YANMAR

YANMAR CO.,LTD.

0BTNV-G00101
PRINTED IN JAPAN

SERVICE MANUAL

INDUSTRIAL ENGINES

YANMAR

SERVICE MANUAL

INDUSTRIAL ENGINES

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YANMAR LIMITED WARRANTY

What is Covered by this Warranty?

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

Note: Yanmar engines may be equipped with external components including, but not limited to: wiring harnesses, electrical devices, control panels, radiators, air filters, fuel filters, and/or exhaust systems that are supplied and/or installed by manufacturers other than Yanmar. For warranty information on such external components, please contact the machine or component manufacturer directly or see your authorized Yanmar dealer or distributor.

THIS WARRANTY IS PROVIDED IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED. YANMAR SPECIFICALLY DISCLAIMS ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, except where such disclaimer is prohibited by law. IF SUCH DISCLAIMER IS PROHIBITED BY LAW, THEN IMPLIED WARRANTIES SHALL BE LIMITED IN DURATION TO THE LIFE OF THE EXPRESS WARRANTY.

How Long is the Warranty Period?

The Yanmar standard limited warranty period runs for a period of **twenty-four (24) months or two-thousand (2000) engine operation hours**, whichever occurs first. An extended limited warranty of thirty-six (36) months or three thousand (3000) engine operating hours, whichever occurs first, is provided for these specific parts only: the cylinder block, cylinder head, crankshaft forging, connecting rods, flywheel, flywheel housing, camshaft, timing gear, and gear case. The Warranty Period for both the standard limited warranty and the extended limited warranty (by duration or operation hours) begins on the date of delivery to the original retail purchaser and is valid only until the applicable warranted duration has passed or the operation hours are exceeded, whichever comes 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. Acceptable forms of proof of delivery date include, but are not limited to: the original warranty registration or sales receipts or other documents maintained in the ordinary course of business by Yanmar dealers and / or distributors, indicating the date of delivery of the Yanmar product to the original retail purchaser. This information is necessary to establish whether the Yanmar product is still within the warranty period. Thus, Yanmar strongly recommends you register your engine as soon as possible after purchase in order to facilitate any future warranty matters.

You are responsible for the transportation of the engine to and from the repair location as designated by Yanmar.

DANGER

FIRE AND EXPLOSION HAZARD!

- Diesel fuel is flammable and explosive under certain conditions.
- If the unit has an electric fuel pump, when you prime the fuel system, turn the key switch to the ON position for 10 to 15 seconds to allow the electric fuel pump to prime the system.
- If the unit has a mechanical fuel pump, when you prime the fuel system, operate the fuel priming lever of the mechanical fuel pump several times until the fuel filter cup is filled with fuel.
- Failure to comply will result in death or serious injury.

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DANGER

FIRE AND EXPLOSION HAZARD!

- Diesel fuel is flammable and explosive under certain conditions.
- Only fill the fuel tank with diesel fuel. Filling the fuel tank with gasoline may result in a fire and will damage the engine.
- NEVER refuel with the engine running.
- Wipe up all spills immediately.
- Keep sparks, open flames or any other form of ignition (match, cigarette, static electric source) well away when refueling.
- NEVER overfill the fuel tank.
- Fill the fuel tank. Store any containers containing fuel in a well-ventilated area, away from any combustibles or sources of ignition.
- Failure to comply will result in death or serious injury.

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CAUTION

The illustrations and descriptions of optional equipment in this manual, such as the operator's console, are for a typical engine installation. Refer to the documentation supplied by the optional equipment manufacturer for specific operation and maintenance instructions.

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CAUTION

If any indicator illuminates during engine operation, stop the engine immediately. Determine the cause and repair the problem before you continue to operate the engine.

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CAUTION

- Only use the engine oil specified. Other engine oils may affect warranty coverage, cause internal engine components to seize and / or shorten engine life.
- Prevent dirt and debris from contaminating the engine oil. Carefully clean the oil cap / dipstick and the surrounding area before you remove the cap.
- NEVER mix different types of engine oil. This may adversely affect the lubricating properties of the engine oil.
- NEVER overfill. Overfilling may result in white exhaust smoke, engine overspeed or internal damage.

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CAUTION

- Only use the engine coolant specified. Other engine coolants may affect warranty coverage, cause an internal buildup of rust and scale and / or shorten engine life.
- Prevent dirt and debris from contaminating the engine coolant. Carefully clean the radiator cap and the surrounding area before you remove the cap.
- NEVER mix different types of engine coolants. This may adversely affect the properties of the engine coolant.

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CAUTION

- NEVER overfill the engine with engine oil.
- ALWAYS keep the oil level between the upper and lower lines on the oil cap / dipstick.

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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 five 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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Section 4

GENERAL SERVICE INFORMATION

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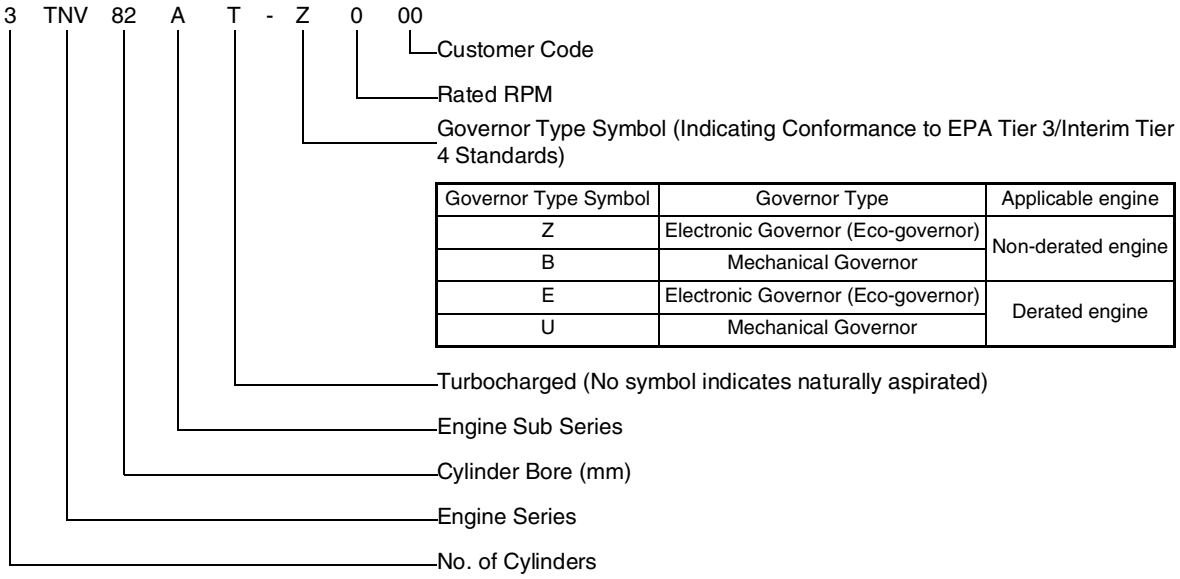
FUNCTION OF COOLING SYSTEM COMPONENTS

Components	Functions
Cooling System	The TNV engine is liquid-cooled by means of a cooling system. The cooling system consists of a radiator, radiator cap, engine cooling fan, engine coolant pump, thermostat, and reserve tank. ***Note that all cooling system components are required for proper engine operation. Since some of the components are application specific, they must be carefully selected by an application engineer. The application specific items are not part of the basic engine package as shipped from the Yanmar factory.***
Engine Cooling Fan	The engine cooling fan is driven by a V-belt which is powered by the crankshaft V-pulley. The purpose of the engine cooling fan is to circulate air through the radiator.
Engine Coolant Pump	The engine coolant pump circulates the engine coolant through the cylinder block and the cylinder head and returns the engine coolant to the radiator.
Radiator	The radiator acts as a heat exchanger. As the engine coolant circulates through the cylinder block it absorbs heat. The heat in the engine coolant is dissipated in the radiator. As the engine cooling fan circulates air through the radiator, the heat is transferred to the air.
Radiator Cap	The radiator cap controls the cooling system pressure. The cooling system is pressurized to raise the boiling point of the engine coolant. As the engine coolant temperature rises, the system pressure and the coolant volume increases. When the pressure reaches a preset value, the release valve in the radiator cap opens and the excess engine coolant flows into the reserve tank. As the engine coolant temperature is reduced, the system pressure and volume is reduced and the vacuum valve in the radiator cap opens allowing the engine coolant to flow from the reserve tank back into the radiator.
Reserve Tank	The reserve tank contains the overflow of engine coolant from the radiator. If you need to add engine coolant to the system, add it to the reserve tank; not the radiator.
Thermostat	A thermostat is placed in the cooling system to prevent the engine coolant from circulating into the radiator until the engine coolant temperature reaches a preset temperature. When the engine is cold, no engine coolant flows through the radiator. Once the engine reaches its operating temperature, the thermostat opens and allows the engine coolant to flow through the radiator. By letting the engine warm up as quickly as possible, the thermostat reduces engine wear, deposits and emissions.

SPECIFICATIONS

Description of Model Number



Governor Type Symbol	Governor Type	Applicable engine
Z	Electronic Governor (Eco-governor)	Non-derated engine
B	Mechanical Governor	
E	Electronic Governor (Eco-governor)	Derated engine
U	Mechanical Governor	

Engine Speed Specifications

Notation	Available Engine Speed	Intended Uses
VH	3200 - 3600 RPM (min^{-1})	Lawn Mower, Construction, Industrial Machine
VM	2000 - 3000 RPM (min^{-1})	Agricultural, Construction, Industrial Machines
CH	3000 or 3600 RPM (min^{-1})	2-pole Generator Sets, Irrigation Pumps
CL	1500 or 1800 RPM (min^{-1})	4-pole Generator Sets, Irrigation Pumps

VH: Variable High Speed
VM: Variable Medium Speed
CH: Constant High Speed
CL: Constant Low Speed

4TNV98 (~ EPA Tier2)

Engine Model	4TNV98						
Version	CL			VM			
Type	Vertical In-line Diesel Engine						
Combustion System	Direct Injection						
Aspiration	Natural						
No. of Cylinders	4						
Bore × Stroke	98 × 110mm						
Displacement	3.319L						
Continuous Rated Output	min^{-1}	1500	1800				
	kW	30.9	36.8				
	PS	42.0	50.0				
Max. Rated Output (Net)	min^{-1}	1500	1800	2000	2200	2400	2500
	kW	34.6	41.2	41.9	45.6	49.3	51.1
	PS	47.0	56.0	57.0	62.0	67.0	69.5
High Idling	min^{-1}	1600 ± 25	1895 ±25	2180 ± 25	2400 ± 25	2590 ± 25	2700 ± 25
Engine Weight (Dry) *with Flywheel Housing	248 kg			235 kg			
PTO Position	Flywheel End						
Direction of Rotation	Counterclockwise Viewed From Flywheel End						
Cooling System	Liquid-Cooled with Radiator						
Lubricating System	Forced Lubrication with Trochoid Pump						
Normal Oil Pressure at Rated Engine Speed	0.29 - 0.39 MPa						
Normal Oil Pressure at Low Idle Speed	0.06 MPa						
Starting System	Electric Starting (Starter Motor: DC12V (2.3 kW)) ***						
	Alternator: DC12V, 40A***						
	Recommended Battery Capacity: 12V, 64Ah*** (5h rating)						
Dimensions (L × W × H)*	719 × 498 × 742 mm						
Engine Oil Pan Capacity**	10.5/6.0L (Dipstick Upper Limit / Lower Limit)						
Engine Coolant Capacity	4.2L Engine Only						
Standard Cooling Fan	410mm O.D., 6 Blade Pusher-Type ***						
Crank V-pulley dia./ Fan V-pulley dia.	ϕ130/ ϕ130mm ***						

* *Engine specifications without radiator.*

** *Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.*

*** *May vary depending on application.*

4TNV88-B (complies with EPA Interim Tier4)

Engine Model		4TNV88-B												
Version		CL	VM											
Type		Vertical, 4-cycle water-cooled diesel engine												
Combustion System		Direct Injection												
Aspiration		Natural aspiration												
No. of Cylinders		4												
Bore × Stroke		ϕ88 × 90mm												
Displacement		2.190L												
Continuous Rated Output	min^{-1}	1500	1800											
	kW	16.4	19.6											
	PS	22.3	26.7											
Max. Rated Output (Net)	min^{-1}	1500	1800	2000	2100	2200	2300	2400	2500	2600	2700	2800		3000
	kW	18.0	21.6	24.1	25.3	26.5	27.7	28.8	30.1	31.3	32.5	33.7		35.4
	PS	24.5	29.4	32.7	34.4	36.0	37.6	39.2	40.9	42.5	44.2	45.8		48.1
High Idling	min^{-1}	1600 ±25	1895 ±25	2180 ±25	2290 ±25	2400 ±25	2510 ±25	2590 ±25	2700 ±25	2810 ±25	2920 ±25	2995 ±25		3210 ±25
Engine Weight (dry) *with Flywheel Housing		183kg	170kg											
PTO Position		Flywheel End												
Direction of Rotation		Counterclockwise Viewed From Flywheel End												
Governor		Mechanical governor (All-speed governor)												
Cooling System		Liquid-Cooled with Radiator												
Lubricating System		Forced Lubrication with Trochoid Pump												
Normal Oil Pressure	Rated Engine Speed	0.29-0.44 (3.0-4.5) MPa	0.32-0.47 (3.3-4.8) MPa											
	Low Idle Speed	≥ 0.06 (≥ 0.6) MPa												
Starting System		Electric Starting (Starter Motor: DC12V (1.7kW)) ***												
Charging system		Alternator (DC12V/40A) ***												
Recommended Battery Capacity		12V-64Ah*** (5h rating)												
Starting aid device		Super-quick Heating Glow plug												
Dimensions (L × W × H)*		684 × 523 × 617	659 × 523 × 617											
Engine Oil Pan Capacity**		7.4L/4.0L (Dipstick Upper Limit / Lower Limit)												
Engine Coolant Capacity		2.7L Engine Only												
Standard Cooling Fan		Resin F type pusher fan - ϕ370(EF) x 6												
Crank V-pulley dia./ Fan V-pulley dia.		ϕ120/ ϕ90	ϕ110/ ϕ110											

* *Engine specifications without radiator.*

** *Engine oil capacity for a "Deep Standard" oil pan. Refer to the operation manual provided by the driven machine manufacturer for the actual engine oil capacity of your machine.*

*** *May vary depending on application.*

Section 5

PERIODIC MAINTENANCE

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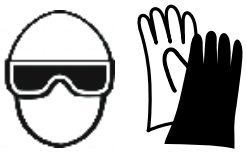
⚠ CAUTION



COOLANT HAZARD!

- Wear eye protection and rubber gloves when you handle long life or extended life engine coolant. If contact with the eyes or skin should occur, flush eyes and wash immediately with clean water.
- Failure to comply may result in minor or moderate injury.

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⚠ CAUTION

FLYING OBJECT HAZARD!

- ALWAYS wear eye protection when servicing the engine and when using compressed air or high-pressure water. Dust, flying debris, compressed air, pressurized water or steam may injure your eyes.
- Failure to comply may result in minor or moderate 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 the primary strainer (if equipped) from the fuel tank filler port. If removed, dirt and debris could get into the fuel system causing it to clog.

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CAUTION

- Only use the engine oil specified. Other engine oils may affect warranty coverage, cause internal engine components to seize and / or shorten engine life.
- Prevent dirt and debris from contaminating the engine oil. Carefully clean the oil cap / dipstick and the surrounding area before you remove the cap.
- NEVER mix different types of engine oil. This may adversely affect the lubricating properties of the engine oil.
- NEVER overfill. Overfilling may result in white exhaust smoke, engine overspeed or internal damage.

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The engine oil in a new engine becomes contaminated from the initial break-in of internal parts. It is very important that the initial oil and filter change is performed as scheduled.

Note: The oil drain plug may be in another location if an optional oil pan is used.

Drain the engine oil as follows:

1. Make sure the engine is level.
2. Start the engine and bring it up to operating temperature.
3. Stop the engine.
4. Remove one of the oil filler caps **(Figure 5-1, (1))** to vent the engine crankcase and allow the engine oil to drain more easily.
5. Position a container under the engine to collect waste oil.

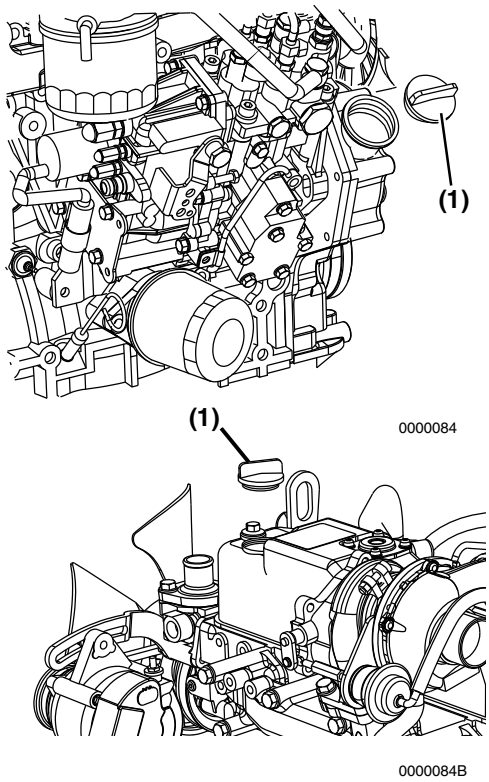

Figure 5-1

6. Remove the oil drain plug **(Figure 5-2, (1))** from the engine oil pan. Allow oil to drain.
7. After all oil has been drained from the engine, reinstall the oil drain plug **(Figure 5-2, (1))** and tighten to 139.8 - 47.0 ft·lb (53.9 - 63.7 N·m; 5.5 - 6.5 kgf·m).
8. Dispose of used oil properly.

Remove the engine oil filter as follows:

1. Turn the engine oil filter **(Figure 5-2, (2))** counterclockwise **(Figure 5-2, (3))** using a filter wrench.

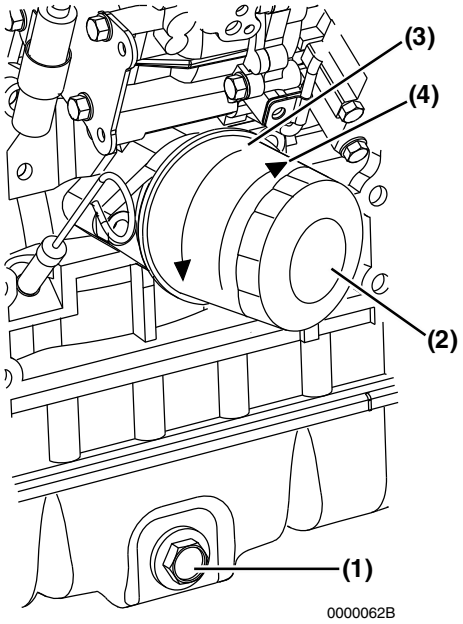

Figure 5-2

2. Clean the engine oil filter mounting face.
3. Lightly coat the gasket on the new oil filter with engine oil. Install the new engine oil filter manually by turning it clockwise **(Figure 5-2, (4))** until it contacts the mounting surface. Tighten to 14 - 17 ft·lb (19.6 - 23.5 N·m; 2.0 - 2.4 kgf·m) or one additional turn using the filter wrench.

Clean Air Cleaner Element

Note that a typical air cleaner is shown in **Figure 5-12** and **Figure 5-13** for illustrative purposes only.

The engine performance is adversely affected when the air cleaner element is clogged with dust. Be sure to clean the air filter element periodically.

1. Unlatch and remove the air cleaner cover **(Figure 5-12, (1))**.

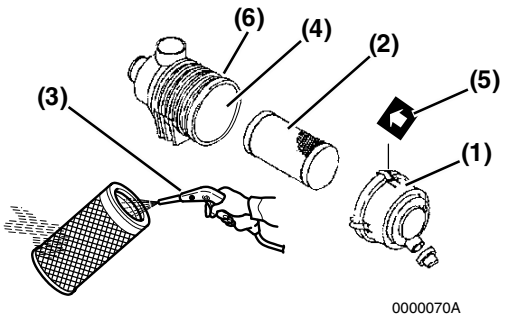

Figure 5-12

2. Remove the element **(Figure 5-12, (2))** (outer element if equipped with two elements).

⚠ CAUTION

FLYING OBJECT HAZARD!

- **ALWAYS wear eye protection when servicing the engine and when using compressed air or high-pressure water. Dust, flying debris, compressed air, pressurized water or steam may injure your eyes.**
- **Failure to comply may result in minor or moderate injury.**

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3. Blow air **(Figure 5-12, (3))** through the element from the inside out using 42 - 71 psi (0.29 - 0.49 MPa; 3.0 - 5.0 kgf/cm^2) compressed air to remove the particulates. Use the lowest possible air pressure to remove the dust without damaging the element.
4. If the air cleaner is equipped with a double element, only remove and replace the inner element **(Figure 5-13, (1))** *if the engine lacks power or the dust indicator actuates (if equipped)*.

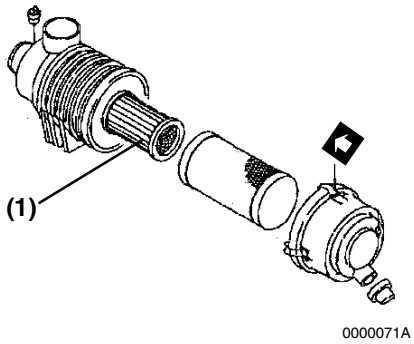


Figure 5-13

5. The inner element should not be removed when cleaning or replacing the outer element. The inner element is used to prevent dust from entering the engine while servicing the outer element.

The non-turbo TNV engines use a crankcase breather system that has a spring-backed diaphragm **(Figure 5-20, (1))** in the valve cover **(Figure 5-20, (2))**. When the crankcase pressure reaches a predetermined value, the diaphragm opens a passage that allows crankcase fumes to be routed to the intake manifold.

To inspect the diaphragm and spring **(Figure 5-20, (3))**:

1. Remove the bolts retaining the diaphragm cover **(Figure 5-20, (4))**.

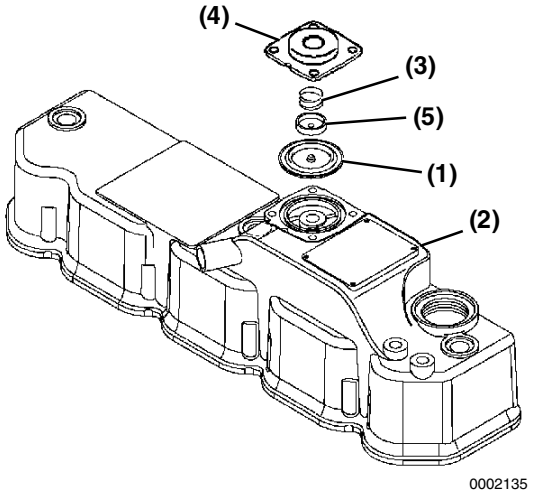


Figure 5-20

2. Remove the diaphragm cover, spring, diaphragm plate **(Figure 5-20, (5))** and diaphragm.
3. Inspect the diaphragm for tears. Inspect the spring for distortion. Replace components if necessary.
4. Reinstall the diaphragm, diaphragm plate, spring and diaphragm cover. Tighten the diaphragm bolts to specified torque.

Failure of the diaphragm and / or spring will cause the loss of pressure control and allow an excessive amount of crankcase fumes to be routed to the intake manifold. This could result in excessive deposits in the intake system, high engine exhaust smoke levels, excessive engine oil consumption, and / or engine run-on due to the burning of the engine oil.

Inspection Item		Standard	Limit	Reference Page
Valve Stem Seal Projection From Cylinder Head				*See Reassembly of Intake and Exhaust Valves on page 6-45.*
2 Valves	3TNV82A	0.618 - 0.629 in. (15.7 - 16.0 mm)	-	
	4TNV84	0.736 - 0.748 in. (18.7 - 19.0 mm)	-	
	3TNV84 (T)		-	
	4TNV88		-	
4 Valves	4TNV84T	0.389 - 0.401 in. (9.9 - 10.2 mm)	-	
	4TNV94L	0.460 - 0.472 in. (11.7 - 12.0 mm)	-	
	4TNV98 (T)		-	
	4TNV106 (T)	0.606 - 0.614 in. (15.4 - 15.6 mm)	-	

Push Rod

Inspection Item	Standard	Limit	Reference Page
Push Rod Bend - All Models	Less than 0.0012 in. (0.03 mm)	0.0012 in. (0.03 mm)	*See Push Rod Bend on page 6-41 and 6-56.*

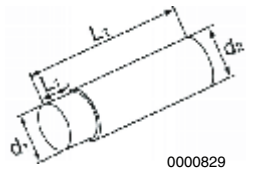
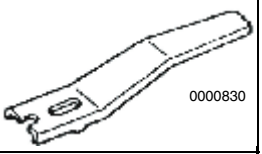
Rocker Arm and Shaft

Model	Inspection Item	Standard	Limit	Reference Page
3TNV82A, 3TNV84, 3TNV84T, 3TNV88, 4TNV84, 4TNV84T, 4TNV88	Arm Shaft Hole Diameter	0.6299 - 0.6307 in. (16.000 - 16.020 mm)	0.6327 in. (16.07 mm)	*See Inspection of Rocker Arm Assembly on page 6-41 and 6-56.*
	Shaft Outside Diameter	0.6286 - 0.6293 in. (15.966 - 15.984 mm)	0.6276 in. (15.94 mm)	
	Oil Clearance	0.0006 - 0.0021 in. (0.016 - 0.054 mm)	0.0051 in. (0.13 mm)	
4TNV94L, 4TNV98, 4TNV98T, 4TNV106, 4TNV106T	Arm Shaft Hole Diameter	0.7283 - 0.7291 in. (18.500 - 18.520 mm)	0.7311 in. (18.57 mm)	
	Shaft Outside Diameter	0.7272 - 0.7280 in. (18.470 - 18.490 mm)	0.7260 in. (18.44 mm)	
	Oil Clearance	0.0004 - 0.0020 in. (0.010 - 0.050 mm)	0.0051 in. (0.13 mm)	

(Piston Ring Cont.)

Model	Inspection Item		Standard	Limit	Reference Page
3TNV88, 4TNV88	Top Ring	Ring Groove Width	0.0811 - 0.0817 in. (2.060 - 2.075 mm)	-	*See Inspection of Pistons, Piston Rings and Wrist Pin on page 6-83.*
		Ring Width	0.0776 - 0.0783 in. (1.970 - 1.990 mm)	0.0768 in. (1.950 mm)	
		Side Clearance	0.0028 - 0.0041 in. (0.070 - 0.105 mm)	-	
		End Gap	0.0079 - 0.157 in. (0.200 -.0400 mm)	0.0193 in. (0.490 mm)	
	Second Ring	Ring Groove Width	0.0797 - 0.0803 in. (2.025 - 2.040 mm)	0.0843 in. (2.140 mm)	
		Ring Width	0.0776 -- 0.0783 in. (1.970 - 1.990 mm)	0.0768 in. (1.950 mm)	
		Side Clearance	0.0014 - 0.0028 in. (0.035 - 0.070 mm)	0.0075 in. (0.190 mm)	
		End Gap	0.0079 - 0.0157 in. (0.200 - 0.400 mm)	0.0193 in. (0.490 mm)	
	Oil Ring	Ring Groove Width	0.1581 - 0.1587 in. (4.015 - 4.030 mm)	0.1626 in. (4.130 mm)	
		Ring Width	0.1563 -.1571 in. (3.970 - 3.990 mm)	0.1555 in. (3.950 mm)	
		Side Clearance	0.0010 - 0.0024 in. (0.025 - 0.060 mm)	0.0071 in. (0.180 mm)	
		End Gap	0.0079 - 0.0157 in. (0.200 - 0.400 mm)	0.0193 in. (0.490 mm)	

(Special Service Tools Cont.)

<table>
<tr><th>No.</th><th>Tool Name</th><th>Applicable Model and Tool Size</th><th>Illustration</th></tr>
<tr><td>4</td><td>Connecting Rod Bushing Replacer (For Removal/ Installation of Connecting Rod Bushing)</td><td>
<table>
<tr><th>Model</th><th>L1</th><th>L2</th><th>d1</th><th>d2</th></tr>
<tr><td>3TNV82A</td><td>0.984 in. (25 mm)</td><td>3.346 in. (85 mm)</td><td>0.906 in. (23 mm)</td><td>1.024 in. (26 mm)</td></tr>
<tr><td>3TNV84, 3TNV84T, 3TNV88, 4TNV84, 4TNV84T, 4TNV88,</td><td>0.787 in. (20 mm)</td><td>3.937 in. (100 mm)</td><td>1.024 in. (26 mm)</td><td>1.142 in. (29 mm)</td></tr>
<tr><td>4TNV94L, 4TNV98, 4TNV98T</td><td>0.787 in. (20 mm)</td><td>3.937 in. (100 mm)</td><td>1.181 in. (30 mm)</td><td>1.299 in. (33 mm)</td></tr>
<tr><td>4TNV106, 4TNV106T</td><td>0.787 in. (20 mm)</td><td>3.937 in. (100 mm)</td><td>1.457 in. (37 mm)</td><td>1.575 in. (40 mm)</td></tr>
<tr><td colspan="5">Locally Manufactured</td></tr>
</table>
</td><td> 
0000829</td></tr>
<tr><td>5</td><td>Valve Spring Compressor (For Removal/ Installation of Valve Spring)</td><td>Yanmar Part No.
129100-92630</td><td> 
0000830</td></tr>
<tr><td>6</td><td>Stem Seal Installer (for Installing Valve Stem Seal)</td><td>
<table>
<tr><th>Model</th><th>d1</th><th>d2</th><th>d3</th><th>L1</th><th>L2</th><th>L3</th></tr>
<tr><td>3TNV82A</td><td>0.598 in. (15.2 mm)</td><td>0.827 in. (21 mm)</td><td>0.472 in. (12 mm)</td><td>0.622 in. (15.8 mm)</td><td>2.559 in. (65 mm)</td><td>0.157 in. (4 mm)</td></tr>
<tr><td>3TNV84, 3TNV84T, 3TNV88, 4TNV84, 4TNV88</td><td>0.638 in. (16.2 mm)</td><td>0.866 in. (22 mm)</td><td>0.531 in. (13.5 mm)</td><td>0.740 in. (18.8 mm)</td><td>2.559 in. (65 mm)</td><td>0.157 in. (4 mm)</td></tr>
<tr><td>4TNV84T</td><td>0.508 in. (12.9 mm)</td><td>0.748 in. (19 mm)</td><td>0.453 in. (11.5 mm)</td><td>0.394 in. (10 mm)</td><td>2.559 in. (65 mm)</td><td>0.157 in. (4 mm)</td></tr>
<tr><td>4TNV94L, 4TNV98, 4TNV98T</td><td>0.598 in. (15.2 mm)</td><td>0.827 in. (21 mm)</td><td>0.472 in. (12 mm)</td><td>0.465 in. (11.8 mm)</td><td>2.559 in. (65 mm)</td><td>0.157 in. (4 mm)</td></tr>
<tr><td>4TNV106, 4TNV106T</td><td>0.598 in. (15.2 mm)</td><td>0.827 in. (21 mm)</td><td>0.472 in. (12 mm)</td><td>0.610 in. (15.5 mm)</td><td>2.559 in. (65 mm)</td><td>0.157 in. (4 mm)</td></tr>
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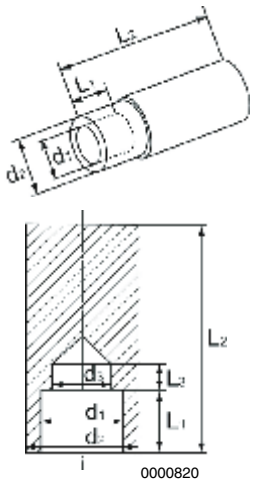
</td><td> 
0000820</td></tr>
</table>

2. Remove the cylinder head bolts **(Figure 6-11, (1))**.
3. Lift the cylinder head away from the cylinder block. Discard the cylinder head gasket **(Figure 6-11, (2))**. Position the cylinder head on the work bench to prevent damage to the combustion surface.

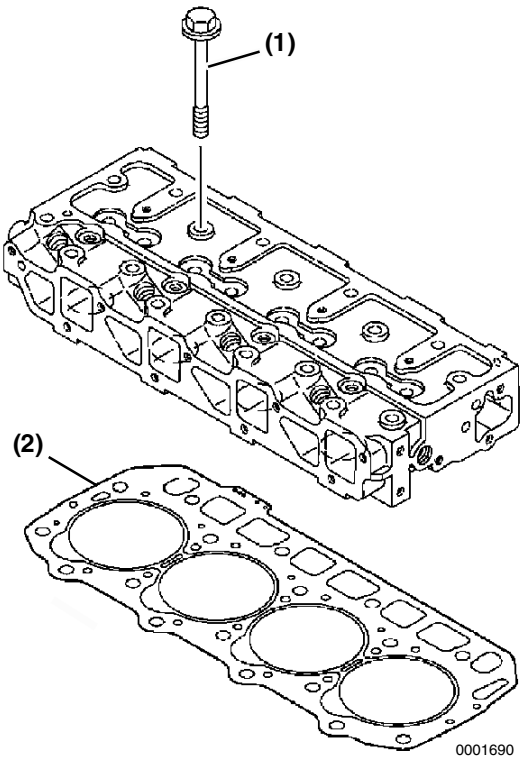


Figure 6-11

Removal of Intake / Exhaust Valves

1. Place the cylinder head on the work bench with the combustion side down.
2. Remove the valve cap **(Figure 6-13, (1))** and keep with the valve it was installed on.
3. Using the valve spring compressor tool, compress one of the valve springs **(Figure 6-12)**.

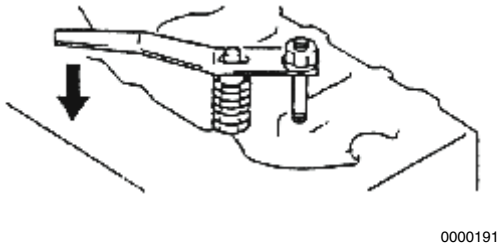


Figure 6-12

4. Remove the valve keepers **(Figure 6-13, (2))**.
5. Slowly release the tension on the valve spring.
6. Remove the spring retainer **(Figure 6-13, (3))** and valve spring **(Figure 6-13, (4))**.

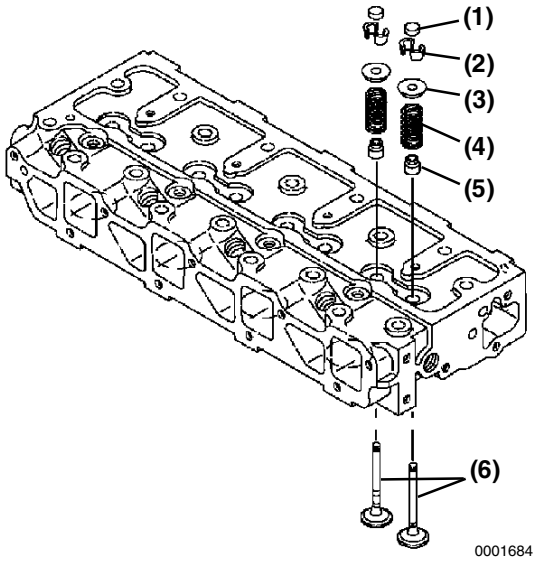


Figure 6-13

7. Repeat the procedure with all remaining valves.

4-VALVE CYLINDER HEAD

4-Valve Cylinder Head Components

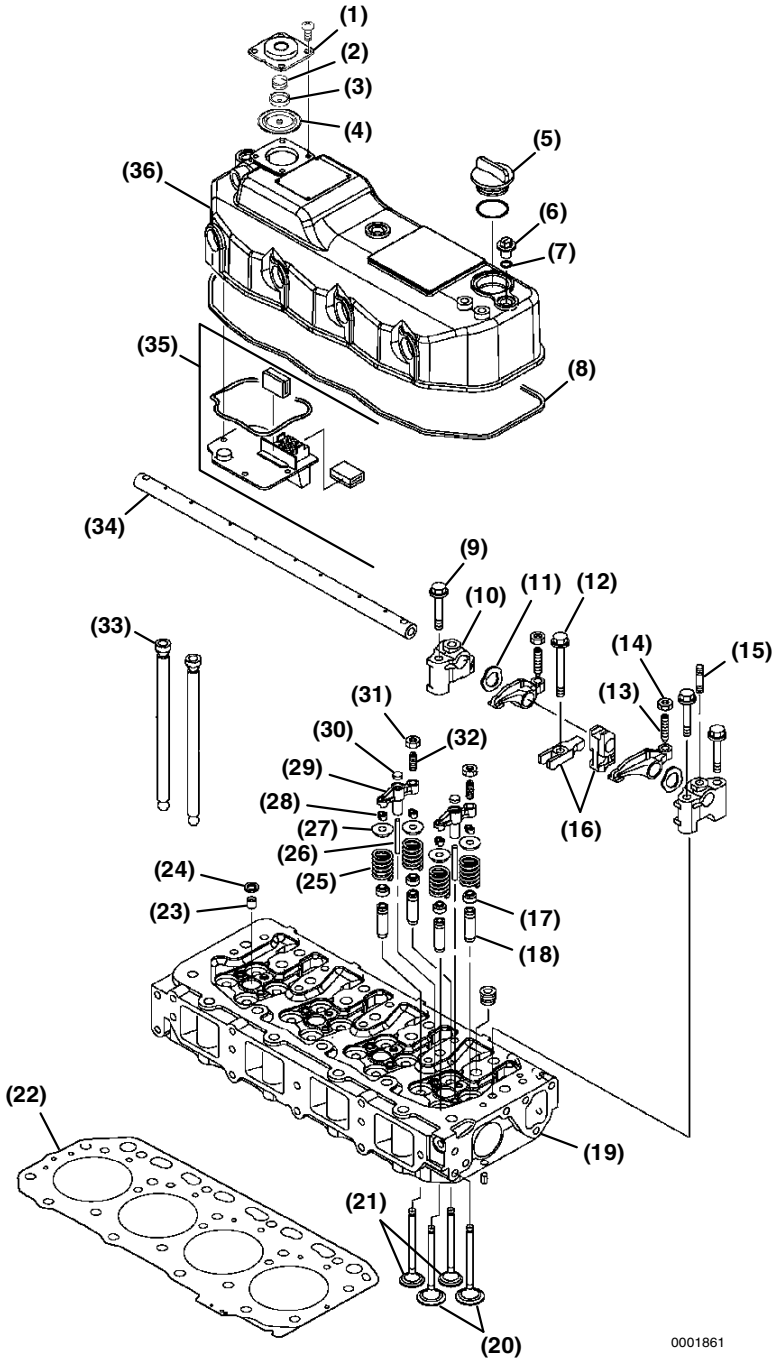


Figure 6-39

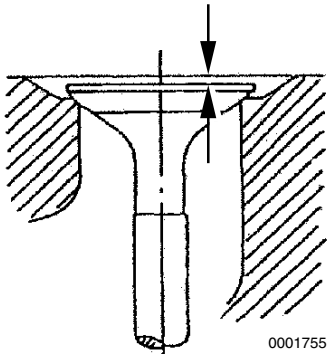


Figure 6-59

Valve Face and Valve Seat

Always check the clearance between the valve and valve guide before grinding or lapping the valve seats. *See Intake / Exhaust Valve and Guide on page 6-7 for the service limit.* If the clearance exceeds the limit, replace the valve and/or valve guide to bring the clearance within the limit.

Roughness or burrs will cause poor seating of a valve. Visually inspect the seating surfaces of each valve and valve seat to determine if lapping or grinding is needed.

Visually inspect all valves faces and valve seats for pitting, distortion, cracking, or evidence of overheating. Usually the valves and valve seats can be lapped or ground to return them to serviceable condition. Severely worn or damaged components will require replacement.

Coat the valve seat with a thin coat of bluing compound. Install the valve and rotate to distribute bluing onto the valve face. The contact pattern should be approximately centered on the valve face **(Figure 6-60, (1))** and even in width.

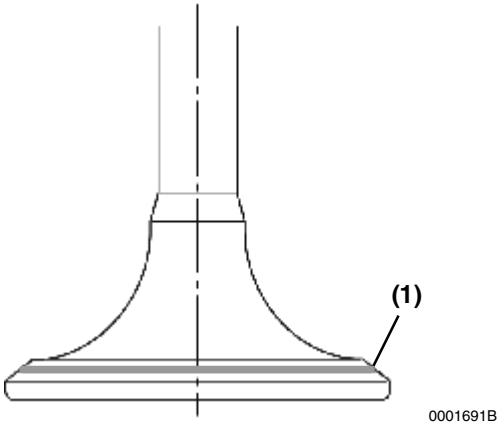


Figure 6-60

Also visually inspect the valve seat for even contact.

Light cutting can be performed by the use of a hand-operated cutter **(Figure 6-61)**.

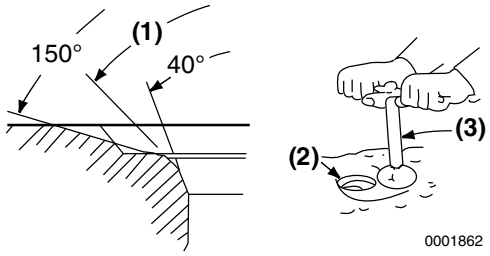


Figure 6-61

Valve seat diameter can be adjusted by top-grinding with a 150° stone to make the seat diameter smaller, and bottom-grinding using a 40° stone to make the seat diameter larger. Once the seat location has been corrected, grind and lap the seat angle **(Figure 6-61, (1))** to specification. *See Cylinder Head on page 6-6 for specifications.*

7. Tighten the lock nut **(Figure 6-83, (1))**, while holding the valve bridge **(Figure 6-83, (3))** with a wrench **(Figure 6-83, (2))**. Verify that the valve clearance **(Figure 6-84, (2)** is zero "0".

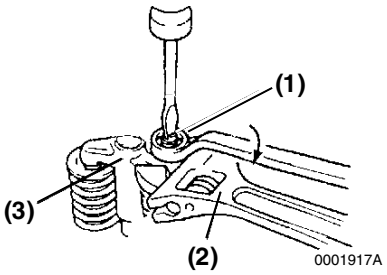


Figure 6-83

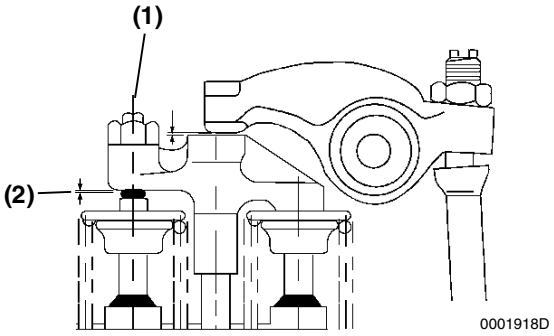


Figure 6-84

Note: There is a tendency for the clearance to decrease slightly when the lock nut is tightened. It is suggested that you make the initial clearance adjustment is made slightly on the "loose" side before tightening the lock nut.

8. To adjust the actual valve clearance between the rocker arm and the valve bridge, insert a feeler gauge **(Figure 6-85, (1))** of the correct thickness *(See Adjustment Specifications on page 6-6)* between the rocker arm **(Figure 6-85, (2))** and valve bridge **(Figure 6-85, (3))**. Record the results and use this value as an indication of wear.

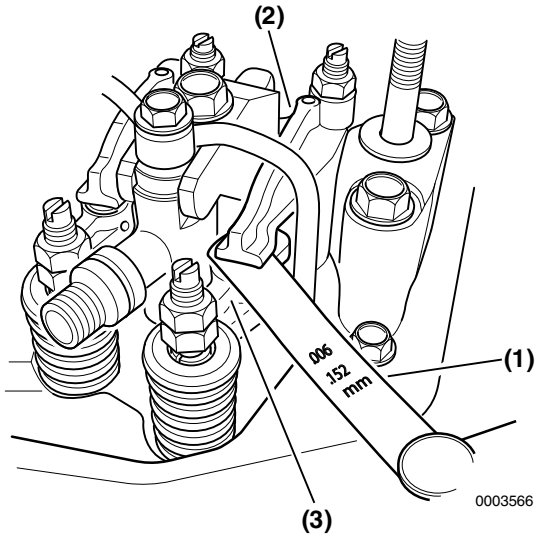


Figure 6-85

9. If adjustment is required, proceed to the next step.
10. Loosen the valve adjusting screw lock nut **(Figure 6-86, (5))** and valve adjusting screw **(Figure 6-86, (4))** on the rocker arm **(Figure 6-86, (3))** and check the clearance gap **(Figure 6-86, (2))** for evidence of dirt or wear.

Note: There is a tendency for the clearance to decrease slightly when the lock nut is tightened. It is suggested that you make the clearance adjustment is made slightly on the "loose" side before tightening the lock nut.

11. Adjust the valve clearance **(Figure 6-86, (2))** by turning the adjusting screw **(Figure 6-86, (4))** until there is a slight "drag" on the feeler gauge when sliding it between the rocker arm and the valve bridge.

IMPORTANT

Mark the connecting rod caps and connecting rods so the caps and connecting rods stay together.

(a) Remove the bearing cap. Do not remove the bearing inserts at this time.

(b) Wipe oil from the bearing insert and crankshaft journal surfaces.

(c) Place a piece of PLASTIGAGE® **(Figure 6-101, (1))** along the full width of the bearing insert.

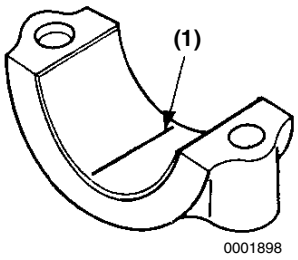


Figure 6-101

IMPORTANT

Do not rotate the crankshaft when using PLASTIGAGE. A false reading may result.

(d) Reinstall bearing cap and tighten to specification. *See Special Torque Chart on page 6-25.*

(e) Remove bearing cap.

(f) Compare the width of the flattened PLASTIGAGE to the graduation marks on the package **(Figure 6-102, (1))**. The mark that most closely matches the width of the flattened PLASTIGAGE will indicate the bearing oil clearance.

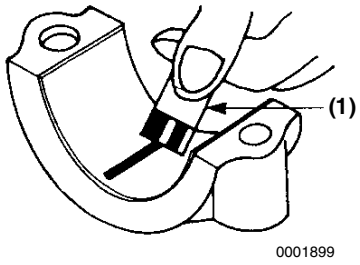


Figure 6-102

(g) Repeat with remaining connecting rods.

IMPORTANT

Do not allow the connecting rod to contact the crankshaft journal during piston removal. Damage to the bearing journal may result.

3. Use a wooden dowel against the connecting rod and tap the piston / connecting rod assembly out of the cylinder.
4. Mark the cylinder number on the piston and connecting rod.
5. Remove the bearing inserts **(Figure 6-103, (2))**.
6. Remove the compression rings **(Figure 6-103, (3))** from the piston using a piston ring expander.
7. Remove the oil ring **(Figure 6-103, (4))** from the piston using a piston ring expander.

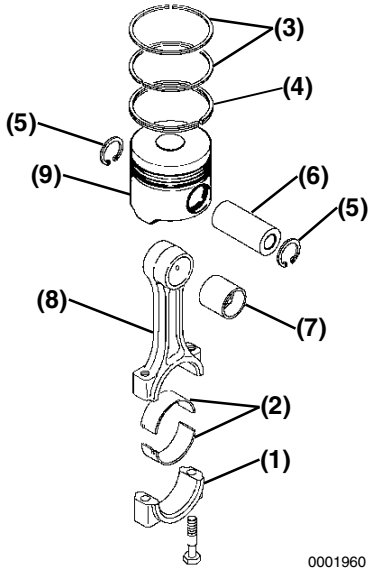


Figure 6-103

8. Remove the circlips **(Figure 6-103, (5))** from the wrist pin.
9. Remove the wrist pin **(Figure 6-103, (6))** and connecting rod **(Figure 6-103, (8))** from the piston **(Figure 6-103, (9))**.
10. Repeat the steps until all pistons are removed and dissembled.

- When honing is completed, wash the cylinder block with hot water and soap. The cylinder wall is adequately cleaned when a white rag wiped in cylinder comes out clean. Use brushes to clean all passages and crevices. Rinse with hot water and dry with compressed air. Apply clean engine oil to all steel surfaces to prevent rusting.

Reassembly of Crankshaft and Piston Components

Notes:

- Proceed slowly. Make no forced assemblies unless a pressing operation is called for. All parts must be perfectly clean and lightly lubricated when assembled.
- Use new gaskets, seals and O-rings during assembly.
- Liberally apply clean engine oil to all internal parts during assembly.
- All fasteners should be tightened to a given torque. If a special torque is not provided in the *Special Torque Chart on page 6-25*, tighten to standard torque specifications. *See Tightening Torques for Standard Bolts and Nuts on page 4-46.*

Reassembly of Pistons

1. Select the parts needed to reassemble the piston and connecting rod for one cylinder.
2. If removed, install a new wrist pin bushing **(Figure 6-130, (7))** using a press and the appropriate service tool. Be sure to align the oil holes.

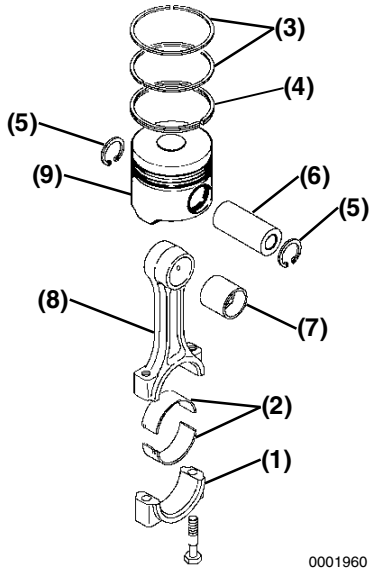


Figure 6-130

3. Reinstall one circlip **(Figure 6-130, (5))** into the piston. Ensure the circlip is securely seated in the groove.

IMPORTANT

*The piston and connecting rod must be assembled together in the correct orientation. The orientation of the piston and connecting rod are **different** depending on engine model.*

Piston to Connecting Rod Orientation - By Model	
All TNV models - 82, 84(T), 88, 94, and 98(T)	Only TNV models - 106(T)
Orient the piston identification mark stamped on top of the piston on the same side as the rod and cap match marks stamped on the connecting rod.	Orient the piston identification mark stamped on top of the piston on the opposite side as the rod and cap match marks stamped on the connecting rod.

Final Reassembly of Engine

1. Reinstall the starter motor.
2. Reinstall the cylinder head. *See Reassembly of Cylinder Head on page 6-46 for the 2-valve cylinder head or 6-62 for the 4-valve cylinder head.*
3. Reinstall the engine in the machine.
4. Reconnect the fuel and coolant lines.
5. Reinstall the alternator.
6. Reconnect and adjust the throttle cable.
7. Reconnect all electrical connections.
8. Fill the engine with oil and coolant.
9. Reconnect the battery cables, negative (-) cable last.

Section 7

FUEL SYSTEM

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FUEL SYSTEM SPECIFICATIONS

Special Torque Chart

Component		Tightening Torque	Lubricating Oil Application (Thread Portion and Seat Surface)
Fuel Injector Retainer Bolt		29 ft·lb (39.2 N·m; 4 kgf·m)	Not Applied
Fuel Pump Drive Gear Nut	3TNV82A to 4TNV88	58 - 65 ft·lb (78 - 88 N·m; 8 - 9 kgf·m)	Not Applied
	4TNV94 to 4TNV106T	83 - 91 ft·lb (113 - 123 N·m; 11.5 - 12.5 kgf·m)	Not Applied
High-Pressure Fuel Injection Line Nuts		22 - 25 ft·lb (29 - 34 N·m; 3.0 - 3.5 kgf·m)	Not Applied
Fuel Return Line Bolts		69 - 87 in·lb (7.8 - 9.8 N·m; 0.8 - 1.0 kgf·m)	Not Applied
Fuel Injection Pump Mounting Nuts		17 - 21 ft·lb (23 - 28 N·m; 2.3 - 2.9 kgf·m)	Not Applied
Fuel Injector Nozzle Case Nut		30 - 33 ft·lb (39.2 - 44.1 N·m; 4 - 4.5 kgf·m)	Not Applied
Fuel Injection Pump Plunger Plug	3TNV82A to 4TNV88	22 - 26 ft·lb (30 - 35 N·m; 3.1 - 3.6 kgf·m)	Not Applied
	4TNV94 to 4TNV106T	30 - 33 ft·lb (40 - 45 N·m; 4.1 - 4.6 kgf·m)	Not Applied

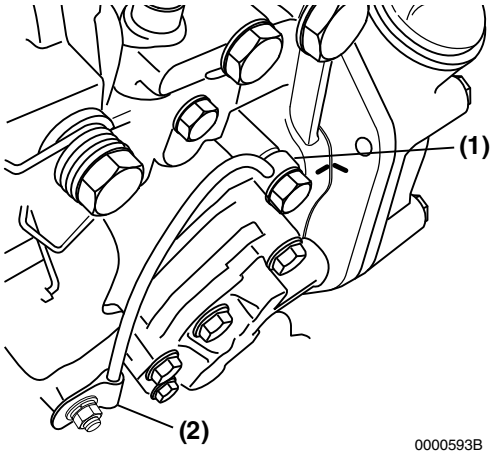


Figure 7-12

15. Remove the fuel injection pump drive gear cover **(Figure 7-13, (1))** from the gear case cover **(Figure 7-13, (2))**.

Note: The fuel injection pump drive gear cover is secured with an adhesive sealant. Use a gasket scraper to separate the fuel injection pump cover from the gear case cover.

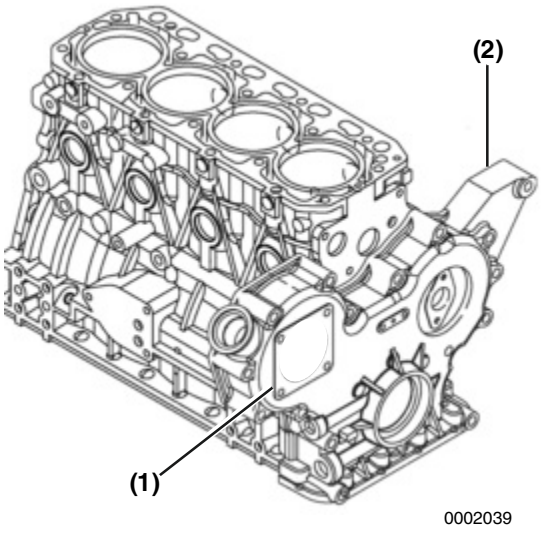


Figure 7-13

Note: TNV82-88 shown.

16. To position the fuel injection pump for easier removal and installation, install a dial indicator *(see Checking and Adjusting Fuel Injection Timing on page 7-30)* into the injection pump plunger opening. Using a wrench on the crankshaft pulley bolt, rotate the crankshaft until the dial indicator shows that injection pump plunger is at the bottom of it's stroke.
17. To aid in reassembly, make reference marks on the fuel injection pump drive gear, and on either the gear case cover or idler gear.

CAUTION

After marking the position of the pump drive gear, do not rotate the engine crankshaft. Rotating the crankshaft will cause the fuel injection pump to become misaligned.

0000048en

- On TNV82-88 model engines, the idler gear is not visible. Make a reference mark on the fuel injection pump drive gear **(Figure 7-14, (1))** and a matching mark on the bore of the gear case opening **(Figure 7-14, (2))**.

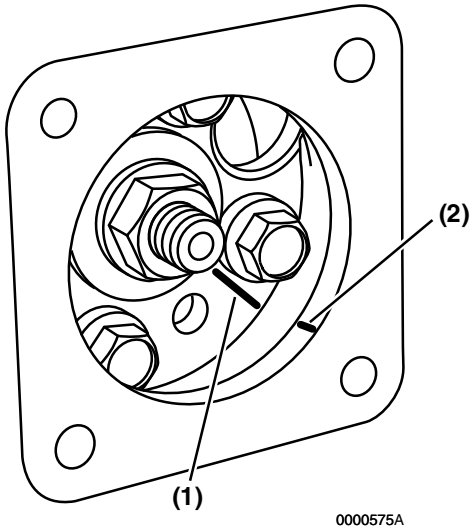


Figure 7-14

Checking Fuel Injection Timing

Note: Some fuel may drain from the fuel injection pump during this process. Make provisions to contain any such spillage.

1. Turn off the fuel valve in the fuel supply hose and the fuel return hose.
2. Clamp shut the fuel injection pump fuel return hose leading to fuel filter **(Figure 7-39, (1))**.

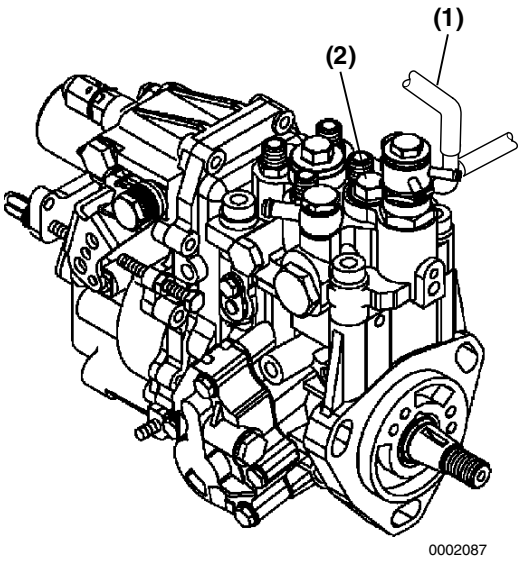


Figure 7-39

IMPORTANT

Clean the top of the fuel injection pump to prevent any contamination when the fuel injection pump plunger plug is removed.

3. Remove the forward fuel injection pump plunger plug **(Figure 7-39, (2))** on the top of the fuel injection pump.
4. Install a dial indicator adapter and clamp into the pump plunger opening.

Note: Use the Yanmar part no. 158090-51831 M14 adapter for the MP2 fuel injection pumps (TNV82 - 88 model engines) or Yanmar part no. 158090-51841 for the M16 adapter used on the MP4 fuel injection pumps (TNV94 - 106 model engines) and Yanmar part no. 23000-013000 plunger adapter clamp **(Figure 7-40,** (1)).

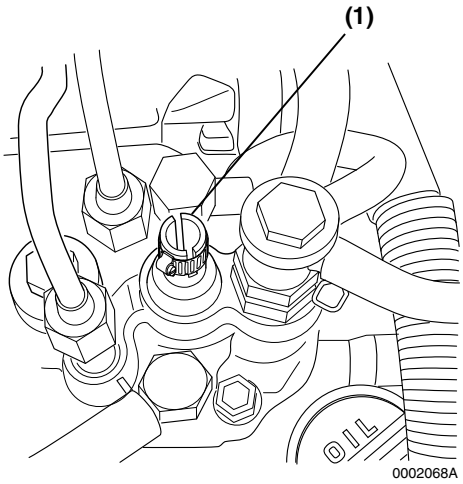
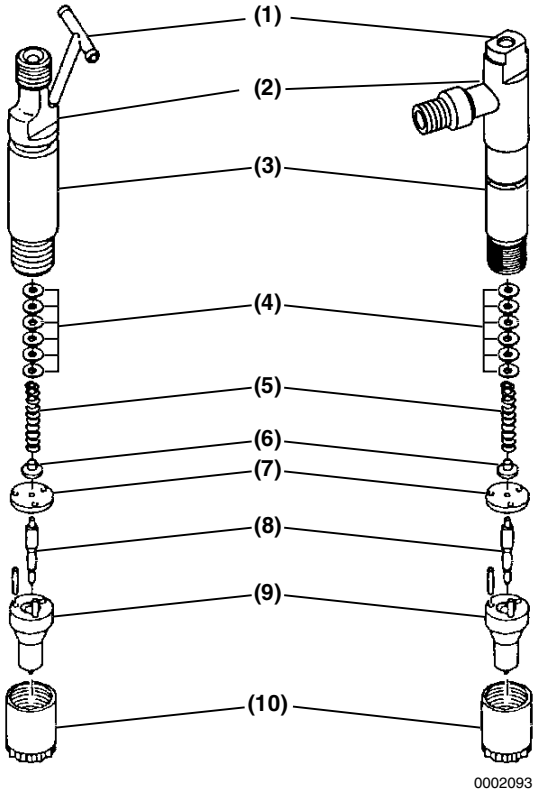


Figure 7-40

5. Install a dial indicator **(Figure 7-41, (1))**, Mitutoyo No. 2050SB or equivalent, with a 30 mm extension, Yanmar part no. 158090-51870 or Mitutoyo No. 303613, into the adapter. Secure with the Yanmar part no. 23000-013000 plunger adapter clamp **(Figure 7-40,** (1)) at approximately the mid-point of its travel.

Adjusting Fuel Injector Pressure

The fuel injectors open when pressure reaches a predetermined pressure threshold. They close when the pressure is reduced below that threshold. The pressure threshold can be adjusted by adding or removing shims **(Figure 7-58, (3))**.



1 – Fuel Return Passage
2 – Injector ID Location
3 – Injector Body
4 – Pressure Adjusting Shims
5 – Spring
6 – Spring Seat
7 – Valve Stop Spacer
8 – Nozzle Valve
9 – Nozzle Body
10 – Nozzle Case Nut

Figure 7-58

The injection pressure will change by approximately 275 psi (1.9 MPa; 19 kgf/cm^2) for every 0.1 mm (0.004 in.) in shim thickness.

See the parts catalog for available shims.

CAUTION

Each pressure adjusting shim removed or added changes the pressure threshold by approximately 275 psi (1.9 MPa, 19 kgf/cm^2). Adding adjusting shims increases the threshold pressure. Removing adjusting shims reduces the pressure threshold.

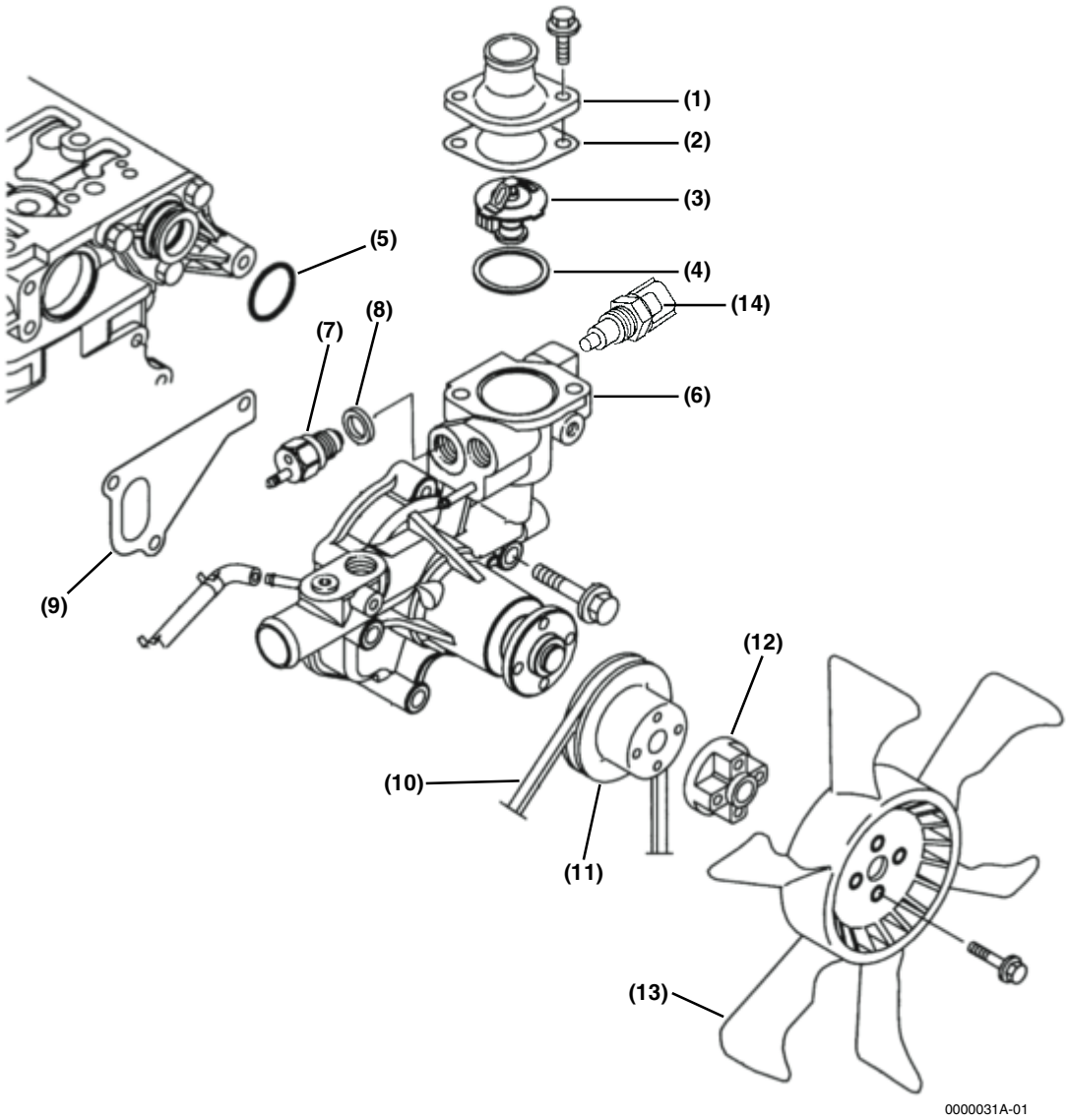
0000081en

1. Disassemble the fuel injector assembly. *See Disassembly and Inspection of Fuel Injectors on page 7-39*.
2. Remove or add adjusting shims as needed.
3. Reassemble the fuel injector assembly. *See Reassembly of Fuel Injectors on page 7-41*.
4. Retest the fuel injector. *See Testing of Fuel Injectors on page 7-38*. If the injector cannot be adjusted to the appropriate pressure, discard the fuel injector.

Reassembly of Fuel Injectors

1. Secure the injector in a soft-jawed vise with the nozzle end up.
2. Reinstall the shims, nozzle spring, nozzle spring seat, valve stop spacer, nozzle valve, and nozzle body.
3. Reinstall the nozzle case nut. Tighten it to specification. *See Special Torque Chart on page 7-11*.

ENGINE COOLANT PUMP COMPONENTS



1 – Thermostat Cover
2 – Thermostat Cover Gasket
3 – Thermostat
4 – Thermostat O-Ring
5 – Special O-Ring
6 – Engine Coolant Pump
7 – Temperature Switch
8 – Gasket
9 – Engine Coolant Pump Gasket
10 – V-Belt
11 – Engine Coolant Pump V-Pulley
12 – Spacer
13 – Engine Coolant Fan
14 – Water temperature sensor (Electronically controlled engine)

Figure 8-2

BEFORE YOU BEGIN SERVICING

⚠ WARNING

ENTANGLEMENT 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

BURN HAZARD!

- 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.
- Failure to comply could result in death or serious injury.

0000015en

⚠ WARNING

FUME / BURN 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.

0000014en

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6. Reinstall the gear case cover and crankshaft pulley. *See Installation of Gear Case Cover on page 6-97.*
7. Reinstall the engine coolant pump V-pulley **(Figure 9-13, (1))**, spacer **(Figure 9-13, (2))**, engine cooling fan **(Figure 9-13, (3))** and engine cooling fan guard (if equipped).

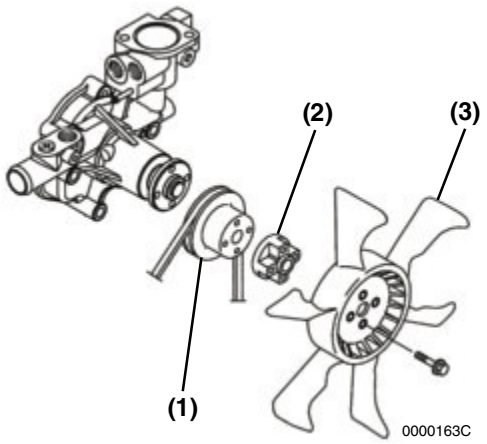


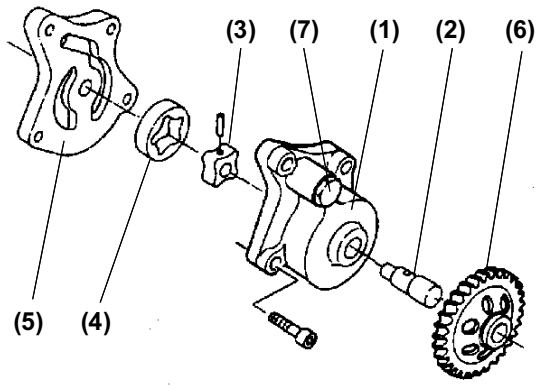
Figure 9-13

8. Reinstall the V-belt. Tighten the V-belt to the proper tension as described in *Check and Adjust Cooling Fan V-Belt on page 5-22*.

TROCHOID OIL PUMP

3TNV82A-B, 3TNV88-B, 3TNV88-U, 4TNV88-B4TNV88-U, 3TNV84T-Z, 4TNV84T-Z Oil Pump Components

The oil pump on these model engines is located in the front gear case and is driven by the same gear train that drives the camshaft and fuel injection pump. You must remove the front gear case cover to gain access to the oil pump.



1 – Body
2 – Shaft
3 – Inner rotor
4 – Outer rotor
5 – Cover
6 – Drive gear
7 – Pressure regulator valve

Figure 9-14

BEFORE YOU BEGIN SERVICING

⚠ WARNING

ENTANGLEMENT 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

FUME / BURN 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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⚠ WARNING

Never apply over 40 psi (2.8 kgf/cm) to the waste gate actuator.

0000026en

⚠ CAUTION

FLYING OBJECT HAZARD!

- ALWAYS wear eye protection when servicing the engine and when using compressed air or high-pressure water. Dust, flying debris, compressed air, pressurized water or steam may injure your eyes.
- Failure to comply may result in minor or moderate injury.

0000003en

CAUTION

For maximum engine life, Yanmar recommends that when shutting the engine down, you allow the engine to idle, without load, for five 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.

0000008en

PERIODIC INSPECTION

Inspect the turbocharger at regularly scheduled intervals.

Application	Inspection interval					
	200 hours	400 hours	500 hours	800 hours	1000 hours	2000 hours
Construction Equipment			First 6 months or 500 hrs		First 12 months or 1000 hrs	Every 24 months or 2000 hrs
Farm Equipment	First 6 months or 200 hrs	First 12 months or 400 hrs		Every 24 months or 800 hrs		
Engine Oil and Filter Replacement	Based on engine operation manual					

Visual Inspection

1. Check for indications of oil leaks at the oil inlet and outlet lines. Repair or replace the oil lines as needed.
2. Inspect the air inlet connection to the turbocharger's turbine side for cracks or broken hardware. Repair or replace the connection as needed.
3. Inspect the exhaust outlet connection to the turbocharger's compressor side for cracks or broken hardware. Repair or replace the connection as needed.

Inspection of Rotor Rotation

1. With the engine cool and not operating, manually rotate the rotor. Smooth rotation is normal. Any catching or resistance to rotation is an indication of abnormal operation. Replace the turbocharger or have it repaired by a qualified repair facility.
2. Start the engine.
3. After the engine reaches normal operating temperature, place a stethoscope firmly against the turbocharger case.
4. Increase the rpm gradually. A high-pitched sound, occurring at intervals of two or three seconds, is an indication of abnormal operation. Replace the turbocharger or have it repaired by a qualified repair facility.

Inspection of Rotor Play

To inspect the rotor, the turbocharger must be removed. Inspect for maximum rotor end play and run-out limits before reinstalling.

Removal of Turbocharger

1. Shut down the engine and allow the turbocharger to cool. Remove the exhaust outlet connection from the turbocharger housing.
2. Remove the air inlet connection from the turbocharger housing.

CAUTION

Do not allow any material to fall into the oil lines or the oil inlet and outlet ports of the turbocharger.

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3. Remove the inlet and outlet oil lines from the turbocharger. Plug the lines and ports with tape to prevent contamination. Discard the sealing washers and O-rings. Inspect the oil lines and replace if damaged.
4. Remove the turbocharger mounting nuts from the mounting studs. Lift the turbocharger from the engine and place it on a clean, level working surface.
5. Discard the turbocharger exhaust manifold gasket.

STARTER MOTOR SPECIFICATIONS

Yanmar Part Number			129900-77010
Nominal Output			3.0 hp (2.3 kW)
Weight			12.1 lb (5.5 kg)
Revolution Direction (As Viewed From Pinion)			Clockwise
Engagement System			Magnetic Shift
No-load	Terminal Voltage / Current		11 V / 140 A max
	Revolution		4100 rpm (min^{-1})
Loaded	Terminal Voltage / Current		2.5 V / 1050 A max
	Torque		18 ft-lb (24.5 N·m; 2.5 kgf·m) minimum
Clutch System			Overrunning
Pinion Projection Voltage at 212°F (100 °C)			8.6 V max
Pinion DP or Module / Number of Teeth			M3/9
Difference (O-ring, Oil Seal)			Dry (none)
Application			Standard
Brush	Spring Force		7.868 lbf (35 N; 3.6 kgf)
	Height	Standard	0.591 in. (15 mm)
		Limit	0.354 in. (9 mm)
Magnetic Switch	Series Coil Resistance		0.27 W at 68°F (20°C)
	Shunt Coil Resistance		0.60 W at 68°F (20°C)
Commutator	Outside Diameter	Standard	1.437 in. (36.5 mm)
		Limit	1.398 in. (35 mm)
	Run-Out	Standard	0.001 in. (0.03 mm)
		Limit	0.008 in. (0.2 mm)
	Insulation Depth	Standard	0.020 - 0.031 in. (0.5 - 0.8 mm)
		Limit	0.008 in. (0.2 mm)
Armature	Run-Out	Standard	0.001 in. (0.03 mm)
		Limit	0.008 in. (0.02 mm)
Bearing Type	Armature Front	Nominal Number	6903DDU
	Armature Rear		608DDU
	Pinion Front		60004DDU
	Pinion Rear		6904DDU
Pinion Projection Length (Length L)			0.012 - 0.059 in. (0.3 - 1.5 mm)

Reassembly of Starter Motor

1. Apply the appropriate starter bendix grease (obtain locally) to the pinion shaft. Reassemble the pinion shaft **(Figure 11-27, (5))**, pinion clutch assembly **(Figure 11-27, (1))**, return spring **(Figure 11-27, (4))** and pinion stop **(Figure 11-27, (3))**. Reinstall the retaining ring **(Figure 11-27, (2))** in the groove in the pinion shaft. Slide the piston stop over the retaining ring.

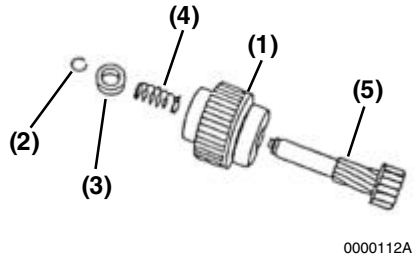


Figure 11-27

2. Reinstall the pinion clutch assembly into the bearing retainer assembly.
3. Reinstall the bearing retainer assembly and pinion assembly to the gear housing. Reinstall and tighten the three M4 bolts.
4. Apply a small amount of high temperature lithium grease (obtain locally) to the sliding portions of the shift lever **(Figure 11-28, (1))**. Reassemble the torsion spring **(Figure 11-28, (2))**, shift lever and dust cover(s) **(Figure 11-28, (3))**, plunger **(Figure 11-28, 4)** and magnetic switch assembly **(Figure 11-28, (5))**.

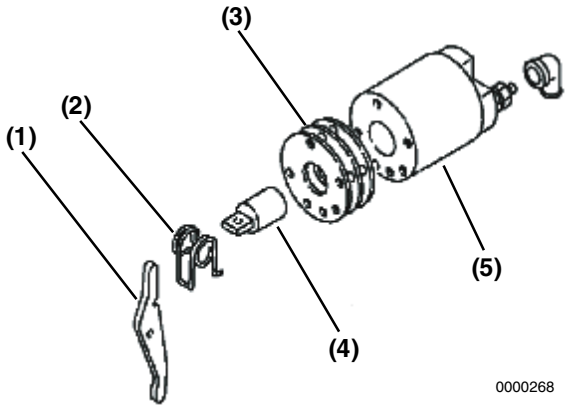


Figure 11-28

5. Reassemble the magnetic switch assembly to the gear housing. Pry the pinion away from the gear housing to allow installation of the magnetic switch assembly **(Figure 11-29)**.

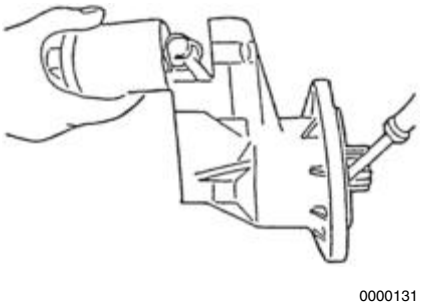


Figure 11-29

6. Secure the magnetic switch assembly to the gear housing using the two M6 bolts.

ALTERNATOR SPECIFICATIONS

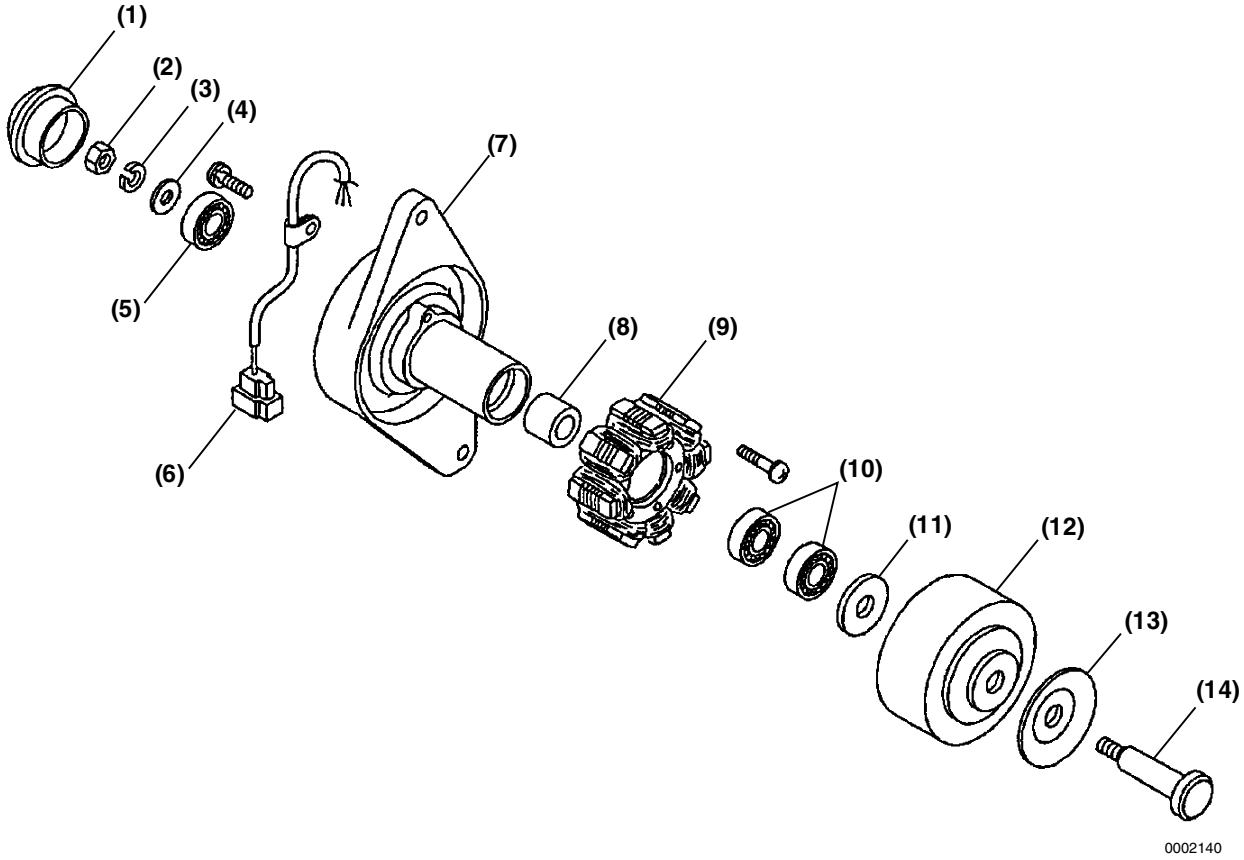
Yanmar Part Number	129423-77200
Nominal Output (13.5 Volts Heat)	40 Amps
Weight	6.17 lb (2.8 kg)
Revolution Direction (As Viewed From Pulley)	Clockwise
Rating	Continuous
Battery Voltage	12 Volts
Rated Revolution	5000 rpm (min^{-1})
Operating Range	1350 - 18000 rpm (min^{-1})
Grounding Characteristics	Negative (-) Side of Circuit
Integrated Regulator	IC Regulator
Outside Diameter of Pulley	2.724 in. (69.2 mm)
Belt Shape	Type A

DYNAMO SPECIFICATIONS

Yanmar Part Number		119910-77200
Nominal Output		20 Amps
Weight		3.97 lb (1.8 kg)
Revolution Direction (As Viewed From Pulley)		Clockwise
Rating		Continuous
Battery Voltage		12 Volts
Rated Revolution		3500 rpm
Operating Range		1400 - 6600 rpm
Grounding Characteristics		Negative (-) Side of Circuit
Regulator		Current Limiter (Yanmar Part No. 119653-77710)
Outside Diameter of Pulley	A-Belt	2.56 in. (65 mm)
	Special M-Belt	2.28 in. (58 mm)
Belt Shape		Type A or Type Special M

DYNAMO COMPONENT LOCATION

Yanmar Part No. 171301-77201 dynamo is used in this section to show the service procedures for the representative dynamo. For specific part detail, see the *Parts Catalog* for the engine you are working on.



1 – Rear Cover
2 – Nut
3 – Lock Washer
4 – Flat Washer
5 – Rear Bearing
6 – Output Wire and Connector
7 – Plate
8 – Spacer
9 – Stator Assembly
10 – Front Bearing (2 used)
11 – Flat Washer
12 – Flywheel Assembly
13 – Pulley Half
14 – Through Bolt

Figure 12-20

INTRODUCTION

None of the components of the electronic control system can be individually repaired. When any component is faulty and needs repair, the entire assembly must be replaced.

ELECTRONIC CONTROL SYSTEM

Model 4TNV84T-Z, 4TNV98-E, 4TNV98-Z and 4TNV98T-Z engines come with the Exhaust Gas Recirculation (EGR) system to conform to the next engine emission regulations (EPA 2008 rules). The EGR system and an electronic governor (Eco-governor) constitute an electronic engine control system.

The electronic engine control system regulates the exhaust gas recirculation flow rate and the fuel injection volume depending on the engine load and speed signals from the engine controller (E-ECU), so that the exhaust gas is kept clean according to the emission control regulations. **Figure 13-1** illustrates the electronic engine control system.

Features of the electronic engine control system include:

- Engine speed control schemes
  Droop control / Low-idling speed up / Auto deceleration / High-idling speed down / Black smoke suppression
- Starting aid
  Auto preheating / After heating
- Engine failure detection
- CAN communication with the control system of the driven machine

Although these features are described in section 4-7, whether they are available as options differs among machines/vehicles; for more information, see the instruction manuals for the respective machines/vehicles.

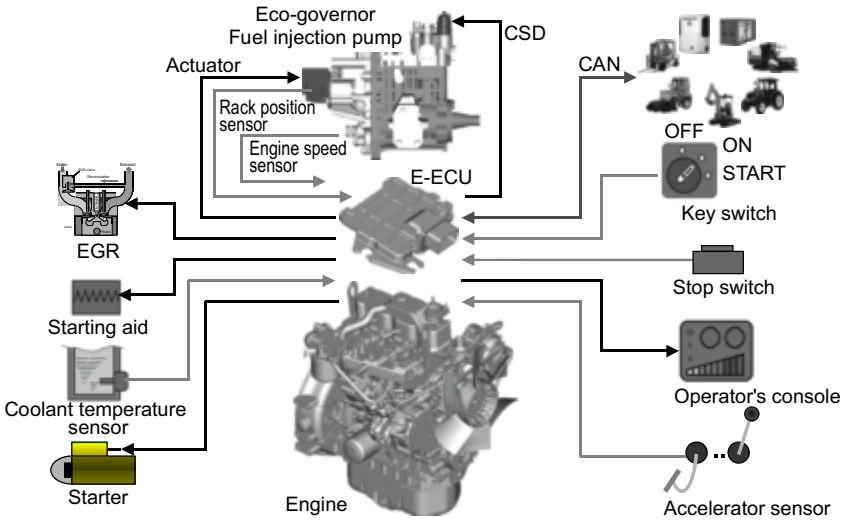


Figure 13-1

CONVERSION OF AWG TO EUROPEAN STANDARDS

Conductor Size (AWG)	Conductor Diameter (mm)	Conductor Cross-sectional Area (mm^2)
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) @ 0.0005067 mm^2		

Diagnosis Description

1) Initial diagnosis with the diagnosis tool	• Check the fault indication. • Check the sensor voltage (AD value). *For details of the method and the procedure of diagnosis, see P.15-136

2) Check of connectors/wiring	• Before beginning your work, be sure to turn off the key switch. • Check that the connector of the rack actuator is correctly inserted. • Check that the wiring of the rack actuator is not disconnected or the insulation of the wiring is not peeled.

3) Failure Diagnostic Work	• Check the input voltage of the rack position sensor (voltage of the sensor 12V line). • Check the harness for correct continuity. *For details of the method and the procedure of diagnosis, see P.15-136

Diagnosis Description

1) Initial diagnosis with the diagnosis tool	• Check the fault indication. • Check that the foot pedal movement is correctly recognized. *For details of the method and the procedure of diagnosis, see P.15-144

2) Check of connectors/wiring	• Before beginning your work, be sure to turn off the key switch. • Check that the connector of the foot pedal is correctly inserted. • Check that the wiring of the foot pedal is not disconnected or the insulation of the wiring is not peeled.

3) Failure Diagnostic Work	• Check the foot pedal for correct continuity. • Check the harness for correct continuity. *For details of the method and the procedure of diagnosis, see P.15-144

Diagnosis Description

1) Initial diagnosis with the diagnosis tool	• Check the fault indication. • Check that the foot pedal movement is correctly recognized. *For details of the method and the procedure of diagnosis, see P.15-144

2) Check of connectors/wiring	• Before beginning your work, be sure to turn off the key switch. • Check that the connector of the foot pedal is correctly inserted. • Check that the wiring of the foot pedal is not disconnected or the insulation of the wiring is not peeled.

3) Failure Diagnostic Work	• Check the foot pedal for correct continuity. • Check the harness for correct continuity. *For details of the method and the procedure of diagnosis, see P.15-144

Diagnosis Description

1) Initial diagnosis with the diagnosis tool	• Check the fault indication. • Check the sensor voltage. *For details of the method and the procedure of diagnosis, see P.15-148

2) Check of connectors/wiring	• Before beginning your work, be sure to turn off the key switch. • Check that the connector of the atmospheric pressure sensor is correctly inserted. • Check that the wiring of the atmospheric pressure sensor is not disconnected or the insulation of the wiring is not peeled.

3) Failure Diagnostic Work	• Check the resistance value of the atmospheric pressure sensor. • Check the harness for correct continuity. • Check the output voltage of the atmospheric pressure sensor. *For details of the method and the procedure of diagnosis, see P.15-148

(3) P0119/2: Intermittent Failure with Cooling Water Temperature Sensor

DTC	P0119/2	Intermittent Failure with Cooling Water Temperature Sensor

DTC Detecting Conditions

1 - Precondition; 2 - Detecting condition(s); 3 - Flashing pattern of failure indicator	Check points
1. Engine running. 2. Unconfirmed error detected 10 times. 3: Does not flash.	Connector Harness High-accuracy cooling water temperature sensor E-ECU

Movement at Error occurrence

Error Mode	[Run As Is]: After detecting the error, the system lets the engine continue to run without any restrictions.
Run restricted?	No.
Recovery Conditions	No.
Remarks	

Estimation of Failure cause/Error condition

- The connector may not be properly connected.
- Wiring defect of the harness
  - The cooling water temperature sensor's signal wires may be short-circuited with GND.
  - The cooling water temperature sensor's signal wires may be disconnected or short-circuited with POWER SUPPLY.
  - GND wire of the cooling water temperature sensor may be disconnected.
- The cooling water temperature sensor may be faulty.
  - Signal wire in the sensor may be disconnected, or short circuited.
  - Sensor GND wire in the sensor may be disconnected.

Diagnosis Description

1) Initial diagnosis with the diagnosis tool	• Check the fault indication. • Check the battery voltage.

2) Engine Inspection	• Turn the key switch off to stop the engine. • Check the battery voltage using a circuit tester. • Inspect the charging system of the engine . • After a little, turn the key switch on to check if the DTC is detected. *For description and procedure of engine inspection, see the Service manual (“Engine”).

3) Failure Diagnostic Work	• Check that the battery wiring is not disconnected or the insulation of the wiring is not peeled.

Diagnosis Description

1) Initial diagnosis with the diagnosis tool	• Check the fault indication. • Check the output signal of the rack actuator relay. • Check the movement of the rack actuator relay by the active control function. *For details of the method and the procedure of diagnosis, see P.15-170

2) Check of connectors/wiring	• Before beginning your work, be sure to turn off the key switch. • Check that the connector of the rack actuator relay is correctly inserted. • Check that the wiring of the rack actuator relay is not disconnected or the insulation of the wiring is not peeled.

3) Failure Diagnostic Work	• Check the resistance value of the rack actuator relay. • Check the harness for correct continuity. *For details of the method and the procedure of diagnosis, see P.15-170

Diagnosis Description

1) Initial diagnosis with the diagnosis tool	• Check the fault indication. • Check the output signal of the CSD solenoid valve. • Check the movement of the CSD solenoid valve by the active control function. *For details of the method and the procedure of diagnosis, see P.15-178

2) Check of connectors/wiring	• Before beginning your work, be sure to turn off the key switch. • Check that the connector of the CSD solenoid valve is correctly inserted. • Check that the wiring of the CSD solenoid valve is not disconnected or the insulation of the wiring is not peeled.

3) Failure Diagnostic Work	• Check the resistance value of the CSD solenoid valve coil. • Check the harness for correct continuity. *For details of the method and the procedure of diagnosis, see P.15-178

Diagnosis Description

1) Initial diagnosis with the diagnosis tool	• Check the fault indication. • Check the output signal of the EGR step motor. • Check the movement of the EGR step motor by the active control function. *For details of the method and the procedure of diagnosis, see P.15-182

2) Check of connectors/wiring	• Before beginning your work, be sure to turn off the key switch. • Check that the connector of the EGR step motor is correctly inserted. • Check that the wiring of the EGR step motor is not disconnected or the insulation of the wiring is not peeled.

3) Failure Diagnostic Work	• Check the coil resistance of the EGR step motor. • Check the harness for correct continuity. *For details of the method and the procedure of diagnosis, see P.15-182

Diagnosis Description

1) Initial diagnosis with the diagnosis tool	• Check the fault indication. • Check the output signal of the EGR step motor. • Check the movement of the EGR step motor by the active control function. *For details of the method and the procedure of diagnosis, see P.15-182

2) Check of connectors/wiring	• Before beginning your work, be sure to turn off the key switch. • Check that the connector of the EGR step motor is correctly inserted. • Check that the wiring of the EGR step motor is not disconnected or the insulation of the wiring is not peeled.

3) Failure Diagnostic Work	• Check the coil resistance of the EGR step motor. • Check the harness for correct continuity. *For details of the method and the procedure of diagnosis, see P.15-182

Diagnosis Description

1) Initial diagnosis with the diagnosis tool	• Check the fault indication. • Check that the input signal of the water temperature switch is correctly recognized. *For details of the method and the procedure of diagnosis, see P.15-187

2) Engine Inspection	• Turn the key switch off to stop the engine. • Check the engine cooling system. • After a little, turn the key switch on to check if the DTC is detected. *For description and procedure of engine inspection, see the Service manual (“Engine”).

3) Failure Diagnostic Work	• Check the water temperature switch system. *For details of the method and the procedure of diagnosis, see P.15-187

Diagnosis Description

1) Initial diagnosis with the diagnosis tool	• Check the fault indication. • Check the movement of the rack actuator by the active control function. *For details of the method and the procedure of diagnosis, see P.15-193

2) Check of connectors/wiring	• Before beginning your work, be sure to turn off the key switch. • Check that the connector of the rack actuator is correctly inserted. • Check that the wiring of the rack actuator is not disconnected or the insulation of the wiring is not peeled.

3) Failure Diagnostic Work	• Check the resistance value of the rack actuator solenoid. • Check the harness for correct continuity. *For details of the method and the procedure of diagnosis, see P.15-193

Diagnosis Description

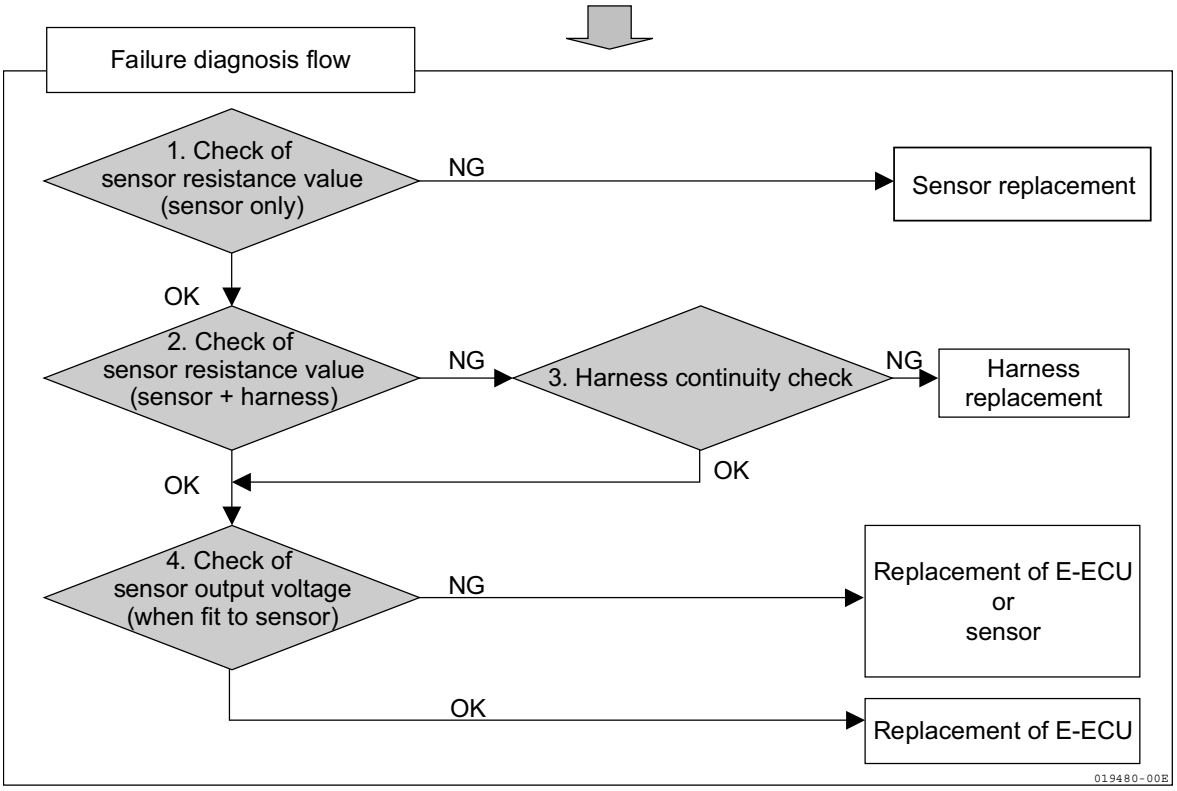
1) Initial diagnosis with the diagnosis tool	• Check the fault indication. • Check the battery voltage. *For details of the method and the procedure of diagnosis, see P.15-205

2) Check of connectors/wiring	• Before beginning your work, be sure to turn off the key switch. • Check that the connector of the CAN communication is correctly inserted. • Check that the wiring of the CAN communication is not disconnected or the insulation of the wiring is not peeled.

3) Failure Diagnostic Work	• Check the battery voltage. • Check the harness for correct continuity. *For details of the method and the procedure of diagnosis, see P.15-205

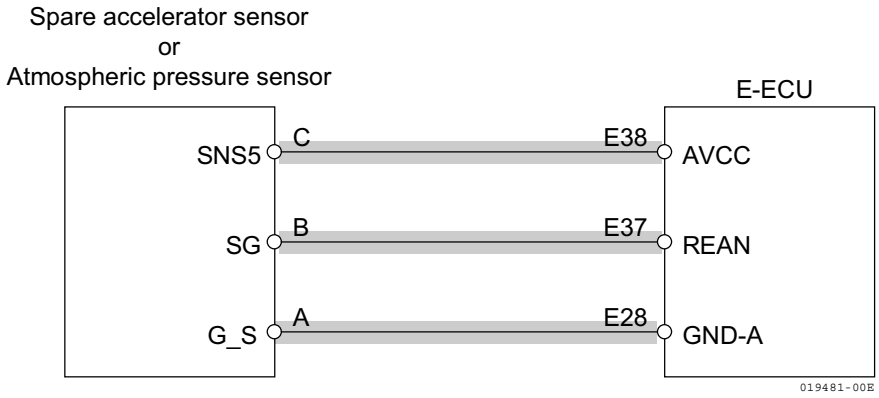
3. Execution check of the directive rack position control:
   - Connect the all connectors (sensors, E-ECU).
   - Connect the diagnosis tool, and log in to the diagnosis tool after key switch turning-on.
   - Execute the directive rack position control with the diagnosis tool “Diagnosis Test: Active control”.At this time, set the rack position arbitrarily within an allowable setting range.
   - After the execution, check if the rack actuator moved to the set rack position.

NG	Replace the fuel injection pump.
OK	Replace the E-ECU.



Wiring Diagram

	: Check points



*For the E-ECU Pin Layout, see [E-ECU Pin Layout Diagram] (P.15-134).

3. Check of harness continuity:
   • Remove the cooling water temperature sensor and E-ECU from the harness.
   • Check the harness continuity using a circuit tester.

Terminal	Continuity	Status
Sensor signal wire E16 (E25) [E-ECU ñ between sensor connector]	Available	OK: normal
	Unavailable	NG: harness disconnection
Sensor GND wire E28 [Between E-ECU and sensor connector]	Available	OK: normal
	Unavailable	NG: harness disconnection
Between E16 and other terminal/GND (between E25 and other terminal/GND)	Unavailable	OK: normal
	Available	NG: harness short-circuited with GND
E28 ñ GND/E45/E47	Available	OK: normal
	Unavailable	NG: harness disconnection
Between E28 and other terminals	Unavailable	OK: normal
	Available	NG: harness short-circuited with another wiring

NG	• Check if the harness is damaged, or if the wiring is correct. • Replace the harness.
OK	Check the output voltage of the cooling water temperature sensor. → Go to [4. Output voltage check of the cooling water temperature sensor:]

4. Output voltage check of the cooling water temperature sensor:
   • Connect the 2G eco-checker harness between E-ECU and machine's harness (for details, see[How to use the 2G eco-checker harness] (P.15-135). And connect the all connectors (sensors, E-ECU).
   • Measure the voltage between sensor signal E16 and E28 (E35 and E28) using a circuit tester.

Voltage	Status	Action
E16(E25) ≤ 0.2[V]	NG	• Replace the harness. • Replace the cooling water temperature sensor.
0.2[V] < E16(E25) < 4.8V	OK (Normal range)	ReplaceE-ECU.
4.8V ≤ E16(E25)	NG	• Replace the harness. • Replace the cooling water temperature sensor.

NG	• Check if the harness is damaged, or if the wiring is correct. • Replace the harness.
OK	ReplaceE-ECU.

Work Description

1. Battery voltage check:
   - Set the accelerator at the lowest position, and operate the engine.
   - Measure the battery voltage using a circuit tester.

Terminal	Specification
Battery voltage (in the normal condition)	10 to 16 [V]

NG	• Check the alternator. • Replace the battery.
OK	Check the harness for correct continuity. → Go to [2. Check of harness continuity:]

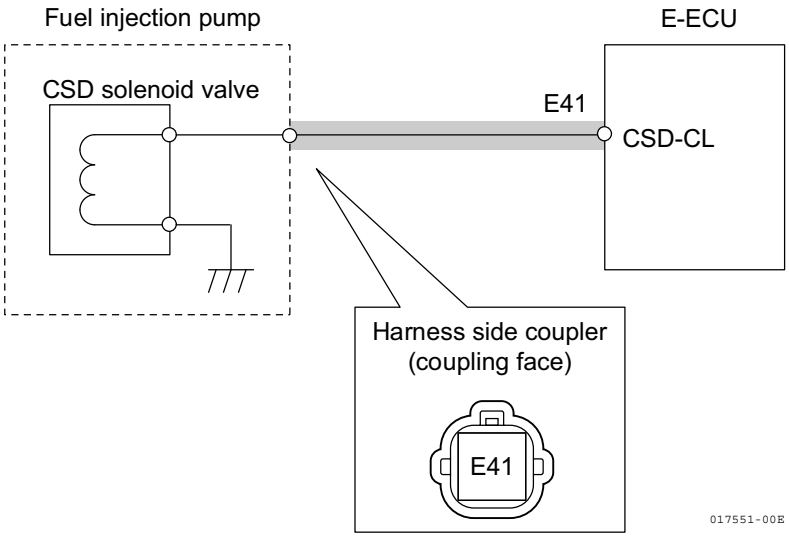
2. Check of harness continuity:
   - Remove the connector of the spare speed sensor and E-ECU from the harness.
   - Check the harness continuity using a circuit tester.

Terminal	Continuity	Status
Alternator P terminal (E10) [Between E-ECU and alternator]	Available	OK: normal
	Unavailable	NG: harness disconnection
Alternator IG terminal [Between Key switch and alternator]	Available	OK: normal
	Unavailable	NG: harness disconnection
Alternator B terminal [Between battery and alternator]	Available	OK: normal
	Unavailable	NG: harness disconnection
Between E10 and GND/E45/E47	Unavailable	OK: normal
	Available	NG: harness short-circuited with GND

NG	• Check if the harness is damaged, or if the wiring is correct. • Replace the harness.
OK	• Check the alternator. • Replace the E-ECU.

Wiring Diagram

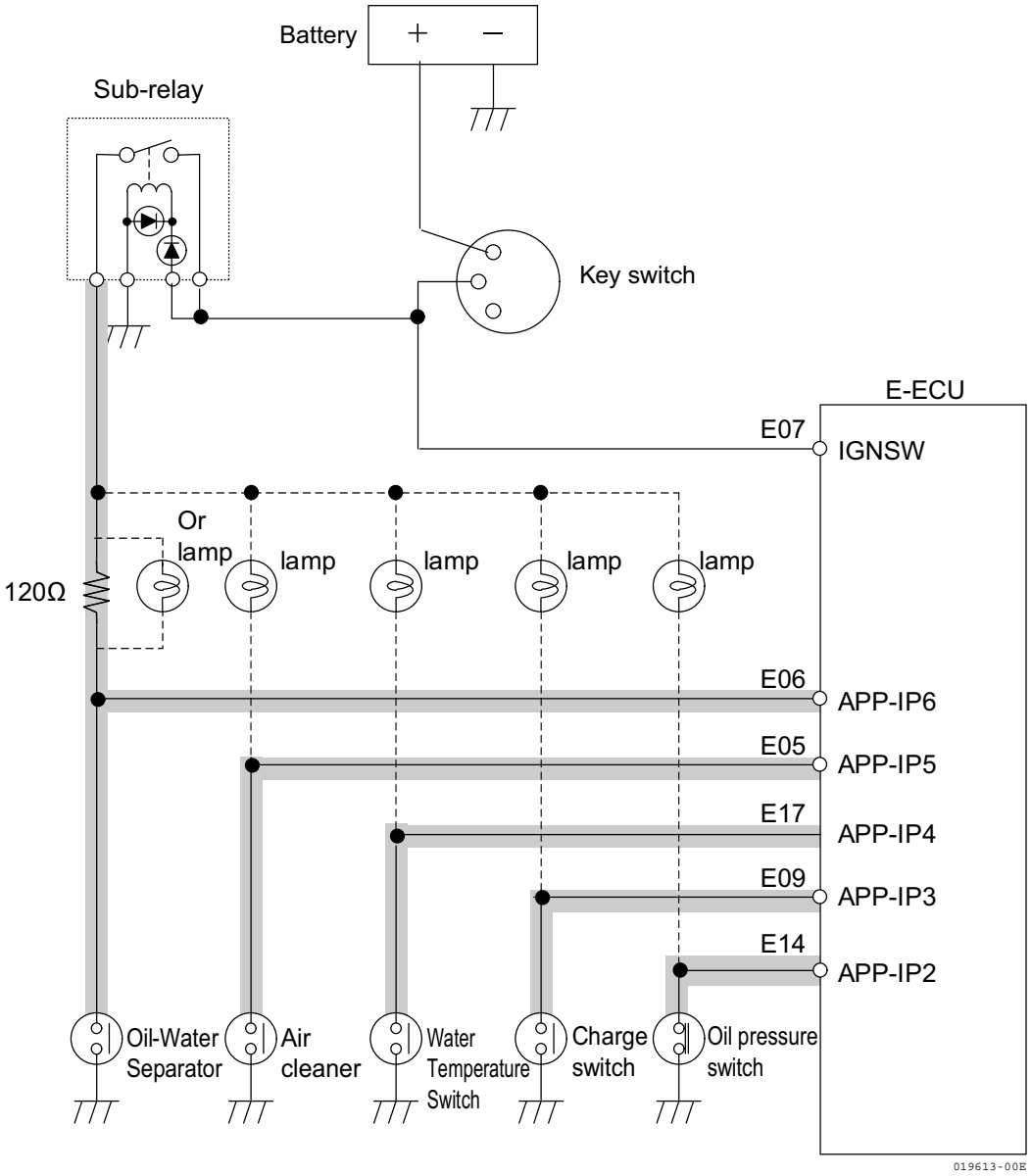
	: Check points



*For the E-ECU Pin Layout, see [E-ECU Pin Layout Diagram] (P.15-134).

Wiring Diagram

	: Check points



*For the E-ECU Pin Layout, see [E-ECU Pin Layout Diagram] (P.15-134).

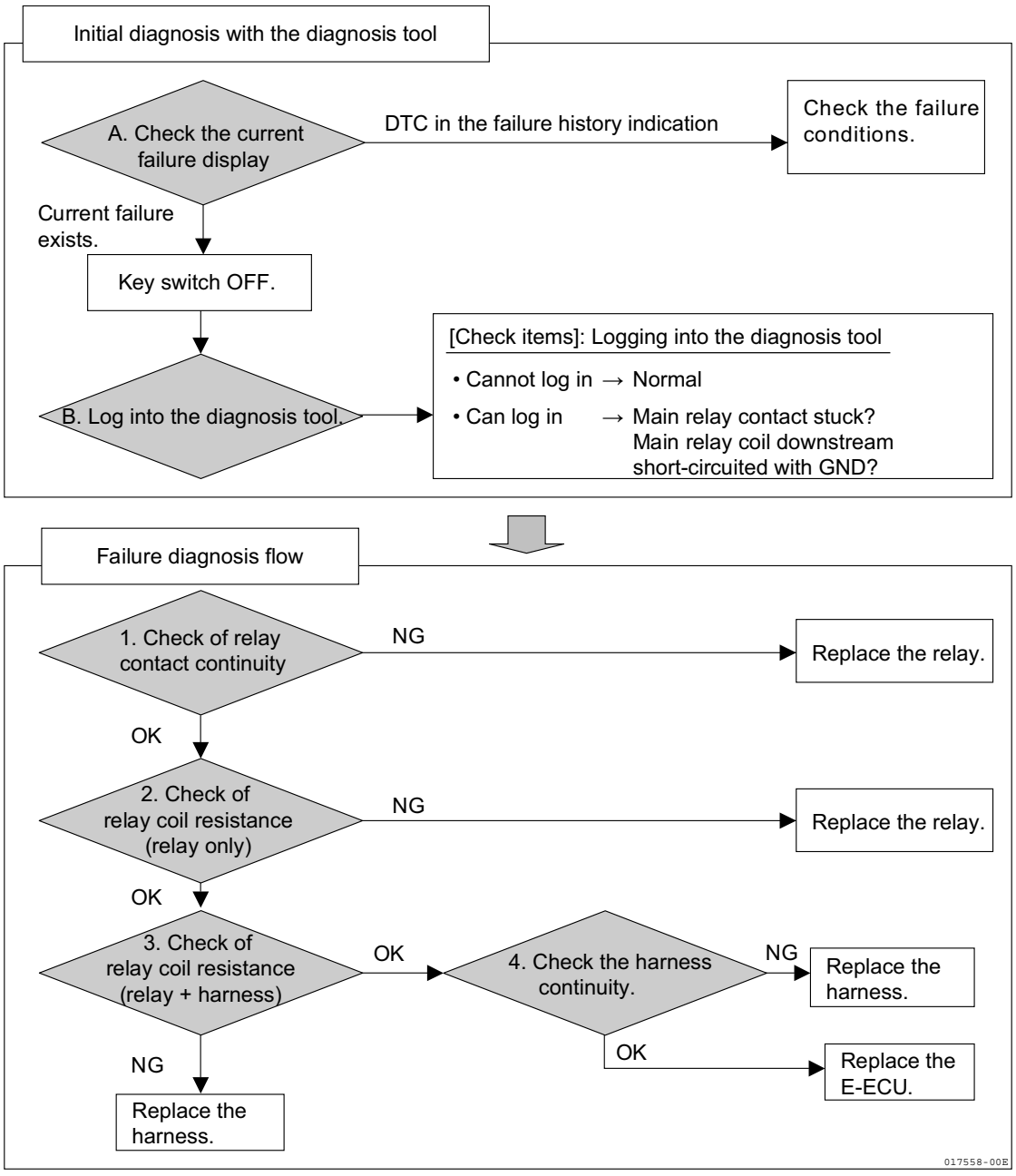
Main relay

Related DTC

DTC	P0686/4	Main relay error

Work flow

***For details of the work, see after-mentioned "<Work Description>."For the operation of the diagnosis tool, see "Diagnosis tool Operation Manual" separately.**



Flashing Patterns	Error Item			DTC	Referenced page number
	Area		Status		
1-7	Rack Actuator Relay		Failure (low voltage)	P1222/4	P.15-66
			Failure (high voltage)	P1223/3	P.15-68
			Intermittent failure	P1224/2	P.15-70
1-8	Spare Accelerator Sensor		Failure (low voltage)	P0222/4	P.15-22
			Failure (high voltage)	P0223/3	P.15-24
			Intermittent failure	P0224/2	P.15-26
			Lower limit error	P1225/1	P.15-28
			Upper limit error	P1226/0	P.15-30
			Communication error	P1227/8	P.15-32
1-9	Atmospheric Pressure Sensor		Failure (low voltage)	P2228/4	P.15-34
			Failure (high voltage)	P2229/3	P.15-36
			Intermittent failure	P2230/2	P.15-38
2-1	Oil Pressure Switch		Failure (disconnection)	P1192/4	P.15-100
2-2	Charge Switch		Failure (disconnection)	P1562/4	P.15-104
2-3	ECU Supply Voltage		Lower limit error	P0562/1	P.15-56
			Upper limit error	P0563/0	P.15-58
2-4	SENSOR 5V		Failure (low voltage)	P0642/4	P.15-53
			Failure (high voltage)	P0643/3	P.15-54
			Intermittent failure	P1644/2	P.15-55
2-5	ECU Internal Temperature		Rise Error	P0634/0	P.15-43
3-1	Oil Pressure		Lower limit error	P1198/1	P.15-102
3-2	Battery Charge		Lower limit error	P1568/1	P.15-106
3-3	Cooling Water Temperature		Error	P1217/0	P.15-108
3-4	Air Cleaner		Mechanical failure	P1101/0	P.15-110
3-5	Oil-Water Separator		Mechanical failure	P1151/0	P.15-112
3-6	Cooling Water Temperature		Rise Error	P0217/0	P.15-51
4-1	ECU Internal	Flash ROM		P0605/12	P.15-123
		EEPROM		P0601/12	P.15-122
		Sub CPU	CRC error	P1610/12	P.15-122
			Send ACK error	P1611/12	P.15-122
			Communication error	P1612/12	P.15-122
		Map format		P1620/12	P.15-123
		ECU Temperature Sensor	Failure (low voltage)	P0668/4	P.15-40
			Failure (high voltage)	P0669/3	P.15-41
			Intermittent failure	P1664/2	P.15-42

TROUBLESHOOTING BY MEASURING COMPRESSION PRESSURE

Compression pressure drop is one of the major causes of increasing blow-by gas (engine oil contamination or increased engine oil consumption as a resultant phenomenon) or starting failure. The compression pressure is affected by the following factors:

1. Degree of clearance between the piston and cylinder
2. Degree of clearance at the intake / exhaust valve seat
3. Gas leak from the nozzle gasket or cylinder head gasket

The pressure will drop due to increased parts wear. Pressure drop reduces the durability of the engine.

A pressure drop may also be caused by a scratched cylinder or piston, dust entrance from the dirty air cleaner element or a worn or broken piston ring. Measure the compression pressure to determine the condition of the engine.

Compression Pressure Measurement Method

1. Warm up the engine.
2. Stop the engine. Remove the high-pressure fuel injection lines as an assembly from the engine.

For engines with 2 valve cylinder heads

3. Remove the fuel injector from the cylinder to be measured. *See Removal of Fuel Injectors on page 7-35*.

CAUTION

Remove or install the high-pressure fuel injection lines as an assembly whenever possible. Disassembling the high-pressure fuel injection lines from the retainers or bending any of the fuel lines will make it difficult to reinstall the fuel lines.

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For engines with 4 valve cylinder heads

4. Remove the valve cover assembly. *See Removal of Valve Cover on page 6-52*. Remove the fuel injector from the cylinder to be tested. *See Removal of Fuel Injectors on page 7-35*.
5. Turn off the fuel supply valve in the fuel supply line. Disconnect the fuel injection pump stop solenoid at the connector. This prevents the fuel injection pump from injecting fuel during compression testing.
6. Before installing the compression gauge **((Figure 15-1, (1))** 2 valve engine, **(Figure 15-2, (1))** 4 valve engine) adapter, crank the engine with the stop solenoid disconnected for a few seconds to clear the cylinder of any residual fuel.
7. Install a nozzle seat at the tip end of the compression gauge adapter. Install the compression gauge and the compression gauge adapter at the cylinder to be measured.
8. Crank the engine until the compression gauge reading is stabilized.

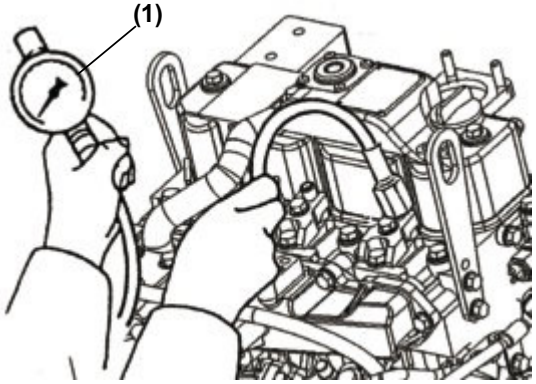

Figure 15-1

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