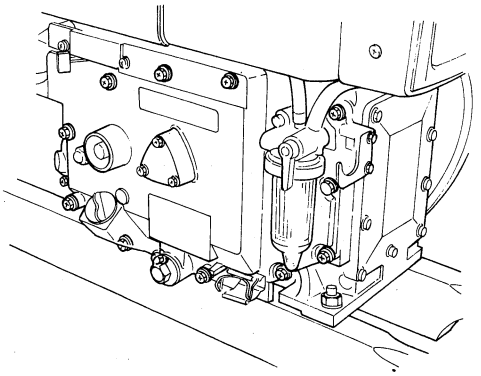
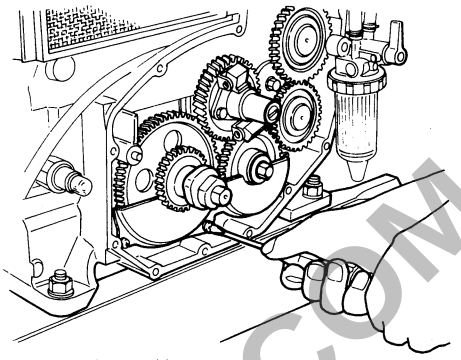
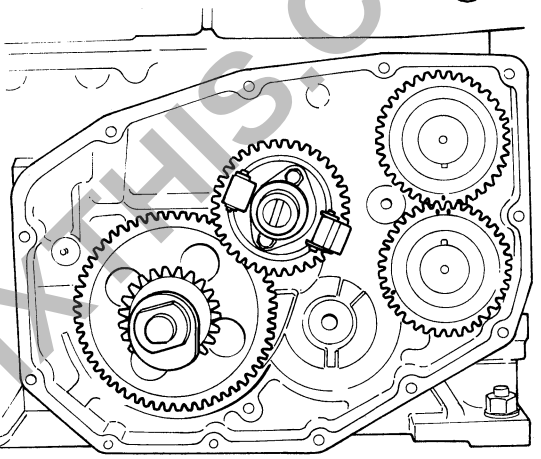
14. Take off the gear housing.

1) Remove the fuel filter attaching bolts. (Leave the inlet and outlet pipes of the fuel filter attached.)
2) Remove the gear housing bolts. (Check whether all bolts at the bottom are removed.)

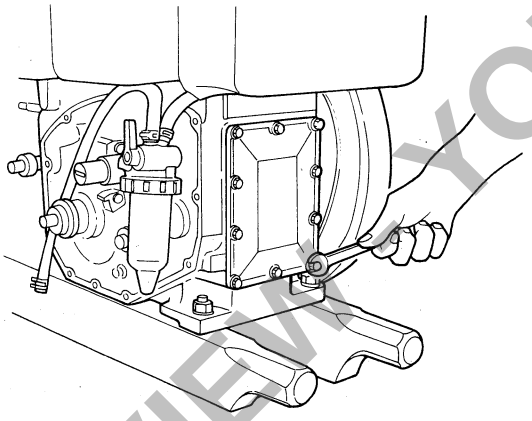


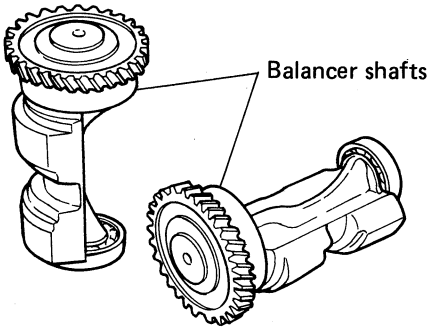




15. Take off the cylinder rear cover.

○ *The cover uses liquid sealant.*





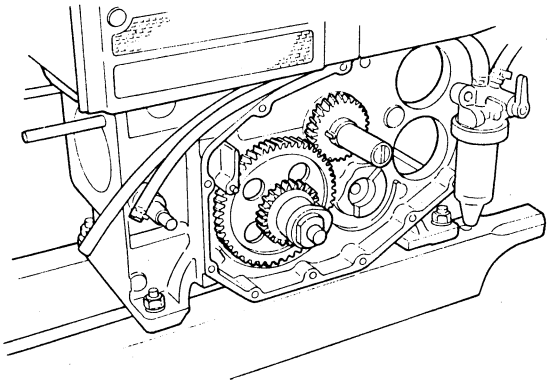
(except TF50, TF60, TF70)

16. Pull out the balancer shaft.

1. Remove the gear cover.
2. Remove the idle gear.
3. Remove the balancer shaft bearing retainer.
4. Pull out the balancer shafts.

○ *Balancer shaft timing marks.*
1 on the upper
3 on the lower

○ *Use a mallet or a plastic hammer to pull out the balancer shaft.*



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5. Main Bolt/Nut Tightening Torques

Unit: kg-m

Name of parts	TF50	TF60, TF70	TF80, TF90	TF110, TF120	TF140, TF160
Balance weight bolt	4.50 – 5.50	←	←	←	8.3 – 9.3
Fuel cam tightening nut	9.00 – 11.00	←	←	←	←
Fuel pump clamping nut	2.30 – 2.90	←	←	←	←
Fuel injection valve retaining nut	2.00	←	←	←	2.3 – 2.9
High-pressure cap nut	2.60 – 3.00	2.70 – 3.30	←	←	←

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9. Troubleshooting

Trouble and possible cause	Remedy
Insufficient output	
1. Reduction in compression pressure	
(1) Improper intake/exhaust valve clearance	Adjust to the proper clearance (0.2 mm)
(2) Poor contact of intake/exhaust valve seat	Re-fit valve and seat.
(3) Valve stem seizing	Repair or replace valve stem.
(4) Damaged or broken valve spring	Replace spring.
(5) Pressure leak through cylinder head gasket	Replace gasket.
(6) Broken or sticking piston ring	Replace piston ring.
(7) Worn piston ring or liner	Disassemble and repair engine.
2. Incorrect fuel injection system	
(1) Poor injection timing	Adjust injection timing.
(2) Defective nozzle	Repair or replace nozzle.
3. Incorrect fuel system	
(1) Clogging in fuel strainer element	Replace element.
(2) Air bubbles in fuel system	Bleed the fuel system.
(3) Contamination in tank	Clean the tank.
(4) Oil leakage in fuel injection pipe	Tighten or replace injection pipe.
(5) Poor fuel flow in fuel injection pump	Repair the pump by disassembly.
(6) Poor fuel injection caused by improperly adjusted governor linkage.	Readjust the governor linkage.
4. Poor air inflow	
(1) Clogging in air cleaner element	Wash with water or replace element.
(2) Excessive intake/exhaust valve clearance	Adjust to the proper clearance (0.2 mm).
5. Overheating	
(1) Wrong engine oil	Switch to the specified engine oil.
(2) Insufficient cooling water	Add water.
(3) Worn or broken V-belt	Adjust or replace belt.
(4) Clogging or leakage in radiator	Repair, clean or replace radiator.
(6) Improper intake/exhaust valve clearance	Adjust to the proper clearance (0.2 mm).
(7) Excess back pressure in exhaust system	Clean out or replace exhaust system.
(8) Inaccurate injection timing	Adjust the injection timing after checking.
6. Excessive engine oil consumption	
(1) Loose gearcase bolt or drain plug	Increase the tightening torque.
(2) Deteriorated crankshaft oil seal	Replace oil seal.
(3) Defective cylinder head bonnet gasket packing	Replace gasket packing.
(4) Wear of intake/exhaust valve or valve guide	Replace valve or valve guide.
(5) Broken piston ring	Replace piston ring.
(6) Incorrect position of piston ring end gaps	Adjust ring position.
(7) Worn or sticking piston ring	Replace piston or piston rings.
(8) Piston ring fitted in opposite position	Fit to the correct position
(9) Worn piston or cylinder liner	Replace piston or cylinder liner

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8. Maintenance Schedule

System	Item	Daily	Every 100 hrs.	Every 300 hrs.	Every 600 hrs.
Fuel system	Fuel level check and refilling	○			
	Fuel tank draining		○		
	Fuel filter element cleaning	(If the deposited water raises the float, remove the bowl to drain the water on completion of work.)		○	

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3. Specifications

3-1 Specifications of engine with radiator and hopper

Model	Unit	TF50	TF50-H	TF60	TF60-H	TF70	TF70-H	TF80	TF80-H	TF90	TF90-H	TF110	TF110-H	TF120	TF120-H	TF140	TF140-H	TF160	TF160-H
Type		Horizontal, water-cooled 4-cycle diesel																	
Combustion system		Direct injection																	

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4. Service Standards

Unit: mm

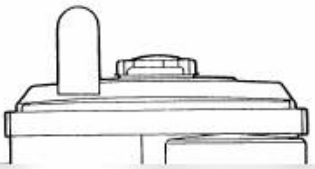
Division	Component	Item		TF50		TF60, TF70		TF80, TF90		TF110, TF120		TF140, TF160		Corrective Action
				Standard	Limit	Standard	Limit	Standard	Limit	Standard	Limit	Standard	Limit	
Engine main part	Cylinder head	Cylinder head combustion surface distortion		0.03 or less	0.05	0.03 or less	0.05	0.03 or less	0.05	0.03 or less	0.05	0.03 or less	0.05	Correct with a surface grinder
		Valve seat angle (deg.)	Intake	120°	–	120°	–	120°	–	120°	–	120°	–	
			Exhaust	90°	–	90°	–	90°	–	90°	–	90°	–	
		Top clearance		0.56 ~ 0.74	– –	TF60 0.56–0.74 TF70 0.56–0.74	– –	TF80 0.65–0.85 TF90 0.65–0.86	– –	TF110 0.70–0.90 TF120 0.70–0.90	– –	TF140 0.75–0.95 TF160 0.75–0.95	– –	
	Piston	Cylinder liner to-piston clearance		0.079 ~ 0.139	0.30	TF60 0.094–0.154 TF70 0.100–0.160	0.30 0.31	TF80 0.103–0.163 TF90 0.113–0.178	0.32 0.34	TF110 0.121–0.186 TF120 0.129–0.194	0.35 0.37	TF140 0.112–0.177 TF160 0.120–0.185	0.34 0.35	
		Piston pin bore diameter		ϕ22.000–ϕ22.009	ϕ22.029	ϕ23.000–ϕ23.009	ϕ23.029	ϕ26.000–ϕ26.009	ϕ26.029	ϕ28.000–ϕ28.009	ϕ28.029	ϕ32.000–ϕ32.011	ϕ32.031	Replace if beyond limit
		Piston pin bore-pin clearance		0–0.018	0.045	0–0.018	0.045	0–0.022	0.045	0–0.022	0.045	0–0.022	0.045	
	Piston pin outside diameter			ϕ21.991–ϕ22.000	ϕ21.950	ϕ22.991–ϕ23.000	ϕ22.950	ϕ25.987–ϕ26.009	ϕ25.960	ϕ27.987–ϕ28.000	ϕ27.960	ϕ31.989–ϕ32.000	ϕ31.960	Replace if beyond limit
	Piston ring	Piston ring end gap	No. 1	0.25–0.45	1.5	TF60 0.20–0.40 TF70 0.20–0.40	1.5	TF80 0.20–0.40 TF90 0.30–0.50	1.5	0.30–0.50	1.5	0.30–0.50	1.5	Replace if beyond limit
			No. 2, 3	0.25–0.45		0.20–0.40		0.30–0.50		TF110 0.25–0.45 TF120 0.30–0.50		0.30–0.50		
			Oil	0.10–0.30		0.20–0.40		0.30–0.50				0.30–0.50		
		Ring-to-groove clearance	No. 1	0.070–0.105	0.2	0.095–0.130	0.2	0.095–0.130	0.2	0.095–0.130	0.2	0.095–0.130	0.2	
			No. 2, 3	0.045–0.080	0.15	0.070–0.105		0.050–0.085		0.050–0.085		0.050–0.085		
			Oil	0.20–0.055	0.15	0.020–0.055	0.15	0.020–0.055	0.15	0.020–0.055	0.15	0.025–0.060	0.15	
	Connecting rod	Crank pin bearing inside diameter		ϕ36.000–ϕ36.042	ϕ36.1	ϕ43.000–ϕ43.042	ϕ43.1	ϕ45.000–ϕ45.042	ϕ45.1	ϕ48.001–ϕ48.038	ϕ48.1	ϕ54.000–ϕ54.045	ϕ54.1	Replace the crankpin bearing
		Crank pin-to-bearing clearance		0.018–0.077	0.1	0.028–0.086	0.1	0.028–0.086	0.1	0.028–0.086	0.1	0.022–0.092	0.1	
		Crank pin bearing surface		–	–	–	–	–	–	–	–	–	–	Replace if improperly surface
		Piston pin-bearing inside diameter		ϕ22.025–ϕ22.038	Φ22.1	ϕ23.025–ϕ23.038	ϕ23.1	ϕ26.025–ϕ26.038	ϕ26.1	ϕ28.025–ϕ28.038	ϕ28.1	ϕ32.030–ϕ32.050	ϕ32.1	Replace the piston pin bearing
		Piston pin-to-bearing clearance		0.025–0.047	0.10	0.025–0.047	0.11	0.025–0.051	0.11	0.025–0.051	0.11	0.030–0.061	0.12	
		Thrust clearance		0.2–0.4	0.6	0.2–0.4	0.6	0.2–0.4	0.6	0.2–0.4	0.6	0.2–0.4	0.6	
		Bent or twisted rod		–	0.08/100	–	0.08/100	–	0.08/100	–	0.08/100	–	–	Replace if beyond limit
	Cylinder liner	Cylinder liner inside diameter		ϕ74.000–ϕ74.030	ϕ74.18	TF60 ϕ75.000–ϕ75.030 TF70 ϕ78.000–ϕ78.030	TF60 ϕ75.22 TF70 ϕ78.23	TF80 ϕ80.000–ϕ80.030 TF90 ϕ85.000–ϕ85.035	TF80 ϕ80.18 TF90 ϕ85.19	TF110 ϕ88.000–ϕ88.035 TF120 ϕ92.000–ϕ92.035	TF110 ϕ88.20 TF120 ϕ92.21	TF140 ϕ96.000–ϕ96.035 TF160 ϕ102.000–ϕ102.035	TF140 ϕ96.22 TF160 ϕ102.23	Replace if beyond limit
		Cylinder liner projection		0.020–0.080	–	0.02–0.08	–	0.02–0.08	–	0.02–0.08	–	0.02–0.08	–	
	Cylinder block	Distortion of head combustion surface		0.05 or less	–	0.05 or less	–	0.05 or less	–	0.05 or less	–	0.05 or less	–	Re-fit with surface grinder
	Main bearing	Main bearing		–	–	–	–	–	–	–	–	–	–	1. Ensure smooth and noiseless rotation 2. Replace if rotation is rough and noisy
	Crank shaft	Crank pin outside diameter		ϕ35.965–ϕ35.982	ϕ35.89	ϕ42.956–ϕ42.972	ϕ42.88	ϕ44.956–ϕ44.972	ϕ44.88	ϕ47.952–ϕ47.973	ϕ47.88	ϕ53.953–ϕ53.978	ϕ53.953	Replace if beyond limit
		Crankshaft side gap		0.02–0.45	–	0.01–0.21	–	0.56–1.09	–	0.66–1.24	–	1.02–1.61	–	
		Crankshaft to crank pin bearing clearance		0.018–0.077	0.1	0.028–0.086	0.1	0.028–0.086	0.1	0.028–0.086	0.1	0.022–0.092	0.1	
		Worn oil seal		–	–	–	–	–	–	–	–	–	–	1. Check for oil leakage 2. Replace if oil leaks

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6.4. Disassembly

1. **Drain out the cooling water.**
   Remove the radiator cap. Open the drain cock at the bottom of the cylinder head.



4. **Remove the air cleaner together with the intake pipe.**

5. **Remove the exhaust muffler.**

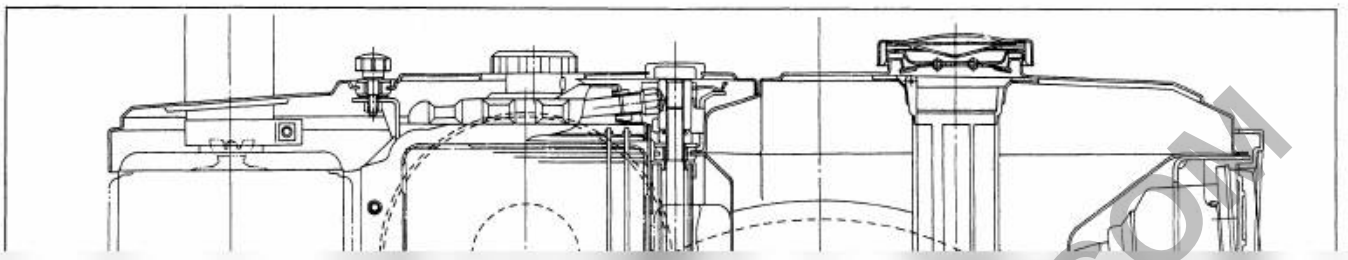


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