

GENERAL INFORMATION

CHAPTER 1

DO NOT DISASSEMBLE ENGINE OR ENGINE COMPONENTS DURING THE WARRANTY PERIOD. DISASSEMBLY OF ENGINE OR COMPONENTS MAY VOID THE WARRANTY. SEE YOUR WARRANTY CERTIFICATE FOR DETAILS.

PLEASE CONTACT YOUR KOMATSU SERVICE REPRESENTATIVE FOR AUTHORIZATION AND/OR GUIDANCE FOR ANY WORK INVOLVING DISASSEMBLY DURING THE WARRANTY PERIOD.

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HOW TO USE THIS MANUAL

(1) Description

This manual explains how to use "removal, installation, disassembly, assembly, inspection and adjustment" and "troubleshooting".

(2) Definition of Terms

WARNING: Instructions and precautions that may lead to fatal hazards and/or serious injuries if not observed properly.

CAUTION: Instructions and precautions that require special attention and may lead to problems and/or accidents as well as damages to the vehicle and/or components.

NOTE: Provides additional information that facilitates operation.

Standard: Indicates tolerances for inspection and adjustment.

Repair limit: Indicates maximum or minimum values allowed for inspection and adjustment.

(3) Definition of Units

The units and numerical values in this Standard are SI units, and those given in () in this Standard are based on the Meter unit system.

Example: Tightening torque 59 - 78 N·m (6.0 - 8.0 kgf·m)

SI unit (Metric system)

Main unit changes

Measure	SI	Conventional unit	Conversion factor to SI
Acceleration	m/s ²	G	9.80665
Torque, moment	N·m	kgf·m	9.80665
Force	N	kgf	9.80665
Pressure	MPa	kgf/cm ²	0.0980665
	kPa	mmHg	0.133322
Power efficiency	kW	PS	0.735499
	W	kcal/h	1.16279
Volume	cm ³	cc	1
Spring constant	N/mm	kgf/mm	9.80665
Fuel consumption	*g/kW·h	g/PS·h	1.3596

* The conventional unit can be used for SI.

(4) Description

Caution: At the beginning of each section, the precautions exclusive to the section are described.

Preparation: At the beginning of each section and during the trouble shooting items, the Special tools, gauges, and other tools to be prepared before operation are described. Some commercial service tools, assumed to be available in any workshop, are omitted.

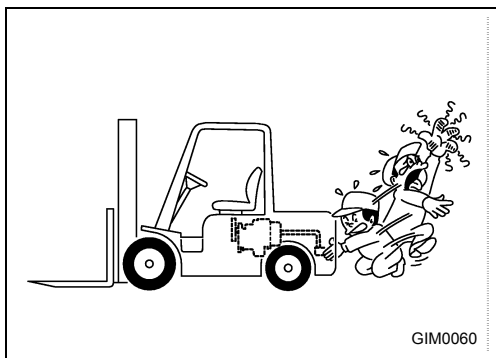
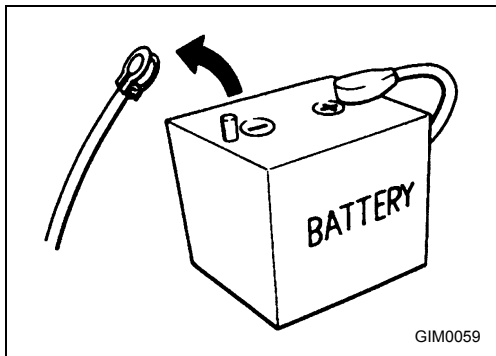
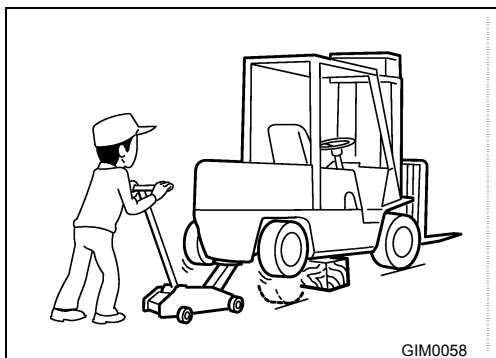
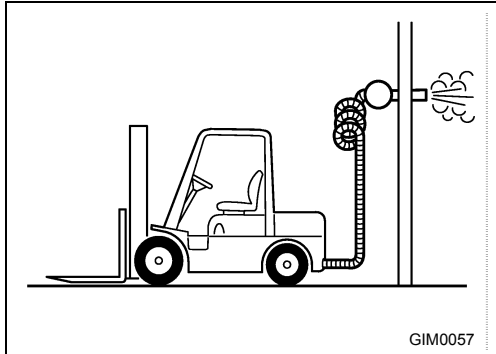
Description: To perform correct operations, operational procedures, notes, Special tools, and other service information are described.

CAUTION: Descriptions of visual inspections and cleaning of removed parts are generally omitted. Please remember that actual operations require these processes.

PRECAUTIONS FOR SAFETY AND QUALITY

- The following precautions must be carefully observed for safe and appropriate service work.
- Only the qualified and designated personnel must perform inspections, repairs and adjustments.
- Always keep the workplace clean, and store the tools neatly in the specified places.

(1) Safe Operation



- Do not run engines inside the workshop without proper ventilation such as ventilation ducts.
- Keep the workshop well ventilated and free of any flammable materials. Special care should be taken when flammable or poisonous materials such as gasoline are handled.
- Discard waste oil after oil changes or parts treatment in accordance with local laws and regulations.
- Be careful of burns and injury when working on high-temperature parts, rotating parts, or sliding portions.
- Before starting work in a pit or enclosed area, ensure that adequate ventilation is provided for discharging any hazardous emissions.
- Do not work underneath a vehicle supported only by a jack. Always use rectangular lumbers at the prescribed points to support the vehicle.
- Support it at the prescribed points and lock it in position with safety devices before lifting the vehicle.
- When removing a heavy component such as the engine and vehicle side, be careful the vehicle body does not become off-balance and fall.
- Do not smoke during service work.
- Do not wear any rings and necklaces when working. These objects may cause electric short.
- Before starting repair work that requires no battery power, always turn OFF the ignition switch, and disconnect the negative battery cable.
- Do not touch any metal portions immediately after the engine is stopped. Otherwise the heated metals may cause burns. Do not attempt to remove any cooling system parts such as the radiator cap while the engine is hot.
- To perform repair work safely and efficiently, always use appropriate commercial service tools and specified Special tools wherever required.

(2) Correct Operation

- Make sure that you understand the symptoms before starting trouble shooting.
- Check correct installation status prior to removal or disassembly. Put matching mark to the place after making sure that the mark does not interfere with the function of the parts .

PRECAUTIONS FOR SAFETY AND QUALITY

- Once they are removed, always replace parts indicated as "do not reuse" with new ones. This includes: oil seals, gaskets, packings, O-rings, lock washers, cotter pins, and self-locking nuts.
- Replace inner and outer races of tapered or needle roller bearings as a set.
- Arrange disassembled parts in order and prevent them from being mixed-up.
- Clean or flush disassembled parts prior to inspection or assembly.
- Use Genuine parts for replacement.
- Use authorized grease and sealer.
- Release the pressure before disconnecting pressurized piping or hoses.
- Be sure to check for leakage after repairing fuel, oil, coolant, exhaust, or vacuum systems.

(3) Precautions for Radio Equipment Installation

Check the following when installing a commercial/ham radio or mobile phone. If mounting position is not chosen carefully, the unit may interfere with the electronic control system.

- Separate the antenna as far from the Engine Control System as possible.
- Route an antenna feeder line at least 20 cm apart from the control unit harness.
- Adjust antenna and feeder line to eliminate radio wave interference.

PRECAUTIONS

(1) Precautions in Draining Engine Coolant

- Drain coolant only after the engine has cooled down.

(2) Precautions for Disconnecting Fuel Piping

- Operation should be done in a place free from fire.
- Release fuel pressure before operation. (Electronic controlled specifications): Refer to "Release of Fuel Pressure" in EC section.
- After disconnecting, plug the pipe to prevent fuel from draining.

(3) Precautions for Removing and Disassembling

- Use correct special tools in the specified position. Always pay attention to safety.
- Be careful not to lose surface accuracy of mating or sliding surfaces.
- To prevent foreign material from entering the engine, close openings with appropriate tape as necessary.
- Arrange disassembled parts in their normal positions in order to simplify locating the cause of damage or excessive wear and to ensure correct reassembly.
- As a rule, nuts and bolts must be tightened in a diagonal manner starting from an outer one. If a particular tightening sequence is provided separately, follow the sequence.

(4) Precautions for Inspection, Correction, and Replacement

- Following the inspection procedure, inspect the parts adequately and repair or replace as necessary. Perform the same inspections even for new parts and replace them if necessary.

(5) Precautions for Assembly and Installation

- Always use a torque wrench when tightening bolts and nuts.
- Unless otherwise specified, tighten nuts and bolts from inside to outside in a crisscross pattern. Tighten them gradually and evenly in 2 to 3 steps.
- Always replace gasket, packing, oil seals, and O-rings with new ones.
- For each part, perform adequate cleaning/washing and drying with a dryer. In particular, ensure that the oil and coolant passages are free from plugging and clogging.
- Remove any dirt and lint on sliding and mating surfaces. Before assembly, apply ample amount of engine oil to sliding surfaces.
- If coolant was drained, bleed air from the system.
- After assembly, start engine and increase the engine speed, then check coolant, fuel, oil, grease, and exhaust gas for leakage.

PRECAUTIONS

(6) Parts Requiring Angle Tightening

- When tightening the following parts, use an angle wrench (Special tool).
- Cylinder head bolt
Before assembly, verify that no grease/oil and dust are present on the cylinder head, cylinder block mounting face, and head gasket. Then apply antirust oil or engine oil to the threads and head bottoms of the head bolts.

(7) Caution for Use of Power Tools

- The use of power tools such as an air runner is only allowed for disassembly. Do not use them for assembly.

(8) Precautions for Liquid Gasket Application

REMOVING PARTS ATTACHED WITH LIQUID GASKET

- Remove mounting nuts and bolts. Remove liquid gasket using a seal cutter (Special tool).

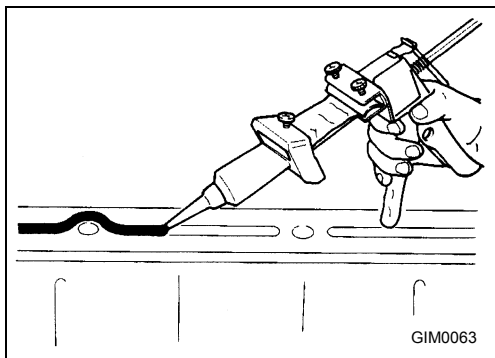
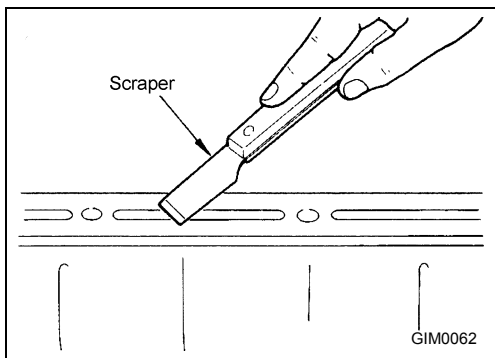
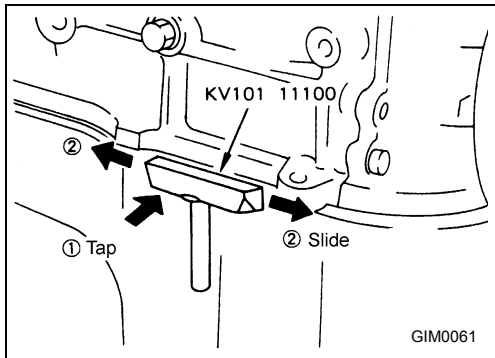
CAUTION:

- * **Be careful not to damage the mating surfaces.**

- In positions where a seal cutter is difficult to use, lightly tap with a plastic hammer, and remove.

CAUTION:

- * **Be careful not to scratch the mating surfaces when using a screwdriver.**



LIQUID GASKET APPLICATION INSTRUCTION

1. Remove any old liquid gasket remaining on the gasket application surface and its mating surface using a scraper.
 - Remove any old liquid gasket remaining in the gasket application groove and on the threads of bolts and bolt holes.
2. Wipe the gasket application surface and its mating surface using Isozole or any equivalent thinner to remove any moisture, oil, and foreign material.
3. Set genuine liquid gasket to tube presser (commercial service tool).
4. Apply a continuous bead of liquid gasket to the specified position at the specified diameter.
 - Apply liquid gasket in the application groove.
 - Apply liquid gasket inside bolt holes as a rule. Make sure to carefully read the relevant instructions.
 - Attaching should be done within 5 minutes after gasket application.
 - Immediately wipe off any protruding liquid gasket.
 - Do not retighten nuts and bolts after installation.
 - After finishing work, wait at least 30 minutes before refilling engine oil and coolant.

CAUTION:

- * **Follow any directions specified in the text on the following pages.**

TIGHTENING TORQUE

(1) Standard Bolt Tightening Torque

Upper column:Lubricated (Antirust oil is applied to abrasive faces of threads and seating faces)

Lower column:No lubrication (Threads and seating faces are completely degreased)

	Thread size		Unit	4T (Bolt)	7T (Bolt)	9T (Bolt)
	Diameter	Pitch				
Hexagon head bolt and nut	M6	1	N·m	3.82 - 4.41	6.37 - 7.45	9.22 - 10.8
			(kgf·m)	(0.39 - 0.45)	(0.65 - 0.76)	(0.94 - 1.1)
			N·m	5.00 - 6.47	8.43 - 10.8	11.8 - 15.7
			(kgf·m)	(0.51 - 0.66)	(0.86 - 1.1)	(1.2 - 1.6)
	M8	1.25	N·m	9.32 - 10.8	15.7 - 17.7	22.6 - 25.5
			(kgf·m)	(0.95 - 1.1)	(1.6 - 1.8)	(2.3 - 2.6)
			N·m	12.7 - 15.7	20.6 - 26.5	29.4 - 37.3
			(kgf·m)	(1.3 - 1.6)	(2.1 - 2.7)	(3.0 - 3.8)
	M10	1.25	N·m	19.6 - 22.6	32.4 - 38.2	47.1 - 53.9
			(kgf·m)	(2.0 - 2.3)	(3.3 - 3.9)	(4.8 - 5.5)
			N·m	25.5 - 33.3	43.1 - 54.9	61.8 - 78.5
			(kgf·m)	(2.6 - 3.4)	(4.4 - 5.6)	(6.3 - 8.0)
		1.5	N·m	18.6 - 21.6	30.4 - 36.3	44.1 - 52
			(kgf·m)	(1.9 - 2.2)	(3.1 - 3.7)	(4.5 - 5.3)
			N·m	24.5 - 31.4	41.2 - 52	58.8 - 74.5
			(kgf·m)	(2.5 - 3.2)	(4.2 - 5.3)	(6.0 - 7.6)
Flanged bolt	M6	1	N·m	4.9 - 5.69	8.14 - 9.51	11.8 - 13.7
			(kgf·m)	(0.5 - 0.58)	(0.83 - 0.97)	(1.2 - 1.4)
			N·m	5.98 - 7.65	9.81 - 12.7	14.7 - 18.6
			(kgf·m)	(0.61 - 0.78)	(1.0 - 1.3)	(1.5 - 1.9)
	M8	1.25	N·m	11.8 - 13.7	19.6 - 23.5	28.4 - 33.3
			(kgf·m)	(1.2 - 1.4)	(2.0 - 2.4)	(2.9 - 3.4)
			N·m	14.7 - 18.6	24.5 - 31.4	35.3 - 45.1
			(kgf·m)	(1.5 - 1.9)	(2.5 - 3.2)	(3.6 - 4.6)
	M10	1.25	N·m	24.5 - 29.4	41.2 - 48.1	59.8 - 69.6
			(kgf·m)	(2.5 - 3.0)	(4.2 - 4.9)	(6.1 - 7.1)
			N·m	30.4 - 39.2	51.0 - 64.7	73.6 - 93.2
			(kgf·m)	(3.1 - 4.0)	(5.2 - 6.6)	(7.5 - 9.5)
		1.5	N·m	23.5 - 27.5	39.2 - 46.1	56.9 - 65.7
			(kgf·m)	(2.4 - 2.8)	(4.0 - 4.7)	(5.8 - 6.7)
			N·m	29.4 - 37.3	49.0 - 61.8	69.6 - 89.2
			(kgf·m)	(3.0 - 3.8)	(5.0 - 6.3)	(7.1 - 9.1)

CAUTION:

- Except special nuts and bolts.
- The bolts applicable to this table have one of the following marks embossed on their heads.

4T.....4

7T.....7

9T.....9

TIGHTENING TORQUE

Standard Bolt Tightening Torque (Cont'd)

TAPER SCREW TIGHTENING TORQUE

Allowable materials for tightening Normal size	Unit	Aluminum		Cast iron	
		Standard	Max. value	Standard	Max. value
R1/8	N·m	7.8	11.8	15.7	21.6
	(kgf-m)	0.796	1.2	1.6	2.2
R1/4	N·m	19.6	29.4	34.3	44.1
	(kgf-m)	2.0	3.0	3.5	4.5
R3/8	N·m	39.2	54.9	53.9	73.5
	(kgf-m)	4.0	5.6	5.5	7.5

(2) Engine Part Tightening Torque

TIGHTENING TORQUE AT VARIOUS POINTS OF ENGINE

Tightening point	Unit	Standard	Max. value
Cylinder head (lubricated)	Separately given		
Main bearing cap (lubricated)	Separately given		
Crankshaft pulley bolt (lubricated)	N·m	220.5	240.1
	(kgf-m)	22.5	24.5
Flywheel bolt (lubricated)	N·m	132	142
	(kgf-m)	13.47	14.49
Connecting rod nut (lubricated)	N·m	31.4	37.3
	(kgf-m)	3.2	3.81
Rear plate bolt	N·m	44.1	58.8
	(kgf-m)	4.5	6.0
Camshaft sprocket bolt	N·m	39.2	49
	(kgf-m)	4.0	5.0
Oil filter stud	N·m	29.4	39.2
	(kgf-m)	3.0	4.0
Oil filter element	N·m	14.7	20.6
	(kgf-m)	1.5	2.1
Spark plug	N·m	19.6	29.4
	(kgf-m)	2.0	3.0
Engine slinger bolt	N·m	22.6	25.5
	(kgf-m)	2.31	2.6
Rocker cover nut	N·m	13.7	15.7
	(kgf-m)	1.4	1.6
Water temperature gauge	N·m	15.7	19.6
	(kgf-m)	1.6	2.0
Oil pressure switch	N·m	15.7	21.6
	(kgf-m)	1.6	2.2
Exhaust manifold nut	N·m	41.2	48.1
	(kgf-m)	4.2	4.91
Straight screw plug (For head top face)	N·m	44.1	58.9
	(kgf-m)	4.5	5.5
Oil pan drain plug	N·m	29.4	39.2
	(kgf-m)	3.0	4.0

TIGHTENING TORQUE

Engine Part Tightening Torque (Cont'd)

Tightening point	Unit	Standard	Max. value
Mass air flow sensor mounting screw	N·m	1.27	1.67
	(kgf-m)	0.13	0.17
Fuel tube flare nut	N·m	16.0	23.0
	(kgf-m)	1.63	2.35
Crankshaft position sensor plug bolt	N·m	6.37	7.45
	(kgf-m)	0.65	0.76
Thermo-housing relief plug	N·m	6.37	7.45
	(kgf-m)	0.65	0.76

CYLINDER HEAD

Tightening torque for general service at the tightening procedure (5) as shown in the left figure: can be tightened with torque of **50.6 ft/lbs. (68.6 N·m) (7.0 kgf-m)**.

Tightening procedure

③ Step

	Tightening torque (Reference)	N·m (kgf-m)
①	19.6 - 23.52 (2.0 - 2.3)	Tightening for brake-in
②	68.6 (7.0)	
③	0.0	Return
④	19.6 - 23.52 (2.0 - 2.3)	Retightening
⑤	90° - 92°	

Assembly sequence

← Crankshaft pulley side

Precautions before assembling

- Do not allow oil or dust to get on cylinder head, mounting surface of cylinder block, and head gasket.
- Apply anticorrosive oil onto head bolt thread and surface under the head.

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MAIN BEARING CAP

61.5 - 68.7 ft/lbs. (83.4 - 93.2 N·m) (8.51 - 9.51 kgf-m)

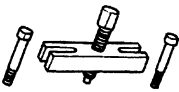
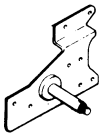
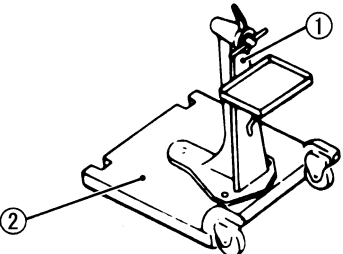
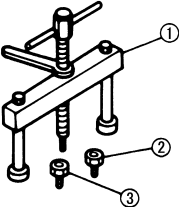
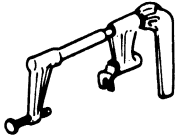
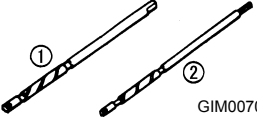
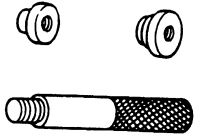
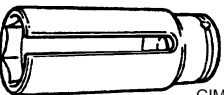
- Apply antirust oil or engine oil to the bolt threads and head bottom.
- Do not use any power tools such as an air runner for assembly.

Assembly sequence

← Crankshaft pulley side

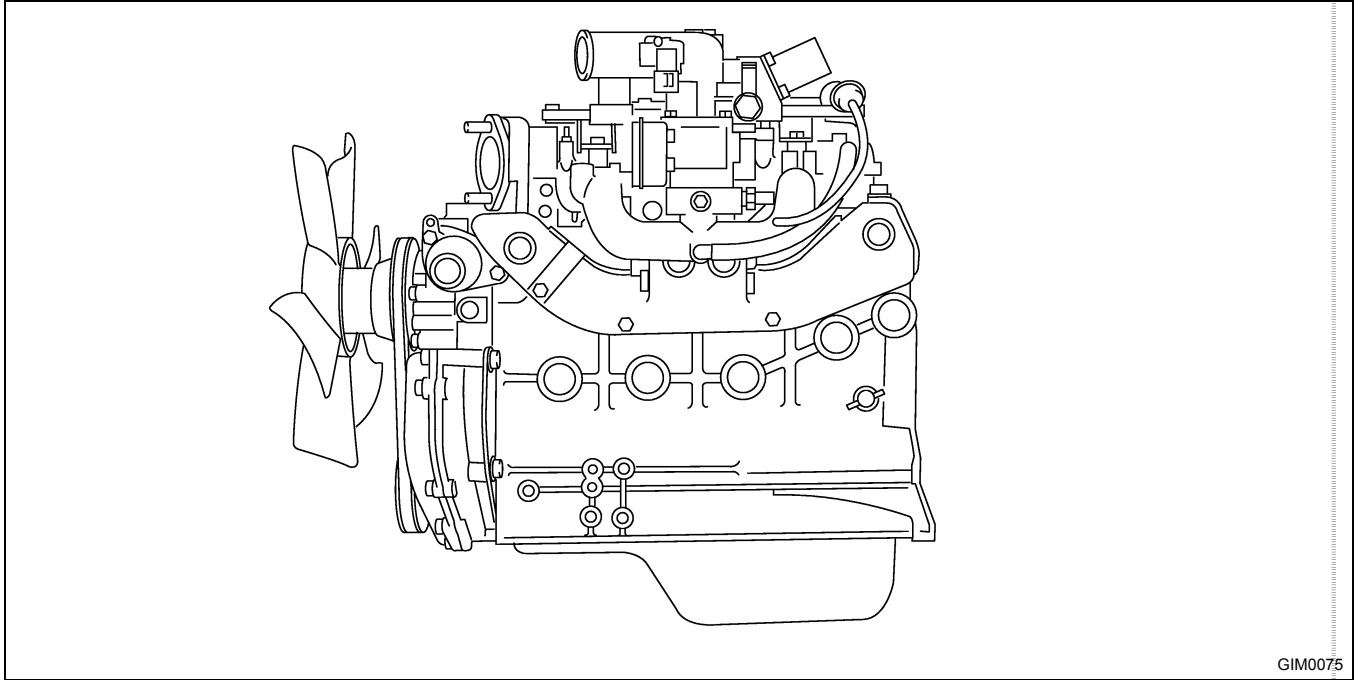
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SPECIAL SERVICE TOOLS

Tool number	Tool name	
KV11103000	Pulley puller	 <p style="text-align: right;">GIM0065</p>
ST05240001	 <p style="text-align: right;">GIM0066</p>	
ST0501S000 (1) ST05011000 (2) ST05012000	Engine stand assembly Engine stand Stand	 <p style="text-align: right;">GIM0067</p>
KV101041S0 (1) KV10104110 (2) ST16512001 (3) ST16701001	Crankshaft main bearing cap puller Crankshaft main bearing puller Adapter Adapter	 <p style="text-align: right;">GIM0068</p>
ST12070000	 <p style="text-align: right;">GIM0069</p>	
ST1102S000	Valve guide reamer set Valve guide reamer 7.00 mm	 <p style="text-align: right;">GIM0070</p>
ST1524S000 KV10105500 ST15243000	Front oil seal drift Rear oil seal drift Drift rod	 <p style="text-align: right;">GIM0071</p>
KV10113700	Heated oxygen sensor wrench	 <p style="text-align: right;">GIM0072</p>

ENGINE OUTSIDE DRAWINGS

ELECTRONIC CONTROLLED SPECIFICATIONS



GIM0075

MAIN SPECIFICATIONS

Engine type	K21		
Engine control system	ELECTRONICALLY CONTROLLED SPECIFICATIONS		
Fuel specification	Gasoline	LPG	Combined
Total displacement in ³ (cc)	126 (2,065)		
Shape of combustion chamber	Bathtub		
Valve mechanism	OHV		
Bore x stroke in. (mm)	3.5 x 3.27 in. (89 x 8)3		
Compression ratio	8.7 : 1	9.3 : 1	8.7 : 1
Compression pressure [MPa (kg/cm ² ,psi)/rpm]	1.2 (12.5, 178)/250	1.3 (13.0, 185)/250	1.2 (12.5, 178)/250
Horsepower Specification	60.1 HP @ 2,950 rpm ± 50 rpm		
Engine speed control system	Engine Control System, electronically controlled throttle		
Fuel in use (Note 1)	Unleaded regular gasoline	At 20P	See the left column
Maximum output [kW (PS)/rpm]	42.0 (57.1)/2,700		
Maximum torque [N·m (kgf·m)/rpm]	160.0 (16.3)/2,000		
Valve opening/closing timing (degree)	Intake open (BTDC)	14	
	Intake close (ABDC)	30	
	Exhaust open (BBDC)	32	
	Exhaust close (ATDC)	12	
Valve clearance (mm)	Intake (when engine is hot)	0.015 in. (0.38)	
	Exhaust (when engine is hot)	0.015 in. (0.38)	
Firing order	1-3-4-2		
Ignition timing (idling) (BTDC deg.)	0		
On board idle speed (rpm)	ATM	700	
	MTM	700	
On board high-idle speed (rpm)	ATM	2,700	
	MTM	2,700	
Allowable maximum engine speed (rpm)	Instantaneous, no load	3,600	
	Continuous load	3000	
PTO system	Silent chain-driven/side PTO		
Engine oil (originally fitted)	Specification	10W-30 (Class SJ and higher grade)	
	Amount (L)	4.0 qts. (3.8L) INCLUDING FILTER	
Engine dimensions (length x width x height) (Note 2) (mm)	28.85 X 22.16 X 29.25 in. (732.7 x 562.9 x 743)		
Engine weight (w/o coolant, w/ oil) (Note 2) (kg)	304.24 lbs. (138kg)		

Note 1: Fuel

Gasoline: Use unleaded regular gasoline with an octane rating of 89 or more.

LPG: Use a fuel of 30P or more in cold seasons. In ambient temperature of 23° F (-5°C) or less, use a 100P fuel.

Note 2: The engine dimensions and weight differs with the customer specifications. The above data should be deemed as reference.

MAIN SPECIFICATIONS

Engine type		K25		
Engine control system		Electronic controlled specifications		
Fuel specification		Gasoline	LPG	Dual-Fuel
Total displacement in. (cc)		151.8 in. ³ (2,488cc)		
Shape of combustion chamber		Bathtub		
Valve mechanism		OHV		
Bore x stroke in. (mm)		3.5 x 3.94 in. (89 x 100)		
Compression ratio		8.7 : 1	9.3 : 1	8.7 : 1
Compression pressure [MPa (kg/cm ² , psi)/rpm]		1.2 (12.5, 177.8)/250	1.3 (13.0, 185)/250	1.2 (12.5, 177.8)/250
Horsepower Specification		65.7 HP @ 2,900 rpm		
Engine speed control system		Engine Control System, electronically controlled throttle		
Fuel in use (Note 1)		Unleaded regular gasoline	At 20P	
Maximum output [kW (PS)/rpm]		41.4 (56.3)/2,400	44.0 (59.9)/2,400	
Maximum torque [N·m (kgf·m)/rpm]		181.4 (18.5)/1,600		
Valve opening/closing timing (degree)	Intake open (BTDC)	14		
	Intake close (ABDC)	30		
	Exhaust open (BBDC)	32		
	Exhaust close (ATDC)	12		
Valve clearance (mm)	Intake (when engine is hot)	0.015 in. (0.38)		
	Exhaust (when engine is hot)	0.015 in. (0.38)		
Firing order		1-3-4-2		
Ignition timing (idling) (BTDC deg.)		0		
On board idle speed (rpm)	ATM	700		
	MTM	700		
On board high-idle speed (rpm)	ATM	2,700		
	MTM	2,700		
Allowable maximum engine speed (rpm)	Instantaneous, no load	3,600		
	Continuous load	3,000		
PTO system		Silent chain-driven/side PTO		
Engine oil (originally fitted)	Specification	10W-30 (Class SJ or more)		
	Amount (L)	4.0 qts. (3.8L) Including Filter		
Engine dimensions (length x width x height) (Note 2) (mm)		28.85 x 22.16 x 29.25 in. (732.7 x 562.9 x 743)		
Engine weight (w/o coolant, w/ oil) (Note 2) (kg)		304.24 lbs. (138kg)		

Note 1: Fuel

Gasoline: Use unleaded regular gasoline with an octane rating of 89 or more.

LPG: Use a fuel of 30P or more in cold seasons. In ambient temperature of 23° F (-5°C) or less, use a 100P fuel.

Note 2: The engine dimensions and weight differs with the customer specifications. The above data should be deemed as reference.

MAIN SPECIFICATIONS

MAIN SPECIFICATIONS OF IGNITION SYSTEM

Engine type		K21			K25		
Engine control system		Electronic controls			Electronic controls		
Fuel specification		Gasoline	LPG	Dual-Fuel	Gasoline	LPG	Dual-Fuel
Ignition device		Non-contact type (Engine Control System)			Non-contact type (Engine Control System)		
Ignition coil (with power transistor)		Independent cylinder distribution type			Independent cylinder distribution type		
Crankshaft position sensor	Crankshaft position sensor (POS)	IC Type			IC Type		
	Camshaft position sensor (PHASE)	IC Type			IC Type		
Distributor (with ignition coil)		-			-		
Spark plug	Type	22401-FU412			22401-FU412		
	Gap (mm)	.035 in. (0.9)			.035 in. (0.9)		

FUEL SYSTEM AND ENGINE SPEED CONTROL SYSTEM

Engine type		K21			K25		
Engine control system		Electronic controls			Electronic controls		
Fuel specification		Gasoline	LPG	Dual-Fuel	Gasoline	LPG	Dual-Fuel
Fuel device standard type		Electronic controlled fuel injection device (Engine Control System)			Electronic controlled fuel injection device (Engine Control System)		
Fuel device		Gasoline injector	LPG injector	Gasoline & LPG	Gasoline injector	LPG injector	Gasoline & LPG
Air-fuel ratio control device		Air-fuel ratio feedback control			Air-fuel ratio feedback control		
Starting auxiliary device		Electric throttle control actuator			Electric throttle control actuator		
Idle load control type		Electric throttle control actuator			Electric throttle control actuator		
Engine speed control type		Electric throttle control actuator			Electric throttle control actuator		

EXHAUST GAS CLEANUP DEVICE LIST

Engine type		K21			K25		
Engine control system		Electronic controls			Electronic controls		
Fuel specification		Gasoline	LPG	Dual-Fuel	Gasoline	LPG	Dual-Fuel
Catalytic device (Reducing HC, CO, Nox)	Type	Three-way catalyst (Monolith)			Three-way catalyst (Monolith)		
	Location	In counter weight with muffler separated			In counter weight with muffler separated		
	Capacity	0.475 qts. (0.45L)			0.475 qts. (0.45L)		
PCV gas recirculation device		Closed type			Closed type		

STANDARD AND REPAIR LIMIT

INSPECTION AND ADJUSTMENT

- Oil capacity H line
4.0 qts. (3.8L) Including Filter
- Oil capacity L line
2.85 qts. (2.7L)
- (Oil filter capacity)
0.317 qts. (0.3L)
- Fan belt deflection (When pressed by a force of approximately
22 ft/lbs. (10 kgf)
Standard .433 - .519 in. (11 - 13mm)
- Compression [MPa (kgf/cm², psi)/rpm]
Standard 1.226 (12.5, 178)/250 (K21)
1.27 (13.0, 184.9)/250 (K25)
- Difference between each cylinder (kgf/cm², psi/rpm)
Repair limit 1.0, 14.2/300
- Spark plug gap
Standard 0.035 in. (0.9mm)
- Distributor (Full transistor type) air gap
Standard .0138-.0177 in. (0.35 - 0.45mm)
- Valve clearance (Hot)
Standard Intake: .015 in. (0.38mm)
Exhaust:.015 in. (0.38mm)
- Thermostat valve opening temperature (STD)
Standard 169.7° F (76.5° C)
- Idle speed and ignition timing (BTDC°/rpm)
Standard
0/750±50 (K21)
0/750±50 (K25)

CYLINDER HEAD

- Cylinder head
Material Aluminum alloy
Distortion limit .0039 in. (0.1mm)

CYLINDER BLOCK

- Block upper surface
Distortion limit .0039 in. (0.1mm)
- Bore diameter dimension
Standard 3.50-3.51 in. 89.00 - 89.05mm (K21, K25)
- Bore diameter wear
Repair limit .0079 in. (0.2mm)
- Bore diameter out-of-round
Standard .0079 in. (0.02mm) or less
- Bore diameter taper
Standard .0008 in. (0.02mm) or less
- Bore diameter out-of-round and taper
Repair limit .0039 in. (0.1mm)

STANDARD AND REPAIR LIMIT

PISTON

- Piston
 - Type Thermal flow type
 - Material Aluminum alloy
 - Outer diameter Standard
3.502 - 3.504 in. (88.965 - 89.015mm) (All)
- Clearance between piston and cylinder
 - Standard .00098 - .0017 in. (0.025 - 0.045mm)
- Piston pin outer diameter (mm)
 - Standard .7871 - .7877 in. (19.993 - 19.998mm) (All)
- Piston pin fitting quality
 - Standard To a degree allowing movement by finger
- Piston ring end clearance
 - Standard Top .011 - .017 in. (0.28 - 0.43mm)
 - Second .0177 - .0236 in. (0.45 - 0.60mm)
 - Oil .0078 - .0236 in. (0.20 - 0.60mm)
 - Limit values .0394 in. (1.00mm)
- Clearance between piston ring and ring groove
 - Standard Top .0017 - .0031 in. (0.045 - 0.080mm)
 - Second .0012 - .0027 in. (0.030 - 0.070mm)
 - Oil .0026 - .0053 in. (0.065 - 0.135mm)
 - Repair limit Top .0039 in. (0.10mm)
 - Second .0039 in. (0.10mm)
 - Oil —

CONNECTING ROD

- Distance between both end hole centers
 - Standard 5.67 in. (143.97 - 144.03mm) (K25)
 - 6.00 in. (152.47 - 152.53mm) (K21)
- Large end hole diameter
 - Standard 1.89 in. (48.0 - 48.013mm) (K21, K25)
- Small end hole diameter
 - Standard .786 in. (19.965 - 19.978mm) (K21, K25)
- Bend (per 3.937 in. (100 mm))
 - Repair limit .002 in. (0.05mm)
- Distortion (per 100 mm)
 - Repair limit .002 in. (0.05mm)
- Large end thrust clearance
 - Standard .0078 in. (0.2 - 0.3mm)
 - Repair limit .0157 in. (0.40mm)
- Large end oil clearance
 - Standard .0012 - .0026 in. (0.030 - 0.066mm) (All)
 - Repair limit .004 in. (0.10mm)
- Difference in weight (Piston combination)
 - Standard 4g or less

CRANKSHAFT

- Bend
 - Repair limit .0002 in. (0.05mm)
- End play
 - Standard .0002 in. (0.05 - 0.18mm)
 - Repair limit .0079 in. (0.20mm)
- Journal dimension
 - Standard 2.478 in. (62.942 - 62.955mm)
- Pin standard dimension
 - Standard 1.77 in. (44.961 - 44.974mm) (All)
- Journal oil clearance
 - Standard .0008 - .0029 in. (0.020 - 0.073mm)

STANDARD AND REPAIR LIMIT

- Repair limit .004 in. (0.10mm)
- Pin oil clearance
- Standard .0013 - .0026 in. (0.032 - 0.066mm)

FLYWHEEL

- Flywheel surface swing
- Repair limit .004 in. (0.10mm)
- Ring gear surface swing
- Repair limit .0197 in. (0.50mm)
- Flatness
- Repair limit .0118 in. (0.30mm)

CAMSHAFT

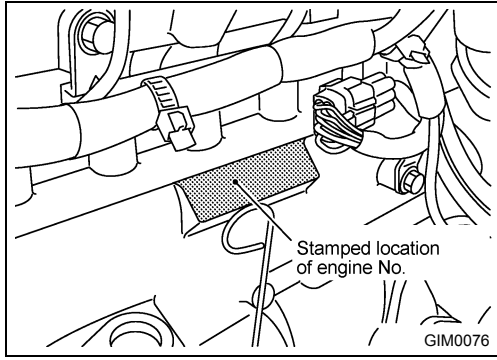
- Bend
- Repair limit .002 in. (0.05mm)
- Camshaft height
- Standard 1.447 - 1.448 in. (36.750 - 36.800mm) (For both intake and exhaust)
- Size reduction limit 1.44 in.(36.5mm)
- Journal dimension
- Standard Front 1.789 in. (45.434 - 45.447mm)
- Center 1.728 in. (43.897 - 43.910mm)
- Rear 1.624 in. (41.218 - 41.231mm)
- End play)
- Standard .00098 - .01004 in. (0.025 - 0.255mm)
- Repair limit .0157 in. (0.40mm)
- Journal oil clearance
- Standard Front 0.025 - 0.051mm
- Center 0.038 - 0.064mm
- Rear 0.025 - 0.051mm
- Repair limit Front 0.10mm
- Center 0.15mm
- Rear 0.10mm

VALVE

- Head outer diameter
- Standard Intake 1.50 in. (38.0 - 38.3mm)
- Exhaust 1.26 in. (32.0 - 32.3mm)
- Valve stem outer diameter
- Standard Intake .275 in. (6.97 - 6.985mm)
- Exhaust .274 in. (6.945 - 6.960mm)
- Valve guide inner diameter
- Standard Intake .276 in. (7.0 - 7.018mm)
- Exhaust .276 in. (7.0 - 7.018mm)
- Clearance between valve stem and valve guide
- Standard Intake 0.020 - 0.053mm
- Exhaust 0.040 - 0.073mm
- Repair limit Intake 0.10
- Exhaust 0.10
- Clearance between valve lifter and lifter guide
- Standard .0006 - .0021 in. (0.016 - 0.052mm)
- Clearance between crankshaft and flywheel
- Standard 0 - .0015 in. (0 - 0.038mm)
- Clearance between rocker shaft and rocker arm
- Standard .0008 - .0021 in. (0.020 - 0.054mm)
- Valve clearance (Hot)
- Intake .015 in. (0.38±0.03mm)
- Exhaust .015 in. (0.38±0.03mm)

STAMPED LOCATION OF ENGINE NO.

Stamped location of engine number



TROUBLE SHOOTING

Refer to each section for details.

Condition	Possible causes	Action	Application	
			Common	Electronic controlled specifications
Incident in ignition system	• Malfunction of low-voltage electronic distribution ignition coil	Replace.		√
	• Condenser malfunction	Replace.	√	
	•			
	• Spark plug malfunction	Clean, adjust gap or replace.	√	
	•			
	• Ignition coil malfunction	Replace.	√	
	•			
Incident in fuel system Refer to EF section for the LPG model.	• Loose or open primary wire connection	Repair or replace.	√	
	• Insufficient fuel	Fill.	√	
	• Contaminated fuel filter	Replace.	√	
	• Plugged or contaminated fuel piping	Wash.	√	
	• Plugged or contaminated fuel injector	Clean or replace.		√
	• Fuel pump malfunction	Repair or replace.	√	
	•			
Lowered compression pressure	•			
	• Poor tightening of spark plug or inappropriate gasket	Tighten to correct torque or replace.	√	
	• Inappropriate engine oil grade or deteriorated viscosity	Replace with appropriate grade of oil.	√	
	• Inappropriate valve clearance	Adjust.	√	
	• Compression pressure leak from valve seat	Remove head and perform fine grinding to valve.	√	
	• Stuck valve stem	Repair or replace cylinder head and valve.	√	
	• Broken or chip valve spring	Replace valve spring.	√	
	• Compression pressure leakage from head gasket	Replace head gasket.	√	
	• Worn or stuck piston ring	Replace piston ring.	√	
• Worn piston ring or cylinder	Engine overhaul (troubleshooting procedure) a. Put a small amount of engine oil from the ignition plug hole and measure the compression pressure. b. If the pressure builds up, a possible cause is in the cylinder or piston ring. c. If the pressure remains unchanged, the leakage can be attributed to the valve, cylinder head or head gasket.			

TROUBLE SHOOTING

(1) Engine Adjustment

Condition	Cause	Action
1. Engine noise		
Slapping noise of bearing and crankshaft	Bearing looseness	Replace.
	Bearing seizure	Replace.
	Crankshaft bend	Repair or replace.
	Uneven wear of journal	Correct.
	Excessive end play	Replace center bearing.
Slapping noise of piston, connecting rod	Bearing looseness	Replace.
	Bearing seizure	Replace.
	Piston looseness	Replace piston pin(s) or bushing(s).
	Piston looseness relative to cylinder	Reselect.
	Piston ring damage	Replace.
	Poor rod alignment	Realign.
Slapping noise of camshaft	Bearing looseness	Replace.
	Excessive axial looseness	Replace bearing thrust plate(s).
	Rough gear tooth face(s)	Correct.
	Gear damage	Replace.
Timing chain noise	Inappropriate tension	Adjust.
	Damaged or sagged chain	Replace.
	Worn sprocket	Replace.
	Damaged or loose tensioner	Replace.
	Excessive camshaft-to-bearing clearance	Replace.
Slapping noise of valve gear	Inappropriate valve clearance	Adjust.
	Loose Adjust. screw(s)	Replace.
	Worn rocker face(s)	Replace.
	Worn valve guide(s)	Replace guide(s).
	Loose valve spring(s)	Replace.
	Valve seizure	Repair or replace.
Slapping noise of water pump	Inappropriate end play	Replace.
	Damaged impeller	Replace.
2. Other mechanical damage		
Stuck valve	Inappropriate clearance	Adjust.
	Valve stem - insufficient guide-to-guide clearance	Clean stem(s), ream guide(s).
	Loose or damaged spring	Replace.
	Seized or damaged valve stem(s)	Replace or clean.
	Poor fuel quality	Use good fuel.
Burnt valve seat(s)	Inappropriate valve clearance	Adjust.
	Deteriorated valve spring(s)	Replace.
	Edged valve end(s)	Replace bulb.
	Too narrow valve seat width	Correct valve seat(s).
	Engine overheat	Repair or replace.
	Overrun	Operate in optimum speed range.
	Stuck valve guide(s)	Correct.

TROUBLE SHOOTING

(1) Engine Adjustment(Cont'd)

Condition	Cause	Action
Excessive wear of cylinder piston(s)	Insufficient engine oil	Refill or replace oil.
	Contaminated engine oil	Clean crankcase, replace oil filter.
	Poor quality oil	Use specified oil.
	Engine overheat temperature	Repair or replace.
	Wrong combination of piston and connecting rod	Repair or replace.
	Inappropriate clearance of piston ring	Reselect and adjust.
	Piston ring damage	Replace.
	Damaged air cleaner	Wash.
	Too rich air-fuel mixture	Adjust.
	Overrun	Operate in optimum speed range.
	Stuck choke valve	Clean and adjust.
Excessive use of choke valve	Start engine properly.	
Poor functioning of connecting rod(s)	Insufficient engine oil	Fill oil.
	Low oil pressure	Repair.
	Use of poor quality oil	Use specified oil.
	Rough crank surface(s)	Grind surface(s), replace bearing(s).
	Plugged oil passage	Clean.
	Wear or damage of bearing	Replace.
	Inappropriate bearing	Correct.
	Bearing looseness	Replace.
Poor connecting rod alignment	Repair or replace.	
Poor functioning of crankshaft bearing(s)	Insufficient engine oil	Fill or replace oil.
	Low oil pressure	Correct.
	Use of poor quality oil	Use specified oil.
	Uneven wear of crank journal(s)	Repair
	Plugged oil passage of crankshaft	Wash.
	Wear or damage of bearing	Replace.
	Inappropriate bearing	Correct.
	Damaged bearing(s)	Replace.

TROUBLE SHOOTING

Engine Adjust. (Cont'd)

Condition	Possible causes	Action
No or slow cranking	• Inappropriate engine oil grade	Replace oil with a proper one.
	• Battery is discharged	Charge battery.
	• Battery damage	Replace battery.
	• Loose fan belt	Belt tension Adjust.
	• Incident in charge system	Check and repair
	• Incident in starter system wiring	Repair.
	• Starter switch malfunction	Repair or replace.
	• Starter motor malfunction	Repair or replace. (Starter circuit troubleshooting procedure) If the light turns off or dims when the starter switch is turned to "ON" with the headlights on: a: Check the battery. b: Check the electric connections and wirings. c: Check the starter motor. If the light remains bright when the starter switch is turned to "ON" with the headlights on: a: Check the wiring between battery and starter motor. b: Check the starter switch. c: Check the starter motor.
Engine is cranked but not started. Refer to EF section for the LPG model.	Such incidents are attributed to the following factors, but most likely, the ignition system or the fuel system is the main cause.	
	• Incident in ignition system	(troubleshooting procedure)
	• Incident in fuel system	Check the spark plug following the steps below.
	• Dynamic valve system does not operate normally.	Disconnect the ignition coil from the No.1 plug and keep it 10 mm away from the engine metal portions. Then crank the engine.
	• Poor compression	If a good spark is available: a. Check the ignition plugs. b. Check the ignition timing. c. Check the fuel system. d. Check the compression pressure. If no spark is available: a. Check the primary coil current. b. If the current level is high, check the primary coil for short circuit.
Inappropriate idling		
Incident in fuel system Refer to EF section for the LPG model.	• Damaged or plugged fuel injector	Clean or replace.
	• Inappropriate idle Adjust.	Adjust.
	• Plugged air cleaner	Replace element.
	• Damaged manifold gasket	Replace gasket
Lowered compression pressure		Already described.
Engine power does not increase to an appropriate level		Adjust.
Lowered compression pressure		Already described.
Incident in ignition system	• Inappropriate ignition timing	Adjust.
	• Spark plug malfunction	Clean, adjust or replace.
Incident in fuel system Refer to EF section for the LPG model.	• Plugged fuel piping	Clean
	• Plugged or contaminated fuel filter	Replace.
	• Fuel pump malfunction	Repair or replace
	• Poor throttle valve opening	Adjust.
	• Fuel pump malfunction	Adjust.

TROUBLE SHOOTING

Engine Adjust. (Cont'd)

Condition	Possible causes	Action
Incident in intake system	• Plugged air cleaner	Replace element
	• Air leakage from electronic throttle insulator	Replace insulator.
	• Air leakage from manifold gasket	Replace gasket
Engine over temperature (Overheat)	• Insufficient amount of coolant	Fill coolant.
	• Loose fan belt.	Adjust belt tension.
	• Worn or loose fan belt	Replace.
	• Malfunctioning thermostat	Replace.
	• Water pump malfunction	Replace.
	• Plugged or leaking radiator	Wash, repair, or replace.
	• Radiator cap damage	Replace.
	• Air in cooling system piping	Retighten cooling system piping, bleed system.
	• Improper engine oil grade	Replace with appropriate grade of engine oil.
• Inappropriate ignition timing	Adjust.	
Overcool	• Malfunctioning thermostat	Replace.
Other	• Inappropriate octane rating of fuel	Replace with specified octane rating of fuel.
	• Insufficient tire air pressure	Charge to specified air pressure.
	• Brake dragging	Adjust.
	• Clutch slippage	Adjust.
Engine noise		
Knocking	• Engine overload	Operate with light load
	• Knocking due to carbon deposits	Remove cylinder head and eliminate carbon deposits.
	• Knocking due to inappropriate ignition timing	Adjust ignition timing.
	• Knocking due to inappropriate octane rating of fuel	Use specified octane rating of fuel.
	• Too advance ignition (Inappropriate spark plug selection)	Use specified type of spark plug.
Mechanical slapping		
Crankshaft bearing slapping	• Strong and heavy noise from engine during acceleration	A possible cause is in damage/wear of bearing or uneven wear of crankshaft.
	• To identify the noise generation point, attempt to cause misfires at each cylinder.	Need to replace bearing and adjust or replace crankshaft.
	• If misfires at a particular cylinder stop the noise, that cylinder is the noise source.	
Connecting rod bearing slapping	• This noise is also generated during engine acceleration but at a little more rapid pitch than crank slapping.	Take the same action as that for crankshaft bearing.
	• To identify the noise generation point, attempt to cause misfires at each cylinder.	
	• If misfires at a particular cylinder almost stop the noises, that cylinder is the noise source.	
Piston and cylinder slapping	• Mechanical rapping noise that increases according the engine speed but decreases as the engine is warmed up is attributed to the pistons and cylinders.	This noise is caused by excessive wear of cylinders and accompanied by engine power deterioration and excessive oil consumption.
	• To identify the noise generation point, attempt to cause misfires at each cylinder.	For a corrective action, engine overhaul is needed.
Piston pin slapping	• This noise is generated at piston TDC and BDC positions.	A possible cause is wear of the piston pin hole or piston pin.
	• To identify the noise generation point, attempt to cause misfires at each cylinder.	Need to replace piston and piston pin assembly.

TROUBLE SHOOTING

Engine Adjust. (Cont'd)

Condition	Possible causes	Action
Water pump noise	<ul style="list-style-type: none"> • This noise is generated from worn or damaged bearing(s) due to the uneven sliding faces. 	Replace water pump.
Excessive oil consumption		
Oil leakage	<ul style="list-style-type: none"> • Worn piston ring groove(s) and ring(s) 	Replace piston(s) and piston ring(s).
	<ul style="list-style-type: none"> • Deteriorated valve oil seal lip(s) 	Replace valve oil seal(s).
	<ul style="list-style-type: none"> • Worn valve stem(s) 	Replace valve(s).
Other	<ul style="list-style-type: none"> • Use of inappropriate quality of oil 	Use specified oil.
	<ul style="list-style-type: none"> • Engine overheat 	Already described
Inappropriate fuel consumption		
Refer to description of engine power deterioration. Other Refer to EF section for the LPG model.	<ul style="list-style-type: none"> • Excessive idling speed 	Adjust to specified level.
	<ul style="list-style-type: none"> • Insufficient throttle return 	Adjust.
	<ul style="list-style-type: none"> • Fuel leakage 	Repair fuel piping and additionally tighten connections.
Incident due to other factors		
Low oil pressure	<ul style="list-style-type: none"> • Use of inappropriate quality of oil 	Replace specified oil.
	<ul style="list-style-type: none"> • Engine over temperature (Overheat) 	Already described.
	<ul style="list-style-type: none"> • Oil pump regulator valve malfunction 	Overhaul or replace oil pump.
	<ul style="list-style-type: none"> • Oil pump malfunction 	Overhaul or replace oil pump.
	<ul style="list-style-type: none"> • Oil filter malfunction 	Replace with a new one.
	<ul style="list-style-type: none"> • Enlarged clearance of each sliding component 	Disassemble and replace relevant sliding component(s).
	<ul style="list-style-type: none"> • Clogged oil strainer 	Wash.
	<ul style="list-style-type: none"> • Malfunction of oil pressure gauge pressure switch 	Replace with a new one.
Excessive wear of sliding part(s)	<ul style="list-style-type: none"> • Low oil pressure 	Already described.
	<ul style="list-style-type: none"> • Poor quality of oil or foreign objects in oil 	Replace oil element and oil with appropriate ones.
	<ul style="list-style-type: none"> • Poor performance of air cleaner 	Check element.
	<ul style="list-style-type: none"> • Overheat or excessive cooling 	Already described.
	<ul style="list-style-type: none"> • Inappropriate air-fuel ratio 	Check fuel system.
Bite of sliding parts	<ul style="list-style-type: none"> • Low oil pressure 	Already described.
	<ul style="list-style-type: none"> • Insufficient clearance 	Adjust clearance to specified value.
	<ul style="list-style-type: none"> • Engine over temperature (Overheat) 	Already described.
	<ul style="list-style-type: none"> • Inappropriate air-fuel ratio 	Check fuel system.

TROUBLE SHOOTING

(2) Engine LPG Fuel System

Condition	Possible causes	Action
Fuel leakage		
Nasty smell	• Looseness of piping connection	Tighten.
	• Operating malfunction of vaporizer	Repair and adjust.
	• Poor connection or some foreign object is caught in between plunger rubber seat and valve seat of solenoid valve	Clean and rub.
	• Operating malfunction of lock off mechanism	Adjust.
Excessive fuel consumption	• Looseness of piping connection	Retighten and adjust.
	• Primary side room pressure at idle is excessively high.	Clean and adjust.
	• Clogged air cleaner	Wash.
Low output	• Operating malfunction of vaporizer	Repair and adjust.
	• Looseness of piping connection or clogged filter	Clean and retighten.
	• Adjusting malfunction of vaporizer primary and secondary room pressures	Adjust.
	• Use improper fuel.	Use proper fuel.
	• Clogged fuel passage	Clean.
Inconsistent or rough idle	• Improper position or operating malfunction of electric throttle control actuator	Adjust.
	• Operating malfunction of vaporizer	Repair and adjust.
	• Operating malfunction of vaporizer valve (It is closed improperly.)	Clean, adjust or replace.
Engine hesitation or hunting	• Operating malfunction of vaporizer	Adjust.
	• Adjusting malfunction of idle speed	Adjust.
Poor starting engine	• Insufficient fuel	Refill fuel.
	• Operating malfunction	Make sure that manual valve is opened.
	• Operating malfunction of solenoid valve	Check and repair wiring, switch, and solenoid valve.
	• Operating malfunction of vaporizer	Replace.
	• Water pump malfunction	Repair and adjust
	• Adjusting malfunction of idle speed	Adjust.
Operating malfunction of vaporizer	• Adjusting malfunction of vaporizer pressures	Adjust.
	• Leakage from vaporizer	Clean, adjust, or replace.
	• Damage of diaphragm	Replace.
	• Foreign materials enter vaporizer inside	Clean and adjust.
	• Leakage by looseness of setscrew	Tighten.
	• Overcool of vaporizer (Fur deposit, damage of hose, poor coolant circulation)	Check, clean, and adjust.
	• Tar deposit in valve	Remove tar and clean.