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### YANMAR LIMITED WARRANTY

#### What is Covered by this Warranty?

Yanmar warrants to the original retail purchaser that your new Yanmar TNE Series Industrial Engine will be free from defects in material and / or workmanship for the duration of the warranty period.

#### How Long is the Warranty Period?

The Yanmar standard limited warranty period begins on the date of the delivery of the new Yanmar TNE Series Industrial Engine to the first retail purchaser and extends for a period of **twenty-four (24) months or two-thousand (2000) engine operation hours**, whichever occurs first.

#### What the Engine Owner Must Do:

If you believe your Yanmar engine has experienced a failure due to a defect in material and / or workmanship, you must contact an authorized Yanmar industrial engine dealer or distributor within thirty (30) days of discovering the failure. You must provide proof of ownership of the engine, proof of the date of the engine purchase and delivery, and documentation of the engine operation hours. You are responsible for the transportation of the engine to and from the repair location as designated by Yanmar.

Yanmar strongly recommends you register your engine as soon as possible after purchase in order to facilitate any future warranty matters.

#### To Locate an Authorized Yanmar Industrial Engine Dealer or Distributor:

You can locate your nearest authorized Yanmar industrial engine dealer or distributor by visiting the Yanmar Corp., Ltd. web site at:

<http://www.yanmar.co.jp>

- The Japanese language page will be displayed. For English language “click” on “English Page.”
- “Click” on “Network” in the web site heading to view the “Yanmar Worldwide Network.”
- Choose and “Click” on the desired product group.
- “Click” on the Icon closest to your region.
- “Click” on the desired country or Associate company to locate your nearest authorized Yanmar industrial engine dealer or distributor.
- You may also contact Yanmar by clicking on “Inquiry” in the web site heading.

#### What Yanmar Will Do:

Yanmar warrants to the original retail purchaser of a new Yanmar engine that Yanmar will make such repairs and / or replacements necessary to correct any defects in materials and / or workmanship discovered during the warranty period. Such repairs and / or replacements will be made at a location designated by Yanmar.

**⚠ DANGER****FIRE AND EXPLOSION HAZARD!**

- Diesel fuel is extremely flammable and explosive under certain conditions.
- Before you operate the engine, check for fuel leaks. Replace rubberized fuel hoses every two years or every 2000 hours of engine operation, whichever comes first, even if the engine has been out of service. Rubberized fuel lines tend to dry out and become brittle after two years or 2000 hours of engine operation, whichever comes first.
- Failure to comply will result in death or serious injury.

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**⚠ DANGER****CRUSH HAZARD!**

- When you need to transport an engine for repair have a helper assist you attach it to a hoist and load it on a truck.
- NEVER stand under hoisted engine. If the hoist mechanism fails, the engine will fall on you, causing serious injury or death.
- Failure to comply will result in death or serious injury.

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**⚠ DANGER****EXPLOSION HAZARD!**

- NEVER check the remaining battery charge by shorting out the terminals. This will result in a spark and may cause an explosion or fire. Use a hydrometer to check the remaining battery charge.
- If the electrolyte is frozen, slowly warm the battery before you recharge it.
- Failure to comply will result in death or serious injury.

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## Section 4

# GENERAL SERVICE INFORMATION

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### **⚠ DANGER**



#### **FIRE AND EXPLOSION HAZARD!**

- Diesel fuel is extremely flammable and explosive under certain conditions.
- Be sure to place the diesel fuel container on the ground when transferring diesel fuel from the pump to the container. Hold the hose nozzle firmly against the side of the container while filling it. This prevents static electricity build-up which could cause sparks and ignite fuel vapors.
- NEVER place diesel fuel or other flammable material such as oil, hay or dried grass close to the engine during engine operation or shortly after shut down.
- Failure to comply will result in death or serious injury.

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### **⚠ DANGER**



#### **FIRE AND EXPLOSION HAZARD!**

- Diesel fuel is extremely flammable and explosive under certain conditions.
- Before you operate the engine, check for fuel leaks. Replace rubberized fuel hoses every two years or every 2000 hours of engine operation, whichever comes first, even if the engine has been out of service. Rubberized fuel lines tend to dry out and become brittle after two years or 2000 hours of engine operation, whichever comes first.
- Failure to comply will result in death or serious injury.

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### **CAUTION**

- Only use diesel fuels recommended by Yanmar for the best engine performance, to prevent engine damage and to comply with EPA / ARB warranty requirements.
- Only use clean diesel fuel.
- NEVER remove primary strainer from the fuel tank filler port (if equipped). If removed, dirt and debris could get into the fuel system causing it to clog.

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Note that a typical fuel tank is shown. The fuel tank on your equipment may be different.

1. Clean the area around the fuel cap (**Figure 4-2, (1)**).
2. Remove the fuel cap (**Figure 4-2, (1)**) from the fuel tank (**Figure 4-2, (2)**).

## GENERAL SERVICE INFORMATION

### 4TNE92-NMHA

Engine Model	4TNE92-NMHA	
Version	VM	
Type	Vertical Inline Diesel Engine	
Combustion System	Indirect Injection	
Aspiration	Natural	
No. of Cylinders	4	
Bore x Stroke	3.62 x 3.94 in (92 x 100 mm)	
Displacement	162.3 cu in (2.659 L)	
Max. Rated Output (Net)	rpm (min <sup>-1</sup> )	2050
	hp SAE	39.0
	kW	29.1
	PS	39.6
High Idle Speed (Bare Engine)	2450 ± 25 rpm	
Low Idle Speed (Bare Engine)	850 ± 25 rpm	
Engine Weight (Dry)*	491.6 lb (194 kg)	
PTO Position	Flywheel Side	
Direction of Rotation	Counterclockwise Viewed From Flywheel Side	
Cooling System	Liquid-Cooled With Radiator	
Lubricating System	Forced Lubrication With Trochoid Pump At normal operating speeds, oil pressure is: 42 - 57 psi (0.29 - 0.39 MPa; 3.0 - 4.0 kgf/cm <sup>2</sup> ) At idle, oil pressure is: No less than 8.5 psi (0.06 MPa; 0.6 kgf/cm <sup>2</sup> )	
Starting System	Electric Starting - Starter Motor: DC12V, 3.1 hp (2.3 kW)	
	Alternator: DC12V, 60A	
	Recommended Battery Capacity: 12V, 622 CCA (Cold Cranking Amps)	
Dimensions (L x W x H)*	24.9 x 19.6 x 26.6 in (632 x 498 x 676 mm)	
Engine Oil Pan Capacity	9.7 / 7.6 qt (9.2 / 7.2 L) (Dipstick Upper Limit / Lower Limit)	
Engine Coolant Capacity	1.11 gal (4.2 L) Engine Only	

\* Engine Specifications Without Cooling Fan, Radiator, Muffler, and Air Cleaner.

This section of the *Service Manual* describes the procedures for proper care and maintenance of the engine.

### CAUTION



**NEVER** permit anyone to operate the engine or driven machine without proper training.

- Read and understand this Operation Manual before you operate the machine to ensure that you follow safe operating practices and maintenance procedures.
- Machine safety signs and labels are additional reminders for safe operating and maintenance techniques.
- See your authorized Yanmar industrial engine dealer or distributor for additional training.

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### DANGER



#### **EXPLOSION HAZARD!**

- **NEVER** check the remaining battery charge by shorting out the terminals. This will result in a spark and may cause an explosion or fire. Use a hydrometer to check the remaining battery charge.
- If the electrolyte is frozen, slowly warm the battery before you recharge it.
- Failure to comply will result in death or serious injury.

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### DANGER



#### **FIRE AND EXPLOSION HAZARD!**

- Only use the key switch to start the engine.
- **NEVER** jump start the engine. Sparks caused by jumping the battery to the starter terminals may cause a fire or explosion.
- Failure to comply will result in death or serious injury.

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### CAUTION

For maximum engine life, Yanmar recommends that when shutting the engine down, you allow the engine to idle, without load, for 5 minutes. This will allow the engine components that operate at high temperatures, such as the turbocharger (if equipped) and exhaust system, to cool slightly before the engine itself is shut down.

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### CAUTION

**NEVER** use an engine starting aid such as ether. Engine damage will result.

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### CAUTION

Make sure the engine is installed on a level surface. If a continuously running engine is installed at an angle greater than 20° (in any direction) or if an engine runs for short periods of time (less than 3 minutes) at an angle greater than 25° in any direction, engine oil may enter the combustion chamber causing excessive engine speed and generate white smoke. This may cause serious engine damage.

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### CAUTION

**New Engine Break In:**

- On the initial engine start-up, allow the engine to idle for approximately 15 minutes while you check for proper engine oil pressure, diesel fuel leaks, engine oil leaks, coolant leaks, and for proper operation of the indicators and / or gauges.
- During the first hour of operation, vary the engine speed and load on the engine. Short periods of maximum engine speed and load are desirable. Avoid prolonged operation at minimum or maximum engine speeds and loads for the next 4 to 5 hours.
- During the break-in period, carefully observe the engine oil pressure and engine temperature.
- During the break-in period, check the engine oil and coolant levels frequently.

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### CAUTION

**NEVER** engage the starter motor while the engine is running. This may damage the starter motor pinion and / or ring gear.

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5. Install the new V-belt. Refer to the table for proper tension.


New V-belt Tension		
A	B	C
5/16 ~7/16 in (8~12 mm)	3/16 ~5/16 in (5~8 mm)	1/4 ~7/16 in (7~11 mm)

6. After adjusting, run the engine for 5 minutes or more. Check the tension again using the specifications for a used V-belt.

Used V-belt Tension		
A	B	C
3/8 ~1/2 in (10~14 mm)	1/4 ~3/8 in (7~10 mm)	5/16 ~1/2 in (9~13 mm)

**Check Battery**

**⚠ DANGER**




**EXPLOSION HAZARD!**

- NEVER check the remaining battery charge by shorting out the terminals. This will result in a spark and may cause an explosion or fire. Use a hydrometer to check the remaining battery charge.
- If the electrolyte is frozen, slowly warm the battery before you recharge it.
- Failure to comply will result in death or serious injury.

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**⚠ WARNING**




**BURN HAZARD!**

- Batteries contain sulfuric acid. NEVER allow battery fluid to come in contact with clothing, skin or eyes. Severe burns could result. ALWAYS wear safety goggles and protective clothing when servicing the battery. If contact with the skin and / or eyes should occur, flush with a large amount of water and obtain prompt medical treatment.
- Failure to comply could result in death or serious injury.

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**CAUTION**



Be environmentally responsible. Follow these procedures for hazardous waste disposal. Failure to follow these procedures may seriously harm the environment.

- Follow the guidelines of the EPA or other governmental agency for the proper disposal of hazardous materials such as engine oil, diesel fuel and engine coolant. Consult the local authorities or reclamation facility.
- NEVER dispose of hazardous materials irresponsibly by dumping them into a sewer, on the ground or into ground water or waterways.

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10. Remove the fuel filter sensor assembly **(Figure 5-15, (5))** by turning it to the left **(Figure 5-15, (3))**.
11. Carefully remove the in-line fuel filter **(Figure 5-15, (7))** from the output nipple **(Figure 5-15, (8))** that goes to the fuel injection pump.
12. Dispose of the fuel, fuel filters and O-ring (if replaced) properly. Follow the guidelines of the EPA or other government agency.
13. Carefully install the new in-line fuel filter **(Figure 5-15, (7))** into the output nipple **(Figure 5-15, (8))**.
14. Carefully install the fuel filter sensor assembly **(Figure 5-15, (5))** in the new fuel filter using the new O-ring supplied with the fuel filter **(Figure 5-15, (2))** by turning the fuel filter sensor assembly to the right **(Figure 5-15, (9))**.
15. Install the drain plug **(Figure 5-15, (1))** on the new fuel filter **(Figure 5-15, (3))** by turning the drain plug to the right **(Figure 5-15, (8))**. Hand tighten only.
16. Clean the fuel filter mounting surface **(Figure 5-15, (10))** and apply a small amount of diesel fuel to the gasket of the new filter.
17. Install the new fuel filter **(Figure 5-14, (2))** by turning it to the right **(Figure 5-14, (4))** until it contacts the mounting surface. Tighten one additional turn.
18. Open all fuel cocks in the fuel line.
19. Reconnect the fuel filter sensor connector **(Figure 5-14, (1))**.
20. Prime the fuel system. *See Priming the Fuel System on page 4-12.*
21. Check for fuel leaks.

<b>Applicable In-Line Fuel Filter Part No. (Figure 5-15, (7))</b>	
4TNE92-NMH 4TNE92-NMHA 4TNE98-NMH	129901-55860

<b>Applicable Fuel Filter Part No. (Figure 5-14, (2))</b>	
4TNE92-NMH 4TNE92-NMHA 4TNE98-NMH	129901-55850

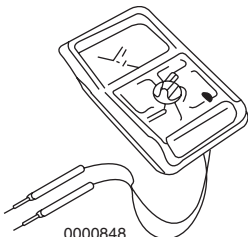
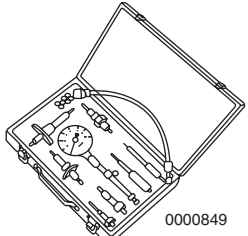
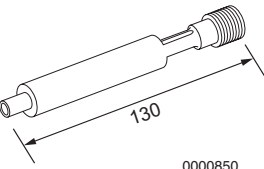
**Gear Train and Camshaft**

**Camshaft**

Inspection Item			Standard	Limit	Reference Page
Side Gap			0.0020 - 0.0079 in (0.05 - 0.20 mm)	0.0118 in (0.30 mm)	<i>See Removal of Camshaft on page 6-39</i>
Bending (1/2 the Dial Gauge Reading)			0 - 0.0008 in (0 - 0.02 mm)	0.0020 in (0.05 mm)	<i>See Inspection of Camshaft on page 6-46</i>
Cam Height			1.6707 - 1.6758 in (42.435 - 42.565 mm)	1.6608 in (42.185 mm)	
Camshaft Oil Clearance	Gear End	Bushing Inside Diameter	1.9681 - 1.9707 in (49.990 - 50.055 mm)	1.9736 in (50.130 mm)	
		Camshaft Outside Diameter	1.9656 - 1.9665 in (49.925 - 49.950 mm)	1.9642 in (49.890 mm)	
		Oil Clearance	0.0016 - 0.0051 in (0.04 - 0.130 mm)	0.0094 in (0.240 mm)	
	Intermediate	Bushing Inside Diameter	1.9685 - 1.9695 in (50.000 - 50.025 mm)	1.9724 in (50.100 mm)	
		Camshaft Outside Diameter	1.9650 - 1.9659 in (49.910 - 49.935 mm)	1.9636 in (49.875 mm)	
		Oil Clearance	0.0026 - 0.0045 in (0.065 - 0.115 mm)	0.0089 in (0.225 mm)	
	Flywheel End	Bushing Inside Diameter	1.9685 - 1.9695 in (50.000 - 50.025 mm)	1.9724 in (50.100 mm)	
		Camshaft Outside Diameter	1.9656 - 1.9665 in (49.925 - 49.950 mm)	1.9642 in (49.890 mm)	
		Oil Clearance	0.0020 - 0.0039 in (0.050 - 0.100 mm)	0.0083 in (0.210 mm)	

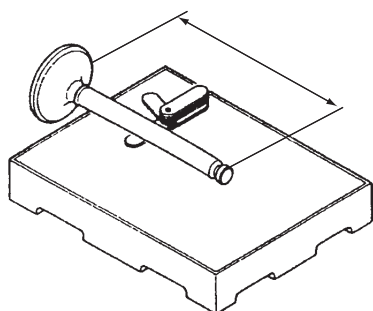
**Idler Gear Shaft and Bushing**

Inspection Item		Standard	Limit	Reference Page
Shaft Outside Diameter		1.8091 - 1.9675 in (45.950 - 49.975 mm)	1.8071 in (45.900 mm)	<i>See Inspection of Idler Gear and Shaft on page 6-47</i>
Bushing Inside Diameter		1.8110 - 1.8120 in (46.000 - 46.025 mm)	1.8140 in (46.075 mm)	
Clearance		0.0010 - 0.0030 in (0.025 - 0.075 mm)	0.0069 in (0.175 mm)	

No.	Instrument Name	Application	Illustration
15	Circuit Tester	For measuring resistance, voltage and continuity of electrical circuits	 <p>0000848</p>
16	Compression Gauge Kit	For measuring compression pressure Gauge Set Part No. TOL-97190080	 <p>0000849</p>
	New Compression Test Adaptor	Adapter for direct injection 2-valve cylinder head Adapter Part No. 119802-92950	 <p>0000850</p>

### Valve Stem Straightness

Place the valve stem on a flat inspection block or layout bed. Roll the valve until a gap can be observed between a portion of the valve stem and the surface of the block or bed. Use a feeler gauge to measure the gap (**Figure 6-18**). See *Intake / Exhaust Valve and Guide* on page 6-5 for the service limit.

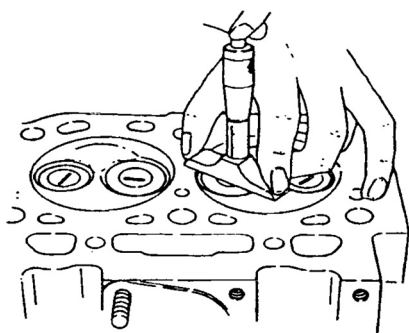


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**Figure 6-18**

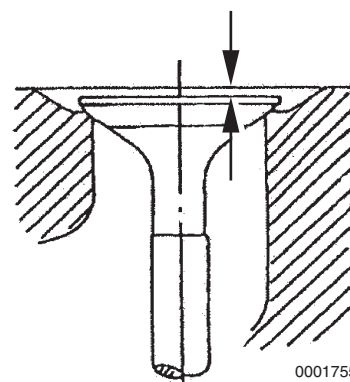
### Valve Sink

Insert the valves into their proper places and press them down until they are fully seated. Use a depth micrometer (**Figure 6-19**) to measure the difference between the cylinder head surface and the combustion surface of each exhaust and intake valve (**Figure 6-20**). See *Cylinder Head* on page 6-5 for the service limit.



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**Figure 6-19**



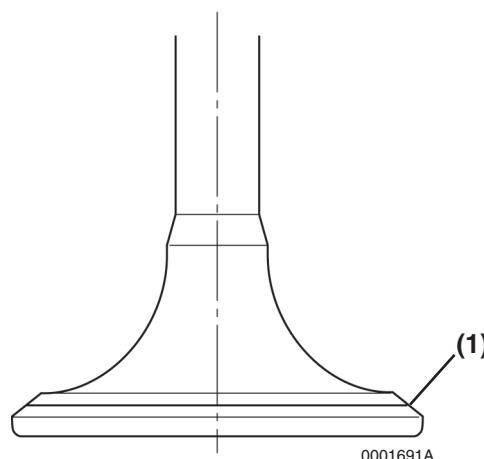
0001755

**Figure 6-20**

### Valve Seat

Always check the clearance between the valve and valve guide before correcting the valve seat (**Figure 6-21, (1)**). If the clearance exceeds the limit, replace the valve or valve guide to bring the clearance within the limit.

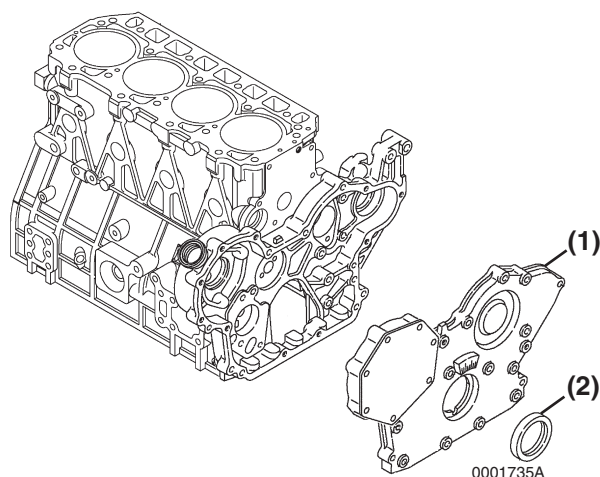
Roughness, or burrs will cause poor seating of a valve. Visually inspect the seating of each valve and determine if lapping or grinding is needed. Grinding is needed if the cylinder head's seat width exceeds standard limits. See *Cylinder Head* on page 6-5 for the service limit.



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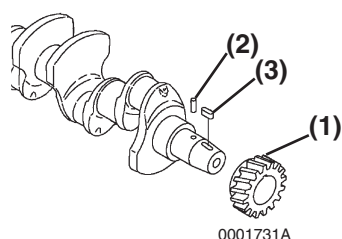
**Figure 6-21**

Lap the valve seat and cylinder head with a mixture of valve compound and engine oil.



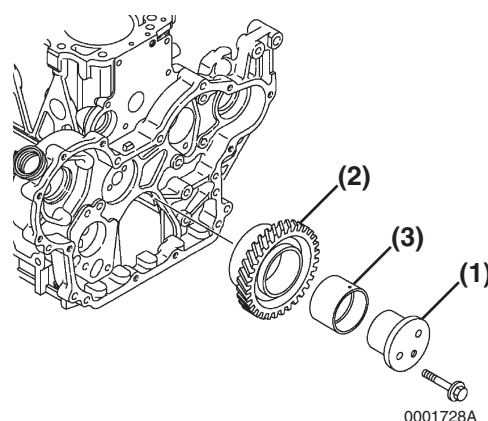
**Figure 6-40**

4. Remove the bolts from the timing gears.
  - Remove the crankshaft gear (**Figure 6-41, (1)**). If using a gear puller, be careful not to damage the treads in the end of the crankshaft. Remove the parallel pin (**Figure 6-41, (2)**) and the key (**Figure 6-41, (3)**) from the crankshaft.



**Figure 6-41**

- Remove the bolts from the idler gear shaft. Remove the idler gear shaft (**Figure 6-42, (1)**), idler gear (**Figure 6-42, (2)**) and bushing (**Figure 6-42, (3)**).



**Figure 6-42**

## Removal of Pistons

### CAUTION

Keep the piston pin parts, piston assemblies and connecting rod assemblies together to be returned to the same position during the reassembly process. Label the parts using an appropriate method.

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Note: It is necessary to rotate the crankshaft to access some of the connecting rod assemblies at the bottom dead center position.

1. Using a feeler gauge, measure the connecting rod thrust clearance as shown (**Figure 6-43**). See *Connecting Rod* on page 6-10 for the standard limit. If the measurement is out of specification, either the crankshaft or the connecting rod must be replaced.

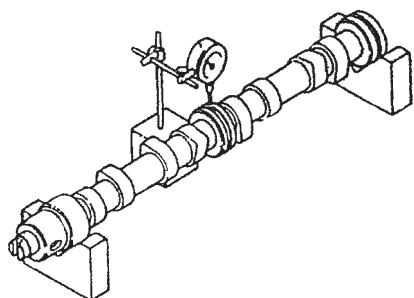
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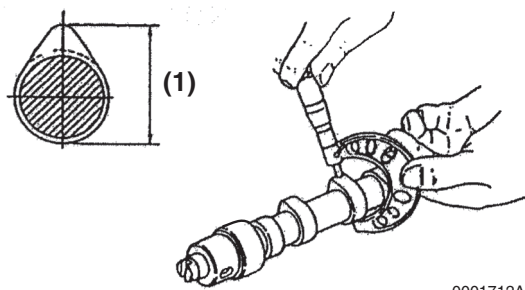
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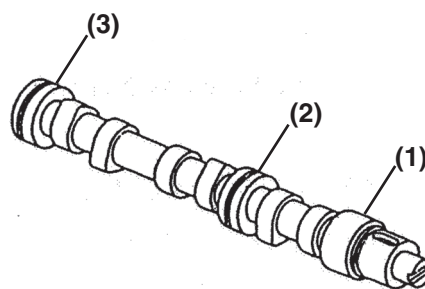
**Figure 6-63**

- Rotate the camshaft and observe the runout.  
See *Camshaft* on page 6-7 for the service limit.
2. Measure the intake / exhaust cam height (**Figure 6-64, (1)**). See *Camshaft* on page 6-7 for the service limit.



**Figure 6-64**

3. Measure the gear end (**Figure 6-65, (1)**), intermediate position (**Figure 6-65, (2)**) and flywheel end (**Figure 6-65, (3)**) bearing surface diameters. Determine the oil clearance. The oil clearance is calculated by subtracting the measured camshaft bearing surface diameter from the camshaft bushing inside diameter. See *Camshaft* on page 6-7 for the service limit.



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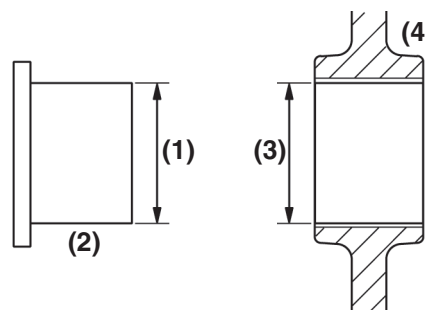
**Figure 6-65**

### Inspection of Camshaft Bushings

If the camshaft bushing are damaged, replace the bushings using the appropriate service tool.

### Inspection of Idler Gear and Shaft

1. Measure the outside diameter (**Figure 6-66, (1)**) of the idler gear shaft (**Figure 6-65, (2)**). See *Idler Gear Shaft and Bushing* on page 6-7 for the service limit.
2. Measure the inside diameter (**Figure 6-65, (3)**) of the idler gear (**Figure 6-65, (4)**). See *Idler Gear Shaft and Bushing* on page 6-7 for the service limit.



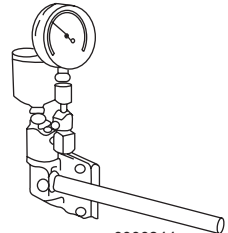
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**Figure 6-66**

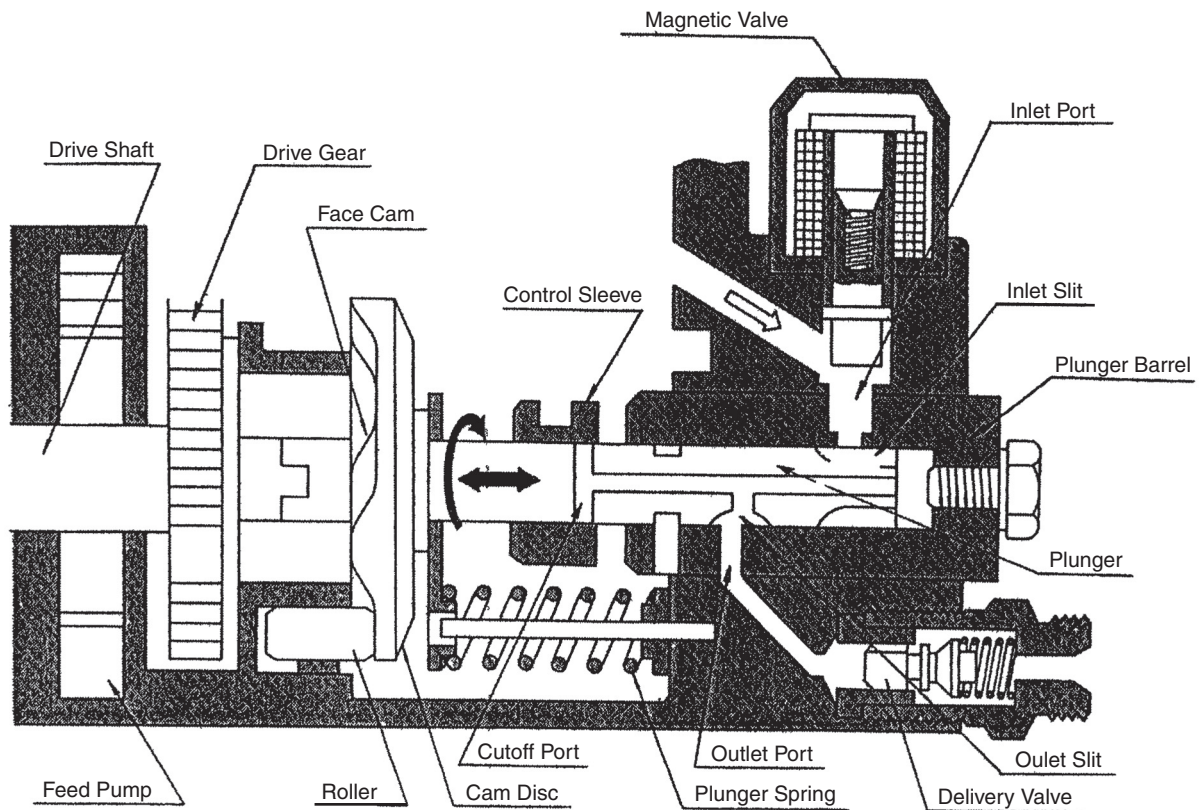
## FUEL SYSTEM SPECIAL TORQUE CHART

Component	Tightening Torque	Lubricating Oil Application (Thread Portion and Seat Surface)	Reference Page
Fuel Injector	29.4 ft·lbs (39.2 N·m, 4 kgf·m)	Not Applied	<i>See Installation of Fuel Injectors on page 7-39</i>
Fuel Pump Drive Gear Nut	43.5 - 51.0 ft·lbs (59 - 69 N·m, 6.0 - 7.0 kgf·m)	Not Applied	<i>See Installation of the Fuel Injection Pump on page 7-31</i>

## MEASURING INSTRUMENTS

1	Fuel Injector Tester	For measuring injection spray pattern of fuel injection nozzle and injection pressure	 <p>0000844</p>
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## PLUNGER OPERATION



0001638

The drive shaft simultaneously drives the feed pump, cam disc and plunger. The plunger spring presses the plunger and cam disc onto the roller. When the cam disc turns by means of the drive shaft, the face cam moves on the roller to activate the plunger's reciprocating operation. When the inlet port of the plunger barrel being pressed into the distributor head and the inlet slit of the plunger overlap, the plunger draws fuel and applies pressure to it.

When the outlet port of the plunger barrel and the outlet slit of the plunger align, the high-pressure fuel opens the delivery valve to be injected into the engine combustion chamber via the nozzle. When the cutoff port reaches the control sleeve, pressure feeding from the plunger is terminated.

At No-Load Maximum Speed Control

**CAUTION**

**NEVER** remove or attempt to remove the tamper-proof devices from the full-load fuel adjusting screw or the high-speed throttle limit screw on the fuel injection pump and governor assembly. These adjustments have been made at the factory to meet all applicable emissions regulations and then sealed.

**NEVER** attempt to make any adjustments to these sealed adjustment screws. If adjustments are required, they can be made only by a qualified fuel injection shop that will ensure the injection pump continues to meet all applicable emissions regulations and then replace the tamper-proof seals.

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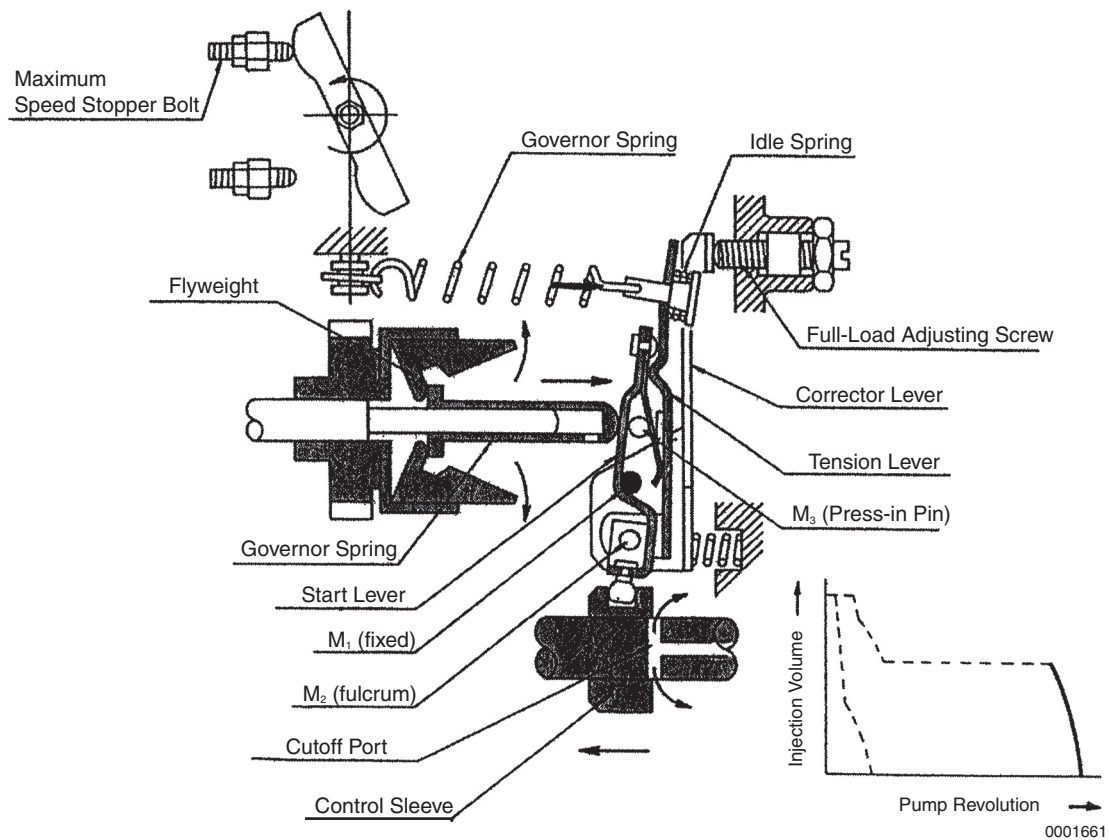
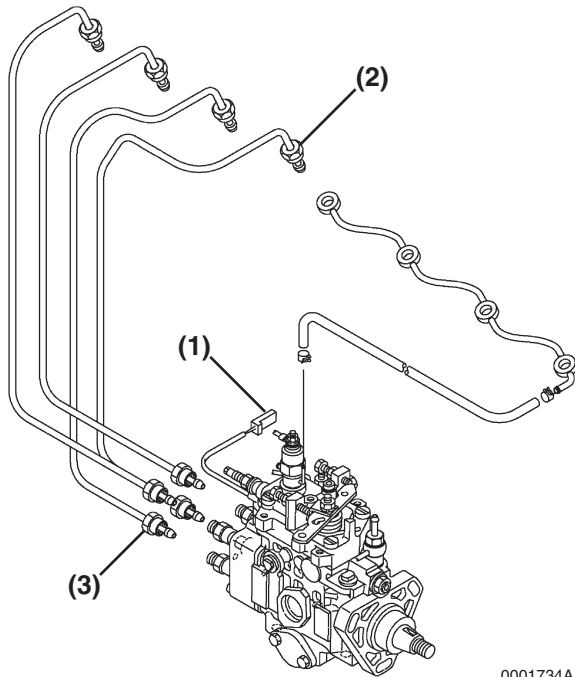


Figure 7-28



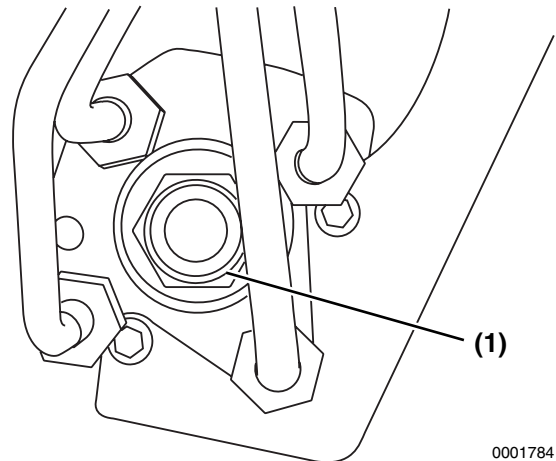
**Figure 7-46**

0001734A

11. Reconnect the throttle linkage.
12. Reconnect the electrical connection to the magnetic valve (stop solenoid) **(Figure 7-46, (1))**.
13. Reinstall fuel tank return line.
14. Reinstall fuel injector return line.
15. Reinstall fuel supply line to the fuel injection pump.
16. Prime the fuel system and check for leaks.

## CHECKING / ADJUSTMENT OF FUEL INJECTION TIMING

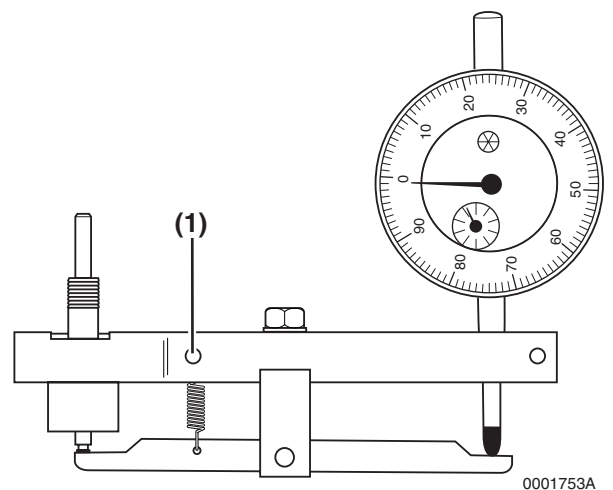
1. Using a wrench on the front crankshaft pulley bolt, rotate the engine clockwise until the timing mark on the crankshaft pulley is aligned with the "O" or TDC (Top Dead Center) mark on the timing grid of the gear case cover.
2. Remove the center bolt **(Figure 7-47, (1))** and sealing washer from the rear of the fuel injection pump.



0001784

**Figure 7-47**

3. Locate Yanmar timing tool (P/N 119770-02020) **(Figure 7-48, (1))**. Install a dial indicator into the timing tool.




0001753A

**Figure 7-48**

4. Install Yanmar timing tool **(Figure 7-49, (1))**, into the port where the bolt was removed. This will provide a reading of the injection pump plunger lift.

This section of the *Service Manual* describes the procedures necessary to service the engine coolant pump.

**⚠ DANGER**




**SCALD HAZARD!**

- **NEVER** remove the radiator cap if the engine is hot. Steam and hot engine coolant will spurt out and seriously burn you. Allow the engine to cool down before you attempt to remove the radiator cap.
- Securely tighten the radiator cap after you check the radiator. Steam can spurt out during engine operation if the cap is loose.
- **ALWAYS** check the level of engine coolant by observing the reserve tank.
- Failure to comply will result in death or serious injury.

000002en

**⚠ WARNING**




**BURN HAZARD!**

- Wait until the engine cools before you drain the engine coolant. Hot engine coolant may splash and burn you.
- Failure to comply could result in death or serious injury.

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**⚠ WARNING**

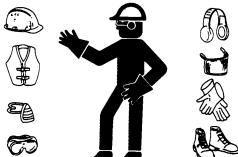


**SEVER HAZARD!**

- Stop the engine before you begin to service it.
- **NEVER** leave the key in the key switch when you are servicing the engine. Someone may accidentally start the engine and not realize you are servicing it. This could result in a serious injury.
- If you must service the engine while it is operating, remove all jewelry, tie back long hair, and keep your hands, other body parts and clothing away from moving / rotating parts.
- Failure to comply could result in death or serious injury.

0000010en

**⚠ WARNING**

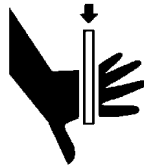


**EXPOSURE HAZARD!**

- Always read and follow safety related precautions found on containers of hazardous substances like parts cleaners, primers, sealants, and sealant removers.
- Failure to comply could result in death or serious injury.

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**⚠ CAUTION**

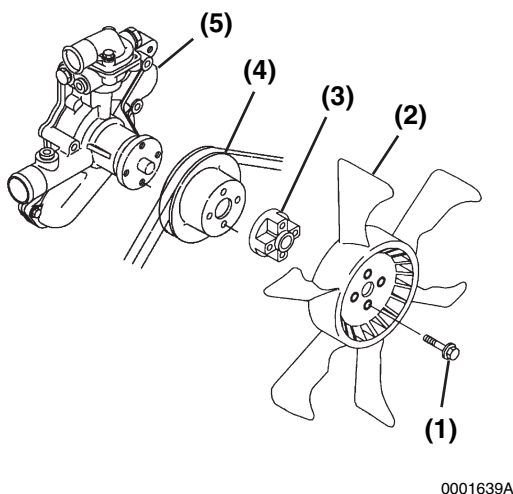


**PINCH HAZARD!**

Carefully rotate the alternator toward the cylinder block while loosening the V-belt. Failure to comply may result in minor or moderate injury.

0000014en

- Remove the engine coolant fan guard (if equipped), engine coolant fan (if equipped) (**Figure 8-8, (2)**), spacer (**Figure 8-8, (3)**), engine coolant pump V-pulley (**Figure 8-8, (4)**) and V-belt.

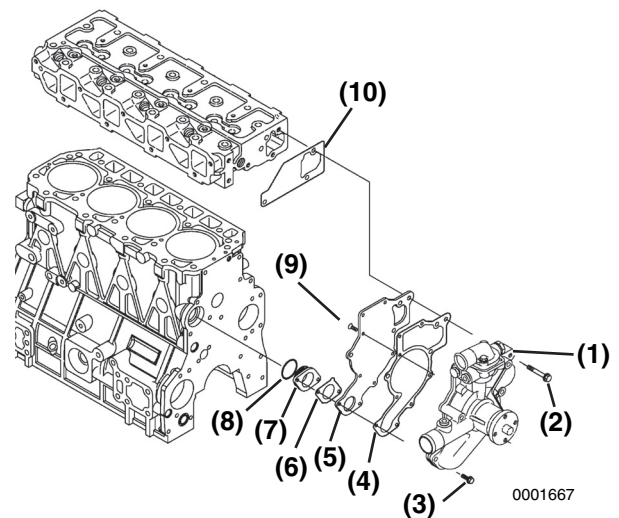


**Figure 8-8**

## Disassembly of the 4TNE92-NMHA Coolant Pump

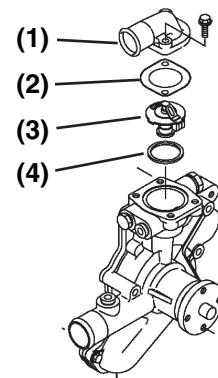
- Remove the engine coolant pump bolts (**Figure 8-9, (2), (3)**). Remove the engine coolant pump (**Figure 8-9, (1)**).
- Remove the bolt (**Figure 8-9, (9)**) holding the cover (**Figure 8-9, (5)**) on the pump. Discard the gaskets (**Figure 8-9, (4), (10)**).

- Disassemble the mechanical seal (**Figure 8-9, (6)**), flange (**Figure 8-9, (7)**), and O-ring (**Figure 8-9, (8)**).



**Figure 8-9**

- Remove the thermostat cover (**Figure 8-10, (1)**). Discard the gasket (**Figure 8-10, (2)**).



**Figure 8-10**

- Remove the thermostat (**Figure 8-10, (3)**). Discard the gasket (**Figure 8-10, (4)**).

## Disassembly of the 4TNE92-NMH and 4TNE98-NMH Coolant Pumps

- Remove the engine coolant pump bolts (**Figure 8-11, (2)**). Remove the engine coolant pump (**Figure 8-11, (1)**). Discard the gasket (**Figure 8-11, (6)**).

## OIL PUMP SERVICE INFORMATION

### Engine Oil Pressure - All Models

Model Number	at Rated Engine rpm	at Low Idle Speed
4TNE92-NMH 4TNE92-NMHA 4TNE98-NMH	42.06 - 56.57 psi (0.29 - 0.39 MPa) (3.0 - 4.0 kgf/cm <sup>2</sup> )	8.5 psi (0.06 MPa, 0.6 kgf/cm <sup>2</sup> ) or greater

### Outer Rotor Outside Clearance - All Models

Model	Standard	Limit	Reference Page
4TNE92-NMH 4TNE92-NMHA 4TNE98-NMH	0.0039 to 0.0061 in (0.100 to 0.155 mm)	0.0098 in (0.25 mm)	<i>Check Outer Rotor Outside Clearance on page 9-10</i>

### Outer Rotor Side Clearance - All Models

Model	Standard	Limit	Reference Page
4TNE92-NMH 4TNE92-NMHA 4TNE98-NMH	0.0020 to 0.0039 in (0.05 to 0.10 mm)	0.0059 in (0.15 mm)	<i>Check Outer Rotor Side Clearance on page 9-10</i>

### Outer Rotor to Inner Rotor Tip Clearance - All Models


Model	Standard	Limit	Reference Page
4TNE92-NMH 4TNE92-NMHA 4TNE98-NMH	—	0.0063 in (0.16 mm)	<i>Outer Rotor to Inner Rotor Tip Clearance on page 9-10</i>

### Rotor Shaft Clearance - All Models

Model	Inspection Item	Standard	Limit	Reference Page
4TNE92-NMH 4TNE92-NMHA 4TNE98-NMH	Gear Case Bearing I.D.	0.5110 to 0.5126 in (12.980 to 13.020 mm)	0.5138 in (13.05 mm)	<i>Check Rotor Shaft Clearance on page 9-10</i>
	Rotor Shaft O.D.	0.5089 to 0.5106 in (12.925 to 12.970 mm)	0.5085 in (12.915 mm)	
	Rotor Clearance	0.0004 to 0.0026 in (0.010 to 0.065 mm)	0.0041 in (0.105 mm)	

This section of the Service Manual describes the servicing of the 4TNE92-NMH, 4TNE92-NMHA, and 4TNE98-NMH starter motors.

**⚠ WARNING**




**SEVER HAZARD!**

- Stop the engine before you begin to service it.
- **NEVER** leave the key in the key switch when you are servicing the engine. Someone may accidentally start the engine and not realize you are servicing it. This could result in a serious injury.
- If you must service the engine while it is operating, remove all jewelry, tie back long hair, and keep your hands, other body parts and clothing away from moving / rotating parts.
- Failure to comply could result in death or serious injury.

0000010en

**⚠ WARNING**




**SHOCK HAZARD!**

- Turn off the battery switch (if equipped) or disconnect the negative battery cable before servicing the electrical system.
- Check the electrical harnesses for cracks, abrasions, and damaged or corroded connectors. **ALWAYS** keep the connectors and terminals clean.
- Failure to comply could result in death or serious injury.

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**⚠ WARNING**



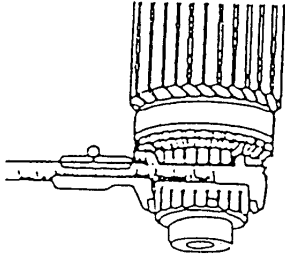
**EXPOSURE HAZARD!**

- Always read and follow safety related precautions found on containers of hazardous substances like parts cleaners, primers, sealants, and sealant removers.
- Failure to comply could result in death or serious injury.

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## Measure Commutator Outside Diameter

Measure the commutator outside diameter. Replace the armature if the measurement is less than the limit.



0000113

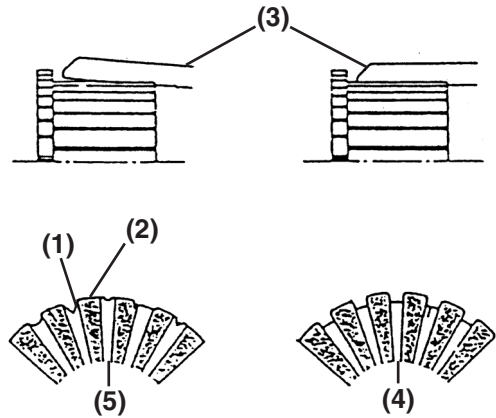
**Figure 10-13**

Standard	Limit
1.437 in (36.5 mm)	1.378 in (35 mm)

## Measure Commutator Insulation Depth

Measure the depth of the insulating material (**Figure 10-14, (1)**) between commutator segments (**Figure 10-14, (2)**). If the depth measures less than the limit, use a hacksaw blade (**Figure 10-14, (3)**) to remove the insulating material until the depth is within the limit.

A normal commutator condition is indicated in (**Figure 10-14, (4)**). An abnormal commutator condition is indicated in (**Figure 10-14, (5)**).



0000118

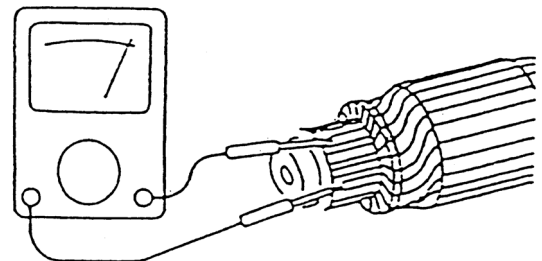
**Figure 10-14**

Standard	Limit
0.020 - 0.031 in (0.5 - 0.8 mm)	0.008 in (0.2 mm)

## Armature Coil Continuity Test

Check for continuity between the commutator segments using a multimeter. The multimeter should indicate continuity.


If the multimeter does not indicate continuity, replace the armature.





0000114

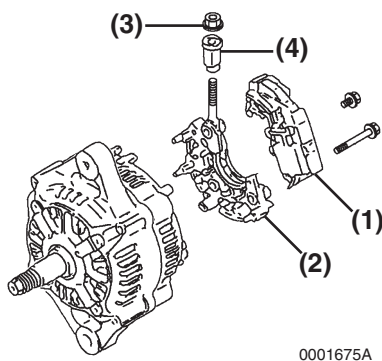
**Figure 10-15**

This section of the Service Manual describes the servicing of the alternator.

<b>⚠ WARNING</b>

<p style="text-align: center;"><b>SEVER HAZARD!</b></p> <ul style="list-style-type: none"> <li>• Stop the engine before you begin to service it.</li> <li>• NEVER leave the key in the key switch when you are servicing the engine. Someone may accidentally start the engine and not realize you are servicing it. This could result in a serious injury.</li> <li>• If you must service the engine while it is operating, remove all jewelry, tie back long hair, and keep your hands, other body parts and clothing away from moving / rotating parts.</li> <li>• Failure to comply could result in death or serious injury.</li> </ul> <p style="text-align: right; font-size: small;">0000010en</p>

<b>⚠ WARNING</b>

<p style="text-align: center;"><b>SHOCK HAZARD!</b></p> <ul style="list-style-type: none"> <li>• Turn off the battery switch (if equipped) or disconnect the negative battery cable before servicing the electrical system.</li> <li>• Check the electrical harnesses for cracks, abrasions, and damaged or corroded connectors. ALWAYS keep the connectors and terminals clean.</li> <li>• Failure to comply could result in death or serious injury.</li> </ul> <p style="text-align: right; font-size: small;">0000009en</p>

<b>⚠ WARNING</b>

<p style="text-align: center;"><b>BURN HAZARD!</b></p> <ul style="list-style-type: none"> <li>• Keep your hands, and other body parts, away from hot engine surfaces such as the muffler, exhaust pipe, turbocharger (if equipped) and engine block during operation and shortly after you shut the engine down. These surfaces are extremely hot while the engine is operating and could seriously burn you.</li> <li>• Failure to comply could result in death or serious injury.</li> </ul> <p style="text-align: right; font-size: small;">0000015en</p>



**Figure 11-5**

Note: Retain the bolts for reassembly.

## CAUTION

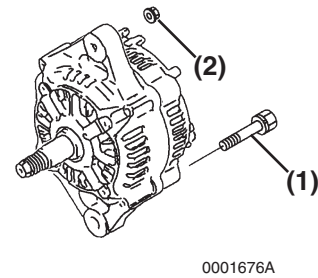
**If bolts of incorrect length are used for reassembly, the bolts may contact the rear frame which will cause loss of regulator control. An excessive amount of voltage could be applied to the battery, resulting in serious battery malfunction.**

5. Remove the bolts retaining the holder (**Figure 11-5, (2)**) to the rear frame housing. Remove the holder.
6. Remove the nuts (**Figure 11-5, (3)**) retaining the insulation bushing (**Figure 11-5, (4)**). Remove the insulation bushing.

## CAUTION

**Be careful not to stretch the stator wires when removing the bushing. Damage to the stator can result.**

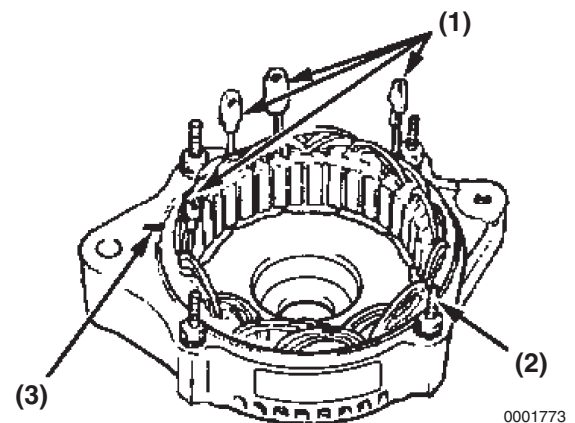
7. Remove the four bolts (**Figure 11-6, (1)**) and four nuts (**Figure 11-6, (2)**) securing the rear frame housing to the front frame housing.



**Figure 11-6**

8. Before disassembling the stator from the front frame housing, scratch a positioning line (**Figure 11-7, (3)**) on the housing in alignment with the lead wire (**Figure 11-7, (1)**) positioning. Make sure that the positioning line does not deviate more than  $\pm 0.02$  in ( $\pm 0.5$  mm).

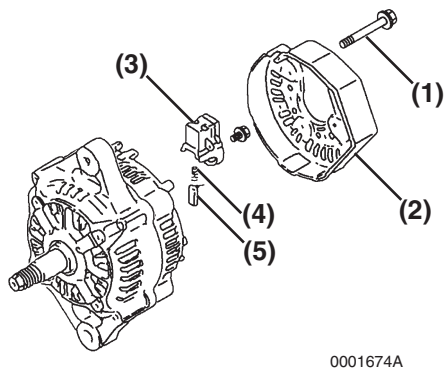
If installing a new stator, align the new stator with the old stator position mark (**Figure 11-7, (3)**). Make sure that the new and old stator positioning lines do not deviate more than  $\pm 0.02$  in ( $\pm 0.5$  mm).



**Figure 11-7**

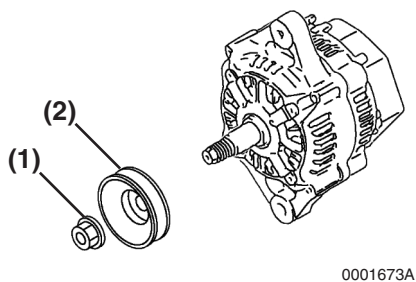
9. If replacing the front frame housing, scratch two positioning lines (**Figure 11-8, (1)**) on the stator before disassembly. Make sure that the positioning lines do not deviate more than  $\pm 0.04$  in ( $\pm 1$  mm). If positioning deviates, the stator lead wire cannot be connected to the rectifier.

7. Install the rear cover (**Figure 11-32, (2)**) to the rear frame housing with three bolts (**Figure 11-32, (1)**).



**Figure 11-32**

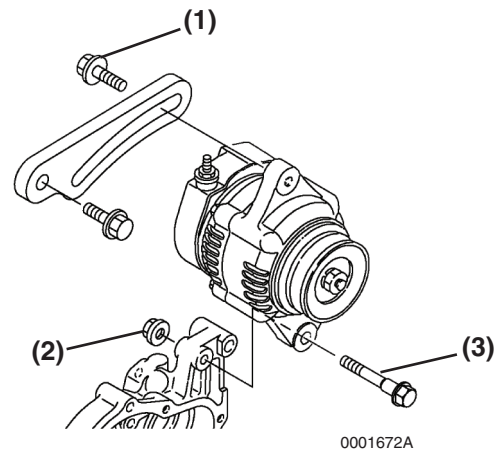
8. Assemble the pulley (**Figure 11-33, (2)**) and nut (**Figure 11-33, (1)**) to the shaft of the rotor assembly. Tighten the nut.



**Figure 11-33**

## Installation of Alternator

1. Position the alternator on the gearcase. Loosely install the nut (**Figure 11-34, (2)**) on the gearcase stud and the V-belt adjuster bolt (**Figure 11-34, (1)**).



**Figure 11-34**

2. Connect the electrical wires to the alternator. Tighten the nuts to 15 - 20 in lbs (1.7-2.3 N•m, 17-23 kgf•cm)
3. Install the V-belt. Tighten the V-belt to the proper tension. *See Check and Adjust Cooling Fan V-belt on page 5-22.*
4. Start the engine. Listen for any unusual sounds from the alternator.

### CAUTION

**Do not use a high pressure wash directly on the alternator. Water will damage the alternator and result in inadequate charging.**

0000049en

5. Verify that the charge indicator is ON while the engine is operating. If the charge indicator is not ON, repair the problem before operating the engine.

## CONVERSION OF AWG TO EUROPEAN STANDARDS

Conductor Size (AWG)	Conductor Diameter (mm)	Conductor Cross-sectional Area (mm <sup>2</sup> )
25	0.455	0.163
24	0.511	0.205
23	0.573	0.259
22	0.644	0.325
21	0.723	0.412
20	0.812	0.519
19	0.992	0.653
18	1.024	0.823
17	1.15	1.04
16	1.29	1.31
15	1.45	1.65
14	1.63	2.08
13	1.83	2.63
12	2.05	3.31
11	2.30	4.15
10	2.59	5.27
9	2.91	6.62
8	3.26	8.35
7	3.67	10.6
6	4.11	13.3
5	4.62	16.8
4	5.19	21.2
3	5.83	26.7
2	6.54	33.6
1	7.35	42.4
0 (1/0)	8.25	53.4
00 (2/0)	9.27	67.5
000(3/0)	10.40	85.0
0000 (4/0)	11.68	107.2
00000 (5/0)	13.12	135.1
000000 (6/0)	14.73	170.3
1.1 circular mil (CM) $\cong$ 0.0005067 mm <sup>2</sup>		

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