



C1.1 Power Unit Manual (Tier 4)

Version 82525

C1.1 Manual
Hydraulic Trip Power Unit for V72 to V100
Auxiliary device power unit



28 horse power (21kW)
13 gallons per minute flow
Max Torque 49.4 ft-lb @ 2400 rpm (67Nm)
2,700 PSI (standard setting)
Dual Aux Control



C1.1 Power Unit Manual

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C1.1 Power Unit Manual

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C1.1 Power Unit Manual

WARRANTY INFORMATION

General Information

Antaeus Foundation Equipment, Inc. (Antaeus) warrants that its new products are free from defects in materials and workmanship for a period of one (1) year from the date of delivery (unless a longer or shorter term warranty was agreed on as written in the purchase agreement) to the original purchaser, subject to the following terms:

Scope of Liability: Antaeus' responsibility under this warranty is strictly limited to, at Antaeus' discretion, the repair or replacement of any parts found to be defective in materials or workmanship after inspection. Such repairs or replacements will be provided at no cost to the user and will be carried out either at Antaeus' facility or by an authorized Antaeus distributor during normal business hours.

Exclusions: This warranty does not cover components or accessories not manufactured by Antaeus, as these items are subject to the warranty of their respective manufacturers. It also does not apply to routine maintenance items (such as engine tune-ups) or consumable parts (such as filters).

Replacement Parts: Any parts replaced or repaired under this warranty are covered only for the balance of the original warranty period, as if they were original components of the product.

Limitations: No other warranties, whether expressed or implied, are provided. Antaeus specifically disclaims any implied warranties of merchantability or fitness for a particular purpose.

Additional Exclusions: This warranty does not include transportation charges, installation costs, downtime, taxes, or any other incidental, indirect, or consequential damages or delays.

Return of Products: If requested by Antaeus, any products or parts covered by this warranty must be returned prepaid, with transportation arranged and paid for by the customer.

Hydraulic oil used in Antaeus equipment must meet the ISO 4406 Cleanliness Code 17/15/11.

Use of oil that does not meet this standard will void the warranty.

Improper use of the equipment—including but not limited to operating with known defective or worn parts, exceeding rated capacity, using unauthorized replacement parts, or performing repairs or modifications not approved by Antaeus—will result in the warranty being voided if such actions are determined by Antaeus to negatively impact the product.

Any welding performed on Antaeus equipment without prior written approval from Antaeus will void the warranty.

Only written authorization signed by an officer of Antaeus may modify or extend this warranty. No employee is permitted to alter the terms or grant additional warranties verbally or otherwise.



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Warnings and Safety

Warnings and Safety



GENERAL SAFETY WARNING
Read and understand the operator's manual before using this equipment. Failure to follow safety instructions may result in serious injury or death. Always wear appropriate personal protective equipment (PPE).



HYDRAULIC FLUID HAZARD
Hydraulic systems are under high pressure. Leaking fluid can penetrate the skin and cause serious injury, including blood poisoning or loss of limb. Seek immediate medical attention if fluid is injected into the skin. Do not inspect hydraulic leaks with your hands.



NOISE HAZARD
Equipment may produce noise levels that exceed permissible exposure limits. Prolonged exposure can cause hearing loss. Always wear hearing protection when operating or working near this equipment.



CRUSHING / PINCH HAZARD
Stay clear of moving parts, suspended loads, and pinch points. Contact with moving components may result in severe injury or death. Never position yourself under or near a raised load.



DIESEL EXHAUST WARNING
Diesel engine exhaust and many of its constituents are known to cause cancer, birth defects, and other reproductive harm. Avoid breathing exhaust fumes. Operate only in well-ventilated areas.



MODIFICATION WARNING
Unauthorized modifications, welding, or use of non-approved parts may compromise safety, cause equipment failure, and void the warranty. Only use Antaeus-approved components and follow factory guidelines.

	WARNING
	<p>California Proposition 65</p> <p>Warning: This product contains chemicals known to the State of California to cause cancer, and birth defects or other reproductive harm.</p> <p>www.P65Warnings.ca.gov</p>



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Warnings and Safety



Warnings and Safety

1. Authorized Personnel Only

Only individuals who are properly trained, experienced, and qualified should operate or maintain this equipment.

2. No Service During Operation

Never adjust, lubricate, or perform repairs while the unit is running or when it is suspended above the ground.

3. Maintain Safety Labels

Do not remove, obscure, or paint over safety or warning labels. Replace any label that is missing, damaged, or unreadable immediately.

4. Required Personal Protective Equipment (PPE)

All personnel working near this equipment must wear approved PPE, including:

- **Hard Hat**
- **Safety Footwear**
- **Safety Glasses**
- **Hearing Protection**

5. Maintain Safe Distance

Stay as far from the operating equipment as practical. Components can loosen and fall—never position yourself beneath equipment that is running or elevated.

6. Approved Replacement Parts Only

When repairing or maintaining the unit, use only parts supplied by, or approved in writing by, APE. Substitutions are not permitted.

NOTICE

No Welding or Flame Cutting

Do not weld, flame cut, or apply heat to this equipment.

7. Flammable Liquids Prohibited

Never store or use flammable liquids on or near the engine.

8. Properly Rated Lifting Gear

Ensure all lifting equipment—cranes, wire ropes, slings, hooks, shackles, etc.—is rated for the maximum anticipated loads.

9. Contact Before Operation if in Doubt

If unsure about the unit's weight, specifications, or performance, consult APE before lifting, handling, or operating the equipment.

10. Daily Wire Rope Inspection

Check all wire rope clips for tightness and inspect wire ropes for wear before each day's operation.

11. Control Ground Vibrations

Verify that vibrations from operation will not cause damage to or collapse nearby structures or excavations.

DANGER

DANGER



NOTICE



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Warnings and Safety



Warnings and Safety

Operating & Maintenance Safety Guidelines

- 12. Ventilate Enclosed Areas**
When operating in enclosed spaces, route exhaust fumes to the outside. Inhalation of exhaust gases can be fatal.
- 13. Clear the Work Area Before Start-Up**
Remove all tools, parts, and electrical cords before starting the unit.
- 14. Battery Safety**
Do not smoke or use open flames near batteries.
Batteries release explosive gases during charging—ensure adequate ventilation.
- 15. Fueling Precautions**
Do not smoke or use open flames when filling the fuel tank.
- 16. Respond to Abnormal Operation Immediately**
If the equipment operates abnormally, stop use at once and correct the problem before resuming.
- 17. Control Pendant Security**
Never leave the control pendant (including radio control) unattended. (If your unit is equipped with a remote pendant)
- 18. Oily Rag Storage**
Store oily rags only in approved containers, well away from the engine exhaust system.
- 19. Auger/Drill Start-Up**
Before starting the Power Unit engine, ensure the auger rotation switch is in NEUTRAL. (if your unit has a pendant)
- 20. Hydraulic Pressure Settings**
Do not adjust hydraulic pressures outside the specifications listed in this manual.
- 21. Hydraulic Hose Safety**
Never operate with damaged or kinked hoses—replace immediately.
Do not lift or support hydraulic hoses using wire rope slings.
Quick Disconnect (QD) Connections
- 22. Never connect QDs while the Power Unit is running.**
Moving Equipment
Do not pull or attempt to move equipment by the hydraulic hoses.
- 23. Hydraulic Leak Safety**
Never use your hands to check for leaks—high-pressure fluid can penetrate the skin and cause severe injury, poisoning, or infection.
Do not attempt leak repairs while the equipment is operating.
Do not tighten or loosen fittings or hoses when the unit is running.
- 24. Equipment Stability**
Always position the Power Unit on level, stable ground.

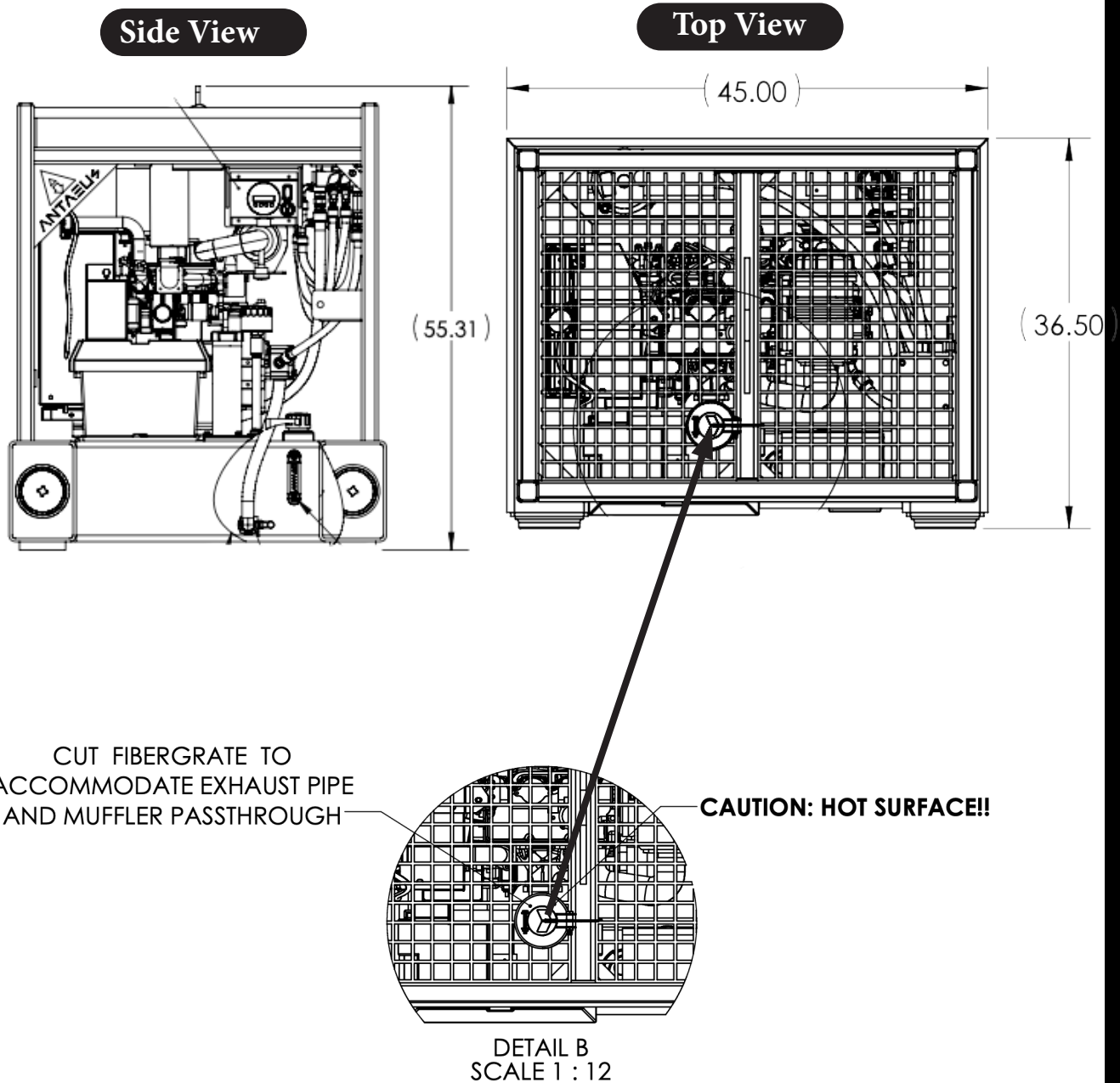




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Dimensions

General Information

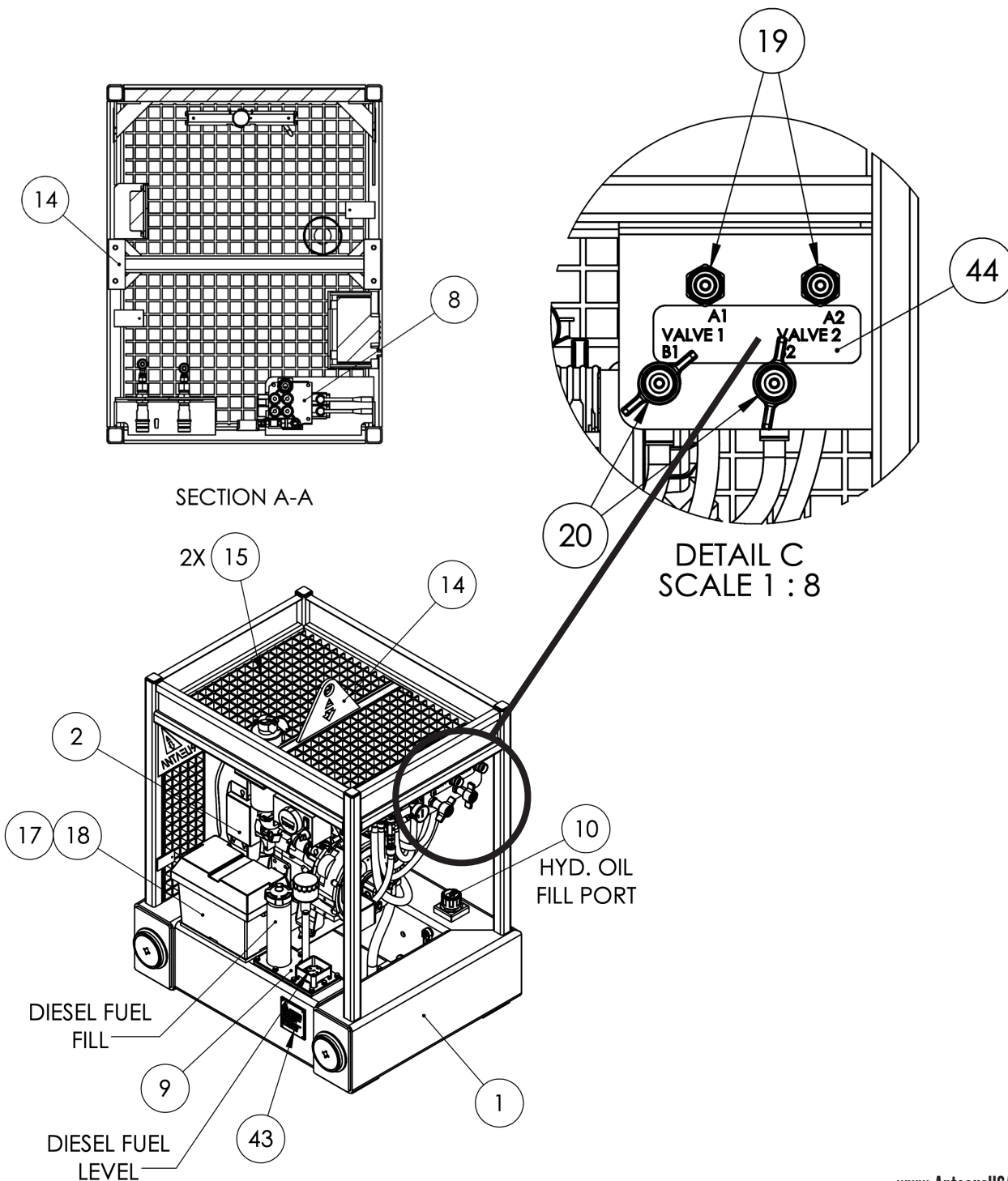




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Parts List

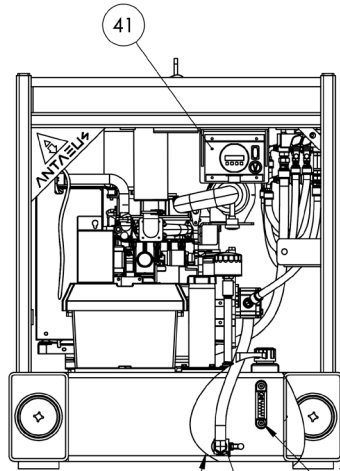




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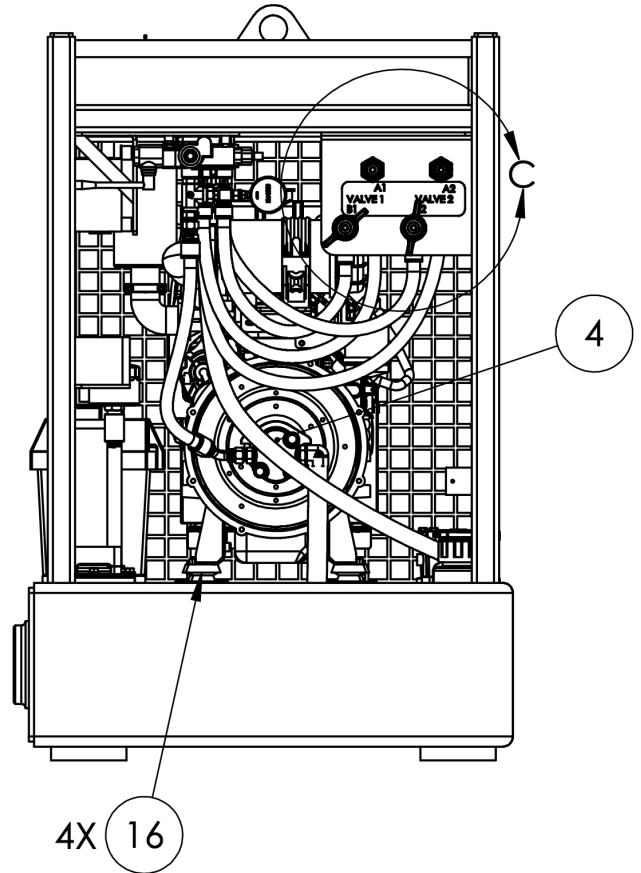
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Parts List

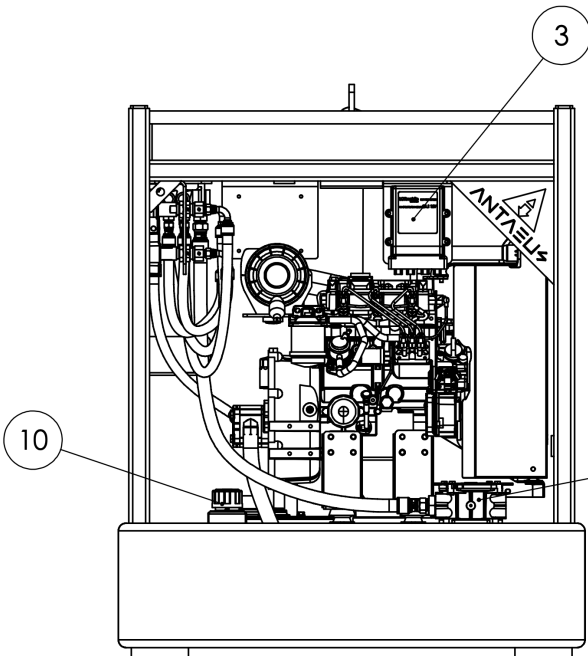


BROKEN-OUT SECTION
DETAILING S.G. & SUCTION PORT
ON INSIDE OF FRAME

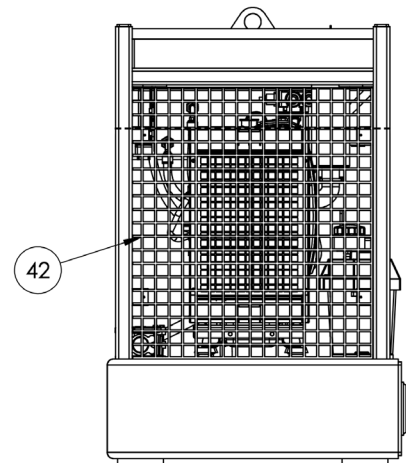
13 11
35 HYD. OIL
LEVEL GAUGE



4X 16



12 5
FILTIR ELEMENT
PG. 3

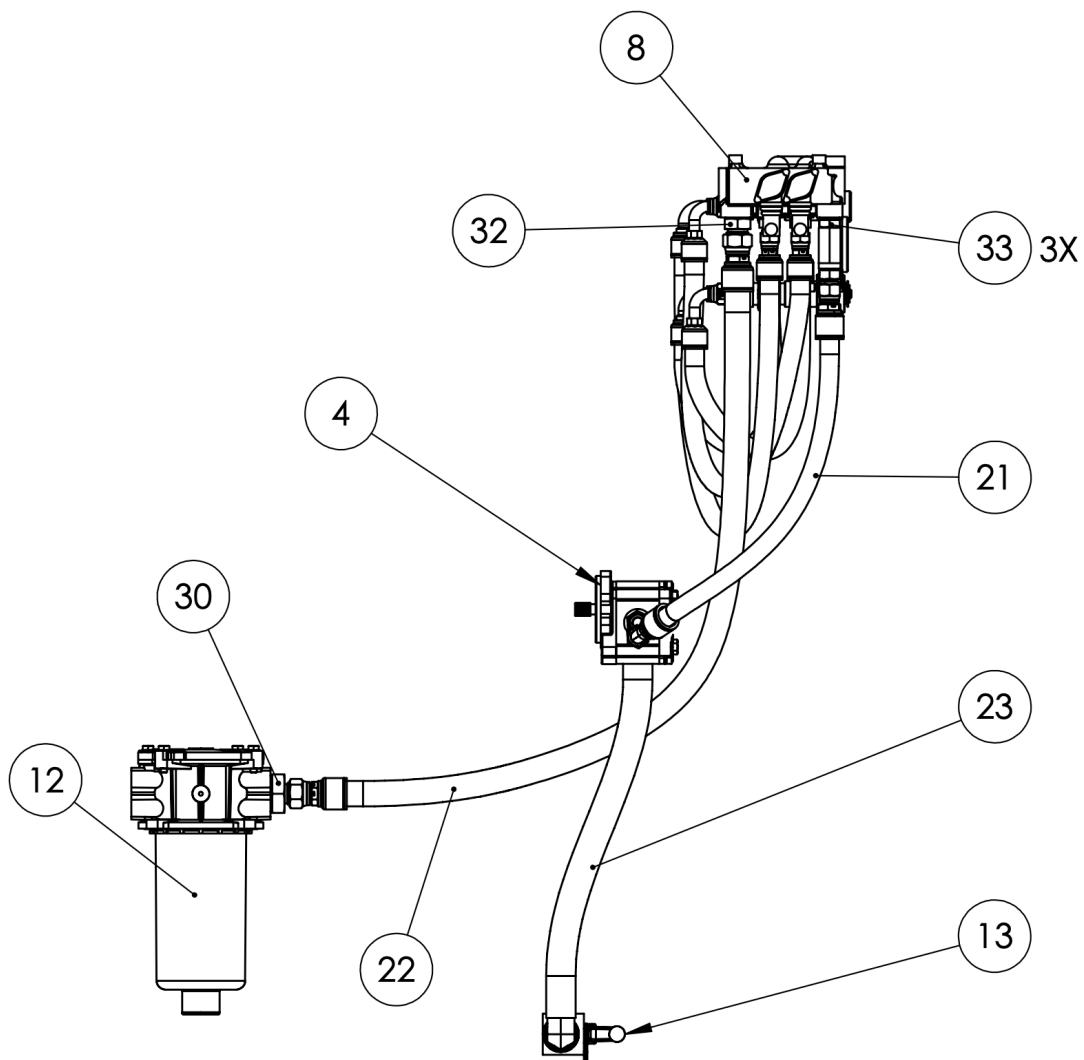




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Parts List

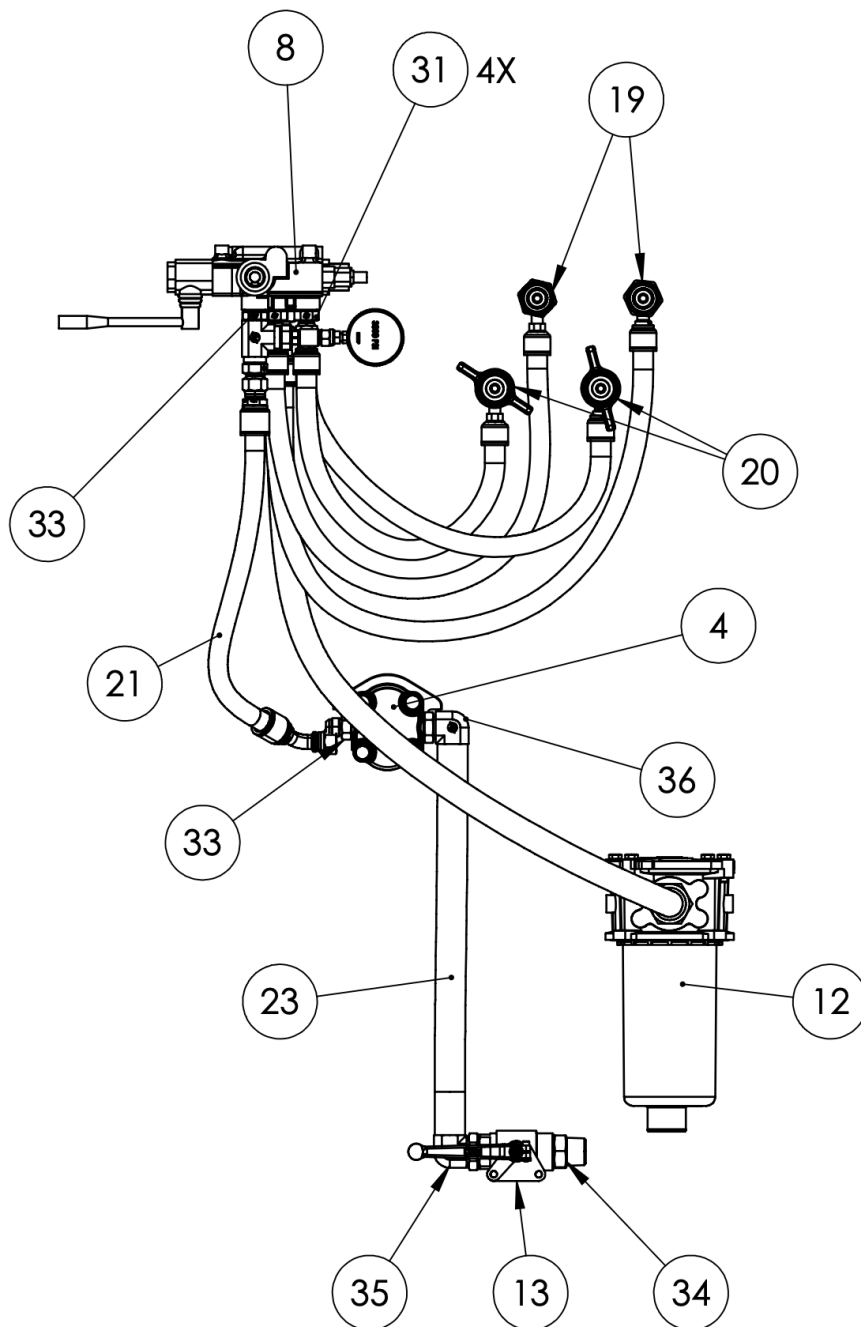




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Parts List

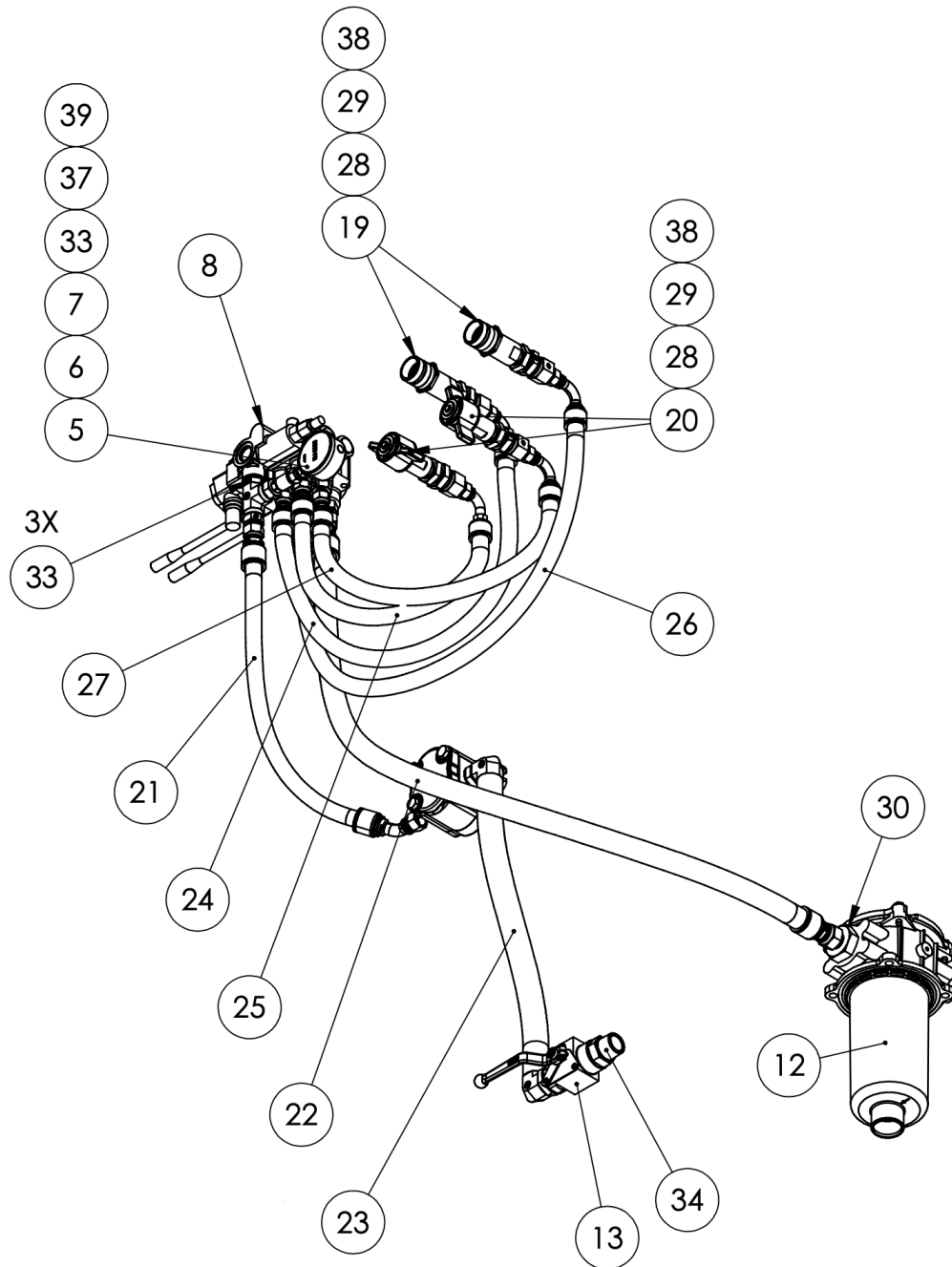




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Parts List





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Parts List

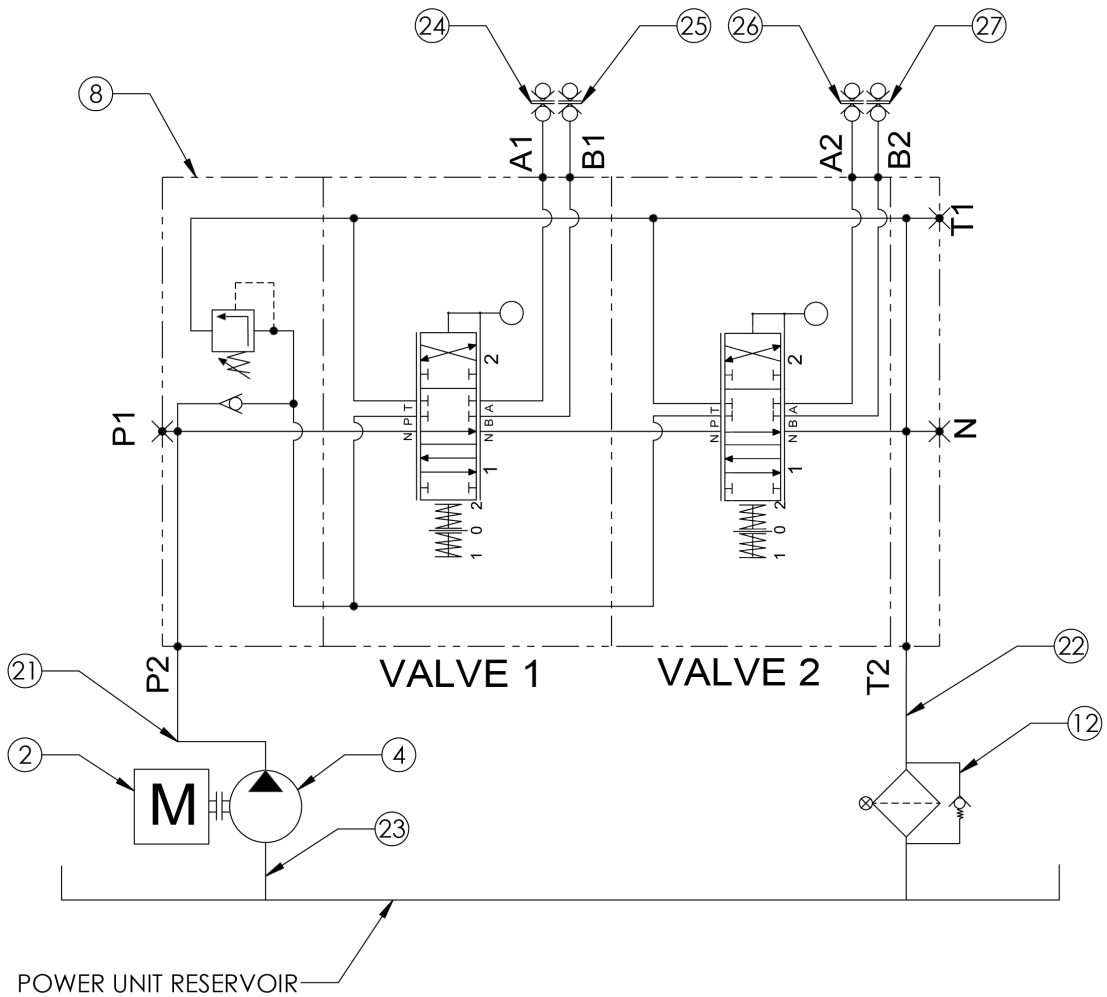
ITEM#	DESCRIPTION	PART NUMBER	QTY.	Q.C.
1	2240691 FULL FRAME ASSY	FDPI, 224069-1 FULL FRAME ASSY	1	
2	C1.1 DIESEL ENGINE, 28.2 HP	CAT, C1.1 5873682	1	
3	C1.1 12V POWER DIST. MODULE	LOR, C1.1 12V PDM	1	
4	MAGISTER, 1.22 CID GEAR PUMP, 9-TOOTH SPLINE, SAE12-INLET, SAE10-OUTLET,CW	MAGISTER, HGP C109S-A02-122R	1	
5	GAUGE, STAUFF, PRESSURE, 2.5IN, 0-3000 PSI, -4 MORB	STAUFF, SPG-063-03000-05-S-U04	1	
6	STAUFF Test 20 - Connection M16x2, Direct gauge adaptor for SMD	STAUFF, SMD20-7/16 UNF-W3	1	
7	#4 MORB TEST COUPLING	STAUFF, SMK20-7/16UNF-W3	1	
8	4/3 OPEN CENTER 3 POSITION SPRING CENTER 3600 PSI DCV	MAGISTER, HCV 2X21	1	
9	FUEL HATCH ASSEMBLY	FDPI, 224069-1 FUEL HATCH ASSY	1	
10	BREATHER, FDP .3 BAR	FDP, TA80B10A102P03	1	
11	FDP 5" SG (LVA20TAPU12S01) -1/2-13	FDPI, LVA20TAPU12S01	1	
12	FILTER ASSEMBLY, RETURN, -24 / -20 ORB, 10 MICRON	MPFILTRI, MPF1841AG11A10HB1ST	1	
13	BVAL1000S4321AZZN	DMIC, BVAL1000S4321AZZN	1	
14	REMOVABLE CROSS MEMBER/LIFTING EYE	224069-1 REMOVABLE CROSS MEMBER	1	
15	1.5IN FIBERGRATE	224069-1 FIBERGRATE	2	
16	Anti-Vibration Rubber Mount (DM 0)	AV Products, DM 0	4	
17	1/2" BATTERY TAP PAD	224069-1 BATTERY TAP PAD	1	
18	BATTERY BOX, NOCO, HM327	NOCO, HM327BK	1	
19	3/4" BRASS WING STYLE SCREW TO CONNECT COUPLING, MALE	DNP, VFF-12-12N	2	
20	3/4" BRASS WING STYLE SCREW TO CONNECT COUPLING, FEMALE	DNP, VFF-12-12C	2	
21	HOSE ASSY, 3000 PSI HOSE, 20IN CL, -10 FJIC HOSE END, -10 FJIC 90° HOSE END	RYCO, T3010D*20IN CL*T2040-1014*T2250-1014	1	
22	HOSE ASSY, -12 3000 PSI HOSE, -12 FJIC HOSE END, -12 FJIC HOSE END	RYCO,T3012D* 50IN CL* T2040-1217* T2040-1217	1	
23	HOSE ASSY. SRX-16*19IN CL*TBC-150 X 4	RYCO, SRX-16*19IN CL*TBC-150 X 4	1	
24	VALVE A1 HOSE ASSY, -08 4000 PSI HOSE, 31IN CUT, -08FJIC HOSE END, -08 FJIC 90° HOSE END	RYCO, T4008D*31" CL*T2040-0812*T2240-0812	1	
25	VALVE B1 HOSE ASSY, 4000 PSI HOSE, 21 IN CUT, -08 FJIC HOSE END, -08 FJIC 90° HOSE END	RYCO, T4008D*21" CL*T2040-0812*2240-0812	1	
26	VALVE A2 HOSE ASSY, 4000 PSI HOSE, 35.5" CUT, -08 FJIC HOSE END, -08 FJIC 90° HOSE END	RYCO, T4008D*35.5" CL*T2040-0812*T2240-0812	1	
27	VALVE B2 HOSE ASSY, 4000 PSI HOSE, 24" CUT, -08 FJIC HOSE END, -08 FJIC 90° HOSE END	RYCO, T4008D*24" CL*T2040-0812*T2240-0812	1	
28	FITTING, 12MP-12MJ Bulkhead Straight	BRENNAN, 2706-12-12	4	
29	FITTING, 12JIC BULKHEAD LOCK NUT	BRENNAN, 0306-12	4	
30	FITTING, STRAIGHT, 20ORB-12JICM	BRENNAN, 6400-12-20-O	1	
31	FITTING, -8 MJIC x -10 MORB STRAIGHT	BRENNAN, 6400-08-10-O	4	
32	FITTING, STRAIGHT, -12MB-12MJ	BRENNAN, 6400-12-12-O	1	
33	FITTING, -10MJIC X -10MORB	BRENNAN, 6400-10-10-O	2	
34	FITTING, 16MB X 16MP	BRENNAN, 6401-16-16-O	1	
35	FITTING, ELBOW, -16 BARB X -16 ORBM, 90	BRENNAN, 4601-16-16-NWO-FG	1	
36	FITTING, ELBOW, -16HB X -12MB, 90 DEGREE	BRENNAN, 4601-16-12-NWO-FG	1	
37	FITTING, -10 MORB-10 FORB Straight Reducer	BRENNAN, 6410-10-04-O	1	
38	FITTING, 12FJ-08MJ STRAIGHT REDUCER (NON-SWIVEL)	BRENNAN, 2406-12-08	4	
39	FITTING, TEE, -10MB X -10FB X -10FB, MALE ON RUN	BRENNAN, 6835-10-10-10-NWO-FG	1	
40	CONTROL MODULE MOUNT ASSY. 1/4" PICKLED	224069-1 CONTROL MODULE MOUNT ASSEMBLY	1	
41	MVP SERIES ELECTRONIC ENGINE CONTROL ENCLOSURE, CONTROLS INC.	MVP-L3100 REV 5.0, CONTROLS INC.	1	
42	1.5IN FIBERGRATE	224069-1 FIBERGRATE RADIATOR COVER	1	
43	224069-1 HPU NAME PLATE	224069-1 ANTAEUS HPU NAMEPLATE PLACARD	1	
44	VALVE ID TAG	224069-1 VALVE TAG	1	



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Hydraulic Schematic

Hydraulic Schematic



NOTES:

1. 132 TOOTH FLY WHEEL(FOR SETTING RPM)
2. RPM SETTING - 2250
3. HYDRAULIC PRESSURE - 2750 PSI
4. GPM - 13
5. FILTER MEETS HF4 AUTOMOTIVE STANDARD(MP FILTRI - MF1801A10HBP01 or SCHROEDER - KZ10)



C1.1 Power Unit Manual

Operations

Operations

Hydraulic Trip System Overview

The hydraulic trip initiates the diesel hammer by raising a cylinder located at the rear of the hammer, which engages the trip mechanism. This system, referred to as the hydraulic trip, is designed to provide a reliable and consistent start.

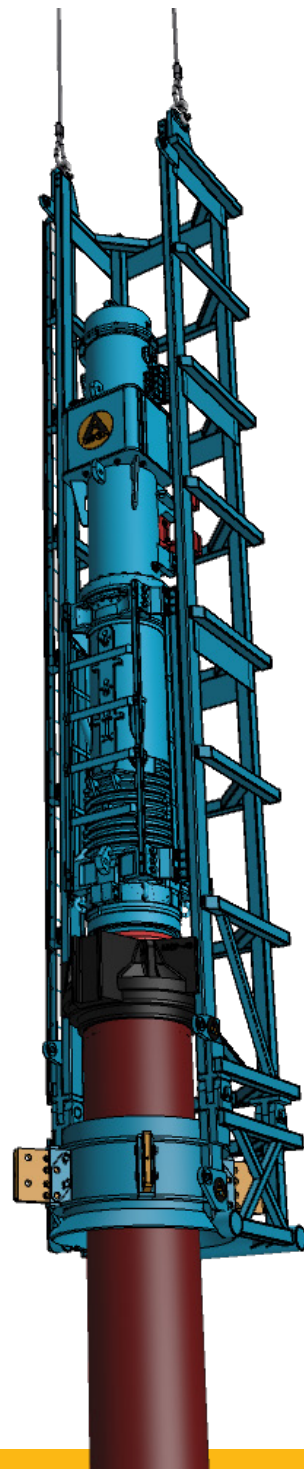
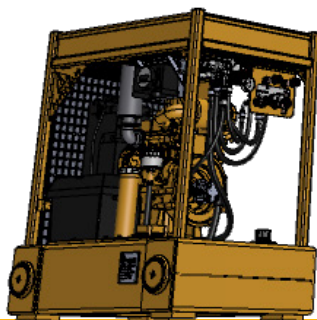
Antaeus employs a push-style design, where the hydraulic cylinder pushes upward from the bottom. This differs from a traditional pull-style system, in which the cylinder is mounted in an inverted position and pulls upward to engage the trip.

Startup Procedure

1. Check hydraulic fluid levels.
2. Check engine oil.
3. Ensure the hammer is positioned on level ground.
4. Start the engine.
5. The engine may run at idle, or it can be throttled up to increase hydraulic flow. Higher flow allows the cylinder to move more quickly.

Safety & Maintenance Notes

- Periodically inspect for leaks in hydraulic hoses.
- Keep hoses clear of the hammer whenever possible to avoid wear, damage, or operational hazards.





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Operations

Operations

Hydraulic Trip Operation – Diesel Hammer

The C1.1 control system is equipped with two levers that operate two auxiliary ports. For a standard hydraulic trip setup on a diesel hammer, only one auxiliary port is required.

Lever Functions:

Lever UP = TRIP UP

Lever DOWN = TRIP DOWN

(If hydraulic lines are reversed, lever functions will be opposite.)

The second auxiliary port may be connected to an additional tool of your choice, provided it operates within the same maximum pressure setting. Both valves share one pressure control, so verify that your auxiliary tool will not be over-pressurized.

Trip Operation Sequence

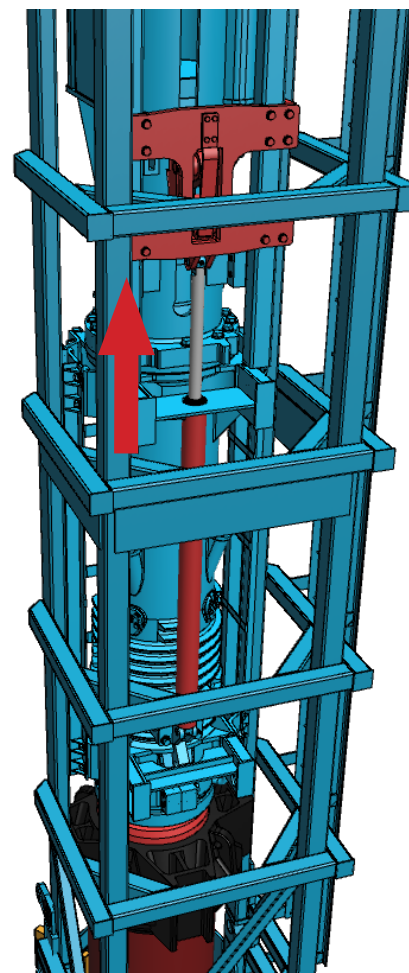
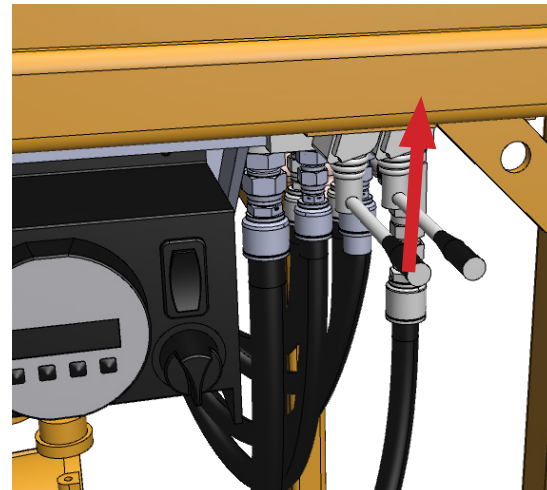
[1] Moving the lever UP raises the piston until it unlocks and drops. The lever will then return to center and lock automatically. Keep the trip in the UP position during pile driving operations to avoid interference.

Important Safety Warning

Do NOT lower the trip while the hammer is running.

Resetting the Trip

- [1] Once the hammer has come to a complete stop, the trip may be lowered by pushing the lever DOWN.
- [2] The trip will re-engage with the piston.
- [3] From this lowered position, the hammer can be re-tripped (started) as required.





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How to Operate

Operations

Setting System Pressure

The default system pressure is 3,000 PSI. This setting is sufficient for most applications. If adjustment is required, follow the procedure below.

Pressure Adjustment Procedure

- [1.] Locate the pressure adjustment valve [\[see red arrow\]](#).
- [2.] To adjust pressure, you must “deadhead” the circuit:
- [3.] Disconnect all hydraulic hoses.
- [4.] With the engine running, fully actuate one of the control levers (any lever not connected to a hose may be used). This forces oil over the relief valve.
- [5.] Read system pressure on the gauge [\[see blue arrow\]](#).
- [6.] Adjust the relief valve up or down to achieve the desired pressure.
- [7.] Once set, tighten the locking nut securely.

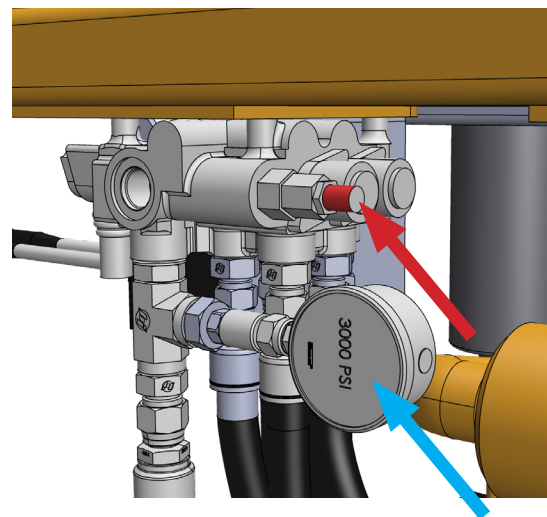
Operational Guidance

If the piston on your diesel hammer rises smoothly and without strain, the current pressure is acceptable.

If the piston or trip mechanism appears to hesitate, stick, or require excessive force, a slight increase in pressure may be necessary.

Always use the lowest pressure setting that reliably operates the trip. Operating at unnecessarily high pressures can increase wear and reduce system longevity.

Important: Never exceed the maximum rated pressure of the system or connected tools.



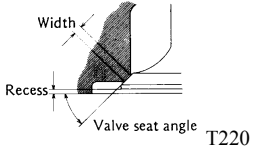


C1.1 Power Unit Manual

Cat C1.1 Diesel Engine Service and Workshop Manual

Displacement 1.13 L (69.0 in3) Compression Ratio: 23:1 Indirect Injected

* Unit for values without unit in the column of inspection item is mm.

Unit	Part	Inspection Items	Standard Dimension	Standard Value	To be Repaired	Allowable Limit	Remarks	
ENGINE	CYLINDER HEAD	Compression pressure of cylinder MPa (kgf/cm ²)		More than 2.94 (More than 30)	Less than 2.45 (Less than 25)		Engine 200 rpm	
		Distortion of face of cylinder head		Less than 0.05	More than 0.12			
		Valve seat (Intake/exhaust)			0.85 – 1.15	1.8		Valve sheet angle 45°
								
		Width of valve seat (intake/exhaust)			1.7 – 2.1	More than 2.5		
		Tightening torque of cylinder head N·m (kgf·m)		49 ~ 52 (5.0 – 5.3)			Coat threads with molybdenum bisulfide based grease.	
MAIN MOVING SYSTEM	CYLINDER BLOCK	Bore	Ø77	Ø77.99 – 77.005	Ø77.2		Over size (0.5)	
		Distortion of upper face of cylinder block		Less than 0.05	0.12			
	PISTON	Skirt diameter (longer diameter)	Ø77	Ø77.9225 – 77.9375				Oversize Piston 0.50 MM
		Clearance to cylinder		Ø0.0525 – 0.0865			0.25	At 20°C
		Inside diameter of piston pin hole	Ø21	Ø20.998 – 21.002			21.016	
		Piston pin hole-to-pin clearance		-0.004 - +0.004			0.02	
	PISTON PIN	Outer diameter of pin	Ø21	Ø20.998 – 21.002			Ø20.98	
		Small end bush-to-pin clearance		0.008 – 0.023			0.08	Oil clearance
	PISTON RING	Piston ring gap:	No.1 ring		0.15 – 0.27		1.0	
			No.2 ring		0.12 – 0.24			
			Oil ring		0.2 – 0.35			
		Piston ring groove-to-ring clearance	No.1 ring		0.06 – 0.1		0.25	
			No.2 ring		0.05 – 0.09			
Oil ring				0.02 – 0.06		0.15		
Ring width		No.1 ring	2	1.97 – 1.99			Oversize Piston Rings 0.50 MM	
	No.2 ring	1.5	1.47 – 1.49					
	Oil ring	4	3.97 – 3.99					



C1.1 Power Unit Manual

Cat C1.1 Diesel Engine Service and Workshop Manual

C1.1 Engine Information

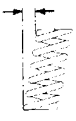
Unit	Part	Inspection Items	Standard Dimension	Standard Value	To be Repaired	Allowable Limit	Remarks	
MAIN MOVING SYSTEM	CONNECTING ROD	Twist between small and large end holes (per 100 mm)		Less than 0.08	More than 0.2			
		Straightness at 100 mm between small and large end hole		Less than 0.05	More than 0.15			
		Front-to-rear clearance between connecting rod and crank pin		0.1 – 0.3		0.7		
		Connecting rod metal-to-crank pin clearance		0.035 – 0.083		0.2	Oil clearance	
		Connecting rod bearing (inner diameter × width)	∅37 × 17.5					
		Connecting rod bolt torque N·m (kgf·m)		29 ~ 34 (3.0 – 3.5)				
		Weight difference with piston (g)		Less than 10				
		Crush height of small end bush		0.034 – 0.079				
		CRANKSHAFT	Diameter of main journal			∅47.964 – 47.965		
	Diameter of crank pin				∅40.964 – 40.975			Under size (0.25, 0.5)
	Roughness, main journal and crank pin		1.6Z					
	Crankshaft deflection				Less than 0.03	More than 0.06		
	Axial play of crankshaft				0.05 – 0.3		0.5	
	No.4 bearing holder thickness				21.85 – 21.95		21.55	
	Diameter of bush (journal metal)				∅47.964 – 47.965			Under size (0.25, 0.5)
	Clearance between crankshaft and journal metal (bush)				0.039 – 0.106		0.2	Oil clearance
	Clearance between crankshaft journal and center bearing				0.039 – 0.092		0.2	Oil clearance Upper No. 2 and 3.
					0.029 – 0.082		0.2	Oil clearance Lower No.4
	VALVE SYSTEM		CAMSHAFT	<p>Height of cam</p> <p>T221</p>	For intake/exhaust	26.565 – 26.62		26.2
		For injection pump			33.94 – 34.06		33.8	
Backlash of cam gear		0.08				0.25		
VALVE		Diameter of intake valve stem			6.955 – 6.97		6.89	
		Diameter of exhaust valve stem			6.94 – 6.955		6.84	
		Clearance between valve stem and valve guide	Inlet		0.03 – 0.06		More than 0.2	
			Exhaust		0.045 – 0.075		More than 0.25	
Thickness of valve (thickness)	<p>T222</p>	1.0	0.775 – 1.075		0.5			



C1.1 Power Unit Manual

Cat C1.1 Diesel Engine Service and Workshop Manual

C1.1 Engine Information

Unit	Part	Inspection Items	Standard Dimension	Standard Value	To be Repaired	Allowable Limit	Remarks	
VALVE SYSTEM	VALVE	Valve clearance (Intake/exhaust)			0.2	0.5	When cooling temperature	
		Valve spring	Spring strength (kgf)		8.1		Less than 7	At 30.4 mm compressed length
			Free height		35		33.5	
			Squareness  T223		Less than 1.2		2.0	
		Inlet valve timing	Open-Before T.D.C	13°				
			Close-After B.D.C.	43°				
		Exhaust valve timing	Open-Before B.D.C.	43°				
	Close-After T.D.C.		13°					
	PUSH ROD	Overall length		157	156.8 – 157.2			
		Outer diameter		Ø6.3				
	ROCKER ARM	Wear, rocker arm shaft		Ø11.66	Ø11.65 – 11.668		Ø11.57	
		Clearance between rocker arm and shaft			0.032 – 0.068		0.2	Oil clearance
LUBRICATION SYSTEM	OIL PUMP	Oil pressure switch operating pressure kPa (kgf/cm ²)		29.4 (0.3)	19.6 – 39.2 (0.2 – 0.4)			
		Relief pressure kPa (kgf/cm ²)			245 – 343 (2.5 – 3.5)			
		Lubrication oil capacity (ℓ)		3.0				With filter change 3.3 ℓ
		Tip clearance (rotor-to-vane)			0.1 – 0.15		0.25	
		Side clearance (rotor-to-cover)			0.1 – 0.15		0.2	
FUEL SYSTEM	INJECTION PUMP	Type		094500-6340			DENSO	
		Injection timing	Before T.D.C.		23 – 25°			
Piston movement before T.D.C.			4.217 – 4.96					

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C1.1 Power Unit Manual

C1.1 Engine Information

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Unit	Part	Inspection Items	Standard Dimension	Standard Value	To be Repaired	Allowable Limit	Remarks	
	INJECTION NOZZLE	Type		093500 – 3320			DENSO	
		Injection pressure MPa (kgf/cm ²)	11.76 (120)	11.27 – 12.25 (115 – 125)				
		Angle of injection direction	4°					
COOLING SYSTEM	COOLING	Cooling method kgf/cm ²		Water cooled, forced circulation				
		Coolant capacity (ℓ)	3.5					
		Thermostat open temperature (°C)	82	80 – 84				
		Thermostat full-open temperature (°C)	95					
		V belt	M30					
ELECTRICAL SYSTEM	STARTER MOTOR	Type		128000 – 0101			DENSO	
		No. of teeth of pinion gear	9					
		Shifting method of pinion		Magnetic shift type				
		Wear of commutator diameter	30			29		
		Stepped wear of commutator		0.05		0.2		
		Bending allowance of armature shaft		0.05	More than 0.08			
		Length of brush	13.5			9		
	Spring force of brush N (kgf)	16.7 (1.7)			Less than 11.76 (1.2)			
	ALTER MOTOR	Type			100211 – 1680			DENSO
		Outside diameter of slip ring			14.4		14.0	
Length of brush				10.5		4.5		
Pulley tightening torque N·m (kgf·m)				58.3 – 78.8 (5.95 – 8.05)				

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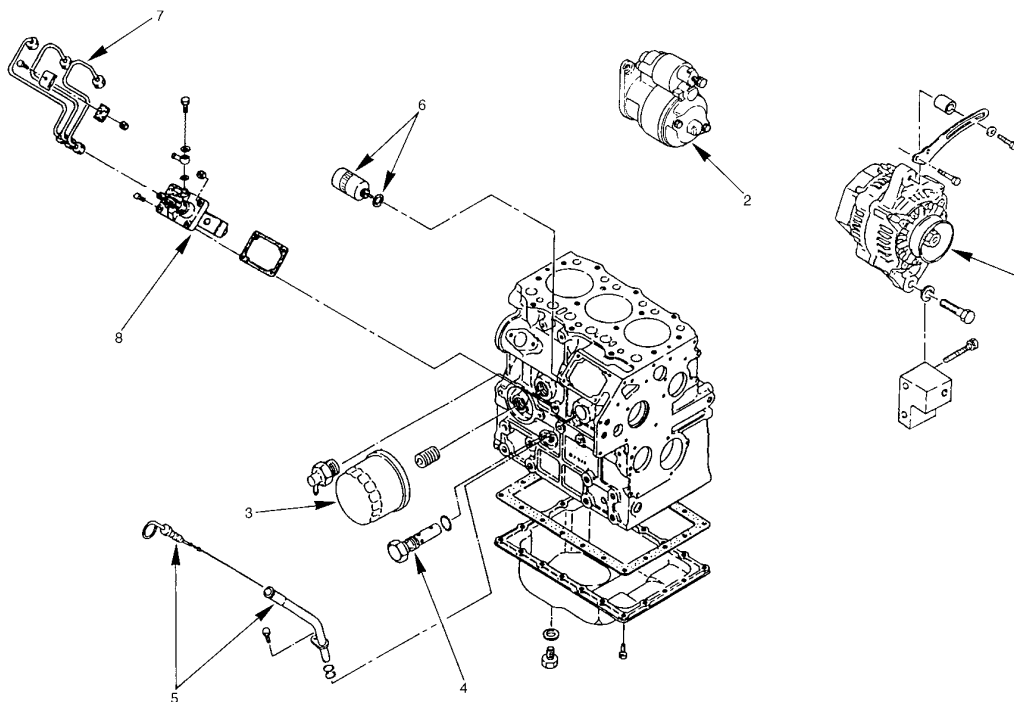
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2-3 Disassembly, Inspection and Reassembly

C1.1 Engine Information

1. DISASSEMBLY



T102

Disassembly

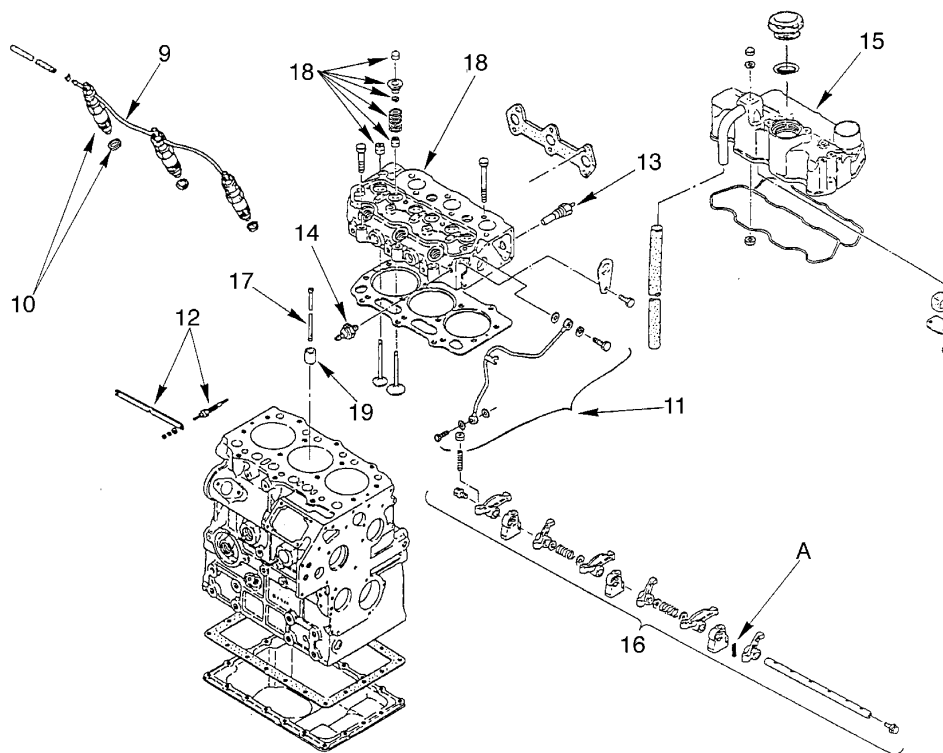
Order	Parts Name
1	Alternator
2	Starting motor
3	Oil filter
4	Relief valve
5	Oil level gauge · Gauge guide
6	Engine stop solenoid · Seal washer
7	Injection pipe
8	Injection pump NOTE: 1. Remove the injection pipes and engine stop solenoid before remove the injection pump. 2. Raise the injection pump and remove the governor link from the control rack. 3. Injection timing has been adjusted by the shims between injection pump and cylinder block. Take note of their thickness and number when removing the injection pump.



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C1.1 Engine Information



T103

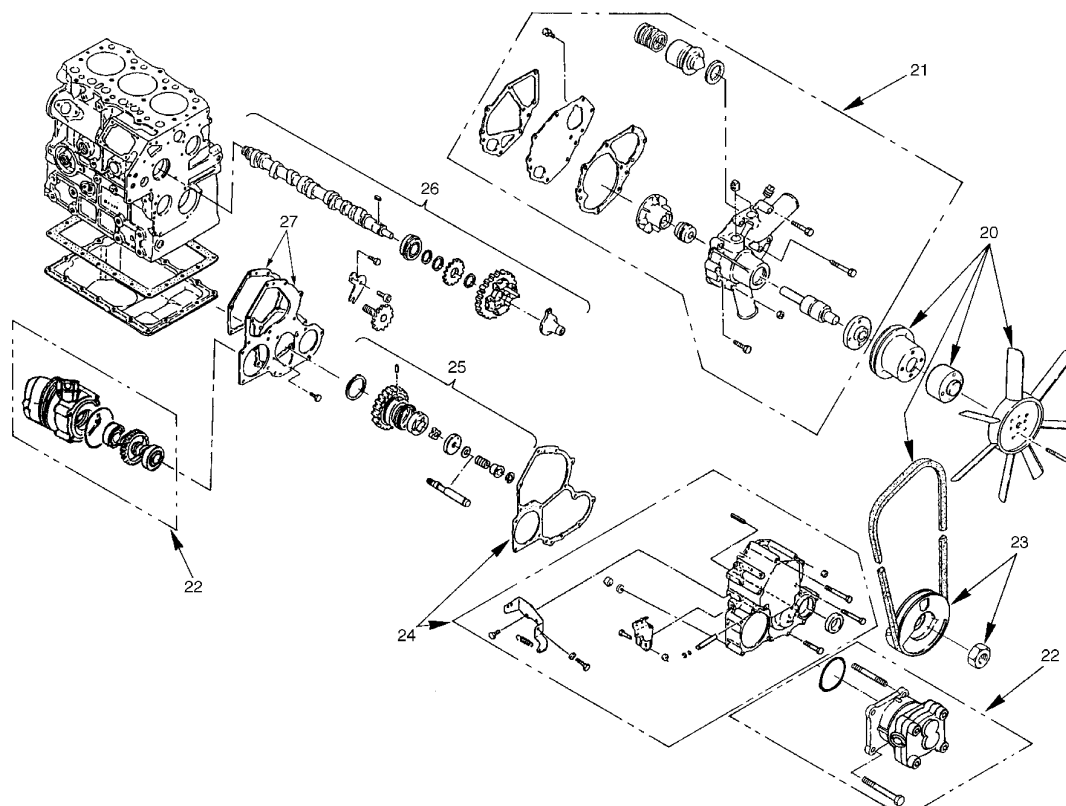
Order	Parts Name
9	Return pipe
10	Injection nozzle · gasket
11	Oil pipe · Eye bolt · Seal washer
12	Glow plug · Connector
13	Thermo-sensor
14	Oil pressure switch
15	Head cover
16	Rocker arm assembly NOTE: Draw out the roll pin (A) from the No. 1 rocker arm bracket, and remove the rocker arm shaft.
17	Push rod
18	Cylinder head · Head gasket NOTE: 1. If necessary, remove the intake valves and exhaust valves with covered shop towel for prevent jump out the parts by spring.
19	Tappet NOTE: Store carefully to ensure they are refitted to the same place.



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C1.1 Engine Information



T104

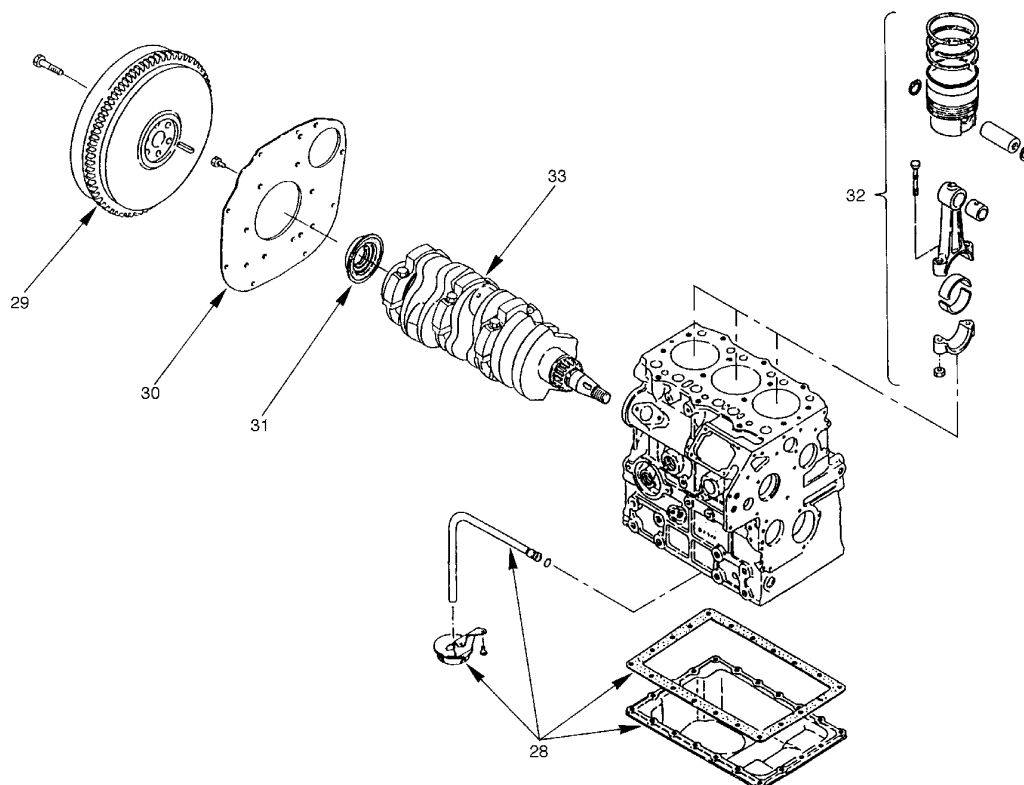
Order	Parts Name
20	Fan holder · Fan pulley · V-belt · Cooling fan
21	Water pump assembly · Thermostat · Gasket
22	Hydraulic oil pump · Power steering oil pump
23	Crankshaft pulley
24	Timing gear case assembly NOTE: Remove the engine stop solenoid and injection pump assembly at first.
25	Idle gear · Oil pump assembly
26	Cam shaft assembly · Tachometer assembly NOTE: Remove the bolts and plate at first, and remove the cam shaft assembly and tachometer assembly.
27	Front plate · Gasket



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T105

Order	Parts Name
28	Oil pan · Gasket · Suction filter · Suction pipe
29	Fly wheel
30	Rear plate
31	Oil seal
32	Piston and connecting rod assembly NOTE: 1. Before extracting piston, remove the carbon deposit from the TDC in the cylinder. 2. Place the connecting rod, cap and bearing removed in order of the cylinders.
33	Crank shaft and bearing holder assembly NOTE: Remove the four bolts, and draw out the crank shaft and bearing holder assembly as a set.

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C1.1 Engine Information

2. DISASSEMBLY AND INSPECTION OF ENGINE MAIN PARTS

* Cautions before start

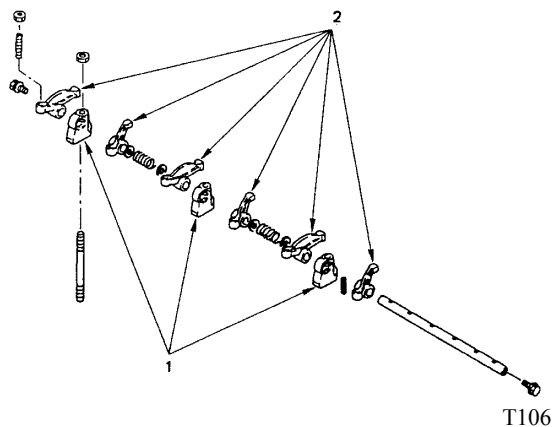
- 1) Check the cylinder block and cylinder head for wear, leakage and damage.
- 2) Remove deposit in oil holes of each part with air and check for clogging.
- 3) Wash each part well to remove dust, contaminated oil, carbon, and other foreign matter.
- 4) Remove carbon deposite on the piston, cylinder head, valves, etc. carefully not to damage parts. (Great care is necessary specifically for aluminum alloy parts.)
- 5) Valves, pistons, connecting rods, metals and other parts which are to be combined as specified should be attached match marks beforehand to prevent confusion.

1) Rocker arm ass'y

Disassembly

- (1) Remove the bolts at both ends of the rocker arm shaft and take out the rocker arm, rocker arm bracket, spring and shim.
- (2) Extract the spring pin which has been driven into the No. 1 cylinder rocker arm bracket and take out the rocker arm, spring and bracket.

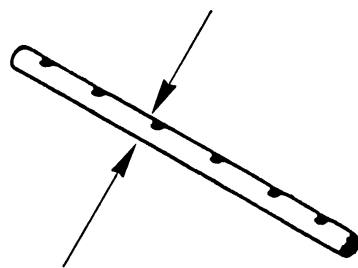
1. Rocker arm bracket
2. Rocker arm



Inspection and service

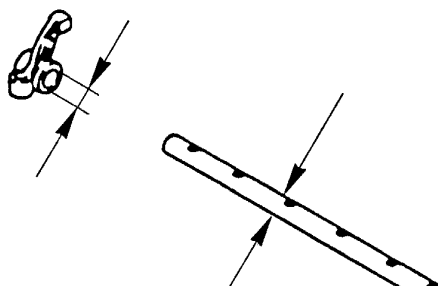
- (1) Using a micrometer, check outside diameter of the rocker arm shaft. If the shaft is worn exceeding service limit, replace it with new one.

Wear of rocker arm shaft \varnothing	
Standard assembling value	Service limit
11.65 – 11.668	Less than 11.57



- (2) Measure the inside diameter of the rocker arm. Calculate the clearance between the rocker arm and rocker arm shaft. If the clearance is excessive, replace the part.

Clearance between rocker arm and rocker arm shaft (mm)	
Standard assembling value	Service limit





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C1.1 Engine Information

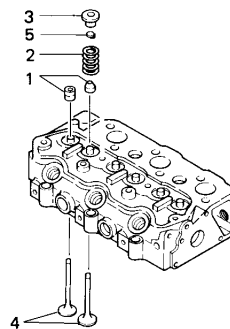
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2) Cylinder head ass'y

Disassembly

- (1) Using a valve spring replacer, compress the valve spring to remove the valve cotter, retainer, spring and valve.
- (2) Remove the valve guide seal.

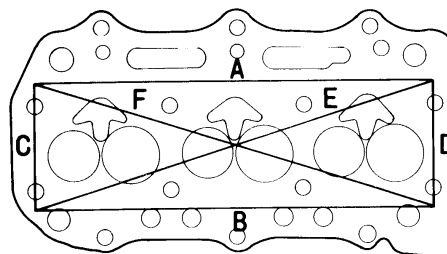
- | | |
|---------------------|-----------------|
| 1. Valve guide seal | 4. Valve |
| 2. Spring | 5. Valve cotter |
| 3. Retainer | |



T109

Inspection and service

- (1) Distortion of cylinder head bottom surface Apply a straight edge to the bottom surface of the cylinder head, and insert a thickness gauge at 6 points from A to F in the right figure and measure distortion. If the distortion exceeds the repair value, correct with surface grinder or the like.



T110

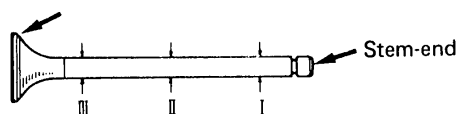
Distortion at cylinder head bottom surface (mm)	
Standard assembling value	Repair value
Less than 0.05	More than 0.12

- (2) Valve guide and valve stem

- ① Check the head and stem of each valve and replace if burnout, wear or deformation is remarkable.

Wear of valve stem (mm)			
Intake valve		Exhaust valve	
Standard assembling value	Service limit	Standard assembling value	Service limit
6.955 – 6.97	6.89	6.94 – 6.955	6.84

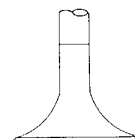
- ② Measure the outside diameter at the position I, II, and III on the valve stem with a micrometer and replace if the result is less than the service limit.



T111

- ③ Replace a valve if its head thickness is less than service limit.

Valve head thickness (mm)	
Standard assembling value	Service limit
0.775 – 1.075	Less than 0.5



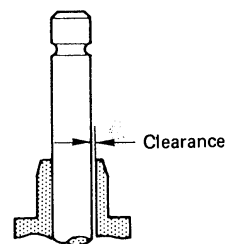


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- ④ Replace the valve if the clearance between the stem and guide exceeds the service limit.

Clearance between valve stem and valve guide (mm)			
Intake valve		Exhaust valve	
Standard assembling value	Service limit	Standard assembling value	Service limit
0.03 – 0.06	More than 0.2	0.045 – 0.075	More than 0.25



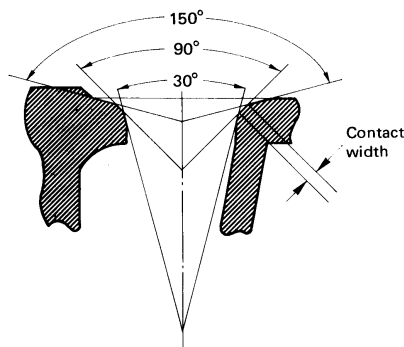
T113

- (3) Valve seat

- ① Since the valve seat is corrected according to the valve guide, be sure to check the valve guide for wear condition first before correcting the seat.

Valve seat contact width (mm)	
Standard assembling value	Repair value
1.7 – 2.1	More than 2.5

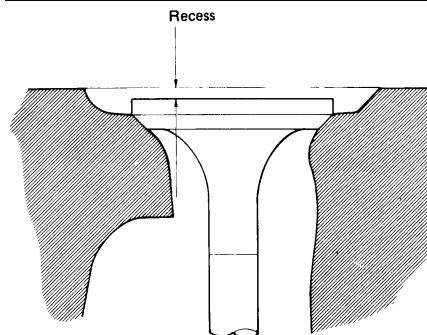
- ② Correct the seat to the standard assembling values of the contact width and recess using seat cutters of 15°, 45° and 75°.



T114

- ③ When the seat recess exceeds the service limit, replace the cylinder head.

Valve seat recess (mm)	
Standard assembling value	Service limit
0.85 – 1.15	More than 1.8



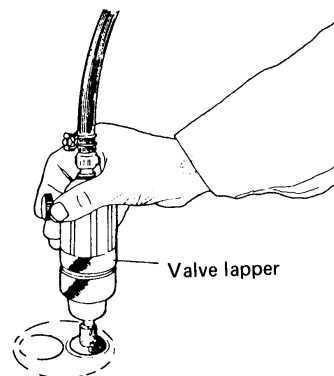
T115



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- ④ Coat the valve seat surface with compound and lap the contact surface turning the valve.
- ⑤ Check that the valve contact surface is within the standard value and the contact position is even.
- ⑥ When the cylinder head is replaced with new one, adjust the seat contact width and seat recess to the specified values with a seat cutter before lapping.

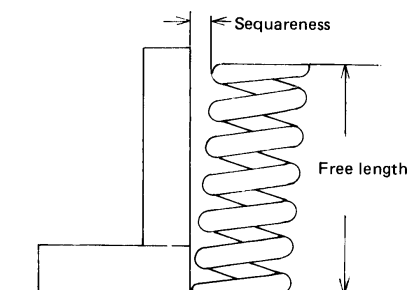


T116

(4) Valve spring

- ① Check the valve spring visually for damage.
- ② Measure the squareness of the spring using a square on a surface plate and replace if the service limit is exceeded.
- ③ Check the free length and spring force with a spring tester and replace if the service limit is exceeded.

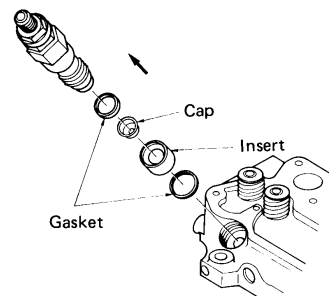
	Standard assembling value	Service limit
Squareness (mm)	1.2	More than 2
Free length (mm)	35	Less than 33.5
Spring force (when compressed to 30.4 mm)	72.9 N (8.1 kgf)	68.6 N (Less than 7 kgf)



T117

(5) Inner face of combustion chamber

- Pull out the cap and insert from the cylinder head. Check and clean the combustion chamber.



T118

NOTE:

1. Do not remove the insert.

Reassembly

Reassemble components in the reverse order to disassembly taking care to the following point. When assembling the valve spring, retainer and cotter, take deep care not to damage the valve guide seal.



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3) Cylinder block

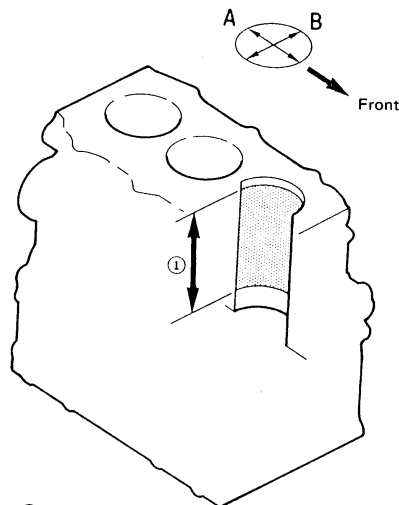
Inspection and service

(1) Check for crack, damage and distortion on the top of the block in the same way as in the cylinder head.

(2) Measurement of cylinder bore

- ① There should be no scratch, rust, corrosion, etc. on the cylinder bore when checked visually.
- ② Measure the cylinder bore at the top, center and bottom respectively in the crankshaft direction (A) and the direction at right angle to it (B). If the repair value is exceeded, finish to an oversize by boring.
- ③ The above-described bore top corresponding to the top ring position at the piston TDC about **10 mm** below the cylinder block top surface, and the bottom corresponds to the oil ring position at the BDC about **100 mm** below the cylinder block top surface.
- ④ Use a cylinder gauge (inside dial gauge) for the measurement. Apply the gauge correctly at right angle to the bore wall surface.
- ⑤ Cylinder honing shall be conducted by boring according to the following specifications. Honing specifications (2-step honing according to Dia specifications)
 - Grinding stone: Tokyo Dia SD120/140 N100M (bronze type)
 - Finishing: GC600JB
 - Grinding stone size: 100L × 4W
 - Speed: 162 rpm
 - Axial feeding speed: 13 m/min
 - Gauge pressure: Rough finishing: 15kgf/cm²
Finishing: 5 kgf/cm²
 - Finishing stroke: 9
 - Honing allowance: 0.04 mm (diameter)
 - Cross hatch overall angle: 40°
 - Surface roughness: 2 – 4 μ

Distortion on cylinder block top surface (mm)	
Standard assembling value	Repair value
Less than 0.05	More than 0.12



① Ring sliding range

T119

(Unit: mm)

Model	Standard assembling value		Standard assembling value	
C1.1	ø77 - ø77.019	1st boring 0.5	ø77.5 - ø77.519	



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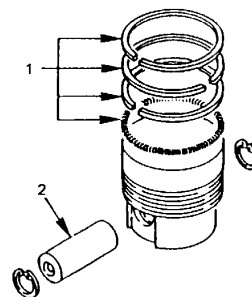
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4) Piston and piston ring

Disassembly

- (1) Remove the piston ring using a piston ring tool.
- (2) Remove the snap ring and extract the piston pin.

1. Piston ring
2. Piston pin



T120

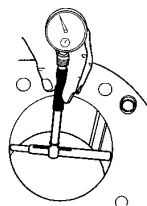
Inspection

(1) Piston

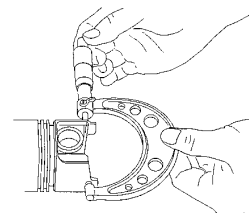
- ① Check the piston for crack, streak and burnout on the outside surface and replace if remarkable.
- ② Measure the longer diameter at 10 mm above the lower end of the piston skirt and bore of the cylinder in the thrust direction, calculate the clearance, and replace if the repair value is exceeded.
- ③ When the cylinder is substituted with an oversize one, use a piston of an oversize.

Clearance between cylinder and piston (mm)		
Model	Standard assembling value	Service limit
C1.1	0.0425 – 0.0765	More than 0.25

		Skirt bottom Diameter
C1.1	S.T.D. Piston	76.9325-76.9475
	O.S. 0.5 Piston	77.4325-77.4475



T121



T122

- ④ Measure the piston pin hole diameter and piston pin outside diameter and replace if the clearance exceeds the service limit.

Clearance between piston pin hole and piston pin (mm)		
Model	Standard assembling value	Service limit
C1.1	-0.004 ~ +0.004	More than 0.02



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(2) Piston ring

- ① Replace worn out or damaged piston ring, if any.
- ② Insert a ring at a right angle to the least worn out skirt of a cylinder, measure the clearance of ring end gap with a thickness gauge and replace if the end gap exceeds the service limit.

Piston ring end gap (mm)		
C1.1	Standard assembling value	Service limit
Top ring	0.2 – 0.35	1.0
Second ring	0.15 – 0.20	1.0
Oil ring	0.15 – 0.35	1.0

- ③ Measure the clearance between the piston ring groove and ring and replace if the service limit is exceeded.

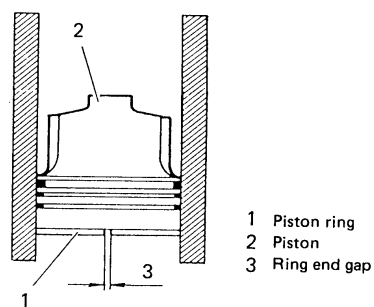
- ④ When the cylinder is replaced with an over size one, use a piston ring set of over size accordingly. Piston kit composed of piston and piston rings are available.

⑤ Piston ring installing procedure

Install the piston ring to the piston as shown in the right figure.

(3) Piston pin

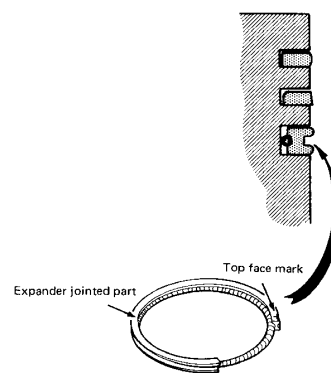
Measure the outside diameter of the piston pin and replace if the service limit is exceeded.



- 1 Piston ring
- 2 Piston
- 3 Ring end gap

T123

Clearance between piston ring groove and ring (mm)		
	Standard assembling value	Service limit
Top ring	0.06 – 0.1	More than 0.25
Second ring	0.05 – 0.09	More than 0.25
Oil ring	0.02 – 0.06	More than 0.15



T124

Piston pin outside dia. (ø)	
Standard assembling value	Service limit
20.998 – 21.002	Less than 20.98



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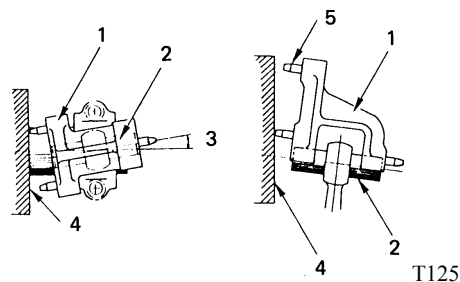
5) Connecting rod

Inspection

- (1) Check for torsion, parallelism and damage.
Measure the torsion and parallelism using a connecting rod aligner and correct or replace if the repair value is exceeded.

1. Gauge
2. Piston pin
3. Torsion
4. Flat part of aligner
5. Pin

Torsion and parallelism of connecting rod (mm)		
	Standard assembling value	Repair value
Torsion (per 100 mm)	Less than 0.08	More than 0.2
Parallelism (per 100 mm)	Less than 0.05	More than 0.15



- (2) Measure the bore of the connecting rod small end bush and replace if the clearance to the piston pin exceeds the service limit.

Clearance between bush and piston pin (mm)	
Standard assembling value	Service limit
0.008 – 0.023	More than 0.08

- (3) Install the connecting rod to the crankshaft, measure the axial play and replace the connecting rod if the service limit is exceeded.

Axial play of connecting rod and crank pin (mm)	
Standard assembling value	Service limit
0.1 – 0.3	More than 0.7



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6) Connecting rod metal

Inspection

- (1) Check the metal and if peeling, melting, uneven wear, improper contact or other damage is noticed, replace the metal.
- (2) Measure the oil clearance of the crank pin and metal using plasti-gauge.
 - ① Remove oil dust or other foreign matter stuck to the metal and crank pin.
 - ② Cut plasti-gauge to the length same as the metal width and place it on the crank pin in parallel with the crankshaft avoiding the oil hole.
 - ③ Install the connecting rod metal and connecting rod cap and tighten with the specified tightening torque.

Tightening torque	29 – 34 N·m (23.6 Ft Lbs)
-------------------	------------------------------

NOTE: Never turn the connecting rod at this time.

- ④ Remove the connecting rod cap and measure the plasti-gauge width with the scale printed on the gauge envelope.

NOTE: Measure the widest part of the plasti-gauge.

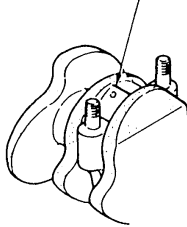
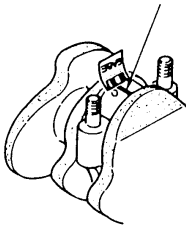
- (3) If the oil clearance exceeds the service limit according to the result of the measurement, replace the metal or grind the crank pin and replace with a metal of undersize.

NOTE:

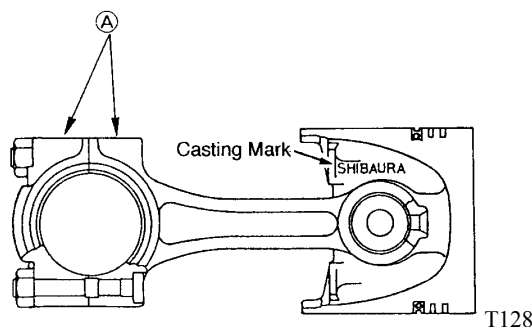
1. When the crank shaft pin outside is ground, check the oil clearance before installing it.
2. Grind the crank pin precisely referring to the paragraph of the crank shaft about the finishing accuracy and oil holes.

Reassembly (piston and connecting rod)

- (1) Heat the piston to about 100°C with a piston heater or the like and install it aligning the SHIBAURA mark in the piston and match mark at (A) of the connecting rod.
- (2) Care should be taken to the figure match mark at (A) of the connecting rod.
- (3) Install the piston ring to the piston facing the stamp at the end surface of the ring end gap upward.
- (4) When the connecting rod or piston and piston pin are replaced, weight variation among cylinders with the rod, piston and piston ring installed should be within 10 g.

Clearance between crank pin and connecting rod metal (oil clearance) (mm)	
Standard assembling value	Service limit
0.035 – 0.083	More than 0.2
<p>Set a plasti-gauge.</p>  <p style="text-align: center;">Plasti-gauge</p> <p style="text-align: right;">T126</p>	<p>Measure the oil clearance.</p>  <p style="text-align: center;">Plasti-gauge</p> <p style="text-align: right;">T127</p>

Metal size	Crankshaft pin outside dia. Finishing dimension (ø)
S.T.D.	40.964 - 40.975
U.S. 0.25	40.714 - 40.725
U.S. 0.50	40.464 - 40.475





C1.1 Power Unit Manual

1) Disassembly, inspection and reassembly of bearing holder

Disassembly and inspection

Center bearing

- (1) Remove the bearing holder, and replace the metal if peeling, melting, uneven wear, or improper contact is noticed.
- (2) Measure the oil clearance of the crankshaft center journal and metal using a plasti-gauge.
- (3) If the oil clearance exceeds the service limit according to the result of the measurement, replace the metal or grind the crankshaft center journal according to paragraph 9) and replace with a metal of undersize.

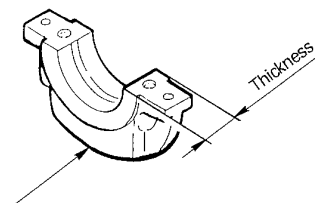
Clearance between crankshaft center journal and metal (oil clearance) (mm)		
Model	Standard assembling value	Service limit
C1.1	0.039 – 0.092	More than 0.2

Rear bearing holder

Check the bearing holder and replace if wear, improper contact, seizure, or other damage is noticed, or thickness exceeds the service limit.

Rear bearing holder thickness (mm)		
Model	Standard assembling value	Service limit
C1.1	21.85 – 21.95	21.55

C1.1		
	Metal size	Crankshaft center journal finishing dimension (ø)
	STD.	47.964 – 47.965
	U.S. 0.25	47.714 – 47.715
	U.S. 0.50	47.464 – 47.465



No.4 Bearing holder

T129

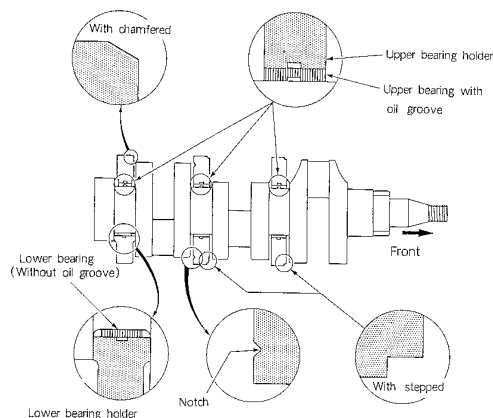
Reassembly (bearing holder, center bearing, thrust washer)

- (1) Install the bearing holder with identification cutting mark at the center and the bearing holder with thrust washer to the flywheel side, facing the chamfered side forward.
- (2) Install the thrust washer facing the oil groove to the crankshaft thrust surface.

Bearing holder tightening torque (Made of aluminium die cast only)	20 – 25 N·m (2.0 – 2.5 kgf·m)
--	----------------------------------

- (3) Install the metal with oil groove to the upper side and the one without oil groove to the lower side.

NOTE: Be sure to confirm that the oil holes of the bearing holder and block are aligned.



T130

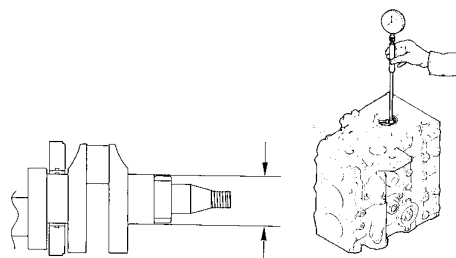


C1.1 Power Unit Manual

8) Crankshaft bearing (bush)

Inspection

- (1) Check the bearing (bush) and replace if peeling, melting, uneven wear, improper contact, or other damage is notice.
- (2) Measure the oil clearance of the bearing (bush) and crankshaft journal using a cylinder gauge and micrometer.
- (3) If the oil clearance exceeds the service limit according to the result of measurement, replace the bearing (bush) or grind the crankshaft journal according to paragraph 9) and replace with a bearing (bush) of undersize.



T131

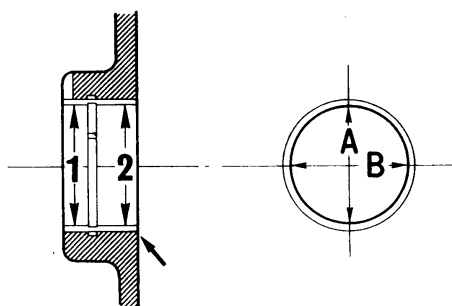
T132

Clearance between crankshaft journal and bearing (bush) (oil clearance) (mm)		
Model	Standard assembling value	Service limit
C1.1	0.039 – 0.106	More than 0.2

Model	One piece main bushing	Crankshaft journal outside dia. Finishing dimension (φ)
C1.1	STD.	47.964 – 47.965
	U.S. 0.25	47.714 – 47.715
	U.S. 0.50	47.464 – 47.465

NOTE:

1. Measure the dimensions in the A and B directions at the position 1 and 2 in the right figure avoiding the oil hole of the bearing (bush) and calculate difference from the maximum value of the crankshaft journal (oil clearance).
2. When replacing the bush, push it up using a press or the like. At this time, align the oil holes and push it up until the bush end surface becomes level with the outside machined surface of the cylinder block (see the arrow mark in the right figure).
3. When the crankshaft journal is ground, confirm the oil clearance before reinstalling it.



T133



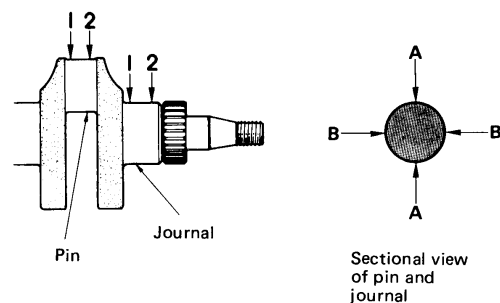
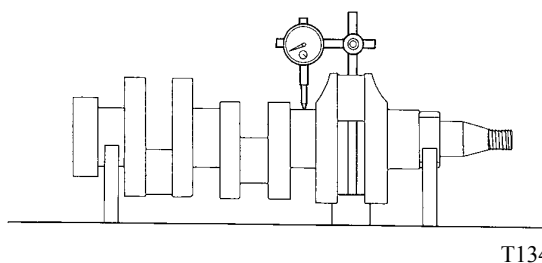
C1.1 Power Unit Manual

9) Crankshaft

Inspection

- (1) To measure run-out of the crankshaft, support the crankshaft using a V block as shown in the right figure, apply a dial gauge to the crankshaft center journal, read the indication on the dial gauge rotating the shaft one turn gently. If the service limit is exceeded, correct or replace.
- (2) Check the crankshaft oil seal for damage or wear on the contact surface and oil hole clogging.
- (3) Check the crankshaft journal and pin for damage, irregular wear (ellipticity, conicalness), and shaft diameter and grind the journal and pin if the service limit or repair value is exceeded and replace the bearing (bush) and connecting rod metal respectively with one of undersize. Measure the dimensions of the journal and pin in the AA and BB directions at the position 1 and 2 avoiding the oil holes.

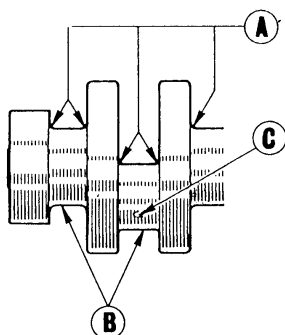
Crankshaft run-out (mm)	
Standard assembling value	Service limit
Less than 0.03	More than 0.06



NOTE: Finishing accuracy when grinding the crankshaft to undersize shall be as follows.

- Ⓐ R at pin and journal: **3R ± 0.2**
- Ⓑ Finishing accuracy: **1.6 Z(▽▽▽)**
- Ⓒ R around oil hole
 - At max. part: **2R**
 - At min. part: **0.5R**

Finish using #400 sand paper.



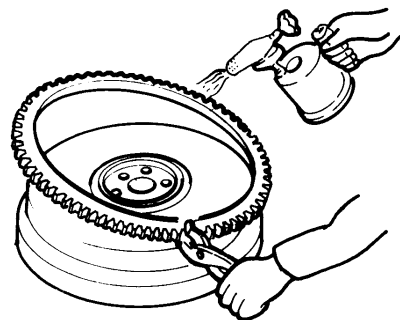
Irregular wear limit of crankshaft journal and pin (mm)		
More than 0.05		
Shaft dia. At Main crankshaft journal		
	Outside dia. Finishing dimension	
STD.	47.964 – 47.965	
U.S. 0.25	47.714 – 47.715	
U.S. 0.50	47.464 – 45.465	
Shaft dia. At crankshaft pin (∅)		
	Outside dia. Finishing dimension	
STD.	40.964 – 40.975	
U.S. 0.25	40.714 – 40.725	
U.S. 0.50	40.464 – 40.475	

10) Flywheel and ring gear

Inspection

Check the ring gear and replace if damage or remarkable wear is noticed.

When the wear is limited to a small area, remove the ring gear, turn it about 90 degrees and shrinkage-fit to reuse it. To shrinkage-fit the ring gear, heat it to 120 – 150°C to allow it to expand.

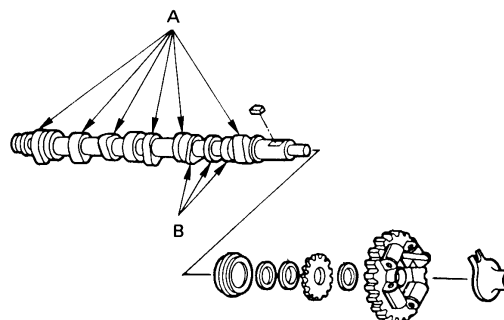


T137

11) Cam shaft ass'y

Inspection

- (1) Check the journal and cam for wear and damage and replace if the service limit is exceeded.
- (2) Correct insignificant uneven wear or scars on the cam surface using oil stone or the like.



T138

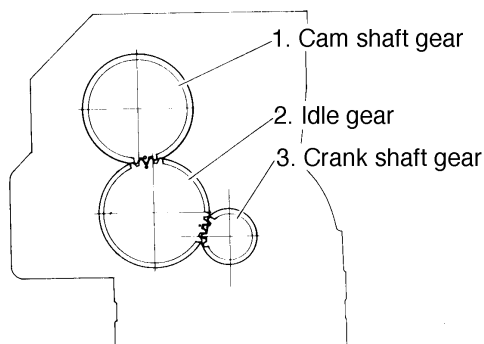
A. Height of intake/exhaust valve cams (mm)	
Standard assembling value	Service limit
26.56 – 26.63	Less than 26.1
B. Height of injection pump cams (mm)	
Standard assembling value	Service limit
33.94 – 34.06	Less than 33.8

12) Timing gear

Inspection

- (1) If pitting or remarkable wear is observed on the tooth face of gears, replace the gear.
- (2) Measure the backlash of gears and replace if the service limit is exceeded.

Timing gear backlash (mm)	
Standard assembling value	Service limit
0.08	More than 0.25



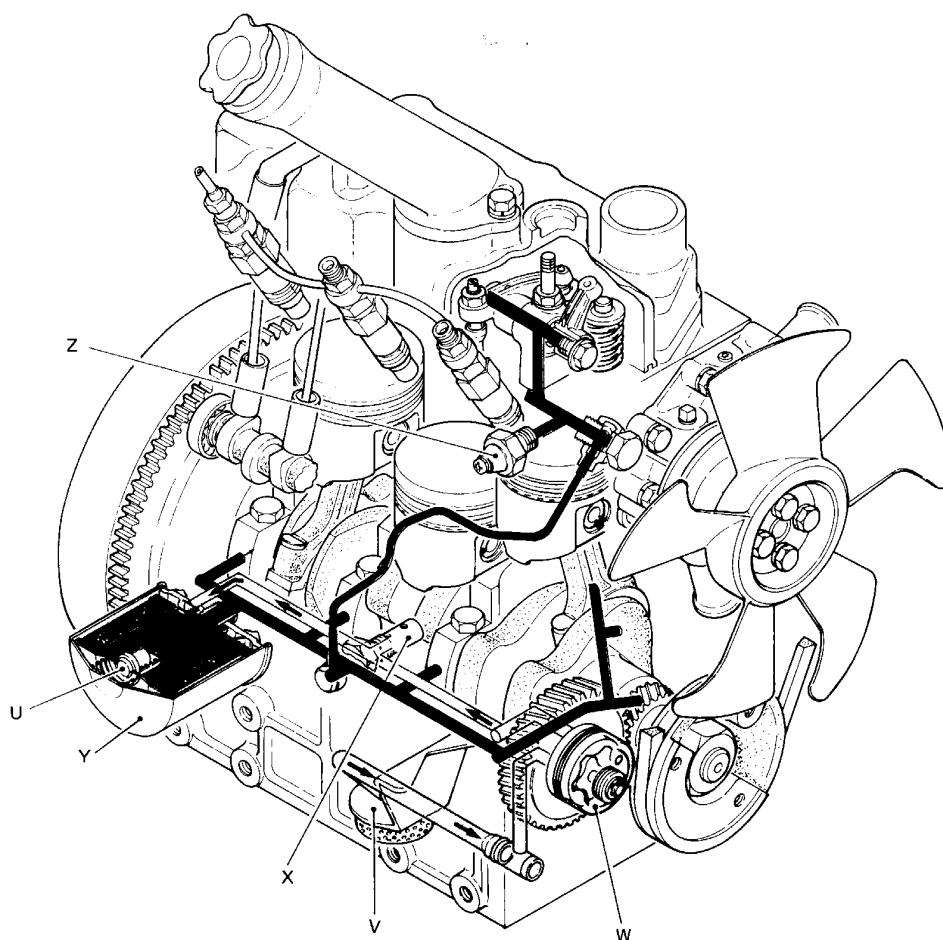
T139



C1.1 Power Unit Manual

13) Oil flow

C1.1 Engine Information



- U: Safety valve
- V: Suction filter
- W: Oil pump
- X: Relief valve
- Y: Oil filter
- Z: Oil puessure siwtch



C1.1 Power Unit Manual

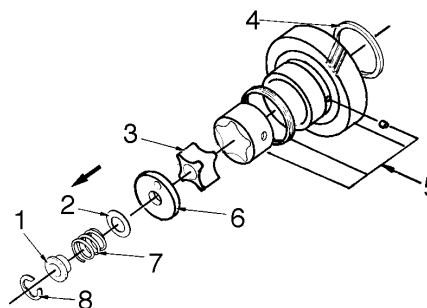
14) Oil pump

Disassembly

Removal from engine

- (1) Remove the snap ring.
- (2) Take out the collar, spring and shim.
- (3) Take out the idle gear, vane, and oil pump cover together.
- (4) Extract the rotor and thrust washer.
- (5) Extract the oil pump cover from the idle gear.

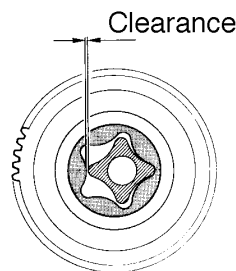
- | | |
|------------------|--------------------|
| 1. Collar | 5. Idle gear ass'y |
| 2. Shim | 6. Oil pump cover |
| 3. Rotor | 7. Spring |
| 4. Thrust washer | 8. Snap ring |



T141

Inspection and reassembly

- (1) Check the oil pump cover, rotor and vane and replace if worn out or damaged remarkably.
- (2) Check the clearance between the rotor and vane and replace if the service limit (0.25 mm) is exceeded.
- (3) Reassemble in the order reverse to disassembly.
 - ① Install the crankshaft gear and idle gear aligning the match mark.
 - ② Adjust the side clearance of the rotor and vane to **0.1 – 0.15 mm**. (See the assembling order 12, T162.)

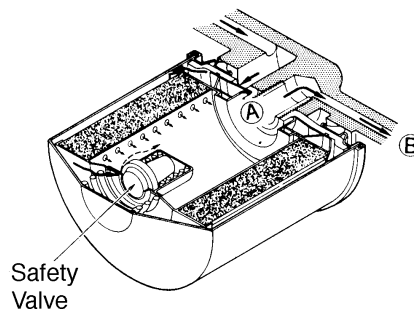


T142

15) Oil filter

Structure and Functions

- (1) The cartridge type oil filter is excellent in filtering performance.
- (2) Since it is of the full-flow type, when the filter is clogged, the safety valve is opened to allow the oil to flow, preventing seizure or other troubles.
- (3) The oil fed under pressure with the oil pump enters ① is filtered by the element, and supplied to each part from ②.
When the element is clogged, the oil is supplied to each part without passing through the element.



T143

Replacement

- (1) Replace the oil filter every 200 hours of operation.
- (2) Coat the filter mounting surface with oil and tighten the filter by hand.
- (3) Do not reuse the filter if it is removed once.



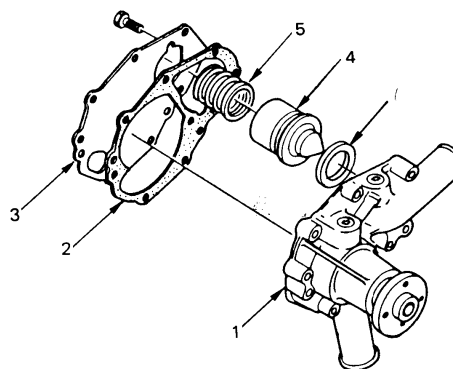
C1.1 Power Unit Manual

16) Water pump assembly and thermostat

Disassembly

- (1) Remove the set plate gasket.
- (2) Remove the thermostat spring.
 1. Water pump ass'y
 2. Gasket
 3. Set plate
 4. Thermostat
 5. Spring
 6. Gasket

NOTE: The pump main body is aluminum die cast and should be replaced as ass'y if subjected to water leakage or other troubles.



T144

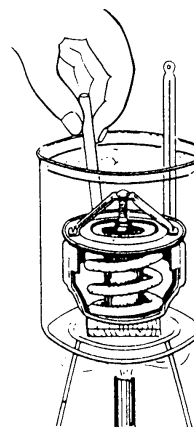
Specification and inspection

Thermostat

- (1) Replace if the valve is opened even only slightly at normal temperature.
- (2) Immerse the thermostat in water, increase the water temperature gradually and check the valve opening temperature and valve lift.

NOTE: 3 to 5 minutes are required until the valve is operated.

Model	C1.1	
Type	Wax pellet	
Opening temperature		73° - 77°C
Full-opening temperature		87°C
Valve lift (at water temperature 82°C)		6.0 mm



T145

Reassembly

Reassemble the components in the reverse order to disassembly.



C1.1 Power Unit Manual

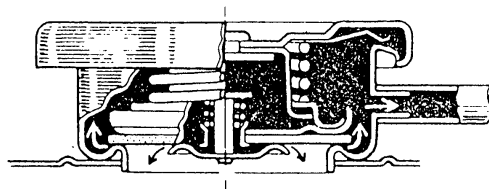
17) Radiator

Specifications and structure

Structure

- (1) The radiator is provided with the plate fin having superior anti-vibration characteristics.
- (2) The radiator cap is of the pressure type (sealing type) for higher cooling efficiency.
 When the cooling water is heated to high temperature (high pressure), the pressure valve is pushed and opened to release excessive pressure from the overflow pipe (shown by white arrow mark).
 When the cooling water temperature reduces and the inside pressure becomes lower than the atmospheric pressure, the negative pressure valve is opened to protect the radiator from being crushed under the atmospheric pressure (shown by black arrow mark).

Specifications	
Fin type	Corrugated
Cooling water volume	3.5 ℓ
Pressure valve starting pressure	68.6 – 88.2 kPa (0.7 – 0.9 kgf/cm ²)
Negative pressure valve starting pressure	– 4.9 kPa (0.04 – 0.05 kgf/cm ²)
Heat radiation volume	15,000 kcal/h



T146

Inspection

- (1) Check the radiator pipe for water leakage and repair or replace if unsatisfactory.
- (2) Check the radiator fin and remove dust, mud, or other foreign matter clogging in the air passage, if any.
- (3) Check the pressure valve and negative pressure valve of the radiator cap for valve opening pressure and sealing condition. Replace if defective.
- (4) Check the radiator hose and replace if damaged or aged.
- (5) If the net is clogged, remove and clean.



C1.1 Power Unit Manual

18) Fuel filter

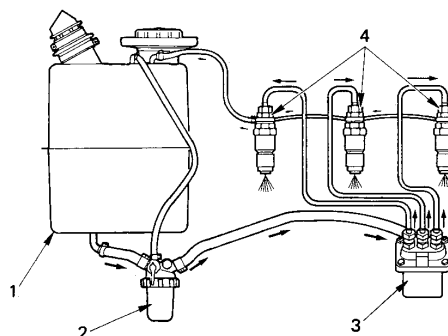
Fuel passage

Fuel passage

The fuel flows as shown in the figure from the tank, pressurized by the injection pump to high pressure, and fed to the nozzle and injected to the combustion chamber.

The fuel after lubricating the nozzle needle is returned to the tank through the overflow pipe.

- | | |
|----------------|----------------------|
| 1. Tank | 3. Injection pump |
| 2. Fuel filter | 4. Nozzle and holder |



T147

Inspection

If water, dust, or other foreign matter is observed in the transparent plastic case, clean and replace the filter if necessary.

Disassembly and reassembly

- (1) Remove the filter turning the filter ring nut counterclockwise.

NOTE: Take care to the O-ring fitted between the ring nut and main body, coat with grease before tightening.

- (2) Coat the area of the element to be mounted to the main body with grease and install the element by hand.

19) Governor

Structure and functions

- (1) Governor

This governor is a mechanical all-speed governor. It is installed in the gear case. The fly weight ass'y is installed to the cam shaft and its movement is transmitted to the control rack of the injection pump through the slider control lever link. The spring which controls the movement of the fly weight is hitched to the arm COMPL and tension lever. The spring tension is changed by changing the governor lever so as to control the engine speed.

- (2) Maximum speed set bolt

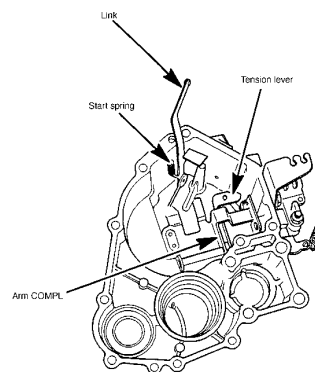
A bolt is mounted on the cylinder block. This bolt limits the movement of the arm COMPL (unloaded maximum rpm). This bolt has been adjusted and sealed at the factory.

- (3) Smoke set, start spring

These are built into the cylinder block, to regulate fuel injection amount at high speed range. Regulation of fuel injection amount at middle speed range is made

with torque control spring to realize bigger torque.

A start spring is placed between the gear case and link. This spring automatically functions to increase injection amount of fuel at the time of engine start. The smoke set had been adjusted at the factory.



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C1.1 Power Unit Manual

20) Injection pump

Specification

Disassembly, Inspection and Reassembly

- (1) Disassembly, inspection, and reassembly of injection pump. If the trouble has been verified to be in the injection pump, do not disassemble other than at shop specializing in this operation.

21) Nozzle and holder

Specifications

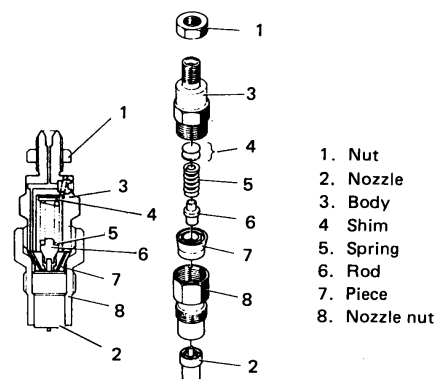
Part code		Nozzle type	Throttle type
Ass'y No.		Needle valve dia.	ø6
		Pintle dia.	ø1
		Valve opening pressure	11.27 – 12.25 MPa (115 – 125 kg/cm ²)
Nozzle holder		Adjustment pressure	12.25 – 12.74 MPa (125 – 130 kg/cm ²)
Nozzle		Injection angle	4°

Structure and functions

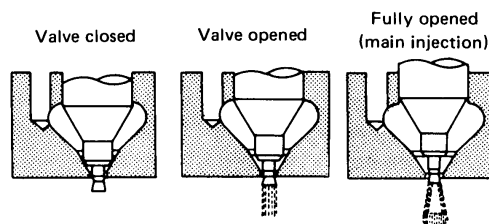
The nozzle is finished super-precisely to inject the fuel which is fed from the injection pump under pressure to the combustion room in good condition. Components as shown in the right figure are incorporated.

The fuel is fed under pressure from the oil hole of the nozzle holder main body to the nozzle body. When the pressure exceeds the specified value, it pushes the spring, injected from the nozzle, and at the same time lubricates and cools the nozzle and nozzle body.

The oil leaking at this time is returned to the tank by the return pipe.



T149



Heavy Equipment Restoration Parts LLC
 email: EngineParts2@gmail.com
 Phone: 269 673 1638



C1.1 Power Unit Manual

C1.1 Engine Information

Disassembly and inspection

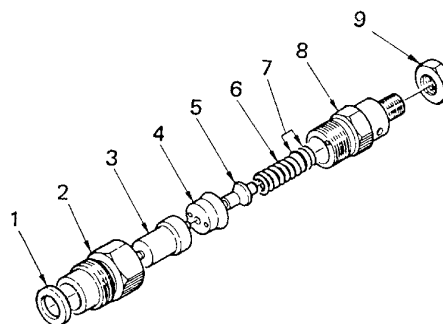
- (1) Place the nozzle holder (body) in a vice and disassemble turning the nozzle nut.

NOTE: Take care not to allow the needle valve to drop when removing the nozzle.

- (2) Wash the nozzle and needle valve and check for seizure and sticking of the nozzle and fuel leakage on the seat surface. Correct fuel leakage of the seat by lapping.
- (3) Check the distance piece upper and lower contact areas and correct to be stucked closely.
- (4) Check the push rod for wear on the nozzle needle valve contact surface and check the spring seat for crack.

Reassembly and adjustment

- (1) When assembling a new nozzle ass'y, heat light oil to 50 - 60°C and remove the rust preventive oil in it. Slide the body and needle valve to ensure that they slide lightly.
- (2) Invert the body, place the shim, spring, rod, piece and nozzle on it in this order, cover the nozzle nut and tighten.
- (3) After assembly, check for the nozzle injection pressure.
 1. Adjust by the adjusting washer (shim) so that the injection is started at 11.76 MPa (120 kgf/cm²) using a nozzle tester.
 2. The pressure increases or decreases about 0.98 MPa (10 kgf/cm²) by a washer of 0.1 mm.



1. Gasket
2. Nozzle nut
Tightening torque: 29.4 - 49 N·m (3 - 5 kgf·m)
3. Nozzle
4. Piece
5. Rod
6. Spring
7. Shim
8. Body
9. Nut
Tightening torque: 29.4 - 39.2 N·m (3 - 4 kgf·m)

Heavy Equipment Restoration Parts LLC
Phone: 269 673 1638
email: EngineParts2@gmail.com

- (4) Injection condition
 1. Small drops should not be mixed in the spray.
 2. The oil should be injected describing a cone by straight lines toward the center line of the nozzle.
 3. Place white paper at about 30 cm from the nozzle and confirm that the spray is approximately circular when injected.
 4. Keep the oil pressure lower by 1.96 MPa (20 kgf/cm²) than the specified value 11.76 MPa (120 kgf/cm²) and check that the test oil does not drop form the nozzle end.



C1.1 Power Unit Manual

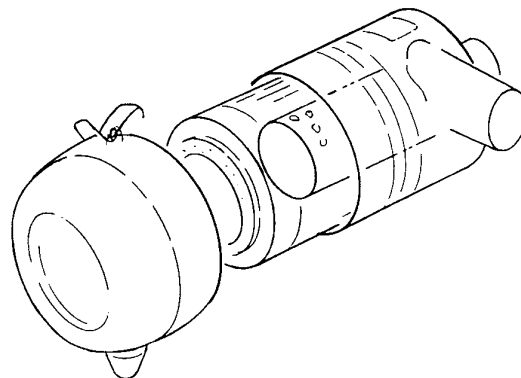
22) Air Cleaner

Structure and functions

- (1) The air cleaner is connected to the cylinder with the air cleaner hose.
- (2) The air cleaner is of the cyclone type incorporating filter element and removes dust from the intake air.

Inspection and replacement

- (1) Take out the element every 100 – 200 hours and blow compressed air (less than 0.686 MPa, 7 kg/cm²) from the inside and clean. (Clean the dust deposit on the dust pan also.)
- (2) If soot or oil has stuck to the element, immerse it in neutral detergent for about 15 minutes and then wash by shaking several times. Rinse in clean water sufficiently and dry naturally.
- (3) When the air cleaner is used in dusty place, clean it earlier.
- (4) After cleaning 6 times or once every year, replace the element with new one.
- (5) After completion of cleaning, apply light from the inside of the element and it should be replaced with new one if breakage, pin hole, and especially thinner part is observed or if the gasket is broken.
- (6) Do not use the element before drying completely.



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C1.1 Power Unit Manual

3. ENGINE REASSEMBLY

★ Cautions before assembly

1. Wash parts to be installed. (Especially wash oil passage bearing, piston and cylinder bore carefully.)
2. Coat the sliding and rotating parts of the cylinder bore, piston, bearing and other parts with new oil before installing.
3. Replace the gaskets with new ones. If necessary, use liquid packing to prevent oil leakage.
4. Do not tighten bolts and nuts for aluminum alloy parts excessively. Tighten them with specified torque.

Reassembly

1. Relief valve assembly with O-ring.

Relief valve tightening torque
59 – 69 N·m (6 – 7 kgf·m)

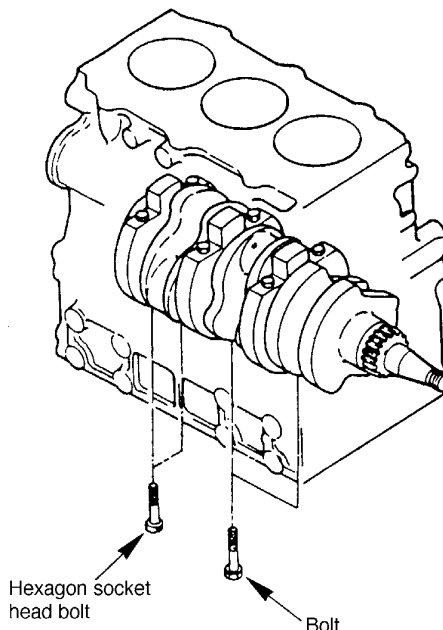
2. Crank shaft and bearing holder assembly.

Cylinder block to bearing holder tightening torque
25 – 29 N·m (2.5 – 3.0 kgf·m)

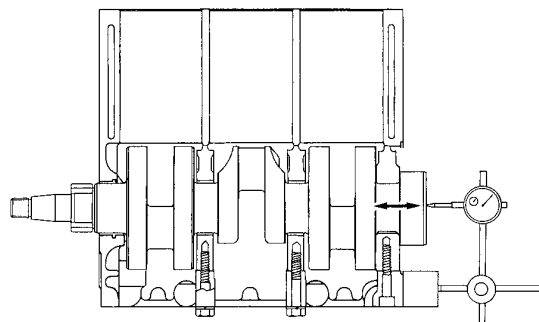
NOTE:

1. Take care not to damage the bush in the cylinder block by the crank shaft gear when install the crank shaft and bearing holder assembly
2. Install the two hexagon socket head bolts for the fly wheel side bearing holder.
3. Measure the end play of crank shaft.

Crankshaft end play	
Standard value	0.05 ~ 0.3 mm
Service limit	0.5 mm



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3. Oil seal

4. Rear plate

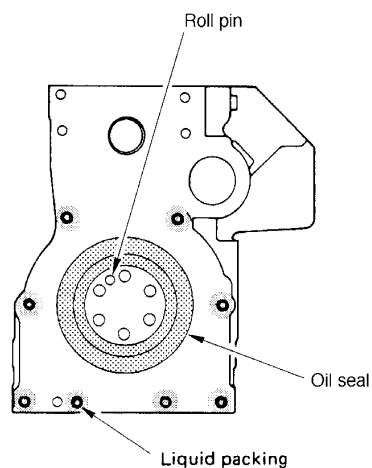
NOTE: Apply the liquid gasket to around the M 10 screw holes for rear plate.

Rear plate tightening torque:
46 ~ 54 N·m (4.7 ~ 55 kgf·m)

5. Fly wheel

Align the hole to the roll pin on the crankshaft.

Fly wheel tightening torque
69 ~ 78 N·m (7.0 ~ 8.0 kgf·m)



T155

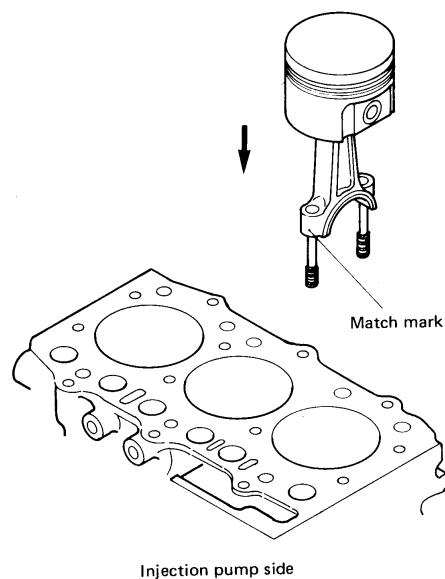
6. Piston and connecting rod assembly

- ① Coat the metal surface, piston and piston ring with engine oil.
- ② Turn the ring to allow the oil to ensure the ring groove sufficiently, and set the ring end gaps at 120° respectively avoiding piston pin direction and the direction at a right angle to the piston pin.
- ③ Insert the ring facing the connecting rod figure match mark toward the injection pump side, using ring pliers.

NOTE: Place the smallest connecting rod figure match mark to the front side so that the figures increase gradually.

- ④ Tighten the connecting rod cap with the specified torque and check for the axial play.

Connecting rod tightening torque
29 ~ 34 N·m (3.0 ~ 3.5 kgf·m)



T156

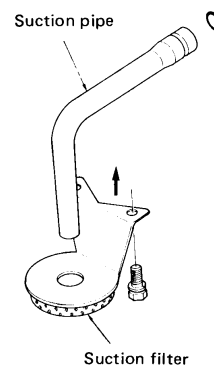
NOTE:

1. After tightening, confirm that the crankshaft moves lightly.
2. The connecting rod should move 0.1 – 0.3 mm in the axial direction.

7. Suction pipe and Suction filter

- ① Fit an O-ring to the suction pipe and insert the suction pipe to the cylinder block.
- ② Place the suction pipe end into the suction filter and fix the suction filter.

Suction filter tightening torque
9 ~ 3 N·m (0.9 ~ 1.3 kgf·m)



T157

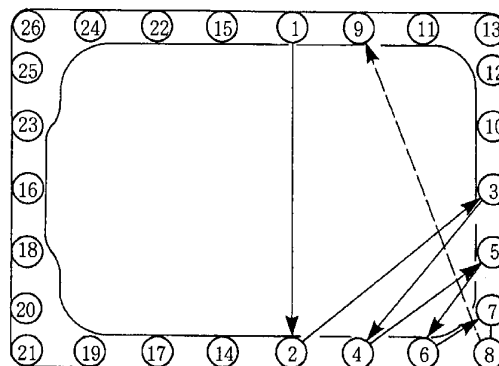


C1.1 Power Unit Manual

8 Oil pan

Start tightening the bolts of the oil pan from the center, then tighten the opposing bolt on opposite side on the diagonal and specified torque.

Oil pan tightening torque
10 – 12.7 N·m (1.0 – 1.3 kgf·m)



Tightening Order

T158

9 Oil level gauge and Gauge guide

Install the oil level gauge and gauge guide using 2 O-rings.

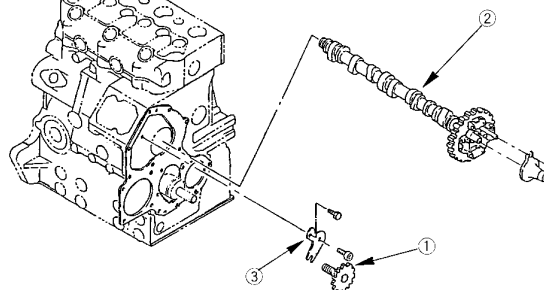
10 Front plate

Install the front plate together with the gasket.

11 Cam shaft ass'y · Tachometer shaft · Plate

- ① Install the tachometer shaft.
- ② Install the cam shaft ass'y (taking care to the bearing).
- ③ Fix the tachometer shaft and cam shaft ass'y with the plate.

Plate tightening torque
9 ~ 13 N·m (0.9 ~ 1.3 kgf·m)

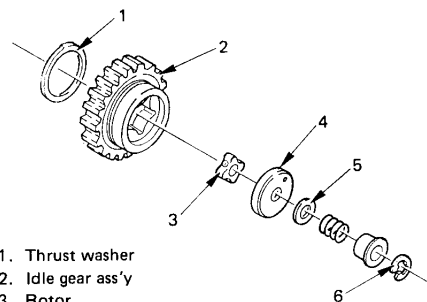


T159

NOTE: Install the timing gear case taking care so that the slider is not dislocated from the guide pin.

12 Idle gear · Oil pump ass'y

- ① Install a thrust washer to the idle gear shaft.
- ② Install the idle gear ass'y.
- ③ Align the match marks of the idle gear, crankshaft gear and cam shaft gear and install idle gear ass'y to the idle gear shaft.
- ④ Install the rotor.
- ⑤ Install the oil pump cover, shim, spring and collar and fix with a E shape clip.



1. Thrust washer
2. Idle gear ass'y
3. Rotor
4. Oil pump cover
5. Shim
6. E shape clip

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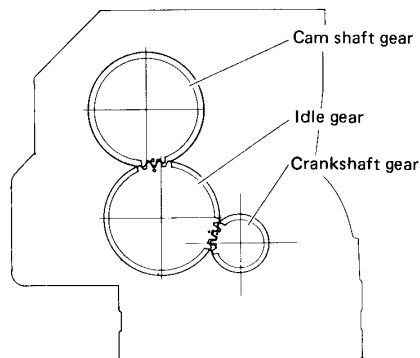
T160



C1.1 Power Unit Manual

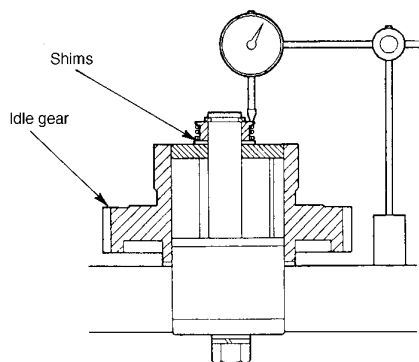
NOTE:

1. Coat the rotor and vane both sides with grease before installing them.
2. Never turn the crankshaft until the timing gear case is installed.
3. Turn the oil pump cover clockwise and counterclockwise, fix the hole at the center of the spring pin inserting hole moving distance, and then install the gear case.



T161

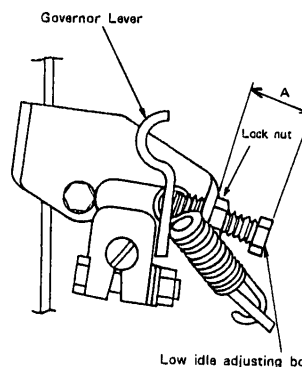
- ⑥ Adjust the shims so that the oil pump, rotor and vane side clearance is **0.1 – 0.15 mm**.



T162

13 Timing gear case

- ① Untighten the lock nut and remove the low idle set bolt.
- ② Install the start spring between the timing gear case and governor link.
- ③ Inserting the link into the cylinder block hole while turn the governor lever to clockwise and hold it, and then install the timing gear case.
- ④ Reinstall the low idle set bolt and secure the lock nut.

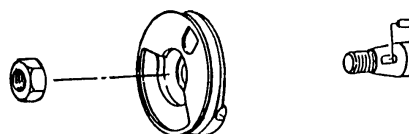


T163

14 Crankshaft pulley

Install the key and assemble the crankshaft pulley and crankshaft.

Crankshaft pulley tightening torque
118 ~ 127 N·m (12 ~ 13 kgf·m)



T164

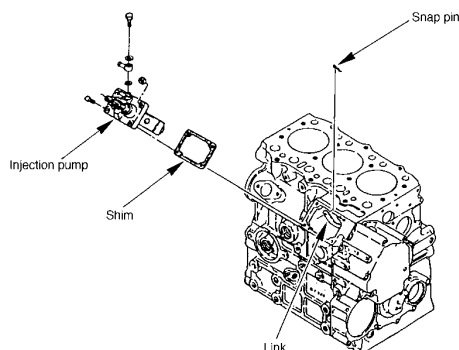


C1.1 Power Unit Manual

15 Injection pump assembly

- ① Fit the shim which has been removed at the time of disassembly, connect the control rack of the injection pump and link, and fix with the snap pin.
- ② Tighten the injection pump with bolts and nut.

Injection pump tightening torque
5 ~ 7 N·m (0.5 ~ 0.7 kgf·m)



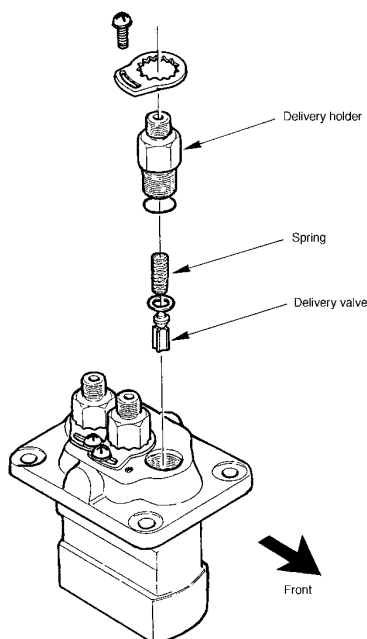
T165

16 Injection timing adjustment

Usually the injection timing is adjusted properly by the step of the order 15.

When the injection pump, cam shaft assembly or cylinder block is replaced, adjust the injection timing in the following procedure.

- ① Install the injection pump inserting a shim of 0.5 mm in thickness according to the procedure of order 15.
- ② Remove the delivery valve holder on the injection pump front side (radiator side).
- ③ Extract the delivery valve and spring and reinstall the delivery valve holder.
- ④ Move the governor lever in the fuel increasing direction and flow the fuel near 25° before compression TDC of the No. 1 piston (front side) and then the fuel flows out of the delivery valve holder.
- ⑤ Turn the crankshaft gently clockwise from the condition of above (4), and then the fuel flowing out of the delivery holder stops. Read the piston position before TDC at this time. If it is late more than 23° decrease the shim thickness and if earlier more than 25° increase the shim thickness.



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Engine Model	C1.1
Injection timing (before TDC)	23 ~ 25°
Piston displacement (before TDC)	4.217 ~ 4.96 mm



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Cat C1.1 Diesel Engine Service and Workshop Manual

C1.1 Engine Information

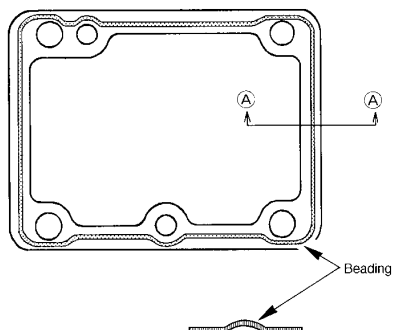
Engine Model C1.1			
Piston displacement to crankshaft angle (before TDC)			
(°)	Displacement	(°)	Displacement
20	3.206	25	4.963
21	3.529	26	5.356
22	3.866	27	5.763
23	4.217	28	6.184
24	4.583		

NOTE:

1. When shim is not required, coat required packing before installing.
 2. The injection timing varies about 2° with 0.3 mm of shims.
 3. Mix assemble a shim (0.5 mm) without beading when you need adjusting shims more than 1.0 mm.
 4. Thickness is stamped on the shims.
- ⑥ Install the delivery valve and spring in the injection pump.

Injection timing adjusting shim	
Thickness (mm)	Part code
0.2	131437310
0.3	131437320
0.4	131437330
0.5	131437340
*0.5	*131437630 (* without beading)

Delivery holder tightening torque
39 ~ 44 N·m (4.0 ~ 4.5 kgf·m)



T167

17 Oil filter

Coat the mounting surface with a small quantity of oil and tighten by hand.

18 Engine stop solenoid

Tighten the engine stop solenoid lightly by pliers.

19 Tappet

Coat the oil to tappets and install.

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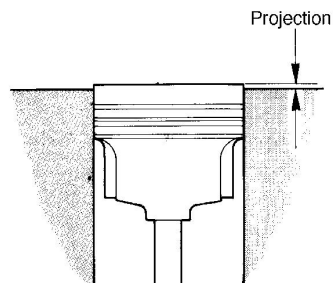


C1.1 Power Unit Manual

20 Cylinder head

- ① Position each of the pistons at top dead center and, using a dial indicator, determine the distance each piston projection above the face of the block.

NOTE: Measure each of the pistons while holding a slight down pressure on the piston. Use the dimension taken from the cylinder which has the greatest projection and select a head gasket as indicated in the following chart.



NOTE: The variation in the amount of protrusion among all pistons must be within 0.1 mm.

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Measured value (mm)	C1.1		Tightened Thickness
More than 0.55 – under 0.65			t = 1.2
More than 0.65 – less than 0.75			t = 1.3

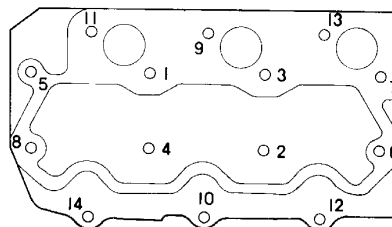
NOTE: Lowest for digits of code numbers are stamped on the head gasket. Install head gasket with code numbers at top.

- ② Tighten the cylinder head in several steps in the order as shown in the right figure and tighten with the specified torque finally.

Cylinder head tightening torque
49 ~ 52 N·m (5.0 ~ 5.3 kgf·m)

NOTE:

1. Take care to the spring pin which positions the cylinder head ass'y.
2. Coat the thread with grease containing disulfide molybdenum.



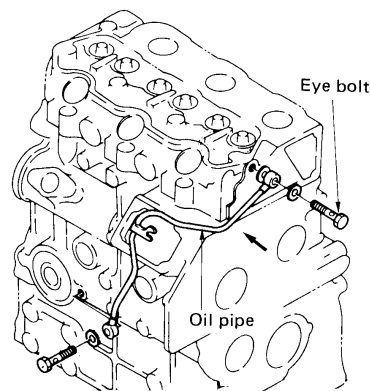
T170



C1.1 Power Unit Manual

21 Oil pipe

Eye bolt tightening torque
10 ~ 13 N·m (1.0 ~ 1.3 kgf·m)

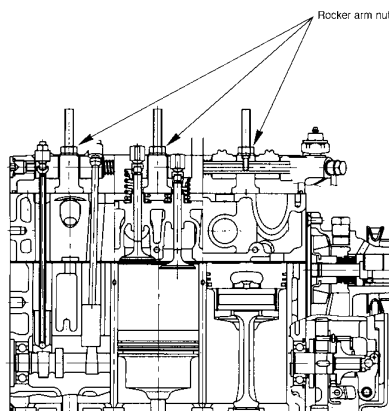


T171

22 Push rod Rocker arm ass'y

Install the push rod and rocker arm ass'y

Rocker arm ass'y tightening torque
20 ~ 25 N·m (2.0 ~ 2.5 kgf·m)



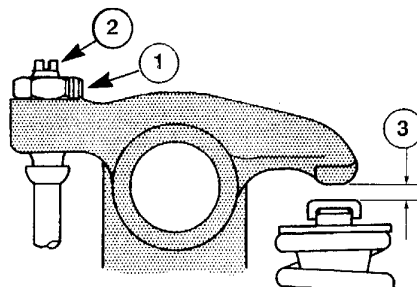
T172

23 Valve clearance adjustment

Untighten the nut of the intake and exhaust valves and adjust to 0.2 mm with adjust screw.

NOTE:

1. Adjust the valve clearance while cold.
2. Set the No. 1 cylinder at the compression TDC, adjust the valve clearance of the No. 1 intake and exhaust valves, and No. 2 exhaust valve, turn the crankshaft 240° counterclockwise when viewed from the front side, and adjust the No. 2 intake, and No. 3 intake and exhaust valves.



1. Locknut
2. Adjusting Screw
3. Valve Clearance 0.2 mm

24 Head cover

Evenly tighten the cylinder head cover, taking care on the packing.

Head cover tightening torque
10 ~ 12 N·m (1.0 ~ 1.2 kgf·m)

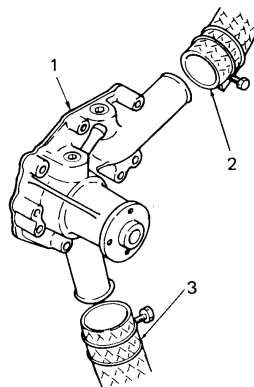
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C1.1 Power Unit Manual

25 Water pump ass'y · Radiator hose

1. Water pump ass'y
2. Radiator hose (upper)
3. Radiator hose (lower)



26 Glow plug · Connector

	Glow plug tightening torque
	8 – 15 N·m (0.8 – 1.5 kgf·m)

T174

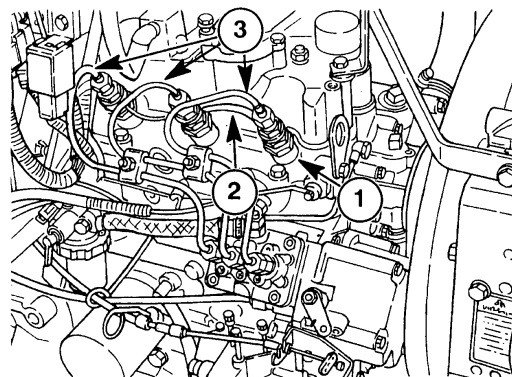
27 Oil pressure switch

	Oil pressure switch tightening torque
	15 ~ 20 N·m (1.5 ~ 2.0 kgf·m)

28 Nozzle and holder ass'y

Tighten the cap and gasket positively, tighten with specified torque using a nozzle holder socket, and install the return pipe.

	Nozzle and holder tightening torque
	59 – 68.6 N·m (6.0 – 7.0 kgf·m)



29 Return pipe COMPL · Injection pipe

Injection pipe
After installing the return pipe, install the injection pipe.

	Injection pipe tightening torque
	19.6 ~ 24.5 N·m (2.0 ~ 2.5 kgf·m)

1. Nozzle and holder
2. Return pipe
3. Injection pipe

T176

30 Alternator ass'y

Install the alternator ass'y taking care to the direction of the adjusting plate.

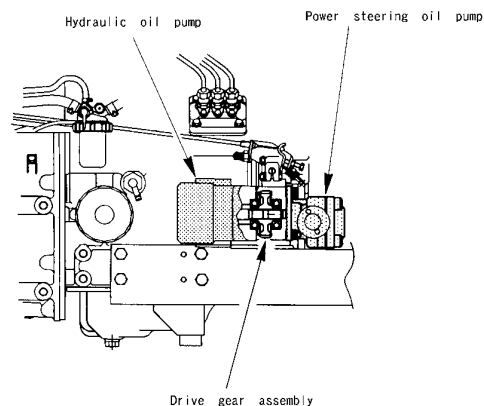
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31 Drive gear assembly, Hydraulic oil pump and power steering oil pump

- ① Install the drive gear assembly to the hydraulic pump and then install them to the gear case.
- ② Install the power steering oil pump to front of the gear case.



T177

32 V belt · Fan pulley · Cooling fan

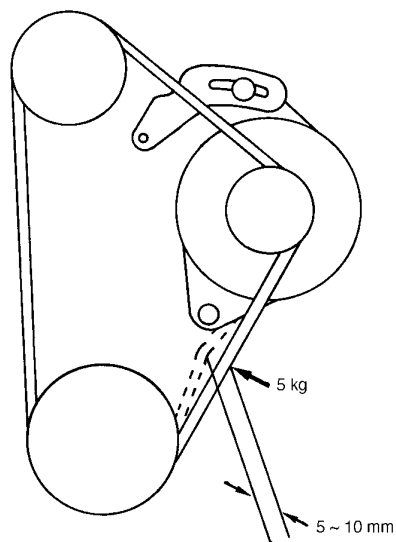
- ① Install the fan pulley and cooling fan and then V belt.
- ② Adjust the belt tension with the alternator so that it is deflected 5~10 mm at the middle point between the crankshaft pulley and alternator pulley when depressed by a finger (about 5 kgf) and tighten.

Cooling fan tightening torque
8.8 ~ 12.7 N·m (0.9 ~ 1.3 kgf·m)

33 Exhaust manifold (Muffler assembly)

34 Pressure plate · Clutch disk

Install the pressure plate and clutch disk referring to paragraph 3-2, Clutch.



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C1.1 Power Unit Manual

C1.1 Engine Information

2-5 Trouble Shooting

Trouble	Cause	Remedy
Engine does not start.	Defective key switch Insufficient charging or completely discharged battery. No fuel. Air mixed in the fuel system. Clogged fuel filter. Irregular or improper fuel supply. Defective glow plug. Improper viscosity of lubricating oil. Clogged air cleaner. Not compression. Defective engine stop solenoid. Trouble of IOS system.	Connect or correct contact points properly. Charge. Replenish the fuel. Correct points allowing the air to enter the fuel. Replace the fuel filter. Trouble of injection pump. Have corrected in work specified by Nippon Denso. Replace to disconnected wire of glow plug. Check and change. Clean the air cleaner. Check an correct each part. Check or replace wiring. Refer to 3-8 Electric Units and Accessories.
Irregular engine speed	Air mixed in the fuel system. Uneven fuel injection. Clogged fuel filter. Trouble of speed governor. Improper function of engine main body.	Discharge air from the fuel. Trouble of injection pump. Have corrected or replaced in a work specified by Nippon Denso. Replace the fuel filter. Check and adjust. Overhaul, check and correct each part.
Engine stops during operation	No fuel in fuel tank. Clogged fuel filter. Air mixed in the fuel system. Improper functions of engine main body.	Replenish fuel. Replace the filter. Correct points to allow the air to enter the fuel system. Check and correct each part.
Engine overheat	Insufficient cooling water. Loosened or slipping fan belt. Failure of fan belt. Clogged radiator. Clogged radiator fin. Cooling water passage clogged with dust, fur, etc. Improper function of thermostat. Insufficient lubricating oil. Overload.	Replenish the cooling water, and check and repair water leaking points. Clean oil dust, etc. and retighten. Replace. Clean the radiator. Clean. Wash. Check and replace Replenish. Decrease the load.



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C1.1 Engine Information

Trouble	Cause	Remedy
Improper color of engine exhaust (white or blue)	Too much engine oil. Too low viscosity of engine oil. Improper injection timing.	Check and adjust the quantity. Check and change. Too late. Correct.
Improper engine exhaust (black or dark gray)	Improper fuel. Excessive fuel injection. Damaged engine block. Overload. Clogged air cleaner.	Check and change. Check and adjust. Check and correct each part. Reduce the load. Clean the elements.
Improper charging.	Loosened fan belt. Trouble in wiring of each part. Defective battery. Defective alternator.	Correct belt tension. Check and repair. Replace. Replace.
Starter does not operate.	Loosened or disconnected wiring of each part. Dropped battery voltage. Defective safety switch. Trouble in starter.	Check and install or tighten. Charge the battery. Replace. Check and correct the starter.
Oil pressure lamp does not go out.	Insufficient engine oil. Trouble in pressure switch. Oil leakage from lubricating system. Clogged oil filter. Short circuit between oil pressure lamp and oil pressure switch.	Replenish to specified gauge level. Replace the switch. Check and retighten. Replace with new one. Repair.
Oil pressure lamp does not light up with the key switch turned ON. (While engine stops.)	Burnt out lamp. Disconnected wire between battery and oil pressure lamp.	Replace the lamp. Repair.



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C1.1 Engine Information

2-1 Engine Sectional View

