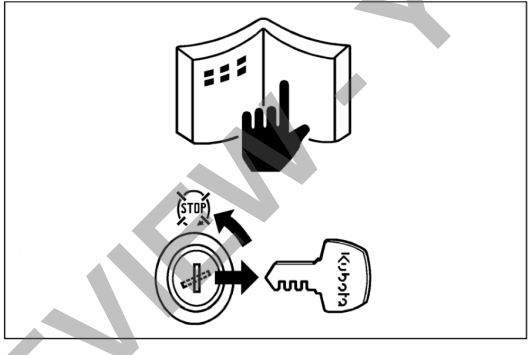
⚠ SAFETY FIRST

This symbol, the industry's "Safety Alert Symbol", is used throughout this manual and on labels on the machine itself to warn of the possibility of personal injury. Read these instructions carefully.

It is essential that you read the instructions and safety regulations before you attempt to repair or use this unit.

⚠ **DANGER**	**: Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.**
⚠ **WARNING**	**: Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.**
⚠ **CAUTION**	**: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.**
■ **IMPORTANT**	**: Indicates that equipment or property damage could result if instructions are not followed.**
■ **NOTE**	**: Gives helpful information.**



BEFORE SERVICING AND REPAIRING

- Read all instructions and safety instructions in this manual and on your engine safety decals.
- Clean the work area and engine.
- Park the machine on a firm and level ground.
- Allow the engine to cool before proceeding.
- Stop the engine, and remove the key.
- Disconnect the battery negative cable.

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SPECIFICATIONS

Model			D1403-B (E)	D1703-B (E)
Number of Cylinders			3	
Type			Vertical, water-cooled, 4-cycle diesel engine	
Bore x Stroke		mm (in.)	80 x 92.4 (3.15 x 3.64)	87 x 92.4 (3.43 x 3.64)
Total Displacement		cm^3 (cu. in.)	1393 (85.01)	1647 (100.55)
Engine	SAE Net Cont.	kW/rpm (HP/rpm)	18.6/2800 (25.0/2800)	22.4/2800 (30.0/2800)
	SAE Net Intermittent	kW/rpm (HP/rpm)	21.6/2800 (29.0/2800)	25.7/2800 (34.5/2800)
	SAE Gross Intermittent	kW/rpm (HP/rpm)	23.1/2800 (31.0/2800)	27.6/2800 (37.0/2800)
	DIN6271-NA	kW/rpm (PS/rpm)	18.4/2800 (25.0/2800)	22.1/2800 (30.0/2800)
	DIN6271-NB	kW/rpm (PS/rpm)	20.6/2800 (28.0/2800)	24.6/2800 (33.5/2800)
	DIN70020	kW/rpm (PS/rpm)	22.1/2800 (30.0/2800)	26.5/2800 (36.0/2800)
Maximum Bare Speed		rpm	3000	
Minimum Idling Speed		rpm	700 to 750	
Combustion Chamber			Spherical Type	
Fuel Injection Pump			Bosch Type Mini Pump (PFR 3M)	
Governor			Centrifugal Ball Mechanical Governor	
Direction of Rotation			Counter-clockwise (Viewed from flywheel side)	
Injection Nozzle			BOSCH Throttle-Type	
Injection Timing			0.314 rad. (18°) Before T.D.C	
Firing Order			1-2-3	
Injection Pressure			13.73 MPa (140 kgf/cm^2, 1991 psi)	
Compression Ratio			23 : 1	
Lubricating System			Forced Lubrication by trochoid Pump	
Oil Pressure Indicating			Electrical Type Switch	
Lubricating Filter			Full Flow Paper Filter (Cartridge Type)	
Cooling System			Pressurized radiation, forced Circulation with Water Pump	
Starting System			Electric Starting with Starter	
			12 V 1.2 kw	
Starting Support Device			By Glow Plug in Combustion Chamber	
Battery			12V 70 to 80 AH	
Dynamo for Charing			12V, 360W	
Fuel			Diesel Fuel No.2-D (ASTM D975)	
Lubricating Oil			Class CF lubricating oil as per API classification is recommended. If this class of lubricating oil is not available, preferably use Class CD or CE lubricating oil. For details on recommended lubricating oils, see page S-12, 15.	
* Lubricating Oil Capacity	Oil pan depth 90 mm (3.54 in.)		5.6 ℓ (1.48 US gals, 1.23 Imp gals)	
	Oil pan depth 124 mm (4.88 in.)		7.0 ℓ (1.85 US gals, 1.54 Imp gals)	
Weight (Dry)		kg (lbs)	148 (326)	

*90 mm (3.54 in.) Oil pan depth is optional

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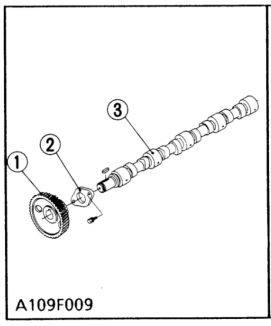
[4] TROUBLESHOOTING

Symptom	Probable Cause	Solution	Reference Page
Engine does not start	• No fuel	Replenish fuel	
	• Air in the fuel system	Vent air	
	• Water in the fuel system	Change fuel and repair or replace fuel system	
	• Fuel pipe clogged	Clean	
	• Fuel filter clogged	Clean or change	S-16
	• Excessively high viscosity of fuel or engine oil at low temperature	Use the specified fuel or engine oil	S-15
	• Fuel with low cetane number	Use the specified fuel	
	• Fuel leak due to loose injection pipe retaining nut	Tighten nut	
	• Incorrect injection timing	Adjust	S-50
	• Fuel cam shaft worn	Replace	
	• Injection nozzle clogged	Clean	
	• Injection pump malfunctioning	Repair or replace	
	• Seizure of crankshaft, camshaft, piston, cylinder liner or bearing	Repair or replace	
	• Compression leak from cylinder	Replace head gasket, tighten cylinder head bolt, glow plug and nozzle holder	S-23
	• Improper valve timing	Correct or replace timing gear	
	• Piston ring and liner worn	Replace	S-9, 40
	• Excessive valve clearance	Adjust	S-17
Starter does not run	• Battery discharged	Charge	
	• Starter malfunctioning	Repair or replace	
	• Key switch malfunctioning	Repair or replace	
	• Wiring disconnected	Connect	
Engine revolution is not smooth	• Fuel filter clogged or dirty	Clean or change	S-16
	• Air cleaner clogged	Clean or change	S-16
	• Fuel leak due to loose injection pipe retaining nut	Tighten nut	
	• Injection pump malfunctioning	Repair or replace	
	• Incorrect nozzle opening pressure	Adjust	S-52
	• Injection nozzle stuck or clogged	Repair or replace	
	• Fuel over flow pipe clogged	Clean	
	• Governor malfunctioning	Repair	
Either white or blue exhaust gas is observed	• Excessive engine oil	Reduce to the specified level	
	• Piston ring and liner worn or stuck	Repair or replace	S-9, 40
	• Incorrect injection timing	Adjust	S-50
	• Deficient compression	Adjust top clearance	S-23
Either black or dark gray exhaust gas is observed	• Overload	Lessen the load	
	• Low grade fuel used	Use the specified fuel	
	• Fuel filter clogged	Clean or change	
	• Air cleaner clogged	Clean or change	
	• Deficient nozzle injection	Repair or replace the nozzle	
Deficient output	• Incorrect injection timing	Adjust	S-50
	• Engine's moving parts seem to be seizing	Repair or replace	
	• Uneven fuel injection	Repair or replace the injection pump	
	• Deficient nozzle injection	Repair or replace the nozzle	S-52
	• Compression leak	Replace head gasket, tighten cylinder head bolt, glow plug and nozzle holder	

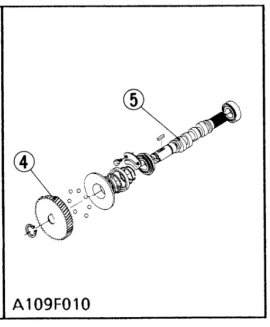
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[6] CAMSHAFT



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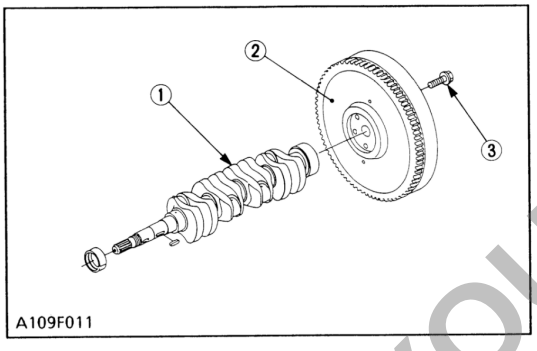


A109F010

The camshaft (3) is made of special cast iron and the journal and cam sections are chilled to resist wear. The journal sections are force-lubricated. The fuel camshaft (5) controls the reciprocating movement of the injection pump. The fuel camshaft is made of carbon steel and the cam sections are quenched and tempered to provide greater wear resistance.

(1) Cam Gear
(2) Camshaft Stopper
(3) Camshaft
(4) Injection Pump Gear
(5) Fuel Camshaft

[7] FLYWHEEL



A109F011

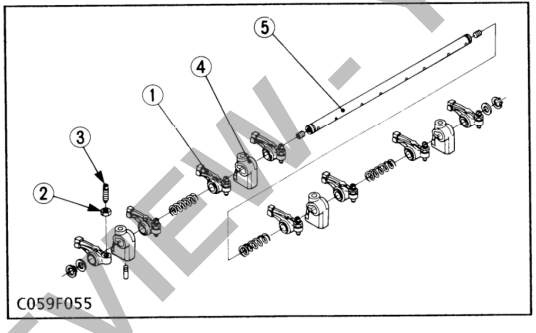
The flywheel stores the rotating force in the combustion stroke as inertial energy, reduces crankshaft rotating speed fluctuation and maintains the smooth rotating conditions.

The flywheel periphery is inscribed with the marks showing fuel injection timing angle lines and top dead center mark **TC**.

The flywheel has gear teeth around its outer rim, which mesh with the drive pinion of the starter.

(1) Crankshaft
(2) Flywheel
(3) Flywheel Screw

[8] ROCKER ARM



C059F055

The rocker arm assembly includes the rocker arms (1), rocker arm brackets (4) and rocker arm shaft (5) push rods to an open/close movement of the inlet and exhaust valves.

Lubricating oil pressurized through the bracket to the rocker arm shaft, which serves as a fulcrum so that the rocker arm and the entire system are lubricated sufficiently.

(1) Rocker Arm
(2) Lock Nut
(3) Adjusting Screw
(4) Rocker Arm Bracket
(5) Rocker Arm Shaft

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[6] MAINTENANCE CHECK LIST

To maintain long-lasting and safe engine performance, make it a rule to carry out regular inspections by following the table below.

Item		Service Interval										
		Every 50 hours	Every 100 hours	Every 150 hours	Every 200 hours	Every 300 hours	Every 400 hours	Every 500 hours	Every 800 hours	Every 1500 hours	Every one year	Every two years
Checking fuel pipes and clamps		☆										
* Changing engine oil	(1) Oil pan depth (90 mm) (3.54 in.)			☆								
	(2) Oil pan depth (124 mm) (4.88 in.)				☆							
Cleaning air filter element			☆									
Cleaning fuel filter element			☆									
Checking fan belt tension and damage			☆									
Checking water pipes and clamps					☆							
* Changing oil filter cartridge	(1) Oil pan depth (90 mm) (3.54 in.)					☆						
	(2) Oil pan depth (124 mm) (4.88 in.)						☆					
Changing fuel filter cartridge							☆					
Cleaning radiator interior								☆				
Changing radiator cleaner and coolant												☆
Changing air filter element											☆	
Checking valve clearance									☆			
** Checking injection nozzle pressure										☆		
Changing water pipes and clamps												☆
Changing fuel pipes and clamps												☆

(1), (2) For generators (1800/1500 rpm) and general construction / industrial machinery and farm equipment
* Change engine oil and oil cartridge after the first 50 hours of operation.
** Maintenance interval as per EPA instructions.

⚠ CAUTION

- **When changing or inspecting, be sure to level and stop the engine.**

■ NOTE

Lubricating Oil

With the emission control now in effect, the CF-4 and CG-4 lubricating oils have been developed for use of a low-sulfur fuel on-road vehicle engines. When an off-road vehicle engine runs on a high-sulfur fuel, it is advisable to employ the CF, CD or CE lubricating oil with a high total base number. If the CF-4 or CG-4 lubricating oil is used with a high-sulfur fuel, change the lubricating oil at shorter intervals.

- **Lubricating oil recommended when a low-sulfur or high-sulfur fuel is employed.**

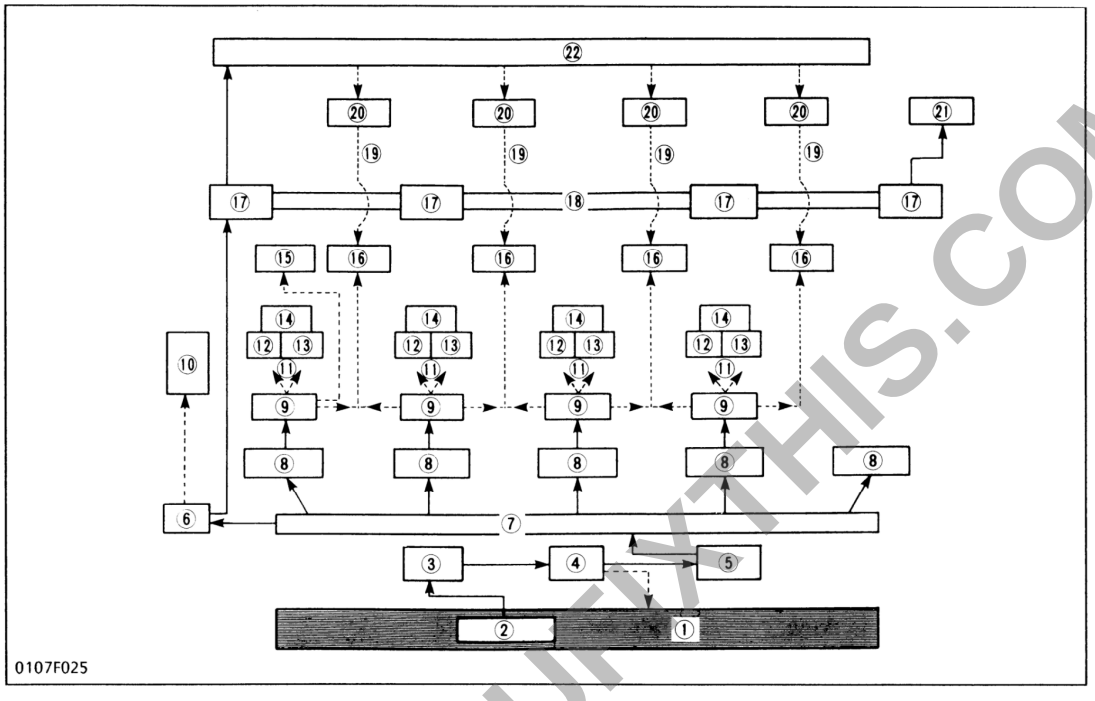
Fuel / Lubricating oil class	Low sulfur	High sulfur	Remarks
CF	❍	❍	TBN ≥ 10
CF-4	❍	X	
CG-4	❍	X	

❍ : Recommendable X : Not recommendable

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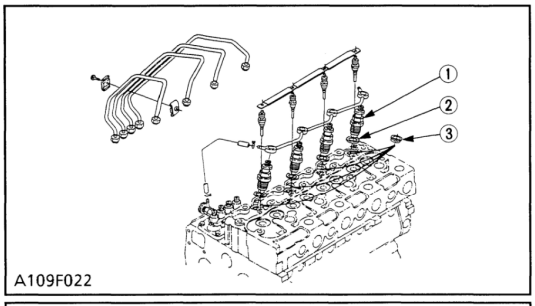
Engine Oil Flow

(1) Oil Pan
(2) Oil Strainer
(3) Oil Pump
(4) Relief Valve
(5) Oil Filter Cartridge
(6) Idle Gear
(7) Main Oil Gallery
(8) Main Bearing
(9) Big End
(10) Timing Gear
(11) Splash
(12) Bore
(13) Small End
(14) Piston
(15) Fuel Camshaft
(16) Tappets
(17) Camshaft Bearing
(18) Camshaft
(19) Drain
(20) Rocker Arm
(21) Oil Switch
(22) Rocker Arm Shaft

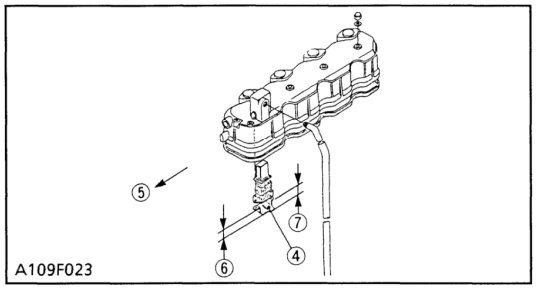
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[3] CYLINDER HEAD AND VALVES



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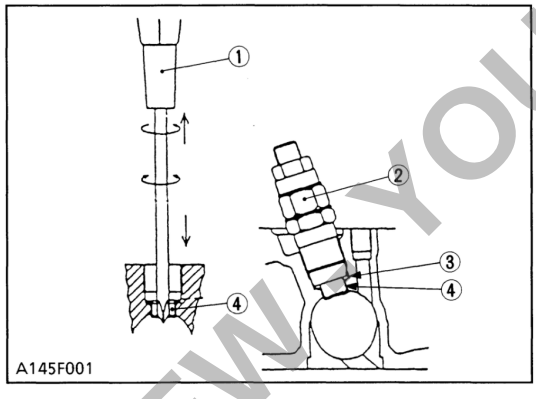
Cylinder Head Cover and Nozzle Holder

1. Remove the injection pipes and overflow pipes.
2. Remove the glow plugs.
3. Remove the nozzle holder and copper gaskets.
4. Remove the heat seal.
5. Remove the head cover.

(When reassembling)

- Check to see that the cylinder head cover gasket is not defective.
- Be sure to place the heat seal (3) and breather oil shield (4) (See Fig).

(1) Nozzle Holder
(2) Copper Gasket
(3) Heat Seal
(4) Breather Oil Shield
(5) Gear Case Side
(6) Short Plate
(7) Long Plate



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Nozzle Heat Seal Service Removal Procedure

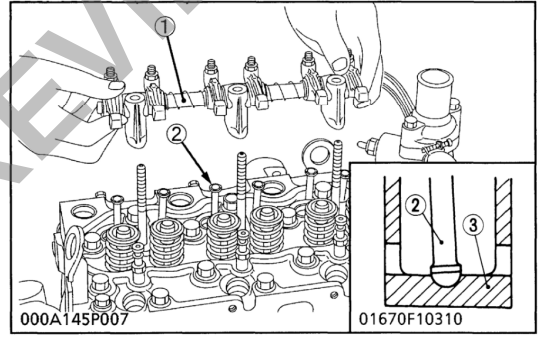
■ IMPORTANT

- **Use a plus (phillips head) screw driver that has a Dia. which is bigger than the heat seal hole (Approx. 6 mm) 1/4 in..**

1. Drive screw driver lightly into the heat seal hole.
2. Turn screw driver three or four times each way.
3. While turning the screw driver, slowly pull the heat seal out together with the injection nozzle gasket.

   If the heat seal drops, repeat the above procedure. Heat seal and injection nozzle gasket must be changed when the injection nozzle is removed for cleaning or for service.

(1) Plus Screw Driver
(2) Injection Nozzle
(3) Injection Nozzle Packin
(4) Heat Seal



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Rocker Arm, Push Rod and In./Ex. Manifold

1. Remove the rocker arm as a unit.
2. Remove the push rods.
3. Remove the In./Ex. manifold.

(When reassembling)

- When putting the push rods onto the tappets, check to see if their ends are properly engaged with the grooves.

■ IMPORTANT

- **After reassembling the rocker arm, be sure to adjust the valve clearance.**

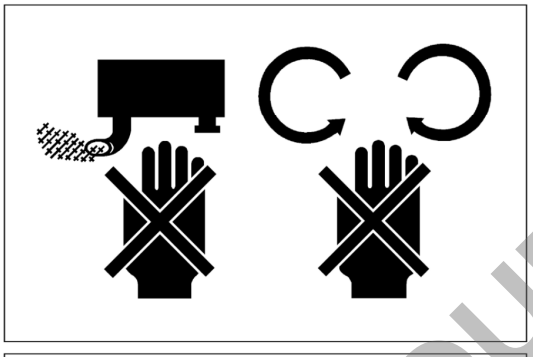
(1) Rocker Arm
(2) Push Rod
(3) Tappet

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SAFETY STARTING

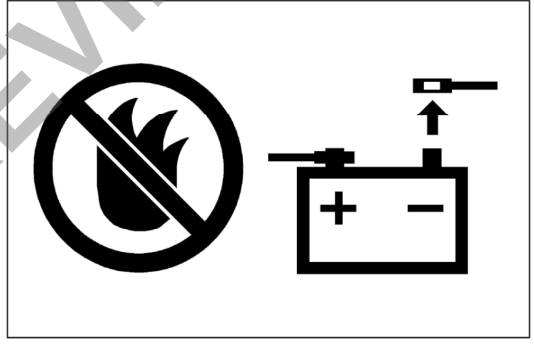
- Do not start the engine by shorting across starter terminals or bypassing the safety start switch.
- Unauthorized modifications to the engine may impair the function and / or safety and affect engine life.



SAFETY WORKING

- Do not work on the machine while under the influence of alcohol, medication, or other substances or while fatigued.
- Wear close fitting clothing and safety equipment appropriate to the job.
- Use tools appropriate to the work. Makeshift tools, parts, and procedures are not recommended.
- When servicing is performed together by two or more persons, take care to perform all work safely.
- Do not touch the rotating or hot parts while the engine is running.
- Never remove the radiator cap while the engine is running, or immediately after stopping. Otherwise, hot water will spout out from radiator. Only remove radiator cap when cool enough to touch with bare hands. Slowly loosen the cap to first stop to relieve pressure before removing completely.
- Escaping fluid (fuel or hydraulic oil) under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting hydraulic or fuel lines. Tighten all connections before applying pressure.
- Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.





AVOID FIRES

- Fuel is extremely flammable and explosive under certain conditions. Do not smoke or allow flames or sparks in your working area.
- To avoid sparks from an accidental short circuit, always disconnect the battery negative cable first and connect it last.
- Battery gas can explode. Keep sparks and open flame away from the top of battery, especially when charging the battery.
- Make sure that no fuel has been spilled on the engine.

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