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WORKSHOP MANUAL GASOLINE, LPG ENGINE

WG752-E2, DF752-E2

Kubota

TO THE READER

This Workshop Manual has been prepared to provide servicing personnel with information on the mechanism, service and maintenance of KUBOTA Gasoline / LPG Fuel Engines (WG 752-E2 and DF752-E2). It is divided into two parts, "Mechanism" and "Servicing".

■ Mechanism

Information on the construction and function are included. This part should be understood before proceeding with troubleshooting, disassembling and servicing.

■ Servicing

Under the heading "General" comes general precautions, check and maintenance and special tools. For each Engine and Generator section, there are troubleshooting, servicing specification lists, checking and adjusting, disassembling and assembling, and servicing which cover procedures, precautions, factory specifications and allowable limits.

All information illustrations and specifications contained in this manual are based on the latest product information available at the time of publication. The right is reserved to make changes in all information at any time without notice.

Due to covering many models of this manual, illustration being used, have not been specified as one model.

February 2001

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SAFETY FIRST

This symbol, the industry's "Safety Alert Symbol", is used throughout this manual and decals on the engine 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

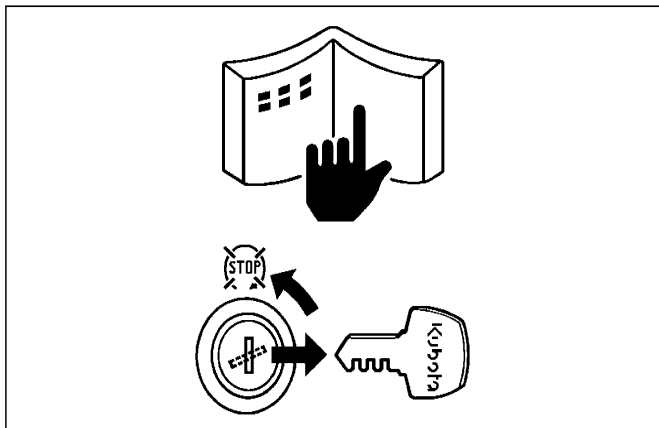
: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

■ IMPORTANT

: Indicates that equipment or property damage could result if instructions are not followed.

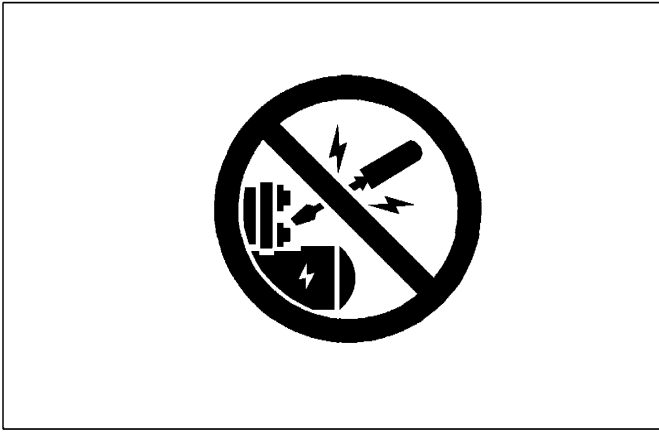
■ NOTE

: Gives helpful information.



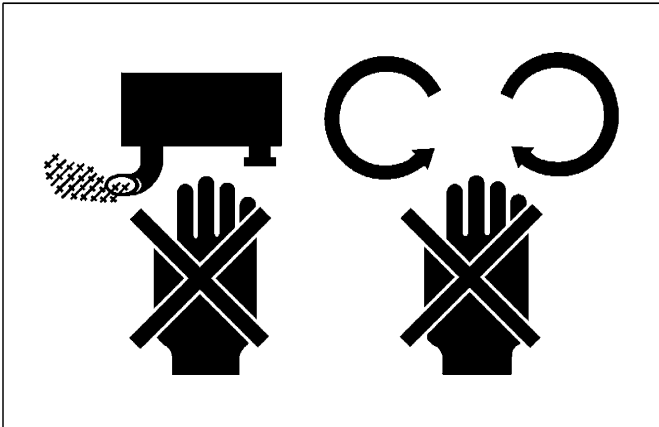
BEFORE SERVICING AND REPAIRING

- Read all instructions and safety instructions in this manual and on your engine safety decals.
- Clean the work area and engine.
- Place the engine 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.



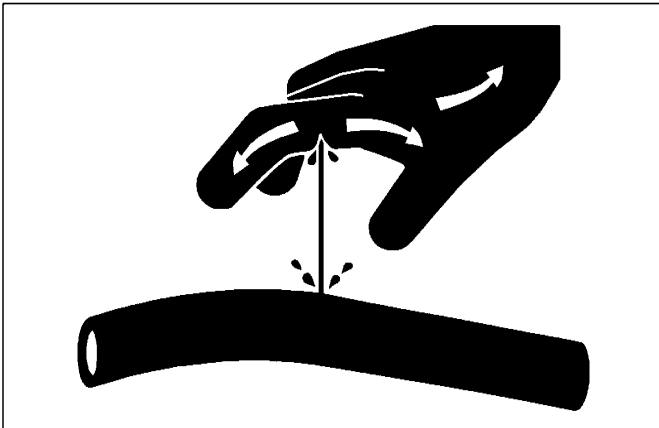
SAFETY STARTING

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



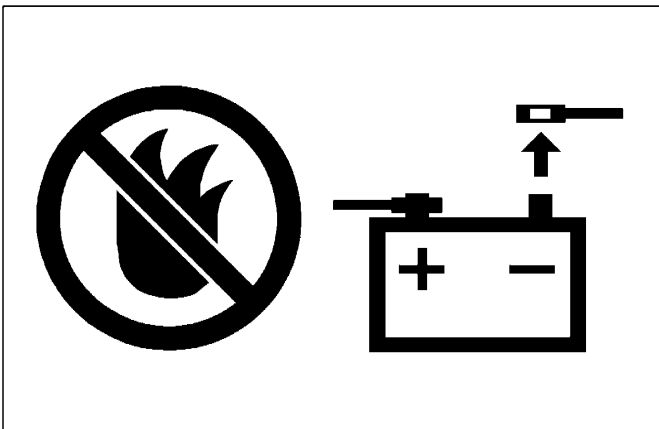
SAFETY WORKING

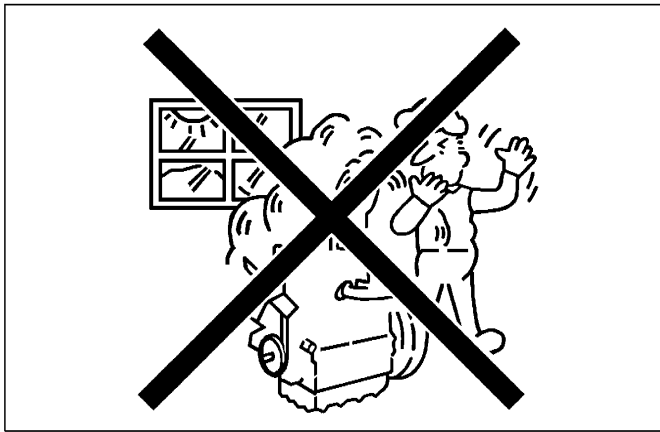
- Do not work on the engine while under the influence of alcohol, medication, or other substances or while fatigued.
- Wear close fitting clothing and safety equipment appropriate to the job.
- Use tools appropriate to the work. Makeshift tools, parts, and procedures are not recommended.
- When servicing 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) under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting 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

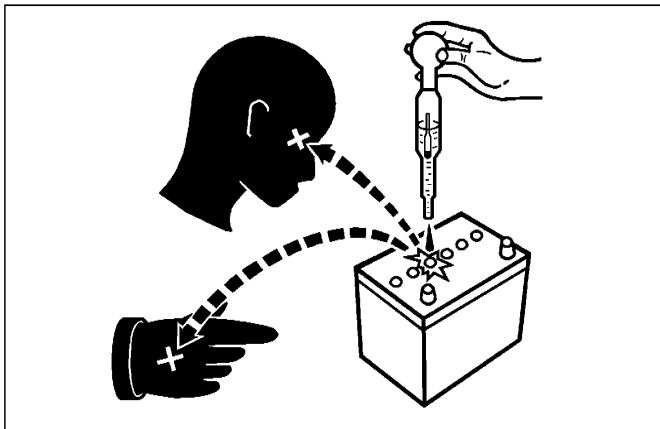
- Fuel is extremely flammable and explosive under certain conditions. Do not smoke or allow flames or sparks in your working area.
- To avoid sparks from an accidental short circuit, always disconnect the battery negative cable first and connect it last.
- Battery gas can explode. Keep sparks and open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





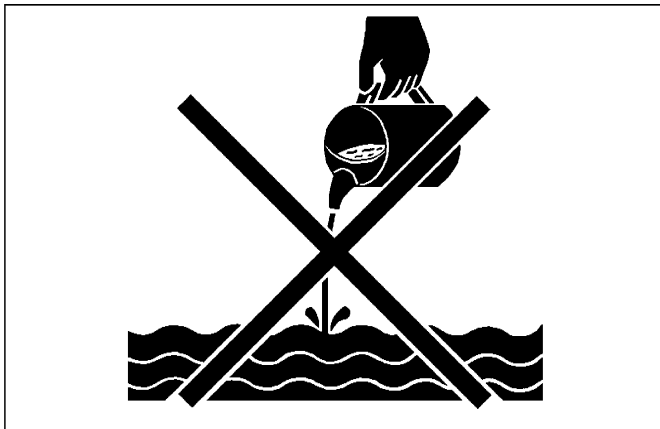
VENTILATE WORK AREA

- If the engine must be running to do some work, make sure the area is well ventilated. Never run the engine in a closed area. The exhaust gas contains poisonous carbon monoxide.



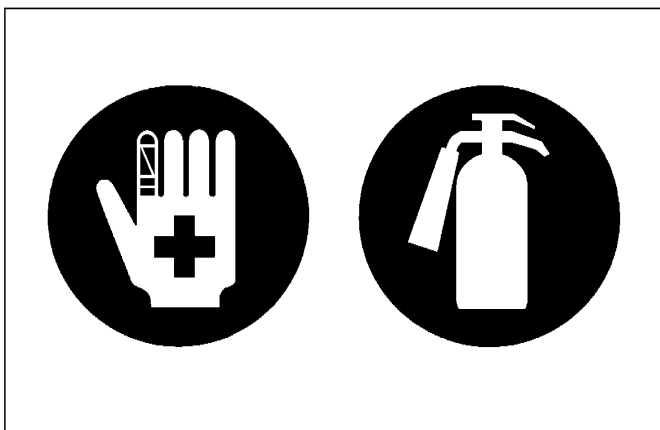
PREVENT ACID BURNS

- Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, clothing and cause blindness if splashed into eyes. Keep electrolyte away from eyes, hands and clothing. If you spill electrolyte on yourself, flush with water, and get medical attention immediately.



DISPOSE OF FLUIDS PROPERLY

- Do not pour fluids into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, electrolyte and other harmful waste.



PREPARE FOR EMERGENCIES

- Keep a first aid kit and fire extinguisher handy at all times.
- Keep emergency numbers for doctors, ambulance service, hospital and fire department near your telephone.

IMPORTANT ITEMS OF EXHAUST EMISSION REGULATION

- To conform with U.S. EPA and CARB SOREs (Small Off Road Engines) emission regulations, the WG752-E2 / DF752-E2 engine must observe below items.

1. INLET AND EXHAUST SYSTEM

The WG752-E2 / DF752-E2 engine must use the below air cleaner and inlet pipe, and exhaust back pressure of the muffler must be within the below values.

Part	Part No.
Genuine air cleaner	15372-11010
Genuine inlet pipe	12581-11620

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Brake horse power	SAE net int.	Allowable maximum exhaust back pressure
17.1 kW (23 HP) / 3600 min ⁻¹ (rpm)		19.6 kPa (147.1 mmHg) / 3600 min ⁻¹ (rpm)

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Any modifications to the fuel system or any adjustments made on this engine will cause this engine to be in non-compliance with emission regulations.

2. ALTITUDE COMPENSATION KIT

■ IMPORTANT

- EPA and CARB emission regulations require the ultimate users, as their obligation, to improve the emission of the non-road SI engine under 19 kW install the appropriate genuine altitude compensation kit. The engine manufacturer provides this kit in case the engine is operated at an altitude that exceeds the standard level, as guaranteed by the engine manufacturer. For this purpose, Kubota prepared genuine Altitude compensation kit described below. The ultimate user of SI engines must comply with this regulation through the installation of the appropriate Altitude compensation kit for the altitude range the engine will operate.
- See page S-67 for reference to the exchange of altitude compensation kit.

Altitude Kit	Altitude Ranges
Carburetor (with 0 m kit) *	0 m (0 ft) ←→ 700 m (2300 ft)
Carburetor with 1000 m kit	300 m (1000 ft) ←→ 1700 m (5600 ft)
Carburetor with 2000 m kit	1300 m (4300 ft) ←→ 2700 m (8900 ft)

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3. LPG REGULATOR WITH VAPORIZER (DF752-E2)

When operating DF752-E2 on LP Gas, only a KUBOTA GENUINE LPG REGULATOR KIT can be used.

4. KUBOTA RECOMMENDED LPG FUEL SPECIFICATIONS (DF752-E2)

- Commercial Propane gas only.
- Equivalent to Propanes H-D-5 of GPA* standards.

(vol %)

C ₃ H ₈	C ₃ H ₆	C ₄ H ₁₀	Others
≥ 90 %	≤ 5 %	≤ 2.5 %	—

*GPA means Gas Processors Association (U.S.A.)

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5. LENGTH OF THE LPG VAPOR HOSE (DF752-E2)

The length of the LPG vapor hose between the LPG carburetor and its regulator must be within 280 to 320 mm (11.02 to 12.60 in.).

The incorrect use of the hose may not conform to EPA and CARB EMISSION REGULATIONS.

SPECIFICATIONS

Model		WG752-E2	DF752-E2	
Type		Vertical, water cooled, 4-cycle Gasoline engine	Vertical, water cooled, 4-cycle Dual Fuel (Gasoline / LPG) engine	
			Gasoline fuel	LPG fuel
Number of Cylinders		3		
Bore × Stroke		68 × 68 mm (2.68 × 2.68 in.)		
Total Displacement		740 cc (45.21 cu.in.)		
Brake Horsepower	SAE Net (Cont. H.P.)	13.4 kW / 3600 min ⁻¹ (rpm) (18.0 HP / 3600 min ⁻¹ (rpm))		12.7 kW / 3600 min ⁻¹ (rpm) (17.0 HP / 3600 min ⁻¹ (rpm))
	SAE Net (Intermittent H.P.)	17.1 kW / 3600 min ⁻¹ (rpm) (23.0 HP / 3600 min ⁻¹ (rpm))		16.4 kW / 3600 min ⁻¹ (rpm) (22.0 HP / 3600 min ⁻¹ (rpm))
	SAE Gross (Intermittent H.P.)	18.5 kW / 3600 min ⁻¹ (rpm) (24.8 HP / 3600 min ⁻¹ (rpm))		17.7 kW / 3600 min ⁻¹ (rpm) (23.8 HP / 3600 min ⁻¹ (rpm))
Maximum Bare Speed		3800 to 4000 min ⁻¹ (rpm)		
Minimum Bare Idling Speed		1400 to 1600 min ⁻¹ (rpm)		
Cylinder Head		Overhead-Valve		
Ignition System		Full-Transistor (Distributor type)		
Governor		Centrifugal Ball Type Mechanical Governor		
Direction of Rotation		Counter-Clockwise (Viewed From Flywheel)		
Spark Plug		NGK BKR4E-11		
Ignition Timing		B.T.D.C. 17 to 19 °		
Firing Order		1-2-3		
Compression Ratio		9.2 : 1		
Lubricating System		Forced Lubrication by Trochoid Pump		
Oil Pressure Indication		Electrical Type Switch		
Lubricating Filter		Full Flow Paper Filter (Cartridge Type)		
Cooling System		Pressurized Radiator (not included in the basic model), Forced Circulation with Water Pump		
Starting System		Electric Starting with Cell Starter (12 V, 0.7 kW)		
Battery		12 V, 35 AH or Equivalent		
Alternator		12 V, 150 W		
Fuel		*Unleaded Automobile Gasoline	*Standard Commercial LP Gas	
Lubricating Oil		Better Than SF Class (API)		
Lubricating Oil Capacity		3.25 L (3.4 U.S.qts)		
Weight (Dry)		61.7 kg (136.0 lbs)		
Application		General Power Source		

*Do not use gasoline blended with methyl alcohol.

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*KUBOTA RECOMMENDED LPG FUEL SPECIFICATIONS

- Commercial Propane gas only.
- Equivalent to Propanes H-D-5 of GPA* standards.

(vol %)

C ₃ H ₈	C ₃ H ₆	C ₄ H ₁₀	Others
≥ 90 %	≤ 5 %	≤ 2.5 %	—

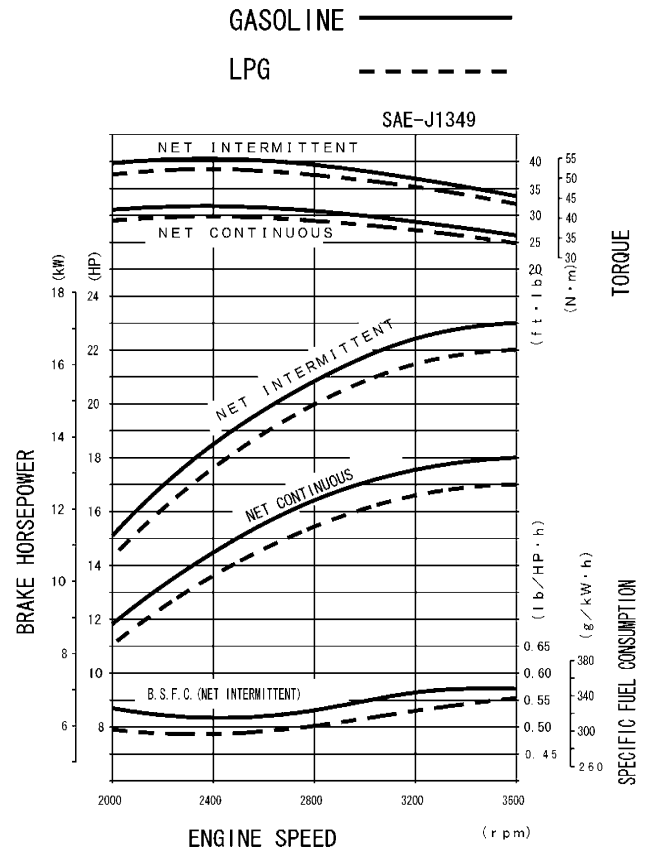
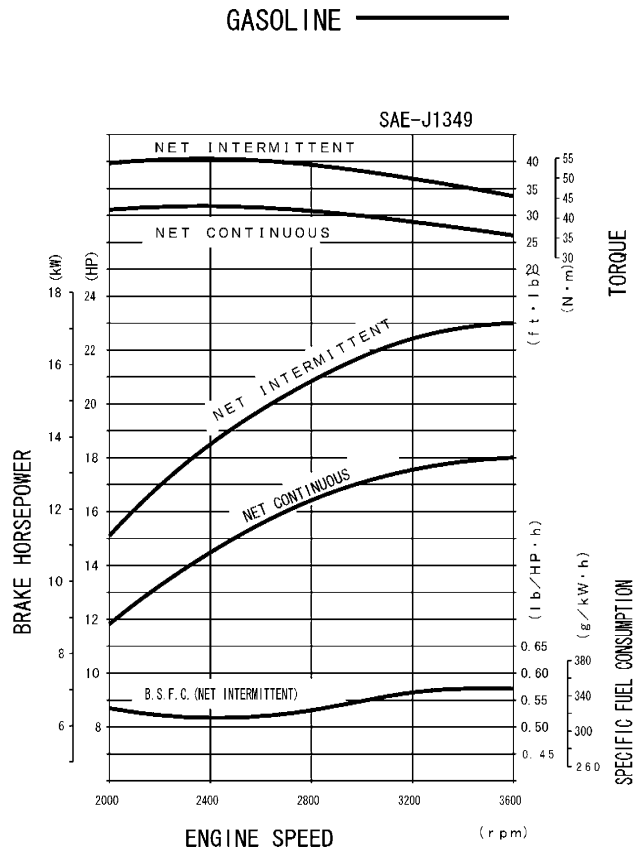
*GPA means Gas Processors Association (U.S.A.)

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PERFORMANCE CURVES

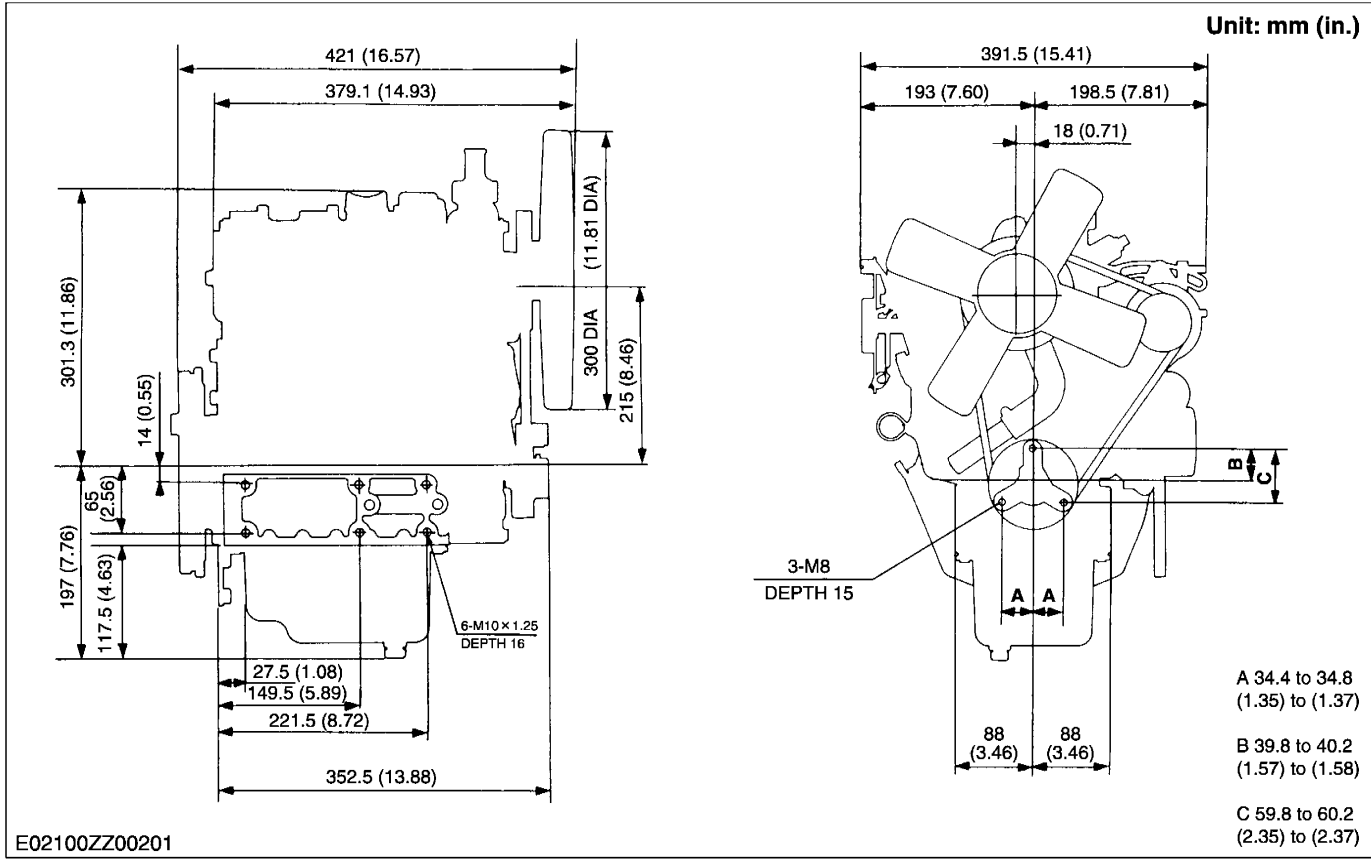
WG752-E2

DF752-E2

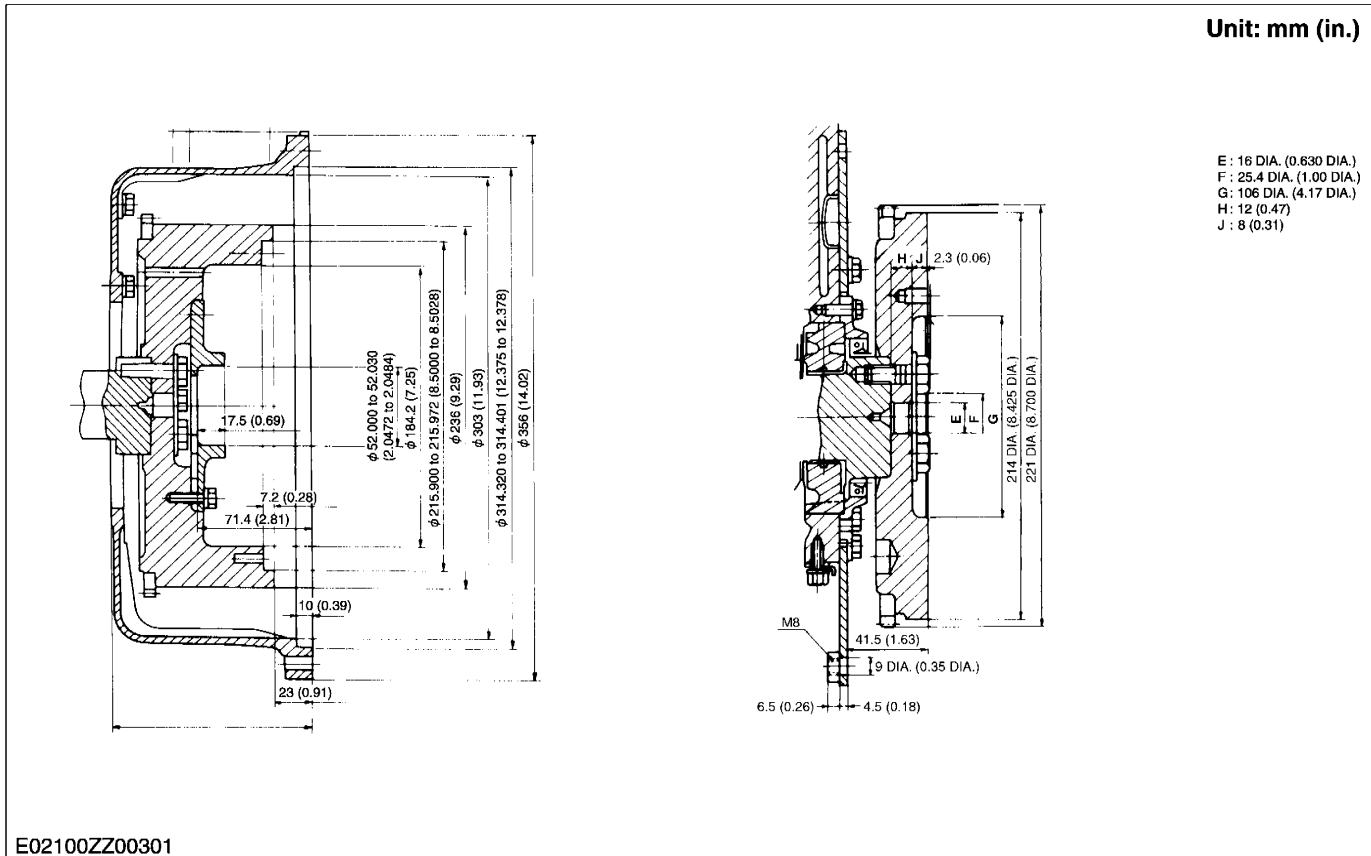


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DIMENSIONS



Flywheel Housing SAE No.5 (Clutch No.6-1/2)

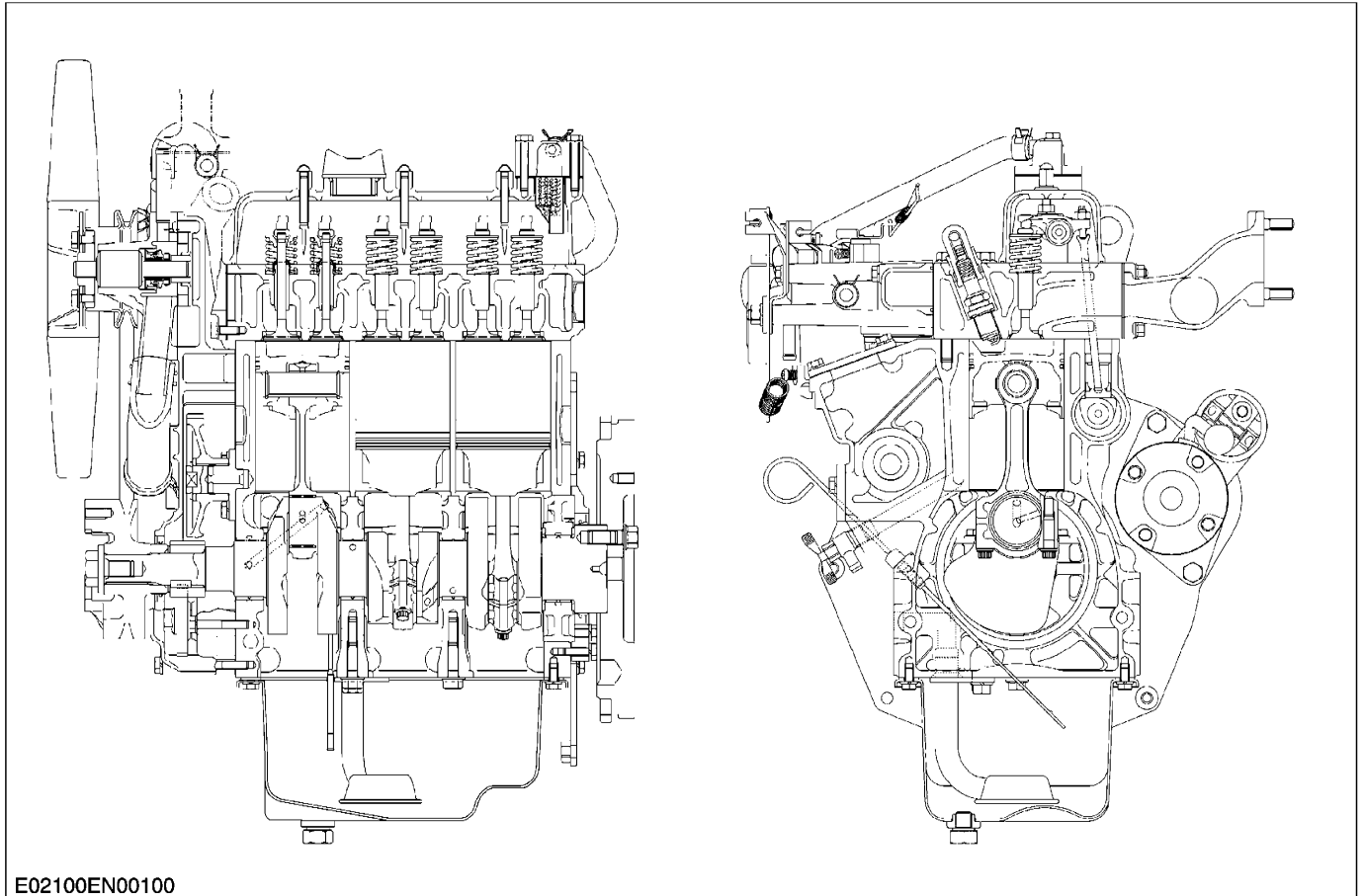


MECHANISM

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1. FEATURE



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KUBOTA's liquid-cooled gasoline / LP Gas engine models WG752-E2 and DF752-E2 are designed to emit less noxious fumes into the air while meeting the exact same durability standards maintained by our world-renowned diesel engines.

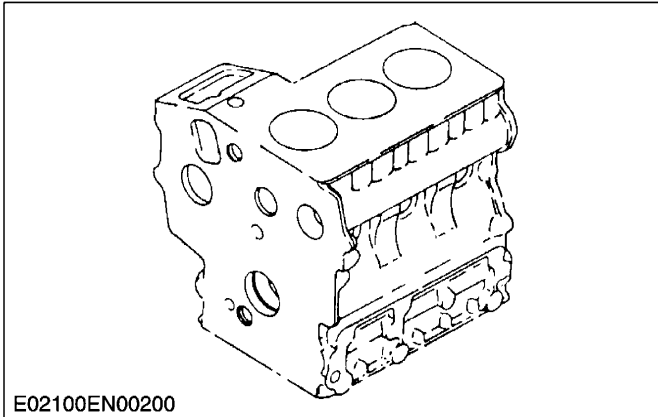
WG752-E2; This is a gasoline engine.

DF752-E2; This is a Dual Fuel (gasoline / LPG) engine.

(-E) model was developed with an eye toward clean exhaust gas which is more environmentally friendly.

2. ENGINE BODY

[1] CYLINDER BLOCK

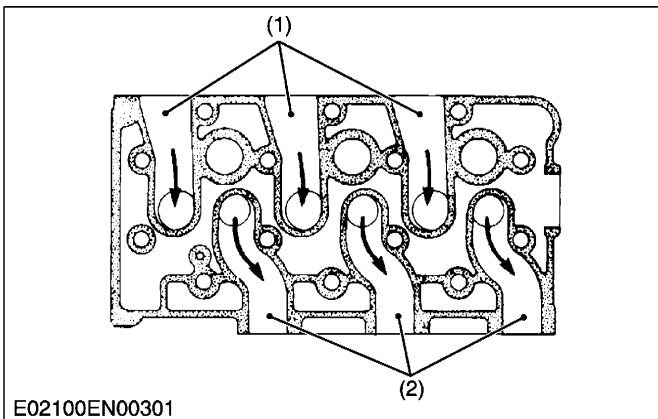


The engine has a high durability tunnel-type cylinder block in which the crank bearing component is a constructed body. Furthermore, liner less type, allow effective cooling, less distortion, and greater wear-resistance. The noise level is reduced to a minimum because each cylinder has its own chamber.

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[2] CYLINDER HEAD

(1) Intake and Exhaust Port



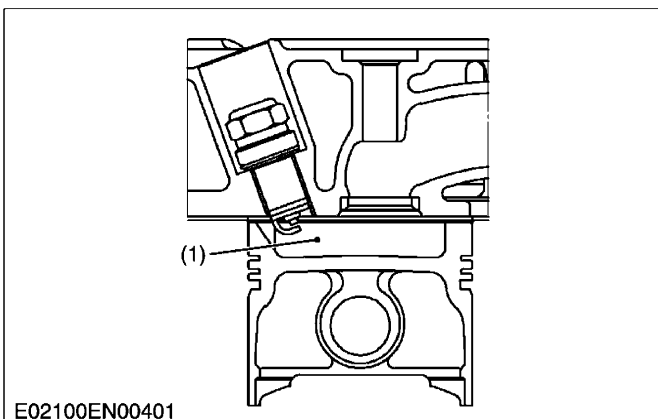
The cross-flow type intake / exhaust ports, which lower the heat conduction from the exhaust port to the intake port. The low heat conduction keeps the intake air from being heated and expanded by the exhaust gas.

(1) Intake Port

(2) Exhaust Port

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(2) Combustion System

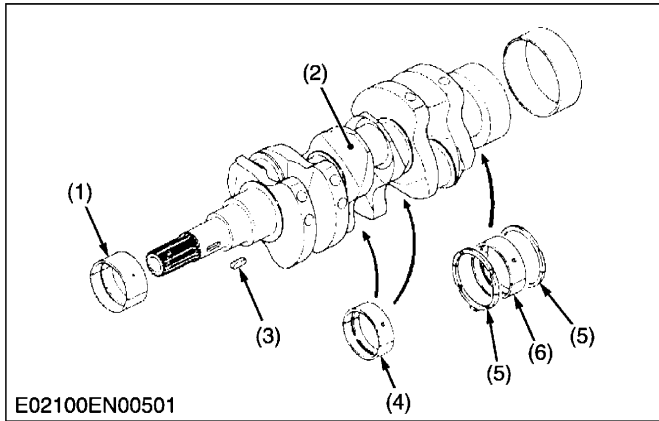


A newly designed combustion chamber that is dedicated for gasoline and LPG, reduces emissions and noise during the most demanding operation.

(1) Main Combustion Chamber

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[3] CRANKSHAFT



The crankshaft with the connecting rod converts the reciprocating motion of the piston into rotating motion.

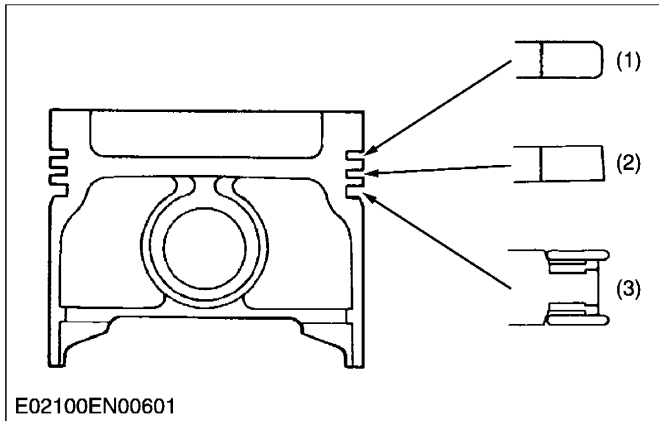
The crankshaft (2) has oil passages drilled so that oil can flow from the main bearings to the crank pin bearings.

The front journal is supported by a sleeve type bearing (crankshaft bearing 1) (1), the intermediate journal by a split type (crankshaft bearing 3) (4), and the rear by a split type (crankshaft bearing 2) (6) with thrust bearings (5).

- (1) Crankshaft Bearing 1
- (2) Crankshaft
- (3) Feather Key
- (4) Crankshaft Bearing 3
- (5) Thrust Bearing
- (6) Crankshaft Bearing 2

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[4] PISTON AND PISTON RINGS



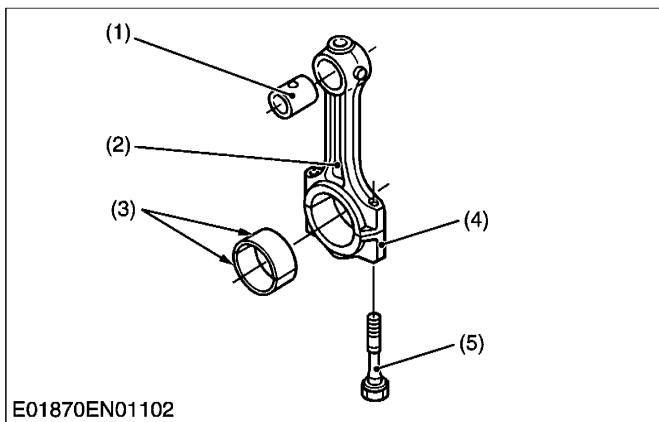
The piston has a slightly oval shape when cold (in consideration of thermal expansion) and a concave head.

Three rings are installed in grooves in the piston.

- (1) Top Compression Ring (Barrel Faced Type)
- (2) Second Compression Ring (Taper Faced Type)
- (3) Oil Ring (Combined Steel Type)

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[5] CONNECTING ROD

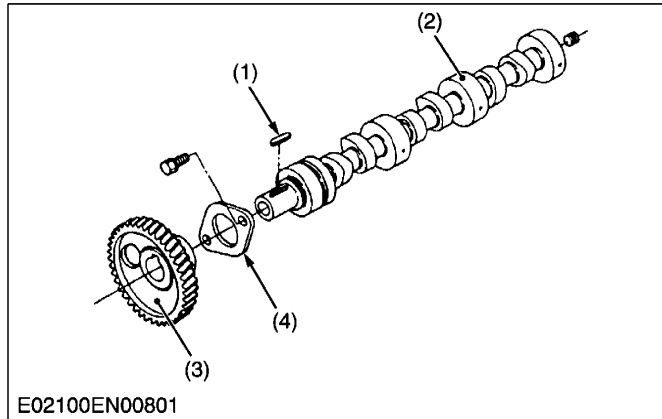


The connecting rod (2) is used to connect the piston with the crankshaft. The big end of the connecting rod has a crank pin bearing (3) (split type) and the small end has a small end bushing (1) (solid type).

- (1) Small End Bushing
- (2) Connecting Rod
- (3) Crank Pin Bearing
- (4) Connecting Rod Cap
- (5) Connecting Rod Screw

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[6] CAMSHAFT



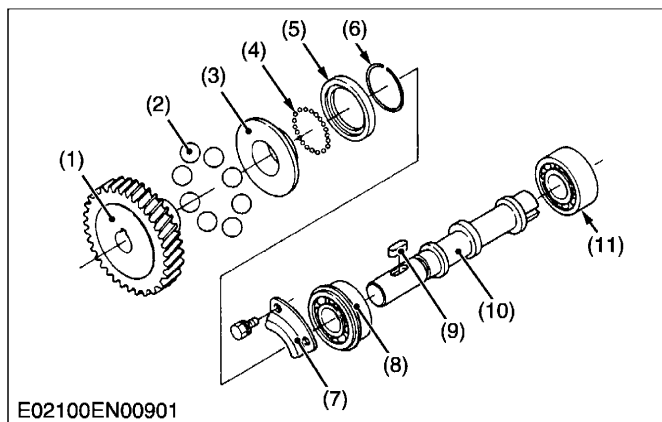
The camshaft (2) is made of special cast iron, and the journal and cam sections are chilled to resist wear.

The cams on the camshaft cause the intake and exhaust valves to open as the camshaft rotates. The bearing and journals are force-lubricated.

- | | |
|-----------------|----------------------|
| (1) Feather Key | (3) Cam Gear |
| (2) Camshaft | (4) Camshaft Stopper |

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[7] DISTRIBUTOR DRIVESHAFT

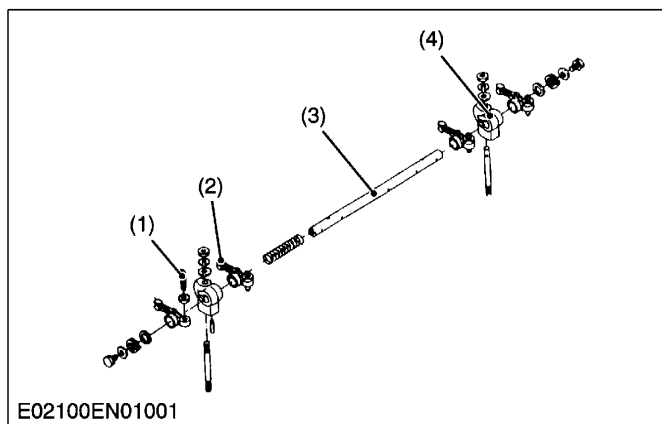


The distributor drive shaft (10) controls the ignition timing of the distributor and is equipped with steel ball (2) to control the governor.

- | | |
|-------------------------------|------------------------------|
| (1) Distributor Drive Gear | (7) Stopper |
| (2) Steel Ball | (8) Ball Bearing |
| (3) Governor Sleeve | (9) Feather Key |
| (4) Steel Ball | (10) Distributor Drive Shaft |
| (5) Governor Ball Case | (11) Ball Bearing |
| (6) Governor Sleeve Snap Ring | |

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[8] ROCKER ARM ASSEMBLY



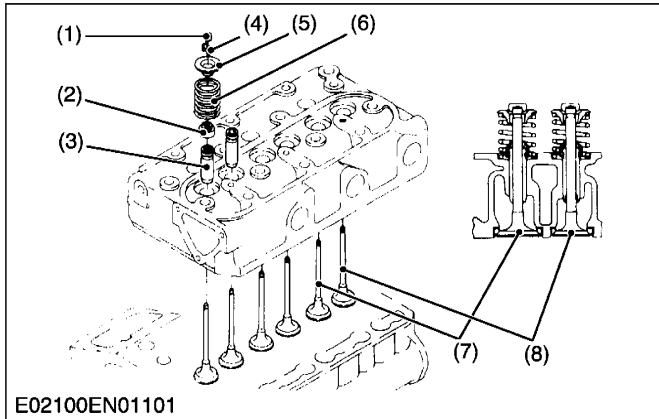
The rocker arm assembly includes the rocker arms (2) and adjusting screws (1), the end of which rests on the push rods, rocker arm brackets (4) and rocker arm shaft (3).

The rocker arms swing and transmits the reciprocating motion of the push rods to the inlet and exhaust valves to open and close them.

- | | |
|---------------------|------------------------|
| (1) Adjusting Screw | (3) Rocker Arm Shaft |
| (2) Rocker Arm | (4) Rocker Arm Bracket |

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[9] INLET AND EXHAUST VALVES



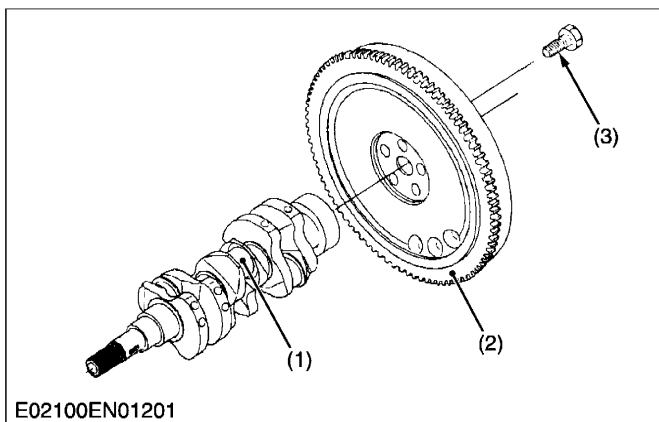
The valve and its guide for the inlet are different from those for the exhaust.

Other parts, such as the spring (6), spring retainer (5), collet (4), stem seal (2), and cap (1) are the same for both the inlet and exhaust.

- | | |
|-----------------|---------------------|
| (1) Valve Cap | (5) Spring Retainer |
| (2) Stem Seal | (6) Spring |
| (3) Valve Guide | (7) Inlet Valve |
| (4) Collet | (8) Exhaust Valve |

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[10] FLYWHEEL



The flywheel (2) is connected with the crankshaft (1), it stores the rotating force in the combustion stroke as inertial energy to rotate the crankshaft smoothly.

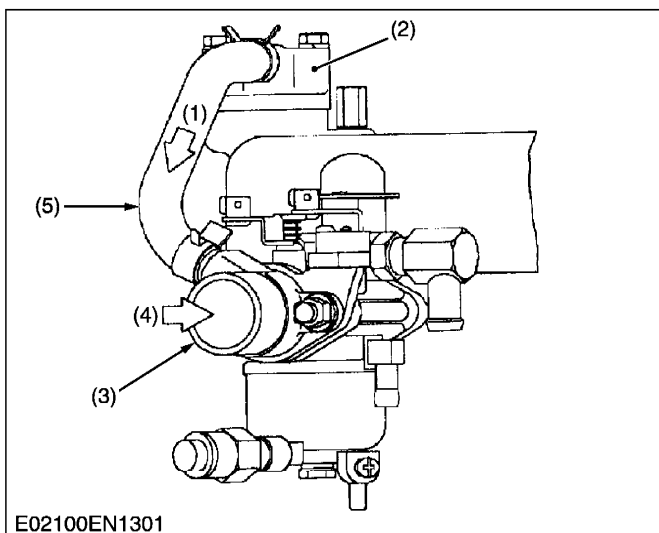
The flywheel periphery is provided with marks showing fuel injection timing and top dead center.

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

- | | |
|----------------|-----------------------------|
| (1) Crankshaft | (3) Flywheel Mounting Screw |
| (2) Flywheel | |

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[11] CLOSED BREATHER



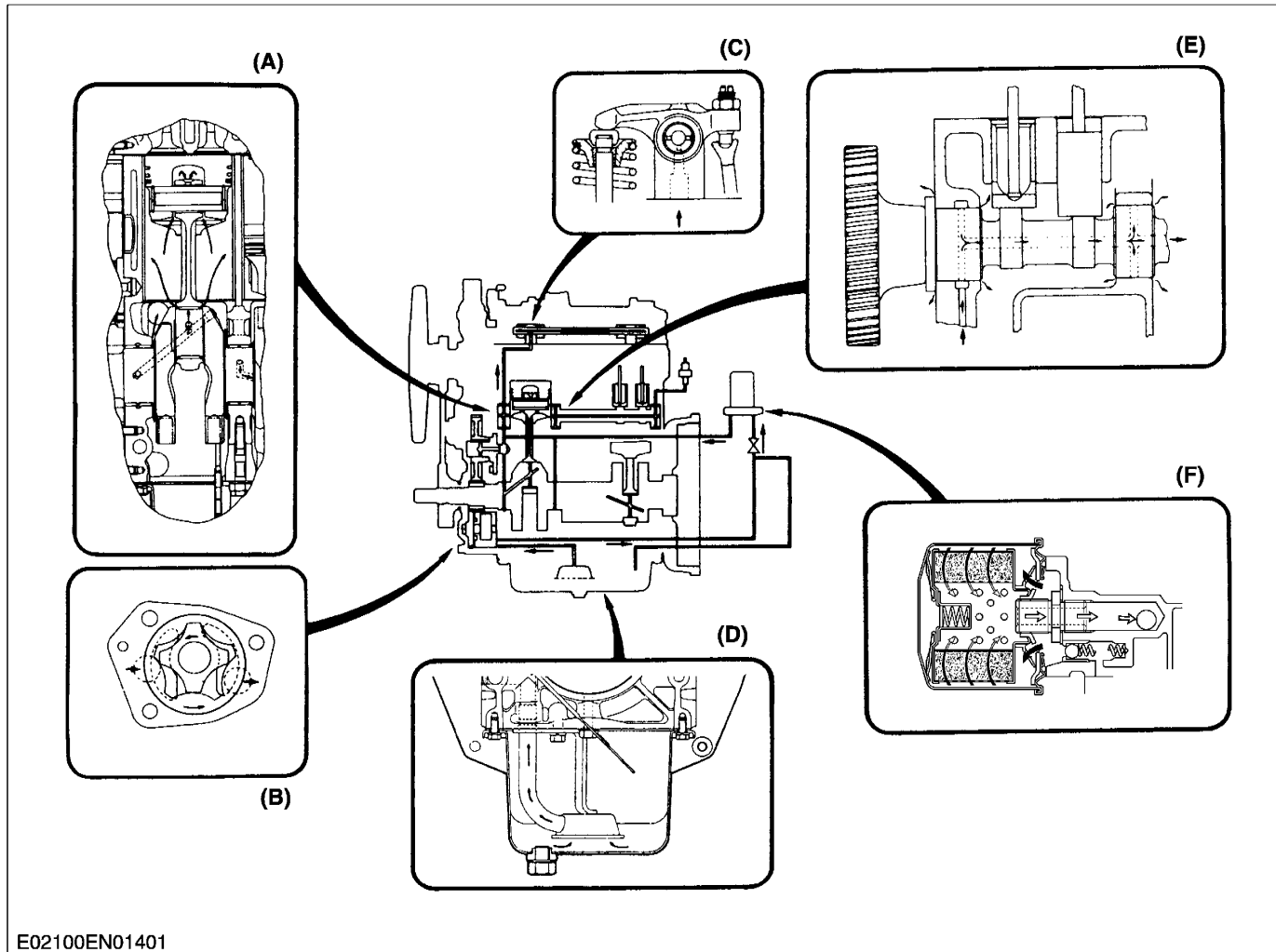
Blow-by gas (1) from crankcase is deoiled in the breather assembly (2) and sends to the air cleaner flange (3) where the blow-by gas (1) is mixed with the intake air (4).

- | | |
|------------------------|-------------------|
| (1) Blow-by Gas | (4) Intake Air |
| (2) Breather Assembly | (5) Breather Pipe |
| (3) Air Cleaner Flange | |

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3. LUBRICATING SYSTEM

[1] GENERAL



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The lubricating system consists of an oil strainer, an oil pump, a relief valve, an oil filter cartridge and an oil pressure switch. The oil pump sucks the lubricating oil in the oil pan through the strainer and sends it to the oil filter cartridge, where the oil is further filtered.

The filtered oil is forced to the crankshaft, the connecting rods, the idle gear, the camshaft and the rocker arm shaft through the oil passage in the cylinder block and the shafts to lubricate the bearings.

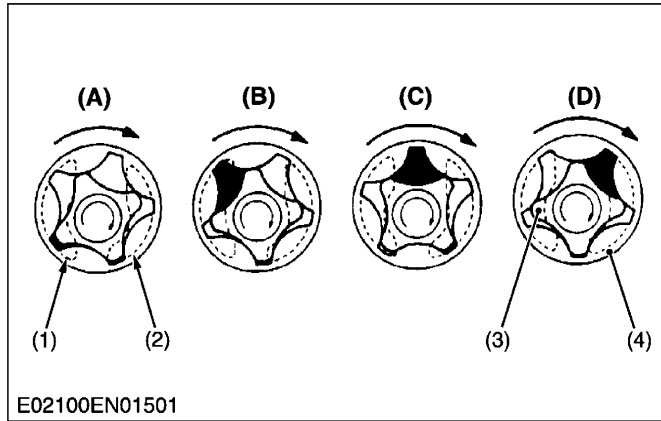
Some oil, splashed by the crankshaft or thrown off from the bearings, lubricates other engine parts: the pistons, the cylinder walls, the piston pins, the tappets, the push rods, the timing gears, and the inlet and exhaust valves.

[A] Piston
[B] Oil Pump

[C] Rocker Arm and Rocker Arm Shaft
[D] Oil Strainer

[E] Camshaft
[F] Oil Filter Cartridge and Relief Valve

[2] OIL PUMP



The oil pump is a trochoid pump, whose rotors have trochoid lobes. The inner rotor (3) has 4 lobes and the outer rotor (4) has 5 lobes, and they are eccentrically engaged with each other. The inner rotor, which is driven by the crankshaft through the gears, rotates the outer rotor in the same direction, varying the space between the lobes.

While the rotors rotate from (A) to (B), the space leading to the inlet port increases, which causes the vacuum to suck in the oil from the inlet port.

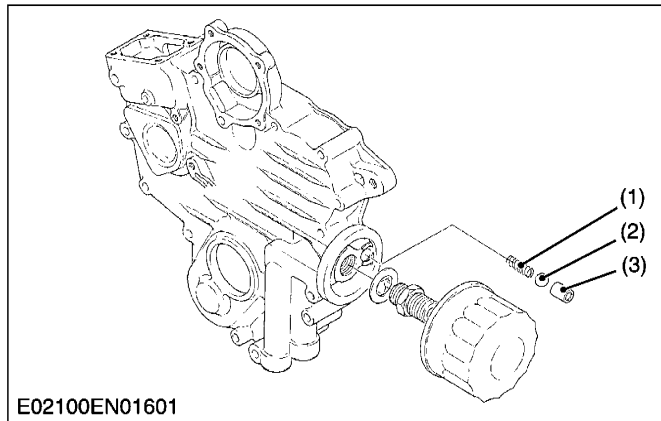
When the rotors rotate to (C), the space between both rotors switches from the inlet port to the outlet port.

At (D), the space decreases and the sucked oil is discharged from the outlet port.

- (1) Inlet Port
- (2) Outlet Port
- (3) Inner Rotor
- (4) Outer Rotor

W1014618

[3] RELIEF VALVE



The relief valve prevents the damage to the lubricating system due to the high pressure of the oil.

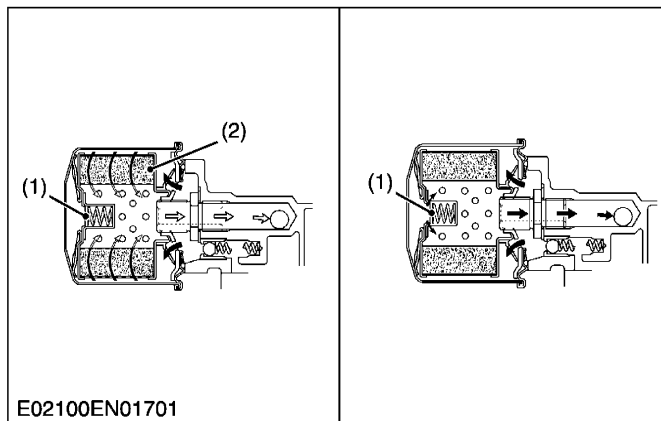
The relief valve is ball direct acting type, and is best suited for low pressures.

When the pressure of the oil, forced by the pump, exceeds the specified value, the oil pushes back the ball (2) and escapes to the oil pan.

- (1) Spring
- (2) Ball
- (3) Valve Seat

W1014722

[4] OIL FILTER CARTRIDGE



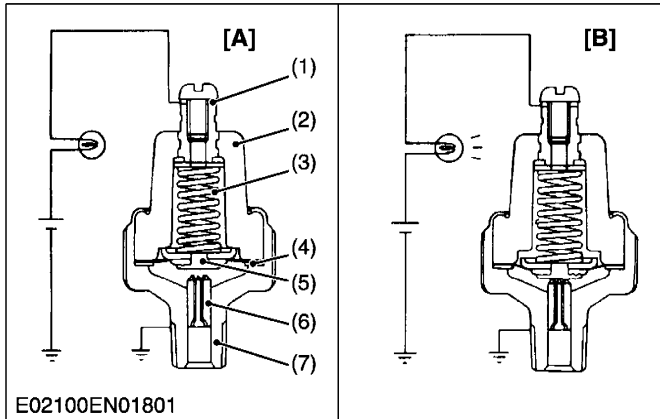
After lubricating, the lubricating oil brings back various particles of grit and dirt to the oil pan. Those particles and the impurities in the lubricating oil can cause wear or seizure of the engine parts. It may also impair the physical and chemical properties of the oil itself.

The lubricating oil which is force-fed by the pump, is filtered by the filter cartridge with the filter element (2). When the filter element accumulates on excessive amount of dirt and the oil pressure in the inlet line builds up by 98 kPa (1.0 kgf/cm², 14 psi) more than the outlet line, the bypass valve (1) opens to allow the oil to flow from the inlet into the outlet line, bypassing the filter element.

- (1) Bypass Valve
- (2) Filter Element

W1014815

[5] OIL PRESSURE SWITCH



The oil pressure switch is mounted on the cylinder block and is led to the lubricating oil passage.

When the oil pressure falls below the specified value, the oil pressure warning lamp lights.

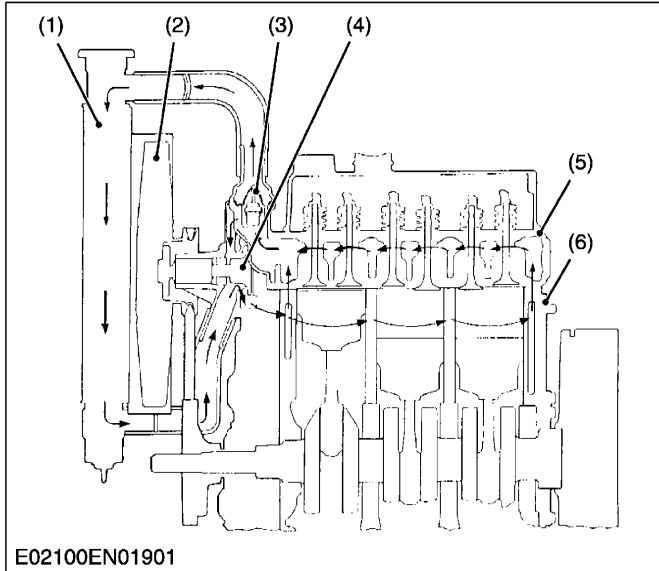
- (1) Terminal
- (2) Insulator
- (3) Spring
- (4) Rubber Gasket
- (5) Contact Rivet
- (6) Contact
- (7) Oil Switch Body

[A] At the proper oil pressure
[B] At lower oil pressure, 49
kPa (0.5 kgf/cm², 7 psi) or
less

W1014969

4. COOLING SYSTEM

[1] GENERAL



The cooling system consists of a radiator (1), a centrifugal water pump (4), a suction fan (2) and a thermostat (3).

The water is cooled through the radiator core, and the fan behind the radiator pulls the cooling air through the core to improve cooling.

The water pump sucks the coolant from the radiator or from the cylinder head and forces it into the cylinder block.

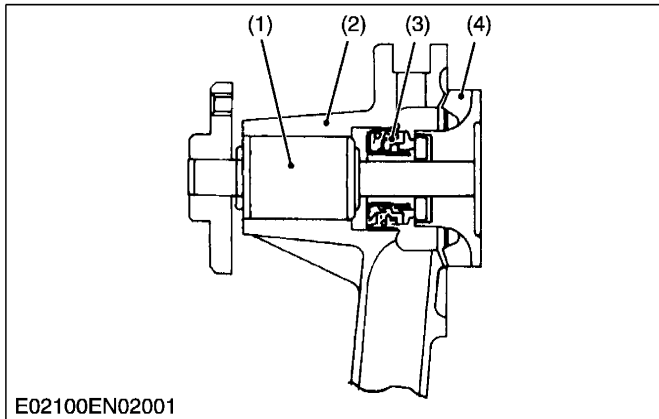
The thermostat opens or closes according to the coolant temperature, to allow the coolant to flow from the cylinder block to the radiator while open, or only to the water pump while closed.

Thermostat opening temperature	Approx. 82 °C 179.6 °F
--------------------------------	---------------------------

- (1) Radiator
- (2) Cooling Fan
- (3) Thermostat
- (4) Water Pump
- (5) Cylinder Head
- (6) Cylinder Block

W1015128

[2] WATER PUMP



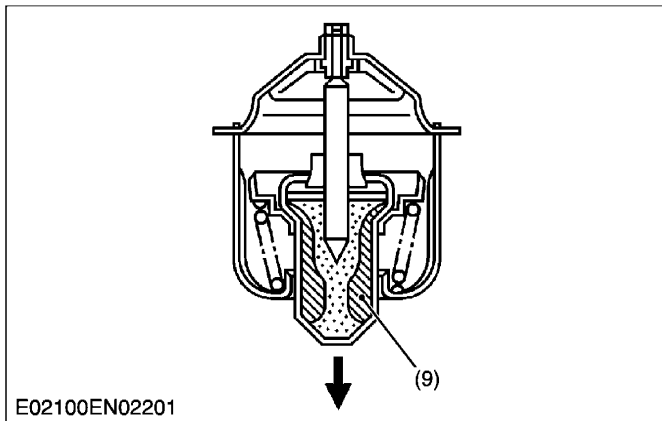
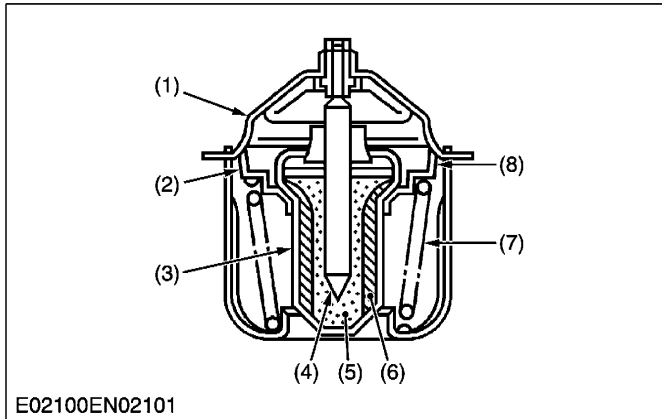
The water pump is driven by the crankshaft and a V belt. The rotating impeller (4) in the water pump sucks the coolant from the radiator and sends it into the water jacket in the cylinder block.

The mechanical seal (3) prevents the water from entering the bearing unit (1).

- (1) Bearing Unit
- (2) Water Pump Body
- (3) Mechanical Seal
- (4) Water Pump Impeller

W1015323

[3] THERMOSTAT



The thermostat is of the wax pellet type.

The thermostat controls the flow of the coolant to the radiator to keep the proper temperature.

The case (1), which serves as a valve seat (1), has a spindle inserted in the pellet (3) which is installed to the valve (2). The spindle is covered with the synthetic rubber (5) in the pellet.

The wax is charged between the pellet and the rubber.

■ **At low temperatures (lower than 82 °C)**

The valve (2) is seated by the spring (7) and the coolant circulates in the engine through the water return pipe without running into the radiator.

Only the air in the water jacket escapes to the radiator through the leak hole (8) on the thermostat.

■ **At high temperatures (higher than 82 °C)**

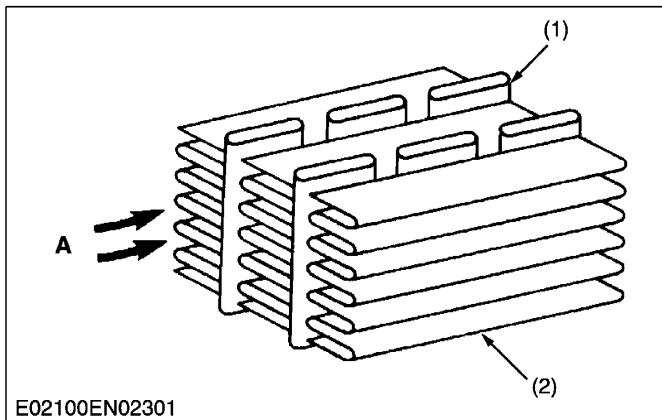
As the coolant temperature rises, the wax in the pellet (3) turns liquid and expands, repelling the spindle, which causes the pellet to lower.

The valve (2) opens to send the coolant to the radiator.

- | | |
|----------------------|------------------|
| (1) Seat | (6) Wax (solid) |
| (2) Valve | (7) Spring |
| (3) Pellet | (8) Leak Hole |
| (4) Spindle | (9) Wax (liquid) |
| (5) Synthetic Rubber | |

W1015407

[4] RADIATOR

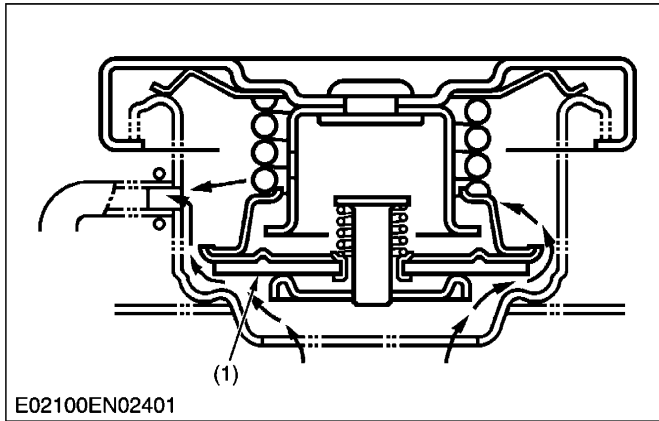


The radiator core consists of coolant carrying tubes (1) and fins (2) meeting at a right angle with the tubes. The fin is a louverless, corrugated type which is light in weight, high in heat exchange ratio and less apt to clog. The water in the tubes is cooled by the air flowing through the tube walls and fins.

- | | |
|----------|------------------------|
| (1) Tube | A : Cooling Air |
| (2) Fin | |

W1015697

[5] RADIATOR CAP

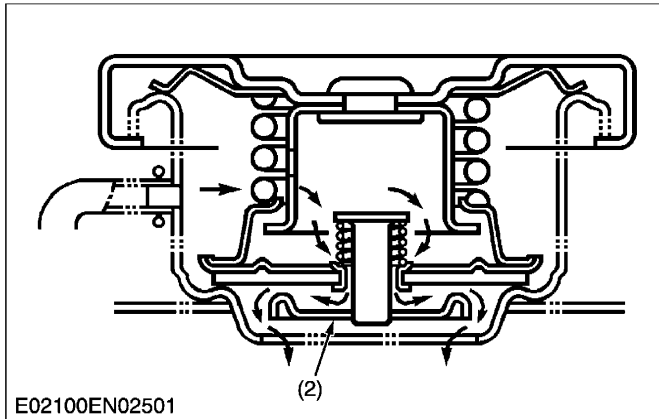


The pressure type radiator cap prevents differences in pressure between the inside and the outside of the radiator from deforming the radiator.

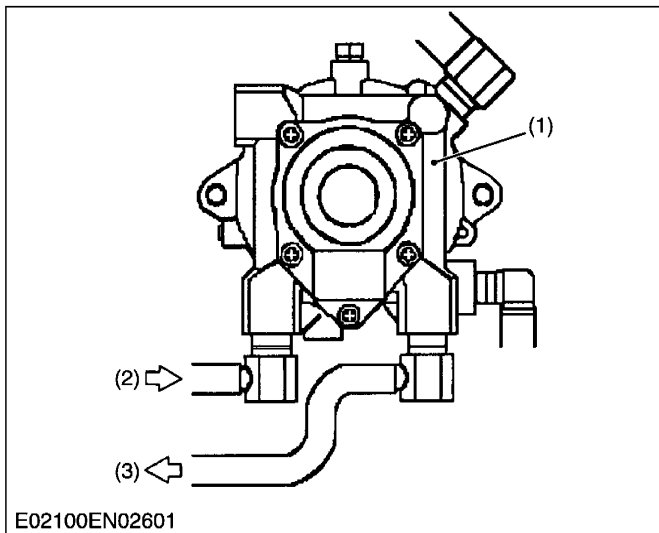
When the water temperature rises and the pressure in the radiator increases above the specified pressure, the pressure valve (1) opens to reduce the internal pressure. When the coolant temperature falls and a vacuum forms in the radiator, the vacuum valve (2) opens to introduce the air into the radiator.

- (1) Pressure Valve (Opening pressure 88 kPa (0.9 kgf/cm², 13 psi))
- (2) Vacuum Valve

W1015805



[6] VAPORIZER (DF752-E2)



When evaporating by primary chamber of vaporizer liquid LPG needs the evaporation heat.

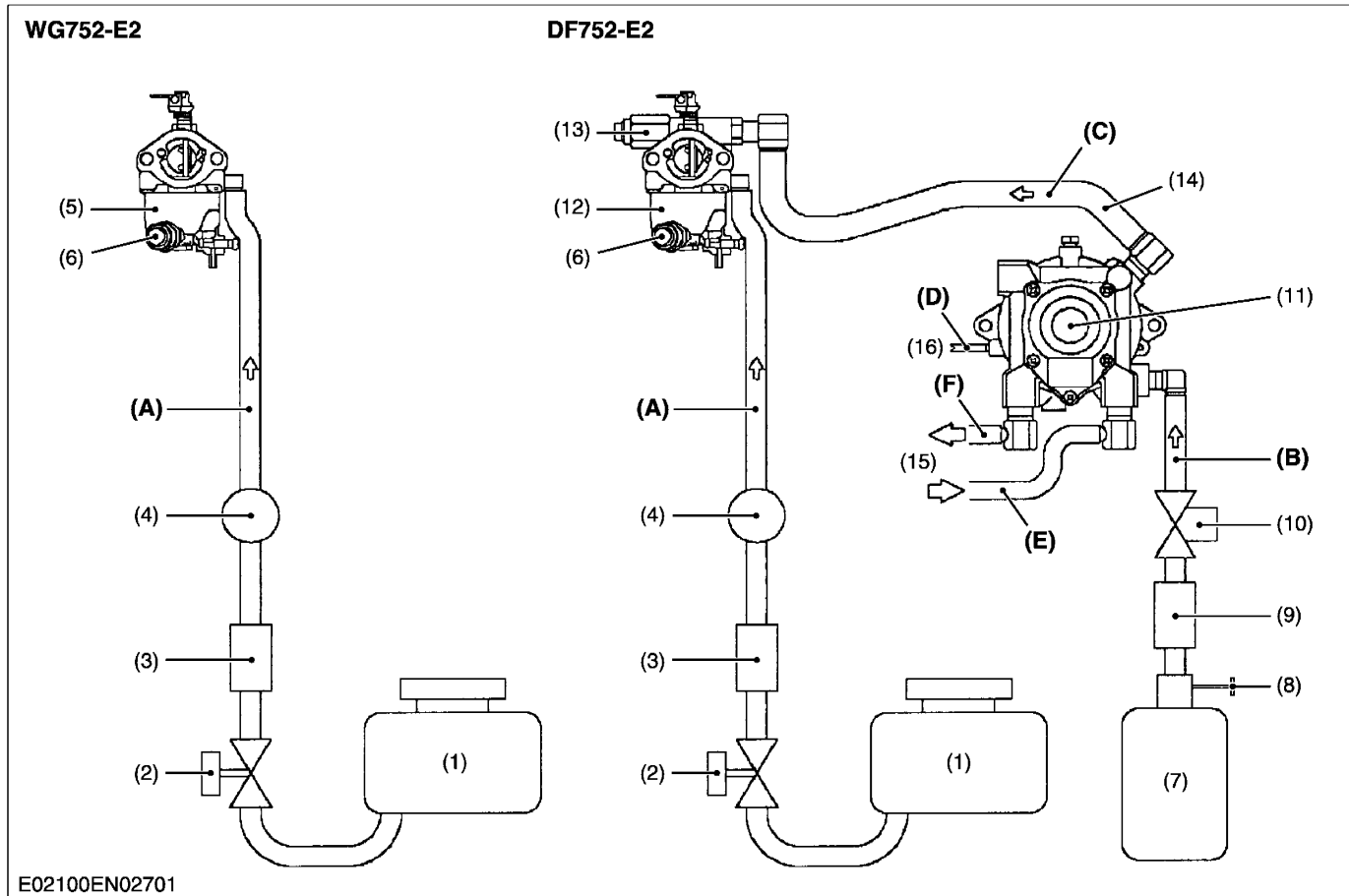
This vaporizer installs the water jacket, throws the coolant of engine, heats primary chamber, promotes evaporation, and prevents valves being frozen.

- (1) Vaporizer
- (2) Hot Water In
- (3) Hot Water Out

W1015895

5. FUEL SYSTEM

[1] GENERAL



- | | | | |
|-------------------------------|----------------------------|--------------------------|------------------------|
| (1) Gasoline Tank* | (8) LPG Manual Valve* | (15) Water Hose* | (D) Vacuum Line |
| (2) Gasoline Cock* | (9) LPG Filter* | (16) Vacuum Hose* | (E) Hot Water In Line |
| (3) Fuel Filter | (10) LPG Shut Off Valve* | | (F) Hot Water Out Line |
| (4) Fuel Feed Pump | (11) Vaporizer / Regulator | | |
| (5) Carburetor | (12) DF Carburetor | | |
| (6) Gasoline Cut Off Solenoid | (13) LPG Cut Off Solenoid | | |
| (7) LPG Tank* | (14) Vapor Hose* | | |
| | | (A) Gasoline Line | |
| | | (B) Liquid Propane Line | |
| | | (C) Gaseous Propane Line | |
- Component Marked * Is Not Provided by KUBOTA.

WG752-E2:

The fuel is fed from the fuel tank (1) through the fuel filter (3) to the carburetor (5) by the fuel feed pump (4).

DF752-E2:

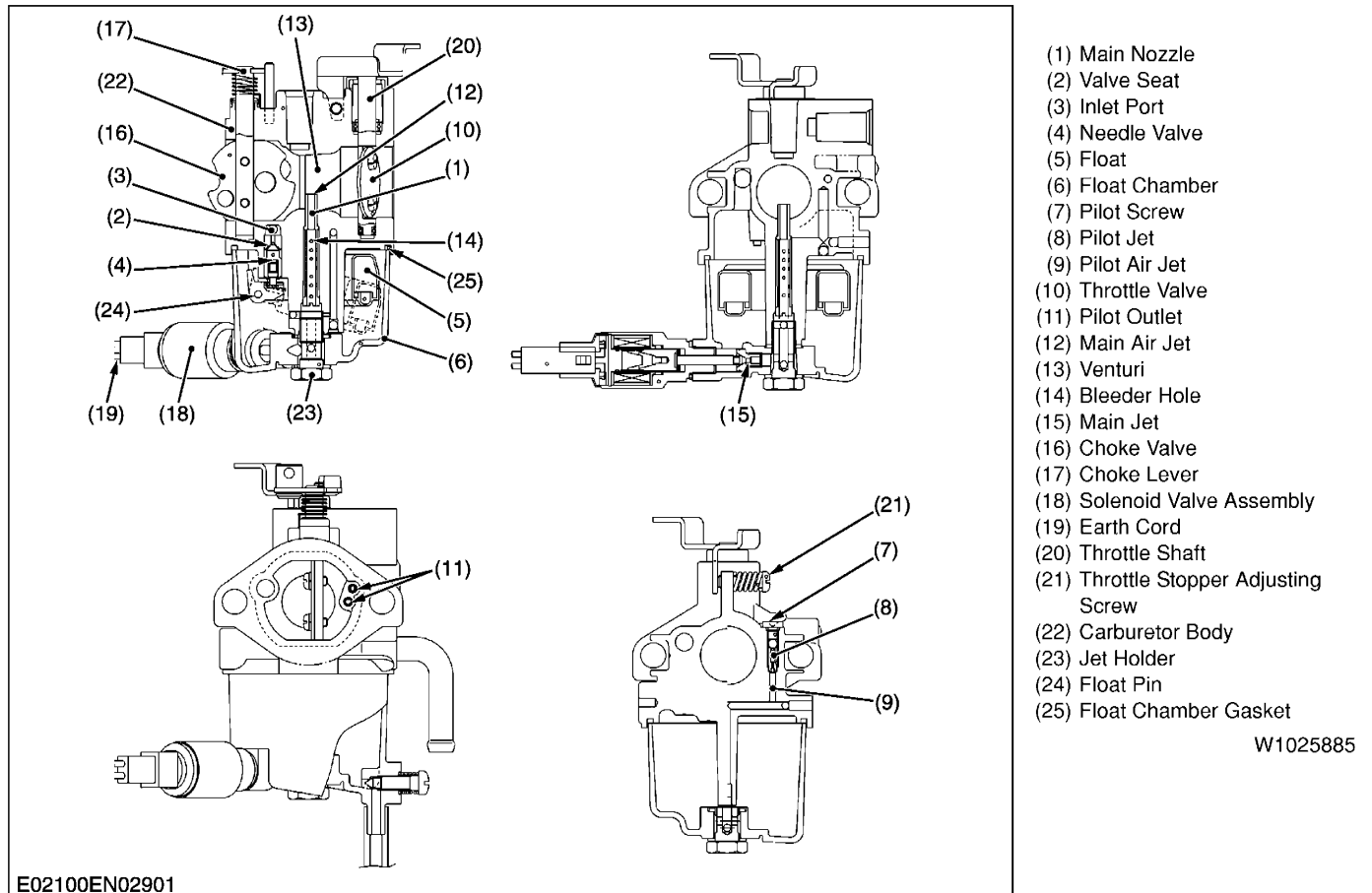
This fuel system has 2 ways. Gasoline fuel is the same as WG752-E2.

For LPG fuel, the liquid fuel stored in the LPG tank (7) is sent to vaporizer (11) by pressure in the gaseous phase in the tank through the fuel filter (9) and shut off valve (10).

The liquid fuel is evaporated in vaporizer and is sent to the DF Carburetor (12) as a gaseous fuel of gas pressure near the atmospheric pressure.

The DF Carburetor (12) mixes the gas and air is supplied in the cylinder.

[2] CARBURETOR (WG752-E2)



Designed for general purpose use, this carburetor provides engines with the ideal fuel-air mixture for all speed ranges.

1) Float Chamber

When the gasoline in the fuel tank flows into the float chamber (6), the float (5) rises and, when a predetermined amount of gasoline is in the chamber, it pushes the needle valve (4) against the valve seat (2) to stop additional gasoline from entering through the inlet port (3). As the gasoline is consumed, the float goes down and more gasoline is led into the chamber to maintain a constant distance between the main nozzle (1) and the level of the gasoline.

2) Starting System

To start an engine in cold weather, the fuel-air mixture must be richer than normal. A choke valve (16) controlled by the choke lever (17) is provided to enrich the mixture.

As the choke valve is closed, the air supply is restricted to make the mixture rich. This rich mixture is then supplied to the intake manifold to facilitate starting.

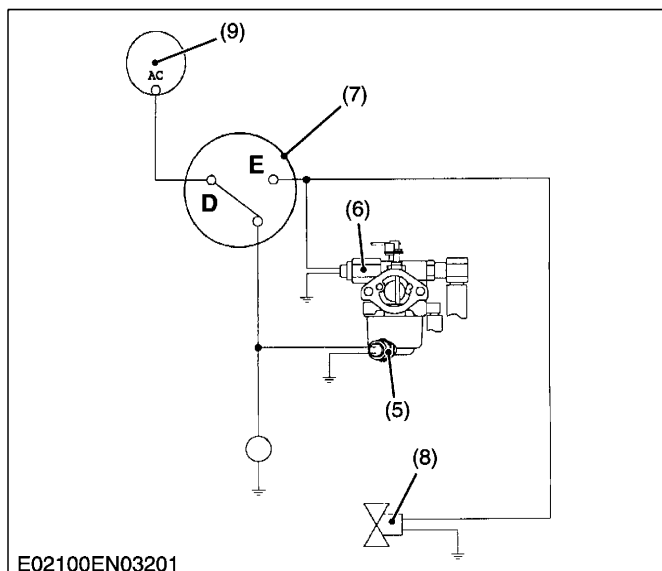
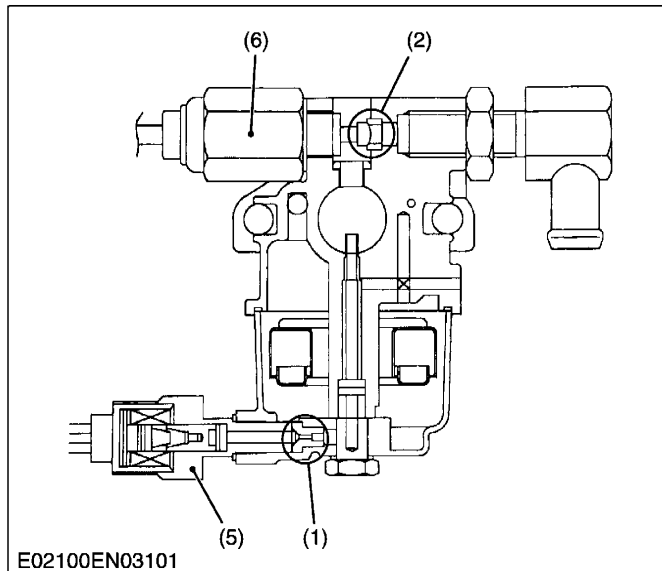
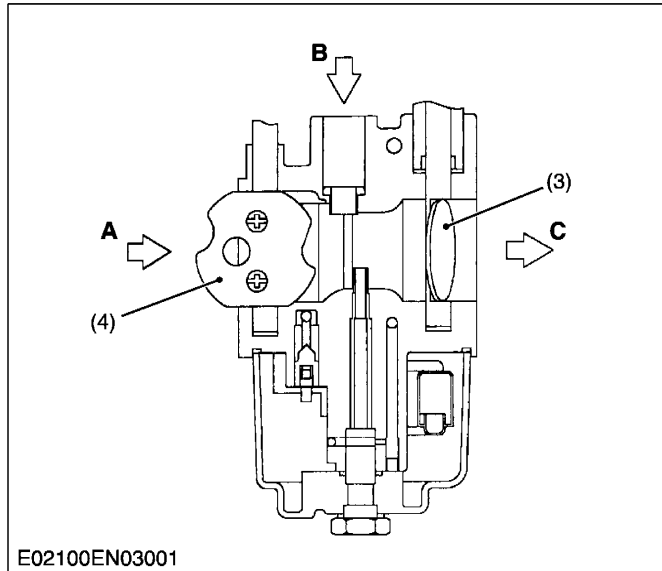
3) Slow System

When the throttle valve (10) closes, air that flows into the cylinder passes along the valve at a high speed. As a result, a negative pressure is created in the pilot outlet (11) which has an outlet port in the inner wall. This causes gasoline in the main nozzle (1) to flow through the pilot jet (8) to be sucked into the cylinder. Air that enters from the pilot air jet (9) is mixed with gasoline in the pilot jet (8), atomized in an appropriate condition, sprayed from the pilot outlet (11) and sucked into the cylinder through the main passage. The slow speed of the engine is controlled by changing the jet area with the pilot jet (8).

4) Main Carburetor System

The speed of air that flows into the cylinder increases when it passes the venturi (13), and the negative pressure increases as a result at the tip of the main nozzle (1). The negative pressure causes the gasoline in the float chamber (6) to flow through the main jet (15) and to be sucked into the main nozzle (1). Air which flows from the main air jet (12) into the bleeder hole (14) of the main nozzle (1) is mixed with gasoline, atomized in an appropriate condition, then sprayed from the nozzle tip to the venturi (13) and sucked with the main air into the cylinder.

[3] DF CARBURETOR (DF752-E2)



■ **NOTE**

- **DF Carburetor operates the same as a gasoline carburetor in gasoline fuel.**

With the fuel select switch (7) in the “**GASOLINE**” position (**D**) and the main switch in the “**ON**” position, the battery current flows to the gasoline cut off solenoid (5). Therefore gasoline fuel in the float chamber flows to the mixing chamber.

When the fuel select switch (7) is turned to the “**LPG**” position (**E**), the battery current stops to the gasoline cut off solenoid (5) and flows to the LPG cut off solenoid (6) and LPG shut off solenoid valve (8).

Then, the gasoline fuel flow is shut and LPG fuel flows to the mixing chamber.

The mixer meters both fuel and air, and procedures an air / fuel mixture that has the proper ratio as required by the engine.

When the engine rotates, the LPG fuel flows out from main jet (2) to venturi a constant amount and is mixed with air quantity corresponding to the opening of the throttle valve (4) and is supplied to the cylinder.

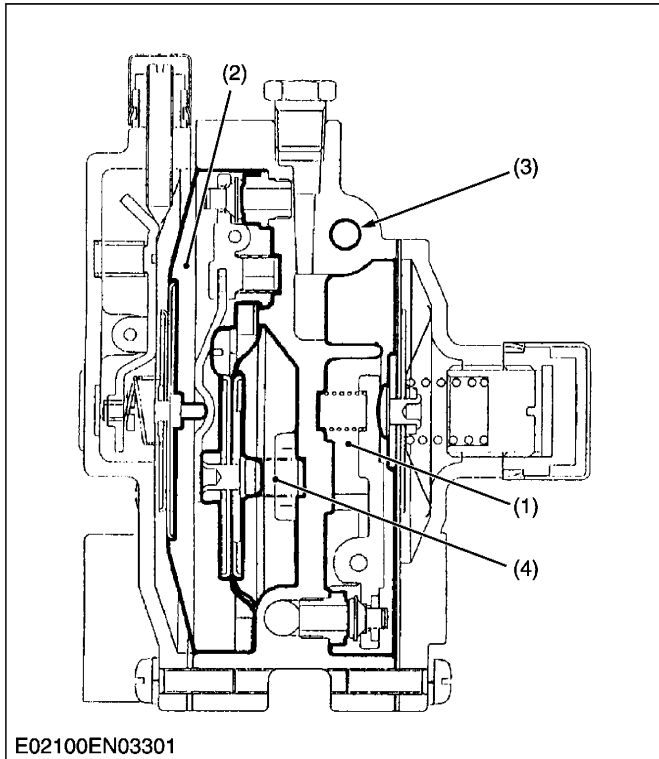
When the main switch (9) turned to the “**OFF**” position, the battery current stops to the both of solenoids.

Then, both gasoline fuel and LPG fuel can not flow to the mixing chamber.

- | | |
|---------------------------------|--------------------------|
| (1) Gasoline Main Jet | (A) Air |
| (2) LPG Main Jet | (B) LPG Fuel (gaseous) |
| (3) Throttle Valve | (C) Mixture (Air / Fuel) |
| (4) Choke Valve | (D) Gasoline Position |
| (5) Gasoline Cut Off Solenoid | (E) LPG Position |
| (6) LPG Cut Off Solenoid | |
| (7) Fuel Select Switch | |
| (8) LPG Shut Off Solenoid Valve | |
| (9) Main Switch | |

W1016872

[4] VAPORIZER (DF752-E2)



Vaporizer is a device which converts the liquid fuel into the gaseous fuel and the following structures and functions are possessed.

1) Primary Chamber

The liquid fuel is decompressed (the first decompression) and it is evaporated.

2) Secondary Chamber

The fuel which flows in is decompressed from the primary chamber to the vicinity of the atmospheric pressure further (the second decompression).

3) Water Passage

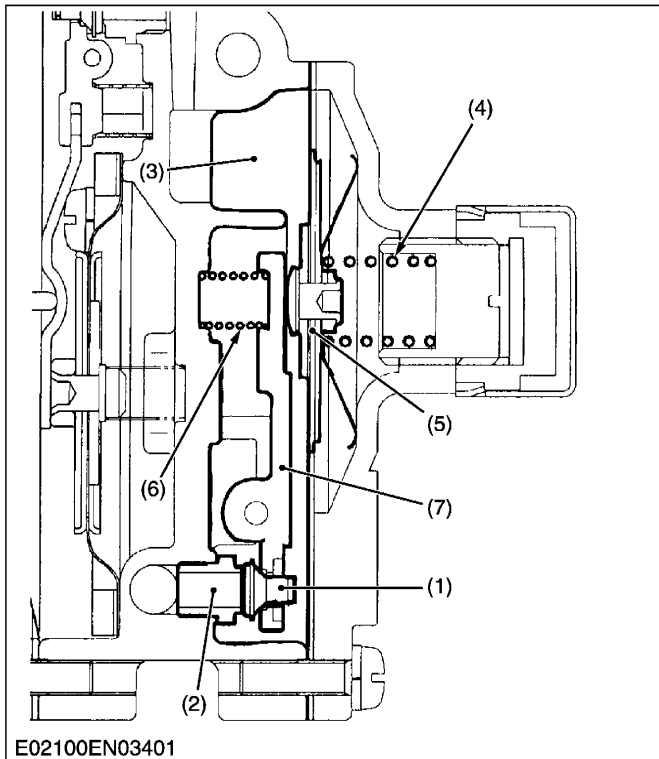
The coolant of the engine is made to circulate as a heat source to evaporate the LPG.

4) Vacuum Lock Chamber

When the engine stops, the fuel from primary chamber is prevented from flowing out.

- | | |
|-----------------------|-------------------------|
| (1) Primary Chamber | (3) Water Passage |
| (2) Secondary Chamber | (4) Vacuum Lock Chamber |

W1017179



■ Primary Chamber

The liquid fuel which pushes the primary valve (1) open passes between the valve and the valve seat (2), enters primary chamber (3), and decompresses and is evaporated.

When the inflow of the fuel continues and the primary chamber pressure rises more than the specified pressure 32.7 kPa (0.3 kgf/cm², 4.3 psi), the tension in the diaphragm spring (4) is overcome and do the push up of primary diaphragm (5).

At this time, do the push up of primary valve lever spring (6) of primary valve lever (7), primary valve (1) is shut, and the inflow of the fuel is intercepted.

The tension in the diaphragm spring (4) grows more than the primary chamber pressure when the fuel is consumed and the primary chamber pressure lowers more than a regulated value and a primary diaphragm is depressed below.

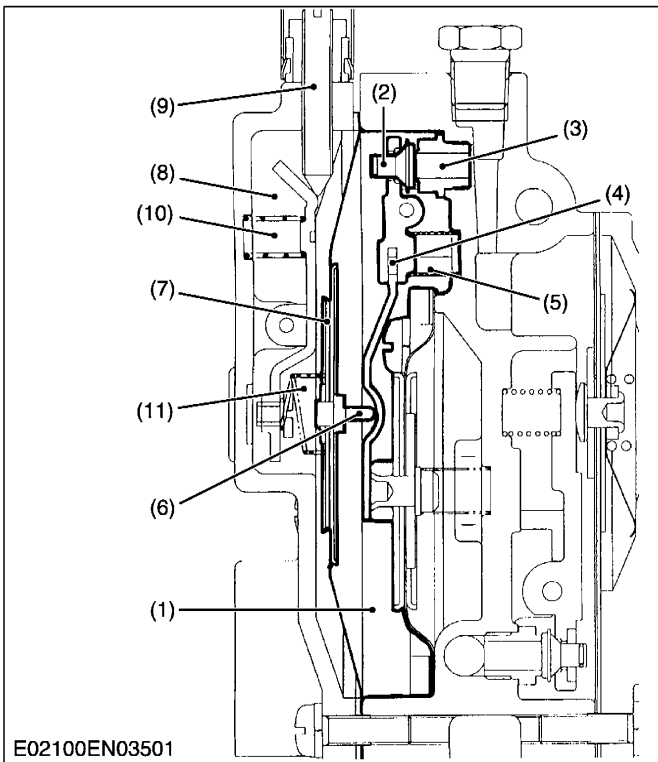
The primary valve lever (7) is depressed at the same time.

A primary valve opens and the fuel flows in again.

When the diaphragm tears by any chance and the fuel flows in the primary diaphragm spring side, the primary diaphragm spring side is connected with second chamber in the balance passage so that the fuel should not flow out outside.

- | | |
|------------------------------|--------------------------------|
| (1) Primary Valve | (5) Primary Diaphragm |
| (2) Valve Seat | (6) Primary Valve Lever Spring |
| (3) Primary Chamber | (7) Primary Valve Lever |
| (4) Primary Diaphragm Spring | |

W1017359



■ Secondary Chamber

The fuel adjusted with primary chamber to the specified pressure enters secondary chamber (1) between secondary valve (2) and the valve seat (3) and is decompressed to the vicinity of the atmospheric pressure almost.

A secondary valve is assembled to a part of the secondary valve lever (4) supported to body and is shut by the tension of the spring of a secondary valve spring (5).

A secondary diaphragm pin (6) touches the edge besides this lever (4).

The one side of secondary diaphragm (7) is faced in secondary chamber and the other side faces atmosphere chamber (8).

When the engine stops, the atmospheric pressure is led in secondary chamber and a secondary valve is shut by the tension of a secondary valve spring.

When the engine rotates, the negative pressure is generated in the venturi tube of the mixer.

As for this negative pressure, working secondary diaphragm (7) is pulled to the second chamber side by the difference pressure with atmosphere chamber by second chamber.

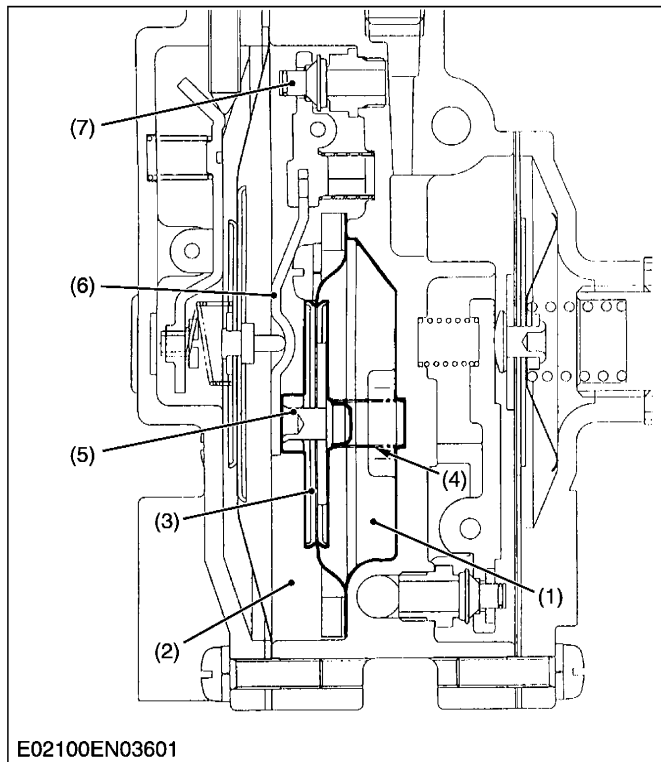
Do the push up of the secondary valve lever (4) by this working, secondary valve is opened, and the fuel flows in.

When pressure in chamber rises by the fuel which flows in, the diaphragm is pushed to the atmosphere chamber side and narrows the opening of the valve and decreases the supply of the fuel.

Secondary chamber is almost maintained in the atmospheric pressure by the thing to repeat such working.

- | | |
|----------------------------|---------------------------|
| (1) Secondary Chamber | (6) Diaphragm Pin |
| (2) Secondary Valve | (7) Secondary Diaphragm |
| (3) Valve Seat | (8) Atmosphere Chamber |
| (4) Secondary Valve Lever | (9) Idle Adjust Screw |
| (5) Secondary Valve Spring | (10) Balance Lever Spring |
| | (11) Balance Spring |

W1017686



■ Vacuum Lock Chamber

1) Operation when engine stops

Because pressure on the vacuum lock chamber (1) side and the secondary chamber (2) side is equal, vacuum lock diaphragm (3) is pushed to the second chamber side by the tension of vacuum lock diaphragm spring (4).

Secondary valve and the seat are made to close as vacuum lock diaphragm pin (5) pushes secondary valve lever (6) and the fuel leakage is prevented.

2) Operation at engine starting

The negative pressure is caused in inlet manifold at the same time as the cranking's beginning.

This negative pressure acts in vacuum lock chamber (1) and vacuum lock diaphragm (3) is drawn to the vacuum lock chamber side.

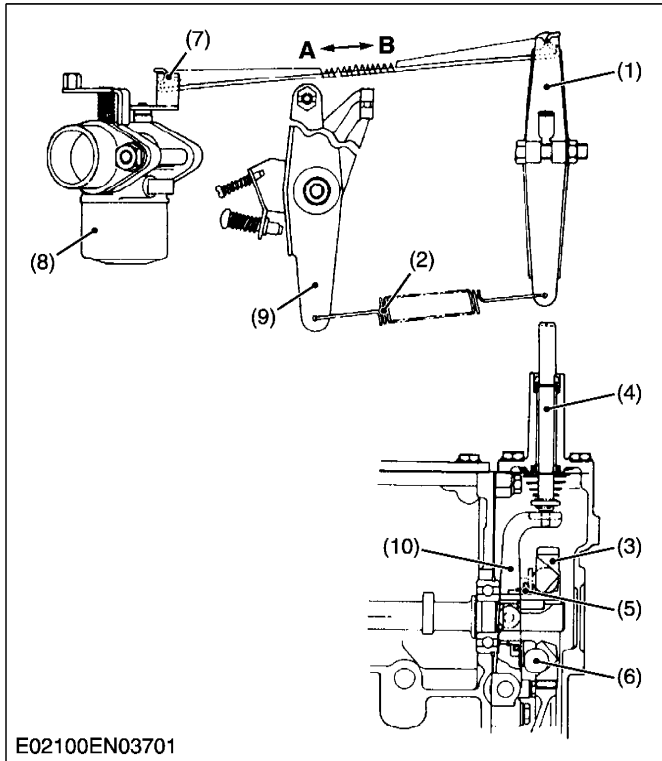
As a result, the movement of secondary valve lever (6) becomes free and the fuel inflow adjustment due to secondary valve (7) becomes possible.

The negative pressure in inlet manifold always works while the engine is rotating and the movement of secondary valve lever is tuned to the movement of secondary diaphragm.

- | | |
|----------------------------------|---------------------------|
| (1) Vacuum Lock Chamber | (5) Diaphragm Pin |
| (2) Secondary Chamber | (6) Secondary Valve Lever |
| (3) Vacuum Lock Diaphragm | (7) Secondary Valve |
| (4) Vacuum Lock Diaphragm Spring | |

W1018164

[5] GOVERNOR



E02100EN03701

The engine is equipped with a centrifugal ball mechanical governor which activates the throttle in response to engine speed.

When the engine is carrying a load and running at rated speed, the speed will drop if the load is increased even slightly. In this case, the governor automatically opens the throttle valve of the carburetor to maintain the original speed.

Dumping the load suddenly will cause a rapid increase in speed. In this case, the governor automatically moves the throttle valve in closing direction to prevent the engine from increasing its speed.

1) When engine is carrying a load and running at rated speed

When there is no change in load, the centrifugal force of the ball (6) which is attached to the governor gear (3) balances with the tensile force of the governor spring (2) via governor sleeve (5), fork lever (10), governor lever shaft (4) and governor lever (1). The engine speed and output are thus kept constant.

2) When load is applied to engine

When the load is applied to the engine running at rated speed, the speed of the governor gear (3) which is connected to the idle gear decreases. As a result, the centrifugal force of the ball (6) becomes smaller. The tensile force of the spring (2) overcomes the centrifugal force, and the governor lever (1) causes the throttle lever (7) to move in the open direction (B). The original engine speed is thus maintained.

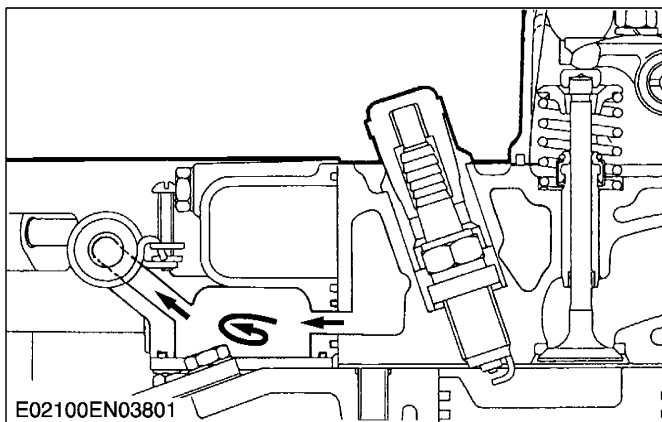
3) When load is dumped

When the load is dumped suddenly, the centrifugal force of the ball (6) overcomes the tensile force of the spring (2). As a result, the governor lever (1) causes the throttle lever (7) to move in the shut direction (A) and prevents the engine from increasing its speed.

- | | |
|--------------------------|--------------------------------|
| (1) Governor Lever | (6) Ball |
| (2) Governor Spring | (7) Throttle Lever |
| (3) Governor Gear | (8) Carburetor / DF Carburetor |
| (4) Governor Lever Shaft | (9) Speed Control Lever |
| (5) Governor Sleeve | (10) Fork Lever |

W1018388

[6] INLET MANIFOLD



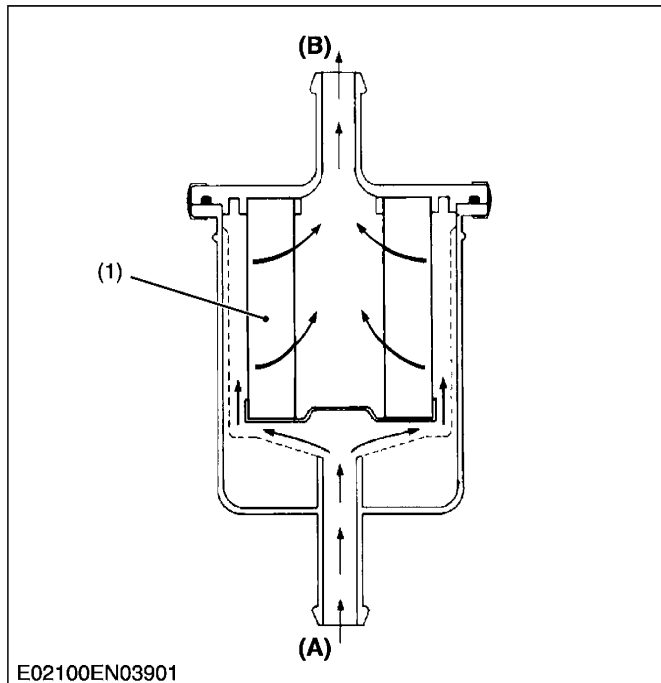
E02100EN03801

Part of water heated in the water jacket is channeled to the inlet manifold, where the hot water heats the fuel-air mixture for better carburetion. Heating effect is particularly good when the engine is running at low speeds and with light load in cold weather, thus improving fuel economy and acceleration.

- (1) Intake Manifold

W1018693

[7] FUEL FILTER (FOR GASOLINE LINE)



E02100EN03901

The fuel filter is installed in the fuel line between the fuel tank and the feed pump.

As the fuel flows from the inlet (A) through the filter element (1), the dirt and impurities in the fuel are filtered, allowing only clean fuel to penetrate the inside of the filter element. The cleaned fuel flows out from the outlet (B).

Type of filter element	Accordion-pleated paper type
Material of filter element	Cotton fiber
Filter mesh	15 μm (0.00059 in.)

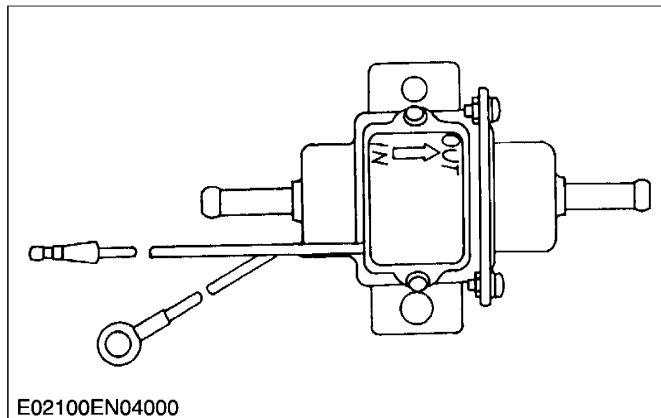
(1) Filter Element

(A) Inlet

(B) Outlet

W1018764

[8] ELECTRO MAGNETIC FUEL FEED PUMP (FOR GASOLINE LINE)



E02100EN04000

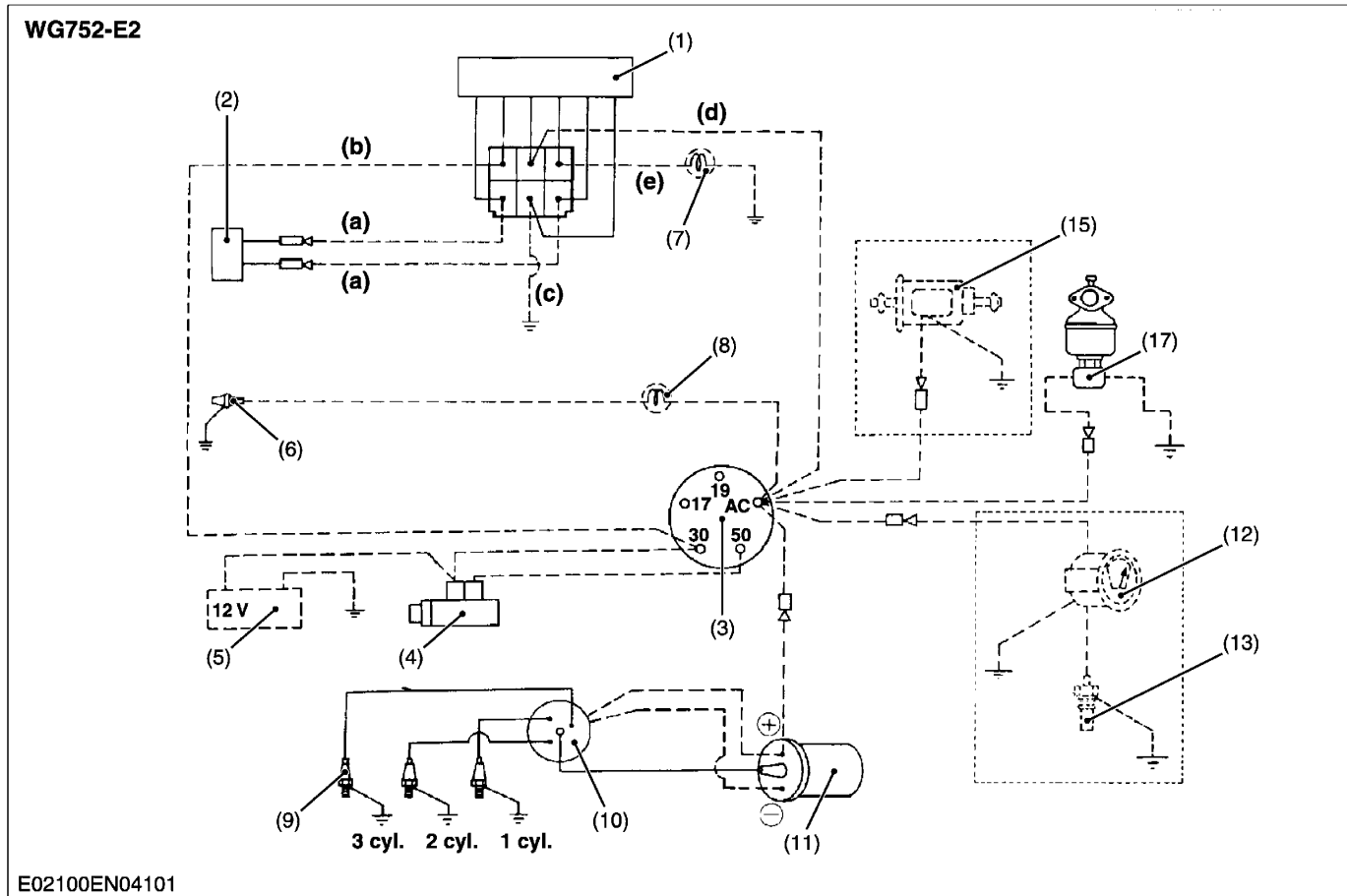
An electro magnetic pump uses a transistor that causes the pump to start pumping fuel when the engine is switched on.

Therefore, fuel is supplied to the carburetor regardless of engine speed. This pump is driven by the battery. It can therefore be operated even with the engine being stopped.

W1018942

6. ELECTRICAL SYSTEM

[1] WIRING DIAGRAM



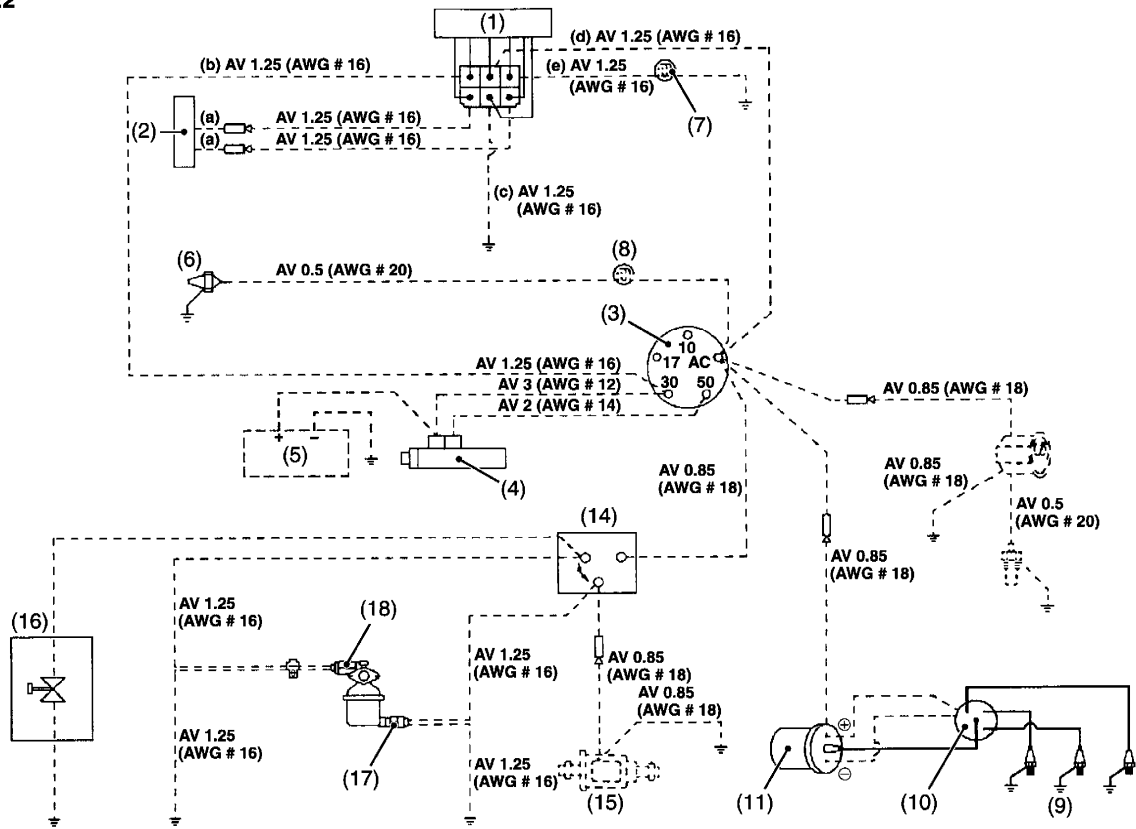
- | | | | |
|-----------------|--------------------------|------------------------------------|----------------------|
| (1) Regulator | (8) Oil Lamp | (14) Fuel Selector Switch** | (a) Blue Lead Wire |
| (2) Dynamo | (9) Spark Plug | (15) Gasoline Fuel Pump* | (b) Red Lead Wire |
| (3) Key Switch | (10) Distributor | (16) LPG Shut Off Solenoid Valve** | (c) Black Lead Wire |
| (4) Starter | (11) Ignition Coil | (17) Gasoline Cut Off Solenoid | (d) Yellow Lead Wire |
| (5) Battery* | (12) Temperature Gauge* | (18) LPG Cut Off Solenoid | (e) Green Lead Wire |
| (6) Oil Switch | (13) Temperature Sensor* | | |
| (7) Charge Lamp | | | |

The electrical system of the engine consists of a starting system (including a starter and others), a charging system (including a dynamo, a regulator and others), a battery and an oil switch.

■ NOTE

- Components marked * are not included in the basic model.
- Components marked ** are not provided by KUBOTA.
- When no charge lamp is used, do not connect the charge lamp circuit to the ground circuit. Otherwise, a huge current will flow into the charge lamp circuit, damaging the regulator.

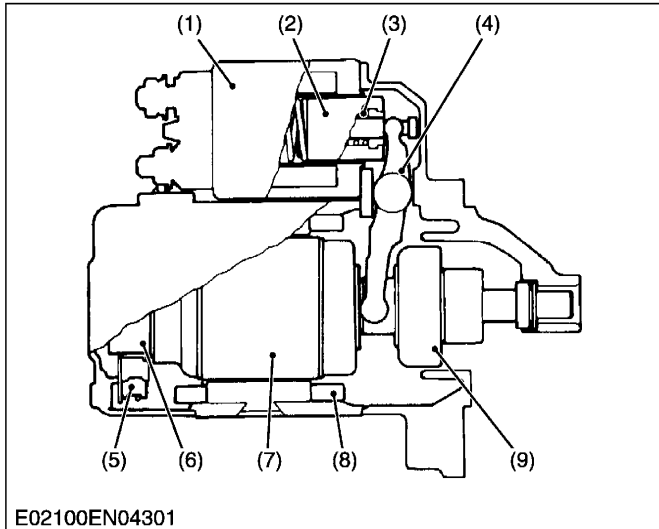
DF752-E2



E02100EN04201

[2] STARTING SYSTEM

(1) Starter



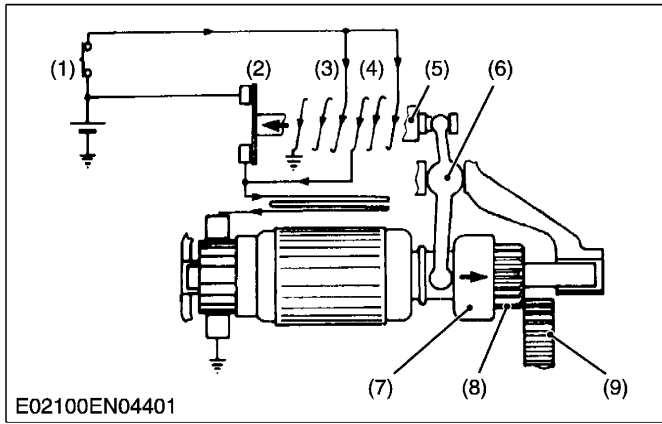
E02100EN04301

The starter is the electromagnetic drive type.

Type of motor	DC, Series-wound, Electromagnetic drive
Nominal output	12 V
Nominal output	0.7 kW
Nominal output	30 seconds (Do not rotate continuously for longer periods.)
Direction of rotation	Clockwise as viewed from pinion side

- (1) Solenoid Switch
- (2) Plunger
- (3) Spring
- (4) Shift Lever
- (5) Brush
- (6) Commutator
- (7) Armature
- (8) Field Coil
- (9) Overrunning Clutch

W1019349



1) Operation of Starter

■ **When key switch is turned to “START” position**

The contacts of key switch (1) close and the holding coil (3) is connected to the battery to pull the plunger (5).

The pull-in coil (4) and the starting motor are also connected to the battery.

The pinion (8) is pushed against the ring gear (9) with the overrunning clutch (7) by the shift lever (6) and the magnetic switch is closed.

■ **When the solenoid switch is closed**

The current from the battery flows through the solenoid switch (2) to the starting motor.

The pinion (8), which is pushed against the ring gear (9) and rotated along the spline, meshes with the ring gear to crank the engine.

The engine starts and increases its speed.

While the pinion spins faster than the armature, the overrunning clutch (7) allows the pinion to spin independently from the armature.

The pull-in coil (4) is short-circuited through the solenoid switch (2) and the key switch (1).

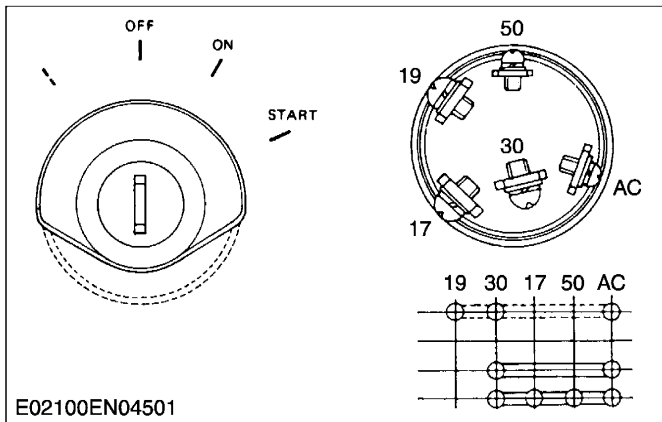
■ **When the key switch is released**

The current from the battery flows to the holding coil (3) through the pull-in coil (4) to diminish the magnetism between them.

The plunger (5) is pushed by the spring to pull in the pinion.

- | | |
|---------------------|------------------------|
| (1) Key Switch | (6) Shift Lever |
| (2) Solenoid Switch | (7) Overrunning Clutch |
| (3) Holding Coil | (8) Pinion |
| (4) Pull-in Coil | (9) Ring Gear |
| (5) Plunger | |

W1019580



2) Key Switch (not included in the basic model)

The key switch has 4 positions. The terminal “30” is connected to the battery.

It is released at the “START” position and returns to the “ON” position.

■ **START**

When the key is turned to the “START” position, through the “ON” position the current is supplied to the starter.

- 50 To Starter
- 30 From Battery
- AC To Regulator, Oil Lamp and Accessory

■ **ON**

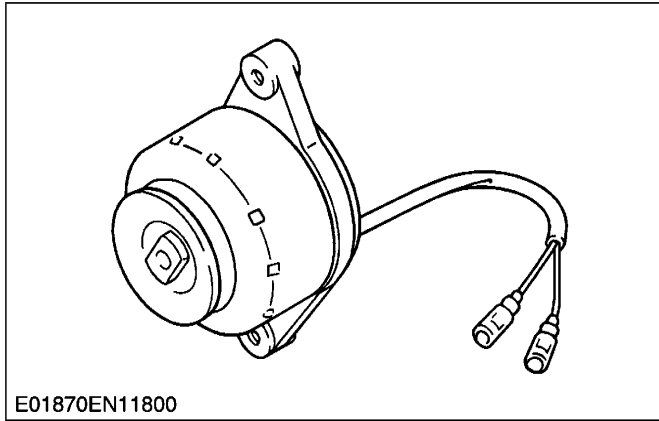
Only the terminal “AC” is connected to the battery. At any position of the key except the “OFF” position, the terminal “AC” is connected to the “30” terminal.

- 30 From Battery
- AC To Regulator, Oil Lamp and Accessory

W1020046

[3] CHARGING SYSTEM

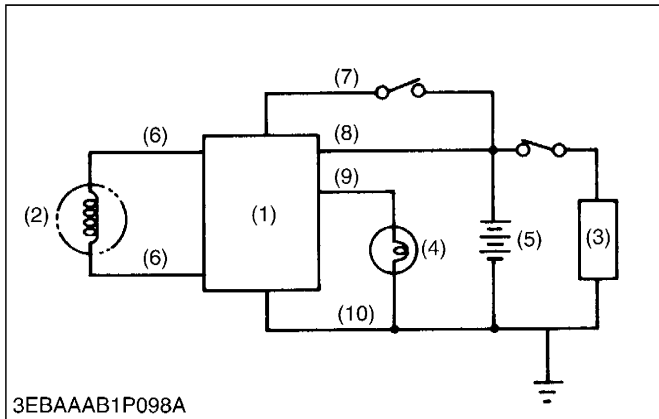
(1) Alternator



This alternator is an 8-8 pole rotating magnet type generator. It is simple in construction, consisting of a stator and rotor. The rotor is made up of eight permanent magnet pole pieces assembled on a shaft and rotates on the center of the stator around which eight electromagnetic coils are provided for. This alternator produces higher voltage in slow speed rotation, and charges electric current to the battery during engine idling.

W1020362

(2) Regulator

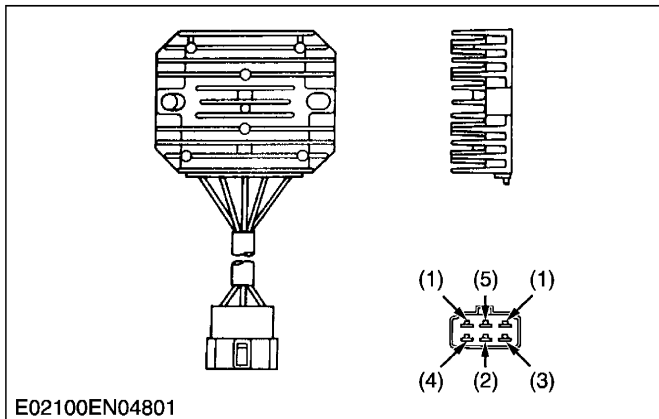


The regulator performs rectification and voltage regulation. The regulator converts AC into DC which flows through the power consuming circuits and the battery, and also charges the battery. If however, the battery voltage exceeds a certain level. The DC current is cut off from the charging circuit to prevent overcharging.

Model	RS5130
Part No.	19267-6460-1
Weight	Approx. 250 g
Regulated voltage	14 to 15 V
Battery to be used	12 V
Charge indication lamp	12 V, 3.4 W
Alternator to be used	Under 70 V of peak value of no-load voltage Under 16 A of output current

- (1) Regulator
- (2) Alternator
- (3) Load
- (4) Charge Lamp
- (5) Battery
- (6) Blue Lead Wire
- (7) Yellow Lead Wire
- (8) Red Lead Wire
- (9) Green Lead Wire
- (10) Black Lead Wire

W1020412



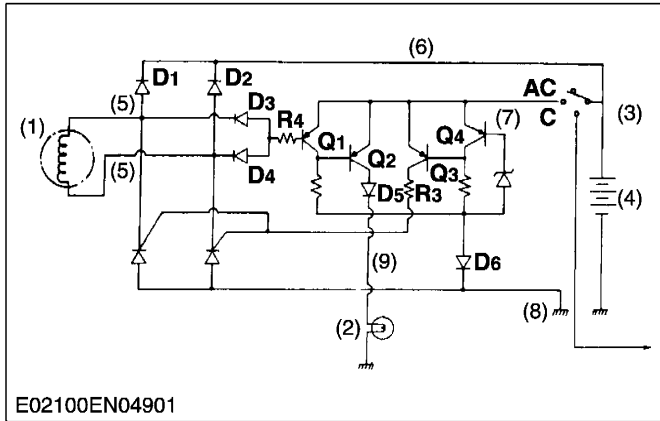
■ Features

1. This small-sized regulator can control large output current because charging current is supplied and stopped by thyristor (series system).
2. Built-in AC diode generation detecting circuit permits a charge indication lamp (12 V, 3.4 W) to be easily connected.
3. Protection diode protects regulator when battery is wrongly connected.

- (1) Blue Lead Wire
- (2) Yellow Lead Wire
- (3) Red Lead Wire
- (4) Green Lead Wire
- (5) Black Lead Wire

W1020684

(3) Charging Mechanism



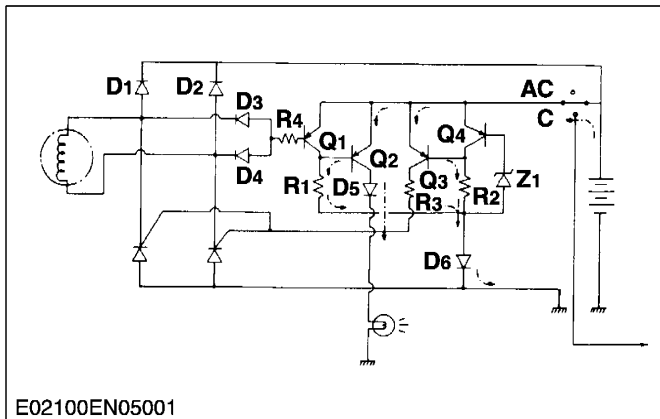
The charging mechanism is described in four sections:

1. When key switch is ON
2. At starting
3. In charging
4. Over-charge protection

- (1) GEN: Magnet type AC generator
- (2) LAMP: Charge indication lamp (not included in the basic engine)
- (3) KEY SW: Key switch (not included in the basic engine)
- (4) BATT: Battery (not included in the basic engine)
- (5) Blue: GEN connecting terminal
- (6) Red: BATT + connecting terminal
- (7) Yellow: BATT voltage test terminal
- (8) Black: BATT - connecting terminal
- (9) Green: LAMP connecting terminal

- S₁, S₂: Output control / rectification thyristor (SCR)
- D₁, D₂: Output rectifying diode
- D₃, D₄: GEN generation detecting diode
- D₅, D₆: Protection diode for wrong connecting of BATT
- Z₁: BATT terminal voltage setting diode
- Q₁: GEN generation detecting transistor
- Q₂: LAMP on / off transistor
- Q₃: Gate current control transistor
- Q₄: BATT voltage detecting transistor

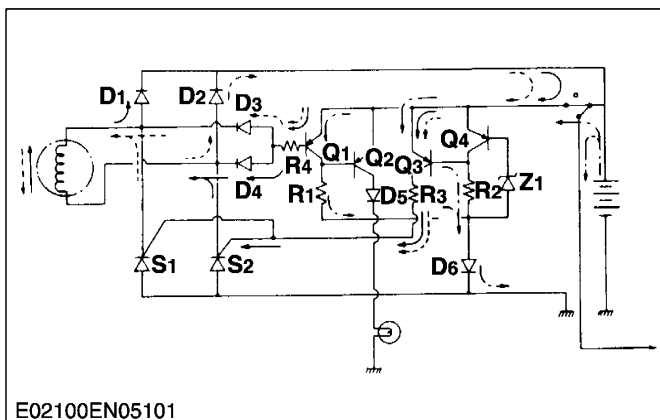
W1020823



1) When Key Switch is "ON"

When the engine is at standstill with key switch set at position 1, the circuit functions to light LAMP, as shown in Fig. 1. With key switch at position 1, current flows to base of Q₂ through the route of BATT → emitter / base of Q₂ → R₁ → D₆ → BATT and collector of Q₂ is then turned on. As a result, current also flows to LAMP through the route of BATT → emitter / collector of Q₂ → D₅ → LAMP → BATT lighting LAMP to indicate that charging is not carried out. At this time, though current flows to base of Q₃ through the route of BATT → emitter / base of Q₃ → R₂ → D₆ → BATT, collector of Q₃ has no current because GEN is stationary.

W1021905

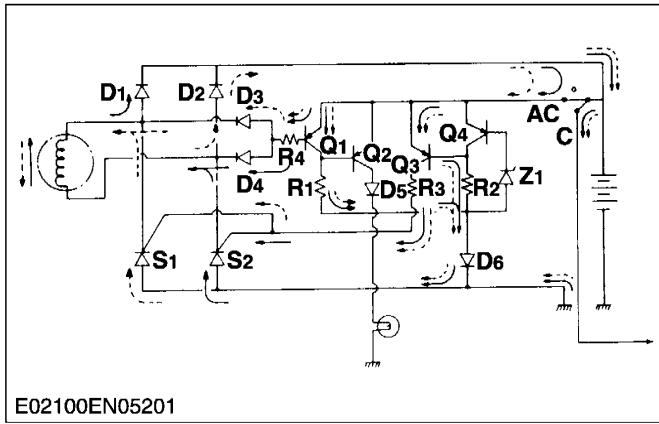


2) At Starting

When key switch is turned to position 2, coil of starter relay is energized and starter starts engine. GEN also starts generation for charging and LAMP is turned off.

In detail, with GEN starting, current flows to base of Q₁ through the route of GEN → D₁ → emitter / base of Q₁ → R₄ → D₄ → GEN, or GEN → D₂ → emitter / base of Q₁ → R₄ → D₃ → GEN, and therefore current also flows through Q₁, shortcircuiting emitter and base of Q₂. As a result, base current of Q₂ is interrupted, Q₂ is turned off and accordingly current to LAMP is also interrupted.

W1022213



3) In Charging

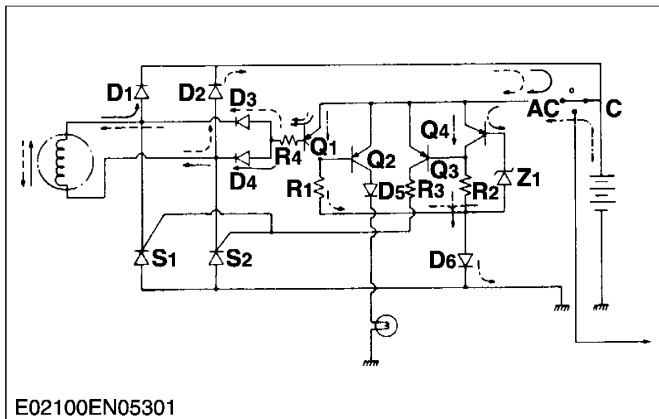
Because BATT terminal voltage just after engine start is lower than setting value (14 to 15 V), or lower than zener level of Z_1 , current is not supplied to base of Q_4 and Q_4 is off, as shown in Fig. 2. Q_3 is on with base current which flows through the route of BATT → emitter / base of Q_3 → R_2 → D_6 → BATT, and gate current is supplied to S_1 or S_2 through the route of GEN → D_1 → emitter / collector of Q_3 → R_3 → gate / cathode of S_2 → GEN, or GEN → D_2 → emitter / collector of Q_3 → R_3 → gate / cathode of S_1 → GEN.

When engine speed is increased so that GEN generation voltage becomes higher than BATT terminal voltage, S_1 or S_2 is turned on and, as shown in Fig. 3, charge current is supplied to BATT through the route of GEN → D_1 → BATT → anode / cathode of S_2 → GEN, or GEN → D_2 → BATT → anode / cathode of S_1 → GEN.

After S_1 or S_2 is turned on, collector current of Q_1 and base current of Q_3 are supplied by GEN, not BATT.

When key switch is turned to position 1 after engine is started, BATT is charged, if BATT terminal voltage is lower than the setting value, or zener level of Z_1 .

W1022479

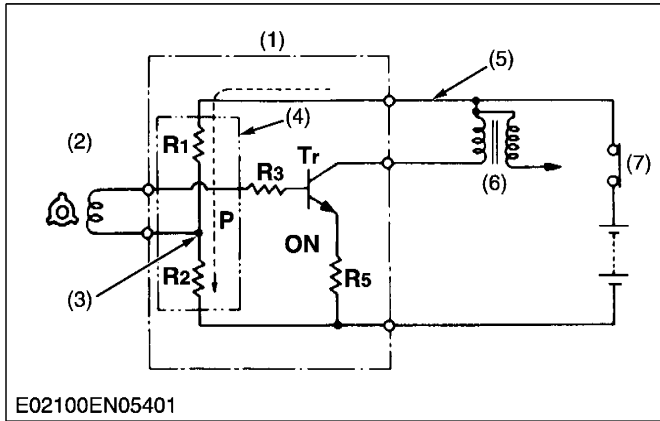


4) Over-Charge Protection

When BATT terminal voltage is higher than the setting value or zener level of Z_1 , BATT is not charged by the function of circuit as shown in Fig. 4. That is, Q_4 is on with base current which flows through the route of BATT → emitter / base of Q_4 → Z_1 → D_6 → BATT, shortcircuiting emitter and base of Q_3 . Therefore, Q_3 is off with no base current and gate current is not supplied to S_1 and S_2 . Consequently S_1 and S_2 are off and BATT is not charged.

W1023416

[4] IGNITION SYSTEM

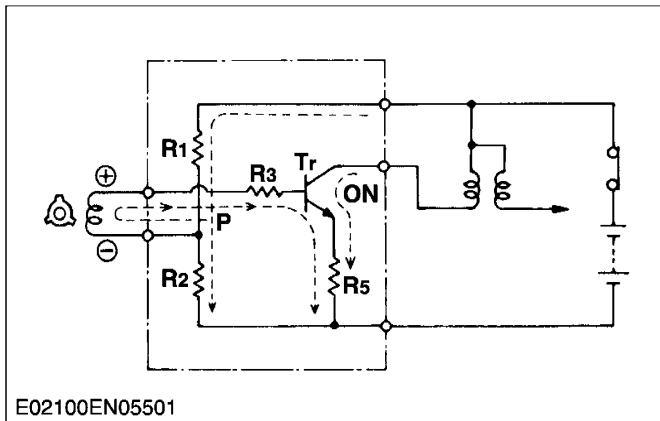


■ When the engine is off

When the ignition switch is turned on, the fixed bias voltage – the voltage at point **P** (the voltage supplied by the battery and divided by resistors **R₁** and **R₂**) – is slightly higher than the operating voltage of transistor. The transistor thus turns on and delivers a current to the primary coil of the ignition coil.

- | | |
|---------------------------------------|---|
| (1) Igniter | (5) With No Externally-
Connected Resistor |
| (2) Pick-up Coil | (6) Ignition Coil |
| (3) Voltage at Point P is low. | (7) Ignition Switch |
| (4) Fixed Bias Circuit | |

W1023617

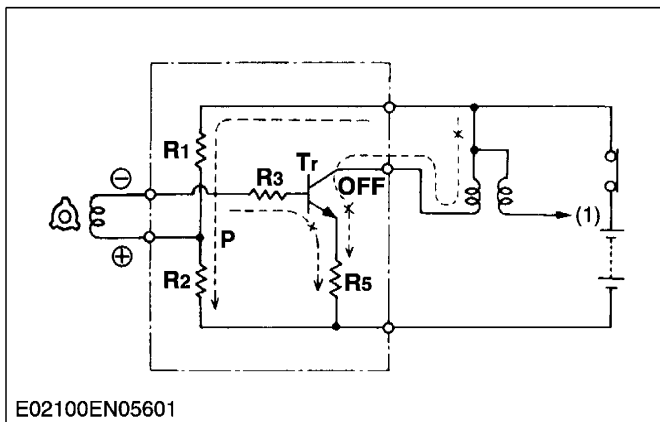


■ When the voltage produced by the pick-up coil is positive

After the engine is started, the signal rotor of the distributor rotates and an AC voltage develops in the pick-up coil.

When the output voltage of the pick-up coil is positive, the voltage at point **P** combined with this output voltage is applied to the base of the transistor. The combined voltage is higher than the operating voltage of the transistor so that the transistor remains on and the current to the primary coil of the ignition coil continues to flow.

W1023768



■ When the voltage produced by the pick-up coil is negative

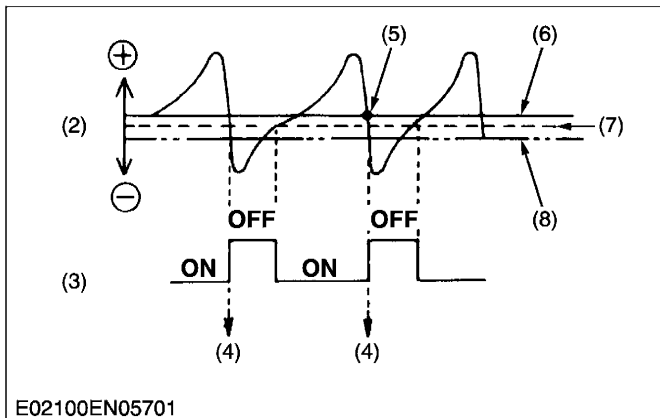
When the output voltage of the pick-up coil is negative, the voltage at point **P** falls below the operating voltage of the transistor. The transistor then turns off and cuts the current flowing to the primary coil of the ignition coil. As a result, a high-voltage is produced by the secondary coil of the ignition coil. The transistor remains off as long as the output voltage of the pick-up coil is negative.

As the engine runs, the transistor turns on and off repeatedly as described above. Every time it turns off, a high voltage is produced in the secondary coil of the ignition coil. This is the current that ignites the spark plug.

Described above is a conventional fully-transistorized ignition circuit. In such circuits, the transistor does not turn off until coil. The secondary voltage tends to decrease as the engine speed increases. To prevent this, the dwell (the amount of time the transistor is turned on) must be controlled.

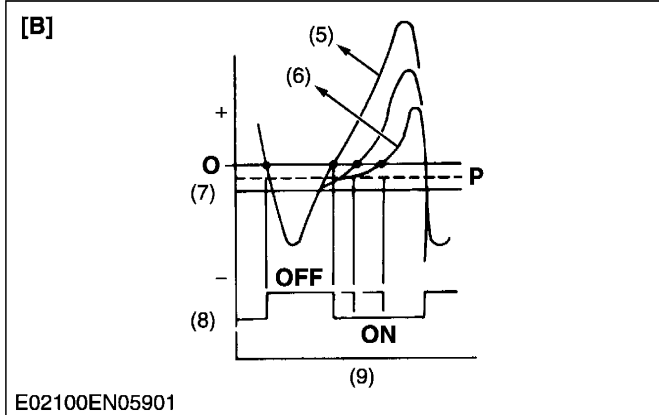
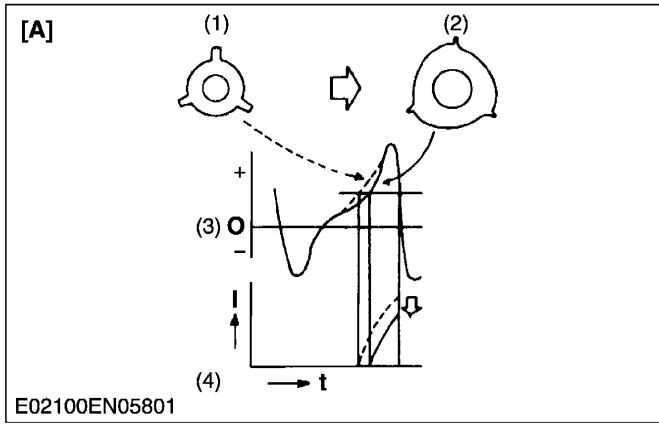
Items (1), (2) and (3) above describes so far the conventional fully-transistorized ignition system.

- | | |
|--|---|
| (1) High Voltage Generation | (5) When the teeth on the signal
coil pass a projection leading
from the pick-up tube |
| (2) Voltage Waveform of the
Ignition Signal | (6) DC Voltage at Point P |
| (3) Transistor Operation | (7) Operating Voltage of the
Transistor |
| (4) Ignition | (8) Ground Potential |



W1023828

KiSC issued 04, 2006 A



■ Dwell control by the pick-up coil waveform

This ignition system of this engine features a unique dwell control method which utilizes changes in the output waveform of the pick-up coil. In order for the waveform to have a sharper rising edge, the teeth of the distributor's signal rotor are designed as shown in Fig. A.

Unlike conventional fully-transistorized ignition circuits, the fixed bias voltage "P" of this ignition circuit is set at a lower level than the operating voltage of the transistor. For this reason, a voltage does not develop in the pick-up coil even when the key switch is turned on, preventing a current from flowing into the ignition coil.

Therefore, as the signal rotor increases in speed, the output voltage of the pick-up coil becomes greater and the rising edge of the waveform becomes sharper. (See Fig. B.) As a result, the transistor turns on faster than in a conventional fully-transistorized ignition circuit. Yet it turns off at the same time as the transistor in a conventional circuit. Consequently, the amount of time the transistor is turned on increases (the dwell becomes wider).

As explained above, this ignition system makes use of changes in the output waveform of the pick-up coil to increase the closing angle at high engine speeds.

- (1) Ordinary Shape
- (2) Dwell Controlled Shape
- (3) Waveform of the Pick-up Coil
- (4) Waveform of the Primary Current
- (5) Output Waveform of the Pick-up Coil
- (6) Increase in RPM
- (7) Operating Level of Tr 1
- (8) Tr 1 Operation
- (9) Rotor Angle

W1024336

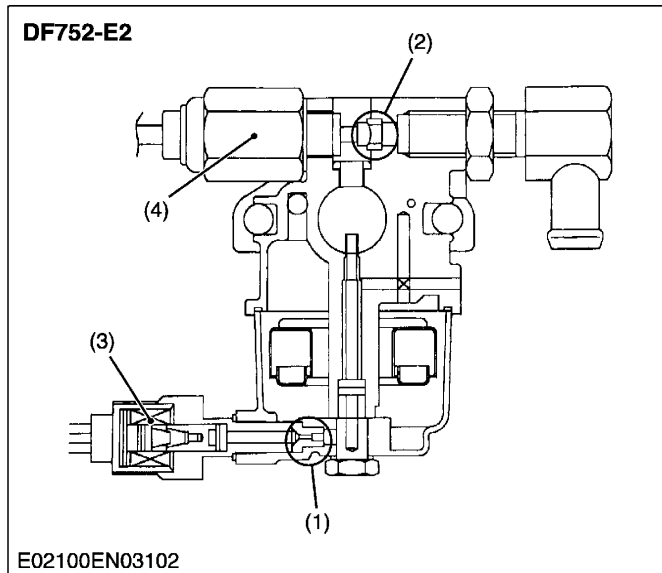
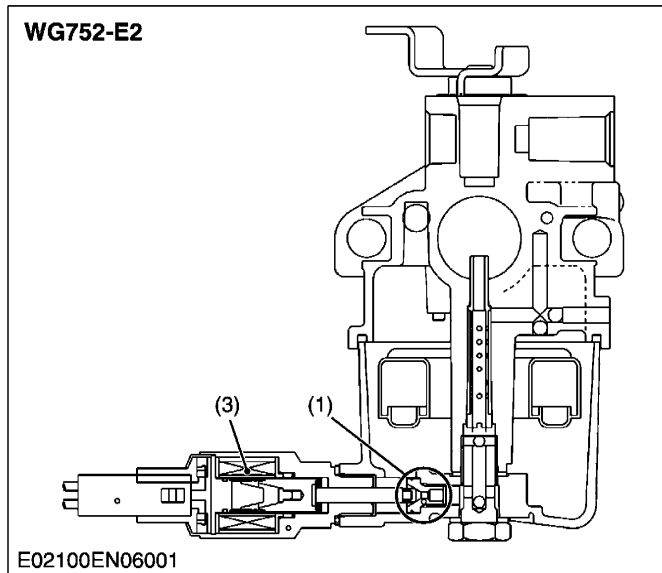
[5] SOLENOID

When the key switch is turned on, a current flows to the solenoid, which in turn opens the solenoid valve.

When the key switch is turned off, the solenoid valve closes, blocking the gasoline main jet (1) / LPG main jet (2).

- | | |
|-----------------------|-----------------------------|
| (1) Gasoline Main Jet | (3) Gasoline Solenoid Valve |
| (2) LPG Main Jet | (4) LPG Solenoid Valve |

W1025445



SERVICING

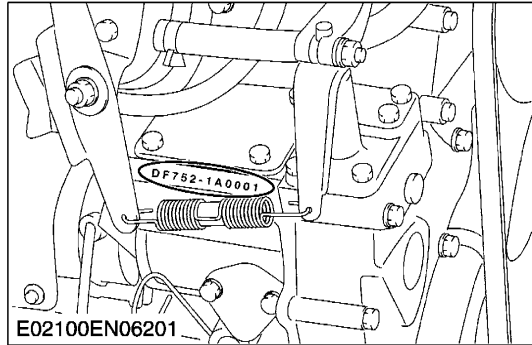
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1. GENERAL

[1] ENGINE IDENTIFICATION



When contacting your local KUBOTA dealer, always specify the engine serial number.

■ **NOTE**

- The serial number is marked on specified position shown in the figure.

■ **Engine Serial Number**

The engine serial number is an identified number for the engine. It is marked after the engine model number.

It indicates month and year of manufacture as follows.

· **Year of manufacture**

Alphabet or Number	Year	Alphabet or Number	Year
1	2001	6	2006
2	2002	7	2007
3	2003	8	2008
4	2004	9	2009
5	2005		

· **Month of manufacture**

Month	Engine Serial Number	
	0001 ~ 9999	10000 ~
January	A0001 ~ A9999	B0001 ~
February	C0001 ~ C9999	D0001 ~
March	E0001 ~ E9999	F0001 ~
April	G0001 ~ G9999	H0001 ~
May	J0001 ~ J9999	K0001 ~
June	L0001 ~ L9999	M0001 ~
July	N0001 ~ N9999	P0001 ~
August	Q0001 ~ Q9999	R0001 ~
September	S0001 ~ S9999	T0001 ~
October	U0001 ~ U9999	V0001 ~
November	W0001 ~ W9999	X0001 ~
December	Y0001 ~ Y9999	Z0001 ~

e.g.: DF752-1A0001

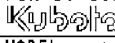
“WG” indicates Water Cooled and Gasoline Engine.

“DF” indicates Dual Fuel Engine.

“1” indicates 2001 and “A” indicates January.

So, 1A indicates that the engine was manufactured on January, 2001.

W1010519

<p>IMPORTANT ENGINE INFORMATION THIS ENGINE CONFORMS TO U.S. EPA PH2 AND 2001 CALIFORNIA EMISSION REGULATIONS FOR SI SORES.</p>	
<p> KUBOTA Corporation</p>	
MODEL : *****	ENGINE DISP. : ***.1CC
FAMILY : ***** EM	
EPA USEFUL LIFE CATEGORY : CLASS A	
UNLEADED GASOLINE AND COMMERCIAL PROPANE GAS ONLY	
REFER TO OPERATOR'S MANUAL FOR MAINTENANCE SPECIFICATIONS AND ADJUSTMENTS.	
	EG651-1

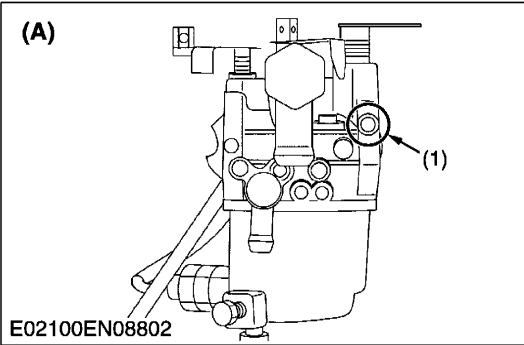
E02100EN08700

■ **Emission Label**

This label is attached on the cylinder head cover of the engine certified to the requirements of EPA / CARB Emission regulations.

The content of the label is approved officially by EPA / CARB.

W1122181



■ **Tamper Resistance**

KUBOTA Corporation is to provide safeguards for the parts where never to be adjusted, and is approved by EPA / CARB for the purpose of this engine to be in compliance with EPA / CARB Emission Regulations through its useful life. Intentional removable and adjustment of such tamper resistance are subject to the penalty.

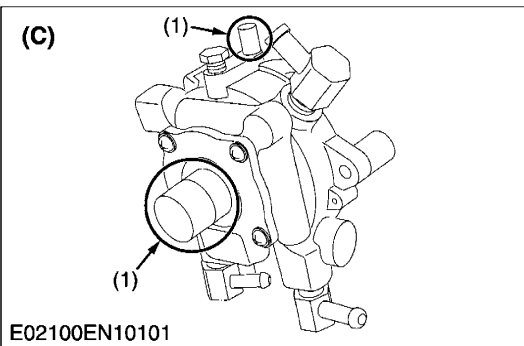
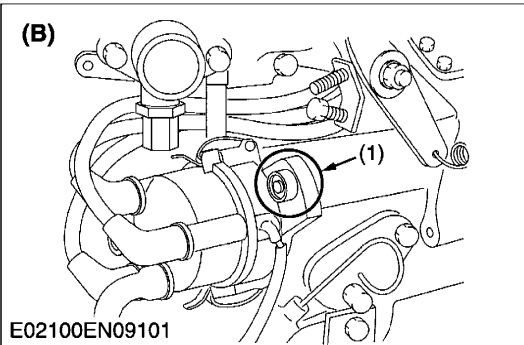
(1) Tamper Resistance

(A) Carburetor

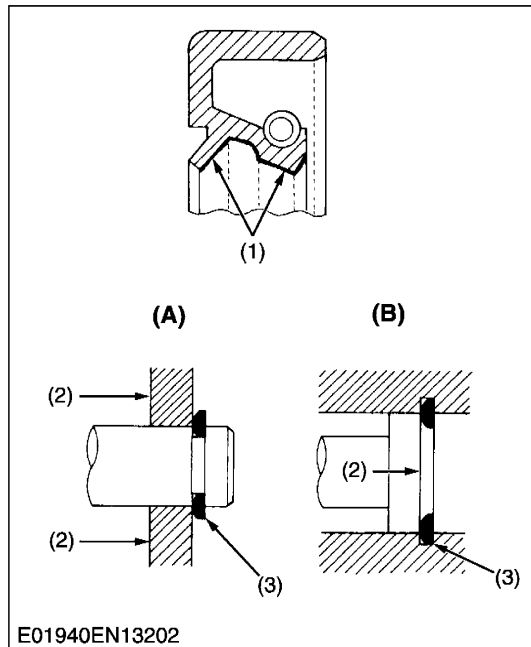
(B) Distributor

(C) Vaporizer

W1122255



[2] GENERAL PRECAUTION



- During disassembly, carefully arrange removed parts in a clean area to prevent confusion later. Screws and nuts should be replaced in their original position to prevent reassembly errors.
- When special tools are required, use KUBOTA genuine special tools. Special tools which are not frequently used should be made according to the drawings provided.
- Before disassembling or servicing live wires, make sure to always disconnect the grounding cable from the battery first.
- Remove oil and dirt from parts before measuring.
- Use only KUBOTA genuine parts for parts replacement to maintain engine performance and to ensure safety.
- Gaskets and O-rings must be replaced during reassembly. Apply grease to new O-rings or oil seals before assembling.
- When reassembling external or internal snap rings, position them so that the sharp edge faces against the direction from which force is applied.
- Be sure to perform run-in the serviced or reassembled engine. Do not attempt to give heavy load at once, or serious damage may result to the engine.

⚠ CAUTION

- **Certain components used in this engine (cylinder head-gasket, exhaust gasket, etc.) contain asbestos. Handle with care according to safety regulation.**

- | | |
|---|------------------------|
| (1) Grease | (A) External Snap Ring |
| (2) Force | (B) Internal Snap Ring |
| (3) Place the Sharp Edge against the Direction of Force | |

W1011734

[3] TIGHTENING TORQUES

Screws, bolts and nuts must be tightened to the specified torque using a torque wrench. Several screws, bolts and nuts such as those used on the cylinder head must be tightened in proper sequence and at the proper torque.

(1) Tightening Torques for Special Use Screws, Bolts and Nuts

■ NOTE

- In removing and applying the screws, bolts and nuts marked with “*”, pneumatic wrench or similar pneumatic tool, if employed, must be used with enough care not to get them seized.
- For “**” marked screws, bolts and nuts on the table, apply engine oil to their threads and seats before tightening.

Item	N·m	kgf·m	ft-lbs
* Cylinder head cover cap nut	3.9 to 5.9	0.4 to 0.6	2.9 to 4.3
Spark plug	19.6 to 24.5	2.0 to 2.5	14.5 to 18.1
* Rocker arm bracket nuts	9.8 to 11.3	1.00 to 1.15	7.2 to 8.3
* Cylinder head screw	37.2 to 42.1	3.8 to 4.3	28.0 to 31.7
Fan drive pulley retaining screw	118 to 127	12.0 to 13.0	86.8 to 94.0
* Idle gear shaft mounting screw	9.8 to 11.3	1.00 to 1.15	7.2 to 8.3
* Connecting rod screw	26.5 to 30.4	2.7 to 3.1	19.5 to 22.4
* Flywheel screw	53.9 to 58.8	5.5 to 6.0	39.8 to 43.4
* Bearing case cover mounting screw	9.8 to 11.3	1.00 to 1.15	7.2 to 8.3
* Main Bearing case screw 2	26.5 to 30.4	2.7 to 3.1	19.5 to 22.4
* Main Bearing case screw 1	12.7 to 15.7	1.3 to 1.6	9.4 to 11.6
Oil switch	14.7 to 19.6	1.5 to 2.0	10.8 to 14.5
Drain plug	32.4 to 37.3	3.3 to 3.8	23.9 to 27.5
Starter B terminal nut	8.8 to 11.8	0.9 to 1.2	6.5 to 8.7
Carburetor mounting nut	23.5 to 27.5	2.4 to 2.8	17.4 to 20.2
Joint for LPG hose of vaporizer (local arrangement)	19.6 to 32.9	2.0 to 4.0	14.5 to 28.8
Joint for vapor hose of vaporizer	29.4 to 58.8	3.0 to 6.0	21.6 to 43.2
Joint for water hose of vaporizer	29.4 to 58.8	3.0 to 6.0	21.6 to 43.2

W1012736

(2) Tightening Torques for General Use Screws, Bolts and Nuts

Grade Nominal Diameter	Standard Screw and Bolt ④			Special Screw and Bolt ⑦			
	Unit	N·m	kgf·m	ft-lbs	N·m	kgf·m	ft-lbs
M6		7.9 to 9.3	0.80 to 0.95	5.8 to 6.9	9.8 to 11.3	1.00 to 1.15	7.23 to 8.32
M8		17.7 to 20.6	1.8 to 2.1	13.0 to 15.2	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
M10		39.2 to 45.1	4.0 to 4.6	28.9 to 33.3	48.1 to 55.9	4.9 to 5.7	35.4 to 41.2
M12		62.8 to 72.6	6.4 to 7.4	46.3 to 53.5	77.5 to 90.2	7.9 to 9.2	57.1 to 66.5

W10371750

Screw and bolt material grades are shown by numbers punched on the screw and bolt heads. Prior to tightening, be sure to check out the numbers as shown below.

Punched number	Screw and bolt material grade
None or 4	Standard screw and bolt SS41, S20C
7	Special screw and bolt S43C, S48C (Refined)

W1012705

[4] TROUBLESHOOTING

(1) For Gasoline Fuel

Symptom	Probable Cause	Solution	Reference Page
Engine Will Not Turn Over	<ul style="list-style-type: none"> • Engine jammed • Battery discharged • Starter malfunctioning • Wires disconnected 	Check engine to find the problem and repair it Charge Repair or replace Reconnect	S-70
Engine Turns Over Slowly but Does Not Start	<ul style="list-style-type: none"> • Increased resistance of moving parts • Excessively high viscosity engine oil at low temperature 	Repair or replace Use specified engine oil	S-16
Engine Turns Over at Normal Speed but Does Not Start	<ul style="list-style-type: none"> • No fuel • Compression leak • Improper valve clearance • Defective ignition unit • Defective spark plug • Defective fuel system • Over choked • Flooding from carburetor • Clogged air cleaner 	Replenish fuel Check the compression pressure and repair Adjust Replace Adjust spark plug gap or replace Check fuel line and carburetor and repair Clean spark plug Check carburetor and repair Clean or replace	S-32 S-33 S-18, 76 S-15
Rough Low-Speed Running and Idling	<ul style="list-style-type: none"> • Defective ignition unit • Defective spark plug • Defective spark plug cords • Incorrect carburetor idle adjustment • Incorrect governor adjustment • Improper valve clearance 	Replace Adjust spark plug gap or replace Replace Adjust Adjust Adjust	S-18, 76 S-77 S-66 S-65 S-33
Rough High-Speed Running	<ul style="list-style-type: none"> • Defective ignition unit • Defective spark plug • Defective spark plug cords • Incorrect governor adjustment 	Replace Adjust spark plug gap or replace Replace Adjust	S-18, 76 S-77 S-65
Engine Speed Does Not Increase	<ul style="list-style-type: none"> • Incorrect governor adjustment • Defective ignition unit • Incorrect carburetor adjustment • Clogged air cleaner 	Adjust Replace Adjust Clean or replace	S-65 S-65, 66 S-15

W1014322

Symptom	Probable Cause	Solution	Reference Page
Defection Output	<ul style="list-style-type: none"> • Improper intake or exhaust valve sealing • Incorrect governor adjustment • Excessive carbon in engine • Improper valve clearance • Piston ring and cylinder worn • Clogged air cleaner 	Replace Adjust Remove carbon Adjust Replace Clean or replace	S-65 S-33 S-55, 60 S-15
Engine Noise	<ul style="list-style-type: none"> • Improper valve clearance • Spark knock due to low-octane fuel or carbon • Rattles from loosely mounted external components 	Adjust Use higher-octane fuel and remove carbon Retighten	S-33

W1124025

(2) For LPG Fuel

Engine Turns Over at Normal Speed but Does Not Start	<ul style="list-style-type: none"> • No LPG fuel • Vacuum lock system is defective • Mistake of throttle lever position 	Replenish LPG fuel Check of taking valve of LPG tank Check of shut off valve Check of vacuum hose Replace vaporizer Set the throttle lever to the low idle position	S-20 S-66
Rough Low-Speed Running and Idling	<ul style="list-style-type: none"> • Lack of amount of gas supply • Idling is defective 	Replenish LPG fuel Check of shut off valve Replace vaporizer Set the throttle lever to the low idle position	S-66
Defection Output	<ul style="list-style-type: none"> • Density of the LPG is rich • LPG shortage 	Replace vaporizer Repair or replace of fuel system Replace vaporizer	

W1125618

[5] SERVICING SPECIFICATIONS

(1) Engine Body

Item		Factory Specification	Allowable Limit
Cylinder Head Surface	Flatness	—	0.05 mm 0.0020 in.
Top Clearance		1.45 to 1.75 mm 0.0571 to 0.0690 in.	—
Compression Pressure		1.27 MPa 13.0 kgf/cm ² 185 psi	0.88 MPa 9.0 kgf/cm ² 128 psi
Variance Among Cylinders		—	10 % or less
Valve Clearance (Cold)		0.145 to 0.185 mm 0.00571 to 0.00728 in.	—
Valve Seat	Width	2.12 mm 0.0835 in.	—
Valve Seat	Angle	0.79 rad. 45°	—
Valve Face	Angle	0.79 rad. 45°	—
Valve Recessing		0.75 to 0.95 mm 0.0295 to 0.0374 in.	1.2 mm 0.047 in.
Valve Stem to Valve Guide	Clearance	0.030 to 0.057 mm 0.00118 to 0.00224 in.	0.10 mm 0.0039 in.
Valve Stem	O.D.	5.968 to 5.980 mm 0.23496 to 0.23543 in.	—
Valve Guide	I.D.	6.010 to 6.025 mm 0.23661 to 0.23720 in.	—
Valve Timing (Intake Valve)	Open	0.35 rad. (20°) before T.D.C.	—
	Close	0.79 rad. (45°) after B.D.C.	—
Valve Timing (Exhaust Valve)	Open	0.87 rad. (50°) before B.D.C.	—
	Close	0.26 rad. (15°) after T.D.C.	—

W1013874

Item		Factory Specification	Allowable Limit
Valve Spring	Free Length	31.3 to 31.8 mm 1.23 to 1.25 in.	28.4 mm 1.12 in.
	Setting Load	64.7 N 6.6 kgf 14.6 lbs	54.9 N 5.6 kgf 12.3 lbs
	Setting Length	27.0 mm 1.063 in.	27.0 mm 1.063 in.
	Tilt	–	1.2 mm 0.047 in.
Rocker Arm Shaft to Rocker Arm	Clearance	0.016 to 0.045 mm 0.00063 to 0.00177 in.	0.15 mm 0.0059 in.
Rocker Arm Shaft	O.D.	10.473 to 10.484 mm 0.41232 to 0.41276 in.	–
Rocker Arm	I.D.	10.500 to 10.518 mm 0.41339 to 0.41410 in.	–
Push Rod	Alignment	–	0.25 mm 0.0098 in.
Tappet to Tappet Guide Bore	Clearance	0.016 to 0.052 mm 0.00063 to 0.00205 in.	0.10 mm 0.0039 in.
Tappet	O.D.	17.966 to 17.984 mm 0.70732 to 0.70803 in.	–
Tappet Guide Bore	I.D.	18.000 to 18.018 mm 0.70866 to 0.70937 in.	–
Camshaft	Side Clearance	0.15 to 0.31 mm 0.0059 to 0.0122 in.	0.5 mm 0.0197 in.
Camshaft	Alignment	–	0.01 mm 0.0004 in.
Cam Height	Intake	26.88 mm 1.0583 in.	26.83 mm 1.0563 in.
	Exhaust	26.88 mm 1.0583 in.	26.83 mm 1.0563 in.
Camshaft Journal to Camshaft Bearing	Oil Clearance	0.050 to 0.091 mm 0.00197 to 0.00358 in.	0.12 mm 0.0047 in.
Camshaft Journal	O.D.	32.934 to 32.950 mm 1.29661 to 1.29724 in.	–
Camshaft Bearing	I.D.	33.000 to 33.025 mm 1.29921 to 1.30020 in.	–

W1014538

Item		Factory Specification	Allowable Limit	
Timing Gear Crank Gear to Idle Gear	Backlash	0.043 to 0.124 mm 0.00169 to 0.00488 in.	0.15 mm 0.0059 in.	
	Idle Gear to Cam Gear	0.047 to 0.123 mm 0.00185 to 0.00484 in.	0.15 mm 0.0059 in.	
	Idle Gear to Distributor Drive Gear	0.041 to 0.124 mm 0.00165 to 0.00488 in.	0.15 mm 0.0059 in.	
	Crank Gear to Oil Pump Drive Gear	0.041 to 0.123 mm 0.00161 to 0.00484 in.	0.15 mm 0.0059 in.	
Idle Gear	Side Clearance	0.20 to 0.46 mm 0.0079 to 0.0180 in.	0.60 mm 0.0236 in.	
Idle Gear Shaft to Idle Gear Bushing	Clearance	0.020 to 0.084 mm 0.00079 to 0.00331 in.	0.10 mm 0.0039 in.	
	Idle Gear Shaft	O.D.	19.967 to 19.980 mm 0.78610 to 0.78661 in.	–
	Idle Gear Bushing	I.D.	20.000 to 20.051 mm 0.78740 to 0.78941 in.	–
Piston Pin Bore	I.D.	18.000 to 18.011 mm 0.70866 to 0.70910 in.	18.05 mm 0.7106 in.	
Piston Ring Clearance	Compression Ring 1, 2	0.04 to 0.08 mm 0.0016 to 0.0031 in.	0.15 mm 0.0059 in.	
	Oil Ring	0.06 to 0.15 mm 0.0024 to 0.0059 in.	–	
Ring Gap	Compression Ring 1, 2	0.15 to 0.35 mm 0.0059 to 0.0138 in.	1.25 mm 0.0492 in.	
	Oil Ring	0.25 to 0.45 mm 0.0098 to 0.0177 in.	1.25 mm 0.0492 in.	
Connecting Rod	Alignment	–	0.05 mm 0.0020 in.	
Piston Pin to Small End Bushing	Clearance	0.02 to 0.04 mm 0.0008 to 0.0016 in.	0.10 mm 0.0039 in.	
	Piston Pin	O.D.	18.000 to 18.005 mm 0.7087 to 0.7089 in.	–
	Small End Bushing	I.D.	18.025 to 18.040 mm 0.70965 to 0.71024 in.	–
Crankshaft	Alignment	–	0.02 mm 0.0008 in.	

W1016466

Item		Factory Specification	Allowable Limit
Crankshaft Journal to Crankshaft Bearing 1		Oil Clearance 0.034 to 0.106 mm 0.00134 to 0.00417 in.	0.20 mm 0.0079 in.
Crankshaft Journal	O.D.	39.934 to 39.950 mm 1.57221 to 1.57284 in.	–
Crankshaft Bearing 1	I.D.	39.984 to 40.040 mm 1.57417 to 1.57638 in.	–
Crankshaft Journal to Crankshaft Bearing 2 (Flywheel Side)		Oil Clearance 0.028 to 0.059 mm 0.00110 to 0.00232 in.	0.20 mm 0.0079 in.
Crankshaft Journal	O.D.	43.978 to 43.993 mm 1.73142 to 1.73201 in.	–
Crankshaft Bearing 2	I.D.	43.984 to 44.026 mm 1.73165 to 1.73331 in.	–
Crankshaft Journal to Crankshaft Bearing 3 (Intermediate)		Oil Clearance 0.028 to 0.059 mm 0.00110 to 0.00232 in.	0.20 mm 0.0079 in.
Crankshaft Journal	O.D.	39.934 to 39.950 mm 1.57221 to 1.57284 in.	–
Crankshaft Bearing 3	I.D.	39.978 to 39.993 mm 1.57394 to 1.57453 in.	–
Crankpin to Crankpin Bearing		Oil Clearance 0.020 to 0.051 mm 0.00079 to 0.00201 in.	0.15 mm 0.0059 in.
Crankpin	O.D.	33.959 to 33.975 mm 1.33697 to 1.33760 in.	–
Crankpin Bearing	I.D.	33.995 to 34.010 mm 1.33839 to 1.33898 in.	–
Crankshaft		Side Clearance 0.15 to 0.31 mm 0.0059 to 0.0122 in.	0.50 mm 0.0197 in.
Cylinder Liner [Standard]		I.D. 68.000 to 68.019 mm 2.67717 to 2.67791 in.	68.169 mm 2.68381 in.
Cylinder Liner [Oversize: 0.50 mm (0.0196 in.)]		I.D. 68.500 to 68.519 mm 2.6968 to 2.6976 in.	68.669 mm 2.7035 in.

W1022015

(2) Lubricating System

Item		Factory Specification	Allowable Limit
Engine Oil Pressure	At Idle Speed	More than 69 kPa 0.7 kgf/cm ² 10 psi	—
	At Rated Speed	196 to 441 kPa 2.0 to 4.5 kgf/cm ² 28 to 64 psi	186 kPa 1.9 kgf/cm ² 27 psi
Inner Rotor to Outer Rotor	Clearance	0.03 to 0.14 mm 0.0012 to 0.0055 in.	0.25 mm 0.0098 in.
Outer Rotor to Pump Body	Clearance	0.07 to 0.15 mm 0.0028 to 0.0059 in.	0.30 mm 0.0118 in.
Inner Rotor to Cover	End Clearance	0.75 to 0.135 mm 0.00295 to 0.00531 in.	0.20 mm 0.0079 in.
Oil Filter	Opening Pressure of By-pass Valve	98 kPa 1.0 kgf/cm ² 14.2 psi of pressure difference	—

W1024567

(3) Cooling System

Thermostat	Valve Opening Temperature (At Beginning)	80.5 to 83.5 °C 177 to 182 °F	—
	Valve Opening Temperature (Opened Completely)	95 °C 203 °F	—
Radiator	Water Leakage Test Pressure	No leak at specified pressure 137 kPa 1.4 kgf/cm ² 20 psi	—
Radiator Cap	Pressure Falling Time	10 seconds or more 88 → 59 kPa 0.9 → 0.6 kgf/cm ² 13 → 9 psi	—
Fan Belt	Tension	7.0 to 9.0 mm / 98 N 0.28 to 0.35 in. / 98 N (10kgf, 22 lbs)	—

W1026075

(4) Electrical System**Starter**

Item	Factory Specification	Allowable Limit
Commutator O.D.	32.0 mm 1.260 in.	31.0 mm 1.220 in.
Difference of O.D.'s	Less than 0.05 mm 0.002 in.	0.4 mm 0.016 in.
Mica Undercut	0.5 to 0.8 mm 0.020 to 0.031 in.	0.4 mm 0.008 in.
Brush Length	17.0 mm 0.669 in.	11.5 mm 0.453 in.

W1026757

Alternator

No-load Output	AC 20 V or more at 5200 min ⁻¹ (rpm)	—
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W1027296

Regulator

Regulating Voltage	14 to 15 V	—
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W1027492

Spark Plug

Spark Plug Gap	1.0 to 1.1 mm 0.039 to 0.043 in.	—
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W1027540

Ignition Coil

Primary Coil Resistance	1.3 to 1.6 Ω	—
Secondary Coil Resistance	10.7 to 14.5 k Ω	—
Power Source Line Voltage	Approx. 12 V	—

W1027594

Distributor

Air Gap	0.2 to 0.4 mm 0.008 to 0.016 in.	—
High Tension Cord #1 Resistance	2.81 to 4.79 k Ω	—
High Tension Cord #2 Resistance	3.40 to 5.80 k Ω	—
High Tension Cord #3 Resistance	3.57 to 6.09 k Ω	—
Center Cord Resistance	3.06 to 5.22 k Ω	—
Ignition Timing	0.31 rad. (18°) B.T.D.C.	—

W1027739

Fuel Cut Off Solenoid

Fuel Cut Off Solenoid for Gasoline Resistance	38 Ω at 20 °C	—
Fuel Cut Off Solenoid for LPG Resistance	28 Ω at 20 °C	—

W1154907

[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		Interval							Reference Page	Remarks
		Every 8 hours (daily)	Every 50 hours (weekly)	Every 100 hours	Every 200 hours	Every 1000 hours	Every 1 year	Every 2 years		
Each parts	Check / Clean	●								
Engine oil	Check / Replenish	●							S-14	
	Change		(Initial change)		●				S-16	
Oil filter cartridge	Change		(Initial change)		●				S-16	
Spark plug	Clean			●					S-18	
	Adjust			★					S-18	
	Change					●			S-18	
Ignition wires	Change							●	S-77	
Air cleaner element	Check	★							S-14	
	Clean	★	●						S-15	
	Change						●*		S-14	
Intake pipe / clamp bands	Change							●		
Fuel filter	Check / Clean			●						
	Change							●	S-17	
Fuel tank	Clean							●		Gasoline line
	Check setting	★			●					LPG line
Fuel pipe / clamps (Gasoline line)	Check		●						S-17	
	Change							●	S-17	
Fuel pipe / clamps (LPG line: LPG tank ~ Dual carburetor) (DF752-E2 only)	Check the connector	●								
	Check fuel leakage		●							
	Change							●		
Carburetor	Clean							●		
LPG vaporizer regulator (DF752-E2 only)	Check					●			S-20	Hot water line / vacuum lock pipe
	Change							●	S-20	Hot water line / vacuum lock pipe
	Check inner parts							●	S-24	
Battery	Check		●							
	Change							●		
Radiator coolant	Check	●							S-15	
	Change							●	S-22	
Radiator hoses and clamp bands	Check				●				S-19	
	Change							●	S-19	
Radiator and water jacket	Clean							●	S-22	
Fan belt tension	Check			●					S-18	
	Adjust			★					S-18	
Valve clearance	Adjust					●			S-33	
Cylinder head	Clean					●			S-46, 47	
Valve seats	Check / Relap					●			S-47	

★: If necessary

* Change more often when operating under dusty conditions.

To keep your KUBOTA performing for many years of service, use only genuine KUBOTA replacement parts.

W1029462

- Change engine oil and oil filter after the first 50 hours of operation.



CAUTION

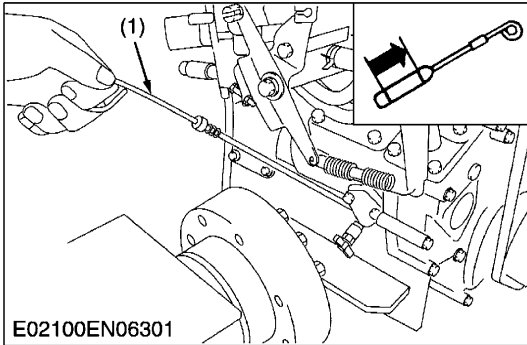
- When changing or inspecting, be sure to level and stop the engine.

NOTE

- Regarding the daily check items, see the operator's manual.

[7] CHECK AND MAINTENANCE

(1) Check Points of Every 8 Hours (Daily)



Checking Engine Oil Level

CAUTION

- Be sure to stop the engine before checking the engine oil level.

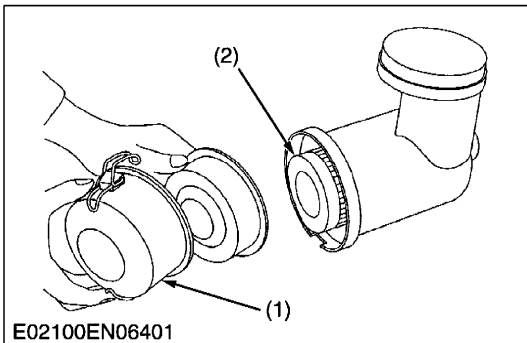
1. Level the engine and check the oil level on the dipstick (1).
2. If the level below the lower mark, add new oil engine to the upper mark.

IMPORTANT

- When using an oil of different maker or viscosity from the previous one, drain an old oil.
- Never mix two different types' of oil.
- Use the proper SAE Engine oil according to ambient temperatures.

(1) Dipstick

W1034103



Checking Air Cleaner Element (If necessary)

1. Remove the dust cup in the air cleaner.
2. Check the dust in the dust cup and the element.

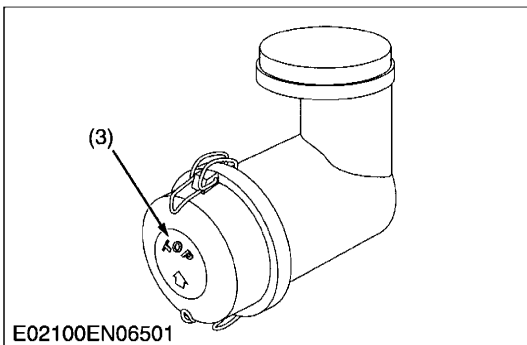
(When reassembling)

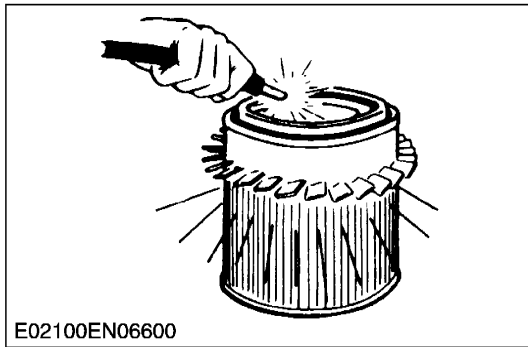
- Install the air cleaner dust cup with "TOP" indicated on the rear of the cup.

(1) Dust Cup
(2) Element

(3) "TOP" Mark

W1034274





Cleaning Air Cleaner Element (If necessary)

- To clean the element, use clean dry compressed air on the inside of the element.
Air pressure at the nozzle must not exceed 205 kPa (2.1 kgf/cm², 30 psi).
- If the element is stained with carbon or oil, replace the element.

■ IMPORTANT

- Make sure the wing bolt for the element is tight enough. If it is loose, dust and dirt may be sucked, wearing down the cylinder liner and piston ring earlier and thereby resulting in poor power output.
- Do not overservice the air cleaner element.

■ NOTE

- Change the element once a year or every 6th cleaning.

W1034417

Checking the Setting of LPG Fuel Tank (If necessary) (DF752-E2)

- Check the setting of LPG fuel tank.

W1034538

Checking the Connector (DF752-E2)

- Check the connector in LPG line (pipes and clamps).

W1034608

Checking Coolant Level

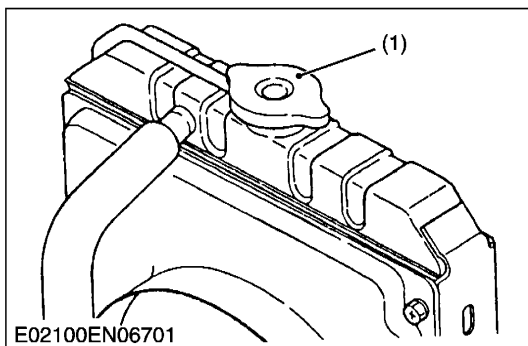
⚠ CAUTION

- Do not remove the radiator cap while operating or immediately after stopping. Otherwise, hot water will spout out from the radiator. Wait for more than ten minutes to cool the radiator, before opening the cap.

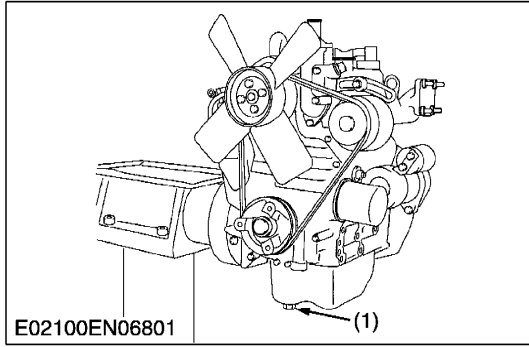
- Remove the radiator cap and check to see that the coolant level is just below the port.
- If low, add coolant to the radiator.
- If equipped the reserve tank, check the reserve tank and keep the coolant level between the **FULL** and **LOW** marks.
- If low, add coolant to the reserve tank.

(1) Radiator Cap

W1034687



(2) Check Points of Initial 50 Hours



Changing Engine Oil

CAUTION

- **Be sure to stop the engine before changing the engine oil.**
- 1. After warming up, stop the engine.
- 2. Place an oil pan underneath the engine.
- 3. Remove the drain plug (1) to drain the dirty engine oil completely.
- 4. Inspect the drain plug gasket. Replace it damaged.
- 5. Reinstall the drain plug.
- 6. Fill the new engine oil up to the upper mark on the dipstick.

IMPORTANT

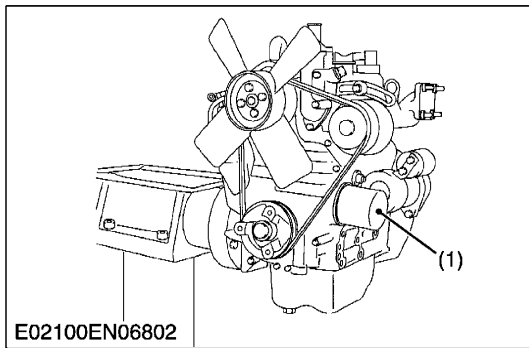
- **The API classification of the engine oil should be SF class grade.**
- **When using an oil of different maker or viscosity from the previous one, drain an old oil.**
- **Never mix two different types' of oil.**
- **Use the proper SAE Engine oil according to ambient temperatures.**

Above 25 °C (77 °F) SAE 30 or SAE 10W-30
 0 °C to 25 °C (32 °F to 77°F) SAE 20 or SAE 10W-30
 -12 °C to 0 °C (10 °F to 32°F) SAE 10 or SAE 10W-30
 Below -12 °C (10 °F) SAE 5W-30

Tightening torque	Drain plug	32.4 to 37.3 N·m 3.3 to 3.8 kgf·m 23.9 to 27.5 ft·lbs
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(1) Drain Plug

W1034806



Changing Engine Oil Filter Cartridge

CAUTION

- **Be sure to stop the engine before changing the oil filter cartridge.**
- 1. Remove the engine oil filter cartridge (1) with the filter wrench.
- 2. Apply engine oil slightly to the rubber gasket of new cartridge.
- 3. Install the new cartridge, screwing it in by hand.
Over-tightening may cause deformation of the rubber gasket.
- 4. After the cartridge has been changed, the engine oil level normally lowers a little. Add engine oil to proper level.

IMPORTANT

- **To prevent serious damage to the engine, replacement oil filter cartridge must be highly efficient. Use only a genuine KUBOTA filter cartridge or its equivalent.**

(1) Engine Oil Filter Cartridge

W1035779

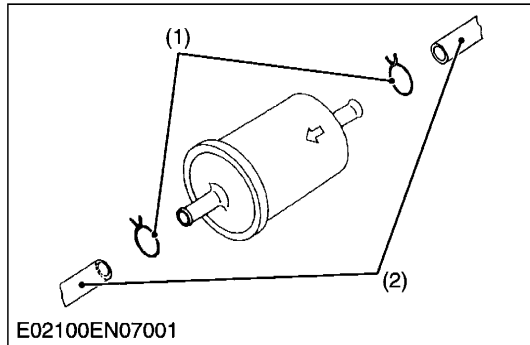
(3) Check Points of Every 50 Hours (Weekly)**Cleaning the Air Cleaner Element**

1. See page S-15.

W1035941

⚠ CAUTION

- Stop the engine when attempting the check and change prescribed below.
- Remember to check the fuel line periodically. The fuel line is subject to wear and aging, fuel may leak out onto the running engine, causing a fire.

**Checking Fuel Hose (Gasoline Fuel Line)**

Check the fuel hoses every 100 hours of operation.

1. Since the fuel hose (2) is made of rubber, it ages regardless of the period of service.

Change the fuel hose together with the clamp every two years.

2. However, if the fuel hose and clamp are found to be damaged or deteriorate earlier than two years, then change or remedy.
3. After the fuel hose and the clamp have been changed, bleed the fuel system.

(1) Clamp

(2) Fuel Hose

W1036027

Checking Fuel Leakage (LPG Fuel Line) (DF752-E2)**■ IMPORTANT**

- Never test for gas leaks with a FLAME.

■ NOTE

- Check for fuel leakage by using soapy water or gas-detector, if leakage is found, correct leakage.

W1036199

Liquid Fuel Check

1. Open the shutoff valve on the tank.
2. Check for
 - a: Fuel tank to filter
 - b: Filter to shutoff valve
 - c: Shutoff valve to vaporizer.

W1036273

Gaseous Fuel Check

1. Check the hose clamp and vapor hose.
2. Confirm that there is no leakage from the vapor hose.

W1036381

Checking Battery Electrolyte Level

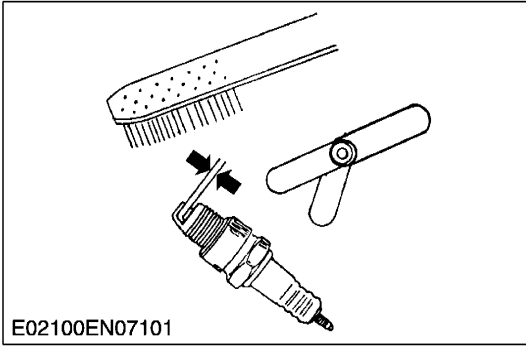
1. Check the battery electrolyte level.
2. If the level is below than lower level line, add the distilled water to pour level of each cell.

⚠ CAUTION

- Never remove the vent plugs while the engine is running.
- Keep electrolyte away from eyes, hands and clothes.
If you are spattered with it, wash it away completely with water immediately and get medical attention.
- Wear eye protection and rubber gloves when working around battery.

W1036435

(4) Check Points of Every 100 Hours



Checking Spark Plug Gap

1. Remove the spark plug, and remove carbon from the electrode with a wire brush or other tools.
2. Measure the spark plug gap with a feeler gauge, and repair or replace the plug if the measured gap differs from the factory specification.
3. Replace the plug if the electrode or the insulator is deformed or cracked.
4. Tighten the plug with a plug wrench.

Spark plug gap	Factory spec.	1.0 to 1.1 mm 0.039 to 0.043 in.
Spark plug	NGK BKR 4E-11	

W1036547

Checking and Cleaning Fuel Filter (Gasoline Line)

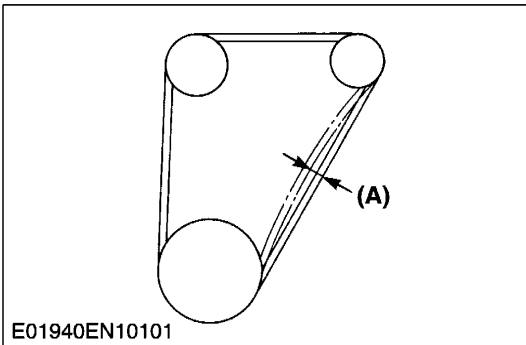
1. Check the fuel filter.
2. If the fuel filter is dirty, clean it or replace it.



CAUTION

- Stop the engine when attempting to check and clean the fuel filter.
- Gasoline fuel is extremely flammable, so avoid fires.

W1036876

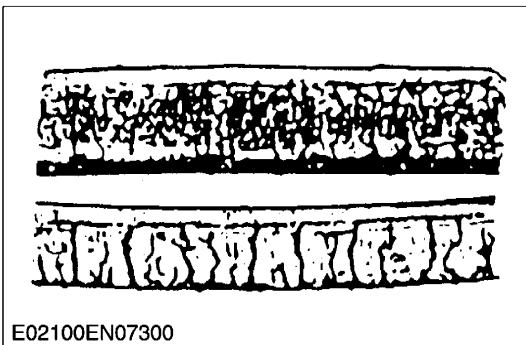


Fan Belt Tension

1. Measure the deflection (A), depressing the belt halfway between the fan drive pulley and alternator at specified force (98 N, 10 kgf, 22 lbs).
2. If the measurement is not within the factory specifications, loosen the alternator mounting screws and relocate the alternator to adjust.

Deflection (A)	Factory spec.	7.0 to 9.0 mm 0.28 to 0.35 in.
----------------	---------------	-----------------------------------

W1036976



Fan Belt Damage and Wear

1. Check the fan belt for damage.
2. If the fan belt is damaged, replace it.
3. Check if the fan belt is worn and sunk in the pulley groove.
4. If the fan belt is nearly worn out and deeply sunk in the pulley groove, replace it.

W1037077

(5) Check Points of Every 200 Hours

Changing Engine Oil

1. See page S-16.

W1037167

Changing Engine Oil Filter Cartridge

1. See page S-16.

W1037212

Checking the Setting of LPG Fuel Tank (DF752-E2)

W1037258

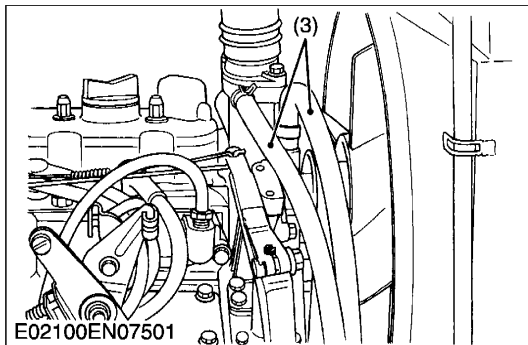
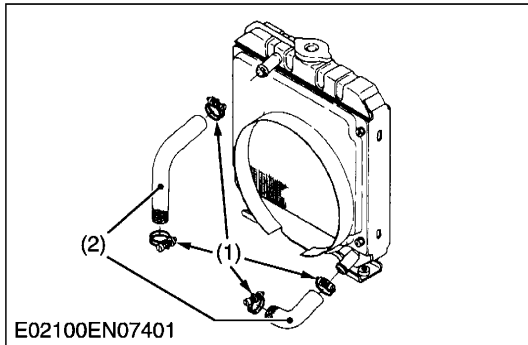
Checking the Radiator Hoses

1. Check to see if the radiator hoses (2) are properly fixed every 200 hours of operation or every six months, whichever comes first.
2. If clamp bands (1) are loose or water leaks, tighten bands securely. Replace hoses and tighten clamp bands securely, if radiator hoses are swollen, hardened or cracked.
3. Replace hoses and clamp bands every 2 years or earlier if checked and found that hoses are swollen, hardened or cracked.

- (1) Clamp
- (2) Radiator Hose

- (3) Hot Water Pipes to Vaporizer (DF752-E2)

W1037305



(6) Check Points of Every 1000 Hours

Changing the Spark Plug

1. See page S-18.

W1037574

Checking the Hot Water Lines (DF752-E2)

1. See page S-19.

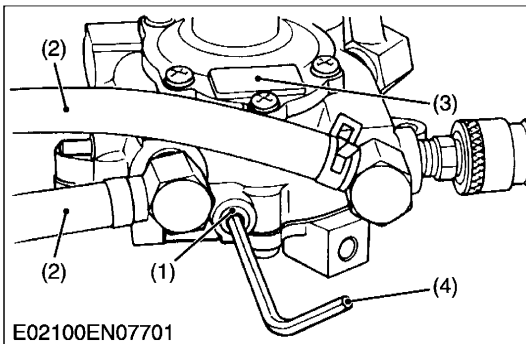
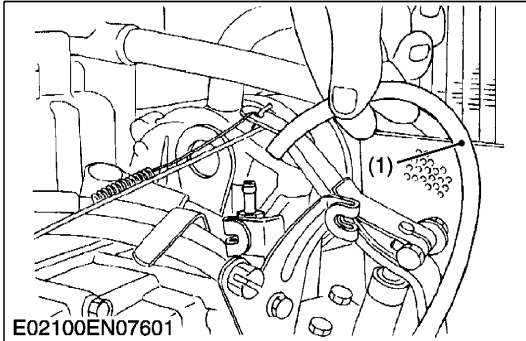
W1037619

Checking the Vacuum Lock Hose (DF752-E2)

1. Check the vacuum lock hose (1) for damage.
2. If the hose is damaged, replace it.

- (1) Vacuum Lock Hose

W1037676



Draining Tar (Vaporizer for DF752-E2)

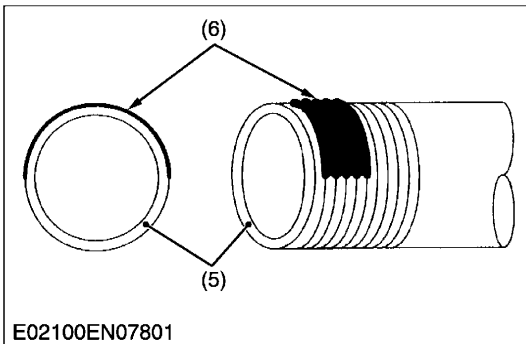
1. Run the engine until it is warmed up.
2. The shut off valve is shut and the engine is stopped naturally.
3. Place an oil pan underneath the drain port.
4. Remove the drain plug (1), and drain tar.
5. Tighten the plug.

■ NOTE

- Apply a liquid gasket (Three Bond 1104 or equivalent) to the thread of the plug.

- | | |
|----------------|-------------------|
| (1) Drain Plug | (4) Wrench |
| (2) Water Hose | (5) Joint |
| (3) Vaporizer | (6) Liquid Gasket |

W1037753



Adjusting the Valve Clearance

1. See page S-33.

W1037919

Cleaning the Cylinder Head

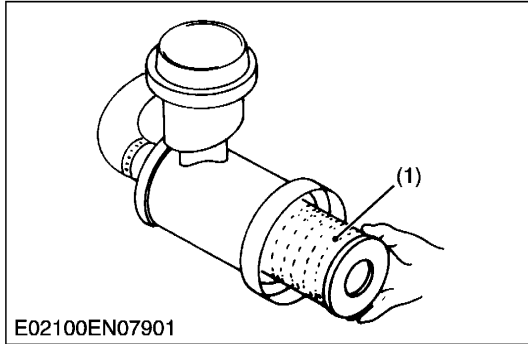
1. See page S-46.

W1037964

Checking and Relapping the Valve Seats

1. See page S-47.

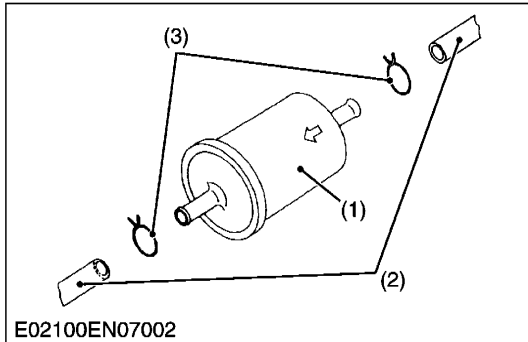
W1038011

(7) Check Points of Every 1 Year**Changing the Air Cleaner Element**

1. See page S-14.
2. After cleaning the dust cup, remove the air cleaner element.
3. Replace the new air cleaner element.

(1) Air Cleaner Element

W1038073

**Changing Fuel Filter and Fuel Hose (for Gasoline Fuel)**

1. Close the fuel tank cock.
2. Replace the fuel filter (1) with a new one.
3. Replace the hose (2) and clamp (3).

(1) Fuel Filter
(2) Fuel Hose

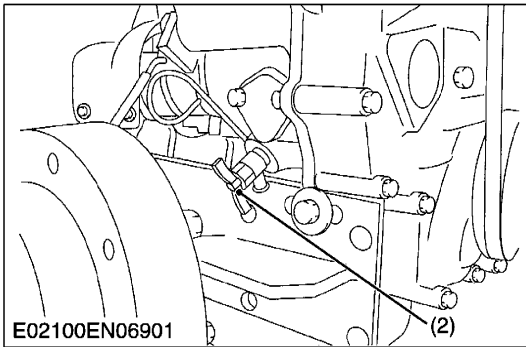
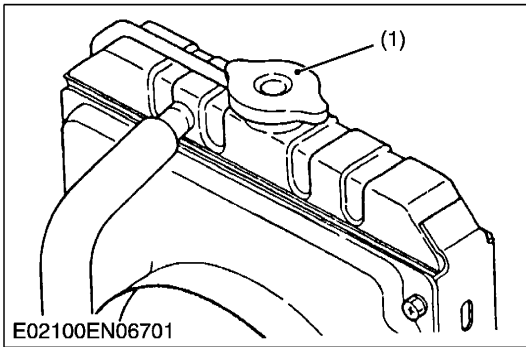
(3) Clamp

W1038225

Cleaning the Fuel Tank (Gasoline Fuel)

1. Following the unit / machine's operators manual, drain the gasoline fuel in the fuel tank.
2. Clean the fuel tank inside.

W1038331



Changing Radiator Coolant and Cleaning of Water Jacket (Radiator Interior)

1. The cooling system should be cleaned on the following occasions:
 - Every one year service.
 - When adding anti-freeze.
 - When changing from water containing anti-freeze to pure water.

⚠ CAUTION

- Do not remove the radiator cap until cooling water temperature is enough cooled. Then loosen the cap slightly to relieve any excess pressure before removing the cap completely.

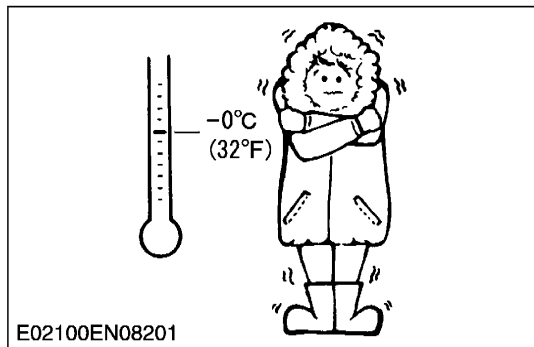
■ IMPORTANT

- Use clean, fresh water to fill the radiator.
- To drain the used coolant completely, open the radiator drain cocks and remove the radiator cap.
- Do not use the anti-freeze during hot weather to maintain engine performance since the boiling point of coolant rises.
- The radiator should be filled with part anti-freeze and part water at all times as recommended by the anti-freeze manufacturer.
- Do not use an anti-freeze and scale inhibitor at the same time.

(1) Radiator Cap

(2) Drain Cock

W1038430



Anti-Freeze

If it freezes, coolant can damage the cylinders and radiator. It is necessary, if the ambient temperature falls below 0 °C (32 °F), to remove coolant after operating or to add anti-freeze to it.

- There are two types of anti-freeze available: use the permanent type (PT) for this engine.
- Before adding anti-freeze for the first time, clean the radiator interior by pouring fresh water and draining it a few times.
- The procedure for mixing water and anti-freeze differs according to the make of the anti-freeze and the ambient temperature. Basically, it should be referred to SAE J1034 standard, more specifically also to SAE J814c.
- Mix the anti-freeze with water, and then fill into the radiator.

■ IMPORTANT

- **When the anti-freeze is mixed with water, the anti-freeze mixing ratio must be less than 50 %.**

Vol % anti-freeze	Freezing point		Boiling point	
	°C	°F	°C	°F
40	-24	-12	106	222
50	-37	-34	108	226

* At 1.013×10^5 PA (760 mmHg) pressure (atmospheric). A higher boiling point is obtained by using a radiator pressure cap which permits the development of pressure within the cooling system.

■ NOTE

- **The above data represents industrial standards that necessitate a minimum glycol content in the concentrated anti-freeze.**
- **When the coolant level drops due to evaporation, add water only to keep the anti-freeze mixing ratio less than 50 %. In case of leakage, add anti-freeze and water in the specified mixing ratio.**
- **Anti-freeze absorbs moisture. Keep unused anti-freeze in a tightly sealed container.**
- **Do not use radiator cleaning agents when anti-freeze has been added to the coolant.**
(Anti-freeze contains an anti-corrosive agent, which will react with the radiator cleaning agent forming sludge which will affect the engine parts.)

W1039218

(8) Check Points of Every 2 Years**Changing the Ignition Wires**

1. See page S-77.

W1039828

Changing the Intake Pipe and Clamps

1. Change the intake pipe and the clamps between the air cleaner and the carburetor.

W1039884

Changing the Fuel Pipe and the Clamps (LPG Line)

1. Change the fuel pipe and the clamps (LPG line).

W1039929

Changing the Hot Water Pipes and the Vacuum Lock Pipe (DF752-E2)

1. See page S-19.

W1039974

Checking the Vaporizer Inner Parts (DF752-E2)

1. See page S-24.

W1040710

Primary Chamber (Vaporizer for LPG Fuel)**■ IMPORTANT**

- When checking the fuel system after completely consuming the fuel in piping.
- Treat a seal tape or liquid gasket when install each connector.

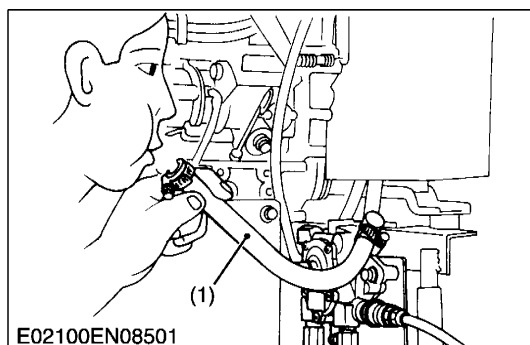
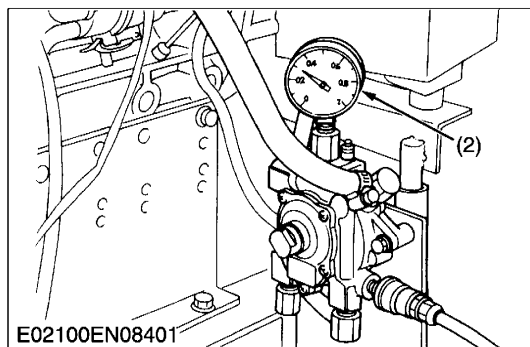
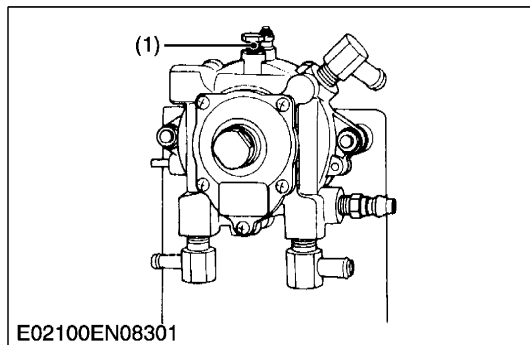
1. Run the engine until it is warmed up.
2. The shut off valve is shut and the engine is stopped naturally.
3. Disconnect the plug (1).
4. Set the presser gauge (2).
5. The shut off valve is opened and the engine is started, and check the presser.
6. If the presser is not within the factory specification, replace the vaporizer.

Pressure	Factory spec.	30.0 to 34.3 kPa 0.30 to 0.35 kgf/cm ² 4.4 to 4.9 psi

(1) Plug

(2) Presser Gauge

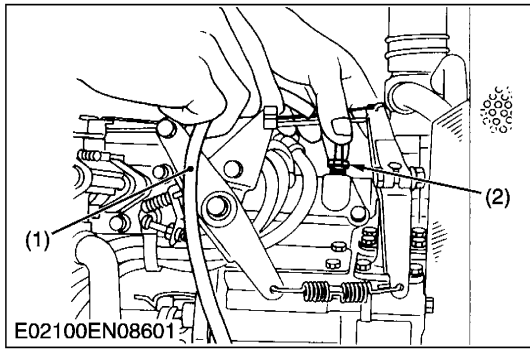
W1040021

**Air Tight of Secondary Chamber (Vaporizer for LPG Fuel)**

1. Disconnect the vapor hose (1) on the mixer side.
2. Breath is blown lightly or compressed air (9.8 kPa, 0.1 kgf/cm², 1.4 psi).
3. It is confirmed that the air does not leak.
4. If there is a leakage, replace the vaporizer.

(1) Vapor Hose

W1040313



Vacuum Lock System

1. After warming up, and set the low idling speed.
2. Disconnect the vacuum lock hose (1), and close the joint manifold by finger.
3. Confirm the thing that the engine stops.

(1) Vacuum Lock Hose

(2) Joint

W1040451

Changing the Battery

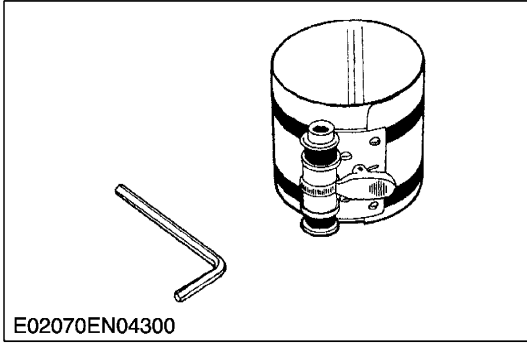
1. Change the Battery.

W1040610

Changing the Radiator Hose and Clamps

1. See page S-19.

W1040659

[8] SPECIAL TOOLS

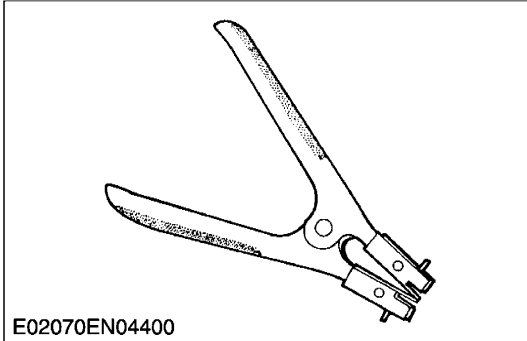
E02070EN04300

Piston Ring Compressor

Code No: 07909-32111

Application: Use exclusively for pushing in the piston with ease.

W1040782



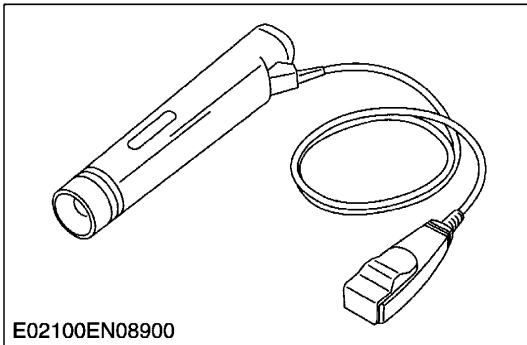
E02070EN04400

Piston Ring Tool

Code No: 07909-32121

Application: Use exclusively for removing or installing the piston ring with ease.

W1040834

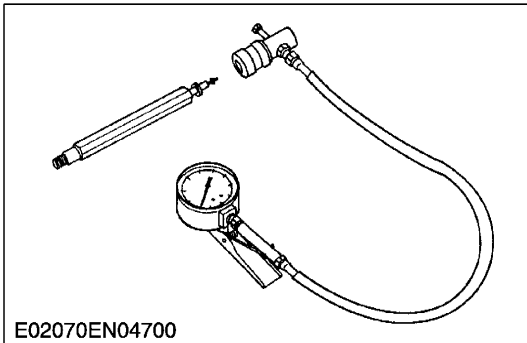


E02100EN08900

Timing Light

Application: Use to adjust the ignition timing.

W1040886



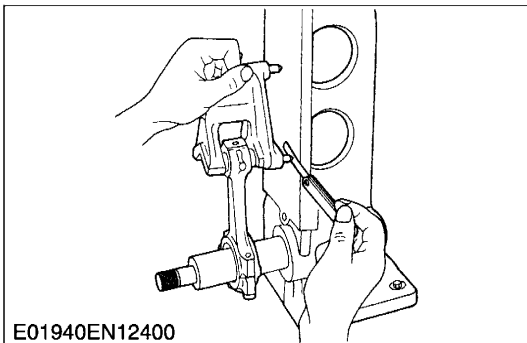
E02070EN04700

Compression Tester

Code No: 07909-30251

Application: Use to measure gasoline engine compression and diagnose the engine for a major overhaul.

W1040934



E01940EN12400

Connecting Rod Alignment Tool

Code No: 07909-31661

Application: Use to check the connecting rod alignment.

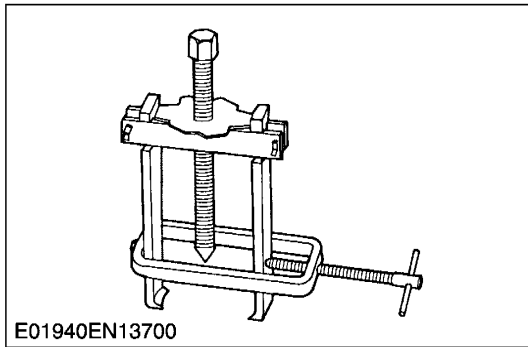
Applicable range: Connecting rod big end I.D.

30 to 75 mm (1.18 to 2.95 in. dia.)

Connecting rod length

65 to 330 mm (2.56 to 12.99 in.)

W1040999



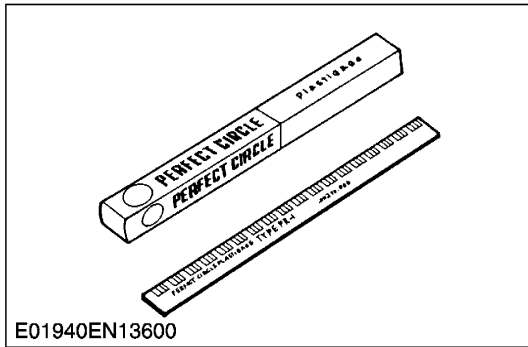
E01940EN13700

Special-Use Puller Set

Code No: 07916-09032

Application: Use exclusively for pulling out bearing, gears and other parts with ease.

W1041074



E01940EN13600

Press Gauge

Code No: 07909-30241

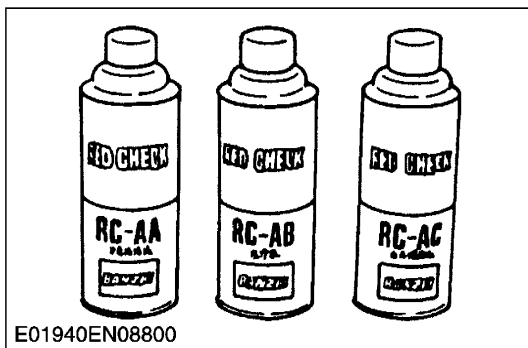
Application: Use to check the oil clearance between crankshaft and bearing, etc.

Measuring range: Green . . . 0.025 to 0.076 mm
(0.001 to 0.003 in.)

Red 0.051 to 0.152 mm
(0.002 to 0.006 in.)

Blue 0.102 to 0.229 mm
(0.004 to 0.009 in.)

W1041181



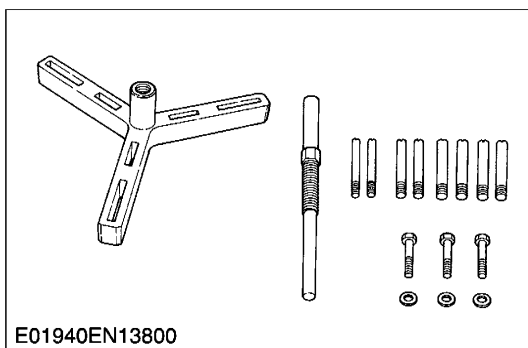
E01940EN08800

Red Check (Crack Check Liquid)

Code No: 07909-31371

Application: Use to check cracks on cylinder head, cylinder block, etc.

W1041309



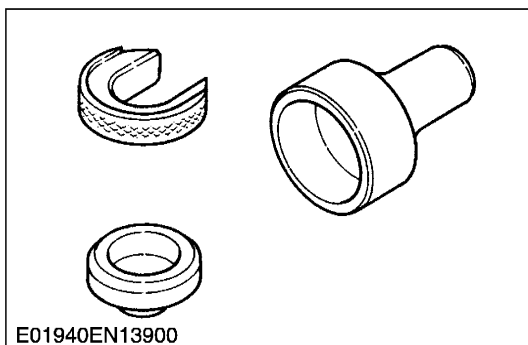
E01940EN13800

Flywheel Puller

Code No: 07916-32011

Application: Use exclusively for removing the flywheel with ease.

W1041361



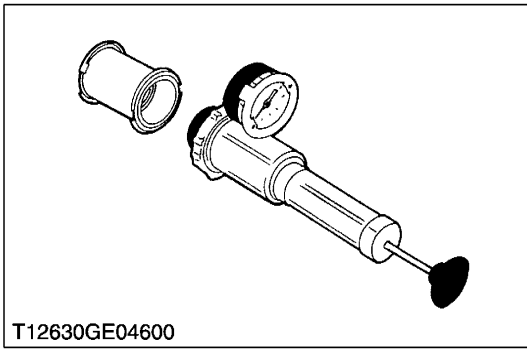
E01940EN13900

Auxiliary Socket for Fixing Crankshaft Sleeve

Code No: 07916-34041

Application: Use exclusively for fixing the crankshaft sleeve.

W1041415



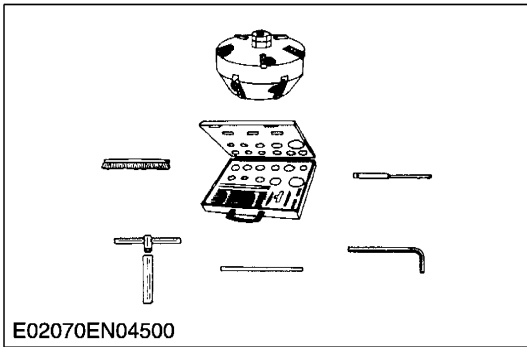
Radiator Tester

Code No: 07909-31551

Application: Use to check of radiator cap pressure, and leaks from cooling system.

Adaptor: BANZAI code no. RCT-2A-30S

W1041467



Valve Seat Cutter Set

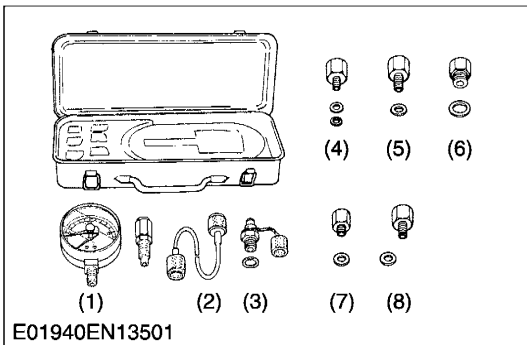
Code No: 07909-33102

Application: Use to reseal valves.

Angle: 0.785 rad. (45°)
0.262 rad. (15°)

Diameter: 28.6 mm (1.126 in.)
31.6 mm (1.244 in.)
35.0 mm (1.378 in.)
38.0 mm (1.496 in.)
41.3 mm (1.626 in.)
50.8 mm (2.000 in.)

W1041593



Oil Pressure Tester

Code No: 07916-32032

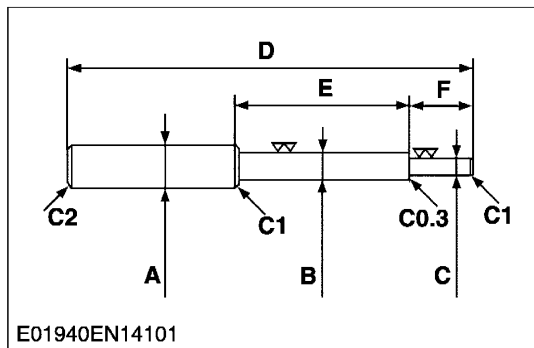
Application: Use to measure lubricating oil pressure.

- | | |
|--------------------|---------------|
| (1) Gauge | (5) Adaptor 2 |
| (2) Cable | (6) Adaptor 3 |
| (3) Threaded Joint | (7) Adaptor 4 |
| (4) Adaptor 1 | (8) Adaptor 5 |

W1041711

NOTE

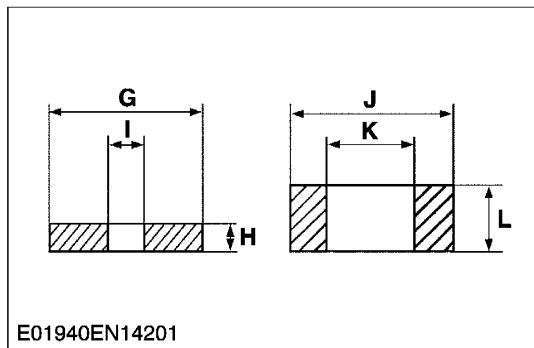
- The following special tools are not provided, so make them referring to the figure.



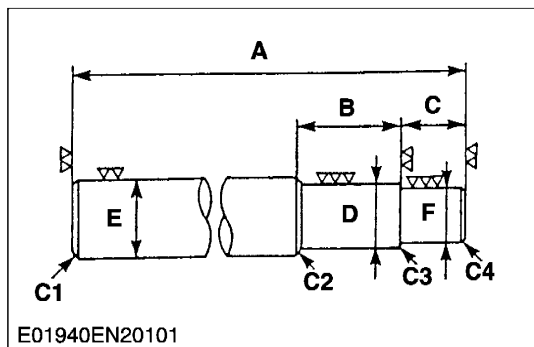
Valve Guide Replacing Tool

Application: Use to press out and press fit the valve guide.

A	20 mm dia. (0.79 in. dia.)
B	9.96 to 9.98 mm dia. (0.3921 to 0.3929 in. dia.)
C	5.5 to 5.7 mm dia. (0.2165 to 0.2244 in. dia.)
D	200 mm (7.87 in.)
E	80 mm (3.15 in.)
F	40 mm (1.58 in.)
G	15 mm (0.59 in.)
H	5 mm (0.197 in.)
I	6.0 to 6.1 mm dia. (0.236 to 0.240 in. dia.)
J	18 mm dia. (0.71 in. dia.)
K	10.6 to 10.7 mm dia. (0.417 to 0.421 in. dia.)
L	7 mm (0.276 in.)
C1	Chamfer 1.0 mm (0.039 in.)
C2	Chamfer 2.0 mm (0.079 in.)
C0.3	Chamfer 0.3 mm (0.012 in.)



W1041866

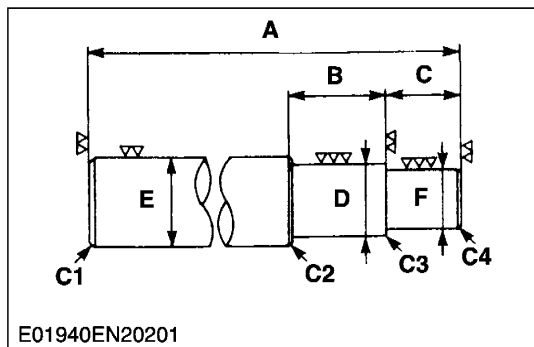


Idle Gear Bushing Replacing Tool

Application: Use to press out and press fit the idle gear bushing.

A	150 mm (5.91 in.)
B	30 mm (1.18 in.)
C	20 mm (0.79 in.)
D	21.90 to 21.95 mm dia. (0.8622 to 0.8642 in. dia.)
E	25 mm dia. (0.98 in. dia.)
F	19.90 to 19.95 mm dia. (0.7835 to 0.7854 in. dia.)

W1042095

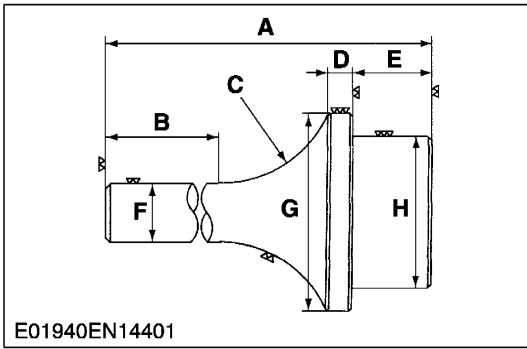


Connecting Rod Small End Bushing Tool

Application: Use to press out and press fit the connecting rod small end bushing.

A	145 mm (5.71 in.)
B	25 mm (0.98 in.)
C	20 mm (0.79 in.)
D	19.90 to 19.95 mm dia. (0.7835 to 0.7854 in. dia.)
E	25 mm dia. (0.98 in. dia.)
F	17.90 to 17.95 mm dia. (0.7047 to 0.7067 in. dia.)

W1042345

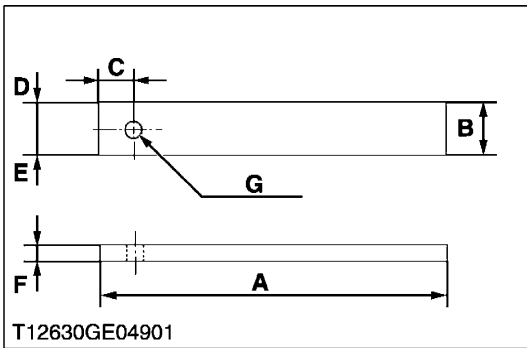


Crankshaft Bearing 1 Replacing Tool

Application: Use to press out and press fit the crankshaft bearing 1.

A	130 mm (5.12 in.)
B	65 mm (2.56 in.)
C	1.57 rad. (40°)
D	10 mm (0.39 in.)
E	22 mm (0.87 in.)
F	20 mm dia. (0.79 in. dia.)
G	43.90 to 43.95 mm dia. (1.7283 to 1.7303 in. dia.)
H	39.90 to 39.95 mm dia. (1.5709 to 1.5728 in. dia.)

W1042501



Flywheel Stopper

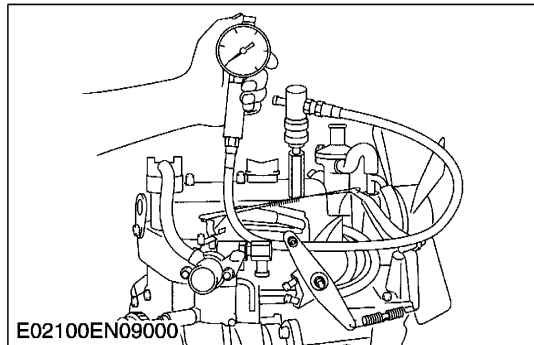
Application: Use to loosen and tighten the flywheel screw.

A	200 mm (7.87 in.)
B	30 mm (1.18 in.)
C	20 mm (0.79 in.)
D	15 mm (0.59 in.)
E	15 mm (0.59 in.)
F	8 mm (0.31 in.)
G	10 mm dia. (0.39 in. dia.)

W1066337

2. ENGINE BODY

[1] CHECKING AND ADJUSTING



Compression Pressure

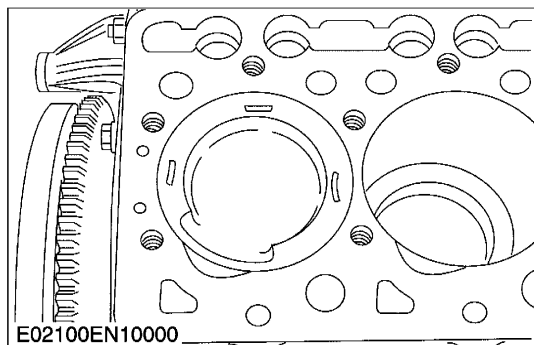
1. After warming up the engine, stop it and remove the air cleaner, the muffler and all spark plugs.
2. Install a compression tester (Code No: 07909-30251) for gasoline / LPG engines to spark plug hole.
3. Run the engine with the starter for 5 to 10 seconds keeping throttle valve fully open.
4. Read the maximum pressure. Measure the pressure more than twice.
5. If the measurement is below the allowable limit, apply a small amount of oil to the cylinder wall through the spark plug holes and measure the compression pressure again.
6. If the compression pressure is still less than the allowable limit, check the top clearance, valve and cylinder head.
7. If the pressure increases after applying oil, check the cylinder wall and piston rings.

■ NOTE

- Check the compression pressure with the specified valve clearance.
- Always use a fully charged battery for performing this test.
- Variances in cylinder compression values should be under 10 %.

Compression pressure	Factory spec.	1.27 MPa 13.0 kgf/cm ² 185 psi
	Allowable limit	0.88 MPa 9.0 kgf/cm ² 128 psi

W1043937



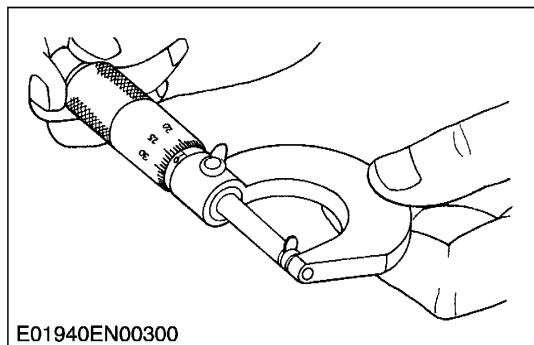
Top Clearance

1. Remove the cylinder head and the head gasket completely.
2. Bring the piston to it TDC, and fasten 1.5 mm dia. 5 to 7 mm long fuse wires to 3 to 4 spots on the piston top with grease so as to avoid the intake and exhaust valve and combustion chamber ports.
3. Bring the piston to its middle position, install the cylinder head, and tighten the cylinder head bolts to specification. (Head gasket must be changed to new one.)
4. Turn the flywheel until the piston passes through the TDC.
5. Remove the cylinder head, and measure the thickness of the fuses.
6. If the measurement is not within the factory specification, check the oil clearance between the crankpin and bearing and between the piston pin and bushing.

■ NOTE

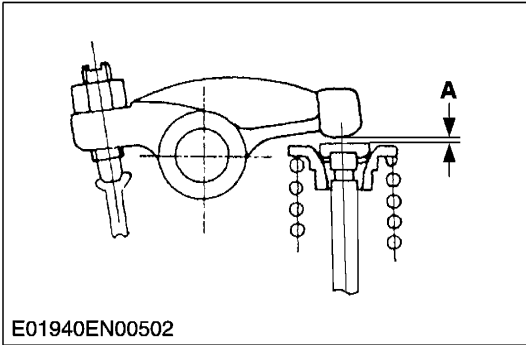
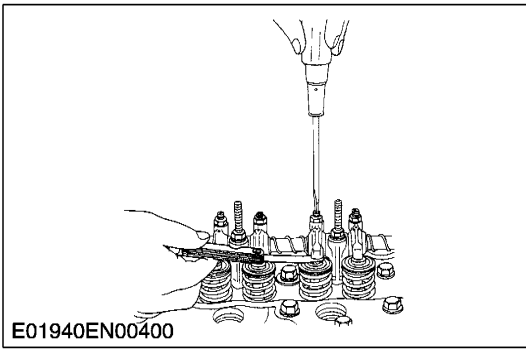
- After checking the top clearance, be sure to assemble the cylinder head with a new cylinder head gasket.

Top clearance	Factory spec.	1.45 to 1.75 mm 0.0571 to 0.0690 in.
---------------	---------------	---



Tightening torque	Cylinder head bolt	37.2 to 42.1 N·m 3.8 to 4.3 kgf·m 28.0 to 31.7 ft·lbs
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W1044194



Checking Valve Clearance

■ **IMPORTANT**

- Valve clearance must be checked and adjusted when engine is cold.
1. Remove the head cover.
 2. Align the “1TC” mark on the flywheel and projection on the housing so that the No. 1 piston comes to the compression or overlap top dead center.
 3. Check the following valve clearance marked with “☆” using a feeler gauge.
 4. If the clearance, adjust with the adjusting screw.

Valve clearance	Factory spec.	0.145 to 0.185 mm 0.0057 to 0.0073 in.
-----------------	---------------	---

■ **NOTE**

- The “TC” marking on the flywheel is just for No. 1 cylinder. There is no “TC” marking for the other cylinders.
- No. 1 piston comes to the T.D.C. position when the “TC” marking is aligned with the projection in the window on flywheel-housing. Turn the flywheel 0.26 rad. (15°) clockwise and counter clockwise to see if the piston is at the compression top dead center or the overlap position. Now referring to the table below, readjust the valve clearance. (The piston is at the top dead center when both the IN. and EX. valves do not move; it is at the overlap position when both the valves move.)
- Finally turn the flywheel 6.28 rad. (360°) and align the “TC” marking and the projection perfectly. Adjust the other valve clearance as required.
- After turning the flywheel counter clockwise twice or three times, recheck the valve clearance.
- After adjusting the valve clearance, firmly tighten the lock nut of the adjusting screw.

Number of cylinders Valve arrangement Adjustable cylinder Location of piston		IN.	EX
When No. 1 piston is compression top dead center	1st	☆	☆
	2nd		☆
	3rd	☆	
When No. 1 piston is overlap position	1st		
	2nd	☆	
	3rd		☆

A : Valve Clearance

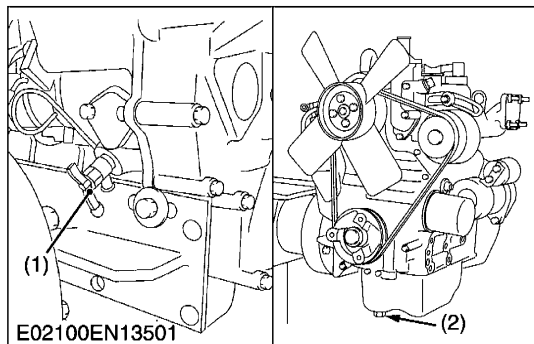
W1059460

[2] DISASSEMBLING AND ASSEMBLING

■ IMPORTANT

- When reassembling, replace all of the O-rings and gaskets by new ones.
- When disassembling the LPG engine after completely consuming the fuel in piping.

(1) Draining Coolant and Oil



Draining Coolant and Engine Oil

⚠ CAUTION

- Never remove radiator cap until coolant temperature is below its boiling point. Then loosen cap slightly to the stop to relieve any excess pressure before removing cap completely.

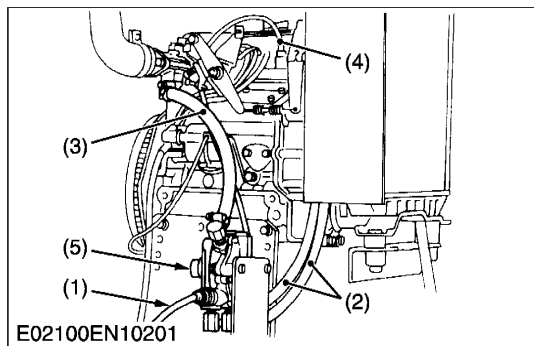
1. Prepare a bucket. Open the drain cock to drain coolant.
2. Prepare an oil pan. Remove the drain plug to drain engine oil in the pan.

(1) Drain Cock

(2) Drain Plug

W1045705

(2) External Components



LPG Hose and Water Hose (DF752-E2)

1. Disconnect the LPG hose (1).
2. Disconnect the water hose (2).
3. Disconnect the vapor hose (3) and vacuum lock hose (4).
4. Remove the vaporizer (5) (if necessary).

■ IMPORTANT

- When disassembling the fuel system, make sure that the fuel valve is closed.

(When reassembling)

- See page S-68.

(1) LPG Hose

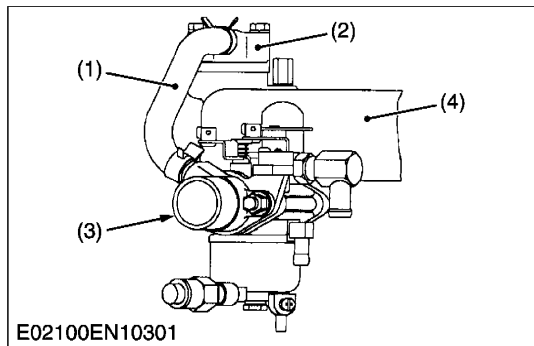
(2) Water Hose

(3) Vapor Hose

(4) Vacuum Lock Hose

(5) Vaporizer

W1045823



Closed Breather

1. Disconnect the breather hose (1).

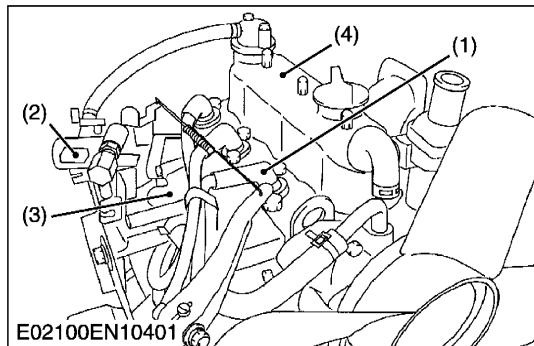
(1) Closed Breather Hose

(2) Closed Breather Assembly

(3) Air Cleaner Flange

(4) Head Cover

W1045993



Ignition Cords, Inlet Manifold and Cylinder Head Cover

1. Remove the spark plug cap and the spark plug (1).
2. Remove the carburetor (2).
3. Remove the inlet manifold (3).
4. Remove the cylinder head cover (4).

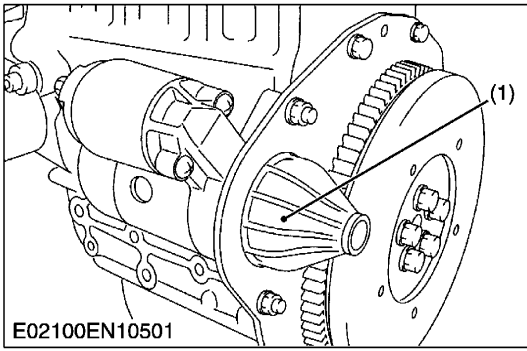
(1) Spark Plug

(2) Carburetor

(3) Inlet Manifold

(4) Cylinder Head Cover

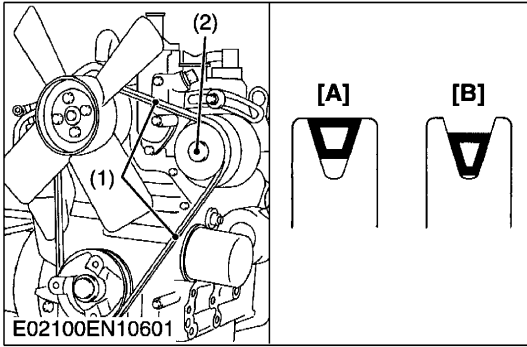
W1046078



Starter

1. Remove the starter (1).
- (1) Starter

W1046195



Alternator and Fan Belt

1. Remove the alternator (1).
2. Remove the fan.
3. Remove the fan belt (2).

(When reassembling)

- Check to see that there are no cracks on the belt surface.
- See page S-18.

■ IMPORTANT

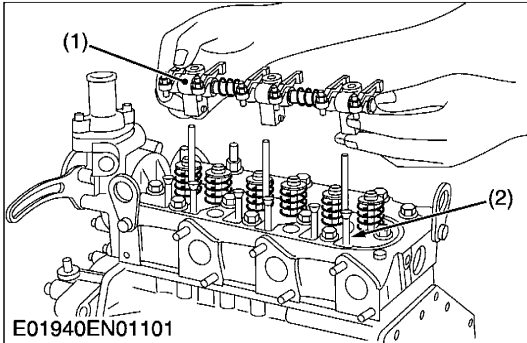
- **After reassembling the fan belt, be sure to adjust the fan belt tension.**

- (1) Fan Belt
(2) Alternator

- [A] Good
[B] Bad

W1046320

(3) Cylinder Head and Valves



Rocker Arm Assembly and Push Rod

1. Remove the rocker arm bracket mounting nuts, and remove the rocker arm assembly (1).
2. Remove the push rods (2).

(When reassembling)

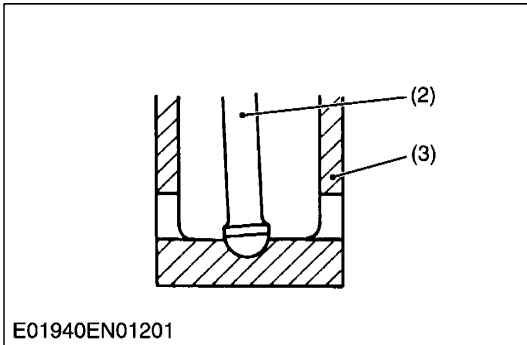
- Insert the push rods into the tappets securely.
- Adjust the valve clearance. (See page S-33.)
- Apply engine oil to the rocker arm bracket nuts. And tighten them.

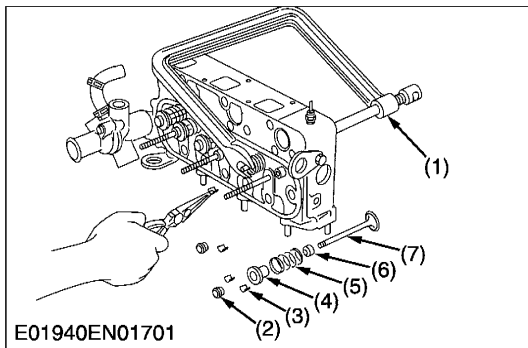
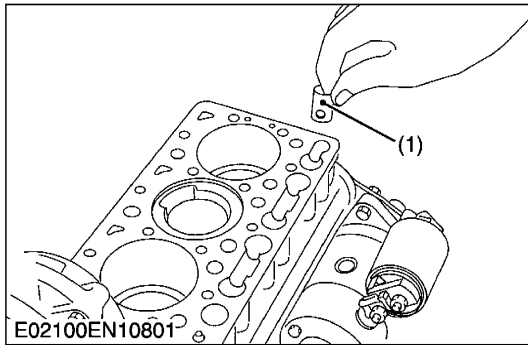
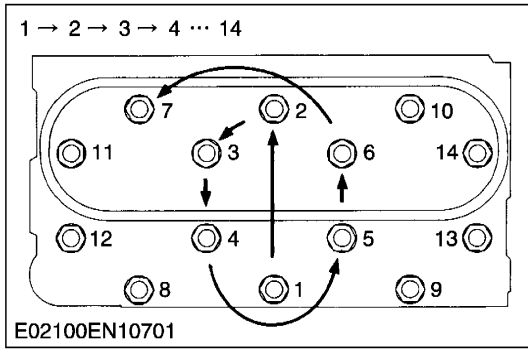
Tightening torque	Rocker arm bracket nut	9.8 to 11.3 N·m 1.00 to 1.15 kgf·m 7.2 to 8.3 ft·lbs
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- (1) Rocker Arm Assembly
(2) Push Rod

- (3) Tappet

W1046498





Cylinder Head and Tappet

1. Remove the cylinder head screws in the order of [14] to [1] (See figure) and remove the cylinder head.
2. Remove the cylinder head gasket.
3. Remove the tappets (1) from the crankcase.

(When reassembling)

- Replace the head gasket with a new one.
- Before installing the tappets, apply engine oil thinly around them.
- Install the cylinder head.
- Tighten the cylinder head screw gradually screw in the order of [1] to [14] after applying engine oil.

NOTE

- **Mark the cylinder number to the tappets to prevent interchanging.**
- **When reusing the head bolt, apply engine oil to its thread (when use a new head bolt “rust-preventive oil applied”, use it without applying engine oil to it) and seat surface before fitting it.**

Tightening torque	Cylinder head screw	37.2 to 42.1 N·m 3.8 to 4.3 kgf·m 28.0 to 31.7 ft-lbs
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(1) Tappet

W1046680

Valves

1. Remove the valve caps (2).
2. Remove the valve spring collet (3), pushing the valve spring retainer (4) by valve spring replacer (1).
3. Remove the valve spring retainer (4), valve spring (5) and valve stem seal (6).
4. Remove the valve (7).

(When reassembling)

- Wash the valve stem and valve guide hole, and apply engine oil sufficiently.
- After installing the valve spring collets, lightly tap the stem to assure proper fit with a plastic hammer.

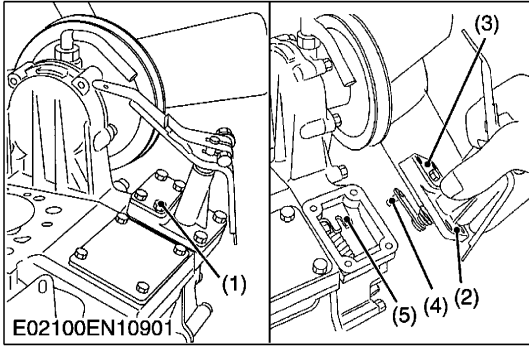
IMPORTANT

- **Don't change the combination of valve and valve guide.**

- | | |
|---------------------------|---------------------|
| (1) Valve Spring Replacer | (5) Valve Spring |
| (2) Valve Cap | (6) Valve Stem Seal |
| (3) Valve Spring Collet | (7) Valve |
| (4) Valve Spring Retainer | |

W1047054

(4) Speed Control Lever and Distributor



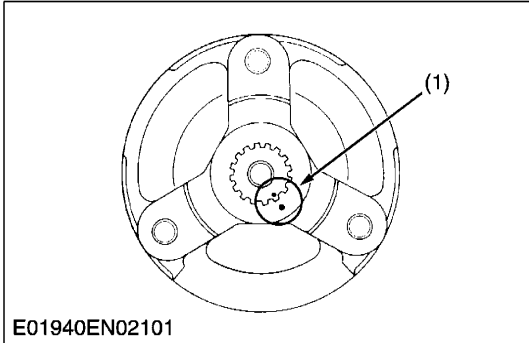
Speed Control Plate

1. Remove the screws (1) and separate the speed control plate (2).
(When reassembling)

- Remove the speed control plate (2) and make sure that the governor lever shaft (4) is correctly set in the governor fork (5).

- | | |
|-------------------------------|--------------------------|
| (1) Screws and Copper Washers | (4) Governor Lever Shaft |
| (2) Speed Control Plate | (5) Governor Fork |
| (3) Speed Control Plate Cover | |

W1047256



Fan Drive Pulley

1. Set the stopper to the flywheel.
2. Remove the fan drive pulley retaining screw.
3. Draw out the fan drive pulley with a puller.

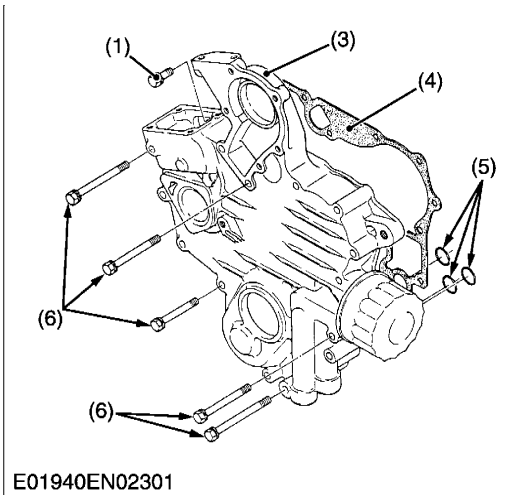
(When reassembling)

- Install the pulley to the crankshaft, aligning the aligning marks (1) on them.
- Apply engine oil to the fan drive pulley retaining screws. And tighten them.

Tightening torque	Fan drive pulley retaining screw	118 to 127 N·m 12.0 to 13.0 kgf·m 86.8 to 94.0 ft·lbs
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- (1) Aligning Marks

W1048447



Gear Case

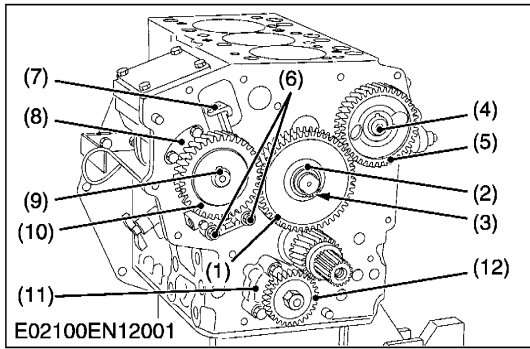
1. Remove the screw (1) of inside the gear case and outside screws.
2. Disconnect the start spring (2) in the speed control plate mounting hole.
3. Remove the gear case (3).

(When reassembling)

- Apply a liquid gasket (Three Bond 1215 or equivalent) to both sides of the gear case gasket (4).
- Be sure to set three O-rings (5) inside the gear case.

- | | |
|--------------------|----------------------|
| (1) Screw (Inside) | (4) Gear Case Gasket |
| (2) Start Spring | (5) O-ring |
| (3) Gear Case | (6) Screw |

W10174840

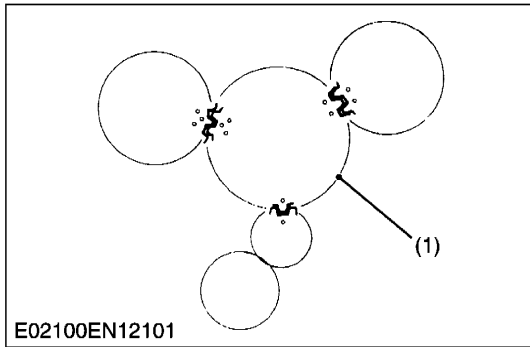


Idle Gear, Camshaft, Distributor Drive Shaft and Fork Lever

1. Remove the external snap ring (3).
2. Remove the idle collar 2 (2) and idle gear (1).
3. Remove the camshaft stopper mounting screws.
4. Remove the camshaft (4) with camgear (5).
5. Remove the fork lever mounting screws (6).
6. Remove the fork lever (7).
7. Remove the distributor drive shaft stopper (8).
8. Remove the distributor drive shaft (9).

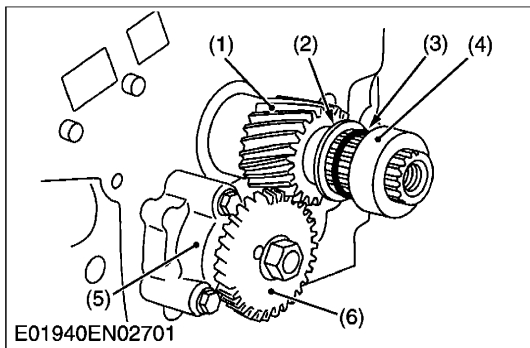
(When reassembling)

- Install the idle gear, aligning the marks on the gears referring the figure.



- | | |
|------------------------|-----------------------------|
| (1) Idle Gear | (7) Fork Lever |
| (2) Idle Collar 2 | (8) Stopper |
| (3) External Snap Ring | (9) Distributor Drive Shaft |
| (4) Camshaft | (10) Distributor Drive Gear |
| (5) Camgear | (11) Oil Pump |
| (6) Mounting Screw | (12) Oil Pump Drive Gear |

W1048876



Oil Pump and Crankshaft Gear

1. Remove the oil pump gear (6).
2. Remove the oil pump (5).
3. Remove the collar (4), O-ring (3) and oil slinger (2).
4. Remove the crankshaft gear (1) with a puller.

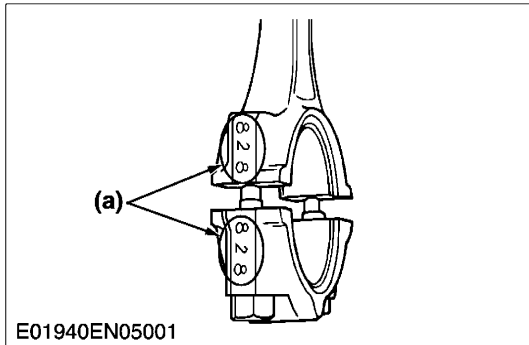
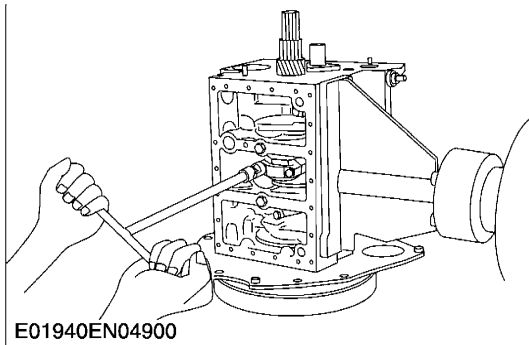
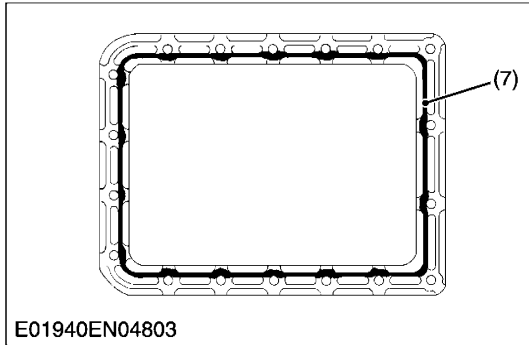
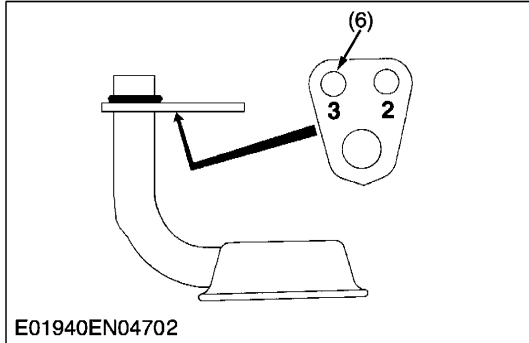
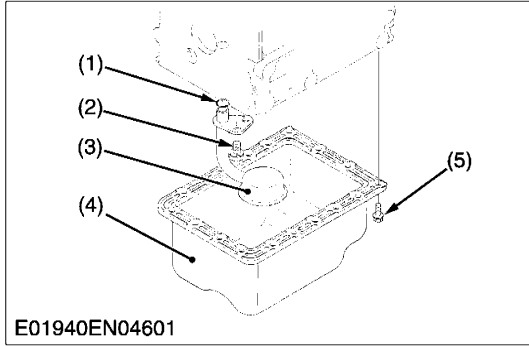
(When reassembling)

- Install the collar after aligning the marks on the gears. (See the figure at "Idle Gear and Camshaft".)

- | | |
|----------------------------|-----------------------|
| (1) Crankshaft Gear | (4) Crankshaft Collar |
| (2) Crankshaft Oil Slinger | (5) Oil Pump |
| (3) O-ring | (6) Oil Pump Gear |

W10180290

(5) Connecting Rod and Piston



Oil Pan and Oil Strainer

1. Remove the oil pan mounting screws.
2. Remove the oil pan (4) by lightly tapping the rim of the pan with a wooden hammer.
3. Remove the oil strainer (3).

(When reassembling)

- After cleaning the oil strainer, check to see that the filter mesh is clean, and install it.
- Visually check the O-ring (1), apply engine oil, and install it.
- Securely check the O-ring to the oil strainer.
- To avoid uneven tightening, tighten oil pan mounting screws in diagonal order from the center.
- Using the hole (6) numbered “3”, install the oil strainer by mounting screw.

■ IMPORTANT

- **Scrape off the old adhesive completely. Now apply new adhesive 3 to 5 mm (0.12 to 0.20 in.) thick all over the contact surface. Apply the adhesive also on the center of the flange as well as on the inner wall of each bolt hole.**
- **Cut the nozzle of the “fluid sealant” (Three Bond 1217D) container at its second notch. Apply “fluid sealant” about 5 mm (0.20 in.) thick. Within 20 minutes after the application of fluid sealant, reassemble the components. Wait then for about 30 minutes, and pour oil in the crankcase.**

- | | |
|------------------|-----------------------------|
| (1) O-ring | (5) Oil Pan Mounting Screws |
| (2) Screw | (6) Hole |
| (3) Oil Strainer | (7) Fluid Sealant |
| (4) Oil Pan | |

W10265670

Connecting Rod Cap

1. Remove the connecting rod caps.

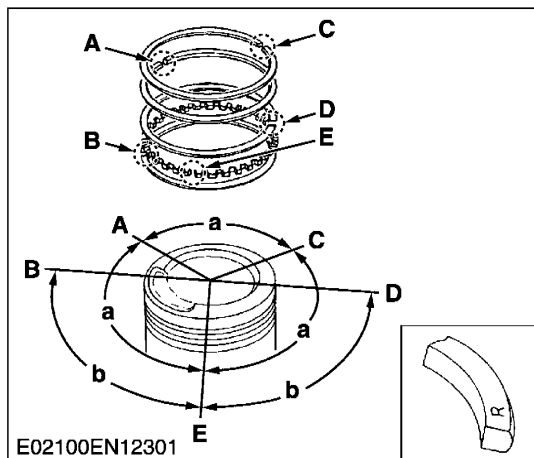
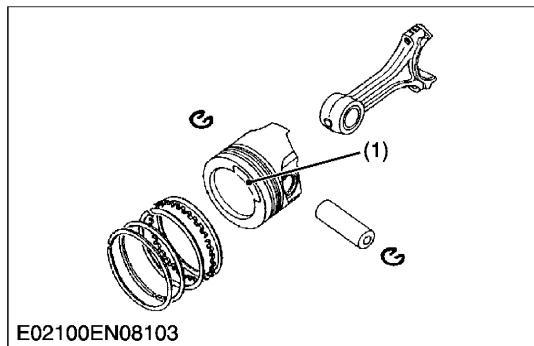
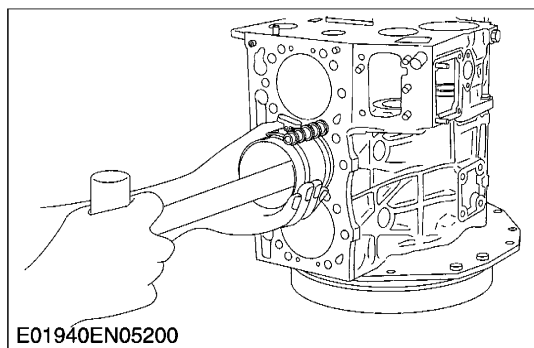
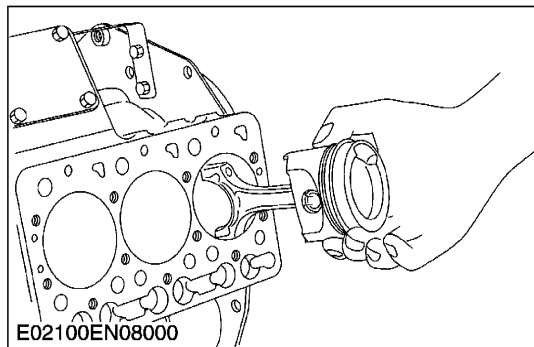
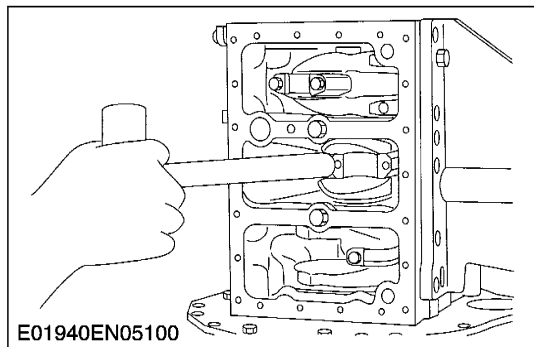
(When reassembling)

- Align the alignment number marks (a) with each other. (Face the marks toward distributor side.)
- Apply engine oil to the connecting rod screws and lightly screw it in by hand, then tighten it to the specified torque.
If the connecting rod screw won't be screwed in smoothly, clean the threads.
If the connecting rod screw is still hard to screw in, replace it.

Tightening torque	Connecting rod screw	26.5 to 30.4 N·m 2.7 to 3.1 kgf·m 19.5 to 22.4 ft·lbs
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(a) Alignment Number Mark

W10275480



Pistons, Connecting Rod and Piston Rings

1. Turn the flywheel and bring the piston to top dead center.
2. Draw out the piston upward by lightly tapping it from the bottom of the crankcase with the grip of a hammer.
3. Draw out the other piston in the same method as above.

(When reassembling)

- When inserting the piston into the cylinder, place the gap (C) of the top compression ring on the opposite side of the slant portion (1), and stagger the gaps (A), (E) of the second compression ring and spacer making 2.09 rad. (120°) from the gap of the top compression ring. Further, stagger the gaps (D), (B) of the upper and lower side rail making 1.57 rad. (90°) from the gap of the spacer.
- Apply engine oil to the piston pin and the bushing. On reassembling the piston and the connecting rod, set the recess of the piston facing towards the alignment marks on the connecting rod.
- When inserting the piston pin to the piston, heat the piston in oil (80 °C, 176 °F) for 10 to 15 minutes.

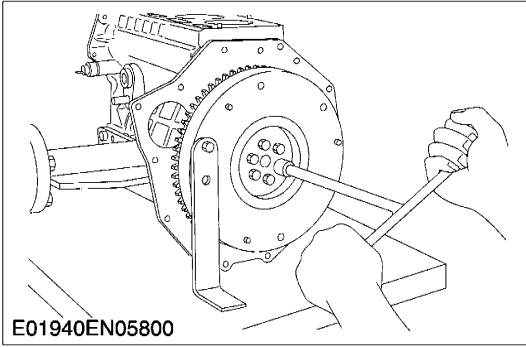
■ IMPORTANT

- Do not change the combination of cylinder and piston. Make sure of the position of each piston by marking. For example, mark “1” on the No. 1 piston.
- Carefully insert the pistons using a piston ring compressor. Otherwise, their chrome-plated section may be scratched, causing trouble inside the cylinder.

- | | |
|---------------------------------|----------------------|
| (1) Slant Portion | D : Side Rail Gap |
| | E : Spacer Gap |
| A : Second Compression Ring Gap | a : 2.09 rad. (120°) |
| B : Side Rail Gap | b : 1.57 rad. (90°) |
| C : Top Compression Ring Gap | |

W1050108

(6) Crankshaft



Flywheel

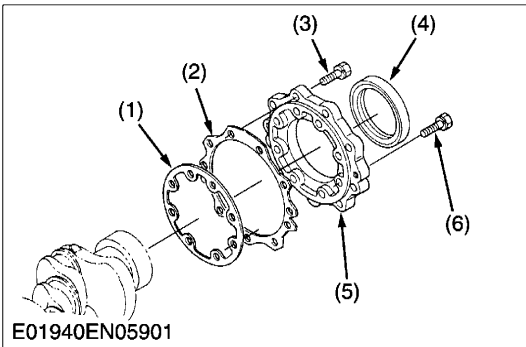
1. Fit the stopper to the flywheel.
2. At first, remove two pieces of the flywheel screws.
3. Insert two pieces of the flywheel guide screws in the holes.
4. Remove all flywheel screws.
5. Remove the flywheel slowly along the flywheel guide screws.

(When reassembling)

- Insert two pieces of the flywheel guide screws.
- Fit the flywheel giving care to the position of the knock pin.
- Apply engine oil to the threads and the undercut surface of the flywheel bolt and fit the bolt.

Tightening torque	Flywheel screw	53.9 to 58.8 N·m 5.5 to 6.0 kgf·m 39.8 to 43.4 ft·lbs
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W10290240



Bearing Case Cover

1. Remove the bearing case cover mounting screws. First, remove inside screws (6) and then outside screws (3).
2. Screw two removed screws into the screw hole of bearing case cover (5) to remove it.

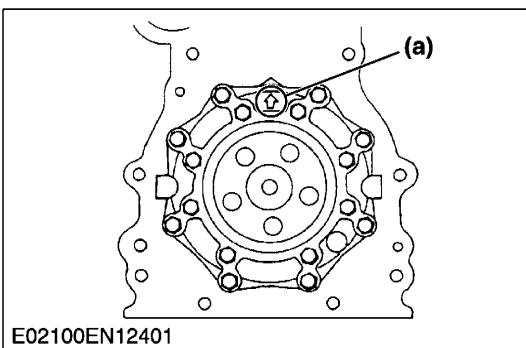
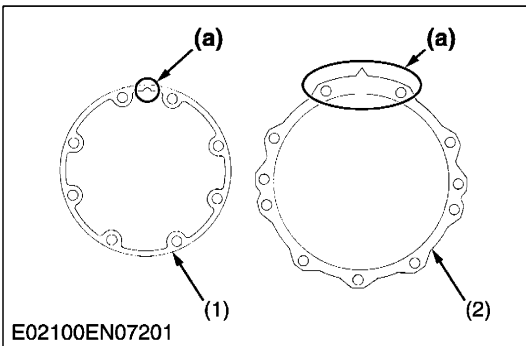
■ IMPORTANT

- The length of inside screws and outside screws are different. Do not take a mistake using inside screws and outside screws.

(When reassembling)

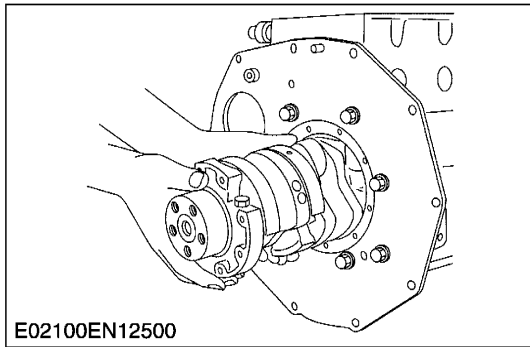
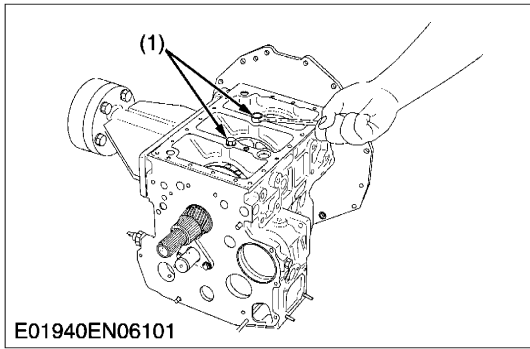
- Fit the bearing case gasket (1) and the bearing case cover gasket (2) with correct directions.
- Install the bearing case cover to position the casting mark “↑” on it upward.
- Apply engine oil to the oil seal lip and take care that it is not rolled when installing.
- Tighten the bearing case cover mounting screws with even force on the diagonal line.

Tightening torque	Bearing case cover mounting screw	9.8 to 11.3 N·m 1.00 to 1.15 kgf·m 7.2 to 8.3 ft·lbs
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- | | |
|---------------------------------------|---------------------------------------|
| (1) Bearing Case Gasket | (5) Bearing Case Cover |
| (2) Bearing Case Cover Gasket | (6) Bearing Case Cover Mounting Screw |
| (3) Bearing Case Cover Mounting Screw | |
| (4) Oil Seal | (a) Upside |

W10292140



Crankshaft Assembly

1. Remove the main bearing case screw 2 (1).
2. Pull out the crankshaft assembly.

■ **IMPORTANT**

- **Take care to protect crankshaft bearing 1 from scratches, caused by the crank shaft, etc.**

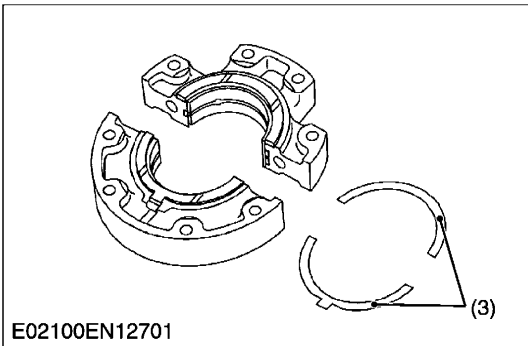
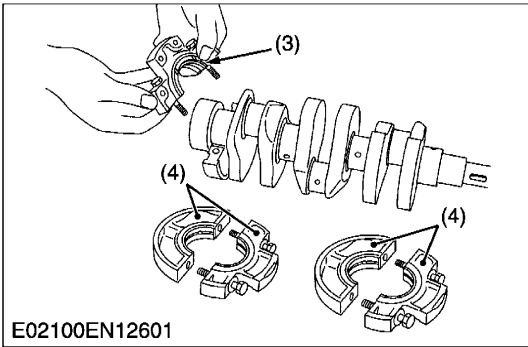
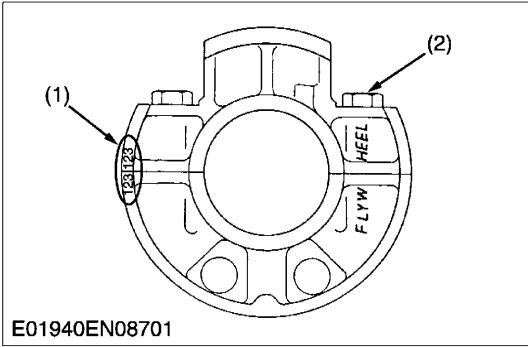
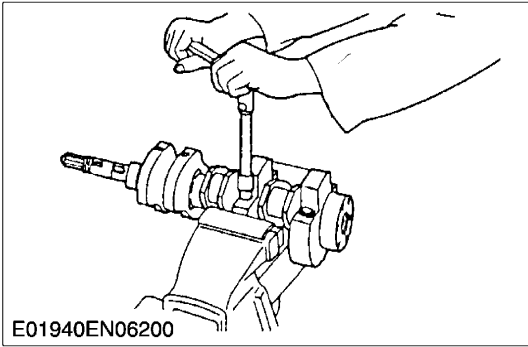
(When reassembling)

- Clean the oil passage of the crankshaft with compressed air.
- Apply oil to the main bearing case screw 2 (1).
- Install the crankshaft assembly, aligning the screw hole of main bearing case with the screw hole of crankcase.
- Clean the oil passage of the crankshaft with compressed air.

Tightening torque	Main bearing case screw 2	26.5 to 30.4 N·m 2.7 to 3.1 kgf·m 19.5 to 22.4 ft-lbs
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(1) Main Bearing Case Screw 2

W10295750



Main Bearing Case Assembly

1. Remove the two main bearing case screws 1, and remove the main bearing and crankshaft bearing 2.
2. Remove the main bearing case assembly 1 and 2 as above.

(When reassembling)

- Clean the oil passage in the main bearing case.
- Apply clean engine oil on the bearings.
- Install the main bearing case assemblies in the original positions. Since diameters of main bearing case vary, install them in order of makings (A, B) from the gear case side.
- Match the alignment numbers (1) on the main bearing case.
- When installing the main bearing case 1 and 2, face the mark “FLYWHEEL” to the flywheel.
- Apply engine oil to the main bearing case screw 1.
- Install the thrust bearing (3) with its oil groove facing outward.
- Confirm that the main bearing case moves smoothly after tightening the main bearing case screw 1 to the specified torque.

Tightening torque	Main bearing case screw 1	12.7 to 15.7 N·m 1.3 to 1.6 kgf·m 9.4 to 11.6 ft-lbs
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(1) Alignment Number

(2) Main Bearing Case Screw 1

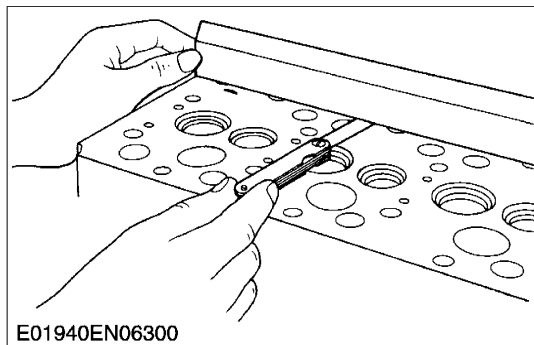
(3) Thrust Bearing

(4) Order Marking (A or B)

W10297990

[3] SERVICING

(1) Cylinder Head and Valves



Cylinder Head Surface Flatness

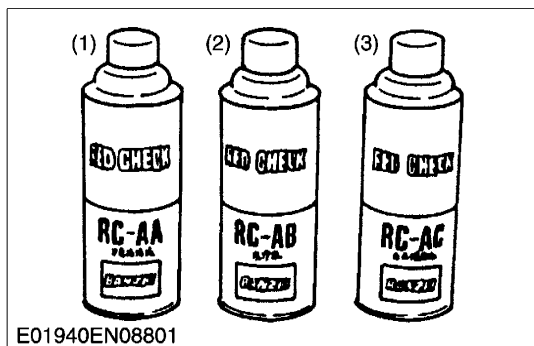
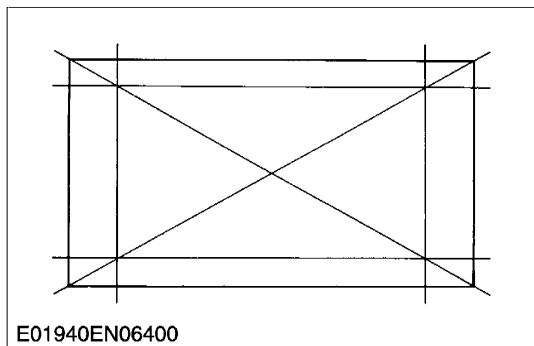
1. Clean the cylinder head surface.
2. Place a straightedge on the cylinder head's four sides and two diagonal as shown in the figure.
3. Measure the clearance with a feeler gauge.
4. If the measurement exceeds the allowable limit, correct it with a surface grinder.

■ **IMPORTANT**

- Be sure to check the valve recessing after correcting.

Cylinder head surface flatness	Allowable limit	0.05 mm 0.0020 in.
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W10301620



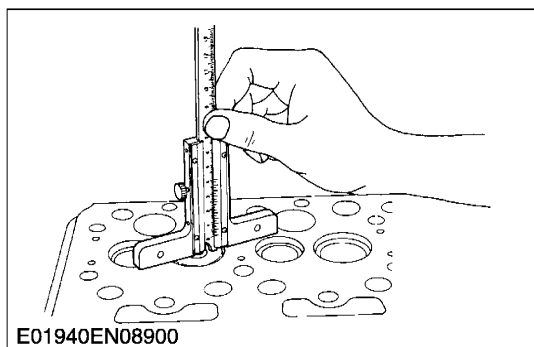
Cylinder Head Flaw

1. Prepare an air spray red check (Code No. 07909-31371).
2. Clean the surface of the cylinder head with detergent (2).
3. Spray the cylinder head surface with the red permeative liquid (1). Leave it five to ten minutes after spraying.
4. Wash away the red permeative liquid on the cylinder head surface with the detergent (2).
5. Spray the cylinder head surface with white developer (3).
6. If flawed, it can be identified as red marks.

- (1) Red Permeative Liquid
(2) Detergent

- (3) White Developer

W10303200

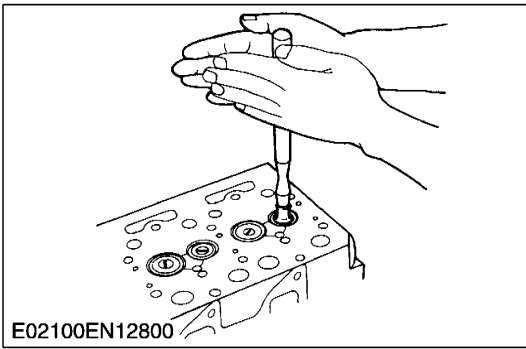


Valve Recessing

1. Clean the cylinder head surface, valve face and valve seat.
2. Insert the valve into the valve guide.
3. Measure the valve recessing with a depth gauge.
4. If the measurement exceeds the allowable limit, replace the valve.
5. If it still exceeds the allowable limit after replacing the valve, replace the cylinder head.

Valve recessing	Factory spec.	0.75 to 0.95 mm 0.0295 to 0.0374 in.
	Allowable limit	1.20 mm 0.0472 in.

W10305870



Valve Lapping

1. Apply compound evenly to the valve lapping surface.
2. Insert the valve into the valve guide. Lap the valve onto its seat with a valve flapper or screwdriver.
3. After lapping the valve, wash the compound away and apply oil, then repeat valve lapping with oil.
4. Apply prussian to the contact surface to check the seated rate. If it is less than 70 %, repeat valve lapping again.

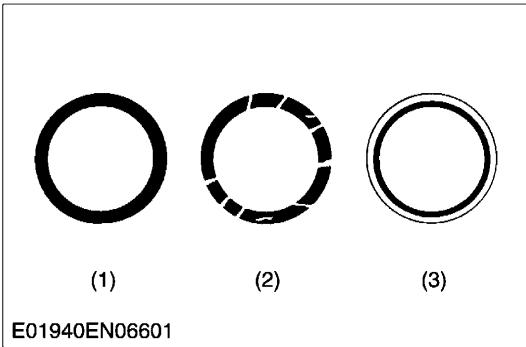
■ **IMPORTANT**

- **When valve lapping is performed, be sure to check the valve recessing and adjust the valve clearance after assembling the valve.**

- (1) Correct
- (2) Incorrect

- (3) Incorrect

W10309820



Correcting Valve and Valve Seat

■ **NOTE**

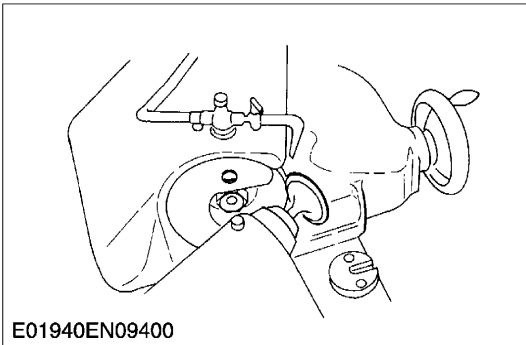
- **Before correcting the valve and seat, check the valve stem and the I.D. of the valve guide section, and repair them if necessary.**
- **After correcting the valve seat, be sure to check the valve recessing.**

1) Correcting Valve

1. Correct the valve with a valve refacer.

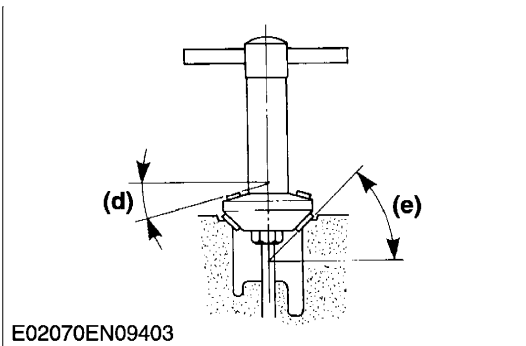
2) Correcting Valve Seat

1. Slightly correct the seat surface with seat cutter (Code No. 07909-33102).



Tightening torque	Intake valve	0.79 rad. 45°
	Exhaust valve	0.79 rad. 45°

2. Resurface the seat surface with a 0.52 rad. (30°) valve seat cutter to intake valve seat and with a 0.26 rad. (15°) valve seat cutter to exhaust valve seat so that the width is close to specified valve seat width (In: 2.19 mm, 0.0862 in., Ex: 1.56 mm, 0.0614 in.).
3. After resurfacing the seat, inspect for even valve seating, apply a thin film of compound between the valve face and valve seat, and fit them with valve lapping tool.
4. Check the valve seating with prussian blue. The valve seating surface should show good contact all the way around.



(a) Identical Dimensions

(b) Valve Seat Width

(c) 0.52 rad. (30°)

(d) 0.26 rad. (15°)

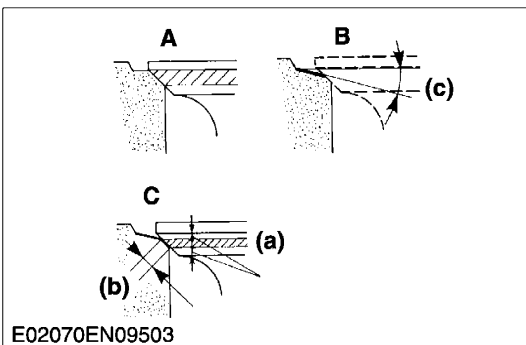
(e) 0.79 rad. (45°)

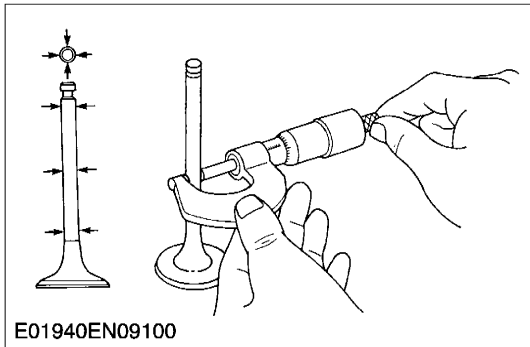
(A) Check Contact

(B) Correct Seat Width

(C) Check Contact

W10319540

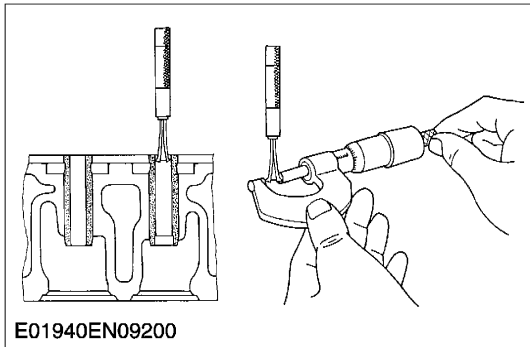




Clearance between Valve Stem and Valve Guide

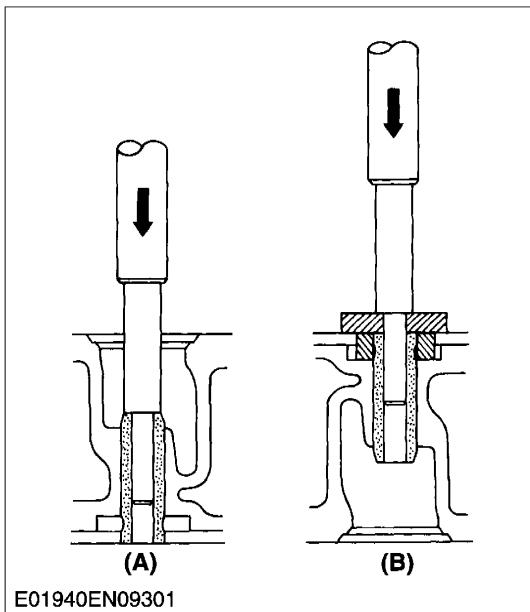
1. Remove carbon from the valve guide section.
2. Measure the valve stem O.D. with an outside micrometer.
3. Measure the valve guide I.D. with a small hole gauge, and calculate the clearance.
4. If the clearance exceeds the allowable limit, replace the valves.
If it still exceeds the allowable limit, replace the valve guide.

Clearance between valve stem and valve guide	Factory spec.	0.030 to 0.057 mm 0.00118 to 0.00224 in.
	Allowable limit	0.10 mm 0.0039 in.



Valve stem O.D.	Factory spec.	5.968 to 5.980 mm 0.23496 to 0.23543 in.
Valve guide I.D.	Factory spec.	6.010 to 6.025 mm 0.23661 to 0.23720 in.

W10311740



Replacing Valve Guide

(When removing)

1. Press out the used valve guide using a valve guide replacing tool.

(When installing)

1. Clean a new valve guide and valve guide bore, and apply engine oil to them.
2. Press in a new valve guide using a valve guide replacing tool.
3. Ream precisely the I.D. of the valve guide to the specified dimension.

Valve guide I.D. (Intake and exhaust) (a)	Factory spec.	6.010 to 6.025 mm 0.23661 to 0.23720 in.
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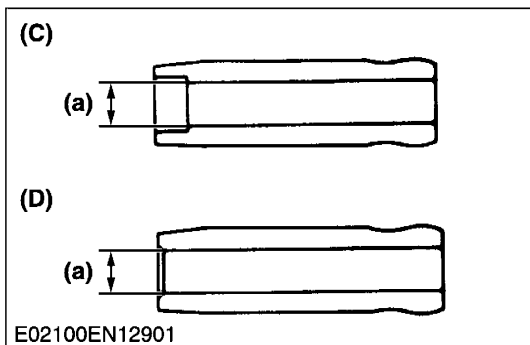
Finishing	6.3S ▽▽▽
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■ IMPORTANT

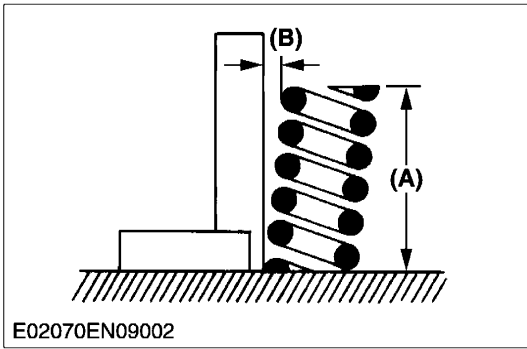
- Do not hit the valve guide with a hammer during replacement.

(A) When Removing
(B) When Installing

(C) Finishing Size of Exhaust Valve Guide
(D) Finishing Size of Inlet Valve Guide



W10314690



E02070EN09002

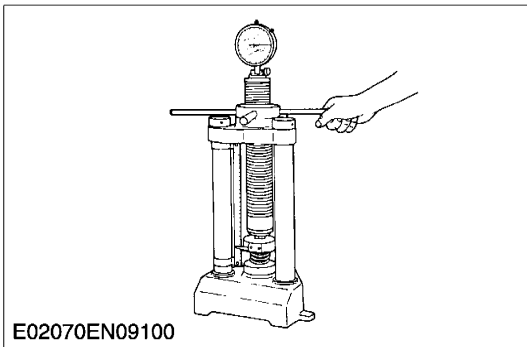
Free Length and Tilt of Valve Spring

1. Measure the free length (A) of valve spring with venire calipers. If the measurement is less than the allowable limit, replace it.
2. Put the valve spring on a surface plate, place a square on the side of the valve spring.
3. Check to see if the entire side is in contact with the square. Rotate the valve spring and measure the maximum tilt (B). Check the entire surface of the valve spring for scratches. If there is any defect, replace it.

Free length (A)	Factory spec.	31.3 to 31.8 mm 1.23 to 1.25 in.
	Allowable limit	28.4 mm 1.12 in.

Tilt (B)	Allowable limit	1.2 mm 0.047 in.
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W11157830



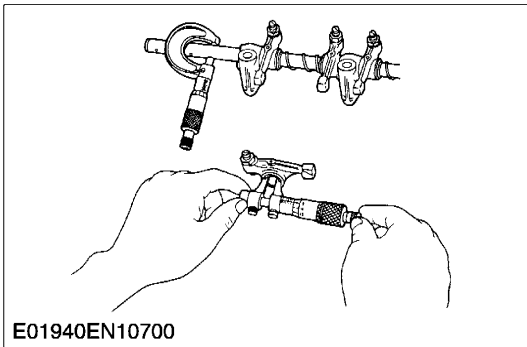
E02070EN09100

Valve Spring Setting Load

1. Place the valve spring on a tester and compress it to the same length it is actually compressed the engine.
2. Read the compression load on the gauge.
3. If the measurement is less than the allowable limit, replace it.

Setting load / Setting length	Factory spec.	64.7 N / 27.0 mm 6.6 kgf / 27.0 mm 14.6 lbs / 1.063 in.
	Allowable limit	54.9 N / 27.0 mm 5.6 kgf / 27.0 mm 12.3 lbs / 1.063 in.

W11177330



E01940EN10700

Oil Clearance between Rocker Arm and Rocker Arm Shaft

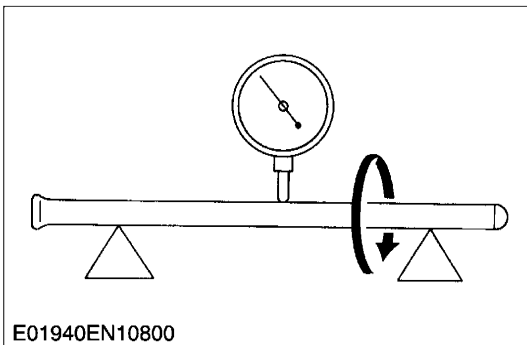
1. Measure the rocker arm shaft O.D. with an outside micrometer.
2. Measure the rocker arm I.D. with an inside micrometer, and then calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit, replace the rocker arm and measure the oil clearance again. If it still exceeds the allowable limit, replace also the rocker arm shaft.

Oil clearance between rocker arm and rocker arm shaft	Factory spec.	0.016 to 0.045 mm 0.00063 to 0.00177 in.
	Allowable limit	0.15 mm 0.0059 in.

Rocker arm shaft O.D.	Factory spec.	10.473 to 10.484 mm 0.41232 to 0.41276 in.
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Rocker arm I.D.	Factory spec.	10.500 to 10.518 mm 0.41339 to 0.41410 in.
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W11199710



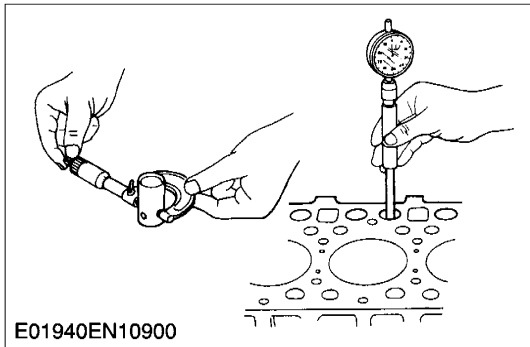
E01940EN10800

Push Rod Alignment

1. Place the push rod on V blocks.
2. Measure the push rod alignment.
3. If the measurement exceeds the allowable limit, replace the push rod.

Push rod alignment	Allowable limit	0.25 mm 0.0098 in.
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W11220210



Oil Clearance between Tappet and Tappet Guide Bore

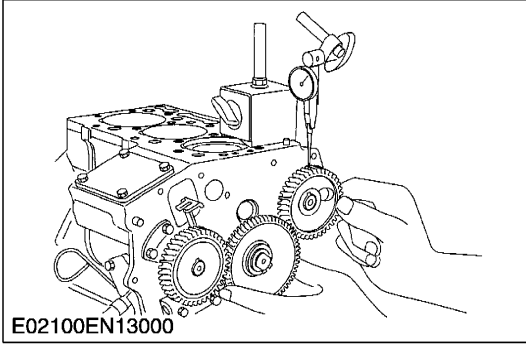
1. Measure the tappet O.D. with an outside micrometer.
2. Measure the I.D. of the tappet guide bore with a cylinder gauge, and calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit or the tappet is damaged, replace the tappet.

Oil clearance between tappet and tappet guide bore	Factory spec.	0.016 to 0.052 mm 0.00063 to 0.00205 in.
	Allowable limit	0.10 mm 0.0039 in.

Tappet O.D.	Factory spec.	17.966 to 17.984 mm 0.70732 to 0.70803 in.
Tappet guide bore I.D.	Factory spec.	18.000 to 18.018 mm 0.70866 to 0.70937 in.

W11231410

(2) Timing Gears, Camshaft and Fuel Camshaft



Timing Gear Backlash

1. Set a dial indicator (lever type) with its tip on the gear tooth.
2. Move the gear to measure the backlash, holding its mating gear.
3. If the backlash exceeds the allowable limit, check the oil clearance of the shaft and the gear.
4. If the oil clearance is proper, replace the gear.

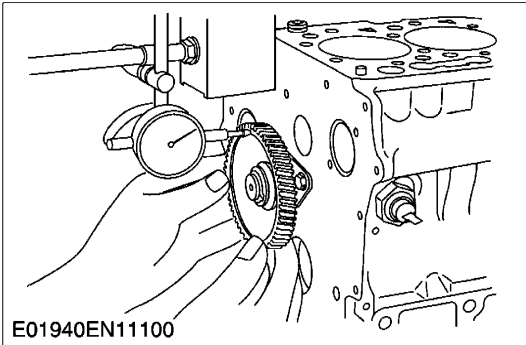
Backlash between idle gear and crank gear	Factory spec.	0.043 to 0.124 mm 0.00169 to 0.00488 in.
	Allowable limit	0.15 mm 0.0059 in.

Backlash between idle gear and cam gear	Factory spec.	0.047 to 0.123 mm 0.00185 to 0.00488 in.
	Allowable limit	0.15 mm 0.0059 in.

Backlash between idle gear and distributor drive gear	Factory spec.	0.041 to 0.124 mm 0.00165 to 0.00484 in.
	Allowable limit	0.15 mm 0.0059 in.

Backlash between oil pump drive gear and crank gear	Factory spec.	0.041 to 0.123 mm 0.00161 to 0.00484 in.
	Allowable limit	0.15 mm 0.0059 in.

W11264830

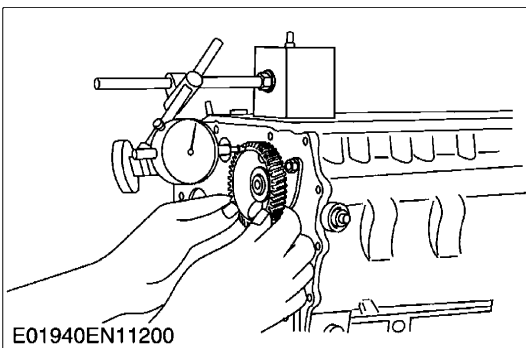


Idle Gear Side Clearance

1. Set a dial indicator with its tip on the idle gear.
2. Measure the side clearance by moving the idle gear to the front and rear.
3. If the measurement exceeds the allowable limit, replace the idle gear collar.

Idle gear side clearance	Factory spec.	0.20 to 0.46 mm 0.0079 to 0.0180 in.
	Allowable limit	0.60 mm 0.0236 in.

W11286770

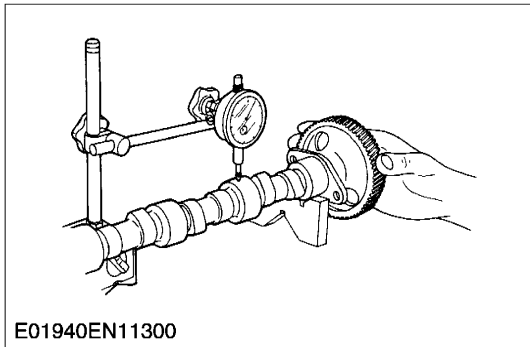


Camshaft Side Clearance

1. Set a dial indicator with its tip on the camshaft.
2. Measure the side clearance by moving the cam gear to the front and rear.
3. If the measurement exceeds the allowable limit, replace the camshaft stopper.

Camshaft side clearance	Factory spec.	0.15 to 0.31 mm 0.0059 to 0.0122 in.
	Allowable limit	0.50 mm 0.0197 in.

W11299720

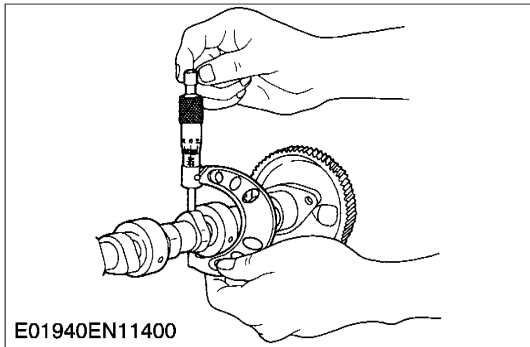


Camshaft Alignment

1. Support the camshaft with V blocks on the surface plate at both end journals.
2. Set a dial indicator with its tip on the intermediate journal.
3. Measure the camshaft alignment.
4. If the measurement exceeds the allowable limit, replace the camshaft.

Camshaft alignment	Allowable limit	0.01 mm 0.0004 in.
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W11312720

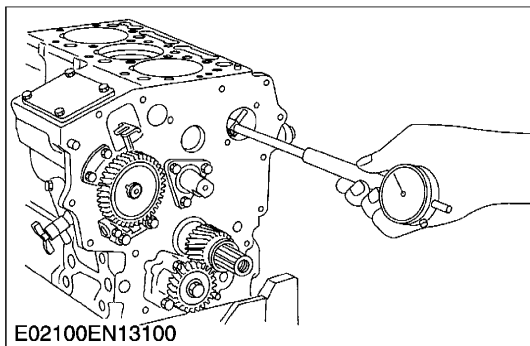


Cam Height

1. Measure the height of the cam at its highest point with an outside micrometer.
2. If the measurement is less than the allowable limit, replace the camshaft.

Cam height of intake and exhaust	Factory spec.	26.88 mm 1.0583 in.
	Allowable limit	26.83 mm 1.0563 in.

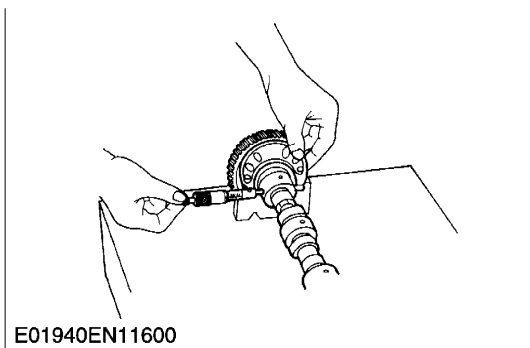
W11324040



Oil Clearance of Camshaft Journal

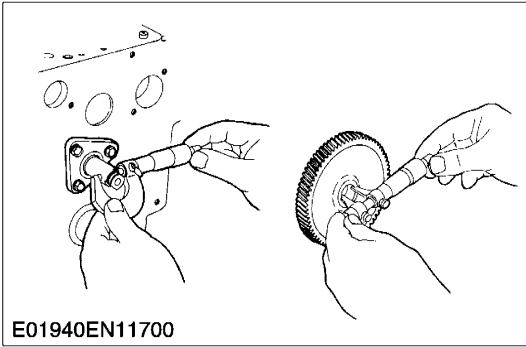
1. Measure the camshaft journal O.D. with an outside micrometer.
2. Measure the cylinder block bore I.D. for camshaft with a cylinder gauge, and calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit, replace the camshaft.

Oil clearance of camshaft journal	Factory spec.	0.050 to 0.091 mm 0.00197 to 0.00358 in.
	Allowable limit	0.12 mm 0.0047 in.



Camshaft journal O.D.	Factory spec.	32.934 to 32.950 mm 1.2966 to 1.29724 in.
Camshaft Bearing I.D. (Cylinder block bore I.D.)	Factory spec.	33.000 to 33.025 mm 1.29921 to 1.30020 in.

W11335580



Oil Clearance between Idle Gear Shaft and Idle Gear Bushing

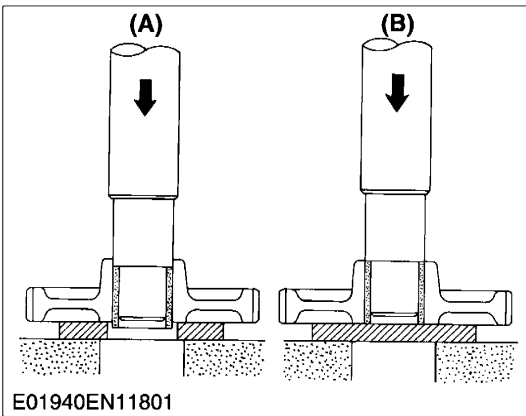
1. Measure the idle gear shaft O.D. with an outside micrometer.
2. Measure the idle gear bushing I.D. with an inside micrometer, and calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit, replace the bushing.

If it still exceeds the allowable limit, replace the idle gear shaft.

Oil clearance between idle gear shaft and idle gear bushing.	Factory spec.	0.020 to 0.084 mm 0.00079 to 0.00331 in.
	Allowable limit	0.10 mm 0.0039 in.

Idle gear shaft O.D.	Factory spec.	19.967 to 19.980 mm 0.78610 to 0.78661 in.
Idle gear bushing I.D.	Factory spec.	20.000 to 20.051 mm 0.78740 to 0.78941 in.

W11356150



Replacing Idle Gear Bushing

(When removing)

1. Press out the used idle gear bushing using an idle gear bushing replacing tool.

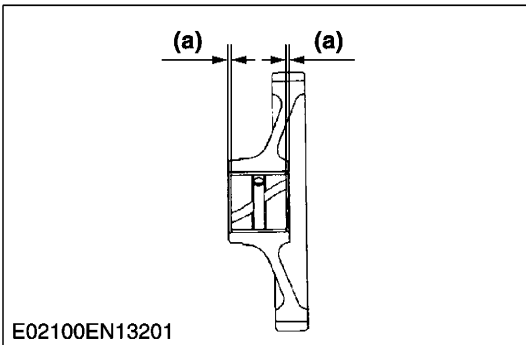
(When installing)

1. Clean a new idle gear bushing and idle gear bore, and apply engine oil to them.
2. Press in a new bushing using an idle gear bushing replacing tool, until it is flush with the end of the idle gear.

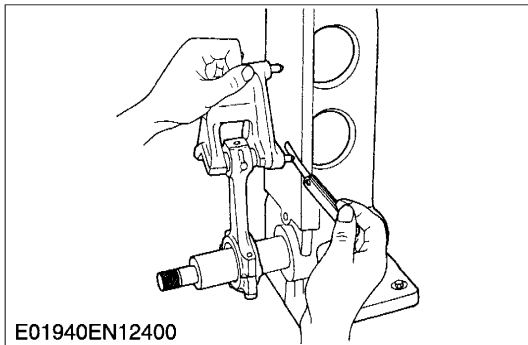
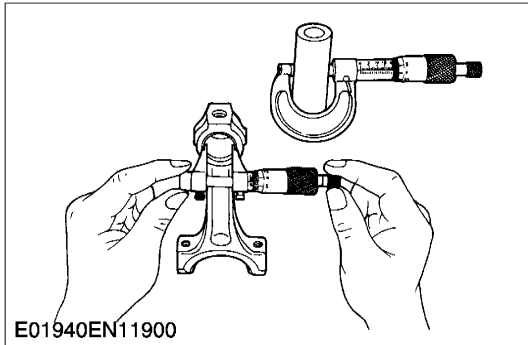
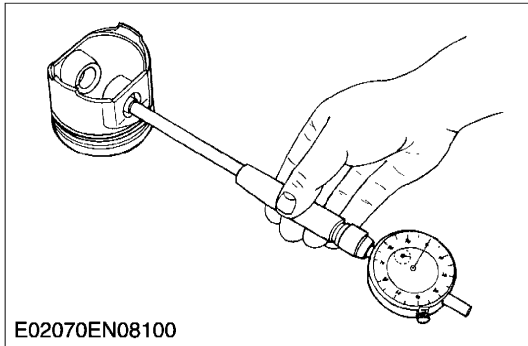
(A) When Removing
(B) When Installing

(a) 0 to 0.2 mm
(0 to 0.0079 in.)

W11373220



(3) Piston and Connecting Rod



Piston Pin Bore I.D.

1. Measure the piston pin bore I.D. in both the horizontal and vertical directions with a cylinder gauge.
2. If the measurement exceeds the allowable limit, replace the piston.

Piston pin bore I.D.	Factory spec.	18.000 to 18.011 mm 0.70866 to 0.70910 in.
	Allowable limit	18.05 mm 0.7106 in.

W11406200

Oil Clearance between Piston Pin and Small End Bushing

1. Measure the piston pin O.D. where it contacts the bushing with an outside micrometer.
2. Measure the small end bushing I.D. with an inside micrometer, and calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit, replace the bushing. If it still exceeds the limit, replace the piston pin.

Oil clearance between piston pin and small end bushing	Factory spec.	0.02 to 0.04 mm 0.0008 to 0.0016 in.
	Allowable limit	0.10 mm 0.0039 in.

Piston pin O.D.	Factory spec.	18.000 to 18.005 mm 0.7087 to 0.7089 in.
Small end bushing I.D.	Factory spec.	18.025 to 18.040 mm 0.70965 to 0.71024 in.

W11420110

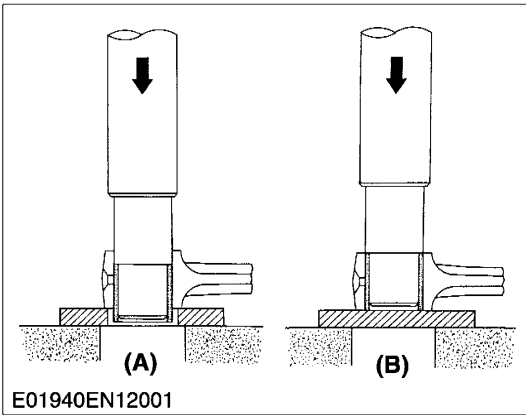
Connecting Rod Alignment

■ NOTE

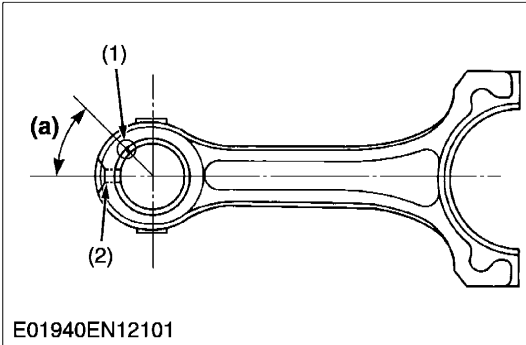
- **Since the I.D. of the connecting rod small end bushing is the basis of this check, check the bushing for wear before hand.**
1. Remove the crankpin bearing, and install the connecting rod cap.
 2. Install the piston pin in the connecting rod.
 3. Install the connecting rod on the connecting rod alignment tool (Code No. 07909-31661).
 4. Put a gauge over the piston pin, and move it against the face plate.
 5. If the gauge does not fit squarely against the face plate, measure the space between the gauge and the face plate.
 6. If the measurement exceeds the allowable limit, replace the connecting rod.

Space between gauge pin and face plate	Allowable limit	0.05 mm 0.0020 in.
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W11499650



E01940EN12001



E01940EN12101

Replacing Small End Bushing

(When removing)

1. Press out the used bushing using a small end bushing replacing tool.

(When installing)

1. Clean a new small end bushing and bore, and apply engine oil to them.
2. Insert a new bushing onto the tool and press-fit it with a press so that the seam (1) of bushing positions as shown in the figure, until it is flush with the connecting rod.
3. Drill a hole to the bushing with aligning the oil hole (2) of connecting rod. (Refer to the figure.)

NOTE

- Be sure to chamfer the oil hole circumference with an oil stone.

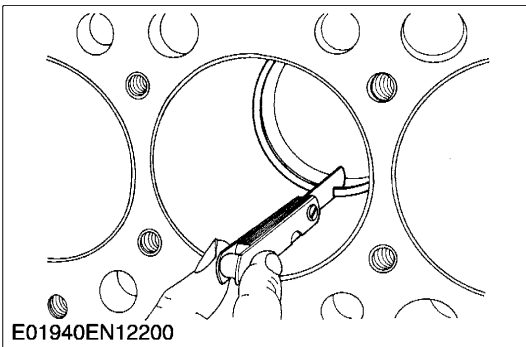
Oil clearance between piston pin and small end bushing (Spare parts)	Factory spec.	0.02 to 0.04 mm 0.0008 to 0.0016 in.
	Allowable limit	0.10 mm 0.0039 in.

Small end bushing I.D.	Factory spec.	18.025 to 18.040 mm 0.70965 to 0.71024 in.
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- (1) Seam
(2) Oil Hole

- (A) When Removing**
(B) When Installing
(a) 0.79 rad. (45°)

W11437590



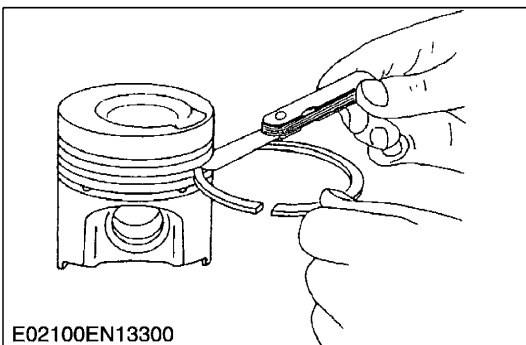
E01940EN12200

Piston Ring Gap

1. Insert the piston ring into the lower part of the cylinder (the least worn out part) with a piston ring compressor and piston.
2. Measure the ring gap with a feeler gauge.
3. If the measurement exceeds the allowable limit, replace the piston ring.

Piston ring gap	Compression ring 1, 2	Factory spec.	0.15 to 0.35 mm 0.0059 to 0.0138 in.
		Allowable limit	1.25 mm 0.0492 in.
	Oil ring	Factory spec.	0.25 to 0.45 mm 0.0098 to 0.0177 in.
		Allowable limit	1.25 mm 0.0492 in.

W11466710



E02100EN13300

Clearance between Piston Ring and Piston Ring Groove

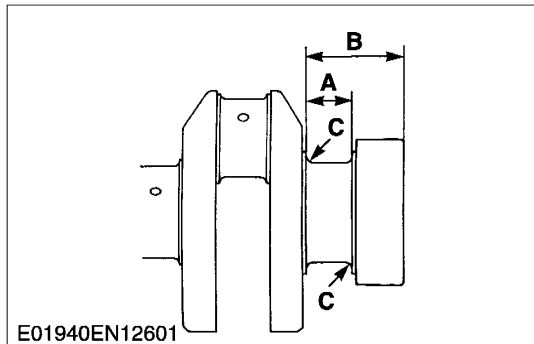
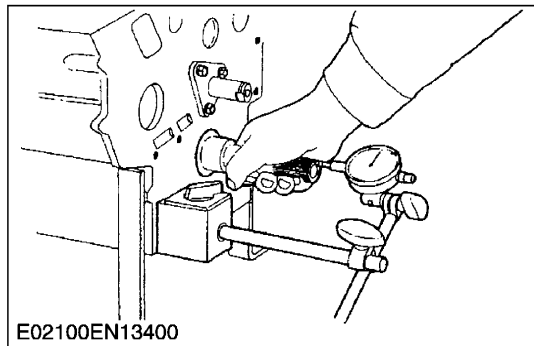
1. Clean the rings and the ring grooves, and install each ring in its groove.
2. Measure the clearance between the ring and the groove with a feeler gauge.
3. If the clearance exceeds the allowable limit, replace the piston ring.
4. If the clearance still exceeds the allowable limit with new ring, replace the piston.

Clearance between piston ring and piston ring groove	Compression ring 2	Factory spec.	0.04 to 0.08 mm 0.0016 to 0.0031 in.
		Allowable limit	0.15 mm 0.0059 in.
	Oil ring	Factory spec.	0.06 to 0.15 mm 0.0024 to 0.0059 in.

W11485500

KiSC issued 04, 2006 A

(4) Crankshaft



Crankshaft Side Clearance

1. Set a dial indicator with its tip on the end of the crankshaft.
2. Measure the side clearance by moving the crankshaft to the front and rear.
3. If the measurement exceeds the allowable limit, replace the thrust bearings.
4. If the same size bearing is useless because of the crankshaft journal wear, replace it with an oversize one referring to the table and figure.

Crankshaft side clearance	Factory spec.	0.15 to 0.31 mm 0.0059 to 0.0122 in.
	Allowable limit	0.50 mm 0.0197 in.

(Reference)

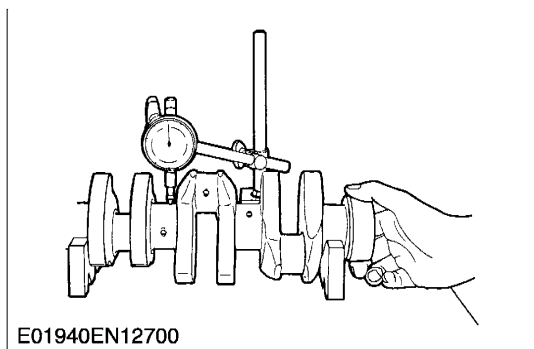
- Oversize thrust bearing

Oversize	Bearing	Code Number	Marking
0.2 mm 0.008 in.	Thrust bearing 1 02	15261-23951	020 OS
	Thrust bearing 2 02	15261-23971	020 OS
0.4 mm 0.016 in.	Thrust bearing 1 04	15261-23961	040 OS
	Thrust bearing 2 04	15261-23981	040 OS

- Oversize dimensions of crankshaft journal

Oversize	0.2 mm 0.008 in.	0.4 mm 0.016 in.
Dimension A	23.40 to 23.45 mm 0.9134 to 0.9154 in.	23.80 to 23.85 mm 0.9213 to 0.9232 in.
Dimension B	46.1 to 46.3 mm 1.815 to 1.823 in.	46.3 to 46.5 mm 1.815 to 1.831 in.
Dimension C	1.8 to 2.2 mm radius 0.071 to 0.087 in. radius	1.8 to 2.2 mm radius 0.071 to 0.087 in. radius
(0.8-S) The crankshaft journal must be fine-finished to higher than $\nabla\nabla\nabla\nabla$.		

W11554750

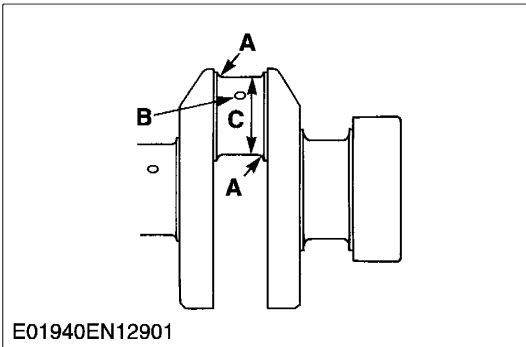
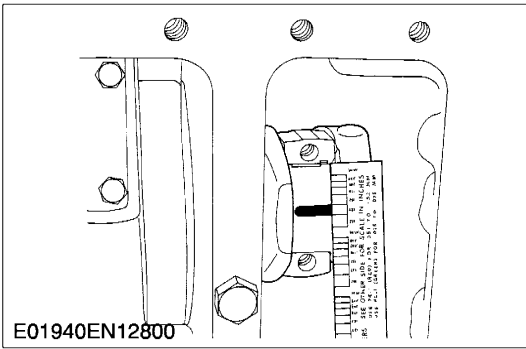


Crankshaft Alignment

1. Support the crankshaft with V blocks on the surface plate at both end journals.
2. Set a dial indicator with its tip on the intermediate journal.
3. Measure the crankshaft alignment.
4. If the measurement exceeds the allowable limit, replace the crankshaft.

Crankshaft alignment	Allowable limit	0.02 mm 0.0008 in.
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W11613530



Oil Clearance between Crankpin and Crankpin Bearing

1. Clean the crankpin and crankpin bearing.
2. Put a strip of plastigage (Code No. 07909-30241) on the center of the crankpin.
3. Install the connecting rod cap and tighten the connecting rod screws to the specified torque, and remove the cap again.
4. Measure the amount of the flattening with the scale, and get the oil clearance.
5. If the oil clearance exceeds the allowable limit, replace the crankpin bearing.
6. If the same size bearing is useless because of the crankpin wear, replace it with an undersize one referring to the table and figure.

■ **NOTE**

- **Never insert the plastigage into the crankpin oil hole.**
- **Be sure not to move the crankshaft while the connecting rod screws are tightened.**

Oil clearance between crankpin and crankpin bearing	Factory spec.	0.020 to 0.051mm 0.00079 to 0.00201 in.
	Allowable limit	0.15 mm 0.0059 in.

Crankpin O.D.	Factory spec.	33.959 to 33.975 mm 1.33697 to 1.33760 in.
Crankpin bearing I.D.	Factory spec.	33.995 to 34.010 mm 1.33839 to 1.33898 in.

(Reference)

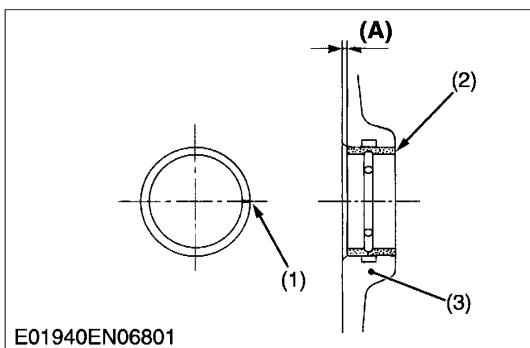
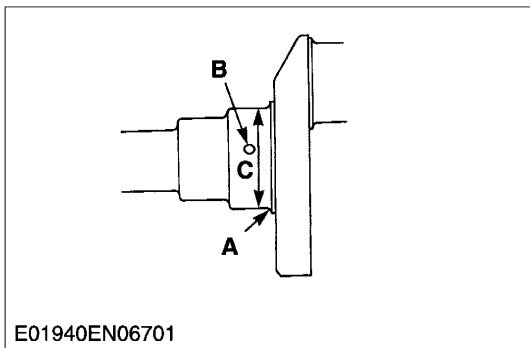
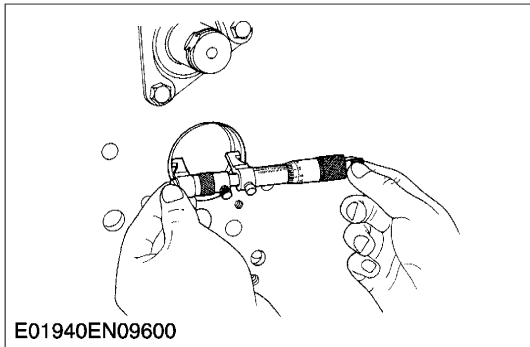
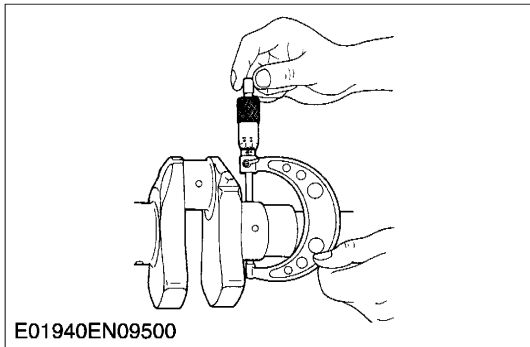
- Undersize crankpin bearing.

Undersize	Bearing	Code Number	Marking
0.2mm 0.008 in.	Crankpin bearing 02	15861-22971	020 US
0.4mm 0.016 in.	Crankpin bearing 04	15861-22981	040 US

- Undersize dimensions of crankpin.

Dimension	Undersize	
	0.2 mm 0.008 in.	0.4 mm 0.016 in.
A	2.3 to 2.7 mm radius 0.091 to 0.106 in. radius	2.3 to 2.7 mm radius 0.091 to 0.106 in. radius
B	4.0 mm radius 0.16 in. radius	4.0 mm radius 0.16 in. radius
C	33.759 to 33.775 mm 1.32910 to 1.32973 in.	33.559 to 33.575 mm 1.32122 to 1.32185 in.
(0.8-S) The crankpin must be fine-finished to higher than ∇∇∇∇ .		

W11625390



Oil Clearance between Crankshaft Journal and Crankshaft Bearing 1

1. Measure the O.D. of the crankshaft front journal with an outside micrometer.
2. Measure the I.D. of the crankshaft bearing 1 with an inside micrometer, and calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit, replace the crankshaft bearing 1.
4. If the same size bearing is useless because of the crankshaft journal wear, replace it with an undersize one referring to the table and figure.

Oil Clearance between Crankshaft Journal and Crankshaft Bearing 1	Factory spec.	0.034 to 0.106 mm 0.00134 to 0.00417 in.
	Allowable limit	0.20 mm 0.0079 in.

Crankshaft journal O.D.	Factory spec.	39.934 to 39.950 mm 1.57221 to 1.57284 in.
Crankshaft bearing 1 I.D.	Factory spec.	39.984 to 40.040 mm 1.57417 to 1.57638 in.

W10323470

(Reference)

- Undersize crankshaft bearing 1

Undersize	Bearing	Code Number	Marking
0.2 mm 0.008 in.	Crankshaft bearing 1 02	15861-23911	020 US
0.4 mm 0.016 in.	Crankshaft bearing 1 04	15861-23921	040 US

- Undersize dimensions of crankshaft journal

Dimension \ Undersize	0.2 mm 0.008 in.	0.4 mm 0.016 in.
A	1.8 to 2.2 mm radius 0.071 to 0.087 in. radius	1.8 to 2.2 mm radius 0.071 to 0.087 in. radius
B	5.0 mm dia. 0.20 in. dia.	5.0 mm dia. 0.20 in. dia.
C	39.734 to 39.750 mm 1.56433 to 1.56496 in.	39.534 to 39.550 mm 1.55646 to 1.55709 in.

(0.8-S)
The crankshaft journal must be fine-finished to higher than $\nabla\nabla\nabla\nabla$.

W10328440

Replacing Crankshaft Bearing 1

(When removing)

1. Press out the used crankshaft bearing 1 using a crankshaft bearing 1 replacing tool.

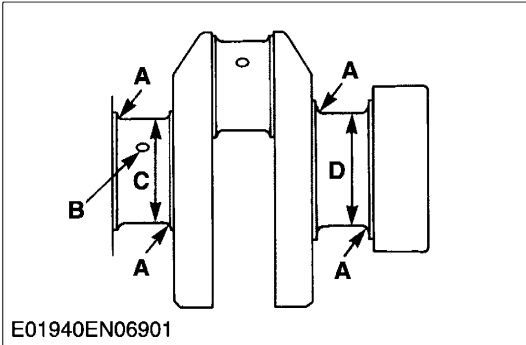
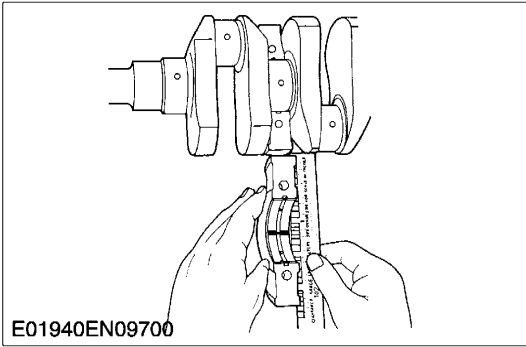
(When installing)

1. Clean a new crankshaft bearing 1 and crankshaft journal bore, and apply engine oil to them.
2. Using a crankshaft bearing 1 replacing tool, press in a new bearing 1 (2) so that its seam (1) directs toward the exhaust manifold side. (See figure.)

Dimension (A)	Factory spec.	0.0 to 0.3 mm 0.00 to 0.012 in.
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- (1) Seam
- (2) Crankshaft Bearing 1
- (3) Cylinder Block
- (A) Dimension**

W10342000



Oil Clearance between Crankshaft Journal and Crankshaft Bearing 2 and Crankshaft Bearing 3

1. Put a strip of plastigage (Code No. 07909-30241) on the center of the journal.
2. Install the bearing case and tighten the bearing case screws 1 to the specified torque, and remove the bearing case again.
3. Measure the amount of the flattening with the scale, and get the oil clearance.
4. If the oil clearance exceeds the allowable limit, replace the crankshaft bearing 2 (crankshaft bearing 3).
5. If the same size bearing is useless because of the crankshaft journal wear, replace it with an undersize one referring to the table and figure.

■ **NOTE**

- Be sure not to move the crankshaft while the bearing case screws are tightened.

Oil clearance between crankshaft journal and crankshaft bearing 2 and crankshaft bearing 3	Factory spec.	0.028 to 0.059 mm 0.00110 to 0.00232 in.
	Allowable limit	0.20 mm 0.0079 in.

Crankshaft journal O.D. (Intermediate)	Factory spec.	39.934 to 39.950 mm 1.57221 to 1.57284 in.
Crankshaft bearing 3 I.D.	Factory spec.	39.978 to 39.993 mm 1.57394 to 1.57453 in.

Crankshaft journal O.D. (Flywheel side)	Factory spec.	43.978 to 43.993 mm 1.73142 to 1.73201 in.
Crankshaft bearing 2 I.D.	Factory spec.	43.984 to 44.026 mm 1.73165 to 1.73331 in.

(Reference)

- Undersize crankshaft bearing 2 and 3

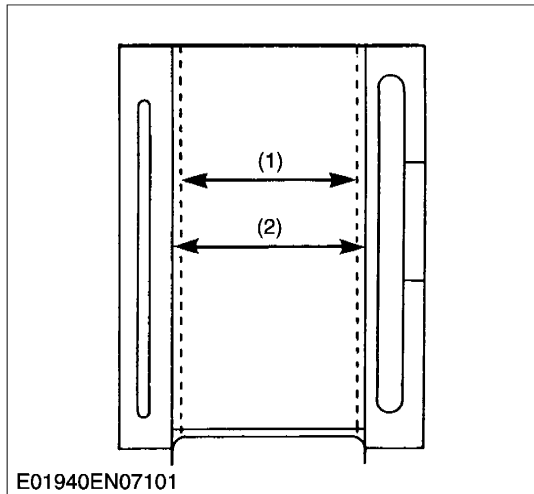
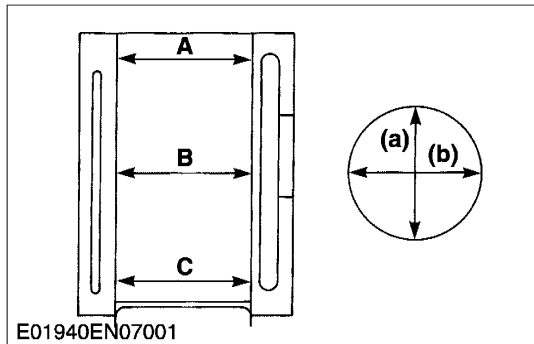
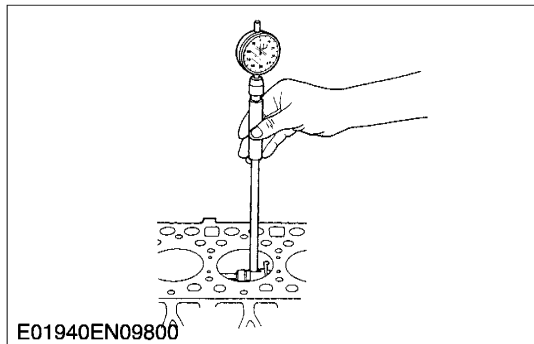
Undersize	Bearing	Code Number	Marking
0.2 mm 0.008 in.	Crankshaft bearing 2 02	15694-23931	020 US
	Crankshaft bearing 3 02	15861-23861	020 US
0.4 mm 0.016 in.	Crankshaft bearing 2 04	15694-23941	040 US
	Crankshaft bearing 3 04	15861-23871	040 US

- Undersize dimensions of crankshaft journal

Dimension	Undersize	0.2 mm 0.008 in.	0.4 mm 0.016 in.
	A		1.8 to 2.2 mm radius 0.071 to 0.087 in. radius
B		3.0 mm dia. 0.12 in. dia.	3.0 mm dia. 0.12 in. dia.
C		39.734 to 39.750 mm 1.56433 to 1.56496 in.	39.534 to 39.550 mm 1.55646 to 1.55709 in.
D		43.734 to 43.750 mm 1.72181 to 1.72244 in.	43.534 to 43.550 mm 1.71394 to 1.71457 in.
(0.8-S) The crankshaft journal must be fine-finished to higher than ▽▽▽▽ .			

W10344030

(5) Cylinder



Cylinder Wear

1. Measure the I.D. of the cylinder at the six positions (see figure.) with a cylinder gauge to find the maximum and minimum I.D.'s.
2. Get the difference (Maximum wear) between the maximum and the minimum I.D.'s.
3. If the wear exceeds the allowable limit, bore and hone to the oversize found, the cylinder should be bored. (Refer to “**Correcting Cylinder**”.)
4. Visually check the cylinder wall for scratches. If deep scratches are found, the cylinder should be bored. (Refer to “**Correcting Cylinder**”.)

Cylinder liner I.D.	Factory spec.	68.000 to 68.019 mm 2.67717 to 2.67791 in.
	Allowable limit	68.169 mm 2.68381 in.

- (A) Top
- (B) Middle
- (C) Bottom (Skirt)

- (a) Right-angled to Piston Pin
- (b) Piston Pin Direction

W10360060

Correcting Cylinder (Oversize 0.50 mm, 0.0196 in.)

1. When the cylinder is worn beyond the allowable limit, bore and hone it to the specified dimension.

Oversized cylinder liner I.D.	Factory spec.	68.500 to 68.519 mm 2.6968 to 2.6976 in.
	Allowable limit	68.669 mm 2.7035 in.
Finishing	Hone to 1.2 to 2.0 mm R max. ▽▽▽ (0.000047 to 0.000079 in. R max.)	

2. Replace the piston and piston rings with oversize ones.

Oversize	Part Name	Code Number	Marking
0.50 mm 0.0196 in.	Piston	EG601-2191-0	050 OS
	Piston ring assembly	12691-2109-3	050 OS

NOTE

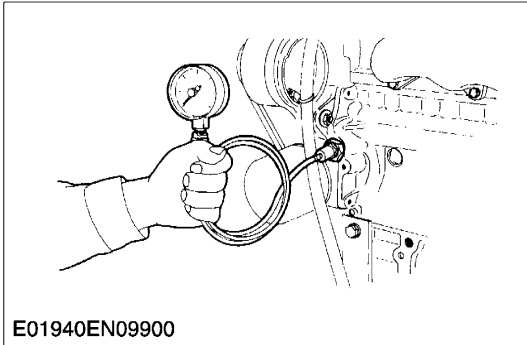
- When the oversize cylinder is worn beyond the allowable limit, replace the cylinder block with a new one.

- (1) Cylinder I.D. (Before Correction)
- (2) Oversized Cylinder I.D.

W10367470

3. LUBRICATING SYSTEM

[1] CHECKING



E01940EN09900

Engine Oil Pressure

1. Remove the oil switch, and set a oil pressure tester (Code No. 07916-32032).
2. Start the engine. After warming up, measure the oil pressure of rated speeds.
3. If the oil pressure is less than the allowable limit, check the following.
 - Engine oil insufficient
 - Oil pump defective
 - Oil strainer clogged
 - Oil filter cartridge clogged
 - Oil gallery clogged
 - Excessive oil clearance
 - Foreign matter in the relief valve

Engine oil pressure	At idle speed	Factory spec.	more than 69 kPa 0.7 kgf/cm ² 10 psi
	At rated speed	Factory spec.	196 to 441 kPa 2.0 to 4.5 kgf/cm ² 28 to 64 psi
		Allowable limit	186 kPa 1.9 kgf/cm ² 27 psi

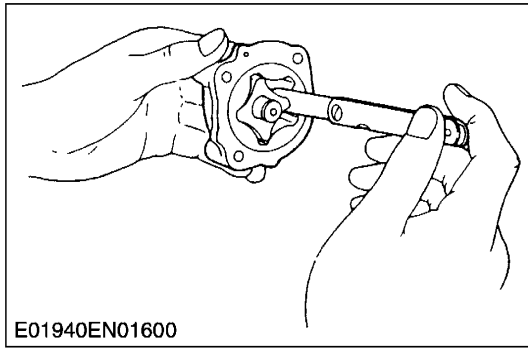
(When reassembling)

- After checking the engine oil pressure tighten the oil switch to the specified torque.

Tightening torque	Oil switch	14.7 to 19.6 N·m 1.5 to 2.0 kgf·m 10.8 to 14.5 ft-lbs
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W10373890

[2] SERVICING

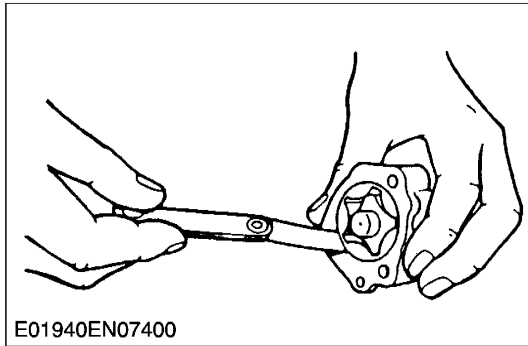


Clearance between Inner Rotor and Outer Rotor

1. Measure the clearance between lobes of the inner rotor and the outer rotor with a feeler gauge.
2. If the clearance exceeds the factory specifications, replace the oil pump rotor assembly.

Clearance between inner rotor and outer rotor	Factory spec.	0.03 to 0.14 mm 0.0012 to 0.0055 in.
	Allowable limit	0.25 mm 0.0098 in.

W10378950

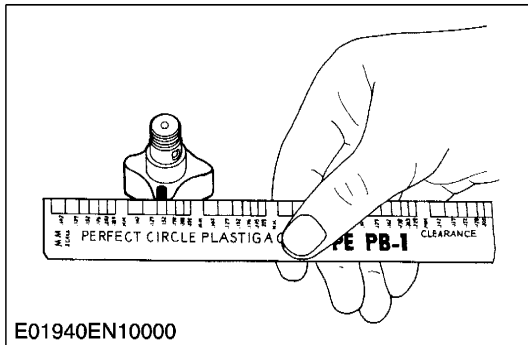


Clearance between Outer Rotor and Pump Body

1. Measure the clearance between the outer rotor and the pump body with a feeler gauge.
2. If the clearance exceeds the factory specifications, replace the oil pump rotor assembly.

Clearance between outer rotor and pump body	Factory spec.	0.07 to 0.15 mm 0.0028 to 0.0059 in.
	Allowable limit	0.30 mm 0.0118 in.

W10381420



Clearance between Rotor and Cover

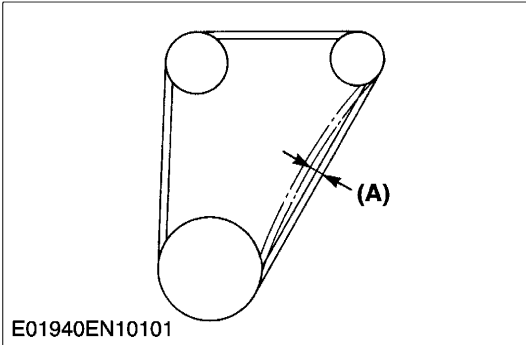
1. Put a strip of plastigage (Code No. 07909-30241) onto the rotor face with grease.
2. Install the cover and tighten the screws.
3. Remove the cover carefully, and measure the amount of the flattening with the scale and get the clearance.
4. If the clearance exceeds the factory specifications, replace oil pump rotor assembly.

Clearance between rotor and cover	Factory spec.	0.075 to 0.135 mm 0.00295 to 0.00531 in.
	Allowable limit	0.20 mm 0.0079 in.

W10382660

4. COOLING SYSTEM

[1] CHECKING AND ADJUSTING

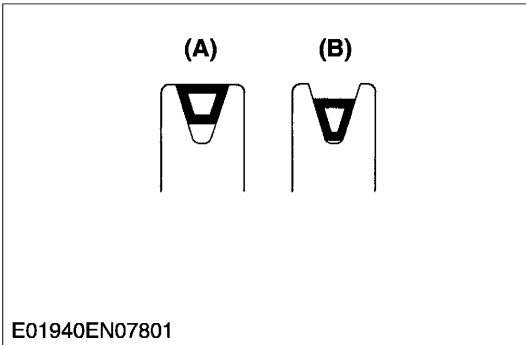


Fan Belt Tension

1. Measure the deflection (A), depressing the belt halfway between the fan drive pulley and alternator at specified force (98 N, 10 kgf, 22 lbs).
2. If the measurement is not within the factory specifications, loosen the alternator mounting screws and relocate the alternator to adjust.

Deflection (A)	Factory spec.	7.0 to 9.0 mm 0.28 to 0.35 in.
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W10384280



Fan Belt Damage and Wear

1. Check the fan belt for damaged.
2. If the fan belt is damaged, replace it.
3. Check if the fan belt is worn and sunk in the pulley groove.
4. If the fan belt is nearly worn out and deeply sunk in the pulley groove, replace it.

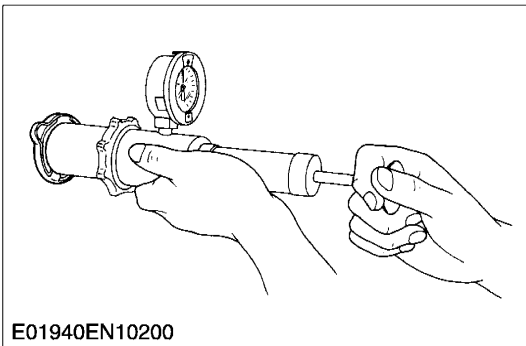
(A) Good

(B) Bad

W10385490

CAUTION

- When removing the radiator cap, wait at least ten minutes after the engine has stopped and cooled down. Otherwise, hot water may gush out, scalding nearby people.

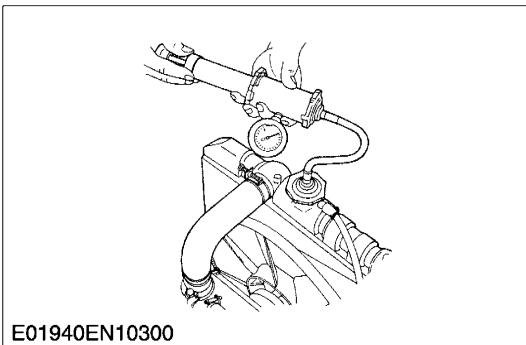


Radiator Cap Air Leakage

1. Set a radiator tester (Code No. 07909-31551) and an adapter (BANZAI Code No. RCT-2A-30S) on the radiator cap.
2. Apply the specified pressure (88 kPa, 0.9 kgf/cm², 13 psi), and measure the time for the pressure to fall to 59 kPa (0.6 kgf/cm², 9 psi).
3. If the measurement is less than the factory specification, replace the radiator cap.

Pressure falling time	Factory spec.	More than 10 seconds for pressure fall from 88 to 59 kPa (from 0.9 to 0.6 kgf/cm ² , from 13 to 9 psi)
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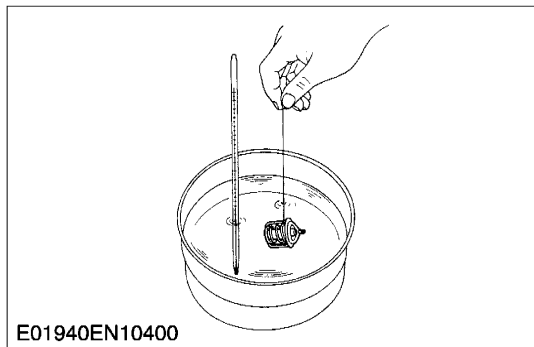


Radiator Water Leakage

1. Pour a specified amount of water into the radiator.
2. Set a radiator tester (Code No. 07909-31551) with an adapter (BANZAI Code No. RCT-2A-30S) and raise the water pressure to the specified pressure.
3. Check the radiator for water leaks.
4. For water leak from the pinhole, replace the radiator or repair with the radiator cement. When water leak is excessive, replace the radiator.

Radiator water leakage test pressure	Factory spec.	137 kPa 1.4 kgf/cm ² 20 psi
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W10389070



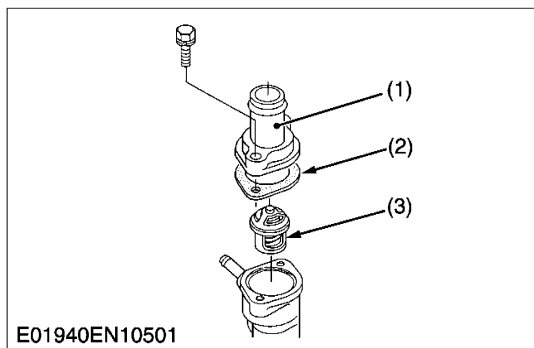
Thermostat Valve Opening Temperature

1. Suspend the thermostat in the water by a string with its end inserted between the valve and seat.
2. Heating the water gradually, read the temperature when the valve opens and leaves the string.
3. Continue heating and read the temperature when the valve opens approx. 6 mm (0.236 in.).
4. If the measurement is not within the factory specifications, replace the thermostat.

Thermostat's valve opening temperature	Factory spec.	80.5 to 83.5 °C 177 to 182 °F
Temperature at which thermostat completely opens	Factory spec.	95 °C 203 °F

W10390350

[2] DISASSEMBLING AND ASSEMBLING



Thermostat Assembly

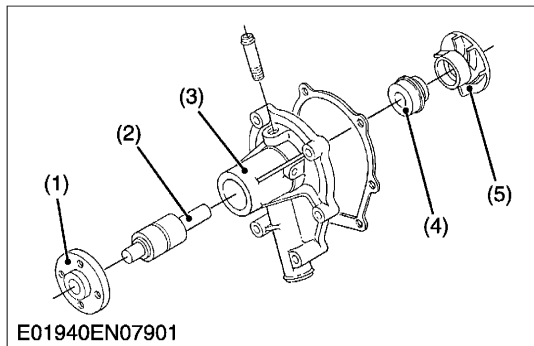
1. Remove the thermostat cover mounting screws, and remove the thermostat cover (1).
2. Remove the thermostat assembly (3).

(When reassembling)

- Apply a liquid gasket (Three Bond 1215 or equivalent) only at the thermostat cover side of the thermostat cover gasket (2).

- (1) Thermostat Cover
- (2) Thermostat Cover Gasket
- (3) Thermostat Assembly

W10393690



Water Pump Assembly

1. Loosen the alternator mounting bolts, and remove the fan belt.
2. Remove the fan and fan pulley.
3. Remove the water pump assembly from the gear case cover.
4. Remove the water pump flange (1).
5. Press out the water pump shaft (2) with the impeller (5) on it.
6. Remove the impeller from the water pump shaft (2).
7. Remove the mechanical seal (4).

(When reassembling)

- Apply a liquid gasket (Three Bond 1215 or equivalent) to the both sides of gasket.
- Replace the mechanical seal with new one.

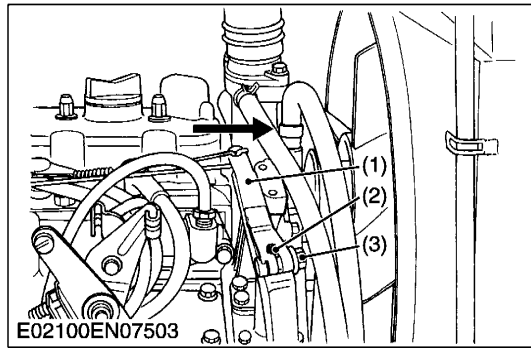
- (1) Water Pump Flange
- (2) Water Pump Shaft
- (3) Water Pump Body
- (4) Mechanical Seal
- (5) Impeller

W10395040

5. FUEL SYSTEM

[1] CHECKING AND ADJUSTING

(1) Governor



Adjusting Governor

1. Loosen the governor lever nut (3).
2. Set the throttle valve to the fully “open” position with the governor lever (1), turn the groove on the governor lever shaft (2) fully clockwise with a screwdriver (to open the governor completely), and then tighten the nut (3) in this position.

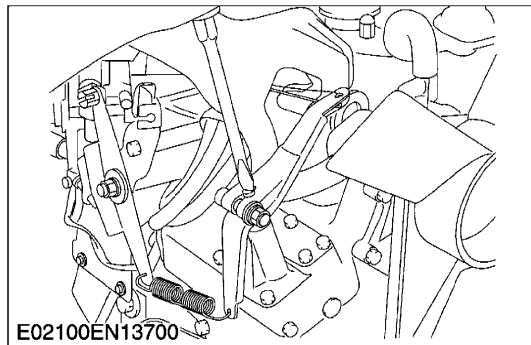
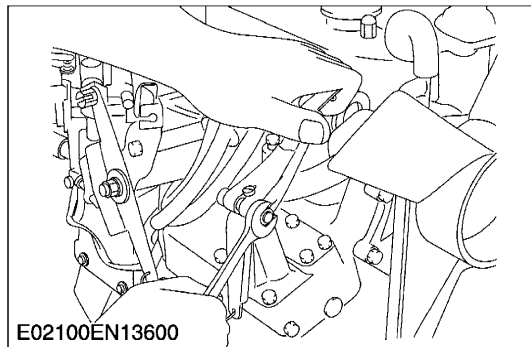
Tightening torque	Governor lever nut	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.2 ft-lbs
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(1) Governor Lever

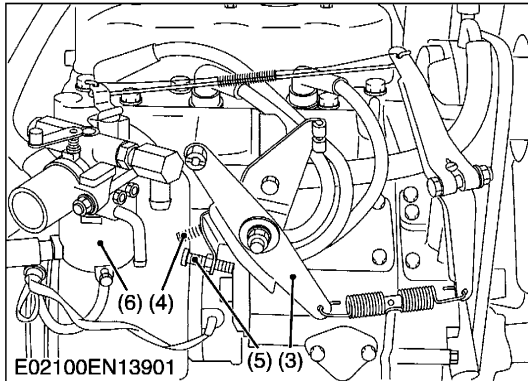
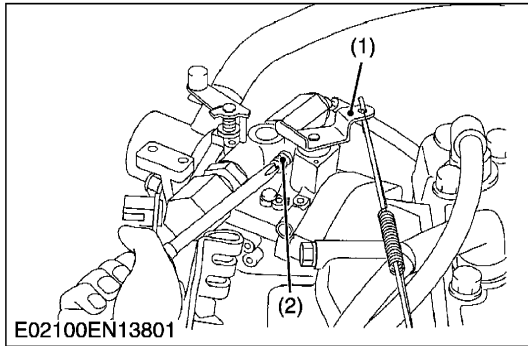
(3) Governor Lever Nut

(2) Governor Lever Shaft

W1076333



(2) Engine Speed



Adjusting Engine Speed

1. Warm up the engine at a medium speed for 10 to 15 minutes.
2. Engine speed is adjusted to approx. 1500 min^{-1} (rpm) by the speed control lever (3).
3. Throttle valve (1) is closed by hand and the rpm of the engine is adjusted with the throttle adjust screw (2) to 1200 min^{-1} (rpm) (1100 to 1300 min^{-1} (rpm)).
4. Adjust the low-idling speed adjust screw (4) until the engine rpm reaches 1500 min^{-1} (rpm) (1400 to 1600 min^{-1} (rpm)) with the speed control lever (3) in the minimum speed position.
5. Adjust the high-idling speed adjust screw (5) until the engine speed reaches 3850 min^{-1} (rpm) (3850 to 3950 min^{-1} (rpm)) with the speed control lever (3) in the maximum speed position.

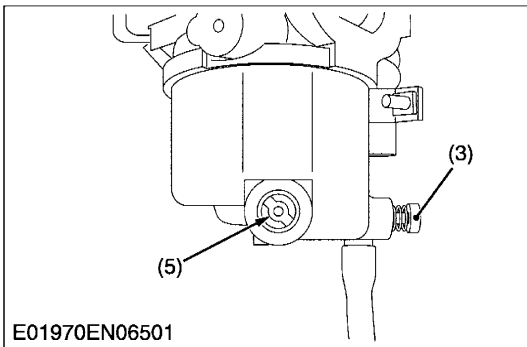
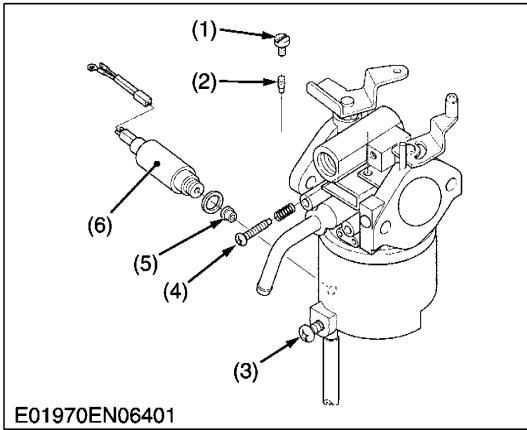
- (1) Throttle Valve
 (2) Throttle Adjust Screw
 (3) Speed Control Lever
 (4) Low-Idling Adjust Screw

- (5) High-Idling Adjust Screw
 (6) Carburetor (WG752-E2) or
 D.F. Carburetor (DF752-E2)

W1076471

(3) Carburetor

(A) Altitude Compensation Kit



Main Jet and Pilot Jet

1. Remove the carburetor. (See page S-34.)
2. Loosen the drain screw (3) to let fuel out.
3. Remove the gasoline solenoid (6).
4. Remove the main jet (5).
5. Install the high-altitude kit's main jet onto the carburetor.
6. Tighten the throttle adjust screw (4) and remove the screw (1).
7. Replace the existing pilot jet (2) with the high-altitude kit's pilot jet.
8. Install the gasoline solenoid (6).
9. Install the carburetor in place. (See page S-34.)
10. Readjust the governor. (See page S-65.)
11. Adjust the engine speed. (See page S-66.)

■ NOTE

- After install the carburetor, the adjustment of governor and engine speed are executed. (See page S-65, 66.)
- Prepare a screwdriver that fits the main jet / pilot jet screws in order not to damage the main jet and pilot jet.
- Replace the air cleaner packing and the carburetor packing with new ones.
- Make sure there is no leak at the air cleaner packing and the carburetor packing.

■ IMPORTANT

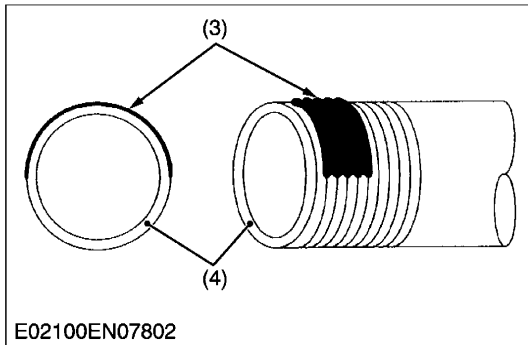
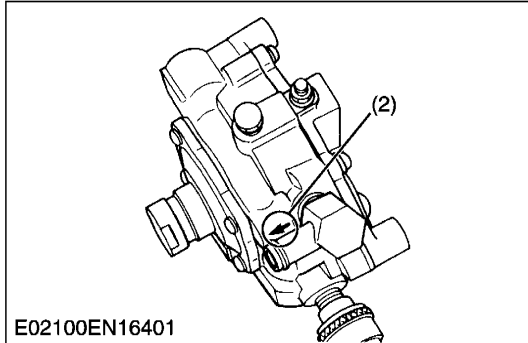
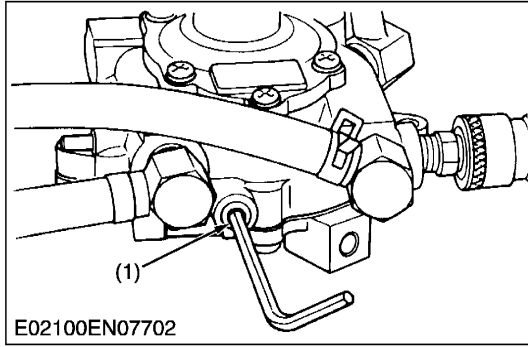
- Keep the carburetor inner parts which is removed from standard carburetor.

Tightening torque	Carburetor mounting nut	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.2 ft-lbs
	Gasoline solenoid	7.8 to 11.7 N·m 0.8 to 1.2 kgf·m 5.8 to 8.7 ft-lbs
	Main jet	1.0 to 2.9 N·m 0.7 to 2.1 kgf·m 5.0 to 15.2 ft-lbs
	Pilot jet	1.0 to 3.9 N·m 0.7 to 2.9 kgf·m 5.0 to 20.5 ft-lbs

- (1) Pilot Screw
 (2) Pilot Jet
 (3) Drain Screw

- (4) Throttle Adjust Screw
 (5) Main Jet
 (6) Gasoline Solenoid

(4) Vaporizer (DF752-E2)



Joints (Fittings)

1. The direction of the joint for vapor hose is decided upon and a mark (2) is made.
2. The direction of the joint for water hose is decided upon and a mark is made.

NOTE

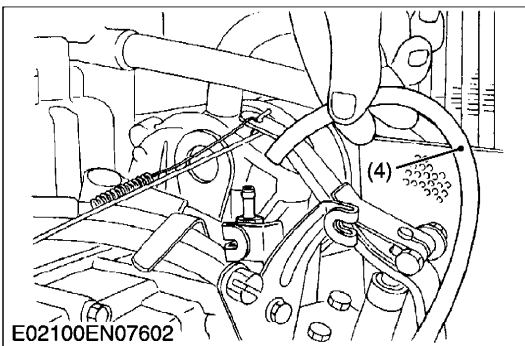
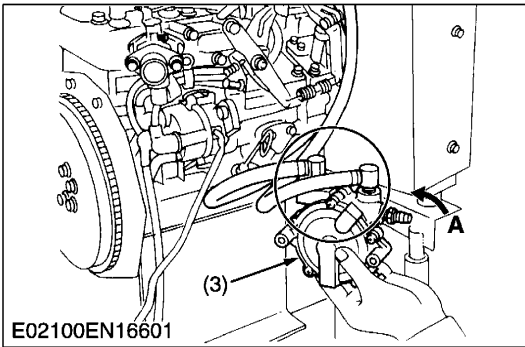
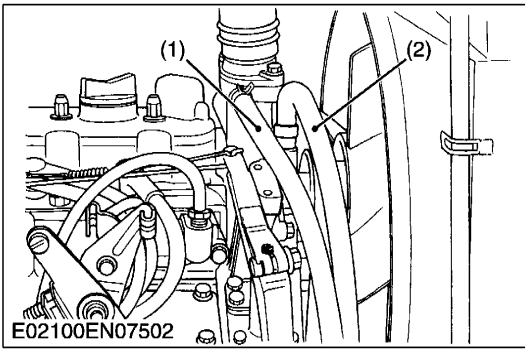
- Vaporizer must be installed in an upright position (water hoses at bottom).
- The joints (fitting) can be adjusted to any position. The joint must be tight in that position.
- Apply an approved for GAS or LPG use liquid gasket (Three Bond #1104 or its equivalent) to thread (see figure.) and tighten it.
- Drain plug (1) must not be obstructed; so that it can be removed during maintenance.
- Apply liquid gasket to the thread of each joint and tighten them.
- After selecting the joint (fitting) positions, insure that there are no leaks.

Tightening torque	Joint for LPG hose (local arrangement)	19.6 to 32.9 N·m 2.0 to 4.0 kgf·m
	Joint for vapor hose	29.4 to 58.8 N·m
	Joint for water hose	3.0 to 6.0 kgf·m

(1) Drain Plug
(2) Mark

(3) Liquid Gasket
(4) Joint

W1082628



Piping

1. Connect the water hose (1) and (2) through the vaporizer.
2. The water joint part of vaporizer is adjusted to the upper side (A) and coolant is replenished through radiator, to bleed air in the vaporizer.
3. Vaporizer (3) is returned to former position.
4. Connect the vapor hose.
5. Connect the vacuum lock hose (4).
6. Tighten the vaporizer (3).
7. Connect the LPG hose.
 - O.D. of joint for vapor hose: ϕ 12.7 mm, ϕ 0.5 in.
 - O.D. of joint for water hose: ϕ 9.0 mm, ϕ 0.35 in.

⚠ CAUTION

- All fuel connections added to this engine must be installed by qualified personnel and utilizing recognized procedures and standards.
- These non-KUBOTA installed parts, such as hoses, fittings, piping, should be approved for LPG use and conform to UL, CSA, NFPA, and all other recognized standards.
- An approved, listed fuel filter and electromechanical positive shutoff must be installed between the LPG tank and KUBOTA vaporizer. (Not KUBOTA Provided)

■ NOTE

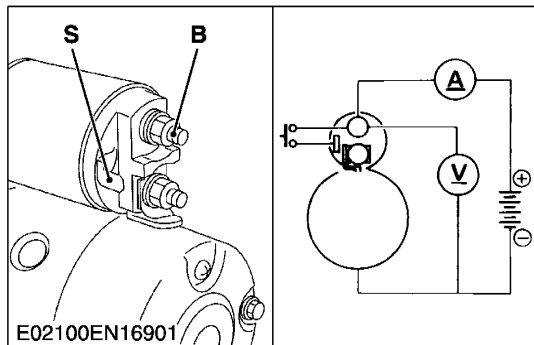
- The LPG liquid in joint (fitting) to the vaporizer / regulator is not provided in the KIT by KUBOTA, due to the many different connection requirements by the OEM. The female thread into the vaporizer / regulator is a PT 1/4 METRIC thread. To insure good sealing the correct fitting must be used.
- Vapor hose between the vaporizer and mixer must be of 280 to 320 mm (11.02 to 12.60 in.) in length, to assure correct emissions and proper operation.
- Perform air bleeding of the vaporizer (water passage).
- Each hose must be tightened with a hose clamp.

- | | |
|----------------|----------------------|
| (1) Water Hose | (3) Vaporizer |
| (2) Water Hose | (4) Vacuum Lock Hose |

W1083003

6. ELECTRICAL SYSTEM

[1] STARTER CHECKING



No-Load Test

1. Connect a cable from the negative terminal of the battery to the body of the starter.
2. Connect a voltmeter across “B” terminal and the body of the starter, and an ammeter across the positive terminal of the battery and “B” terminal of the starter.
3. Connect a switch between “B” and “S” terminals of the starter, and run the starter.
4. The starter should run at the specified rate. (See table.)

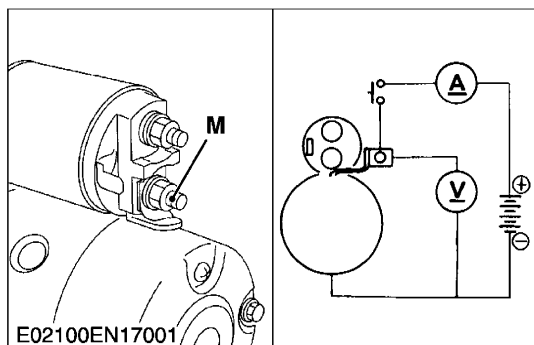
(Reference)

Supply Voltage	11.5 V
Current	Less than 53 A
Speed	More than 7000 min ⁻¹ (rpm)

NOTE

- Test with a cable and an ammeter for large current, and a fully charged battery.

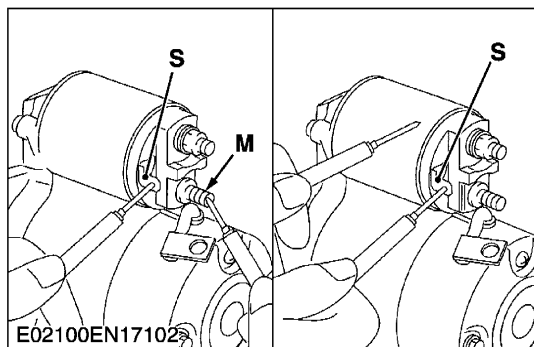
W1083531



Motor Test

1. Disconnect the connecting lead to “M” terminal and connect a voltmeter across the lead and the body of the starter.
2. Connect a cable between the negative terminal of the battery and the starter body.
3. Connect an ammeter and a switch in series between the positive terminal of the battery and the connecting lead, and run the starter.
4. The starter should run at the specified rate. (See “No-load test”.)

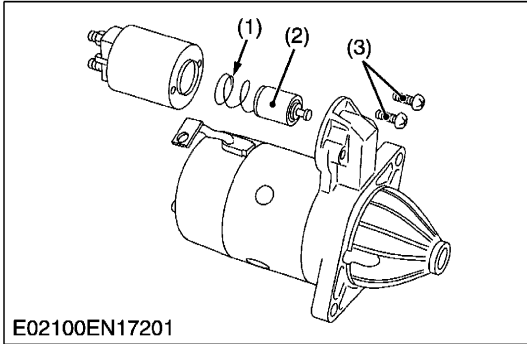
W1083893



Solenoid Switch

1. Check the continuity across “S” and “M” terminals, and across “S” terminal and the body with an ohmmeter.
2. If not continuous, replace.

W1083979

(1) Disassembling and Assembling

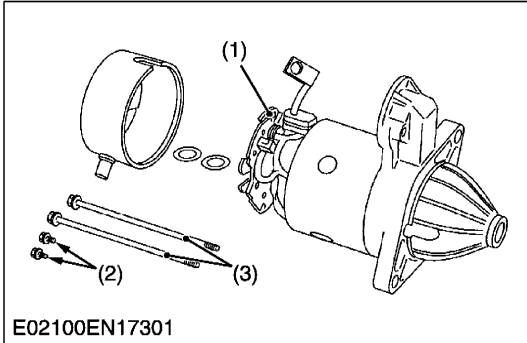
E02100EN17201

Solenoid Switch

1. Remove the screws (3) to separate the solenoid switch.
2. Pull out the plunger (2) and the spring (1).

- (1) Spring
(2) Plunger
(3) Screw

W1084096



E02100EN17301

End Frame

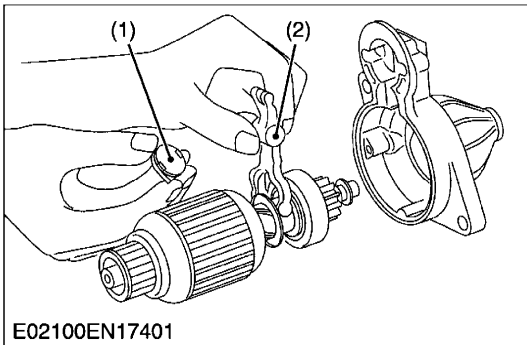
1. Remove the through bolts (3) and the screw (2).
2. Remove the rear end frame.
3. Lift the brush and remove the brush holder (1).
4. Remove the yoke assembly.

NOTE

- Do not miss the thrust washers behind the commutator.

- (1) Brush Holder
(2) Screw
(3) Through Bolt

W1084194



E02100EN17401

Armature

1. Pull out the armature.
2. Remove the plate (1) and the lever (2).

(When reassembling)

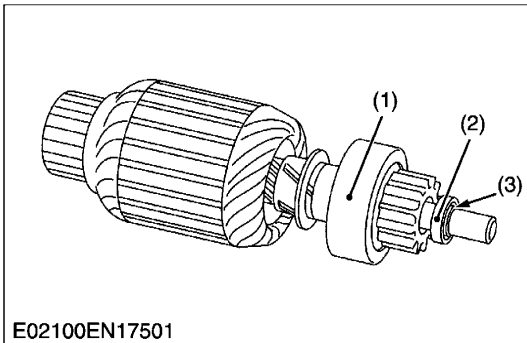
- Install the lever, noting its direction. (See figure.)

NOTE

- Do not miss the thrust washers on the front of the armature shaft.

- (1) Plate
(2) Lever

W1084322



E02100EN17501

Overrunning Clutch

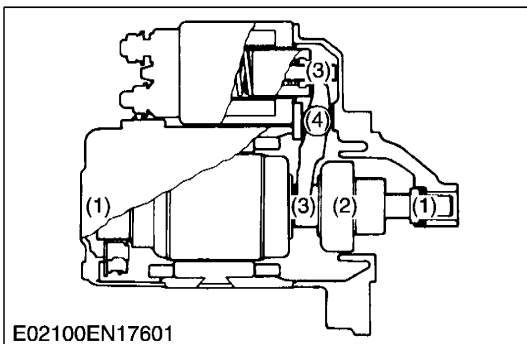
1. Tap in the stop ring (3).
2. Remove the retainer ring (2).
3. Remove the stop ring (3) and the overrunning clutch (1).

(When reassembling)

- Install the stop ring first, then the retainer ring, and then pull up the stop ring with a puller.

- (1) Overrunning Clutch
(2) Retainer Ring
(3) Stop Ring

W1084443



E02100EN17601

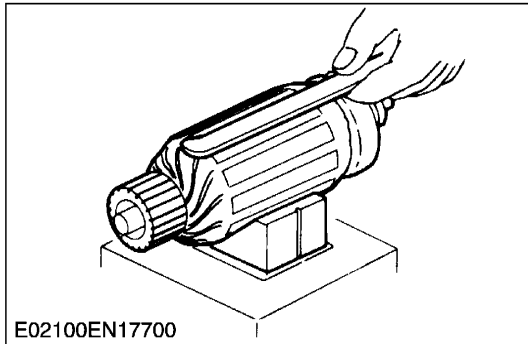
Lubrication

Before reassembling, lubricate the following.

- (1) Bearings in the end frames and the washers.
- (2) Sliding surface between the armature shaft and overrunning clutch (with low viscosity oil).
- (3) Shift lever where it engages with the plunger and the overrunning clutch.
- (4) Plunger where it contacts with solenoid housing.

W1084566

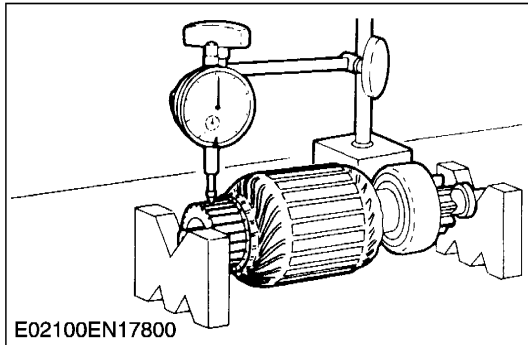
(2) Servicing



Armature Coil

1. Place the armature on a growler to check for the short circuits, and slowly rotate the armature holding an iron piece above the core.
2. If the iron piece vibrates against the core, replace the armature.
3. Check the continuity across each segment of the commutator and the armature shaft.
4. If continuous, replace the armature.

W1084671



Commutator

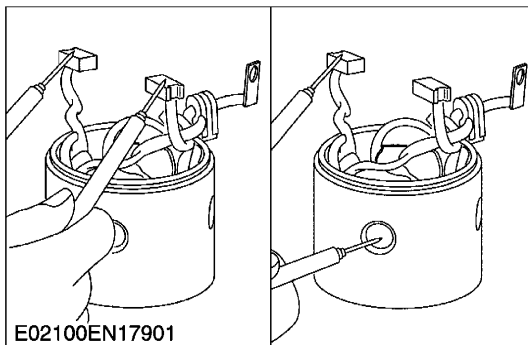
1. Rotate the armature in V blocks to check out-of-roundness and run-out, setting a dial indicator with its tip on the commutator.
2. If the variance among the readings is more than the allowable limit, turn the armature in the lathe.
3. If the depth of undercut is less than the allowable limit, undercut with a hacksaw blade or an undercutter.
4. Sand off all burrs with sandpaper.

NOTE

- When the smallest radius of the commutator is less than the allowable limit, replace the armature shaft.

Variance on commutator O.D.	Allowable limit	0.05 mm 0.0020 in.
Commutator O.D.	Allowable limit	31 mm 1.22 in.
Commutator undercut	Allowable limit	0.2 mm 0.008 in.

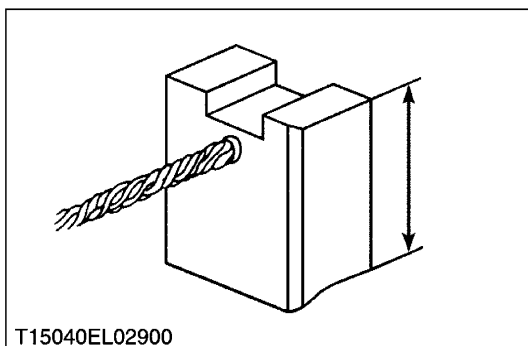
W1084892



Field Coil

1. Check the continuity between the brushes.
2. If not continuous, replace the yoke assembly.
3. Check the continuity across the yoke and the brush or the connecting lead.
4. If continuous, check for the breakage of the insulation.
5. If not repairable, replace the yoke assembly.
6. Check that the pole and windings are not loose.

W1085069

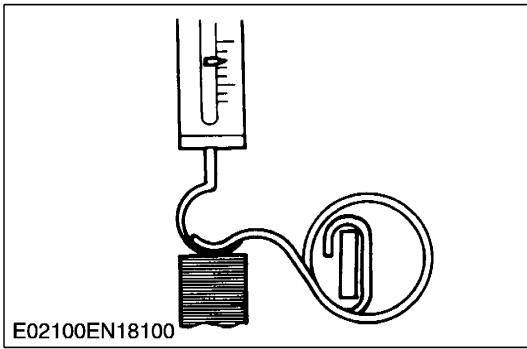


Brush

1. Clean off the brush and check for the wear.
2. If unevenly worn, correct.
3. If worn to less than the allowable limit, replace.
4. Check that the brushes move freely in the brush holder.

Brush length	Factory spec.	17 mm 0.67 in.
	Allowable limit	11.5 mm 0.453 in.

W1086211

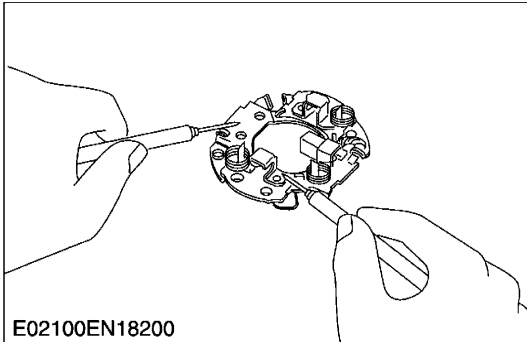


Brush Spring

1. Pull the brush in the brush holder with a spring scale.
2. Measure the brush spring tension required to raise the spring from contact position with the commutator.
3. If the tension is less than the allowable limit, replace the spring.

Brush length	Factory spec.	13.7 to 25.5 N·m 1.4 to 2.6 kgf·m 3.1 to 5.7 ft-lbs
	Allowable limit	13.7 to 25.5 N·m 1.4 to 2.6 kgf·m 3.1 to 5.7 ft-lbs

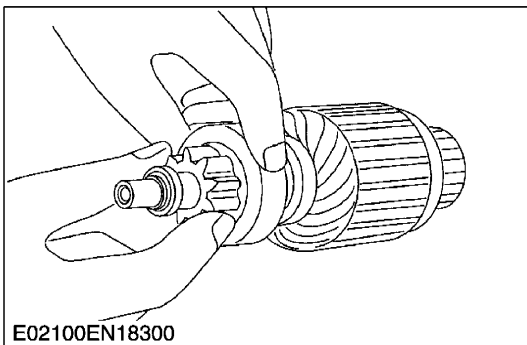
W1086323



Brush Holder

1. Check the continuity across the insulated brush holder and the brush holder support.
2. If continuous, replace the brush holder assembly.

W1086509



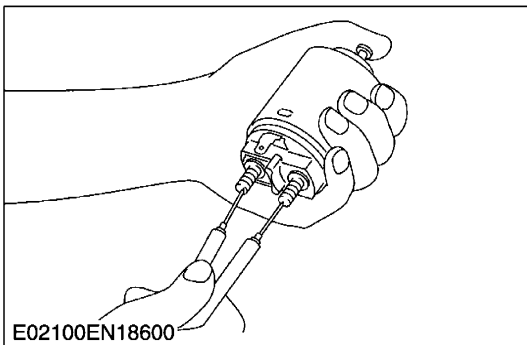
Overrunning Clutch

1. Check the pinion and if worn or damaged, replace the clutch assembly.
2. Check that the pinion turns freely and smoothly in the overrunning direction and does not slip in the cranking direction.
3. If the pinion slip or does not turn in both directions, replace the overrunning clutch assembly.

■ **NOTE**

- Do not wash off the grease in the overrunning clutch with the chemicals or oils.

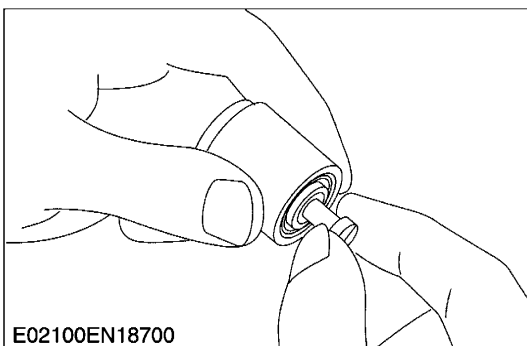
W1086577

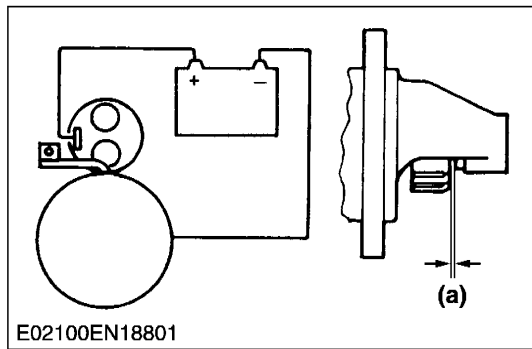


Solenoid Switch

1. Check the continuity across “B” and “M” terminals with an ohmmeter, pushing in the plunger.
2. If not continuous or if a certain value is indicated, replace the solenoid switch.
3. Pull the pull-rod to check the spring built in the plunger.

W1086675





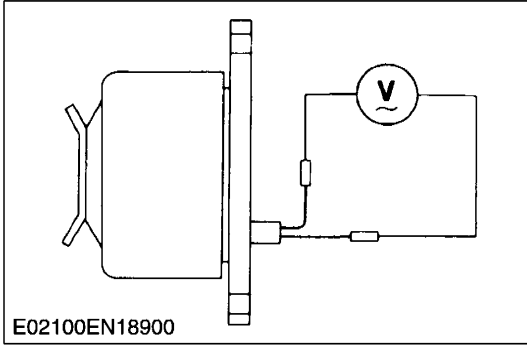
Pinion Clearance

1. Reassemble the starter with connecting leads unconnected.
2. Connect a cable from the negative terminal of the battery to the starter body and a cable from “S” terminal of the starter to the positive terminal of the battery to force out the pinion.
3. Push back the pinion slightly to kill the play, and measure the pinion clearance.
4. If the clearance is not within the specified values, add or remove the washer between the solenoid switch and front end frame.

Pinion clearance (a)	Factory spec.	0.5 to 2.0 mm 0.020 to 0.079 in.
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W1086779

[2] ALTERNATOR AND REGULATOR CHECKING

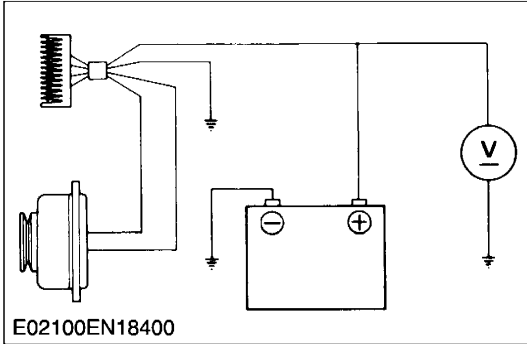


No-Load Alternator Output

1. Disconnect the lead wires from the alternator.
2. Start the engine and operate the alternator at the specified speed.
3. Measure the output voltage with a volt meter.
If the measurement is not within the specified values, replace the alternator.

No-load output	Factory spec.	AC 20 V or more at 5200 min ⁻¹ (rpm)
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W1088054



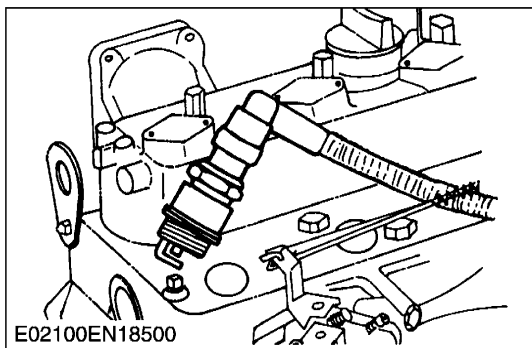
Regulating Voltage

1. Complete the charging circuit with a fully charged battery and operate the alternator at the specified speed.
2. Measure the battery voltage with a volt meter.
3. If the measurement is not within the specified values, replace the regulator.

Regulating voltage	Factory spec.	14 to 15 V at 5200 min ⁻¹ (rpm)
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W1088178

[3] SPARK PLUG AND IGNITION COIL CHECKING



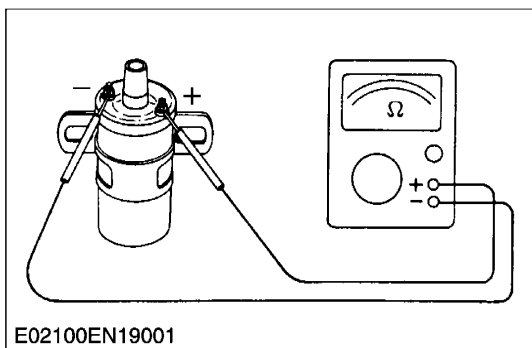
Spark Test

1. Remove the spark plug, put it inside the high voltage cord cap firmly, and then ground the threaded section to the engine body (not to painted or resin parts).
2. Rotate the starter with the key switch and check that the plug sparks.

CAUTION

- This test is hazardous of electric shocks. Never use hand or screwdriver to press the plug to ground it to the engine body.
- Keep inflammables away from the engine.

W1088291

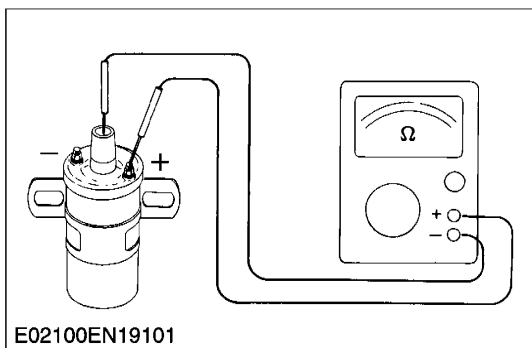


Inspect Primary Coil Resistance

1. Disconnect high-tension cord.
2. Disconnect distributor wire connector.
3. Using an ohmmeter, measure the resistance between the positive (+) and negative (-) terminals.

Resistance	Factory spec.	1.3 to 1.6 Ω
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W1088375

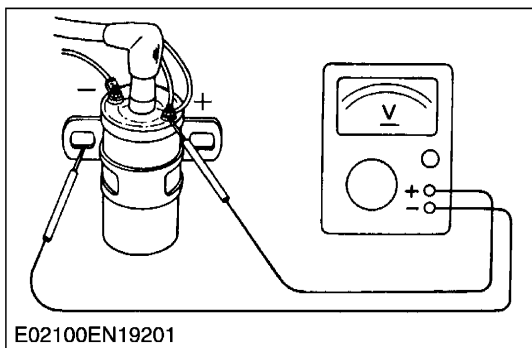


Inspect Secondary Coil Resistance

1. Using an ohmmeter, measure the resistance between the positive (+) terminal and high-tension terminal.

Resistance	Factory spec.	10.7 to 14.5 Ω
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W1088478



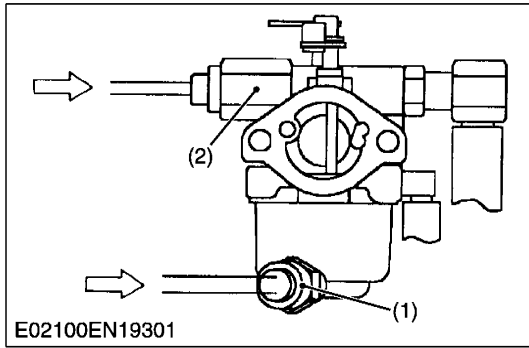
Check Power Source Line

1. With the key switch at ON and using a voltmeter, connect the positive (+) probe to the ignition coil (+) terminal and the negative (-) probe to the body ground.
2. If a problem is found, check the ignition switch and wire harness.

Voltage	Factory spec.	Approx. 12 V
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W1088558

[4] SOLENOID CHECKING



Fuel Cut Off Solenoid (WG752, DF752)

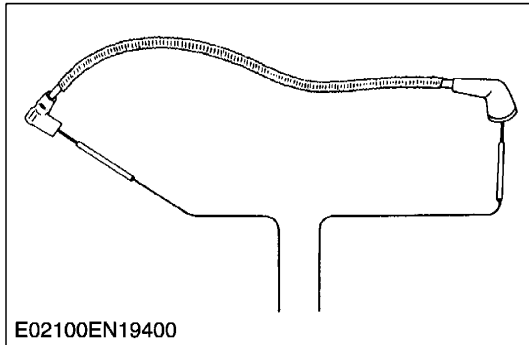
1. Disconnect the connector.
2. Measure the resistance with an ohmmeter between the connector terminals.
3. If the factory specification is not indicated the solenoid is faulty.

WG752, DF752: for Gasoline	Factory spec.	Approx. 38 Ω
DF752: for LPG		Approx. 28 Ω

(1) Fuel Cut Off Solenoid for Gasoline (2) Fuel Cut Off Solenoid for LPG

W1088665

[5] HIGH TENSION CORD CHECKING

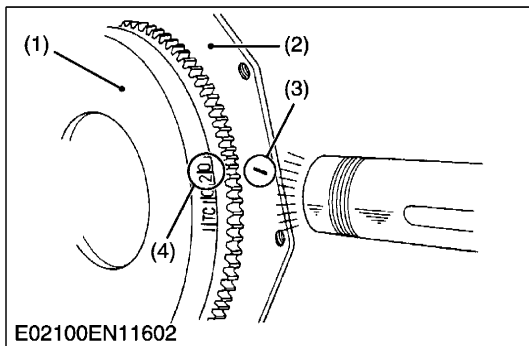


High Tension Cord

1. Using an ohmmeter, check that the resistance does not exceed the maximum.
2. If more than maximum, check the terminals, and replace the high-tension cord and / or distributor cap as required.

Resistance	High tension cord #1	2.81 to 4.79 kΩ
	High tension cord #2	3.40 to 5.80 kΩ
	High tension cord #3	3.57 to 6.09 kΩ
	Center cord	3.06 to 5.22 kΩ

W1088824



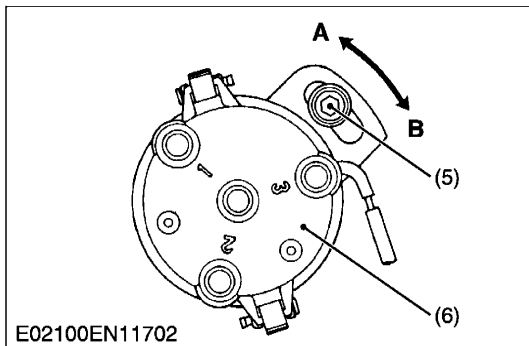
Ignition Timing

1. Using a timing light, check that the ignition timing (stamps on the flywheel) (4) is aligned with the mark (3) on the rear end plate (2).
2. If the timing is wrong, loosen the distributor mounting screw (5) and turn the distributor (6) so that the ignition timing (stamps on the flywheel) is aligned with the mark on the rear end plate.
See page S-37.

Ignition timing	Factory spec.	0.315 rad. (18°) before T.D.C.
-----------------	---------------	--------------------------------

- | | |
|---------------------|--------------------------------|
| (1) Flywheel | (5) Distributor Mounting Screw |
| (2) Rear End Plate | (6) Distributor |
| (3) Mark | (A) To retard |
| (4) Ignition Timing | (B) To advance |

W1090027



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