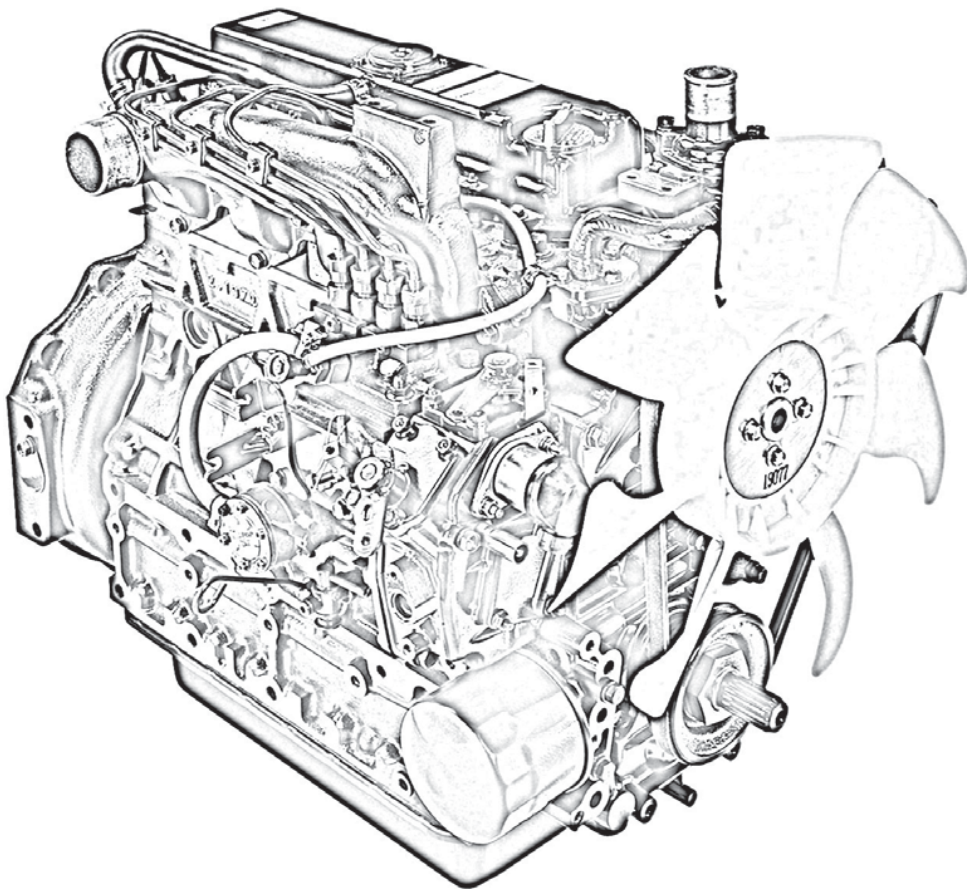


03-M Serie

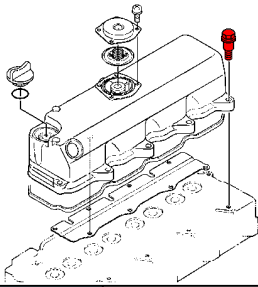


TIGHTENING TORQUES

(1) Special Tightening Torques

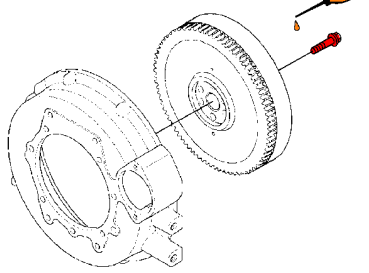
For " * " marked screws, bolts and nuts on under table, apply engine oil to their threads and seats before tightening.

Cylinder head cover screw



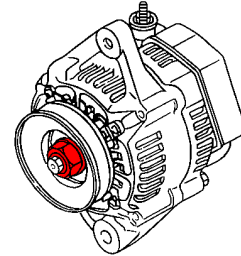
D1503-M-EB	
D1703-M-EB	6.9 to 11.3 N·m
D1803-M-EB	0.70 to 1.15 kgf·m
V2203-M-EB	5.1 to 8.3 ft-lbs
V2403-M-EB	

Flywheel screw *



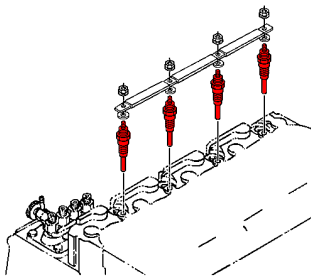
D1503-M-EB	
D1703-M-EB	98.0 to 107.8 N·m
D1803-M-EB	10.0 to 11.0 kgf·m
V2203-M-EB	72.3 to 79.5 ft-lbs
V2403-M-EB	

Alternator pulley nut



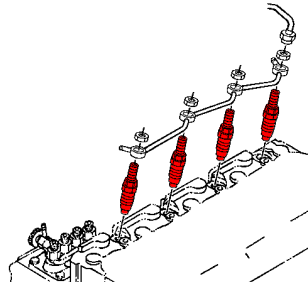
D1503-M-EB	
D1703-M-EB	58.3 to 78.9 N·m
D1803-M-EB	5.95 to 8.05 kgf·m
V2203-M-EB	43.0 to 58.2 ft-lbs
V2403-M-EB	

Glow plug



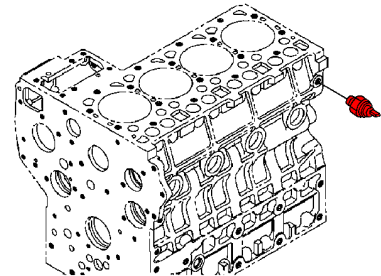
D1503-M-EB	
D1703-M-EB	19.6 to 24.5 N·m
D1803-M-EB	2.0 to 2.5 kgf·m
V2203-M-EB	14.5 to 18.1 ft-lbs
V2403-M-EB	

Nozzle holder assembly



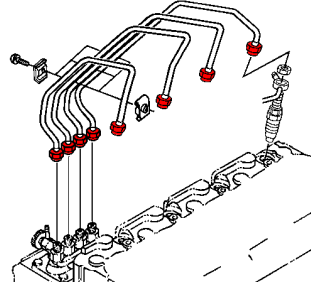
D1503-M-EB	
D1703-M-EB	49.0 to 68.6 N·m
D1803-M-EB	5.0 to 7.0 kgf·m
V2203-M-EB	36.2 to 50.6 ft-lbs
V2403-M-EB	

Oil switch taper screw



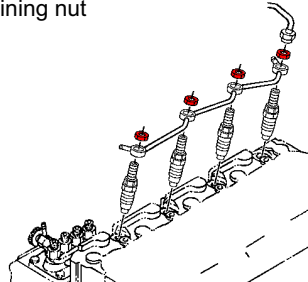
D1503-M-EB	
D1703-M-EB	14.7 to 19.6 N·m
D1803-M-EB	1.5 to 2.0 kgf·m
V2203-M-EB	10.8 to 14.5 ft-lbs
V2403-M-EB	

Injection pipe retaining nut



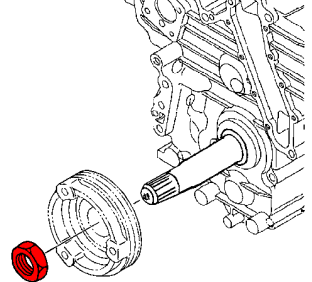
D1503-M-EB	
D1703-M-EB	24.5 to 34.3 N·m
D1803-M-EB	2.5 to 3.5 kgf·m
V2203-M-EB	18.1 to 25.3 ft-lbs
V2403-M-EB	

Overflow pipe assembly retaining nut



D1503-M-EB	
D1703-M-EB	19.6 to 24.5 N·m
D1803-M-EB	2.0 to 2.5 kgf·m
V2203-M-EB	14.5 to 18.1 ft-lbs
V2403-M-EB	

Fan drive pulley mounting nut



D1503-M-EB	
D1703-M-EB	137.3 to 156.9 N·m
D1803-M-EB	14.0 to 16.0 kgf·m
V2203-M-EB	101.3 to 115.7 ft-lbs
V2403-M-EB	

(2) General Tightening Torques

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.

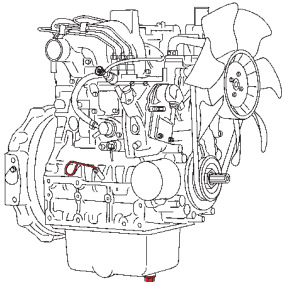
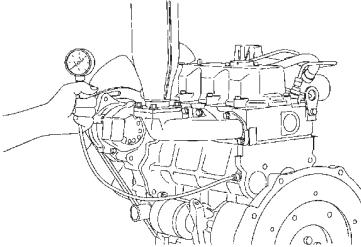
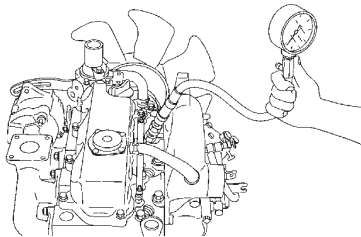
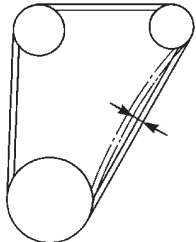
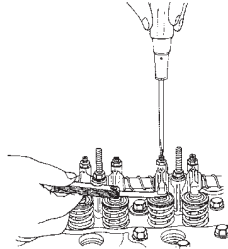
None or 4 : Standard grade

7 : Special grade

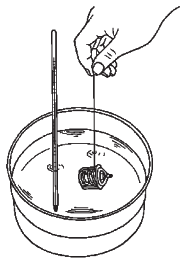
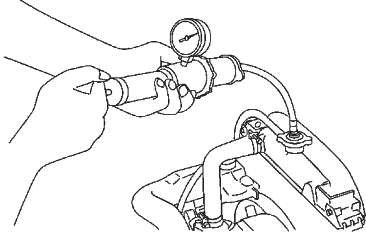
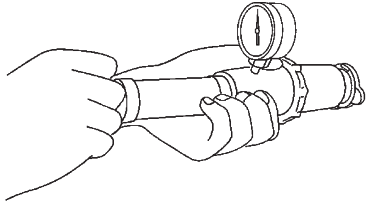
Nominal Diameter	Standard Grade	Special Grade
M6	7.9 to 9.3 N·m 0.80 to 0.95 kgf·m 5.8 to 6.9 ft-lbs	9.8 to 11.3 N·m 1.00 to 1.15 kgf·m 7.23 to 8.32 ft-lbs
M8	17.7 to 20.6 N·m 1.8 to 2.1 kgf·m 13.0 to 15.2 ft-lbs	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
M10	39.2 to 45.1 N·m 4.0 to 4.6 kgf·m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

SERVICING SPECIFICATIONS

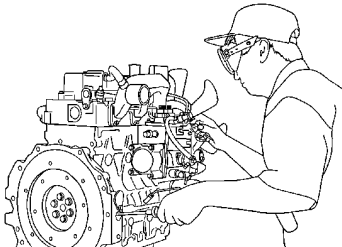
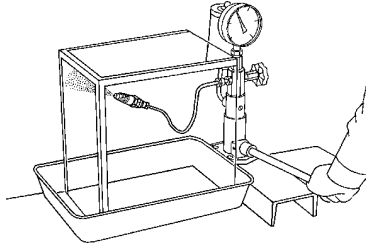
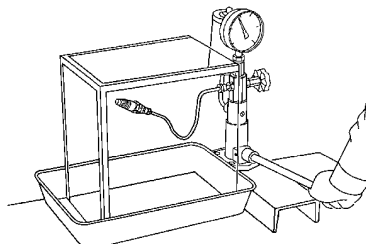
(1) ENGINE BODY

Item			Factory Specification	Allowable Limit
Lubricating oil capacity 	Oil pan depth 124 mm (4.88 in.)	D1503-M-E2B D1703-M-E2B D1803-M-E2B	7.0 L 1.85 U.S.gals. 1.54 Imp.gals.	—
		V2003-M-E2B V2003-M-T-E2B V2203-M-E2B V2403-M-E2B	9.5 L 2.51 U.S.gals. 2.09 Imp.gals.	—
	Oil pan depth 90 mm (3.54 in.)	D1503-M-E2B D1703-M-E2B D1803-M-E2B	5.6 L 1.48 U.S.gals. 1.23 Imp.gals.	—
		V2003-M-E2B V2003-M-T-E2B V2203-M-E2B V2403-M-E2B	7.6 L 2.01 U.S.gals. 1.67 Imp.gals.	—
Engine oil pressure 	Engine oil pressure (At idle speed)	All models	—	49 kPa 0.5 kgf/cm ² 7 psi
	Engine oil pressure (At rated speed)	All models	294.2 to 441.0 kPa 3.0 to 4.5 kgf/cm ² 42.7 to 64.0 psi	245 kPa 2.5 kgf/cm ² 36 psi
Compression pressure 		All models	3.53 to 4.02 MPa / 290 min ⁻¹ (rpm) 36 to 41 kgf/cm ² / 290 min ⁻¹ (rpm) 512 to 583 psi / 290 min ⁻¹ (rpm)	2.55 MPa / 290 min ⁻¹ (rpm) 26 kgf/cm ² / 290 min ⁻¹ (rpm) 370 psi / 290 min ⁻¹ (rpm)
Fan belt 	Tension	All models	7.0 to 9.0 mm (0.28 to 0.35 in.) deflection at 98 N (10 kgf, 22 lbs) of force	—
Valve clearance (When cold) 		All models	0.18 to 0.22 mm 0.0071 to 0.0087 in.	—

(3) COOLING SYSTEM

Item			Factory Specification	Allowable Limit
Thermostat 	Valve opening temperature (At beginning)	All models	69.5 to 72.5 °C 157.1 to 162.5 °F	—
	Valve opening temperature (Opened completely)	All models	85 °C 185 °F	—
Radiator 	Water tightness	All models	No water leak at 137 kPa 1.4 kgf/cm ² 20 psi	—
Radiator cap 	Pressure falling time	All models	10 seconds or more for pressure falling from 88 to 59 kPa (from 0.9 to 0.6 kgf/cm ² , from 13 to 9 psi)	—

(4) FUEL SYSTEM

Item			Factory Specification	Allowable Limit
Injection pump 	Injection timing	All models	0.297 to 0.331 rad. before T.D.C. 17 to 19° before T.D.C.	—
Injection nozzle 	Injection pressure	All models	13.7 to 14.7 MPa 140 to 150 kgf/cm ² 1991 to 2133 psi	—
Injection nozzle 	Valve seat tightness	All models	No fuel leak at 12.75 MPa 130 kgf/cm ² 1849 psi	—



SAFETY FIRST

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

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



DANGER

: Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING

: Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION

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



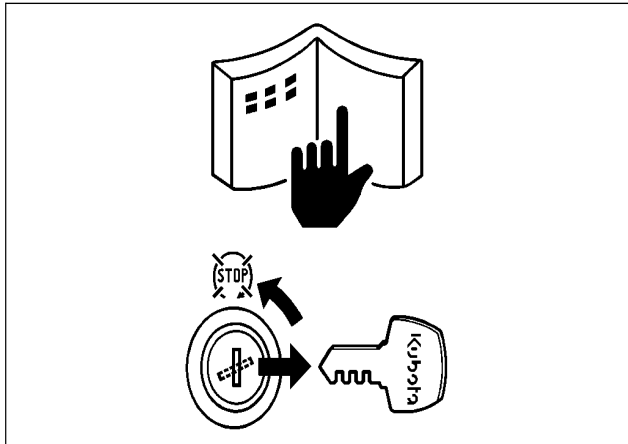
IMPORTANT

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



NOTE

: Gives helpful information.



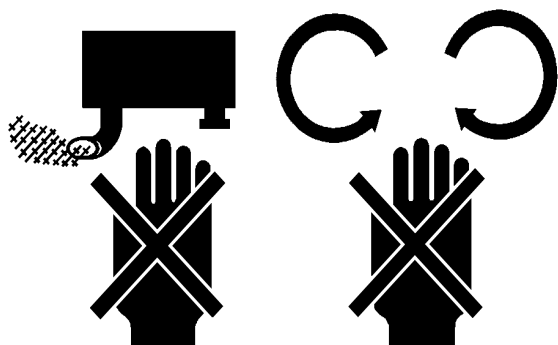
BEFORE SERVICING AND REPAIRING

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



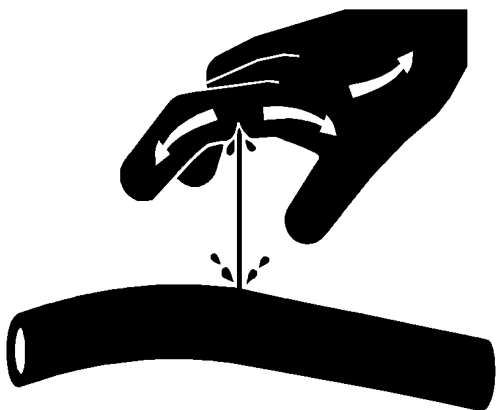
SAFETY STARTING

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



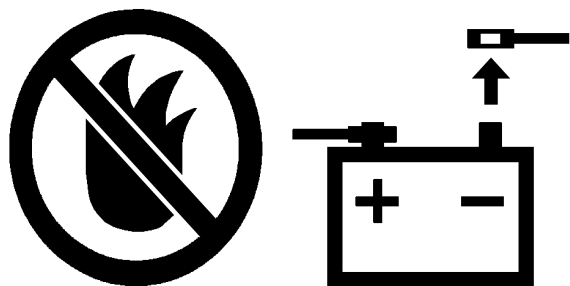
SAFETY WORKING

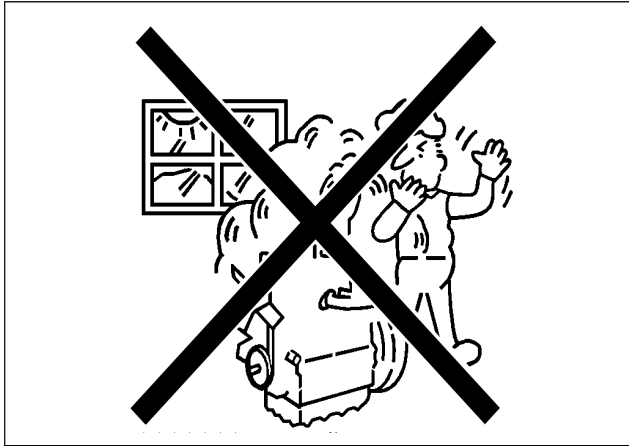
- Do not work on the machine while under the influence of alcohol, medication, or other substances or while fatigued.
- Wear close fitting clothing and safety equipment appropriate to the job.
- Use tools appropriate to the work. Makeshift tools, parts, and procedures are not recommended.
- When servicing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



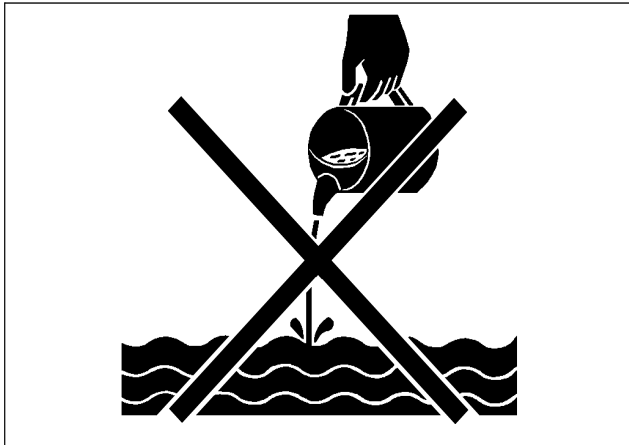
AVOID FIRES

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

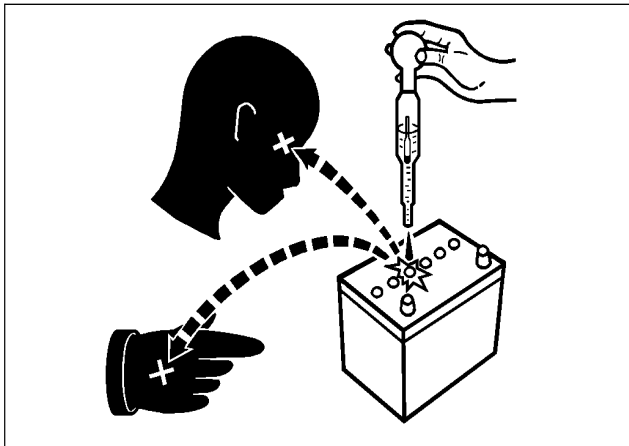


**VENTILATE WORK AREA**

- 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.

**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.

**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.

**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.

SPECIFICATIONS

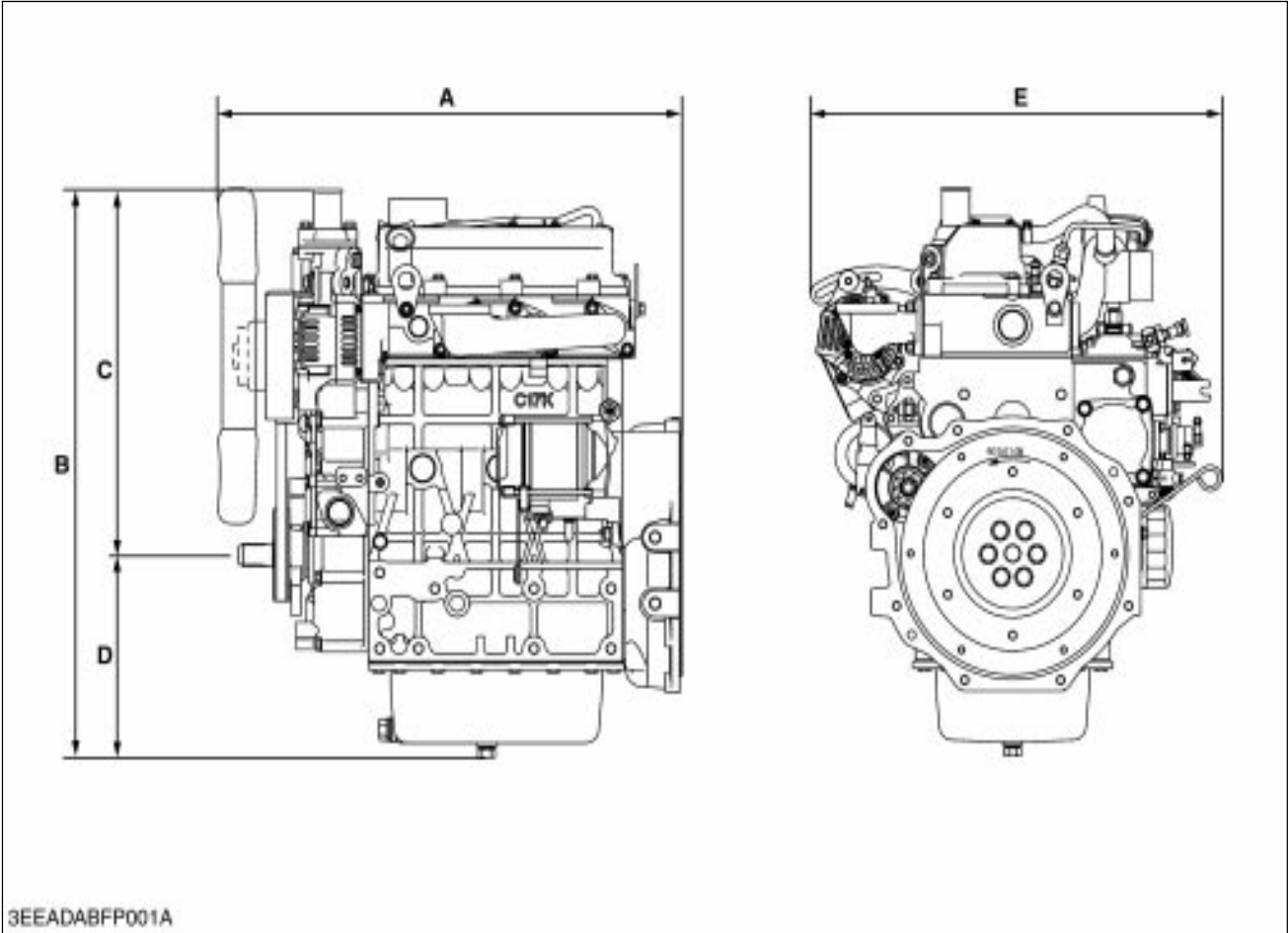
Model		D1503-M-DI	D1503-M-DI-T	D1703-M-DI	D1803-M-DI
Number of Cylinders		3			
Type		Vertical, Water-cooled, 4 cycle DI diesel engine			
Bore × Stroke mm × mm (in. × in.)		83 × 92.4 (3.26 × 3.64)		87 × 92.4 (3.43 × 3.64)	87 × 102.4 (3.43 × 4.04)
Total Displacement cm ³ (cu.in.)		1499 (91.47)		1647 (100.51)	1826 (111.43)
SAE Net Cont. kW/rpm (HP/rpm)		20.1 / 2800 (27.0 / 2800)	27.2 / 2800 (36.5 / 2800)	22.7 / 2800 (30.4 / 2800)	23.9 / 2600 (32.1 / 2600)
SAE Net Intermittent kW/rpm (HP/rpm)		23.5 / 2800 (31.5 / 2800)	31.3 / 2800 (42.0 / 2800)	26.1 / 2800 (35.0 / 2800)	27.2 / 2600 (36.5 / 2600)
SAE Gross Intermittent kW/rpm (HP/rpm)		24.8 / 2800 (33.2 / 2800)	32.7 / 2800 (43.8 / 2800)	27.4 / 2800 (36.7 / 2800)	28.4 / 2600 (38.1 / 2600)
Maximum Bare Speed (rpm)		3000			2800
Maximum Idling Speed (rpm)		750 to 850			
Combustion Chamber		Troiddal Type (Direct Injection)			
Fuel Injection Pump		Bosch “K” Type Mini Pump			
Governor		Centrifugal Ball Type, All Speed Mechanical Governor			
Direction of Rotation		Counter-Clockwise (viewed from flywheel side)			
Injection Nozzle		Bosch “P” Type Hole Nozzle			
Injection Timing		0.201 rad (11.5 °) Before T.D.C.		0.175 rad (10 °) Before T.D.C.	
Firing Order		1-2-3			
Injection Pressure	1st. Stage	18.6 MPa (190 kgf/cm ² , 2702 psi)			
	2nd. Stage	22.6 MPa (230 kgf/cm ² , 3271 psi)			
Compression Ratio		20	19	20	
Lubricating System		Forced Lubrication by Trochoid Pump			
Cooling System		Pressurized radiation, forced circulation with water pump			
Starting System		Electric Starting with Starter			
		12 V, 1.4 kW			
Starting Support Device		Pre-heating by Glow Plug in Combustion Chamber			
Battery		12 V, 60 A (75D31R)			12 V, 88 A (115E41R)
Charging Alternator		12 V, 360 W		12 V, 480 W	
Fuel		Diesel Fuel No.2-D or No.2-DLS			
Lubricating Oil		Better than CD class (API)			
Lubricating Oil Capacity	Oil Pan Depth 90 mm (3.54 in.)	5.6 L (1.48 U.S.gals., 1.23 Imp.gals.)			
	Oil Pan Depth 124 mm (4.88 in.)	7.0 L (1.85 U.S.gals., 1.54 Imp.gals.)			
Weight (Dry) BB spec. kg (lbs)		148 (326)	152 (335)	148 (326)	151 (333)

W10275180

Model		V2203-M-DI	V2403-M-DI
Number of Cylinders		4	
Type		Vertical, Water-cooled, 4 cycle DI diesel engine	
Bore × Stroke mm × mm (in. × in.)		87 × 92.4 (3.43 × 3.64)	87 × 102.4 (3.43 × 4.04)
Total Displacement cm ³ (cu.in.)		2197 (134.07)	2434 (148.53)
SAE Net Cont. kW/rpm (HP/rpm)		30.2 / 2800 (40.5 / 2800)	31.8 / 2600 (42.6 / 2600)
SAE Net Intermittent kW/rpm (HP/rpm)		34.8 / 2800 (46.7 / 2800)	36.6 / 2600 (34.8 / 2800)
SAE Gross Intermittent kW/rpm (HP/rpm)		36.4 / 2800 (48.8 / 2800)	38.0 / 2600 (51.0 / 2600)
Maximum Bare Speed (rpm)		3000	3000
Maximum Idling Speed (rpm)		750 to 850	
Combustion Chamber		Troiddal Type (Direct Injection)	
Fuel Injection Pump		Bosch "K" Type Mini Pump	
Governor		Centrifugal Ball Type, All Speed Mechanical Governor	
Direction of Rotation		Counter-Clockwise (viewed from flywheel side)	
Injection Nozzle		Bosch "P" Type Hole Nozzle	
Injection Timing		0.192 rad (11 °) Before T.D.C.	
Firing Order		1-3-4-2	
Injection Pressure	1st. Stage	18.6 MPa (190 kgf/cm ² , 2702 psi)	
	2nd. Stage	22.6 MPa (230 kgf/cm ² , 3271 psi)	
Compression Ratio		20	
Lubricating System		Forced Lubrication by Trochoid Pump	
Cooling System		Pressurized radiation, forced circulation with water pump	
Starting System		Electric Starting with Starter	
		12 V, 1.4 kW	12 V, 2.0 kW
Starting Suport Device		Pre-heating by Glow Plug in Combustion Chamber	
Battery		12 V, 88 A (115E41R)	12 V, 92 A (130E41R)
Charging Alternator		12 V, 480 W	
Fuel		Diesel Fuel No.2-D or No.2-DLS	
Lubricating Oil		Better than CD class (API)	
Lubricating Oil Capacity	Oil Pan Depth 90 mm (3.54 in.)	7.6 L (2.01 U.S.gals., 1.67 Imp.gals.)	
	Oil Pan Depth 124 mm (4.88 in.)	9.5 L (2.51 U.S.gals., 2.09 Imp.gals.)	
Weight (Dry) BB spec. kg (lbs)		180 (397)	184 (406)

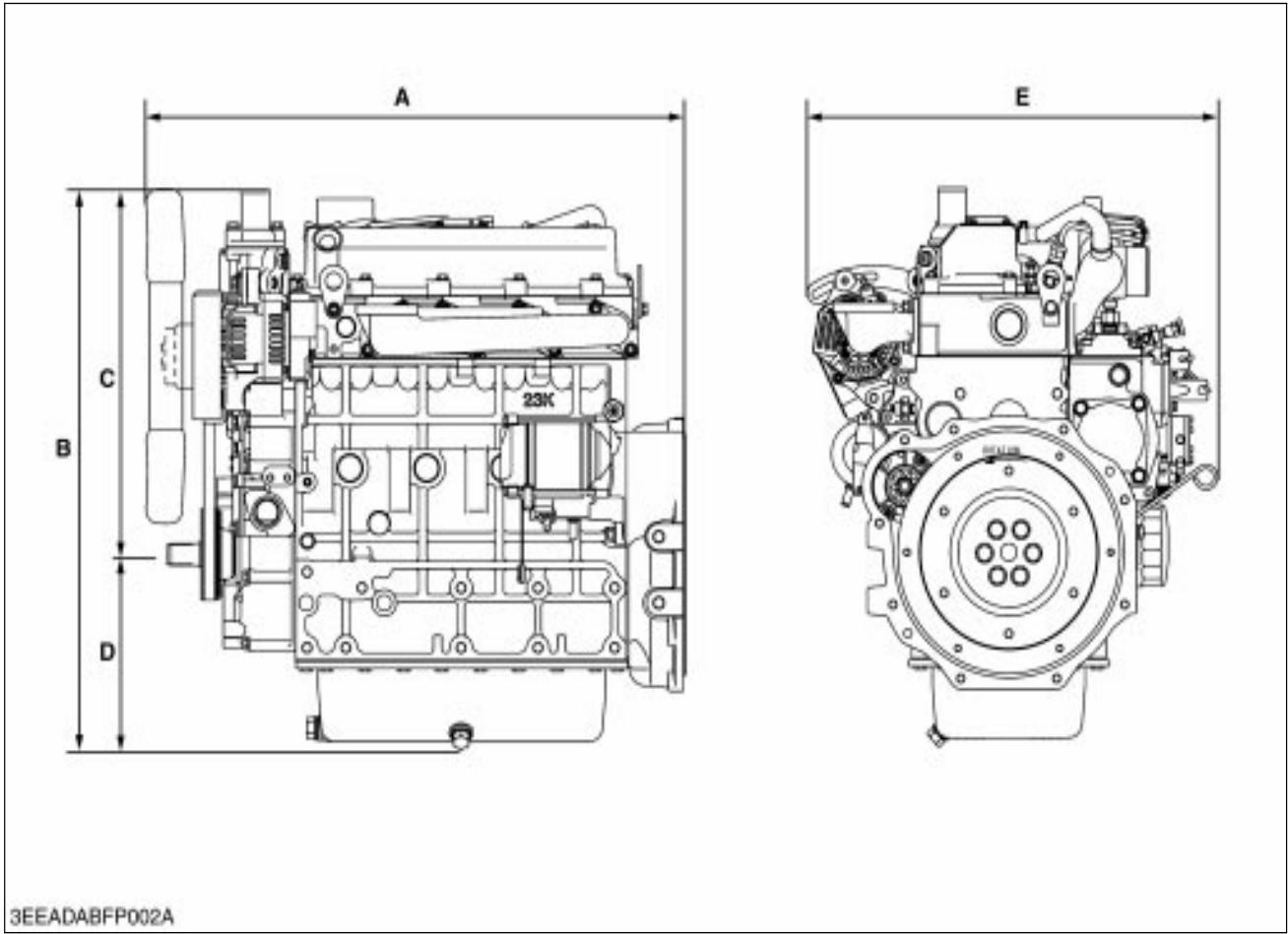
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DIMENSIONS



	D1503-M-DI	D1503-M-DI-T	D1703-M-DI	D1803-M-DI
A	599.2 mm (23.59 in.)	599.2 mm (23.59 in.)	572.1 mm (22.52 in.)	575.9 mm (22.67 in.)
B	643.5 mm (25.33 in.)	644.0 mm (25.35 in.)	643.3 mm (25.33 in.)	685.0 mm (26.97 in.)
C	414.2 mm (16.31 in.)	414.2 mm (16.31 in.)	414.0 mm (16.30 in.)	419.0 mm (16.50 in.)
D	229.3 mm (9.03 in.)	229.8 mm (9.05 in.)	229.3 mm (9.03 in.)	266.0 mm (10.47 in.)
E	514.4 mm (20.25 in.)	514.4 mm (20.25 in.)	507.1 mm (19.96 in.)	499.0 mm (19.65 in.)

W1031045



	V2203-M-DI	V2403-M-DI
A	667.1 mm (26.26 in.)	670.9 mm (26.41 in.)
B	635.0 mm (25.00 in.)	684.5 mm (26.95 in.)
C	414.0 mm (16.30 in.)	419.0 mm (16.50 in.)
D	221.0 mm (8.70 in.)	265.5 mm (10.45 in.)
E	507.1 mm (19.96 in.)	499.0 mm (19.65 in.)

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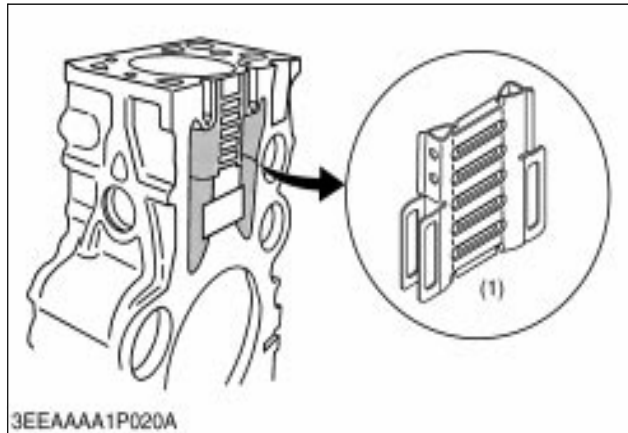
MECHANISM

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3. FUEL SYSTEM	M-4
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1. ENGINE BODY

[1] HOLLOW CORE



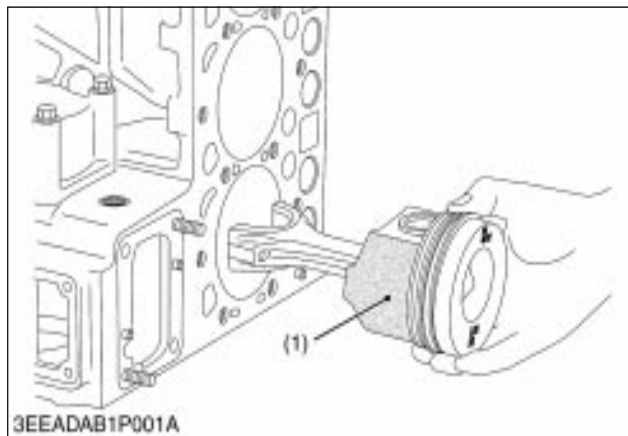
The cylinder block has a hollow core (1) already cast inside the cylinder-to-cylinder water jacket.

In this core, there is a pair of vertical cooling passages (right and left) as well as multiple horizontal cooling channels that interconnect these cooling passages. This design allows smoother cooling water flow through the cylinder block, which cools down a wider range between the cylinders more effectively.

(1) Hollow Core

W1013048

[2] PISTON



Piston's skirt is coated with **molybdenum disulfide★**, which reduces the piston slap noise and thus the entire operating noise.

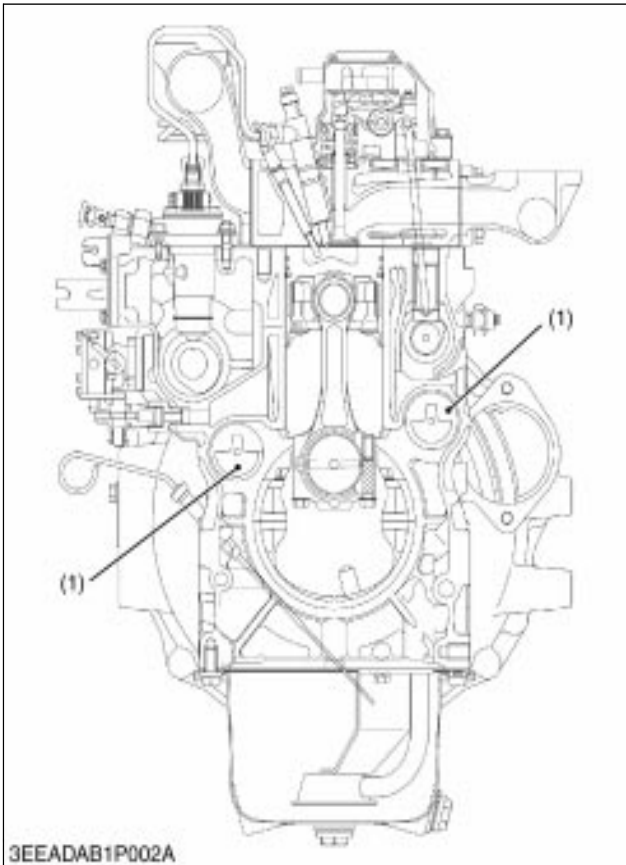
★Molybdenum disulfide (MoS₂)

The molybdenum disulfide (1) serves as a solid lubricant, like a Graphite or Teflon. This material helps resist metal wears even with little lube oil.

(1) Molybdenum Disulfide

W1013114

[3] BUILT-IN DYNAMIC BALANCER (BALANCER MODEL ONLY)



Engine are sure to vibrate by piston's reciprocation. Theoretically, three-cylinder engines are much less prone to cause vibration than four-cylinder ones (second inertia, etc.). However, any engine has many moving parts in addition to its pistons and cannot be completely free from vibration.

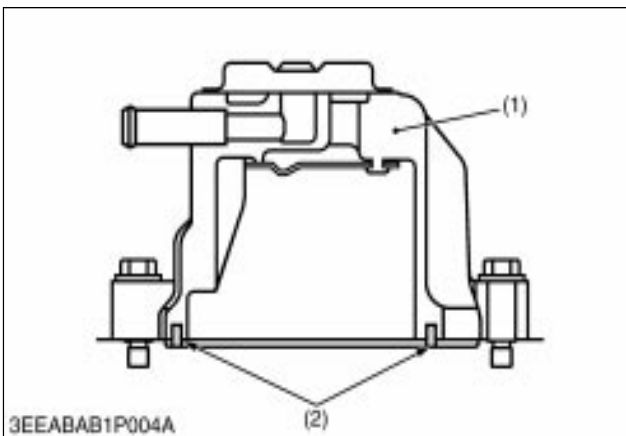
The four cylinders engine V2203 and V2403 can be fitted with balance weight on crankcase to absorb the second inertia mentioned above and reduce vibration.

This engine is internally provide with two balancers (1), one at the suction side and the other at the exhaust side.

(1) Balancer

W1013221

[4] HALF-FLOATING HEAD COVER



The rubber packing (2) is fitted in to maintain the cylinder head cover (1) 0.5 mm or so off the cylinder head. This arrangement helps reduce noise coming from the cylinder head.

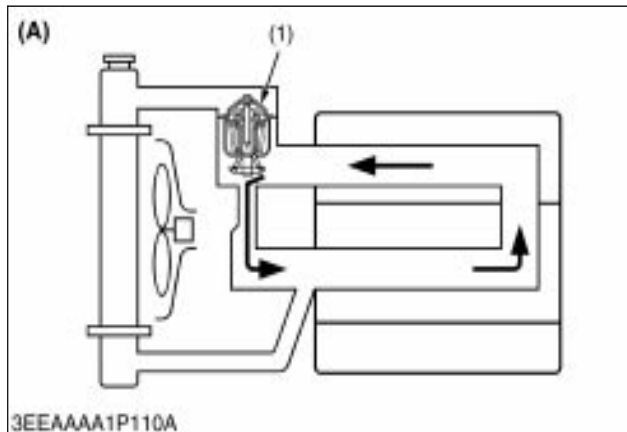
(1) Cylinder Head Cover

(2) Rubber Packing

W1013327

2. COOLING SYSTEM

[1] BOTTOM BYPASS SYSTEM



Bottom bypass system is introduced in 03-M-DI Series for improving the cooling performance of the radiator.

While the temperature of coolant in the engine is low, the thermostat (1) is held closed and the coolant is allowed to flow through the bypass pipe and to circulate in the engine.

When the temperature exceeds the thermostat valve opening level, the thermostat (1) fully opens itself to prevent the hot coolant from flowing through the bypass into the engine.

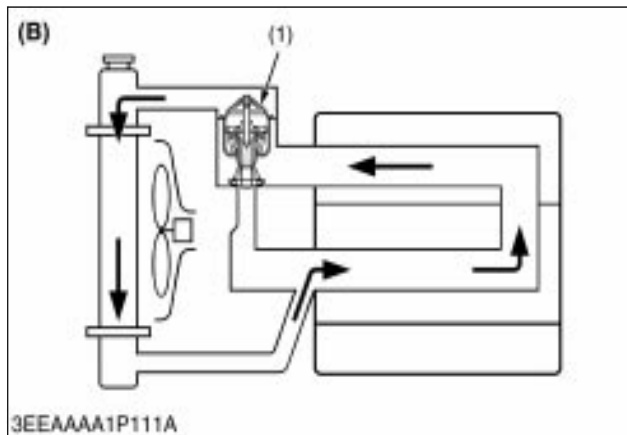
In this way, the radiator can increase its cooling performance.

(1) Thermostat

(A) Thermostat Closed

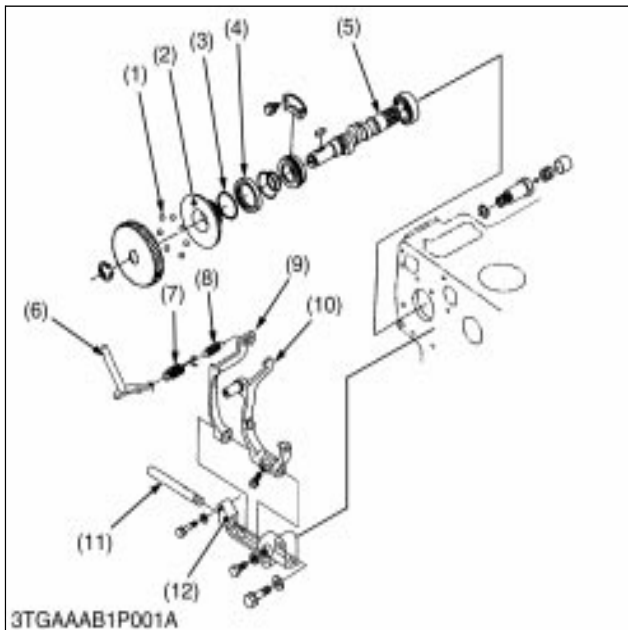
(B) Thermostat Open

W1013406



3. FUEL SYSTEM

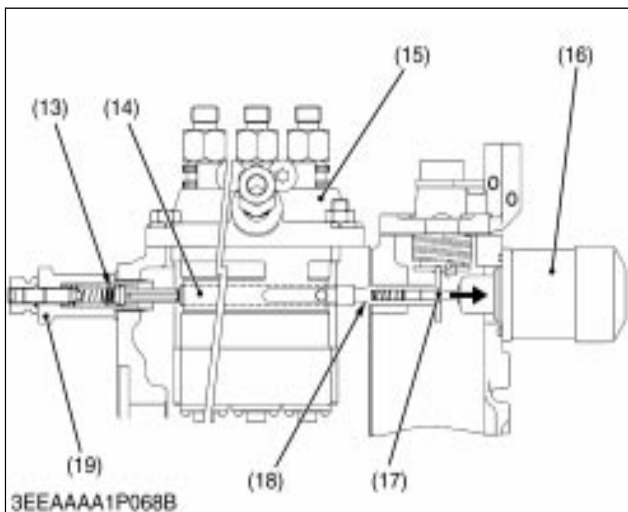
[1] GOVERNOR



The governor serves to keep engine speed constant by automatically adjusting the amount of fuel supplied to the engine according to changes in the load. This engine employs an all-speed governor which controls the centrifugal force of the steel ball (1) weight, produced by rotation of the fuel camshaft (5), and the tension of the governor spring 1 (7) and 2 (8) are balanced.

- | | |
|------------------------|------------------------|
| (1) Steel Ball | (7) Governor Spring 1 |
| (2) Governor Sleeve | (8) Governor Spring 2 |
| (3) Steel Ball | (9) Fork Lever 2 |
| (4) Governor Ball Case | (10) Fork Lever 1 |
| (5) Fuel Camshaft | (11) Fork Lever Shaft |
| (6) Governor Lever | (12) Fork Lever Holder |

W1017186



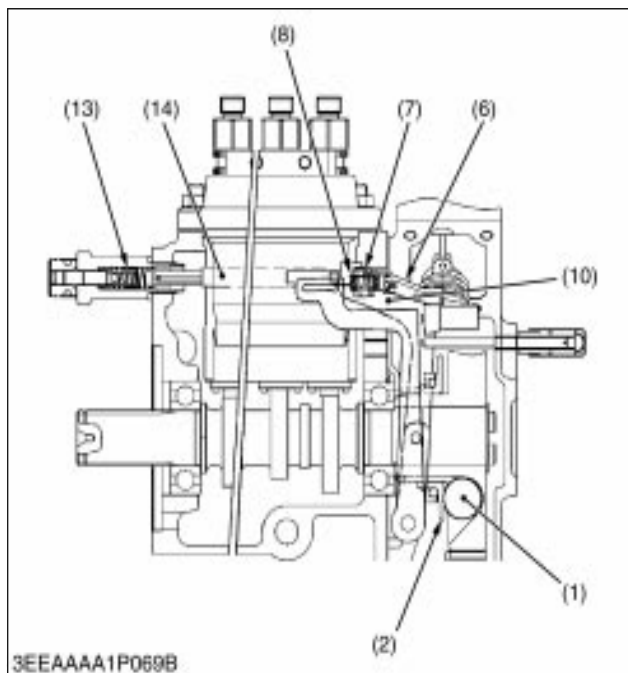
■ At Start

Flowing of the battery current into the engine stop solenoid (16), the plunger (17) is actuated to arrow direction.

Since the steel ball (1) have no centrifugal force, the control rack (14) is pushed to the right by the start spring (13). Accordingly, the control rack (14) moves to the maximum injection position to assure easy starting.

- | | |
|---------------------------|-----------------------|
| (13) Start Spring | (17) Plunger |
| (14) Control Rack | (18) Guide |
| (15) Injection Pump | (19) Idling Apparatus |
| (16) Engine Stop Solenoid | |

W1017215



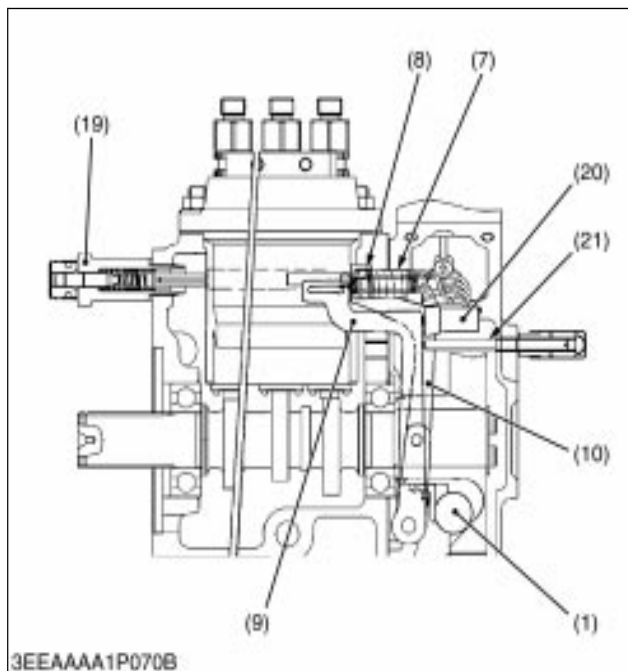
■ At Idling

When the speed control lever is set at the idling position after the engine starts, the governor spring 1 (7) does not work at all and the governor spring 2 (8) does only act slightly. The governor sleeve (2) is pushed leftward by a centrifugal force of steel ball (1).

Therefore, the fork lever 1 (10) and control rack (14) are moved to the left by the governor sleeve (2) and then the start spring (13) is compressed by the control rack (14). As a result, the control rack (14) is kept at a position where a centrifugal force of steel ball (1) and forces of start spring (13), governor spring 2 (8) are balanced, providing stable idling.

- | | |
|-----------------------|-----------------------|
| (1) Steel Ball | (8) Governor Spring 2 |
| (2) Governor Sleeve | (10) Fork Lever 1 |
| (6) Governor Lever | (13) Start Spring |
| (7) Governor Spring 1 | (14) Control Rack |

W1017317



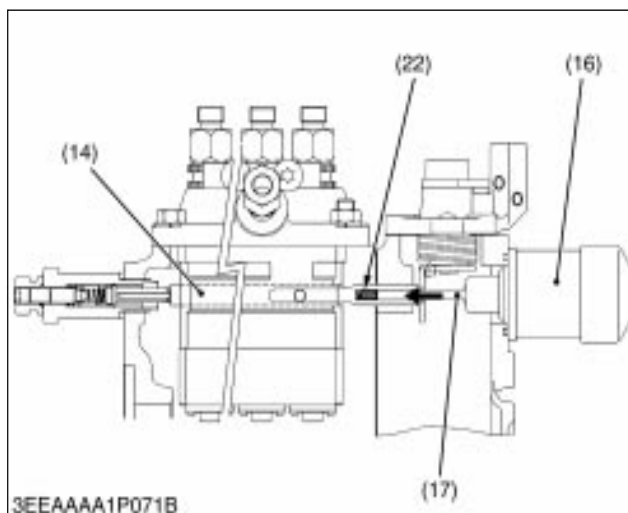
■ At High Speed Running with Overload

When an overload is applied to the engine running at a high speed, the centrifugal force of steel ball (1) becomes small as the engine speed is dropped, and fork lever 2 (9) is pulled to the right by the governor springs 1 (7) and 2 (8), increasing fuel injection. Though, fork lever 2 (9) becomes ineffective in increasing fuel injection when it is stopped by the adjusting screw (21).

After that, when the force of torque spring (20) becomes greater than the centrifugal force of the steel ball (1), fork lever 1 (10) moves rightward to increase fuel injection, causing the engine to run continuously at a high torque.

- | | |
|-----------------------|-----------------------|
| (1) Steel Ball | (10) Fork Lever 1 |
| (7) Governor Spring 1 | (19) Idling Apparatus |
| (8) Governor Spring 2 | (20) Torque Spring |
| (9) Fork Lever 2 | (21) Adjusting Screw |

W1017384



■ To Stop Engine

When the battery current stops, the plunger (17) of engine stop solenoid (16) is returned to the original position, the spring (22) to keep the control rack (14) in "No fuel injection" position.

- | | |
|---------------------------|--------------|
| (14) Control Rack | (17) Plunger |
| (16) Engine Stop Solenoid | (22) Spring |

W1018007

SERVICING

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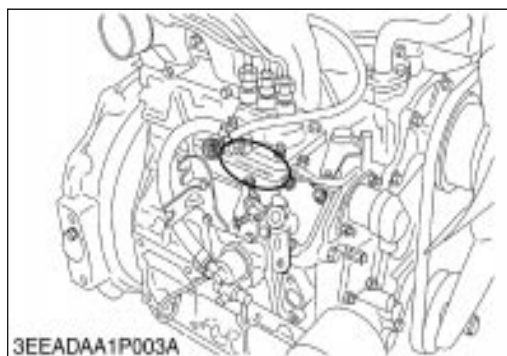
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1. GENERAL

[1] ENGINE IDENTIFICATION

(1) Model Name and Engine Serial Number



When contacting the manufacture, always specify your engine model name and serial number.

The engine model and its serial number need to be identified before the engine can be serviced or parts replaced.

■ 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	F	2015
2	2002	G	2016
3	2003	H	2017
4	2004	J	2018
5	2005	K	2019
6	2006	L	2020
7	2007	M	2021
8	2008	N	2022
9	2009	P	2023
A	2010	R	2024
B	2011	S	2025
C	2012	T	2026
D	2013	V	2027
E	2014		

• 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 ~

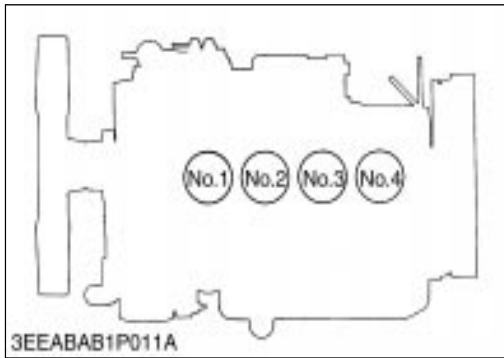
e.g. D1803-1A0001

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

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

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(2) Cylinder Number

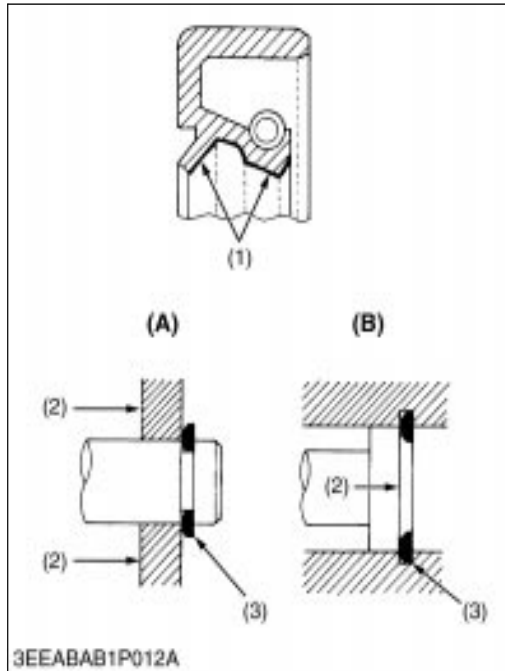


The cylinder numbers of 03-M-DI Series diesel engine are designated as shown in the figure.

The sequence of cylinder numbers is given as No.1, No.2, No.3 and No.4 starting from the gear case side.

W1011077

[2] GENERAL PRECAUTION



- During disassembly, carefully arrange removed parts in a clean area to prevent confusion later. Screws, bolts 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.

(1) Grease

(2) Force

(3) Place the Sharp Edge against the Direction of Force

(A) External Snap Ring**(B) Internal Snap Ring**

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 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 “*”, a 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.
- The letter “M” in Size x 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	Size x Pitch	N·m	kgf·m	ft-lbs
Cylinder head cover screw	M6 × 1.0	6.9 to 11.3	0.7 to 1.15	5.1 to 8.32
* Cylinder head screw	M11 × 1.25	93.1 to 98.0	9.5 to 10.0	68.7 to 72.3
* Main bearing case screw 1	M9 × 1.25	46.1 to 50.9	4.7 to 5.2	34.0 to 37.6
* Main bearing case screw 2	M10 × 1.25	68.6 to 73.5	7.0 to 7.5	50.6 to 54.2
* Flywheel screw	M12 × 1.25	98.0 to 107.8	10.0 to 11.0	72.3 to 79.5
* Connecting rod screw	M8 × 1.0	44.1 to 49.0	4.5 to 5.0	32.5 to 36.2
* Rocker arm bracket screw	M8 × 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
* Idle gear shaft screw	M8 × 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Fan drive pulley mounting nut	—	137.3 to 156.9	14.0 to 16.0	101.3 to 115.7
* Bearing case cover screw	M8 × 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Glow plug	M10 × 1.25	19.6 to 24.5	2.0 to 2.5	14.5 to 18.1
Nozzle holder clamp screw	—	25.5 to 29.4	2.6 to 3.0	18.8 to 21.7
Oil Switch taper screw	PT 1/8	14.7 to 19.6	1.5 to 2.0	10.8 to 14.5
Injection pipe retaining nut	M12 × 1.5	14.7 to 24.5	1.5 to 2.5	10.8 to 18.1
Overflow pipe assembly retaining screw	—	9.8 to 11.3	1.0 to 1.15	7.2 to 8.3
Camshaft set screw	M8 × 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Hi-idling body	—	44.1 to 49.0	4.5 to 5.0	32.6 to 36.3

W1013236

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

Grade Nominal Diameter	Standard Screw and Bolt ④			Special Screw and Bolt ⑦		
	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 SS400, S20C
7	Special screw and bolt S43C, S48C (Refined)

W1012705

[5] SERVICING SPECIFICATIONS

ENGINE BODY

Item		Factory Specification	Allowable Limit
Cylinder Head Surface	Flatness	—	0.05 mm / 500 mm 0.0020 in. / 19.69 in.
Compression Pressure (When Cranking with Starting Motor)		2.94 to 3.24 MPa / 290 min ⁻¹ (rpm) 30 to 33 kgf/cm ² / 290 min ⁻¹ (rpm) 427 to 469 psi / 290 min ⁻¹ (rpm)	2.35 MPa / 290 min ⁻¹ (rpm) 24 kgf/cm ² / 290 min ⁻¹ (rpm) 341 psi / 290 min ⁻¹ (rpm)
Difference among Cylinders		—	10 % or less
Top Clearance		0.60 to 0.70 mm 0.0236 to 0.0276 in.	—
Valve Clearance (When Cold)		0.18 to 0.22 mm 0.0071 to 0.0087 in.	—
Valve Seat	Width (Intake)	2.12 mm 0.0835 in.	—
	Width (Exhaust)	2.12 mm 0.0835 in.	—
Valve Seat	Angle (Intake)	1.047 rad 60 °	—
	Angle (Exhaust)	0.785 rad 45 °	—
Valve Face	Angle (Intake)	1.047 rad 60 °	—
	Angle (Exhaust)	0.785 rad 45 °	—
Valve Stem to Valve Guide	Clearance	0.040 to 0.070 mm 0.0016 to 0.0028 in.	0.1 mm 0.0039 in.
Valve Stem	O.D.	7.960 to 7.975 mm 0.31339 to 0.31398 in.	—
Valve Guide	I.D.	8.015 to 8.030 mm 0.31555 to 0.31614 in.	—
Valve Recessing	Protrusion	0.05 mm 0.0020 in.	—
	Recessing	to 0.15 mm 0.0059 in.	0.4 mm 0.0157 in.

W1013874

ENGINE BODY (Continued)

Item		Factory Specification	Allowable Limit
Valve Timing (Intake Valve)	Open	0.16 rad (9 °) 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	0.21 rad (12 °) after T.D.C.	—
Valve Spring	Free Length	41.7 to 42.2 mm 1.6417 to 1.6614 in.	41.2 mm 1.6220 in.
	Setting Load / Setting Length	117.6 N / 35.0 mm 12.0 kgf / 35.0 mm 26.4 lbs / 1.3780 in.	100.0 N / 35.0 mm 10.2 kgf / 35.0 mm 22.5 lbs / 1.3780 in.
	Tilt	—	1.0 mm 0.039 in.
Rocker Arm Shaft to Rocker Arm	Clearance	0.016 to 0.045 mm 0.00063 to 0.00177 in.	0.1 mm 0.0039 in.
Rocker Arm Shaft	O.D.	13.973 to 13.984 mm 0.55012 to 0.55055 in.	—
Rocker Arm	I.D.	14.000 to 14.018 mm 0.55118 to 0.55189 in.	—
Push Rod	Alignment	—	0.25 mm 0.0098 in.
Tappet to Tappet Guide	Clearance	0.020 to 0.062 mm 0.00079 to 0.00244 in.	0.07 mm 0.0028 in.
Tappet	O.D.	23.959 to 23.980 mm 0.94327 to 0.94410 in.	—
Tappet Guide	I.D.	24.000 to 24.021 mm 0.94488 to 0.94571 in.	—

W1013874

ENGINE BODY (Continued)

Item		Factory Specification	Allowable Limit
Timing Gear Crank Gear to Idle Gear	Backlash	0.0415 to 0.1122 mm 0.00163 to 0.00442 in.	0.15 mm 0.0059 in.
	Idle Gear to Cam Gear	0.0415 to 0.1154 mm 0.00163 to 0.00454 in.	0.15 mm 0.0059 in.
Idle Gear to Injection Pump Gear	Backlash	0.0415 to 0.1154 mm 0.00163 to 0.00454 in.	0.15 mm 0.0059 in.
Crank Gear to Oil Pump Gear	Backlash	0.0415 to 0.1090 mm 0.00163 to 0.00429 in.	0.15 mm 0.0059 in.
Idle Gear to Balancer Gear (Balancer Model Only)	Backlash (Intake side)	0.0350 to 0.1160 mm 0.00138 to 0.00457 in.	0.15 mm 0.0059 in.
	Backlash (Exhaust side)	0.0350 to 0.1160 mm 0.00138 to 0.00457 in.	0.15 mm 0.0059 in.
Idle Gear	Side Clearance	0.12 to 0.48 mm 0.0047 to 0.0189 in.	0.9 mm 0.0354 in.
Idle Gear Shaft to Idle Gear Bushing	Clearance	0.025 to 0.066 mm 0.00098 to 0.00260 in.	0.1 mm 0.0039 in.
Idle Gear Shaft	O.D.	37.959 to 37.975 mm 1.49445 to 1.49508 in.	—
Idle Gear Bushing	I.D.	38.000 to 38.025 mm 1.49606 to 1.49704 in.	—
Camshaft	Side Clearance	0.07 to 0.22 mm 0.0028 to 0.0087 in.	0.3 mm 0.0118 in.
Camshaft	Alignment	—	0.01 mm 0.0004 in.
Cam	Height (Intake / Exhaust)	33.90 mm 1.3346 in.	33.85 mm 1.3327 in.
Camshaft Journal to Cylinder Block Bore	Clearance	0.050 to 0.091 mm 0.0020 to 0.0036 in.	0.15 mm 0.0059 in.
Camshaft Journal	O.D.	39.934 to 39.950 mm 1.57221 to 1.57284 in.	—
Cylinder Block Bore	I.D.	40.000 to 40.025 mm 1.57480 to 1.57579 in.	—
Balancer Shaft (Balancer Model Only)	Side Clearance	0.07 to 0.22 mm 0.0028 to 0.0087 in.	0.3 mm 0.0118 in.
Balancer Shaft Journal 1 to Balancer Shaft Bearing 1 (Balancer Model Only)	Clearance	0.030 to 0.111 mm 0.00118 to 0.00437 in.	0.2 mm 0.0079 in.
Balancer Shaft Journal 1	O.D.	43.934 to 43.950 mm 1.72968 to 1.73031 in.	—
Balancer Shaft Bearing 1	I.D.	43.980 to 44.045 mm 1.73149 to 1.73405 in.	—

W1013874

ENGINE BODY (Continued)

Item			Factory Specification	Allowable Limit
Balancer Shaft Journal 2 to Balancer Shaft Bearing 2 (Balancer Model Only)		Clearance	0.030 to 0.111 mm 0.00118 to 0.00437 in.	0.2 mm 0.0079 in.
	Balancer Shaft Journal 2	O.D.	41.934 to 41.950 mm 1.65094 to 1.65157 in.	—
	Balancer Shaft Bearing 2	I.D.	41.980 to 42.045 mm 1.65275 to 1.65531 in.	—
Balancer Shaft Journal 3 to Balancer Shaft Bearing 3 (Balancer Model Only)		Clearance	0.020 to 0.094 mm 0.00079 to 0.00370 in.	0.2 mm 0.0079 in.
	Balancer Shaft Journal 3	O.D.	21.947 to 21.960 mm 0.86405 to 0.86456 in.	—
	Balancer Shaft Bearing 3	I.D.	21.980 to 22.041 mm 0.86535 to 0.86775 in.	—
Piston Pin Bore		I.D.	25.000 to 25.013 mm 0.98425 to 0.98476 in.	25.05 mm 0.9862 in.
Top Ring to Ring Groove	D1703-M-DI D1803-M-DI V2203-M-DI V2403-M-DI	Clearance	0.050 to 0.090 mm 0.0020 to 0.0035 in.	0.2 mm 0.0079 in.
Second Ring to Ring Groove	D1503-M-DI D1503-M-DI-T	Clearance	0.093 to 0.128 mm 0.0037 to 0.0050 in.	0.2 mm 0.0079 in.
	D1703-M-DI D1803-M-DI V2203-M-DI V2403-M-DI		0.050 to 0.090 mm 0.0020 to 0.0035 in.	0.2 mm 0.0079 in.
Oil Ring to Ring Groove	D1503-M-DI D1503-M-DI-T	Clearance	0.020 to 0.060 mm 0.0008 to 0.0021 in.	0.15 mm 0.0059 in.
	D1703-M-DI D1803-M-DI V2203-M-DI V2403-M-DI		0.030 to 0.070 mm 0.0012 to 0.0028 in.	0.15 mm 0.0059 in.
Top Ring		Ring Gap	0.20 to 0.35 mm 0.0079 to 0.0138 in.	1.25 mm 0.0492 in.
Second Ring	D1503-M-DI	Ring Gap	0.30 to 0.45 mm 0.0118 to 0.0177 in.	1.25 mm 0.0492 in.
	D1503-M-DI-T		0.40 to 0.55 mm 0.0157 to 0.0217 in.	1.25 mm 0.0492 in.
	D1703-M-DI D1803-M-DI V2203-M-DI V2403-M-DI		0.35 to 0.50 mm 0.0138 to 0.0197 in.	1.25 mm 0.0492 in.

W1013874

ENGINE BODY (Continued)

Item			Factory Specification	Allowable Limit
Oil Ring	D1503-M-DI D1503-M-DI-T	Ring Gap	0.25 to 0.45 mm 0.0098 to 0.0177 in.	1.25 mm 0.0492 in.
	D1703-M-DI D1803-M-DI V2203-M-DI V2403-M-DI		0.20 to 0.40 mm 0.0079 to 0.0157 in.	1.25 mm 0.0492 in.
Connecting Rod		Alignment	—	0.05 mm 0.0020 in.
Piston Pin to Small End Bushing		Clearance	0.014 to 0.038 mm 0.00055 to 0.00150 in.	0.15 mm 0.0059 in.
Piston Pin		O.D.	25.002 to 25.011 mm 0.98433 to 0.98468 in.	—
Small End Bushing		I.D.	25.025 to 25.040 mm 0.98523 to 0.98582 in.	—
Crankshaft		Alignment	—	0.02 mm 0.00079 in.
Crankshaft Journal to Crankshaft Bearing 1 (Serial No. : below 3R9999)		Oil Clearance	0.040 to 0.118 mm 0.00157 to 0.00465 in.	0.2 mm 0.0079 in.
	Crankshaft Journal	O.D.	51.921 to 51.940 mm 2.04413 to 2.04488 in.	—
			59.921 to 59.940 mm 2.35909 to 2.35984 in.	—
	Crankshaft Bearing 1	I.D.	51.980 to 52.039 mm 2.04646 to 2.04878 in.	—
			59.980 to 60.039 mm 2.36142 to 2.36374 in.	—
Crankshaft Journal to Crankshaft Bearing 1 (Serial No. : above 3S0001)		Oil Clearance	0.040 to 0.118 mm 0.00157 to 0.00465 in.	0.2 mm 0.0079 in.
Crankshaft Journal		O.D.	59.921 to 59.940 mm 2.35909 to 2.35984 in.	—
Crankshaft Bearing 1		I.D.	59.980 to 60.039 mm 2.36142 to 2.36374 in.	—

W1029676

ENGINE BODY (Continued)

Item			Factory Specification	Allowable Limit
Crankshaft Journal to Crankshaft Bearing 2 (Serial No. : below 3R9999) Crankshaft Journal Crankshaft Bearing 2	D1503-M-DI D1503-M-DI-T D1703-M-DI V2203-M-DI	Oil Clearance O.D.	0.040 to 0.104 mm 0.00157 to 0.00409 in. 51.921 to 51.940 mm 2.04413 to 2.04488 in.	0.2 mm 0.0079 in. —
	D1803-M-DI V2403-M-DI		59.921 to 59.940 mm 2.35909 to 2.35984 in.	—
	D1503-M-DI D1503-M-DI-T D1703-M-DI V2203-M-DI	I.D.	51.980 to 52.025 mm 2.04646 to 2.04823 in.	—
	D1803-M-DI V2403-M-DI		59.980 to 60.025 mm 2.36142 to 2.36318 in.	—
Crankshaft Journal to Crankshaft Bearing 2 (Serial No. : above 3S0001) Crankshaft Journal Crankshaft Bearing 2		Oil Clearance O.D. I.D.	0.040 to 0.104 mm 0.00157 to 0.00409 in. 59.921 to 59.940 mm 2.35909 to 2.35984 in. 59.980 to 60.025 mm 2.36142 to 2.36318 in.	0.2 mm 0.0079 in. — —
Crankpin to Crankpin Bearing Crankpin Crankpin Bearing		Oil Clearance O.D. I.D.	0.025 to 0.087 mm 0.00098 to 0.00343 in. 46.959 to 46.975 mm 1.84878 to 1.84941 in. 47.000 to 47.046 mm 1.85039 to 1.85220 in.	0.2 mm 0.0079 in. — —
Crankshaft	D1503-M-DI D1503-M-DI-T D1703-M-DI V2203-M-DI	Side Clearance	0.15 to 0.35 mm 0.0059 to 0.0138 in.	0.5 mm 0.0197 in.
	D1803-M-DI V2403-M-DI		0.15 to 0.31 mm 0.0059 to 0.0122 in.	0.5 mm 0.0197 in.
Crankshaft Sleeve		Wear	—	0.1 mm 0.0039 in.

W1013874

ENGINE BODY (Continued)

Item			Factory Specification	Allowable Limit
Cylinder Bore [Standard]	D1503-M-DI D1503-M-DI-T	I.D.	83.000 to 83.022 mm 3.26772 to 3.26858 in.	+ 0.15 mm + 0.0059 in.
	D1703-M-DI D1803-M-DI V2203-M-DI V2403-M-DI		87.000 to 87.022 mm 3.42519 to 3.42606 in.	+ 0.15 mm + 0.0059 in.
[Oversize]	D1503-M-DI D1503-M-DI-T	I.D.	83.250 to 83.272 mm 3.27756 to 3.27843 in.	+ 0.15 mm + 0.0059 in.
	D1703-M-DI D1803-M-DI V2203-M-DI V2403-M-DI		87.250 to 87.272 mm 3.43503 to 3.43590 in.	+ 0.15 mm + 0.0059 in.

W1198742

LUBRICATING SYSTEM

Engine Oil Pressure	At Idle Speed	—	49 kPa 0.5 kgf/cm ² 7 psi
	At Rated Speed	294 to 441 kPa 3.0 to 4.5 kgf/cm ² 43 to 64 psi	245 kPa 2.5 kgf/cm ² 36 psi
Engine Oil Pressure Switch	Working Pressure	49 kPa 0.5 kgf/cm ² 7 psi	—
Inner Rotor to Outer Rotor	Clearance	0.03 to 0.14 mm 0.0012 to 0.0055 in.	0.2 mm 0.0079 in.
Outer Rotor to Pump Body	Clearance	0.11 to 0.19 mm 0.0043 to 0.0075 in.	0.25 mm 0.0098 in.
Inner Rotor to Cover	Clearance	0.105 to 0.150 mm 0.00413 to 0.00591 in.	0.2 mm 0.0079 in.

W1013973

COOLING SYSTEM

Item		Factory Specification	Allowable Limit
Fan Belt	Tension	7.0 to 9.0 mm (0.28 to 0.35 in.) deflection at 98 N (10 kgf, 22 lbs) of force	—
Thermostat	Valve Opening Temperature (At Beginning)	69.5 to 72.5 °C 157.1 to 162.5 °F	—
	Valve Opening Temperature (Opened Completely)	85 °C 185 °F	—
Radiator	Water Tightness	No leaks at 137 kPa 1.4 kgf/cm ² 20 psi	—
Radiator Cap	Pressure Falling Time	10 seconds or more for pressure falling from 88 to 59 kPa from 0.9 to 0.6 kgf/cm ² from 13 to 9 psi	—

W1013874

FUEL SYSTEM

Injection Pump	D1503-M-DI D1503-M-DI-T	Injection Timing	0.18 to 0.22 rad (10.5 to 12.5 °) before T.D.C.	—
	D1703-M-DI D1803-M-DI		0.16 to 0.19 rad (9.0 to 11.0 °) before T.D.C.	
	V2203-M-DI V2403-M-DI		0.17 to 0.21 rad (10.0 to 12.0 °) before T.D.C.	
Injection Nozzle		Injection Pressure 1st. stage	18.6 to 20.1 MPa 190 to 205 kgf/cm ² 2702 to 2916 psi	—
Injection Nozzle Valve Seat		Valve Seat Tightness	When the pressure is 16.67 MPa (170 kgf/cm ² , 2418 psi), the valve seat must be fuel tightness.	—

W1013973

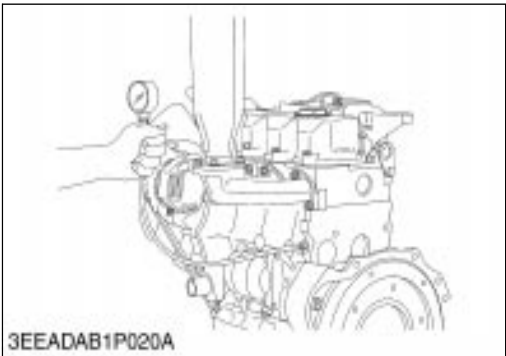
ELECTRICAL SYSTEM

Item			Factory Specification	Allowable Limit
Starter	Commutator	D1503-M-DI D1503-M-DI-T D1703-M-DI D1803-M-DI V2203-M-DI	O.D. 30.0 mm 1.181 in.	29.0 mm 1.142 in.
		V2403-M-DI	35.0 mm 1.378 in.	34.0 mm 1.339 in.
	Mica	D1503-M-DI D1503-M-DI-T D1703-M-DI D1803-M-DI V2203-M-DI	Under Cut 0.50 to 0.80 mm 0.0197 to 0.0315 in.	0.20 mm 0.0079 in.
		V2403-M-DI	0.50 to 0.90 mm 0.0197 to 0.0354 in.	0.20 mm 0.0079 in.
	Brush		Length 15.0 mm 0.591 in.	11.0 mm 0.433 in.
Brush Holder and Holder Support			Resistance	Infinity
Alternator			No-load voltage	More than 13.5 V
Stator			Continuity	—
Rotor	D1503-M-DI		Resistance	2.9 Ω
		D1503-M-DI-T D1703-M-DI D1803-M-DI V2203-M-DI V2403-M-DI	2.1 Ω	—
Slip Ring			O.D. 14.4 mm 0.567 in.	14.0 mm 0.551 in.
Brush			Length 10.5 mm 0.413 in.	8.4 mm 0.331 in.
Glow Plug			Resistance	Approx. 1.0 Ω
Stop Solenoid				
Pulling Coil			Resistance	Approx. 0.38 Ω
Holding Coil			Resistance	Approx. 15.58 Ω

W1075692

3. LUBRICATING SYSTEM

[1] Checking



Engine Oil Pressure

1. Remove the engine oil pressure switch, and set a oil pressure tester (Code No.: 07916-32032).

2. Start the engine. After warming up, measure the oil pressure of both idling and 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

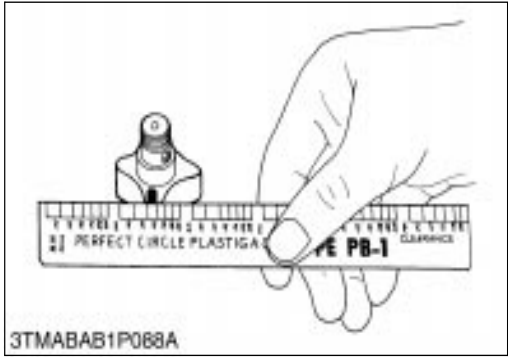
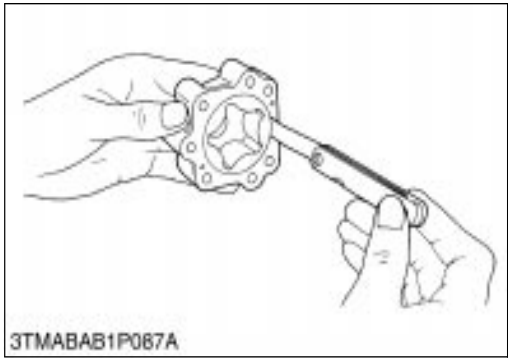
Engine oil pressure	At idle speed	Allowable limit	49 kPa 0.5 kgf/cm ² 7 psi
	At rated speed	Factory spec.	294.2 to 441 kPa 3.0 to 4.5 kgf/cm ² 42.7 to 64 psi
		Allowable limit	245 kPa 2.5 kgf/cm ² 36 psi

(When reassembling)

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

W1034952

[2] Servicing



Rotor Lobe Clearance

- 1. Measure the clearance between lobes of the inner rotor and the outer rotor with a feeler gauge.
- 2. Measure the clearance between the outer rotor and the pump body with a feeler gauge.
- 3. 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.
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Clearance between outer rotor and pump body	Factory spec.	0.11 to 0.19 mm 0.0043 to 0.0075 in.
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W1035296

Clearance between Rotor and Cover

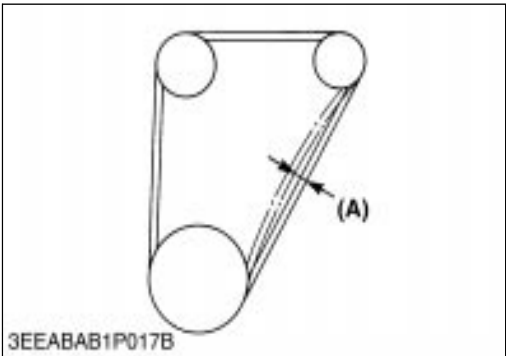
- 1. Put a strip of plastigage (Code No.: 07909-30241) onto the rotor face with grease.
- 2. Install the cover and tighten the screws.
- 3. Remove the cover carefully, and measure the width of the press gauge with a sheet of gauge.
- 4. If the clearance exceeds the factory specifications, replace oil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

Clearance between inner rotor and cover	Factory spec.	0.105 to 0.150 mm 0.00413 to 0.00591 in.
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W1035444

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 pulley 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 / 98 N or 10 kgf 0.28 to 0.35 in. / 98 N or 22 lbs
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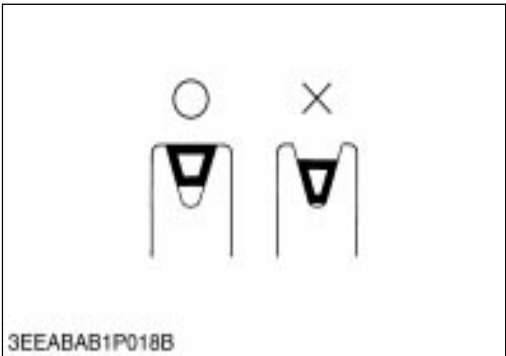
W1035667



Fan Belt Damage and Wear

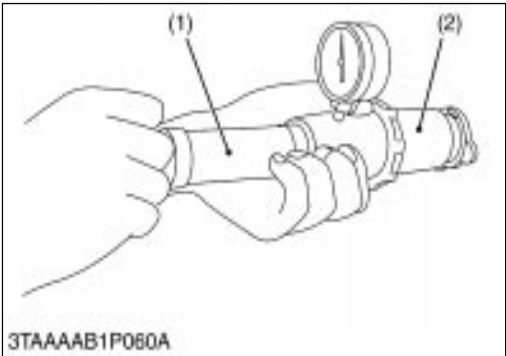
- 1. Check the fan belt for damage.
- 2. If the fan belt is damaged, replace it.
- 3. Check if the fan belt is worn and sunk in the pulley groove.
- 4. If the fan belt is nearly worn out and deeply sunk in the pulley groove, replace it.

W1035758



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

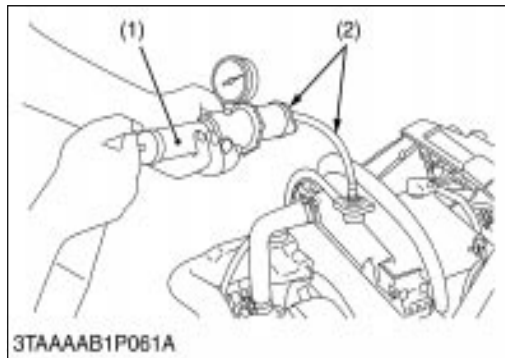
- 1. Set a radiator tester (1) and adaptor (2) (BANZAI Code No. RCT-2A-30S) on the radiator cap.
- 2. Apply the specified pressure (88 kPa, 0.9 kgf/cm², 13 psi), and measure the time for the pressure to fall to 59 kPa (0.6 kgf/cm², 9 psi).
- 3. If the measurement is less than the factory specification,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

(2) Adaptor

W10387530



Radiator Water Leakage

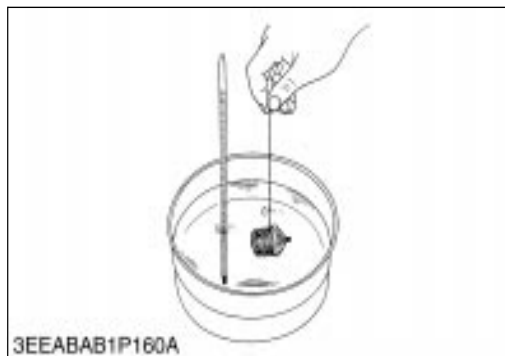
1. Pour a specified amount of water into the radiator.
2. Set a radiator tester (1) (Code No. 07909-31551) and an adaptor (2) (BANZAI Code No. RCT-2A-30S) and raise the water pressure to the specified pressure.
3. Check the radiator for water leaks.
4. For water leak from the pinhole, repair with the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

Radiator water leakage test pressure	Factory spec.	137 kPa 1.3 kgf/cm ² 19 psi
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(1) Radiator Tester

(2) Adaptor

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.	69.5 to 72.5 °C 157.1 to 162.5 °F
Temperature at which thermostat completely opens	Factory spec.	85 °C 185 °F

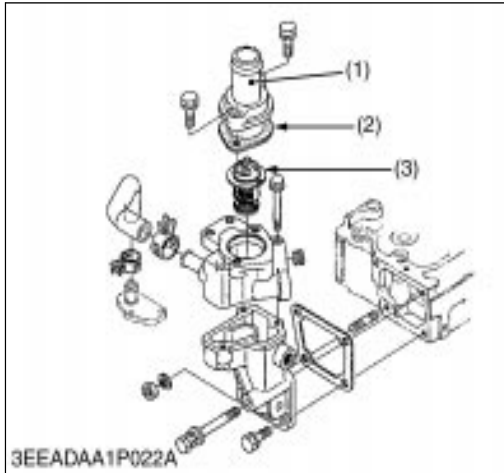
W1035849

[2] DISASSEMBLING AND ASSEMBLING



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.



Thermostat Assembly

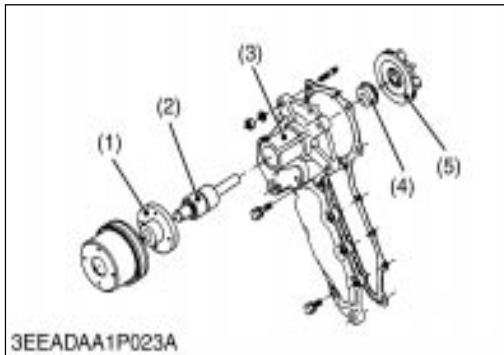
- Remove the thermostat cover mounting screws, and remove the thermostat cover (1).
- Remove the thermostat assembly (3).

(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 | (3) Thermostat Assembly |
| (2) Thermostat Cover Gasket | |

W1105115



Water Pump Assembly

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

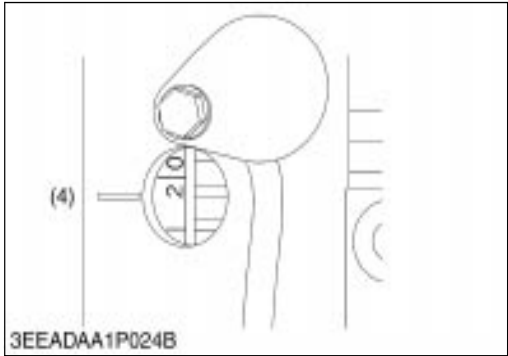
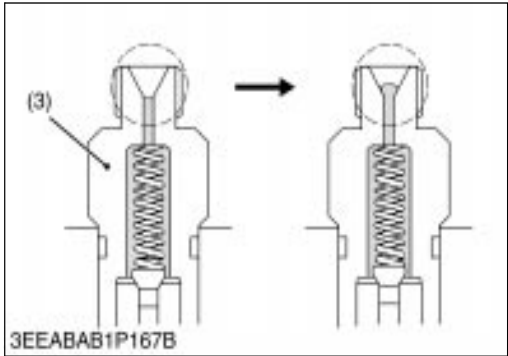
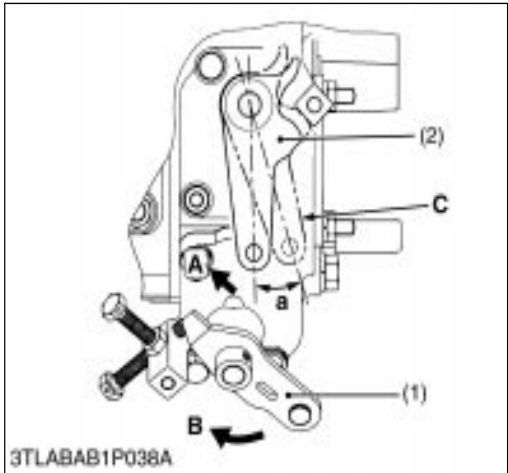
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|-----------------------|---------------------|
| (1) Water Pump Flange | (4) Mechanical Seal |
| (2) Water Pump Shaft | (5) Impeller |
| (3) Water Pump Body | |

W1105227

5. FUEL SYSTEM

[1] CHECKING AND ADJUSTING

(1) Injection Pump



Injection Timing

1. Remove the stop solenoid.
2. Remove the injection pipes and nozzle.
3. Set the speed control lever to maximum fuel discharge position.

(Reference)

- Turn the flywheel with screwdriver.

NOTE

- For V2203-M and V2403-M, the pumps have a displacement angle. In adjusting the injection timing, pull the stop lever (2) from its free position by 0.267 ± 0.035 rad ($15.3 \pm 2^\circ$) toward the stop position.

1. Turn the flywheel counterclockwise (facing the flywheel) until the fuel fills up to the hole of the delivery valve holder for 1st cylinder.
2. Turn the flywheel further and stop turning when the fuel begins to flow over, to get the present injection timing.
3. (The flywheel has mark 1TC and four lines indicating every 0.087 rad (5°) of crank angle from 0.175 rad (10°) to 0.436 rad (25°) before mark 1TC) Calculate the angle which the center of the window points out. If the calculation differs from specified injection timing, add or remove the shim to adjust.

Model	Injection Timing
D1503-M-DI D1503-M-DI-T	0.18 to 0.22 rad (10.5° to 12.5°) B.T.D.C.
D1703-M-DI D1803-M-DI	0.16 to 0.19 rad (9.0° to 11.0°) B.T.D.C.
V2203-M-DI V2403-M-DI	0.17 to 0.21 rad (10.0° to 12.0°) B.T.D.C.

- (1) Speed Control Lever
(2) Stop Lever
(3) Delivery Valve Holder
(4) Timing Mark

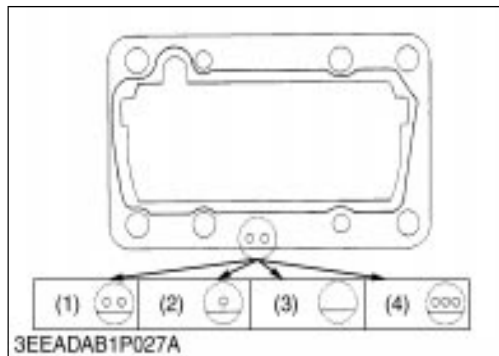
- A: To STOP Position**
B: To Max. Speed Position
C: Stop Lever in Free Position

a: 0.267 ± 0.035 rad ($15.3 \pm 2^\circ$)

W1036402

Injection Timing (Continued)**■ NOTE**

- The sealant is applied to both sides of the soft metal gasket shim. The liquid gasket is not required for assembling.
- Shims are available in thickness of 0.20 mm, 0.25 mm, 0.30 mm and 0.35 mm. Combine these shims for adjustments.
- Addition or reduction of shim (0.05 mm, 0.0020 in.) delays or advances the injection timing by approx. 0.0087 rad (0.5 °).
- In disassembling and replacing, be sure to use the same number of new gasket shims with the same thickness.



- (1) 2-Holes: 0.20 mm (Shim)
 (2) 1-hole: 0.25 mm (Shim)

- (3) Without hole: 0.30 mm (Shim)
 (4) 3-Holes: 0.35 mm (Shim)

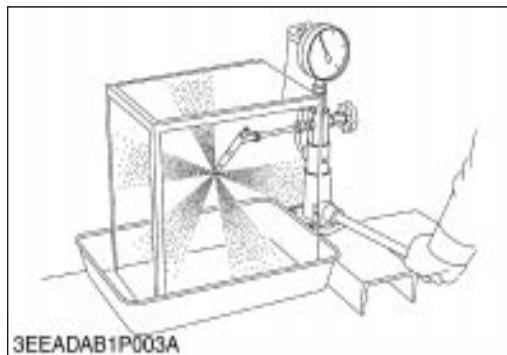
W1111075

(2) Injection Nozzle



CAUTION

- Check the nozzle injection pressure and condition after confirming that there is nobody standing in the direction the fume goes. If the fume from the nozzle directly contacts the human body, cells may be destroyed and blood poisoning may be caused.



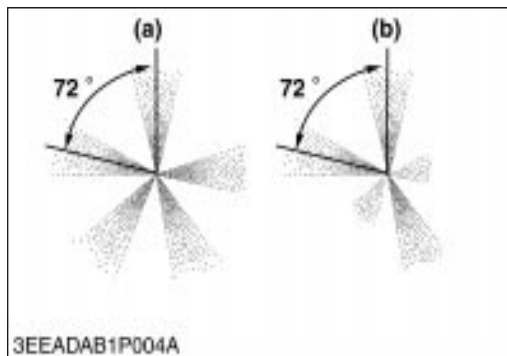
Nozzle Injection Pressure

- Set the injection nozzle to the nozzle tester.
- Slowly move the tester handle to measure the pressure at which fuel begins jetting out from the nozzle.
- If the measurement is not within the factory specifications, replace the injection nozzle assembly.

Fuel injection pressure 1st. stage	Factory spec.	18.6 to 20.1 MPa 190 to 205 kgf/cm ² 2702 to 2916 psi
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(1) Adjusting Washer

W1037197



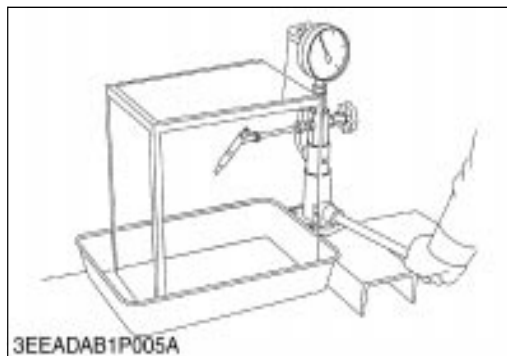
Nozzle Spraying Condition

- Set the injection nozzle to a nozzle tester (Code No. 07909-31361), and check the nozzle spraying condition.
- If the spraying condition is defective, replace the injection nozzle assembly.

(a) Good

(b) Bad

W1037394



Valve Seat Tightness

- Set the injection nozzle to a nozzle tester (Code No. 07909-31361).
- Raise the fuel pressure, and keep at 16.67 MPa (170 kgf/cm², 2418 psi) for 10 seconds.
- If any fuel leak is found, replace the injection nozzle assembly.

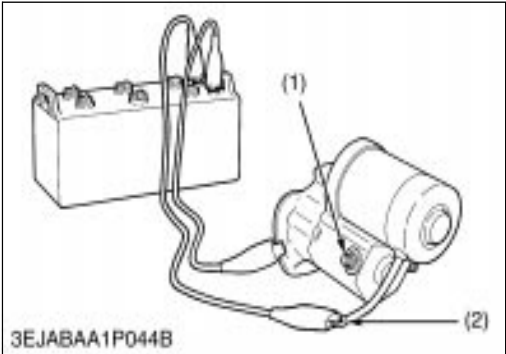
Valve seat tightness	Factory spec.	No fuel leak at 16.67 MPa 170 kgf/cm ² 2418 psi
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W1088949

6. ELECTRICAL SYSTEM

[1] CHECKING

(1) Starter



Motor Test

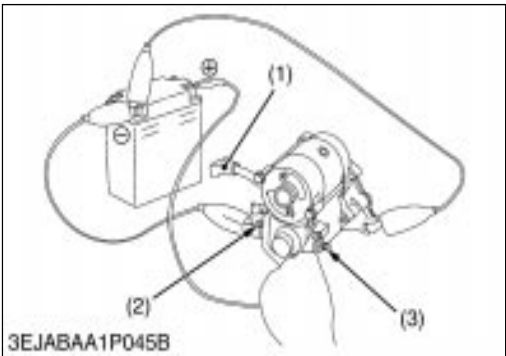
 CAUTION

- Secure the starter to prevent it from jumping up and down while testing the motor.
- Disconnect the battery negative cable from the battery.
 - Disconnect the battery positive cable and the leads from the starter **B** terminal.
 - Remove the starter from the engine.
 - Disconnect the connecting lead (2) from the starter **C** terminal (1).
 - Connect a jumper lead from the connecting lead (2) to the battery positive terminal post.
 - Connect a jumper lead momentarily between the starter motor housing and the battery negative terminal post.
 - If the motor dose not run, check the motor.

Tightening torque	B terminal nut	8.8 to 11.8 N·m 0.9 to 1.2 kgf·m 6.5 to 8.7 ft·lbs
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(1) **C** Terminal (2) Connecting Lead

W1145152



Magnetic Switch Test

- Disconnect the battery negative cable from the battery.
- Disconnect the battery positive cable and the leads from the starter **B** terminal.
- Remove the starter from the engine.
- Disconnect the connecting lead (1) from the starter **C** terminal (2).
- Connect a jumper lead from the starter **S** terminal (3) to the battery positive terminal post.
- Connect a jumper lead momentarily between the starter **C** terminal (2) and the battery negative terminal post.
- If the pinion gear dose not pop out, check the magnetic switch.

■ NOTE

- This test should be carried out for a short time, about 3 to 5 seconds.

(1) Connecting Lead (3) **S** Terminal
(2) **C** Terminal

W1145350

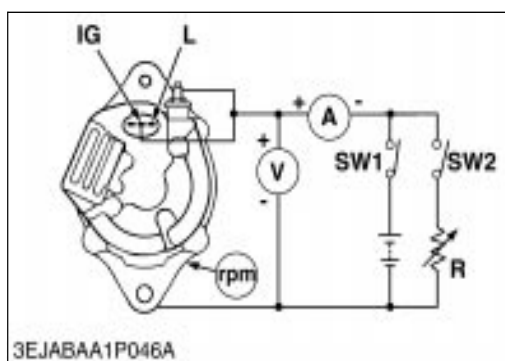
(2) Alternator

(Precaution when checking)

- If disconnect the **B** terminal or coupler, engine will stop by emergency device.
- Do not directly connect the **L** terminal with the **B** terminal. Otherwise the three exciting diodes may be damaged. When connecting the **L** terminal, insert a 3.4 W lamp between the **L** and **B** terminals.
- Always use a full charged battery.
- Be careful to observe the proper polarity of the battery. Never install the battery in the wrong direction.
- Never disconnect the battery while the alternator is operating.

■ NOTE

- Check the alternator with alternator test bench.

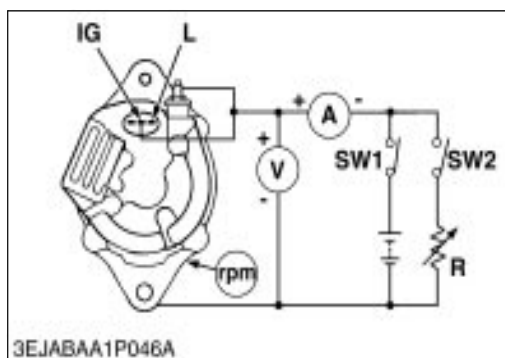


Regulating Voltage

1. Make the connections as shown in the figure, and turn on switch **SW1**.
2. Increase the alternator speed to 83.3 s^{-1} (5000 rpm).
3. Turn on switch **SW2**. Adjust load resistance **R** so that the ammeter shows 10 A.
4. Check that the voltage reading on the voltmeter is within the factory specifications.

Regulating voltage	Factory spec.	14.2 to 14.8 V
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W1150547

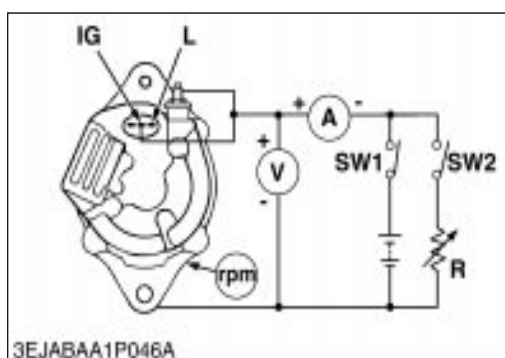


No-load Characteristics

1. Make the connection as shown in the figure, and turn on switch **SW1**.
2. Increase the alternator speed so that the pointer of the ammeter swings to the plus side.
3. Turn on switch **SW1** to decrease the speed, and read the speed at which the voltage is equal to the factory specifications.
4. The speed must be below the factory specifications.

No-load characteristics	Factory spec.	19.2 s^{-1} (1150 rpm) or less at 13.5 V
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W1150876



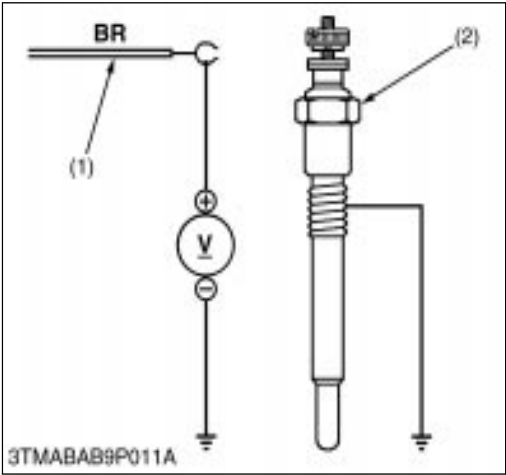
Output Characteristics

1. Make the connection as shown in the figure, and turn on switch **SW1** and **SW2**.
2. Increase the alternator speed while adjusting the load resistance so that the voltage complies with the factory specifications.
3. Read the speed at which the current is equal to the factory specifications.
4. The speed must be below the factory specifications.
5. Decrease the speed so that the current approaches zero, then turn off switches **SW1** and **SW2**.

Output characteristics	Factory spec.	40 A or more at 13.5 V, 83.3 s^{-1} (5000 rpm)
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W1151013

(3) Glow Plug



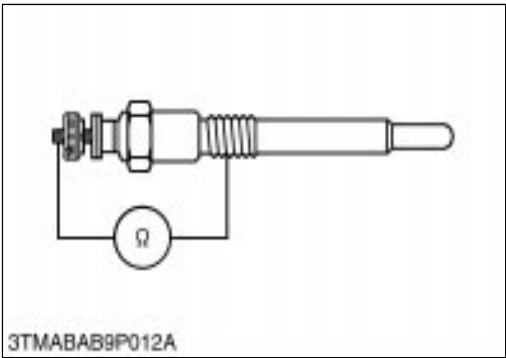
Lead Terminal Voltage

1. Disconnect the wiring lead (1) from the glow plug (2) after turning the main switch off.
2. Turn the main switch key to the **“PREHEAT”** position, and measure the voltage between the lead terminal and the chassis.
3. Turn the main switch key to the **“START”** position, and measure the voltage with a voltmeter between the lead terminal and the chassis.
4. If the voltage at either position differs from the battery voltage, the wiring harness or main switch is faulty.

Voltage (Lead terminal – Engine body)	Main switch key at “PREHEAT”	Approx. battery voltage
	Main switch key at “START”	Approx. battery voltage

(1) Wiring Lead (Positive) (2) Glow Plug

W1014913



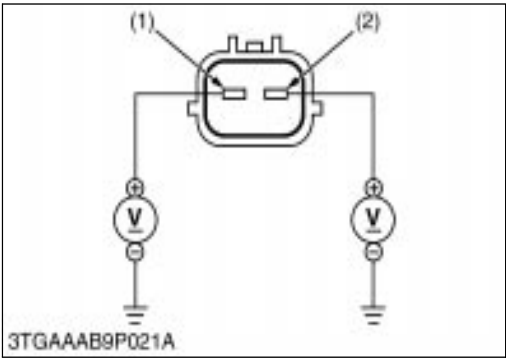
Glow Plug Continuity

1. Disconnect the lead from the glow plugs.
2. Measure the resistance with an ohmmeter between the glow plug terminal and the engine body.
3. If 0 ohm is indicated, the screw at the tip of the glow plug and the housing are short-circuited.
4. If the factory specification is not indicated, the glow plug is faulty.

Glow plug resistance	Factory spec.	Approx. 1.0 Ω
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W1015115

(4) Engine Stop Solenoid



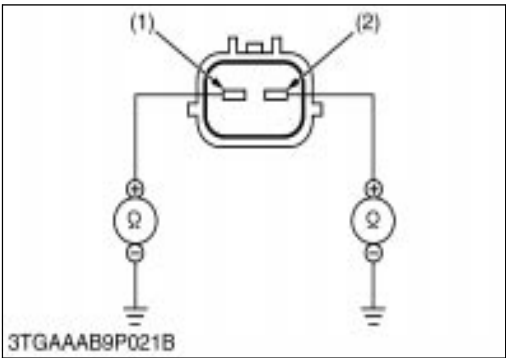
Connector Voltage

1. Disconnect the **2P** connector from engine stop solenoid.
2. Turn the main switch key to the **“ON”** position.
3. Measure the voltage with voltmeter between the terminal **1** (1) (Black / White), terminal **2** (2) (White / Black) and Body.
4. If the voltage differs from the battery voltage, the wiring harness or main switch is faulty.

Voltage	Terminal 1 – Body	Approx. battery voltage
	Terminal 2 – Body	

(1) Terminal 1 (2) Terminal 2

W1015556



Stop Solenoid Coil

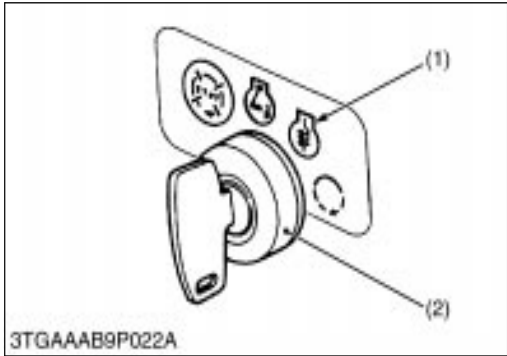
1. Disconnect the **2P** connector from engine stop solenoid.
2. Measure the resistance with an ohmmeter between the terminal **1** (1), terminal **2** (2) and body.
3. If resistance differs from the factory specification, the coil is faulty.

Resistance	Terminal 1 – Body	Approx. 0.38 Ω
	Terminal 2 – Body	Approx. 15.58 Ω

(1) Terminal 1 (Pulling Coil) (2) Terminal 2 (Holding Coil)

W1015848

(5) Glow Lamp Relay

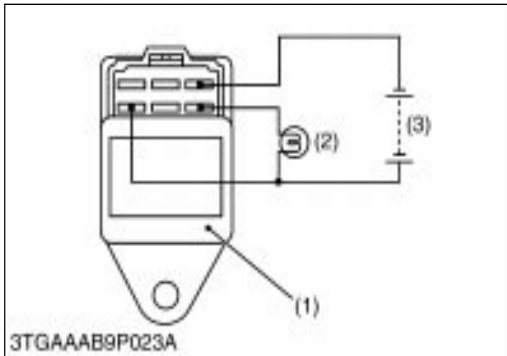


Glow Lamp and Glow Lamp Relay

- 1. Check the glow lamp indicator lights up then lights off after about 5 seconds when main switch (2) is turned to glow position (1).
- 2. If the glow lamp indicator does not lights up, the fuse, glow lamp, glow lamp relay or wiring harness is faulty.

(1) Glow Position (2) Main Switch

W1016072



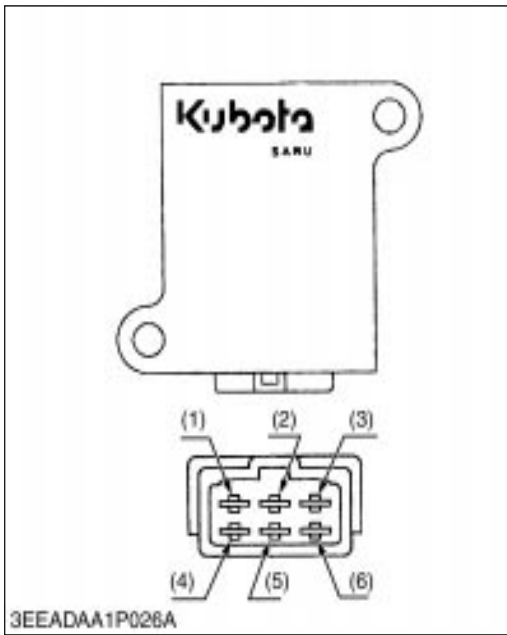
Glow Lamp Relay

- 1. Remove the glow lamp relay (1).
- 2. Connect the jumper leads as shown in the figure left.
- 3. If the bulb (2) lights up when connecting a jumper lead to battery (3) and go off about 5 seconds late, the glow lamp relay (1) is proper.

(1) Glow Lamp Relay (3) Battery (12 V)
(2) Bulb

W1016173

(6) Starter Auto Reduction Unit



Continuity

- 1. Disconnect the 6P connector from the starter auto reduction unit.
- 2. Remove the starter auto reduction unit from the machine.
- 3. Measure the resistance according to below the matrix chart by circuit tester.

	Negative Terminal					
	1	2	3	4	5	6
Positive Terminal	1	∞	∞	∞	∞	∞
	2	∞	∞	155	100	7
	3	∞	∞	∞	∞	∞
	4	∞	∞	∞	∞	∞
	5	∞	∞	∞	∞	∞
	6	∞	55	∞	90	60

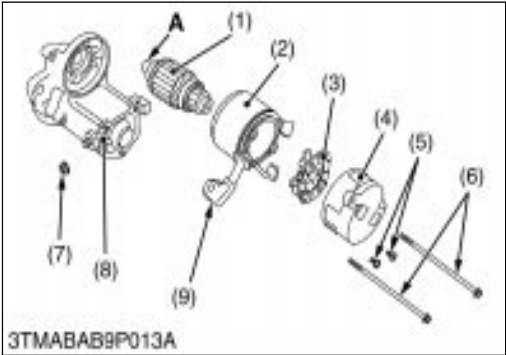
Unit : Ω *The value of resistance is approximate.

- (1) Input Terminal from Key Switch **50** Terminal
- (2) Output Terminal for an External Relay
- (3) Output Terminal for Starter **ST** Terminal
- (4) Input Terminal from Alternator **P** Terminal
- (5) Input Terminal from Key Switch **AC** Terminal
- (6) Output Terminal for Ground

W1108872

[2] DISASSEMBLING AND ASSEMBLING

(1) Starter



Disassembling Motor

1. Disconnect the connecting lead (9) from the magnet switch (8).
2. Remove the screws (6), and then separate the end frame (4), yoke (2) and armature (1).
3. Remove the two screws (5), and then take out the brush holder (3) from the end frame (4).

(When reassembling)

- Apply grease to the spline teeth A of the armature (1).

Tightening torque	Nut (7)	5.9 to 11.8 N·m 0.6 to 1.2 kgf·m 4.3 to 8.7 ft·lbs
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- (1) Armature

(2) Yoke

(3) Brush Holder

(4) End Frame

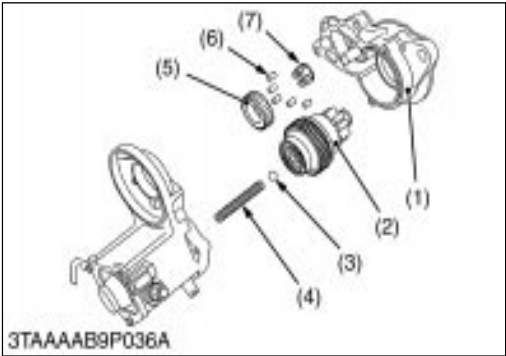
(5) Screw

(6) Screw
- (7) Nut

(8) Magnet Switch

(9) Connecting Lead
- A: Spline Teeth

W1016288



Disassembling Magnet Switch

1. Remove the drive end frame (1) mounting screws.
2. Take out the overrunning clutch (2), ball (3), spring (4), gear (5), rollers (6) and retainer (7).

(When reassembling)

- Apply grease to the gear teeth of the gear (5) and overrunning clutch (2), and ball (3).

- (1) Drive End Frame

(2) Overrunning Clutch

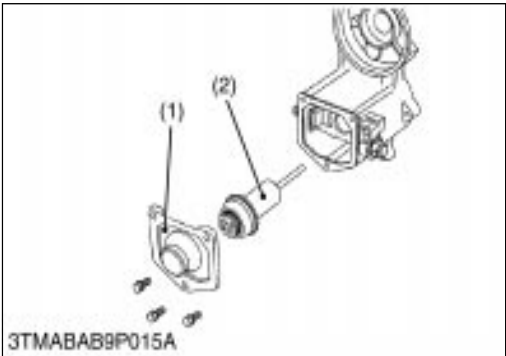
(3) Ball

(4) Spring
- (5) Gear

(6) Roller

(7) Retainer

W1016728



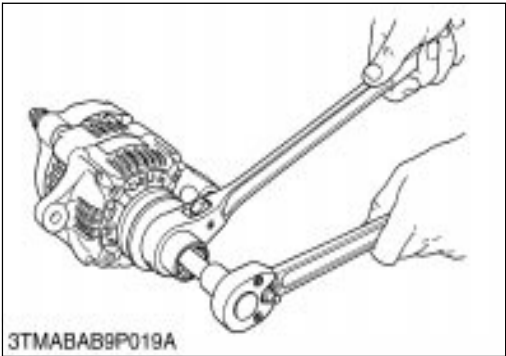
Plunger

1. Remove the end cover (1).
2. Take out the plunger (2).

- (1) End Cover
- (2) Plunger

W1016883

(2) Alternator



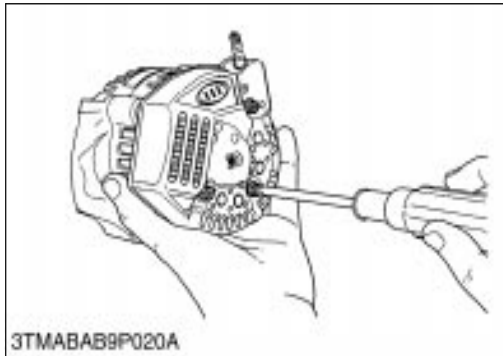
Pulley

1. Secure the hexagonal end of the pulley shaft with a double-ended ratchet wrench as shown in the figure, loosen the pulley nut with a socket wrench and remove it.

(When reassembling)

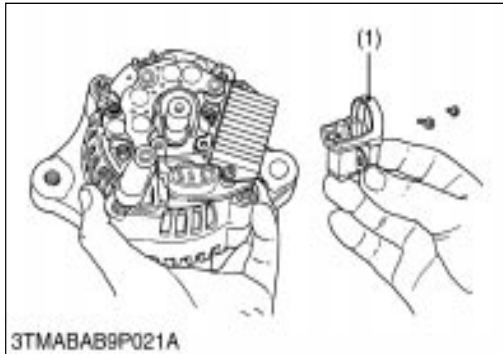
Tightening torque	Pulley nut	58.3 to 78.9 N·m 5.95 to 8.05 kgf·m 43.0 to 58.2 ft·lbs
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W1018728

**Rear End Cover**

1. Unscrew the three rear end cover screws and the **B** terminal nut, and remove the rear end cover.

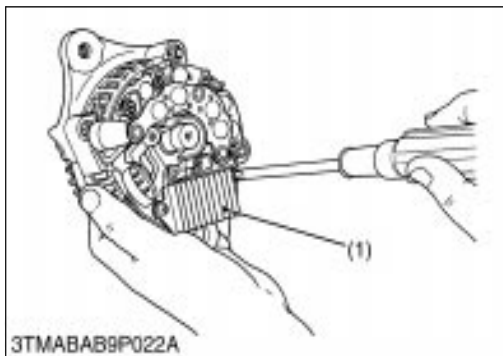
W1018982

**Brush Holder**

1. Unscrew the two screws holding the brush holder (1), and remove the brush holder (1).

(1) Brush Holder

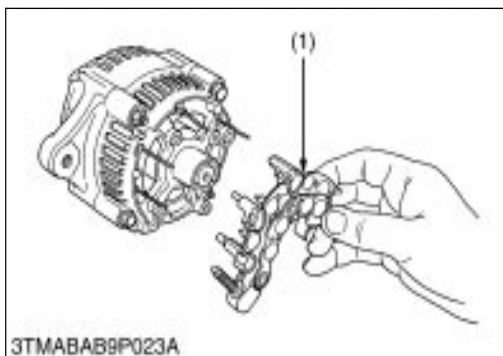
W1019054

**IC Regulator**

1. Unscrew the three screws holding the IC regulator (1), and remove the IC regulator (1).

(1) IC Regulator

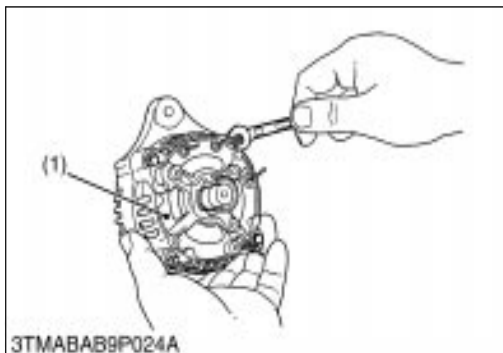
W1019123

**Rectifier**

1. Remove the four screws holding the rectifier (1) and the stator lead wires.
2. Remove the rectifier (1).

(1) Rectifier

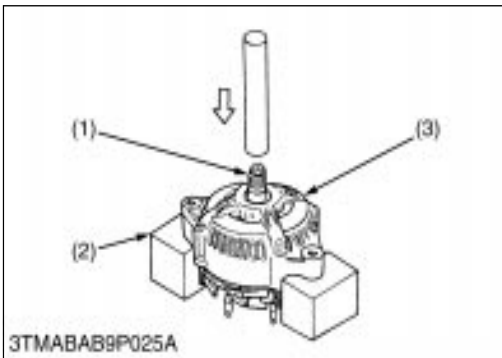
W1019192

**Rear End Frame**

1. Unscrew the two nuts and two screws holding the drive end frame and the rear end frame (1).
2. Remove the rear end frame (1).

(1) Rear End Frame

W1019274

**Rotor**

1. Press out the rotor (1) from drive end frame (3).

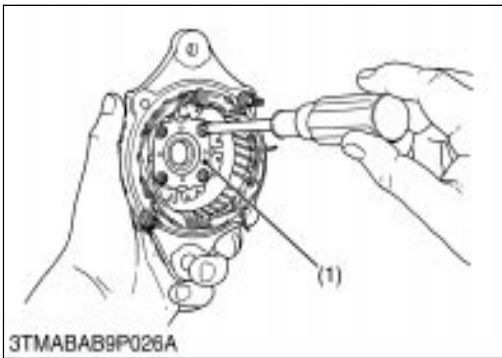
■ IMPORTANT

- Take special care not to drop the rotor and damage the slip ring or fan, etc..

- (1) Rotor
(2) Block

- (3) Drive End Frame

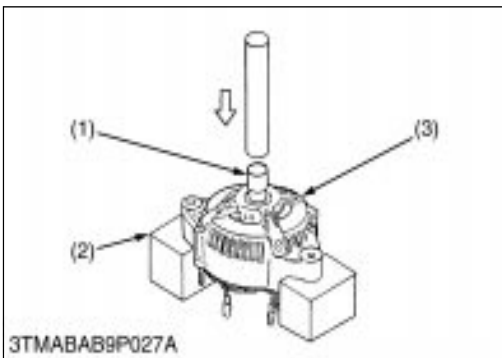
W1019438

**Retainer Plate**

1. Unscrew the four screws holding the retainer plate (1), and remove the retainer plate (1).

- (1) Retainer Plate

W1019542

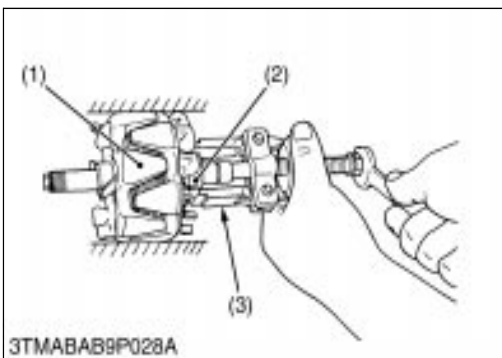
**Bearing on Drive End Side**

1. Press out the bearing from drive end frame (3) with a press and jig (1).

- (1) Jig
(2) Block

- (3) Drive End Frame

W1019611

**Bearing at Slip Ring Side**

1. Lightly secure the rotor (1) with a vise to prevent damage, and remove the bearing (2) with a puller (3).

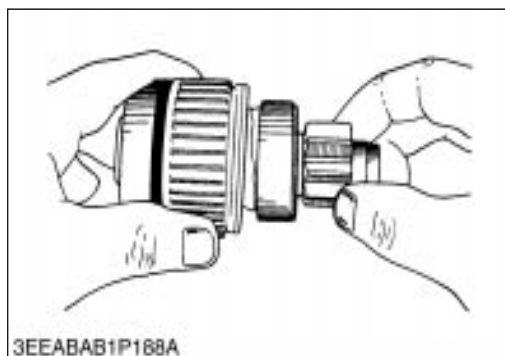
- (1) Rotor
(2) Bearing

- (3) Puller

W1019701

[3] SERVICING

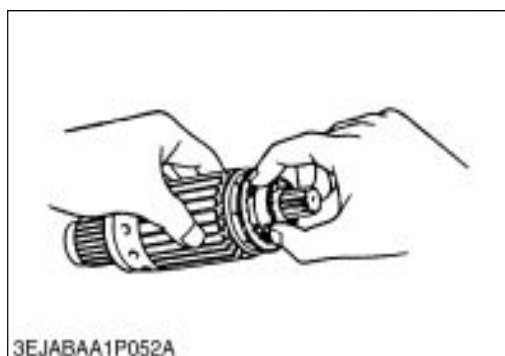
(1) Starter



Overrunning Clutch

1. Inspect the pinion for wear or damage.
2. If there is any defect, replace the overrunning clutch assembly.
3. Check that the pinion turns freely and smoothly in the overrunning direction and dose not slip in the cranking directions.
4. If the pinion slips or dose not rotate in the both directions, replace the overrunning clutch assembly.

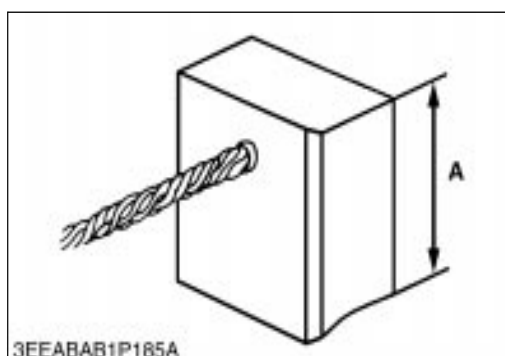
W1156799



Armature Bearing

1. Check the bearing for smooth rotation.
2. If it dose not smooth rotation, replace it.

W1156718

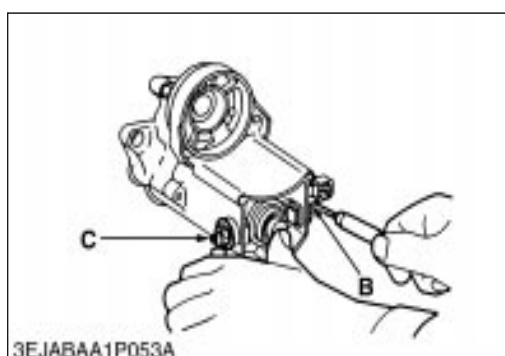


Brush Wear

1. If the connect face of the brush is dirty or dusty, clean it with emery paper.
2. Measure the brush length "A" with vernier caliper.
3. If the length is than the allowable limit, replace the yoke assembly and brush holder.

Brush length A	Factory spec.	15.0 mm 0.591 in.
	Allowable limit	11.0 mm 0.433 in.

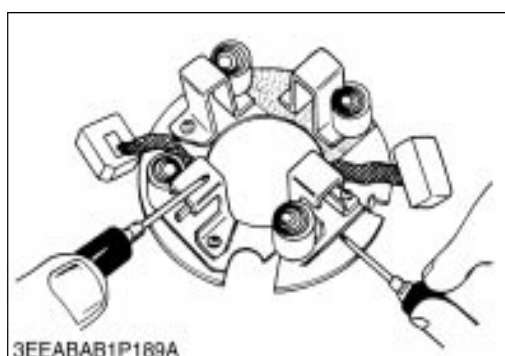
W1156360



Magnet Switch

1. Check the continuity across the "C" terminal and the "B" terminal with an ohmmeter pushing the plunger.
2. If it dose not conducts, check the contacts.

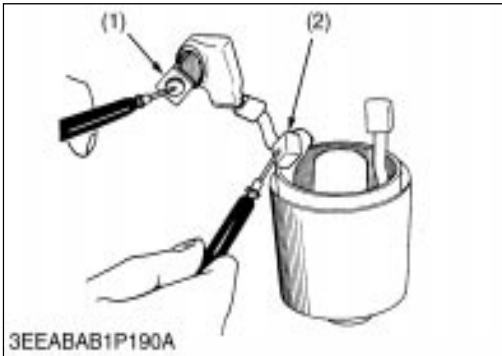
W1157257



Brush Holder

1. Check the continuity across the brush holder and the holder support with an ohmmeter.
2. If it conducts, replace the brush holder.

W1156895

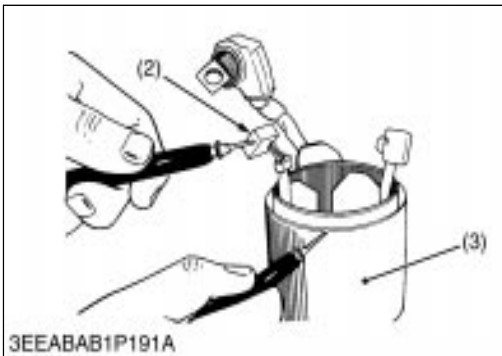
**Field Coil**

1. Check the continuity across the lead (1) and brush (2) with an ohmmeter.
2. If it dose not conduct, replace the yoke assembly.
3. Check the continuity across the brush (2) and yoke (3) with an ohmmeter.
4. If it conducts, replace the yoke assembly.

(1) Lead
(2) Bush

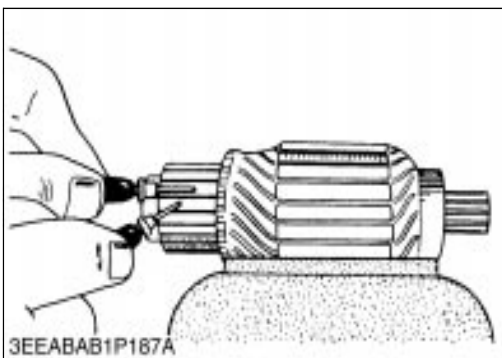
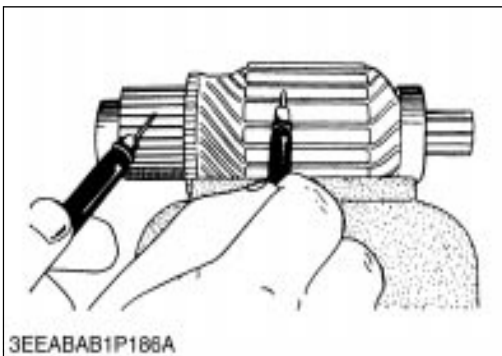
(3) Yoke

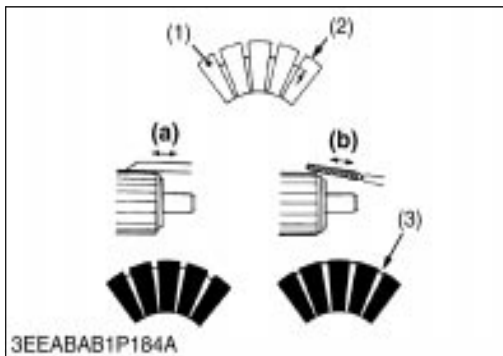
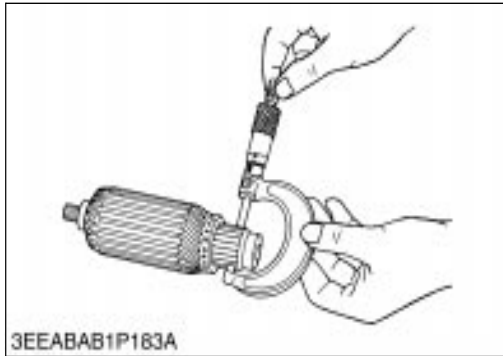
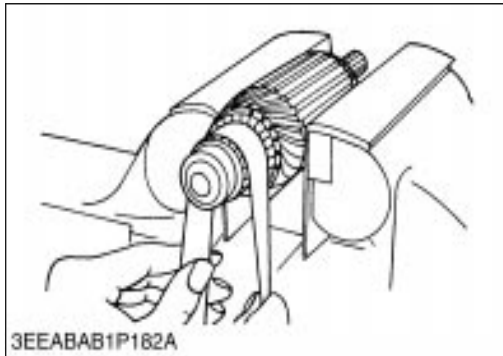
W1156968

**Armature Coil**

1. Check the continuity across the commutator and armature coil core with an ohmmeter.
2. If it conducts, replace the armature.
3. Check the continuity across the segments of the commutator with an ohmmeter.
4. If it dose not conduct, replace the armature.

W1156507





Commutator and Mica

1. Check the contact of the commutator for wear, and grind the commutator with emery paper if it is slightly worn.
2. Measure the commutator O.D. with an outside micrometer at several points.
3. If the minimum O.D. is less than the allowable limit, replace the armature.
4. If the difference of the O.D.'s exceeds the allowable limit, correct the commutator on a lathe to the factory specification.
5. Measure the mica undercut.
6. If the undercut is less than the allowable limit, correct it with a saw blade and chamfer the segment edges.

Commutator O.D.	Factory spec.	D1503-M-DI D1503-M-DI-T D1703-M-DI D1803-M-DI V2203-M-DI	30.0 mm 1.181 in.
		V2403-M-DI	35.0 mm 1.378 in.
	Allowable limit	D1503-M-DI D1503-M-DI-T D1703-M-DI D1803-M-DI V2203-M-DI	29.0 mm 1.142 in.
		V2403-M-DI	34.0 mm 1.339 in.

Difference of O.D.'s	Factory spec.	Less than 0.02 mm 0.0008 in.
	Allowable limit	0.05 mm 0.0020 in.

Mica under cut	Factory spec.	D1503-M-DI D1503-M-DI-T D1703-M-DI D1803-M-DI V2203-M-DI	0.50 to 0.80 mm 0.0197 to 0.0315 in.
		V2403-M-DI	0.50 to 0.90 mm 0.0197 to 0.0354 in.
	Allowable limit		0.20 mm 0.0079 in.

- (1) Segment
(2) Depth of Mica
(3) Mica

(a) Correct
(b) Incorrect

W1155802

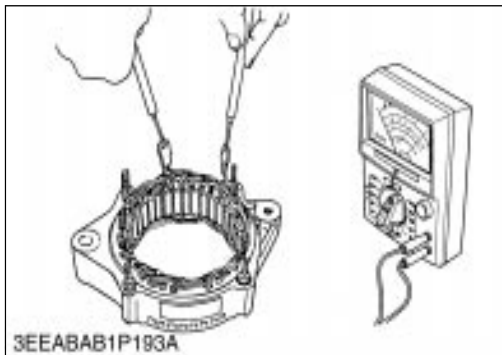
(2) Alternator



Bearing

1. Check the bearing for smooth rotation.
2. If it does not rotate smoothly, replace it.

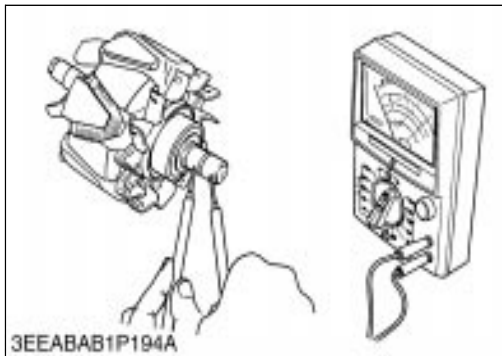
W1019790

**Stator**

1. Check the continuity across each stator coil lead and core with an ohmmeter.
2. If infinity is not indicated, replace it.

Resistance	Factory spec.	Continuity
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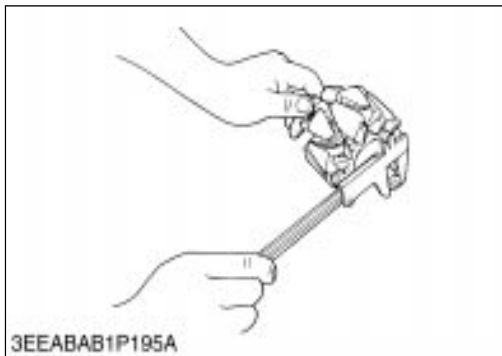
W1019964

**Rotor**

1. Measure the resistance across the slip rings with an ohmmeter.
2. If the resistance is not the factory specification, replace it.
3. Check the continuity across the slip ring and core with an ohmmeter.
4. If infinity is not indicated, replace it.

Resistance	Factory spec.	D1503-M-DI	2.9 Ω
		D1503-M-DI-T D1703-M-DI D1803-M-DI V2203-M-DI V2403-M-DI	2.1 Ω

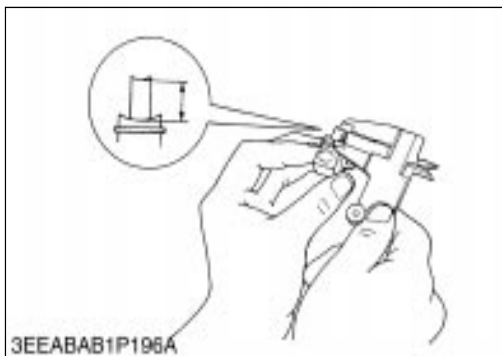
W1020094

**Slip Ring**

1. Check the slip ring for score.
2. If scored, correct with an emery paper or on a lathe.
3. Measure the O.D. of slip ring with vernier calipers.
4. If the measurement is less than the allowable limit, replace it.

Slip ring O.D.	Factory spec.	14.4 mm 0.567 in.
	Allowable limit	14.0 mm 0.551 in.

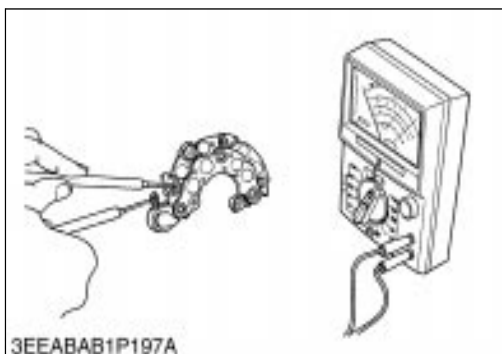
W1020208

**Brush Wear**

1. Measure the brush length with vernier calipers.
2. If the measurement is less than allowable limit, replace it.
3. Make sure that the brush moves smoothly.
4. If the brush is defective, replace it.

Brush length	Factory spec.	10.5 mm 0.413 in.
	Allowable limit	8.4 mm 0.331 in.

W1020329

**Rectifier**

1. Check the continuity across each diode of rectifier with an analog ohmmeter. Conduct the test in the ($R \times 1$) setting.
2. The rectifier is normal if the diode in the rectifier conducts in one direction and does not conduct in the reverse direction.

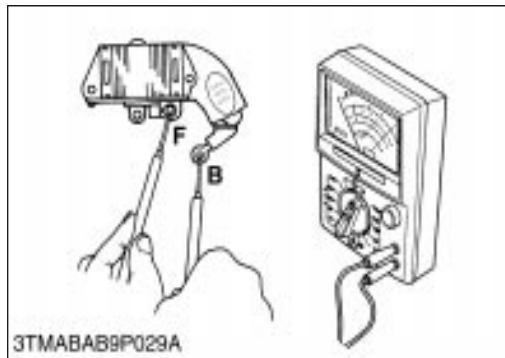
■ IMPORTANT

- Do not use a 500 V megger for measuring because it will destroy the rectifier.

■ NOTE

- Do not use an auto digital multimeter. Because it's very hard to check the continuity of rectifier by using it.

W1020452

**IC Regulator**

1. Check the continuity across the **B** terminal and the **F** terminal of IC regulator with an analog ohmmeter. Conduct the test in the (R × 1) setting.
2. The IC regulator is normal if the IC regulator conducts in one direction and does not conduct in the reverse direction.

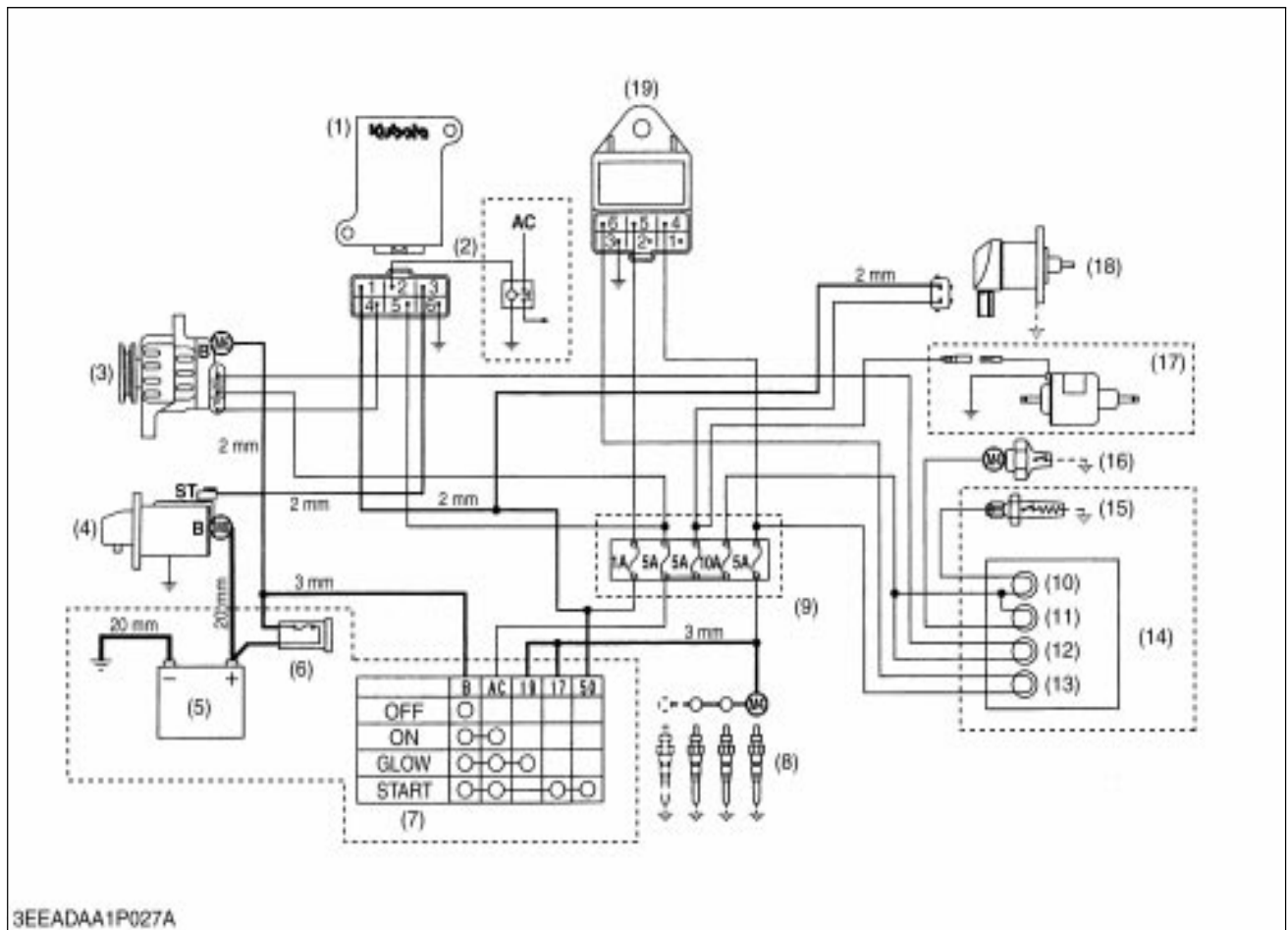
IMPORTANT

- Do not use a 500 V megger for measuring because it will destroy the IC regulator.

NOTE

- Do not use an auto digital multimeter. Because it's very hard to check the continuity of IC regulator by using it.

W1020645

(3) Wiring Diagram

- (1) Starter Auto Reduction Unit
 (2) External Relay (less than 200 mA)
 (3) Alternator
 (4) Starter
 (5) Battery (12V)

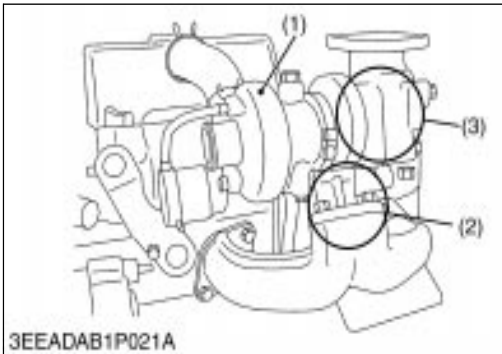
- (6) Fuse (3 cyl : 50 A, 4 cyl : 65 A)
 (7) Key Switch
 (8) Glow Plugs
 (9) Fuse Box
 (10) Water Temperature Lamp

- (11) Oil Pressure Lamp
 (12) Charge Lamp
 (13) Glow Lamp
 (14) Pilot Lamps (12 V, 3.4W)
 (15) Water Temperature Switch

- (16) Oil Switch
 (17) Fuel Feed Pump
 (18) Stop Solenoid
 (19) Timer (Glow Lamp)

7. TURBO CHARGER SYSTEM

[1] CHECKING

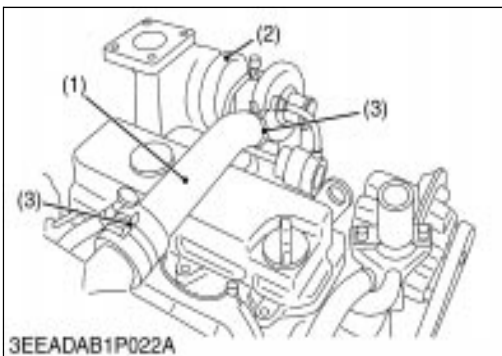


Turbine Side

1. Check the exhaust port (3) and inlet port (2) side of the turbine housing (1) to see if there is no exhaust gas leak.
2. If any gas leak is found, retighten the bolts and nuts or replace the gasket with new one.

- (1) Turbine Housing (3) Exhaust Port
(2) Inlet Port

W1069824

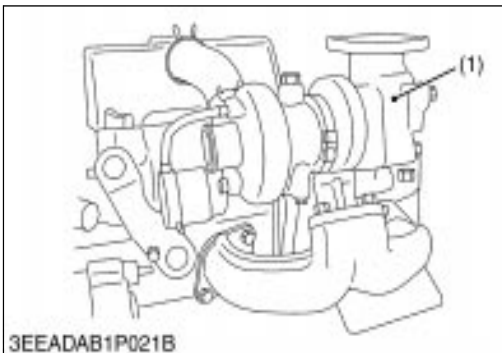


Compressor Side

1. Check the inlet pipe 1 (1) of the compressor cover (2) to see if there is no air leak.
2. Check for loose connections or cracks in the suction side of the intake pipe.
3. If any air leak is found, change the clamp (3) and or inlet pipes.

- (1) Inlet Pipe 1 (3) Clamp
(2) Compressor Cover

W1069939

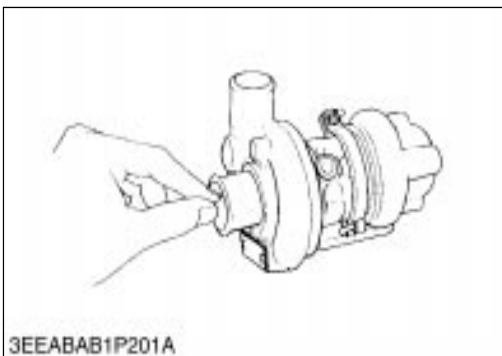


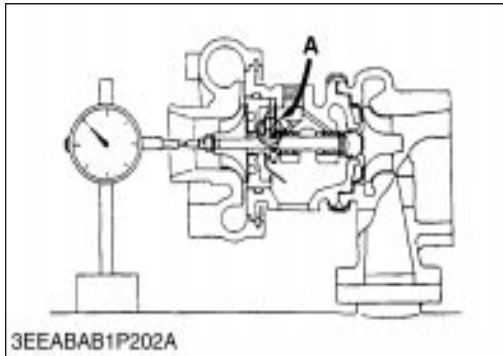
Wheel Shaft

1. Remove the intake pipe and flange (1).
2. Turn the compressor wheel gently with a finger and check for contact.
3. If the wheel does not turn smoothly and / or found the damage, and abnormal sound, check the axial and radial clearance.
4. If the compressor / turbine wheel and housing is found to be damaged, replace the turbocharger assembly with new one.

- (1) Flange

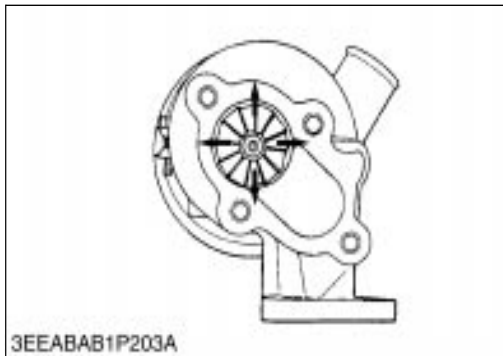
W1070041



**Axial Clearance**

1. Set the dial gauge.
2. Move the shaft in the direction, and measure the end play.
3. If the end play **A** exceeds 0.12 mm (0.0047 in.), replace the turbocharger assembly with new one.

W1070163

**Radial Clearance**

1. Move the compressor / turbine wheel (up and down / right and left).
2. If the wheel contact to the housing, replace the turbocharger assembly with new one.

W1070268

[2] DISASSEMBLING AND ASSEMBLING

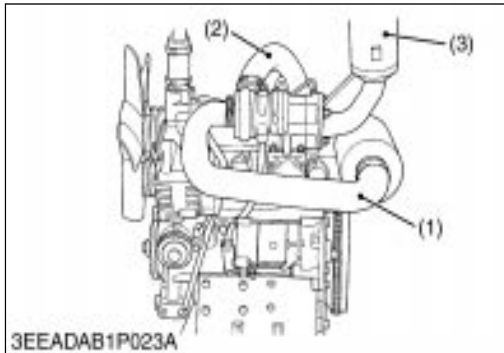


CAUTION

- While the engine is running and or just after it stops, the turbocharger is hot, be careful not to touch the turbocharger.

NOTE

- When detaching and attaching the turbocharger assembly, be very careful not to allow dust, dirt and other foreign matters in the oil pipes.
- When the turbocharger assembly has been replaced, pour fresh engine oil through the oil filter port of the turbocharger.
- Before starting the engine, make sure that the air cleaner is in position.



Air Cleaner and Muffler

1. Remove the intake pipe (1).
2. Remove the inlet pipe (2).
3. Remove the muffler (3).

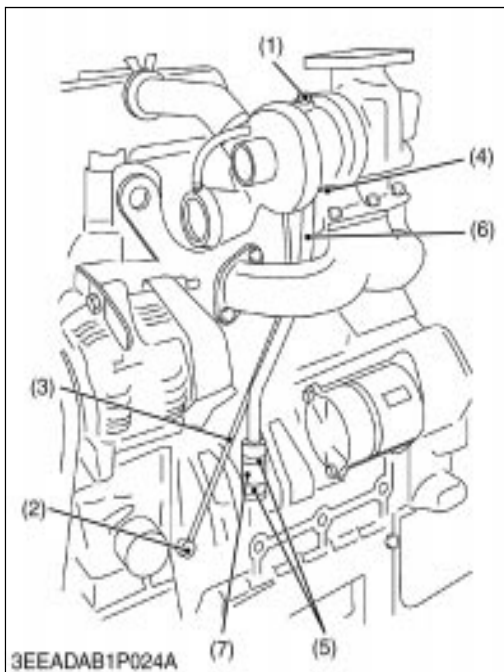
(When reassembling)

- Replace the gasket with new one.

(1) Intake Pipe
(2) Inlet Pipe 1

(3) Muffler

W1070719



Oil Pipe

1. Remove the joint bolt (1), (2) and take off the oil pipe 1 (3).
2. Remove the bolts (4) and release the clamp (5).
3. Disconnect the oil pipe 2 (6) and pipe 4 (7).

(When reassembling)

- Pour fresh engine oil through the oil filter port of the turbocharger.
- Replace the gaskets with new one.
- Be careful not to allow dust, dirt and other foreign matters in the oil pipes.

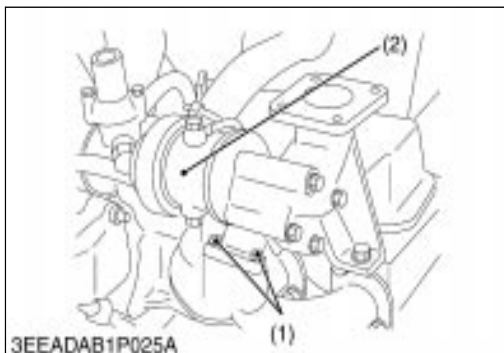
NOTE

- Tape or plug all opening to prevent foreign matters from damaging the oil cavities in the turbocharger.

(1) Joint Bolt
(2) Joint Bolt
(3) Oil Pipe 1
(4) Bolt

(5) Clamp
(6) Oil Pipe 2
(7) Oil Pipe 4

W1070836



Turbocharger

1. Remove the bolt (1).
2. Take off the turbocharger assemble (2).

(When reassembling)

- Replace the gasket with new one.

(1) Bolt

(2) Turbocharger Assemble

W1071031