine Gear Oil Level - Checking

Check the marine gear oil level. Refer to the manufacturers recommendations for gear oil requirements.

Different models of marine gears will have the marine gear oil dipstick in various locations. The locations shown are typical.



Coolant Level - Checking

Warning: Check the coolant level only when the engine is stopped. Wait until the temperature is below 50°C [120°F] before removing the pressure cap. Failure to do so can cause personal injury from heated coolant spray.

Remove the pressure 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.

Fill to level shown; cold engine.

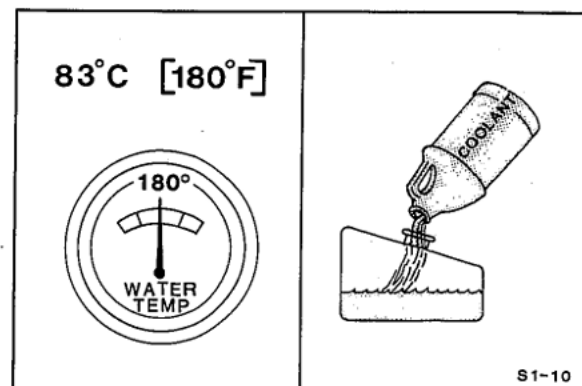
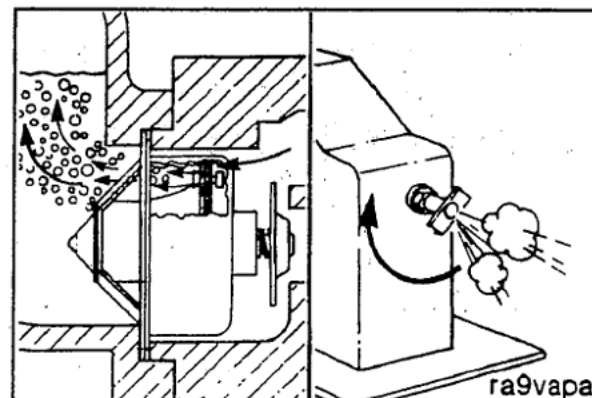
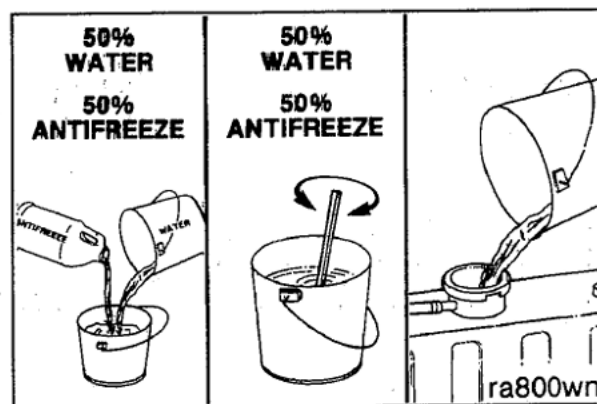
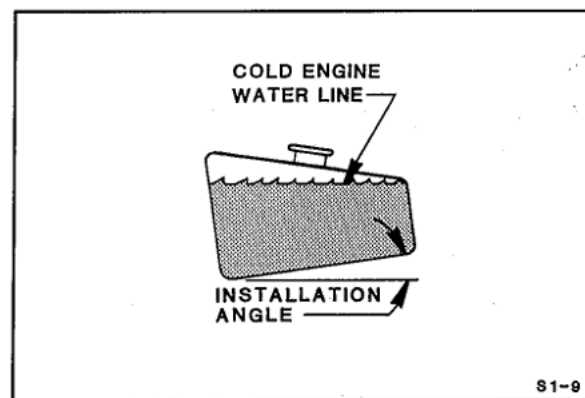
Fill the system with a 50 percent mixture of water and ethylene-glycol base antifreeze.

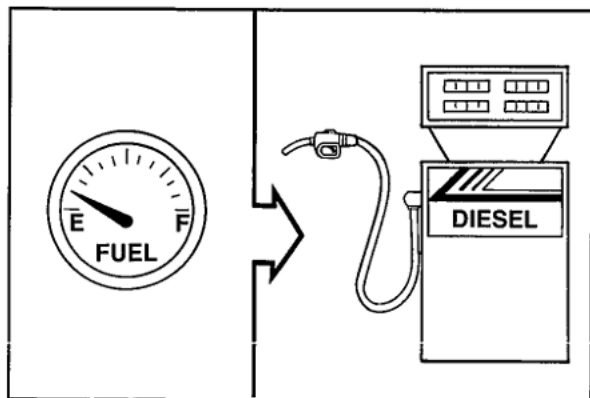
Caution: During filling, air must be vented from the engine coolant passages. The air vents through the thermostat "jiggle pins" and notched vent hole. Be sure to open the petcock on the aftercooler for B Series, 220 to 250 horsepower engines. Wait 2 to 3 minutes to allow air to be vented. Add coolant mixture to fill the coolant system.

After filling the system, operate the engine until the coolant temperature reaches 83°C [180°F].

Allow the engine to cool to 50°C [120°F] or below before removing the pressure cap.

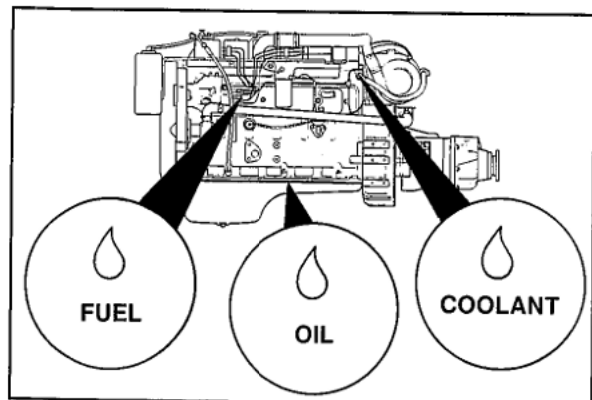
Fill the expansion tank with a mixture of 50 percent antifreeze and water.





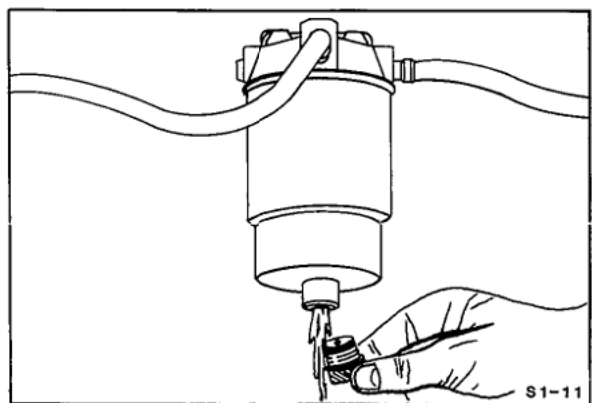
Fuel Level - Checking

Use only good quality ASTM No. 2 D climatized diesel fuel.



Fuel, Oil and Water Leaks - Inspection

Inspect for fuel, coolant or oil leaks.



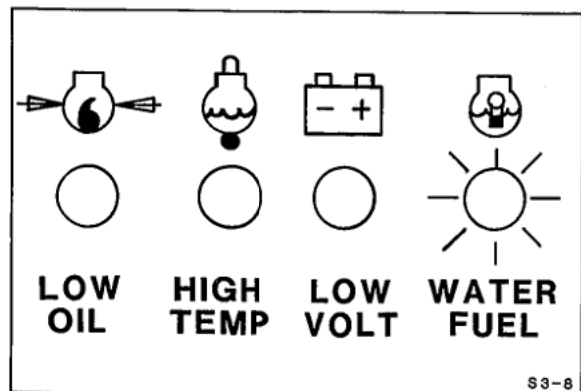
Fuel/Water Separator - Draining



Remove the drain plug and drain the water from the filter/separator bowl. Dispose of properly.

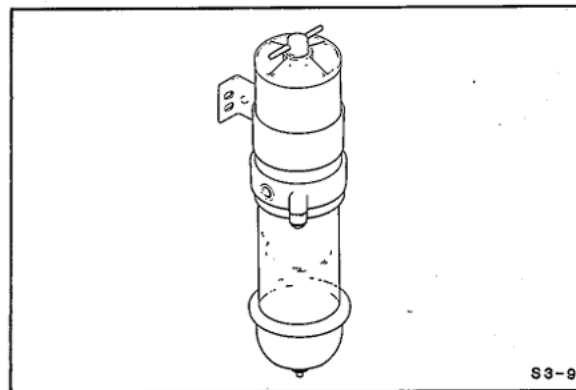


Install the drain plug.



If the engine is equipped with an alarm panel (optional on Premium instrument panels) the water/fuel alarm will light and sound an alarm when the water level in the Racor® fuel water separator exceeds 19 mm [3/4 inch]. Drain immediately.

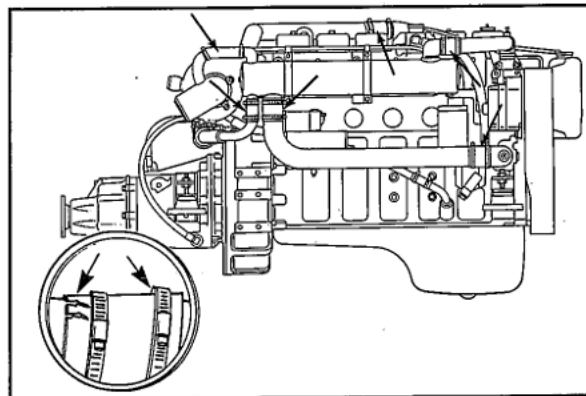
If a fuel/water separator with a transparent bowl is used, the water level is visible in the bowl.



Cooling System - Inspection

Inspect for damaged hoses and loose or damaged hose clamps. Replace as required.

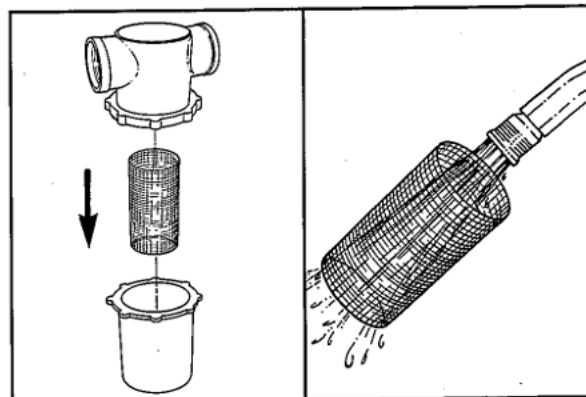
Torque Value: 5 N•m [44 in-lb]



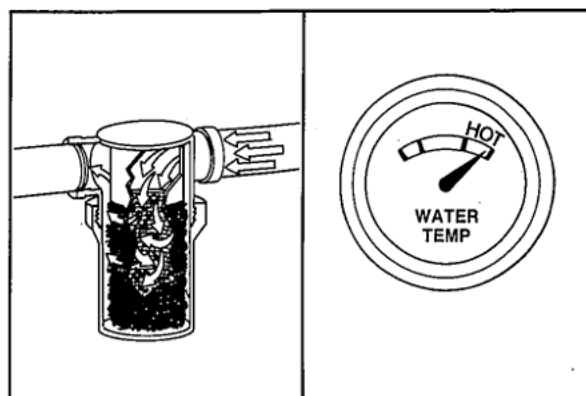
Raw Water Strainer - Cleaning

Typical raw water strainer.

Depending on the operating environment, clean the raw water strainer daily or as required. Some units can be operated up to, but **no** longer than 6 months, before cleaning. The raw water inlet valve **must** be closed before servicing the strainer and opened after cleaning is completed.



Caution: A restricted or clogged strainer will result in hotter than normal, or over heated, engine coolant and marine gear oil temperatures.



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Operating - Record

A record of the operating engine oil pressure and coolant temperature is recommended.

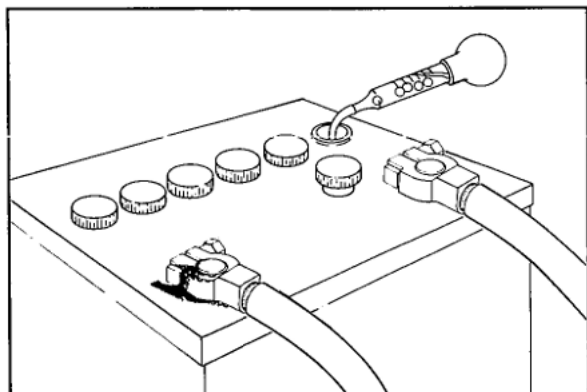
Section 4 - Maintenance Procedures at 3 Months or 250 Hours

Section Contents

	Page
Air Intake System - Checking.....	4-6
Battery - Checking.....	4-2
Specific Gravity Check - Conventional Lead-Acid Batteries.....	4-2
Terminal Connections - Checking.....	4-2
Coolant System - Checking.....	4-7
Engine Mounts - Checking.....	4-7
General Information.....	4-2
Lubricating Oil and Filter Change Interval.....	4-3
Wiring - Inspection.....	4-6
Zinc Plug - Inspection and Replacement.....	4-7

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.



Battery - Checking

Specific Gravity Check - Conventional Lead-Acid Batteries



Warning: Acid can be dangerous to personnel and corrosive to equipment.



If conventional-lead acid batteries are used, remove the cell caps and check the electrolyte (water and sulfuric acid solution) level.



Fill each battery cell with distilled water. Refer to the battery manufacturer's instructions for the correct level of the electrolyte.

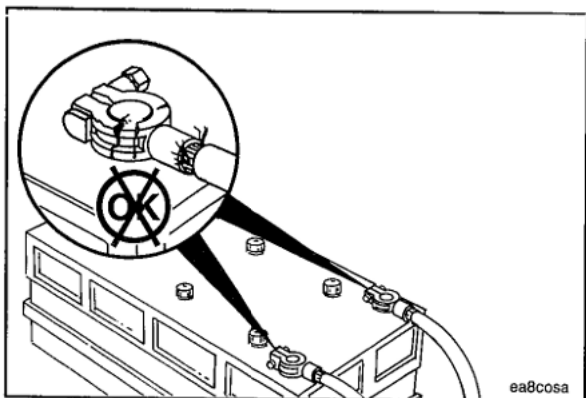
NOTE: Maintenance-free batteries are sealed. Water can **not** be added to the cells.



If the specific gravity of any cell of a conventional lead-acid battery is below 1.200, charge the battery. Refer to the accompanying chart to determine lead-acid battery state-of-charge based on specific gravity.

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

ea800ka



ea800sa

Terminal Connections - Checking



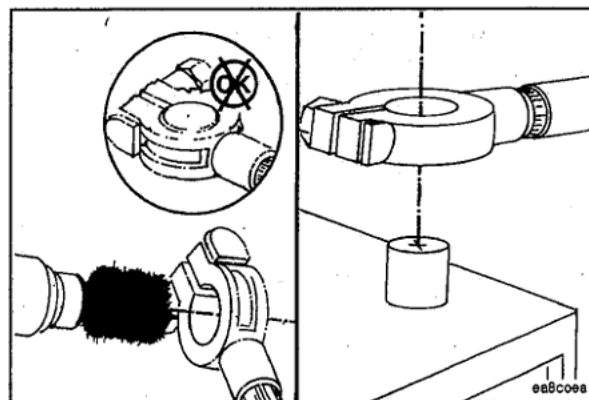
Visually inspect the terminals for loose, broken, or corroded connections.

Repair or replace broken cables or terminals.

If the connections are corroded remove the cables and use a battery brush to clean the cable and battery terminals.

Install and tighten the cables.

Use grease to coat the terminals to prevent corrosion.



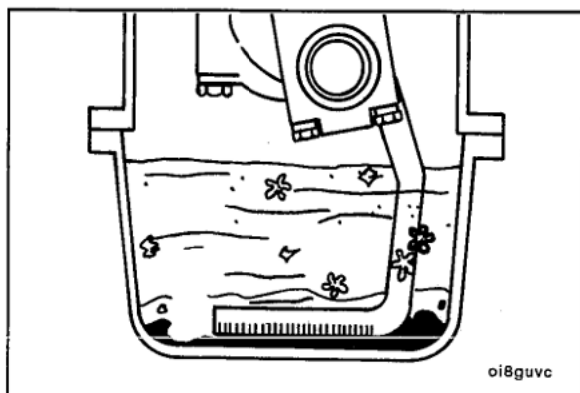
Lubricating Oil and Filter Change Interval

Warning: Avoid prolonged and repeated skin contact with used engine oils. Such prolonged and repeated contact can cause serious skin disorders or other serious bodily injury.



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

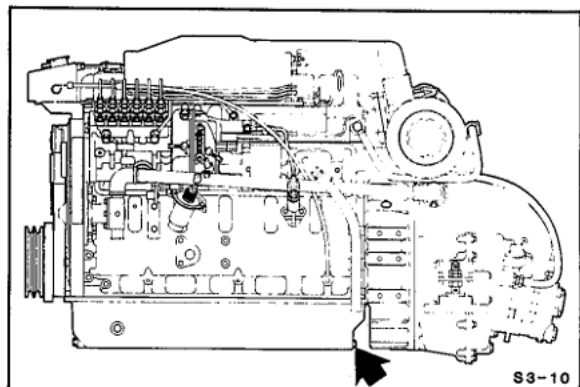
PROTECT THE ENVIRONMENT: Handling and disposal of used engine oil can be subject to federal, state and local law and regulation. Use authorized waste disposal facilities, including civic amenity sites and garages providing authorized facilities for receipt of used oil. If in doubt, contact your state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



Caution: If the engine is being operated, under no circumstances can the oil drain interval extend beyond 250 hours, or 3 months. Extended oil change intervals increase the contaminants in the oil and decrease the life of the engine components.

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.



11/16 inch or 18 mm

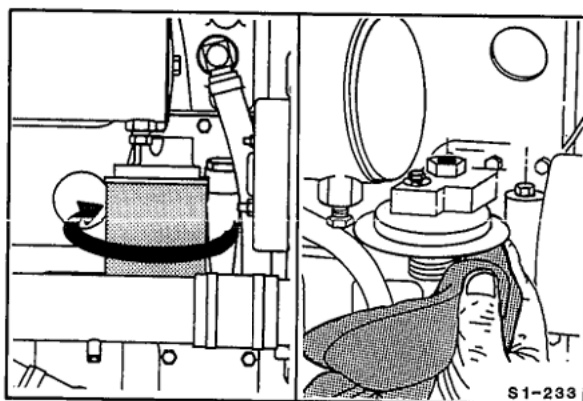


Warning: Hot oil can cause personal injury.



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

NOTE: Use a container that can hold at least 22 liters [23 U.S. quarts] of oil.



118 to 131 mm Filter Wrench



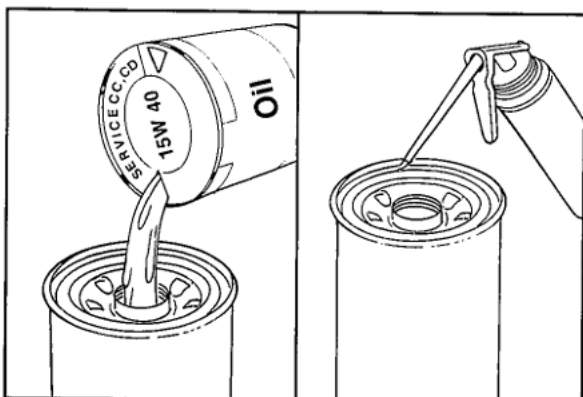
Clean around the filter head.



Remove the filter.



Clean the gasket surface.

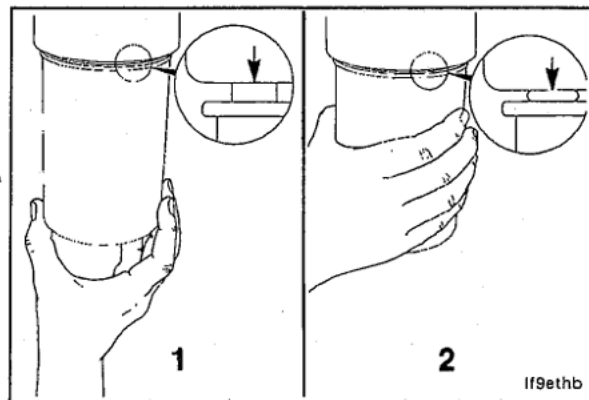


Caution: Fill the oil filters with clean lubricating oil. The lack of lubrication during the delay until the filters are pumped full of oil is harmful to the engine.

Use clean 15W-40 oil to lubricate the oil seal.

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

Install the filter as specified by the filter manufacturer.

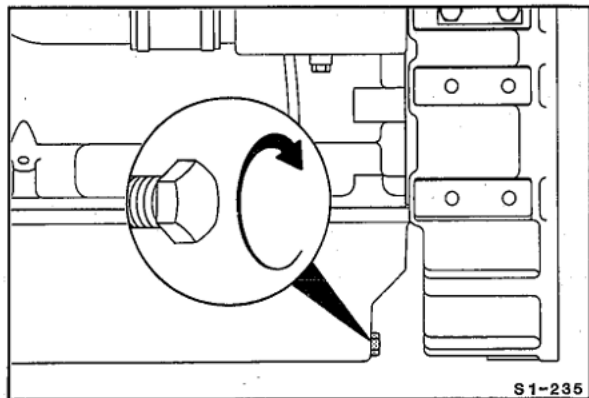


11/16 inch or 18 mm

If removed, clean and check the oil drain plug threads and sealing surface.

Install and tighten the plug.

Torque Value: 80 N•m [60 ft-lb]



Use high-quality CE/SG multi-graded lubricating oil.

Choose the correct oil for your operating climate as outlined in Specifications and Torque Values, Section V.

NOTE: CD/SF oil can be used in areas where CE/SG is not yet available.

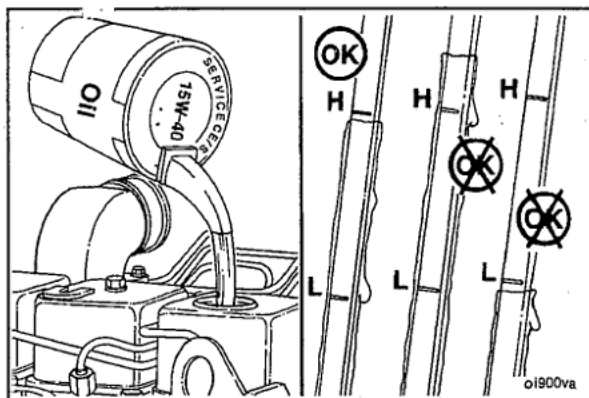
If CD/SF oil is used, change the oil at one-half of the recommended interval.

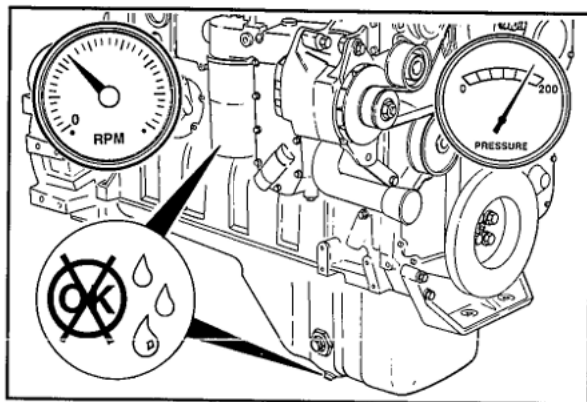


Fill the engine with clean 15W-40 oil to the proper level.

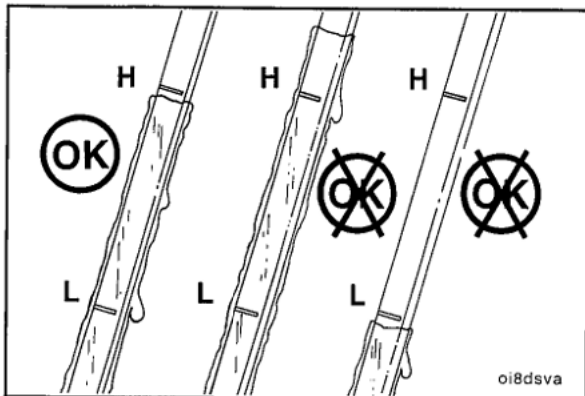
Oil Pan Capacities

4B Series:	9.5 litre	[10 U.S. quarts]
6B Series	14 litres	[15 U.S. quarts]
6C Series	19 litres	[20 U.S. quarts]





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

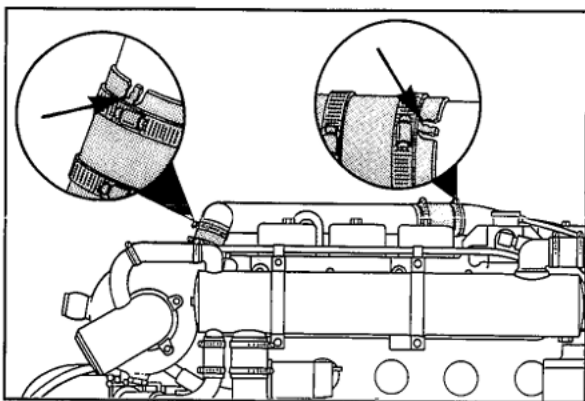


Shut off the engine.

Allow 5 minutes for the oil to drain to the pan.

Use the dipstick to check the oil level.

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



Air Intake System - Checking

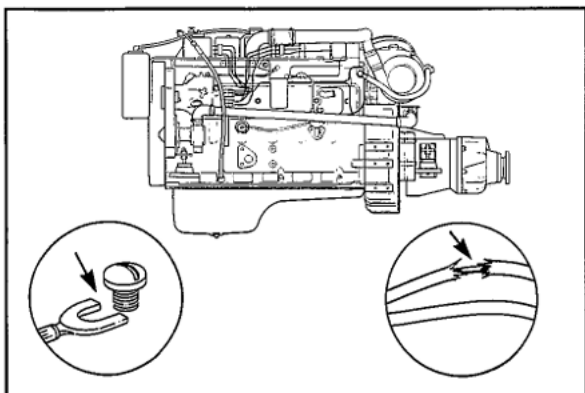
Caution: Never operate the engine without an air cleaner.



Inspect the intake piping for damage, cracked hoses and loose clamps. Correct any faults.



Torque Value: 5 N•m [44 in-lb]



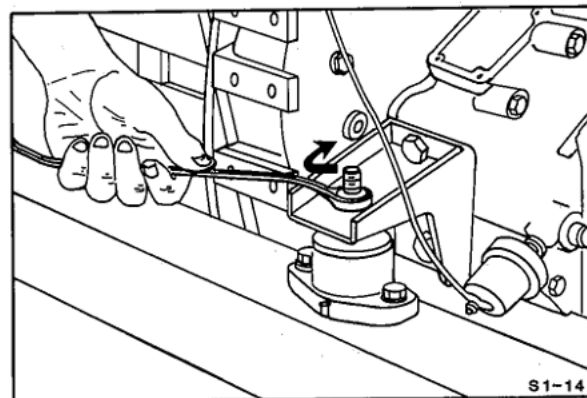
Wiring - Inspection

An overall inspection of all wiring is recommended. Look for discolored connections which indicate heating due to a poor electrical connection.

Also look for loose connections, insulation damage, battery connection corrosion, and condition.

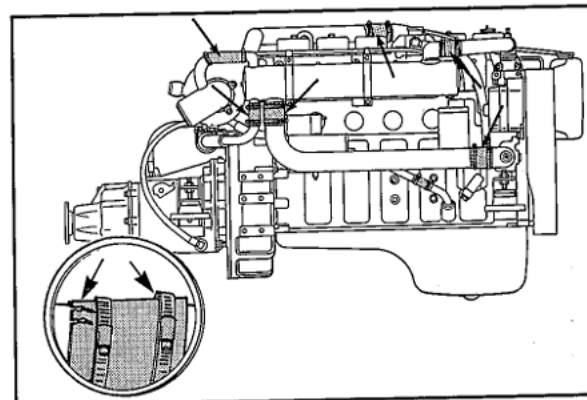
Engine Mounts - Checking

Check the mounting bolts for tightness.



Coolant System - Checking

Check the water hoses for leaks, cracks and loose clamps.

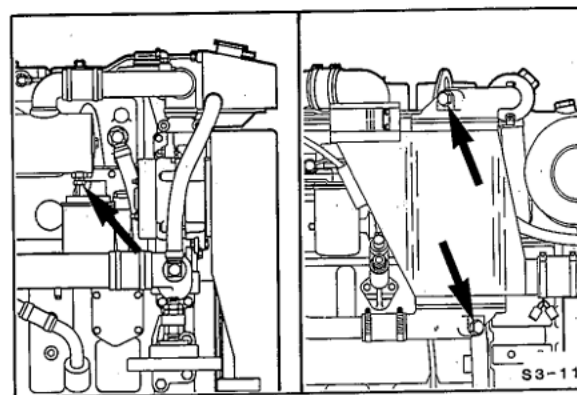


Zinc Plug - Inspection and Replacement

The zinc plug locations.

NOTE: A zinc plug is located in the front of the heat exchanger on the bottom.

The 6B-300 horsepower and the 6C-400 horsepower engines both have two additional zinc plugs located at the top and at the bottom of the cast aftercooler.

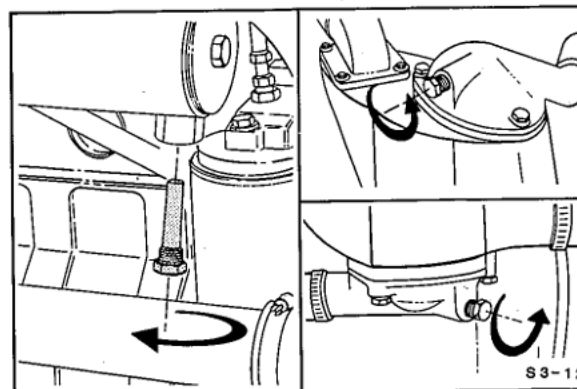


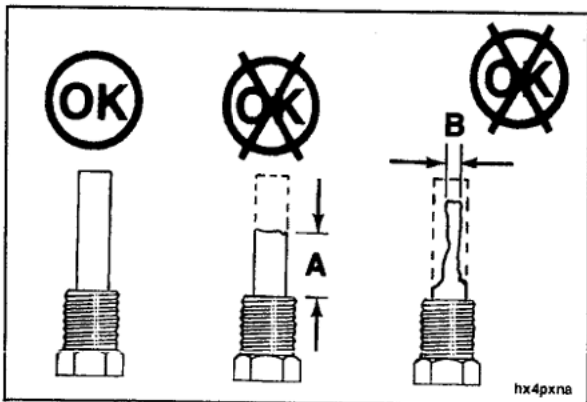
22 mm

Shut off the raw water inlet valve on the vessel hull.

Remove the zinc plug(s).

NOTE: In some cases, it may be necessary to hold the welded fitting on the heat exchanger with an additional wrench to prevent damage to the exchanger.





Inspect the plug. If it has eroded over 50 percent, replace it.

Erosion Limits

New

A = Approximately 19 mm [0.75 in.] 51 mm [2 in.]

B = Approximately 6.4 mm [0.25 in.] 16 mm [0.625 in.]

Install the zinc plug(s). Open the raw water inlet valve on the vessel hull.

NOTE: Do **not** use teflon tape or pipe sealant on the threads since this would insulate the zinc anode.

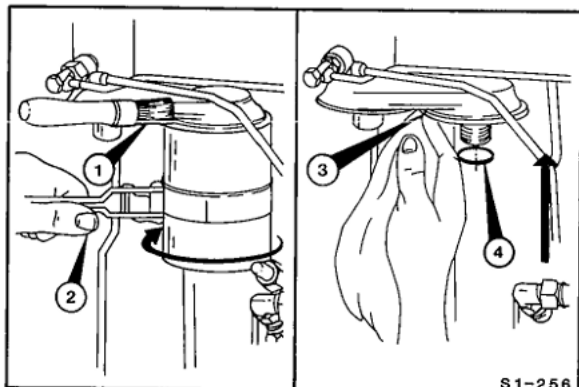
Section 5 - Maintenance Procedures at 6 Months or 500 Hours

Section Contents

	Page
Air Cleaner - Inspection	5-10
Antifreeze Concentration - Checking	5-8
Coolant Additive Concentration - Checking (C Series Only)	5-8
Coolant Filter	5-9
Coolant Filter - Replacement (C Series Only)	5-9
Fuel Filter - Changing	5-2
Fuel System - Venting	5-5
Fuel/Water Separator Element - Changing	5-3
General Information	5-2
Injection Pump - Venting	5-6
Light Duty Air Cleaner - Replacement	5-10
Low Pressure Lines and Fuel Filter - Venting	5-5
Medium/Heavy Duty Element - Replacement	5-11

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.



S1-256

Fuel Filter - Changing



75 to 80 mm Filter Wrench

Clean the area around the filter head (1).



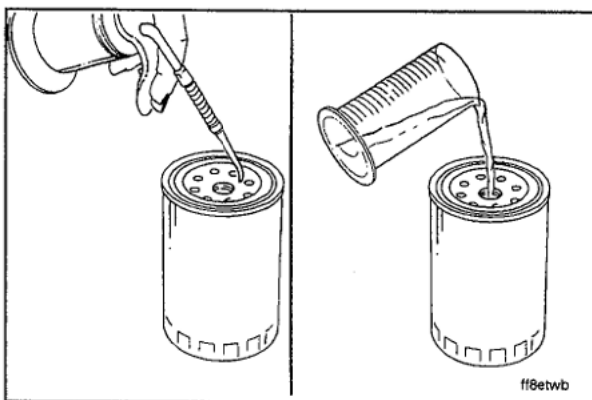
Remove the filter (2).



Clean the gasket surface of the filter head (3).



Replace the o-ring (4).

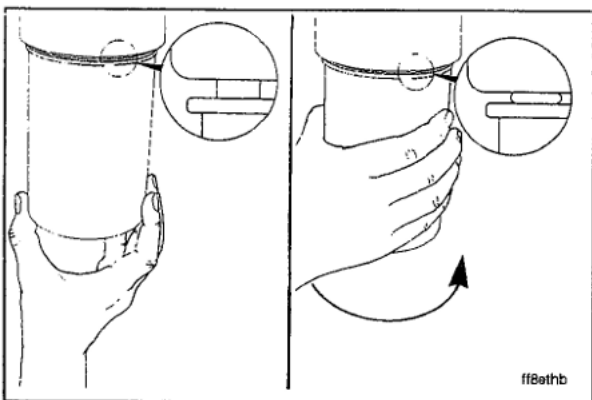


ff8etwb



Use clean 15W-40 oil to lubricate the o-ring seal.

Fill the new filter with clean fuel.



ff8etwb



Caution: Mechanical over-tightening can distort the thread or damage the filter element seal.



Install the filter as specified by the manufacturer or by screwing the filter can on tightly by hand. Do **not** use a wrench.

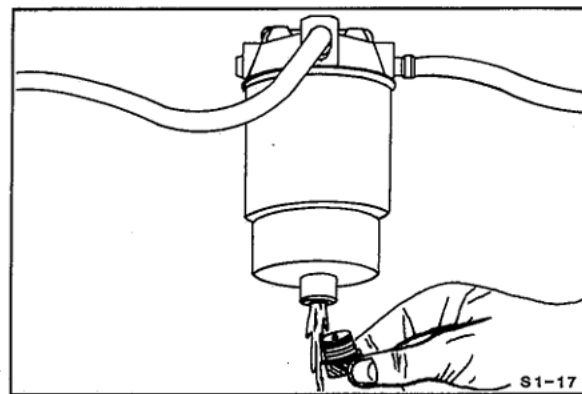


Fuel/Water Separator Element - Changing

NOTE: If there is a valve in the supply line to this filter, close it to prevent fuel from draining from the tank.

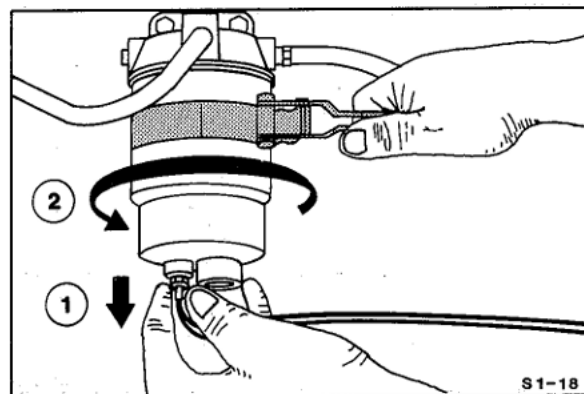
Remove the drain plug and drain the filter/separator bowl.

Install the drain plug.

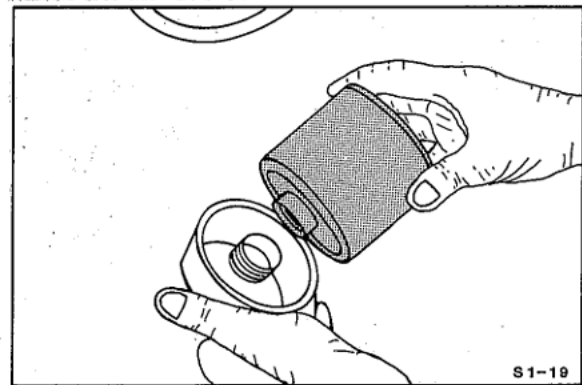


90 to 95 mm Filter Wrench

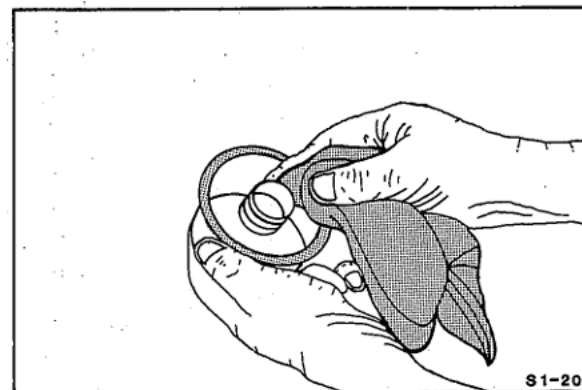
Disconnect the water level sending unit wiring and remove the element with the bowl connected.

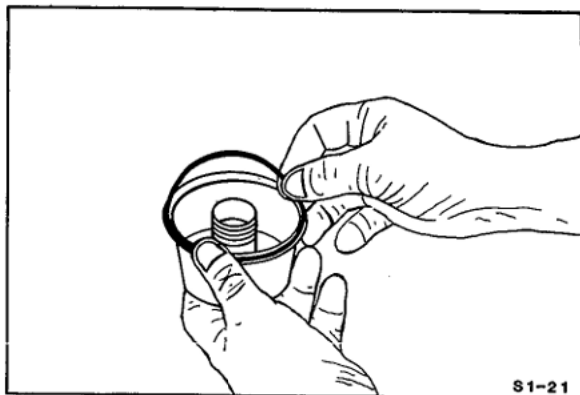


Remove the bowl and discard the filter.

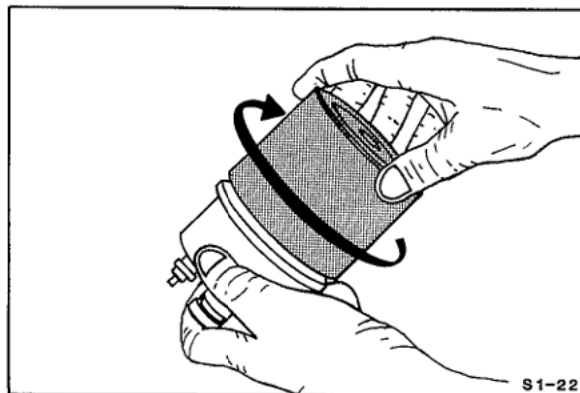


Clean the bowl and o-ring groove.

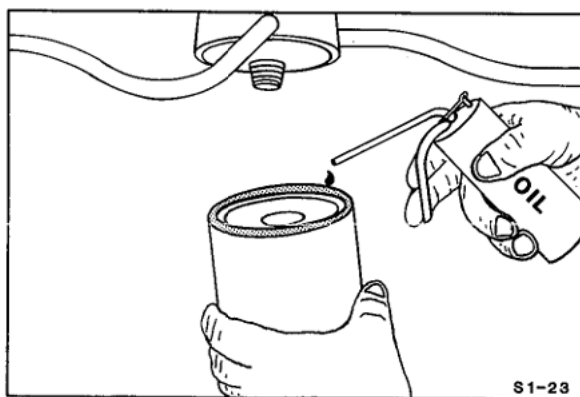




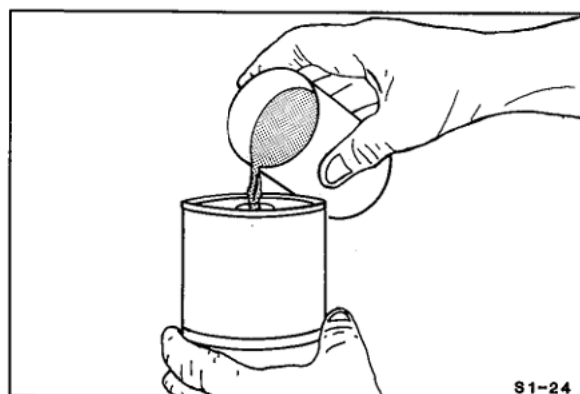
Use clean diesel fuel to lubricate the new o-ring and install it into the bowl gland.



Spin the bowl onto the new element. Do **not** overtighten.

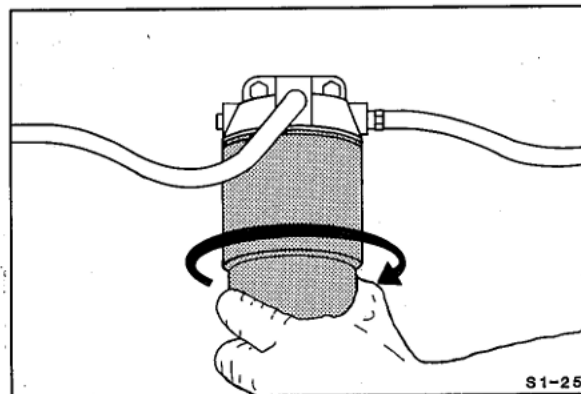


Use clean 15W-40 oil or fuel to lubricate the element gasket.



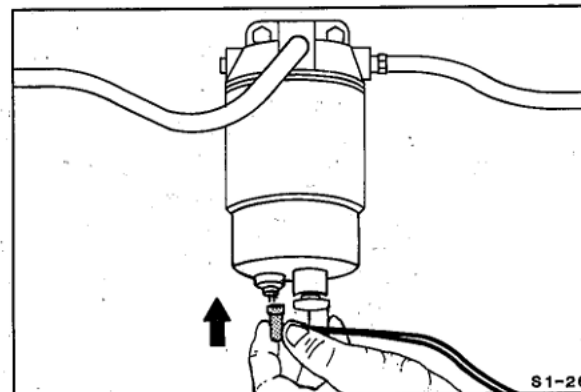
Fill the bowl element assembly with clean diesel fuel.

Spin the bowl/element assembly onto the head.



Connect the water level sending unit wiring.

NOTE: If a valve in the fuel/water separator supply line was closed before changing the filter element, open the valve.

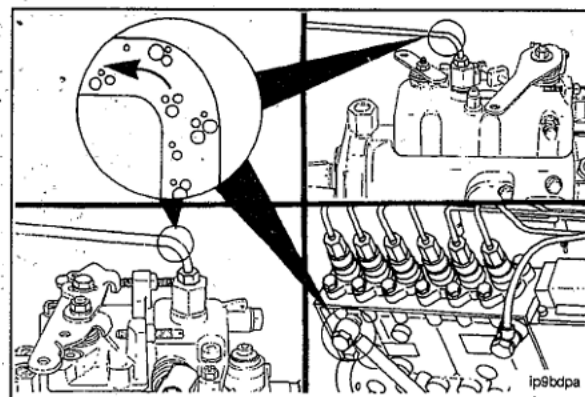


Fuel System - Venting

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 will be vented automatically if the fuel filter is changed in accordance with the instructions.

Manual venting will be required if:

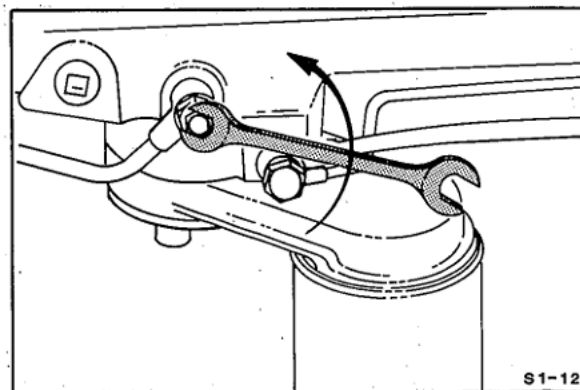
- The fuel filter is **not** filled prior to installation.
- Injection pump is replaced.
- High pressure fuel line connections are loosened or lines replaced.
- Initial engine start up or start up after an extended period of no engine operation.
- Fuel tank has run empty.



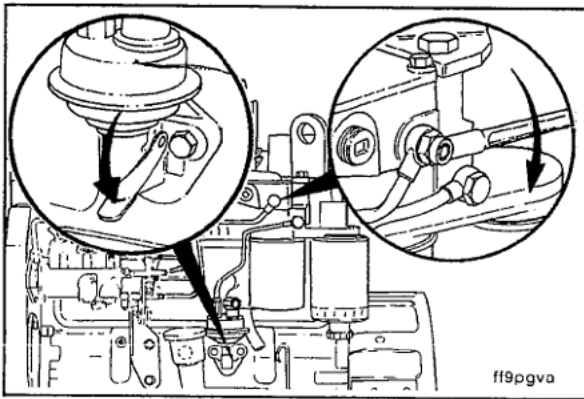
Low Pressure Lines and Fuel Filter - Venting

10 mm

Loosen the fuel vent screw on the filter head.



S1-12



B Series 64 Through 210 HP

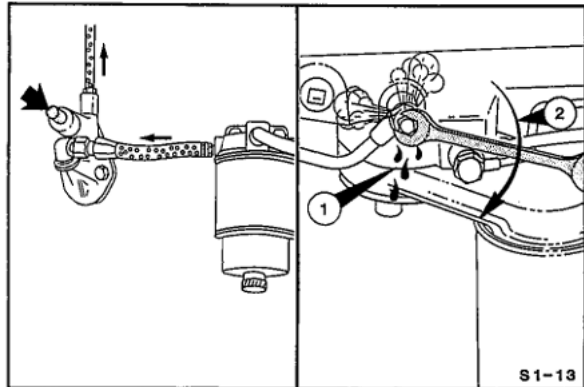


Operate the plunger on the lift pump until the fuel flowing from the fitting is free of air. Move the lever to the locked upward position.



Tighten the vent screw.

Torque Value: 8 N•m [71 in-lb]



B Series 220 HP Through C Series 400 HP



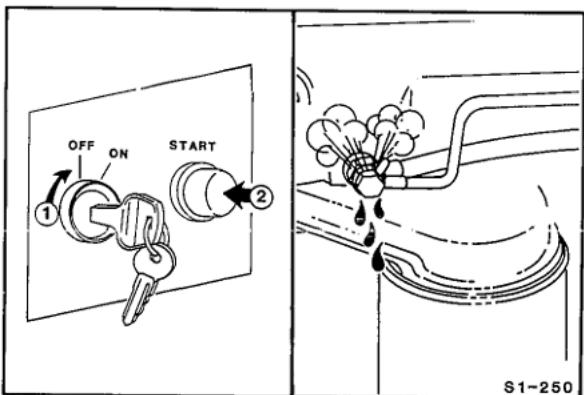
10 mm

Operate the priming pump plunger to purge the air from the filter head.



Tighten the fuel vent screw.

Torque Value: 8 N•m [71 in-lb]

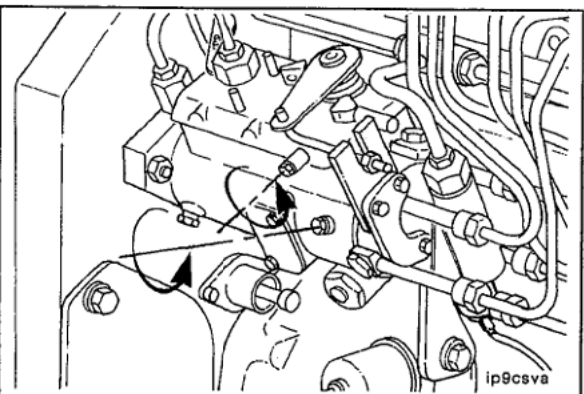


Warning: It is necessary to put the engine in the "RUN" position. Because the engine can start, be sure to follow all the safety precautions. Use the normal engine starting procedures.



Caution: When using the starting motor to vent the system, do not engage it for more than 30 seconds at a time; wait 2 minutes between engagements.

Air can also be vented through the fuel drain manifold line by operating the starting motor.



Injection Pump - Venting



8 mm

Vent the Lucas CAV pump at the locations shown in the illustration.

B Series 64 through 210 HP

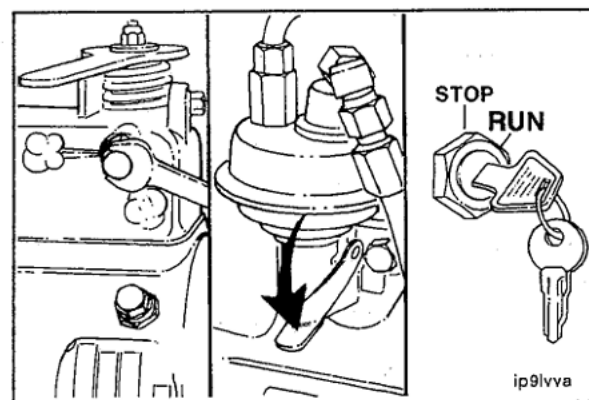
8 mm

Air/fuel can be pumped from this location with the hand lever on the lift pump if the fuel solenoid valve is energized.

Move the lever to the locked upward position.

Tighten the vent screw.

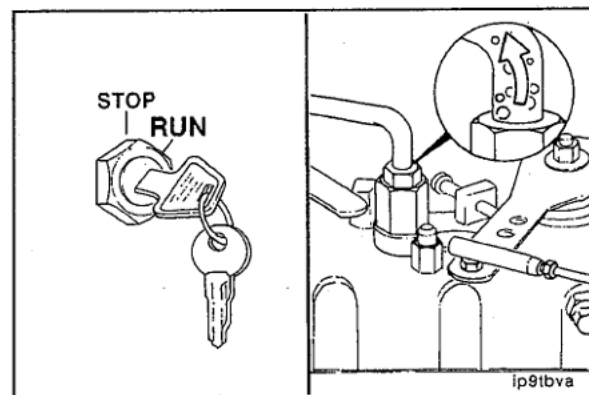
Torque Value: 8 N•m [71 in-lb]



Air can be vented from the pump through the fuel drain manifold line by operating the starting motor.

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.

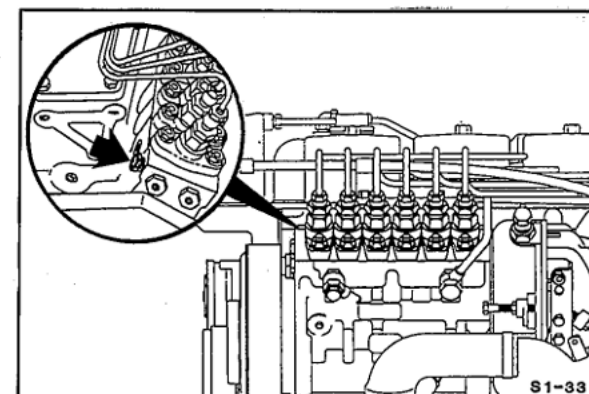
Caution: When using the starting motor to vent the system, do not engage it for more than 30 seconds at a time: Wait 2 minutes between engagements.



B Series 220 HP through C Series 400 HP

10 mm

Vent the Nippondenso and Bosch pumps at the vent screw which is located on the engine side of the pumps at the front.



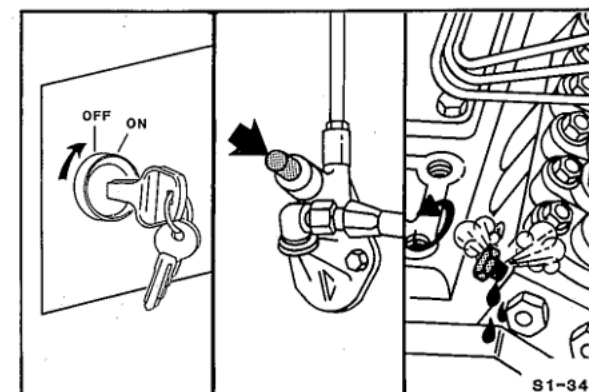
B Series 220 HP Through C Series 400 HP

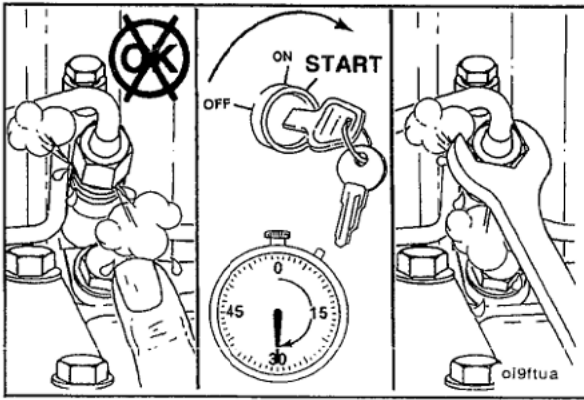
Turn the key switch to the "ON" position to energize the fuel solenoid.

Push the lift pump plunger repeatedly until no more air comes from the fuel pump vent screw.

Tighten the fuel pump vent screw.

Torque Value: 8 N•m [71 in-lb]



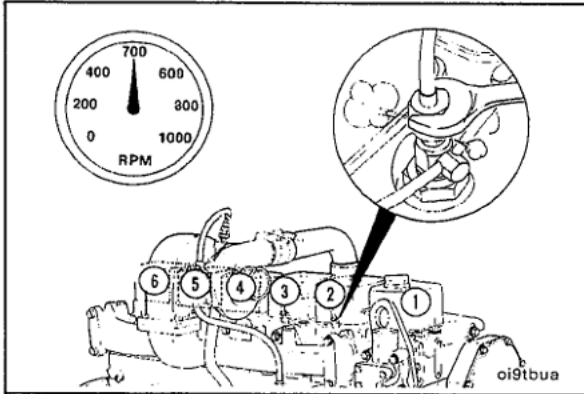


17 mm

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 the fittings at the injectors and cranking the engine to allow entrapped air to escape from the lines. Tighten the fittings.

Torque Value: 30 N•m [22 ft-lb]

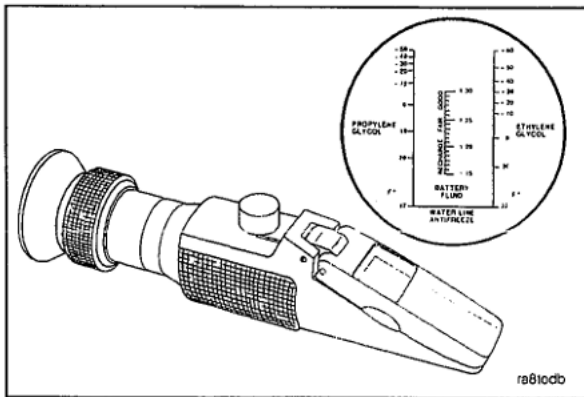


17 mm

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

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

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



Antifreeze Concentration - Checking

Check the antifreeze concentration. Use a mixture of 50 percent water and 50 percent ethylene-glycol base antifreeze to protect the engine by -37°C [-34°F] year around.

Antifreeze is essential in any climate.

It broadens the operating temperature range by lowering the coolant freezing point and by raising its boiling point.

The corrosion inhibitors also protect the cooling system components from corrosion and provides longer component life.



Coolant Additive Concentration - Checking (C Series Only)

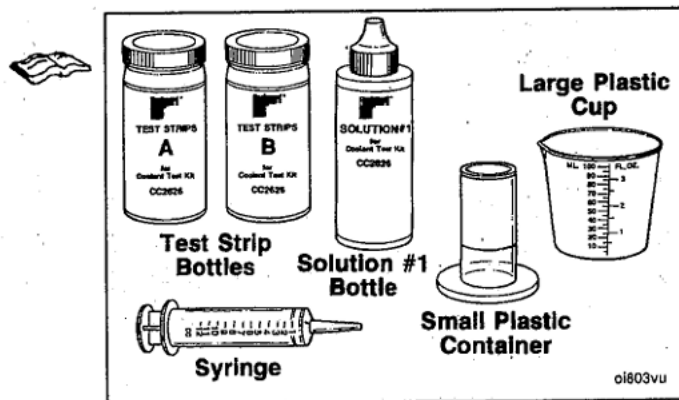


Caution: Inadequate concentration of the coolant additive can result in major corrosive damage to cooling system components. Over concentration can cause formation of "gel" that can cause restriction, plugging of passages, and overheating.

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

The cooling system **must** contain the proper coolant additive units to provide the best chemical protection. Refer to the Specifications and Torque Values, Section V.

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

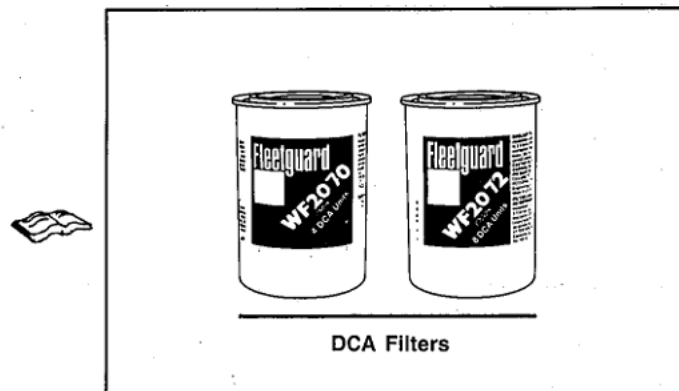


Coolant Filter

(C Series Only)

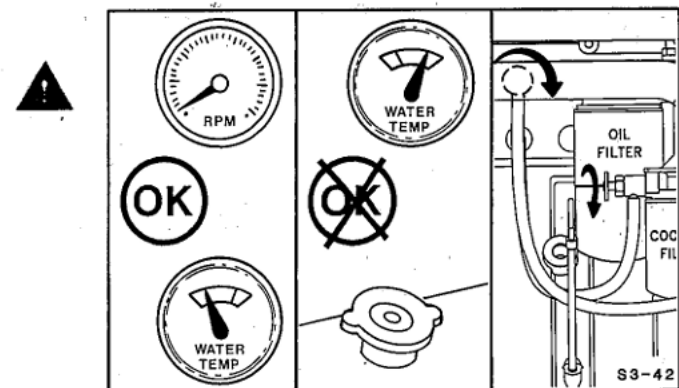
The correct coolant filter to be used is determined by the total cooling system capacity and other operational factors.

Refer to the DCA4 Maintenance Guide in Specifications and Torque Values, Section V for correct selection of the filter.

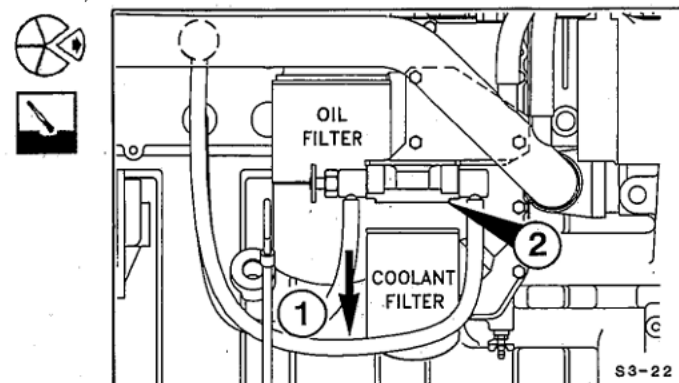


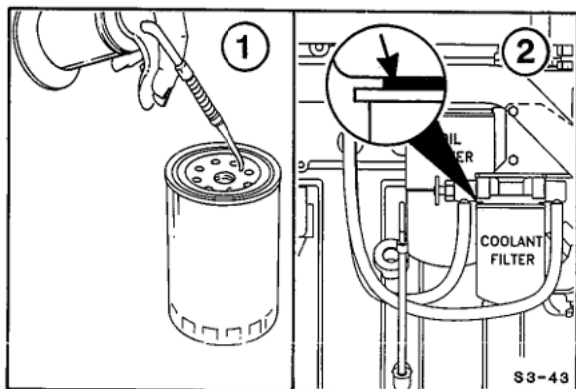
Coolant Filter - Replacement (C Series Only)

Warning: Do not remove the pressure cap from a hot engine. Hot steam will cause serious personal injury. Wait until the coolant temperature is below 50° C [120° F] before removing the cap. Remove the cap and close the shutoff valves before removing the coolant filter. Failure to do so can result in personal injury from heated coolant spray.



Remove and discard the coolant filter (1). Clean the gasket surface (2).





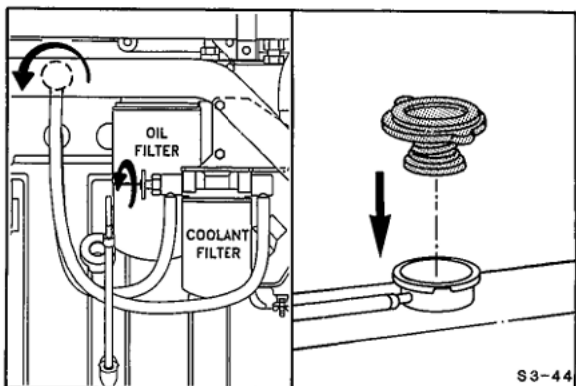
Apply a light film of lubricating oil to the gasket sealing surface before installing the coolant filter (1).



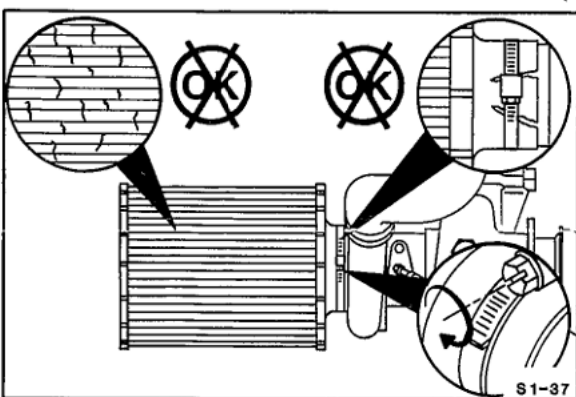
Caution: Mechanical over-tightening can distort the threads or damage the filter head.



Install the filter as specified by the filter manufacturer (2).



Open the shutoff valves and install the coolant system pressure cap.



Air Cleaner - Inspection

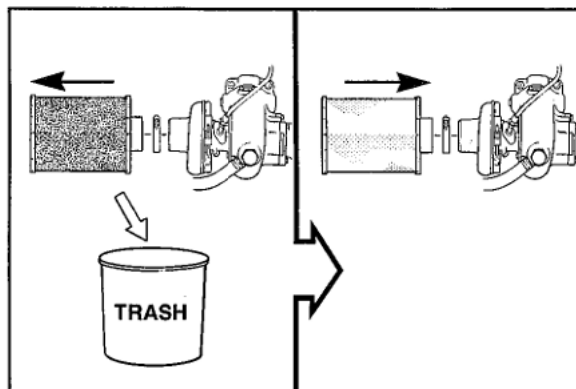
Inspect the air cleaner for damage, oil or water contamination, cracks, perforations, or loose clamps.



Torque Values:

Worm type 5 N•m [44 in-lb]

T-bolt type 8 N•m [71 in-lb]



Light Duty Air Cleaner - Replacement

5/16 Inch Socket or Screwdriver

The light duty air cleaner is replaced as a unit.

Tighten the clamp.



Torque Values:

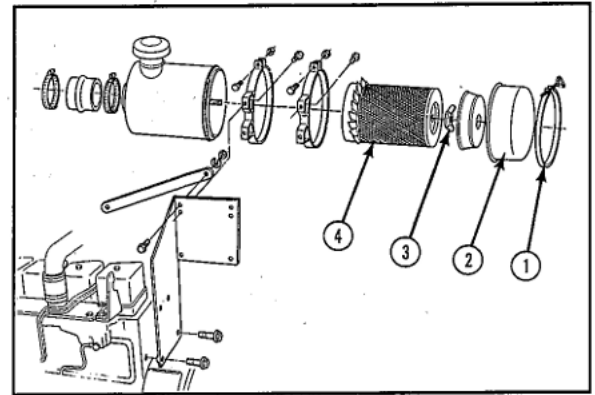
Worm type 5 N•m [44 in-lb]

T-bolt type 8 N•m [71 in-lb]

Medium/Heavy Duty Element - Replacement

- Remove the band clamp (1)
- Remove the dust cover (2)
- Remove the wing nut (3)
- Remove the air filter element (4)
- Clean the air cleaner components and install a new element in the reverse order of removal.

Do **not** use oil in the cannister case.



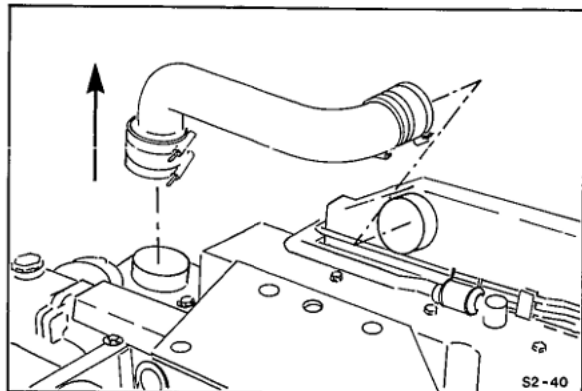
Section 6 - Maintenance Procedures at 12 Months or 1000 Hours

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	Page
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Drive Belt and Tension Bearing - Checking	6-8
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Rotor Assembly Clearance - Measure	6-11
Valve - Adjustment	6-2
Four Cylinder Adjustment	6-3
Six Cylinder Adjustment	6-4
Valve - Adjustment (Alternate Method)	6-5

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.



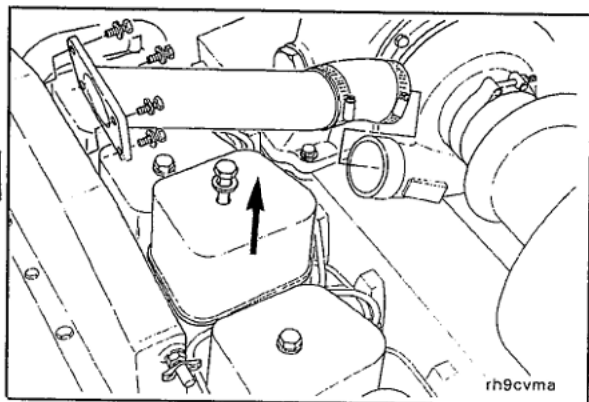
Valve - Adjustment



Screwdriver

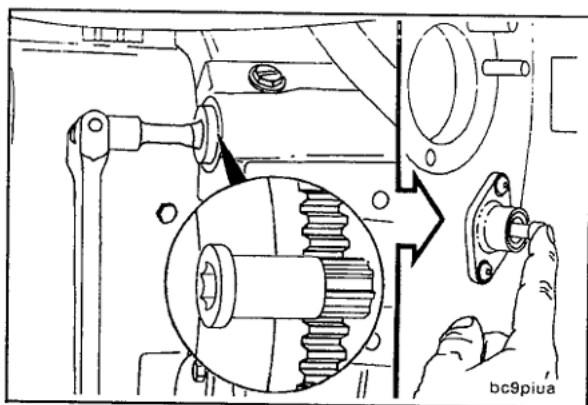


Remove the air crossover tube if the tube interferes with removal of the valve cover(s).



15 mm

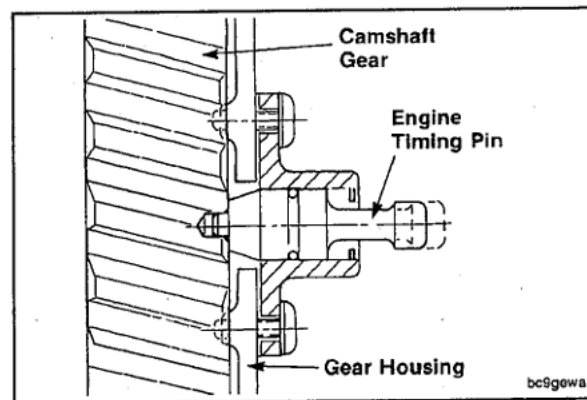
Remove the valve cover(s).



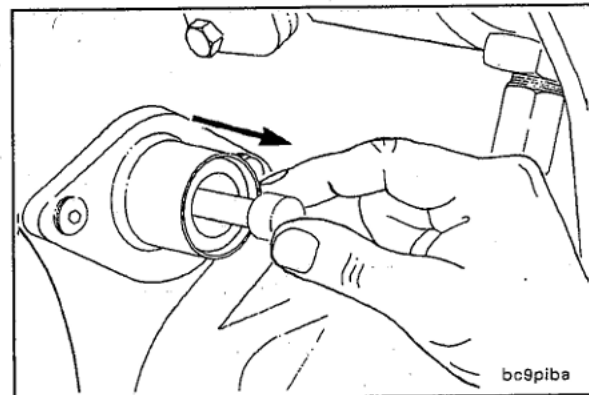
1/2 Inch Drive, Part No. 3377371 Engine Barring Gear

Locate Top Dead Center (TDC) for cylinder No. 1 by barring crankshaft slowly while pressing on the engine timing pin.

When the pin engages the hole in the camshaft gear, cylinder No. 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 inch] - B Series

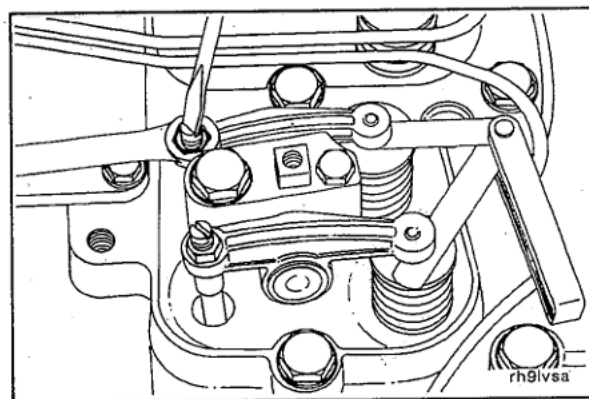
Exhaust Clearance: 0.508 mm [0.020 inch] - B Series

Intake Clearance: 0.30 mm [0.012 inch] - C Series

Exhaust Clearance: 0.61 mm [0.024 inch] - C Series

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.



Four Cylinder Adjustment

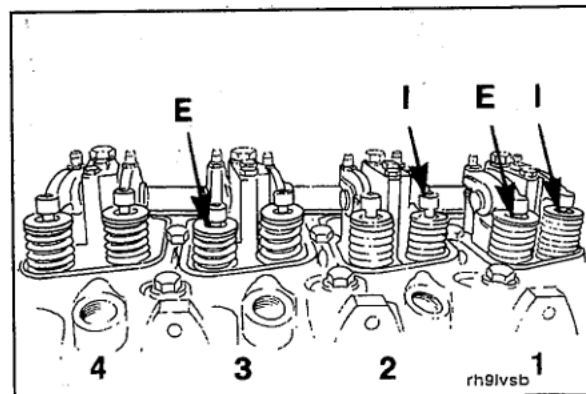
14 mm, Flatblade Screwdriver

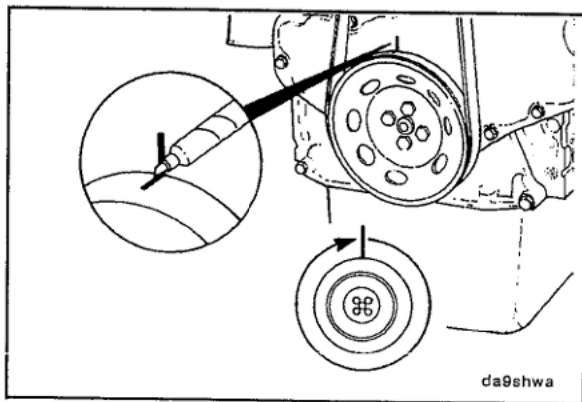
Locate TDC for cylinder No. 1.

Check/adjust the valves as indicated in the illustration (I = Intake; E = Exhaust).

Tighten the locknut and measure the valve lash again.

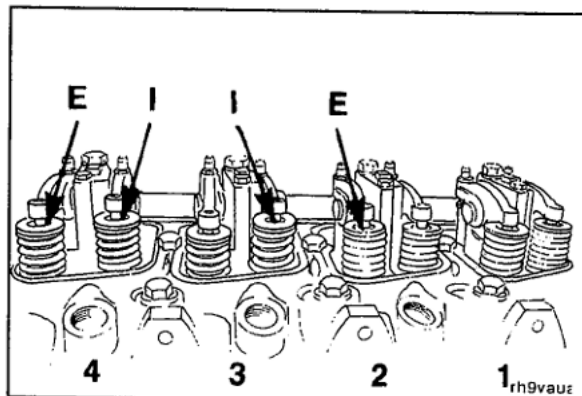
Torque Value: 24 N•m [18 ft-lb]





Mark the pulley and rotate the crankshaft 360 degrees.

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



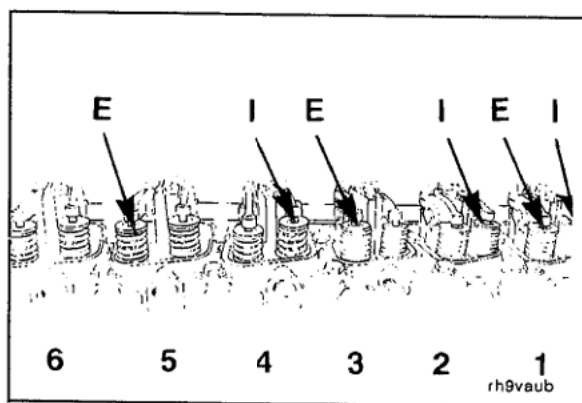
14 mm, Flatblade Screwdriver

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]



Six Cylinder Adjustment

14 mm, Flatblade Screwdriver

Locate TDC for cylinder No. 1.

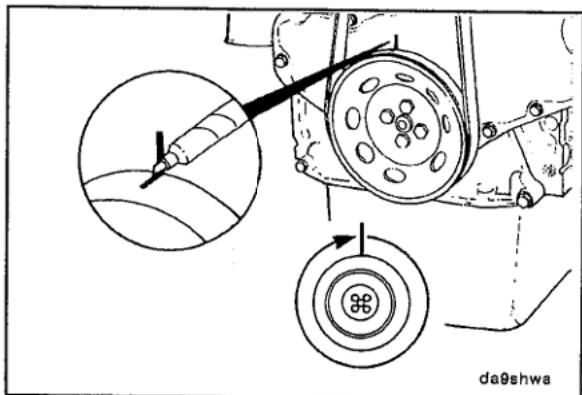


Check/adjust the valves as indicated in the illustration (I = Intake; E = Exhaust).

Tighten the lock nut and measure the valve lash again.



Torque Value: 24 N•m [18 ft-lb]



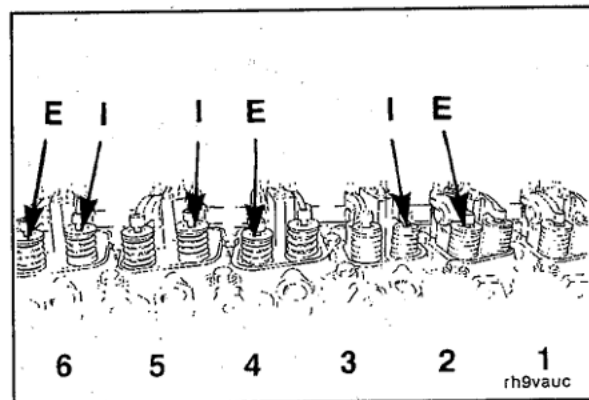
Mark the pulley/vibration damper and rotate the crankshaft 360 degrees.

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

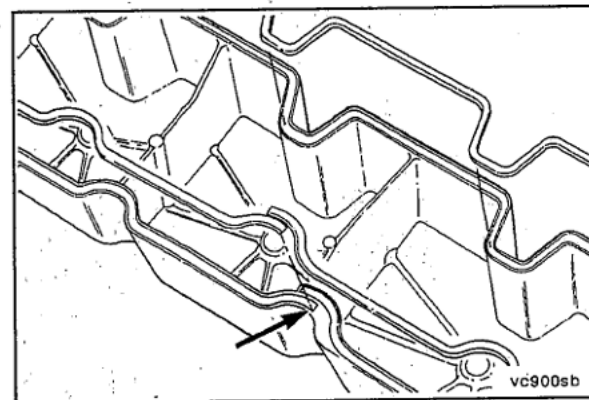
Adjust the valves as indicated in the illustration.

Tighten the lock nut and measure the valve lash again.

Torque Value: 24 N•m [18 ft-lb]



Install the rubber seal into the groove in the C Series valve cover. Start the installation at the overlap area shown in the illustration. Do **not** stretch the rubber seal.

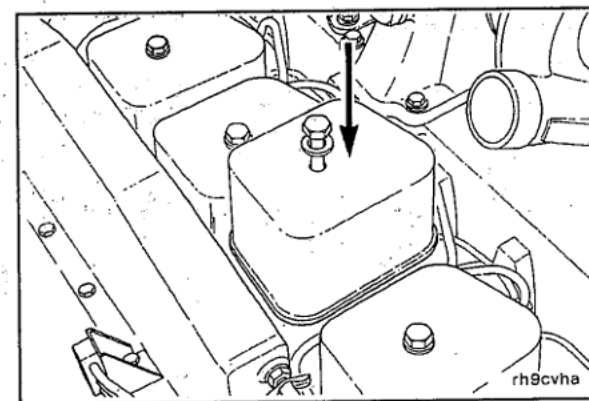


15 mm

Install the gaskets, o-rings and valve cover(s) and tighten the capscrews.

Install the air crossover if removed.

Torque Value: 24 N•m [18 ft-lb]



Valve - Adjustment (Alternate Method)

NOTE: An alternate procedure may be used in applications where access and visibility of reference marks are limited.

The Cylinder That is on its Compression Stroke (Intake Valve Just Closed) is:

1
3
4
2

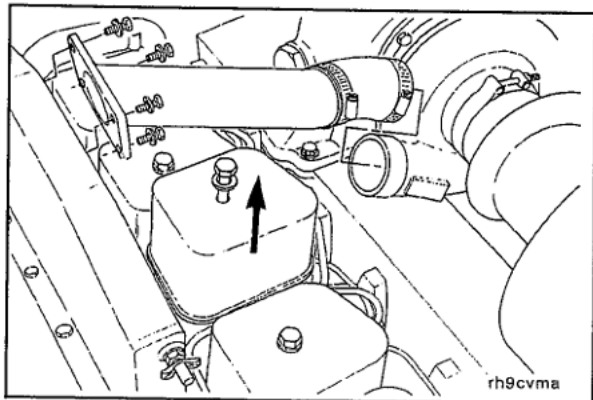
Check/Set Valves on Cylinder Number:

2
1
3
4

The following method does **not** require any reference marks and can begin with any cylinder. This method will work on any four cycle engine.

Follow the sequence shown to set the valves on a four-cylinder engine.

NOTE: The valve closest to the front of the engine on each cylinder is the intake valve.



15 mm

Remove the valve cover(s).



The Cylinder That is on its Compression Stroke (Intake Valve Just Closed) is:

1
5
3
6
2
4

Check/Set Valves on Cylinder Number:

4
1
5
3
6
2

Follow the sequence shown to set the valves on a six-cylinder engine.

FOUR-CYLINDER: FIRING ORDER

1 - 3 - 4 - 2

SIX-CYLINDER ENGINE: FIRING ORDER

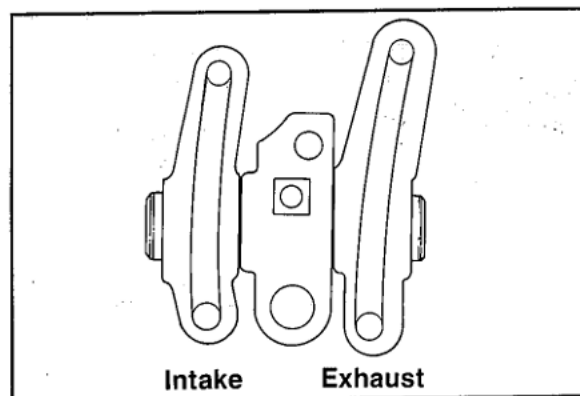
1 - 5 - 3 - 6 - 2 - 4

NOTE: The following steps provide additional explanation and examples.

- Knowledge of the firing order is required.
- The cylinders are numbered in sequence from the front of the engine.

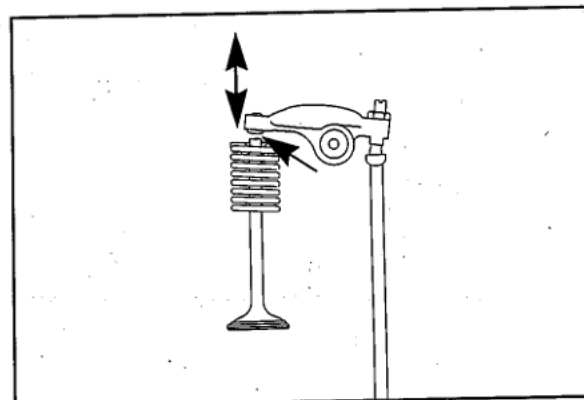
Begin the procedure by rotating the crankshaft and observing the intake valves. The opening of an intake valve on any cylinder will be the starting point for the valve setting sequence. Cylinder No. 3 intake valve is shown.

The smaller rocker lever identifies the intake valves. For example: watch the intake valve on cylinder No. 3.



Continue rotating the crankshaft until the intake valve on cylinder No. 3 is closed. This is observed by seeing the upward travel of the rocker lever. There should normally be a gap between the valve stem and rocker lever.

NOTE: Stop rotation of the crankshaft as soon as the upward movement of the rocker lever has stopped.



The valves for the previous cylinder in the firing order can be set. The intake valve on cylinder No. 3 has just closed so the valves on cylinder No. 1 are positioned for adjustment.

FOUR-CYLINDER ENGINE FIRING ORDER:

1 3 4 2

Intake Valve Closed
Set Valves on Cylinder No. 1

However, if it were a six-cylinder engine and cylinder No. 3 intake valve had just closed as indicated, then the valves on cylinder No. 5 (the previous cylinder in the firing order) would be positioned for adjustment.

SIX-CYLINDER ENGINE FIRING ORDER:

1 5 3 6 2 4

Intake Valve Closed
Set Valves on Cylinder No. 5

FOUR-CYLINDER: FIRING ORDER

1 3 4 2

Intake Valve Closed
Set Valves on Cylinder No. 3

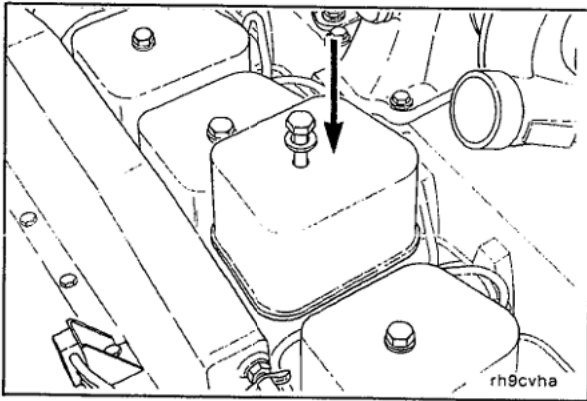
The next step in the valve setting sequence is to rotate the crankshaft to open and close the intake valve on the next cylinder in the firing order. Since the example starting point was cylinder No. 3, the next cylinder for a four-cylinder engine is cylinder No. 4.

SIX-CYLINDER ENGINE FIRING ORDER:

1 5 3 6 2 4

Intake Valve Closed
Set Valves on Cylinder No. 3

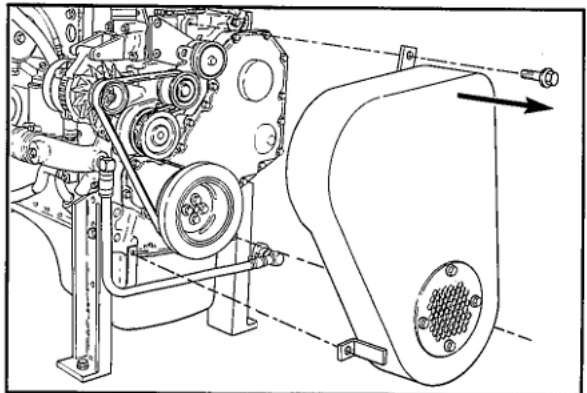
Similarly, if it is a six-cylinder engine, rotate the crankshaft to open and close the intake valve on cylinder No. 6 and adjust the valves on cylinder No. 3.

**15 mm**

Install the gaskets, o-rings and valve cover(s). Tighten the capscrews.



Torque Value: 24 N•m [18 ft-lb]

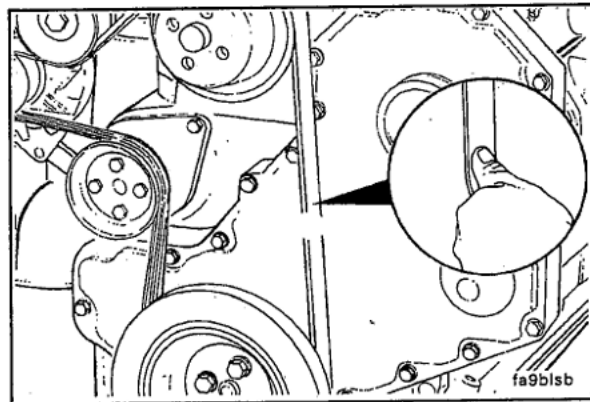
**Drive Belt and Tension Bearing - Checking****10 mm Socket and Extension**

Remove the protective cover.



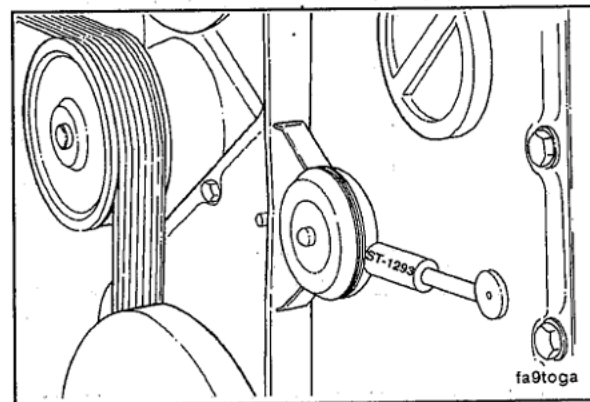
Measure the belt deflection at the longest span of the belt.

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].



3/8 Inch Square Drive

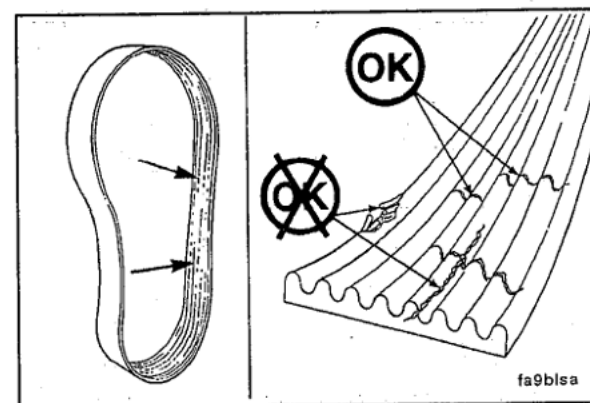
Remove the drive belt.

Inspect the belt for damage.

Transverse (across the belt width) cracks are acceptable.

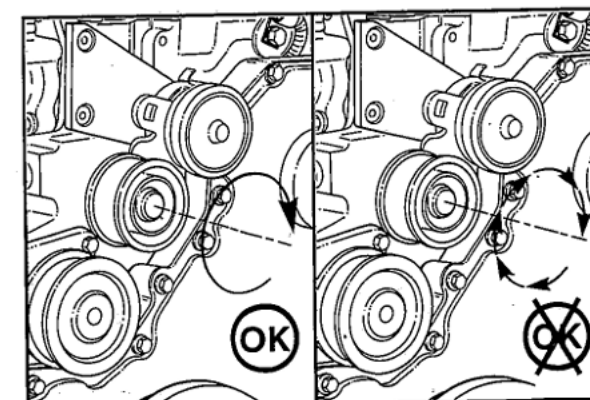
Longitudinal (direction of belt length) cracks that intersect with transverse cracks are **not** acceptable.

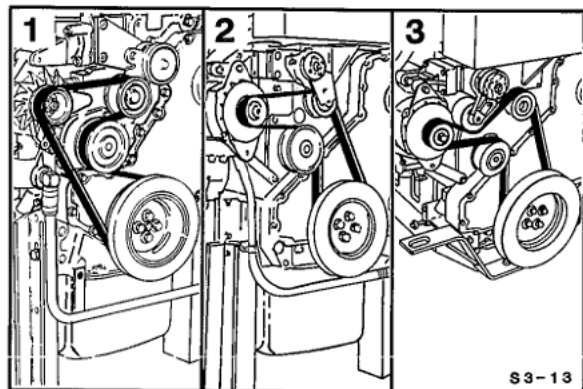
Replace the belt if it has unacceptable cracks, is frayed or has pieces of material missing.



NOTE: The tensioner pulley **must** spin freely with no rough spots detected under hand pressure.

Check the tensioner bearing.





S3-13

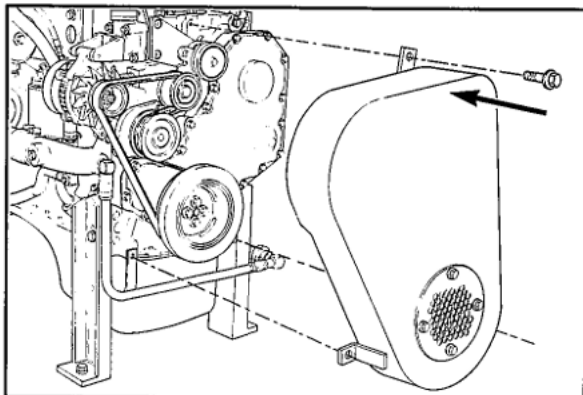
**3/8 Inch Square Drive**

Install the drive belt.

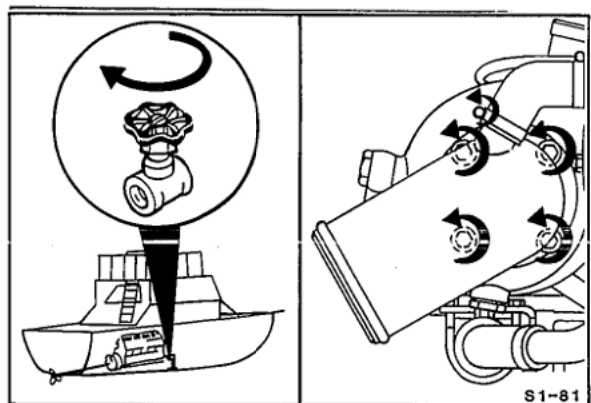


Verify that the correct belt wrap is used for your engine. The belt wraps shown are for:

1. All B Series engines
2. Early C-300 HP engines.
3. C-400 HP engines.

**13 mm**

Install the protective cover and tighten the capscrews.

**Torque Value:** 24 N•m [18 ft-lb]

S1-81

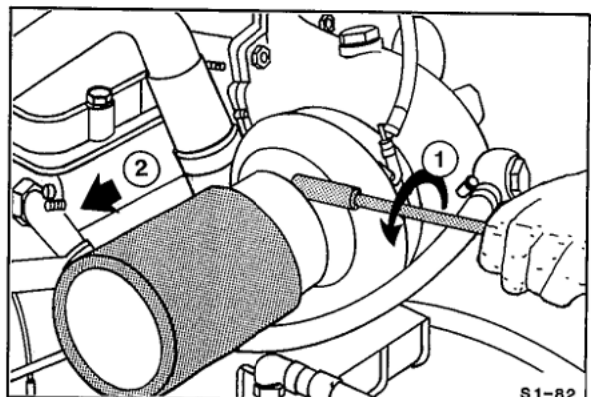
**Turbocharger - Checking****10 mm, 5/16 Inch Nut Driver or Screwdriver**

Shut off the raw water inlet valve on the boat hull, if equipped with one.



Remove the turbocharger exhaust elbow.

The best time to do this check could be before placing into winter storage.



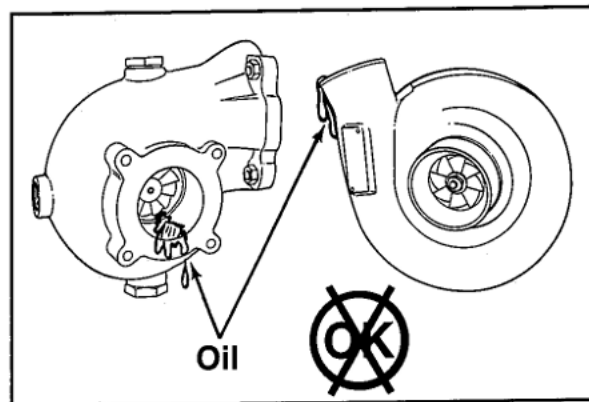
S1-82

**7/16 Inch Deep Socket**

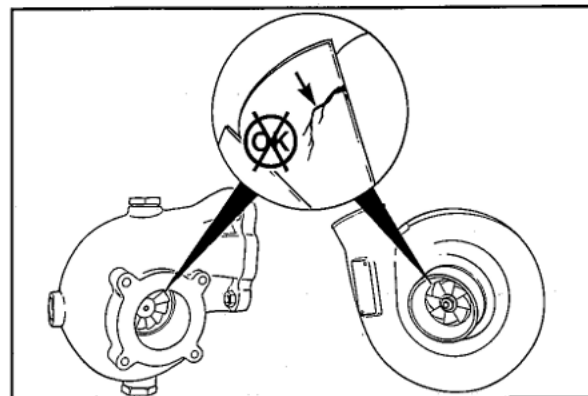
Remove the air cleaner.



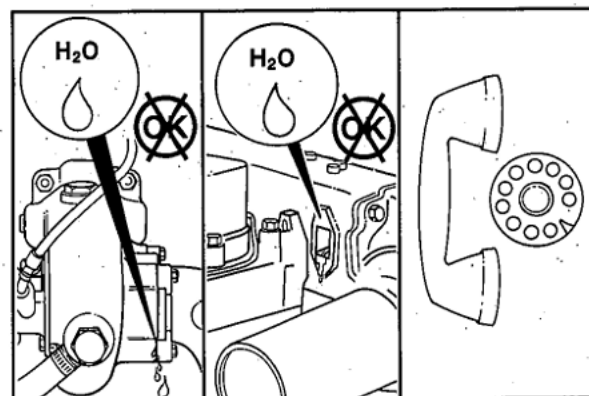
Look for oil leakage in the crossover and the exhaust pipe.



Look for damaged compressor or turbine blades and check that the compressor spins freely.



Inspect for evidence of water in the turbocharger impeller area. If water is evident, inspect the exhaust manifold ports. If water is evident, contact an Authorized Service Center.



Rotor Assembly Clearance - Measure

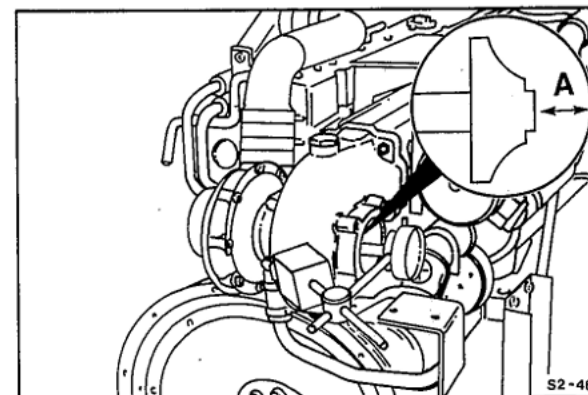
Measure the shaft end play.

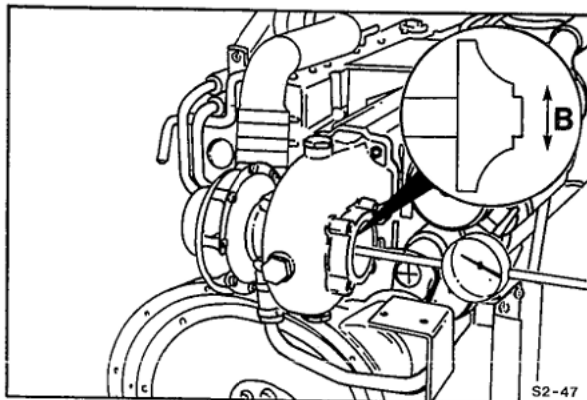


End Play (A)		
mm		in
*0.10	MIN	[0.004]
0.16	MAX	[0.006]
**0.026	MIN	[0.001]
0.076	MAX	[0.003]

* For turbochargers with a serial number **before** 840638.

** For turbocharger with a serial number **after** and **including** 840638.





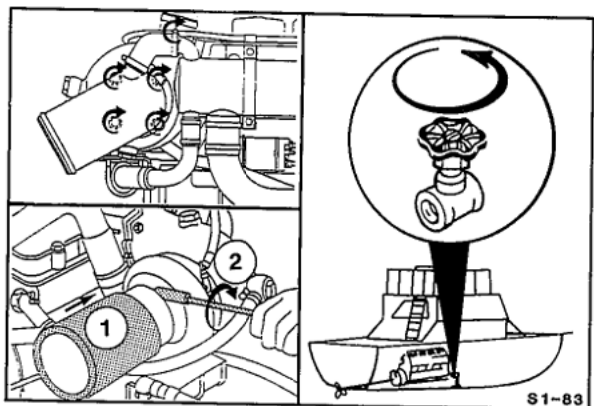
Measure radial clearance of the shaft.

Radial Clearance (B)

mm		in
0.30	MIN	[0.012]
0.46	MAX	[0.018]

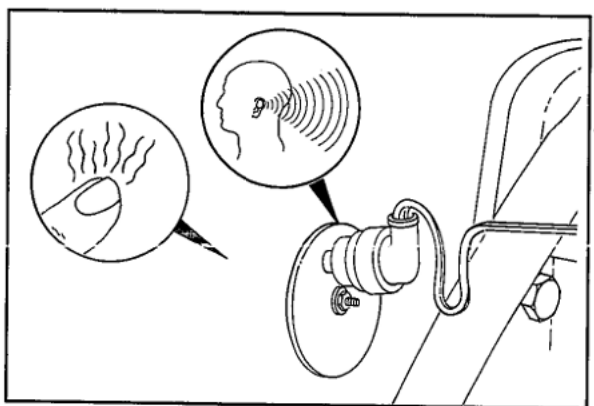


The turbocharger should be removed for replacement or rebuilt if the clearances are beyond these limits. (Refer to the Shop Manual, Bulletin No. 3810206 for rebuild procedures.)



If the turbocharger checks out OK, install the air cleaner and exhaust elbow.

Open the raw water inlet valve on the vessel hull.



Coolant Heaters - Checking

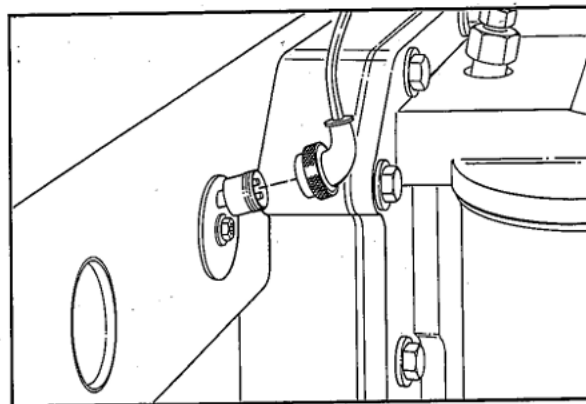
When operating, the engine block heater will make an audible sound and the engine block will be warm to the touch in the water jacket areas.

Coolant Heaters - Replacement

Preparatory Step:

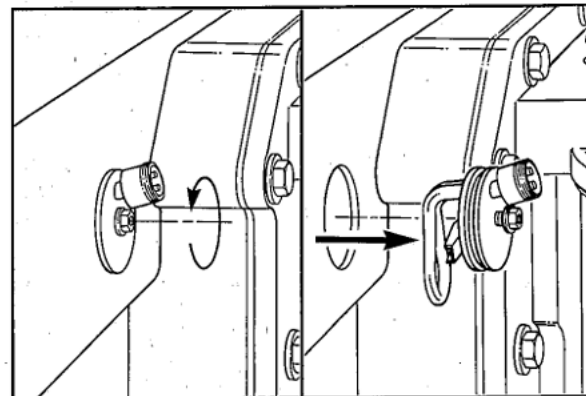
- Disconnect the block heater electrical power source.
- Drain the coolant. Refer to Section 7 for coolant draining.

Disconnect the block heater electrical cord from the element.



5 mm

Loosen the block heater screw and remove the block heater from the block.



5 mm

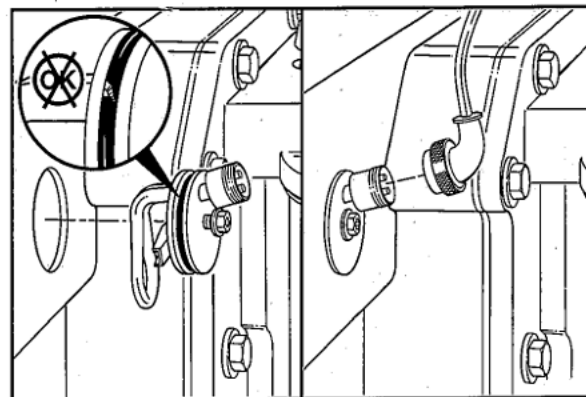
Clean the bore in the cylinder block.

Check the o-ring on the heater to make sure it is **not** damaged.

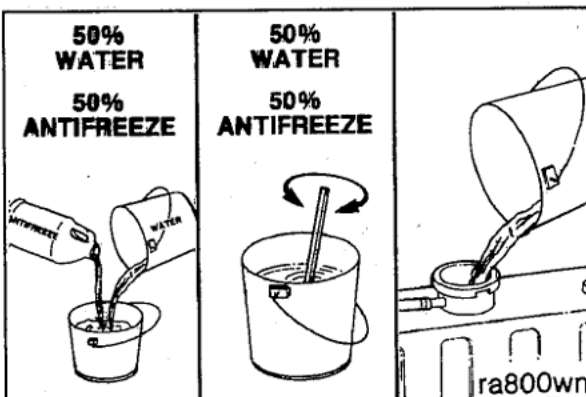
Slide the heater into the seated position and tighten the retaining screw.

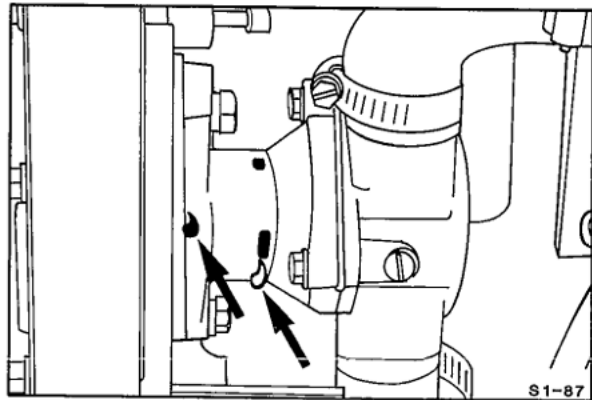
Torque Value: 12 Nm [9 ft-lb]

Connect the electrical cord to the heater.



Fill the cooling system. Refer to Section 7 for coolant filling.



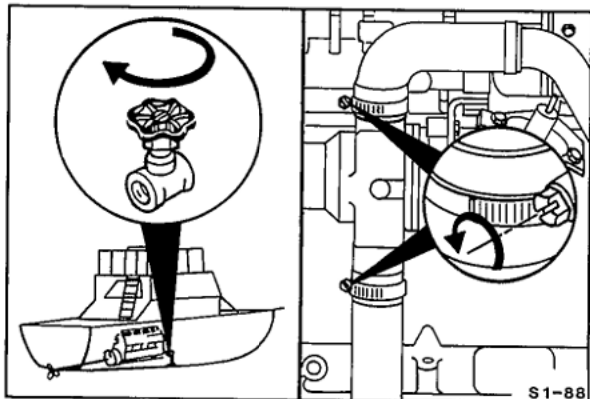


Raw Water Pump (B Series 64 Through 210 HP) - Inspection

Inspecting For Seal Leakage



Inspect the raw water pump for evidence of water or oil indicating seal leakage. If seal leakage is evident, refer to Section A for replacing the pump.



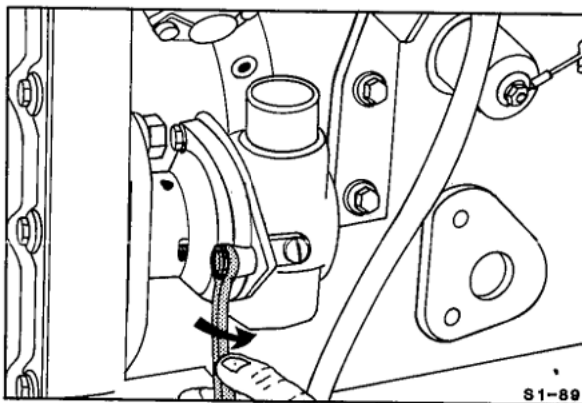
Impeller Inspection



5/16 Inch Nutdriver or Screwdriver

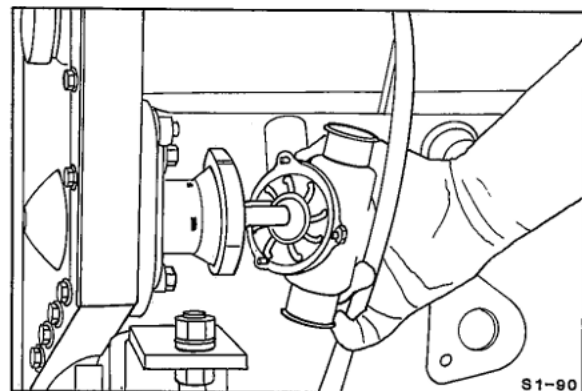
Shut off the raw water inlet valve on the vessel hull.

Disconnect the raw water pump inlet and outlet connections.



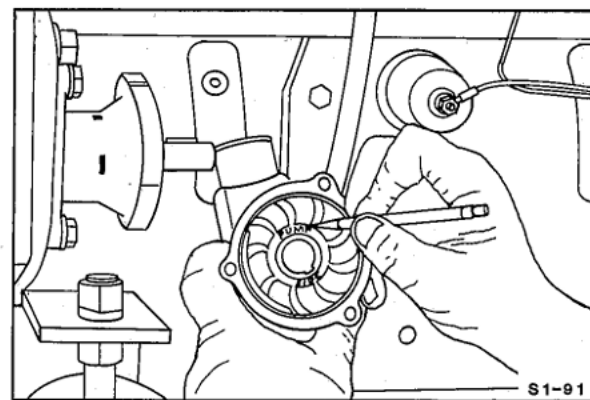
7/16 Inch

Remove the three impeller housing mounting capscrews.



Remove the impeller housing. Usually the impeller will stay in the housing when it is removed.

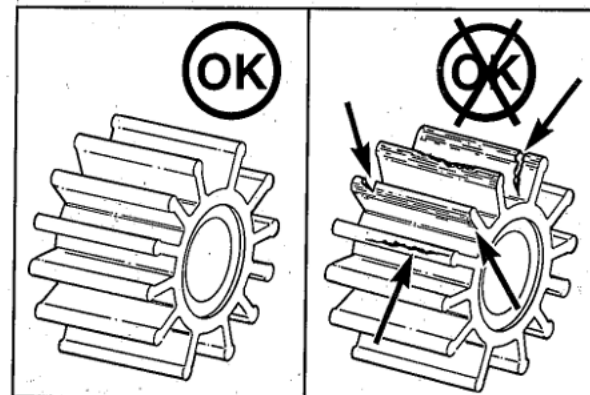
Mark the impeller to be sure of proper installation if it is to be used again.



Remove the impeller and rubber bushing from the housing.

Inspect for damage such as rips, tears or chunks of material missing.

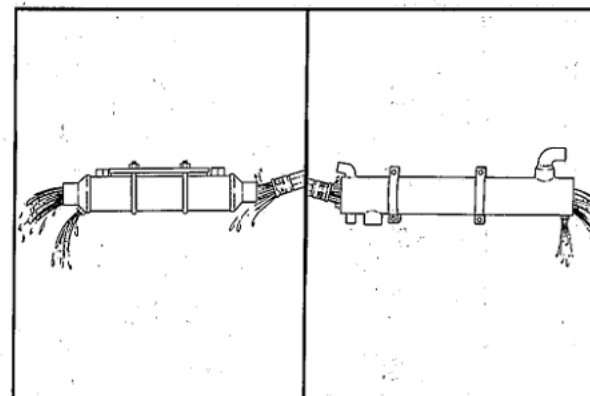
Replace as necessary.



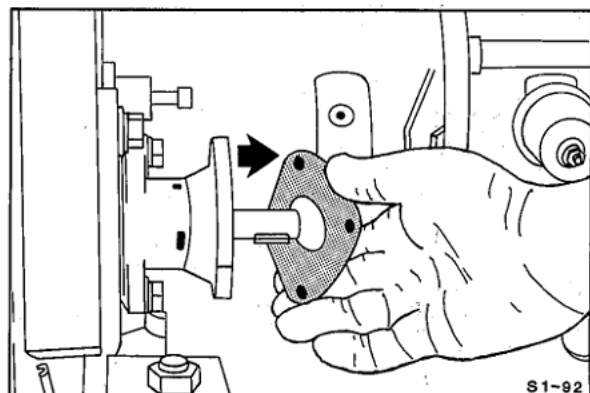
Caution: If the impeller has failed, the engine heat exchanger and the marine gear oil cooler must be flushed.

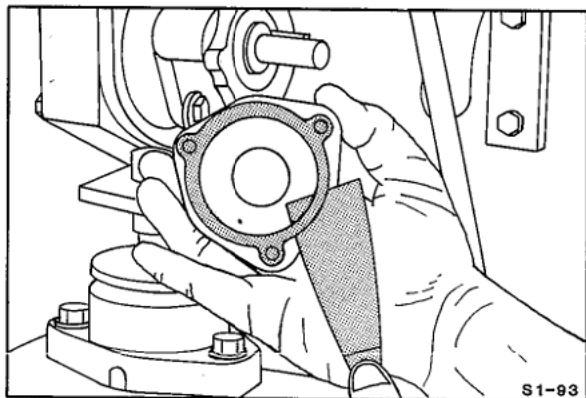
Impeller debris can also drop into the inlet piping or circuit. Make sure all debris is flushed before installing a new impeller, otherwise additional impeller failures or engine overheating will occur.

Refer to the procedures in flushing these components in Section 6.

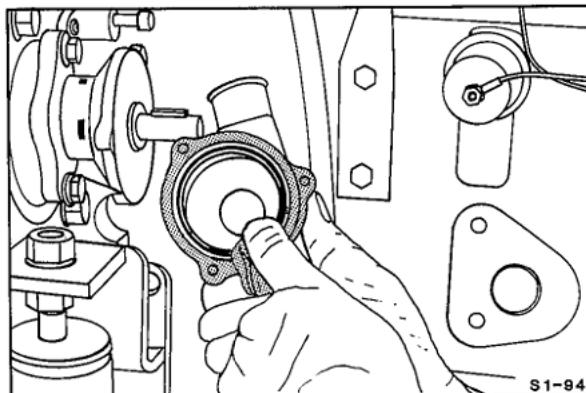


Remove the spacer plate.

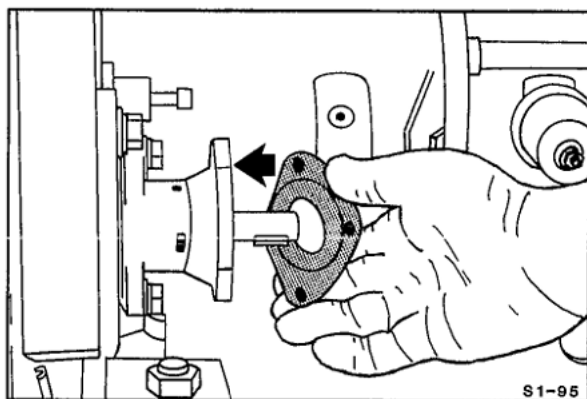




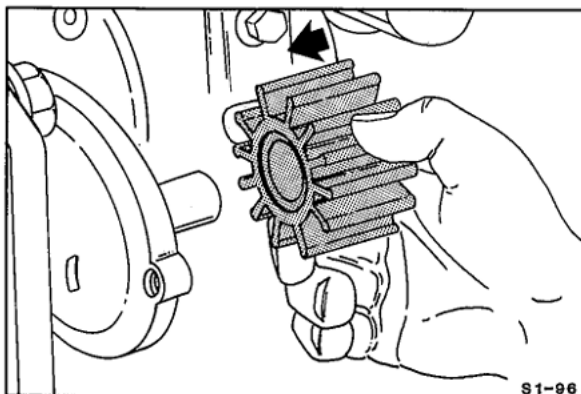
Clean the gasket surfaces.



Clean the impeller housing, especially the o-ring sealing surface.



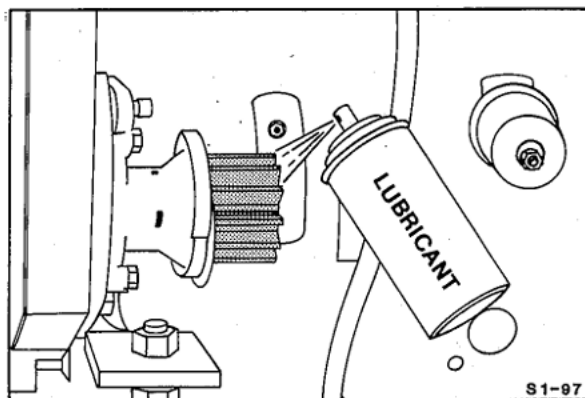
Install a new gasket and the spacer plate.



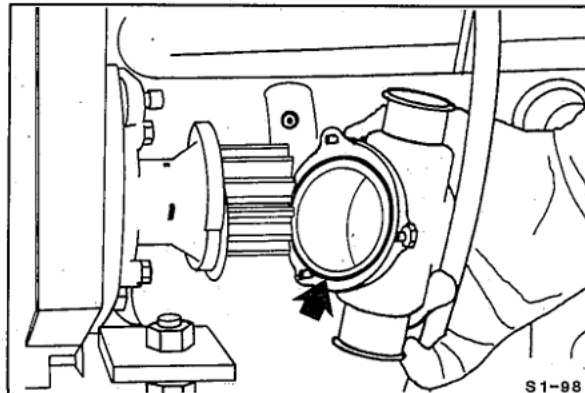
Install the impeller on the pump shaft.

NOTE: If installing the used impeller, install it in the same position it was removed from.

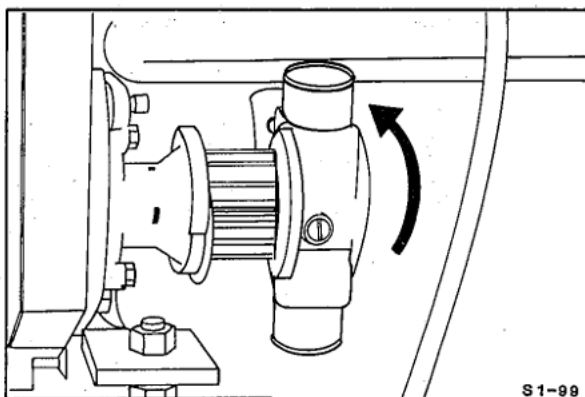
Use clean glycerin, silicone spray or a non-petroleum base lubricant to lubricate the impeller before installing it into the housing.



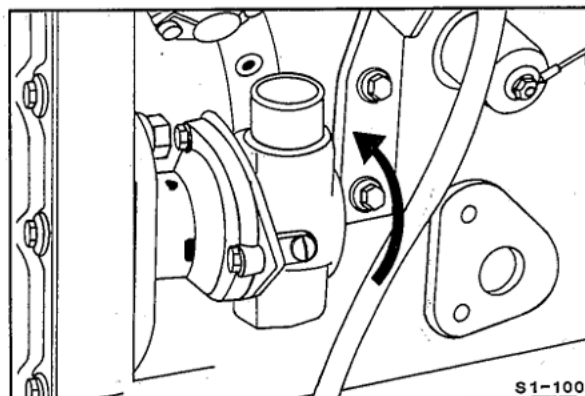
Install a new o-ring into the housing.

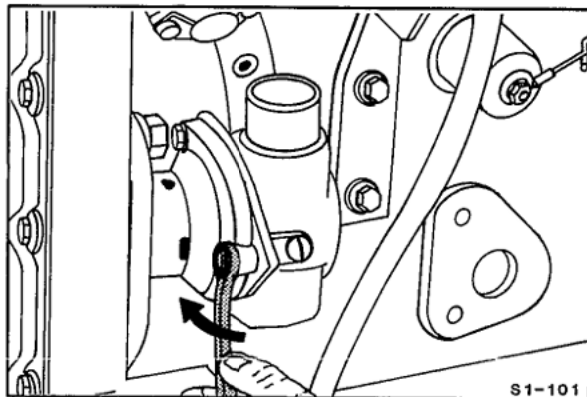


To install the impeller housing over the impeller, twist the housing **clockwise** as it is pushed over the impeller.



Rotate the housing **clockwise** to align the mounting holes.



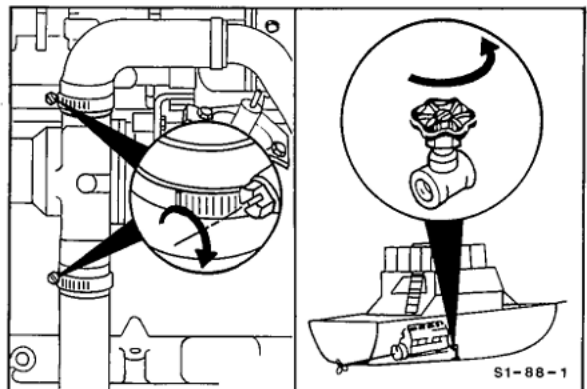


7/16 Inch

Install and tighten the impeller housing mounting cap-screws.



Torque Value: 8 N•m [71 in-lb]



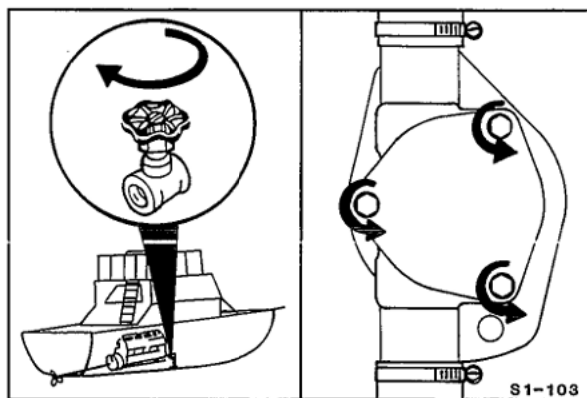
5/16 Inch Nutdriver or Screwdriver

Connect the water connections.



Torque Value: 5 N•m [44 in-lb]

Open the water inlet valve on the vessel hull.



Raw Water Pump (B Series 300 HP and C Series 400 HP) - Inspection

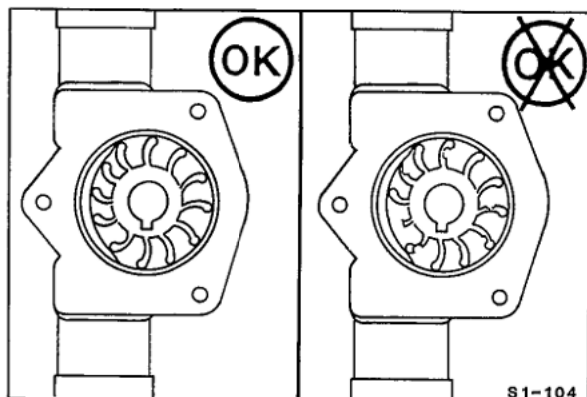


1/2 Inch

Shut off the raw water inlet valve on the vessel hull.



Remove the pump cover plate.



NOTE: It may be necessary to remove the impeller to examine for chunking or torn vanes.



If the impeller appears to be OK, clean and install the cover plate.



If damaged vanes are evident, refer to Section A for detailed instructions for impeller replacement.



Marine Gear Oil - Change

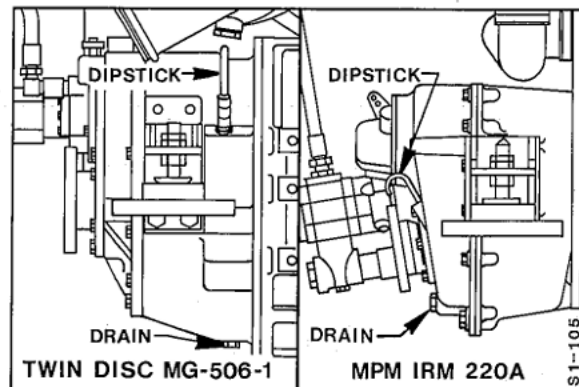
Change the oil for the first time after about 50 hours of operation, then each year thereafter.

Consult the marine gear manufacturer's Operator Manual for oil specifications, quantities, and all necessary maintenance required.

When changing the marine gear oil, the marine gear oil cooler **must** be removed to drain trapped fluid.

The oil **must** also be changed if the gear has **not** been operated for over 6 months.

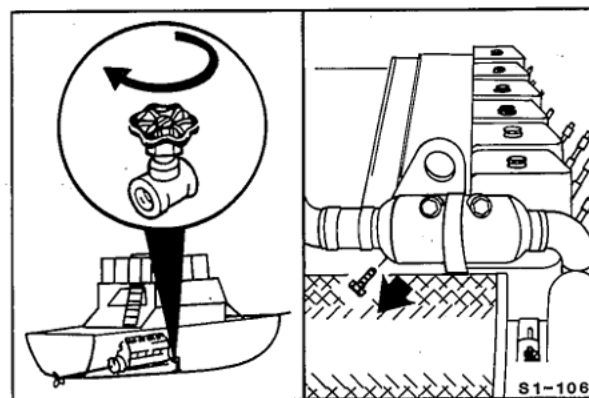
Typical gear box drain and dipstick locations.



Marine Gear Oil Cooler - Flushing

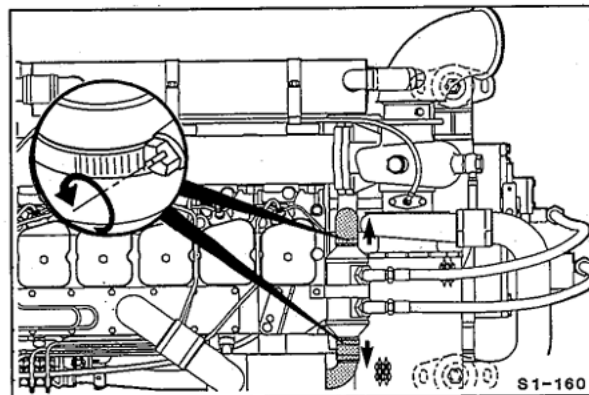
Shut off the raw water inlet valve on the vessel hull, if so equipped.

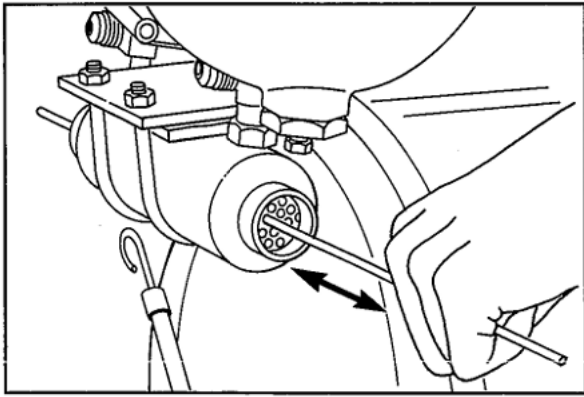
Remove the marine gear oil cooler drain plug and drain the raw water from the gear oil cooler.



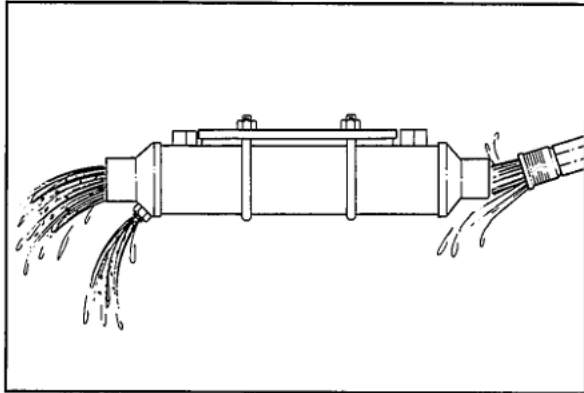
5/16 Inch Nutdriver or Screwdriver

Disconnect the water in and out connections.

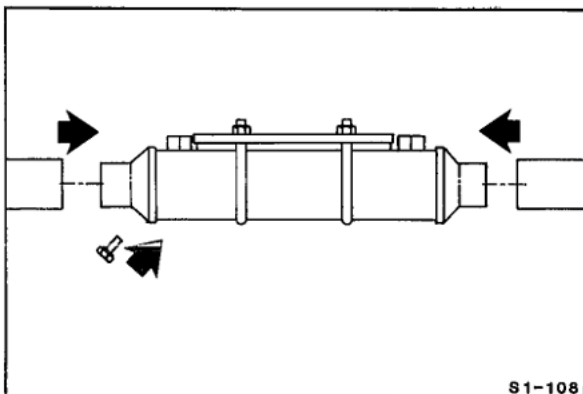




Use a 4.76 mm [3/16 inch] diameter brass rod to clean out any build up in the cooler tubes.



Use clean water to flush all the debris from the cooler. Make sure the debris flushed from the cooler does **not** enter the water supply pipe.

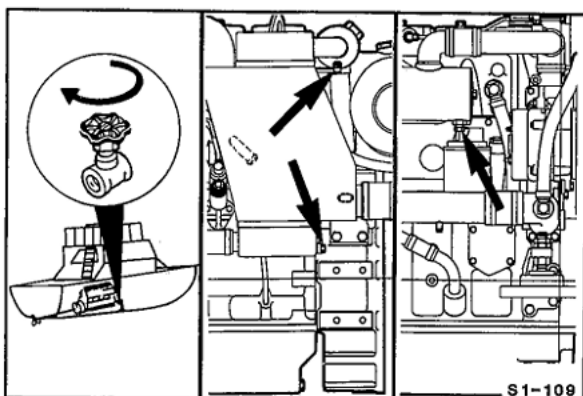


7/16 Inch and 5/16 Inch Nutdriver

Install the drain plug and water connections.



Open the raw water valve on the vessel hull, if closed.



Raw Water Heat Exchanger - Flushing

7/16 Inch

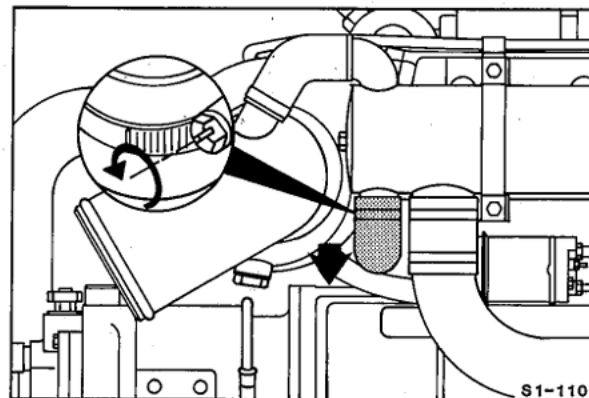
Shut off the raw water valve on the vessel hull.



Remove the marine gear oil cooler drain plug and the zinc plugs from the aftercooler, if so equipped.

5/16 Inch Nutdriver or Screwdriver

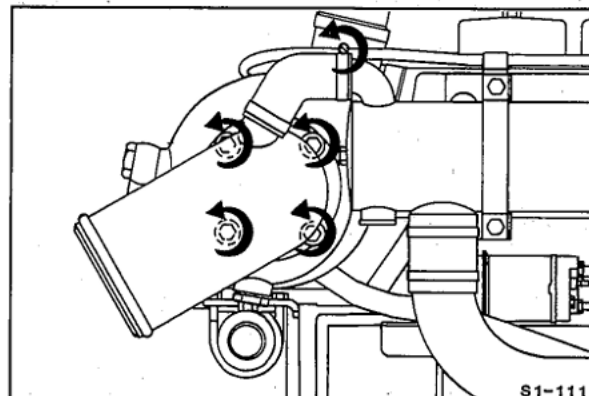
Disconnect the raw water inlet connection.



S1-110

10 mm, 5/16 Inch Nutdriver or Screwdriver

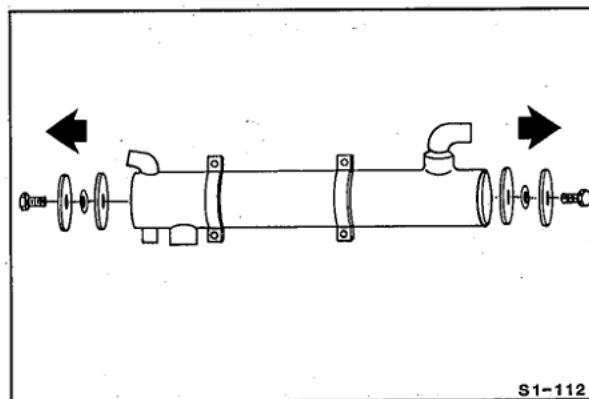
Remove the turbocharger exhaust elbow.



S1-111

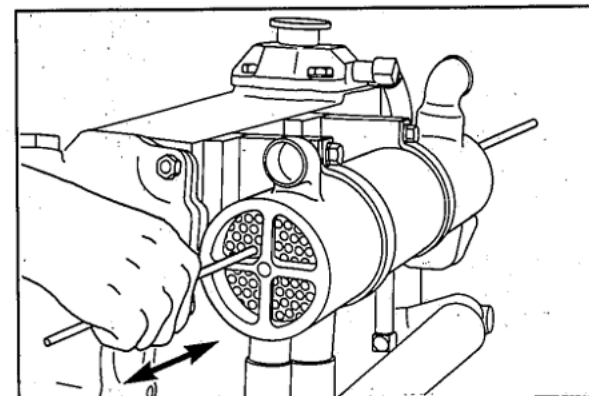
9/16 Inch

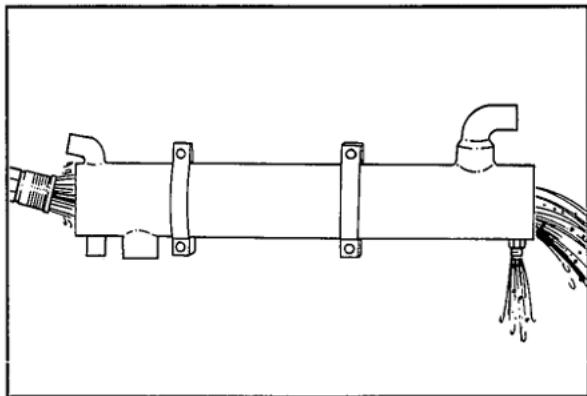
Remove the heat exchanger end caps.



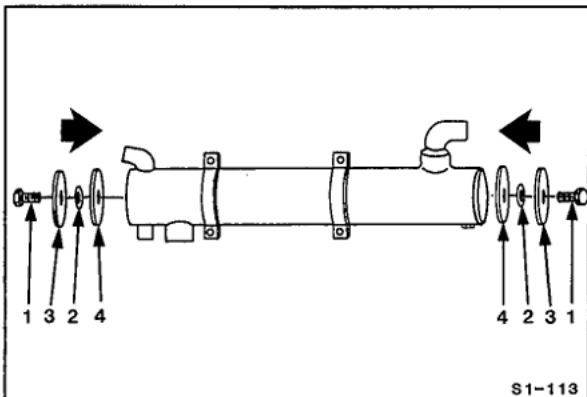
S1-112

Use a 4.76 mm [3/16 inch] diameter brass rod to clean out any build up in the heat exchanger tubes.





Use clean water to flush the heat exchanger tubes from the rear. Make sure the end cavities are cleared of all debris.



9/16 Inch

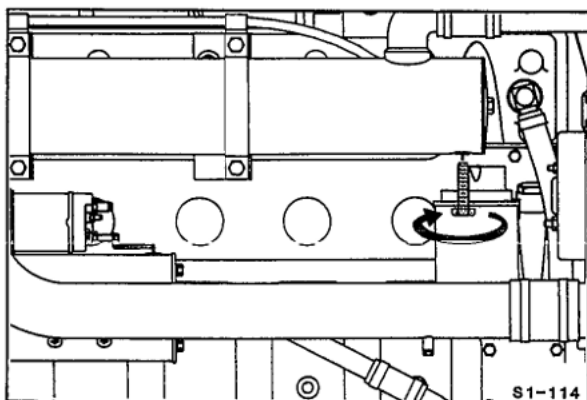
Use new sealing washers (2) and gaskets (4) when installing the end caps (3).



Tighten the retaining screws (1).

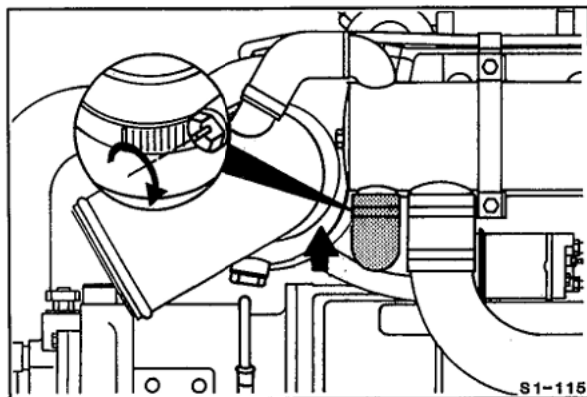


Torque Value: 47.5 N•m [35 ft-lb]



11/16 and 7/8 Inch

Install the zinc plug.



5/16 Inch Nutdriver or Screwdriver

Install the raw water inlet connection.



Torque Value: 5 N•m [44 in-lb]



10 mm, 5/16 Inch Nutdriver or Screwdriver

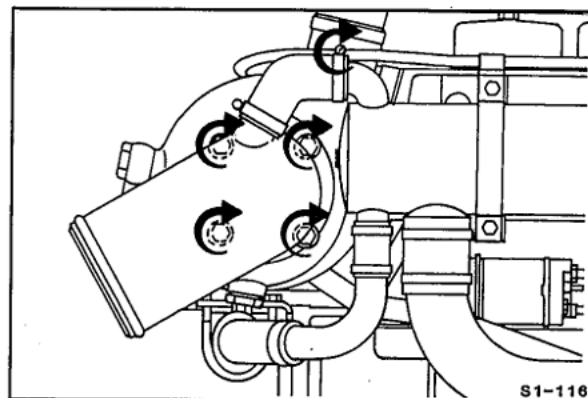
Install the turbocharger exhaust connection.

Tighten the mounting capscrews.

Torque Value: 24 N•m [18 ft-lb]

Tighten the elbow hose clamp.

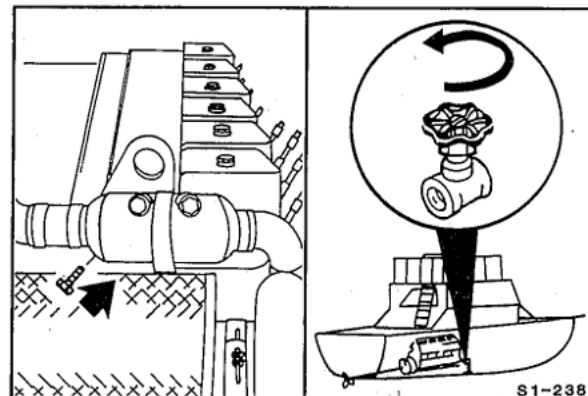
Torque Value: 5 N•m [44 in-lb]



7/16 Inch

Install the marine gear oil cooler drain plug.

Open the raw water valve on the vessel hull.

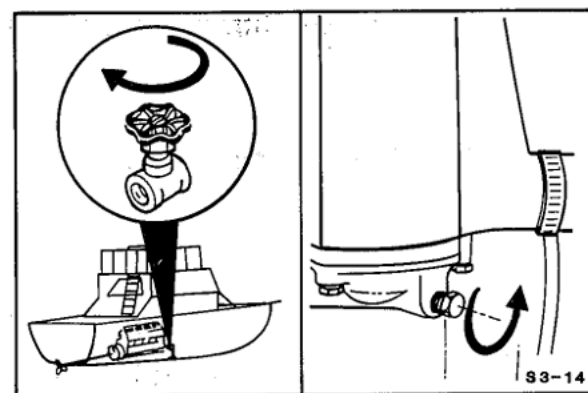


Raw Water Aftercooler - Cleaning/Flushing

7/8 Inch

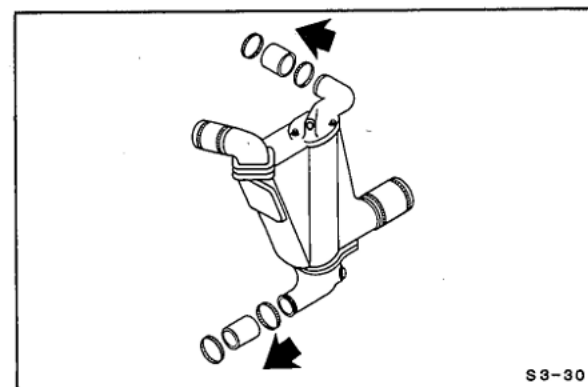
Shutoff the raw water supply valve on the vessel hull.

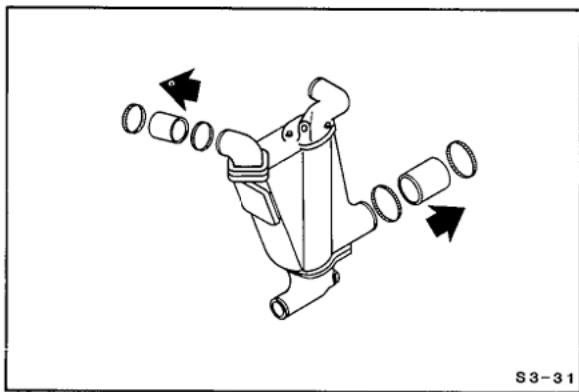
Remove the zinc plug from the aftercooler lower water header to drain the aftercooler.



5/16 Inch Nutdriver

Remove the raw water transfer tubes from the aftercooler.

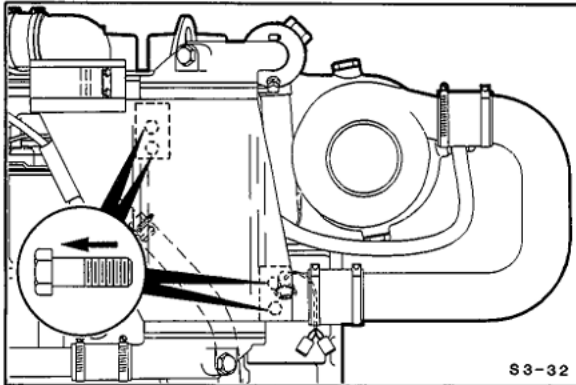




S3-31

**7/16 Inch**

Loosen the T-bolt clamps on the aftercooler air inlet and air outlet hose couplings. Remove the hose couplings from the aftercooler. Engines equipped with the air heater will require removal of the heater element wiring and some engines have the throttle cable attached to the aftercooler that will require removal.



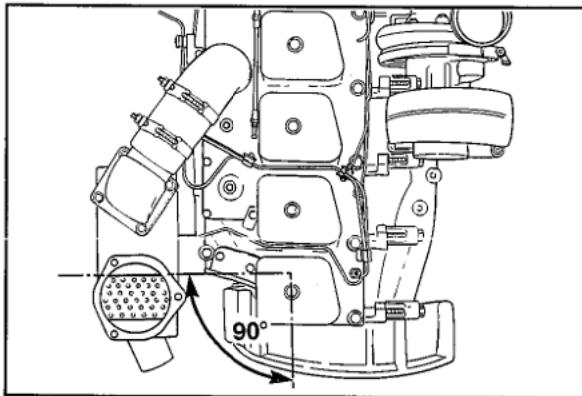
S3-32

**13 mm**

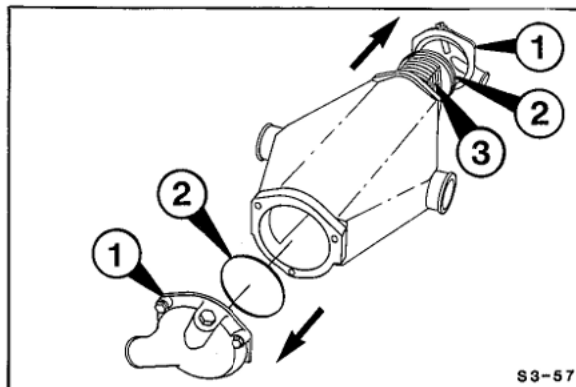
Remove the two hex head flange capscrews which hold the cast aftercooler to the flywheel housing bracket and the two which hold the aftercooler to the intake manifold bracket.



Remove the aftercooler.



To properly cool the intake air, the core **MUST** be positioned with the flat sides to the front and rear. When the core is correctly positioned, the tube rows will be at 90 degrees to the engine centerline as shown in the illustration. Be sure the o-rings on each end of the core are in position to fit into the housing chamfers when the core is installed.



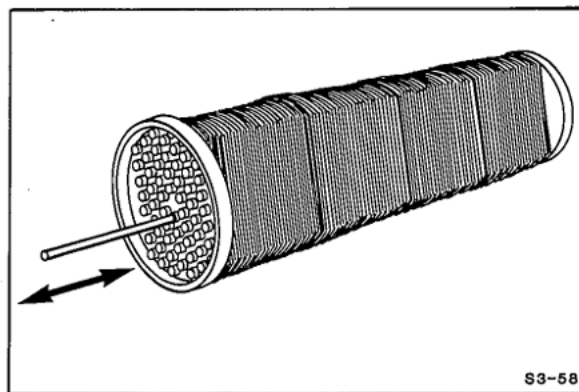
S3-57

**17 mm**

Remove the top and bottom endcaps (1) from the housing and the o-rings (2) from the core (3).

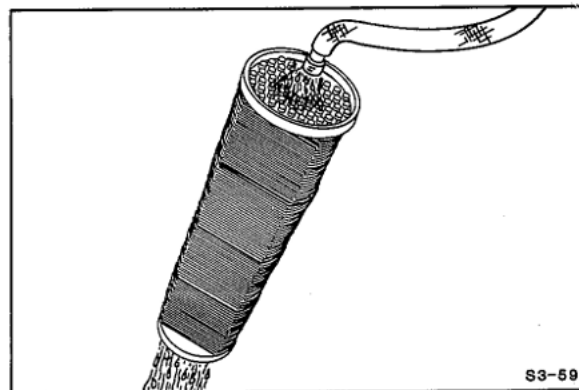


Use a 4.76 mm [3/16 inch] diameter brass rod to clean out any buildup of scale in the aftercooler tubes.



S3-58

Use clean water to flush the tubes of any loose debris.

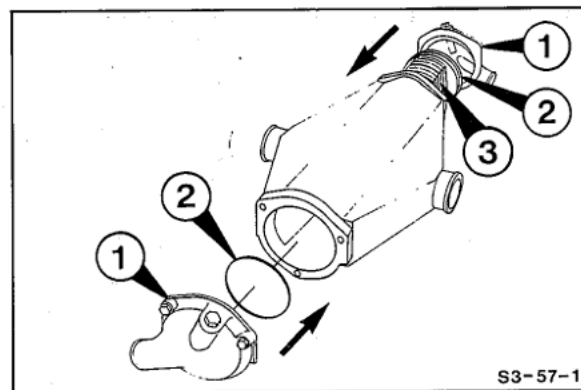


S3-59

17 mm

Install the core (3) into the housing. Install the o-rings (2) onto the ends of the core and then install the top and bottom end caps (1).

Torque Value: 30 N•m [22-ft-lb]



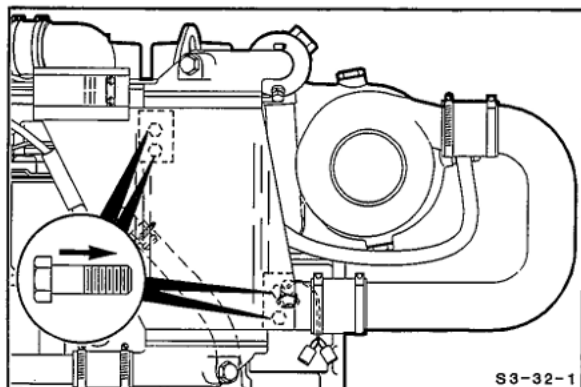
S3-57-1

13 mm

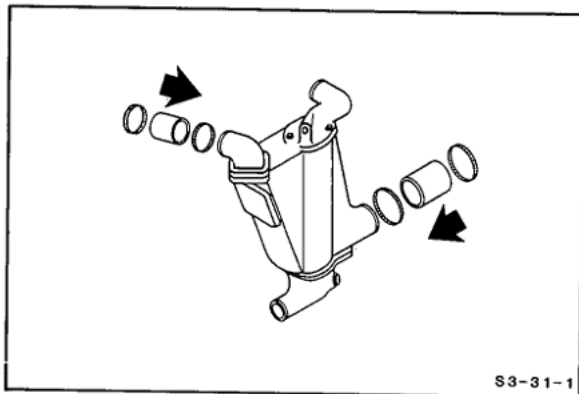
Install the two capscrews which hold the cast aftercooler to the intake manifold bracket.

Install the two capscrews which hold the cast aftercooler to the flywheel housing bracket.

Torque Value: 30 N•m [22 ft-lb]



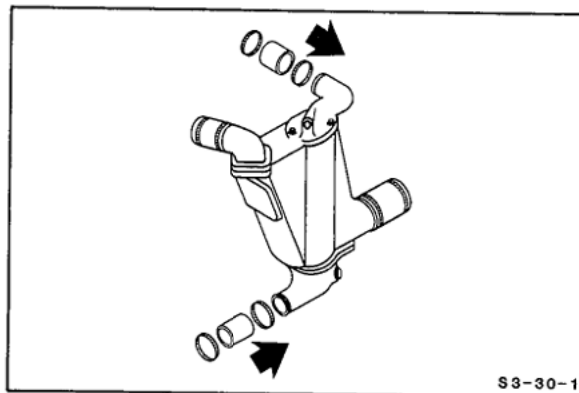
S3-32-1

**7/16 Inch**

Install the air inlet and air outlet hose couplings on the aftercooler. Tighten the T-bolt clamps.



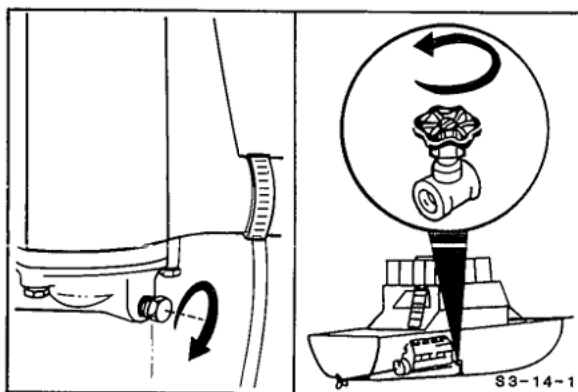
Torque Value: T-Bolt Type 8 N•m [71 in-lb]
Worm Type 5 N•m [44 in-lb]

**5/16 Inch or Flat Screwdriver**

Install the raw water transfer tube couplings on the aftercooler.



Torque Value: 5 N•m [44 in-lb]

**7/8 inch**

Install the zinc plug in the aftercooler lower water header.



Open the raw water inlet valve.

Section 7 - Maintenance Procedures at 24 Months or 2000 Hours

Section Contents

	Page
Cooling System Maintenance	7-2
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Coolant System Filling.....	7-5
Cooling System - Cleaning.....	7-3
Cooling System - Flushing.....	7-4
General Information	7-2
Vibration Damper - Inspection	7-6
Rubber Damper.....	7-7
Viscous Damper.....	7-6
Vibration Damper - Replacement	7-8
Rubber Damper.....	7-8
Viscous Damper.....	7-8

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.

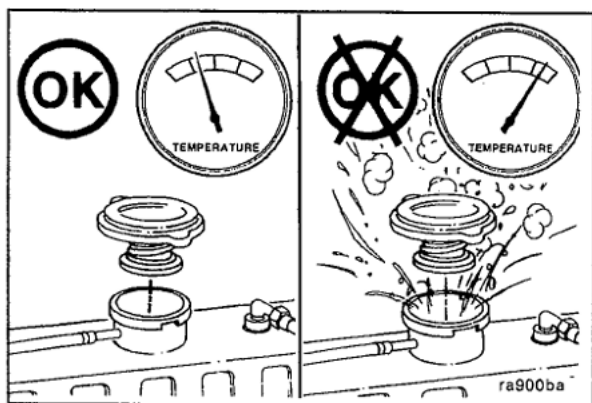
Cooling System Maintenance

Coolant Draining



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

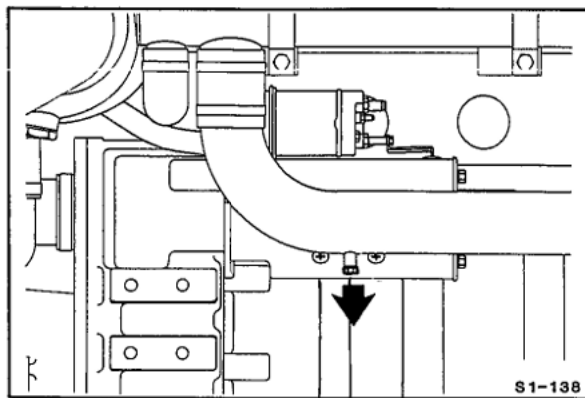
- Avoid excessive contact - wash thoroughly after contact.
- Keep out of reach of children.



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.



Caution: 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.

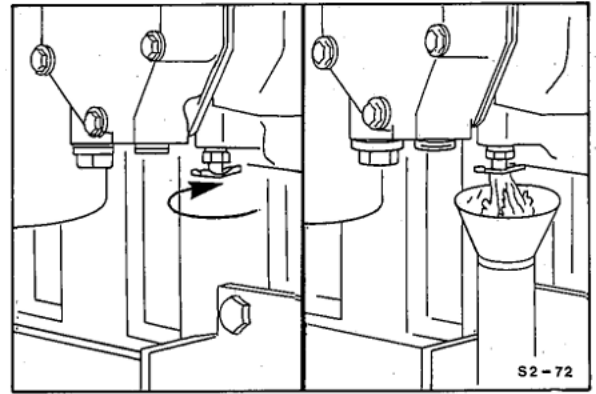


Drain the B Series engine cooling system by removing the drain plug on the water transfer tube (exhaust side of engine). A drain pan with a capacity of 254 liters [6 U.S. gallons] will be adequate in most installations. After the cooling system completely drained, install the drain plug.

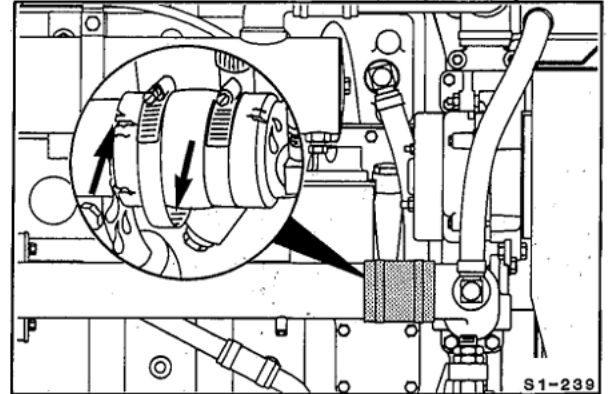
If the cooling system shows mineral build-up scale, rust or oil, use a heavy duty cooling system cleaner and follow the manufacturer's instructions.

Drain the C Series engine cooling system by opening the drain valve on the engine oil cooler (exhaust side of engine). A drain pan with a capacity of 31.7 liters [7.5 U.S. gallons] will be adequate in most installations. After the cooling system is completely drained, close the drain valve.

If the cooling system shows mineral build-up, scale, rust, or oil, use a heavy duty cooling system cleaner and follow the manufacturer's instructions.



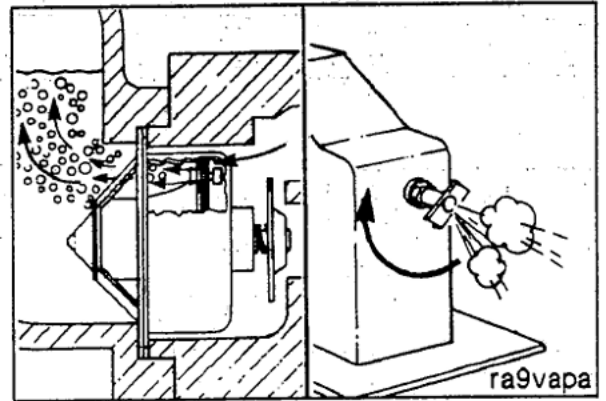
Check for damaged hoses and loose or damaged hose clamps. Replace as required.



Cooling System - Cleaning

Warning: Cleaning solutions typically contain strong chemicals that can cause burns or other injury if used improperly. Read all warning labels carefully before using.

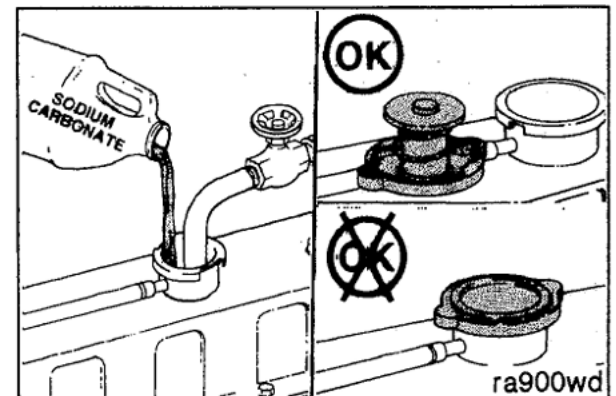
Caution: During filling, air must be vented from the engine coolant passages. Open the venting petcock on the aftercooler for B Series 220 HP and 250 HP engines. The system must be filled slowly to prevent air locks. Wait 2 to 3 minutes to allow air to be vented, then add mixture to bring the level to the top.



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

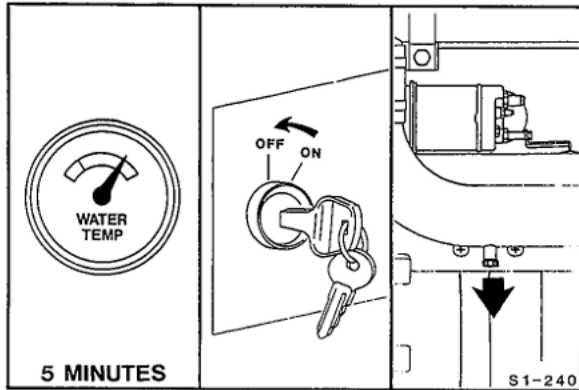
NOTE: Use 0.5 kilogram [1.0 pound] of sodium carbonate for every 23 liters [6.0 U.S. gallons] of water.

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



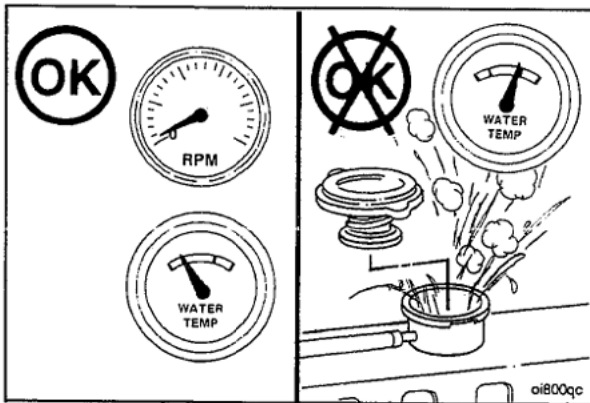


NOTE: The performance of RESTORE is dependent on time, temperature, and concentration levels. An extremely scaled or flow restricted system, for example, may require higher concentrations of cleaners, high temperatures, or longer cleaning times. RESTORE can be safely used up to twice the recommended concentration levels. Extremely scaled or fouled systems may require more than one cleaning.



Operate the engine for 5 minutes with the coolant temperature above 83°C [180°F].

Shut off the engine and drain the cooling system.

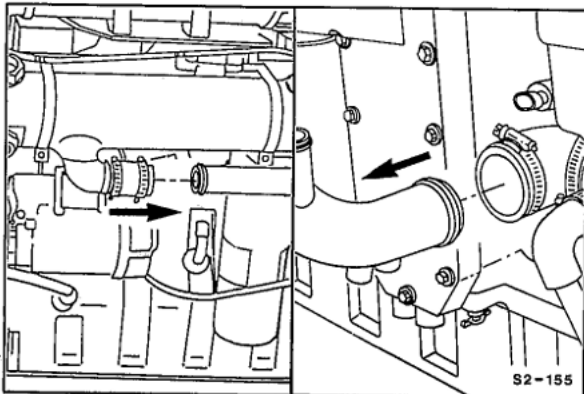


Cooling System - Flushing



Caution: Do not pour cold water into a hot engine. Doing so may crack the cylinder head or the cylinder block. Do not operate engine without coolant for even a few minutes.

When cleaning is complete, drain cleaning solution and flush system. For best result, engine should be reverse flushed. Allow engine to cool as much as possible before flushing with cold water.



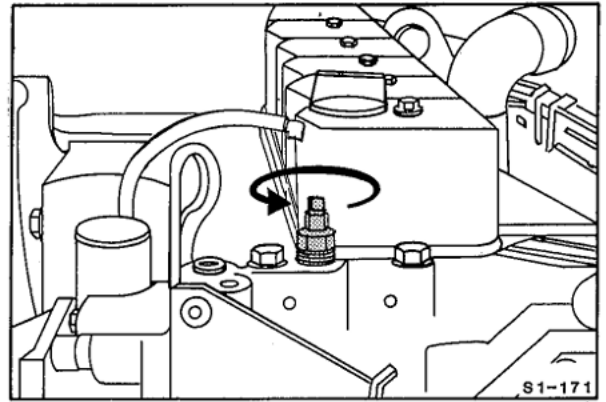
5/16 Inch

Remove the engine water inlet transfer tube from the engine.

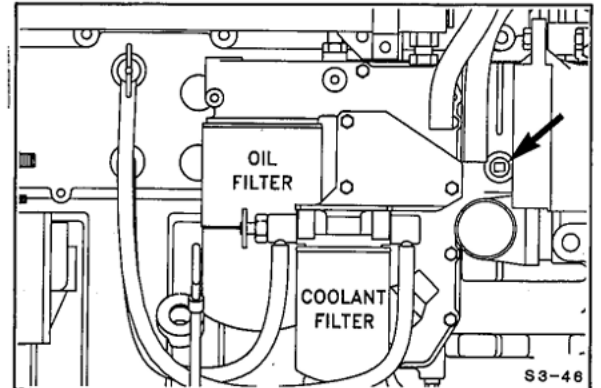


B Series Only**7/8 Inch**

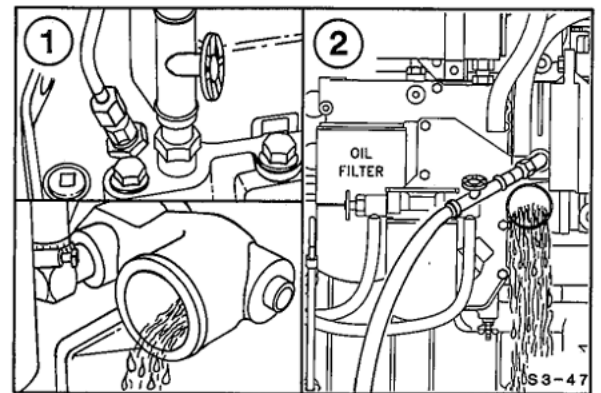
Remove the wires from the temperature sensor. (Either wire may be installed on either terminal). Remove the temperature sensor.

**C Series Only****1/2 Inch Square Drive, Long Extension**

Remove the pipe plug from the exhaust side, toward the front of the block.

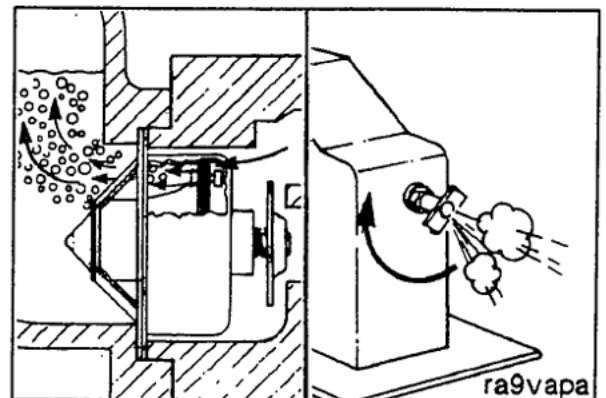


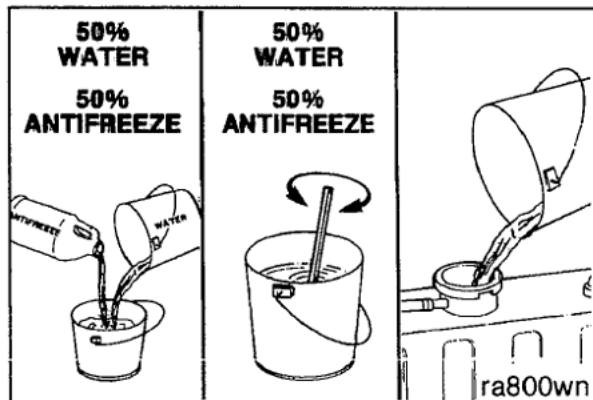
Attach the water supply to the temperature sensor location (B Series) (1) or front block opening (C Series) (2) and back flush the engine.

**Coolant System Filling**

B Series engines have a maximum fill rate of 14 liters per minute [3.5 U.S. gallons per minute]. Do **not** exceed this fill rate.

Caution: The system must be filled slowly 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 B Series 220 HP and 250 HP aftercooled engines. Wait 2 to 3 minutes to allow air to be vented, then add mixture to bring the level to the top.





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

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

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



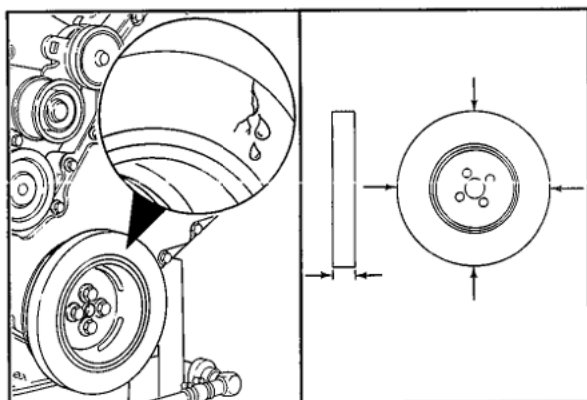
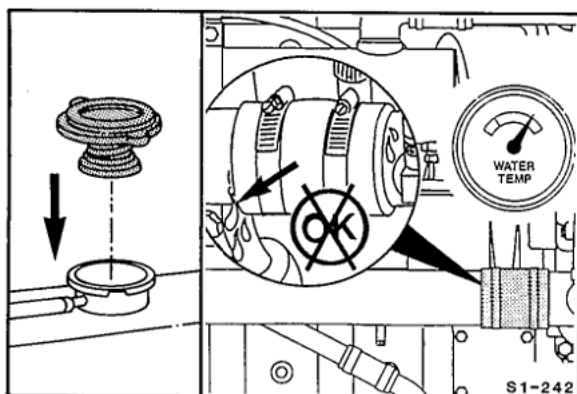
Use the amount of DCA4 corrosion inhibitor given in Section V to protect the C Series engine cooling system.



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



Install the pressure cap. Operate the engine until it reaches a temperature of 83°C [180°F]. Check for coolant leaks and add coolant as necessary.



Vibration Damper - Inspection

Viscous Damper

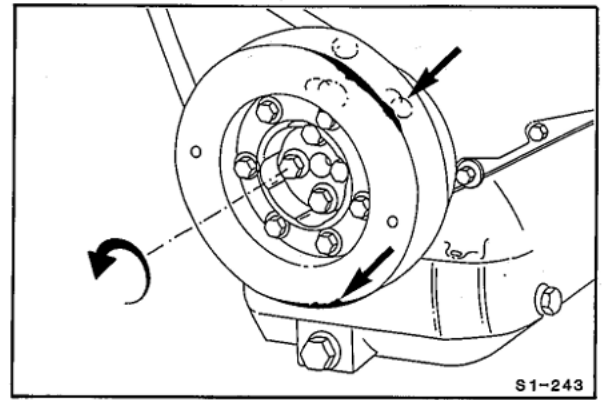


Caution: The silicone fluid in the damper will become solid after extended service and will make the damper inoperative. An inoperative damper can cause major engine or driveline failures.



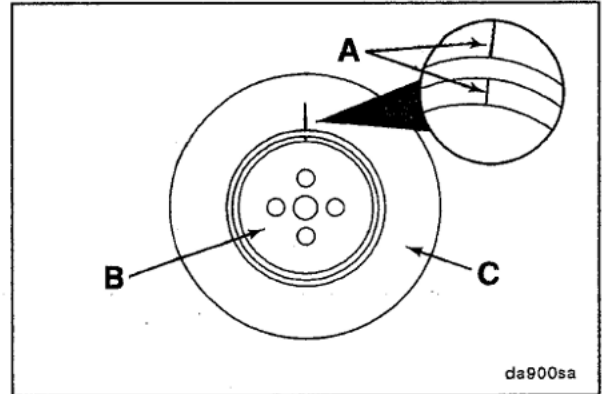
Inspect the damper for evidence of fluid loss, dents, and wobble. Visually inspect the vibration damper thickness for any deformation or raising of the damper front cover plate.

Inspect the mounting web for cracks. Inspect the housing for dents or raised surfaces. Remove and replace the damper if any of these defects are identified.



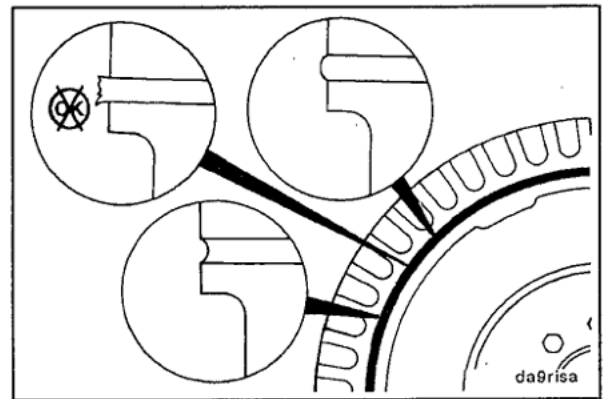
Rubber Damper

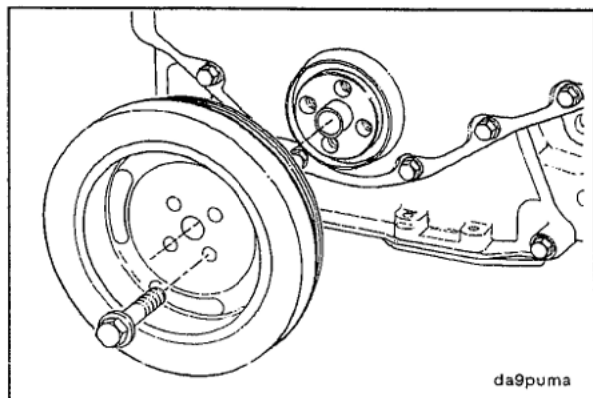
Check the index lines (A) on the damper hub (B) and the inertia member (C). If the lines are more than 1.59 mm [1/16 inch] out of alignment, replace the damper.



Inspect the rubber member for deterioration. If pieces of rubber are missing or if the elastic member is more than 3.18 mm [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.





Vibration Damper - Replacement

Rubber Damper

Preparatory Steps:

- Disconnect the ground battery cable.
- Remove the belt cover.
- Remove the drive belt.



15 mm (B-Series) 18 mm (C-Series)

Remove the mounting capscrews.



Replace the damper.



Torque Values:

B-Series 125 N•m [92 ft-lb]

C-Series 200 N•m [148 ft-lb]

Viscous Damper

Preparatory Steps:

- Disconnect the negative battery cable.
- Remove the drive belt.



15 mm (B-Series) 18 mm (C-Series)

Remove the mounting capscrews.



Replace the damper.



Torque Values:

B-Series 125 N•m [92 ft-lb]

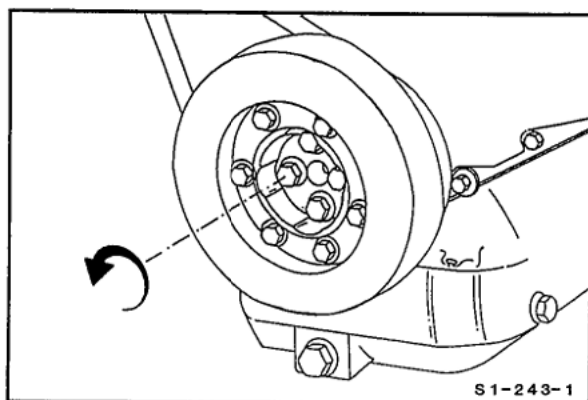
C-Series 200 N•m [148 ft-lb]

NOTE: Damper to adapter capscrews.

Torque Values:

B-Series 40 N•m [30 ft-lb]

C-Series 77 N•m [57 ft-lb]



Section D - System Diagrams

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General Information

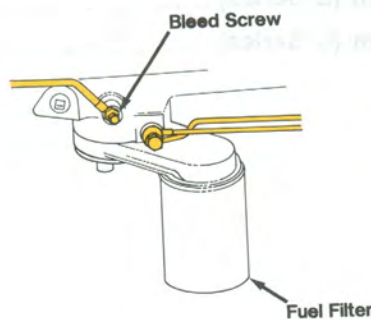
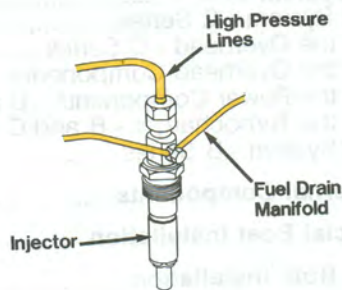
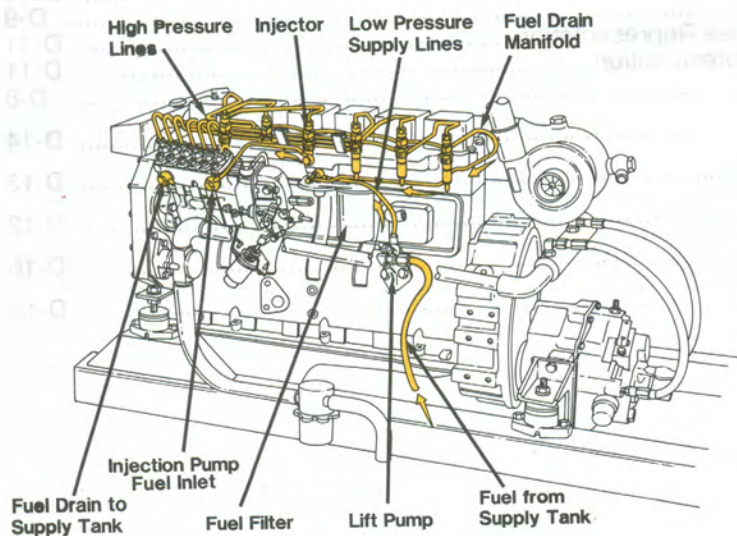
The following drawings show the flow through the engine systems. Although parts can change between different applications and installations, the flow remains the same. The systems shown are:

- Fuel System
- Air System
- Exhaust System
- Lubrication Oil System
- Cooling System
- Electrical System

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

Fuel System - B and C Series Representation

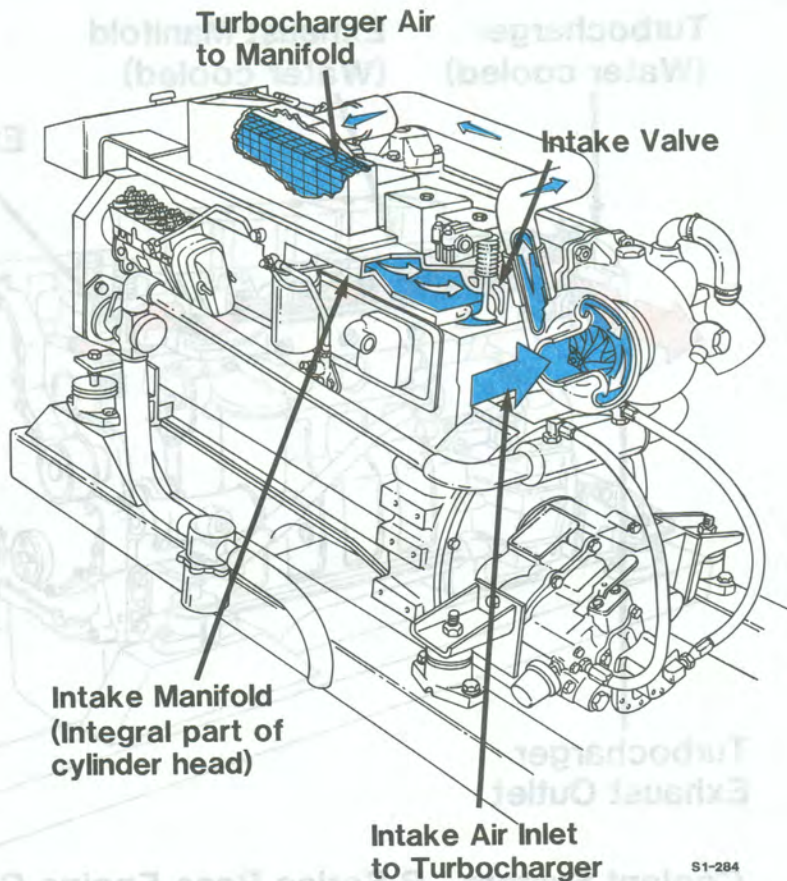
NOTE: B Series shown.



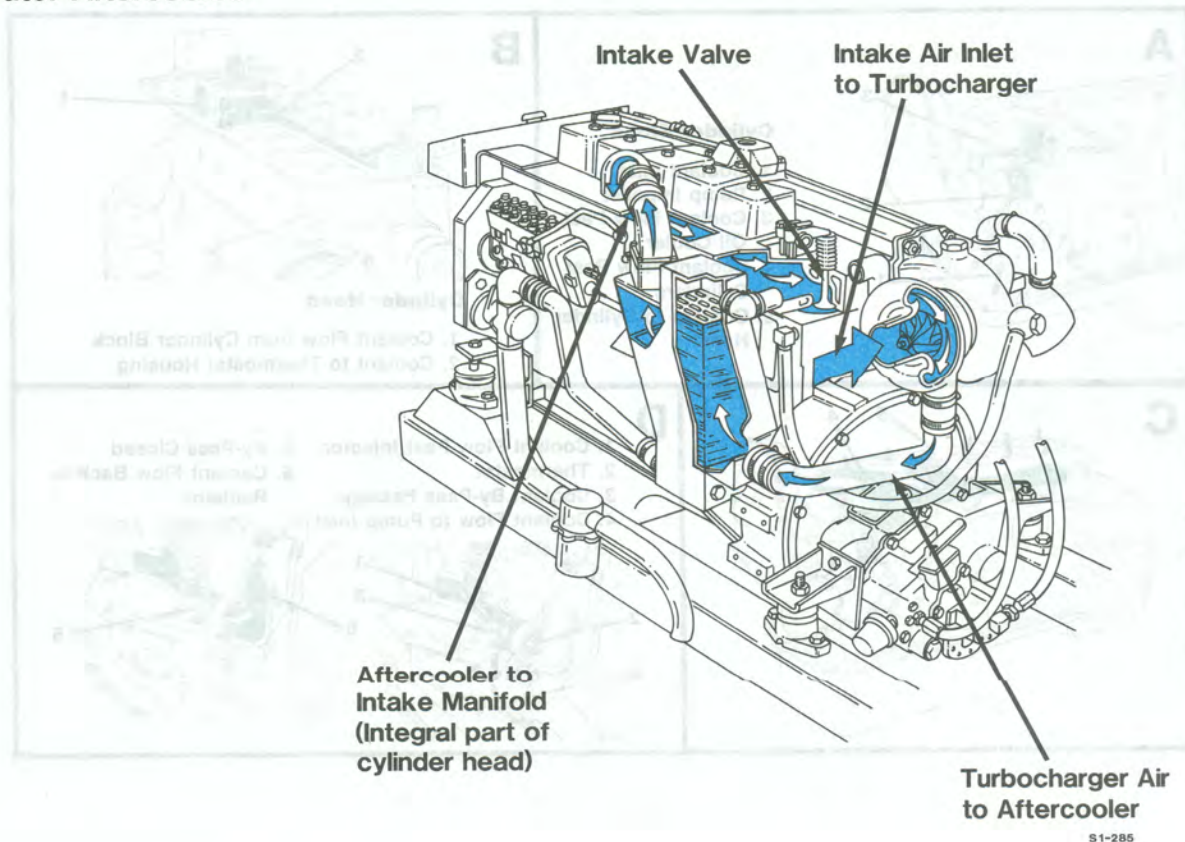
Air System - B and C Series Representation

NOTE: B Series shown.

Engine Coolant Aftercooled

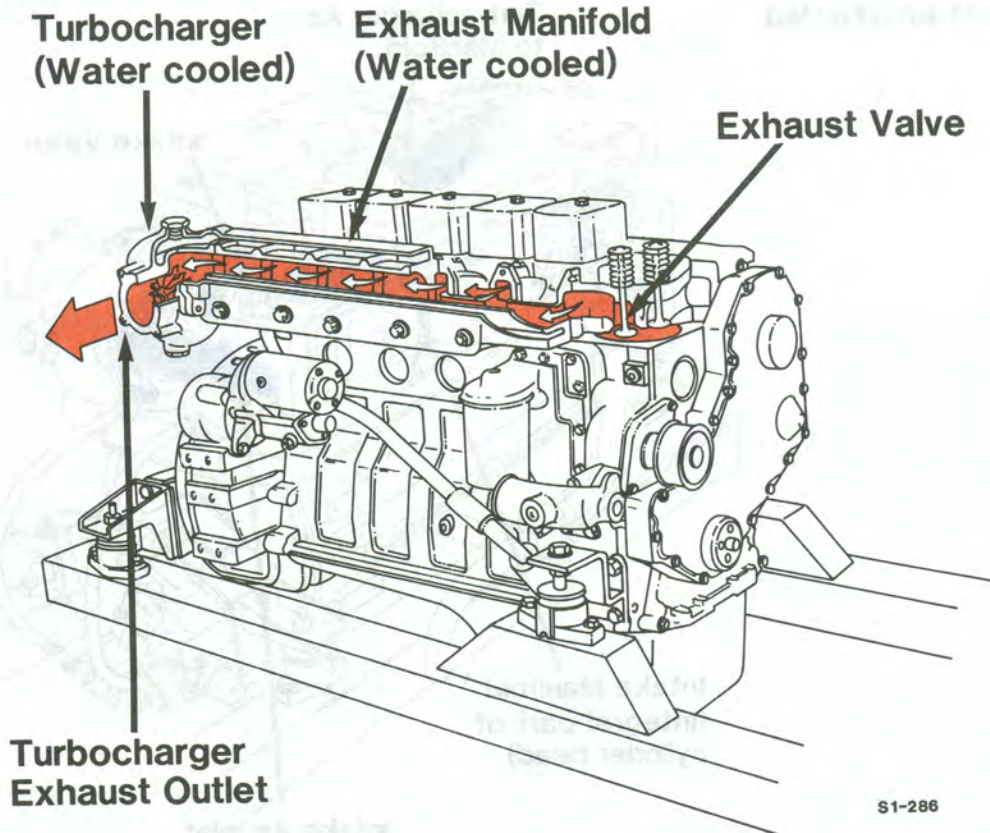


Raw Water Aftercooled



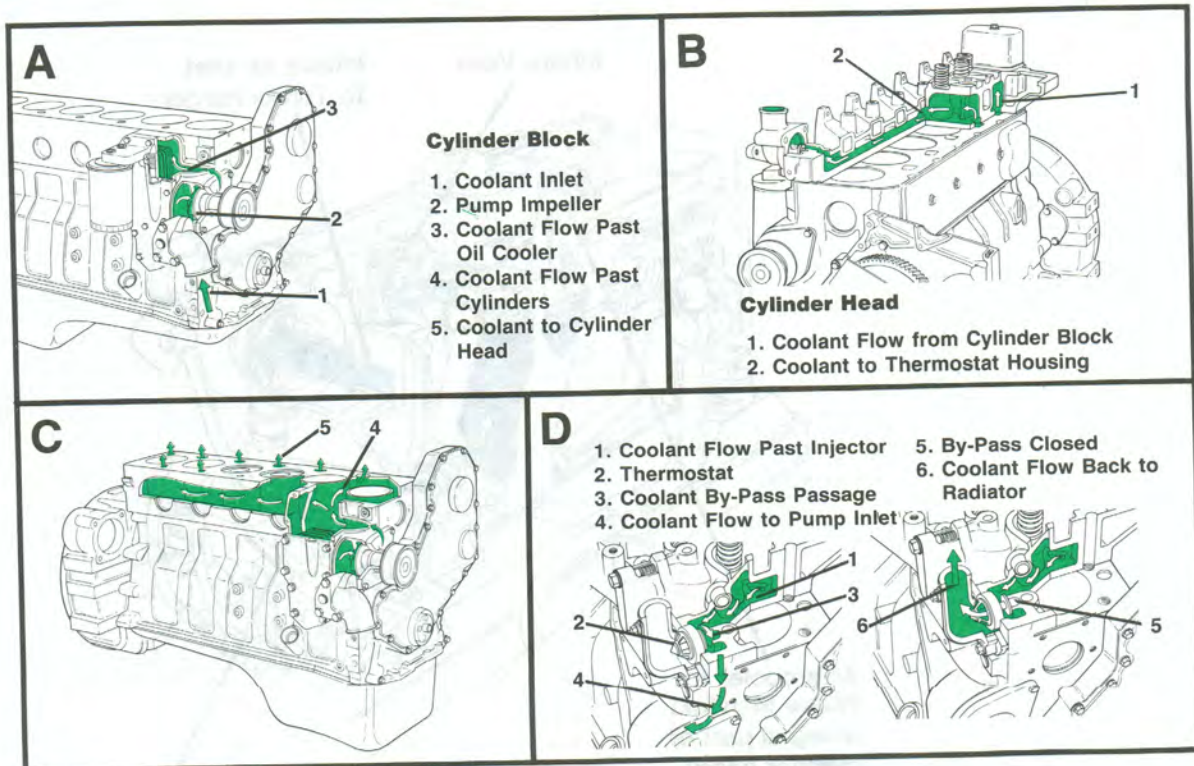
Exhaust System - B and C Series Representation

NOTE: B Series shown.



No

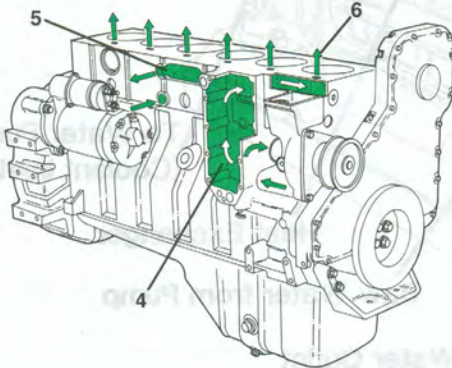
Coolant System - B Series Base Engine Coolant Flow



yes Coolant System - C Series Base Engine Coolant Flow

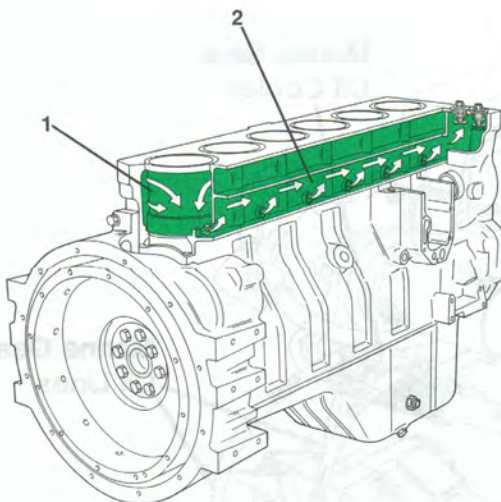
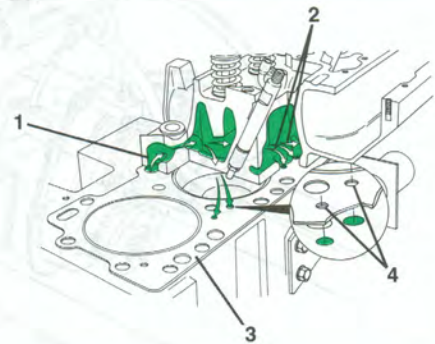
Cylinder Block

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



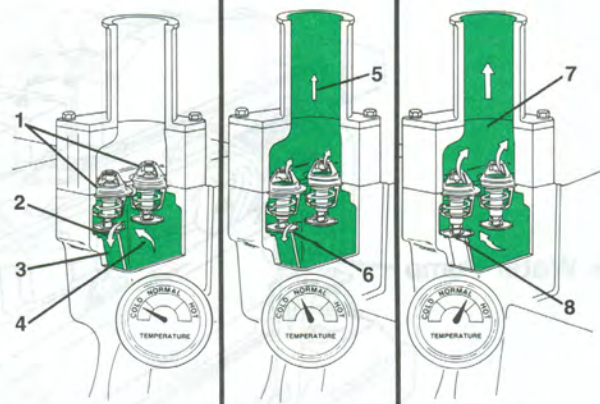
Cylinder Head

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



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

Thermostat



Closed

1. Thermostats
2. Coolant to Pump Inlet
3. Bypass Passage
4. Coolant from Lower Coolant Manifold

Intermediate

5. Partial Coolant Flow to Radiator
6. Restricted Coolant Flow to Bypass

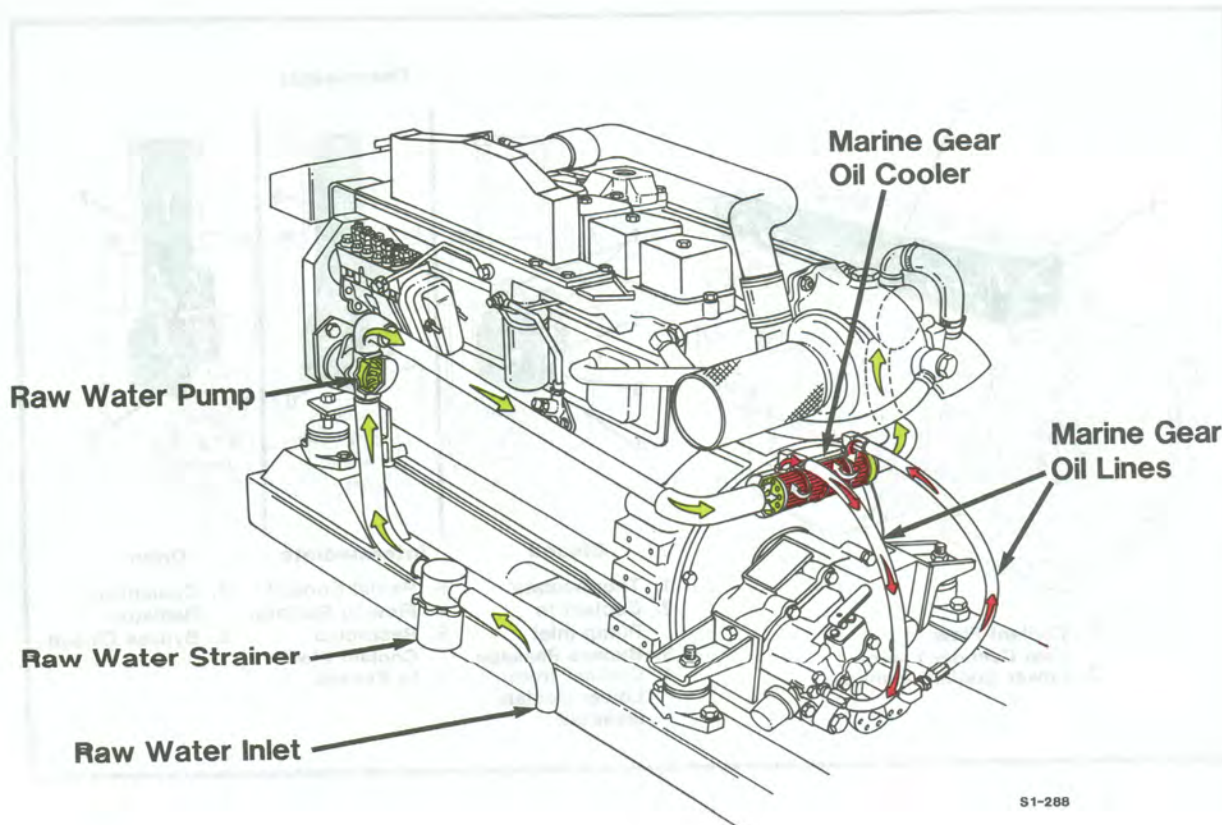
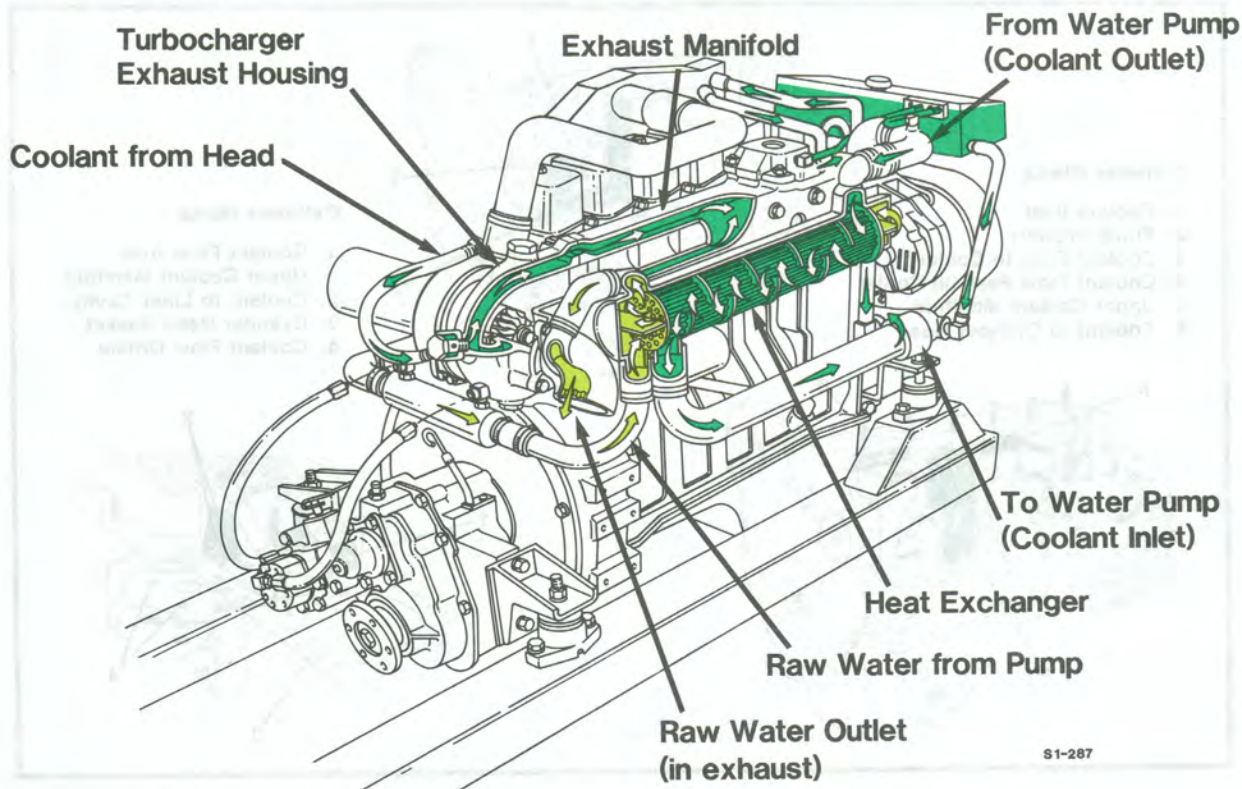
Open

7. Coolant to Radiator
8. Bypass Closed

Coolant System - B and C Series Representation

NOTE: B Series shown.

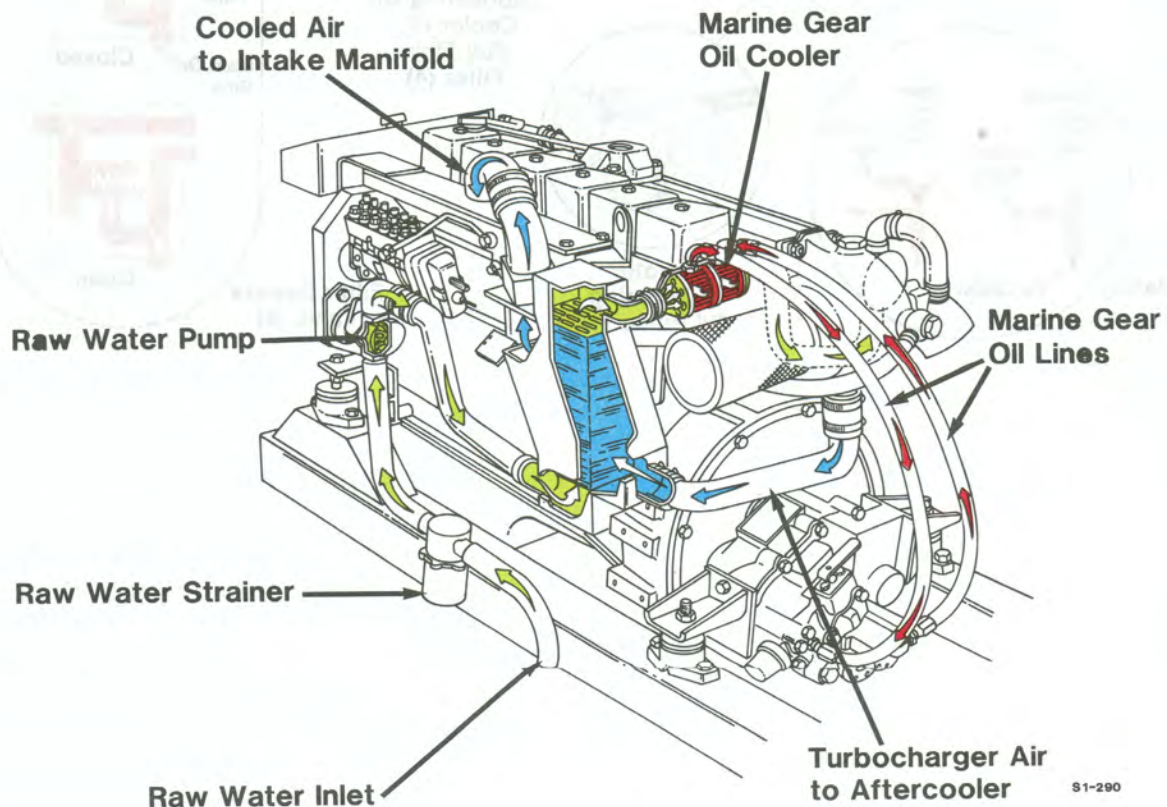
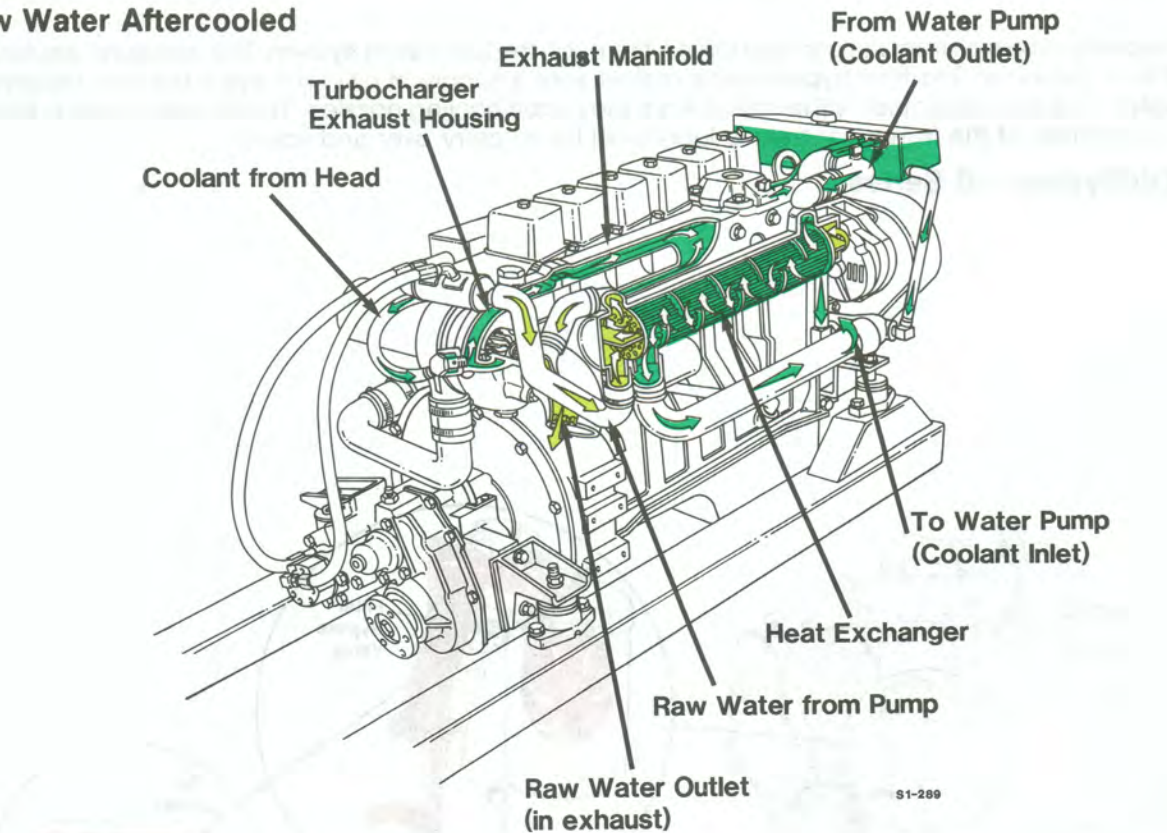
Engine Coolant Aftercooled



Coolant System - B and C Series Representation (Continued)

NOTE: B Series shown.

Raw Water Aftercooled

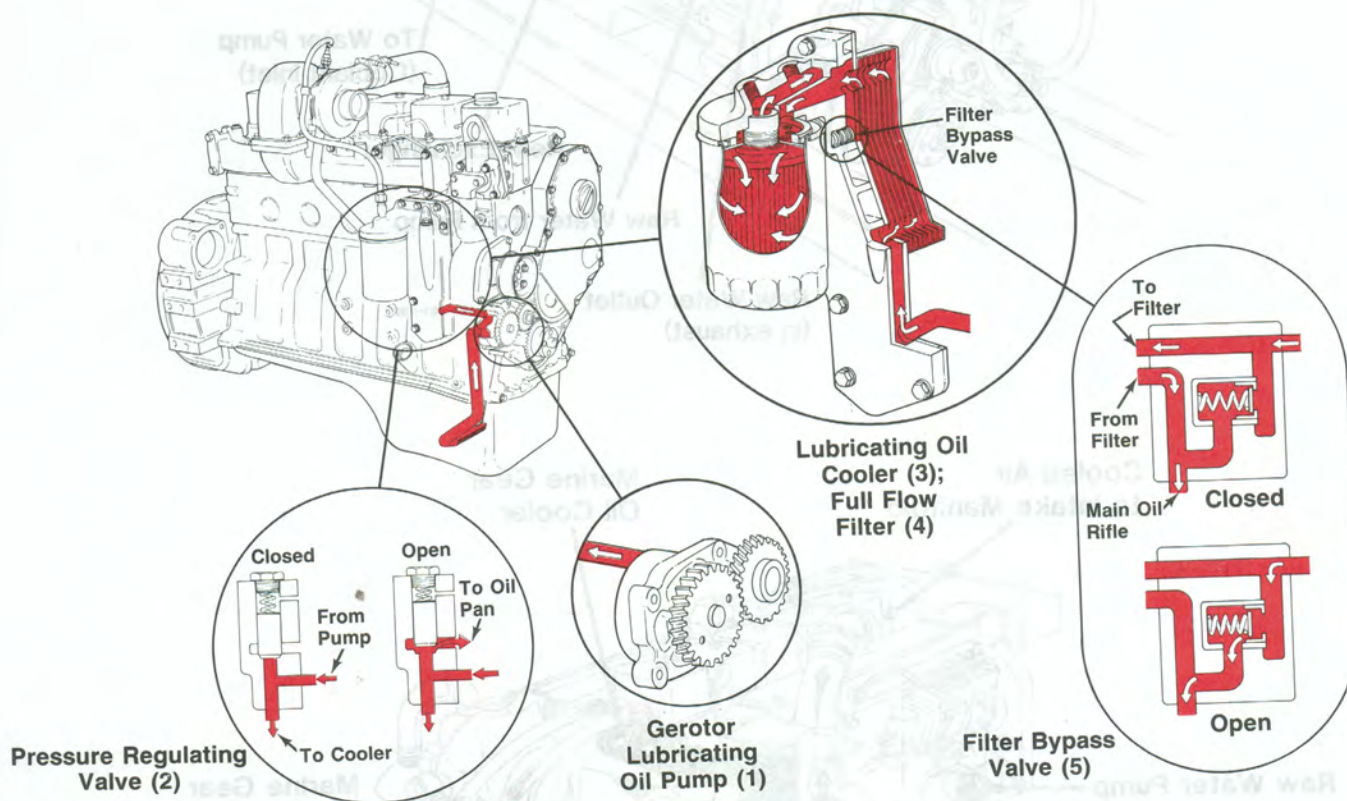


Lubrication Oil System

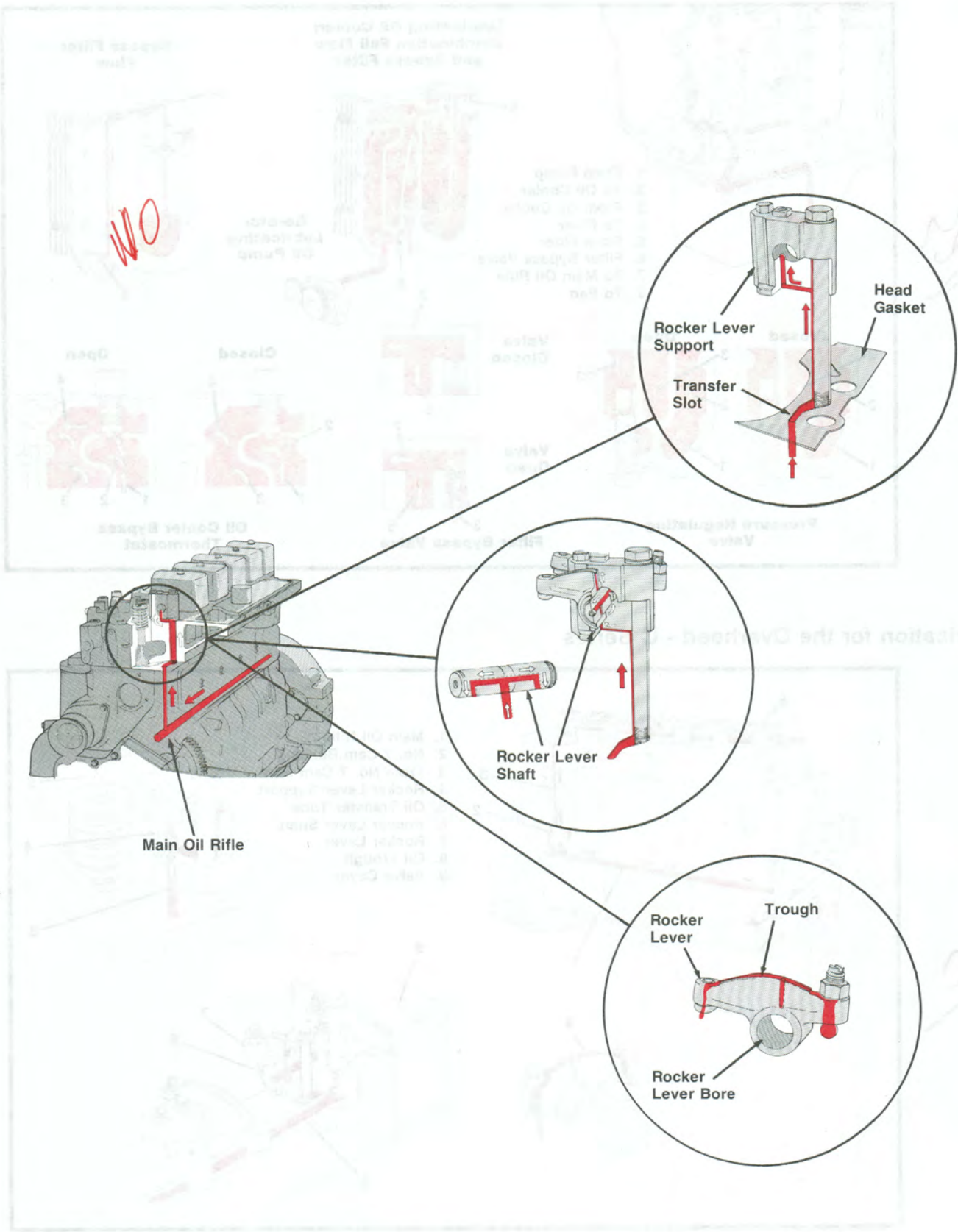
The schematic below illustrates the lubrication of the various components in the engine. The arrows indicate the flow path.

Briefly stated, the pump draws oil from the pan and forces it through the lubrication system. The pressure regulating valve controls the oil pressure. The filter bypass valve makes sure a supply of oil in the event the filter becomes plugged. The piston pins are lubricated by the splash from the piston cooling nozzles. The oil pump gear is forced lubricated. The remainder of the front gear train is lubricated by oil carry over and splash.

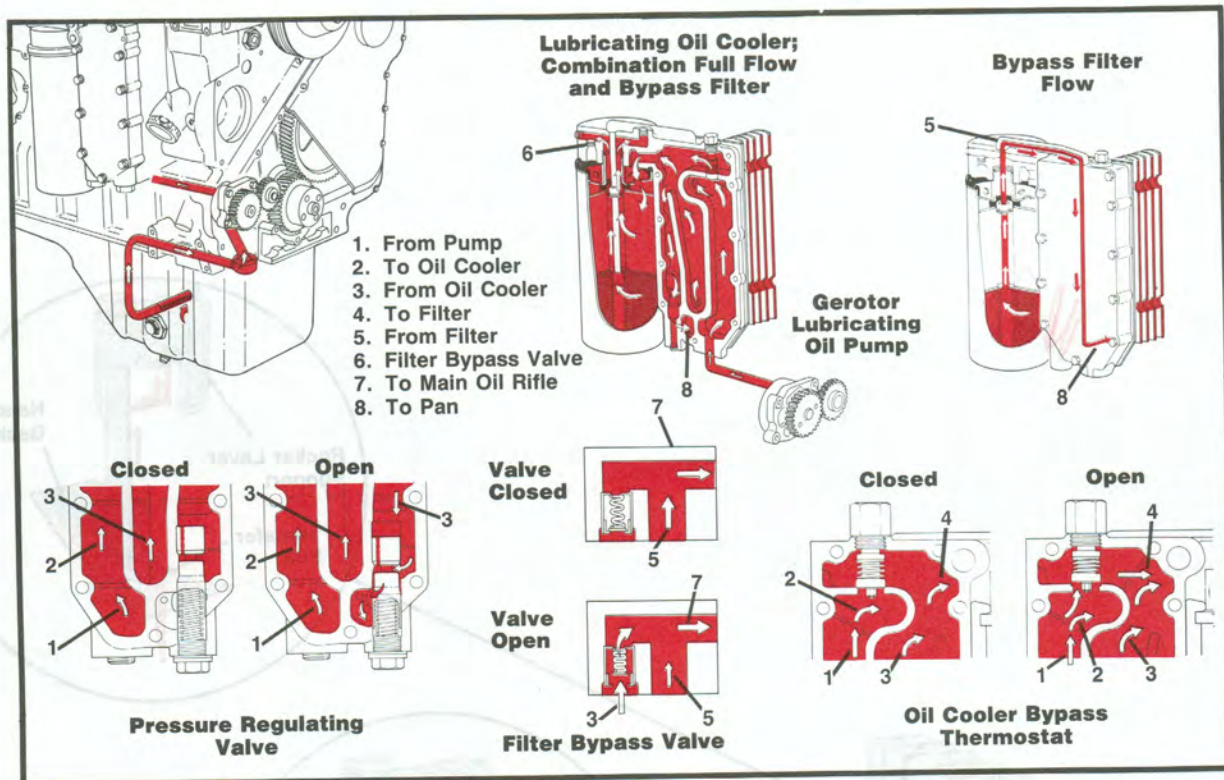
Lubrication Oil System - B Series



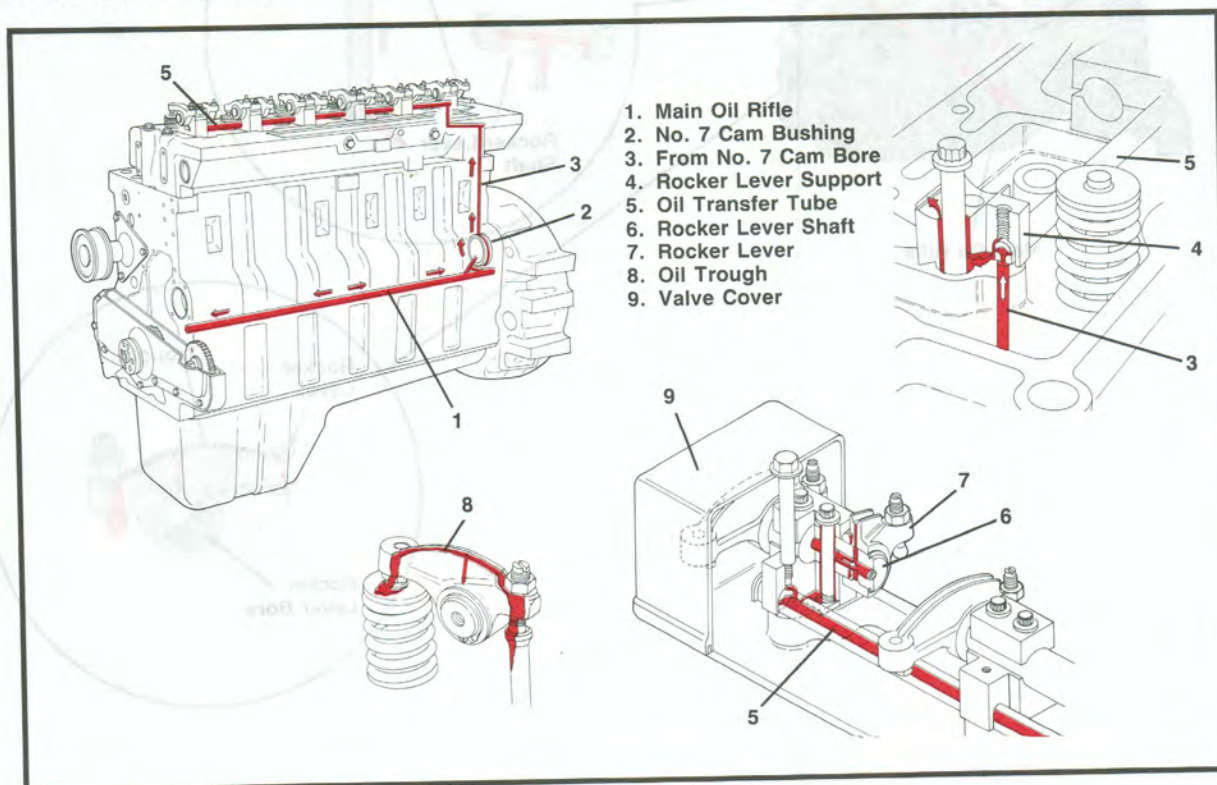
Lubrication for the Overhead Components - B Series



Lubricating Oil System - C Series

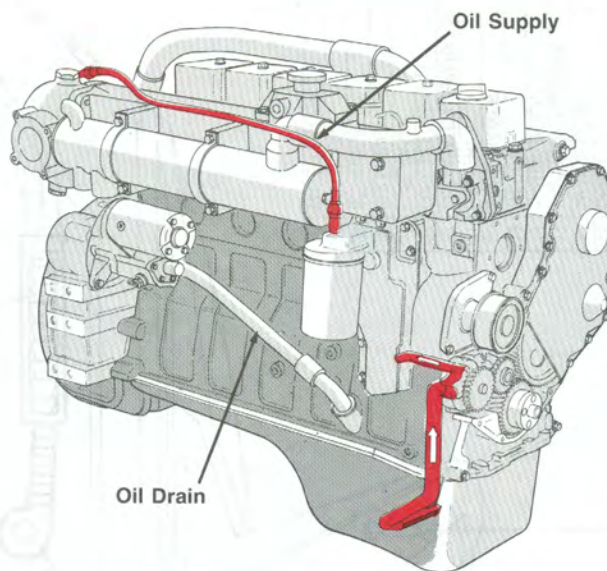


Lubrication for the Overhead - C Series



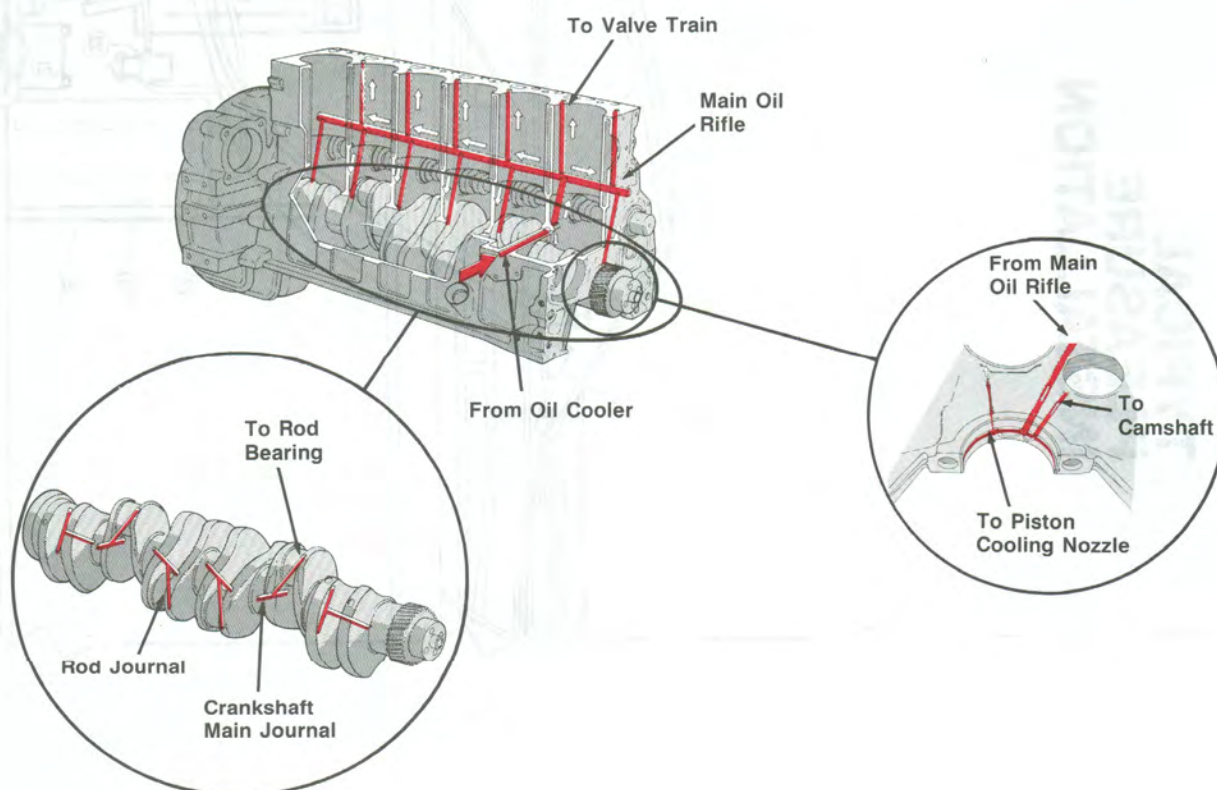
Lubrication for the Turbocharger - B and C Series Representation

NOTE: B Series engine shown.



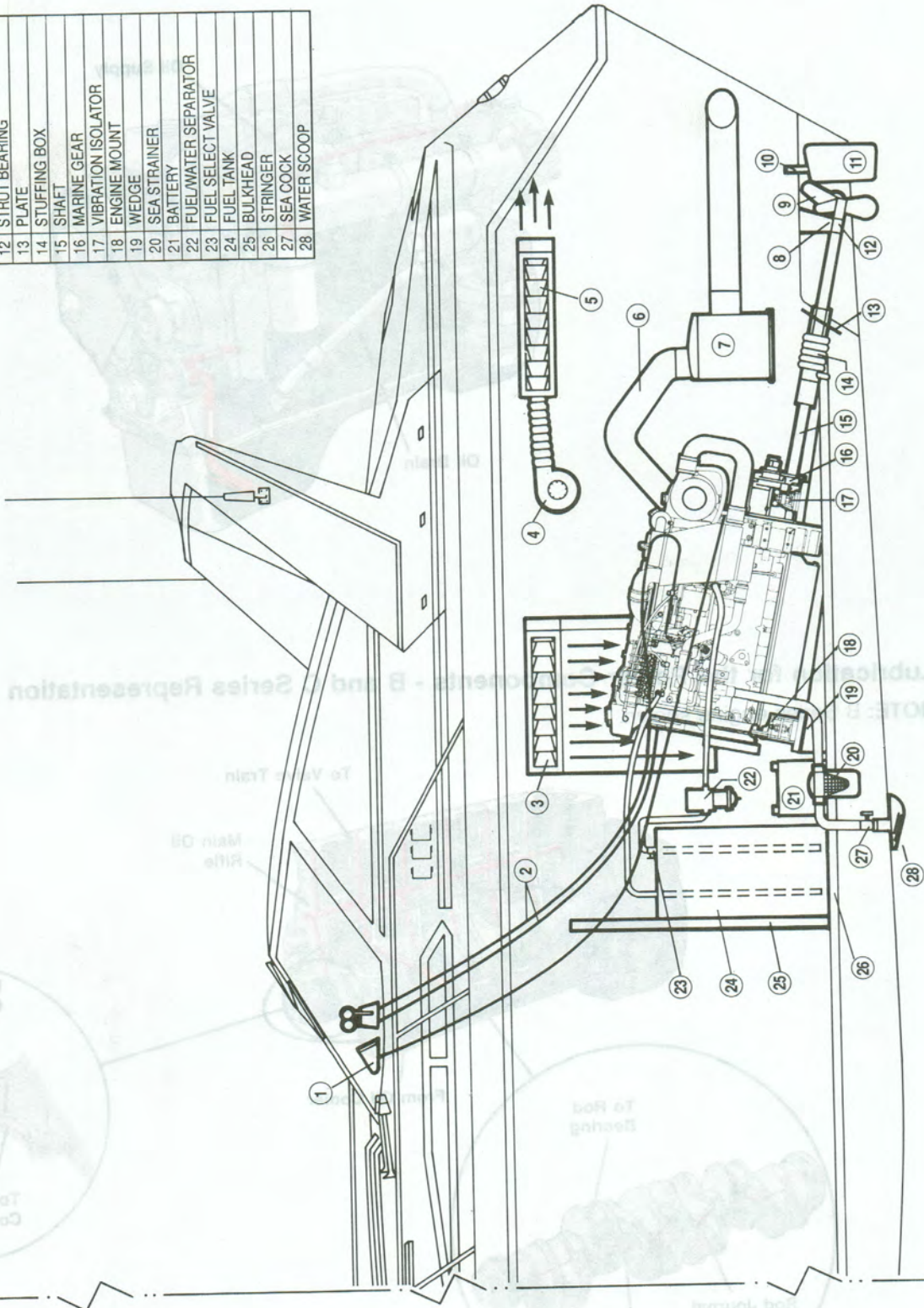
Lubrication for the Power Components - B and C Series Representation

NOTE: B Series engine shown.



Typical Pleasure Boat Installation

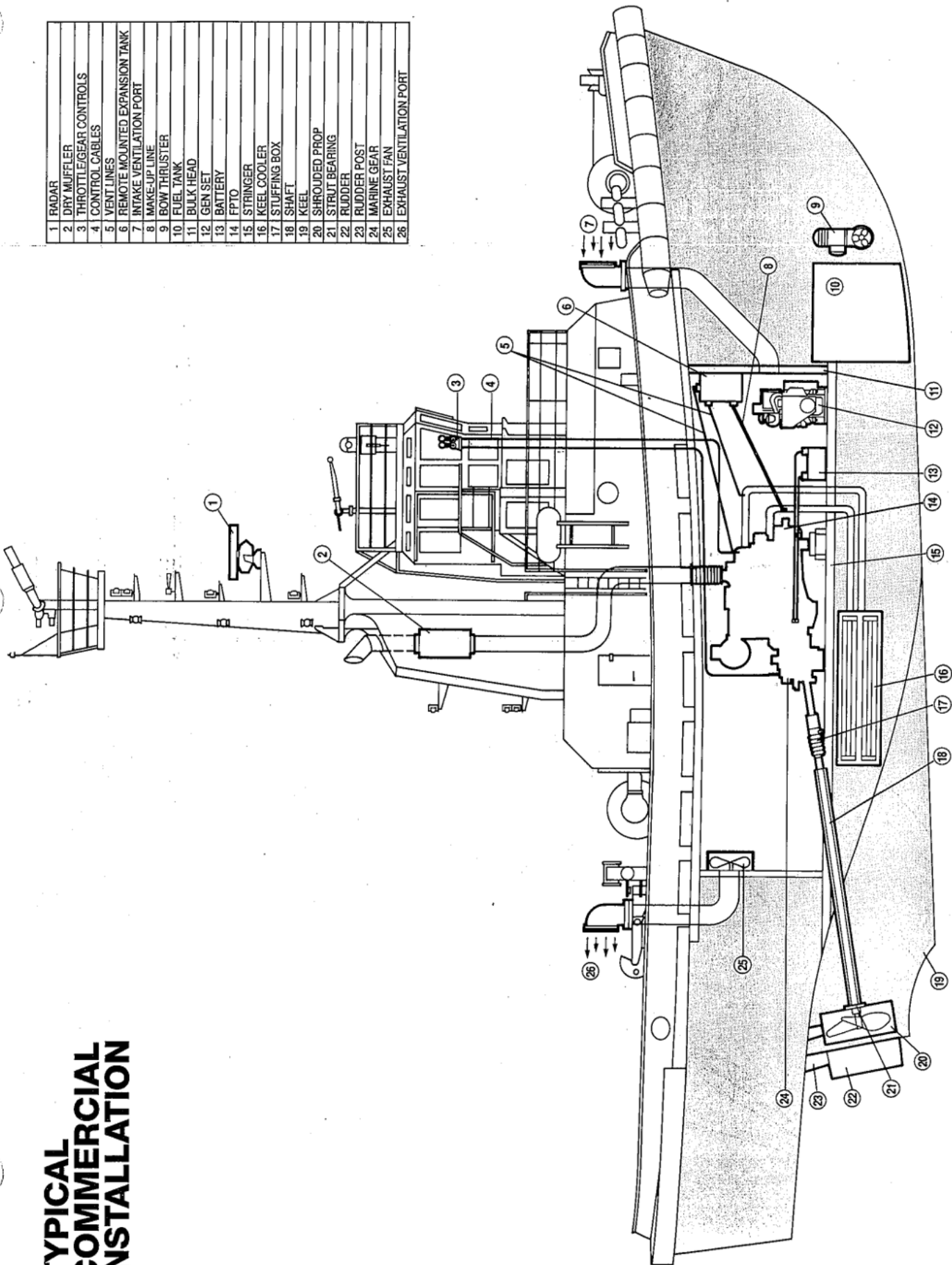
1	INSTRUMENT PANEL
2	CONTROL CABLES
3	INTAKE VENTILATION PORT
4	EXHAUST BLOWER
5	EXHAUST VENTILATION PORT
6	RISER
7	WATERLIFT MUFFLER
8	STRUT
9	PROP
10	RUDDER POST
11	RUDDER
12	STRUT BEARING
13	PLATE
14	STUFFING BOX
15	SHAFT
16	MARINE GEAR
17	VIBRATION ISOLATOR
18	ENGINE MOUNT
19	WEDGE
20	SEA STRAINER
21	BATTERY
22	FUEL/WATER SEPARATOR
23	FUEL SELECT VALVE
24	FUEL TANK
25	BULKHEAD
26	STRINGER
27	SEA COCK
28	WATER SCOOP



**TYPICAL
PLEASURE
INSTALLATION**

Typical Commercial Boat Installation

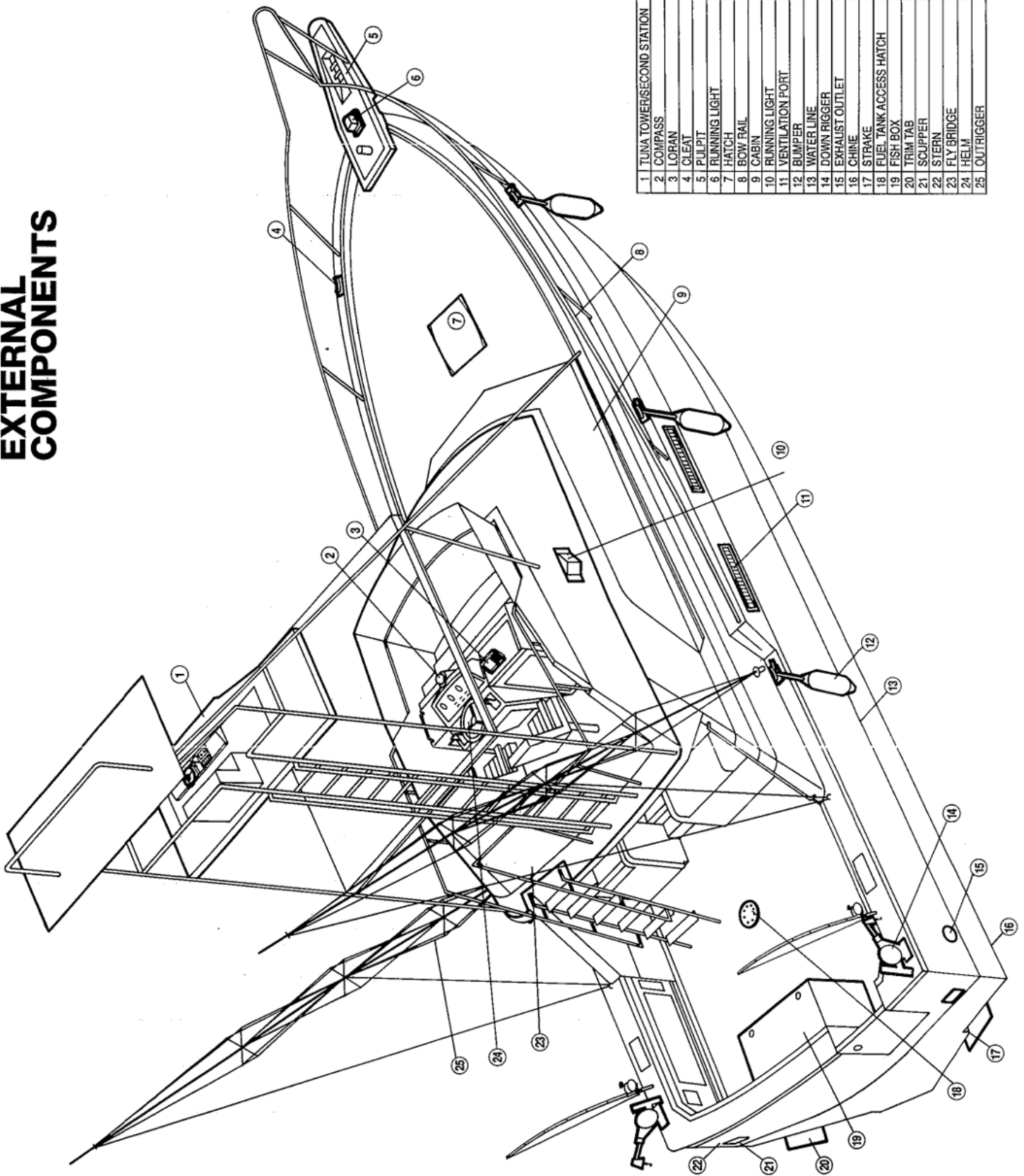
1	RADAR
2	DRY MUFFLER
3	THROTTLE/GEAR CONTROLS
4	CONTROL CABLES
5	VENT LINES
6	REMOTE MOUNTED EXPANSION TANK
7	INTAKE VENTILATION PORT
8	MAKE-UP LINE
9	BOW THRUSTER
10	FUEL TANK
11	BULK HEAD
12	GEN SET
13	BATTERY
14	FPTO
15	STRINGER
16	KEEL COOLER
17	STUFFING BOX
18	SHAFT
19	KEEL
20	SHROUDED PROP
21	STRUT BEARING
22	RUDDER
23	RUDDER POST
24	MARINE GEAR
25	EXHAUST FAN
26	EXHAUST VENTILATION PORT



**TYPICAL
COMMERCIAL
INSTALLATION**

Typical Boat External Components

EXTERNAL COMPONENTS



NOTES

Lined area for notes, consisting of multiple horizontal lines.

Wiring Diagram (B Series)

FOR SINGLE STATION SYSTEM

WATER TEMP. SENDER P/N 3913628
(VDO P/N 323478)

F°	OHMS
105	287.4
180	64.5
210	39.7

OIL PRESS. SENDER P/N 3913627
(VDO P/N 3360430)

PSI	OHMS
0	10
60	90.5
150	187

FOR DUAL STATION SYSTEM

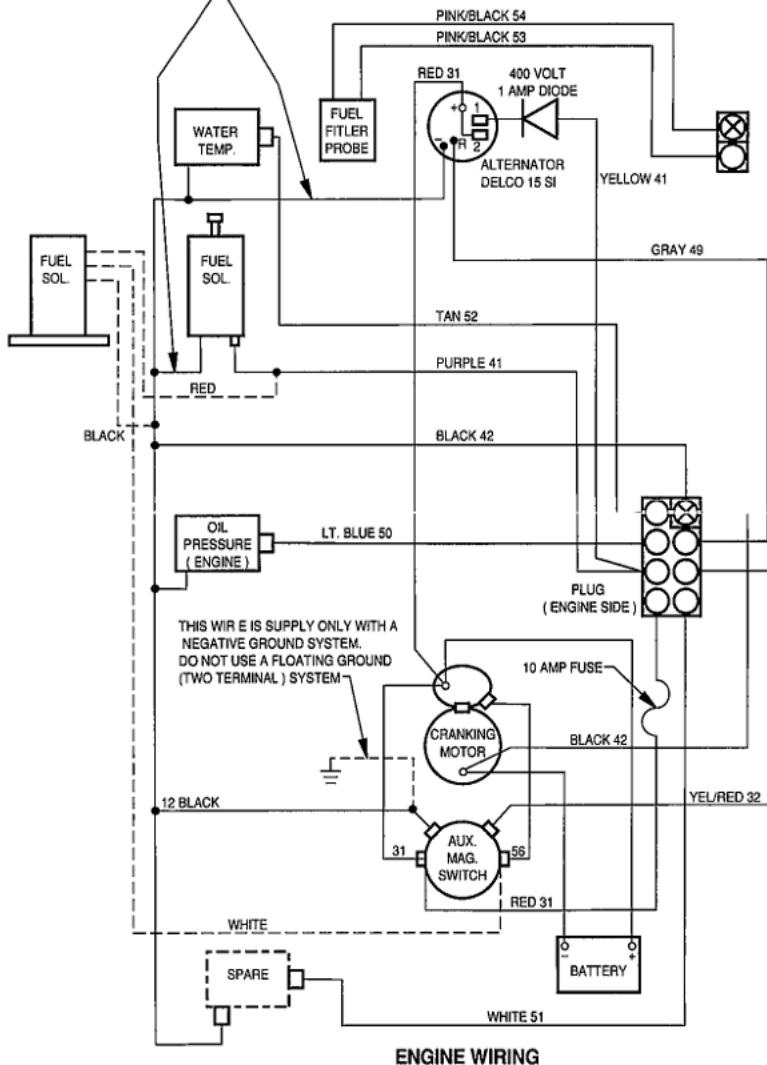
WATER TEMP. SENDER P/N 3914081
(VDO P/N 325007)

F°	OHMS
100	144
150	55
200	23
250	11

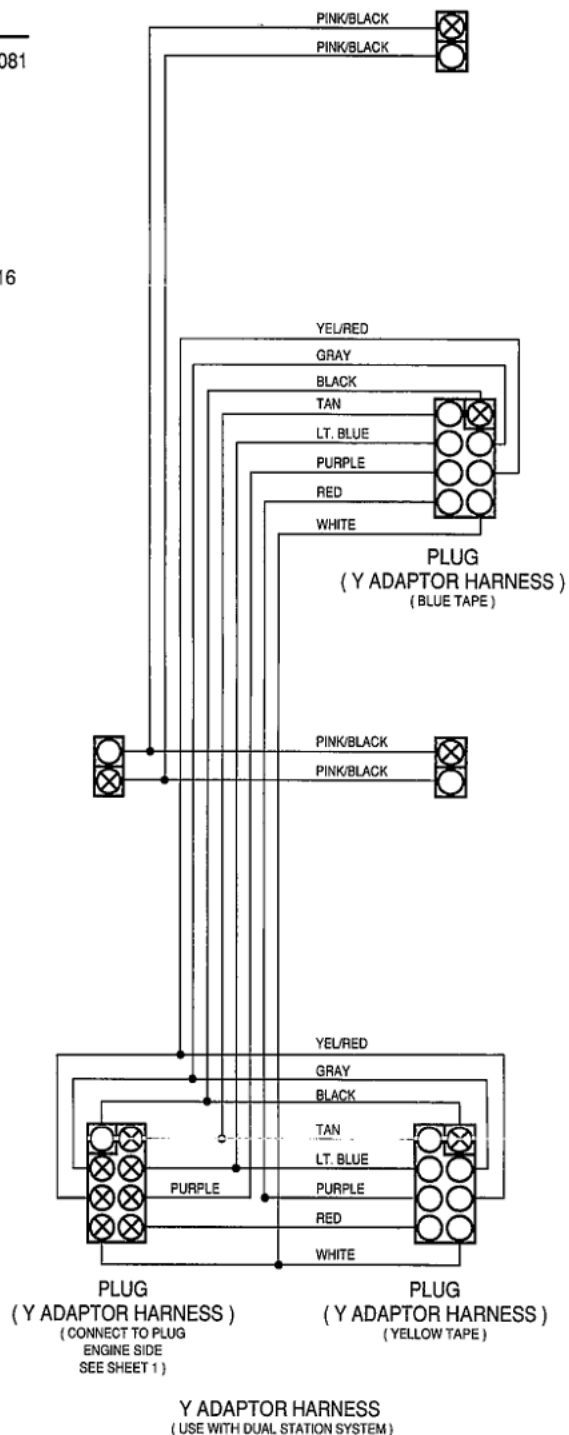
OIL PRESS. SENDER P/N 3913616
(VDO P/N 3360430)

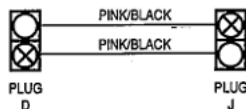
PSI	OHMS
0	5
60	45
150	93

THESE WIRES IN THE ENGINE WIRING HARNESS HAVE NO CONNECTION IN A NEGATIVE GROUND SYSTEM AND MUST BE LEFT UNCONNECTED. THESE WIRES ARE USED FOR THE NEGATIVE TERMINAL IN A FLOATING GROUND (TWO TERMINAL) SYSTEM.

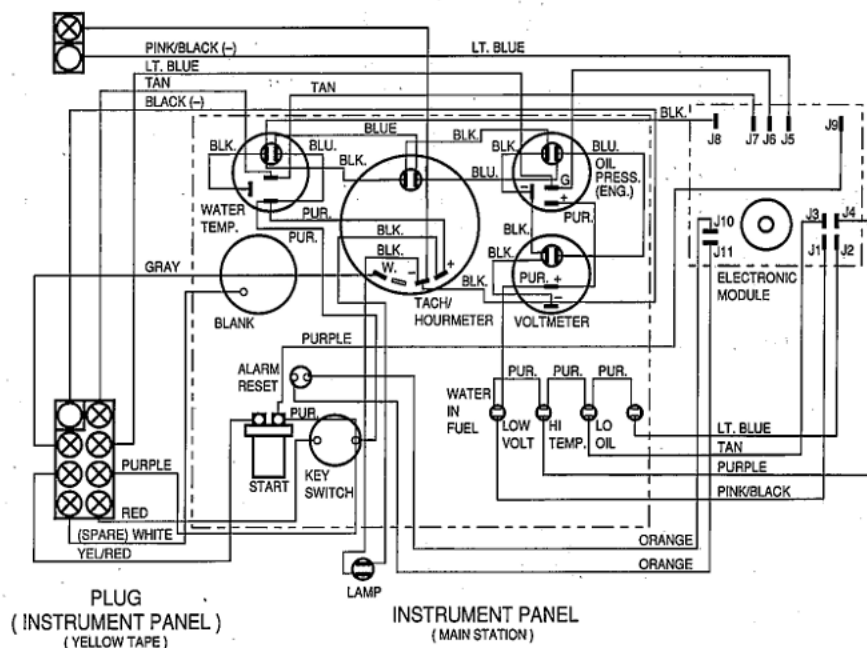
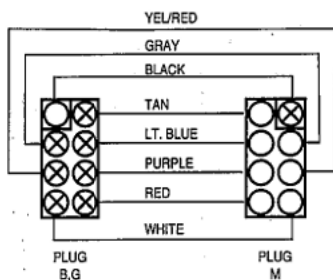
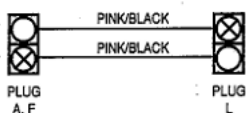
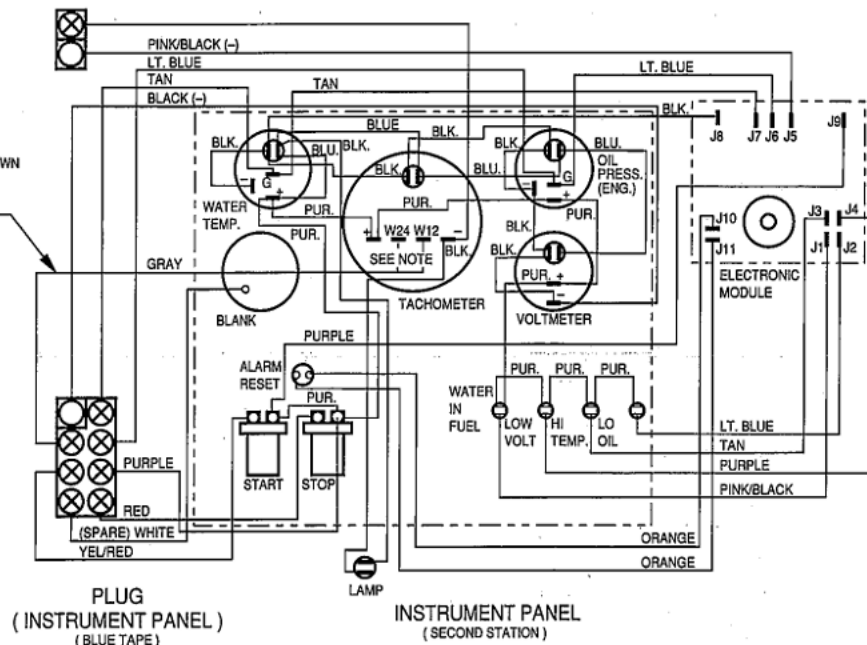
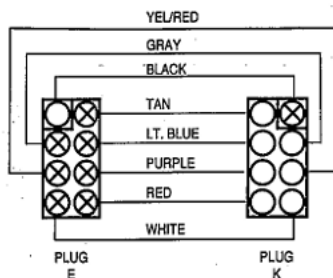


ENGINE WIRING





NOTE: THE GRAY WIRE TO TACHOMETER IS SHOWN CONNECTED TO WIRE W12 (12 VOLT SYSTEM). FOR A 24 VOLT SYSTEM THE GRAY WIRE NEEDS TO BE CONNECTED TO W24 TERMINAL.



EXTENSION HARNESS

Wiring Diagram (C Series)

FOR SINGLE STATION SYSTEM

WATER TEMP. SENDER P/N 3913628

F°	OHMS
105	287.4
180	64.5
210	39.7

OIL PRESS. SENDER P/N 3913627

PSI	OHMS
0	10
60	90.5
150	187

FOR DUAL STATION SYSTEM

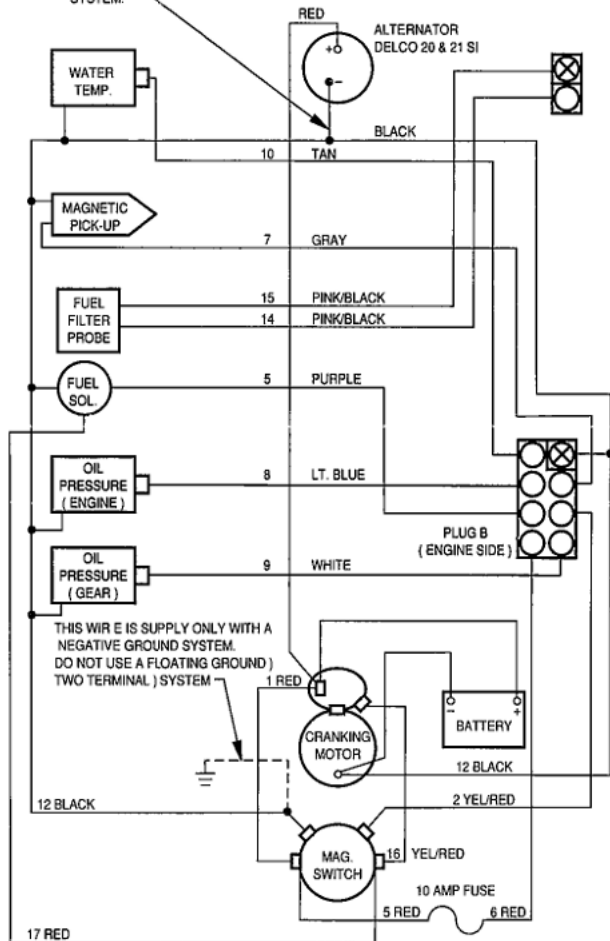
WATER TEMP. SENDER P/N 3914081

F°	OHMS
100	144
150	55
200	23
250	11

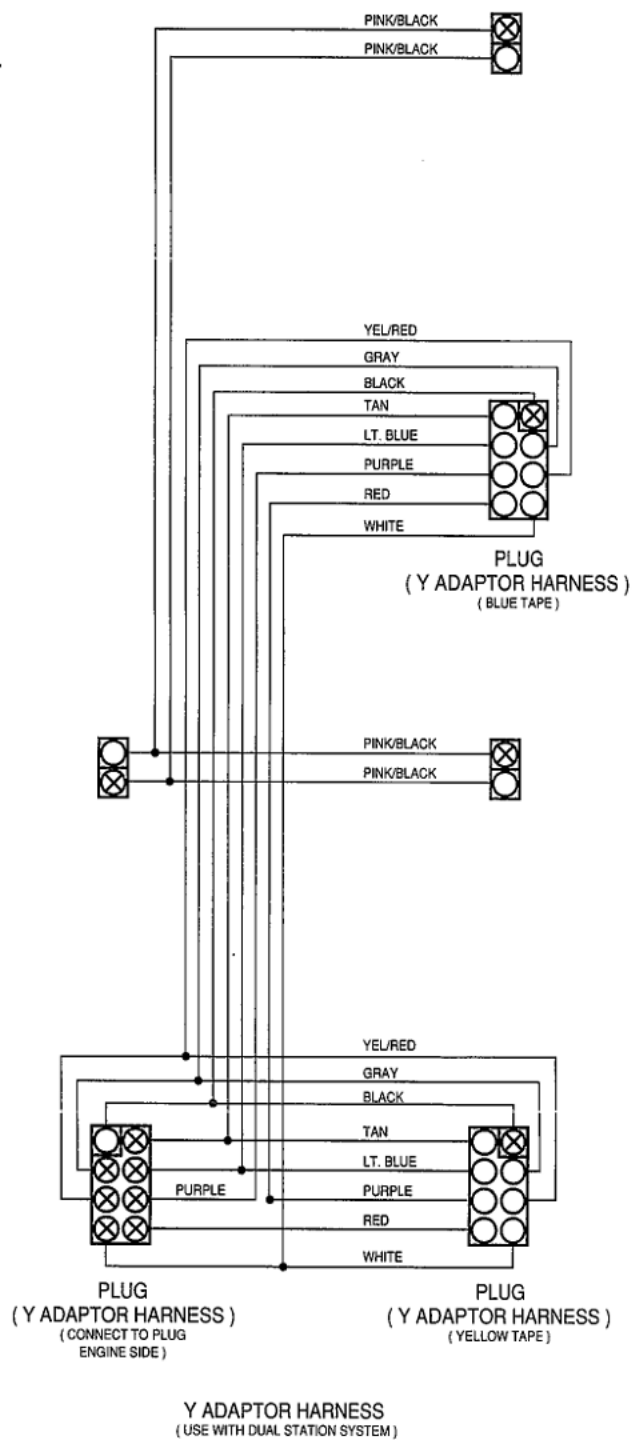
OIL PRESS. SENDER P/N 3913616

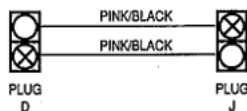
PSI	OHMS
0	5
60	45
150	93

THESE WIRES IN THE ENGINE WIRING HARNESS HAVE NO CONNECTION IN A NEGATIVE GROUND SYSTEM AND MUST BE LEFT UNCONNECTED. THESE WIRES ARE USED FOR THE NEGATIVE TERMINAL IN A FLOATING GROUND (TWO TERMINAL) SYSTEM.

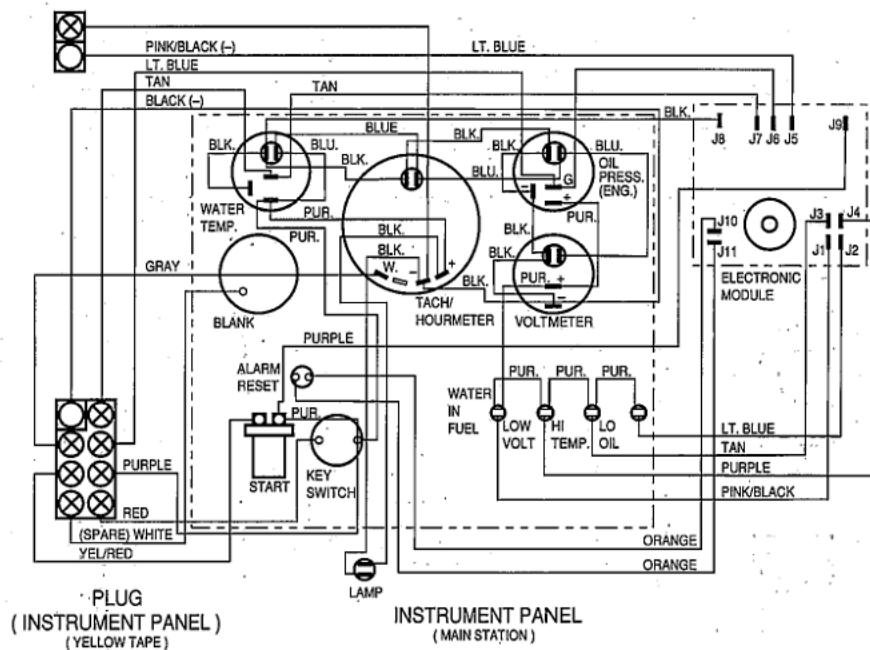
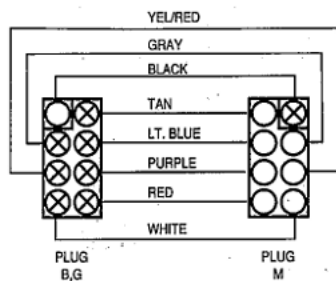
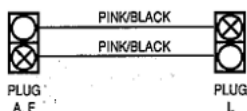
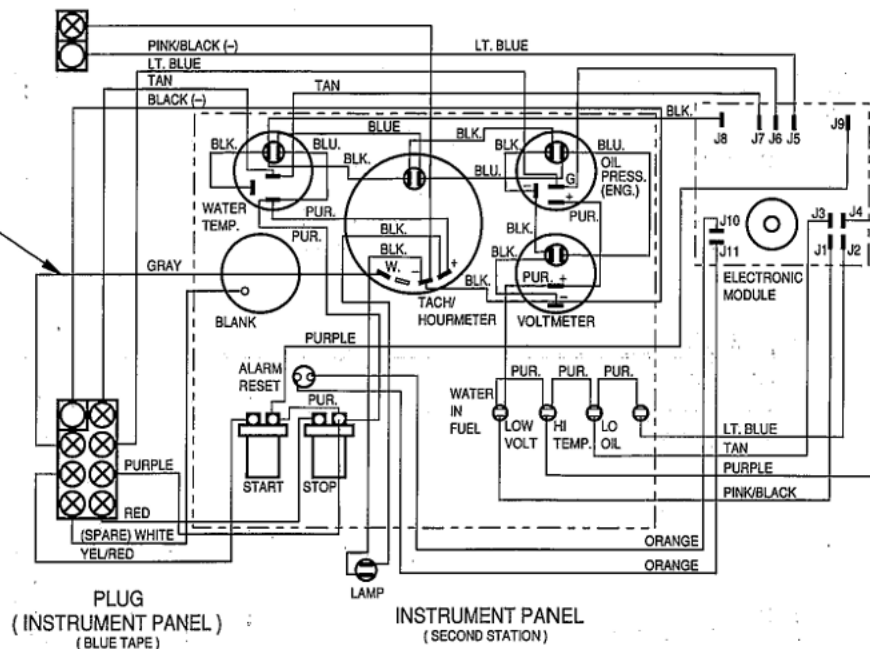
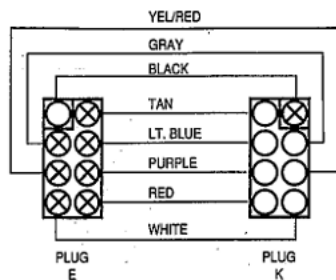


ENGINE WIRING



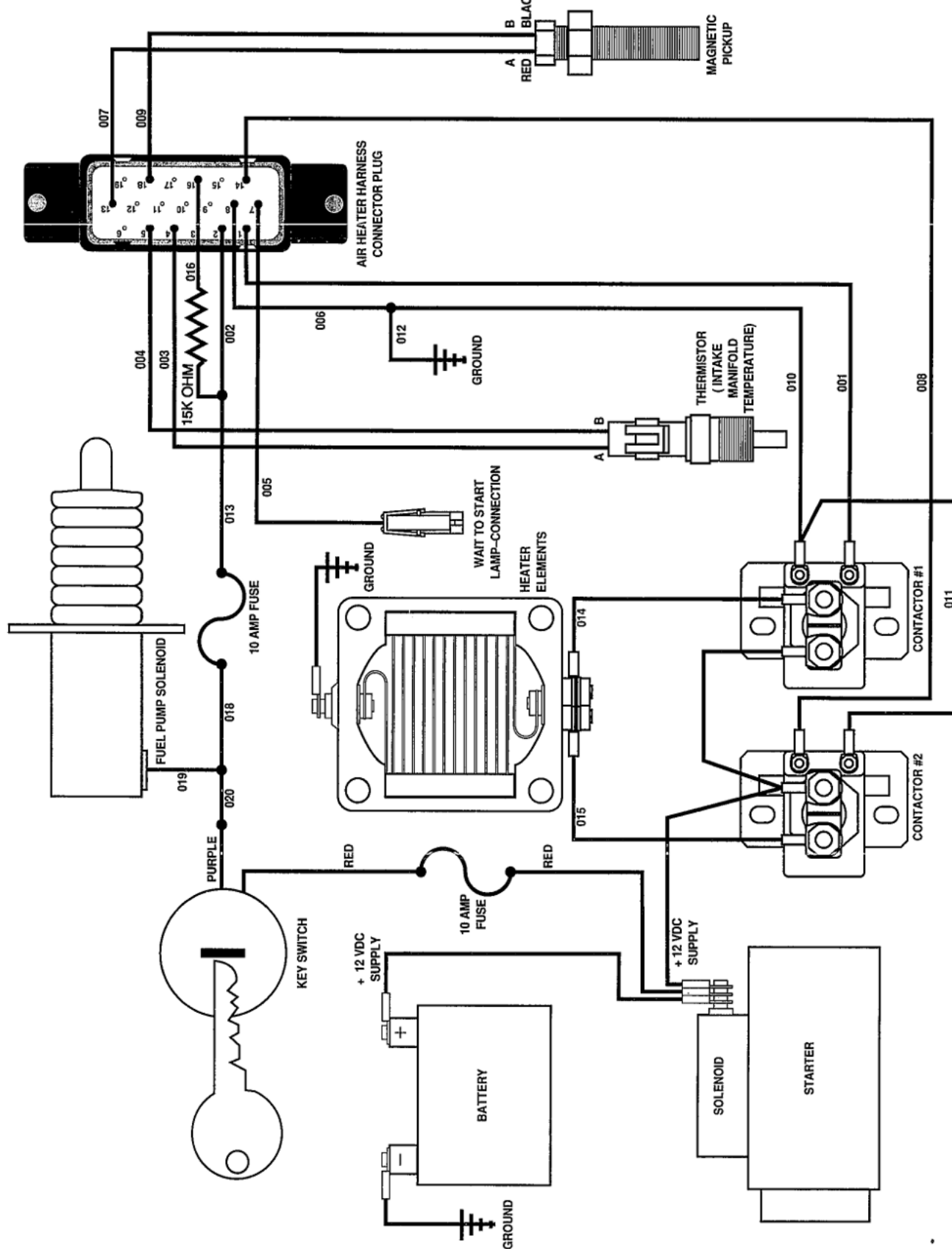


NOTE: THE GRAY WIRE TO TACHOMETER IS SHOWN CONNECTED TO WIRE W12 (12 VOLT SYSTEM). FOR A 24 VOLT SYSTEM THE GRAY WIRE NEEDS TO BE CONNECTED TO W24 TERMINAL.

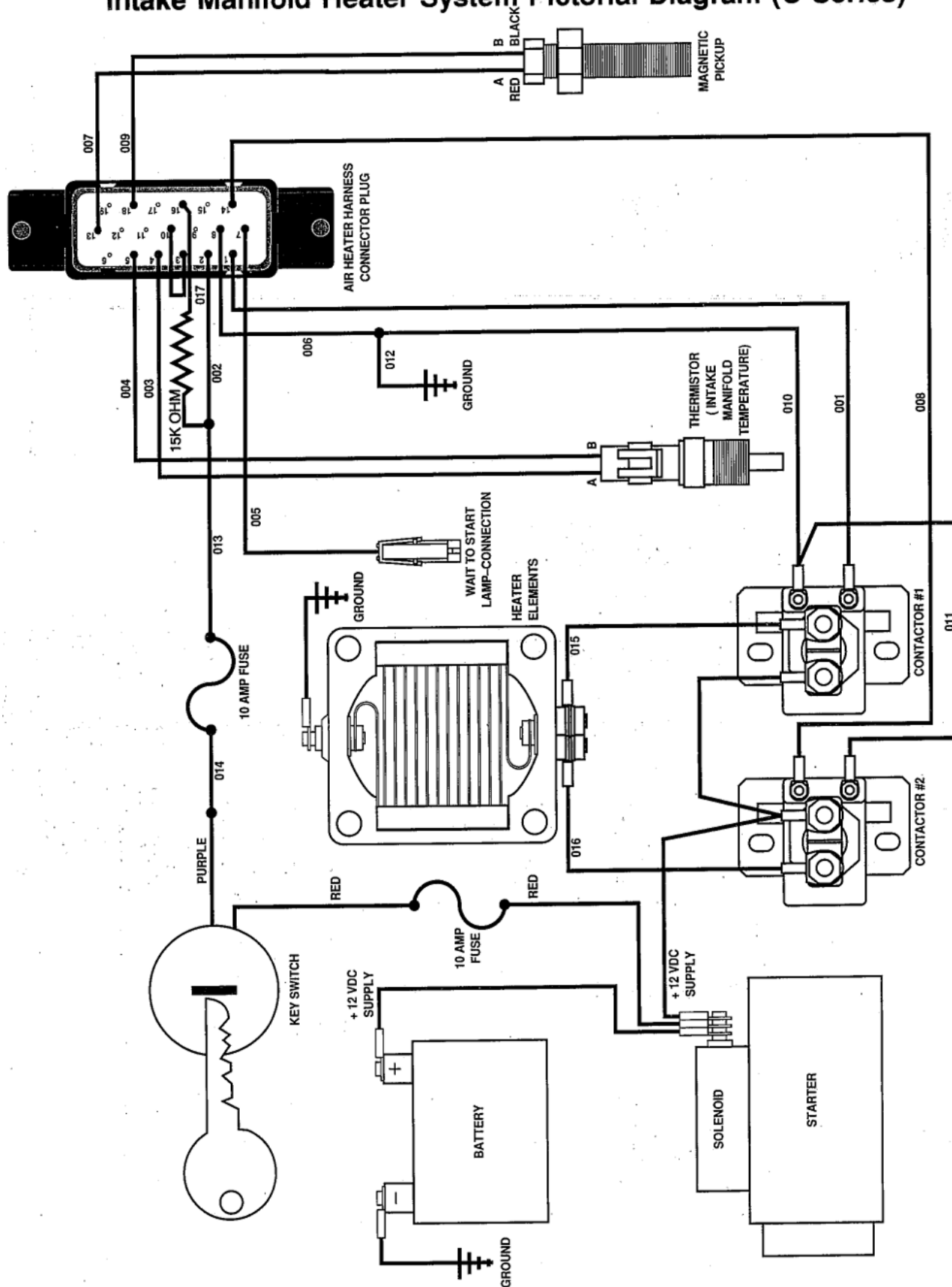


EXTENSION HARNESS

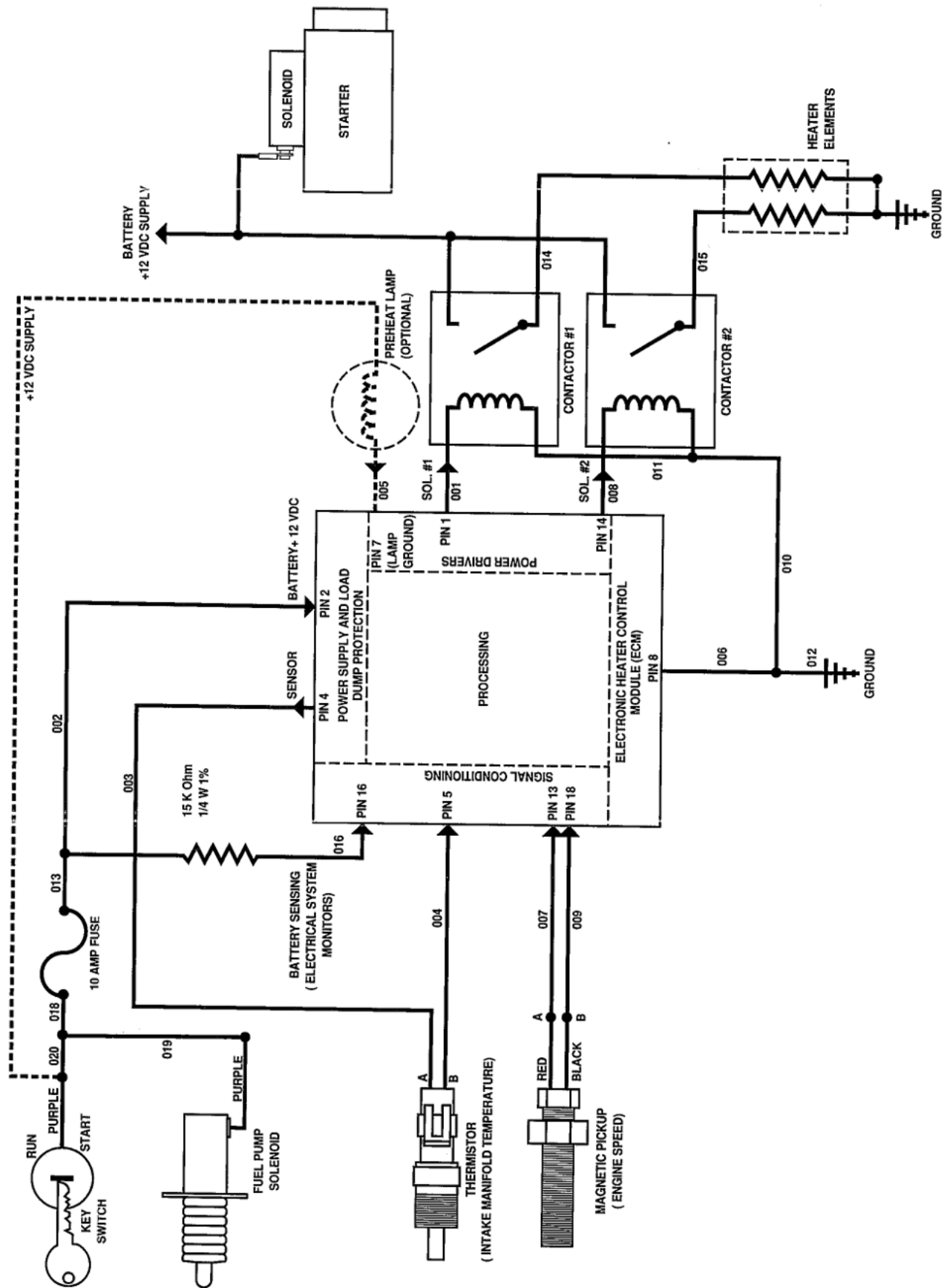
Intake Manifold Heater System Pictorial Diagram (B-Series)



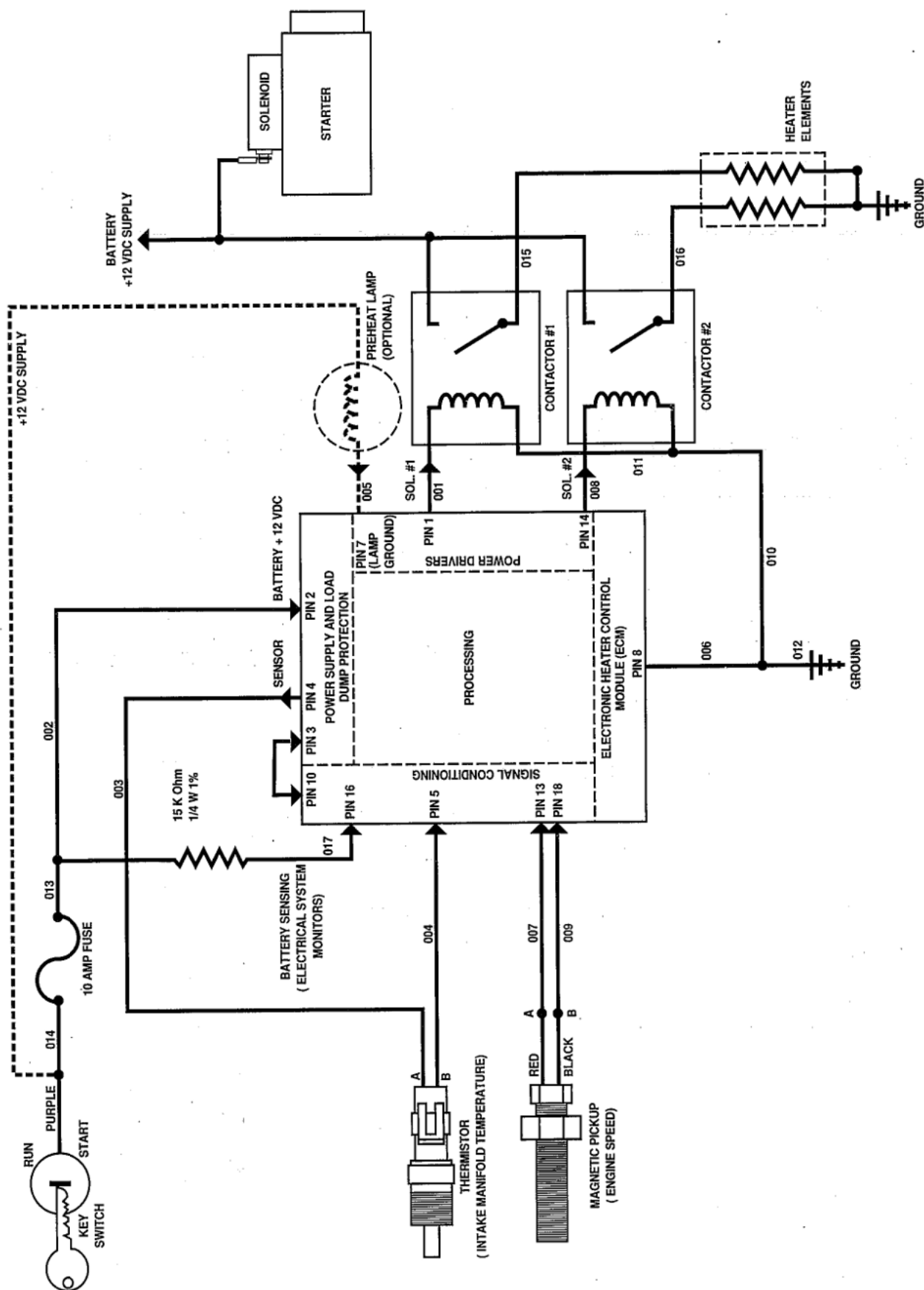
Intake Manifold Heater System Pictorial Diagram (C-Series)



Intake Manifold Heater System Schematic (B-Series)

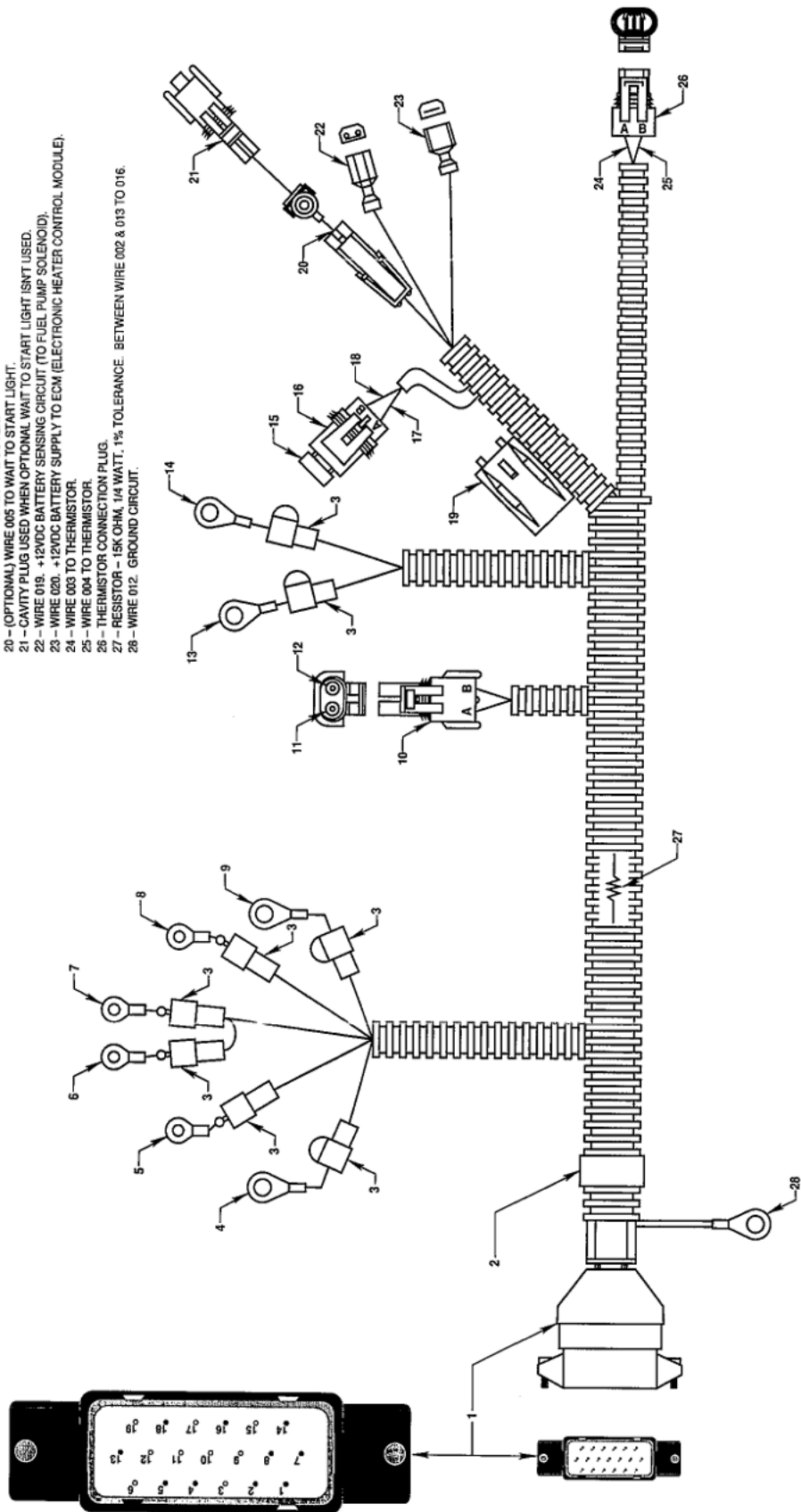


Intake Manifold Heater System Schematic (C-Series)

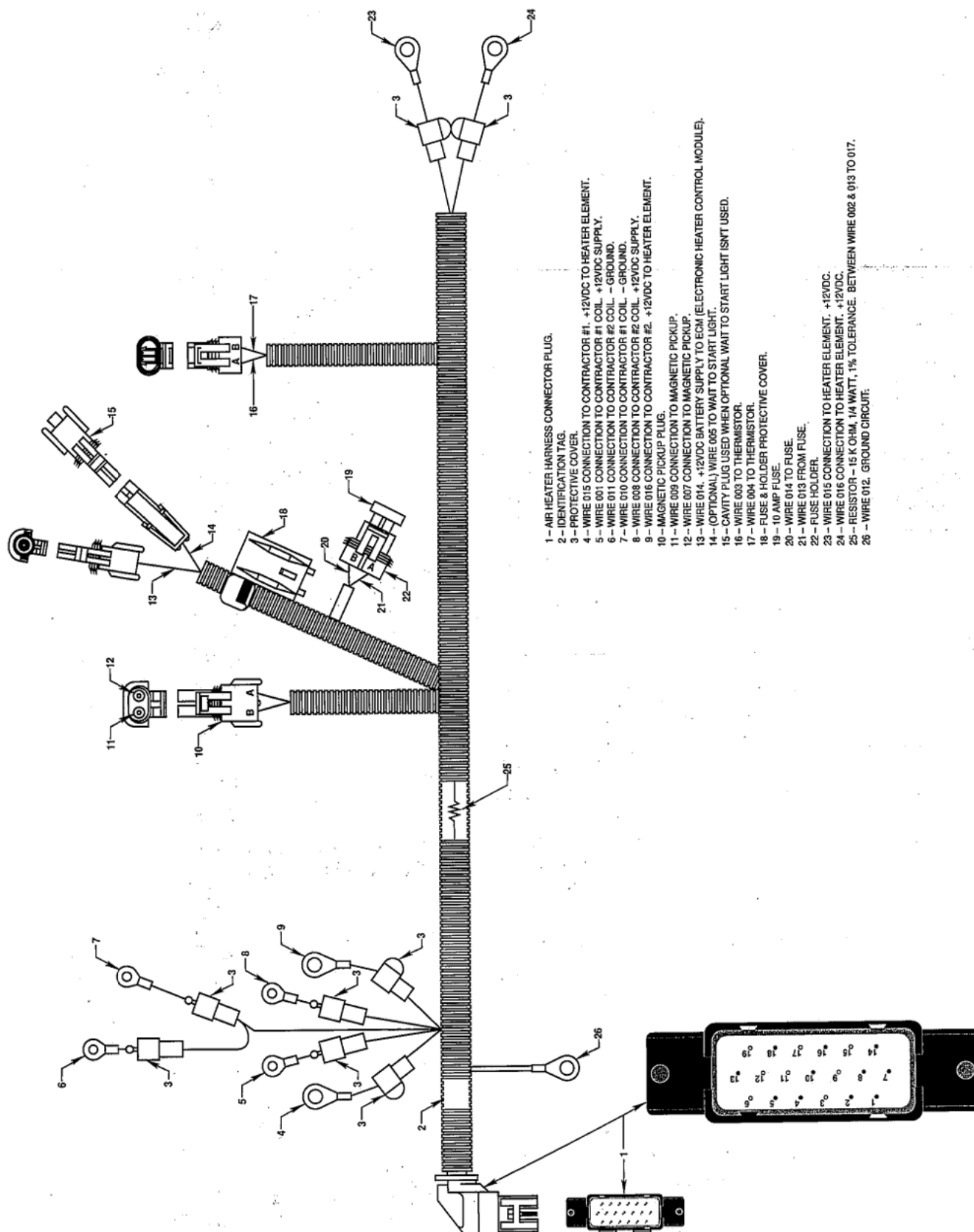


Intake Manifold Heater System Harness Drawing (B-Series)

- 1 - AIR HEATER HARNESS CONNECTOR PLUG.
- 2 - IDENTIFICATION TAG.
- 3 - PROTECTIVE COVER.
- 4 - WIRE 014 CONNECTION TO CONTRACTOR #1. +12VDC TO HEATER ELEMENT.
- 5 - WIRE 001 CONNECTION TO CONTRACTOR #1 COIL. +12VDC SUPPLY.
- 6 - WIRE 011 CONNECTION TO CONTRACTOR #2 COIL. - GROUND.
- 7 - WIRE 010 CONNECTION TO CONTRACTOR #1 COIL. - GROUND.
- 8 - WIRE 008 CONNECTION TO CONTRACTOR #2 COIL. +12VDC SUPPLY.
- 9 - WIRE 015 CONNECTION TO CONTRACTOR #2. +12VDC TO HEATER ELEMENT.
- 10 - MAGNETIC PICKUP PLUG.
- 11 - WIRE 007 CONNECTION TO MAGNETIC PICKUP.
- 12 - WIRE 009 CONNECTION TO MAGNETIC PICKUP.
- 13 - WIRE 014 CONNECTION TO HEATER ELEMENT. +12VDC.
- 14 - WIRE 015 CONNECTION TO HEATER ELEMENT. +12VDC.
- 15 - 10 AMP FUSE.
- 16 - FUSE HOLDER.
- 17 - WIRE 013 TO FUSE.
- 18 - WIRE 018 FROM FUSE.
- 19 - FUSE & HOLDER PROTECTIVE COVER.
- 20 - (OPTIONAL) WIRE 005 TO WAIT TO START LIGHT.
- 21 - CAVITY PLUG USED WHEN OPTIONAL WAIT TO START LIGHT ISN'T USED.
- 22 - WIRE 019. +12VDC BATTERY SENSING CIRCUIT (TO FUEL PUMP SOLENOID).
- 23 - WIRE 020. +12VDC BATTERY SUPPLY TO ECM (ELECTRONIC HEATER CONTROL MODULE).
- 24 - WIRE 003 TO THERMISTOR.
- 25 - WIRE 004 TO THERMISTOR.
- 26 - THERMISTOR CONNECTION PLUG.
- 27 - RESISTOR - 15K OHM, 1/4 WATT, 1% TOLERANCE BETWEEN WIRE 002 & 013 TO 016.
- 28 - WIRE 012. GROUND CIRCUIT.



Intake Manifold Heater System Harness Drawing (C-Series)



Section T - Troubleshooting

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Troubleshooting Procedures and Techniques

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

A thorough analysis of the problem is the key to successful troubleshooting. The more information known about a complaint, the faster and easier the problem can be solved.

It is **not** possible to include all the possible solutions to problems that can happen; however, these charts will stimulate a thought process that will lead to the cause and correction of the problem.

Follow these basic troubleshooting steps:

- Get all the facts concerning the problem.
- Analyze the problem thoroughly.
- Relate the symptoms to the basic engine and components.
- Consider any recent maintenance or repair action that can relate to the problem.
- Double-check before beginning any disassembly.
- Solve the problem by using the logic charts and doing the easiest things first.
- Determine the cause of the problem and make a thorough repair.
- After repairs have been made, operate the engine to make sure the cause of the problem has been corrected.

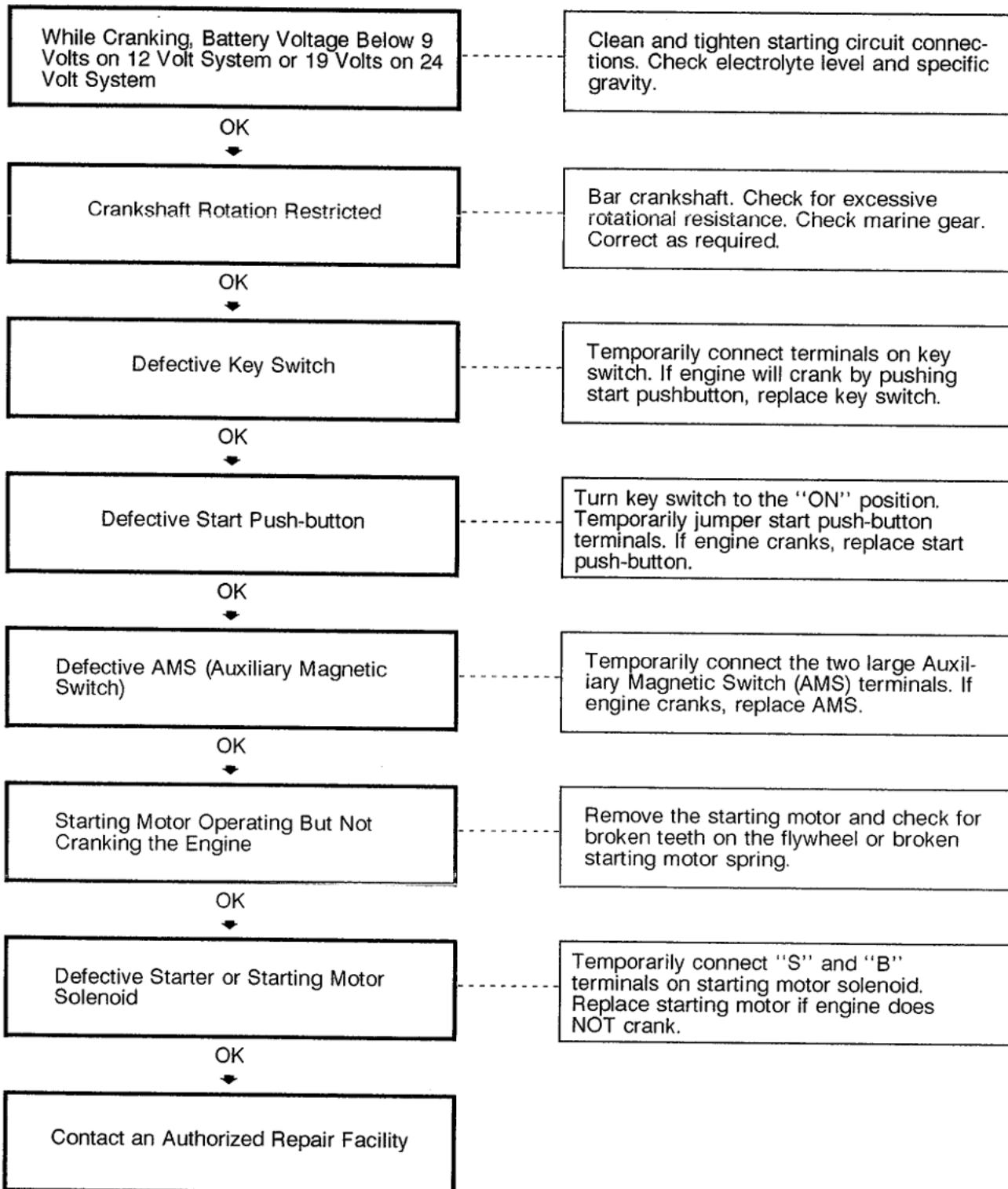
Troubleshooting Symptoms

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 the corrective action.

Engine Will Not Crank or Cranks Slowly

Cause

Corrections



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

Cause

Corrections

Engine Cranking Speed too Slow
(Below 120 RPM)

Check engine cranking RPM. Refer to
Engine Will Not Crank or Cranks Slowly.

OK
↓

Temperature Too Low. Starting Aid
Needed or Not Working Properly

Check, repair or replace cold starting aid if
necessary. See Section V for Performance
Data requirements on Minimum Ambient
Temperature for Cold Start (No Aids).

OK
↓

No Fuel in Supply Tank

Check/replenish fuel supply. Fill
fuel/water separator with clean fuel.
Vent air from fuel system.

OK
↓

Air in the Fuel System

Vent the fuel system and check for suction
leaks. Check fuel pick-up tube in fuel tank.

OK
↓

Fuel Supply Restricted

Clean or replace pre-filters and screens
and check fuel lines for restrictions. Check
all shutoff valves.

OK
↓

Intake Air System Restricted

Check intake air system for restrictions.

OK
↓

Fuel Contaminated

Verify by operating engine from a
temporary supply tank.

OK
↓

(Continued)

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

Cause

Corrections

Valves Incorrectly Adjusted

Adjust valves.

OK
↓One or More Injectors Worn or
Malfunctioning

Check or replace injectors.

OK
↓

Injection Pump Timing Not Correct

Check injection pump timing.

OK
↓

Fuel Injection Pump Malfunctioning

Repair or replace the fuel injection
pump.OK
↓

Contact an Authorized Repair Facility

Engine Cranks But Will Not Start - No Smoke From Exhaust

Cause

Corrections

No Fuel in Tank

Add fuel.

OK
↓

Electrical or Manual Fuel Shutdown
Not Open

Turn keyswitch "ON". Verify that fuel
solenoid allows fuel shutoff lever to go to
full open position.

OK
↓

If the Condition Occurs During Initial Start,
Following an Extended Period of Non Use or
After Replacing a Fuel System Component,
Air in the Fuel System

Vent the fuel system.

OK
↓

If Previous Engine Operation Had
Been Normal, Injection Pump Not Getting
Fuel

Loosen the vent plug at the filter head end.
Operate the hand primer on the lift pump to
check for fuel. Clean or replace lift pump if
necessary.

OK
↓

Fuel Filter Plugged With Water or
Other Contamination

Drain fuel-water separator or replace
fuel filter.

OK
↓

Fuel Supply Pump (Lift Pump)
Malfunctioning

Repair or replace lift pump.

OK
↓

Worn or Malfunctioning Injection Pump

Loosen the high pressure line at two injec-
tors and visually check fuel delivery while
cranking the engine. Replace the pump if
fuel is **not** being delivered.

OK
↓

Injection Pump Timing Incorrect

Verify timing or time the injection pump.

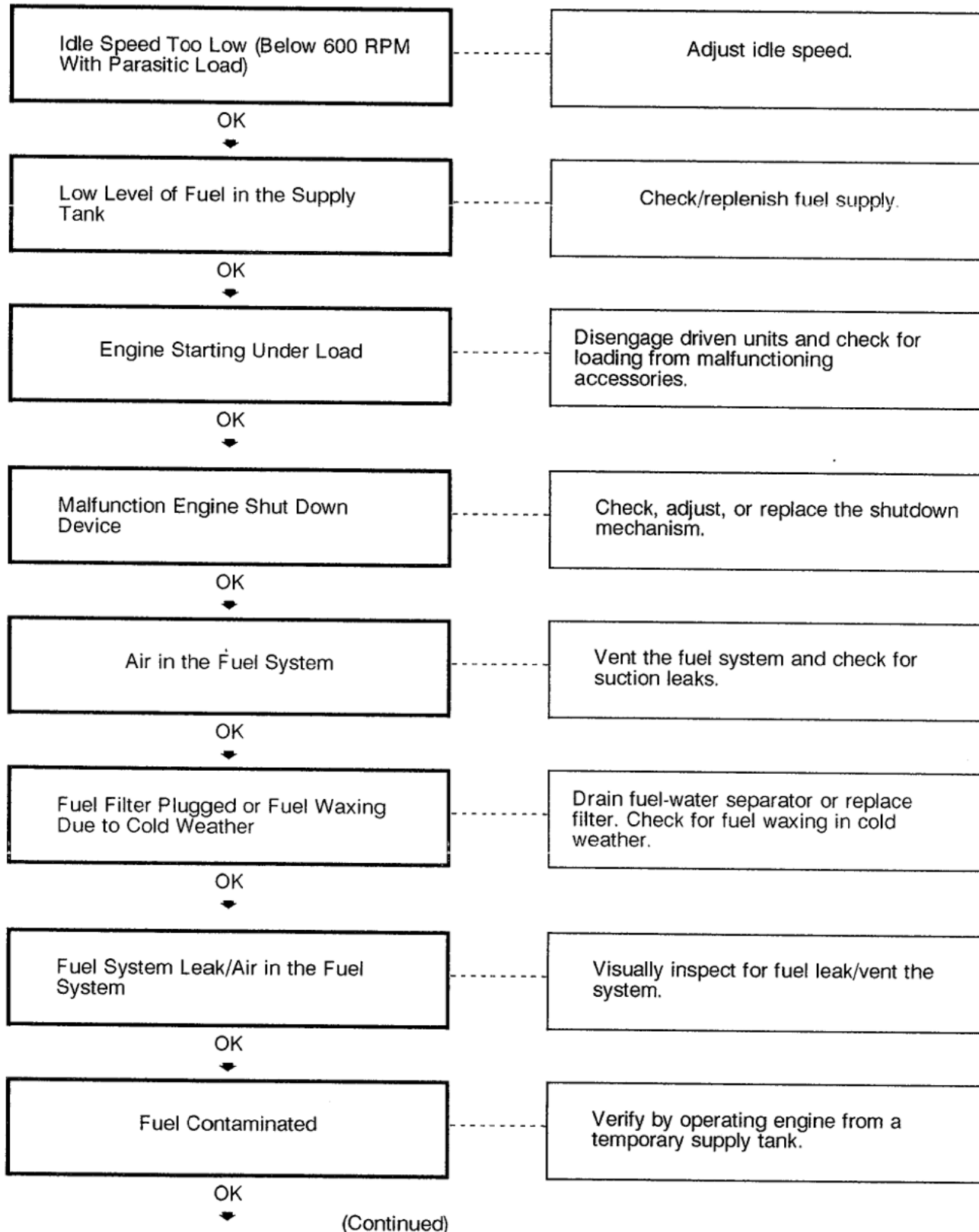
OK
↓

Contact an Authorized Repair Facility

Engine Starts But Will Not Keep Running

Cause

Corrections



Engine Starts But Will Not Keep Running (Continued)

Cause

Corrections

Fuel Drain Manifold or Return Line
Restricted. (Lucas CAV Only).

Check/correct the restriction.

OK
↓

Injection Pump Out of Time

Check or correct pump timing.

OK
↓

Contact an Authorized Repair Facility

Engine Will Not Shut Off**Cause****Corrections**

Fuel Shutoff Lever Not Going to Shutoff Position

Verify the solenoid is not being energized by a short in the wiring. Check the linkage to the shutoff lever for binding. Check for the ability of the spring in the pump to pull the lever to the shutoff position.

OK

Engine Operating on Fumes Drawn into Air Intake

Eliminate the source of fumes, or direct fumes out of engine compartment.

OK

Fuel Leaking to Intake Manifold

Check for porosity between the fuel filter mounting to the intake manifold.

OK

Contact an Authorized Repair Facility

Rough Idle, Warm Engine

Cause

Corrections

Idle Speed Set Too Low (Below 750 RPM With Parasitic Load)

Check or adjust low idle adjustment.

OK
↓

Engine Mounts Damaged, Loose or Misaligned

Verify condition of mounts. (Refer to the vessel manufacturer's service instructions).

OK
↓

High Pressure Fuel Leak

Inspect/correct leaks in the high pressure lines, fittings, injection sealing washers or delivery valve seals. (See Section A).

OK
↓

Air in Fuel System

Vent fuel system and check for suction leaks.

OK
↓

Injector Nozzles Plugged or Inoperative

Repair or replace injectors.

OK
↓

Injection Pump Timing Incorrect

Check or correct injection timing.

OK
↓

(Continued)

Rough Idle, Warm Engine (Continued)

Cause

Corrections

Injection Pump Malfunctioning or Worn

Repair or replace pump.

OK

Valve Not Seating

Adjust valves (see Section 6).

OK

Contact an Authorized Repair Facility

Engine Surges at Idle

Cause

Corrections

Low Fuel Level in the Tank

Fill supply tank.

OK
↓

Idle Speed Set Too Low or Not Properly Adjusted

Check or adjust low idle setting.

OK
↓

Air in the Fuel System

Vent fuel system and check for suction leaks.

OK
↓

Restricted Fuel Supply

Clean or replace pre-filters and screens and check fuel lines for restriction.

OK
↓

Malfunctioning Injectors

Check/replace injectors.

OK
↓

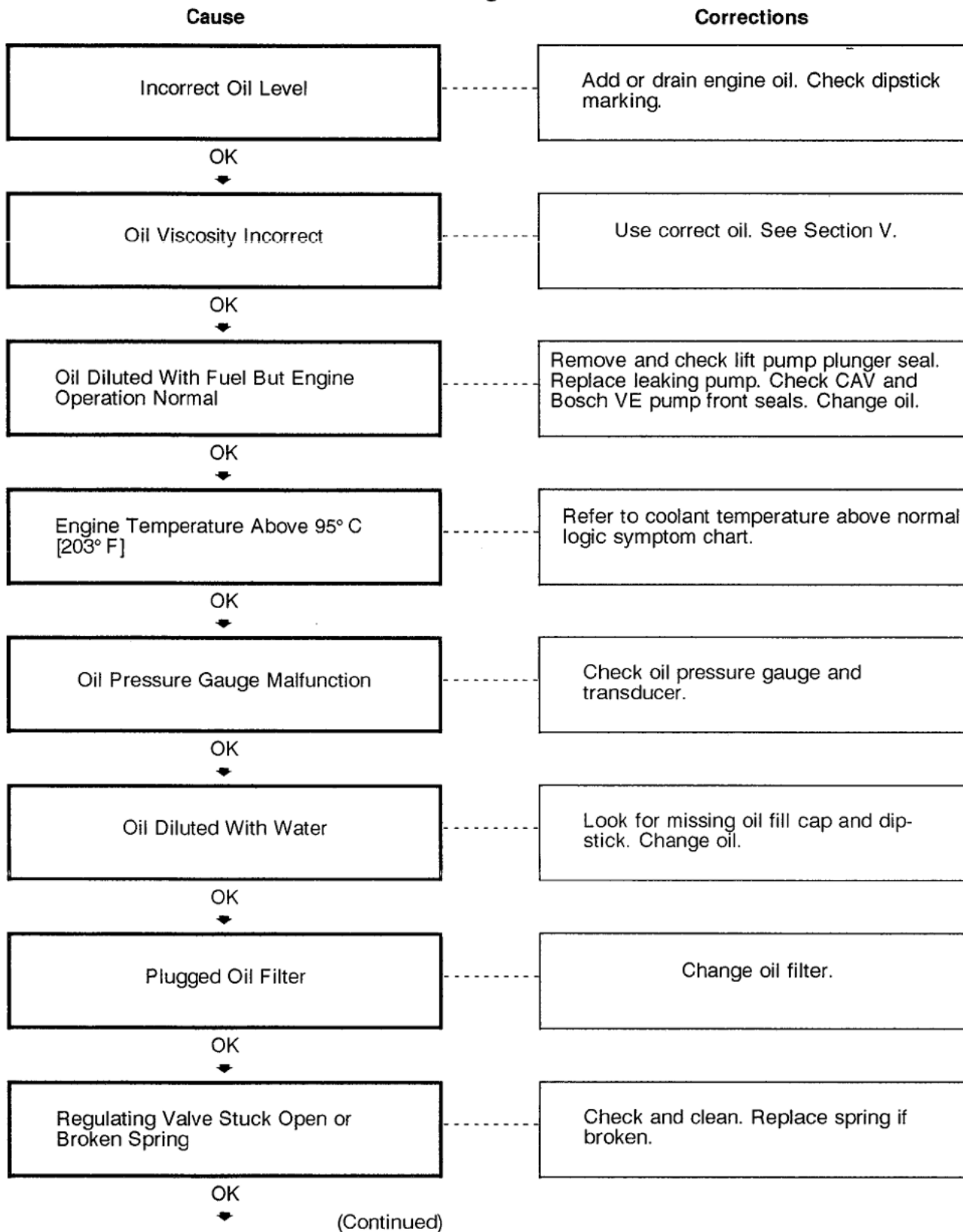
Malfunctioning or Worn Injection Pump

Remove pump. Have pump recalibrated or replace pump.

OK
↓

Contact an Authorized Repair Facility

Lubricating Oil Pressure Low



Lubricating Oil Pressure Low (Continued)

Cause

Corrections

Oil Diluted With Coolant (Antifreeze)

Check oil cooler, core plugs, cylinder liner, head gasket, block and head for leaks. Replace leaking components and change oil.

OK

Incorrect Oil Specifications

Check oil specifications.

OK

Loose or Missing Pipe Plug

Check for external leak along fuel pump side of block, oil cooler cover and gear housing.

OK

Oil Viscosity Low Due to Operating Above Normal Coolant Temperature Range of 80° C [175° F] to 90° C [195° F]

Refer to Coolant Temperature Above Normal Chart.

OK

Oil Diluted With Fuel Accompanied by Rough Engine Operation or Low Power

Check for a stuck injector nozzle. If injectors are okay, repair or replace injection pump. Change oil.

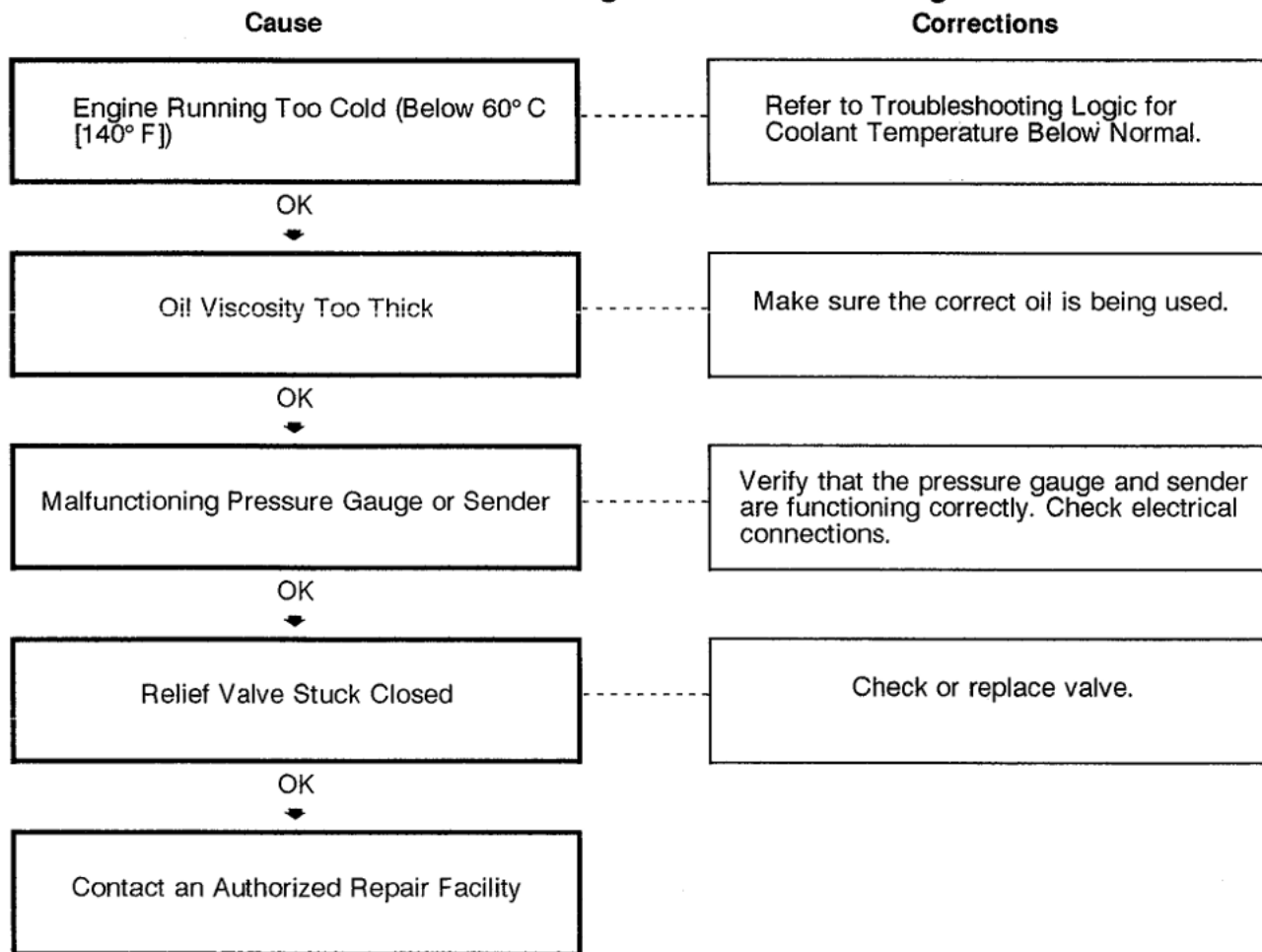
OK

If Oil Cooler Was Replaced, Shipping Plugs Left in Cooler

Check/remove shipping plugs.

OK

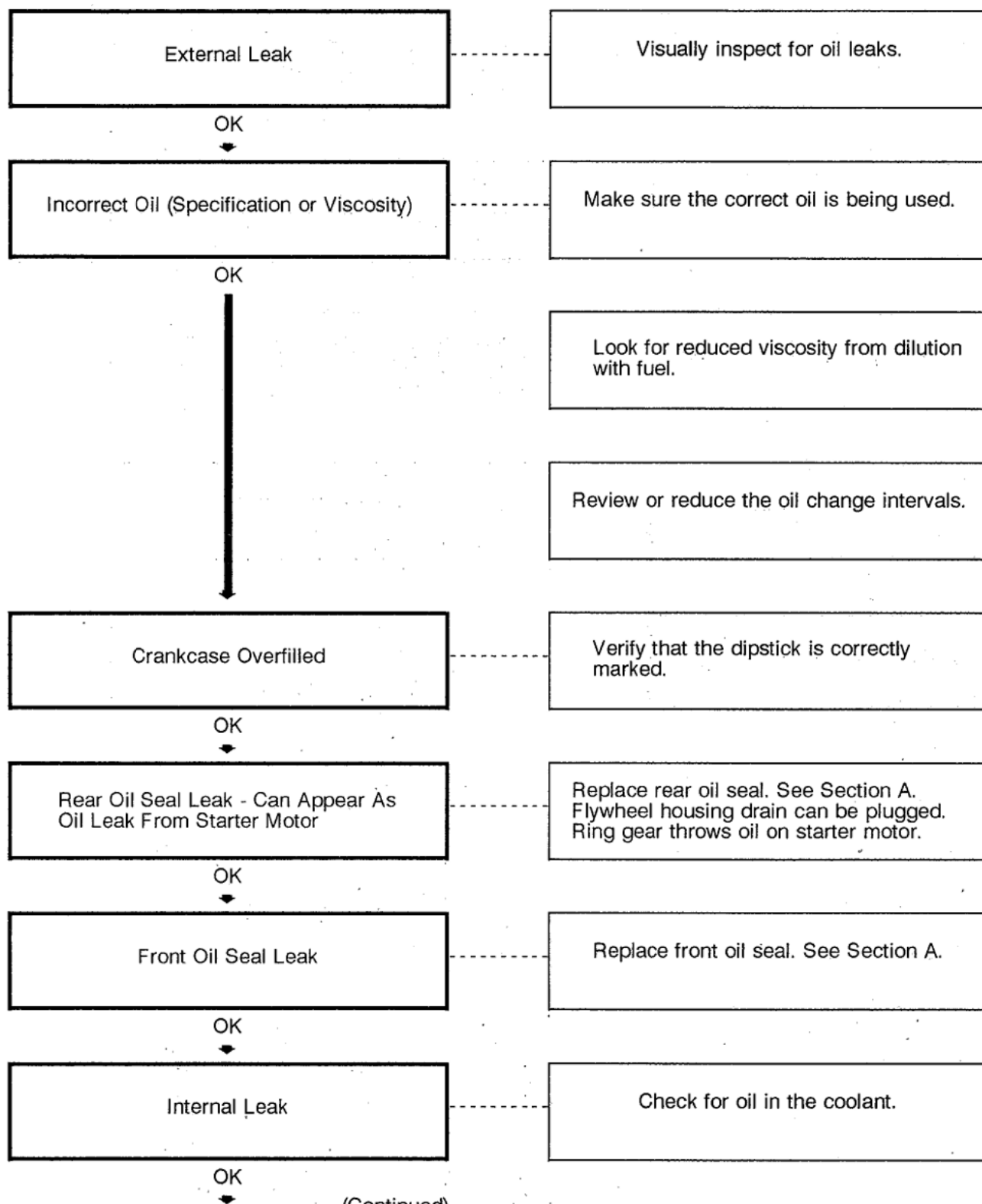
Contact an Authorized Repair Facility

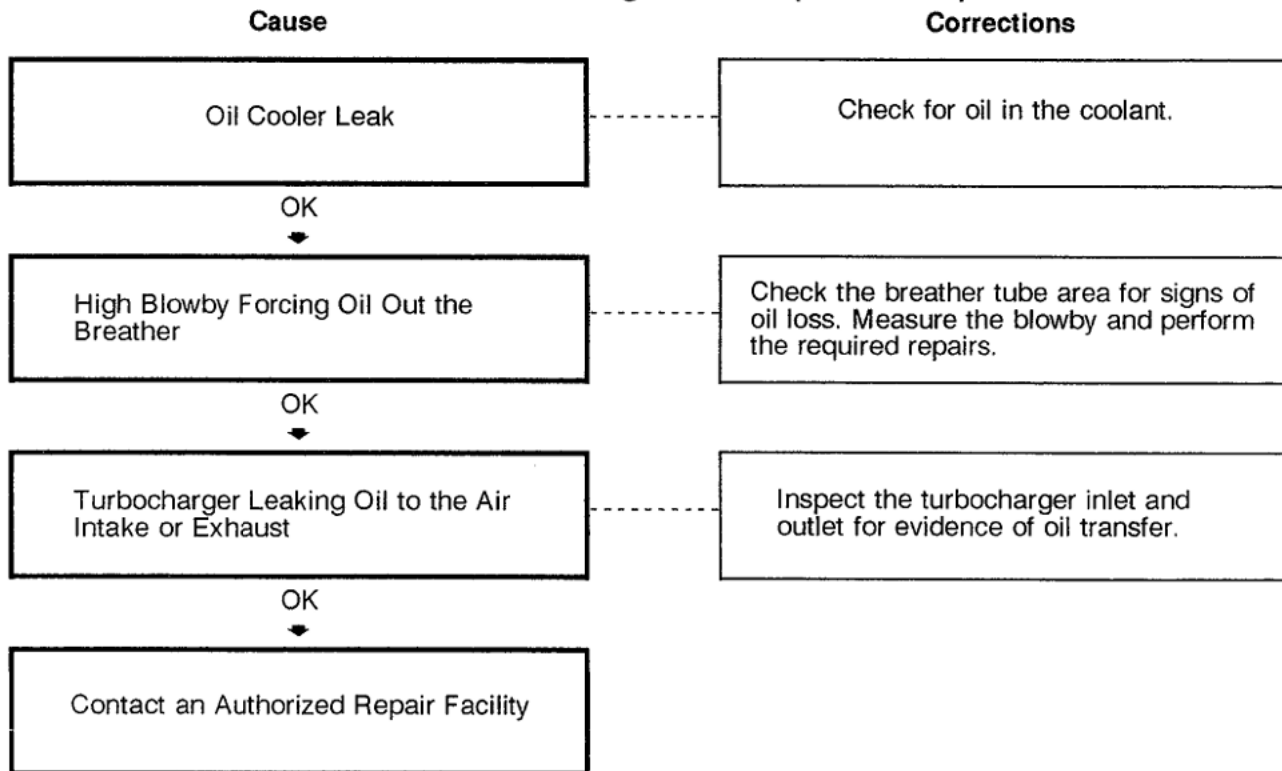
Lubricating Oil Pressure Too High

Lubricating Oil Loss

Cause

Corrections



Lubricating Oil Loss (Continued)

Coolant Temperature Above Normal**Cause****Corrections**

Low Coolant Level

Check both the recovery bottle and the expansion tank. Add coolant.

OK
↓

Air Trapped in Coolant

Vent the cooling system to remove air/check engine vent lines.

OK
↓

Malfunctioning Temperature Sensor or Gauge

Check/replace temperature sensor/gauge.

OK
↓

Malfunctioning Raw Water Pump or System

Check through hull valve and fitting, strainer, raw water pump, impeller, gear oil cooler or aftercooler plugged.

OK
↓

Improper Oil Level

Add/drain oil to the proper level.

OK
↓

Loose Drive Belt on Engine Water Pump

Check/correct belt tension.

OK
↓

Incorrect/Malfunctioning Pressure Cap

Replace cap with one rated at 103 kPa [15 psi]

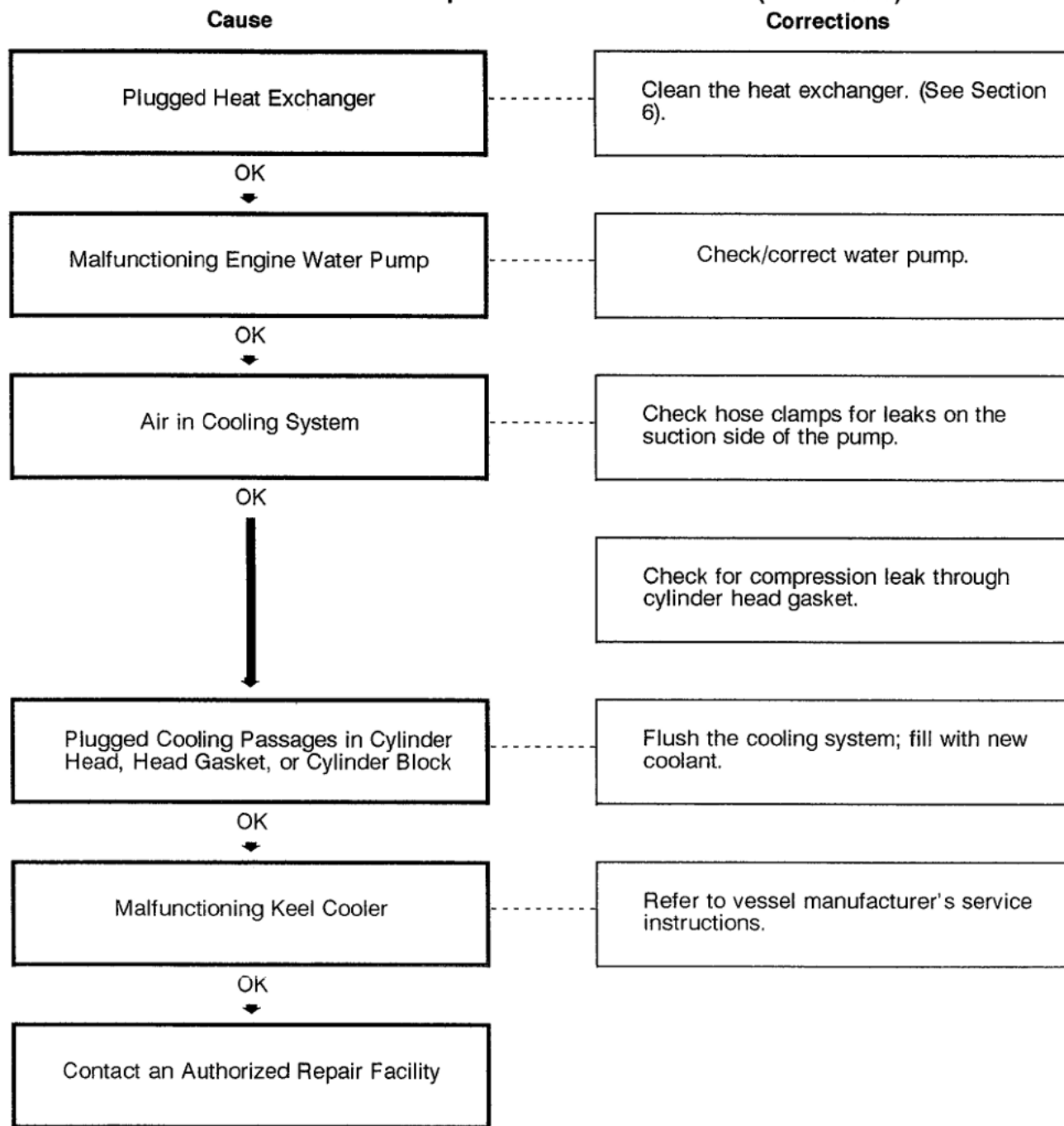
OK
↓

Malfunctioning, Incorrect, or Missing Thermostat

Check/replace the thermostat.

OK
↓

(Continued)

Coolant Temperature Above Normal (Continued)

Coolant Loss

Cause

Corrections

Overfilling of Expansion Tank

Leave 25 to 40 mm [1 to 1-1/2 inches] expansion space in expansion tank.

OK
↓

Hose Leaking

Visually inspect the hoses and connections to locate the leak.

OK
↓

External Engine Leak

Visually inspect the engine and components for seal or gasket leaks.

OK
↓

Leaking Compression Gasses From Head or Exhaust Manifold Gaskets, or Cracked Exhaust Manifold, Resulting in Coolant Loss

Inspect for exhaust manifold cracks or defective head gasket or exhaust manifold gasket. Replace as required.

OK
↓

Lubricating Oil Cooler Leak

Check or replace the oil cooler. Look for coolant in the oil.

OK
↓

Engine Coolant Type Aftercooler Leaking

Check/replace the aftercooler. Check for coolant in the intake manifold and engine oil.

OK
↓

Contact an Authorized Repair Facility

Coolant Temperature Below Normal

Cause

Corrections

Operating in Cold Weather

Avoid excessive operation at idle. Increase engine load and speed to warm up engine.

OK
↓

Temperature Gauge or Sensor
Malfunctioning

Test the gauge and sensor. Repair or
replace if necessary.

OK
↓

Thermostats Incorrect or Malfunctioning

Check thermostats and replace if
necessary. Check for debris in coolant.

OK
↓

Contact an Authorized Repair Facility

Contaminated Coolant

Cause

Corrections

Rusty Coolant, Operation Without
Correct Mixture of Coolant and
Additives

Drain and flush the cooling system. Fill
with correct mixture of coolant and
additives.

OK
↓

Review the coolant change interval.

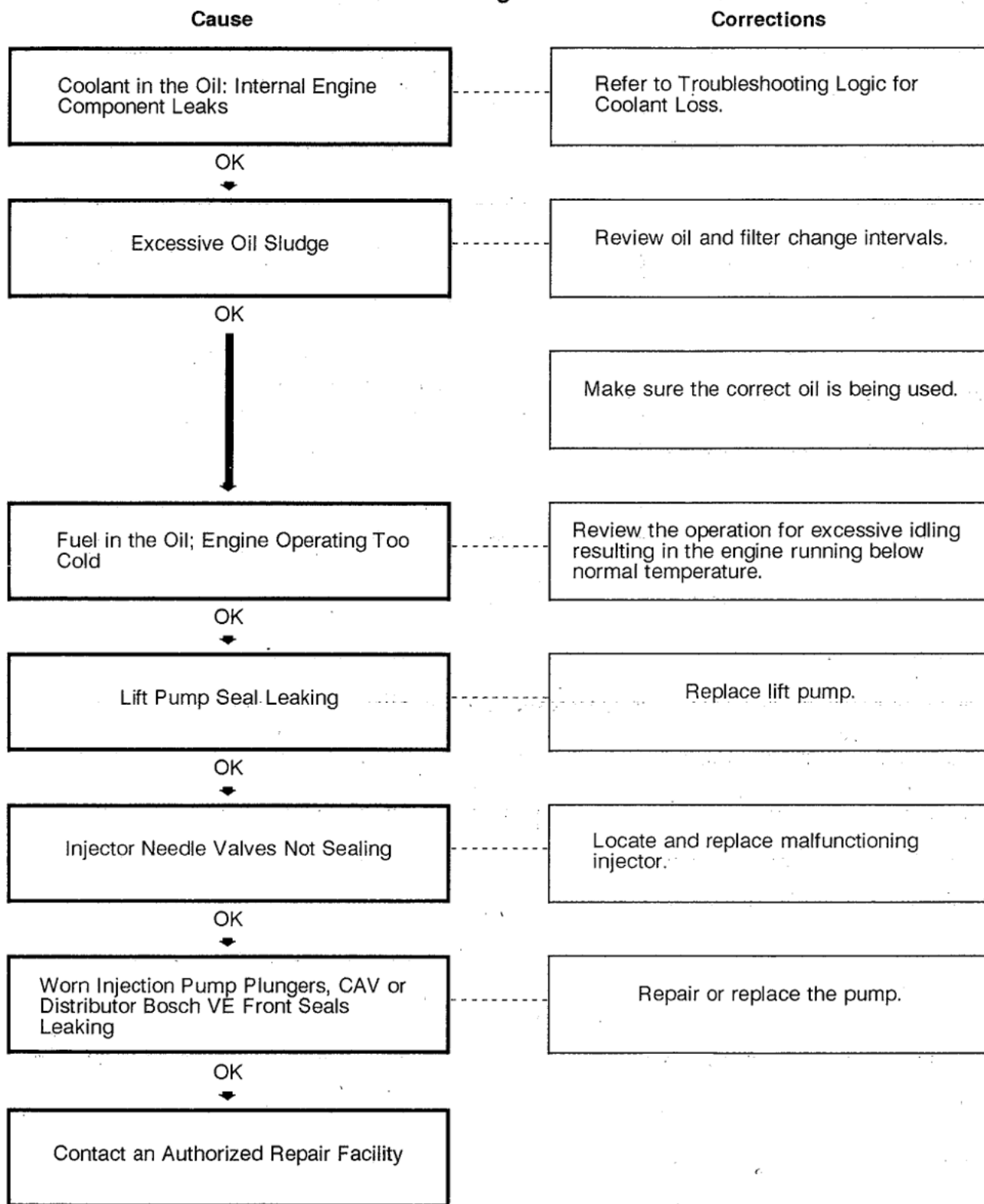
Oil Leaks From Oil Cooler, Head
Gasket, Head and Cylinder Block

Refer to Troubleshooting Logic for
Lubricating Oil Loss.

OK
↓

Contact an Authorized Repair Facility

Lubricating Oil Contaminated



Fuel or Oil Leaking From Exhaust Manifold

Cause	Corrections
Operating for Extended Periods Under Light or No Load Conditions	Review operational procedures.
OK ↓	
Intake Air Restriction	Check or replace the filter element.
OK ↓	
Engine Idling Too Long	Review operation for excessive idling (more than 10 minutes).
OK ↓	
Faulty Injector	Locate and replace malfunctioning injector. Check for proper sealing washer and injector installation.
OK ↓	
Obstructed Turbocharger Drain Line	Check or clean line.
OK ↓	
Turbocharger Seals Leaking Oil	Check or replace the turbocharger.
OK ↓	
Fuel Injection Pump Overfueling	Repair or replace the pump.
OK ↓	
Contact an Authorized Repair Facility	

Exhaust Smoke Excessive Under Load

Cause

Corrections

Engine Running Too Cold (White Smoke)

Refer to Troubleshooting Logic for "Engine Running Too Cold".

OK
↓

Air Cleaner Plugged

Inspect air cleaner. Clean and replace.

OK
↓

Engine Overloaded

Boat is too heavy or the propellers too big.

OK
↓

Air in Fuel System

Bleed fuel system and check for suction leaks.

OK
↓

Injection Pump Timing Not Correct

Check and adjust injection pump timing.

OK
↓

Air Leak Between Turbocharger and Intake or Exhaust Manifold

Correct leak.

OK
↓

More than One Seal Washer Under Injector Nozzle or Wrong Washer Part Number

Remove extra washers or install correct washer.

OK
↓

(Continued)

Exhaust Smoke Excessive Under Load (Continued)

Cause	Corrections
Injector Nozzle Malfunctioning	Remove and have nozzles tested. Replace injectors if necessary.
OK ↓	
Exhaust Back Pressure Too Excessive	Measure and correct if above 75 mm Hg [3 in. Hg].
OK ↓	
Air Flow Through Aftercooler Restricted	Inspect cooler fins - clean or replace if necessary.
OK ↓	
Malfunctioning Boost Control or Overfueled Injection Pump	Repair or replace injection pump. (See Section A).
OK ↓	
Malfunctioning Turbocharger	Replace turbocharger.
OK ↓	
Contact an Authorized Repair Facility	

Exhaust White Smoke Excessive

Cause

Corrections

Air Heater Not Operating

Check/repair air heater system.

OK
↓

Ambient Temperature Too Low.
Starting Aid Needed or Not Working
Properly

Check, repair or replace cold starting aid if
necessary. See Section V for performance
data requirements on minimum ambient
temperature for cold start (no aids).

OK
↓

Coolant Temperature Too Low

Refer to chart for "Coolant Tempera-
ture Below Normal".

OK
↓

Fuel Quality Poor

Verify by operating engine with known
fuel quality.

OK
↓

Injectors Installed With More Than One
Sealing Washer or With the Incorrect
Washer.

Check and/or correct.

OK
↓

Injectors Malfunctioning

Repair or replace injectors.

OK
↓

Coolant or Water Leaking Into the
Combustion Chamber

Refer to "Coolant Loss" troubleshooting
logic chart. Inspect raw water aftercooler
for water leak.

OK
↓

Injection Pump Incorrectly Timed

Check injection pump timing.

OK
↓

Contact an Authorized Repair Facility

Engine Will Not Reach Rated RPM - No Load

Cause

Corrections

Throttle Linkage Incorrectly Adjusted

Adjust linkage for stop-to-stop fuel control lever travel.

OK
↓

Partially Engaged Mechanical Shut-down Lever

Check/place shutdown lever in RUN position.

OK
↓

Malfunctioning Tachometer

Verify engine speed with and tachometer; correct as required.

OK
↓

Fuel Supply Inadequate

Check/repair or correct restriction.

OK
↓

AFC (Boost Control Line) Leaking

Check/repair leak.

OK
↓

High Speed Stop Screw Incorrectly Adjusted

Verify that high speed stop screw seal has not been broken.

OK
↓

Restricted Manifold Drain Line

Check/remove restriction.

OK
↓

Malfunctioning Injection Pump

Repair or replace pump.

OK
↓

Contact an Authorized Repair Facility

Low Power

Cause

Corrections

Fuel Control Lever Not Moving to Full Throttle

Check/correct for stop-to-stop travel.

OK
↓

Mechanical/Shutdown Lever Partially Engaged

Check/replace shutdown lever in run position.

OK
↓

Additional Weight in Boat or Change in Trim

Remove weight and/or retrim vessel.

OK
↓

Lubricating Oil Level Too High

Drain oil to proper level.

OK
↓

Intake or Exhaust System Restricted

Check intake and exhaust systems for restrictions. Inspect air filter and replace as necessary.

OK
↓

Air Leak Between Turbocharger and Intake Manifold

Correct leak.

OK
↓

Exhaust Leak Between Turbocharger and Exhaust Manifold

Correct leak.

OK
↓

Air in the Fuel System

Bleed the fuel system and check for suction leaks.

OK
↓

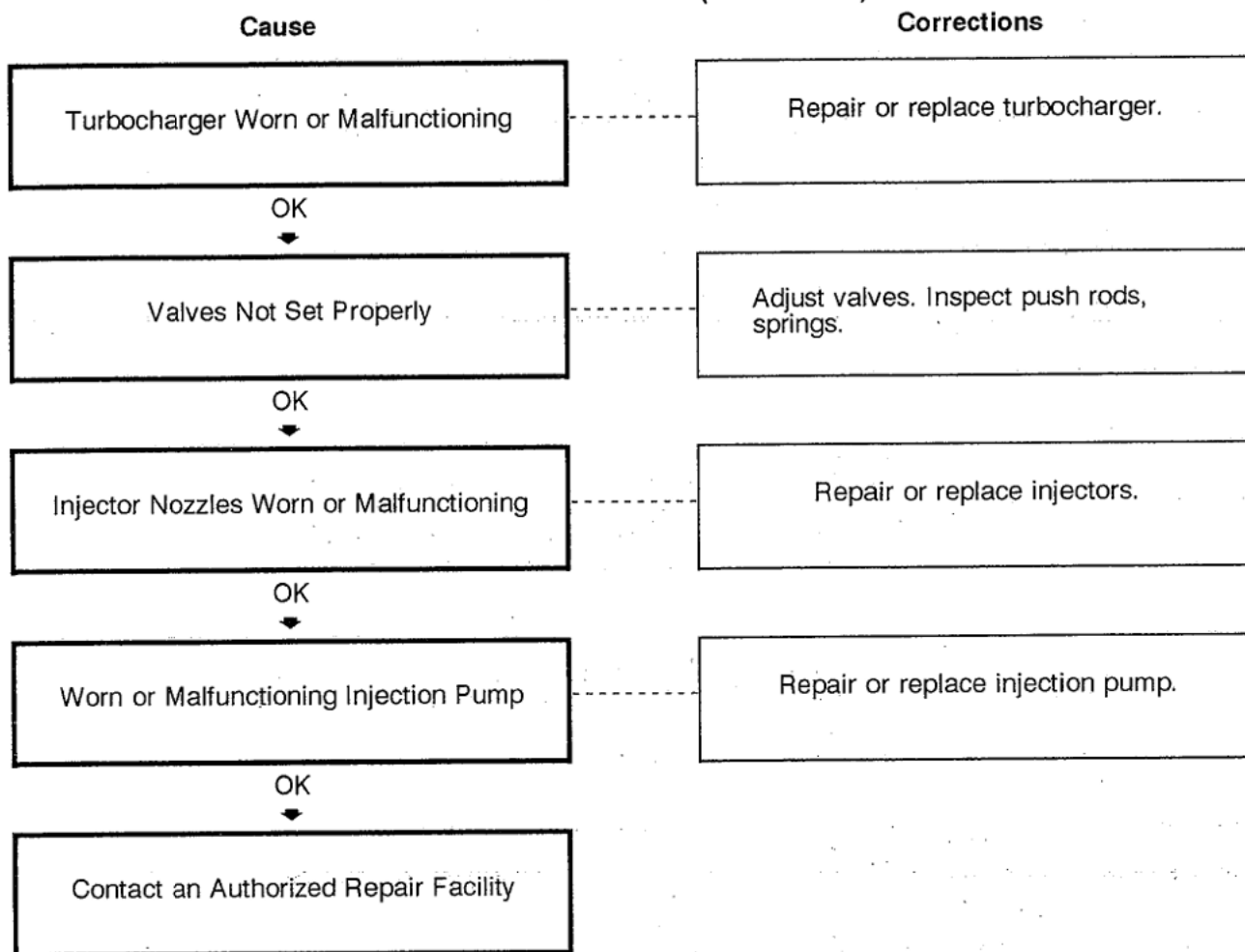
(Continued)

Low Power (Continued)

Cause	Corrections
Fuel Supply Restricted	Clean pre-filters and screens and check fuel line for restriction. Replace fuel filter.
OK ↓	
Air Fuel Control Line Leak	Check/tighten fittings.
OK ↓	
Malfunctioning Lift Pump	Check or replace the lift pump. Note: On diaphragm pumps, the lever must be in the upward position.
OK ↓	
Fuel Quality Poor	Verify by operating engine from a temporary tank that contains good fuel and refer to fuel oil specifications.
OK ↓	
High Fuel Temperatures (Above 71° C [160° F])	Fill tank. Shield from heat source.
OK ↓	
Air Side of Aftercooler Dirty or Plugged	Replace stamped steel aftercooler or clean cast version.
OK ↓	
High Intake Air Temperature - 17 ° C [30° F] Above Ambient	Use outside air to air cleaner in warm weather.
OK ↓	
Injection Pump Timing Not Correct	Check timing.
OK ↓	

(Continued)

Low Power (Continued)



Engine Misfiring

Cause

Corrections

Contaminated Fuel

Verify by operating from a temporary supply tank.

OK
↓

Air in Fuel System

Bleed fuel system and check for suction leaks.

OK
↓

Fuel Injection Lines Leaking

Inspect and replace broken lines.

OK
↓

Incorrect Valve Adjustment

Inspect push rods and springs and adjust the valves.

OK
↓

Injector Nozzles Plugged or Inoperative

Repair or replace injectors.

OK
↓

Injection pump Timing Incorrect

Check or time injection pump.

OK
↓

Contact an Authorized Repair Facility

Fuel Knock

Cause

Corrections

Air in Fuel System

Bleed fuel system and check for suction leaks.

OK
↓

Poor Quality Fuel

Verify by operating from a temporary tank with good fuel; clean and flush the fuel supply tanks.

OK
↓

Operating Temperature of Coolant Incorrect

Refer to "Low Coolant Temperature" troubleshooting logic.

OK
↓

Incorrect Injection Pump Timing

Check pump timing.

OK
↓

Injection Nozzles Malfunctioning

Remove nozzles. Test and repair.

OK
↓

Contact an Authorized Repair Facility

Excessive Fuel Consumption

Cause

Corrections

Fuel Leak

Check/correct the source of the leak.

OK
↓

Poor Quality Fuel

Make sure quality No. 2 fuel is being used.

OK
↓

Vessel Overloaded or Improperly Trimmed

Correct condition.

OK
↓

Intake Air or Exhaust Restriction

Refer to Troubleshooting Logic for Excessive Exhaust Smoke

OK
↓

Incorrect Fuel Pump Timing

Check or time the pump.

OK
↓

Worn or Malfunctioning Injectors

Check/repair or replace the injectors

OK
↓

Valves Not Seating

Check or adjust the valves.

OK
↓

Contact an Authorized Repair Facility

Vibration Excessive

Cause

Corrections

Engine Low Idle Speed Set Too Low

See Section A for correct idle adjustment and Section V for idle specifications.

OK
↓

Engine Not Running Smoothly

Refer to Troubleshooting Logic for Rough Running or Misfiring.

OK
↓

Loose or Broken Engine Mounts

Check/replace engine mounts. (Refer to the vessel manufacturer's service instructions.)

OK
↓

Marine Gear not aligned to drive shaft

Operate at low speed until corrections are made. Refer to Section A.

OK
↓

Bent or Damaged Propeller or Drive Shaft

Operate at low speed until corrections are made.

OK
↓

Malfunctioning Vibration Damper

Inspect/replace the vibration damper.

OK
↓

Worn or Damaged Alternator Bearing

Check/replace the alternator.

OK
↓

Vibration Generated by Driven Auxiliary Equipment

Refer to manufacturer's service instructions.

OK
↓

Contact an Authorized Repair Facility

Excessive Engine Noises

Cause	Corrections
Drive Belt Squeal, Insufficient Tension or Abnormally High Loading	Check the tensioner and inspect the drive belt. Make sure water pump, tensioner pulley, fan hub and alternator turn freely.
OK ↓	
Intake Air or Exhaust Leaks	Refer to Troubleshooting Logic for Excessive Exhaust Smoke Under Load.
OK ↓	
Excessive Valve Lash	Adjust valves. Make sure the push rods are not bent or the rocker levers are not severely worn.
OK ↓	
Turbocharger Noise	Check turbocharger impeller and turbine wheel for housing contact.
OK ↓	
Bearing Clatter	Run engine at minimum load and speed necessary to reach repair facility.
OK ↓	
Idle Clatter - Marine Gear Noise at Idle speed	Not harmful. Not a cause for concern
OK ↓	
Noise in Marine Gear Above 1500 RPM	Check or replace vibration damper. Check marine gear. Refer to manufacturer's instructions.
OK ↓	
Contact an Authorized Repair Facility	

Alternator Not Charging or Insufficient Charging

Cause

Corrections

Loose or Corroded Battery Connections

Clean or tighten battery connections.

OK
↓

Wiring Harness or Electrical Connections Problems

Check, repair or replace the wiring.

OK
↓

Alternator Belt Slipping

Check or replace belt tensioner.

OK
↓

Alternator Pulley Loose on Shaft

Tighten pulley.

OK
↓

Voltmeter Malfunctioning

Check or replace the voltmeter.

OK
↓

Malfunctioning Alternator

Replace alternator.

OK
↓

Contact an Authorized Repair Facility

Instrumented Test Locations - General Information

There are three basic sections in the following Instrumented Test Locations package:

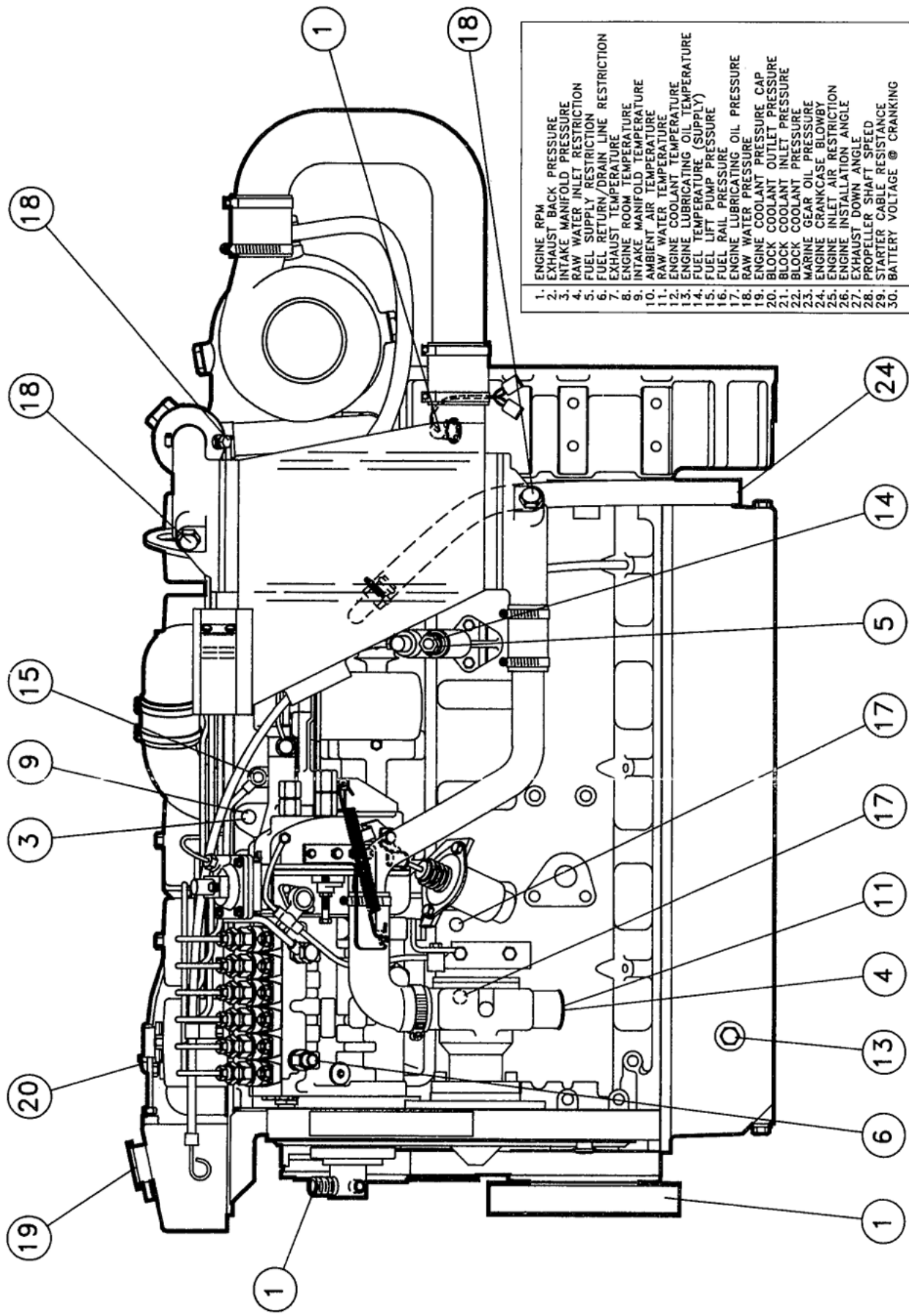
1. There are two charts that are identified as test locations, one for B-Series and the other for the C-Series. The charts have three columns which detail each inspection test name and references it to a number. The center column, (identified as Number of Test Points on Each Drawing View) lists all the views that show a specific test location. These views are identified by letters, (A-engine side view-port, B-side view starboard, C-top, and D-front). The number preceding the view letter identifies the number of locations that can be used. Example: Engine RPM is test point No. 1, and can be found on View A in three separate locations or View D in one location for the B-Series engines.
2. There are four views that point out various test points on the B-Series and the same for the C-Series models.
3. The inspection/test point information pages give specific details on each one of the 30 points. Information given includes tools and gauges required, RPM required, fittings needed and additional information notes.

INSPECTION AND TEST LOCATIONS

B SERIES ENGINES

TEST POINT NUMBER	NUMBER OF TEST POINTS ON EACH DRAWING VIEW	INSPECTION/TEST POINT NAME
1.	3-A,1-D	ENGINE RPM
2.	1-C	EXHAUST BACK PRESSURE
3.	1-A,1-C	INTAKE MANIFOLD PRESSURE
4.	1-A	RAW WATER INLET RESTRICTION
5.	1-A	FUEL SUPPLY RESTRICTION
6.	1-A,1-D	FUEL RETURN/DRAIN LINE RESTRICTION
7.	1-C	EXHAUST TEMPERATURE
8.		ENGINE ROOM TEMPERATURE
9.	1-A,1-C	INTAKE MANIFOLD TEMPERATURE
10.		AMBIENT AIR TEMPERATURE
11.	1-A	RAW WATER TEMPERATURE
12.	2-C	ENGINE COOLANT TEMPERATURE
13.	1-A,1-D	ENGINE LUBRICATING OIL TEMPERATURE
14.	1-A	FUEL TEMPERATURE (SUPPLY)
15.	1-A	FUEL LIFT PUMP PRESSURE
16.	N/A	FUEL RAIL PRESSURE
17.	2-A,1-B	ENGINE LUBRICATING OIL PRESSURE
18.	3-A,1-C	RAW WATER PRESSURE
19.	1-A,1-B,1-C,1-D	ENGINE COOLANT PRESSURE CAP
20.	1-A,1-B,1-C,1-D	BLOCK COOLANT OUTLET PRESSURE
21.	1-B,1-D	BLOCK COOLANT INLET PRESSURE
22.	2-C	BLOCK COOLANT PRESSURE
23.		MARINE GEAR OIL PRESSURE
24.	1-A,1-D	ENGINE CRANKCASE BLOWBY
25.	1-C	ENGINE INLET AIR RESTRICTION
26.	1-B,1-C	ENGINE INSTALLATION ANGLE
27.	1-B	EXHAUST DOWN ANGLE
28.		PROPELLER SHAFT SPEED
29.	1-B	STARTER CABLE RESISTANCE
30.		BATTERY VOLTAGE AT CRANKING
31.		
32.		

View A - B Series

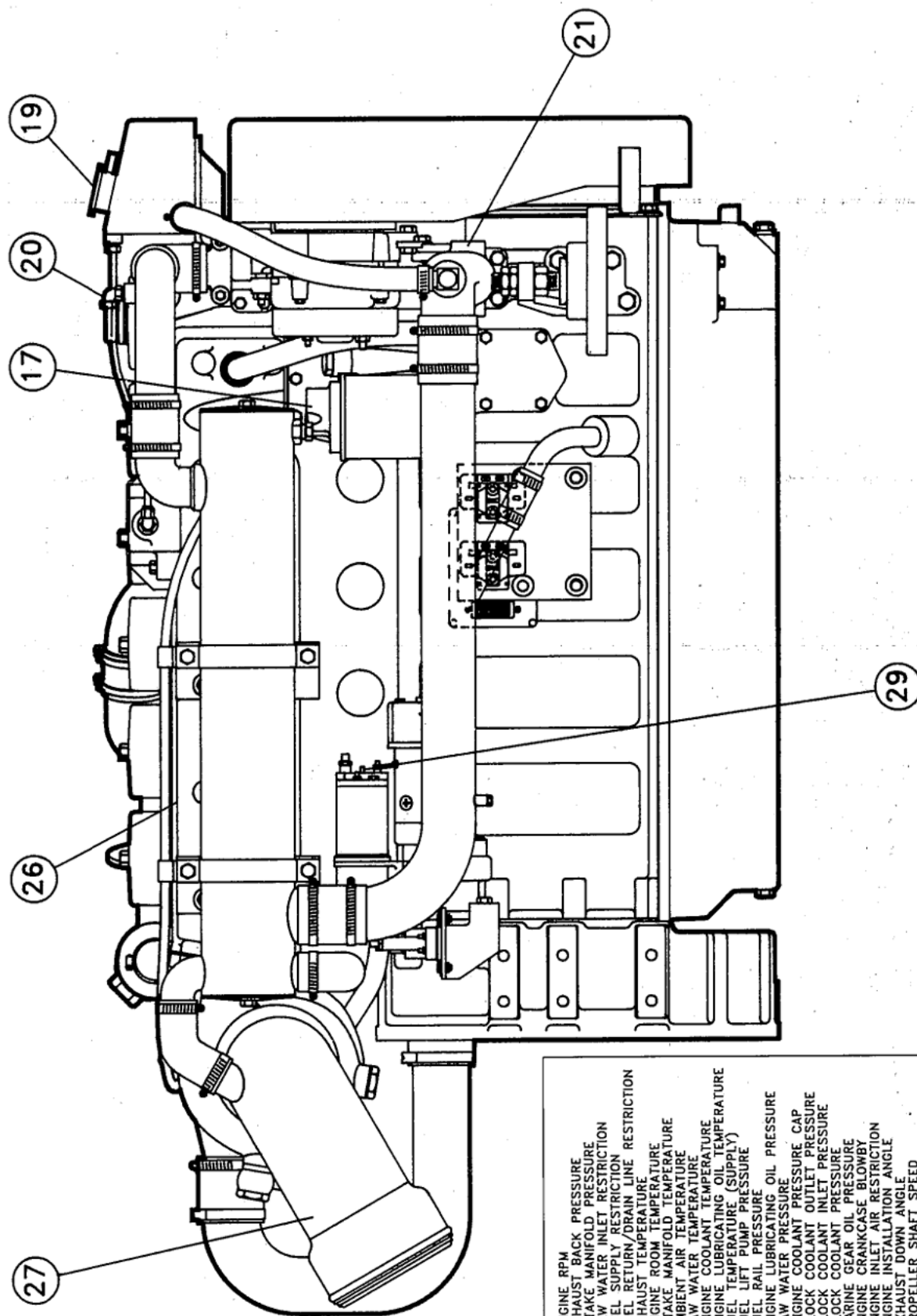


- 1. ENGINE RPM
- 2. EXHAUST BACK PRESSURE
- 3. INTAKE MANIFOLD PRESSURE
- 4. RAW WATER INLET RESTRICTION
- 5. FUEL SUPPLY RESTRICTION
- 6. FUEL RETURN/DRAIN LINE RESTRICTION
- 7. EXHAUST TEMPERATURE
- 8. ENGINE ROOM TEMPERATURE
- 9. INTAKE MANIFOLD TEMPERATURE
- 10. AMBIENT AIR TEMPERATURE
- 11. RAW WATER TEMPERATURE
- 12. ENGINE COOLANT TEMPERATURE
- 13. ENGINE LUBRICATING OIL TEMPERATURE
- 14. FUEL TEMPERATURE (SUPPLY)
- 15. FUEL LIFT PUMP PRESSURE
- 16. FUEL RAIL PRESSURE
- 17. ENGINE LUBRICATING OIL PRESSURE
- 18. RAW WATER PRESSURE
- 19. ENGINE COOLANT PRESSURE CAP
- 20. BLOCK COOLANT OUTLET PRESSURE
- 21. BLOCK COOLANT INLET PRESSURE
- 22. BLOCK COOLANT PRESSURE
- 23. MARINE GEAR OIL PRESSURE
- 24. ENGINE CRANKCASE BLOWBY
- 25. ENGINE INLET AIR RESTRICTION
- 26. ENGINE INSTALLATION ANGLE
- 27. EXHAUST DOWN ANGLE
- 28. PROPELLER SHAFT SPEED
- 29. STARTER CABLE RESISTANCE
- 30. BATTERY VOLTAGE @ CRANKING

S3-85

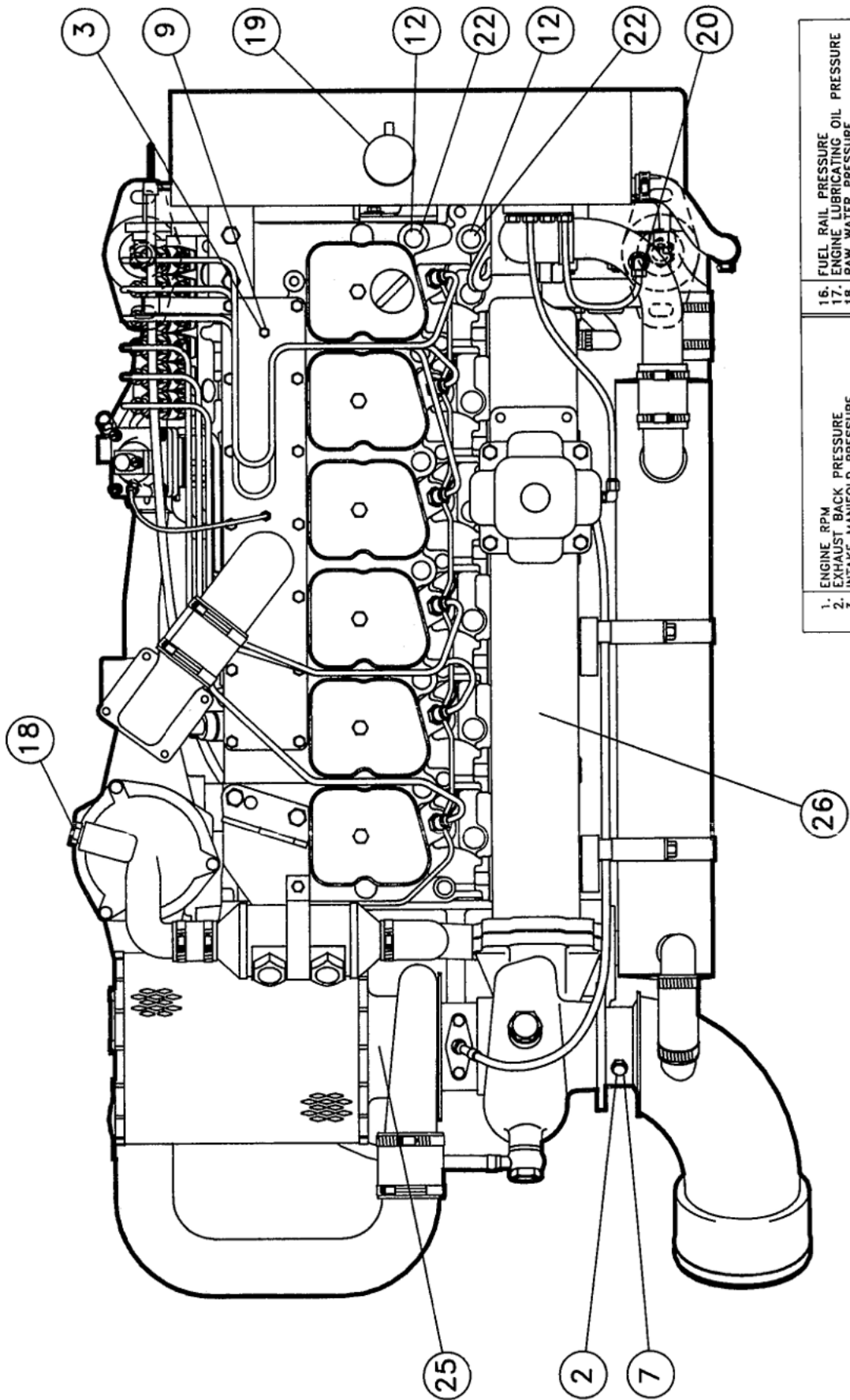
View B - B Series

S3-86



1. ENGINE RPM
2. EXHAUST BACK PRESSURE
3. INTAKE MANIFOLD PRESSURE
4. RAW WATER INLET RESTRICTION
5. FUEL SUPPLY RESTRICTION
6. FUEL RETURN/DRAIN LINE RESTRICTION
7. EXHAUST TEMPERATURE
8. ENGINE ROOM TEMPERATURE
9. INTAKE MANIFOLD TEMPERATURE
10. AMBIENT AIR TEMPERATURE
11. RAW WATER TEMPERATURE
12. ENGINE COOLANT TEMPERATURE
13. ENGINE LUBRICATING OIL TEMPERATURE
14. FUEL TEMPERATURE (SUPPLY)
15. FUEL LIFT PUMP PRESSURE
16. FUEL RAIL PRESSURE
17. ENGINE LUBRICATING OIL PRESSURE
18. RAW WATER PRESSURE
19. ENGINE COOLANT PRESSURE CAP
20. BLOCK COOLANT OUTLET PRESSURE
21. BLOCK COOLANT INLET PRESSURE
22. MARINE GEAR OIL PRESSURE
23. ENGINE CRANKCASE BLOWBY
24. ENGINE INLET AIR RESTRICTION
25. ENGINE INSTALLATION ANGLE
26. EXHAUST DOWN ANGLE
27. PROPELLER SHAFT SPEED
28. STARTER CABLE RESISTANCE
29. BATTERY VOLTAGE @ CRANKING
- 30.

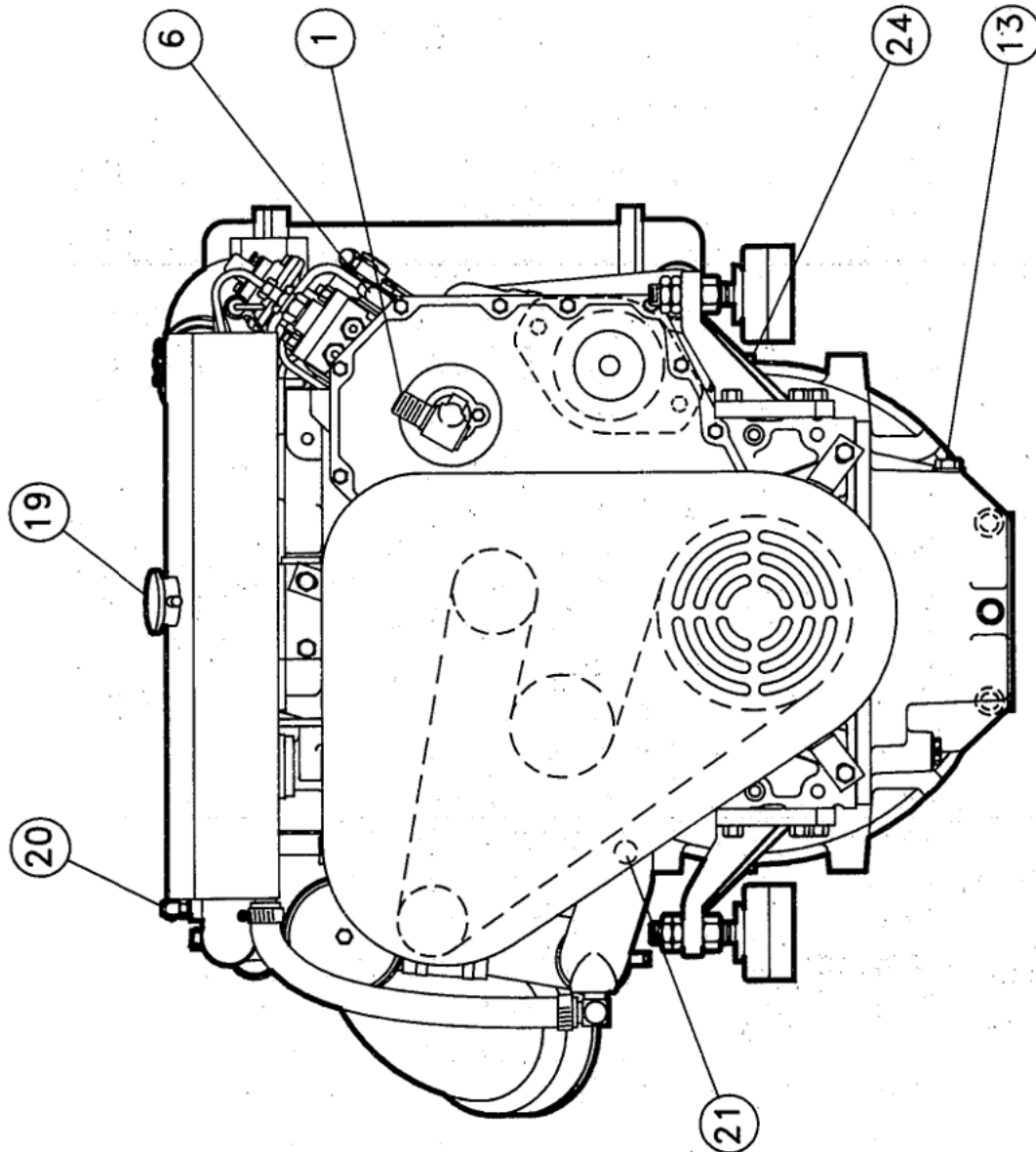
View C - B Series



1. ENGINE RPM	16. FUEL RAIL PRESSURE
2. EXHAUST BACK PRESSURE	17. ENGINE LUBRICATING OIL PRESSURE
3. INTAKE MANIFOLD PRESSURE	18. RAW WATER PRESSURE
4. FUEL SUPPLY INLET RESTRICTION	19. ENGINE COOLANT PRESSURE CAP
5. FUEL RETURN/RAIN LINE RESTRICTION	20. BLOCK COOLANT OUTLET PRESSURE
6. EXHAUST TEMPERATURE	21. BLOCK COOLANT INLET PRESSURE
7. ENGINE ROOM TEMPERATURE	22. BLOCK COOLANT PRESSURE
8. INTAKE MANIFOLD TEMPERATURE	23. MARINE GEAR OIL PRESSURE
9. AMBIENT AIR TEMPERATURE	24. ENGINE CRANKCASE BLOWBY
10. RAW WATER TEMPERATURE	25. ENGINE INLET AIR RESTRICTION
11. ENGINE COOLANT TEMPERATURE	26. ENGINE INSTALLATION ANGLE
12. ENGINE LUBRICATING OIL TEMPERATURE	27. EXHAUST DOWN ANGLE
13. FUEL TEMPERATURE (SUPPLY)	28. PROPELLER SHAFT SPEED
14. FUEL LIFT PUMP PRESSURE	29. STARTER CABLE RESISTANCE
	30. BATTERY VOLTAGE @ CRANKING

S3-87

View D - B Series



S3-88

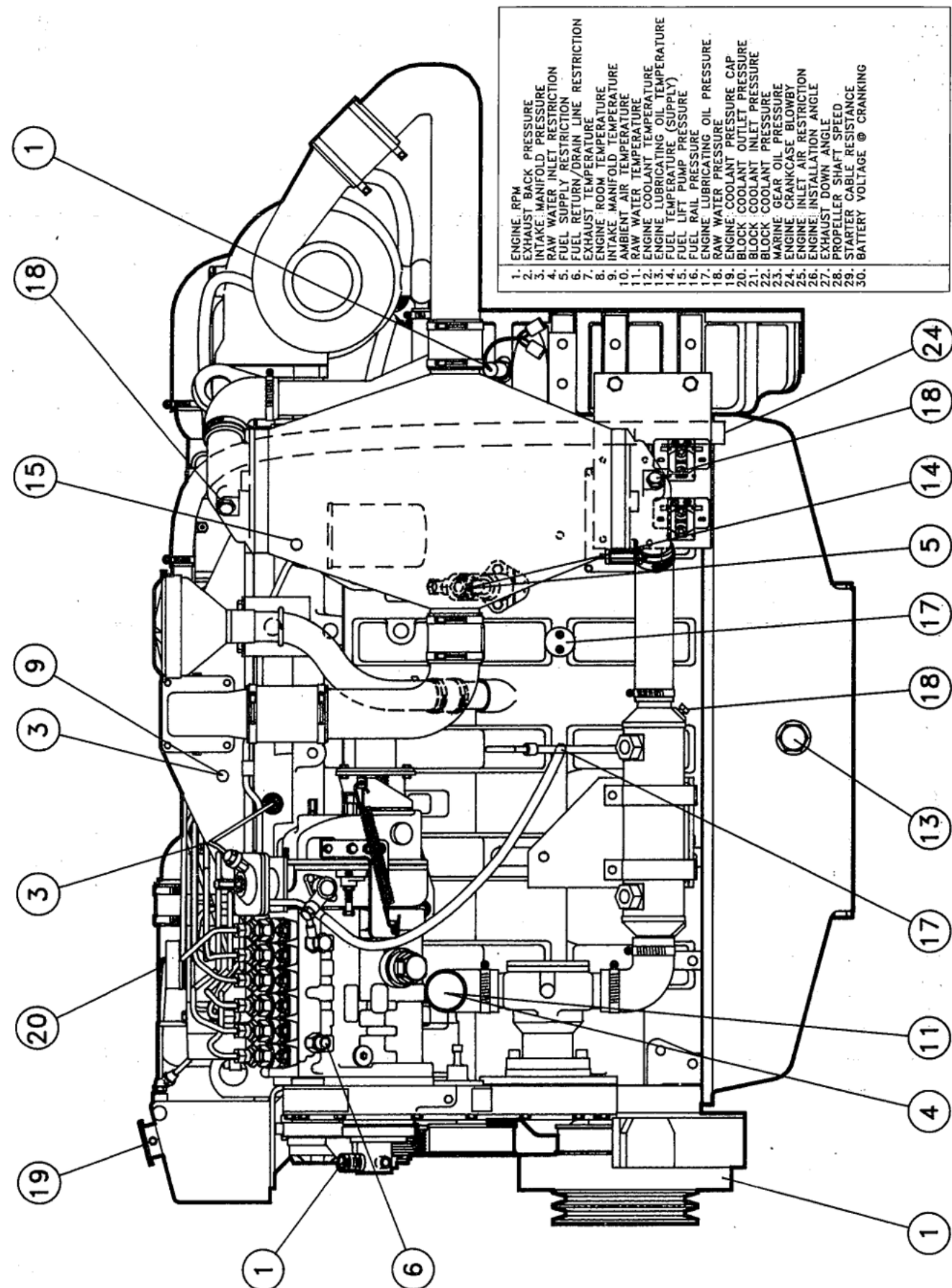
- | | |
|-----|-------------------------------------|
| 1. | ENGINE RPM |
| 2. | EXHAUST BACK PRESSURE |
| 3. | INTAKE MANIFOLD PRESSURE |
| 4. | RAW WATER INLET RESTRICTION |
| 5. | FUEL SUPPLY RESTRICTION |
| 6. | FUEL RETURN/ DRAIN LINE RESTRICTION |
| 7. | EXHAUST TEMPERATURE |
| 8. | ENGINE ROOM TEMPERATURE |
| 9. | INTAKE MANIFOLD TEMPERATURE |
| 10. | AMBIENT AIR TEMPERATURE |
| 11. | RAW WATER TEMPERATURE |
| 12. | ENGINE COOLANT TEMPERATURE |
| 13. | ENGINE LUBRICATING OIL TEMPERATURE |
| 14. | FUEL TEMPERATURE (SUPPLY) |
| 15. | FUEL LIFT PUMP PRESSURE |
| 16. | FUEL RAIL PRESSURE |
| 17. | ENGINE LUBRICATING OIL PRESSURE |
| 18. | RAW WATER PRESSURE |
| 19. | ENGINE COOLANT PRESSURE CAP |
| 20. | BLOCK COOLANT OUTLET PRESSURE |
| 21. | BLOCK COOLANT INLET PRESSURE |
| 22. | MARINE GEAR OIL PRESSURE |
| 23. | ENGINE CRANKCASE BLOWBY |
| 24. | ENGINE INLET AIR RESTRICTION |
| 25. | ENGINE INSTALLATION ANGLE |
| 26. | EXHAUST DOWN ANGLE |
| 27. | PROPELLER SHAFT SPEED |
| 28. | STARTER CABLE RESISTANCE |
| 29. | BATTERY VOLTAGE @ CRANKING |
| 30. | |

INSPECTION AND TEST LOCATIONS

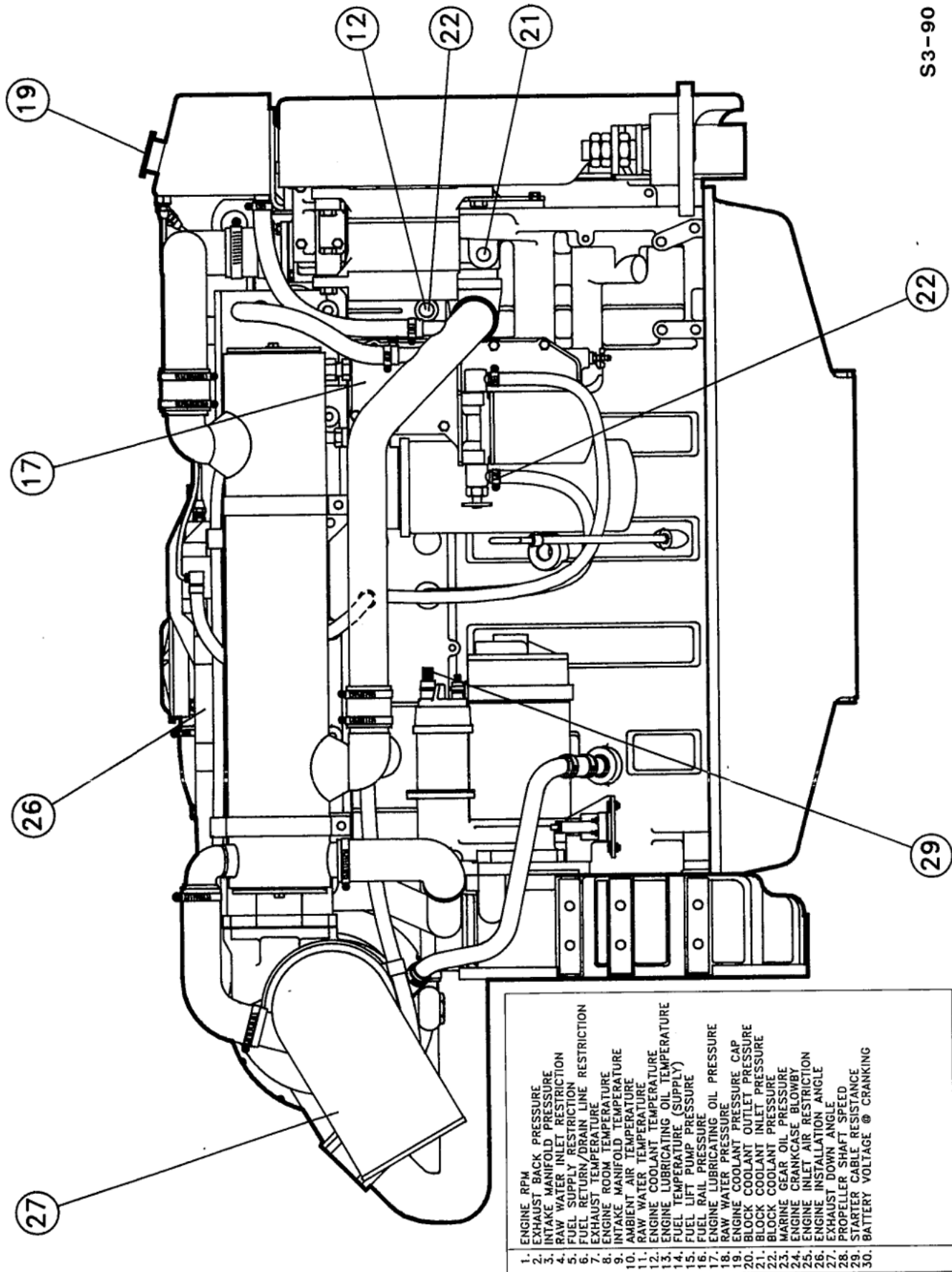
C SERIES ENGINES

TEST POINT NUMBER	NUMBER OF TEST POINTS ON EACH DRAWING VIEW	INSPECTION/TEST POINT NAME
1.	3-A,1-D	ENGINE RPM
2.	1-C	EXHAUST BACK PRESSURE
3.	2-A	INTAKE MANIFOLD PRESSURE
4.	1-A,1-D	RAW WATER INLET RESTRICTION
5.	1-A	FUEL SUPPLY RESTRICTION
6.	1-A	FUEL RETURN/DRAIN LINE RESTRICTION
7.	1-C	EXHAUST TEMPERATURE
8.		ENGINE ROOM TEMPERATURE
9.	1-A	INTAKE MANIFOLD TEMPERATURE
10.		AMBIENT AIR TEMPERATURE
11.	1-A,1-D	RAW WATER TEMPERATURE
12.	1-B	ENGINE COOLANT TEMPERATURE
13.	1-A,1-D	ENGINE LUBRICATING OIL TEMPERATURE
14.	1-A	FUEL TEMPERATURE (SUPPLY)
15.	1-A	FUEL LIFT PUMP PRESSURE
16.	N/A	FUEL RAIL PRESSURE
17.	2-A,1-B	ENGINE LUBRICATING OIL PRESSURE
18.	3-A,1-C	RAW WATER PRESSURE
19.	1-A,1-B,1-C,1-D	ENGINE COOLANT PRESSURE CAP
20.	1-A,1-C	BLOCK COOLANT OUTLET PRESSURE
21.	1-B	BLOCK COOLANT INLET PRESSURE
22.	2-B	BLOCK COOLANT PRESSURE
23.		MARINE GEAR OIL PRESSURE
24.	1-A,1-D	ENGINE CRANKCASE BLOWBY
25.	1-C	ENGINE INLET AIR RESTRICTION
26.	1-B,1-C	ENGINE INSTALLATION ANGLE
27.	1-B	EXHAUST DOWN ANGLE
28.		PROPELLER SHAFT SPEED
29.	1-B	STARTER CABLE RESISTANCE
30.		BATTERY VOLTAGE AT CRANKING
31.		
32.		

View A - C Series

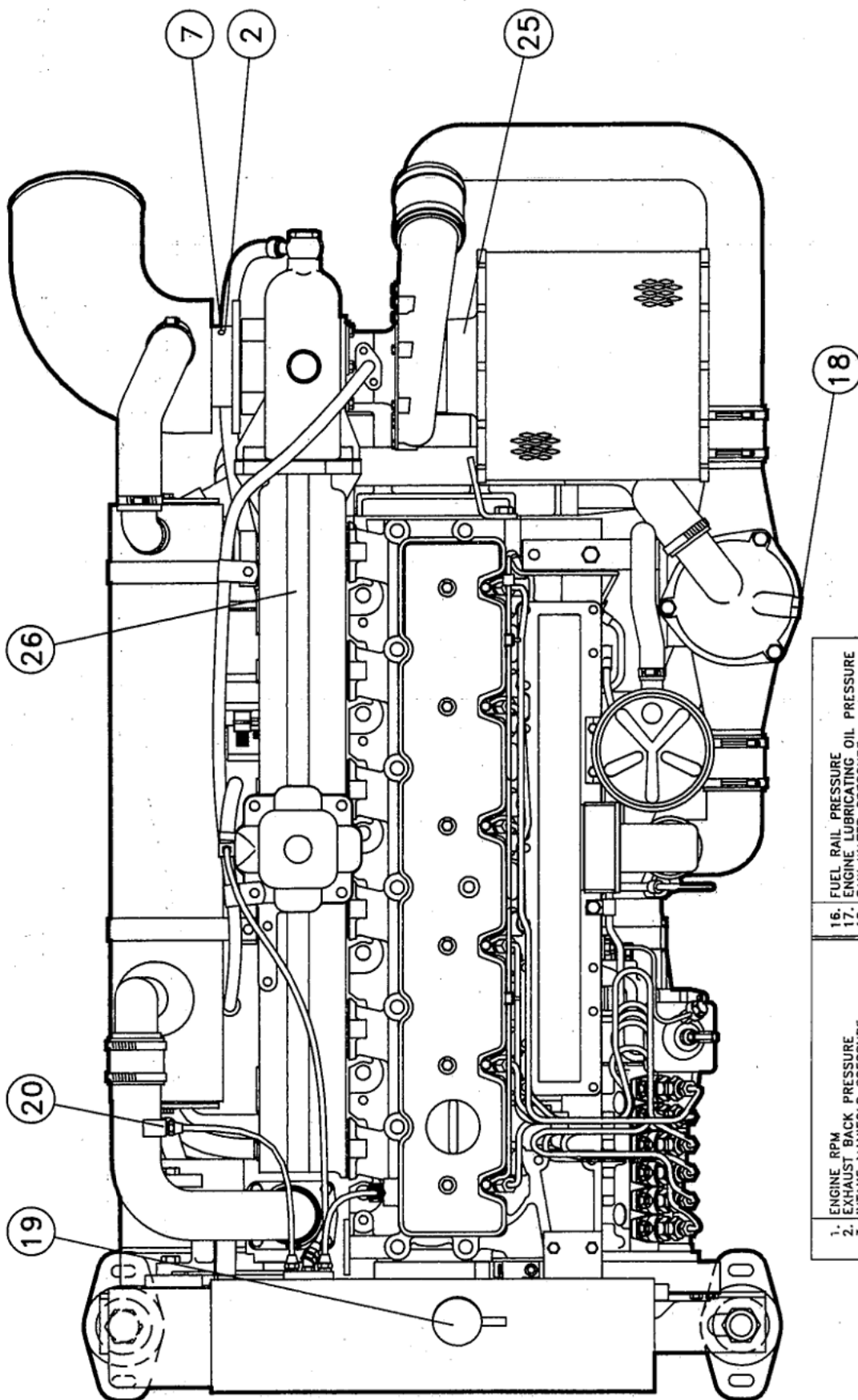


View B - C Series



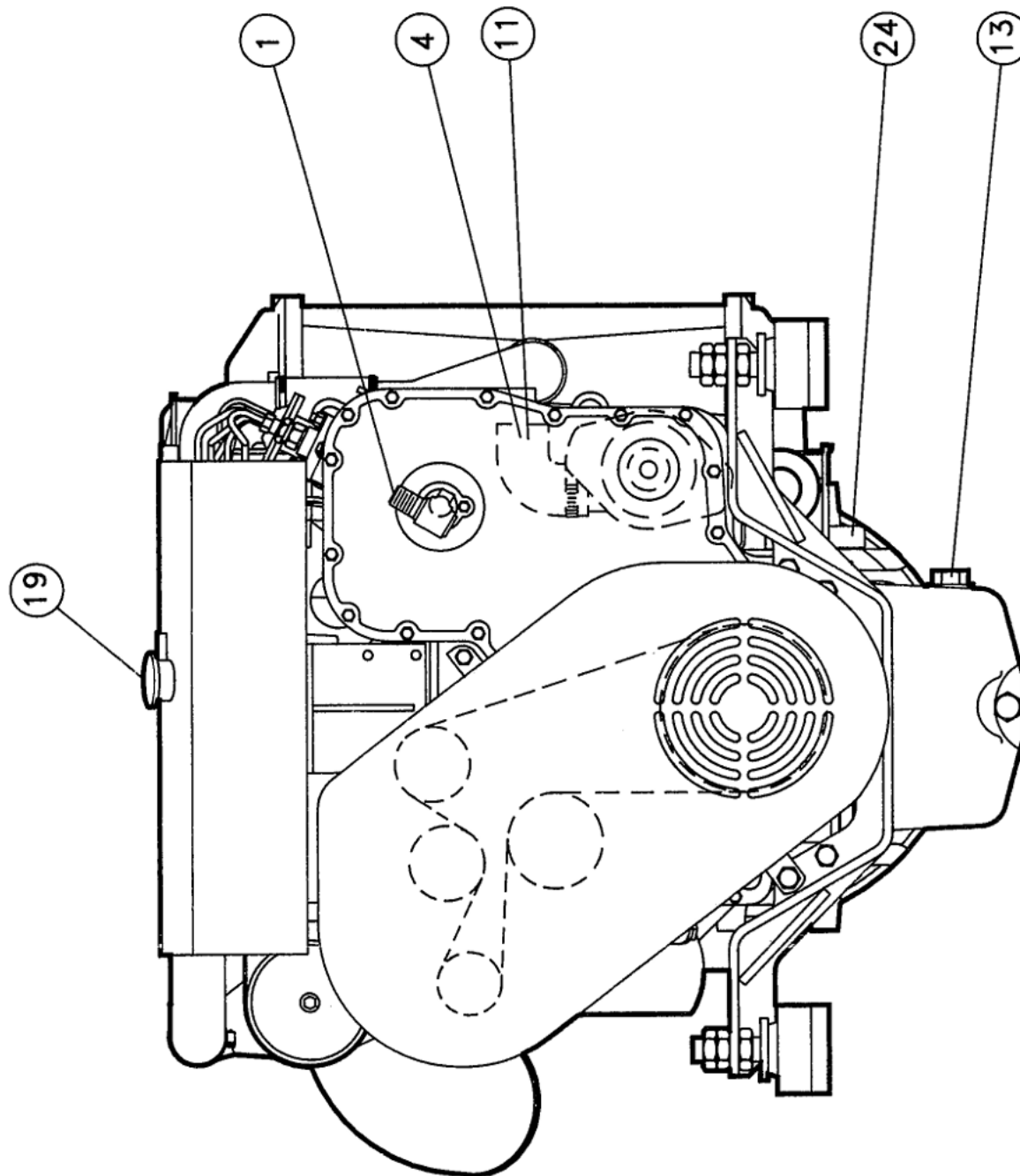
S3-90

View C - C Series



1. ENGINE RPM	16. FUEL RAIL PRESSURE
2. EXHAUST BACK PRESSURE	17. ENGINE LUBRICATING OIL PRESSURE
3. INTAKE MANIFOLD PRESSURE	18. RAW WATER PRESSURE
4. RAW WATER INLET RESTRICTION	19. ENGINE COOLANT PRESSURE CAP
5. FUEL SUPPLY RESTRICTION	20. BLOCK COOLANT OUTLET PRESSURE
6. FUEL RETURN/DRAIN LINE RESTRICTION	21. BLOCK COOLANT INLET PRESSURE
7. EXHAUST TEMPERATURE	22. BLOCK COOLANT PRESSURE
8. ENGINE ROOM TEMPERATURE	23. MARINE GEAR OIL PRESSURE
9. INTAKE MANIFOLD TEMPERATURE	24. ENGINE CRANKCASE BLOWBY
10. AMBIENT AIR TEMPERATURE	25. ENGINE INLET AIR RESTRICTION
11. RAW WATER TEMPERATURE	26. ENGINE INSTALLATION ANGLE
12. ENGINE COOLANT TEMPERATURE	27. EXHAUST DOWN ANGLE
13. ENGINE LUBRICATING OIL TEMPERATURE	28. PROPELLER SHAFT SPEED
14. FUEL TEMPERATURE (SUPPLY)	29. STARTER CABLE RESISTANCE
15. FUEL LIFT PUMP PRESSURE	30. BATTERY VOLTAGE @ CRANKING

View D - C Series



S3-92

1.	ENGINE RPM
2.	EXHAUST BACK PRESSURE
3.	INTAKE MANIFOLD PRESSURE
4.	RAW WATER INLET RESTRICTION
5.	FUEL SUPPLY RESTRICTION
6.	FUEL RETURN/DRAIN LINE RESTRICTION
7.	EXHAUST TEMPERATURE
8.	ENGINE ROOM TEMPERATURE
9.	INTAKE MANIFOLD TEMPERATURE
10.	AMBIENT AIR TEMPERATURE
11.	RAW WATER TEMPERATURE
12.	ENGINE COOLANT TEMPERATURE
13.	ENGINE LUBRICATING OIL TEMPERATURE
14.	FUEL TEMPERATURE (SUPPLY)
15.	FUEL LIFT PUMP PRESSURE
16.	FUEL RAIL PRESSURE
17.	ENGINE LUBRICATING OIL PRESSURE
18.	RAW WATER PRESSURE
19.	ENGINE COOLANT PRESSURE CAP
20.	BLOCK COOLANT OUTLET PRESSURE
21.	BLOCK COOLANT INLET PRESSURE
22.	ENGINE CRANKCASE BLOWBY
23.	MARINE GEAR OIL PRESSURE
24.	ENGINE INLET AIR RESTRICTION
25.	ENGINE INSTALLATION ANGLE
26.	EXHAUST DOWN ANGLE
27.	PROPELLER SHAFT SPEED
28.	STARTER CABLE RESISTANCE
29.	BATTERY VOLTAGE @ CRANKING

INSPECTION/TEST POINT INFORMATION

B AND C SERIES ENGINES

Test Point: No. 01

Inspection/Test Name: ENGINE RPM

Inspection/Test Device: OPTICAL TACHOMETER PART NO. 3377462/MAGNETIC PICK-UP AND TACHOMETER/TACHOMETER DRIVE AND HAND TACHOMETER

Type of Measurement:

Speed (RPM): Min. Gauge 0 to 4000 RPM

Inspection/Test Connection or Opening Size: 3/4-16 UNF MAGNETIC PICK-UP

Engine Operational Mode:

(Idle): X (High Idle): X (Rated Load): X

Additional Information: OPTICAL TACHOMETER IS THE PREFERRED TESTER, HAND HELD TACHOMETER MAY BE USED OFF OF TACHOMETER DRIVE AND ELECTRONIC TACHOMETER OFF OF MAGNETIC PICKUP.

Test Point: No. 02

Inspection/Test Name: EXHAUST BACK PRESSURE

Inspection/Test Device: MANOMETER PART NO. ST-1111-3/MAGNAHELIC GAUGE (MERCURY DIAL GAUGE)

Type of Measurement:

Pressure (mm Hg/[in Hg]): Minimum Gauge 0 to 254 mm Hg [0 to 10 in Hg]

Inspection/Test Connection or Opening Size: 1/8 NPT

Engine Operational Mode:

(Rated Load): X (Transient Speed/Load): X

Additional Information: A 49.4 TO 61.4 MM [24 TO 36 INCH] COPPER TUBE SHOULD BE INSTALLED BETWEEN THE EXHAUST OUTLET FLANGE AND THE TEST GAUGE HOSE TO PREVENT HEAT DAMAGE.

Service Tool: (Part No.): 3376656

(Name): Tee 1/8 NPT

(Part No.): 3377244

(Name): Quick-Connect

(Part No.): None

(Name): Nipple 1/8 NPT

(Part No.): None

(Name): Compression Fitting (Thermal Probe)

Test Point: No. 03

Inspection/Test Name: INTAKE MANIFOLD PRESSURE

Inspection/Test Device: MAGNAHELIC/PRESSURE GAUGE PART NO. ST-1273

Type of Measurement:

Pressure (mm Hg/[in Hg]): Min. Gauge 0 to 1905 mm Hg [0 to 75 in Hg]

Inspection/Test Connection or Opening Size: 1/8 NPT BOOST LINE / INTAKE COVER

Engine Operational Mode:

(Rated Load): X (Transient Speed/Load): X

Additional Information: TEST CONNECTION MUST BE INSTALLED ON INTAKE MANIFOLD SIDE OF AFTERCOOLER. NOTE: CONNECTIONS CAN BE INSTALLED INTO THE CYLINDER HEAD.

Service Tool: (Part No.): 3377244

(Name): Quick-Connect 1/8 NPT

(Part No.): 3376516

(Name): Probe Seal Adapter

(Part No.): 3376656

(Name): Tee 1/8 NPT

(Part No.): None

(Name): Nipple 1/8 NPT

Test Point: No. 04**Inspection/Test Name:** RAW WATER INLET RESISTRICTION**Inspection/Test Device:** MANOMETER PART NO. ST-1111-3 (in Hg)/MAGNAHELIC GAUGE/VACUUM GAUGE**Type of Measurement:**

Vacuum (Restriction) (mm Hg/[in Hg]): Min. Gauge 0 to 762 mm Hg [0 to 30 in Hg]

Inspection/Test Connection or Opening Size: 1/8 NPT**Engine Operational Mode:**

(Rated Load): X (Transient Speed/Load): X

Additional Information: A "T" ADAPTER BETWEEN THE RAW WATER INLET HOSE AND PUMP INLET CONNECTION WILL BE REQUIRED. ADAPTER SIZE: 1 1/4, 1 1/2, AND 1 3/4 INCH

Service Tool: (Part No.): 3376656 (Name): Tee 1/8 NPT
(Part No.): 3377244 (Name): Quick-Connect
(Part No.): 3376516 (Name): Probe Seal Adapter
(Part No.): None (Name): Nipple 1/8 NPT

Test Point: No. 05**Inspection/Test Name:** FUEL SUPPLY RESTRICTION**Inspection/Test Device:** MAGNAHELIC/VACUUM GAUGE PART NO. ST-434**Type of Measurement:**

Vacuum (Restriction) (mm Hg/[in Hg]): Min. Gauge 0 to 381 mm Hg [0 to 15 in Hg]

Inspection/Test Connection or Opening Size: 1/4 NPT (LIFT PUMP INLET)**Engine Operational Mode:**

(Rated Load): X (Transient Speed/Load): X

Additional Information: A "T" ADAPTER BETWEEN THE LIFT PUMP INLET AND THE FUEL SUPPLY LINE WILL BE REQUIRED.

Service Tool: (Part No.): 3377860 (Name): Quick-Connect 1/4 NPT
(Part No.): None (Name): Tee 1/4 NPT
(Part No.): None (Name): Nipple 1/4 NPT
(Part No.): 3376652 (Name): 1/8 X 1/4 NPT Bushing
(Part No.): 3376516 (Name): Probe Seal Adapter

Test Point: No. 06**Inspection/Test Name:** FUEL RETURN/DRAIN LINE RESTRICTION**Inspection/Test Device:** MAGNAHELIC / PRESSURE GAUGE PART NO. ST-1273**Type of Measurement:**

Pressure (mm Hg/[in Hg]): Min. Gauge 0 to 762 mm Hg [0 to 30 in Hg]

Inspection/Test Connection or Opening Size: 3/16 INSIDE DIAMETER DISTRIBUTOR PUMP
1/4 NPT INLINE PUMP**Engine Operational Mode:**

(Rated Load): X (Transient Speed/Load): X

Additional Information: "T" ADAPTER NEEDS TO BE BETWEEN THE FUEL PUMP DRAIN CONNECTION AND FUEL RETURN. OPENING SIZE: 3/8 INSIDE DIAMETER HOSE INLINE PUMP.

Service Tool: (Part No.): 3377860 (Name): Quick-Connect 1/4 NPT
(Part No.): 3376516 (Name): Probe Seal Adapter
(Part No.): None (Name): Tee 1/4 NPT
(Part No.): None (Name): Nipple 1/4 NPT
(Part No.): 3376652 (Name): 1/8 X 1/4 NPT Bushing
(Part No.): None (Name): 1/4 NPT X 3/16, 5/16, and 3/8 inch Barb Hose Connect

Test Point: No. 07

Inspection/Test Name: EXHAUST TEMPERATURE

Inspection/Test Device: DIGITAL THERMOMETER PART NO. 3822666 AND PROBE PART NO. 3822988

Type of Measurement:

Temperature (C): Min. Gauge -18 to 801 Degrees
(F): Min. Gauge [0 to 1500 Degrees]

Inspection/Test Connection or Opening Size: 1/8 NPT

Engine Operational Mode:

(Rated Load): X (Transient Speed/Load): X

Additional Information: EXHAUST ELBOWS NOT DRILLED AND TAPPED WITH A TEST POINT WILL REQUIRE AN ADAPTER BETWEEN TURBOCHARGER AND EXHAUST ELBOW (SEE EXHAUST BACK PRESSURE IN TEST POINT NO. 2).

Test Point: No. 08

Inspection/Test Name: ENGINE ROOM TEMPERATURE

Inspection/Test Device: DIGITAL THERMOMETER PART NO. 3822666 AND PROBE PART NO. 3822988

Type of Measurement:

Temperature (C): Min. Gauge -18 to 93 Degrees
(F): Min. Gauge [0 to 200 Degrees]

Engine Operational Mode:

(Rated Load): X (Transient Speed/Load): X

Additional Information: TEMPERATURE PROBE SHOULD BE LOCATED NEAR THE CENTER-REAR OF THE ENGINE ROOM AT THE SAME LEVEL AS THE AIR INTAKE POINT.

Test Point: No. 09

Inspection/Test Name: INTAKE MANIFOLD TEMPERATURE

Inspection/Test Device: DIGITAL THERMOMETER PART NO. 3822666 AND PROBE PART NO. 3822988

Type of Measurement:

Speed (C): Min. Gauge -18 to 150 Degrees
(F): Min. Gauge [0 to 300 Degrees]

Inspection/Test Connection or Opening Size: 1/8 NPT

Engine Operational Mode:

(Rated Load): X (Transient Speed/Load): X

Additional Information: NOTE: (SEE INTAKE MANIFOLD PRESSURE CHECK FOR TOOLING IN TEST POINT NO. 3).

Test Point: No. 10

Inspection/Test Name: AMBIENT AIR TEMPERATURE AT VESSEL ENGINE ROOM VENT DUCT

Inspection/Test Device: DIGITAL THERMOMETER PART NO. 3822666 AND PROBE PART NO. 3822988

Type of Measurement:

Temperature (C): Min. Gauge -18 to 65 Degrees
(F): Min. Gauge [0 to 150 Degrees]

Engine Operational Mode:

(Idle): X (Rated Load): X (Transient Speed/Load): X

Additional Information: PLACE PROBE ON THE OUT SIDE OF THE VESSEL NEAR THE INLET AIR VENTILATION DUCT.

Test Point: No. 11

Inspection/Test Name: RAW WATER TEMPERATURE

Inspection/Test Device: DIGITAL THERMOMETER PART NO. 3822666 AND PROBE PART NO. 3822988

Type of Measurement:

Temperature (C): Min. Gauge -18 to 65 Degrees
(F): Min. Gauge [0 to 150 Degrees]

Engine Operational Mode:

(Idle): X (Rated Load): X (Transient Speed/Load): X

Additional Information: WATER TEMPERATURE PROBE CAN BE INSTALLED INTO THE WATER INLET RESTRICTION FIXTURE (SEE RAW WATER INLET RESTRICTION TOOLING IN TEST POINT NO. 4).

Test Point: No. 12

Inspection/Test Name: ENGINE COOLANT TEMPERATURE

Inspection/Test Device: DIGITAL THERMOMETER PART NO. 3822666 AND PROBE PART NO. 3822988

Type of Measurement:

Temperature (C): Min. Gauge -18 to 121 Degrees
(F): Min. Gauge [0 to 250 Degrees]

Inspection/Test Connection or Opening Size: 1/2 NPT

Engine Operational Mode:

(Idle): X (Rated Load): X (Transient Speed/Load): X

Additional Information: NOTE: (SEE BLOCK COOLANT/BLOCK COOLANT OUTLET PRESSURE FOR TOOLING IN TEST POINT NO. 20).

Test Point: No. 13

Inspection/Test Name: ENGINE LUBRICATING OIL TEMPERATURE

Inspection/Test Device: DIGITAL THERMOMETER PART NO. 3822666 AND PROBE PART NO. 3822988

Type of Measurement:

Temperature (C): Min. Gauge -18 to 150 Degrees
(F): Min. Gauge [0 to 300 Degrees]

Inspection/Test Connection or Opening Size: OIL PAN SIDE - M22X1.50

Engine Operational Mode:

(Rated Load): X

Additional Information: NOTE: PART NO. 3908110 THREADED PLUG WILL REDUCE THE OPENING SIZE FROM M22X1.50 TO 1/8 NPT, USE PART NO. 3902425 SEALING WASHER.

Service Tool: (Part No.): 3376516 (Name): Probe Seal Adapter

Test Point: No. 14

Inspection/Test Name: FUEL TEMPERATURE (SUPPLY)

Inspection/Test Device: DIGITAL THERMOMETER PART NO. 3822666 AND PROBE PART NO. 3822988

Type of Measurement:

Temperature (C): Min. Gauge -18 to 65 Degrees
(F): Min. Gauge [0 to 150 Degrees]

Engine Operational Mode:

(Rated Load): X (Transient Speed/Load): X

Additional Information: NOTE: (SEE FUEL SUPPLY RESTRICTION FOR TOOLING IN TEST POINT NO. 5).

Test Point: No. 15

Inspection/Test Name: FUEL LIFT PUMP PRESSURE

Inspection/Test Device: PRESSURE GAUGE PART NO. 3375278 OR 3375905

Type of Measurement:

Pressure (kPa/[psi]): Min. Gauge 0 to 414 kPa [0 to 60 psi] Inline Pump
0 to 69 kPa [0 to 10 psi] Distributor Pump

Inspection/Test Connection or Opening Size: M6 X 1.00 WITH PART NO. 3911446 FITTING

Engine Operational Mode:

(High Idle): X (Rated Load): X (Transient Speed/Load): X

Additional Information: WITH THE ABOVE LISTED FITTING, USE INJECTOR DRAIN CAPSCREW, SEAL, AND MODIFIED INJECTOR DRAIN LINE.

Service Tool: (Part No.): 3905307 (Name): Banjo Connector Screw
(Part No.): 3903380 (Name): Banjo Connector Seal
(Part No.): 3911446 (Name): Banjo Connector Screw
(Part No.): 3912954 (Name): Fuel Manifold (Modified)

Test Point: No. 16 NOTE: Not applicable to B/C Series engines

Engine Series: PT

Inspection/Test Name: FUEL RAIL PRESSURE

Test Point: No. 17

Inspection/Test Name: ENGINE LUBRICATING OIL PRESSURE

Inspection/Test Device: PRESSURE GAUGE PART NO. 3375275

Type of Measurement:

Pressure (kPa/[psi]): Min. Gauge 0 to 689 kPa [0 to 100 psi]

Inspection/Test Connection or Opening Size: 1/8 NPT Engine Operational Mode:

(Idle): X (Rated Load): X (Transient Speed/Load): X

Additional Information: CYLINDER BLOCK (MAIN OIL RIFLE) - OIL COOLER COVER (TURBOCHARGER AND ENGINE SUPPLY PASSAGE).

Service Tool: (Part No.): 3377244 (Name): Quick-Connect

Test Point: No. 18

Inspection/Test Name: RAW WATER PRESSURE

Inspection/Test Device: PRESSURE GAUGE PART NO. 3375905

Type of Measurement:

Pressure (kPa/[psi]): Min. Gauge 0 to 172 kPa [0 to 25 psi]

Inspection/Test Connection or Opening Size: 1/8 NPT -- GEAR OIL COOLER

Engine Operational Mode:

(Idle): X (High Idle): X

Additional Information: TEST RAW WATER PUMP OUTLET FOR MAXIMUM PRESSURE OR AT EACH END OF EACH COMPONENT AFTERCOOLER, GEAR OIL COOLER, AND HEAT EXCHANGER FOR PRESSURE DROP.

Service Tool: (Part No.): 3377244 (Name): Quick-Connect 1/8 NPT (Gear Cooler)
(Part No.): 3376653 (Name): Pipe Reducing Bushing 1/2 to 1/8 NPT

Test Point: No. 19

Inspection/Test Name: ENGINE COOLANT PRESSURE CAP
Inspection/Test Device: STANDARD RADIATOR CAP TESTER
Type of Measurement:

Pressure ... (kPa/[psi]): Min. Gauge 0 to 172 kPa [0 to 25 psi]

Engine Operational Mode:
(Stop): X

Additional Information: PRESSURE TEST EXPANSION TANK CAP / PRESSURE TEST TOTAL ENGINE COOLANT SYSTEM.

Service Tool: (Part No.): J24460 (Name): Radiator Cap and Cooling System Tester (Kent-Moore)
(Part No.): SVT262 (Name): Cooling System Tester (Snap-On)

Test Point: No. 20

Inspection/Test Name: BLOCK COOLANT OUTLET PRESSURE
Inspection/Test Device: PRESSURE GAUGE PART NO. 3375275
Type of Measurement:

Pressure (kPa/[psi]): Min. Gauge 0 to 517 kPa [0 to 75 psi]

Inspection/Test Connection or Opening Size: 1/8 NPT

Engine Operational Mode:
(High Idle): X (Rated Load): X (Transient Speed/Load): X

Additional Information: MEASURE BLOCK COOLANT OUTLET PRESSURE AFTER THE THERMOSTAT.

Service Tool: (Part No.): 3377244 (Name): Quick-Connect
(Part No.): 3376656 (Name): Tee 1/8 NPT
(Part No.): None (Name): Nipple 1/8 NPT

Test Point: No. 21

Inspection/Test Name: BLOCK COOLANT INLET PRESSURE
Inspection/Test Device: MAGNAHELIC/PRESSURE GAUGE PART NO. 3375936
Type of Measurement:

Pressure (kPa/[psi]): Min. Gauge -34 to 207 kPa [-5 to 30 psi]

Inspection/Test Connection or Opening Size: 1/2 NPT

Engine Operational Mode:
(Idle): X (High Idle): X (Rated Load): X (Transient Speed/Load): X

Additional Information: SYSTEM PRESSURE ALWAYS MUST BE POSITIVE AND WITHIN 35 KPA [5 PSI] OF ENGINE OUTLET WATER PRESSURE.

Service Tool: (Part No.): 3376656 (Name): Pipe Reducing Bushing 1/2 to 1/8 NPT
(Part No.): 3377244 (Name): Quick-Connect

Test Point: No. 22

Inspection/Test Name: BLOCK COOLANT PRESSURE
Inspection/Test Device: PRESSURE GAUGE PART NO. 3375275
Type of Measurement:

Pressure (kPa/[psi]): Min. Gauge 0 to 517 kPa [0 to 75 psi]

Inspection/Test Connection or Opening Size: 1/2 NPT

Engine Operational Mode:
(High Idle): X (Rated Load): X (Transient Speed/Load): X

Additional Information: BLOCK WATER TEMPERATURE AND BLOCK WATER PRESSURE CAN BE INSTALLED IN THE SAME TEST LOCATION.

Service Tool: (Part No.): 3376653 (Name): Pipe Reducing Bushing 1/2 to 1/8 NPT
(Part No.): 3377244 (Name): Quick-Connect
(Part No.): 3376516 (Name): Probe Seal Adapter
(Part No.): 3376656 (Name): Tee 1/8 NPT
(Part No.): None (Name): Nipple 1/8 NPT

Test Point: No. 23

Inspection/Test Name: MARINE GEAR OIL PRESSURE

Inspection/Test Device: PRESSURE GAUGE PART NO. 3375884

Type of Measurement:

Pressure (kPa/[psi]): Min. Gauge 0 to 2758 kPa [0 to 400 psi]

Inspection/Test Connection or Opening Size: 1/8 and 1/4 NPT

Engine Operational Mode:

(Idle): X (High Idle): X (Rated Load): X (Transient Speed/Load): X

Additional Information: SEE MANUFACTURE'S MANUAL FOR TEST POINT LOCATIONS AND OPERATING PRESSURES.

Test Point: No. 24

Inspection/Test Name: ENGINE CRANKCASE BLOWBY

Inspection/Test Device: MANOMETER (WATER-H₂O) PART NO. ST-111-3

Type of Measurement:

Pressure (mm H₂O/H₂O): Min. Gauge 0 to 914 mm H₂O [0 to 36 in H₂O]

Inspection/Test Connection or Opening Size: 3/4 inch Inside Diameter HOSE

Engine Operational Mode:

(Rated Load): X (Transient Speed/Load): X

Additional Information: 0.221 inch ORIFICE SIZE REQUIRED (B SERIES)

0.302 inch ORIFICE SIZE REQUIRED (C SERIES).

Service Tool: (Part No.): 3822476 (Name): Engine Blow-By Adapter (B Series)

(Part No.): 3822566 (Name): Engine Blow-By Adapter (C Series)

Test Point: No. 25

Inspection/Test Name: ENGINE INTAKE INLET AIR RESTRICTION

Inspection/Test Device: MANOMETER-(H₂O) PART NO. ST-111-3

Type of Measurement:

Vacuum (Restriction) (mm H₂O/in H₂O): Min. Gauge 0 to 914 mm H₂O [0 to 36 in H₂O]

Engine Operational Mode:

(Rated Load): X (Transient Speed/Load): X

Additional Information: AN ADAPTER MAY BE REQUIRED BETWEEN THE AIR CLEANER AND TURBO-CHARGER INLET FLANGE. THIS TEST NOT REQUIRED ON NEW SUPPLIED CUMMINS PACKAGE UNITS.

Test Point: No. 26

Inspection/Test Name: ENGINE INSTALLATION ANGLE

Inspection/Test Device: LEVEL AND ANGLE INDICATOR PART NO. 3375855

Type of Measurement:

Level/Angle (Degrees): Min. Gauge 0 to 45 Degrees

Engine Operational Mode:

(Stop): X

Additional Information: TEST GAUGE MAY BE PLACED ON CYLINDER HEAD OR VALVE COVER FOR TEST MEASUREMENT IF THE EXHAUST MANIFOLD CAN NOT BE USED.

Test Point: No. 27

Inspection/Test Name: EXHAUST DOWN ANGLE

Inspection/Test Device: LEVEL AND ANGLE INDICATOR PART NO. 3375855

Type of Measurement:

Level/Angle (Degrees): Min. Gauge 0 to 45 Degrees

Engine Operational Mode:

(Stop):

Additional Information: PLACE TEST GAUGE ON EXHAUST ELBOW CONNECTION / EXHAUST PIPING.

Test Point: No. 28

Inspection/Test Name: PROPELLER SHAFT SPEED

Inspection/Test Device: OPTICAL TACHOMETER PART NO. 3377462

Type of Measurement:

Speed (RPM): Min. Gauge 0 to 4000 RPM

Engine Operational Mode:

(Rated Load): X (Transient Speed/Load): X

Additional Information: SHAFT SPEED VERSUS ENGINE SPEED WILL VERIFY THE MARINE GEAR RATIO.

Test Point: No. 29

Inspection/Test Name: STARTER CABLE RESISTANCE

Inspection/Test Device: VOLT/OHM METER PART NO. 3377161 AND AMMETER

Type of Measurement:

Electrical (Ohms): .0012 With 12 Volt System
.002 With 24 Volt System

Engine Operational Mode:

(Cranking): X

Additional Information: NOTE: A BATTERY VOLTAGE DROP CHECK AND TOTAL SYSTEM CURRENT DRAW TEST MUST BE TAKEN TO CALCULATE STARTER CABLE RESISTANCE.

Test Point: No. 30

Inspection/Test Name: BATTERY VOLTAGE AT CRANKING

Inspection/Test Device: VOLTAGE METER PART NO. 3377161

Type of Measurement:

Electrical (Volts): Min. Gauge 0 to 50 VOLTS D.C.

Inspection/Test Connection or Opening Size: BATTERY POSITIVE AND NEGATIVE TERMINAL.

Engine Operational Mode:

(Stop): X (Cranking): X

Additional Information: CONNECT VOLTMETER ACROSS THE POSITIVE AND NEGATIVE POST OF THE BATTERY. CRANK ENGINE AND RECORD VOLTAGE DURING CRANKING CYCLE.

Instrumentation Gauge -- Cross Reference

MEASUREMENT VALUE	CUMMINS P/N	NAME
0 to 30 in Hg	3375274 --	VACUUM GAUGE
0 to 30 in Hg	ST-434	VACUUM GAUGE
0 to 30 in Hg	3377181	VACUUM GAUGE
0 to 30 in Hg	ST-1111-3	MANOMETER - WITH HG.
0 to 30 in Hg	3375936 **	PRESSURE/ VACUUM GAUGE
0 to 30 psi		
0 to 30 in Hg	3375907 ^^	VACUUM GAUGE
0 to 60 in Hg	3375276 --	MAGNAHELIC
	**	GAUGE
0 to 75 in Hg	ST-1273	PRESSURE GAUGE
0 to 30 psi	3375936 **	PRESSURE/ VACUUM GAUGE
0 to 30 in Hg		
0 to 30 psi	3375905 ^^	PRESSURE GAUGE
0 to 75 psi	3375278 --	PRESSURE GAUGE
	**	
0 to 100 psi	3375275 --	PRESSURE GAUGE
0 to 300 psi	3375277 --	PRESSURE GAUGE
	**	
0 to 300 psi	3375932	SNAP RAIL PRESSURE GAUGE
0 to 400 psi	3375884 ^^	PRESSURE GAUGE
0 to 600 psi	ST-1190-47 ==	PRESSURE GAUGE
0 to 600 psi	3375879 ^^	PRESSURE GAUGE
+ 1200° F	3822666	DIGITAL THERMOMETER
	3377106	TEMPERATURE KIT
ENGINE BLOW-BY IN H2O	ST-1111-3	MANOMETER - WITH H2O
ENGINE INSTALLATION ANGLE	3375855	INDICATOR LEVEL AND ANGLE
ENGINE AND PROPELLER SHAFT RPM	3377462	OPTICAL TACHOMETER
VOLT/OHM METER	3377161	DIGITAL MULTIMETER

NOTE: IF GAUGE IS INCLUDED IN A SERVICE TOOL OR KIT THE FOLLOWING CODE IS USED:

- Part No. 3375273 PORTABLE PRESSURE TEST KIT
- ** Part No. 3375935 MARINE TEST KIT
- ^^ Part No. 3375689 FUEL PUMP TEST STAND
- == Part No. 3376375 FUEL MEASURING INSTRUMENT

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Repair Tools Required for All Repair Procedures

Sockets	Wrenches	Other
	8 mm	Allen Wrench (8 mm)
10 mm	10 mm	Breaker Bar (1/2 in. sq. drive)
12 mm	12 mm	
13 mm	13 mm	Flat Screwdriver
15 mm	15 mm	Ratchet (3/8 in. sq. drive)
17 mm	17 mm (open end)	Ratchet (1/2 in. sq. drive)
	18 mm	
22 mm (deep well)	19 mm	Filter Wrenches (75 to 80 and 90 to 95 mm)
24 mm (deep well)	22 mm	Drill Motor (1/4 inch)
	24 mm	Drill Bit 3 mm [1/8 inch]
	3/8 inch	Slide Hammer
		Flat Chisel
7/16 (deep well)	7/16 inch	T-Bar Puller (75 mm)
		Sheet Metal Screw (No. 10)
		Torque Wrench
	1/2 inch	Pliers
	9/16 inch	5/16 Nut Driver
	7/8 inch	Plastic Hammer
	1-1/4 inch	Pry Bar
		Injector Bore Cleaning Brush
		Electric Engraver
		Hand Held Tachometer or Electrical (Strobe) Tachometer
		Silicone Spray Lube
		Silicone Grease
		Permatex No. 2 Sealant

Cooling System Repair Summary

Component To Be Replaced	Tools	Preparatory Steps
Belt Guard Drive Belt	Torque Wrench 10 mm Socket, Short Extension Breaker Bar (1/2 inch square drive) 13 mm Socket, 3/8 drive ratchet	
Belt Tensioner	Ratchet (3/8 inch drive) 15 mm Socket and Torque Wrench	Remove the protective cover and drive belt.
Water Pump	13 mm Socket Wrench and Torque Wrench Ratchet (3/8 inch drive)	Drain the coolant, remove the protective cover and drive belt.
Thermostat	13 and 16 mm Ratchet (3/8 inch drive) Torque Wrench	Drain the coolant, remove the protective cover, and drive belt, loosen the alternator link, remove the alternator mounting capscrew and thermostat housing, disconnect the negative battery cable.
Engine Block Heater	7/8 Inch Wrench	Drain the coolant.
Temperature Sensors	3/8 Inch Wrench	Drain the coolant.
Draining the Raw Water System	1/4 and 7/8 Inch Wrench	
Raw Water Pump	5/16 Inch Nutdriver or Screwdriver 15 mm Wrench	Drain raw water system.
Raw Water Pump Impeller 64 to 220 HP	3/8 Inch Wrench Small Flat Screwdriver	Drain raw water system.
Raw Water Pump Impeller 300 HP B Series, through 400 HP C Series	1/2 Inch Wrench Small Flat Screwdriver Two Pair Needle Nose Pliers	Drain raw water system.
Heat Exchanger	1/4 Inch Wrench 5/16 Inch Nutdriver or Screwdriver 13 mm Wrench	Drain.
Marine Gear Oil Cooler	7/16 Inch Wrench 5/16 Inch Nutdriver or Screwdriver 7/8 Inch Wrench 10 mm Socket & Extension	
Exhaust Manifold Cover Gasket	7/16 and 9/16 Inch Wrenches 13 mm Wrench Plastic Hammer	
Raw Water Aftercooler	15 mm and 7/16 Inch Socket Ratchet (3/8 inch drive) 7/8 Inch Wrench 5/16 Inch Socket or Flat Screwdriver Torque Wrench	

Cooling System Replacement Procedures

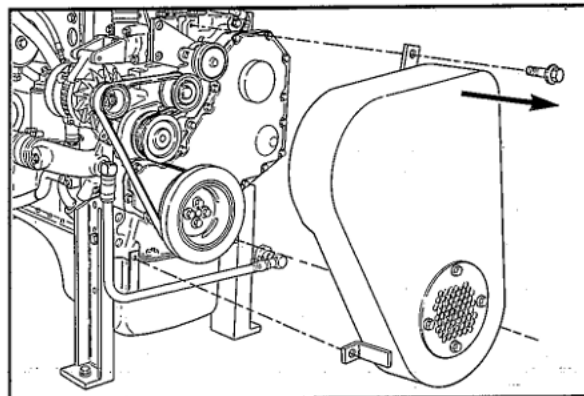
Drive Belt - Replacement

10 mm, Ratchet and Extension

Remove the protective cover.

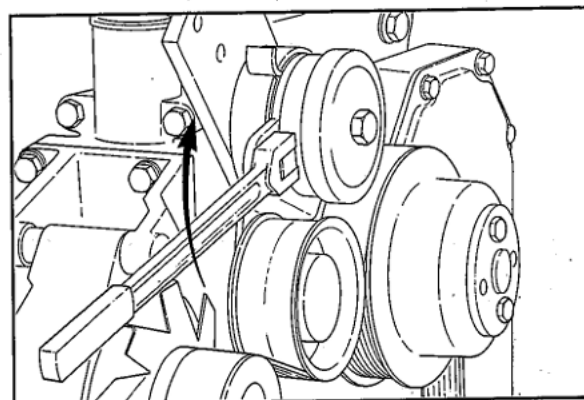
When installing the protective cover, tighten the mounting capscrews.

Torque Value: 24 N•m [18 ft-lb]



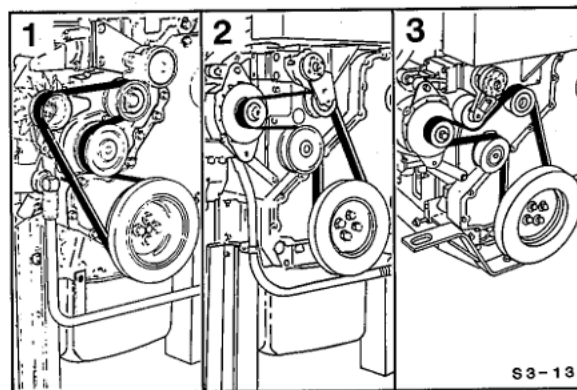
3/8 Inch Square Drive Breaker Bar

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



Verify that the correct belt wrap is used for your engine. The belt wraps shown are for:

1. All B Series engines.
2. Early C-300 HP engines.
3. C-400 HP engines.



Belt Tensioner - Replacement

15 mm

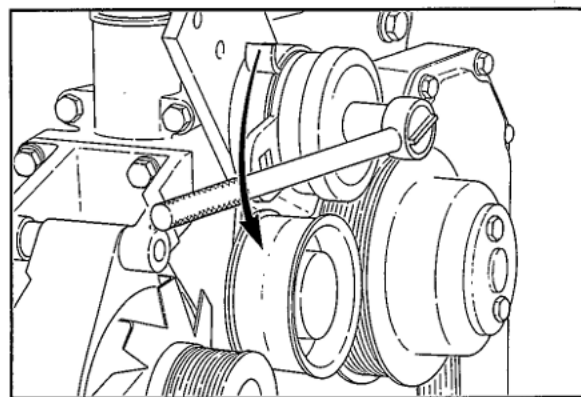
Preparatory Steps:

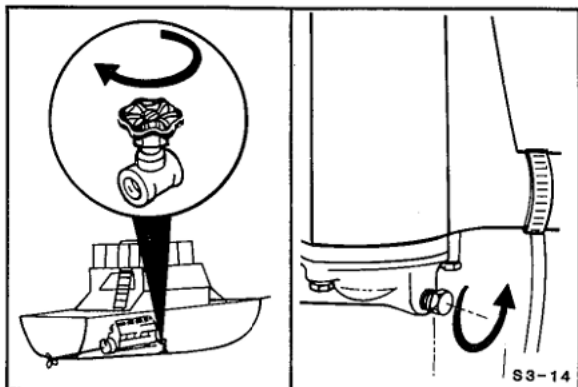
- Remove the protective cover.
- Remove the drive belt.

Remove the belt tensioner from the bracket. Reverse this procedure to install the belt tensioner. Be sure that the tensioner tang is in the tensioner bracket hole.

Tighten the capscrew.

Torque Value: 43 N•m [32 ft-lb]

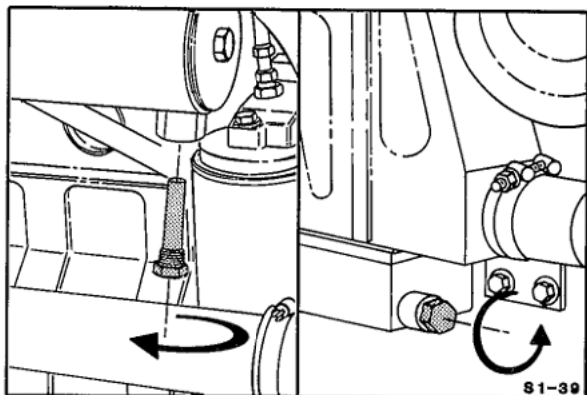




Raw Water System - Draining

Preparatory Step:

Shut off the raw water valve on the vessel hull.



3/8, 7/16 Inch

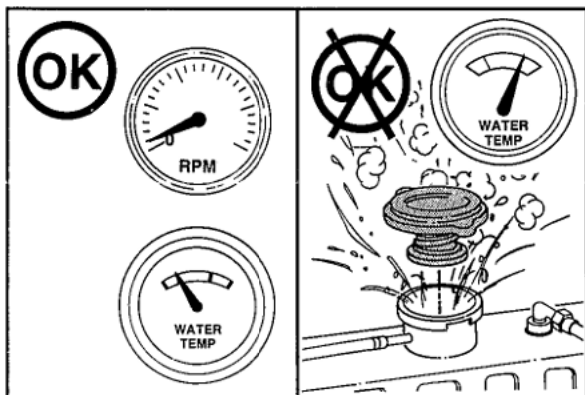


Remove the zinc plug(s) from the heat exchanger, if applicable, and raw water aftercooler on B-300 and C-400 HP engines.

Remove the drain plug from the marine gear oil cooler.

Verify that all water is drained from the raw water pipes and hoses on the engine.

After the system is completely drained, replace all hoses, drain plugs, and zinc plugs that were removed.



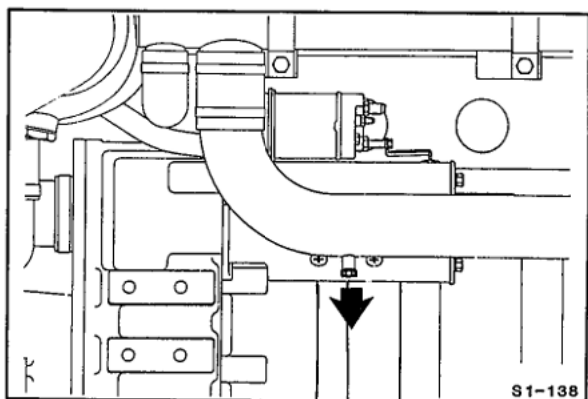
Coolant - Draining



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.



Caution: Any time the coolant system is drained, the coolant heater (if so equipped) must be disconnected. If not, it will burn the element up from overheating. The coolant heater must not be energized again until the engine has warmed up enough for the thermostats to open and purge any air pockets still present after filling.



5/16 Inch (Square Head)

Drain B Series engine coolant systems by removing the drain plug on the water transfer tube.

A drain pan with a capacity of 26.7 liters [7 U.S. gallons] is adequate for most applications.

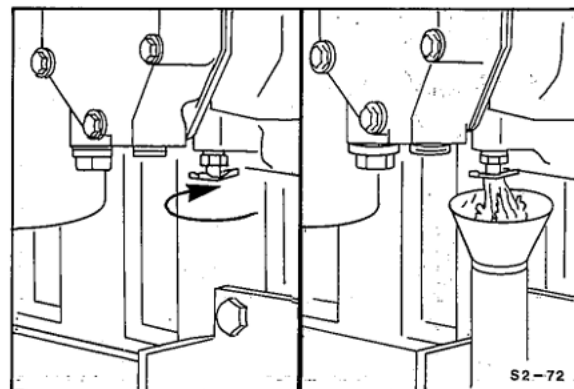
Removing the expansion tank cap will allow the coolant to drain faster.

Section A - Adjustment, Replacement and Repair B and C Series

Drain the C Series engine cooling system by opening the drain valve on the engine oil cooler. A drain pan with a capacity of 26.7 liters [7 U.S. gallons] will be adequate in most applications.

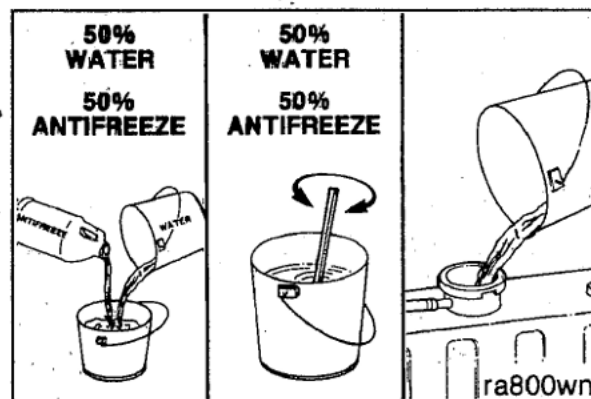
Removing the expansion tank cap will allow the coolant to drain faster.

Cooling System Replacement Procedures Page A-7



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

Refer to Section 7 for coolant filling.



Water Pump - Replacement

13 mm

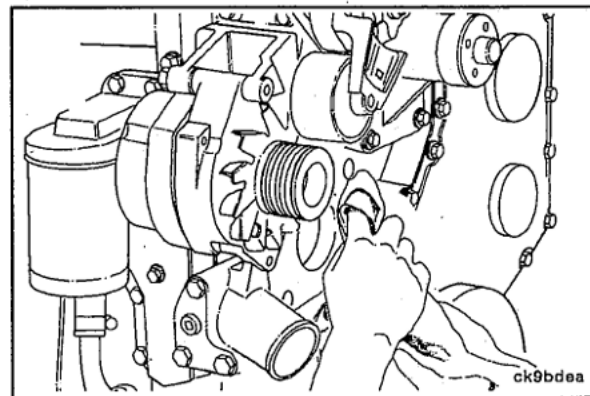
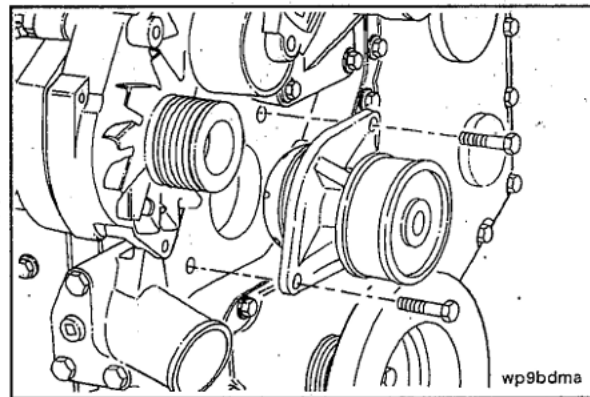
Preparatory Steps:

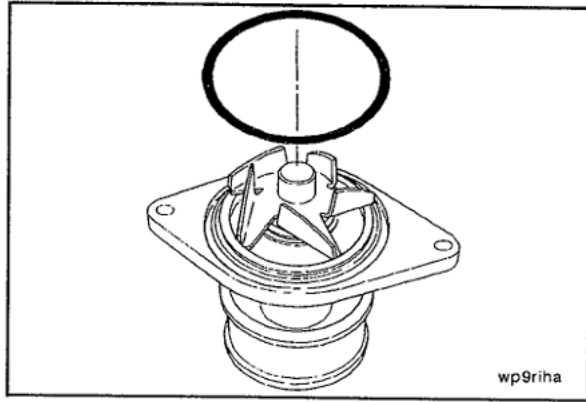
- Remove the protective cover.
- Drain the coolant.
- Lift the tensioner and remove the drive belt from the water pump pulley.
- Remove the alternator link on C Series engines from the water pump.

Remove the water pump and complete the following steps.

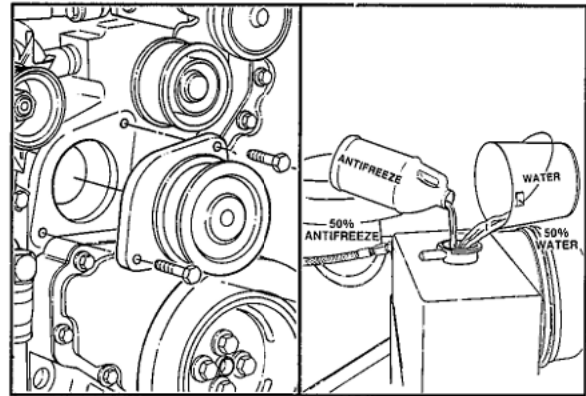
Make sure the coolant heater is **not** connected.

Clean the sealing surface on the cylinder block.





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



13 mm

Install the water pump. Install the alternator link on C Series engines. The installation torque on the capscrew is:

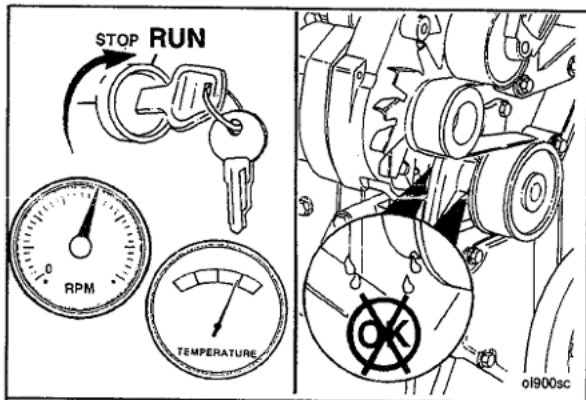


Torque Value: 24 N•m [18 ft-lb]



Close the coolant drain.

Refer to Section V for the correct amount of DCA-4 corrosion inhibitor to use in a C Series engine. Make sure the coolant system is completely filled with a 50 percent mixture of ethylene-glycol base antifreeze and water.

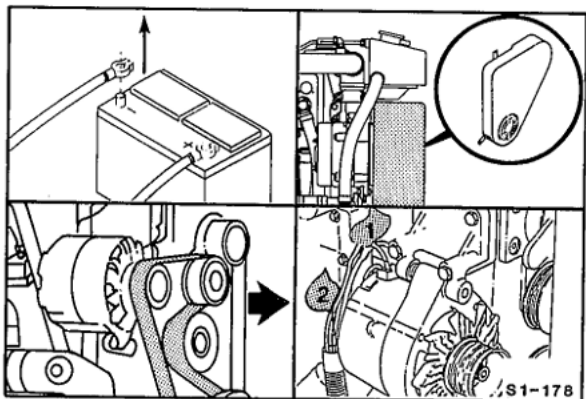


3/8 Inch Square Drive Breaker Bar

Lift the tension arm to install the drive belt.



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



Thermostat - Replacement

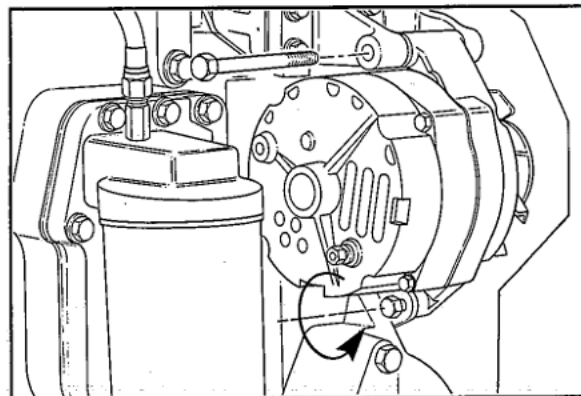
Preparatory Steps, both B and C Series engines:

- Disconnect the ground cable from the battery terminal.
- Remove the belt guard.
- Remove the drive belt.
- Tag and remove wires from the alternator.
- Unplug the coolant heater (if so equipped).
- Drain 13.2 liters [14 U.S. quarts] of coolant from the engine.

13 mm - B Series

3/4 Inch - C Series

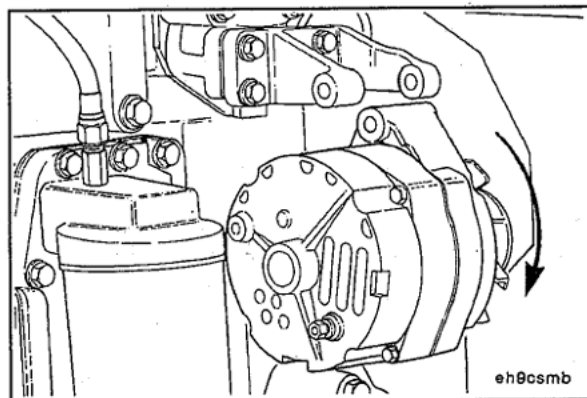
Loosen the alternator link capscrew.



B Series Engines Only

16 mm

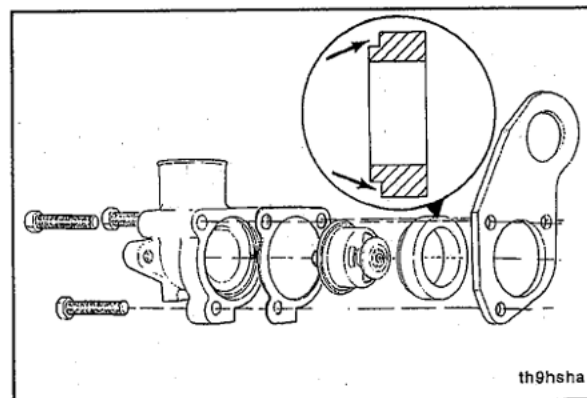
Remove the alternator mounting capscrew. Lower the alternator.



10 mm

Remove the thermostat housing, lifting bracket and thermostat.

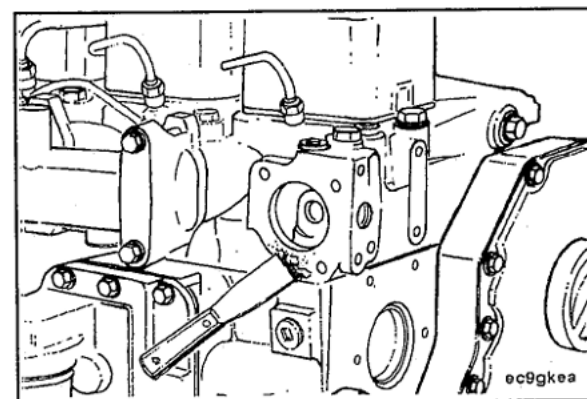
The installation torque on the capscrew is 24 N•m [18 ft-lb].

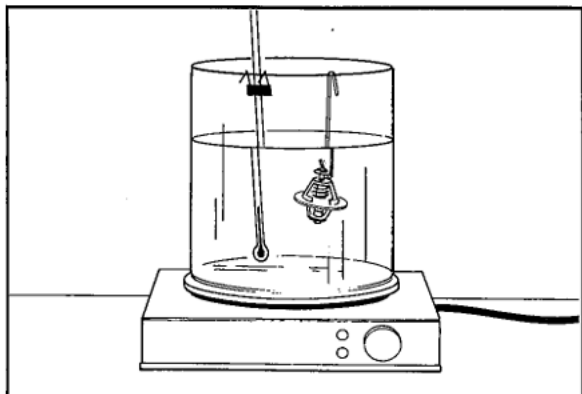


Caution: Do not let any debris fall into the thermostat cavity when cleaning gasket surfaces.

Clean the mating 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.



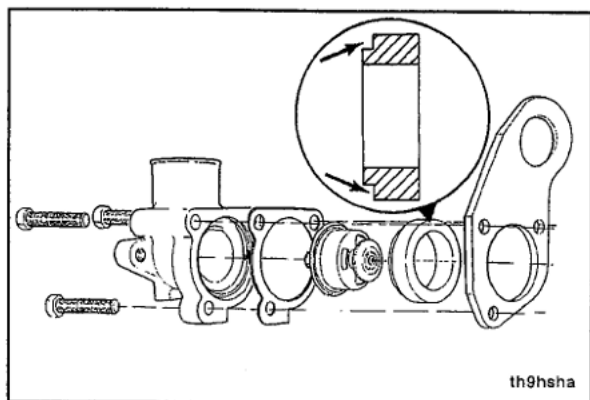


The thermostat can be checked for correct operation.

Requirements

Starts to open at 83°C [181°F]

Fully open at 95°C [203°F]



Install the new thermostat.

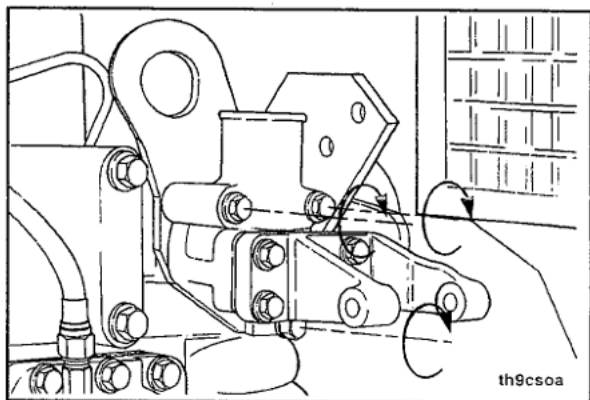


Make sure the new gasket is aligned with the capscrew holes.



Position the new seal as shown.

Install the capscrews and use your fingers to tighten.

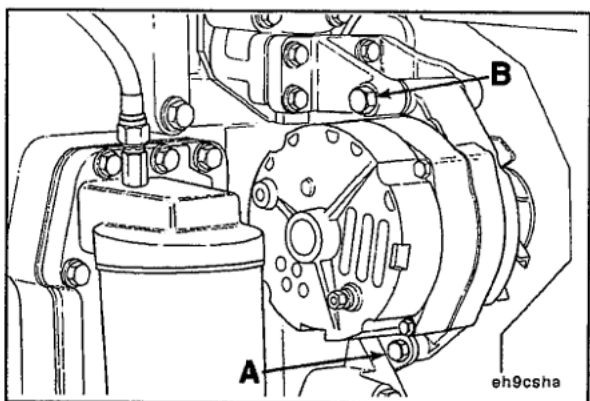


10 mm



Tighten all the capscrews.

Torque Value: 24 N•m [18 ft-lb]



13, 16 mm



Position the alternator and install the mounting capscrews.



Torque Value:

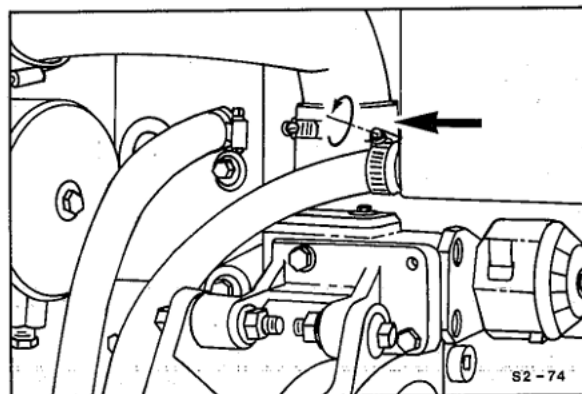
(A) Alternator Link: 24 N•m [18 ft-lb]

(B) Alternator Mounting: 43 N•m [32 ft-lb]

C Series Only

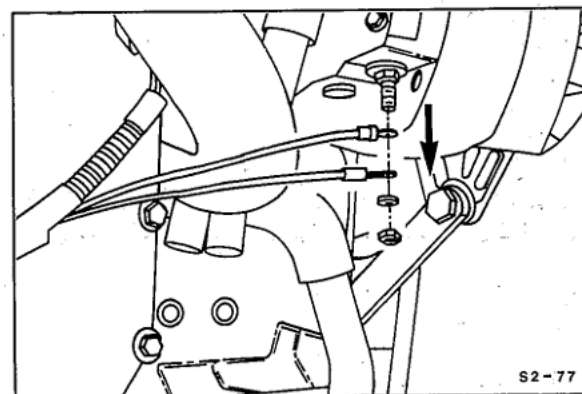
5/16 Inch or Flat Screwdriver

Remove the fill line from the expansion tank and the water transfer tube.



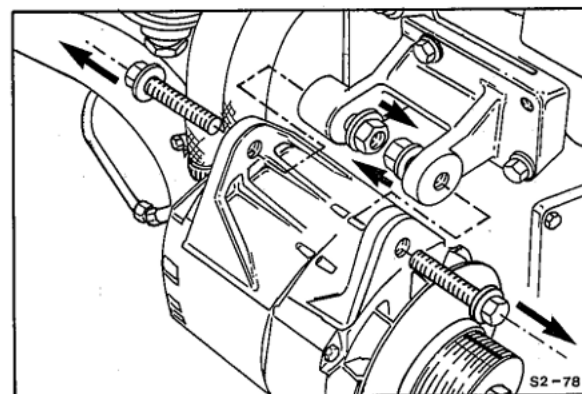
5/16, 7/16 Inch

Label and remove the alternator leads. This allows the alternator to be lowered without stressing the leads.



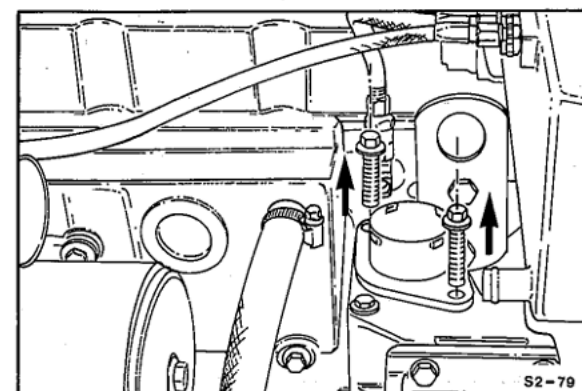
19, 15 mm

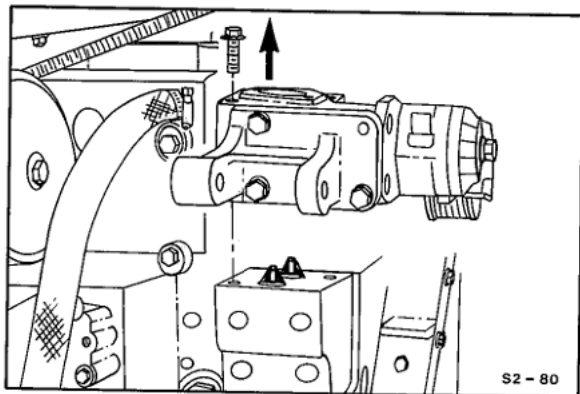
Remove the alternator mounting bolts and nuts. Lower the alternator.



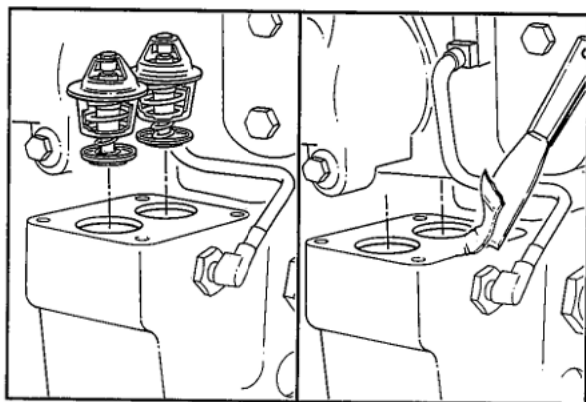
10 mm

Remove the capscrews from the thermostat housing and water outlet connection. The water outlet connections does **not** need to be removed from the thermostat housing.





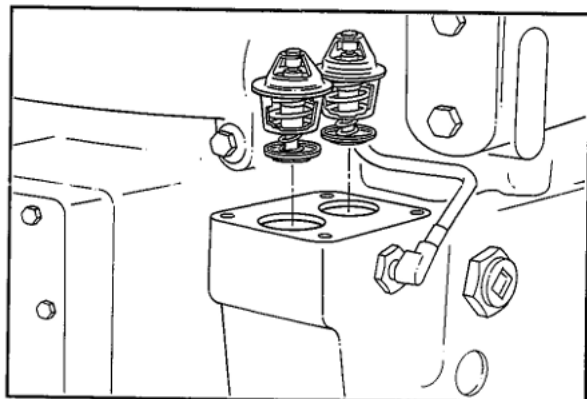
Remove the thermostat housing and belt tensioner assembly.



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



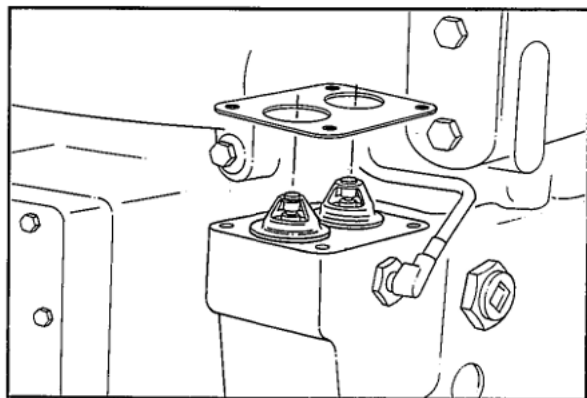
Remove the thermostats and clean the gasket surfaces.



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.

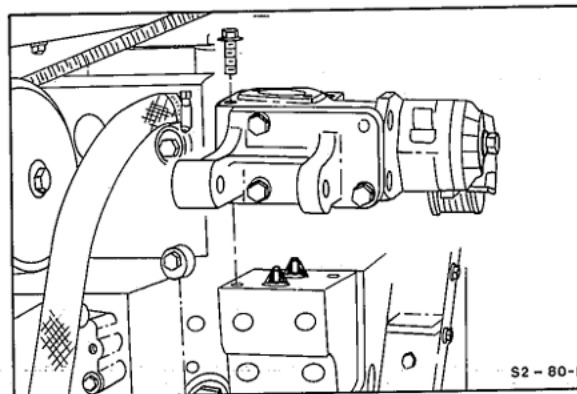


Install the new thermostats.

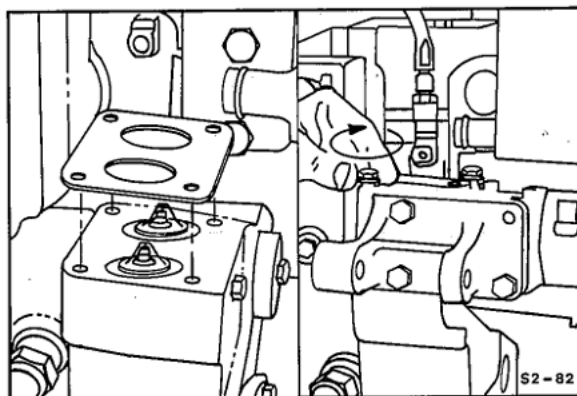


Position a new gasket over the thermostats.

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



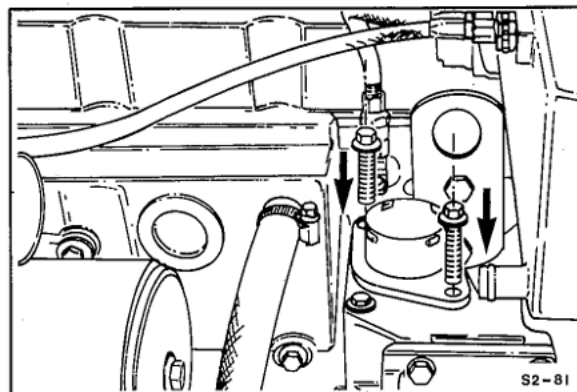
Make sure the gasket is aligned with the capscrew holes. Install the capscrews and use your fingers to tighten.



10 mm

Install a new gasket and the water outlet connection. Tighten all capscrews.

Torque Value: 24 N•m [18 ft-lb]



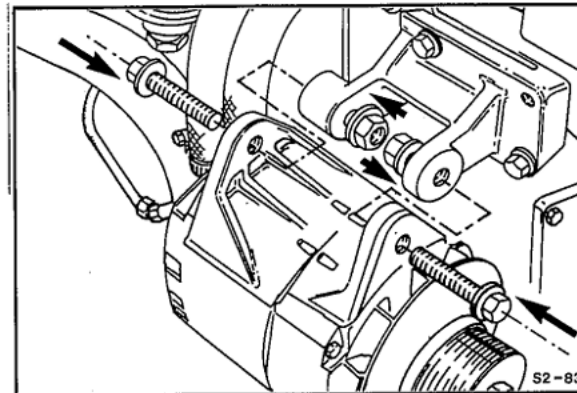
18, 19 mm

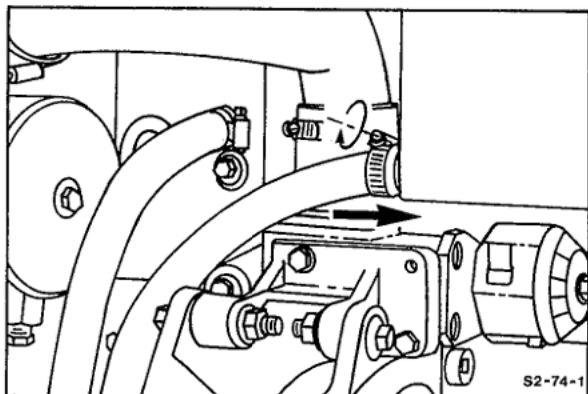
Position the alternator and install the mounting bolts and nuts.

Torque Value:

(Alternator Mounting) 77 N•m [57 ft-lb]

(Alternator Link) 43 N•m [32 ft-lb]





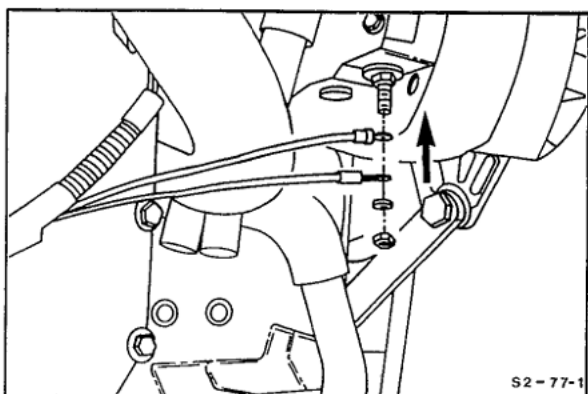
B and C Series

5/16 Inch or Flat Screwdriver

Install the fill line on the expansion tank and the water transfer tube.

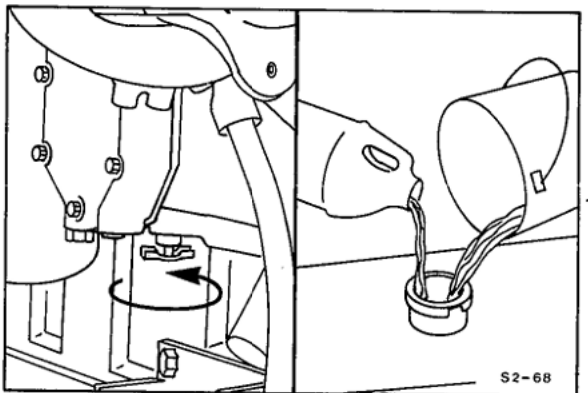


Torque Value: 5 N•m [44 in-lb]



5/16, 7/16 Inch

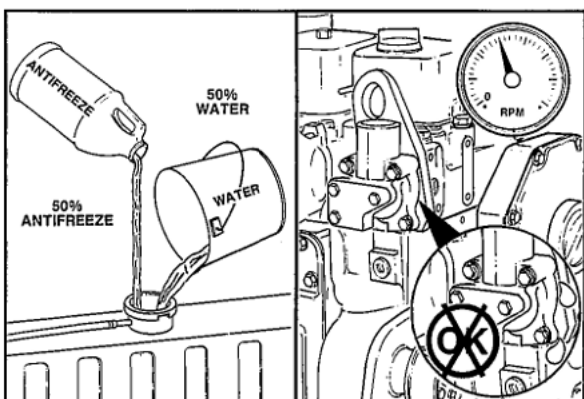
Install the alternator leads.



- Install the water outlet hose coupling on the engine water outlet connection.
- Install the drive belt.
- Verify that the coolant drain plug is in place (B Series) or that the drain valve is closed (C Series).



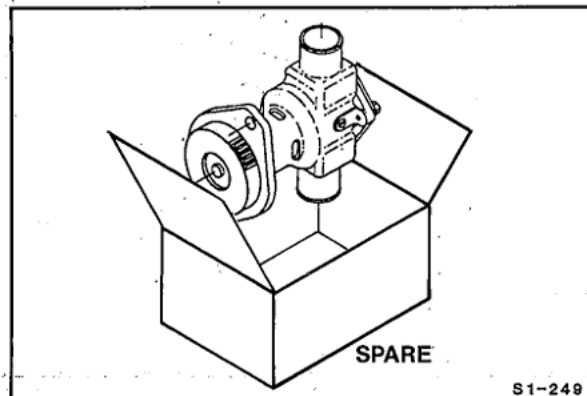
Fill the cooling system with a mixture of 50 percent water and 50 percent ethylene-glycol type antifreeze. Refer to Section V for the correct amount of DCA4 corrosion inhibitor for C Series engines.



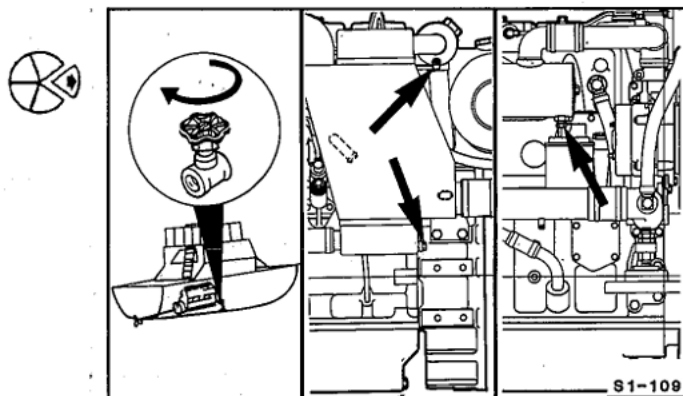
Install the pressure cap. Operate the engine until it reaches a temperature of 83° C [181° F] and check for coolant leaks.

Raw Water Pump - Replacement

NOTE: Repairs are limited to changing the impeller and the gasket. A spare pump, complete with drive gear installed, should be kept on board.

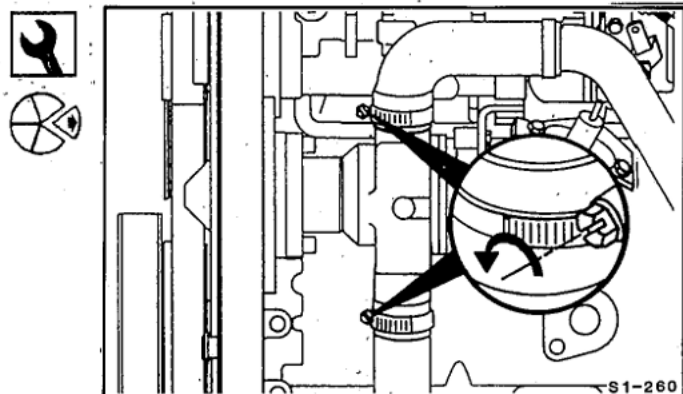


Shut off the water inlet valve.
Drain the raw water system.



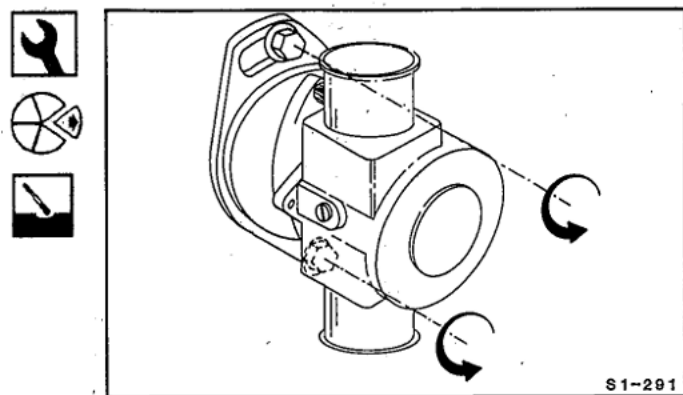
5/16 Inch Nutdriver or Screwdriver

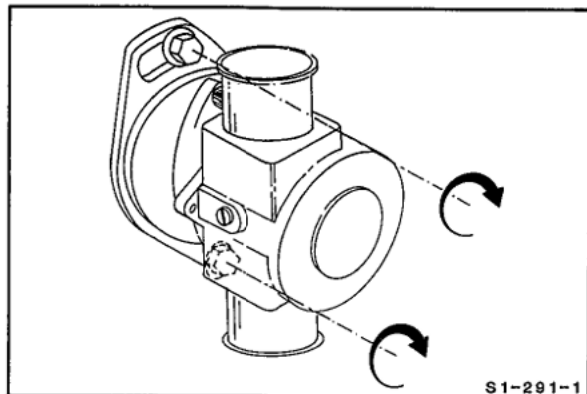
Remove the raw water inlet and outlet connections.



15 mm

Remove the capscrews which hold the raw water pump adapter flange to the gear cover.
Remove the raw water pump and flange assembly.
Remove and clean the gasket surfaces.





15 mm

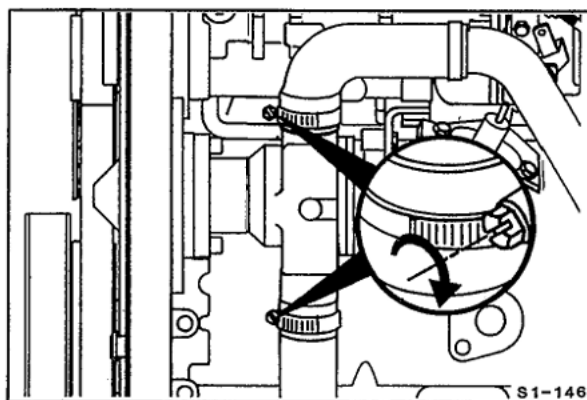
Install a new gasket and the raw water pump and flange assembly into the gear cover.



Install the two flange head mounting capscrews.



Torque Value: 77 N•m [57 ft-lb]

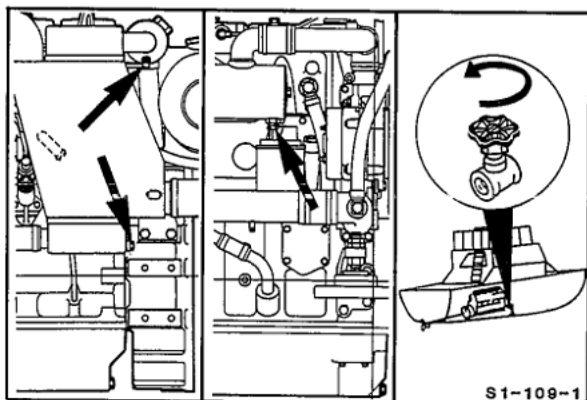


5/16 or Flat Screwdriver, 7/8 Inch

Install the raw water inlet and outlet hoses on the raw water pump and tighten the hose clamps.



Torque Value: 5 N•m [4 ft-lb]



7/8 Inch

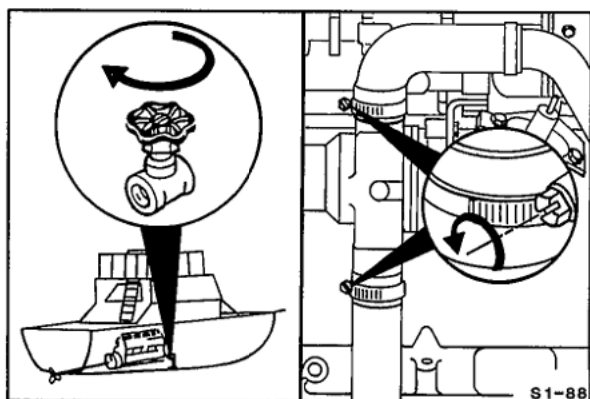
Install the zinc plug into the heat exchanger and into the aftercooler of the B-300 or C-400 HP.



Open the raw water inlet valve.



If you have a wet exhaust system, start the engine and check for water flow from the exhaust.



Raw Water Pump Impeller (B Series 64 through 250 HP) - Replacement



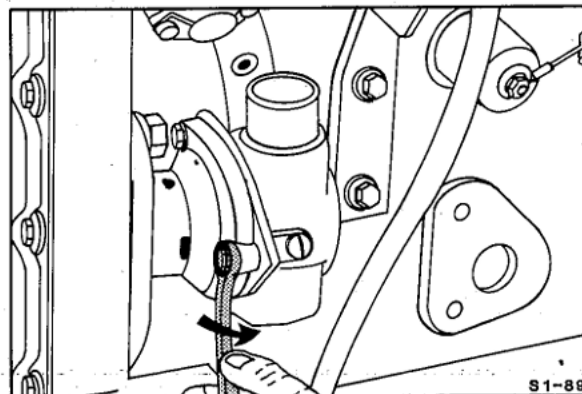
5/16 Inch Nutdriver or Screwdriver

Shut off the water inlet valve.

Remove the raw water inlet and outlet connections.

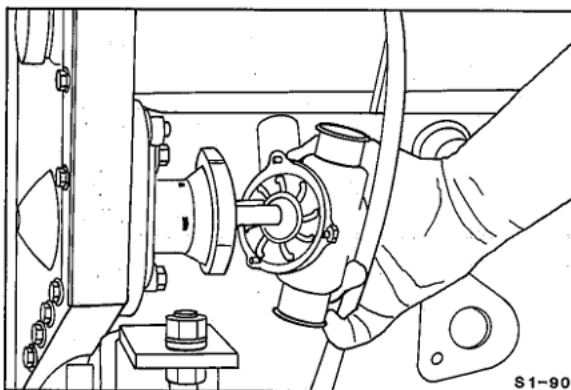
3/8 Inch

Remove the impeller housing mounting capscrews.

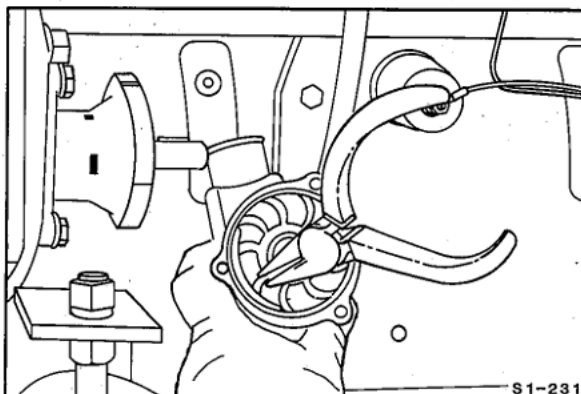


Remove the impeller housing. Usually the impeller will remain in the housing.

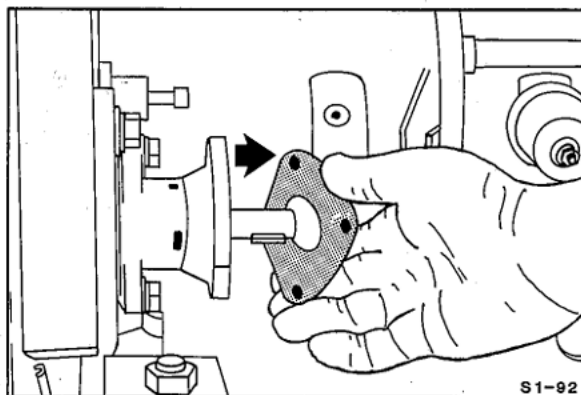
NOTE: It is possible that the shaft key could fall out when removing the impeller. Watch to prevent losing it.

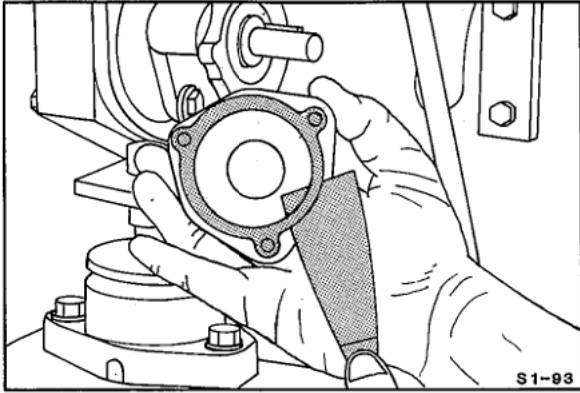


Remove the impeller from the impeller housing.

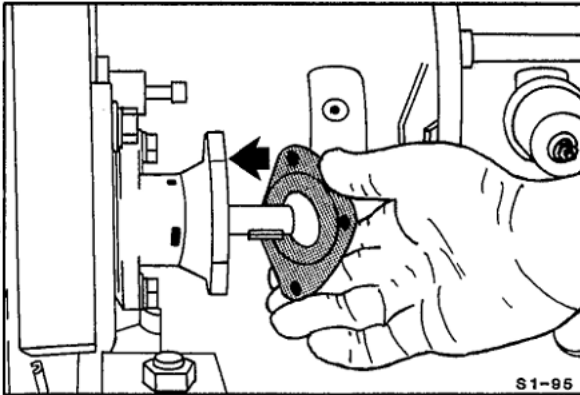


The spacer plate between the impeller housing and the bearing housing is sealed with a rubber o-ring and a gasket. Replace both when changing the impeller.

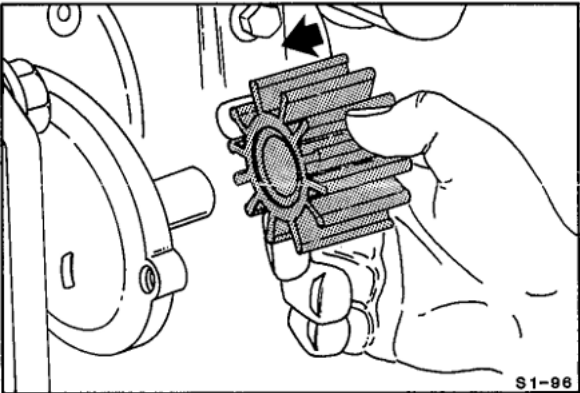




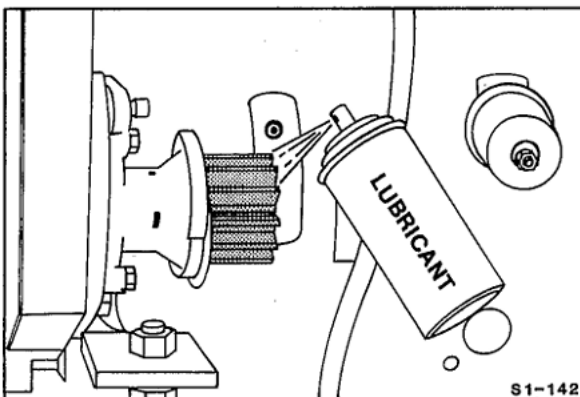
Clean all sealing surfaces as necessary.



Install a new gasket and the spacer plate.



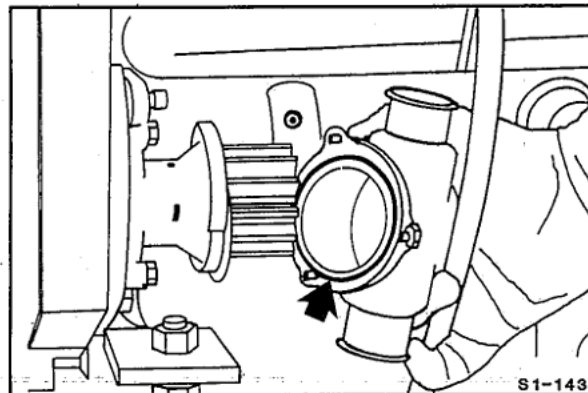
Install a new impeller on the shaft.



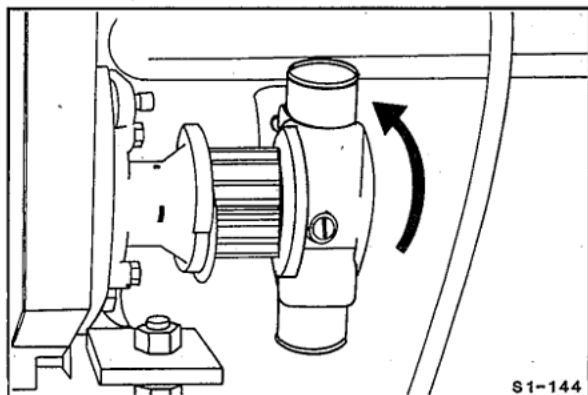
Use glycerin, spray silicon, or a non-petroleum base lubricant to lubricate the impeller housing.

Clean the o-ring sealing area.

Install a new o-ring into the impeller housing.



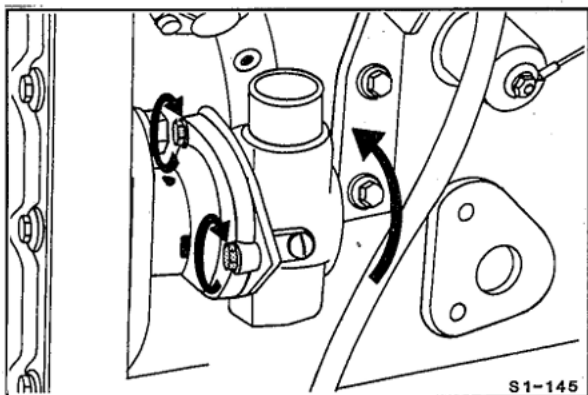
To install the impeller housing over the impeller, twist the housing as it is pushed over the impeller.



3/8 Inch

Continue to rotate the housing until the housing capscrew holes, as well as the inlet and outlet connections, are positioned correctly. Install and tighten the mounting capscrews.

Torque Value: 8 N•m [71 in-lb]

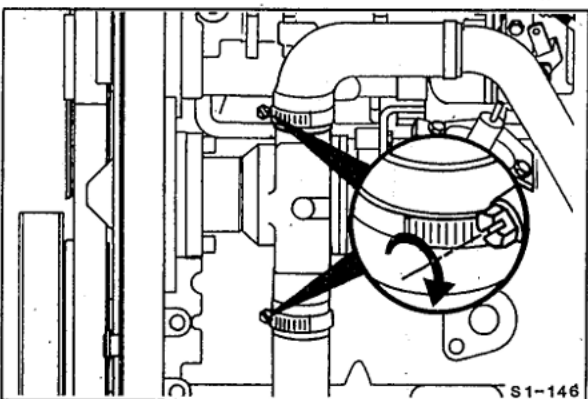


5/16 Inch Nutdriver or Screwdriver

Connect and tighten the water connection clamps.

Torque Value: 5 N•m [44 in-lb]

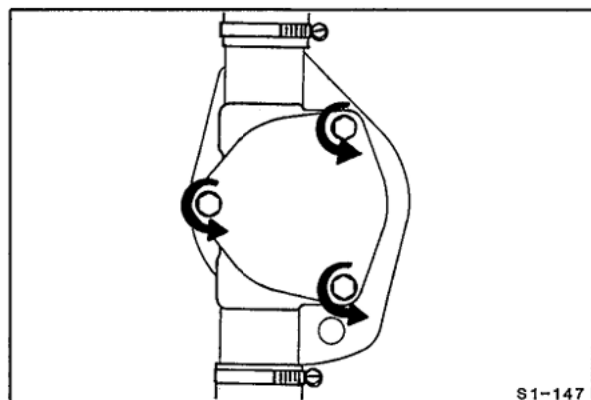
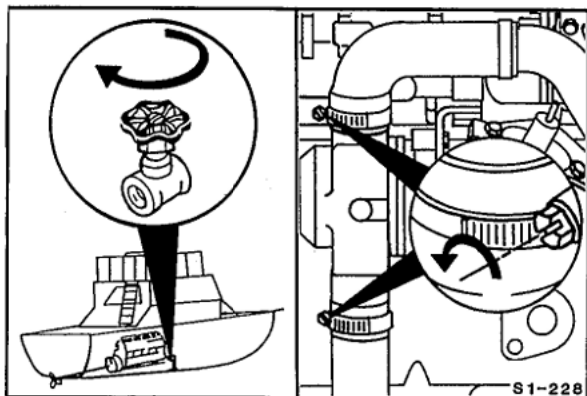
Turn on the water inlet valve.



Raw Water Pump Impeller (B-300 HP and all C Series) - Replacement

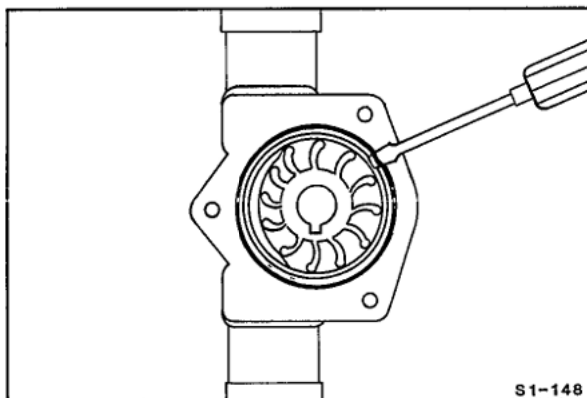
Preparatory Steps:

- Shut off the water inlet valve.
- Drain the water from the pump.



1/2 Inch

Remove the three cap screws and lift off the cover.

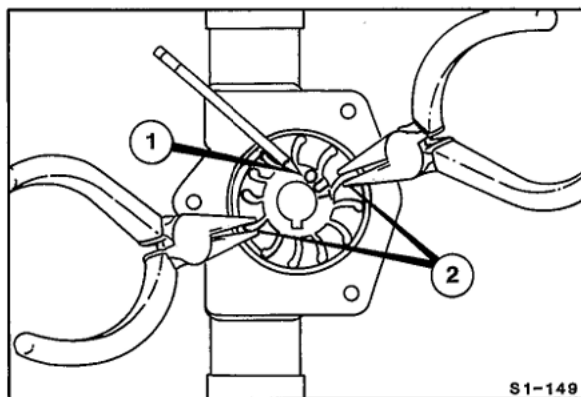


Small Screwdriver

Remove the o-ring.



Clean the o-ring groove.



Two Pair Needle Nose Pliers

Mark the impeller to indicate which side is out if you intend to use it again.



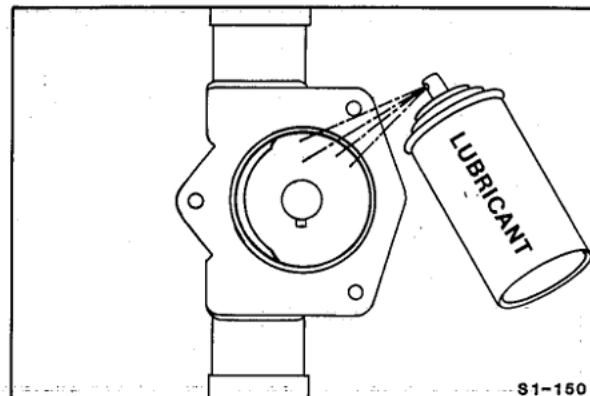
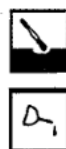
Grasp the impeller by two vanes 180 degrees apart and pull it out of the housing.



NOTE: It is possible that the impeller key could fall out when removing the impeller. Watch to prevent losing it.

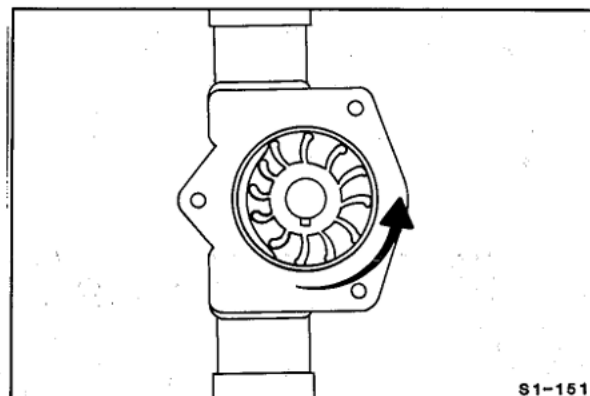
Clean the internal pump surfaces.

Use silicone oil or glycerine to lubricate.



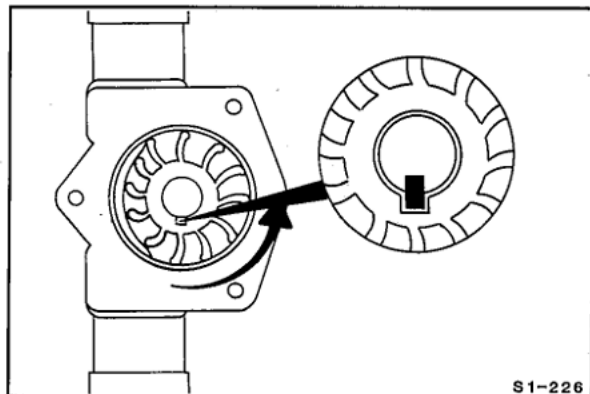
S1-150

Guide the impeller into the housing twisting it **counter-clockwise** as it is advanced so that the vanes will be deflected in the proper direction.



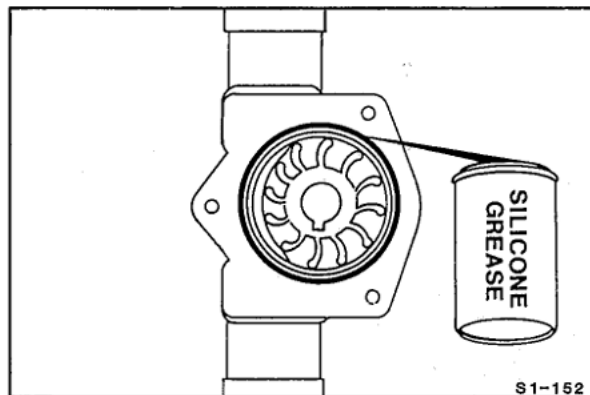
S1-151

Continue to turn the impeller while pushing it into the housing. It will slide all the way in when the keyway lines up with the key.

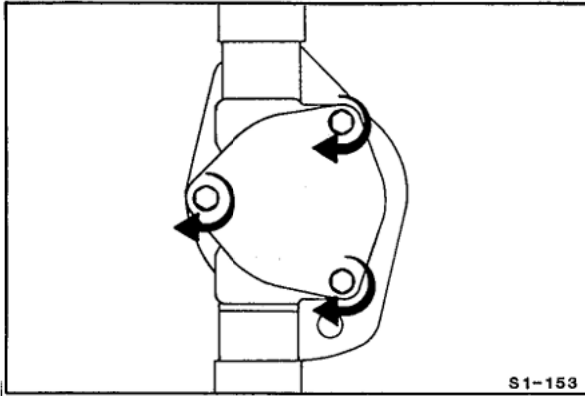


S1-226

Insert the new o-ring into the impeller housing. Use a little silicone grease to hold it in place.



S1-152



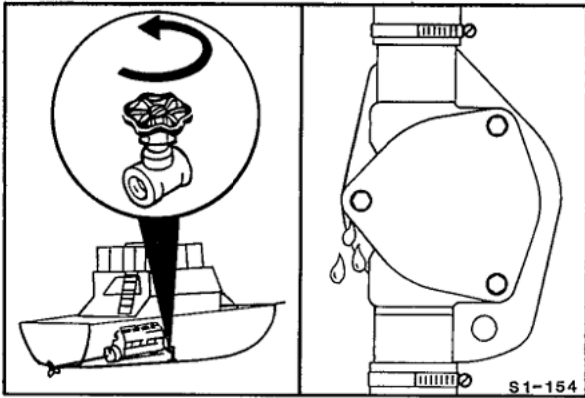
1/2 Inch

Install a new gasket, cover plate and capscrews.



Tighten the capscrews.

Torque Value: 24 N•m [18 ft-lb]



Open the water inlet valve and check for leaks.

If you have a wet exhaust system, start the engine and check for water flow from the exhaust.



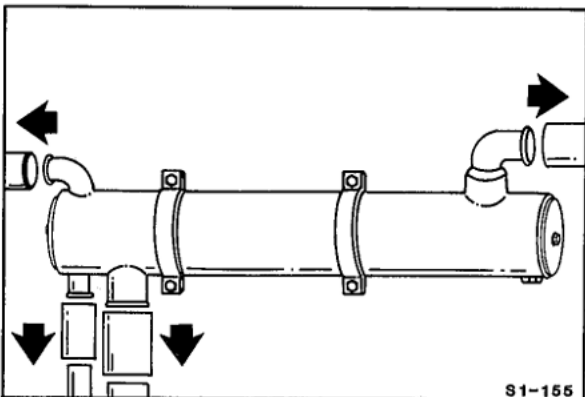
Heat Exchanger - Replacement

Preparatory Steps:

- Shut off the raw water inlet valve.
- Disconnect the coolant heater (if so equipped).
- Drain the engine coolant.
- Drain the raw water system.



Caution: Any time the coolant system is drained, the coolant heater (if so equipped) must be disconnected. If not, it will burn the element up from overheating.



5/16 Inch Nutdriver or Screwdriver

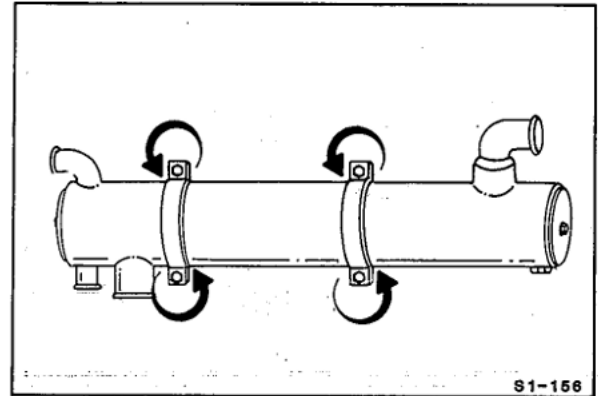
Disconnect all the heat exchanger water connections.



13 mm

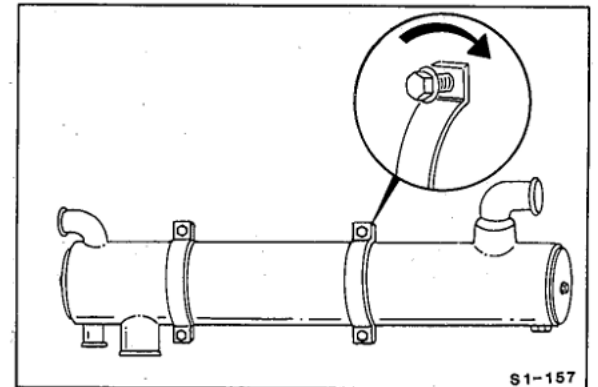
Remove the four mounting capscrews.

Remove the heat exchanger.



Loosely install the new heat exchanger.

Do **not** tighten the mounting capscrews at this time.

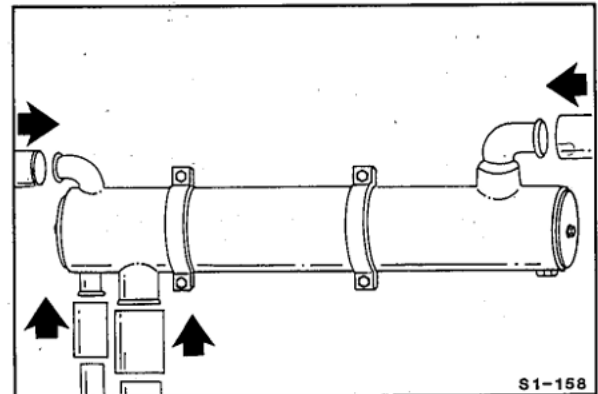


5/16 Inch Nutdriver or Screwdriver

Position the heat exchanger so that all the water connections can be connected.

Tighten all the connection hose clamps.

Torque Value: 5 N•m [4 ft-lb]

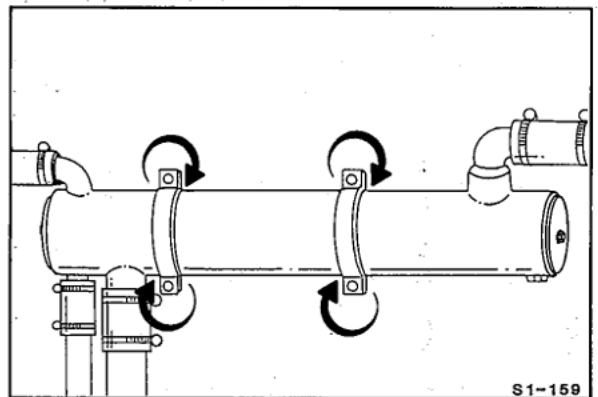


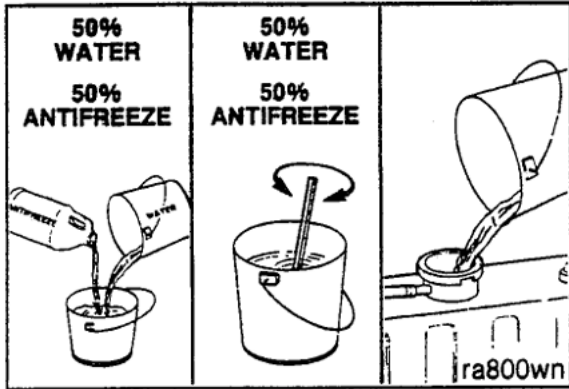
13 mm

Caution: Do not overtighten the mounting capscrews.

Tighten the capscrews.

Torque Value: 24 N•m [18 ft-lb]

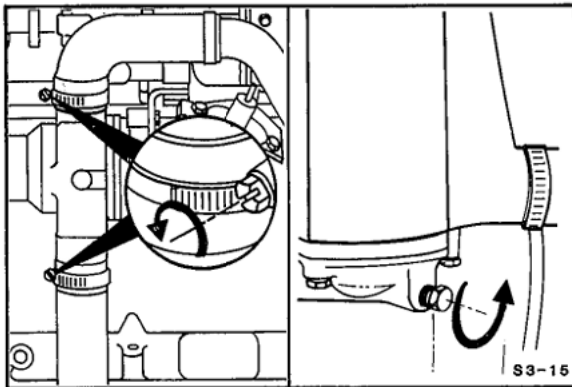




Fill the cooling system with a mixture of 50 percent water and 50 percent ethylene-glycol type antifreeze. Refer to Section V for the correct amount of DCA4 corrosion inhibitor for C Series engines.

Refer to Section 7 for coolant fill procedure.

Open the raw water inlet valve.



Marine Gear Oil Cooler - Replacement



7/8 Inch

Shut off the raw water inlet valve.

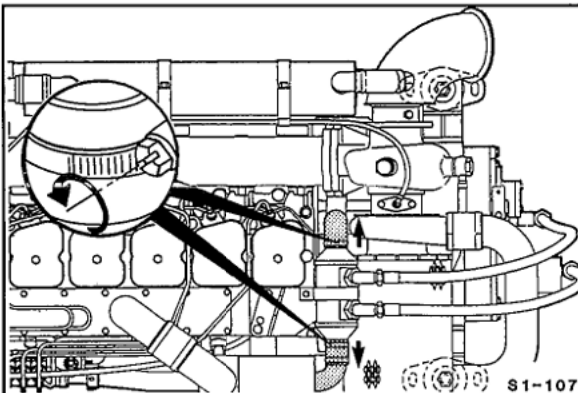


Drain the raw water system.



Remove the zinc plug from the aftercooler on the B-300 HP or C-400 HP.

After the water is drained, install the zinc plug.

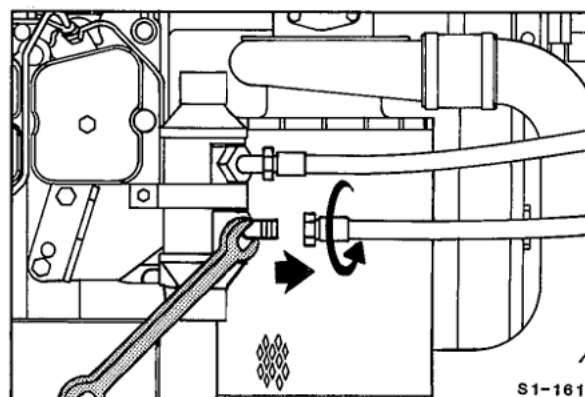


5/16 Inch Nutdriver or Screwdriver

Loosen the water hose clamps.



NOTE: The C Series marine gear oil cooler is located low on the fuel pump side of the block.



7/8 Inch



Caution: To prevent damage to the oil cooler, adequately support the fittings when loosening or tightening the supply lines. Do not allow oil to spill into the air cleaner element.

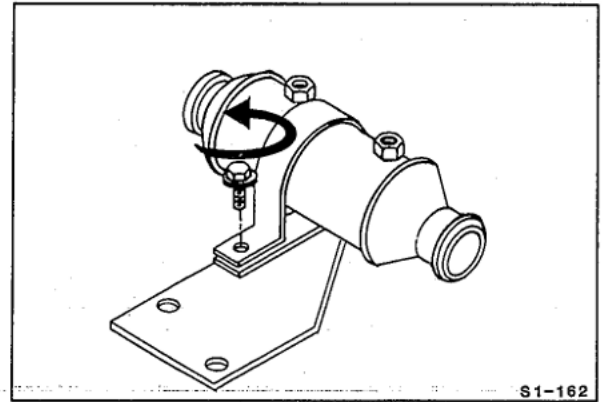


Disconnect and plug the oil lines to prevent oil spillage.

10 mm

Remove the oil cooler.

NOTE: The cooler will contain marine gear oil, avoid spills.



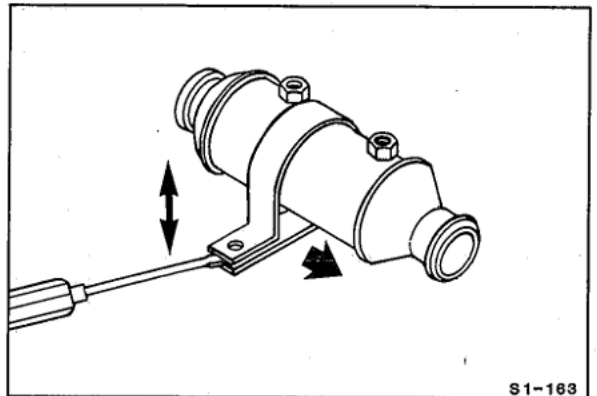
S1-162

7/8 Inch and Screwdriver

When replacing the oil cooler, it will be necessary to replace or use again the fittings and mounting brackets.

Remove the fittings.

Pry the brackets sufficiently to slide off the cooler.

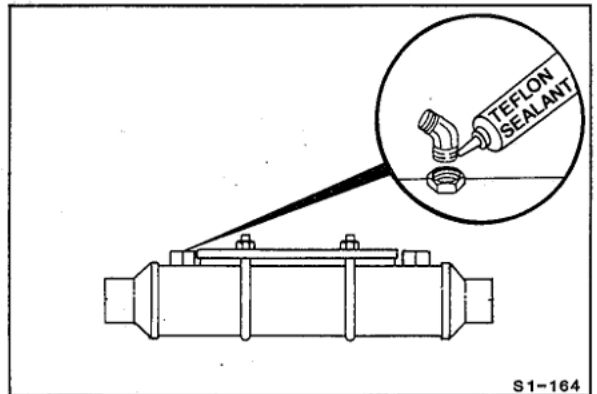


S1-163

Slide the brackets onto the new cooler.

Caution: Do not allow the liquid teflon to get into the cooler when installing the fittings.

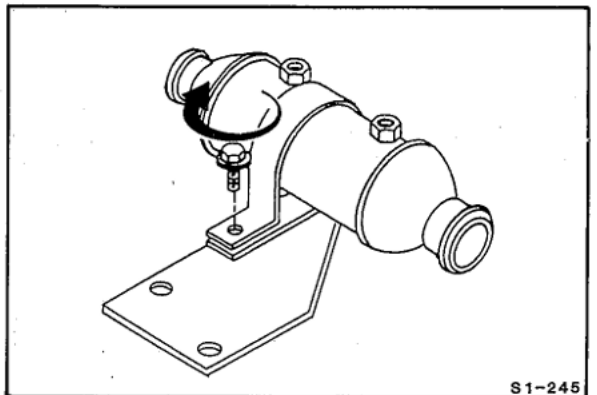
Apply liquid teflon sealant to the threads and install the fittings into the cooler.



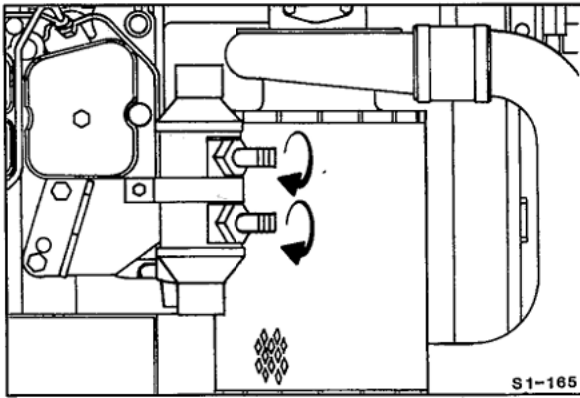
S1-164

10 mm

Install the cooler to its mounting location at the rear of the head using the flange head capscrews.



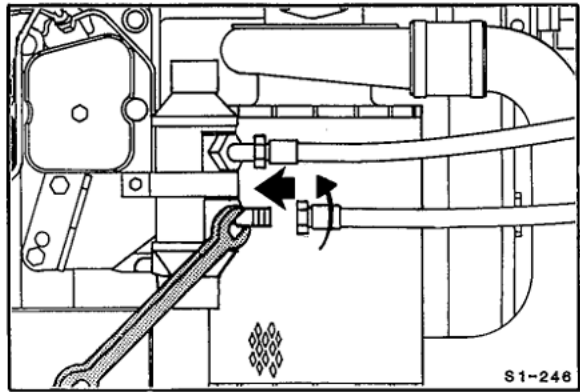
S1-245



Caution: Do not back the marine gear oil fittings up (counterclockwise) to obtain alignment as this will cause a bad seal on the threads.



Tighten the fittings in a **clockwise** rotation stopping at the desired position to allow proper alignment of the oil supply hoses.

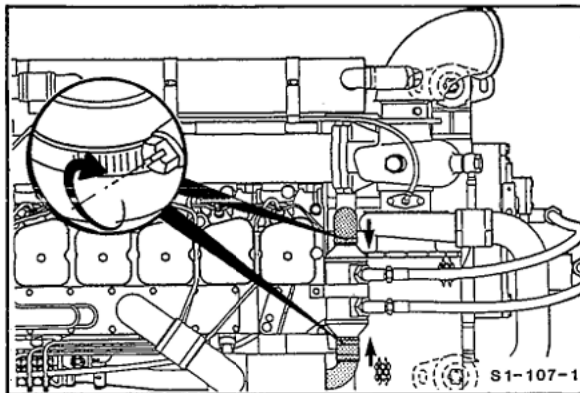


7/8 Inch

Make sure the mating surfaces are clean.



Connect the gear oil lines to the cooler.



5/16 Inch Nutdriver or Screwdriver

Install the hoses and tighten the clamps.



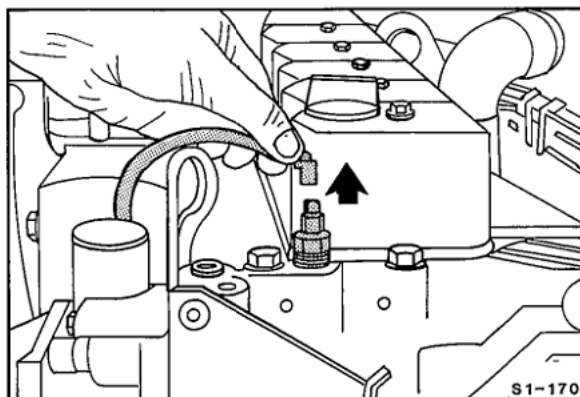
Open the raw water inlet valve.



Torque Value: 5 N•m [44 in-lb]



Run the engine to fill the oil cooler with oil and then shut off the engine and check the marine gear oil level. Add oil if necessary.



Temperature Sensor - Checking/Replacement

Preparatory Steps:

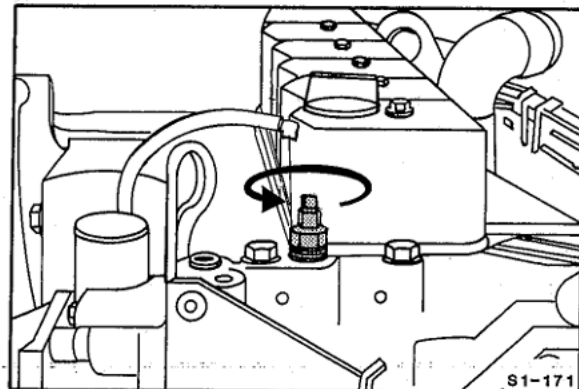
- Drain the coolant to below the level of the sensor.
- Disconnect the temperature wiring.



NOTE: The B Series is shown, the C Series temperature sensor is located on the exhaust side of the block to the rear of the alternator. Refer to Section E for specific location.

7/8 Inch

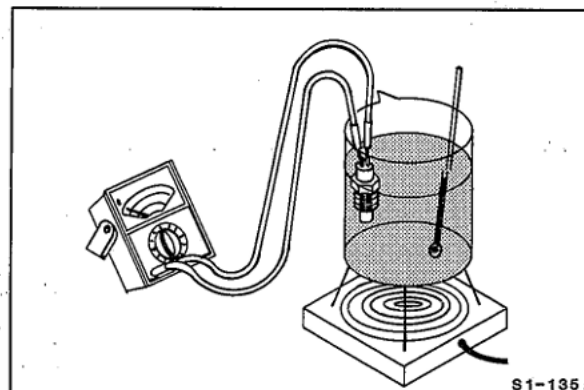
Remove the temperature sensor.



Check for proper resistance; terminal to terminal at various temperatures. Heat container of water or oil with a thermometer submerged in the fluid.



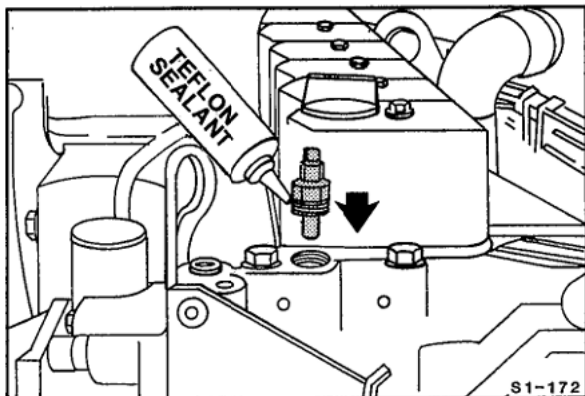
Attach ohmmeter leads, one to each terminal, and submerge the sensing part of the sensor into the fluid. Stir continuously while heating the fluid. Compare ohmmeter reading with the chart below.



Calibration For Senders

(Both 12 Volt and 24 Volt Systems Use The Same Senders)

For Single System Water Temp. Sender P/N 3913628 (VDO P/N 323478)		For Dual Station System Water Temp. Sender P/N 3914081 (VDO P/N 325007)	
F°	Ohms	F°	Ohms
105	287.4	100	144
180	64.5	150	55
210	39.7	200	23
		250	11



7/8 Inch

Apply liquid teflon to the threads of the sensor.



Install and tighten the sensor.

Torque Value: 50 N•m [37 ft-lb]

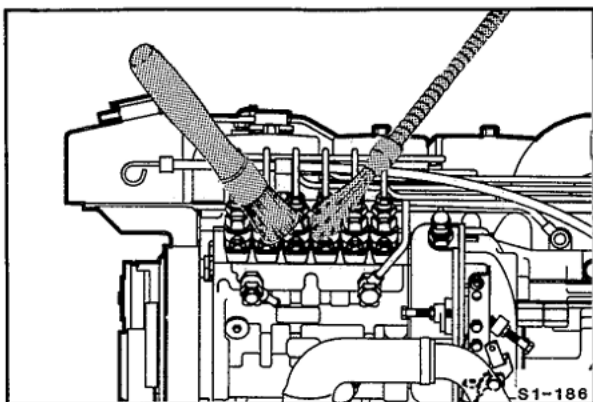


Connect the wiring.



Fuel System Repair Summary

Component To Be Replaced	Tools	Preparatory Step
Low Pressure Fuel Line	10 and 17 mm Sockets, 14 and 20 mm Open End Wrenches/Crowfoot	Clean debris from fittings. Remove the fuel filter.
Lift Pump	10 and 17 mm Sockets, 14 and 20 mm Open End Wrenches/Crowfoot	Clean debris.
Fuel Drain Manifold	10 and 18 mm Sockets.	C-300 HP - Drain 1.9 liters [2.0 U.S. quarts] coolant from the engine.
Injection Pump Supply Line	14, 16, 17, 19, 24 mm	Clean debris from all injection pump supply line fittings.
High Pressure Fuel Lines	17 mm Open End/Crowfoot	Clean debris.
Injectors	Brass drift, Hammer, 24 mm Deep Well Socket, Injector Bore Brush, 17 mm Open End Wrench/Crowfoot, 10 mm Socket	Thoroughly clean around injectors. Disconnect the high pressure fuel line. Disconnect the fuel drain manifold.
Electric Fuel Shut-off Valve	24 mm	Remove the electrical connection. Clean around the valve. When removing valve, be careful not to drop the piston and spring.
Fuel Shutoff Solenoid	8, 10 mm (Bosch)	
Fuel Filter Head Adapter	Adjustable Pliers, 24 mm Large Flat Screwdriver	Clean debris. Remove fuel filter.
AFC Tube	Two 1/2 inch Open End Wrenches/Crowfoot	
Oil Latchout Line	15 mm, 9/16 Inch Open End (Nippondenso), 7/16 Inch Open End (Bosch)	Clean debris from fitting on injection pump.
CAV Injection Pump	8, 13, 14, 22 mm, 75 mm T-Bar Puller	Remove all the fuel lines. Remove the control linkage.
Bosch VE, Rotary Injection Pump	8, 10, 13, 15, 24 mm, Part No. 3377371 Engine Barring Gear, 1/2 Inch Square Drive, 75 mm T-Bar Puller	Remove all the fuel lines. Remove the control linkage.
Nippondenso Injection Pump	10, 13, 14, 21, 27, 34 mm, 75 mm T-Bar Puller, Two M8x1.25 Capscrews, 15 mm Socket, Long Extension, 17 mm Open End/Crowfoot	Remove all the fuel lines. Remove the control linkage. Remove the fuel filter. Remove the oil latchout line.
Bosch In-Line Injection Pump	7/16 Inch, Two 1/2 Inch Open End Wrenches/Crowfoot, 10, 13, 15, 19 24, 27 mm, 75 mm T-Bar Puler, Part No. 3377371 Engine Barring Gear, 17 mm Open End Wrench, Tachometer, Screwdriver	Remove all the fuel lines. Remove the control linkage. Remove the fuel shutoff solenoid. Remove the fuel filter.

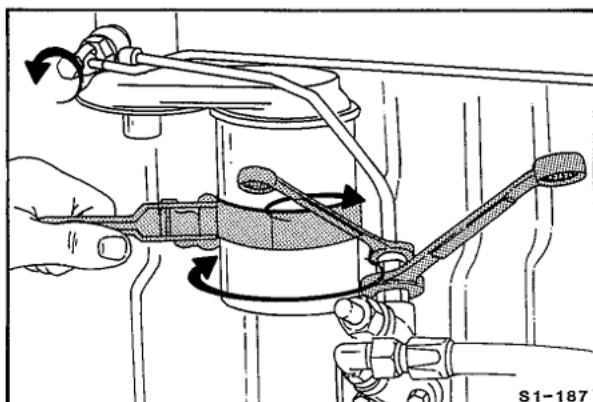


Fuel System Replacement Procedures

Fuel System Components - Cleaning



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



Low Pressure Fuel Line - Replacement

Preparatory Steps:

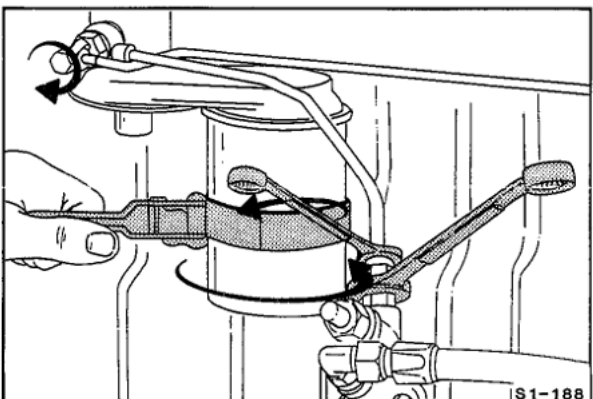
- Clean debris from the fittings.
- Remove the fuel filter.



10 and 17 mm Sockets, 14 and 20 mm Open End Wrenches



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



10 and 17 mm Sockets, 14 and 20 mm Open End Wrenches/Crowfoot



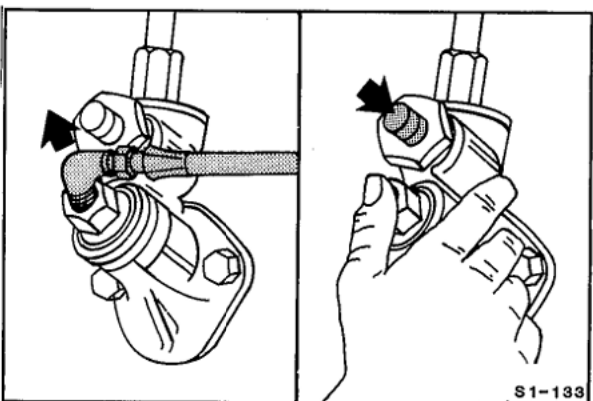
Install the fuel line to the lift pump and filter head. Use two wrenches to tighten the connection to the lift pump.



Torque Value: 24 N•m [18 ft-lb] (Low Pressure Line)
8 N•m [71 in-lb] (Vent Screw)

Replace the fuel filter.

Follow the filter manufacturers' recommendations for tightening.



Fuel Flow - Checking



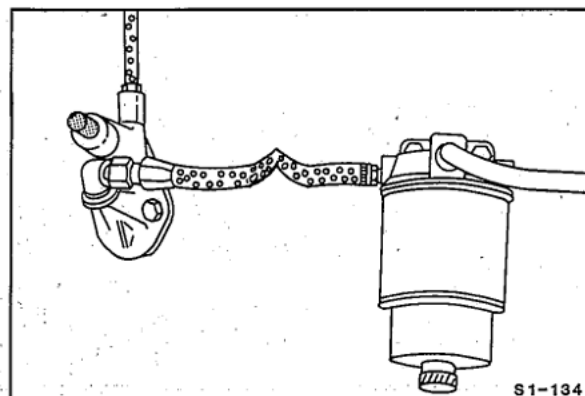
Disconnect the inlet line to the lift pump.



Operate the hand plunger and check for suction.

If suction is **not** detected, rotate the engine crankshaft 90 degrees and repeat the check.

If there is suction, check for an obstruction in the fuel supply line or tank.



Lift Pump - Replacement

Preparatory Step:

- Clean debris from around the lift pump.

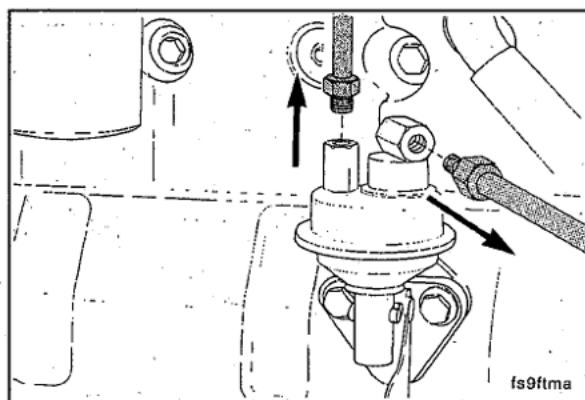
NOTE: The diaphragm style lift pump is used on 64 through 210 HP engines.

The piston style lift pump is used on 220 through 400 HP engines.

Diaphragm Style Lift Pump

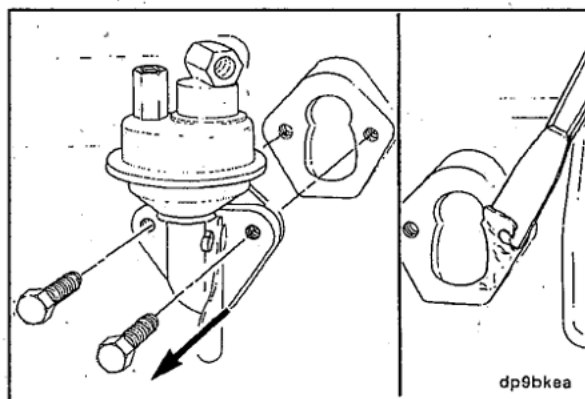
14, 20 mm

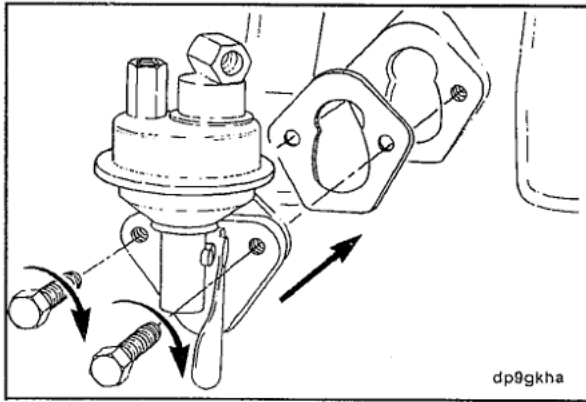
Disconnect the fuel lines.



10 mm

Remove the lift pump and clean the mounting surface on the cylinder block.





10 mm

Install a new gasket and the lift pump.

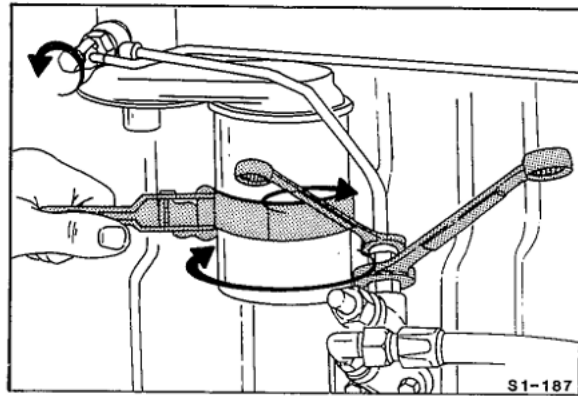


NOTE: The priming lever in the down position will help in the installation, but the lever **must** be put in the locked up position to allow maximum pumping capability after installation is completed.



Connect the fuel lines.

Torque Value: 24 N•m [18 ft-lb]

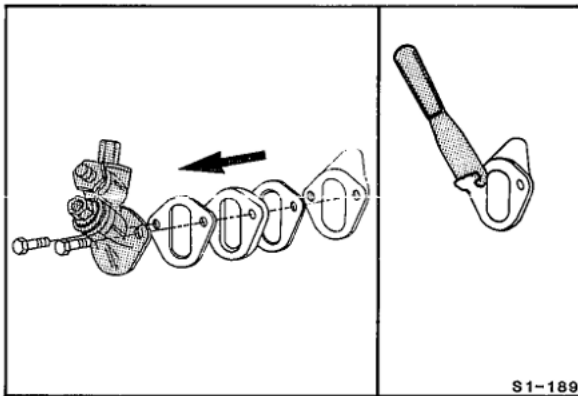


Piston Style Pump

10 and 17 mm Sockets, 14 and 20 mm Open End Wrenches/Crowfoot



- Disconnect the low pressure fuel lines.



10 mm

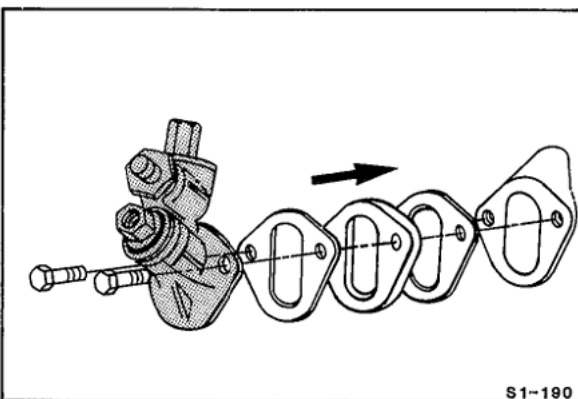
Remove the lift pump.



Clean the mounting surfaces on the cylinder block and both sides of the mounting spacer.



NOTE: The C Series engines do **not** have a mounting spacer.



10 mm

Install the lift pump.



Torque Value: 24 N•m [18 ft-lb]



Notes:

1. On B Series engines, install two gaskets and mounting spacer as shown.
2. On C Series engines, install only one gasket. No mounting spacer is required.

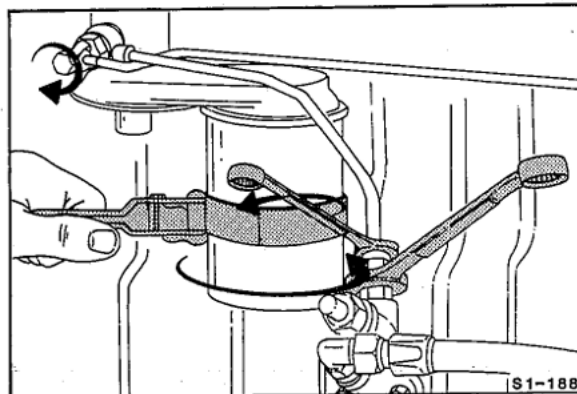
**10 and 17 mm Sockets, 14 and 20 mm Open End
Wrenches/Crowfoot**

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] (Low Pressure Line)
8 N•m [71 in-lb] (Vent Screw)

Replace the fuel filter.

Follow the manufacturers' recommendation for tightening.



Fuel Drain Manifold - Replacement

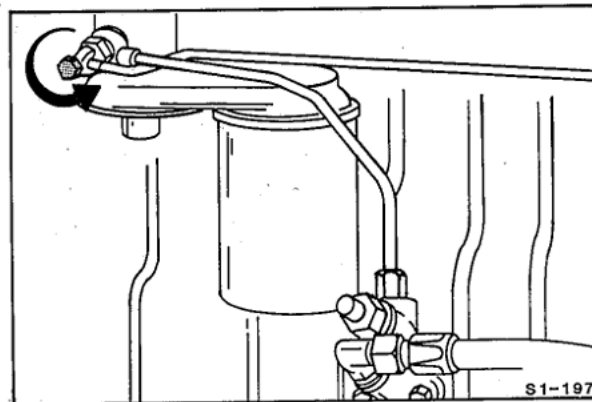
Preparatory Steps:

- Clean debris.
- For the C-300 HP engines, drain at least 1.9 liter [2 U.S. quarts] of engine coolant from the engine and remove the coolant hose connections to the aftercooler.

B Series Engines

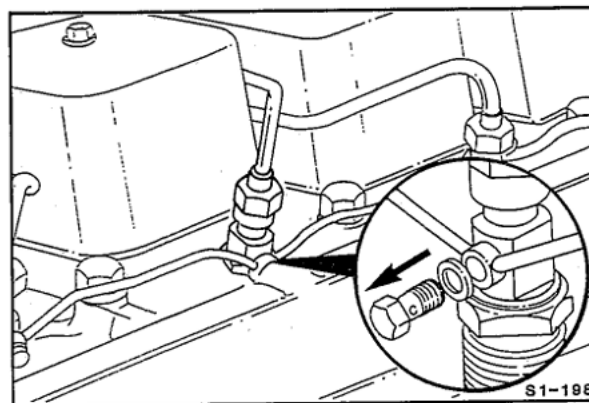
10 mm

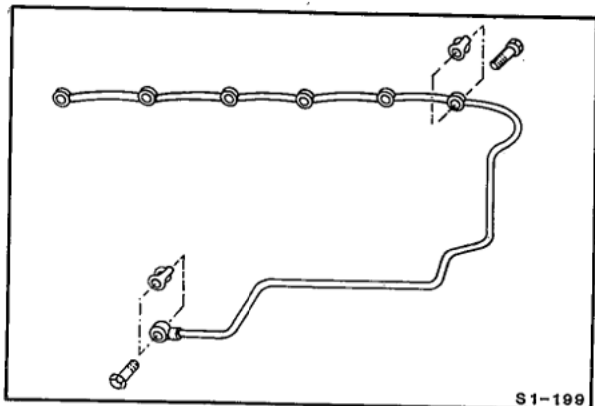
Disconnect the drain line fitting.



10 mm

Remove the banjo fitting screws and washers from the injector.





Caution: Use new sealing washers.

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

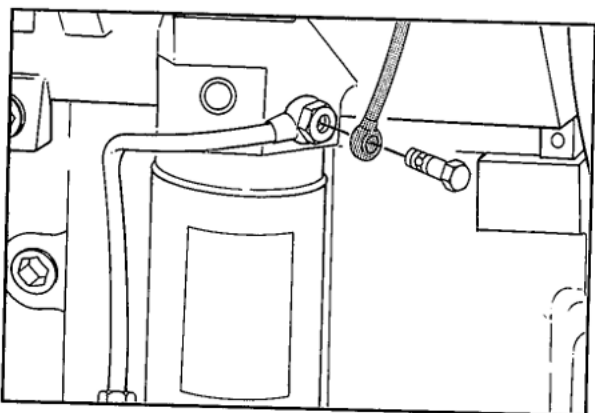


Torque Value:

Banjo fitting screw 15 N•m [11 ft-lb]

Banjo fitting 8 N•m [71 in-lb]

Clamp screw 24 N•m [18 ft-lb]



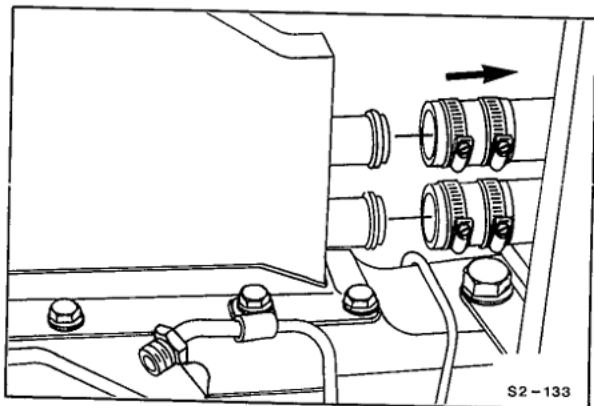
C Series Engines

10 mm

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



Installation Torque: 8 N•m [71 in-lb]



18 mm Socket

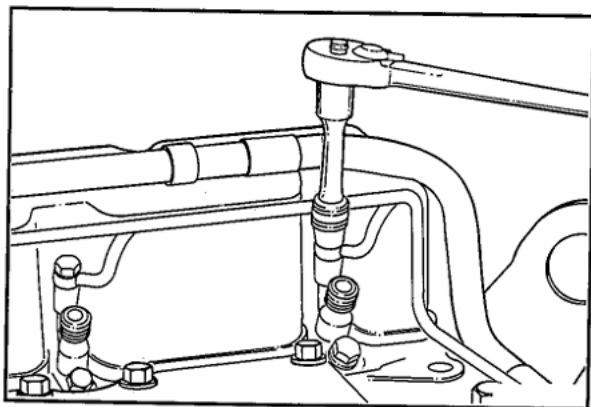
For the C-300 HP engines, you **must** remove the after-cooler lines before removing the fuel drain line clamp located at the rear of the intake manifold.



Installation Torque:

Fuel drain line clamp 55 N•m [40 ft-lb]

Aftercooler hose clamps 5 N•m [44 in-lb]



10 mm

Remove the banjo capscrews from the injectors on C Series engines.



Use new sealing washers

Install the manifold in the reverse order of removal.

Torque Value: 9 N•m [80 in-lb]



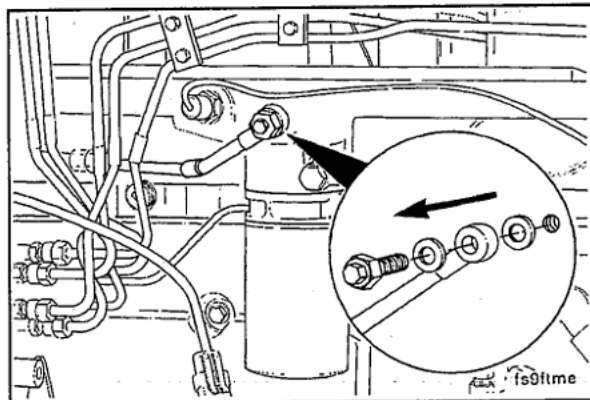
Injection Pump Supply Line - Replacement

Preparatory Step:

- Clean debris from all injection pump supply line fittings.

17 mm

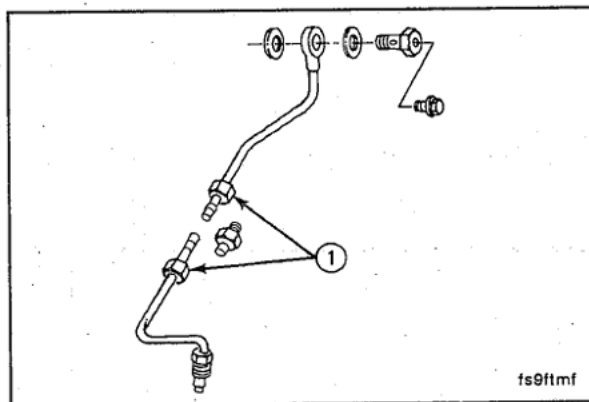
Remove the vent screw banjo fitting.



14, 16, and 17 mm

Remove the supply line (Bosch distributor pump type shown).

Replace the seals (1) in the fittings if the line is disassembled.



14, 16, 17, 19 and 24 mm

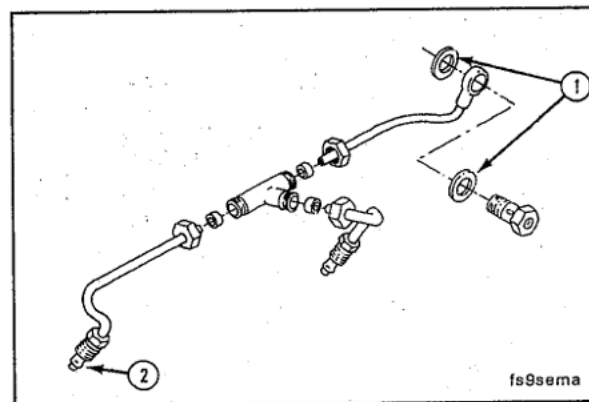
The Lucas CAV pump has two fittings for the supply line.

Assemble the supply line in the reverse order of removal.

Replace the seals in the fittings if the line is disassembled.

Replace banjo fitting sealing washers (1) and ferrules (2) each time they are removed.

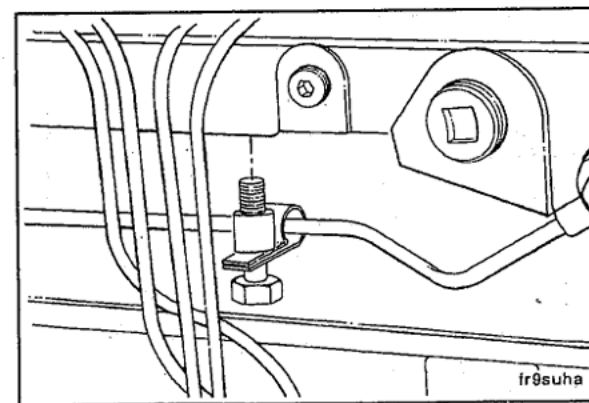
Torque Value: 32 N•m [24 ft-lb]



8 or 17 mm

Some engines have additional fuel line support. Install as required.

Torque Value: 18 N•m [24 ft-lb]

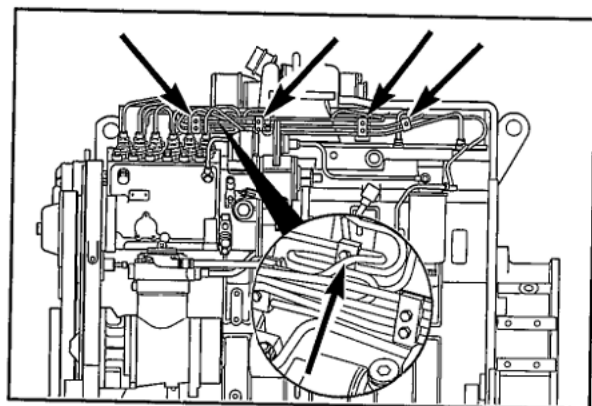


High Pressure Fuel Lines - Replacement

Preparatory Step:

- Clean debris.

NOTE: For C Series engines, it is normally easier to remove the high pressure fuel lines if the fuel drain manifold is removed first.

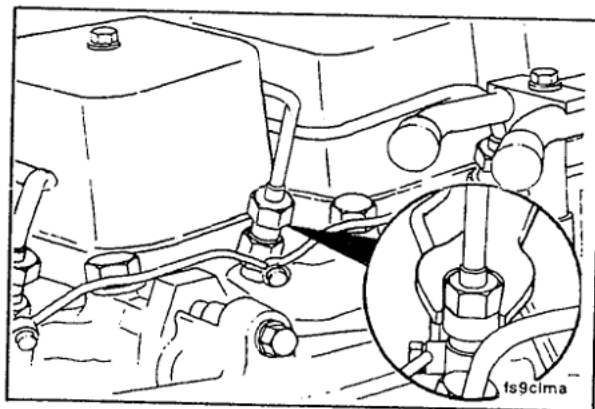


Caution: Moving the lines more than 3.2 mm [1/8 inch] from their "free state" to line up with the fuel injection pump outlets may put enough stress on the fuel lines to cause premature high pressure line failure.



Loosen the vibration isolator capscrews so the fuel lines can be easily moved.

NOTE: To prevent breakage to the fuel lines, they **must** be connected to the injector and fuel injection pump in a "free state" without forcing the connecting nuts. Since the fuel lines are properly sized for a specific application, bending should **not** be necessary.

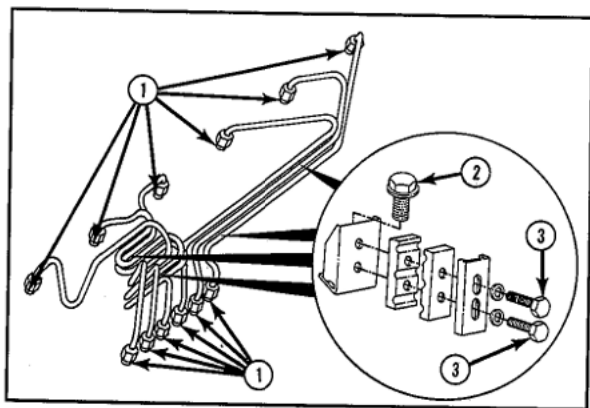


17 mm



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.



17 or 19 mm

Disconnect the line(s) from the fuel pump.



Caution: If removed, install the support clamp in the original position and make sure the lines do not contact each other or another component.



Install the lines in the reverse order of removal.

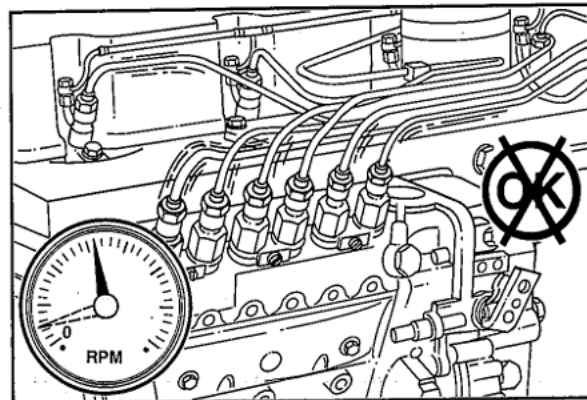
Torque Value:

1. Line Fittings 30 N•m [22 ft-lb]
2. Support Bracket 24 N•m [18 ft-lb]
3. Support Clamp 6 N•m [53 in-lb]



Operate the engine through the entire speed range (idle to high idle) to check for excessive vibration of the fuel lines at any speed.

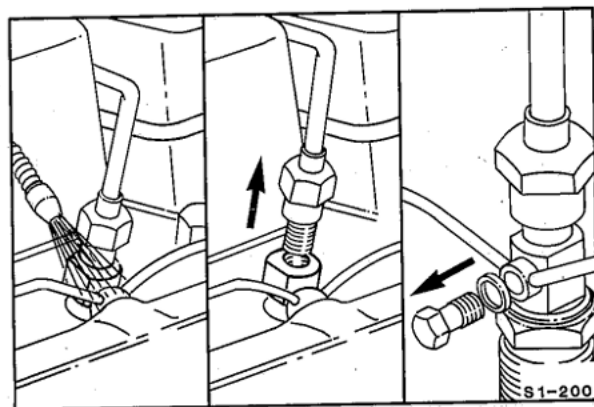
NOTE: Excessive vibration will lead to premature high pressure line failure. If excessive vibration is present, loosen the isolator capscrews to release any binding or misalignment.



Injector (B Series) - Replacement

Preparatory Steps:

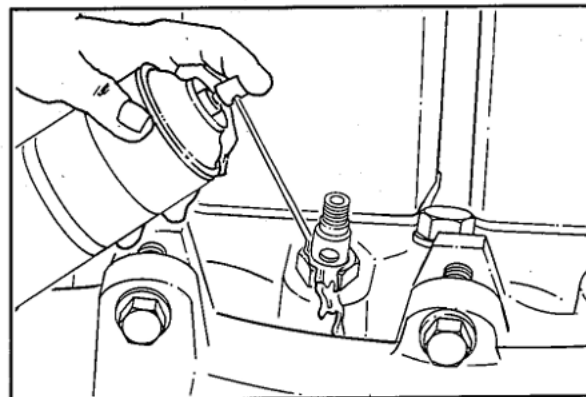
- Thoroughly clean around the injectors.
- Disconnect the high pressure fuel lines.
- Disconnect the fuel drain manifold.



Rust Penetrating Solvent

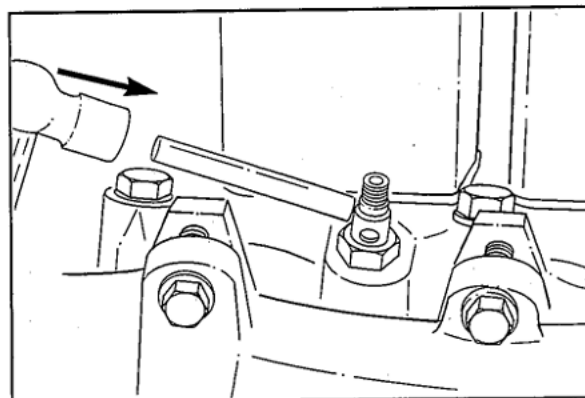
Caution: When rust has formed on the hold down nuts, the injector can turn in the bore when the nut is loosened. This will cause severe damage to the head by the injector locating ball cutting a groove in the bore.

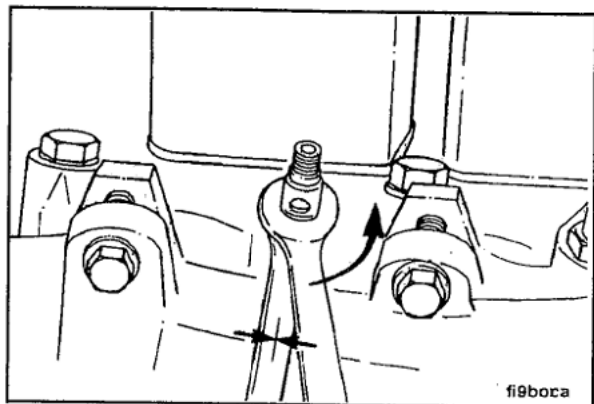
Use rust penetrating solvent to soak the nuts for a minimum of 3 minutes.



Brass Drift, Hammer

If necessary, hit the injector body to loosen any rust.





16, 24 mm

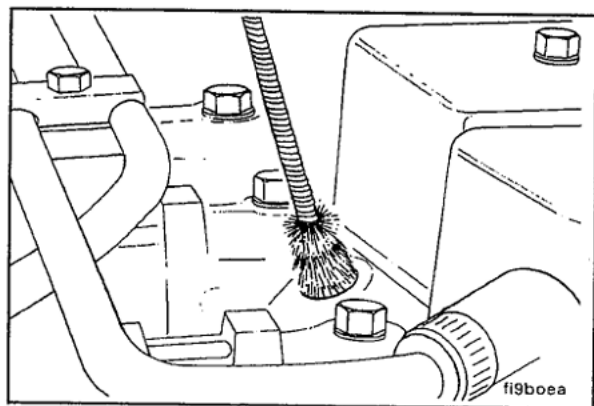


Caution: The injector must not rotate in the bore of the cylinder head. This will damage the cylinder head.



Remove the injector.

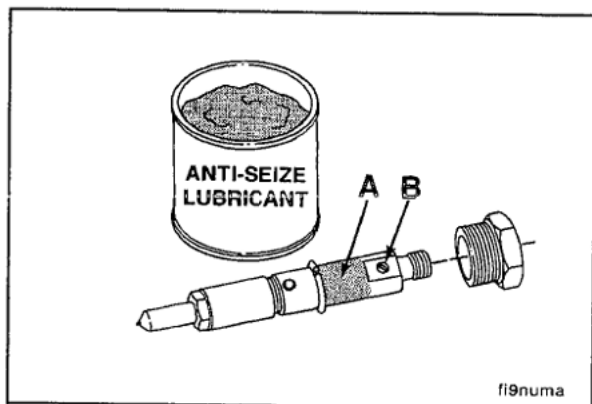
Hold the injector body with the 16 mm wrench while you loosen the hold-down nut with a 24 mm box end wrench.



Injector Bore Brush



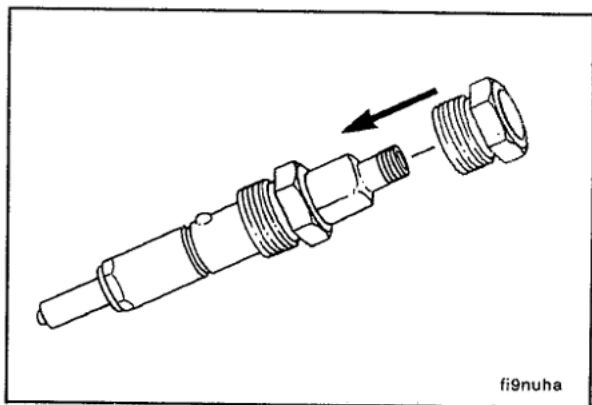
Clean the injector nozzle bores. If loose debris is in the injector bore, you should either use some type of vacuum or disconnect the fuel pump solenoid circuit and crank the engine to blow the debris from the bore.



Remove the injector hold down nut.



Apply a film of anti-seize compound to the injector surface (A). Avoid getting compound in the fuel drain hole (B).

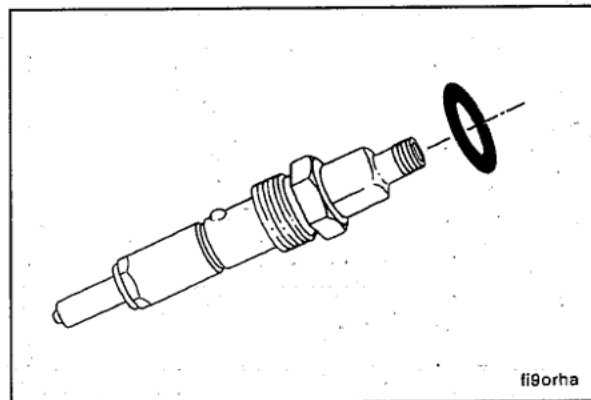


Install the hold down nut on the injector body and push it over the circlip until it "snaps" into place.

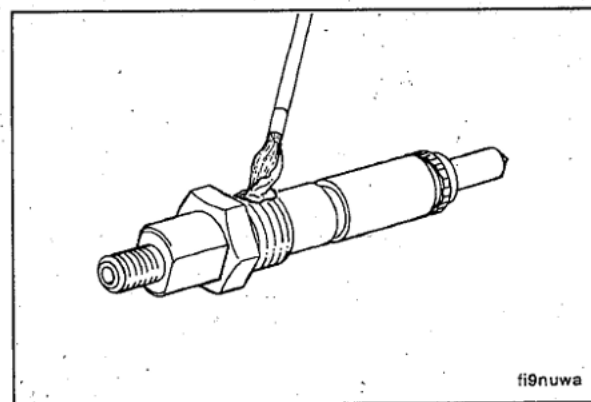
Section A - Adjustment, Replacement and Repair B and C Series

Install a new o-ring into the recessed groove on the top of the hold down nut.

Make sure it is **not** cut or twisted when installing.



Apply a film of anti-seize compound to the threads of the injector hold down nut.

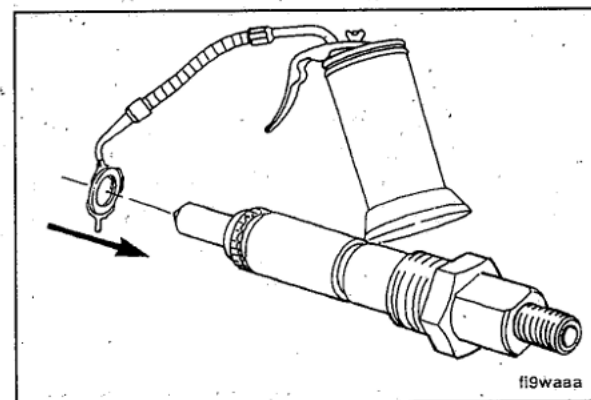
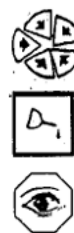


Assemble the injector and a new copper washer.

Use only one washer.

Service Tip: A light film of clean 15W-40 engine oil, between the washer and injector can help to keep the washer from falling during installation.

Make sure the injector bore does **not** have an existing sealing washer in it. Use the correct part number sealing washer.

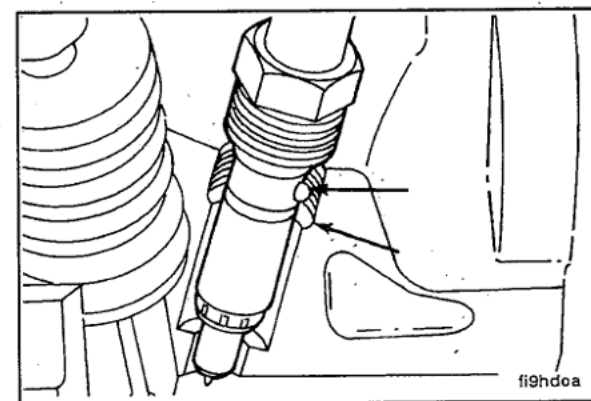


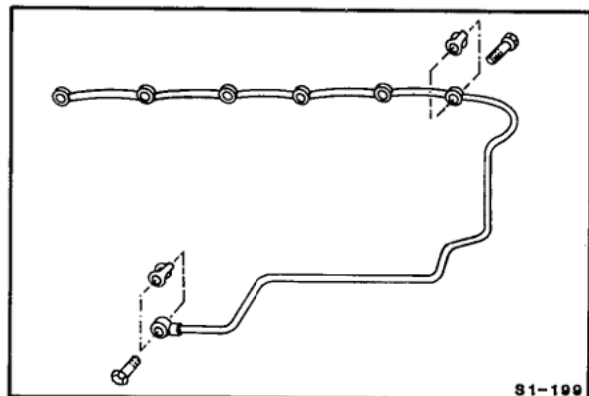
24 mm

Install the injectors with the protrusion on the side of the nozzle into the notch of the cylinder head.

Tighten the injector nozzle nuts.

Torque Value: 60 N•m [44 ft-lb]





10 mm



Caution: Use new seals and sealing washers.

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

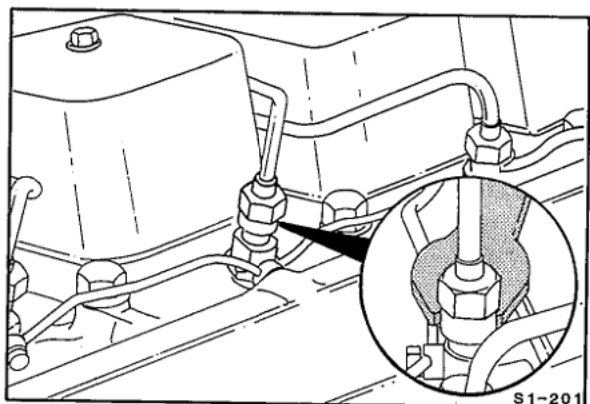


Torque Value:

Banjo fitting screw 15 N•m [11 ft-lb]

Banjo fitting 8 N•m [71 in-lb]

Clamp screw 24 N•m [18 ft-lb]

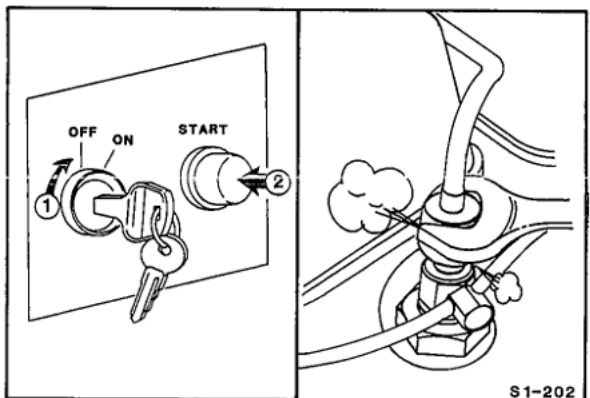


17 mm

Install the high pressure fuel lines.



Leave the fittings loose at the injectors.



17 mm Crowfoot



Warning: It is necessary to turn the start switch to the "ON" position in order to get fuel to flow through the pump and injection lines to vent the air from them. The engine can start, so be sure to follow all safety precautions. Use normal starting procedures.



Crank the engine to allow entrapped air to vent from the lines.



Tighten the fittings.

Torque Value: 30 N•m [22 ft-lb]

Injectors (C Series) - Replacement

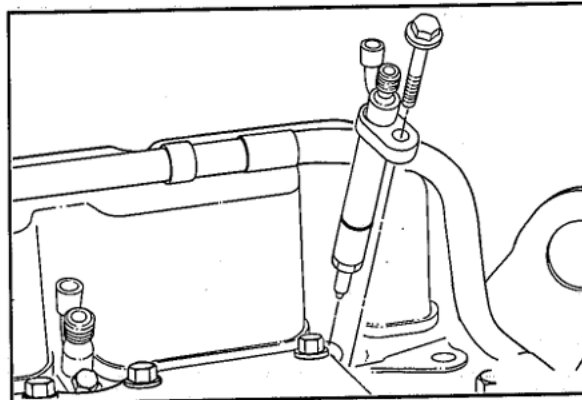
Preparatory Steps:

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

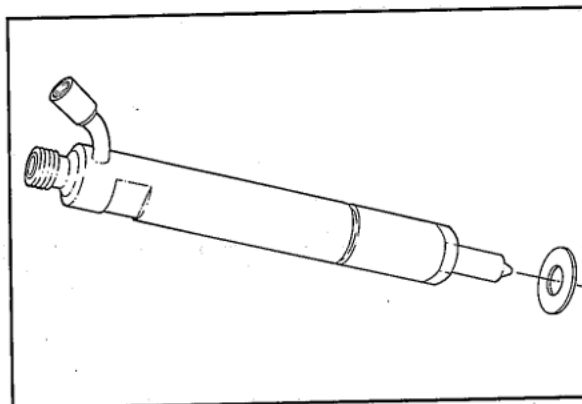
10 mm

Remove the injectors.

NOTE: An injector puller, Part No. 3822482, is available for hard to remove injectors.

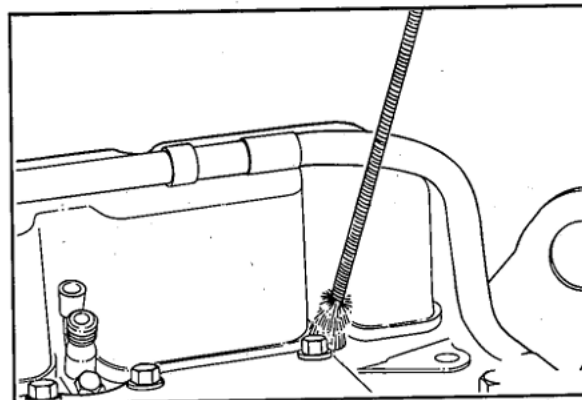


Remove and discard the sealing washers.

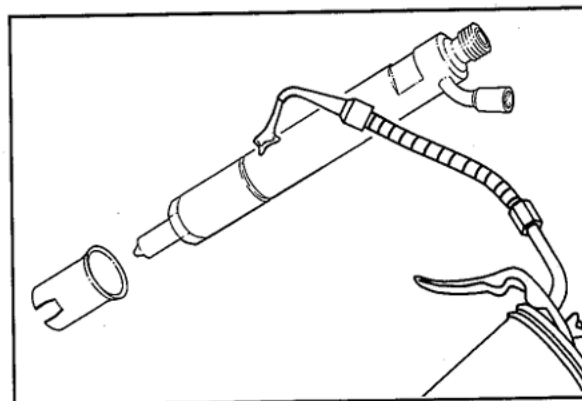


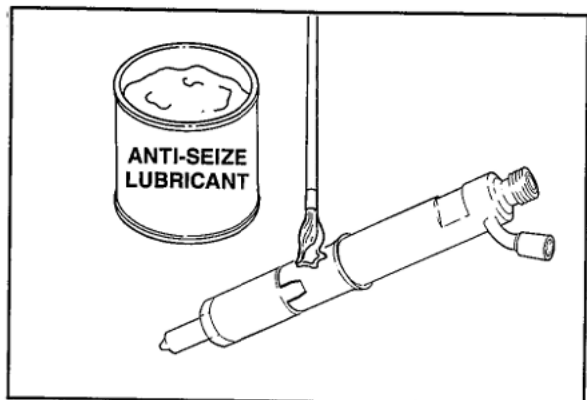
Injector Bore Brush

Clean the injector nozzle bore. If loose debris is in the injector bore, you should either use some type of vacuum or disconnect the fuel pump solenoid circuit and crank the engine to blow the debris from the bore.

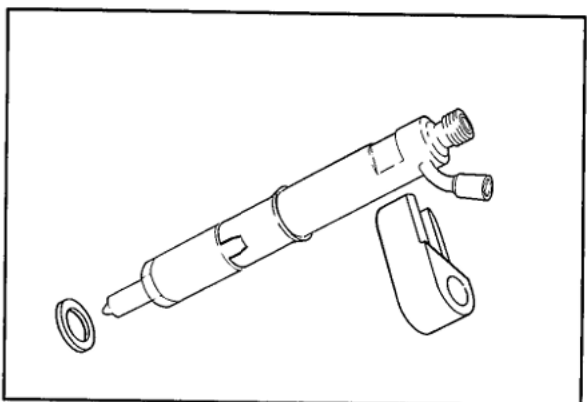


Use clean 15W-40 oil to lubricate and install new sealing sleeves on the injectors as illustrated.





Use clean anti-seize compound to lubricate the sealing lips.



Assemble the injector, sealing sleeve, a new copper sealing washer and the hold down clamp.

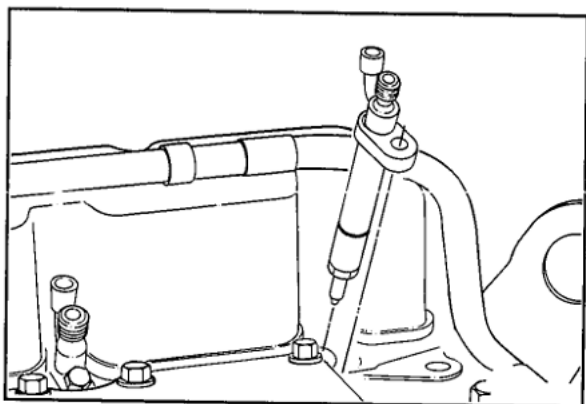
Use only one washer.



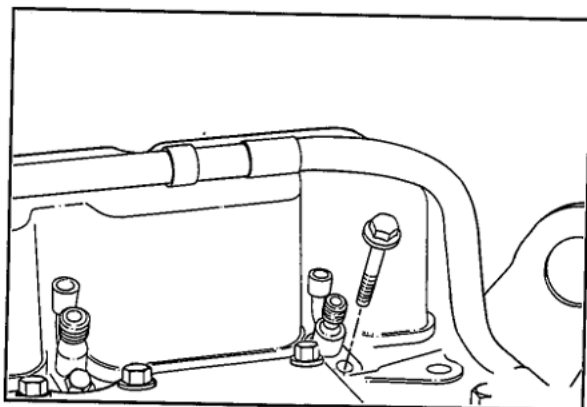
Service Tip: A light coat of clean 15W-40 engine oil between the washer and injector can help to keep the washer from falling during installation.



Make sure that the injector bore does **not** have an existing sealing washer in it. Use the correct part number washer.



Install the injector assembly into the injector bore. The injector fuel return connection **must** be toward the valve cover.



10 mm

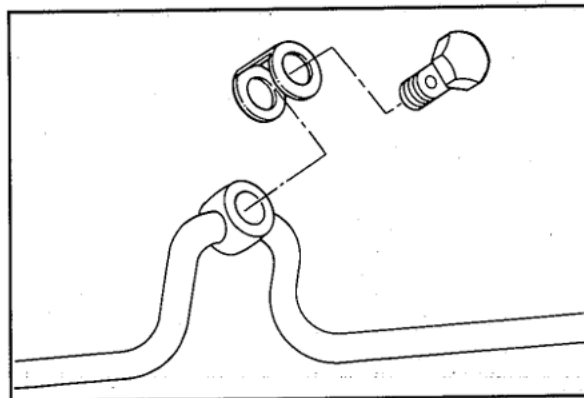
Install the hold down capscrew.



Torque Value: 30 N•m [22 ft-lb]



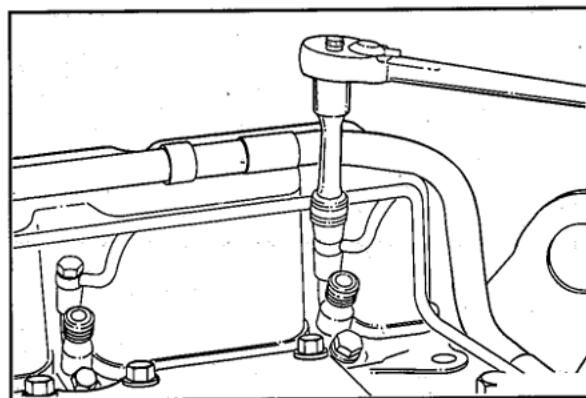
Install the fuel drain manifold with new copper sealing washers and the banjo screws as illustrated.



10 mm

Install the fuel drain manifold.

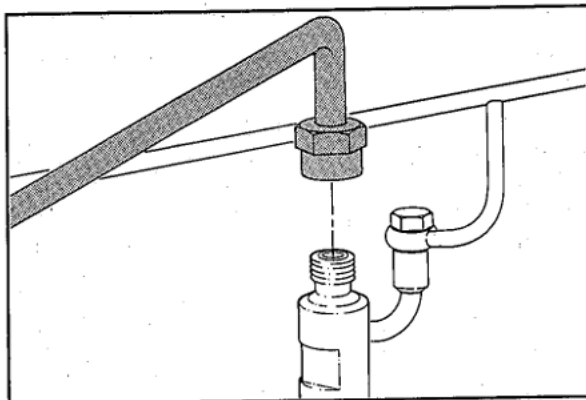
Torque Value: 9 N•m [80 in-lb]



17 mm

Install the high pressure fuel lines.

Leave the fittings loose at the injectors.



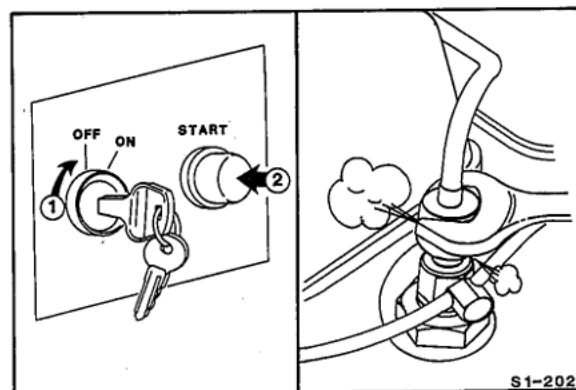
17 mm Crowfoot

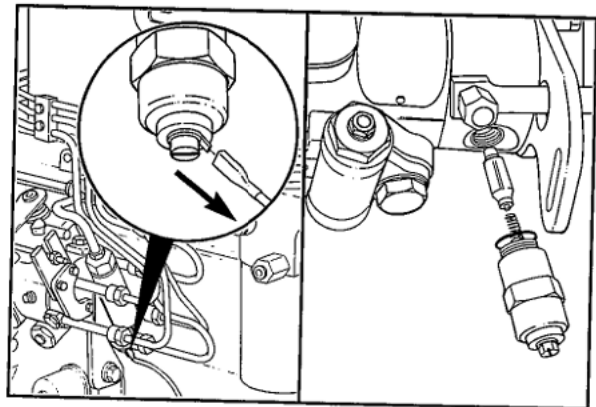
Warning: It is necessary to turn the start switch to the "ON" position in order to get fuel to flow through the pump and injection lines to vent the air from them. The engine can start, so be sure to follow all safety precautions. Use normal starting procedures.

Crank the engine to allow entrapped air to vent from the lines.

Tighten the fittings.

Torque Value: 30 N•m [22 ft-lb]





Electric Fuel Shutoff Valve (CAV) - Replacement B Series, 64 through 210 HP)

24 mm

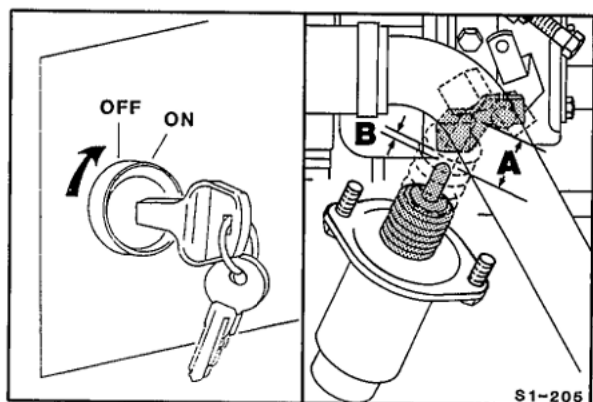
Disconnect the electrical connection.

Clean around the valve.

When removing the valve, be careful **not** to drop the piston and spring.

Install the valve.

Torque Value: 14 N•m [11 ft-lb]



Fuel Shutoff Solenoid - Checking/ Replacement

(Nippondenso and Bosch)

Activate the switch and check the plunger travel.

A = 6.5 mm [1.44 in]

B = 3.2 mm [0.13 in]

When energized, the plunger **must** be retracted to allow a clearance of 3.2 mm [0.13 inch] from the plunger to the shutoff lever. The solenoid **must** operate without binding.



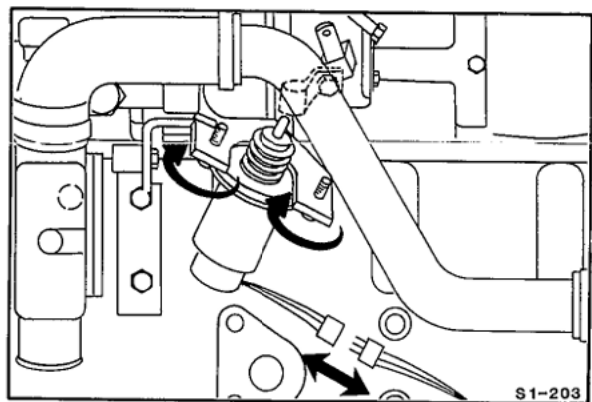
Battery Voltage	Min Voltage		Resistance			
			Min Ohms	Min Ohms	Min Ampres	Min Ampres
	Pull-In	Hold-In	Pull-In	Hold-In	Pull-In	Hold-In
12	10	4.5	0.17	13.6	58.8	0.33
24	20	9.0	0.68	50	29.4	0.18

Nippondenso Pumps (B 220 through 300 HP, C 400 HP)

10 mm

Unplug the electrical connector.

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

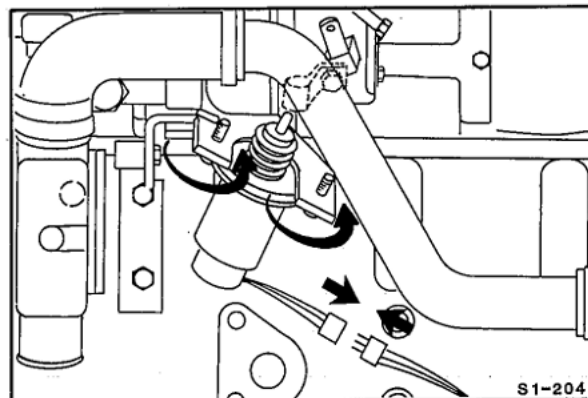


Section A - Adjustment, Replacement and Repair B and C Series

Install the new solenoid below the bracket and tighten the capscrews.

Torque Value: 10 N•m [7 ft-lb]

Plug in the electrical connector.



Bosch Pump (CTA 300 HP)

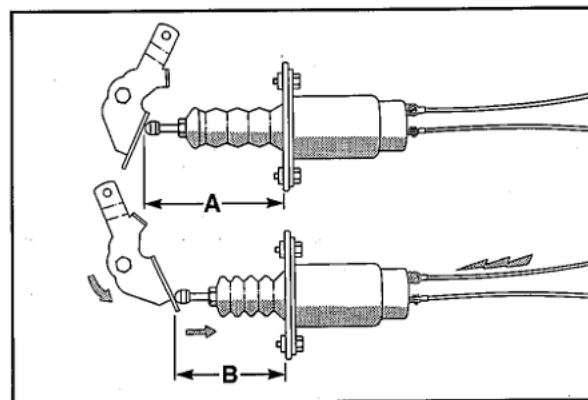
Activate the switch and check the plunger travel.

A = 86.6 mm [3.4 in]

B = 60.2 mm [2.4 in]

Caution: The plunger must be retracted when the solenoid is activated to the run position "B". The solenoid must operate without binding.

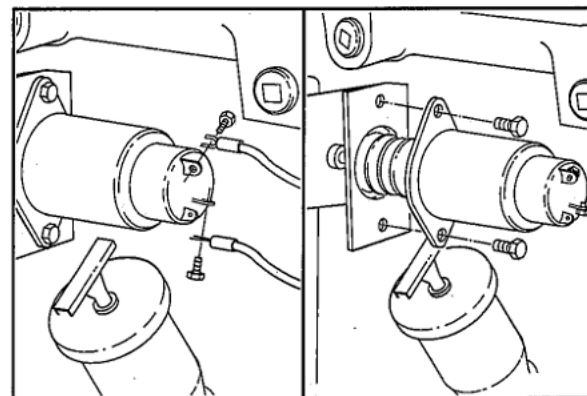
Alignment is crucial in order for the solenoid to operate properly.



8 mm

Disconnect the fuel shutoff solenoid wiring.

Remove the mounting capscrews.

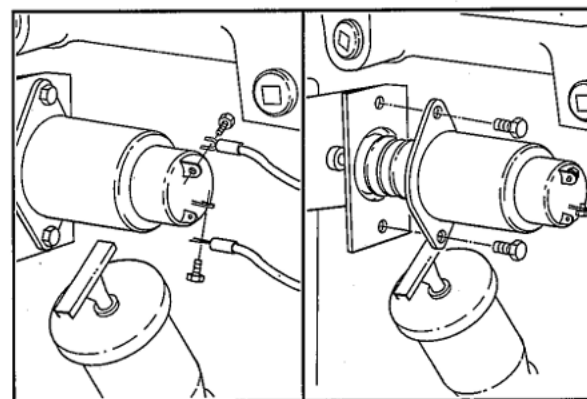


8 mm

Install the new solenoid and connect the wires.

Check carefully to see that the Synchro-Start acorn nut or Trombetta plunger is centered (side to side) on the fuel pump shut down lever.

Torque Value: 10 N•m [7 ft-lb]

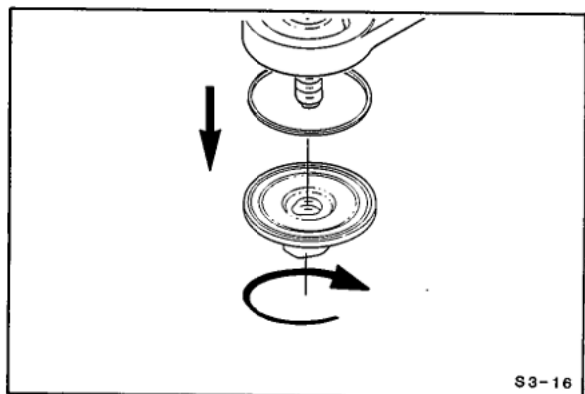


Fuel Filter Head Adapter - Replacement

Preparatory Steps:

- Clean debris.
- Remove the fuel filter.

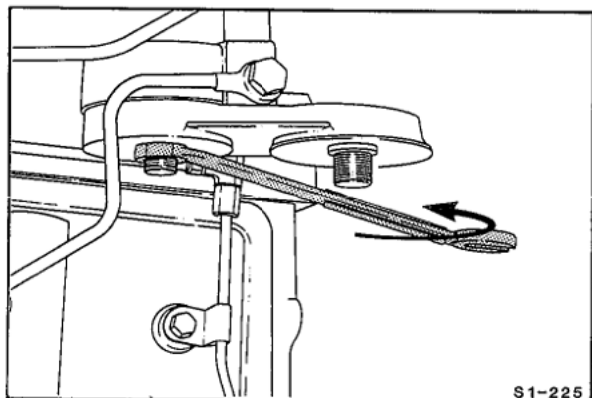
NOTE: The B Series, 220 through 300 HP only, use an offset fuel filter head. This moves the fuel filter to allow room for the Nippondenso injection pump.



Adjustable Pliers



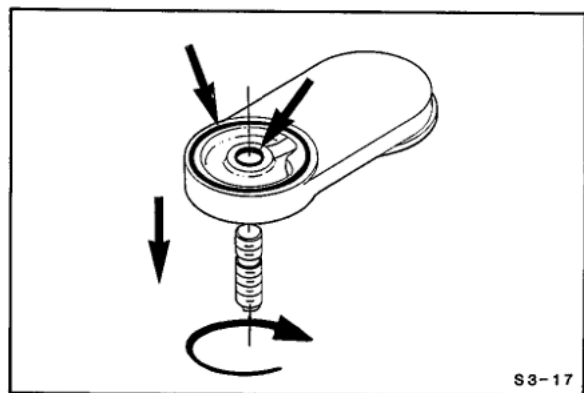
Remove the filter head cover and rectangular ring seal from the fuel filter adapter screw.



24 mm



Remove the jam nut from the fuel filter adapter screw.



Large Flat Screwdriver

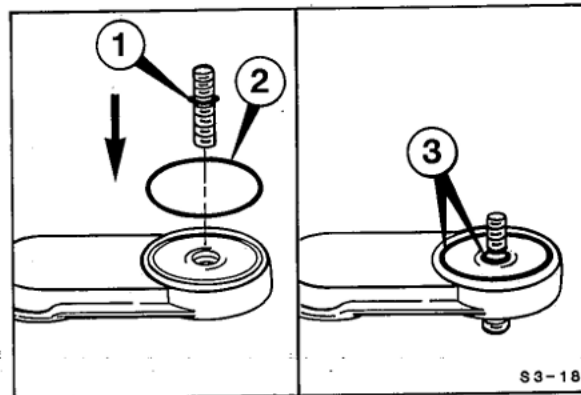


Remove the fuel filter adapter screw, fuel filter head and rectangular ring seals from the intake manifold filter head.

Section A - Adjustment, Replacement and Repair B and C Series

Install the new small rectangular ring seal on the filter head adapter screw (1) and the new larger seal into the filter head groove (2). Place the screw into the adapter.

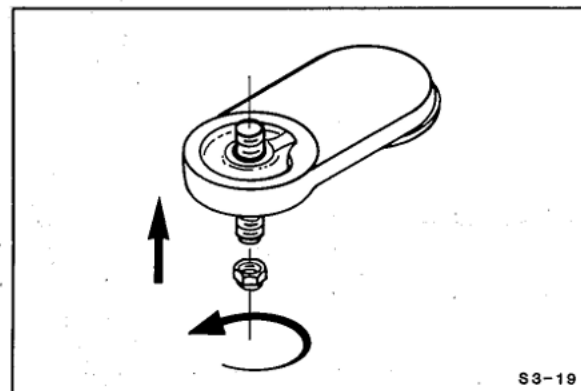
Use clean 15W-40 oil to lubricate the seals and the center hole (3).



S3-18

Large Flat Screwdriver

Place the filter head adapter screw into the filter head and install the filter head adapter screw. Turn screw until it bottoms.

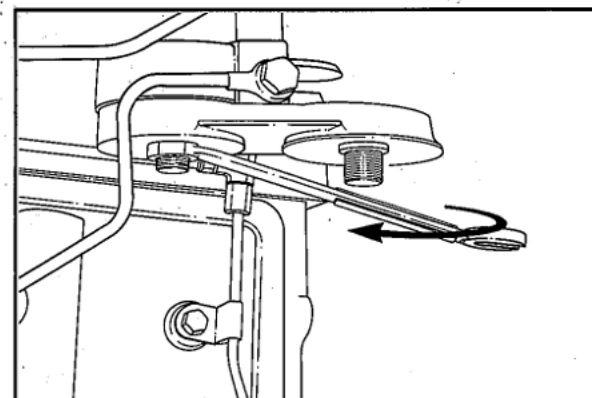


S3-19

24 mm

Install the jam nut. Tighten

Torque Value: 32 N•m [24 ft-lb]

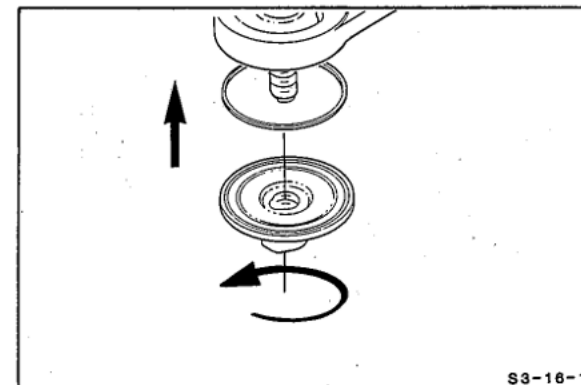


Adjustable Pliers

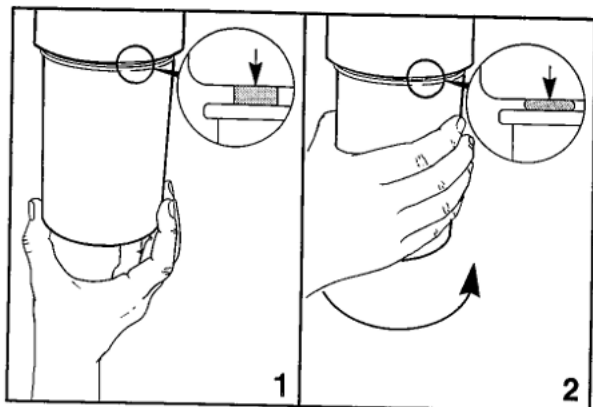
Install the new rectangular ring seal into the filter head cover.

Use clean 15W-40 oil to lubricate the seal.

Install the filter head cover. Turn cover until seal touches filter head, then turn an additional 1/4 to 1/2 of a turn.



S3-16-1

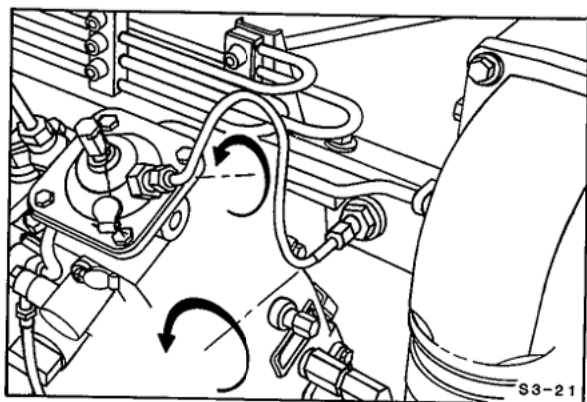


Fill the new filter with clean No. 2 diesel fuel.

Use clean 15W-40 oil to lubricate the gasket.



Install the filter and tighten one-half of a turn after the gasket contacts the filter head.



Air Fuel Control (AFC) Tube - Replacement

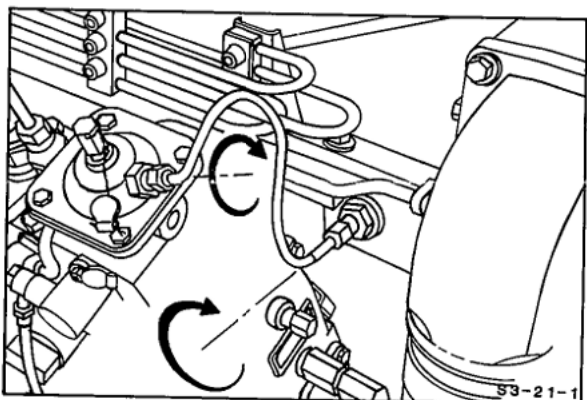


Two 1/2 Inch Open End Wrenches

Remove the AFC tube.

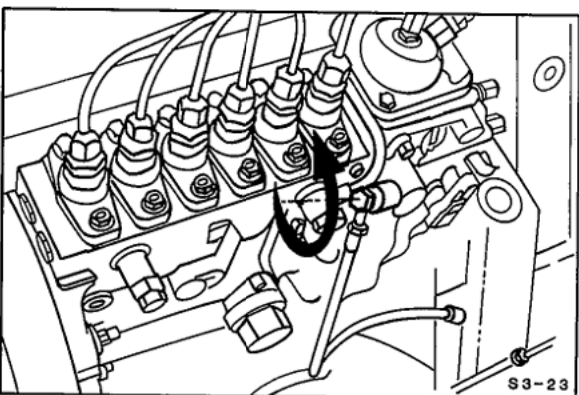


NOTE: The B Series engines, 220 through 300 HP, and the C Series engines, use an AFC line and an oil latchout line, both of which are connected to the injection pump. Disconnect both lines before removing the injection pump.



Two 1/2 Inch Open End Wrenches

Install the AFC tube.



Oil Latchout Line - Replacement

15 mm, Nippondenso Pump

7/16 Inch, Bosch Pump



Preparatory Step:

- Clean debris from the fitting on the injection pump.

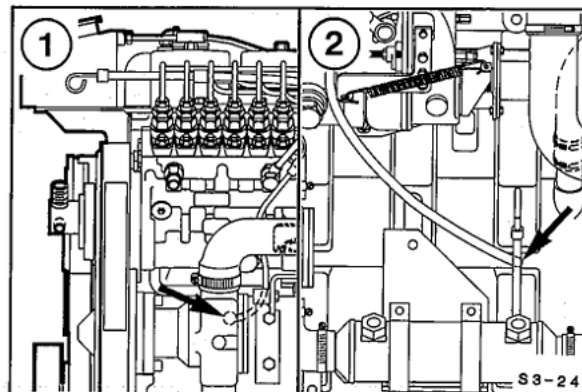


Remove the oil line from the injection pump.

9/16 Inch Open End Wrench (Nippondenso Pump (1))
7/16 Inch Open End Wrench (Bosch Pump (2))

Remove the line from the oil pressure fitting on the engine block, B Series (1) and C Series (2).

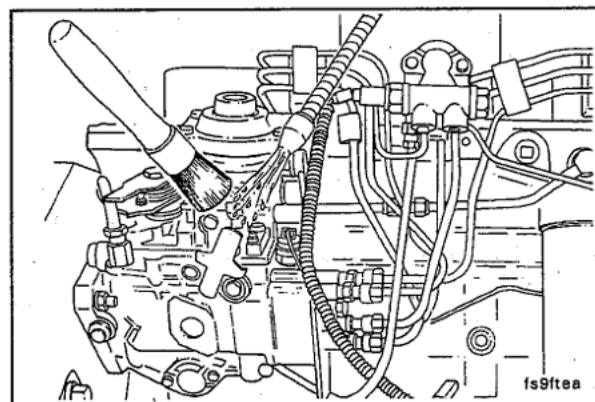
Install in the reverse order of removal.



Fuel Injection Pump (CAV) - Replacement
(B Series, 64 to 210 HP)

NOTE: A diesel engine **cannot** 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 unit.

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.

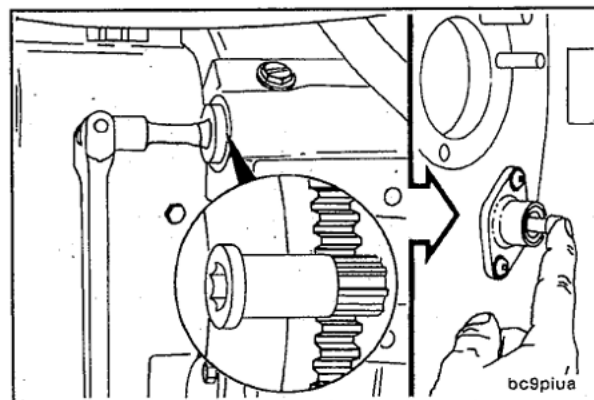


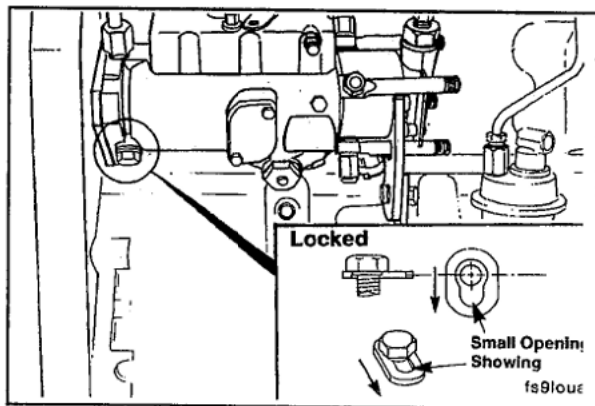
Preparatory Steps:

- Disconnect the battery ground cable.
- Remove all the fuel lines.
- Remove the control linkage.

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

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





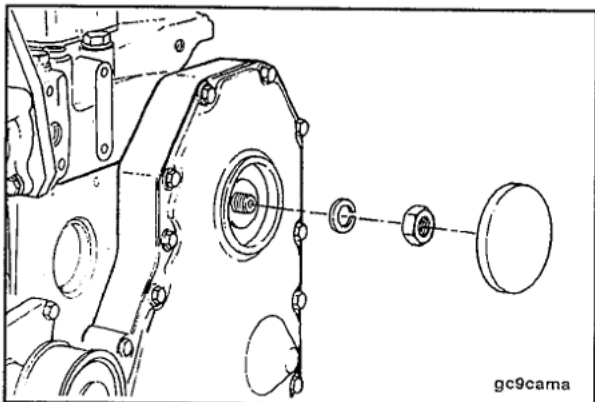
14 mm

Loosen the lock screw and position the special washer, then tighten the lock screw against the pump drive shaft.



Note the position of the pump timing mark to gear housing timing mark.

Torque Value: 8 Nm [71 in-lb]

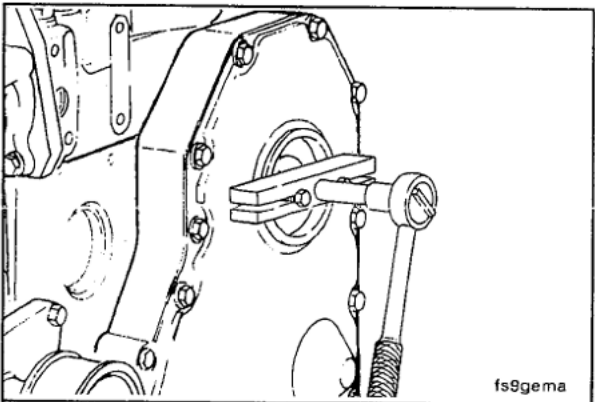


22 mm

Remove the gear cover access cap.

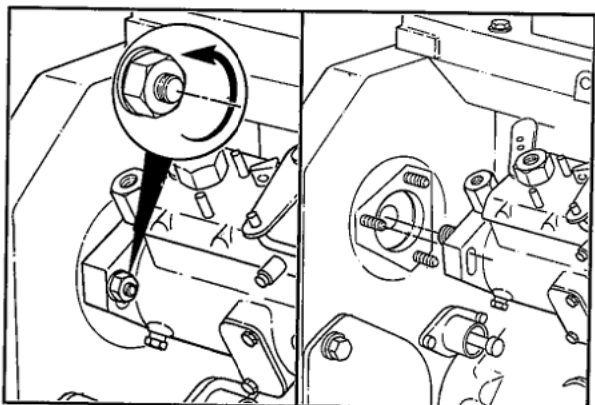


Remove the nut and washer from the fuel pump shaft.



75 mm T-Bar Puller

Pull the fuel pump drive gear loose from the shaft.



13 mm

Caution: Do not drop drive gear key when removing pump.



Remove the three mounting nuts.



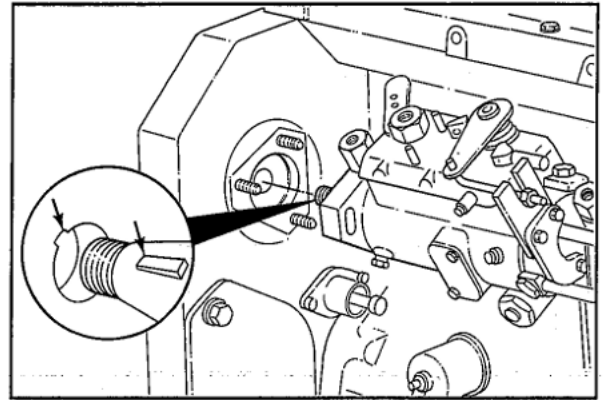
Remove the fuel pump.

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

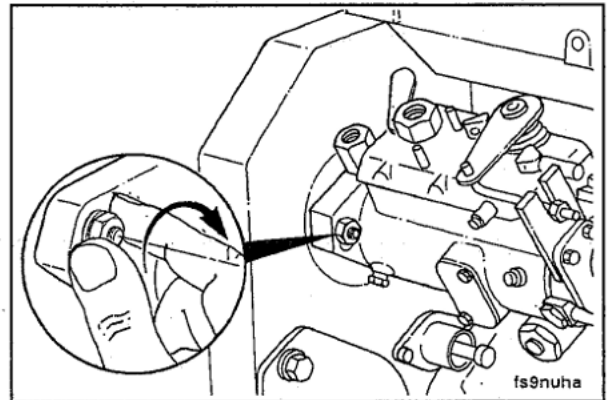
The keyway in the shaft of new and reconditioned pumps will be locked in a position corresponding to the keyway in the drive gear when cylinder No. 1 is at TDC on the compression stroke.

Install a new gasket between the pump and gear housing.

After verifying that cylinder No. 1 is at TDC, install the pump. Make sure the key does **not** fall into the gear housing.



Attach the pump by finger tightening the three mounting nuts. The pump **must** be free to move in the slots.

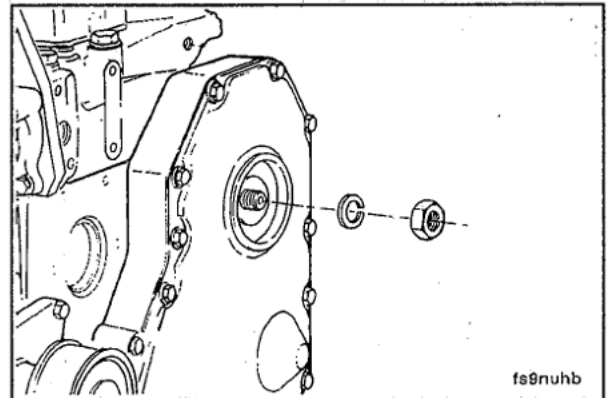


22 mm

Attach the pump drive shaft nut and spring washer. The pump may rotate slightly due to gear helix and clearance. This is acceptable providing the pump is free to move on the flange slots and the crankshaft does **not** move.

NOTE: Do **not** overtighten. This is **not** the final torque.

Torque Value: 15 to 20 N•m [11 to 15 ft-lb]



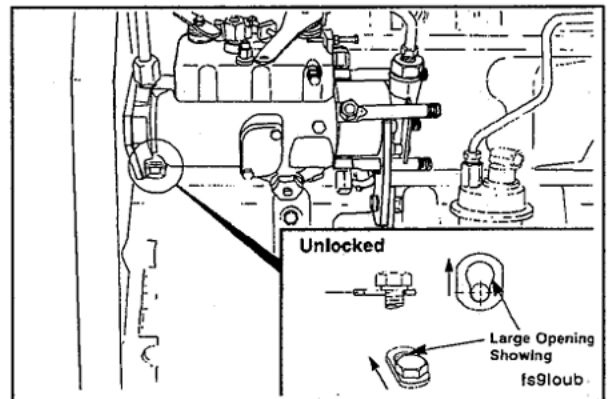
14 mm

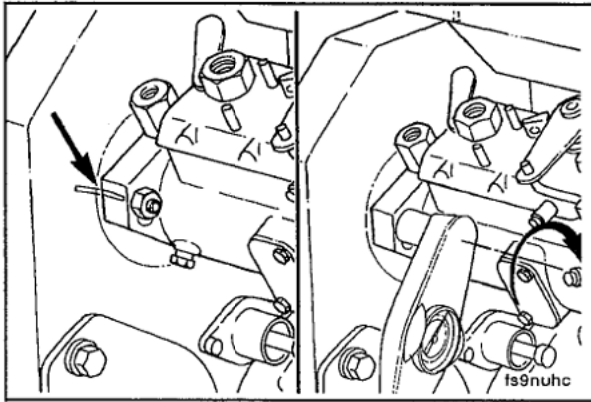
If installing the removed pump, unlock the pump by loosening the lock screw. Position the special washer behind the lock screw head.

Tighten the pump lock screw.

Torque Value: 20 N•m [15 ft-lb]

Caution: The pump shaft must be unlocked after installation to prevent pump damage.



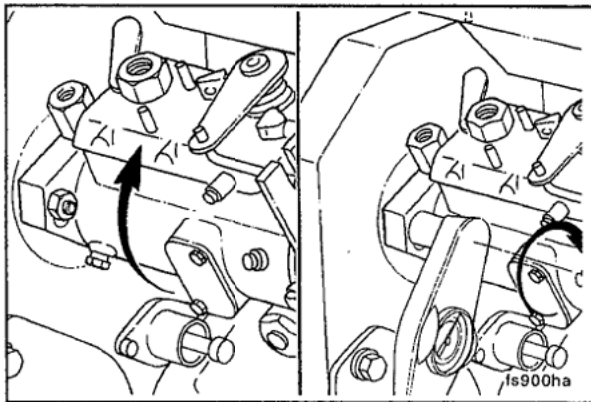


13 mm

When **installing the removed pump**, rotate the pump to align the scribe marks to their original position. Tighten the three mounting nuts.



Torque Value: 24 N•m [18 ft-lb]



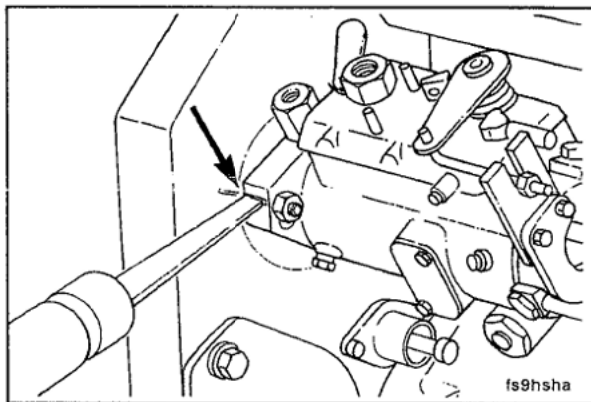
13 mm

If **installing a new or rebuilt pump** without scribe marks, take up gear lash by rotating the pump against the direction of drive rotation.

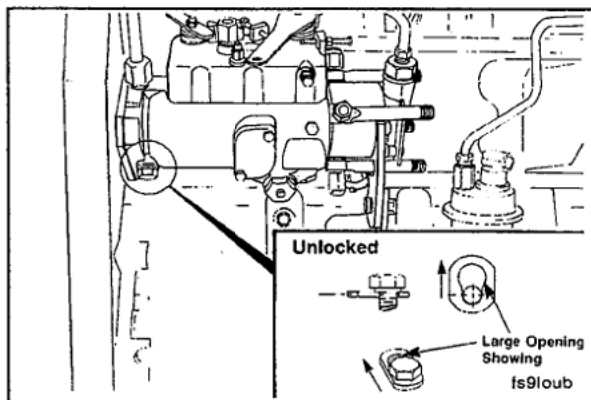


Tighten pump retaining nuts.

Torque Value: 24 N•m [18 ft-lb]



If a **new or rebuilt pump** is being installed, permanently mark the injection pump flange to match the mark on the gear housing.



14 mm

To unlock the pump, loosen the lock screw and position the special washer behind the lock screw head.

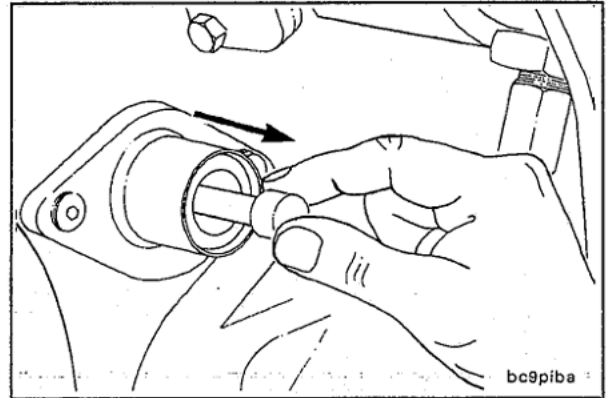


Tighten the pump lock screw.

Torque Value: 20 N•m [15 ft-lb]



NOTE: Be sure to disengage the timing pin.

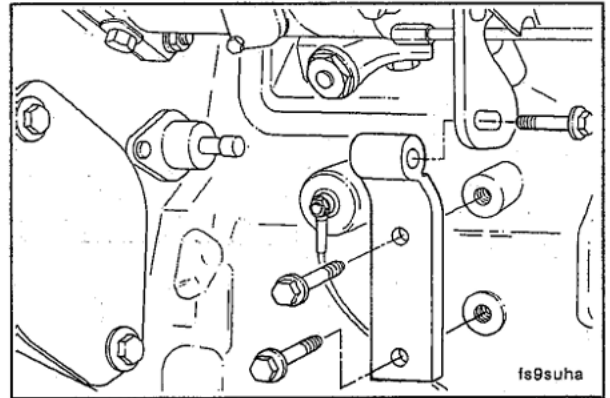


13 mm

Attach the injection pump support bracket. Finger tighten all cap screws before final tightening.

NOTE: Tighten the bracket to block mounting cap screw before tightening the bracket to injection pump cap screws.

Torque Value: 24 N•m [18 ft-lb]

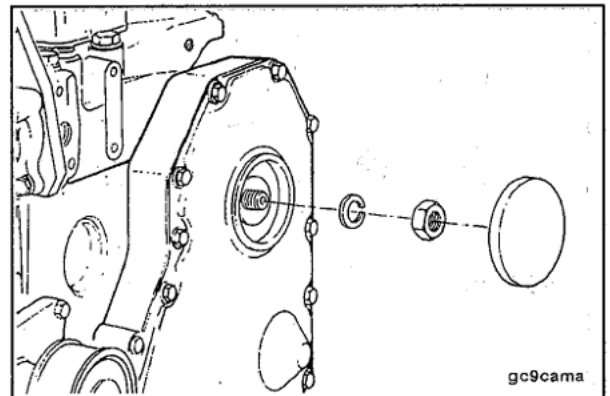


22 mm

Tighten the drive gear mounting nut.

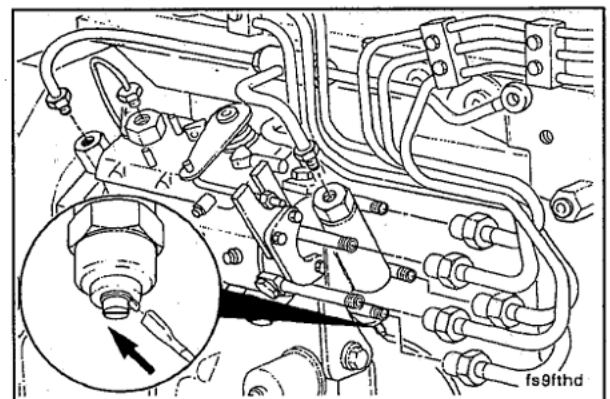
Install the access cap.

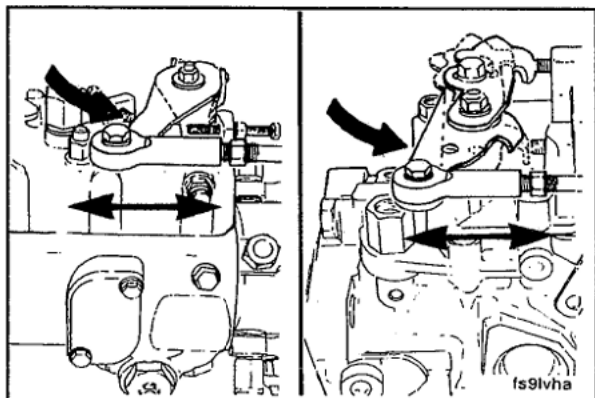
Torque Value: 65 N•m [48 ft-lb]



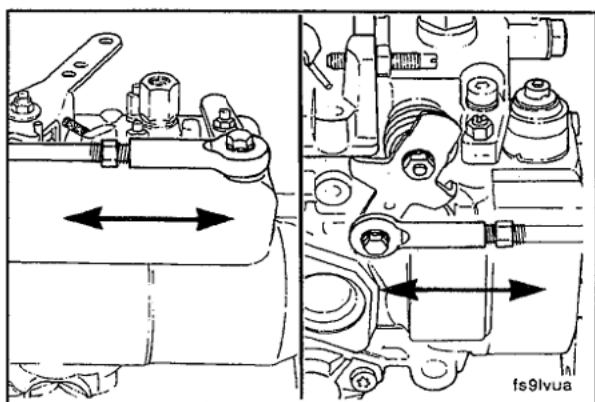
8 mm

Install the solenoid wiring and all fuel lines.

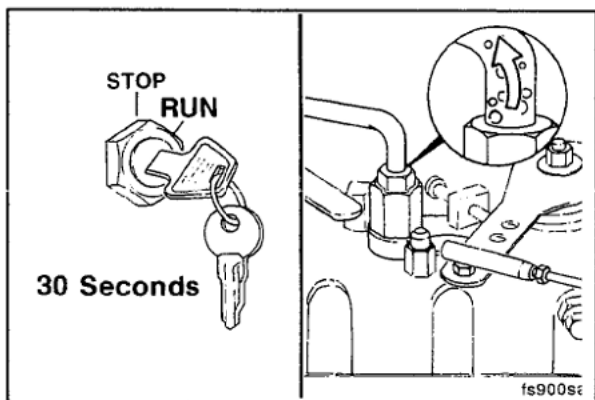




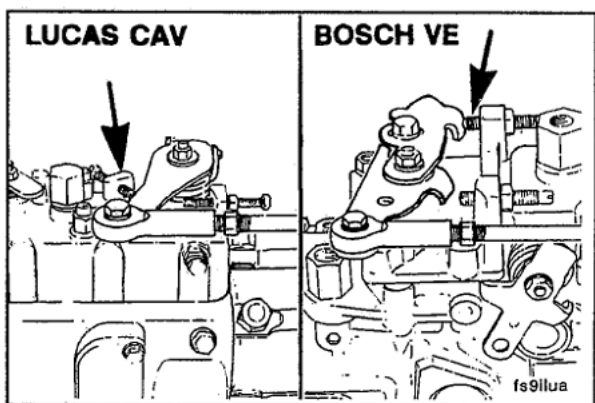
NOTE: When connecting the cable/rod to the control lever, adjust the length so the lever has stop-to-stop movement.



NOTE: Similarly, adjust the length of the cable/rod to the mechanical shut down lever so there is a stop-to-stop movement.



Vent all air from the fuel system.



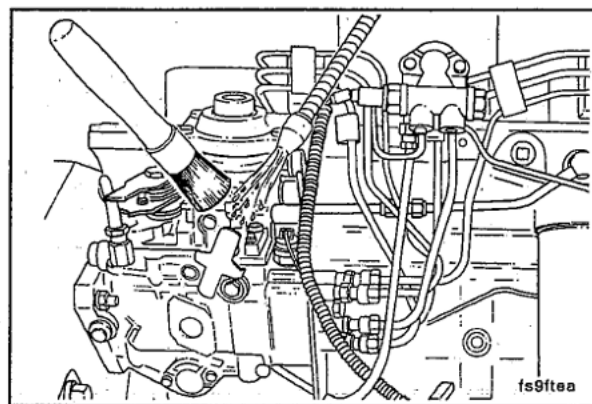
If necessary, adjust the idle speed.

Fuel Injection Pump (Bosch Distributor) - Replacement

6BT - 152 HP

NOTE: A diesel engine **cannot** 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 unit.

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.



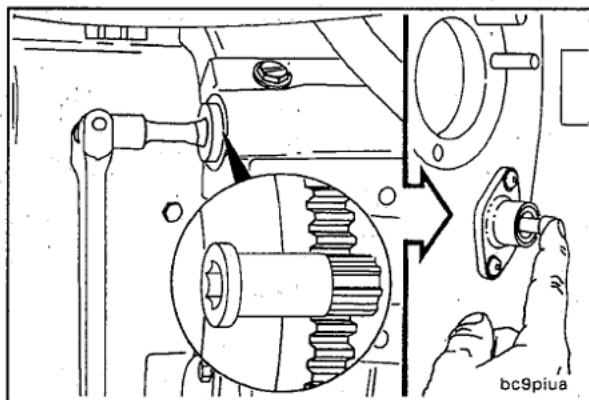
Preparatory Steps:

- Disconnect the battery ground cable.
- Remove all the fuel lines.
- Remove the control linkage.

1/2 Inch Square Drive, Part No. 3377371 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.

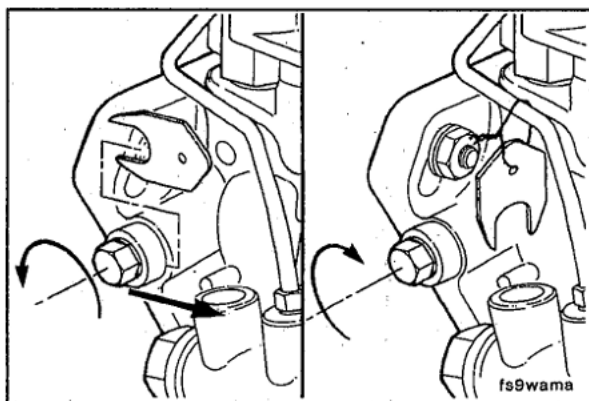
To prevent damage to the timing pin, be sure to disengage the pin after locating TDC.

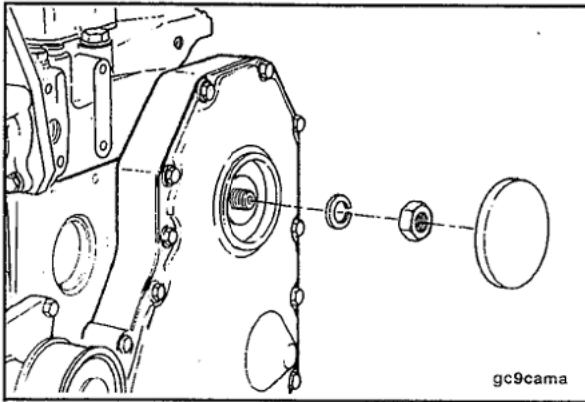


10 mm

The special washer on the Bosch injection pump **must** be removed so the lockscrew can be tightened against the drive shaft. Note the position of the pump timing mark to gear housing timing mark.

Torque Value: 30 N•m [22 ft-lb]



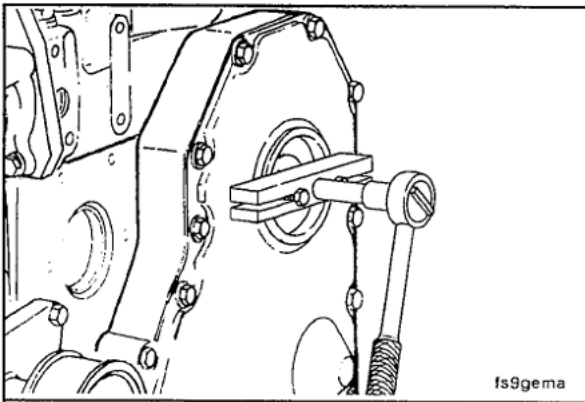


24 mm

Remove the gear cover access cap.

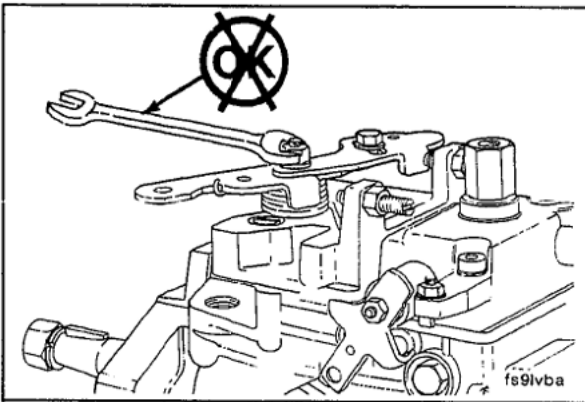


Remove the nut and washer from the fuel pump shaft.

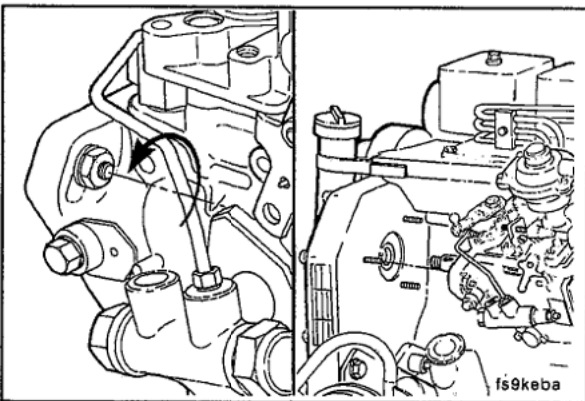


75 mm T-Bar Puller

Pull the fuel pump drive gear loose from the shaft.



Caution: Do not remove the control lever. The lever is indexed to shaft during pump calibration.



15 mm

Caution: Do not drop drive gear key when removing pump.



Remove the three mounting nuts.

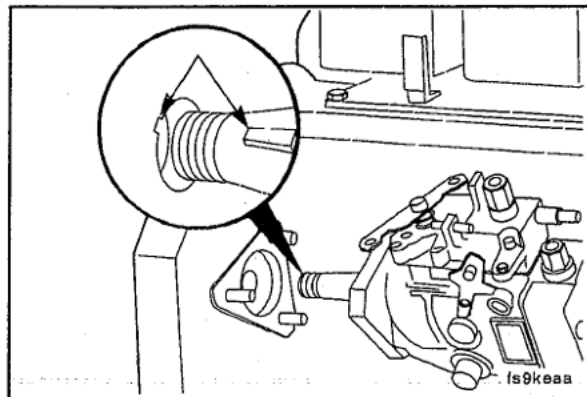


Remove the fuel pump.

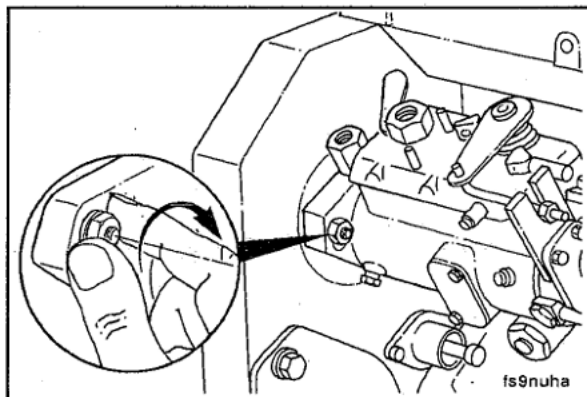
Make sure the engine has cylinder No. 1 at TDC.

The keyway in the shaft of new and reconditioned pumps will be locked in a position corresponding to the keyway in the drive gear when cylinder No. 1 is at TDC on the compression stroke.

After verifying that cylinder No. 1 is at TDC, install the pump. Make sure the key does **not** fall into the gear housing.



Attach the pump by finger tightening the three mounting nuts. The pump **must** be free to move in the slots.

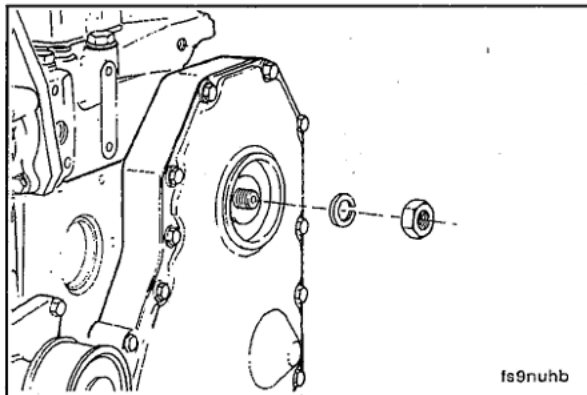


24 mm

Attach the pump drive shaft nut and spring washer. The pump may rotate slightly due to gear helix and clearance. This is acceptable providing the pump is free to move on the flange slots and the crankshaft does **not** move.

NOTE: Do **not** overtighten. This is **not** the final torque.

Torque Value: 15 to 20 N•m [11 to 15 ft-lb]

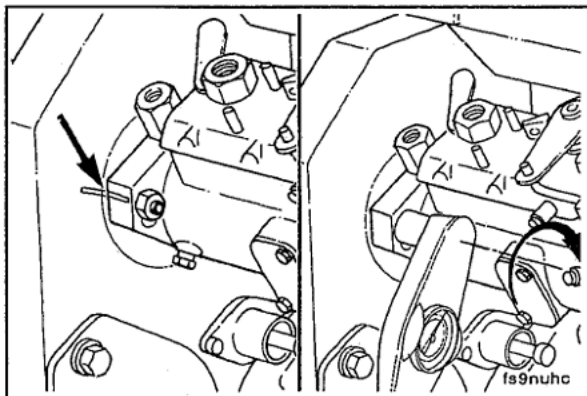


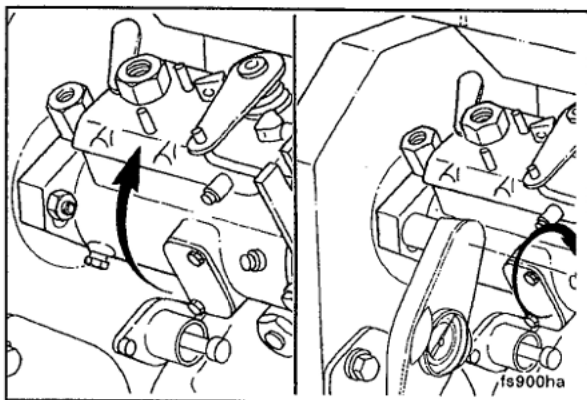
15 mm

If installing the original removed pump, install the pump on the engine. Rotate the pump to align the scribe marks to their original position. Tighten the three mounting nuts.

Caution: The pump shaft must be unlocked after installation to prevent pump damage.

Torque Value: 24 N•m [18 ft-lb]



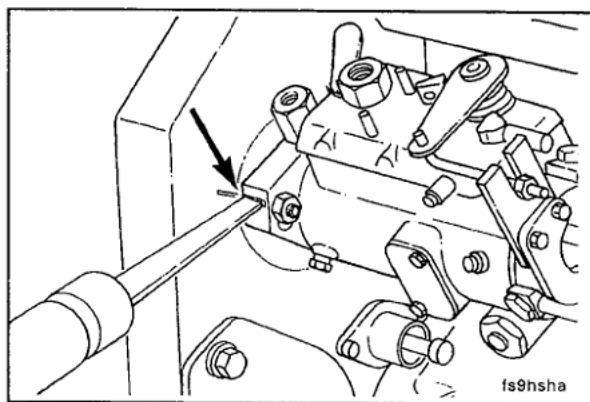


15 mm

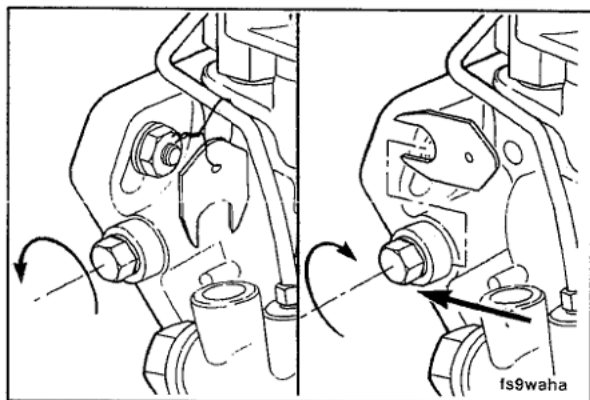
If installing a new or rebuilt pump without scribe marks, take up gear lash by rotating the pump against the direction of drive rotation.

Tighten pump retaining nuts.

Torque Value: 24 N•m [18 ft-lb]



If a new or rebuilt pump is being installed, permanently mark the injection pump flange to match the mark on the gear housing.

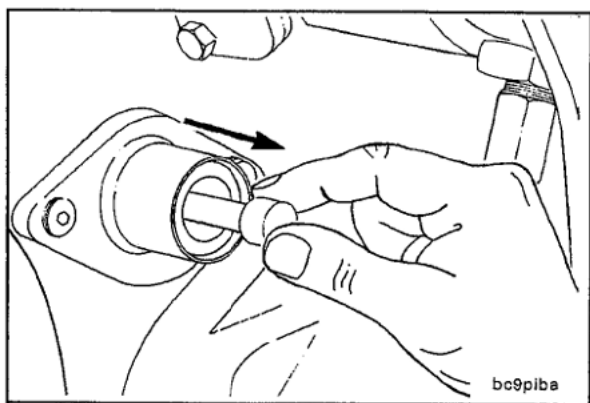


10 mm

NOTE: On the Bosch pump, the special washer is wired to the pump and **must** be installed under the lockscrew.

Tighten the pump lockscrew.

Torque Value: 13 N•m [10 ft-lb]



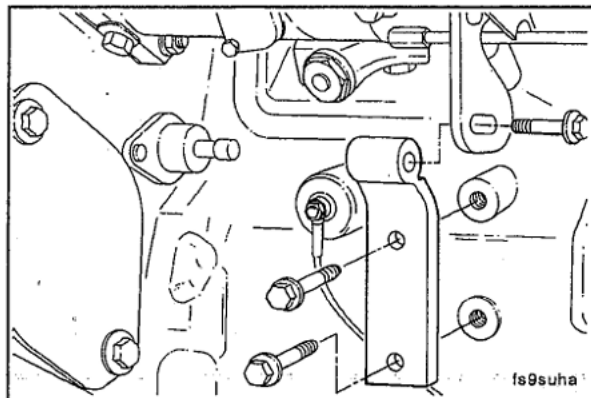
NOTE: Be sure to disengage the timing pin.

13 mm

Attach the injection pump support bracket. Finger tighten all capscrews before final tightening.

NOTE: Tighten the bracket to block mounting capscrew before tightening the bracket to injection pump capscrews.

Torque Value: 24 N•m [18 ft-lb]

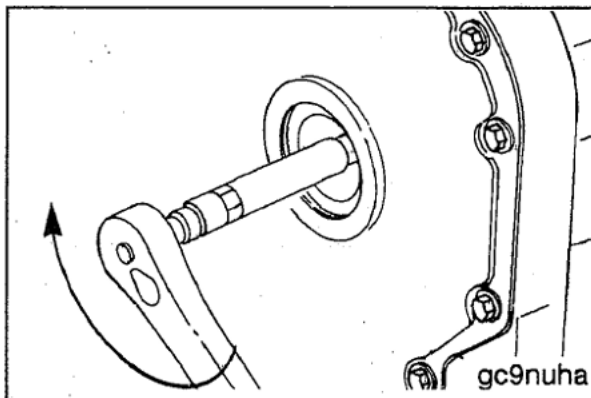


24 mm

Tighten the drive gear mounting nut.

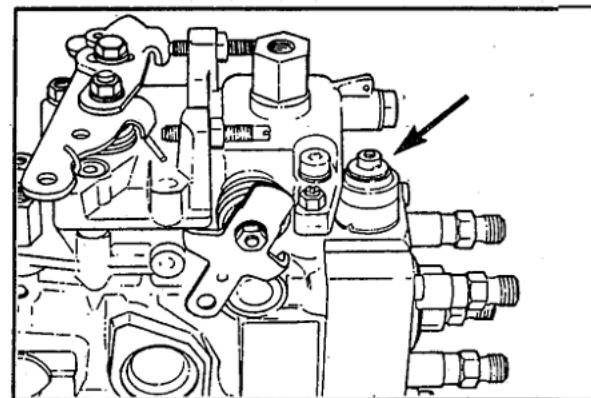
Install the access cap.

Torque Value: 65 N•m [48 ft-lb]

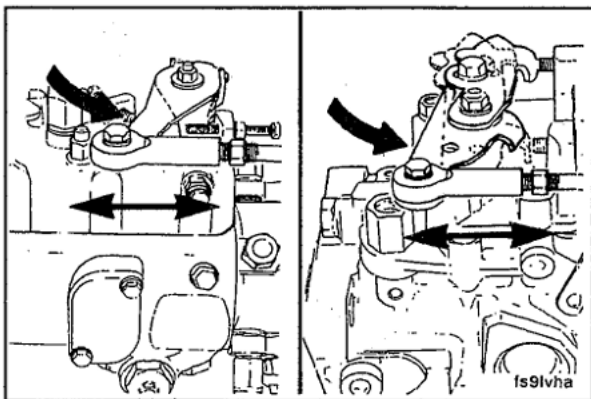


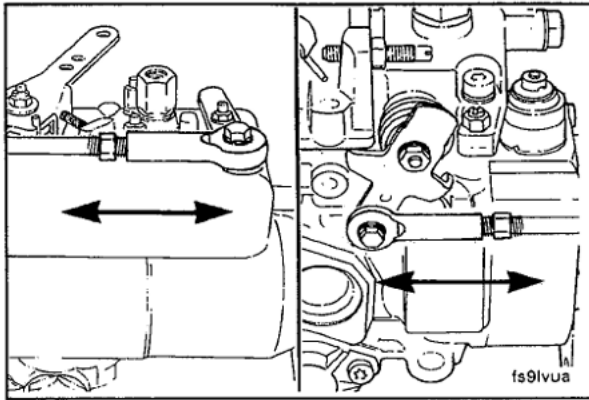
8 mm

Install the solenoid wiring and all fuel lines.

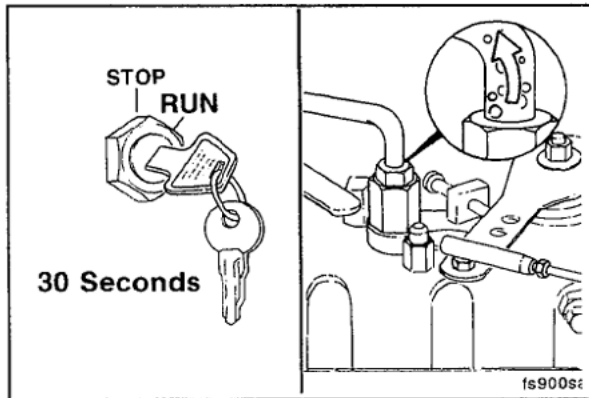


NOTE: When connecting the cable/rod to the control lever, adjust the length so the lever has stop-to-stop movement.

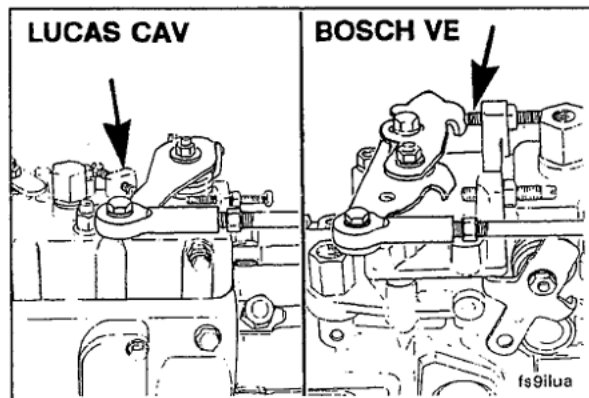




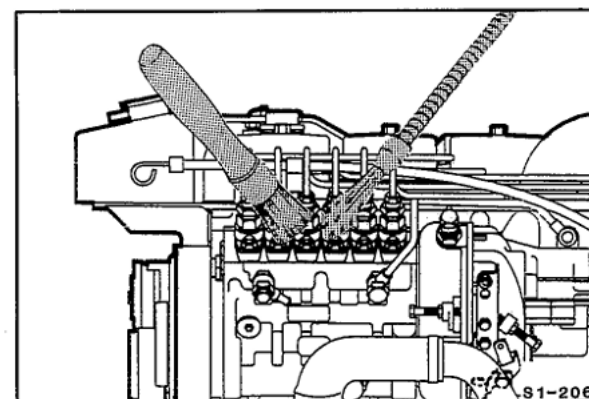
NOTE: Similarly, adjust the length of the cable/rod to the mechanical shut down lever so there is a stop-to-stop movement, if used.



Vent all air from the fuel system.



If necessary, adjust the idle speed.



Fuel Injection Pump (Nippondenso) - Replacement

(6BTA Series 220 to 300 HP and CTA 400 HP)

NOTE: A diesel engine **cannot** 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 unit.



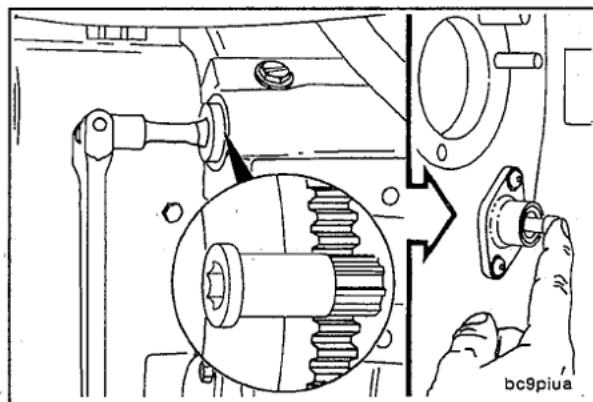
Clean all external surfaces of the injection pump, including all line connections and fittings that are to be disconnected. Clean the area around the injection pump gear cover to prevent dirt from entering the crankcase.

Preparatory Steps:

- Disconnect the battery ground cable.
- Remove all the fuel lines.
- Remove the control linkage.
- Remove the fuel shutoff solenoid.
- Remove the fuel filter.
- Remove the oil latchout line.

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

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



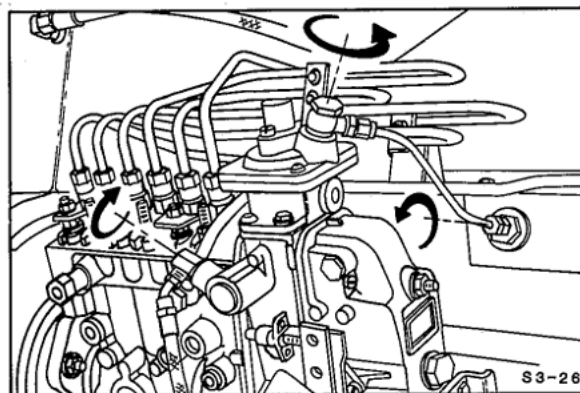
13 and 14 mm

Disconnect the lubricating oil supply line from the injection pump.

Disconnect the lubricating oil supply line from the engine block.

Disconnect the AFC line from the injection pump and intake manifold.

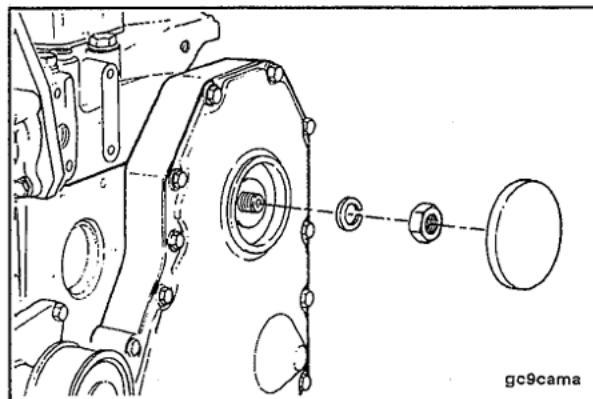
Disconnect the oil latchout line from the injection pump.

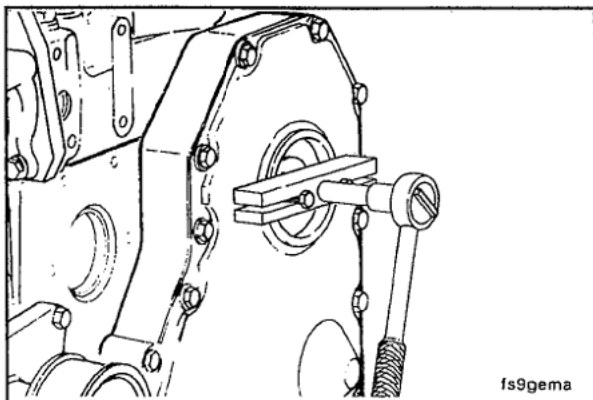


27 mm

Remove the gear cover access cap.

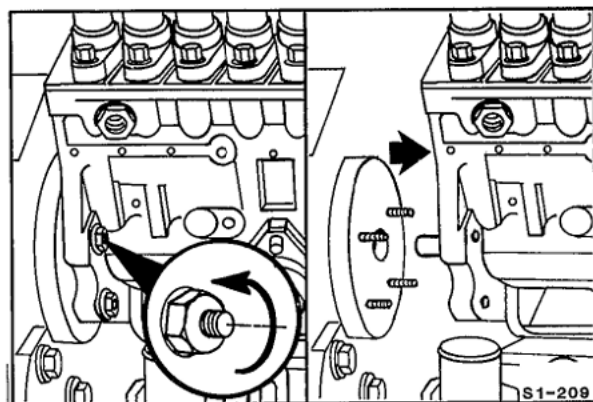
Remove the nut and washer from the fuel pump shaft.





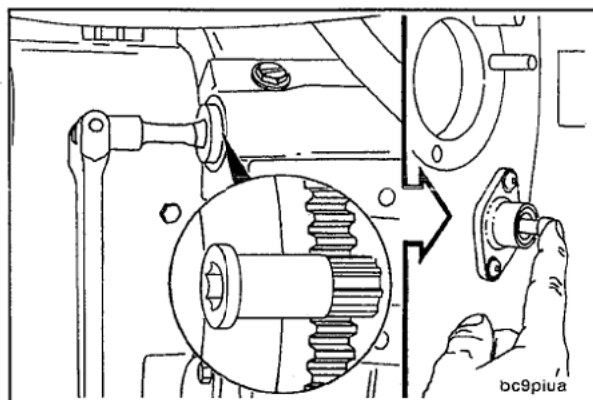
75 mm T-Bar, Two M8 x 1.25 Capscrews

Pull the pump gear loose from the drive shaft.



15 mm Socket, Long Extension

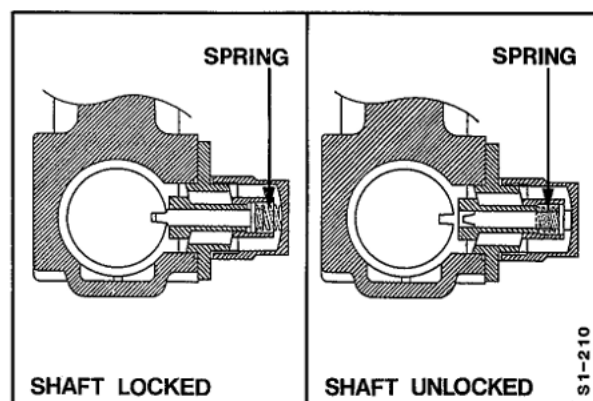
Remove the four mounting nuts and injection pump.



Injection Pump - Installation

Make sure the crankshaft has No. 1 cylinder at Top Dead Center (TDC).

NOTE: The fuel pump drive gear may need to be held in its normal position to allow crankshaft rotation.



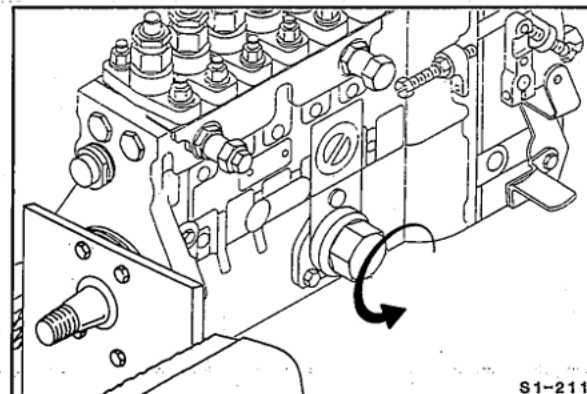
Injection Pump - Timing

The injection pump also has a plastic timing pin and spring located under the cap on the outboard side of the pump. This pin locates the pump shaft to correspond with TDC for cylinder No. 1. After the pump is installed, the spring is placed **under** the head of the timing pin and the cap is installed.

34 mm

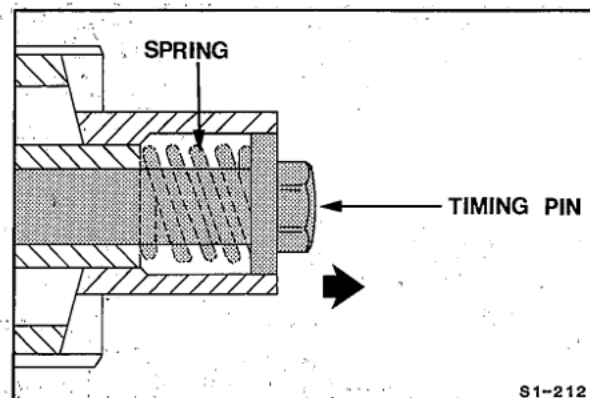
Mount the pump on a suitable bracket.

Remove the cap from the pump locking device. The cap is located on the outboard side of the pump.



S1-211

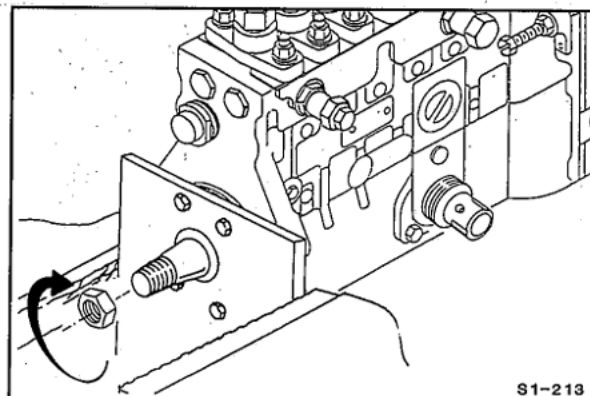
Remove the plastic timing pin and spring.



S1-212

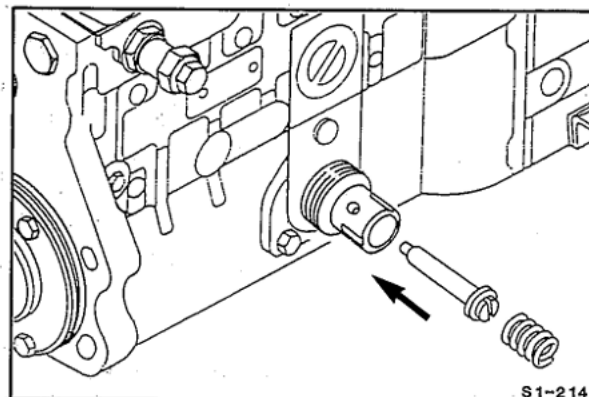
27 mm

Install the nut on the pump shaft.

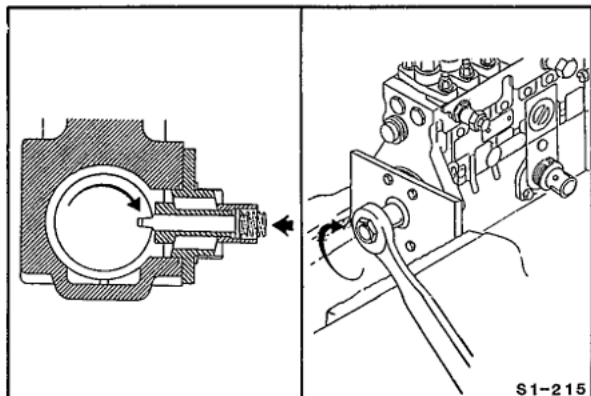


S1-213

Install the timing pin first, then the spring. The tapered end of the pin should be horizontal, to properly match the slot in the pump shaft.



S1-214



27 mm

Depress the spring and rotate the pump shaft until the tip of the timing pin goes into the slot in the pump shaft. The pump shaft is then in the correct position for the crankshaft to have No. 1 piston at TDC.

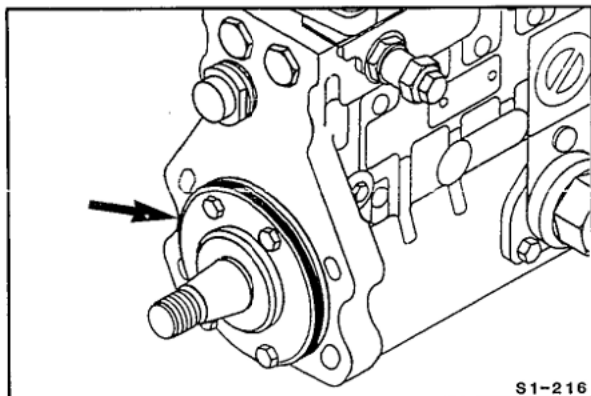


Install the cap loosely.



Remove the nut from the pump shaft.

NOTE: Although unlikely, it is possible that the timing pin will match the pump notch when the timing pin is first inserted. If so, the pump will be locked. Do **not** exert more than 7 N•m [10 ft-lb] torque to turn the pump shaft. If the pump shaft does **not** turn with 7 N•m [10 ft-lb] torque, remove the spring and timing pin, then rotate the pump slightly. Repeat the previous step again.



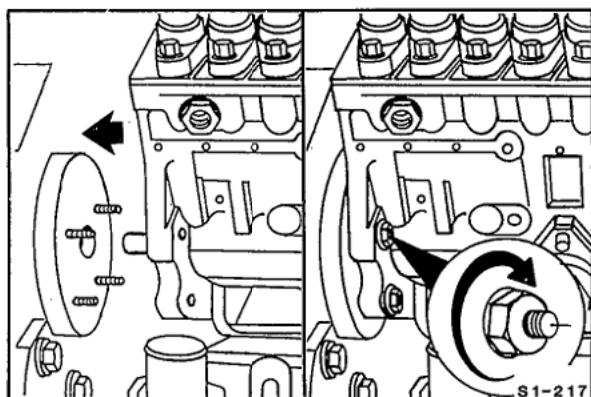
Make sure the o-ring seal for the pilot is correctly installed.



Use clean 15W-40 engine oil to lubricate the mounting flange and o-ring seal.

The pump shaft taper **must** be free of oil or debris.

Replace the o-ring if the original is damaged, loose or swelled.



15 mm

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



Install the mounting nuts.



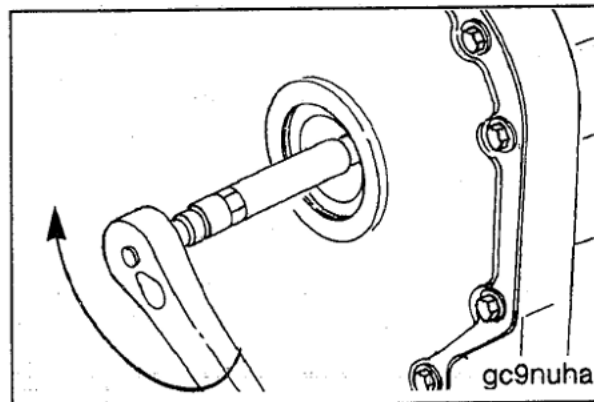
Torque Value: 43 N•m [32 ft-lb]

27 mm

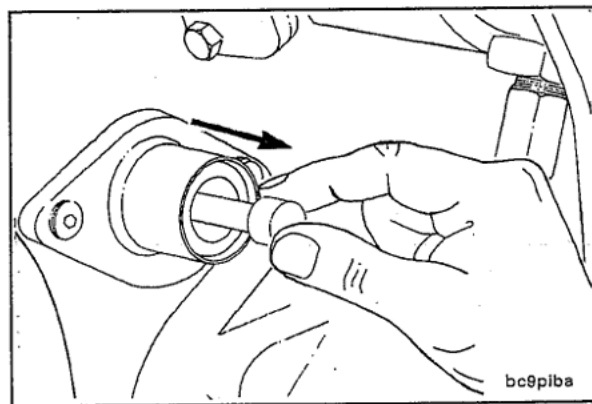
Caution: To prevent damage to the timing pins, do not exceed the torque value given. This is not the final torque value for the retaining nut.

Install the nut and washer.

Torque Value: 10 to 15 N•m [7 to 11 ft-lb]



Disengage the engine timing pin.



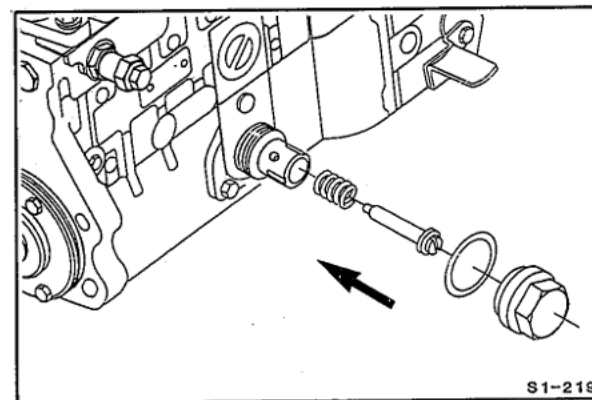
34 mm

Remove the cap from the pump locking device.

Remove the spring and timing pin. Install the spring first, then the timing pin.

Install the copper sealing washer and locking device cap.

Torque Value: 70 N•m [50 ft-lb]



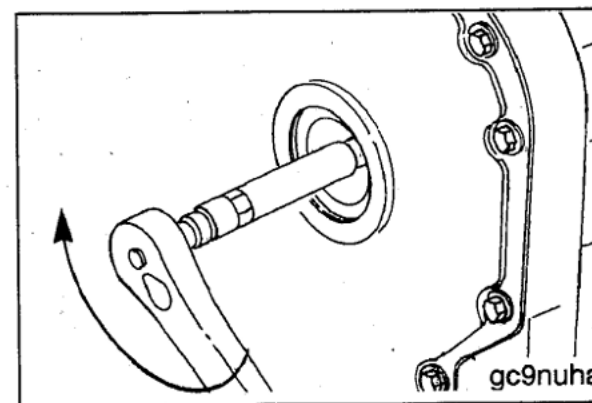
27 mm

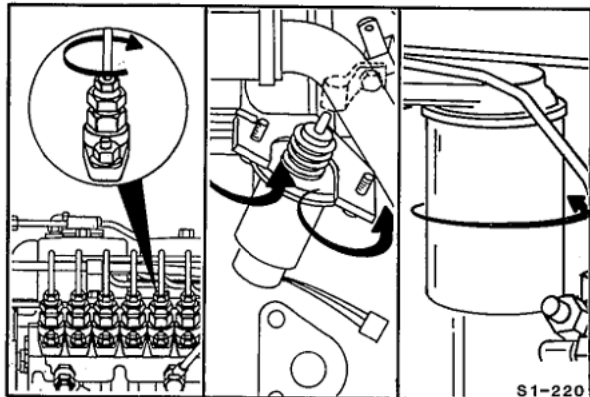
Tighten the fuel pump drive nut.

Torque Value: 123 N•m [92 ft-lb]

Install the gear cover access cap hand tight.

NOTE: If a new or rebuilt pump is installed, it must be prelubed. Refer to page A-72 for these instructions.

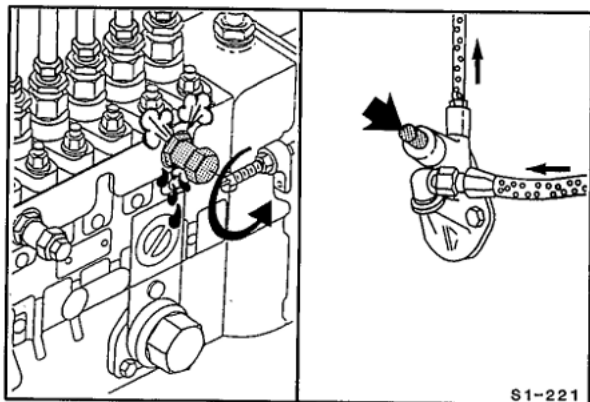




Install the fuel lines, control linkage, fuel shutoff solenoid, fuel filter, AFC line and oil latchout line.

Torque Value:

High Pressure Fuel Lines 30 N•m [22 ft-lb]
Pressure Relief Valve Fitting 15 N•m [11 ft-lb]
Low Pressure Fuel Supply Fitting 15 N•m [11 ft-lb]



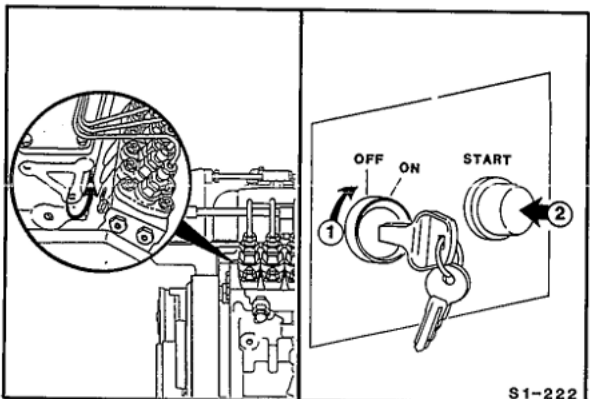
22 mm

Vent the air from the fuel filter and low pressure fuel lines at the pump. Loosen the pump supply line banjo fitting. Manually operate the lift pump until solid fuel appears at the fitting.



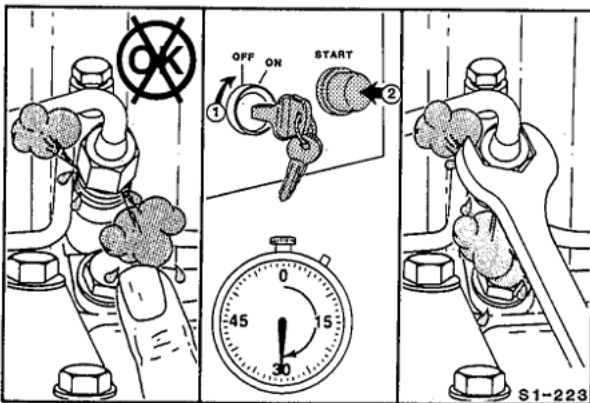
Tighten the pump banjo fitting.

Torque Value: 15 N•m [11 ft-lb]



10 mm

The fuel pump **must** be vented after installation. Loosen the vent screw located near the front on the side nearest to the engine. Place the fuel control in the "RUN" position. Crank the engine so air can vent from the pump, then tighten the vent screw.



High Pressure Lines - Venting

17 mm

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



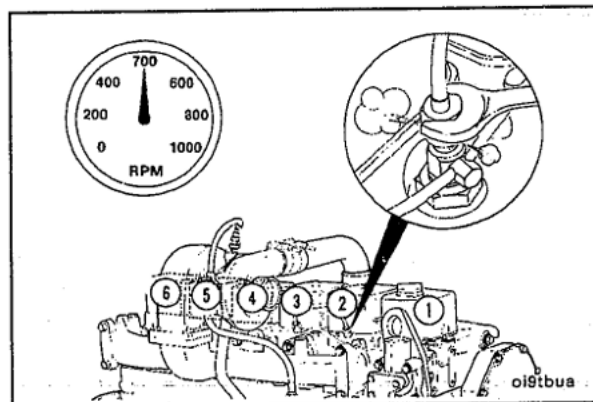
Loosen the fittings at the injectors and crank the engine to allow entrapped air to vent from the lines. Tighten the fittings.



Torque Value: 30 N•m [22 ft-lb]

Warning: Do not vent a hot engine as this can 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.

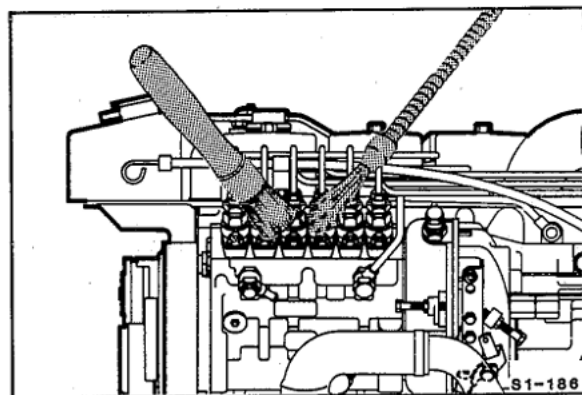


Fuel Injection Pump (Bosch Inline) - Replacement

(CTA Series 300 HP)

NOTE: A diesel engine **cannot** 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 unit.

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.

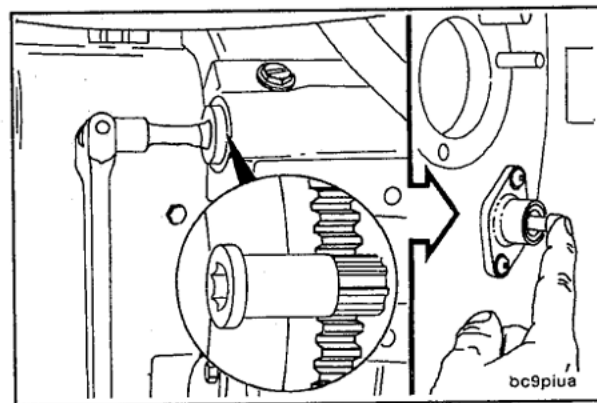


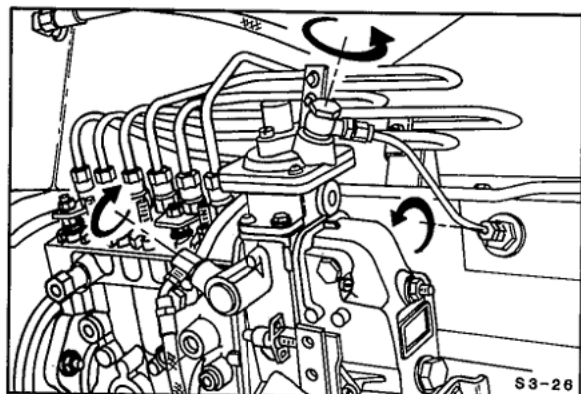
Preparatory Steps:

- Disconnect the battery ground cable.
- Remove all the fuel lines.
- Remove the control linkage.
- Remove the fuel shutoff solenoid.
- Remove the fuel filter.

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

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



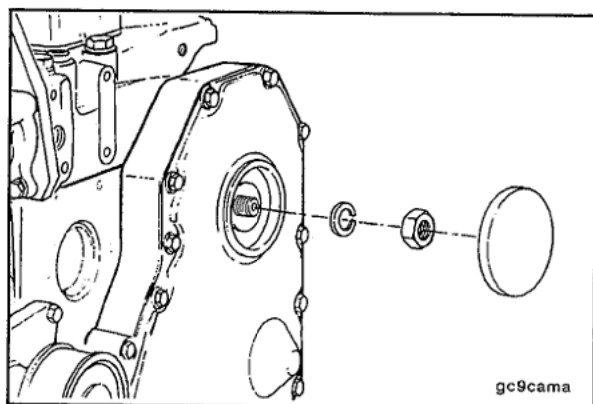


7/16 Inch, Two 1/2 Inch Open End Wrenches

Disconnect the AFC line from the injection pump and intake manifold.



Disconnect the oil latchout line from the injection pump.

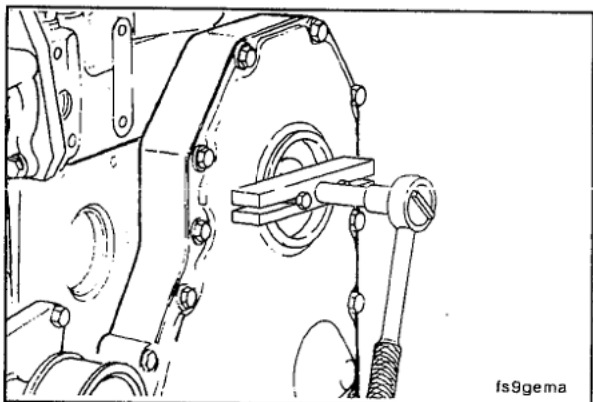


27 mm

Remove the gear cover access cap.

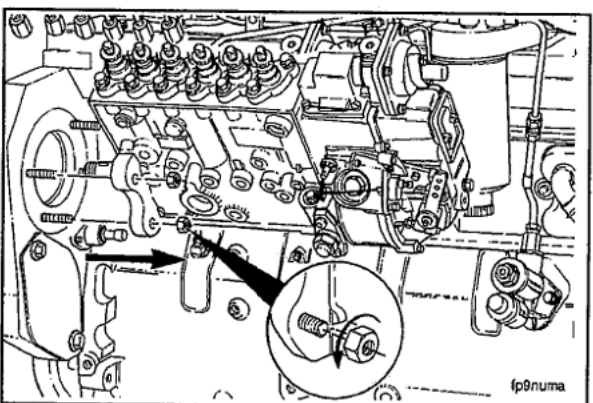


Remove the nut and washer from the fuel pump shaft.



75 mm T-Bar Puller

Pull the fuel pump drive gear loose from the shaft.



15 mm

Remove the four mounting nuts.

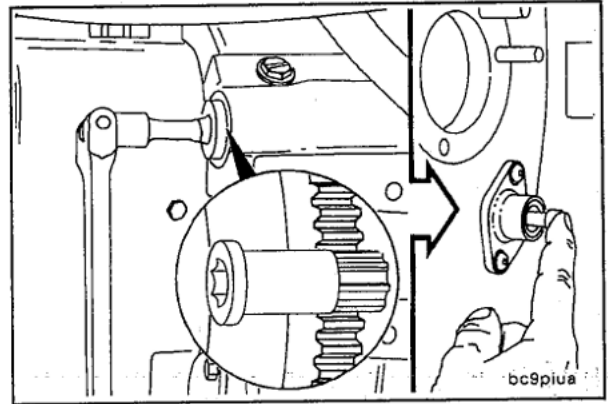


Remove the fuel pump.

Injection Pump - Installation

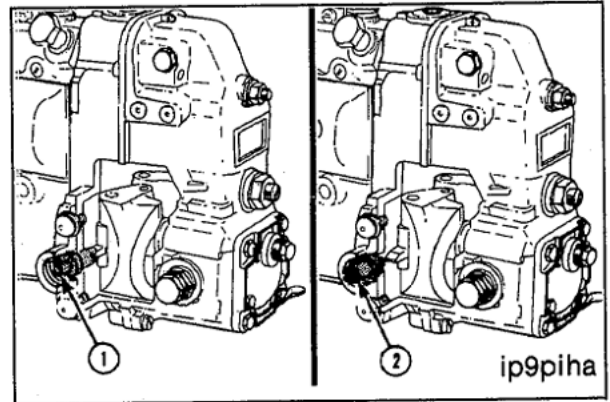
Part No. 3377371 Engine Barring Gear

Caution: Make sure the crankshaft has cylinder No. 1 at TDC.



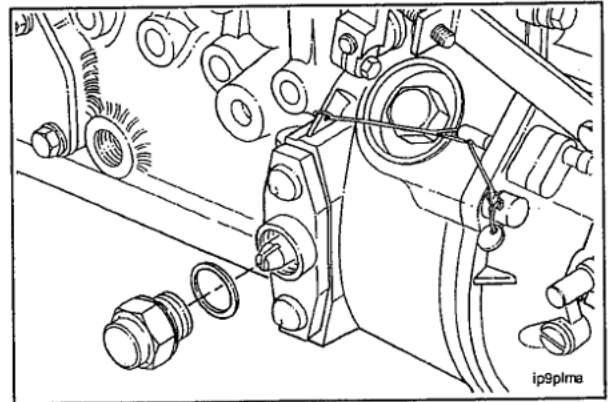
Injection Pump - Timing

The injection pump also has a timing pin (1), located in the governor housing, to position the pump shaft to correspond with TDC for cylinder No. 1. After the pump is installed, the pin is to be reversed and stored in the housing (2).

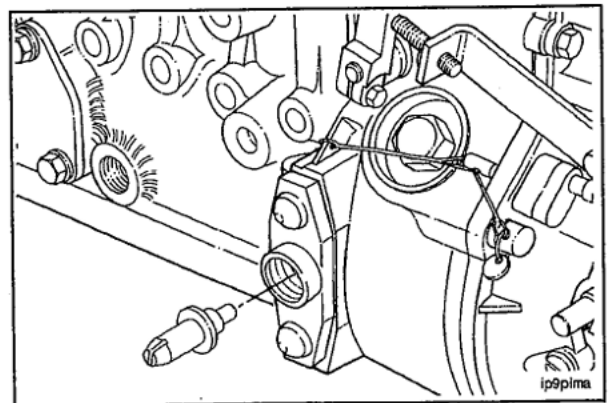


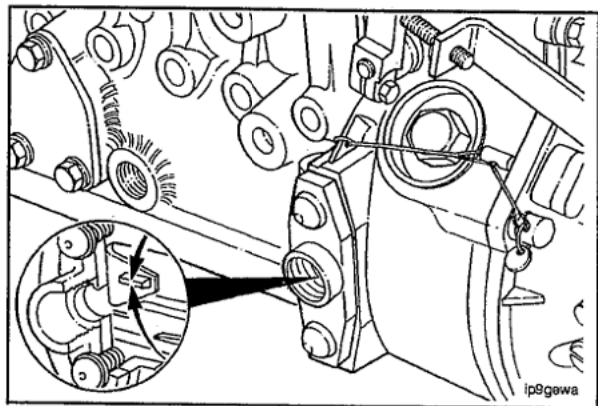
24 mm

Remove the access plug.

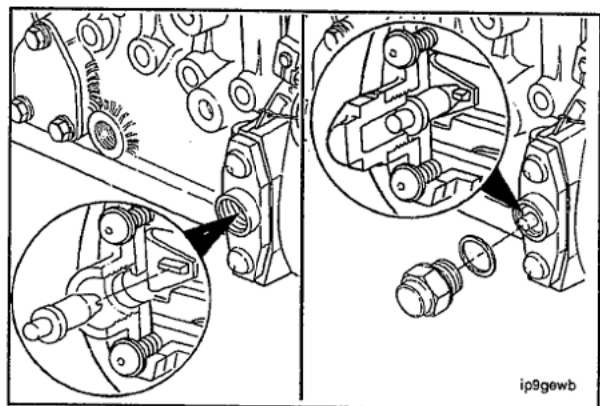


Remove the fuel pump timing pin.



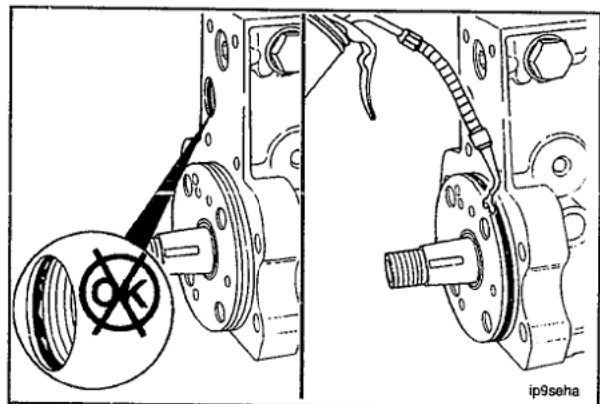


If the timing tooth is **not** aligned with the timing pin hole, rotate the pump shaft until the timing tooth aligns.



Reverse the position of the 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.

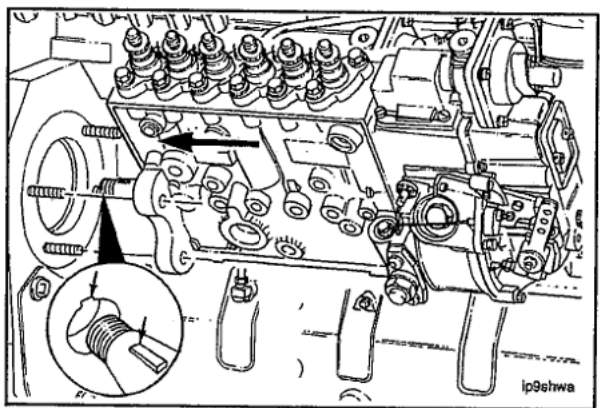


Caution: Make sure the o-ring seals for the fill orifice and pilot are correctly installed and are not damaged.



Install a new o-ring if the original is damaged, loose or swelled.

Use clean 15W-40 oil to lubricate the mounting flange and o-ring seal.

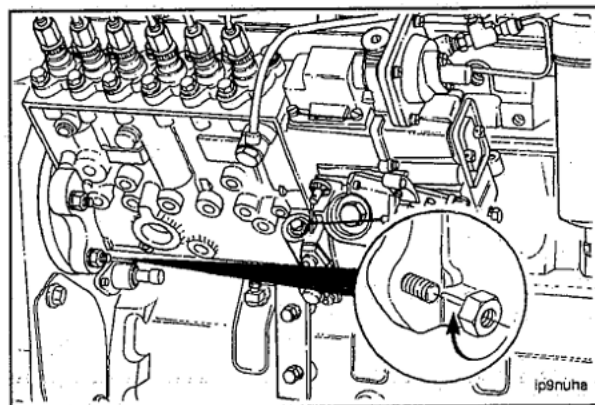


Slide the pump shaft through the drive gear and position the pump flange onto the mounting studs.

15 mm

Install the mounting nuts.

Torque Value: 43 N•m [32 ft-lb]

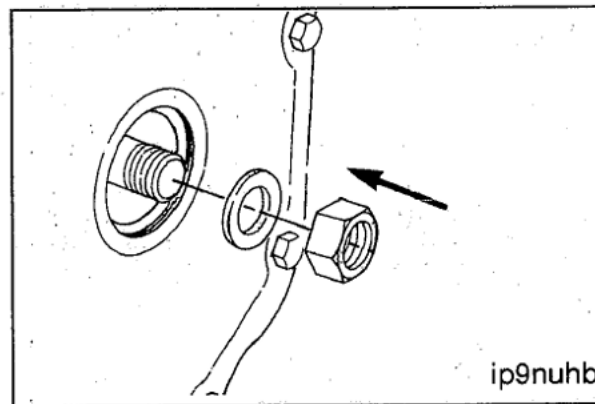


27 mm

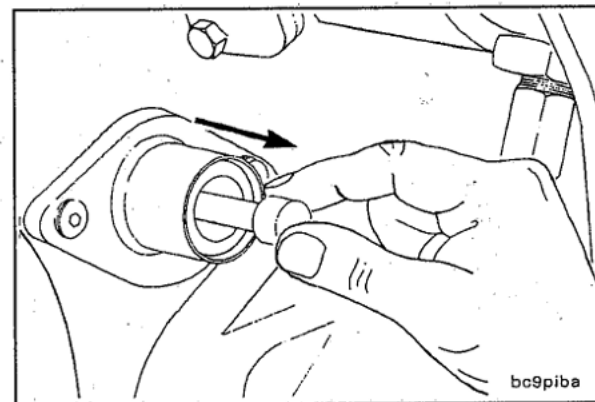
Install the retaining nut and washer.

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

Torque Value: 10 to 15 N•m [7 to 11 ft-lb]



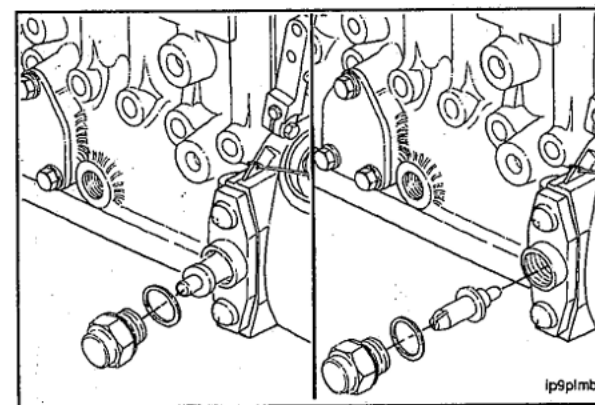
Disengage the engine timing pin.

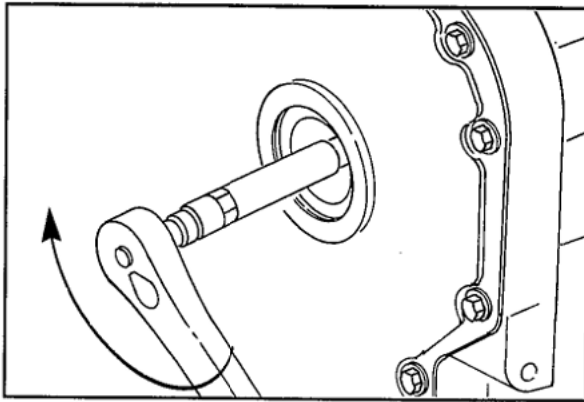


24 mm

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

Torque Value: 15 N•m [11 ft-lb]





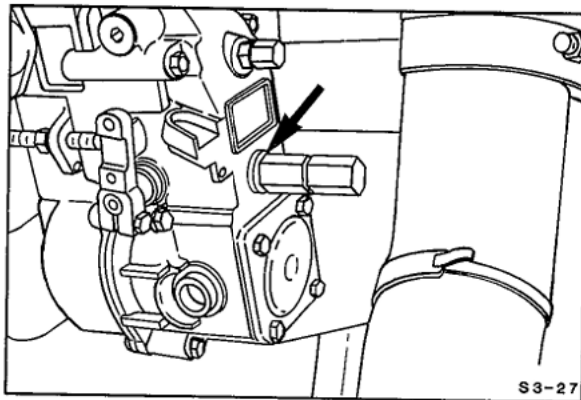
27 mm

Tighten the fuel pump drive nut.

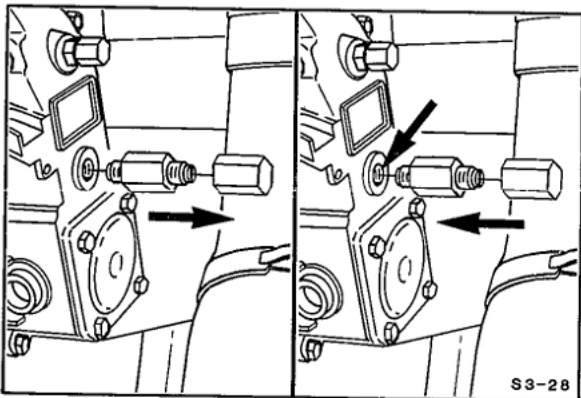


Torque Value: 105 N•m [77 ft-lb]

Install the gear cover access cap hand tight.



Caution: If a replacement or repaired pump is installed, be sure to add engine oil to the governor housing before starting the engine. Failure to do so will result in damage to the governor fly weights. Oil may be added to the RSV governor which has an AFC and oil pressure latchout through the bumper spring locknut hole.



19 mm

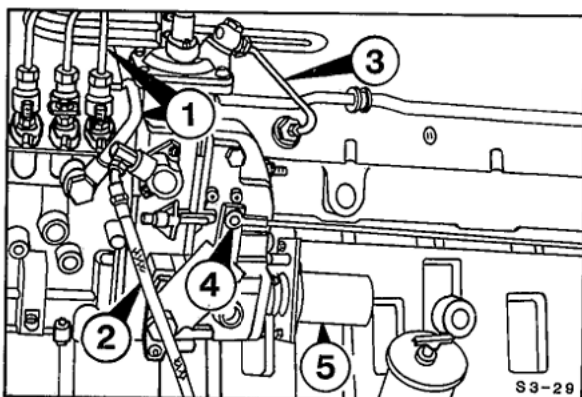
Remove the bumper spring locknut.



Add 750 cc [26 oz.] clean engine oil to fill the governor cavity to the level of the bumper spring locknut hole.



Install the bumper spring locknut and adjusting screw. Tighten the locknut.



Install the fuel lines (1), oil lines (2), AFC line (3), control linkage (4) and fuel shutoff solenoid (5).



Torque Value:

High Pressure Fuel Lines 30 N•m [22 ft-lb]

Pressure Relief Valve Fitting 15 N•m [11 ft-lb]

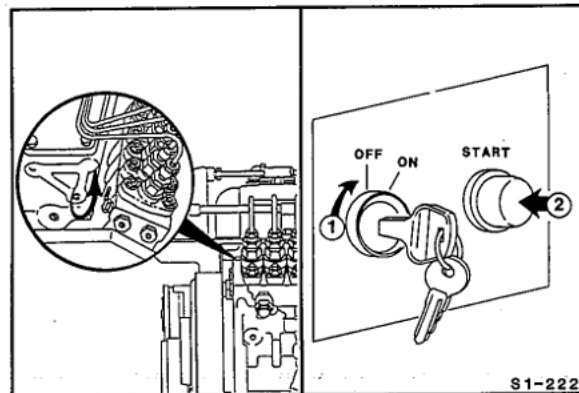
Low Pressure Fuel Supply Fitting 15 N•m [11 ft-lb]

Injection Pump - Venting

10 mm

The pump **must** be vented after installation. Loosen the vent screw located near the front on the side nearest to the engine. Place the fuel control in the "RUN" position. Crank the engine so air can vent from the pump, then tighten the vent screw.

Torque Value: 3 to 5 N•m [26 to 44 in-lb]



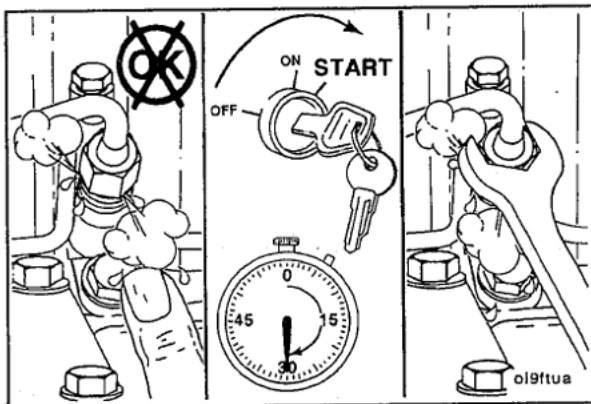
S1-222

17 mm

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

Vent the high pressure fuel lines. Loosen the fitting at the No. 1 injector. Place the switch in the "ON" position. Crank the engine so air can vent from the fuel line, then tighten the fitting.

Torque Value: 30 N•m [22 ft-lb]



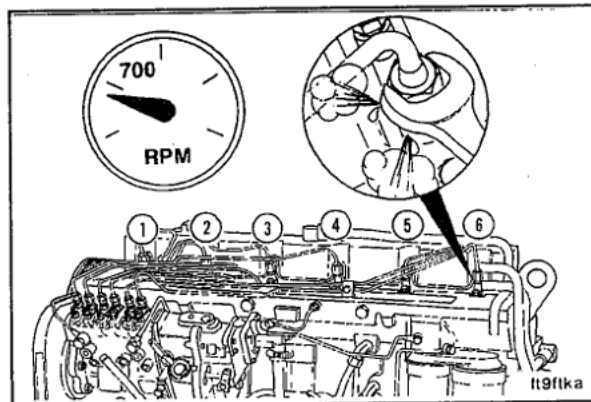
019ftua

17 mm

Loosen the fitting at No. 6 injector next. Place the switch in the "ON" position and crank the engine so that air can vent from the No. 6 fuel line. Tighten the fitting.

Torque Value: 30 N•m [22 ft-lb]

The engine will continue to run on No. 1 and 6 cylinders. Run the engine until it operates smoothly, normally 30 seconds maximum.

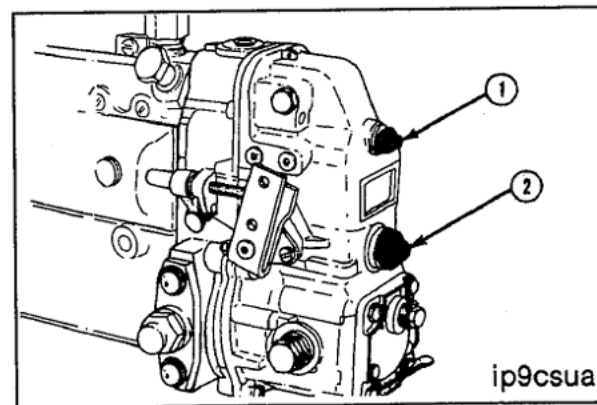


ft9ftka

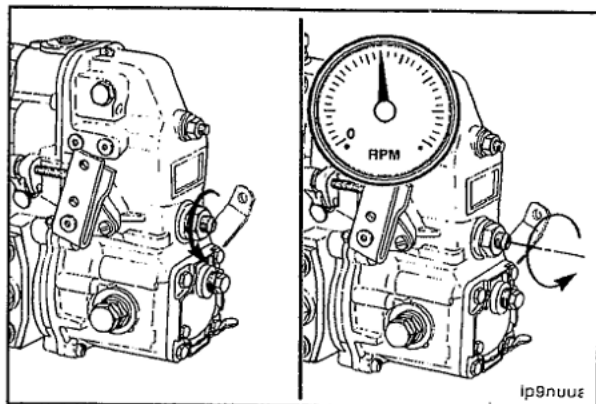
Injection Pump - Idle Speed Adjustment (Inline Pumps)

RSV Governor

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



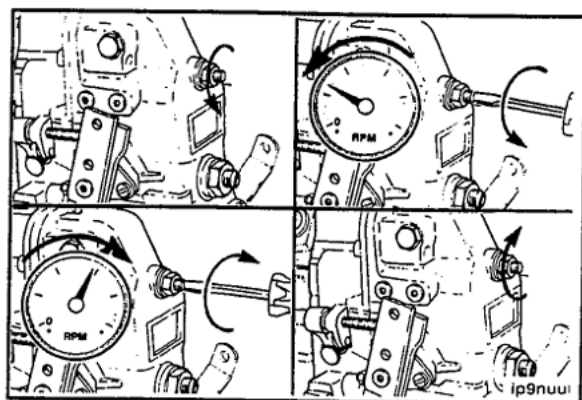
ip9csua



19 mm, Screwdriver and Tachometer

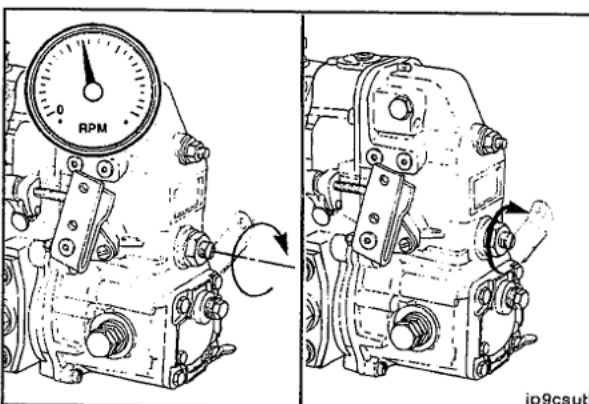
First, loosen the locknut and back out the bumper spring screw until there is no change in engine speed.

NOTE: The speed should drop 25 to 75 RPM as the screw is backed out.



13 mm, Screwdriver and Tachometer

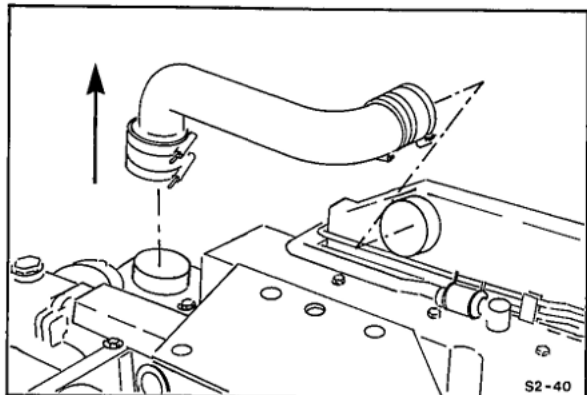
Loosen the locknut and adjust the idle screw to 25 to 75 RPM less than the desired speed. Turn the screw **counterclockwise** to decrease RPM; **clockwise** to increase RPM. Tighten the locknut.



Turn the bumper spring **clockwise** until the desired idle speed is obtained. Tighten the locknut.

Air System Repair Summary

Component To Be Replaced	Tools	Preparatory Steps
Air Crossover Tube	5/16 Inch or Flat Screwdriver, 7/16 Inch	
Intake Manifold Cover and Gasket	10 mm	Remove the high pressure fuel lines. Disconnect the cold starting aid, if used. Remove the air crossover tube.
Aftercooler (Engine Coolant Type) and Gasket	8, 10 mm, 5/16 Inch or Flat Screwdriver	Disconnect the cold starting aid, if used. Remove the high pressure fuel lines. Drain 2 liters [2.1 U.S. quarts] of coolant.
Aftercooler (Raw Water Type)	5/16 Inch or Flat Screwdriver, 7/16, 7/8 Inch, 13 mm	Disconnect the air heater element wires, if equipped.
Turbocharger	10, 13, 15, 16 mm, 5/16 Inch or Flat Screwdriver, 7/16 Inch, 1-1/4 Inch Punch, Hammer	Shut off the raw water inlet valve. Drain the raw water system. Drain at least 7.6 liters [2 U.S. gallons] of engine coolant. Disconnect the intake and exhaust piping.
Exhaust Manifold Cover Gasket	5/16 Inch or Flat Screwdriver. 9/16 Inch Open End, 13 mm, Plastic Hammer	
Exhaust Manifold or Gasket	16 mm Socket (B Series), 13 mm (C Series)	Drain the raw water system. Drain the engine cooling system. Remove the heat exchanger. Remove the turbocharger. Remove the exhaust manifold cover (manifold replacement only).



Air System Replacement Procedures

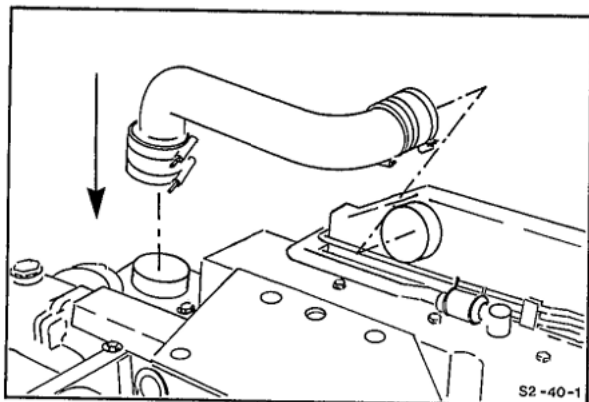
Air Crossover Tube - Replacement



5/16 Inch or Flat Screwdriver, 7/16 Inch



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



5/6 Inch or Flat Screwdriver, 7/16 Inch



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

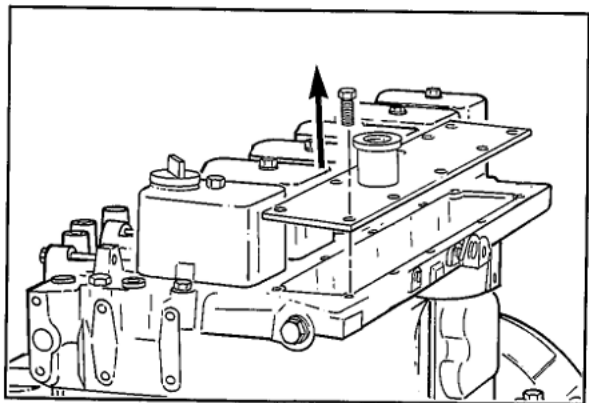


Torque Values: T-bolt type 8 N•m [71 in-lb]
Worm type 5 N•m [44 in-lb]

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.



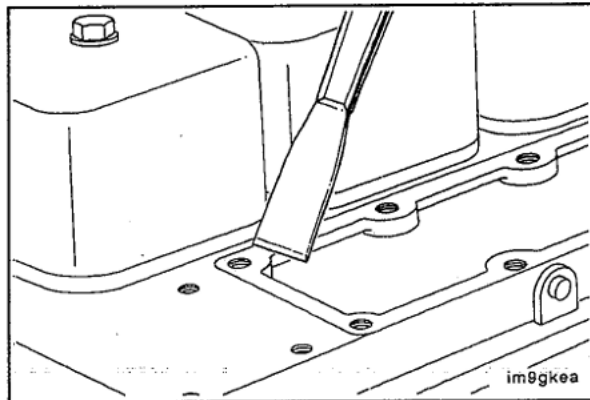
10 mm



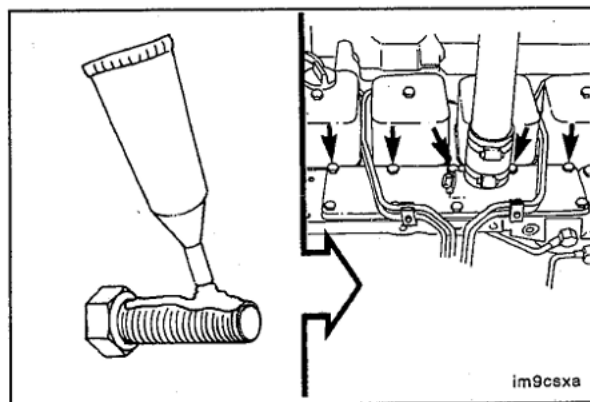
Remove the manifold cover and gasket.

Clean the sealing surface.

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



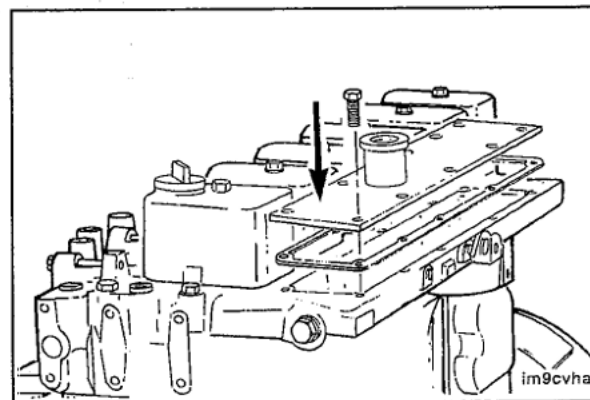
NOTE: The holes shown in the illustration are drilled through and **must** be sealed by applying liquid teflon sealant to the capscrews.



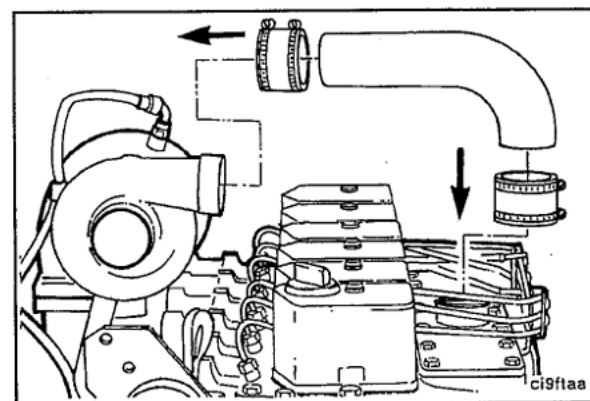
10 mm

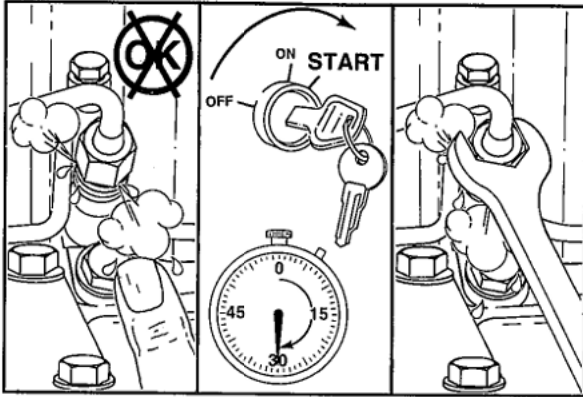
Install a new gasket and the cover.

Torque Value: 24 N•m [18 ft-lb]



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



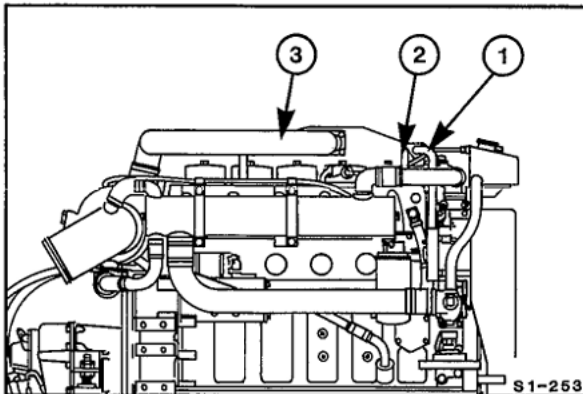


Install and vent the high pressure fuel lines.

Aftercooler and Gasket (Engine Coolant Type) - Replacement

Preparatory Steps:

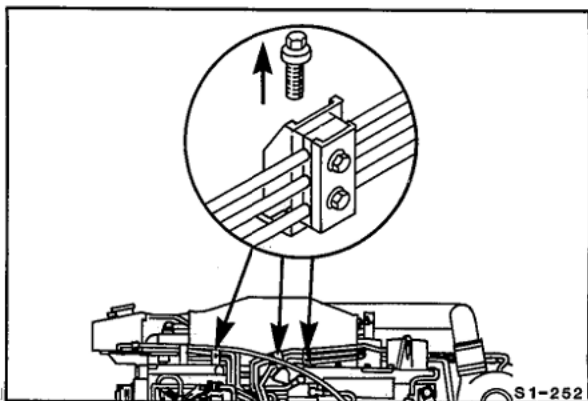
- Disconnect the cold starting aid, if used.
- Remove the high pressure fuel lines.
- Drain 2 liters [2.1 U.S. quarts] of coolant.



8 mm



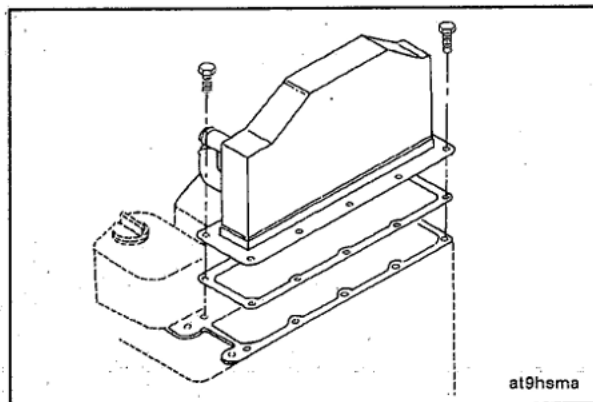
Remove the coolant supply tube (1), the coolant return tube (2), and the air crossover tube (3). This picture shows a B Series engine. The C Series coolant lines are on the rear of the aftercooler instead of the front as shown here.



Remove the high pressure fuel lines. Refer to Section A - Fuel System Replacement Procedures.

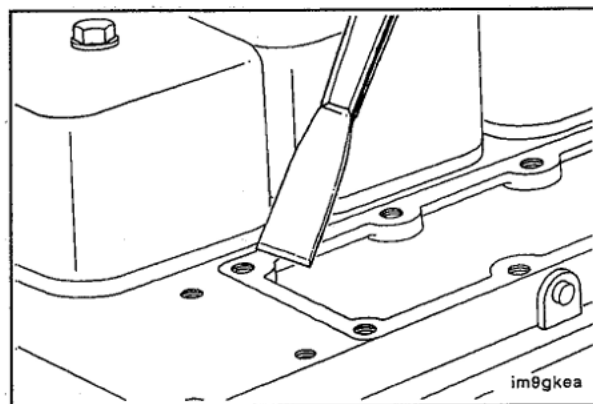
10 mm

Remove the aftercooler housing and gasket.



Clean the sealing surface.

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

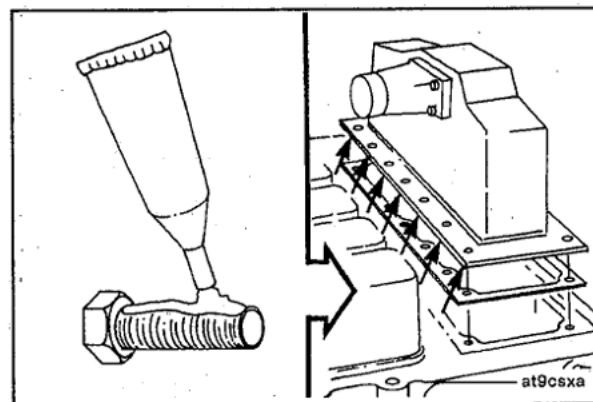


10 mm

NOTE: The holes shown in the illustration are drilled through, and are open to the intake manifold, which is integral to the head.. Apply liquid teflon sealant to the capscrews.

Install the aftercooler housing and a new gasket.

Torque Value: 24 N•m [18 ft-lb]

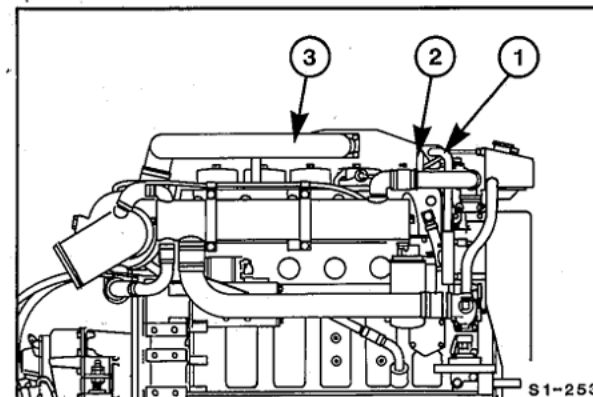


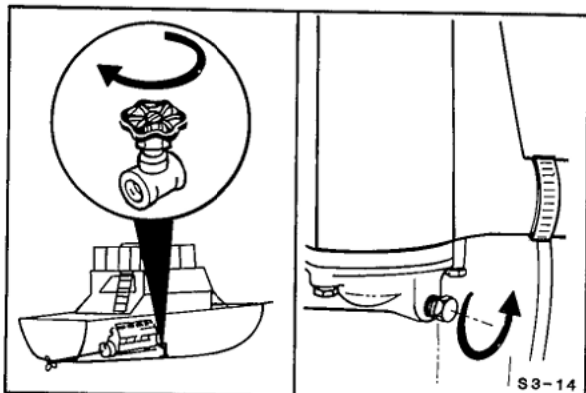
5/16 Inch or Flat Screwdriver

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

Install and vent the high pressure fuel lines.

Torque Values: T-bolt type 8 N•m [71 in-lb]
Worm type 5 N•m [44 in-lb]





7/8 Inch

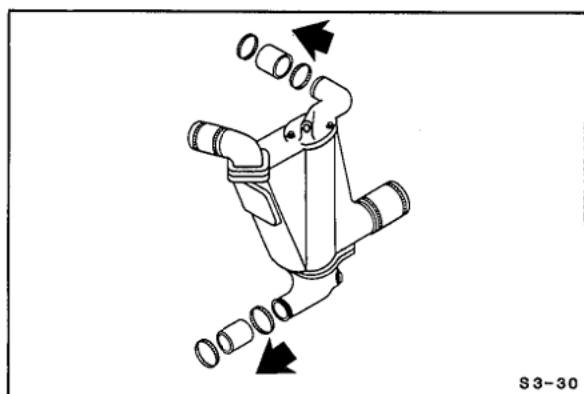
Close the raw water inlet valve.



Remove the zinc plug from the aftercooler lower water header to drain the raw water system.

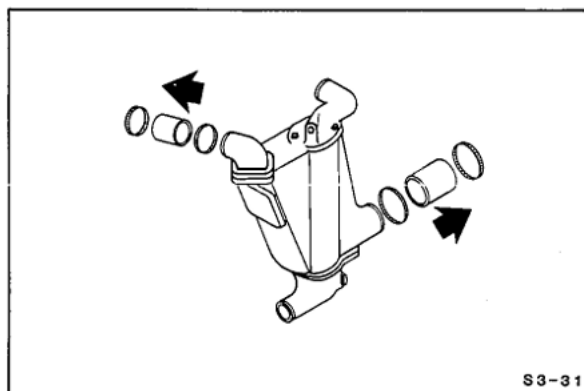
Preparatory Steps:

- Disconnect the air heater element wires, if equipped.



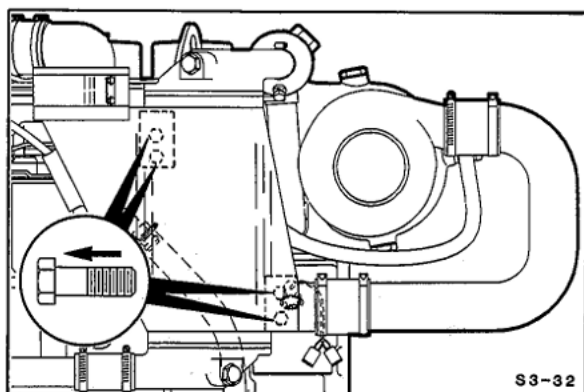
5/16 or Flat Screwdriver

Loosen the raw water hose clamps and remove the raw water transfer hose couplings from the aftercooler.



7/16 Inch

Loosen the T-bolt clamps on the aftercooler air inlet and air outlet hose couplings. Remove the hose couplings from the aftercooler.



13 mm

Remove the two hex head flange capscrews which hold the cast aftercooler to the flywheel housing bracket and the two which hold the aftercooler to the intake manifold bracket.

Remove the aftercooler.

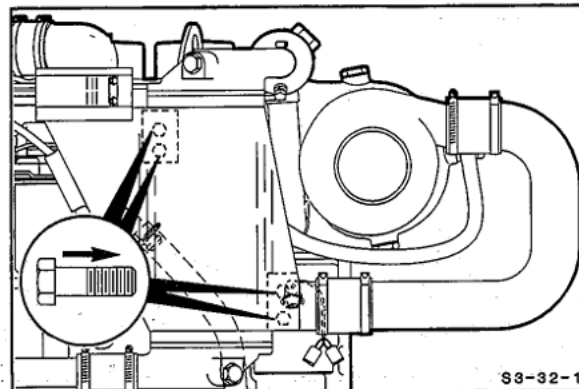


13 mm

Install the two capscrews which hold the cast aftercooler to the intake manifold bracket.

Install the two capscrews which hold the cast aftercooler to the flywheel housing bracket.

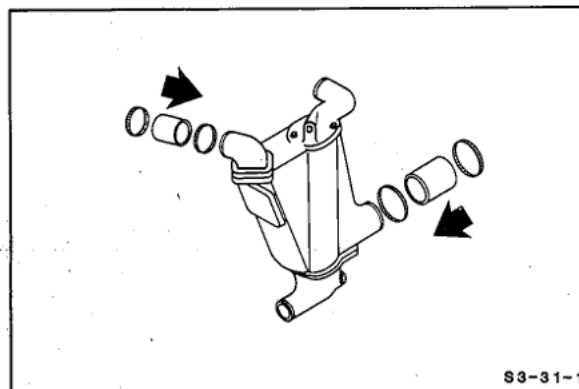
Torque Value: 30 N•m [22 ft-lb]



7/16 Inch

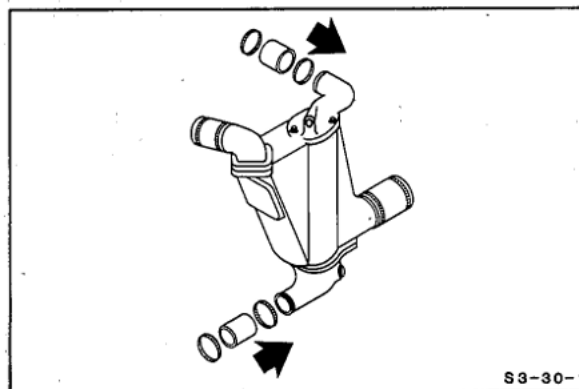
Install the air inlet and air outlet hose couplings on the aftercooler. Tighten the T-bolt clamps.

Torque Values: T-bolt type 8 N•m [71 in-lb]
Worm type 5 N•m [44 in-lb]



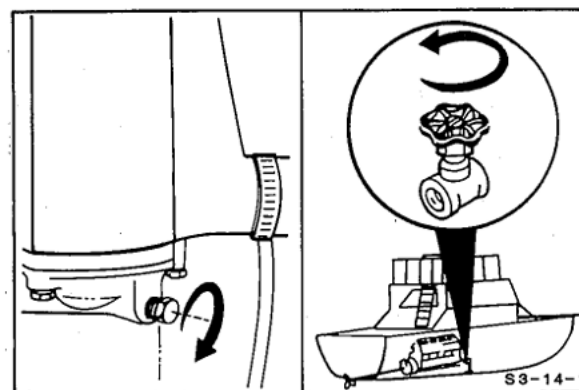
5/16 Inch or Flat Screwdriver

Install the raw water transfer tube couplings on the aftercooler.



7/8 Inch

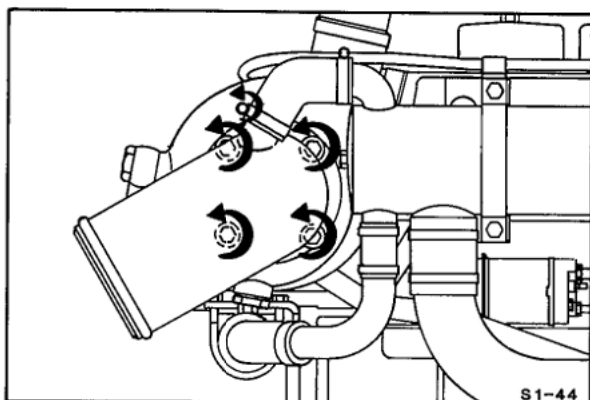
Install the zinc plug in the aftercooler lower water header.
Open the raw water inlet valve.



Turbocharger - Replacement

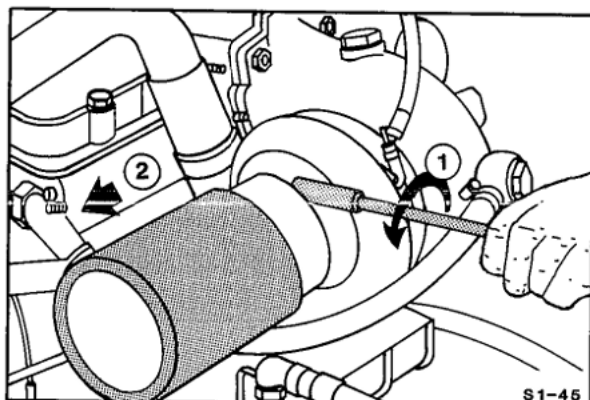
Preparatory Steps:

- Shut off the raw water inlet valve.
- Drain the raw water system.
- Drain at least 7.6 liters [2 U.S. gallons] of engine coolant.
- Disconnect the intake and the exhaust piping.



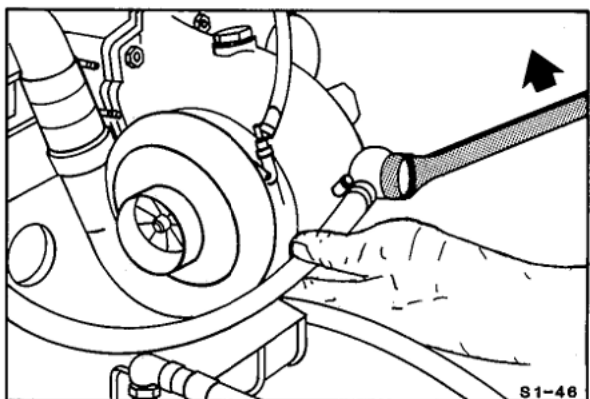
10 mm, 5/16 Inch Nutdriver or Screwdriver

Loosen the clamps and remove the exhaust outlet connection.



7/16 Inch

Remove the air filter.



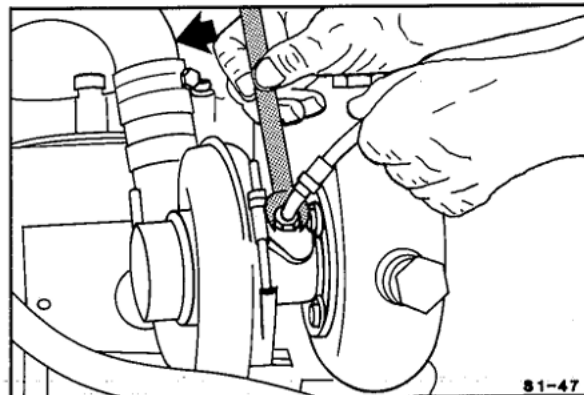
1-1/4 Inch

Disconnect the turbocharger water supply hose.



16 mm

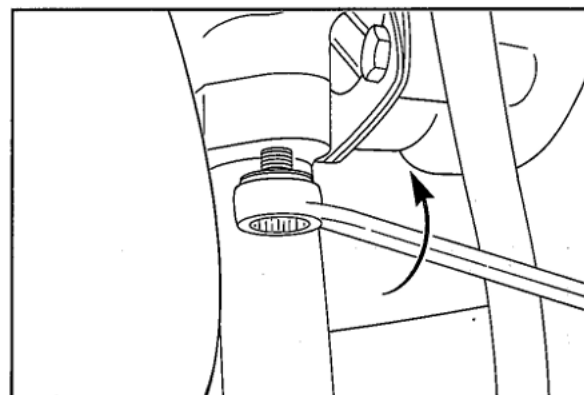
Disconnect the turbocharger oil supply hose.



S1-47

10 mm

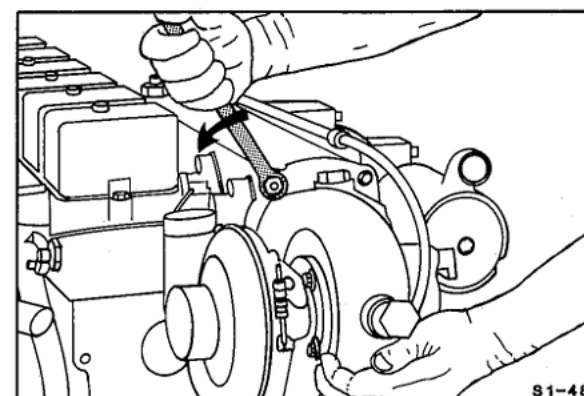
Remove the two capscrews from the oil drain fitting.



15 mm

Remove the four mounting nuts.

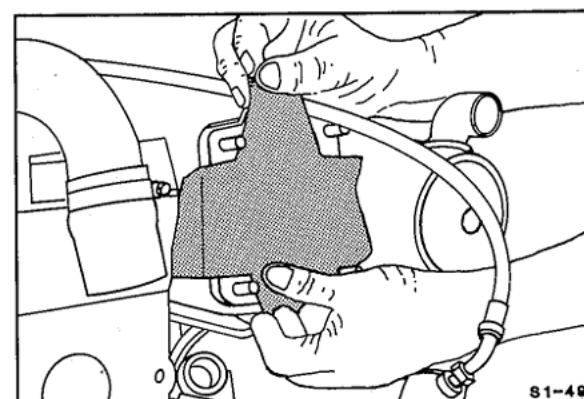
Caution: When removing the turbocharger, a minimum amount of coolant can still be in the turbocharger. Be careful not to let the coolant drain into the turbocharger oil drain tube.



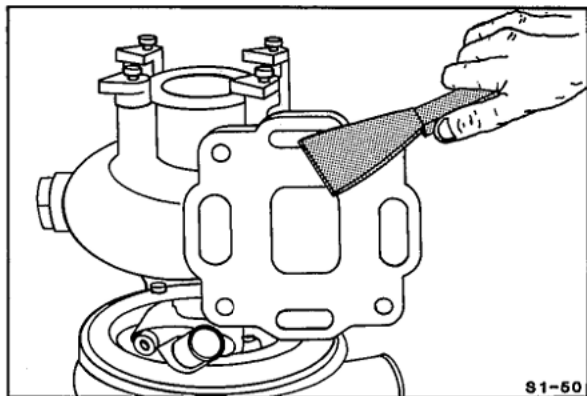
S1-48

Caution: Cover the opening to prevent material from falling into the manifold.

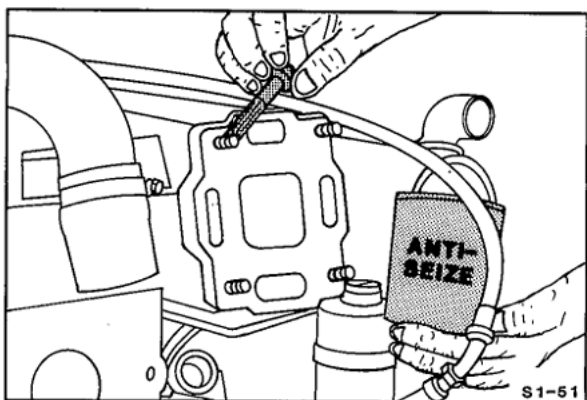
Clean and inspect the sealing surfaces.



S1-49



If the turbocharger is to be used again, clean the sealing surfaces. A cleaning solvent is also necessary to remove any oil or coolant on the turbocharger and manifold gasket surfaces. Also clean the exhaust elbow mating surface.

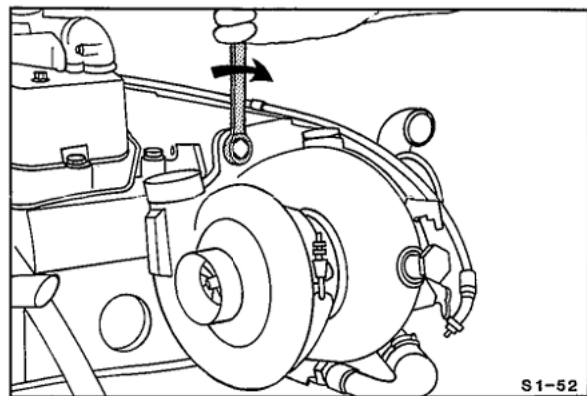


Install a new gasket.

Apply anti-seize compound to the mounting stud threads.

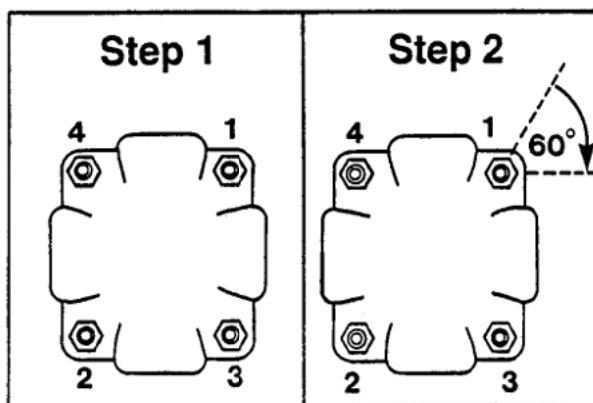


NOTE: Gasket can be installed improperly by 90 degrees. Match the hole sizes of the gasket to the same in the exhaust manifold.



15 mm

Install the turbocharger.



Step 1

Torque the turbocharger mounting nuts in the sequence shown.



Torque Value: 43 N•m [32 ft-lb]



After the engine has been made ready for starting, run until operating temperature is achieved, then shut the engine off.

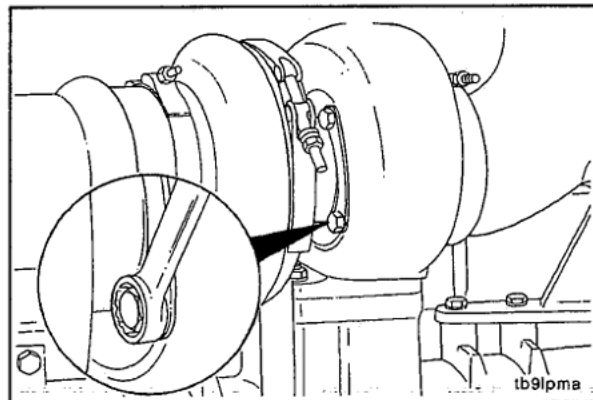
Step 2

Tighten each nut an additional flat (60 degrees/43 N•m) rotation.

Operate the engine and check for leaks.

13 mm

Installing a new or rebuilt turbocharger can require loosening the turbine housing capscrews to position the bearing housing to connect the turbocharger drain tube.

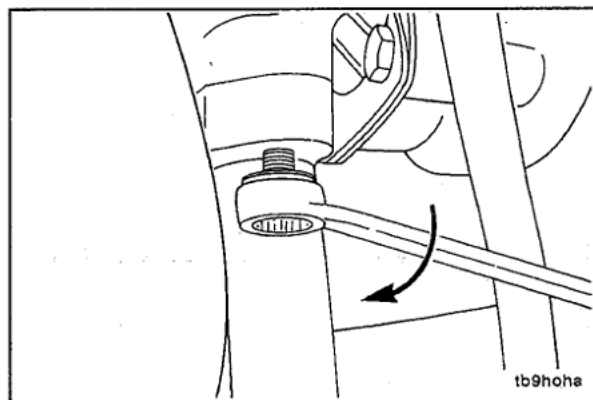


10 mm

Use a new gasket and install the turbocharger oil drain connection.

Tighten the capscrews.

Torque Value: 24 N•m [18 ft-lb]

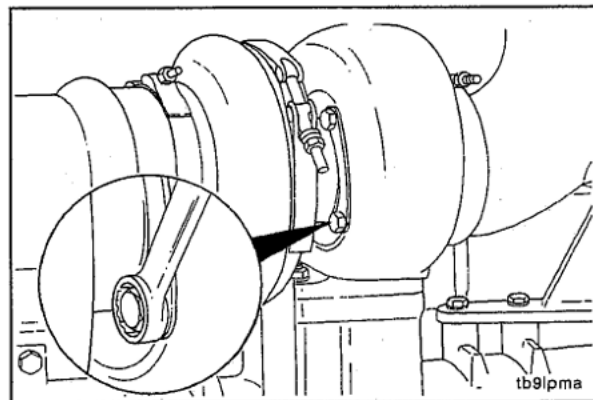


13 mm

If loosened, tighten the turbine housing capscrews.

Torque Value: 11.3 N•m [100 in-lb]

Bend the lockplate tabs against the capscrew heads to prevent loosening.

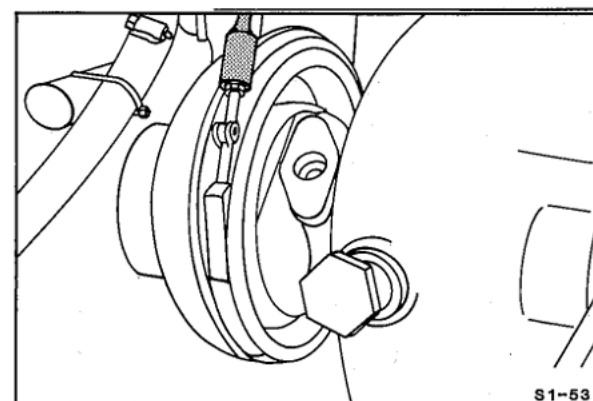


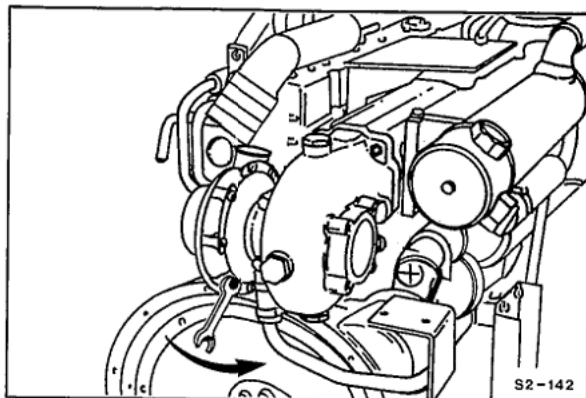
7/16 Inch - B Series Only

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

Tighten the clamp.

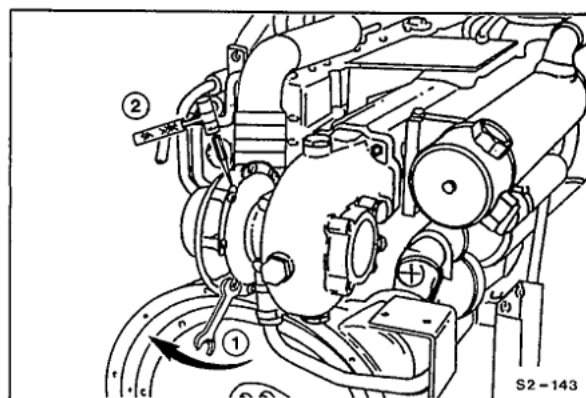
Torque Value: 5.7 N•m [50 in-lb]





10 mm - C Series Only

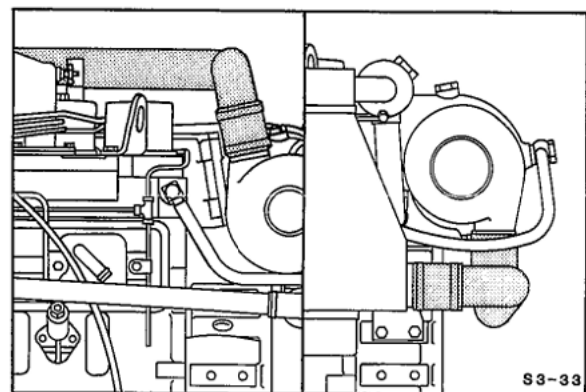
If the compressor housing air outlet does **not** align with the air crossover tube, bend the compressor housing lockplates back and loosen the compressor housing cap-screws. Position the compressor housing outlet to align with the air crossover tube.



10 mm, Punch, Hammer - CTA Series Only

If loosened, tighten the compressor housing cap screws (1). Bend the lockplates into the flats to prevent loosening (2).

Torque Value: 11 N•m [97 in-lb]

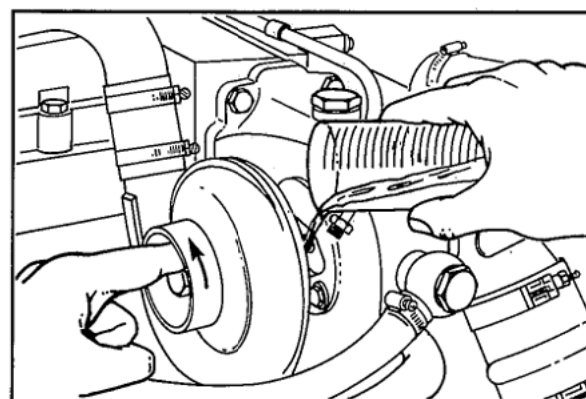


5/16 Inch Nutdriver or Screwdriver

Install the air tube on the turbocharger compressor.

Tighten the clamps.

Torque Values: T-bolt type 5 N•m [44 in-lb]
 Worm type 8 N•m [71 in-lb]



Caution: New or rebuilt turbochargers must be lubricated before engine start up.

Pour 55 to 85 cc [2 to 3 U.S. ounces] of clean 15W-40 oil into the supply fitting.

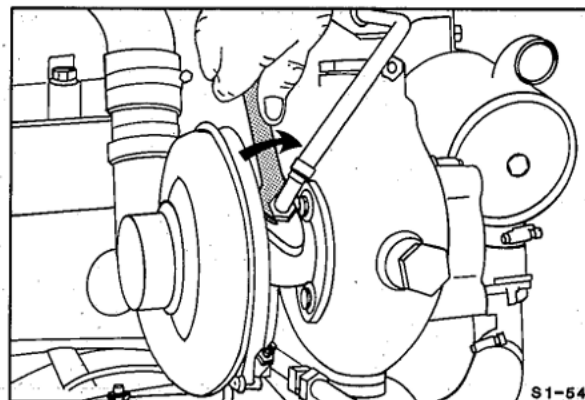
NOTE: Rotate the turbine wheel to allow the oil to enter the turbocharger.

16 mm

Connect the oil supply line.

Tighten the fitting.

Torque Value: 15 N•m [11 ft-lb]



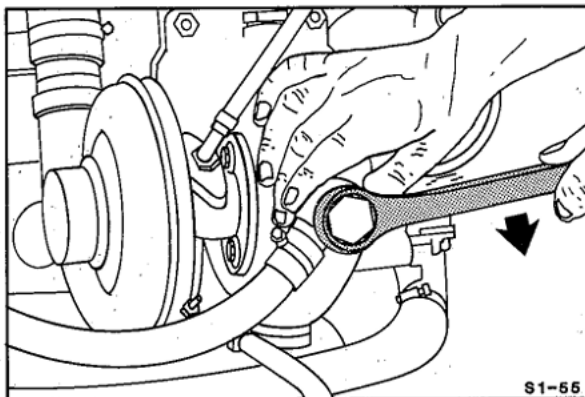
S1-54

1-1/4 Inch

Connect the water supply line.

New copper sealing washers may be necessary if leakage occurs at this connection.

Torque Value: 66 N•m [49 ft-lb]



S1-55

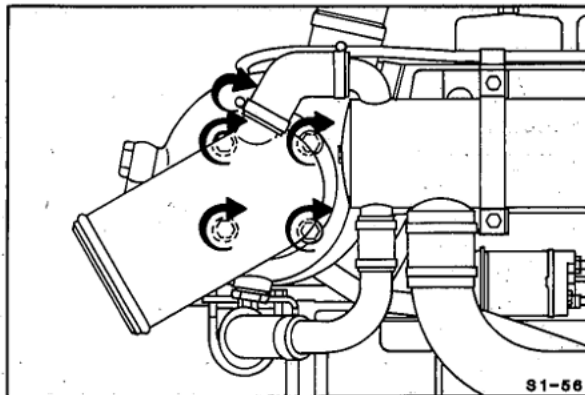
10 mm, 5/16 Inch Nutdriver or Screwdriver

Install the exhaust outlet connection.

Torque Values:

Exhaust elbow capscrews 24 N•m [18 ft-lb]

Hose clamps 5 N•m [44 in-lb]

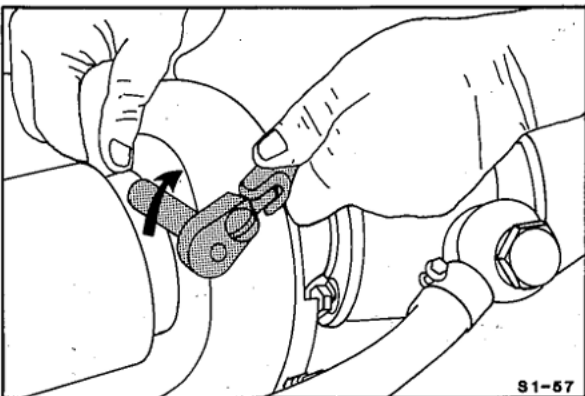


S1-56

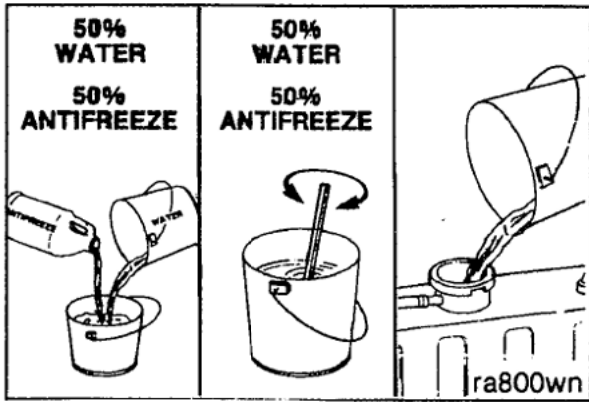
7/16 Inch

Install the air cleaner.

Torque Values: T-bolt type 8 N•m [71 in-lb]
Worm type 5 N•m [44 in-lb]

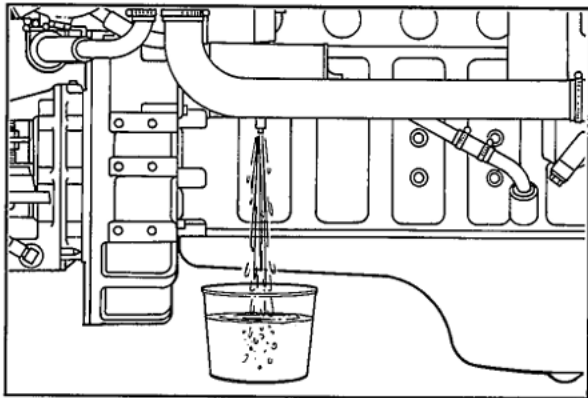


S1-57



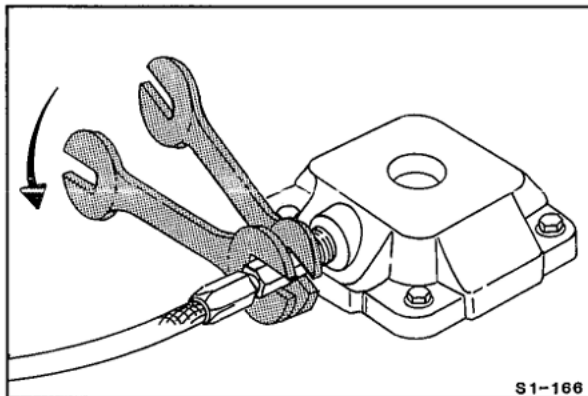
Fill the coolant system. Refer to Section 7 for coolant system filling and bleeding instructions.

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



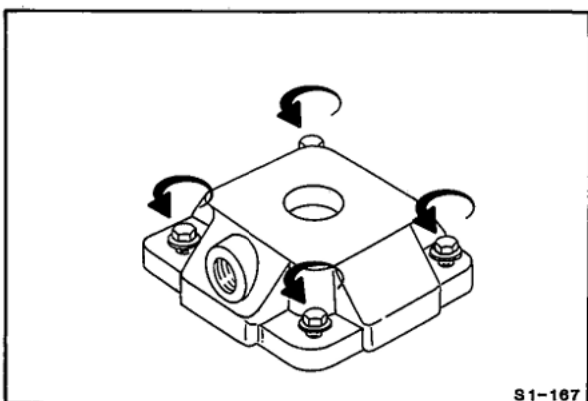
Exhaust Manifold Cover Gasket - Replacement

Drain at least 7.57 liters [2 U.S. gallons] of coolant.



9/16, 5/16 Inch or Screwdriver

Disconnect the vent line from the cover.



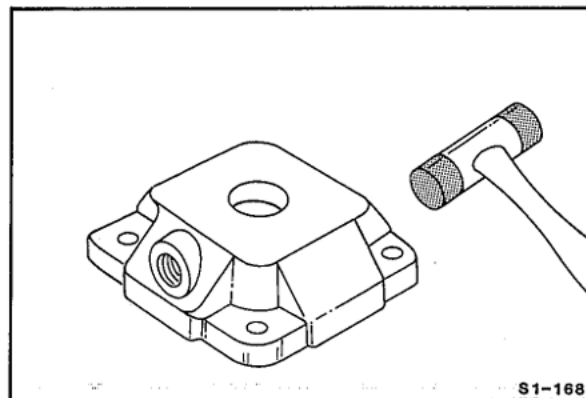
13 mm

Remove the flange head capscrews.



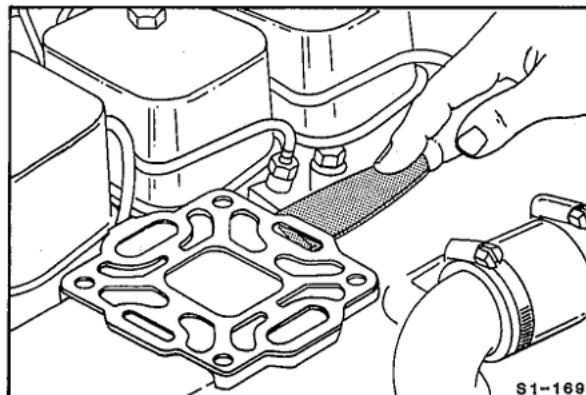
Plastic Hammer

Remove the cover.



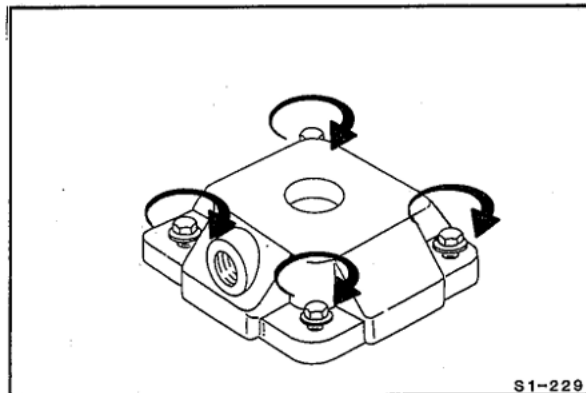
Caution: Do not allow any gasket material or debris to fall into the exhaust or coolant ports of the manifold when cleaning.

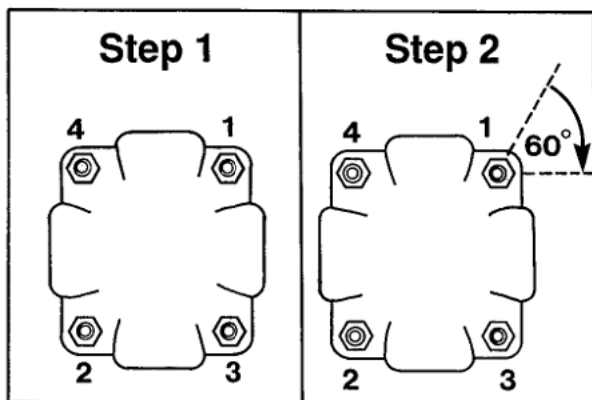
Clean the gasket from the cover and exhaust manifold.



13 mm

Use a new gasket and install the cover and capscrews.
Tighten the capscrews.





13 mm

Tighten the capscrews.



Step 1

Torque the capscrews in the sequence shown.



Torque Value: 43 N•m [32 ft-lb]

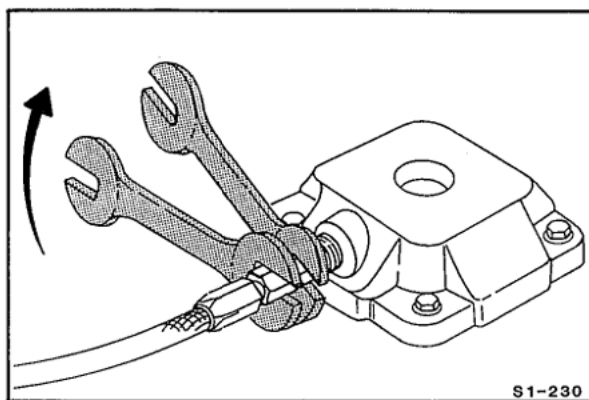


Start the engine and run until operating temperature is achieved, then shut off the engine.

Step 2

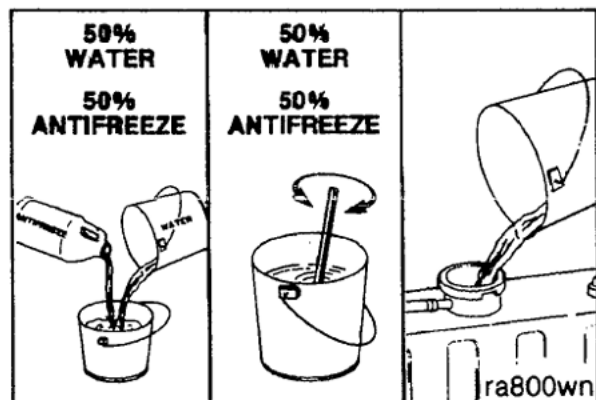
Tighten each capscrew an additional flat (60 degrees).

Operate the engine and check for leaks.



9/16, 5/16 Inch or Screwdriver

Connect the vent line.



Fill the cooling system. Refer to Section 7.

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

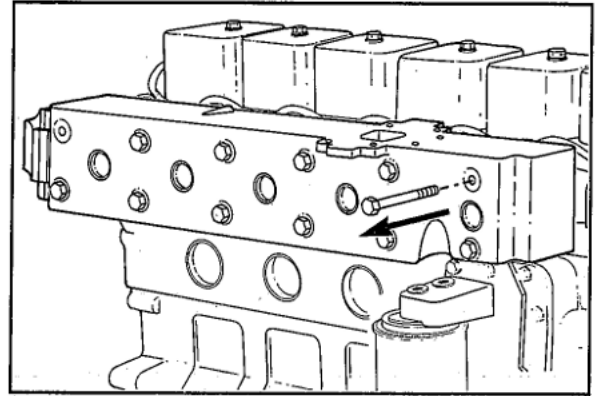
Exhaust Manifold or Gasket - Checking/Replacement

Preparatory Steps:

- Disconnect the battery ground cable.
- Drain the raw water system.
- Drain the engine cooling system.
- Remove the heat exchanger.
- Remove the exhaust manifold cover (manifold replacement only).
- Remove the turbocharger.

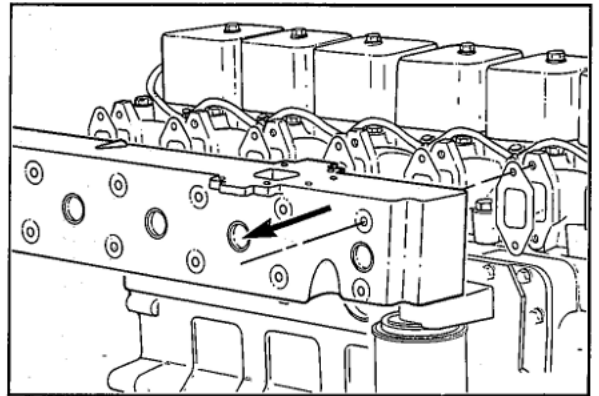
16 mm Socket (B Series), 13 mm (C Series)

Remove the mounting capscrews.

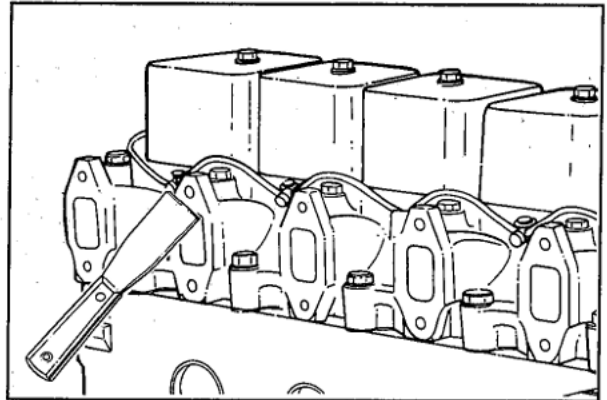


Warning: Because the exhaust manifold weighs more than 23 Kg [50 lb], two people or a hoist will be required to lift it to avoid personal injury.

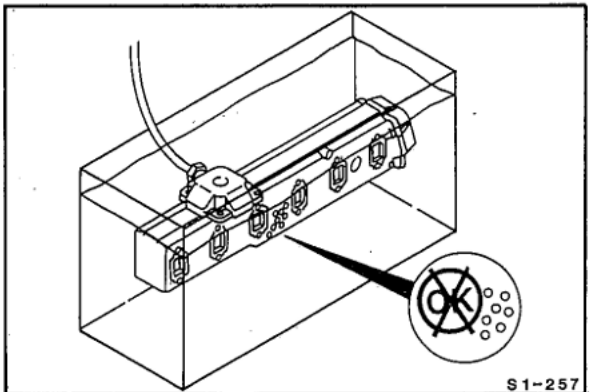
Remove the manifold.

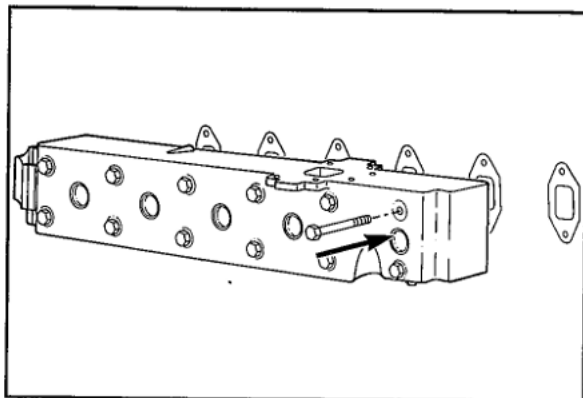


Clean the sealing surfaces.

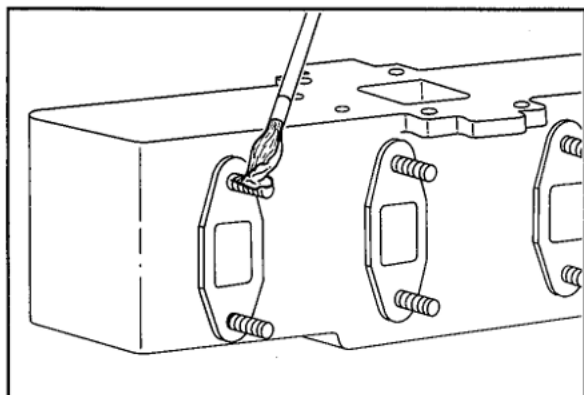


The exhaust manifold can be checked for leaks by capping the top and end outlets, submerging into a tank of water and applying 483 kPa [70 psi] of air pressure. If any air bubbles are observed, the manifold **must** be replaced.

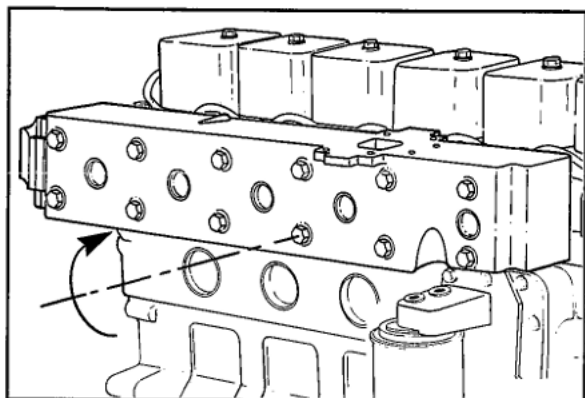




Install the capscrews and new gaskets.



Apply anti-seize compound to the mounting bolt threads.



16 mm (B Series), 13 mm (C Series)



Warning: Because the exhaust manifold weighs more than 23 Kg [50 lb], two people or a hoist will be required to lift it to avoid personal injury.



Install the manifold and capscrews.



Tighten the capscrews.

Start at the center of the manifold and alternately torqueing to each end of the manifold until completed.

Torque Value: 43 N•m [32 ft-lb]

Then, follow the same sequence and tighten the capscrews again to the same torque values.

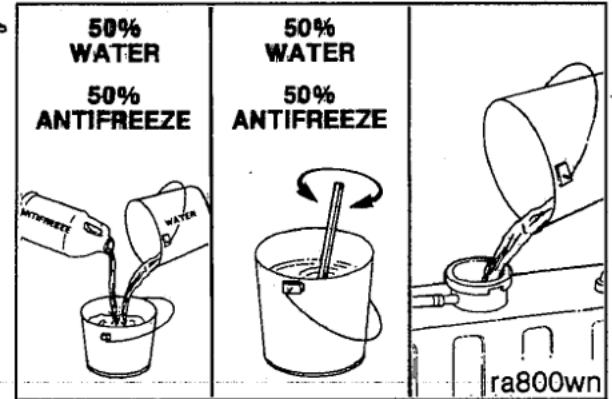


- Install the components removed in the preparatory steps.
- Install the turbocharger.
- Install the exhaust manifold cover (manifold replacement only).
- Install the heat exchanger.
- Open the raw water inlet valve.
- Connect the battery ground cable.

Fill the coolant system. Refer to Section 7 for coolant system filling and bleeding instructions.

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

Operate the engine and check for leaks.



Lubricating System Repair Summary

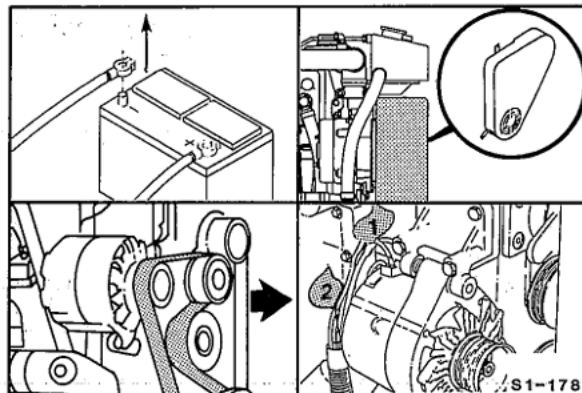
Component To Be Replaced	Tools	Preparatory Steps
Oil Pressure Regulator, Valve and/or Spring (B Series Engines)	1/4 Inch, 5/16 Inch or Flat Screwdriver, 10, 13, 16, 19 mm, 19 mm Box Wrench, 90 to 95 mm Filter Wrench, 9 mm or 3/8 Inch Wood Dowel Rod	Disconnect the ground cable from the battery. Unplug the coolant heater, if so equipped. Remove the belt guard. Remove the drive belt.
Oil Pressure Regulator, Valve and/or Spring (C Series Engines)	22 mm	Clean debris from regulator plug area.
Lubricating Oil Thermostat (C Series Only)	32 mm Open End	Clean debris from around lubricating oil thermostat.
Oil Cooler Element and/or Gasket (B Series Engines)	90 to 95 mm Filter Wrench, 5/16 Inch or Flat Screwdriver, 10, 13, 17 mm, 16, 19 mm or 5/8 Inch, 3/4 Inch, 3/8 Inch Square Drive	Disconnect the ground cable from the battery. Unplug the coolant heater, if so equipped. Drain the coolant. Remove the belt guard. Remove the drive belt.
Oil Cooler Element and/or Gasket (C Series Engines)	118 to 131 mm Filter Wrench, 5/16 Inch or Flat Screwdriver, 10 mm; 7/16, 11/32, 5/8 Inch	Disconnect the ground cable from the battery. Unplug the coolant heater, if so equipped. Drain the coolant. Remove the belt guard. Remove the drive belt.
Oil Pressure Sending Unit	17 mm Open End	Disconnect the wires from the oil pressure sending unit. If the sending unit is located behind the B Series raw water pump, shut off the raw water intake valve on the vessel hull. Remove the B Series raw water pump.

Lubricating System Replacement Procedures

Oil Pressure Regulator Valve and/or Spring (B Series) - Replacement

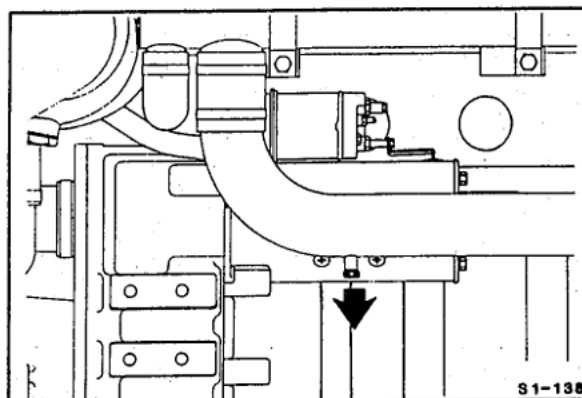
Preparatory Steps:

- Disconnect the ground cable from the battery.
- Unplug the coolant heater if so equipped.
- Remove the belt guard.
- Remove the drive belt.



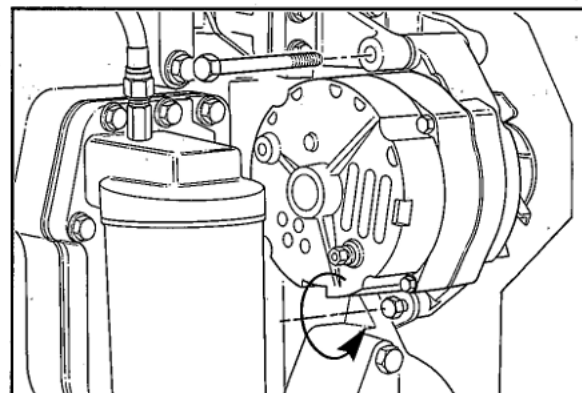
1/4 Inch

Drain the coolant.



13 mm

Remove the capscrew from the alternator link.



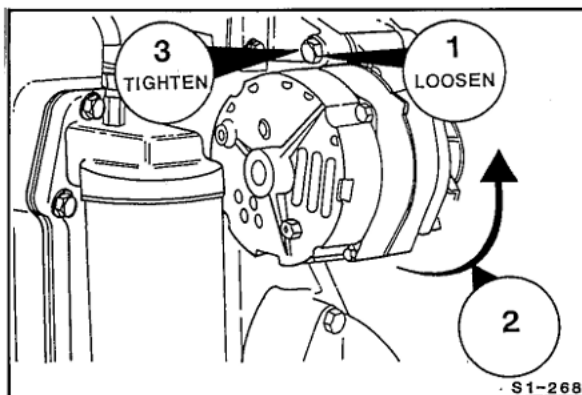
16 mm

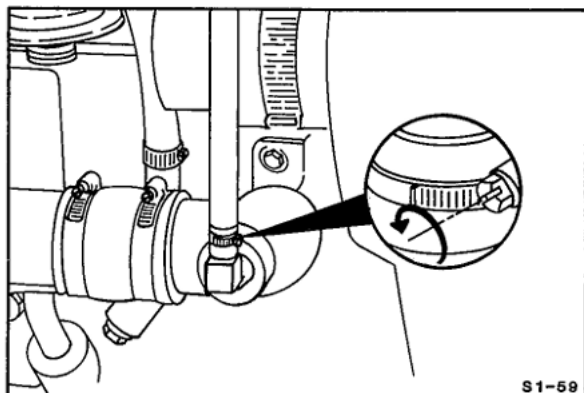
Loosen the alternator capscrew.

Rotate the alternator up to obtain access to the pressure regulator plug.

The alternator wires may **not** need to be disconnected at this time. If so, label them before disconnecting.

Tighten the alternator mounting capscrew to keep the alternator out of the way.





5/16 Inch or Flat Screwdriver

Loosen the hose clamp and remove and water make-up hose from the elbow hose coupling at the engine water inlet.

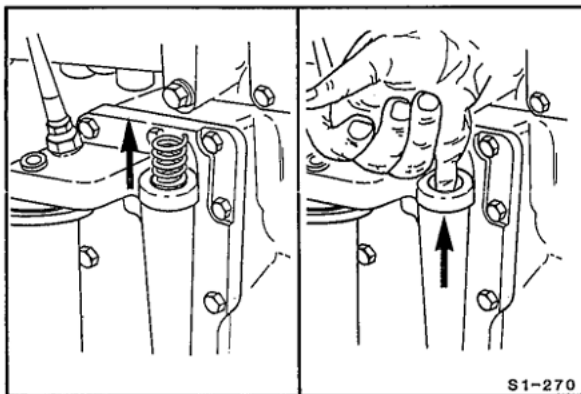
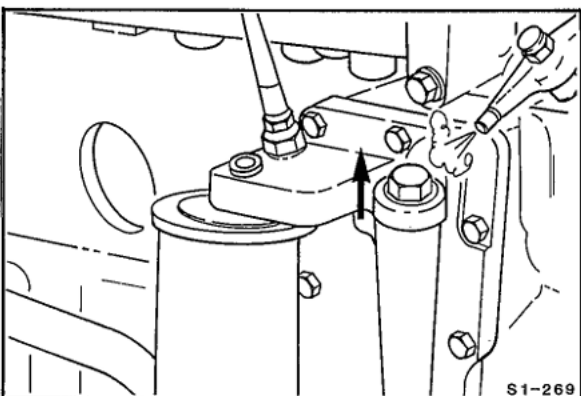


19 mm Box Wrench

Clean all the debris from around the pressure regulator plug.



Remove the threaded plug from the oil cooler cover.

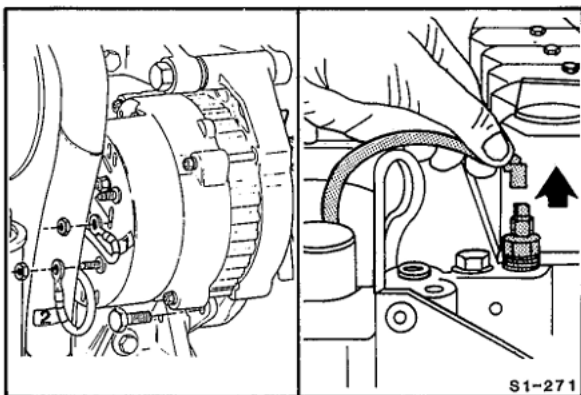


Flat Screwdriver

Remove the compression spring from the pressure regulator bore.



Remove the pressure regulator plunger by inserting your little finger into the plunger bore and pulling upward. A magnet will also be helpful in extracting the pressure regulator plunger.



If the pressure regulator plunger is struck and **cannot** be extracted, it will be necessary to remove the oil cooler cover plate. Temporarily install the regulator plug to prevent debris entering the regulator while further cleaning of the oil cooler cover plate is performed.

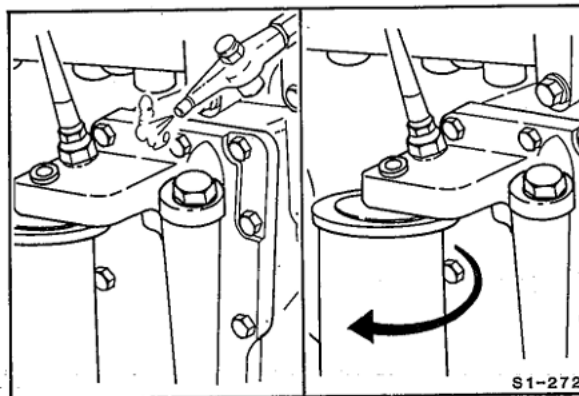
To gain access to the oil cooler cover plate capscrews:

- Identify and remove the alternator leads.
- Remove the two coolant temperature sensor leads (identification unnecessary).



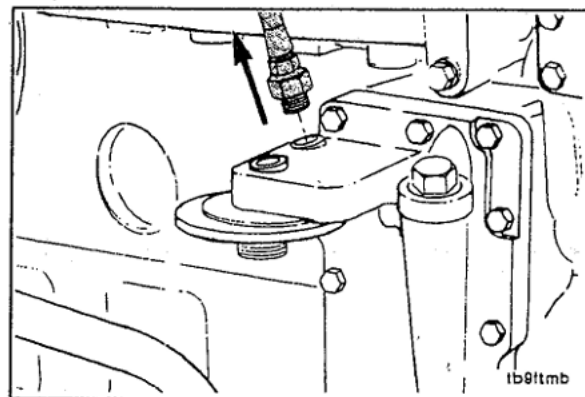
90 to 95 mm Filter Wrench

Clean all the debris from around the oil cooler cover plate.
Remove the filter.



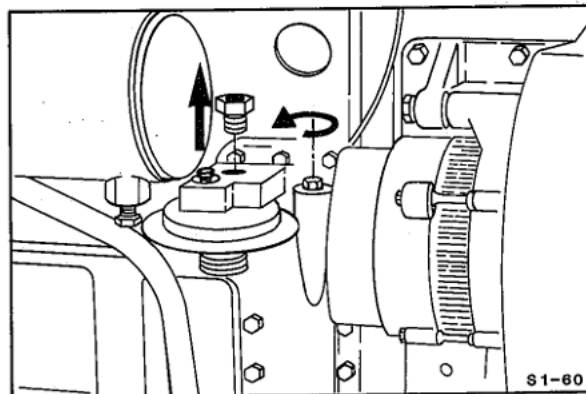
16 and 19 mm

Disconnect the turbocharger oil supply line.



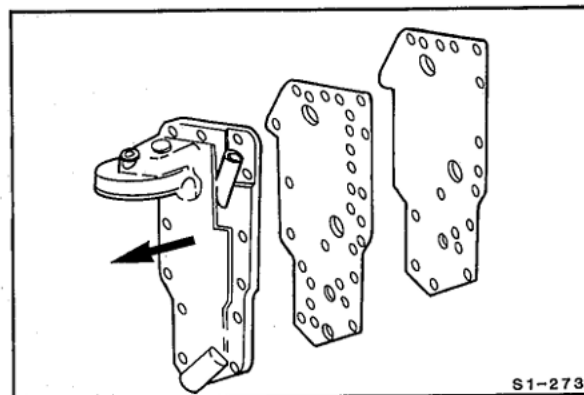
19 mm

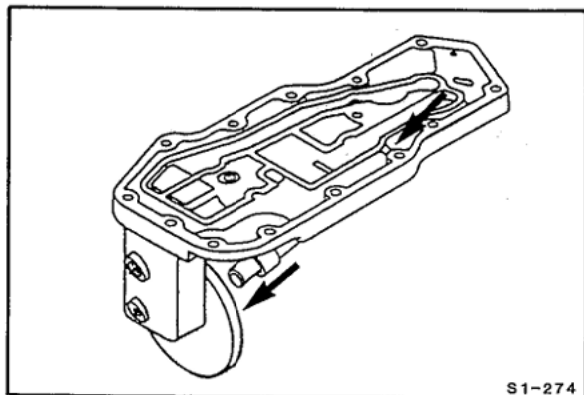
Remove the oil supply fitting from the oil cooler to allow access to the oil cooler mounting screw.



10 mm

Remove the oil cooler cover plate and outer gasket. The oil cooler and inner gasket will normally stay in place if **not** disturbed.





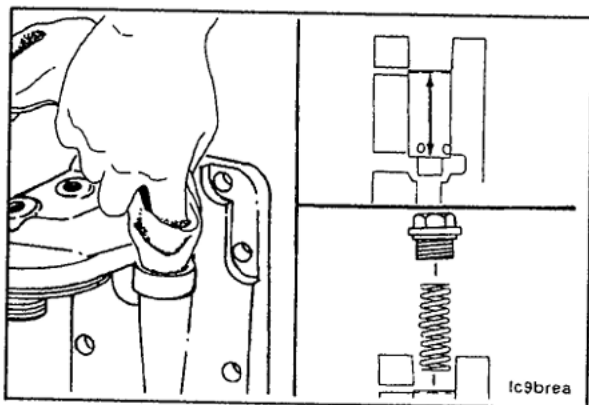
9 mm or 3/8 Inch Wood Dowel Rod

Caution: Be careful not to damage the plunger bore.



Apply pressure on the bottom of the pressure regulator plunger to remove the plunger.

S1-274



Clean and inspect the bore and regulator plunger. If the plunger bore is damaged, replace the oil cooler cover plate.



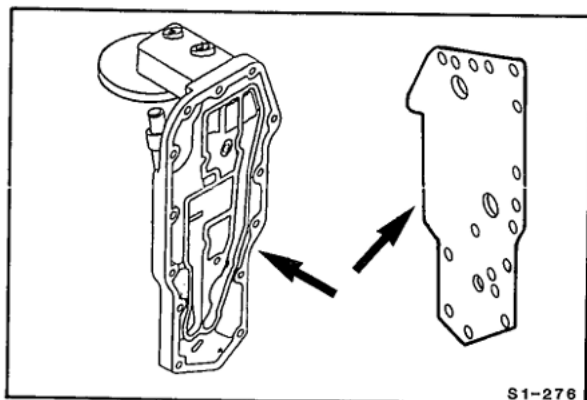
Apply a light coat of 15W-40 lubricating oil to the plunger and bore before assembly.



Caution: The plunger must operate freely in the bore in order to regulate the oil pressure.

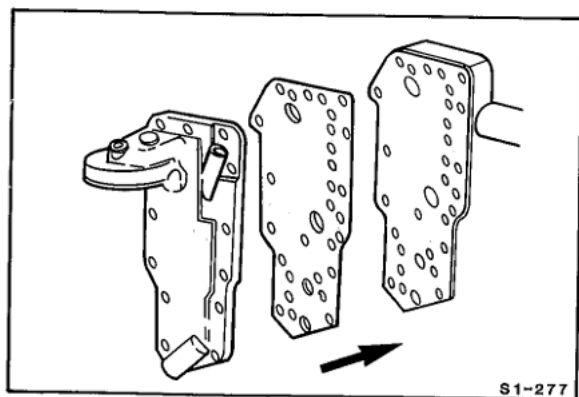


lc9brea



Clean the sealing surfaces of the oil cooler cover and the outside of the cooler core.

S1-276



10 mm

Assemble the new oil cooler cover gasket and cooler cover to the oil cooler element and block.



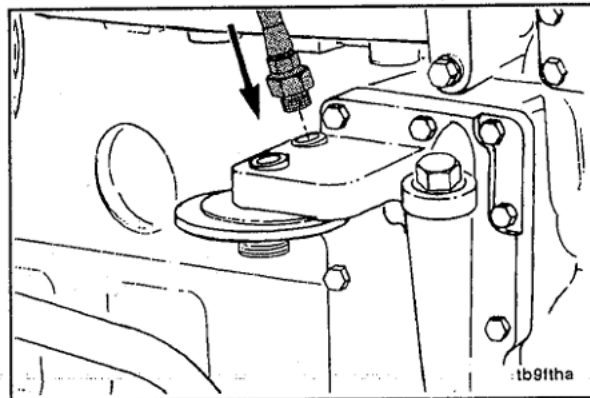
Torque Value: 24 N•m [18 ft-lb]



S1-277

16 and 19 mm

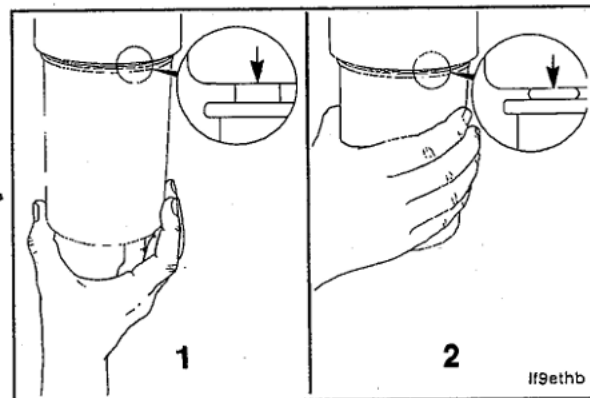
Install the turbocharger oil supply fitting into the oil filter head and connect the turbocharger oil supply line.



Caution: Fill the new oil filter with clean 15W-40 oil. The lack of lubrication during the delay until the filter is pumped full of oil is harmful to the engine.

Install the filter.

Follow the manufacturer's instructions for installation.



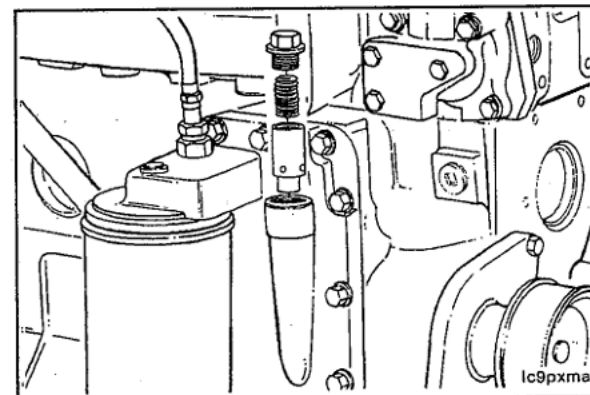
19 mm Box Wrench

Apply a light coating of 15W-40 lubricating oil to the pressure regulator plunger and compression spring.

Drop the plunger into the bore with the small end down. Drop the compression spring on the plunger.

Install the threaded plug.

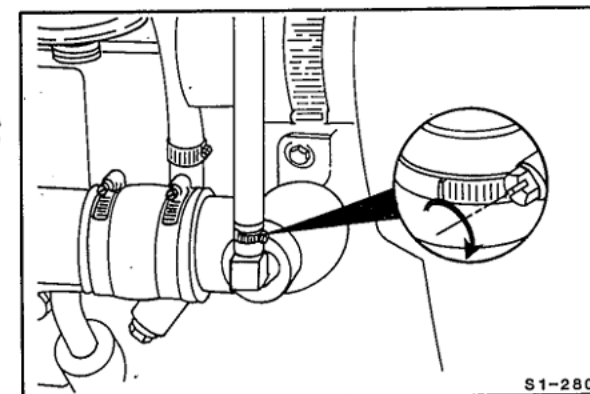
Torque Value: 80 N•m [59 ft-lb]

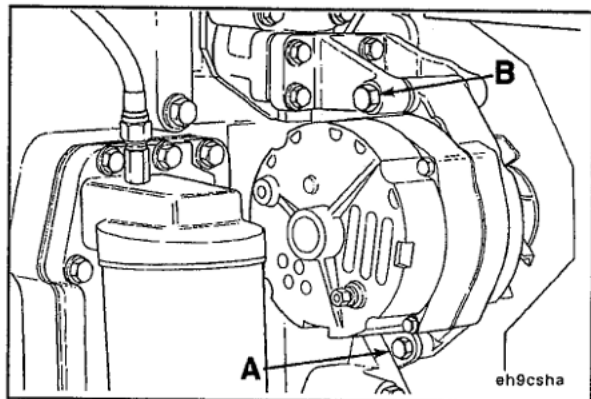


5/16 Inch or Flat Screwdriver

Install the water make-up line on the water inlet connection fitting and tighten the hose clamps.

Torque Value: 5 N•m [44 in-lb]





13 and 16 mm

Position the alternator.



Install the alternator link cap screw.

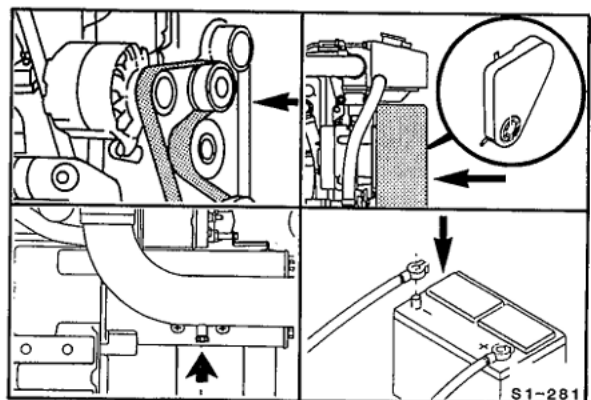
Tighten the alternator link cap screw A.



Torque Value: 24 N•m [18 ft-lb]

Tighten the alternator mounting cap screw B.

Torque Value: 43 N•m [32 ft-lb]

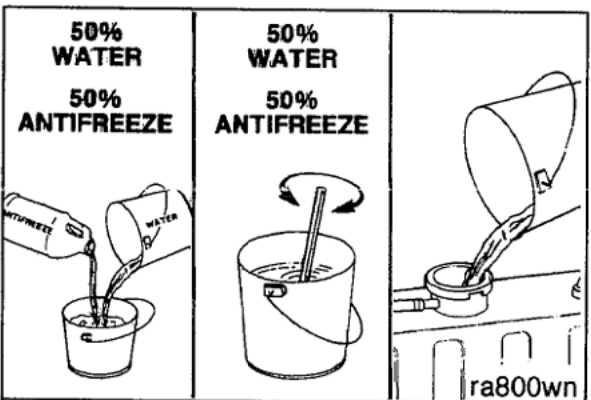


Install the drive belt.

Install the belt guard.

Install the drain plug.

Connect the battery negative cable last.



Fill the engine coolant system and install the pressure cap.

Operate the engine until the coolant temperature reaches 82°C [180°F] and check for leaks.

Shut off the engine and check the coolant and oil levels.

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

Oil Pressure Regulator Valve and/or Spring (C Series) - Replacement

Preparatory Steps:

- Clean debris from regulator plug area.

22 mm

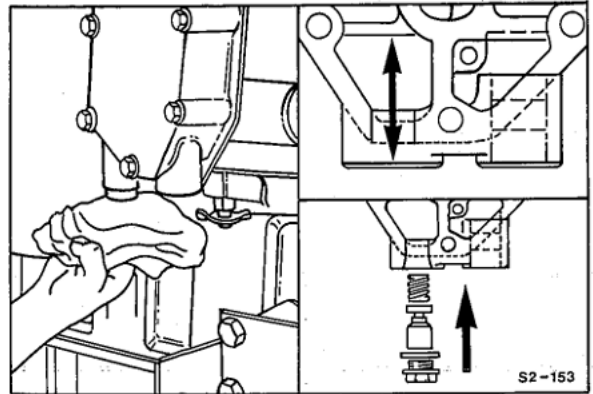
Remove the plug and regulator valve.

Clean and inspect the bore and regulator valve before assembly.

The valve **must** move freely in the bore.

Install the regulator and spring.

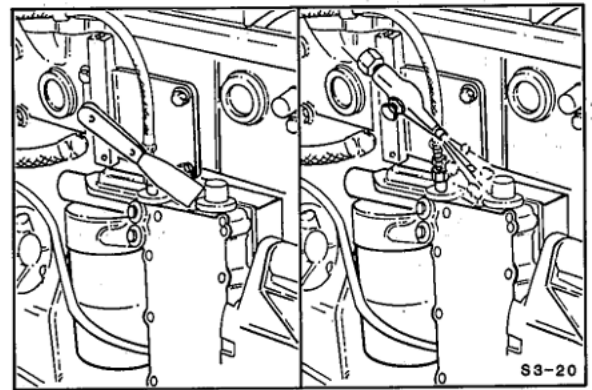
Torque Value: 80 N•m [59 ft-lb]



Lubricating Oil Thermostat (C Series Only) - Replacement

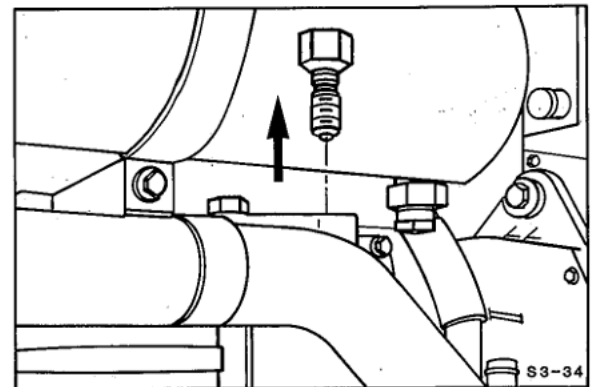
Preparatory Steps:

- Clean debris from around lubricating oil thermostat located on top of lubricating oil cooler.



32 mm Open End

Remove the thermostat.

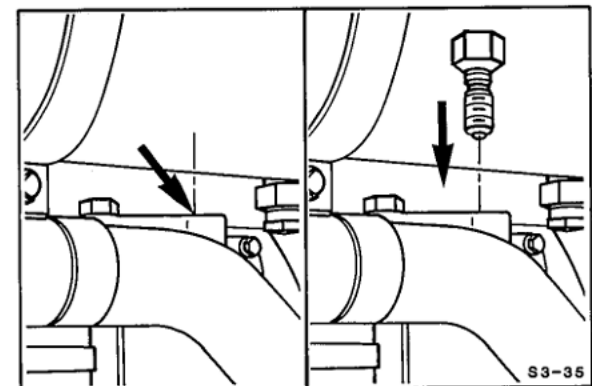


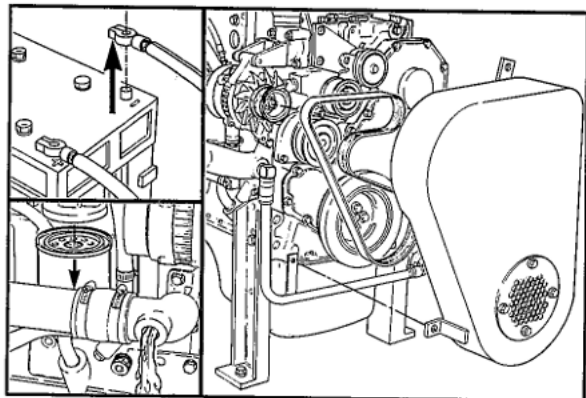
32 mm Open End

Clean and inspect the bore before assembly.

Install the oil thermostat.

Torque Value: 50 N•m [37 ft-lb]





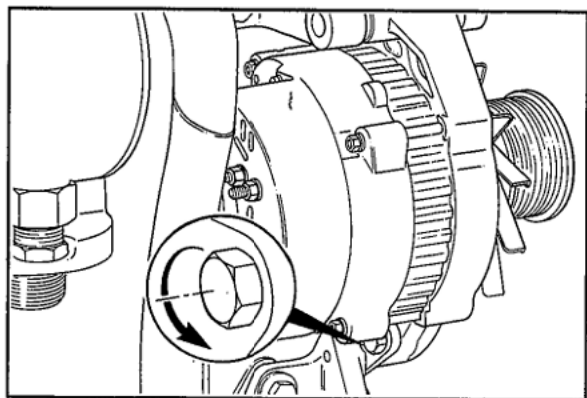
Oil Cooler Element and/or Gasket (B Series) - Replacement



90 to 95 mm Filter Wrench

Preparatory Steps:

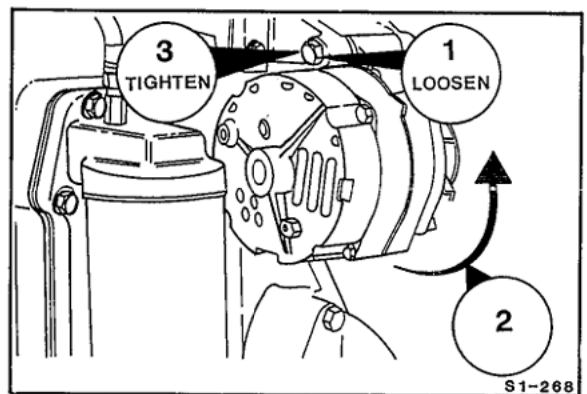
- Disconnect the ground cable from the battery.
- Unplug the coolant heater if so equipped.
- Drain the coolant.
- Remove the belt guard.
- Remove the drive belt.
- Remove the oil filter.



13 mm



Remove the cap screw from the alternator link as shown in the illustration.



16 mm

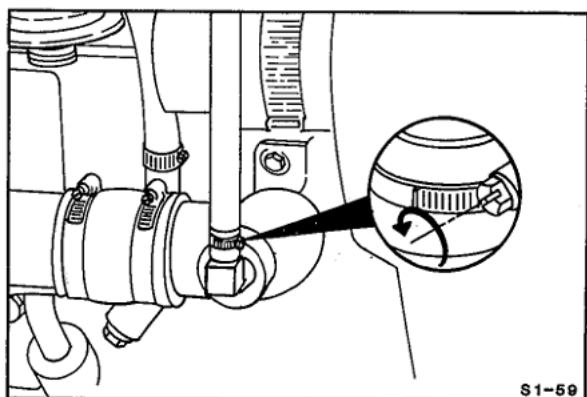


Loosen the alternator mounting cap screw (1).

Rotate the alternator up to attain access to the oil cooler cover cap screws (2).

The alternator wires do **not** need to be disconnected.

Tighten the alternator mounting cap screw to keep it out of the way (3).



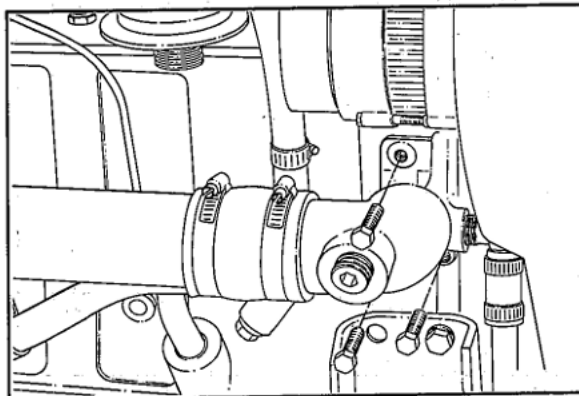
5/16 Inch Nutdriver or Screwdriver



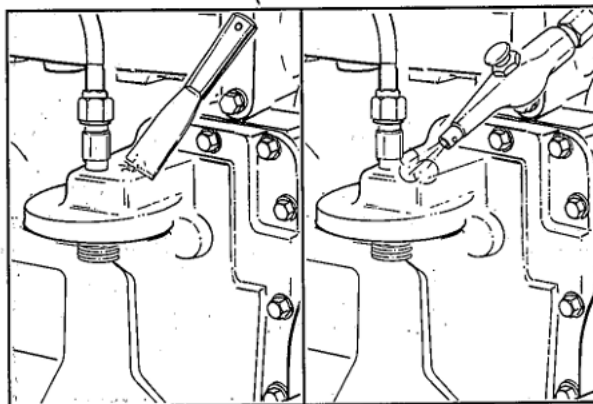
Loosen the clamps and remove the make-up line that goes from the expansion tank to the water inlet connection.

17 mm

Remove the water inlet connection mounting screws to allow the connection to pull out for removal of the cooler assembly.

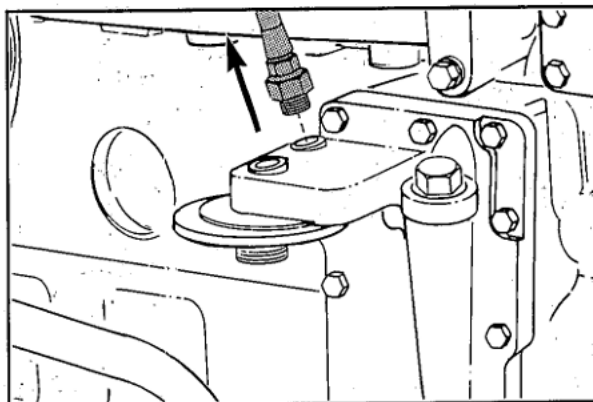


Clean around the oil cooler cover.



16 and 19 mm or 5/8 and 3/4 Inch

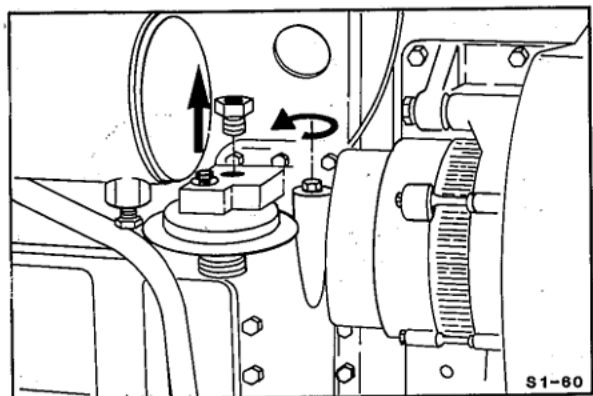
Disconnect the turbocharger oil supply line.

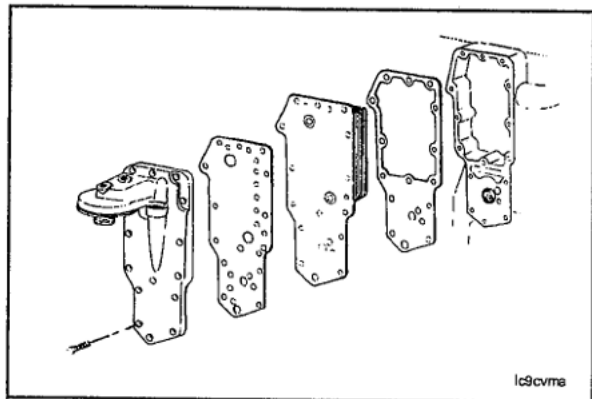


19 mm or 3/4 Inch

Remove the oil supply fitting from the oil cooler to allow access to the oil cooler mounting screw.

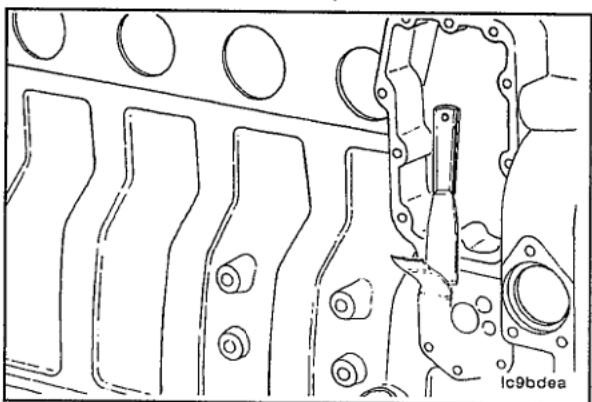
Loosen the oil pressure regulator cap before removing the oil cooler.



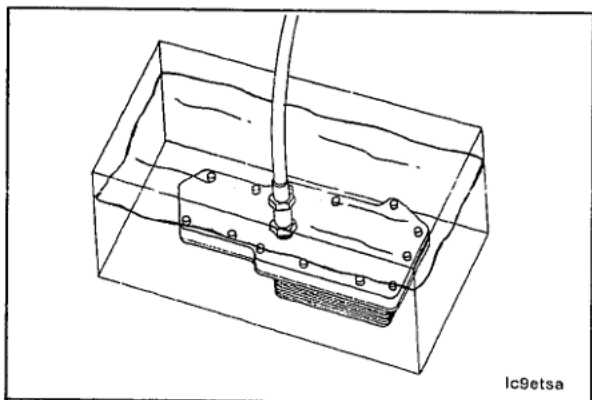


10 mm

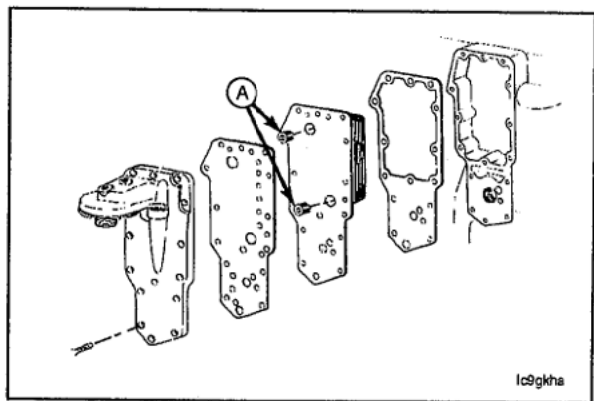
Remove the oil cooler cover, gaskets and cooler element.



Clean the sealing surfaces.



Submerge the oil cooler into a tank of water. Use 483 kPa [70 psi] air pressure to check the element for leaks that can be identified by air bubbles.



13 mm



Caution: If a new element is being installed, be sure to remove the shipping plugs (A) from the new cooler element. Failure to do so will prevent oil flow through the oil cooler and the filter, resulting in engine damage.



Use new gaskets and install the element and cover.



Tighten the capscrews.

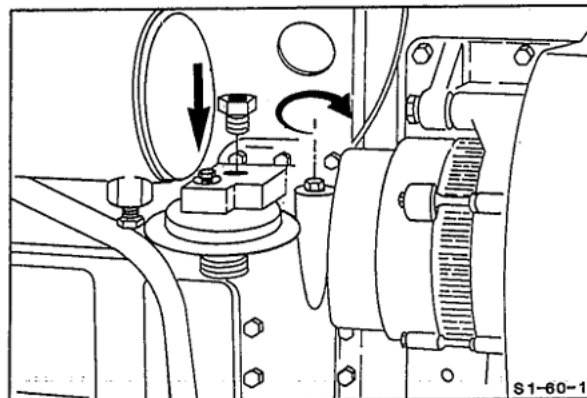
Torque Value: 24 N•m [18 ft-lb]

16 and 19 mm

Install the turbocharger oil supply fitting and connect the line.

Tighten the oil pressure regulator valve cap.

Torque Value: 80 N•m [59 ft-lb]

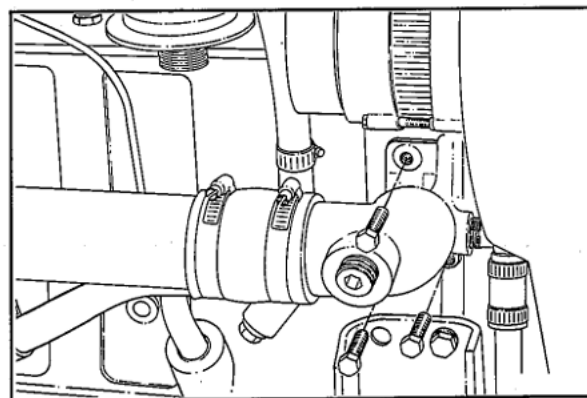


17 mm

Install a new o-ring and connect the water inlet connection.

Tighten the clamps.

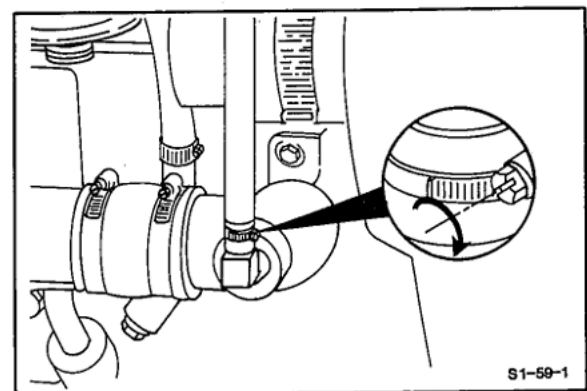
Torque Value: 5 N•m [44 in-lb]



5/16 Inch or Flat Screwdriver

Install the make-up line that goes from the expansion tank to the water inlet connection. Tighten the clamps.

Torque Value: 5 N•m [44 in-lb]



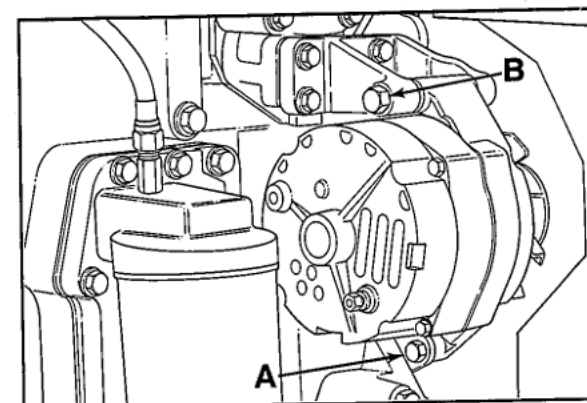
13 and 16 mm

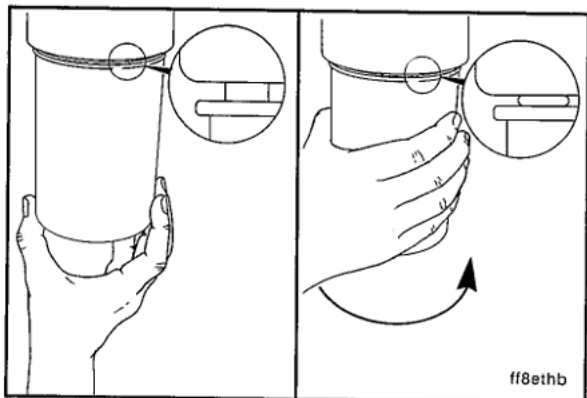
Position the alternator and install the alternator link.

Tighten the alternator mounting capscrews.

A = 24 N•m [18 ft-lb]

B = 43 N•m [32 ft-lb]

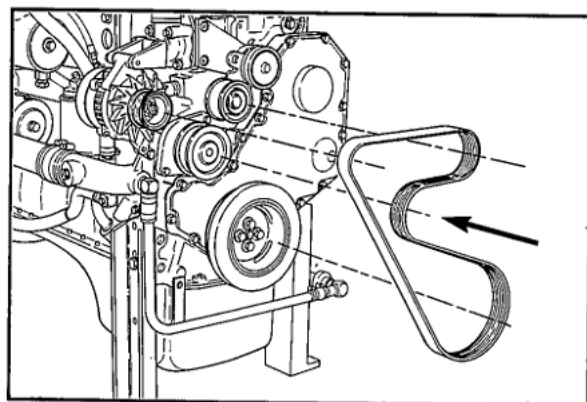




Fill the new oil filter with clean 15W-40 oil.

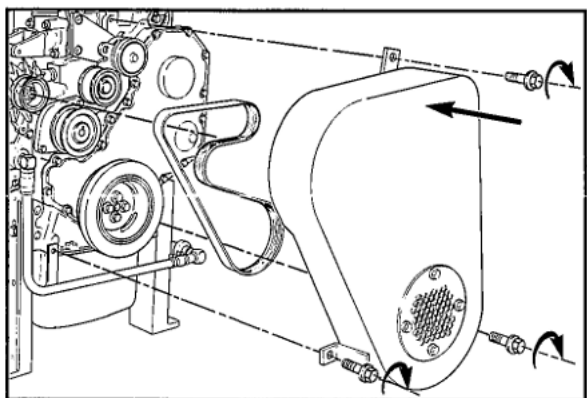
Use clean 15W-40 oil to lubricate the oil seal.

Install the filter, following the manufacturers' instructions.



3/8 Inch Square Drive

Install the drive belt.

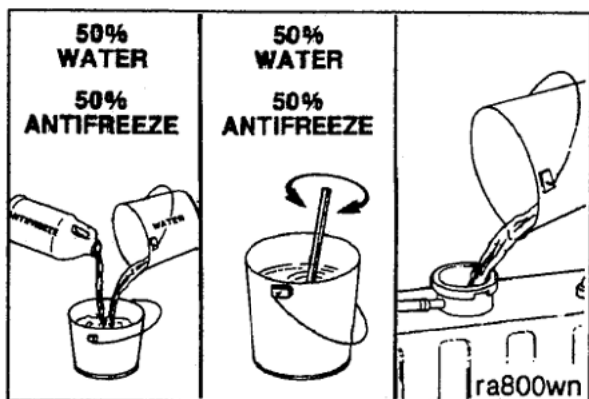


13 mm

Install the belt guard.

Tighten the capscrews.

Torque Value: 24 N•m [18 ft-lb]



Connect the ground cable to the battery.

Fill the cooling system and operate the engine for a minimum of 5 minutes to check for leaks.

Shut off the engine and check the oil level.

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

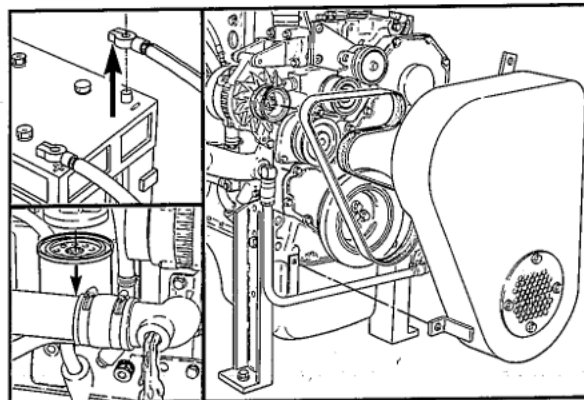


Oil Cooler Element and/or Gasket (C Series) - Replacement

118 to 131 mm Filter Wrench

Preparatory Steps:

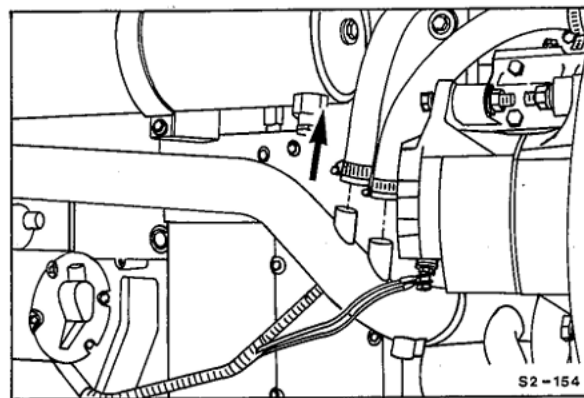
- Disconnect the ground cable from the battery.
- Unplug the coolant heater if so equipped.
- Drain the coolant.
- Remove the belt guard.
- Remove the drive belt.
- Remove the oil filter.



5/16 Inch or Flat Screwdriver

Loosen the hose clamps on the coolant bypass hoses at the water transfer tube.

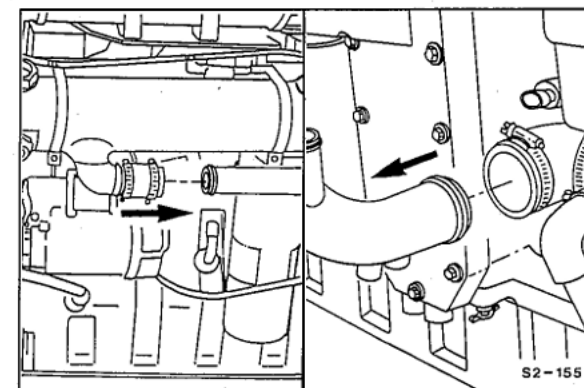
Remove the bypass hoses from the water transfer tube.



5/16 Inch or Flat Screwdriver

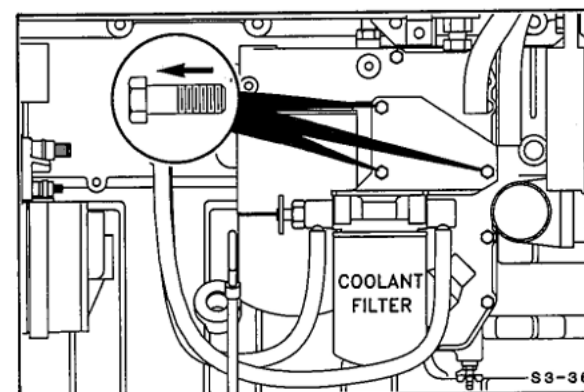
Loosen the hose clamps on the water transfer tube.

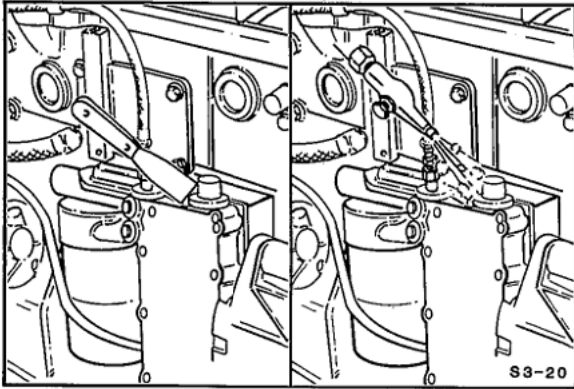
Remove the water transfer tube.



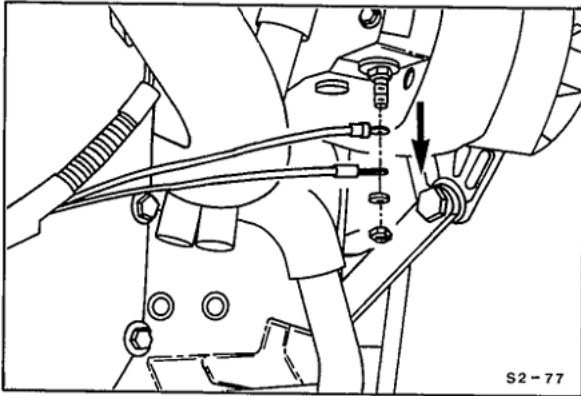
10 mm

Remove the corrosion resistor bracket from the lube oil cooler cover.



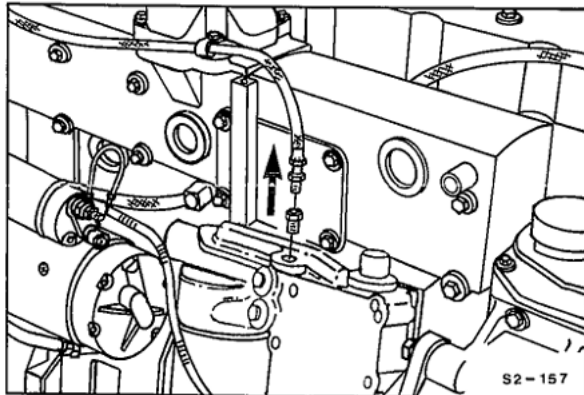


Clean all debris from around the oil cooler.



7/16, 11/32 Inch

Disconnect and label the leads from the alternator.

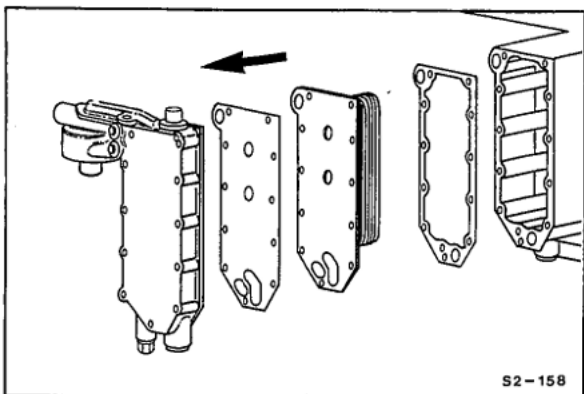


5/8 Inch

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



Remove the oil filter.

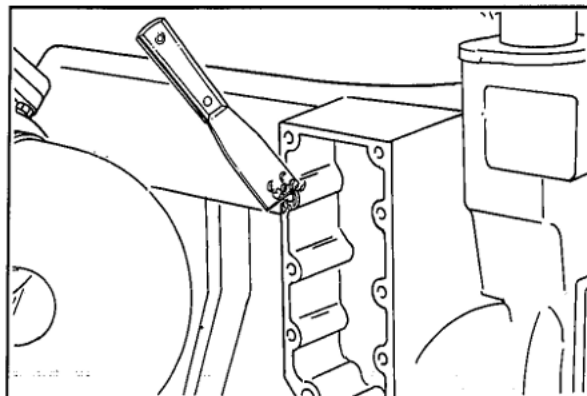


10 mm

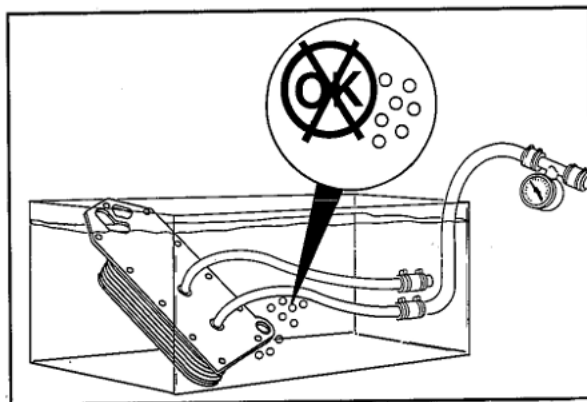
Remove the oil cooler cover, element, and gaskets.



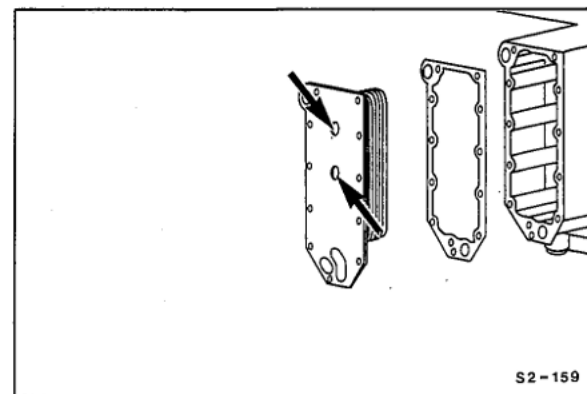
Clean the sealing surfaces.



Submerge the oil cooler into a tank of water. Use 483 kPa [70 psi] air pressure to check the element for leaks that can be identified by air bubbles.

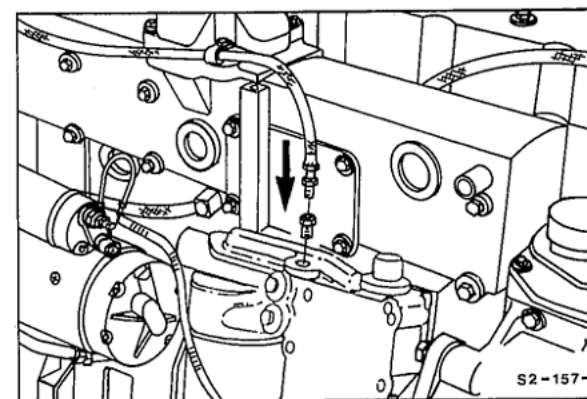


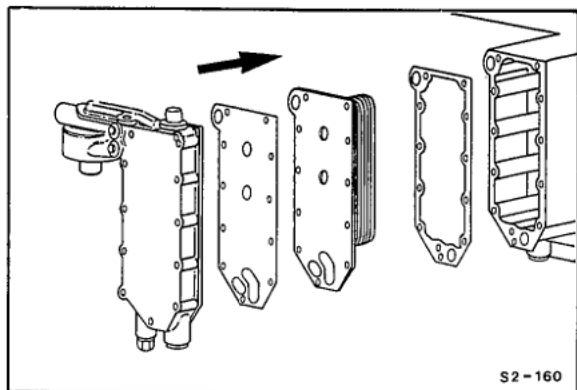
Caution: Be sure to remove the shipping plugs from the new cooler element. Failure to remove these plugs will prevent oil flow through the oil cooler and the filter causing engine damage.



Connect the turbocharger oil supply line.

Torque Value: 15 N•m [11 ft-lb]



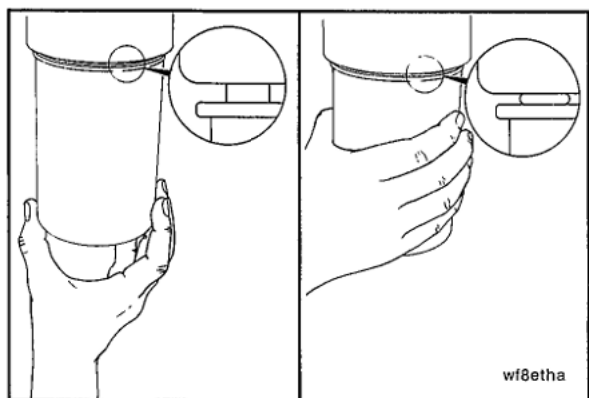


10 mm

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



Torque Value: 24 N•m [18 ft-lb]



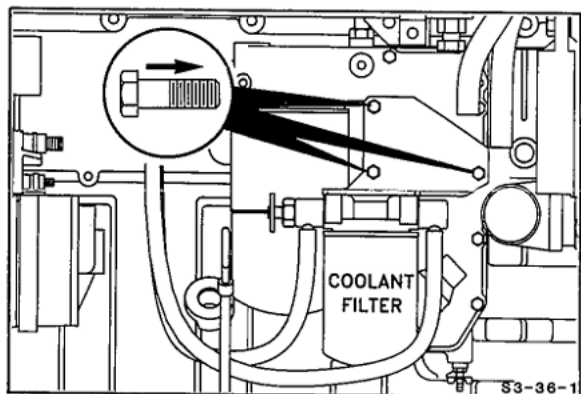
Caution: Fill the new oil filter with clean 15W-40 oil. The lack of lubrication during the delay until the filter is pumped full of oil is harmful to the engine.



Install the filter.



Follow the manufacturer's instructions for installation.

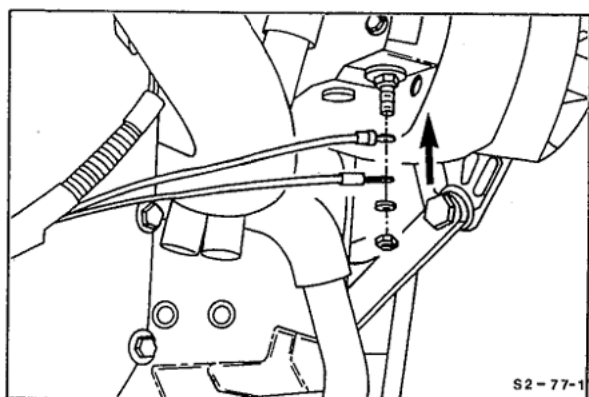


10 mm

Install the corrosion resistor bracket on the lube oil cooler cover.



Torque Value: 24 N•m [18 ft-lb]



7/16, 11/32 Inch

Connect the leads to the alternator.

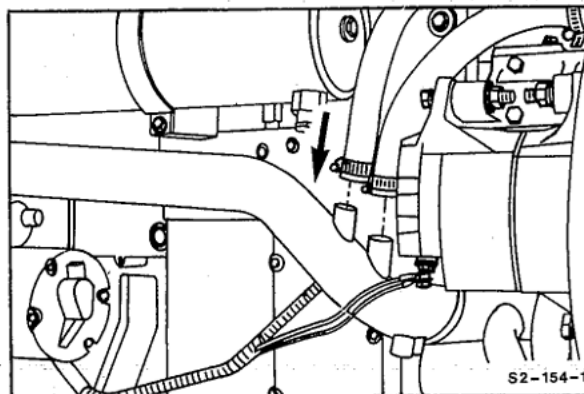


5/16 or Flat Screwdriver

Install the water transfer tube.

Tighten the hose clamps.

Torque Value: 5 N•m [44 in-lb]

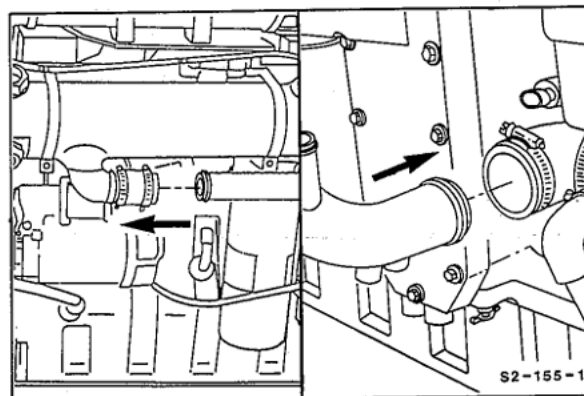


5/16 or Flat Screwdriver

Install the water bypass hoses on the water transfer tube.

Tighten the hose clamps.

Torque Value: 5 N•m [44 in-lb]



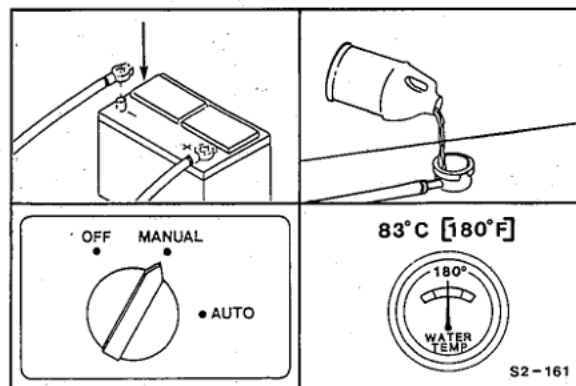
Connect the ground cable to the negative battery terminal.

Fill the coolant system.

Start the engine and operate until the coolant temperature reaches 83° C [180° F] and check for leaks.

Shut off the engine.

Check the coolant and oil levels.



Oil Pressure Sending Unit - Replacement

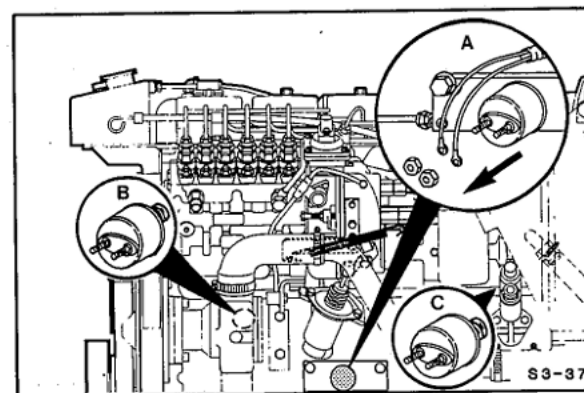
Preparatory Steps:

- Shut off the raw water intake valve on the vessel hull if the unit is in location (B).
- Remove the raw water pump if the unit is in location (B).
- Disconnect the wires from the oil pressure sending unit.

(A) Location on B Series engines with the extension oil block option.

(B) Normal location on present B Series engines.

(C) Location on C Series engines.



Single Station
Sending Unit
P.N. 3913627

PSI	Ohms
0	10
60	90.5
150	187

Dual Station
Sending Unit
P.N. 3913616

PSI	Ohms
0	5
60	45
150	93



17 mm Open End



Remove the sending unit.



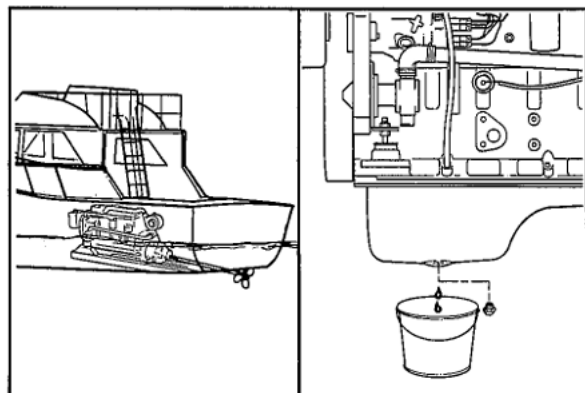
12 and 24 volt systems use the same sending unit.



To check, apply a known pressure to the sending unit. Measure the electrical resistance between the two terminals.



Install in the reverse order of removal.

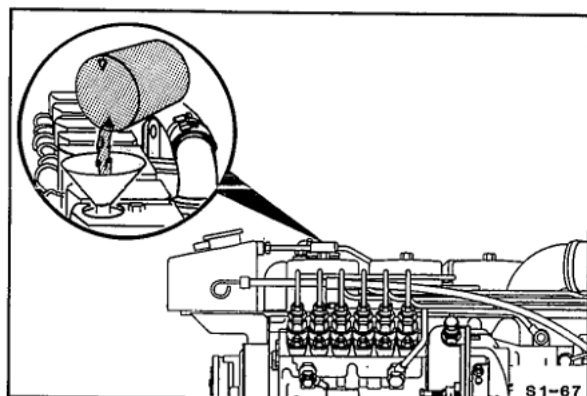


Dipstick - Replacement or Calibration

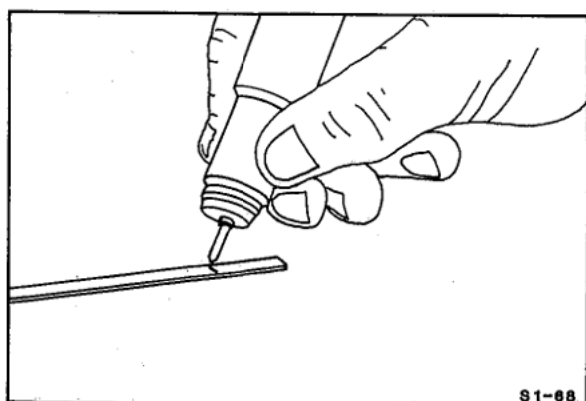
- Drain the engine oil and dispose of properly.
- With the vessel in the water, and at normal trim, check the oil pan sump to see if it is free of oil. Allow at least 5 minutes for oil to drain down if the engine had previously been running.
- Install the oil pan drain plug.

Torque Value: 80 N•m [59 ft-lb]

- If the engine has **not** previously been running, make sure the oil filter is full of oil.



- Add 8.5 liters [9 U.S. quarts] of 15W-40 oil to a 4B Series engine.
- Add 12.3 liters [13 U.S. quarts] of 15W-40 oil to a 6B Series engine.
- Add 15.1 liters [16 U.S. quarts] of 15W-40 oil to a 6C Series engine.

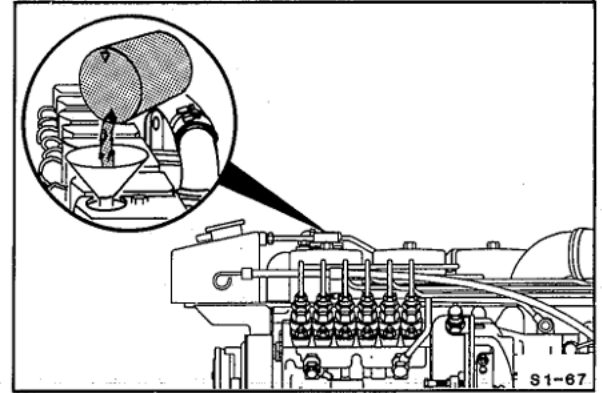


Electric Engraver

Allow 5 minutes for the oil to drain to the sump and mark the dipstick low level.

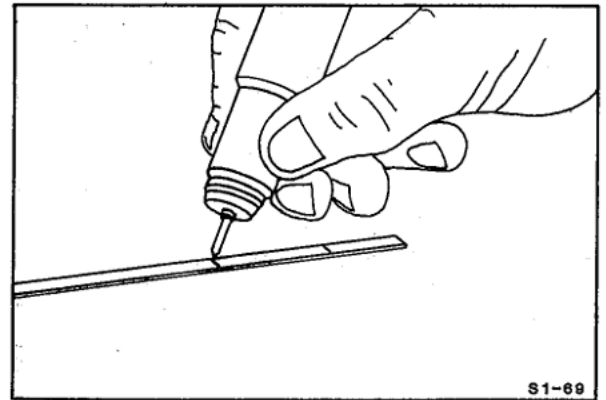
If the dipstick was **not** originally marked correctly, clearly void the original mark.

- Add an additional 0.9 liters [1 U.S. quart] of 15W-40 oil to a 4B Series engine to bring the oil level to the high position.
- Add an additional 1.9 liters [2 U.S. quarts] of 15W-40 oil to a 6B Series engine to bring the oil level to the high position.
- Add an additional 3.8 liters [4 U.S. quarts] of 15W-40 oil to a 6C Series engine to bring the oil level to the high position.



Electric Engraver

Allow 5 minutes for the oil to drain down and mark the dipstick high level.



Crankshaft Seal Repair Summary

Component To Be Replaced	Tools	Preparatory Steps
Front Crankshaft Seal	15 mm (B Series) 18 mm (C Series) 3 mm or 1/8 Inch Drill Bit Slide Hammer and Adapter for No. 10 Sheet Metal Screw, Hammer	Disconnect the negative battery cable. Remove the belt guard. Remove the drive belt.
Rear Crankshaft Seal	9/16 Inch, 19 mm, 3 mm or 1/8 Inch Drill Bit Slide Hammer and Adapter for No. 10 Metal Screw, Hammer	Disconnect the negative battery cable. Remove the starting motor.
Tappet Cover or Gasket (B Series Only)	75 to 80 mm Filter Wrench, 10 mm	Remove the fuel lift pump. Remove the fuel injection pump. Remove the raw water and air lines. Remove the aftercooler and its connections on the B-300 HP.

Crankshaft Seal - Replacement Procedures

Front Crankshaft Seal - Replacement

15 mm, B Series, 18 mm, C Series

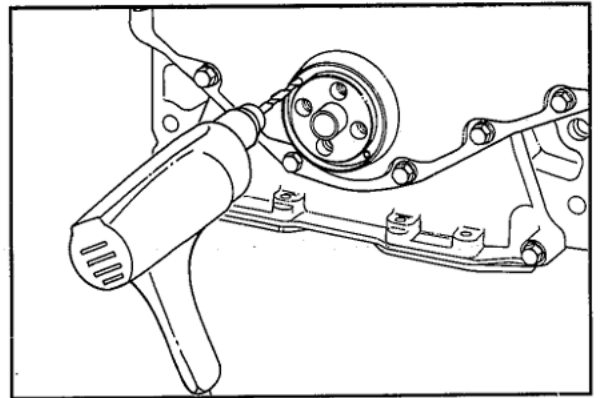
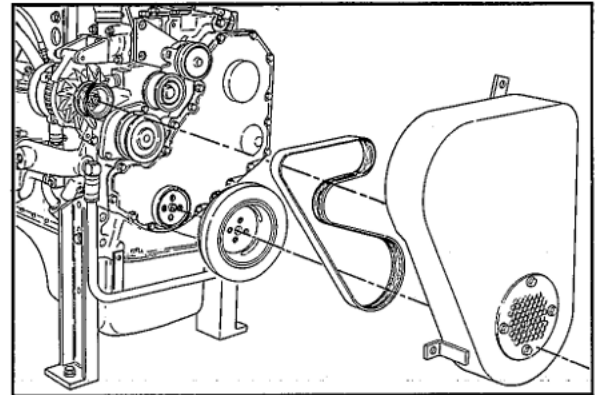
Preparatory Steps:

- Disconnect the ground battery cable.
- Remove the belt guard.
- Remove the drive belt.

Remove the crankshaft damper and pulley from the crankshaft and complete the following steps.

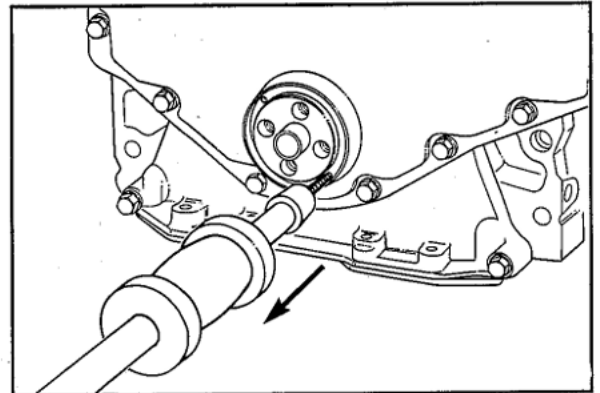
3 mm or 1/8 Inch Drill Bit

Drill two holes 180 degrees apart into the metal part of the seal.



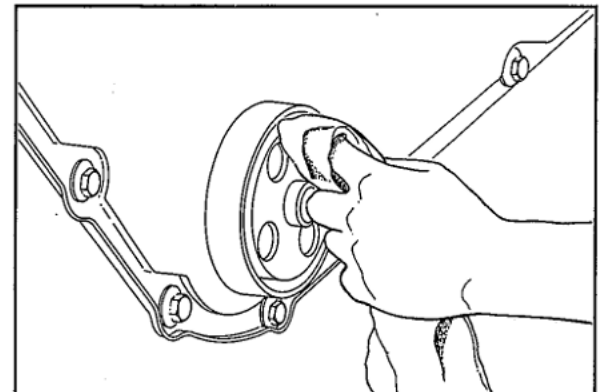
Slide Hammer and Adapter for No. 10 Sheet Metal Screw

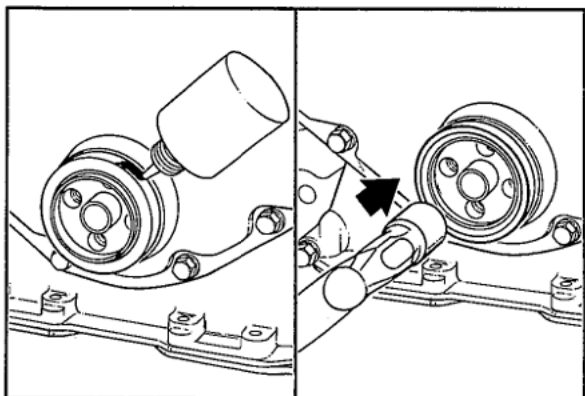
Remove the seal.



Caution: Teflon seals must be installed on a clean, dry surface.

Clean and dry the sealing surface.





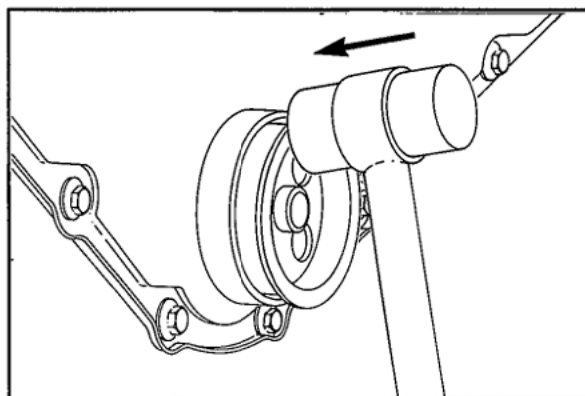
Caution: Use the pre-packaged seal starter ring to install the seal over the crankshaft.



Use Loctite 277 or equivalent to coat the outside diameter of the seal.

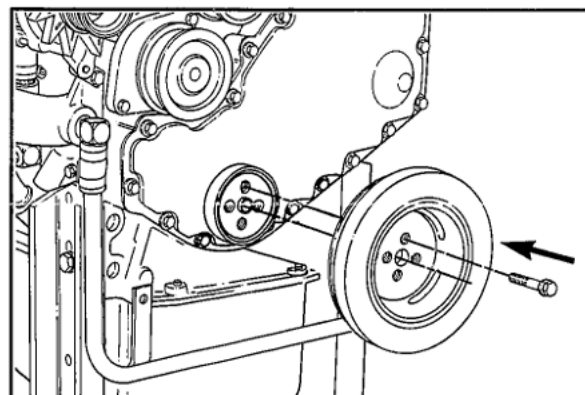


Push the seal onto the pilot and into the bore in the front cover. Remove the pilot.



Use the installation tool from the seal replacement kit to install the seal to the correct depth in the bore.

To prevent damage to the seal, hit the installation tool alternately at the 12:00, 3:00, 6:00 and 9:00 o'clock positions.



13, 15 mm (B Series), 18 mm (C Series)

Install the crankshaft pulley and damper.



Tighten the cap screws.



Torque Values:

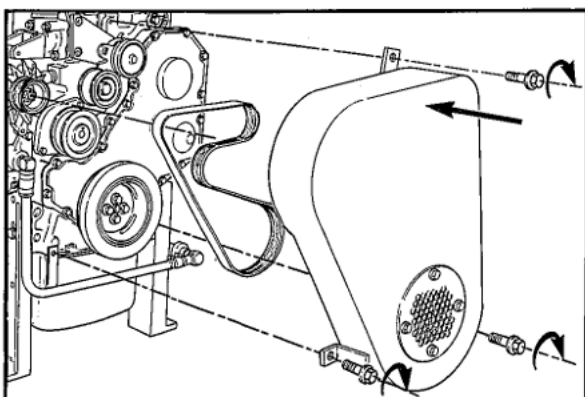
125 N•m

[92 ft-lb] B Series

200 N•m

[148 ft-lb] C Series

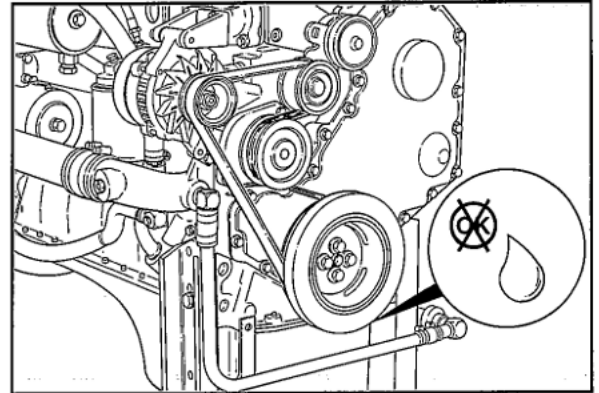
40 N•m [30 ft-lb] B Series Damper to Adapter Capscrews



Install the drive belt and belt guard.

Connect the ground battery cable.

Operate the engine and check for leaks.



Rear Crankshaft Seal - Replacement

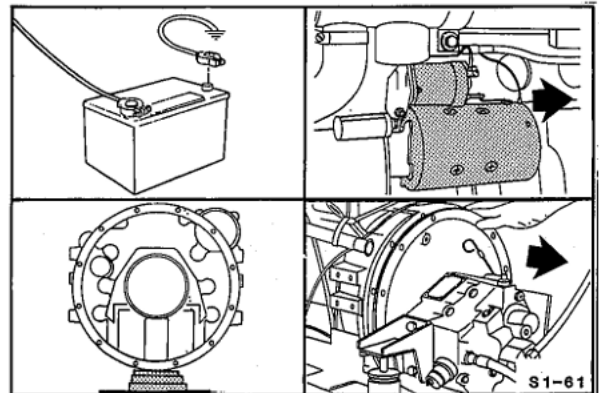
Preparatory Steps:

- Disconnect the ground battery cable.

Warning: Because the starting motor weighs more than 23 Kg [50 lb], two people or a hoist will be required to lift it to avoid personal injury.

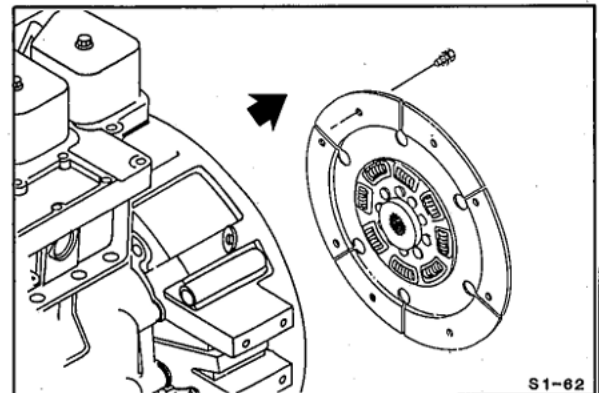
- Remove the motor.

Adequately support the engine. Remove the marine gear.



9/16 Inch

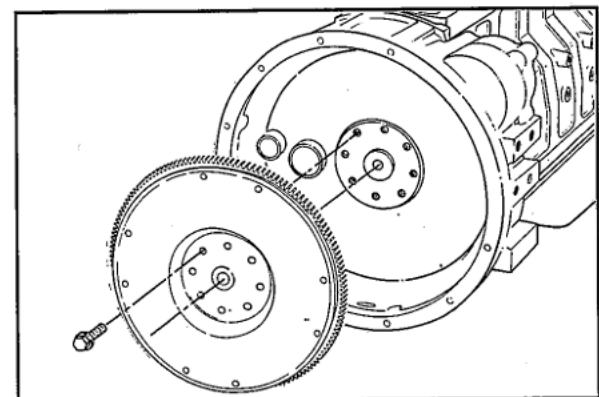
Remove the drive plate.

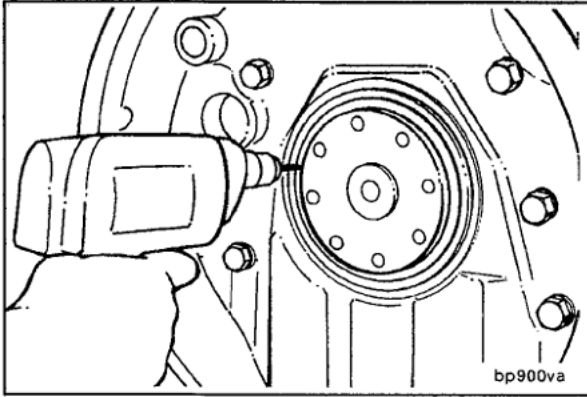


19 mm

Warning: Because the flywheel weighs more than 23 Kg [50 lb] two people or a hoist will be required to lift it to avoid personal injury.

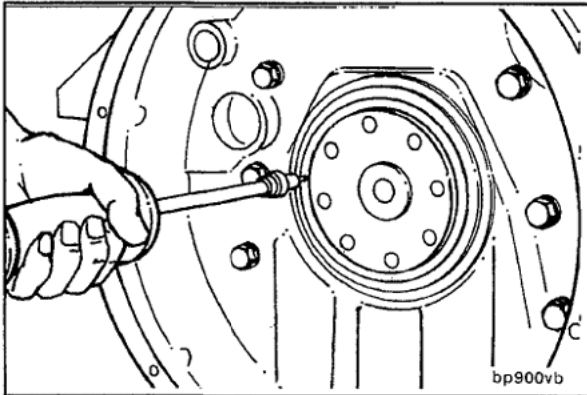
Remove the flywheel.





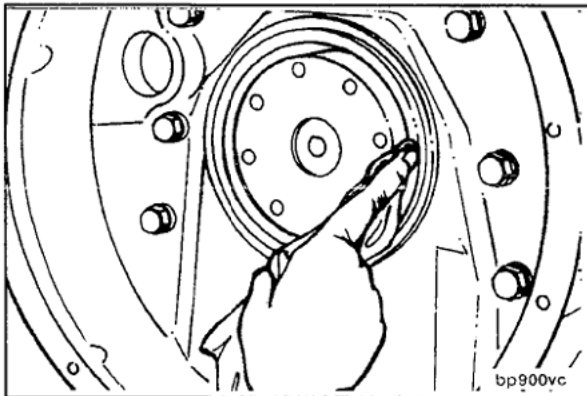
3 mm or 1/8 Inch Drill Bit

Drill two holes 180 degrees apart into the metal part of the seal.



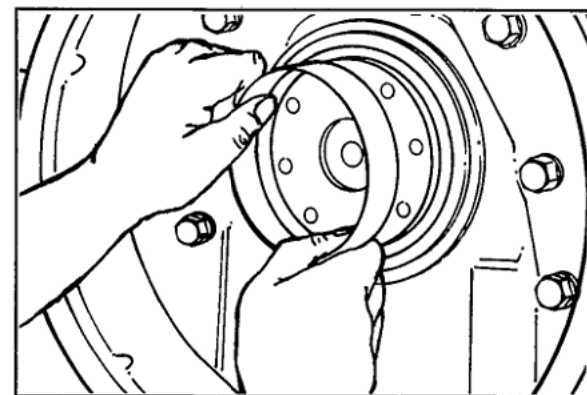
Slide Hammer and Adapter for a No. 10 Sheet Metal Screw

Remove the seal.



Caution: Teflon seals must be installed on a clean, dry surface.

Clean and dry the sealing surface.



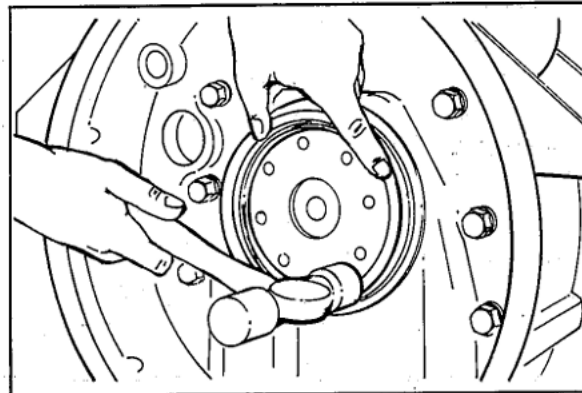
Caution: Use the pre-packaged seal starter ring to install the seal over the crankshaft.

Use a mild soap on the outside diameter of the seal to ease installation.

Do **not** use Loctite on the rear seal.

Use the installation tool from the seal replacement kit to install the seal to the correct depth. To prevent damage to the seal, hit the installation tool alternately at the 12:00, 3:00, 6:00 and 9:00 o'clock positions.

NOTE: Make sure the seal is completely installed into the rear housing.



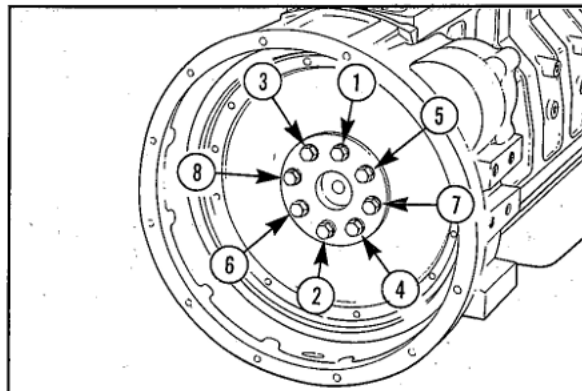
19 mm

Warning: Because the flywheel weighs more than 23 Kg [50 lb], two people or a hoist will be required to lift it to avoid personal injury.

Install the flywheel.

Tighten the capscrews in the sequence illustrated.

Torque Value: 137 N•m [101 ft-lb]

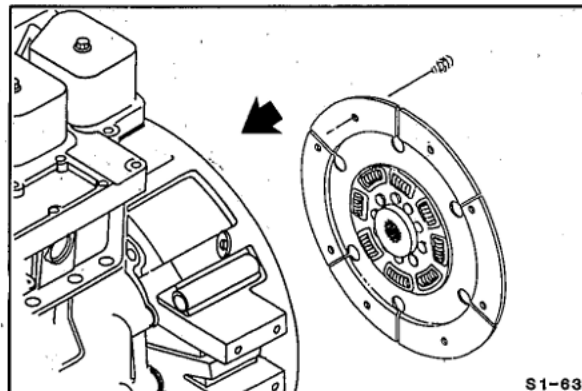


9/16 Inch

Install the drive plate with the spring hub in as illustrated.

Tighten the capscrews.

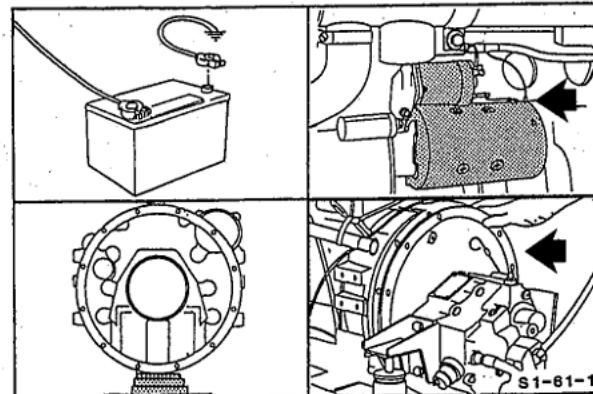
Torque Value: 47.5 N•m [35 ft-lb]

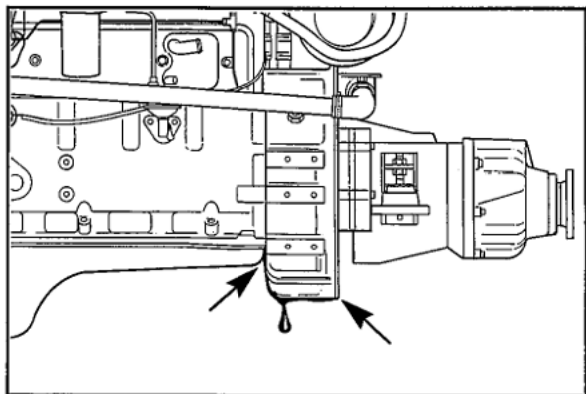


— Install the marine gear.

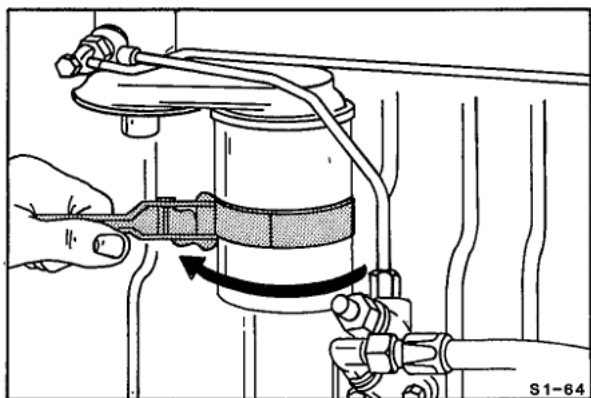
Warning: Because the starting motor weighs more than 23 Kg [50 lb], two people or a hoist will be required to lift it to avoid personal injury.

- Install the starting motor.
- Connect the ground battery cable.
- Remove the temporary engine supports.





Operate the engine and check for leaks.



Tappet Cover or Gasket (B Series) - Replacement

Preparatory Steps:

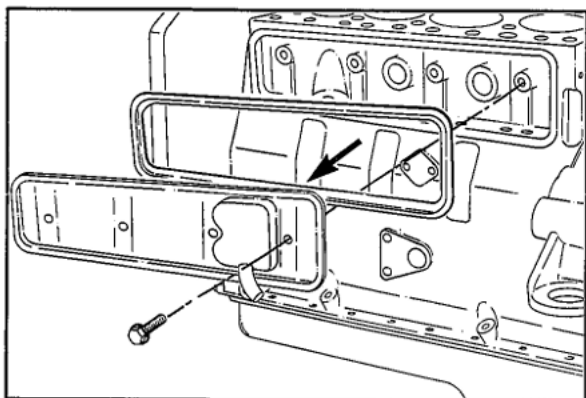
- Remove the fuel lift pump.
- Remove the fuel injection pump.
- Remove the aftercooler and its connections on the B-300 HP.
- Remove the raw water and air lines.



75 to 80 mm Filter Wrench



Remove the fuel filter and complete the following steps.

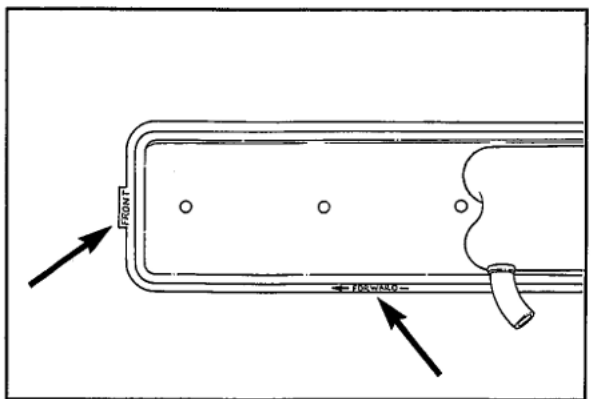


10 mm

Remove the tappet cover and gasket.



Clean the gasket sealing surfaces.



Some of the tappet cover gaskets have an adhesive back. Pull off the protective cover on the gasket to expose the adhesive surface.



Attach the gasket to the cover.



Apply K&W copper coat gasket sealant or equivalent to the block side of the gasket.



If a rubber gasket is used, do **not** use sealant. The tab **must** be to the front of the engine and the word "front" **must** be visible from the outside of the cover.

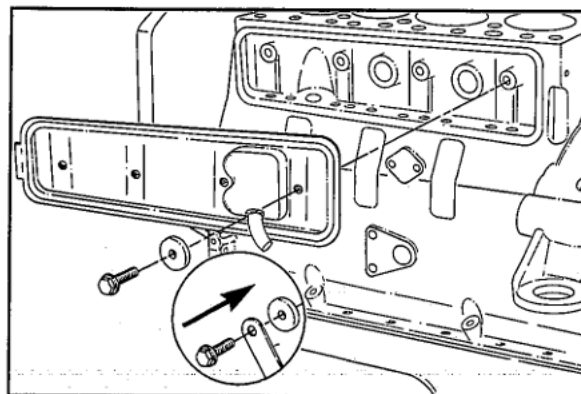
10 mm

Install the cover and baffle with the capscrews and new rubber seals.

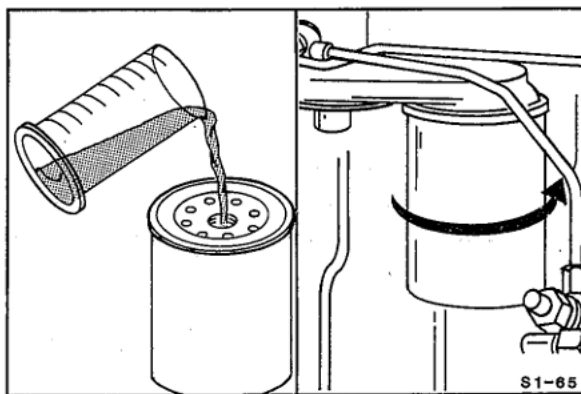
When installing the cover, position seals between the fuel drain lines and cover.

Tighten the capscrews.

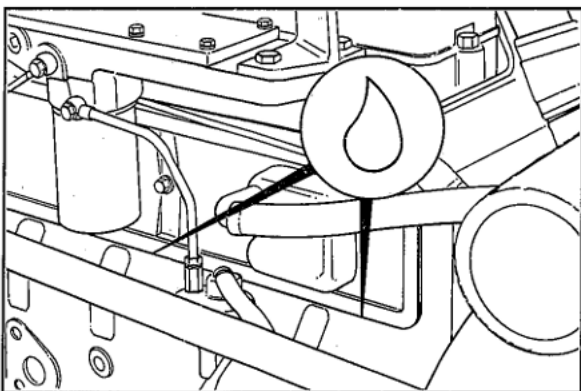
Torque Value: 24 N•m [18 ft-lb]



Fill the filter with clean fuel and install it to the head.



Install the parts removed in the Preparatory Steps and operate the engine and check for leaks.



Mounting and Drive Plate Repair Summary

Component To Be Replaced	Tools	Preparatory Steps
Drive Plate	9/16 Inch Socket, Ratchet, Torque Wrench	Disconnect the negative battery cable. Remove the marine gear.
Engine Mount	18 mm Socket, Ratchet, Torque Wrench	Disconnect the negative battery cable.

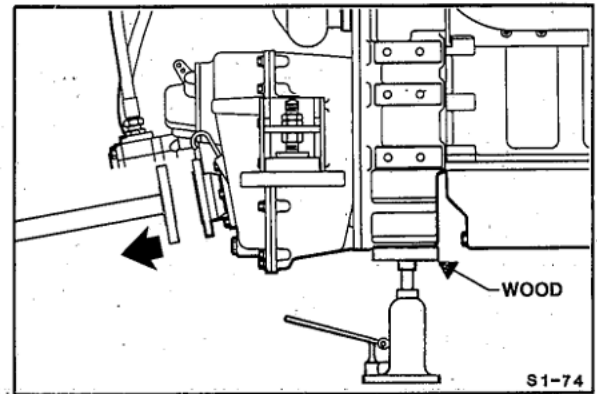
Drive Plate - Replacement

Preparatory Steps:

- Disconnect the negative battery cable.

Warning: Because the marine gear weighs more than 23 Kg [50 lb], two people or a hoist will be required to lift it to avoid personal injury.

- Disconnect the propeller shaft and support if necessary.
- Remove the marine gear.

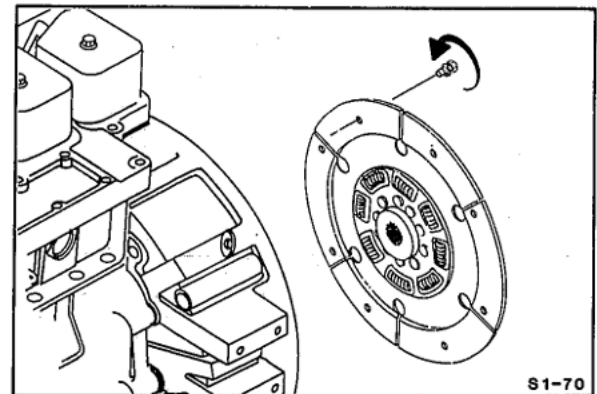


9/16 Inch

Note the installation position of the original drive plate. Some plates may require the springs inward, while others may be an opposite position.

- Remove the drive plate.
- Install the drive plate.
- Tighten the capscrews.
- Connect the negative battery cable.

Torque Value: 47.5 N•m [35 ft-lb]



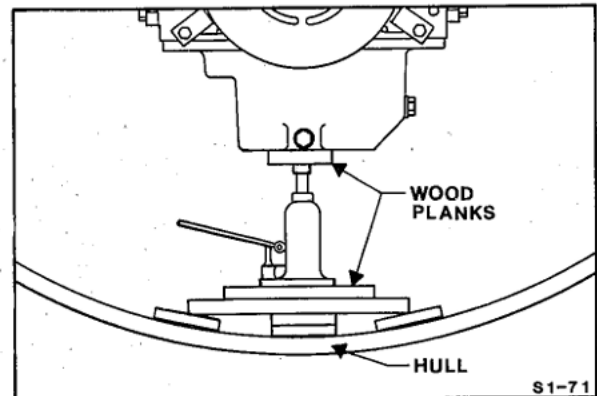
Engine Mount - Replacement

The Front Engine Mount

Preparatory Step:

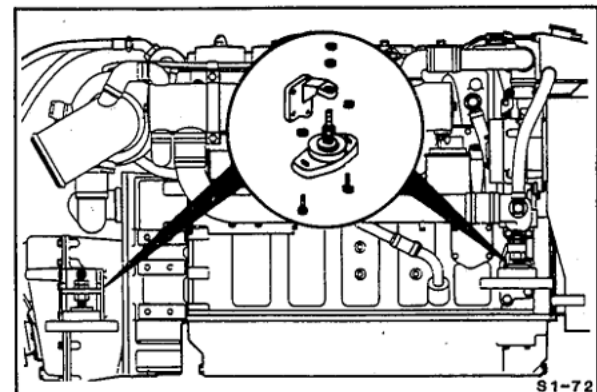
- Disconnect the negative battery cable.

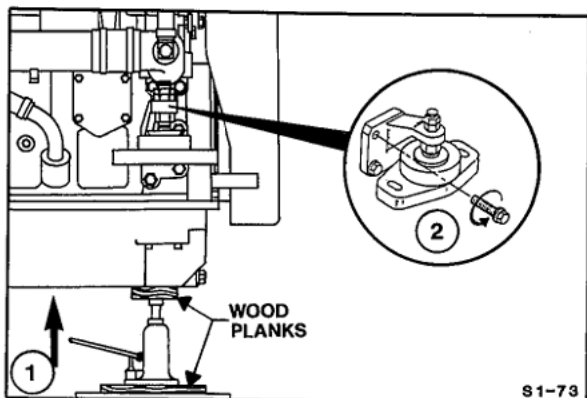
Use a jack to support the engine while changing mounts. Use pieces of wood to distribute the load over the oil pan and hull. The piece under the oil pan **must** be at least 200 mm [8 inches] long (placed transversely) and 40 mm [1-1/2 inches] thick. Spread the load over as much of the hull as possible with wood planks. Take up any slack in the jack.



Remove the vertically exposed nuts or bolts used on the front mounts. Loosen those on the rear mounts.

NOTE: Replace either the front or rear set of mounts before removing the second set.

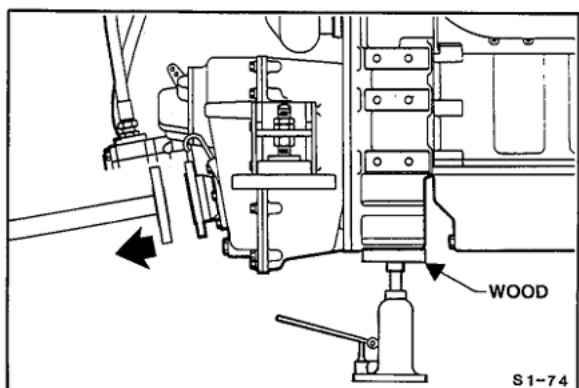




18 mm

Jack the front of the engine just enough to allow the mounts to be free of the base rails. Remove the six capscrews (three to a side) holding the mounts to the block and remove the mounts and isolators, if used.

Connect the negative battery cable.

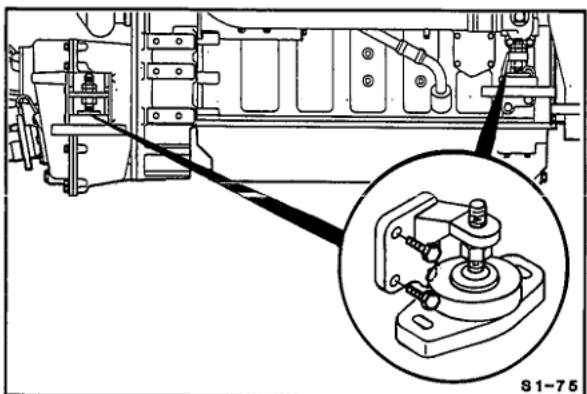


The Rear Engine Mount.

Preparatory Step:

- Disconnect the negative battery cable.

The same general method of jacking up the engine is used as with the front mount except that the jack is placed under the flywheel housing and if the drive shaft does **not** include two or more universal joints, it **must** be disconnected from the marine gear.

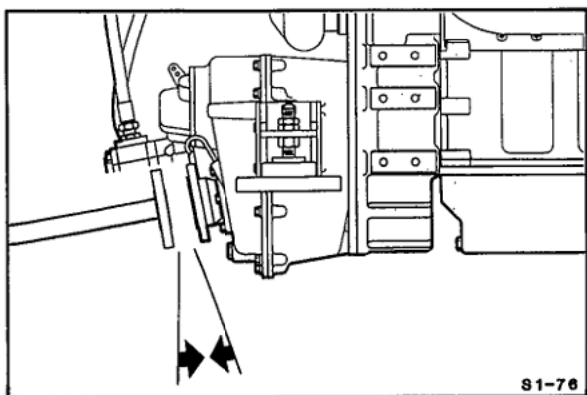


18 mm and Torque Wrench

Assemble the mounts in reverse order. Snug up the capscrews that retain the mounts to the block and marine gear. Remove the jack.

Tighten the capscrews.

Torque Value: 60 N•m [45 ft-lb]



Check for and correct any misalignment between the marine gear and drive shaft.

Refer to "Marine Installation Recommendations", Bulletin No. 3382579 for instructions.

Connect the negative battery cable.

Engine Electrical System Repair Summary

Component To Be Replaced	Tools	Preparatory Steps
Starting Motor	10 and 16 mm Wrench 10 mm and 12 point Socket - B Series 12 mm, 12 point Socket - C Series Ratchet and Torque Wrench	Disconnect the ground cable to the battery.
Alternator	Ratchet, 11, 10 and 16 mm Socket and Torque Wrench 1/2 Inch Square Drive Breaker Bar	Disconnect the ground cable to the battery. Remove the drive belt and protective cover.
Battery	9/16 and 1/2 Inch Wrench	
Gauge	9 mm Wrench	Gain access to the panel Tag and disconnect the wiring.
Tachometer Adjustment	Small Screwdriver, Hand Held or Electrical (Strobe) Tachometer	Gain access to the tachometer adjusting screw Start the engine.

NOTE: Electrical System Wiring Diagrams are in Section D.

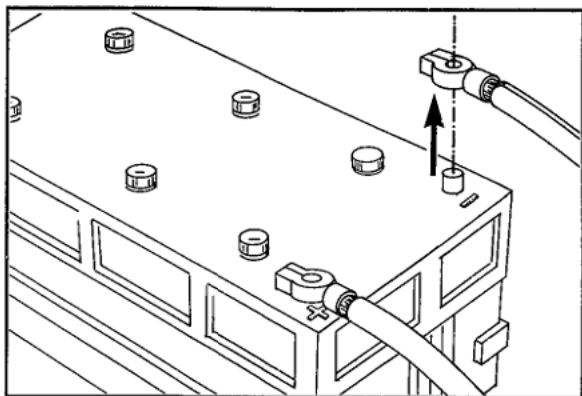
Electrical System - Replacement Procedures

Starting Motor - Replacement

Preparatory Step:



- Disconnect the cable from the negative battery terminal.



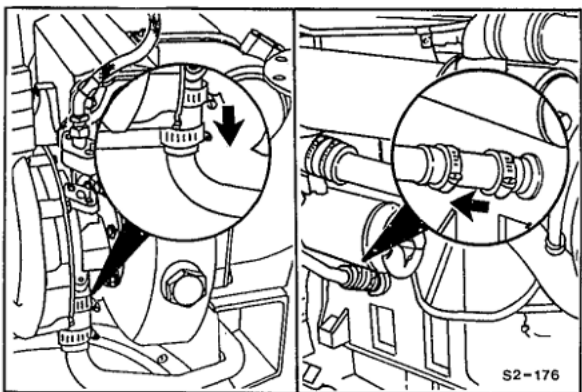
5/16 Inch or Flat Screwdriver



Loosen the hose clamps and remove the turbocharger oil drain tube.



Installation Torque: 5 N•m [44 in-lb]



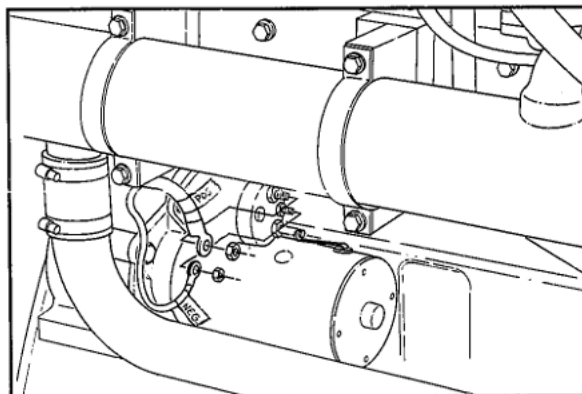
10 and 16 mm (B Series), 3/8 and 3/4 Inch (C Series)



Tag each electrical wire as to location.



Remove the wires from the starter terminals.



10 mm 12 Point Socket, Long Extension and Torque Wrench (B Series)



12 mm 12 Point Socket, Long Extension and Torque Wrench (C Series)



Warning: Because the starter motor weighs more than 23 Kg [50 lb], two people or a hoist will be required to lift it to avoid personal injury.



Remove the starter motor.

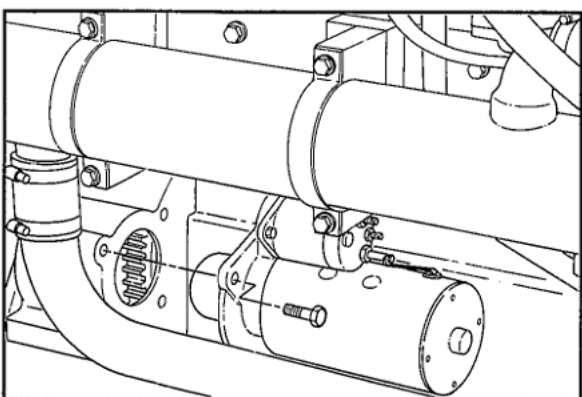


Install the starter motor in reverse order of removal.



Torque Value: 43 N•m [32 ft-lb] B Series
77 N•m [57 ft-lb] C Series

Install the turbocharger oil drain tube.

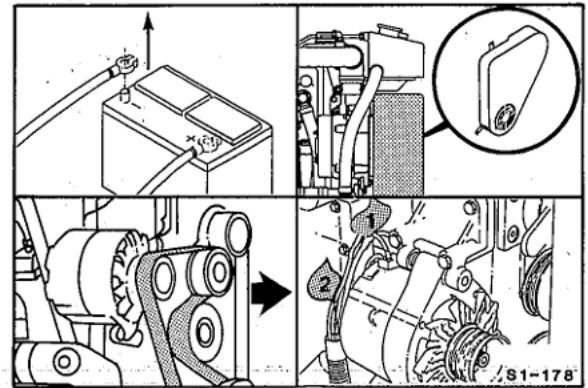


Alternator - Replacement

3/8 Inch Square Drive, 11 and 13 mm

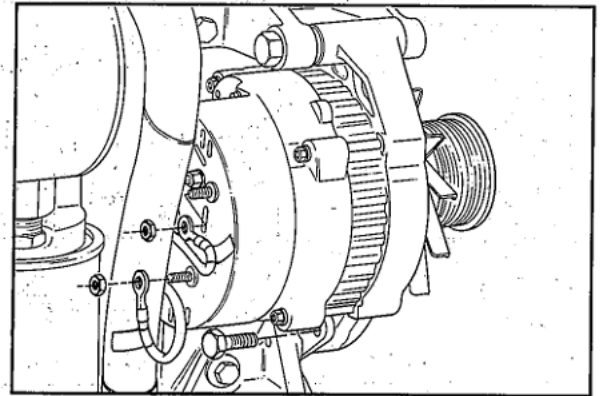
Preparatory Steps:

- Disconnect the battery ground battery cable.
- Remove the belt guard.
- Remove the drive belt from the alternator pulley.
- Tag and remove all alternator wires and complete the following steps.



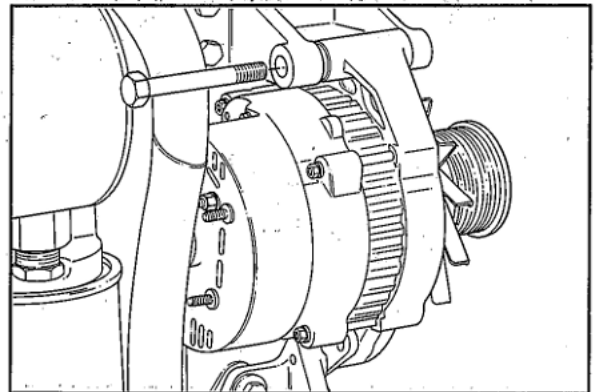
13 mm (B Series), 19 mm (C Series)

Remove the alternator link capscrew.



16 mm (B Series); 15, 18, and 19 mm (C Series)

Remove the alternator mounting capscrew(s).



13 and 16 mm (B Series), 15, 18 and 19 mm (C Series)

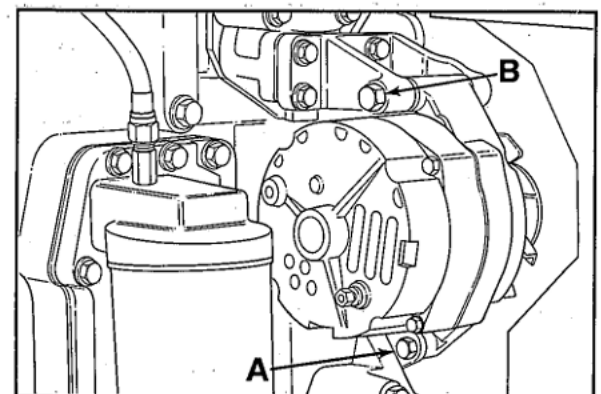
Install the alternator in the reverse order of removal. Tighten the capscrews as illustrated.

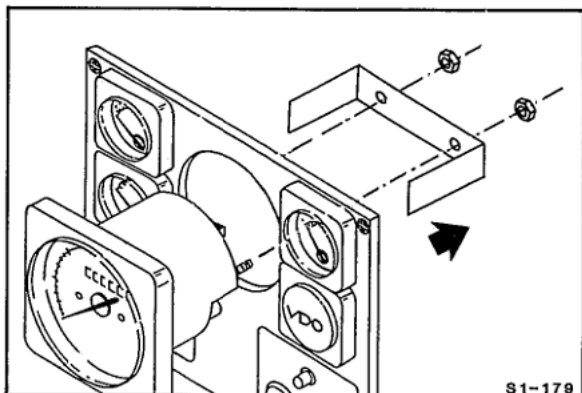
Torque Value: Both B and C Series

A - 24 N•m [18 ft-lb]

B - 43 N•m [32 ft-lb]

Install the alternator wires, drive belt, belt guard and negative battery cable.





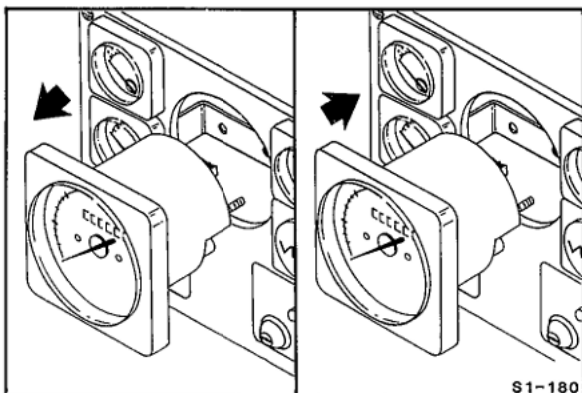
Gauge - Replacement

9 mm

Preparatory Step:

- Disconnect the battery ground cable.
- Tag and disconnect the appropriate wiring.

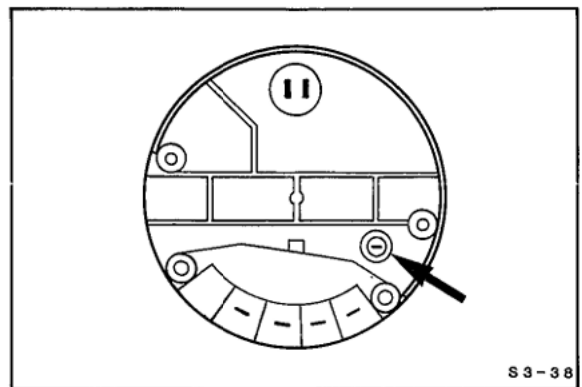
Remove the mounting nuts and bracket.



9 mm

Remove the defective gauge.

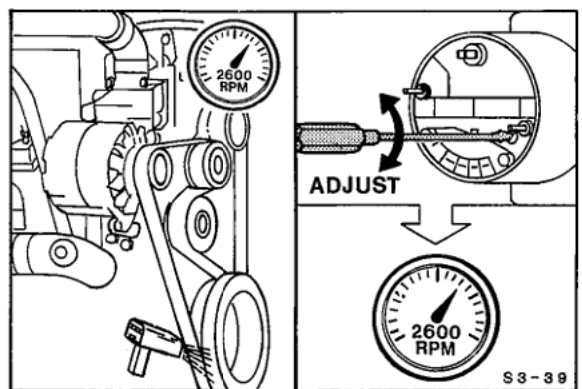
Install the new gauge in reverse order of removal.



Tachometer (Alternator Type) - Adjustment

Early premium instrument panels received the speed signal from the alternator.

The tachometer calibration screw is on the rear of the tachometer.



Start the engine. Allow it to operate at approximately rated speed.

Use an electronic or mechanical tachometer to determine the actual engine speed.

Adjust the panel tachometer to indicate the actual engine speed.

If there is a second station panel, repeat this procedure for the second station tachometer.

Tachometer (Magnetic Pick-Up Type) - Adjustment

Later premium instrument panels receive the speed signal from the magnetic pickup in the flywheel housing.

A selector switch for the flywheel size and a tachometer calibration screw are both located on the rear of the tachometer.

Verify that the selector switch is in the correct position.

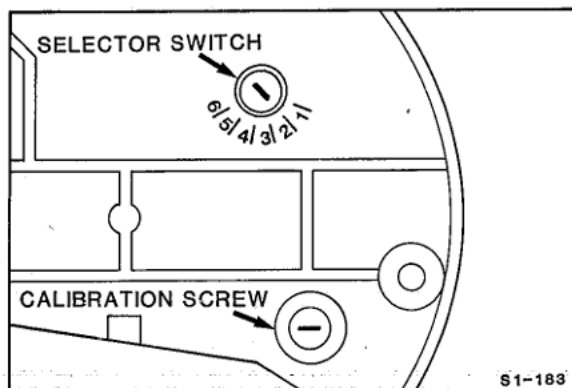
Position	Engine	Flywheel	No. Ring Gear Teeth
3	C	#3	127
4	C	#2	138
5	C	#1	158
	B	#3	159

NOTE: Positions 1, 2 and 6 are **not** used.

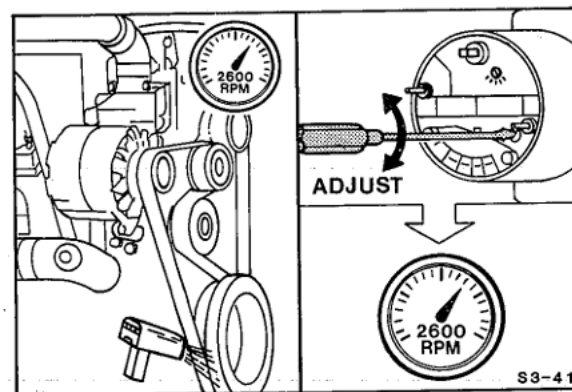
Start the engine. Allow it to operate at approximately rated speed.

Use a calibrated hand tachometer as previously mentioned to determine the actual engine speed.

If there is a second station panel, verify that the selector switch is in the correct position. Repeat this procedure for the second station tachometer.



S1-183



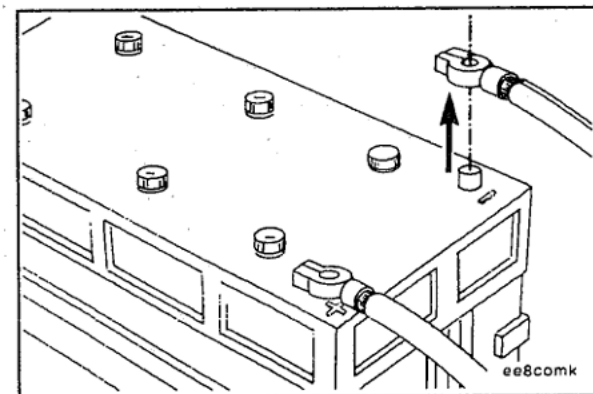
S3-41

Auxiliary Magnetic Switch (AMS) - Replacement

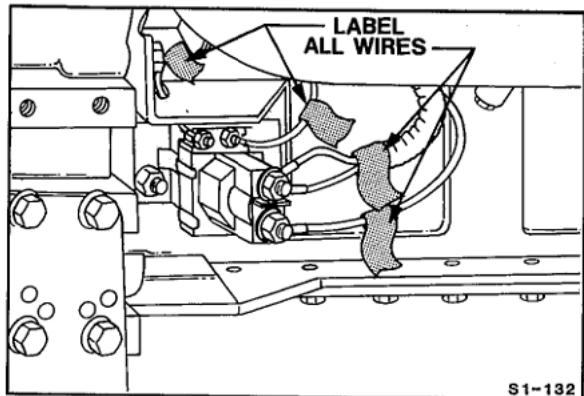
1/2 Inch

Caution: When removing and connecting the battery cables, disconnect the ground lead first and connect the ground lead last to avoid electrical shock or sparks which can ignite explosive gases.

Remove the battery ground cable.



ee8comk

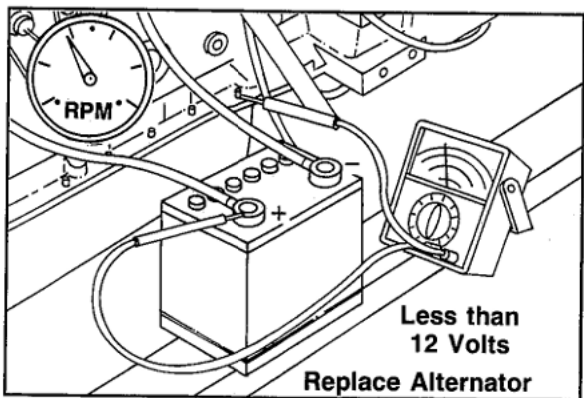


3/8 Inch, 19 mm

Label and disconnect the leads from the AMS.



Remove and replace the AMS.



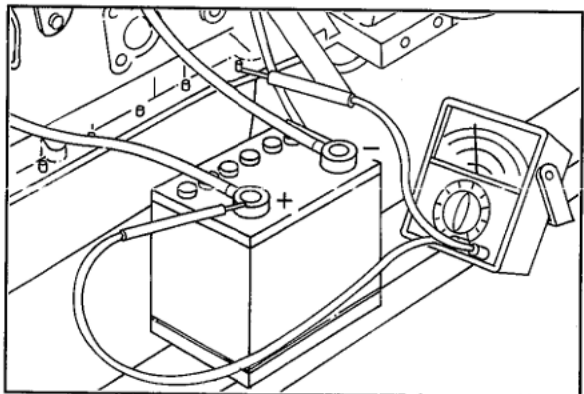
Alternator - Checking

If low battery charge was found to be the problem, check the engine alternator.



After checking for proper battery cable connection and with the engine running, measure the voltage between the positive battery cable and the engine block (ground).

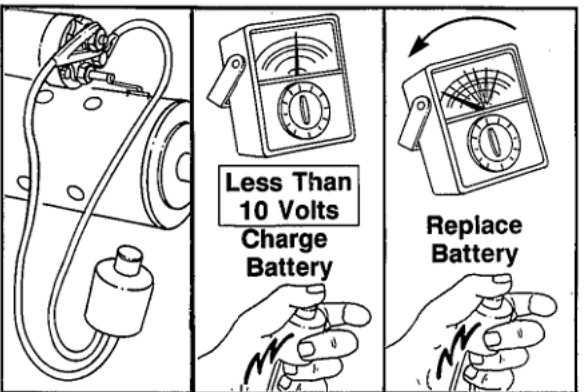
Replace the alternator if voltage is less than 12 volts DC for 12 volt system or 24 volts DC for 24 volt system.



Battery - Checking

Measure the voltage between the positive battery cable and the engine block (ground). Note the voltage.

NOTE: Additional battery checking procedures are in Section 4.



Using a remote start connection, attempt to engage the starting motor while observing the voltage.



If the voltage reads less than 10 volts DC, charge the battery.

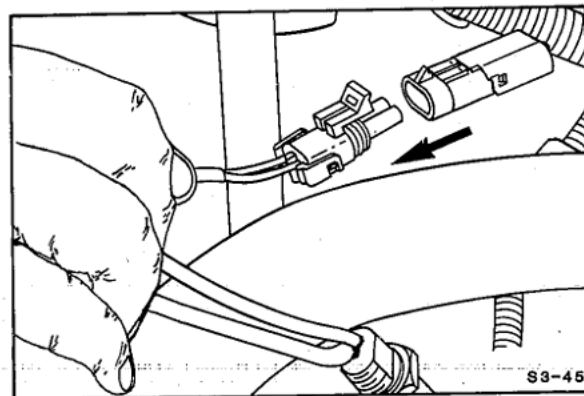
If the voltage drops rapidly, more than 2.4 volts DC, replace the battery.

The troubleshooting procedure is the same for 24 volt systems.

- Voltage Limit - 20 volts DC
- Voltage Drop - 4.8 volts

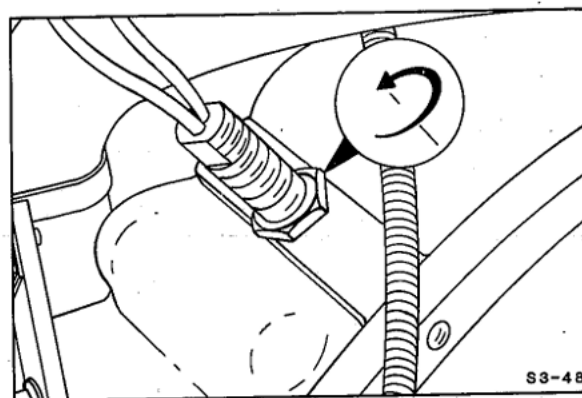
Magnetic Pickup - Replacement

Unplug the magnetic pickup from the wiring harness.



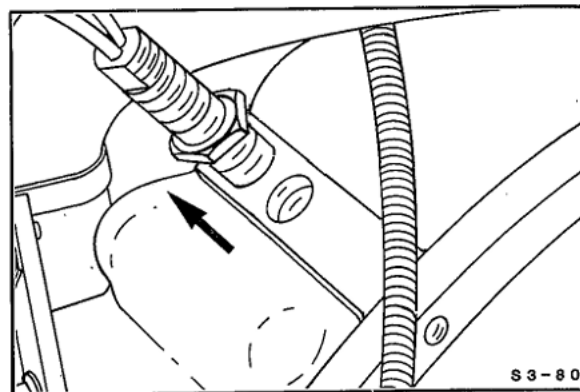
1 1/8 inch

Loosen the locknut from the flywheel housing.

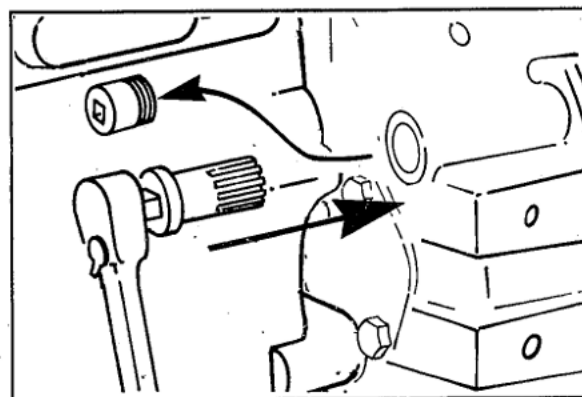


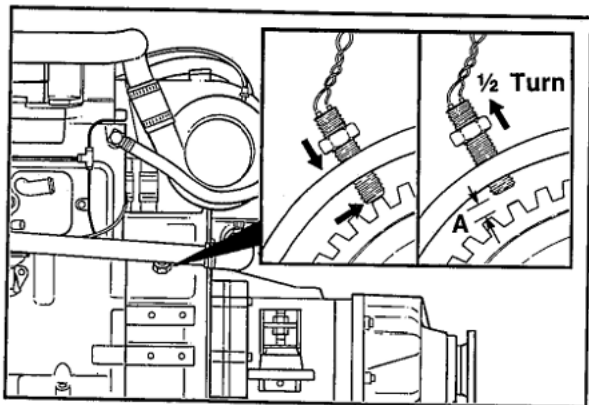
3/4 inch

Remove the magnetic pickup from the flywheel housing.



Use barring gear Part No. 3377371 to rotate the crankshaft so that a ring gear tooth is at the center of the hole for the magnetic pickup.



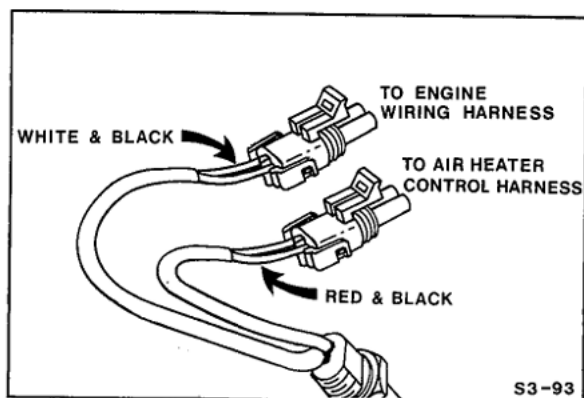


3/4, 1 1/8 inch

Turn the magnetic pickup until the magnet end touches the ring gear tooth.



Then back off a 1/2 of a turn and while holding the magnetic pickup, tighten the jam nut.



Install the magnetic pickup receptacle which has the red and black leads on the air heater control harness plug. The white and black wired plug is connected to the wiring harness for the tachometer sensing.

Intake Manifold Heater System B-300 and C-400 HP

General Information

White smoke indicates unburned fuel during cold engine operation.

The intake manifold heater system is **not** directly connected to the fuel system but it monitors the temperature of the air to the engine. The thermistor sends varying resistance values to the Electronic Control Module (ECM). The ECM in turn controls the optional "Wait to Start" light and heater solenoids.

The intake manifold heater elements operate in both the preheat, postheat, and postheat recycle modes.

* In preheat, the ignition switch is in the RUN position but the engine has **not** been started.

* In postheat and postheat recycle, the engine is running.

The proper operation of the intake manifold heater system and starting procedures will preclude excessive engine starter motor use and minimize white exhaust smoke when the engine is first started.

NORMAL OPERATION OF THE INTAKE MANIFOLD HEATER SYSTEM

ENGINE INTAKE MANIFOLD TEMP.	PREHEAT CYCLE TIME IGN. KEY "ON" BEFORE CRANK CYCLE	POSTHEAT CYCLE OCCURS IGN. KEY "ON" AFTER CRANK CYCLE	POSTHEAT RECYCLE MODE AFTER POST HEAT
Above 35°C [95°F]	None	None	None
23.1°C to 35°C [73.6°F to 95°F]	10-Seconds	None	25/75 (1)
15.1°C to 23°C [59.2°F to 73.4°F]	10-Seconds	20-Seconds	50/50 (2)
0°C to 15°C [32.1°F to 59°F]	15-Seconds	20-Seconds	50/50 (2)
Below 0°C [32°F]	20-Seconds	20-Seconds	50/50 (2)

Cycle Mode	Element (Heater)	5 Second Time Intervals						
		On	Off	On	Off	On	Off	On
(1) 25/75	1	On	Off	Off	Off	On	Off	Off
	2	Off	Off	On	Off	Off	Off	On
(2) 50/50	1	On	Off	On	Off	On	Off	On
	2	Off	On	Off	On	Off	On	Off

Intake Manifold Heater Operation

The intake manifold heater option is installed between the raw water aftercooler and the intake manifold. The heater is totally electrically operated. The intake manifold heater aids in reducing white smoke at start-up and will aid in the engine's startability at colder temperatures. Components required to operate the intake heater are:

- * Ignition Key Switch
- * Air Heater Control Moduel (ECM)
- * Thermistor
- * Solenoids
- * Intake Heater (with two elements)
- * Magnetic Pickup
- * and related Wiring

The Intake Heater System operates as follows:

- * Ignition switch in the RUN position supplies voltage to the AIR HEATER SYSTEM.
- * ECM receives supply voltage from the ignition switch.
- * The ECM will receive electrical signals from sensors mounted on the engine.
- * The ECM will sense battery voltage off of the fuel pump solenoid circuit.
- * The THERMISTOR will sense intake manifold temperature and will change its resistance value for different temperatures to the ECM. Temperatures below 35°C [95°F] will activate the ECM's heater command circuit. This is known as the PREHEAT CYCLE.
- * The ECM heater command circuit will provide voltage to activate the AIR HEATER SOLENOIDS. Supply current/voltage to the heater elements is provided by a cable connected to the starter solenoid.
- * Different temperatures sensed by the THERMISTOR will dictate different PREHEAT cycle times, up to a maximum of 20 seconds.

NOTE: BOTH ELEMENTS WILL HEAT DURING THIS CYCLE.

- * The start button on the instrument panel can now be pushed to start the engine.

NOTE: If the start button is pushed before the cycle time is complete, the ECM will automatically shut off the elements during cranking.

- * The MAG-PICKUP "speed sensor" on the flywheel housing will sense engine speed. An electrical signal will be sent to the ECM indicating that the engine speed is over (600 RPM) B Series and over (350 RPM) C Series.

- * Battery voltage will be monitored by the ECM system. Operating voltage range is (MIN 10.5 to MAX. 17 volts DC).

- * Also at this time, the THERMISTOR senses intake manifold temperature. If the temperature is below 24°C [75°F], the system will start into a POSTHEAT CYCLE mode.

- * This cycle may continue for up to 20 seconds maximum.

NOTE: BOTH ELEMENTS WILL HEAT DURING THIS CYCLE.

- * The POSTHEAT RECYCLE mode will start after the POSTHEAT mode.

NOTE: The POSTHEAT RECYCLE will occur for a maximum of 20 minutes if the intake manifold temperature is below 35°C [95°F], system voltage is between 10.5 and 17 volts DC, and the engine is running between 600 and 1200 RPM on B-Series or 350 to 1200 RPM on C-Series.

- * The POSTHEAT RECYCLE mode will activate the heater elements in two sequence modes.

- * 25/75 - both elements cycle on and off with a 5 second delay between element activation. Each activation cycle will last for 5 seconds and only one element will be activated at a time.

- * 50/50 - both elements cycle on and off for 5 seconds.
Note: Only one element will be activated at a time.

- * POSTHEAT RECYCLE will operate for a maximum of 20 minutes. This operating cycle can be interrupted at any time, if any one of the following conditions occur:

1. Engine exceeds 1200 RPM.
2. Intake manifold temperature exceeds 35°C [95°F].
3. ECM battery sensing voltage below 10.5 VDC or above 17 VDC.

- * If the POSTHEAT RECYCLE is interrupted during its 20 minute cycle, the cycle will restart, and reset for another 20 minutes if all of the following conditions occur:

1. Engine below 1000 RPM.
2. Intake manifold temperature below 30°C [85°F].
3. ECM battery sensing voltage between 10.5 - 17 VDC.

- * Once the 20 minute POSTHEAT RECYCLE has ended, the ignition key must be turned to the off position and back to the run position to restart the air heater cycles again.

- * Note: All appropriate wiring diagrams are in Section D of this manual.

“Wait to Start” Light Circuit - Operation and Diagnosis

The following information detailing the “wait to start” light circuit normal operation and possible fault troubleshooting requires a “wait to start” light. This light is presently supplied by the boat builder in some cases. If your boat is **not** equipped with this option, refer to Section A of this manual for details of a (“wait to start” light - installation) procedure if necessary.

Normal Operation

When the ignition switch is turned ON, the “wait to start” light will blink ON and OFF one time. This occurrence is a system check, when the ECM is powered up by battery voltage from the fuel pump solenoid circuit (purple wire from the engine wiring harness). During the time the light blinks, the ECM provides voltage to activate one heater solenoid momentarily, which can be heard as a click sound. To check the air heater system above 35°C [95°F], disconnect the wiring harness from the thermistor. This will initiate a 20 second preheat cycle, no POSTHEAT or POSTHEAT RECYCLE, and the “wait to start” light will blink continuously after the 20 second PREHEAT CYCLE.

Possible Fault 1 - Air Heater Does Not Operate

- A. If the “wait to start” light does **not** blink on when the ignition switch is turned ON, but comes on and remains on for more than 20 seconds, check the following.
 - 1. Defective fuse in the air heater wiring harness.
 - 2. Open circuit between the engine wiring and air heater harnesses at the fuel pump solenoid (purple wire).
 - 3. No voltage to the air heater fuse holder cavity B (wire No. 018) on B-Series and (No. 014) on C-Series.
 - 4. Open circuit between air heater fuse holder cavity A (wire No. 013) and pin No. 2 in the heater harness multi-pin connector.
- B. If the “wait to start” light does **not** come on under any condition, check the following.
 - 1. Defective “wait to start” lamp.
 - 2. No supply voltage to the “wait to start” lamp.
 - 3. An open circuit between the ground side of the “wait to start” lamp and pin No. 7 in the air heater wiring harness multi-pin connector.
 - 4. Open ground circuit between the engine block, which wire 012 connects to and the ECM ground connection (pin 8).
 - 5. Replace the ECM if the above check is ok.
- C. If the “wait to start” light blinks on one time only, check the following.
 - 1. Low or no sensing voltage to the ECM. Check continuity between pin No. 2 and 16. A resistance value of 15 K ohms + or - 1% should be indicated. If not, replace the resistor.
 - 2. The thermistor or thermistor circuit is shorted. Check the resistance value between pin No. 4 and 5 at the multi pin connector. The resistance should not be 0 ohms. If so, replace the defective thermistor or repair the harness.

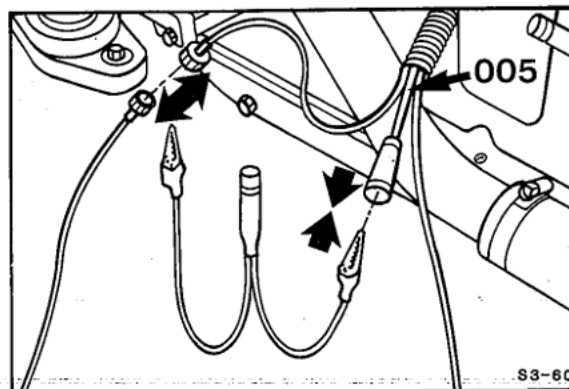
Possible Fault 2 - Air Heater Will Only Preheat

The “wait to start” light is on for a 20 second preheat cycle at any ambient temperature and then blinks on and off continuously as long as the ignition switch is ON. The items below would also apply if the “wait to start” lamp starts blinking during engine operation. If this occurs, check the following:

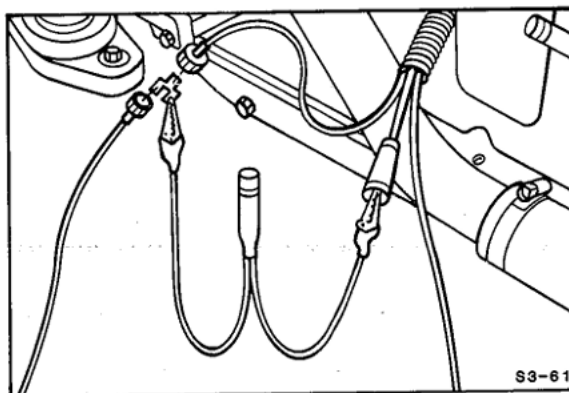
- 1. Air heater harness is disconnected from the thermistor.
- 2. Faulty (open circuit) thermistor.
- 3. Open circuit in the air heater wiring harness to the thermistor. Check continuity between the thermistor harness plug cavity A (wire No. 003) and pin No. 4 in the heater harness multi-pin connector. Do the same check between cavity B (wire No. 004) and pin No. 5.
- 4. Replace the ECM if the above checks are ok.

Wait to Start Light - Installation

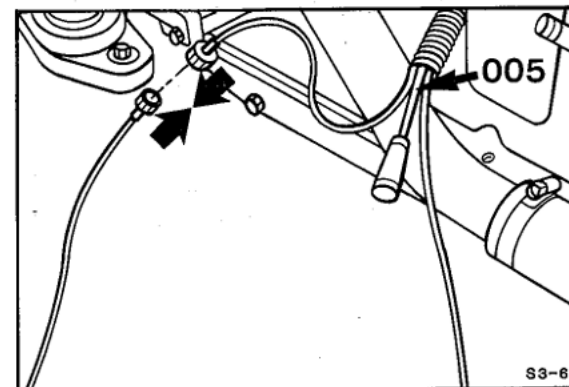
If an optional "wait to start" light is **not** supplied, connect a temporary test light (500 mA maximum) to the (wait to start lamp) wire No. 005. This is the third lead that is in the wiring harness that goes to the fuel solenoid.



Connect the other lead of the test light to positive 12 VDC. This can be done at the fuel solenoid connection or the battery if so desired.



Remove the temporary test light when operational and troubleshooting checks have been completed.



Intake Manifold Heater - Checking

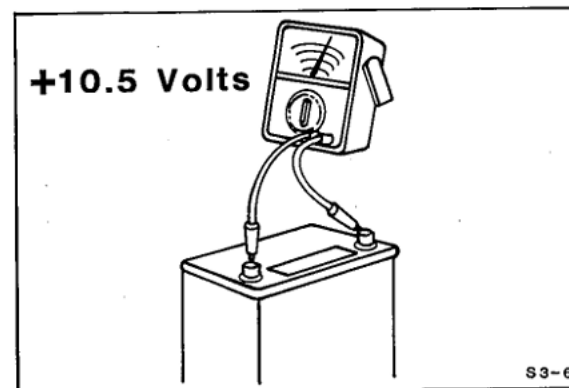
Battery Voltage - Checking

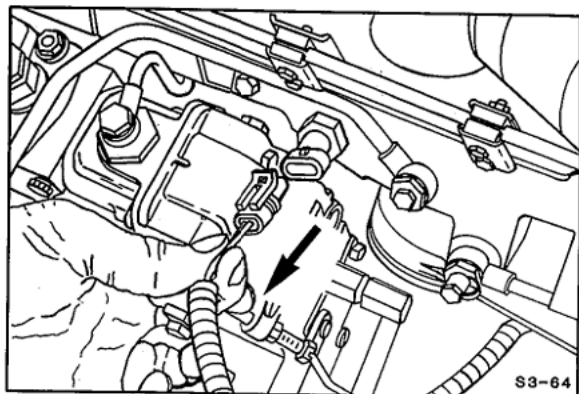
Connect a multimeter. Check voltage between the battery positive terminal on the starter and ground on the engine.



The battery voltage **must** be above 10.5 volts DC and below 17 volts DC.

A normal reading is 12 to 13 volts DC.

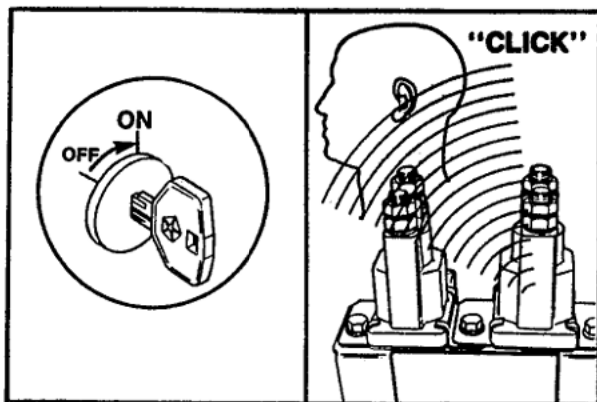




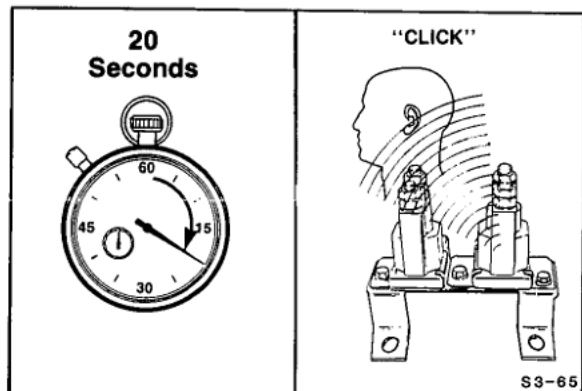
Thermistor Circuit - Checking



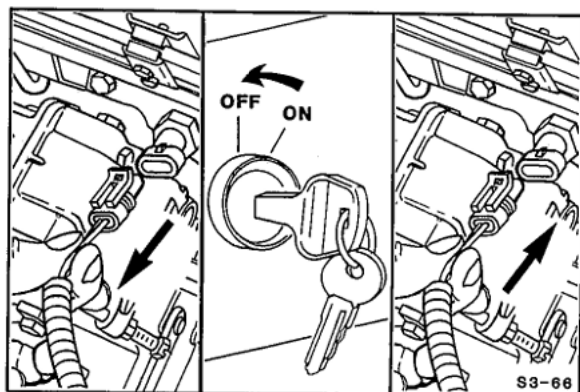
Disconnect the thermistor electrical connector, which is located in the intake manifold.



Turn the key switch to the ON position.
Both heater solenoids should click on.
The "Wait to Start" light should come on.



Wait 20 seconds.
Both solenoids should click off.
The "Wait to Start" light will flash once per second.
This indicates an open circuit in the thermistor wiring.

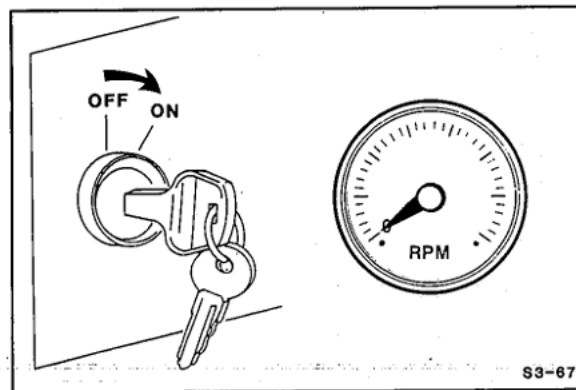


Disconnecting the thermistor simulates this condition. No intake manifold heater postheat will occur while the thermistor is disconnected.

Turn the ignition switch to the OFF position.
Connect the thermistor wire harness connector.

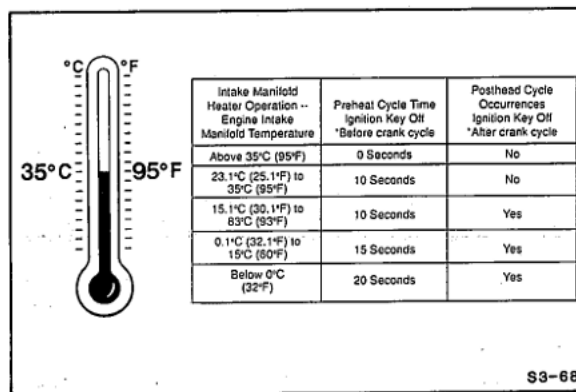
Preheat Cycle - Checking

Turn the ignition switch to the ON position.
Do **not** start the engine.



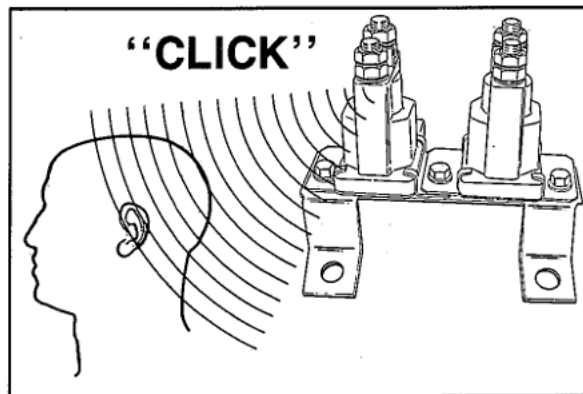
NOTE: If the intake manifold air temperature is below 35° C [95° F], the heater will preheat before the engine starts.

(As long as the intake manifold air temperature is below 35° C [95° F], this will repeat each time the key switch is turned from the OFF to the ON position.)



Both solenoids should click on if the intake manifold temperature is below 35° C [95° F].

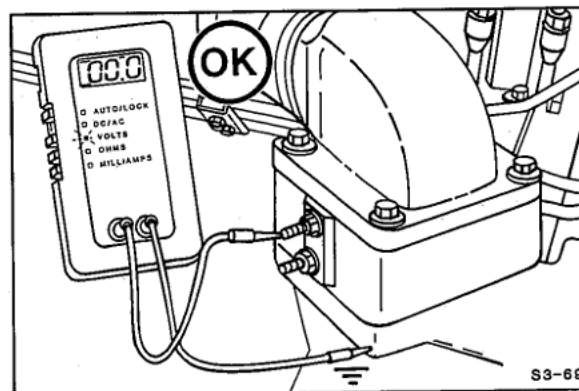
NOTE: If the engine has been running, and the temperature is above 35° C [95° F], the preheat cycle will **not** start.

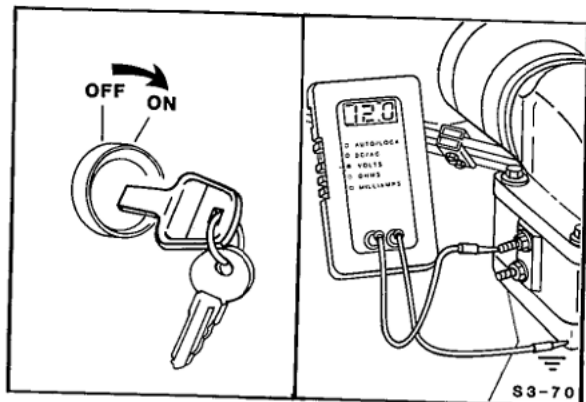


Post Heat Cycle - Checking

Connect the positive lead of the voltmeter or test lights to the heater terminals.

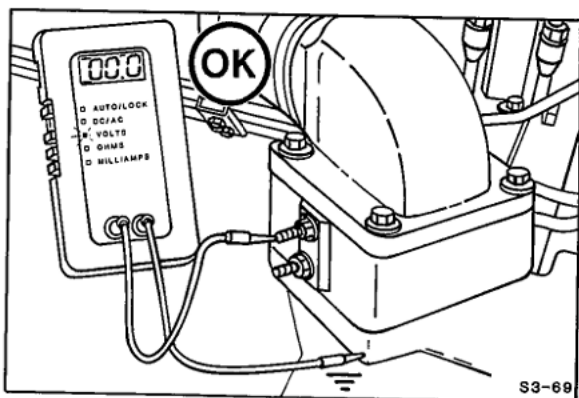
Ground negative leads to engine block.





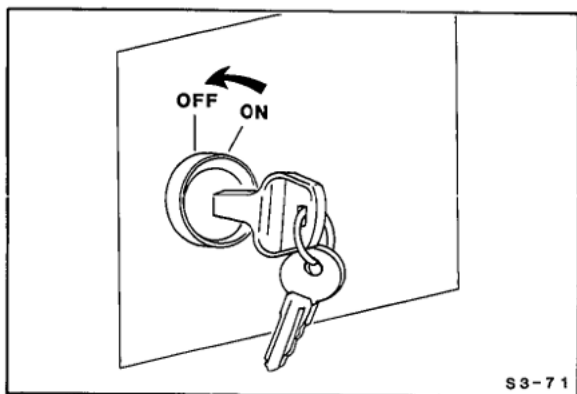
A. Turn the key switch ON.

If the intake air manifold temperature is below 35° C [95° F], the multimeter should indicate at least 10.5 volts or test lights should be illuminated.



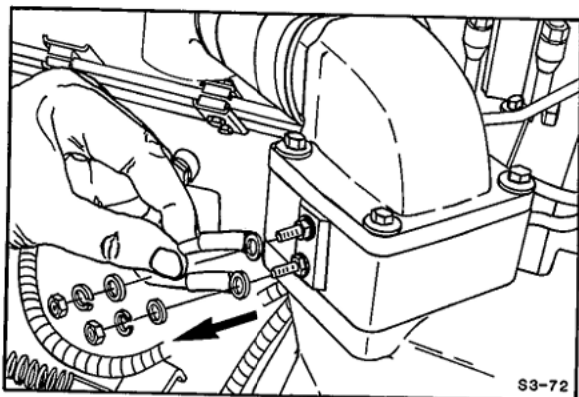
B. Wait 20 seconds, or when the voltmeter voltage drops to 0, then push the start pushbutton for a maximum of 10 seconds.

The voltmeter should indicate zero voltage while cranking.



If the engine does **not** start, turn the key switch OFF.

Then repeat Steps A and B. After the engine is running (at less than 1200 RPM) the voltmeter should indicate at least 10.5 volts if the intake manifold temperature is below 23° C [75° F].



Intake Manifold Heater Element - Checking/Replacement

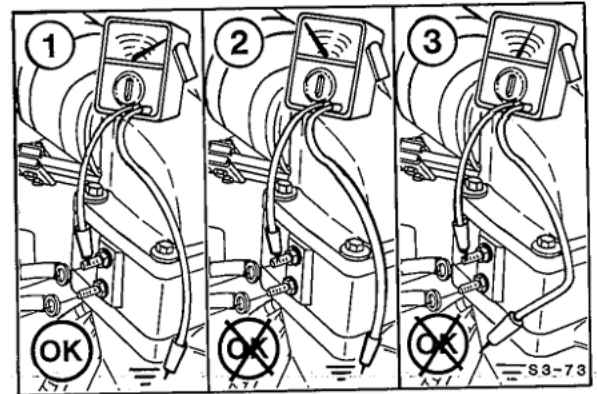
3/8 inch

Disconnect the ground cable from the battery.

Remove the two wires from the heater.

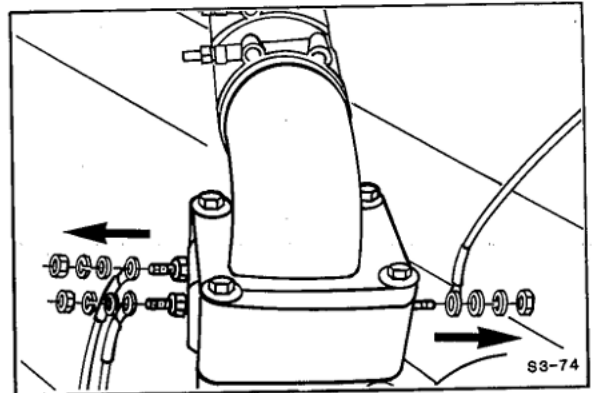
Use an ohmmeter and check the resistance from ground to each heater terminal. The resistance should indicate "0". Replace the heater or repair connections if necessary.

1. Meter indicates "0" = Good heaters
2. Meter does **not** move = Bad heaters
3. Meter indicates, but **not** "0" = Dirty or corroded connections - clean and repair as necessary.



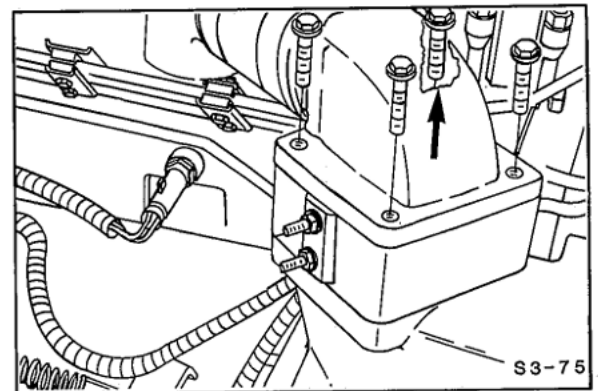
5/16 inch

Remove all three electrical leads from the intake manifold heater.

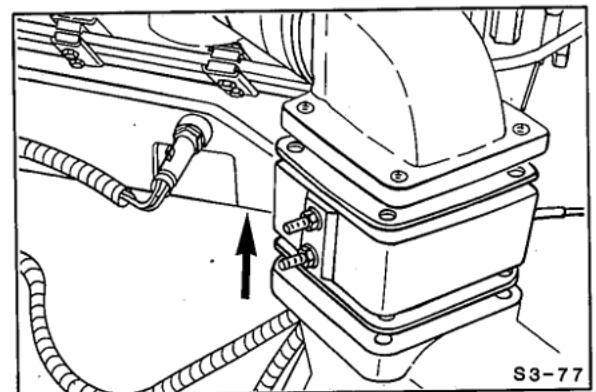


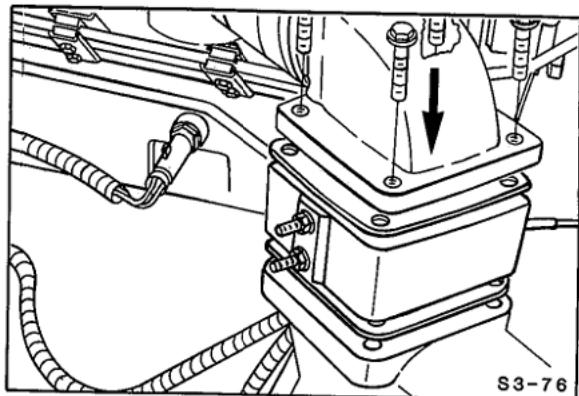
10 mm

Remove the four capscrews which attach the air cross-over connection and heater.



Remove the heater and gaskets.
Clean the mounting surfaces.



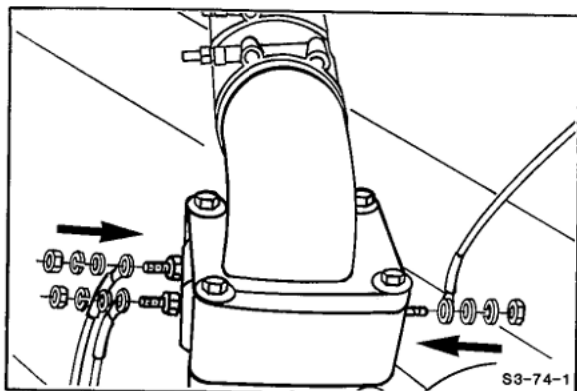


Install new gaskets and the intake manifold heater.

Install the four capscrews and the single black (ground) heater lead.

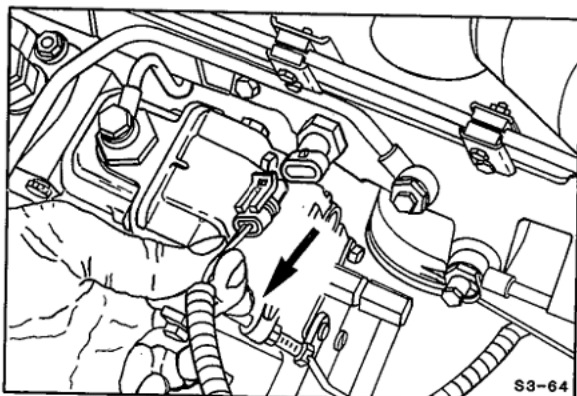


Torque Value: 24 N•m [18 ft-lb]



5/16 inch

Install the two red and the single black intake manifold heater leads on the heater terminals.



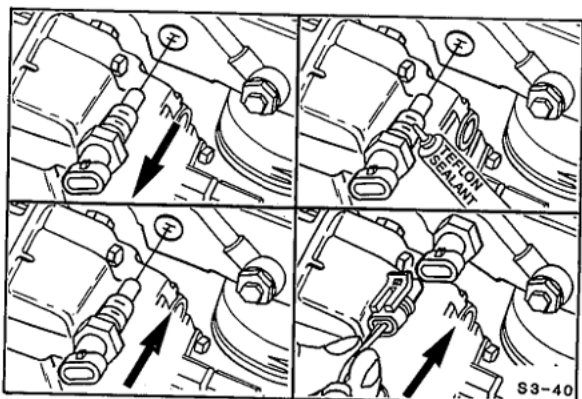
Air Heater Thermistor - Replacement

The B Series air heater thermistor is located in the air intake manifold just forward of the fuel filter outlet connection.

The C Series air heater thermistor is located in the air intake manifold cover just forward of the air heater.



Disconnect the wiring from the thermistor.



1-1/16 inch

Remove the air heater thermistor.



Apply liquid teflon sealant to the threads of the new thermistor.



Install the thermistor.

Torque Value: 24 N•m [18 ft-lb]

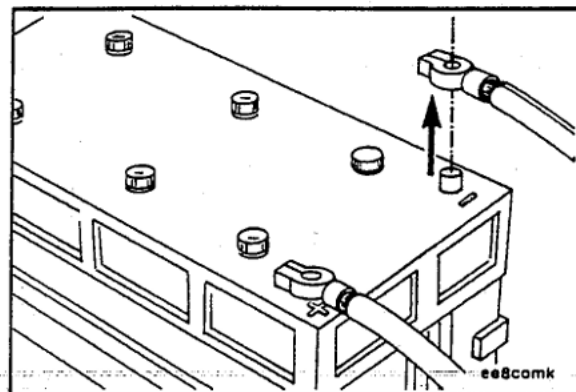


Install the thermistor wiring.



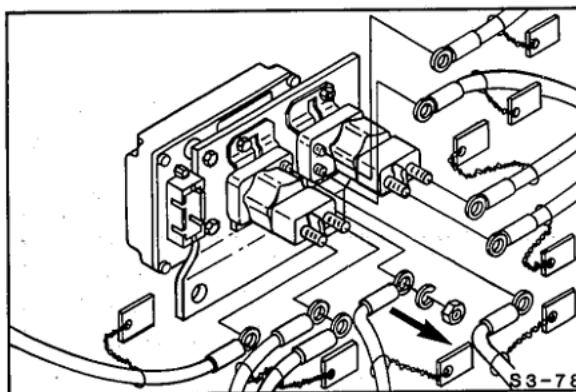
Air Heater Solenoid - Replacement

Disconnect the ground cable from the battery terminal.



5/16, 1/2 inch

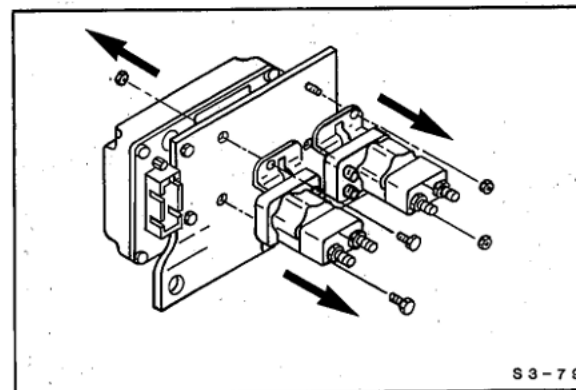
Label and remove the leads on the air heater solenoid(s) to be replaced.



7/16 inch

Remove the air heater solenoid(s) from the mounting plate.

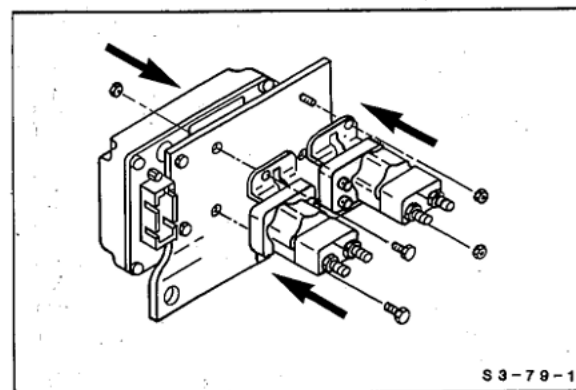
NOTE: The right hand solenoid is held by a nut at the top.

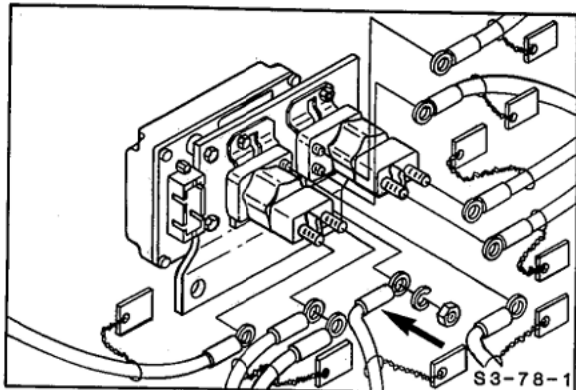


7/16 inch

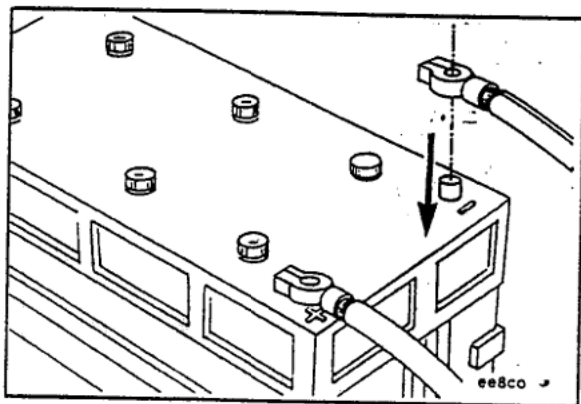
Mount the new solenoid(s) with the small coil terminals toward the center of the assembly.

Torque Value: 9 N•m [80 in-lb]

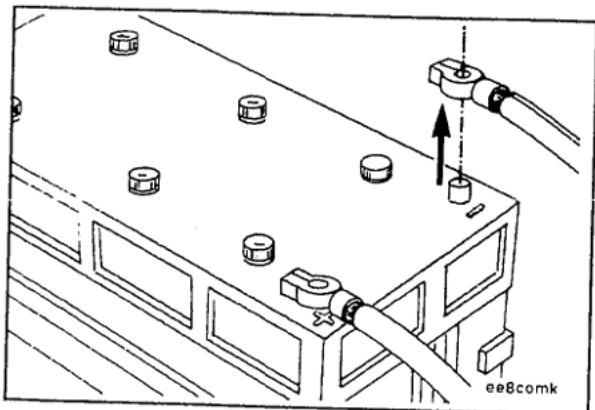




5/16, 1/2 inch
Install the leads.

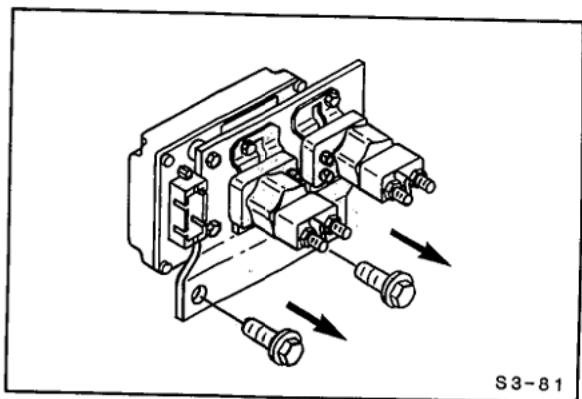


Connect the ground cable to the battery terminal.



Air Heater Control Module (ECM) - Replacement

Disconnect the ground cable from the battery terminal.



18 mm

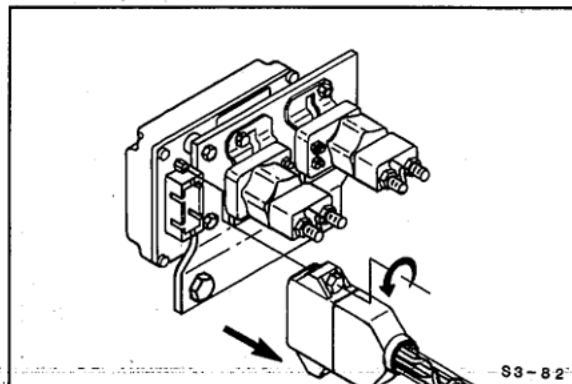
Remove the two capscrews which hold the bracket to the engine block.



1/4 inch

Loosen the jackscrews which hold the ECM plug to the ECM.

Remove the plug from the ECM.

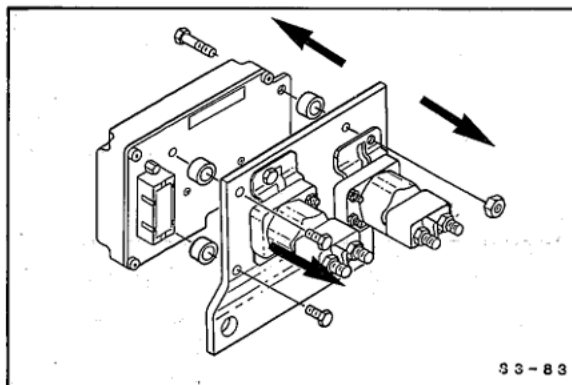


S3-82

7/16 inch

Remove the nut from the top right solenoid bracket.

Remove the ECM mounting capscrews and spacers.

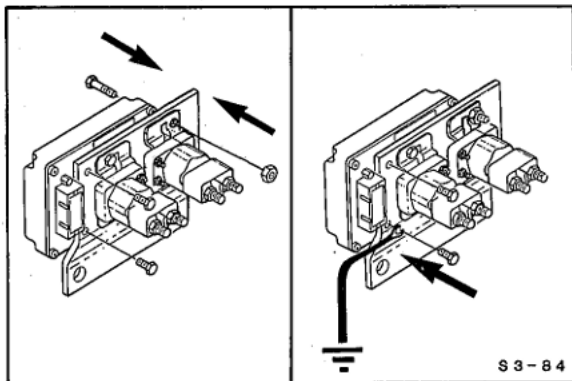


S3-83

7/16 inch

Install the new ECM on the bracket.

Install the black ground lead under the lower capscrew head. Install the nut on the top right bracket.

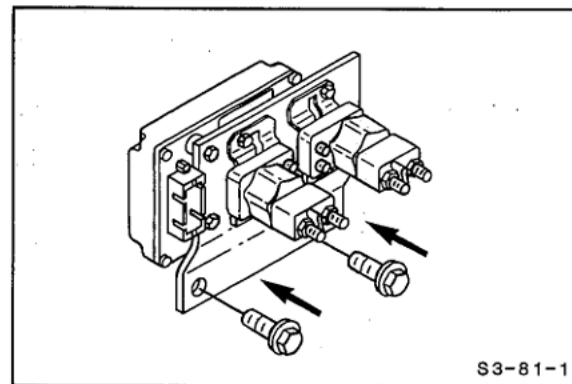


S3-84

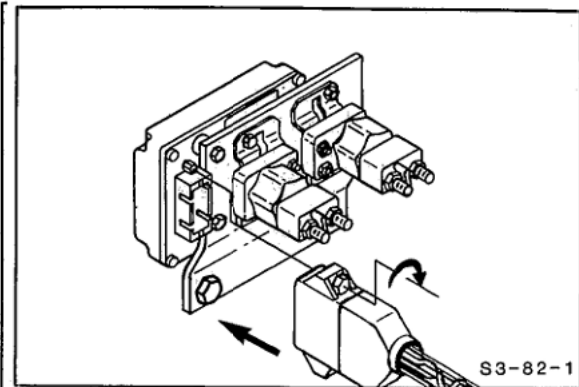
18 mm

Install the bracket on the engine block.

Torque Value: 70 N•m [55 ft-lb]



S3-81-1

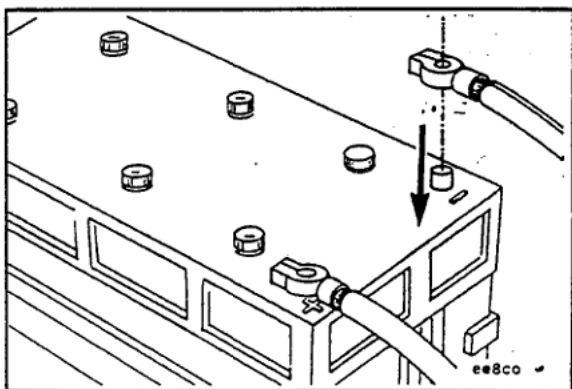


1/4 inch

Install the ECM plug.



Tighten the jackscrews hand tight.



Connect the ground cable to the battery terminal.

Section V - Specifications and Torque Values

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Engine Specifications - General Data

ENGINE MODEL: 4B/4BT-M

GENERAL ENGINE DATA

	Metric [U.S. Customary]
Type	4 cycle, Inline, 4 cylinder
Bore and Stroke	102 mm [4.02 in] x 120 mm [4.72 in]
Displacement	3.9 litre [239.3 C.I.D.]
C.G. Distance from Front Face of Block (Engine Only)	269 mm [10.6 in]
C.G. Distance above Crankshaft Centerline (Engine Only)	168 mm [6.6 in]

ENGINE MOUNTING

Maximum Allowable Bending Moment at Rear Face of Block	1356 Nm [1000 lb-ft]
Minimum/Maximum Static Installation Angle (Front Up)	0 degrees/12 degrees
Minimum/Maximum Static Installation Angle for V-drive Installations (Front Up)	3 degrees/15 degrees
Maximum Operation Angle (Front Up)	15 degrees

FUEL SYSTEM

Maximum Allowable Restriction to Fuel Pump	
With Clean Filter	63.5 mm Hg [2.5 in Hg]
With Dirty Filter	100 mm Hg [4 in Hg]
Maximum Allowable Return Line Pressure	259 mm Hg [10.2 in Hg]

EXHAUST SYSTEM

Maximum Allowable Back Pressure	75 mm Hg [3.0 in Hg]
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AIR INDUCTION SYSTEM

Maximum Allowable Intake Restriction	
4B Clean/Dirty Element	254 to 508 mm H ₂ O [10 to 20 in H ₂ O]
4BT Clean/Dirty Element	380 to 635 mm H ₂ O [15 to 25 in H ₂ O]
Maximum Allowable Engine Room ΔT (Engine Intake Air-Ambient Air At Rated Condition)	17° C [30° F]

LUBRICATION SYSTEM

Oil Pressure	
At Idle Speed-Minimum	69 kPa [10 psi]
Normal Operating Range	207 to 448 kPa [30 to 65 psi]
Maximum Allowable Oil Temperature	120° C [250° F]
Oil Pan Capacity High/Low	9.5 to 8.5 litre [10 to 9 U.S. qts]
Total System Capacity	10.4 litre [11 U.S. qts]
Maximum Operational Angularity of Oil Pan (See Engine Mounting)	
Front Down	20 degrees
Front Up	45 degrees
Side to Side	45 degrees

COOLING SYSTEM

Coolant Capacity	
Engine Only	8.3 litre [8.8 U.S. qts]
Engine with Heat Exchanger	13.2 litre [14.0 U.S. qts]
Maximum External Pressure Loss in Cooling System	35.0 kPa [5.0 psi]
Maximum Static Pressure of Coolant (exclusive of Pressure Cap)	103 kPa [15.0 psi]
Standard Thermostat (modulating) Range	83° to 95° C [181° to 203° F]
Maximum Coolant Temperature	96° C [205° F]
Minimum Allowable Coolant Expansion Space - % of System Capacity	5%
Minimum Coolant Makeup Capacity	1.7 litre [1.8 U.S. qts]
Maximum Raw Water Pressure	103 kPa [15 psi]
Maximum Raw Water Pump Inlet Restriction	127 mm Hg [5.0 in Hg]
Maximum Raw Water Pump Initial Suction Lift	3.0 m [10.0 ft]

ELECTRICAL SYSTEM

Wiring Diagram Number	3920281
Minimum Recommended Battery Capacity (12 volt system)	
Cold Soak at 0° C [32° F] or Above-Cold Cranking Amperes - CCA	800
Reserve Capacity - minutes	160
Maximum Allowable Resistance of Starting Circuit - Ohms	0.0012
Minimum Recommended Battery Capacity (24 volt system)	
Cold Soak at 0° C [32° F] or Above-Cold Cranking Amperes - CCA	400
Reserve Capacity - minutes	160
Maximum Allowable Resistance of Starting Circuit - Ohms	0.0020

Engine Specifications - General Data

ENGINE MODEL: 6B/6BT/6BTA

GENERAL ENGINE DATA

	Metric [U.S. Customary]
Type	4 cycle, Inline, 6 cylinder
Bore and Stroke	102 mm [4.02 in] x 120 mm [4.72 in]
Displacement	5.9 litre [359.0 C.I.D.]
C.G. Distance from Front Face of Block (Engine Only)	338 mm [13.3 in]
C.G. Distance above Crankshaft Centerline (Engine Only)	168 mm [6.6 in]

ENGINE MOUNTING

Maximum Allowable Bending Moment at Rear Face of Block	1356 Nm [1000 lb-ft]
Minimum/Maximum Static Installation Angle (Front Up)	0 degrees/12 degrees
Minimum/Maximum Static Installation Angle for V-drive Installations (Front Up)	3 degrees/15 degrees
Maximum Operating Angle (Front Up)	15 degrees

FUEL SYSTEM

Maximum Allowable Restriction to Fuel Pump	
With Clean Filter	63.5 mm Hg [2.5 in Hg]
With Dirty Filter	100 mm Hg [4 in Hg]
Maximum Allowable Return Line Pressure - 6B/6BT	259 mm Hg [10.2 in Hg]
- 6BTAM1/M2	517 mm Hg [20.4 in Hg]

EXHAUST SYSTEM

Maximum Allowable Back Pressure 75 mm Hg [3.0 in Hg]

AIR INDUCTION SYSTEM

Maximum Allowable Intake Restriction	
6B Clean/Dirty Element	254 to 508 mm H ₂ O [10 to 20 in H ₂ O]
6BTA Clean/Dirty Element	380 to 635 mm H ₂ O [15 to 25 in H ₂ O]
Maximum Allowable Engine Room ΔT (Engine Intake Air-Ambient Air At Rated Condition) 17° C [30°F]	

LUBRICATION SYSTEM

LUBRICATION SYSTEM	
Oil Pressure	
At Idle Speed-Minimum	69 kPa [10 psi]
Normal Operating Range	207-to 448 kPa [30 to 65 psi]
Maximum Allowable Oil Temperature	120° C [250° F]
Oil Pan Capacity High/Low	14.1 to 12.3 litre [15 to 13 U.S. qts]
Total System Capacity	15 litre [16 U.S. qts]
Maximum Operational Angularity of Oil Pan (See Engine Mounting)	
Front Down	10 degrees
Front Up	45 degrees
Side to Side	35 degrees

COOLING SYSTEM

Coolant Capacity	
Engine Only	12.0 litre [13.6 U.S. qts]
Engine with Heat Exchanger	20.6 litre [21.6 U.S. qts]
Maximum External Pressure Loss in Cooling System	35.0 kPa [5.0 psi]
Maximum Static Pressure of Coolant (exclusive of Pressure Cap)	103.0 kPa [15.0 psi]
Standard Thermostat (modulating) Range	83° to 95° C [181° to 203° F]
Maximum Coolant Temperature	96° C [205° F]
Minimum Allowable Coolant Expansion Space - % of System Capacity	5%
Minimum Coolant Makeup Capacity	2.4 litre [2.7 U.S. qts]
Maximum Raw Water Pressure	103.0 kPa [15.0 psi]
Maximum Raw Water Pump Inlet Restriction	127.0 mm Hg [5.0 in Hg]
Maximum Raw Water Pump Initial Suction Lift	3.0 m [10.0 ft]

ELECTRICAL SYSTEM

Wiring Diagram Number	3920281
Minimum Recommended Battery Capacity (12 volt system)	
6B/6BT/6BTA250 Cold Soak at -0° C [32° F] or Above-Cold Cranking Amperes - CCA	950
6BTA300 Cold Soak at 0° C [32° F] or Above-Cold Cranking Amperes - CCA	1100
Reserve Capacity - minutes	160
Maximum Allowable Resistance of Starting Circuit - Ohms	0.0012
Minimum Recommended Battery Capacity (24 volt system)	
Cold Soak at -0° C [32° F] or Above-Cold Cranking Amperes - CCA	475
Reserve Capacity - minutes	160
Maximum Allowable Resistance of Starting Circuit - Ohms	0.0020

Engine Specifications - General Data

ENGINE MODEL: 6CTA

GENERAL ENGINE DATA

	Metric [U.S. Customary]
Type	4 cycle, Inline, 6 cylinder
Bore and Stroke	114 mm [94.49 in] x 135 mm [5.32 in]
Displacement	8.3 litre [504.5 C.I.D.]
C.G. Distance from Front Face of Block (Engine Only)	427 mm [16.8 in]
C.G. Distance above Crankshaft Centerline (Engine Only)	163 mm [6.4 in]

ENGINE MOUNTING

Maximum Allowable Bending Moment at Rear Face of Block	1356 Nm [1000 lb-ft]
Minimum/Maximum Static Installation Angle (Front Up)	0 degrees/12 degrees
Minimum/Maximum Static Installation Angle for V-drive Installations (Front Up)	3 degrees/15 degrees
Maximum Operation Angle (Front Up)	15 degrees

FUEL SYSTEM

Maximum Allowable Restriction to Fuel Pump	
With Clean Filter	63.5 mm Hg [2.5 in Hg]
With Dirty Filter	100 mm Hg [4 in Hg]
Maximum Allowable Return Line Pressure	517 mm Hg [20.4 in Hg]

EXHAUST SYSTEM

Maximum Allowable Back Pressure	75 mm Hg [3.0 in Hg]
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AIR INDUCTION SYSTEM

Maximum Allowable Intake Restriction	
Clean/Dirty Element	380 to 635 mm H ₂ O [15 to 25 in H ₂ O]
Maximum Allowable Engine Room ΔT (Engine Intake Air-Ambient Air At Rated Condition)	17° C [30° F]

LUBRICATION SYSTEM

Oil Pressure	
At Idle Speed-Minimum	69 kPa [10 psi]
Normal Operating Range	205 to 517 kPa [30 to 75 psi]
Maximum Allowable Oil Temperature	120° C [250° F]
Oil Pan Capacity High/Low	19 to 15 litre [20 to 16 U.S. qts]
Total System Capacity	23.8 litre [25.2 U.S. qts]
Maximum Operational Angularity of Oil Pan (See Engine Mounting)	
Front Down	45 degrees
Front Up	35 degrees
Side to Side	45 degrees

COOLING SYSTEM

Coolant Capacity	
Engine Only	12.3 litre [13.0 U.S. qts]
Engine with Heat Exchanger	26.5 litre [28.0 U.S. qts]
Maximum External Pressure Loss in Cooling System	35.0 kPa [5.0 psi]
Maximum Static Pressure of Coolant (exclusive of Pressure Cap)	103.0 kPa [15.0 psi]
Standard Thermostat (modulating) Range	83° to 95° C [181° to 203° F]
Maximum Coolant Temperature	96° C [205° F]
Minimum Allowable Coolant Expansion Space - % of System Capacity	5%
Minimum Coolant Makeup Capacity	2.5 litre [2.6 U.S. qts]
Maximum Raw Water Pressure	103 kPa [15 psi]
Maximum Raw Water Pump Inlet Restriction	127 mm Hg [5.0 in Hg]
Maximum Raw Water Pump Initial Suction Lift	3.0 m [10.0 ft]

ELECTRICAL SYSTEM

Wiring Diagram Number	3920281
Minimum Recommended Battery Capacity (12 volt system)	
Cold Soak at -18° C [0° F] or Above-Cold Cranking Amperes - CCA	1800
Reserve Capacity - minutes	640
Cold Soak at 0° C [32° F] or Above-Cold Cranking Amperes - CCA	1280
Reserve Capacity - minutes	480
Maximum Allowable Resistance of Starting Circuit - Ohms	0.0012
Minimum Recommended Battery Capacity (24 volt system)	
Cold Soak at -18° C [32° F] or Above-Cold Cranking Amperes - CCA	900
Reserve Capacity - minutes	320
Cold Soak at 0° C [32° F] or Above-Cold Cranking Amperes - CCA	640
Reserve Capacity - minutes	240
Maximum Allowable Resistance of Starting Circuit - Ohms	0.0020

Engine Specifications - Performance Data**4B-64BHP****GENERAL ENGINE DATA***

Metric [U.S. Customary]

Engine Model 4B3.9-M
Rating Type Continuous
Rated Engine Power 48 KW [64 BHP]
Rated Engine Speed RPM 2200
High Idle Speed Range RPM 2332 to 2420
Idle Speed Range RPM 700 to 900
Engine Torque 207 Nm [152 ft-lb]
Brake Mean Effective Pressure 663 kPa [96 psi]
Compression Ratio 17.0:1
Piston Speed 8.8 m/sec [1731 ft/min]
Maximum Torque Capacity from Front of Crank**
Firing Order 1.3.4.2

FUEL SYSTEM*

Fuel Consumption 12.9 litre/hr [3.4 GPH]
Approximate Fuel Flow to Pump 20 litre/hr [5 GPH]
Fuel Transfer Pump Pressure Range 3.5 to 69 kPa [0.5 to 10 psi]

ENGINE WEIGHTS (Dry Weights)

Engine Only 381 kg [840 lb]
With Heat Exchanger Cooling System + 33 kg [72 lb]
With Twin Disc MG-5050 Marine Gear + 86 kg [189 lb]
With Twin Disc MG-502 Marine Gear + 70 kg [155 lb]

AIR SYSTEM*

Intake Air Flow 60 litre/sec [130 CFM]
Heat Rejection to Ambient 6 kW [400 BTU/min]
Min Ambient Temp for Cold Start (No Aids) 0° C [32° F]

EXHAUST SYSTEM*

Exhaust Gas Flow 160 litre/sec [350 CFM]
Exhaust Gas Temperature 570° C [1050° F]

COOLING SYSTEM*

Heat Rejection to Coolant 47 kW [2640 BTU/min]
Engine Water Flow 151 litre/min [40 GPM]
Raw Water Flow 68 litre/min [18 GPM]
Pressure Cap Rating w/Heat Exchanger 103.41 kPa [15 psi]

CPL: 0591

DATE: November 1991

*All Data at Rated Conditions

**Consult Installation Direction Booklet for Limitations

Engine Specifications - Performance Data

4B-76BHP

GENERAL ENGINE DATA*

	Metric [U.S. Customary]
Engine Model	4B3.9-M
Rating Type	Medium Continuous
Rated Engine Power	57 kW [76 BHP]
Rated Engine Speed RPM	2500
High Idle Speed Range RPM	2650 to 2750
Idle Speed Range RPM	700 to 900
Engine Torque	216 Nm [159 ft/lb]
Brake Mean Effective Pressure	693 kPa [101 psi]
Compression Ratio	17.0:1
Piston Speed	10.0 m/sec [1969 ft/min]
Maximum Torque Capacity from Front of Crank**	
Firing Order	1.3.4.2

FUEL SYSTEM*

Fuel Consumption	15.5 litre/hr [4.1 GPH]
Approximate Fuel Flow to Pump	23 litre/hr [6 GPH]
Fuel Transfer Pump Pressure Range	3.5 to 69 kPa [0.5 to 10 psi]

ENGINE WEIGHTS (Dry Weights)

Engine Only	381 kg [840 lb]
With Heat Exchanger Cooling System	+ 33 kg [72 lb]
With Borg Warner 71C Marine Gear	+ 65.8 kg [145 lb]

AIR SYSTEM*

Intake Air Flow	70 litre/sec [140 CFM]
Heat Rejection to Ambient	8 kW [400 BTU/min]
Min Ambient Temp for Cold Start (No Aids)	0° C [32° F]

EXHAUST SYSTEM*

Exhaust Gas Flow	190 litre/sec [400 CFM]
Exhaust Gas Temperature	580° C [1080° F]

COOLING SYSTEM*

Heat Rejection to Coolant	51 kW [2900 BTU/min]
Engine Water Flow	167 litre/min [44 GPM]
Raw Water Flow	75 litre/min [20 GPM]
Pressure Cap Rating w/Heat Exchanger	103.41 kPa [15 psi]

INSTALLATION DIAGRAMS:

With Borg Warner 71C Marine Gear	3911730
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CPL: 0591

DATE: November 1991

*All Data at Rated Conditions

**Consult Installation Direction Booklet for Limitations

Engine Specifications - Performance Data**4B-80BHP****GENERAL ENGINE DATA***

	Metric [U.S. Customary]
Engine Model	4B3.9-M
Rating Type	Recreation/Light Duty
Rated Engine Power	60 kW [80 BHP]
Rated Engine Speed RPM	2800
High Idle Speed Range RPM	2968 to 3080
Idle Speed Range RPM	700 to 900
Engine Torque	203 Nm [150 ft/lb]
Brake Mean Effective Pressure	652 kPa [95 psi]
Compression Ratio	17.0:1
Piston Speed	11.2 m/sec [2205 ft/min]
Maximum Torque Capacity from Front of Crank**	
Firing Order	1.3.4.2

FUEL SYSTEM*

Fuel Consumption	17.0 litre/hr [4.5 GPH]
Approximate Fuel Flow to Pump	24 litre/hr [6 GPH]
Fuel Transfer Pump Pressure Range	3.5 to 69 kPa [0.5 to 10 psi]

ENGINE WEIGHTS (Dry Weights)

Engine Only	381 kg [840 lb]
With Heat Exchanger Cooling System	+ 33 kg [72 lb]
With Borg Warner 71C Marine Gear	+ 65.8 kg [145 lb]

AIR SYSTEM*

Intake Air Flow	70 litre/sec [150 CFM]
Heat Rejection to Ambient	9 kW [500 BTU/min]
Min Ambient Temp for Cold Start (No Aids)	0° C [32° F]

EXHAUST SYSTEM*

Exhaust Gas Flow	220 litre/sec [450 CFM]
Exhaust Gas Temperature	650° C [1200° F]

COOLING SYSTEM*

Heat Rejection to Coolant	56 kW [3200 BTU/min]
Engine Water Flow	189 litre/min [50 GPM]
Raw Water Flow	87 litre/min [23 GPM]
Pressure Cap Rating w/Heat Exchanger	103.41 kPa [15 psi]

INSTALLATION DIAGRAMS:

With Borg Warner 71C Marine Gear	3911730
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CPL: 0721

DATE: November 1991

*All Data at Rated Conditions

**Consult Installation Direction Booklet for Limitations

Engine Specifications - Performance Data

4BT-130BHP

GENERAL ENGINE DATA*

	Metric [U.S. Customary]
Engine Model	4BT3.9-M
Rating Type	Medium Continuous
Rated Engine Power	97 kW [130 BHP]
Rated Engine Speed RPM	2500
High Idle Speed Range RPM	2650 to 2750
Idle Speed Range RPM	700 to 900
Engine Torque	307 Nm [273 ft/lb]
Brake Mean Effective Pressure	1186 kPa [172 psi]
Compression Ratio	16.5:1
Piston Speed	10.0 m/sec [1969 ft/min]
Maximum Torque Capacity from Front of Crank**	
Firing Order	1.3.4.2

FUEL SYSTEM*

Fuel Consumption	24.8 litre/hr [6.5 GPH]
Approximate Fuel Flow to Pump	34 litre/hr [9 GPH]
Fuel Transfer Pump Pressure Range	3.5 to 69 kPa [0.5 to 10 psi]

ENGINE WEIGHTS (Dry Weights)

Engine Only	390 kg [860 lb]
With Heat Exchanger Cooling System	+ 33 kg [72 lb]
With Borg Warner 71C Marine Gear	+ 65.8 kg [145 lb]

AIR SYSTEM*

Intake Manifold Pressure	533 mm Hg [21 in Hg]
Intake Air Flow	100 litre/sec [220 CFM]
Heat Rejection to Ambient	12 kW [700 BTU/min]
Min Ambient Temp for Cold Start (No Aids)	0° C [32° F]

EXHAUST SYSTEM*

Exhaust Gas Flow	260 litre/sec [550 CFM]
Exhaust Gas Temperature	480° C [900° F]

COOLING SYSTEM*

Heat Rejection to Coolant	82 kW [4600 BTU/min]
Engine Water Flow	167 litre/min [44 GPM]
Raw Water Flow	75 litre/min [20 GPM]
Pressure Cap Rating w/Heat Exchanger	103.41 kPa [15 psi]

INSTALLATION DIAGRAMS:

With Borg Warner 71C Marine Gear	3884427-A
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CPL: 0741

DATE: November 1991

*All Data at Rated Conditions

**Consult Installation Direction Booklet for Limitations

Engine Specifications - Performance Data**4BT-150BHP****GENERAL ENGINE DATA***

	Metric [U.S. Customary]
Engine Model	4BT3.9-M
Rating Type	Recreational/Light Duty
Rated Engine Power	112 kW [150 BHP]
Rated Engine Speed RPM	2800
High Idle Speed Range RPM	2968 to 3080
Idle Speed Range RPM	700 to 900
Engine Torque	381 Nm [281 ft/lb]
Brake Mean Effective Pressure	1222 kPa [177 psi]
Compression Ratio	16.5:1
Piston Speed	11.2 m/sec [2205 ft/min]
Maximum Torque Capacity from Front of Crank**	
Firing Order	1.3.4.2

FUEL SYSTEM*

Fuel Consumption	28.7 litre/hr [7.6 GPH]
Approximate Fuel Flow to Pump	37 litre/hr [10 GPH]
Fuel Transfer Pump Pressure Range	3.5 to 69 kPa [0.5 to 10 psi]

ENGINE WEIGHTS (Dry Weights)

Engine Only	390 kg [860 lb]
With Heat Exchanger Cooling System	+ 33 kg [72 lb]
With Borg Warner 71C Marine Gear	+ 65.8 kg [145 lb]

AIR SYSTEM*

Intake Manifold Pressure	711 mm Hg [28 in Hg]
Intake Air Flow	130 litre/sec [270 CFM]
Heat Rejection to Ambient	14 kW [800 BTU/min]
Min Ambient Temp for Cold Start (No Aids)	0° C [32° F]

EXHAUST SYSTEM*

Exhaust Gas Flow	320 litre/sec [700 CFM]
Exhaust Gas Temperature	480° C [900° F]

COOLING SYSTEM*

Heat Rejection to Coolant	95 kW [5400 BTU/min]
Engine Water Flow	189 litre/min [50 GPM]
Raw Water Flow	87 litre/min [23 GPM]
Pressure Cap Rating w/Heat Exchanger	103.41 kPa [15 psi]

INSTALLATION DIAGRAMS:

With Borg Warner 71C Marine Gear	3884427-A
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CPL: 0741

DATE: November 1991

*All Data at Rated Conditions

**Consult Installation Direction Booklet for Limitations

Engine Specifications - Performance Data

6B-98BHP

GENERAL ENGINE DATA*

	Metric [U.S. Customary]
Engine Model	6B5.9-M
Rating Type	Continuous
Rated Engine Power	73 kW [98 BHP]
Rated Engine Speed RPM	2200
High Idle Speed Range RPM	2332 to 2420
Idle Speed Range RPM	700 to 900
Engine Torque	317 Nm [233 ft/lb]
Brake Mean Effective Pressure	677 kPa [98 psi]
Compression Ratio	17.0:1
Piston Speed	8.8 m/sec [173 ft/min]
Noise Level - dB	97.5
Maximum Torque Capacity from Front of Crank**	
Firing Order	1.5.3.6.2.4

FUEL SYSTEM*

Fuel Consumption	19.3 litre/hr [5.1 GPH]
Approximate Fuel Flow to Pump	26 litre/hr [7 GPH]
Fuel Transfer Pump Pressure Range	3.5 to 69 kPa [0.5 to 10 psi]

ENGINE WEIGHTS (Dry Weights)

Engine Only	452 kg [995 lb]
With Heat Exchanger Cooling System	+ 43 kg [95 lb]
With Twin Disc MG-5050 Marine Gear	+ 86 kg [189 lb]
With Twin Disc MG-506 Marine Gear	+ 100 kg [220 lb]

AIR SYSTEM*

Intake Air Flow	80 litre/sec [180 CFM]
Heat Rejection to Ambient	10 kW [600 BTU/min]
Min Ambient Temp for Cold Start (No Aids)	0° C [32° F]

EXHAUST SYSTEM*

Exhaust Gas Flow	230 litre/sec [500 CFM]
Exhaust Gas Temperature	540° C [1000° F]

COOLING SYSTEM*

Heat Rejection to Coolant	64 kW [3600 BTU/min]
Engine Water Flow	151 litre/min [40 GPM]
Raw Water Flow	68 litre/min [18 GPM]
Pressure Cap Rating w/Heat Exchanger	103.41 kPa [15 psi]

INSTALLATION DIAGRAMS:

With Borg Warner 72C Marine Gear (Keel cooled)	3911731
With Borg Warner 72C Marine Gear (heat exchanger cooled)	3884427-B

CPL: 0714

DATE: November 1991

*All Data at Rated Conditions

**Consult Installation Direction Booklet for Limitations

Engine Specifications - Performance Data**6B-115BHP****GENERAL ENGINE DATA***

Metric [U.S. Customary]

Engine Model 6B5.9-M
Rating Type Medium Continuous
Rated Engine Power 86 kW [115 BHP]
Rated Engine Speed RPM 2500
High Idle Speed Range RPM 2650 to 2750
Idle Speed Range RPM 700 to 900
Engine Torque 327 Nm [241 ft/lb]
Brake Mean Effective Pressure 700 kPa [101 psi]
Compression Ratio 17:1
Piston Speed 10.0 m/sec [1969 ft/min]
Maximum Torque Capacity from Front of Crank**
Firing Order 1.5.3.6.2.4

FUEL SYSTEM*

Fuel Consumption 23.8 litre/hr [6.3 GPH]
Approximate Fuel Flow to Pump 32 litre/hr [8 GPH]
Fuel Transfer Pump Pressure Range 3.5 to 69 kPa [0.5 to 10 psi]

ENGINE WEIGHTS (Dry Weights)

Engine Only 452 kg [995 lb]
With Heat Exchanger Cooling System + 43 kg [95 lb]
With Borg Warner 72C Marine Gear + 69 kg [153 lb]

AIR SYSTEM*

Intake Air Flow 100 litre/sec [210 CFM]
Heat Rejection to Ambient 12 kW [700 BTU/min]
Min Ambient Temp for Cold Start (No Aids) 0° C [32° F]

EXHAUST SYSTEM*

Exhaust Gas Flow 290 litre/sec [600 CFM]
Exhaust Gas Temperature 620° C [1150° F]

COOLING SYSTEM*

Heat Rejection to Coolant 79 kW [4500 BTU/min]
Engine Water Flow 167 litre/min [44 GPM]
Raw Water Flow 75 litre/min [20 GPM]
Pressure Cap Rating w/Heat Exchanger 103.41 kPa [15 psi]

INSTALLATION DIAGRAMS:

With Borg Warner 72C Marine Gear (keel cooled) 3911731
With Borg Warner 72C Marine Gear (heat exchanger cooled) 3884427-B

CPL: 0714

DATE: November 1991

*All Data at Rated Conditions

**Consult Installation Direction Booklet for Limitations

Engine Specifications - Performance Data

6B-120BHP

GENERAL ENGINE DATA*

	Metric [U.S. Customary]
Engine Model	6B5.9-M
Rating Type	Recreational/Light Duty
Rated Engine Power	90 kW [120 BHP]
Rated Engine Speed RPM	2800
High Idle Speed Range RPM	2968 to 3080
Idle Speed Range RPM	700 to 900
Engine Torque	305 Nm [225 ft/lb]
Brake Mean Effective Pressure	652 kPa [95 psi]
Compression Ratio	17:1
Piston Speed	11.2 m/sec [2205 ft/min]
Maximum Torque Capacity from Front of Crank**	
Firing Order	1.5.3.6.2.4

FUEL SYSTEM*

Fuel Consumption	25.3 litre/hr [6.7 GPH]
Approximate Fuel Flow to Pump	32 litre/hr [8 GPH]
Fuel Transfer Pump Pressure Range	3.5 to 69 kPa [0.5 to 10 psi]

ENGINE WEIGHTS (Dry Weights)

Engine Only	452 kg [995 lb]
With Heat Exchanger Cooling System	+ 43 kg [95 lb]
With Borg Warner 72C Marine Gear	+ 69 kg [153 lb]

AIR SYSTEM*

Intake Air Flow	120 litre/sec [250 CFM]
Heat Rejection to Ambient	13 kW [700 BTU/min]
Min Ambient Temp for Cold Start (No Aids)	0° C [32° F]

EXHAUST SYSTEM*

Exhaust Gas Flow	370 litre/sec [800 CFM]
Exhaust Gas Temperature	680° C [1250° F]

COOLING SYSTEM*

Heat Rejection to Coolant	83 kW [4700 BTU/min]
Engine Water Flow	189 litre/min [50 GPM]
Raw Water Flow	87 litre/min [23 GPM]
Pressure Cap Rating w/Heat Exchanger	103.41 kPa [15 psi]

INSTALLATION DIAGRAMS:

With Borg Warner 72C Marine Gear (keel cooled)	3911731
With Borg Warner 72C Marine Gear (heat exchanger cooled)	3884427-B

CPL: 0791

DATE: November 1991

*All Data at Rated Conditions

**Consult Installation Direction Booklet for Limitations

Engine Specifications - Performance Data**6BT-152BHP****GENERAL ENGINE DATA***

	Metric [U.S. Customary]
Engine Model	6BT5.9-M
Rating Type	Medium Continuous
Rated Engine Power	113 kW [152 BHP]
Rated Engine Speed RPM	2500
High Idle Speed Range RPM	2650 to 2750
Idle Speed Range RPM	700 to 900
Engine Torque	433 Nm [319 ft/lb]
Brake Mean Effective Pressure	925 kPa [134 psi]
Compression Ratio	16.5:1
Piston Speed	10.0 m/sec [1967 ft/min]
Maximum Torque Capacity from Front of Crank**	
Firing Order	1.5.3.6.2.4

FUEL SYSTEM*

Fuel Consumption	29.6 litre/hr [7.8 GPH]
Approximate Fuel Flow to Pump	59.2 litre/hr [15.6 GPH]
Fuel Transfer Pump Pressure Range	3.5 to 69 kPa [0.5 to 10 psi]

ENGINE WEIGHTS (Dry Weights)

Engine Only	466 kg [1025 lb]
With Heat Exchanger Cooling System	+ 43 kg [95 lb]
With Borg Warner 71C Marine Gear	+ 65.8 kg [145 lb]

AIR SYSTEM*

Intake Manifold Pressure	864 mm Hg [34.0 in Hg]
Intake Air Flow	139 litre/sec [295 CFM]
Heat Rejection to Ambient	98.4 kW [5594 BTU/min]
Min Ambient Temp for Cold Start (No Aids)	0° C [32° F]

EXHAUST SYSTEM*

Exhaust Gas Flow	367 litre/sec [777 CFM]
Exhaust Gas Temperature	399° C [750 ° F]

COOLING SYSTEM*

Heat Rejection to Coolant	98.4 kW [5594 BTU/min]
Engine Water Flow	167 litre/min [44 GPM]
Raw Water Flow	75 litre/min [20 GPM]
Pressure Cap Rating w/Heat Exchanger	103.41 kPa [15 psi]

INSTALLATION DIAGRAMS:

With Twin Disc MG-502-1 Marine Gear	3884426-A
With Twin Disc MG-5050 Marine Gear	3884588-B
With Borg Warner 7000 Marine Gear	3910561
With MRM IRM-220A Marine Gear	3884425-A

CPL: 1289

DATE: November 1991

*All Data at Rated Conditions

**Consult Installation Direction Booklet for Limitations

Engine Specifications - Performance Data

6BT-180BHP

GENERAL ENGINE DATA*

	Metric [U.S. Customary]
Engine Model	6BT5.9-M
Rating Type	Medium Continuous
Rated Engine Power	134 kW [180 BHP]
Rated Engine Speed RPM	2500
High Idle Speed Range RPM	2650 to 2750
Idle Speed Range RPM	700 to 900
Engine Torque	512 Nm [378 ft/lb]
Brake Mean Effective Pressure	1096 kPa [159 psi]
Compression Ratio	16.5:1
Piston Speed	10.0 m/sec [1969 ft/min]
Maximum Torque Capacity from Front of Crank**	
Firing Order	1.5.3.6.2.4

FUEL SYSTEM*

Fuel Consumption	36.6 litre/hr [9.7 GPH]
Approximate Fuel Flow to Pump	45 litre/hr [12 GPH]
Fuel Transfer Pump Pressure Range	3.5 to 69 kPa [0.5 to 10 psi]

ENGINE WEIGHTS (Dry Weights)

Engine Only	466 kg [1025 lb]
With Heat Exchanger Cooling System	+ 43 kg [95 lb]
With Twin Disc MG-502-1 Marine Gear	+ 70 kg [155 lb]
With Borg Warner 7000 Marine Gear	+ 113 kg [250 lb]

AIR SYSTEM*

Intake Manifold Pressure	1092 mm Hg [43 in Hg]
Intake Air Flow	210 litre/sec [450 CFM]
Heat Rejection to Ambient	18 kW [1000 BTU/min]
Min Ambient Temp for Cold Start (No Aids)	0° C [32° F]

EXHAUST SYSTEM*

Exhaust Gas Flow	480 litre/sec [1000 CFM]
Exhaust Gas Temperature	400° C [760° F]

COOLING SYSTEM*

Heat Rejection to Coolant	120 kW [6900 BTU/min]
Engine Water Flow	167 litre/min [44 GPM]
Raw Water Flow	75 litre/min [20 GPM]
Pressure Cap Rating w/Heat Exchanger	103.41 kPa [15 psi]

INSTALLATION DIAGRAMS:

With Twin Disc MG 502-1 Marine Gear	3884426-A
With Twin Disc MG-5050 Marine Gear	3884588-B
With MRM IRM-220A Marine Gear	3884425-A
With Borg Warner 7000 Marine Gear	3910561

CPL: 0742

DATE: November 1991

*All Data at Rated Conditions

**Consult Installation Direction Booklet for Limitations

Engine Specifications - Performance Data

6BT-210BHP

GENERAL ENGINE DATA*

	Metric [U.S. Customary]
Engine Model	6BT5.9-M
Rating Type	Recreational/Light Duty
Rated Engine Power	157 kW [210 BHP]
Rated Engine Speed RPM	2600
High Idle Speed Range RPM	2810 to 2910
Idle Speed Range RPM	700 to 900
Engine Torque	575 Nm [424 ft/lb]
Brake Mean Effective Pressure	1228 kPa [178 psi]
Compression Ratio	16.5:1
Piston Speed	10.4 m/sec [2047 ft/min]
Maximum Torque Capacity from Front of Crank**	
Firing Order	1.5.3.6.2.4

FUEL SYSTEM*

Fuel Consumption	42.3 litre/hr [11.2 GPH]
Approximate Fuel Flow to Pump	49 litre/hr [13 GPH]
Fuel Transfer Pump Pressure Range	3.5 to 69 kPa [0.5 to 10 psi]

ENGINE WEIGHTS (Dry Weights)

Engine Only	466 kg [1025 lb]
With Heat Exchanger Cooling System	+ 43 kg [95 lb]
With Twin Disc MG-502-1 Marine Gear	+ 70 kg [155 lb]
With Twin Disc MG-5050 Marine Gear	+ 86 kg [189 lb]
With Borg Warner 7000 Marine Gear	+ 113 kg [250 lb]

AIR SYSTEM*

Intake Manifold Pressure	1295 mm Hg [51 in Hg]
Intake Air Flow	240 litre/sec [500 CFM]
Heat Rejection to Ambient	21 kW [1200 BTU/min]
Min Ambient Temp for Cold Start (No Aids)	0° C [32° F]

EXHAUST SYSTEM*

Exhaust Gas Flow	540 litre/sec [1150 CFM]
Exhaust Gas Temperature	420° C [780° F]

COOLING SYSTEM*

Heat Rejection to Coolant	139 kW [7900 BTU/min]
Engine Water Flow	174 litre/min [46 GPM]
Raw Water Flow	83 litre/min [22 GPM]
Pressure Cap Rating w/Heat Exchanger	103.41 kPa [15 psi]

INSTALLATION DIAGRAMS:

With Twin Disc MG-502-1 Marine Gear	3884426-A
With Twin Disc MG-5050 Marine Gear	3884588-B
With Borg Warner 7000 Marine Gear	3910561
With MRM IRM-220A Marine Gear	3884425-A

CPL: 0742

DATE: November 1991

*All Data at Rated Conditions

**Consult Installation Direction Booklet for Limitations

Engine Specifications - Performance Data

6BTA-220BHP

GENERAL ENGINE DATA*

Engine Model	Metric [U.S. Customary]
Rating Type	6BTA5.9-M1
Rated Engine Power	Medium Continuous
Rated Engine Speed RPM	164 kW [220 BHP]
High Idle Speed Range RPM	2500
Idle Speed Range RPM	2660 to 2770
Engine Torque	700 to 900
Brake Mean Effective Pressure	626 Nm [462 ft/lb]
Compression Ratio	1338 kPa [194 psi]
Piston Speed	15.5:1
Maximum Torque Capacity from Front of Crank**	10.0 m/sec [1969 ft/min]
Firing Order	1.5.3.6.2.4

FUEL SYSTEM*

Fuel Consumption	41.2 litre/hr [10.9 GPH]
Approximate Fuel Flow to Pump	147 litre/hr [39 GPH]
Fuel Transfer Pump Pressure Range	124 to 172 kPa [18 to 25 psi]

ENGINE WEIGHTS (Dry Weights)

Engine Only	470 kg [1035 lb]
With Heat Exchanger Cooling System	+ 43 kg [95 lb]
With Twin Disc MG-502-1 Marine Gear	+ 70 kg [155 lb]
With MPM IRM-220A Marine Gear	+ 55 kg [122 lb]

AIR SYSTEM*

Intake Manifold Pressure	1016 mm Hg [40 in Hg]
Intake Air Flow	220 litre/sec [460 CFM]
Heat Rejection to Ambient	21 kW [1200 BTU/min]
Min Ambient Temp for Cold Start (No Aids)	10° C [50° F]

EXHAUST SYSTEM*

Exhaust Gas Flow	510 litre/sec [1050 CFM]
Exhaust Gas Temperature	430° C [800° F]

COOLING SYSTEM*

Heat Rejection to Coolant	136 kW [7700 BTU/min]
Engine Water Flow	167 litre/min [44 GPM]
Raw Water Flow	106 litre/min [28 GPM]
Pressure Cap Rating w/Heat Exchanger	103.41 kPa [15 psi]

INSTALLATION DIAGRAMS:

With Twin Disc MG-502-1 Marine Gear	3914852
With Twin Disc MG-506-1 Marine Gear	3884426-B
With MPM IRM-220A Marine Gear	3884425-B
With Borg Warner 7000 Marine Gear	3915609

CPL: 1322

DATE: November 1991

*All Data at Rated Conditions

**Consult Installation Direction Booklet for Limitations

Engine Specifications - Performance Data**6BTA-250BHP****GENERAL ENGINE DATA***

Metric [U.S. Customary]

Engine Model	6BTA5.9-M1
Rating Type	Recreational/Light Duty
Rated Engine Power	186 kW [250 BHP]
Rated Engine Speed RPM	2600
High Idle Speed Range RPM	2770 to 2880
Idle Speed Range RPM	650 to 850
Engine Torque	684 Nm [505 ft/lb]
Brake Mean Effective Pressure	1462 kPa [212 psi]
Compression Ratio	15.5:1
Piston Speed	10.4 m/sec [2047 ft/min]
Maximum Torque Capacity from Front of Crank**	
Firing Order	1.5.3.6.2.4

FUEL SYSTEM*

Fuel Consumption	47.4 litre/hr [12.5 GPH]
Approximate Fuel Flow to Pump	155 litre/hr [41 GPH]
Fuel Transfer Pump Pressure Range	124 to 172 kPa [18 to 25 psi]

ENGINE WEIGHTS (Dry Weights)

Engine Only	470 kg [1035 lb]
With Heat Exchanger Cooling System	+ 43 kg [95 lb]
With Twin Disc MG-502 Marine Gear	+ 70 kg [155 lb]
With MRM IRM-220A Marine Gear	+ 55 kg [122 lb]

AIR SYSTEM*

Intake Manifold Pressure	1168 mm Hg [46 in Hg]
Intake Air Flow	250 litre/sec [520 CFM]
Heat Rejection to Ambient	24 kW [1400 BTU/min]
Min Ambient Temp for Cold Start (No Aids)	10° C [50° F]

EXHAUST SYSTEM*

Exhaust Gas Flow	580 litre/sec [1250 CFM]
Exhaust Gas Temperature	440° C [820° F]

COOLING SYSTEM*

Heat Rejection to Coolant	156 kW [8900 BTU/min]
Engine Water Flow	173 litre/min [46 GPM]
Raw Water Flow	114 litre/min [30 GPM]
Pressure Cap Rating w/Heat Exchanger	103.41 kPa [15 psi]

INSTALLATION DIAGRAMS:

With Twin Disc MG-502-1 Marine Gear	3914852
With Twin Disc MG-5050 Marine Gear	3884591-B
With MPM IRM-220A Marine Gear	3884425-B
With Borg Warner 7000 Marine Gear	3915609

CPL: 1322

DATE: November 1991

*All Data at Rated Conditions

**Consult Installation Direction Booklet for Limitations

Engine Specifications - Performance Data

6BTA-300BHP

GENERAL ENGINE DATA*

	Metric [U.S. Customary]
Engine Model	6BTA5.9-M2
Rating Type	Recreational/Light Duty
Rated Engine Power	224 kW [300 BHP]
Rated Engine Speed RPM	2800
High Idle Speed Range RPM	2970 to 3140
Idle Speed Range RPM	650 to 850
Engine Torque	763 Nm [562 ft/lb]
Brake Mean Effective Pressure	1629 kPa [236 psi]
Compression Ratio	15.5:1
Piston Speed	11.2 m/sec [2205 ft/min]
Maximum Torque Capacity from Front of Crank**	
Firing Order	1.5.3.6.2.4

FUEL SYSTEM*

Fuel Consumption	61.3 litre/hr [16.2 GPH]
Approximate Fuel Flow to Pump	166 litre/hr [44 GPH]
Fuel Transfer Pump Pressure Range	124 to 172 kPa [18 to 25 psi]

ENGINE WEIGHTS (Dry Weights)

Engine Only	489 kg [1075 lb]
With Heat Exchanger Cooling System	+ 43 kg [95 lb]
With Twin Disc MG-506-1 Marine Gear	+ 100 kg [220 lb]
With MRM IRM-220A Marine Gear	+ 55 kg [122 lb]

AIR SYSTEM*

Intake Manifold Pressure	1346 mm Hg [53 in Hg]
Intake Air Flow	290 litre/sec [620 CFM]
Heat Rejection to Ambient	31 kW [1800 BTU/min]
Min Ambient Temp for Cold Start (No Aids)	10° C [50° F]

EXHAUST SYSTEM*

Exhaust Gas Flow	760 litre/sec [1600 CFM]
Exhaust Gas Temperature	510° C [950° F]

COOLING SYSTEM*

Heat Rejection to Coolant	202 kW [11500 BTU/min]
Engine Water Flow	189 litre/min [50 GPM]
Raw Water Flow	208 litre/min [55 GPM]
Pressure Cap Rating w/Heat Exchanger	103.41 kPa [15 psi]

INSTALLATION DIAGRAMS:

With Twin Disc MG-506-1 Marine Gear	3884523-B
With MRM IRM-220A Marine Gear	3884523-A
With Twin Disc MG-5050 Marine Gear	3884594-B

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DATE: November 1991

*All Data at Rated Conditions

**Consult Installation Direction Booklet for Limitations

Engine Specifications - Performance Data**6CTA-250BHP****GENERAL ENGINE DATA***

Metric [U.S. Customary]

Engine Model	6CTA8.3-M1
Rating Type	Continuous
Rated Engine Power	186 kW [250 BHP]
Rated Engine Speed - (RPM)	[2100]
High Idle Speed Range - (RPM)	[2254 to 2467]
Idle Speed Range - (RPM)	[700 to 900]
Engine Torque	847 Nm [625 ft/lb]
Brake Mean Effective Pressure	1286 kPa [187 psi]
Compression Ratio	15.5:1
Piston Speed	9.5 m/sec [1862 ft/min]
Maximum Torque Capacity from Front of Crank**	1.5.3.6.2.4
Firing Order	

FUEL SYSTEM*

Fuel Consumption	48.5 litre/hr [12.8 GPH]
Approximate Fuel Flow to Pump	107 litre/hr [28.2 GPH]
Fuel Transfer Pump Pressure Range	124 to 172 kPa [18 to 25 psi]

ENGINE WEIGHTS (Dry Weights)

Engine Only	666 kg [1466 lb]
With Heat Exchanger Cooling System	+ 45 kg [100 lb]
With Twin Disc MG-507A Marine Gear	+ 160 kg [354 lb]

AIR SYSTEM*

Intake Manifold Pressure	711 mm Hg [28 in Hg]
Intake Air Flow	210 litre/sec [460 CFM]
Heat Rejection to Ambient	25 kW [1400 BTU/min]
Min Ambient Temp for Cold Start (No Aids)	0° C [32° F]

EXHAUST SYSTEM*

Exhaust Gas Flow	530 litre/sec [1100 CFM]
Exhaust Gas Temperature	470° C [880° F]

COOLING SYSTEM*

Heat Rejection to Coolant	161 kW [9200 BTU/min]
Engine Water Flow	249 litre/min [66 GPM]
Raw Water Flow	204 litre/min [54 GPM]
Pressure Cap Rating w/Heat Exchanger	103.41 kPa [15 psi]

INSTALLATION DIAGRAMS:

With Twin Disc MG-507A-1 Marine Gear	3884540-B
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CPL: 1221

DATE: November 1991

*All Data at Rated Conditions

**Consult Installation Direction Booklet for Limitations

Engine Specifications - Performance Data

6CTA-300BHP

GENERAL ENGINE DATA*

Engine Model	Metric [U.S. Customary]
Rating Type	6CTA8.3-M1
Rated Engine Power	Medium Continuous
Rated Engine Speed RPM	224 kW [300 BHP]
High Idle Speed Range RPM	2500
Idle Speed Range RPM	2750 to 2900
Engine Torque	600 to 800
Brake Mean Effective Pressure	854 Nm [630 ft/lb]
Compression Ratio	1296 kPa [188 psi]
Piston Speed	15.5:1
Maximum Torque Capacity from Front of Crank**	11.3 m/sec [2217 ft/min]
Firing Order	1.5.3.6.2.4

FUEL SYSTEM*

Fuel Consumption	58.3 litre/hr [15.4 GPH]
Approximate Fuel Flow to Pump	70 litre/hr [18 GPH]
Fuel Transfer Pump Pressure Range	124 to 172 kPa [18 to 25 psi]

ENGINE WEIGHTS (Dry Weights)

Engine Only	658 kg [1450 lb]
With Heat Exchanger Cooling System	+ 55 kg [120 lb]
With Twin Disc MG-507A Marine Gear	+ 160 kg [354 lb]

AIR SYSTEM*

Intake Manifold Pressure	955 mm Hg [37 in Hg]
Intake Air Flow	300 litre/sec [630 CFM]
Heat Rejection to Ambient	29 kW [1700 BTU/min]
Min Ambient Temp for Cold Start (No Aids)	0° C [32° F]

EXHAUST SYSTEM*

Exhaust Gas Flow	710 litre/sec [1500 CFM]
Exhaust Gas Temperature	440° C [830° F]

COOLING SYSTEM*

Heat Rejection to Coolant	192 kW [10900 BTU/min]
Engine Water Flow	284 litre/min [75 GPM]
Raw Water Flow	235 litre/min [62 GPM]
Pressure Cap Rating w/Heat Exchanger	103.41 kPa [15 psi]

INSTALLATION DIAGRAMS:

With Twin Disc MG-507A-1 Marine Gear	3884540-B
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CPL: 1221

DATE: November 1991

*All Data at Rated Conditions

**Consult Installation Direction Booklet for Limitations

Engine Specifications - Performance Data**6CTA-400BHP****GENERAL ENGINE DATA***

	Metric [U.S. Customary]
Engine Model	6CTA8.3-M2
Rating Type	Recreational/Light Duty
Rated Engine Power	298 kW [400 BHP]
Rated Engine Speed RPM	2600
High Idle Speed Range RPM	2800 to 2900
Idle Speed Range RPM	600 to 800
Engine Torque	1095 Nm [808 ft/lb]
Brake Mean Effective Pressure	1662 kPa [241 psi]
Compression Ratio	15.5:1
Piston Speed	11.7 m/sec [2305 ft/min]
Maximum Torque Capacity from Front of Crank**	
Firing Order	1.5.3.6.2.4

FUEL SYSTEM*

Fuel Consumption	79.9 litre/hr [21.1 GPH]
Approximate Fuel Flow to Pump	159 litre/hr [42 GPH]
Fuel Transfer Pump Pressure Range	124 to 172 kPa [18 to 25 psi]

ENGINE WEIGHTS (Dry Weights)

Engine Only	767 kg [1690 lb]
With Heat Exchanger Cooling System	+ 55 kg [120 lb]
With Twin Disc MG-507A-1 Marine Gear	+ 160 kg [354 lb]
With Twin Disc MG-5061A Marine Gear	+ 95 kg [210 lb]
With MPM IRM-301A2 Marine Gear	+ 110 kg [243 lb]

AIR SYSTEM*

Intake Manifold Pressure	1278 mm Hg [50 in Hg]
Intake Air Flow	370 litre/sec [790 CFM]
Heat Rejection to Ambient	40 kW [2300 BTU/min]
Minimum Ambient Temp for Cold Starting (No Aids)	10° C [50° F]

EXHAUST SYSTEM*

Exhaust Gas Flow	950 litre/sec [2000 CFM]
Exhaust Gas Temperature	490° C [920° F]

COOLING SYSTEM*

Heat Rejection to Coolant	263 kW [15000 BTU/min]
Engine Water Flow	295 litre/min [78 GPM]
Raw Water Flow	238 litre/min [63 GPM]
Pressure Cap Rating w/Heat Exchanger	103.41 kPa [15 psi]

INSTALLATION DIAGRAMS:

With Twin Disc MG-507A-1 Marine Gear	3884549-A
With Twin Disc MG-5061-A Marine Gear	3884609-A

CPL: 1282

DATE: November 1991

*All Data at Rated Conditions

**Consult Installation Direction Booklet for Limitations

Fuel Recommendations/Specifications



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

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

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

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

NOTE: No. 1 D fuel can be used, however, fuel economy will suffer.

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.

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

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.

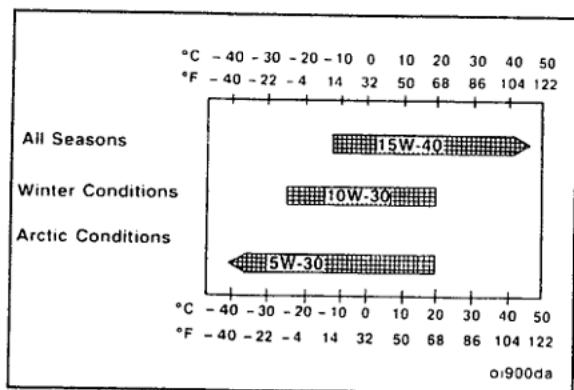
NOTE: CD/SF engine oils can be used in areas where CE/SG oil is **not** yet available, but the oil change interval **must** be reduced to one half the interval given in the maintenance schedule.

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 lubricating 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 can 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.

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 a 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 can 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.

SUPPLEMENTAL COOLANT ADDITIVES (C-Series only)

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

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

SCA CONCENTRATION - The recommended concentration level of DCA4 is one unit per 3.7 liter [1 U.S. gallon]. The DCA4 concentration **must** never exceed 2.0 units per 3.7 liter [1 U.S. gallon] nor fall below 0.5 unit per 3.7 liter [1 U.S. gallon].

DCA4 FILTER CHANGE INTERVAL - Supplemental Coolant Additives deplete during normal engine operation. Cummins recommends that the level be maintained by installation of a service coolant filter on the engine at every 16,000 km [10,000 miles] 250 hours or 6 months interval.

COOLANT TEST KITS (C-Series only)

DCA4 CONCENTRATION TESTS - As noted above, the primary method is to maintain proper DCA4 concentration levels by changing the service coolant filter at every 16,000 km [10,000 miles] 500 hours or 6 months. Fleetguard DCA4 "dip strip" test Kit Part No. CC 2626 or Fleetguard Monitor C Part No. CC2700 **must** be used if testing is deemed necessary due to:

— Addition of unrelated make up coolant in excess of 5.7 liters [6 U.S. quarts] between maintenance intervals.

- Troubleshooting of cooling system problems in the fleet (such as corrosion or seal leakage)
- An optional program in some fleets to monitor SCA levels to determine if maintenance intervals are acceptable.

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

DCA4 Unit Maintenance Guide (C-Series only)

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

* If DCA60L is used, do **not** use a filter that contains coolant additives. The combination of liquid and filter coolant additives will result in overconcentration.

Maintenance Intervals		
Total Cooling System Capacity Liters [U.S. Gallons] (A)	Initial Charge (B)	6 Months 500 Hours 16,000 KM [10,000 MI]
30 to 57 [6 to 12]	WF-2074	WF-2070

Notes:

- A. Consult the boat manufacturer's maintenance information for total cooling system capacity.
- B. After draining and replacing the coolant, install the initial per charge coolant filter to provide the recommended level of DCA4 concentration.
- C. Change coolant filters at regular intervals to protect the cooling system.
- D. Check the coolant additive concentration regularly. Check cooling systems using DCA4 only with DCA4 Coolant Test Kit, Fleetguard® Part No. CC-2626.

Engine Component Torque Values (B-Series)

Socket Or Wrench Size MM [Inch]		Torque Nm	[Ft-Lb]
10	Aftercooler Mounting (Engine Coolant Type)	24	[18]
13	(Raw Water Type)	30	22
8	Aftercooler Water Hose Clamp	5	[44 in-lb]
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 (Worm Type)	5	[44 in-lb]
11	(T-Bolt Type)	8	[71 in-lb]
15	Exhaust Manifold	43	[32]
15	Exhaust Outlet Pipe Mtg Bracket	43	[32]
[7/16]	Exhaust Outlet Pipe, V-Band Clamp	8	[71 in-lb]
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 Low Pressure Supply Banjo Screw (in Filter Head)	15	[11]
17	Fuel Banjo Screw (in Head)	32	[24]
10	Fuel Vent Screw (in Banjo)	8	[71 in-lb]
10	Fuel Banjo Screw (Injector)	8	[71 in-lb]
75 to 85	Fuel Filter	3/4 Turn After Contact	
24	Fuel Filter Adapter Nut	32	[24]
17	Fuel Line Fitting (High Pressure)	30	[22]
22	Fuel Pump Drive Gear (with Pump Unlocked) (CAV)	65	[48]
27	Fuel Pump Drive Gear (with Pump Unlocked) (Nippondenso)	123	[92]
10	Fuel Pump Lock (Bosch)	30	[22]
	Fuel Pump Unlock (Bosch)	13	[10]
14	Fuel Pump Lock (CAV)	8	[71 in-lb]
	Fuel Pump Unlock (CAV)	20	[15]
13	Fuel Pump Mounting Nuts	24	[18]
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]
18	Lifting Bracket (Rear)	77	[57]
75 to 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	[80 in-lb]
14	Rocker Lever Nut	24	[18]
10	Starter Mounting	43	[32]

Engine Component Torque Values (B-Series) (Continued)

Socket Or Wrench Size MM [Inch]		Torque Nm	[Ft-Lb]
10	Tappet Cover/Fuel Drain Line Supports	24	[18]
10	Thermostat Housing.....	24	[18]
13	Turbine Housing	11	[8]
10	Turbocharger Compressor Housing Clamp	6	[53 in-lb]
15	Turbocharger Mounting Nuts	43	[32]
13	Turbocharger Drain Tube.....	24	[18]
16	Turbocharger Oil Supply (Both Ends).....	24	[18]
15	Water Inlet Connection	43	[32]
13	Water Pump Mounting	24	[18]
15	Valve Cover	24	[18]
--	Valve Cover Oil Fill	Hand Tighten	

Engine Component Torque Values (C-Series)

Socket Or Wrench Size MM [Inch]		Torque Nm	[Ft-Lb]
10	Aftercooling Mounting.....	24	[18]
8	Aftercooler Water Hose Clamp.....	5	[44 in-lb]
13	Alternator Link	24	[18]
13	Alternator Mounting Bolt (10-15 SI)	43	[32]
10	Alternator Support (Upper).....	24	[18]
13	Belt Tensioner to Bracket	43	[32]
5 Allen	Belt Tensioner Bracket to Block.....	24	[18]
18	Crankshaft Damper.....	200	[148]
8	Crossover Clamp	5	[44 in-lb]
15	Exhaust Manifold	43	[32]
16	Exhaust Outlet Pipe Mounting	43	[32]
11	Exhaust Outlet Pipe, V-Band Clamp	5	[44 in-lb]
10	Fan Bracket Mounting.....	24	[18]
13	Fan Hub	43	[32]
16	Fan Hub (60 mm Bolt Circle)	43	[32]
24	Flame Start Aid.....	40	[30]
19	Flywheel	137	[101]
18	Flywheel Housing	60	[45]
[1/2]	Flywheel Housing Drain Plug.....	43	[32]
--	Front Cover Cap	--- Hand Tighten ---	
15	Front Engine Support Mounting.....	112	[82]
17	Fuel Banjo Screw (in Filter Head)	32	[24]
Slot	Fuel Vent Screw in Banjo	8	[71 in-lb]
75 to 85	Fuel Filter	3/4 Turn After Contact	
19	Fuel Low Pressure Supply at Pump.....	15	[11]
10	Fuel Low Pressure Return at Filter Head	8	[71 in-lb]
24	Fuel Filter Adapter Nut	32	[24]
17	Fuel Line Fitting (High Pressure).....	30	[22]
27	Fuel Pump Drive Gear (MW)	105	[77]
24	Fuel Pump Lock	15	[11]
15	Fuel Pump Mounting Nut	43	[32]

Engine Component Torque Values (C-Series) (Continued)

Socket Or Wrench Size MM [Inch]		Torque Nm	[Ft-Lb]
10	Fuel Pump to Bracket.....	24	[18]
10	Fuel Pump Vent Screw (PES6MW)	5	[44 in-lb]
15	Fuel Solenoid Bracket.....	43	[32]
15	Fuel Pump Support Bracket to Cylinder Block	43	[32]
10	Fuel Solenoid Mounting	10	[89 in-lb]
10	Fuel Transfer Pump Mounting/Cover Plate.....	24	[18]
10	Gear Cover.....	24	[18]
10	Injector Fuel Drain Manifold.....	9	[80 in-lb]
10	Injector Retaining Capscrew	24	[18]
10	Intake Manifold Cover.....	24	[18]
18	Lifting Bracket	77	[57]
118 to 131	Oil Filter.....	3/4 Turn After Contact	
10	Oil Cooler Cover	24	[18]
17	Oil Pan Drain Plug.....	80	[60]
17	Oil Pan Heater Plug.....	80	[60]
22	Oil Pressure Regulator Valve	80	[60]
32	Oil Thermostat	50	[37]
15	PTO Adapter.....	77	[57]
13	PTO Adapter Cover Plate A Drive.....	43	[32]
15	PTO Adapter Cover Plate B Drive.....	77	[57]
[3/4]	PTO Gear Nut A Drive	100	[74]
[15/16]	PTO Gear Nut B Drive	134	[100]
[11/16]	PTO Flange Companion	85	[63]
14	Rocker Lever Nut.....	24	[18]
15	Starter Mounting (12 Point)	77	[57]
10	Tachometer Drive Retainer	3	[27 in-lb]
10	Thermostat Housing.....	24	[18]
T-25 Torx	Timing Pin Flange Mounting	5	[44 in-lb]
13	Turbine Housing	11	[97 in-lb]
[7/16]	Turbocharger Compressor Housing Clamp	6	[53 in-lb]
15	Turbocharger Mounting Nut	43	[32]
10	Turbocharger Drain Tube.....	24	[18]
16	Turbocharger Oil Supply (Both Ends).....	15	[11]
8	Water Hose Clamps.....	5	[44 in-lb]
[3/8]	Water Inlet Plugs	34	[25]
10	Water Pump Mounting	24	[18]
15	Valve Cover	24	[18]
--	Valve Cover Oil Fill	Hand Tighten	

Weight and Measures - Conversion Factors

QUANTITY	U.S. CUSTOMARY		METRIC		FROM U.S. CUSTOMARY TO METRIC MULTIPLY BY	FROM METRIC TO U.S. CUSTOMARY MULTIPLY BY
	Unit Name	Abbr.	Unit Name	Abbr.		
Area	sq. inch	in ²	sq. millimeters	m ²	645.16	0.001550
			sq. centimeters	cm ²	6.452	0.155
	sq. foot	ft ²	sq. meter	m ²	0.0929	10.764
Fuel Consumption	pounds per horsepower hour	lb/hp-hr	grams per kilowatt hour	g/kw-hr	608.277	0.001645
Fuel Performance	miles per gallon	mpg	kilometers per liter	km/l	0.4251	2.352
	gallons per mile	gpm	liters per kilometer	l/km	2.3527	0.4251
Force	pounds force	lbf	Newton	N	4.4482	0.224809
Length	inch	in	millimeters	mm	25.40	0.039370
	foot	ft	millimeters	mm	304.801	0.00328
Power	horsepower	hp	kilowatt	kw	0.746	1.341
Pressure	pounds force per sq. in	psi	kilopascal	kPa	6.8948	0.145037
	inches of mercury	in Hg	kilopascal	kPa	3.3769	0.29613
	inches of water	in H ₂ O	kilopascal	kPa	0.2488	4.019299
	inches of mercury	in Hg	millimeters of mercury	mm Hg	25.40	0.039370
	inches of water	in H ₂ O	millimeters of water	mm H ₂ O	25.40	0.039370
	bars	bars	kilopascals	kPa	100.001	0.00999
	bars	bars	millimeters of mercury	mm Hg	750.06	0.001333
Temperature	fahrenheit	° F	centigrade	° C	(° F-32) ÷ 1.8	(1.8 x ° C) + 32
Torque	pound force per foot	ft lb	Newton-meter	N•m	1.35582	0.737562
	pound force per inch	in lb	Newton-meter	N•m	0.113	8.850756
Velocity	miles/hour	mph	kilometers/hour	kph	1.6093	0.6214
Volume: liquid displacement	gallon (U.S.)	gal.	liter	l	3.7853	0.264179
	gallon (Imp*)	gal.	liter	l	4.546	0.219976
	cubic inch	in ³	liter	l	0.01639	61.02545
	cubic inch	in ³	cubic centimeter	cm ³	16.387	0.06102
Weight (mass)	pounds (avoir.)	lb	kilograms	kg	0.4536	2.204623
Work	British Thermal Unit	BTU	joules	j	1054.5	0.000948
	British Thermal Unit	BTU	kilowatt-hour	kw-hr	0.000293	3414
	horsepower hours	hp-hr	kilowatt-hour	kw-hr	0.746	1.341

Lubricants and Sealants - Engine Assembly

Use the sealants listed below or sealants containing equivalent properties.

Description

1. Pipe Plugs
2. Gaskets
3. Cup Plugs
4. O-rings
5. Rear Camshaft Expansion Plug
6. Fuel Pump Studs
7. Turbocharger Drain (in block)
8. Dipstick Tube (in block)
9. Wet Flywheel Housing to Block
10. Front Seal in Gear Cover
11. Rear Seal in Rear Cover
12. Oil Pan at T-Joint
13. Timing Pin Housing Capscrews
14. Side Oil Fill

Sealing Method

- Precoated teflon or pipe sealer.
 No sealant required.
 Loctite™ 277 or Cummins Sealant Part No. 3375068.
 No sealant required.
 Loctite™ 277 or Cummins Sealant Part No. 3375068.
 Loctite™ 609.
 Loctite™ 277 or Cummins Sealant Part No. 3375068.
 Loctite™ 277 or Cummins Sealant Part No. 3375068.
 K&W Copper Coat™.
 Loctite 277 or 11,264.
 No sealant.
 3-Bond 1207C (Part No. 3823494).
 Loctite™ 59,241 liquid teflon.
 Loctite™ 277 or Cummins Sealant Part No. 3375068.

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 incorrect capscrews can result in engine damage.

Most of the capscrews used on the engines are metric. Some components, such as the marine gear, are installed using U.S. Customary capscrews.

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.

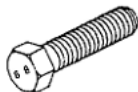

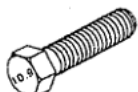

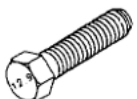

The following examples indicate how capscrews are identified:

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 Thread	Distance Between Threads	Length in Millimeters	Major Thread	Number Threads per Inch	Length in Inches



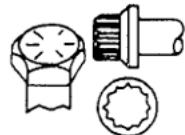
Notes:

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

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.	Nom	ft-lb	Nom	ft-lb	Nom	ft-lb	Nom	ft-lb	Nom	ft-lb	Nom	ft-lb		
mm														
6	9	5	7	4	14	9	11	7	14	9	11	7		
7	14	9	11	7	18	14	14	11	23	18	18	14		
8	25	18	18	14	32	23	25	18	36	27	28	21		
10	40	30	30	25	60	45	45	35	70	50	55	40		
12	70	55	55	40	105	75	80	60	125	95	100	75		
14	115	85	90	65	160	120	125	95	195	145	150	110		
16	180	130	140	100	240	175	190	135	290	210	220	165		
18	230	170	180	135	320	240	250	185	400	290	310	230		

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 Body Size		Capscrew Torque - Grade 5 Capscrew				Capscrew Torque - Grade 8 Capscrew			
		Cast Iron		Aluminum		Cast Iron		Aluminum	
		Nom	ft-lb	Nom	ft-lb	Nom	ft-lb	Nom	ft-lb
1/4 - 20		9	7	8	6	15	11	12	9
- 28		12	9	9	7	18	13	14	10
5/16 - 18		20	15	16	12	30	22	24	18
- 24		23	17	19	14	33	24	25	19
3/8 - 16		40	30	25	20	55	40	40	30
- 24		40	30	35	25	60	45	45	35
7/16 - 14		60	45	45	35	90	65	65	50
- 20		65	50	55	40	95	70	75	55
1/2 - 13		95	70	75	55	130	95	100	75
- 20		100	75	80	60	150	110	120	90
9/16 - 12		135	100	110	80	190	140	150	110
- 18		150	110	115	85	210	155	170	125
5/8 - 11		180	135	150	110	255	190	205	150
- 18		210	155	160	120	290	215	230	170
3/4 - 10		325	240	255	190	460	340	365	270
- 16		365	270	285	210	515	380	410	300
7/8 - 9		490	360	380	280	745	550	600	440
- 14		530	390	420	310	825	610	660	490
1 - 8		720	530	570	420	1100	820	890	660
- 14		800	590	650	480	1200	890	960	710

Section S - Service Assistance

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Section S - Service Assistance

Routine

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 refer to the directory in this section for the nearest Cummins Authorized Repair Location.

Emergency

The Cummins Customer Relations Department 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 in 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 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 are listed in this section. 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

Division and Regional Offices

NOTE: The following list contains offices in U.S., Canada, Australia, New Zealand, and Puerto Rico.

United States

Northern Division Office

Cummins Engine Company, Inc.
2629 Waterfront
Parkway East Drive
Suite 200
Indianapolis, IN 46204
Telephone: (317) 328-3740

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.
584 First Street East
Sonoma, CA 95476
Telephone: (707)935-3842

Plains Regional Office

Cummins Engine Company, Inc.
1303 Walnut Hill Lane
Suite 100
Irving, TX 75038
Telephone: (214)580-7745

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.
Suite 303
22359 Longheed Highway
Maple Ridge, B.C. V2X 7G2
Telephone: (604)463-2359

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.
C/O Cummins Alberta
14755 - 121 A Avenue
Edmonton, Alberta T5L 2T2
Telephone: (403)455-2151

Australia Regional Office

Cummins Diesel Australia

513-515 Maroondah Highway
Ringwood 3134
Victoria, Australia
Telephone: (3) 871-2222

NOTE: This office also serves New Zealand.

Cummins Americas Regional Office

Cummins Caribbean

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

NOTE: This office serves Puerto Rico and South America excluding Brazil.

Distributors and Branches - United States**Alabama****Birmingham Distributor**

Cummins Alabama, Inc.
2200 Pinson Highway
P.O. Box 1147
Birmingham, AL 35201
Telephone: (205) 841-0421

Mobile Branch

Cummins Alabama, Inc.
1924 Beltline Highway,
I-65 North
P.O. Box 2566
Mobile, AL 36601
Telephone: (205) 456-2236

Mobile Marine Branch

Cummins Alabama, Inc.
Marine Center
921 Corporate Drive South
P.O. Box 2566
Mobile, AL 36601
Telephone: (205) 456-2236

Mobile Onan Branch

Cummins Alabama, Inc.
Cummins/Onan/Power Systems Center
3422 Georgia Pacific Avenue
Mobile, AL 36617
Telephone: (205) 452-6426

Montgomery Branch

Cummins Alabama, Inc.
2325 West Fairview Avenue
P.O. Box 9271
Montgomery, AL 36108
Telephone: (205) 263-2594

Alaska**Anchorage - (Branch of Seattle)**

Cummins Northwest, Inc.
2618 Commercial Drive
Anchorage, AK 99501-3095
Telephone: (907) 279-7594

Arizona**Phoenix Distributor and Branch**

Cummins Southwest, Inc.
2239 North Black Canyon Hwy.
P.O. Box 6688
Phoenix, AZ 85005-6688
Telephone: (602) 252-8021

Phoenix Generator Branch

Cummins Southwest, Inc.
Power Systems Division
2222 N. 23rd Drive
Phoenix, AZ 85009
Telephone: (602) 252-8021

Tucson Branch

Cummins Southwest, Inc.
1912 West Prince Road
Tucson, AZ 85705
Telephone: (602) 887-7440

Arkansas**Little Rock - (Branch of Memphis)**

Cummins Mid-South, Inc.
6600 Interstate 30
Little Rock, AR 72209
Telephone: (Sales): (501) 569-5600
(Service): (501) 569-5656
(Parts): (501) 569-5613

Van Buren - (Branch of Memphis)

Cummins Mid-South, Inc.
1906 N. 6th Street Memphis
Van Buren, AR 72956
Telephone: Sales: (501) 474-7953
Parts: (501) 474-7951
Service: (501) 474-7955 & 474-7956

California**San Leandro Distributor**

Cummins West, Inc.
1515 Aurora Drive
San Leandro, CA 94577
Telephone: (415) 351-6101

Bakersfield Branch

Cummins West, Inc.
301 East Fourth Street
Bakersfield, CA 93307
Telephone: (805) 325-9407

Eureka/Arcata Branch

Cummins West, Inc.
4801 West End Road
Arcata, CA 95521
Telephone: (707) 822-7385

Fresno Branch

Cummins West, Inc.
2740 Church Avenue
Fresno, CA 93706
Telephone: (209) 486-6050

Los Angeles Industrial Branch

Cummins West, Inc.
1939 Deere Avenue
Irvine, CA 92714
Telephone: (714) 756-8700

Los Angeles Branch

Cummins West, Inc.
1661 McGarry Street
Los Angeles, CA 90021
Telephone: (213) 746-3850
Branch: (213) 746-6410

Montebello Branch

Cummins West, Inc.
1105 South Greenwood Avenue
Montebello, CA 90640
Telephone: (213) 728-8111

Redding Branch

Cummins West, Inc.
2725 Favretto Avenue
Redding, CA 96001
Telephone: (916) 241-2154

Rialto Branch

Cummins West, Inc.
161 East Valley Road
Rialto, CA 92376
Telephone: (714) 877-0433

San Diego Branch

Cummins West, Inc.
9191 Kearny Villa Court
San Diego, CA 92123
Telephone: (619) 278-4160

San Leandro Branch

Cummins West, Inc.
1601 Aurora Drive
San Leandro, CA 94577
Telephone: (415) 351-6101

Stockton Office

Cummins West, Inc.
41 W. Yokuts Avenue, Suite 131
Stockton, CA 95207
Telephone: (209) 473-0386

West Sacramento Branch

Cummins West, Inc.
2661 Evergreen Avenue
West Sacramento, CA 95691
Telephone: (916) 371-0630

Colorado**Denver Distributor**

Cummins Power, Inc.
5100 East 58th Avenue
Commerce City, CO 80022
Telephone: (303) 287-0201

Denver Generator Branch

Gen Power, Inc.
3801 E. 50th Avenue
Denver, CO 80216
Telephone: (303) 399-7697

Grand Junction Branch

Cummins Power, Inc.
2380 U.S. Highway 6 & 50
P.O. Box 339
Grand Junction, CO 81501
Telephone: (303) 242-5776

Greeley Branch

Cummins Power, Inc.
250 Sixth Avenue
Greeley, CO 80631
Telephone: (303) 351-0448

Connecticut**Hartford Distributor**

Cummins - Connecticut, Inc.
260 Murphy Road
Hartford, CT 06114
Telephone: (203) 527-9156
Parts: (203) 525-5606

Florida

Tampa Distributor

Cummins Southeastern Power, Inc.
Corporate Office and Energy System
5421 N. 59th Street
Tampa, FL 33610
Telephone: (813) 621-7202

Ft. Myers Branch

Cummins Southeastern Power, Inc.
2671 Edison Avenue
Ft. Myers, FL 33902
Telephone: (813) 337-1211

Jacksonville Branch

Cummins Southeastern Power, Inc.
2060 West 21st Street
P.O. Box 12036
Jacksonville, FL 32209
Telephone: (904) 355-3437

Miami Branch

Cummins Southeastern Power, Inc.
9900 N.W. 77th Court
Hialeah Gardens, FL 33016
Telephone: (305) 821-4200

Orlando Branch

Cummins Southeastern Power, Inc.
4020 North Orange Blossom Trail
Orlando, FL 32810
Telephone: (407) 298-2080

Tampa Branch

Cummins Southeastern Power, Inc.
5910 E. Hillsborough Avenue
P. O. Box 11737
Tampa, FL 33680
Telephone: (813) 626-1101

Georgia

Atlanta Distributor

Cummins South, Inc.
5125 Georgia Highway 85
College Park, GA 30349
Telephone: (404) 763-0151

Albany Branch

Cummins South, Inc.
1915 W. Oakbridge Drive
Albany, GA 31707-4938
Telephone: (912) 888-6210

Atlanta Branch

Cummins South, Inc.
100 University Avenue, S.W.
Atlanta, GA 30315-2202
Telephone: (404) 527-7800

Augusta Branch

Cummins South, Inc.
1255 New Savannah Road
Augusta, GA 30901-3891
Telephone: (404) 722-8825

Dalton Branch

Cummins South, Inc.
204 Carbondale Road
Dalton, GA 30720-5303
Telephone: (404) 277-1144

Savannah Branch

Cummins South, Inc.
8 Interchange Court
Savannah, GA 31401-1627
Telephone: (912) 232-5565

Hawaii

Honolulu Distributor

Cummins Hawaii, Inc.
215 Puuhale Road
Honolulu, HI 96819-2235
Telephone: (808) 845-6606

Idaho

Boise - (Branch of Salt Lake City)

Cummins Intermountain, Inc.
2851 Federal Way City
P.O. Box 5212
Boise, ID 83705
Telephone: (208) 336-5000

Pocatello - (Branch of Salt Lake City)

Cummins Intermountain, Inc.
1429 Highway 30 West
Pocatello, ID 83201
Telephone: (208) 234-1661

Illinois

Chicago Distributor

Cummins Northern Illinois, Inc.
7145 Santa Fe Drive
Hodgkins, IL 60525
Telephone: (708) 579-9222

Bloomington-Normal - (Branch of Indianapolis)

Cummins Mid-States Power, Inc.
P.O. Box 348
(at U.S. 51 N and I-55)
Bloomington-Normal, IL 61761
Telephone: (309) 452-4454

Harrisburg (Branch of St. Louis)

Cummins Gateway, Inc.
Rt. 4, Box 629
Harrisburg, IL 62946
Telephone: (618) 244-1232

Rock Island - (Branch of Omaha)

Cummins Great Plains Diesel, Inc.
7820-42nd Street West
Rock Island, IL 61204
Telephone: (309) 787-4300

Rockford Branch

Cummins Northern Illinois, Inc.
4617 Sandy Hollow Road
Rockford, IL 61109
Telephone: (815) 874-1700

Indiana

Indianapolis Distributor

Cummins Mid-States Power, Inc.
2421 Production Drive
Indianapolis, IN 46241
Telephone: (317) 243-7979

Evansville - (Branch of Louisville)

Cummins Cumberland, Inc.
7901 Highway 41 N.
Evansville, IN 47711
Telephone: (812) 867-4400

Ft. Wayne Branch

Cummins Mid-States Power, Inc.
3415 Coliseum Blvd. West
(At Jct. I-69 & 30/33)
Ft. Wayne, IN 46808
Telephone: (219) 482-3691

Gary - (Branch of Chicago)

Cummins Northern Illinois, Inc.
1440 Texas Street
Gary, IN 46402
Telephone: (219) 885-5591

Indianapolis Branch

Cummins Mid-States Power, Inc.
P. O. Box 41317
3621 West Morris Street
Indianapolis, IN 46241
Telephone: (317) 244-7251

Linton Branch

Cummins Mid-States Power, Inc.
1244 N.E. A Street
(Indiana Highway 54 East)
Linton, IN 47441-0678
Telephone: (812) 847-2201 and
(812) 847-2202

Iowa

Cedar Rapids - (Branch of Omaha)

Cummins Great Plains Diesel, Inc.
625 - 33rd Avenue SW
P.O. Box 1107
Cedar Rapids, IA 52406
Telephone: (319) 366-7537
(24 hours)

Des Moines - (Branch of Omaha)

Cummins Great Plains Diesel, Inc.
1680 N.E. 51st Avenue
P.O. Box B
Des Moines, IA 50313
Telephone: (515) 262-9591
Parts: (515) 262-9744
(515) 262-9591 after midnight

Des Moines - (Branch of Omaha)

Midwestern Power Products
Division of Cummins Great Plains Diesel, Inc.
10100 Dennis Drive
Des Moines, IA 50322
Telephone: (515) 278-5521

Kansas**Colby - (Branch of Kansas City, Missouri)**

Cummins Mid-America, Inc.
1880 South Range
P.O. Drawer "P"
Colby, KS 67701
Telephone: (913) 462-3945
(913) 462-3143

Garden City - (Branch of Kansas City, Missouri)

Cummins Mid-America, Inc.
2203 W. Jones Frontage Road
Box 2598
Garden City, KS 67846
Telephone: (316) 275-2277

Olathe - (Branch of Kansas City, Missouri)

Cummins Mid-America, Inc.
11615 South Rogers Road
P. O. Box 3108
Olathe, KS 66062
Telephone: (913) 469-5660

Wichita - (Branch of Kansas City, Missouri)

Cummins Mid-America, Inc.
5101 North Broadway (67219)
P.O. Box 2681
Wichita, KS 67201
Telephone: (316) 838-0875

Kentucky**Louisville Distributor**

Cummins Cumberland, Inc.
(Corporate Office)
9822 Bluegrass Parkway
Louisville, KY 40299
Telephone: (502) 491-6060

Hazard Branch

Cummins Cumberland, Inc.
Highway 15 South
P.O. Box 510
Hazard, KY 41701
Telephone: (606) 436-5718

Louisville Branch

Cummins Cumberland, Inc.
9820 Bluegrass Parkway
Louisville, KY 40299
Telephone: (502) 491-4263

Louisiana**Morgan City - (Branch of Memphis)**

Cummins Mid-South, Inc.
Hwy. 90 East
P.O. Box 1229
Amelia, LA 70340
Telephone: (504) 631-0576

New Orleans - (Branch of Memphis)

Cummins Mid-South, Inc.
110 E. Airline Highway
Kenner, LA 70062
Telephone: (504) 468-3535

Maine**Bangor (Branch of Boston)**

Cummins North Atlantic, Inc.
142 Target Industrial Circle
Bangor, ME 04401
Telephone: (207) 941-1061

Scarborough - (Branch of Boston)

Cummins North Atlantic, Inc.
10 Gibson Road
Scarborough, ME 04074
Telephone: (207) 883-8155

Maryland**Baltimore Distributor**

Cummins Chesapeake, Inc.
6120 Holabird Avenue
Baltimore, MD 21224
Telephone: (301) 633-5161

Baltimore Branch

Cummins Chesapeake
3140 Washington Boulevard
Baltimore, MD 21230-1090
Telephone: (301) 644-6500

Massachusetts**Boston Distributor**

Cummins North Atlantic, Inc.
100 Allied Drive
Dedham, MA 02026
Telephone: (617) 329-1750

West Springfield Branch

Cummins North Atlantic, Inc.
124 Ashley Avenue
West Springfield, MA 01089
Telephone: (413) 737-2659

Michigan**Detroit Distributor**

Cummins Michigan, Inc.
41216 Vincent Court
Novi, MI 48375
Telephone: (313) 478-9700

Blissfield, Michigan

Diesel Fuel Systems, Inc.
Subsidiary of Cummins Michigan, Inc.
109 East Adrian Street
Blissfield, MI 49228
Telephone: (517) 486-4324

Dearborn Branch

Cummins Michigan, Inc.
3760 Wyoming Avenue
Dearborn, MI 48120
Telephone: (313) 843-6200

Grand Rapids Branch

Cummins Michigan, Inc.
3715 Clay Avenue, S.W.
Grand Rapids, MI 49508
Telephone: (616) 538-2250

Grand Rapids Branch

Standby Power, Inc.
7580 Expressway Drive S.W.
Grand Rapids, MI 49548
Telephone: (616) 281-2211

Iron Mountain - (Branch of De Pere)

Cummins Great Lakes, Inc.
P.O. Box 703
1901 North Stephenson Avenue
Iron Mountain, MI 49801
Telephone: (906) 774-2424

Saginaw Branch

Cummins Michigan, Inc.
722 N. Outer Drive
Saginaw, MI 48605
Telephone: (517) 752-5200

Standby Power - (Branch of Detroit)

Standby Power, Inc.
12130 Dixie
Redford, MI 48239
Telephone: (313) 538-0200

Minnesota**St. Paul Distributor**

Cummins Diesel Sales, Inc.
2690 Cleveland Avenue North
St. Paul, MN 55113
(Mailing Address)
P.O. Box 64578
St. Paul, MN 55164
Telephone: (612) 636-1000

Duluth Branch

Cummins Diesel Sales, Inc.
3115 Truck Center Drive
Duluth, MN 55806
Telephone: (218) 628-3641

Hibbing Branch

Cummins Diesel Sales, Inc.
604 West 41st Street
P.O. Box 159
Hibbing, MN 55746
Telephone: (218) 263-7558

Mississippi**Jackson - (Branch of Memphis)**

Cummins Mid-South, Inc.
325 New Highway 49 South
P.O. Box 54224
Jackson, MS 39288-4224
Telephone: Admin.: (601) 932-7016
Parts: (601) 932-2720
Service: (601) 939-1800

Missouri

Kansas City Distributor

Cummins Mid-America, Inc.
1760 Universal
Kansas City, MO 64120
General Accounting Office
Telephone: (816) 483-5070

Kansas City Branch

Cummins Mid-America, Inc.
3527 Gardner Avenue
Kansas City, MO 64120
Telephone: (816) 483-6313

Kansas City Fuel Systems Branch

KC Diesel & Electric
2810 Nicholson
Kansas City, MO 64120
Telephone: (816) 241-3400

Joplin Branch

Cummins Mid-America, Inc.
3507 East 20th Street
Joplin, MO 64801
Telephone: (417) 623-1661

Springfield Branch

Cummins Mid-America, Inc.
3637 East Kearney
Springfield, MO 65803
Telephone: (417) 862-0777

St. Louis Distributor

Cummins Gateway, Inc.
7210 Hall Street
St. Louis, MO 63147
Telephone: (314) 389-5400

Columbia Branch

Cummins Gateway, Inc.
5221 Highway 763 North
Columbia, MO 65202-1028
Telephone: (314) 449-3711

Sikeston Branch

Cummins Gateway, Inc.
101 Keystone Drive
Sikeston, MO 63801
Telephone: (314) 472-0303

Montana

Billings - (Branch of Denver)

Cummins Power, Inc.
5151 Midland Road
P.O. Box 30377
Billings, MT 59101
Telephone: (406) 245-4194

Great Falls - (Branch of Denver)

Cummins Power, Inc.
415 Vaughn Road (59404)
P.O. Box 1199
Great Falls, MT 59403
Telephone: (406) 452-8561

Missoula - (Branch of Seattle)

Cummins Northwest, Inc.
4950 North Reserve Street
Missoula, MT 59802-1498
Telephone: (406) 728-1300

Nebraska

Omaha Distributor and Branch

Cummins Great Plains
Diesel, Inc.
5515 Center Street
P.O. Box 6068
Omaha, NE 68106
Telephone: (402) 551-7678
(24 hours) or
(402) 493-4656

Kearney Branch

Cummins Great Plains
Diesel, Inc.
515 Central Avenue
P.O. Box 1326
Kearney, NE 68847
Telephone: (308) 234-1994

Nevada

Elko - (Branch of Salt Lake City)

Cummins Intermountain, Inc.
5370 East Idaho Street
Elko, NV 89801
Telephone: (702) 738-6405

Las Vegas - (Branch of Salt Lake City)

Cummins Intermountain, Inc.
2750 Losee Road
North Las Vegas, NV 89030
Telephone: (702) 399-2339
Mailing Address:
P. O. Box 3997
North Las Vegas, NV 89036-3998

Sparks - (Branch of Salt Lake City)

Cummins Intermountain, Inc.
150 Glendale Avenue
Sparks, NV 89431
Telephone: (702) 331-4983

New Jersey

Newark - (Branch of Bronx)

Cummins Metropower, Inc.
Routes U.S. 1 & 22
Newark, NJ 07114
Telephone: (201) 242-2255

New Mexico

Albuquerque - (Branch of Phoenix)

Cummins Southwest, Inc.
1921 Broadway N.E.
Albuquerque, NM 87102
Telephone: (505) 247-2441

Farmington - (Branch of Phoenix)

Cummins Southwest, Inc.
1101 North Troy King Road
Farmington, NM 87401
Telephone: (505) 327-7331

New York

Bronx Distributor

Cummins Metropower, Inc.
890 Zerega Avenue
Bronx, NY 10473
Telephone: (212) 892-2400

Albany - (Branch of Boston)

Cummins North Atlantic, Inc.
101 Railroad Avenue
Albany, NY 12205
Telephone: (518) 459-1710

Buffalo - (Branch of Boston)

Cummins North Atlantic, Inc.
480 Lawrence Bell Dr.
Williamsville, NY 14221-7090
Telephone: (716) 631-3211

Plainview Branch

Cummins Metropower, Inc.
105 South Service Road
Plainview, NY 11803
Telephone: (516) 249-7500

Syracuse - (Branch of Boston)

Cummins North Atlantic, Inc.
29 Eastern Avenue
Syracuse, NY 13211
Telephone: (305) 437-2751

North Carolina

Charlotte Distributor

Cummins Atlantic, Inc.
11101 Nations Ford Road
P.O. Box 240729
Charlotte, NC 28224-8843
Telephone: (704) 588-1240

Charlotte Branch

Cummins Atlantic, Inc.
3700 North Interstate 85
Charlotte, NC 28206
Telephone: (704) 596-7690

Greensboro Branch

Cummins Atlantic, Inc.
513 Preddy Boulevard
P.O. Box 22066
Greensboro, NC 27420-2066
Telephone: (919) 275-4531

Wilson Branch

Cummins Atlantic, Inc.
1514 Cargill Avenue
P.O. Box 1177
Wilson, NC 27894-1177
Telephone: (919) 237-9111

North Dakota**Dickinson - (Branch of St. Paul)**

Cummins Diesel Sales, Inc.
Highway 10 West
P.O. Box 1246
Dickinson, ND 58602
Telephone: (701) 225-9194
(701) 677-5354
after 12:30 a.m.

Fargo - (Branch of St. Paul)

Cummins Diesel Sales, Inc.
4050 West Main Avenue (58103)
P.O. Box 2111
Fargo, ND 58107
Telephone: (701) 282-2466

Grand Forks - (Branch of St. Paul)

Cummins Diesel Sales, Inc.
4728 Gateway Drive
P.O. Box 636
Grand Forks, ND 58201
Telephone: (701) 775-8197
(701) 772-7689
after 12:30 a.m.

Minot - (Branch of St. Paul)

Cummins Diesel Sales, Inc.
1501 - 20th Avenue, S.E.
P.O. Box 1179
Minot, ND 58702
Telephone: (701) 852-3585
(701) 839-3417
after 12:30 a.m.

Ohio**Columbus Distributor and Branch**

Cummins Ohio, Inc.
4000 Lyman Drive
Hilliard (Columbus), OH 43026
Telephone: (614) 771-1000

Akron Branch

Cummins Ohio, Inc.
1033 Kelly Avenue
Akron, OH 44306
Telephone: (216) 773-7821

Cincinnati Branch

Cummins Ohio, Inc.
10470 Evendale Drive
Cincinnati, OH 45241
Telephone: (513) 563-6670

Cincinnati Branch

Power Systems Division
Cummins Ohio, Inc.
10660 Evendale Drive
Cincinnati, OH 45241
Telephone: (513) 563-9303

Cleveland Branch

Cummins Ohio, Inc.
7585 Northfield Road
Cleveland, OH 44146
Telephone: (216) 439-6800

Lima Branch

Cummins Ohio, Inc.
960 Broadway
Lima, OH 45804
Telephone: (419) 227-2641

Strasburg Branch

Cummins Ohio, Inc.
777 South Wooster Avenue
Box 136
Strasburg, OH 44680
Telephone: (216) 878-5511
After hours: (216) 364-1433

Toledo Branch

Cummins Ohio, Inc.
801 Illinois Avenue
Maumee
(Toledo), OH 43537
Telephone: (419) 893-8711

Youngstown Branch

Cummins Ohio, Inc.
7145 Masury Road
Hubbard
(Youngstown), OH 44425
Telephone: (216) 534-1935

Oklahoma**Duncan - (Branch of Arlington)**

Cummins Southern Plains, Inc.
1400 East Bois D'Arc
P.O. Box 310
Duncan, OK 73534-0310
Telephone: (405) 255-1414
(24 Hours)

Oklahoma City - (Branch of Arlington)

Cummins Southern Plains, Inc.
5800 West Reno
P.O. Box 1636
Oklahoma City, OK 73101-1636
Telephone: (405) 946-4481
(24 hours)

Tulsa - (Branch of Arlington)

Cummins Southern Plains, Inc.
16525 E. Skelly Drive
P.O. Box 471616
Tulsa, OK 74147-1616
Telephone: (918) 234-3240
(24 hours)

Oregon**Bend - (Branch of Seattle)**

Cummins Northwest, Inc.
3500 N. Highway 97 (97701-5729)
P.O. Box 309
Bend, OR 97709-0309
Telephone: (503) 389-1900

Eugene - (Branch of Seattle)

Cummins Northwest, Inc.
91201 Industrial Parkway
Coburg, OR 97401

(Mailing Address)
P.O. Box 10877
Eugene, OR 97440-2887
Telephone: (503) 687-0000

Medford - (Branch of Seattle)

Cummins Northwest, Inc.
4045 Crater Lake Highway
Medford, OR 97504-9796
Telephone: (503) 779-0151

North Bend - (Branch of Seattle)

Cummins Northwest, Inc.
612 California Avenue (97459-3402)
P.O. Box 447
North Bend, OR 97459-0105
Telephone: (503) 756-3111

Pendleton - (Branch of Seattle)

Cummins Northwest, Inc.
223 S.W. 23rd Street
Pendleton, OR 97801-1810
Telephone: (503) 276-2561

Portland - (Corporate Branch of Seattle)

Cummins Northwest, Inc.
4711 N. Basin Avenue
P. O. Box 2710 (97208-2710)
Portland, OR 97217-3557
Telephone: (503) 289-0900

Portland - (Branch of Seattle)

Cummins Northwest, Inc.
4711 N. Basin Avenue
P. O. Box 2710 (97208-2710)
Portland, OR 97217-3557
Telephone: (503) 289-0900

Pennsylvania**Philadelphia Distributor**

Cummins Diesel Engines, Inc.
3941 Commerce Avenue
Willow Grove, PA 19090-1108
Telephone: (215) 657-2200

Philadelphia (Bristol) Branch

Cummins Diesel Engines, Inc.
2727 Ford Road
Bristol, PA 19007
Telephone: (215) 785-6005

Clearfield Branch

Cummins Diesel Engines, Inc.
Clearfield Parts Center
501 Williams Street
Clearfield, PA 16830
Telephone: (814) 765-2421

Harrisburg Branch

Cummins Diesel Engines, Inc.
4499 Lewis Road
Harrisburg, PA 17111-2541
Telephone: (717) 564-1344

Monroeville Branch

Cummins Diesel Engines, Inc.
2740 Mosside Boulevard
Monroeville, PA 15146
Telephone: (412) 856-6700

Puerto Rico

Puerto Nuevo - (Branch of Tampa)

Cummins Diesel Power, Inc.
Calle C #31 El Matadero
Puerto Nuevo, Puerto Rico 00920
Telephone: (809) 793-0300

South Carolina

Charleston - (Branch of Charlotte)

Cummins Atlantic, Inc.
3010 West Montague Avenue
P.O. Box 10341
Charleston, SC 29411-0341
Telephone: (803) 554-5112

Columbia - (Branch of Charlotte)

Cummins Atlantic, Inc.
1233 Bluff Road
P.O. Box 13543
Columbia, SC 29201-3543
Telephone: (803) 799-2410

South Dakota

Rapid City - (Branch of Omaha)

Cummins Great Plains
Diesel, Inc.
2310 Haines Avenue
P.O. Box 244
Rapid City, SD 57701
Telephone: (605) 343-6130

Sioux Falls - (Branch of Omaha)

Cummins Great Plains
Diesel, Inc.
701 East 54th Street North
Sioux Falls, SD 57104
Telephone: (605) 336-1715
(605) 334-6492

Tennessee

Memphis Distributor & Distribution Center

Cummins Mid-South, Inc.
666 Riverside Drive
P.O. Box 3080
Memphis, TN 38103
Telephone: (901) 577-0666

Chattanooga - (Branch of Atlanta)

Cummins South, Inc.
1509 East 26th Street
Chattanooga, TN 37407-1095
Telephone: (615) 629-1447

Knoxville - (Branch of Louisville)

Cummins Cumberland, Inc.
1211 Ault Road
Knoxville, TN 37914
Telephone: (615) 523-0446

Memphis Branch

Cummins Mid-South, Inc.
1784 E. Brooks Road
Memphis, TN 38116
Telephone:
Sales/Admin.-(901) 345-7424
Parts - - - -(901) 345-1784
Service - - - -(901) 345-6185

Nashville - (Branch of Louisville)

Cummins Cumberland, Inc.
706 Spence Lane
Nashville, TN 37217
Telephone: (615) 366-4341

Texas

Arlington Distributor and Branch

Cummins Southern Plains, Inc.
600 N. Watson Road
P.O. Box 90027
Arlington, TX 76004-3027
Telephone: (817) 640-6801
(24 hours)

Amarillo Branch

Cummins Southern Plains, Inc.
5224 Interstate 40 -
Expressway East
P.O. Box 31570
Amarillo, TX 79120-1570
Telephone: (806) 373-3793
(24 hours)

Corpus Christi Branch

Cummins Southern Plains, Inc.
1302 Corn Products Road
P.O. Box 48
Corpus Christi, TX 78403-0048
Telephone: (512) 289-0700
(24 hours)

Dallas Branch

Cummins Southern Plains, Inc.
3707 Irving Boulevard
Dallas, TX 75247
Telephone: (214) 631-6400
(24 hours)

El Paso - (Branch of Phoenix)

Cummins Southwest, Inc.
14333 Gateway West
El Paso, TX 79927
Telephone: (915) 852-4200

Fort Worth Branch

Cummins Southern Plains, Inc.
3250 North Freeway
Fort Worth, TX 76111
Telephone: (817) 624-2107
(24 hours)

Houston Branch

Cummins Southern Plains, Inc.
4750 Homestead Road
P.O. Box 1367
Houston, TX 77251-1367
Telephone: (713) 675-7421
(24 hours)

Mesquite Branch

Cummins Southern Plains, Inc.
2615 Big Town Blvd.
Mesquite, TX 75150
Telephone: (214) 321-5555
(24 hours)

Odessa Branch

Cummins Southern Plains, Inc.
1210 South Grandview
P.O. Box 633
Odessa, TX 79760-0633
Telephone: (915) 332-9121
(24 hours)

San Antonio Branch

Cummins Southern Plains, Inc.
6226 Pan Am Expressway North
P.O. Box 18385, Serna Station
San Antonio, TX 78218-0385
Telephone: (512) 655-5420
(24 hours)

Utah

Salt Lake City Distributor

Cummins Intermountain, Inc.
1030 South 300 West
P.O. Box 25428
Salt Lake City, UT 84125
Telephone: (801) 355-6500

Vernal Branch

Cummins Intermountain, Inc.
1435 East 335 South
P.O. Box 903
Vernal, UT 84078
Telephone: (801) 789-5732

Virginia

Bristol - (Branch of Louisville)

Cummins Cumberland, Inc.
400 Stage Coach Road
1-81 at Old Airport Road
Bristol, VA 24201
Telephone: (703) 669-4200

Norfolk - (Branch of Charlotte)

Cummins Atlantic, Inc.
Cummins/Onan Power Systems
1114 Ballentine Blvd.
Norfolk, VA 23504
Telephone: (804) 627-9470

Richmond - (Branch of Charlotte)

Cummins Atlantic, Inc.
3900 Deepwater Terminal Road
Richmond, VA 23234
Telephone: (804) 232-7891

Roanoke - (Branch of Charlotte)

Cummins Atlantic, Inc.
5307 Peters Creek Road
P.O. Box 7237
Roanoke, VA 24019-7237
Telephone: (703) 362-1673

Washington**Seattle Distributor**

Cummins Northwest, Inc.
811 S.W. Grady Way (98055-2944)
P.O. Box 9811
Renton, WA 98057-9811
Telephone: (206) 235-3400

Chehalis Branch

Cummins Northwest, Inc.
1200 N.W. Maryland
Chehalis, WA 98532-1813
Telephone: (206) 748-8841

Longview Branch

Cummins Northwest, Inc.
1153 Third Avenue (98632-3204)
P.O. Box 1459
Longview, WA 98632-0141
Telephone: (206) 425-0100

Spokane Branch

Cummins Northwest, Inc.
E. 3904 Trent Avenue (99202-4471)
P.O. Box 2746 -
Terminal Annex
Spokane, WA 99220-2746
Telephone: (509) 534-0411

Tacoma Branch

Cummins Northwest, Inc.
3701 Pacific Highway East
Tacoma, WA 98424-1135
Telephone: (206) 922-2191

Yakima Branch

Cummins Northwest, Inc.
1905 East Central Avenue (98901-3609)
P.O. Box 9129
Yakima, WA 98909-0129
Telephone: (509) 248-9033

West Virginia**Charleston - (Branch of Louisville)**

Cummins Cumberland, Inc.
Charleston Ordnance Center
P.O. Box 8456
South Charleston, WV 25303
Telephone: (304) 744-6373

Fairmont - (Branch of Louisville)

Cummins Cumberland, Inc.
South Fairmont Exit, I-79
Rt. 73, South
P.O. Box 988
Fairmont, WV 26554
Telephone: (304) 367-0196

Wisconsin**DePere Distributor**

Cummins Great Lakes, Inc.
875 Lawrence Drive
(Mailing Address)
P.O. Box 530
DePere (Green Bay), WI 54115-0530
Telephone: (414) 337-1991

Chippewa Falls Branch

Cummins Great Lakes, Inc.
Route #7
Box Number 88
Chippewa Falls (Eau Claire), WI 54729
Telephone: (715) 832-4329

DePere Branch

Cummins Great Lakes, Inc.
939 Lawrence Drive
(Mailing Address)
P. O. Box 530
DePere, WI 54115-0530
Telephone: (414) 336-9631

Milwaukee Branch

Cummins Great Lakes, Inc.
9401 South 13th Street
Oak Creek, WI 53154
Telephone: (414) 768-7400

Wyoming**Gillette - (Branch of Denver)**

Cummins Power, Inc.
2700 Hwy. 14 & 16 North
P.O. Box 1207 (82717)
Gillette, WY 82716
Telephone: (307) 682-9611

Rock Springs - (Branch of Salt Lake City)

Cummins Intermountain, Inc.
2000 Foothill Blvd.
P.O. Box 1634
Rock Springs, WY 82901
Telephone: (307) 362-5168

Distributors and Branches - Canada

Alberta

Edmonton Distributor

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

Calgary Branch

Cummins Alberta
703-64 Avenue S.E.
Calgary, Alberta T2H 2C3, Canada
Telephone: (403) 255-6691

Fort McMurray Branch

Cummins Alberta
158 Becker Crescent
Fort McMurray, Alberta T9K 1M7, Canada
Telephone: (403) 791-6836

Hinton Branch

Cummins Alberta
135 Veats Avenue
Hinton, Alberta T7V 1S8, Canada
Telephone: (403) 865-5111

Lethbridge Branch

Cummins Alberta
230 - 24th Street North
Lethbridge, Alberta T1J 3N2, Canada
Telephone: (403) 329-6144

British Columbia

Vancouver Distributor

Cummins British Columbia
4270 Dawson Street
Burnaby, B.C. V5C 4B1, Canada
Telephone: (604) 299-9111

Kamloops Branch

Cummins British Columbia
976 Laval Crescent
Kamloops, B.C. Canada V2C 5P5
Telephone: (604) 828-2388

Sparwood Branch

Cummins British Columbia
731 Douglas Fir Road
Sparwood, B.C. V0B 2G0, Canada
Telephone: (604) 425-0522

Tumbler Ridge Branch

Cummins British Columbia
Box 226
Tumbler Ridge, B.C.
Canada V0C 2W0
Telephone: (604) 242-4217

Manitoba

Winnipeg Distributor

Cummins Mid-Canada Ltd.
489 Oak Point Road
P.O. Box 1860
Winnipeg, MB R3C 3R1, Canada
Telephone: (204) 632-5470

New Brunswick

Fredericton - (Branch of Montreal)

Diesel Cummins
Branch of Cummins Americas, Inc.
Vanier Highway
P.O. Box 1178, Station "A"
Fredericton,
New Brunswick E3B 5C8, Canada
Telephone: (506) 452-1940

Newfoundland

St. John's - (Branch of Montreal)

Diesel Cummins
Branch of Cummins Americas, Inc.
122 Clyde Avenue
Donovans Industrial Park
(Mailing Address)
P. O. Box 159
Donovans Industrial Park
Mount Pearl, Newfoundland A1N 2C2
Canada
Telephone: (709) 364-6972

Nova Scotia

Halifax - (Branch of Montreal)

Diesel Cummins
Branch of Cummins Americas, Inc.
3204 Barrington Street
Halifax, Nova Scotia B3K 2X6, Canada
Telephone: (902) 429-6613

Ontario

Toronto Distributor

Cummins Ontario Inc.
150 N. Queen Street
Etobicoke, Ontario M9C 1A8
P.O. Box 40, Station "U"
Toronto, Ontario M8Z 5N1
Telephone: (416) 621-9921

Milton Branch

Dieselguard
Division of Cummins Ontario Inc.
40 Chisholm Dr.
Milton, Ontario L9T 4N9
Telephone: (416) 876-4623

Oakville Industrial Branch

Cummins Ontario Inc.
301 Wyecroft Road
Oakville, Ontario L6K 2H2, Canada
Telephone: (416) 844-5851

Ottawa Branch

Cummins Ontario Inc.
3189 Swansea Crescent
Ottawa, Ontario K1G 3W5, Canada
Telephone: (613) 736-1146

Thunder Bay Branch

Cummins Ontario Inc.
1400 W. Walsh Street
Thunder Bay
Ontario P7C 4V9, Canada
Telephone: (807) 577-7561

Whitby Branch

Cummins Ontario Inc.
1311 Hopkins Street
Whitby, Ontario L1N 2C2, Canada
Telephone: (416) 668-1375

Quebec

Montreal Distributor

Diesel Cummins Branch of Cummins
Americas, Inc.
7200 Trans Canada Highway
Pointe Claire, Quebec H9R 1C2, Canada
Telephone: (514) 695-8410

Montreal Branch

Diesel Cummins Branch of Cummins
Americas, Inc.
7200 Trans Canada Highway
Pointe Claire, Quebec H9R 1C2, Canada
Telephone: (514) 695-8410
Sales: (514) 694-5143
Parts: (514) 694-5880

Quebec City Branch

Diesel Cummins Branch of Cummins
Americas, Inc.
2400 Watt Street
Ste. Foy, Quebec G1P 3T3, Canada
Telephone: (418) 651-2911

Saskatchewan

Lloydminster - (Branch of Winnipeg)

Cummins Mid-Canada Ltd.
3709 - 44th Street
P.O. Box 959
Lloydminster, SK S9V 0Y9, Canada
Telephone: (403) 825-2062

Regina - (Branch of Winnipeg)

Cummins Mid-Canada Ltd.
110 Kress Street
P.O. Box 98
Regina, SK S4P 2Z5, Canada
Telephone: (306) 721-9710

Saskatoon - (Branch of Winnipeg)

Cummins Mid-Canada, Ltd.
3001 Faithful Avenue
P.O. Box 7679
Saskatoon, SK S7K 4R4, Canada
Telephone: (306) 933-4022

Distributors and Branches - Australia**Sydney (Lansvale)**

Cummins Diesel Sales & Service
P.O. Box 150
164-170 Hume Highway
Lansvale, 2166
Cabramatta 2166
New South Wales,
Australia
Telephone: (61-2) 728-6211

Branches:**Adelaide (Gepps Cross)**

Cummins Diesel Sales & Service
P.O. Box 108
45-49 Cavan Road
Gepps Cross, 5094
Blair Athol, 5084
South Australia, Australia
Telephone: (61-8) 262-5211

Brisbane (Darra)

Cummins Diesel Sales & Service
P.O. Box 124
2506 Ipswich Road
Darra, 4076
Queensland, Australia
Telephone: (61-7) 375-3277

Cairns

Cummins Diesel Sales & Service
Cnr. Toohey & Knight Streets
Portsmith, Cairns, 4870
Queensland, Australia
Telephone: (61-70) 52-1488

Canberra

Cummins Diesel Sales & Service
15-27 Baydon Road
Queanbeyan, 2620
A.C.T., Australia
Telephone: (61-62) 97-3433

Darwin (Winnellie)

Cummins Diesel Sales & Service
P.O. Box 37587
Lot 1758 Graffin Crescent
Winnellie, 5789
Winnellie, Darwin, 578
Northern Territory, Australia
Telephone: (61-89) 47-0766

Devonport

Cummins Diesel Sales & Service
P.O. Box 72E
2 Matthews Way
East Devonport, 7310
Tasmania, Australia
Telephone: (61-04) 24-8800

Grafton (South Grafton)

Cummins Diesel Sales & Service
P.O. Box 18
18-20 Induna Street
South Grafton, 2461
New South Wales, Australia
Telephone: (61-66) 42-3655

Kalgoorlie

Cummins Diesel Sales & Service
P.O. Box 706
Kalgoorlie, 6430
Western Australia, Australia
Location:
Cnr. Keogh Way & Atabara Street
Telephone: (61-90) 71-2994

Mackay

Cummins Diesel Sales & Service
P.O. Box 842
4 Presto Avenue
Mackay, 4740
Queensland, Australia
Telephone: (61-79) 55-1222

Melbourne (Campbellfield)

Cummins Diesel Sales & Service
Private Bag 9, G.P.O.
1788-1800 Hume Highway
Campbellfield 3061
Victoria, Australia
Telephone: (61-3) 357-5622

Moorabbin

Cummins Diesel Sales & Service
P.O. Box 368
Moorabbin, 3189
Victoria, Australia
Location:
5 Linton Street
Telephone: (61-3) 555-2255

Mount Gambier

Cummins Diesel Sales & Service
P.O. Box 2219
2 Avey Road
Mount Gambier, 5290
South Australia, Australia
Telephone: (61-87) 25-6422

Newcastle

Cummins Diesel Sales & Service
21 Galleghan Street
Hexham, 2322
New South Wales, Australia
Telephone: (61-49) 64-8466

Perth (Welshpool)

Cummins Diesel Sales & Service
P.O. Box 275
50 Kewdale Road
Kewdale, 6106
Cloverdale, 6105
Western Australia, Australia
Telephone: (61-9) 458-5911

Swan Hill

Cummins Diesel Sales & Service
P.O. Box 1264
5 McAllister Road
Swan Hill, 3585
Victoria, Australia
Telephone: (61-50) 32-9722

Tamworth

Cummins Diesel Sales & Service
P.O. Box 677
Lot 65 Gunnedah Road
Tamworth, 2320
New South Wales, Australia
Telephone: (61-67) 65-5455

Wodonga

Cummins Diesel Sales & Service
P.O. Box 174
9-11 McKoy Street
Wodonga, 3690
Victoria, Australia
Telephone: (61-60) 24-3655

Distributors and Branches - New Zealand

Auckland

Lees Power
8 The Furlong
Takanini, Auckland,
New Zealand
Telephone: (64-9) 299-7448

Branches:

Auckland

Lees Power
P.O. Box 12-120
440 Church Street
Penrose, Auckland,
New Zealand
Telephone: (64-9) 591-009

Christchurch

Lees Power
P.O. Box 16-149, Hornby
268 Main South Road
Sockburn, Christchurch,
New Zealand
Telephone: (64-3) 497-178

Napier

Lees Power
P.O. Box 3021, Onekawa
Austin Street
Onekawa, Napier,
New Zealand
Telephone: (64-70) 436-129

Palmerston North

Lees Power
P.O. Box 9024
852-860 Tremaine Avenue
Palmerston North,
New Zealand
Telephone: (64-63) 62-209

Rotorua

Lees Power
P.O. Box 934
Te Ngae Road
Rotorua, New Zealand
Telephone: (64-73) 56-699

Wellington

Lees Power
P.O. Box 30-447,
Port Road South
Seaview, Lower Hutt,
New Zealand
Telephone: (64-4) 686-029

Regional Offices - International**Latin America Area Office - Hialeah**

Cummins Americas, Inc.
16085 N.W. 52nd Avenue
Hialeah, FL 33014
U.S.A.

Telephone: (305) 621-4451

Countries	Argentina	Honduras
Covered:	Bolivia	Nicaragua
	Chile	Panama
	Costa Rica	Paraguay
	Dominican Republic	Peru
	El Salvador	Uruguay
	Guatemala	

Colombia Regional Office - Bogota

Cummins Engine Co. de Colombia S.A.
Carrera 11A No. 90-15 Of. 601/602
Bogota, D.E., Colombia
Telephone: (57-1) 218-6248

Mailing Address:

Apartado Aereo 90988
Bogota D.E., Colombia
Countries
Covered: Colombia
Ecuador

Venezuela Regional Office - Caracas

Cummins Engine Company
Oficina del Delegado
Torre La Primera, Oficina 5-D
Av. Francisco de Miranda
Chacao, Caracas 1060, Venezuela

Mailing Address:

Cummins Engine Company M-227
c/o Jet Cargo International
P.O. Box 020010
Miami, FL 33102-0010
Telephone: (58-2) 32-0563, 32-7187
Country
Covered: Venezuela

India Kirloskar Office - Pune

Kirloskar Cummins Limited
Kothrud
Pune - 411 029, India
Telephone: (91-212) 33-0240, 33-1074, 33-1105
Countries
Covered: Bhutan
India
Nepal

Brazil Cumbrasa Office - Sao Paulo

Cummins Brasil S.A.
Rua Jati, 266
07270 Guarulhos
Sao Paulo, Brazil

Mailing Address:

P.O. Box 13
07270 Guarulhos
Sao Paulo, Brazil
Telephone: (55-11) 945-9811
Country
Covered: Brazil

South And East Asia Area Office - Singapore

Cummins Diesel Sales Corporation
8 Tanjong Penjuru
Jurong Industrial Estate
Singapore 2260
Telephone: (65) 265-0155

Countries	Bangladesh	Laos
Covered:	Brunei	Malaysia
	Burma	Philippines
	Cambodia	Singapore
	Guam	Sri Lanka
	Hong Kong	Taiwan
	Indonesia	Thailand
		Vietnam

South Pacific Area Office - Scoresby

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

Countries	Australia	New Caledonia
Covered:	French Polynesia	New Zealand
	(including Tahiti)	
	South Pacific Islands (including	
	Eastern New Guinea,	
	Fiji Islands, and the Solomon Is-	
	lands)	

North Asia Area Office - Tokyo

Cummins Diesel Sales Corporation
1-12-10 Shintomi
Chuo-ku, Tokyo 104
Japan
Telephone: (81-3) 555-3131/2/3/4/5
Countries
Covered: Japan
South Korea

China Regional Office - Beijing

Cummins Corporation
China World Tower, Suite 917
China World Trade Centre
No. 1 Jianguo Men Wai
Beijing 100004
People's Republic of China
Telephone: (86-1) 505-4209/10
Country
Covered: China

U.K. Area Office - New Malden

Cummins Engine Company Limited
46-50 Coombe Road
New Malden
Surrey KT3 4QL
England
Telephone: (44-1) 949-6171

U.K. Regional Office - Wellingborough

Cummins Diesel
Denington Estate
Wellingborough
Northants, NN8 2QH
England
Telephone: (44-933) 76211
Countries
Covered: Ireland
United Kingdom

Middle East Regional Office - Mechelen

Cummins Diesel N.V.
Blarenberglaan 4
Industriepark Noord 2
2800 Mechelen
Belgium
Telephone: (32-15) 200031
Countries: Afghanistan Lebanon Sudan
Covered: Bahrain North Yemen Syria
Cyprus Oman Turkey
Egypt Pakistan United
Iran Quatar Arab
Iraq Saudi Arabia Emirates
Jordan South Yemen
Kuwait

Daventry

Cummins Engine Company Ltd.
Royal Oak Way South
Daventry, Northants NN11 5NU
England
Telephone: (44-327) 76000

Darlington

Cummins Engine Company Limited
Yarm Road
Darlington, Co. Durham DL1 4PW
England
Telephone: (44-325) 460606

Shotts

Cummins Engine Company Limited
Calderhead Road
Shotts, Lanarkshire ML7 4JT
Scotland
Telephone: (44-786) 824879

East and Southern Africa Regional Office - Harare

Cummins Diesel International Ltd.
72 Birmingham Road
(Heavy Industrial Sites)
Southerton
Harare, Zimbabwe

Mailing Address:

P.O. Box 8440, Causeway
Harare, Zimbabwe
Telephone: (263-4) 67645

Countries	Botswana	Namibia
Covered:	Congo	Reunion
	Djibouti	Seychelles
	Ethiopia	Samalia
	Kenya	South Africa
	Lesotho	Swaziland
	Madagascar	Tanzania
	Malawi	Uganda
	Mauritius	Zambia
	Mozambique	Zimbabwe

West/Northern Africa Regional Office - Mechelen

Cummins Diesel N.V.
Blarenberglaan 4
Industriepark Noord 2
2800 Mechelen
Belgium
Telephone: (32-15) 200031
Countries: Benin Guinea Bissau
Covered: Burkina Faso Liberia
Burundi Mali
Cameroon Malta
Cape Verde Mauritania
Central African Republic Morocco
Chad Niger
Cote d'Ivoire Nigeria
Equatorial Guinea Rwanda
Guinea Sao Tome &
Gabon Principe
Gambia Senegal
Ghana Sierre Leone
Guinea Togo
Tunisia
Zaire

North Africa Regional Office - Algiers

Cummins Corporation
Bureau de Liaison
38, Lotissement Benachour Abdelkader
Cheraga
42300 Wilaya de Tipasa
Algeria
Telephone: (213) 281-06-90
Countries
Covered: Algeria
Angola

European Regional Office - Mechelen

Cummins Diesel N.V.
Blarenberglaan 4
Industriepark Noord 2
2800 Mechelen
Belgium
Telephone: (32-15) 200031
Countries Austria Iceland
Covered: Belgium Israel
Czechoslovakia Luxembourg
Denmark Netherlands
Finland Norway
Greece Portugal
Hungary Sweden
Switzerland

France Regional Office - Lyon

Cummins Diesel Sales Corporation
39, rue Ampere - Zone Industrielle
69680 Chassieu
France
Telephone: (33) 78-90-43-05
Country
Covered: France

Italy Regional Office - Milan

Cummins Diesel Italia S.p.A.
Piazza Locatelli 8
Zona Industriale
20098 San Giuliano Milanese
Milan, Italy
Telephone: (39-2) 982-81235/6/7
Country
Covered: Italy

Mexico Cummsa Office - Mexico City

Cummins, S.A. de C.V.
Arquimedes No. 209
Col. Polanco
11560 Mexico, D.F.
Mexico

Mailing/Shipping Address:

Gonzalez de Castilla Inc.
P.O. Box 1391
4605 Modern Lane
Modern Industrial Park
Laredo, TX 78040
Telephone: (52-5) 254-3822
Country
Covered: Mexico

Germany Regional Office - Gross-Gerau

Cummins Diesel Deutschland GmbH
Odenwaldstr. 23
D-6080 Gross-Gerau
Federal Republic of Germany
Telephone: (49-6152) 174-0

Mailing Address:

P.O. Box 1134
D-6080 Gross Gerau
Federal Republic of Germany
Countries Albania
Covered: Bulgaria
Federal Republic of Germany
German Democratic Republic
Poland
Romania
U.S.S.R.
Yugoslavia

Spain Representation Office - Madrid

Cummins Diesel N.V.
C Andarrios 11-C
28043 Madrid
Spain
Telephone: (34-1) 759-2880
Country
Covered: Spain

Moscow

Cummins Engine Co., Inc.
c/o Control Data Corporation
Krasnopresnenskaya Nab. 12, Office 2006
123100 Moscow
U.S.S.R.
Telephone: (7-95) 253-8379

Distributors - International

ABU DHABI

-See United Arab Emirates

AFGHANISTAN

-See Middle East Regional Office

ALBANIA

-See Germany Regional Office -
Gross Geran

ALGERIA

Algiers

Cummins Corporation
Bureau de Liaison
38, Lotissement Benachour Abdelkader
Cheraga
43200 Wilaya de Tipasa
Algeria
Telephone: (213) 281-0690

AMERICAN SAMOA

Pago Pago

Burns Philp (South Seas) Co. Ltd.
P.O. Box 129
Pago Pago, American Samoa
Telephone: (684) 633-4281

ANDORRA

-See European Regional Office
- Mechelen

ANGUILLA

-See Antigua

ANTIGUA

Miami (Office In U.S.A.)

Cummins Southeastern Power, Inc.
9900 N.W. 77 Court
Hialeah Gardens, FL 33016
Telephone: (305) 821-4200

ARGENTINA

Buenos Aires

Motores Stork
Werkspoor S.A.I.C.
Av. Ader 3707-11
1605 Carapachay
Buenos Aires, Argentina
Telephone: (54-1)766-0865/0738/0580

ARUBA, ISLAND OF

-See Netherlands Antilles

AUSTRIA

Vienna

Cummins-Industriemotoren
Ges.m.b.H.
Bickfordstr. 25
A-7201 Neudoerfl Austria
Telephone: (43-26) 22-77-418

AZORES ISLANDS

-See Portugal

BAHAMAS

Miami (Office in U.S.A.)

Cummins Southeastern Power, Inc.
9900 N.W. 77 Court
Hialeah Gardens, FL 33016
Telephone: (305) 821-4200

BAHRAIN

Bahrain

Yusuf Bin Ahmed Kanoo W.L.L.
Kanoo Commercial
P.O. Box 45, Manama
Bahrain
Telephone: (973) 252454

BALEARIC ISLANDS

Madrid (Office in Spain)

Cummins Ventas y Servicio, S.A.
Torrelaguna, 56
28027 Madrid, Spain

BANGLADESH

Dhaka

Equipment & Engineering Co., Ltd.
P.O. Box 2339
Dhaka 1000, Bangladesh

Location:

56, Dilkusha Commercial Area
2nd Floor/Eastern Block
Telephone: (880-2) 34357, 34060

BARBADOS

Miami (Office in U.S.A.)

Cummins Southeastern Power, Inc.
9900 N.W. 77 Court
Hialeah Gardens, FL 33016
Telephone: (305) 821-4200

BELGIUM

Brussels

Cummins Distributor
Belgium S.A.
623/629 Chaussee de Haecht
B-1030 Brussels, Belgium
Telephone: (24 hr.)
(32-2) 216-81-10

BELIZE

Miami (Office in U.S.A.)

Cummins Southeastern Power, Inc.
9900 N.W. 77 Court
Hialeah Gardens, FL 33016
Telephone: (305) 821-4200

BENIN

-See Togo

BERMUDA

Bronx (Office in U.S.A.)

Cummins Metropower, Inc.
890 Zerega Avenue
Bronx, NY 10473
Telephone: (212) 892-2400

BHUTAN

Pune (Office in India)

Cummins Diesel Sales &
Service (India) Ltd.
35A/1/2, Erandawana
Pune - 411 038, India
Telephone: (91-212) 56096/7/8

BOLIVIA

La Paz

Machinery & Auto Service
Casilla 4042
La Paz, Bolivia

Location:

Av. 20 de Octubre Esq.
Rosendo Gutierrez
Telephone: (591-2) 379650, 366394

BONAIRE, ISLAND OF

-See Netherlands Antilles

BOTSWANA

-See East and Southern
Africa Regional Office
Harare

BRAZIL

Ananindeua

Marcos Marcelino & Companhia
Ltda.
Rodovia BR-316, Km 9
67000 Ananindeua, Para,
Brazil
Telephone: (55-91) 235-4100/4132/
4143/4012

Belo Horizonte

Distribuidora Cummins
Minas Ltda.
Rua Pl, 25, Caicara
30770 Belo Horizonte,
Minas Gerais, Brazil
Telephone: (55-31) 462-5144

Campo Grande

Distribuidora Cummins
Mato Grosso Ltda.
Rodovia BR 163 Km 01
79060 Campo Grande
Mato Grosso do Sul, Brazil
Telephone: (55-67) 387-1166

Curitiba

Festugato S.A.,
Distribuidora Cummins
Rua Brasilio Itibere, 2195
80230 Curitiba, Parana
Brazil
Telephone: (55-41) 222-4036

Fortaleza

Distribuidora Cummins Diesel
Do Nordeste Ltda.
Av. da Abolicao, 3882,
Mucuripe
60165 Fortaleza, Ceara
Brazil
Telephone: (55-85) 244-9292

Golainian

Distribuidora de Motores Cummins
Centro Oeste Ltda.
Av. Caiapo 777 - Sta. Genoveva
74410 Goiania, Goias
Brazil
Telephone: (55-62) 264-1144

Manaus

Distribuidora Cummins
Amazonas Ltda.
Estrada da Ponta Negra, 6080 - Sao
Jorge
69037 Manaus, Amazonas,
Brazil
Telephone: (55-92) 238-7174/7177/
8856/7631

Porto Alegre

Distribuidora Cummins
Meridional S.A.
Rua Dona Alzira, 98, Sarandi
91050 Porto Alegre,
Rio Grande do Sul, Brazil
Telephone: (55-512) 40-8222

Rio de Janeiro

Distribuidora Cummins
Leste Ltda.
Rua Sariema, 138-Olaria
21030 Rio de Janeiro,
Rio de Janeiro, Brazil
Telephone: (55-21) 290-7899

Sao Paulo

Companhia Distribuidora
de Motores Cummins
Rua Martin Burchard, 291 - Bras
03043 Sao Paulo,
Sao Paulo, Brazil
Telephone: (55-11) 270-2311

Sao Paulo

Motores Cummins Diesel
do Brasil Ltda.
Av. Thomaz Edson, 448 - Barra Funda
01140 Sao Paulo,
Sao Paulo, Brazil
Telephone: (55-11) 826-9376, 867-3702

BRITISH VIRGIN ISLANDS

-See Puerto Rico

BRUNEI

-See Malaysia

BURKINA - FASO

-See West/Northern Africa Regional
Office - Mechelen

BULGARIA

-See Germany Regional Office - Gross
Gerau

BURMA**Kuala Lumpur (Office In Malaysia)**

Contact: Scott &
English (M) Sdn Bhd
P.O. Box 10324
50710 Kuala Lumpur
West Malaysia
Location:
16 Jalan Chan Sow Lin
55200 Kuala Lumpur
West Malaysia
Telephone: (60-3) 2211033

BURUNDI**Brussels (Office in Belgium)**

Bureau Technique Bia, S.A.
Rameistraat, 123
B-1900 - Overijse, Belgium*
Telephone: (32-2) 6892811

CAMBODIA

-See South & East Asia
Regional Office - Singapore

CAMEROON**Limbe**

LEYCAM Motors Ltd.
P.O. Box 307
Limbe
Cameroon
Telephone: (237) 33-22-66

CANARY ISLANDS**Madrid (Office in Spain)**

Cummins Ventas y
Servicio, S.A.
Torrelaguna, 56
28027 Madrid, Spain

CAPE VERDE

-See West/Northern Africa
Regional Office - Mechelen

CENTRAL AFRICAN REPUBLIC

-See West/Northern Africa
Regional Office - Mechelen

CEYLON

-See Sri Lanka

CHAD

-See West/Northern Africa
Regional Office - Mechelen

CHILE**Santiago**

Distribuidora Cummins Diesel
S.A.C.I.
Casilla Postal 1230
Santiago, Chile

Location:
Avda. Providencia 2653, Office 1901
Providencia
Telephone: (56-2) 321940, 517464/5/6

CHINA, PEOPLE'S REPUBLIC

-See China Regional
Office - Beijing

COLOMBIA**Barranquilla**

Cummins de Colombia S.A.
Apartado Aereo 5347
Barranquilla, Colombia
Location: Calle 30, No. 19 - 21
Telephone: (57-58) 40-11-99, 40-13-46

Bogota

Cummins Colombiana Ltda.
Apartado Aereo No. 7431
Bogota, D.E. Colombia
Location:
Av. Americas X Carrera
42C No. 19-45
Bogota, D.E., Colombia
Telephone: (57-1) 244-5688/5882

Bucaramanga

Cummins API, Ltda.
Apartado Aereo 352
Bucaramanga, Colombia
Location:
Autopista a Giron, Km 7
Telephone: (57-73) 68060

Cali

Distribuidora Cummins del Valle, Ltda.
Apartado Aereo No. 6398
Cali, Colombia

Location: Av. 3a. #39-35 - Vipasa
Telephone: (57-3) 65-4343

Medellin

Equipos Tecnicos Ltda.
Apartado Aereo No. 2046
Medellin, Colombia
Location: Carrera 52 No. 10-184
Telephone: (57-4) 255-4200

Pereira

Equipos Tecnicos Ltda. C.Q.R.
Apartado Aereo No. 1240
Pereira, Colombia
Location: Carrera 8a. No. 45-39
Telephone: (57-63) 366341/43

COMOROS

-See East and Southern
Africa Regional Office
Harare

CONGO, PEOPLE'S REPUBLIC**Brussels (Office in Belgium)**

Bureau Technique Bia, S.A.
Rameistraat, 123
B-1900
Overijse, Belgium
Telephone: (32-2) 6892811

CORSICA

-See France

COSTA RICA**San Jose**

Servicios Unidos, S.A.
P.O. Box 559
San Jose, Costa Rica
Location:
Curridabat
Telephone Office: (506) 53-93-93
Telephone Service Shop:
(506) 26-00-76

COTE D'IVOIRE**Abidjan**

AFI-TECHNIK
2 Rue Clement Ader, Zone 4
04 B.P. 350
Abidjan 04
Cote d'Ivoire
Telephone: (225) 35-70-96, 35-65-06

CUBA

Miami (Office in U.S.A.)

Cummins Southeastern Power, Inc.
9900 N.W. 77 Court
Hialeah Gardens, FL 33016
Telephone: (305) 821-4200

CURACAO, ISLAND OF

-See Netherlands Antilles

CYPRUS

Nicosia

Alexander Dimitriou & Sons Ltd.
P.O. Box 1932
Nicosia, Cyprus
Telephone: (357-2) 461350

CZECHOSLOVAKIA

-See European Regional
Office - Mechelen

DENMARK

Glostrup

P. L. Industrimaskiner A/S
Post Box 166
2605 Broendby, Denmark

Location:
Midtager 22
Telephone: (45-2) 96-21-61

DJIBOUTI

-See East and Southern
Africa Regional Office -
Harare

DOMINICA

Miami (Office in U.S.A.)

Cummins Southeastern Power, Inc.
9900 N.W. 77 Court
Hialeah Gardens, FL 33016
Telephone: (305) 821-4200

DOMINICAN REPUBLIC

Santo Domingo

Argico C. Por A.
P.O. Box 292-2 FERIA
Santo Domingo
Dominican Republic, ZP-6

Location:
Calle Jose A. Soler
No. 3, ESQ.
Avenida Lope de Vega
Telephone: (809) 562-6281

DUBAI

-See United Arab Emirates

ECUADOR

Guayaquil

Motores Cummins (MOTCUM) S.A.
P.O. Box 1062
Guayaquil, Ecuador

Location:
Avenida Carlos Julio
Arosemena Km. 4
Telephone: (593-4) 204264, 202600

QUITO

Rectificadora Botar S.A.
P.O. Box 3344
Quito, Pichincha, Ecuador
Location:
Av. 10 de Agosto No. 5980
Telephone: (593-2) 241-544

EGYPT

Cairo

ADAT*
P.O. Box 1572
25, Pyramids Road
Giza
Cairo, Egypt
Telephone: (20-2) 850077, 851829

Cairo (Egyptian Marine Market)

Egypt Diesel (Sales Office)
6 Abdel Rahman Abu Taleb Street
P.O. Box 72
Savada Nafisa
Cairo 11411, Egypt
Telephone: (20) 3631413

EL SALVADOR

San Salvador

Salvador Machinery
Company, S.A. de C.V.
P.O. Box 125
San Salvador, El Salvador
Location:
Blvd. Ejercito Nacional
Telephone: (503) 711022, 228388

ENGLAND

-See United Kingdom

* All applications **except** marine market.

EQUATORIAL GUINEA

-See West/Northern Africa Regional
Office - Mechelen

ETHIOPIA

Addis Ababa

AFCOR (Ethiopia) P.L.C.
P.O. Box 263
Addis Ababa, Ethiopia
Telephone: 128130

FAROE ISLANDS

Wellingborough (Office in United Kingdom)

Cummins Diesel
Denington Industrial Estate
Wellingborough
Northants NN8 2QH,
England

FERNANDO PO

-See Spain

FIJI

Suva

Burns Philp (South Seas) Co. Ltd.
P.O. Box 355
Suva, Fiji
Telephone: (679) 31-1777

FINLAND

Helsinki

Machinery OY
P.O. Box 56
Location:
Teollisuuskatu 29
SF 00511 Helsinki, Finland
Telephone: Nat: (9-0) 77221
Int: (358-0) 77221

FRANCE

Lyon

Cummins Diesel
Sales Corporation
38, rue Ampere Z.I.
69680 Chassieu, France
Telephone: (33-7) 8-90-43-05

GABON

Libreville

SODIM T.P.
B.P. 506
Libreville, Gabon
Location:
Zone Industrielle d'Oloumi
Telephone: (241) 72-06-85

GAMBIA

-See West/Northern Africa
Regional Office - Mechelen

GERMANY, EAST

-See W. Germany Regional Office -
Gross-Gerau

GERMANY, WEST

Gross-Gerau

Cummins Diesel Deutschland GmbH
P.O. Box 1134
D-6080 Gross-Gerau,
W. Germany

Location: Odenwaldstr. 23
Telephone: (49-6152) 174-0

GHANA

Accra

Leyland DAF (Ghana) Ltd.
P.O. Box 2969
Accra, Ghana

Location:
39/40 Ring Road South
Industrial Estate
Telephone: 22-88-06

GREECE**Athens (Ag. Ioannis Rentis)**

Cummins Distributor Hellas Ltd.
4b Thessalonikis Str.
182 33 Ag. Ioannis Rentis
Greece
Telephone: (1) 493-1086

Workshop:
Cummins Distributor Hellas Ltd.
4 Thessalonikis Str.
Telephone: (30-1) 491-5264

GREENLAND

-See Denmark

GRENADA**Miami (Office in U.S.A.)**

Cummins Southeastern Power, Inc.
9900 N.W. 77 Court
Hialeah Gardens, FL 33016
Telephone: (305) 821-4200

GUADELOUPE**Miami (Office in U.S.A.)**

Cummins Southeastern Power, Inc.
9900 N.W. 77 Court
Hialeah Gardens, FL 33016
Telephone: (305) 821-4200

GUAM**Tamuning**

Mid-Pac Far East, Inc.
150 E. Harmon
Industrial Park Road
Tamuning, Guam 96911
Telephone: (671) 646-5447/1770

GUATEMALA**Guatemala City**

Maquinaria y Equipos, S.A.
P.O. Box 2304
Guatemala City, Guatemala

Location:
Carretera Amatitlan
Km 12 zona 12
Telephone: (502-2) 773334/7/9

GUINEA

-See West/Northern Africa Regional
Office - Mechelen

GUINEA BISSAU

-See West/Northern Africa Regional
Office - Mechelen

GUYANA**Miami (Office in U.S.A.)**

Cummins Southeastern Power, Inc.
9900 N.W. 77 Court
Hialeah Gardens, FL 33016
Telephone: (305) 821-4200

GUYANA, FRENCH**Miami (Office in U.S.A.)**

Cummins Southeastern Power, Inc.
9900 N.W. 77 Court
Hialeah Gardens, FL 33016
Telephone: (305) 821-4200

HAITI**Miami (Office in U.S.A.)**

Cummins Southeastern Power, Inc.
9900 N.W. 77 Court
Hialeah Gardens, FL 33016
Telephone: (305) 821-4200

HOLLAND

-See Netherlands

HONDURAS**Tegucigalpa**

Comercial Laeisz
Honduras, S.A.
P.O. Box 1022
Tegucigalpa, D.C., Honduras

Location:
Zona La Burrera,
Blvd. Toncontin
Frente a Gasolinera Esso.
Telephone: (504) 333570, 331148,
335615

HONG KONG**Kowloon**

Cummins Diesel Sales & Service Ltd.
G.P.O. Box 10004
Hong Kong, B.C.C.

Location:
Unison Industrial Centre
15th Floor, Units C & D
27-31 Au Pui Wan Street
Fo Tan, Shatin
Telephone: (852-0) 6065678

HUNGARY**Vienna (Office in Austria)**

Cummins-Industriemotoren
Ges. m.b.H.
Bickfordstr. 25
A-7201 Neudorf, Austria

ICELAND**Reykjavik**

Bjorn & Halldor Ltd.
P.O. Box 8560
Sidumula 19
128 Reykjavik, Iceland
Telephone: (354-1) 36030, 36930

INDIA**Pune**

Cummins Diesel Sales &
Service (India) Ltd.
35A/1/2, Erandawana
Pune - 411 038, India
Telephone: (91-212) 31234, 31534,
31635, 30066,
30166, 30356,
31706

INDONESIA**Jakarta**

P.T. Alltrak 1978
P.O. Box 64/KBJL
Jakarta Selatan 12330, Indonesia
Location:
J1. R.S.C. Veteran No. 4
Bintaro, Rempoa
Telephone: (62-21) 773377, 773155,
772401

IRAN

-See Middle East Regional
Office - Mechelen

IRAQ**Genk (Office in Belgium)**

Industrial Construction Consultancy,
N.V.
Essenlaan 5, Bus 4
3600 Genk
Belgium
Telephone: (32-11) 38-48-32

IRELAND**Wellingborough (Office in England)**

Cummins Diesel
Denington Estate
Wellingborough
Northants NN8 2QH, England

ISRAEL**Tel Aviv**

Israel Engines &
Trailers Co. Ltd.
Levinson Brothers Engineers
P. O. Box 390
Tel Aviv, Israel 61003

Location:
33 Hahashmal Street
Telephone: (972-3) 622671/2/3/4/5

ITALY**Milan**

Cummins Diesel Italia S.p.A.
Piazza Locatelli, 8 (gia' Via Basento)
Zona Industriale
20098 S. Giuliano
Milanese (Milan), Italy
Telephone: (39-2) 988-1235/6/7

Rome

O. ME. CO. S.p.A.
Via Trionfale 12526
00135 Roma, Italy
Telephone: (39-6) 376-5152/5151/5702

IVORY COAST

-See Cote d' Ivoire

JAMAICA**Miami (Office in U.S.A.)**

Cummins Southeastern Power, Inc.
9900 N.W. 77 Court
Hialeah Gardens, FL 33016
Telephone: (305) 821-4200

JAPAN**Tokyo**

Cummins Diesel (Japan) Ltd.
1-12-10-Shintomi
Chuo-ku, Tokyo 104
Japan
Telephone: (81-3) 555-8511

JORDAN**Amman**

S.E.T.I. Jordan Limited
P.O. Box 8053
Amman, Jordan
Telephone: (962-6) 621867

KENYA

Nairobi

Werrot & Company Limited
P.O. Box 41216
Nairobi, Kenya

Location:
Lusaka Road
Telephone: (254) 150-20316

KOREA, SOUTH

Seoul

Hwa Chang Trading Co., Ltd.
Central P.O. Box No. 216
Seoul, South Korea

Location:
143-11 Doksan-Dong, Kuro-Ku
Telephone: (82-2) 854-0071/2/3/4/5,
869-1411/2/3

Repair Shop:
336-6, Won-Doug, Osan-City
Kyeonggi-Province, South Korea
Telephone: (82-339) 73-0235/6/7/8,
73-2146

KUWAIT

Kuwait

General Transportation &
Equipment Co.
(Sales Department)
P.O. Box 1096
13011 Safat, Kuwait

Location:
Shuwaikh Behind
Canada Dry Factory
Telephone: (965) 4833380/81

Kuwait

General Transportation &
Equipment Co.
(Service Department)
East Ahmadi Area
13011 Safat, Kuwait
Telephone: (965) 3981577

LAOS

-See South and East
Asia Regional Office
- Singapore

LEBANON

Beirut

S.E.T.I. Charles Keller
S.A.L.
IMM.B.P. 16-6726
Beirut, Lebanon

Location:
Corniche du Fleuve
Telephone: (961-1) 425040/41, 426042

LESOTHO

-See East/South Africa Regional Office -
Harare

LIBERIA

Monrovia

Electromotor, Inc.
P.O. Box 573
Monrovia, Liberia

Location 1:
U.N. Drive, Bushrod Island, Waitown
Telephone: (231) 22-19-50, 22-29-38

Location 2:
Tubman Blvd. & 3rd St.
Telephone: (231) 26-12-40, 26-12-41

LIBYA

Valletta (Office in Malta)

Plant and Equipment Ltd.
Regency House
254, Republic Street
Valletta, Malta

LIECHTENSTEIN

-See Switzerland

LUXEMBOURG

Brussels (Office in Belgium)

Cummins Distributor Belgium S.A.
623/629 Chausse de Haecht
B-1030 Brussels, Belgium
Telephone: (32-2) 216-81-10

MACAU

-See Hong Kong

MADAGASCAR

-See East and Southern
Africa Regional Office -
Harare

MADEIRA ISLANDS

-See Portugal

MALAWI

-See East and Southern
Africa Regional Office -
Harare

MALAYSIA

Kuala Lumpur

Cummins Diesel Sales & Service
Div. of Scott & English
(M) Sdn. Bhd.
P.O. Box 10324
50710 Kuala Lumpur, West Malaysia

Location:
16 Jalan Chan Sow Lin
55200 Kuala Lumpur, West Malaysia
Telephone: (60-3) 2211033

MALI

-See West/Northern Africa Regional
Office - Mechelen

MALTA

Valletta

Plant & Equipment Ltd.
254, Republic Street
Valletta, Malta
Telephone: (356) 23-26-20, 23-33-43

MARTINIQUE

Miami (Office in U.S.A.)

Cummins Southeastern Power, Inc.
9900 N.W. 77 Court
Hialeah Gardens, FL 33016
Telephone: (305) 821-4200

MAURITANIA

-See West/Northern Africa Regional
Office - Mechelen

MAURITIUS

-See East/South Africa Regional
Office - Harare

MEXICO

Guadalajara

Cummins de Occidente, S.A.
Apartado Postal 1-1065
44890 Guadalajara,
Jalisco, Mexico

Location:
Calz. Gonzalez Gallo No. 2213
Col. El Rosario
Telephone: (52-36) 39-3101, 39-3153

Merida

Cummins del Sureste, S.A. de C.V.
Av. Aviacion 647
Esquina Calle 100, Col. Sambula
97000 Merida, Yucatan
Mexico

Mexico City

Cummins de Mexico, S.A.
Norte 35 No. 1015
Col. Industrial Vallejo
07700 Mexico 14, D.F., Mexico
Telephone: (52-5) 567-37-00

Monterrey

Tecnica Automotriz, S.A.
Ave. Universidad
No. 3637 Nte.
Monterrey, Nuevo Leon, Mexico
Telephone: (52-83) 51-41-51, 51-46-56

MOROCCO

Casablanca

Societe Auto-Hall, S.A.
44, Boulevard Lalla Yacout
Casablanca, Morocco
Telephone: (212) 31-84-60, 31-70-52,
31-90-56, 31-70-44

MOZAMBIQUE

-See East and Southern
Africa Regional Office -
Harare

NAMIBIA (Southwest Africa)

Windhoek

Propower, Namibia
P.O. Box 3637, Windhoek
Namibia (Southwest Africa)
Location: 7 Nasmyth Street
Telephone: (264-61) 37693

NEPAL**Pune (Office in India)**

Cummins Diesel Sales &
Service (India) Ltd.
35A/1/2, Erandawana
Pune, - 411 038, India
Telephone: 56096/7/8

NETHERLANDS**Dordrecht**

Cummins Diesel Sales &
Service, b.v.
Galvanistraat 35
3316 GH DORDRECHT
Netherlands
Telephone: (31-78) 18-12-00

NETHERLANDS ANTILLES**Miami (Office in U.S.A.)**

Cummins Southeastern Power, Inc.
9900 N.W. 77 Court
Hialeah Gardens, FL 33016
Telephone: (305) 821-4200

NEW CALEDONIA

-See South Pacific Regional
Office - Melbourne

NEW GUINEA

-See Papua New Guinea

NICARAGUA**Managua**

F. Alf. Pellas & Cia.
6a. Calle N.O.,
30 y 31 Avs. N.O., Zona 5
Apartado Postal No. 46
Managua, Nicaragua
Telephone: (505-2) 660616

NIGER**Niamey**

MECA Diesel
B.P. 11279
Niamey, Niger
Telephone: (227) 73-41-90

NIGERIA**Lagos**

SCOATRAC
P.M.B. 21108
Ikeja, Lagos
Nigeria

Location:

Apapa-Oshodi Expressway
Isolo Industrial Estate,
Isolo

Telephone: (234-1) 52-16-83, 52-17-74,
52-46-70, 52-18-03,
52-36-08

Paris (Office in France)

SCOATRAC
c/o SCA
9/11 rue Robert de Flers
75740 Paris, Cedex 15
France
Telephone: (33-1) 40-58-48-48

NORTHERN IRELAND

-See United Kingdom

NORWAY**Oslo**

Cummins Diesel Salg & Service A/S
Verkseier Furulunds vei 11
Boks 6288
Etterstad 0603, Oslo 6
Norway
Telephone: (47-2) 326110

OMAN**Ruwi**

Universal Engineering
Services L.L.C.
P.O. Box 5688
Ruwi
Sultanate of Oman
Telephone: (968) 797589

PAKISTAN**Karachi**

Primepower Diesels
Sultan Centre - Ground Floor
11 West Wharf Road
Karachi 2, Pakistan
Telephone: (92-21) 202733/4

PANAMA**Panama City**

TRACTOMOVIL, S.A.
Apartado Postal #9532
Panama City 4, Panama
Telephone: (507) 341111, 341868,
341948

PAPUA NEW GUINEA**Sydney (Office in Australia)**

Cummins Diesel Sales & Service
P.O. Box 150
Cabramatta, 2166
New South Wales, Australia

PARAGUAY**Asuncion**

Automotores y Maquinaria,
S.R.L.
Yegros y Fulgencio R. Moreno
P.O. Box 1160
Asuncion, Paraguay
Telephone: (595-21) 93-111/15

PERU**Lima**

Comercial Diesel
del Peru S.A.
P.O. Box 14-0234
Lima, Peru

Location:

Ave. V.R. Haya
de la Torre 2648
Lima 3, Peru
Telephone: (51-14) 32-9990, 31-5761,
32-7639, 32-7518

PHILIPPINES**Makati (Head Office)**

CDSS, Inc.
P.O. Box 248
Makati
Philippines
Location:
6264 Estacion Street
Makati, Metro Manila
Telephone: (63-2) 85-81-56, 87-45-16/17,
87-61-84, 87-61-23,
87-59-01

Mikati

W & L Corporation
Rm. 704, 7th Floor
FNM Lopez Bldg.
Legaspi cor Herrera Sts.
Legaspi Village, Makati
Metro Manila, Philippines
Telephone: (63-2) 8163031/2

Tondo

Power Systems, Inc. (Navotas)
1099 P.O. Box 3241
Manila CPO
Philippines

Location:

160 H Lopez Blvd., Balut
Tondo, Manila
Telephone: (63-2) 264561/2/3/4/5,
208709

POLAND

-See W. Germany Regional Office -
Gross-Gerau

PORTUGAL**Lisbon**

Electro Central
Vulcanizadora, Lda.
P.O. Box 3077
1302 Lisbon, Portugal

Location:

Rua Conselheiro
Martins de Carvalho
Lote 1480
1400 Lisboa (Restelo)
Telephone: (351-1) 615361

QATAR**Doha**

Jaidah Motors & Trading Co.
P.O. Box 150
Doha, Qatar (Arabian Gulf)
Telephone: (974) 426161 Sales
(974) 810000 Spares &
Service

REUNION

-See East/South Africa Regional
Office - Harare

RIO DE ORO

-See Spain

ROMANIA

-See W. Germany Regional Office -
Gross-Gerau

RUSSIA

-See U.S.S.R.

RWANDA

Brussels (Office in Belgium)

Bureau Technique Bia, S.A.
Rameistraat, 123
B-1900 - Overijse, Belgium
Telephone: (32-2) 6892811

ST. LUCIA

Miami (Office in U.S.A.)

Cummins Southeastern Power, Inc.
9900 N.W. 77 Court
Hialeah Gardens, FL 33016
Telephone: (305) 821-4200

ST. MARTIN, ISLAND OF

-See Netherlands Antilles

ST. VINCENT

Miami (Office in U.S.A.)

Cummins Southeastern Power, Inc.
9900 N.W. 77 Court
Hialeah Gardens, FL 33016
Telephone: (305) 821-4200

SAN MARINO

-See Italy

SAO TOME AND PRINCIPE

-See West/Northern Africa Regional
Office - Mechelen

SAUDI ARABIA

Dammam

General Contracting Company
P.O. Box 5111
Dammam 31422, Saudi Arabia
Telephone: (966-3) 842-1216

SCOTLAND

-See United Kingdom

SENEGAL

Dakar

NOSOCO Dept. Matforce
B.P. 341
Dakar, Senegal
Location:
10 Avenue Faidherbe
Telephone: (221) 22-18-35, 22-30-40

SEYCHELLES

-See East/Southern Africa Regional Of-
fice - Harare

SIERRA LEONE

-See West/Northern Africa Regional
Office - Mechelen

SINGAPORE

Singapore

Applied Diesel Sales & Service
8 Tanjong Penjuru
Jurong Industrial Estate
Singapore 2260
Telephone: (65) 261-3555

SOLOMON ISLANDS

-See South Pacific Regional
Office - Melbourne

SOMALIA

-See East and Southern
Africa Regional Office -
Harare

SOUTH AFRICA

Isando

Propower Pty. Ltd.
Cnr. Diesel and Industry Roads
P.O. Box 12
Isando 1600, Transvaal
South Africa
Telephone: (27-11) 974-2751

SOUTHWEST AFRICA

-See Namibia

SPAIN

Madrid

Cummins Ventas y
Servicio S.A.
Torrelaguna, 56
28027 Madrid, Spain
Telephone: (34-91) 267-2000/2404

SPANISH GUINEA

-See Spain

SRI LANKA

Colombo

Blackwood Hodge (Ceylon) Ltd.
P.O. Box 27
Moratuwa, Sri Lanka
Location: (Service Department)
653, Galle Road
Laxapathiya
Moratuwa, Sri Lanka
Telephone: (94-1) 505354, 507330

SUDAN

Khartoum

Bittar Engineering Ltd.
P.O. Box 1011
Gamhuria Street
Khartoum, Sudan
Telephone: (249-11) 70952, 71245,
70306

SURINAM

Miami (Office in U.S.A.)

Cummins Southeastern Power, Inc.
9900 N.W. 77 Court
Hialeah Gardens, FL 33016
Telephone: (305) 821-4200

SWAZILAND

-See South Africa

SWEDEN

Stockholm

SMA Maskin AB
Aggelundavagen 25
S-17562 Jarfalla
Sweden
Telephone: (46-8) 760-0080

SWITZERLAND

Zurich

Robert Aebi AG
Baumaschinen und
Spezialfahrzeuge
Uraniastrasse 31/33
8023 Zurich, Switzerland
Telephone: (41-1) 211-0970

SYRIA

Damascus

Puzant Yacoubian & Sons
P.O. Box 3617
Damascus, Syria
Location:
Abou Baker El Saddik Street
Kafar Sousse Square
Telephone: (963-11) 231547/8/9

TAHITI, ISLAND OF

-See French Polynesia

TAIWAN

Taipei

Cummins Corporation - Taiwan
4th Floor
238, Chungshan N Road
Section 6
Taipei, Taiwan
Telephone: (886-2) 834-9168,
836-6414/8143

TANZANIA

Dar es Salaam

Falcon Engineering Africa Ltd.
P.O. Box 5272
Dar es Salaam
Tanzania
Telephone: 23268

THAILAND

Bangkok

Diethelm & Company Ltd.
280 New Road
G.P.O. Box 14
Bangkok 10100, Thailand
Location:
1696 New Petchburi Road
Bangkok 10310
Telephone: (66-2) 254-4900

TOGO

Lome

Togomat
Zone Industrielle CNPME
B.P. 1641
Lome, Togo
Telephone: (228) 21-23-95

TONGA, ISLAND OF

Nuku-Alofa

Burns Philp
(Tonga) Co. Ltd.
P.O. Box 55
Nuku-Alofa, Tonga
Telephone: 21-500

TRINIDAD and TOBAGO**Miami (Office in U.S.A.)**

Cummins Southeastern Power Inc.
9900 N.W. 77 Court
Hialeah Gardens, FL 33016
Telephone: (305) 821-4200

TUNISIA**Tunis**

Dalmas et Cie
2 Rue de Thebes
2014 Megrine Riadh
Tunisia
Telephone: (216-1) 49-55-99, 49-51-50,
49-57-65, 49-52-29

TURKEY**Istanbul**

Hamamcioglu Muesseseleri
Ticaret T.A.S.
P.K. 136
80222 Sisli
Istanbul, Turkey
Location:
Buyukdere Caddesi, 13/A
P.O. Box 136
80222 Sisli
Istanbul, Turkey
Telephone: (90-1) 131-3406

UGANDA

-See East and Southern
Africa Regional Office -
Harare

UNITED ARAB EMIRATES**Abu Dhabi**

Darco Machinery
P.O. Box 2263
Abu Dhabi,
United Arab Emirates
Telephone: (971-2) 562712
(Umm al Nar office
and workshop)

UNITED KINGDOM**Wellingborough**

Cummins Diesel
Denington Estate
Wellingborough
Northants NN8 2QH, England
Telephone: (44-933) 76231

UPPER VOLTA

-See Burkina - Taso

URUGUAY**Montevideo**

Santaro S.A.
P.O. Box 379
Montevideo
Uruguay
Telephone: (598-2) 93908

U.S.S.R.

-See European Regional
Office - Mechelen
Contact address in Moscow:
Cummins Engine Co.
c/o Control Data Corporation
Krasnopresnenskaya Nab. 12,
Office 2006
123100 Moscow
U.S.S.R.
Telephone: (7-095) 253-83-79

VATICAN CITY

-See Italy

VENEZUELA**Caracas**

Sudimat
Apartado Postal 1322
Caracas 1010
Venezuela
Location:
Final Avenida San Martin
a 100 Metros de la Loteria de Caracas
Urb. la Quebradita
Telephone: (58-2) 442-6161/2647

Caracas

Equipos Diesel C.A.
(EQUIDICA)
Edif. Insenica, Calle 11-1
La Urbina - Caracas
Venezuela
Telephone: (58-2) 241-7043/74

Maracaibo

Equipos y Servicios, C.A.
(ESERCA)
Apartado Postal No. 1484
Maracaibo, Edo. Zulia, Venezuela
Telephone: (58-61) 34-4858, 34-4376

Valencia

Dieselval, C.A.
Avenida Lisandro Alvarado,
La Florida
Apartado Postal 3147
Valencia - Edo. Carabobo, Venezuela
Telephone: (58-41) 50-557/8

VIETNAM

-See South and East Asia
Regional Office - Singapore

WESTERN SAMOA**Apia**

Burns Philp
(South Seas) Co. Ltd.
P.O. Box 188
Apia, Western Samoa
Telephone: 20-800

YEMEN, NORTH**Sana'a**

Zubieri Trading Co.
P.O. Box 535
Sana'a, Yemen Arab Republic
Location:
Zubieri Street
Telephone: (967-2) 79336, 79149

YEMEN, SOUTH

-See Middle East Regional Office -
Mechelen

YUGOSLAVIA**Belgrade**

Univerzal Commercial
Representations
Auto Put Beograd - Zagreb 22
11000 Beograd
Yugoslavia
Location:
Majke Jevrosime 51
Telephone: (38-11) 600-333

ZAIRE**Brussels (Office in Belgium)**

Bureau Technique Bia, S.A.
Rameistraat, 123
B-1900 - Overijse, Belgium
Telephone: (32-2) 689-28-11

Kinshasa

Bureau Technique Bia, S.P.R.L.
B.P. 8843
Kinshasa 1
Zaire

Location:
Avenue Bobozo
(ex-Route des Poids Lourds)
Kinshasa-Limete, Zaire
Telephones: (243) 77797/8, 78427

ZAMBIA**Ndola**

N.E.I. (Zambia) Ltd.
P.O. Box 71501
Ndola, Zambia
Telephone: (260-2) 610729

ZIMBABWE**Harare**

Cummins Zimbabwe (Pvt) Ltd.
P.O. Box ST363
Southerton
Harare, Zimbabwe
Telephones: (263-4) 67645, 69220

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Section C - Component Manufacturers

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United States and United Kingdom Offices

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 Heaters

Cummins Electronics Co.
2851 State St.
Columbus, IN 47201
Telephone: (812) 377-8601

Alternators

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

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

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

Belts

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

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

Coolant Heaters

Fleetguard, Inc.
Route 8
Cookeville, TN 38501
Telephone: (615) 526-9551

Drive Plates

Lipe Corp.
806 Enerson Ave.
P.O. Box 4825
Syracuse, NY 13221
Telephone: (315) 488-5411

R&D Ltd.
Meadow Works
Clothall Road
Baldock
Hertfordshire SG7 6PD
England
Telephone: 0462-892391

Electric Starting Motors

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

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

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

Filters

Donaldson Co., Inc.
P.O. Box 1299
Minneapolis, MN 55440

Fleetguard International Corp.
Cavalry Hill Industrial Park
Weedon
Northampton NN7 4TD
England
Telephone: 0327-41313

Fleetguard, Inc.
Route 8
Cookeville, TN 38501
Telephone: (615) 526-9551

Gauges

Diversified Systems, Inc.
6226 La Pas Trail
P.O. Box 68041
Indianapolis, IN 46268
Telephone: (317) 299-9547

M&G Electronics
889 Seahawk Circle
P.O. Box 8187
Virginia Beach, VA 23450
Telephone: (804) 468-6000

VDO Instruments, Inc.
980 Brooke Road
Winchester, VA 22601
Telephone: (703) 665-0100

Heat Exchangers

Sen-Dure Products, Inc.
25 Moffitt Blvd.
Bay Shore, NY 11706
Telephone: (516) 665-0689

Magnetic Pickups

Airpax Corporation
150 Knotter Drive
Cheshire, CT 06410
Telephone: (203) 272-0301

Marine Gears

MPM, Padova, Italy, Div. of
Z-F of North America
500 Barclay Blvd.
Lincolnshire, IL 60069
Telephone: (312) 634-3500
MPM Division of Z-F
Veale dell' Industria, 48

35100 Padova, Italy
Telephone: (049) 807-1020

Twin Disc, Inc.
1328 Racine St.
Racine, WI 53403
Telephone: (404) 634-1981

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

Raw Water Pumps

Sherwood Div.
Lear Siegler, Inc.
E. Jefferson Ave.
Iron & Williams Sts.
Detroit, MI 48207
Telephone: (313) 259-2095

NOTES

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Section W - Warranty

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United States and Canada Marine Propulsion Products

PRODUCTS WARRANTED

This warranty applies to Cummins Engine Company, Inc, hereinafter 'Cummins', Products used in marine propulsion applications in the United States* and Canada and delivered to the first user on or after October 1, 1991. The 'Product' consists of a new Cummins engine and other accompanying new components. These Products have the following rating designations:

RECREATION/LIGHT DUTY COMMERCIAL RATING

Engines with this rating are intended for powering marine pleasure craft used for personal use only and for powering some marine commercial boats such as gillnetters, bowpickers, skiffs, oil skimmers, and small fishing craft.

This power rating is intended for use in variable load applications where full power is limited to one hour out of every eight hours of operation. Also, reduced power operations must be at or below 200 RPM of the the maximum rated RPM. This rating is an ISO 3046 Fuel Stop Power Rating and is for applications that operate less than 750 hours per year.

MEDIUM CONTINUOUS RATING

Engines with this rating are intended for powering commercial boats such as lobster boats, crew boats, party fishing boats, charter fishing boats, long range cruisers, harbor and coastal patrol boats, search and rescue boats, fire boats, bay shrimpers, clam boats, crab boats and seine skiffs.

This power rating is intended for continuous use in variable load applications where full power is limited to six hours out of every twelve hours of operation. Also, reduced power operations must be at or below 200 RPM of the maximum rated RPM. This is an ISO 3046 Fuel Stop Power Rating and is for applications that operate less than 3000 hours per year.

CONTINUOUS RATING

Engines with this rating are intended for powering commercial boats such as buoy tenders, research vessels, offshore supply boats, fishing trawlers, purse seiners, tugs, tow boats, and car/passenger ferries.

This power rating is intended for continuous use in applications requiring uninterrupted service at full power. This rating is the ISO 3046 Standard Power Rating and the SAE J1228 Continuous Crankshaft Power Rating.

COVERAGE

Base Engine Warranty

This warranty covers any failures of the Product, under normal use and service, which results from a defect in material or workmanship (Warrantable Failure). Coverage begins with the sale of the engine by Cummins and continues for the Duration stated below. The Duration commences either on the date of delivery of the Product to the first user, or on the date the unit is first leased, rented or loaned, or when the product has been operated for 50 hours, whichever occurs first.

RATING	Duration-Whichever Occurs First	
	Months	Hours
Recreational/Light Duty Commercial-Personal Use	12	Unlimited
Recreational/Light Duty Commercial- <u>Commercial Use</u>	12	750
Medium Continuous	12	3000
Continuous	12	Unlimited

Extended Major Components Warranty

The Extended Major Components Warranty applies to engines other than A, B and C series. It covers Warrantable Failures of the engine cylinder block, camshafts, crankshaft and connecting rods (Covered Parts). Bushing and bearing failures are not covered. This coverage begins with the expiration of the Base Engine Warranty and ends three years or 10,800 hours of operation, whichever occurs first, from the date of delivery to the first user.

Consumer Products

The warranty on Consumer Products in the United States is a **LIMITED** warranty. **CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.** Any implied warranties applicable to Consumer Products terminates concurrently with the expiration of the express warranties applicable to such products. Some states do not allow the exclusion of incidental or consequential damages, or limitations

or how long an implied warranty lasts, so the above limitations or exclusions may differ in certain areas of the United States.

These warranties are provided to all Owners until the end of the applicable duration stated above.

CUMMINS RESPONSIBILITIES

During the Base Engine Warranty

Cummins will pay for all parts and labor needed to repair the damage to the Product resulting from a Warrantable Failure. Labor costs will be paid in accordance with Cummins published Standard Repair Time guidelines. All repairs will be performed during normal business hours.

Cummins will pay for the lubricating oil, antifreeze, filter elements and other maintenance items that are not reusable due to the Warrantable Failure.

When it is necessary for mechanics to make on-site warranty repairs, Cummins will pay up to six hours total travel expenses for mechanics to and from the repair dock.

Cummins will pay reasonable labor costs for engine removal and reinstallation when necessary to make the warranty repair.

During the Extended Major Components Warranty

Cummins will pay for the repair or, at its option, replacement of the defective Covered Part and of any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

OWNER RESPONSIBILITIES

During the Base Engine Warranty

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during warranty repairs unless such items are not reusable due to the Warrantable Failure.

During the Extended Major Components Warranty

Owner is responsible for the cost of all labor needed to repair the Product, including the labor cost for component removal and reinstallation. When Cummins elects to repair a part instead of replacing it, Owner is not responsible for the labor needed to repair the part.

Owner is responsible for the cost of all parts required for the repair except for the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements, and other maintenance items replaced during the repair.

Additional Responsibilities During Both Warranties

Owner is responsible for the operation and maintenance of the Product as specified in the Cummins Operation and Maintenance Manuals. Proof of proper maintenance, use of proper fuel, oil, lubricants and coolant are the responsibility of the Owner.

Owner must notify a Cummins Distributor, authorized dealer or other location approved by Cummins of any Warrantable Failure before the expiration of this warranty and make the product available for repair by such facility. Locations in the United States are listed in the Cummins U.S. and Canada Sales and Service Directory.

In the event of any Product failure, Owner is responsible for the cost of towing the boat to the repair dock and for all associated docking and harbor charges.

Owner is responsible for communication expenses, meals, lodging and similar costs incurred by Owner as a result of Warrantable Failure.

Owner is responsible for maintaining the engine hourmeter in good working order at all times and to ensure that the hourmeter accurately reflects the total hours of operation of the product.

Owner is responsible for costs to investigate complaints, unless the problem is caused by a defect in Cummins material or workmanship.

Owner is responsible for non-Engine repairs and for "downtime" expenses, cargo damage, fines, and all business costs and losses resulting from a Warrantable Failure.

LIMITATIONS

Cummins is not responsible for failures or damage resulting from what Cummins determines to be abuse or neglect, including but not limited to: operation without adequate coolant or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or air intake systems; improper storage, starting, warm-up, run-in, or shutdown practices; unauthorized modifications of the Engine. Cummins is also not responsible for failures caused by incorrect fuel, or by water, dirt, or other contaminants in the fuel.

Cummins is also not responsible for failures resulting from:

1. Use or application of the product inconsistent with its rating designation set forth above.
2. Incorrect installation

Before a claim for excessive oil consumption will be considered, Owner must submit adequate documentation as required by Cummins Engine Company to show that consumption exceeds Cummins published standards.

Parts used in warranty repairs may be new Cummins parts, Cummins approved rebuilt parts or repaired parts. Cummins is not responsible for failures resulting from the use of parts not supplied by Cummins.

A new Cummins or Cummins-approved rebuilt part used to replace a Warranted Part assumes the identity of the Warranted Part it replaced and is entitled to the remaining coverage hereunder.

Failures of belts and hoses are covered only during the first 90 days of the warranty period.

CUMMINS DOES NOT COVER WEAR OR WEAROUT OF COVERED PARTS.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

THE WARRANTY SET FORTH HEREINAFTER IS THE SOLE WARRANTY MADE BY CUMMINS IN REGARD TO THESE PRODUCTS. THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

*Includes American Samoa, Commonwealth of Northern Mariana Islands, Guam, Puerto Rico, and U. S. Virgin Islands.

International Marine Propulsion Products

PRODUCTS WARRANTED

This warranty applies to Cummins Engine Company, hereinafter 'Cummins', Products used in marine propulsion applications anywhere in the world except in the United States* and Canada and delivered to the first user on or after October 1, 1991. The 'Product' consists of a new Cummins engine and other accompanying new Cummins components. These Products have the following rating designations:

RECREATION/LIGHT DUTY COMMERCIAL RATING

Engines with this rating are intended for powering marine pleasure craft used for personal use only and for powering some marine commercial boats.

This power rating is intended for use in variable load applications where full power is limited to one hour out of every eight hours of operation. Also, reduced power operations must be at or below 200 RPM of the maximum rated RPM. This rating is an ISO 3046 Fuel Stop Power Rating and is for applications that operate less than 750 hours per year.

MEDIUM CONTINUOUS RATING

This power rating is intended for continuous use in variable load applications where full power is limited to six hours out of every twelve hours of operation. Also, reduced power operations must be at or below 200 RPM of the maximum rated RPM. This is an ISO 3046 Fuel Stop Power Rating and is for applications that operate less than 3000 hours per year.

CONTINUOUS RATING

This power rating is intended for continuous use in applications requiring uninterrupted service at full power. This rating is the ISO 3046 Standard Power Rating and the SAE J1228 Continuous Crankshaft Power Rating.

COVERAGE

Base Engine Warranty

This warranty covers any failures of the Product, under normal use and service, which results from a defect in material or workmanship (Warrantable Failure). Coverage begins with the sale of the engine by Cummins and continues for the Duration stated below. The Duration commences either on the date of delivery of the Product to the first user, or on the date the unit is first leased, rented or loaned, or when the engine has been operated for 50 hours, whichever occurs first.

RATING	Duration-Whichever Occurs First	
	Months	Hours
Recreation/Light Duty Commercial - Personal Use	12	Unlimited
Recreation/Light Duty Commercial - <u>Commercial Use</u>	12	750
Medium Continuous	12	3000
Continuous	12	Unlimited

Extended Major Components Warranty

The Extended Major Components Warranty applies to engines other than A, B and C series. It covers Warrantable Failures of the engine cylinder block, camshafts, crankshaft and connecting rods (Covered Parts). Bushing and bearing failures are not covered. This coverage begins with the expiration of the Base Engine Warranty and ends three years or 10,800 hours of operation, whichever occurs first, from the date of delivery to the first user.

These warranties are provided to all Owners until the end of the Duration stated above.

CUMMINS RESPONSIBILITIES

During the Base Engine Warranty

Cummins will pay for all parts and labor needed to repair the damage to the Product resulting from a Warrantable Failure. Labor costs will be paid in accordance with Cummins published Standard Repair Time guidelines. All repairs will be performed during normal business hours.

Cummins will pay for the lubricating oil, antifreeze, filter elements and other maintenance items that are not reusable due to the Warrantable Failure.

When it is necessary for mechanics to make on-site warranty repairs, Cummins will pay up to six hours total travel expenses for mechanics to and from the repair dock.

Cummins will pay reasonable labor costs for engine removal and reinstallation when necessary to make the warranty repair.

During the Extended Major Components Warranty

Cummins will pay for the repair or, at its option, replacement of the defective Covered Part and of any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

OWNER RESPONSIBILITIES

During the Base Engine Warranty

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements and other maintenance items replaced during warranty repairs unless such items are not reusable due to the Warrantable Failure.

During the Extended Major Components Warranty

Owner is responsible for the cost of all labor needed to repair the Product, including the labor cost for component removal and reinstallation. When Cummins elects to repair a part instead of replacing it, Owner is not responsible for the labor needed to repair the part.

Owner is responsible for the cost of all parts required for the repair except for the defective Covered Part and any Covered Part damaged by a Warrantable Failure of the defective Covered Part.

Owner is responsible for the cost of lubricating oil, antifreeze, filter elements, and other maintenance items replaced during the repair.

Additional Responsibilities During Both Warranties

Owner is responsible for the operation and maintenance of the Product as specified in the Cummins Operation and Maintenance Manuals. Proof of proper maintenance, use of proper fuel, oil, lubricants and coolant are the responsibility of the Owner.

Owner must notify a Cummins Distributor, authorized dealer or other location approved by Cummins of any Warrantable Failure before the expiration of this warranty and make the product available for repair by such facility. Locations are listed in the Cummins International Service Directory.

In the event of any Product failure, Owner is responsible for the cost of towing the boat to the repair dock and for all associated docking and harbor charges.

Owner is responsible for communication expenses, meals, lodging and similar costs incurred by Owner as a result of Warrantable Failure.

Owner is responsible for maintaining the engine hourmeter in good working order at all times and to ensure that the hourmeter accurately reflects the total hours of operation of the product.

Owner is responsible for costs to investigate complaints, unless the problem is caused by a defect in Cummins material or workmanship.

Owner is responsible for non-Engine repairs and for "downtime" expenses, cargo damage, fines, and all business costs and losses resulting from a Warrantable Failure.

LIMITATIONS

Cummins is not responsible for failures or damage resulting from what Cummins determines to be abuse or neglect, including, but not limited to: operation without adequate coolant or lubricants; overfueling; overspeeding; lack of maintenance of lubricating, cooling or air intake systems; improper storage, starting, warm-up, run-in, or shutdown practices; unauthorized modifications of the Engine. Cummins is also not responsible for failures caused by incorrect fuel, or by water, dirt, or other contaminants in the fuel.

Cummins is also not responsible for failures resulting from:

1. Use or application of the product inconsistent with its rating designation set forth above.
2. Incorrect installation

Before a claim for excessive oil consumption will be considered, Owner must submit adequate documentation as required by Cummins Engine Company to show that consumption exceeds Cummins published standards.

Parts used in warranty repairs may be new Cummins parts, Cummins approved rebuilt parts or repaired parts. Cummins is not responsible for failures resulting from the use of parts not supplied by Cummins.

A new Cummins or Cummins-approved rebuilt part used to replace a Warranted Part assumes the identity of the Warranted Part it replaced and is entitled to the remaining coverage hereunder.

Failures of belts and hoses are covered during the first 90 days of the warranty period.

CUMMINS DOES NOT COVER WEAR OR WEAROUT OF COVERED PARTS.

CUMMINS IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

THE WARRANTY SET FORTH HEREINAFTER IS THE SOLE WARRANTY MADE BY CUMMINS IN REGARD TO THESE PRODUCTS. THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

In case of consumer sales, in some countries, the Owner has statutory rights which cannot be affected or limited by the terms of this warranty.

Nothing in this warranty excludes or restricts any contractual rights the Owner may have against third parties.

*Includes American Samoa, Commonwealth of Northern Mariana Islands, Guam, Puerto Rico, and U. S. Virgin Islands.

NOTES

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Publication Titles

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

B Series

Bulletin No.	Title of Publication
3810206	Shop
3810234	Alternative Repair
3810486	Troubleshooting and Repair
3810350	Standard Repair Times
3822100-01	Parts Catalog 4B, 4BT3.9 Marine
3822119-01	Parts Catalog 6BT5.9 Marine
3884392	Parts Catalog 6BTA5.9 Marine 250 HP With Nippondenso Fuel Pump
3884261-01	Parts Catalog 6BTA5.9 Marine 300 HP With Nippondenso Boost Controlled Fuel Pump
3884228	Parts Catalog 6BTA5.9 Marine 250 HP With CAV Fuel Pump
3377575	Service Products Catalog

C Series

3810275	Shop
3810234	Alternative Repair
3666003	Troubleshooting and Repair
3810327	Standard Repair Times
3810348	Injection Pumps and Injectors for B and C Engines
3810312	Specifications Manual
3884333	Parts Catalog 6CTA8.3 Marine
3377575	Service Products Catalog

Service Literature Ordering Location

Region

United States and Canada

U.K., Europe, Mid-East, Africa,
and Eastern European Countries

South and Central America
(excluding Brazil and Mexico)

Brazil and Mexico

Far East (excluding
Australia and New Zealand)

Australia and New Zealand

Ordering Location

Cummins Distributors

or

Cummins Engine Co., Inc.
Publishing Services CMC 40924
Box 3005
Columbus, IN 47202-3005

Cummins Engine Co., Ltd.
Royal Oak Way South
Daventry
Northants, NN11 5NU, England

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

Cummins Engine Co., Inc.
International Parts Order Dept., MC 40931
Box 3005
Columbus, IN 47202-3005

Cummins Diesel Sales Corp.
Literature Center
8 Tanjong Penjuru
Jurong Industrial Estate
Singapore

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).

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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