1. Specifications and Performance

1-1 2TNE68

* **Output conditions:** Intake back pressure ≤ 250 mmAq, Exhaust back pressure ≤ 550 mmAq, other conditions complying with JIS D 1005–1986. After minimum 30 hour's run-in.

Item	Model / Unit	2TNE68		
Application	—	VM	CH	VH
Type	—	Vertical, 4-cycle water-cooled diesel engine		
Combustion system	—	Special swirl pre-combustion chamber		
No. of cylinders – Bore × Stroke	mm	2 – 68 × 72		

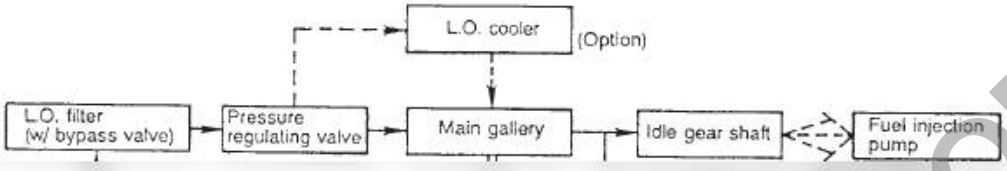
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2. Lubrication system diagram

(1) Indirect injection system



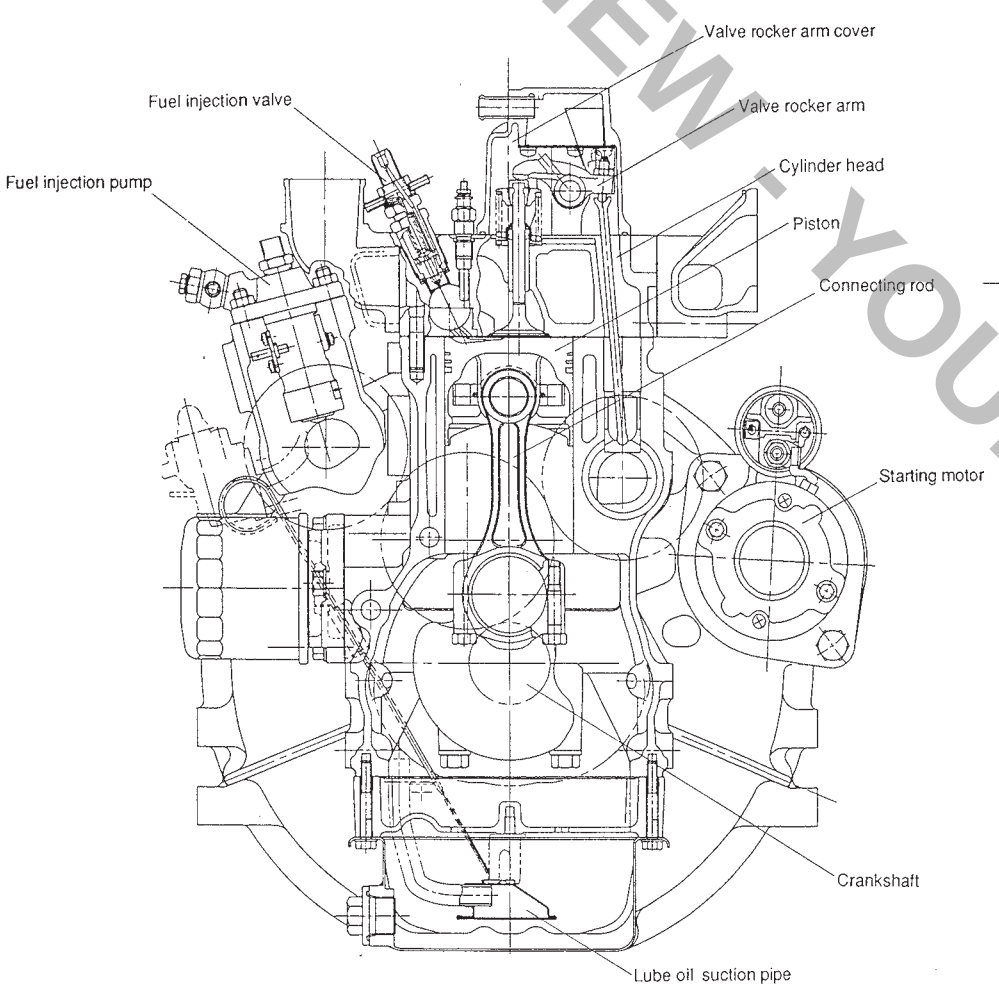
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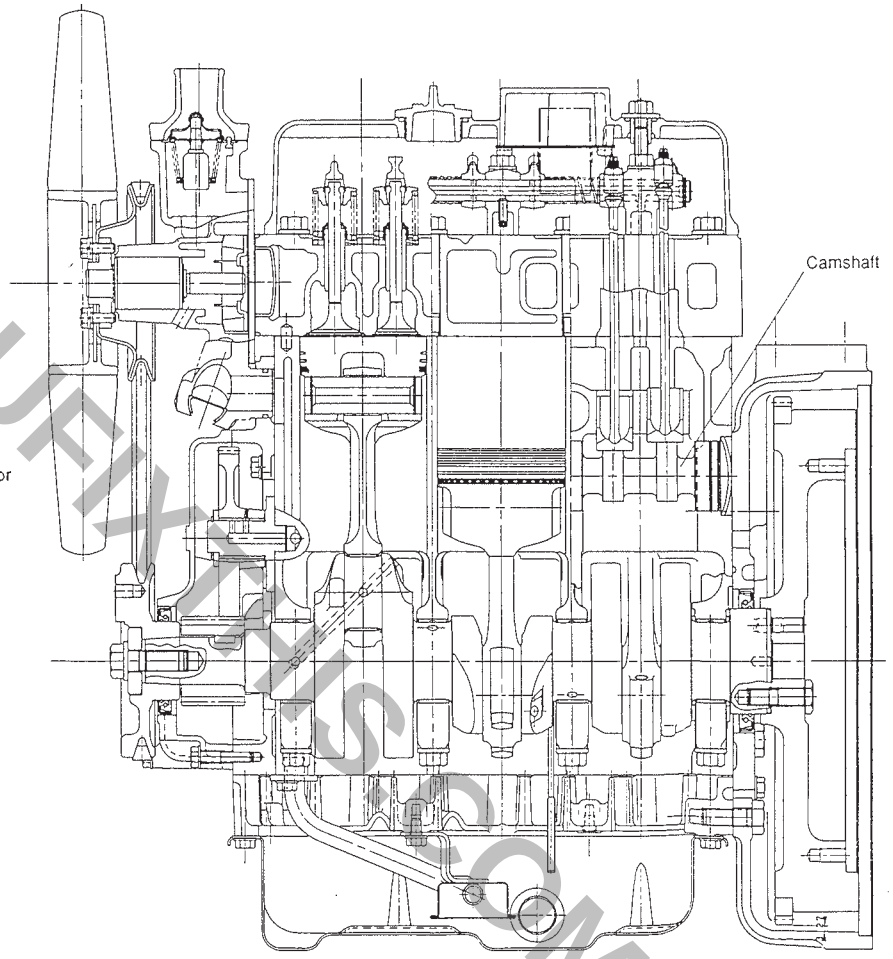
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2. Cross Sectional Views

2-1. Special Swirl Pre-combustion Chamber System (Indirect Injection System)





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10. Tightening Torque

10-1 Main bolt/nut

(Unit: kgf-m)

No.	Item	Model / Torque	2/3TNE68	3TNE74	3TNE78A 3TNE82A	3/4TNE82, 3/4TNE84(T), 3/4TNE88
1	Cylinder head bolt	Lubricating oil applied (Thread dia. × pitch)	3.8~4.2 (M8 × 1.25)	6.0~6.5 (M9 × 1.25)	6.8~7.2 (M9 × 1.25)	8.7~9.3 (M10 × 1.25)
2	Connecting rod bolt	Lubricating oil applied (Thread dia. × pitch)	2.3~2.8 (M7 × 1.0)	2.3~2.8 (M7 × 1.0)	3.8~4.2 (M8 × 1.0)	4.5~5.5 (M9 × 1.0)

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10.1.2 Specifications

Manufacturer's model (Hitachi)	-	ACFA68
Yanmar code	-	129423-77200
Rating	-	Continuous
Battery voltage	V	12
Nominal output (13.5 V heat)	A	40
Rated revolution	min^{-1}	5,000
Operating revolution	min^{-1}	1,350 to 18,000

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4. Troubleshooting

4-1. Trouble causes and remedies

The following table summarizes the symptoms and causes of general troubles. If any symptom of trouble is found, a corrective action shall be taken before the said symptom develops into a serious accident.

Carefully read Chapter 6, Measurement, Inspection and Adjustments, and Chapter 7, Measuring Procedures, Service Data and Countermeasures. Familiarize yourself with Chapter 6 and Chapter 7, which practice is extremely important for extending the service life of the engine.

Cause \ Symptom of trouble		Fails to start				Insufficient engine output			Poor exhaust color		High knocking sound during combustion	Abnormal engine noise	Uneven combustion sound	Hunting		Large engine vibration	Poor return to low speed	Excessive fuel consumption	Lubricating oil				Much blow-by gas	Cooling water		Air intake		Exhaust temperature rise				Corrective action
		Engine will not start.	Engine starts but stops soon			Exhaust color			During work					During idling	During work			Excessive consumption	Excessive consumption	Diluted by fuel oil	Mixture with water	Low L.O. pressure		Overheat	Low water temperature	Pressure drop	Pressure rise					
			Exhaust smoke																													
			Nil	Less	More	Regular	White	Black	White	Black																						
Engine System	Improper clearance of intake/exhaust valve	○	○			○						○														○					Adjust valve clearance (Refer to Chapter 6, 6-2.)
	Compression leakage from the valve seat					○		○		○		○						○					○			○					Rap valve seat (Refer to Chapter 7, 7-1-2.)
	Seized intake/exhaust valve	○			○	○		○		○		○			○	○				○			○			○					Correct or replace.
	Blowout of cylinder head gasket					○															○			○							Replace the gasket. (Refer to Chapter 8, 8-2-(10))
	Seized or broken piston ring	○			○		○		○			○		○		○			○	○			○	○					○		Replace the piston ring. (Refer to Chapter 7, 7-4-3, 4, (5))
	Worn piston ring, piston and cylinder	○			○		○		○										○	○			○								Make honing and use oversize parts. (Refer to Chapter 7, 7-2-3. & 7-4-(8))
	Seized crank pin metal and bearing	○	○									○		○	○	○							○								Repair or replace.
	Improper arrangement of piston ring joints		○				○												○				○								Correct the ring joint positions. (Refer to Chapter 7, 7-4-(5))
	Reverse assembly of the piston ring						○		○										○				○								Properly reassemble. (Refer to Chapter 7, 7-4-(5))
	Worn crank pin and journal metal					○						○		○	○	○						○									Measure and replace . Refer to Chapter 7, 7-5-3. and 7-7-(5))
	Loosened connecting rod bolt											○				○						○									Tighten bolt to the specified torque. (Refer to Chapter 10, 10-1.)
	Foreign matter trapped in combustion chamber	○										○							○				○								Disassemble and repair the combustion chamber. Eliminate foreign matter.
	Excessive gear backlash											○																			Adjust meshing of gears. (Refer to Chapter 7, 7-8-(2))
	Worn valve guide of intake/exhaust valves						○												○				○								Measure and replace. (Refer to Chapter 7, 7-1-(3))
	Poor governor		○											○	○	○	○														Repair and adjust. (Refer to Chapter 13.)
	Improper open/close timing of intake/exhaust valves	○					○	○	○	○		○																			Adjust valve clearance (refer to Chapter 6, 6-2) and check intake/exhaust valve timing (Refer to Chapter 9, 9-1)
Turbocharger	Dirty blower							○		○																○						Clean the blower.
	Waste gate malfunction							○		○																○						Disassemble and inspect the waste gate.
	Worn journal bearing						○		○																							Disassemble and inspect the journal bearing.
Cooling Water System	Cooling effect of radiator, excessive								○									○						○								Malfunction of thermostat (kept closed). (Refer to Chapter 6, 6-9)
	Cooling effect of radiator, insufficient							○																					○			Malfunction of thermostat (kept opened). (Refer to Chapter 6, 6-9) Slipping fan belt (Refer to Chapter 6, 6-3)
	Insufficient cooling water level							○																○					○			Check water leakage from Cooling water system (Refer to Chapter 6, 6-7) and clean cooling water system (Refer to chapter 3, 3-1)
	Cracked water jacket																				○	○		○								Repair and replace.
	Slackened fan belt tension							○																○					○			Adjust fan belt tension. (Refer to Chapter 6, 6-3)
	Poor thermostat							○																○	○							Check or replace. (Refer to Chapter 6, 6-9)

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2. Inspection and adjustment

2.1 Periodic maintenance schedule

The engine periodic inspection timing is hard to determine as it varies with the application, load status, qualities of the fuel and lubricating oils used and handling status. General rules are described here.

○: User-maintenance ◎: Parts replacement ●: Shop-inspection

Classification	Item	Daily	Maintenance period				
			Every	Every 250	Every 500	Every 1000	Every 2000

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8. Disassembly and Reassembly

Peripheral parts such as air cleaner, muffler and radiator differ in installation and types for each application. Therefore, description in this Chapter is started with the steps to be taken just after the peripheral parts have been removed.

Perform the procedure, with reference to the attached drawings, "Engine component Exploded View."

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7. Measuring Procedure, Service Data and Corrective Action

In maintaining various parts, make measurement according to the following measurement procedure. If any trouble is found and if any part deviates from the standard size, replace it with a new one. However, if any part within the limit is expected to deviate from the standard presumably because of the record of its use, be sure to replace such a part beforehand.

7-1. Cylinder head

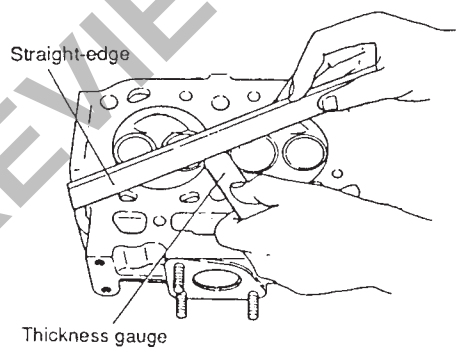
1. Distortion and inspection of the combustion surface

(1) Remove intake/exhaust valves and fuel injection valve from the engine. Clean the surface of the cylinder head.

(2) Place a straight-edge along each of the four sides and each diagonal of the cylinder head. Measure the clearance between the straight-edge and combustion surface with a thickness gauge.

(mm)

Cylinder head combustion surface distortion	Standard	Wear limit
All models	0.05 or less	0.15



(Measuring the combustion surface distortion)

(3) Visually check to see if the combustion surface is free from discoloration, cracks, and crazing. In addition, use the color check kit for cracks and crazing.

2. Intake/exhaust valve seats

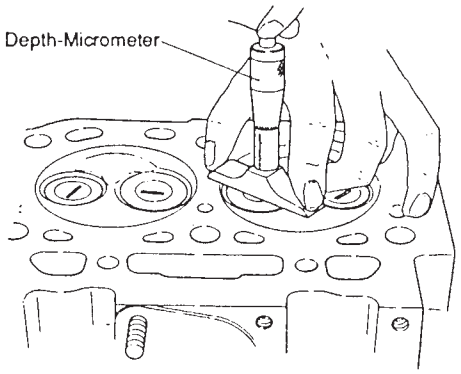
(1) Valve sinking

Over long periods of use and repeated lappings, combustion efficiency may drop. Measure the sinking depth and replace the valve and valve seat if the valve sinking depth exceeds the standard value.

(mm)

		2/3TNE68		3TNE74	
		Standard	Wear limit	Standard	Wear limit
Valve sinking depth	Intake valve	0.3~0.5	1.0	0.4~0.6	1.0
	Exhaust valve	0.75~0.95	1.0	VM:0.75~0.95 CH:0.40~0.60 VH:0.40~0.60	1.0

		3TNE78A 3TNE82A		3/4TNE82, 3/4TNE84(T), 3/4TNE88	
		Standard	Wear limit	Standard	Wear limit
Valve sinking depth	Intake valve	0.296 ~0.496	1.0	0.306 ~0.506	1.0
	Exhaust valve	0.3~0.5	1.0	0.3~0.5	1.0



(Measuring the valve sinkage)

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6. Measurement, Inspection and Adjustment

6-1. Measuring the compression pressure

1. Measuring Procedure

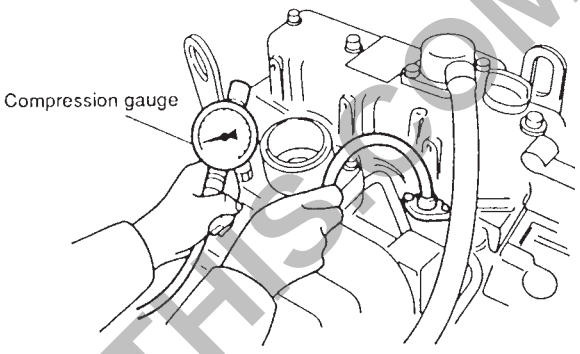
(1) Warm up the engine. Remove the fuel injection pipe and fuel injection valve from the cylinder to be measured.

(2) Crank the engine before attaching the compression gauge adapter.

∗ : *1. Crank the engine when the regulator handle has been turned to "STOP" position (no injection state).*
2. For the compression gauge and compression gauge adapter, refer to Chapter 5, 5-2.

(3) Attach the compression gauge adapter and compression gauge to the cylinder to be measured.

∗ : *Never fail to attach the gasket to the tip of the adapter.*



Measuring the compression pressure

(4) Crank the engine by the starting moter until the reading of the compression gauge is stabilized, by taking steps shown in (2), ∗1.

[Reference: List of Engine Compression Pressures]

Model	Compression pressure at 250 rpm (kgf/cm²)		Dispersion of compression pressure among cylinders (kgf/cm²)
	Standard	Limit	
2TNE68	33 ± 1	25	2 ~ 3
3TNE68	33 ± 1	25	2 ~ 3
3TNE74	35 ± 1	27	2 ~ 3
3TNE78A	32 ± 1	25	2 ~ 3
3TNE82A	31 ± 1	24	2 ~ 3
3TNE82	31 ± 1	24	2 ~ 3
3TNE84	33 ± 1	25	2 ~ 3
3TNE88	35 ± 1	27	2 ~ 3
4TNE82	31 ± 1	24	2 ~ 3
4TNE84	33 ± 1	25	2 ~ 3
4TNE88	35 ± 1	27	2 ~ 3
3TNE84T	30 ± 1	24	2 ~3
4TNE84T	30 ± 1	24	2 ~3

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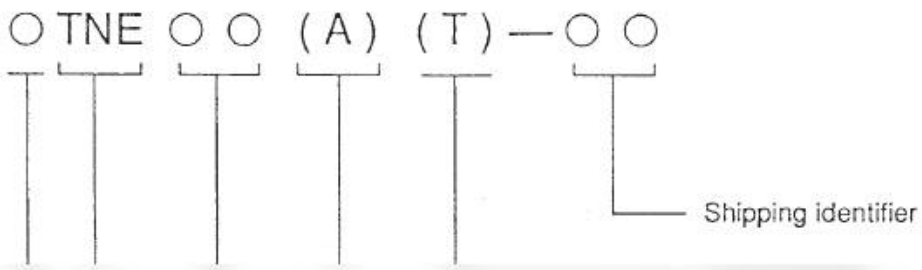
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○ Descriptive Breakdown of Model Name



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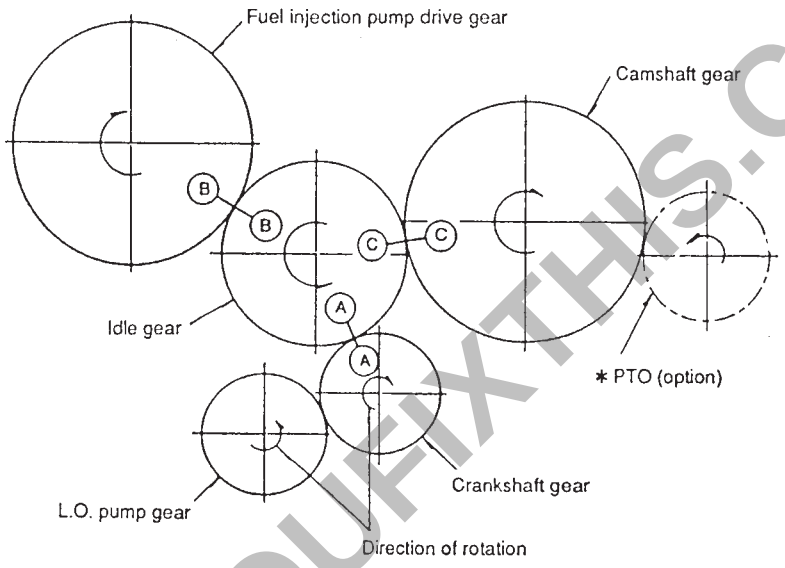
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4. Gear train

After installing each gear, make sure that aligning marks Ⓐ,Ⓑ and Ⓒ of the idle gear are aligned with those of the fuel injection pump gear, cam gear and crank gear.

(View the gear case)

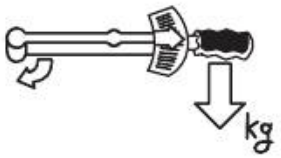


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(5) FASTENER TORQUE

⚠ WARNING



•Torquing Fasteners

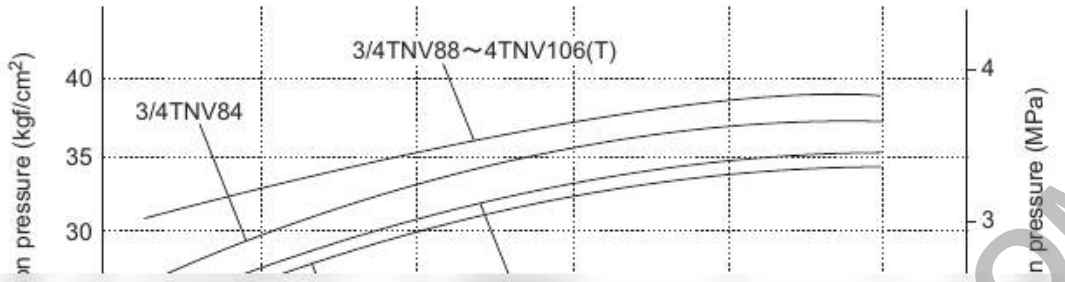
Always follow the torque values and procedures as designated in the service manual. Incorrect values, procedures and or tools may cause damage to the engine and or personal injury.

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(3) Engine speed and compression pressure (for reference)



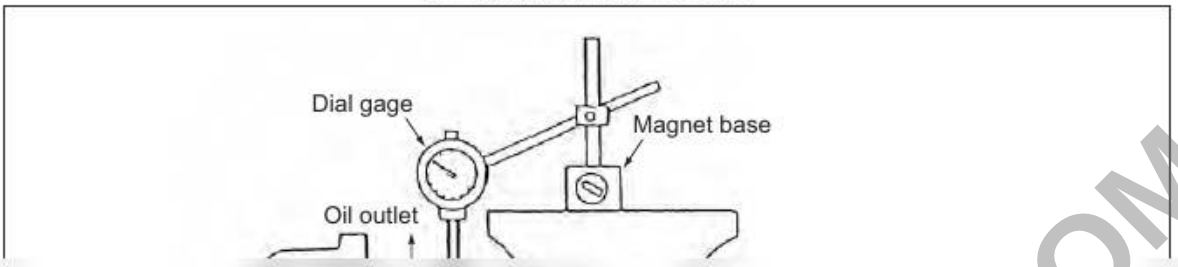
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8.3.3 Waste gate valve adjustment procedure

Rotor play in radial direction



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(2) Crankshaft

mm

Inspection item			Standard	Limit	Reference page
Bending (1/2 the dial gauge reading)			-	0.02	4.4.5.(2)
Crank pin	3TNV82A	Pin outside diameter	42.952 to 42.962	42.902	
		Metal inside diameter	43.000 to 43.042	-	
		Metal thickness	1.487 to 1.500	-	
		Clearance	0.038 to 0.090	0.150	
	TNV84 to 88	Pin outside diameter	47.952 to 47.962	47.902	
		Metal inside diameter	48.000 to 48.026	-	
		Metal thickness	1.492 to 1.500	-	
		Clearance	0.038 to 0.074	0.150	
	4TNV94L•98	Pin outside diameter	57.952 to 57.962	57.902	
		Metal inside diameter	58.000 to 58.026	-	
		Metal thickness	1.492 to 1.500	-	
		Clearance	0.038 to 0.074	0.150	
	4TNV106(T)	Pin outside diameter	63.952 to 63.962	63.902	
		Metal inside diameter	64.016 to 64.042	-	
		Metal thickness	1.984 to 1.992	-	
		Clearance	0.054 to 0.090	0.150	
Crank journal	3TNV82A	Journal outside diameter	46.952 to 46.962	46.902	
		Metal inside diameter	47.000 to 47.032	-	
		Metal thickness	1.987 to 2.000	-	
		Clearance	0.038 to 0.080	0.150	
	TNV84 to 88 Selective pairing	Journal outside diameter	53.952 to 53.962	53.902	
		Metal inside diameter	54.000 to 54.020	-	
		Metal thickness	1.995 to 1.990	-	
		Clearance	0.038 to 0.068	0.150	
	4TNV94L•98 Selective pairing	Journal outside diameter	64.952 to 64.962	64.902	
		Metal inside diameter	65.000 to 65.020	-	
		Metal thickness	1.995 to 2.010	-	
		Clearance	0.038 to 0.068	0.150	
	4TNV106(T) Selective pairing	Journal outside diameter	75.952 to 75.962	75.902	
		Metal inside diameter	76.014 to 76.034	-	
		Metal thickness	2.488 to 2.503	-	
		Clearance	0.052 to 0.082	0.150	

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