WSM

WORKSHOP MANUAL
ZERO TURN MOWER

ZD321,ZD326,ZD331

Kubota

KiSC issued 04, 2007 A

TO THE READER

This Workshop Manual has been prepared to provide servicing personnel with information on the mechanism, service and maintenance of ZD321, ZD326 and ZD331. It is divided into three parts, "General", "Mechanism" and "Servicing".

■ **General**

Information on the product identification, the general precautions, maintenance check list, check and maintenance and special tools are described.

■ **Mechanism**

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

Refer to Workshop Manual Diesel Engine, Mechanism (Code No. 9Y021-01874) for the one which has not been described to this workshop manual.

■ **Servicing**

Information on the troubleshooting, servicing specification lists, tightening torque, checking and adjusting, disassembling and assembling, and servicing which cover procedures, precautions, factory specifications and allowable limits.

All information illustrations and specifications contained in this manual are based on the latest product information available at the time of publication.

The right is reserved to make changes in all information at any time without notice.

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

December 2006

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.

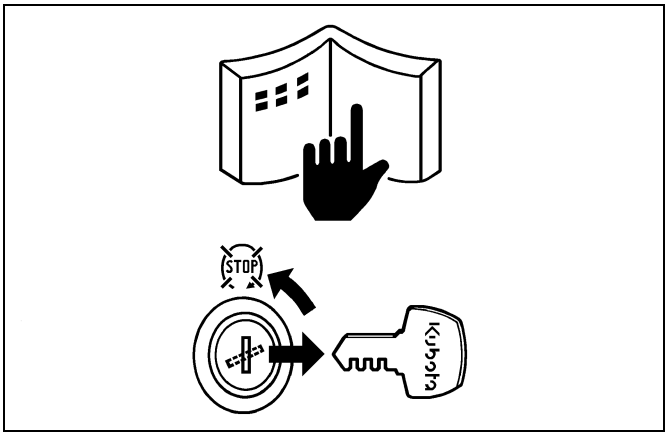
DANGER : Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

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.

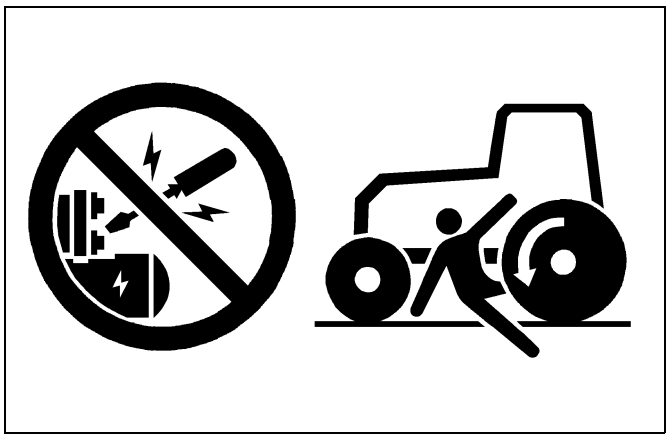
■ IMPORTANT : Indicates that equipment or property damage could result if instructions are not followed.

■ NOTE : Gives helpful information.



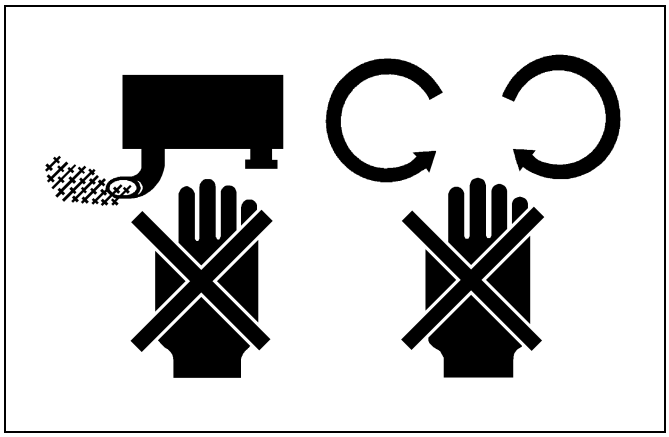
BEFORE SERVICING AND REPAIRING

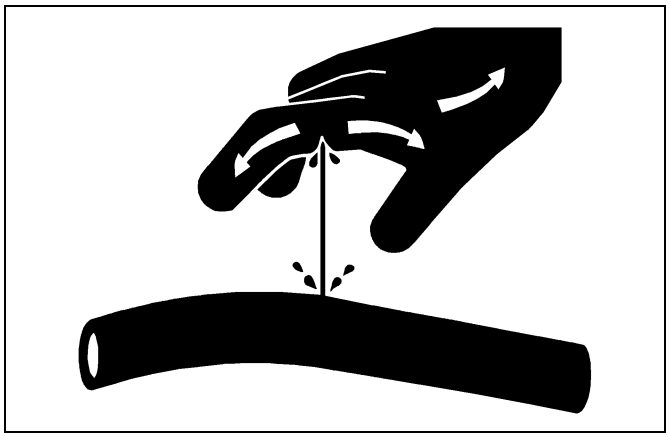
- Read all instructions and safety instructions in this manual and on your machine safety decals.
- Clean the work area and machine.
- Park the machine on a firm and level ground, and set the parking brake.
- Lower the implement to the ground.
- Stop the engine, and remove the key.
- Disconnect the battery negative cable.
- Hang a "**DO NOT OPERATE**" tag in operator station.



SAFETY STARTING

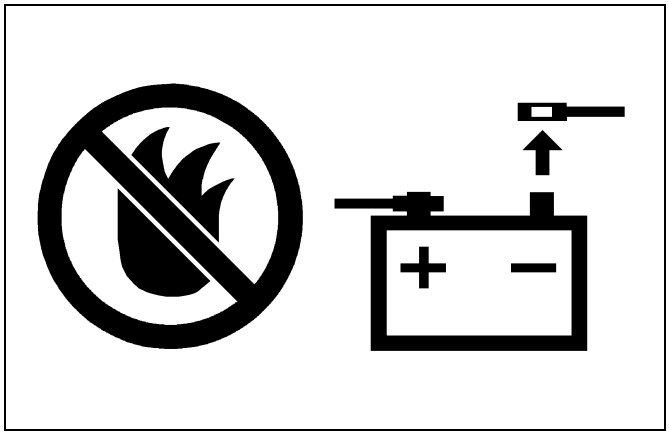
- Do not start the engine by shorting across starter terminals or bypassing the safety start switch.
- Do not alter or remove any part of machine safety system.
- Before starting the engine, make sure that all shift levers are in neutral positions or in disengaged positions.
- Never start the engine while standing on ground. Start the engine only from operator's seat.





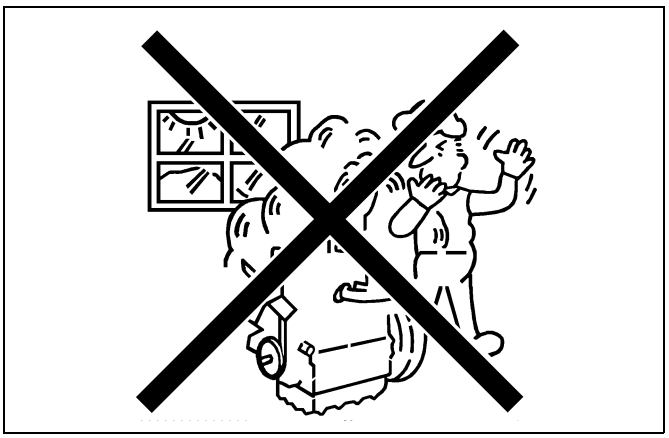
SAFETY WORKING

- 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 work under the machine that is supported solely by a jack. Always support the machine by safety stands.
- 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.



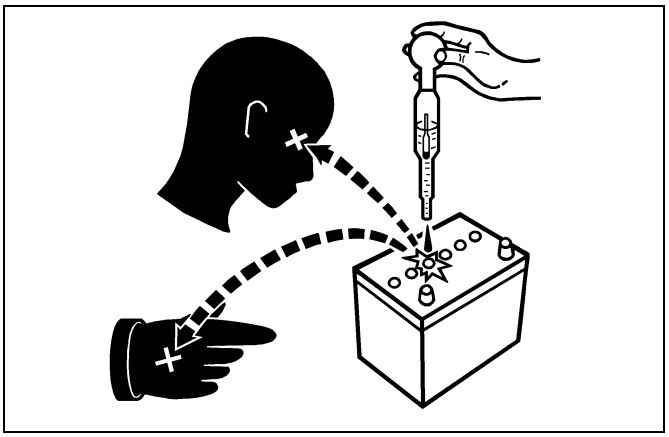
AVOID FIRES

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



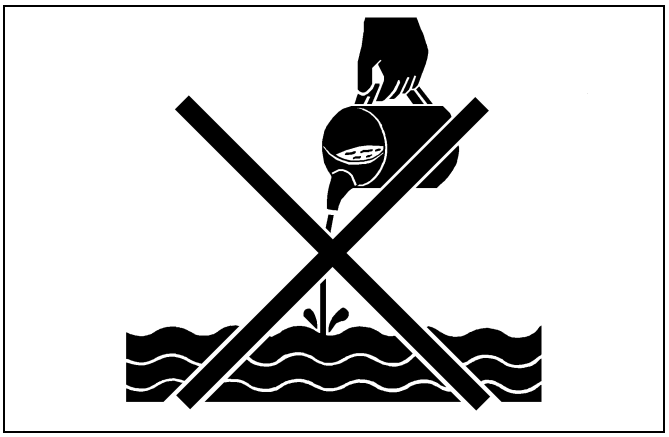
VENTILATE WORK AREA

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



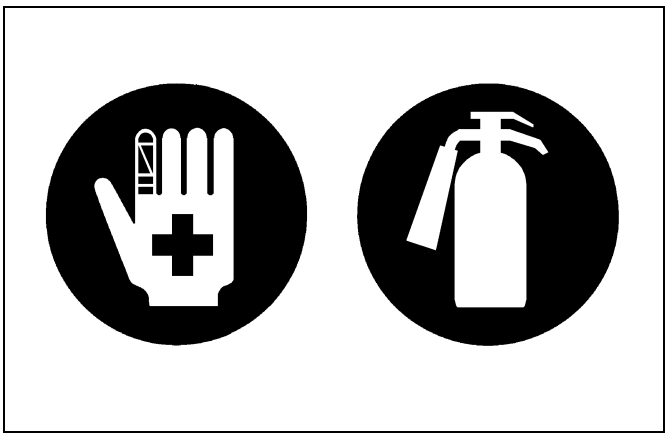
PREVENT ACID BURNS

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



DISPOSE OF FLUIDS PROPERLY

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

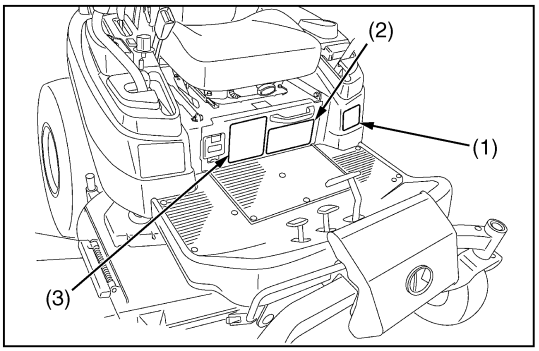


PREPARE FOR EMERGENCIES

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

SAFETY DECALS

The following safety decals are installed on the machine.
If a decal becomes damaged, illegible or is not on the machine, replace it. The decal part number is listed in the parts list.



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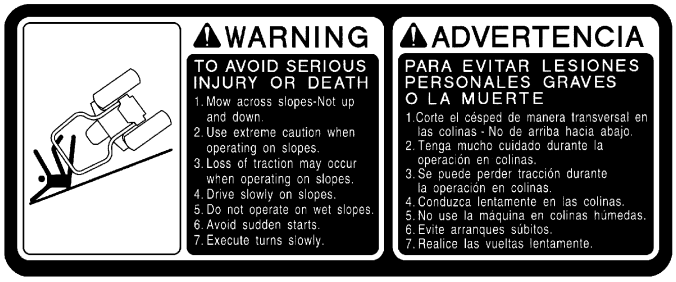
(2) Part No. K3181-6584-1



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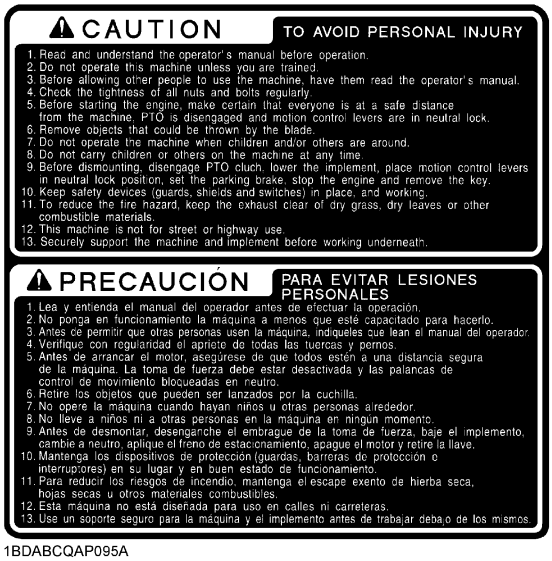

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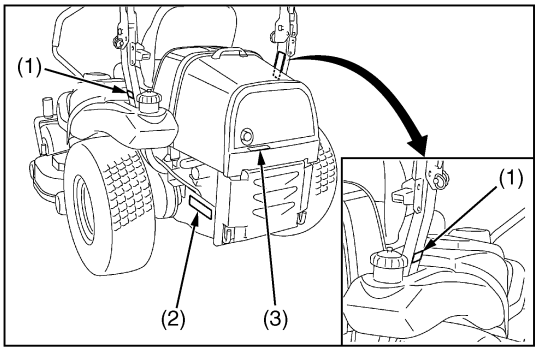

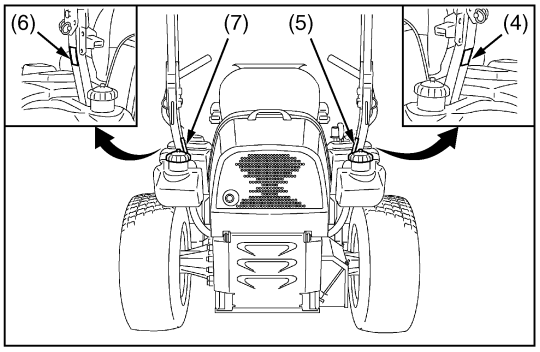

(1) Part No. K3181-6587-1
Diesel fuel No fire only

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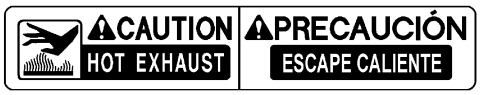
(2) Part No. K3181-6583-1

1BDABCQAP103A

(3) Part No. K3181-6532-1



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(4) Part No. K3181-6564-1

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(5) Part No. K3181-6563-1

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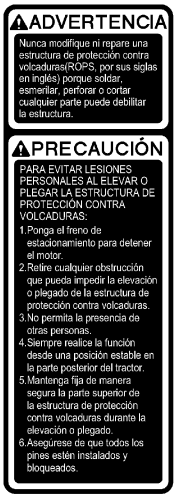
(6) Part No. K3181-6566-1



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(7) Part No. K3181-6565-1

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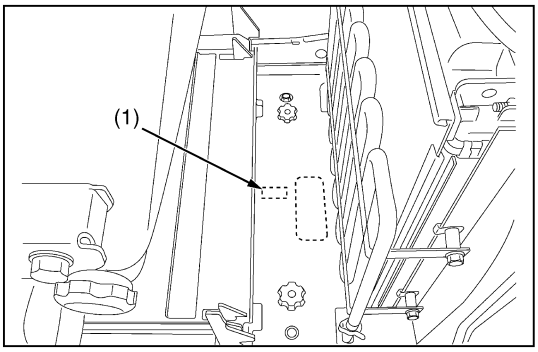
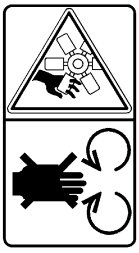


(1) Part No. K3111-6591-1
Do not get your hands close to fan belt.



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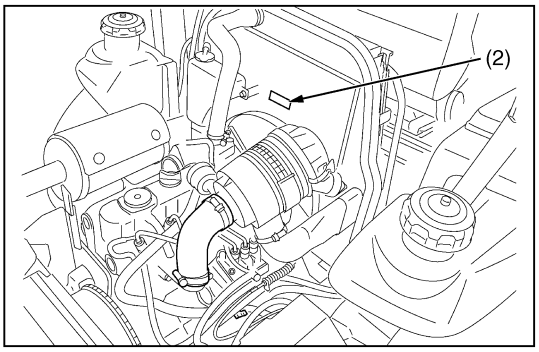

(2) Part No. K3181-6586-1
Do not get your hands close to engine fan and fan belt.

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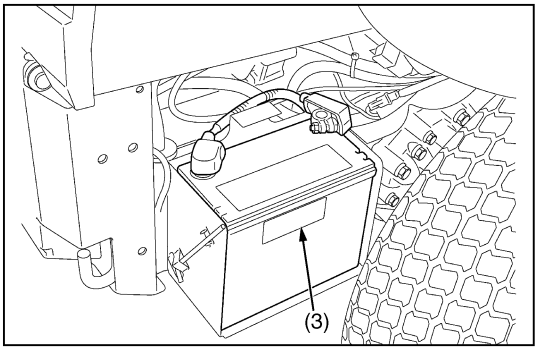

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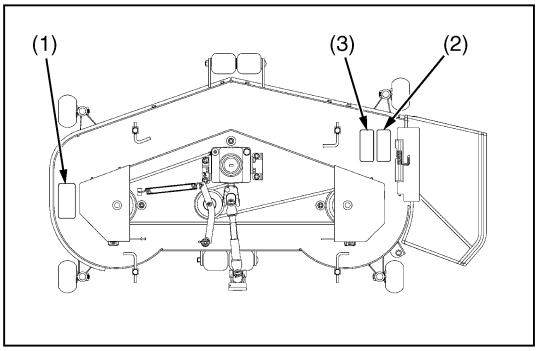

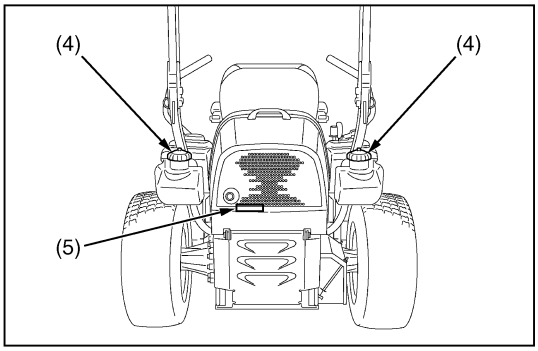

(1) Part No. K5681-7312-1

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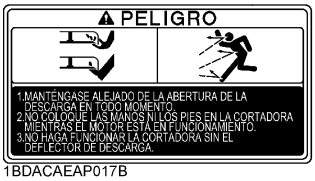
(2) Part No. K5681-7311-1

1BDACAEAP016B

(3) Part No. K5681-7310-1



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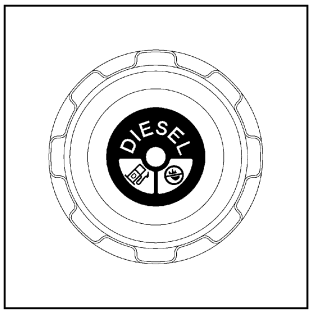
(4) Part No. K3181-2481-1



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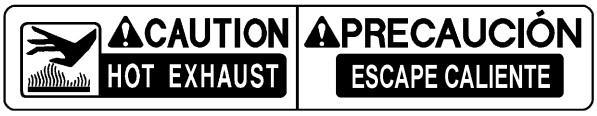

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CARE OF DANGER, WARNING AND CAUTION LABELS

1. Keep danger, warning and caution labels clean and free from obstructing material.
2. Clean danger, warning and caution labels with soap and water, dry with a soft cloth.
3. Replace damaged or missing danger, warning and caution labels with new labels.
4. If a component with danger, warning and caution label(s) affixed is replaced with new part, make sure new label(s) is(are) attached in the same location(s) as the replaced component.
5. Mount new danger, warning and caution labels by applying on a clean dry surface and pressing any bubbles to outside edge.

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SPECIFICATIONS

Model			ZD321N	ZD321	ZD326S	ZD326P	ZD331P	ZD331LP
Engine	Model		D782-E2-ZD		D1005-E2-ZD-2		D1305-E3-ZD	
	Maximum engine power (Gross)		15.7 kW (21 HP)*1		19.4 kW (26 HP)*1		23.1 kW (31 HP)*1	
	Type		Liquid-cooled					
	Number of cylinders		3					
	Bore and stroke		67 x 73.6 mm (2.64 x 2.90 in.)		76 x 73.6 mm (2.99 x 2.90 in.)		78 x 88.0 mm (3.07 x 3.46 in.)	
	Total displacement		778 cm^3 (47.5 cu.in.)		1001 cm^3 (61.1 cu.in.)		1261 cm^3 (77.0 cu.in.)	
	Rated revolution		3200 min^{-1} (rpm)				3000 min^{-1} (rpm)	
	Fuel		Diesel fuel No. 1 [below – 10 °C (14 °F)] Diesel fuel No. 2 [above – 10 °C (14 °F)]					
	Starter		Electric starter with battery, glow plug, 12 V, 1.1 kW					
	Lubrication		Forced lubrication by gear pump					
	Cooling		Liquid with pressurized radiator					
	Battery		51 R (12 V, RC : 70 min, CCA : 450 A)					
Capacities	Fuel tank		49 L (13 U.S.gals, 11 Imp.gals)					
	Engine crankcase (with filter)		3.5 L (3.70 U.S.qts, 3.08 Imp.qts)		3.9 L (4.1 U.S.qts, 3.4 Imp.qts)		5.7 L (6.0 U.S.qts, 5.0 Imp.qts)	
	Engine coolant		2.7 L (2.85 U.S.qts, 2.38 Imp.qts)		3.5 L (3.70 U.S.qts, 3.08 Imp.qts)			
	Recovery tank		0.25 L (0.26 U.S.qts, 0.22 Imp.qts)					
	Transmission including rear axle gear case		12.1 L (12.8 U.S.qts, 10.6 Imp.qts)*3					
Dimensions	Overall length		2185 mm (56.0 in.)		2220 mm (87.4 in.)			2335 mm (91.9 in.)
	Overall width Without mower deck		1365 mm (53.7 in.)	1460 mm (57.5 in.)				
	Overall height	With ROPS upright	1915 mm (75.4 in.)					
		With ROPS folded	1555 mm (61.2 in.)					
	Wheel base		1410 mm (55.5 in.)					1525 mm (60.0 in.)
	Minimum ground clearance		130 mm (5.12 in.) with 54 in., 60 in.		130 mm (5.12 in.) with 60 in.		130 mm (5.12 in.) with 60 in., 72 in.	
	Tread	Front	975 mm (38.4 in.)					1070 mm (42.1 in.)
		Rear	1100 mm (43.3 in.)	1150 mm (45.3 in.)				

NOTE: Specifications and design subject to change without notice.
*1 : Manufacurer's estimate
[N] : Narrow tread
[S] : Special
[P] : Semi-pneumatic Non Flat Tire
[LP] : Long wheel base and equipped with 72 in. mower.
*2 : At 3200 min^{-1} (rpm) [ZD321, ZD326]
At 3000 min^{-1} (rpm) [ZD331]
*3 : Oil amount when the oil level is at the upper level.

Model			ZD321N	ZD321	ZD326S	ZD326P	ZD331P	ZD331LP
Weight (with Mower Deck)			730 kg (1609 lbs) with 54 in.	755 kg (1664 lbs) with 60 in.	798 kg (1759 lbs) with 60 in.	813 kg (1792 lbs) with 60 in.	820 kg (1808 lbs) with 60 in.	845 kg (1863 lbs) with 72 in.
Travelling system	Tires	Front	15 x 6.0-6 (4PR) Rib			15 x 6.0-6 (Semi-pneumatic Non Flat Tire) Rib		
		Rear	26 x 10.5-12 (4PR) Turf	26 x 12.0-12 (4PR) Turf				
	Travelling speeds	Forward	0 to 15.0 km/h (0 to 9.3 mph)*2			0 to 17.0 km/h (0 to 10.6 mph)*2		
		Reverse	0 to 8.3 km/h (0 to 5.2 mph)*2			0 to 8.5 km/h (0 to 5.3 mph)*2		
	Steering		2-Hand levers					
	Transmission		2-Hydrostatic transmission with gear					
	Parking brake		Wet multi disc / foot applied, released					
	Min. turning radius		0 mm (0 in.)					
PTO	Revolution		1 speed (2530 rpm at 3200 engine rpm)				1 speed (2538 rpm at 3000 engine rpm)	
	Drive system		Shaft drive, KUBOTA 10 tooth in involute spline					
	Clutch type		Wet multi discs					
	PTO brake		Wet single disc					

NOTE: Specifications and design subject to change without notice.
*1 : Manufacurer's estimate
[N] : Narrow tread
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[LP] : Long wheel base and equipped with 72 in. mower.
*2 : At 3200 min^{-1} (rpm) [ZD321, ZD326]
At 3000 min^{-1} (rpm) [ZD331]
*3 : Oil amount when the oil level is at the upper level.

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Model			RCK54P-321Z	RCK60P-331Z	RCK72P-331Z
PRO commercial deck (fabricated deck)	Suitable machine		ZD321N	ZD321, ZD326S, ZD326P, ZD331P	ZD331LP
	Mounting method		Quick joint, parallel linkage		
	Adjustment of cutting height		Dial gauge		
	Cutting width		1375 mm (54 in.)	1524 mm (60.0 in.)	1829 mm (72.0 in.)
	Cutting height		25 to 127 mm (1.0 to 5.0 in.)		
	Weight (approx.)		128 kg (281 lbs)	148 kg (327 lbs)	169 kg (373 lbs)
	Blade spindle speed		58.8 r/s (3530 min^{-1} (rpm))*1	56.0 r/s (3360 min^{-1} (rpm))*1	47.2 r/s (2830 min^{-1} (rpm))*1
	Blade tip velocity		87.8 m/s (17300 fpm)*1	92.0 m/s (18100 fpm)*1	92.6 m/s (18200 fpm)*1
	Blade length		475 mm (18.7 in.)	523 mm (20.6 in.)	625 mm (24.6 in.)
	Number of blades		3		
	Dimensions	Total length	940 mm (37.0 in.)	1002 mm (39.4 in.)	1170 mm (46.1 in.)
		Total width	1704 mm (67.1 in.)	1911 mm (75.2 in.)	2224 mm (87.6 in.)
		Total height	353 mm (13.9 in.)	358 mm (14.1 in.)	

NOTE: Specifications and design subject to change without notice.
*1 : Engine max. revolution.

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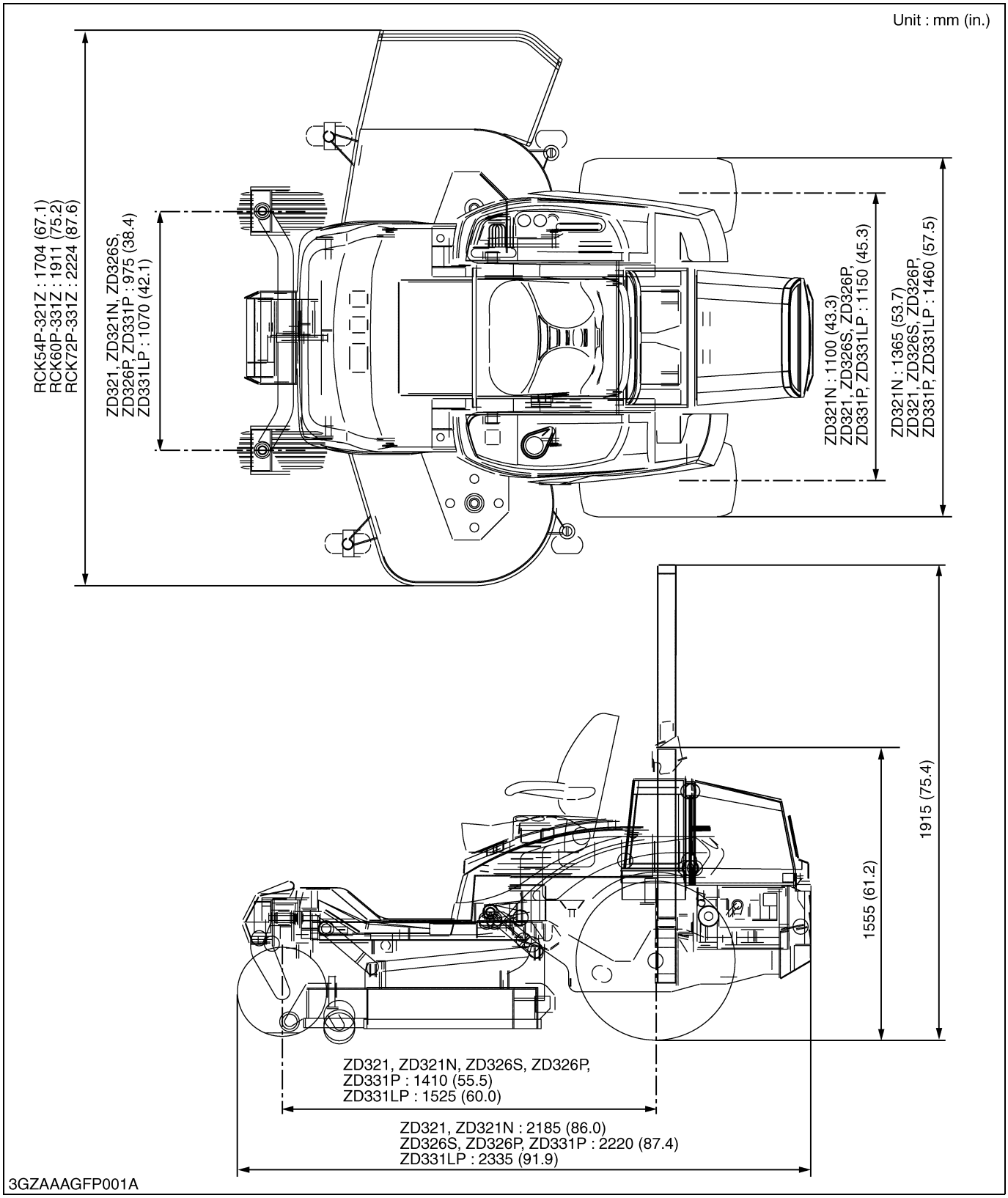
DIMENSIONS


Unit : mm (in.)
RCK54P-321Z : 1704 (67.1)
RCK60P-331Z : 1911 (75.2)
RCK72P-331Z : 2224 (87.6)
ZD321, ZD321N, ZD326S, ZD326P, ZD331P : 975 (38.4)
ZD331LP : 1070 (42.1)
ZD321N : 1100 (43.3)
ZD321, ZD326S, ZD326P, ZD331P, ZD331LP : 1150 (45.3)
ZD321N : 1365 (53.7)
ZD321, ZD326S, ZD326P, ZD331P, ZD331LP : 1460 (57.5)
1915 (75.4)
1555 (61.2)
ZD321, ZD321N, ZD326S, ZD326P, ZD331P : 1410 (55.5)
ZD331LP : 1525 (60.0)
ZD321, ZD321N : 2185 (86.0)
ZD326S, ZD326P, ZD331P : 2220 (87.4)
ZD331LP : 2335 (91.9)
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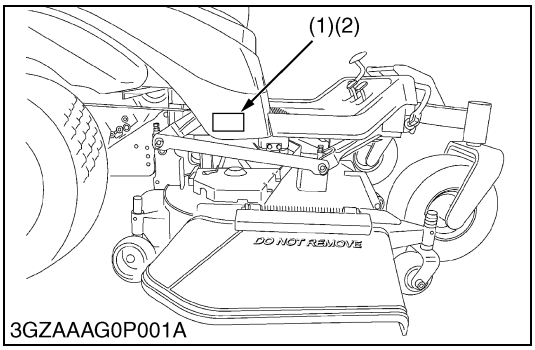
G GENERAL

GENERAL

CONTENTS

1. IDENTIFICATION



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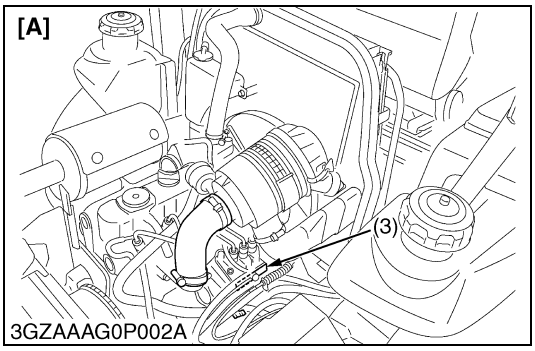

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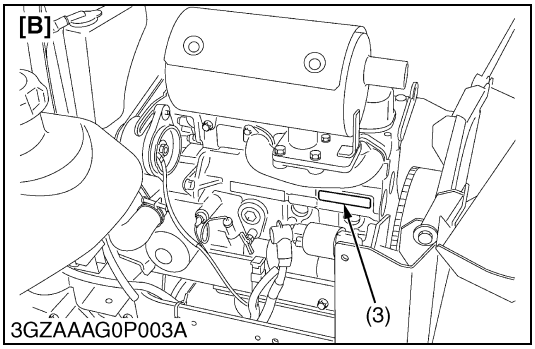
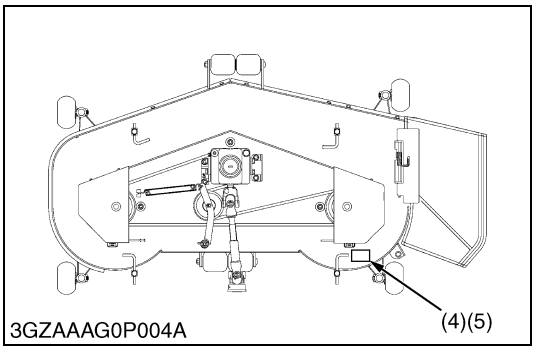
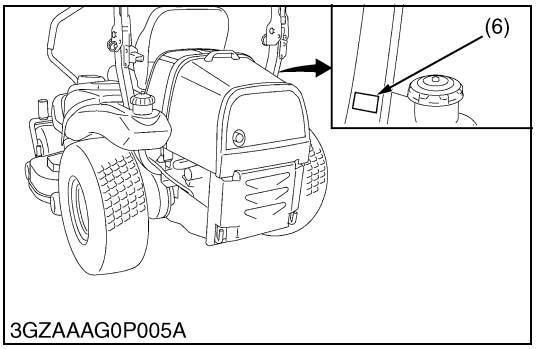


3GZAAAG0P003A



3GZAAAG0P004A



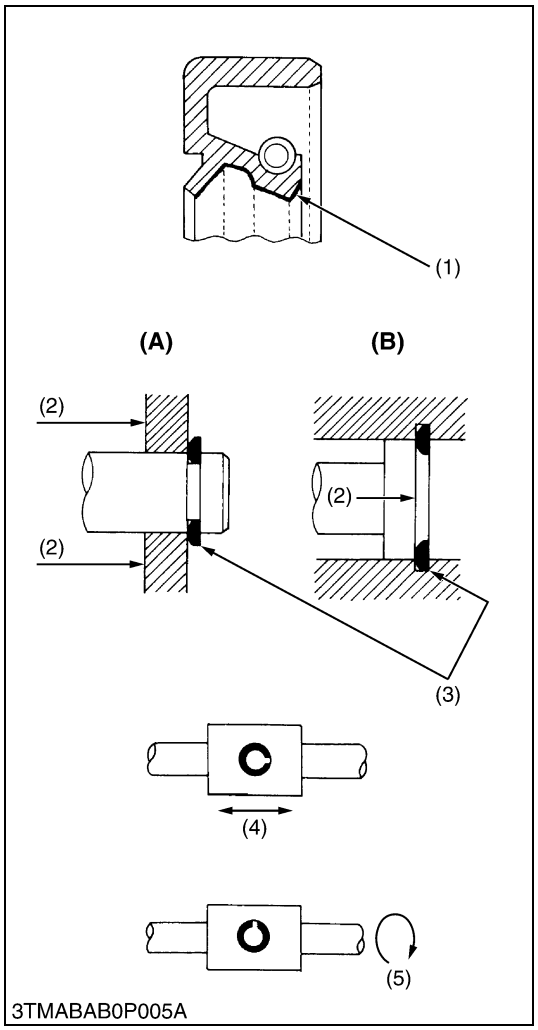
3GZAAAG0P005A

When contacting your local KUBOTA distributor, always specify engine serial number (3), machine serial number (2), mower serial number (4) and hour meter reading.

(1) Machine Identification Plate
(2) Machine Serial Number
(3) Engine Serial Number
(4) Mower Serial Number
(5) Mower Identification Plate
(6) ROPS Serial Number

W1010714

2. GENERAL PRECAUTIONS



3TMABAB0P005A

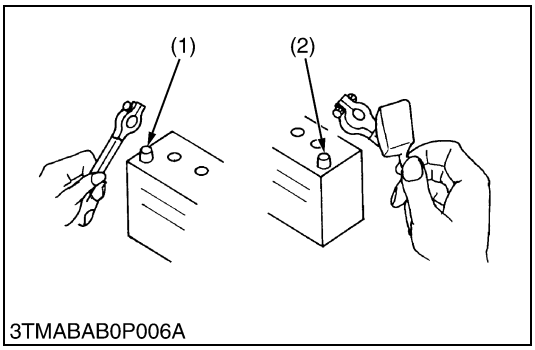
- During disassembly, carefully arrange removed parts in a clean area to prevent confusion later. Screws, bolts and nuts should be installed in their original position to prevent reassembly errors.
- When special tools are required, use KUBOTA genuine special tools. Special tools which are not frequently used should be made according to the drawings provided.
- Before disassembling or servicing electrical wires, always disconnect the ground cable from the battery first.
- Remove oil and dirt from parts before measuring.
- Use only KUBOTA genuine parts for parts replacement to maintain machine performance and to assure safety.
- Gaskets and O-rings must be replaced during reassembly. Apply grease to new O-rings or oil seals before assembling. See the figure left side.
- When reassembling external snap rings or internal snap rings, they must be positioned so that sharp edge faces against the direction from which a force is applied. See the figure left side.
- When inserting spring pins, their splits must face the direction from which a force is applied. See the figure left side.
- To prevent damage to the hydraulic system, use only specified fluid or equivalent.

(1) Grease
(2) Force
(3) Sharp Edge
(4) Axial Force
(5) Rotating Movement

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

W1010904

3. HANDLING PRECAUTIONS FOR ELECTRICAL PARTS AND WIRING



3TMABAB0P006A

To ensure safety and prevent damage to the machine and surrounding equipment, heed the following precautions in handling electrical parts and wiring.

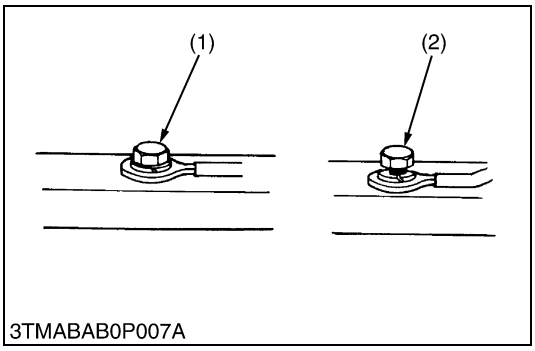
■ **IMPORTANT**

- **Check electrical wiring for damage and loosened connection every year. To this end, educate the customer to do his or her own check and at the same time recommend the dealer to perform periodic check for a fee.**
- **Do not attempt to modify or remodel any electrical parts and wiring.**
- **When removing the battery cables, disconnect the negative cable first. When installing the battery cables, connect the positive cable first.**

(1) Negative Terminal (2) Positive Terminal

W1011114

[1] WIRING

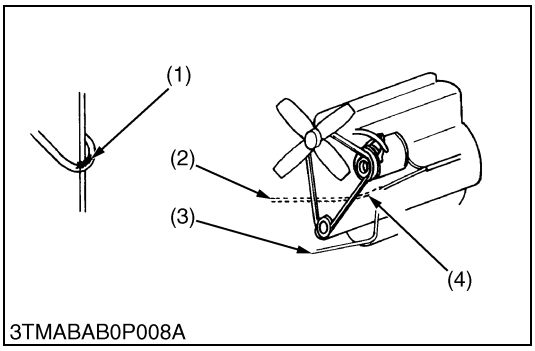


3TMABAB0P007A

- Securely tighten wiring terminals.

(1) Correct
(Securely tighten)
(2) Incorrect
(Loosening leads to faulty contact)

W1011216

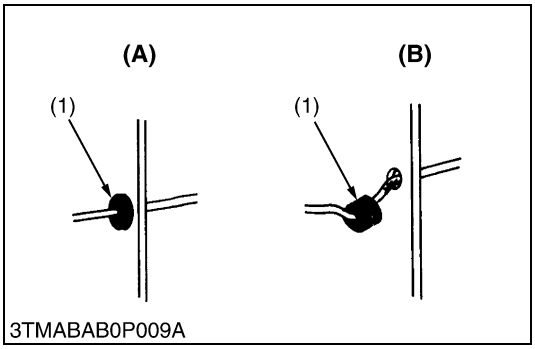


3TMABAB0P008A

- Do not let wiring contact dangerous part.

(1) Wiring (Correct)
(2) Wiring (Incorrect)
(3) Dangerous Part
(4) Dangerous Part

W1011313



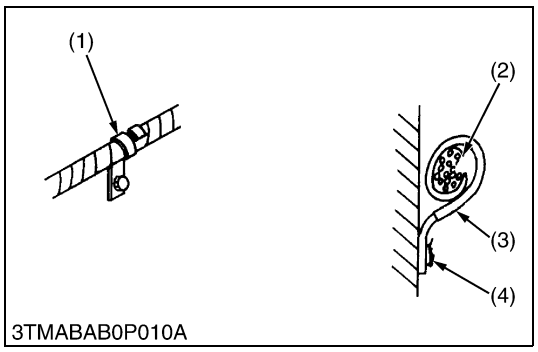
3TMABAB0P009A

- Securely insert grommet.

(1) Grommet

(A) Correct
(B) Incorrect

W1011388

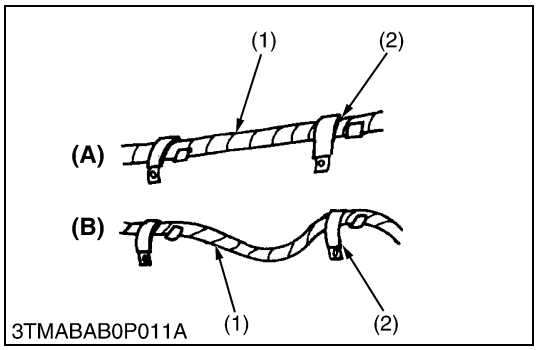


3TMABAB0P010A

- Securely clamp, being careful not to damage wiring.

(1) Clamp
• Wind Clamp Spirally
(2) Wire Harness
(3) Clamp
(4) Welding Dent

W1011458

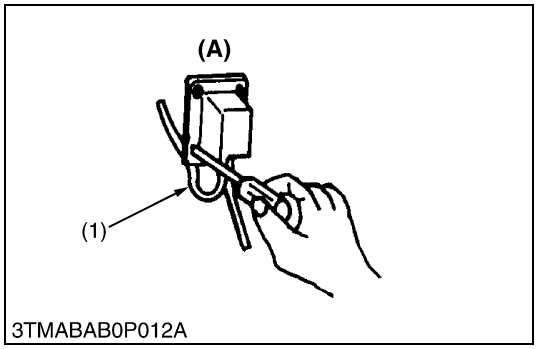


3TMABAB0P011A

- Clamp wiring so that there is no twist, unnecessary sag, or excessive tension, except for movable part, where sag be required.

(1) Wiring
(2) Clamp
(A) Correct
(B) Incorrect

W1011587

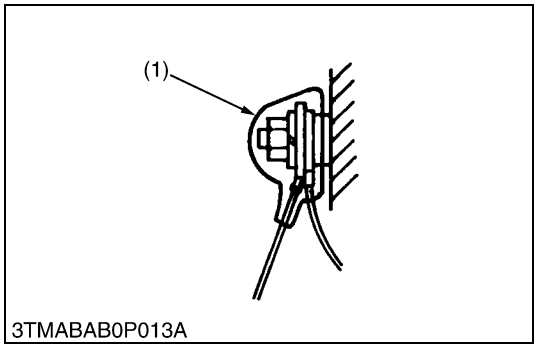


3TMABAB0P012A

- In installing a part, take care not to get wiring caught by it.

(1) Wiring
(A) Incorrect

W1011670



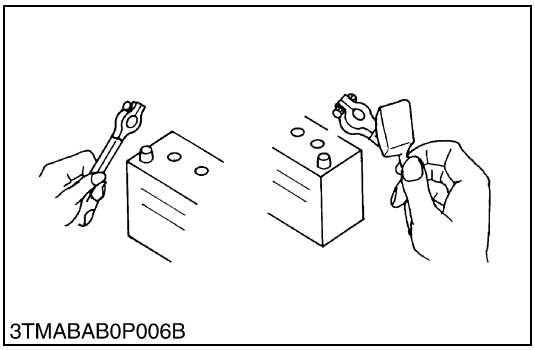
3TMABAB0P013A

- After installing wiring, check protection of terminals and clamped condition of wiring, only connect battery.

(1) Cover
• Securely Install Cover

W1011735

[2] BATTERY


3TMABAB0P006B

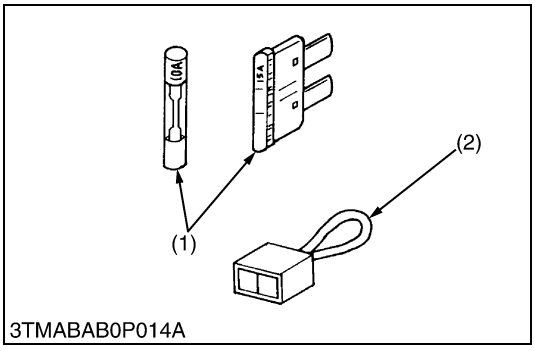
- Take care not to confuse positive and negative terminal posts.
- When removing battery cables, disconnect negative cable first. When installing battery cables, check for polarity and connect positive cable first.
- Do not install any battery with capacity other than is specified (Ah).
- After connecting cables to battery terminal posts, apply high temperature grease to them and securely install terminal covers on them.
- Do not allow dirt and dust to collect on battery.

CAUTION

- **Take care not to let battery liquid spill on your skin and clothes. If contaminated, wash it off with water immediately.**
- **Before recharging the battery, remove it from the machine.**
- **Before recharging, remove cell caps.**
- **Do recharging in a well-ventilated place where there is no open flame nearby, as hydrogen gas and oxygen are formed.**

W1011816

[3] FUSE



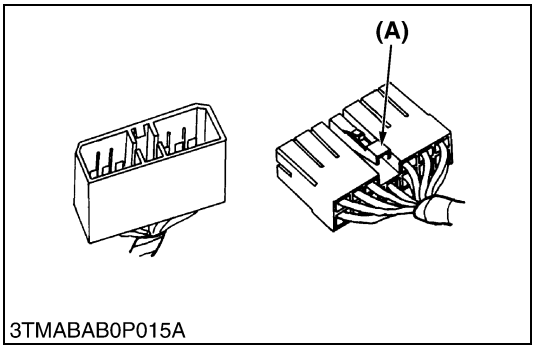
3TMABAB0P014A

- Use fuses with specified capacity.
  Neither too large or small capacity fuse is acceptable.
- Never use steel or copper wire in place of fuse.
- Do not install working light, radio set, etc. on machine which is not provided with reserve power supply.
- Do not install accessories if fuse capacity of reserve power supply is exceeded.

(1) Fuse (2) Slow Blow Fuse

W1012092

[4] CONNECTOR

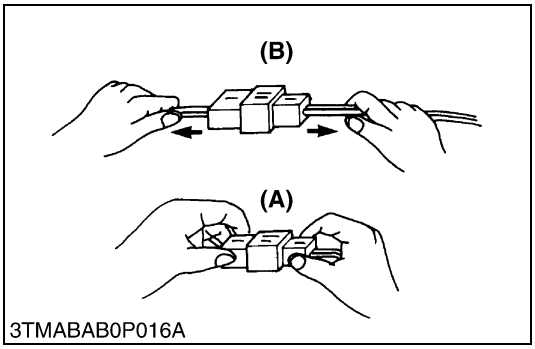


3TMABAB0P015A

- For connector with lock, push lock to separate.

(A) Push

W1012211

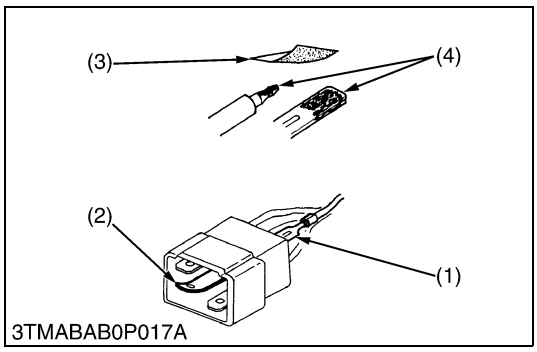


3TMABAB0P016A

- In separating connectors, do not pull wire harnesses.
- Hold connector bodies to separate.

(A) Correct **(B) Incorrect**

W1012272

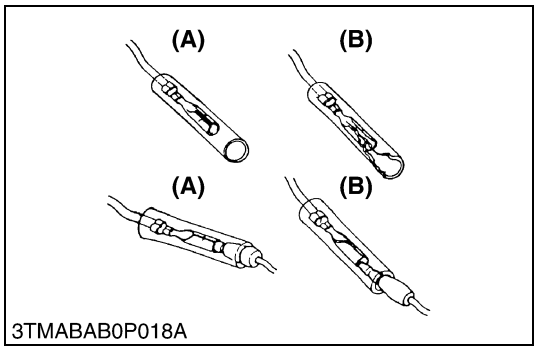


3TMABAB0P017A

- Use sandpaper to remove rust from terminals.
- Repair deformed terminal. Make certain there is no terminal being exposed or displaced.

(1) Exposed Terminal
(2) Bend Terminal
(3) Sandpaper
(4) Rust

W1012346



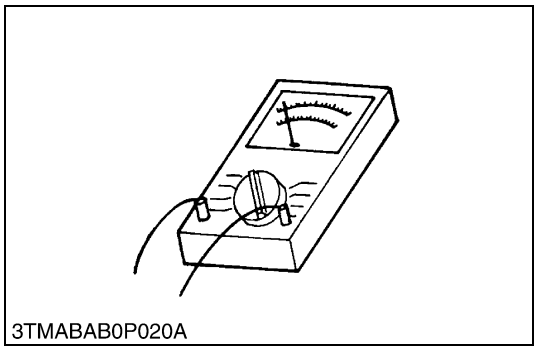
3TMABAB0P018A

- Make certain that there is no female connector being too open.

(A) Correct
(B) Incorrect

W1012430

[5] HANDLING OF CIRCUIT TESTER


3TMABAB0P020A

- Use tester correctly following manual provided with tester.
- Check for polarity and range.

W1012684

4. LUBRICANTS, FUEL AND COOLANT

No.	Place		Capacity			Lubricants, fuel and coolant
			ZD321	ZD326	ZD331	
1	Fuel		49 L 13 U.S.gals 11 Imp.gals			No. 2-D diesel fuel No. 1-D diesel fuel if temperature is below –10 °C (14 °F)
2	Coolant	Cooling system	2.7 L 2.85 U.S.qts 2.38 Imp.qts		3.5 L 3.70 U.S.qts 3.08 Imp.qts	Fresh clean water (soft water) with anti-freeze
		Recovery tank	0.25 L 0.26 U.S.qts 0.22 Imp.qts			
3	Engine crankcase		3.5 L* 3.70 U.S.qts 3.08 Imp.qts	3.9 L* 4.1 U.S.qts 3.4 Imp.qts	5.7 L* 6.0 U.S.qts 5.0 Imp.qts	Engine oil : API Service Classification CF or better Below 0 °C (32 °F) : SAE30, SAE10W-30 or 15W-40 0 to 25 °C (32 to 77 °F) : SAE20, SAE10W-30 or 15W-40 Above 25 °C (77 °F) : SAE10W, SAE10W-30 or 15W-40
4	Transmission case with filter, hose and rear axle gear case (RH and LH)		12.1 L 12.8 U.S.qts 10.6 Imp.qts			KUBOTA UDT or SUPER UDT fluid**
5	Mower gear case		0.4 L 0.4 U.S.qts 0.4 Imp.qts			SAE 90 gear oil (API service classification : more than GL-3)

■ **NOTE**
- *** Oil amount when the oil level is the upper of the oil level gauge.**
- **** KUBOTA original transmission hydraulic fluid.**

■ **IMPORTANT**
- **To prevent serious damage to hydraulic system, use only KUBOTA genuine fluid or its equivalent.**

Greasing, oiling (Machine)				
No.	**Place**	**No. of greasing point**	**Capacity**	**Type of grease**
6	Motion control lever pivot bushing and contact position	6	Until grease overflows	SAE multi-purpose type grease NLG1-2 or NLG1-1 (GC-LB)
7	Center pin	1		
8	King pin	2		
9	Front wheel	2		
10	Front lift arm	2		
11	Universal joint	3		
12	Seat adjuster	2		
13	Throttle cable	2	Moderate amount	Engine oil
Greasing (Mower)				
14	Universal joint	3	Until grease overflows	SAE multi-purpose type grease NLG1-2 or NLG1-1 (GC-LB)
15	Three spindle shafts	3		
16	Belt tension pulley	1		
17	Belt tension pivot	1		
18	Front anti-scalp roller	2		
19	Front anti-scalp roller pivot boss	2		

5. TIGHTENING TORQUES

[1] GENERAL USE SCREWS, BOLTS AND NUTS

Screws, bolts, and nuts whose tightening torques are not specified in this Workshop Manual should be tightened according to the table below.

Indication on top of bolt	⬡ 4 No-grade or 4T						⬡ 7 7T						⬡ 9 9T		
Material of bolt	SS400, S20C						S43C, S48C						SCr435, SCM435		
Material of opponent part	Ordinariness			Aluminum			Ordinariness			Aluminum			Ordinariness		
Unit / Diameter	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft
M6 (6 mm, 0.24 in.)	7.9 to 9.3	0.80 to 0.95	5.8 to 6.8	7.9 to 8.8	0.80 to 0.90	5.8 to 6.5	9.81 to 11.2	1.00 to 1.15	7.24 to 8.31	7.9 to 8.8	0.80 to 0.90	5.8 to 6.5	12.3 to 14.2	1.25 to 1.45	9.05 to 10.4
M8 (8 mm, 0.31 in.)	18 to 20	1.8 to 2.1	13 to 15	17 to 19	1.7 to 2.0	13 to 14	24 to 27	2.4 to 2.8	18 to 20	18 to 20	1.8 to 2.1	13 to 15	30 to 34	3.0 to 3.5	22 to 25
M10 (10 mm, 0.39 in.)	40 to 45	4.0 to 4.6	29 to 33	32 to 34	3.2 to 3.5	24 to 25	48 to 55	4.9 to 5.7	36 to 41	40 to 44	4.0 to 4.5	29 to 32	61 to 70	6.2 to 7.2	45 to 52
M12 (12 mm, 0.47 in.)	63 to 72	6.4 to 7.4	47 to 53	–	–	–	78 to 90	7.9 to 9.2	58 to 66	63 to 72	6.4 to 7.4	47 to 53	103 to 117	10.5 to 12.0	76.0 to 86.7
M14 (14 mm, 0.55 in.)	108 to 125	11.0 to 12.8	79.6 to 92.5	–	–	–	124 to 147	12.6 to 15.0	91.2 to 108	–	–	–	167 to 196	17.0 to 20.0	123 to 144
M16 (16 mm, 0.63 in.)	167 to 191	17.0 to 19.5	123 to 141	–	–	–	197 to 225	20.0 to 23.0	145 to 166	–	–	–	260 to 304	26.5 to 31.0	192 to 224
M18 (18 mm, 0.71 in.)	246 to 284	25.0 to 29.0	181 to 209	–	–	–	275 to 318	28.0 to 32.5	203 to 235	–	–	–	344 to 402	35.0 to 41.0	254 to 296
M20 (20 mm, 0.79 in.)	334 to 392	34.0 to 40.0	246 to 289	–	–	–	368 to 431	37.5 to 44.0	272 to 318	–	–	–	491 to 568	50.0 to 58.0	362 to 419

W1034542

[2] STUD BOLTS

Material of opponent part	Ordinariness			Aluminum		
Unit / Diameter	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft
M8 (8 mm, 0.31 in.)	12 to 15	1.2 to 1.6	8.7 to 11	8.9 to 11	0.90 to 1.2	6.5 to 8.6
M10 (10 mm, 0.39 in.)	25 to 31	2.5 to 3.2	18 to 23	20 to 25	2.0 to 2.6	15 to 18
M12 (12 mm, 0.47 in.)	29.5 to 49.0	3.0 to 5.0	21.7 to 36.1	31.4	3.2	23.1
M14 (14 mm, 0.55 in.)	62 to 73	6.3 to 7.5	46 to 54	–	–	–
M16 (16 mm, 0.63 in.)	98.1 to 112	10.0 to 11.5	72.4 to 83.1	–	–	–
M18 (18 mm, 0.71 in.)	172 to 201	17.5 to 20.5	127 to 148	–	–	–

W1048139

[3] METRIC SCREWS, BOLTS AND NUTS

Grade	Property class 8.8 (8.8)			Property class 10.9 (10.9)		
Unit / Nominal Diameter	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft
M8	24 to 27	2.4 to 2.8	18 to 20	30 to 34	3.0 to 3.5	22 to 25
M10	48 to 55	4.9 to 5.7	36 to 41	61 to 70	6.2 to 7.2	45 to 52
M12	78 to 90	7.9 to 9.2	58 to 66	103 to 117	10.5 to 12.0	76 to 86.7
M14	124 to 147	12.6 to 15.0	91.2 to 108	167 to 196	17.0 to 20.0	123 to 144
M16	197 to 225	20.0 to 23.0	145 to 166	260 to 304	26.5 to 31.0	192 to 224

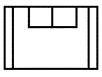
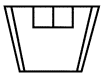
W1016172

[4] AMERICAN STANDARD SCREWS, BOLTS AND NUTS WITH UNC OR UNF THREADS

Grade	SAE GR.5			SAE GR.8		
Unit / Nominal Diameter	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft
5/16	23.1 to 27.7	2.35 to 2.83	17.0 to 20.5	32.6 to 39.3	3.32 to 4.00	24.0 to 29.0
3/ 8	48 to 56	4.9 to 5.8	35.0 to 42.0	61.1 to 73.2	6.23 to 7.46	45.0 to 54.0
1/ 2	109 to 130	11.1 to 13.2	80.0 to 96.0	149.2 to 178.9	15.21 to 18.24	110.0 to 132.0
9/16	149.2 to 178.9	15.21 to 18.24	110.0 to 132.0	217.0 to 260.3	22.12 to 26.54	160.0 to 192.0
5/ 8	203.4 to 244	20.74 to 24.88	150.0 to 180.0	298.3 to 357.9	30.42 to 36.49	220.0 to 264.0

W1022485

[5] PLUGS

Shape	Size	Material of opponent part					
		Ordinariness			Aluminum		
		N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft
Tapered screw 	R1/8	13 to 21	1.3 to 2.2	9.4 to 15	13 to 21	1.3 to 2.0	9.4 to 15
	R1/4	25 to 44	2.5 to 4.5	18 to 32	25 to 34	2.5 to 3.5	18 to 25
	R3/8	49 to 88	5.0 to 9.0	37 to 65	49.0 to 58	5.0 to 6.0	37 to 43
	R1/2	59 to 107	6.0 to 11.0	44 to 79.5	59 to 78	6.0 to 8.0	44 to 57
Straight screw 	G1/4	25 to 34	2.5 to 3.5	18 to 25	–	–	–
	G3/8	62 to 82	6.3 to 8.4	46 to 60	–	–	–
	G1/2	49 to 88	5.0 to 9.0	37 to 65	–	–	–

0000001666E

6. MAINTENANCE CHECK LIST

No.	Items \ Period		Service interval												After since	Reference page		
			50	100	150	200	250	300	350	400	450	500	550	600				
1	Engine oil	Change	★	☆		☆		☆		☆		☆		☆	every 100 Hr	G-17		
2	Engine oil filter	Replace	★			☆				☆				☆	every 200 Hr	G-17		
3	Transmission fluid and rear axle gear case (RH and LH) fluid	Change								★					every 400 Hr	G-20		
4-1	HST transmission oil filter	Replace	★			☆				☆				☆	every 200 Hr	G-18		
4-2	Hydraulic oil filter	Replace	★							☆					every 400 Hr	G-18		
5	Front axle pivot	Adjust		★		☆				☆				☆	every 200 Hr	G-19		
6	Safety device	Check	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	every 50 Hr	G-21		
7	Greasing (without mower)	–	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	every 50 Hr	G-23		
8	Mower gear box oil	Check	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	every 50 Hr	G-25		
		Change			☆			☆			☆			☆	every 150 Hr	G-29		
9	Air cleaner primary element	Clean		☆		☆		☆		☆		☆		☆	every 100 Hr	G-24	*1	@
		Replace													every 1 year	G-31		
10	Battery condition	Check		☆		☆		☆		☆		☆		☆	every 100 Hr	G-25		
11	Fan belt	Adjust		☆		☆		☆		☆		☆		☆	every 100 Hr	G-27		
12	Parking brake	Adjust		☆		☆		☆		☆		☆		☆	every 100 Hr	G-28	*2	
13	Fuel filter element	Check		☆		☆		☆		☆		☆		☆	every 100 Hr	G-27		@
		Replace								☆					every 400 Hr	G-31	*2	
14	Fuel line	Check		☆		☆		☆		☆		☆		☆	every 100 Hr	G-27		@
		Replace													every 2 years	G-34	*2	
15	Radiator hose and clamp	Check				☆				☆				☆	every 200 Hr	G-29		
		Replace													every 2 years	G-34	*2	
16	Hydraulic hose	Check				☆				☆				☆	every 200 Hr	G-30		
		Replace													every 2 years	G-34	*2	

W1037757

No.	Items \ Period		Service interval													Reference page		
			50	100	150	200	250	300	350	400	450	500	550	600	After since			
17	Motion control lever pivot	Adjust				☆				☆				☆	every 200 Hr	G-30		
18	Intake air line	Check				☆				☆				☆	every 200 Hr	G-30		@
		Replace													every 2 years	G-34	*3	
19	Throttle cable	Oil	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	every 50 Hr	G-24		
20	Fuel injection nozzle injection pressure	Check													every 1500 Hr	–		@
21	Injection pump	Check													every 3000 Hr	–		@
22	Radiator	Clean													every 1 year	G-32		
23	Coolant	Change													every 1 year	G-32		
24	Mower gear box oil seal	Replace													every 2 years	G-34	*2	
25	Fuel system	Bleed													Service as required	G-36		
26	Fuse	Replace														G-35		
27	Blade	Replace														G-36		
28	Mower belt	Replace														G-36		

W1025112

■ **IMPORTANT**

- **The jobs indicated by ★ must be done initially.**
  ***1 This maintenance should be done daily more often in dusty condition than in normal conditions. Suggested cleaning interval is every 100 hours in normal conditions.**
  ***2 These items should be serviced by an authorized KUBOTA Dealer, unless the owner has the proper tools and is mechanically proficient.**
- **The items listed above (@ marked) are registered as emission related critical parts by KUBOTA in the U.S.EPA non-road emission regulation. As the engine owner, you are responsible for the performance of the required maintenance on the engine according to the above instruction.**
  Please see the Warranty Statement in detail.

7. CHECK AND MAINTENANCE

CAUTION

- **Be sure to check and service the machine on a flat place with engine shut off, the parking brake on and chock the wheels.**

[1] DAILY CHECK

To prevent trouble from occurring, it is important to know the condition of the machine. Check the following items before starting.

Checking

- Check areas where previous trouble was experienced.
- Walk around the machine.

1. Tire pressure, wear and damage
2. Oil and water leak
3. Engine oil level
4. Transmission fluid level
5. Coolant level in the recovery tank
6. Damage of machine body, tightness of all bolts and nuts
7. Radiator screen
8. Bonnet screen
9. Brake play
10. Air cleaner primary element
11. Fuel level
12. Oiling

- Mower

1. Oil leak
2. Make sure blade cap screws are tight.
3. Check blades for wear or damage.
4. Check all hardware.
5. Make sure all pins are in place.
6. Mower deck cleaning
7. Greasing

- While sitting in the operator's seat,

1. Motion control lever
2. Parking brake

- Turning the key switch **"ON"**

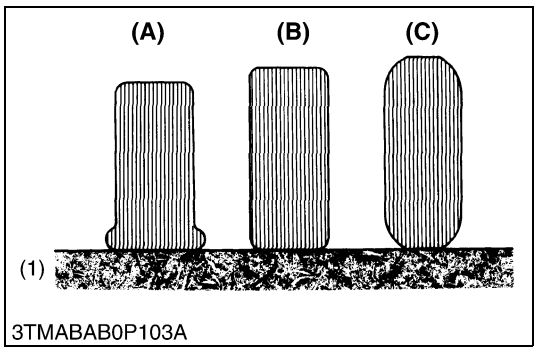
1. Performance of the easy checker light

- Starting the engine,

1. Color of the exhaust fumes
2. Safety start switch, seat safety control and another safety control and another safety devices.
3. Check for abnormal noise and vibration.

- Others

1. Check the areas where previous trouble was experienced.



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Checking Tire Pressure

WARNING

To avoid personal injury:

- **Do not attempt to mount a tire on a rim. This should be done by a qualified person with the proper equipment.**
- **Always maintain the correct tire pressure.**
  Inflation pressure in front tires rises quickly when using compressed air.
  Do not inflate tires above the recommended pressure shown in the Operator's Manual.

■ **IMPORTANT**

- **Do not use tires larger than specified.**

■ **Inflation Pressure**

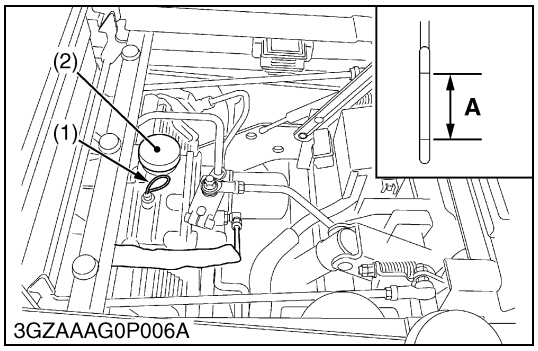
Though the inflation pressure is factory-set to the prescribed level, it naturally drops slowly in the course of time. Thus, check it and inflate as necessary.

	Tire Sizes	Recommended Inflation Pressure
Front	15 × 6.0-6 (Semi-pneumatic Non Flat Tire)	–
	15 × 6.0-6, 4PR Rib	160 kPa (1.6 kgf/cm^2, 23 psi)
Rear	26 × 10.5-12, 4PR Turf	120 kPa (1.2 kgf/cm^2, 17 psi)
	26 × 12.0-12, 4PR Turf	120 kPa (1.2 kgf/cm^2, 17 psi)

(1) Ground

(A) Insufficient
(B) Normal
(C) Excessive

W1041550



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Checking Transmission Fluid Level

1. Park the machine on a flat surface, lower the implement to the ground and shut off engine and remove the key.
2. Raise and lock the operator's seat.
3. To check the oil level, draw out the dipstick, wipe it clean, replace it, and draw it out again. Check to see that the oil level lies between the two notches. If the level is too low, add new oil to the prescribed level at the oil inlet.
   (See page G-7.)

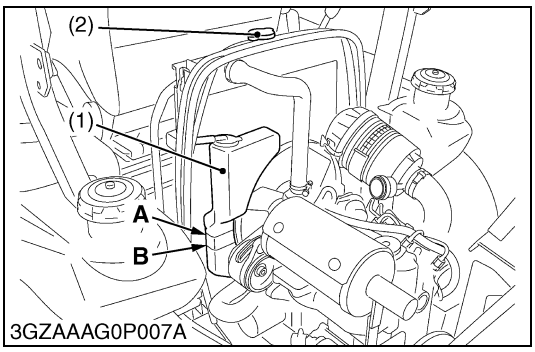
■ **IMPORTANT**

- **If oil level is low, do not run engine.**

(1) Oil Level Dipstick
(2) Oil Plug and Breather Cup

(A) Oil level is acceptable within this range.

W1041984



Checking Coolant Level

CAUTION

To avoid personal injury:

- **Do not remove the radiator cap when the engine is hot. Then loosen cap slightly to the stop to relieve any excess pressure before removing cap completely.**

Check the coolant level daily both the radiator and the recovery tank before staring engine.

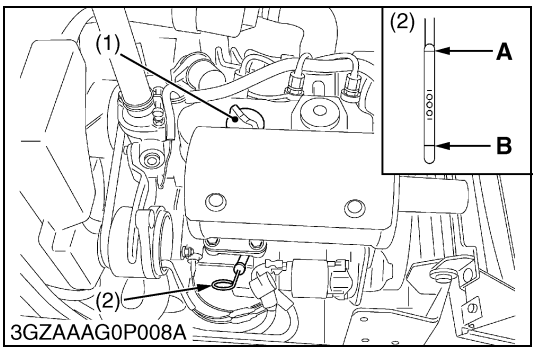
1. Remove the radiator cap and check to see that the coolant level is just below the fill port.
2. Check to see that the coolant level is between the **"FULL"** and **"LOW"** marks of recovery tank.
3. When the coolant level drops due to evaporation, add water only up to just below the fill port of the radiator and the full level of the recovery tank.
   In case of leakage, add anti-freeze and water in the specified mixing ratio up to the full level.
   (See page G-7.)

■ **IMPORTANT**

- **If the radiator cap has to be removed, follow the caution above and securely retighten the cap.**
- **Use clean, distilled water and anti-freeze to fill the recovery tank.**

(1) Recovery Tank — **A : FULL**
(2) Radiator Cap — **B : LOW**

W1042377



Checking Engine Oil Level

CAUTION

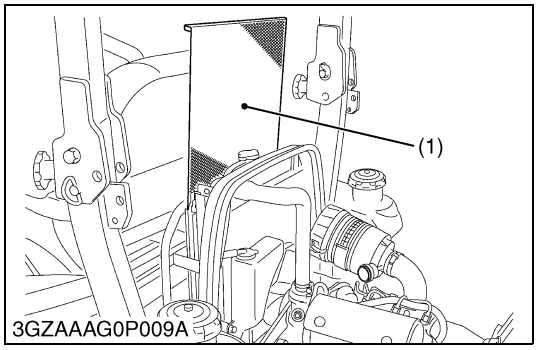
To avoid personal injury:

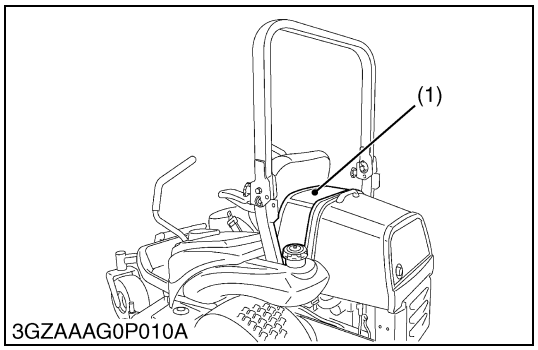
- **Always stop the engine and remove the key before checking oil.**

1. Check engine oil before starting and 5 minutes or more after the engine has stopped.
2. Wipe dipstick area clean.
3. To check the oil level, remove the dipstick, wipe it clean, replace it, and draw it out again. Check to see that the oil level is between the two lines.
4. Add new oil to the prescribed level at the oil port if necessary.
5. When using a different brand or viscosity oil from the previous one, remove all of the old oil and oil filter. Never mix two different types of oil.
6. Use the proper Engine Oil SAE according to the ambient temperatures. (See page G-7.)

(1) Engine Oil Port — **A : Upper Level**
(2) Oil Level Dipstick — **B : Lower Level**

W1042659





Checking and Cleaning Radiator to Prevent Overheating

CAUTION

To avoid personal injury:

- **Be sure to stop the engine and remove the key before cleaning.**

■ **IMPORTANT**

- **The air intake area must be clear of debris to prevent the engine from overheating.**

Daily or after every 5 hours of operation, check to be sure the radiator screen and radiator core are clean. Dirt or chaff on the radiator screen or radiator core decrease cooling performance.

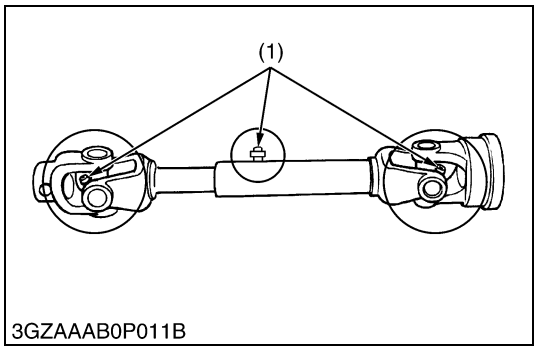
1. Remove the radiator screen and bonnet screen, and remove all foreign material.
2. Remove the dust from between the fins and the tube.
3. Tighten the fan drive belt as necessary. For this, refer to “EVERY 100 HOURS” in Maintenance section.
4. If scale forms in the tube, clean with the scale inhibitor or its equivalent.
5. Each time the panel screen is covered with grass during operation, rub it off the screen with hand. Check the radiator screen from time to time if grass accumulates.
6. If the dust or chaff has accumulated inside of the bonnet, remove the radiator screen and clean inside completely.
   After cleaning, replace the radiator screens properly.

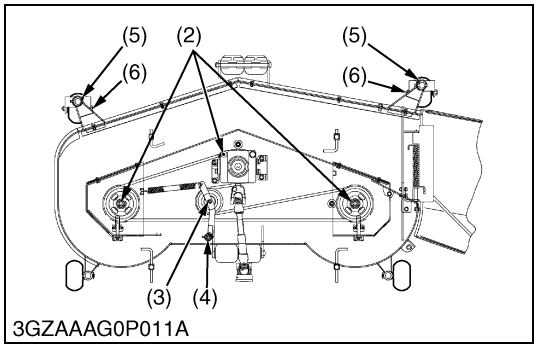
■ **NOTE**

- **When assembling the panel screen, be sure to fit it in the runners.**

(1) Radiator Screen
(2) Bonnet Screen

W1043048





Greasing (Mower)

CAUTION

To avoid personal injury:

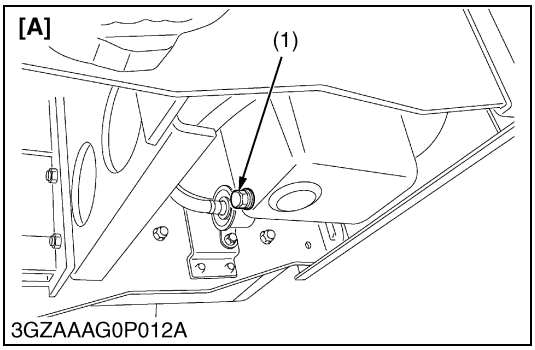
- **Be sure to stop the engine and remove the key before greasing.**

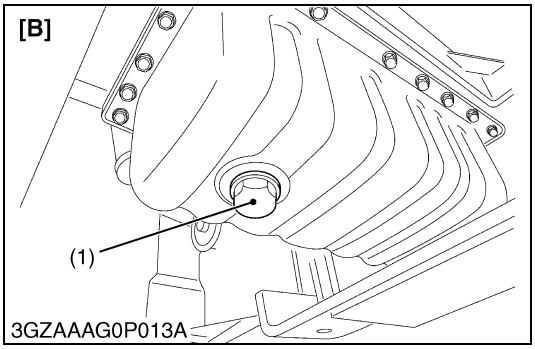
1. Apply grease to the following position as figures.

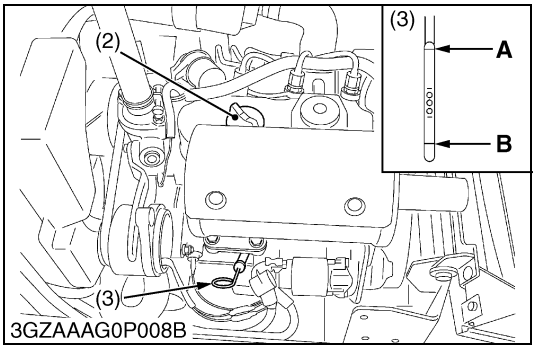
(1) Mower Universal Joint
(2) Spindle Shaft
(3) Belt Tension Pulley
(4) Belt Tension Pivot
(5) Front Side Anti-scalp Bracket
(6) Front Side Anti-scalp Roller

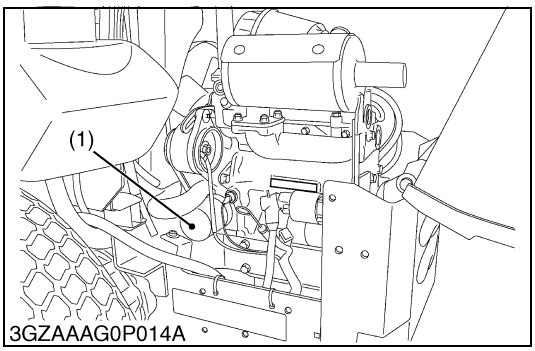
W1043490

[2] CHECK POINTS OF INITIAL 50 HOURS









Changing Engine Oil

CAUTION

- **Be sure to stop the engine before changing oil.**

1. Start and warm up the engine for approx. 5 minutes.
2. Place an oil pan underneath the engine.
3. To change the used oil, remove the drain plug (1) at the bottom of the engine and drain the oil completely.
4. Screw in the drain plug (1).
5. Fill with the new oil up to upper line on the dipstick (3).

■ **IMPORTANT**

- **When using an oil of different manufacture or viscosity from the previous one, remove all of the old oil.**
- **Never mix two different type of oil.**
- **Use the proper SAE engine oil according to ambient temperatures.**
  Refer to "LUBRICANTS, FUEL AND COOLANT".
  (See page G-7.)

Engine oil capacity	ZD321	3.5 L 3.70 U.S.qts 3.08 Imp.qts
	ZD326	3.9 L 4.1 U.S.qts 3.4 Imp.qts
	ZD331	5.7 L 6.0 U.S.qts 5.0 Imp.qts

(1) Drain Plug
(2) Oil Inlet Plug
(3) Dipstick

[A] ZD321
[B] ZD326, ZD331
A : Upper Level
B : Lower Level

W1030749

Replacing Engine Oil Filter Cartridge

CAUTION

- **Be sure to stop the engine before changing the oil filter cartridge.**
- **Allow engine to cool down sufficiently, oil can be hot and may cause burns.**

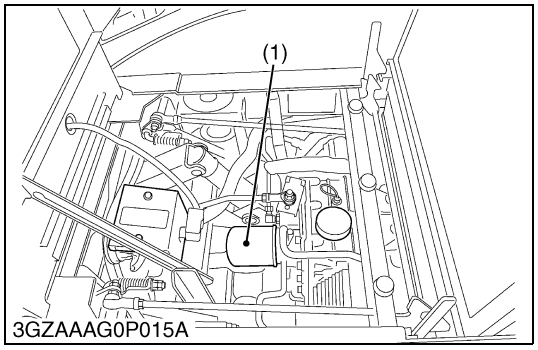
1. Remove the engine oil filter cartridge (1) with the filter wrench.
2. Apply a slight coat of oil onto the rubber gasket of new cartridge.
3. To install the new cartridge, screw it in by hand. Over tightening may cause deformation of rubber gasket.
4. After the cartridge has been replaced, the engine oil level normally lowers a little. Add engine oil to proper level. Check for oil leaks around filter gasket.

■ **IMPORTANT**

- **To prevent serious damage to the engine, element of recommended type must be used. Use only a genuine KUBOTA filter or its equivalent.**

(1) Engine Oil Filter Cartridge

W1030949



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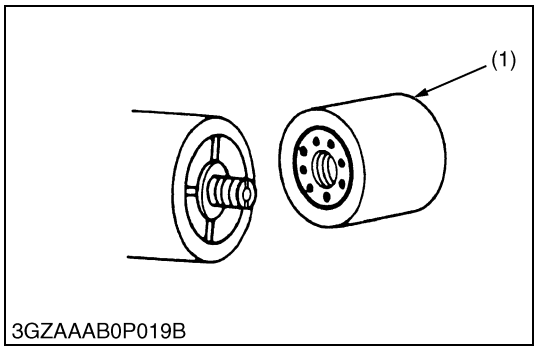

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Replacing HST Transmission Oil Filter Cartridge

CAUTION

- **Be sure to stop the engine before changing the oil filter cartridge.**
- **Allow transmission case to cool down sufficiently; oil can be hot and may cause burns.**

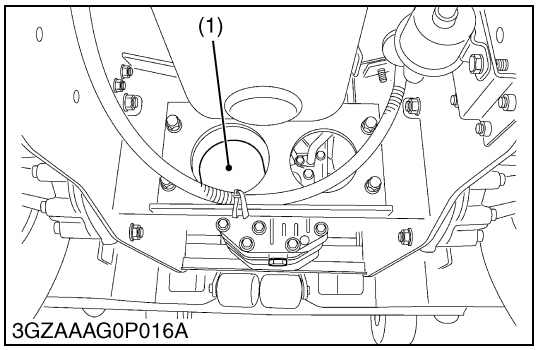
1. The HST transmission oil filter cartridge must be changed every 200 service hours.
2. Place an oil pan underneath the oil filter cartridge. (Do not drain oil.)
3. Remove the oil filter cartridge by using the filter wrench.
4. Apply a slight coat of oil onto the cartridge gasket.
5. Tighten the filter quickly until it contacts the mounting surface. Tighten filter by hand an additional 1/2 turn only.
6. After the new cartridge has been replaced, the transmission fluid level normally lowers a little. Add fluid to proper level. Check for oil leaks around filter gasket.

IMPORTANT

- **To prevent serious damage or premature failure to the hydraulic system, use only a KUBOTA genuine filter.**

(1) HST Transmission Oil Filter Cartridge

W1031068



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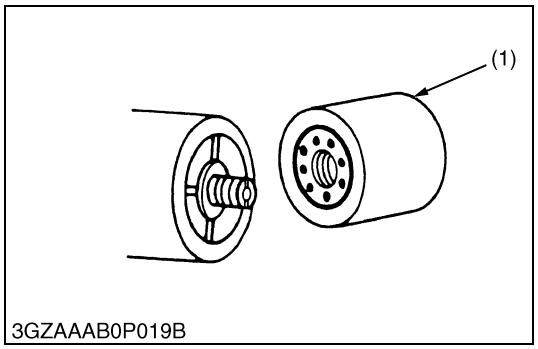

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Replacing Transmission Oil Filter Cartridge

CAUTION

- **Be sure to stop the engine before changing the oil filter cartridge.**
- **Allow transmission case to cool down sufficiently; oil can be hot and may cause burns.**

1. The oil filter cartridge must be changed every 400 service hours.
2. To drain the transmission oil, place oil pan underneath the transmission case and the rear axle gear case (RH and LH) and remove the drain plug at the bottom of the transmission case and the rear axle gear case (RH and LH).
3. After draining, reinstall the drain plugs.
4. Remove the oil filter cartridge by using the filter wrench.
5. Apply a slight coat of oil onto the cartridge gasket.
6. Tighten the filter quickly until it contacts the mounting surface. Tighten filter by hand an additional 1/2 turn only.
7. After the new cartridge has been replaced, the transmission fluid level normally lowers a little. Add fluid to proper level. Check for oil leaks around filter gasket.

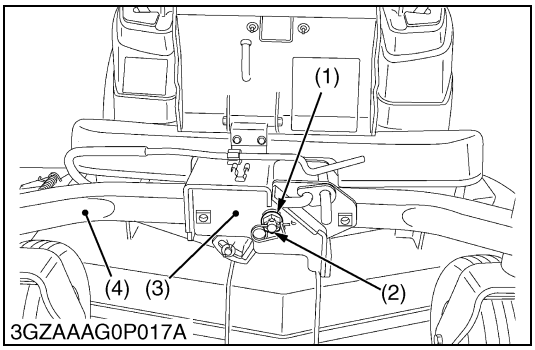
IMPORTANT

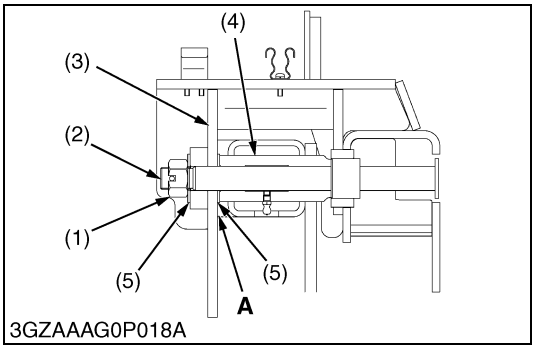
- **To prevent serious damage or premature failure to the hydraulic system, use only a KUBOTA genuine filter.**

(1) Transmission Oil Filter Cartridge

W1051648

[3] CHECK POINT OF INITIAL 100 HOURS





Adjusting Front Axle Pivot

1. Lift up and securely block the front of the machine.
2. Measure the clearance **(A)** between the front axle (4) and front axle support (3).
3. If the measurement exceeds the allowable limit, remove the set spring and adjust the end play by slotted nut (1).

■ **NOTE**

- **When fastening the center pin (2), tighten the nut (1) so that the front axle maybe oscillated smoothly by hand.**

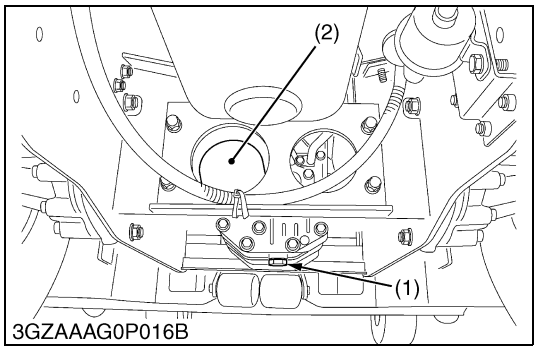
Front axle end play **(A)**	Factory spec.	0 to 0.2 mm 0 to 0.008 in.
	Allowable limit	0.5 mm 0.02 in.

(1) Slotted Nut
(2) Center Pin
(3) Front Axle Support
(4) Front Axle
(5) Plain Washer

(A) Front Axle End Play

W1053511

[4] CHECK POINT OF INITIAL 400 HOURS



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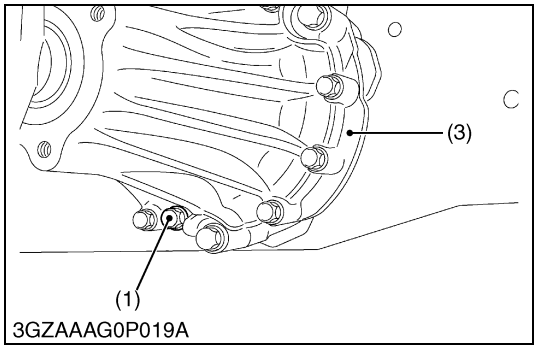

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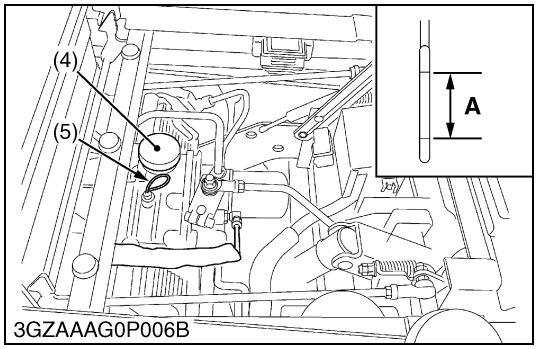

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Changing Transmission Fluid and Rear Axle Gear Case Oil (RH and LH)

CAUTION

To avoid personal injury:

- **Be sure to stop the engine and remove the key before changing or checking the oil.**
- **Allow transmission case to cool down sufficiently; oil can be hot and may cause burns.**

The fluid in the transmission case is also used for the hydrostatic drive system.

1. To drain the transmission oil, place oil pan underneath the transmission case and the rear axle gear case (RH and LH) and remove the drain plug at the bottom of the transmission case and the rear axle gear case (RH and LH).
2. After draining, reinstall the drain plugs.
3. Fill with UDT, SUPER UDT hydrostatic transmission fluid or its equivalent up to the upper line of the gauge.

■ **IMPORTANT**

- **It takes time to have the oil poured from the transmission case reach the rear axle case (RH and LH). Pour the regulated amount of oil slowly.**

4. After running the engine for a few minutes, stop it and check the oil level again; add oil to the prescribed level.

■ **IMPORTANT**

- **Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.**
  Keep the engine at medium speed for a few minutes to insure proper lubrication of all parts so there is no damage to transmission.
- **Use only multi-grade transmission oil. Use of other oils may damage the transmission or hydraulic system.**
  Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-7.)
- **Do not mix different brands oil together.**

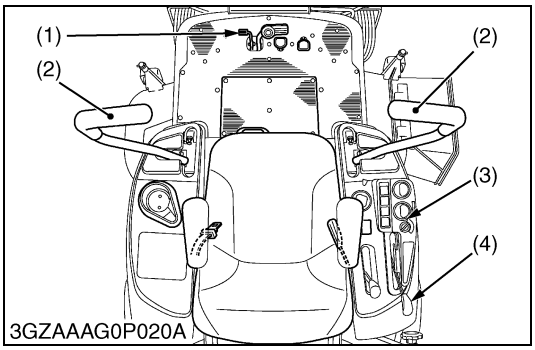
Transmission fluid capacity (with filter and hose)	12.1 L 12.8 U.S.qts 10.6 Imp.qts

(1) Drain Plug
(2) Transmission Oil Filter
(3) Rear Axle Gear Case LH
(4) Oil Plug and Breather Cup
(5) Dipstick

A : Oil level acceptable within this range.

W1048918

[5] CHECK POINTS OF EVERY 50 HOURS



Checking Safety Device

CAUTION

To avoid personal injury:

- **Do not allow anyone near the machine while testing.**
- **If the machine does not pass one of the following tests, do not operate the machine.**
- **Sit on operator's seat for all tests except for Test 1.**

■ **Test 1 (OPERATOR NOT ON THE SEAT)**

1. Securely set the parking brake.
2. Shift the PTO lever (4) to **"DISENGAGE" (OFF)** position.
3. Set the motion control levers (3) to the **"NEUTRAL LOCK"** position.
4. Turn the key switch (3) to **"START"** position.
5. The engine must not crank.

■ **Test 2 (OPERATOR ON THE SEAT)**

1. Do not set the parking brake. (Release it from test 1.)
2. Shift the PTO lever (4) to **"DISENGAGE" (OFF)** position.
3. Set the motion control levers (2) to the **"NEUTRAL LOCK"** position.
4. Turn the key switch (3) to **"START"** position.
5. The engine must not crank.

■ **Test 3 (OPERATOR ON THE SEAT)**

1. Securely set the parking brake.
2. Shift the PTO lever (4) to **"DISENGAGE" (OFF)** position.
3. Grasp the motion control levers (2) and move then inward from **"NEUTRAL LOCK"** position to **"NEUTRAL"** position and then release the levers.
4. Turn the key switch (3) to **"START"** position.
5. The engine must not crank.

■ **Test 4 (OPERATOR ON THE SEAT)**

1. Securely set the parking brake.
2. Shift the PTO lever (4) to **"ENGAGE" (ON)** position.
3. Grasp the motion control levers (2) to the **"NEUTRAL LOCK"** position to **"NEUTRAL"** position.
4. Turn the key switch (3) to **"START"** position.
5. The engine must not crank.

■ **Test 5 (OPERATOR ON THE SEAT)**

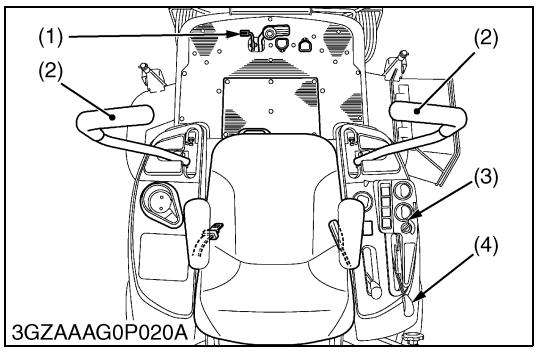
1. Start the engine.
2. Keeps the parking brake securely set.
3. Shift the PTO lever (4) to **"DISENGAGE" (OFF)** position.
4. Grasp the motion control levers (2) and move then inward from **"NEUTRAL LOCK"** position to **"NEUTRAL"** position and then release the levers.
5. The engine must shut off after a short time delay.

■ **IMPORTANT**

- **For this test only, the engine will shut off in a few seconds.**

(1) Parking Brake Lock Pedal
(2) Motion Control Lever
(3) Key Switch
(4) PTO Lever

W1050412



■ **Test 6 (OPERATOR ON THE SEAT)**

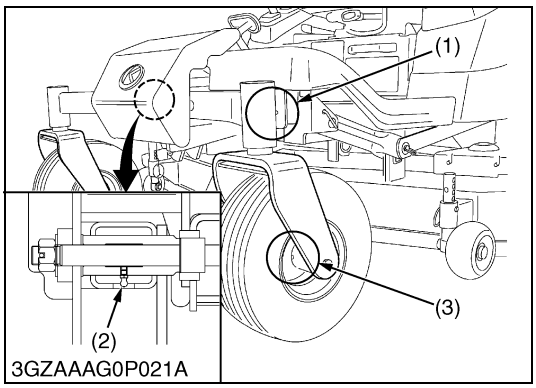
1. Start the engine.
2. Do not set the parking brake.
3. Shift the PTO lever (4) to **"DISENGAGE" (OFF)** position.
4. Grasp the motion control levers (2) and move then inward from **"NEUTRAL LOCK"** position to **"NEUTRAL"** position and then release the levers.
5. Stand up. (Do not get off the machine.)
6. The engine must shut off.

■ **Test 7 (OPERATOR ON THE SEAT)**

1. Start the engine.
2. Do not set the parking brake.
3. Shift the PTO lever (4) to **"ENGAGE" (ON)** position.
4. Stand up. (Do not get off the machine.)
5. The engine must shut off.

(1) Parking Brake Lock Pedal
(2) Motion Control Lever
(3) Key Switch
(4) PTO Lever

W1032761



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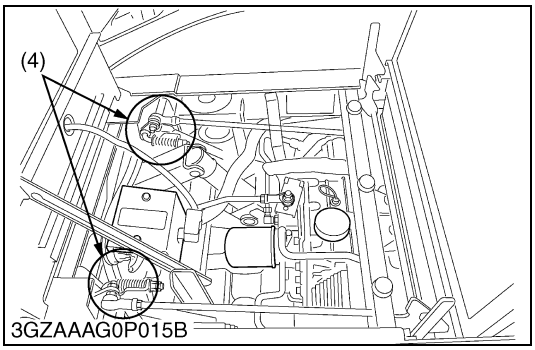

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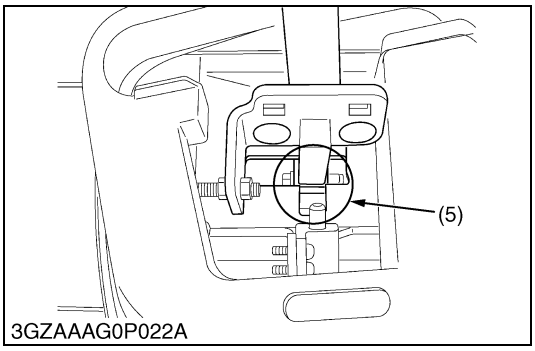

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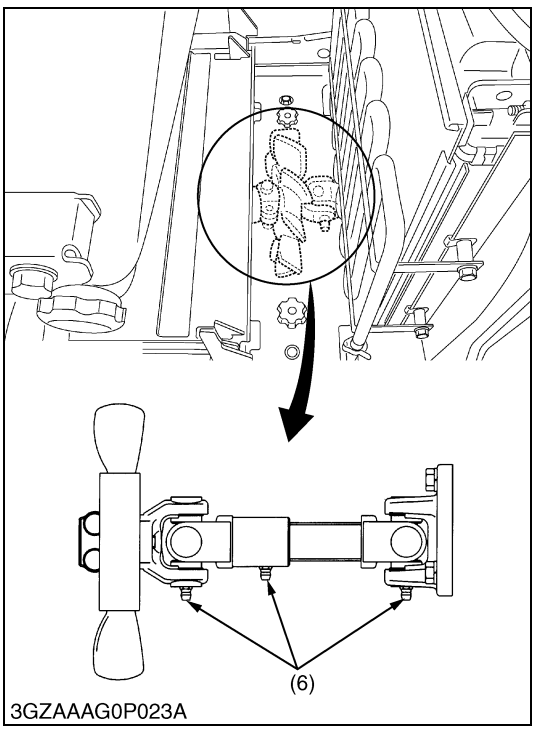

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Greasing

1. Apply a grease to the following position as figures.

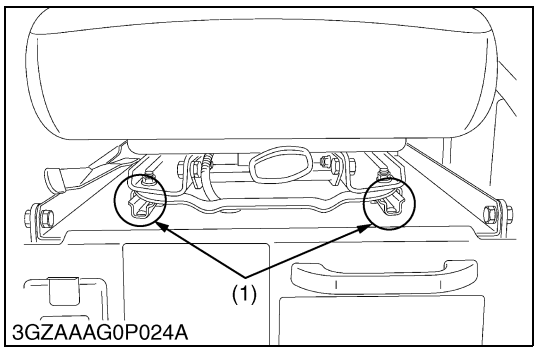
CAUTION

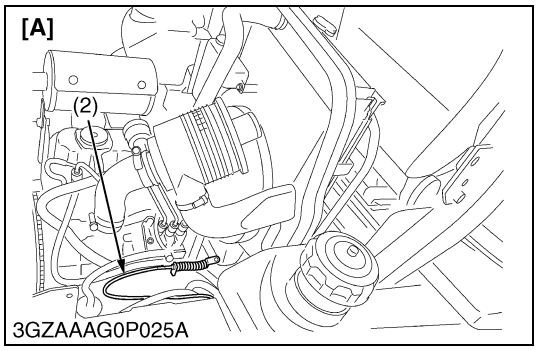
To avoid personal injury:

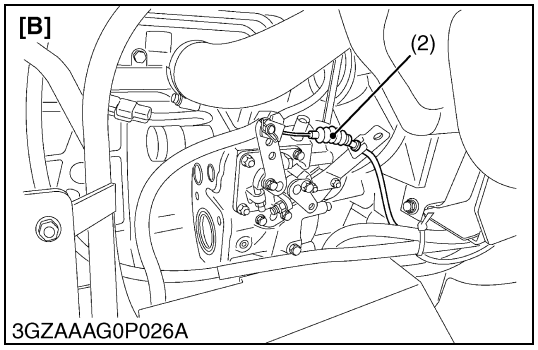
- **Be sure to stop the engine and remove the key before greasing.**

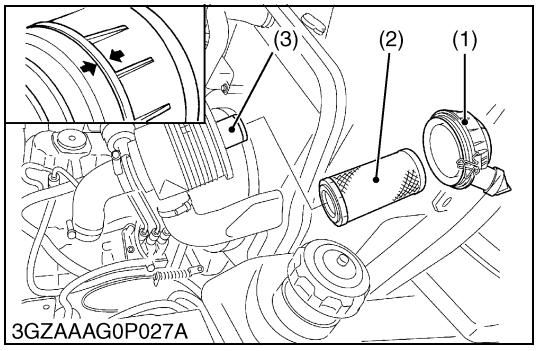
(1) King Pin (LH · RH)
(2) Center Pin
(3) Front Wheel (LH · RH)
(4) Motion Control Lever Pivot Bushing (LH · RH)
(5) Motion Control Levers (LH · RH)
(6) Machine Universal Joint

W1034228









Greasing (Continued)

1. Apply a grease to the following position as figures.

CAUTION

To avoid personal injury:

- **Be sure to stop the engine and remove the key before greasing.**

(1) Seat Adjuster
(2) Throttle Cable (Oil)

[A] ZD321
[B] ZD326, ZD331

W1035206

Cleaning Air Cleaner Element

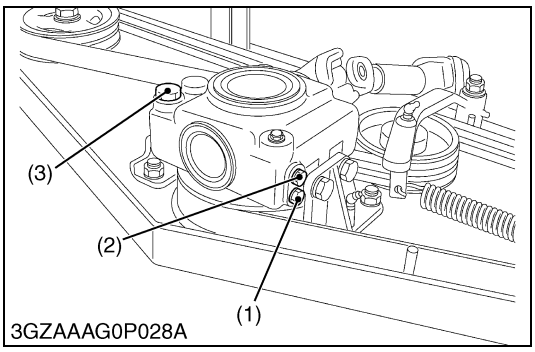
1. The air cleaner uses a dry element, never apply oil.
2. Do not touch the filter element except where cleaning is required. To clean the element, use clean and dry compressed air on the inside of the element. Air pressure should not exceed 205 kPa (2.1 kgf/cm^2, 30 psi).

■ **NOTE**

- **Operating in dusty conditions requires more frequent maintenance.**
- **Align the arrow marks when reinstalling the air cleaner cover.**

(1) Air Cleaner Cover
(2) Air Cleaner Primary Element
(3) Air Cleaner Core

W1053698



Checking Gear Box Oil Level

CAUTION

To avoid personal injury:

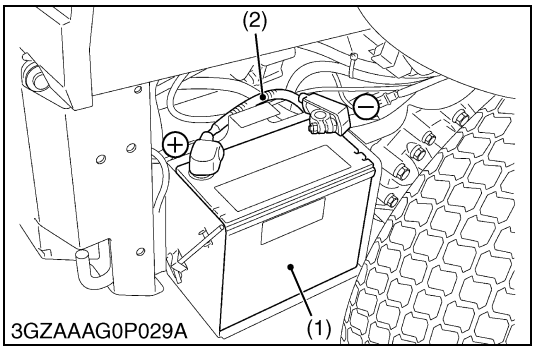
- **Always stop the engine and remove the key before checking oil.**

1. Park the machine on a flat surface and lower the mower to the ground.
   To check the oil level, loosen check plug bolt and check to see that the oil level is just below the check plug port.
   If the level is too low, add new oil to the prescribed level at the oil inlet.
   (See page G-7.)

(1) Drain Plug (Bolt)
(2) Check Plug (Bolt)
(3) Oil Filler Plug

W1054012

[6] CHECK POINTS OF EVERY 100 HOURS



Checking Battery Condition

CAUTION

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

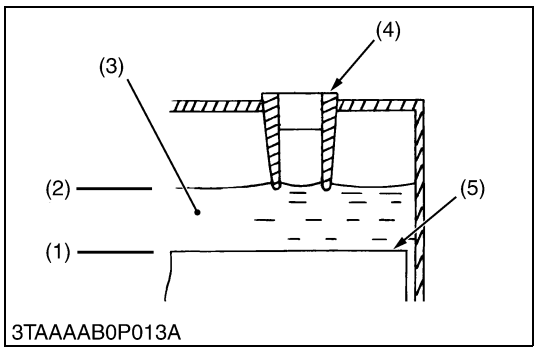
Mishandling the battery shortens the service life and adds to maintenance costs.

The original battery is a maintenance-free, non accessible type battery.

If the battery is weak, the engine will be difficult to start and the lights will become dim. It is important to check the battery periodically.

(1) Battery
(2) Ground Cable

W1083097



■ Battery Charging

DANGER

To avoid serious injury or death:

- **When the battery is being activated, hydrogen and oxygen gases in the battery are extremely explosive. Keep open sparks and flames away from the battery at all times, especially when charging the battery.**

CAUTION

- **When charging battery, ensure that the vent caps are securely in place (if equipped).**
- **When disconnecting the cables from the battery, start with the negative terminal first.**
  When connecting the cables to the battery, start with the positive terminal first.
- **Never check battery charge by placing a metal object across the posts.**
  Use a voltmeter or hydrometer.
  (For accessible maintainable type batteries with removable vent caps.)

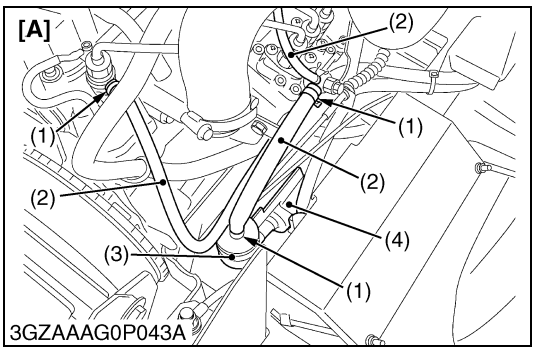
1. Make sure each electrolyte level is at the bottom of vent wells, if necessary add distilled water in a well-ventilated area.
2. The water in the electrolyte evaporates during recharging. Liquid shortage damages the battery. Excessive liquid spills over and damages the machine body.
3. To slow charge the battery, connect the battery positive terminal to the charger positive terminal and the negative to the negative, then recharge in the standard fashion.
4. A boost charge is only for emergencies. It will partially charge the battery at a higher rate and in a short time.
   When using a boost-charged battery, it is necessary to recharge the battery as soon as possible.
   Failure to do this will shorten the battery's service life.
5. When the specific gravity of electrolyte reaches 1.27 to 1.29, charge has completed.
6. When exchanging an old battery with new one, use a battery of equal specification shown in "SPECIFICATIONS".
   (For non-accessible maintenance-free type batteries.)
   Maintenance-free, non-accessible batteries are designed to eliminate the need to add water. Yet the volume of electrolyte above plates may eventually become depleted due to abnormal conditions such as high heat or improper regulator setting. Use a voltmeter to check the state of charge. (See reference chart to determine if charging is necessary.)

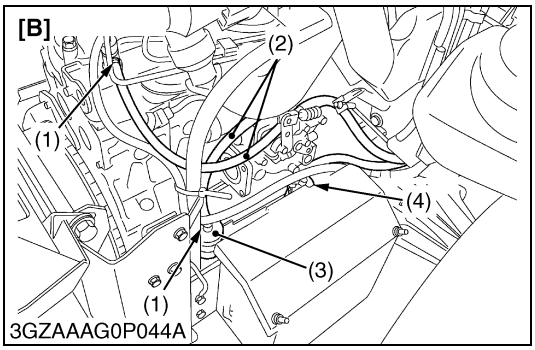
Battery voltage	Reference state of charge
12.6	100 % (Full charge)
12.4	75 %
12.2	50 %
12.0	25 %
11.8	0 %

(1) Vent well
(2) Separator
(3) Electrolyte

(A) Highest Level
(B) Lowest Level

W1035046





Checking Fuel Lines and Fuel Filter

CAUTION

- **Be sure to stop the engine and remove the key when attempting to make the following checks and changes.**
- **Never fail to check the fuel lines periodically. The fuel lines are subject to wear and age. Fuel may leak out onto the running engine, causing a fire.**

The fuel line connections should be checked annually or every 100 service hours, whichever comes first.

1. The fuel lines is made of rubber and ages regardless of service period.
2. If the fuel line and clamps are found damages or deteriorated, replace them.
3. Check fuel filter, if it is clogged by debris, and replace it.

IMPORTANT

- **When the fuel line is disconnected for maintenance or repair, close both ends of the fuel line with a piece of clean cloth or paper to prevent dust and dirt from entering. In addition, particular care must be taken not to admit dust and dirt into the fuel pump. Entrance of dust and dirt causes malfunction of the fuel pump and injector components.**

(1) Pipe Clamps
(2) Fuel Line
(3) Fuel Filter
(4) Fuel Pump

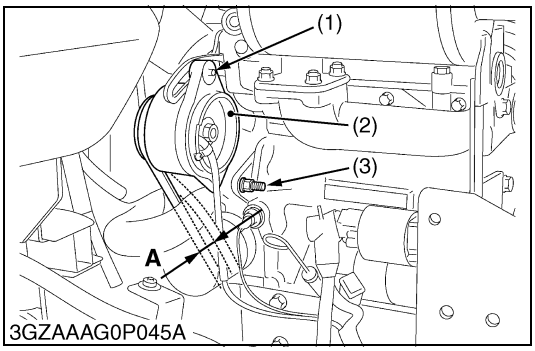
[A] ZD321
[B] ZD326, ZD331

W1034725

Changing Engine Oil

1. See page G-16.

W1034674



Adjusting Fan Belt Tension

CAUTION

- **Be sure to stop the engine and remove the key before checking belt tension.**

1. If the fan drive belt becomes loose, the engine may overheat.
2. To adjust, loosen bolts and turn the alternator to tighten the belt.
3. After adjustment, securely tighten the bolts.

Moderate belt tension:

The belt deflect approx. 10 mm (0.4 in.) when the center of the belt is depressed with finger pressure of 98 N (10 kgf, 22 lbf).

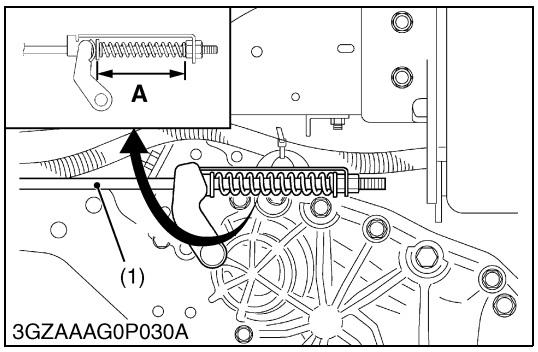
Fan belt tension **(A)**	Factory spec.	Approx. 10 mm 0.4 in.

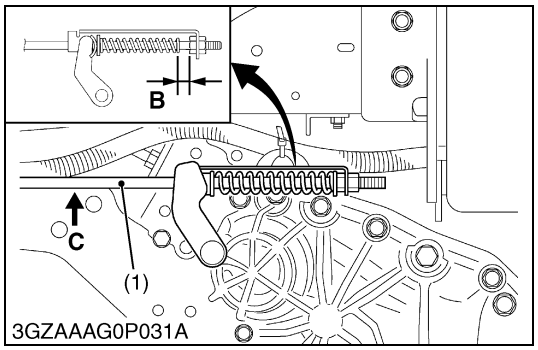
IMPORTANT

- **When replacing fan belt, be careful not to catch it on the cap under the water pump. See the illustration to the left.**

(1) Tension bolt
(2) Alternator
(3) Adjustment bolt

W1037821





Checking Parking Brake

CAUTION

To avoid personal injury:

- **Park the machine on a hard and level surface.**
- **Stop the engine and chock the wheels before checking or adjusting.**

■ **IMPORTANT**

- **Wrong adjustment may cause machine damage.**

■ **Check brake spring**

1. Place the motion control levers to **"NEUTRAL LOCK"** position.
2. Be sure to chock the rear wheels.
3. Apply the parking brake to the lock position.
4. Check the length of the brake springs on both sides.
5. Release the parking brake completely.
6. Hold the brake rod lightly.
7. Check the brake spring play.
8. If these dimensions are not correct, adjust them.

Proper brake spring length with the brake applied to the lock position (**A**)	Factory spec.	115 to 117 mm 4.53 to 4.61 in.

Proper brake spring play (**B**)	Factory spec.	The spring must have play Reference : 0.5 to 1.0 mm 0.02 to 0.04 in.

■ **Adjustment of brake spring play**

1. Place the motion control lever to the **"NEUTRAL LOCK"** position.
2. Be sure to chock the rear wheels.
3. Release the parking brake completely.
4. Loosen the lock nuts.
5. Hold the brake rod by hand.
6. Tighten the nut to the correct space between the end of the spring and the nut.
7. Lock the nuts.
8. Adjust the other side spring to the same dimension.

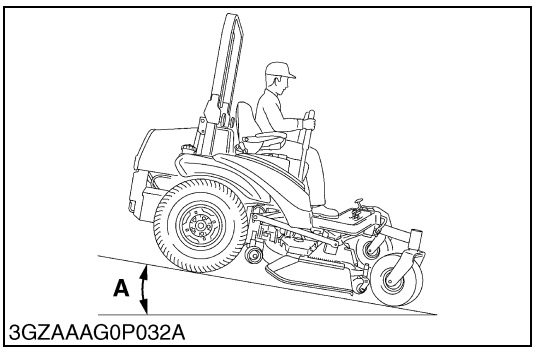
■ **Adjustment of brake length**

1. Place the motion control lever to the **"NEUTRAL LOCK"** position.
2. Apply the parking brake to the lock position.
3. Loosen the lock nuts.
4. Adjust the spring length to the recommendation.
5. Lock the nuts.
6. Check the brake spring play to the recommendation. If there is no play, adjust the brake spring play again.
7. Adjust the other side spring to the same dimension.

(1) Brake Rod

A : Parking Brake Spring Length
B : Parking Brake Spring Play
C : Hold the Brake Rod

W1059278



■ **Check on the slope**
1. Place the machine on a 17° ramp.
2. Apply the parking brake.
3. Place the motion control levers in **"NEUTRAL LOCK"** position and shut off the engine.
4. Check that the machine does not move.

■ **NOTE**
- **For parking brake test purposes only use 17° ramp.**

(1) Lock Nut
(2) Bolt
(A) Under 17° Ramp

W1037508

[7] CHECK POINTS OF EVERY 150 HOURS

Changing Mower Gear Box Oil

1. See page G-25.

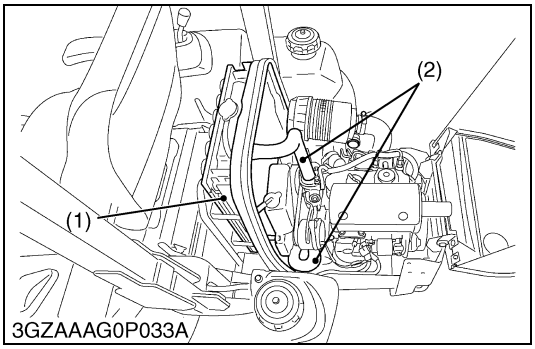
W1036280

[8] CHECK POINTS OF EVERY 200 HOURS

Adjusting Front Axle Pivot

1. See page G-19.

W1064227



Checking Radiator Hose and Clamp

■ **NOTE**
- **Check to see if the radiator hoses are properly fixed every 200 hours of operation or 6 months, whichever comes first.**

1. If clamp bands are loose or water leaks, tighten clamp band securely.
2. Replace radiator hoses (2) and tighten hose clamps securely, if radiator hoses (2) are swollen, hardened or cracked.

■ **NOTE**
- **Take the following actions in the event the coolant temperature be nearly or more than the boiling point, what is called "Overheating".**
- **Park the machine in a safe place and keep the engine unloaded idling.**
- **Do not stop the engine suddenly, but stop it after about 5 minutes of unloaded idling**
- **Keep yourself well away from the machine for further 10 minutes or while the steam is blown out.**
- **Checking that there gets no danger such as burning, get rid of the causes of overheating and then start the engine again.**

(1) Radiator Core
(2) Radiator Hose

W1036392

Changing Engine Oil Filter Cartridge

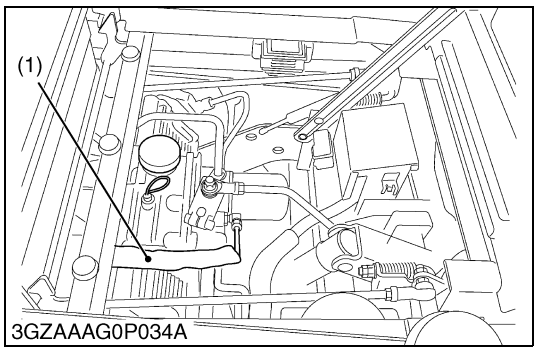
1. See page G-17.

W1061492

Changing HST Transmission Oil Filter Cartridge

1. See page G-18.

W1052031



Checking Hydraulic Hose

CAUTION

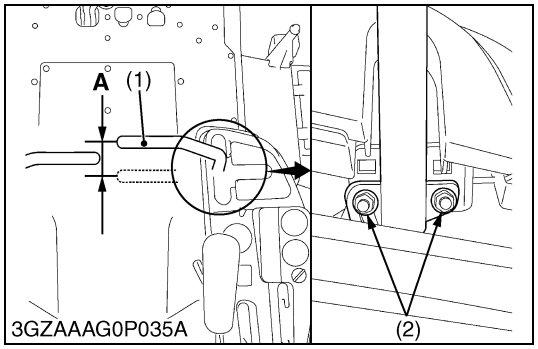
To avoid personal injury:

- **Be sure to stop the engine and remove the key before checking and replacing hydraulic hose.**
- **Allow transmission case to cool down sufficiently; oil can be hot and may cause burns.**

1. Check to see the hose is tight and not damaged.
2. If the worn or damaged of the hose is found, replace it.

(1) Mower Lift Cylinder Hose

W1036641



Adjusting the Motion Control Lever Pivot

CAUTION

To avoid personal injury:

- **Be sure to stop the engine and set the parking brake to "ON" before checking.**

Lever free travel **(A)**	Factory spec.	2 to 15 mm 0.08 to 0.59 in.

1. Set the motion control lever (1) in the **"NEUTRAL"** position.
2. Slightly move the lever back and forth and measure the free travel at the top of lever stroke.
3. If the free travel limits are exceeded, remove the fender and retighten the nut (3) to specified torque.

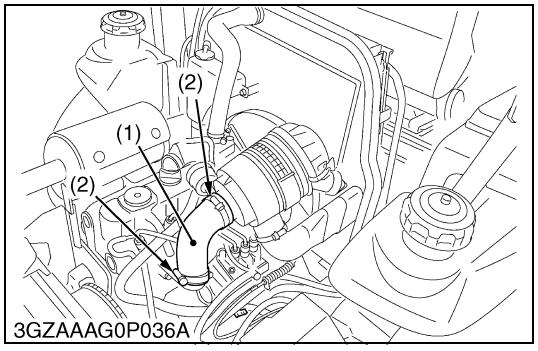
■ **NOTE**

- **If the motion control lever pivot bolt (2) is maladjusted, speed control may be difficult.**

Tightening torque	Pivot bolt	18.6 to 20.6 N·m 1.9 to 2.1 kgf·m 13.7 to 15.2 lbf·ft

(1) Motion Control Lever
(2) Bolt
(3) Nut
(A) Free Travel

W1063124



Checking Intake Air Line

1. Check to see that hoses and hose clamps are tight and not damaged.
2. If hoses and clamps are found worn or damaged, replace or repair them at once.

(1) Hose
(2) Clamp

W1037686

[9] CHECK POINT OF EVERY 400 HOURS

Replacing Fuel Filter

1. See page G-27.

W1040109

Replacing Transmission Oil Filter Cartridge

1. See page G-18.

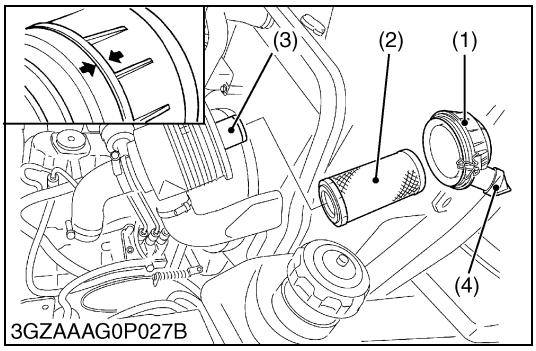
W1061793

Changing Transmission Fluid and Rear Axle Gear Case Oil (RH and LH)

1. See page G-20.

W1049489

[10] CHECK POINTS OF EVERY 1 YEAR



Replacing Air Cleaner Element (Primary and Core)

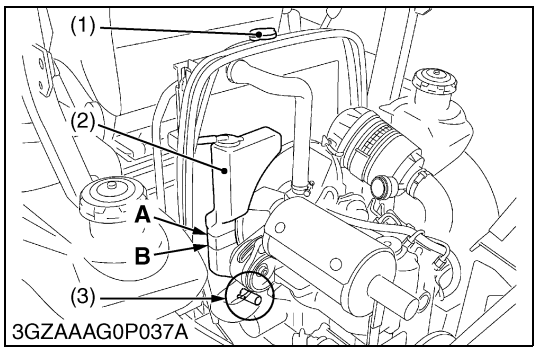
1. Remove the air cleaner element (2) once a year.

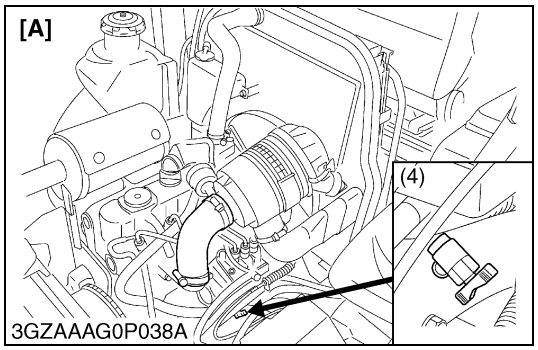
■ **IMPORTANT**

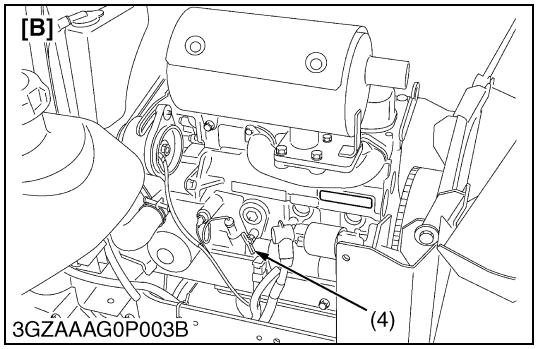
- **The air cleaner uses a dry element, never apply oil.**
- **Do not run the engine with filter element removed.**
- **Be sure to refit the air cleaner cover (1) as shown in the figure. If the air cleaner cover (1) is improperly fitted, evacuator valve (4) will not function and dust will adhere to the element.**
- **If it is loose, dust and dirt may be sucked in, wearing down the cylinder and piston rings earlier and thereby resulting in poor power output.**

(1) Air Cleaner Cover
(2) Air Cleaner Primary Element
(3) Air Cleaner Core
(4) Evacuator Valve

W1037268







Flushing Cooling System and Changing Coolant

CAUTION

- **Do not remove the radiator cap when the engine is hot. Then loosen cap slightly to the stop to relieve any excess pressure before removing cap completely.**

1. Stop the engine and let cool down.
2. To drain the coolant, open the radiator drain cock (4) and remove the radiator drain plug (3) and remove the radiator cap (1). The radiator cap (1) must be removed to completely drain the coolant.
3. After all coolant is drained, close the drain cock (4) and install the drain plug (3).
4. Fill with clean water and cooling system cleaner.
5. Follow directions of the cleaner instruction.
6. After flushing, fill with clean water and anti-freeze until the coolant level is just below the fill port on the radiator. Install the radiator cap (1) securely.
7. Fill with coolant up to the **"FULL"** mark on the recovery tank.
8. Start and operate the engine for a few minutes.
9. Stop the engine and let cool. Check coolant level of recovery tank (2) and add coolant if necessary.

■ **IMPORTANT**

- **Do not start engine without coolant.**
- **Use clean, fresh water and anti-freeze to fill the radiator and recovery tank.**
- **When the anti-freeze is mixed with water, the anti-freeze mixing ratio must be less than 50 %.**
- **Securely tighten radiator cap. If the cap is loose or improperly fitted, water may leak out and the engine could overheat.**
- **Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-7.)**

Coolant capacity	Cooling system	ZD321 ZD326	2.6 L 2.7 U.S.qts 2.3 Imp.qts
		ZD331	3.8 L 4.0 U.S.qts 3.3 Imp.qts
	Recovery tank	ZD321 ZD326 ZD331	0.25 L 0.26 U.S.qts 0.22 Imp.qts

(1) Radiator Cap
(2) Recovery Tank
(3) Drain Plug
(4) Drain Cock

[A] ZD321
[B] ZD326, ZD331
A: FULL
B: LOW

W1037402

Flushing Cooling System and Changing Coolant (Continued)

■ **Anti-Freeze**

If coolant freezes, the cylinders and radiator can be damaged. It is necessary, if the ambient temperature falls below 0 °C (32 °F), to remove coolant mix it with anti-freeze and full the radiator with it.

1. There are two types of anti-freeze available; use the permanent type (PT) for this engine.
2. Before adding anti-freeze for the first time, clean the radiator interior by pouring fresh water and draining it a few times.
3. The procedure for mixing of water and anti-freeze differs according to the maker of the anti-freeze and the ambient temperature, basically should be referred to SAE J1034, more specially also to SAE J814c.
4. Mix the anti-freeze with water, and then fill in to the radiator.

Vol % Anti-freeze	Freezing Point		Boiling Point*	
	°C	°F	°C	°F
40	– 24	– 12	106	222
50	– 37	– 34	108	226

* At 101 kPa (760 mmHg) pressure (atmospheric). A higher boiling point is obtained by using a radiator pressure cap which permits the development of pressure within the cooling system.

■ **NOTE**

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

W1037674

[11] CHECK POINT OF EVERY 2 YEARS

Replacing Hydraulic Hose

1. Replace the hose.
   Refer to “Checking Hydraulic Hose”. (See page G-30.)

W1067327

Replacing Radiator Hose

1. Replace the hoses and clamps.
   Refer to “Checking Radiator Hose and Hose Clamp”. (See page G-29.)

W1067436

Replacing Fuel Lines

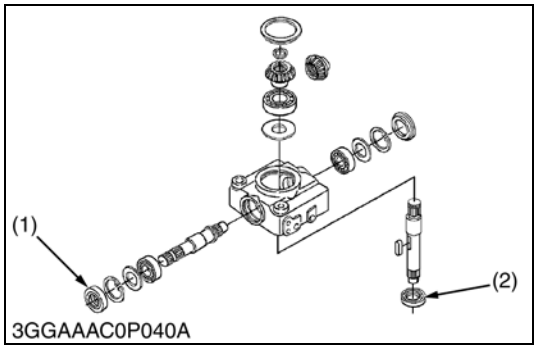
1. Replace the fuel line.
   Refer to “Checking Fuel Lines and Fuel Filter”. (See page G-27.)

W1082371

Replacing Intake Air Line

1. Replace the intake air line.
   Refer to “Checking Intake Air Line”. (See page G-30.)

W1052932



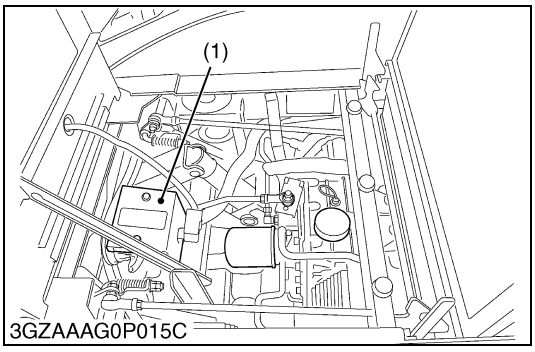
Replacing Mower Gear Box Seals

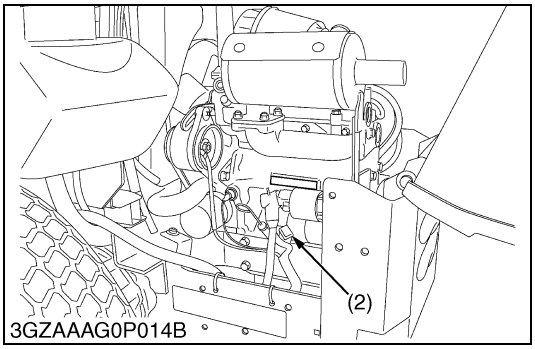
1. Replace the mower gear box oil seals (1), (2).
   Refer to “Disassembling Gear Box Assembly”. (See page 6-S8.)

(1) Oil Seal (2) Oil Seal

W1038357

[12] OTHERS





Replacing Fuses

1. The electrical system is protected from potential damage by fuses.
   A blown fuse indicates that there is an overload or short somewhere in the electrical system.
2. If any of the fuses should blow, replace with a new one of the same capacity.

■ **IMPORTANT**

- **Before replacing a blown fuse, determine why the fuse blew and make any necessary repairs. Failure to follow this procedure may result in serious damage to the electrical system.**

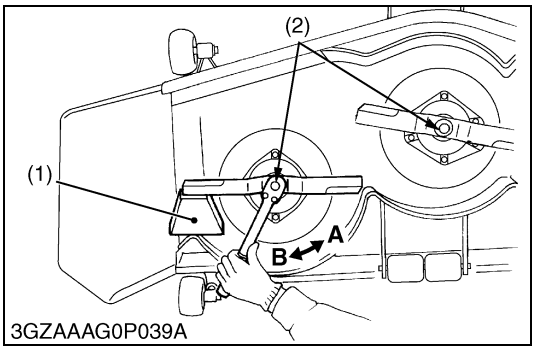
■ **Protected Circuit**

FUSE NO. (ID LABEL)	CAPACITY (A)	Protected circuit
1	20A	Engine stop
	15A	Charge system
	15A	Main system
	15A	Aux. outlet
	10A	Control system
	(20A)	*(Work light)
2	Slow blow fuse 40 A	Check circuit against wrong battery connection

*Option : The fuse should be in only when the work light is attached.

(1) Fuse Location (2) Slow Blow Fuse

W1038470



Retightening Mower Blade Screw

CAUTION

- **To avoid injury, always handle the mower blade with care.**

1. Tilt up the mower and turn it over to expose the mower blades.
2. Wedge a wooden block (1) securely between the mower blade and mower deck.
3. Retighten the mower blade screw to the specified torque.
4. If the mower blade screw (2) is worn or broken, replace it.

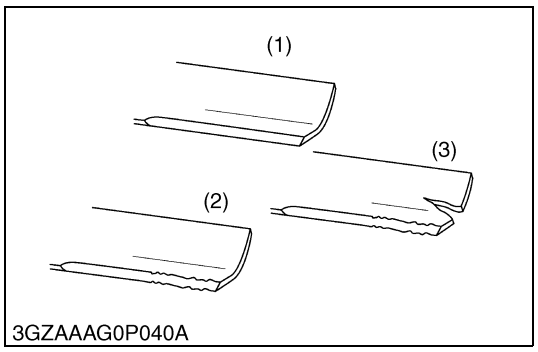
■ **NOTE**

- **The screw of the red-painted mower blade is of inverse helical type.**

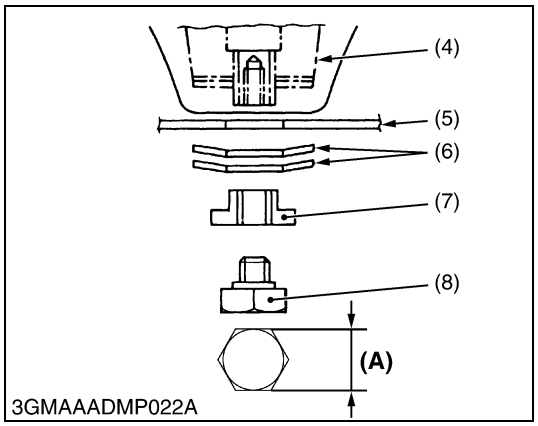
Tightening torque	Mower blade screw	98.0 to 117.6 N·m 10.0 to 12.0 kgf·m 72.0 to 86.8 lbf·ft

(1) Wooden Block **A : Loosen**
(2) Mower Blade Screw **B : Tighten**

W1022525



3GZAAAG0P040A



3GMAAADMP022A

Checking Mower Blade and Replacing Mower Blade

1. Check the cutting edge of mower blade.
2. Sharpen the cutting edges, if the mower blades are as shown in figure (2).
3. Replace the mower blades, if they are as shown in figure (3).

■ **NOTE**

- **To sharpen the mower blades by yourself, clamp the mower blade securely in a vise and use a large mill file along the original bevel.**
- **To balance the mower blade, place a small rod through the center hole and check to see if the blade balances evenly. File heavy side of the blade until it balance out even.**

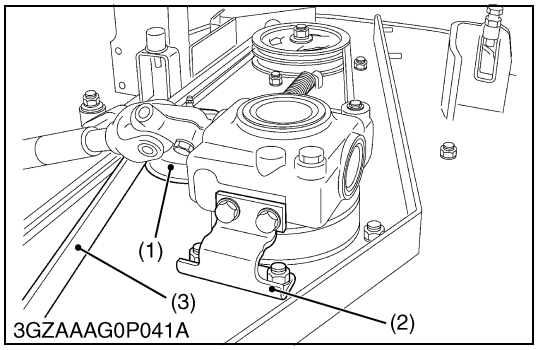
4. Tilt up the mower deck.
5. Wedge a wooden block securely between the mower blade and mower deck or use a box wrench over the pulley nut to prevent the spindle from rotating while removing the blade bolts; then loosen the blade bolts.
6. Pass the spline boss through the blade (5) and 2 cup washers (6), and tighten the bolt (8).

■ **NOTE**

- **Make sure that the cup washer is not flattened out or worn; this cause blade to slip excessively.**
  Replace the 2 cup washers if either is damaged.

(1) New Blade
(2) Worn Blade
(3) Cracked Blade
(4) Spindle Holder
(5) Blade
(6) 2 Cup Washers
(7) Lock Washer
(8) Bolt
(A) 30 mm (1-3/16 in.)

W1022841



3GZAAAG0P041A

Replacing Mower Belt

1. Remove the mower deck from the machine.
2. Remove the left and right hand shield from the mower deck.
3. Clean around the gear box.
4. Remove the belt from the tension pulley.
5. Remove the right hand bracket which mounts the gear box to the mower deck and slip the belt over the top of the gear box.
6. To install a new belt, reverse the above procedure.

Tightening torque	Bracket mounting screw	27.6 to 90.2 N·m 8.0 to 9.2 kgf·m 57.1 to 66.5 lbf·ft

(1) Tension Pulley
(2) Bracket (RH)
(3) Belt

W1069194

Bleeding Fuel System

Air must be removed:

1. When the fuel filter or lines are removed.
2. When tank is completely empty.
3. After the tractor has not been used for a long period of time.

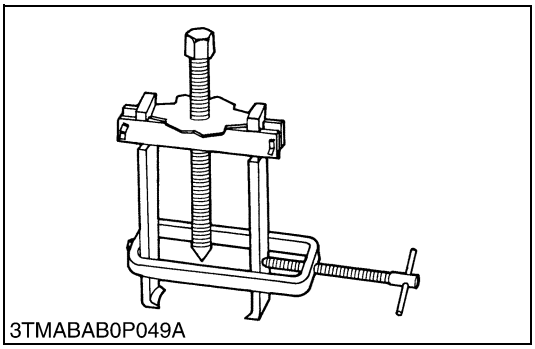
Bleeding procedure is as follows:

1. Fill the fuel tank with fuel.
2. Turn the key switch to **"ON"** position for about 30 seconds. Doing so allows fuel pump to work and pump air out of the fuel system.
3. Start the engine and run for about 30 seconds, and then stop the engine.

W1069400

8. SPECIAL TOOLS

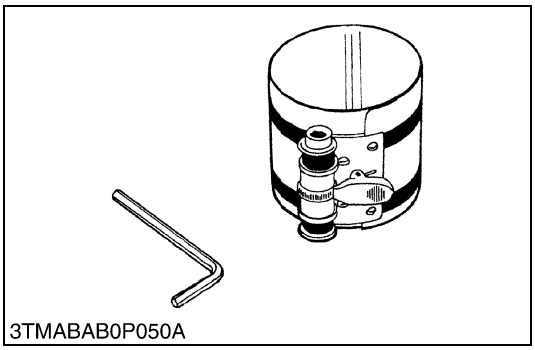
[1] SPECIAL TOOLS FOR ENGINE


3TMABAB0P049A

Special Use Puller Set

Code No.: 07916-09032
Application: Use exclusively for pulling out bearing, gears and other parts with ease.

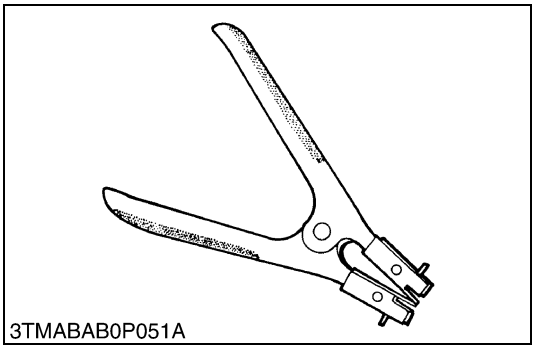
W10520950


3TMABAB0P050A

Piston Ring Compressor

Code No.: 07909-32111
Application: Use exclusively for pushing in the piston with piston rings into the cylinder.

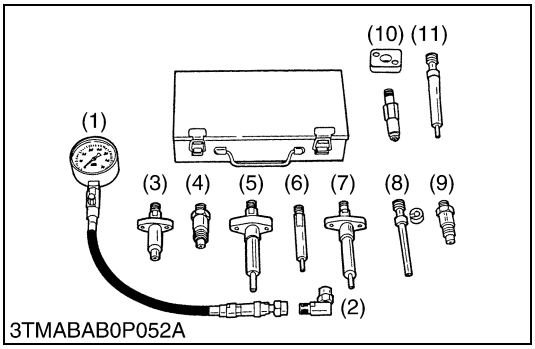
W10520290


3TMABAB0P051A

Piston Ring Tool

Code No.: 07909-32121
Application: Use exclusively for removing or installing the piston ring with ease.

W10241500



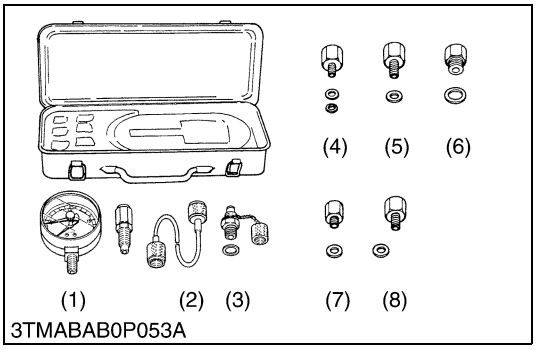
3TMABAB0P052A

Diesel Engine Compression Tester

Code No.: 07909-30208 (Assembly) 07909-31251 (G)
07909-30934 (A to F) 07909-31271 (I)
07909-31211 (E and F) 07909-31281 (J)
07909-31231 (H)
Application: Use to measure diesel engine compression and diagnostics of need for major overhaul.

(1) Gauge
(2) **L** Joint
(3) Adaptor **A**
(4) Adaptor **B**
(5) Adaptor **C**
(6) Adaptor **E**
(7) Adaptor **F**
(8) Adaptor **G**
(9) Adaptor **H**
(10) Adaptor **I**
(11) Adaptor **J**

W10508990



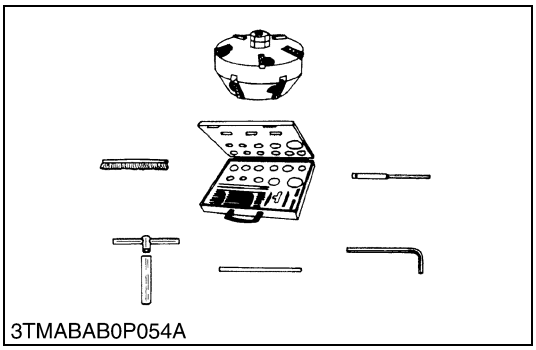
3TMABAB0P053A

Oil Pressure Tester

Code No.: 07916-32032
Application: Use to measure lubricating oil pressure.

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

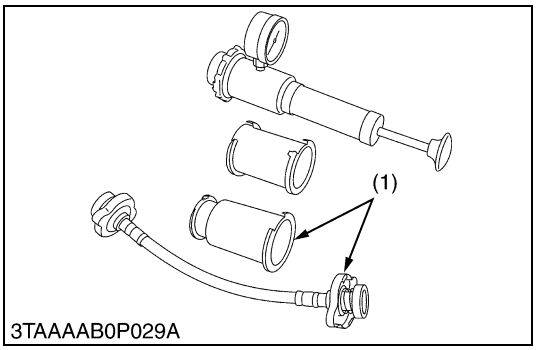
W10243180


3TMABAB0P054A

Valve Seat Cutter

Code No.: 07909-33102
Application: Use to reseat valves.
Angle: 0.785 rad (45°)
0.262 rad (15°)
Diameter: 28.6 mm (1.126 in.) 38.0 mm (1.496 in.)
31.6 mm (1.244 in.) 41.3 mm (1.626 in.)
35.0 mm (1.378 in.) 50.8 mm (2.000 in.)

W10244580

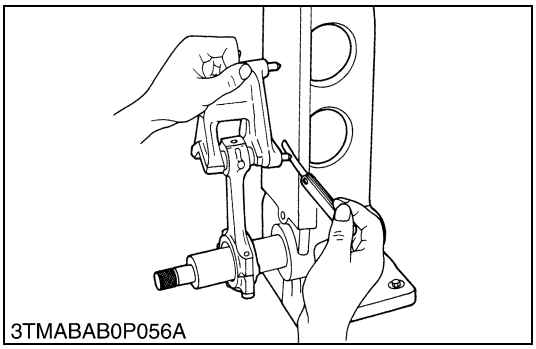


3TAAAAB0P029A

Radiator Tester

Code No.: 07909-31551
Application: Use to check of radiator cap pressure, and leaks from cooling system.
Remarks: Adaptor (1) BANZAI Code No. RCT-2A-30S.

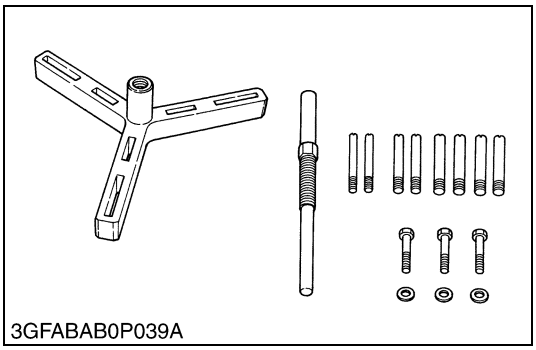
W10519660


3TMABAB0P056A

Connecting Rod Alignment Tool

Code No.: 07909-31661
Application: Use to check the connecting rod alignment.
Applicable: Connecting rod big end I.D.
range 30 to 75 mm (1.18 to 2.95 in.) dia.
Connecting rod length
65 to 300 mm (2.57 to 11.81 in.)

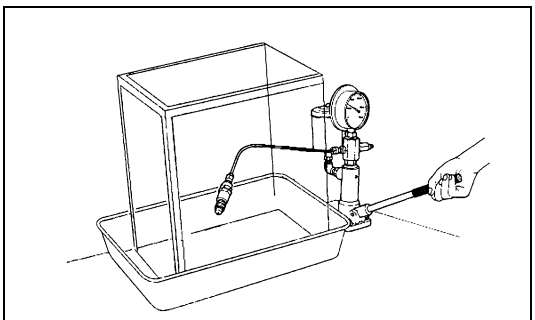
W10245830


3GFABAB0P039A

Flywheel Puller

Code No.: 07916-32011
Application: Use exclusively for removing the flywheel with ease.

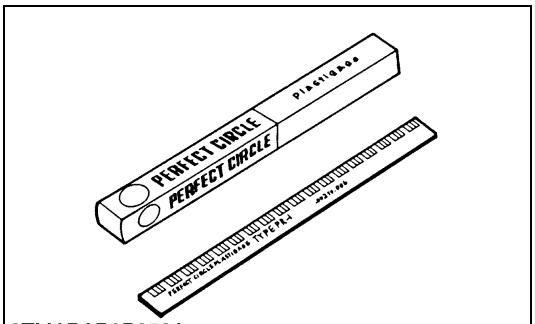
W1038597


3TLABAB1P041A

Nozzle Tester

Code No.: 07909-31361
Application: Use to check the fuel injection pressure and spray pattern of nozzle.
Measuring range: 0 to 50 MPa (0 to 500 kgf/cm^2, 0 to 7000 psi)

W10246530

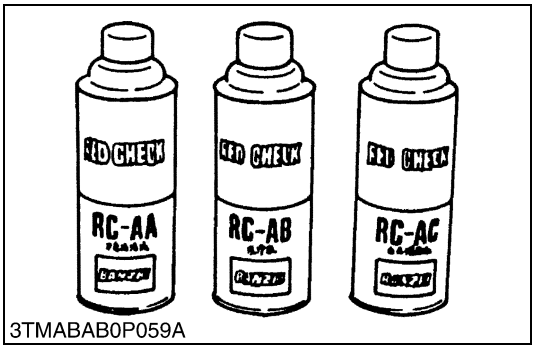


3TMABAB0P058A

Plastigage

Code No.: 07909-30241
Application: Use to check the oil clearance between crankshaft and bearing, etc.
Measuring range: Green .... 0.025 to 0.076 mm (0.001 to 0.003 in.)
Red ..... 0.051 to 0.152 mm (0.002 to 0.006 in.)
Blue ..... 0.102 to 0.229 mm (0.004 to 0.009 in.)

W10247190



3TMABAB0P059A

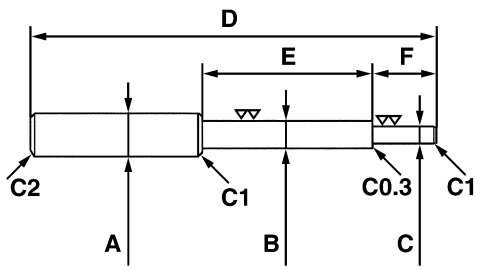
Red Check

Code No.: 07909-31371
Application: Use to check cracks on cylinder head, cylinder block, etc.

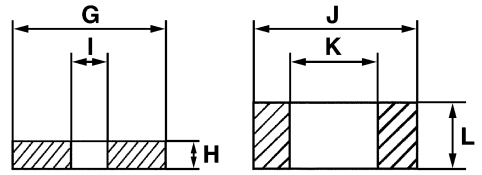
W10249090

■ **NOTE**

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



3TMABAB0P063A



3TMABAB0P064A

Valve Guide Replacing Tool

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

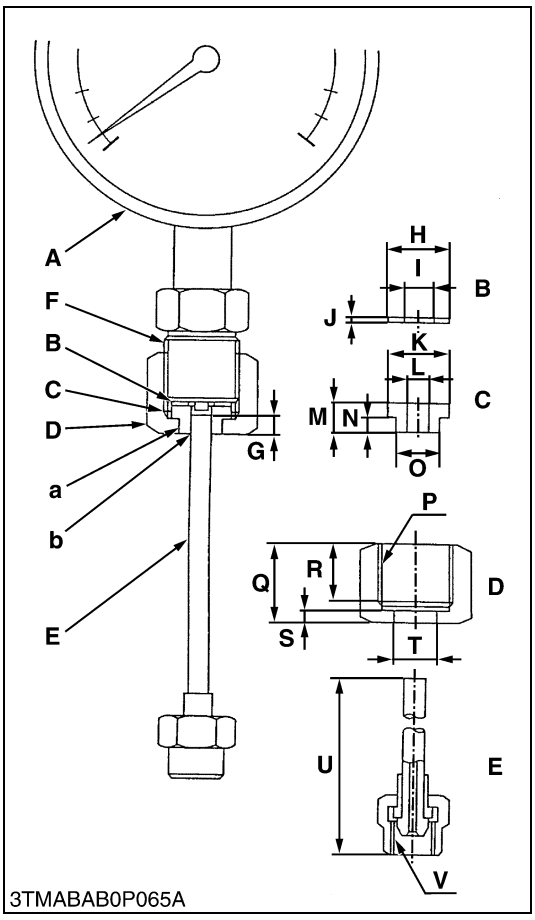
■ **D782-E2-ZD**

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

■ **D1005-E2-ZD, D1305-E3-ZD**

A	20 mm dia. (0.79 in. dia.)
B	11.7 to 11.9 mm dia. 0.460 to 0.468 in.dia.
C	6.5 to 6.6 mm dia. 0.256 to 0.259 in.dia.
D	225 mm (8.86 in.)
E	70 mm (2.76 in.)
F	45 mm (1.77 in.)
G	25 mm (0.98 in.)
H	5 mm (0.197 in.)
I	6.7 to 7.0 mm dia. (0.263 to 0.275 in.dia.)
J	20 mm dia. (0.787 in.dia.)
K	12.5 to 12.8 mm dia. (0.482 to 0.5004 in.dia.)
L	8.9 to 9.1 mm (0.350 to 0.358 in.)
C1	Chamfer 1.0 mm (0.039 in.)
C2	Chamfer 2.0 mm (0.079 in.)
C0.3	Chamfer 0.3 mm (0.012 in.)

W1038973



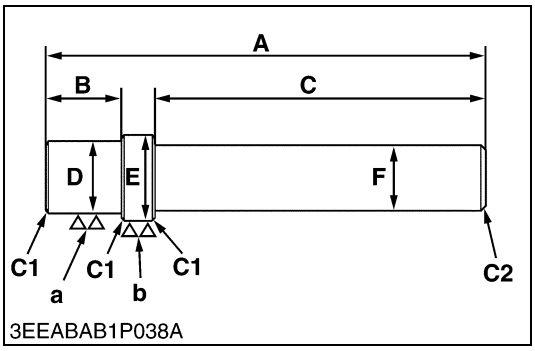
3TMABAB0P065A

Injection Pump Pressure Tester

Application: Use to check fuel tightness of injection pumps.

A	Pressure gauge full scale : More than 29.4 MPa (300 kgf/cm^2, 4267 psi)
B	Copper gasket
C	Flange (Material : Steel)
D	Hex. nut 27 mm (1.06 in.) across the plat
E	Injection Pipe
F	PF 1/2
G	5 mm (0.20 in.)
H	17 mm dia. (0.67 in.dia.)
I	8 mm dia. (0.31 in.dia.)
J	1.0 mm (0.039 in.)
K	17 mm dia. (0.67 in.dia.)
L	6.10 to 6.20 mm dia. (0.2402 to 0.2441 in. dia.)
M	8 mm (0.31 in.)
N	4 mm (0.16 in.)
O	11.97 to 11.99 mm dia. (0.4713 to 0.4721 in. dia.)
P	PF 1/2
Q	23 mm (0.91 in.)
R	17 mm (0.67 in.)
S	4 mm (0.16 in.)
T	12.00 to 12.02 mm dia. (0.4724 to 0.4732 in. dia.)
U	100 mm (3.94 in.)
V	M12 x P1.5
a	Adhesive application
b	Fillet welding on the enter circumference

W1038691



3EEABAB1P038A

Bushing Replacing Tool

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

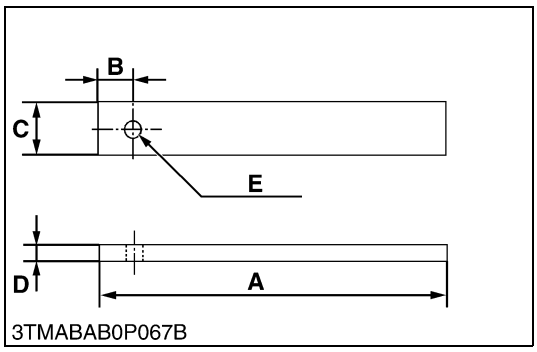
1. For small end bushing

A	145 mm (5.71 in.)
B	20 mm (0.79 in.)
C	100 mm (3.94in.)
D	19.90 to 19.95 mm dia. (0.7835 to 0.7854 in. dia.)
E	21.90 to 21.95 mm dia. (0.8622 to 0.8642 in. dia.)
F	25 mm dia. (0.98 in. dia.)
a	6.3 μm (250 μin.)
b	6.3 μm (250 μin.)

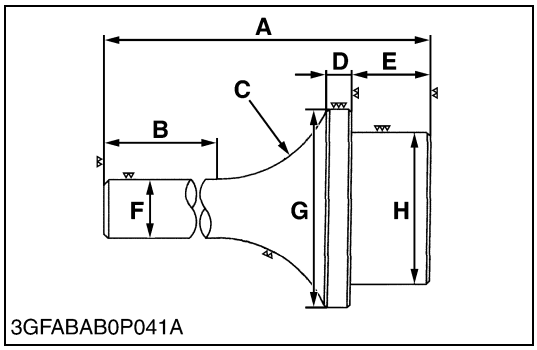
2. For idle gear bushing

A	150 mm (5.91 in.)
B	20 mm (0.79 in.)
C	100 mm (3.94 in.)
D	19.90 to 19.95 mm dia. (0.7835 to 0.7854 in. dia.)
E	21.90 to 21.95 mm dia. (0.8622 to 0.8642 in. dia.)
F	25 mm dia. (0.98 in.dia.)
a	6.3 μm (250 μin.)
b	6.3 μm (250 μin.)

W12358870



3TMABAB0P067B



3GFABAB0P041A

Flywheel Stopper

Application: Use to loosen and tighten the flywheel screw.

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

W12365478

Crankshaft Bearing 1 Replacing Tool

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

[Press Out]

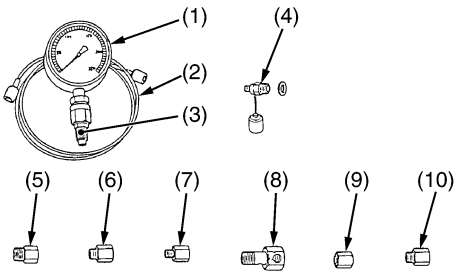
A	135 mm (5.31 in.)
B	72 mm (2.83 in.)
C	1.57 rad. (40°)
D	10 mm (0.39 in.)
E	22 mm (0.87 in.)
F	20 mm dia. (0.79 in. dia.)
G	48.90 to 48.95 mm dia. (1.9251 to 1.9271 in. dia.)
H	43.90 to 43.95 mm dia. (1.7283 to 1.7303 in. dia.)

[Press Fit]

A	130 mm (5.12 in.)
B	72 mm (2.83 in.)
C	1.57 rad. (40°)
D	9 mm (0.35 in.)
E	24 mm (0.95 in.)
F	20 mm dia. (0.79 in. dia.)
G	68 mm dia. (2.68 in. dia.)
H	39.90 to 39.95 mm dia. (1.5709 to 1.5728 in. dia.)

W78965412

[2] SPECIAL TOOLS FOR MACHINE



3TMABAB0P077A

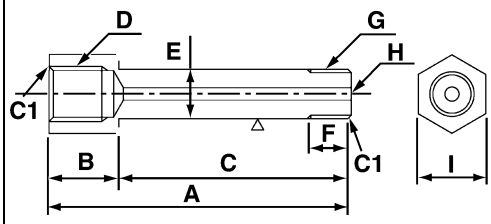
Relief Valve Pressure Tester

Code No.: 07916-50045

Application: This allows easy measurement of relief set pressure.

(1) Gauge (07916-50322)
(2) Cable (07916-50331)
(3) Threaded Joint (07916-50401)
(4) Threaded Joint (07916-50341)
(5) Adaptor **B** (M18 × P1.5) (07916-50361)
(6) Adaptor **C** (PS3/8) (07916-50371)
(7) Adaptor **D** (PT1/8) (07916-50381)
(8) Adaptor **E** (PS3/8) (07916-50392)
(9) Adaptor **F** (PF1/2) (07916-62601)
(10) Adaptor **58** (PT1/4) (07916-52391)

W1026741



3GZAAAD0P051A

HST Relief Valve Adaptor

Application: This adaptor is used to measure the HST relief valve pressure.

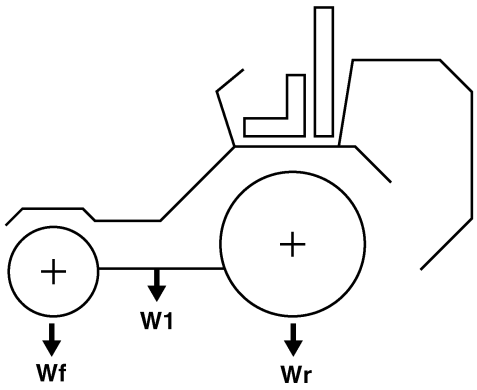
A	80 mm (3.15 in.)
B	20 mm (0.79 in.)
C	60 mm (2.36 in.)
D	G 1/4 × 15 mm (0.59 in.)
E	12 mm (0.47 in.)
F	13 mm dia. (0.51 in. dia.)
G	G 1/4
H	3 mm dia. (0.118 in. dia.)
I	19 mm (0.75 in.)
C1	Chamfer 1.0 mm (0.039 in.)

W1040355

9. IMPLEMENT LIMITATIONS

The KUBOTA Tractor has been thoroughly tested for proper performance with implements sold or approved by KUBOTA. Use with implements which are not sold or approved by KUBOTA and which exceed the maximum specifications listed below, or which are otherwise unfit for use with the KUBOTA Tractor may result in malfunctions or failures of the tractor, damage to other property and injury to the operator or others. [Any malfunctions or failures of the tractor resulting from use with improper implements are not covered by the warranty.]

	Maximum loading weight		Implement weight W1	Maximum total weight
	Front axle Wf	Rear axle Wr		
ZD321[N]	200 kg (440 lbs)	920 kg (2028 lbs)	200 kg (440 lbs)	1120 kg (2468 lbs)
ZD326P[S]				
ZD331P[L]				



3GZAAAG0P042A

1 ENGINE

SERVICING

CONTENTS

1. TROUBLESHOOTING

Symptom	Probable Cause	Solution	Reference Page
Engine Does Not Start	No fuel	Replenish fuel	G-7
	Air in the fuel system	Vent air	G-36
	Water in the fuel system	Change fuel and repair or replace fuel system	–
	Fuel pipe clogged	Clean or replace	G-34
	Fuel filter clogged	Replace	G-30
	Excessively high viscosity of fuel or engine oil at low temperature	Use specified fuel or engine oil	G-7
	Fuel with low cetane number	Use specified fuel	–
	Fuel leak due to loose injection pipe retaining nut	Tighten retaining nut	–
	Incorrect injection timing	Adjust	1-S25, 37, 42
	Fuel camshaft worn	Replace	1-S36
	Injection nozzle clogged	Clean or replace	1-S33
	Injection pump malfunctioning	Replace	1-S37, 42
	Seizure of crankshaft, camshaft, piston, cylinder or bearing	Repair or replace	1-S44 to 51 1-S63 to 77
	Compression leak from cylinder	Replace head gasket, tighten cylinder head screw, glow plug and nozzle holder	1-S35
	Improper valve timing	Correct or replace timing gear	1-S39, 43
	Piston ring and cylinder worn	Replace	1-S45, 50
	Excessive valve clearance	Adjust	1-S21
	Stop solenoid malfunctioning	Replace	1-S32
Starter Does Not Run	Battery discharged	Charge	G-26
	Starter malfunctioning	Repair or replace	1-S32, 5-S19
	Key switch malfunctioning	Replace	5-S8
	Wiring disconnected	Connect	–

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KiSC issued 04, 2007 A

Symptom	Probable Cause	Solution	Reference Page
Engine Revolution Is Not Smooth	Fuel filter clogged or dirty	Replace	G-30
	Air cleaner clogged	Clean or replace	G-24
	Fuel leak due to loose injection pipe retaining nut	Tighten retaining nut	1-S32
	Injection pump malfunctioning	Replace	1-S37, 42
	Incorrect nozzle opening pressure	Adjust	1-S27
	Injection nozzle stuck or clogged	Replace	1-S33
	Governor malfunctioning	Repair	1-S40
Either White or Blue Exhaust Gas Is Observed	Excessive engine oil	Reduce to specified level	G-17
	Piston ring and cylinder worn or stuck	Replace	1-S45, 50
	Incorrect injection timing	Adjust	1-S25, 37, 42
Either Black or Dark Gray Exhaust Gas Is Observed	Overload	Lessen the load	–
	Low grade fuel used	Use specified fuel	–
	Fuel filter clogged	Replace	G-30
	Air cleaner clogged	Clean or replace	G-24
	Deficient nozzle injection	Replace nozzle	1-S33

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Symptom	Probable Cause	Solution	Reference Page
Deficient Output	Incorrect injection timing	Adjust	1-S25, 37, 42
	Engine's moving parts seem to be seizing	Repair or replace	–
	Injection pump malfunctioning	Replace	1-S37, 42
	Deficient nozzle injection	Replace nozzle	1-S33
	Compression leak	Check the compression pressure and repair	1-S20
	Gas leak from exhaust system	Repair or replace	–
Excessive Lubricant Oil Consumption	Piston ring's gap facing the same direction	Shift ring gap direction	1-S45
	Oil ring worn or stuck	Replace	1-S45
	Piston ring groove worn	Replace piston	1-S46
	Valve stem and valve guide worn	Replace	1-S55
	Crankshaft bearing and crank pin bearing worn	Replace	1-S44, 51
	Oil leaking due to defective seals or packing	Replace	–
Fuel Mixed into Lubricant Oil	Injection pump's plunger worn	Replace	1-S37, 42
	Deficient nozzle injection	Replace nozzle	1-S33
	Injection pump broken	Replace	1-S37, 42
Water Mixed into Lubricant Oil	Head gasket defective	Replace	1-S35
	Cylinder block or cylinder head flawed	Replace	–
Low Oil Pressure	Engine oil insufficient	Replenish	G-7
	Oil strainer clogged	Clean	1-S44
	Relief valve stuck with dirt	Clean	–
	Relief valve spring weaken or broken	Replace	–
	Excessive oil clearance of crankshaft bearing	Replace	1-S51
	Excessive oil clearance of crankpin bearing	Replace	1-S44
	Excessive oil clearance of rocker arm	Replace	1-S34
	Oil passage clogged	Clean	–
	Different type of oil	Use specified type of oil	G-7
	Oil pump defective	Replace	–

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Symptom	Probable Cause	Solution	Reference Page
High Oil Pressure	Different type of oil	Use specified type of oil	G-7
	Relief valve defective	Replace	–
Engine Overheated	Engine oil insufficient	Replenish	G-7
	Fan belt broken or elongated	Replace or adjust	G-27
	Coolant insufficient	Replenish	G-7
	Radiator net and radiator fin clogged with dust	Clean	G-32
	Inside of radiator corroded	Clean or replace	G-32
	Coolant flow route corroded	Clean or replace	–
	Radiator cap defective	Replace	–
	Overload running	Reduce the load	–
	Head gasket defective	Replace	1-S35
	Incorrect injection timing	Adjust	1-S25, 37, 42
	Unsuitable fuel used	Use specified fuel	–
Battery Quickly Discharged	Battery electrolyte insufficient	Replenish distilled water and charge	G-25
	Fan belt slips	Adjust belt tension or replace	G-27
	Wiring disconnected	Connect	–
	Rectifier defective	Replace	–
	Alternator defective	Replace	–
	Battery defective	Replace	–

W1014322

2. SERVICING SPECIFICATIONS

[1] D782-E2-ZD

ENGINE BODY

Item		Factory Specification	Allowable Limit
Valve Clearance (Cold)		0.145 to 0.185 mm 0.00571 to 0.00728 in.	–
Compression Pressure		2.84 to 3.24 MPa 29.0 to 33.0 kgf/cm^2 413 to 469 psi	2.26 MPa 23.0 kgf/cm^2 327 psi
Difference among Cylinders		–	10 % or less
Top Clearance		0.50 to 0.70 mm 0.0197 to 0.0276 in.	–
Cylinder Head Surface	Flatness	–	0.05 mm 0.0020 in.
Valve Recessing	Intake and Exhaust	–0.10 to 0.10 mm –0.0039 to 0.0039 in.	0.30 mm 0.0118 in.
Valve Stem to Valve Guide	Clearance	0.030 to 0.057 mm 0.00118 to 0.00224 in.	0.10 mm 0.0039 in.
Valve Stem	O.D.	5.968 to 5.980 mm 0.23496 to 0.23543 in.	–
Valve Guide	I.D.	6.010 to 6.025 mm 0.23661 to 0.23720 in.	–
Valve Face	Angle	0.785 rad 45 °	–
Valve Seat	Angle	0.785 rad 45 °	–
	Width	2.12 mm 0.0835 in.	–
Valve Spring	Free Length	31.3 to 31.8 mm 1.232 to 1.252 in.	28.4 mm 1.118 in.
	Tilt	–	1.2 mm 0.047 in.
	Setting Load / Setting Length	64.7 N / 27.0 mm 6.6 kgf / 27.0 mm 14.6 lbf / 1.063 in.	54.9 N / 27.0 mm 5.6 kgf / 27.0 mm 12.3 lbf / 1.063 in.

W10138740

ENGINE BODY (Continued)

Item		Factory Specification	Allowable Limit
Rocker Arm Shaft to Rocker Arm	Oil Clearance	0.016 to 0.045 mm 0.00063 to 0.00177 in.	0.15 mm 0.0059 in.
Rocker Arm Shaft	O.D.	10.473 to 10.484 mm 0.41232 to 0.41276 in.	–
Rocker Arm	I.D.	10.500 to 10.518 mm 0.41339 to 0.41410 in.	–
Push Rod	Alignment	–	0.25 mm 0.0098 in.
Tappet to Tappet Guide	Oil Clearance	0.016 to 0.052 mm 0.00063 to 0.00205 in.	0.10 mm 0.0039 in.
Tappet	O.D.	17.966 to 17.984 mm 0.70732 to 0.70803 in.	–
Tappet Guide	I.D.	18.000 to 18.018 mm 0.70866 to 0.70937 in.	–
Timing Gear			
Crank Gear to Idle Gear	Backlash	0.043 to 0.124 mm 0.00169 to 0.00488 in.	0.15 mm 0.0059 in.
Idle Gear to Cam Gear	Backlash	0.047 to 0.123 mm 0.00185 to 0.00484 in.	0.15 mm 0.0059 in.
Idle Gear to Injection Pump Gear	Backlash	0.046 to 0.124 mm 0.00181 to 0.00488 in.	0.15 mm 0.0059 in.
Crank Gear to Oil Pump Drive Gear	Backlash	0.041 to 0.123 mm 0.00161 to 0.00484 in.	0.15 mm 0.0059 in.
Idle Gear	Side Clearance	0.20 to 0.51 mm 0.0079 to 0.0201 in.	0.80 mm 0.0315 in.
Camshaft	Side Clearance	0.15 to 0.31 mm 0.0059 to 0.0122 in.	0.50 mm 0.0197 in.
	Alignment	–	0.01 mm 0.0004 in.
Cam Height	Intake and Exhaust	26.88 mm 1.0583 in.	26.83 mm 1.0563 in.
Camshaft Journal to Cylinder Block Bore	Oil Clearance	0.050 to 0.091 mm 0.00197 to 0.00358 in.	0.15 mm 0.0059 in.
Camshaft Journal	O.D.	32.934 to 32.950 mm 1.29661 to 1.29724 in.	–
Cylinder Block Bore	I.D.	33.000 to 33.025 mm 1.29921 to 1.30020 in.	–

W1013874

ENGINE BODY (Continued)

Item		Factory Specification	Allowable Limit
Idle Gear Shaft to Idle Gear Bushing	Oil Clearance	0.020 to 0.084 mm 0.00079 to 0.00331 in.	0.10 mm 0.0039 in.
Idle Gear Shaft	O.D.	19.967 to 19.980 mm 0.78610 to 0.78661 in.	–
Idle Gear Bushing	I.D.	20.000 to 20.051 mm 0.78740 to 0.78941 in.	–
Piston Pin Bore	I.D.	20.000 to 20.013 mm 0.78740 to 0.78791 in.	20.05 mm 0.7894 in.
Piston Pin to Small End Bushing	Oil Clearance	0.014 to 0.038 mm 0.00055 to 0.00150 in.	0.10 mm 0.0039 in.
Piston Pin	O.D.	20.002 to 20.011 mm 0.78748 to 0.78783 in.	–
Small End Bushing	I.D.	20.025 to 20.040 mm 0.78839 to 0.78897 in.	–
Piston Pin to Small End Bushing (Spare Parts)	Oil Clearance	0.015 to 0.075 mm 0.00059 to 0.00295 in.	0.15 mm 0.0059 in.
Small End Bushing	I.D.	20.026 to 20.077 mm 0.78843 to 0.79043 in.	–
Piston Ring Gap	Top Ring	0.15 to 0.30 mm 0.0059 to 0.0118 in.	1.20 mm 0.0472 in.
	Second Ring	0.30 to 0.45 mm 0.0118 to 0.0177 in.	1.20 mm 0.0472 in.
	Oil Ring	0.15 to 0.30 mm 0.0059 to 0.0118 in.	1.20 mm 0.0472 in.
Piston Ring to Piston Ring Groove Second Ring	Clearance	0.090 to 0.120 mm 0.00354 to 0.00472 in.	0.15 mm 0.0059 in.
Oil Ring	Clearance	0.04 to 0.08 mm 0.0016 to 0.0031 in.	0.15 mm 0.0059 in.
Connecting Rod	Alignment	–	0.05 mm 0.0020 in.
Crankshaft	Side Clearance	0.15 to 0.31 mm 0.0059 to 0.0122 in.	0.50 mm 0.0197 in.
	Alignment	–	0.02 mm 0.0008 in.

W10138740

ENGINE BODY (Continued)

Item		Factory Specification	Allowable Limit
Crankpin to Crankpin Bearing	Oil Clearance	0.020 to 0.051 mm 0.00079 to 0.00201 in.	0.15 mm 0.0059 in.
Crankpin	O.D.	33.959 to 33.975 mm 1.33697 to 1.33760 in.	–
Crankpin Bearing	I.D.	33.995 to 34.010 mm 1.33839 to 1.33898 in.	–
Crankshaft Journal to Crankshaft Bearing 1	Oil Clearance	0.034 to 0.106 mm 0.00134 to 0.00417 in.	0.20 mm 0.0079 in.
Crankshaft Journal	O.D.	39.934 to 39.950 mm 1.57221 to 1.57284 in.	–
Crankshaft Bearing 1	I.D.	39.984 to 40.040 mm 1.57417 to 1.57638 in.	–
Crankshaft Journal to Crankshaft Bearing 2 (Flywheel Side)	Oil Clearance	0.028 to 0.059 mm 0.00110 to 0.00232 in.	0.20 mm 0.0079 in.
Crankshaft Journal	O.D.	43.934 to 43.950 mm 1.72968 to 1.73031 in.	–
Crankshaft Bearing 2	I.D.	43.978 to 43.993 mm 1.73142 to 1.73201 in.	–
Crankshaft Journal to Crankshaft Bearing 3 (Intermediate)	Oil Clearance	0.028 to 0.059 mm 0.00110 to 0.00232 in.	0.20 mm 0.0079 in.
Crankshaft Journal	O.D.	39.934 to 39.950 mm 1.57221 to 1.57284 in.	–
Crankshaft Bearing 3	I.D.	39.978 to 39.993 mm 1.57394 to 1.57453 in.	–
Cylinder Liner	I.D.	67.000 to 67.019 mm 2.63779 to 2.63854 in.	67.150 mm 2.64370 in.
Cylinder Liner [Oversize : 0.25 mm (0.0098 in.)]	I.D.	67.250 to 67.269 mm 2.64764 to 2.64839 in.	67.400 mm 2.65354 in.

W10138740

LUBRICATING SYSTEM

Item		Factory Specification	Allowable Limit
Engine Oil Pressure	At Idle Speed	More than 49 kPa 0.5 kgf/cm^2 7 psi	–
	At Rated Speed	196 to 441 kPa 2.0 to 4.5 kgf/cm^2 28 to 64 psi	147 kPa 1.5 kgf/cm^2 21 psi
Inner Rotor to Outer Rotor	Clearance	0.03 to 0.14 mm 0.0012 to 0.0055 in.	–
Outer Rotor to Pump Body	Clearance	0.07 to 0.15 mm 0.0028 to 0.0059 in.	–
Inner Rotor to Cover	Clearance	0.075 to 0.135 mm 0.00295 to 0.00531 in.	–

W10139730

COOLING SYSTEM

Fan Belt	Tension	7.0 to 9.0 mm / 98 N (10 kgf, 22 lbf) 0.28 to 0.35 in. / 98 N (10 kgf, 22 lbf)	–
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 Cap	Pressure Falling Time	10 seconds or more 88 → 59 kPa 0.9 → 0.6 kgf/cm^2 13 → 9 psi	–
Radiator	Water Leakage Test Pressure	No leak at specified pressure 177 kPa 1.8 kgf/cm^2 25.7 psi	–

W10135990

FUEL SYSTEM

Item		Factory Specification	Allowable Limit
Injection Pump	Injection Timing (3200 min^{-1} (rpm))	0.28 to 0.31 rad (16 to 18°) before T.D.C.	–
Pump Element	Fuel Tightness	–	13.73 MPa 140 kgf/cm^2 1991 psi
Delivery Valve	Fuel Tightness	10 seconds 13.73 → 12.75 MPa 140 → 130 kgf/cm^2 1991 → 1849 psi	5 seconds 13.73 → 12.75 MPa 140 → 130 kgf/cm^2 1991 → 1849 psi
Injection Nozzle	Injection Pressure	13.73 to 14.71 MPa 140 to 150 kgf/cm^2 1991 to 2134 psi	–
Injection Nozzle Valve Seat	Valve Seat Tightness	When the pressure is 12.75 MPa (130 kgf/cm^2, 1849 psi), the valve seat must be fuel tightness.	–

W10139730

[2] D1005-E2-ZD, D1305-E3-ZD

ENGINE BODY

Item		Factory Specification	Allowable Limit
Valve Clearance (Cold)		0.145 to 0.185 mm 0.00571 to 0.00728 in.	–
Compression Pressure		3.73 to 4.11 MPa 38.0 to 42.0 kgf/cm^2 541 to 597 psi	2.26 MPa 23.0 kgf/cm^2 327 psi
Difference among Cylinders		–	10 % or less
Top Clearance	D1005-E2-ZD	0.55 to 0.70 mm 0.0022 to 0.027 in.	–
	D1305-E3-ZD	0.80 to 1.00 mm 0.032 to 0.0393 in.	–
Cylinder Head Surface	Flatness	–	0.05 mm 0.002 in.
Valve Recessing	Intake and Exhaust	–0.05 to 0.25 mm –0.0019 to 0.0098 in.	0.40 mm 0.016 in.
Valve Stem to Valve Guide	Clearance	0.035 to 0.065 mm 0.0014 to 0.0025 in.	0.10 mm 0.0039 in.
Valve Stem	O.D.	6.960 to 6.975 mm 0.2741 to 0.2746 in.	–
Valve Guide	I.D.	7.010 to 7.025 mm 0.2760 to 0.2765 in.	–
Valve Face	Angle (Intake)	1.0 rad 60 °	–
	Angle (Exhaust)	0.79 rad 45 °	–
Valve Seat	Angle (Intake)	1.0 rad 60 °	–
	Angle (Exhaust)	0.79 rad 45 °	–
	Width	2.12 mm 0.0835 in.	
Valve Spring	Free Length	37.0 to 37.5 mm 1.46 to 1.47 in.	36.5 mm 1.44 in.
	Tilt	–	1.0 mm 0.039 in.
	Setting Load	117.4 N / 31.0 mm 11.97 kgf / 31.0 mm 26.39 lbf / 1.22 in.	100.0 N / 31.0 mm 10.20 kgf / 31.0 mm 22.48 lbf / 1.22 in.

W10138740

ENGINE BODY (Continued)

Item		Factory Specification	Allowable Limit
Rocker Arm Shaft to Rocker Arm	Clearance	0.016 to 0.045 mm 0.00063 to 0.0017 in.	0.10 mm 0.0039 in.
Rocker Arm Shaft	O.D.	11.973 to 11.984 mm 0.47138 to 0.47181 in.	–
Rocker Arm	I.D.	12.000 to 12.018 mm 0.47244 to 0.47314 in.	–
Push Rod	Alignment	–	0.25 mm 0.0098 in.
Tappet to Tappet Guide	Clearance	0.020 to 0.062 mm 0.00079 to 0.0024 in.	0.07 mm 0.003 in.
Tappet	O.D.	19.959 to 19.980 mm 0.78579 to 0.78661 in.	–
Tappet Guide	I.D.	20.000 to 20.021 mm 0.78740 to 0.78822 in.	–
Timing Gear			
Crank Gear to Idle Gear 1	Backlash	0.032 to 0.115 mm 0.0013 to 0.00452 in.	0.15 mm 0.0059 in.
Idle Gear 1 to Cam Gear	Backlash	0.036 to 0.114 mm 0.0014 to 0.00448 in.	0.15 mm 0.0059 in.
Idle Gear 1 to Injection Pump Gear	Backlash	0.034 to 0.116 mm 0.0014 to 0.00456 in.	0.15 mm 0.0059 in.
Governor Gear Governor Gear to Injection Pump Gear	Backlash	0.030 to 0.117 mm 0.0012 to 0.00460 in.	0.15 mm 0.0059 in.

W1013874

ENGINE BODY (Continued)

Item		Factory Specification	Allowable Limit
Idle Gear Shaft to Gear Bushing			
Idle Gear 1	Clearance	0.020 to 0.054 mm 0.00079 to 0.0021 in.	0.10 mm 0.0039 in.
Idle Gear Bushing	I.D.	26.000 to 26.021 mm 1.0237 to 1.0244 in.	–
Idle Gear Shaft 1	O.D.	25.967 to 25.980 mm 1.0224 to 1.0228 in.	–
Idle Gear			
Idle Gear 1	Side Clearance	0.20 to 0.51 mm 0.0079 to 0.020 in.	0.80 mm 0.031 in.
Camshaft	Side Clearance	0.07 to 0.22 mm 0.003 to 0.0087 in.	0.30 mm 0.012 in.
	Alignment	–	0.01 mm 0.0004 in.
Cam Height	Intake	28.80 mm 1.134 in.	28.75 mm 1.132 in.
	Exhaust	29.0 mm 1.14 in.	28.95 mm 1.140 in.
Camshaft Journal to Cylinder Block Bore	Oil Clearance	0.050 to 0.091 mm 0.0020 to 0.0035 in.	0.15 mm 0.0059 in.
Camshaft Journal	O.D.	35.934 to 35.950 mm 1.4147 to 1.4153 in.	–
Cylinder Block Bore	I.D.	36.000 to 36.025 mm 1.4173 to 1.4183 in.	–
Piston Pin Bore	I.D.	22.000 to 22.013 mm 0.86615 to 0.86665 in.	22.03 mm 0.8673 in.
Piston Pin to Small End Bushing	Clearance	0.014 to 0.038 mm 0.00056 to 0.0014 in.	0.15 mm 0.0059 in.
Piston Pin	O.D.	22.002 to 22.011 mm 0.86622 to 0.86657 in.	–
Small End Bushing	I.D.	22.025 to 22.040 mm 0.86713 to 0.86771 in.	–

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ENGINE BODY (Continued)

Item		Factory Specification	Allowable Limit
Piston Ring Gap	Top Ring	0.30 to 0.45 mm 0.012 to 0.017 in.	1.25 mm 0.0492 in.
	Second Ring	0.30 to 0.45 mm 0.012 to 0.017 in.	1.25 mm 0.0492 in.
	Oil Ring	0.25 to 0.40 mm 0.0098 to 0.015 in.	1.25 mm 0.0492 in.
Piston Ring to Piston Ring Groove **[D1005-E2-ZD]**			
Second Ring	Clearance	0.085 to 0.112 mm 0.0034 to 0.00440 in.	0.2 mm 0.008 in.
Oil Ring	Clearance	0.020 to 0.055 mm 0.00079 to 0.0021 in.	0.15 mm 0.0059 in.
Piston Ring to Piston Ring Groove **[D1305-E3-ZD]**			
Second Ring	Clearance	0.095 to 0.122 mm 0.0038 to 0.00480 in.	0.2 mm 0.008 in.
Oil Ring	Clearance	0.020 to 0.060 mm 0.00079 to 0.0023 in.	0.15 mm 0.0059 in.
Connecting Rod	Alignment	–	0.05 mm 0.002 in.
Crankshaft	Alignment	–	0.02 mm 0.0008 in.
Crankshaft to Crankshaft Bearing 1 **[D1005-E2-ZD]**	Oil Clearance	0.034 to 0.114 mm 0.0013 to 0.00448 in.	0.20 mm 0.0079 in.
Crankshaft	O.D.	47.934 to 47.950 mm 1.8872 to 1.8878 in.	–
Crankshaft Bearing 1	I.D.	47.984 to 48.048 mm 1.8892 to 1.8916 in.	–
Crankshaft to Crankshaft Bearing 1 **[D1305-E3-ZD]**	Oil Clearance	0.034 to 0.103 mm 0.0014 to 0.00405 in.	0.20 mm 0.0079 in.
Crankshaft	O.D.	51.921 to 51.940 mm 2.0442 to 2.0448 in.	–
Crankshaft Bearing 1	I.D.	51.974 to 52.024 mm 2.0463 to 2.0481 in.	–

W10138740

ENGINE BODY (Continued)

Item		Factory Specification	Allowable Limit
Crankshaft to Crankshaft Bearing 2 **[D1005-E2-ZD]**	Oil Clearance	0.034 to 0.095 mm 0.0014 to 0.0037 in.	0.20 mm 0.0079 in.
Crankshaft Journal	O.D.	47.934 to 47.950 mm 1.8872 to 1.8878 in.	–
Crankshaft Bearing 2	I.D.	47.984 to 48.029 mm 1.8892 to 1.8909 in.	–
Crankshaft to Crankshaft Bearing 2 **[D1305-E3-ZD]**	Oil Clearance	0.034 to 0.103 mm 0.0014 to 0.00405 in.	0.20 mm 0.0079 in.
Crankshaft Journal	O.D.	51.921 to 51.940 mm 2.0442 to 2.0448 in.	–
Crankshaft Bearing 2	I.D.	51.974 to 52.024 mm 2.0463 to 2.0481 in.	–
Crankshaft to Crankshaft Bearing 3 **[D1005-E2-ZD]**	Oil Clearance	0.034 to 0.098 mm 0.0014 to 0.0038 in.	0.20 mm 0.0079 in.
Crankshaft Journal	O.D.	51.921 to 51.940 mm 2.0442 to 2.0449 in.	–
Crankshaft Bearing 3	I.D.	51.974 to 52.019 mm 2.0463 to 2.0479 in.	–
Crankshaft to Crankshaft Bearing 3 **[D1305-E3-ZD]**	Oil Clearance	0.034 to 0.103 mm 0.0014 to 0.00405 in.	0.20 mm 0.0079 in.
Crankshaft Journal	O.D.	51.921 to 51.940 mm 2.0442 to 2.0448 in.	–
Crankshaft Bearing 3	I.D.	51.974 to 52.024 mm 2.0463 to 2.0481 in.	–
Crankpin to Crankpin Bearing	Oil Clearance	0.029 to 0.091 mm 0.0011 to 0.0036 in.	0.20 mm 0.0079 in.
Crankpin	O.D.	39.959 to 39.975 mm 1.5732 to 1.5738 in.	–
Crankpin Bearing	I.D.	40.040 to 40.050 mm 1.5764 to 1.5767 in.	–
Crankshaft	Side Clearance	0.15 to 0.31 mm 0.0059 to 0.012 in.	0.50 mm 0.020 in.
Cylinder Liner I.D.	D1005-E2-ZD	76.000 to 76.019 mm 2.9922 to 2.9928 in.	76.15 mm 2.998 in.
	D1305-E3-ZD	78.000 to 78.019 mm 3.0709 to 3.0716 in.	78.15 mm 3.077 in.
Cylinder (Oversized)	D1005-E2-ZD	76.500 to 76.519 mm 3.0119 to 3.0125 in.	76.65 mm 3.015 in.
	D1305-E3-ZD	78.500 to 78.519 mm 3.0906 to 3.0912 in.	78.65 mm 3.096 in.

W10138740

LUBRICATING SYSTEM

Item		Factory Specification	Allowable Limit
Engine Oil Pressure	At Idle Speed	More than 49 kPa 0.50 kgf/cm^2 7.1 psi	–
	At Rated Speed	197 to 441 kPa 2.00 to 4.50 kgf/cm^2 28.5 to 64.0 psi	147 kPa 1.50 kgf/cm^2 21.3 psi
Inner Rotor to Outer Rotor	Clearance	0.06 to 0.18 mm 0.002 to 0.0071 in.	–
Outer Rotor to Pump Body	Clearance	0.100 to 0.180 mm 0.00394 to 0.00708 in.	–
Inner Rotor to Cover	Clearance	0.025 to 0.075 mm 0.00099 to 0.0029 in.	–

W10139730

COOLING SYSTEM

Fan Belt	Tension	7.0 to 9.0 mm / 98 N (10 kgf, 22 lbf) 0.28 to 0.35 in. / 98 N (10 kgf, 22 lbf)	–
Thermostat **[D1005-E2-ZD]**	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	–
Thermostat **[D1305-E3-ZD]**	Valve Opening Temperature (At Beginning)	80.5 to 83.5 °C 176.9 to 182.3 °F	–
	Valve Opening Temperature (Opened Completely)	95 °C 203 °F	–
Radiator Cap	Pressure Falling Time	10 seconds or more 88 → 59 kPa 0.90 → 0.60 kgf/cm^2 13 → 8.5 psi	–
Radiator	Water Leakage Test Pressure	No leak at specified pressure 177 kPa 1.8 kgf/cm^2 25.7 psi	–

W10135990

FUEL SYSTEM

Item		Factory Specification	Allowable Limit
Injection Pump	Injection Timing	0.30 to 0.33 rad (17 to 19°) before T.D.C.	–
Pump Element	Fuel Tightness	–	13.73 MPa 140.0 kgf/cm^2 1991 psi
Delivery Valve	Fuel Tightness	10 seconds 13.73 → 12.75 MPa 140.0 → 130.0 kgf/cm^2 1991 → 1849 psi	5 seconds 13.73 → 12.75 MPa 140.0 → 130.0 kgf/cm^2 1991 → 1849 psi
Injection Nozzle	Injection Pressure	13.73 to 14.70 MPa 140.0 to 150.0 kgf/cm^2 1991 to 2133 psi	–
Injection Nozzle Valve Seat	Valve Seat Tightness	When the pressure is 12.75 MPa (130.0 kgf/cm^2, 1849 psi), the valve seat must be fuel tightness.	–

W10139730

3. TIGHTENING TORQUES

Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts : See page G-9.)

[D782-E2-ZD]

Item	Size x Pitch	N·m	kgf·m	lbf·ft
*Cylinder head cover screw	M6 x 1	6.86 to 11.3	0.7 to 1.15	5.1 to 8.3
Injection pipe retaining nut	M12 x 1.5	24.5 to 34.3	2.5 to 3.5	18.1 to 25.3
Overflow pipe retaining nut	M12 x 1.5	19.6 to 24.5	2.0 to 2.5	14.5 to 18.1
Nozzle holder assembly	M20 x 1.5	49.0 to 68.6	5.0 to 7.0	36.2 to 50.6
Glow plug	M8 x 1	7.8 to 14.7	0.8 to 1.5	5.8 to 10.8
*Rocker arm bracket nut	M6 x 1	9.81 to 11.2	1.00 to 1.15	7.24 to 8.31
*Cylinder head screw	M8 x 1.25	37.3 to 42.2	3.8 to 4.3	27.5 to 31.1
*Fan drive pulley screw	M12 x 1.5	117.7 to 127.5	12.0 to 13.0	86.8 to 94.0
*Idle gear shaft mounting screw	M6 x 1	9.8 to 11.3	1.00 to 1.15	7.2 to 8.3
Oil pump mounting screw	M8 x 1.25	17.7 to 21.6	1.80 to 2.20	13.0 to 15.9
*Connecting rod screw	M7 x 0.75	26.5 to 30.4	2.7 to 3.1	19.5 to 22.4
*Flywheel screw	M10 x 1.25	53.9 to 58.8	5.5 to 6.0	39.8 to 43.4
Bearing case cover mounting screw	M6 x 1	9.8 to 11.3	1.00 to 1.15	7.2 to 8.3
*Main bearing case screw 2	M7 x 1	26.5 to 30.4	2.7 to 3.1	19.5 to 22.4
*Main bearing case screw 1	M6 x 1	12.7 to 15.7	1.3 to 1.6	9.4 to 11.6
Oil pressure switch	PT 1/8	15 to 19	1.5 to 2.0	11 to 14
Nozzle holder	–	34.3 to 39.2	3.5 to 4.0	25.3 to 28.9
Drain plug with copper gasket	M12 x 1.25	32.4 to 37.3	3.3 to 3.8	23.9 to 27.5
Drain plug with copper gasket	M22 x 1.5	63.7 to 73.5	6.5 to 7.5	47.0 to 54.2
Drain plug with rubber coated gasket	M22 x 1.5	44.1 to 53.9	4.5 to 5.5	32.5 to 39.8

W1013236

■ **NOTE**

- **For "*" marked screws, bolts and nuts on the table, apply engine oil to their threads and seats before tightening.**
- **The letter "M" in Size 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.**

[D1005-E2-ZD, D1305-E3-ZD]

Item	Size x Pitch	N·m	kgf·m	lbf·ft
Cylinder head cover screw (D1005-E2-ZD)	M7 x 1.0	7 to 8	0.7 to 0.9	5 to 6
Cylinder head cover screw	M6 x 1.0	9.81 to 11.2	1.00 to 1.15	7.23 to 8.31
*Cylinder head screw	M10 x 1.25	64 to 68	6.5 to 7.0	47 to 50
*Main bearing case screw 1	M8 x 1.25	30 to 34	3.0 to 3.5	22 to 25
*Main bearing case screw 2	M9 x 1.25	49 to 53	5.0 to 5.5	37 to 39
*Flywheel screw	M10 x 1.25	54 to 58	5.5 to 6.0	40 to 43
*Connecting rod screw	M8 x 1.0	42 to 46	4.2 to 4.7	31 to 33
*Rocker arm bracket nuts (D1005-E2-ZD)	M7 x 1.0	22 to 26	2.2 to 2.7	16 to 19
*Rocker arm bracket screw (D1305-E3-ZD)	M7 x 1.0	22 to 26	2.2 to 2.7	16 to 19
*Idle gear shaft screws	M6 x 1.0	9.81 to 11.2	1.00 to 1.15	7.23 to 8.31
*Fan drive pulley screw	M14 x 1.5	236 to 245	24.0 to 25.0	174 to 180
*Bearing case cover mounting screw	M6 x 1.0	9.81 to 11.2	1.00 to 1.15	7.23 to 8.31
Glow plugs	M8 x 1.0	8 to 14	0.8 to 1.5	6 to 10
Nozzle holder assembly	M20 x 1.5	49 to 68	5.0 to 7.0	37 to 50
Nozzle holder	–	35 to 39	3.5 to 4.0	26 to 28
Oil pressure switch	PT 1/8	15 to 19	1.5 to 2.0	11 to 14
Injection pipe retaining nuts	M12 x 1.5	25 to 34	2.5 to 3.5	18 to 25
Overflow pipe assembly retaining nut	M12 x 1.5	20 to 24	2.0 to 2.5	15 to 18
Drain plug with rubber coated gasket	M22 x 1.5	45 to 53	4.5 to 5.5	33 to 39

W1013236

■ **NOTE**

- **For "*" marked screws, bolts and nuts on the table, apply engine oil to their threads and seats before tightening.**
- **The letter "M" in Size 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.**

4. CHECKING, DISASSEMBLING AND SERVICING

[1] CHECKING AND ADJUSTING

(1) Engine Body

Compression Pressure

1. Run the engine until it is warmed up.
2. Stop the engine.
3. Remove the air cleaner, the muffler and all glow plugs (or nozzles).
4. Set a compression tester with the adaptor to the glow plug hole (or nozzle hole).
   Nozzle hole : Adaptor **H** (07909-31231)
   Glow plug hole : Adaptor **L** (07909-31301)
5. After making sure that the stop lever is set at the stop position (non-injection), run the engine with the starter and measure the compression pressure.
6. Repeat steps 4 and 5 for each cylinder.
7. If the measurement is below the allowable limit, apply a small amount of oil to the cylinder wall through the glow plug hole (or nozzle hole) and measure the compression pressure again.
8. If the compression pressure is still less than the allowable limit, check the top clearance, valve clearance and cylinder head.
9. If the compression pressure increases after applying oil, check the cylinder wall and piston rings.

■ **NOTE**

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

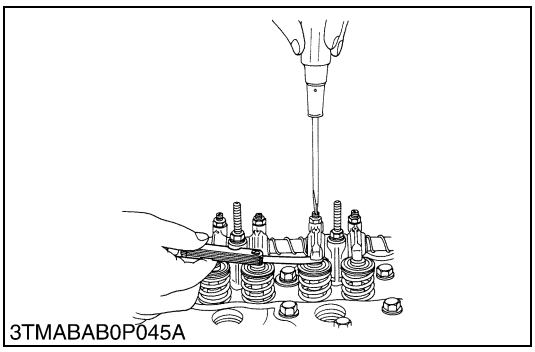
[D782-E2-ZD]

Compression pressure	Factory spec.	2.84 to 3.24 MPa 29 to 33 kgf/cm^2 412 to 469 psi
	Allowable limit	2.26 MPa 23 kgf/cm^2 327 psi

[D1005-E2-ZD, D1305-E3-ZD]

Compression pressure	Factory spec.	3.73 to 4.11 MPa 38.0 to 42.0 kgf/cm^2 541 to 597 psi
	Allowable limit	2.26 MPa 23.0 kgf/cm^2 327 psi

W10178940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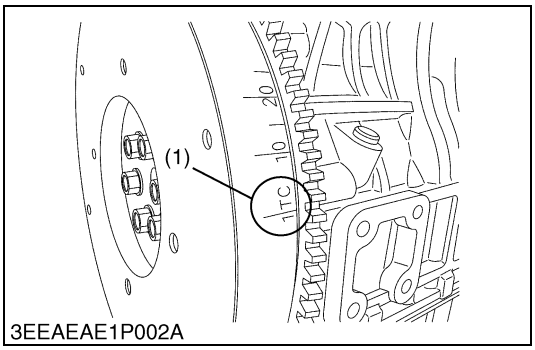

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Valve Clearance

■ **IMPORTANT**

- **Valve clearance must be checked and adjusted when engine is cold.**

1. Remove the cylinder head cover and the glow plugs.
2. Align the **"1TC"** mark (1) on the flywheel and alignment mark so that the No. 1 piston comes to the compression top dead center.
3. Check the following valve clearance marked with "☆" using a thickness gauge.
4. If the clearance is not within the factory specifications, adjust with the adjusting screw.
5. Then turn the flywheel 6.28 rad (360 °), and align the **"1TC"** mark (1) on the flywheel and alignment mark so that the No. 1 piston comes to the overlap position.
6. Check the following valve clearance marked with "☆" using a feeler gauge.

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

Valve clearance	Factory spec.	0.145 to 0.185 mm 0.00571 to 0.00728 in.

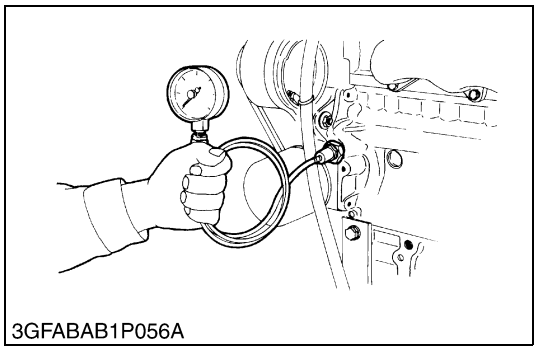
■ **NOTE**

- **The sequence of cylinder numbers is given as No. 1, No. 2 and No. 3 starting from the gear case side.**
- **After adjusting the valve clearance, secure the adjusting screw with the lock nut.**

(1) **"1TC"** Mark

W10155550

(2) Lubricating System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Engine Oil Pressure

1. Remove the engine oil pressure switch, and set an oil pressure tester.
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	Factory spec.	More than 49 kPa 0.50 kgf/cm^2 7.1 psi
	At rated speed	Factory spec.	197 to 441 kPa 2.00 to 4.50 kgf/cm^2 28.5 to 64.0 psi
		Allowable limit	147 kPa 1.50 kgf/cm^2 21.3 psi

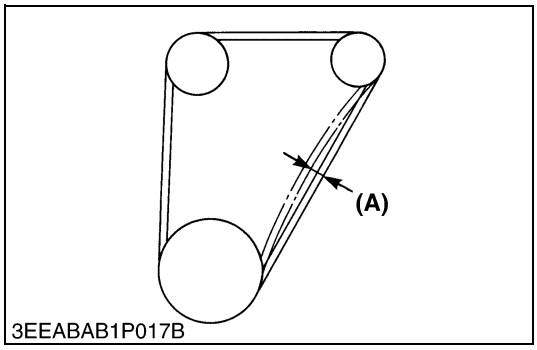
(When reassembling)

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

Tightening torque	Oil pressure switch	15 to 19 N·m 1.5 to 2.0 kgf·m 11 to 14 lbf·ft

W10349520

(3) Cooling System



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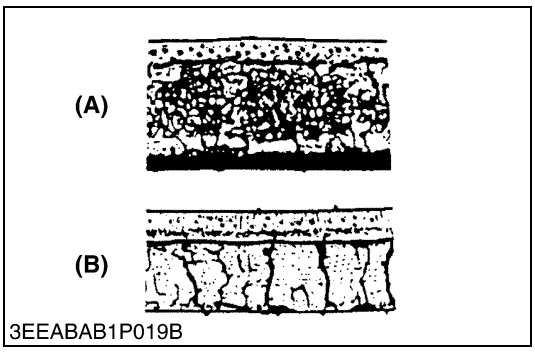
Fan Belt Tension

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 lbf).
2. If the measurement is not within the factory specifications, loosen the alternator mounting screws and relocate the alternator to adjust.

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

(A) Deflection

W10356670



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.

(A) Good **(B) Bad**

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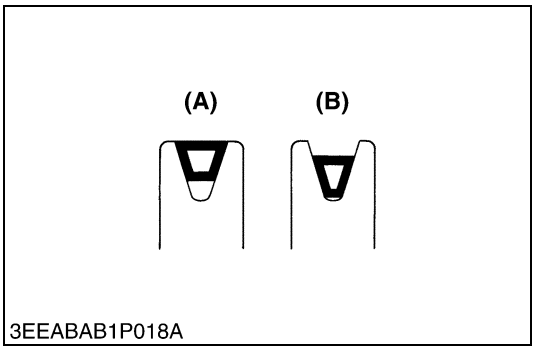
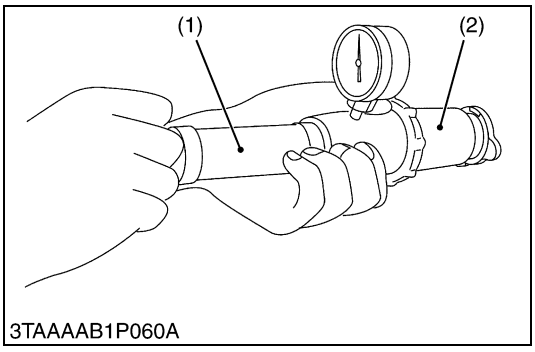


CAUTION

- **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.**



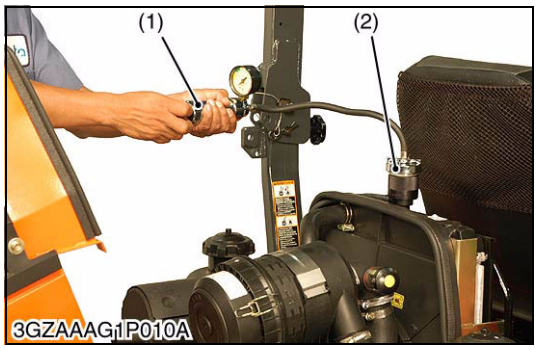
Radiator Cap Air Leakage

1. Set a radiator tester (1) and an adaptor (2) on the radiator cap.
2. Apply the specified pressure 88 kPa (0.9 kgf/cm^2, 13 psi), and measure the time for the pressure to fall to 59 kPa (0.6 kgf/cm^2, 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 0.90 to 0.60 kgf/cm^2, from 13 to 8.5 psi)

(1) Radiator Tester (2) Adaptor

W1054156



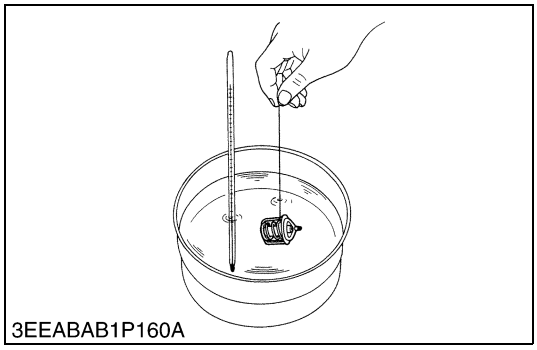
Radiator Water Leakage

1. Pour a specified amount of water into the radiator.
2. Set a radiator tester (1) and an adaptor (2) and raise the water pressure to the specified pressure.
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.	177 kPa 1.8 kgf/cm^2 25.7 psi

(1) Radiator Tester (2) Adaptor

W1016903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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. 8 mm (0.315 in.).
4. If the measurement is not within the factory specifications, replace the thermostat.

[D782-E2-ZD]

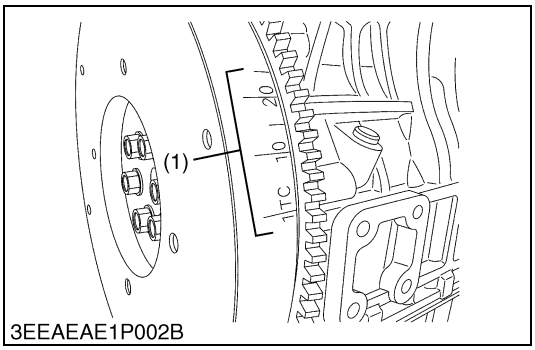
Thermostat's valve opening temperature	Factory spec.	69.5 to 72.5 °C 157.1 to 162.5 °F
Temperature at which thermostat completely opens	Factory spec.	85 °C 185 °F

[D1005-E2-ZD, D1305-E3-ZD]

Thermostat's valve opening temperature	Factory spec.	80.5 to 83.5 °C 176.9 to 182.3 °F
Temperature at which thermostat completely opens	Factory spec.	95 °C 203 °F

W1035849

(4) Fuel System



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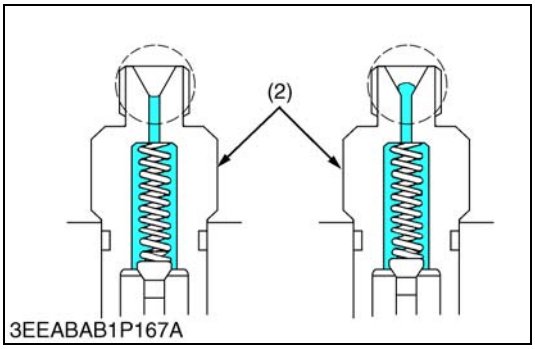

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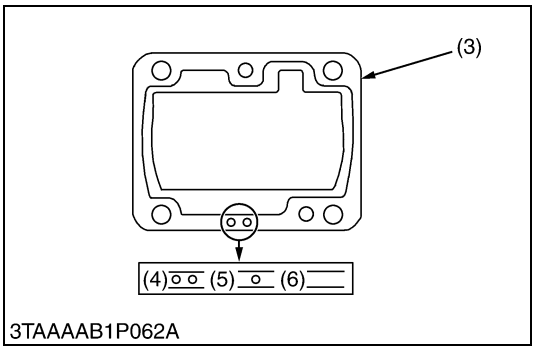

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Injection Timing

1. Remove the injection pipes.
2. Remove the engine stop solenoid.
3. Turn the flywheel counterclockwise (viewed from flywheel side) until the fuel fills up to the hole of the delivery valve holder (2) for No. 1 cylinder.
4. After the fuel fills up to the hole of the delivery valve holder for No. 1 cylinder, turn back (clockwise) the flywheel around 1.57 rad (90 °).
5. Turn the flywheel counterclockwise to set at around 0.44 rad (25 °) before T.D.C..
6. Slowly turn the flywheel counterclockwise and stop turning when the fuel begins to come up, to get the present injection timing.
7. Check to see the degree on flywheel.
   The flywheel gas mark “1TC”, “10” and “20” for the crank angle before the top dead center of No. 1 cylinder.
8. If injection timing is out of adjustment, readjust the timing with shims.

[D782-E2-ZD]

Injection timing	Factory spec.	0.28 to 0.31 rad (16 to 18 °) before T.D.C.

[D1005-E2-ZD, D1305-E3-ZD]

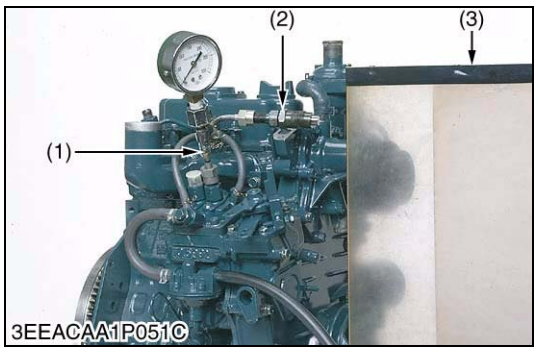
Injection timing	Factory spec.	0.30 to 0.33 rad (17 to 19 °) before T.D.C.

■ **NOTE**

- **The liquid gasket is not required for assembling.**
- **Shims are available in thickness of 0.175 mm (0.00689 in.), 0.20 mm (0.0079 in.), 0.25 mm (0.0098 in.) and 0.30 mm (0.012 in.). Combine these shims for adjustments.**
- **The 0.175 mm thick shim is coated only on the lower face. Therefore, do not use the 0.175 mm thick shim as the top shim of the combination (injection pump side), because this cause oil leakage.**
- **Addition or reduction of shim (0.05 mm, 0.002 in.) delays or advances the injection timing by approx. 0.0087 rad (0.50 °).**
- **In disassembling and replacing the injection pump, be sure to use the same number of new shims with the same thickness.**

(1) Timing Line
(2) Delivery Valve Holder
(3) Shim (Soft Metal Gasket Shim)
(4) Two-holes : 0.175 mm (0.00689 in.)
Two-holes : 0.20 mm (0.0079 in.)
(5) One-hole : 0.25 mm (0.0098 in.)
(6) Without hole : 0.30 mm (0.012 in.)

W1017170



Fuel Tightness of Pump Element

1. Remove the engine stop solenoid.
2. Remove the injection pipes and glow plugs.
3. Install the injection pump pressure tester to the injection pump.
4. Install the injection nozzle (2) jetted with the proper injection pressure to the injection pump pressure tester (1). (Refer to the photo.)
5. Set the speed control lever to the maximum speed position.
6. Run the starter to increase the pressure.
7. If the pressure can not reach the allowable limit, replace the pump with new one or repair with a Kubota-authorized pump service shop.

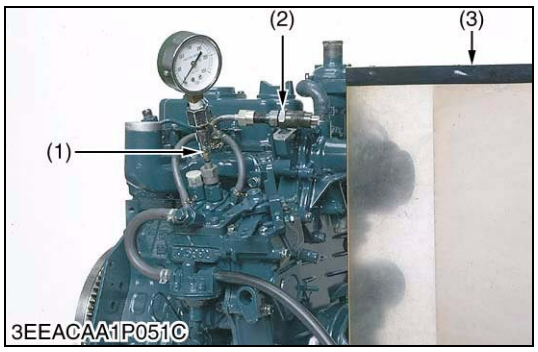
Fuel tightness of pump element	Allowable limit	13.73 MPa 140.0 kgf/cm^2 1991 psi

■ **NOTE**

- **Never try to disassemble the injection pump assembly. For repairs, you are strongly requested to contact a Kubota-authorized pump service shop.**

(1) Injection Pump Pressure Tester (3) Protection Cover for Jetted Fuel
(2) Injection Nozzle

W1017430



Fuel Tightness of Delivery Valve

1. Remove the engine stop solenoid.
2. Remove the injection pipes and glow plugs.
3. Set a pressure tester to the fuel injection pump.
4. Install the injection nozzle (2) jetted with the proper injection pressure to the injection pump pressure tester (1).
5. Run the starter to increase the pressure.
6. Stop the starter when the fuel jets from the injection nozzle. After that, turn the flywheel by the hand and raise the pressure to approx. 13.73 MPa (140.0 kgf/cm^2, 1991 psi).
7. Now turn the flywheel back about half a turn (to keep the plunger free). Maintain the flywheel at this position and clock the time taken for the pressure to drop from 13.73 to 12.75 MPa (from 140.0 to 130.0 kgf/cm^2, from 1991 to 1849 psi).
8. Measure the time needed to decrease the pressure from 13.73 to 12.75 MPa (140.0 to 130.0 kgf/cm^2, 1991 to 1849 psi).
9. If the measurement is less than allowable limit, replace the pump with new one or repair with a Kubota-authorized pump service shop.

Fuel tightness of delivery valve	Factory spec.	10 seconds 13.73 → 12.75 MPa 140.0 → 130.0 kgf/cm^2 1991 → 1849 psi
	Allowable limit	5 seconds 13.73 → 12.75 MPa 140.0 → 130.0 kgf/cm^2 1991 → 1849 psi

■ **NOTE**

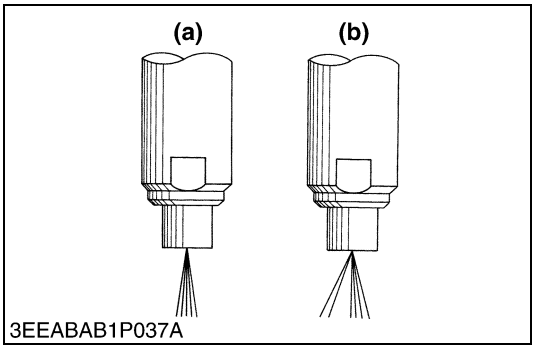
- **Never try to disassemble the injection pump assembly. For repairs, you are strongly requested to contact a Kubota-authorized pump service shop.**

(1) Injection Pump Pressure Tester (3) Protection Cover for Jetted Fuel
(2) Injection Nozzle

W1017786

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.**



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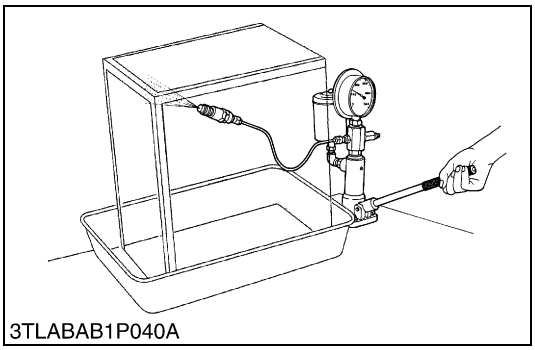
Nozzle Spraying Condition

1. Set the injection nozzle to a nozzle tester, and check the nozzle spraying condition.
2. If the spraying condition is defective, replace the nozzle piece.

(a) Good **(b) Bad**

W10181310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Fuel Injection Pressure

1. Set the injection nozzle to a nozzle tester.
2. Slowly move the tester handle to measure the pressure at which fuel begins jetting out from the nozzle.
3. If the measurement is not within the factory specifications, replace the adjusting washer (1) in the nozzle holder to adjust it.

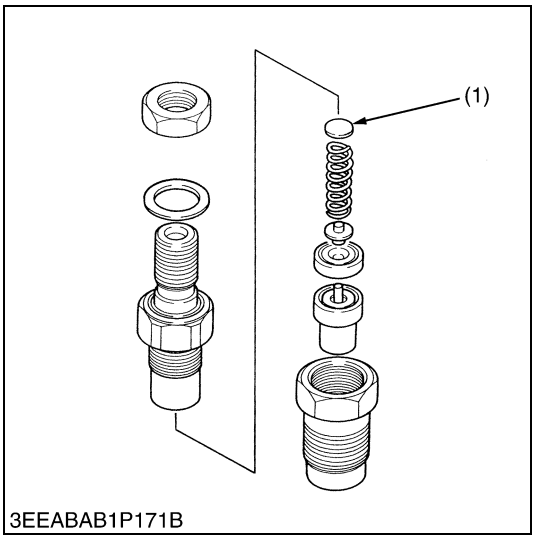
(Reference)

- Pressure variation with 0.01 mm (0.0004 in.) difference of adjusting washer thickness.
  Approx. 235 kPa (2.4 kgf/cm^2, 34 psi)

Fuel injection pressure	Factory spec.	13.73 to 14.70 MPa 140.0 to 150.0 kgf/cm^2 1991 to 2133 psi

(1) Adjusting Washer

W10182100



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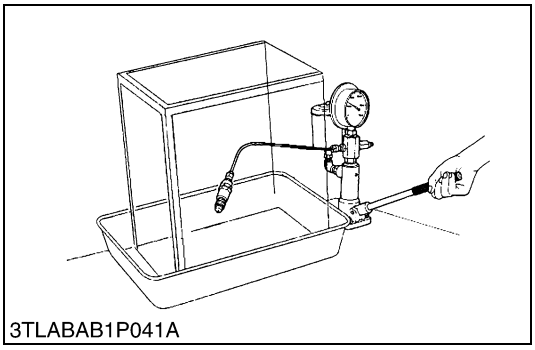
Valve Seat Tightness

1. Set the injection nozzle to a nozzle tester.
2. Raise the fuel pressure, and keep at 12.75 MPa (130.0 kgf/cm^2, 1849 psi) for 10 seconds.
3. If any fuel leak is found, replace the nozzle piece.

Valve seat tightness	Factory spec.	No fuel leak at 12.75 MPa 130.0 kgf/cm^2 1849 psi

W10183690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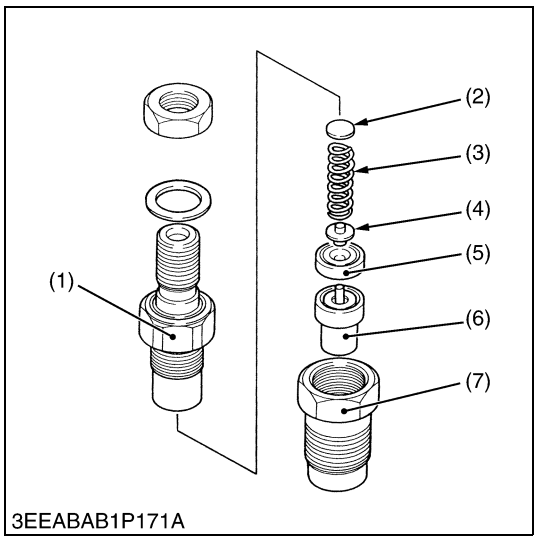


Nozzle Holder

1. Secure the nozzle retaining nut (7) with a vise.
2. Remove the nozzle holder (1), and take out parts inside.

(When reassembling)

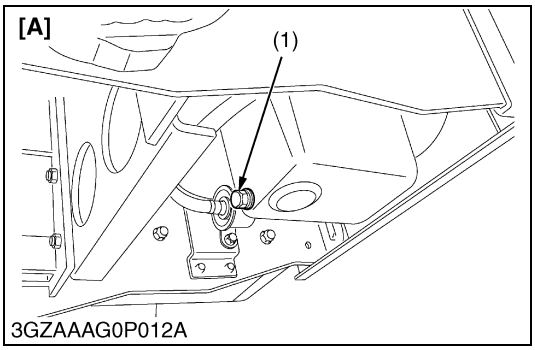
- Assemble the nozzle in clean fuel oil.
- Install the push rod (4), noting its direction.
- After assembling the nozzle, be sure to adjust the fuel injection pressure.

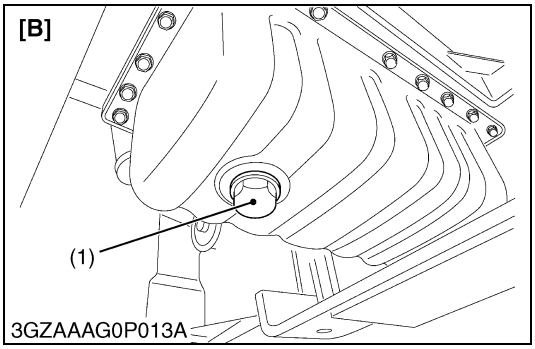
Tightening torque	Nozzle holder	35 to 39 N·m 3.5 to 4.0 kgf·m 26 to 28 lbf·ft
	Overflow pipe retaining nut	20 to 24 N·m 2.0 to 2.5 kgf·m 15 to 18 lbf·ft
	Nozzle holder assembly	49 to 68 N·m 5.0 to 7.0 kgf·m 36 to 50 lbf·ft

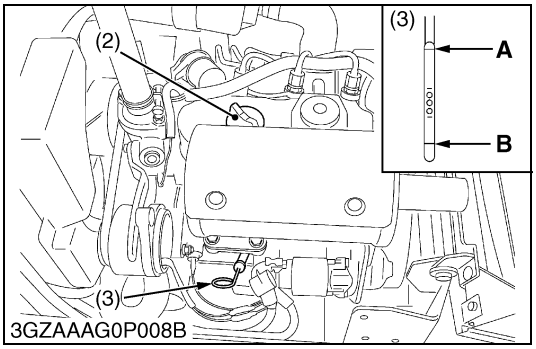
(1) Nozzle Holder
(2) Adjusting Washer
(3) Nozzle Spring
(4) Push Rod
(5) Distance Piece
(6) Nozzle Piece
(7) Nozzle Retaining Nut

W1018491

[2] SEPARATING ENGINE







Draining Engine Oil

1. Park the machine on level ground.
2. Start and warm up the engine for approx. 5 minutes.
3. Place an oil pan underneath the engine.
4. Remove the drain plug (1) to drain oil.
5. After draining, screw in the drain plug (1).

(When refilling)

- Fill the engine oil up to the upper line on the dipstick (3).

Engine oil capacity	ZD321	3.5 L 3.70 U.S.qts 3.08 Imp.qts
	ZD326	3.9 L 4.1 U.S.qts 3.4 Imp.qts
	ZD331	5.7 L 6.0 U.S.qts 5.0 Imp.qts

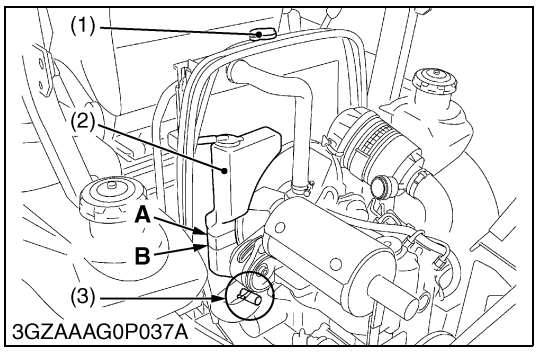
■ **IMPORTANT**

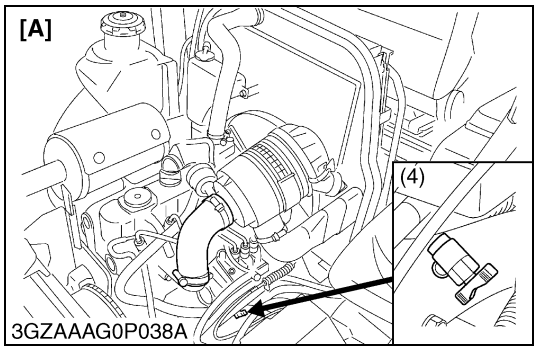
- **Never mix two different type of oil.**
- **Use the proper SAE Engine Oil according to ambient temperatures.**
  Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-7.)

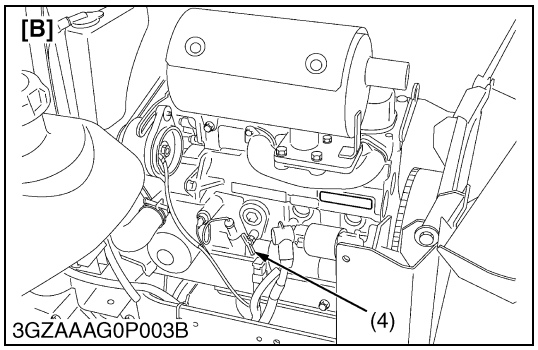
(1) Drain Plug
(2) Oil Inlet Plug
(3) Dipstick

[A] ZD321
[B] ZD326, ZD331
A : Upper Level
B : Lower Level

W1019220







Draining Coolant

CAUTION

- **Never open the radiator cap while operating or immediately after stopping. Otherwise, hot water will spout out from the radiator. Wait for more than ten minutes to cool the radiator, before opening the cap.**

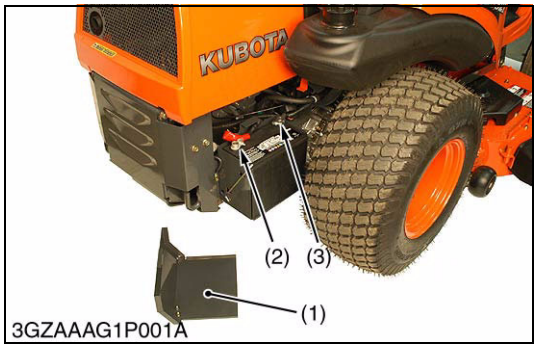
1. Stop the engine and let cool down.
2. Remove the radiator coolant drain plug (3) and engine coolant drain plug (4) to drain the coolant.
3. Remove the radiator cap (1) to completely drain the coolant.
4. After all coolant is drained, close the drain plugs.

Coolant	Capacity	ZD321 ZD326	Radiator	2.7 L 2.85 U.S.qts 2.38 Imp.qts
		ZD331	Radiator	3.5 L 3.70 U.S.qts 3.08 Imp.qts
		—	Recovery tank	0.25 L 0.26 U.S.qts 0.22 Imp.qts

(1) Radiator Cap
(2) Recovery Tank
(3) Radiator Coolant Drain Plug
(4) Engine Coolant Drain Cock

[A] ZD321
[B] ZD326, ZD331
A : Upper Level
B : Lower Level

W1019510



Battery

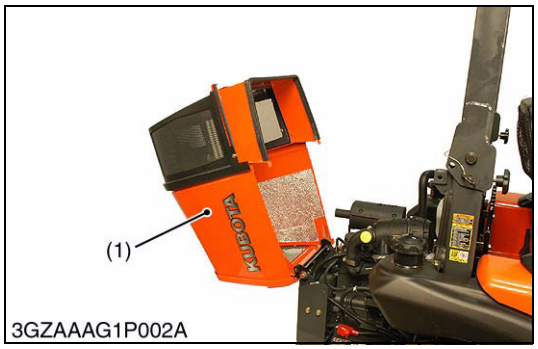
CAUTION

- **When disconnecting the battery cables, disconnect the negative cable from the battery first. When connecting, connect the positive cable to the battery first.**

1. Remove the battery cover (1).
2. Disconnect the negative cable (3) from the battery.
3. Disconnect the positive cable (2) from the battery.

(1) Battery Cover
(2) Positive Cable
(3) Negative Cable

W1019788

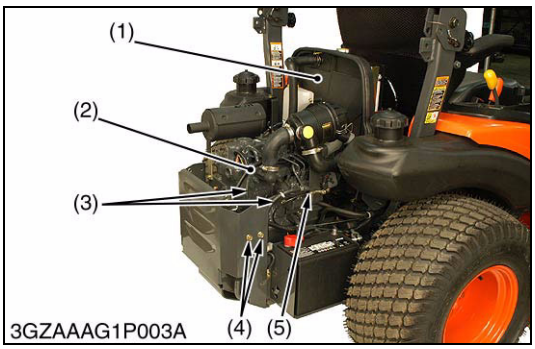


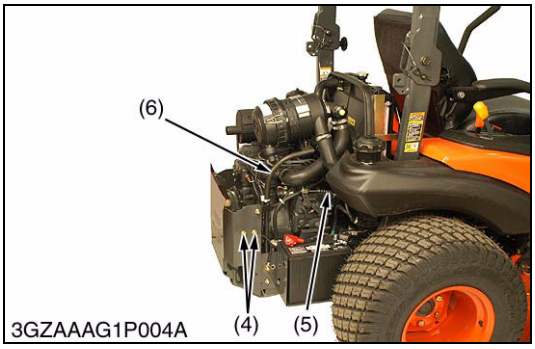
Bonnet

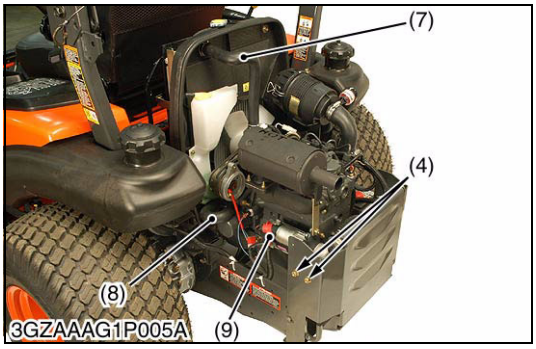
1. Remove the snap pin and bonnet mounting screw, then remove the bonnet (1).

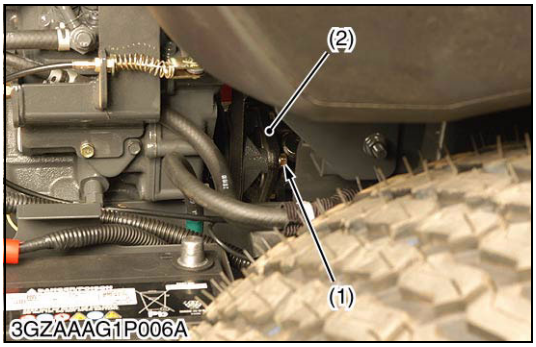
(1) Bonnet

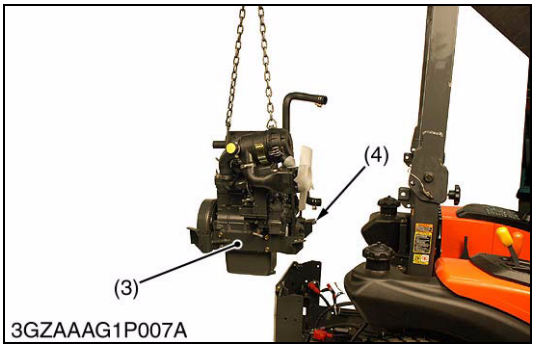
W1019921











Fan Shroud, Electric Wiring and Others

1. Disconnect the wiring connectors for engine stop solenoid, glow plug, coolant temperature sensor, engine oil pressure switch and dynamo.
2. Remove the positive cable (9) from starter motor.
3. Disconnect the accelerator wire (5).
4. Remove the air filter support (6) (ZD326 and ZD331).
5. Disconnect the fuel hoses (3) from engine.
6. Disconnect the water hoses (7), (8) and fan shroud (1).
7. Remove the engine stopper (4).

(When reassembling)

- When accelerator wire is installed, adjust the wiring length as hit both the idling speed adjusting bolt and the maximum speed adjusting bolt by lever within the stroke of the accelerator lever.

(1) Fan Shroud
(2) Wiring Harness
(3) Fuel Hose
(4) Engine Stopper
(5) Accelerator Wire (Throttle Cable)
(6) Air Filter Support
(7) Upper Hose
(8) Lower Hose
(9) Positive Cable

W1042721

Separating Engine

1. Remove the universal joint mounting screws (1).
2. Disconnect the universal joint (2) from fun drive pulley.
3. Remove the engine mounting nuts.
4. Separate the engine.
5. Remove the engine support LH (4) and RH (3).

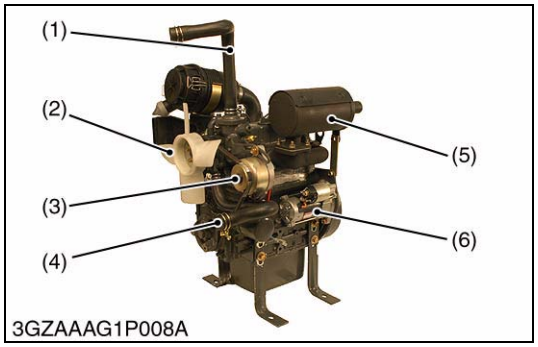
(When reassembling)

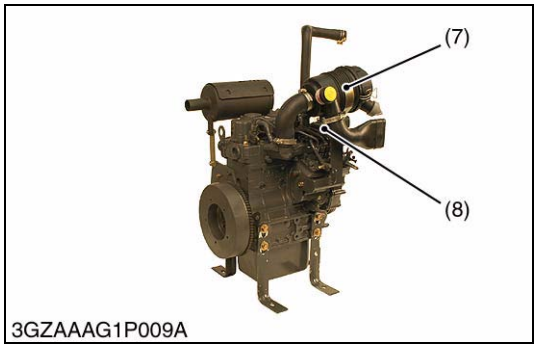
- Apply grease to the all splines on the drive shaft.

Tightening torque	Universal joint mounting screw	26.0 to 28.0 N·m 2.7 to 2.9 kgf·m 19.2 to 20.7 lbf·ft
	Engine mounting nut	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 lbf·ft

(1) Universal Joint Mounting Screw
(2) Universal Joint
(3) Engine Support (RH)
(4) Engine Support (LH)

W1046765





Dynamo, Fan Belt and Muffler

1. Remove the radiator hoses (1), (4).
2. Remove the cooling fan (2) and fan pulley.
3. Remove the dynamo (9) and fan belt.
4. Remove the muffler (5).
5. Remove the starter (6).
6. Disconnect the inlet hose, and remove the air cleaner (7) with inlet hose. Then remove the engine stop solenoid (8).

(When reassembling)

- Check to see that there are no cracks on the belt surface.

■ **IMPORTANT**

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

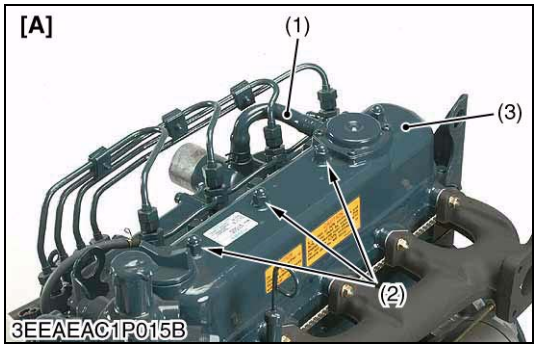
Tightening torque	Engine support mounting screw	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.4 to 41.2 lbf·ft

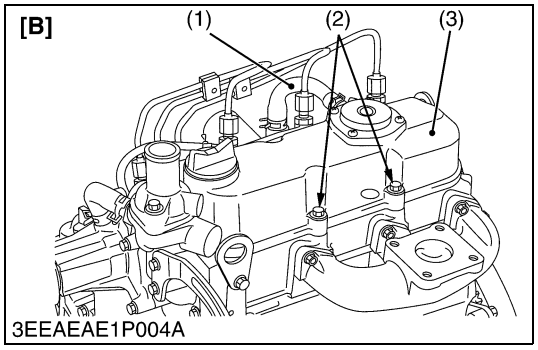
(1) Upper Hose
(2) Cooling Fan
(3) Dynamo
(4) Lower Hose
(5) Muffler
(6) Starter
(7) Air Cleaner with Inlet Hose
(8) Engine Stop Solenoid

W1024919

[3] DISASSEMBLING AND ASSEMBLING

(1) Cylinder Head and Valve





Cylinder Head Cover

1. Disconnect the breather hose (1).
2. Remove the cylinder head cover screw (2).
3. Remove the cylinder head cover (3).

(When reassembling)

- Check to see if the cylinder head cover gasket is not defective.

[D1005-E2-ZD]

Tightening torque	Cylinder head cover screw	6.9 to 8.8 N·m 0.7 to 0.9 kgf·m 5.1 to 6.5 lbf·ft

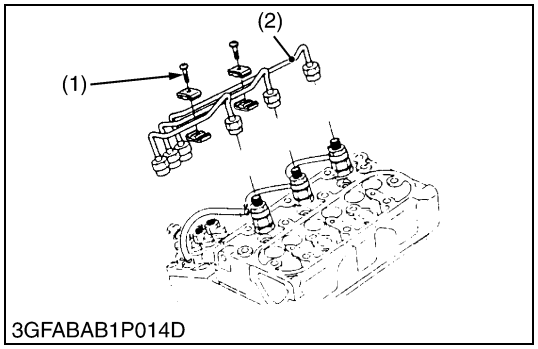
[D782-E2-ZD, D1305-E3-ZD]

Tightening torque	Cylinder head cover screw	9.81 to 11.2 N·m 1.00 to 1.15 kgf·m 7.23 to 8.31 lbf·ft

(1) Breather Hose
(2) Cylinder Head Cover Screw
(3) Cylinder Head Cover

[A] D1005-E2-ZD
[B] D782-E2-ZD, D1305-E3-ZD

W1028468



Injection Pipes

1. Loosen the screws to the pipe clamp (1).
2. Detach the injection pipes (2).

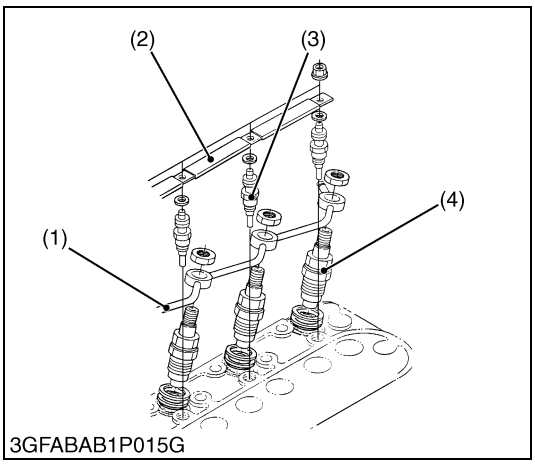
(When reassembling)

- Sent compressed air into the pipes to blow out dust. Then, reassemble the pipes in the reverse order.

Tightening torque	Injection pipe retaining nut	25 to 34 N·m 2.5 to 3.5 kgf·m 18 to 25 lbf·ft

(1) Pipe Clamp
(2) Injection Pipe

W1028640



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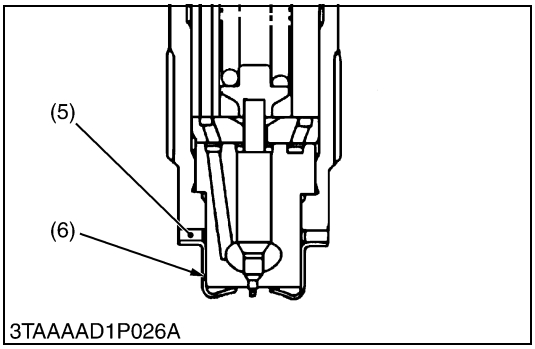

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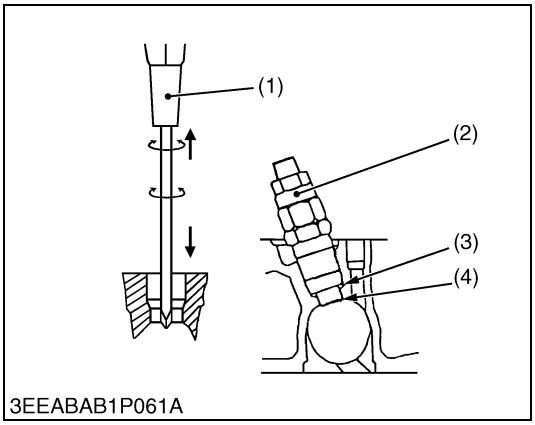

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Nozzle Holder Assembly and Glow Plug

1. Remove the overflow pipe (1).
2. Remove the nozzle holder assemblies (4).
3. Remove the copper gasket (5) and heat seal (6).
4. Remove the lead (2) from the glow plugs (3).
5. Remove the glow plugs (3).

(When reassembling)

- Replace the copper gasket and heat seal with new one.

Tightening torque	Overflow pipe retaining nut	20 to 24 N·m 2.0 to 2.5 kgf·m 15 to 18 lbf·ft
	Nozzle holder assembly	49 to 68 N·m 5.0 to 7.0 kgf·m 37 to 50 lbf·ft
	Glow plug	8 to 14 N·m 0.8 to 1.5 kgf·m 6 to 10 lbf·ft

(1) Overflow Pipe
(2) Lead
(3) Glow Plug
(4) Nozzle Holder Assembly
(5) Copper Gasket
(6) Heat Seal

W1024604

Nozzle Heat Seal Service Removal Procedure

■ **IMPORTANT**

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

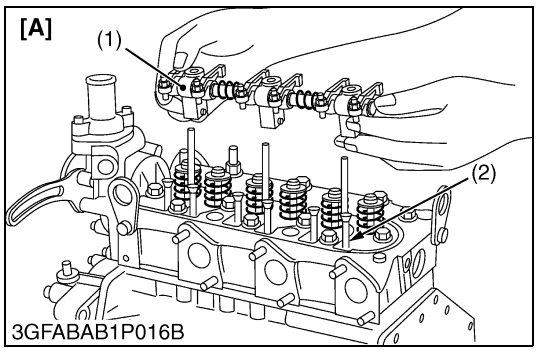
1. Drive screw driver (1) lightly into the heat seal hole.
2. Turn screw driver three or four times each way.
3. While turning the screw driver, slowly pull the heat seal (4) out together with the injection nozzle gasket (3).
4. If the heat seal drops, repeat the above procedure.

(When reassembling)

- Heat seal and injection nozzle gasket must be changed when the injection nozzle is removed for cleaning or for service.

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

W1021255



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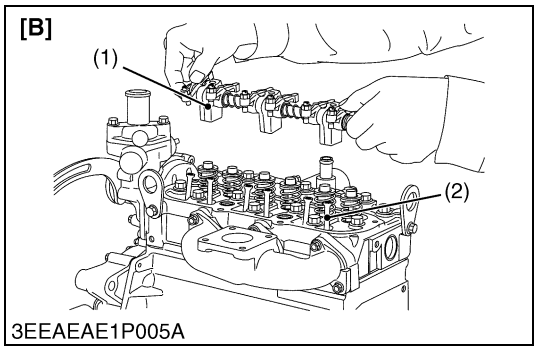

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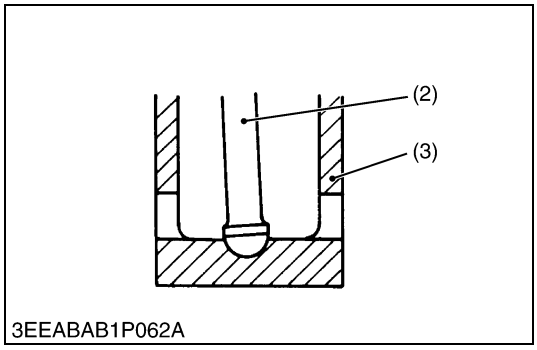

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Rocker Arm and Push Rod

1. Remove the rocker arm bracket screws.
2. Detach the rocker arm assembly (1).
3. Remove the push rods (2).

(When reassembling)

- When putting the push rods (2) onto the tappets (3), check to see if their ends are properly engaged with the dimples.

■ **IMPORTANT**

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

[D782-E2-ZD]

Tightening torque	Rocker arm bracket screw	9.81 to 11.2 N·m 1.00 to 1.15 kgf·m 7.24 to 8.31 lbf·ft

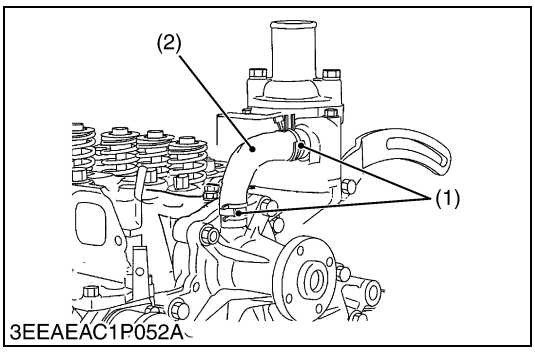
[D1005-E2-ZD, D1305-E3-ZD]

Tightening torque	Rocker arm bracket screw	22 to 26 N·m 2.2 to 2.7 kgf·m 16 to 19 lbf·ft

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

[A] D1005-E2-ZD
[B] D782-E2-ZD, D1305-E3-ZD

W1021437



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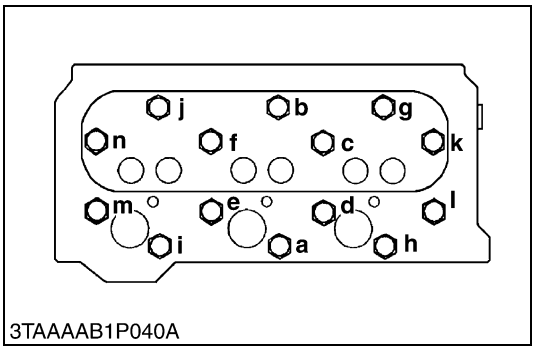

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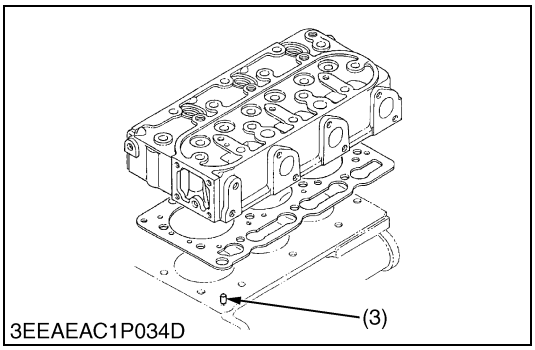

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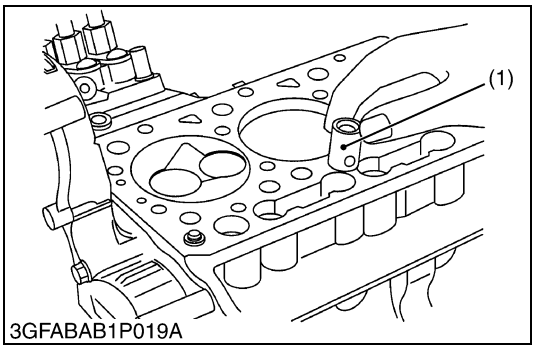

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Cylinder Head and Cylinder Head Gasket

1. Loosen the pipe clamps (1), and remove the water return pipe (2).
2. Remove the cylinder head screw in the order of (**n**) to (**a**) and remove the cylinder head.
3. Remove the cylinder head gasket.

(When reassembling)

- Replace the cylinder head gasket with new one.
- When mounting the gasket, set it to the pin pipe holes. Take care not to mount it reversely.
- The cylinder head should be free of scratches and dust.
- Install the cylinder head, using care not to damage the gasket.
- After applying engine oil to the thread of screws, tighten them in several steps and specified sequence (**a**) to (**n**).

■ **NOTE**

- **Do not use O-ring on the pin pipe.**
- **It is not necessary to retighten the cylinder head screw and to readjust valve clearance after engine warmed up.**

[D782-E2-ZD]

Tightening torque	Cylinder head screw	37.3 to 42.2 N·m 3.8 to 4.3 kgf·m 27.5 to 31.1 lbf·ft

[D1005-E2-ZD, D1305-E3-ZD]

Tightening torque	Cylinder head screw	64 to 68 N·m 6.5 to 7.0 kgf·m 47 to 50 lbf·ft

(1) Clamp
(2) Return Pipe
(3) Pin Pipe

n to a : To Loosen
a to n : To Tighten

W10205250

Tappets

1. Remove the tappets (1) from the crankcase.

(When reassembling)

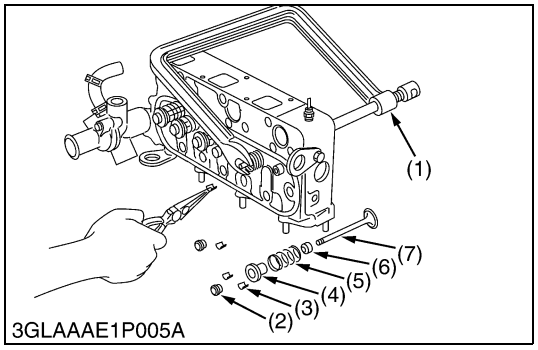
- Visually check the contact between tappets and cams for proper rotation. If defect is found, replace tappets.
- Before installing the tappets, apply engine oil thinly around them.

■ **IMPORTANT**

- **Do not change the combination of tappet and tappet guide.**

(1) Tappet

W10209700



Valves

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

(When reassembling)

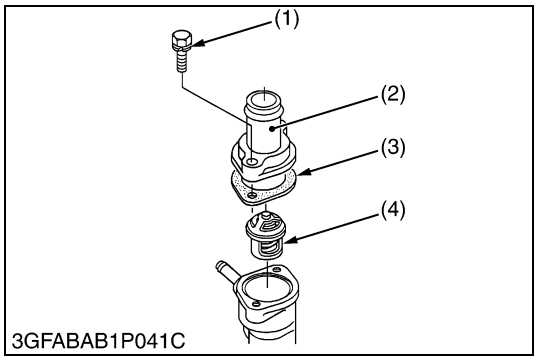
- Wash the valve stem and valve guide hole, and apply engine oil sufficiently.
- After installing the valve spring collets, lightly tap the stem to assure proper fit with a plastic hammer.

■ **IMPORTANT**

- **Do not change the combination of valve and valve guide.**

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

W10211070



Thermostat Assembly

1. Remove the thermostat cover mounting screws (1), and remove the thermostat cover (2).
2. Remove the thermostat assembly (4).

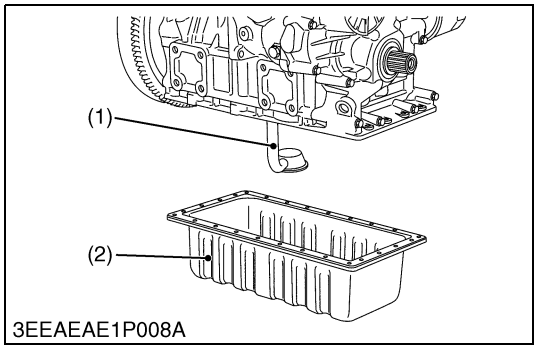
(When reassembling)

- Apply a liquid gasket (Three Bond 1215 or equivalent) only at the thermostat cover side of the gasket (3).

(1) Thermostat Cover Mounting Screw
(2) Thermostat Cover
(3) Thermostat Cover Gasket
(4) Thermostat Assembly

W10363950

(2) Gear Case and Timing Gears

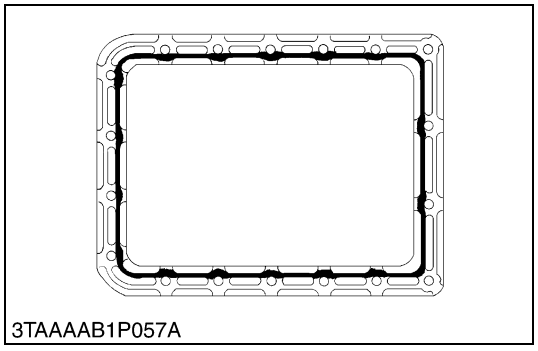


Oil Pan and Oil Strainer (D1305-E3-ZD)

1. Remove the oil pan mounting screws.
2. Remove the oil pan (2).
3. Remove the oil strainer (1).

(When reassembling)

- After cleaning the oil strainer, check to see that the filter mesh in clean, and install it.
- Visually check the O-ring, apply engine oil, and install it.
- Securely fit the O-ring to the oil strainer.
- To avoid uneven tightening, tighten oil pan mounting screws in diagonal order form the center.

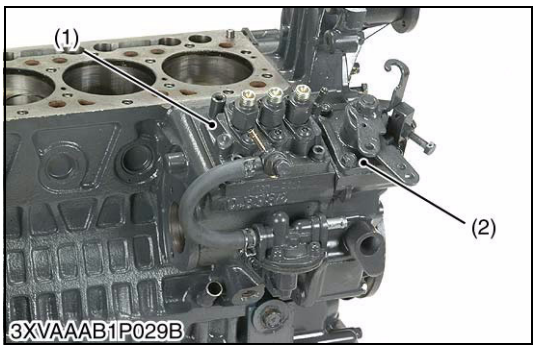


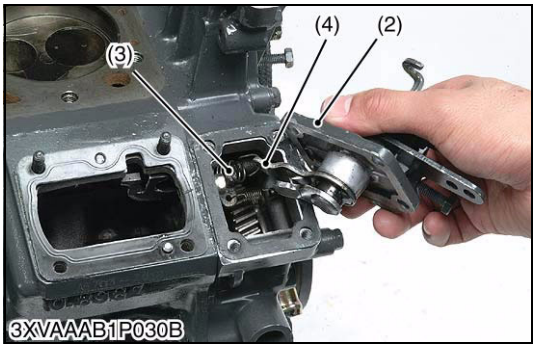
■ **IMPORTANT**

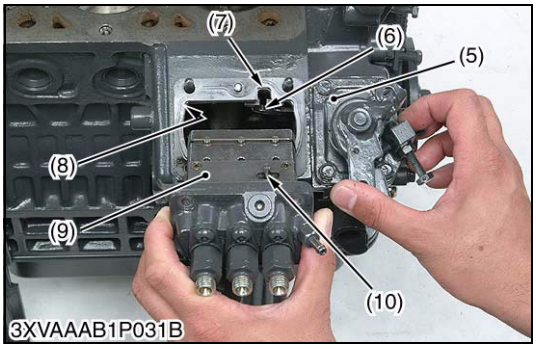
- **Scrape off the old adhesive completely. Wipe the sealing surface clean using waste cloth soaked with gasoline. Now apply new adhesive 3.0 to 5.0 mm (0.12 to 0.19 in.) thick all over the contact surface. Apply the adhesive also on the center of the flange as well as on the inner wall of each screw hole.**
- **Cut the nozzle of the "liquid gasket" container at its second notch. Apply "liquid gasket" about 5.0 mm (0.19 in.) thick. Within 20 minutes after the application of fluid sealant, reassemble the components. Wait then for about 30 minutes, and pour oil in the crankcase.**

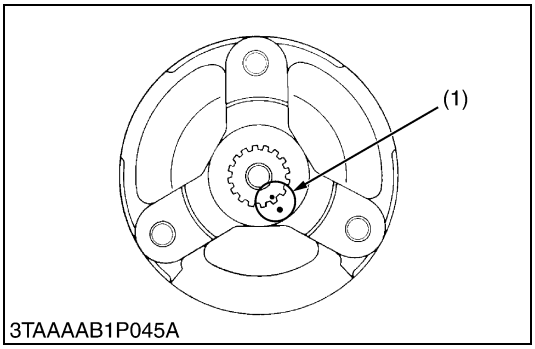
(1) Oil Strainer
(2) Oil Pan

W10236610









Injection Pump and Speed Control Plate (D782-E2-ZD)

1. Remove the socket head screws and nuts, and remove the injection pump (1).
2. Remove the screws and separate the speed control plate (2), taking care not to damage the governor spring (3).
3. Disconnect the governor spring (3) and remove the speed control plate (2).

(When reassembling)

- Hook the governor spring (3) to the governor lever (4) first and install the speed control plate (2).
- Be sure to place the copper washers underneath two screws (5). (Two screws (5) in the upper of the speed control plate (2).)
- Position the slot (6) on the fork lever just under the slot (7) on the crankcase.
- Insert the injection pump (1) so that the control rod (9) should be pushed by the idling adjusting spring (8) at its end and the pin (10) on the rod engages with the slow (6) on the fork lever (as shown in the photo).

■ **NOTE**

- **The sealant is applied to both sides of the soft metal gasket shim. The liquid gasket is not required for assembling.**
- **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) Injection Pump
(2) Speed Control Plate
(3) Governor Spring
(4) Governor Lever
(5) Screw and Copper Washer
(6) Slot (Fork Lever Side)
(7) Slot (Crankcase Side)
(8) Idling Adjusting Spring
(9) Control Rod
(10) Pin

W1063799

Fan Drive Pulley

1. Secure the flywheel to keep it from turning.
2. Remove the fan drive pulley screw.
3. Draw out the fan drive pulley with a puller.

(When reassembling)

- Install the pulley to crankshaft, aligning the mark (1) on them (3-cylinder engine).
- Apply engine oil to the fan drive pulley retaining screw. And tighten it.

[D782-E2-ZD]

Tightening torque	Fan drive pulley screw	117.7 to 127.5 N·m 12.0 to 13.0 kgf·m 86.8 to 94.0 lbf·ft

[D1005-E2-ZD, D1305-E3-ZD]

Tightening torque	Fan drive pulley screw	236 to 245 N·m 24.0 to 25.0 kgf·m 174 to 180 lbf·ft

(1) Aligning Mark

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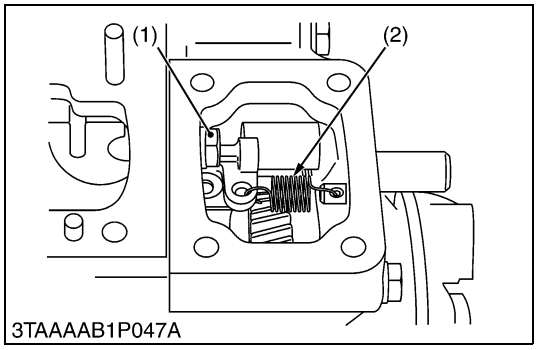

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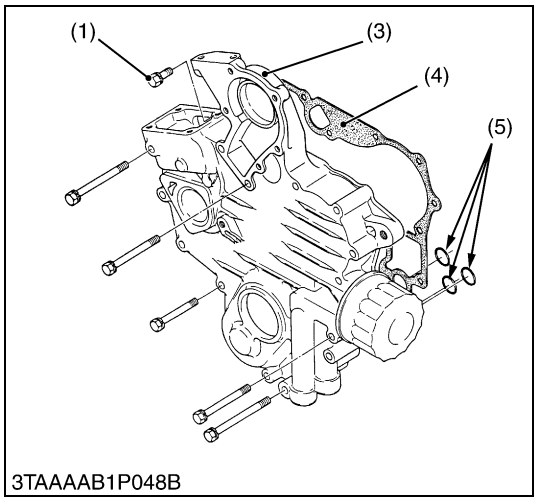

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Gear Case (D782-E2-ZD)

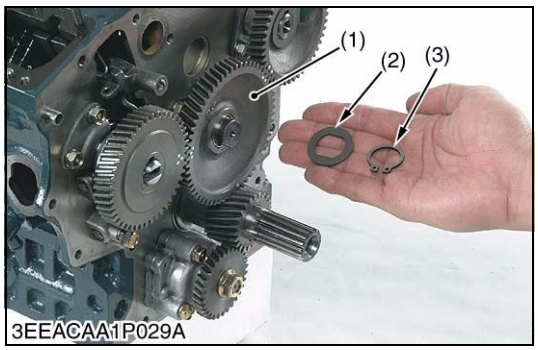
1. Remove the screw (1).
2. Disconnect the start spring (2) in the speed control plate mounting hole.
3. Remove the gear case (3).

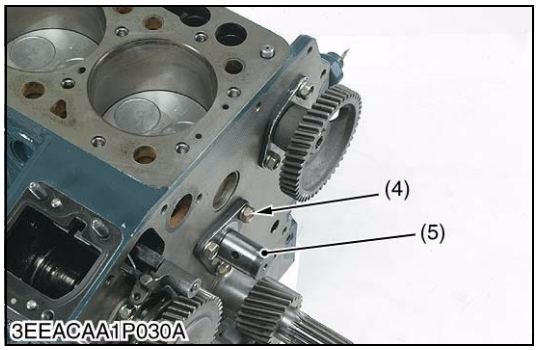
(When reassembling)

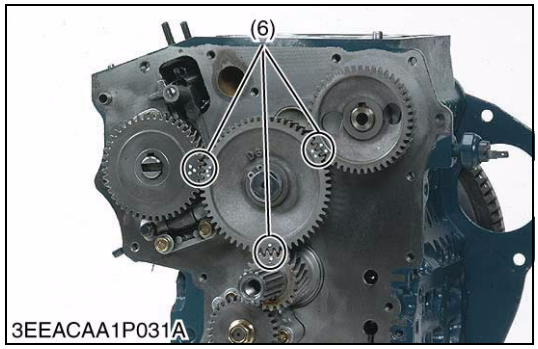
- Apply a liquid gasket (Three Bond 1215 or equivalent) to both sides of the gear case gasket (4).
- Be sure to set three O-rings (5) inside the gear case.

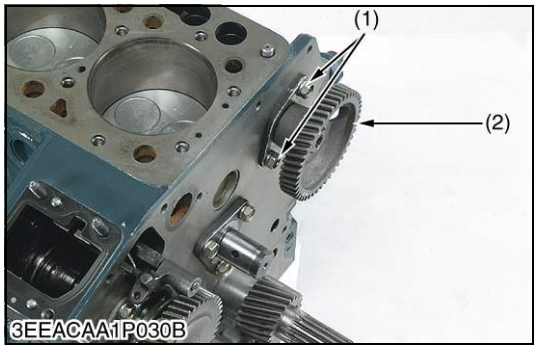
(1) Screw
(2) Start Spring
(3) Gear Case
(4) Gear Case Gasket
(5) O-rings

W10174840









Idle Gear (D782-E2-ZD)

1. Remove the external snap ring (3), the collar (2) and the idle gear (1).
2. Remove the idle gear shaft mounting screws (4).
3. Remove the idle gear shaft (5) (if necessary).

(When reassembling)

- Apply engine oil to the idle gear shaft mounting screw (4). And tighten them.
- Install the idle gear, aligning the mark (6) on the gears referring to the photo.

Tightening torque	Idle gear shaft mounting screw	9.8 to 11.3 N·m 1.00 to 1.15 kgf·m 7.2 to 8.3 lbf·ft

(1) Idle Gear
(2) Idle Gear Collar
(3) External Snap Ring
(4) Idle Gear Shaft Mounting Screw
(5) Idle Gear Shaft
(6) Alignment Mark

W1030437

Camshaft (D782-E2-ZD)

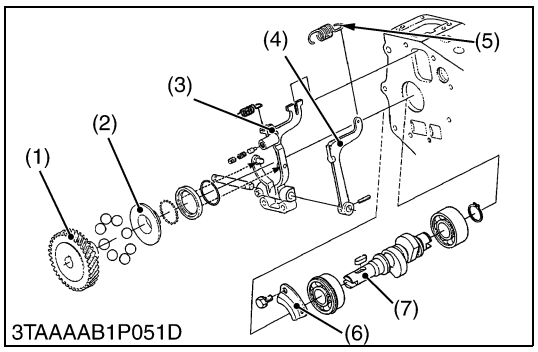
1. Remove the camshaft mounting screws (1) and draw out the camshaft with gear (2) on it.

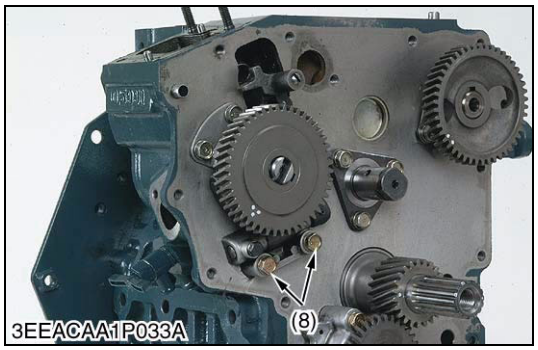
(When reassembling)

- When install the camshaft, apply engine oil to the camshaft journals.
- Apply engine oil to the camshaft mounting screws. And tighten them.

(1) Camshaft Mounting Screw
(2) Camshaft Gear

W1030808





Fuel Camshaft (D782-E2-ZD)

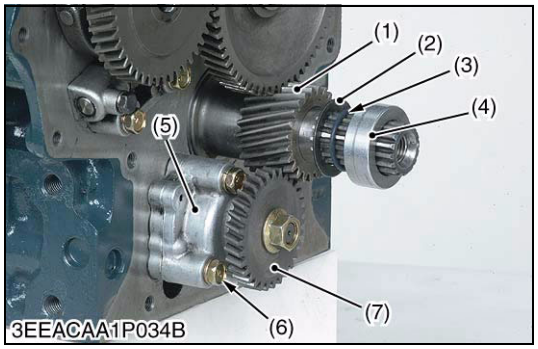
1. Remove the retaining plate (6).
2. Remove the fork lever holder mounting screws (8), then draw out the injection pump gear (1) and fuel camshaft (7) with the governor fork assembly.

(When reassembling)

- Hook the governor spring (5) to the fork lever 2 (4) before installing the fork lever assembly to the crankcase.

(1) Injection Pump Gear
(2) Governor Sleeve
(3) Fork Lever 1
(4) Fork Lever 2
(5) Governor Spring
(6) Retaining Plate
(7) Fuel Camshaft
(8) Fork Lever Holder Mounting Screw

W10178820



Oil Pump and Crankshaft Gear (D782-E2-ZD)

1. Remove the oil pump gear (7).
2. Remove the oil pump mounting screw (6) and the oil pump (5).
3. Remove the collar (4), O-ring (3) and crankshaft oil slinger (2).
4. Remove the crankshaft gear (1) with a puller.

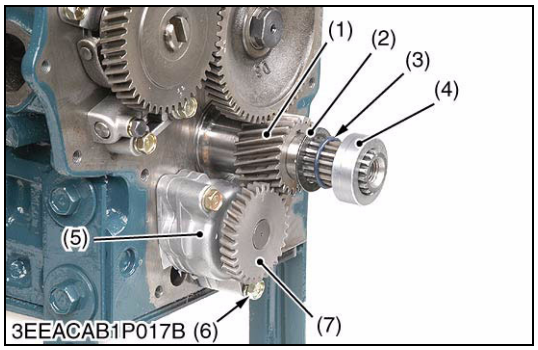
(When reassembling)

- Install the collar (4) after aligning the marks on the gears. (See the photo at “Idle Gear”.)

Tightening torque	Oil pump mounting screw	17.7 to 21.6 N·m 1.80 to 2.20 kgf·m 13.0 to 15.9 lbf·ft

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

W10180290



Oil Pump and Crankshaft Gear (D782-E2-ZD)

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

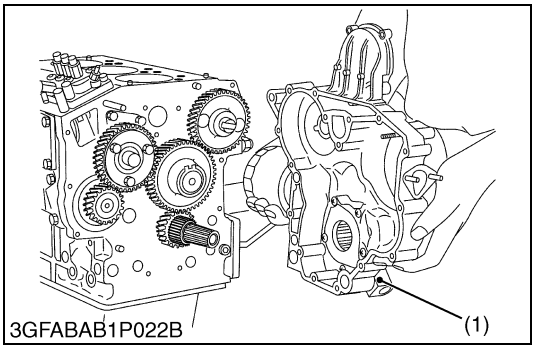
(When reassembling)

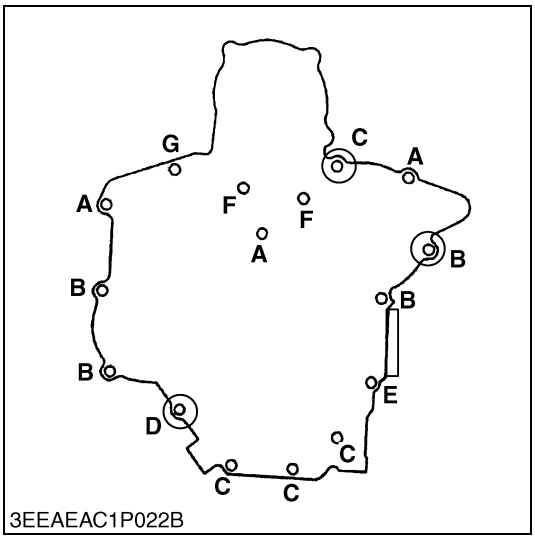
- Install the collar (4) after aligning the marks on the gears. (See the photo at “Idle Gear”.)

Tightening torque	Oil pump mounting screw	17.7 to 21.6 N·m 1.80 to 2.20 kgf·m 13.0 to 15.9 lbf·ft

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

W10314010





Gear Case (D1005-E2-ZD)

1. Remove the gear case.

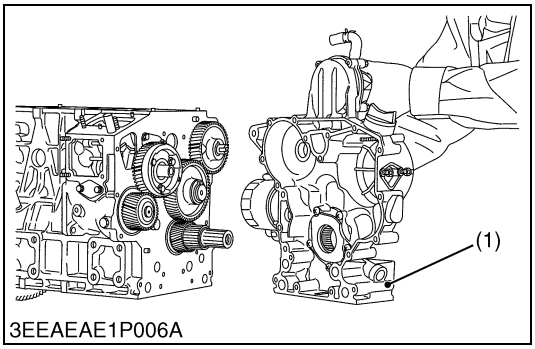
(When reassembling)

- Grease thinly to the oil seal, and install it, ensuring the lip does not come off.

(1) Gear Case

A : Bolt Length = 45 mm (1.8 in.)
B : Bolt Length = 50 mm (2.0 in.)
C : Bolt Length = 55 mm (2.2 in.)
D : Bolt Length = 65 mm (2.6 in.)
E : Bolt Length = 68 mm (2.7 in.)
F : Bolt Length = 85 mm (3.3 in.)
G : Nut

W1069515



Gear Case (D1305-E3-ZD)

1. Remove the fuel feed pump.
2. Remove the gear case.

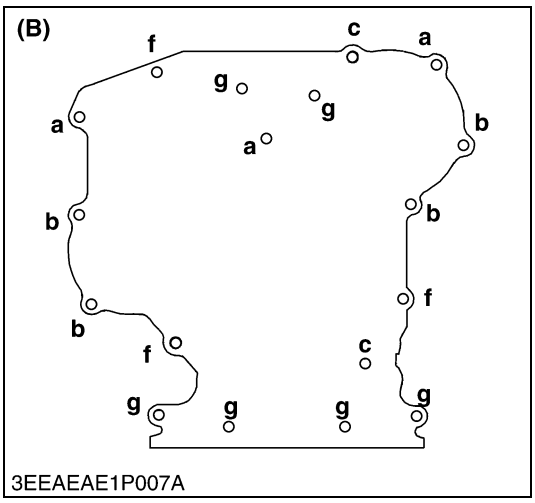
(When reassembling)

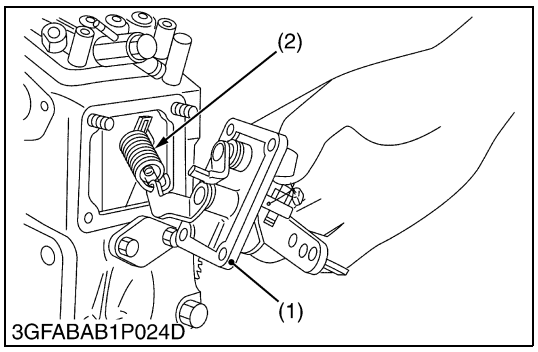
- Grease thinly to the oil seal, and install it, ensuring the lip does not come off.

(1) Gear Case

A : Bolt Length = 45 mm (1.8 in.)
B : Bolt Length = 50 mm (2.0 in.)
C : Bolt Length = 55 mm (2.2 in.)
D : Bolt Length = 70 mm (2.8 in.)
E : Bolt Length = 85 mm (3.3 in.)
F : Nut

W1030917





Speed Control Plate (D1005-E2-ZD, D1305-E3-ZD)

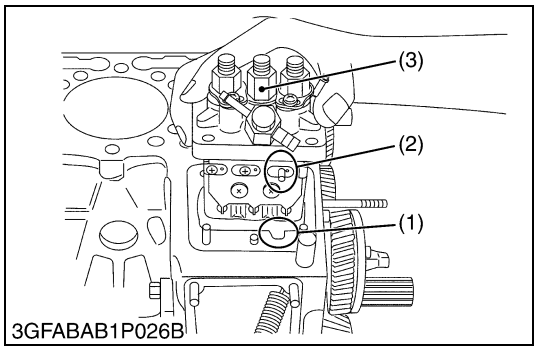
1. Remove the engine stop solenoid.
2. Remove the speed control plate (1).

(When reassembling)

- Apply a liquid gasket (Three Bond 1215 or equivalent) to both sides of the solenoid cover gasket and control plate gasket.
- Be careful not to drop the governor spring (2) into the crankcase.

(1) Speed Control Plate (2) Governor Spring

W1031942



Injection Pump (D1005-E2-ZD, D1305-E3-ZD)

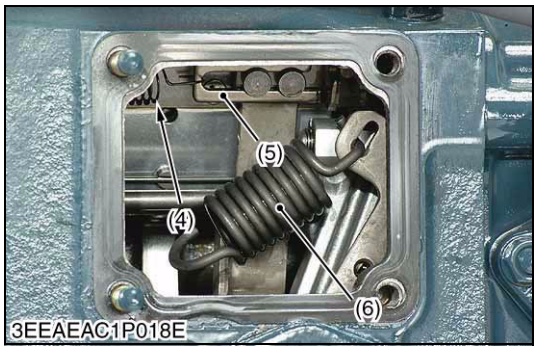
1. Disconnect the start spring (4) on the thrust lever side (5).
2. Align the control rack pin (2) with the notch (1) on the crankcase, and remove the injection pump (3).
3. Remove the injection pump shims.
4. In principle, the injection pump should not be disassembled.

(When reassembling)

- When installing the injection pump, insert the control rack pin (2) firmly into the groove (7) of the thrust lever of fork lever.

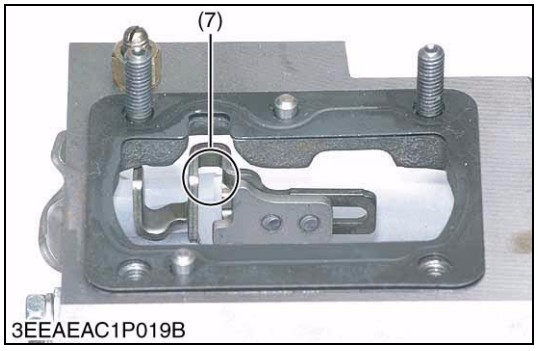
■ **NOTE**

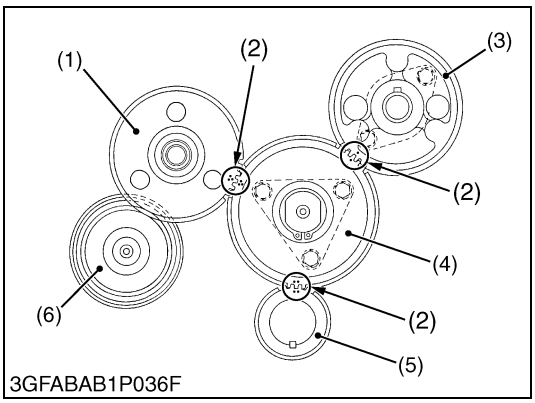
- **Addition or reduction of shim (0.05 mm, 0.002 in.) delays or advances the injection timing by approx. 0.0087 rad (0.50 °).**
- **In disassembling and replacing, be sure to use the same number or new gasket shims with the same thickness.**



(1) Notch
(2) Control Rack Pin
(3) Injection Pump
(4) Start Spring
(5) Thrust Lever
(6) Governor Spring
(7) Groove

W1033441





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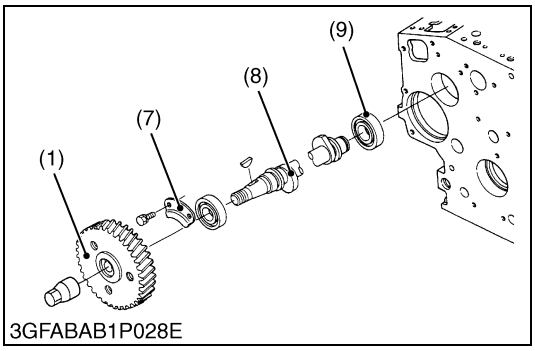

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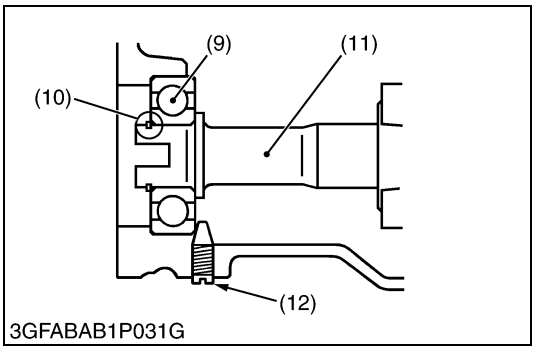

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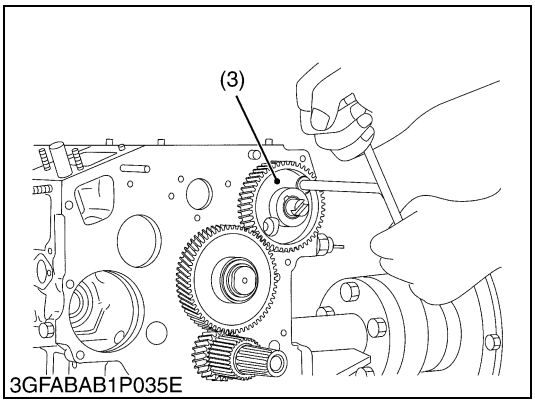

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Cam Gear, Idle Gear 1 and Governor Gear (D1005-E2-ZD, D1305-E3-ZD)

1. Remove the idle gear 1 (4).
2. Remove the fuel camshaft stopper (7).
3. Draw out the injection pump gear (1) with fuel camshaft (8).
4. Remove the camshaft stopper bolt.
5. Remove the cam gear (3) with camshaft.
6. Remove the external snap ring (10) from the governor shaft (11).
7. Remove the governor gear (6) with governor shaft (11).

■ **NOTE**

- **Three-lever type fork lever**
  To remove the governor shaft, follow the procedures in 5, 6 above and never remove fork lever and the max torque limiter.

(When reassembling)

- Apply engine oil thinly to the fuel camshaft before installation.
- Make sure to assemble the external snap ring of the governor shaft.
- Check the governor shaft for smooth rotation.

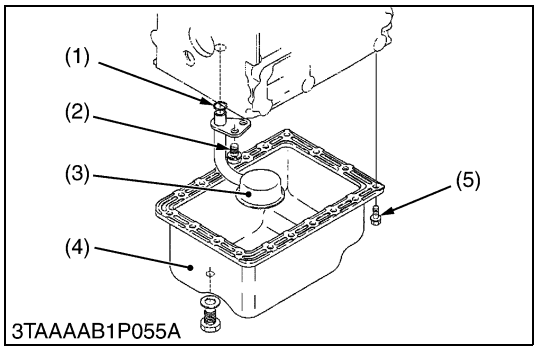
■ **IMPORTANT**

- **When replacing the ball bearing of governor shaft, securely fit the ball bearing (9) to the crankcase, apply an adhesive (Three Bond 1324B or equivalent) to the set screw (12), and fasten the screw until its tapered part contacts the circumferential end of the ball bearing.**
- **When installing the idle gear, be sure to align the alignment marks on each gears.**

(1) Injection Pump Gear
(2) Alignment Mark
(3) Cam Gear
(4) Idle Gear 1
(5) Crank Gear
(6) Governor Gear
(7) Fuel Camshaft Stopper
(8) Fuel Camshaft
(9) Ball Bearing
(10) External Snap Ring
(11) Governor Shaft
(12) Set Screw

W1033942

(3) Piston and Connecting Rod



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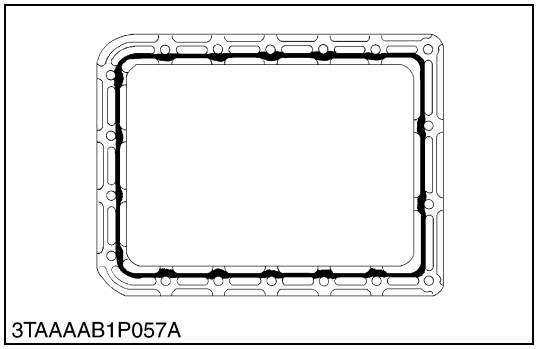
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Oil Pan and Oil Strainer (D782-E2-ZD, D1005-E2-ZD)

1. Remove the oil pan mounting screws (5).
2. Remove the oil pan (4).
3. Remove the oil strainer (3).

(When reassembling)

- After cleaning the oil strainer, check to see that the filter mesh in clean, and install it.
- Visually check the O-ring (1), apply engine oil, and install it.
- Securely fit the O-ring to the oil strainer.
- To avoid uneven tightening, tighten oil pan mounting screws in diagonal order form the center.

■ **IMPORTANT**

- **Scrape off the old adhesive completely. Wipe the sealing surface clean using waste cloth soaked with gasoline. Now apply new adhesive 3 to 5 mm (0.12 to 0.20 in.) thick all over the contact surface. Apply the adhesive also on the center of the flange as well as on the inner wall of each screw hole.**
- **Cut the nozzle of the "liquid gasket" container at its second notch. Apply "liquid gasket" about 5 mm (0.20 in.) thick. Within 20 minutes after the application of fluid sealant, reassemble the components. Wait then for about 30 minutes, and pour oil in the crankcase.**

(1) O-ring
(2) Screw
(3) Oil Strainer
(4) Oil Pan
(5) Oil Pan Mounting Screw

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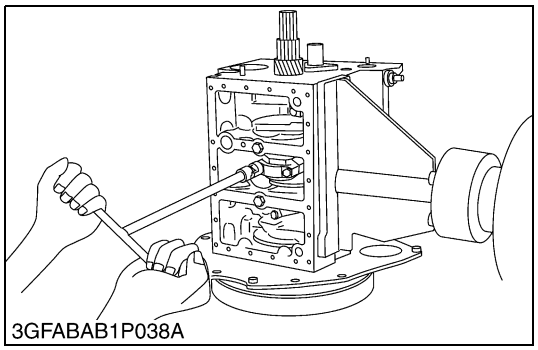
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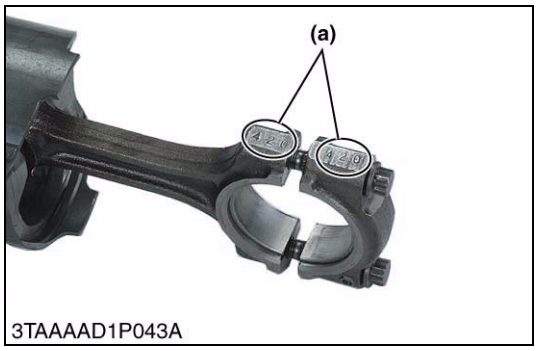
Connecting Rod

1. Remove the connecting rod cap.

(When reassembling)

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

Tightening torque	Connecting rod screw	42 to 46 N·m 4.2 to 4.7 kgf·m 31 to 33 lbf·ft



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(a) Mark

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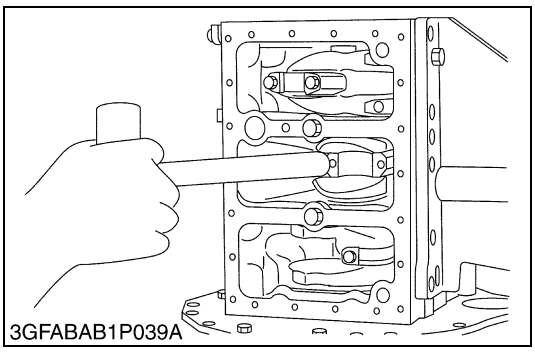
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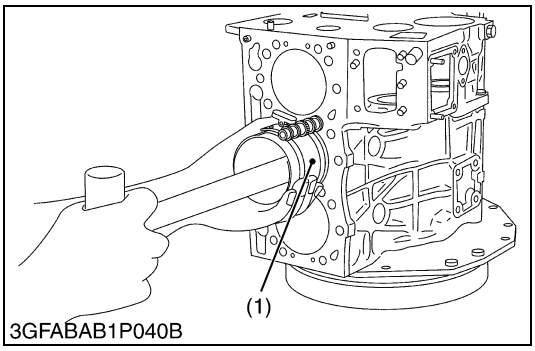

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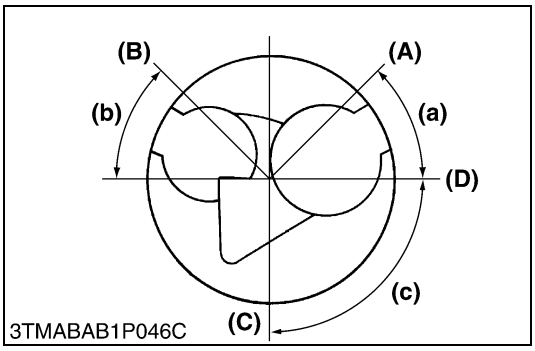

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Pistons

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

(When reassembling)

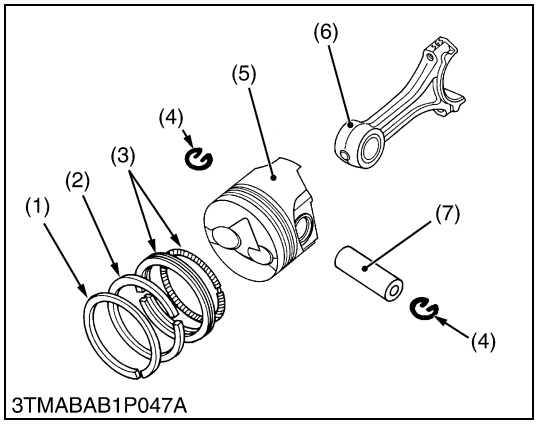
- Before inserting the piston into the cylinder, apply enough engine oil to the piston.
- When inserting the piston into the cylinder, face the mark on the connecting rod to the injection pump.

■ **IMPORTANT**

- **Do not change the combination of cylinder and piston. Make sure of the position of each piston by marking. For example, mark "1" on the No.1 piston.**
- **When installing the piston into the cylinder, place the gaps of all the piston rings as shown in the figure.**
- **Carefully insert the pistons using a piston ring compressor (1). Otherwise, their chrome-plated section may be scratched, causing trouble inside the cylinder.**

(1) Piston Ring Compressor
(A) Top Ring Gap
(B) Second Ring Gap
(C) Oil Ring Gap
(D) Piston Pin Hole
(a) 0.79 rad (45 °)
(b) 0.79 rad (45 °)
(c) 1.57 rad (90 °)

W10277450



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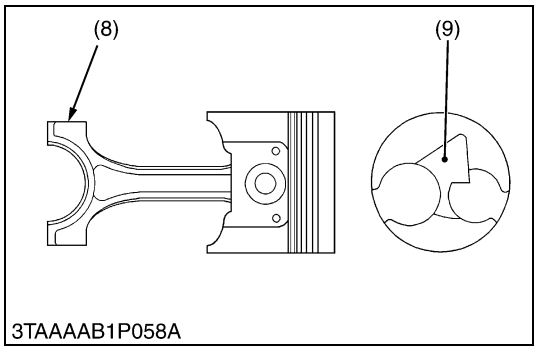

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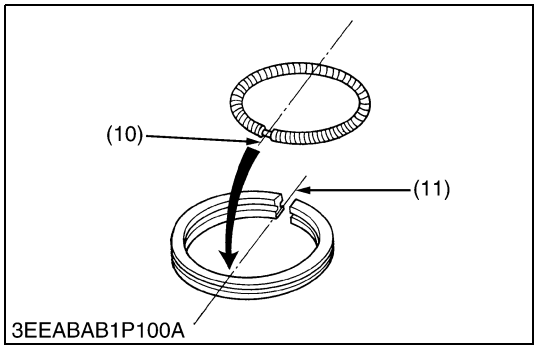

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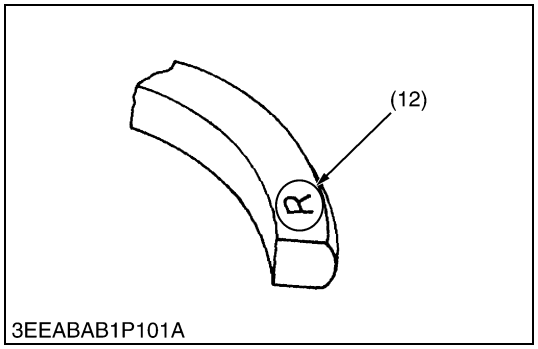

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Piston Ring and Connecting Rod

1. Remove the piston rings using a piston ring tool.
2. Remove the piston pin (7), and separate the connecting rod (6) from the piston (5).

(When reassembling)

- When installing the ring, assemble the rings so that the manufacturer's mark (12) near the gap faces the top of the piston.
- When installing the oil ring onto the piston, place the expander joint (10) on the opposite side of the oil ring gap (11).
- Apply engine oil to the piston pin.
- When installing the connecting rod to the piston, immerse the piston in 80 °C (176 °F) oil for 10 to 15 minutes and insert the piston pin to the piston.
- When installing the connecting rod to the piston, align the mark (8) on the connecting rod to the fan-shaped concave (9).

■ **NOTE**

- **Mark the same number on the connecting rod and the piston so as not to change the combination.**

(1) Top Ring
(2) Second Ring
(3) Oil Ring
(4) Piston Pin Snap Ring
(5) Piston
(6) Connecting Rod
(7) Piston Pin
(8) Mark
(9) Fan-shaped Concave
(10) Expander Joint
(11) Oil Ring Gap
(12) Manufacturer's Mark

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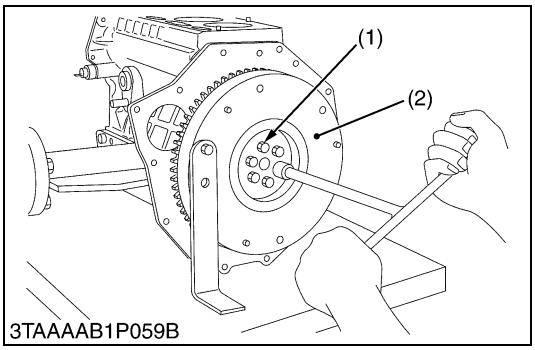
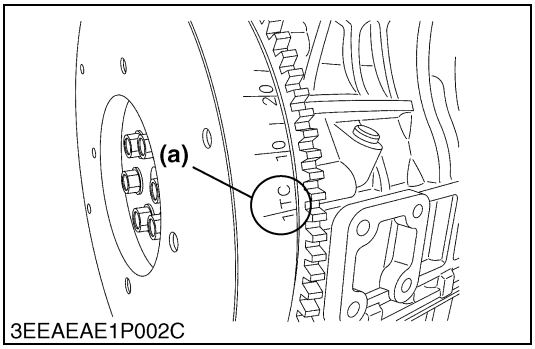
(4) Flywheel and Crankshaft





Flywheel

1. Secure the flywheel to keep it from turning, using a flywheel stopper.
2. Remove all flywheel screws (1) and then remove the flywheel (2).

(When reassembling)

- Align the **"1TC"** mark **(a)** on the outer surface of the flywheel horizontally with the alignment mark. Now fit the flywheel in position.
- Apply engine oil to the threads and the undercut surface of the flywheel screw and fit the screw.

Tightening torque	Flywheel screw	54 to 58 N·m 5.5 to 6.0 kgf·m 40 to 43 lbf·ft

(1) Flywheel Screw
(2) Flywheel
(a) 1TC Mark

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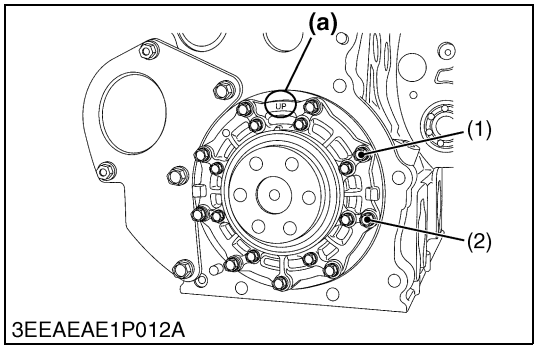

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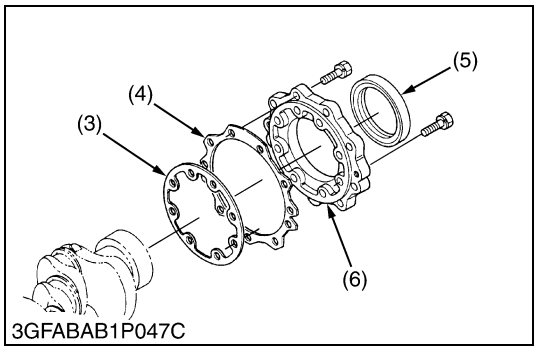

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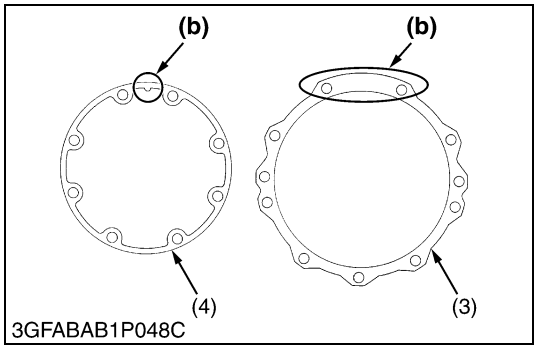

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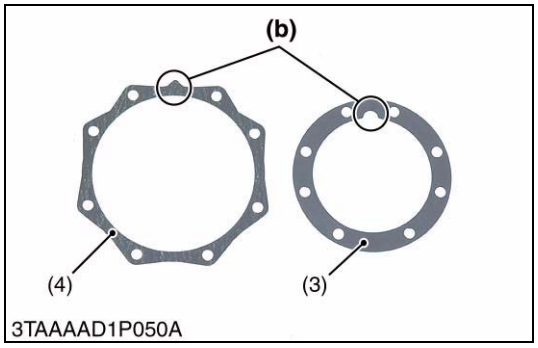

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Bearing Case Cover

1. Remove the bearing case cover mounting screws.
2. Remove the bearing case cover (6).

(When reassembling)

- Fit the bearing case gasket (3) and the bearing case cover gasket (4) with correct directions.
- Install the bearing case cover (6) to position the casting mark **"UP"** on it upward.
- Apply engine oil to the oil seal (5) lip and take care that it is not rolled when installing.
- Tighten the bearing case cover mounting screws with even force on the diagonal line.

Tightening torque	Bearing case cover mounting screw	9.81 to 11.2 N·m 1.00 to 1.15 kgf·m 7.23 to 8.31 lbf·ft

(1) Bearing Case Cover Mounting Screw (Inside)
(2) Bearing Case Cover Mounting Screw (Outside)
(3) Bearing Case Gasket
(4) Bearing Case Cover Gasket
(5) Oil Seal
(6) Bearing Case Cover
(a) Top Mark "UP"
(b) Upside

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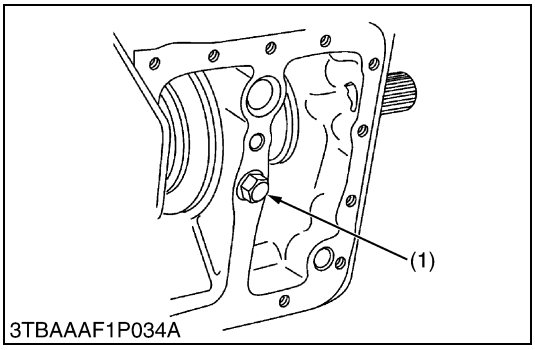

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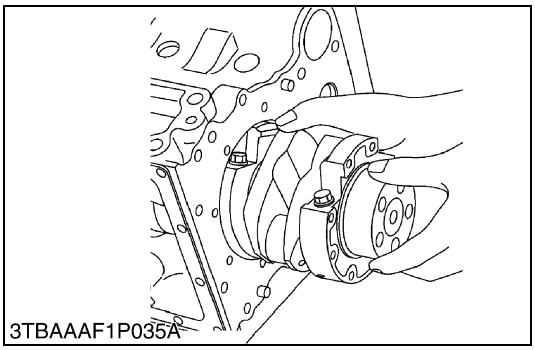
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Crankshaft Assembly (D782-E2-ZD)

1. Remove the main bearing case screw 2 (1).
2. Turn the crankshaft to set the crank pin of the third cylinder to the bottom dead center. Then draw out the crankshaft until the crank pin of the second cylinder comes to the center of the third cylinder.
3. Turn the crankshaft by 2.09 rad. (120°) counterclockwise to set the crank pin of the second cylinder to the bottom dead center. Draw out the crankshaft until the crank pin of the first cylinder comes to the center of the third cylinder.
4. Repeat the above steps to draw out all the crankshafts.

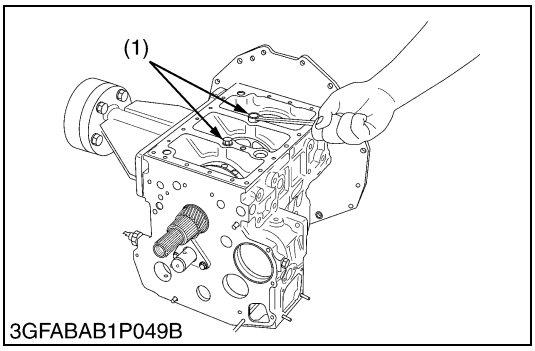
(When reassembling)

- Clean the oil passage of the crankshaft with compressed air.
- Install the crankshaft assembly, aligning the screw hole of main bearing case screw 2 with the screw hole of crankcase.
- When tightening the main bearing case 2, apply oil to the main bearing case screw 2 and screw by hand before tightening the specific torque. If not smooth to screw by hand, align the screw holes between the crankcase and the main bearing case.

Tightening torque	Main bearing case screw 2	27 to 30 N·m 2.7 to 3.1 kgf·m 20 to 22 lbf·ft

(1) Main Bearing Case Screw 2

W1031360



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Crankshaft Assembly (D1005-E2-ZD)

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

■ **IMPORTANT**

- **Take care to protect crankshaft bearing 1 from scratches, caused by the crank gear, etc.. (Wrap the gear in vinyl tape, etc.)**

(When reassembling)

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

Tightening torque	Main bearing case screw 2	49.0 to 53.9 N·m 5.0 to 5.5 kgf·m 36.2 to 39.8 lbf·ft

(1) Main Bearing Case Screw 2

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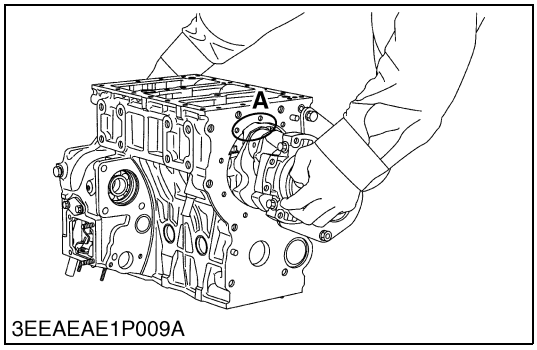

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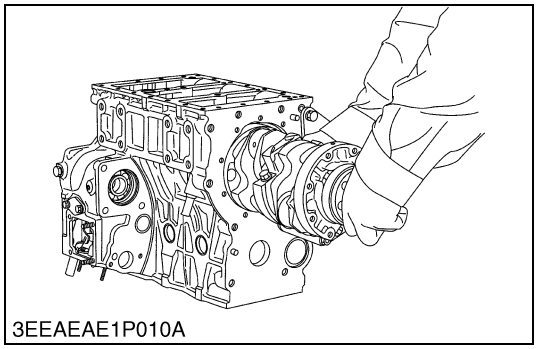
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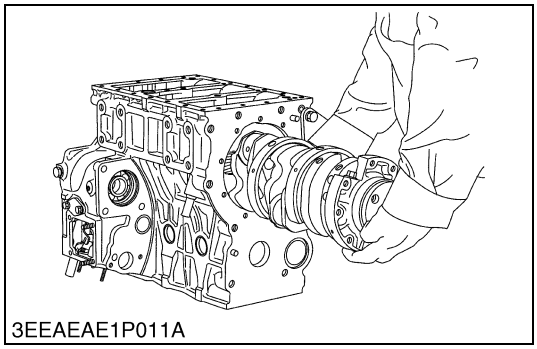
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Crankshaft Assembly (D1305-E3-ZD)

1. Remove the main bearing case screw 2.
2. Turn the crankshaft to set the crankpin of the third cylinder to the **A**. Then draw out the crankshaft until the crankpin of the second cylinder comes to the center of the third cylinder.
3. Turn the crankshaft by 2.09 rad (120 °) counterclockwise to set the crankpin of the second cylinder to the **A**. Draw out the crankshaft until the crankpin of the first cylinder comes to the center of third cylinder.
4. Repeat the above steps to draw out all the crankshaft.

(When reassembling)

- Clean the oil passage of the crankshaft with compressed air.
- Install the crankshaft assembly, aligning the screw hole of main bearing case screw 2 with the screw hole of crankcase.
- When tightening the main bearing case 2, apply oil to the main bearing case screw 2 and screw by hand before tightening the specific torque. If not smooth to screw by hand, align the screw holes between the crankcase and the main bearing case.

Tightening torque	Main bearing case screw 2	49 to 53 N·m 5.0 to 5.5 kgf·m 37 to 39 lbf·ft

A : Cut place for removing and installing the crankshaft

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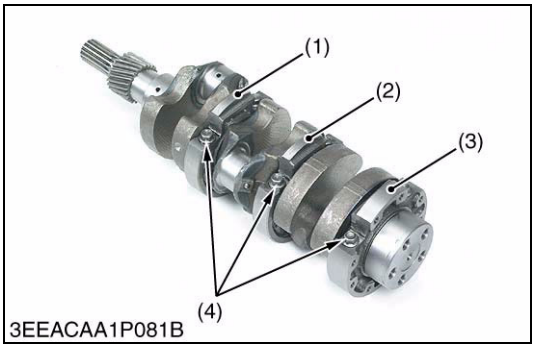

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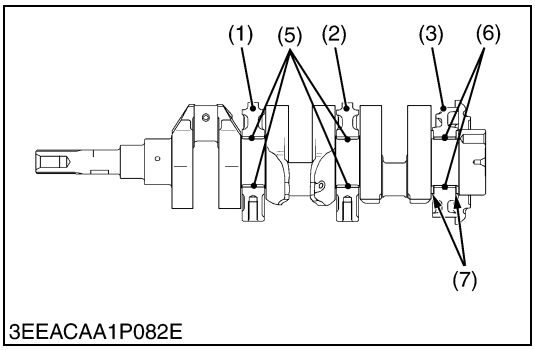

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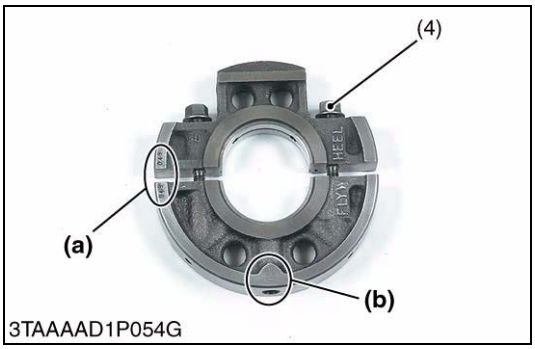

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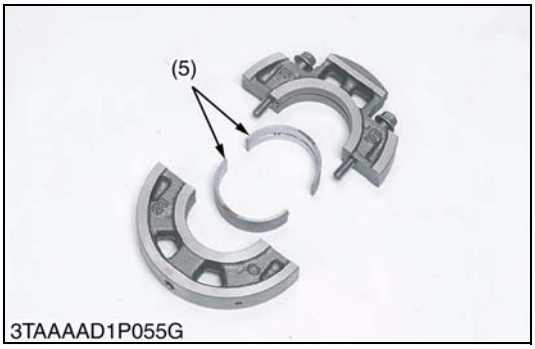

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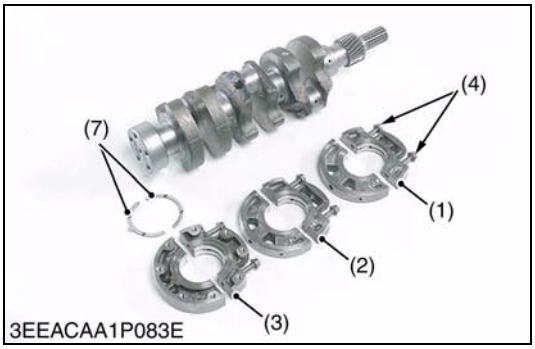

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Main Bearing Case Assembly

1. Remove the two main bearing case screws 1 (4), and remove the main bearing case assembly 1 (1), being careful with crankshaft bearing 3 (5).
2. Remove the main bearing case assembly 2 (2) and the main bearing case assembly (3) as above. Keep in mind, however, that the thrust bearing (7) is installed in the main bearing case assembly (3).

(When reassembling)

- Clean the oil passage in the main bearing cases.
- Apply clean engine oil to the bearings.
- Install the main bearing case assemblies in original positions. Since diameters of main bearing cases vary, install them in order of marking **(b)** from the gear case side. (Refer to the figure.).
- Match the alignment numbers **(a)** on the main bearing case assembly 1 (1).
- Do the same for the main bearing case assembly 2 (2) and the main bearing case assembly (3) too.
- When installing the main bearing case 1 and 2, face the mark **"FLYWHEEL"** to the flywheel.
- Install the thrust bearing (7) with its oil groove facing outward.
- Confirm that the main bearing case moves smoothly after tightening the main bearing case screw 1 to the specified torque.

[D782-E2-ZD]

Tightening torque	Main bearing case screw 1	13 to 15 N·m 1.3 to 1.6 kgf·m 9.4 to 11 lbf·ft

[D1005-E2-ZD, D1305-E3-ZD]

Tightening torque	Main bearing case screw 1	30 to 34 N·m 3.0 to 3.5 kgf·m 22 to 25 lbf·ft

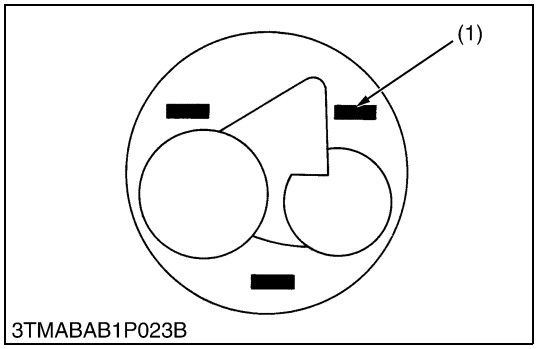
(1) Main Bearing Case Assembly 1
(2) Main Bearing Case Assembly 2
(3) Main Bearing Case Assembly
(4) Main Bearing Case Screw 1
(5) Crankshaft Bearing 3
(6) Crankshaft Bearing 2
(7) Thrust Bearing

(a) Alignment Number
(b) Marking (1 or 2) (D782-E2-ZD)
Marking (A, B, C)
(D1005-E2-ZD, D1305-E3-ZD)

W1031597

[4] SERVICING

(1) Cylinder Head and Valves



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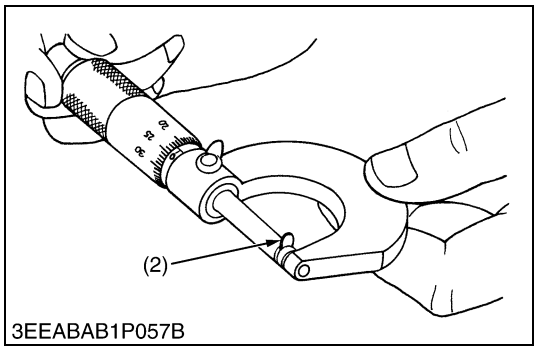

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Top Clearance

1. Remove the cylinder head. (Do not attempt to remove the cylinder head gasket.)
2. Move the piston up and stick a strip of fuse [1.5 mm dia. (0.059 in. dia.), 5 to 7 mm long (0.197 to 0.276 in. long)] on the piston head at three positions with grease so as to avoid the intake and exhaust valves and the combustion chamber ports.
3. Lower the piston, and install the cylinder head and tighten the cylinder head screws to the specified torque.
4. Turn the flywheel until the piston exceeds top dead center.
5. Remove the cylinder head, and measure the thickness of the squeezed fuses.
6. If the measurement is not within the factory specifications, check the oil clearance between the crankpin and crankpin bearing and between the piston pin and small end bushing.

■ **NOTE**

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

[D782-E2-ZD]

Top clearance	Factory spec.	0.50 to 0.70 mm 0.020 to 0.027 in.

[D1005-E2-ZD, D1305-E3-ZD]

Top clearance	Factory spec.	0.80 to 1.00 mm 0.032 to 0.0393 in.

[D782-E2-ZD]

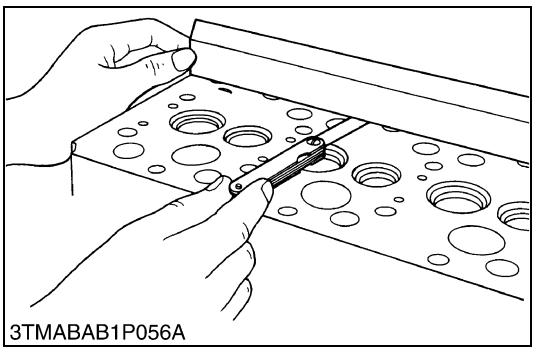
Tightening torque	Cylinder head screw	38 to 42 N·m 3.8 to 4.3 kgf·m 28 to 31 lbf·ft

[D1005-E2-ZD, D1305-E3-ZD]

Tightening torque	Cylinder head screws	64 to 68 N·m 6.5 to 7.0 kgf·m 47 to 50 lbf·ft

(1) Fuse (2) Fuse

W1020190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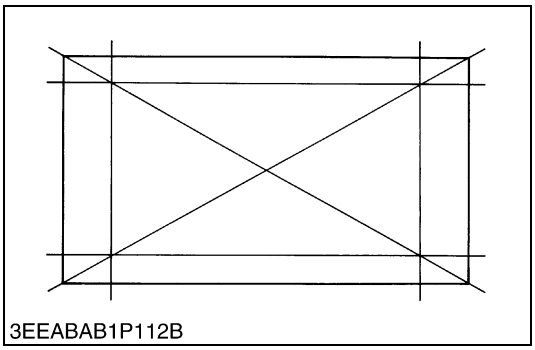
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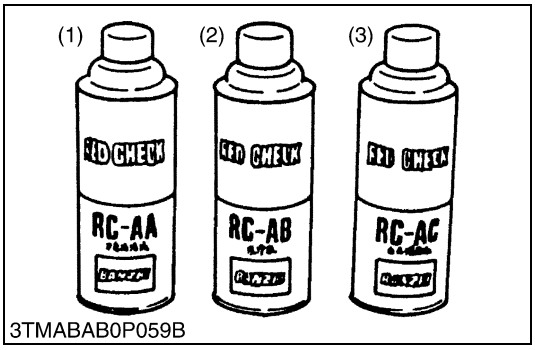

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Cylinder Head Surface Flatness

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

■ **IMPORTANT**

- **Do not place the straightedge on the combustion chamber.**
- **Be sure to check the valve recessing after correcting.**

Cylinder head surface flatness	Allowable limit	0.05 mm 0.002 in.

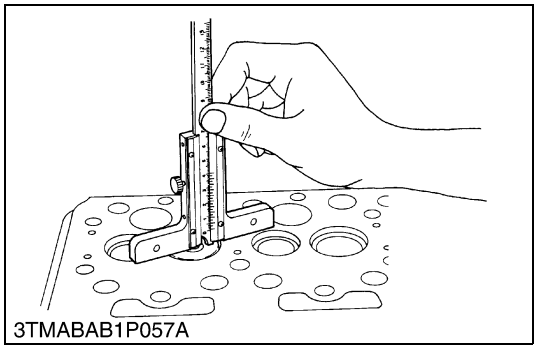
W1027737

Cylinder Head Flaw

1. Prepare an air spray red check.
2. Clean the surface of the cylinder head with detergent (2).
3. Spray the cylinder head surface with the red permeative liquid (1). Leave it five to ten minutes after spraying.
4. Wash away the read permeative liquid on the cylinder head surface with the detergent (2).
5. Spray the cylinder head surface with white developer (3).
6. If flawed, it can be identified as red marks.

(1) Red Permeative Liquid
(2) Detergent
(3) White Developer

W1076542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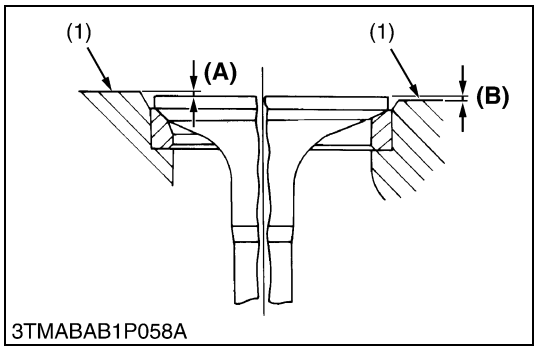

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Valve Recessing

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

[D782-E2-ZD]

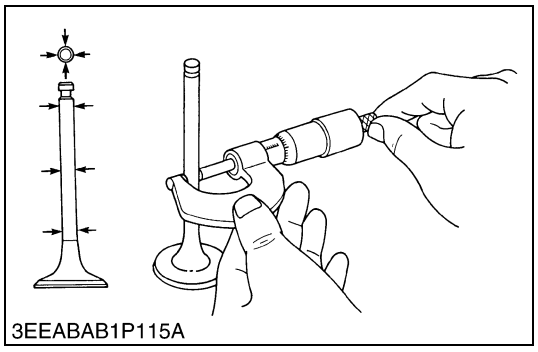
Valve recessing (Intake and exhaust)	Factory spec.	0.10 (protrusion) to 0.10 (recessing) mm 0.0039 (protrusion) to 0.0039 (recessing) in.
	Allowable limit	0.30 (recessing) mm 0.012 (recessing) in.

[D1005-E2-ZD, D1305-E3-ZD]

Valve recessing	Factory spec.	0.05 (protrusion) to 0.25 (recessing) mm 0.002 (protrusion) to 0.0098 (recessing) in.
	Allowable limit	0.40 (recessing) mm 0.016 (recessing) in.

(1) Cylinder Head Surface **(A) Recessing** **(B) Protrusion**

W10768800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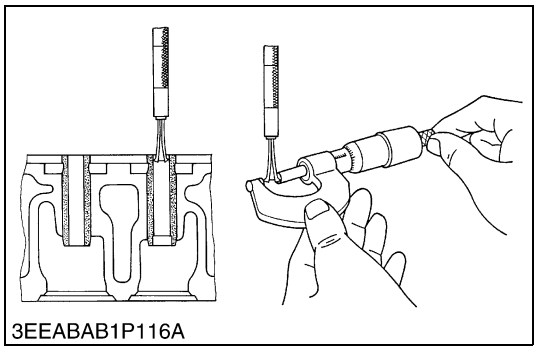
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Clearance between Valve Stem and Valve Guide

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

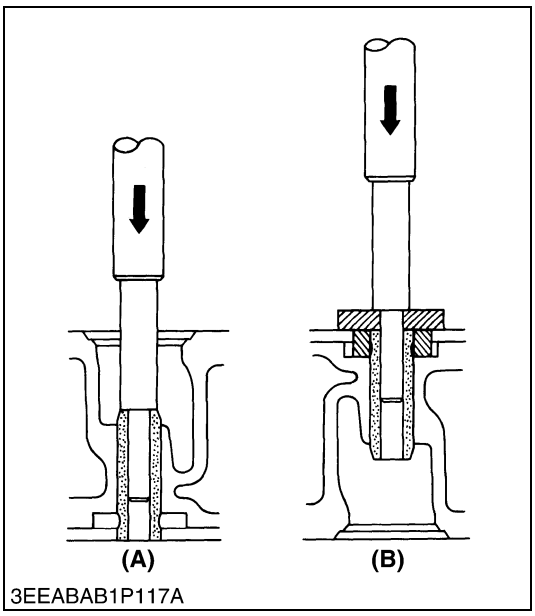
[D782-E2-ZD]

Clearance between valve stem and valve guide	Factory spec.	0.030 to 0.057 mm 0.0012 to 0.0022 in.
	Allowable limit	0.10 mm 0.0039 in.
Valve stem O.D.	Factory spec.	5.968 to 5.980 mm 0.2350 to 0.2354 in.
Valve guide I.D.	Factory spec.	6.010 to 6.025 mm 0.2366 to 0.2372 in.

[D1005-E2-ZD, D1305-E3-ZD]

Clearance between valve stem and valve guide	Factory spec.	0.035 to 0.065 mm 0.0014 to 0.0025 in.
	Allowable limit	0.10 mm 0.0039 in.
Valve stem O.D.	Factory spec.	6.960 to 6.975 mm 0.2741 to 0.2746 in.
Valve guide I.D.	Factory spec.	7.010 to 7.025 mm 0.2760 to 0.2765 in.

W10774950



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Replacing Valve Guide

(When removing)

1. Press out the used valve guide using a valve guide replacing tool. (See page **"SPECIAL TOOLS"**.)

(When installing)

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

[D782-E2-ZD]

Valve guide I.D. (Intake and exhaust)	Factory spec.	6.010 to 6.025 mm 0.2366 to 0.2372 in.

[D1005-E2-ZD, D1305-E3-ZD]

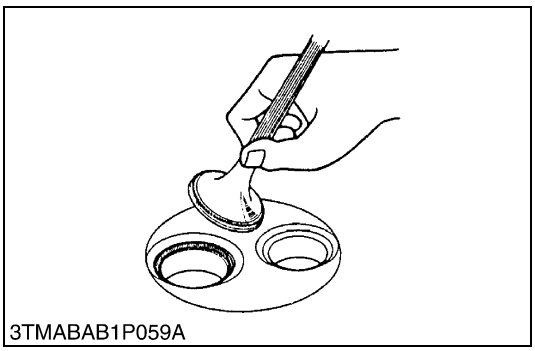
Valve guide I.D. (Intake and exhaust)	Factory spec.	7.010 to 7.025 mm 0.2760 to 0.2765 in.

■ **IMPORTANT**

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

(A) When Removing **(B) When Installing**

W10278890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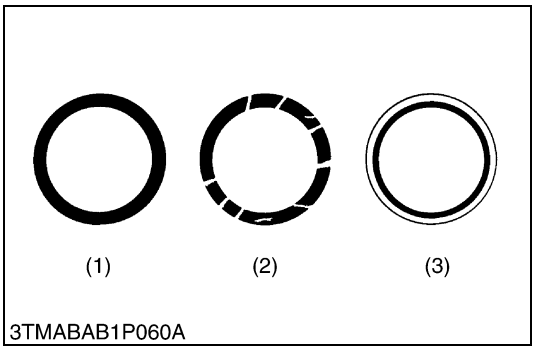
Valve Seating

1. Coat the valve face lightly with prussian blue and put the valve on its seat to check the contact.
2. If the valve does not seat all the way around the valve seat or the valve contact is less than 70 %, correct the valve seating as follows.
3. If the valve contact does not comply with the reference value, replace the valve or correct the contact of valve seating.

Valve seat width	Factory spec.	2.12 mm 0.0835 in.

(1) Correct
(2) Incorrect
(3) Incorrect

W10282190



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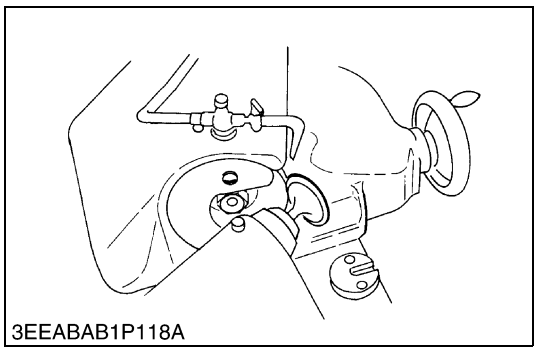
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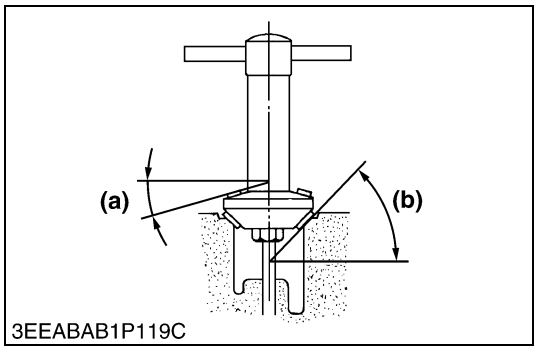

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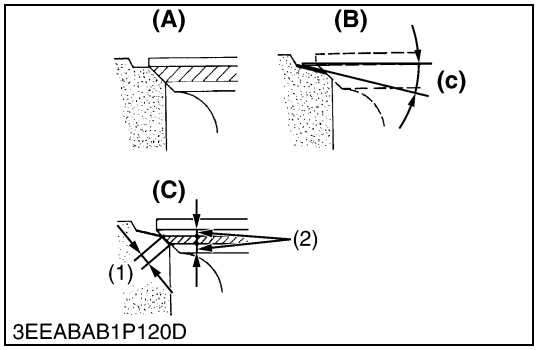

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Correcting Valve and Valve Seat

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

1) Correcting Valve

1. Correct the valve with a valve refacer.

[D782-E2-ZD]

Valve face angle	Factory spec.	0.785 rad 45 °

[D1005-E2-ZD, D1305-E3-ZD]

Valve face angle	Factory spec.	IN.	1.0 rad 60 °
		EX.	0.79 rad 45 °

2) Correcting Valve Seat

1. Slightly correct the seat surface with a 1.0 rad (60 °) (intake valve) or 0.79 rad (45 °) (exhaust valve) valve seat cutter.
2. Resurface the seat surface with a 0.52 rad (30 °) valve seat cutter to intake valve seat and with a 0.26 rad (15 °) valve seat cutter to exhaust valve seat so that the width is close to specified valve seat width (2.12 mm, 0.0835 in.).
3. After resurfacing the seat, inspect for even valve seating, apply a thin film of compound between the valve face and valve seat, and fit them with valve lapping tool.
4. Check the valve seating with prussian blue. The valve seating surface should show good contact all the way around.

[D782-E2-ZD]

Valve seat angle	Factory spec.	0.785 rad 45 °

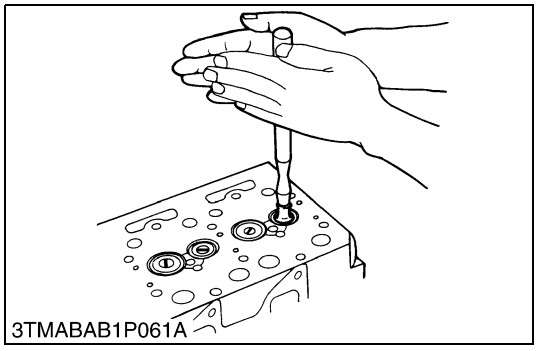
[D1005-E2-ZD, D1305-E3-ZD]

Valve seat angle	Factory spec.	IN.	1.0 rad 60 °
		EX.	0.79 rad 45 °

(1) Valve Seat Width
(2) Identical Dimensions

(A) Check Contact
(B) Correct Seat Width
(C) Check Contact
(a) 0.26 rad (15 °) or 0.52 rad (30 °)
(b) 0.79 rad (45 °) or 1.0 rad (60 °)
(c) 0.52 rad (30 °) or 0.26 rad (15 °)

W10283500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Valve Lapping

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

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

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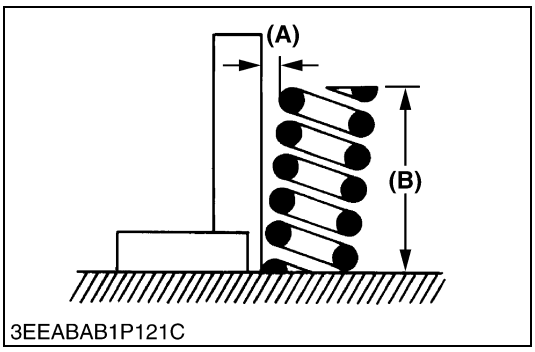

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Free Length and Tilt of Valve Spring

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

[D782-E2-ZD]

Tilt **(A)**	Allowable limit	1.2 mm 0.047 in.
Free length **(B)**	Factory spec.	31.3 to 31.8 mm 1.24 to 1.25 in.
	Allowable limit	28.4 mm 1.12 in.

[D1005-E2-ZD, D1305-E3-ZD]

Tilt **(A)**	Allowable limit	1.0 mm 0.039 in.
Free length **(B)**	Factory spec.	37.0 to 37.5 mm 1.46 to 1.47 in.
	Allowable limit	36.5 mm 1.44 in.

(A) Tilt **(B) Free Length**

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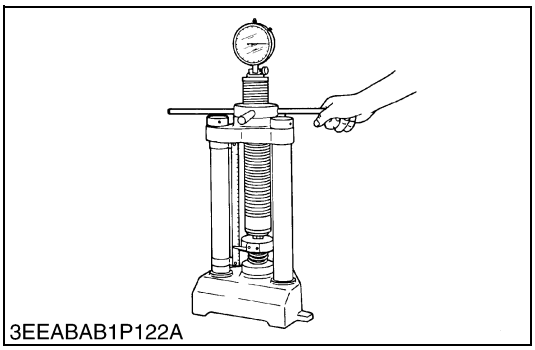
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Valve Spring Setting Load

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

[D782-E2-ZD]

Setting load / Setting length	Factory spec.	65 N / 27.0 mm 6.6 kgf / 27.0 mm 15 lbf / 1.06 in.
	Allowable limit	55 N / 27.0 mm 5.6 kgf / 27.0 mm 12 lbf / 1.06 in.

[D1005-E2-ZD, D1305-E3-ZD]

Setting load / Setting length	Factory spec.	117.4 N / 31.0 mm 11.97 kgf / 31.0 mm 26.39 lbf / 1.22 in.
	Allowable limit	100.0 N / 31.0 mm 10.20 kgf / 31.0 mm 22.48 lbf / 1.22 in.

W10784360


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Oil Clearance between Rocker Arm and Rocker Arm Shaft

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

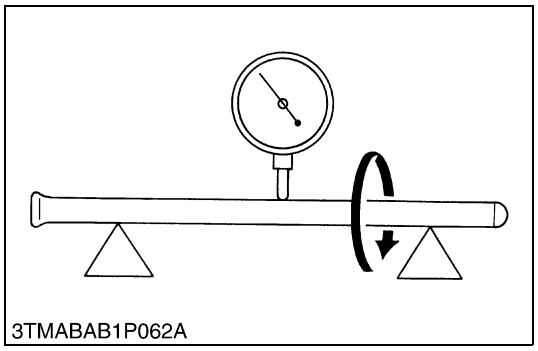
[D782-E2-ZD]

Oil clearance between rocker arm and rocker arm shaft	Factory spec.	0.016 to 0.045 mm 0.00063 to 0.0017 in.
	Allowable limit	0.15 mm 0.0059 in.
Rocker arm shaft O.D.	Factory spec.	10.473 to 10.484 mm 0.41233 to 0.41275 in.
Rocker arm I.D.	Factory spec.	10.500 to 10.518 mm 0.41339 to 0.41409 in.

[D1005-E2-ZD, D1305-E3-ZD]

Oil clearance between rocker arm and rocker arm shaft	Factory spec.	0.016 to 0.045 mm 0.00063 to 0.0017 in.
	Allowable limit	0.10 mm 0.0039 in.
Rocker arm shaft O.D.	Factory spec.	11.973 to 11.984 mm 0.47138 to 0.47181 in.
Rocker arm I.D.	Factory spec.	12.000 to 12.018 mm 0.47244 to 0.47314 in.

W10291500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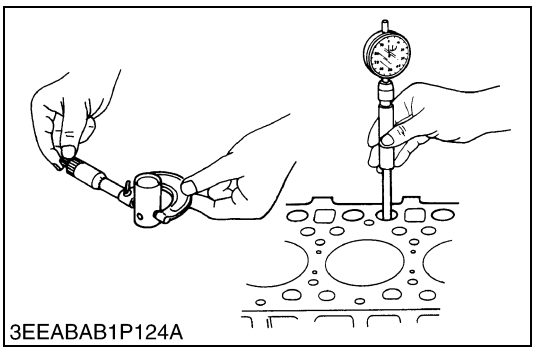
Push Rod Alignment

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

Push rod alignment	Allowable limit	0.25 mm 0.0098 in.

W10292900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Oil Clearance between Tappet and Tappet Guide Bore

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

[D782-E2-ZD]

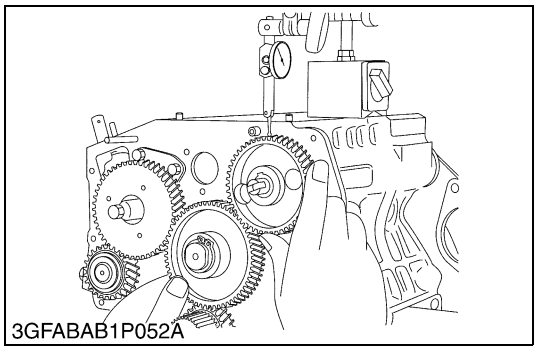
Oil clearance between tappet and tappet guide bore	Factory spec.	0.016 to 0.052 mm 0.00063 to 0.0020 in.
	Allowable limit	0.10 mm 0.0039 in.
Tappet O.D.	Factory spec.	17.966 to 17.984 mm 0.70733 to 0.70803 in.
Tappet guide bore I.D.	Factory spec.	18.000 to 18.018 mm 0.70866 to 0.70937 in.

[D1005-E2-ZD, D1305-E3-ZD]

Oil Clearance between tappet and tappet guide bore	Factory spec.	0.020 to 0.062 mm 0.00079 to 0.0024 in.
	Allowable limit	0.07 mm 0.003 in.
Tappet O.D.	Factory spec.	19.959 to 19.980 mm 0.78579 to 0.78661 in.
Tappet guide bore I.D.	Factory spec.	20.000 to 20.021 mm 0.78740 to 0.78822 in.

W1051412

(2) Timing Gears, Camshaft and Governor Gear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Timing Gear Backlash

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

[D782-E2-ZD]

Backlash between idle gear and crank gear	Factory spec.	0.043 to 0.124 mm 0.00169 to 0.00488 in.
	Allowable limit	0.15 mm 0.0059 in.
Backlash between idle gear and cam gear	Factory spec.	0.047 to 0.123 mm 0.00185 to 0.00484 in.
	Allowable limit	0.15 mm 0.0059 in.
Backlash between idle gear and injection pump gear	Factory spec.	0.046 to 0.124 mm 0.00181 to 0.00488 in.
	Allowable limit	0.15 mm 0.0059 in.
Backlash between oil pump drive gear and crank gear	Factory spec.	0.041 to 0.123 mm 0.00161 to 0.00484 in.
	Allowable limit	0.15 mm 0.0059 in.

[D1005-E2-ZD, D1305-E3-ZD]

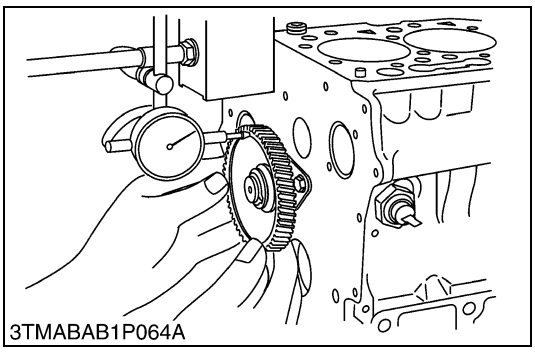
Backlash between idle gear 1 and crank gear	Factory spec.	0.032 to 0.115 mm 0.0013 to 0.00452 in.
	Allowable limit	0.15 mm 0.0059 in.
Backlash between idle gear 1 and cam gear	Factory spec.	0.036 to 0.114 mm 0.0014 to 0.00448 in.
	Allowable limit	0.15 mm 0.0059 in.
Backlash between idle gear 1 and injection pump gear	Factory spec.	0.034 to 0.116 mm 0.0014 to 0.00456 in.
	Allowable limit	0.15 mm 0.0059 in.

W10280630

Governor Gear Backlash

Backlash between injection pump gear and governor gear	Factory spec.	0.030 to 0.117 mm 0.0012 to 0.00460 in.
	Allowable limit	0.15 mm 0.0059 in.

W1041576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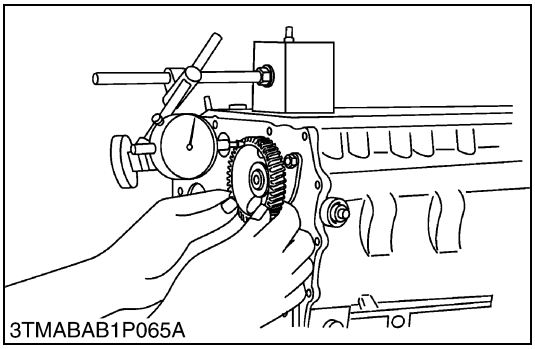
Idle Gear and Idle Gear 1 Side Clearance

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

Idle gear and idle gear 1 side clearance	Factory spec.	0.20 to 0.51 mm 0.0079 to 0.020 in.
	Allowable limit	0.80 mm 0.031 in.

W10285590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Camshaft Side Clearance

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

[D782-E2-ZD]

Camshaft side clearance	Factory spec.	0.15 to 0.31 mm 0.0059 to 0.012 in.
	Allowable limit	0.50 mm 0.0197 in.

[D1005-E2-ZD, D1305-E3-ZD]

Camshaft side clearance	Factory spec.	0.07 to 0.22 mm 0.003 to 0.0087 in.
	Allowable limit	0.30 mm 0.012 in.

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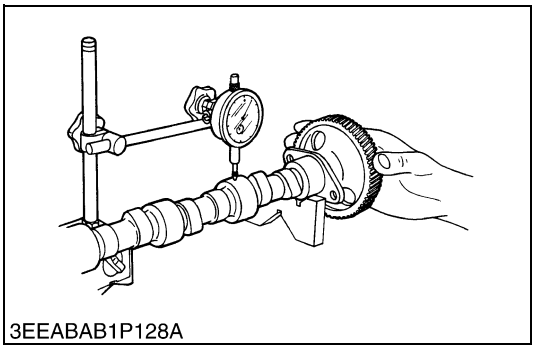
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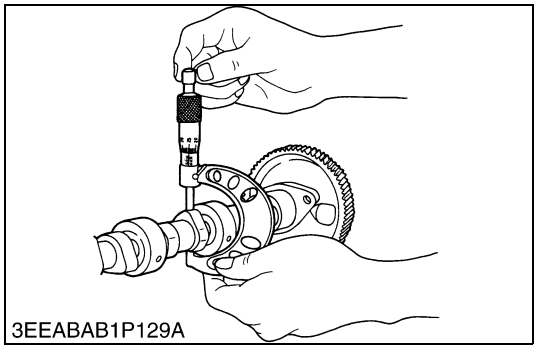
Camshaft Alignment

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

Camshaft alignment	Allowable limit	0.01 mm 0.0004 in.

W10296710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Cam Height

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

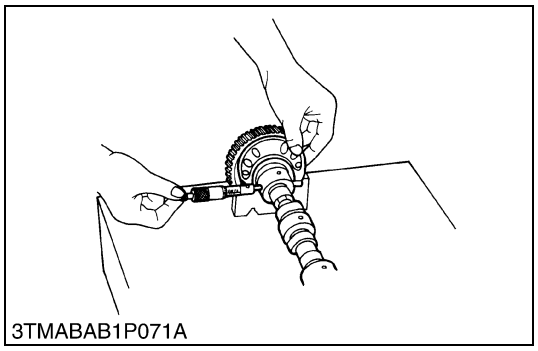
[D782-E2-ZD]

Cam height of intake and exhaust	Factory spec.	26.88 mm 1.058 in.
	Allowable limit	26.83 mm 1.056 in.

[D1005-E2-ZD, D1305-E3-ZD]

Cam height of intake	Factory spec.	28.80 mm 1.134 in.
	Allowable limit	28.75 mm 1.132 in.
Cam height of exhaust	Factory spec.	29.0 mm 1.14 in.
	Allowable limit	28.95 mm 1.140 in.

W10297880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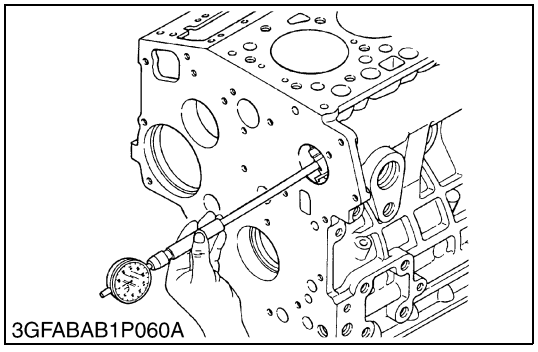
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Oil Clearance of Camshaft Journal

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

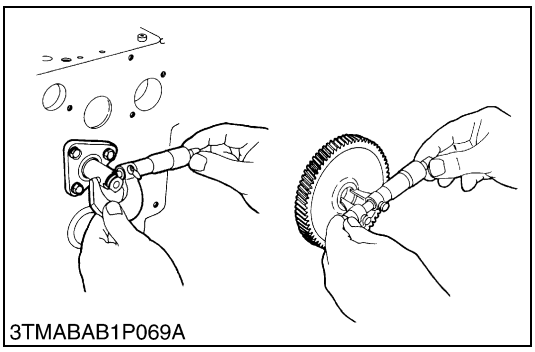
[D782-E2-ZD]

Oil clearance of camshaft journal	Factory spec.	0.050 to 0.091 mm 0.00197 to 0.00358 in.
	Allowable limit	0.15 mm 0.0059 in.
Camshaft journal O.D.	Factory spec.	32.934 to 32.950 mm 1.2966 to 1.2972 in.
Camshaft Bearing I.D. (Cylinder block bore I.D.)	Factory spec.	33.000 to 33.025 mm 1.2992 to 1.3002 in.

[D1005-E2-ZD, D1305-E3-ZD]

Oil clearance of camshaft journal	Factory spec.	0.050 to 0.091 mm 0.0020 to 0.0035 in.
	Allowable limit	0.15 mm 0.0059 in.
Camshaft journal O.D.	Factory spec.	35.934 to 35.950 mm 1.4147 to 1.4153 in.
Camshaft bearing I.D. (Cylinder block bore I.D.)	Factory spec.	36.000 to 36.025 mm 1.4173 to 1.4183 in.

W10299330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Oil Clearance between Idle Gear, Idle Gear 1, Idle Gear Shaft and Idle Gear Bushing

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

[D782-E2-ZD]

Oil clearance between idle gear shaft and idle gear bushing	Factory spec.	0.020 to 0.084 mm 0.00079 to 0.0033 in.
	Allowable limit	0.10 mm 0.0039 in.
Idle gear shaft O.D.	Factory spec.	19.967 to 19.980 mm 0.78611 to 0.78661 in.
Idle gear bushing I.D.	Factory spec.	20.000 to 20.051 mm 0.78740 to 0.78941 in.

[D1005-E2-ZD, D1305-E3-ZD]

Oil clearance between idle gear shaft and idle gear bushing	Factory spec.	0.020 to 0.054 mm 0.00079 to 0.0021 in.
	Allowable limit	0.10 mm 0.0039 in.
Idle gear shaft 1 O.D.	Factory spec.	25.967 to 25.980 mm 1.0223 to 1.0228 in.
Idle gear bushing 1 I.D.	Factory spec.	26.000 to 26.021 mm 1.0237 to 1.0244 in.

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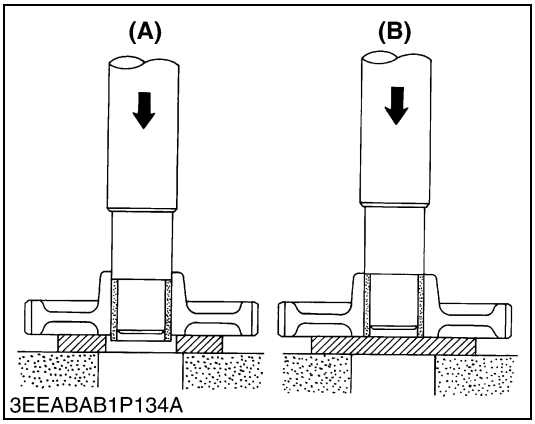

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Replacing Idle Gear Bushing

(When removing)

1. Press out the used idle gear bushing using an idle gear bushing replacing tool. (See page **"SPECIAL TOOLS"**.)

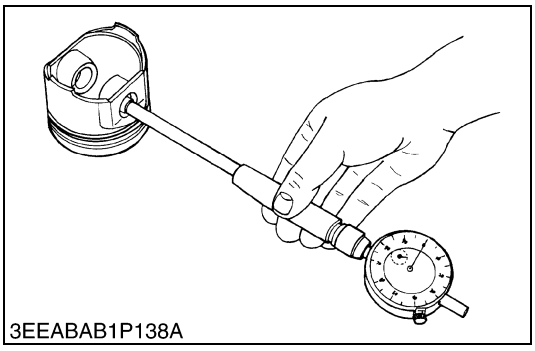
(When installing)

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

(A) When Removing **(B) When Installing**

W10302410

(3) Piston and Connecting Rod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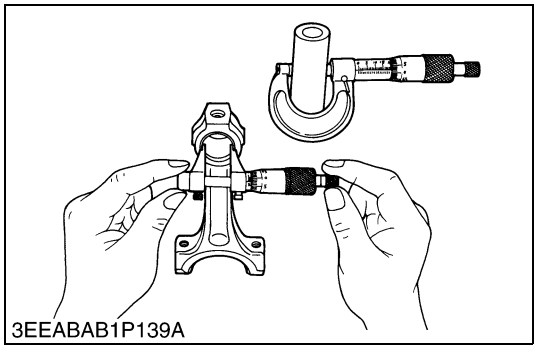
Piston Pin Bore I.D.

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

Piston pin bore I.D.	Factory spec.	22.000 to 22.013 mm 0.86615 to 0.86665 in.
	Allowable limit	22.03 mm 0.8673 in.

W10304770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Oil Clearance between Piston Pin and Small End Bushing

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

[D782-E2-ZD]

Oil clearance between piston pin and small end bushing	Factory spec.	0.014 to 0.038 mm 0.00055 to 0.0014 in.
	Allowable limit	0.10 mm 0.0039 in.
Piston pin O.D.	Factory spec.	20.002 to 20.011 mm 0.78748 to 0.78783 in.
Small end bushing I.D.	Factory spec.	20.025 to 20.040 mm 0.78839 to 0.78898 in.

[D1005-E2-ZD, D1305-E3-ZD]

Oil clearance between piston pin and small end bushing	Factory spec.	0.014 to 0.038 mm 0.00055 to 0.0014 in.
	Allowable limit	0.15 mm 0.0059 in.
Piston pin O.D.	Factory spec.	22.002 to 22.011 mm 0.86622 to 0.86657 in.
Small end bushing I.D.	Factory spec.	22.025 to 22.040 mm 0.86713 to 0.86771 in.

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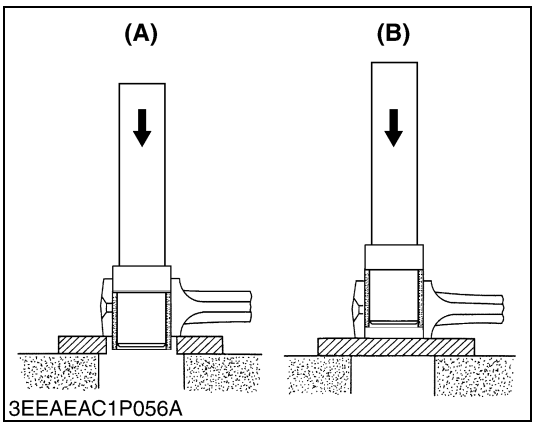

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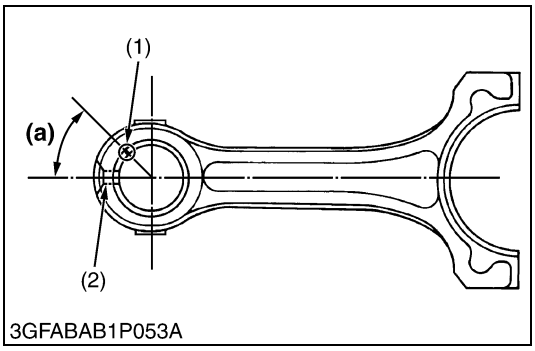

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Replacing Small End Bushing

(When removing)

1. Press out the used bushing using a small end bushing replacing tool. (See page **"SPECIAL TOOLS"**.)

(When installing)

1. Clean a new small end bushing and bore, and apply engine oil to them.
2. Using a small end bushing replacing tool, press in a new bushing (service parts) taking due care to see that the connecting rod oil hole matches the bushing hole.

[D782-E2-ZD]

Oil clearance between piston pin and small end bushing (Spare parts)	Factory spec.	0.015 to 0.075 mm 0.00059 to 0.0030 in.
	Allowable limit	0.15 mm 0.0059 in.
Small end bushing I.D. (Spare parts)	Factory spec.	20.026 to 20.077 mm 0.78843 to 0.79043 in.

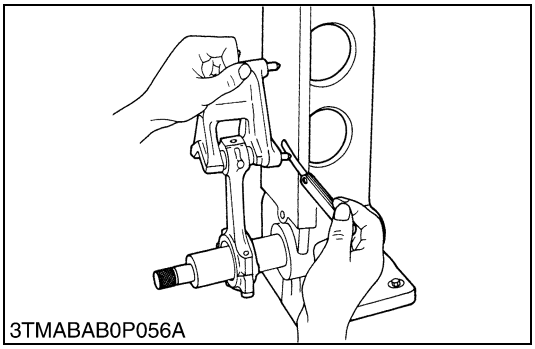
[D1005-E2-ZD, D1305-E3-ZD]

Oil clearance between piston pin and small end bushing (Spare parts)	Factory spec.	0.015 to 0.038 mm 0.00056 to 0.0014 in.
	Allowable limit	0.15 mm 0.0059 in.
Small end bushing I.D. (Spare parts)	Factory spec.	22.025 to 22.040 mm 0.86713 to 0.86771 in.

(1) Seam
(2) Oil Hole

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

W10307120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Connecting Rod Alignment

■ **NOTE**

- **Since the I.D. of the connecting rod small end bushing is the basis of this check, check bushing for wear beforehand.**

1. Install the piston pin into the connecting rod.
2. Install the connecting rod on the connecting rod alignment tool.
3. Put a gauge over the piston pin, and move it against the face plate.
4. If the gauge does not fit squarely against the face plate, measure the space between the pin of the gauge and the face plate.
5. If the measurement exceeds the allowable limit, replace the connecting rod.

Connecting rod alignment	Allowable limit	0.05 mm 0.002 in.

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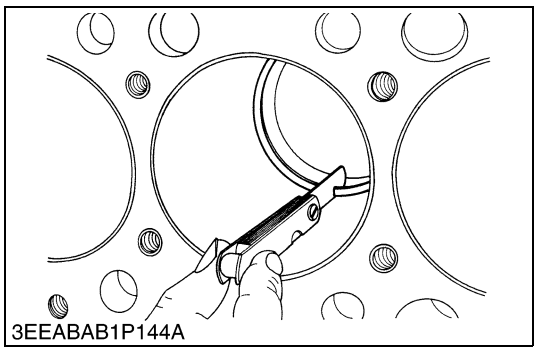
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Piston Ring Gap

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

[D782-E2-ZD]

Piston ring gap	Top ring	Factory spec.	0.15 to 0.30 mm 0.0059 to 0.011 in.
		Allowable limit	1.20 mm 0.0472 in.
	Second ring	Factory spec.	0.30 to 0.45 mm 0.012 to 0.017 in.
		Allowable limit	1.20 mm 0.0472 in.
	Oil ring	Factory spec.	0.15 to 0.30 mm 0.0059 to 0.011 in.
		Allowable limit	1.20 mm 0.0472 in.

[D1005-E2-ZD, D1305-E3-ZD]

Piston ring gap	Top ring	Factory spec.	0.30 to 0.45 mm 0.012 to 0.017 in.
		Allowable limit	1.25 mm 0.0492 in.
	Second ring	Factory spec.	0.30 to 0.45 mm 0.012 to 0.017 in.
		Allowable limit	1.25 mm 0.0492 in.
	Oil ring	Factory spec.	0.25 to 0.40 mm 0.0098 to 0.015 in.
		Allowable limit	1.25 mm 0.0492 in.

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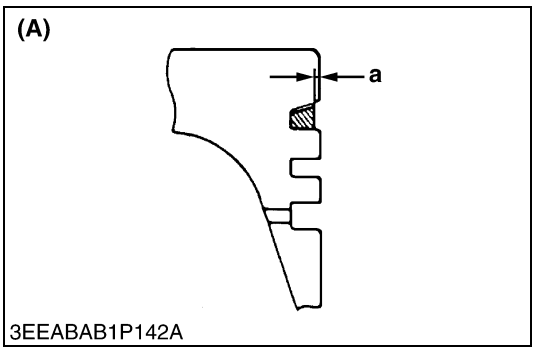
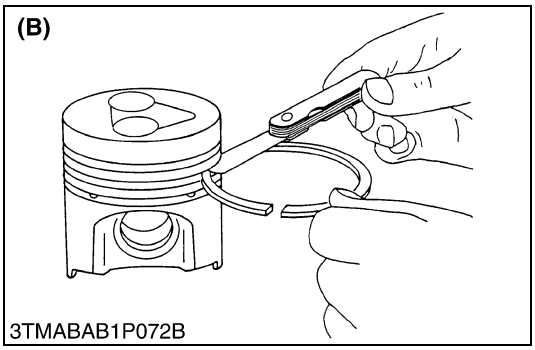




Clearance between Piston ring and Piston Ring Groove

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

[D782-E2-ZD]

Clearance between piston ring and piston ring groove	Second ring	Factory spec.	0.090 to 0.12 mm 0.0036 to 0.0047 in.
		Allowable limit	0.15 mm 0.0059 in.
	Oil ring	Factory spec.	0.04 to 0.08 mm 0.002 to 0.0031 in.
		Allowable limit	0.15 mm 0.0059 in.

[D1005-E2-ZD]

Clearance between piston ring and piston ring groove	Second ring	Factory spec.	0.085 to 0.112 mm 0.0034 to 0.00440 in.
		Allowable limit	0.20 mm 0.0079 in.
	Oil ring	Factory spec.	0.020 to 0.055 mm 0.00079 to 0.0021 in.
		Allowable limit	0.15 mm 0.0059 in.

[D1305-E3-ZD]

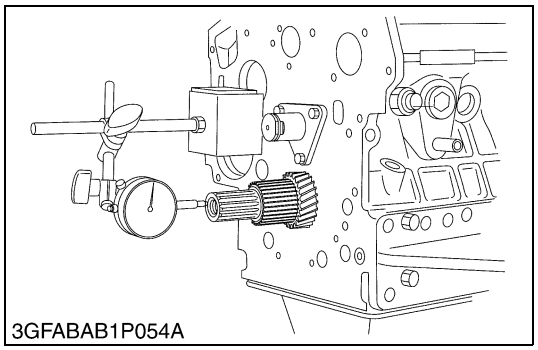
Clearance between piston ring and piston ring groove	Second ring	Factory spec.	0.095 to 0.122 mm 0.0038 to 0.00480 in.
		Allowable limit	0.2 mm 0.008 in.
	Oil ring	Factory spec.	0.020 to 0.060 mm 0.00079 to 0.0023 in.
		Allowable limit	0.15 mm 0.0059 in.

Factory specification : **a**	More than 0.2 mm 0.008 in.

(A) Top Ring (Key Stone Type) **(B) 2nd, Oil Ring**

W10312390

(4) Crankshaft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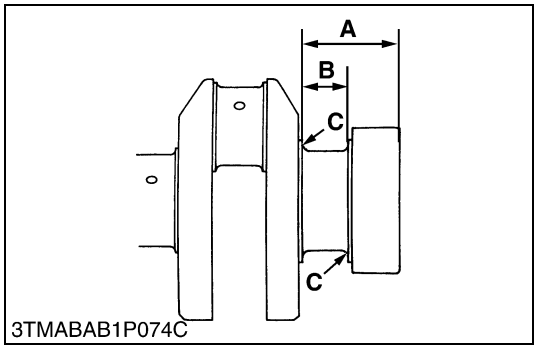

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Crankshaft Side Clearance

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

Crankshaft side clearance	Factory spec.	0.15 to 0.31 mm 0.0059 to 0.012 in.
	Allowable limit	0.50 mm 0.020 in.

(Reference)

- Oversize dimensions of crankshaft journal

[D782-E2-ZD]

Oversize	0.2 mm 0.008 in.	0.4 mm 0.02 in.
Dimension **A**	46.10 to 46.30 mm 1.815 to 1.822 in.	46.30 to 46.50 mm 1.823 to 1.831 in.
Dimension **B**	23.40 to 23.45 mm 0.9213 to 0.9232 in.	23.80 to 23.85 mm 0.9370 to 0.9390 in.
Dimension **C**	1.8 to 2.2 mm radius 0.071 to 0.086 in. radius	1.8 to 2.2 mm radius 0.071 to 0.086 in. radius
The crankshaft journal must be fine-finished to higher than ∇∇∇∇.		(0.8S)

[D1005-E2-ZD, D1305-E3-ZD]

Oversize	0.20 mm 0.0079 in.	0.40 mm 0.016 in.
Dimension **A**	51.50 to 51.70 mm 2.028 to 2.035 in.	51.60 to 51.80 mm 2.032 to 2.039 in.
Dimension **B**	28.20 to 28.25 mm 1.111 to 1.112 in.	28.40 to 28.45 mm 1.119 to 1.12 in.
Dimension **C**	2.3 to 2.7 mm radius 0.091 to 0.106 in. radius	2.3 to 3.7 mm radius 0.091 to 0.106 in. radius
The crankshaft journal must be fine-finished to higher than ∇∇∇∇		(0.8-S)

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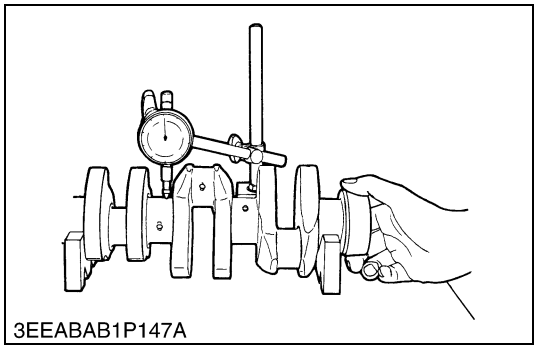
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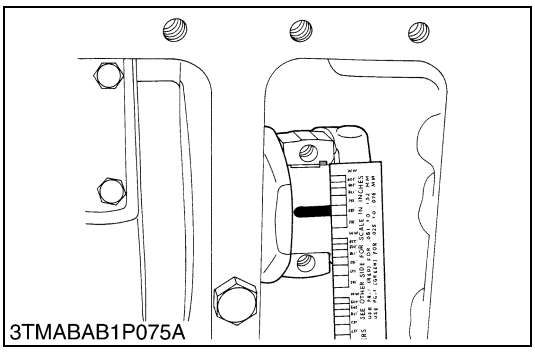
Crankshaft Alignment

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

Crankshaft alignment	Allowable limit	0.02 mm 0.0008 in.

W10330010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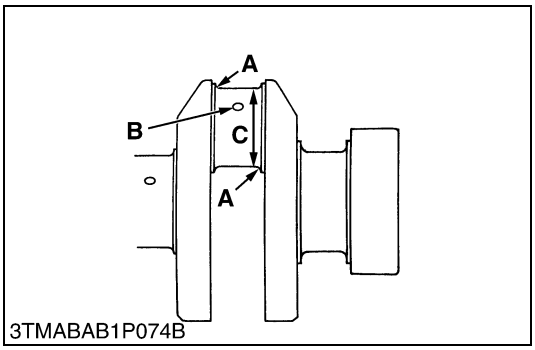

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Oil Clearance between Crankpin and Crankpin Bearing

1. Clean the crankpin and crankpin bearing.
2. Put a strip of plastigage on the center of the crankpin.
3. Install the connecting rod cap and tighten the connecting rod screws to the specified torque, and remove the cap again.
4. Measure the amount of the flattening with the scale, and get the oil clearance.
5. If the oil clearance exceeds the allowable limit, replace the crankpin bearing.
6. If the same size bearing is useless because of the crankpin wear, replace it with an undersize one referring to the table and figure.

■ **NOTE**

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

[D782-E2-ZD]

Oil clearance between crankpin and crankpin bearing	Factory spec.	0.020 to 0.051mm 0.00079 to 0.0020 in.
	Allowable limit	0.15 mm 0.0059 in.
Crankpin O.D.	Factory spec.	33.959 to 33.975 mm 1.3370 to 1.3375 in.
Crankpin bearing I.D.	Factory spec.	33.995 to 34.010 mm 1.3384 to 1.3389 in.

[D1005-E2-ZD, D1305-E3-ZD]

Oil clearance between crankpin and crankpin bearing	Factory spec.	0.029 to 0.091 mm 0.0011 to 0.0036 in.
	Allowable limit	0.20 mm 0.0079 in.
Crankpin O.D.	Factory spec.	39.959 to 39.975 mm 1.5732 to 1.5738 in.
Crankpin bearing I.D.	Factory spec.	40.040 to 40.050 mm 1.5764 to 1.5767 in.

(Reference)

- Undersize dimensions of crankpin

[D782-E2-ZD]

Undersize	0.20 mm 0.0079 in.	0.40 mm 0.016 in.
Dimension **A**	2.3 to 2.7 mm radius 0.091 to 0.10 in.radius	2.3 to 2.7 mm radius 0.091 to 0.10 in.radius
*Dimension **B**	1.0 to 1.5 mm relief 0.040 to 0.059 in. relief	1.0 to 1.5 mm relief 0.040 to 0.059 in. relief
Dimension **C**	33.759 to 33.775 mm dia. 1.3291 to 1.32973 in. dia.	33.559 to 33.575 mm dia. 1.3213 to 1.3218 in. dia.
(0.8S) The crankpin must be fine-finished to higher than ∇∇∇∇. *Holes to be de-burred and edges rounded with 1.0 to 1.5 mm (0.0394 to 0.0591 in.) relief.		

[D1005-E2-ZD, D1305-E3-ZD]

Undersize	0.20 mm 0.0079 in.	0.40 mm 0.016 in.
Dimension **A**	2.8 to 3.2 mm radius 0.11 to 0.12 in. radius	2.8 to 3.2 mm radius 0.11 to 0.12 in. radius
*Dimension **B**	1.0 to 1.5 mm relief 0.040 to 0.059 in. relief	1.0 to 1.5 mm relief 0.040 to 0.059 in. relief
Dimension **C**	39.759 to 39.775 mm dia. 1.5654 to 1.5659 in. dia.	39.559 to 39.575 mm dia. 1.5575 to 1.5580 in. dia.
(0.8-S) The crankpin must be fine-finished to higher than ∇∇∇∇ *Holes to be de-burred and edges rounded with 1.0 to 1.5 mm (0.040 to 0.059 in.) relief.		

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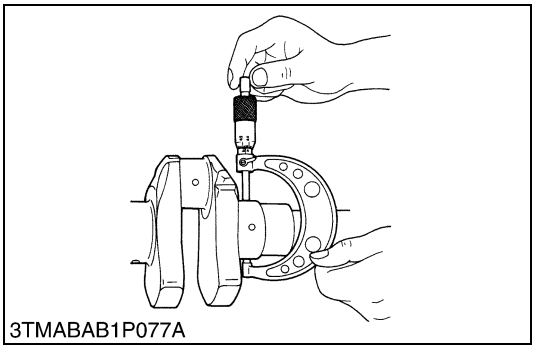
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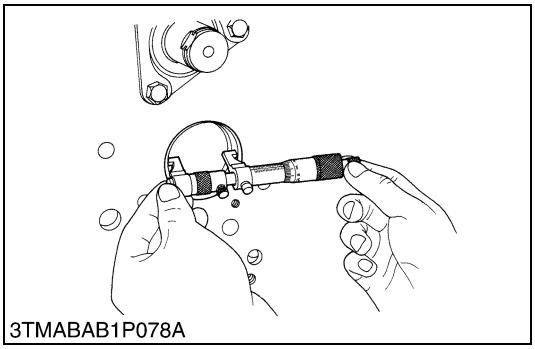
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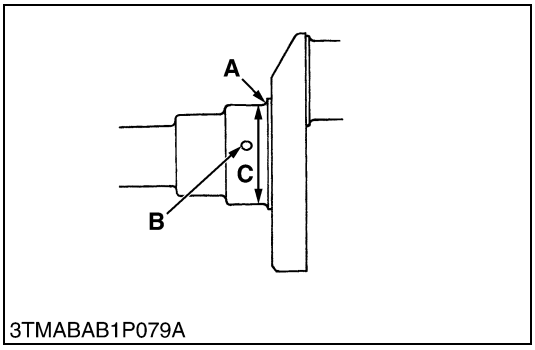

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Oil Clearance between Crankshaft Journal and Crankshaft Bearing 1

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

[D782-E2-ZD]

Oil Clearance between crankshaft journal and crankshaft bearing 1	Factory spec.	0.0340 to 0.106 mm 0.00134 to 0.00417 in.
	Allowable limit	0.20 mm 0.0079 in.
Crankshaft journal O.D.	Factory spec.	39.934 to 39.950 mm 1.5722 to 1.5728 in.
Crankshaft bearing 1 I.D.	Factory spec.	39.984 to 40.040 mm 1.5742 to 1.5764 in.

[D1005-E2-ZD]

Oil clearance between crankshaft journal and crankshaft bearing 1	Factory spec.	0.034 to 0.114 mm 0.0014 to 0.00448 in.
	Allowable limit	0.20 mm 0.0079 in.
Crankshaft journal O.D.	Factory spec.	47.934 to 47.950 mm 1.8872 to 1.8877 in.
Crankshaft bearing 1 I.D.	Factory spec.	47.984 to 48.048 mm 1.8892 to 1.8916 in.

[D1305-E3-ZD]

Oil clearance between crankshaft journal and crankshaft bearing 1	Factory spec.	0.034 to 0.103 mm 0.0014 to 0.00405 in.
	Allowable limit	0.20 mm 0.0079 in.
Crankshaft journal O.D.	Factory spec.	51.921 to 51.940 mm 2.0442 to 2.0448 in.
Crankshaft bearing 1 I.D.	Factory spec.	51.974 to 52.024 mm 2.0463 to 2.0481 in.

(Reference)

- Undersize dimensions of crankshaft journal

[D782-E2-ZD]

Undersize	0.2 mm 0.008 in.	0.4 mm 0.016 in.
Dimension **A**	1.8 to 2.2 mm radius 0.071 to 0.087 in.radius	1.8 to 2.2 mm radius 0.071 to 0.087 in.radius
*Dimension **B**	1.0 to 1.5 mm relief 0.040 to 0.059 in. relief	1.0 to 1.5 mm relief 0.040 to 0.059 in. relief
Dimension **C**	39.734 to 39.750 mm dia. 1.5643 to 1.5650 in. dia.	39.534 to 39.550 mm dia. 1.5565 to 1.5571 in. dia.
(0.8S) The crankshaft journal must be fine-finished to higher than ∇∇∇∇. *Holes to be de-burred and edges rounded with 1.0 to 1.5 mm (0.0394 to 0.0591 in.) relief.		

[D1005-E2-ZD]

Undersize	0.2 mm 0.0079 in.	0.4 mm 0.016 in.
Dimension **A**	2.3 to 2.7 mm radius 0.091 to 0.10 in. radius	2.3 to 2.7 mm radius 0.091 to 0.10 in. radius
*Dimension **B**	1.0 to 1.5 mm relief 0.040 to 0.059 in. relief	1.0 to 1.5 mm relief 0.040 to 0.059 in. relief
Dimension **C**	47.734 to 47.750 mm dia. 1.8793 to 1.8799 in. dia.	47.534 to 47.550 mm dia. 1.8715 to 1.8720 in. dia.
(0.8-S) The crankshaft journal must be fine-finished to higher than ∇∇∇∇ *Holes to be de-burred and edges rounded with 1.0 to 1.5 mm (0.040 to 0.059 in.) relief.		

[D1305-E3-ZD]

Undersize	0.20 mm 0.0079 in.	0.40 mm 0.016 in.
Dimension **A**	2.3 to 2.7 mm radius 0.091 to 0.10 in. radius	2.3 to 2.7 mm radius 0.091 to 0.10 in. radius
*Dimension **B**	1.0 to 1.5 mm relief 0.040 to 0.059 in. relief	1.0 to 1.5 mm relief 0.040 to 0.059 in. relief
Dimension **C**	51.721 to 51.740 mm dia. 2.0363 to 2.0370 in. dia.	51.521 to 51.540 mm dia. 2.0284 to 2.0291 in. dia.
(0.8-S) The crankshaft journal must be fine-finished to higher than ∇∇∇∇ *Holes to be de-burred and edges rounded with 1.0 to 1.5 mm (0.040 to 0.059 in.) relief.		

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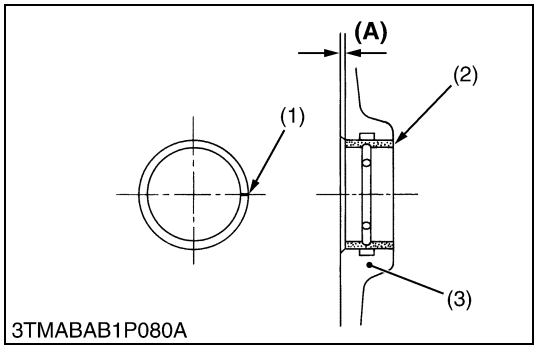

Replacing Crankshaft Bearing 1

(When removing)

1. Press out the used crankshaft bearing 1 using a crankshaft bearing 1 replacing tool. (See page **"SPECIAL TOOLS"**.)

(When installing)

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

Dimension **(A)**	Factory spec.	0 to 0.3 mm 0 to 0.01 in.

(1) Seam
(2) Crankshaft Bearing 1
(3) Cylinder Block
(A) Dimension

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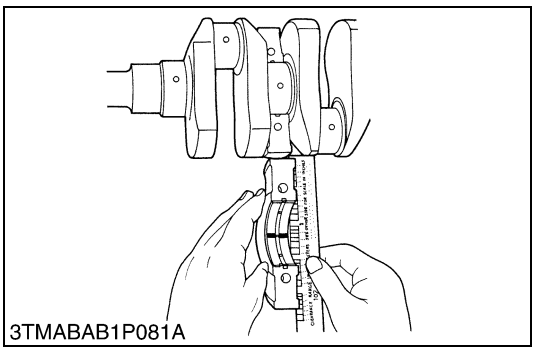
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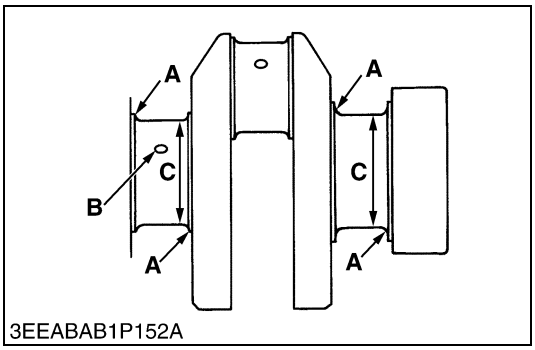

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Oil Clearance between Crankshaft Journal and Crankshaft Bearing 2 (Crankshaft Bearing 3)

1. Put a strip of plastigage on the center of the journal.
2. Install the bearing case and tighten the baring case screws 1 to the specified torque, and remove the bearing case again.
3. Measure the amount of the flattening with the scale and get the oil clearance.
4. If the clearance exceeds the allowable limit, replace the crankshaft bearing 2 (1) and crankshaft bearing (3).
5. If the same size bearing is useless because of the crankshaft journal wear, replace it with an undersize one referring to the table and figure.

■ **NOTE**

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

[D782-E2-ZD]

Oil clearance between crankshaft journal and crankshaft bearing 2 (crankshaft bearing 3)	Factory spec.	0.028 to 0.059 mm 0.0011 to 0.0023 in.
	Allowable limit	0.20 mm 0.0079 in.
Crankshaft journal O.D. (Flywheel side)	Factory spec.	43.934 to 43.950 mm 1.7297 to 1.7303 in.
Crankshaft bearing 2 I.D.	Factory spec.	43.978 to 43.993 mm 1.7315 to 1.7320 in.
Crankshaft journal O.D. (Intermediate)	Factory spec.	39.934 to 39.950 mm 1.5722 to 1.5728 in.
Crankshaft bearing 3 I.D.	Factory spec.	39.978 to 39.993 mm 1.5740 to 1.5745 in.

[D1005-E2-ZD]

Oil clearance between crankshaft journal and crankshaft bearing 2	Factory spec.	0.034 to 0.095 mm 0.0014 to 0.0037 in.
	Allowable limit	0.20 mm 0.0079 in.
Crankshaft journal O.D. (Intermediate)	Factory spec.	47.934 to 47.950 mm 1.8872 to 1.8877 in.
Crankshaft bearing 2 I.D.	Factory spec.	47.984 to 48.029 mm 1.8892 to 1.8909 in.
Oil clearance between crankshaft journal and crankshaft bearing 3	Factory spec.	0.034 to 0.098 mm 0.0014 to 0.0038 in.
	Allowable limit	0.20 mm 0.0079 in.
Crankshaft journal O.D. (Flywheel side)	Factory spec.	51.921 to 51.940 mm 2.0442 to 2.0448 in.
Crankshaft bearing 3 I.D.	Factory spec.	51.974 to 52.019 mm 2.0463 to 2.0479 in.

[D1305-E3-ZD]

Oil clearance between crankshaft journal and crankshaft bearing 2	Factory spec.	0.034 to 0.103 mm 0.0014 to 0.00405 in.
	Allowable limit	0.20 mm 0.0079 in.
Crankshaft journal O.D. (Intermediate)	Factory spec.	51.921 to 51.940 mm 2.0442 to 2.0448 in.
Crankshaft bearing 2 I.D.	Factory spec.	51.974 to 52.024 mm 2.0463 to 2.0481 in.
Oil clearance between crankshaft journal and crankshaft bearing 3	Factory spec.	0.034 to 0.103 mm 0.0014 to 0.00405 in.
	Allowable limit	0.20 mm 0.0079 in.
Crankshaft journal O.D. (Flywheel side)	Factory spec.	51.921 to 51.940 mm 2.0442 to 2.0448 in.
Crankshaft bearing 3 I.D.	Factory spec.	51.974 to 52.019 mm 2.0463 to 2.0481 in.

(Reference)

- Undersize dimensions of crankshaft journal

[D782-E2-ZD]

Undersize	0.2 mm 0.008 in.	0.4 mm 0.016 in.
Dimension **A**	1.8 to 2.2 mm radius 0.071 to 0.087 in.radius	1.8 to 2.2 mm radius 0.071 to 0.087 in.radius
*Dimension **B**	1.0 to 1.5 mm relief 0.040 to 0.059 in. relief	1.0 to 1.5 mm relief 0.040 to 0.059 in. relief
Dimension **C**	39.734 to 39.750 mm dia. 1.5643 to 1.5650 in. dia.	39.534 to 39.550 mm dia. 1.5565 to 1.5571 in. dia.
Dimension **D**	43.734 to 43.750 mm dia. 1.72181 to 1.72244 in. dia.	43.534 to 43.550 mm dia. 1.71394 to 1.71457 in. dia.
(0.8S) The crankshaft journal must be fine-finished to higher than ∇∇∇∇. *Holes to be de-burred and edges rounded with 1.0 to 1.5 mm (0.0394 to 0.0591 in.) relief.		

[D1005-E2-ZD]

Undersize	0.2 mm 0.0079 in.	0.4 mm 0.016 in.
Dimension **A**	2.3 to 2.7 mm radius 0.091 to 0.10 in. radius	2.3 to 2.7 mm radius 0.091 to 0.10 in. radius
*Dimension **B**	1.0 to 1.5 mm relief 0.040 to 0.059 in. relief	1.0 to 1.5 mm relief 0.040 to 0.059 in. relief
Dimension **C**	47.734 to 47.750 mm dia. 1.8793 to 1.8799 in. dia.	47.534 to 47.550 mm dia. 1.8715 to 1.8720 in. dia.
Dimension **D**	51.721 to 51.740 mm dia. 2.0363 to 2.0370 in. dia.	51.521 to 51.540 mm dia. 2.0284 to 2.0291 in. dia.
(0.8-S) The crankshaft journal must be fine-finished to higher than ∇∇∇∇ *Holes to be de-burred and edges rounded with 1.0 to 1.5 mm (0.0394 to 0.0591 in.) relief.		

[D1305-E3-ZD]

Undersize	0.20 mm 0.0079 in.	0.40 mm 0.016 in.
Dimension **A**	2.3 to 2.7 mm radius 0.091 to 0.10 in. radius	2.3 to 2.7 mm radius 0.091 to 0.10 in. radius
*Dimension **B**	1.0 to 1.5 mm relief 0.040 to 0.059 in. relief	1.0 to 1.5 mm relief 0.040 to 0.059 in. relief
Dimension **C**	51.721 to 51.740 mm dia. 2.0363 to 2.0370 in. dia.	51.521 to 51.540 mm dia. 2.0284 to 2.0291 in. dia.
(0.8-S) The crankshaft journal must be fine-finished to higher than ∇∇∇∇ *Holes to be de-burred and edges rounded with 1.0 to 1.5 mm (0.040 to 0.059 in.) relief.		

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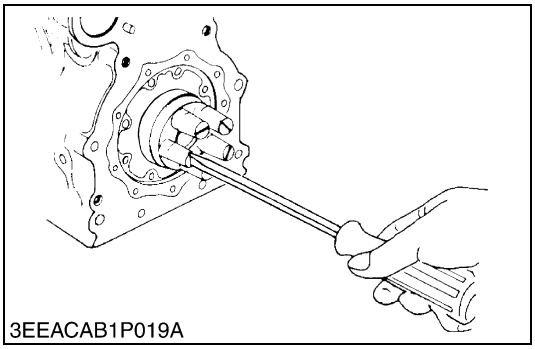

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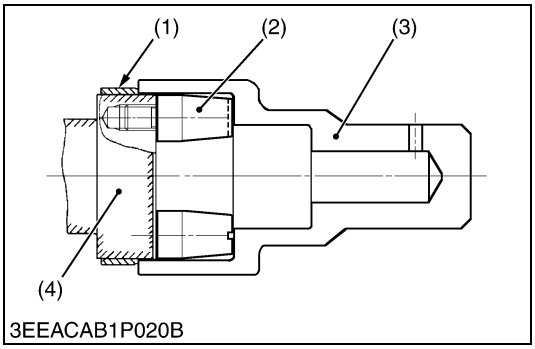

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Replacing Crankshaft Sleeve

1. Remove the used crankshaft sleeve.
2. Set the sleeve guide (2) to the crankshaft.
3. Heat a new sleeve to a temperature between 150 and 200 °C (302 and 392 °F), and fix the sleeve to the crankshaft as shown in figure.
4. Press fit the sleeve using the auxiliary socket for pushing (3).

■ **NOTE**

- **Mount the sleeve with its largely chamfered surface facing outward.**
- **Should heating is not enough, a sleeve might stop halfway, so careful.**

(1) Crankshaft Sleeve
(2) Sleeve Guide
(3) Auxiliary Socket for Pushing
(4) Crankshaft

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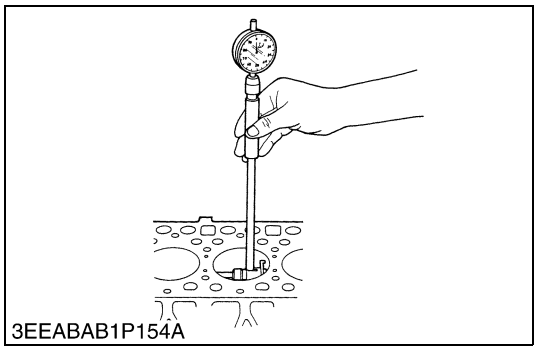
(5) Cylinder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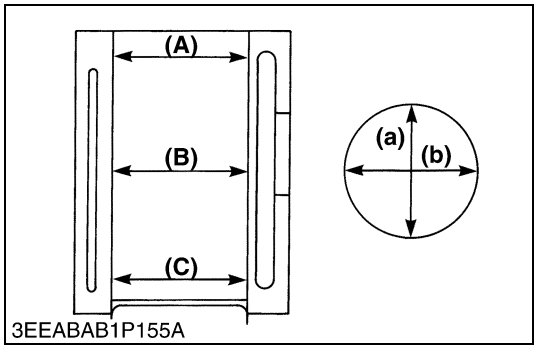

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Cylinder Wear

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

[D782-E2-ZD]

Cylinder liner I.D.	Factory spec.	67.000 to 67.019 mm 2.6378 to 2.6385 in.
	Allowable limit	67.150 mm 2.6437 in.

[D1005-E2-ZD]

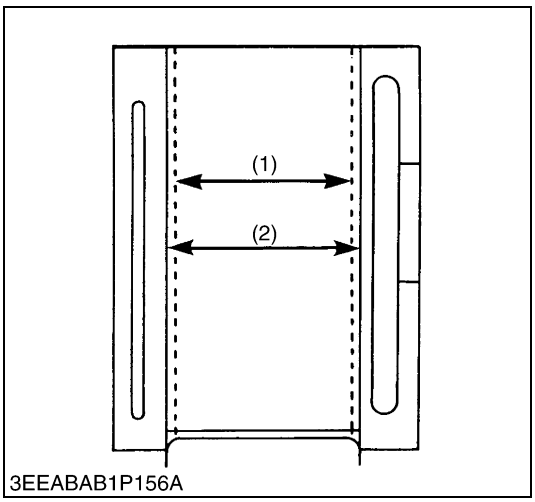
Cylinder I.D.	Factory spec.	76.000 to 76.019 mm 2.9922 to 2.9928 in.
	Allowable limit	76.15 mm 2.998 in.

[D1305-E3-ZD]

Cylinder I.D.	Factory spec.	78.000 to 78.019 mm 3.0709 to 3.0716 in.
	Allowable limit	78.15 mm 3.077 in.

(A) Top
(B) Middle
(C) Bottom (Skirt)
(a) Right-angled to Piston Pin
(b) Piston Pin Direction

W10343890



Correcting Cylinder

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

[D782-E2-ZD]

Cylinder liner I.D.	Factory spec.	67.250 to 67.269 mm 2.6477 to 2.6483 in.
	Allowable limit	67.400 mm 2.6535 in.
Finishing	Hone to 2.2 to 3.0 μmRz (0.000087 to 0.00012 in.μRz) ∇∇∇.	

[D1005-E2-ZD]

Oversized cylinder liner I.D.	Factory spec.	76.500 to 76.519 mm 3.0119 to 3.0125 in.
	Allowable limit	76.65 mm 3.018 in.
Finishing	Hone to 1.2 to 2.0 mm μR max. ∇∇∇ (0.000047 to 0.000079 in. μR max.)	

[D1305-E3-ZD]

Oversized cylinder liner I.D.	Factory spec.	78.500 to 78.519 mm 3.0906 to 3.0912 in.
	Allowable limit	78.65 mm 3.096 in.
Finishing	Hone to 1.2 to 2.0 mm μR max. ∇∇∇ (0.000047 to 0.000079 in. μR max.)	

2. Replace the piston and piston rings with oversize ones.
   Oversize : 0.25 mm (0.0098 in.) (D782-E2-ZD)
   Oversize : 0.5 mm (0.02 in.) (D1005-E2-ZD, D1305-E3-ZD)

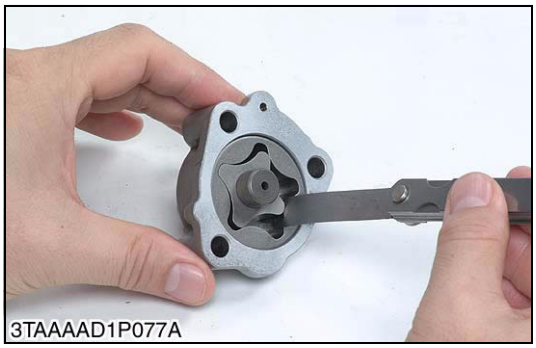
■ **NOTE**

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

(1) Cylinder I.D. (Before Correction) (2) Cylinder I.D. (Oversize)

W10344480

(6) Oil Pump (D782-E2-ZD)



Rotor Lobe Clearance

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

Rotor lobe clearance	Factory spec.	0.030 to 0.14 mm 0.0012 to 0.0055 in.

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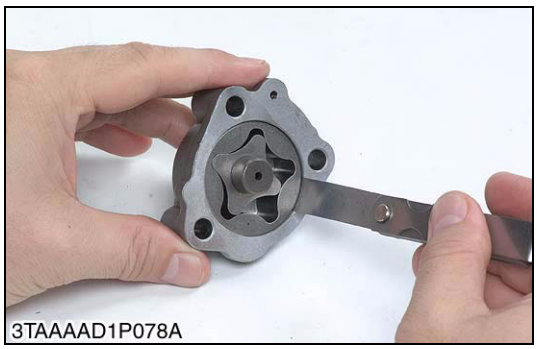
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Clearance between Outer Rotor and Pump Body

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

Clearance between outer rotor and pump body	Factory spec.	0.070 to 0.15 mm 0.0028 to 0.0059 in.

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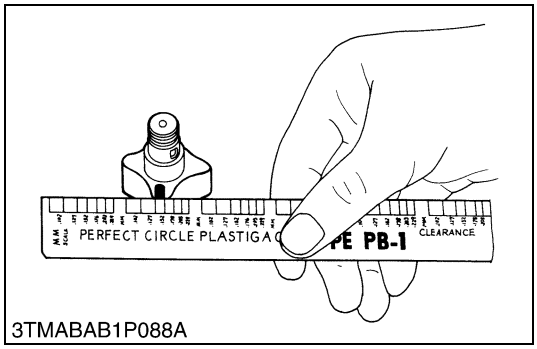

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Clearance between Rotor and Cover

1. Put a strip of plastigage onto the rotor face with grease.
2. Install the cover and tighten the screws.
3. Remove the cover carefully, and measure the amount of the flattening with the scale and get the clearance.
4. If the clearance exceeds the factory specifications, replace oil pump rotor assembly.

Clearance between rotor and cover	Factory spec.	0.0750 to 0.135 mm 0.00296 to 0.00531 in.

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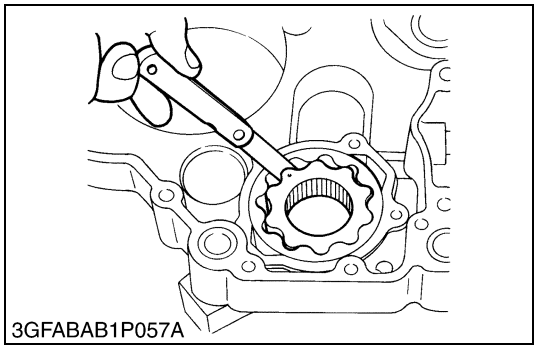
(7) Oil Pump (D1005-E2-ZD, D1305-E3-ZD)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Rotor Lobe Clearance

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

Rotor lobe clearance	Factory spec.	0.060 to 0.18 mm 0.0024 to 0.0070 in.

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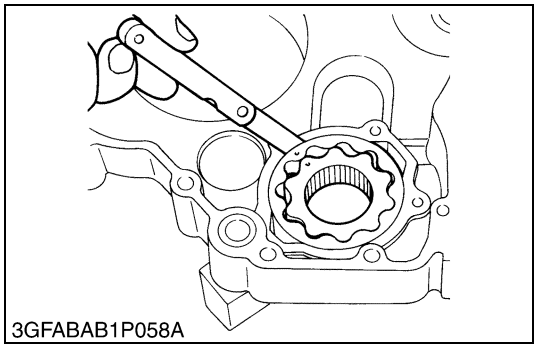
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Clearance between Outer Rotor and Pump Body

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

Clearance between outer rotor and pump body	Factory spec.	0.100 to 0.180 mm 0.00394 to 0.00708 in.

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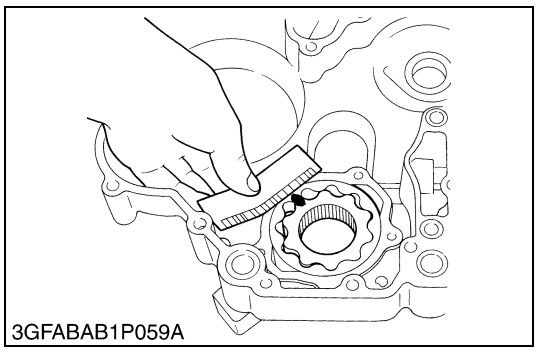
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Clearance between Rotor and Cover

1. Put a strip of plastigage onto the rotor face with grease.
2. Install the cover and tighten the screws.
3. Remove the cover carefully, and measure the amount of the flattening with the scale and get the clearance.
4. If the clearance exceeds the factory specifications, replace the oil pump rotor assembly.

Clearance between rotor and cover	Factory spec.	0.025 to 0.075 mm 0.00099 to 0.0029 in.

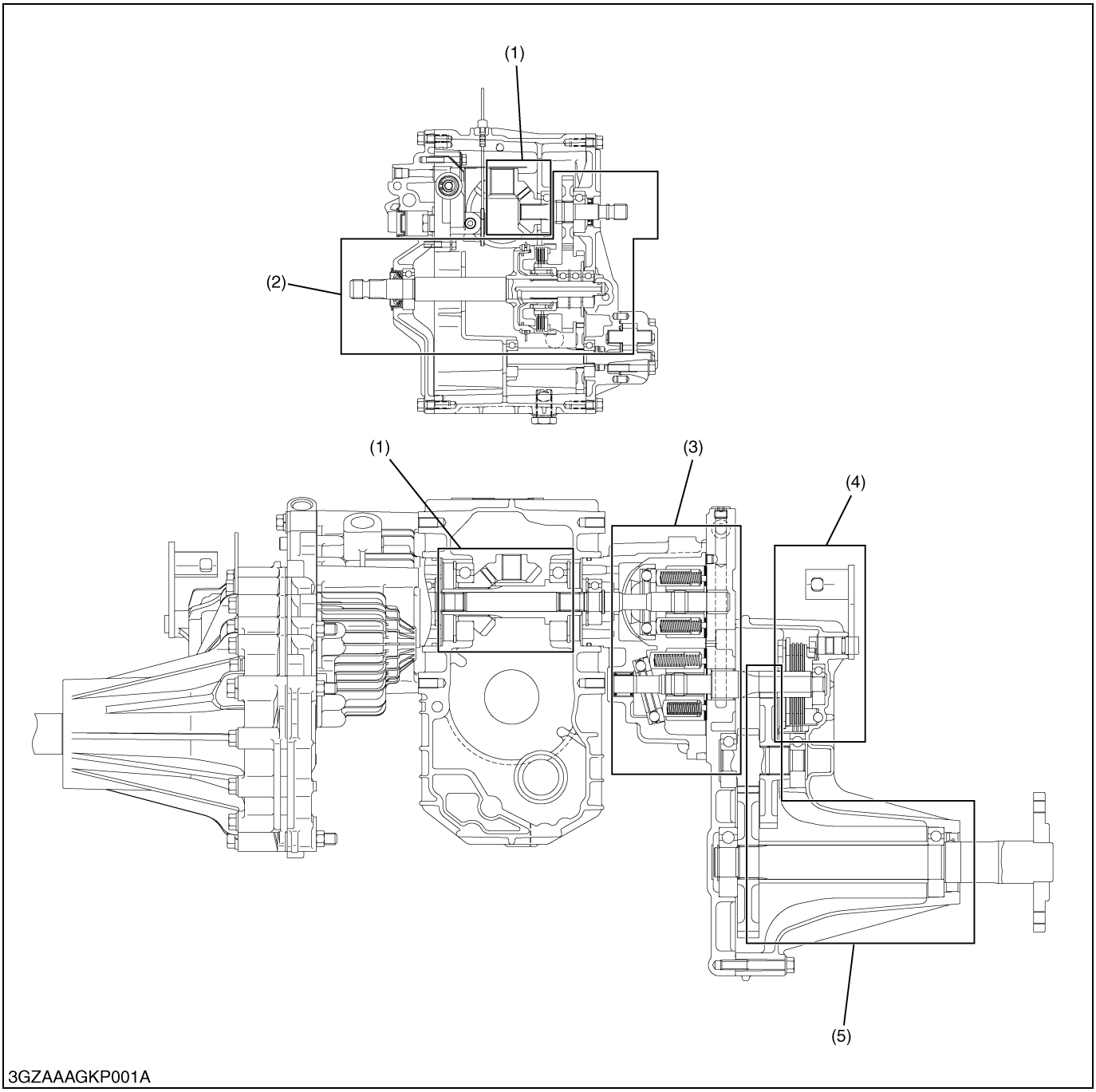
W10357320

2 TRANSAXLE

MECHANISM

CONTENTS

1. STRUCTURE



(1) Bevel Gear Section (3) Hydrostatic Transmission (4) Brake Section (5) Final Reduction Gear Section
(2) PTO Section

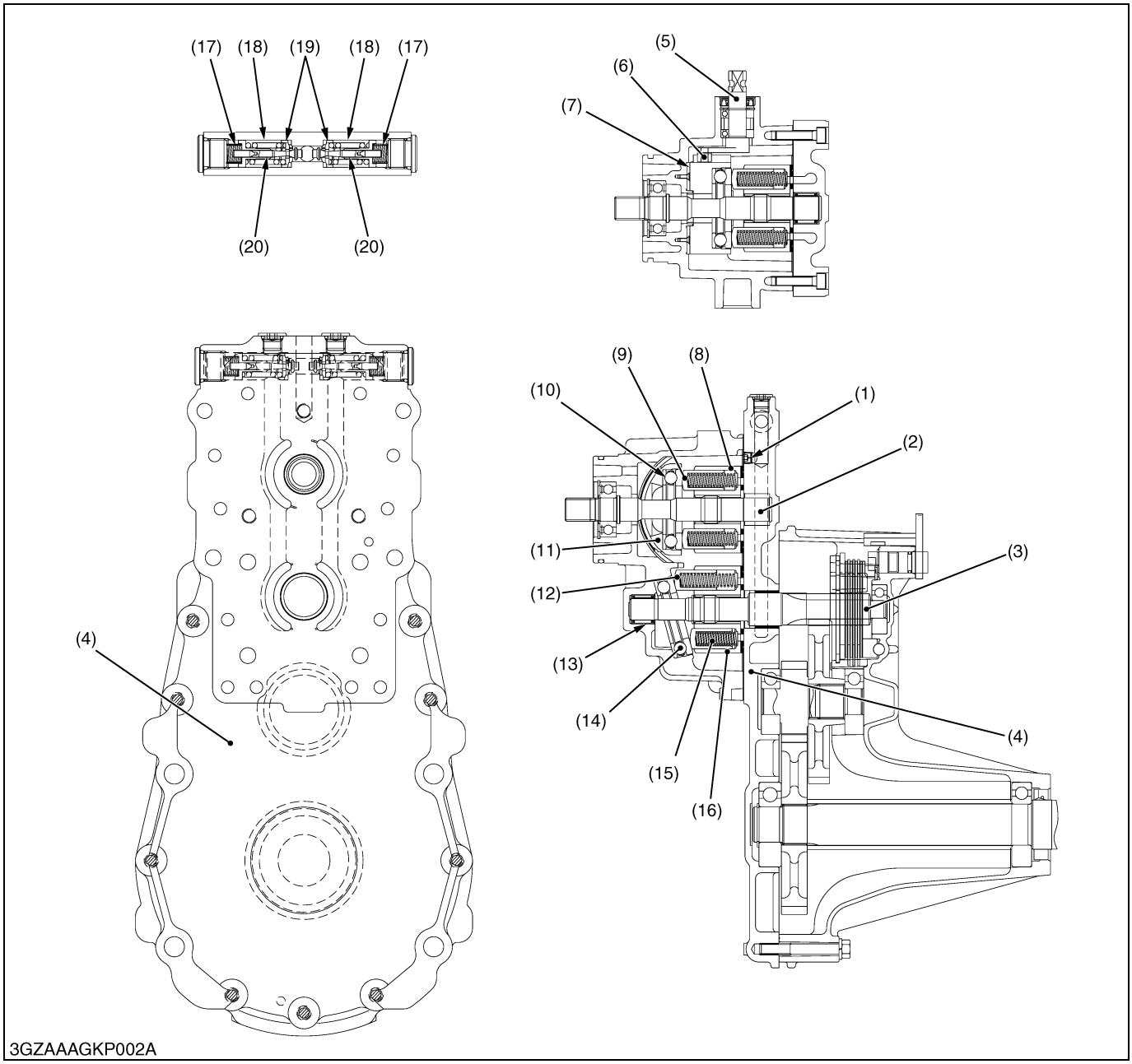
Transmission consists of bevel gear section (1) hydrostatic transmission (3), brake section (4), final reduction gear section (5), and PTO section (2).

Power from engine is transmitted through transmission to mower and rear wheels.

2. TRAVELLING SYSTEM

[1] HYDROSTATIC TRANSMISSION

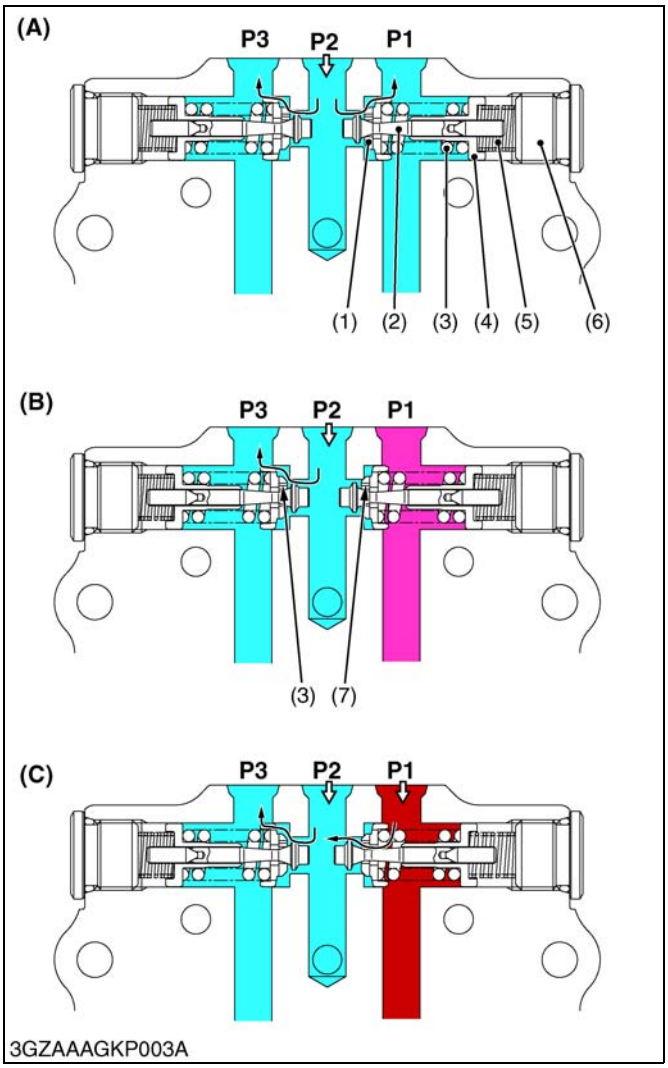
(1) Structure



(1) Lubricating Orifice
(2) Pump Shaft
(3) Brake Shaft (8T) (Motor Shaft)
(4) Center Section
(5) Trunnion Arm
(6) Slot Guide
(7) Cradle Bearing
(8) Cylinder Block (Pump)
(9) Piston (Pump)
(10) Thrust Ball Bearing
(11) Swashplate
(12) Piston (Motor)
(13) Needle Bearing
(14) Thrust Ball Bearing
(15) Piston Spring
(16) Cylinder Block (Motor)
(17) Check Valve Spring
(18) Relief Valve Spring
(19) Check Valve
(20) High Pressure Relief Valve

The hydrostatic transmission consists of variable displacement piston pump, fixed displacement piston motor and valve system.

(2) Check Valve and High Pressure Relief Valve



The check and high-pressure relief valve consists of pressure poppet (2), check valve seat (1), relief valve spring (3), spring guide (4) and check valve spring (5).

The valve is used to prevent an overload that would happen at a quick start, sudden stop or even during usual running. This valve doubles as a check valve.

The check and high-pressure relief valves are laid out facing each other as shown in the figure.

In neutral, both valves are open and charging oil enters into the main oil circuit through the valves. **(A)**

At normal operation, the check valve in the high-pressure side is closed and it pushes and opens the another one. An excessive charge flow goes through the charge relief valve into HST housing. **(B)**

The check and high-pressure relief valve along the high-pressure line serves as a a high-pressure relief valve. If the pressure exceeds a high-pressure limit level, the pressure poppet opens itself against the relief valve spring (3) force and opens the valve seat that is located between the check valve seat (1) and the pressure poppet (2). Now the flow goes from **P1** to **P2** and **P3**. **(C)**

If the **P1** pressure drops, the relief valve spring forces the valve seat closed against the pressure. The high-pressure oil at **P1** does not flow to **P2** any longer.

As discussed above, the check and high-pressure relief valve protects engines, pumps, motors, gears and even the machine itself from overload.

Oil temperature	Valve operating pressure
50 °C (122 °F)	19.5 to 22.5 MPa 199 to 229 kgf/cm^2 2830 to 3260 psi

Condition

- ZD321, ZD326 at engine speed 1800 min^{-1} (rpm)
- ZD331 at engine speed 1600 min^{-1} (rpm)

(1) Check Valve Seat
(2) Pressure Poppet
(3) Relief Valve Spring
(4) Spring Guide
(5) Check Valve Spring
(6) Valve Plug
(7) Neutral Orifice

(A) In Neutral (Stop)
(B) When Check Valve Activating (Normal Operation)
(C) When High Pressure Relief Valve Activating
P1 :Forward
P2 :Change
P3 :Reverse

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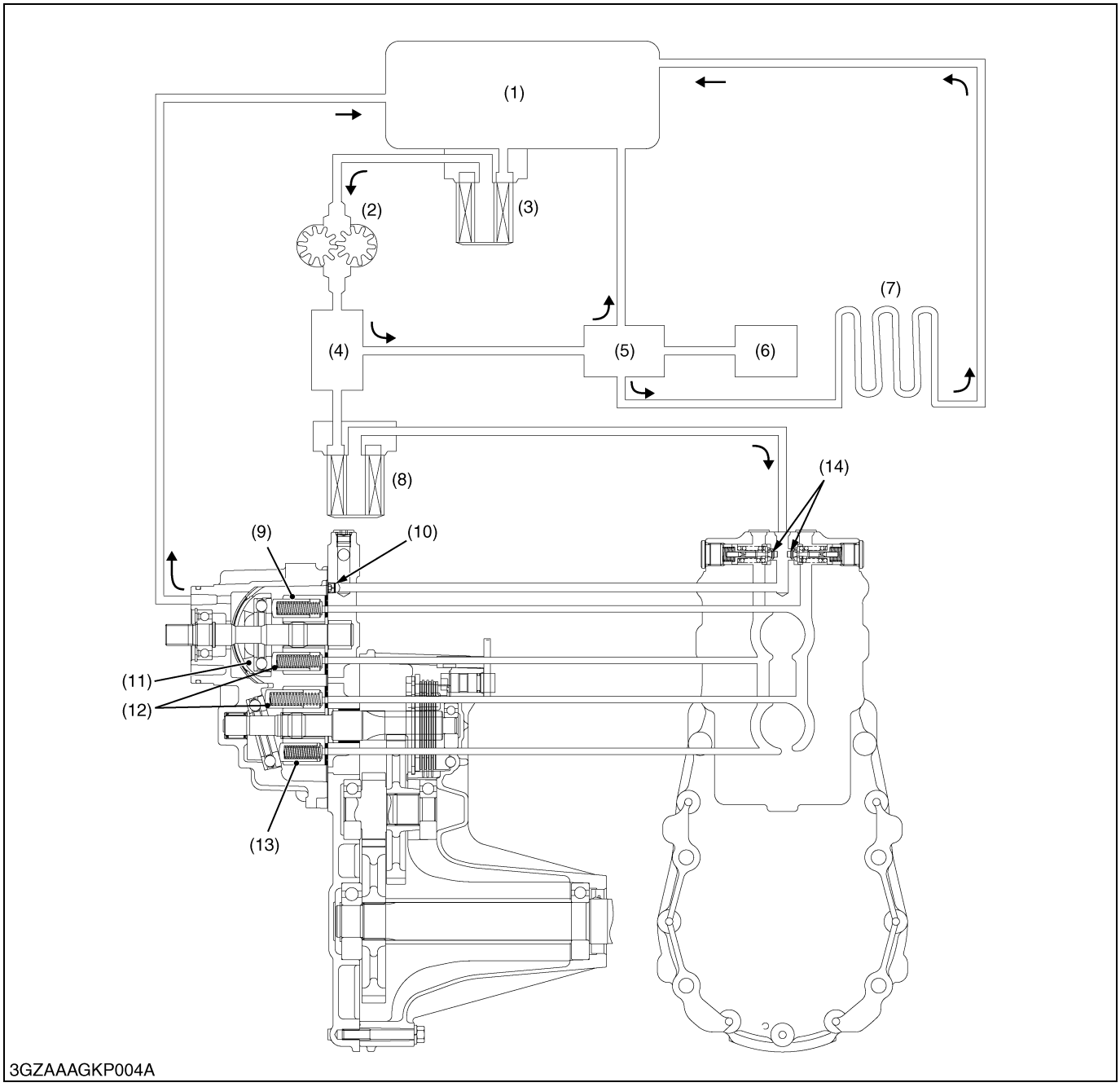
(3) Oil Flow



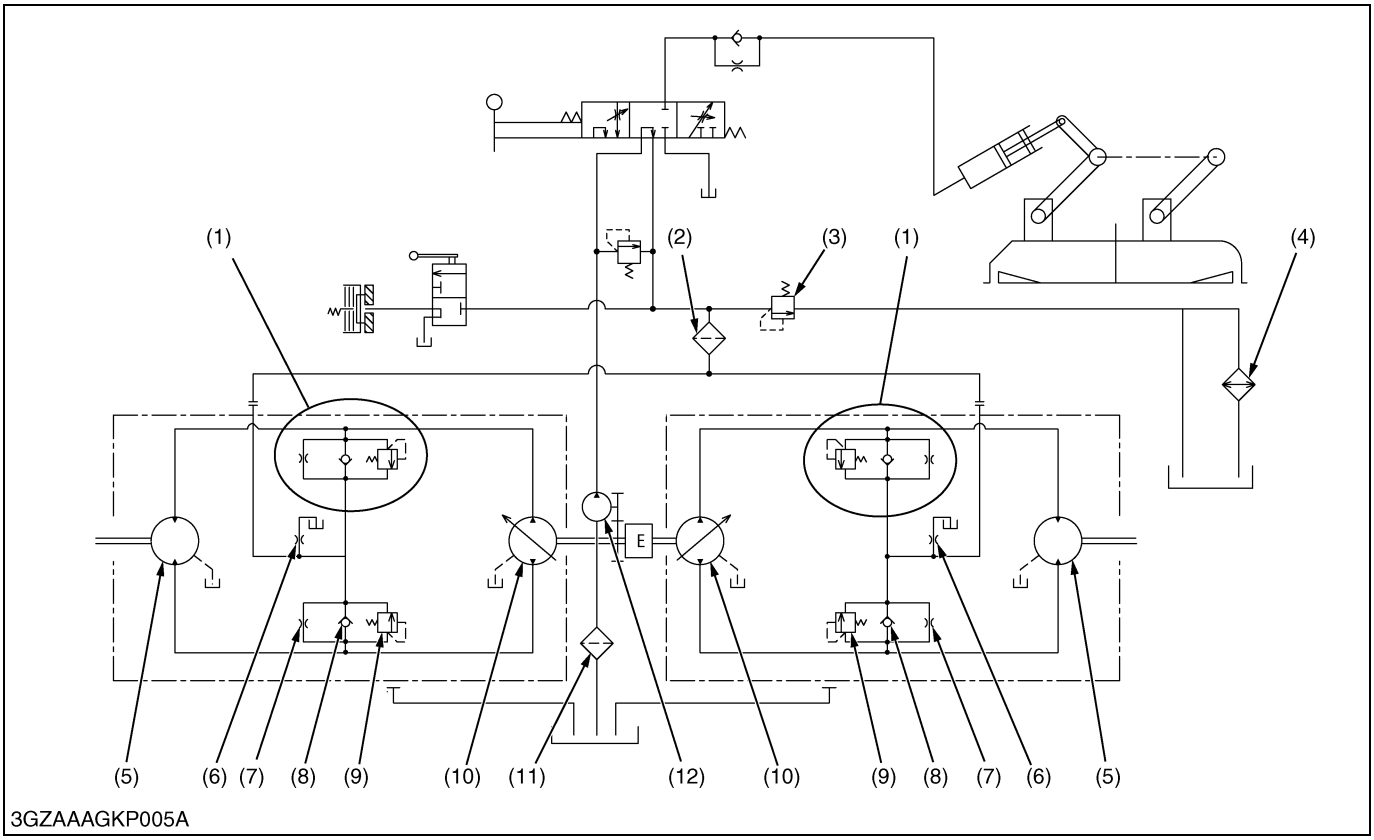
(1) Transmission Case
(2) Hydraulic Pump
(3) Oil Filter Cartridge
(4) Control Valve
(5) Regulator Valve
(6) PTO Clutch
(7) Oil Cooler
(8) Oil Filter Cartridge
(9) Cylinder Block (Pump)
(10) Lubricating Orifice
(11) Swashplate
(12) Piston
(13) Cylinder Block (Motor)
(14) Check and High Pressure Relief Valve

The pump and motor are joined in a closed hydraulic loop and most of oil circulates within the main oil circuit. A little oil lubricates and oozes out from the clearance between the moving parts of the case. Then oil in the main oil circuit of the HST needs to be supplied a want.

The charge oil is sent to the HST housing after the control valve and oil filter cartridge pass with the hydraulic pump. And, pressure is always controlled to the charge oil with the regulator valve.

The charge oil aids smooth operation of pistons for pump and motor. And overflow oil from HST housing return to the transmission case.

(4) Power Trains Operation



(1) Check and High Pressure Relief Valve
(2) Oil Filter
(3) Regulator Valve (Charge Relief Valve)
(4) Oil Cooler
(5) Motor
(6) Lubricating Orifice
(7) Neutral Orifice
(8) Check Valve
(9) High Pressure Relief Valve
(10) Pump
(11) Suction Oil Filter
(12) Hydraulic Pump

■ Neutral

With the motion control levers in the **NEUTRAL** position, the piston springs in the pump block in the pumps force the swash plates to a position that is parallel to the pump body. With the swash plates parallel to the pump body, the pistons do not reciprocate in the cylinder block, they merely rotate, and no oil is being drawn in or discharged from the pump. The machine is in a zero displacement position and the machine remains stationary.

Oil returning from the HST housing and hydraulic pump is directed through the regulating valve before returning to the transmission case.

■ Forward

As the motion control levers are pushed forward, the swash plates in the pumps move from the neutral position (parallel to the pump body) to a forward angle position. Piston springs inside the cylinder bores force the pistons against the swash plates.

As the cylinder block rotates, the pistons follow the contour of the swash plate, moving outward, drawing oil into their bores. As the cylinder block continues to rotate, the pistons are forced into their bores, discharging oil under pressure.

High-pressure oil from the pumps is routed to the motors, driving the machine forward.

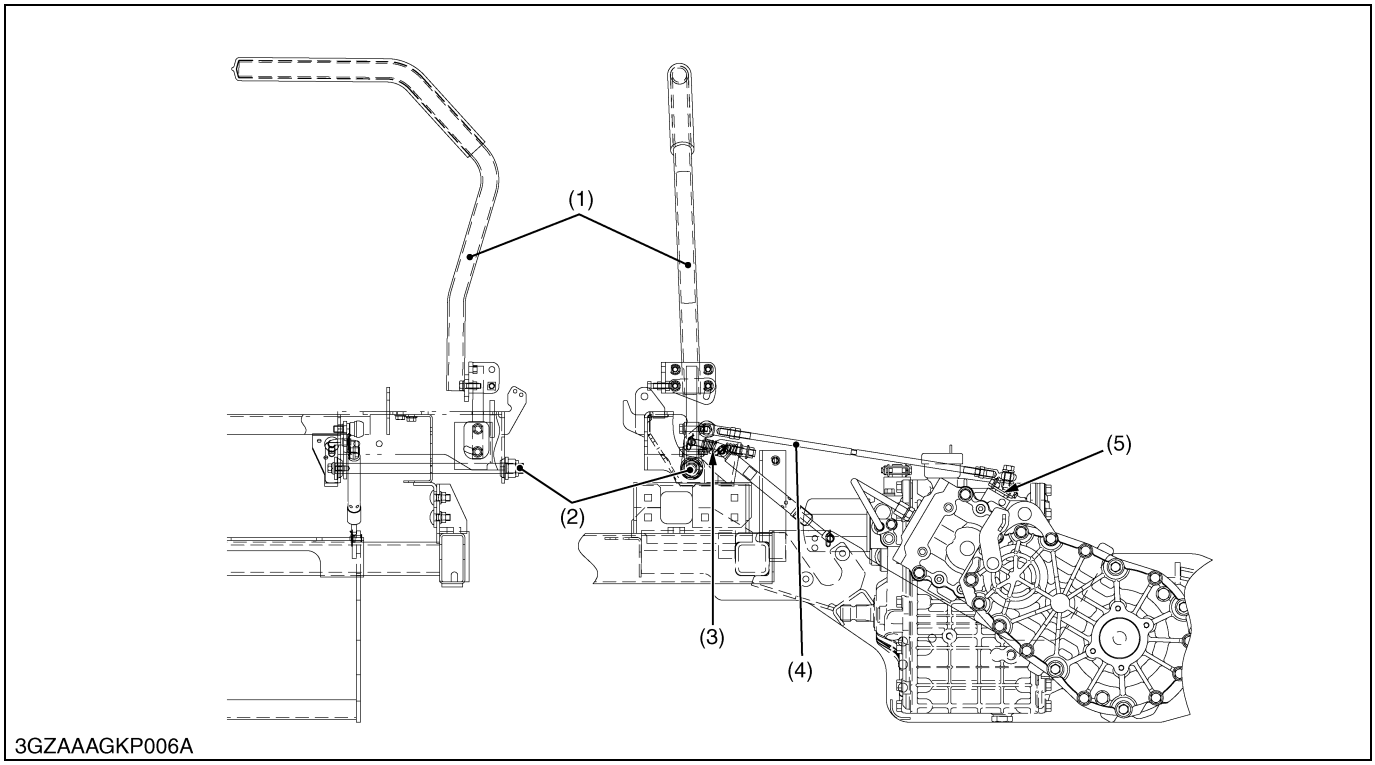
■ Reverse

Reverse operation is accomplished by reversing the angle applied to the pump swash plates, reversing the flow of high-pressure oil to the motors.

(Reference)

- Regulating valve setting pressure (PTO clutch operating pressure) :
  ZD321, ZD326 : 0.65 to 0.75 MPa (6.7 to 7.6 kgf/cm^2, 95 to 100 psi) at engine speed 1800 min^{-1} (rpm)
  ZD331 : 0.65 to 0.75 MPa (6.7 to 7.6 kgf/cm^2, 95 to 100 psi) at engine speed 1600 min^{-1} (rpm)

(5) Control Linkage



(1) Motion Control Lever (3) Speed Limit Spring (4) Speed Control Rod (5) Trunnion Arm
(2) Speed Shaft

The motion control lever (1) and the trunnion shaft of variable swashplate are linked with the speed shaft (2), speed control rod (4) and the trunnion arm (5). As the motion control lever (1) is pushed, the swashplate rotates and forward travelling speed increases. Pulling the motion control lever (1) increases reverse speed.

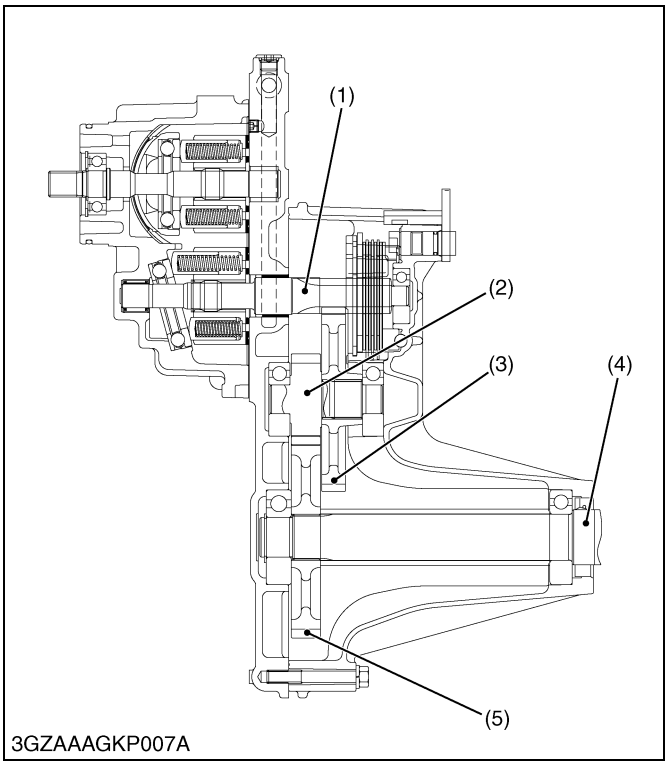
A neutral position can be requested by the thing to operate the motion control lever (1). Moreover, it is possible to fix to a neutral position by putting the motion control lever (1) in the neutral slot. The motion control lever (1) is pushed by the speed limit spring's (3) working when the motion control lever (1) is removed from the neutral slot. As the result, the machine synchronizes with the movement of the motion control lever (1) and begins to move slowly. (The machine is set like this.) The damper connected to the speed shaft (2) restricts the movement of the linkage to prevent abrupt operation or reversing.

■ **Steering**

The Zero-Turn Mower does not have a separate steering system. Steering is accomplished by varying the wheel motor speeds. This gives the machine a zero-turn capability.

As the control levers are moved to a full left turn position, the right hydraulic pump is moved to the full-speed forward position and the left pump is moved to the full-speed reverse position. This will allow the machine to pivot around its center.

(6) Final Reduction Gear Section



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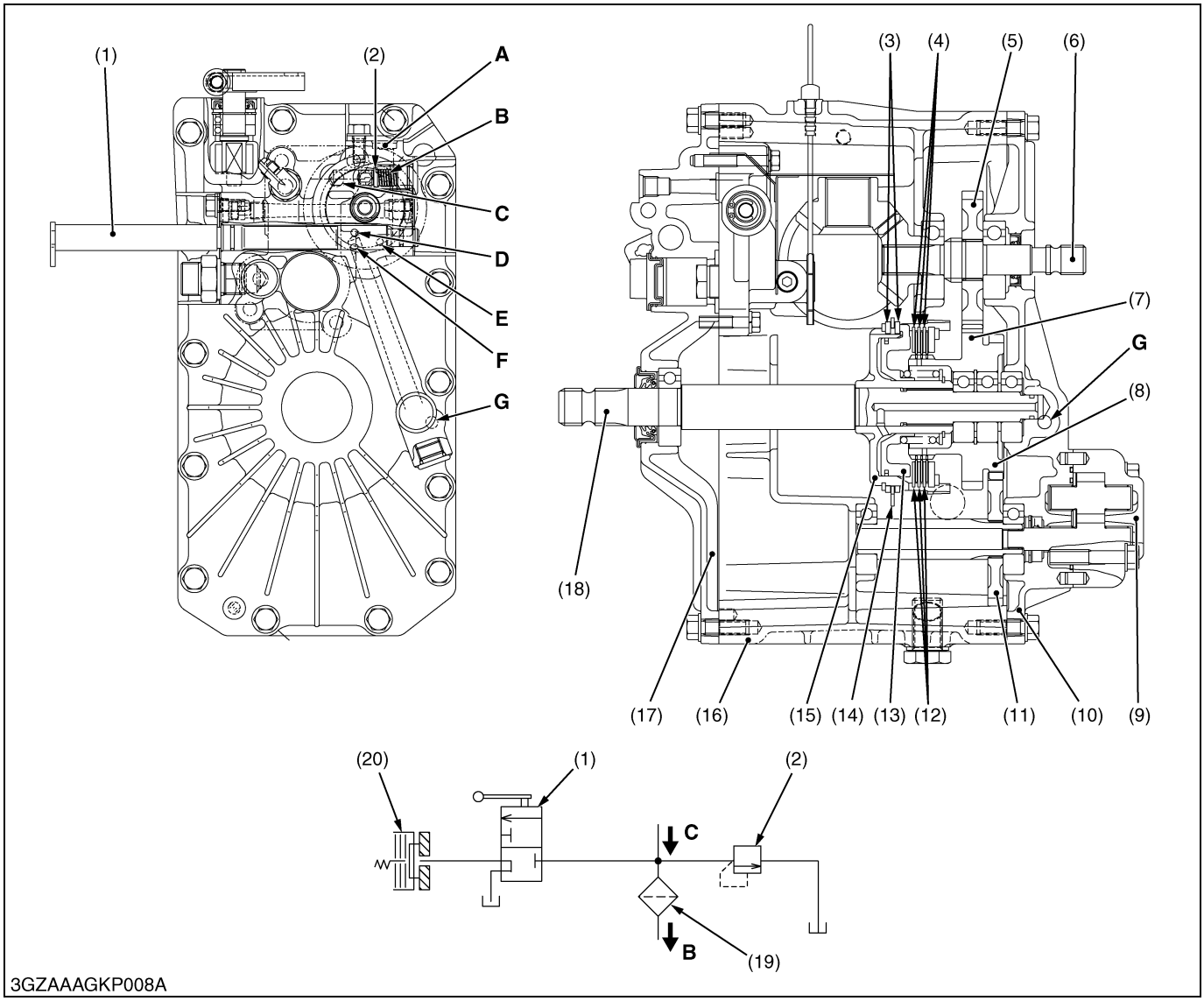
As for this machine, power is transmitted from the 8T gear on the brake shaft (1) to the rear axle (4) through 53T gear (3), 17T or 19T gear shaft (2) and 49T or 51T gear (5).

(1) Brake Shaft (8T)
(HST Motor Shaft)
(2) 17T Gear Shaft
(ZD321, ZD321N, ZD326S)
19T Gear Shaft
(ZD326P, ZD331P, ZD331LP)
(3) 53T Gear
(4) Rear Axle
(5) 51T Gear
(ZD321, ZD321N, ZD326S)
49T Gear
(ZD326P, ZD331P, ZD331LP)

W1014950

(7) PTO System

PTO Clutch and Valve



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(1) PTO Valve Lever
(2) Regulator Valve
(3) PTO Brake Plate
(4) PTO Clutch Plate
(5) 34T Gear (ZD321, ZD326)
33T Gear (ZD331)
(6) Input Shaft
(7) 43T Gear (ZD321, ZD326)
39T Gear (ZD331)
(8) 35T Gear
(9) Hydraulic Pump
(10) Center Case, Rear Cover
(11) 32T Gear
(12) PTO Clutch Disc
(13) Piston
(14) PTO Brake Disc
(15) PTO Case
(16) Center Case
(17) Center Case, Front Cover
(18) PTO Shaft
(19) Oil Filter Cartridge
(20) PTO Clutch

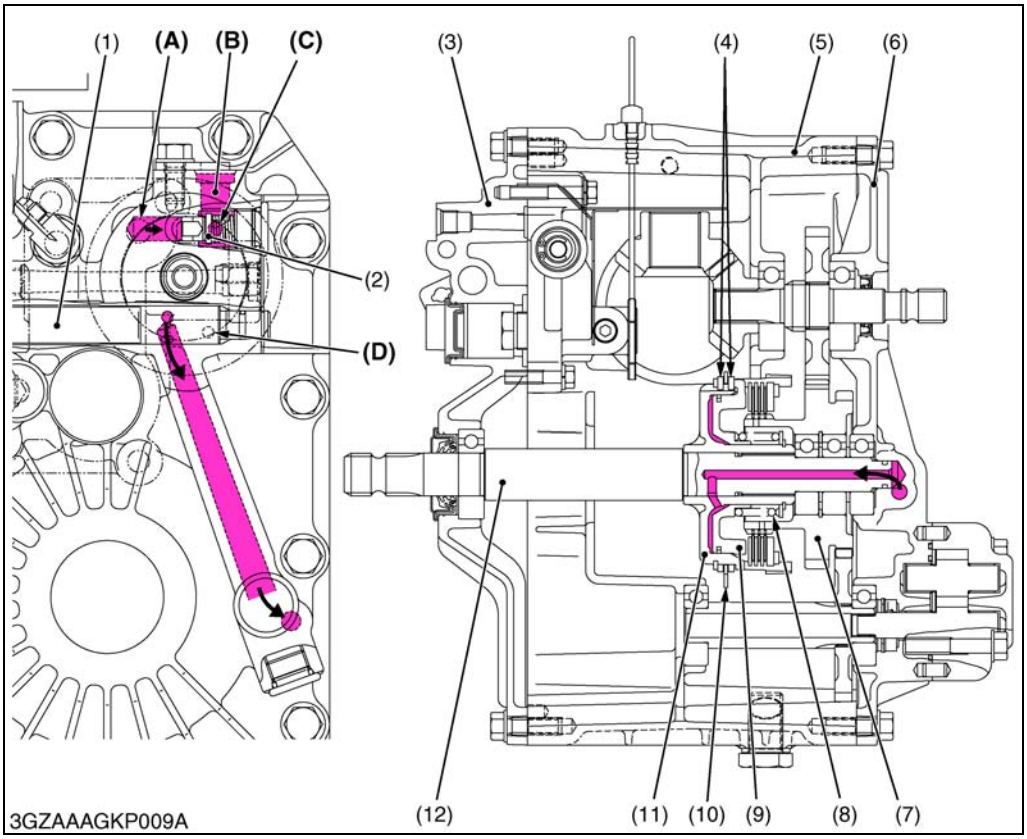
A : To Oil Cooler
B : To Hydrostatic Transmission
C : From Hydraulic Pump
D : From Hydraulic Pump to Valve Lever
E : From PTO Shaft to Center Case (Drain Port)
F : From PTO Valve Lever to PTO Shaft
G : To PTO Shaft

The ZD series equipped with hydraulic independent PTO clutch (wet multi-plates type). Therefore, the engine power could engage or disengage to the PTO shaft (18) without stopping the machine movement.

The PTO clutch (20) has three clutch discs (12), three clutch plates (4), clutch piston (13) and so on.

The clutch piston (13) is actuated by hydraulic oil flow the hydraulic pump through regulator valve (2).

■ PTO Clutch “Engaged”



(1) PTO Clutch Valve
(2) Poppet
(3) Center Case, Front Cover
(4) Brake Pressure Plate
(5) Center Case
(6) Center Case, Rear Cover
(7) Clutch Gear
(8) Spring
(9) Clutch Piston
(10) Brake Disc
(11) Clutch Spline Boss
(12) Clutch Shaft (PTO Shaft)

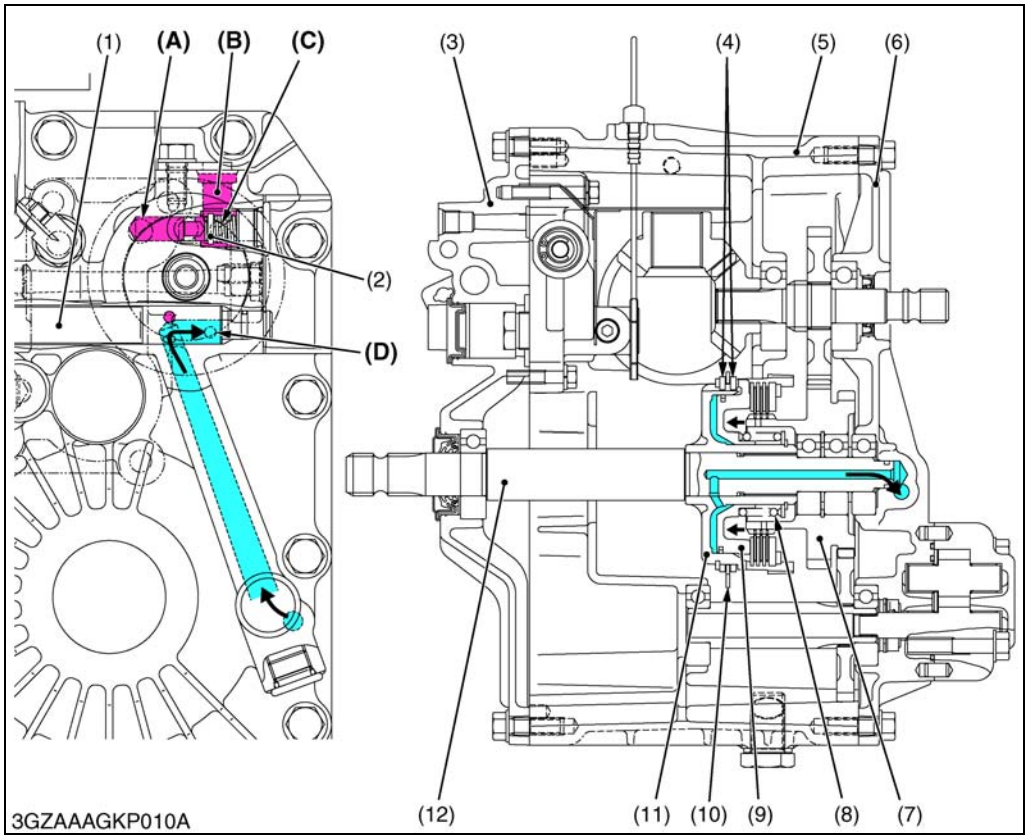
(A) From Hydraulic Pump
(B) To Oil Cooler
(C) To Hydrostatic Transmission
(D) To Center Case

W1015966

When the PTO clutch lever is set at the **“Engaged”** position, the PTO clutch valve (1) rotates and form the oil line to the PTO clutch pack.

Oil entering the clutch pack pushes the clutch piston (9) to engage the clutch pack.

■ PTO Clutch “Disengaged”



(1) PTO Clutch Valve
(2) Poppet
(3) Center Case, Front Cover
(4) Brake Pressure Plate
(5) Center Case
(6) Center Case, Rear Cover
(7) Clutch Gear
(8) Spring
(9) Clutch Piston
(10) Brake Disc
(11) Clutch Spline Boss
(12) Clutch Shaft (PTO Shaft)

(A) From Hydraulic Pump
(B) To Oil Cooler
(C) To Hydrostatic Transmission
(D) To Center Case

W1016225

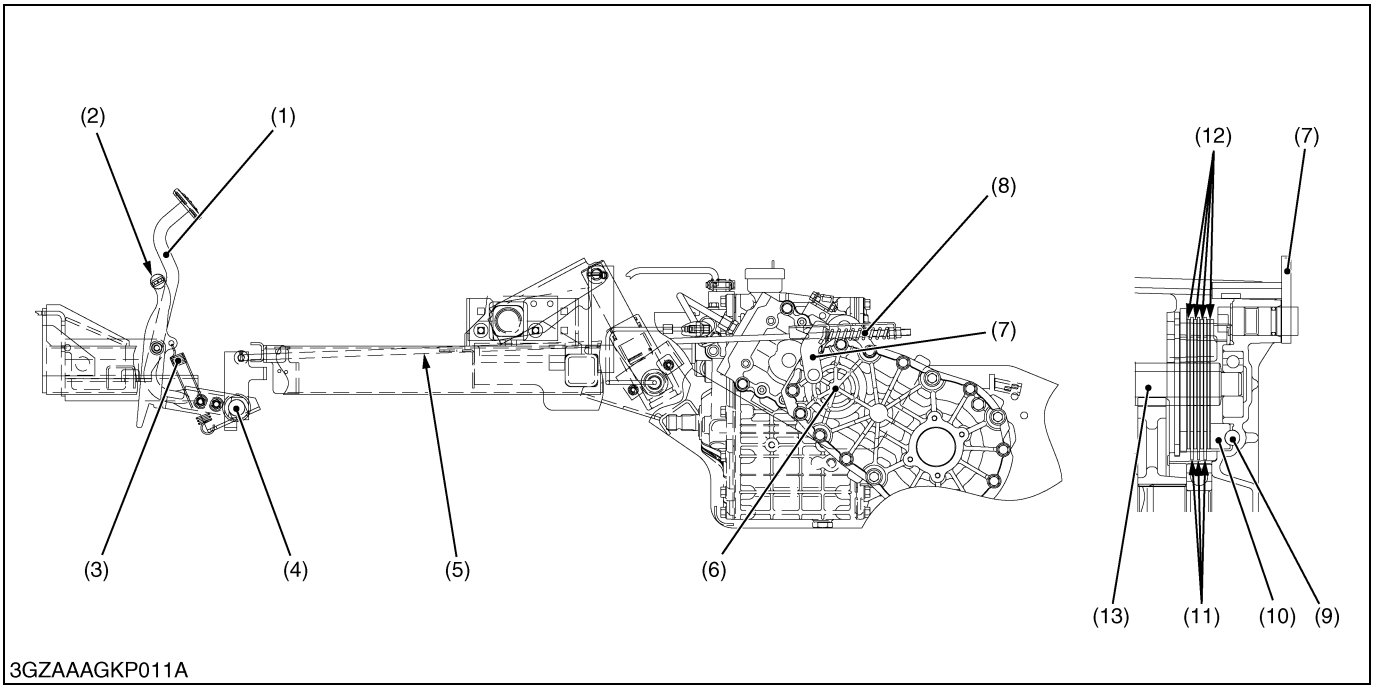
After starting the engine, when the PTO clutch lever is set at the **“Disengaged”** position, the hole of PTO valve lever dose not face to hydraulic pump port.

Since oil from hydraulic pump is blocked at the PTO valve lever, oil dose not flow to the PTO shaft. Blocked oil flows to the hydrostatic transmission and oil cooler to the regulator valve.

Oil in the clutch pack drained through the PTO valve lever into the center case (5).

Thus the clutch piston (9) is pushed back by the spring (8). When the piston (9) is pushed back, the piston pushed the brake plate (4) and brake disc (10), the rotation and drag of the PTO shaft (12) stop.

(8) Parking Brake



(1) Brake Pedal
(2) Parking Lock Pedal
(3) Brake Pedal Return Spring
(4) Brake Shaft
(5) Brake Rod
(6) Brake Assembly
(7) Brake Arm
(8) Brake Spring
(9) Ball
(10) Actuator
(11) Brake Disk
(12) Brake Plate
(13) HST Motor Shaft (Brake)

The parking brake is composed of brake pedal (1), parking lock pedal (2), brake pedal return spring (3), brake shaft (4), brake rods (5), brake arms (7) and brake assemblies (6).

The brake is mechanical wet disks type.

When the brake pedal (1) is pressed, the brake shaft (4) is rotated forward and the brake rods (5) is pulled forward. And the brake arms (7) are rotated forward.

The brake arms (7) is connected mechanically to the grooves of the actuators (10).

The brake arms (7) rotates the actuators (10) and the actuators (10) mounting on three balls pushes the brake disks (11) and brake plates (12) to stop the brake shafts rotation.

As both the brake pedal (1) and parking lock pedal (2) are pressed, the parking brake will be applied and locked.

SERVICING

CONTENTS

1. TROUBLESHOOTING

Symptom	Probable Cause	Solution	Reference Page
Vehicle Will Not Stop in Neutral Position	Improper neutral adjustment	Adjust neutral	2-S6
	Improper speed control rod adjustment	Adjust	2-S6
Vehicle Jerky and Noisy When Starting	Transmission oil insufficient	Replenish	2-S14
	Air entering from suction pipe	Retighten	–
	Transmission oil filter cartridge clogged	Replace	G-17
	Hydrostatic transmission defective	Replace	2-S28
Loss of Power	Control linkage defective	Repair or replace	–
	Transmission oil insufficient	Replenish	2-S14
	Transmission oil filter cartridge clogged	Replace	G-17
	Hydraulic pump defective	Replace	2-S24
	Hydrostatic transmission defective	Replace	2-S28
System Operates in One Direction Only	Check valve defective	Replace	2-S29
	Control linkage defective	–	–
System Operating Hot	Transmission oil insufficient	Replenish	2-S14
	Transmission oil filter cartridge clogged	Replace	G-17
	HST fan defective	Replace	2-S24
	Overload working	–	–
Noise from Transmission	Transmission oil insufficient	Replenish	2-S14
	Gear worn	Replace	–
	Improper backlash between 16T or 18T bevel gear and 19T bevel gear	Adjust	2-S37
	Bearing worn	Replace	–

W1014322

TRAVELLING GEAR SHIFT SECTION

Symptom	Probable Cause	Solution	Reference Page
Noise from Transmission	Transmission oil insufficient	Refill	2-S14
	Gear worn or broken	Replace	–
	Bearings worn	Replace	–

W1013580

PTO SECTION

PTO Clutch Slip	Operating pressure is low	Check	–
	PTO clutch valve malfunctioning	Repair or replace	2-S20
	Clutch disc or drive plate excessively worn	Replace	2-S25
PTO Shaft Does Not Rotate	PTO clutch malfunctioning	Repair or replace	2-S25
PTO Clutch Operating Pressure Is Low	Transmission oil improper or insufficient	Replenish or change	2-S14
	Regulator valve malfunctioning	Check or replace	2-S20
PTO Clutch Drags	Brake plate excessively worn	Replace	2-S25
	Clutch spring weaken or broken	Replace	2-S25
	Deformation of pressure plate or steel plate	Replace	2-S25

W1013718

PARKING BRAKE SECTION

Brake Drags	Brake spring play too small	Adjust	G-28
	Brake return spring weaken or broken	Replace	–
Poor Braking Force	Brake spring play excessive	Adjust	G-28
	Brake disc worn	Replace	2-S34

W1013718

2. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
Regulator Valve (HST Charge Relief Valve)	Setting pressure [at engine speed ZD321, ZD326 : 3200 min^{-1} (rpm) ZD331 : 3000 min^{-1} (rpm)]	0.75 to 0.95 MPa 7.7 to 9.6 kgf/cm^2 110 to 130 psi	–
PTO Clutch	Operating pressure [at engine speed ZD321, ZD326 : 1800 min^{-1} (rpm) ZD331 : 1600 min^{-1} (rpm)]	0.65 to 0.75 MPa 6.7 to 7.6 kgf/cm^2 95 to 100 psi	–
Check and High Pressure Relief Valve	Relief valve setting pressure [at engine speed ZD321, ZD326 : 1800 min^{-1} (rpm) ZD331 : 1600 min^{-1} (rpm)]	20.0 to 22.0 MPa 204 to 224 kgf/cm^2 2900 to 3190 psi	
Maximum Speed At Maximum Engine rpm	Wheel rotation ZD321, ZD321N, ZD326S ZD326P, ZD331P, ZD331LP	 133 to 135 min^{-1} (rpm) 148 to 150 min^{-1} (rpm)	–
Motion Control Lever Alignment	Gap	0 to 2 mm 0 to 0.08 in.	–
	Space	10 to 20 mm 0.4 to 0.8 in.	–
16T or 18T Bevel Gear to 19T Bevel Gear	Backlash	0.25 to 0.30 mm 0.0099 to 0.011 in.	–

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3. TIGHTENING TORQUES

Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts : See page G-9.)

Item	N·m	kgf·m	lbf·ft
Motion control lever mounting bolt and nut	18 to 20	1.8 to 2.1	13 to 15
Hydrostatic transmission mounting screw (M10, 7T, Aluminum)	40 to 44	4.0 to 4.5	29 to 32
Universal joint mounting screw	26.5 to 28.4	2.7 to 2.9	19.6 to 20.9
Rear axle gear case mounting screw (M12, 7T)	78 to 90	7.9 to 9.2	58 to 66
Rear axle gear case mounting screw (M10, 7T, Aluminum)	40 to 44	4.0 to 4.5	29 to 32
Hydraulic pump mounting screw	40 to 44	4.0 to 4.5	29 to 32
Center case rear cover mounting screw	40 to 44	4.0 to 4.5	29 to 32
Center section mounting hex. socket head screw	40 to 44	4.0 to 4.5	29 to 32
Check and high pressure relief valve plug	30 to 44	3.0 to 4.5	22 to 32
Engine mounting nut	24 to 27	2.4 to 2.8	18 to 20
ROPS mounting screw (M10, 7T)	48 to 55	4.9 to 5.7	36 to 41
Rear wheel mounting screw	108.5 to 130.2	11.1 to 13.3	80 to 96
Center case front cover mounting screw (M10, 7T, Aluminum)	40 to 44	4.0 to 4.5	29 to 32
Hydrostatic transmission and rear axle gear case assembly mounting screw (M10, 7T, Aluminum)	40 to 44	4.0 to 4.5	29 to 32
ROPS connecting plate mounting screw (M8, 7T)	24 to 27	2.4 to 2.8	18 to 20
ROPS connecting plate under mounting screw (M10, 7T)	48 to 55	4.9 to 5.7	36 to 41

W1012736

4. CHECKING AND ADJUSTING

Checking Neutral

1. Park machine safely.
2. Set the motion control levers are in the **NEUTRAL** position.
3. Move the PTO lever to **OFF** position and apply the parking brake.
4. With the operator on the seat and start the engine.
5. Move the throttle lever to **Max. speed** position.
6. Release the parking brake.
7. Check the drive wheels, the wheels should not move.
8. If movements is noted, perform adjustment as follows.

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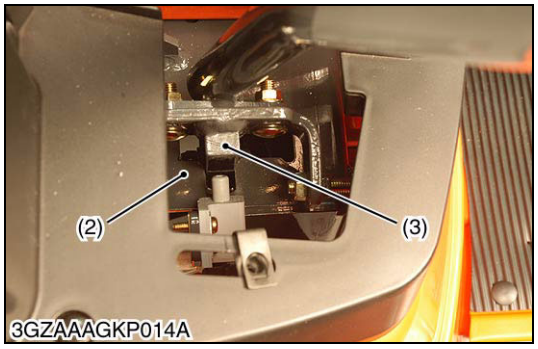

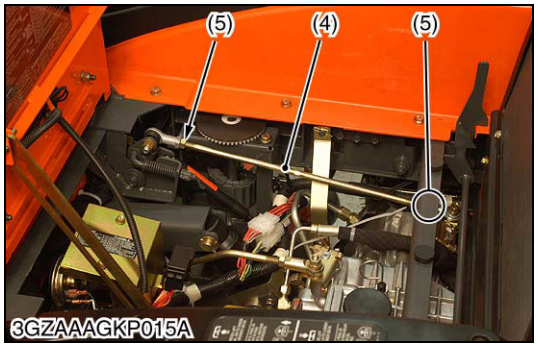

Adjusting Neutral

CAUTION

To avoid personal injury:

- **Park the machine on a hard and level surface.**
- **If it is necessary to run engine in an enclosed area, use a gas tight exhaust pipe extension to remove the fumes.**
- **Always try to work in a well-ventilated area.**
- **Lift up and secure with jack stands or blocking the rear of the machine, do not run the machine while adjusting.**
- **Do not adjust only one of the following adjustment; exclude "MOTION CONTROL LEVER POSITION". They are relative each other.**

1. Turn key switch to **OFF** position.
2. Apply the parking brake.
3. Set the motion control levers (3) to **Neutral lock** position.
4. Raise and latch the seat assembly.
5. Remove the connector from the seat safety switch, then **temporarily** install a jumper wire across the terminals in the connector of the wiring harness.
6. Raise the rear of machine and block up so that rear wheel can rotate freely.
7. Remove the motion control lever cover (1).
8. Loosen the lock nuts from the ball joints on the two rods.
9. Start the engine.
10. Move the throttle lever to **Max. speed** position.
11. Release the parking brake.
12. Turn the speed control rod (4) to extend the rod length and rotate the rear wheel backward. Then, turn the speed control rod (4) in reverse direction and find a position where the rear wheel stops rotating.
13. Then, turn the speed control rod (4) to shorten the rod length and rotate the rear wheel forward. Then, turn the speed control rod (4) in reverse direction and find a position where the rear wheel stops rotating.
14. After taking steps 12 and 13 above, fix the speed control rod (4) length at the midpoint between the two position. Adjust a speed control rod (4) length to be the center of the HST neutral range.
15. Shut off the machine. Remove jumper wire from wire harness connector and plug connector or into seat safety switch.

■ **IMPORTANT**

- **The right and left motion control lever (3) can be adjusted independently.**

(1) Motion Control Lever Cover
(2) Guide Plate
(3) Motion Control Lever
(4) Speed Control Rod
(5) Lock Nut

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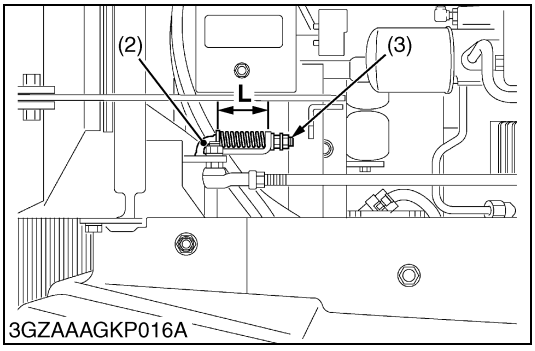

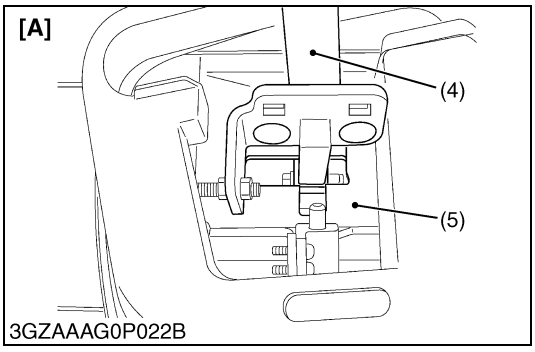

Checking Motion Control Lever Neutral Position

CAUTION

To avoid personal injury:

- **Park the machine on a hard and level surface.**
- **If it is necessary to run engine in an enclosed area, use a gas tight exhaust pipe extension to remove the fumes.**
- **Always try to work in a well-ventilated area.**
- **Lift up and secure with jack stands or blocking the rear of the machine, do not run the machine while adjusting.**
- **Do not adjust only one of the following adjustment; exclude "MOTION CONTROL LEVER POSITION". They are relative each other.**

1. Turn key switch to **OFF** position.
2. Apply the parking brake.
3. Set the motion control lever (4) to **Neutral lock** position and remove the motion control lever cover (1).
4. Raise and latch the seat assembly.
5. Remove the connector from the seat safety switch, then **temporarily** install a jumper wire across the terminals in the connector of the wiring harness.
6. Raise the rear of machine and block up so that rear wheel can rotate freely.
7. Start the engine, and run at maximum speed.
8. Pull the motion control lever (4) to the reverse maximum position and release the motion control lever.
9. Measure the rear wheel rotation.
10. Loosen the lock nut and adjust the speed control bolt length so that the rear wheel rotation would stop.
11. Tighten the lock nut.
12. Check the rear wheel rotation again. If it is not correct, adjust again.
13. Adjust the other side equally.
14. After adjustment, be sure to stop the engine immediately.

(1) Motion Control Lever Cover
(2) Speed Control Bolt
(3) Lock Nut
(4) Motion Control Lever
(5) Guide Plate

[A] "Neutral" Position (Hands Off)
L : 50 mm (2.0 in.)

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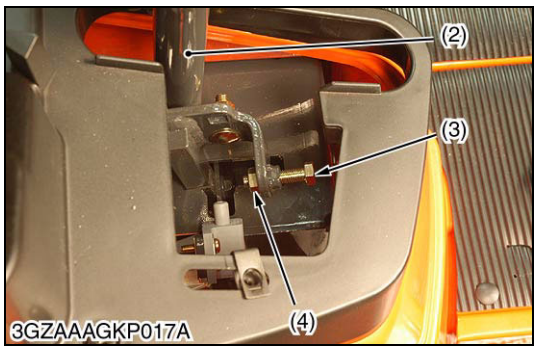

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Adjusting Maximum Speed

CAUTION

To avoid personal injury:

- **Park the machine on a hard and level surface.**
- **If it is necessary to run engine in an enclosed area, use a gas tight exhaust pipe extension to remove the fumes.**
- **Always try to work in a well-ventilated area.**
- **Lift up and secure with jack stands or blocking the rear of the machine, do not run the machine while adjusting.**
- **Do not adjust only one of the following adjustment; exclude "MOTION CONTROL LEVER POSITION". They are relative each other.**

1. Turn key switch to **OFF** position.
2. Apply the parking brake.
3. Set the motion control lever (2) to **Neutral lock** position.
4. Raise and latch the seat assembly.
5. Remove the connector from the seat safety switch, then **temporarily** install a jumper wire across the terminals in the connector of the wiring harness.
6. Remove the motion control lever cover (1).
7. Raise the rear of machine and block up so that rear wheel can rotate freely.
8. Start the engine.
9. Move the throttle lever to **Max. speed** position.
10. Push the motion control lever (2) to the front until the speed set bolt (3) comes into contact with the stopper plate.

■ **NOTE**

- **At this time, the thing that the speed set bolt (3) touches the stopper plate is.**

11. Measure the rotations of rear wheel.
12. If the measurement is not within the factory specifications, loosen the lock nut (4) and adjust the length of speed set bolt (3).

Max. speed: Wheel rotation	Factory spec.	ZD321 ZD321N ZD326S	133 to 135 min^{-1} (rpm) at max. engine speed
		ZD326P ZD331P ZD331LP	148 to 150 min^{-1} (rpm) at max. engine speed

■ **NOTE**

- **The right and left speed set bolt can be adjusted independently.**

(1) Motion Control Lever Cover
(2) Motion Control Lever
(3) Speed Set Bolt
(4) Lock Nut

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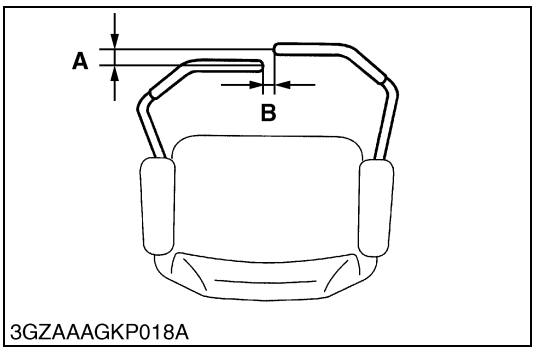

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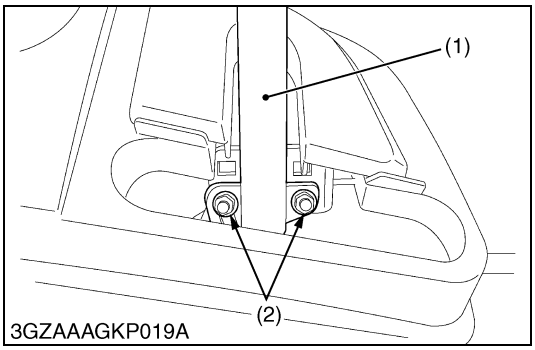

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Checking Motion Control Lever Alignment

CAUTION

- **When checking, park the tractor on flat ground, apply the parking brake.**

1. Check the gap (**A**) and space (**B**) between the motion control levers, at the maximum forward position.
   If positions of the motion control levers are unequal, an adjustment is necessary.

When adjusting alignment

1. Stop the engine and apply the parking brake.
2. Loosen the nut and remove the motion control lever (1).

■ **Lever position (High or Low)**

3. Remove the screw (2) and select the motion control lever position, high or low.
4. Tighten the screw (2) and install the motion control lever (1).

■ **Lever alignment (Right and Left)**

3. Loosen the screws (2).
4. Slide both motion control levers forward or rearward to desired position within tab slots until levers are aligned.
5. Tighten the screws (2).

Gap (**A**)	Factory spec.	0 to 2 mm 0 to 0.08 in.
Space (**B**)	Factory spec.	10 to 20 mm 0.4 to 0.8 in.

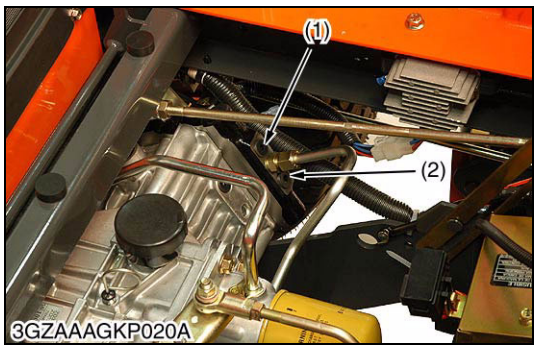
■ **NOTE**

- **If the ends of the levers strike against each other while in the "NEUTRAL" position, move the levers outward to the "NEUTRAL LOCK" position and carefully bend them outward.**
  Move them back to the "NEUTRAL" position and check for the recommended space.

(1) Motion Control Lever
(2) Motion Control Lever Mounting Screw

A : Gap
B : Space

W1029709



Checking Hydrostatic Transmission

CAUTION

- **When checking, park the machine on flat ground, apply the parking brake.**
- **Sit on operator's seat for checking.**

1. After worming up the machine, apply the parking brake and set the stop wood (chock) to the rear wheels.
2. Remove the plug (1) from the HST and set the HST adaptor. Then install the pressure gauge.
3. The safety switch for parking brake is **temporarily** turned on, and the state which can be checked is made.
   (For example) Remove the connector from parking brake switch, then **temporarily** install a jumper wire across the terminals in the connector of the wiring harness.
4. Start the engine.
5. Move the throttle lever to engine speed at 1600 min^{-1} (rpm) (ZD331) or 1800 min^{-1} (rpm) (ZD321, ZD326).
6. Grasp the motion control lever and move then inward from **"NEUTRAL LOCK"** position to position and then slowly push forward. And measure the pressure of HST.
7. At this time, if pressure rise to 19.5 MPa (199 kgf/cm^2, 2830 psi), it is assumed OK.
8. If the operation pressure does not rises to 17.0 MPa (173 kgf/cm^2, 2470 psi), repair or replace the HST.

(Reference)

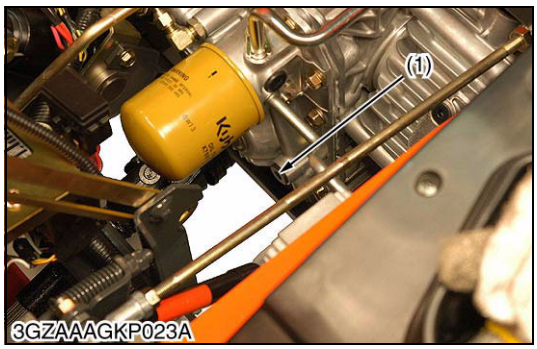
Check and high pressure relief valve pressure	Factory spec.	20.0 to 22.0 MPa 204 to 224 kgf/cm^2 2900 to 3190 psi

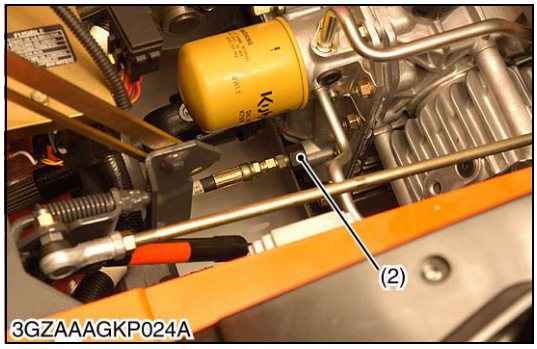
IMPORTANT

- **When the check and high pressure relief valve pressure is measured, the thing that the relief valve is not operated continuously for 5 seconds or more. Otherwise, HST might to break.**
- **The length in the plug (1), (2) threaded portion is approx. 10 mm (0.39 in.). The length in the threaded portion of the adaptor used during pressure measurement should also be within 10 mm (0.39 in.).**

(1) Plug, 1/4 Straight Thread (Forward Side)
(2) Plug, 1/4 Straight Thread (Reverse Side)

W1018429





PTO Clutch Operating Pressure (Hydrostatic Transmission Charge Pressure)

CAUTION

- **When checking, park the tractor on flat ground, apply the parking brake.**

1. Remove the plug (1), then install the adaptor (2) cable and pressure gauge.
2. Start the engine and set speed at 1800 min^{-1} (rpm) (ZD321 and ZD326) and 1600 min^{-1} (rpm) (ZD331).
3. At this time, read the pressure gauge.
4. If the pressure is not within the factory specifications, check the regulator valve and related hydraulic components.

PTO clutch operating pressure	Factory spec.	0.65 to 0.75 MPa 6.7 to 7.6 kgf/cm^2 95 to 100 psi

Condition

- Engine speed …… ZD321 and ZD326 : 1800 min^{-1} (rpm)
  ZD331 : 1600 min^{-1} (rpm)
- Oil temperature … 45 to 55 °C
  113 to 131 °F

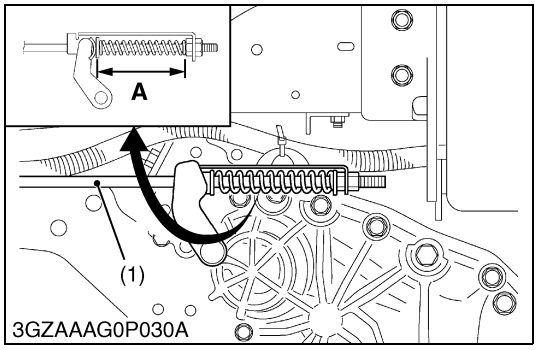
(1) Plug, 3/8 Straight Thread (2) Adaptor

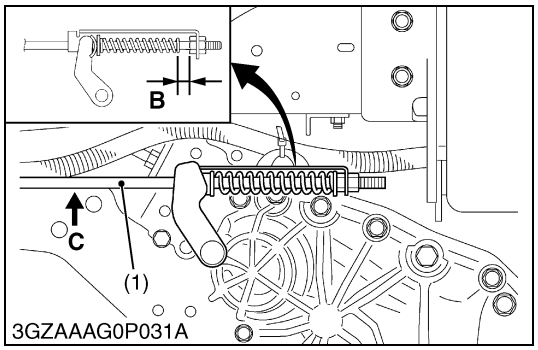
W1014889

Checking Parking Brake

1. See page G-28.

W1015239





Checking and Adjusting Parking Brake

CAUTION

- **Park the machine on a firm and level surface.**
- **Stop the engine and chock the wheels before checking or adjusting.**

■ **IMPORTANT**

- **Wrong adjustment may cause machine damage.**

■ **Check brake spring**

1. place the motion control levers to the **"NEUTRAL LOCK"** position.
2. Be sure to chock the rear wheels.
3. Apply the parking brake to the lock position.
4. Check the length of the brake springs on both sides.

Proper brake spring length (**A**) with the brake applied to the lock position	Factory spec.	115 to 117 mm 4.53 to 4.61 in.

5. Release the parking brake completely.
6. Hold the brake rod (1) lightly.
7. Check the brake spring play.

Proper brake spring play (**B**)	Factory spec.	The spring must have play. Reference : 0.5 to 1.0 mm 0.02 to 0.04 in.

8. If these dimensions are not correct, adjust them.

■ **Adjustment of brake spring play**

1. Place the motion control lever to the **"NEUTRAL LOCK"** position.
2. Be sure to chock the rear wheel.
3. Release the parking brake completely.
4. Loosen the lock nuts.
5. Hold the brake rod (1) by hand.
6. Tighten the nut to the correct space between the end of the spring and the nut.
7. Lock the nuts.
8. Adjust the other side spring to the same dimension.

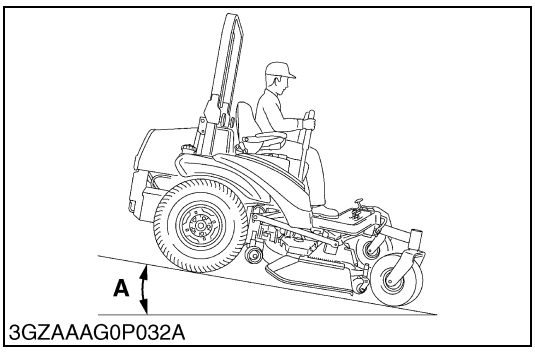
■ **Adjustment of brake length**

1. Place the motion control lever to the **"NEUTRAL LOCK"** position.
2. Apply the parking brake to the lock position.
3. Loosen the lock nuts.
4. Adjust the spring length to the recommendation.
5. Lock the nuts.
6. Check the brake spring play to the recommendation. If there is no play, adjust the brake spring play again.
7. Adjust the other side spring to the same dimension.

(1) Brake Rod

A : Parking Brake Rod Spring Length
B : Parking Brake Spring Play
C : Holding Brake Rod

W1020072



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Checking Parking Brake on the Slope

1. Place the machine on a 17 ° ramp A.
2. Apply the parking brake.
3. Place the motion control levers in **"NEUTRAL LOCK"** position and shut off the engine.
4. Check that the machine does not move.

■ **NOTE**

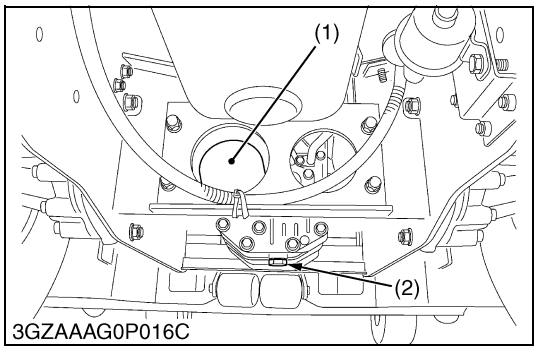
- **For parking brake test purposes, only use 17 ° ramp "A".**

A : 17 ° ramp

W1020729

5. DISASSEMBLING AND ASSEMBLING

[1] SEPARATING TRANSAXLE ASSEMBLY



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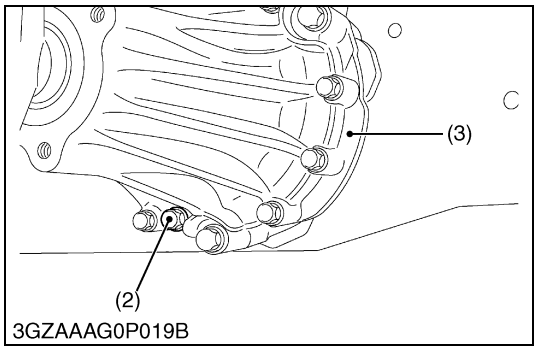

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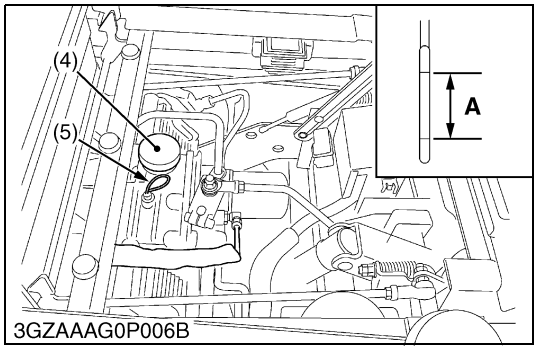

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Draining Transmission Fluid

CAUTION

To avoid personal injury :

- **Be sure to stop the engine and remove the key before changing or checking the oil.**
- **Allow transmission case to cool down sufficiently; oil can be hot and may cause burns.**

The fluid in the transmission case is also used for the hydrostatic drive system.

1. To drain the transmission oil, place oil pan underneath the transmission case and the rear axle gear case (RH and LH) and remove the drain plug at the bottom of the transmission case and the rear axle gear case (RH and LH).
2. After draining, reinstall the drain plugs.
3. Fill with new fluid from filling port after removing the filling plug (4) up the upper notch on the dipstick.

■ **IMPORTANT**

- **If takes time to have the oil poured from the transmission case reach the rear axle case (RH and LH). Pour the regulated amount of oil slowly.**

4. After running the engine for a few minutes, stop it and check the oil level again; add oil to the prescribed level.

■ **IMPORTANT**

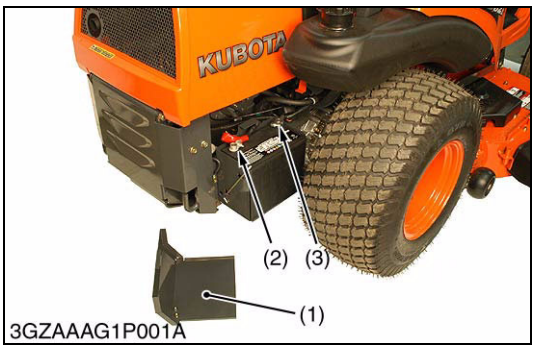
- **Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.**
  Keep the engine at medium speed for a few minutes to insure proper lubrication of all parts so there is no damage to transmission.
- **Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system.**
  Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-7.)
- **Do not mix different brands oil together.**

Transmission fluid capacity	12.1 L 12.8 U.S.qts 10.6 Imp.qts

(1) Transmission Oil Filter
(2) Drain Plug
(3) Rear Axle Gear Case LH
(4) Oil Plug and Breather Cup
(5) Dipstick

A : Oil level acceptable within this range.

W1021139



Battery

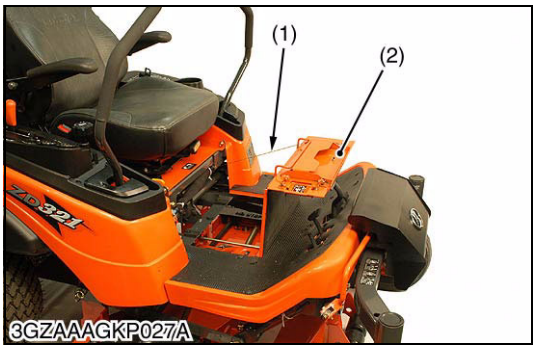
CAUTION

- **When disconnecting the battery cables, disconnect the negative cable from the battery first. When connecting, connect the positive cable to the battery first.**

1. Remove the battery cover (1).
2. Disconnect the negative cable (3) from the battery.
3. Disconnect the positive cable (2) form the battery.

(1) Battery Cover
(2) Positive Cable
(3) Negative Cable

W1025444



Step, Center and Step

1. Remove the clevis pin and remove the cable (1).
2. Remove the clevis pins and remove the step center (2).
3. Remove the front cover (3).
4. Remove the step (4).

(1) Cable
(2) Step Center
(3) Front Cover
(4) Step

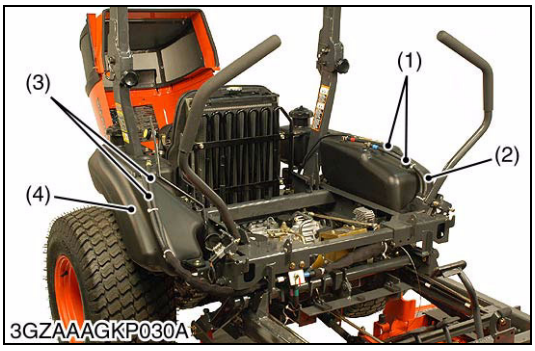
W1025848

Seat Assembly and Fender

1. Raise the seat and disconnect the wiring connector for safety switch.
2. Remove the seat assembly (1) with seat base (2).
3. Remove the fender (LH) (3).
4. Disconnect the wiring connectors for gauges and remove the fender (RH) (4).

(1) Seat Assembly
(2) Seat Base
(3) Fender (LH)
(4) Fender (RH)

W1026094

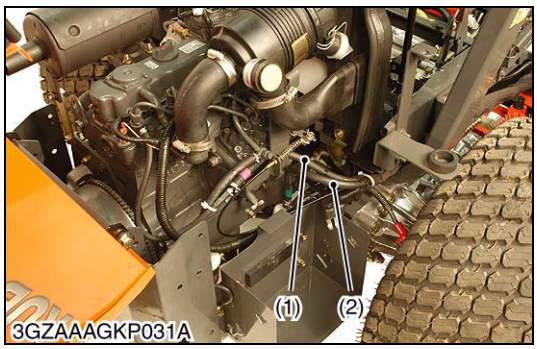


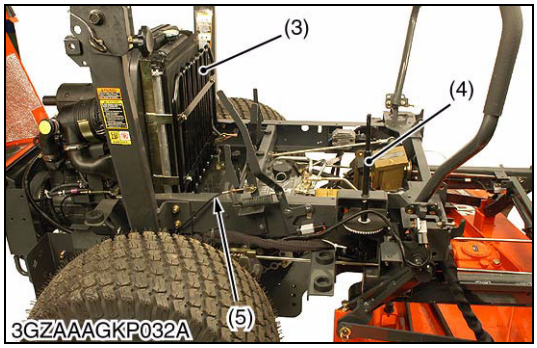
Fuel Tank

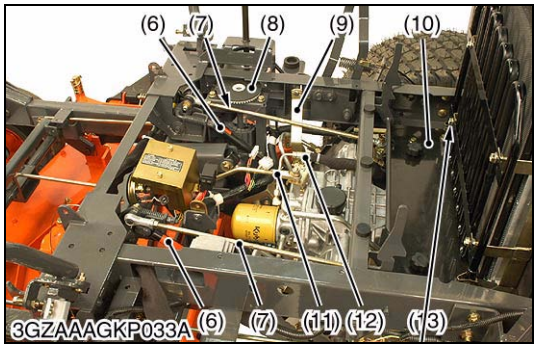
1. Disconnect the wiring connectors for fuel gauge and fuel hoses (1).
2. Remove the fuel tank (LH) (2).
3. Disconnect the fuel hoses (3), and remove the fuel tank (4).

(1) Fuel Hose
(2) Fuel Tank (LH)
(3) Fuel Hose
(4) Fuel Tank (RH)

W1026288







Upper Frame, Oil Cooler and Others

1. Disconnect the return hose (1) and fuel hose (2).
2. Remove the stopper (13) and remove the oil cooler (3).
3. Remove the throttle cable (5).
4. Remove the rod (4).
5. Disconnect the wiring connectors for safety switches and regulator.
6. Remove the speed control rods (7).
7. Remove the dampers (6).
8. Remove the cutting height adjusting gear with stay (8).
9. Remove the hydraulic lift link (9).
10. Remove the bonnet cover (10) and ROPS connecting plate.
11. Remove the hydraulic lift rod (11).
12. Disconnect the hydraulic hose (12).
13. Remove the upper frame (14).
14. Remove the parking brake rods (15).

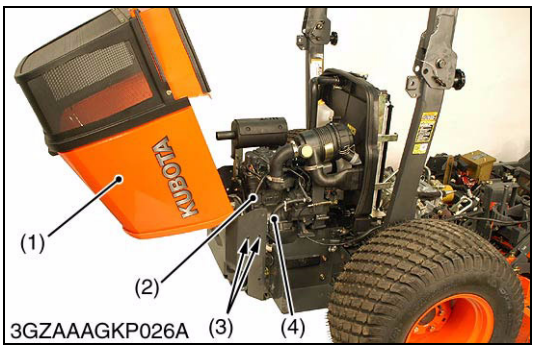
(When reassembling)

■ **NOTE**

- **After assembling the parking brake rods, be sure check the parking brake spring length and play. If the measurement is not within the factory specifications, adjust the spring length and play. (See page 2-S12.)**

(1) Return Hose
(2) Fuel Hose
(3) Oil Cooler
(4) Rod
(5) Throttle Cable
(6) Damper
(7) Speed Control Rod
(8) Cutting Height Adjusting Gear with Stay
(9) Hydraulic Lift Link
(10) Bonnet Cover
(11) Hydraulic Lift Rod
(12) Hydraulic Hose
(13) Stopper (Leaf Spring)
(14) Upper Frame
(15) Parking Brake Rod

W1026458

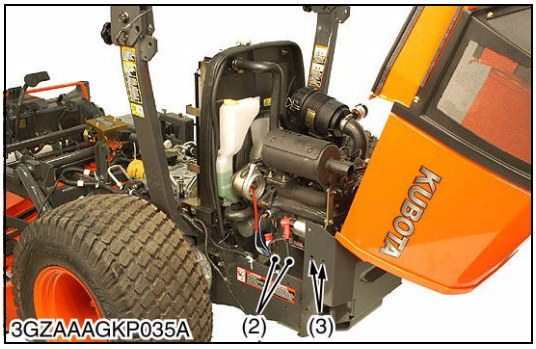


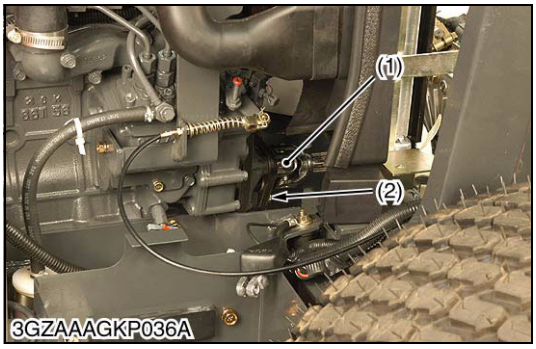
Bonnet, Fuel Hose, Wiring Harness and Others

1. Remove the bonnet (1).
2. Remove the engine stopper (3).
3. Disconnect the wiring harness (2) from engine body.
4. Disconnect the fuel hose (4).

(1) Bonnet
(2) Wiring Harness
(3) Engine Stopper
(4) Fuel Hose

W1027333





Universal Joint

1. Remove the universal joint mounting screws.
2. Disconnect the universal joint (1) from fun drive pulley.

(When reassembling)

- Apply grease to the all splines on the drive shaft.

Tightening torque	Universal joint mounting screw	26.5 to 28.4 N·m 2.7 to 2.9 kgf·m 19.6 to 20.9 lbf·ft

(1) Universal Joint
(2) Universal Joint Mounting Screw

W1027619

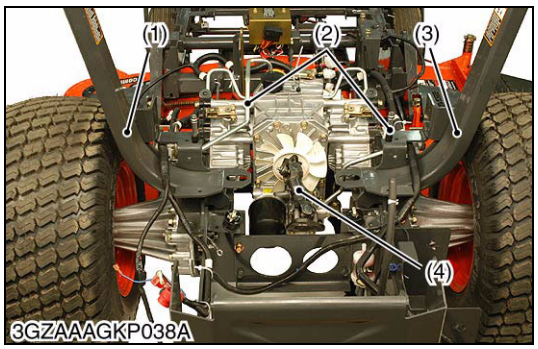
Separating Engine with Radiator Assembly

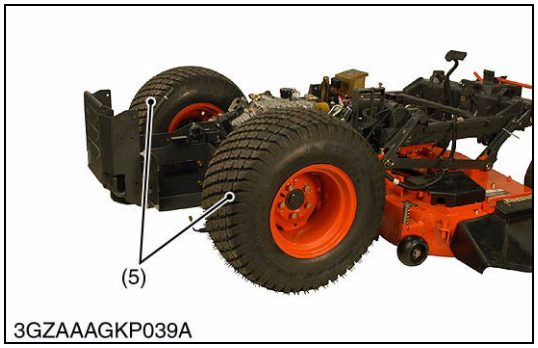
1. Remove the engine mounting nuts.
2. Separate the engine with the radiator from the frame, take care not to damage the radiator.

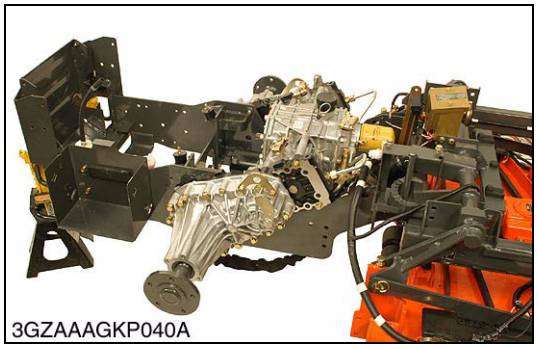
(When reassembling)

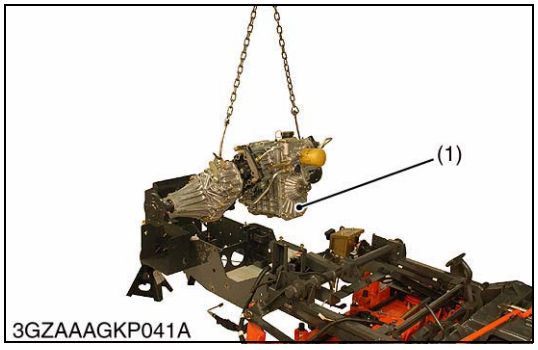
Tightening torque	Engine mounting nut	24 to 27 N·m 2.4 to 2.8 kgf·m 18 to 20 lbf·ft

W1027817









ROPS, Rear Wheel and Others

1. Remove the oil cooler pipes (2).
2. Remove the ROPS upper, and remove the ROPS lower (LH) (1) and ROPS lower (RH) (3).
3. Remove the universal joint (4) from the transaxle.
4. Unscrew the rear wheel mounting.
5. Lift up and secure with jack stands or blocking the rear of the machine frame, and remove the rear wheels (5).

(When reassembling)

■ **NOTE**

- **Remember to mount the cushion rubber on the oil cooler pipe.**

Tightening torque	ROPS mounting screw (M10, 7T)	48 to 55 N·m 4.9 to 5.7 kgf·m 36 to 41 lbf·ft
	Rear wheel mounting screw	108.5 to 130.2 N·m 11.1 to 13.3 kgf·m 80 to 96 lbf·ft

(1) ROPS Lower (LH)
(2) Oil Cooler Pipe
(3) ROPS Lower (RH)
(4) Universal Joint
(5) Rear Wheel

W1027950

Separating Transaxle Assembly

1. Remove the rear axle gear case mounting screws.
2. Separate the transaxle assembly (1) from main frame.

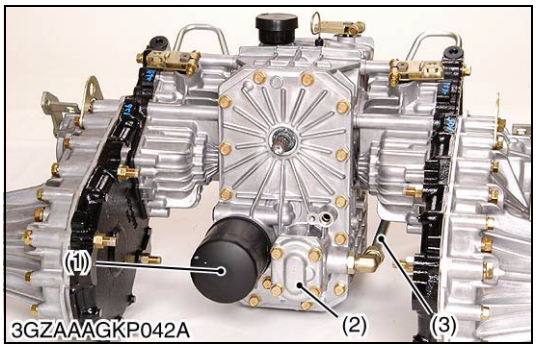
(When reassembling)

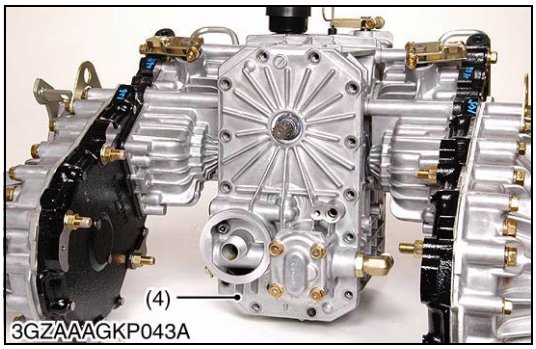
Tightening torque	Rear axle gear case mounting screw (M12)	78 to 90 N·m 7.9 to 9.2 kgf·m 58 to 66 lbf·ft

(1) Transaxle Assembly

W1028393

[2] DISASSEMBLING TRANSAXLE CENTER CASE





Center Case Rear Cover

1. Remove the oil filter cartridge (1).
2. Remove the delivery pipe (3).
3. REmove the center case rear cover (4).

■ **NOTE**

- **Remember to remove the hex. socket head screw hidden behind the filter cartridge (1)**
- **To remove the center case rear cover (4) mounted on the machine, also remove the hydraulic pump (2). This makes fitting the spline between pump shaft and the pump drive shaft easy.**

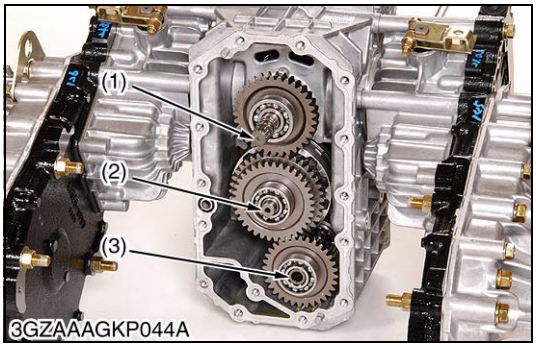
(When reassembling)

- Apply liquid gasket (Three Bond 1208D or equivalent) to joint face of the center case and center case rear cover.
- Take care not to damage the oil seal.

Tightening torque	Center case rear cover mounting screw	40 to 44 N·m 4.0 to 4.5 kgf·m 29 to 32 lbf·ft

(1) Oil Filter Cartridge
(2) Hydraulic Pump
(3) Delivery Pipe
(4) Center Case Rear Cover

W1028608



PTO Clutch Shaft Assembly and Pump Gear Shaft

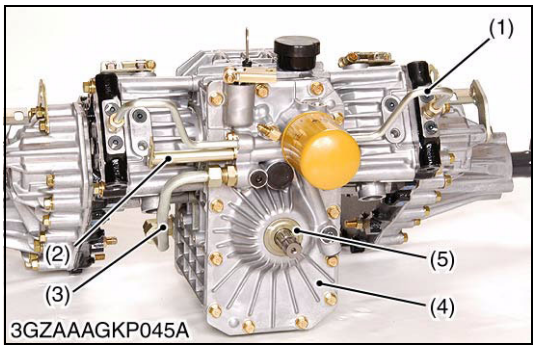
1. Remove the input shaft assembly (1).
2. Remove the PTO clutch shaft assembly (2) and pump shaft assembly (3).

(When reassembling)

- Take care not to damage the PTO shaft oil seal.

(1) Input Shaft Assembly
(2) PTO Clutch Shaft Assembly
(3) Pump Shaft Assembly

W1028891



Center Case Front Cover

■ **NOTE**

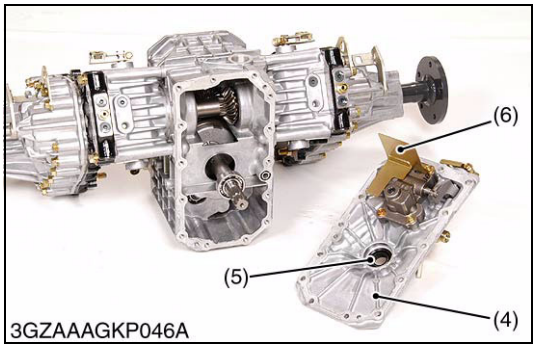
- **To remove the center case front cover (4) mounted on the machine, remove the PTO shaft oil seal (5) first.**

1. Remove the HST Pipe (1).
2. Remove the delivery pipe (3).
3. Remove the PTO clutch lever (2).
4. Remove the center case front cover (4).

(When reassembling)

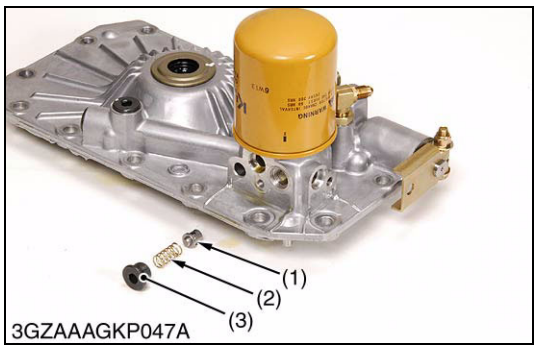
- Take care not to damage the oil seal (5).
- Apply liquid gasket (Three Bond 1208D or equivalent) to joint face of the center case and center case front cover (4).

Tightening torque	Center case front cover mounting screw	40 to 44 N·m 4.0 to 4.5 kgf·m 29 to 32 lbf·ft



(1) HST Pipe
(2) PTO Clutch Lever
(3) Delivery Pipe
(4) Center Case Front Cover
(5) PTO Shaft Oil Seal
(6) Plate

W1029085

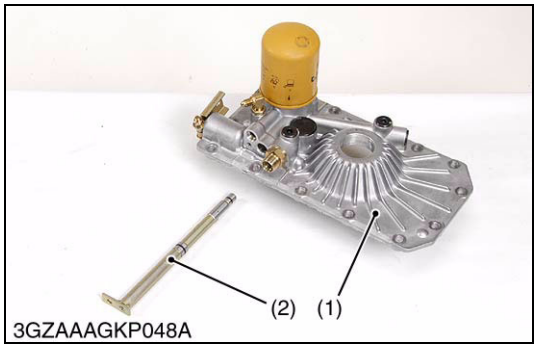


Regulator Valve (HST Charge Pressure Relief Valve)

1. Remove the plug (3).
2. Remove the spring (2) and poppet (1).

(1) Poppet
(2) Spring
(3) Plug

W1029406



PTO Clutch Lever

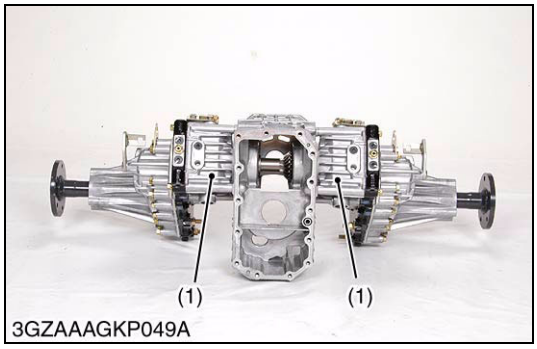
1. Remove the lever stopper and remove the PTO clutch lever (2).

(When reassembling)

- Take care not to damage the O-rings.

(1) Center Case Front Cover
(2) PTO Clutch Lever

W1029637



Separating Hydrostatic Transmission and Rear Axle Gear Case Assembly

1. Remove the hydrostatic transmission and rear axle gear case assembly mounting screws.
2. Separate the hydrostatic transmission and rear axle gear case assembly (1).

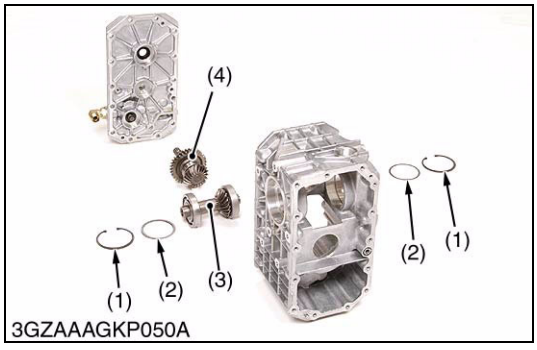
(When reassembling)

- Take care not to damage the O-ring.

Tightening torque	Hydrostatic transmission and rear axle gear case assembly mounting screw	40 to 44 N·m 4.0 to 4.5 kgf·m 29 to 32 lbf·ft

(1) Hydrostatic Transmission and Rear Axle Gear Case Assembly

W1029816



Input Shaft, Spiral Bevel Gear and Joint Shaft

1. Remove the input shaft and spiral bevel gear (4).
2. Remove the internal snap ring (1).

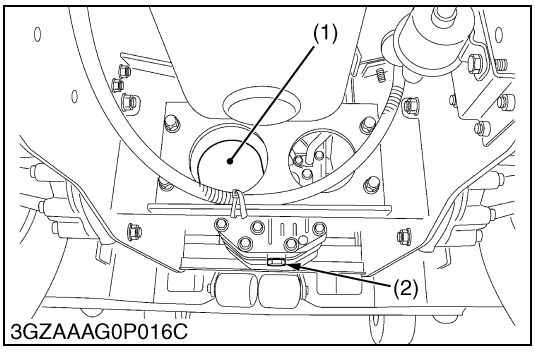
(When reassembling)

- Use same thickness of shims as before disassembling.

(1) Internal Snap Ring
(2) Shim
(3) Joint Shaft Assembly
(4) Spiral Bevel Gear

W1029993

[3] DISASSEMBLING PTO CLUTCH SHAFT ASSEMBLY



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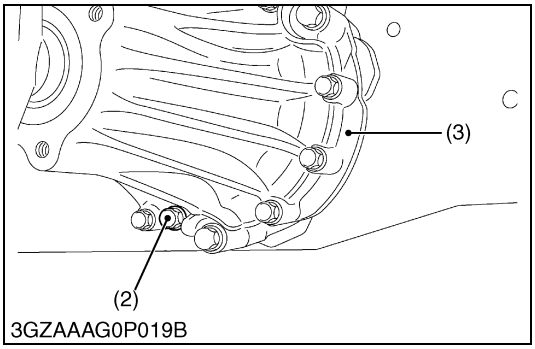

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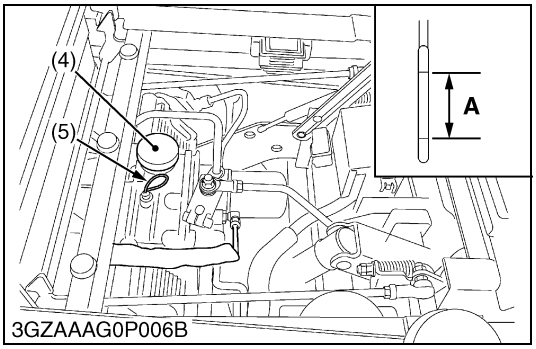

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Draining Transmission Fluid

CAUTION

To avoid personal injury :

- **Be sure to stop the engine and remove the key before changing or checking the oil.**
- **Allow transmission case to cool down sufficiently; oil can be hot and may cause burns.**

The fluid in the transmission case is also used for the hydrostatic drive system.

1. To drain the transmission oil, place oil pan underneath the transmission case and remove the drain plug at the bottom of the transmission case.
2. After draining, reinstall the drain plugs.
3. Measure a volume of draining oil and add new oil of the same volume as the draining oil first.

■ **IMPORTANT**

- **If takes time to have the oil poured from the transmission case reach the rear axle case (RH and LH). Pour the regulated amount of oil slowly.**

4. After running the engine for a few minutes, stop it and check the oil level again; add oil to the prescribed level.

■ **IMPORTANT**

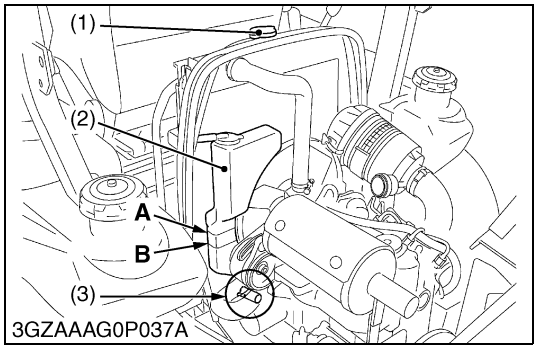
- **Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.**
  Keep the engine at medium speed for a few minutes to insure proper lubrication of all parts so there is no damage to transmission.
- **Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system.**
  Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-7.)
- **Do not mix different brands oil together.**

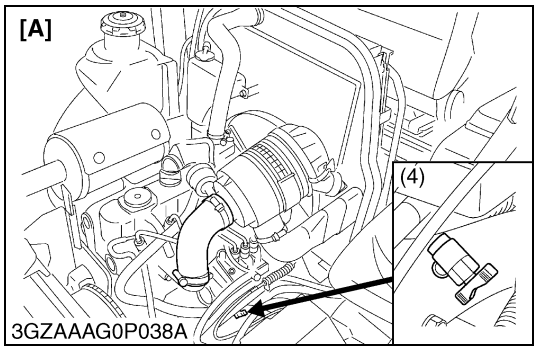
Transmission fluid capacity	12.1 L 12.8 U.S.qts 10.6 Imp.qts

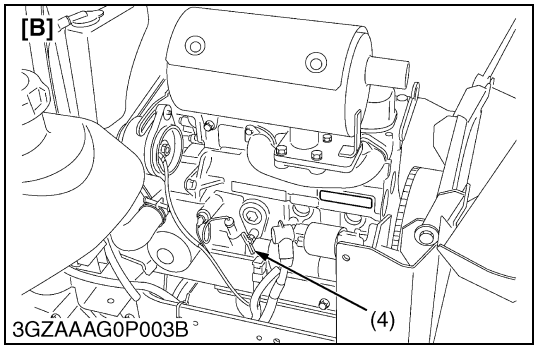
(1) Transmission Oil Filter
(2) Drain Plug
(3) Rear Axle Gear Case LH
(4) Oil Plug and Breather Cup
(5) Dipstick

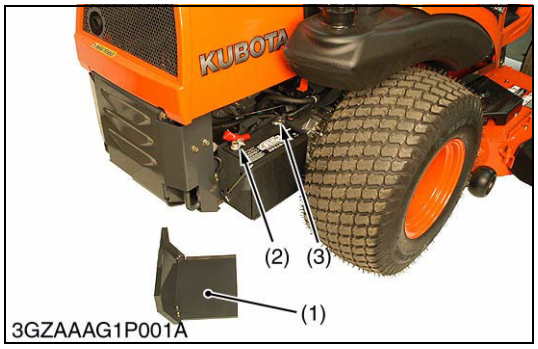
A : Oil level acceptable within this range.

W1034642









Draining Coolant

CAUTION

- **Never open the radiator cap while operating or immediately after stopping. Otherwise, hot water will spout out from the radiator. Wait for more than ten minutes to cool the radiator, before opening the cap.**

1. Stop the engine and let cool down.
2. Remove the radiator coolant drain plug (3) and engine coolant drain plug (4) to drain the coolant.
3. Remove the radiator cap (1) to completely drain the coolant.
4. After all coolant is drained, close the drain plugs.

Coolant	Capacity	ZD321 ZD326	Radiator	2.7 L 2.85 U.S.qts 2.38 Imp.qts
		ZD331	Radiator	3.5 L 3.70 U.S.qts 3.08 Imp.qts
		—	Recovery tank	0.25 L 0.26 U.S.qts 0.22 Imp.qts

(1) Radiator Cap
(2) Recovery Tank
(3) Radiator Coolant Drain Plug
(4) Engine Coolant Drain Cock

[A] ZD321
[B] ZD326, ZD331
A : FULL
B : LOW

W1019510

Battery

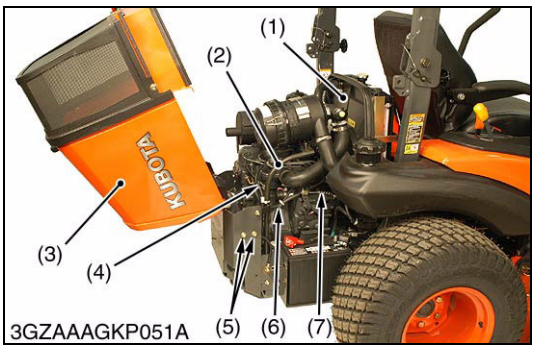
CAUTION

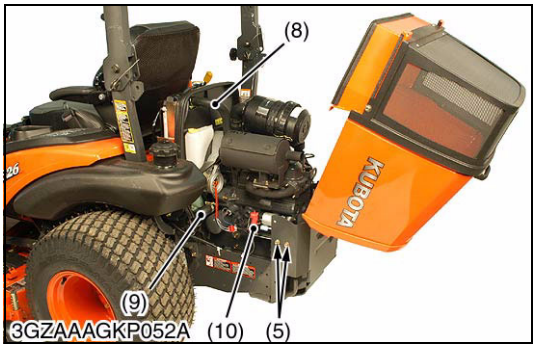
- **When disconnecting the battery cables, disconnect the negative cable from the battery first. When connecting, connect the positive cable to the battery first.**

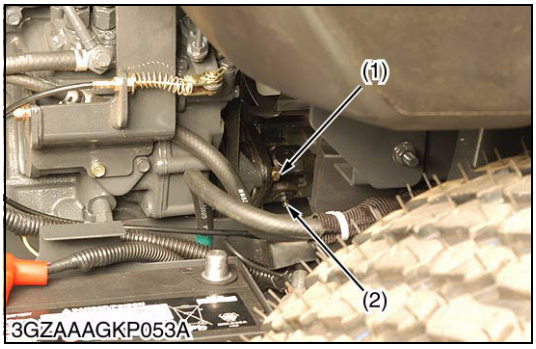
1. Remove the battery cover (1).
2. Disconnect the negative cable (3) from the battery.
3. Disconnect the positive cable (2) form the battery.

(1) Battery Cover
(2) Positive Cable
(3) Negative Cable

W1030653







Bonnet, Fuel Hose, Wiring Harness and Others

1. Remove the snap pin and bonnet mounting screw, then remove the bonnet (3).
2. Disconnect the wiring connectors for engine stop solenoid, glow plug, coolant temperature sensor, engine oil pressure switch and dynamo.
3. Remove the positive cable (10) from starter motor.
4. Disconnect the accelerator wire (7).
5. Remove the air cleaner support (2) (ZD326 and ZD331).
6. Disconnect the fuel hoses (6) from radiator.
7. Disconnect the water hoses (8), (9) and fan shroud (1).
8. Remove the engine stopper (5).

(When reassembling)

- When accelerator wire is installed, adjust the wiring length as hit both the idling speed adjusting bolt and the maximum speed adjusting bolt by lever within the stroke of the accelerator lever.

(1) Fan Shroud
(2) Air Cleaner Support
(3) Bonnet
(4) Wiring Harness
(5) Engine Stopper
(6) Fuel Hose
(7) Accelerator Wire (Throttle Cable)
(8) Upper Hose
(9) Lower Hose
(10) Positive Cable

W1030839

Separating Engine

1. Remove the universal joint mounting screws (1).
2. Disconnect the universal joint (2) from fun drive pulley.
3. Remove the engine mounting nuts.
4. Separate the engine.

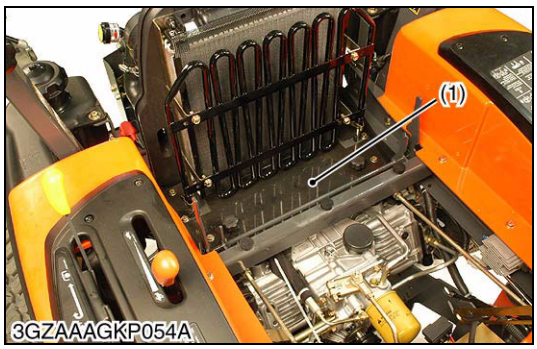
(When reassembling)

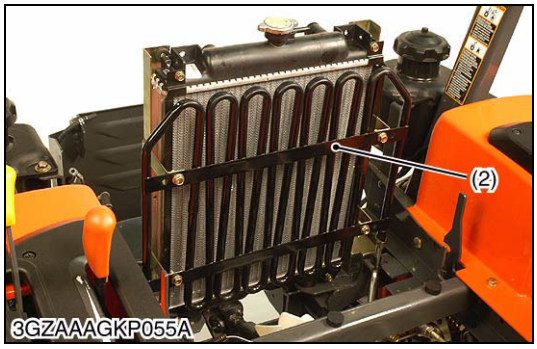
- Apply grease to the all splines on the drive shaft.

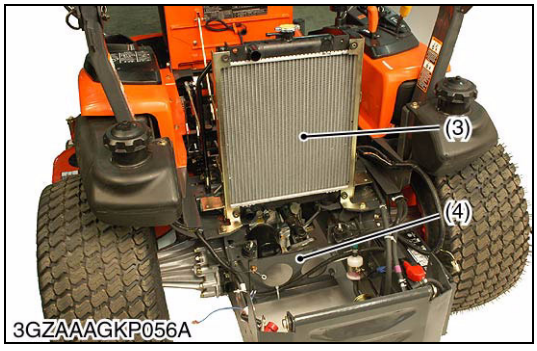
Tightening torque	Universal joint mounting screw	26.5 to 28.4 N·m 2.7 to 2.9 kgf·m 19.6 to 20.9 lbf·ft
	Engine mounting nut	24 to 27 N·m 2.4 to 2.8 kgf·m 18 to 20 lbf·ft

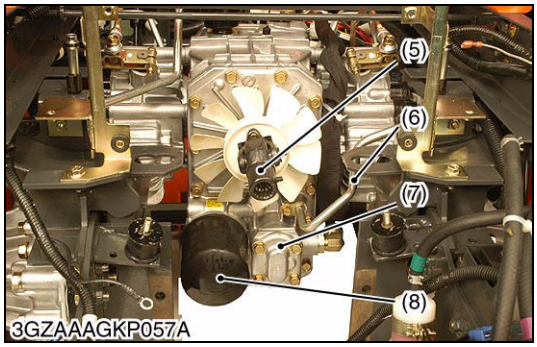
(1) Universal Joint Mounting Screw
(2) Universal Joint

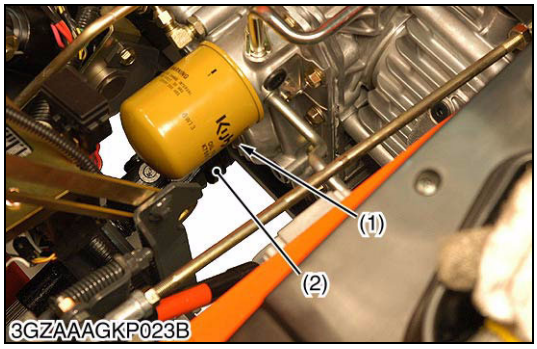
W1031443











Oil Cooler, Radiator, Universal Joint and Others

1. Remove the bonnet cover (1) and ROPS connecting plate.
2. Remove the oil cooler (2).
3. Remove the radiator (3).
4. Remove the ROPS connecting plate under (4).
5. Remove the universal joint (5).
6. Remove the oil cooler pipe (6).
7. Remove the hydraulic pump assembly (7).
8. Remove the oil filter cartridge (8).

(When reassembling)

■ **NOTE**

- **Remember to mount the cushion rubber on the oil cooler pipe.**

Tightening torque	ROPS connecting plate mounting screw (M8)	24 to 27 N·m 2.4 to 2.8 kgf·m 18 to 20 lbf·ft
	ROPS connecting plate under mounting screw (M10)	48 to 55 N·m 4.9 to 5.7 kgf·m 36 to 41 lbf·ft
	Hydraulic pump mounting screw	40 to 44 N·m 4.0 to 4.5 kgf·m 29 to 32 lbf·ft

(1) Bonnet Cover
(2) Oil Cooler
(3) Radiator
(4) ROPS Connecting Plate, Under
(5) Universal Joint
(6) Oil Cooler Pipe
(7) Hydraulic Pump Assembly
(8) Oil Filter Cartridge

W1031708

Universal Joint and PTO Shaft Oil Seal

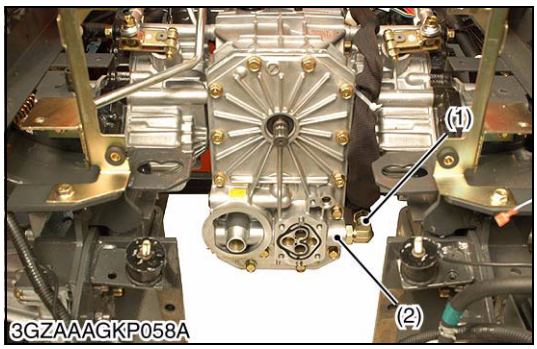
1. Disconnect the universal joint (2).
2. Remove the PTO shaft oil seal (1).

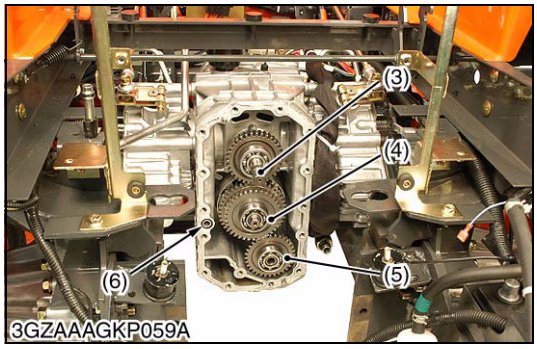
(When reassembling)

- Replace the PTO shaft oil seal with new one.

(1) PTO Shaft Oil Seal
(2) Universal Joint

W1032357





Center Case Rear Cover and PTO Clutch Shaft Assembly

1. Disconnect the delivery pipe (1).
2. Remove the center case rear cover (2).
3. Remove the pump shaft assembly (5).
4. Remove the PTO clutch shaft assembly (4).

■ **NOTE**

- **At this point, the input shaft (3) must be pulled out to prevent interference between the PTO clutch case and the gear.**
- **Note that pulling out the input shaft (3) excessively may cause falling off of the bevel gear from the input shaft (3).**

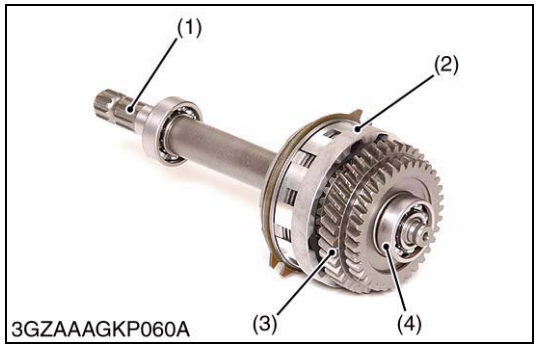
(When reassembling)

- Apply liquid gasket (Three Bond 1208D or equivalent) to joint face of center case and center case rear cover.

Tightening torque	Center case rear cover mounting screw	40 to 44 N·m 4.0 to 4.5 kgf·m 29 to 32 lbf·ft

(1) Delivery Pipe
(2) Center Case Rear Cover
(3) Input Shaft
(4) PTO Clutch Shaft Assembly
(5) Pump Shaft Assembly
(6) O-ring

W1032558

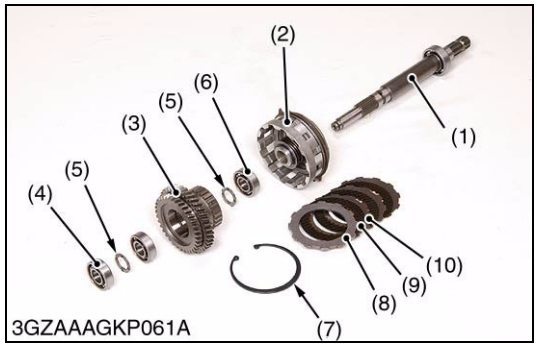


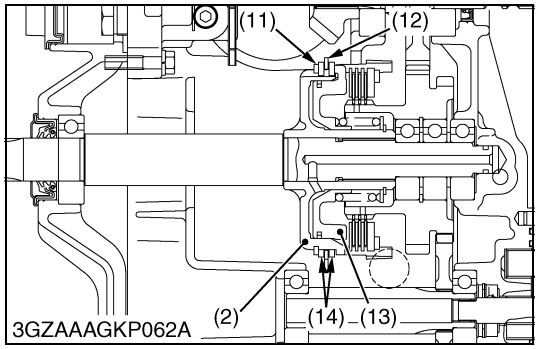
Disassembling PTO Clutch Assembly

1. Remove the bearing (4) and clutch gear (3) with bearing.
2. Remove the internal snap ring (7), pressure plate (8), clutch disk (9) and clutch plate (10).
3. Remove the bearing (6) PTO clutch case (2) from the PTO shaft (1).

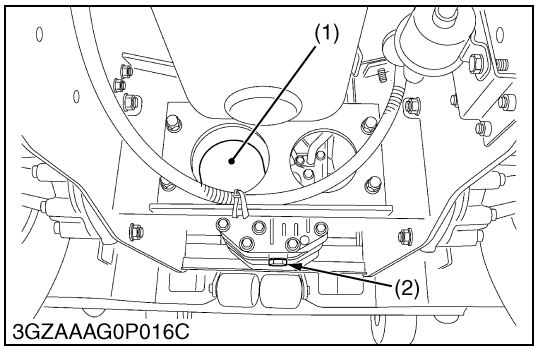
(1) PTO Shaft
(2) PTO Clutch Case
(3) Clutch Gear
(4) Bearing
(5) Collar
(6) Bearing
(7) Internal Snap Ring
(8) Pressure Plate
(9) Clutch Disk
(10) Clutch Plate
(11) External Snap Ring
(12) Brake Disk
(13) Piston
(14) Brake Plate

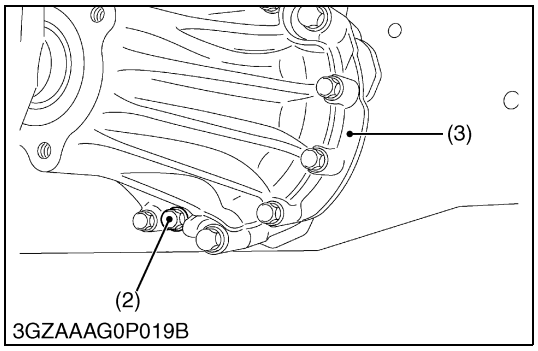
W1033133

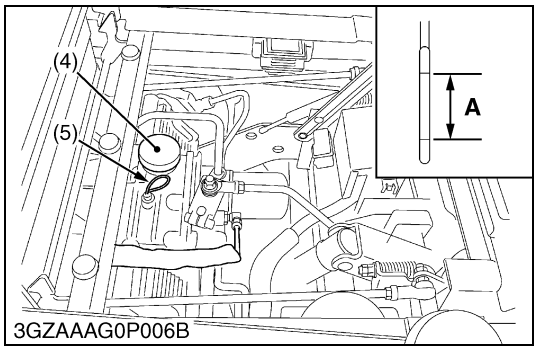




[4] DISASSEMBLING HYDROSTATIC TRANSMISSION AND REAR AXLE GEAR CASE ASSEMBLY







Draining Transmission Fluid

CAUTION

To avoid personal injury :

- **Be sure to stop the engine and remove the key before changing or checking the oil.**
- **Allow transmission case to cool down sufficiently; oil can be hot and may cause burns.**

The fluid in the transmission case is also used for the hydrostatic drive system.

1. To drain the transmission oil, place oil pan underneath the transmission case and the rear axle gear case (RH and LH) and remove the drain plug at the bottom of the transmission case and the rear axle gear case (RH and LH).
2. After draining, reinstall the drain plugs.
3. Fill with new fluid from filling port after removing the filling plug (4) up the upper notch on the dipstick.

■ **IMPORTANT**

- **If takes time to have the oil poured from the transmission case reach the rear axle case (RH and LH). Pour the regulated amount of oil slowly.**

4. After running the engine for a few minutes, stop it and check the oil level again; add oil to the prescribed level.

■ **IMPORTANT**

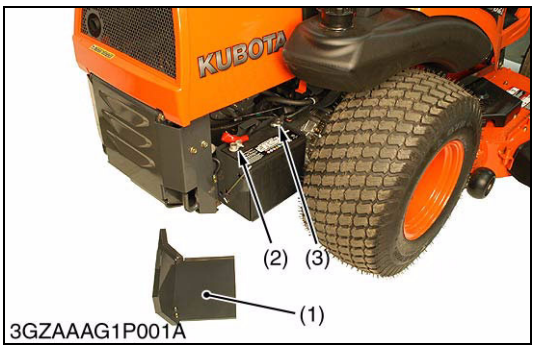
- **Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.**
  Keep the engine at medium speed for a few minutes to insure proper lubrication of all parts so there is no damage to transmission.
- **Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system.**
  Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-7.)
- **Do not mix different brands oil together.**

Transmission fluid capacity	12.1 L 12.8 U.S.qts 10.6 Imp.qts

(1) Transmission Oil Filter
(2) Drain Plug
(3) Rear Axle Gear Case LH
(4) Oil Plug and Breather Cup
(5) Dipstick

A : Oil level acceptable within this range.

W1033436



Battery

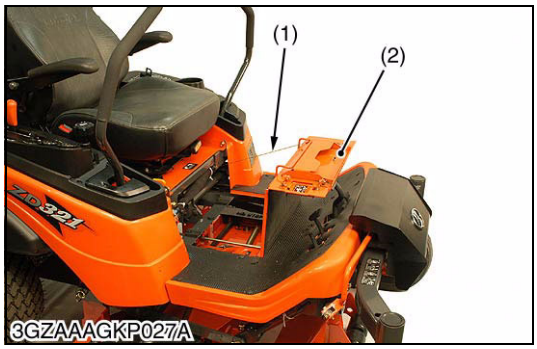
CAUTION

- **When disconnecting the battery cables, disconnect the negative cable from the battery first. When connecting, connect the positive cable to the battery first.**

1. Remove the battery cover (1).
2. Disconnect the negative cable (3) from the battery.
3. Disconnect the positive cable (2) form the battery.

(1) Battery Cover
(2) Positive Cable
(3) Negative Cable

W1033684

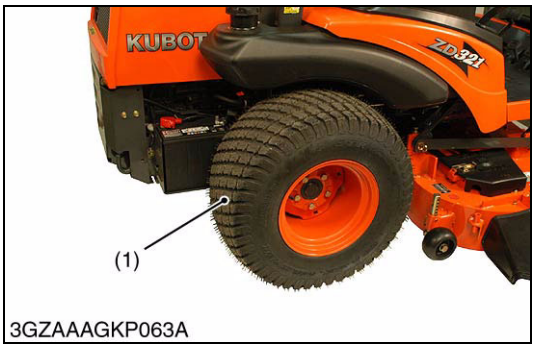


Step, Center and Step

1. Remove the clevis pin and remove the cable (1).
2. Remove the clevis pins and remove the step center (2).
3. Remove the front cover (3).
4. Remove the step (4).

(1) Cable
(2) Step Center
(3) Front Cover
(4) Step

W1033815



Rear Wheel

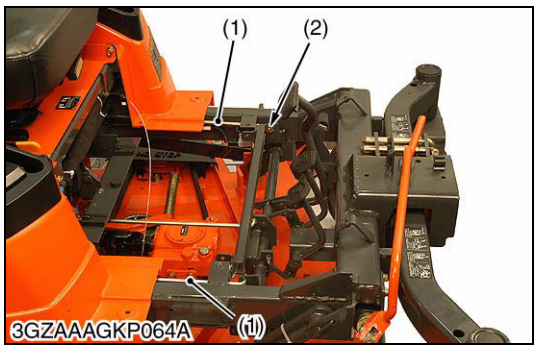
1. Lift up and secure with jack stands or blocking the rear of the machine frame, and remove the rear wheels (1).

(When reassembling)

Tightening torque	Rear wheel mounting screw	108.5 to 130.2 N·m 11.1 to 13.3 kgf·m 80 to 96 lbf·ft

(1) Rear Wheel

W1033946



Parking Brake Rod

1. Remove the parking brake rods (1).

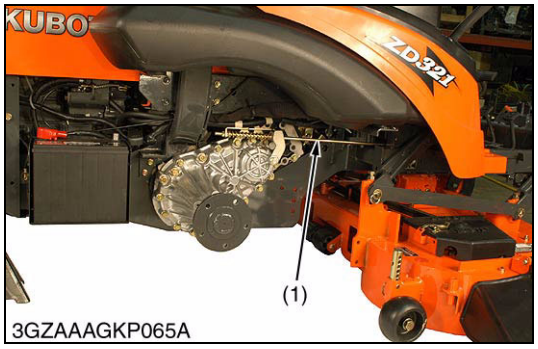
(When reassembling)

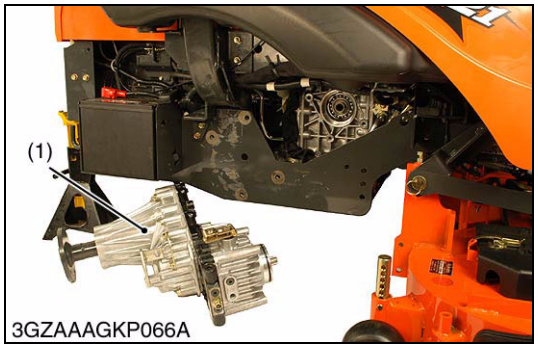
■ **NOTE**

- **Replace the cotter pin (2) with new one.**
- **After assembling the parking brake rods, be sure check the parking brake spring length and play. If the measurement is not within the factory specifications, adjust the spring length and play. (See page 2-S12.)**

(1) Parking Brake Rod (2) Cotter Pin

W1034105





Hydrostatic Transmission and Rear Axle Gear Case Assembly

■ **NOTE**

- **The hydrostatic transmission and rear axle gear case assembly weighs approximately 35 kg (77 lbs). Take extra care in handling.**

1. Remove the hydrostatic transmission mounting screws.
2. Remove the rear axle gear case mounting screws.
3. Separate the hydrostatic transmission and rear axle gear case assembly (1) and the transmission center case.

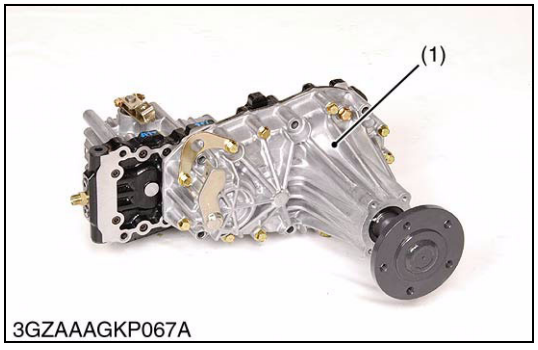
(When reassembling)

- Take care no to damage the O-ring.
- Check the tightening torque on the removed case and other side. (Make sure the screw does not loose).

Tightening torque	Hydrostatic transmission mounting screw (M10)	40 to 44 N·m 4.0 to 4.5 kgf·m 29 to 32 lbf·ft
	Rear axle gear case mounting screw (M12)	78 to 90 N·m 7.9 to 9.2 kgf·m 58 to 66 lbf·ft

(1) Hydrostatic Transmission and Rear Axle Gear Case Assembly

W1034368



Rear Axle Gear Case

1. Remove the rear axle gear case (1).

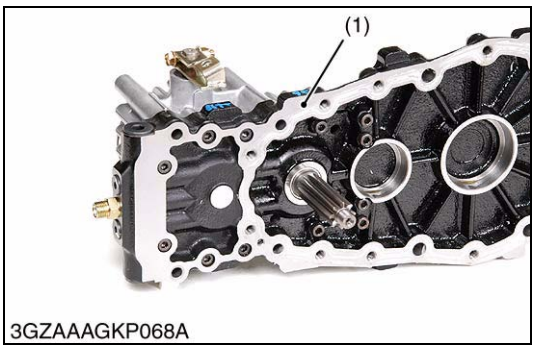
(When reassembling)

- Put in the motor shaft on the brake disc side by aligning the spline. Then mount the rear axle gear case assembly and HST.
- Apply liquid gasket (Three Bond 1208D or equivalent) to joint face of the rear axle gear case and port block (center section).

Tightening torque	Rear axle gear case mounting screw	40 to 44 N·m 4.0 to 4.5 kgf·m 29 to 32 lbf·ft

(1) Rear Axle Gear Case

W1035003



3GZAAAGKP068A

Center Section (Port Block)

1. Separate the center section (1) and the hydrostatic transmission housing.

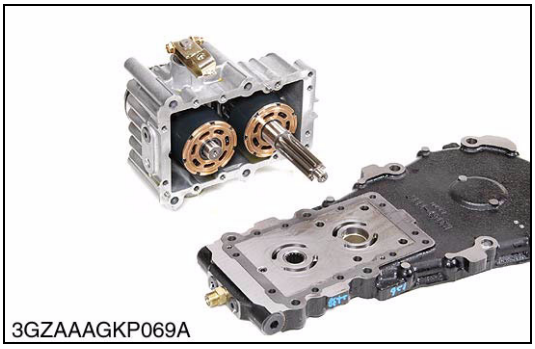
■ **NOTE**

- **Take care not to damage the surface of cylinder blocks pistons and center section.**

Tightening torque	Center section mounting hex. socket head screw	40 to 44 N·m 4.0 to 4.5 kgf·m 29 to 32 lbf·ft

(1) Center Section

W1035192


3GZAAAGKP069A

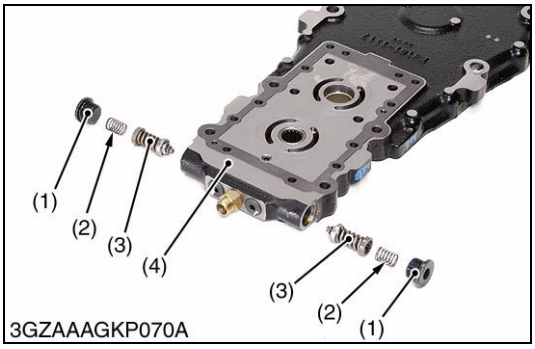
Check and High Pressure Relief Valve Assembly

1. Remove the plug (1) and draw out the spring (2) and check and high pressure relief valve assembly (3).

(When reassembling)

- Take care not to damage the O-ring on the plug.

Tightening torque	Check and high pressure relief valve plug	30 to 44 N·m 3.0 to 4.5 kgf·m 22 to 32 lbf·ft



3GZAAAGKP070A

(1) Plug
(2) Spring
(3) Check and High Pressure Relief Valve Assembly
(4) Center Section

W1035464

Cylinder Block Assembly and Thrust Ball Bearing

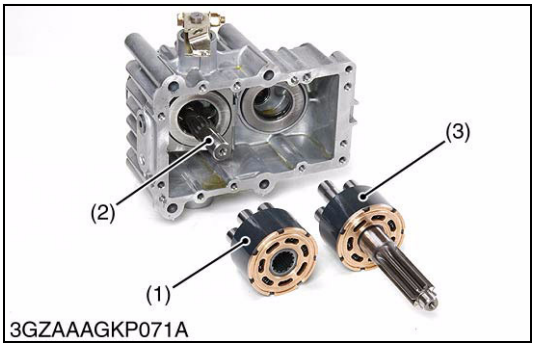
1. Lay the housing on its side.
2. Slide out the cylinder block assembly (pump) (1).
3. Slide out the cylinder block assembly (motor) (3).
4. Remove the thrust ball bearing (4).

■ **NOTE**

- **Take care not to damage the surface of the cylinder blocks.**

(When reassembling)

- Apply clean fluid to the surface of cylinder block.



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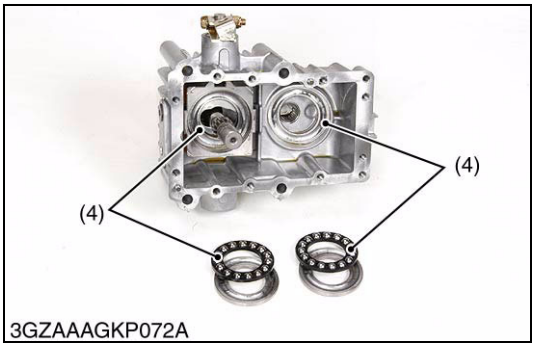
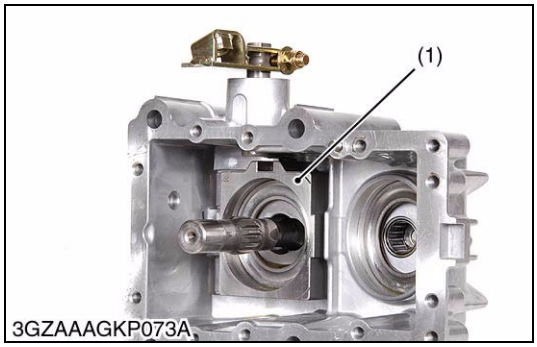
(1) Cylinder Block Assembly (Pump)
(2) Pump Shaft
(3) Cylinder Block Assembly (Motor)
(4) Thrust Ball Bearing

W1035658



3GZAAAGKP072A

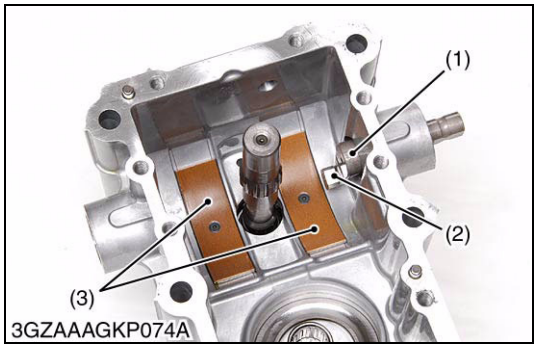


Swashplate

1. Remove the swashplate (1) from the housing.

(1) Swashplate

W1035905

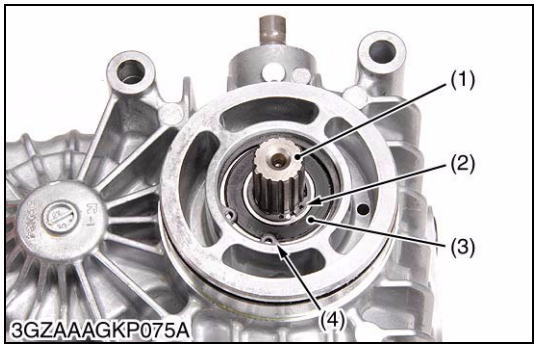


Slot Guide and Cradle Bearing

1. Remove the slot guide (2) from the trunnion arm (1).
2. Remove the cradle bearing (3) from the housing.

(1) Trunnion Arm
(2) Slot Guide
(3) Cradle Bearing

W1035995

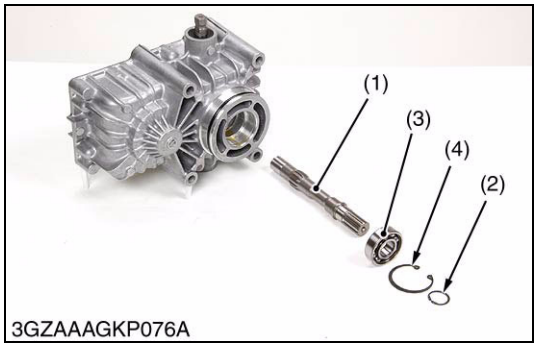


Pump Shaft

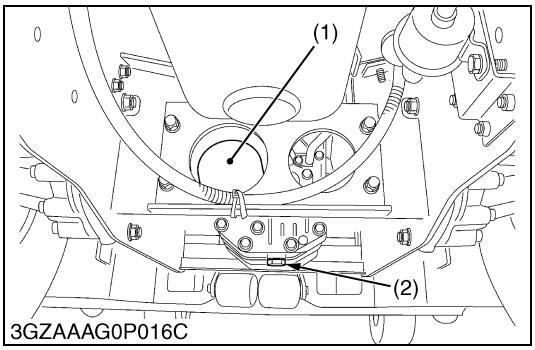
1. Remove the external snap ring (2).
2. Tap the pump shaft (1) with a plastic hammer slightly to side out it from the housing with the ball bearing (3).
3. Remove the internal snap ring (4) and bearing (3).

(1) Pump Shaft
(2) External Snap Ring
(3) Ball Bearing
(4) Internal Snap Ring

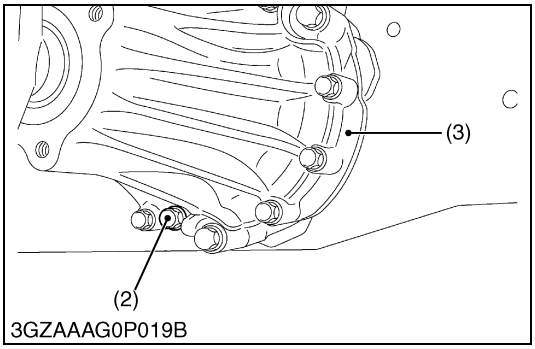
W1036142



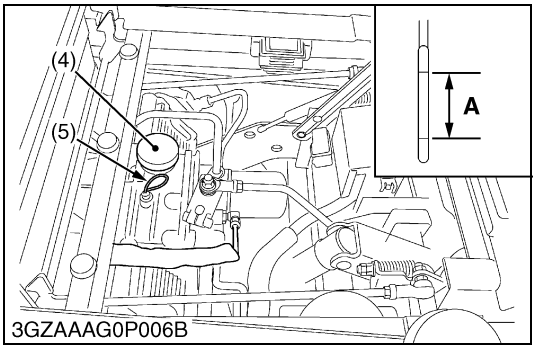
[5] DISASSEMBLING REAR AXLE GEAR CASE



3GZAAAG0P016C



3GZAAAG0P019B



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Draining Transmission Fluid

CAUTION

To avoid personal injury :

- **Be sure to stop the engine and remove the key before changing or checking the oil.**
- **Allow transmission case to cool down sufficiently; oil can be hot and may cause burns.**

The fluid in the transmission case is also used for the hydrostatic drive system.

1. To drain the transmission oil, place oil pan underneath the transmission case and the rear axle gear case (RH and LH) and remove the drain plug at the bottom of the transmission case and the rear axle gear case (RH and LH).
2. After draining, reinstall the drain plugs.
3. Fill with new fluid from filling port after removing the filling plug (4) up the upper notch on the dipstick.

■ **IMPORTANT**

- **If takes time to have the oil poured from the transmission case reach the rear axle case (RH and LH). Pour the regulated amount of oil slowly.**

4. After running the engine for a few minutes, stop it and check the oil level again; add oil to the prescribed level.

■ **IMPORTANT**

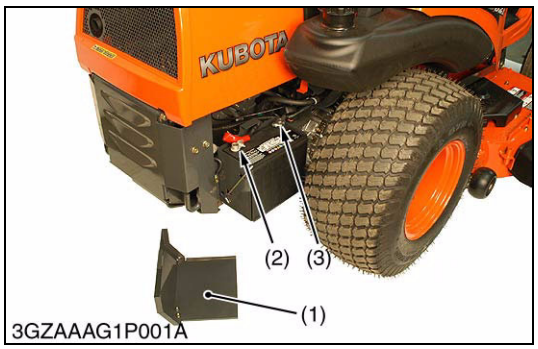
- **Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.**
  Keep the engine at medium speed for a few minutes to insure proper lubrication of all parts so there is no damage to transmission.
- **Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system.**
  Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-7.)
- **Do not mix different brands oil together.**

Transmission fluid capacity	12.1 L 12.8 U.S.qts 10.6 Imp.qts

(1) Transmission Oil Filter
(2) Drain Plug
(3) Rear Axle Gear Case LH
(4) Oil Plug and Breather Cup
(5) Dipstick

A : Oil level acceptable within this range.

W1036345



Battery

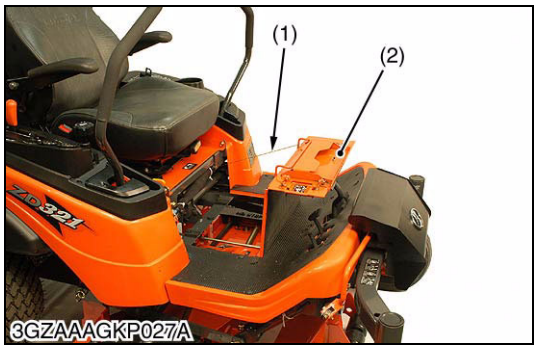
CAUTION

- **When disconnecting the battery cables, disconnect the negative cable from the battery first. When connecting, connect the positive cable to the battery first.**

1. Remove the battery cover (1).
2. Disconnect the negative cable (3) from the battery.
3. Disconnect the positive cable (2) form the battery.

(1) Battery Cover
(2) Positive Cable
(3) Negative Cable

W1036589

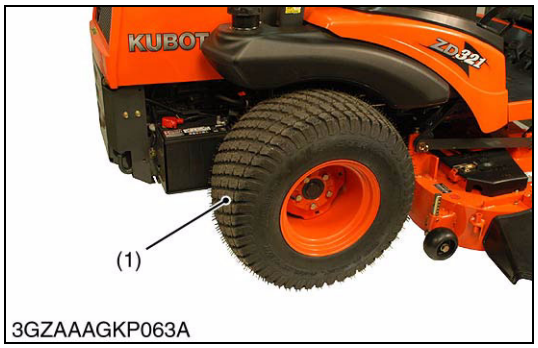


Step, Center and Step

1. Remove the clevis pin and remove the cable (1).
2. Remove the clevis pins and remove the step center (2).
3. Remove the front cover (3).
4. Remove the step (4).

(1) Cable
(2) Step Center
(3) Front Cover
(4) Step

W1036720



Rear Wheel

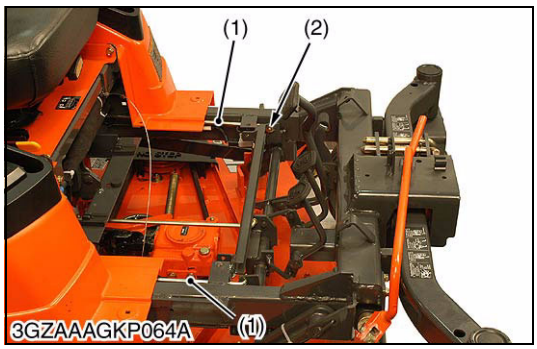
1. Lift up and secure with jack stands or blocking the rear of the machine frame, and remove the rear wheels (1).

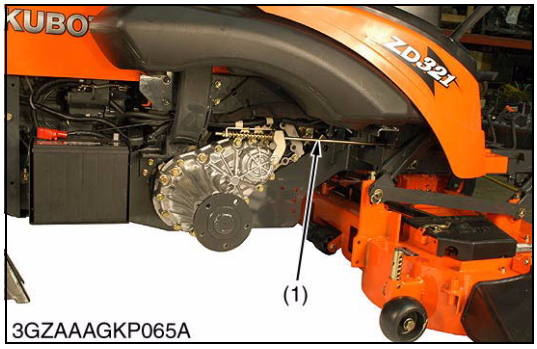
(When reassembling)

Tightening torque	Rear wheel mounting screw	108.5 to 130.2 N·m 11.1 to 13.3 kgf·m 80 to 96 lbf·ft

(1) Rear Wheel

W1036871





Parking Brake Rod

1. Remove the parking brake rods (1).

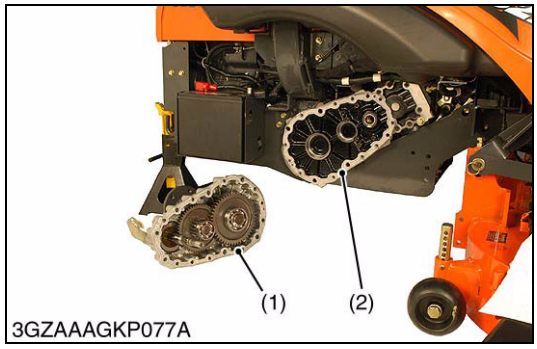
(When reassembling)

■ **NOTE**

- **Replace the cotter pin (2) with new one.**
- **After assembling the parking brake rods, be sure check the parking brake spring length and play. If the measurement is not within the factory specifications, adjust the spring length and play. (See page 2-S12.)**

(1) Parking Brake Rod (2) Cotter Pin

W1037000



Removing Rear Axle Gear Case

1. Remove the rear axle gear case mounting screws.
2. Separate the rear axle gear case assembly (1) and center section (2).

(When reassembling)

- Apply to liquid gasket (Three Bond 1208D or equivalent) to the joint face of the rear axle gear case and center section.

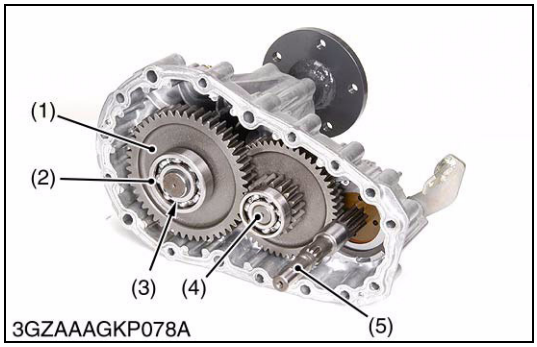
■ **NOTE**

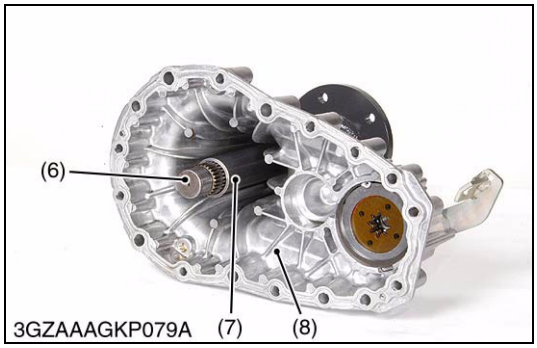
- **If impulse or vibration is applied to the center section after the rear axle gear case assembly (1) was removed, the HST motor-side cylinder block (3) may possibly be deviated as shown in the photo.**
  If this cylinder block (3) should deviate up to the position shown in the photo, it will be unable to be returned to the original position.
  At this time, the center section (2) must be separated for servicing or repair. When the rear axle gear case assembly (1) is removed, therefore, watchful care must be taken so as not to give any impulse and shocks to the center section (2).

Tightening torque	Rear axle gear case mounting screw	40 to 44 N·m 4.0 to 4.5 kgf·m 29 to 32 lbf·ft

(1) Rear Axle Gear Case Assembly (3) Cylinder Block (Motor)
(2) Center Section

W1037133





Rear Axle

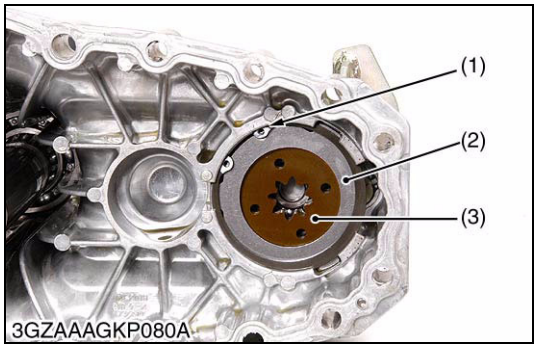
1. Remove the brake shaft (HST motor shaft) (5).
2. Remove the external snap ring (3) and remove the ball bearing (2) with puller.
3. Remove the final reduction gear (1) and gear shaft (4).
4. Remove the collar (7) and tap out the rear axle (6) from rear axle gear case (8).

(When reassembling)

- Do not damage oil seal.

(1) Final Reduction Gear
(2) Ball Bearing
(3) External Snap Ring
(4) Gear Shaft
(5) Brake Shaft (HST Motor Shaft)
(6) Rear Axle
(7) Collar
(8) Rear Axle Gear Case

W1037388



Parking Brake

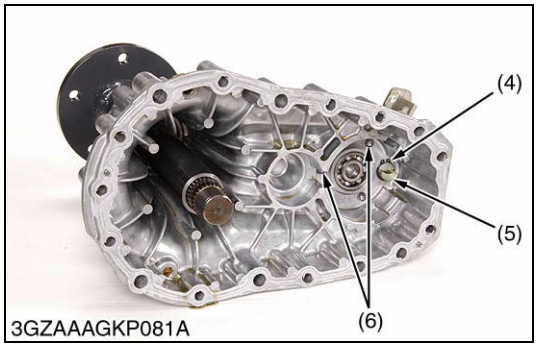
1. Remove the internal snap ring (1), friction plates (2) and brake discs (3).
2. Remove the external snap ring (4), brake arm (5) and balls (6).

(When reassembling)

- Align splines of brake shaft and brake discs (3).
- Do not damage brake discs (3).
- Apply transmission fluid to brake discs (3).

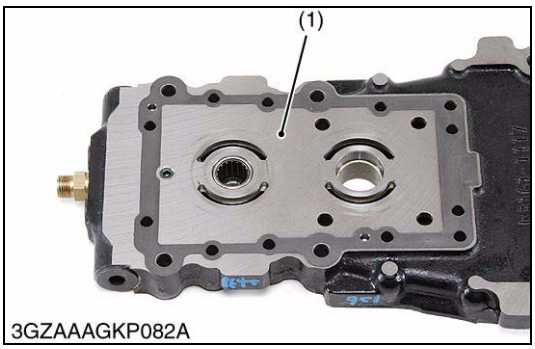
(1) Internal Snap Ring
(2) Friction Plate
(3) Brake Disc
(4) External Snap Ring
(5) Brake Cam
(6) Ball

W1037665



6. SERVICING

[1] HYDROSTATIC TRANSMISSION

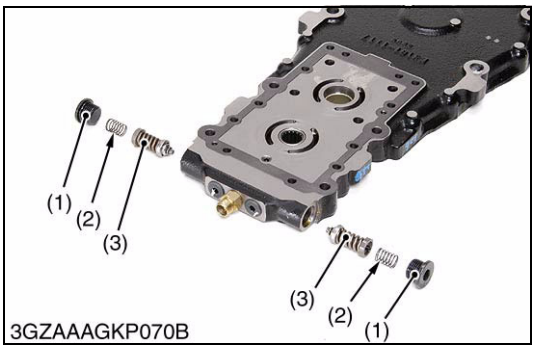


Center Section

1. Check the surface (1) of center section for scratches or wear. If deep scratch or excessive wear is found, replace the hydrostatic transmission assembly.

(1) Surface

W1038177

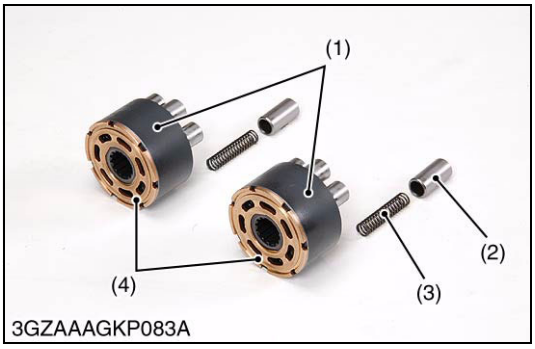


Check and High Pressure Relief Valve

1. Check the check and high pressure relief valve assembly (3) for scratches and damage.
2. Check the spring (2) for breakage and wear.
3. If anything unusual, replace the ball and spring.

(1) Plug
(2) Spring
(3) Check and High Pressure Relief Valve Assembly

W1038284



Cylinder Block Assembly

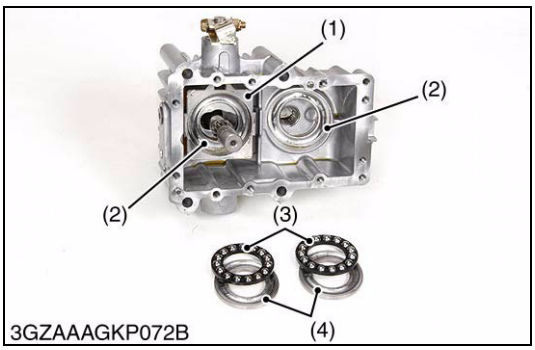
1. Check the cylinder blocks (1) and pistons (2) for scratches and wear.
2. If scratch or worn, replace the cylinder block assembly.
3. Check that the piston (2) and spring (3) are in each cylinder bore.
4. Check the pistons for their free movement in the cylinder block bores.
5. If the piston or the cylinder block is scored, replace the cylinder block assembly.
6. Check the polished face (4) or cylinder block for scoring.
7. If scored, replace the cylinder block assembly.

■ **IMPORTANT**

- **Do not interchange pistons between pump and motor cylinder block. Pistons and cylinder blocks are matched.**

(1) Cylinder Block
(2) Piston
(3) Spring
(4) Polished Face

W1038472

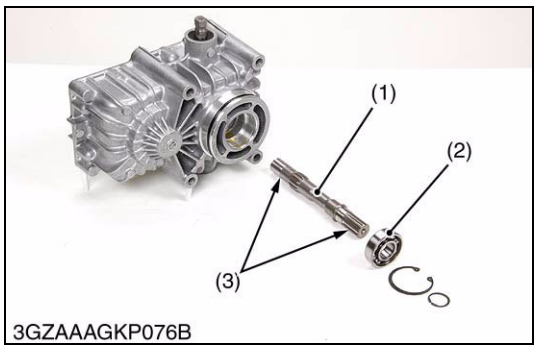


Thrust Washer, Thrust Ball Bearing and Thrust Plate

1. Check the thrust ball bearing (3) for scratches and excessive wear.
2. If worn, replace.
3. Check the thrust plate (4) for scratches and excessive wear.
4. If worn or scored, replace.

(1) Swashplate
(2) Thrust Washer
(3) Thrust Ball Bearing
(4) Thrust Plate

W1038722

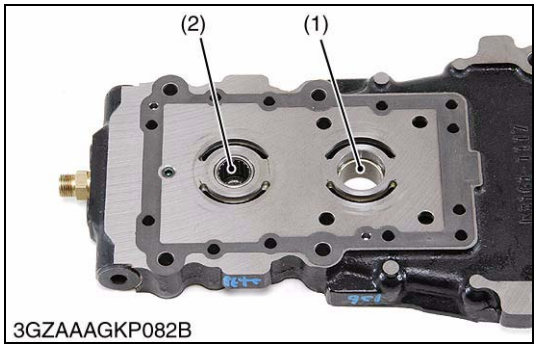


Pump Shaft

1. Check the bearing surface (3) and the ball bearing (2).
2. If the shaft is rough or grooved, replace it.
3. If the ball bearing is worn, replace it.

(1) Pump Shaft
(2) Ball Bearing
(3) Bearing Surface

W1038908



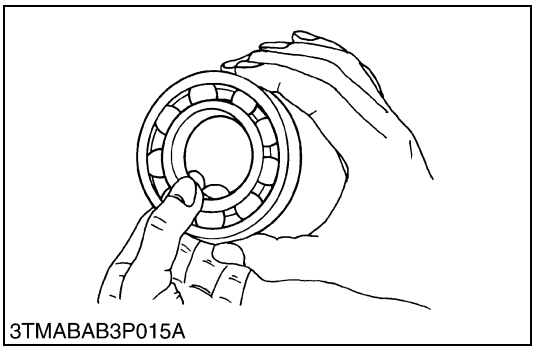
Bush and Needle Bearing

1. Check the bush (1) for wear.
2. If the bush is worn or damaged, replace it.
3. Check the needle bearing (2) for wear.
4. If the needle bearing is worn or damaged, replace it.

(1) Bush
(2) Needle Bearing

W1039153

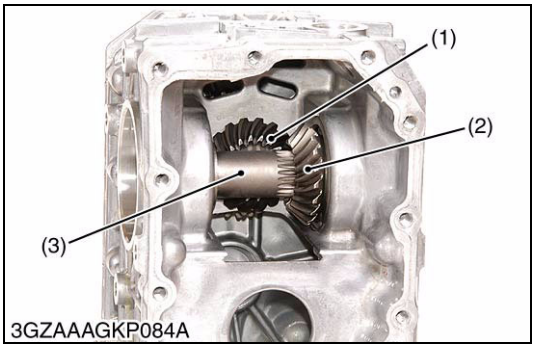
[2] TRANSMISSION CASE


3TMABAB3P015A

Checking Bearing

1. Hold the inner race, and push and pull the outer race in all directions to check for wear and roughness.
2. Apply transmission fluid to the bearing, and hold the inner race. Then, turn the outer race to check rotation.
3. If there is any defect, replace it.

W1039304



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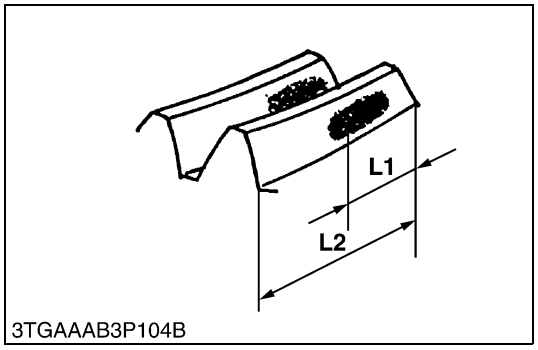
Backlash and Tooth Contact between 16T or 18T Bevel Gear and 19T Bevel Gear

1. Measure the backlash between the 16T or 18T bevel gear (1) and 19T bevel gear (1).
2. When the backlash is too large, decrease the number of shims in the side of the spiral bevel gear, and insert the removed shims in the opposite side. When the backlash is too small, decrease the number of shims in the side of the differential case, and insert the removed shims in the opposite side.
3. Adjust the backlash properly by repeating the above procedure.
4. Apply red lead lightly over several teeth at three positions equally spaced on the hypoid ring gear.
5. Turn the 16T or 18T bevel gear by input shaft while pressing a wooden piece against the periphery of the bevel gear.
6. Check the tooth contact, if not proper, adjust according to the following instruction.

Backlash between 19T bevel gear and 16T or 18T bevel gear	Factory spec.	0.25 to 0.30 mm 0.0099 to 0.011 in.
Tooth contact	Factory spec.	More than 25 % read lead contact area on the gear tooth surface
The position of tooth contact point	Factory spec.	The center of tooth contact at 3/10 of the entire width from the small end

(1) 16T Bevel Gear (ZD321, ZD326)
18T Bevel Gear (ZD331)
(2) 19T Bevel Gear
(3) Joint Shaft

W1039404



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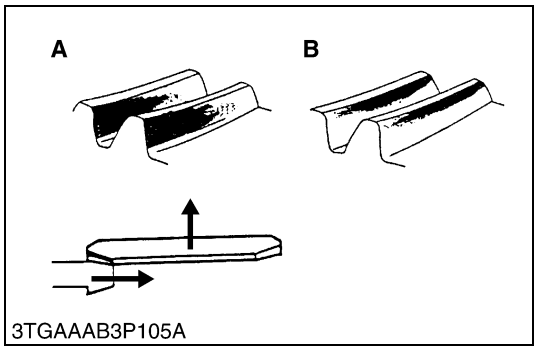

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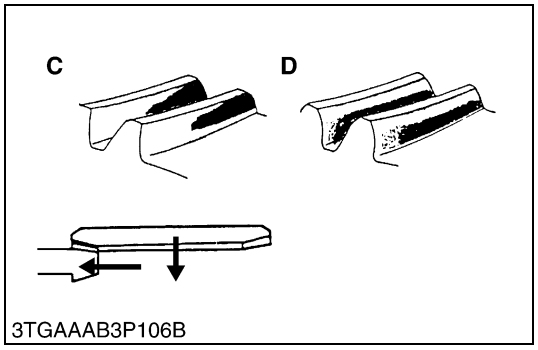

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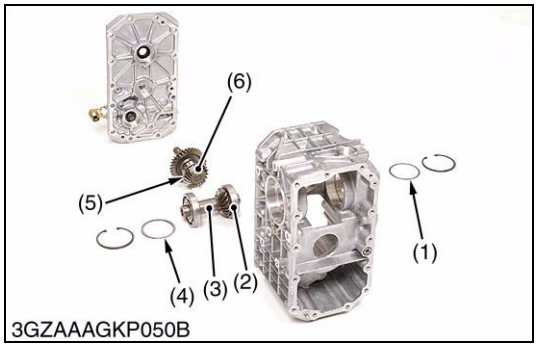

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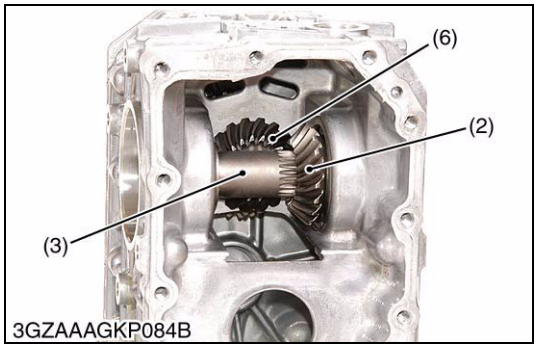

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Correcting of Tooth Contact

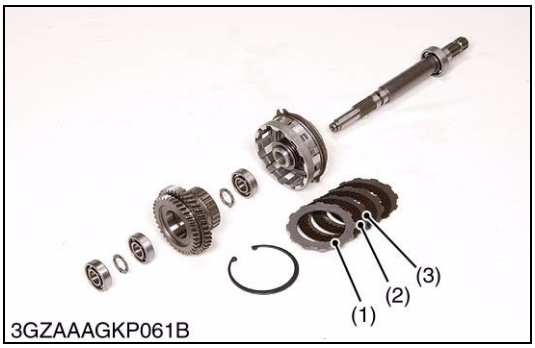
1. Proper contact
   - No adjustment.
2. Correcting of the heel contact and shallow contact
   - It is confirmed whether there is a shim (5).
   - The 16T or 18T bevel gear (6) can be moved to backward by doing to add the shim (5) when not is. (The shim is made the state as it is when there is a shim (5).)
   - And place the 19T bevel gear (2) side shim to the shim (1) to move the 19T bevel gear outside.
   - Repeat above until the proper tooth contact and backlash are achieved.
3. Correcting of the toe contact and deep contact
   - It is confirmed whether there is a shim (5).
   - The 16T or 18T bevel gear (6) can be moved to backward by removing the shim (5) if there is a shim. (The shim (5) is not put when there is no shim.)
   - And place the shim (1) side to the 19T bevel gear (2) side shim to move the 19T bevel gear inside.
   - Repeat above until the proper tooth contact and backlash are achieved.

(1) Shim
(2) 19T Bevel Gear
(3) Joint Shaft
(4) Shim
(5) Shim
(6) 16T or 18T Bevel Gear

L1 : Tooth Contact
L2 : Tooth Bottom
A : Heel Contact
B : Shallow Contact
C : Toe Contact
D : Deep Contact

W1039679

[3] PTO CLUTCH



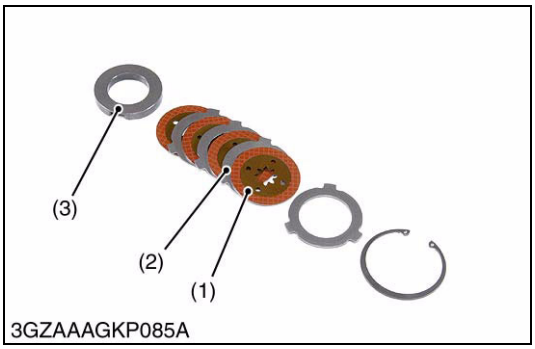
Checking PTO Clutch Discs

1. Check the surface of the pressure plate (1), PTO clutch discs (2) and PTO clutch plates (3).
2. If excessive wear is found, replace it to a new one.

(1) Pressure Plate
(2) PTO Clutch Disc
(3) PTO Clutch Plate

W1040428

[4] BRAKE



Checking Brake Discs, Friction Plates and Actuator

1. Check the surface of the brake discs (2), friction plates (1) and actuator (3). If excessive wear is found, replace it to a new one.

(1) Friction Plate
(2) Brake Disc
(3) Actuator

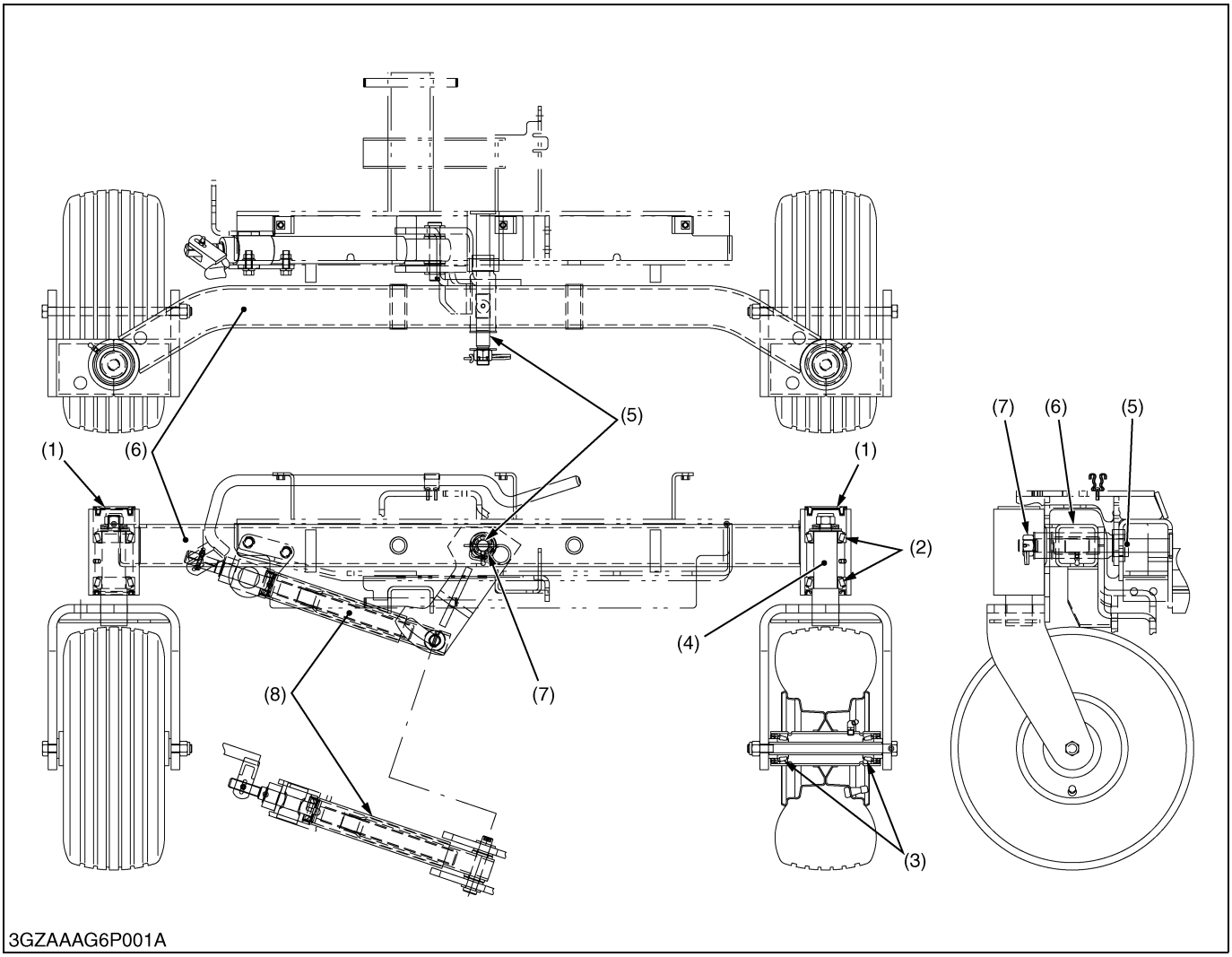
W1040659

3 FRONT AXLE

MECHANISM

CONTENTS

1. STRUCTURE



(1) Cap
(2) Taper Roller Bearing
(3) Taper Roller Bearing
(4) Wheel Bracket
(5) Center Pin
(6) Front Axle
(7) Slotted Nut
(8) Lift Up Adjuster

The front axle is constructed as shown above. The shape of the front axle is relatively simple, and the front axle is supported at its center with the center pin (5), so that steering operation is stable even on uneven grounds in a grass field. And this time, the structure that the front axle can be fixed is adopted.

SERVICING

CONTENTS

1. TROUBLESHOOTING

Symptom	Probable Cause	Solution	Reference Page
Front Wheels Wander to Right or Left	Clearance between center pin and front axle excessive	Replace	–
	Force of the lock nut which tighten the wheel bracket has become down	Adjust	3-S5
	Clearance between front axle and front axle support excessive	Adjust	3-S4

W1014322

2. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
Front Axle End Play	Clearance	0 to 0.2 mm 0 to 0.008 in.	0.5 mm 0.02 in.

W1013874

3. TIGHTENING TORQUES

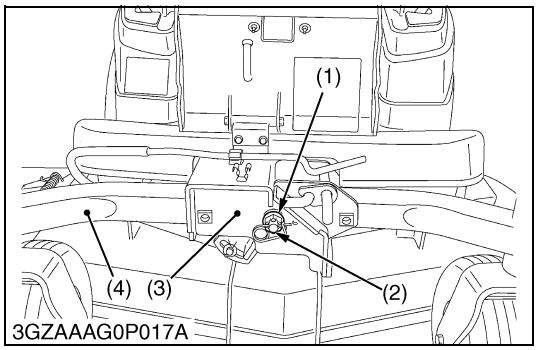
Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts: See page G-9.)

Item	N·m	kgf·m	lbf·ft
Wheel bolt and lock nut	20 to 25	2.1 to 2.5	15 to 18
Wheel bracket lock nut	45 to 55	4.6 to 5.6	34 to 40
Center pin lock nut (Slotted nut)	40 to 80	4.1 to 8.1	30 to 59
Connecting plate mounting screw	48 to 55	4.9 to 5.7	36 to 41

W1012736

4. CHECKING, DISASSEMBLING AND SERVICING

[1] CHECKING AND ADJUSTING



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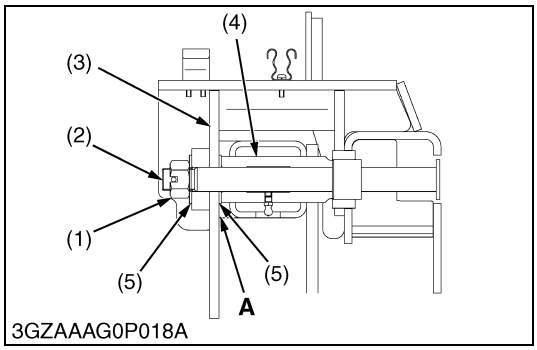


3GZAAAG0P018A

Adjusting Front Axle Pivot

1. Lift up and securely block the front of the machine.
2. Measure the clearance **(A)** between the front axle (4) and front axle support (3).
3. If the measurement exceeds the allowable limit, remove the set spring and adjust the end play by slotted nut (1).

(When reassembling)

Tightening torque	Center pin lock nut (Slotted nut)	40 to 80 N·m 4.1 to 8.1 kgf·m 30 to 59 lbf·ft

■ **NOTE**

- **When fastening the center pin (2), tighten the nut (1) so that the front axle may be oscillated smoothly by hand.**

Front axle end play **(A)**	Factory spec.	0 to 0.2 mm 0 to 0.008 in.
	Allowable limit	0.5 mm 0.02 in.

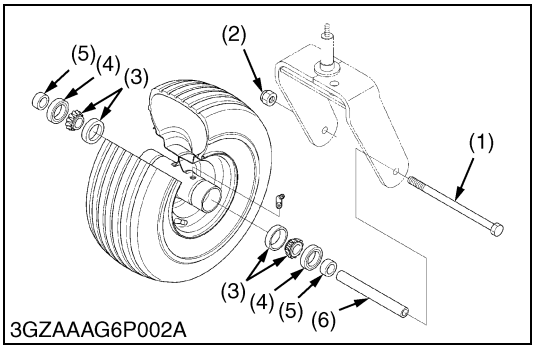
(1) Slotted Nut
(2) Center Pin
(3) Front Axle Support
(4) Front Axle
(5) Plain Washer

(A) Front Axle End Play

W1011206

[2] DISASSEMBLING AND ASSEMBLING

(1) Separating Front Wheel and Wheel Bracket



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Remove the Front Wheel

1. Inspect all parts for wear or damage. Replace the parts as needed.

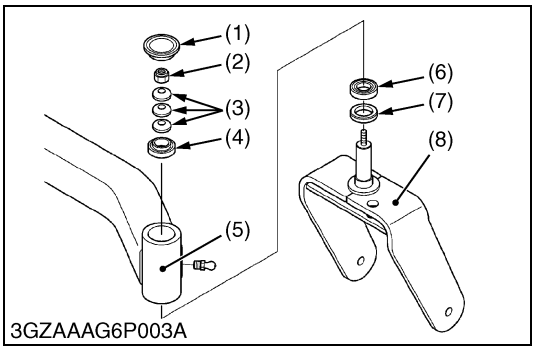
(When reassembling)

- Apply grease to grease fittings. (See page G-8.)

Tightening torque	Front wheel mounting bolt and locking nut	20 to 25 N·m 2.1 to 2.5 kgf·m 15 to 18 lbf·ft

(1) Bolt
(2) Locking Nut
(3) Taper Roller Bearing
(4) Oil Seal
(5) Spacer
(6) Sleeve

W1011397



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Remove the Wheel Bracket

1. Remove the cap (1).
2. Remove the locking nut (2) and wheel bracket (8).
3. Inspect all parts for wear or damage. Replace the parts as needed.

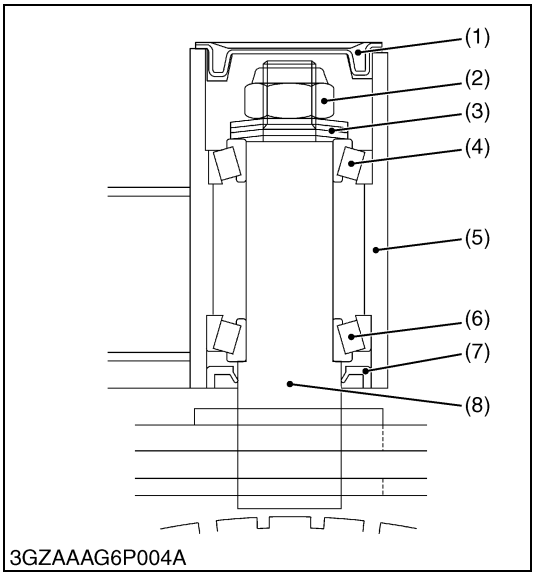
(When reassembling)

- Do not mistake the direction when reassembling the plate spring (3), taper roller bearing (4), (6) and oil seal (7).

Tightening torque	Locking nut tightening torque	45 to 55 N·m 4.6 to 5.6 kgf·m 34 to 40 lbf·ft

(1) Cap
(2) Locking Nut
(3) Plate Spring
(4) Taper Roller Bearing
(5) Front Axle
(6) Taper Roller Bearing
(7) Oil Seal
(8) Bracket

W1011557



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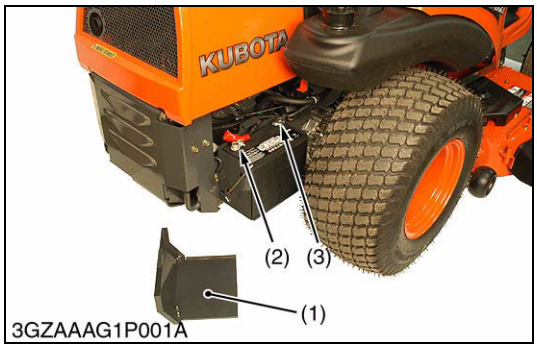
(2) Separating Front Axle Assembly



Battery

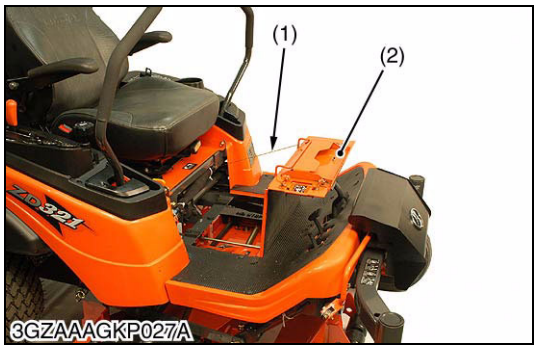
CAUTION

- **When disconnecting the battery cables, disconnect the negative cable from the battery first. When connecting, connect the positive cable to the battery first.**

1. Remove the battery cover (1).
2. Disconnect the negative cable (3) from the battery.
3. Disconnect the positive cable (2) form the battery.

(1) Battery Cover
(2) Positive Cable
(3) Negative Cable

W1012034

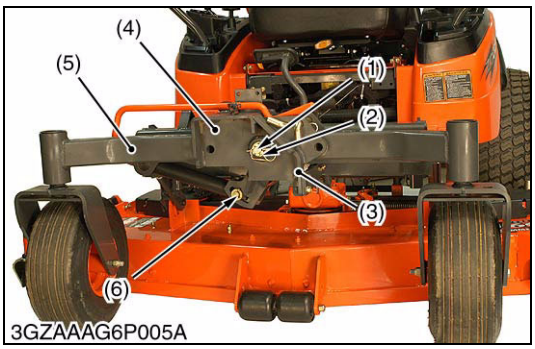


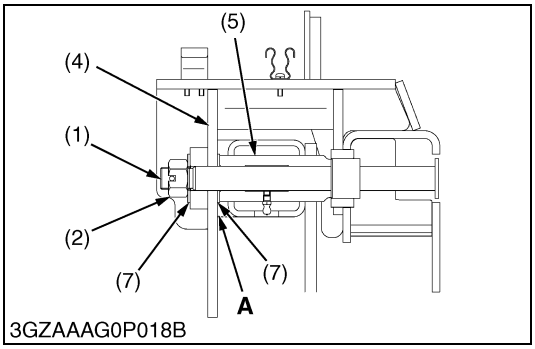
Step, Center and Step

1. Remove the clevis pin and remove the cable (1).
2. Remove the clevis pins and remove the step center (2).
3. Remove the front cover (3).
4. Remove the step (4).

(1) Cable
(2) Step Center
(3) Front Cover
(4) Step

W1012171





Separating Front Axle Assembly

1. Remove the set spring and slotted nut (2).
2. Remove the cotter pin and clevis pin (6).
3. Remove the connecting plate (3).
4. Lift up and secure with jack stands or blocking the front of machine frame.
5. Remove the center pin (1), and separate the front axle assembly (5).

(When reassembling)

■ **NOTE**

- **Do not hit the center pin.**
- **After assembling the front axle assembly, be sure check the front axle end play (A). If the measurement is not within the factory specifications, adjust the front axle end play (A).**

Tightening torque	Center pin lock nut (slotted nut)	40 to 80 N·m 4.1 to 8.1 kgf·m 30 to 59 lbf·ft
	Connecting plate mounting screw	48 to 55 N·m 4.9 to 5.7 kgf·m 36 to 41 lbf·ft

(1) Center Pin
(2) Center Pin Lock Nut (Slotted Nut)
(3) Connecting Plate
(4) Front Axle Support
(5) Front Axle Assembly
(6) Clevis Pin
(7) Plain Washer

A : Front Axle End Play

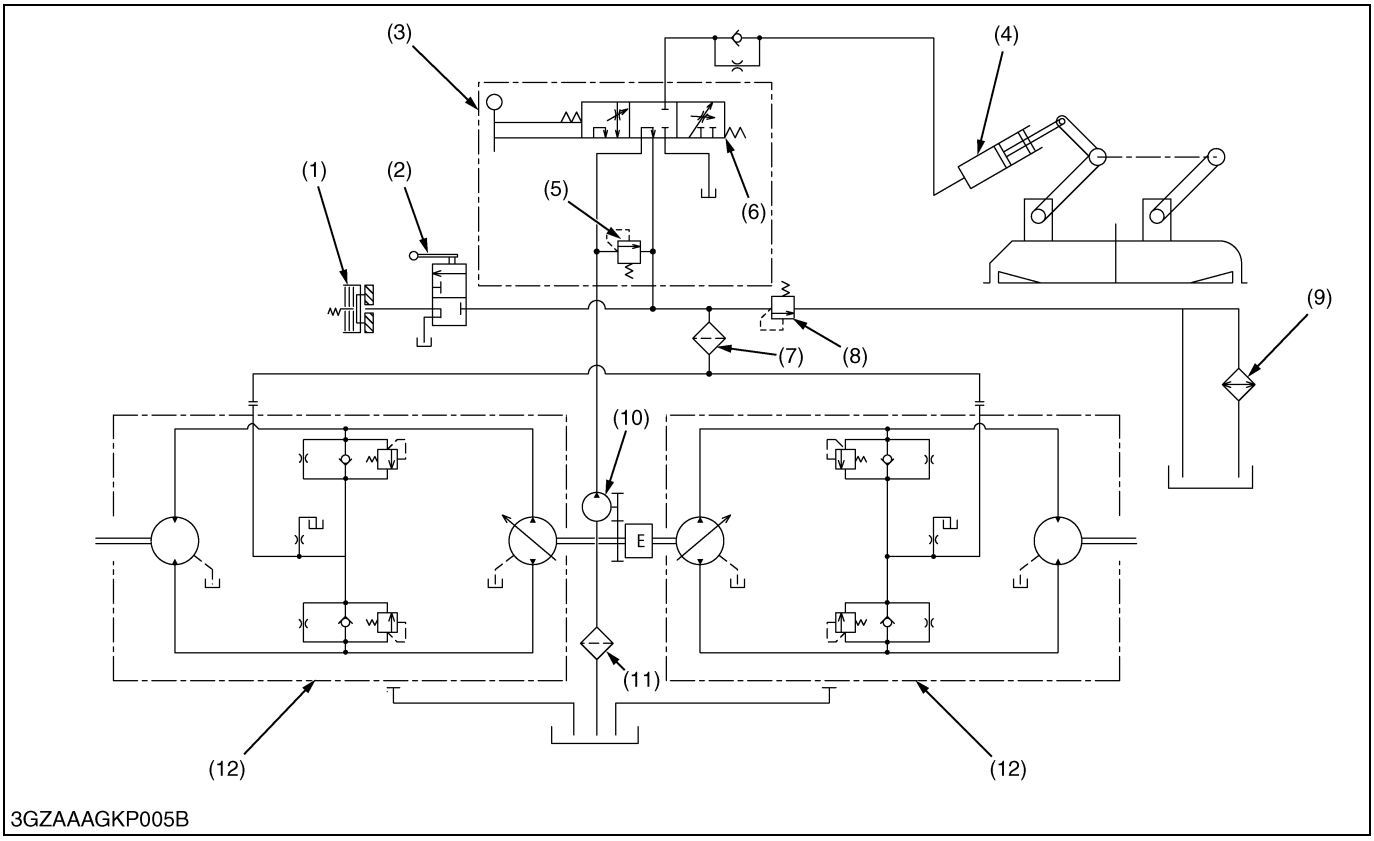
W1012283

4 HYDRAULIC SYSTEM

MECHANISM

CONTENTS

1. HYDRAULIC CIRCUIT



(1) PTO Clutch
(2) PTO Clutch Valve
(3) Hydraulic Control Valve Assembly
(4) Hydraulic Cylinder
(5) Relief Valve
(6) Control Valve
(7) Oil Filter
(8) Regulator Valve
(9) Oil Cooler
(10) Hydraulic Pump
(11) Oil Filter
(12) Hydrostatic Transmission

The hydraulic system of this machine is composed of a hydraulic pump (10), control valve (6), hydraulic cylinder (4) and other components.

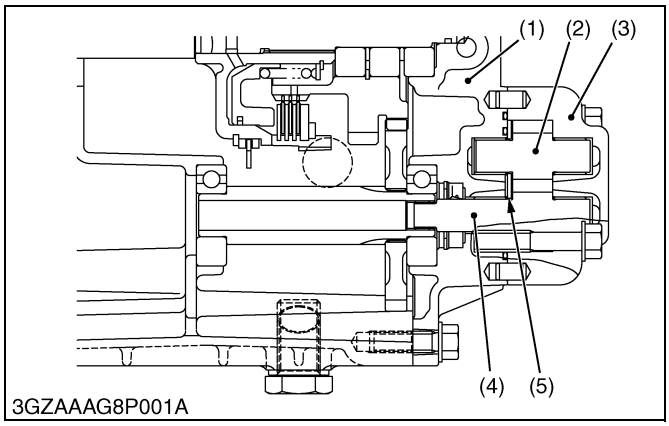
This system has the following functions.

Oil is supplied by hydraulic pump (10) which is driven by engine.

Power from the input shaft (pump shaft) is distributed right and left with the bevel gears and drives each hydrostatic transmission (12).

Moreover, oil from the hydraulic pump (10) is sent to the transmission center case through the control valve. On the other hand, oil is regulated with the regulator valve (8) to constant pressure and sent to the hydrostatic transmission (12) and PTO clutch (1).

2. HYDRAULIC PUMP



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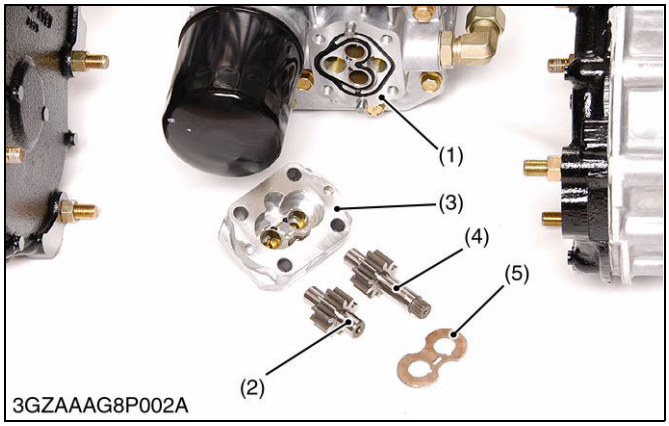

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The hydraulic pump is composed of the casing (1), cover (3), side plate (5), and two spur gears (drive gear (4) and driven gear (2)) that are in mesh.

Hydraulic pump is driven by the pump drive shaft in the transmission case.

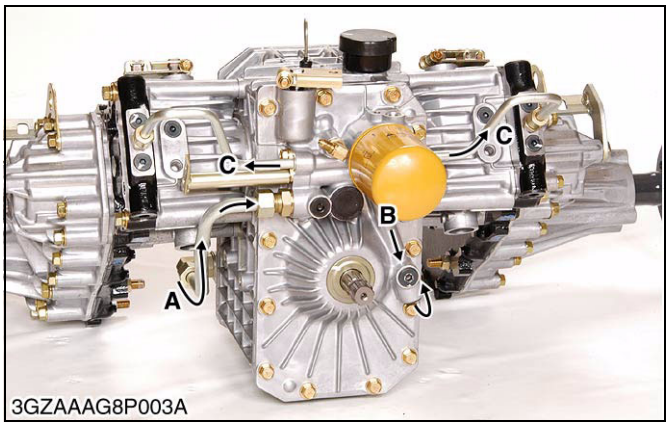
Maximum displacement is as follows.

Displacement	Engine speed	Condition
21.0 L/min. 5.5 U.S.gals/min. 4.6 Imp.gals/min.	ZD321, ZD326 : At 3200 min^{-1} (rpm) ZD331 : At 3000 min^{-1} (rpm)	at no load

(1) Casing
(2) Driven Gear
(3) Cover
(4) Drive Gear
(5) Side Plate

W1013860

3. HYDRAULIC CONTROL VALVE



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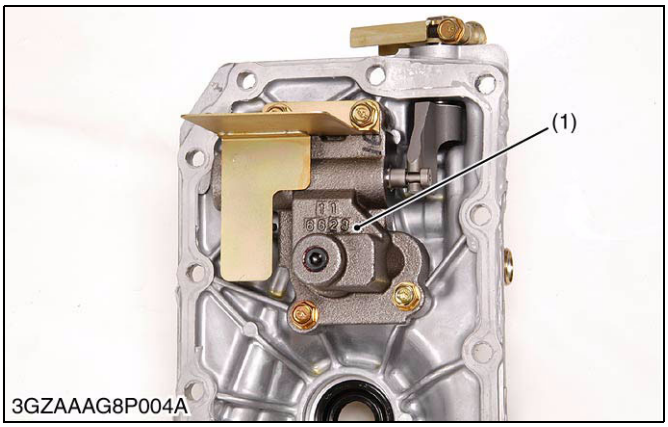

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The hydraulic system is composed of the transmission case (oil tank), cushion oil filter, hydraulic pump, control valve, hydraulic cylinder and etc..

The new series product is provided with a built-in control valve in the case.

The oil flows through the oil filter, and then the oil is sent to the control valve by the pump.

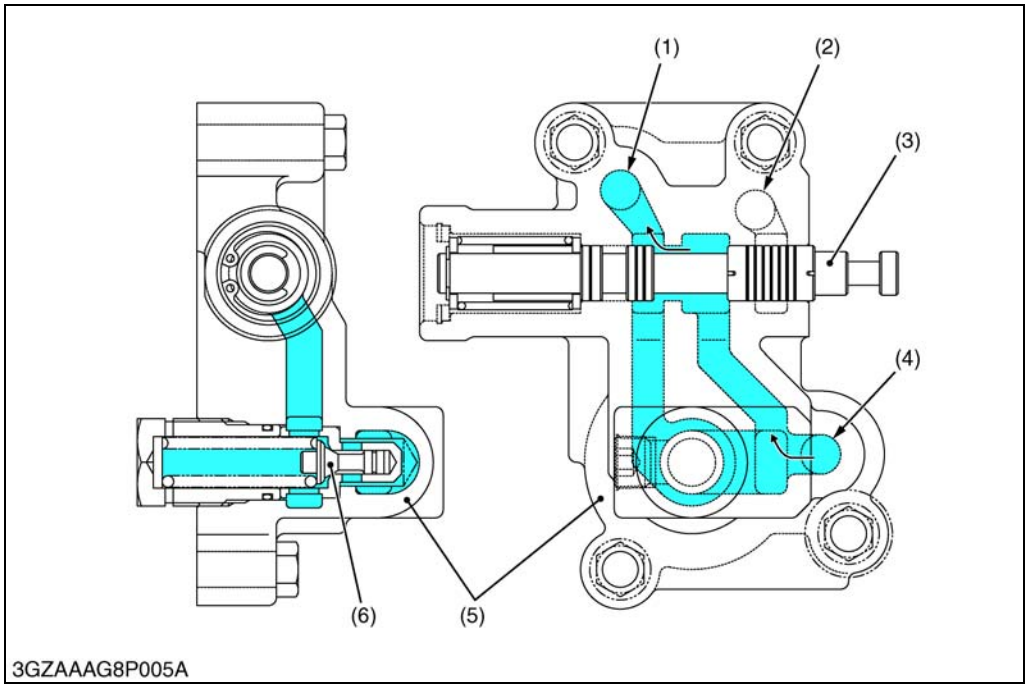
After flowing through the control valve, the oil is sent to the PTO clutch and the HST charge circuit.

(1) Control Valve

A : From Hydraulic Pump
B : To PTO Clutch
C : To Hydrostatic Transmission

W1013483

■Neutral



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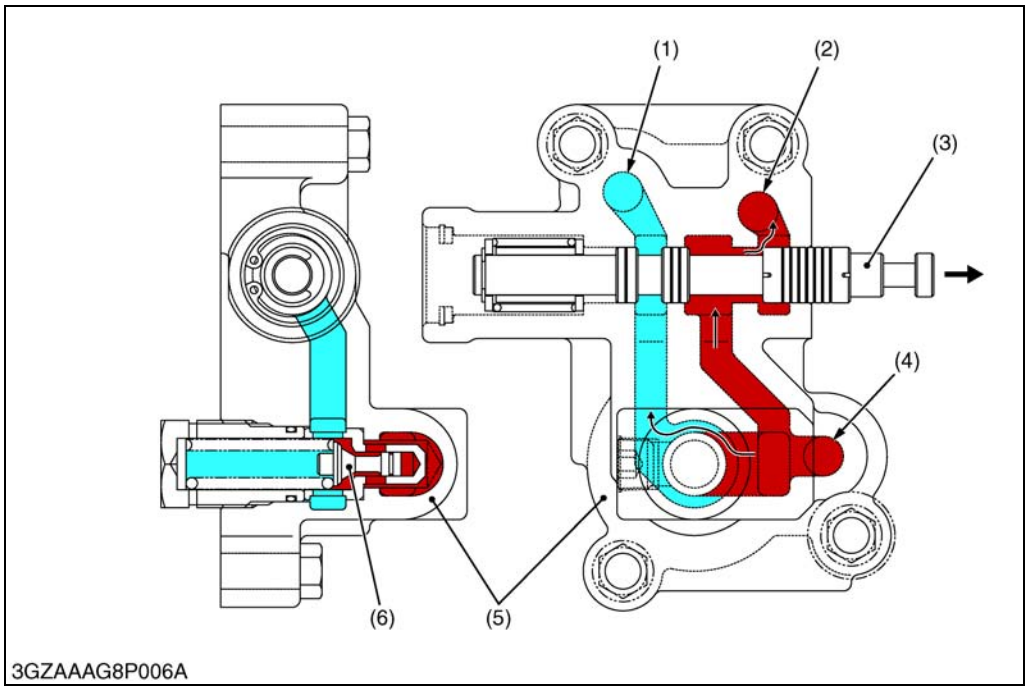
(1) To PTO Clutch and Hydrostatic Transmission
(2) **C** (Cylinder) Port
(3) Spool
(4) **P** (Pump) Port
(5) Valve Body
(6) Relief Valve

W1012655

The oil sent from the pump passes through a gap between the spool (3) and the valve body (5), through the regulator valve, and then flows to the PTO valve and HST charge circuit. The oil sent to the mower-lifting cylinder is interrupted by the spool (3).

■ Lift and Overloaded



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(1) To PTO Clutch and Hydrostatic Transmission
(2) **C** (Cylinder) Port
(3) Spool
(4) **P** (Pump) Port
(5) Valve Body
(6) Relief Valve

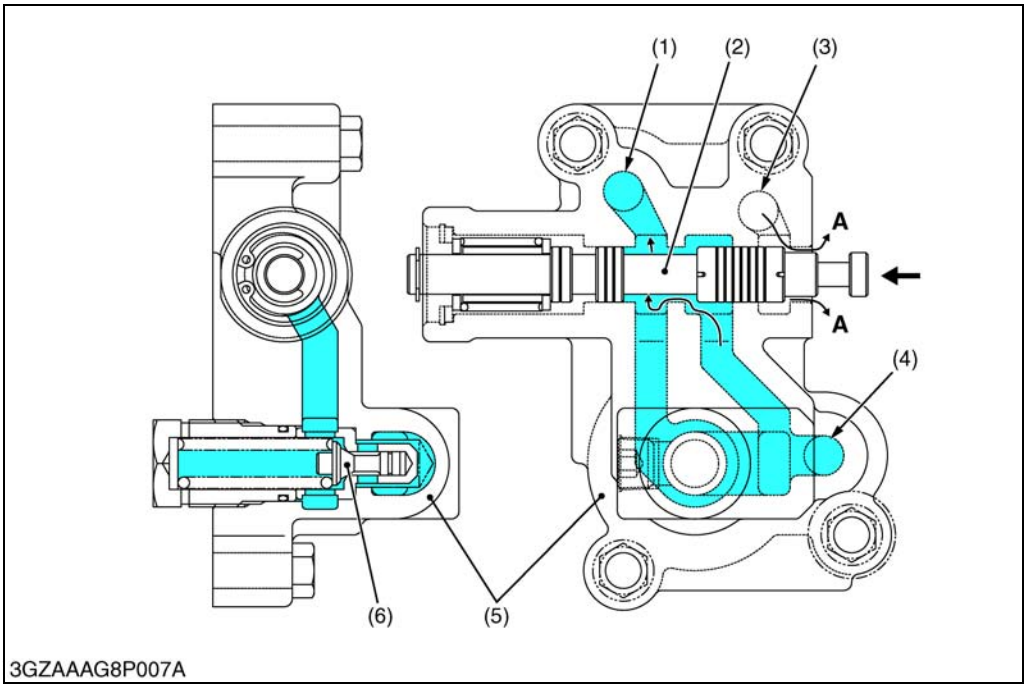
W1012795

The oil flowing from the pump flows through a hydraulic circuit, which is switched over by the spool (3), and is sent to the mower-lifting cylinder (2). When the mower is lifted, the relief valve (6) also operates. As a result, the oil passing through the relief valve (6) is always sent to the PTO valve and HST charge circuit.

(Reference)

- Relief valve setting pressure : 5.5 to 7.0 MPa (56 to 71 kgf/cm^2, 800 to 1000 psi)
- Engine speed : 1800 min^{-1} (rpm) (ZD321, ZD326)
  1600 min^{-1} (rpm) (ZD331)

■ Down



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(1) To PTO Clutch and Hydrostatic Transmission
(2) Spool
(3) **C** (Cylinder) Port
(4) **P** (Pump) Port
(5) Valve Body
(6) Relief Valve

A : Drain directly to the Transmission Center Case

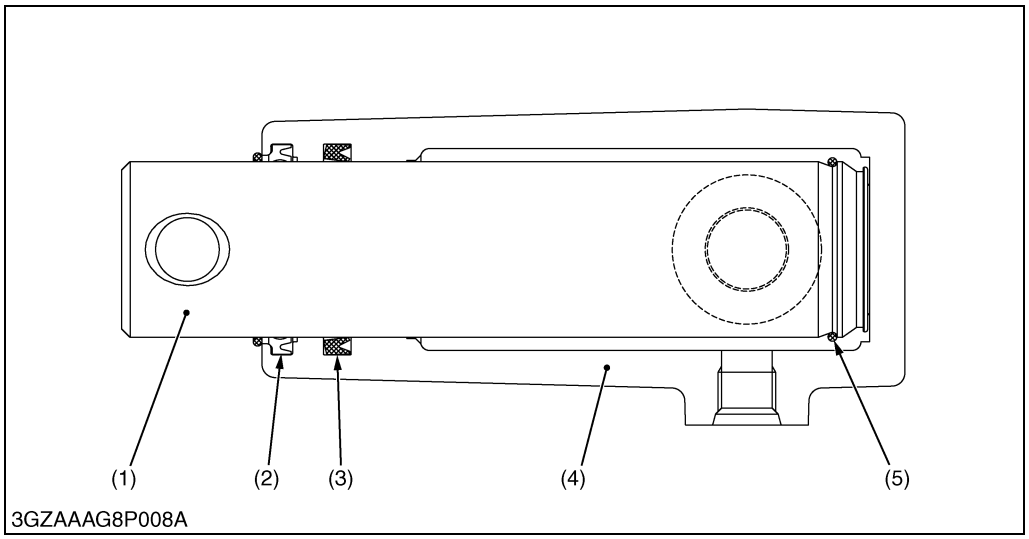
W1013905

The oil sent from the pump passes through a gap between the spool (2) and the valve body (5), through the regulator valve, and then the oil flows to the PTO valve and HST charge circuit.

The mower-lifting cylinder circuit, which has been interrupted by the spool, is returned to the transmission center case by the pressed-in spool, and a new circuit if formed.

Then the oil in the mower-lifting cylinder is discharged to the transmission center case, and the mower goes down.

4. LIFT CYLINDER



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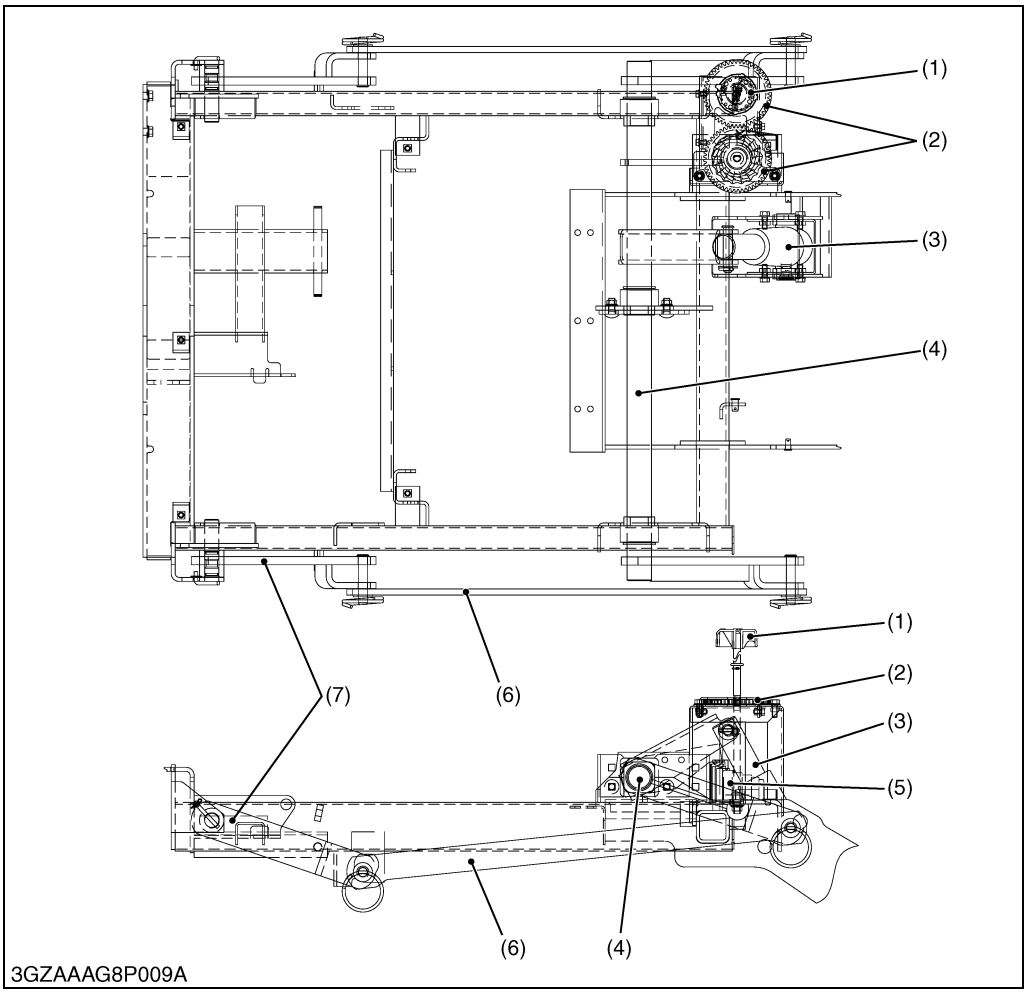
(1) Piston Rod
(2) Scraper
(3) Packing
(4) Cylinder
(5) Snap Ring

W1014031

The lift cylinder consists of the cylinder (4), piston rod (1) and other parts as shown in the figure above.
This cylinder is single acting type.

5. MOWER LINKAGE



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(1) Cutting Height Adjusting Dial
(2) Dial Cam Gear
(3) Lift Cylinder
(4) Lift Shaft
(5) Adjusting Cam
(6) Horizon Plate
(7) Front Arm

W1014267

The lifting of mower is performed by the hydraulic system on the machine.

Front arm (7) and lift shaft are linked with horizon plate (6). When the position control lever is moved to **"LIFT"** position, the lift arm (5) is risen by the oil pressure of hydraulic system.

Therefore, front arm (7) connected with the horizon plate (6) are lifted at the same time.

As this link system is a parallel linkage, the mower can be kept parallel at every position.

The cutting height adjusting dial (1) adjusts cutting height of mower by rotating the adjusting cam (5).

CAUTION

- **Never operate mower in transport position.**

SERVICING

CONTENTS

1. TROUBLESHOOTING

Symptom	Probable Cause	Solution	Reference Page
Mower Does Not Rise	Control valve malfunctioning	Repair or replace	4-S7
	Lift cylinder damaged	Replace	4-S14
	Relief valve spring damaged	Replace	4-S7
	Relief valve setting pressure too low	Adjust	4-S4
	Hydraulic pump defective	Replace	4-S12
	Oil strainer clogged	Clean or replace	G-18
	Suction pipe loosened or broken	Repair or replace	–
	Insufficient transmission oil	Refill	G-7
Mower Does Not Lower	Control valve malfunctioning	Repair or replace	4-S7
Mower Drops by Its Weight	Lift cylinder worn or damaged	Replace	4-S14
	Control valve malfunctioning	Replace	4-S7

W1014322

2. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
Relief Valve (Control Valve)	Setting Pressure [at engine speed ZD321, ZD326 : 1800 min^{-1} (rpm) ZD331 : 1600 min^{-1} (rpm)]	5.5 to 7.0 MPa 56 to 71 kgf/cm^2 800 to 1000 psi	–

W1013874

3. TIGHTENING TORQUES

Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts : See page G-9.)

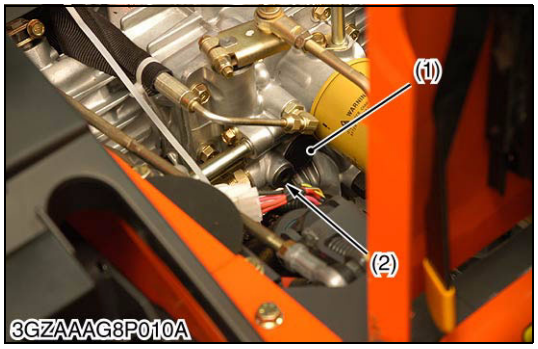
Item	N·m	kgf·m	lbf·ft
Center case front cover mounting screw	40 to 44	4.0 to 4.5	29 to 32
Hydraulic control valve mounting screw	18 to 20	1.8 to 2.1	13 to 15
Relief valve plug	49 to 68	5.0 to 7.0	37 to 50
ROPS connecting plate mounting screw (M8)	24 to 27	2.4 to 2.8	18 to 20
ROPS connecting plate, under mounting screw (M10)	48 to 55	4.9 to 5.7	36 to 41
Hydraulic pump mounting screw	40 to 44	4.0 to 4.5	29 to 32
Cover mounting screw	35 to 39	3.5 to 4.0	26 to 28
Universal joint mounting screw	26.5 to 28.4	2.7 to 2.9	19.6 to 20.9
Engine mounting nut	24 to 27	2.4 to 2.8	18 to 20

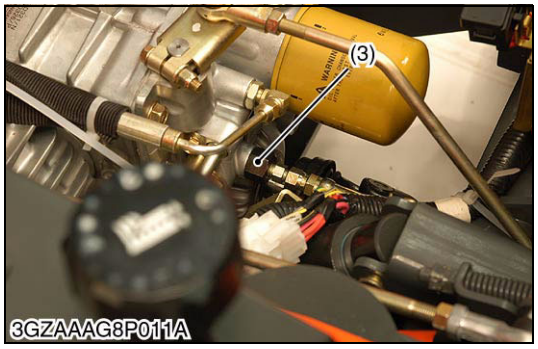
W1012736

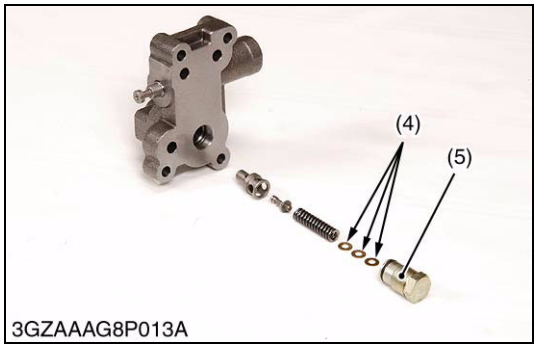
4. CHECKING, DISASSEMBLING AND SERVICING

[1] HYDRAULIC CONTROL VALVE, PUMP AND CYLINDER

(1) Checking and Adjusting







Relief Valve Setting Pressure

1. Remove the plug (2) from the front cover of transmission center case.
2. Install the adaptor (3/8 in., straight thread), cable and pressure gauge.
3. Start the engine and set at maximum speed.
4. Move the control pedal to **"LIFT"** position to operate the relief valve and read the gauge.
5. If the pressure is not within the factory specifications, adjust with the adjusting shims (4).

(Adjusting procedure)

- Remove the plug (1), and remove the plug (5) of relief valve. Then, adjust the thickness of shims.

Relief valve setting pressure	Factory spec.	5.5 to 7.0 MPa 56 to 71 kgf/cm^2 800 to 1000 psi

Condition

- Engine speed …… ZD321 and ZD326 : 1800 min^{-1} (rpm)
  ZD331 : 1600 min^{-1} (rpm)
- Oil temperature … 45 to 55 °C
  113 to 131 °F

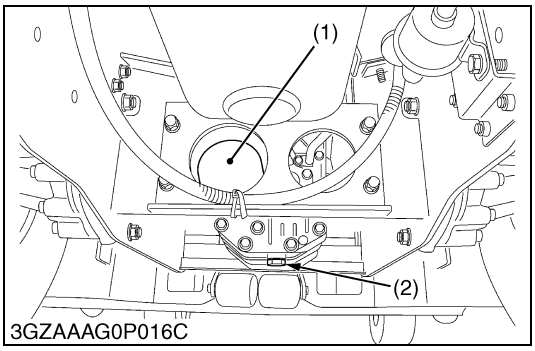
(Reference)

- Replace the hydraulic pump if pressure does not rise in 5 MPa (50 kgf/cm^2, 700 psi) or more.
- Thickness of shims (4): 0.2 mm (0.0079 in.)
  0.3 mm (0.0118 in.)
  0.8 mm (0.0315 in.)

(1) Plug
(2) Plug (3/8 in., straight thread)
(3) Adaptor
(4) Shim
(5) Plug

W1011441

(2) Disassembling and Assembling the Hydraulic Control Valve



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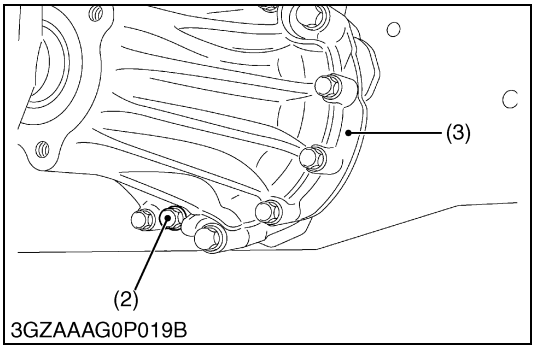

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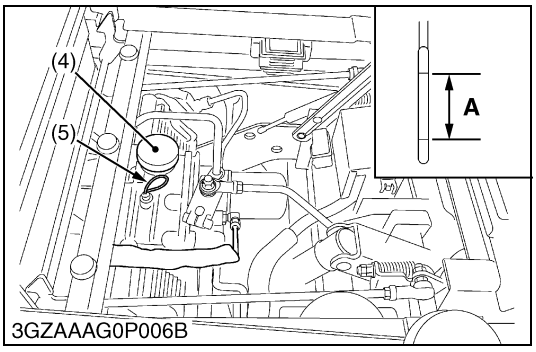

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Draining Transmission Fluid

CAUTION

To avoid personal injury :

- **Be sure to stop the engine and remove the key before changing or checking the oil.**
- **Allow transmission case to cool down sufficiently; oil can be hot and may cause burns.**

The fluid in the transmission case is also used for the hydrostatic drive system.

1. To drain the transmission oil, place oil pan underneath the transmission case and the rear axle gear case (RH and LH) and remove the drain plug at the bottom of the transmission case and the rear axle gear case (RH and LH).
2. After draining, reinstall the drain plugs.
3. Fill with new fluid from filling port after removing the filling plug (4) up the upper notch on the dipstick.

■ **IMPORTANT**

- **If takes time to have the oil poured from the transmission case reach the rear axle case (RH and LH). Pour the regulated amount of oil slowly.**

4. After running the engine for a few minutes, stop it and check the oil level again; add oil to the prescribed level.

■ **IMPORTANT**

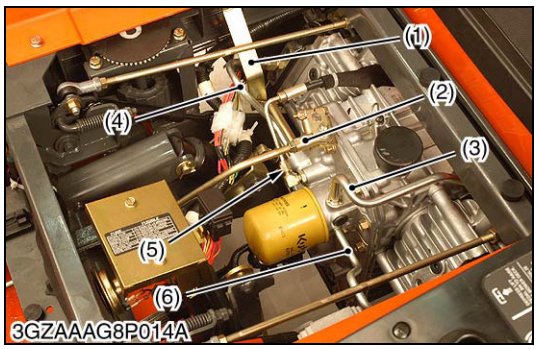
- **Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.**
  Keep the engine at medium speed for a few minutes to insure proper lubrication of all parts so there is no damage to transmission.
- **Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system.**
  Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-7.)
- **Do not mix different brands oil together.**

Transmission fluid capacity	12.1 L 12.8 U.S.qts 10.6 Imp.qts

(1) Transmission Oil Filter
(2) Drain Plug
(3) Rear Axle Gear Case LH
(4) Oil Plug and Breather Cup
(5) Dipstick

A : Oil level acceptable within this range.

W1011712



PTO Clutch Link, Cylinder Hose, Oil Cooler Pipe and HST Charge Pipes

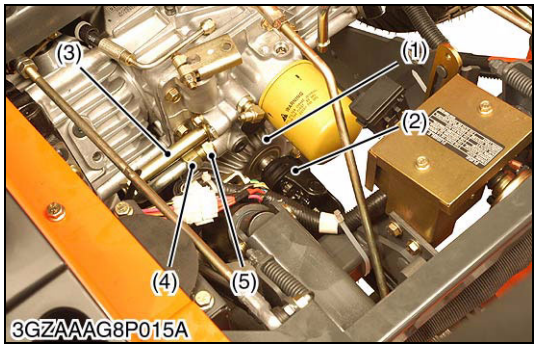
1. Remove the seat and seat base assembly.
2. Remove the PTO clutch link (1).
3. Remove the lift rod (2).
4. Disconnect the oil cooler pipe (3).
5. Remove the HST pipes (4), (6).
6. Disconnect the delivery pipe (5).

(When reassembling)

- Take care not to damage O-ring on the pipes.

(1) PTO Clutch Link
(2) Lift Rod
(3) Oil Cooler Pipe
(4) HST Pipe
(5) Delivery Pipe
(6) HST Pipe

W1011948



PTO Clutch Lever, Delivery Pipe, Pipe Fitting, Universal Joint and PTO Shaft Oil Seal

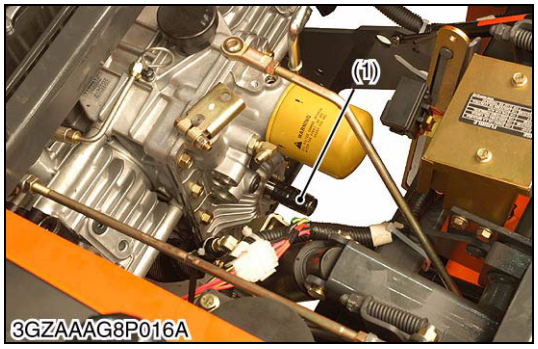
1. Disconnect the universal joint (2).
2. Remove the PTO shaft oil seal (1).
3. Remove the PTO clutch lever stopper, and remove the PTO clutch lever (3).
4. Remove the delivery pipe (4) and pipe fitting (5).

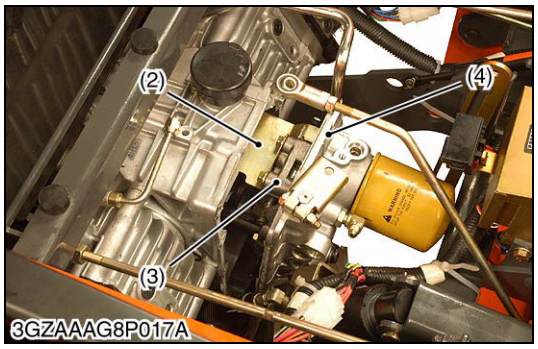
(When reassembling)

- Replace the PTO shaft oil seal (1) with new one.

(1) PTO Shaft Oil Seal
(2) Universal Joint
(3) PTO Clutch Lever
(4) Delivery Pipe
(5) Pipe Fitting

W1012409





Center Case Front Cover Assembly

1. Wrap the tape (1) around the PTO shaft to prevent it from damaging internally of the center case front cover.
2. Remove the center case front cover mounting screw, and separate the center case and center case front cover.
3. Remove the plate (2) from hydraulic control valve (3).
4. Remove the center case front cover assembly (4).

(When reassembling)

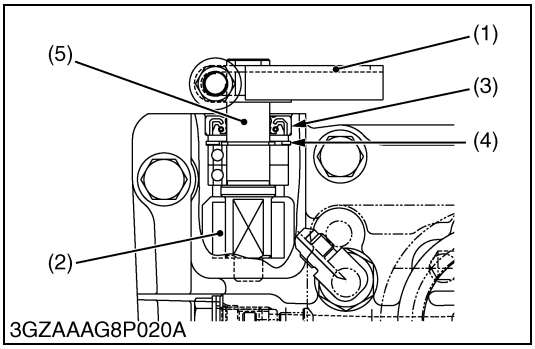
■ **NOTE**

- **Assemble the plate (2) as shown in the photo. If the plate (2) is mounted onto the valve first, the front cover (4) cannot be mounted onto the transmission center case.**
- **Apply liquid gasket (Three Bond 1208D or equivalent) to joint face of center case and center case front cover.**

Tightening torque	Center case front cover mounting screw	40 to 44 N·m 4.0 to 4.5 kgf·m 29 to 32 lbf·ft

(1) Tape
(2) Plate
(3) Hydraulic Control Valve
(4) Front Cover Assembly

W1012659



Lift Shaft and Arm

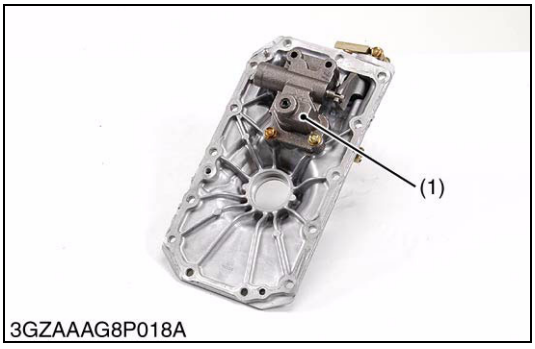
1. Remove the lift arm (1).
2. Remove the oil seal (3).
3. Remove the internal snap ring (4).
4. Remove the lift shaft (5) with ball bearings and remove the arm (2).

(When reassembling)

- Replace the oil seal (3) with new one.

(1) Lift Arm
(2) Arm
(3) Oil Seal
(4) Internal Snap Ring
(5) Lift Shaft

W1013210



Removing Hydraulic Control Valve

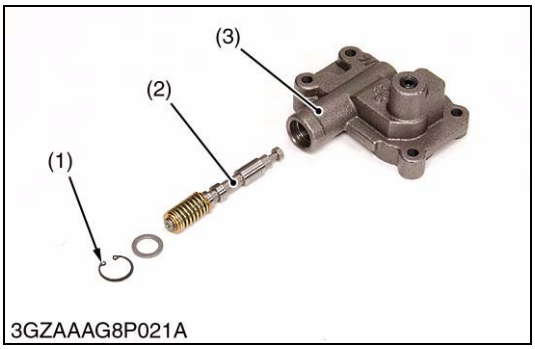
1. Remove the hydraulic control valve (1).

(When reassembling)

Tightening torque	Hydraulic control valve mounting screw	18 to 20 N·m 1.8 to 2.1 kgf·m 13 to 15 lbf·ft

(1) Hydraulic Control Valve

W1013586

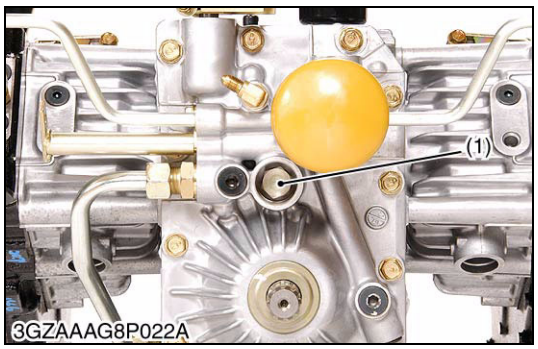


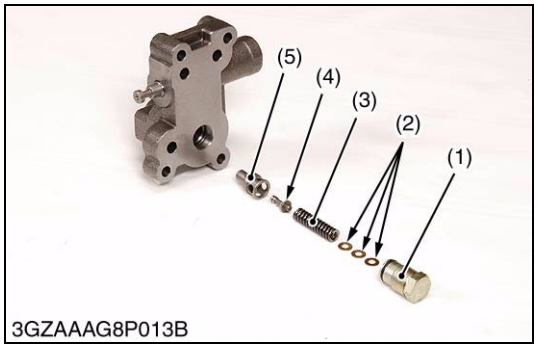
Spool

1. Remove the internal snap ring (1), and remove the spool (2).

(1) Internal Snap Ring
(2) Spool
(3) Valve Body

W1013761





Relief Valve

1. Remove the plug (1), and remove the shims (2), spring (3), poppet (4) and valve seat (5).

(When reassembling)

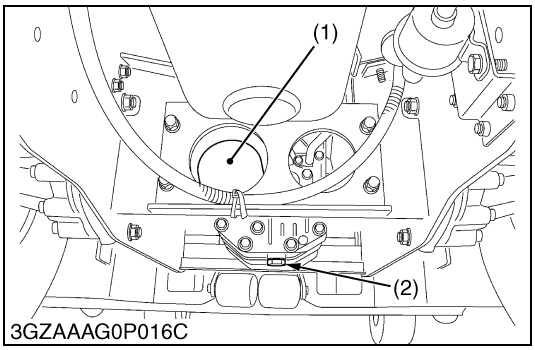
- Take care not to damage the O-ring on plug.

Tightening torque	Relief valve plug	49 to 68 N·m 5.0 to 7.0 kgf·m 37 to 50 lbf·ft

(1) Plug
(2) Shim
(3) Spring
(4) Poppet
(5) Valve Seat

W1013889

(3) Disassembling and Assembling the Hydraulic Pump



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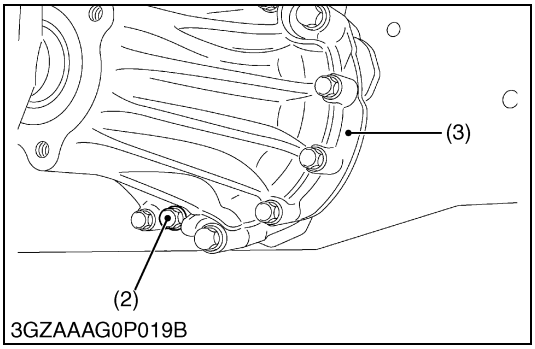

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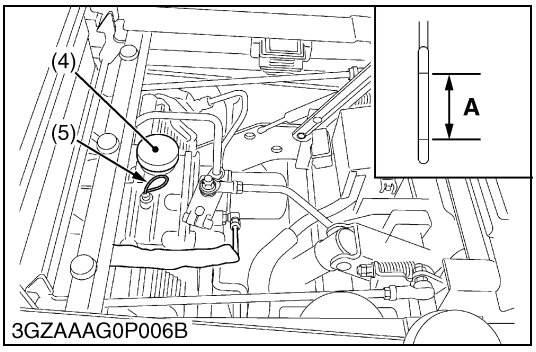

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Draining Transmission Fluid

CAUTION

To avoid personal injury :

- **Be sure to stop the engine and remove the key before changing or checking the oil.**
- **Allow transmission case to cool down sufficiently; oil can be hot and may cause burns.**

The fluid in the transmission case is also used for the hydrostatic drive system.

1. To drain the transmission oil, place oil pan underneath the transmission case and remove the drain plug at the bottom of the transmission case.
2. After draining, reinstall the drain plugs.
3. Measure a volume of draining oil and add new oil of the same volume as the draining oil first.

■ **IMPORTANT**

- **If takes time to have the oil poured from the transmission case reach the rear axle case (RH and LH). Pour the regulated amount of oil slowly.**

4. After running the engine for a few minutes, stop it and check the oil level again; add oil to the prescribed level.

■ **IMPORTANT**

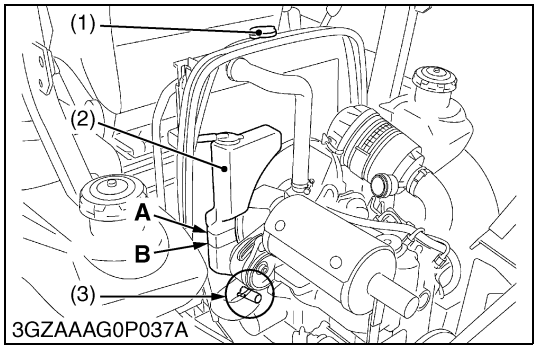
- **Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.**
  Keep the engine at medium speed for a few minutes to insure proper lubrication of all parts so there is no damage to transmission.
- **Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system.**
  Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-7.)
- **Do not mix different brands oil together.**

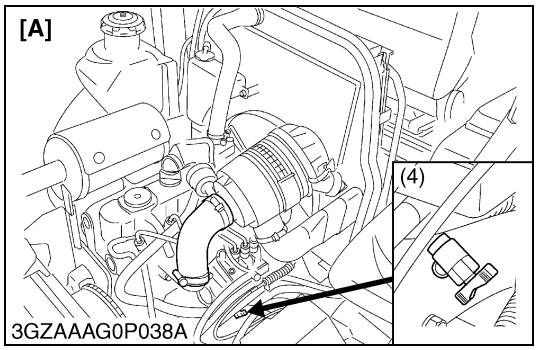
Transmission fluid capacity	18.0 L 19.02 U.S.qts 15.84 Imp.qts

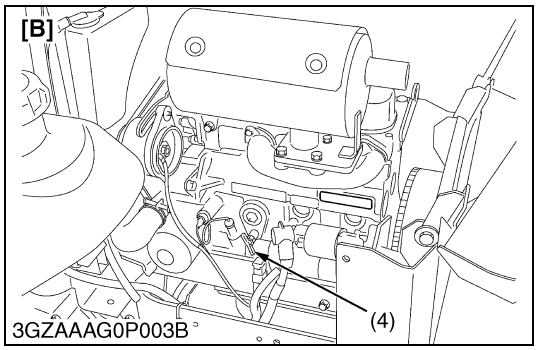
(1) Transmission Oil Filter
(2) Drain Plug
(3) Rear Axle Gear Case LH
(4) Oil Plug and Breather Cup
(5) Dipstick

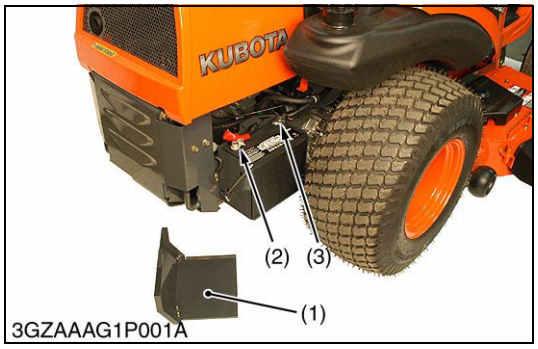
A : Oil level acceptable within this range.

W1034642









Draining Coolant

CAUTION

- **Never open the radiator cap while operating or immediately after stopping. Otherwise, hot water will spout out from the radiator. Wait for more than ten minutes to cool the radiator, before opening the cap.**

1. Stop the engine and let cool down.
2. Remove the radiator coolant drain plug (3) and engine coolant drain plug (4) to drain the coolant.
3. Remove the radiator cap (1) to completely drain the coolant.
4. After all coolant is drained, close the drain plugs.

Coolant	Capacity	ZD321 ZD326	Radiator	2.7 L 2.85 U.S.qts 2.38 Imp.qts
		ZD331	Radiator	3.5 L 3.70 U.S.qts 3.08 Imp.qts
		—	Recovery tank	0.25 L 0.26 U.S.qts 0.22 Imp.qts

(1) Radiator Cap
(2) Recovery Tank
(3) Radiator Coolant Drain Plug
(4) Engine Coolant Drain Cock

[A] ZD321
[B] ZD326, ZD331
A : FULL
B : LOW

W1019510

Battery

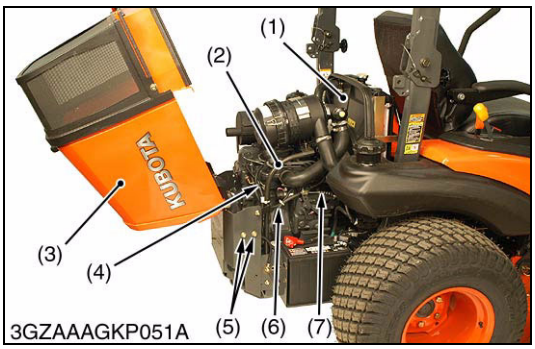
CAUTION

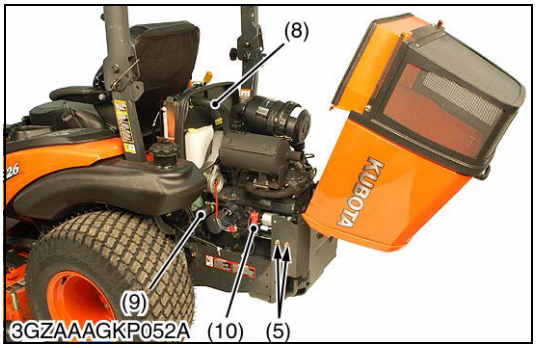
- **When disconnecting the battery cables, disconnect the negative cable from the battery first. When connecting, connect the positive cable to the battery first.**

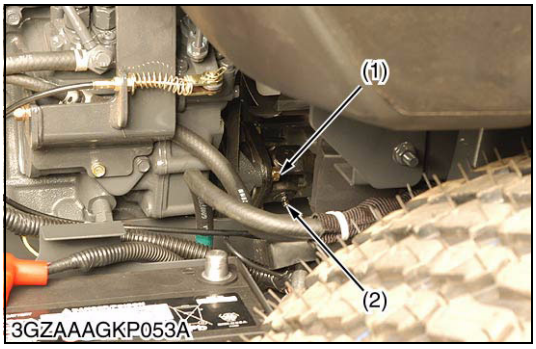
1. Remove the battery cover (1).
2. Disconnect the negative cable (3) from the battery.
3. Disconnect the positive cable (2) form the battery.

(1) Battery Cover
(2) Positive Cable
(3) Negative Cable

W1030653







Bonnet, Fuel Hose, Wiring Harness and Others

1. Remove the snap pin and bonnet mounting screw, then remove the bonnet (3).
2. Disconnect the wiring connectors for engine stop solenoid, glow plug, coolant temperature sensor, engine oil pressure switch and dynamo.
3. Remove the positive cable (10) from starter motor.
4. Disconnect the accelerator wire (7).
5. Remove the air cleaner support (2) (ZD326 and ZD331).
6. Disconnect the fuel hoses (6) from radiator.
7. Disconnect the water hoses (8), (9) and fan shroud (1).
8. Remove the engine stopper (5).

(When reassembling)

- When accelerator wire is installed, adjust the wiring length as hit both the idling speed adjusting bolt and the maximum speed adjusting bolt by lever within the stroke of the accelerator lever.

(1) Fan Shroud
(2) Air Cleaner Support
(3) Bonnet
(4) Wiring Harness
(5) Engine Stopper
(6) Fuel Hose
(7) Accelerator Wire (Throttle Cable)
(8) Upper Hose
(9) Lower Hose
(10) Positive Cable

W1030839

Separating Engine

1. Remove the universal joint mounting screws (1).
2. Disconnect the universal joint (2) from fun drive pulley.
3. Remove the engine mounting nuts.
4. Separate the engine.

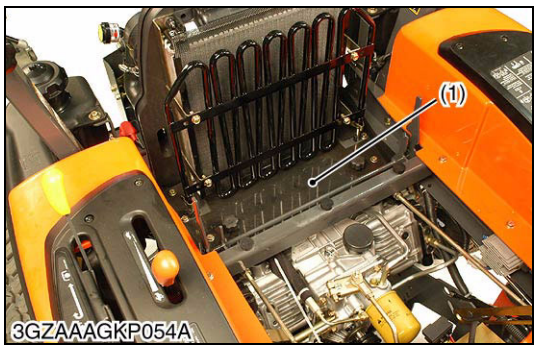
(When reassembling)

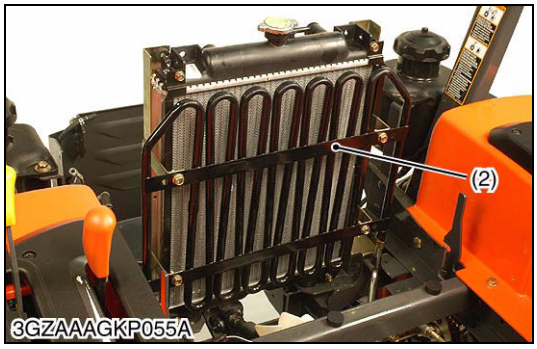
- Apply grease to the all splines on the drive shaft.

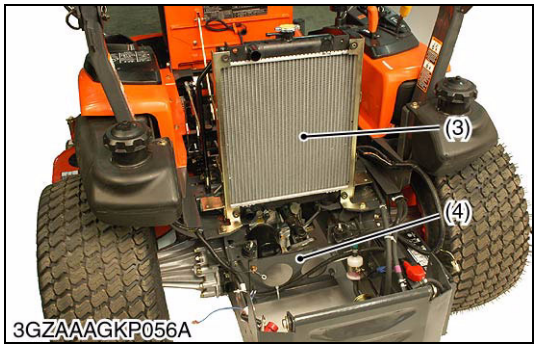
Tightening torque	Universal joint mounting screw	26.5 to 28.4 N·m 2.7 to 2.9 kgf·m 19.6 to 20.9 lbf·ft
	Engine mounting nut	24 to 27 N·m 2.4 to 2.8 kgf·m 18 to 20 lbf·ft

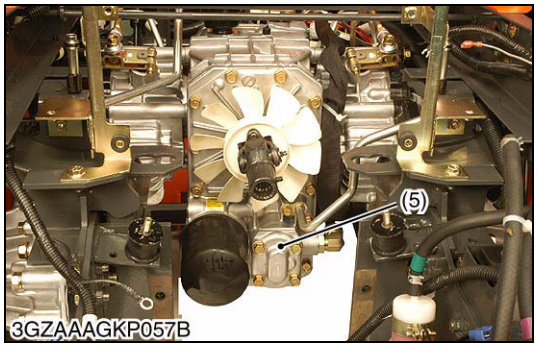
(1) Universal Joint Mounting Screw
(2) Universal Joint

W1014937









Oil Cooler, Radiator, Universal Joint and Removing Hydraulic Pump

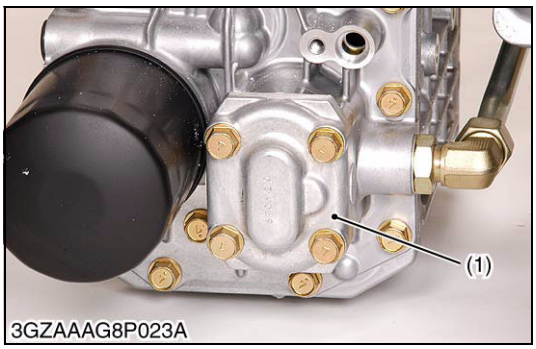
1. Remove the bonnet cover (1) and ROPS connecting plate.
2. Remove the oil cooler (2).
3. Remove the radiator (3).
4. Remove the ROPS connecting plate, under (4).
5. Remove the hydraulic pump (5).

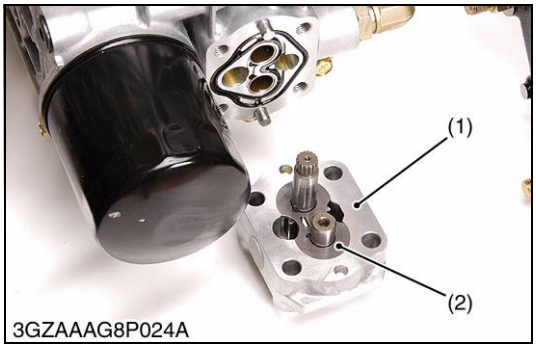
(When reassembling)

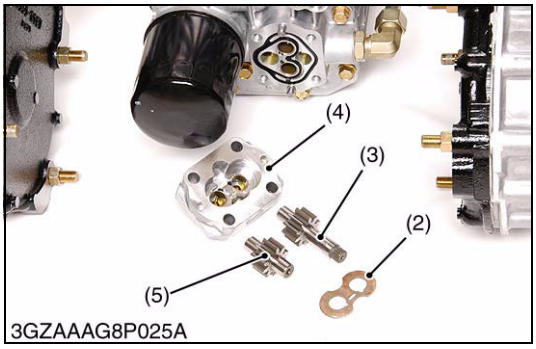
Tightening torque	ROPS connecting plate mounting screw (M8)	24 to 27 N·m 2.4 to 2.8 kgf·m 18 to 20 lbf·ft
	ROPS connecting plate, under mounting screw (M10)	48 to 55 N·m 4.9 to 5.7 kgf·m 36 to 41 lbf·ft
	Hydraulic pump mounting screw	40 to 44 N·m 4.0 to 4.5 kgf·m 29 to 32 lbf·ft

(1) Bonnet Cover
(2) Oil Cooler
(3) Radiator
(4) ROPS Connecting Plate, Under
(5) Hydraulic Pump

W1015122







Hydraulic Pump

1. Remove the hydraulic pump assembly (1).
2. Remove the side plate (2).
3. Remove the drive gear (3) and the driven gear (5) from the casing (4).

(When reassembling)

- Take care not to damage the O-ring.
- Align the holes of the cover and casing.
- Install the side plate, noting its location and direction.
- Install the gears, noting its direction.

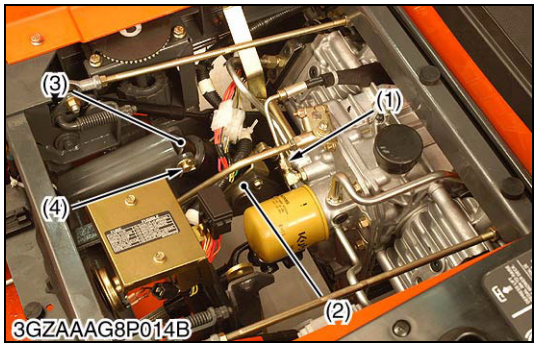
Tightening torque	Cover mounting screw	35 to 39 N·m 3.5 to 4.0 kgf·m 26 to 28 lbf·ft

(1) Hydraulic Pump Assembly
(2) Side Plate
(3) Drive Gear
(4) Casing
(5) Driven Gear

W1015712

[2] LIFTING LINKAGE

(1) Disassembling and Assembling

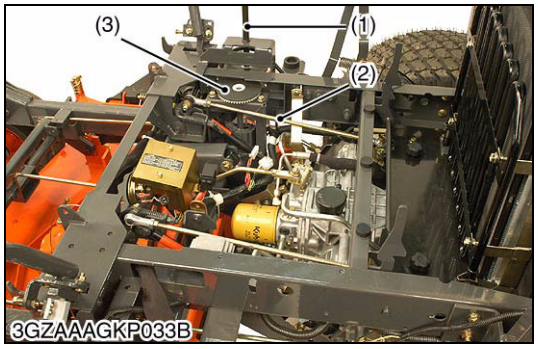


Removing Lift Cylinder

1. Disconnect the cylinder hose (1).
2. Remove the clevis pin (4).
3. Remove the cylinder bracket (2), and remove the bushings.
4. Remove the lift cylinder (3) with cylinder hose (1).

(1) Cylinder Hose
(2) Cylinder Bracket
(3) Lift Cylinder
(4) Clevis Pin

W1016241



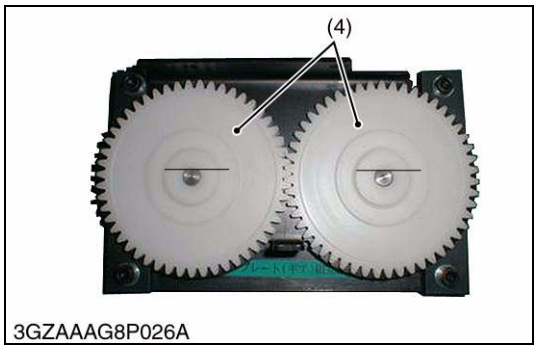
Dial Cam Gear

1. Remove the cam rod (1).
2. Remove the dial cam gear assembly (2).
3. Remove the gear cover (3).
4. Remove the dial cam gears (4).

(When reassembling)

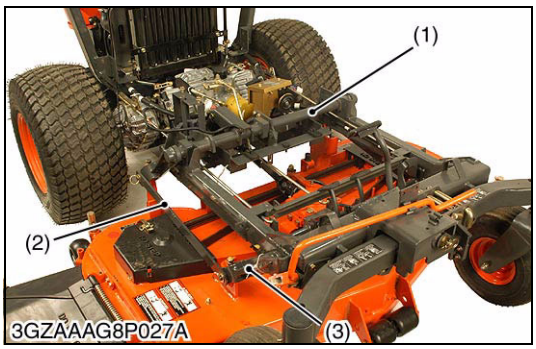
■ **NOTE**

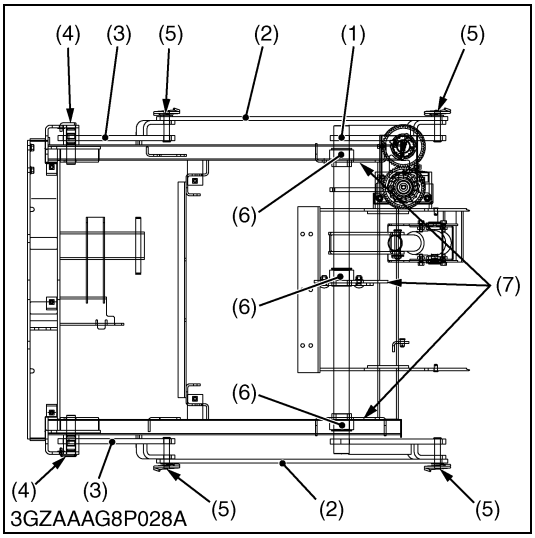
- **When assembling the dial cam gear, align the gear notch as shown in photo.**



(1) Cam Rod
(2) Cam Gear Assembly
(3) Gear Cover
(4) Dial Cam Gear

W1016436





Mower Linkage

1. Remove the clevis pins (5) and horizon plate (2).
2. Remove the front pin (4) and front arm (3).
3. Remove the clevis pin, and disconnect the lift shaft (1) and lift cylinder.
4. Remove the plates (7) and lift shaft (1) with bushings (6).

(When reassembling)

- Apply grease to front pins (4).

(1) Lift Shaft
(2) Horizon Plate
(3) Front Arm
(4) Front Pin
(5) Clevis Pin
(6) Bushing
(7) Plate

W1016668

5 ELECTRICAL SYSTEM

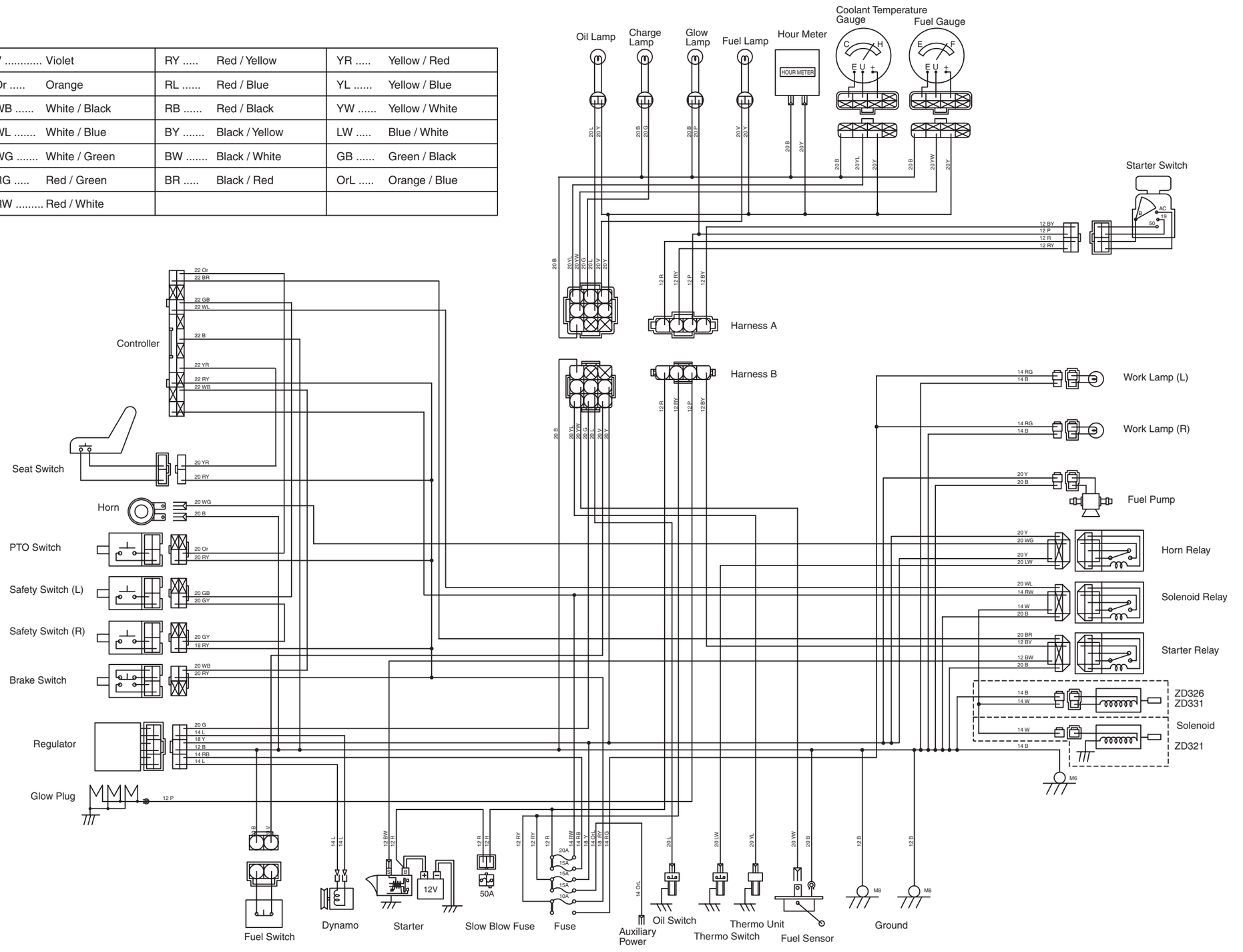
MECHANISM

CONTENTS

1. WIRING DIAGRAM

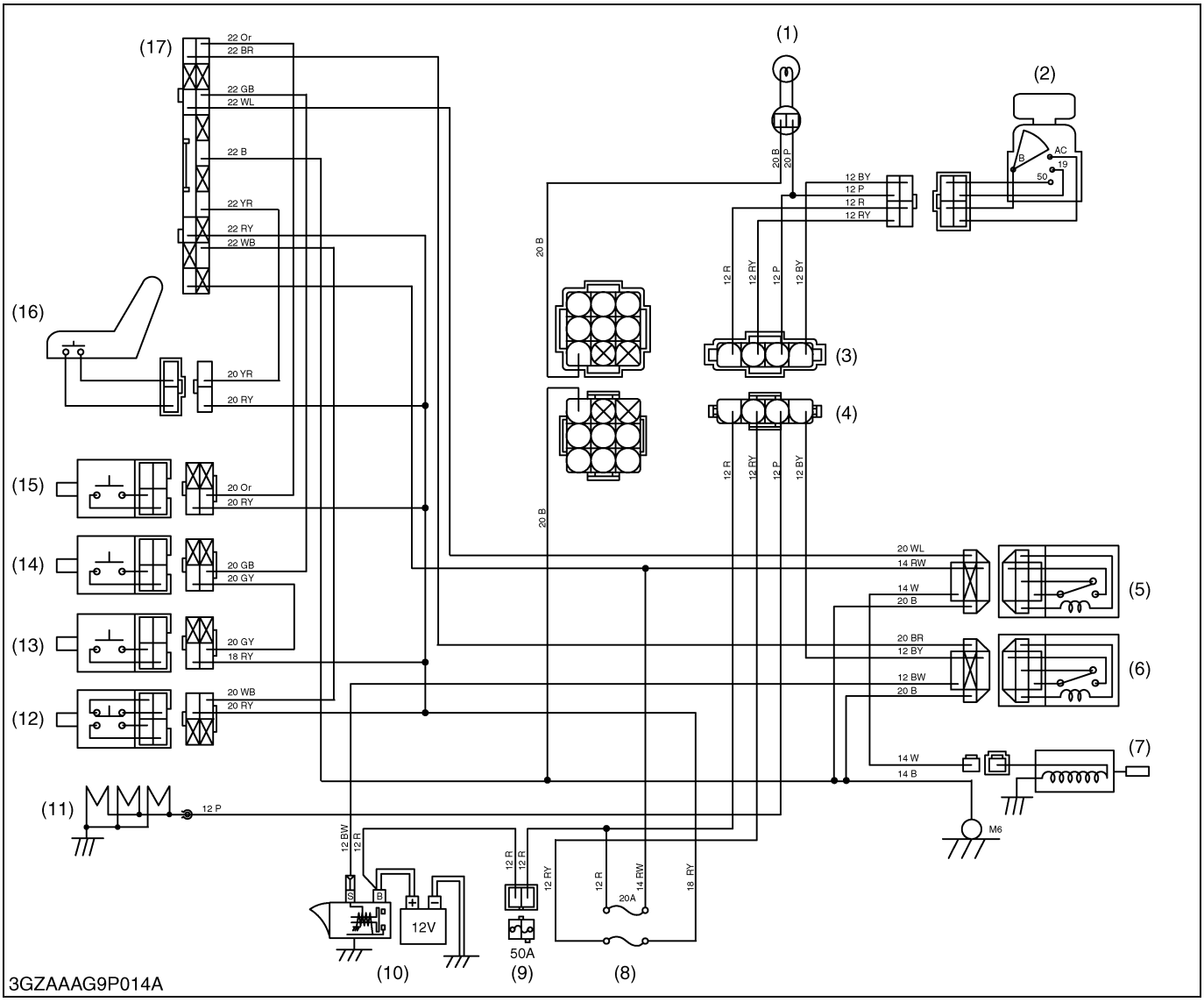
Color of Wiring

W .....White	V ..... Violet	RY ..... Red / Yellow	YR ..... Yellow / Red
R ..... Red	Or ..... Orange	RL ..... Red / Blue	YL ..... Yellow / Blue
L ..... Blue	WB ..... White / Black	RB ..... Red / Black	YW ..... Yellow / White
P ..... Pink	WL ..... White / Blue	BY ..... Black / Yellow	LW ..... Blue / White
B ..... Black	WG ..... White / Green	BW ..... Black / White	GB ..... Green / Black
G ..... Green	RG ..... Red / Green	BR ..... Black / Red	OrL ..... Orange / Blue
Y ..... Yellow	RW ..... Red / White		



3GZAAAG9P013A

2. STARTING SYSTEM



(1) Glow Lamp
(2) Starter Switch
(3) Harness A
(4) Harness B
(5) Solenoid Relay
(6) Starter Relay
(7) Solenoid
(8) Fuse
(9) Slow Blow Fuse
(10) Starter
(11) Glow Plug
(12) Brake Switch
(13) Safety Switch (RH)
(14) Safety Switch (LH)
(15) PTO Switch
(16) Seat Switch
(17) Controller

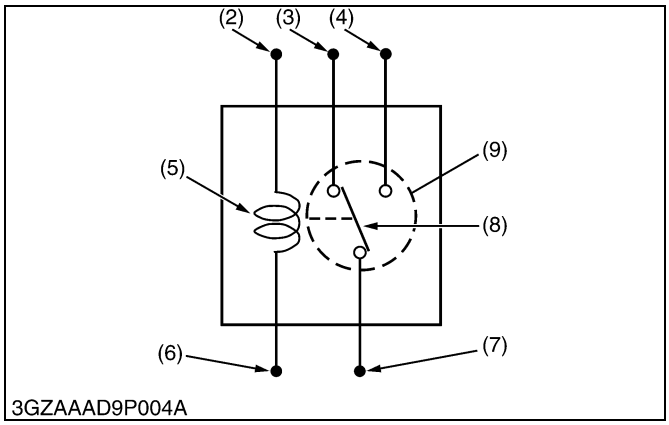
When the main switch is turned to the **PREHEAT** position, the terminal **30** is connected to the terminals **19** and **AC**. The glow plugs become red-hot, and the preheat indicator lamp also lights on while preheating.

When the main switch is then turned to the **START** position with the safety switches on, the terminal **30** is connected to the terminals **50** and **AC**. Consequently, battery current flows to the starter motor and start the engine.

The main switch automatically returns to the **ON** position, the terminal **30** is connected only to the terminal **AC**, thereby causing the starting circuit to be opened, stopping the starter motor.

When the main switch turned from the **ON** position to the **OFF** position, the fuel cut-off solenoid moves the fuel injection pump control rack to the **"No Fuel Injection"** position and stop the engine.

[1] RELAY



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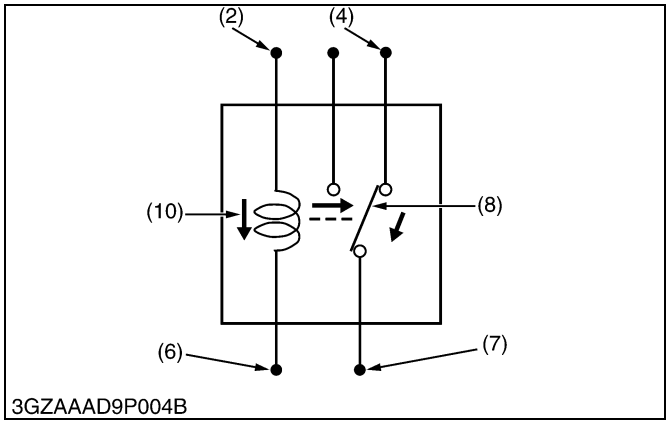

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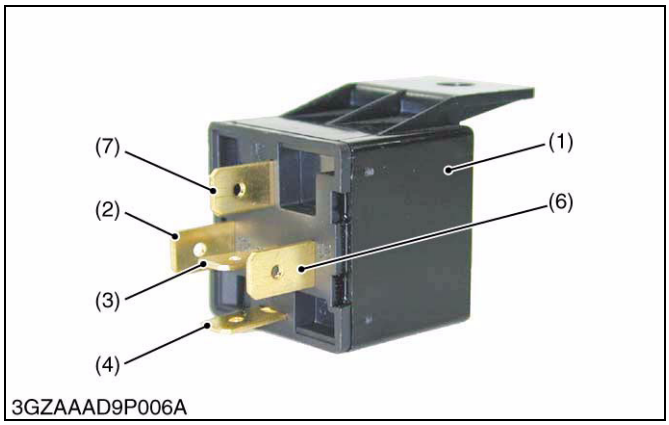


3GZAAAD9P006A

■ Relay

Relay (1) basically consists of relay winding (2) and mechanical contact points (9).

Current flowing from switch to relay winding (5) cause **"ON (Close)"** or **"OFF (Open)"** of mechanical contact points (9).

When current is applied to the winding (energized) (10), a magnetic field pushes the contact lever (8) and normally open terminal is connected.

Function of relay (1) is to control current to be controlled in circuit from distant place (switch location place).

Another function of relay (1) is to control large current by small current.

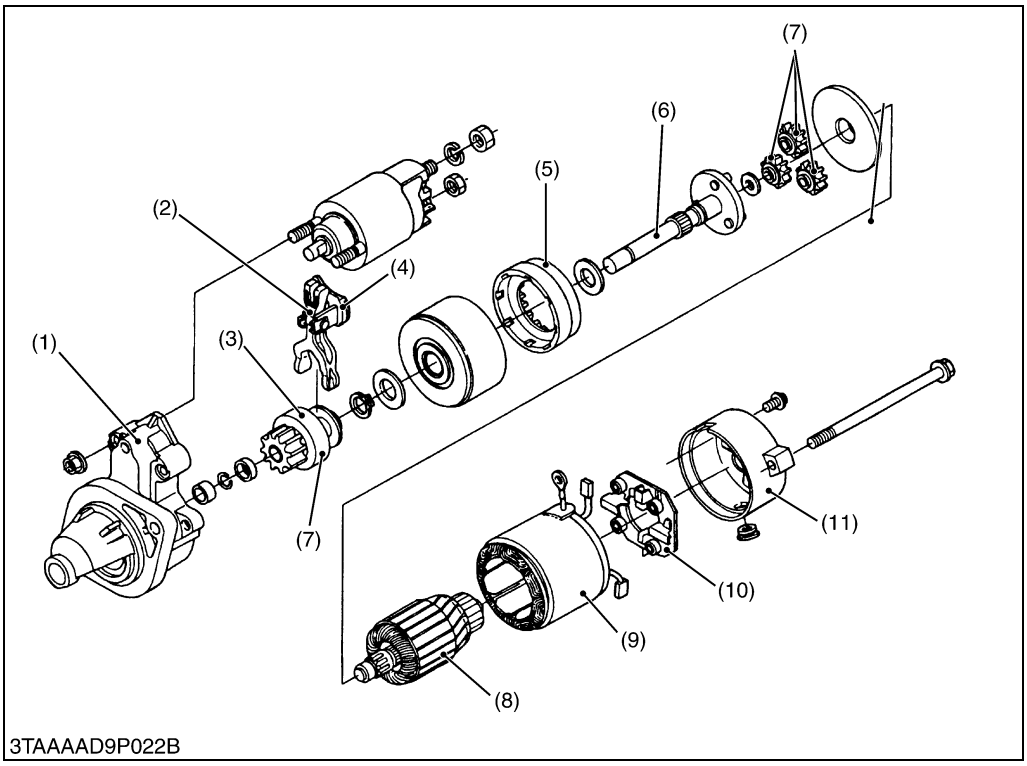
function of each relay are as follows.

- Relay 1 : Relay to horn (overheat alarm relay)
- Relay 2 : Relay to start engine (starter relay)
- Relay 3 : Relay to stop engine (solenoid relay)

(1) Relay
(2) **85** Terminal
(3) **87** Terminal
(4) **87** Terminal
(5) Relay Winding
(6) **86** Terminal
(7) **30** Terminal
(8) Contact Lever
(9) Mechanical Contact Points
(10) Winding (Energized)

W1016715

[2] STARTER



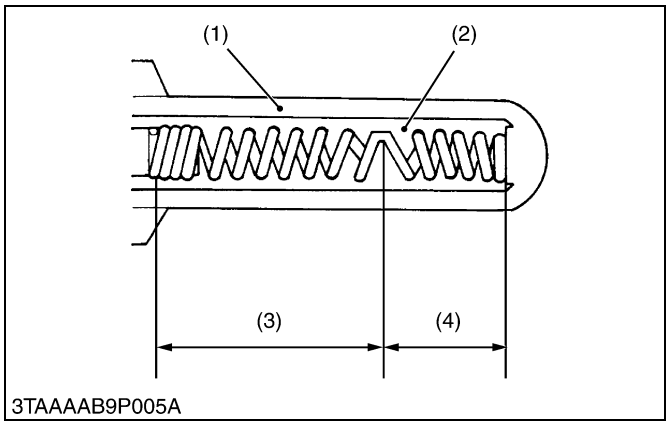
3TAAAAD9P022B

(1) Housing
(2) Magnetic Switch
(3) Overrunning Clutch
(4) Drive Lever
(5) Internal Gear
(6) Gear Shaft
(7) Planetary Gear
(8) Armature Shaft
(9) Yoke
(10) Brush Holder
(11) Rear End Holder

W1012893

The reduction system is used planetary gears, and the speed of gear shaft (6) is reduced to approximately one fifth of the armature shaft (8).

[3] GLOW PLUG



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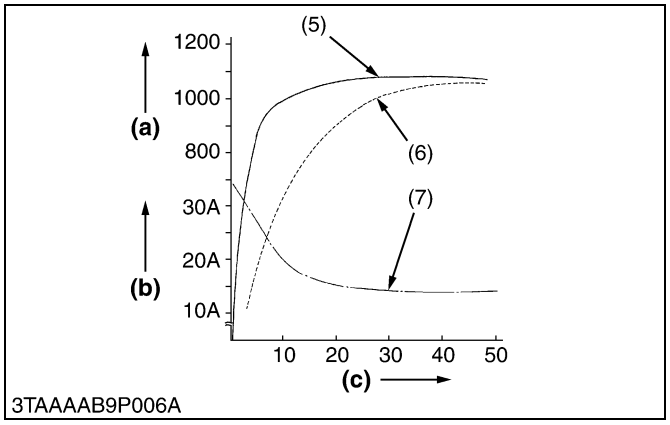


3TAAAAB9P006A

This plug is a two-material type QGS (Quick Glow System) for quick temperature rise, and has self-controlling function as well as excellent durability.

The heater (4) connected in series to the heater (3), which also functions as the resistor, is incorporated in the sheath tube (1) of the super glow plug.

The resistance of this heater (3) cum resistor is small when the temperature is low, while the resistance becomes large when the temperature rises.

Therefore, because sufficient current is flown to the heater (4) during the initial period of energization, the temperature rises quickly and the resistance grows with the rise in the temperature of the resistor, the flowing current is reduces to prevent the heater (4) from being heated.

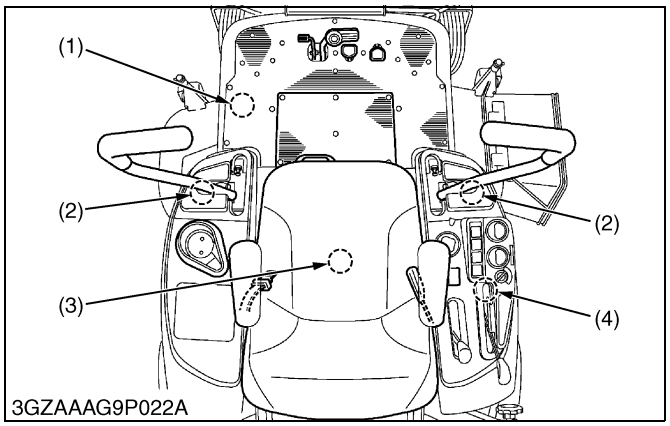
The ignition point is in the area of 2 to 3 mm (0.079 to 0.118 in.) from the tip of the plug in order to reduce its projection into the combustion chamber.

(1) Sheath Tube
(2) Insulation Powder
(3) Heater also functioning as a Resistor
(4) Heater
(5) Super Glow Plug
(6) Conventional Quick-heating type Glow Plug
(7) Glow Plug Current

(a) Glow Plug Temperature (°C)
(b) Current (A)
(c) Time (Sec.)

W1013021

[4] SAFETY SWITCH



3GZAAAG9P022A

Switches are located at the motion control levers, at the parking brake pedal, at the PTO lever and under the operator's seat.

Function of switch is to control current from main switch to relay.

Switches are changed to **"CLOSE"** or **"OPEN"** electrically by changing the motion control levers, or sitting on the operator's seat or engaging the parking brake.

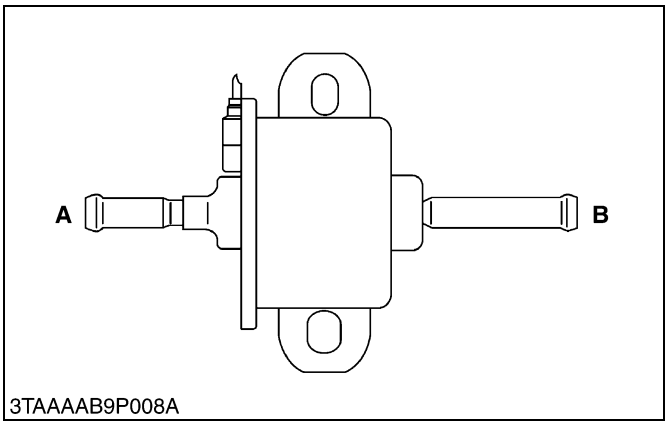
By selecting either normally open or normally closed contact, the switch function is determined.

Safety switch	Type
Seat switch	Normally open
PTO lever switch	Normally open
Parking brake switch	Normally close
Motion control lever (LH) switch	Normally open
Motion control lever (RH) switch	Normally open

(1) Parking Brake Switch
(2) Motion Control Lever Switch
(3) Seat Switch
(4) PTO Lever Switch

W1013337

[5] FUEL PUMP



3TAAAAB9P008A

An electro magnetic fuel pump uses a transistor that causes the pump to start pumping fuel when the main switch is turned to the **"ON"** position.

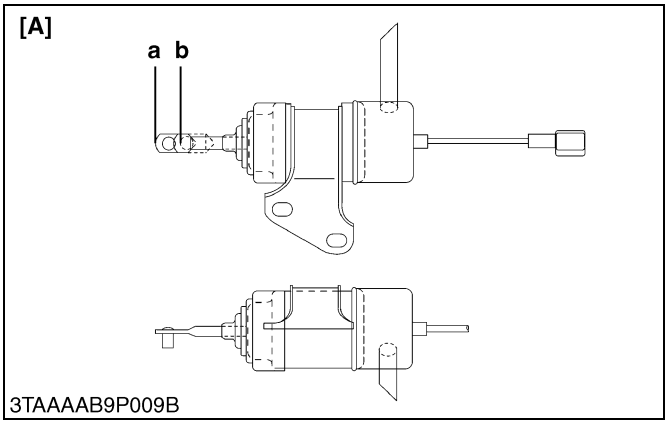
Therefore, fuel is supplied to the fuel injection pump regardless of engine speed. This pump is driven by the battery. It can therefore be operated even with the engine being stopped.

A : Inlet **B : Outlet**

W1013306

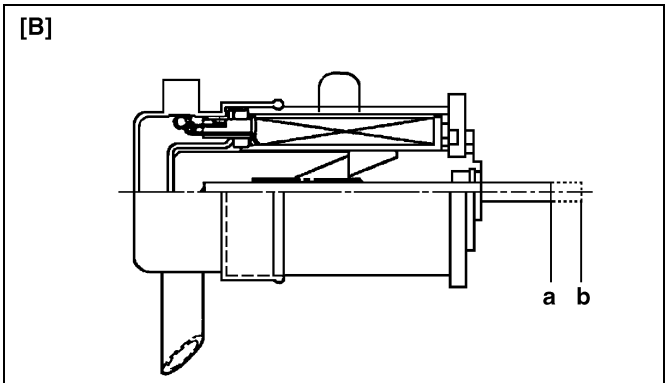
[6] ENGINE STOP SOLENOID

[A]



3TAAAAB9P009B

[B]



3GZAAAG9P015A

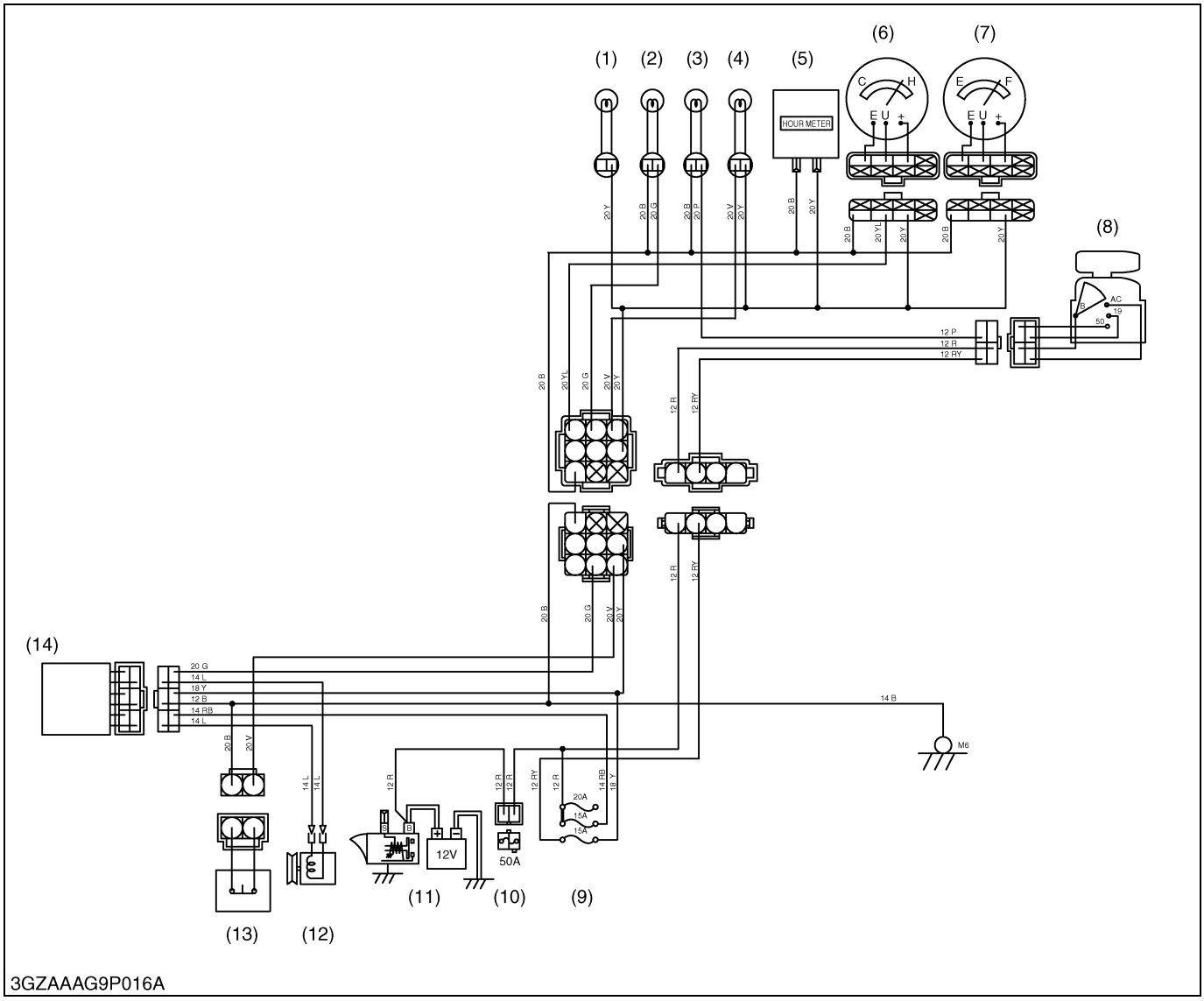
Controller is provided to actuate the engine stop solenoid approx. 10 seconds to stop after the main switch is turned from **ON** position to **OFF** position.

Flowing of the battery current into the coil while the controller's timer works attracts the plunger to actuate the stop lever or control rack of the injection pump. When the battery current stops, the plunger is returned to the original position by the spring.

a : ON **[A] ZD321**
b : OFF **[B] ZD326, ZD331**

W1013394

3. CHARGING SYSTEM



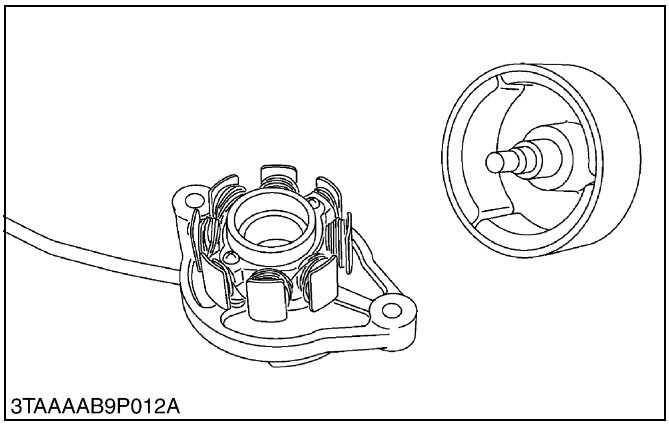
3GZAAAG9P016A

(1) Oil Lamp
(2) Charge Lamp
(3) Glow Lamp
(4) Fuel Lamp
(5) Hour Meter
(6) Coolant Temperature Gauge
(7) Fuel Gauge
(8) Starter Switch
(9) Fuse
(10) Slow Blow Fuse
(11) Starter
(12) Dynamo
(13) Fuel Switch
(14) Regulator

The charging system supplies electric power for various electrical devices and also charges the battery while the engine runs.

It consists of a AC dynamo and a regulator.

[1] AC DYNAMO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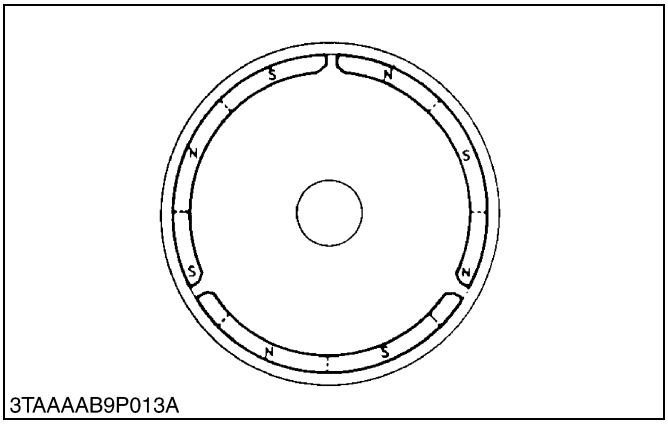


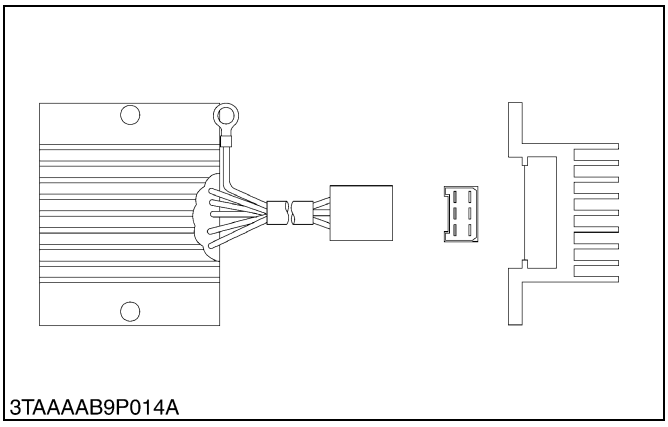
3TAAAAB9P013A

The dynamo is an 8-8 pole rotating magnet type generator. It is simple in construction, consisting of a stator and rotor. The rotor is made up of eight permanent magnet pole pieces assembled on a shaft and rotates on the center of the stator around which eight electromagnetic coils are provided for.

This dynamo produces higher voltage in slow speed rotation, and charges electric current to the battery during engine idling.

W1013535

[2] REGULATOR


3TAAAAB9P014A

The regulator performs rectification and voltage regulation.

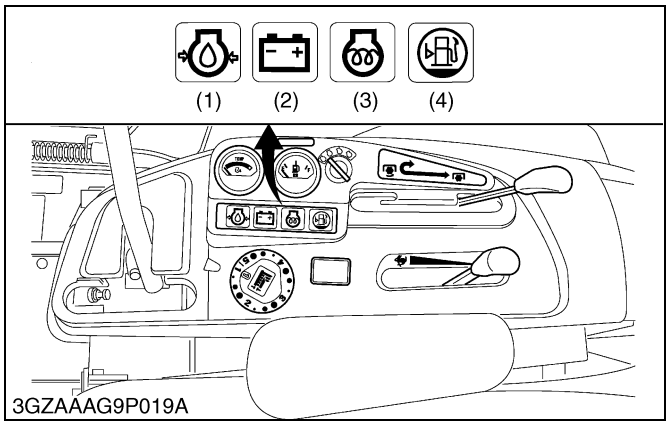
The regulator converts AC into DC which flows through the power consuming circuits and the battery, and also charges the battery.

If however, the battery voltage exceeds a certain level, the DC current is cut off from the charging circuit to prevent overcharging.

W1013678

[3] EASY CHECKER

To check the conditions of tractor easily before and during operation, easy checker combination of lamps on the easy checker board is provided.



3GZAAAG9P019A

■ Indication Items

(1) Oil Pressure Lamp

When the engine oil pressure is low, this lamp illuminates.

(2) Charge Lamp

When the charging system is not functioning properly, this lamp illuminates.

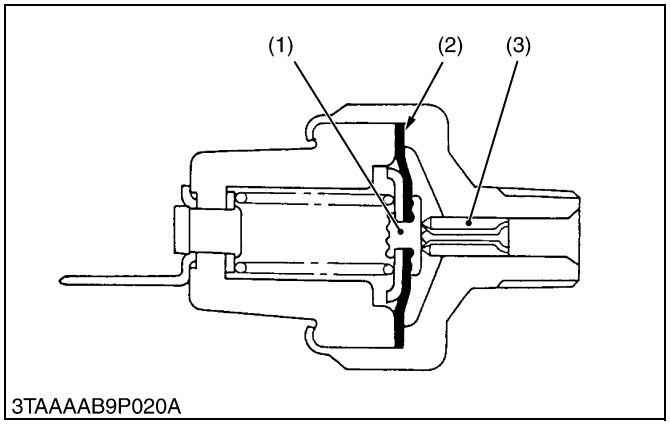
(3) Pre-heat Indicator Lamp

When the key switch is in the **"Pre-heat"** position, the pre-heat indicator lamp illuminates.

(4) Fuel Lamp

When the fuel in the RH tank goes below the prescribed level, the fuel level warning lamp illuminates.

W1013747



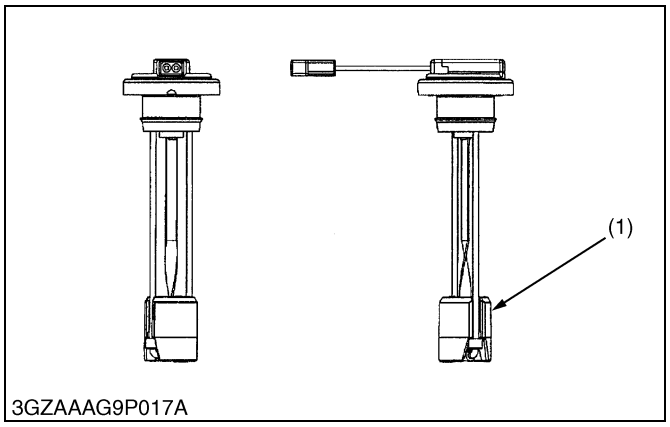
3TAAAAB9P020A

■ Oil Pressure Switch

While oil pressure is high and the force applied to the diaphragm (2) is larger than the spring tension, the terminal contact (1) is open separated from the body contact (3). If the pressure drops below approx. 49 kPa (0.5 kgf/cm^2, 7.1 psi), the contact closes.

(1) Terminal Contact
(2) Diaphragm
(3) Body Contact

W1013868



3GZAAAG9P017A

■ Fuel (Lamp) Switch

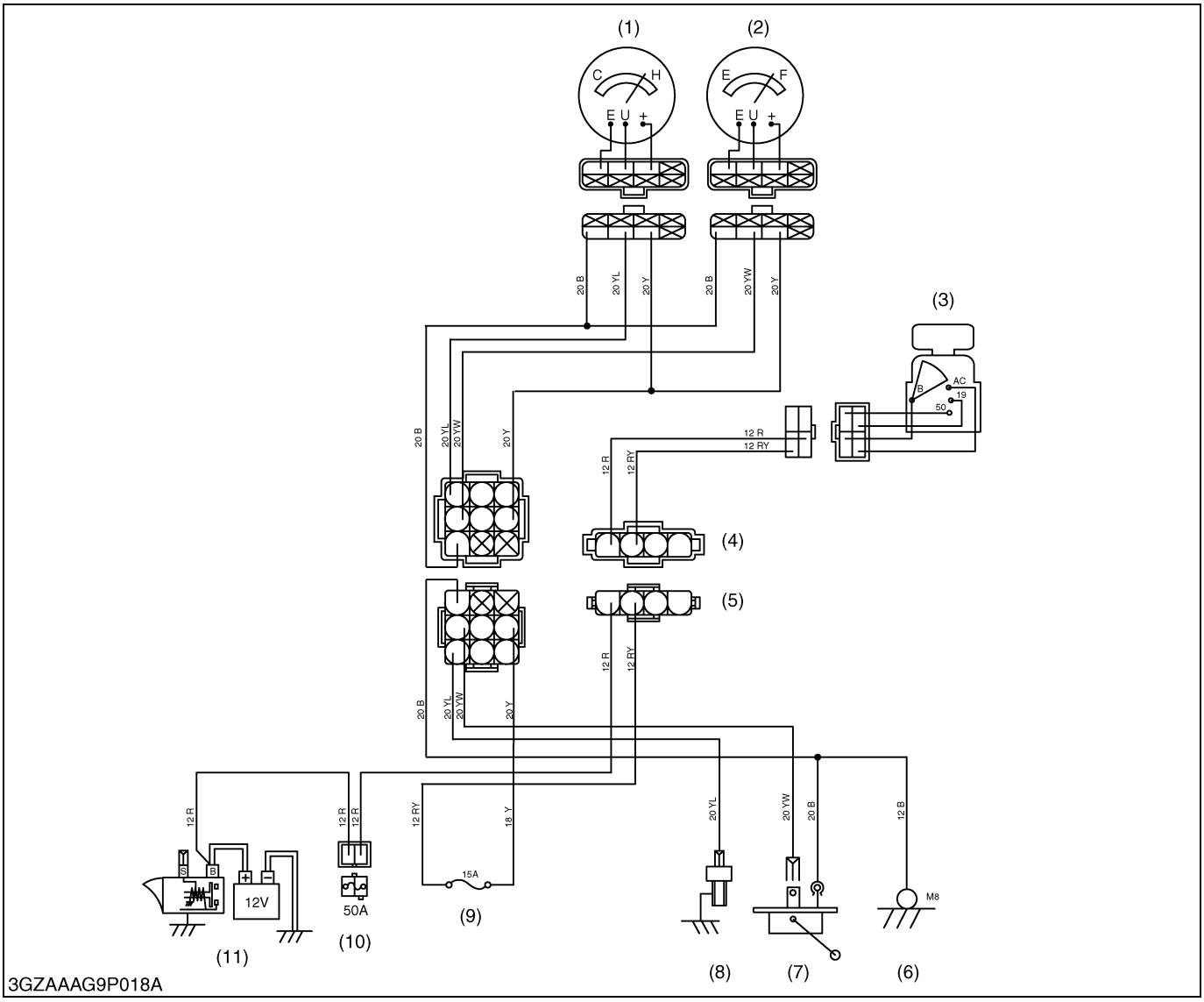
The switch is close when falling more than the prescribed level with the float (1).

When the amount of the remainder in the RH fuel tank becomes 9.0 L (2.38 U.S.gals, 1.98 Imp.gals) or less, the switch is turned on.

(1) Float

W1014853

4. GAUGES

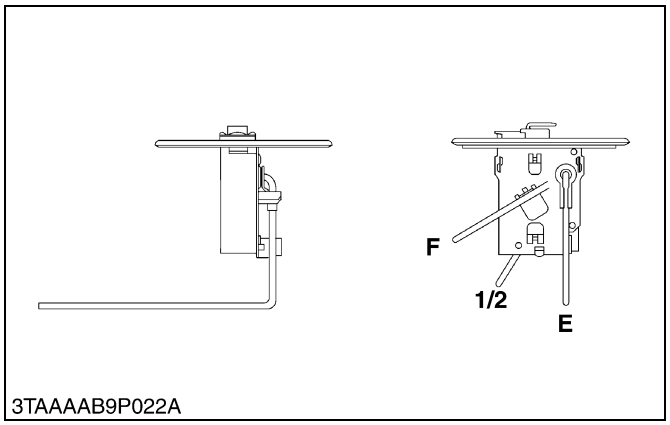


3GZAAAG9P018A

(1) Coolant Temperature Gauge
(2) Fuel Gauge
(3) Starter Switch
(4) Harness A
(5) Harness B
(6) Ground
(7) Fuel Sensor
(8) Thermo Unit
(9) Fuse
(10) Slow Blow Fuse
(11) Starter

The fuel quantity and coolant temperature are indicated by the ammeters. The ammeters indicate each amperage flowing through the fuel level sensor for the fuel quantity detection and through the coolant temperature sensor for the coolant temperature detection.

[1] FUEL QUANTITY



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■ Fuel Level Sensor

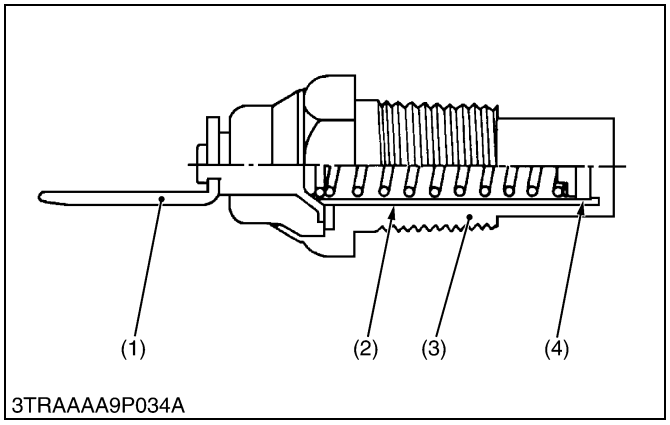
The remaining fuel quantity is detected by the fuel level sensor installed in the fuel tank and indicated on the fuel gauge. For detection, a float and a resistor are used.

As the float lowers, the resistance of the variable resistor varies. The relation between the amount of fuel and the resistance is as follows.

F	1/2	E (Remaining fuel of approx. 5.0 L, 1.32 U.S.gal., 1.10 Imp.gal.)
1 to 5 Ω	28.5 to 36.5 Ω	103 to 117 Ω

W1013985

[2] COOLANT TEMPERATURE



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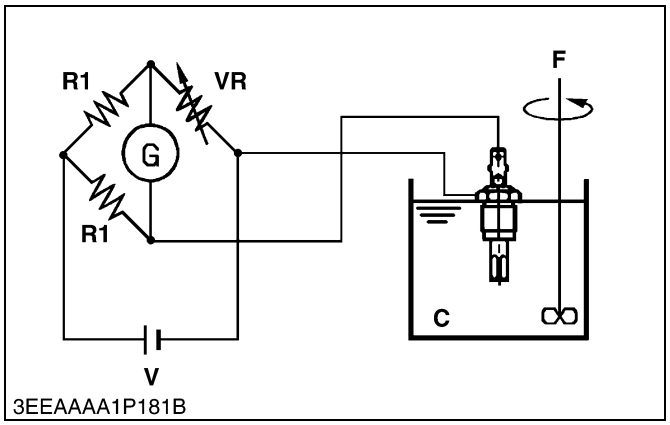

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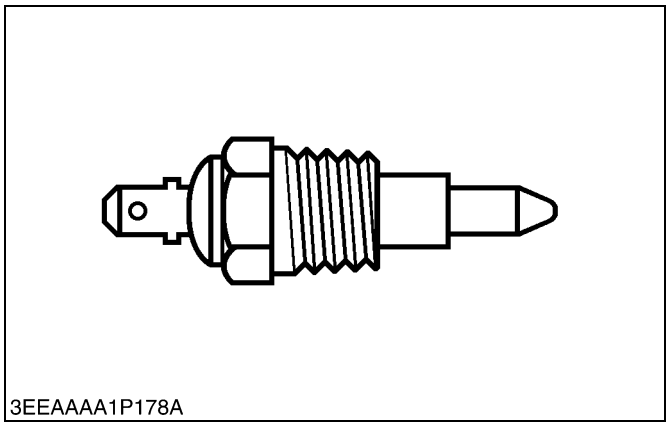

3EEAAAA1P178A

■ Coolant Temperature Sensor (Thermo Unit)

The coolant temperature sensor is installed to the cylinder head of engine, and its tip is in touch with the coolant. It contains a thermistor (4) whose electrical resistance decreases as the temperature increases.

Current varies with changes in the coolant temperature, and the increases or decreases in the current move the pointer of gauge.

Characteristics of Thermistor		
Temperature	**Resistance of VR : ★**	**Condition**
50 °C (122 °F)	153.9 Ω	(A)
80 °C (176 °F)	51.9 Ω	
100 °C (212 °F)	27.4 Ω	
120 °C (248 °F)	16.1 Ω	

★ When galvarnometer shows 0 (Zero).

Condition	Setting Value
(A)	R1 : 54.945 to 55.055 Ω V : DC 6.9 to 7.1 V

(1) Terminal
(2) Insulator
(3) Body
(4) Thermistor

C : Coolant or Silicon Oil
G : Galvanometer
VR : Variable Resistor
F : Flow Velocity (0.14 to 0.15 m/s)

W1021761

■ Coolant Temperature Switch

The coolant temperature switch is installed to the water flange of engine, and its tip is in touch with the coolant.

The overheat alarm activates when the coolant temperature goes up more than the specified value.

When the coolant temperature falls below the specified value, the overheat alarm stops.

Characteristics of Coolant Temperature Switch		
Type	**Operation Temperature**	
	Horn operates	**Horn stops**
Normally open	120 to 126 °C (248 to 258 °F)	116 °C (241 °F)

W1020324

SERVICING

CONTENTS

1. TROUBLESHOOTING

Symptom	Probable Cause	Solution	Reference Page
All Electrical Equipments Do Not Operate	Battery discharged or defective	Recharge or replace	G-26
	Battery positive cable disconnected or improperly connected	Repair or replace	5-S5
	Battery negative cable disconnected or improperly connected	Repair or replace	5-S5
	Slow blow fuse blown	Replace	–
Fuse Blown Frequently	Short-circuited	Repair or replace	G-35

W1014322

BATTERY

Battery Discharges Too Quickly	Battery defective	Replace	G-25
	Dynamo defective	Replace	1-S32
	IC regulator defective	Replace	–
	Wiring harness disconnected or improperly connected (between battery positive terminal and regulator **B** terminal)	Repair or replace	–
	Cooling fan belt slipping	Adjust tension	G-27

W1013718

STARTING SYSTEM

Starter Motor Does Not Operate	Battery discharged or defective	Recharge or replace	G-27
	Slow blow fuse blown	Replace	G-35
	Safety switch defective	Replace	5-S10
	Wiring harness disconnected or improperly connected (between main switch **50** terminal and safety switches, between safety switches and starter motor, between battery positive terminal and starter motor)	Repair or replace	–
	Starter motor defective	Repair or replace	5-S19
	Main switch defective	Replace	–
Engine Does Not Stop When Main Switch Is Turned OFF	Fuse blown (20 A)	Replace	G-35
	Wiring harness disconnected or improperly connected (between main switch **AC** terminal and engine stop solenoid)	Repair or replace	–
	Engine stop solenoid defective	Replace	1-S32
	Controller defective	Replace	–
Engine Does Not Start	Engine stop solenoid defective	Replace	1-S32
	Controller defective	Replace	–

W1010823

CHARGING SYSTEM

Symptom	Probable Cause	Solution	Reference Page
Charging Lamp Does Not Light When Main Switch Is Turned ON	Fuse blown (15 A)	Replace	G-35
	Wiring harness disconnected or improperly connected (between main switch **AC** terminal and panel board, between panel board and dynamo)	Repair or replace	–
	Dynamo defective	Repair or replace	1-S32, 5-S18
	Regulator defective	Replace	–
Charging Lamp Does Not Go Off When Engine Is Running	Wiring harness disconnected or improperly connected (between main switch **30** terminal and dynamo, between panel board and dynamo)	Repair or replace	–
	Dynamo defective	Repair or replace	1-S32, 5-S18
	Regulator defective	Replace	–

W1013580

GAUGES

Fuel Gauge Does Not Function	Fuel gauge defective	Replace	5-S16
	Fuel level sensor defective	Replace	5-S14
	Wiring harness disconnected or improperly connected (between fuel gauge and fuel level sensor)	Repair or replace	–
Coolant Temperature Gauge Does Not Function	Coolant temperature gauge defective	Replace	5-S15
	Coolant temperature sensor defective	Replace	5-S16
	Wiring harness disconnected or improperly connected (between coolant temperature gauge and coolant temperature sensor)	Repair or replace	–

W1011186

2. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
Battery	Voltage	More than 12 V	–
	Potential Difference	Less than 0.1 V	–
Glow Plug	Resistance	Approx. 0.9 Ω	–
Starter			
Commutator	O.D.	30.0 mm 1.181 in.	29.0 mm 1.142 in.
	Difference of O.D.'s	Less than 0.02 mm 0.0008 in.	0.05 mm 0.0020 in.
Mica	Undercut	0.50 to 0.80 mm 0.0197 to 0.0315 in.	0.20 mm 0.0079 in.
Brush	Length	14.0 mm 0.551 in.	9.0 mm 0.354 in.
AC Dynamo	Charging Current / Dynamo Speed	14 to 15 A / 5200 rpm	–
	Charging Voltage / Dynamo Speed	14 to 15 V / 5200 rpm	–

W1013874

3. TIGHTENING TORQUES

Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts : See page G-9.)

Item	N·m	kgf·m	lbf·ft
Starter (**B** terminal nut)	5.9 to 11.8	0.6 to 1.2	4.3 to 8.7
AC dynamo (Stator nut)	39.2 to 44.1	4.0 to 4.5	28.9 to 32.5

W1012736

4. CHECKING, DISASSEMBLING AND SERVICING

CAUTION

- **To avoid accidental short circuit, be sure to attach the positive cable to the positive terminal before the negative cable is attached to the negative terminal.**
- **Never remove the battery cap while the engine is running.**
- **Keep electrolyte away from eyes, hands and clothes. If you are spattered with it, wash it away completely with water immediately.**
- **Keep open sparks and flames away from the battery at all times. Hydrogen gas mixed with oxygen becomes very explosive.**

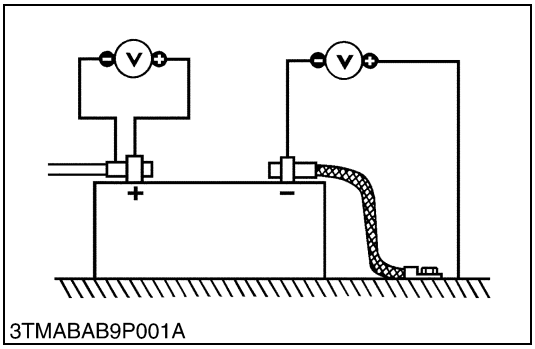
■ IMPORTANT

- **If the machine is to be operated for a short time without battery (using a slave battery for starting), use additional current (lights) while engine is running and insulate terminal of battery. If this advice is disregarded, damage to alternator and regulator may result.**

[1] CHECKING

(1) Battery

3GZAAAG9P001A



3TMABAB9P001A

Battery Voltage

1. Stop the engine and turn the main switch off.
2. Connect the COM (–) lead of the voltmeter to the battery's negative terminal post and the (+) lead to the positive terminal post, and measure the battery voltage.
3. If the battery voltage is less than the factory specification, check the battery specific gravity and recharge the battery.

Battery voltage	Factory spec.	More than 12 V

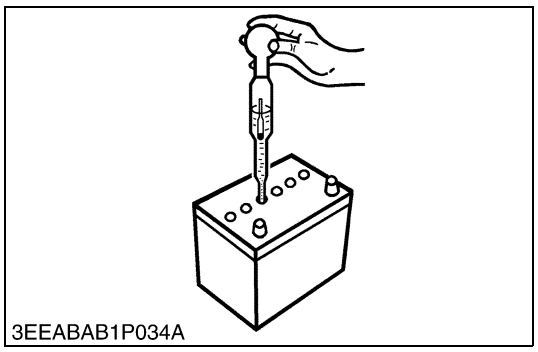
W1015335

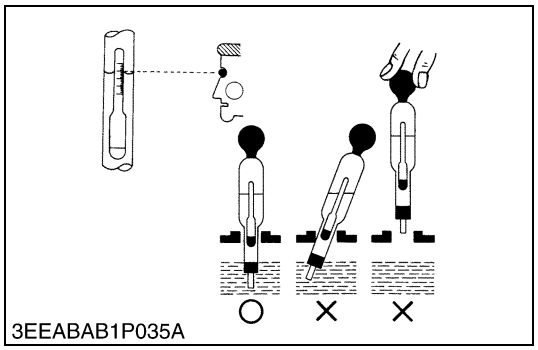
Battery Terminal Connection

1. Turn the main switch on, and turn on the head light.
2. Measure the voltage with a voltmeter across the battery's positive terminal post and the cable terminal, and the voltage across the battery's negative terminal post and the chassis.
3. If the measurement exceeds the factory specification, clean the battery terminal posts and cable clamps, and tighten them firmly.

Potential difference	Factory spec.	Less than 0.1 V

W1015435


3EEABAB1P034A


3EEABAB1P035A

Battery Specific Gravity

1. Check the specific gravity of the electrolyte in each cell with a hydrometer.
2. When the electrolyte temperature differs from that at which the hydrometer was calibrated, correct the specific gravity reading following the formula mentioned in **(Reference)**.
3. If the specific gravity is less than 1.215 (after it is corrected for temperature), charge or replace the battery.
4. If the specific gravity differs between any two cells by more than 0.05, replace the battery.

■ **NOTE**

- **Hold the hydrometer tube vertical without removing it from the electrolyte.**
- **Do not suck too much electrolyte into the tube.**
- **Allow the float to move freely and hold the hydrometer at eye level.**
- **The hydrometer reading must be taken at the highest electrolyte level.**

(Reference)

- Specific gravity slightly varies with temperature. To be exact, the specific gravity decreases by 0.0007 with an increase of 1 °C (0.0004 with an increase of 1 °F) in temperature, and increases by 0.0007 with a decreases of 1 °C (0.0004 with a decrease of 1 °F).

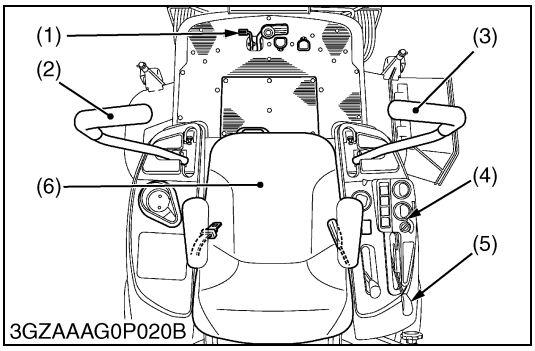
  Therefore, using 20 °C (68 °F) as a reference, the specific gravity reading must be corrected by the following formula:
  - Specific gravity at 20 °C = Measured value + 0.0007 × (electrolyte temperature – 20 °C)
  - Specific gravity at 68 °F = Measured value + 0.0004 × (electrolyte temperature – 68 °F)

Specific Gravity	State of Charge
1.260 Sp. Gr.	100 % Charged
1.230 Sp. Gr.	75 % Charged
1.200 Sp. Gr.	50 % Charged
1.170 Sp. Gr.	25 % Charged
1.140 Sp. Gr.	Very Little Useful Capacity
1.110 Sp. Gr.	Discharged

At an electrolyte temperature of 20 °C (68 °F)

W1015530

(2) Safety Switches



Method of Inspecting Each Control

A defective location can be judge by checking function of each safety switch one by one as shown in the table below.

(Reference)

- Type of Safety Switch
  Parking Brake Lever … Normal Close
  Motion Control Lever … Normal Open
  PTO Lever …… Normal Open
  Operator Seat … Normal Open

(1) Parking Brake Lock Pedal
(2) Motion Control Lever (LH)
(3) Motion Control Lever (RH)
(4) Key Switch
(5) PTO Lever
(6) Operator Seat

W1016450

Combination	State of set such as operation levers					Control operation	
	Motion control lever (LH)	Motion control lever (RH)	PTO lever	Parking brake pedal	Operator seat	Automatic engine stop	Engine start (Right or wrong)
1	Parking position (Neutral)	Parking position (Neutral)	Off position	Lock position	On the seat	Keep running**	Possible
2					Leave the seat*		Impossible
3				Release position*	On the seat		
4			On position*	Lock position			
5		Operating position*	Off position			Stop few seconds later	
6	Operating position*	Parking position					

* In this part, the safety switch is a position of off. And it is a checked place.
** In this part, the voltage of the terminal of the engine stop solenoid is 0 V.

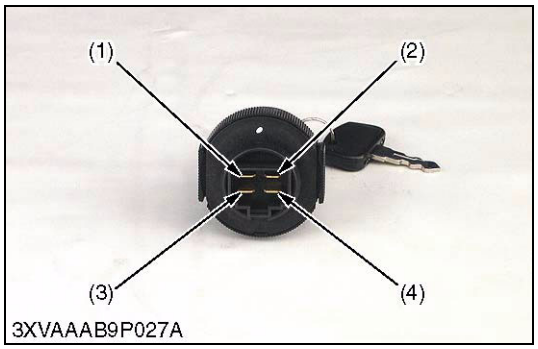
W1016546

■ **How to read meaning from table above.**

After the engine start, for instance,

1. If the engine does not stop in combination 2 when leaving the seat, the seat safety switch is bad. Moreover, the engine cannot be started without as every sitting on the seat.
2. If the engine starts with the parking brake released at combination 3, the parking brake safety switch is bad.
3. If the engine starts in combination 4 when the PTO lever is **ON** position, the PTO lever switch is bad.
4. If the engine starts in combinations 5 and 6 when the motion control lever is a **Operating** position, the motion control lever safety switch is bad. Moreover, the engine stops if the parking pedal is not released within two seconds after the engine starts.

(3) Main Switch



Main Switch Continuity

1) Main Switch Key at OFF Position

1. Set the main switch **OFF** position.
2. Measure the resistance with an ohmmeter across the **B** terminal and the **ACC** terminal, **B** terminal and **ST** terminal, **B** terminal and **G** terminal.
3. If infinity is not indicated, the contacts of the main switch are faulty.

Resistance	**B** terminal – **ACC** terminal	Infinity
	B terminal – **ST** terminal	
	B terminal – **G** terminal	

2) Main Switch Key at ON Position

1. Set the main switch **ON** position.
2. Measure the resistance with an ohmmeter across the **B** terminal and the **ACC** terminal.
3. If 0 ohm is not indicated, the **B** – **ACC** contact of the main switch are faulty.

Resistance	**B** terminal – **ACC** terminal	0 Ω

3) Main Switch Key at PREHEAT Position

1. Set and hold the main switch key at the **PREHEAT** position.
2. Measure the resistance with an ohmmeter across the **B** terminal and the **G** terminal, and measure the resistance across the **B** terminal and the **ACC** terminal.
3. If 0 ohm is not indicated, these contacts of the main switch are faulty.

Resistance	**B** terminal – **G** terminal	0 Ω
	B terminal – **ACC** terminal	

4) Main Switch Key at START Position

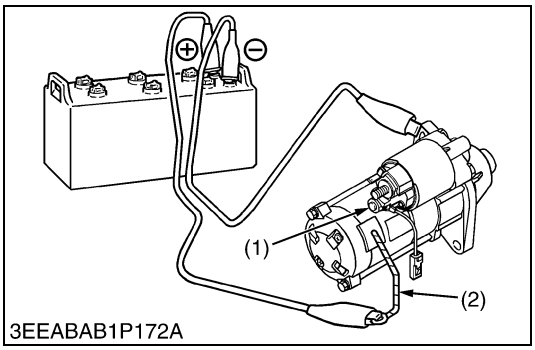
1. Set and hold the main switch key at the **START** position.
2. Measure the resistance with an ohmmeter across the **B** terminal and the **G** terminal, across the **B** terminal and the **ST** terminal, and across the **B** terminal and the **ACC** terminal.
3. If 0 ohm is not indicated, these contacts of the main switch are faulty.

Resistance	**B** terminal – **G** terminal	0 Ω
	B terminal – **ST** terminal	
	B terminal – **ACC** terminal	

(1) **G** Terminal
(2) **ACC** Terminal
(3) **ST** Terminal
(4) **B** Terminal

W10136580

(4) Starter



Motor Test

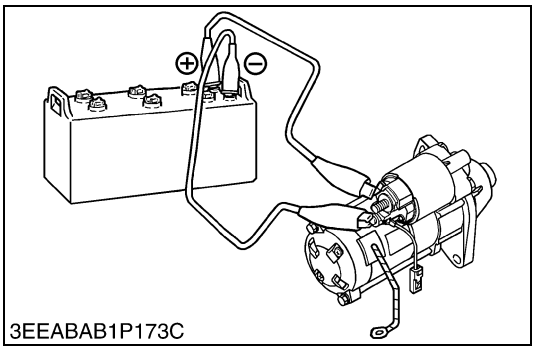
CAUTION

- **Secure the starter to prevent it from jumping up and down while testing the motor.**

1. Disconnect the battery negative cable from the battery.
2. Disconnect the battery positive cable and the leads from the starter.
3. Remove the starter from the engine.
4. Disconnect the connecting lead (2) from the starter **C** terminal (1).
5. Connect a jumper lead from the connecting lead (2) to the battery positive terminal post.
6. Connect a jumper lead momentarily between the starter motor housing and the battery negative terminal post.
7. If the motor does not run, check the motor.

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

W1018134



Magnet Switch Test (Pull-in, Holding Coils)

■ **NOTE**

- **Each test should be carried out for a start time (3 to 5 seconds), and at half of the rated voltage (6V)**

1) Checking Pull-in Coil

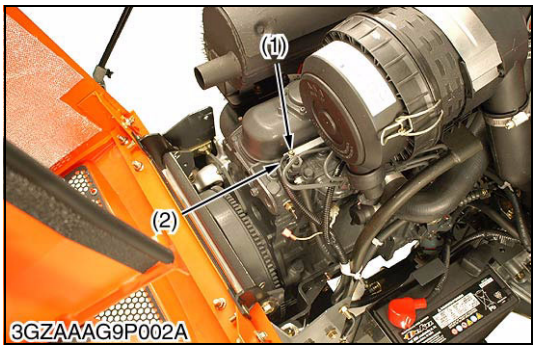
1. Connect jumper lead from the battery's negative terminal post to the **C** terminal.
2. The plunger should be attached strongly when a jumper lead is connected from the battery positive terminal to the **S** terminal.

2) Checking Holding Coil

1. Connect jumper leads from the battery's negative terminal post to the body and the battery's positive terminal post to the **S** terminal.
2. Push the plunger in by hand and release it. Then, the plunger should remain being attracted.

W1018490

(5) Glow Plug



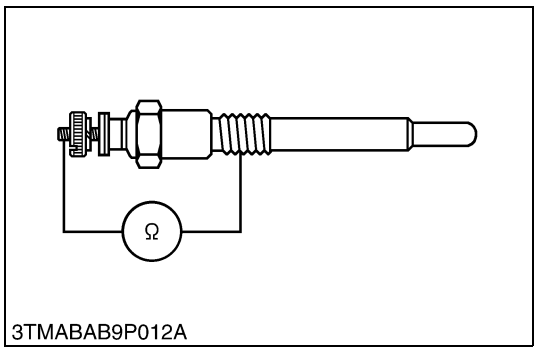
Lead Terminal Voltage

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 - Chassis)	Main switch key at **"PREHEAT"**	Approx. battery voltage
	Main switch key at **"START"**	Approx. battery voltage

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

W1018667



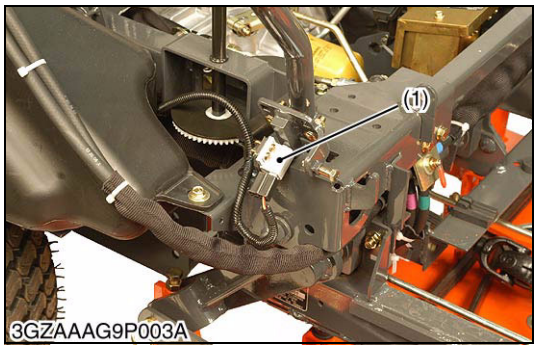
Glow Plug Continuity

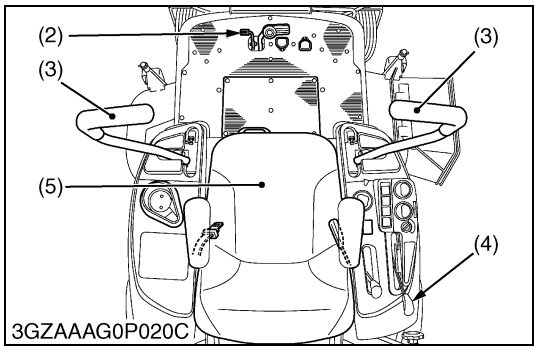
1. Disconnect the lead from the glow plugs.
2. Measure the resistance with an ohmmeter between the glow plug terminal and the chassis.
3. If 0 ohm is indicated, the screw at the tip of the glow plug and the housing are short-circuited.
4. If the factory specification is not indicated, the glow plug is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

Glow plug resistance	Factory spec.	Approx. 0.9 Ω

W1018992

(6) Safety Switch





Safety Switch Continuity

1. Remove the safety switch leads.
2. Connect the circuit tester to the safety switch leads.
3. Measure the resistance between leads.
4. If the safety switch is defective, replace it.

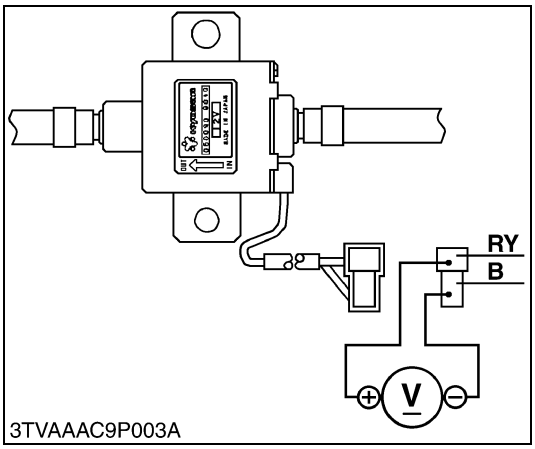
Resistance (Across switch terminal) · Motion control lever · PTO lever · Operator seat	When switch push is pushed	0 Ω
	When switch push is released	Infinity

Resistance (Across switch terminal) · Parking brake pedal	When actuator is pushed	Infinity
	When actuator is released	0 Ω

(1) Safety Switch
(2) Parking Brake Lock Pedal
(3) Motion Control Lever
(4) PTO Lever
(5) Operator Seat

W1019187

(7) Fuel Pump



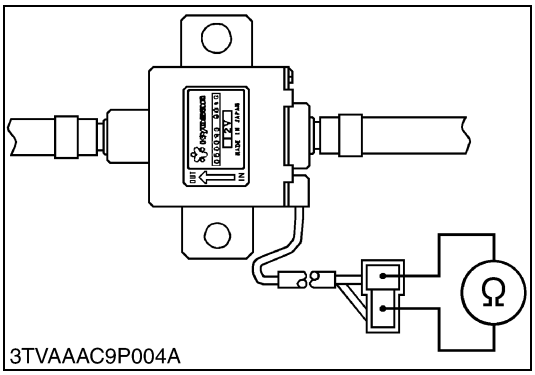
3TVAAAC9P003A

Connector Voltage

1. Disconnect the **2P** connector from the fuel pump.
2. Turn the main switch key to the **"ON"** position, and measure the voltage with a voltmeter between the connector terminals.
3. If the voltage differs from the battery voltage, the wiring harness or main switch is faulty.

Voltage	Between connector terminals	Approx. battery voltage

W1019413



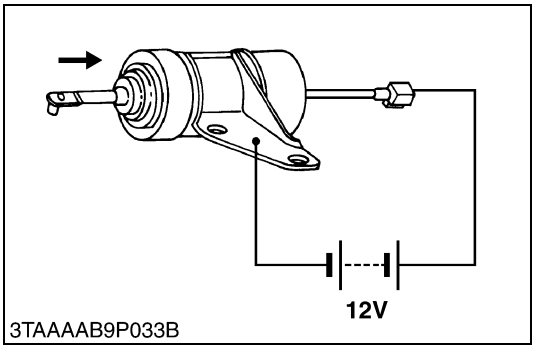
3TVAAAC9P004A

Fuel Pump Continuity

1. Disconnect the **2P** connector from the fuel pump.
2. Check the continuity between the connector terminals with an ohmmeter.
3. If it does not conduct, the fuel pump is faulty.

W1019534

(8) Engine Stop Solenoid



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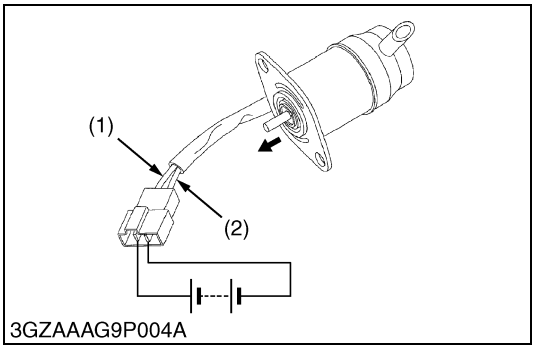


3GZAAAG9P004A

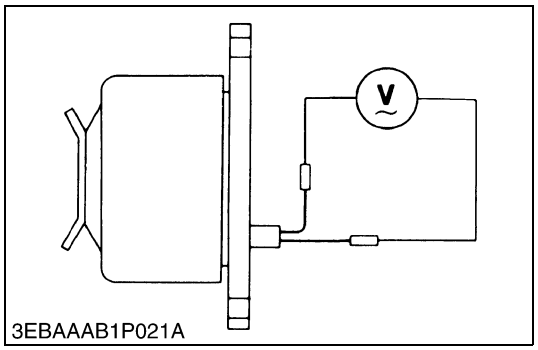
Engine Stop Solenoid Test

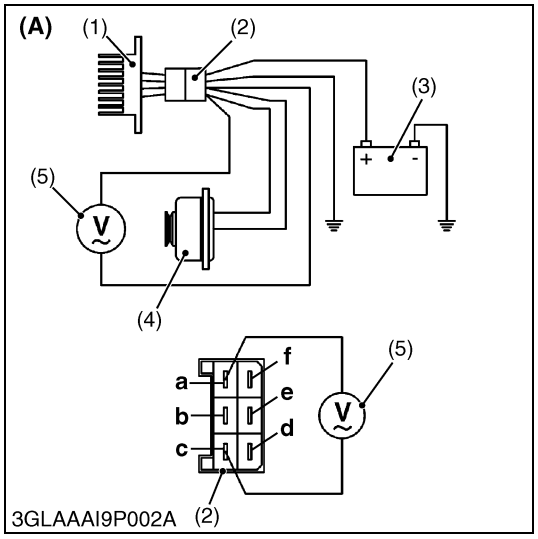
1. Disconnect the connector from the engine stop solenoid.
2. Remove the engine stop solenoid from the engine.
3. Connect the jumper leads from the battery positive terminal to the connector, and from the battery negative terminal to the engine stop solenoid body.
4. If the solenoid plunger is not attracted, the engine stop solenoid is faulty.

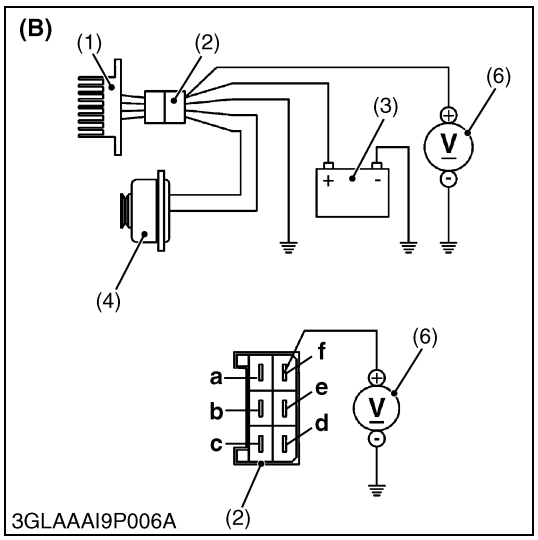
(1) White (2) Black

W1019658

(9) Charging System







No-load Dynamo Output

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

No-load output	Factory spec.	AC 20 V or more

W1048417

Regulation Voltage

CAUTION

- **To avoid personal injury, do not touch the rotating or hot parts while the engine is running.**

■ **NOTE**

- **Before performing this checking, make sure that the no-load dynamo output is proper.**
- **Complete the charging circuit with fully charged battery.**

1. Rum the engine at the rated speed.
2. Keeping the coupler (2) of regulator being connected, measure the voltage with a volt meter (5) across the terminal blue (**a**) and terminal blue (**c**). (Refer to figure **(A)**.)
3. If the measurement is not within the specified value, replace the wire harness between the dynamo (4) and regulator (1).
4. If the measurement is within the specified value, measure the voltage with a volt meter (6) across the terminal red (**f**) and chassis. (Refer to figure **(B)**.)
5. If the measurement is not within specified value, replace the regulator (1).

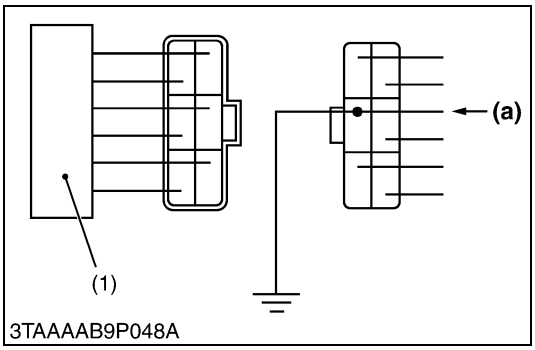
Voltage	Terminal blue (**a**) - Terminal blue (**c**)	AC 20 V or more
	Terminal red (**f**) - Chassis	DC 14 to 15 V

(1) Regulator
(2) Coupler
(3) Battery
(4) Dynamo
(5) Volt Meter (AC)
(6) Volt Meter (DC)

a : Terminal Blue
b : Terminal Black
c : Terminal Blue
d : Terminal Green
e : Terminal Yellow
f : Terminal Red

W1015722

(10) Lighting System

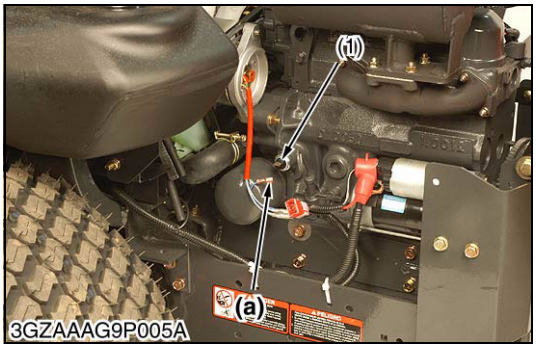


Charge Lamp (Charging Circuit)

1. Remove the under panel.
2. Disconnect the **6P** connector from the regulator after turning the main switch **OFF**.
3. Turn the main switch **ON** and connect a jumper lead from the wiring harness connector terminal (Black) to the chassis.
4. If the charge lamp does not light, the wiring harness or fuse is faulty.

(1) Regulator **(a) From Charge Lamp**

W1024567

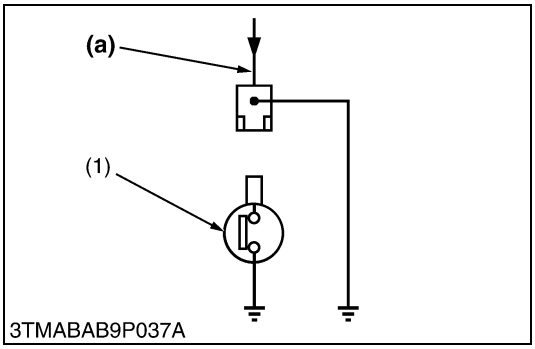


Engine Oil Pressure Lamp

1. Disconnect the lead from the engine oil pressure switch after turning the main switch **OFF**.
2. Turn the main switch **ON** and connect a jumper lead from the lead to the chassis.
3. If the engine oil pressure indicator lamp does not light, the wiring harness is faulty.

(1) Engine Oil Pressure Switch **(a) From Oil Pressure Lamp**

W1024686



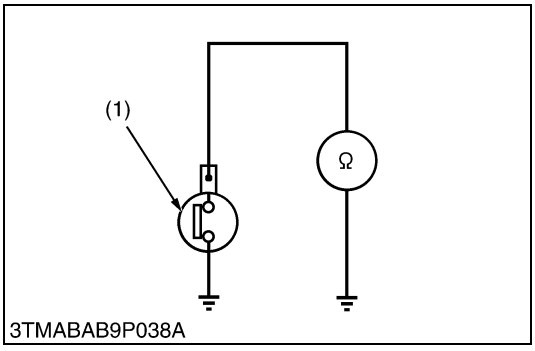
Engine Oil Pressure Switch Continuity

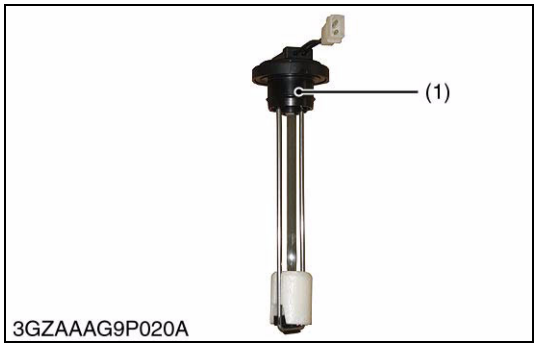
1. Measure the resistance with an ohmmeter across the switch terminal and the chassis.
2. If 0 ohm is not indicated in the normal state, the switch is faulty.
3. If infinity is not indicated at pressure over 4.9 kPa (0.5 kgf/cm^2, 7 psi), the switch is faulty.

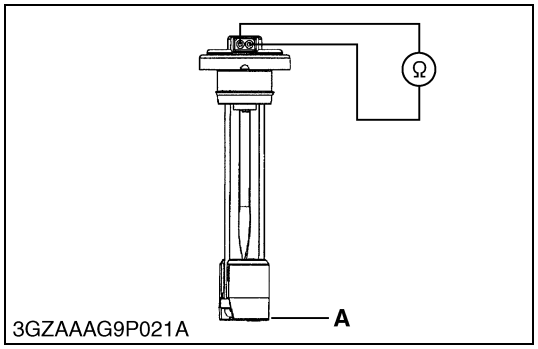
Resistance (Switch terminal - Chassis)	In normal state	0 Ω
	At pressure over approx. 4.9 kPa (0.5 kgf/cm^2, 7 psi)	Infinity

(1) Engine Oil Pressure Switch

W1024804







Fuel Lamp (Fuel Switch)

1) Switch Continuity

1. Remove the fuel switch from the RH fuel tank.
2. Measure the resistance with an ohmmeter across the sensor terminals.
3. If the reference values are not indicated, the sensor is faulty.

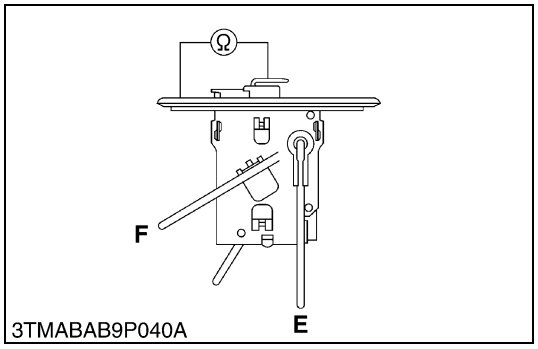
Resistance	Reference value	Float at not lower-most position	Infinity
		Float at lower-most position	Approx. 5 Ω

(1) Fuel Level Sensor

A : Lower-most Position

W1018152

(11) Gauges



Fuel Level Sensor

1) Sensor Continuity

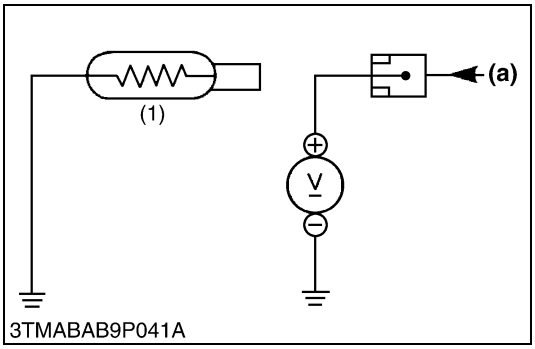
1. Remove the fuel level sensor from the fuel tank.
2. Measure the resistance with an ohmmeter across the sensor terminal and its body.
3. If the reference values are not indicated, the sensor is faulty.

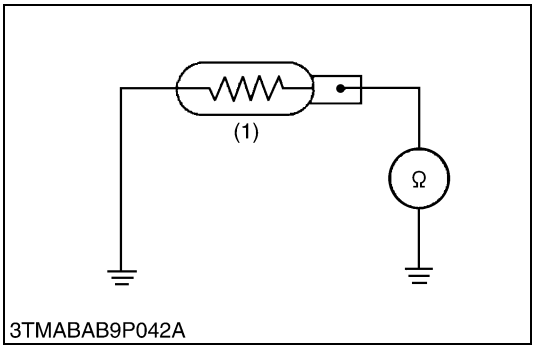
Resistance (Sensor terminal – its body)	Reference value	Float at upper-most position	1 to 5 Ω
		Float at lower-most position	103 to 117 Ω

(1) Fuel Level Sensor

E : Empty
F : Full

W1018566





Coolant Temperature Sensor

1) Lead Terminal Voltage

1. Disconnect the lead from the coolant temperature sensor after turning the main switch **OFF**.
2. Turn the main switch **ON** and measure the voltage with a voltmeter across the lead terminal and the chassis.
   If the voltage differs from the battery voltage, the wiring harness, fuse or coolant temperature gauge is faulty.

Voltage	Lead terminal – Chassis	Approx. battery voltage

2) Sensor Continuity

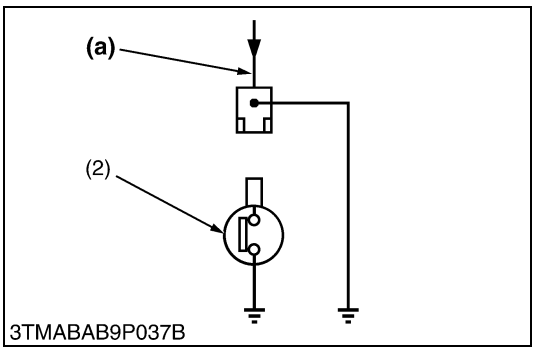
1. Measure the resistances with an ohmmeter across the sensor terminal and the chassis.
2. If the reference value is not indicated, the sensor is faulty.

Resistance (Sensor terminal – Chassis)	Reference value	Approx. 16.1 Ω at 120 °C (248 °F) Approx. 27.4 Ω at 100 °C (212 °F) Approx. 51.9 Ω at 80 °C (176 °F) Approx. 153.9 Ω at 50 °C (122 °F)

(1) Coolant Temperature Sensor
(a) From Temperature Gauge

W1025104

(12) Cooling System

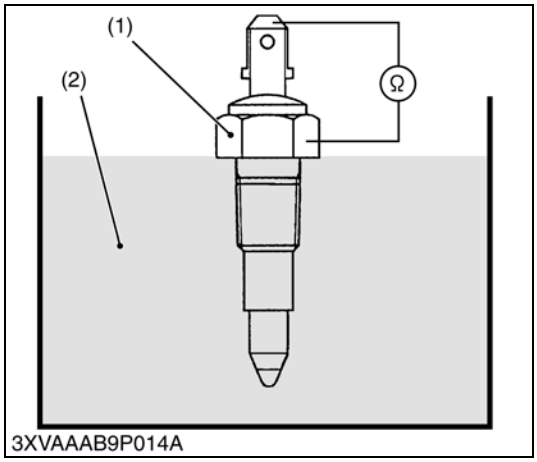


Horn Wiring Harness

1. Disconnect the wiring lead (1) from the coolant temperature switch after turning the main switch **OFF**.
2. Turn the main switch **ON** and connect a jumper lead from lead to the chassis.
3. If the horn does not operate wiring harness or relay is faulty.

(1) Wiring Lead
(2) Coolant Temperature Sensor
(a) From Fan Motor Relay

W1018763



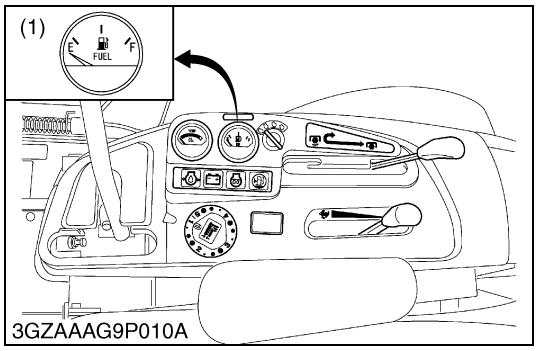
Coolant Temperature Switch

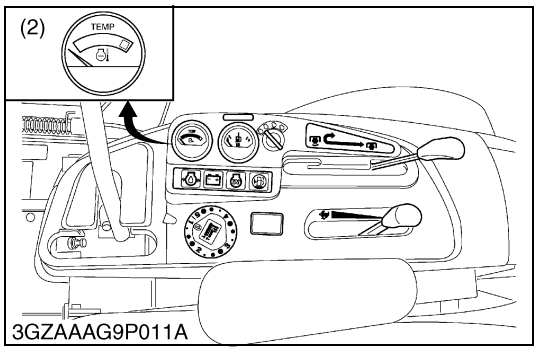
1. Measure the resistance with an ohmmeter across the switch terminal and the switch body.
2. If 0 ohm is not indicated in the coolant temperature at 194 °C (201 °F) or more, the sensor is faulty.
3. If infinity is not indicated in the coolant temperature at lower than 90 °C (194 °F), the sensor is faulty.

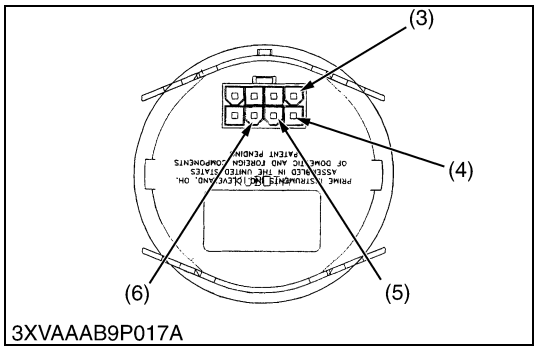
Resistance (Switch terminal – Switch body)	At coolant temperature lower than 116 °C (241 °F)	Infinity
	At coolant temperature more than 120 to 126 °C (248 to 258 °F)	0 Ω

(1) Coolant Temperature Sensor (2) Coolant

W1018994





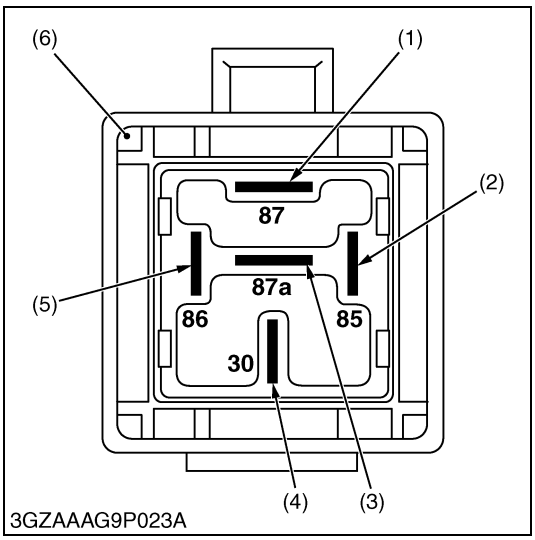


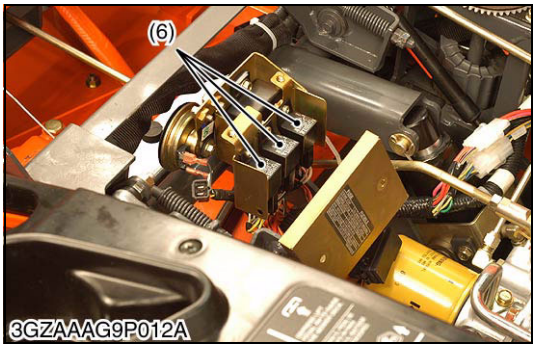
Fuel Gauge and Coolant Temperature Gauge Operation

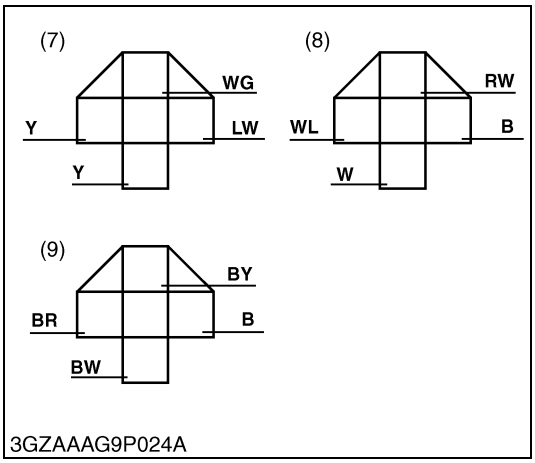
1. Remove the under panel.
2. Turn the main switch to **ON** position. Measure the voltage with a voltmeter across the **S** terminal (3) and **GND** terminal (4) of the gauge.
3. If approx. battery voltage is indicated, the ignition and ground lead connections are good.
4. Turn the main switch to **OFF** position. Connect a jumper lead between **I** terminal (5) and **GND** terminal (4) of the gauge.
5. Turn the main switch to **ON** position. If the gauge resisters a full scale reading under those conditions, the gauge is good. If less than full scale reading is indicated, the gauge is defective and should be replaced.

(1) Fuel Gauge
(2) Temperature Gauge
(3) **S** Terminal
(4) **GND** Terminal
(5) **I** Terminal
(6) Illumination Terminal

W1027205







Relay (Horn, Solenoid and Starter)

1. Disconnect the connector from relay (6) after turning the main switch off.
2. Remove the relay from bracket.
3. Measure the resistance with an ohmmeter across the terminal **85** (2) to terminal **86** (5), terminal **87** (1) to terminal **87a** (3) and terminal **87** (1) to terminal **30** (4).
4. If resistance differs from the factory specifications, the relay is faulty.

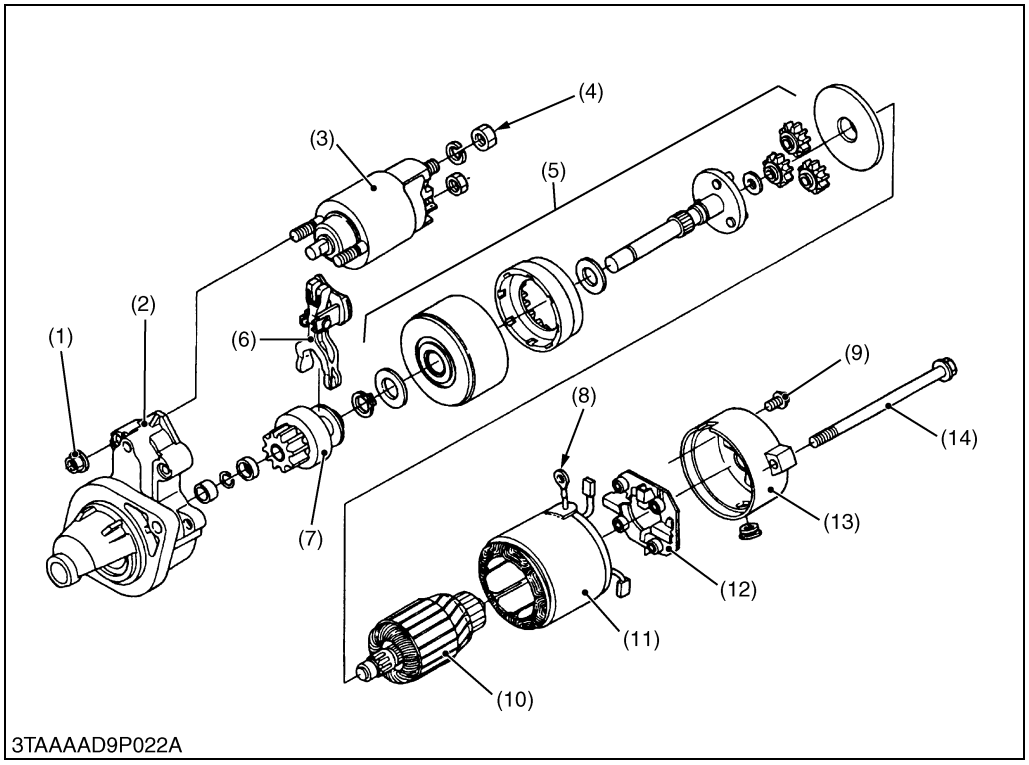
Resistance	Terminal **85** (2) – Terminal **86** (5)	Approx. 90 Ω
	Terminal **87** (1) – Terminal **87a** (3)	0 Ω
	Terminal **87** (1) – Terminal **30** (4)	Infinity

(1) Terminal **87**
(2) Terminal **85**
(3) Terminal **87a**
(4) Terminal **30**
(5) Terminal **86**
(6) Relay (Horn, Solenoid and Starter)
(7) Horn Relay Connector
(8) Solenoid Relay Connector
(9) Starter Relay Connector

W1019186

[2] DISASSEMBLING AND ASSEMBLING

(1) Starting System



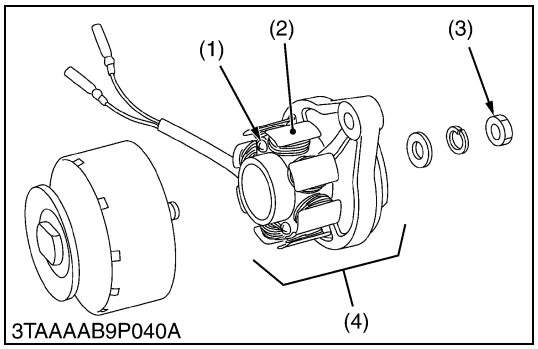
3TAAAAD9P022A

(1) Magnetic Switch Mounting Nut
(2) Housing
(3) Magnetic Switch
(4) **C** Terminal Nut
(5) Shaft Assembly
(6) Drive Lever
(7) Overrunning Clutch
(8) Connecting Lead
(9) Mounting Screw
(10) Armature
(11) Yoke
(12) Brush Holder
(13) Rear End Holder
(14) Through Bolt

W1019204

1. Unscrew the **C** terminal nut (4), and disconnect the connecting lead (8).
2. Unscrew the magnetic switch mounting nuts (1), and remove the magnetic switch (3) from the housing (2).
3. Unscrew the through bolts (14) and mounting screw (9), and remove the rear end frame (13).
4. Remove the brush from the brush holder while holding the spring up.
5. Remove the brush holder (12).
6. Draw out the armature (10) and yoke (11) from the housing.
7. Draw out the shaft assembly (5) with the drive lever (6) and overrunning clutch (7) from the housing.

(2) Charging System



3TAAAAB9P040A

Stator

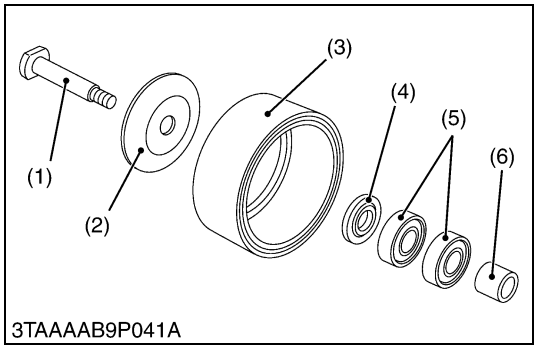
1. Remove the nut (3) and separate the stator comp. (4).
2. Unscrew the screws (1) and remove the stator (2).

(When reassembling)

Tightening torque	Nut	39.2 to 44.1 N·m 4.0 to 4.5 kgf·m 28.9 to 32.5 lbf·ft

(1) Screw
(2) Stator
(3) Nut
(4) Stator Comp.

W1024139



3TAAAAB9P041A

Rotor

1. Tap out the shaft (1) from the rotor (3).

(When reassembling)

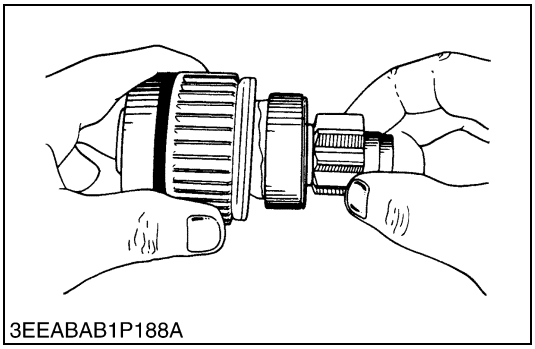
- Take care the direction of the collar (4), the flat side should face to the pulley (2) side.

(1) Shaft
(2) Pulley
(3) Rotor
(4) Collar
(5) Bearings
(6) Collar

W1024281

[3] SERVICING

(1) Starting System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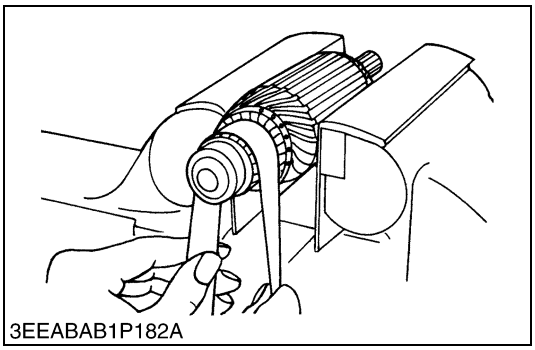
Overrunning Clutch

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 does not slip in the cranking direction.
4. If the pinion slips or does not rotate in the both directions, replace the overrunning clutch assembly.

W1022548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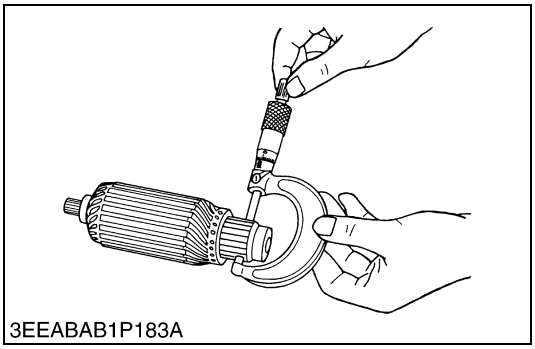
Commutator and Mica

1. Check the contact face 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.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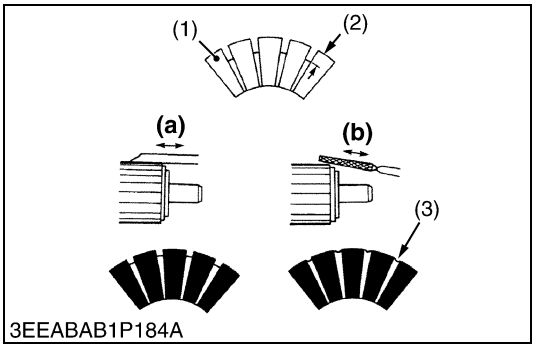
Commutator O.D.	Factory spec.	30.0 mm 1.181 in.
	Allowable limit	29.0 mm 1.142 in.

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

Mica undercut	Factory spec.	0.50 to 0.80 mm 0.0197 to 0.0315 in.
	Allowable limit	0.20 mm 0.0079 in.



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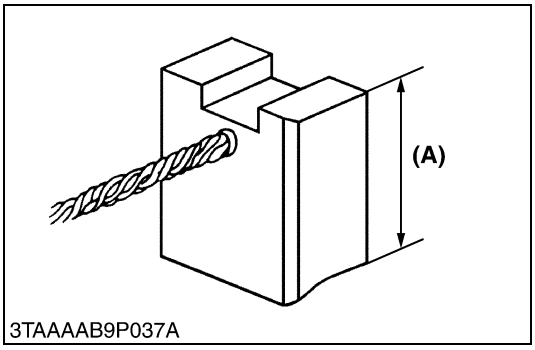
(1) Segment
(2) Undercut
(3) Mica

(a) Correct
(b) Incorrect

W1022696



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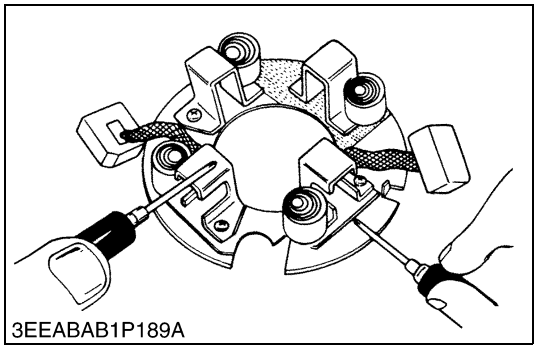
Brush Wear

1. If the contact face of the brush is dirty or dusty, clean it with emery paper.
2. Measure the brush length **(A)** with vernier calipers.
3. If the length is less than the allowable limit, replace the yoke assembly and brush holder.

Brush length **(A)**	Factory spec.	14.0 mm 0.551 in.
	Allowable limit	9.0 mm 0.354 in.

W1022961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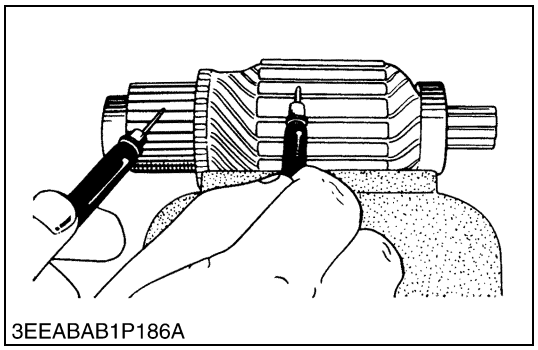
Brush Holder

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

W1023089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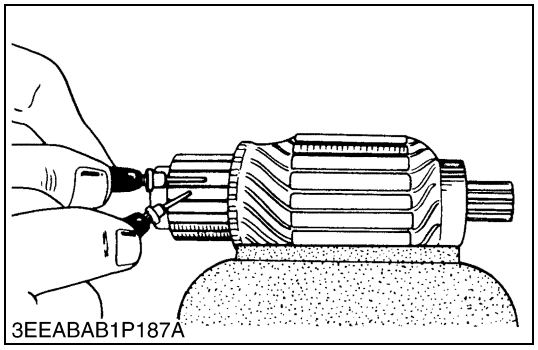
Armature Coil

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 does not conduct, replace the armature.

W1023212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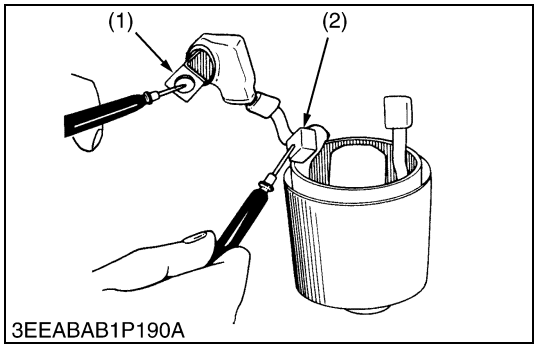

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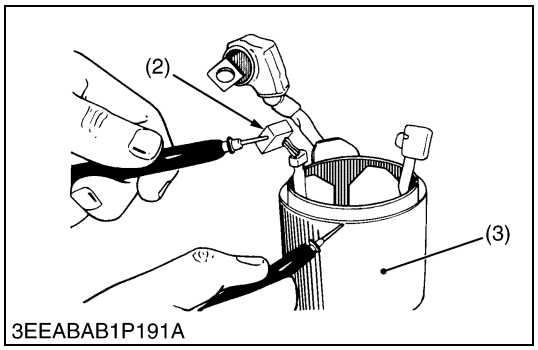
Field Coil

1. Check the continuity across the lead (1) and brush (2) with an ohmmeter.
2. If it does 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) Brush
(3) Yoke

W1023312



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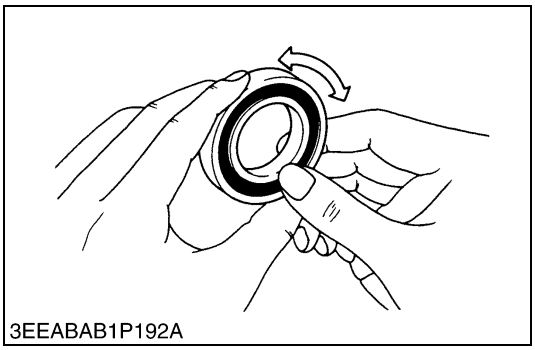
(2) Charging System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Bearing

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

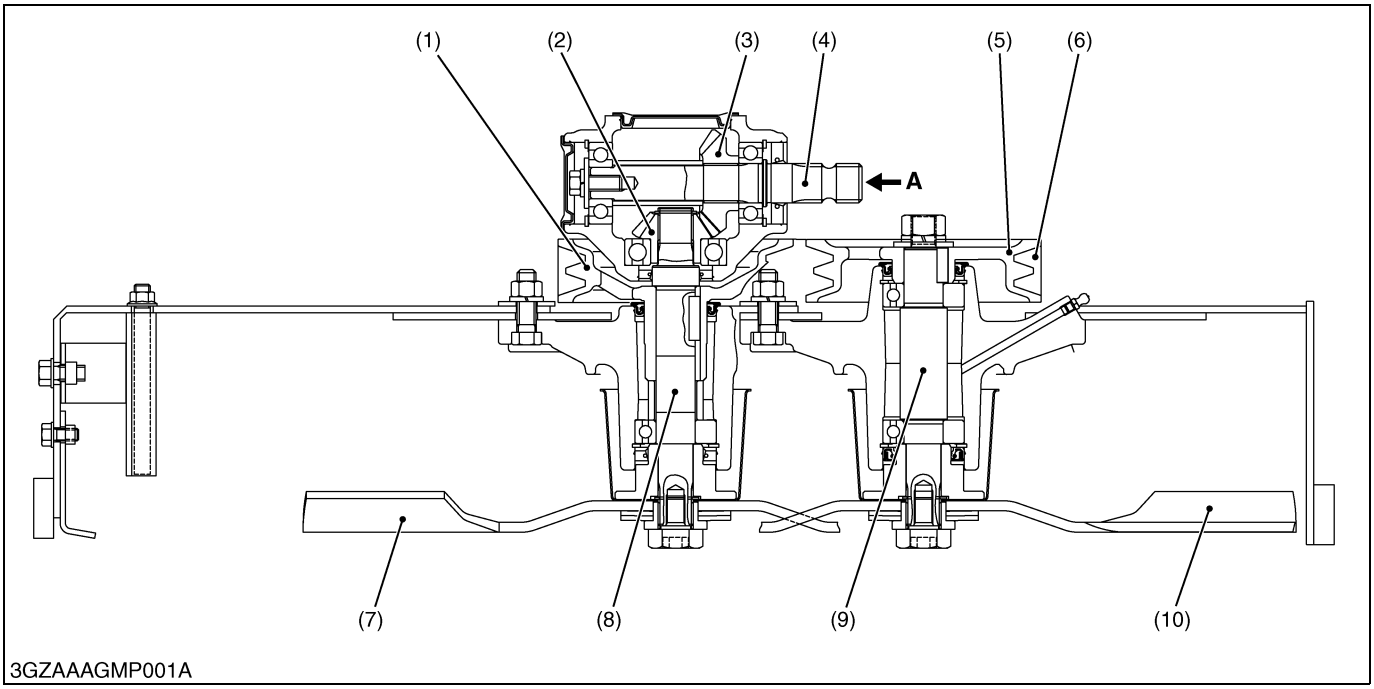
W1024489

6 ROTARY MOWER

MECHANISM

CONTENTS

1. POWER TRANSMISSION



(1) Center Pulley
(2) 16T Bevel Gear (RCK54P-321Z)
15T Bevel Gear (RCK60P-331Z)
17T Bevel Gear (RCK72P-331Z)
(3) 21T Bevel Gear (RCK54P-321Z)
19T Bevel Gear (RCK60P-331Z)
18T Bevel Gear (RCK72P-331Z)
(4) Pinion Shaft
(5) Outer Pulley
(6) Mower Belt
(7) Center Blade
(8) Bevel Gear Shaft
(9) Blade Shaft
(10) Outer Blade

A : From PTO Shaft

The power is transmitted from mid-PTO to blades as follows.

■ **Center Blade**

From PTO Shaft (**A**) → Pinion Shaft (4) → Bevel Gear (3) → Bevel Gear (2) → Bevel Gear Shaft (8) → Center Blade (7)

■ **Outer Blade**

From PTO Shaft (**A**) → Pinion Shaft (4) → Bevel Gear (3) → Bevel Gear (2) → Bevel Gear Shaft (8) → Center Pulley (1) → Mower Belt (6) → Outer Pulley (5) → Blade Shaft (9) → Outer Blade (10)

SERVICING

CONTENTS

1. TROUBLESHOOTING

Symptom	Probable Cause	Solution	Reference Page
Blade Does Not Turn	PTO system malfunctioning	Check transmission	–
	Broken mower belt	Replace mower belt	G-36
Blade Speed Is Slow	Loosen mower belt	Replace mower belt or tension spring	G-36
	Clogged grass	Remove grass	–
	Flattened out or worn cup washer	Replace cup washer	6-S7
	Engine rpm too low	Mow at full throttle, check and reset engine rpm	–
Cutting Is Poor	Worn or bent mower blade	Sharpen or replace mower blade	6-S7
	Loosen mower blade screw	Retighten mower blade screw	6-S7
	Cutting height improper	Adjust cutting height	6-S5
	Ground speed too fast	Slow-down	–
	Low wheel inflation	Add air to correct	–
	Anti-scalp rollers not adjusted correctly	Adjust anti-scalp rollers	6-S4
Mower Is Not Lifted	Broken linkage system	Replace linkage system	–
	Trouble of hydraulic system	Check hydraulic system	–

W1014322

2. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
Pinion Shaft (without Mower Belt)	Turning Force	Less than 117.7 N 12.0 kgf 26.5 lbf	–
	Turning Torque	Less than 1.47 N·m 0.15 kgf·m 1.08 lbf·ft	–
Bevel Gears in Gear Box	Backlash	0.1 to 0.2 mm 0.0039 to 0.0078 in.	0.4 mm 0.157 in.
Front Tip of Blade to Rear Tip of Blade	Difference	0 to 6.0 mm 0 to 0.24 in.	–
Left Tip of Blade to Right Tip of Blade	Difference	Less than 3 mm 0.1181 in.	–

W1013874

3. TIGHTENING TORQUES

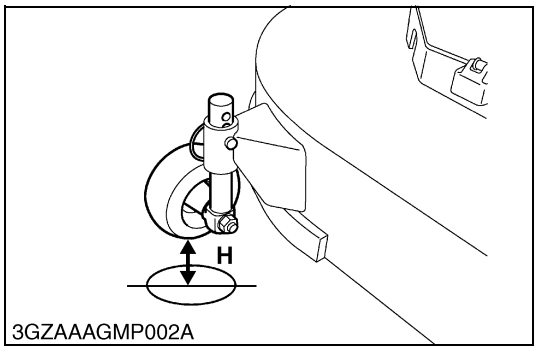
Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts: See page G-9.)

Item	N·m	kgf·m	lbf·ft
Mower blade screw	98.1 to 117	10.0 to 12.0	72.4 to 86.7
Gear box mounting screw (Standard type / Reamer type)	79 to 90	8.0 to 9.2	58 to 66
Center pulley holder screw (Standard type / Reamer type)	79 to 90	8.0 to 9.2	58 to 66
Outer pulley mounting nut	167 to 186	17.0 to 19.0	123 to 137
Pulley holder mounting screw	78 to 90	7.9 to 9.2	58 to 66

W1012736

4. CHECKING, DISASSEMBLING AND ASSEMBLING

[1] CHECKING AND ADJUSTING



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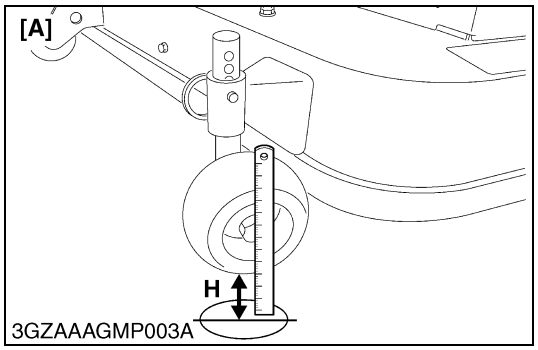

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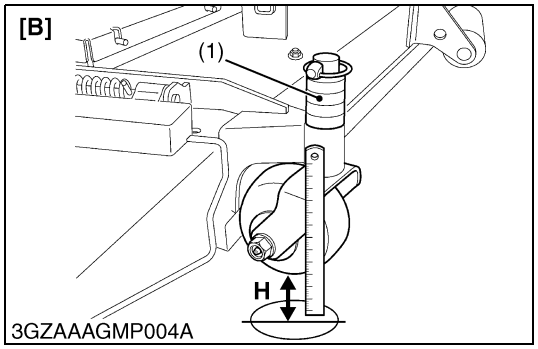

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Adjusting Anti-scalp Rollers

■ **IMPORTANT**

- **The flattest cut can be achieved by having the anti-scalp rollers adjusted off the ground.**
  Check anti-scalp roller adjustments each time the mower deck cutting height is changed.
  It is recommended that all the anti-scalp rollers be kept off the ground to minimize scuffing.

1. Check the machine wheel pressure.
   Inflate wheels to the correct pressure. (See table below.)

	Inflation Pressure
Front wheel	160 kPa, 1.6 kgf/cm^2, 23 psi
Rear wheel	120 kPa, 1.2 kgf/cm^2, 17 psi

2. Start the engine.
3. Raise up the mower deck to the transport position.
   (Also the top end of the lift.)
4. Turn the cutting height control dial to adjust height.
5. Lower the mower deck.

■ **Rear side anti-scalp roller**

6. Adjust height **H** of the rear side anti-scalp roller to one of four positions to approximately 19 mm (0.75 in.) between rollers and ground. Adjust both side rollers to the same height.
7. Install the roller with attaching hardware.

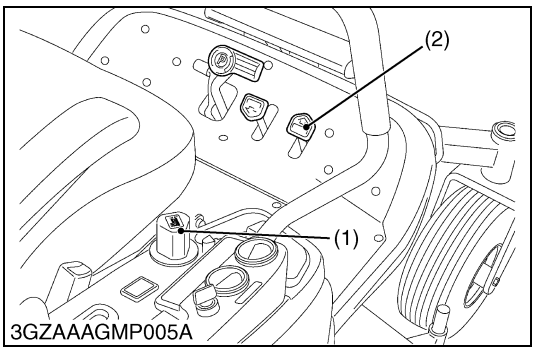
■ **Front side anti-scalp roller**

8. Adjust height **H** of the front side anti-scalp roller to one of seven positions to approximately 19 mm (0.75 in.) between rollers and ground. Adjust both side rollers to the same height.
9. Adjust height of the front side anti-scalp roller by replacing the collar (collar is raised and lowered) to approximately 10 mm (0.39 in.) between rollers and ground.
   Adjust both side rollers to the same height.
10. Install the roller with attaching hardware.

(1) Collar

[A] RCK54P
[B] RCK60P, RCK72P

W1020280



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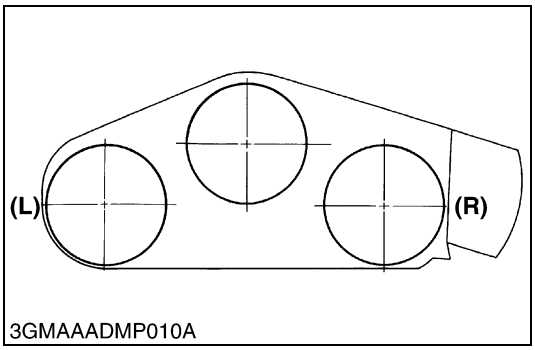

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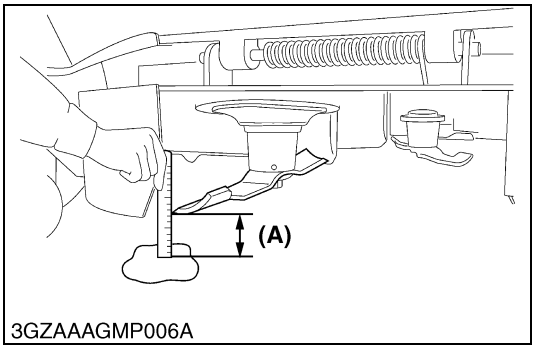

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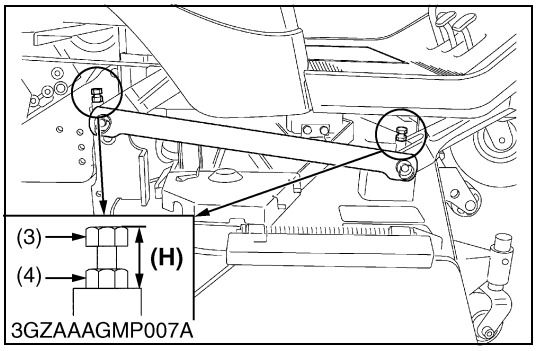

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Adjusting Left and Right Cutting Height

1. Wheel pressure must be correct.
2. Raise up the mower deck to the transport position. (Also the top end).
3. Turn the cutting height set dial (1) to the 3 in. cutting height position.
4. Place 51 mm (2 in.) height wood blocks under each side of the mower deck.
   Anti-scalp rollers must not rest on the wood block.
5. Lower the mower deck.
6. Position mower blade in the Side-to-Side position.
7. Loosen the lock nuts (4) of the right side of the machine.
8. Adjust the cutting height fine tuning bolts (3) to set 80 mm (3 1/8 in.) height.
   Front and rear side bolts must be adjusted.
9. Lock the nuts.
10. Adjust the left side equally.
11. Measure the heights of blade **(L)** and **(R)** from the ground surface and calculate the difference.
12. If the difference between left tip and right tip of blade is not within the factory specification, adjust the length of cutting height fine tuning bolt (3).

Difference (**(L)** - **(R)**) between left tip and right tip of blade	Factory spec.	Less than 3 mm 0.1181 in.

(1) Cutting Height Control Dial
(2) Hydraulic Lift Control Pedal
(3) Cutting Height Fine Tuning Bolt
(4) Lock Nut

(L) Left Blade Measurement Position
(R) Right Blade Measurement Position
(A) Blade Height
(H) Length of Cutting Height Fine Tuning Bolt

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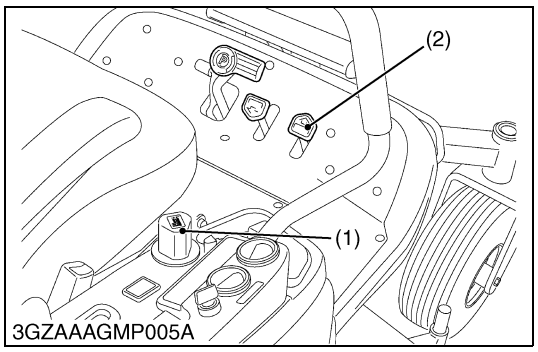

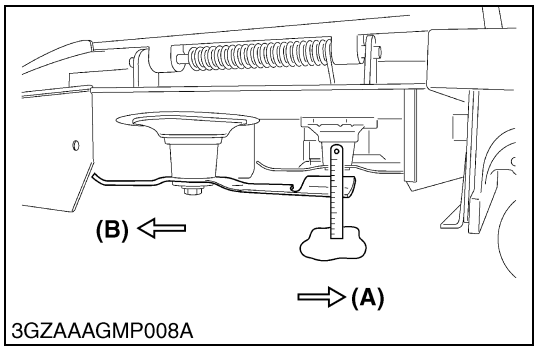

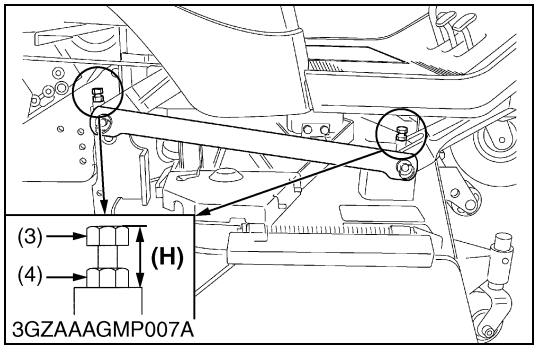

Adjusting Front and Rear Cutting Height

1. Wheel pressure must be correct.
2. Raise up the mower deck to the transport position. (Also the top end).
3. Turn the cutting height set dial (1) to the 3 in. cutting height position.
4. Place 51 mm (2 in.) height wood blocks under each side of the mower deck.
   Anti-scalp rollers must not rest on the wood block.
5. Lower the mower deck.
6. Loosen the lock nuts (4) of the front side of the machine.
7. Adjust the cutting height fine tuning bolts (3) to set 80 mm (3 1/8 in.) height.
   Both front side bolts (3) must be adjusted.
8. Lock the nuts (4).
9. Adjust the other side equally.
10. Measure the heights of blade **(A)** and **(B)** from the ground surface and calculate the difference.
11. If the difference between front tip and rear tip of blade is not within the factory specification, adjust the length **H** of cutting height fine tuning bolt with lock nut (4). The height of rear blade tip **(B)** should be bigger than the front.

Difference (**(B)** - **(A)**) (**(B)** ≥ **(A)**) between front tip and rear tip of blade	Factory spec.	0 to 6.0 mm 0 to 0.24 in.

(1) Cutting Height Control Dial
(2) Hydraulic Lift Control Pedal
(3) Cutting Height Fine Tuning Bolt
(4) Lock Nut
(H) Length of Cutting Height Fine Tuning Bolt
(A) Height of Blade Tip (Front)
(B) Height of Blade Tip (Rear)

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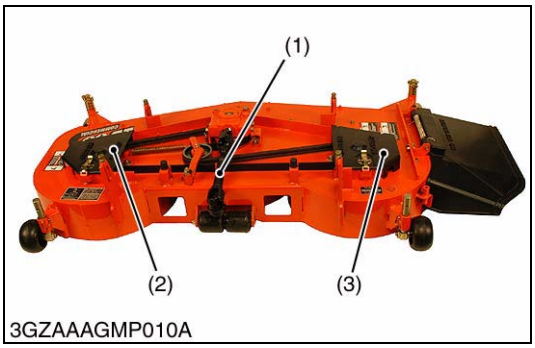
[2] DISASSEMBLING AND ASSEMBLING



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Universal Joint and Belt Covers

1. Remove the universal joint (1).
2. Remove the left and right belt covers (2), (3).

(1) Universal Joint
(2) Belt Cover (Left)
(3) Belt Cover (Right)

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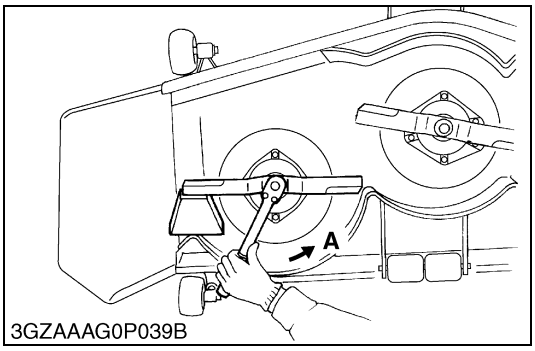

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Mower Blades (Center Blade and Outer Blades)

1. Turn over the mower.
2. Unscrew the mower blade screw (5), and remove the spline boss (4), two cup washers (3), mower blade (2) and dust cover (1).

■ **NOTE**

- **To remove the blade securely, wedge a block of wood between one blade and the mower deck in such position that it will hold the blade safely while loosing or tightening the blade screw.**

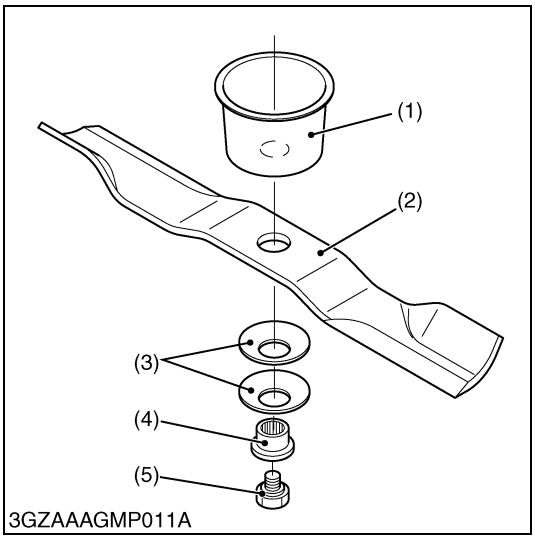
(When reassembling)

- Be sure to assemble the two cup washers between the mower blade and spline boss.

■ **IMPORTANT**

- **Make sure the cup washer is not flattened out or worn, causing blade to slip easily.**
  Replace two cup washers if either is damaged.

Tightening torque	Mower blade screw	98.1 to 117 N·m 10.0 to 12.0 kgf·m 72.4 to 86.7 lbf·ft



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(1) Dust Cover
(2) Mower Blade
(3) Cup Washer
(4) Spline Boss
(5) Mower Blade Screw

A : Loosen

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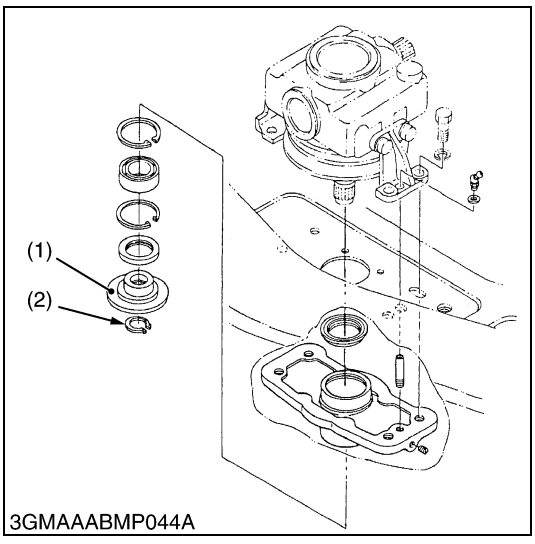

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Blade Boss

1. Remove the external snap ring (2).
2. Remove the blade boss (1).

(1) Blade Boss
(2) External Snap Ring

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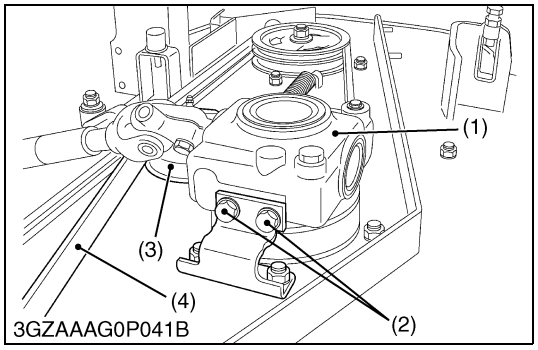

Gear Box and Mower Belt

1. Remove the mower deck from the machine.
2. Remove the left and right hand shield from the mower deck.
3. Clean around the gear box.
4. Remove the belt from the tension pulley.
5. Remove the right hand bracket which mounts the gear box to the mower deck and slip the belt over the top of the gear box.
6. To install a new belt, reverse the above procedure.

(When reassembling)

- Install the reamer screws at their original positions as shown in the figure.

Tightening torque	Gear box mounting screw	79 to 90 N·m 8.0 to 9.2 kgf·m 58 to 66 lbf·ft

(1) Gear Box
(2) Gear Box Mounting Screw
(3) Tension Pulley
(4) Mower Belt

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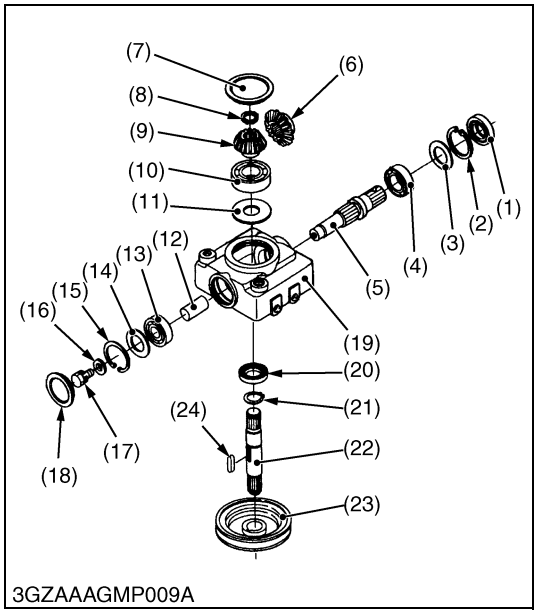

Disassembling Gear Box

1. Unscrew the drain plug, and drain the gear box oil.
2. Remove the center pulley (23) with a puller, and remove the feather key (24) on the bevel gear shaft.
3. Remove the gear box caps (7), (18).
4. Remove the oil seal (1), external snap ring (2) and shim (3).
5. Remove the screw (17), washer (16) and tap out the pinion shaft (5) with ball bearing (4).
6. Remove the bevel gear (6) and pinion shaft collar (12).
7. Remove the internal snap ring (15) and shims (14).
8. Remove the ball bearing (13).
9. Remove the external snap ring (8), and draw out the bevel gear shaft (22).
10. Remove the bevel gear (9) with ball bearing (10).

(When reassembling)

- Replace the oil seals (1), (20) and gear box caps (7), (18) with new ones.
- Check the backlash and turning torque.
  If not proper, adjust with the shims (3), (11) and (14). (See page 6-S11, 12.)

(1) Oil Seal
(2) Internal Snap Ring
(3) Shim
(4) Ball Bearing
(5) Pinion Shaft
(6) 21T Bevel Gear (RCK54P-321Z)
19T Bevel Gear (RCK60P-331Z)
18T Bevel Gear (RCK72P-331Z)
(7) Gear Box Cap
(8) External Snap Ring
(9) 16T Bevel Gear (RCK54P-321Z)
15T Bevel Gear (RCK60P-331Z)
17T Bevel Gear (RCK72P-331Z)
(10) Ball Bearing
(11) Shim
(12) Pinion Shaft Collar
(13) Ball Bearing
(14) Shim
(15) Internal Snap Ring
(16) Washer
(17) Screw
(18) Gear Box Cap
(19) Gear Box
(20) Oil Seal
(21) External Snap Ring
(22) Bevel Gear Shaft
(23) Center Pulley
(24) Feather Key

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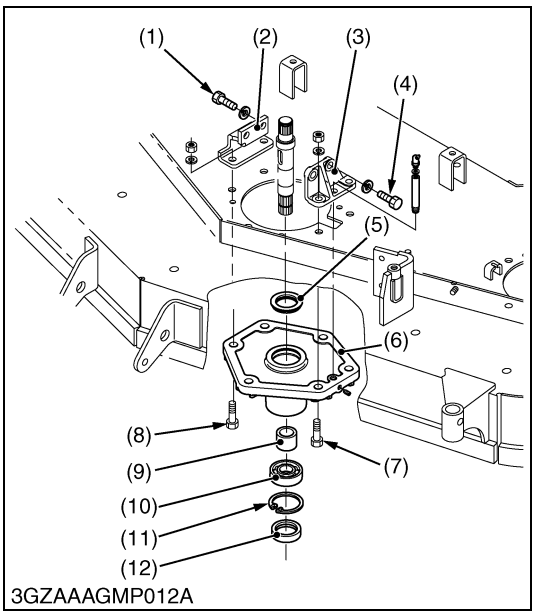

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Center Pulley Holder

1. Unscrew the center pulley holder screws (8) and reamer screws (7).
2. Remove the upper oil seal (5) and lower oil seal (12).
3. Remove the internal snap ring (11) and ball bearing (10).

(When reassembling)

- Replace the oil seals (5), (12) with new ones.
- Install the reamer screws (10) at their original positions as shown in the figure.

■ **NOTE**

- **When reassembling the center pulley holder (6), gear box and gear box stays (2), (3), screw the all screws by hand temporary.**
- **Tighten the screws in the order as below, to prevent the incline the gear box.**
- **Tighten the reamer screws (4) to the gear box first, then tighten the reamer screws (7) to the center pulley holder (6) with specified torque.**
- **Tighten the gear box screws (1) to the gear box, then tighten the center pulley holder screws (8) with specified torque.**
- **See page 6-S8 for tightening torque of gear box screw.**

Tightening torque	Center pulley holder screw (Standard type / Reamer type)	79 to 90 N·m 8.0 to 9.2 kgf·m 58 to 66 lbf·ft

(1) Gear Box Screw
(2) Gear Box Stay RH
(3) Gear Box Stay LH
(4) Gear Box Reamer Screw
(5) Oil Seal
(6) Center Pulley Holder
(7) Center Pulley Holder Reamer Screw
(8) Center Pulley Holder Screw
(9) Collar
(10) Ball Bearing
(11) Internal Snap Ring
(12) Oil Seal

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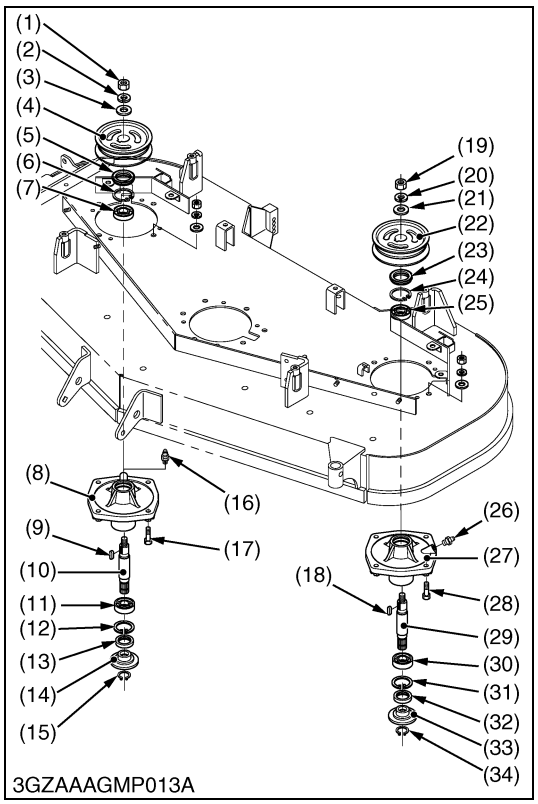

Outer Pulley and Blade Shaft

1. Unscrew the outer pulley mounting nut (19), and remove the outer pulley (22) and feather key (18).
2. Unscrew the pulley holder mounting screws (28), and separate the left pulley holder (27) from the mower deck.
3. Remove the external snap ring (34) on the left blade shaft (29).
4. Remove the spline boss (33) and oil seal (32).
5. Remove the internal snap ring (31) and tap out the left blade shaft (29) with the ball bearings (25), (30), taking care not to damage the grease nipple (26).
6. Remove the oil seal (23) and internal snap ring (24).
7. Remove the ball bearings (25), (30) from the blade shaft (29).
8. Remove the right pulley holder (8) and blade shaft (10) as above.

(When reassembling)

- Replace the oil seals (32), (23), (13) and (5) with new ones.

Tightening torque	Outer pulley mounting nut	167 to 186 N·m 17.0 to 19.0 kgf·m 123 to 137 lbf·ft
	Pulley holder mounting screw	78 to 90 N·m 8.0 to 9.2 kgf·m 58 to 66 lbf·ft

(1) Outer Pulley Mounting Nut
(2) Spring Washer
(3) Plain Washer
(4) Outer Pulley (Right)
(5) Oil Seal
(6) Internal Snap Ring
(7) Ball Bearing
(8) Pulley Holder (Right)
(9) Feather Key
(10) Blade Shaft (Right)
(11) Ball Bearing
(12) Internal Snap Ring
(13) Oil Seal
(14) Spline Boss
(15) External Snap Ring
(16) Grease Nipple
(17) Pulley Holder Mounting Screw
(18) Feather Key
(19) Outer Pulley Mounting Nut
(20) Spring Washer
(21) Plain Washer
(22) Outer Pulley (Left)
(23) Oil Seal
(24) Internal Snap Ring
(25) Ball Bearing
(26) Grease Nipple
(27) Pulley Holder (Left)
(28) Pulley Holder Mounting Screw
(29) Blade Shaft (Left)
(30) Ball Bearing
(31) Internal Snap Ring
(32) Oil Seal
(33) Spline Boss
(34) External Snap Ring

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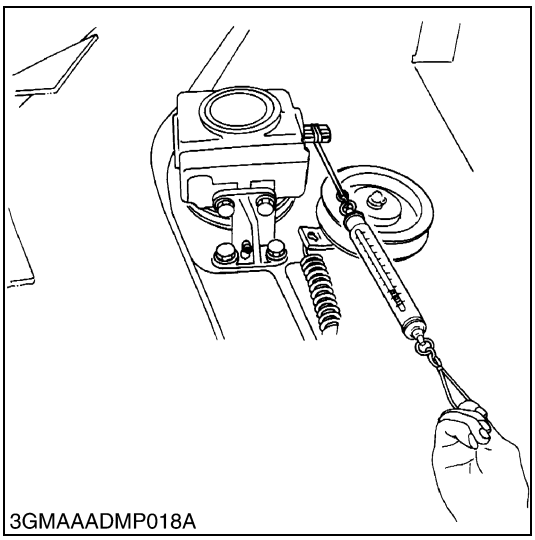
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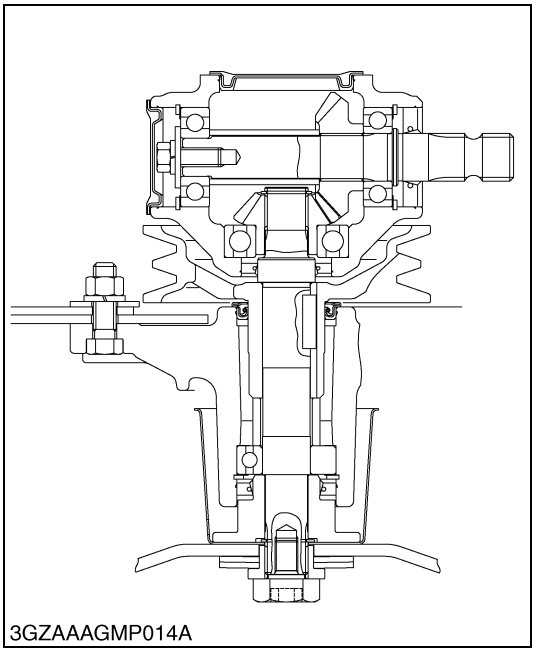
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Turning Torque of Pinion Shaft

1. Remove the mower belt, and reassemble the gear box to the mower deck.
2. Wind a string around the pinion shaft and set a spring balance (or push-pull gauge) to the tip of the string, and then slowly pull the spring balance horizontally to measure the turning force.
3. If the measurement exceeds the factory specification, check the bearings and gears.

Turning force	Factory spec.	Less than 117.7 N 12.0 kgf 26.5 lbf

Turning torque	Factory spec.	Less than 1.47 N·m 0.15 kgf·m 1.08 lbf·ft

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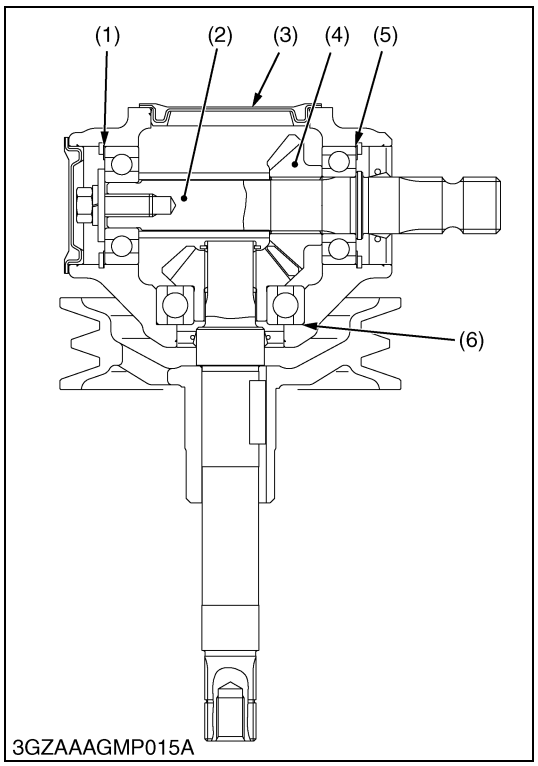

Backlash between Bevel Gears

1. Remove the gear box cap (3).
2. Place fuses the bevel gear (4) on the pinion shaft (2).
3. Turn the pinion shaft (2).
4. Take out the fuses, and measure the thickness of fuses with an outside micrometer. (Backlash equal thickness of fuse)
5. If the backlash exceeds the allowable limit, adjust with shims (1), (5), (6).

Backlash between bevel gears	Factory spec.	0.13 to 0.25 mm 0.0051 to 0.0098 in.
	Allowable limit	0.40 mm 0.0157 in.

(Reference)

- Thickness of adjusting shims (1), (4) : 0.2 mm (0.0079 in.)
  0.3 mm (0.0118 in.)
- Thickness of adjusting shims (6) : 0.1 mm (0.0039 in.)
  0.2 mm (0.0079 in.)

(1) Shim
(2) Pinion Shaft
(3) Gear Box Cap
(4) Bevel Gear
(5) Shim
(6) Shim

W1020126

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Printed in Japan 2007. 04, S, EI, EI, e Code No.9Y111-00092
2006. 12, S, EI, EI, e