WSM

WORKSHOP MANUAL

GASOLINE, LPG, NATURAL GAS ENGINE

WG1605-E3

Kubota

KiSC issued 03, 2021 A

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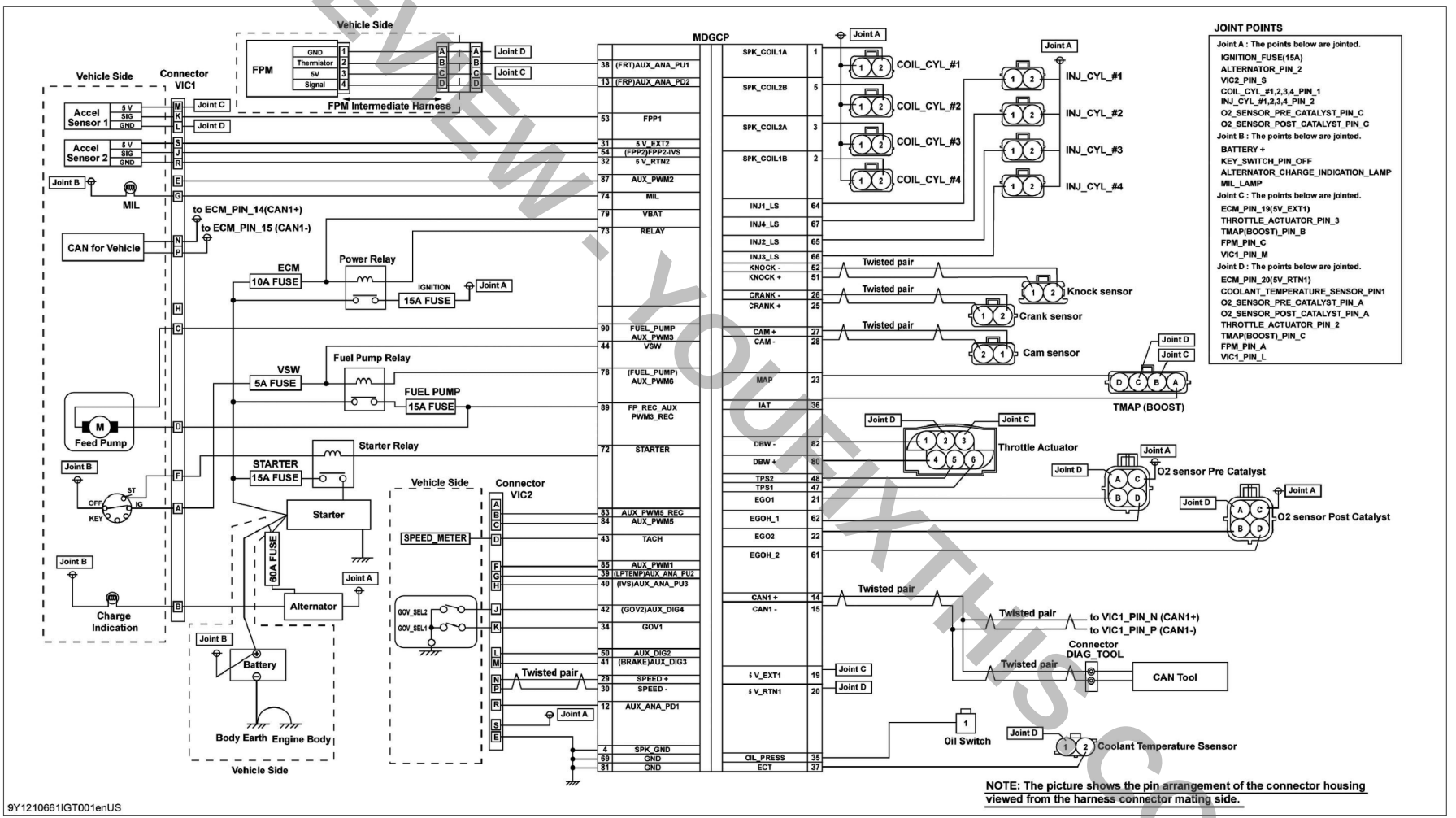
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1. Wiring diagram for WG1605-G-E3



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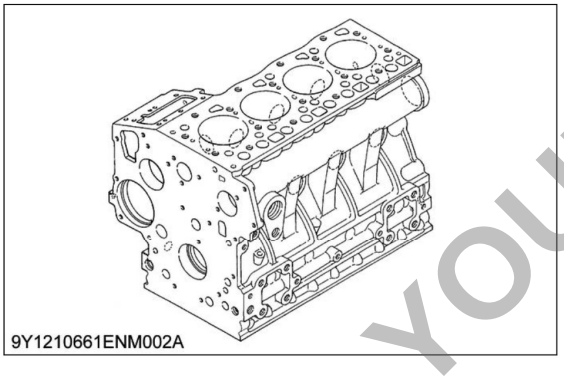
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MECHANISM

1. Engine body

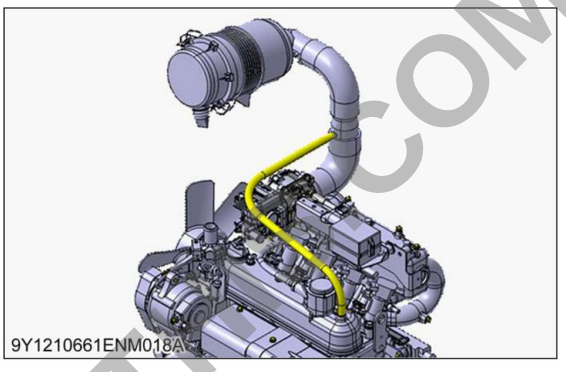
1.1 Cylinder block

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.
To increase the rigidity of the cylinder block, parts of engine block which support main bearing case has thicker rib for additional rigidness to improve noise and vibration.


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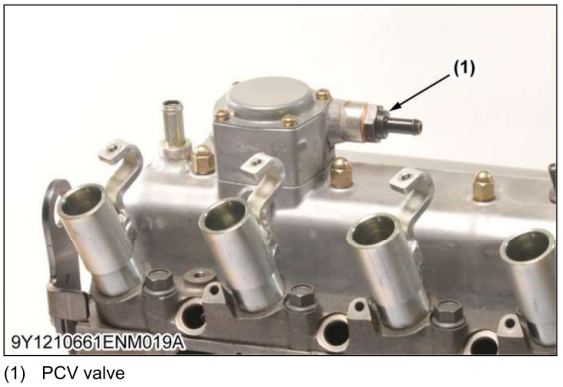
1.2 Positive crankcase ventilation (PCV) system

During normal compression stroke, a small amount of gases in the combustion chamber escapes past the piston. Approximately 70 % of these blowby gases are unburned fuel (HC) that can dilute and contaminate the engine oil, cause corrosion to critical parts, and contribute to sludge build up.
The purpose of the positive crankcase ventilation (PCV) system is to remove these harmful gases from the crankcase before damage occurs and combine them with the engine's normal incoming air / fuel charge.


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1.3 PCV valve

The PCV valve consists of a spring and a valve, and it is installed between an engine body and an intake manifold.
The PCV valve controls the inhalation volume of blow-by gas and the volume of fresh air according to the engine operation status.



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(1) PCV valve

1.4 Cylinder head

1.4.1 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.

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3. Tightening torque

3.1 Tightening torques of screws, bolts and nuts for special use

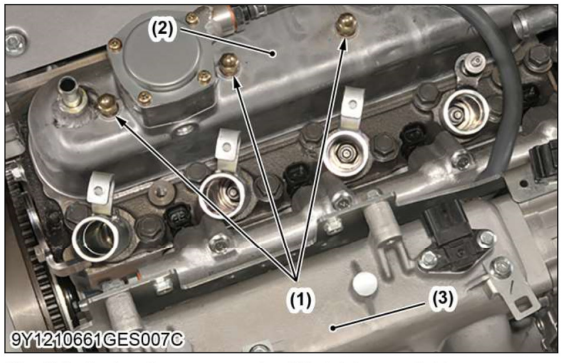
■ NOTE

- **For "*" marked screws, bolts and nuts on the table, apply engine oil to their threads and seats before tightening.**
- **The letter "M" in Size × Pitch means that the screw, bolt or nut dimension stands for metric. The size is the nominal outside diameter in mm of the threads. The pitch is the nominal distance in mm between two threads.**

Item	Dimension × Pitch	N·m	kgf·m	lbf·ft
Cylinder head screw	M10 × 1.25	63.7 to 68.6	6.50 to 6.99	47.0 to 50.5
*Connecting rod screw	M8 × 1.0	41.2 to 46.1	4.21 to 4.70	30.4 to 34.0
*Flywheel screw	M10 × 1.25	53.9 to 58.8	5.50 to 5.99	39.8 to 43.3
*Fan drive pulley screw	M14 × 1.5	235 to 245	24.0 to 24.9	174 to 180
*Main bearing case screw 1	M8 × 1.25	29.4 to 34.3	3.00 to 3.49	21.7 to 25.2
*Main bearing case screw 2	M9 × 1.25	49.0 to 53.9	5.00 to 5.49	36.2 to 39.7
*Cylinder head cover cap nut	M7 × 1.0	6.9 to 8.8	0.71 to 0.89	5.1 to 6.4
Oil pressure switch	PT 1/8	14.7 to 19.6	1.50 to 1.99	10.9 to 14.4
Bearing case cover mounting screw	M6 × 1.0	9.81 to 11.3	1.00 to 1.15	7.24 to 8.33
*Rocker arm bracket nut	M7 × 1.0	21.6 to 26.5	2.21 to 2.70	16.0 to 19.5
*Idle gear shaft mounting screw	M6 × 1.0	9.81 to 11.3	1.00 to 1.15	7.24 to 8.33
Injection pump gear cap nut	M12 × 1.5	58.8 to 68.6	6.00 to 6.99	43.4 to 50.5
Drain plug	M12 × 1.25	32.4 to 37.3	3.31 to 3.80	23.9 to 27.5
Rotation sensor mounting screw	M6 × 1.0	3.0 to 6.0	0.31 to 0.61	2.3 to 4.4
Spark plug	M14 × 1.25	24.5 to 29.4	2.50 to 2.99	18.1 to 21.6
Ignition coil mounting screw/nut	M6 × 1.0	9.81 to 11.3	1.00 to 1.15	7.24 to 8.33
Knock sensor mounting screw	M6 × 1.0	15.0 to 25.0	1.53 to 2.54	11.1 to 18.4
Water temperature sensor	M12 × 1.5	16.7 to 19.6	1.71 to 1.99	12.4 to 14.4
PCV valve	M16 × 1.5	16.0 to 24.0	1.64 to 2.44	11.8 to 17.7
Exhaust manifold mounting nut	M7 × 1.0	15.7 to 18.6	1.60 to 1.89	11.6 to 13.7
Outlet of exhaust manifold nut	M8 × 1.25	29.4 to 34.3	3.00 to 3.49	21.7 to 25.2
Starter B terminal nut	M8 × 1.25	5.88 to 11.8	0.600 to 1.20	4.34 to 8.70
Alternator's pulley nut	—	58.4 to 78.9	5.95 to 8.05	43.1 to 58.2
Inlet of catalytic muffler/converter mounting screw/nut	M10 × 1.25	48.1 to 55.9	4.91 to 5.70	35.5 to 41.2
Outlet of catalytic muffler/converter mounting screw/nut	M12 × 1.25	77.5 to 90.2	7.91 to 9.19	57.2 to 66.5
LPG/natural gas in	—	19.6 to 39.2	2.00 to 3.99	14.5 to 28.9
Lock off valve fitting union	PT 1/4	11.2 to 12.8	1.15 to 1.30	8.26 to 9.44

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3. Remove the intake manifold (3).



(1) Cylinder head cover cap nut (3) Intake manifold
(2) Cylinder head cover

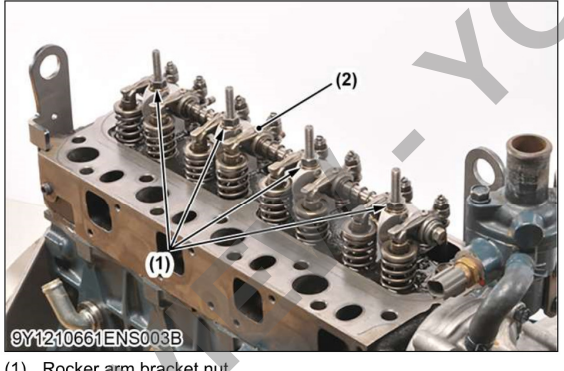
(When reassembling)

- Check to see if the cylinder head cover gasket is not damaged.
- Tighten to the specified tightening torque.

Tightening torque	Cylinder head cover cap nut	6.9 to 8.8 N·m 0.71 to 0.89 kgf·m 5.1 to 6.4 lbf·ft

4.2.3.2 Removing rocker arm and push rod

1. Remove the rocker arm bracket nuts (1).



(1) Rocker arm bracket nut

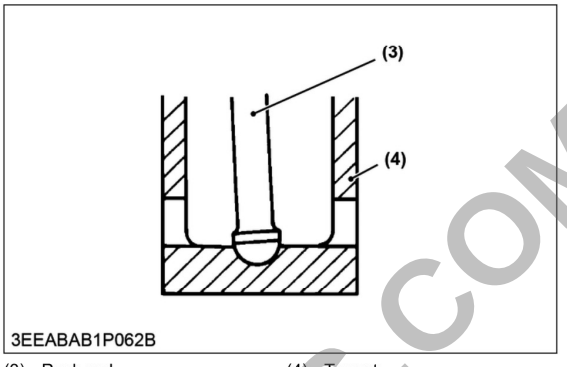
2. Remove the rocker arm assembly (2).
3. Remove the push rods (3).

(When reassembling)

■ IMPORTANT

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

- When putting the push rods (3) onto the tappets (4), check to see if their ends are properly engaged with the dimples.



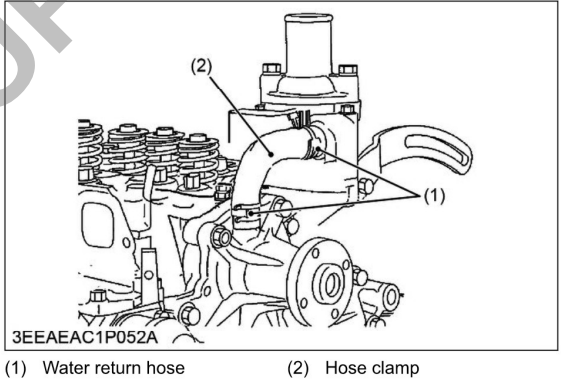
(3) Push rod (4) Tappet

- Tighten to the specified tightening torque.

Tightening torque	Rocket arm bracket nut	21.6 to 26.5 N·m 2.21 to 2.70 kgf·m 16.0 to 19.5 lbf·ft

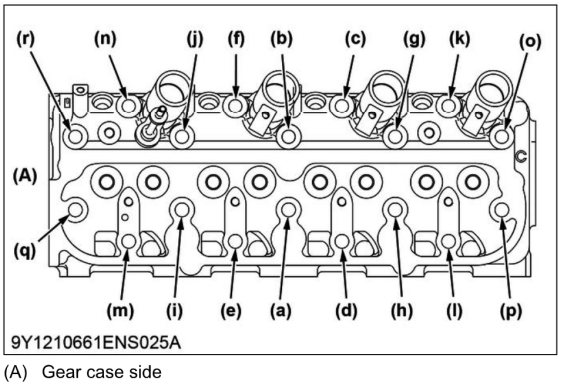
4.2.3.3 Removing cylinder head

1. Loosen the hose clamps (2), and remove the water return hose (1).



(1) Water return hose (2) Hose clamp

2. Remove the cylinder head screw in the order of (r) to (a).



(A) Gear case side

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SERVICING

1. Troubleshooting

1.1 Troubleshooting for general

Symptom	Probable cause	Solution	Reference page
Engine will not turn over	1. Engine jammed	Check engine to find the problem and repair it	–
	2.Battery discharged	Charge	–
	3.Starter malfunctioning	Repair or replace	3-44
	4.Wires disconnected	Reconnect	–
Engine turns over slowly but does not start	1. Increased resistance of moving parts	Repair or replace	–
	2. Excessively high viscosity engine oil at low temperature	Use specified engine oil	2-11
Engine turns over at normal speed but does not start	1. Compression leak	Check the compression pressure and repair	3-36
	2. Improper valve clearance	Adjust	3-36
	3. Damaged ignition coil	Replace	3-43
	4. Damaged spark plug	Adjust spark plug gap or replace	2-15
	5. Clogged air cleaner	Clean or replace	2-14
Rough low-speed running and idling	1. Damaged ignition coil	Replace	3-43
	2. Damaged spark plug	Adjust spark plug gap or replace	2-15
	3. Improper valve clearance	Adjust	3-36
Rough high-speed running	1. Damaged spark plug	Adjust spark plug gap or replace	2-15
	2. Damaged ignition coil	Replace	3-43
Engine speed does not increase	1. Clogged air cleaner	Clean or replace	–
	2. Damaged ignition coil	Replace	3-43
	3. Damaged throttle body	Replace	–
	4. Breather tube has separated	Attach correctly	–
	5. Improper input signal to ECU	Check the wire harness	–
Deficient output	1. Improper intake or exhaust valve sealing	Replace	3-66
	2. Improper valve clearance	Adjust	3-36
	3. Piston ring and cylinder worn	Replace	3-73 3-79

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SPECIFICATIONS

1. Specification for WG1605-G-E3, WG1605-L-E3

Model	WG1605-G-E3	WG1605-L-E3
	Gasoline fuel	LPG fuel
Number of cylinder	4	
Type	Vertical, water cooled, 4-cycle gasoline engine	Vertical, water cooled, 4-cycle LPG engine
Bore × stroke	79.0 × 78.4 mm (3.11 × 3.09 in.)	
Total displacement	1.537 L (93.79 cu.in.)	
SAE Gross Intermittent	42.5 kW (57.0 HP)/3600 min^{-1} (rpm) 37.0 kW (49.6 HP)/3000 min^{-1} (rpm)	41.0 kW (55.0 HP)/3600 min^{-1} (rpm) 36.0 kW (48.3 HP)/3000 min^{-1} (rpm)
ISO/SAE Net Intermittent	38.5 kW (51.6 HP)/3600 min^{-1} (rpm) 33.5 kW (44.9 HP)/3000 min^{-1} (rpm)	37.1 kW (49.8 HP)/3600 min^{-1} (rpm) 32.5 kW (43.6 HP)/3000 min^{-1} (rpm)
ISO Net Continuous	30.8 kW (41.3 HP)/3600 min^{-1} (rpm) 26.8 kW (35.9 HP)/3000 min^{-1} (rpm)	29.7 kW (39.8 HP)/3600 min^{-1} (rpm) 26.1 kW (35.0 HP)/3000 min^{-1} (rpm)
Maximum bare speed	3575 to 3625 min^{-1} (rpm) 2975 to 3025 min^{-1} (rpm)	
Minimum bare idling speed	725 to 775 min^{-1} (rpm)	
Cylinder head	Overhead-Valve	
Ignition system	Full transistor battery ignition type	
Governor	Electronic governor	
Direction of rotation	Counter-Clockwise (Viewed from flywheel side)	
Spark plug type/Spark plug gap	NGK IFR6F8DN 0.70 to 0.80 mm (0.028 to 0.031 in.)	
Ignition timing	0.45 rad (26°) before T.D.C./3000 min^{-1} (rpm), 3600 min^{-1} (rpm) 0.17 rad (10°) before T.D.C./750 min^{-1} (rpm), 800 min^{-1} (rpm)	0.35 rad (20°) before T.D.C./3000 min^{-1} (rpm), 3600 min^{-1} (rpm) 0.17 rad (10°) before T.D.C./750 min^{-1} (rpm), 800 min^{-1} (rpm)
Firing order	1-3-4-2	
Compression ratio	9.1: 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, forced circulation with water pump	
Starting system	Electric starting with starter	
Starting motor	12 V, 1.0 kW	
Battery	12 V, 52 AH or equivalent	
Charging alternator	12 V, 480 W, 720 W	
Fuel	*Unleaded automobile gasoline	Commercial LPG
Lubricating oil	Better than SL Class (API) SAE 10W-30	
Lubricating oil capacity	6.0 L (1.6 U.S.gals)	
Catalytic muffler/Converter	Three way catalyst	

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[WG1605-E3]

	Item	Service interval								
		Every 8 hrs (Daily)	Every 50 hrs (Weekly)	Every 100 hrs	Every 200 hrs	Every 500 hrs	Every 1000 hrs	Every 2000 hrs	Every 1 year	Every 2 years
	Checking engine oil level	☆								
	Checking and fill coolant	☆								
	Checking air cleaner element	if necessary								
	Cleaning air cleaner element	if necessary		☆						
	Checking LPG / natural gas tank setting condition	if necessary								
	Checking LPG / natural gas fuel connector	☆								
	Changing engine oil		★		☆					
	Replacing oil filter cartridge		★		☆					
	Checking gasoline fuel hose and clamp bands		☆							
	Checking LPG / natural gas fuel hose and clamp bands		☆							
	Cleaning spark plug			☆						
	Checking fuel filter			☆						
	Check fan belt tension and damage			☆						
	Replacing fuel filter			if necessary					☆	
	Checking LPG / natural gas tank setting condition				☆				Natural gas only	
	Replacing fan belt					☆				
	Checking radiator hoses and clamp bands				☆					
	Checking PCV valve						☆			
	Checking coolant hose of LPG / natural gas vaporizer						☆			
	Checking LPG / natural gas lock off valve						☆			
	Checking valve clearance						☆			
	Replacing spark plug							☆		
*	Replacing air cleaner element								☆	
	Replacing gasoline fuel hose, clamp bands and fuel filter								☆	
	Cleaning fuel tank inside (for gasoline fuel)								☆	
	Cleaning water jacket and radiator interior								☆	
	Replacing intake air line									☆

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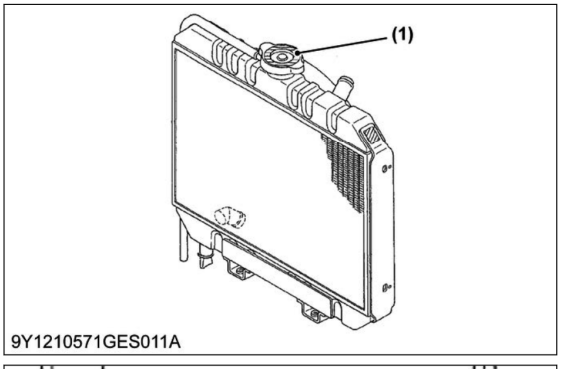
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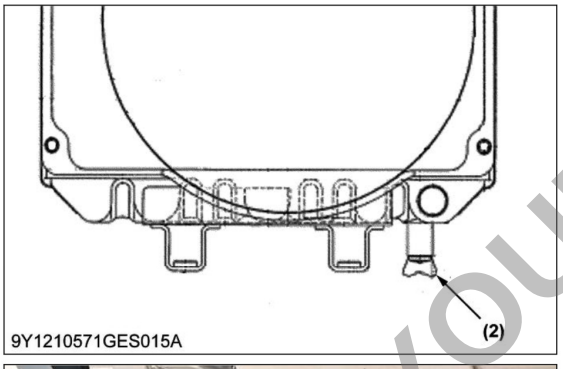
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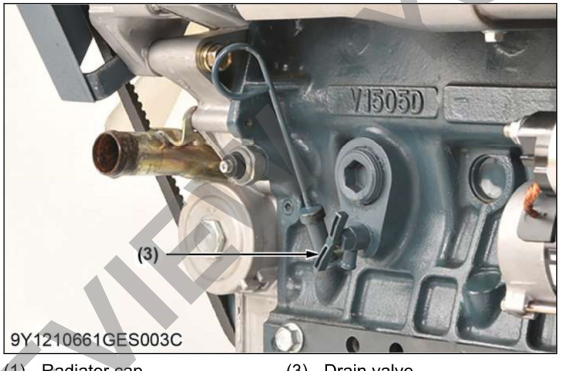
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2. To drain the coolant, open the radiator drain plug (2) and remove the radiator cap (1). Then radiator cap (1) must be removed to completely drain the coolant. And open the drain valve (3) of engine body.

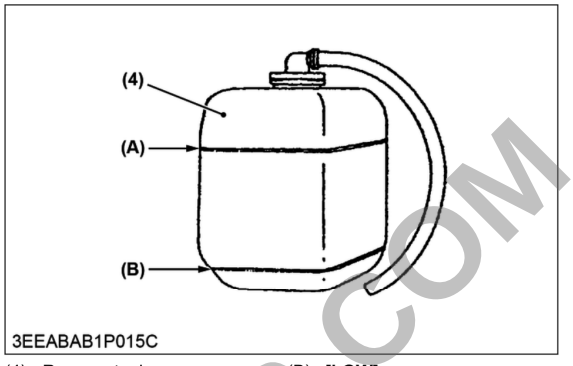






(1) Radiator cap
(2) Drain plug
(3) Drain valve

3. After all coolant is drained, close the drain plug.
4. Fill with clean water and cooling system cleaner.
5. Follow directions of the cleaner instruction.
6. After flushing, fill with clean water and anti-freeze until the coolant level is just below the port. Install the radiator cap (1) correctly.
7. Fill with the coolant up to **[FULL]** (A) mark on the reserve tank (4).



(4) Reserve tank
(A) **[FULL]**
(B) **[LOW]**

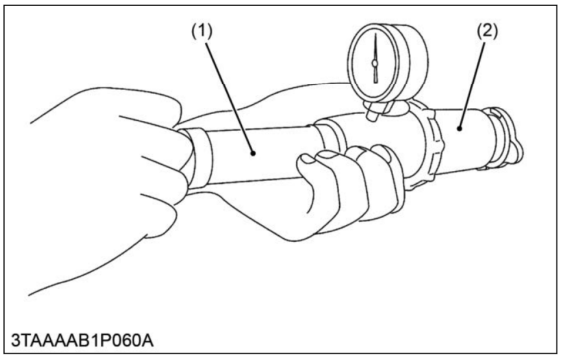
8. Start and operate the engine for a few minutes.

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cooled down. Otherwise, hot water may gush out, scalding nearby people.

Tools required
- Radiator tester

1. Set a radiator tester (1) and an adapter (2) on the radiator cap.



(A) Radiator tester (B) Adapter

2. Apply the specified pressure (90 kPa, 0.92 kgf/cm^2, 13 psi), and measure the time for the pressure to fall to 60 kPa (0.61 kgf/cm^2, 8.7 psi).

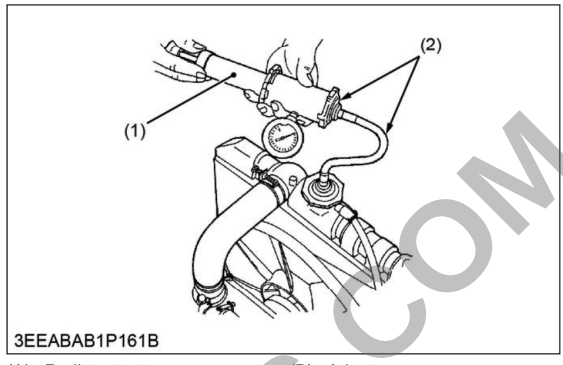
Pressure falling time	Service specification	10 seconds or more 88 → 59 kPa 0.89 → 0.61 kgf/cm^2 12 → 8.6 psi

3. If the measurement is less than the service specification, replace the radiator cap.

4.1.3.5 Checking radiator water leakage

■ NOTE
- **The pressure of the leak test is different from each radiator specification.**
  Thus, do the leak test, refer to the test pressure of each radiator specification.

1. Pour a specified amount of water into the radiator.
2. Set a radiator tester (1) and an adaptor (2) and raise the water pressure to the specified pressure (210 kPa, 2.14 kgf/cm^2, 30.5 psi).



(A) Radiator tester (B) Adaptor

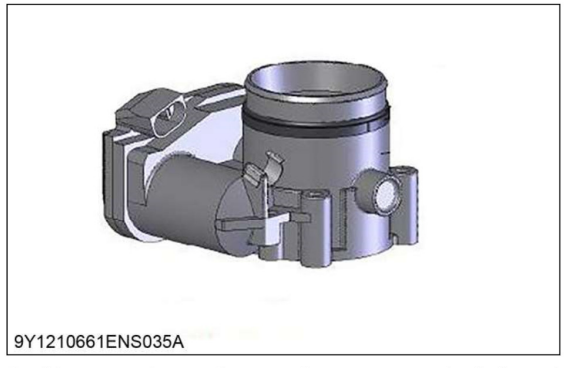
Radiator water leakage test pressure	Service specification	No leak at specified pressure

3. Check the radiator for water leaks.
4. For water leak from the pinhole, repair with the radiator cement. When water leak is excessive, replace the radiator.

4.1.4 Fuel system

4.1.4.1 Checking resistance of throttle body

1. Disconnect the connector.



2. Measure the resistance between terminal 1 and terminal 4 with resistance range of circuit tester.

Resistance	Service specification	Terminal 1 – Terminal 4	Continuity

3. If the resistance is 0 Ω or infinity, replace it.

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