

WSM

WORKSHOP MANUAL

**ZD1211,ZD1211R,
ZD1211L,ZD1211RL**

Kubota

TO THE READER

This Workshop Manual tells the servicing personnel about the mechanism, servicing and maintenance of the ZD1211, ZD1211R, ZD1211L, ZD1211RL. It contains 4 parts: "**Information**", "**General**", "**Mechanism**" and "**Servicing**".

■ **Information**

This section primarily contains information below.

- Safety First
- Safety Decal
- Specifications
- Dimensions

■ **General**

This section primarily contains information below.

- Engine Identification
- Model Identification
- General Precautions
- Maintenance Check List
- Check and Maintenance
- Special Tools

■ **Mechanism**

This section contains information on the structure and the function of the unit. Before you continue with the subsequent sections, make sure that you read this section.

Refer to the latest version of Workshop Manual (Code No. 9Y021-01870 / 9Y021-18200) for the diesel engine / tractor mechanism that this workshop manual does not include.

■ **Servicing**

This section primarily contains information below.

- Troubleshooting
- Servicing Specifications
- Tightening Torques
- Checking, Disassembling and Servicing

All illustrations, photographs and specifications contained in this manual are of the newest information available at the time of publication.

KUBOTA reserves the right to change all information at any time without notice.

Since this manual includes many models, information or illustrations and photographs can show more than one model.

November, 2015

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Record of Revisions

For pdf, use search function {Search word} to find all the revised locations.

Last digit of the Code No.	Issue month	Main Revised Point and Corrective Measures {Search word}	Reference Page
1	2016.07	Updated Specifications Added Error Code Display Updated Torque for Gearbox mounting bolt	I-8, I-9, I-10 5-M16 6-S13
2	2016.07	Updated Maintenance Chart • Added Engine valve clearance Updated Greasing Points	G-14 G-9
3	2017.06	Updated "Battery for storage" contents	G-31

I INFORMATION

INFORMATION

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- 2. SAFETY DECALS I-4
- 3. SPECIFICATIONS I-8
- 4. DIMENSIONS I-10

1. SAFETY FIRST

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 try 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, could result in minor or moderate injury.

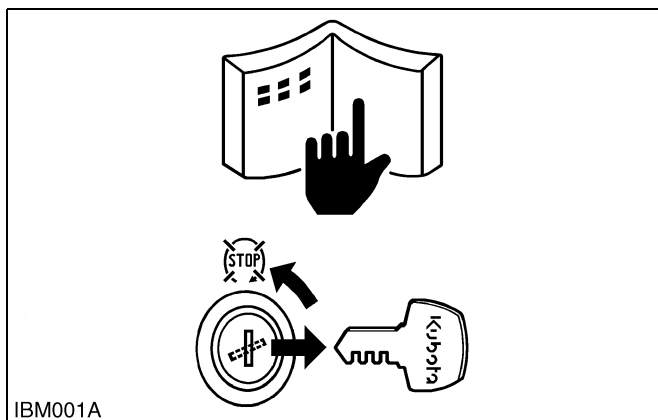
■ IMPORTANT

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

■ NOTE

- Gives helpful information.

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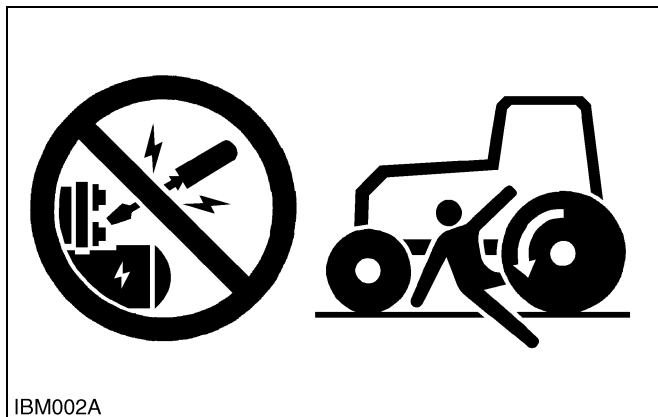


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BEFORE YOU START SERVICE

- 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 stable and level ground, and set the parking brake.
- Lower the implement to the ground.
- Stop the engine, then remove the key.
- Disconnect the battery negative cable.
- Hang a "**DO NOT OPERATE**" tag in the operator station.

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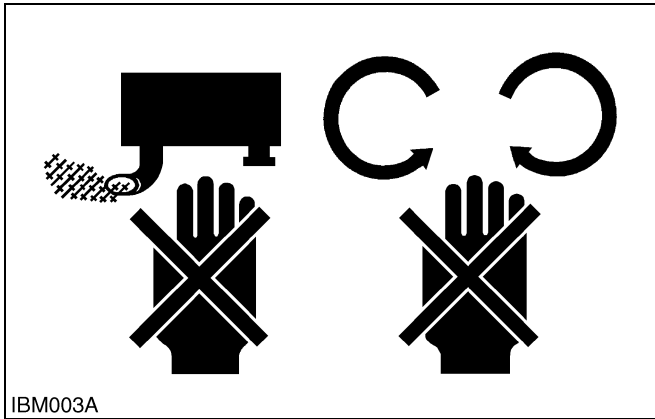


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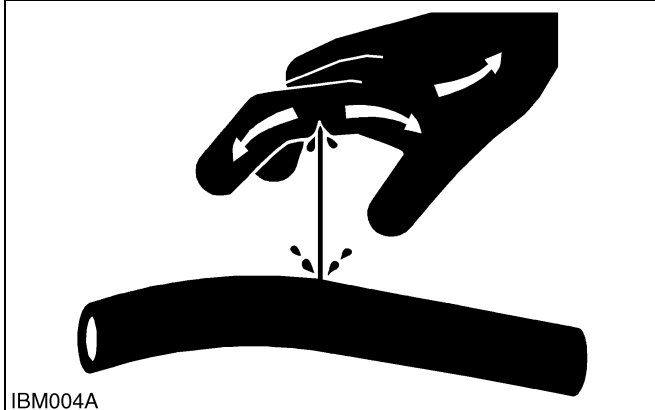
START SAFELY

- Do not do the procedures below when you start the engine.
 - short across starter terminals
 - bypass the safety start switch
- Do not alter or remove any part of machine safety system.
- Before you start the engine, make sure that all shift levers are in neutral positions or in disengaged positions.
- Do not start the engine when you stay on the ground. Start the engine only from operator's seat.

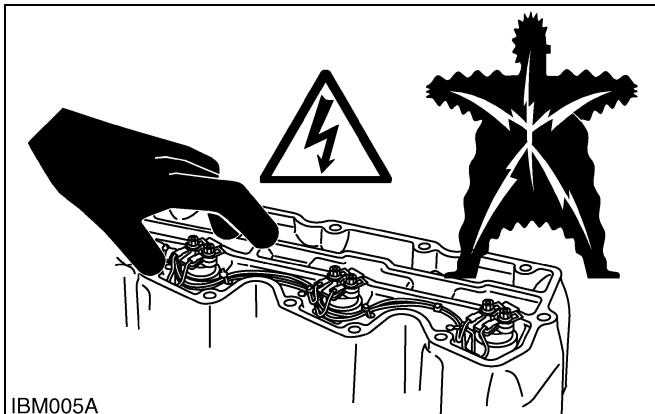
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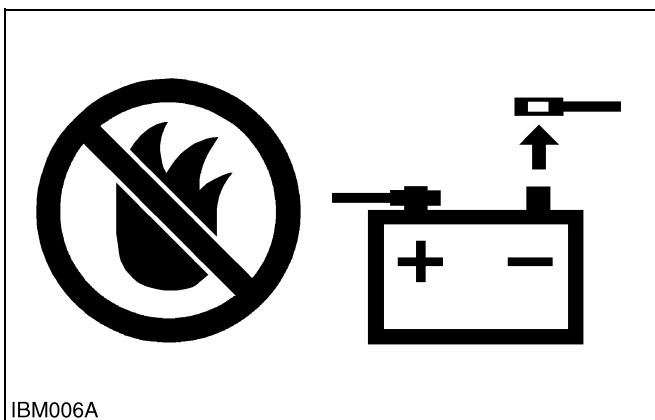
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OPERATE SAFELY

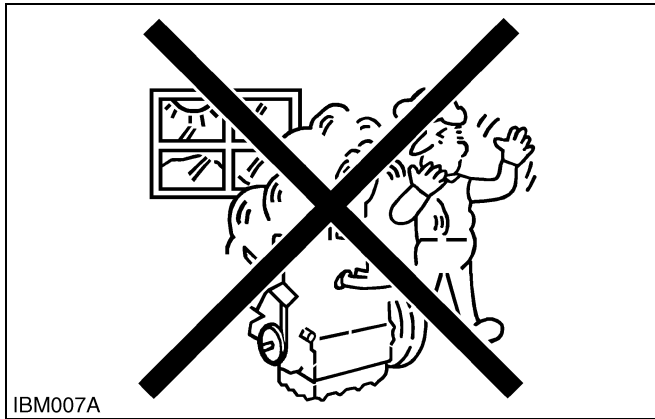
- Do not use the machine after you consume alcohol or medication or when you are tired.
- Put on applicable clothing and safety equipment.
- Use applicable tools only. Do not use alternative tools or parts.
- When 2 or more persons do servicing, make sure that you do it safely.
- Do not operate below the machine that only a jack holds. Always use a safety stand to hold the machine.
- Do not touch the hot parts or parts that turn when the engine operates.
- Do not remove the radiator cap when the engine operates, or immediately after it stops. If not, hot water can spout out from the radiator. Only remove the radiator cap when it is at a sufficiently low temperature to touch with bare hands. Slowly loosen the cap to release the pressure before you remove it fully.
- Released fluid (fuel or hydraulic oil) under pressure can cause damage to the skin and cause serious injury. Release the pressure before you disconnect hydraulic or fuel lines. Tighten all connections before you apply the pressure.
- Do not open a fuel system under high pressure. The fluid under high pressure that stays in fuel lines can cause serious injury. Do not disconnect or repair the fuel lines, sensors, or any other components between the fuel pump and injectors on engines with a common rail fuel system under high pressure.
- Put on an applicable ear protective device (earmuffs or earplugs) to prevent injury against loud noises.
- Be careful about electric shock. The engine generates a high voltage of more than DC100 V in the ECU and is applied to the injector.

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PREVENT A FIRE

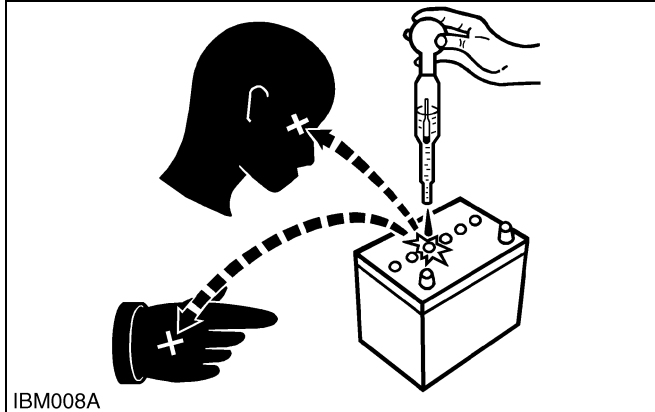
- Fuel is very flammable and explosive under some conditions. Do not smoke or let flames or sparks in your work area.
- To prevent sparks from an accidental short circuit, always disconnect the battery negative cable first and connect it last.
- The battery gas can cause an explosion. Keep the sparks and open flame away from the top of battery, especially when you charge the battery.
- Make sure that you do not spill fuel on the engine.

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**KEEP A GOOD AIRFLOW IN THE WORK AREA**

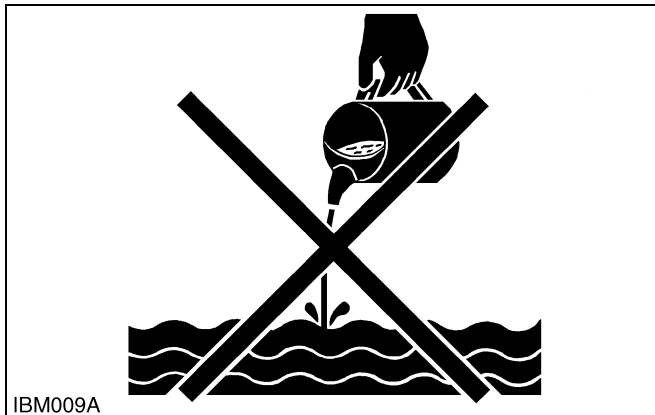
- If the engine is in operation, make sure that the area has good airflow. Do not operate the engine in a closed area. The exhaust gas contains poisonous carbon monoxide.

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**PREVENT ACID BURNS**

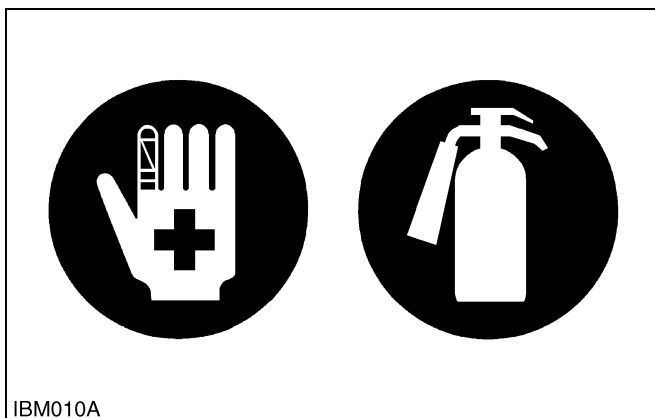
- Keep electrolyte away from your eyes, hands and clothing. Sulfuric acid in battery electrolyte is poisonous and it can burn your skin and clothing and cause blindness. If you spill electrolyte on yourself, clean yourself with water, and get medical aid immediately.

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**DISCARD FLUIDS CORRECTLY**

- Do not discard fluids on the ground, down the drain, into a stream, pond, or lake. Obey related environmental protection regulations when you discard oil, fuel, coolant, electrolyte and other dangerous waste.

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**PREPARE FOR EMERGENCIES**

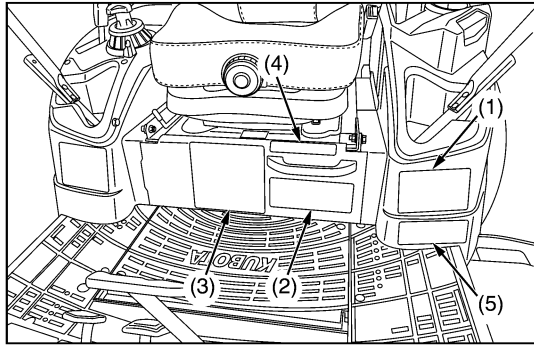
- Keep a first aid kit and fire extinguisher ready at all times.
- Keep the emergency contact telephone numbers near your telephone at all times.

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2. 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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(1) Part No. K3181-6585-1

<p>⚠ WARNING</p> <p>TO AVOID SERIOUS INJURY OR DEATH</p> <ol style="list-style-type: none"> 1. Park the machine on level ground. 2. If necessary to park on an incline, <ol style="list-style-type: none"> ① Stop the machine. ② Apply the parking brake. ③ Stop the engine. <p>If you stop the engine on an incline without applying the parking brake, the machine could move and runaway.</p> <ol style="list-style-type: none"> 3. If the engine stops suddenly during operation, apply the parking brake immediately to prevent machine runaway. 	<p>⚠ ADVERTENCIA</p> <p>PARA EVITAR LESIONES PERSONALES GRAVES O LA MUERTE</p> <ol style="list-style-type: none"> 1. Estacione la máquina en la tierra del nivel. 2. Si es necesario estacionar en una cuesta, <ol style="list-style-type: none"> ① Apague la máquina. ② Aplique el freno de estacionamiento. ③ Luego apague el motor. <p>Si apaga el motor en una cuesta sin aplicar el freno de estacionamiento, la máquina puede moverse sin control.</p> <ol style="list-style-type: none"> 3. Si la máquina se detiene repentinamente durante la operación, enganche el freno de estacionamiento inmediatamente para evitar la pérdida de control.
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(2) Part No. K3181-6584-1

	<p>⚠ WARNING</p> <p>TO AVOID SERIOUS INJURY OR DEATH</p> <ol style="list-style-type: none"> 1. Mow across slopes-Not up and down. 2. Use extreme caution when operating on slopes. 3. Loss of traction may occur when operating on slopes. 4. Drive slowly on slopes. 5. Do not operate on wet slopes. 6. Avoid sudden starts. 7. Execute turns slowly. 	<p>⚠ ADVERTENCIA</p> <p>PARA EVITAR LESIONES PERSONALES GRAVES O LA MUERTE</p> <ol style="list-style-type: none"> 1. Corte el césped de manera transversal en las colinas - No de arriba hacia abajo. 2. Tenga mucho cuidado durante la operación en colinas. 3. Se puede perder tracción durante la operación en colinas. 4. Conduzca lentamente en las colinas. 5. No use la máquina en colinas húmedas. 6. Evite arranques súbitos. 7. Realice las vueltas lentamente.
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(3) Part No. K3441-6582-1

<p>⚠ WARNING</p> <p>TO AVOID SERIOUS INJURY OR DEATH</p> <ol style="list-style-type: none"> 1. Read and understand the operator's manual before operation. 2. Do not operate this machine unless you are trained. 3. Before allowing other people to use the machine, have them read the operator's manual. 4. Check the tightness of all nuts and bolts regularly. 5. Before starting the engine, make certain that everyone is at a safe distance from the machine. PTO is disengaged and motion control levers are in neutral lock. 6. Remove objects that could be thrown by the blade. 7. Do not operate the machine when children and/or others are around. 8. Do not carry children or others on the machine at any time. 9. Before dismounting, disengage PTO clutch, lower the implement, place motion control levers in neutral lock position, set the parking brake, stop the engine and remove the key. 10. Keep safety devices (guards, shields and switches) in place, and working. 11. To reduce the fire hazard, keep the exhaust clear of dry grass, dry leaves or other combustible materials. 12. This machine is not for street or highway use. 13. Securely support the machine and implement before working underneath. 	<p>⚠ ADVERTENCIA</p> <p>PARA EVITAR LESIONES PERSONALES GRAVES O LA MUERTE</p> <ol style="list-style-type: none"> 1. Lea y entienda el manual del operador antes de efectuar la operación. 2. No ponga en funcionamiento la máquina a menos que esté capacitado para hacerlo. 3. Antes de permitir que otras personas usen la máquina, indíqueles que lean el manual del operador. 4. Verifique con regularidad el apriete de todas las tuercas y pernos. 5. Antes de arrancar el motor, asegúrese de que todos estén a una distancia segura de la máquina. La toma de fuerza debe estar desactivada y las palancas de control de movimiento bloqueadas en neutro. 6. Retire los objetos que pueden ser lanzados por la cuchilla. 7. No opere la máquina cuando hayan niños u otras personas alrededor. 8. No lleve a niños ni a otras personas en la máquina en ningún momento. 9. Antes de desmontar, desenganche el embrague de la toma de fuerza, baje el implemento, cambie a neutro, aplique el freno de estacionamiento, apague el motor y retire la llave. 10. Mantenga los dispositivos de protección (guardas, barreras de protección e interruptores) en su lugar y en buen estado de funcionamiento. 11. Para reducir los riesgos de incendio, mantenga el escape exento de hierba seca, hojas secas u otros materiales combustibles. 12. Esta máquina no está diseñada para uso en calles ni carreteras. 13. Use un soporte seguro para la máquina y el implemento antes de trabajar debajo de los mismos.
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(4) Part No. K3441-6569-1

<p>⚠ WARNING</p> <p>When Engine is running, do not open this cover.</p>	<p>⚠ ADVERTENCIA</p> <p>Nunca abra el capó mientras el motor está en funcionamiento.</p>
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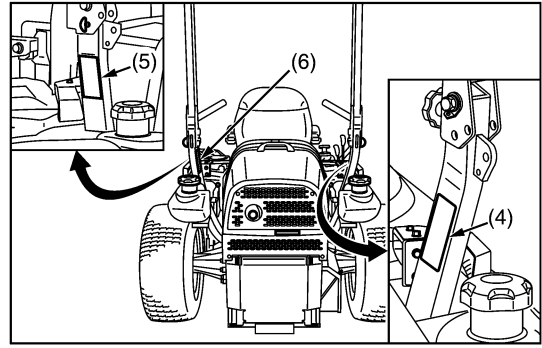
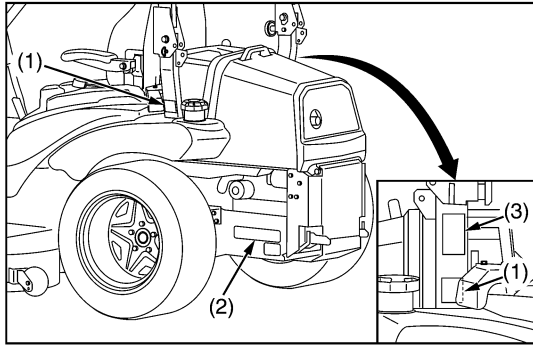
(5) Part No. K3181-6571-1

<p>⚠ WARNING</p> <p>Operation of this equipment may create sparks that can start fires around dry vegetation. A spark arrester may be required. The operator should contact local fire agencies for laws or regulations relating to fire prevention requirements.</p>	<p>⚠ ADVERTENCIA</p> <p>La operación de este equipo puede generar chispas que pueden iniciar incendios en cercanías de vegetación seca. Podría requerirse un parachispas. El operador debería contactar a las agencias de bomberos locales para informarse sobre leyes o normas relacionadas con los requisitos de prevención de incendios.</p>
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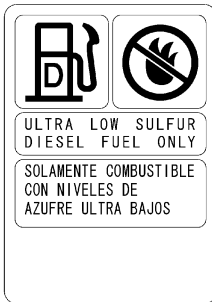
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(1) Part No. K3181-6572-1

Diesel fuel only No fire



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(2) Part No. K3181-6583-2



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(3) Part No. K3441-6566-1



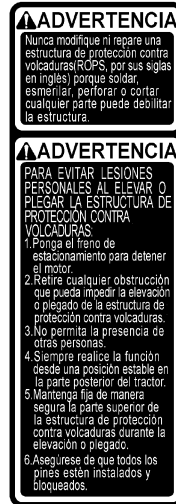
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(4) Part No. K3181-6563-1



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(5) Part No. K3441-6568-1



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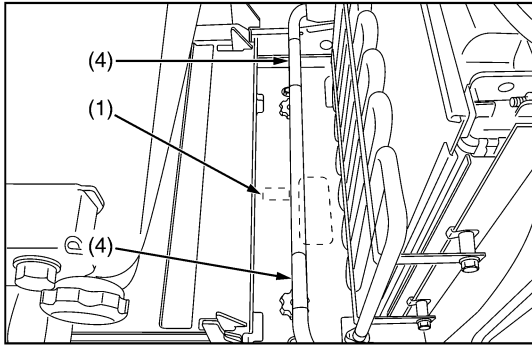
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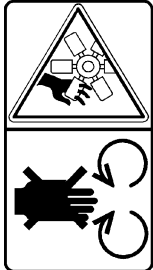
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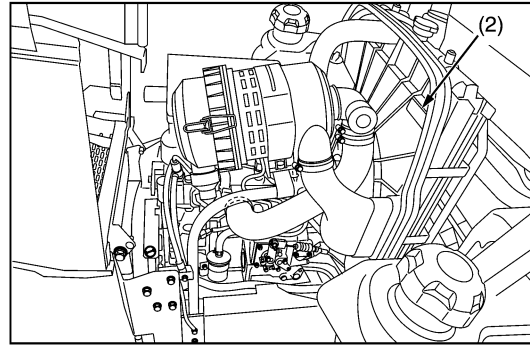


(1) Part No. K3111-6591-1

Do not get your hands close to fan belt.



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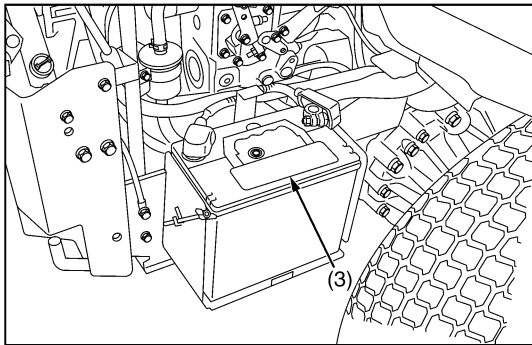


(2) Part No. K3181-6586-1

Do not get your hands close to engine fan and fan belt



1BDABCQAP108A



(3) Part No. K3181-6116-1

(4) Part No. K3441-6593-1

	WARNING	ADVERTENCIA
	TO AVOID PERSONAL INJURY: 1.Keep hands clear of pinch point. 2.Lower hood carefully.	

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FLAMMABLES	SHIELD EYES	KEEP OUT OF THE REACH OF CHILDREN	CAUTION OF SULFURIC ACID	READ INSTRUCTION MANUAL CAREFULLY	EXPLOSIVE
DANGER EXPLOSIVE GASES CIGARETTES, FLAMES OR SPARKS COULD CAUSE BATTERY TO EXPLODE. ALWAYS SHIELD EYES AND FACE FROM BATTERY. DO NOT CHARGE OR USE BOOSTER CABLES OR ADJUST POST CONNECTIONS WITHOUT PROPER INSTRUCTION AND TRAINING. CALIFORNIA PROPOSITION 65 WARNING: Batteries, battery posts, terminals and related accessories contain lead and lead compounds, and other chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. WASH HANDS AFTER HANDLING.			POISON CAUSES SEVERE BURNS CONTAINS SULFURIC ACID. AVOID CONTACT WITH SKIN, EYES OR CLOTHING. IN EVENT OF ACCIDENT, FLUSH WITH WATER AND CALL A PHYSICIAN IMMEDIATELY. KEEP OUT OF REACH OF CHILDREN		
FITTING DATE 0 1 2 3 4 5 6 7 8 9 YEAR			INDICATOR		MADE IN KOREA
1 2 3 4 5 6 7 8 9 10 11 12 MONTH					

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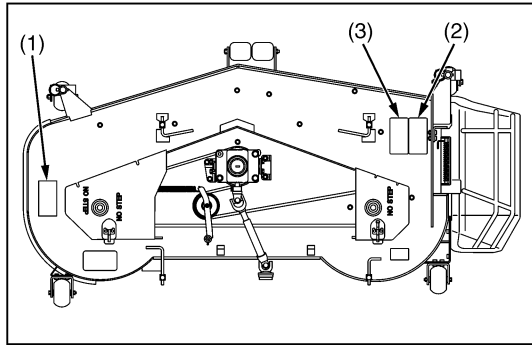
DANGER / POISON

- SHIELD EYES
- EXPLOSIVE GASES can cause blindness or injury.
- NO SPARKS / FLAMES / SMOKING
- SULFURIC ACID can cause blindness or severe burns.
- Flush eyes immediately with water.
- Get medical help fast.

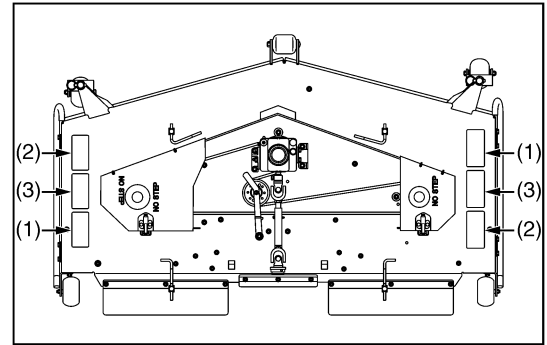
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[RCK60P, RCK72P]



[RCK60R, RCK72R]



(1) Part No. K5681-7312-2



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(2) Part No. K5681-7311-2

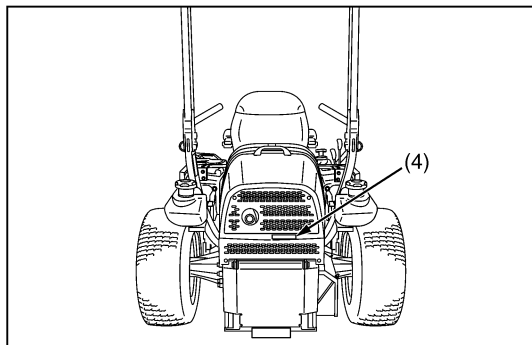


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(3) Part No. K5681-7310-1



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(4) Part No. K3441-6532-1



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9Y1211344INI0004US0

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 replace 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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3. SPECIFICATIONS

Model		ZD1211	ZD1211R	ZD1211L	ZD1211RL	
Engine	Model	D1105				
	Maximum engine power (Gross)	18.5 kw (24.5 HP) (*1) (*2)				
	Type	Liquid-cooled				
	Number of cylinders	3				
	Bore and stroke	78 × 78.4 mm (3.07 × 3.09 in.)				
	Total displacement	1123 cm ³ (68.5 cu.in.)				
	Rated revolution	3000 min ⁻¹ (rpm)				
	Low idling revolution	1400 to 1500 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, 1.2 kW				
	Lubrication	Forced lubrication by gear pump				
	Cooling	Liquid with pressurized radiator				
	Battery	SMF51R (12 V, RC:80 min, CCA:430 A)				
Capacities	Fuel tank	49 L (12.9 U.S.gals., 11 Imp.gals.)				
	Engine crankcase (with filter)	3.9 L (4.1 U.S.qts., 3.4 Imp.qts.)				
	Engine coolant	3.5 L (3.70 U.S.qts., 3.1 Imp.qts.)				
	Recovery tank	0.25 L (0.26 U.S.qts., 0.22 Imp.qts.)				
	Transmission case including rear axle gear case	12.1 L (12.8 U.S.qts., 10.6 Imp.qts.) (*3)				
Dimensions	Overall length	2260 mm (89.0 in.)		2380 mm (93.7 in.)		
	Overall width without mower deck	1510 mm (54.9 in.)		1540 mm (60.6 in.)		
	Overall height	With ROPS upright	2000 mm (78.7 in.)			
		With ROPS folded	1640 mm (64.6 in.)			
	Wheel base	1440 mm (56.7 in.)		1560 mm (61.4 in.)		
	Minimum ground clearance	135 mm (5.31 in.) W/60"		135 mm (5.31 in.) W/72"		
	Tread	Front	1064 mm (41.9 in.)		1250 mm (49.2 in.)	
Rear		1210 mm (47.6 in.)				
Weight (W/O FUEL, W/MOWER DECK)		760 kg (1676 lbs) with 60"	765 kg (1687 lbs) with 60"	790 kg (1742 lbs) with 72"	805 kg (1775 lbs) with 72"	
Travelling system	Tires	Front	15 × 6.0 - 6 (Semi-pneumatic Non Flat Tire) Smooth			
		Rear	26 × 12.0 - 16 (4PR) Turf low profile tire			
	Travelling speeds	Forward	0 to 10.6 mph (0 to 17.0 km/h) (*2)			
		Reverse	0 to 5.3 mph (0 to 8.5 km/h) (*2)			
	Steering	2-Hand levers				
	Transmission	2 - HST w / Gear				
	Parking brake	Wet multi disk / Foot applied, released				
Min. turning radius	0 mm (0 in.)					
PTO	Revolution	1 speed (2540 rpm at 3000 engine rpm)				
	Drive system	Shaft drive, KUBOTA 10 tooth involute spline				
	Clutch type	Wet multi disks				
	PTO brake	Wet multi disks				

(Specifications and design subject to change without notice)

NOTE

- *1: Manufacturer's estimate, SAE J1940
- *2: At 3000 engine rpm [ZD1211, ZD1211R, ZD1211L, ZD1211RL]
- *3: Oil amount when the oil level is at the upper level.

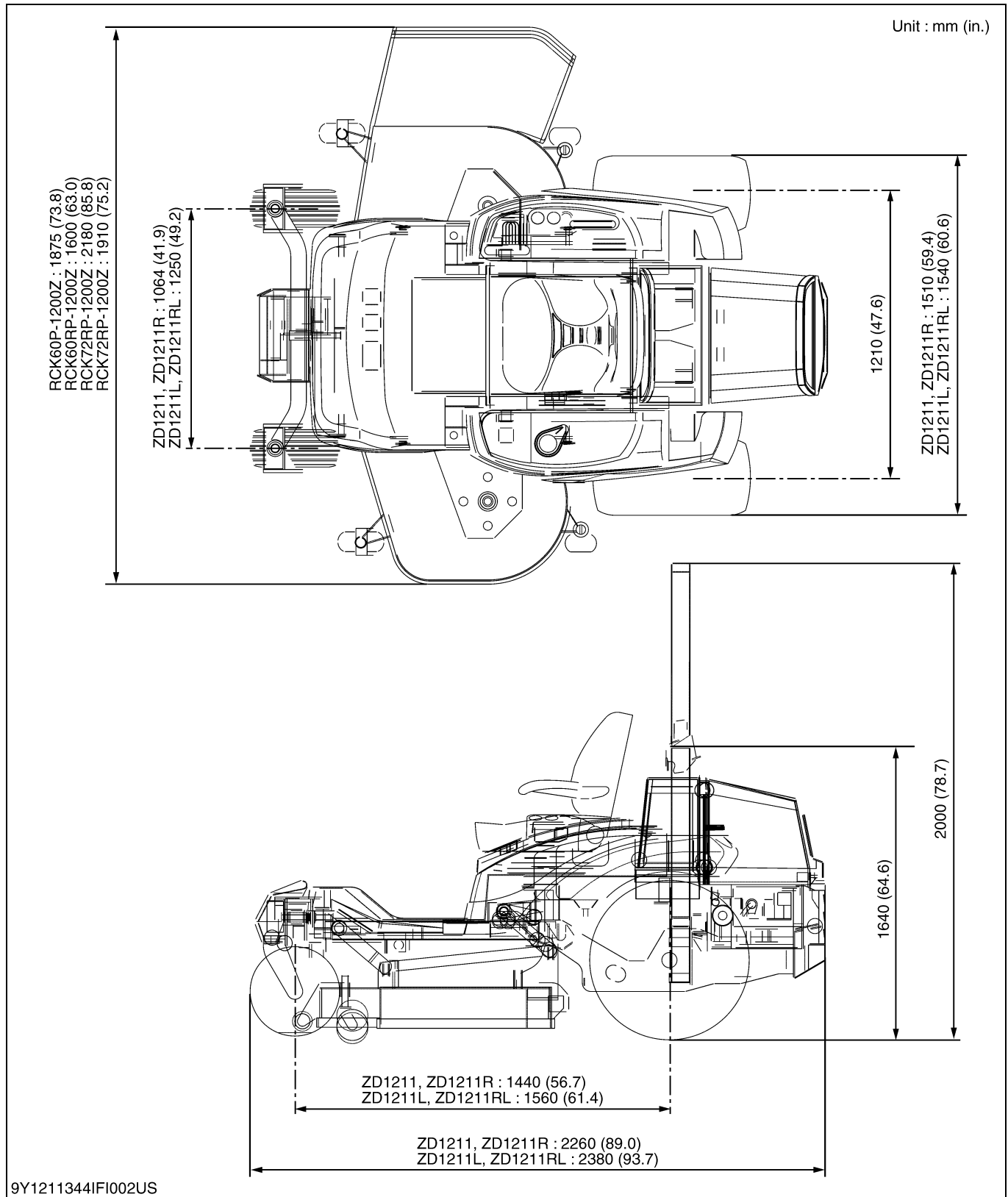
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Model		RCK60P-1200Z	RCK60RP-1200Z	RCK72P-1200Z	RCK72RP-1200Z	
PRO Commercial Deck (Fabricated deck)	Suitable machine	ZD1211	ZD1211R	ZD1211L	ZD1211RL	
	Mounting method	Quick joint, Parallel linkage				
	Adjustment of cutting height	Dial gauge				
	Cutting width	1524 mm (60.0 in.)		1829 mm (72.0 in.)		
	Cutting height	25 to 127 mm (1.0 to 5.0 in.)				
	Weight (Approx.)	140 kg (306 lbs)	145 kg (320 lbs)	165 kg (364 lbs)	160 kg (353 lbs)	
	Blade spindle speed	55.9 r/s (3355 rpm) *1	52.4 r/s (3145 rpm) *1	46.7 r/s (2800 rpm) *1		
	Blade tip velocity	92 m/s (18050 fpm) *1	86 m/s (16900 fpm) *1	92 m/s (18100 fpm) *1	91 m/s (18000 fpm) *1	
	Blade length	523 mm (20.6 in.)		625 mm (24.6 in.)		
	Number of blades	3				
	Mower gear box capacity	0.5 L (0.53 U.S.qts., 0.4 Imp.qts.)	0.4 L (0.42 U.S.qts., 0.4 Imp.qts.)	0.5 L (0.53 U.S.qts., 0.4 Imp.qts.)	0.4 L (0.42 U.S.qts., 0.4 Imp.qts.)	
	Dimensions	Total length	974 mm (38.4 in.)	1000 mm (39.4 in.)	1162 mm (45.8 in.)	1155 mm (45.5 in.)
		Total width	1876 mm (73.9 in.)	1600 mm (63.0 in.)	2180 mm (85.8 in.)	1910 mm (75.2 in.)
Total height		426 mm (16.8 in.)	420 mm (16.5 in.)	421 mm (16.6 in.)	413 mm (16.3 in.)	

*1: Engine Max rpm

9Y1211344INI0007US0

4. DIMENSIONS



G GENERAL

GENERAL

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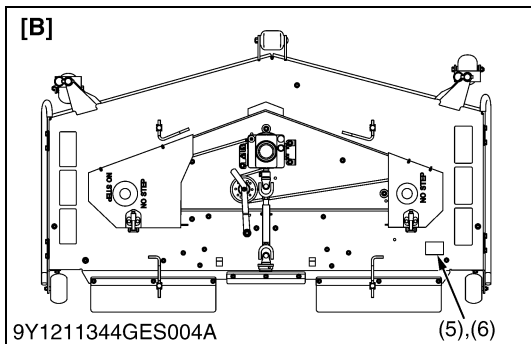
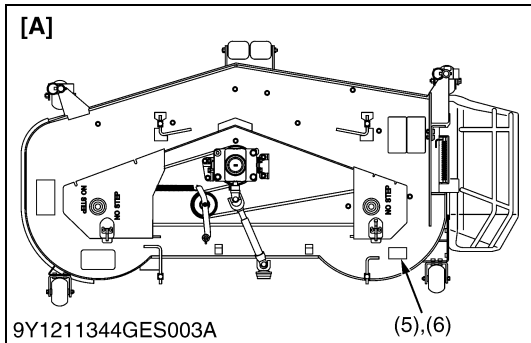
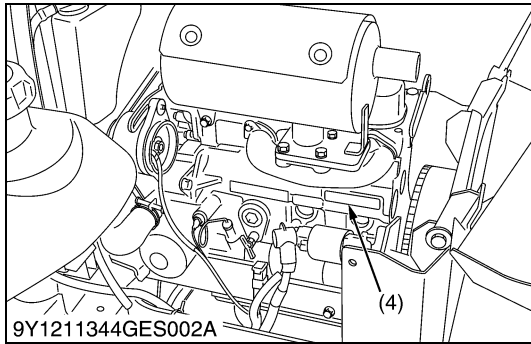
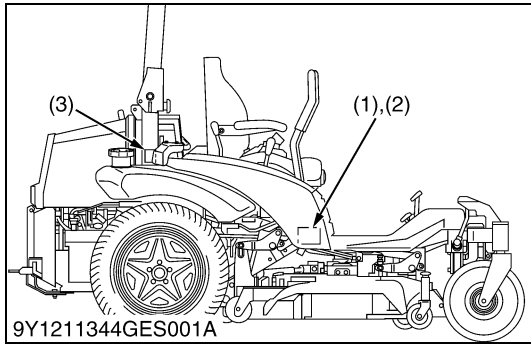
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1. IDENTIFICATION

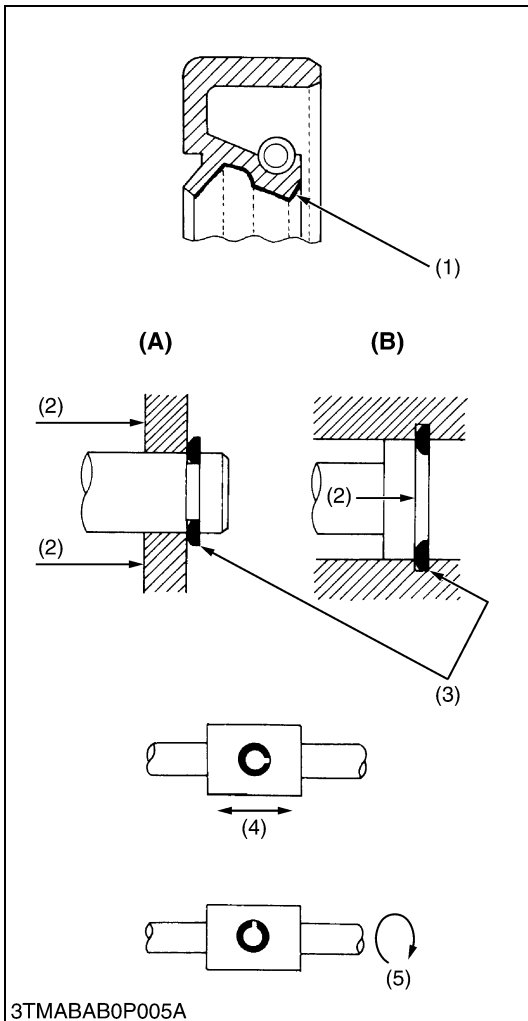
When contacting your local KUBOTA distributor, always specify engine serial number (3), machine serial number (2), mower serial number (4) and hour meter reading.

- (1) Machine Identification Plate **[A] RCK60P, RCK72P**
- (2) Machine Serial Number **[B] RCK60R, RCK72R**
- (3) ROPS Serial Number
- (4) Engine Serial Number
- (5) Mower Identification Plate
- (6) Mower Serial Number

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2. GENERAL PRECAUTIONS



- When you disassemble, carefully put the parts in a clean area to make it easy to find the parts. You must install the screws, bolts and nuts in their initial position to prevent the reassembly errors.
- When it is necessary to use special tools, use KUBOTA special tools. Refer to the drawings when you make special tools that you do not use frequently.
- Before you disassemble or repair machine, make sure that you always disconnect the ground cable from the battery first.
- Remove oil and dirt from parts before you measure.
- Use only KUBOTA genuine parts for replacement to keep the machine performance and to make sure of safety.
- You must replace the gaskets and O-rings when you assemble again. Apply grease (1) to new O-rings or oil seals before you assemble.
- When you assemble the external or internal circlips, make sure that the sharp edge (3) faces against the direction from which force (2) is applied.
- When inserting spring pins, their splits must face the direction from which a force is applied. See the figure on the left side.
- To prevent damage to the hydraulic system, use only specified fluid or equivalent.

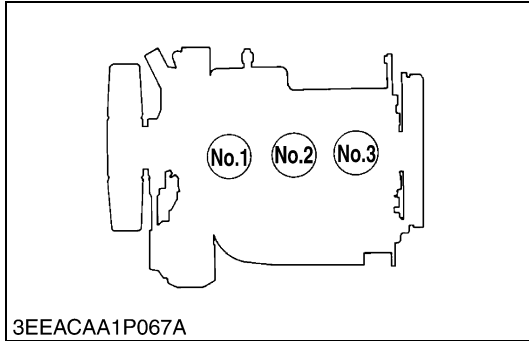
- (1) Grease
- (2) Force
- (3) Sharp Edge
- (4) Axial Force
- (5) Rotating Movement

- (A) External Circlip
- (B) Internal Circlip

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3TMABAB0P005A

3. CYLINDER NUMBER

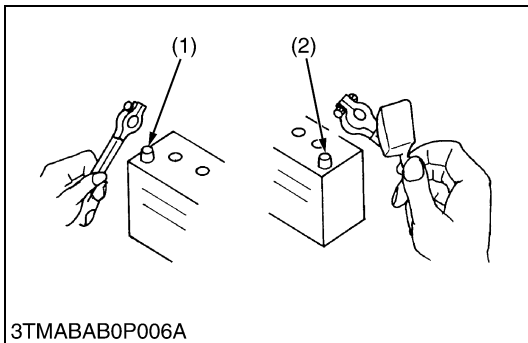


The cylinder numbers of KUBOTA diesel engine are designated as shown in the figure.

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

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4. HANDLING PRECAUTIONS FOR ELECTRICAL PARTS AND WIRING



3TMABAB0P006A

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

■ **IMPORTANT**

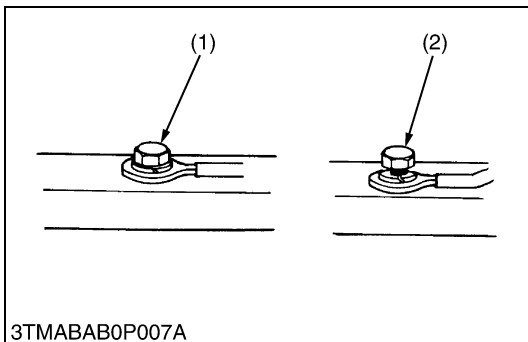
- Check electrical wiring for damage and loosened connection every year. To this end, educate the customer to do his or her own check and at the same time recommend the dealer to perform periodic check for a fee.
- Do not try to modify or remodel any electrical parts and wiring.
- When removing the battery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

(1) Negative Terminal

(2) Positive Terminal

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[1] WIRING



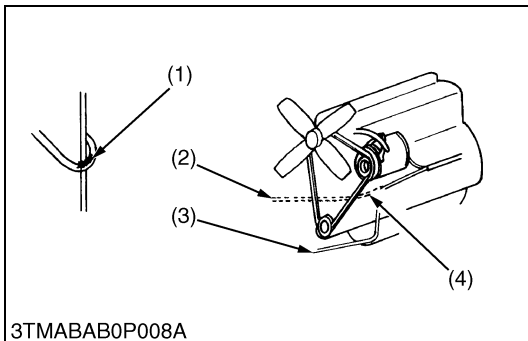
3TMABAB0P007A

- Securely tighten wiring terminals.

(1) Correct
(Securely Tighten)

(2) Incorrect
(Loosening Leads to damaged Contact)

WSM000001GEG0063US0



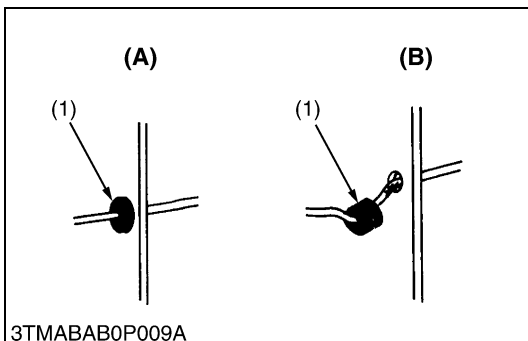
3TMABAB0P008A

- Do not let wiring contact dangerous part.

(1) Dangerous Part (Sharp Edge)
(2) Wiring (Incorrect)

(3) Wiring (Correct)
(4) Dangerous Part

WSM000001GEG0064US0



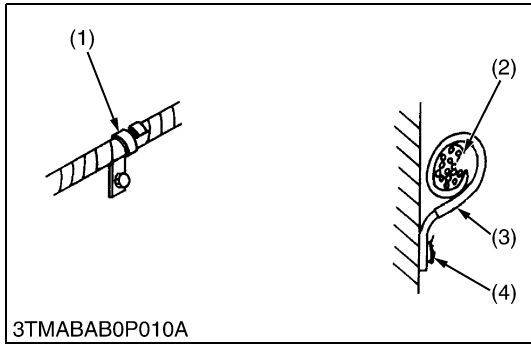
3TMABAB0P009A

- Securely insert grommet.

(1) Grommet

(A) Correct
(B) Incorrect

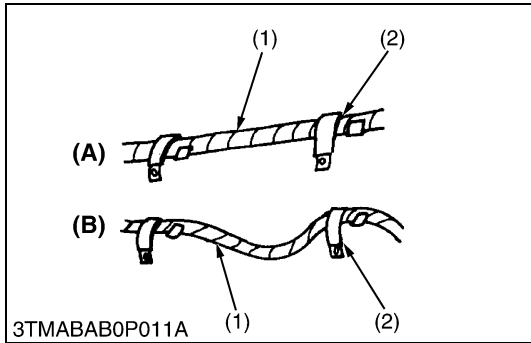
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- Securely clamp, being careful not to damage wiring.

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

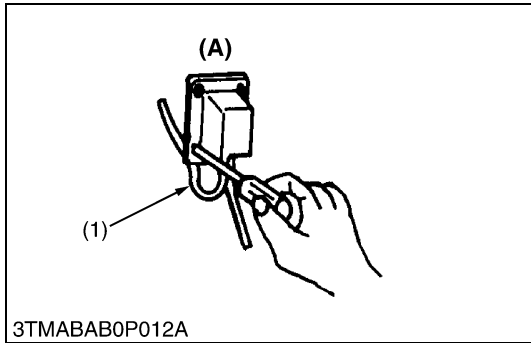
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- Clamp wiring so that there is no twist, unnecessary sag, or excessive tension, except for movable part, where sag be required.

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

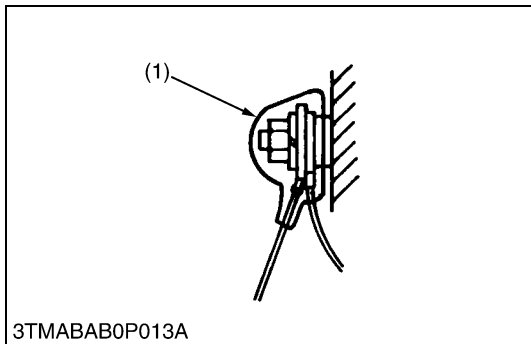
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- In installing a part, be careful not to get wiring caught by it.

- (1) Wiring (A) Incorrect

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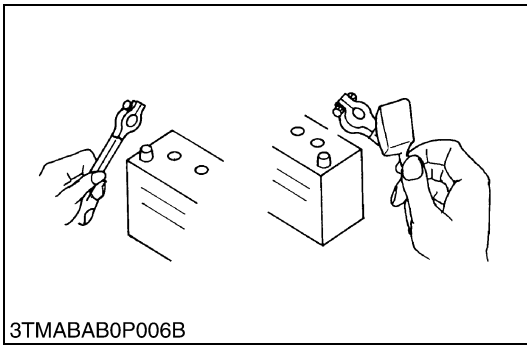


- After installing wiring, check protection of terminals and clamped condition of wiring.

- (1) Cover (Securely Install Cover)

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[2] BATTERY



3TMABAB0P006B

- Be careful not to confuse positive and negative terminal posts.
- When you remove battery cables, disconnect negative cable first. When you install battery cables, check for polarity and connect positive cable first.
- Do not install any battery with capacity other than is specified (Ah).
- After you connect 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.

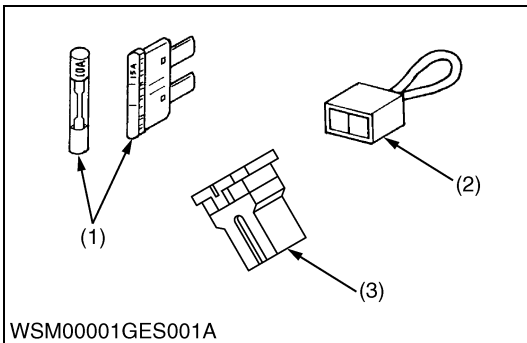
⚠ DANGER

To avoid serious injury or death:

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

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[3] FUSE



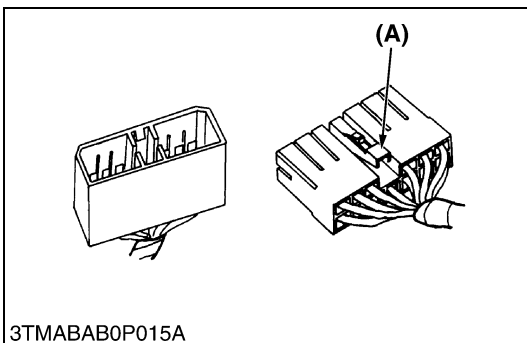
WSM00001GES001A

- Use fuses with specified capacity. Neither too large nor small capacity fuse is acceptable.
- Never use steel nor 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) Fusible Link (3) Slow Blow Fuse

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[4] CONNECTOR

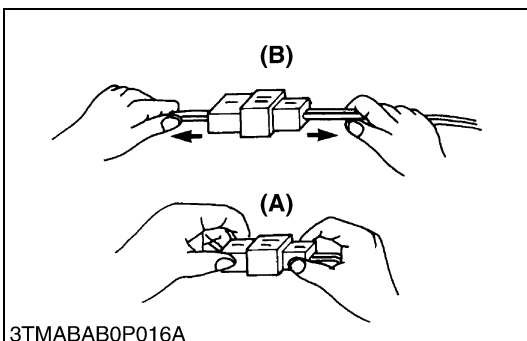


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- For connector with lock, push lock to separate.

(A) Push

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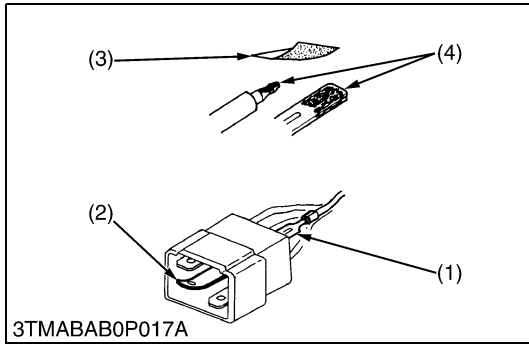


3TMABAB0P016A

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

(A) Correct (B) Incorrect

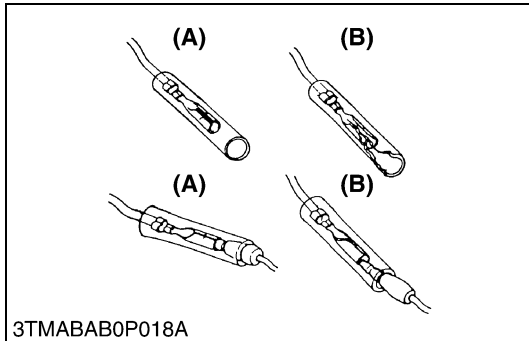
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- Use sandpaper to remove rust from terminals.
- Repair deformed terminal. Make sure that there is no terminal being exposed or displaced.

- (1) Exposed Terminal
- (2) Deformed Terminal
- (3) Sandpaper
- (4) Rust

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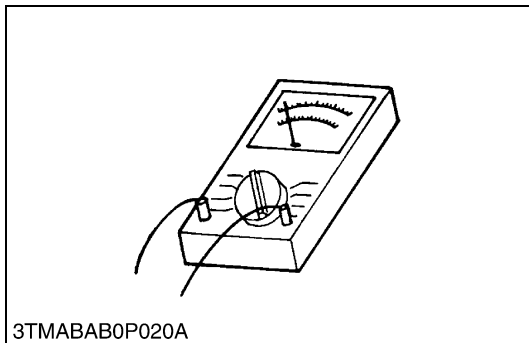


- Make sure that there is no female connector being too open.

- (A) Correct
- (B) Incorrect

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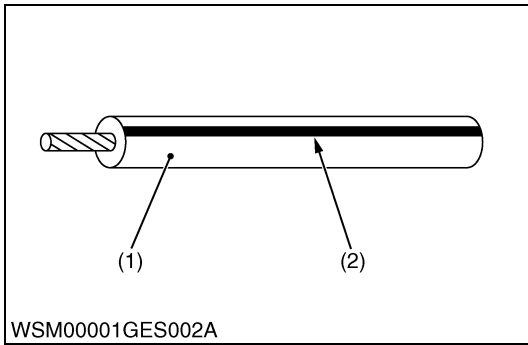
[5] HANDLING OF CIRCUIT TESTER



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

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[6] COLOR OF WIRING



- Colors of wire are specified to the color codes.
- This symbol of "/" shows color with stripe (s).

(An example)

Red stripe on white color: W/R

Color of wiring	Color code
Black	B
Brown	Br
Green	G
Gray	Gy or Gr
Blue	L
Light Green	Lg
Orange	Or
Pink	P
Purple	Pu or V
Red	R
Sky Blue	Sb
White	W
Yellow	Y

(1) Wire Color

(2) Stripe

WSM000001GEG0079US0

5. LUBRICANTS, FUEL AND COOLANT

No.	Place	Capacity				Lubricants
		ZD1211	ZD1211R	ZD1211L	ZD1211 RL	
1	Fuel	50 L (13.1 U.S.gals. 11 Imp.gals.)				<ul style="list-style-type: none"> No. 2-D diesel fuel No. 1-D diesel fuel if temperature is below -10 °C (14 °F)
2	Coolant	3.5 L (3.70 U.S.qts. 3.1 Imp.qts.)				Fresh clean water with anti-freeze
3	Recovery tank	0.25 L (0.26 U.S.qts. 0.2 Imp.qts.)				
4	Engine crankcase	3.9 L (4.1 U.S.qts. 3.4 Imp.qts.)*1				<ul style="list-style-type: none"> Engine oil: API service Classification CF or better Above 25 °C...SAE30, SAE10W-30 or 15W-40 (77 °F) 0 to 25 °C.....SAE20, SAE10W-30 or 15W-40 (32 to 77 °F) Below 0 °C.....SAE10W, SAE10W-30 or 15W-40 (32 °C)
5	Transmission case with filter & hose Rear axle gear case (RH & LH)	12.1 L (12.8 U.S.qts. 10.6 Imp.qts.)				•KUBOTA SUPER UDT-2 fluid*2
6	Mower gear box	0.5 L (0.53 U.S.qts. 0.4 Imp.qts.)	0.4 L (0.42 U.S.qts. 0.4 Imp.qts.)	0.5 L (0.53 U.S.qts. 0.4 Imp.qts.)	0.4 L (0.42 U.S.qts. 0.4 Imp.qts.)	ZD1211, ZD1211L Engine oil: API service Classification SH, SJ or higher SAE10W-30 ZD1211R, ZD1211RL SAE90 gear oil (API service classification: more than GL-3)

NOTE

- *1 Oil amount when the oil level is at the upper level of the oil level gauge.
- *2 The product name of KUBOTA genuine UDT fluid may be different from that in the Operator's Manual depending on countries or territories.

IMPORTANT

- To prevent serious damage to hydraulic systems, use only KUBOTA genuine fluid or its equivalent.

Greasing				
No.	Place	No. of greasing point	Capacity	Type of grease
7	King Pin	2	Until grease overflows	• Multipurpose EP2 Grease (NLGI Grade No.2)
8	Center pin	1		
9	Front wheel	2		
10	Rear mower link bushing	4		
11	Front mower link bushing	2		
12	Universal joint	3		
13	Seat adjuster	2		
14	Parking brake lock pedal	1		
15	Cable (throttle)	2	Moderate amount	• Oil
[Mower]				
16	Universal joint	3	Until grease overflows	• Multipurpose EP2 Grease (NLGI Grade No.2)
17	Three spindle shafts	3		
18	Belt tension pulley	1		
19	Belt tension pivot	1		
20	Front anti scalp roller pivot boss	2		
21	Front anti scalp roller	2		

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■ **NOTE**

Fuel

- **Cetane number of 45 is minimum. Cetane number greater than 50 is preferred, especially for temperatures below -20 °C (-4 °F) or elevations above 1500 m (5000 ft).**
- **Diesel fuels specified to EN 590 or ASTM D975 are recommended.**
- **No.2-D is a distillate fuel of lower volatility for engines in industrial and heavy mobile service. (SAE J313 JUN87)**

Engine Oil

- **Oil used in the engine must have an American Petroleum Institute (API) service classification and Proper SAE Engine Oil according to the ambient temperatures as shown above:**
- **Refer to the following table for the suitable API classification engine oil according to the engine type (with internal EGR, external EGR or non-EGR) and the fuel.**

Fuel used	Engine oil classification (API classification)	
	Oil class of engines except external EGR	Oil class of engines with external EGR
Ultra Low Sulfur Fuel [<0.0015 % (15 ppm)]	CF, CF-4, CG-4, CH-4 or CI-4	CF or CI-4 (Class CF-4, CG-4 and CH-4 engine oils cannot be used on EGR type engines)

EGR: Exhaust Gas Re-circulation

- **The CJ-4 engine oil is intended for DPF (Diesel Particulate Filter) type engines, and cannot be used on this machine.**

	except external EGR	with external EGR
Models	ZD1211, ZD1211R, ZD1211L, ZD1211RL	—

Transmission Oil

- **KUBOTA Super UDT-2: For an enhanced ownership experience, we highly recommend Super UDT-2 to be used instead of standard hydraulic/transmission fluid. Super UDT-2 is a proprietary KUBOTA formulation that delivers superior performance and protection in all operating conditions. Regular UDT is also permitted for use in this machine.**

- **Indicated capacities of water and oil are manufacturer's estimate.**

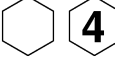
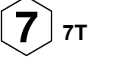
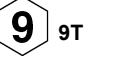
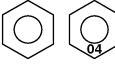
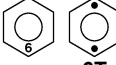
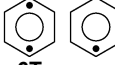
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6. TIGHTENING TORQUES

Tighten screws, bolts and nuts whose tightening torques are not specified in this Workshop Manual according to the table below.

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[1] GENERAL USE SCREWS, BOLTS AND NUTS

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

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[2] STUD BOLTS

Material of opponent part	Ordinariness			Aluminum		
Unit	N-m	kgf-m	lbf-ft	N-m	kgf-m	lbf-ft
M8	12	1.2	8.7	8.9	0.90	6.5
	to 15	to 1.6	to 11	to 11	to 1.2	to 8.6
M10	25	2.5	18	20	2.0	15
	to 31	to 3.2	to 23	to 25	to 2.6	to 18
M12	30	3.0	22	31	3.2	23
	to 49	to 5.0	to 36			
M14	62	6.3	46	-	-	-
	to 73	to 7.5	to 54			
M16	98.1	10.0	72.4	-	-	-
	to 112	to 11.5	to 83.1			
M18	172	17.5	127	-	-	-
	to 201	to 20.5	to 148			

WSM000001GEG0002US0

[3] METRIC SCREWS, BOLTS AND NUTS

Grade	8.8 Property class 8.8			10.9 Property class 10.9			
	Unit	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	76.0 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



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

Grade	SAE GR.5			SAE GR.8			
	Unit	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft
1/4		11.7 to 15.7	1.20 to 1.60	8.63 to 11.5	16.3 to 19.7	1.67 to 2.00	12.0 to 14.6
5/16		23.1 to 27.7	2.36 to 2.82	17.0 to 20.5	33 to 39	3.4 to 3.9	25 to 28
3/8		48 to 56	4.9 to 5.7	36 to 41	61 to 73	6.3 to 7.4	45 to 53
1/2		110 to 130	11.3 to 13.2	81.2 to 95.8	150 to 178	15.3 to 18.1	111 to 131
9/16		150 to 178	15.3 to 18.1	111 to 131	217 to 260	22.2 to 26.5	160 to 191
5/8		204 to 244	20.8 to 24.8	151 to 179	299 to 357	30.5 to 36.4	221 to 263

WSM000001GEG0008US0

[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 19	1.3 to 2.0	9.4 to 14
	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 to 58	5.0 to 6.0	37 to 43
	R1/2	58.9 to 107	6.00 to 11.0	43.4 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	–	–	–

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7. MAINTENANCE CHECK LIST

■ IMPORTANT

- The jobs indicated by ★ must be done initially.
- *1: The initial 50 hours should not be a replacement cycle.
- *2: Air cleaner must be cleaned more often in dusty conditions than in normal conditions.
- *3: Every 1000 hours or every 1 year whichever comes faster.
- *4: Replace if any deterioration (crack, hardening, scar, or deformation) or damage occurred.
- *5: Every 2000 hours or every 2 years whichever comes faster.
- *6: When the battery is used for less than 100 hours per year, check the battery condition by reading the indicator annually.
- *7: The initial 100 hours should not be a replacement cycle.
- 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.

No.	Item		Service Interval												After since	Refer-ence page			
			50	100	150	200	250	300	350	400	450	500	550	600					
1	Engine start system	Check	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	every 50 Hr	G-25		
2	OPC system	Check	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	every 50 Hr	G-26		
3	Mower gear box oil	Check	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	every 50 Hr	G-28		
		Change			☆			☆			☆			☆		every 150 Hr	G-28		
4	Greasing (except mower and mower link bushings)	—	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	every 50 Hr	G-27		
5	Throttle cable	Oil	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	every 50 Hr	G-28		
6	Greasing (mower link bushings, pivot)	—		☆		☆		☆		☆		☆		☆		every 100 Hr	G-34		
7	Air cleaner primary element	Clean		☆		☆		☆		☆		☆		☆		every 100 Hr	G-29	*2	@
		Replace															every 1000 Hr or 1 year	G-35	
	Secondary element	Replace															every 1000 Hr or 1 year	G-35	
8	Fuel filter element	Check		☆		☆		☆		☆		☆		☆		every 100 Hr	G-32		@
		Replace									☆						every 400 Hr	G-32	
9	Fan belt	Adjust		☆		☆		☆		☆		☆		☆		every 100 Hr	G-32		
10	Parking brake	Adjust		☆		☆		☆		☆		☆		☆		every 100 Hr	G-33		
11	Battery condition	Check		☆		☆		☆		☆		☆		☆		every 100 Hr	G-30	*6	
12	Engine oil	Change	★			☆				☆				☆		every 200 Hr	G-22	*1	
13	Engine oil filter	Replace	★			☆				☆				☆		every 200 Hr	G-22	*1	
14	Transmission oil filter [HST]	Replace	★			☆				☆				☆		every 200 Hr	G-23	*1	
15	Front axle pivot	Adjust		★		☆				☆				☆		every 200 Hr	G-23	*7	
16	Transmission fluid and rear axle gear case (RH and LH) fluid	Change								★						every 400 Hr	G-24		

No.	Item		Service Interval													After since	Refer-ence page			
			50	100	150	200	250	300	350	400	450	500	550	600						
17	Hydraulic oil filter	Replace									☆						every 400 Hr	G-35		
18	Engine valve clearance	Adjust															every 800 Hr	1-S12		
19	Fuel injection nozzle injection pressure	Check															every 1500 Hr	1-S18	@	
20	Radiator	Clean															every 2000 Hr or 2 years	G-36	*5	
21	Coolant	Change															every 2000 Hr or 2 years	G-36	*5	
22	Injection pump	Check															every 3000 Hr	1-S16	@	
23	Fuel line	Check															every 1 years	G-32	*3	@
		Replace															every 4 years	G-32	*4	
24	Radiator hose and clamp	Check															every 1 years	G-39	*3	
		Replace															every 4 years	G-39	*4	
25	Hydraulic hose	Check															every 1 years	G-39	*3	
		Replace															every 4 years	G-39	*4	
26	Intake air line	Check															every 1 years	G-40	*3	@
		Replace															every 4 years	G-40	*4	
27	Engine breather hose	Check															every 1 years	G-40	*3	
		Replace															every 4 years	G-41	*4	
28	Mower gear box oil seal	Check															every 1 years	G-40	*3	
		Replace															every 4 years	G-41	*4	
29	Fuel system	Bleed																G-44		
30	Fuse	Replace															Service as required	G-41		
31	Blade	Replace																G-43		
32	Mower belt	Replace																G-44		

9Y1211344GEG0006US0

8. CHECK AND MAINTENANCE



WARNING

To avoid serious injury:

- Be sure to check and service the machine on a level surface with the engine shut off, the key removed and the parking brake securely set or chock the rear wheels.

9Y1211344GEG0007US0

[1] DAILY CHECK

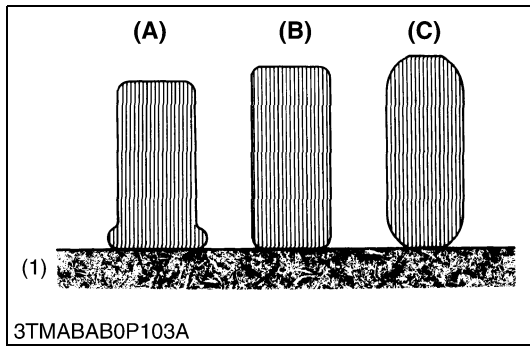
To prevent trouble from occurring, it is important to know the condition of the machine. Check the following items before starting.

9Y1211344GEG0008US0

Checking

- Walk around the machine.
 1. Tire pressure, wear and damage
 2. Oil and water leak
 3. Fuel level
 4. Engine oil level
 5. Transmission fluid level
 6. Coolant level in the radiator and the recovery tank
 7. Damage of machine body, tightness of all bolts and nuts
 8. Machine body cleaning
 9. Radiator screen
 10. Hood screen
 11. Brake play
 12. Oiling
 13. Air cleaner primary element
- Mower
 1. Oil leak
 2. Make sure blade bolts are tight.
 3. Belt and blades wear or damage
 4. Check all hardware
 5. Make sure all pins are in place.
 6. Mower deck cleaning
 7. Greasing
 - Universal joint
 - 3 spindle shafts
 - Belt tension pulley
 - Belt tension pivot
 - Front anti-scalp roller pivot boss
 - Front anti-scalp roller
- 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 systems.
If either of these do not operate properly, contact your local KUBOTA Dealer immediately.
 3. Check for abnormal noise and vibration.
- Others
 1. Check the areas where previous trouble was experienced.

9Y1211344GEG0009US0



Checking Tire Pressure

⚠ WARNING

To avoid personal injury:

- Do not try to mount a tire on a rim. This should be done by a qualified person with the proper equipment.
- Always keep 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

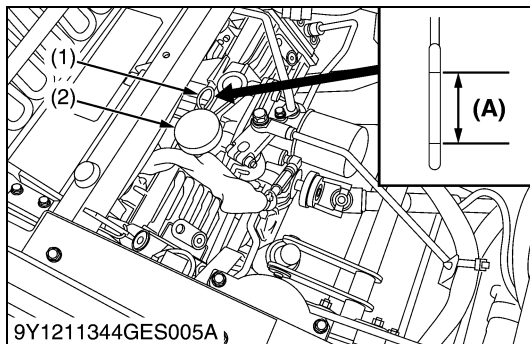
Though the inflation pressure is factory-set to the prescribed level, it naturally drops slowly in the course of time. Thus, check it and inflate as necessary.

	Tire Sizes	Recommended Inflation Pressure
Front	15 × 6.0 - 6, (Semi-pneumatic Non Flat Tire) Smooth	-
Rear	26 × 12.0 - 16, 4PR Turf low profile tire	83 kPa (0.84 kgf/cm ² , 12 psi)

(1) Ground

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

9Y1211344GEG0010US0



Checking Transmission Fluid Level

⚠ WARNING

To avoid serious injury:

- Allow the transmission case to cool down sufficiently when cleaning its surface.

1. Park the machine on a flat surface, lower the implement to the ground and shut off engine and remove the key. Allow machine to idle 1-3 minutes, and then check fluid.
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 "5. LUBRICANTS, FUEL AND COOLANT" on page G-9.)

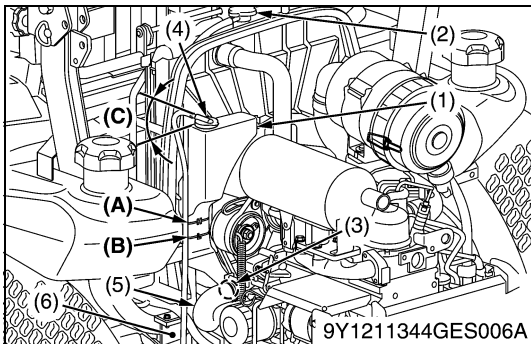
■ IMPORTANT

- 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.

9Y1211344GEG0011US0



Checking Coolant Level

⚠ WARNING

To avoid serious 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 starting 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.

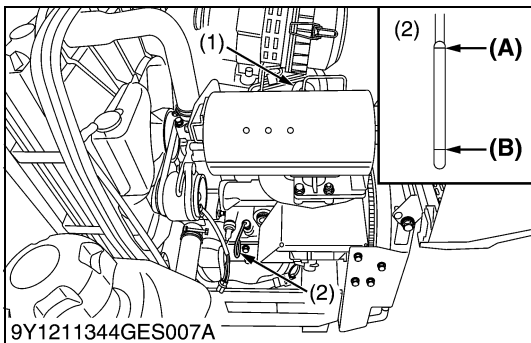
(See page G-9.)

■ 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.
- Set the direction of the recovery tank cap outlet at left front (45 °). Set the bottom tip of the hose between front side of radiator hose and inner side of the frame.(This will prevent the hose from pulling down and open the recovery tank cap.)

- | | |
|-----------------------|------------|
| (1) Recovery Tank | (A) "FULL" |
| (2) Radiator Cap | (B) "LOW" |
| (3) Drain Plug | (C) 45 ° |
| (4) Recovery Tank Cap | |
| (5) Radiator Hose | |
| (6) Frame | |

9Y1211344GEG0012US0



Checking Engine Oil Level

⚠ WARNING

To avoid serious 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-9.)

- | | |
|------------------------|-----------------|
| (1) Engine Oil Port | (A) Upper Level |
| (2) Oil Level Dipstick | (B) Lower Level |

9Y1211344GEG0013US0



Checking Amount of Fuel and Refueling

⚠ CAUTION

To avoid personal injury:

- Handle fuel carefully. If the engine is running, do not fill the fuel tank. If engine is hot, let engine cool several minutes before adding fuel.

Do not smoke while filling the fuel tank or servicing the fuel system. Fill fuel tank only to bottom of filler neck.

Check the fuel level. Be careful that the fuel tank does not become empty.

Fuel tank capacity	50 L 13 U.S.gals 11 Imp.gals
--------------------	------------------------------------

■ IMPORTANT

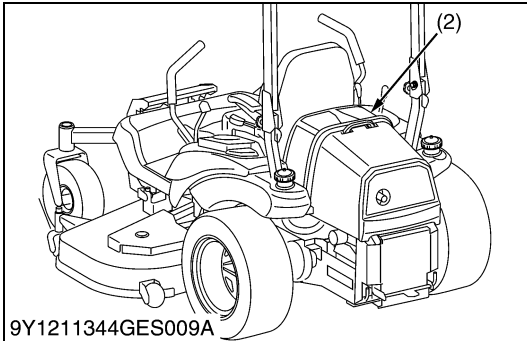
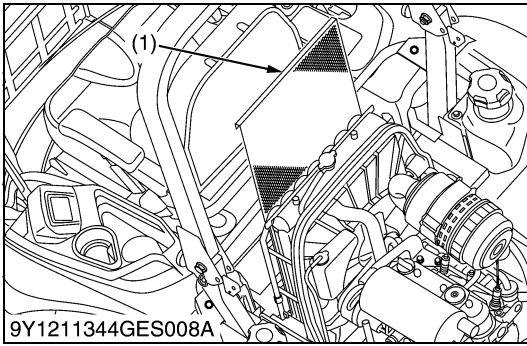
- **Use Diesel Fuel Only.**

1. Use No.2-D diesel fuel.
2. Use No.1-D diesel fuel if the temperature is below -10°C (14°F).
3. Always use a strainer when refueling to prevent fuel injection pump contamination.

■ IMPORTANT

- Do not permit dirt or trash or water to get into the fuel system.
- Be careful not to let the fuel tank become empty, otherwise air will enter the fuel system, necessitating bleeding before next engine start.
- Be careful not to spill fuel during refueling. If a spill should occur, wipe it off at once, or it may cause a fire.
- To prevent condensation (water accumulation) in the fuel tank, fill the tank before parking overnight.
- When refueling, basically fill both fuel tanks full.
- In the case you have a small amount of fuel, if fuel is still in the fuel tank RH, fill the fuel tank LH first.
- The fuel gauge shows the fuel level of fuel tank RH.
When the fuel gauge flashes, fill fuel as soon as possible.
- When the fuel gauge flashes, do not fill fuel on a slope.
Fuel can absorb air and the engine can stall.

9Y1211344GEG0014US0



Checking and Cleaning Radiator to Prevent Overheating

! WARNING

To avoid serious injury:

- Engine components can get extremely hot from operation. To prevent severe burns, do not touch these areas while the engine is running, or immediately after it is turned off. Never operate the engine without heat shields or guards.
- 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 page G-32
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.

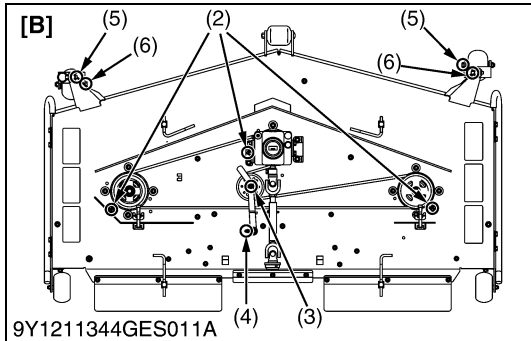
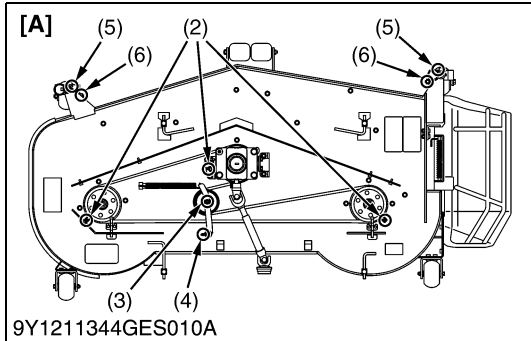
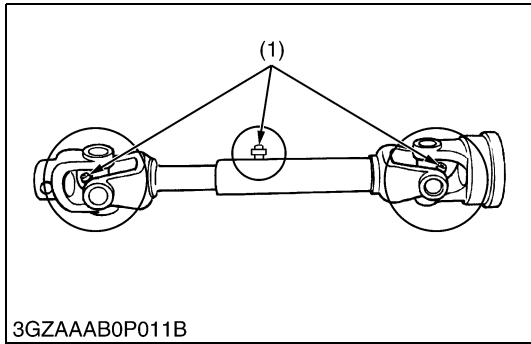
■ NOTE

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

(1) Radiator Screen

(2) Bonnet Screen

9Y1211344GEG0015US0



Greasing (Mower)

⚠ CAUTION

To avoid personal injury:

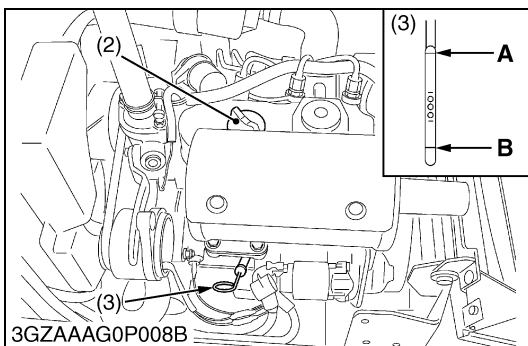
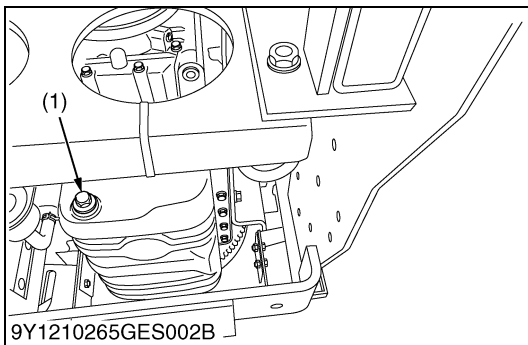
- Be sure to stop the engine and remove the key before greasing.

1. Apply grease to the following position as figures.

- | | |
|--|--------------------|
| (1) Mower Universal Joint | [A] RCK60P, RCK72P |
| (2) Spindle Shaft | [B] RCK60R, RCK72R |
| (3) Belt Tension Pulley | |
| (4) Belt Tension Pivot | |
| (5) Front Anti-scalp Roller Pivot Boss | |
| (6) Front Anti-scalp Roller | |

9Y1211344GEG0016US0

[2] CHECK POINTS OF INITIAL 50 HOURS



Changing Engine Oil

⚠ WARNING

To avoid serious injury:

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

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

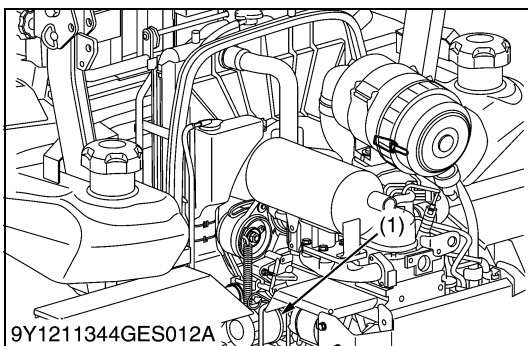
- When using oil of different manufacture or viscosity from the previous one, remove all of the old oil.
- Never mix two different type of oil.
- Use the proper SAE engine oil according to ambient temperatures.

Refer to "LUBRICANTS, FUEL AND COOLANT".
(See page G-9.)

Engine oil capacity	3.9 L 4.1 U.S.qts 3.4 Imp.qts
---------------------	-------------------------------------

- | | |
|--------------------|-----------------------|
| (1) Drain Plug | A: Upper Level |
| (2) Oil Inlet Plug | B: Lower Level |
| (3) Dipstick | |

9Y1211344GEG0017US0



Replacing Engine Oil Filter Cartridge

⚠ WARNING

To avoid serious injury:

- 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.

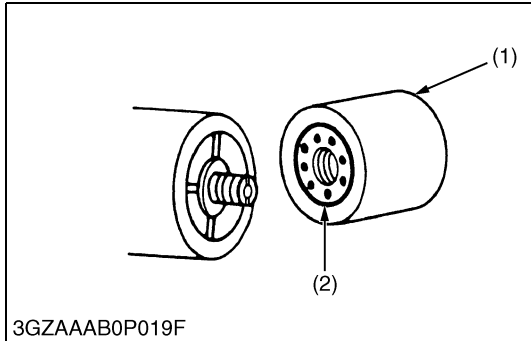
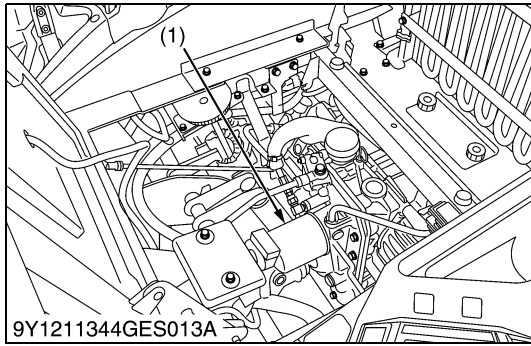
1. Remove the engine oil filter cartridge (1) with the filter wrench.
2. Apply a slight coat of oil onto the rubber gasket of new cartridge.
3. To install the new cartridge, screw it in by hand. Tighten the filter quickly until it contacts the mounting surface. Tighten filter by hand an additional 1/2 turn only. 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

9Y1211344GEG0018US0



Replacing HST Transmission Oil Filter Cartridge

! WARNING

To avoid serious injury:

- 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.

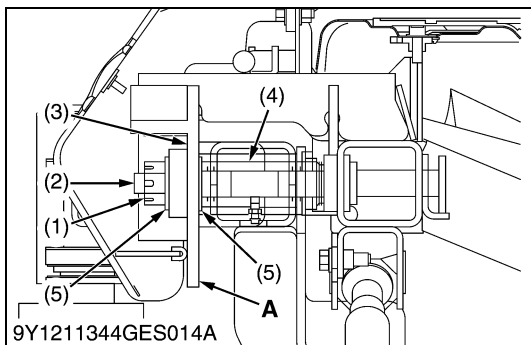
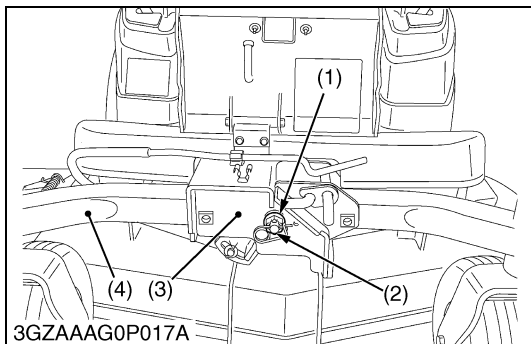
■ IMPORTANT

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

- (1) HST Transmission Oil Filter Cartridge (2) Gasket

9Y1211344GEG0019US0

[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.

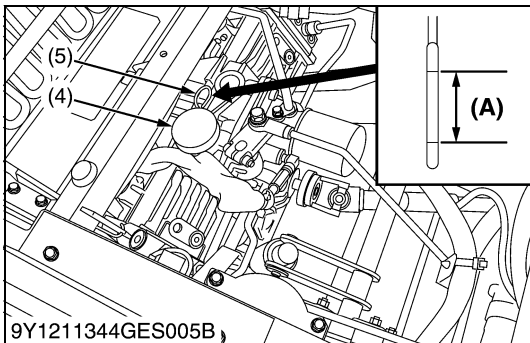
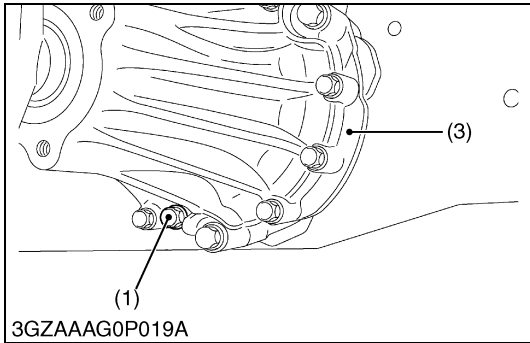
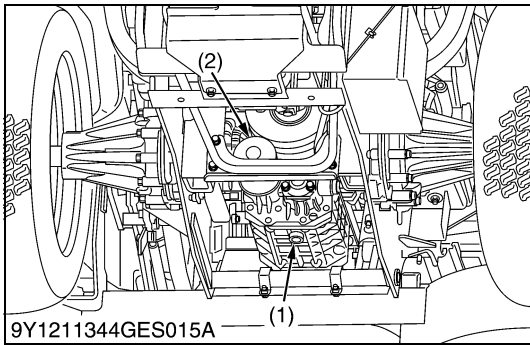
Front axle end play (A)	Factory specification	0 to 0.2 mm 0 to 0.008 in.
	Allowable limit	0.5 mm 0.02 in.

A: Front Axle End Play

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

9Y1211344GEG0020US0

[4] CHECK POINT OF INITIAL 400 HOURS



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

⚠ WARNING

To avoid serious 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 ensure 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-9.)
- Do not mix different brands oil together.

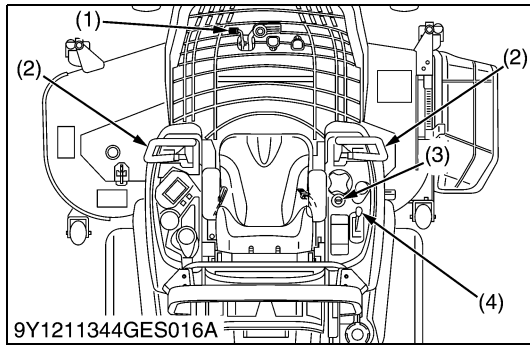
Transmission fluid capacity (with filter and hose)	12.1 L
	12.8 U.S.qts
	10.6 Imp.qts

- (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.

9Y1211344GEG0021US0

[5] CHECK POINTS OF EVERY 50 HOURS



Checking Engine Start System



WARNING

To avoid serious 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 (2) 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 them 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. Keep the parking brake securely set.
3. Shift the PTO lever (4) to "DISENGAGE" (OFF) position.
4. Grasp the motion control levers (2) and move them 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.

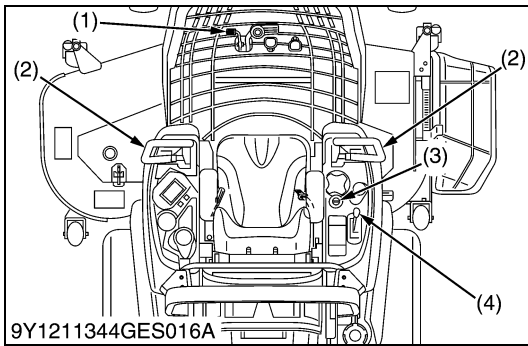
(1) Parking Brake Lock Pedal

(3) Key Switch

(2) Motion Control Lever

(4) PTO Lever

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Checking OPC System

The OPC (Operator Presence Control) system in your machine are designed to protect you while operating. Please check these OPC system periodically. It is recommended to check the OPC system before daily operation.



WARNING

To avoid serious 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.

■ Test 1 (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.

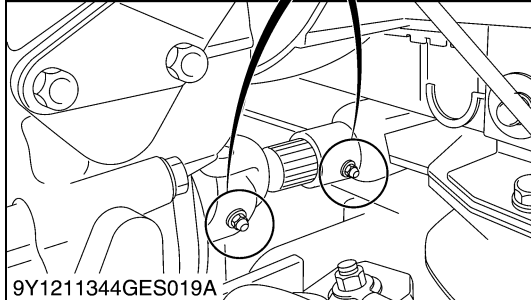
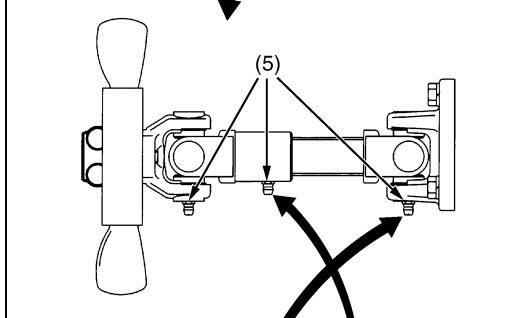
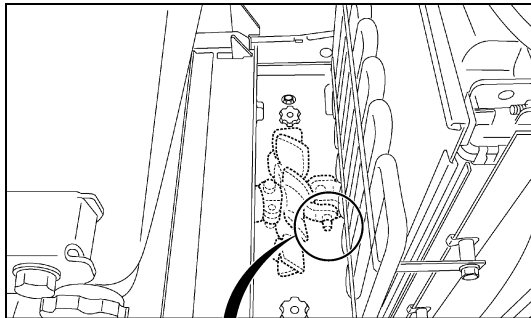
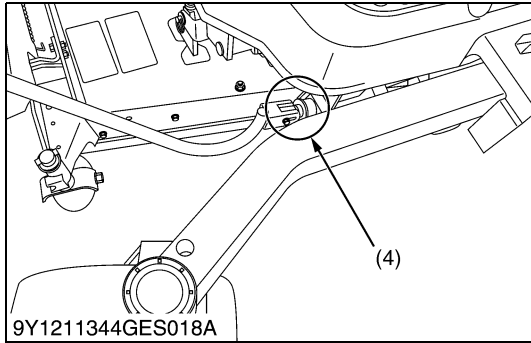
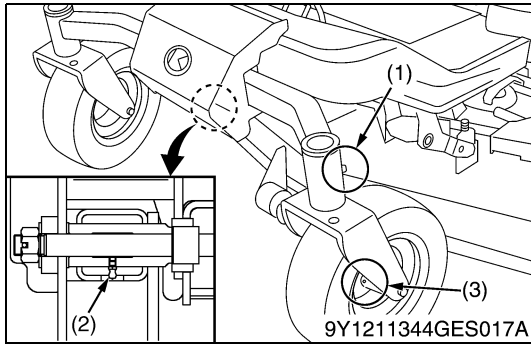
■ Test 2 (OPERATOR ON THE SEAT)

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

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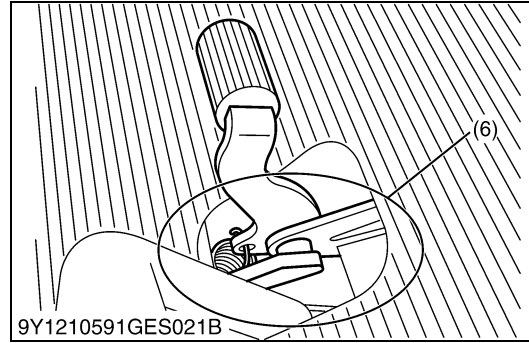
Greasing

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

⚠ WARNING

To avoid serious injury:

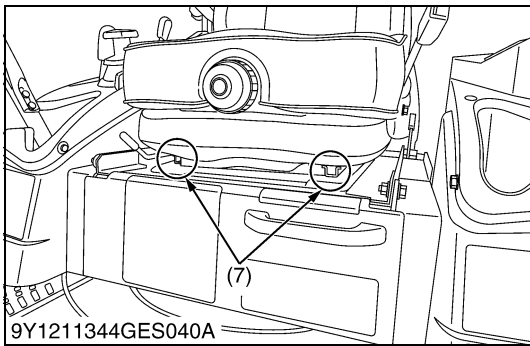
- Be sure to stop the engine and remove the key before greasing.
- **IMPORTANT**
- Put grease into front wheel until grease overflows from both ends of the front wheel.



- | | |
|--------------------------|------------------------------|
| (1) King Pin (LH, RH) | (4) Tilt Lever Arm |
| (2) Center Pin | (5) Machine Universal Joint |
| (3) Front Wheel (LH, RH) | (6) Parking Brake Lock Pedal |

(To be continued)

(Continued)



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

! WARNING

To avoid serious injury:

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

- (7) Seat Adjuster

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Oiling

! WARNING

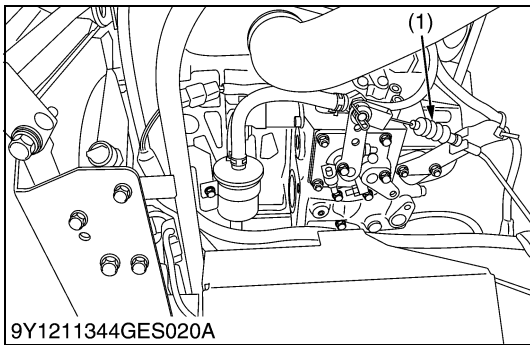
To avoid serious injury:

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

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

- (1) Throttle Cable (Oil)

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Checking Gear Box Oil Level

! WARNING

To avoid serious 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 the check plug and check to see if the oil level is in the range of the check plug port.

If the level is too low, add new oil to the prescribed level at the oil inlet.

(Refer to G-9.)

2. After checking, reinstall the check plug and oil inlet plug correctly.

- (1) Drain Plug
- (2) Oil Inlet Plug with Gauge
- (3) Seal Washer
- (4) Gear Case

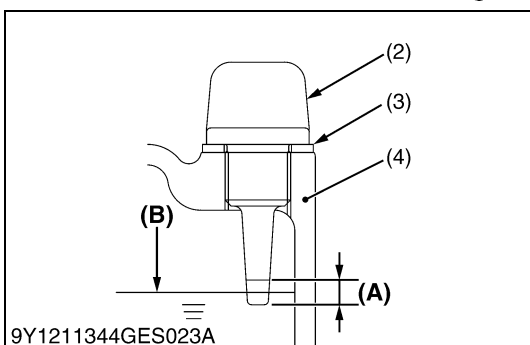
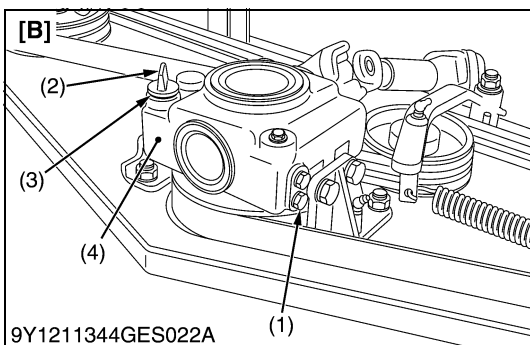
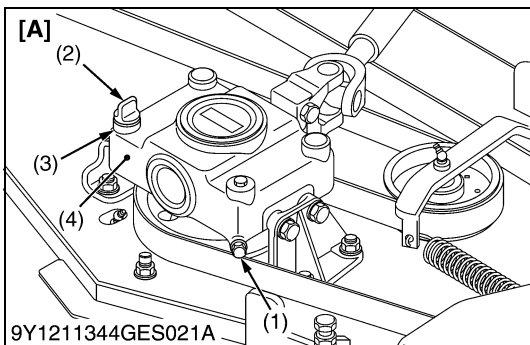
(A) Oil level is acceptable within this range.

(B) Oil level

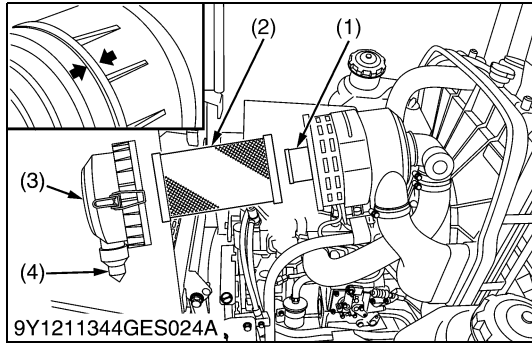
[A] RCK60P, RCK72P

[B] RCK60R, RCK72R

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[6] CHECK POINTS OF EVERY 100 HOURS



Cleaning Air Cleaner Primary Element



WARNING

To avoid serious injury:

- **Be sure to stop engine and remove the key before cleaning air cleaner element.**
1. Remove the air cleaner cover and primary element.
 2. Clean the primary element:
 - When dry dust adheres to the element, blow compressed air from the inside, turning the element. Pressure of compressed air must be under 205 kPa (2.1 kgf/cm², 30 psi).
 3. Replace air cleaner primary element:
Once yearly or after every sixth cleaning, whichever comes first.

■ **NOTE**

- **Check to see if the evacuator valve is blocked with dust.**

■ **IMPORTANT**

- **The air cleaner uses a dry element, do not apply oil.**
- **Do not operate the engine with filter element removed.**
- **Align the arrow marks when reinstalling the air cleaner cover.**
- **Do not touch the secondary element except in cases where replacing is necessary.**
(See page G-35.)

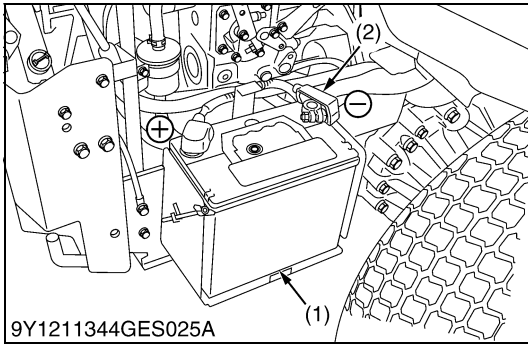
■ **Evacuator Valve**

Open the evacuator valve once a week under ordinary conditions - or daily when used in a dusty place - to get rid of large particles of dust and dirt.

- (1) Secondary Element
(2) Primary Element

- (3) Cover
(4) Evacuator Valve

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Checking Battery Condition

! DANGER

To avoid the possibility of battery explosion:

For the refillable type battery, follow the instructions below.

- Do not use or charge the refillable type battery if the fluid level is below the LOWER (lower limit level) mark. Otherwise, the battery component parts may prematurely deteriorate, which may shorten the battery's service life or cause an explosion. Check the fluid level regularly and add distilled water as required so that the fluid level is between the UPPER and LOWER levels.

! 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.

! WARNING

To avoid serious injury:

- Batteries, battery posts, terminals and related accessories contain lead and lead compounds, and other chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. **WASH HANDS AFTER HANDLING.**
- Never remove the battery cap while the engine is running.
- Keep electrolyte away from eyes, hands and clothes. If you are splattered with it, wash it away completely with water immediately and get medical attention.
- Wear eye protection and rubber gloves when working around battery.

■ NOTE

- The factory-installed battery is of non-refillable type. If the battery is weak, charge the battery or replace it with new one.

■ IMPORTANT

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

The original battery is maintenance free, but needs some servicing.

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

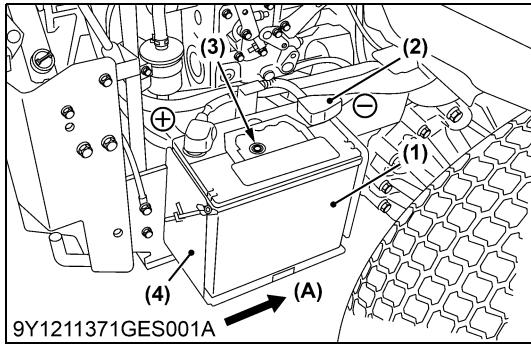
- When exchanging an old battery for new one, use battery of equal specification in table below.

Battery type	Volts (V)	Reserve Capacity (min)	Cold Cranking Amps	Normal Charging Rate (A)
51R	12	80	430	4.5

- (1) Battery
- (2) Ground Cable

- (+) Positive terminal
- (-) Negative terminal

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■ **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.

⚠ WARNING

To avoid serious injury:

- 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.

1. To slow charge the battery, connect the battery positive terminal to the charger positive terminal and the negative to the negative, then charge for at least 1 hour at 4.5 amperes.
2. 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.

3. When the specific gravity of electrolyte reaches 1.27 to 1.29, charge has completed.
4. 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 LCD monitor or a voltmeter to check the state of charge. (See reference chart below to determine if charging is necessary.)

■ **Battery for storage**

1. When storing the machine for a long period, remove the battery from machine, adjust the electrolyte to the proper level and store in a dry place out of direct sunlight.
2. The battery self-discharges while it is stored. Recharge it once every 3 months in hot seasons and once every 6 months in cold seasons.

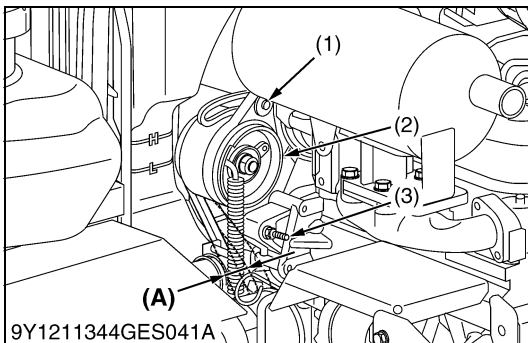
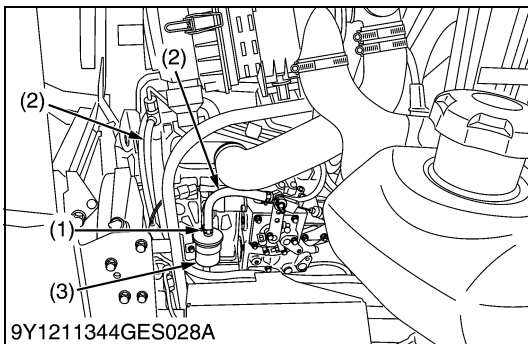
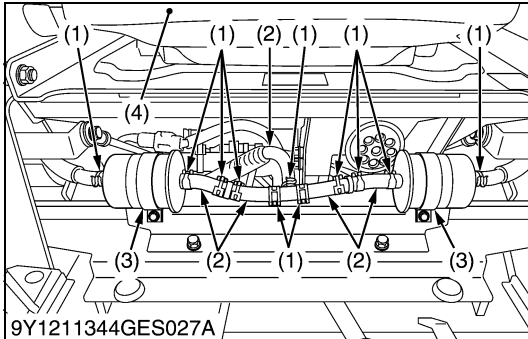
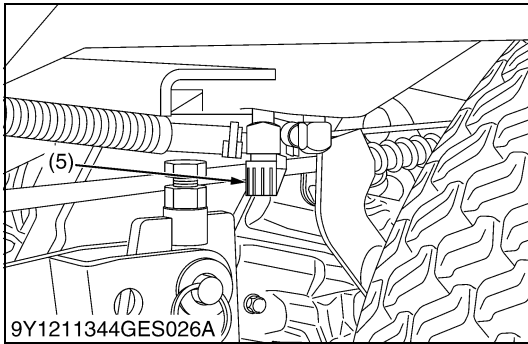
When connecting the cables to the battery, start with the positive terminal first.

The orientation of the negative cable is parallel to the long side (A) of the base battery.

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

- (1) Battery
- (2) Ground Cable
- (3) Indicator
- (4) Base Battery

- (+) Positive terminal
- (-) Negative terminal
- (A) Long Side



Checking Fuel Lines and Fuel Filter

⚠ WARNING

To avoid serious injury:

- 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. Open the center step and bonnet.
2. Close the fuel valves (5) to both fuel tanks RH and LH.
3. The fuel lines are made of rubber and ages regardless of service period.
4. If the fuel line and clamps are found damaged or deteriorated, replace them.
5. Check fuel filter, if it is clogged by debris, 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.
- If replacing fuel filter or fuel lines you must bleed fuel line. Refer to page G-44.

- | | |
|-----------------|----------------|
| (1) Pipe Clamps | (4) Seat |
| (2) Fuel Line | (5) Fuel Valve |
| (3) Fuel Filter | |

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Adjusting Fan Belt Drive Tension

⚠ WARNING

To avoid serious injury:

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

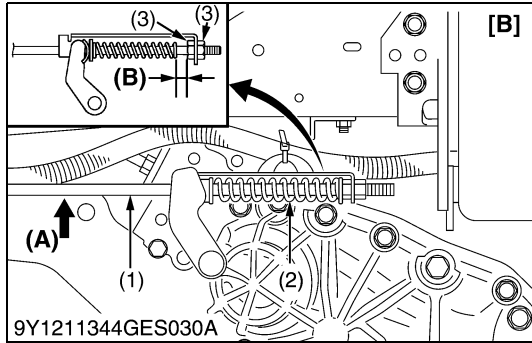
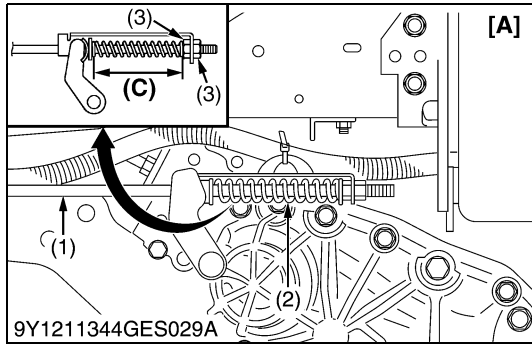
1. If the fan drive belt becomes loose, the engine may overheat. To adjust, loosen bolts and move the alternator outward to tighten the belt. After adjustment, securely tighten the bolts.

Moderate belt tension:

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

- | | |
|------------------|---------------------|
| (1) Tension Bolt | (3) Adjustment Bolt |
| (2) Alternator | (A) 10 mm (0.4 in.) |

9Y1211344GEG0031US0



Adjusting Parking Brake

⚠ WARNING

To avoid serious 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 specification	115 to 117 mm 4.53 to 4.61 in.
--	-----------------------	-----------------------------------

Proper brake spring play (B)	Factory specification	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.

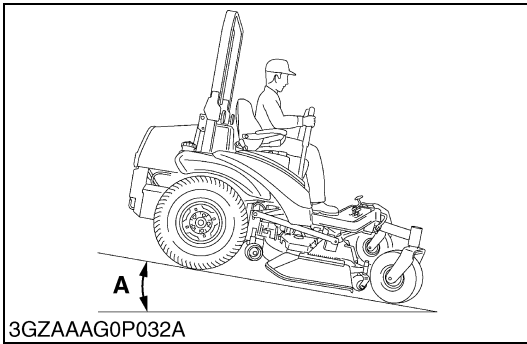
■ Adjustment of brake spring length

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
- (2) Brake Spring
- (3) Lock Nut

- (A) "Hold the Brake Rod"
- (B) "Parking Brake Spring Play"
- (C) "Parking Brake Spring Length"
- [A] When the parking brake is locked.
- [B] When the parking brake is released.

9Y1211344GEG0032US0



■ **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 | A: Under 17 ° Ramp |
| (2) Bolt | |

9Y1211344GEG0033US0

Greasing Mower Link Bushings

⚠ WARNING

To avoid serious injury:

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

1. Grease the following location.
If you operated the machine in extremely wet and muddy conditions, lubricate grease fittings more often.

- | | |
|---------------------------------------|--------------------------------------|
| (1) Front Mower Link Bushing (LH, RH) | (2) Rear Mower Link Bushing (LH, RH) |
|---------------------------------------|--------------------------------------|

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[7] CHECK POINTS OF EVERY 150 HOURS

Changing Mower Gear Box Oil

1. See page G-28.

9Y1211344GEG0035US0

[8] CHECK POINTS OF EVERY 200 HOURS

Changing Engine Oil

1. See page G-22.

9Y1211344GEG0036US0

Adjusting Front Axle Pivot

1. See page G-23.

9Y1211344GEG0037US0

Changing Engine Oil Filter Cartridge

1. See page G-22.

9Y1211344GEG0038US0

Changing HST Transmission Oil Filter Cartridge

1. See page G-23.

9Y1211344GEG0039US0

[9] CHECK POINT OF EVERY 400 HOURS

Replacing Fuel Filter

1. See page G-32.

9Y1211344GEG0043US0

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

1. See page G-24.

9Y1211344GEG0044US0

Replacing Hydraulic Oil Filter

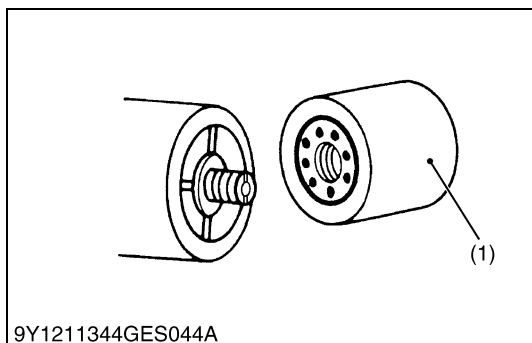
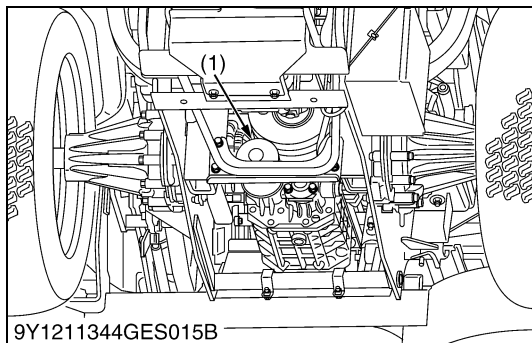
! WARNING

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

1. The oil filter 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&LH) and remove the drain plug at the bottom of the transmission case and the rear axle gear case (RH&LH).
3. After draining, reinstall the drain plugs.
4. Remove the oil filter by using the filter wrench.
5. Apply a slight coat of oil onto the filter 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 filter has been replaced, the transmission fluid level normally lowers a little. Add fluid to proper level. Check for oil leaks around filter gasket.

(1) Hydraulic Oil Filter

9Y1211344GEG0045US0



[10] CHECK POINTS OF EVERY 1000 HOURS OR EVERY 1 YEAR

Replacing Air Cleaner Primary Element and Secondary Element

(See page G-29.)

■ IMPORTANT

- To prevent serious damage to the engine, use only a KUBOTA genuine filter.

[How to remove the secondary element]

1. Pull out the two tabs of the secondary element using a suitable tool (e.g. Flat-blade screwdriver) as shown in the figure.

■ IMPORTANT

- Pull out the tabs only when replacing the secondary element.

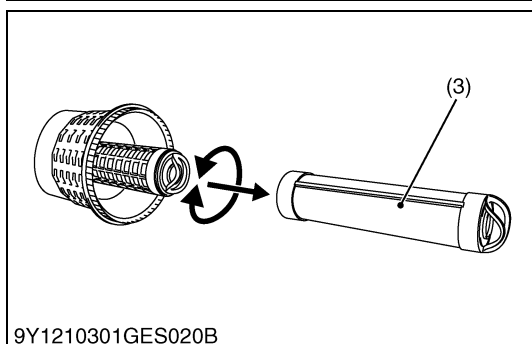
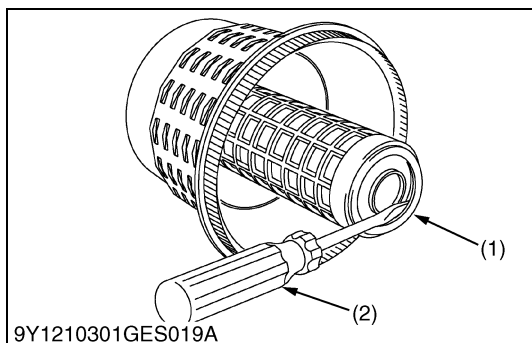
2. While turning slightly, pull out the secondary element.

(1) Tab

(3) Secondary Element

(2) Flat-blade Screwdriver

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[11] CHECK POINTS OF EVERY 1500 HOURS

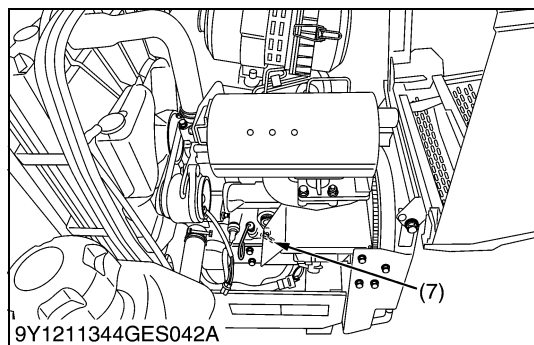
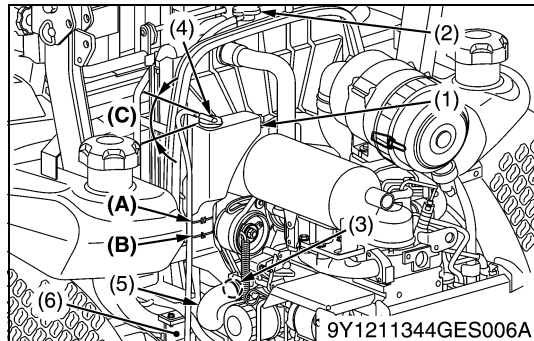
Checking Fuel Injection Nozzle (Injection Pressure)

1. See page 1-S18.

9Y1211344GEG0047US0

[12] CHECK POINTS OF EVERY 2000 HOURS OR EVERY 2 YEARS

Flushing Cooling System and Changing Coolant



⚠ WARNING

To avoid serious 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.

1. Stop the engine and let cool down.
2. To drain the coolant, open the radiator drain valve (7) and remove the radiator drain plug (3) and remove the radiator cap (2). The radiator cap (2) must be removed to completely drain the coolant.
3. After all coolant is drained, close the drain valve (7) 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 (2) 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 (1) 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-9.)
- Set the direction of the recovery tank cap (C) outlet at left front (45 °). Set the bottom tip of the hose between front side of radiator hose and inner side of the frame. (This will prevent the hose from pulling down and open the recovery tank cap.)

Coolant capacity	Cooling system	3.50 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) Recovery Tank | (A) "FULL" |
| (2) Radiator Cap | (B) "LOW" |
| (3) Drain Plug | (C) 45 ° |
| (4) Recovery Tank Cap | |
| (5) Radiator Hose | |
| (6) Frame | |
| (7) Drain Valve | |

(To be continued)

(Continued)



■ Anti-Freeze



WARNING

To avoid serious injury:

- When using anti-freeze, put on some protection such as rubber gloves. (Anti-freeze contains poison.)
- If someone drank anti-freeze, seek immediate medical help. Do NOT make a person throw up unless told to do so by poison control or a health care professional. Use standard first aid and CPR for signs of shock or cardiac arrest. Call your local Poison Control Center or your local emergency number for further assistance.
- When anti-freeze comes in contact with the skin or clothing, wash it off immediately.
- Do not mix different types of Anti-freeze. The mixture can produce chemical reaction causing harmful substances.
- Anti-freeze is extremely flammable and explosive under certain conditions. Keep fire and children away from anti-freeze.
- When draining fluids from the engine, place some container underneath the engine body.
- Do not pour waste onto the ground, down a drain, or into any water source.
- Also, observe the relevant environmental protection regulations when disposing of antifreeze.

Always use a 50/50 mix of long-life coolant and clean soft water in KUBOTA engines.

1. Long-life coolant (hereafter LLC) comes in several types. Use ethylene glycol (EG) type for this engine.
2. Before employing LLC-mixed cooling water, fill the radiator with fresh water and empty it again. Repeat this procedure 2 or 3 times to clean up the inside.
3. Mixing the LLC
Premix 50 % LLC with 50 % clean soft water. When mixing, stir it up well, and then fill into the radiator.
4. The procedure for the mixing of water and anti-freeze differs according to the make of the anti-freeze and the ambient temperature. Refer to SAE J1034 standard, more specifically also to SAE J814c.

(To be continued)

(Continued)

■ **IMPORTANT**

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

Vol % Anti-freeze	Freezing Point		Boiling Point*	
	°C	°F	°C	°F
50	-37	-34	108	226

* At 1.013×10^5 Pa (760 mmHg) pressure (atmospheric).

A higher boiling point is obtained by using a radiator pressure cap which permits the development of pressure within the cooling system.

5. Adding the LLC

(1) Add only water if the coolant level reduces in the cooling system by evaporation.

(2) If there is a mixture leak, add the LLC of the same manufacturer and type in the mixing ratio 50 %.

* Never add any long-life coolant of different manufacturer. (Different brands may have different additive components, and the engine may fail to perform as specified.)

6. When the LLC is mixed, do not employ any radiator cleaning agent. The LLC contains anti-corrosive agent. If mixed with the cleaning agent, sludge may build up, adversely affecting the engine parts.

7. Kubota's genuine long-life coolant has a service life of 2 years. Be sure to change the coolant every 2000 hours or every 2 years whichever comes faster.

■ **NOTE**

- **The above data represent industry standards that necessitate a minimum glycol content in the concentrated anti-freeze.**

9Y1211344GEG0048US0

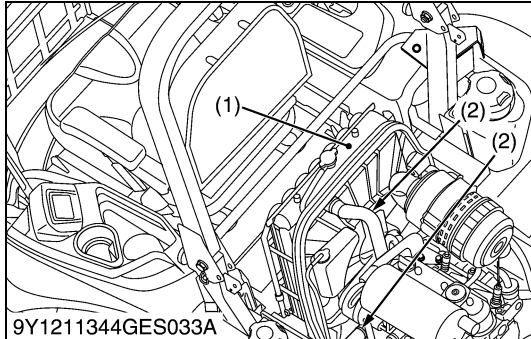
[13] CHECK POINTS OF EVERY 3000 HOURS

Checking Injection Pump

1. See page 1-S16.

9Y1211344GEG0049US0

[14] CHECK POINTS OF EVERY 1 YEAR



Checking Radiator Hose and Clamp

⚠ WARNING

To avoid serious injury:

- Be sure to stop the engine and remove the key before checking radiator hose and clamps.
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.

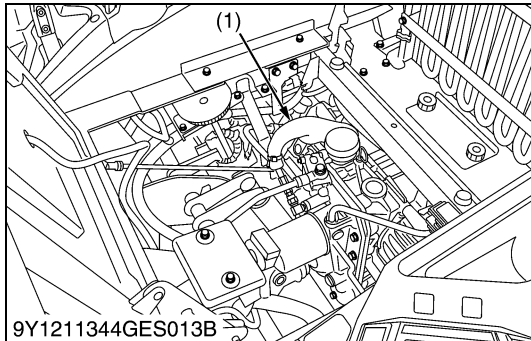
■ NOTE

- 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

9Y1211344GEG0050US0



Checking Hydraulic Hose

⚠ WARNING

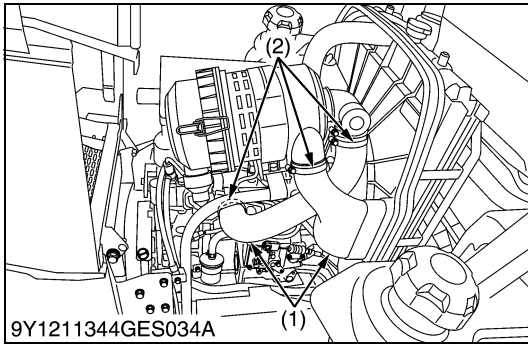
To avoid serious injury:

- Be sure to stop the engine and remove the key before checking and replacing the hydraulic hose.
 - Allow the transmission case to cool down sufficiently; oil can be hot and may cause burns.
 - Escaping hydraulic fluid under pressure has sufficient force to penetrate the skin causing serious personal injury. Before disconnecting lines, be sure to relieve all pressure. Before applying pressure to the system, make sure all connections are tight and that lines, pipes, and hoses are not damaged.
1. Check to see that all lines 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) Mower Lift Cylinder Hose

9Y1211344GEG0051US0





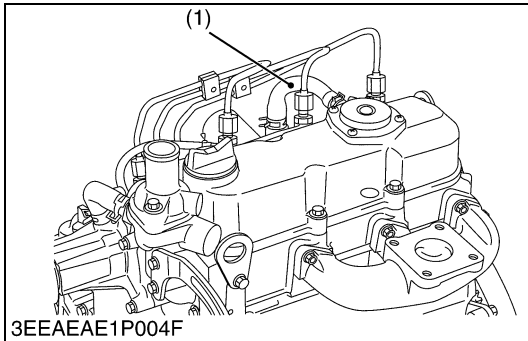
Checking Intake Air Line

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

9Y1211344GEG0052US0

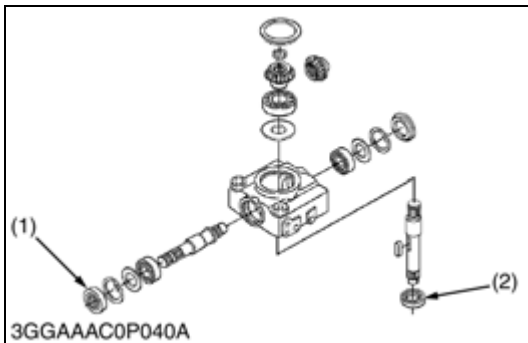


Checking Engine Breather Hose

1. Check the engine breather hose for damage. If damaged or worn, refer to "Replacing Engine Breather Hose" page G-41

(1) Engine Breather Hose

9Y1211344GEG0053US0



Checking Mower Gear Box Seals

1. Check the mower gear box oil seals for damage. If damaged or worn, refer to "Replacing Mower Gear Box Oil Seals" page G-41

(1) Oil Seal

(2) Oil Seal

9Y1211344GEG0054US0

[15] CHECK POINT OF EVERY 4 YEARS

Replacing Hydraulic Hose

1. Replace the hose. Refer to "Checking Hydraulic Hose". (See page G-39.)

9Y1211344GEG0055US0

Replacing Radiator Hose

1. Replace the hoses and clamps. Refer to "Checking Radiator Hose and Hose Clamp". (See page G-39.)

9Y1211344GEG0056US0

Replacing Fuel Lines

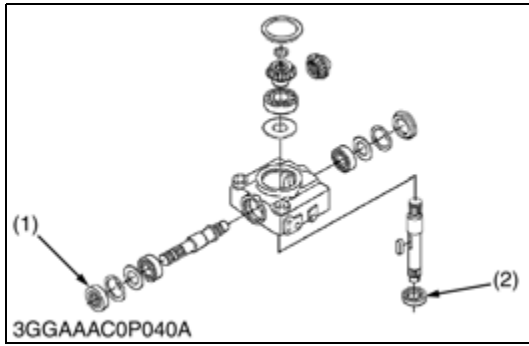
1. Replace the fuel line. Refer to "Checking Fuel Lines and Fuel Filter". (See page G-32.)

9Y1211344GEG0057US0

Replacing Intake Air Line

1. Replace the intake air line. Refer to "Checking Intake Air Line". (See page G-40.)

9Y1211344GEG0058US0

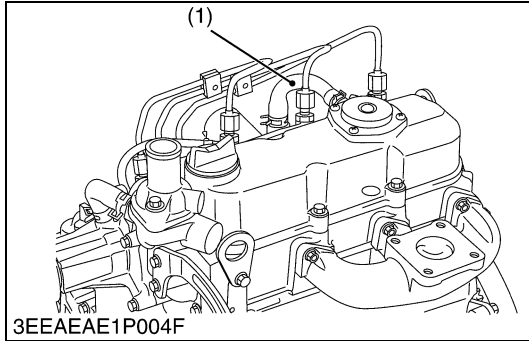


Replacing Mower Gear Box Seals

1. Replace the mower gear box oil seals (1), (2).
Refer to "Disassembling Gear Box Assembly". (See page 6-S14.)

- (1) Oil Seal (2) Oil Seal

9Y1211344GEG0059US0



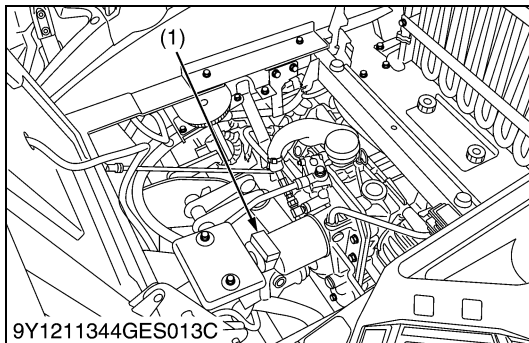
Replacing Engine Breather Hose

1. Replace the engine breather hose (1) with a new one.

- (1) Engine Breather Hose

9Y1211344GEG0060US0

[16] OTHERS



Replacing Fuses

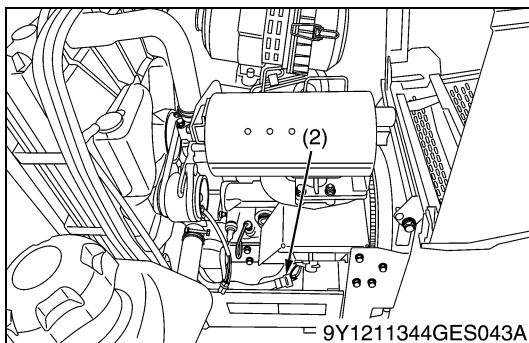
1. The electrical system is protected from potential damage by fuses.
A blown fuse indicates that there is an overload or short somewhere in the electrical system.
2. If any of the fuses should blow, replace with a new one of the same capacity.

■ 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.
- Never "jump" the fuse with wire or foil, or install a larger capacity fuse than is recommended.

■ Protected Circuit

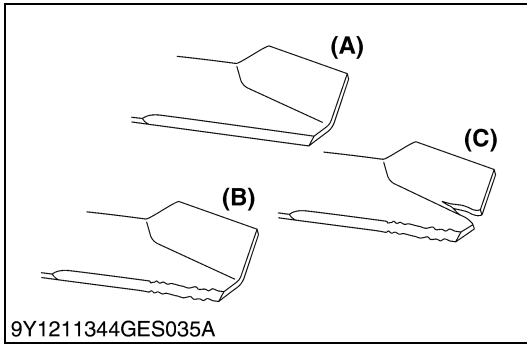
FUSE NO.(ID LABEL)	CAPACITY (A)	Protected circuit
1	20 A	Engine stop
	15 A	Charge system
	15 A	Main system
	15 A	Aux. outlet
	10 A	Control system
	(20 A)	*(Work light)
2	Slow blow fuse 40 A	Check circuit against wrong battery connection



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

- (1) Fuse Location (2) Slow Blow Fuse

9Y1211344GEG0061US0



Checking Mower Blade

WARNING

To avoid serious injury:

- Be sure to stop the engine and remove the key.
- Blades may be sharp. When you handle blades, wear heavy gloves or wrap end of blade with a rag.

■ NOTE

- Before checking or replacing the blade, wipe grass and mud off the top and inside of the mower. Especially clean up the inside of the belt cover, because otherwise the belt life will be reduced.

1. The blade cutting edges must be kept sharp at all times. Sharpen the cutting edges, if they resemble blade (B). Replace the blades if they appear similar to blade (C).

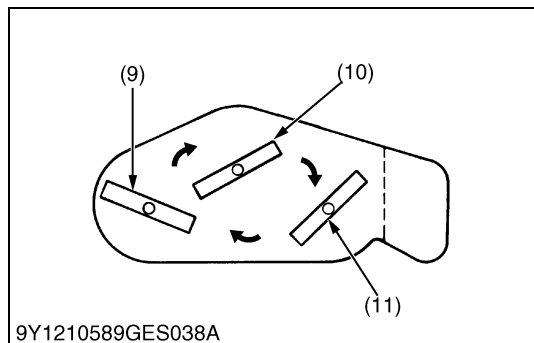
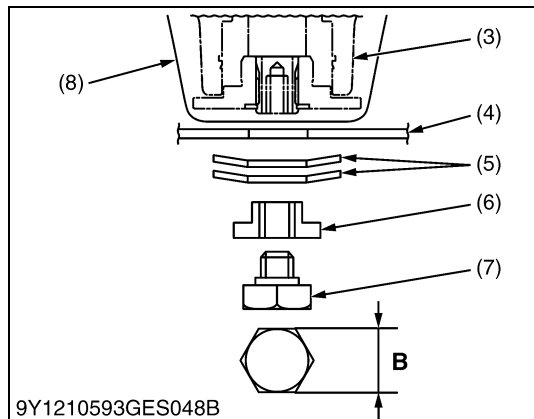
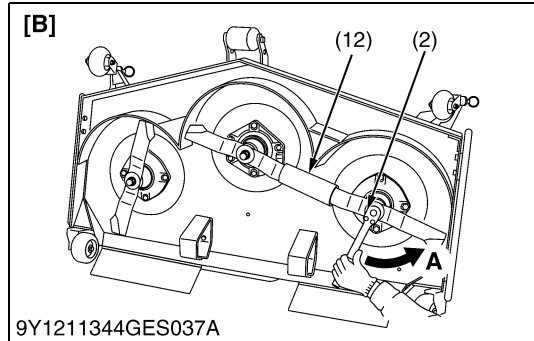
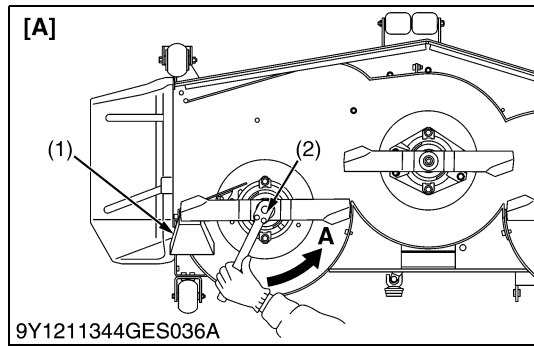
■ IMPORTANT

- Use the proper metric size box or socket wrench to tighten or loosen the blade mounting bolt.

(A) New Blade
(B) Worn Blade

(C) Cracked Blade

9Y1211344GEG0062US0



Replacing Mower Blades

! WARNING

To avoid serious injury:

- Be sure to stop the engine and remove the key.
- Blades may be sharp. When you handle blades, wear heavy gloves or wrap end of blade with a rag.

1. Tilt up the mower deck.
2. **[RCK60P, RCK72P]**

Wedge a block of wood (1) between the blade and mower housing or use a box wrench over the pulley nut to prevent the spindle from rotating while removing the blade bolts; loosen the blade bolt as illustrated.

[RCK60R, RCK72R]

Set the pipe (12) between the blade and the next blade or use a box wrench over the pulley nut to prevent the spindle from rotating while removing the blade bolts; loosen the blade bolt as illustrated.

3. To sharpen the blades yourself, clamp the blade securely in a vise.
Use a large mill file and file along the original bevel until sharp.
4. To check the blade for balance, place a small rod through the center hole. If the blade is not balanced, file the heavy side of the blade until balance is achieved.
5. Pass the spline boss through the blade and 2 cup washers, and tighten the bolt.

■ 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.

■ IMPORTANT

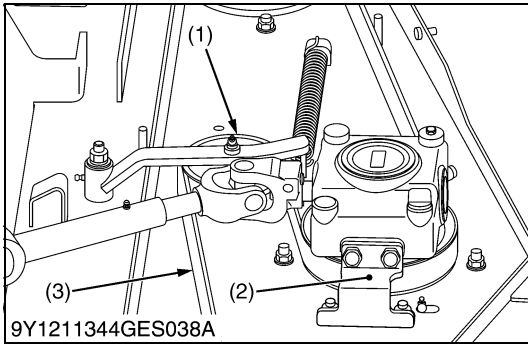
- The blade bolts have Right hand threads. Turn them counterclockwise to loosen.
- To prolong the service life of the blades, reposition them as shown in the figure to the right periodically.

Tightening torque	Mower blade screw	103 to 118 N·m 10.5 to 12.0 kgf·m 75.9 to 87.0 lbf·ft
-------------------	-------------------	---

- | | |
|-----------------------|-------------------|
| (1) Wooden Block | (9) LH Blade |
| (2) Mower Blade Screw | (10) Center Blade |
| (3) Spindle Holder | (11) RH Blade |
| (4) Blade | (12) Pipe |
| (5) 2-Cup Washers | |
| (6) Lock Washer | |
| (7) Bolt | |
| (8) Spindle guard | |

- A: Loosen**
B: 30 mm (1 to 3/16 in.)
[A] RCK60P, RCK72P
[B] RCK60R, RCK72R

9Y1211344GEG0063US0



Replacing Mower Belt

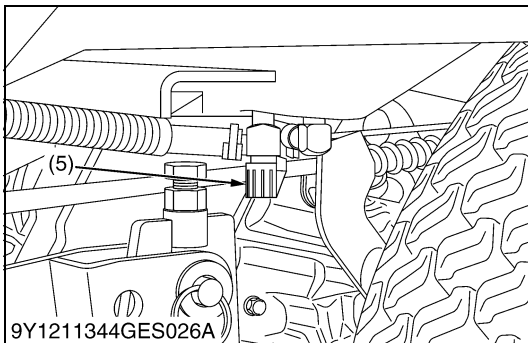
1. Remove the mower deck from the machine.
2. Remove the left and right hand shield from the mower deck.
3. Clean around the gear box.
4. Remove the belt from the tension pulley.
5. Remove the right hand bracket which mounts the gear box to the mower deck and slip the belt over the top of the gear box.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

Tightening torque	Bracket mounting screw	77.6 to 90.2 N·m 8.00 to 9.20 kgf·m 57.1 to 66.5 lbf·ft
-------------------	------------------------	---

- (1) Tension Pulley
(2) Bracket (RH)

(3) Belt

9Y1211344GEG0064US0



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:

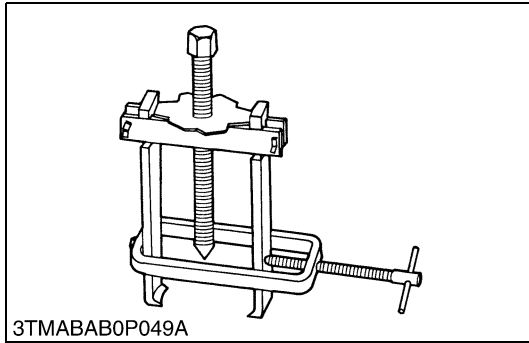
1. Fill the fuel tank with fuel.
2. Close RH tank fuel valve (1) and Open LH tank fuel valve (1).
3. Turn the key switch to **"ON"** position for about 30 seconds. Doing so allows fuel pump to work and pump air out of the fuel system. Do this 3 to 5 times.
4. Close LH tank fuel valve (1) and Open RH tank fuel valve (1).
5. 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. Do this 3-5 times.
6. Make sure both fuel valves (1) are Open.
7. Start the engine and run for about 30 seconds, and then stop the engine.

- (1) Fuel Valve

9Y1211344GEG0065US0

9. SPECIAL TOOLS

[1] SPECIAL TOOLS FOR ENGINE



3TMABAB0P049A

Special Use Puller Set

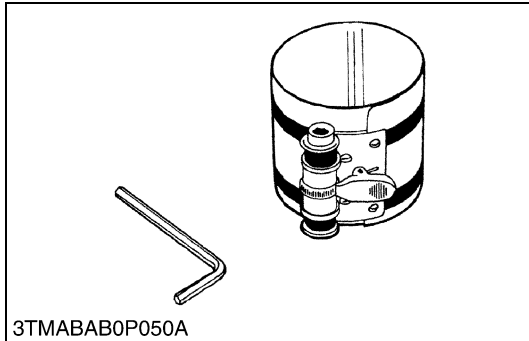
Code No.

- 07916-09032

Application

- Use exclusively to pull out bearing, gears and other parts with ease.

WSM000001GEG0011US0



3TMABAB0P050A

Piston Ring Compressor

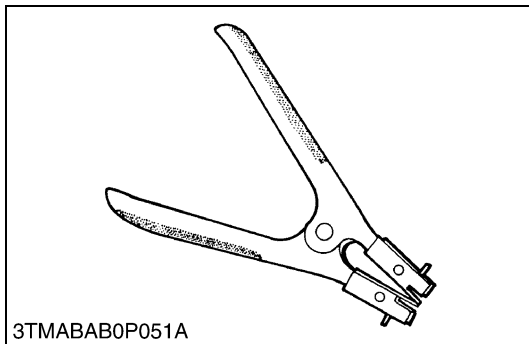
Code No.

- 07909-32111

Application

- Use exclusively to push in the piston with piston rings into the cylinder.

WSM000001GEG0012US0



3TMABAB0P051A

Piston Ring Tool

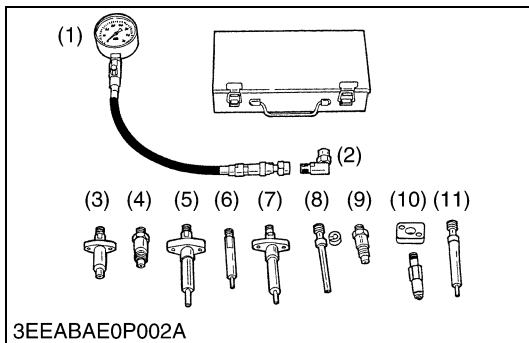
Code No.

- 07909-32121

Application

- Use exclusively to remove or install the piston ring with ease.

WSM000001GEG0013US0



3EEABAE0P002A

Diesel Engine Compression Tester (for Injection Nozzle)

Code No.

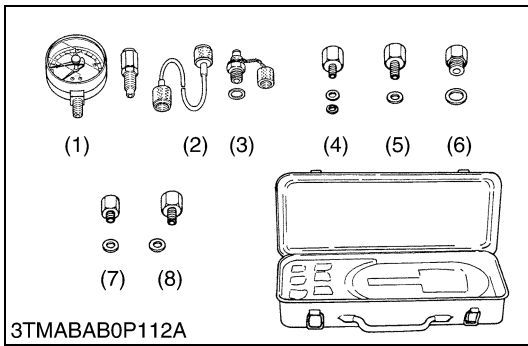
- 07909-30208 (Assembly)
- 07909-30934 (A to F)
- 07909-31211 (E and F)
- 07909-31231 (H)
- 07909-31251 (G)
- 07909-31271 (I)
- 07909-31281 (J)

Application

- Use to measure diesel engine compression and diagnostics of need for major overhaul.

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

WSM000001GEG0014US0



3TMABAB0P112A

Oil Pressure Tester

Code No.

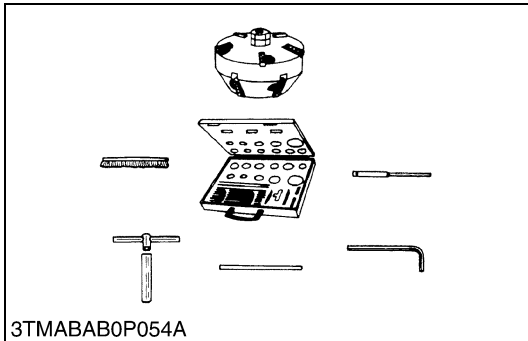
- 07916-32032

Application

- Use to measure lubricating oil pressure.

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

WSM000001GEG0015US0



3TMABAB0P054A

Valve Seat Cutter

Code No.

- 07909-33102

Application

- Use to reseal valves.

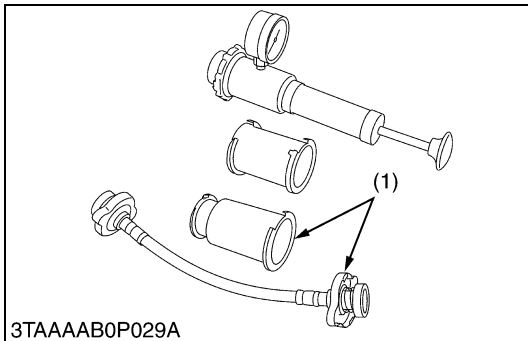
Angle

- 0.79 rad (45°)
- 0.26 rad (15°)

Diameter

- 28.6 mm (1.13 in.)
- 31.6 mm (1.24 in.)
- 35.0 mm (1.38 in.)
- 38.0 mm (1.50 in.)
- 41.3 mm (1.63 in.)
- 50.8 mm (2.00 in.)

WSM000001GEG0016US0



3TAAAB0P029A

Radiator Tester

Code No.

- 07909-31551

Application

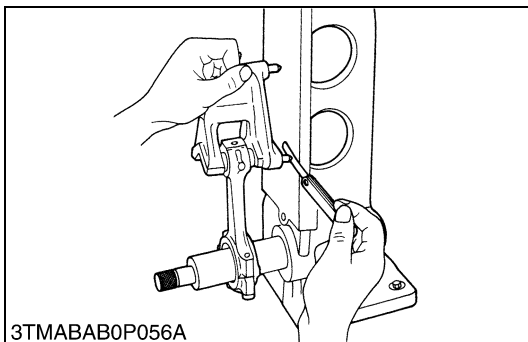
- Use to check of radiator cap pressure, and leaks from cooling system.

Remarks

- Adaptor (1) BANZAI Code No. RCT-2A-30S.

- (1) Adaptor

WSM000001GEG0017US0



3TMABAB0P056A

Connecting Rod Alignment Tool

Code No.

- 07909-31661

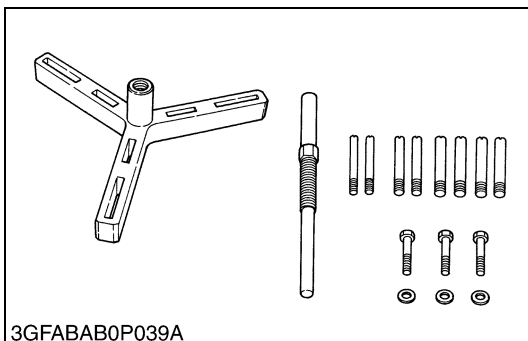
Application

- Use to check the connecting rod alignment.

Applicable range

- Connecting rod big end I.D.
30 to 75 mm dia. (1.2 to 2.9 in. dia.)
- Connecting rod length
65.0 to 300 mm (2.56 to 11.8 in.)

WSM000001GEG0020US0



3GFABAB0P039A

Flywheel Puller

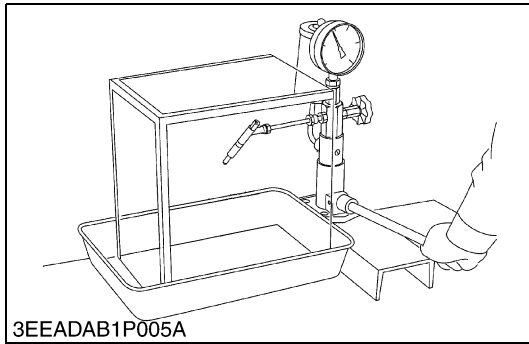
Code No.

- 07916-32011

Application

- Use exclusively to remove the flywheel with ease.

WSM000001GEG0018US0



3EEADAB1P005A

Nozzle Tester**Code No.**

- 07909-31361

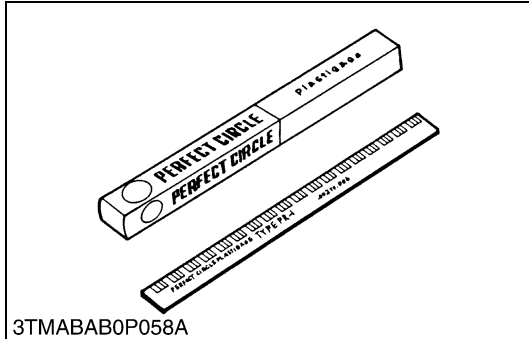
Application

- Use to check the fuel injection pressure and spray pattern of nozzle.

Measuring range

- 0 to 50 MPa (0 to 500 kgf/cm², 0 to 7200 psi)

WSM000001GEG0021US0



3TMABAB0P058A

Plastigauge**Code No.**

- 07909-30241

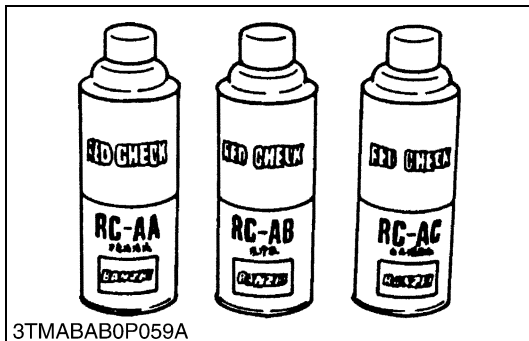
Application

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

Measuring range

- Green: 0.03 to 0.07 mm (0.001 to 0.003 in.)
- Red: 0.05 to 0.1 mm (0.002 to 0.006 in.)
- Blue: 0.1 to 0.2 mm (0.004 to 0.009 in.)

WSM000001GEG0022US0



3TMABAB0P059A

Red Check**Code No.**

- 07909-31371

Application

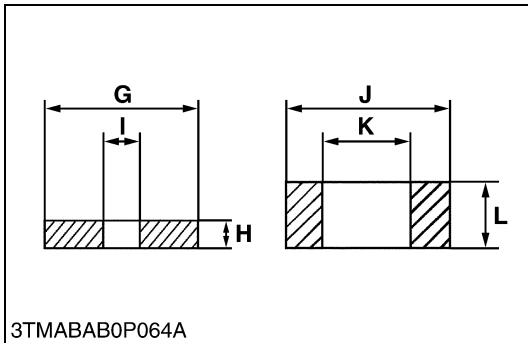
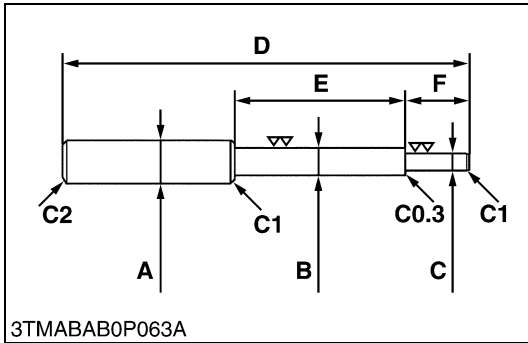
- Use to check cracks on cylinder head, cylinder block, etc..

WSM000001GEG0023US0

■ **NOTE**

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

9Y1211344GEG0066US0



Valve Guide Replacing Tool

Application

- Use to press out and press fit the valve guide.

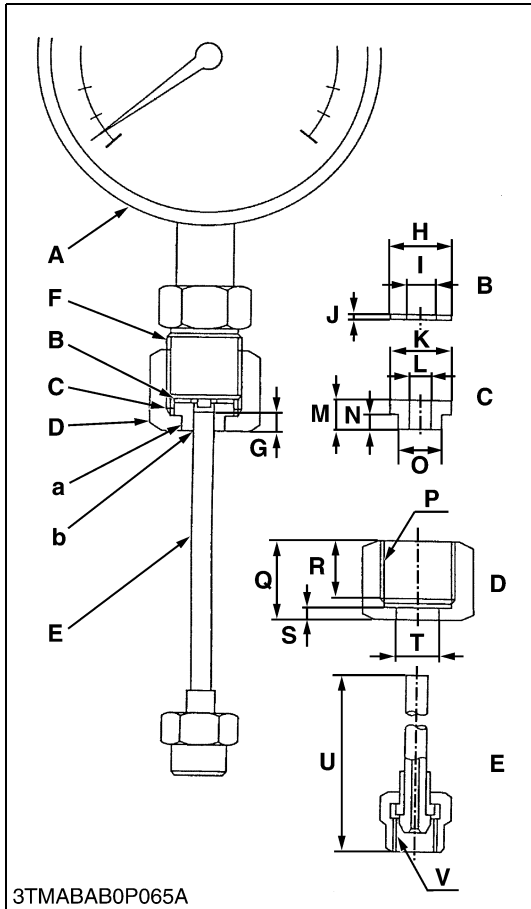
D782-E3-ZD, D902-E3/E4

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-E3/E4, D1105-E4-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.)

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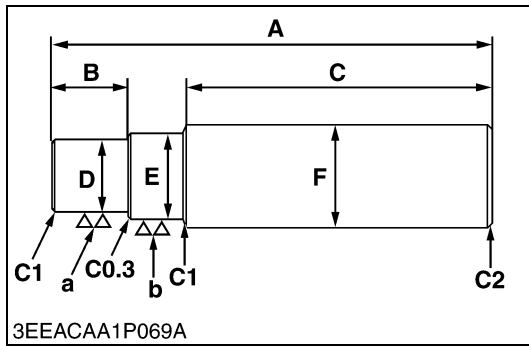
Injection Pump Pressure Tester

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 × P1.5
a	Adhesive application
b	Fillet welding on the enter circumference

9Y1211344GEG0068US0



Bushing Replacing Tool [For D782-E3, D902-E3/E4]

Application

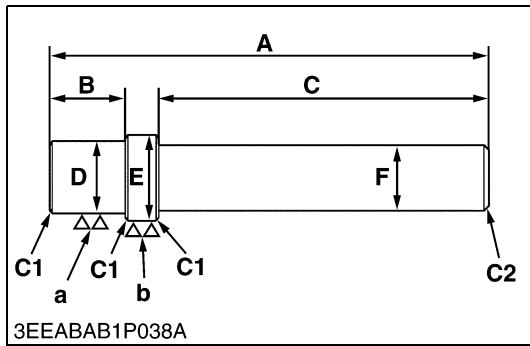
- Use to press out and press fit the bushing.
1. For small end bushing

A	145 mm (5.71 in.)
B	20 mm (0.79 in.)
C	100 mm (3.94 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.)
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.)
a	6.3 μm (250 μin.)
b	6.3 μm (250 μin.)

2. For idle gear bushing

A	150 mm (5.91 in.)
B	23 mm (0.91 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.)
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.)
a	6.3 μm (250 μin.)
b	6.3 μm (250 μin.)

9Y1211344GEG0069US0



Bushing Replacing Tool [For D1005-E3/E4, D1105-E4-ZD, D1305-E3]

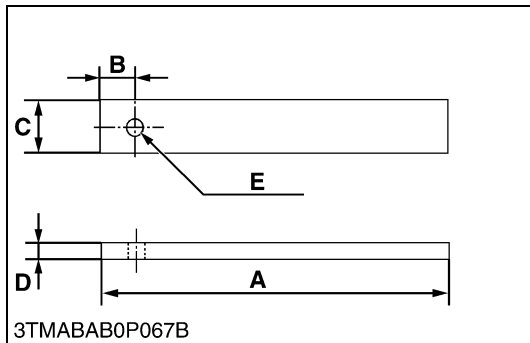
1. For small end bushing

A	157 mm (6.18 in.)
B	24 mm (0.94 in.)
C	120 mm (4.72 in.)
D	21.8 to 21.9 mm dia. (0.859 to 0.862 in. dia.)
E	24.8 to 24.9 mm dia. (0.977 to 0.980 in. dia.)
F	20 mm dia. (0.79 in. dia.)
a	6.3 μm (250 μin.)
b	6.3 μm (250 μin.)
C1	Chamfer 1.0 mm (0.039 in.)
C2	Chamfer 2.0 mm (0.079 in.)

2. For idle gear bushing

A	196 mm (7.72 in.)
B	26 mm (1.0 in.)
C	150 mm (5.91 in.)
D	25.80 to 25.90 mm dia. (1.016 to 1.019 in. dia.)
E	28.80 to 28.90 mm dia. (1.134 to 1.137 in. dia.)
F	20 mm dia. (0.79 in. dia.)
a	6.3 μm (250 μin.)
b	6.3 μm (250 μin.)
C1	Chamfer 1.0 mm (0.039 in.)
C2	Chamfer 2.0 mm (0.079 in.)

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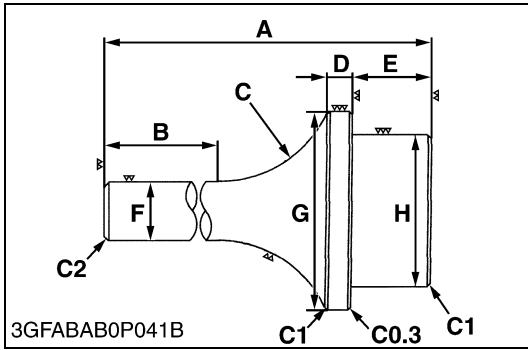
Flywheel Stopper

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.)

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Crankshaft Bearing 1 Replacing Tool

Application

- Use to press out and press fit the crankshaft bearing 1.

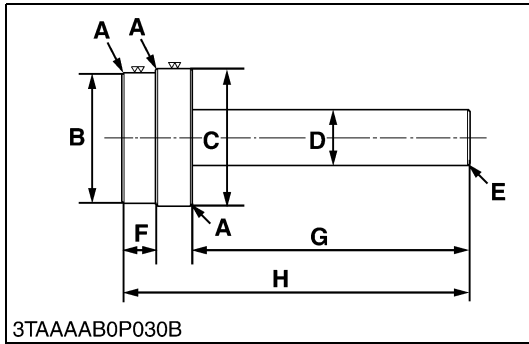
[Press Out]

	D782-E3	D902-E3/E4	D1005-E3/E4 D1105-E4 D1305-E3
A	135 mm (5.31 in.)		
B	72 mm (2.8 in.)		
C	40 mm (1.6 in.)		
D	10 mm dia. (0.39 in. dia.)		
E	22 mm (0.87 in.)	24 mm (0.94 in.)	
F	20 mm dia. (0.79 in. dia.)		
G	47.90 to 47.95 mm dia. (1.886 to 1.887 in. dia.)	51.20 to 51.40 mm dia. (2.016 to 2.023 in. dia.)	
H	43.90 to 43.95 mm dia. (1.729 to 1.730 in. dia.)	47.30 to 47.50 mm dia. (1.863 to 1.870 in. dia.)	
C1	Chamfer 1.0 mm (0.039 in.)		
C2	Chamfer 2.0 mm (0.079 in.)		
C0.3	Chamfer 0.30 mm (0.012 in.)		

[Press Fit]

	D782-E3	D902-E3/E4	D1005-E3/E4 D1105-E4 D1305-E3
A	130 mm (5.12 in.)	135 mm (5.31 in.)	
B	72 mm (2.83 in.)		
C	40 mm (1.6 in.)		
D	9.0 mm (0.35 in.)	10 mm (0.39 in.)	
E	24 mm (0.94 in.)		
F	20 mm dia. (0.79 in. dia.)		
G	68 mm dia. (2.7 in. dia.)		
H	39.90 to 39.95 mm dia. (1.571 to 1.572 in. dia.)	43.90 to 43.95 mm dia. (1.729 to 1.730 in. dia.)	47.30 to 47.50 mm dia. (1.863 to 1.870 in. dia.)
C1	Chamfer 1.0 mm (0.039 in.)		
C2	Chamfer 2.0 mm (0.079 in.)		
C0.3	Chamfer 0.30 mm (0.012 in.)		

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Governor Gear Holder Bushing Replacing Tool [For D1005-E3/E4, D1105-E4]

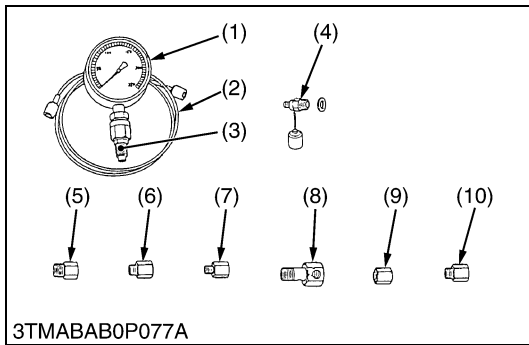
Application

- Use to press out and press fit the governor gear holder bushing.

A	C1: Chamfer 1.0 mm (0.039 in.)
B	73.90 to 74.00 mm dia. (2.910 to 2.913 in. dia.)
C	69.80 to 69.90 mm dia. (2.748 to 2.751 in. dia.)
D	30 mm dia. (1.2 in. dia.)
E	C2: Chamfer 2.0 mm (0.079 in.)
F	18 mm (0.71 in.)
G	150 mm (5.91 in.)
H	188 mm (7.40 in.)

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[2] SPECIAL TOOLS FOR MACHINE



Relief Valve Pressure Tester

Code No.

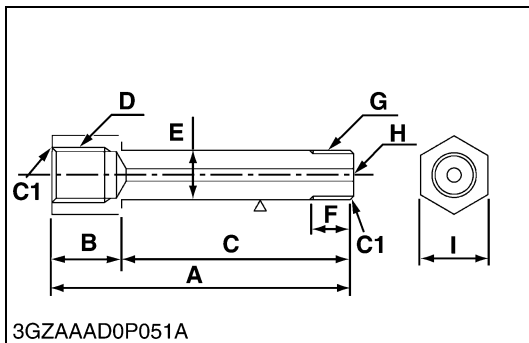
- 07916-50045

Application

- This allows easy measurement of relief set pressure.

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

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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.)

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10. IMPLEMENT LIMITATIONS

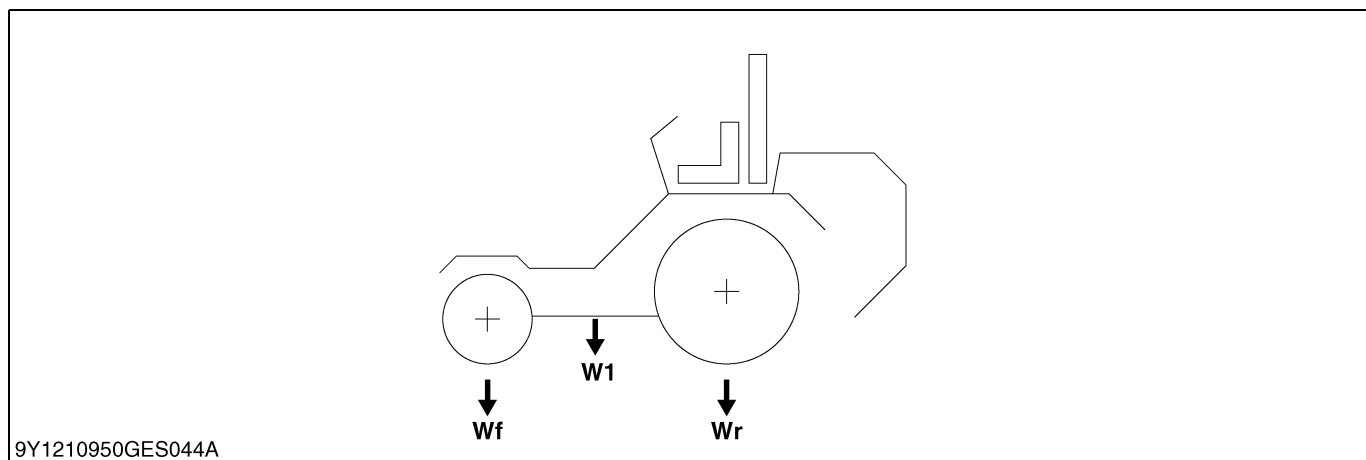
The KUBOTA Machine has been thoroughly tested for proper performance with implements sold or approved by KUBOTA.

Use with implements below may result in malfunctions or failures of the machine, damage to other property and injury to the operator or others.

- Implements are not sold or approved by KUBOTA
- Implements exceed the maximum specifications listed below, or
- Implements are otherwise unfit for use with the KUBOTA Machine

[Any malfunctions or failures of the machine resulting from use with improper implements are not covered by the warranty.]

UNIT	Maximum loading weight		Implement weight W_1	Maximum total weight
	Front axle W_f	Rear axle W_r		
ZD1211, ZD1211R ZD1211L, ZD1211RL	200 kg (440 lbs.)	920 kg (2028 lbs.)	200 kg (440 lbs.)	1120 kg (2468 lbs.)

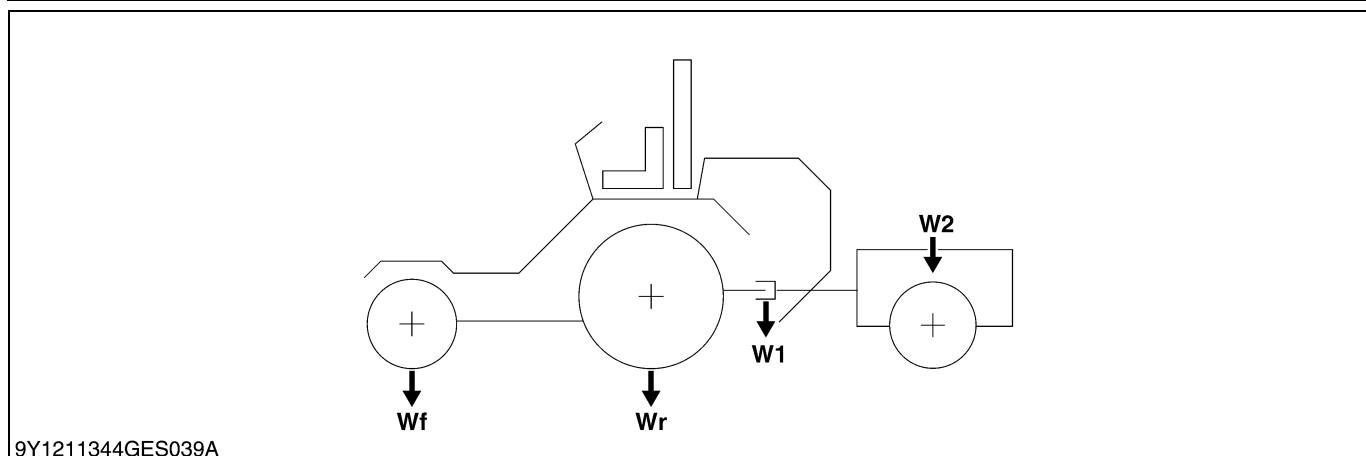


OPTION: When using the hitch kit.

■ **IMPORTANT**

- Do not operate on slope when pulling loads.
- Total towed weight must not exceed combined weight of pulling machine, ballast and operator.
- Follow the manufacturer's recommendations for weight limits for towed equipment.

UNIT	Maximum loading weight		Maximum total weight	Tongue weight W_1	Towing capacity W_2
	Front axle W_f	Rear axle W_r			
ZD1211, ZD1211R ZD1211L, ZD1211RL	200 kg (440 lbs.)	630 kg (1388 lbs.)	830 kg (1829 lbs.)	30 kg (66 lbs.)	100 kg (220 lbs.)



1 ENGINE

MECHANISM

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1. ENGINE BODY	1-M1
[1] CLOSED BREATHER	1-M1
[2] GOVERNOR.....	1-M2
2. LUBRICATING SYSTEM.....	1-M4
3. COOLING SYSTEM	1-M5
4. FUEL SYSTEM.....	1-M6

1. ENGINE BODY

[1] CLOSED BREATHER

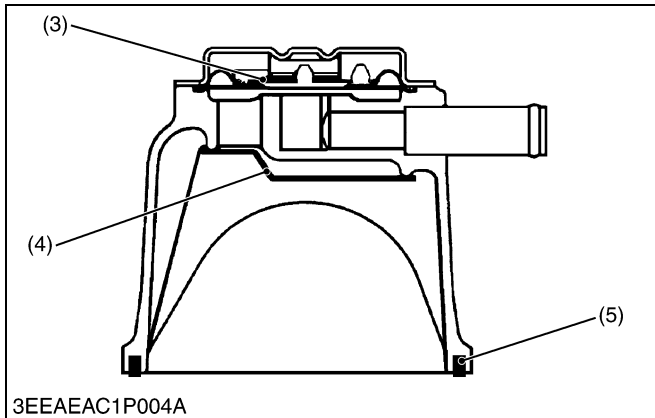


Closed breather system has been adopted to prevent the release of blow-by gas into the atmosphere.

After its oil content is filtered by oil shield (4), the blow by gas is fed back to the intake manifold through breather valve (3) to be used for re-combustion.

- | | |
|-------------------------|--------------------|
| (1) Breather Tube | (4) Oil Shield |
| (2) Cylinder Head Cover | (5) Rubber Packing |
| (3) Breather Valve | |

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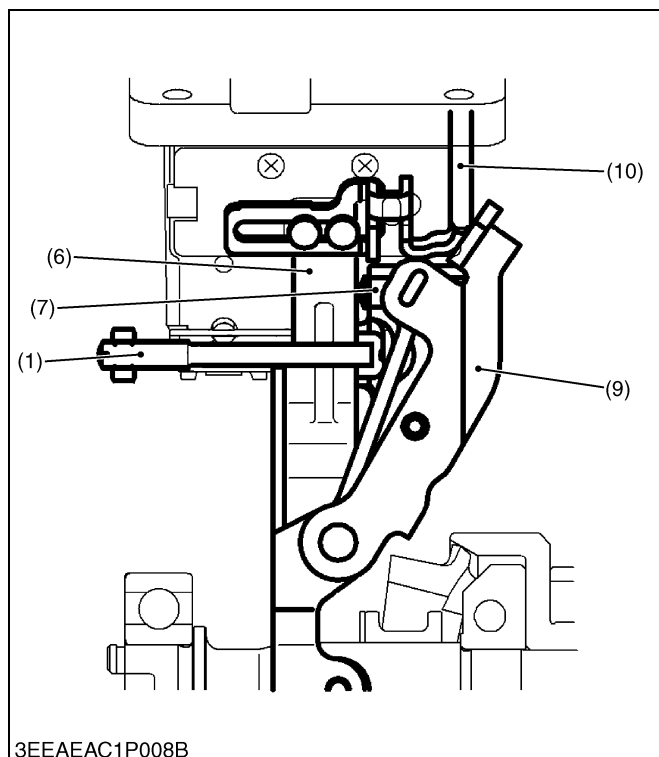
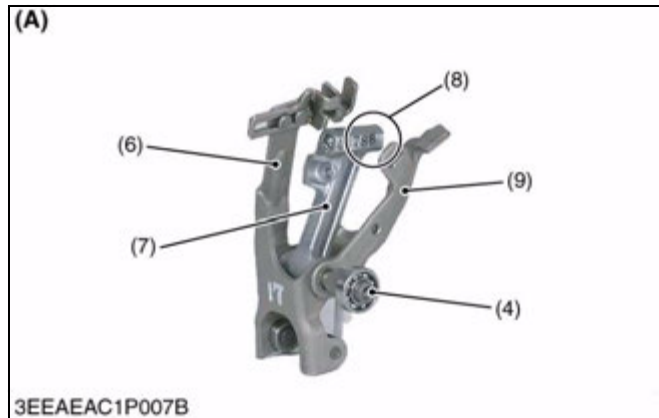
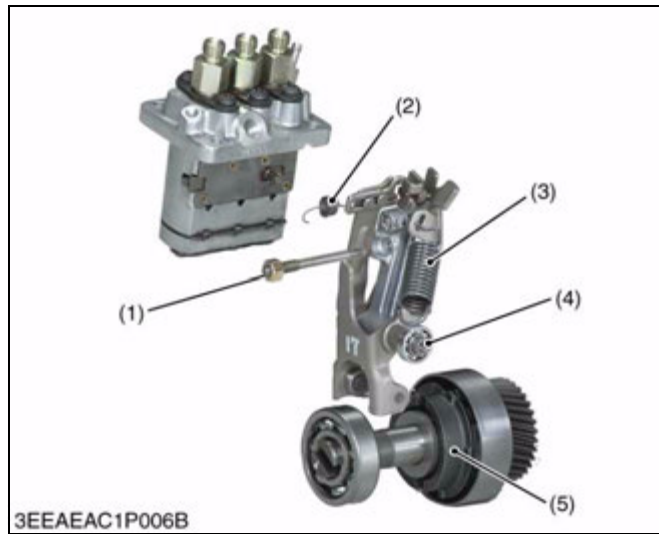


[2] GOVERNOR

Injection pump performance is closely related to the engine performance, and in many ways, the function of an injection pump depends on the governor connected to the pump.

A governor performs an important role in saving fuel while allowing the engine run smoothly.

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The governor system is a mechanical governor that used the governor weight (5).

The governor weight (5) is mounted on the governor shaft that rotates at the same speed as the crankshaft.

Because the feature of this mechanism removes the engine speed directly as a centrifugal force of weight, the speed control that the change in the engine rotational speed is sensitively transmitted to fork lever assembly (A) and accuracy is high.

The fork lever assembly of this engine consists of fork lever 1 (6), for lever 2 (9), and the floating lever (7). A slide plate is installed in fork lever 1. The governor spring (3) is hooked to fork lever 2 (9).

The floating lever (7) installs the torque pin (8) of the output drop prevention at the overload. The start spring (2) is hooked to a slide plate, and holds the control rack in the direction of the full fuel position.

Fork lever 2 (9) and the floating lever are installed in fork lever 1 (6) with the fork lever shaft (4). The max torque limitation (1) device limits the amount of the fuel injection at the overload with the torque pin.

- | | |
|------------------------|--------------------|
| (1) Max Torque Limiter | (7) Floating Lever |
| (2) Start Spring | (8) Torque Pin |
| (3) Governor Spring | (9) Fork Lever 2 |
| (4) Fork Lever Shaft | |
| (5) Governor Weight | |
| (6) Fork Lever 1 | |

(A) Fork Lever Assembly

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(At Rated Operation)

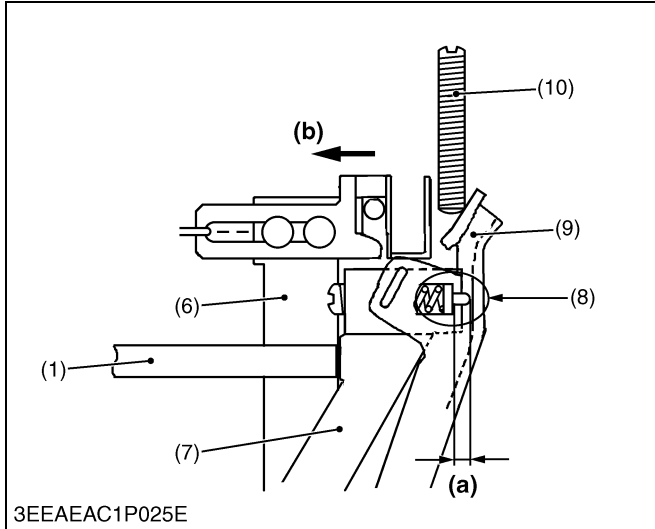
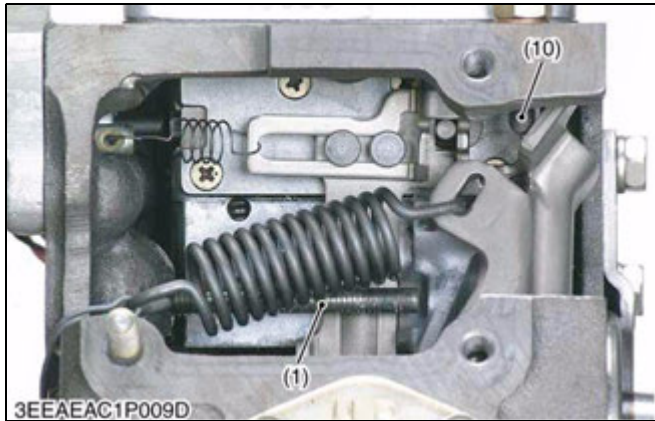
When the engine is running, the fork lever 2 (9) and the floating lever (7) are moving with the fork lever 1 (6) due to the tension of the governor spring (3).

During the time, the torque pin (8) is pressed into the floating lever by centrifugal force of the governor weight (5).

The fork lever 2 (9) comes in contact with the fuel limitation bolt (10), and the fuel injection pump supplies a fuel necessary for rated operation.

- | | |
|------------------------|---------------------------|
| (1) Max Torque Limiter | (9) Fork Lever 2 |
| (6) Fork Lever 1 | (10) Fuel Limitation Bolt |
| (7) Floating Lever | |

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(Overloaded Operation)

The amount of the movement of the fork lever assembly is limited with the fuel limitation bolt (10) and can not be moved in the direction of the fuel increase.

As overload reduces the centrifugal force of the governor weight, which is pressing the torque pin (8) into the floating lever (7), the floating lever pushes the fork lever 1 (6) in the way to increase the fuel supply with the help of the torque spring tension.

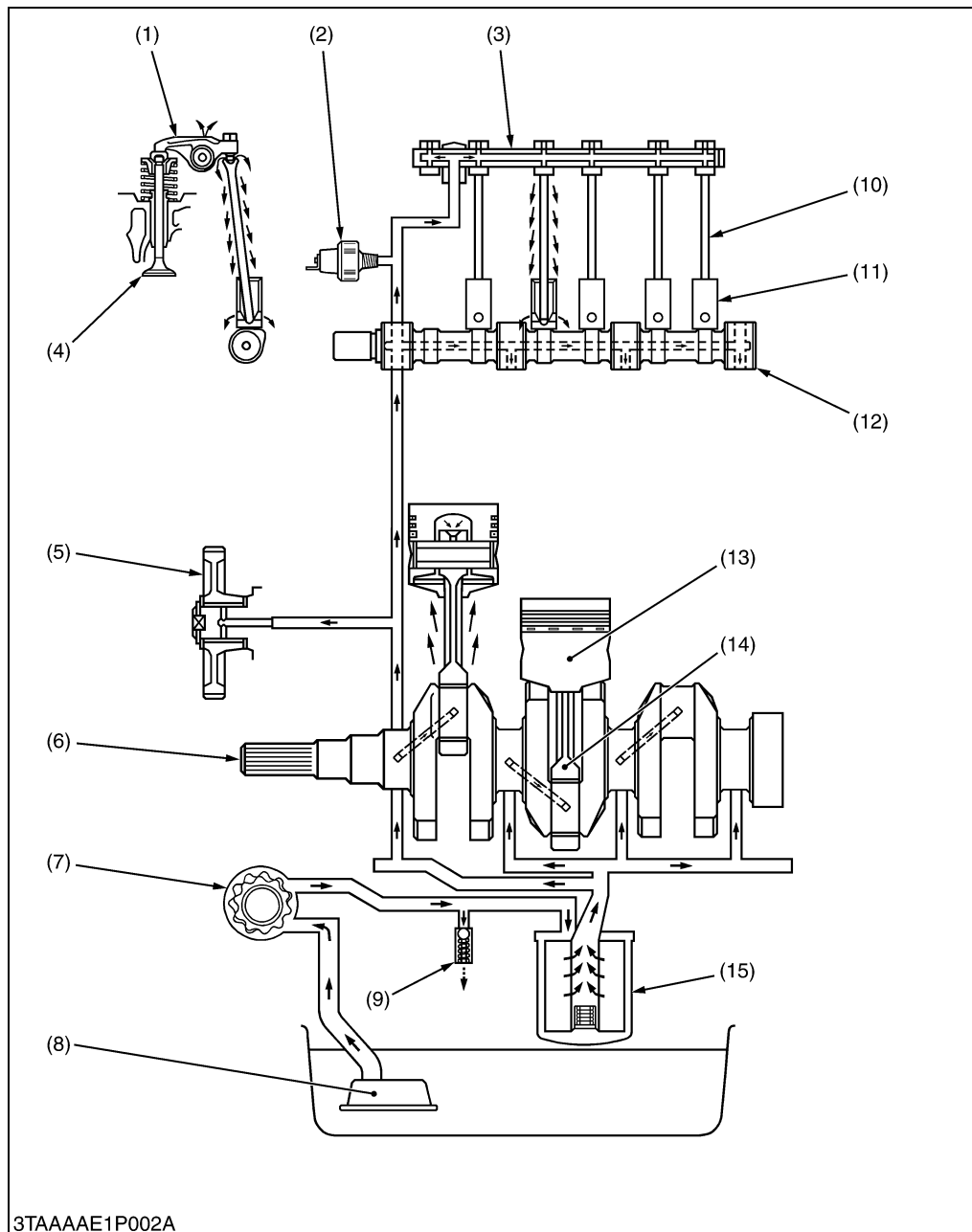
The fuel supply increases (b) in relation to the degree of the torque pin motion, thus preventing the engine speed from dropping.

At the time, the maximum torque limiter (1) prevents superfluous fuel supply and suppresses the generation of black smoke.

- (1) Max Torque Limiter
- (6) Fork Lever 1
- (7) Floating Lever
- (8) Torque Pin
- (9) Fork Lever 2
- (10) Fuel Limitation Bolt
- (a) Distance to which torque pin (8) pushes fork lever 1 (6) out
- (b) Increase of fuel

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2. LUBRICATING SYSTEM



- (1) Rocker Arm
- (2) Oil Pressure Switch
- (3) Rocker Arm Shaft
- (4) Valve
- (5) Idle Gear
- (6) Crankshaft
- (7) Oil Pump
- (8) Oil Strainer
- (9) Relief Valve
- (10) Push Rod
- (11) Tappet
- (12) Camshaft
- (13) Piston
- (14) Connecting Rod
- (15) Oil Filter Cartridge

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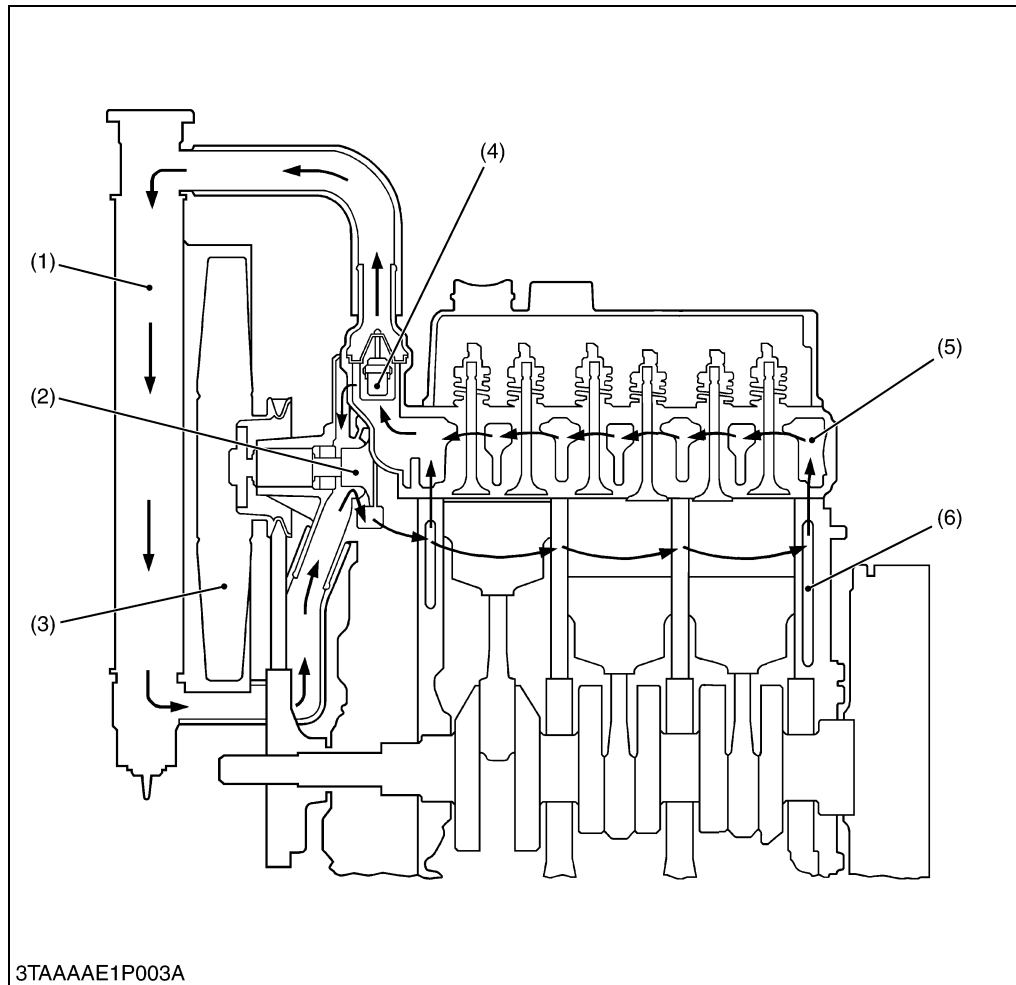
This engine's lubricating system consists of oil strainer (8), oil pump (7), relief valve (9), oil filter cartridge (15) and oil pressure switch (2).

The oil pump sucks lubricating oil from the oil pan through the oil strainer and the oil flows down to the filter cartridge, where it is further filtered. Then the oil is forced to crankshaft (6), connecting rods (14), idle gear (5), camshaft (12) and rocker arm shaft (3) to lubricate each part.

Some part of oil, splashed by the crankshaft or leaking and dropping from gaps of each part, lubricates these parts: piston (13), cylinders, small ends or connecting rods, tappets (11), push rods (10), inlet and exhaust valves (4) and timing gears.

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3. COOLING SYSTEM



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

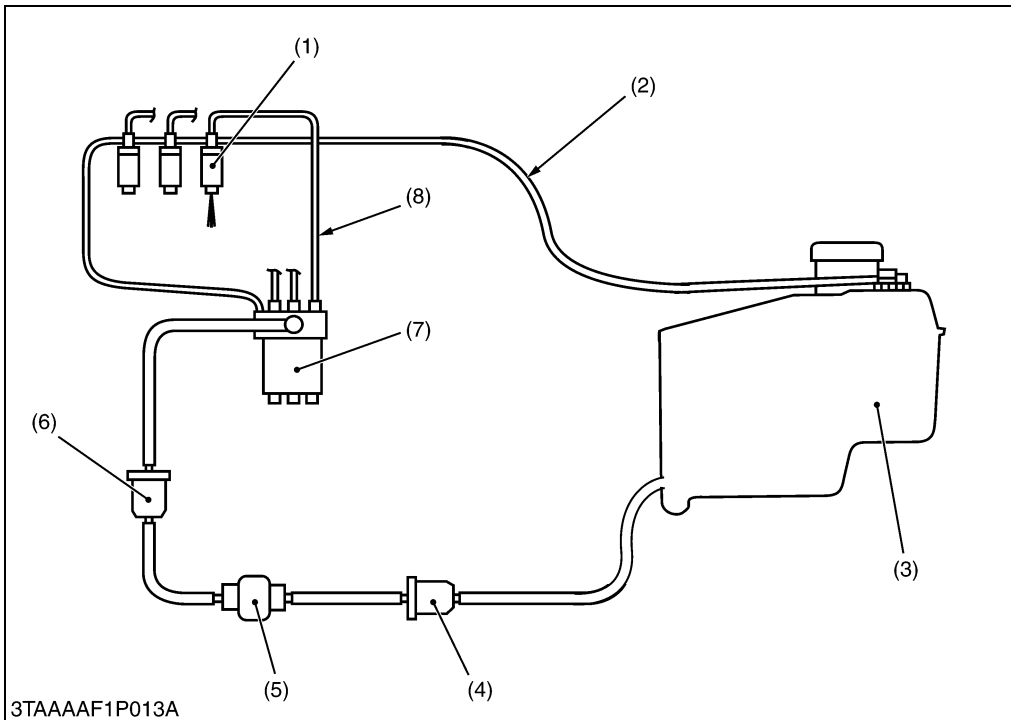
The cooling system consists of a radiator (1), a centrifugal water pump (2), a cooling fan (3) and a thermostat (4). The coolant is cooled through the radiator core, and the cooling fan (3) set behind the radiator (1) pulls cooling air through the radiator core to improve cooling.

The water pump receives water from the radiator or from the cylinder head and force it into the cylinder block.

The thermostat opens or closes according to the water temperature. When the water temperature is high, the thermostat opens to allow the water to flow from the cylinder head to the radiator. When the water temperature is low, the thermostat close to flow the water only to the water pump.

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4. FUEL SYSTEM



- (1) Injection Nozzle
- (2) Fuel Overflow Pipe
- (3) Fuel Tank
- (4) Fuel Filter
- (5) Fuel Feed Pump
- (6) Fuel Filter
- (7) Injection Pump
- (8) Injection Pipe

Fuel from the fuel tank (3) passes through the fuel filter (4), and then enters the injection pump (7) after impurities such as dirt, water, etc. are removed.

The fuel pressurized by the injection pump to the opening pressure (13.7 to 14.7 MPa, 140 to 150 kgf/cm², 1990 to 2133 psi), of the injection nozzle (1) is injected into the combustion chamber.

Part of the fuel fed to the injection nozzle (1) lubricates the moving parts of the needle valve inside the nozzle, then returns to the fuel tank through the fuel overflow pipe (2) from the upper part of the nozzle holder.

9Y1211344ENM0008US0

SERVICING

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1. TROUBLESHOOTING

Symptom	Probable Cause and Checking Procedure	Solution	Reference Page
Engine Does Not Start	1. No fuel	Fill fuel	G-9, G-19
	2. Air in the fuel system	Vent air	G-44
	3. Water in the fuel system	Change fuel and repair or replace fuel system	G-9, G-32
	4. Fuel pipe clogged	Clean or replace	G-32
	5. Fuel filter clogged	Replace	G-32
	6. Excessively high viscosity of fuel or engine oil at low temperature	Use specified fuel or engine oil	G-9
	7. Fuel with low cetane number	Use specified fuel	G-9
	8. Fuel leak due to loose injection pipe retaining nut	Tighten retaining nut	1-S25
	9. Incorrect injection timing	Adjust	1-S15
	10. Fuel camshaft worn	Replace	1-S31
	11. Injection nozzle clogged	Clean or replace	1-S17
	12. Injection pump malfunctioning	Replace	1-S30
	13. Seizure of crankshaft, camshaft, piston, cylinder or bearing	Repair or replace	1-S28 to 1-S36
	14. Compression leak from cylinder	Replace head gasket, tighten cylinder head screw, glow plug and nozzle holder	1-S25, 1-S27
	15. Improper valve timing	Correct or replace timing gear	1-S31
	16. Piston ring and cylinder worn	Replace	1-S34, 1-S51
	17. Excessive valve clearance	Adjust	1-S12
	18. Key switch malfunctioning	Repair or replace	5-S9
	19. Stop solenoid malfunctioning	Check and replace	5-S12
Starter Does Not Run	1. Battery discharged	Charge	G-30 to G-31
	2. Starter malfunctioning	Repair or replace	5-S10
	3. Key switch malfunctioning	Check and replace	5-S9
	4. Wiring disconnected	Connect	5-S6

Symptom	Probable Cause and Checking Procedure	Solution	Reference Page
Engine Revolution Is Not Smooth	1. Fuel filter clogged or dirty	Replace	G-32, G-44
	2. Air cleaner clogged	Clean or replace	G-29
	3. Fuel leak due to loose injection pipe retaining nut	Tighten retaining nut	1-S25
	4. Injection pump malfunctioning	Replace	1-S30
	5. Incorrect nozzle opening pressure	Adjust	1-S18
	6. Injection nozzle stuck or clogged	Replace	1-S17
	7. Governor malfunctioning	Repair	1-S30
Either White or Blue Exhaust Gas Is Observed	1. Excessive engine oil	Reduce to specified level	1-S20
	2. Piston ring and cylinder worn or stuck	Replace	1-S34, 1-S51
	3. Incorrect injection timing	Adjust	1-S15
Either Black or Dark Gray Exhaust Gas Is Observed	1. Overload	Decrease the load	–
	2. Low grade fuel used	Use specified fuel	G-9
	3. Fuel filter clogged	Replace	G-32, G-44
	4. Air cleaner clogged	Clean or replace	G-29
	5. Deficient nozzle injection	Replace nozzle	1-S17
Deficient Output	1. Air cleaner dirty or clogged	Clean or replace	G-29
	2. Incorrect injection timing	Adjust	1-S15
	3. Engine's moving parts seem to be seizing	Repair or replace	–
	4. Injection pump malfunctioning	Replace	1-S30
	5. Deficient nozzle injection	Replace nozzle	1-S17
	6. Compression leak	Check the compression pressure and repair	1-S11
	7. Gas leak from exhaust system	Repair or replace	–
Excessive Lubricant Oil Consumption	1. Piston ring's gap facing the same direction	Shift ring gap direction	1-S33
	2. Oil ring worn or stuck	Replace	1-S33
	3. Piston ring groove worn	Replace piston	1-S34, 1-S47
	4. Valve stem and valve guide worn	Replace	1-S28, 1-S38
	5. Crankshaft bearing and crank pin bearing worn	Replace	1-S36
	6. Oil leaking due to damaged seals or packing	Replace	–
Fuel Mixed into Lubricant Oil	1. Injection pump's plunger worn	Replace	1-S30
	2. Deficient nozzle injection	Replace nozzle	1-S17
	3. Injection pump broken	Replace	1-S30

Symptom	Probable Cause and Checking Procedure	Solution	Reference Page
Water Mixed into Lubricant Oil	1. Head gasket damaged	Replace	1-S27
	2. Cylinder block or cylinder head flawed	Replace	1-S37, 1-S38
Low Oil Pressure	1. Engine oil insufficient	Fill	1-S20
	2. Oil strainer clogged	Clean	1-S32
	3. Relief valve stuck with dirt	Clean	1-M4
	4. Relief valve spring weaken or broken	Replace	1-M4
	5. Excessive oil clearance of crankshaft bearing	Replace	1-S36, 1-S48
	6. Excessive oil clearance of crankpin bearing	Replace	1-S36, 1-S48
	7. Excessive oil clearance of rocker arm	Replace	1-S26, 1-S41
	8. Oil passage clogged	Clean	–
	9. Different type of oil	Use specified type of oil	G-9
	10. Oil pump damaged	Replace	1-S52
High Oil Pressure	1. Different type of oil	Use specified type of oil	G-9
	2. Relief valve damaged	Replace	1-M4
Engine Overheated	1. Engine oil insufficient	Fill	1-S20
	2. Fan belt broken or elongated	Replace or adjust	G-32
	3. Coolant insufficient	Fill	1-S21
	4. Radiator net and radiator fin clogged with dust	Clean	G-20
	5. Inside of radiator corroded	Clean or replace	G-36
	6. Coolant flow route corroded	Clean or replace	–
	7. Radiator cap damaged	Replace	1-S14
	8. Overload running	Reduce the load	–
	9. Head gasket damaged	Replace	1-S27
	10. Incorrect injection timing	Adjust	1-S15
	11. Unsuitable fuel used	Use specified fuel	G-9
Battery Quickly Discharged	1. Battery electrolyte insufficient	Fill distilled water and charge	G-30
	2. Fan belt slips	Adjust belt tension or replace	G-32
	3. Wiring disconnected	Connect	5-S6
	4. Regulator damaged	Check and replace	5-S13
	5. Dynamo damaged	Check and replace	5-S12
	6. Battery damaged	Check and replace	G-30, 5-S6

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2. SERVICING SPECIFICATIONS

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 38.1 to 41.9 kgf/cm ² 541 to 596 psi	2.26 MPa 23.0 kgf/cm ² 328 psi
Difference among Cylinders		–	10 % or less
Top Clearance		0.55 to 0.75 mm 0.022 to 0.029 in.	–
Cylinder Head Surface	Flatness	–	0.05 mm 0.0020 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/ Setting Length	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.
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.	–

Item		Factory Specification	Allowable Limit
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 0.78741 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 0.0015 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.
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	29.00 mm 1.142 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 1.4148 to 1.4153 in.	–
	• Cylinder Block Bore I.D.	36.000 to 36.025 mm 1.4174 to 1.4183 in.	–
Idle Gear Shaft to Gear Bushing	Clearance	0.020 to 0.054 mm 0.00079 to 0.0021 in.	0.10 mm 0.0039 in.
	• Idle Gear Shaft 1 O.D.	25.967 to 25.980 mm 1.0224 to 1.0228 in.	–
	• Idle Gear Bushing I.D.	26.000 to 26.021 mm 1.0237 to 1.0244 in.	–
Piston Pin Bore	I.D.	22.000 to 22.013 mm 0.86615 to 0.86665 in.	22.03 mm 0.8673 in.

Item		Factory Specification	Allowable Limit	
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.	–
Piston Pin to Small End Bushing (Spare Parts)	Oil Clearance	0.015 to 0.038 mm 0.00059 to 0.0014 in.	0.15 mm 0.0059 in.	
	• Small End Bushing	I.D.	22.025 to 22.040 mm 0.86713 to 0.86771 in.	–
Connecting Rod	Alignment	–	0.05 mm 0.002 in.	
Piston Ring Gap	Top Ring	0.15 to 0.25 mm 0.0059 to 0.0098 in.	1.20 mm 0.0472 in.	
	Second Ring	0.40 to 0.55 mm 0.016 to 0.021 in.	1.20 mm 0.0472 in.	
	Oil Ring	0.25 to 0.45 mm 0.0099 to 0.017 in.	1.25 mm 0.0492 in.	
Piston Ring to Piston Ring Groove	Second Ring	0.085 to 0.112 mm 0.0034 to 0.00440 in.	0.20 mm 0.0079 in.	
	Oil Ring	0.02 to 0.06 mm 0.0008 to 0.002 in.	0.15 mm 0.0059 in.	
Crankshaft	Side Clearance	0.15 to 0.31 mm 0.0059 to 0.012 in.	0.50 mm 0.020 in.	
	Alignment	–	0.02 mm 0.0008 in.	
Crankpin to Crankpin Bearing	Oil Clearance	0.029 to 0.091 mm 0.0012 to 0.0035 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.	40.004 to 40.050 mm 1.5750 to 1.5767 in.	–
Crankshaft Journal to Crankshaft Bearing 1	Oil Clearance	0.034 to 0.114 mm 0.0014 to 0.00448 in.	0.20 mm 0.0079 in.	
	• Crankshaft Journal	O.D.	47.934 to 47.950 mm 1.8872 to 1.8877 in.	–
	• Crankshaft Bearing 1	I.D.	47.984 to 48.048 mm 1.8892 to 1.8916 in.	–

Item		Factory Specification	Allowable Limit
Crankshaft Journal to Crankshaft Bearing 2	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 1.8877 in.	–
	• Crankshaft Bearing 2	I.D. 47.984 to 48.029 mm 1.8892 to 1.8909 in.	–
Crankshaft Journal to Crankshaft Bearing 3	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.	–
Cylinder Liner	I.D.	78.000 to 78.019 mm 3.0709 to 3.0716 in.	78.15 mm 3.077 in.
Cylinder Liner (Oversized) [Oversize: 0.5 mm (0.02 in.)]	I.D.	78.500 to 78.519 mm 3.0906 to 3.0912 in.	78.65 mm 3.096 in.

LUBRICATING SYSTEM

Item		Factory Specification	Allowable Limit
Engine Oil Pressure	At Idle Speed	68 kPa 0.69 kgf/cm ² 9.9 psi	–
	At Rated Speed	294 to 441 kPa 3.00 to 4.49 kgf/cm ² 42.7 to 63.9 psi	147 kPa 1.50 kgf/cm ² 21.3 psi
Inner Rotor to Outer Rotor	Clearance	0.060 to 0.18 mm 0.0024 to 0.0070 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.	–

COOLING SYSTEM

Item		Factory Specification	Allowable Limit
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)	80.0 to 84.0 °C 176.0 to 183.2 °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 → 8.6 psi	–
Radiator	Water Leakage Test Pressure	No leak at specified pressure 177 kPa 1.80 kgf/cm ² 25.7 psi	–

FUEL SYSTEM

Item		Factory Specification	Allowable Limit
Injection Pump	Injection Timing (3200 min ⁻¹ (rpm))	0.3011 to 0.3272 rad (17.25 to 18.75 °) 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 149.8 kgf/cm ² 1992 to 2132 psi	–

Item		Factory Specification	Allowable Limit
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.	–

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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 "6. TIGHTENING TORQUES" on page G-12.)

Item	Size × Pitch	N·m	kgf·m	lbf·ft
Cylinder head cover screw	M7 × 1.0	7 to 8	0.7 to 0.9	5 to 6
Cylinder head screw	M10 × 1.25	64 to 68	6.5 to 7.0	47 to 50
*Main bearing case screw 1	M8 × 1.25	30 to 34	3.0 to 3.5	22 to 25
*Main bearing case screw 2	M9 × 1.25	49 to 53	5.0 to 5.5	37 to 39
*Flywheel screw	M10 × 1.25	54 to 58	5.5 to 6.0	40 to 43
*Connecting rod screw	M8 × 1.0	42 to 46	4.2 to 4.7	31 to 33
*Rocker arm bracket nut	M7 × 1.0	22 to 26	2.2 to 2.7	16 to 19
*Idle gear shaft screw	M6 × 1.0	9.81 to 11.2	1.00 to 1.15	7.24 to 8.31
*Fan drive pulley screw	M14 × 1.5	236 to 245	24.0 to 25.0	174 to 180
Bearing case cover mounting screw	M6 × 1.0	10.8 to 12.2	1.10 to 1.25	7.96 to 9.04
Glow plug	M8 × 1.0	7.9 to 14	0.80 to 1.5	5.8 to 10
Nozzle holder assembly	M20 × 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 nut	M12 × 1.5	25 to 34	2.5 to 3.5	18 to 25
Overflow pipe retaining nut (Serial No.: below BTZ999)	M12 × 1.5	20 to 24	2.0 to 2.5	15 to 18
Overflow pipe retaining nut (Serial No.: above BU0001)	M12 × 1.5	35 to 39	3.5 to 4.0	26 to 28
Starter's B terminal nut	M8	5.88 to 11.8	0.600 to 1.20	4.34 to 8.70
Alternator's pulley nut	–	58.4 to 78.9	5.95 to 8.05	43.1 to 58.2
Drain plug with copper gasket	M12 × 1.25	33 to 37	3.3 to 3.8	24 to 27
Drain plug with rubber coated gasket	M22 × 1.5	45 to 53	4.5 to 5.5	33 to 39

■ NOTE

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

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4. CHECKING, DISASSEMBLING AND SERVICING

[1] CHECKING AND ADJUSTING

(1) Engine Body



Compression Pressure

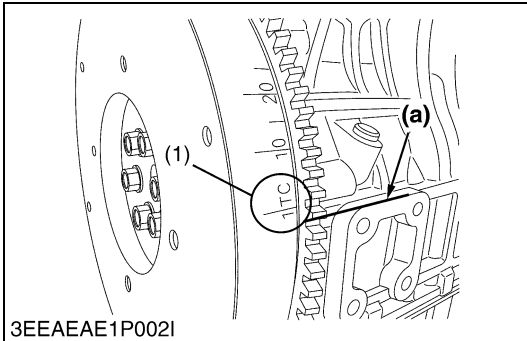
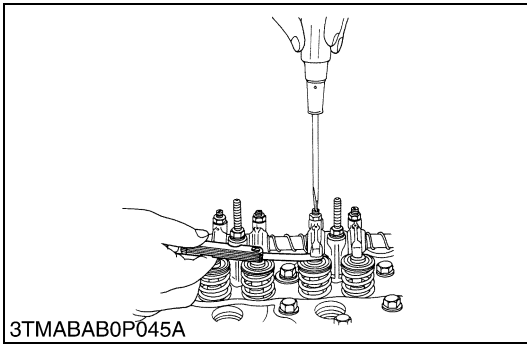
1. Run the engine until it is warmed up.
2. Stop the engine.
3. Remove the air cleaner, the muffler and all glow plugs.
4. Set a compression tester with the adaptor to the glow plug hole.
5. After making sure that the stop lever is set at the stop position (non-injection), run the engine with the starter 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 %.**

Compression pressure	Factory specification	3.73 to 4.11 MPa 38.1 to 41.9 kgf/cm ² 541 to 596 psi
	Allowable limit	2.26 MPa 23.0 kgf/cm ² 328 psi

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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 (a) 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 specification, 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.

Adjustable cylinder location of piston		Number of cylinders Valve arrangement	
		3 cylinder	
		IN.	EX.
When No. 1 piston is at compression top dead center	1st	☆	☆
	2nd		☆
	3rd	☆	
When No. 1 piston is at overlap position	1st		
	2nd	☆	
	3rd		☆
Valve clearance	Factory specification	0.145 to 0.185 mm 0.00571 to 0.00728 in.	

■ **NOTE**

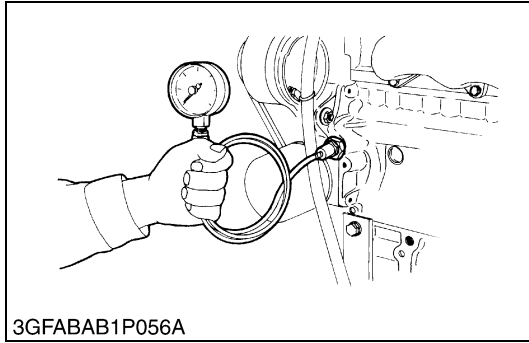
- **The sequence of cylinder numbers is given as No. 1, No. 2 and No. 3 starting from the gear case side.**
- **After adjusting the valve clearance, secure the adjusting screw with the lock nut.**

(1) "1TC" Mark

(a) Alignment Mark

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(2) Lubricating System



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 damaged
 - 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 specification	More than 68 kPa 0.69 kgf/cm ² 9.9 psi
	At rated speed	Factory specification	294 to 441 kPa 3.00 to 4.49 kgf/cm ² 42.7 to 63.9 psi
		Allowable limit	147 kPa 1.50 kgf/cm ² 21.3 psi

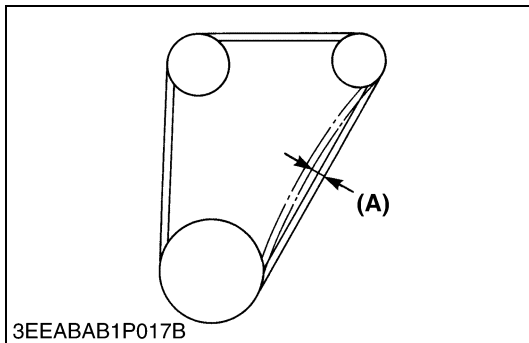
(When reassembling)

- 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
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(3) Cooling System



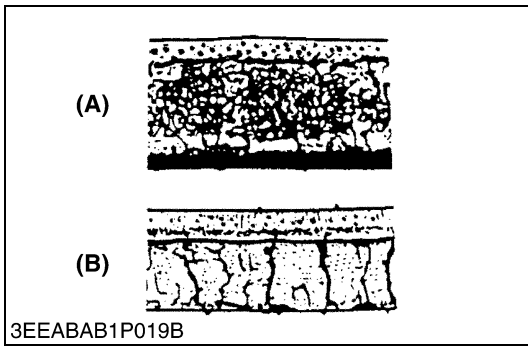
Fan Belt Tension

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 specification, loosen the alternator mounting screws and relocate the alternator to adjust.

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

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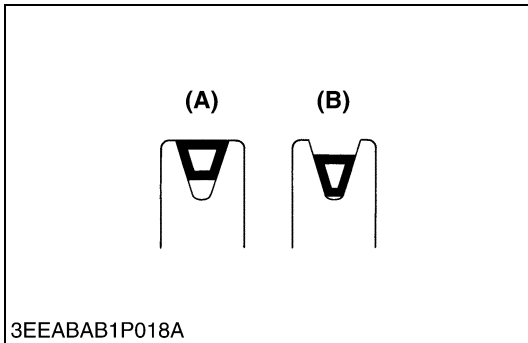
Fan Belt Damage and Wear

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

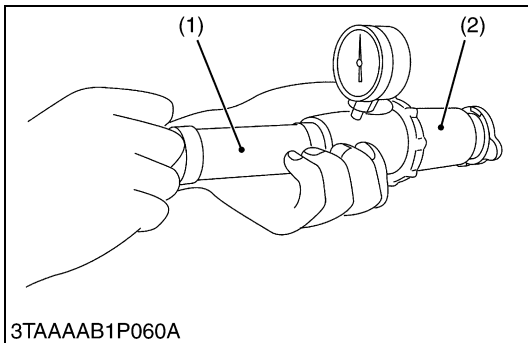
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CAUTION

- When removing the radiator cap, wait at least 10 minutes after the engine has stopped and cooled down. Otherwise, hot water may gush out, scalding nearby people.

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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/cm², 13 psi), and measure the time for the pressure to fall to 59 kPa (0.6 kgf/cm², 9 psi).
3. If the measurement is less than the factory specification, replace the radiator cap.

Pressure falling time	Factory specification	More than 10 seconds for pressure fall from 88 to 59 kPa (from 0.90 to 0.60 kgf/cm ² , from 13 to 8.6 psi)
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(1) Radiator Tester

(2) Adaptor

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Radiator Water Leakage

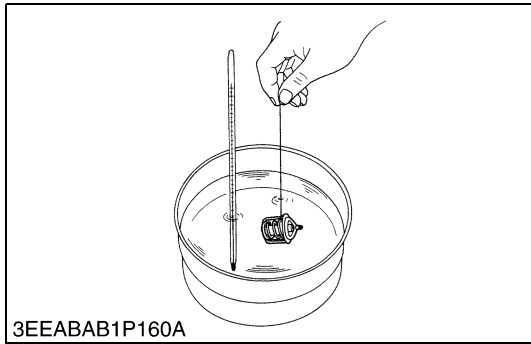
1. Pour a specified amount of water into the radiator.
2. Set a radiator tester (1) and an adaptor (2) and raise the water pressure to the specified pressure.
3. Check the radiator for water leaks.
4. For water leak from the pinhole, repair with the radiator cement. When water leak is excessive, replace the radiator.

Radiator water leakage test pressure	Factory specification	177 kPa 1.80 kgf/cm ² 25.7 psi
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(1) Radiator Tester

(2) Adaptor

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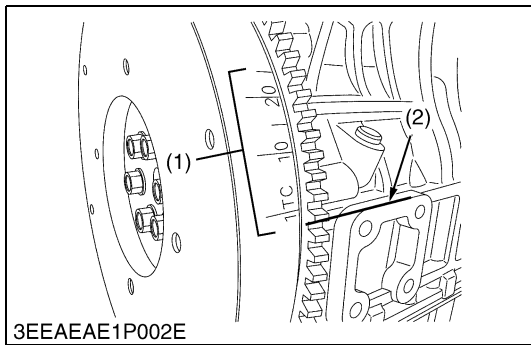
Thermostat Valve Opening Temperature

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 specification, replace the thermostat.

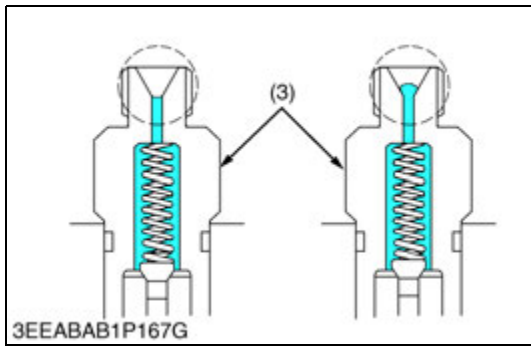
Thermostat's valve opening temperature	Factory specification	80.0 to 84.0 °C 176.0 to 183.2 °F
Temperature at which thermostat completely opens	Factory specification	95 °C 203 °F

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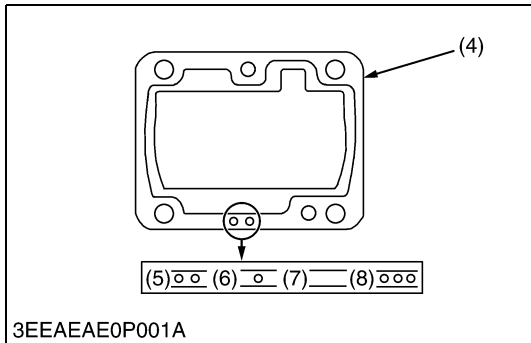
(4) Fuel System



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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 (3) 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 to alignment mark (2) if it is within factory specification.
The flywheel gas mark "1TC", "10" (10 °) and "20" (20 °) shows 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.

Injection timing	Factory specification	0.3011 to 0.3272 rad (17.25 to 18.75 °) before T.D.C.
------------------	-----------------------	--

- | | |
|-----------------------------------|---------------------------------------|
| (1) Timing Line | (5) Two-holes: 0.20 mm (0.0079 in.) |
| (2) Alignment Mark | Two-holes: 0.175 mm (0.00689 in.) |
| (3) Delivery Valve Holder | (6) One-hole: 0.25 mm (0.0098 in.) |
| (4) Shim (Soft Metal Gasket Shim) | (7) Without hole: 0.30 mm (0.012 in.) |
| | (8) Three-holes: 0.35 mm (0.014 in.) |

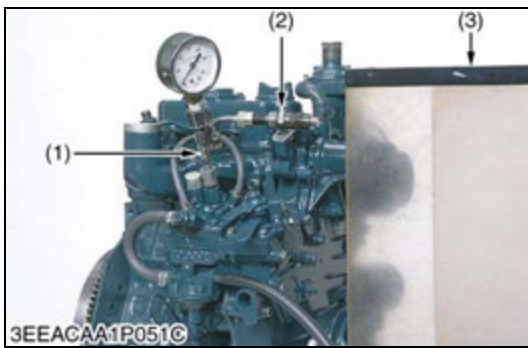
(To be continued)

(Continued)

■ **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.), 0.025 mm (0.0098 in.), 0.30 mm (0.012 in.), and 0.35 mm (0.014 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.

9Y1211344ENS0013US0



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.

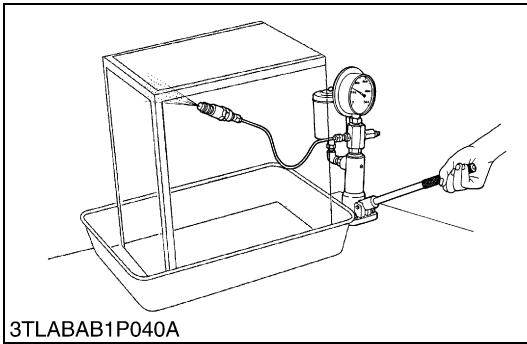
Fuel tightness of pump element	Allowable limit	13.73 MPa 140.0 kgf/cm ² 1991 psi
--------------------------------	-----------------	--

■ **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

9Y1211344ENS0014US0



3TLABAB1P040A

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 specification, replace the adjusting washer (1) in the nozzle holder to adjust it.

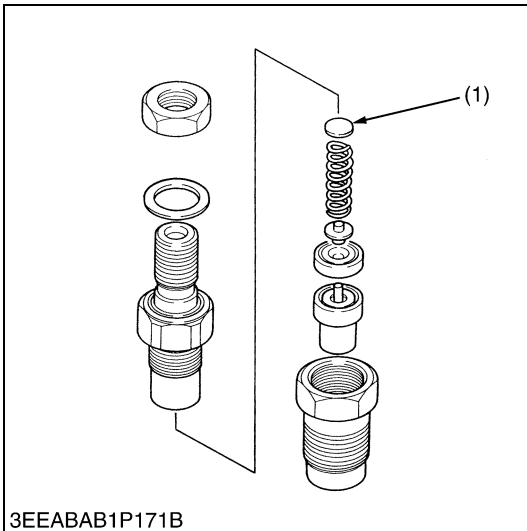
(Reference)

- Pressure variation with 0.01 mm (0.0004 in.) difference of adjusting washer thickness.
Approx. 235 kPa (2.4 kgf/cm², 34 psi)

Fuel injection pressure	Factory specification	13.73 to 14.70 MPa 140.0 to 149.8 kgf/cm ² 1992 to 2132 psi
-------------------------	-----------------------	--

(1) Adjusting Washer

9Y1211344ENS0018US0



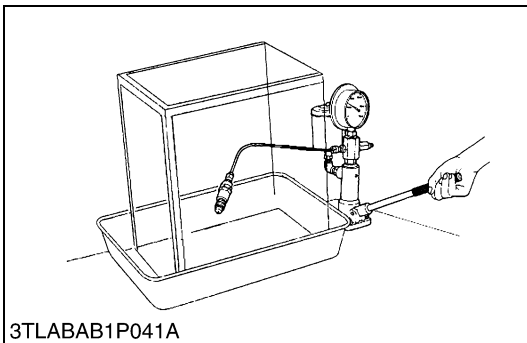
3EEABAB1P171B

Valve Seat Tightness

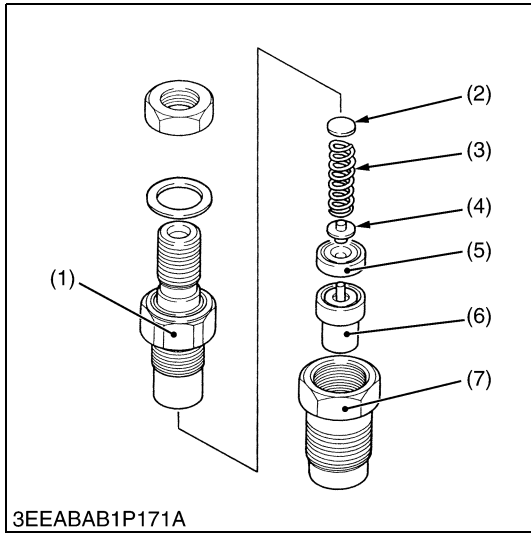
1. Set the injection nozzle to a nozzle tester.
2. Raise the fuel pressure, and keep at 12.75 MPa (130.0 kgf/cm², 1849 psi) for 10 seconds.
3. If any fuel leak is found, replace the nozzle piece.

Valve seat tightness	Factory specification	No fuel leak at 12.75 MPa 130.0 kgf/cm ² 1849 psi
----------------------	-----------------------	---

9Y1211344ENS0019US0



3TLABAB1P041A



Nozzle Holder

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

(When reassembling)

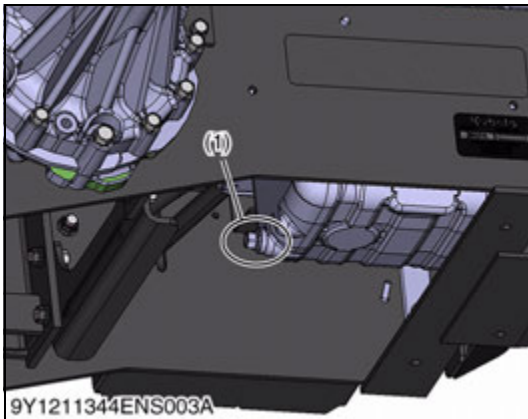
- Assemble the nozzle in clean fuel oil.
- Install the push rod (4), noting its direction.
- After assembling the nozzle, be sure to adjust the fuel injection pressure.

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

9Y1211344ENS0020US0

[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	3.9 L 4.1 U.S.qts 3.4 Imp.qts
---------------------	-------------------------------------

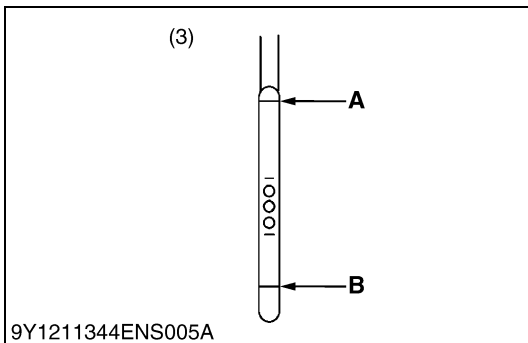
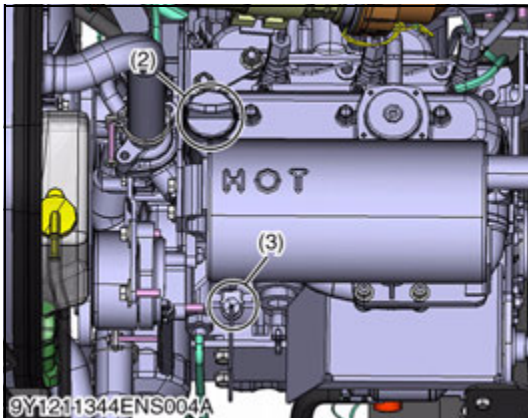
■ IMPORTANT

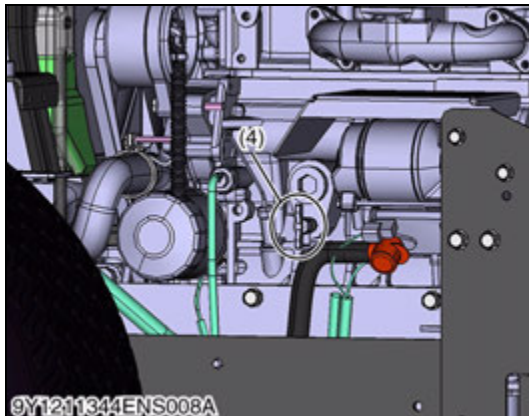
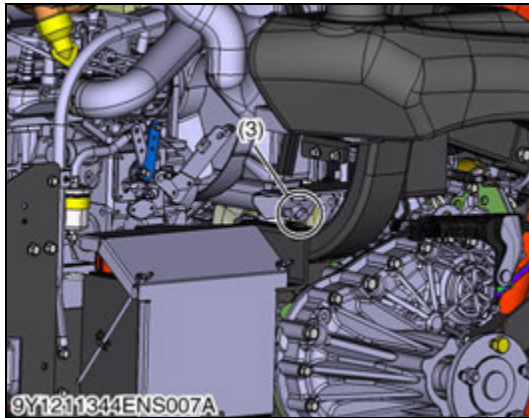
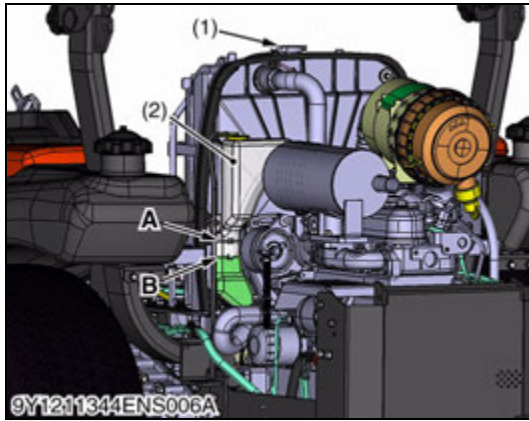
- Never mix two different type of oil.
- Use the proper SAE Engine Oil according to ambient temperatures.

Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-9.)

- | | |
|--------------------|----------------|
| (1) Drain Plug | A: Upper Level |
| (2) Oil Inlet Plug | B: Lower Level |
| (3) Dipstick | |

9Y1211344ENS0021US0





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 10 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 valve (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	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 Valve
- A: Upper Level**
 - B: Lower Level**

9Y1211344ENS002US0

Battery

⚠ WARNING

To avoid serious injury:

- 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

9Y1211344ENS0023US0

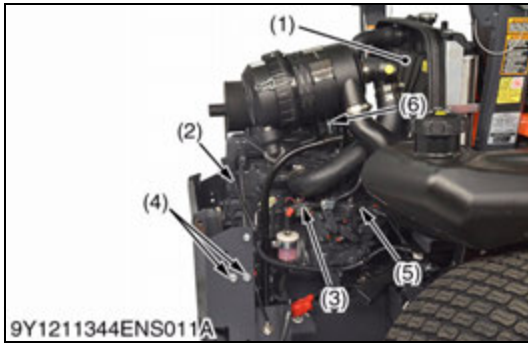


Bonnet

1. Remove the bonnet mounting bolts (1).
2. Remove the bonnet (2).

- | | |
|---------------------------|------------|
| (1) Bonnet Mounting Bolts | (2) Bonnet |
|---------------------------|------------|

9Y1211344ENS0024US0



Fan Shroud, Electric Wiring and Others

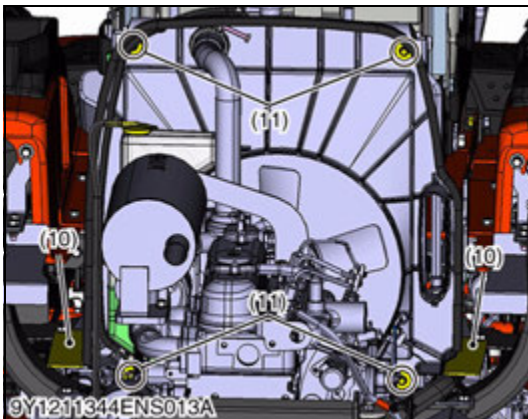
1. Disconnect the wiring connectors for engine stop solenoid, glow plug, coolant temperature sensor, engine oil pressure switch and dynamo.
2. Remove the positive cable (9) from starter motor.
3. Disconnect the accelerator wire (5).
4. Remove the air filter assembly (6).
5. Disconnect the fuel hoses (3) from engine.
6. Disconnect the water hoses (7), (8).
7. Remove both shroud plates (10).
8. Disconnect fan shroud (1), (11).
9. Remove engine stoppers (4).

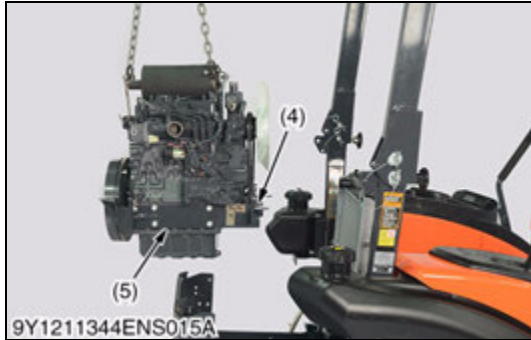
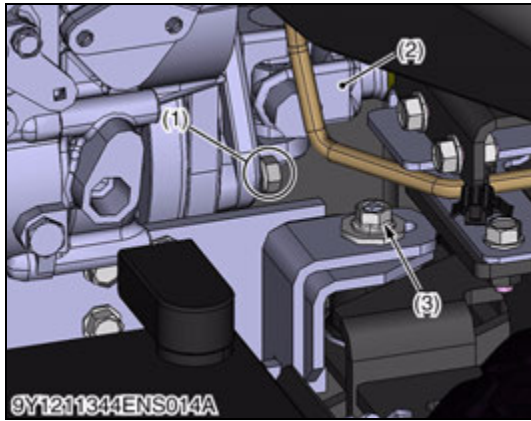
(When reassembling)

- When you install the accelerator wire, adjust the wiring length. The stopper lever must hit the idling speed adjusting bolt and the maximum speed adjusting bolt in the stroke of the accelerator lever.

- | | |
|---------------------------------------|-----------------------|
| (1) Fan Shroud | (7) Upper Hose |
| (2) Wiring Harness | (8) Lower Hose |
| (3) Fuel Hose | (9) Positive Cable |
| (4) Engine Stopper | (10) Shroud Plate |
| (5) Accelerator Wire (Throttle Cable) | (11) Fan Shroud Bolts |
| (6) Air Filter Support | |

9Y1211344ENS0025US0





Separating Engine

1. Raise seat.
2. Remove ROPS connecting plate.
3. Remove universal joint mounting screws (1).
4. Disconnect universal joint (2) from Fan drive pulley.
5. Remove engine mounting nuts.
6. Separate the engine.
7. Remove engine support LH (4) and RH (3).

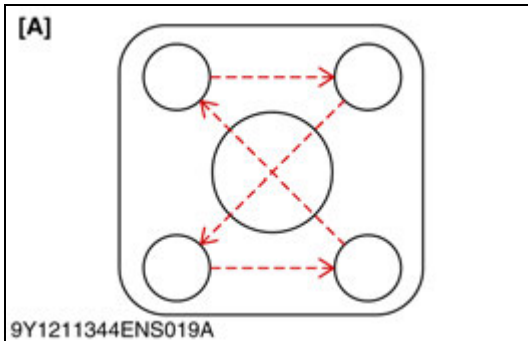
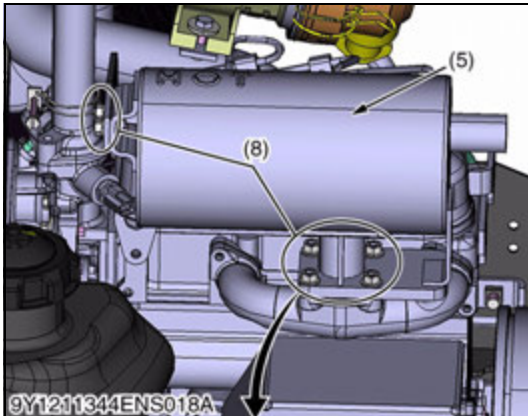
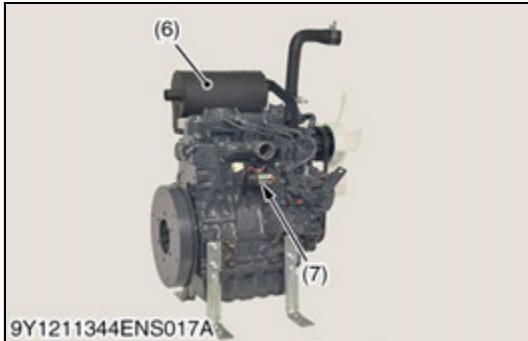
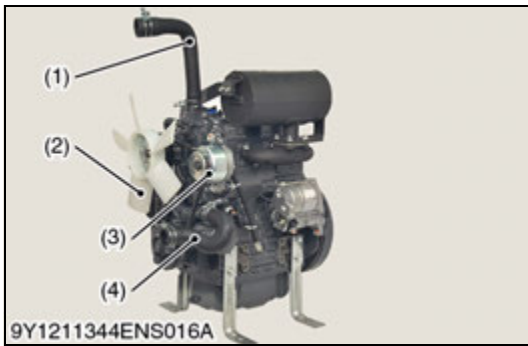
(When reassembling)

- 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	17.6 to 20.6 N·m 1.80 to 2.10 kgf·m 13.0 to 15.1 lbf·ft

- | | |
|------------------------------------|-------------------------|
| (1) Universal Joint Mounting Screw | (4) Engine Support (LH) |
| (2) Universal Joint | (5) Engine Support (RH) |
| (3) Engine Mounting Nut | |

9Y1211344ENS0026US0



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 (6).
5. Remove the starter (5).
6. Remove the engine stop solenoid (7).

(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.**
- **When torquing muffler, tighten in opposite angle direction. See image [A].**

Tightening torque	Engine support mounting bolt	48 to 55 N·m 4.9 to 5.7 kgf·m 36 to 41 lbf·ft
	Muffler mounting nut	23.5 to 27.4 N·m 2.40 to 2.79 kgf·m 17.4 to 20.2 lbf·ft

- | | |
|-----------------|--------------------------|
| (1) Upper Hose | (6) Muffler |
| (2) Cooling Fan | (7) Engine Stop Solenoid |
| (3) Dynamo | (8) Muffler Bolts |
| (4) Lower Hose | |
| (5) Starter | |

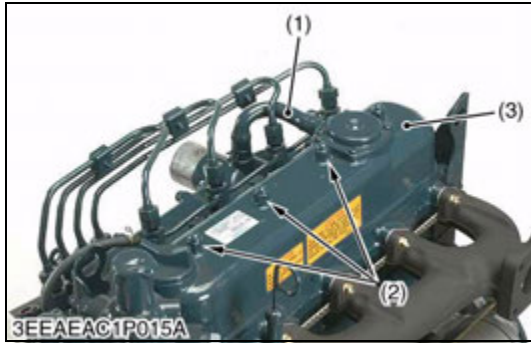
[A] Muffler Bolts Torque Pattern

9Y1211344ENS0027US0

[3] DISASSEMBLING AND ASSEMBLING

(1) D1105-E4

[A] Cylinder Head and Valve



3EEAEAC1P015A

Cylinder Head Cover

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

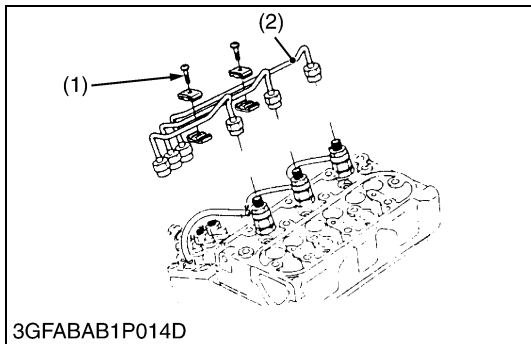
(When reassembling)

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

Tightening torque	Cylinder head cover screw	7 to 8 N·m 0.7 to 0.9 kgf·m 5 to 6 lbf·ft
-------------------	---------------------------	---

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

9Y1211344ENS0028US0



3GFABAB1P014D

Injection Pipes

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

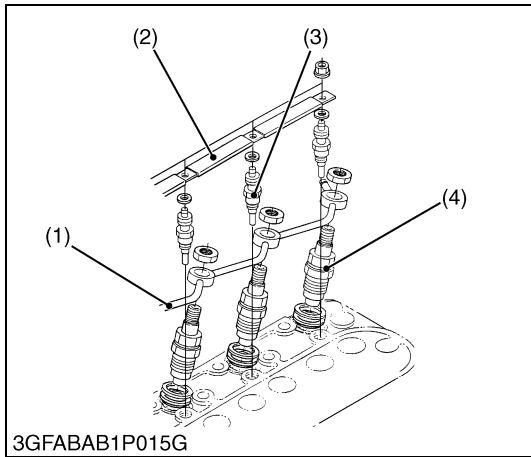
(When reassembling)

- Send 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

9Y1211344ENS0029US0



3GFABAB1P015G

Nozzle Holder Assembly and Glow Plug

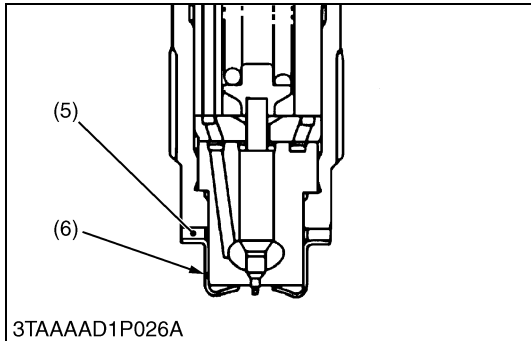
1. Remove the overflow pipe (1).
2. Remove the nozzle holder assemblies (4).
3. Remove the copper gasket (5) and heat seal (6).
4. Remove the lead (2) from the glow plugs (3).
5. Remove the glow plugs (3).

(When reassembling)

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

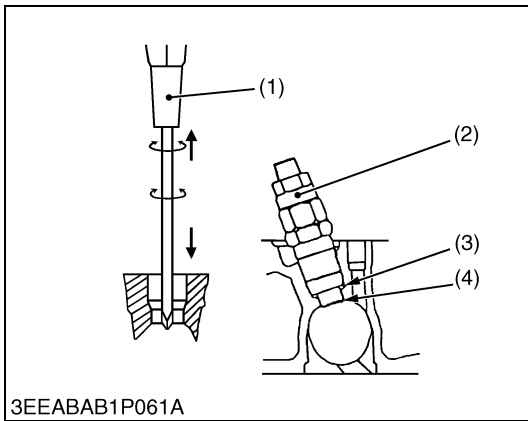
Tightening torque	Overflow pipe retaining nut (Serial No.: below BTZ999)	20 to 24 N·m 2.0 to 2.5 kgf·m 15 to 18 lbf·ft
	Overflow pipe retaining nut (Serial No.: above BU0001)	35 to 39 N·m 3.5 to 4.0 kgf·m 26 to 28 lbf·ft
	Nozzle holder assembly	49 to 68 N·m 5.0 to 7.0 kgf·m 37 to 50 lbf·ft
	Glow plug	7.9 to 14 N·m 0.80 to 1.5 kgf·m 5.8 to 10 lbf·ft

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



3TAAAD1P026A

9Y1211344ENS0030US0



Nozzle Heat Seal Service Removal Procedure

■ **IMPORTANT**

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

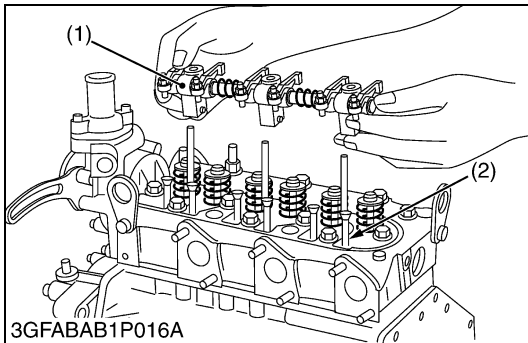
1. Drive screw driver (1) lightly into the heat seal hole.
2. Turn screw driver three or four times each way.
3. While turning the screw driver, slowly pull the heat seal (4) out together with the injection nozzle gasket (3).
4. If the heat seal drops, repeat the above procedure.

(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 | (3) Injection Nozzle Gasket |
| (2) Nozzle Holder | (4) Heat Seal |

9Y1211344ENS0031US0



Rocker Arm and Push Rod

1. Remove the rocker arm bracket screws / nuts.
2. Remove 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.

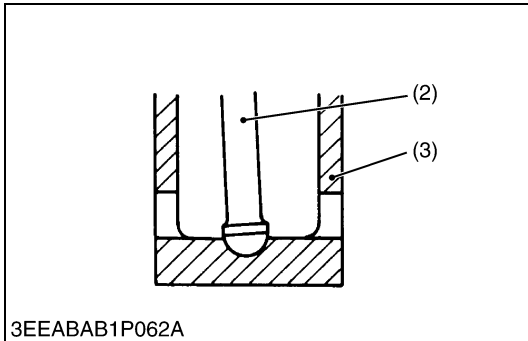
■ **IMPORTANT**

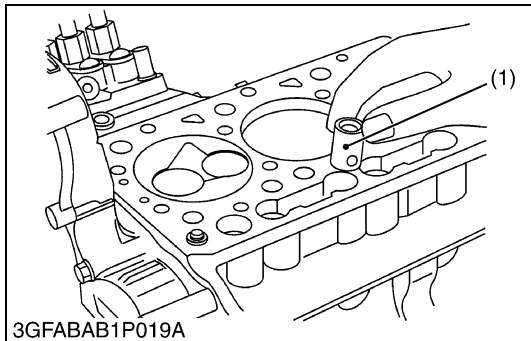
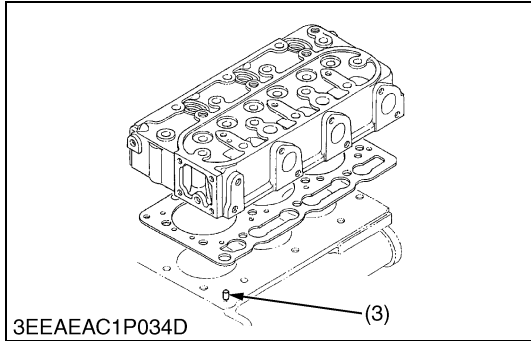
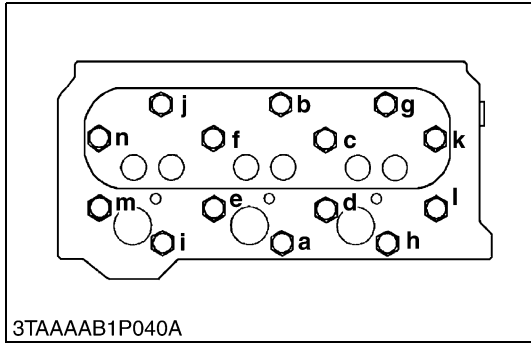
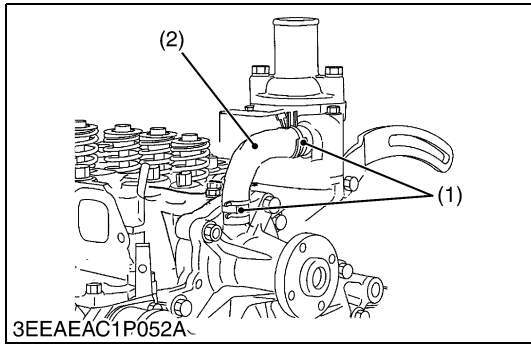
- After installing the rocker arm, be sure to adjust the valve clearance.

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

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

9Y1211344ENS0032US0





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. Be careful 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.

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

9Y1211344ENS0033US0

Tappets

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

(When reassembling)

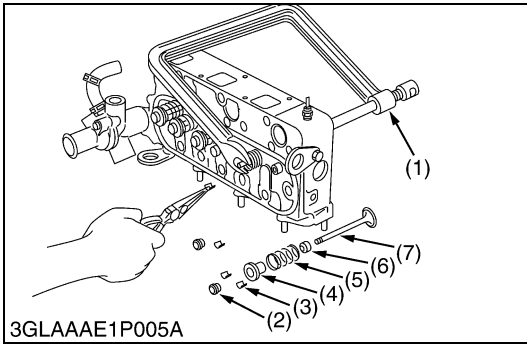
- Visually check the contact between tappets and cams for proper rotation. If problem is found, replace tappets.
- Before installing the tappets, apply engine oil thinly around them.

■ **IMPORTANT**

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

- (1) Tappet

9Y1211344ENS0034US0



3GLAAAE1P005A

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)

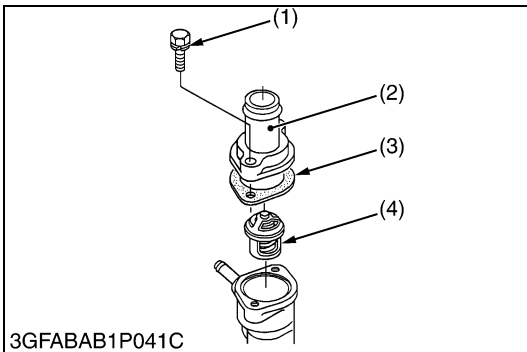
- Wash the valve stem and valve guide hole, and apply engine oil sufficiently.
- After installing the valve spring collets, lightly tap the stem to assure proper fit with a plastic hammer.

■ IMPORTANT

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

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

9Y1211344ENS0035US0



3GFABAB1P041C

Thermostat Assembly

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

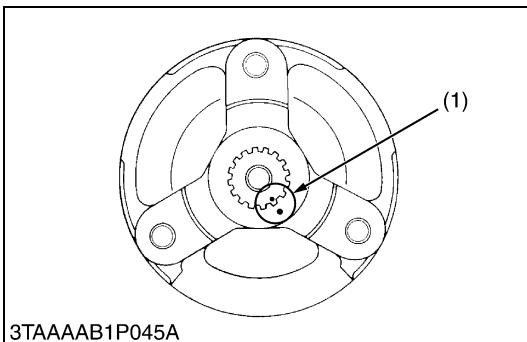
(When reassembling)

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

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

9Y1211344ENS0036US0

[B] Injection pump, Gear Case and Timing Gears



3TAAAB1P045A

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.

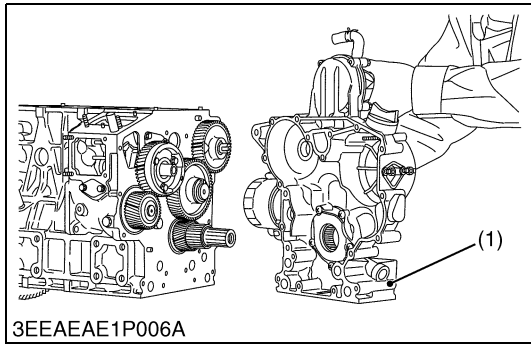
(When reassembling)

- 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.

Tightening torque	Fan drive pulley screw	236 to 245 N·m 24.0 to 25.0 kgf·m 174 to 180 lbf·ft
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- (1) Aligning Mark

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Gear Case

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

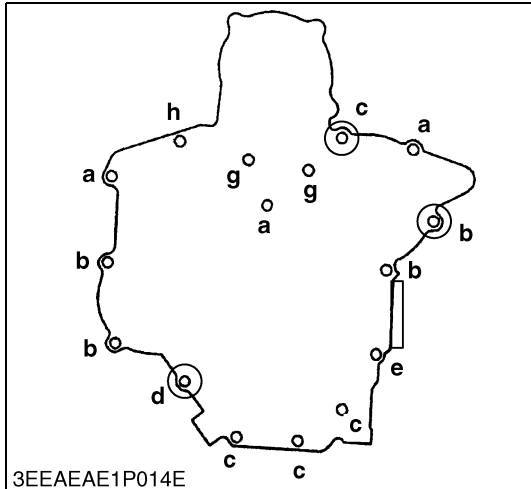
(When reassembling)

- 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 = 65 mm (2.6 in.)
- e: Bolt Length = 68 mm (2.7 in.)
- f: Bolt Length = 70 mm (2.8 in.)
- g: Bolt Length = 85 mm (3.3 in.)
- h: Nut

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Speed Control Plate

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

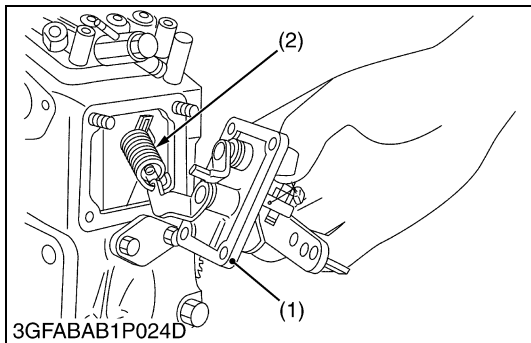
(When reassembling)

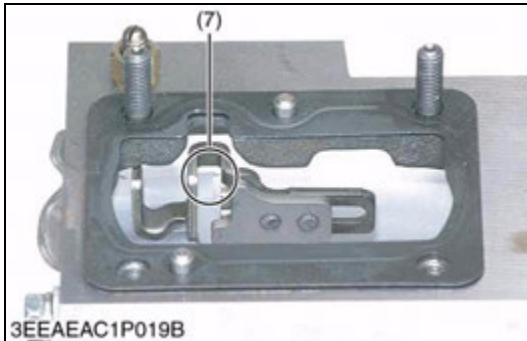
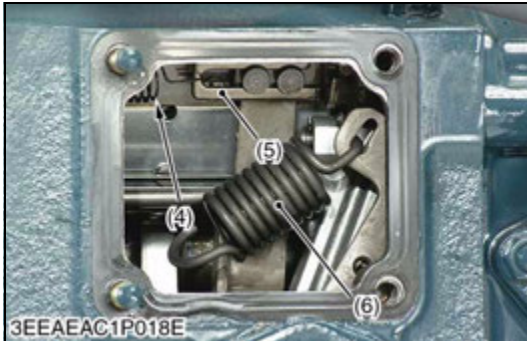
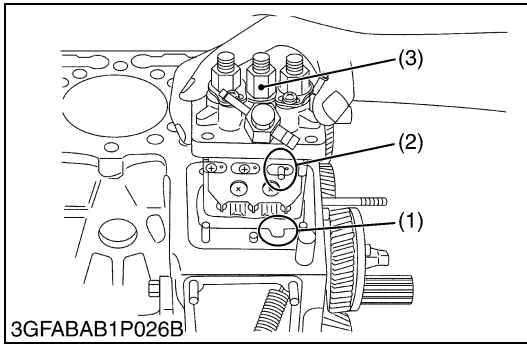
- Apply a liquid gasket (Three Bond 1215 or equivalent) to both sides of the solenoid cover gasket and control plate gasket.
- Be careful not to drop the governor spring (2) into the crankcase.

(1) Speed Control Plate

(2) Governor Spring

9Y1211344ENS0039US0





Injection Pump

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)

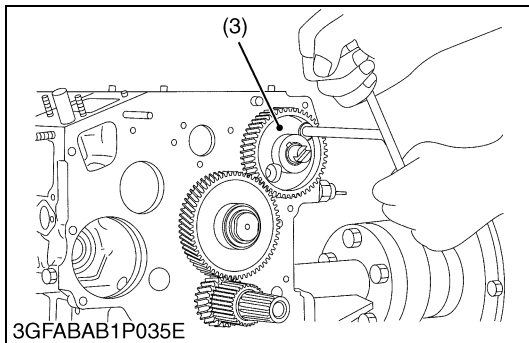
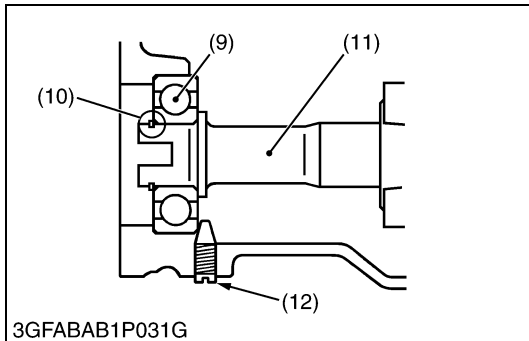
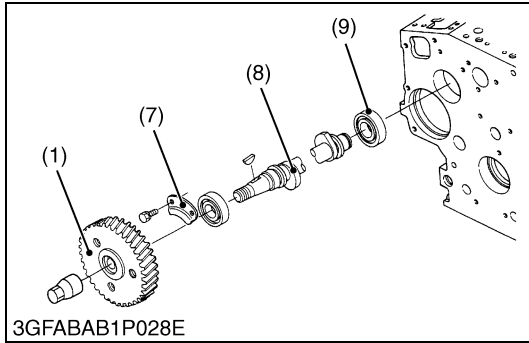
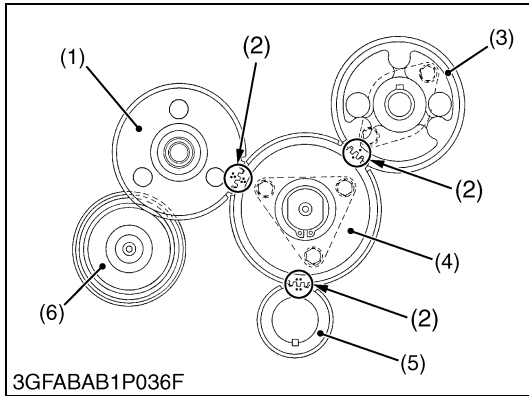
- When installing the injection pump, insert the control rack pin (2) firmly into the groove (7) of the thrust lever of fork lever.

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

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Cam Gear, Idle Gear 1 and Governor Gear

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.

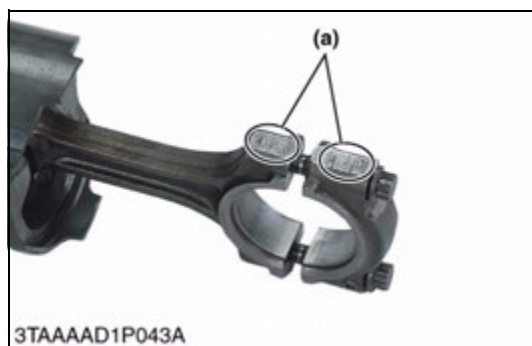
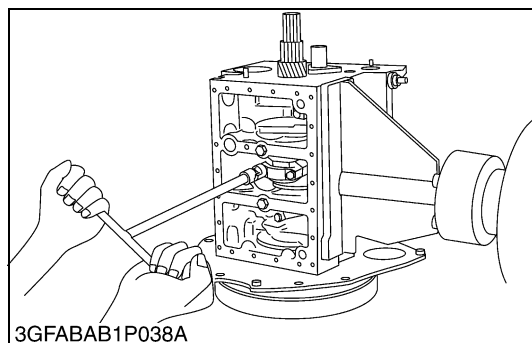
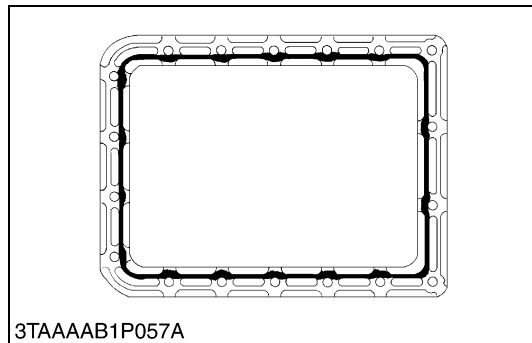
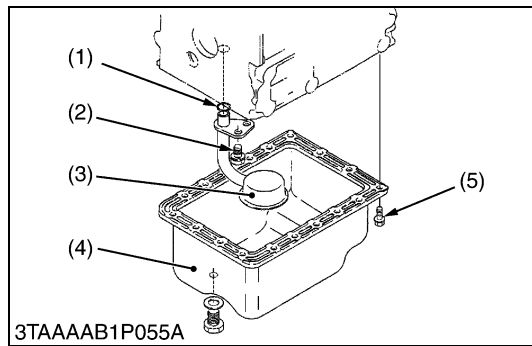
■ **IMPORTANT**

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

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[C] Piston and Connecting Rod



Oil Pan and Oil Strainer (for Standard Oil Pan)

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 is 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 from the center.

■ IMPORTANT

- **Scrape off the old adhesive completely. Wipe the sealing surface clean using waste cloth soaked with gasoline.**
- **Apply "liquid gasket" (Three Bond 1207D or equivalent) about 3.0 to 5.0 mm (0.12 to 0.19 in.) thick. Within 20 minutes after the application of liquid gasket, reassemble the components.**

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

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Connecting Rod

1. Remove the connecting rod cap.

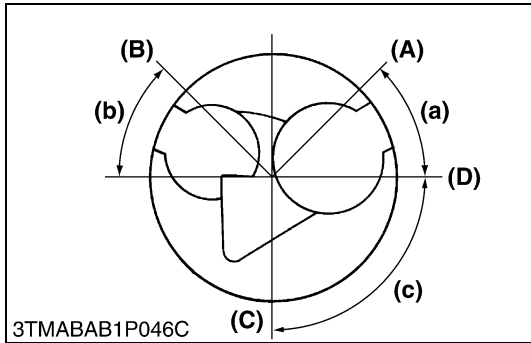
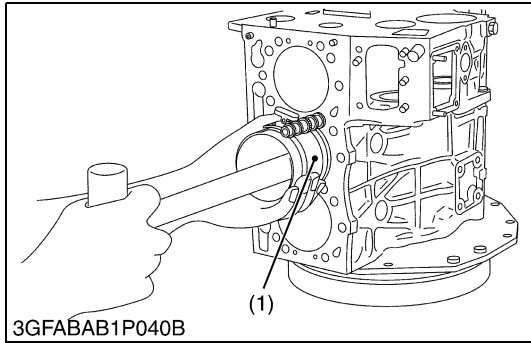
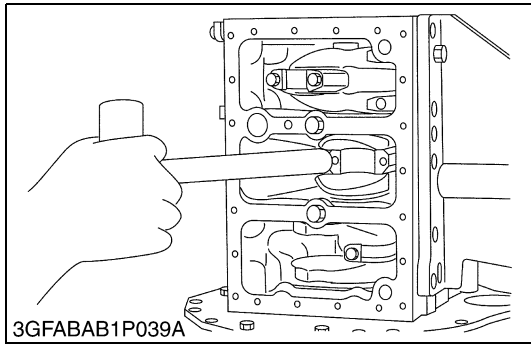
(When reassembling)

- 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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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)

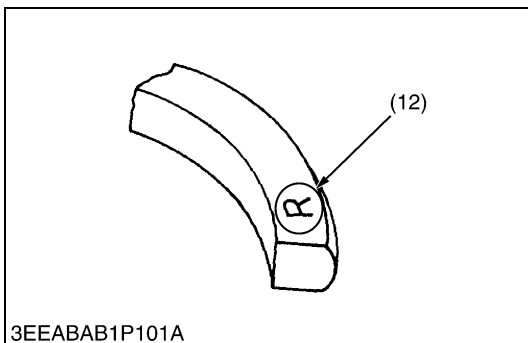
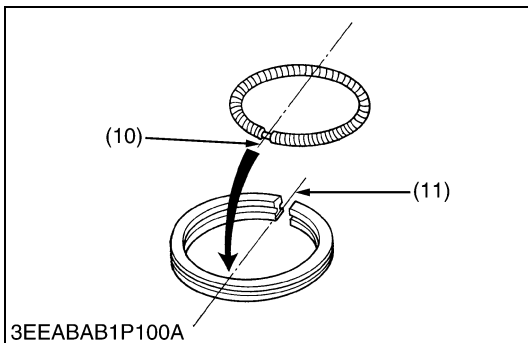
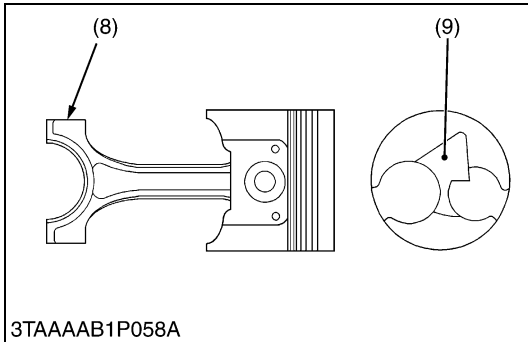
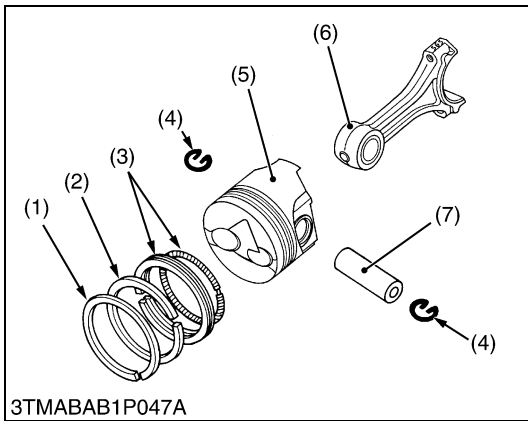
- Before inserting the piston into the cylinder, apply enough engine oil to the piston.
- When inserting the piston into the cylinder, face the mark on the connecting rod to the injection pump.

■ 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) 0.79 rad (45 °) |
| | (b) 0.79 rad (45 °) |
| (A) Top Ring Gap | (c) 1.6 rad (90 °) |
| (B) Second Ring Gap | |
| (C) Oil Ring Gap | |
| (D) Piston Pin Hole | |

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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).

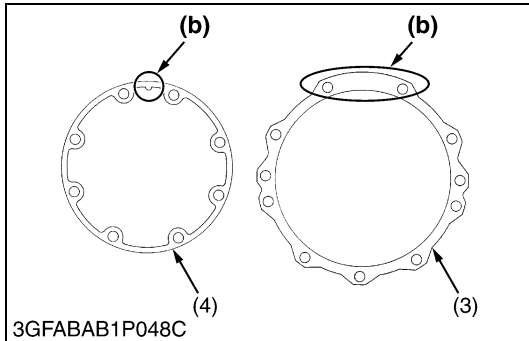
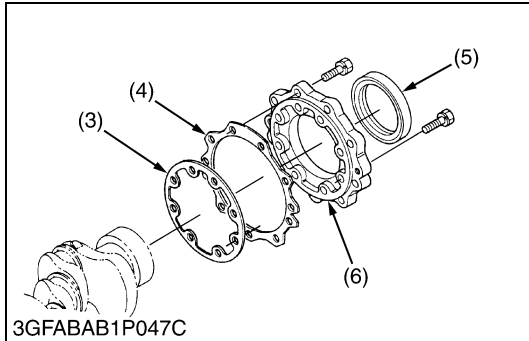
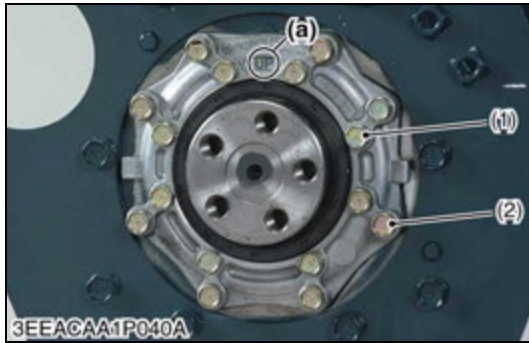
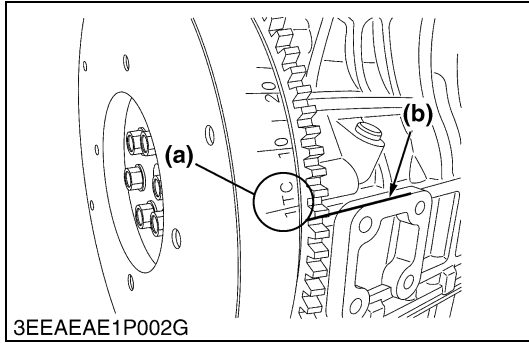
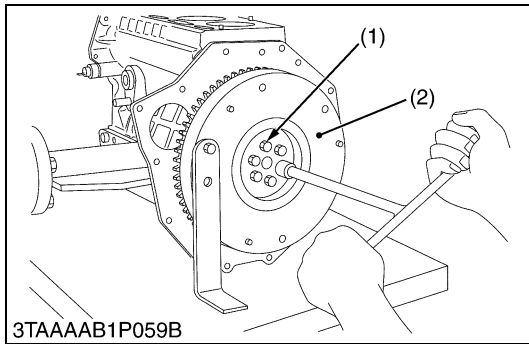
■ **NOTE**

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

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

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[D] 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 (b) on the rear end plate. 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
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- (1) Flywheel Screw
- (2) Flywheel

- (a) 1TC Mark
- (b) Alignment Mark

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Bearing Case Cover

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

■ IMPORTANT

- The length of inside screws (1) and outside screws (2) are different. Do not take a mistake using inside screws and outside screws.

(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 be careful that it is not rolled when installing.
- Tighten the bearing case cover mounting screws with even force on the diagonal line.

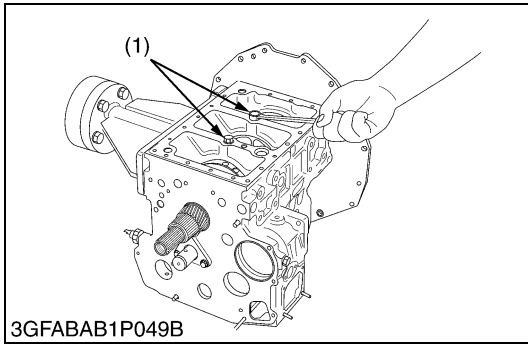
Tightening torque	Bearing case cover mounting screw	10.8 to 12.2 N·m 1.10 to 1.25 kgf·m 7.96 to 9.04 lbf·ft
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- (1) Bearing Case Cover Mounting Screw (Inside) (Long)
- (2) Bearing Case Cover Mounting Screw (Outside) (Short)
- (3) Bearing Case Gasket
- (4) Bearing Case Cover Gasket

- (5) Oil Seal
- (6) Bearing Case Cover

- (a) Top Mark "UP"
- (b) Upside

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Crankshaft Assembly

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

■ **IMPORTANT**

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

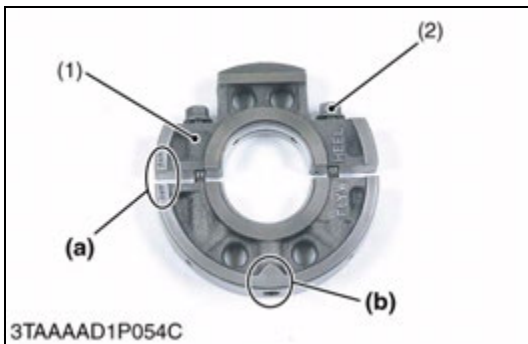
(When reassembling)

- 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.

Tightening torque	Main bearing case screw 2	49 to 53 N·m 5.0 to 5.5 kgf·m 37 to 39 lbf·ft
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(1) Main Bearing Case Screw 2

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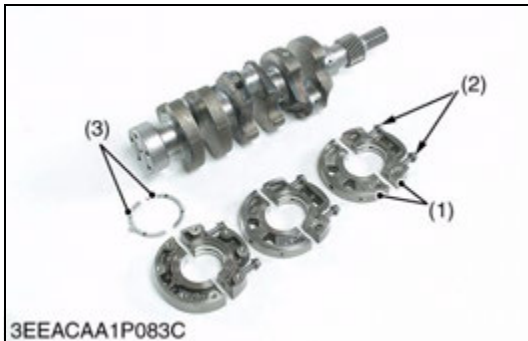


Main Bearing Case Assembly

1. Remove the two main bearing case screws 1 (2) of each main bearing cases.
2. Remove the main bearing case from crankshaft.

(When reassembling)

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



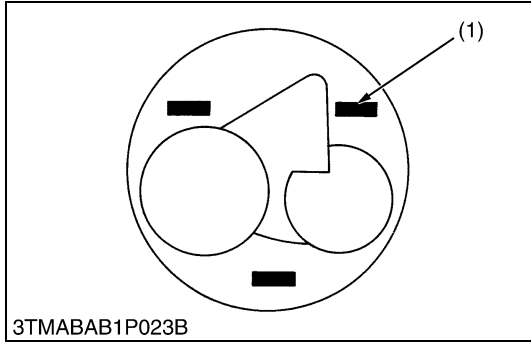
Tightening torque	Main bearing case screw 1	30 to 34 N·m 3.0 to 3.5 kgf·m 22 to 25 lbf·ft
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- (1) Main Bearing Case Assembly 1 (a) Alignment Number
 (2) Main Bearing Case Screw 1 (b) Marking (A, B, C)
 (3) Thrust Bearing

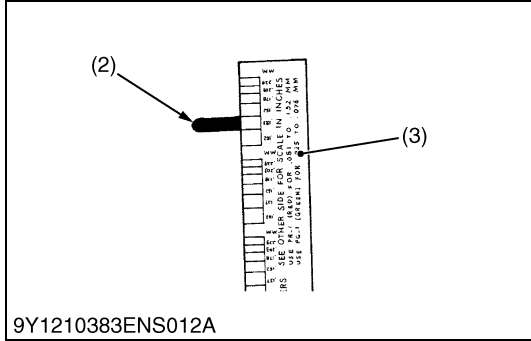
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[4] SERVICING

(1) Cylinder Head and Valves



3TMABAB1P023B



9Y1210383ENS012A

Top Clearance

1. Remove the cylinder head.
2. With the piston at TDC, use grease to attach three or four plastigauges (1) of 5.0 to 7.0 mm (0.20 to 0.27 in.) long to the crown of the piston; keep the gauges away from the intake valve and combustion chamber fittings.
3. Take the piston to an intermediate position, install the cylinder head and tighten the head bolts to the specified torque.
4. Turn the crankshaft so the piston goes through TDC.
5. Remove the cylinder head and compare the width of the crushed plastigauges (2) with the scale.
6. If they are out of spec, check the oil clearance of the crank pin, journals and piston pins.

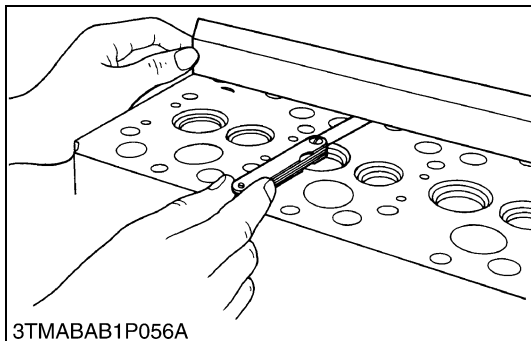
NOTE

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

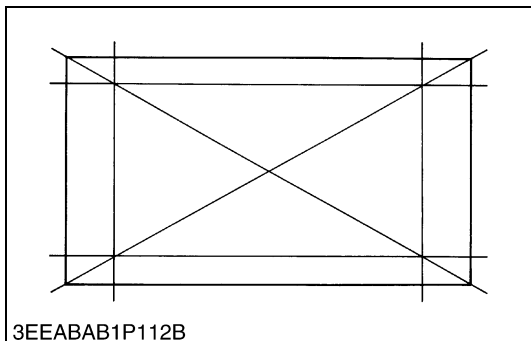
Top clearance	Factory specification	0.55 to 0.75 mm 0.022 to 0.029 in.
Tightening torque	Cylinder head screw	64 to 68 N·m 6.5 to 7.0 kgf·m 47 to 50 lbf·ft

- (1) Plastigaugue (3) Scale
 (2) Crushed Plastigaugue

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3TMABAB1P056A



3EEABAB1P112B

Cylinder Head Surface Flatness

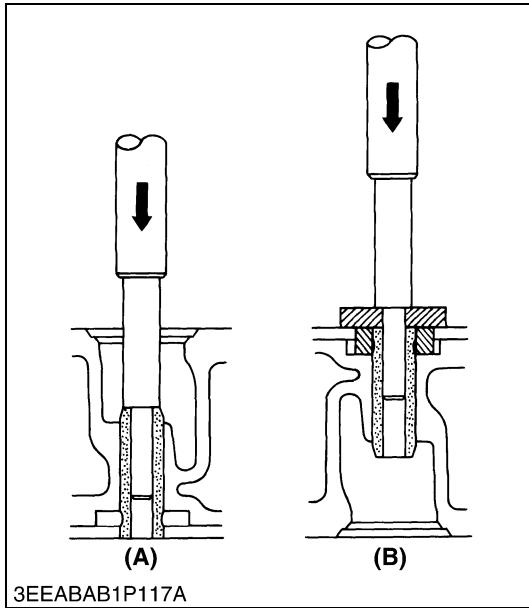
1. Clean the cylinder head surface.
2. Place a straightedge on the cylinder head's four sides and two diagonal as shown in the figure.
3. Measure the clearance with a thickness gauge.
4. If the measurement exceeds the allowable limit, correct it with a surface grinder.

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.
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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.

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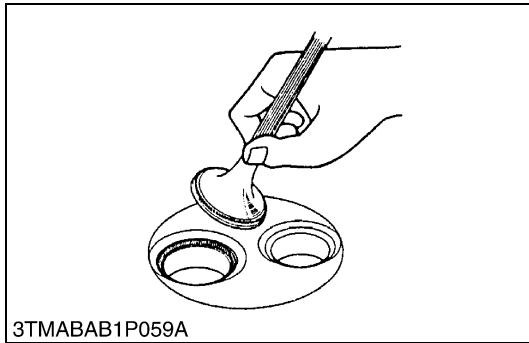
■ IMPORTANT

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

(A) When Removing

(B) When Installing

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Valve Seating

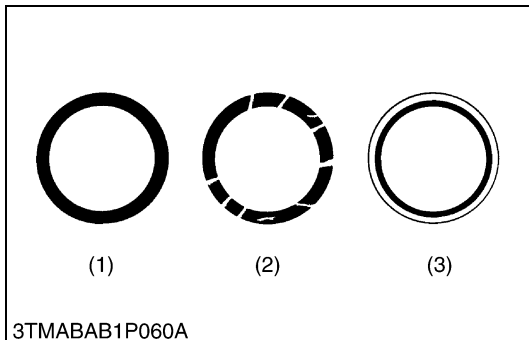
1. Coat the valve face lightly with prussian blue and put the valve on its seat to check the contact.
2. If the valve does not seat all the way around the valve seat or the valve contact is less than 70 %, correct the valve seating as follows.
3. If the valve contact does not comply with the reference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

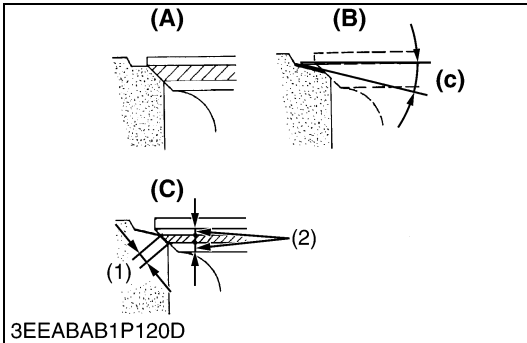
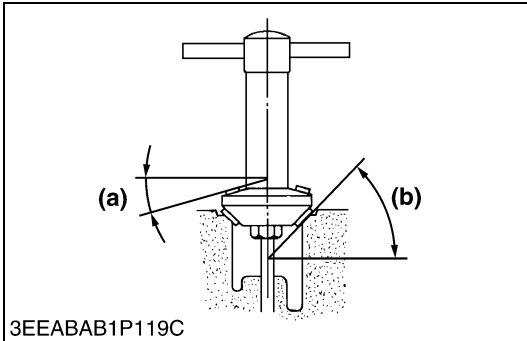
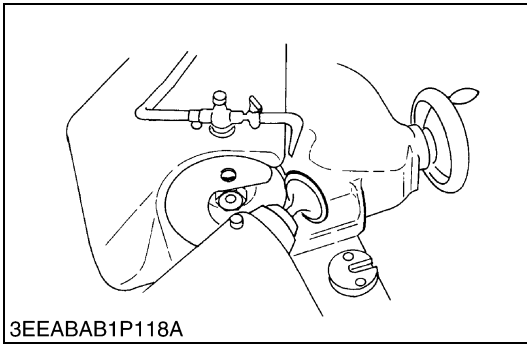
Valve seat width	Factory specification	2.12 mm 0.0835 in.
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- (1) Correct
(2) Incorrect

(3) Incorrect

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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.

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

2) Correcting Valve Seat

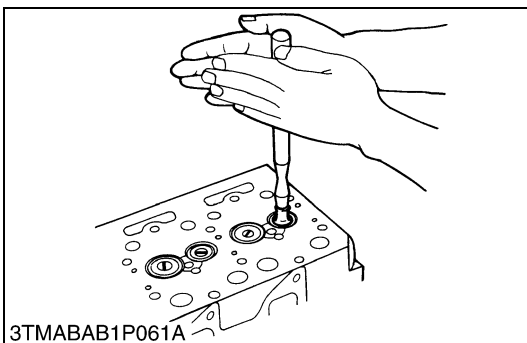
1. Slightly correct the seat surface with a 1.0 rad (60 °) (intake valve) or 0.79 rad (45 °) (exhaust valve) valve seat cutter.
2. Resurface the seat surface with a 0.52 rad (30 °) valve seat cutter to intake valve seat and with a 0.26 rad (15 °) valve seat cutter to exhaust valve seat so that the width 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.

Valve seat angle	Factory specification	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 °)

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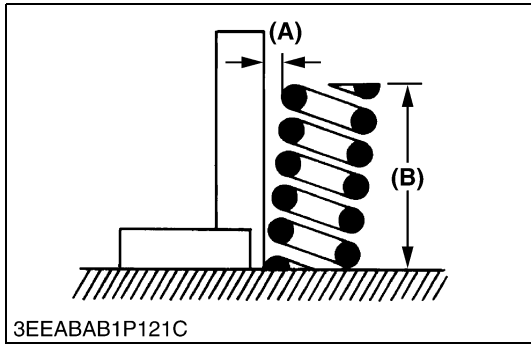
Valve Lapping

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.

9Y1211344ENS0058US0



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 problem, replace it.

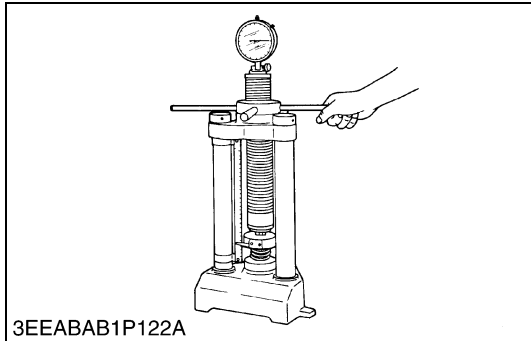
Tilt (A)	Allowable limit	1.0 mm 0.039 in.
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Free length (B)	Factory specification	37.0 to 37.5 mm 1.46 to 1.47 in.
	Allowable limit	36.5 mm 1.44 in.

(A) Tilt

(B) Free Length

9Y1211344ENS0059US0



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.

Setting load / Setting length	Factory specification	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.

9Y1211344ENS0060US0



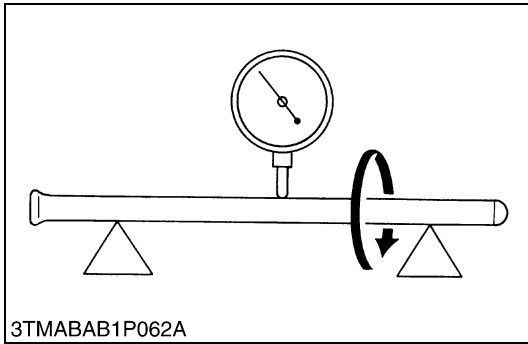
Oil Clearance between Rocker Arm and Rocker Arm Shaft

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

Oil clearance between rocker arm and rocker arm shaft	Factory specification	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 specification	11.973 to 11.984 mm 0.47138 to 0.47181 in.
Rocker arm I.D.	Factory specification	12.000 to 12.018 mm 0.47244 to 0.47314 in.

9Y1211344ENS0061US0



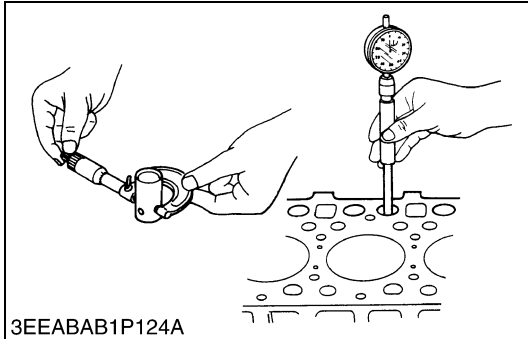
3TMABAB1P062A

Push Rod Alignment

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

Push rod alignment	Allowable limit	0.25 mm 0.0098 in.
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9Y1211344ENS0062US0



3EEABAB1P124A

Oil Clearance between Tappet and Tappet Guide Bore

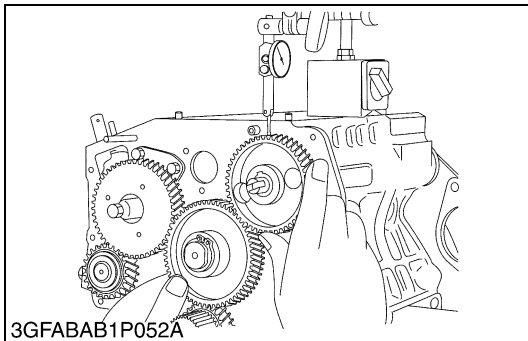
1. Measure the tappet O.D. with an outside micrometer.
2. Measure the I.D. of the tappet guide bore with a cylinder gauge, and calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit or the tappet is damaged, replace the tappet.

Oil Clearance between tappet and tappet guide bore	Factory specification	0.020 to 0.062 mm 0.00079 to 0.0024 in.
	Allowable limit	0.07 mm 0.003 in.

Tappet O.D.	Factory specification	19.959 to 19.980 mm 0.78579 to 0.78661 in.
Tappet guide bore I.D.	Factory specification	20.000 to 20.021 mm 0.78741 to 0.78822 in.

9Y1211344ENS0063US0

(2) Timing Gears, Camshaft and Governor Gear



3GFABAB1P052A

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.

Backlash between idle gear 1 and crank gear	Factory specification	0.032 to 0.115 mm 0.0013 to 0.00452 in.
	Allowable limit	0.15 mm 0.0059 in.

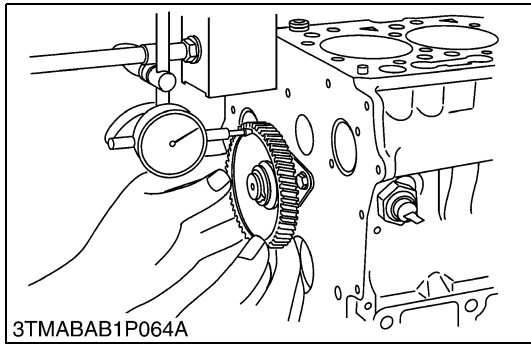
Backlash between idle gear 1 and cam gear	Factory specification	0.036 to 0.114 mm 0.0015 to 0.00448 in.
	Allowable limit	0.15 mm 0.0059 in.

Backlash between idle gear 1 and injection pump gear	Factory specification	0.034 to 0.116 mm 0.0014 to 0.00456 in.
	Allowable limit	0.15 mm 0.0059 in.

Governor Gear Backlash

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

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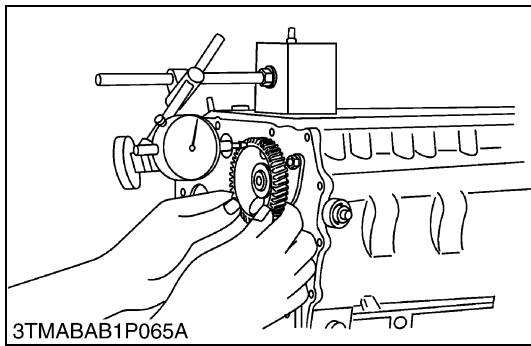


Idle Gear and Idle Gear 1 Side Clearance

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 specification	0.20 to 0.51 mm 0.0079 to 0.020 in.
	Allowable limit	0.80 mm 0.031 in.

9Y1211344ENS0065US0

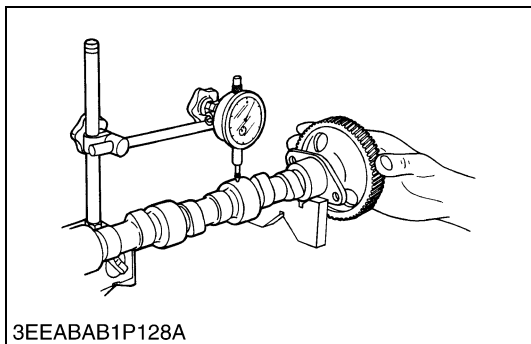


Camshaft Side Clearance

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.

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

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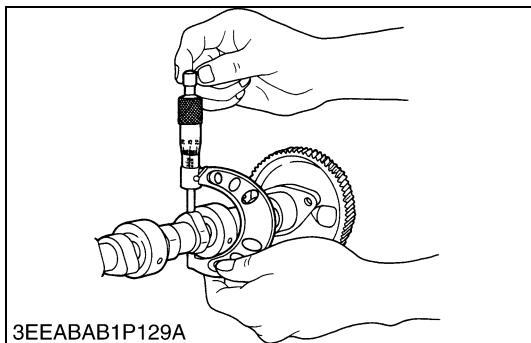


Camshaft Alignment

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.
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9Y1211344ENS0067US0



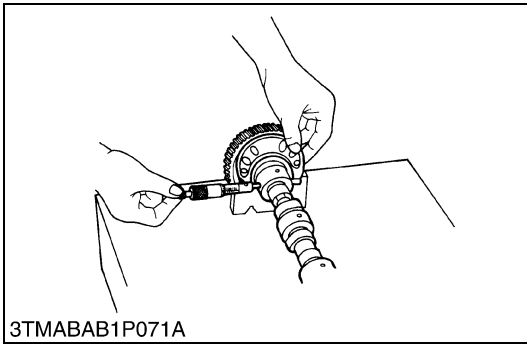
Cam Height

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

Cam height of intake	Factory specification	28.80 mm 1.134 in.
	Allowable limit	28.75 mm 1.132 in.

Cam height of exhaust	Factory specification	29.00 mm 1.142 in.
	Allowable limit	28.95 mm 1.140 in.

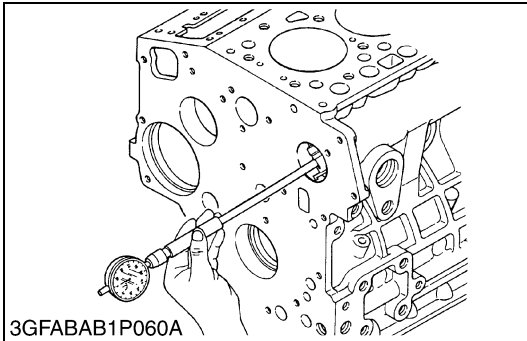
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Oil Clearance of Camshaft Journal

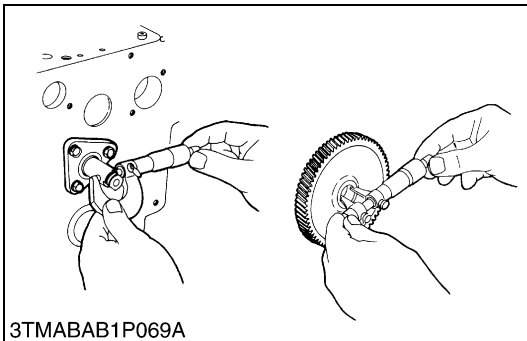
1. Measure the camshaft journal O.D. with an outside micrometer.
2. Measure the cylinder block bore I.D. for camshaft with a cylinder gauge, and calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit, replace the camshaft.

Oil clearance of camshaft journal	Factory specification	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 specification	35.934 to 35.950 mm 1.4148 to 1.4153 in.
Camshaft bearing I.D. (Cylinder block bore I.D.)	Factory specification	36.000 to 36.025 mm 1.4174 to 1.4183 in.

9Y1211344ENS0069US0



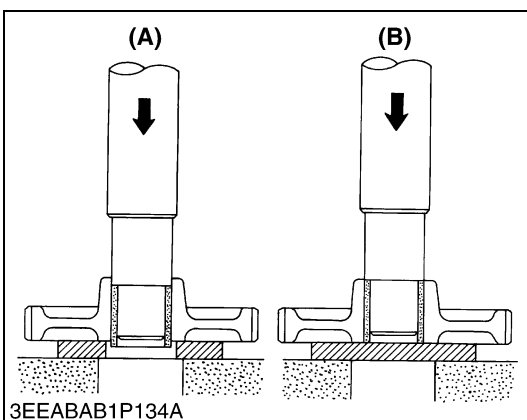
Oil Clearance between Idle Gear, Idle Gear 1, Idle Gear Shaft and Idle Gear Bushing

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.

Oil clearance between idle gear shaft and idle gear bushing	Factory specification	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 specification	25.967 to 25.980 mm 1.0224 to 1.0228 in.
Idle gear bushing 1 I.D.	Factory specification	26.000 to 26.021 mm 1.0237 to 1.0244 in.

9Y1211344ENS0070US0



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)

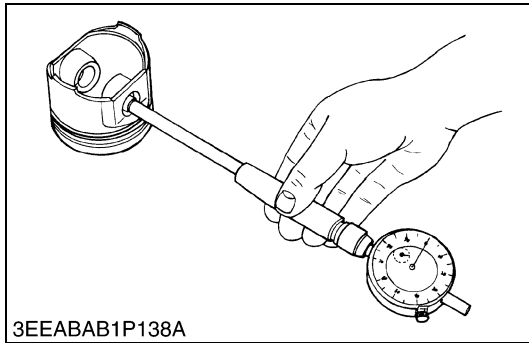
1. Clean a new idle gear bushing and idle gear bore, and apply engine oil to them.
2. Press in a new bushing using an idle gear bushing replacing tool, until it is flush with the end of the idle gear.

(A) When Removing

(B) When Installing

9Y1211344ENS0071US0

(3) Piston and Connecting Rod

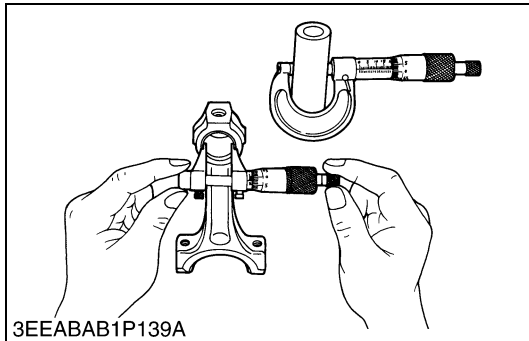


Piston Pin Bore I.D.

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

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

9Y1211344ENS0072US0



Oil Clearance between Piston Pin and Small End Bushing

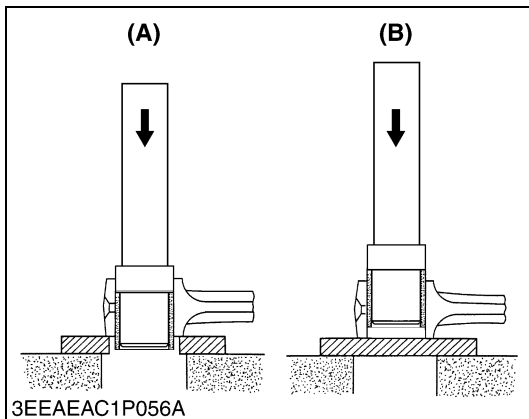
1. Measure the piston pin O.D. where it contacts the bushing with an outside micrometer.
2. Measure the small end bushing I.D. with an inside micrometer, and calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit, replace the bushing. If it still exceeds the allowable limit,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

Oil clearance between piston pin and small end bushing	Factory specification	0.014 to 0.038 mm 0.00056 to 0.0014 in.
	Allowable limit	0.15 mm 0.0059 in.

Piston pin O.D.	Factory specification	22.002 to 22.011 mm 0.86622 to 0.86657 in.
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Small end bushing I.D.	Factory specification	22.025 to 22.040 mm 0.86713 to 0.86771 in.
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Replacing Small End Bushing

(When removing)

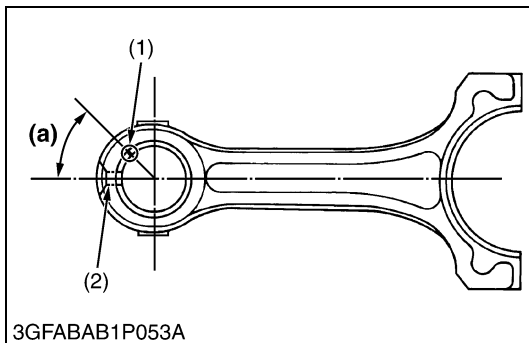
1. Press out the used bushing using a small end bushing replacing tool. (See page "SPECIAL TOOLS".)

(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.

Oil clearance between piston pin and small end bushing (Spare parts)	Factory specification	0.015 to 0.038 mm 0.00059 to 0.0014 in.
	Allowable limit	0.15 mm 0.0059 in.

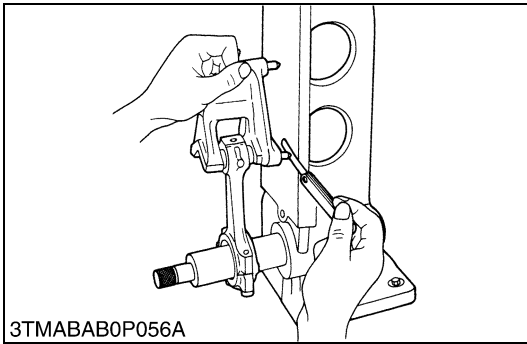
Small end bushing I.D. (Spare parts)	Factory specification	22.025 to 22.040 mm 0.86713 to 0.86771 in.
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- (1) Seam
- (2) Oil Hole

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

9Y1211344ENS0074US0



Connecting Rod Alignment

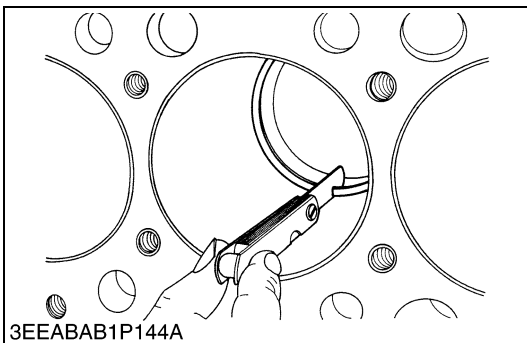
■ **NOTE**

- 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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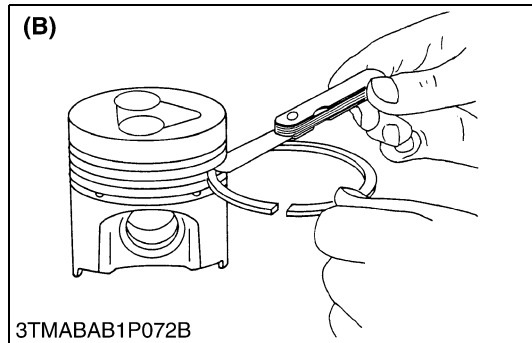
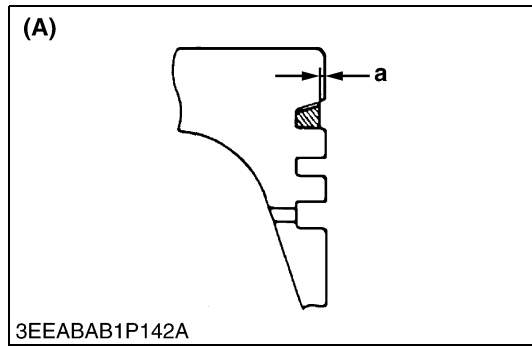


Piston Ring Gap

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.

Piston ring gap	Top ring	Factory specification	0.15 to 0.25 mm 0.0059 to 0.0098 in.
		Allowable limit	1.20 mm 0.0472 in.
	Second ring	Factory specification	0.40 to 0.55 mm 0.016 to 0.021 in.
		Allowable limit	1.20 mm 0.0472 in.
	Oil ring	Factory specification	0.25 to 0.45 mm 0.0099 to 0.017 in.
		Allowable limit	1.25 mm 0.0492 in.

9Y1211344ENS0076US0



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.

Clearance between piston ring and piston ring groove	Second ring	Factory specification	0.085 to 0.112 mm 0.0034 to 0.00440 in.
		Allowable limit	0.20 mm 0.0079 in.
	Oil ring	Factory specification	0.02 to 0.06 mm 0.0008 to 0.002 in.
		Allowable limit	0.15 mm 0.0059 in.

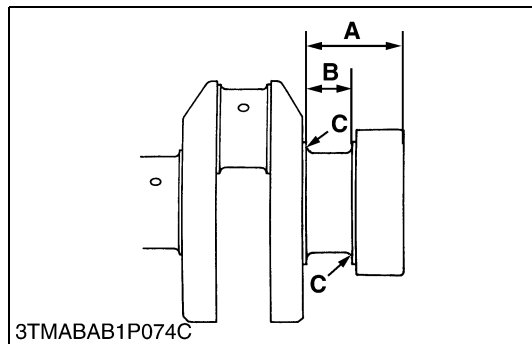
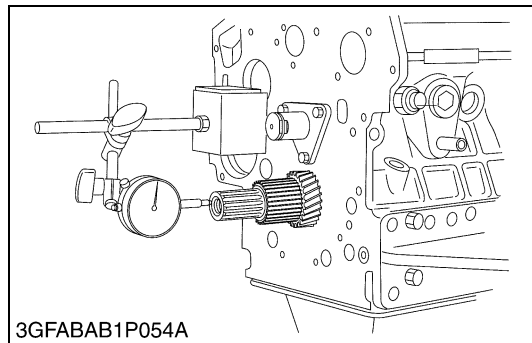
Factory specification: a	More than 0.2 mm 0.008 in.
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(A) Top Ring (Key Stone Type)

(B) 2nd, Oil Ring

9Y1211344ENS0077US0

(4) Crankshaft



Crankshaft Side Clearance

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

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

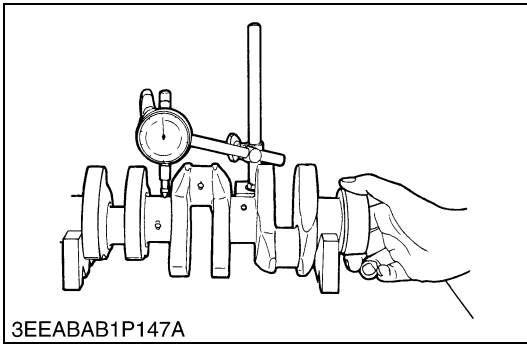
(Reference)

- Oversize dimensions of crankshaft journal

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 Rmax = 0.8S

9Y1211344ENS0078US0



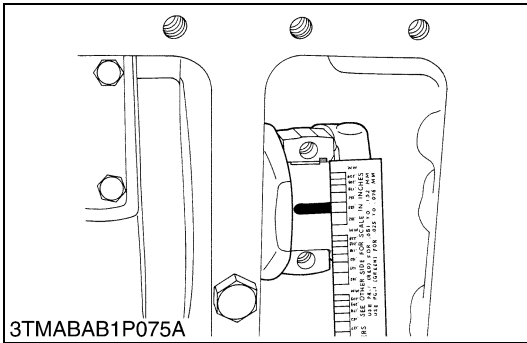
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Crankshaft Alignment

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.
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9Y1211344ENS0079US0



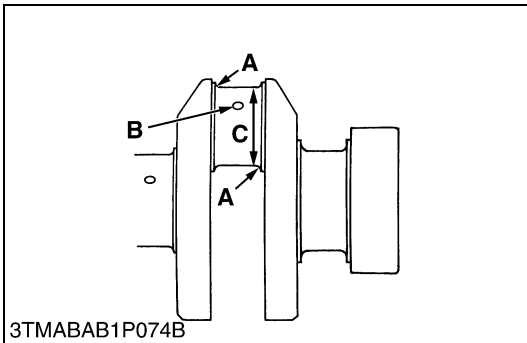
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Oil Clearance between Crankpin and Crankpin Bearing

1. Clean the crankpin and crankpin bearing.
2. Put a strip of plastigauge 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 plastigauge into the crankpin oil hole.
- Be sure not to move the crankshaft while the connecting rod screws are tightened.



3TMABAB1P074B

Oil clearance between crankpin and crankpin bearing	Factory specification	0.029 to 0.091 mm 0.0012 to 0.0035 in.
	Allowable limit	0.20 mm 0.0079 in.

Crankpin O.D.	Factory specification	39.959 to 39.975 mm 1.5732 to 1.5738 in.
Crankpin bearing I.D.	Factory specification	40.004 to 40.050 mm 1.5750 to 1.5767 in.

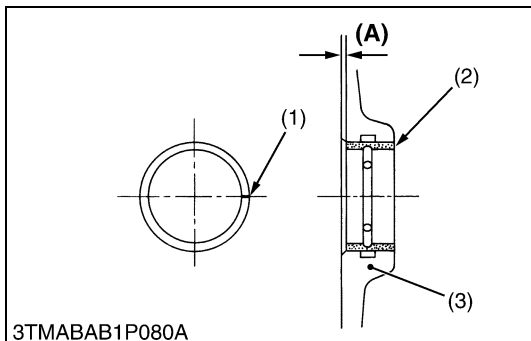
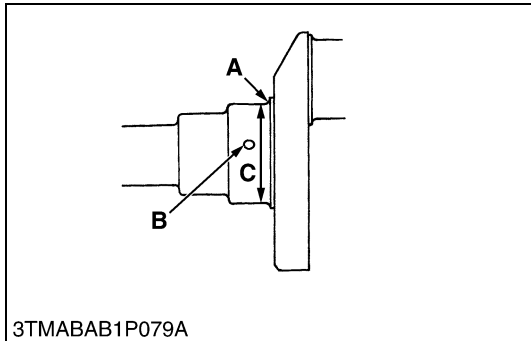
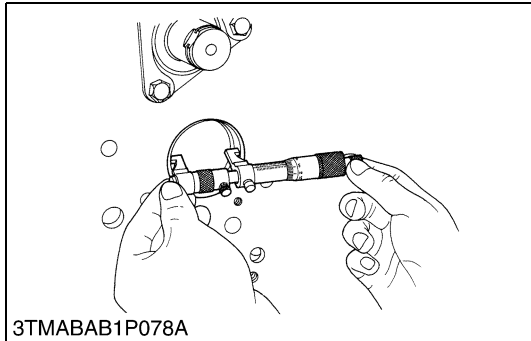
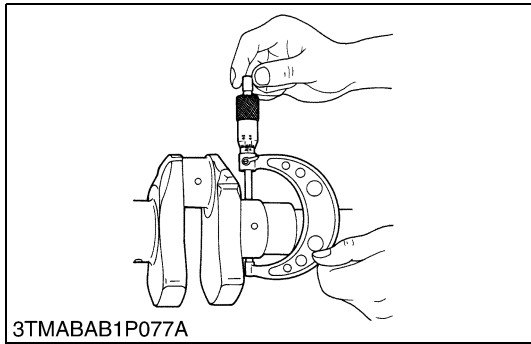
(Reference)

- Undersize dimensions of crankpin

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.

The crankpin must be fine-finished to higher than Rmax = 0.8S.
*Holes to be de-burred and edges rounded with 1.0 to 1.5 mm (0.0394 to 0.0591 in.) relief.

9Y1211344ENS0080US0



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.

Oil clearance between crankshaft journal and crankshaft bearing 1	Factory specification	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 specification	47.934 to 47.950 mm 1.8872 to 1.8877 in.
Crankshaft bearing 1 I.D.	Factory specification	47.984 to 48.048 mm 1.8892 to 1.8916 in.

(Reference)

- Undersize dimensions of crankshaft journal

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.

The crankshaft journal must be fine-finished to higher than Rmax = 0.8S.

*Holes to be de-burred and edges rounded with 1.0 to 1.5 mm (0.0394 to 0.0591 in.) relief.

9Y1211344ENS0081US0

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)

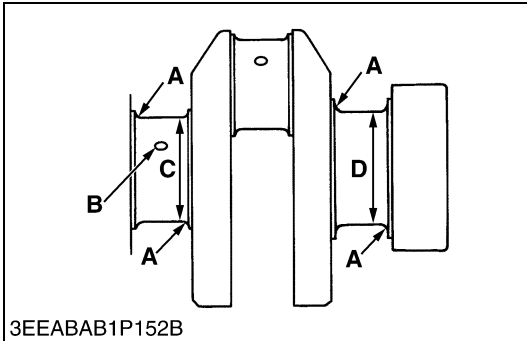
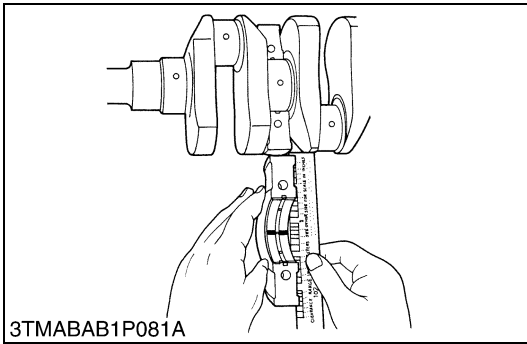
1. Clean a new crankshaft bearing 1 and crankshaft journal bore, and apply engine oil to them.
2. Using a crankshaft bearing 1 replacing tool, press in a new bearing 1 (2) so that its seam (1) directs toward the exhaust manifold side. (See figure.)

Dimension (A)	Factory specification	0 to 0.3 mm 0 to 0.01 in.
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- (1) Seam
- (2) Crankshaft Bearing 1
- (3) Cylinder Block

(A) Dimension

9Y1211344ENS0082US0



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

1. Put a strip of plastigauge on the center of the journal.
2. Install the bearing case and tighten the bearing case screws 1 to the specified torque, and remove the bearing case again.
3. Measure the amount of the flattening with the scale and get the oil clearance.
4. If the 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.**

Oil clearance between crankshaft journal and crankshaft bearing 2	Factory specification	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 specification	47.934 to 47.950 mm 1.8872 to 1.8877 in.
Crankshaft bearing 2 I.D.	Factory specification	47.984 to 48.029 mm 1.8892 to 1.8909 in.

Oil clearance between crankshaft journal and crankshaft bearing 3	Factory specification	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 specification	51.921 to 51.940 mm 2.0442 to 2.0448 in.
Crankshaft bearing 3 I.D.	Factory specification	51.974 to 52.024 mm 2.0463 to 2.0481 in.

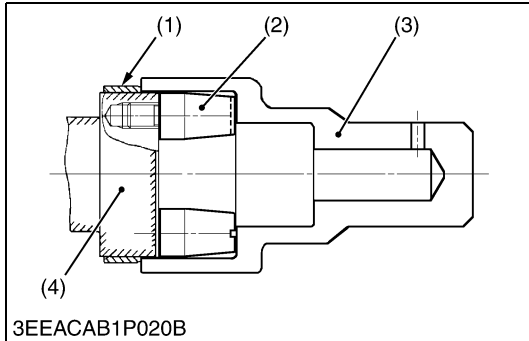
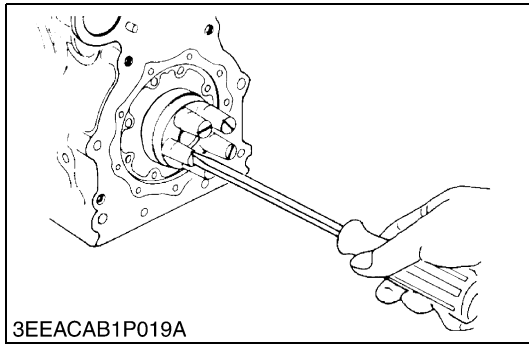
(Reference)

- Undersize dimensions of crankshaft journal

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.

The crankshaft journal must be fine-finished to higher than Rmax = 0.8S
 *Holes to be de-burred and edges rounded with 1.0 to 1.5 mm
 (0.0394 to 0.0591 in.) relief.

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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).

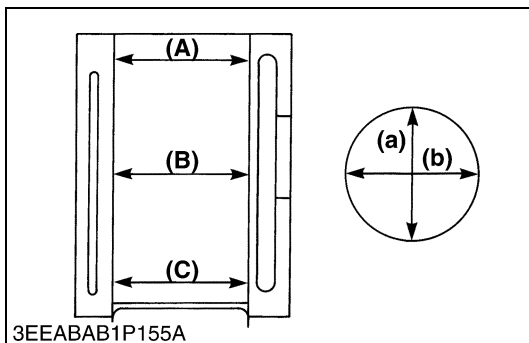
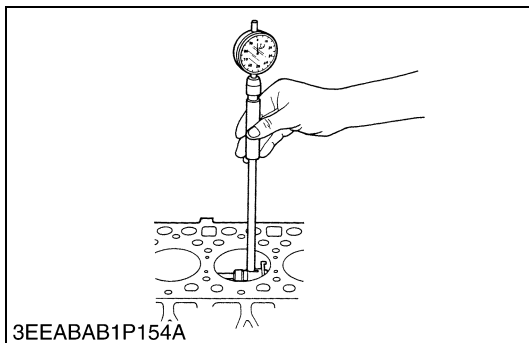
NOTE

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

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(5) Cylinder



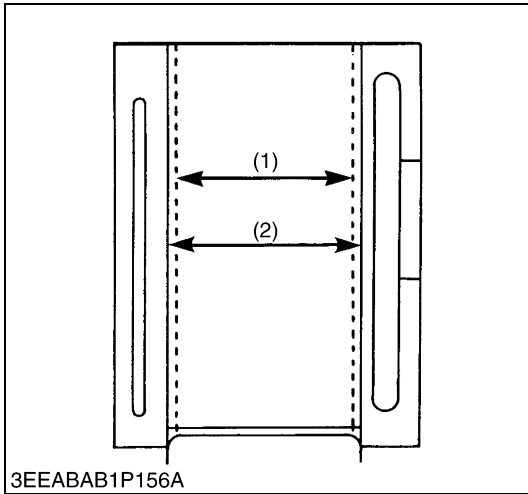
Cylinder Wear

1. Measure the I.D. of the cylinder at the six positions (see figure) with a cylinder gauge to find the maximum and minimum I.D.'s.
2. Get the difference (Maximum wear) between the maximum and the minimum I.D.'s.
3. If the wear exceeds the allowable limit, bore and hone to the oversize 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".)

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

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

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Correcting Cylinder (Oversize)

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

Oversized cylinder liner I.D.	Factory specification	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 μ R max. (0.000047 to 0.000079 in. μ R max.)	

2. Replace the piston and piston rings with oversize ones.
Oversize: 0.5 mm (0.02 in.)

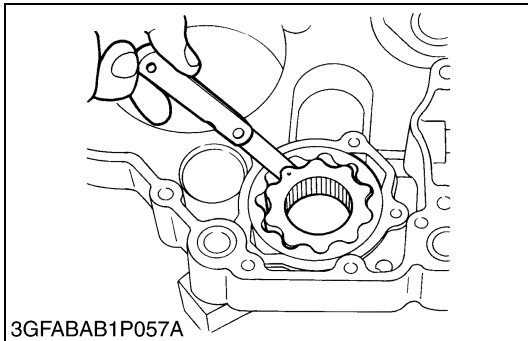
■ **NOTE**

- 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)

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(6) Oil Pump

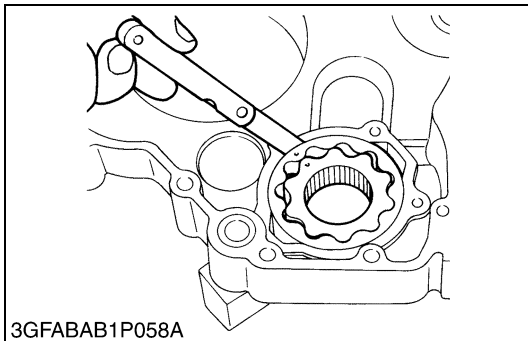


Rotor Lobe Clearance

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 specification, replace the oil pump rotor assembly.

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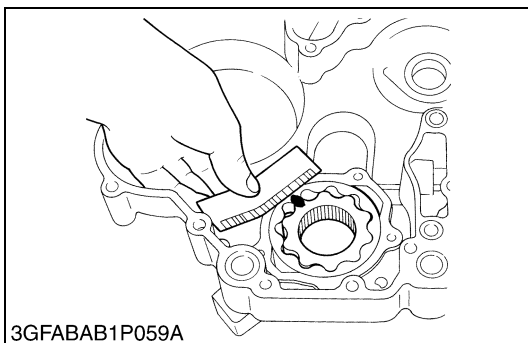


Clearance between Outer Rotor and Pump Body

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

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

1. Put a strip of plastigauge 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 specification, replace the oil pump rotor assembly.

Clearance between rotor and cover	Factory specification	0.025 to 0.075 mm 0.00099 to 0.0029 in.
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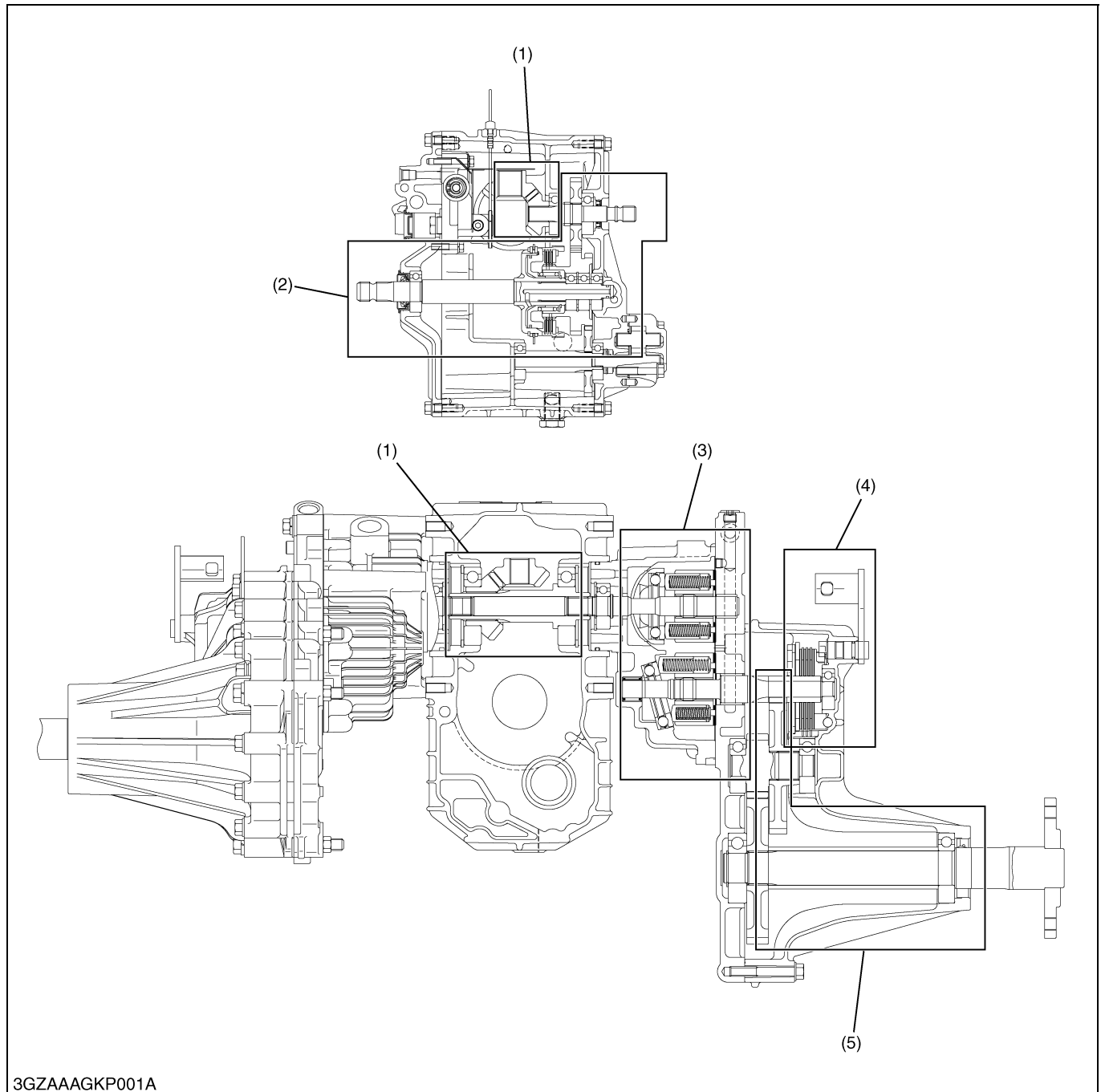
2 TRANSAXLE

MECHANISM

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1. STRUCTURE



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(1) Bevel Gear Section
(2) PTO Section

(3) Hydrostatic Transmission

(4) Brake Section

(5) Final Reduction Gear Section

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

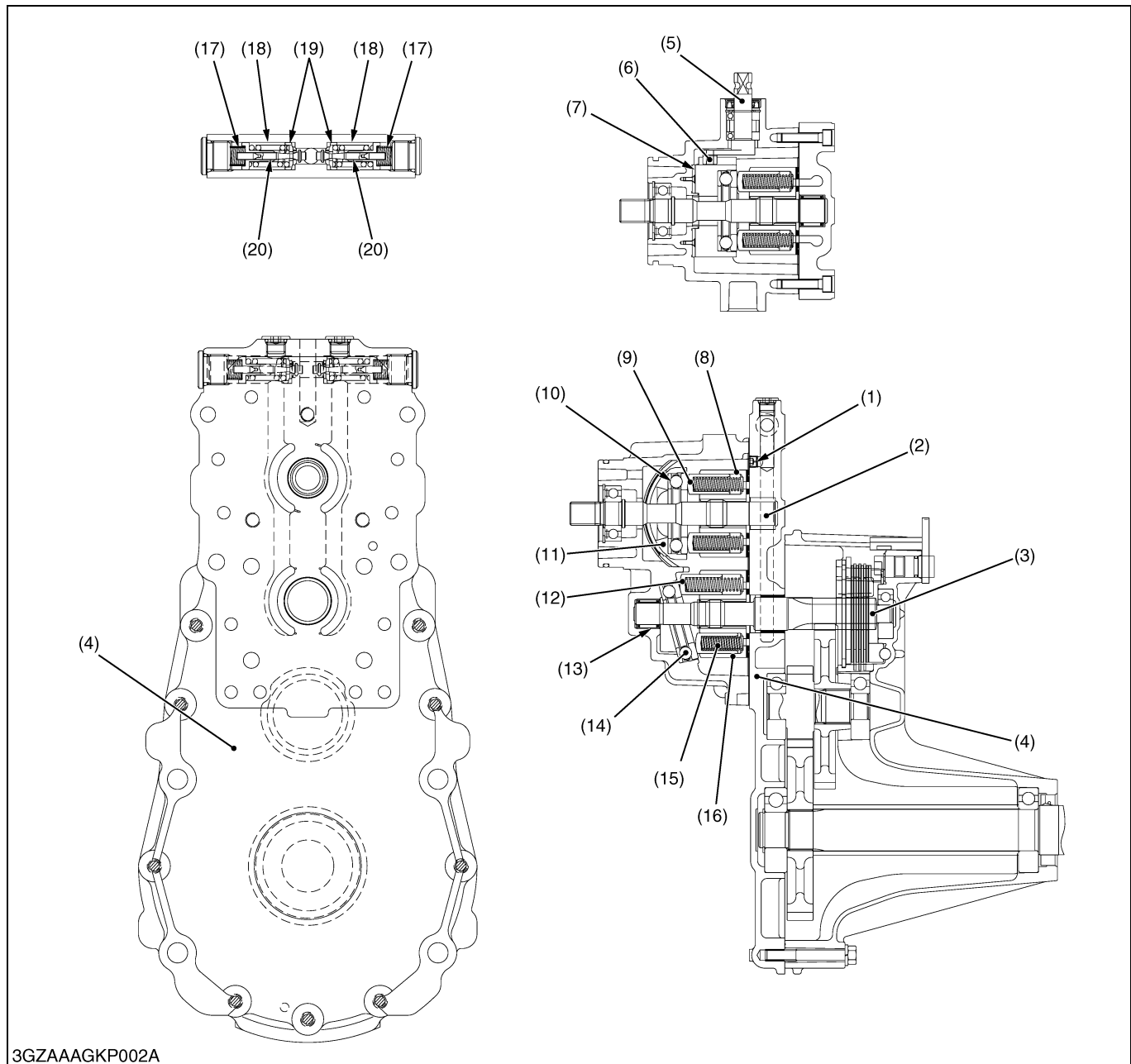
Power from engine is transmitted through transmission to mower and rear wheels.

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2. TRAVELLING SYSTEM

[1] HYDROSTATIC TRANSMISSION

(1) Structure



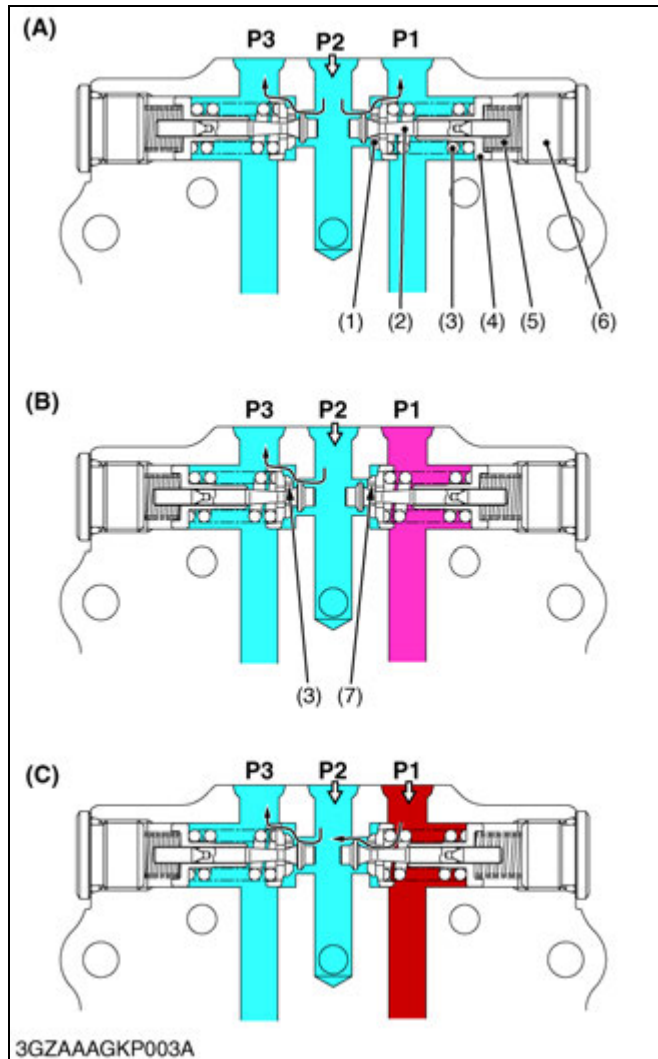
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- | | | | |
|---------------------------------------|---------------------------|--------------------------|---------------------------------|
| (1) Lubricating Orifice | (6) Slot Guide | (11) Swashplate | (16) Cylinder Block (Motor) |
| (2) Pump Shaft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

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

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(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.

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

(B) 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.

(C) The check and high-pressure relief valve along the high-pressure line serves as 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**.

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	At engine speed	Valve operating pressure
50 °C (122 °F)	1600 min ⁻¹ (rpm)	19.5 to 22.5 MPa 199 to 229 kgf/cm ² 2830 to 3260 psi

- (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

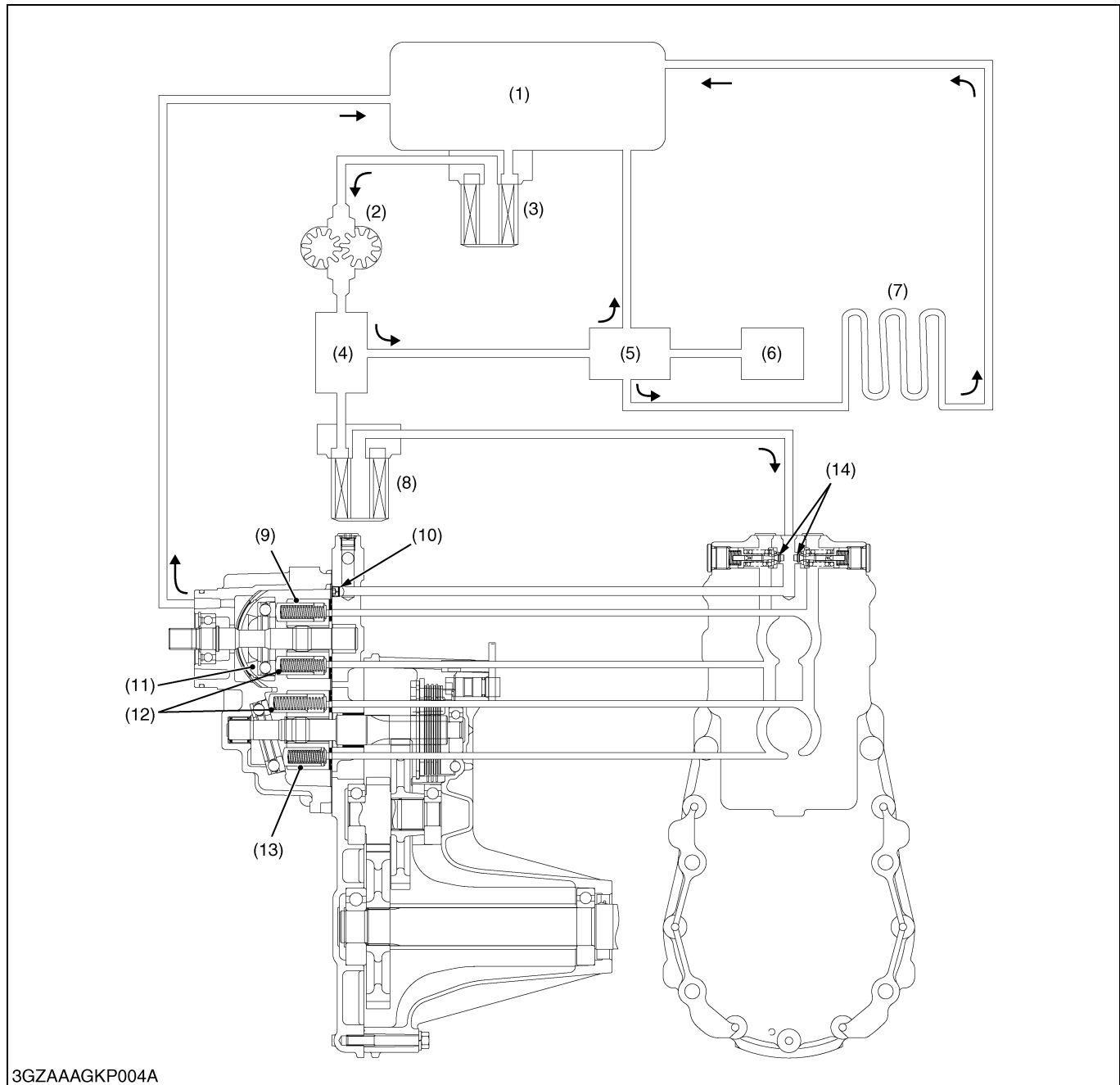
P1: Forward

P2: Change

P3: Reverse

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(3) Oil Flow



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

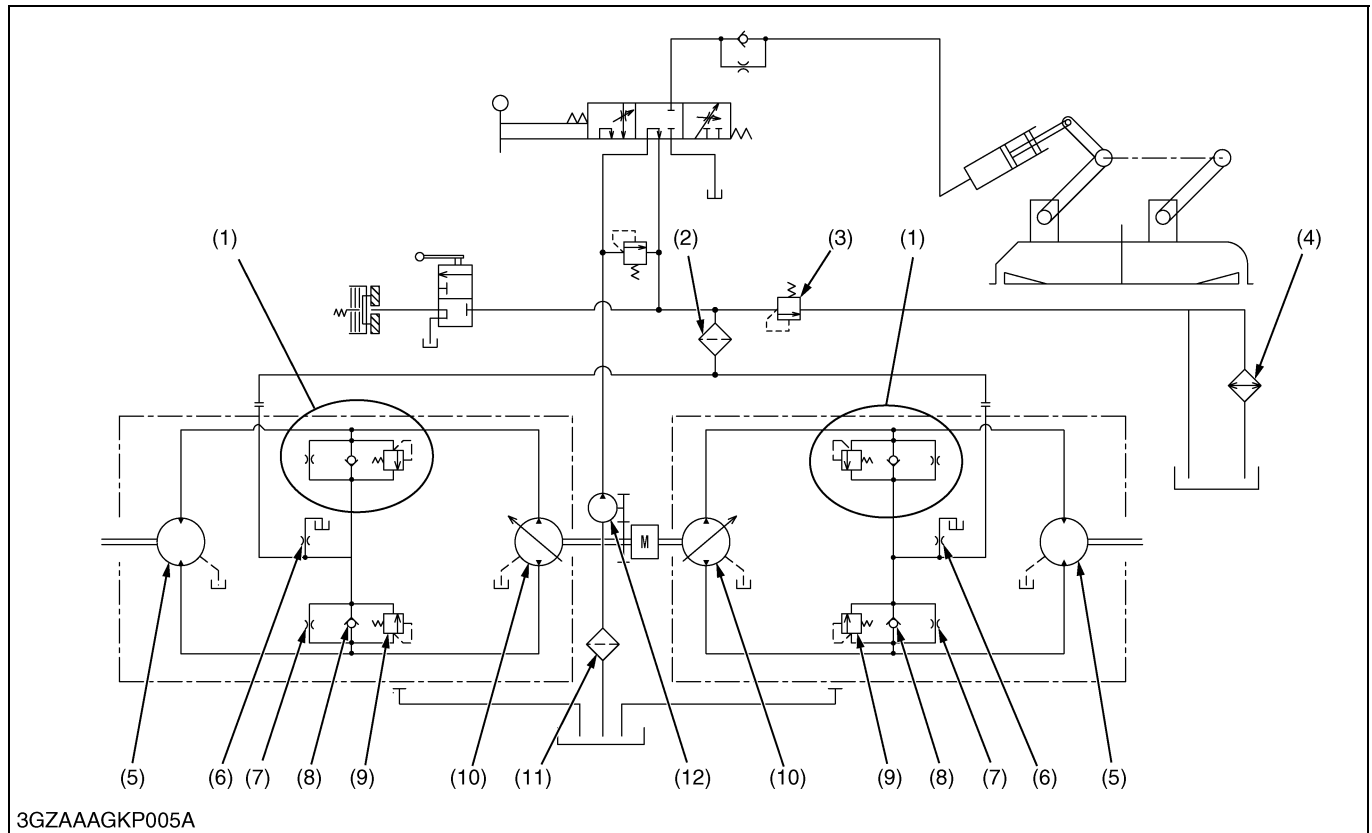
The pump and motor are joined in a closed hydraulic loop and most of oil circulates within the main oil circuit. A little oil lubricates and oozes out from the clearance between the moving parts of the case. Then oil in the main oil circuit of the HST needs to be supplied a want.

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.

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(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

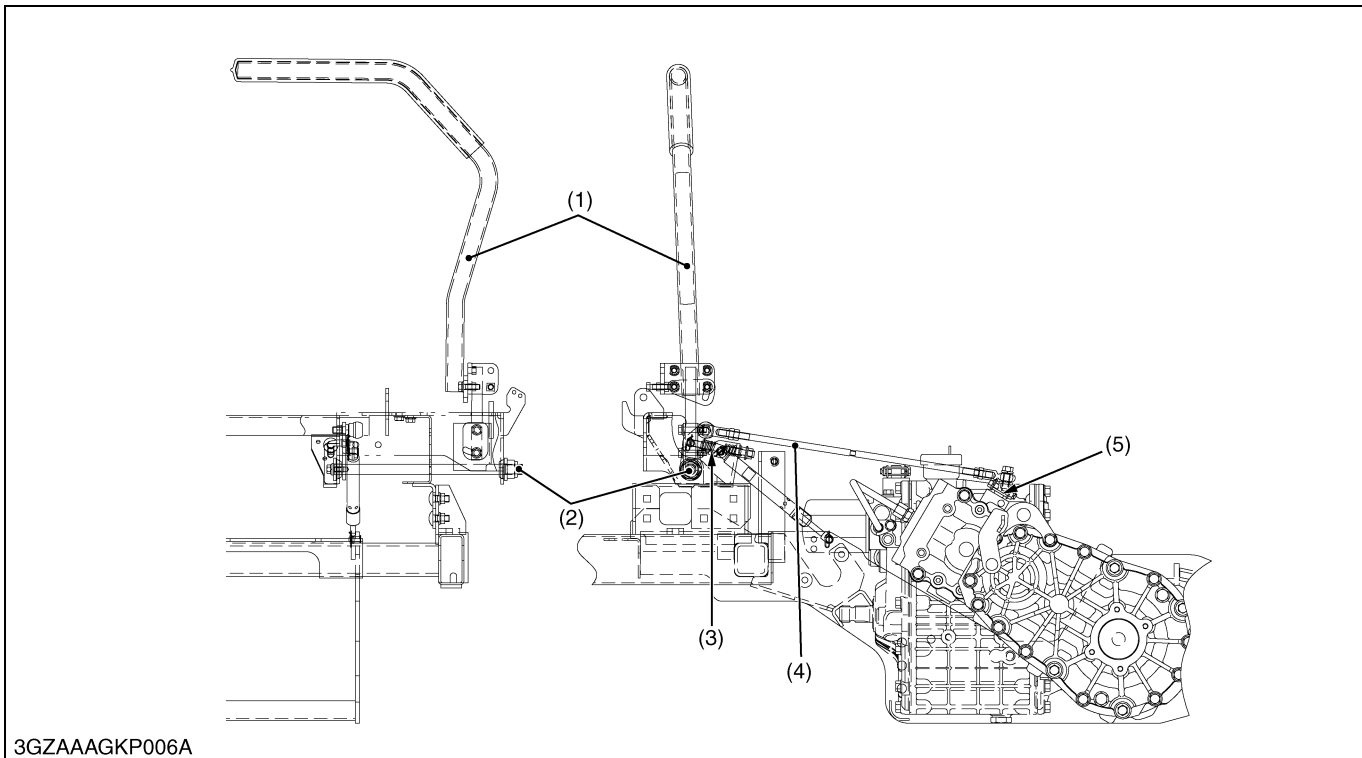
Reverse operation is controlled by reversing the angle applied to the pump swash plates, reversing the flow of high-pressure oil to the motors.

(Reference)

Regulating valve setting pressure (PTO clutch operating pressure)	At engine speed min ⁻¹ (rpm)
0.65 to 0.75 MPa (6.7 to 7.6 kgf/cm ² , 95 to 100 psi)	1600

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(5) Control Linkage



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- | | | | |
|--------------------------|------------------------|-----------------------|------------------|
| (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.

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.

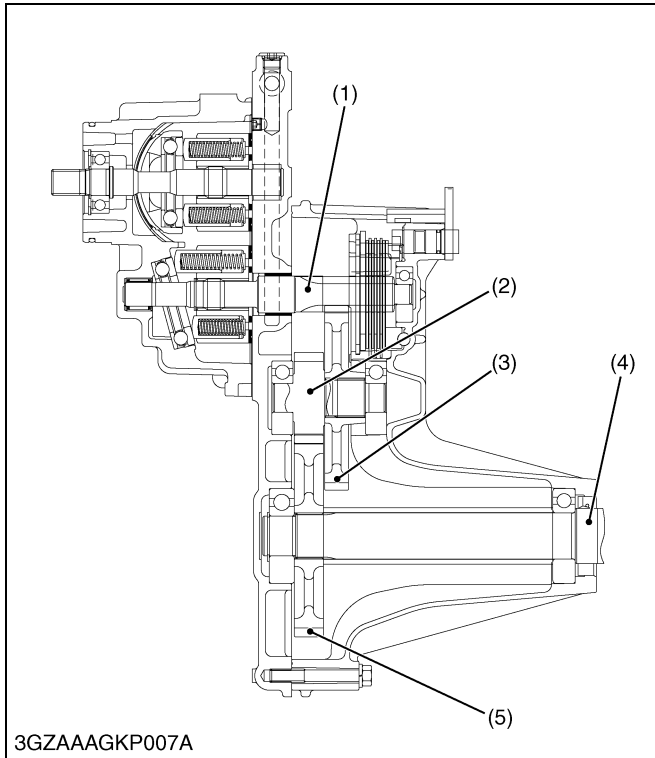
■ Steering

The Zero-Turn Mower does not have a separate steering system. Steering is controlled 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.

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(6) Final Reduction Gear Section



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), 19T gear shaft (2) and 49T gear (5).

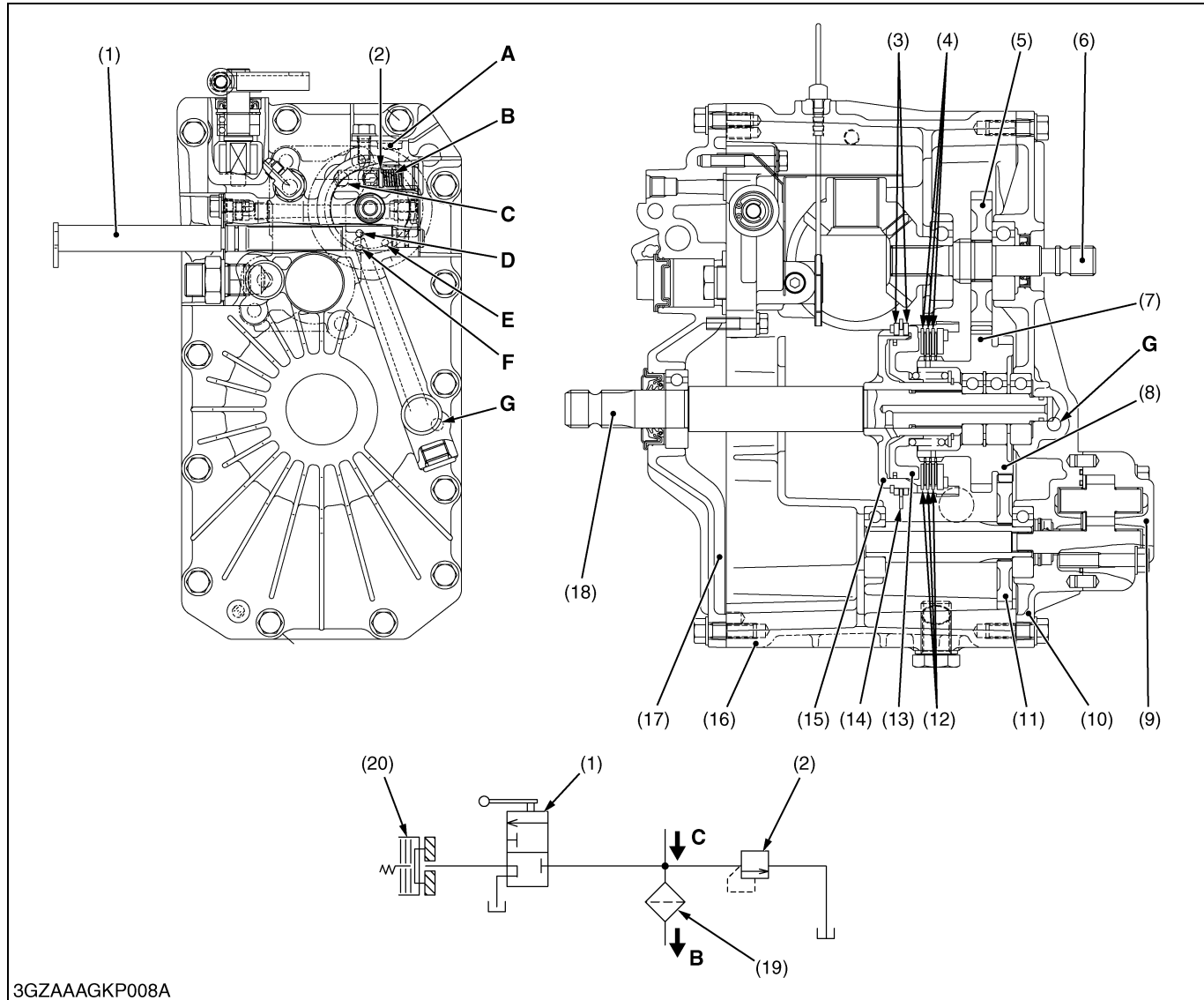
Gear Shaft (2)	Gear (5)
19T	49T

- (1) Brake Shaft (8T) (HST Motor Shaft)
- (2) 19T Gear
- (3) 53T Gear
- (4) Rear Axle
- (5) 49T Gear

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(7) PTO System

PTO Clutch and Valve



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- | | | | |
|----------------------|------------------------------|---------------------------------------|--|
| (1) PTO Valve Lever | (9) Hydraulic Pump | (17) Center Case, Front Cover | C: From Hydraulic Pump |
| (2) Regulator Valve | (10) Center Case, Rear Cover | (18) PTO Shaft | D: From Hydraulic Pump to Valve Lever |
| (3) PTO Brake Plate | (11) 32T Gear | (19) Oil Filter Cartridge | E: From PTO Shaft to Center Case (Drain Port) |
| (4) PTO Clutch Plate | (12) PTO Clutch Disc | (20) PTO Clutch | F: From PTO Valve Lever to PTO Shaft |
| (5) Input Gear | (13) Piston | | G: To PTO Shaft |
| (6) Input Shaft | (14) PTO Brake Disc | A: To Oil Cooler | |
| (7) PTO Gear | (15) PTO Case | B: To Hydrostatic Transmission | |
| (8) 35T Gear | (16) Center Case | | |

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

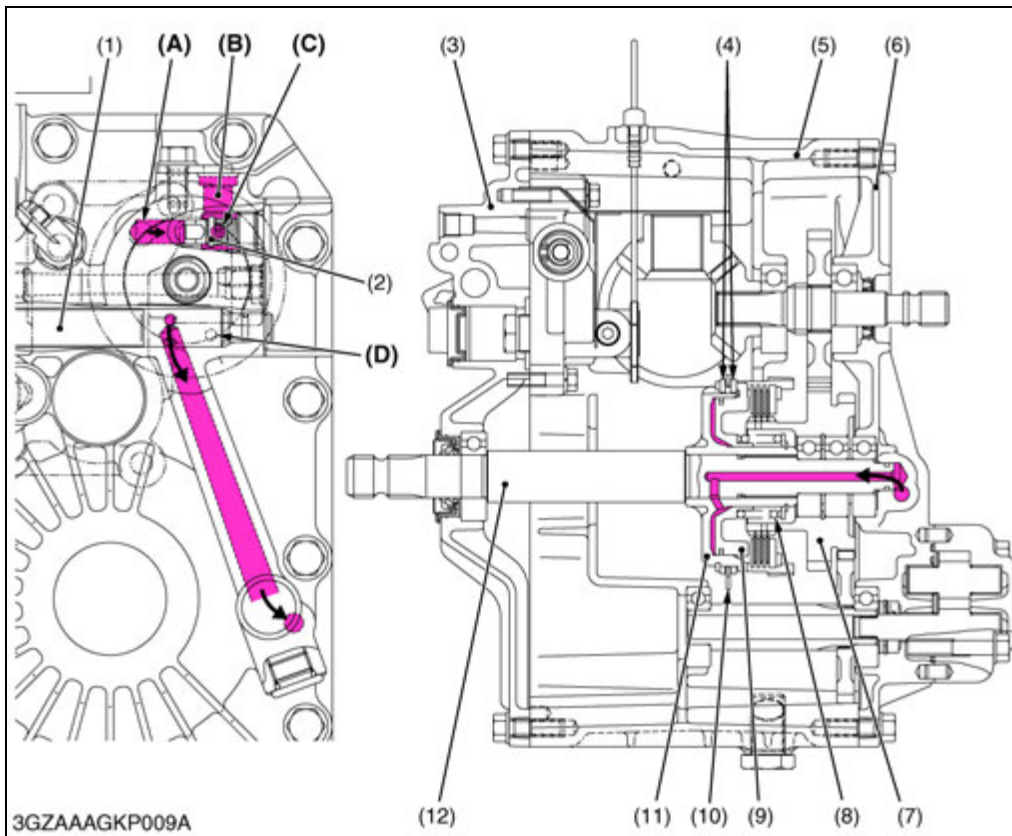
The PTO clutch (20) has clutch discs (12), clutch plates (4), clutch piston (13) and so on.

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

Input Gear	PTO Gear	PTO Clutch Plate	PTO Clutch Disc
33T	39T	4	4

9Y1211344TXM0008US0

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)

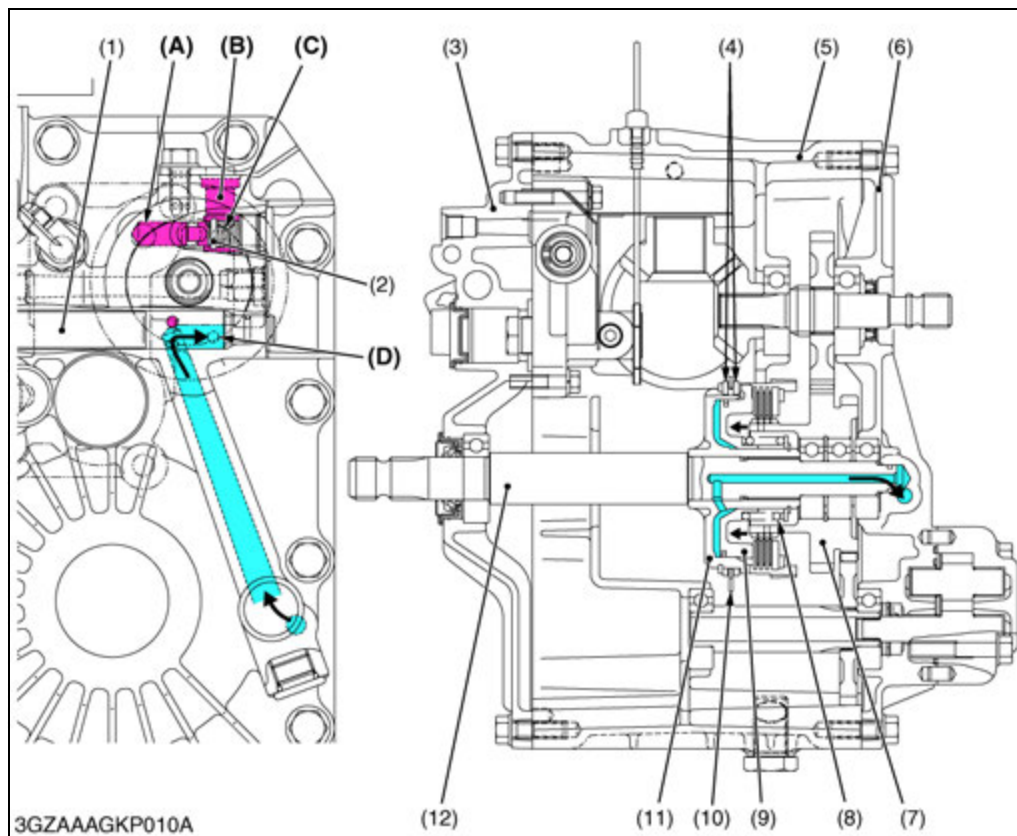
- (A) From Hydraulic Pump**
- (B) To Oil Cooler**
- (C) To Hydrostatic Transmission**
- (D) To Center Case**

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.

9Y1211344TXM0009US0

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

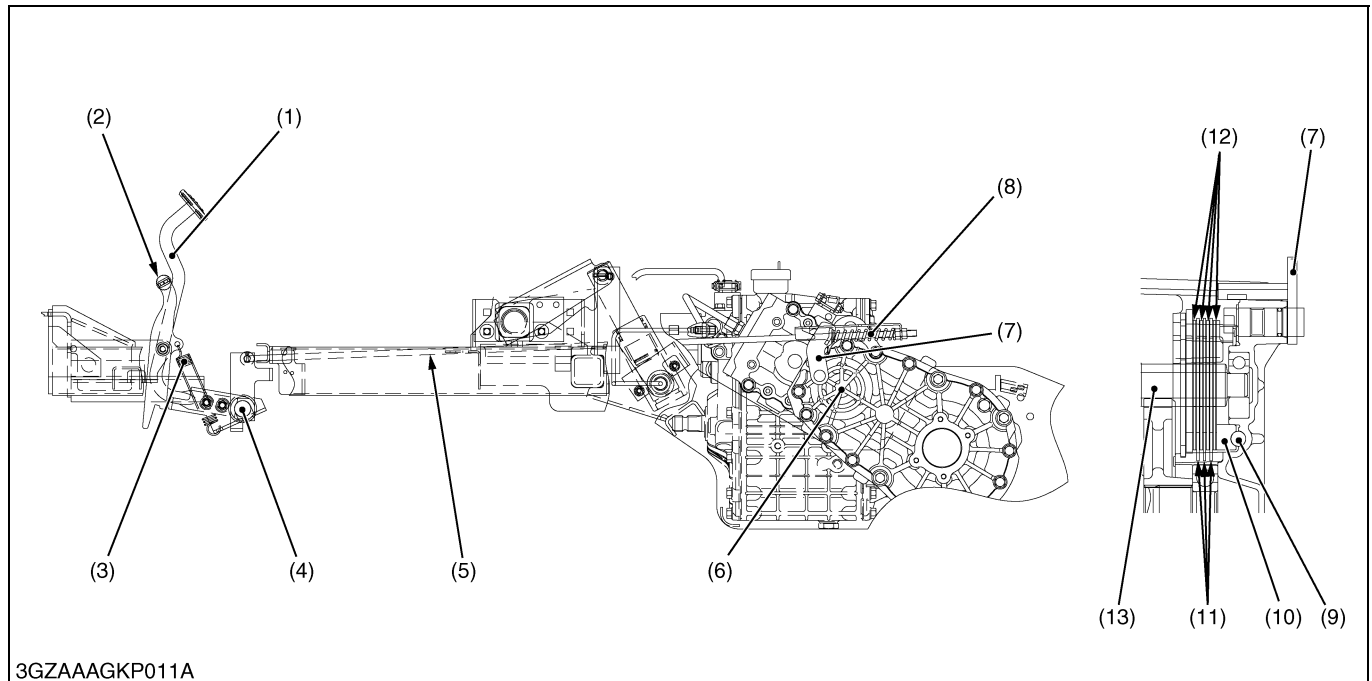
After starting the engine, when the PTO clutch lever is set at the "Disengaged" position, the hole of PTO valve lever dose not face to hydraulic pump port.

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.

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(8) Parking Brake

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

The parking brake consists 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.

9Y1211344TXM0011US0

SERVICING

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1. TROUBLESHOOTING

Symptom	Probable Cause and Checking Procedure	Solution	Reference Page
Vehicle Will Not Stop in Neutral Position	1. Improper neutral adjustment	Adjust neutral	2-S6
	2. Improper speed control rod adjustment	Adjust	2-S6
Vehicle Jerky and Noisy When Starting	1. Transmission oil insufficient	Fill	2-S14
	2. Air entering from suction pipe	Retighten	–
	3. Transmission oil filter cartridge clogged	Replace	G-23
	4. Hydrostatic transmission damaged	Replace	2-S28
Loss of Power	1. Control linkage damaged	Repair or replace	2-S36
	2. Transmission oil insufficient	Fill	2-S14
	3. Transmission oil filter cartridge clogged	Replace	G-23
	4. Hydraulic pump damaged	Check and replace	2-S28
	5. Hydrostatic transmission damaged	Check and replace	2-S10, 2-S28
System Operates in One Direction Only	1. Check valve damaged	Check and replace	2-S10, 2-S31
	2. Control linkage damaged	–	2-S36
System Operating Hot	1. Transmission oil insufficient	Fill	2-S14
	2. Transmission oil filter cartridge clogged	Replace	G-23
	3. HST fan damaged	Check and replace	2-S20
	4. Overload working	Decrease load	–
Noise from Transmission	1. Transmission oil insufficient	Fill	2-S14
	2. Gear worn	Replace	2-S28
	3. Improper backlash between 16T or 18T bevel gear and 19T bevel gear	Adjust	2-S40
	4. Bearing worn	Replace	2-S28

TRAVELLING GEAR SHIFT SECTION

Symptom	Probable Cause and Checking Procedure	Solution	Reference Page
Noise from Transmission	1. Transmission oil insufficient	Refill	2-S14
	2. Gear worn or broken	Replace	2-S21
	3. Bearings worn	Replace	–

PTO SECTION

Symptom	Probable Cause and Checking Procedure	Solution	Reference Page
PTO Clutch Slip	1. Operating pressure is low	Check	2-S11, 2-S22
	2. PTO clutch valve malfunctioning	Repair or replace	2-S11, 2-S22
	3. Clutch disc or drive plate excessively worn	Replace	2-S27, 2-S42
PTO Shaft Does Not Rotate	1. PTO clutch malfunctioning	Repair or replace	2-S27
PTO Clutch Operating Pressure Is Low	1. Transmission oil improper or insufficient	Fill or change	2-S14
	2. Regulator valve malfunctioning	Check or replace	2-S11, 2-S22
PTO Clutch Drags	1. Brake plate excessively worn	Replace	2-S27, 2-S42
	2. Clutch spring weaken or broken	Replace	2-M9, 2-S27
	3. Deformation of pressure plate or steel plate	Replace	2-S27

PARKING BRAKE SECTION

Symptom	Probable Cause and Checking Procedure	Solution	Reference Page
Brake Drags	1. Brake spring play too small	Adjust	G-33
	2. Brake return spring weaken or broken	Replace	2-S13
Poor Braking Force	1. Brake spring play excessive	Adjust	G-33
	2. Brake disc worn	Replace	2-S36

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2. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
Regulator Valve (HST Charge Relief Valve) at engine speed: 3000 min ⁻¹ (rpm)	Setting Pressure	0.75 to 0.95 MPa 7.7 to 9.6 kgf/cm ² 110 to 130 psi	–
PTO Clutch at engine speed: 1600 min ⁻¹ (rpm)	Operating Pressure	0.65 to 0.75 MPa 6.7 to 7.6 kgf/cm ² 95 to 100 psi	–
Check and High Pressure Relief Valve at engine speed: 1600 min ⁻¹ (rpm)	Relief Valve Setting Pressure	19.5 to 22.5 MPa 199 to 229 kgf/cm ² 2830 to 3260 psi	–
Maximum Speed • At Maximum Engine rpm	Forward	158 min ⁻¹ (rpm) or Over	–
	Reverse	149 min ⁻¹ (rpm) or Over	–
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.	–
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 "6. TIGHTENING TORQUES" on page G-12.)

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 assembly screw (M12, 7T)	77.4 to 90.2	7.90 to 9.19	57.1 to 66.5
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	25 to 29	2.6 to 3.0	18 to 21
Check and high pressure relief valve plug	59 to 78	6.0 to 8.0	44 to 58
Engine mounting nut	24 to 27	2.4 to 2.8	18 to 20
ROPS mounting screw (M12, 7T)	77.4 to 90.2	7.90 to 9.19	57.1 to 66.5
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)	48 to 56	4.9 to 5.7	35 to 41
ROPS connecting plate upper mounting screw (M8, 7T)	24 to 27	2.4 to 2.8	18 to 20
ROPS connecting plate lower mounting screw (M10, 7T)	48 to 55	4.9 to 5.7	36 to 41

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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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9Y1211344TXS002A



9Y1211344TXS003A

Adjusting Neutral

WARNING

To avoid serious 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 (1) 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 wheels can rotate freely.
7. Remove the motion control lever cover.
8. Loosen the lock nuts (3) from the ball joints on the two speed control rods (2).
9. Start the engine.
10. Move the throttle lever to **Max. speed** position.
11. Release the parking brake.
12. Turn the speed control rod (2) to extend the rod length and rotate the rear wheel backward. Then, turn the speed control rod (2) in reverse direction and find a position where the rear wheel stops rotating.
13. Then, turn the speed control rod (2) to shorten the rod length and rotate the rear wheel forward. Then, turn the speed control rod (2) 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 (2) length at the midpoint between the two position. Adjust a speed control rod (2) 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.

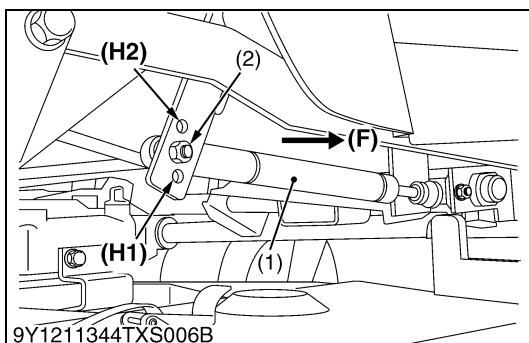
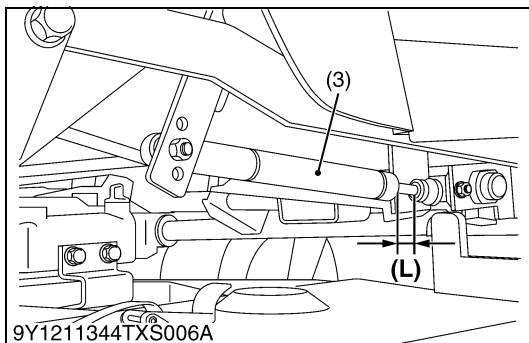
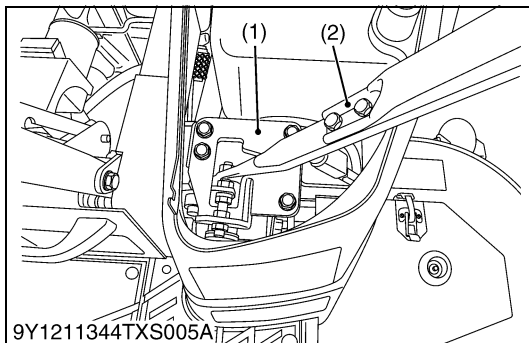
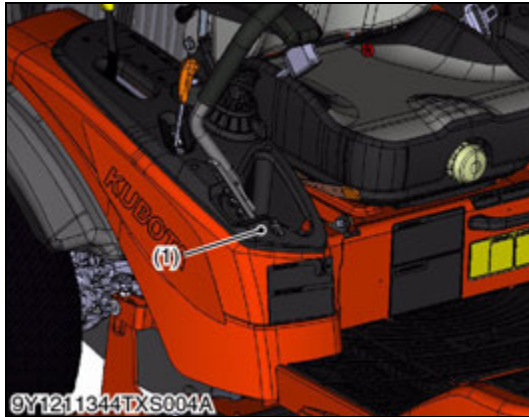
■ IMPORTANT

- The right and left motion control lever (1) can be adjusted independently.

- (1) Motion Control Lever
(2) Speed Control Rod

- (3) Lock Nut

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Checking Motion Control Lever Neutral Position

⚠ WARNING

To avoid serious injury:

- Park the machine on a firm 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 block the rear of the machine, do not run the machine while adjusting. Remove rear wheels.

■ IMPORTANT

- Right and left motion control levers can be adjusted independently.

■ HST NEUTRAL

1. Lift up and secure with jack stands or blocking the rear of the machine frame.
2. Remove both rear wheels.
3. Set the engine speed to **Max. speed** position.
4. Move motion control lever (2) forward and backward.
5. After forward and backward operation, tighten the guide control (1) at the position when wheel axis stops.
6. Adjust the rod length **L** of the damper 28 to 30 mm (1.1 to 1.2 in.) and tighten.

- | | |
|--------------------------|----------------------------------|
| (1) Guide Control | (L) 28 to 32 mm (1.1 to 1.3 in.) |
| (2) Motion Control Lever | |
| (3) Damper | |

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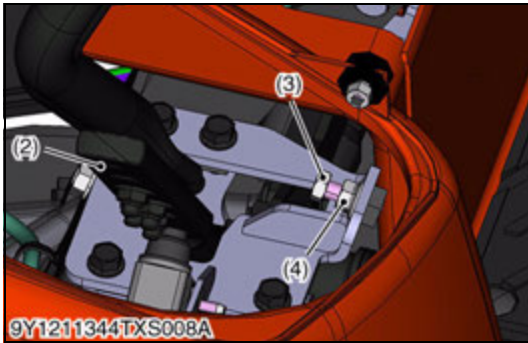
Motion Control Lever Operating Force

■ IMPORTANT

- Adjust the dampers after adjusting HST neutral.
 - Adjusting the motion control lever force will affect the maneuverability.
 - For adjustment of LH and RH, use the same hole location.
1. Change the rear side of the damper to the desired hole location. Tighten the rear side damper nut.

- | | |
|----------------|-------------------------------|
| (1) Damper | (F) Front |
| (2) Damper Nut | (H1) Hole for lighter setting |
| | (H2) Hole for lighter setting |

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Adjusting Maximum Speed

WARNING

To avoid serious 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 wheels 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 speed set bolt (3) touches the stopper plate.

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

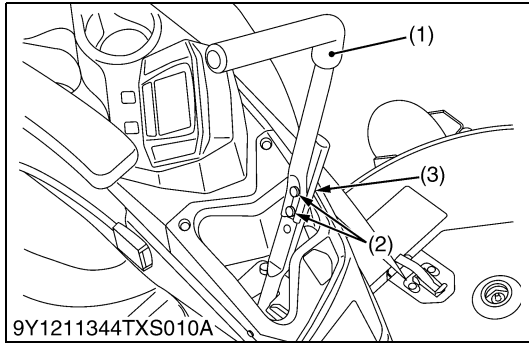
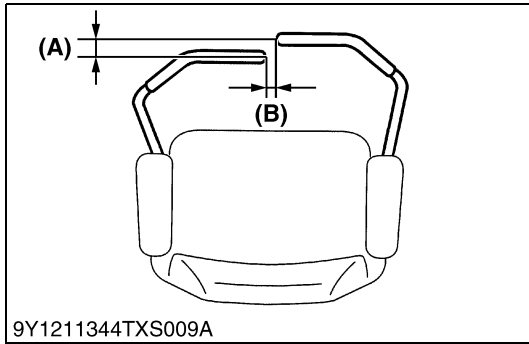
Max. speed: Wheel rotation	Factory specification	Forward	158 min ⁻¹ (rpm) or over at max. engine speed
		Reverse	149 min ⁻¹ (rpm) or over at max. engine speed

■ NOTE

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

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

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Checking Motion Control Lever Alignment

⚠ WARNING

To avoid serious injury:

- Park the machine on a firm and level surface.
 - Stop the engine, remove the key and 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 specification	0 to 2 mm 0 to 0.08 in.
Space (B)	Factory specification	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 | (A) Gap |
| (2) Motion Control Lever Mounting Screw | (B) Space |
| (3) Nut, Washer | |

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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 warming 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 neutral safety switch is temporarily turned on before check can be made.
(For example) Remove the connector from neutral 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 the engine speed specified in the table below.
 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/cm², 2830 psi), it is assumed OK.
 8. If the operation pressure does not rises to 17.0 MPa (173 kgf/cm², 2470 psi), repair or replace the HST.

■ IMPORTANT

- When the check and high pressure relief valve pressure is measured, do not operate the relief valve 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.).

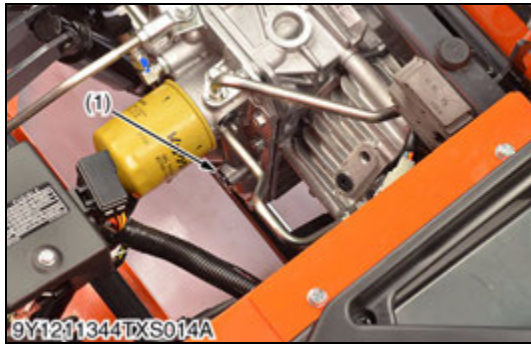
(Reference)

Check and high pressure relief valve pressure	At engine speed 1600 rpm	19.5 to 22.5 MPa 199 to 229 kgf/cm ² 2830 to 3260 psi
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(1) Plug, 1/4 Straight Thread (Forward Side)

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

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PTO Clutch Operating Pressure (Hydrostatic Transmission Charge Pressure)

⚠ WARNING

To avoid serious injury:

- When checking, park the tractor on flat ground, apply the parking brake.
 - Be careful when engaging PTO.
1. Remove the plug (1), then install the adaptor (2) cable and pressure gauge.
 2. Start the engine and set speed at specified one in the table below.
 3. Engage PTO.
 4. At this time, read the pressure gauge.
 5. If the pressure is not within the factory specification, check the regulator valve and related hydraulic components.

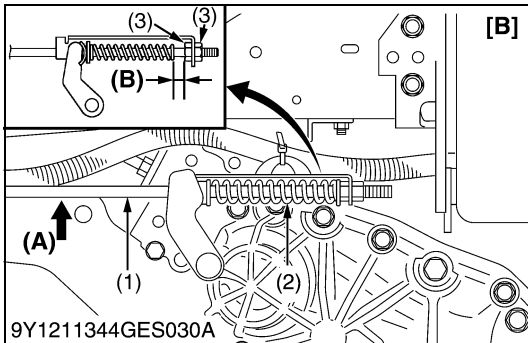
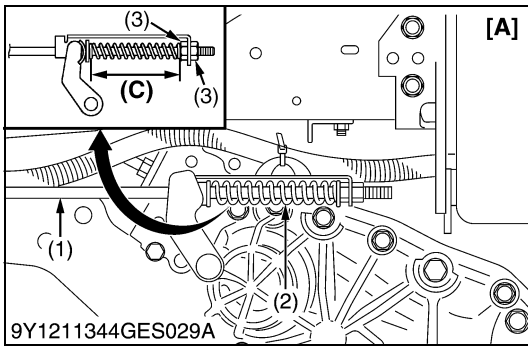
PTO clutch operating pressure at engine speed 1600 min ⁻¹ (rpm)	Factory specification	0.65 to 0.75 MPa 6.7 to 7.6 kgf/cm ² 95 to 100 psi
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Condition

- Oil temperature:
45 to 55 °C (113 to 131 °F)

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

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Checking and Adjusting Parking Brake

⚠ WARNING

To avoid serious 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 specification	115 to 117 mm 4.53 to 4.61 in.
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Proper brake spring play (B)	Factory specification	The spring must have play Reference: 0.5 to 1.0 mm 0.02 to 0.04 in.
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■ **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.

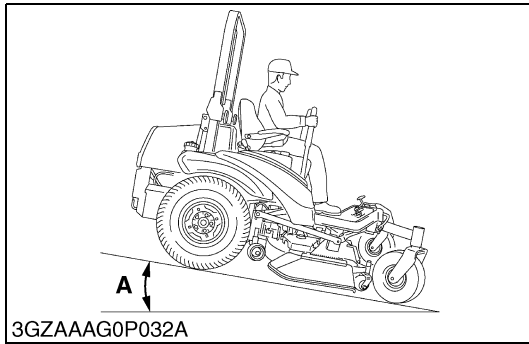
■ **Adjustment of brake spring length**

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
- (2) Brake Spring
- (3) Lock Nut

- (A) "Hold the Brake Rod"
- (B) "Parking Brake Spring Play"
- (C) "Parking Brake Spring Length"
- [A] When the parking brake is locked.
- [B] When the parking brake is released.

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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

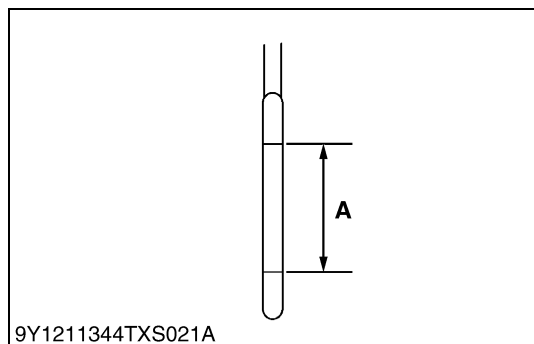
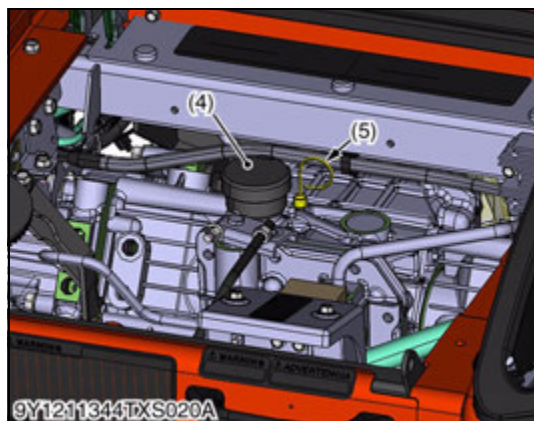
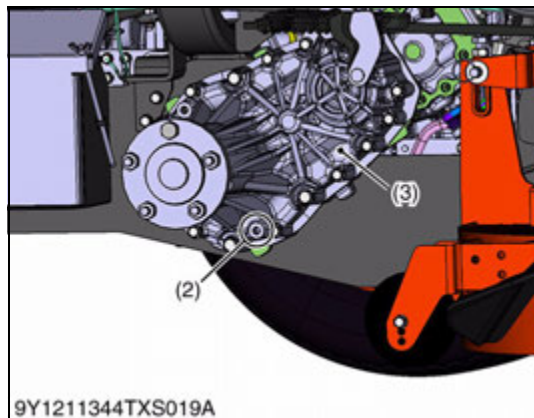
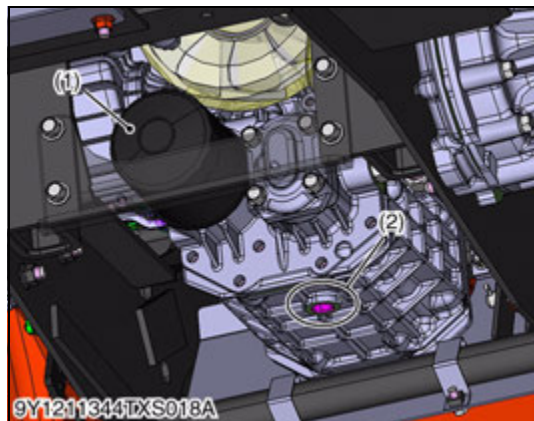
- For parking brake test purposes, only use 17 ° ramp "**A**".

A: 17 ° ramp

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5. DISASSEMBLING AND ASSEMBLING

[1] SEPARATING TRANSAXLE 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

- It takes time to pour the oil from the transmission case to 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

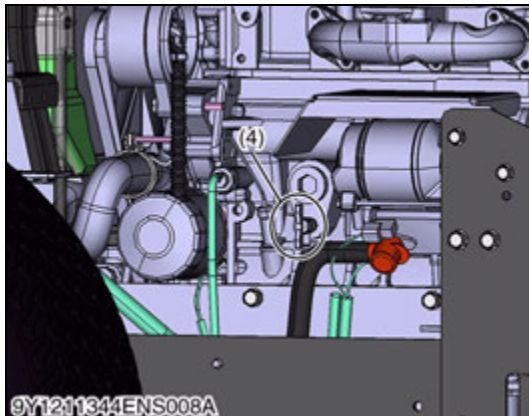
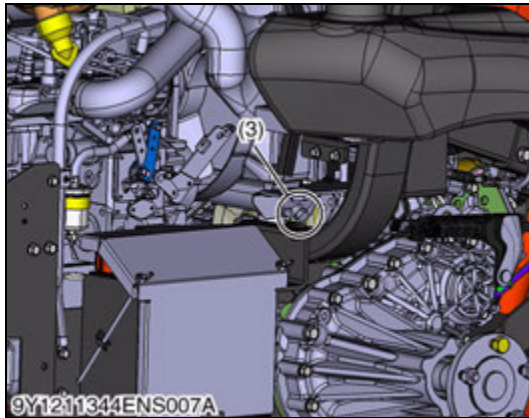
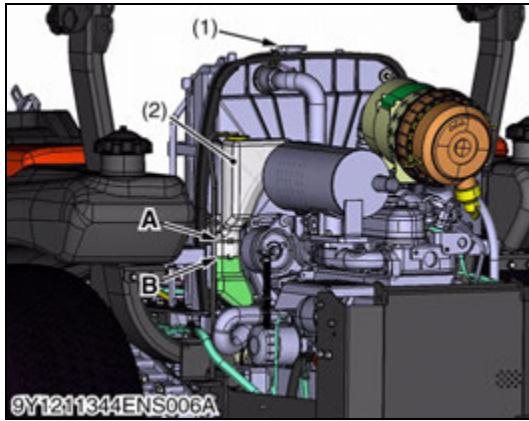
- Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge. Keep the engine at medium speed for a few minutes to ensure proper lubrication of all parts so there is no damage to transmission.
- Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system. Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-9.)
- 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 RH
- (4) Oil Plug and Breather Cup
- (5) Dipstick

A: Oil level acceptable within this range.

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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 10 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 valve (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	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 Valve
- A: Upper Level**
 - B: Lower Level**

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Battery

⚠ WARNING

To avoid serious injury:

- 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

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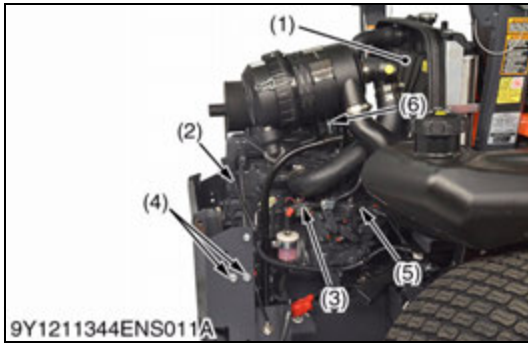


Bonnet

1. Remove the bonnet mounting bolts (1).
2. Remove the bonnet (2).

- | | |
|---------------------------|------------|
| (1) Bonnet Mounting Bolts | (2) Bonnet |
|---------------------------|------------|

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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 assembly (6).
5. Disconnect the fuel hoses (3) from engine.
6. Disconnect the water hoses (7), (8).
7. Remove both shroud plates (10).
8. Disconnect fan shroud (1), (11).
9. Remove engine stoppers (4).

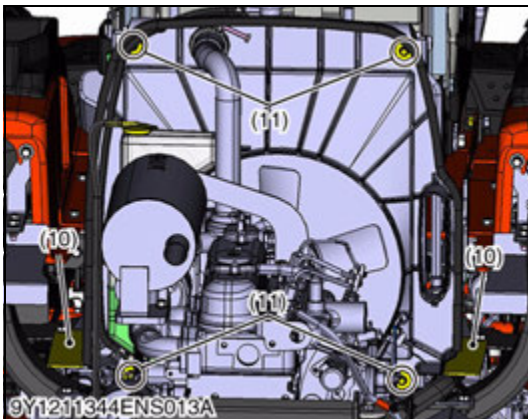
(When reassembling)

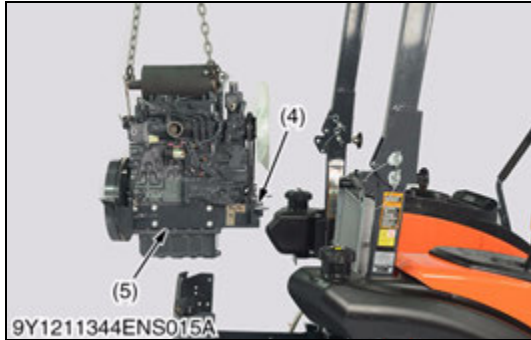
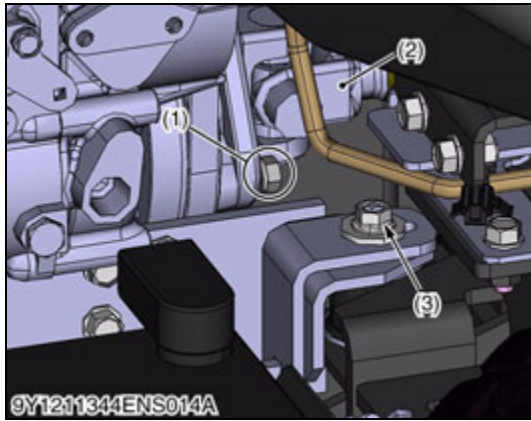
- When you install the accelerator wire, adjust the wiring length. The stopper lever must hit the idling speed adjusting bolt and the maximum speed adjusting bolt in the stroke of the accelerator lever.



- | | |
|---------------------------------------|-----------------------|
| (1) Fan Shroud | (7) Upper Hose |
| (2) Wiring Harness | (8) Lower Hose |
| (3) Fuel Hose | (9) Positive Cable |
| (4) Engine Stopper | (10) Shroud Plate |
| (5) Accelerator Wire (Throttle Cable) | (11) Fan Shroud Bolts |
| (6) Air Filter Support | |

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Separating Engine

1. Raise seat.
2. Remove ROPS connecting plate.
3. Remove universal joint mounting screws (1).
4. Disconnect universal joint (2) from Fan drive pulley.
5. Remove engine mounting nuts.
6. Separate the engine.
7. Remove 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	17.6 to 20.6 N·m 1.80 to 2.10 kgf·m 13.0 to 15.1 lbf·ft

- | | |
|------------------------------------|-------------------------|
| (1) Universal Joint Mounting Screw | (4) Engine Support (LH) |
| (2) Universal Joint | (5) Engine Support (RH) |
| (3) Engine Mounting Nut | |

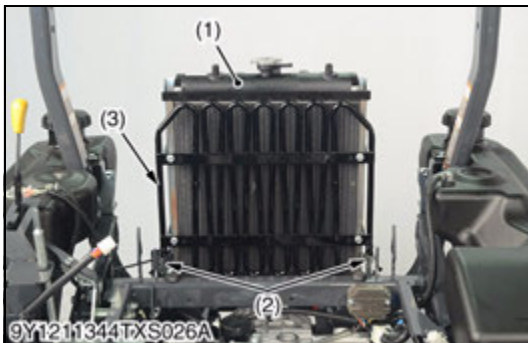
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Step, Center and Step

1. Open step center (2).
2. Remove pin to release cable (1).
3. Remove pin and slide step center rod out.
4. Remove step center (2).
5. Remove front cover (3).
6. Remove step (4).

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

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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.
3. Disconnect LCD Panel.
4. Remove RH and LH fuel vapor hose guards (2).
5. Disconnect fuel vapor hose (3).
6. Remove fuel vapor hose stay (4).
7. Remove fender LH (5).
8. Disconnect key switch.
9. Remove lever grips.
10. Remove mower cutting height adjusting dial.
11. Remove fender RH (6).

- | | |
|----------------------|---------------------|
| (1) Seat Assembly | (4) Fuel Vapor Stay |
| (2) Fuel Vapor Guard | (5) Fender (LH) |
| (3) Fuel Vapor Hose | (6) Fender (RH) |

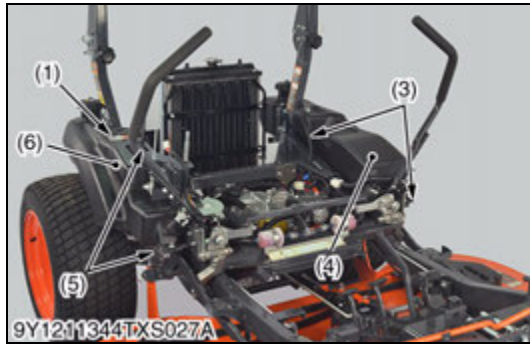
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Radiator and Oil Cooler

1. Remove Radiator (1).
2. Remove Clips (2)
3. Remove Oil Cooler (3) with radiator stay.

- | | |
|--------------|----------------|
| (1) Radiator | (3) Oil Cooler |
| (2) Clips | |

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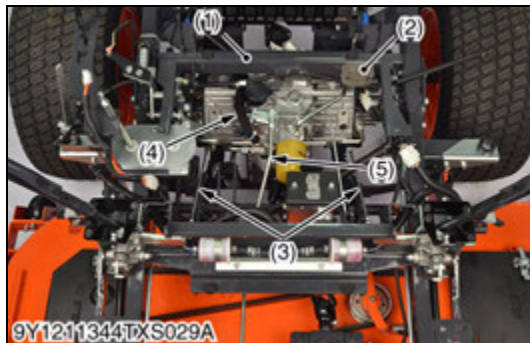
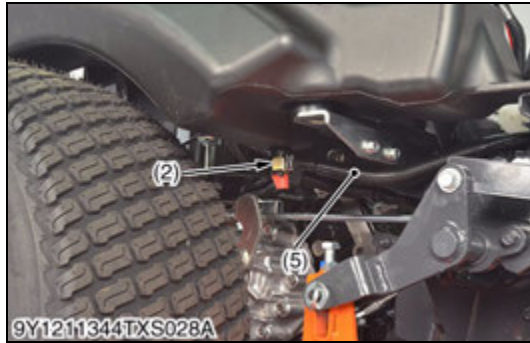


Fuel Tank

1. Disconnect the wiring connectors for fuel gauge (1).
2. Switch off fuel flow by turning fuel cut off switches (2) (one on each tank).
3. Remove fuel hoses (3).
4. Remove fuel hoses (5).
5. Remove fuel hoses (5).
6. Remove RH tank (6).

- | | |
|-------------------------|-------------------|
| (1) Fuel Gauge | (4) LH Fuel Tank |
| (2) Fuel Cut Off Switch | (5) RH Fuel Hoses |
| (3) LH Fuel Hoses | (6) RH Fuel Tank |

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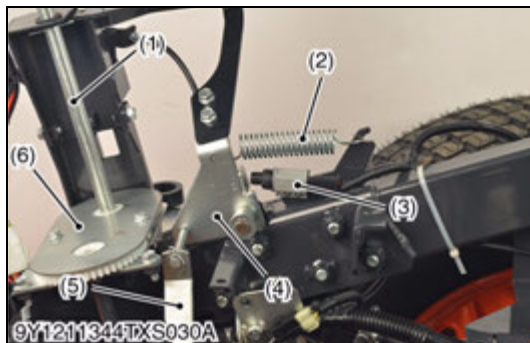


Speed Control Rods and Hydraulic Lift Rod

1. Remove bonnet lock assembly (1).
2. Disconnect regulator (2).
3. Remove speed control rods (3).
4. Disconnect hydraulic lift hose (4).
5. Remove hydraulic lift rod (5).

- | | |
|--------------------------|-------------------------|
| (1) Bonnet Lock Assembly | (4) Hydraulic Lift Hose |
| (2) Regulator | (5) Hydraulic Lift Rod |
| (3) Speed Control Rod | |

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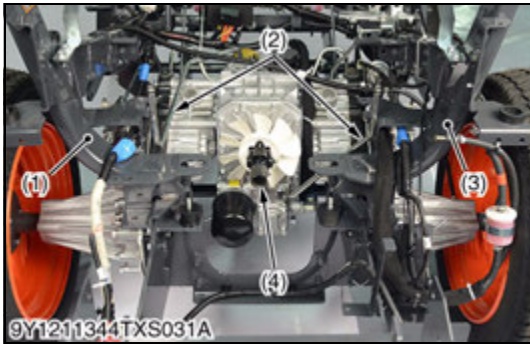


PTO Lever Assembly and Dial Cam

1. Remove dial rod (1).
2. Remove cutting height adjusting gear (6).
3. Remove spring (2).
4. Remove PTO Link (5).
5. Remove PTO Lever (4).
6. Remove PTO safety switch (3).

- | | |
|-----------------------|-----------------------------------|
| (1) Dial Rod | (4) PTO Lever |
| (2) Spring | (5) PTO Link |
| (3) PTO Safety Switch | (6) Cutting Height Adjusting Gear |

9Y1211344TXS0021US0



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. Lift and secure machine with jack stands then remove rear wheels (6).

(When reassembling)

■ **NOTE**

- Make sure to mount the cushion rubber on the oil cooler pipe.
- When tightening ROPS mounting bolts (5), begin with top right bolt and tighten counterclockwise two laps.



Tightening torque	ROPS mounting bolt (M12)	77.4 to 90.2 N·m 7.90 to 9.19 kgf·m 57.1 to 66.5 lbf·ft
	Rear wheel mounting bolt and nut	108.5 to 130.2 N·m 11.1 to 13.3 kgf·m 80 to 96 lbf·ft

- | | |
|---------------------|-------------------------|
| (1) ROPS Lower (LH) | (4) Universal Joint |
| (2) Oil Cooler Pipe | (5) ROPS Mounting Bolts |
| (3) ROPS Lower (RH) | (6) Rear Wheel |

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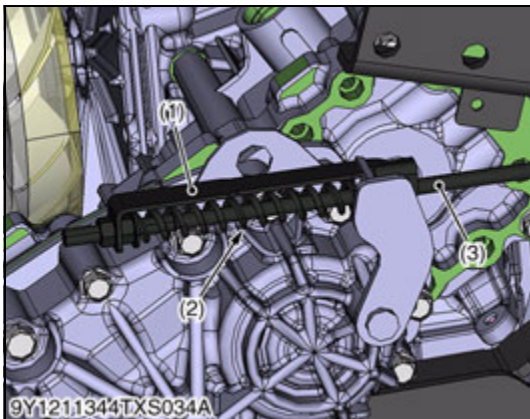


Parking Brake

1. Remove parking brake return plate (1).
2. Remove parking brake spring (2).
3. Remove parking brake rod (3).

(When reassembling)

- Replace the cotter pin with new one.
- After assembling the parking brake rods, be sure to check the parking brake spring length and play. If the measurement is not within the factory specification, adjust the spring length and play. (See page G-33)



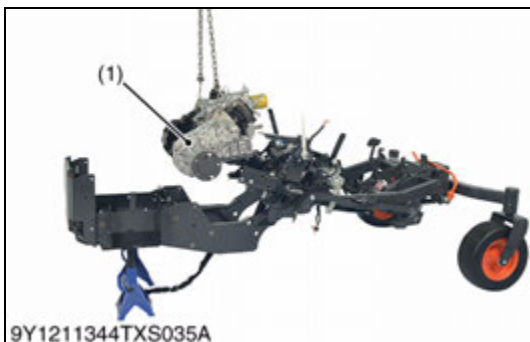
- | | |
|--------------------------------|-----------------------|
| (1) Parking Brake Return Plate | (3) Parking Brake Rod |
| (2) Parking Brake Spring | |

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Separating Transaxle Assembly

1. Remove the rear axle gear case mounting screws.
2. Separate the transaxle assembly (1) from main frame.

(When reassembling)

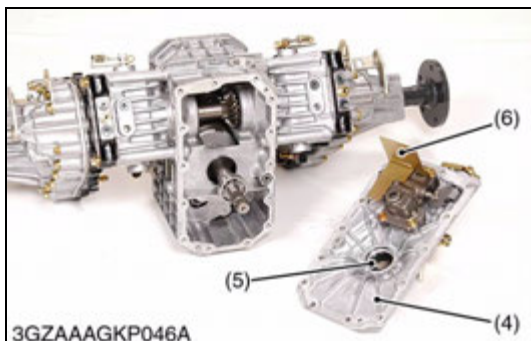
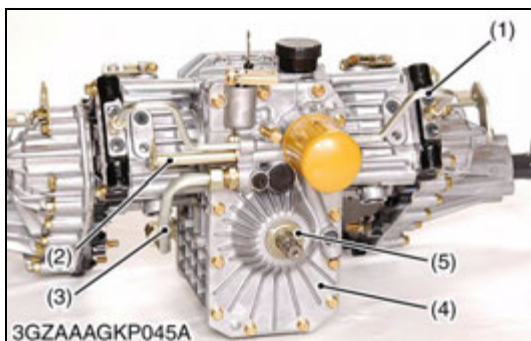
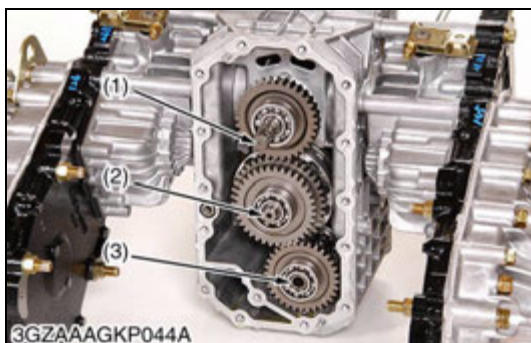
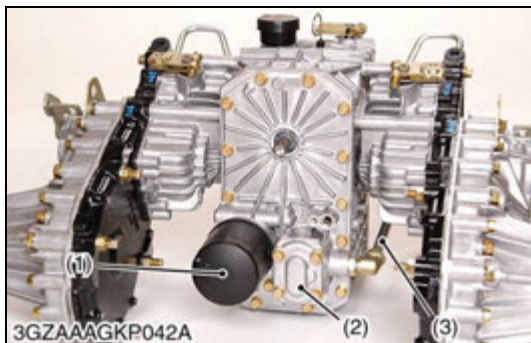


Tightening torque	Rear axle gear case mounting bolt (M12)	77.4 to 90.2 N·m 7.90 to 9.19 kgf·m 57.1 to 66.5 lbf·ft
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- (1) Transaxle Assembly

9Y1211344TXS0023US0

[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

- Make sure 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.
- Be careful 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

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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)

- Be careful not to damage the PTO shaft oil seal.

- (1) Input Shaft Assembly (2) PTO Clutch Shaft Assembly (3) Pump Shaft Assembly

9Y1211344TXS0025US0

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).

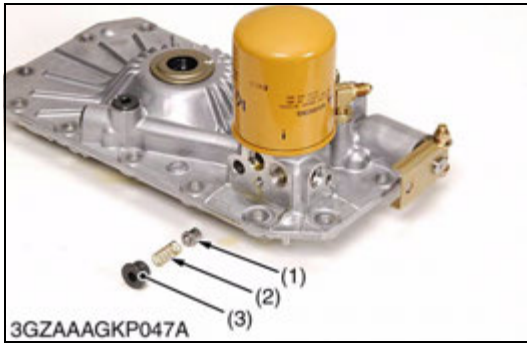
(When reassembling)

- Be careful 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
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- (1) HST Pipe (2) PTO Clutch Lever (3) Delivery Pipe (4) Center Case Front Cover (5) PTO Shaft Oil Seal (6) Plate

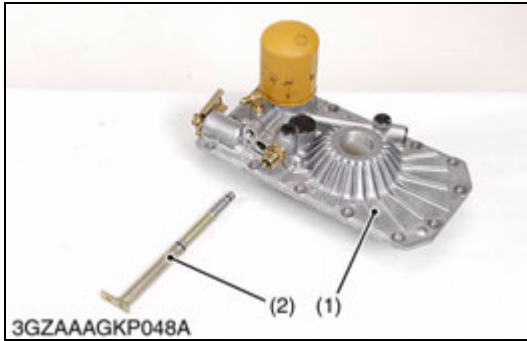
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Regulator Valve (HST Charge Pressure Relief Valve)

1. Remove the plug (3).
 2. Remove the spring (2) and poppet (1).
- (1) Poppet
 - (2) Spring
 - (3) Plug

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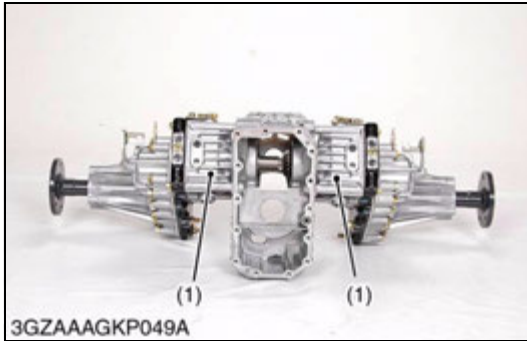


PTO Clutch Lever

1. Remove the lever stopper and remove the PTO clutch lever (2).
- (When reassembling)**
- Be careful not to damage the O-rings.

- (1) Center Case Front Cover
- (2) PTO Clutch Lever

9Y1211344TXS0028US0



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)

- Be careful 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
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- (1) Hydrostatic Transmission and Rear Axle Gear Case Assembly

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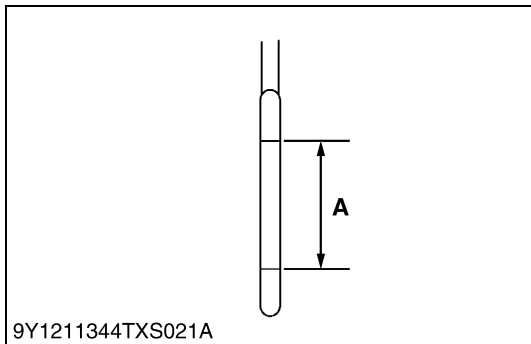
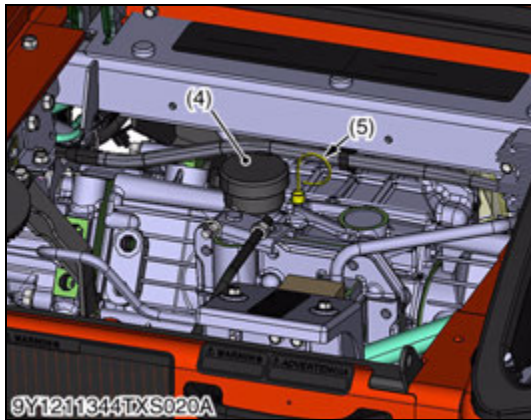
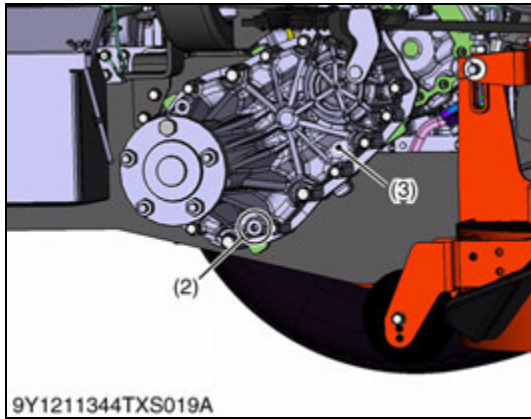
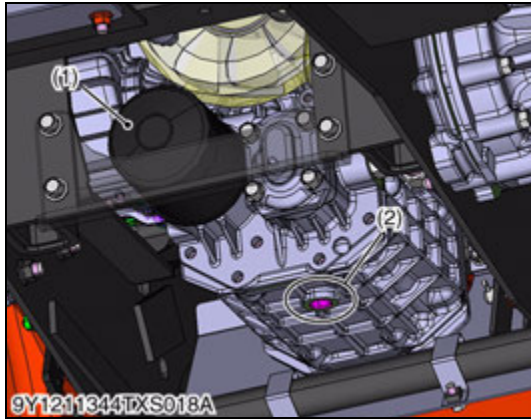
Input Shaft, Spiral Bevel Gear and Joint Shaft

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

9Y1211344TXS0030US0

[3] DISASSEMBLING PTO CLUTCH SHAFT 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 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

- It takes time to pour the oil from the transmission case to 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

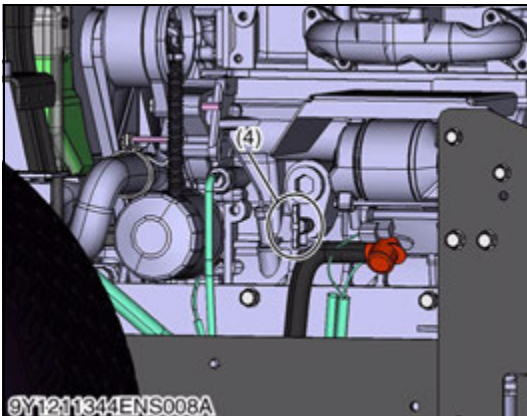
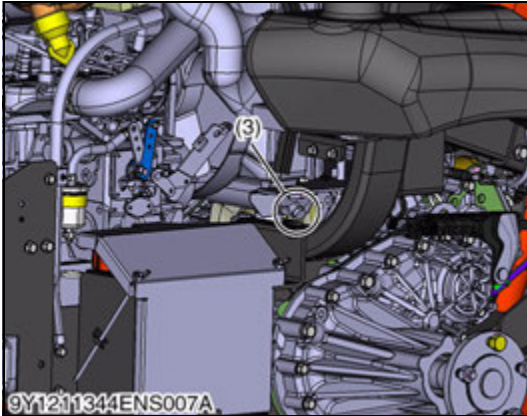
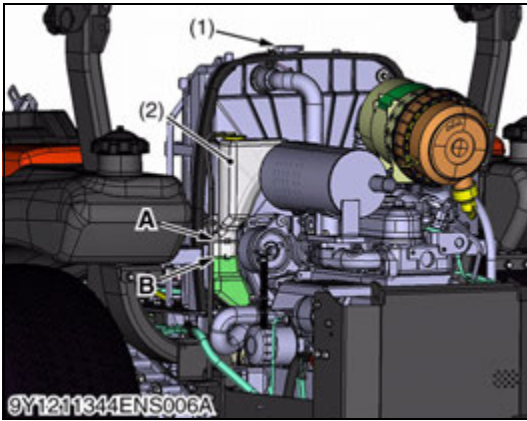
- Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge. Keep the engine at medium speed for a few minutes to ensure proper lubrication of all parts so there is no damage to transmission.
- Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system. Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-9.)
- 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 RH
- (4) Oil Plug and Breather Cup
- (5) Dipstick

A: Oil level acceptable within this range.

9Y1211344TXS0031US0



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 10 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 valve (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	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 Valve

- A: Upper Level**
- B: Lower Level**

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Battery

WARNING

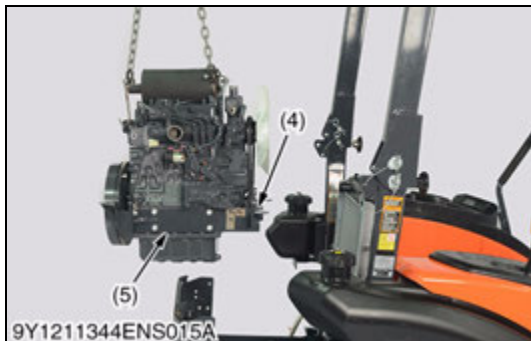
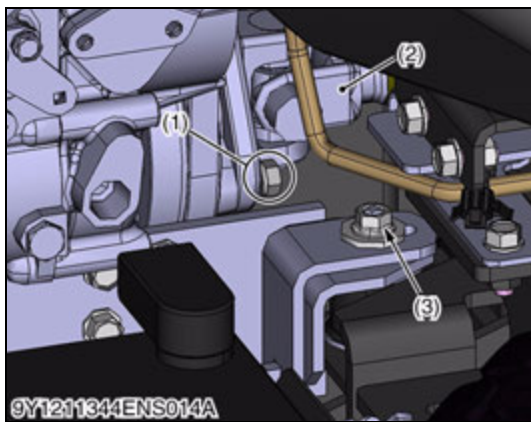
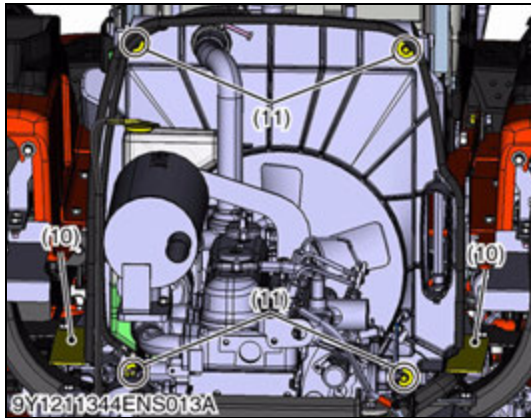
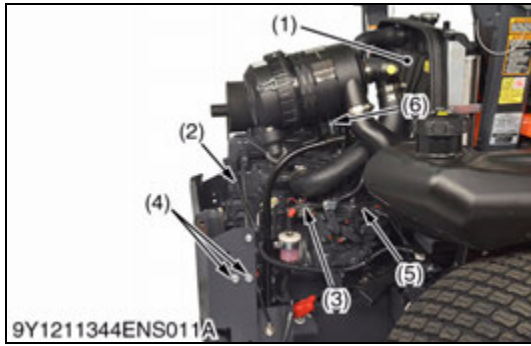
To avoid serious injury:

- 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

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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 assembly (6).
5. Disconnect the fuel hoses (3) from engine.
6. Disconnect the water hoses (7), (8).
7. Remove both shroud plates (10).
8. Disconnect fan shroud (1), (11).
9. Remove engine stoppers (4).

(When reassembling)

- When you install the accelerator wire, adjust the wiring length. The stopper lever must hit the idling speed adjusting bolt and the maximum speed adjusting bolt in the stroke of the accelerator lever.

- | | |
|---------------------------------------|-----------------------|
| (1) Fan Shroud | (7) Upper Hose |
| (2) Wiring Harness | (8) Lower Hose |
| (3) Fuel Hose | (9) Positive Cable |
| (4) Engine Stopper | (10) Shroud Plate |
| (5) Accelerator Wire (Throttle Cable) | (11) Fan Shroud Bolts |
| (6) Air Filter Support | |

9Y1211344ENS0025US0

Separating Engine

1. Raise seat.
2. Remove ROPS connecting plate.
3. Remove universal joint mounting screws (1).
4. Disconnect universal joint (2) from Fan drive pulley.
5. Remove engine mounting nuts.
6. Separate the engine.
7. Remove engine support LH (4) and RH (3).

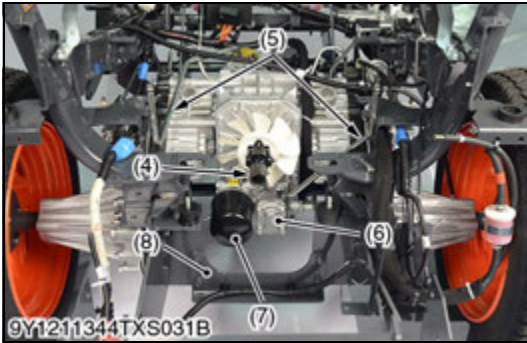
(When reassembling)

- 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	17.6 to 20.6 N·m 1.80 to 2.10 kgf·m 13.0 to 15.1 lbf·ft

- | | |
|------------------------------------|-------------------------|
| (1) Universal Joint Mounting Screw | (4) Engine Support (LH) |
| (2) Universal Joint | (5) Engine Support (RH) |
| (3) Engine Mounting Nut | |

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Oil Cooler, Radiator, Universal Joint and Others

1. Remove the ROPS connecting upper plate (1).
2. Remove the oil cooler (2).
3. Remove the radiator (3).
4. Remove the universal joint (4).
5. Remove the oil cooler pipes (5).
6. Remove ROPS connecting plate lower (8).
7. Remove the hydraulic pump assembly (6).
8. Remove the oil filter cartridge (7).

(When reassembling)

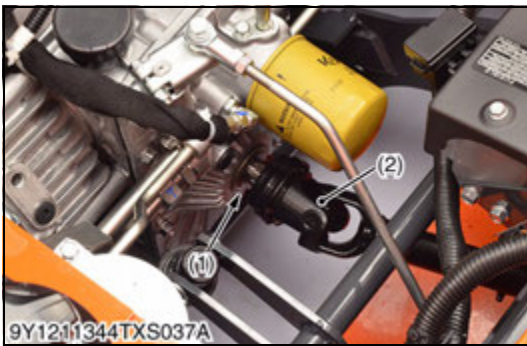
■ **NOTE**

- **Make sure to mount the cushion rubber on the oil cooler pipe.**

Tightening torque	ROPS connecting upper plate mounting screw (M8)	24 to 27 N·m 2.4 to 2.8 kgf·m 18 to 20 lbf·ft
	ROPS connecting plate lower mounting screw (M10)	48 to 55 N·m 4.9 to 5.7 kgf·m 36 to 41 lbf·ft
	Hydraulic pump mounting screw (M10)	40 to 44 N·m 4.0 to 4.5 kgf·m 29 to 32 lbf·ft

- | | |
|---------------------------------|---------------------------------|
| (1) ROPS Connecting Upper Plate | (5) Oil Cooler Pipes |
| (2) Oil Cooler | (6) Hydraulic Pump |
| (3) Radiator | (7) Oil Filter Cartridge |
| (4) Universal Joint | (8) ROPS Connecting Plate Lower |

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Universal Joint and PTO Shaft Oil Seal

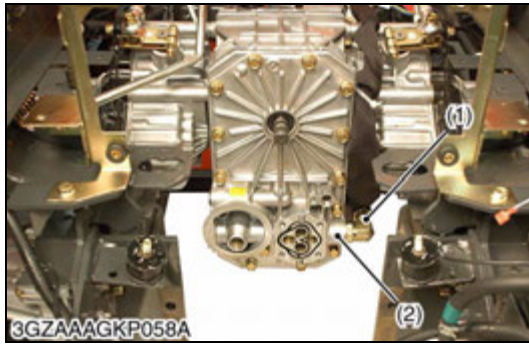
1. Disconnect the universal joint (2).
2. Remove the PTO shaft oil seal (1).

(When reassembling)

- Replace the PTO shaft oil seal with new one.

- | | |
|------------------------|---------------------|
| (1) PTO Shaft Oil Seal | (2) Universal Joint |
|------------------------|---------------------|

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Center Case Rear Cover and PTO Clutch Shaft Assembly

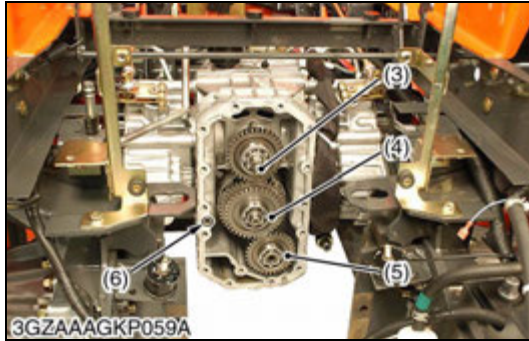
1. Disconnect the delivery pipe (1).
2. Remove the center case rear cover (2).
3. Remove the pump shaft assembly (5).
4. Remove the PTO clutch shaft assembly (4).

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 bevel gear to fall off of the input shaft (3).

(When reassembling)

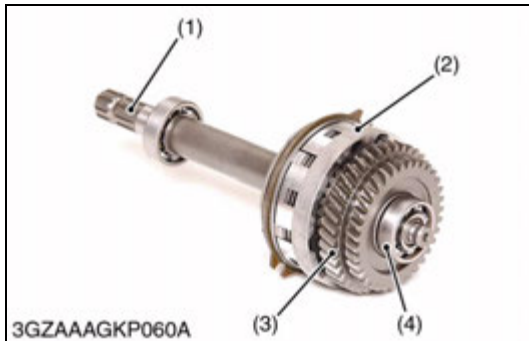
- Apply liquid gasket (Three Bond 1208D or equivalent) to joint face of center case and center case rear cover.



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
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- | | |
|----------------------------|-------------------------------|
| (1) Delivery Pipe | (4) PTO Clutch Shaft Assembly |
| (2) Center Case Rear Cover | (5) Pump Shaft Assembly |
| (3) Input Shaft | (6) O-ring |

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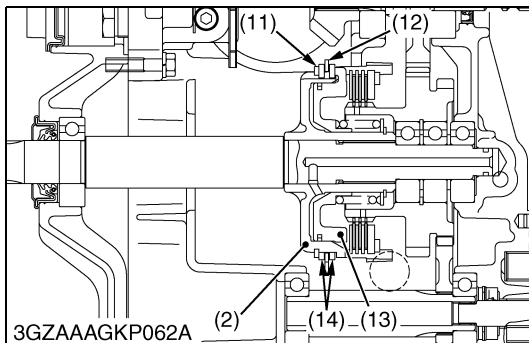
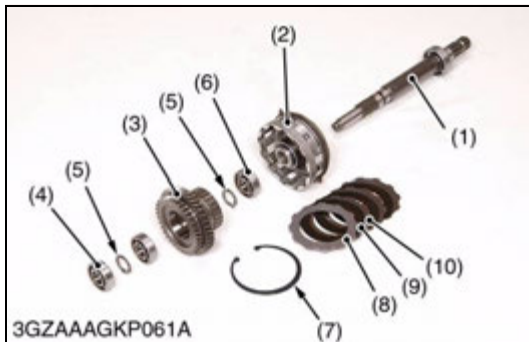


Disassembling PTO Clutch Assembly

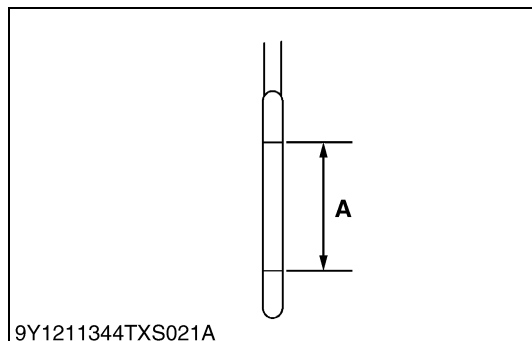
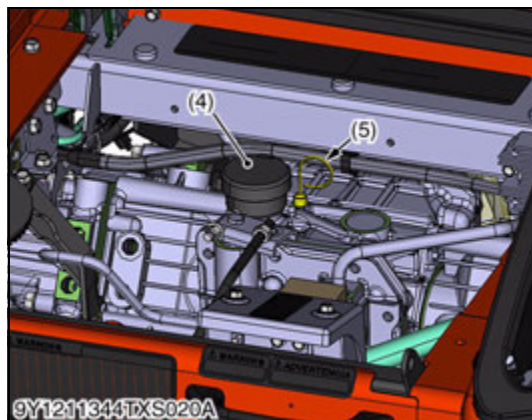
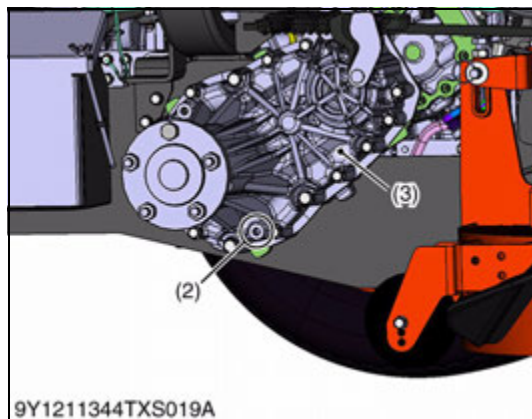
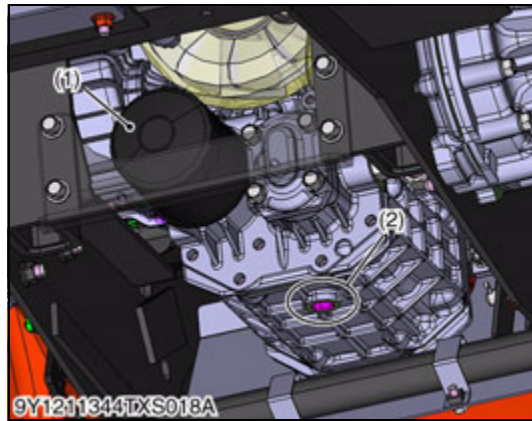
1. Remove the bearing (4) and clutch gear (3) with bearing.
2. Remove the internal snap ring (7), pressure plate (8), clutch disk (9) and clutch plate (10).
3. Remove the bearing (6) PTO clutch case (2) from the PTO shaft (1).

- | | |
|------------------------|-------------------------|
| (1) PTO Shaft | (8) Pressure Plate |
| (2) PTO Clutch Case | (9) Clutch Disk |
| (3) Clutch Gear | (10) Clutch Plate |
| (4) Bearing | (11) External Snap Ring |
| (5) Collar | (12) Brake Disk |
| (6) Bearing | (13) Piston |
| (7) Internal Snap Ring | (14) Brake Plate |

9Y1211344TXS0037US0



[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

- It takes time to pour the oil from the transmission case to 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 ensure 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-9.)

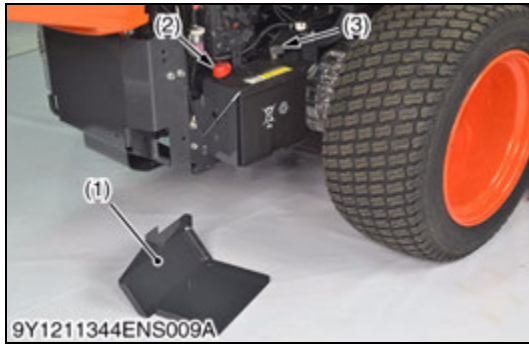
- Do not mix different brands oil together.

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 RH
- (4) Oil Plug and Breather Cup
- (5) Dipstick

A: Oil level acceptable within this range.

9Y1211344TXS0015US0



Battery

⚠ WARNING

To avoid serious injury:

- 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 (3) Negative Cable
 (2) Positive Cable

9Y1211344ENS0023US0



Step, Center and Step

1. Open step center (2).
2. Remove pin to release cable (1).
3. Remove pin and slide step center rod out.
4. Remove step center (2).
5. Remove front cover (3).
6. Remove step (4).

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

9Y1211344TXS0016US0



Rear Wheel

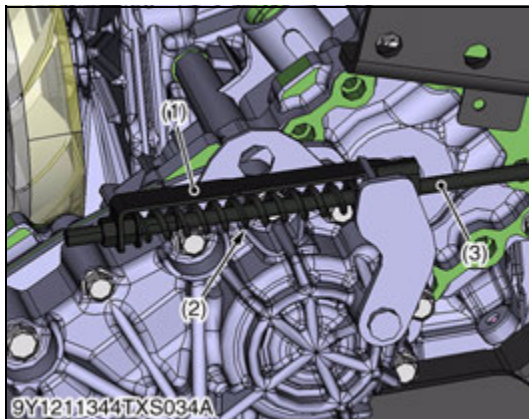
1. Lift and secure machine with jack stands or blocking the rear of the machine frame, and remove the rear wheels (1).

(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

9Y1211344TXS0038US0



Parking Brake Rod

1. Engage parking brake.
2. Remove parking brake return plate (1).
3. Remove parking brake spring (2).
4. Remove parking brake rod (3).

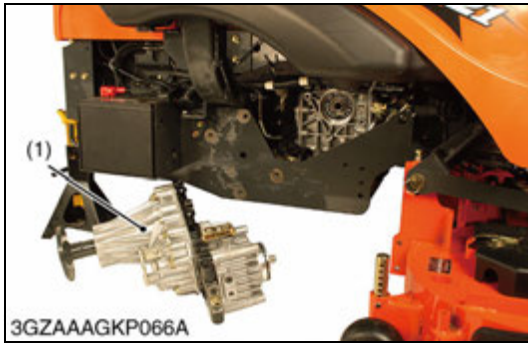
(When reassembling)

■ NOTE

- Replace the cotter pin with new one.
- After assembling the parking brake rods, be sure to check the parking brake spring length and play. If the measurement is not within the factory specification, adjust the spring length and play. (See page G-33.)

- (1) Parking Brake Return Plate (3) Parking Brake Rod
 (2) Parking Brake Spring

9Y1211344TXS0039US0



Hydrostatic Transmission and Rear Axle Gear Case Assembly

■ **NOTE**

- **The hydrostatic transmission and rear axle gear case assembly weighs approximately 35 kg (77 lbs). Be very careful in handling.**

1. Loosen the HST delivery pipe. 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.

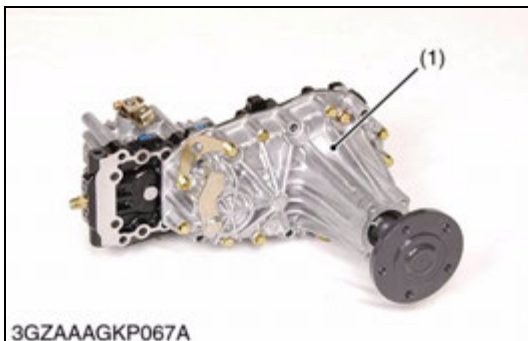
(When reassembling)

- Be careful not 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)	48 to 56 N·m 4.9 to 5.7 kgf·m 35 to 41 lbf·ft
	Rear axle gear case mounting screw (M12)	85 to 90 N·m 8.7 to 9.2 kgf·m 63 to 66 lbf·ft

(1) Hydrostatic Transmission and Rear Axle Gear Case Assembly

9Y1211344TXS0040US0



Rear Axle Gear Case

1. Remove the rear axle gear case (1).

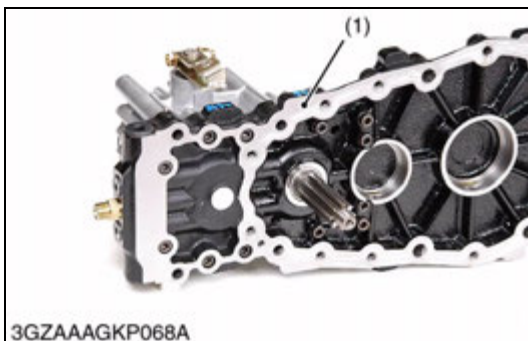
(When reassembling)

- 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

9Y1211344TXS0041US0



Center Section (Port Block)

1. Separate the center section (1) and the hydrostatic transmission housing.

■ **NOTE**

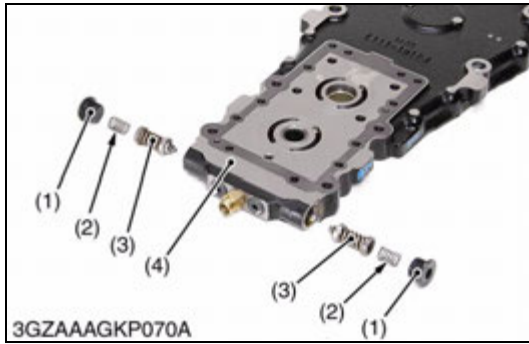
- **Be careful not to damage the surface of cylinder blocks pistons and center section.**

Tightening torque	Center section mounting hex. socket head screw	25 to 29 N·m 2.6 to 3.0 kgf·m 18 to 21 lbf·ft
-------------------	--	---

(1) Center Section

9Y1211344TXS0042US0





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).

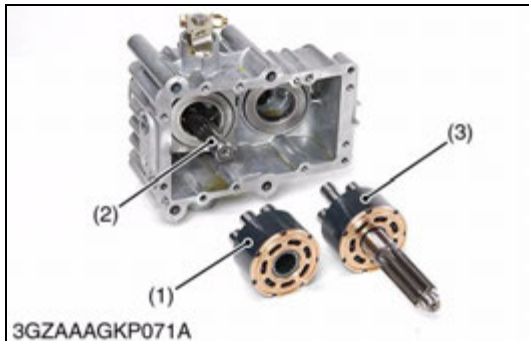
(When reassembling)

- Be careful not to damage the O-ring on the plug.

Tightening torque	Check and high pressure relief valve plug	59 to 78 N·m 6.0 to 8.0 kgf·m 44 to 58 lbf·ft
-------------------	---	---

- | | |
|------------|---|
| (1) Plug | (3) Check and High Pressure Relief Valve Assembly |
| (2) Spring | (4) Center Section |

9Y1211344TXS0043US0



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

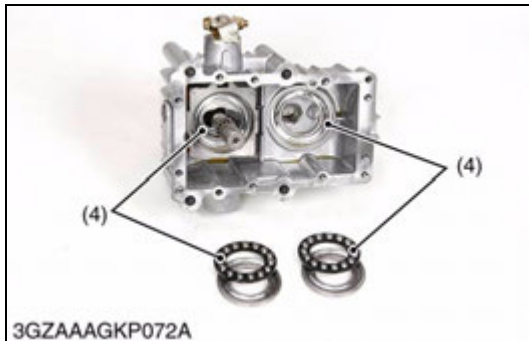
- Be careful not to damage the surface of the cylinder blocks.

(When reassembling)

- Apply clean fluid to the surface of cylinder block.

- | | |
|------------------------------------|-------------------------------------|
| (1) Cylinder Block Assembly (Pump) | (3) Cylinder Block Assembly (Motor) |
| (2) Pump Shaft | (4) Thrust Ball Bearing |

9Y1211344TXS0044US0

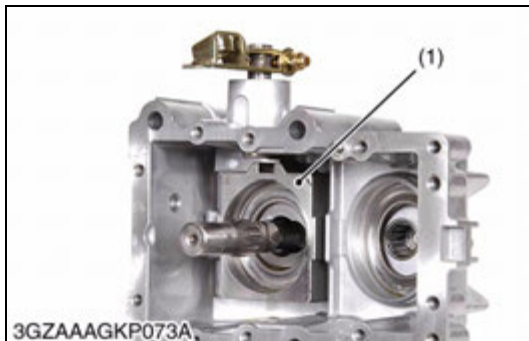


Swashplate

1. Remove the swashplate (1) from the housing.

- | |
|----------------|
| (1) Swashplate |
|----------------|

9Y1211344TXS0045US0



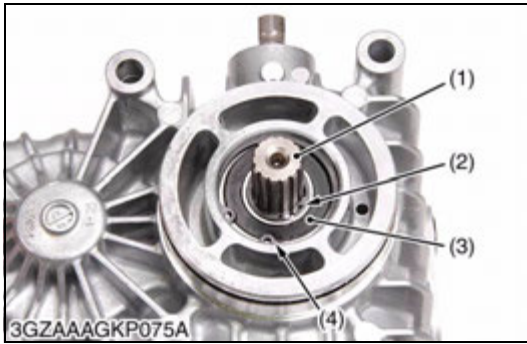
Slot Guide and Cradle Bearing

1. Remove the slot guide (2) from the trunnion arm (1).
2. Remove the cradle bearing (3) from the housing.

- | | |
|------------------|--------------------|
| (1) Trunnion Arm | (3) Cradle Bearing |
| (2) Slot Guide | |

9Y1211344TXS0046US0





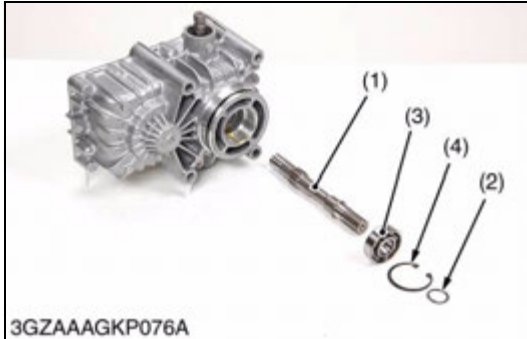
Pump Shaft

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).

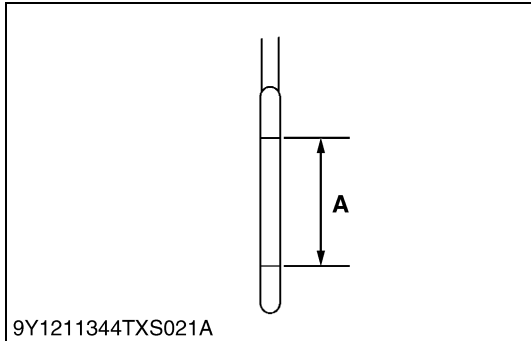
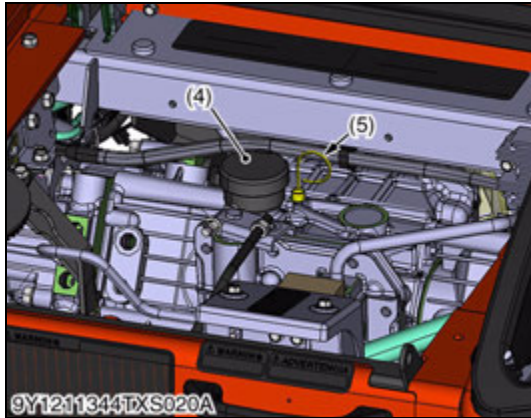
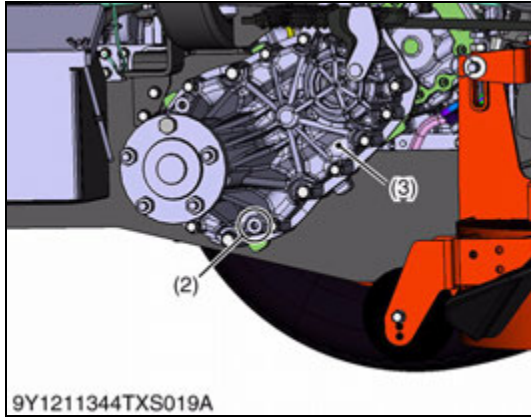
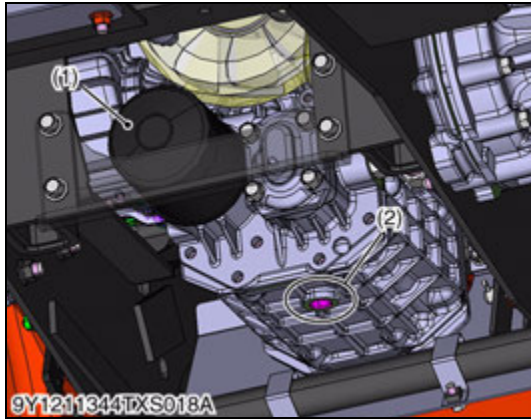
(1) Pump Shaft
(2) External Snap Ring

(3) Ball Bearing
(4) Internal Snap Ring

9Y1211344TXS0047US0



[5] DISASSEMBLING REAR AXLE GEAR CASE



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. After removing the oil plug (4), up the upper notch on the dipstick fill with new fluid from filling port.

IMPORTANT

- It takes time to pour the oil from the transmission case to 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

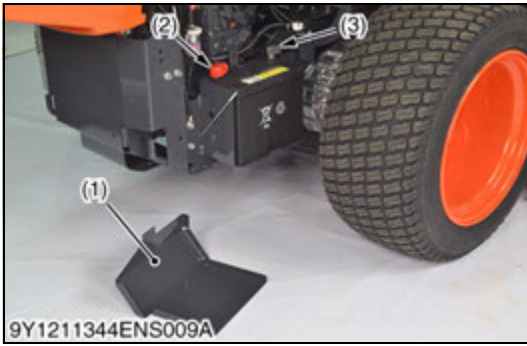
- Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge. Keep the engine at medium speed for a few minutes to ensure proper lubrication of all parts so there is no damage to transmission.
- Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system. Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-9.)
- 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.

9Y1211344TXS0048US0



Battery

⚠ WARNING

To avoid serious injury:

- 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 (3) Negative Cable
 (2) Positive Cable

9Y1211344ENS0023US0



Step, Center and Step

1. Open step center (2).
2. Remove pin to release cable (1).
3. Remove pin and slide step center rod out.
4. Remove step center (2).
5. Remove front cover (3).
6. Remove step (4).

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

9Y1211344TXS0016US0



Rear Wheel

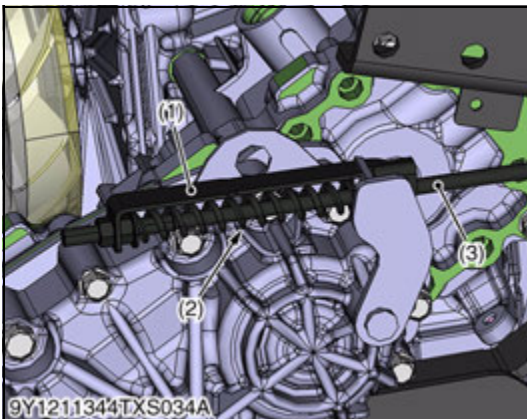
1. Lift and secure machine with jack stands or blocking the rear of the machine frame, and remove the rear wheels (1).

(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

9Y1211344TXS0038US0



Parking Brake Rod

1. Engage parking brake.
2. Remove parking brake return plate (1).
3. Remove parking brake spring (2).
4. Remove parking brake rod (3).

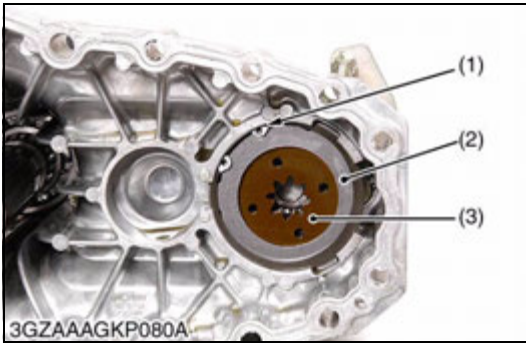
(When reassembling)

■ **NOTE**

- Replace the cotter pin with new one.
- After assembling the parking brake rods, be sure to check the parking brake spring length and play. If the measurement is not within the factory specification, adjust the spring length and play. (See page G-33.)

- (1) Parking Brake Return Plate (3) Parking Brake Rod
 (2) Parking Brake Spring

9Y1211344TXS0039US0



Parking Brake

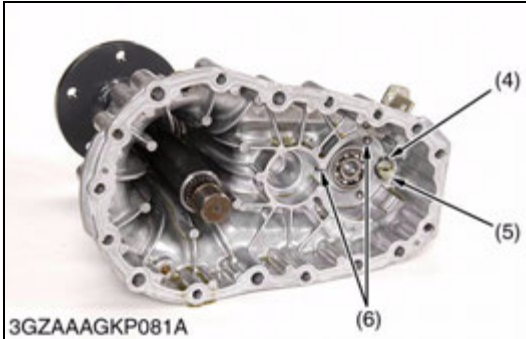
1. Remove the internal snap ring (1), friction plates (2) and brake discs (3).
2. Remove the external snap ring (4), brake cam (5) and balls (6).

(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 | (4) External Snap Ring |
| (2) Friction Plate | (5) Brake Cam |
| (3) Brake Disc | (6) Ball |

9Y1211344TXS0051US0



[6] DISASSEMBLING SPEED LEVER ASSEMBLY



Battery



WARNING

To avoid serious injury:

- 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 | (3) Negative Cable |
| (2) Positive Cable | |

9Y1211344ENS0023US0

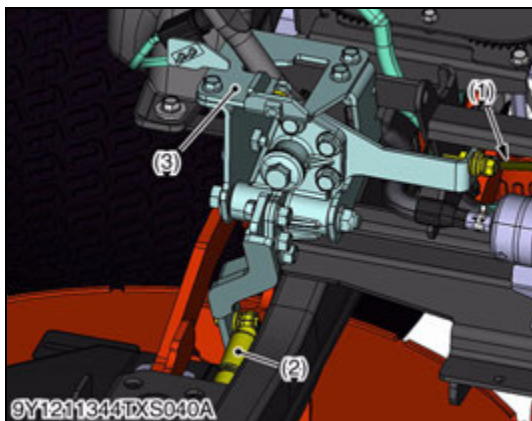


Step, Center and Step

1. Open step center (2).
2. Remove pin to release cable (1).
3. Remove pin and slide step center rod out.
4. Remove step center (2).
5. Remove front cover (3).
6. Remove step (4).

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

9Y1211344TXS0016US0



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.
3. Disconnect LCD Panel.
4. Remove RH and LH fuel vapor hose guards (2).
5. Disconnect fuel vapor hose (3).
6. Remove fuel vapor hose stay (4).
7. Remove fender LH (5).
8. Disconnect key switch.
9. Remove lever grips.
10. Remove mower cutting height adjusting dial.
11. Remove fender RH (6).

- | | |
|----------------------|---------------------|
| (1) Seat Assembly | (4) Fuel Vapor Stay |
| (2) Fuel Vapor Guard | (5) Fender (LH) |
| (3) Fuel Vapor Hose | (6) Fender (RH) |

9Y1211344TXS0052US0

Speed Lever Assembly

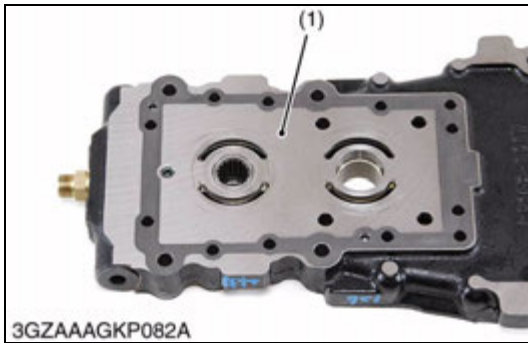
1. Remove speed rod (1).
2. Remove damper (2).
3. Remove plate (3).
4. Remove speed lever assembly.

- | | |
|---------------|-----------|
| (1) Speed Rod | (3) Plate |
| (2) Damper | |

9Y1211344TXS0065US0

6. SERVICING

[1] HYDROSTATIC TRANSMISSION

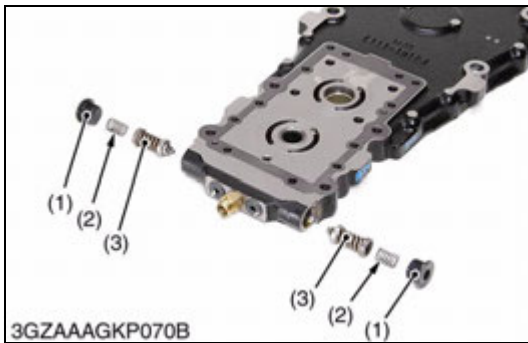


Center Section

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

9Y1211344TXS0053US0



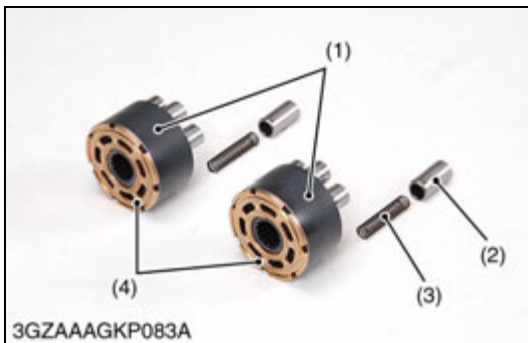
Check and High Pressure Relief Valve

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

9Y1211344TXS0054US0



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.

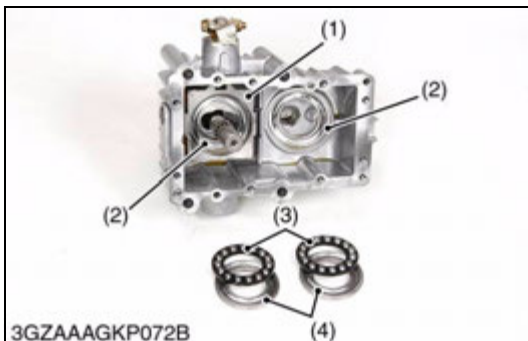
■ IMPORTANT

- 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

9Y1211344TXS0055US0



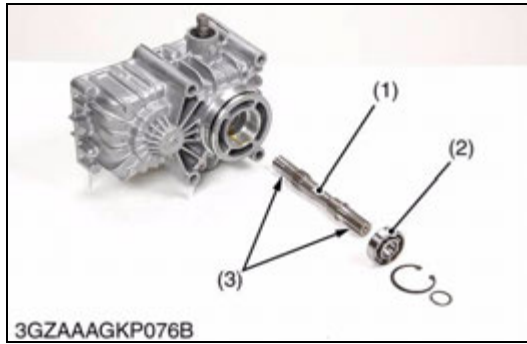
Thrust Washer, Thrust Ball Bearing and Thrust Plate

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

9Y1211344TXS0056US0



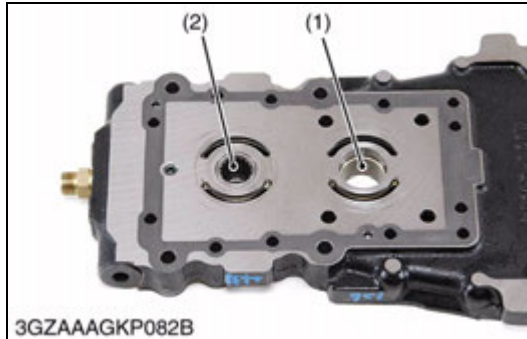
Pump Shaft

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

9Y1211344TXS0057US0



Bush and Needle Bearing

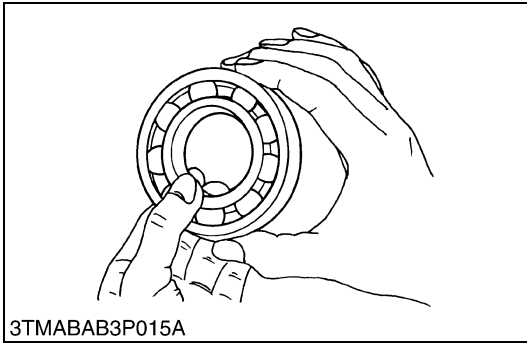
1. Check the bush (1) for wear.
2. If the bush is worn or damaged, replace it.
3. Check the needle bearing (2) for wear.
4. If the needle bearing is worn or damaged, replace it.

(1) Bush

(2) Needle Bearing

9Y1211344TXS0058US0

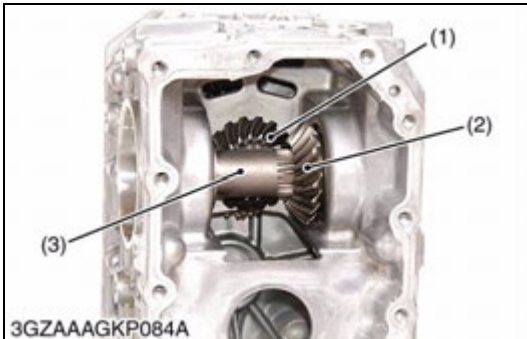
[2] TRANSMISSION CASE



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 problem, replace it.

9Y1211344TXS0059US0



Backlash and Tooth Contact between 18T Bevel Gear and 19T Bevel Gear

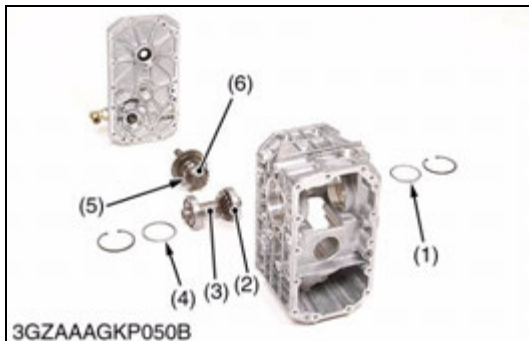
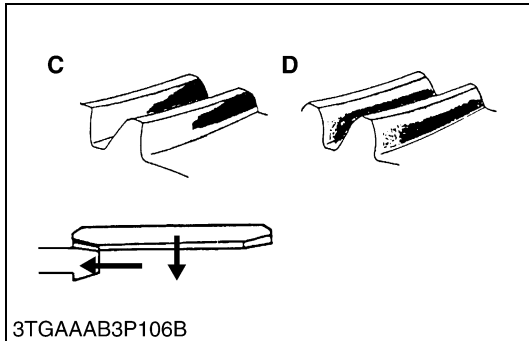
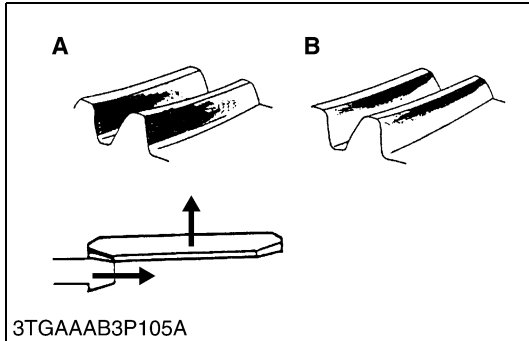
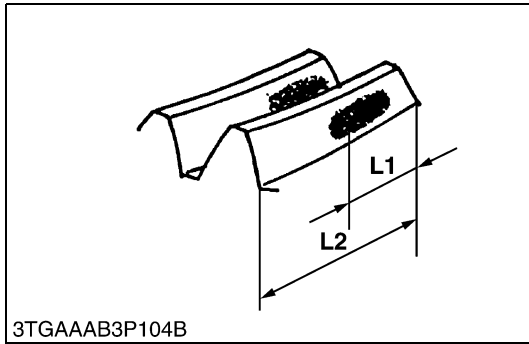
1. Measure the backlash between the 18T bevel gear (1) and 19T bevel gear (2).
2. When the backlash is too large, decrease the number of shims in the side of the spiral bevel gear, and insert the removed shims in the opposite side. When the backlash is too small, decrease the number of shims in the side 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 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 18T bevel gear	Factory specification	0.25 to 0.30 mm 0.0099 to 0.011 in.
Tooth contact		More than 25 % read lead contact area on the gear tooth surface
The position of tooth contact point		The center of tooth contact at 3/10 of the entire width from the small end

- (1) 18T Bevel Gear
(2) 19T Bevel Gear

- (3) Joint Shaft

9Y1211344TXS0060US0



Correcting of Tooth Contact

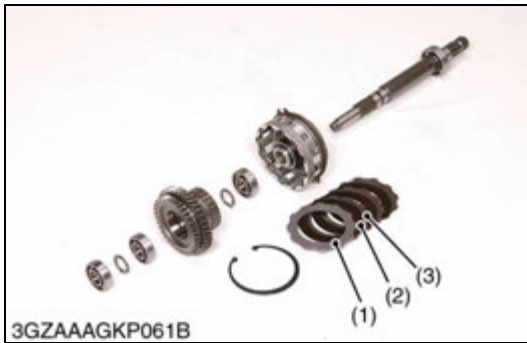
1. Proper contact
 - No adjustment.
2. Correcting of the heel contact and shallow contact
 - Make sure that whether there is a shim (5).
 - The 18T bevel gear (6) can be moved to backward by doing to add the shim (5) when not is. (The shim is made the state as it is when there is a shim (5).)
 - And 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
 - Make sure that whether there is a shim (5).
 - The 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) 18T Bevel Gear

- L1: Tooth Contact**
- L2: Tooth Bottom**
- A: Heel Contact**
- B: Shallow Contact**
- C: Toe Contact**
- D: Deep Contact**

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[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.

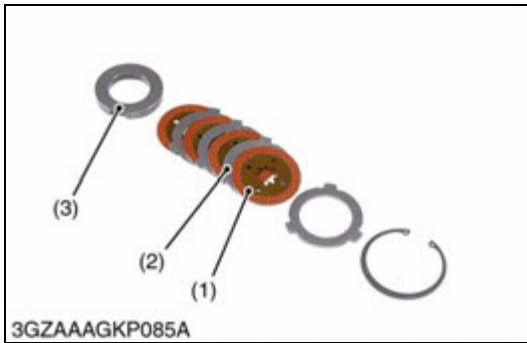
PTO Clutch Plate	PTO Clutch Disc
4	4

- (1) Pressure Plate
- (2) PTO Clutch Disc

- (3) PTO Clutch Plate

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[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.

Number of friction plate	Factory specification	3
Number of brake disc		4

- (1) Friction Plate
- (2) Brake Disc

- (3) Actuator

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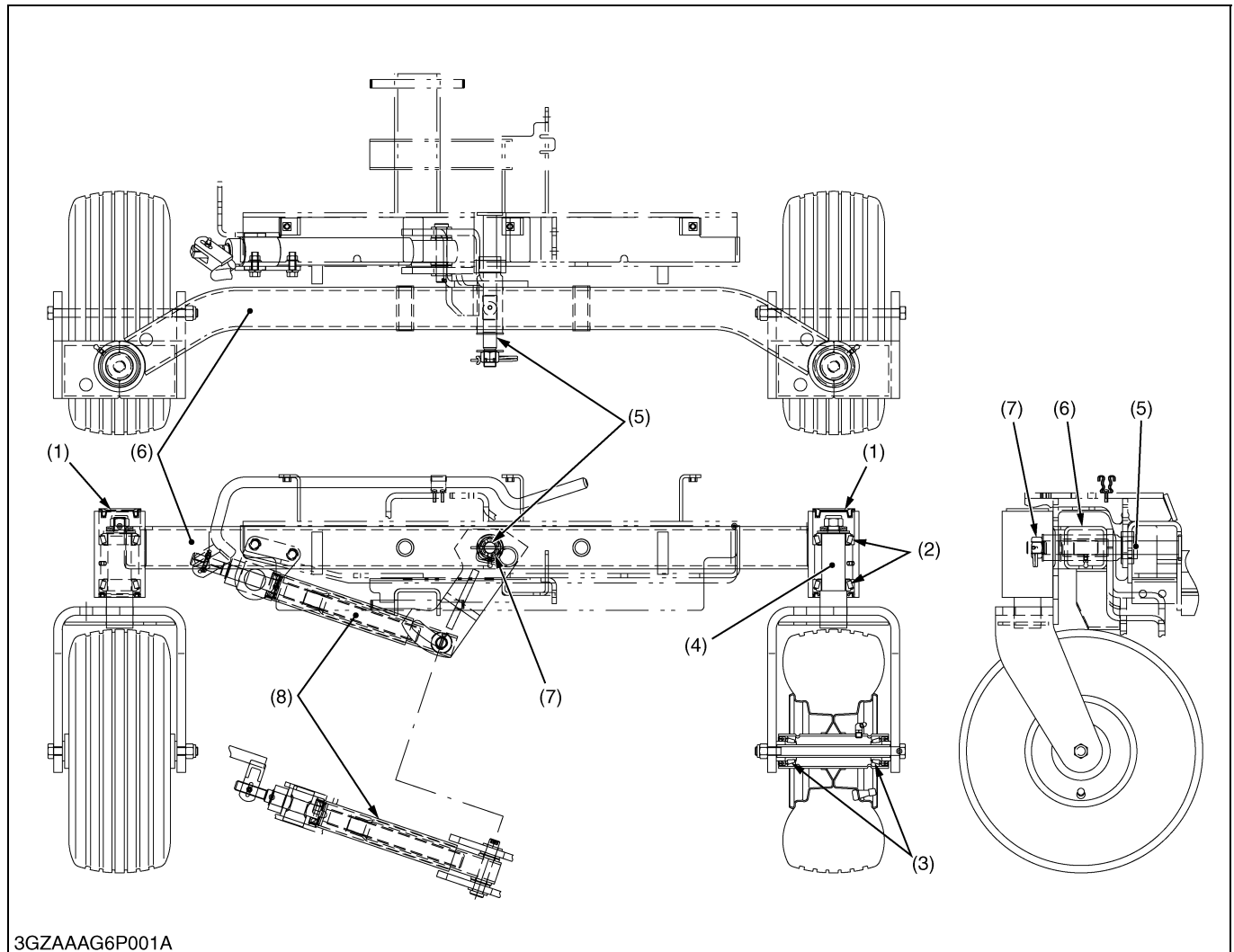
3 FRONT AXLE

MECHANISM

CONTENTS

1. STRUCTURE.....	3-M1
-------------------	------

1. STRUCTURE



- | | | | |
|--------------------------|--------------------------|----------------|----------------------|
| (1) Cap | (3) Taper Roller Bearing | (5) Center Pin | (7) Slotted Nut |
| (2) Taper Roller Bearing | (4) Wheel Bracket | (6) Front Axle | (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.

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SERVICING

CONTENTS

1. TROUBLESHOOTING.....	3-S1
2. SERVICING SPECIFICATIONS	3-S2
3. TIGHTENING TORQUES.....	3-S3
4. CHECKING, DISASSEMBLING AND SERVICING	3-S4
[1] CHECKING AND ADJUSTING.....	3-S4
[2] DISASSEMBLING AND ASSEMBLING	3-S5
(1) Separating Front Wheel and Wheel Bracket	3-S5
(2) Separating Front Axle Assembly	3-S6

1. TROUBLESHOOTING

Symptom	Probable Cause and Checking Procedure	Solution	Reference Page
Front Wheels Wander to Right or Left	1. Clearance between center pin and front axle excessive	Check the clearance and replace the center pin or front axle	3-S6
	2. Tightening torque of locking nut for the wheel bracket weak	Adjust	3-S5
	3. Clearance between front axle and front axle support excessive	Adjust	3-S4

9Y1211344FAS0001US0

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.

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3. TIGHTENING TORQUES

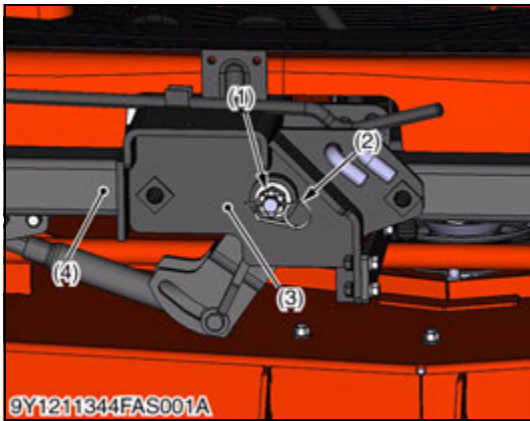
Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts: See page "6. TIGHTENING TORQUES" on page G-12.)

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

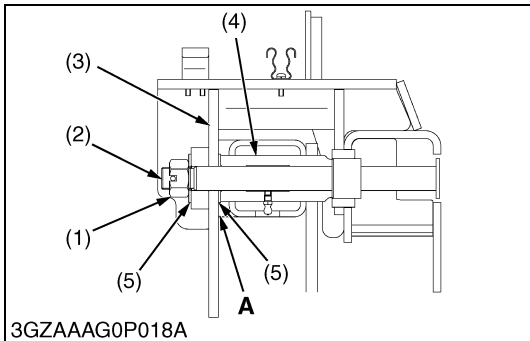
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4. CHECKING, DISASSEMBLING AND SERVICING

[1] CHECKING AND ADJUSTING



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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 specification	0 to 0.2 mm 0 to 0.008 in.
	Allowable limit	0.5 mm 0.02 in.

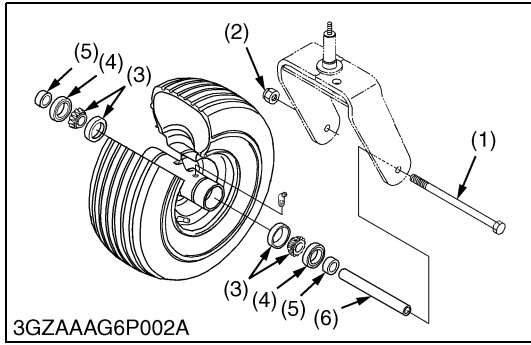
- (1) Slotted Nut
- (2) Center Pin
- (3) Front Axle Support
- (4) Front Axle
- (5) Plain Washer

A: Front Axle End Play

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[2] DISASSEMBLING AND ASSEMBLING

(1) Separating Front Wheel and Wheel Bracket



Remove the Front Wheel

1. Inspect all parts for wear or damage. Replace the parts as needed.

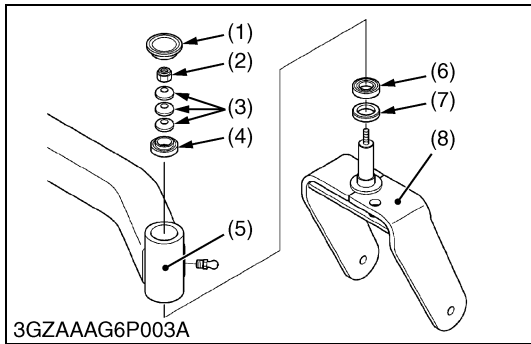
(When reassembling)

- Apply grease to grease fittings. (See page G-9.)

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 | (4) Oil Seal |
| (2) Locking Nut | (5) Spacer |
| (3) Taper Roller Bearing | (6) Sleeve |

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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.

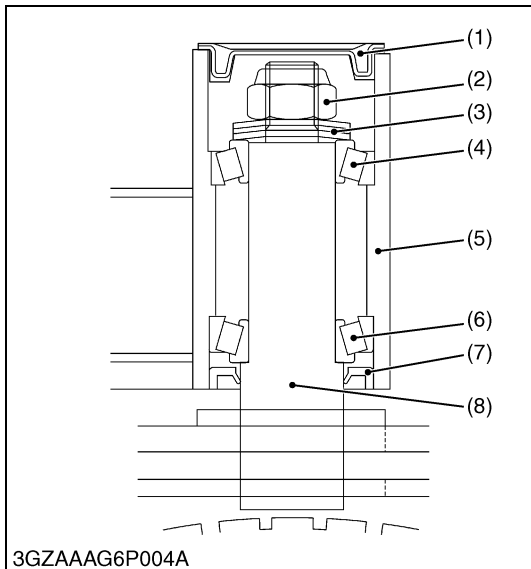
(When reassembling)

- Do not mistake the direction when reassembling the plate spring (3), taper roller bearing (4), (6) and oil seal (7).

Tightening torque	Locking nut	55 to 65 N·m 5.6 to 6.6 kgf·m 41 to 47 lbf·ft
-------------------	-------------	---

- | | |
|--------------------------|--------------------------|
| (1) Cap | (5) Front Axle |
| (2) Locking Nut | (6) Taper Roller Bearing |
| (3) Plate Spring | (7) Oil Seal |
| (4) Taper Roller Bearing | (8) Bracket |

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(2) Separating Front Axle Assembly



Battery



WARNING

To avoid serious injury:

- 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 (3) Negative Cable
(2) Positive Cable

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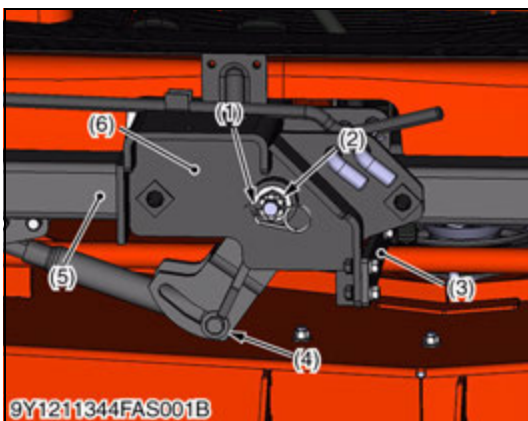


Step, Center and Step

1. Open step center (2).
2. Remove pin to release cable (1).
3. Remove pin and slide step center rod out.
4. Remove step center (2).
5. Remove front cover (3).
6. Remove step (4).

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

9Y1211344TXS0016US0



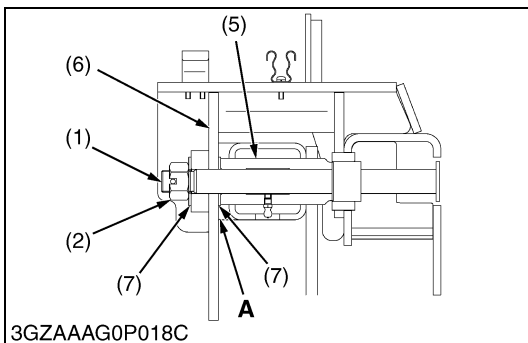
Separating Front Axle Assembly

1. Remove the set spring and slotted nut (2).
2. Remove the cotter pin and clevis pin (4).
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 to check the front axle end play (A). If the measurement is not within the factory specification, 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

Front axle end play A	Factory specification	0 to 0.2 mm 0 to 0.008 in.
	Allowable limit	0.5 mm 0.02 in.

- (1) Center Pin (6) Front Axle Support
(2) Center Pin Lock Nut (Slotted Nut) (7) Plain Washer
(3) Connecting Plate
(4) Clevis Pin
(5) Front Axle Assembly
- A: Front Axle End Play**

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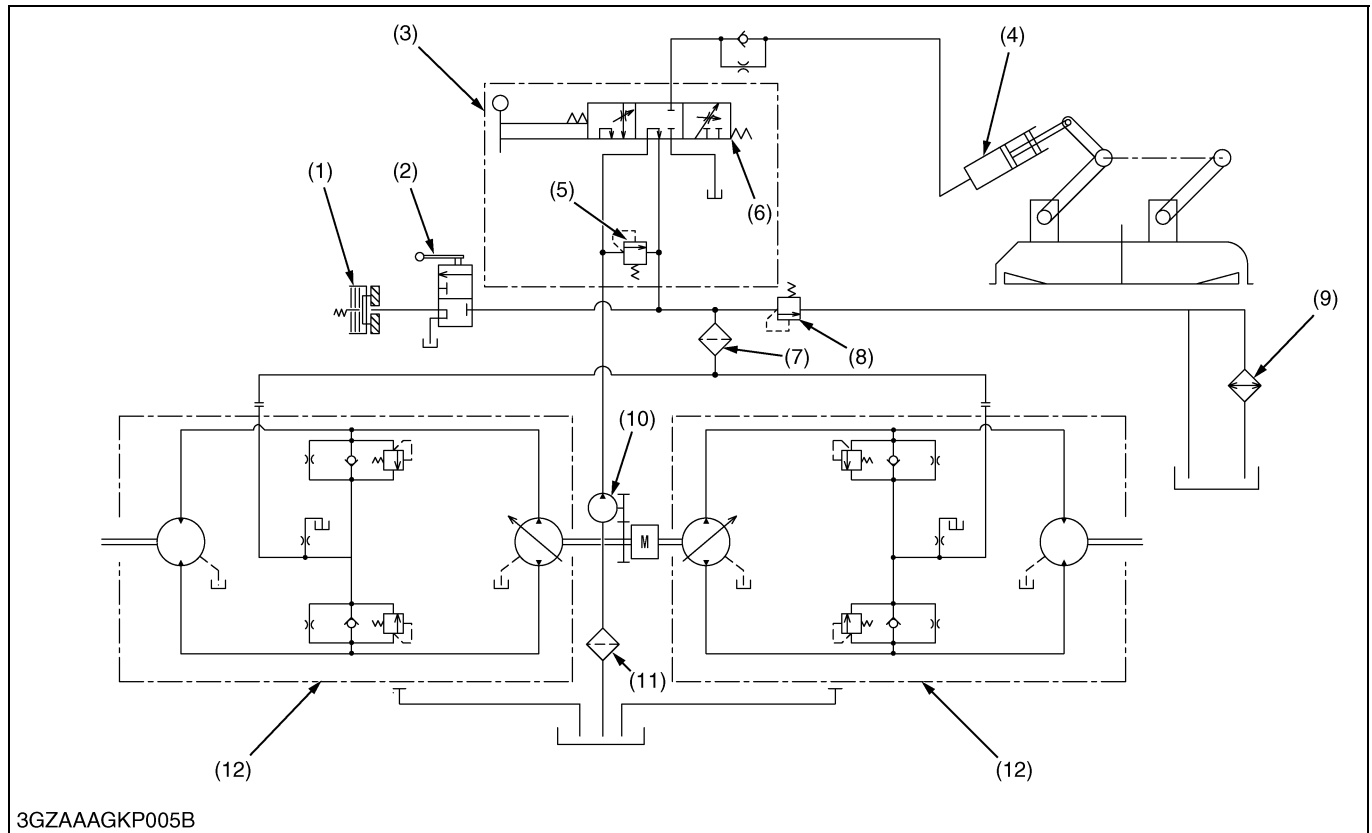
4 HYDRAULIC SYSTEM

MECHANISM

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1. HYDRAULIC CIRCUIT	4-M1
2. HYDRAULIC PUMP.....	4-M2
3. HYDRAULIC CONTROL VALVE.....	4-M3
4. LIFT CYLINDER	4-M6

1. HYDRAULIC CIRCUIT



- | | | | |
|--------------------------------------|------------------------|---------------------|-------------------------------|
| (1) PTO Clutch | (4) Hydraulic Cylinder | (7) Oil Filter | (10) Hydraulic Pump |
| (2) PTO Clutch Valve | (5) Relief Valve | (8) Regulator Valve | (11) Oil Filter |
| (3) Hydraulic Control Valve Assembly | (6) Control Valve | (9) Oil Cooler | (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.

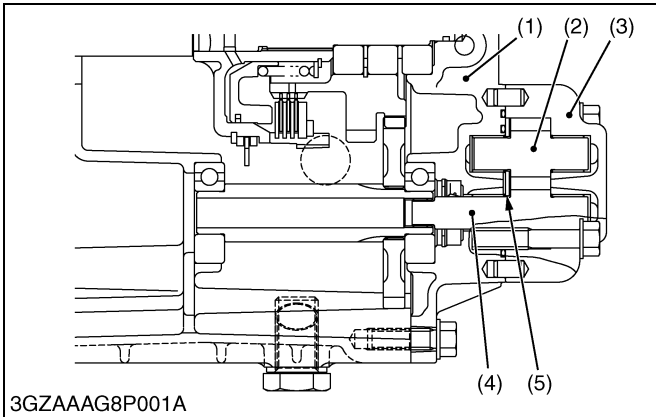
This system has the following functions. Oil is supplied by hydraulic pump (10) which is driven by engine.

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).

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2. HYDRAULIC PUMP



The hydraulic pump consists of the casing (1), cover (3), side plate (5), and two spur gears (drive gear (4) and driven gear (2)) that are in mesh.

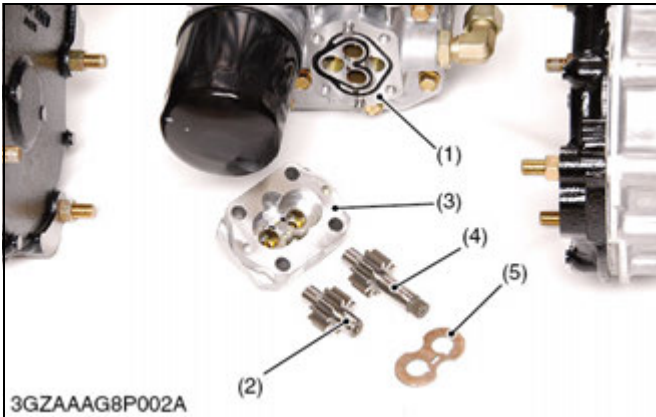
Hydraulic pump is driven by the pump drive shaft in the transmission case.

Maximum displacement is as follows.

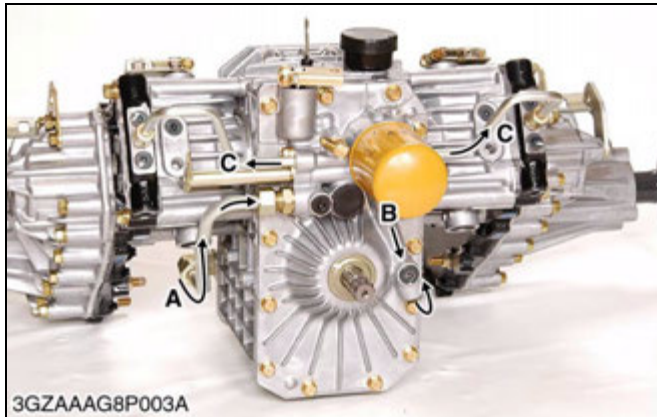
Displacement	Engine speed	Condition
26 L/min. 6.9 U.S.gals/min. 5.7 Imp.gals/min.	At 3200 min ⁻¹ (rpm)	at no load

- (1) Casing
- (2) Driven Gear
- (3) Cover
- (4) Drive Gear
- (5) Side Plate

9Y1211344HYM0002US0



3. HYDRAULIC CONTROL VALVE



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.

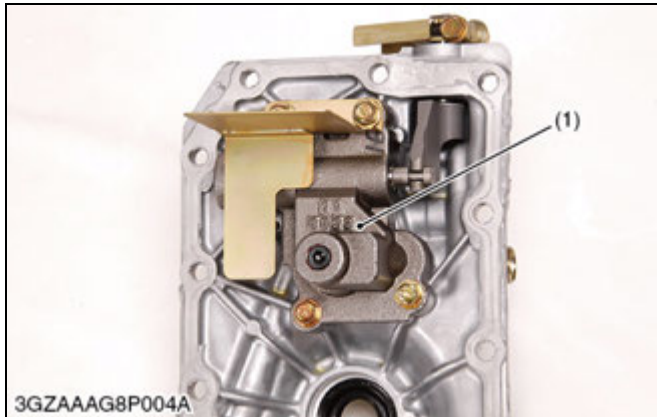
The oil flows through the oil filter, and then the oil is sent to the control valve by the pump.

After flowing through the control valve, the oil is sent to the PTO clutch and the HST charge circuit.

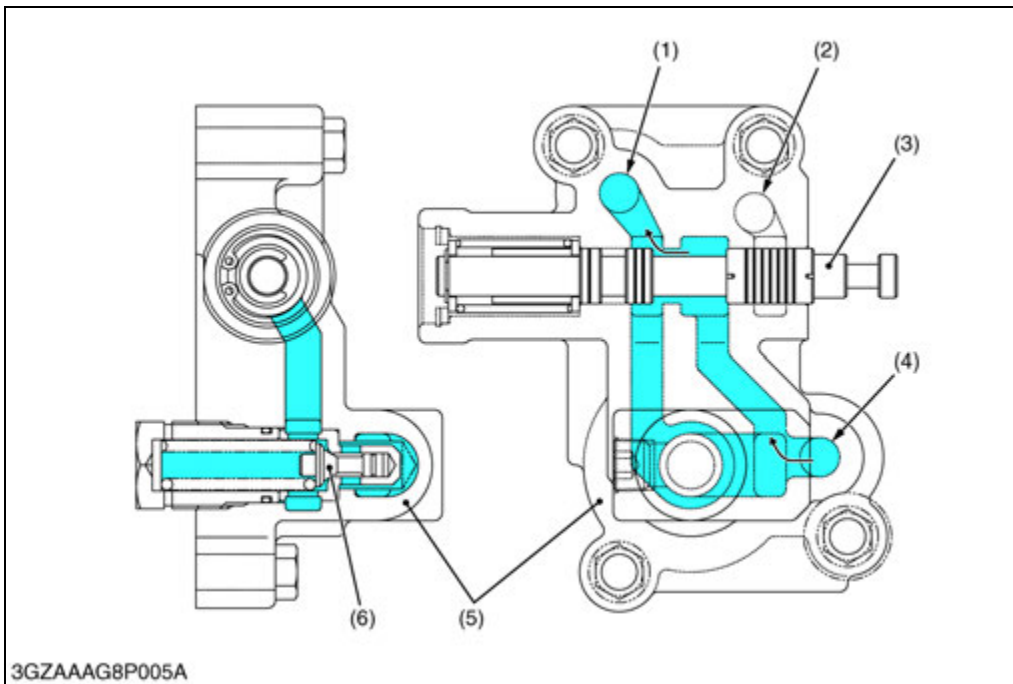
(1) Control Valve

A: From Hydraulic Pump
B: To PTO Clutch
C: To Hydrostatic Transmission

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Neutral

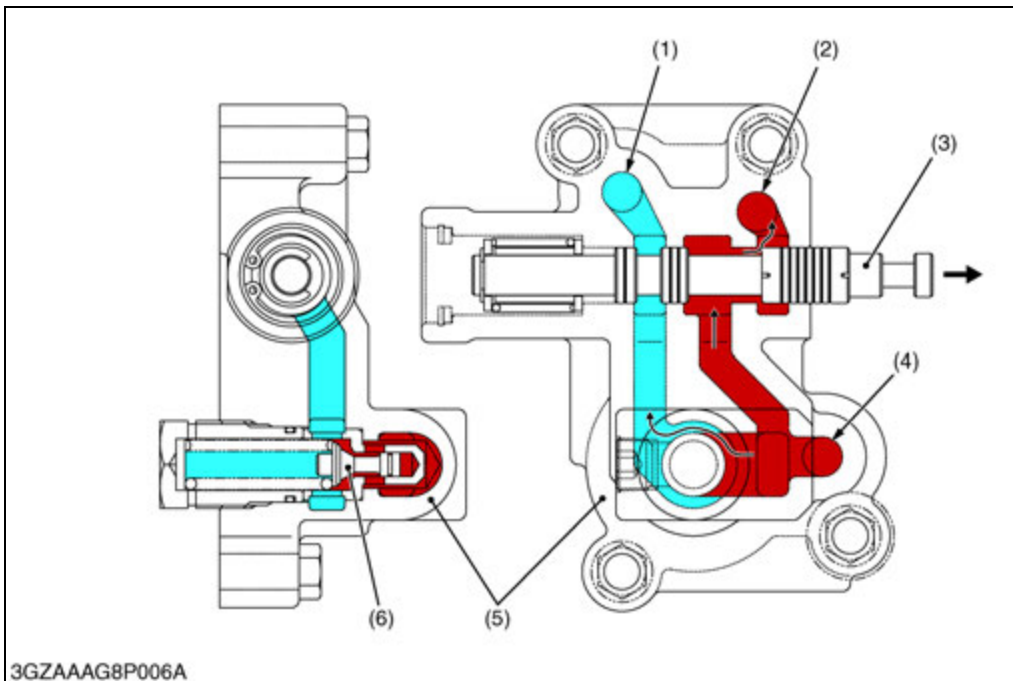


- (1) To PTO Clutch and Hydrostatic Transmission
- (2) C (Cylinder) Port
- (3) Spool
- (4) P (Pump) Port
- (5) Valve Body
- (6) Relief Valve

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).

9Y1211344HYM0004US0

Lift and Overloaded



- (1) To PTO Clutch and Hydrostatic Transmission
- (2) C (Cylinder) Port
- (3) Spool
- (4) P (Pump) Port
- (5) Valve Body
- (6) Relief Valve

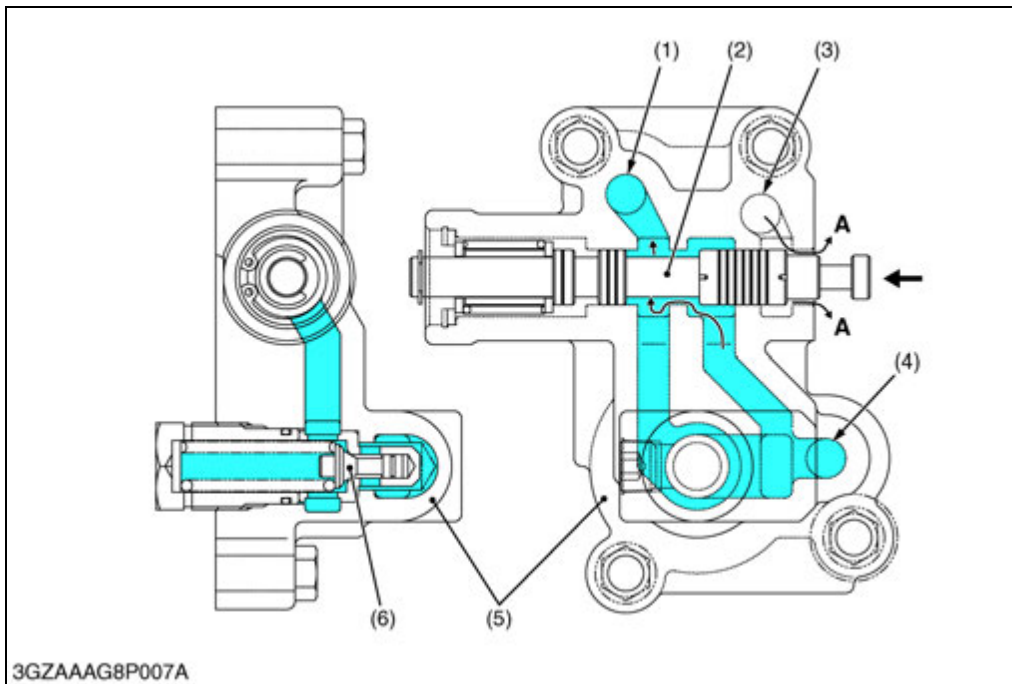
The oil flowing from the pump flows through a hydraulic circuit, which is switched over by the spool (3), and is sent to the mower-lifting cylinder (2). When the mower is lifted, the relief valve (6) also operates. As a result, the oil passing through the relief valve (6) is always sent to the PTO valve and HST charge circuit.

(Reference)

- Relief valve setting pressure: 5.5 to 7.0 MPa (56 to 71 kgf/cm², 800 to 1000 psi)
- Engine speed: 1600 min⁻¹

9Y1211344HYM0005US0

Down



- (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

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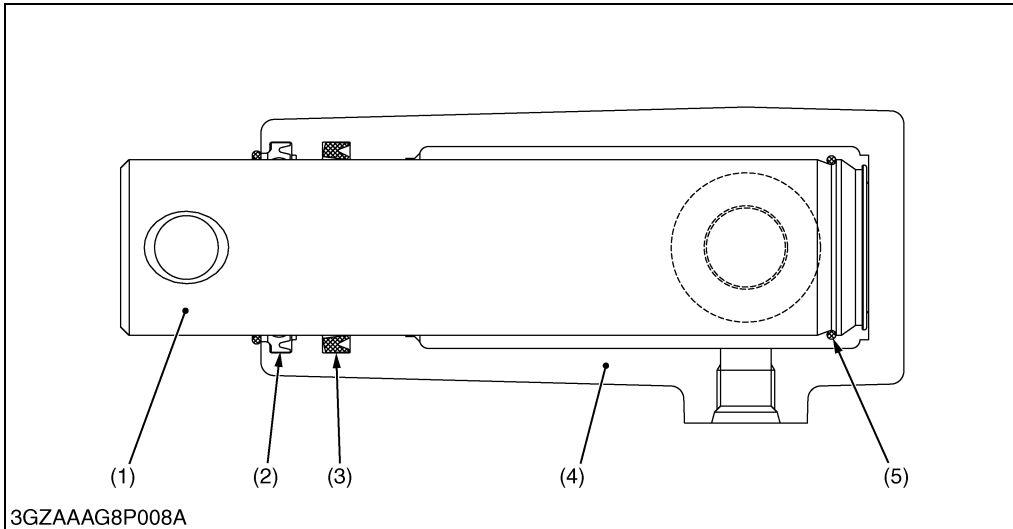
The oil sent from the pump passes through a gap between the spool (2) and the valve body (5), through the regulator valve, and then the oil flows to the PTO valve and HST charge circuit.

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 is formed.

Then the oil in the mower-lifting cylinder is discharged to the transmission center case, and the mower goes down.

9Y1211344HYM0006US0

4. LIFT CYLINDER



- (1) Piston Rod
- (2) Scraper
- (3) Packing
- (4) Cylinder
- (5) Snap Ring

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.

9Y1211344HYM0007US0

SERVICING

CONTENTS

1. TROUBLESHOOTING.....	4-S1
2. SERVICING SPECIFICATIONS	4-S2
3. TIGHTENING TORQUES.....	4-S3
4. CHECKING, DISASSEMBLING AND SERVICING	4-S4
[1] HYDRAULIC CONTROL VALVE, PUMP AND CYLINDER.....	4-S4
(1) Checking and Adjusting.....	4-S4
(2) Disassembling and Assembling the Hydraulic Control Valve.....	4-S5
(3) Disassembling and Assembling the Hydraulic Pump	4-S9

1. TROUBLESHOOTING

Symptom	Probable Cause and Checking Procedure	Solution	Reference Page
Mower Does Not Rise	1. Control valve malfunctioning	Check and repair or replace	4-S4, 4-S7
	2. Lift cylinder damaged	Check and replace	6-S8
	3. Relief valve spring damaged	Check and replace	4-S4
	4. Relief valve setting pressure too low	Check and adjust	4-S4
	5. Hydraulic pump damaged	Check and replace	4-M2, 4-S9
	6. Oil strainer clogged	Clean or replace	–
	7. Suction pipe loosened or broken	Repair or replace	4-M1, 4-S6
	8. Insufficient transmission oil	Refill	4-S5
Mower Does Not Lower	1. Control valve malfunctioning	Check and repair or replace	4-S4, 4-S7
Mower Drops by Its Weight	1. Lift cylinder worn or damaged	Check and replace	6-S8
	2. Control valve malfunctioning	Check and replace	4-S4, 4-S7

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2. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
Relief Valve (Control Valve) at engine speed: 1600 min ⁻¹ (rpm)	Setting Pressure	5.5 to 7.0 MPa 56 to 71 kgf/cm ² 800 to 1000 psi	—

9Y1211344HYS0002US0

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 "6. TIGHTENING TORQUES" on page G-12.)

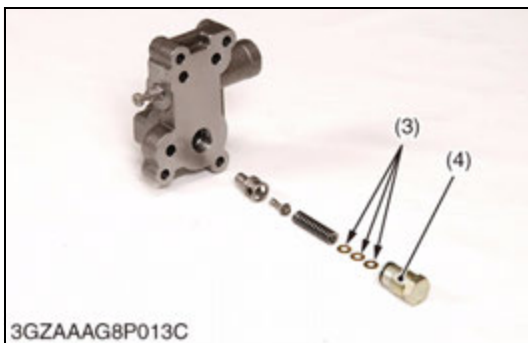
Item	N·m	kgf·m	lbf·ft
Center case front cover mounting screw	40 to 44	4.0 to 4.5	29 to 32
Hydraulic control valve mounting screw	18 to 20	1.8 to 2.1	13 to 15
Relief valve plug	49 to 68	5.0 to 7.0	37 to 50
ROPS connecting plate upper mounting screw (M8)	24 to 27	2.4 to 2.8	18 to 20
ROPS connecting plate, lower 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	39 to 44	4.0 to 4.4	29 to 32
Universal joint mounting screw (M10)	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

9Y1211344HYS0003US0

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), hose 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 under the engine speed below.
5. If the pressure is not within the factory specification, adjust with the adjusting shims (3).

(Adjusting procedure)

- Remove the plug (1), and remove the plug (4) of relief valve. Then, adjust the thickness of shims.

Relief valve (control valve) at engine speed 1600 min ⁻¹ (rpm)	Factory specification	5.5 to 7.0 MPa 56 to 71 kgf/cm ² 800 to 1000 psi
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Condition

- Oil temperature
45 to 55 °C (113 to 131 °F)

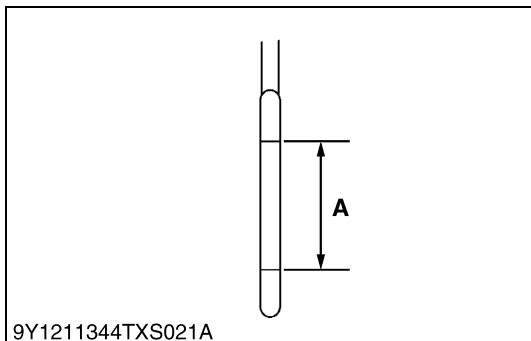
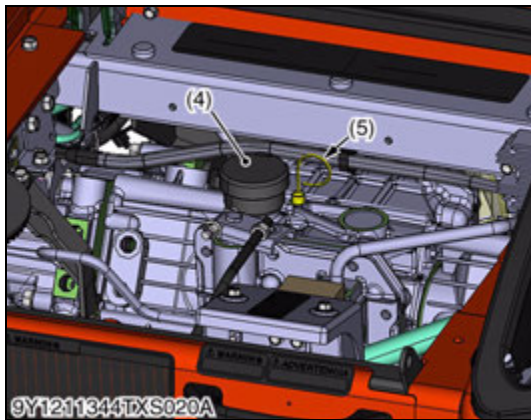
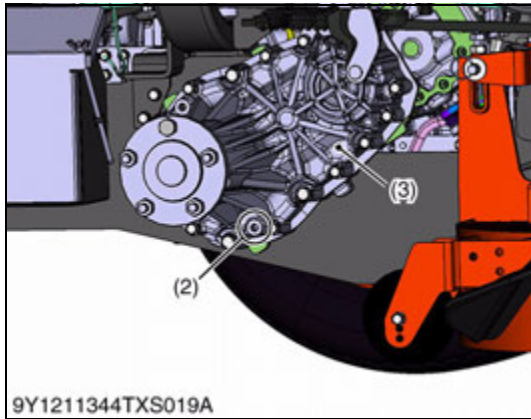
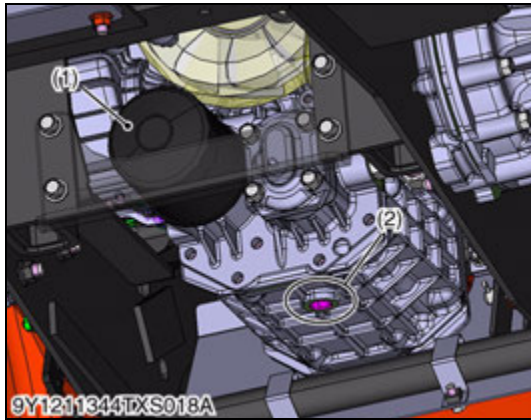
(Reference)

- Replace the hydraulic pump if pressure does not rise in 5 MPa (50 kgf/cm², 700 psi) or more.
- Thickness of shims (3):
0.2 mm (0.0079 in.)
0.3 mm (0.0118 in.)
0.8 mm (0.0315 in.)

- | | |
|-------------------------------------|----------|
| (1) Plug | (3) Shim |
| (2) Plug (3/8 in., straight thread) | (4) Plug |

9Y1211344HYS0004US0

(2) Disassembling and Assembling the Hydraulic Control Valve



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. After removing the oil plug (4), up the upper notch on the dipstick fill with new fluid from filling port.

■ IMPORTANT

- It takes time to pour the oil from the transmission case to 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

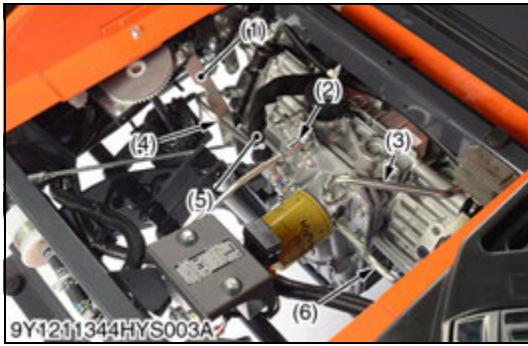
- Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge. Keep the engine at medium speed for a few minutes to ensure proper lubrication of all parts so there is no damage to transmission.
- Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system. Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-9.)
- 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.

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PTO Clutch Link, Cylinder Hose, Oil Cooler Pipe and HST Charge Pipes

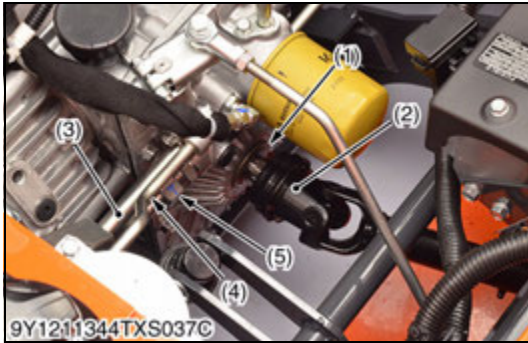
1. Remove the seat and seat base assembly.
2. Remove the PTO clutch link (1).
3. Remove the lift rod (2).
4. Disconnect the oil cooler pipe (3).
5. Remove the HST pipes (4), (6).
6. Disconnect the lift cylinder hose (5).

(When reassembling)

- Be careful not to damage O-ring on the pipes.

- | | |
|---------------------|------------------------|
| (1) PTO Clutch Link | (4) HST Pipe |
| (2) Lift Rod | (5) Lift Cylinder Hose |
| (3) Oil Cooler Pipe | (6) HST Pipe |

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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 | (4) Delivery Pipe |
| (2) Universal Joint | (5) Pipe Fitting |
| (3) PTO Clutch Lever | |

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Center Case Front Cover Assembly

1. Wrap tape around the PTO shaft (1) to prevent it from damaging the inside 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)

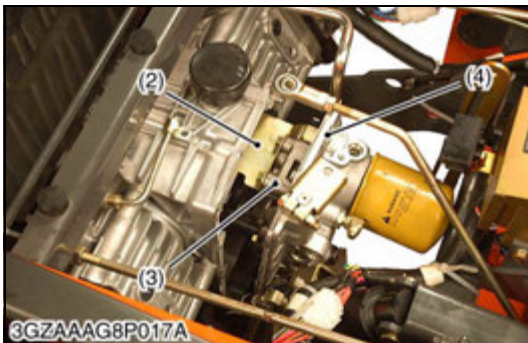
■ NOTE

- 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) PTO Shaft | (3) Hydraulic Control Valve |
| (2) Plate | (4) Front Cover Assembly |

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Lift Shaft and Arm

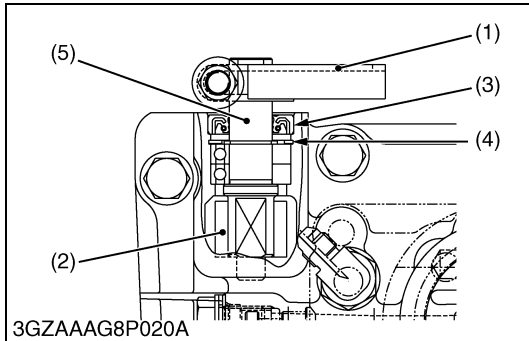
1. Remove the lift arm (1).
2. Remove the oil seal (3).
3. Remove the internal snap ring (4).
4. Remove the lift shaft (5) with ball bearings and remove the arm (2).

(When reassembling)

- Replace the oil seal (3) with new one.

- | | |
|--------------|------------------------|
| (1) Lift Arm | (4) Internal Snap Ring |
| (2) Arm | (5) Lift Shaft |
| (3) Oil Seal | |

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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
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- (1) Hydraulic Control Valve

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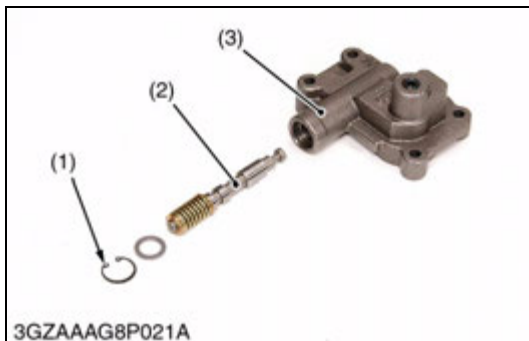


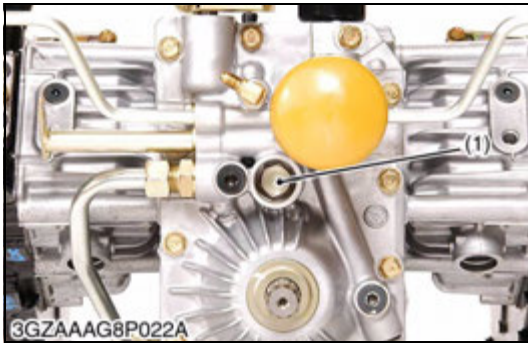
Spool

1. Remove the internal snap ring (1), and remove the spool (2).

- | | |
|------------------------|----------------|
| (1) Internal Snap Ring | (3) Valve Body |
| (2) Spool | |

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Relief Valve

1. Remove the plug (1), and remove the shims (2), spring (3), poppet (4) and valve seat (5).

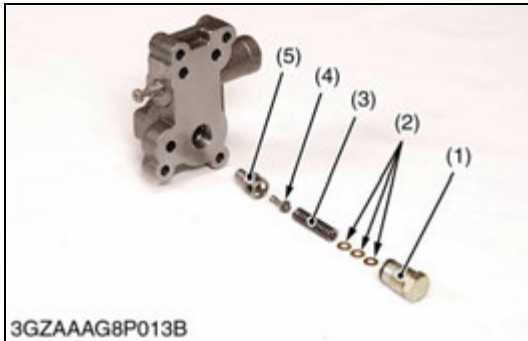
(When reassembling)

- Be careful not to damage the O-ring on plug.

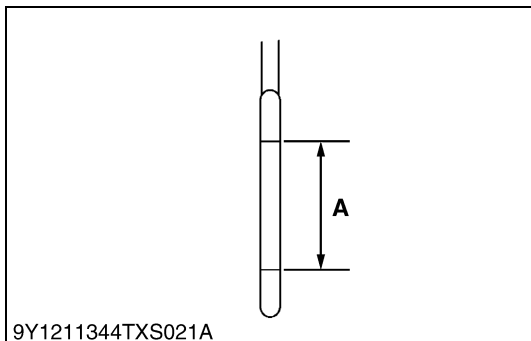
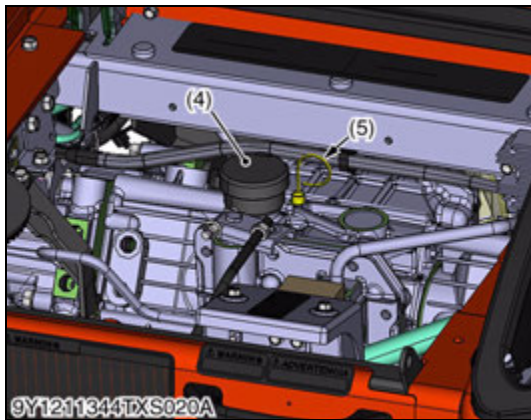
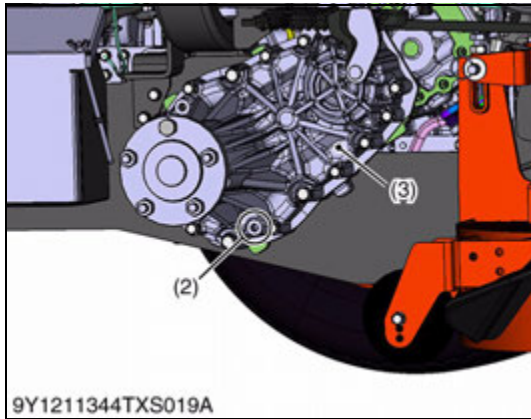
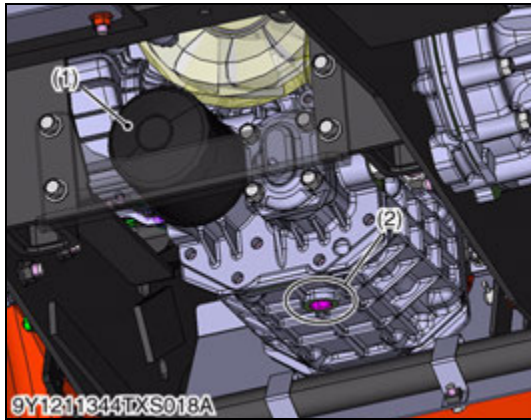
Tightening torque	Relief valve plug	49 to 68 N·m 5.0 to 7.0 kgf·m 37 to 50 lbf·ft
-------------------	-------------------	---

- | | |
|------------|----------------|
| (1) Plug | (4) Poppet |
| (2) Shim | (5) Valve Seat |
| (3) Spring | |

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(3) Disassembling and Assembling the Hydraulic Pump



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. After removing the oil plug (4), up the upper notch on the dipstick fill with new fluid from filling port.

IMPORTANT

- It takes time to pour the oil from the transmission case to 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

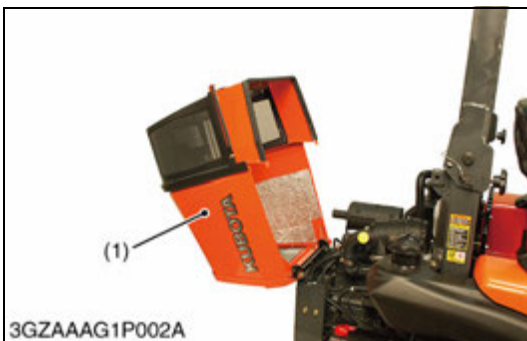
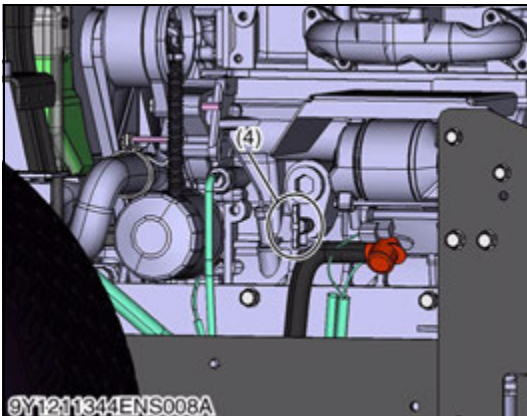
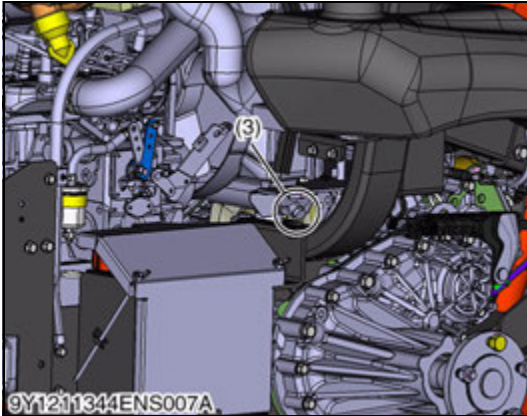
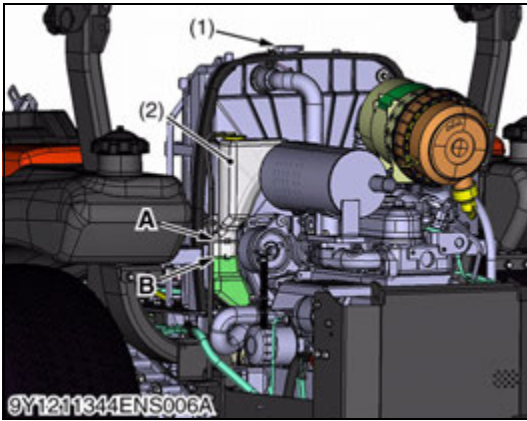
- Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge. Keep the engine at medium speed for a few minutes to ensure proper lubrication of all parts so there is no damage to transmission.
- Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system. Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-9.)
- 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.

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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 10 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 valve (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	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 Valve

- A: Upper Level**
- B: Lower Level**

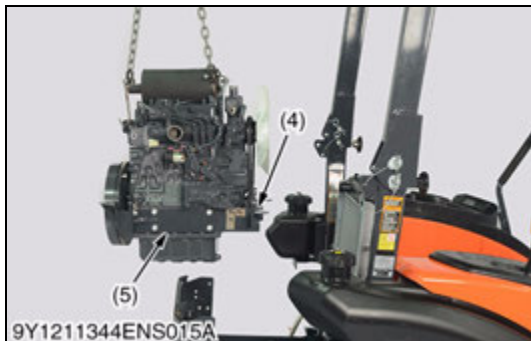
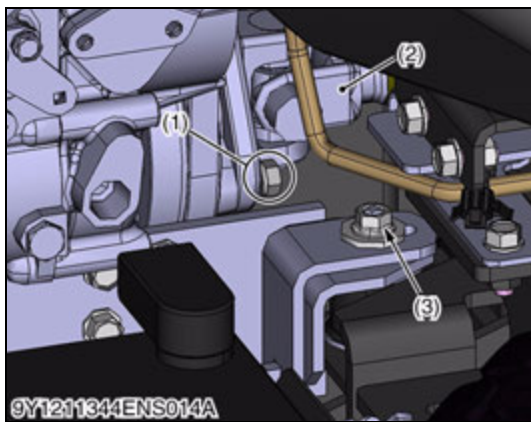
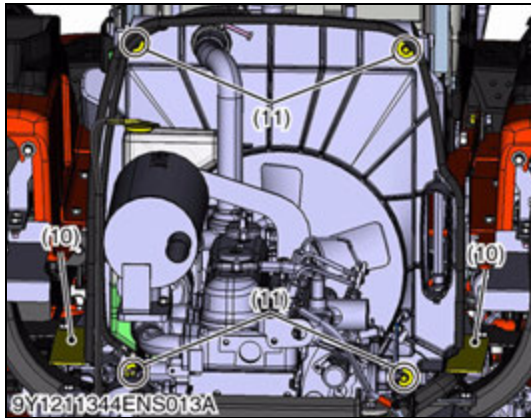
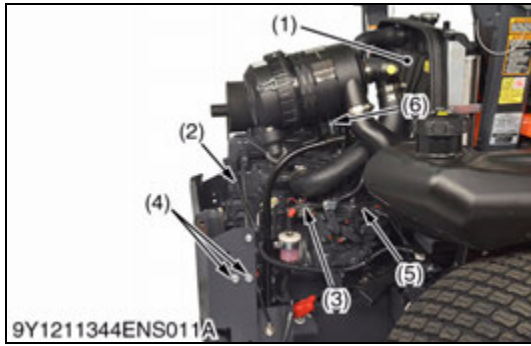
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Bonnet

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

- (1) Bonnet

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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 assembly (6).
5. Disconnect the fuel hoses (3) from engine.
6. Disconnect the water hoses (7), (8).
7. Remove both shroud plates (10).
8. Disconnect fan shroud (1), (11).
9. Remove engine stoppers (4).

(When reassembling)

- When you install the accelerator wire, adjust the wiring length. The stopper lever must hit the idling speed adjusting bolt and the maximum speed adjusting bolt in the stroke of the accelerator lever.

- | | |
|---------------------------------------|-----------------------|
| (1) Fan Shroud | (7) Upper Hose |
| (2) Wiring Harness | (8) Lower Hose |
| (3) Fuel Hose | (9) Positive Cable |
| (4) Engine Stopper | (10) Shroud Plate |
| (5) Accelerator Wire (Throttle Cable) | (11) Fan Shroud Bolts |
| (6) Air Filter Support | |

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Separating Engine

1. Raise seat.
2. Remove ROPS connecting plate.
3. Remove universal joint mounting screws (1).
4. Disconnect universal joint (2) from Fan drive pulley.
5. Remove engine mounting nuts.
6. Separate the engine.
7. Remove 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	17.6 to 20.6 N·m 1.80 to 2.10 kgf·m 13.0 to 15.1 lbf·ft

- | | |
|------------------------------------|-------------------------|
| (1) Universal Joint Mounting Screw | (4) Engine Support (LH) |
| (2) Universal Joint | (5) Engine Support (RH) |
| (3) Engine Mounting Nut | |

9Y1211344ENS0026US0



Oil Cooler, Radiator and Removing Hydraulic Pump

1. Remove the ROPS connecting plate upper (1).
2. Remove the oil cooler (2).
3. Remove the radiator (3).
4. Remove the hydraulic pump (4).

(When reassembling)

Tightening torque	ROPS connecting plate upper mounting screw (M8)	24 to 27 N·m 2.4 to 2.8 kgf·m 18 to 20 lbf·ft
	Hydraulic pump mounting screw	40 to 44 N·m 4.0 to 4.5 kgf·m 29 to 32 lbf·ft

- (1) ROPS Connecting Plate Upper (3) Radiator
(2) Oil Cooler (4) Hydraulic Pump

9Y1211344HYS0015US0



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)

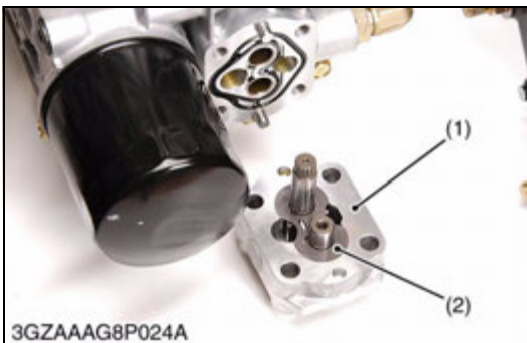
- Be careful not to damage the O-ring.
- Align the holes of the cover and casing.
- Install the side plate, noting its location and direction.
- Install the gears, noting its direction.



Tightening torque	Cover mounting screw	39 to 44 N·m 4.0 to 4.4 kgf·m 29 to 32 lbf·ft
-------------------	----------------------	---

- (1) Hydraulic Pump Assembly (4) Casing
(2) Side Plate (5) Driven Gear
(3) Drive Gear

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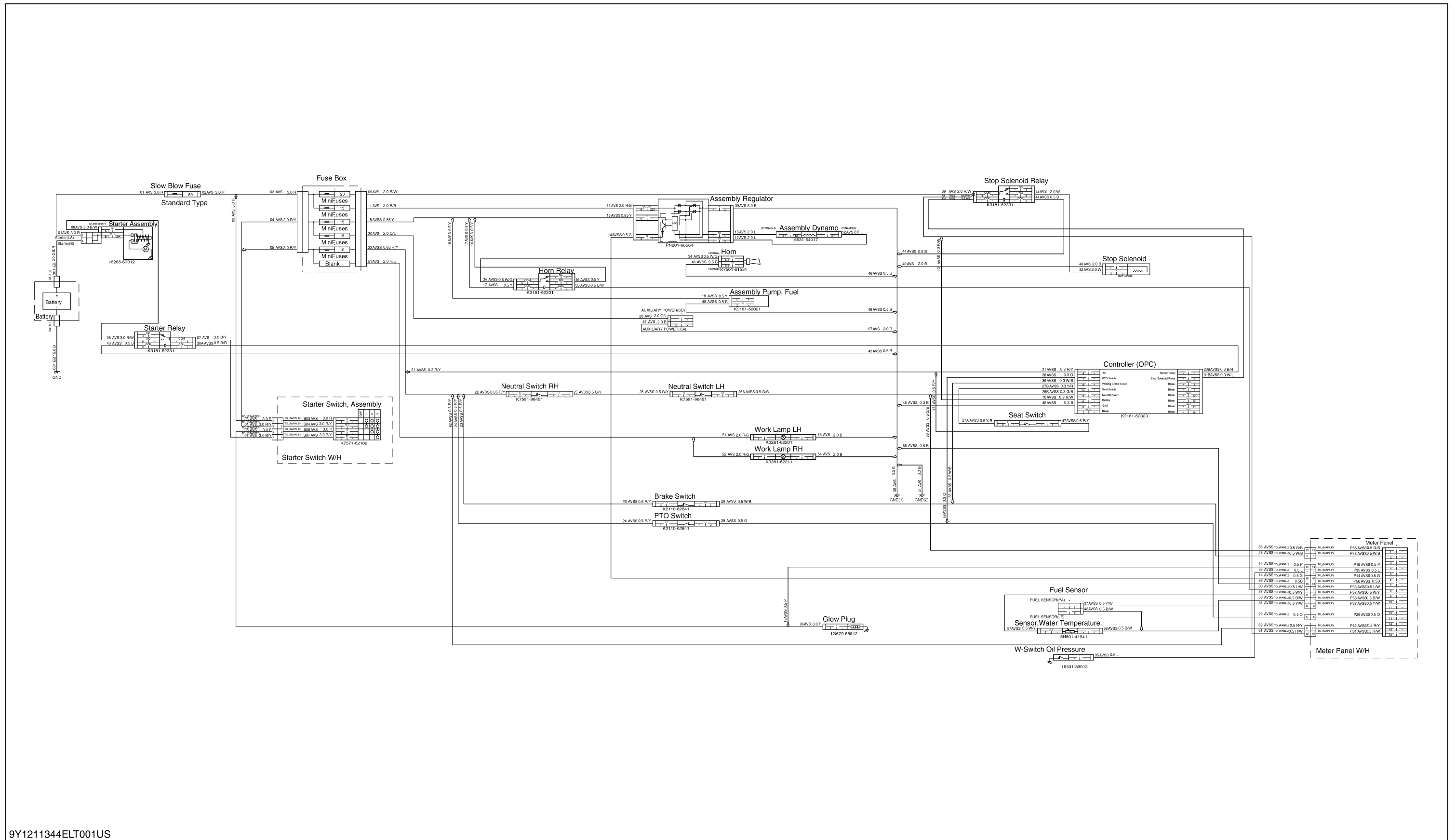
5 ELECTRICAL SYSTEM

MECHANISM

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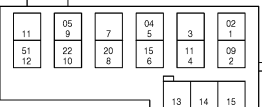




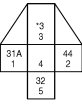



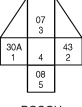
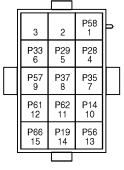


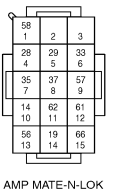



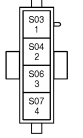



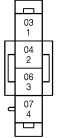













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1. ELECTRICAL DIAGRAM



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2. ELECTRICAL CONNECTOR CHART

<p>AUXILIARY POWER(CA)</p>  <p>YAZAKI CA</p>	<p>FUSE BOX</p>  <p>SUMITOMO 6353-0125</p>	<p>RELAY(HORN)</p>  <p>BOSCH 3334-485-007</p>	<p>STARTER(LA)</p>  <p>RING TERMINAL LA M8</p>																																			
<p>AUXILIARY POWER(CB)</p>  <p>YAZAKI CB</p>	<p>GLOW</p>  <p>--- LE M4</p>	<p>RELAY(SOLENOID)</p>  <p>BOSCH 3334-485-007 *3 09 / 61</p>	<p>STARTER SWITCH</p>  <p>SUMITOMO 250 6070-4481</p>																																			
<p>BRAKE SWITCH</p>  <p>DELPHI 56 02973872</p>	<p>GND(1)</p>  <p>--- LA M8</p>	<p>RELAY(STARTER)</p>  <p>BOSCH 3334-485-007</p>	<p>TO (MAIN P)</p>  <p>AMP MATE-N-LOK 1-480711-0</p>																																			
<p>CONTROLLER</p> <table border="1"> <tr> <td>10</td><td>5</td><td>21</td><td></td><td>31B</td><td>2</td><td>30B</td> </tr> <tr> <td>6</td><td></td><td>4</td><td></td><td>3</td><td></td><td>1</td> </tr> <tr> <td>36</td><td>15</td><td>14</td><td>27B</td><td>12</td><td>45</td><td>11</td> </tr> <tr> <td>13</td><td></td><td></td><td></td><td>10</td><td>28B</td><td>9</td> </tr> <tr> <td></td><td></td><td></td><td></td><td>8</td><td></td><td>7</td> </tr> </table> <p>YAZAKI 91A 7283-8665</p>	10	5	21		31B	2	30B	6		4		3		1	36	15	14	27B	12	45	11	13				10	28B	9					8		7	<p>GND(2)</p>  <p>--- LA M8</p>	<p>S.B.F</p>  <p>YAZAKI 7122-3020</p>	<p>TO (PANEL)</p>  <p>AMP MATE-N-LOK 1-780710-0</p>
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6		4		3		1																																
36	15	14	27B	12	45	11																																
13				10	28B	9																																
				8		7																																
<p>COOLANT TEMPERATURE, SENSOR</p>  <p>AMP E-J-II 2822362-2</p>	<p>HORN(A)</p>  <p>--- 250</p>	<p>SAFTY SWITCH(L)</p>  <p>DELPHI 56 02973872</p>	<p>TO (MAIN S)</p>  <p>AMP MATE-N-LOK 1-480703-0</p>																																			
<p>DYNAMO(A)</p>  <p>YAZAKI CA</p>	<p>HORN(B)</p>  <p>--- 250</p>	<p>SAFTY SWITCH(R)</p>  <p>DELPHI 56 02973872</p>	<p>TO (STARTER)</p>  <p>AMP MATE-N-LOK 1-480702-0</p>																																			
<p>DYNAMO(B)</p>  <p>YAZAKI CA</p>	<p>METER</p> <table border="1"> <tr> <td>P56</td><td>P28</td><td>P19</td><td>P35</td><td>P14</td><td>P58</td><td>P33</td> </tr> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td> </tr> <tr> <td>P57</td><td>P58</td><td>P37</td><td>P29</td><td>P13</td><td>P62</td><td>P61</td> </tr> <tr> <td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td> </tr> </table> <p>AMP 040 MULTILOCK 174046-2</p>	P56	P28	P19	P35	P14	P58	P33	1	2	3	4	5	6	7	P57	P58	P37	P29	P13	P62	P61	9	10	11	12	13	14	15	<p>SEAT SWITCH</p>  <p>Packard 2984883</p>	<p>TO (STARTER)</p>  <p>AMP MATE-N-LOK 1-480702-0</p>							
P56	P28	P19	P35	P14	P58	P33																																
1	2	3	4	5	6	7																																
P57	P58	P37	P29	P13	P62	P61																																
9	10	11	12	13	14	15																																
<p>FUEL PUMP</p>  <p>SUMITOMO 250 6070-2481</p>	<p>OIL SWITCH</p>  <p>--- 250</p>	<p>SOLENOID</p>  <p>SUMITOMO 250 6070-2481</p>	<p>WORK LAMP(L)</p>  <p>SUMITOMO 250 6070-2481</p>																																			
<p>FUEL SENSOR(LE)</p>  <p>--- LE M5</p>	<p>PTO SWITCH</p>  <p>DELPHI 56 02973872</p>	<p>STARTER(1P)</p>  <p>YAZAKI CN(A) 7123-2115</p>	<p>WORK LAMP(R)</p>  <p>SUMITOMO 250 6070-2481</p>																																			
<p>FUEL SENSOR(PA)</p>  <p>--- 250</p>	<p>REGULATOR</p> <table border="1"> <tr> <td>SN</td><td>SN</td><td>SN</td> </tr> <tr> <td>12</td><td>39</td><td>13</td> </tr> <tr> <td>5</td><td>2</td><td>1</td> </tr> <tr> <td>SN</td><td>SN</td><td>SN</td> </tr> <tr> <td>13</td><td>10</td><td>14</td> </tr> <tr> <td>6</td><td>11</td><td>4</td> </tr> </table> <p>YAZAKI CN(B) 7123-2865</p>	SN	SN	SN	12	39	13	5	2	1	SN	SN	SN	13	10	14	6	11	4	<p>STARTER(B)</p>  <p>EARTH TERMINAL BA M8</p>																		
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SN	SN	SN																																				
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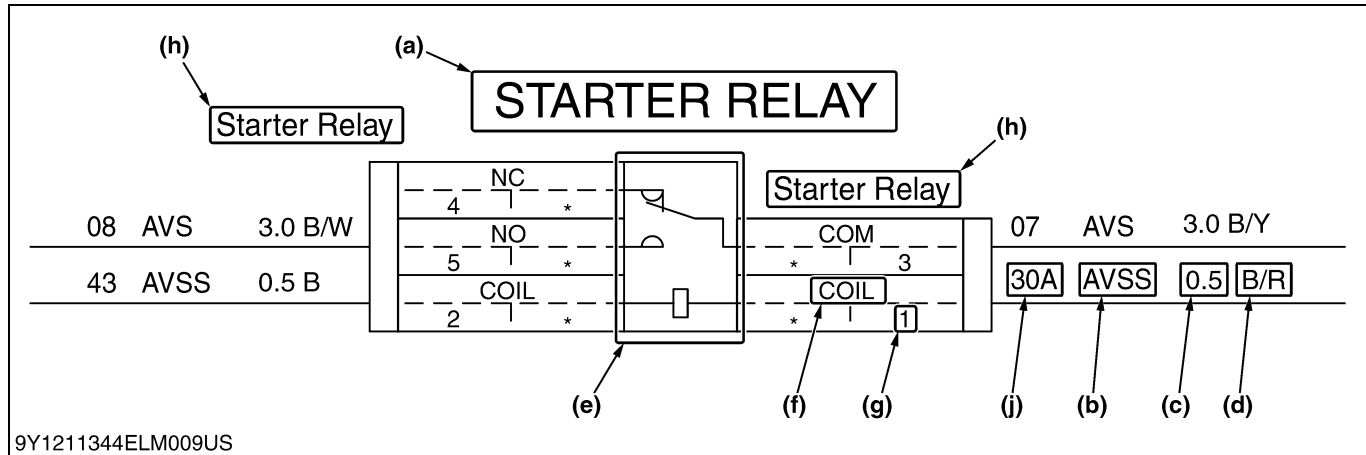
9Y1211344ELM019US

9Y1211344ELM0020US0

3. READING THE ELECTRICAL CIRCUIT DIAGRAMS

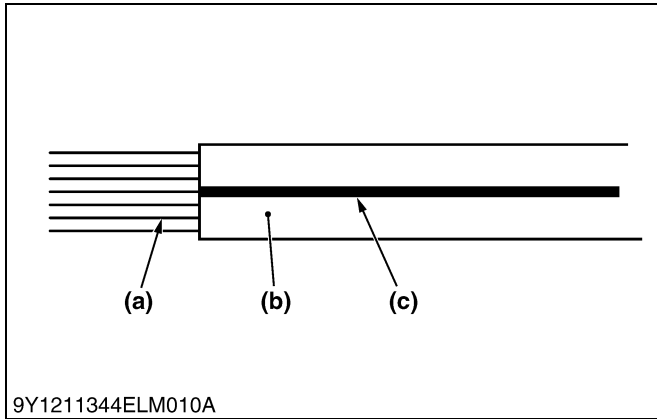
[1] HOW TO READ WIRING DIAGRAM

Electrical Wiring Chart Symbols for Harnesses and Wires

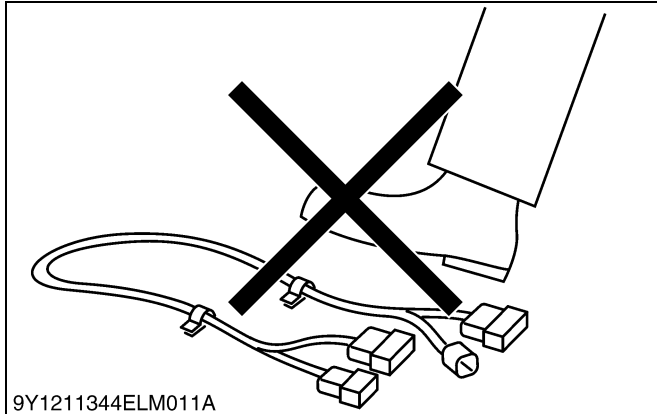


	Item	(Example) Contents of illustration	Reference
(a)	Name of part	STARTER RELAY	
(b)	Wire specification code	All use (common)	
(c)	Wire size	0.50 mm ²	
(d)	Wire color	Black / Red	Wire color page
(e)	Unit symbol	Relay	Unit symbol page
(f)	Pin name	Coil	
(g)	Pin No.	1	
(h)	Connector name	Starter Relay	Connector diagram
(j)	Wire number	30A	

9Y1211344ELM0022US0



9Y1211344ELM010A



9Y1211344ELM011A

Colors of Wiring

Color of wiring	Color code
Black	B
Green	G
Blue	L
Pink	P
Red	R
White	W
Yellow	Y
Brown	BR
Gray	GY
Light Green	LG
Orange	OR
Sky Blue	SB

(Ex.)

1.25-Y/R means :

1.25 : Wire size (mm²)

Y : Base color (yellow)

R : Stripe color (red)

- Do not pull on or step on wires. Also, do not cut wires on burred edges or the like.
- Do not twist or pinch wiring when installing it.

(a) Wire Size (mm²)

(b) Insulation Base Color

(c) Stripe Color

9Y1211344ELM0023US0

Unit Symbol

	(A)	(B)		(A)	(B)		(A)	(B)																			
(1)			(14)			(27)																					
(2)			(15)			(28)																					
(3)			(16)			(29)																					
(4)			(17)			(30)																					
(5)			(18)			<table border="1"> <tr> <td>(31)</td> <td>(32)</td> <td>(33)</td> <td>(34)</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>1</td> <td></td> <td></td> <td></td> </tr> <tr> <td>2</td> <td></td> <td></td> <td></td> </tr> <tr> <td>3</td> <td></td> <td></td> <td></td> </tr> </table> 	(31)	(32)	(33)	(34)					1				2				3				
(31)	(32)	(33)	(34)																								
1																											
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(12)			(25)																								
(13)			(26)																								

9Y1211344ELM012A

- | | | | |
|----------------------------------|---|-------------------------------|--------------------------|
| (1) Variable | (10) Potentiometer with Sliding Contact | (19) Two-Way Breakdown Diode | (28) Horn |
| (2) Non-Linear Variable | (11) Heating Element | (20) Coil | (29) Speaker |
| (3) Fixed Setting | (12) Condenser | (21) a-Contact | (30) AC Voltage Source |
| (4) Step Variable | (13) Electrolytic Capacitor | (22) Auto-Resetting b-Contact | (31) Switch |
| (5) Non Ionizing Radiation (NIR) | (14) Magnetic Core Inductance | (23) Auto-Resetting a-Contact | (32) OFF (No Auto-Reset) |
| (6) Body GND | (15) PNP Transistor | (24) Relay Coil | (33) ON |
| (7) Thermistor | (16) NPN Transistor | (25) Fuse | (34) START (Auto-Reset) |
| (8) Resistor | (17) Semiconductor Diode | (26) Lamp | |
| (9) Variable Resistor | (18) Light-Emitting Diode (LED) | (27) Buzzer | |
- (A) New Symbol**
(B) Old Symbol

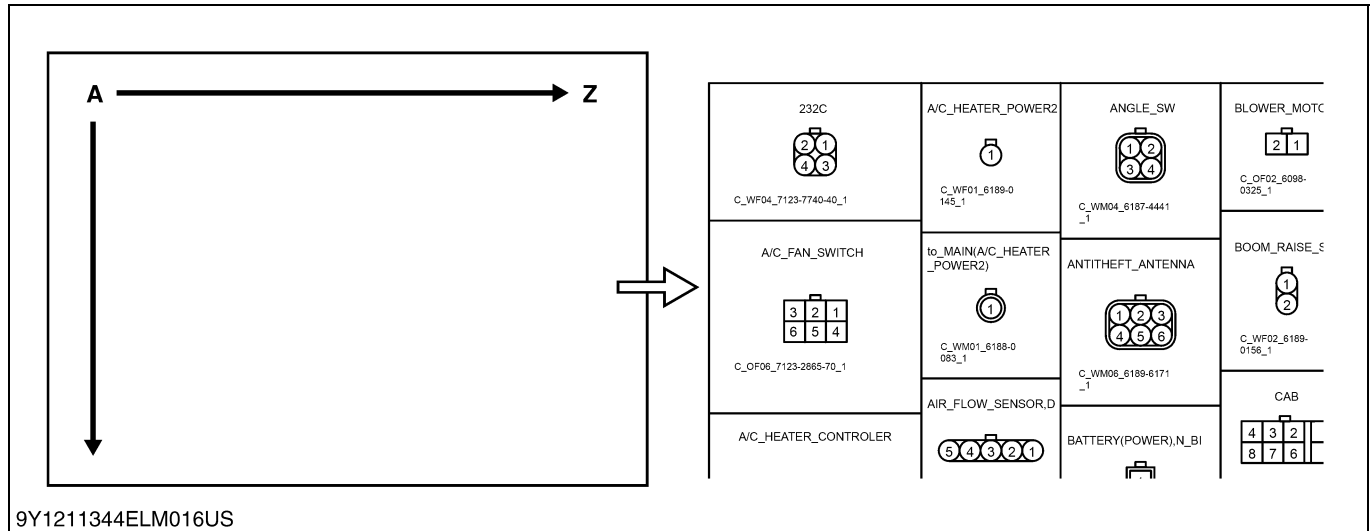
9Y1211344ELM0024US0

[2] LAYOUT OF CONNECTOR DIAGRAMS

(1) Main Layout

Connector Arrangement Sequence

In alphabetical order downwards from top left, and then to column next right.



9Y1211344ELM016US

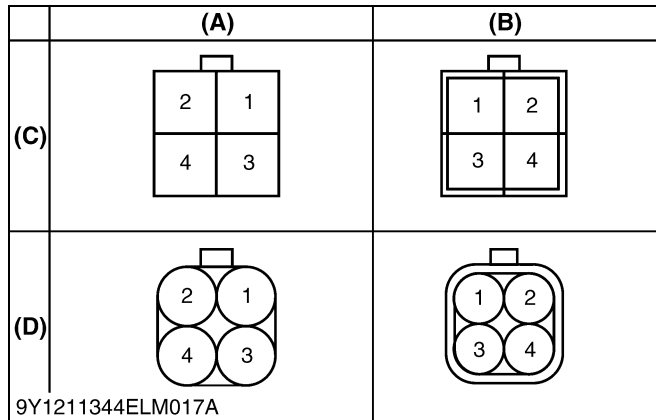
9Y1211344ELM0027US0

Depiction of Connectors

In principle, the connector locking part is shown on the top side.

Female connector terminal numbers start from 1 in the top right corner, looking at the connecting face.

Male connector terminal numbers start from 1 in the top left corner.



9Y1211344ELM017A

(A) Female Connector Terminal

(B) Male Connector Terminal

(C) Not Waterproofed

(D) Waterproofed

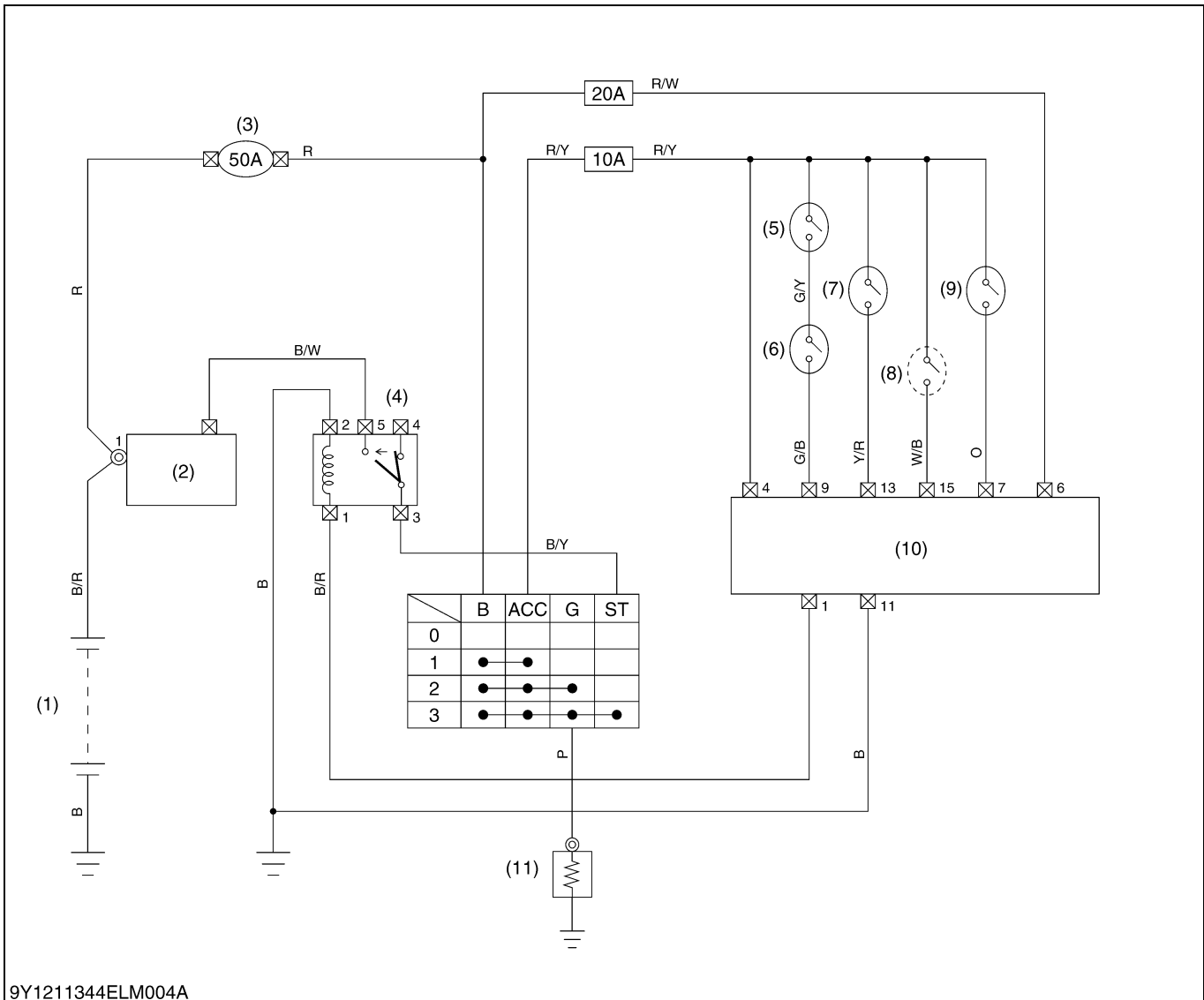
9Y1211344ELM0028US0

[3] PRECAUTIONS ON HANDLING ELECTRICAL CONNECTORS

1. When disconnecting connectors, grasp the body of the connector and pull it out; do not pull on the wiring harness. If the connector is the locking type, release the lock and then pull to disconnect.
2. When removing a connector's plastic cover (for water protection) to inspect it, be careful not to let any water get in the connector. If water does get in, dry it thoroughly before reassembling the connector and putting its plastic cover securely in place.
3. Straighten any bent connector terminals and make sure none are sticking out or missing. Also make sure there is no corrosion on the connector's terminals before connecting it.
4. When connecting a locking connector, be sure to press it in until you hear it click and then pull gently on the harness close to the connector and make sure the harness does not come out.

9Y1211344ELM0030US0

4. STARTING SYSTEM



9Y1211344ELM004A

- (1) Battery
- (2) Starter
- (3) Slow Blow
- (4) Starter Relay
- (5) Neutral (R)
- (6) Neutral (L)
- (7) Seat
- (8) Parking Brake
- (9) PTO
- (10) OPC
- (11) Glow Plug

When the main switch is turned to the **PREHEAT** position, the terminal **B** is connected to the terminals **G** and **ACC**. The glow plugs become red-hot, and the preheat indicator lamp also lights on while preheating.

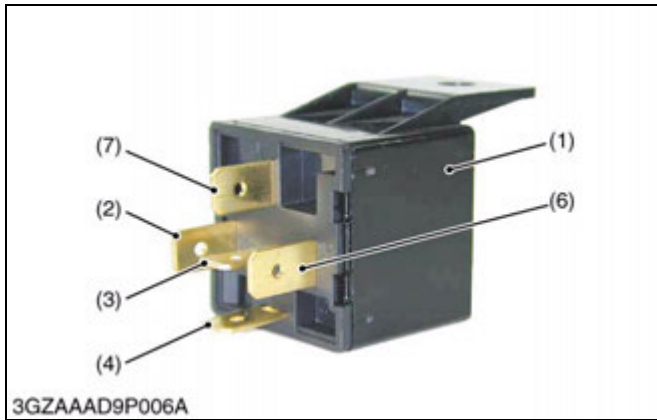
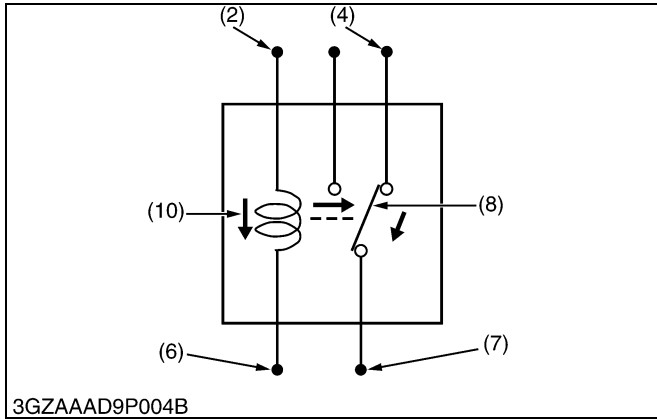
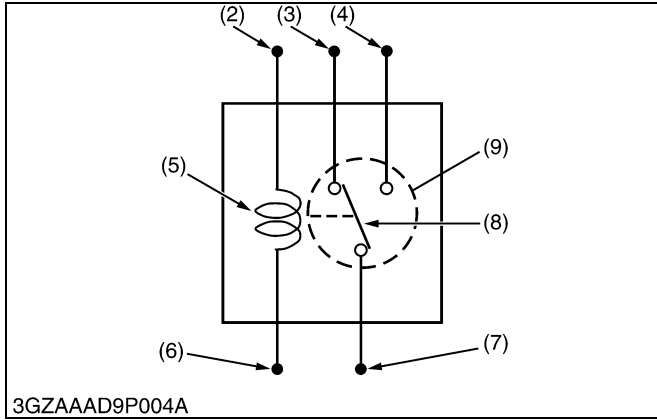
When the main switch is then turned to the **START** position with the safety switches on, the terminal **B** is connected to the terminals **ST** and **ACC**. Consequently, battery current flows to the starter motor and start the engine.

The main switch automatically returns to the **ON** position, the terminal **B** is connected only to the terminal **ACC**, 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.

9Y1211344ELM0002US0

[1] RELAY



Relay

Relay (1) basically consists of relay winding (5) 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).

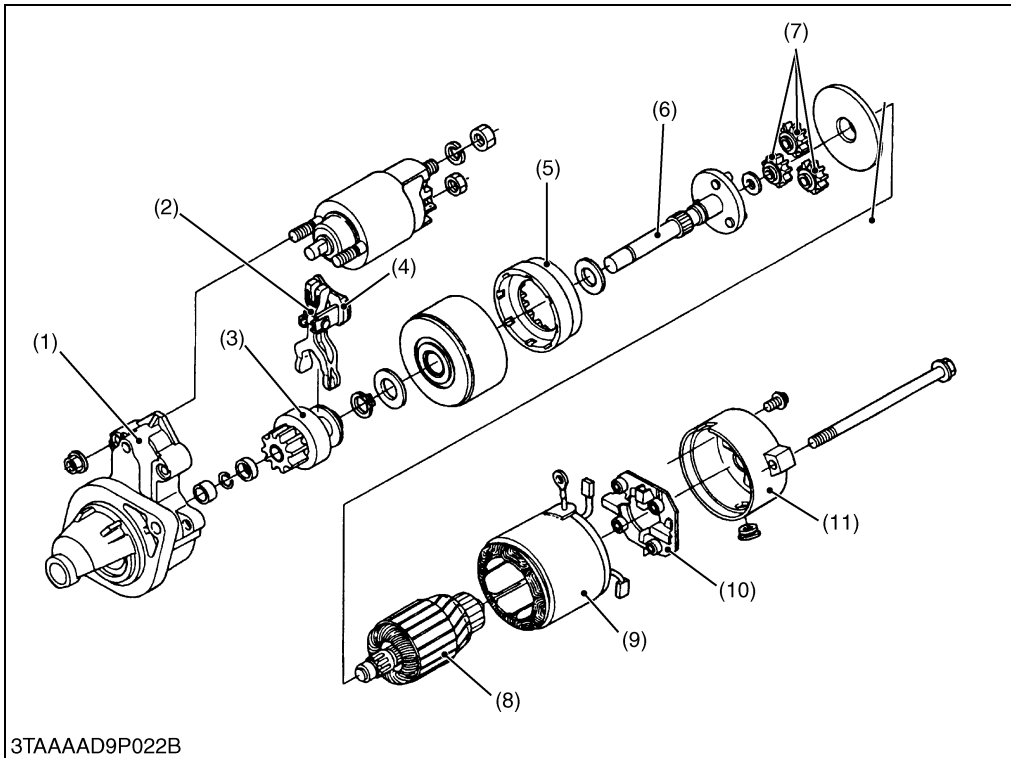
Another function of relay (1) is to control large current by small current.

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 | (6) Terminal 1 |
| (2) Terminal 2 | (7) Terminal 3 |
| (3) Terminal 4 | (8) Contact Lever |
| (4) Terminal 5 | (9) Mechanical Contact Points |
| (5) Relay Winding | (10) Winding (Energized) |

9Y1211344ELM0003US0

[2] STARTER

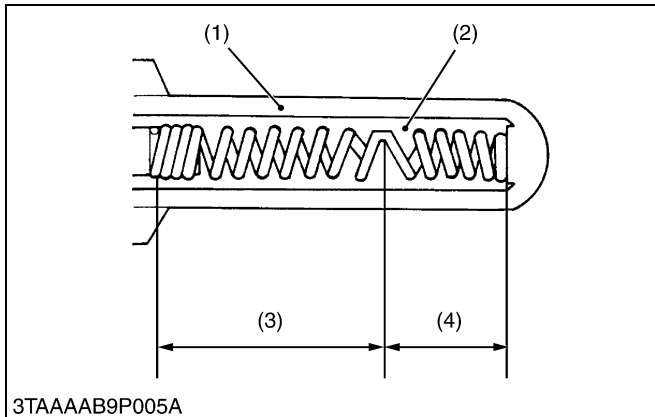
- (1) Housing
- (2) Magnetic Switch
- (3) Overrunning Clutch
- (4) Drive Lever
- (5) Internal Gear
- (6) Gear Shaft
- (7) Planetary Gear
- (8) Armature Shaft
- (9) Yoke
- (10) Brush Holder
- (11) Rear End Holder

3TAAAD9P022B

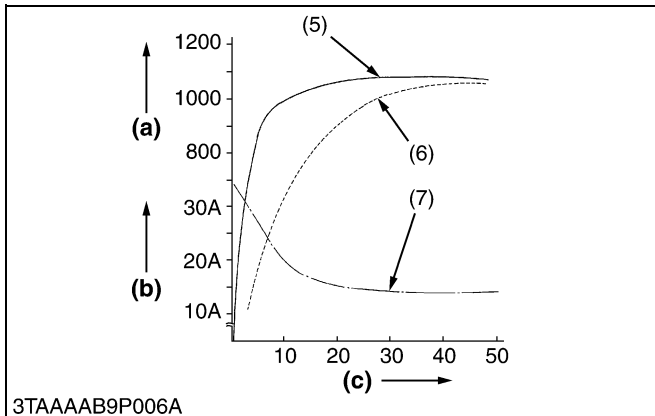
The reduction system uses planetary gears (7), and the speed of gear shaft (6) is reduced to approximately one fifth of the armature shaft (8).

9Y1211344ELM0004US0

[3] GLOW PLUG



3TAAAAB9P005A



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.

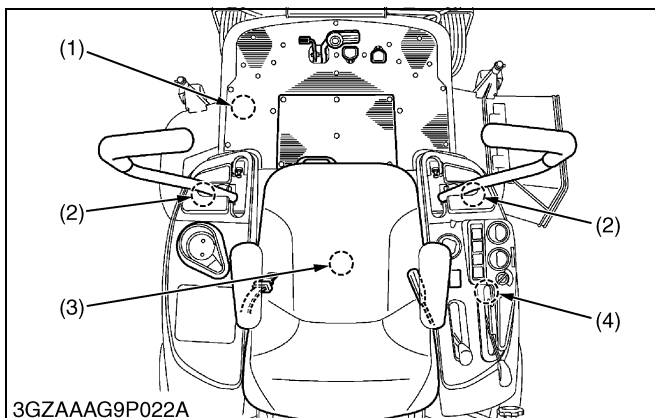
Therefore, because sufficient current is flown to the heater (4) during the initial period of energization, the temperature rises quickly and the resistance grows with the rise in the temperature of the resistor, the flowing current is reduced to prevent the heater (4) from being heated.

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.)

9Y1211344ELM0005US0

[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.

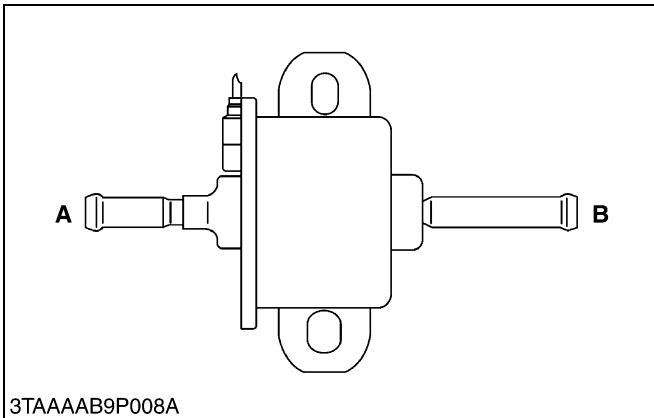
By selecting either normally open or normally closed contact, the switch function is determined.

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

9Y1211344ELM0006US0

[5] FUEL PUMP



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.

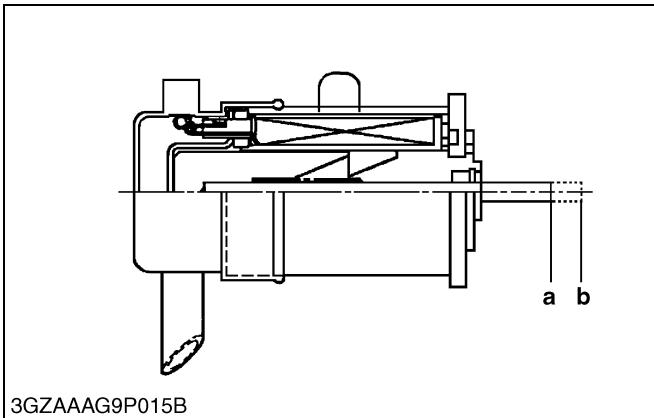
Therefore, fuel is supplied to the fuel injection pump regardless of engine speed. This pump is driven by the battery. It can therefore be operated even with the engine being stopped.

A: Inlet

B: Outlet

9Y1211344ELM0007US0

[6] ENGINE STOP SOLENOID



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.

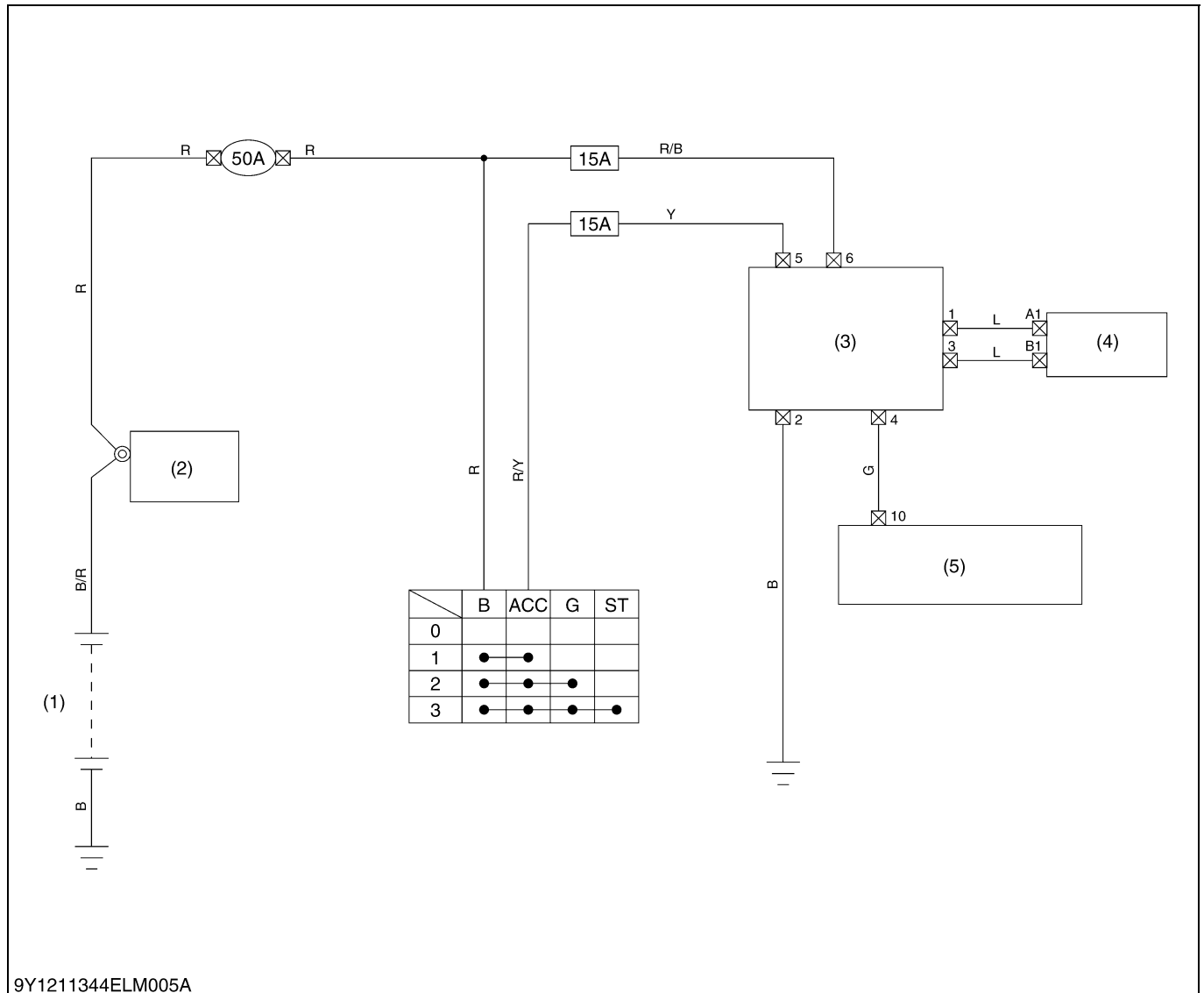
Flowing of the battery current into the coil while the controller's timer works attracts the plunger to actuate the stop lever or control rack of the injection pump. When the battery current stops, the plunger is returned to the original position by the spring.

a: ON

b: OFF

9Y1211344ELM0008US0

5. CHARGING SYSTEM AND EASY CHECKER™



9Y1211344ELM005A

(1) Battery
(2) Starter

(3) Regulator

(4) Dynamo

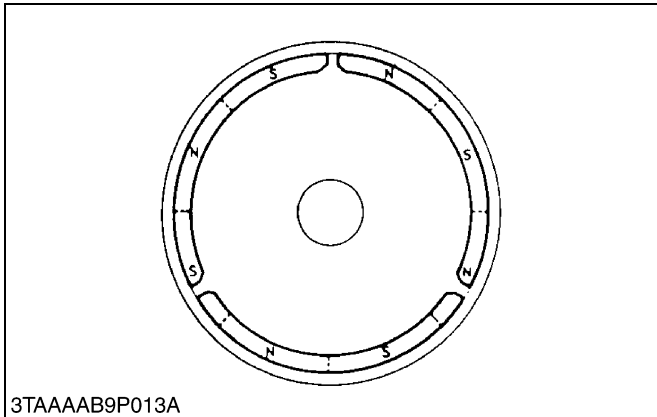
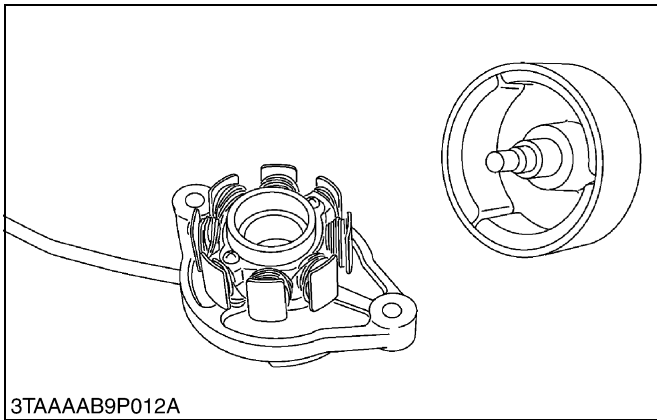
(5) Meter Panel

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.

9Y1211344ELM0009US0

[1] AC DYNAMO

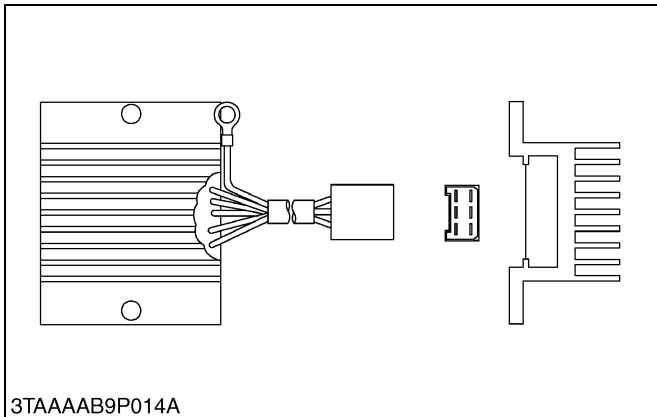


The dynamo is an 8-8 pole rotating magnet type generator. It is simple in construction, consisting of a stator and rotor. The rotor is made up of eight permanent magnet pole pieces assembled on a shaft and rotates on the center of the stator around which eight electromagnetic coils are provided for.

This dynamo produces higher voltage in slow speed rotation, and charges electric current to the battery during engine idling.

9Y1211344ELM0010US0

[2] REGULATOR



The regulator performs rectification and voltage regulation.

The regulator converts AC into DC which flows through the power consuming circuits and the battery, and also charges the battery.

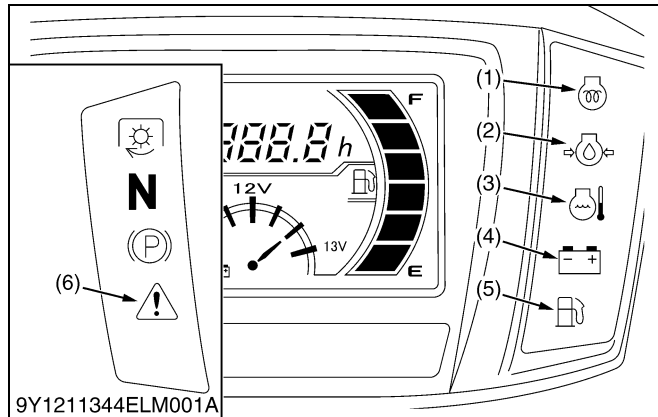
If however, the battery voltage exceeds a certain level, the DC current is cut off from the charging circuit to prevent overcharging.

9Y1211344ELM0011US0

[3] EASY CHECKER™

If the warning lamps of the Easy Checker (TM) come on during operation, immediately stop the engine, and find the cause as shown below. Never operate the machine while Easy Checker (TM) lamp is on.

9Y1211344ELM0012US0



Indication Items

(1) Glow plug Indicator (Pre-heating Indicator)

When the key switch is in the "PREHEAT" position, the glow plug indicator illuminates.

(2) Engine oil pressure

If the oil pressure in the engine goes below the prescribed level, the warning lamp in the Easy Checker (TM) will come on.

If this should happen during operation, and it does not go off when the engine is accelerated to more than 1000 rpm, check level of engine oil. (See "Checking Engine Oil Level" in "LUBRICANTS, FUEL AND COOLANT" in "PERIODIC SERVICE" section)

(3) Engine overheat

If the water temperature gauge reads an unusual level and the warning lamp in the Easy Checker (TM) comes on, the engine may be overheated. Check the machine by referring to "TROUBLESHOOTING" section.

(4) Electrical charge

If the alternator is not charging the battery, the warning lamp in the Easy Checker (TM) will come on.

If this should happen during operation, check the electrical charging system.

(5) Fuel level

If the fuel in the tank goes below the prescribed level, the warning lamp in the Easy Checker (TM) will come on.

If this should happen during operation, refuel as soon as possible. (See "Checking Amount of Fuel and Refueling" in "LUBRICANTS, FUEL AND COOLANT" in "PERIODIC SERVICE" section.)

(To be continued)

(Continued)

■ **IMPORTANT**

- When the fuel warning lamp lights up, refuel the tank as soon as possible. If the machine runs out of fuel and stalls, the engine and its components may be damaged.
- Fill the fuel tank only to bottom of the filler neck.
- Be careful not to empty the fuel tank. Otherwise air may enter the fuel system.
Should this happen, you must bleed the system. (See "Bleeding Fuel System" in "SERVICE AS REQUIRED" in "PERIODIC SERVICE" section.)
- When refueling, basically fill both fuel tanks full.
- In the case you have a small amount of fuel, if fuel is still in the fuel tank RH, fill the fuel tank LH first.
- The fuel gauge shows the fuel level of fuel tank RH. When the fuel gauge flashes, fill fuel as soon as possible.
- When the fuel gauge flashes, do not fill fuel on a slope.
Fuel can absorb air and the engine can stall.
- If the engine stalled with some remaining in the fuel tank RH, close the fuel valve of fuel tank LH and you can operate. (Refer to the following figures.)

(6) **Master system warning**

If trouble should occur at the disconnection of fuel sensor, coolant temperature sensor or LCD monitor malfunction, the indicator flashes as a warning.

9Y1211344ELM0013US0

Service Code Display

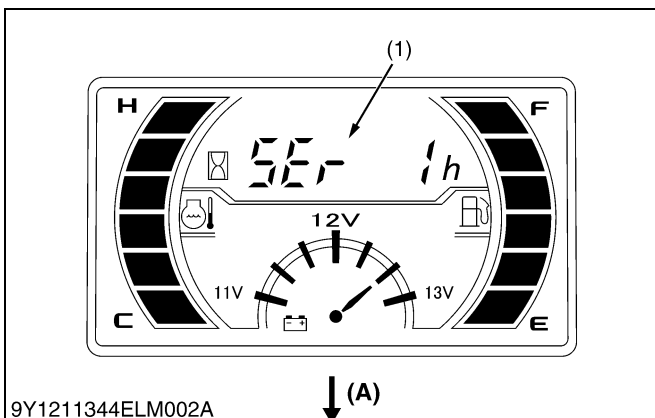
The key switch is on, and if the service code ("SEr 1" or "SEr 2") shown in the figure below is displayed on the LCD monitor, you must do the servicing jobs corresponding to the indication on hour meter (displayed at 10 seconds after that) on the machine.

The service code will show at meter hour: 50 hr, 200 hr, 400 hr, 600 hr, 800 hr, 1000 hr... See "SERVICE INTERVALS" in "MAINTENANCE" section.

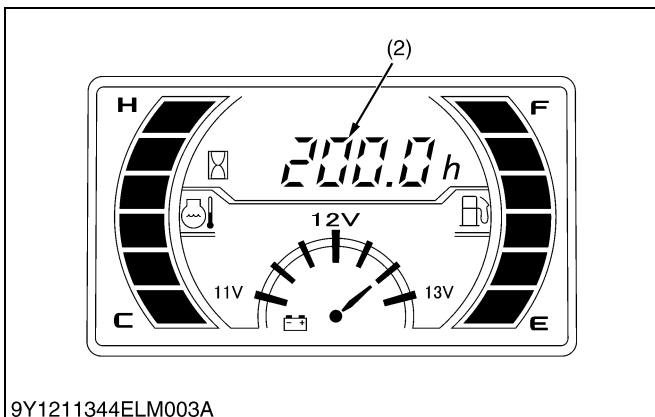
- (1) Service Code
- (2) Hours Used

(A) At 10 seconds after the service code has displayed.

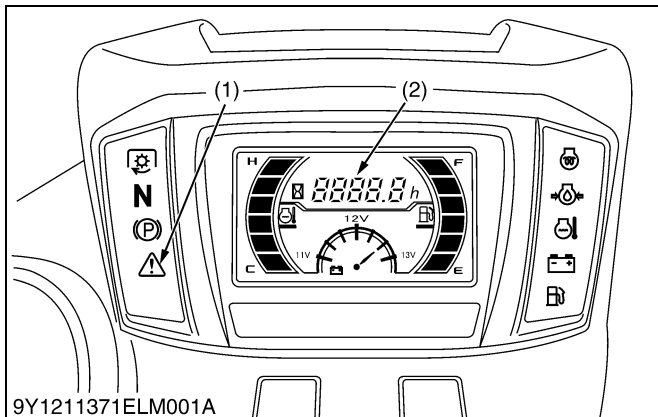
9Y1211344ELM0014US0



9Y1211344ELM002A



9Y1211344ELM003A



9Y1211371ELM001A

Error Code Display

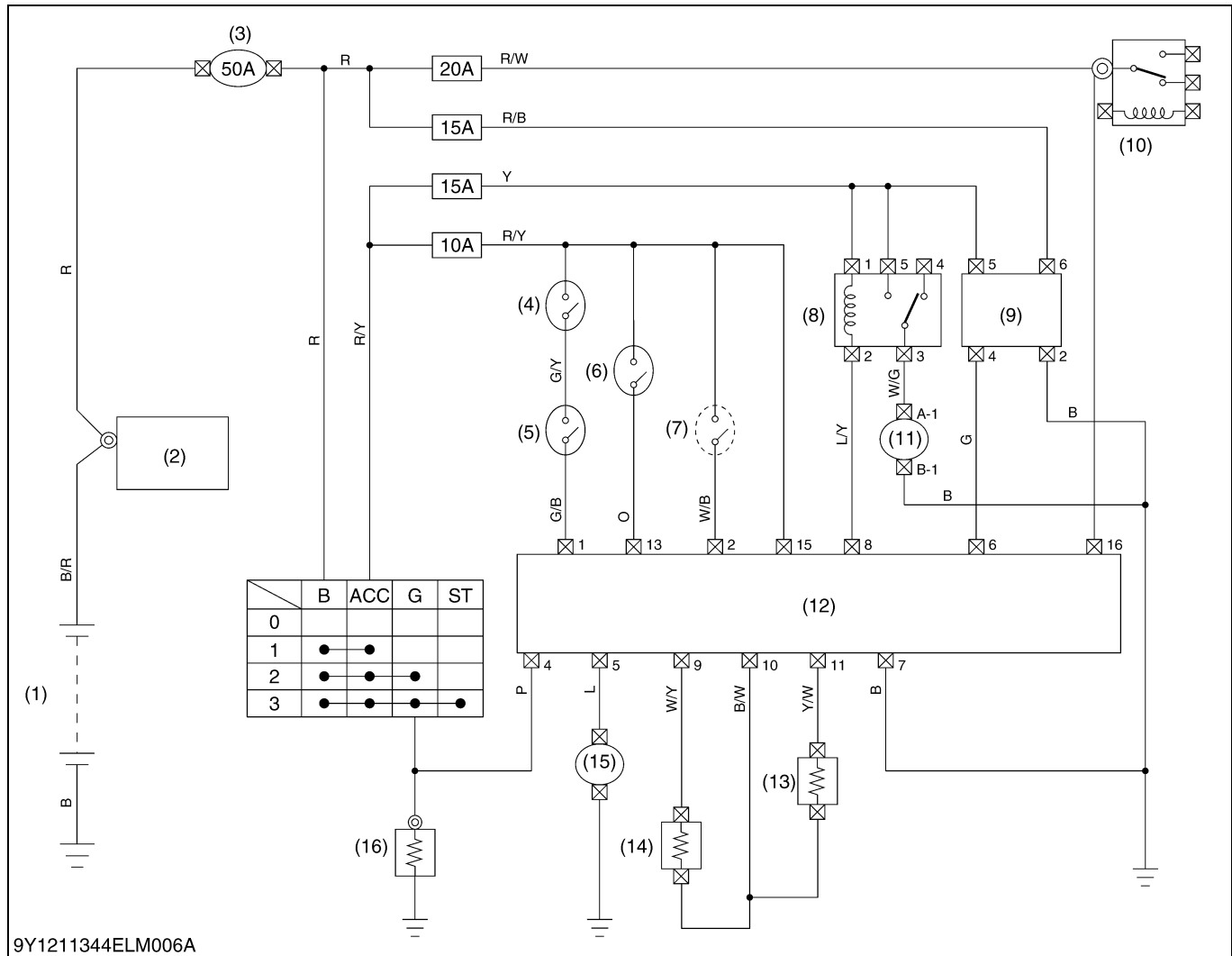
If something is wrong with the power train, the master system warning indicator starts blinking and the error code shown below is displayed on the LCD monitor, indicating the location of the trouble.

- (1) Master system warning indicator
- (2) Error code

Error code	Trouble	Check point or solution
Err 1	Water temperature sensor power circuit trouble	Checking battery voltage or replacing meter panel
Err 2	Fuel sensor power circuit trouble	Checking battery voltage or replacing meter panel
Err 3	Meter panel memory reading trouble	Replacing meter panel

9Y1211344ELM0031US0

6. GAUGES



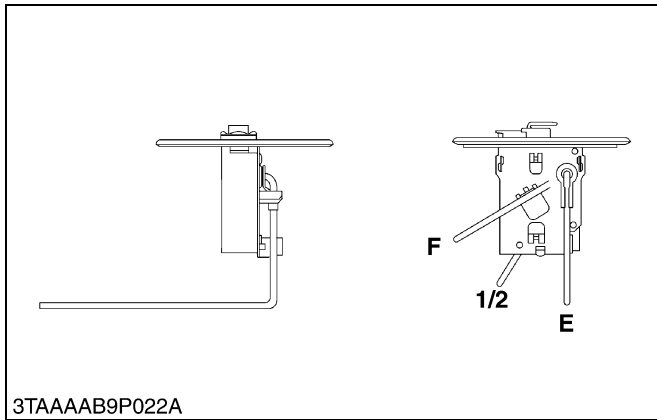
9Y1211344ELM006A

- (1) Battery
- (2) Starter
- (3) Slow Blow Fuse
- (4) Neutral (R)
- (5) Neutral (L)
- (6) PTO
- (7) Parking Brake
- (8) Horn Relay
- (9) Regulator
- (10) Solenoid Relay
- (11) Horn
- (12) Meter Panel
- (13) Fuel Sensor
- (14) Temperature Coolant Sensor
- (15) Oil Pressure Sensor
- (16) Glow Plug

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.

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[1] FUEL QUANTITY



Fuel Level Sensor

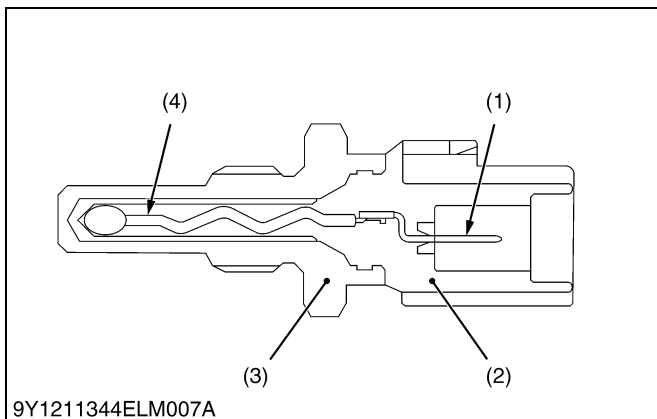
The remaining fuel quantity is detected by the fuel level sensor installed in the fuel tank and indicated on the fuel gauge. For detection, a float and a resistor are used.

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.gals, 1.10 Imp.gals)
1 to 5 Ω	28.5 to 36.5 Ω	103 to 117 Ω

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[2] COOLANT TEMPERATURE



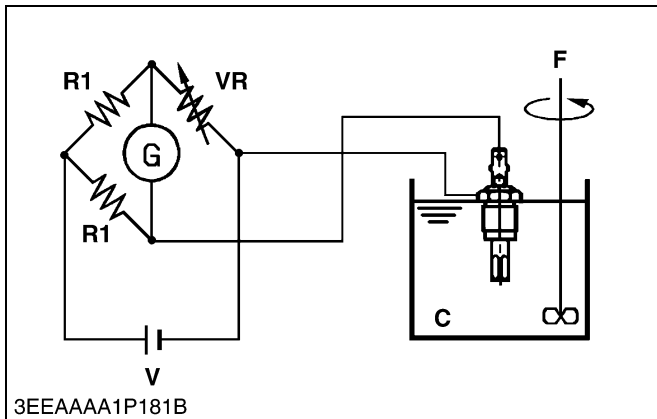
Coolant Temperature Sensor (Thermo Unit)

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)	Approx. 0.811 kΩ	(A)
80 °C (176 °F)	Approx. 0.318 kΩ	
100 °C (212 °F)	Approx. 0.183 kΩ	
120 °C (248 °F)	Approx. 0.110 kΩ	

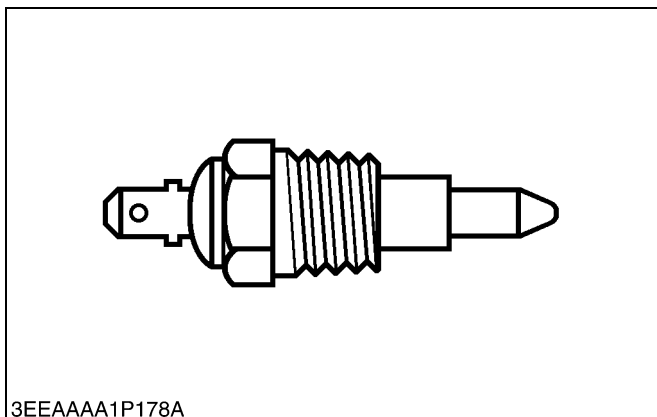
★: When galvanometer shows 0 (Zero).



Condition	Setting Value
(A)	R1: 54.945 to 55.055 W V: 5 ±0.1 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)

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Coolant Temperature Switch

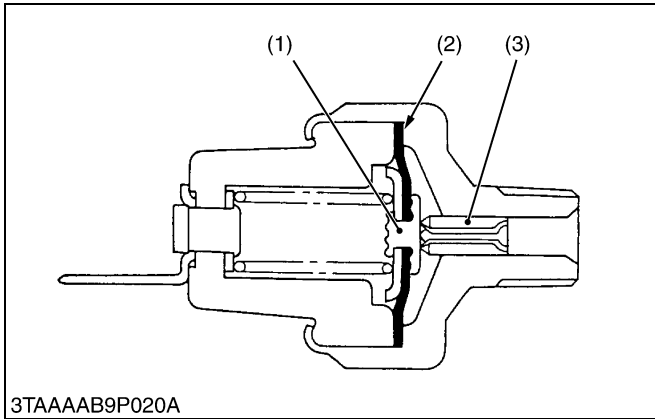
The coolant temperature switch is installed to the water flange of engine, and its tip is in touch with the coolant.

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)

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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/cm², 7.1 psi), the contact closes.

- (1) Terminal Contact
- (2) Diaphragm
- (3) Body Contact

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SERVICING

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1. TROUBLESHOOTING

Symptom	Probable Cause and Checking Procedure	Solution	Reference Page
All Electrical Equipments Do Not Operate	1. Battery discharged or damaged	Recharge or replace	G-30
	2. Battery positive cable disconnected or improperly connected	Repair or replace	5-S6
	3. Battery negative cable disconnected or improperly connected	Repair or replace	5-S6
	4. Slow blow fuse blown	Replace	G-41
Fuse Blown Frequently	1. Short-circuited	Repair or replace	G-41

BATTERY

Symptom	Probable Cause and Checking Procedure	Solution	Reference Page
Battery Discharges Too Quickly	1. Battery damaged	Check and replace	G-30
	2. Dynamo damaged	Check and replace	5-S12, 5-S13
	3. IC regulator damaged	Check and replace	5-S12, 5-S13
	4. Wiring harness disconnected or improperly connected (between battery positive terminal and regulator B terminal)	Repair or replace	5-S6
	5. Cooling fan belt slipping	Adjust tension	G-32

STARTING SYSTEM

Symptom	Probable Cause and Checking Procedure	Solution	Reference Page
Starter Motor Does Not Operate	1. Battery discharged or damaged	Recharge or replace	G-30
	2. Slow blow fuse blown	Replace	G-41
	3. Safety switch damaged	Check and replace	5-S8, 5-S11
	4. 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	5-M1, 5-S6
	5. Starter motor damaged	Check and repair or replace	5-S10
	6. Main switch damaged	Check and replace	5-S9
Engine Does Not Stop When Main Switch Is Turned OFF	1. Fuse blown (20 A)	Replace	G-41
	2. Wiring harness disconnected or improperly connected (between main switch AC terminal and engine stop solenoid)	Repair or replace	5-M1
	3. Engine stop solenoid damaged	Check and replace	5-S12
	4. Controller damaged	Replace	–
Engine Does Not Start	1. Engine stop solenoid damaged	Check and replace	5-S12
	2. Controller damaged	Replace	–

CHARGING SYSTEM

Symptom	Probable Cause and Checking Procedure	Solution	Reference Page
Charging Lamp Does Not Light When Main Switch Is Turned ON	1. Fuse blown (15 A)	Replace	G-41
	2. Wiring harness disconnected or improperly connected (between main switch AC terminal and panel board, between panel board and dynamo)	Repair or replace	5-M1
	3. Dynamo damaged	Check and repair or replace	5-S12, 5-S13
	4. Regulator damaged	Check and replace	5-S12, 5-S13
Charging Lamp Does Not Go Off When Engine Is Running	1. Wiring harness disconnected or improperly connected (between main switch 30 terminal and dynamo, between panel board and dynamo)	Repair or replace	5-M1
	2. Dynamo damaged	Check and repair or replace	5-S12, 5-S13
	3. Regulator damaged	Check and replace	5-S12, 5-S13

GAUGES

Symptom	Probable Cause and Checking Procedure	Solution	Reference Page
Fuel Gauge Does Not Function	1. Fuel gauge damaged	Replace panel	–
	2. Fuel level sensor damaged	Check and replace	5-S15
	3. Wiring harness disconnected or improperly connected (between fuel gauge and fuel level sensor)	Repair or replace panel	5-M1
Coolant Temperature Gauge Does Not Function	1. Coolant temperature gauge damaged	Replace panel	–
	2. Coolant temperature sensor damaged	Check and replace	5-S15
	3. Wiring harness disconnected or improperly connected (between coolant temperature gauge and coolant temperature sensor)	Repair or replace panel	5-M1

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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	–

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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 "6. TIGHTENING TORQUES" on page G-12.)

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

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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 splattered 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.

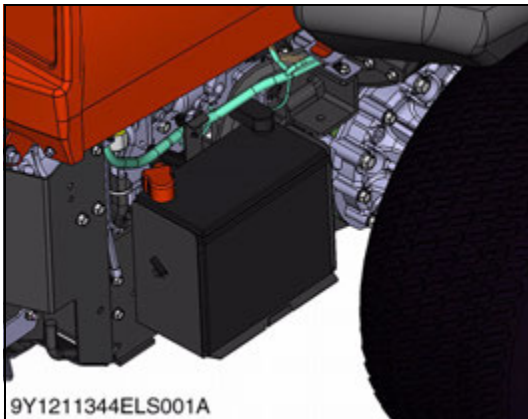
■ IMPORTANT

- 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.

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[1] CHECKING

(1) Battery

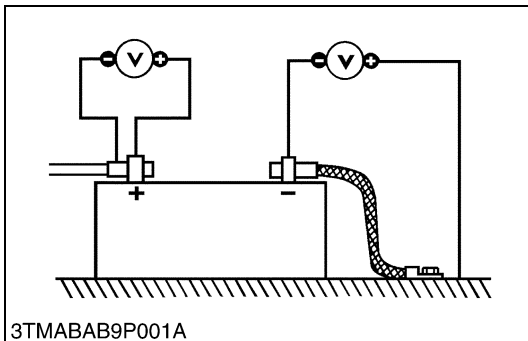


Battery Voltage

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 specification	More than 12 V
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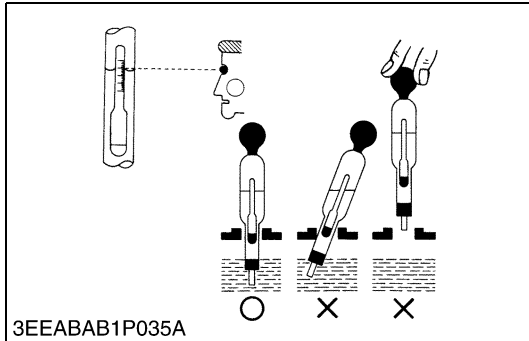
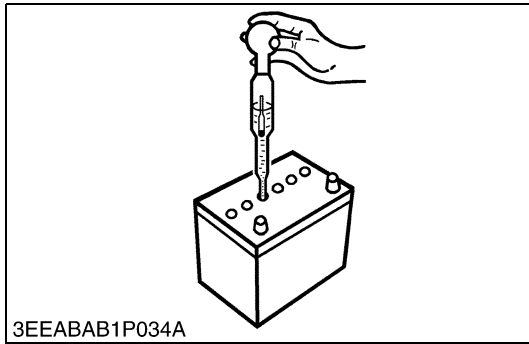


Battery Terminal Connection

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 specification	Less than 0.1 V
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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:

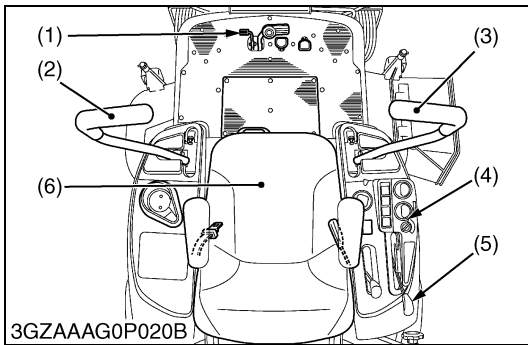
- Specific gravity at 20 °C = Measured value + 0.0007 × (electrolyte temperature – 20 °C)
- Specific gravity at 68 °F = Measured value + 0.0004 × (electrolyte temperature – 68 °F)

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)

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(2) Safety Switches



Method of Inspecting Each Control

A damaged 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

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.

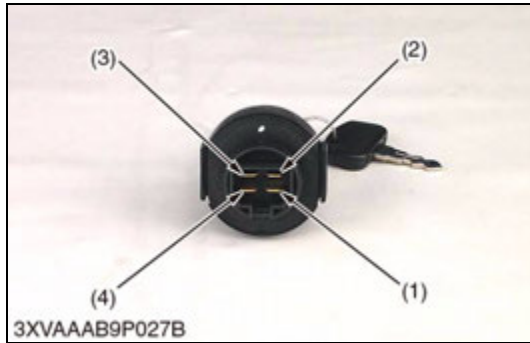
■ How to read meaning from table above.

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.

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(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
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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.

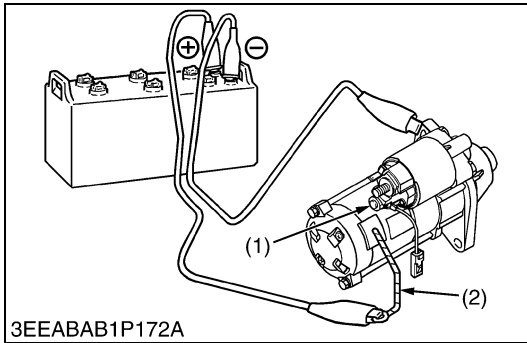
Resistance	B terminal – G terminal	0 Ω
	B terminal – ST terminal	
	B terminal – ACC terminal	

- (1) **B** Terminal
- (2) **ACC** Terminal

- (3) **G** Terminal
- (4) **ST** Terminal

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(4) Starter



Motor Test



CAUTION

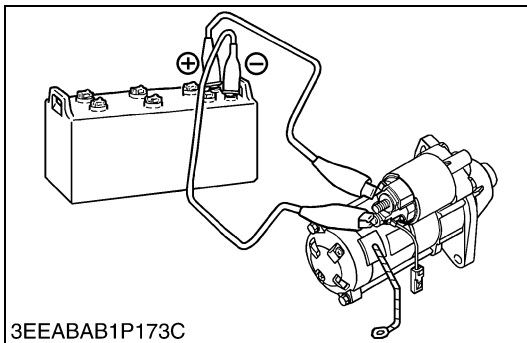
- **Secure the starter to prevent it from jumping up and down while testing the motor.**

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

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Magnet Switch Test (Pull-in, Holding Coils)

NOTE

- **You must do each test for a start time (3 to 5 seconds), and at half of the rated voltage (6 V).**

1) Checking Pull-in Coil

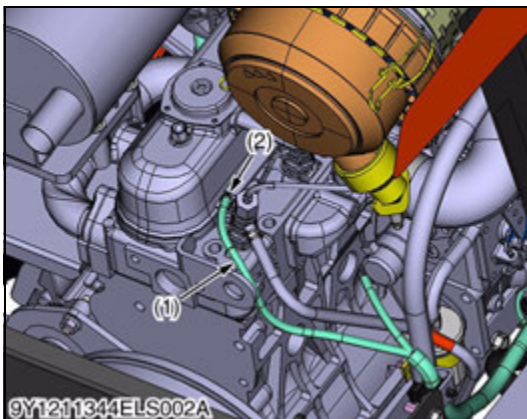
1. Connect jumper lead from the battery's negative terminal post to the C terminal.
2. The plunger should be attached strongly when a jumper lead is connected from the battery positive terminal to the S terminal.

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.

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(5) Glow Plug



Lead Terminal Voltage

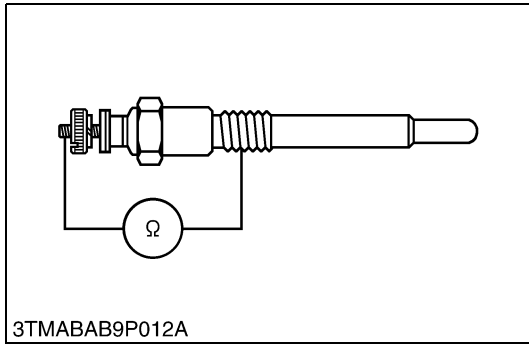
1. Disconnect the wiring lead (1) from the glow plug (2) after turning the main switch off.
2. Turn the main switch key to the "PREHEAT" position, and measure the voltage between the lead terminal and the chassis.
3. Turn the main switch key to the "START" position, and measure the voltage with a voltmeter 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

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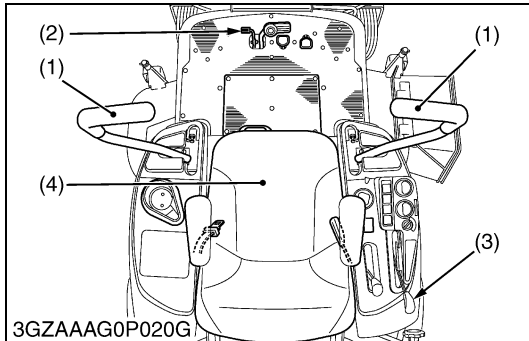
Glow Plug Continuity

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

Glow plug resistance	Factory specification	Approx. 0.9 Ω
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(6) Safety Switch

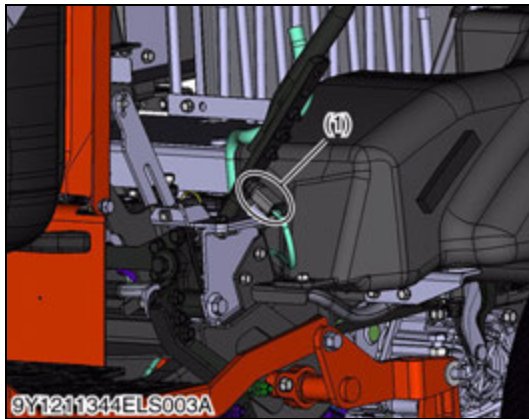


Safety Switch Continuity

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 damaged, replace it.

■ For removing seat switch

1. Remove seat assembly.
2. Remove seat base plate.
3. Disconnect seat cloth from the back of seat frame (5).
4. Insert hand between seat cushion and cloth.
5. Use other hand to remove seat switch (4).

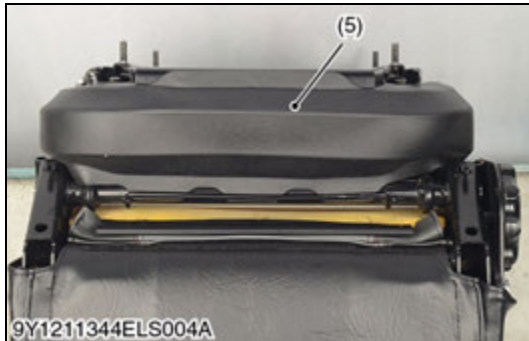


Resistance (Across switch terminal) • Motion control lever • PTO lever • Operator seat	When switch push is pushed	0 Ω
	When switch push is released	Infinity

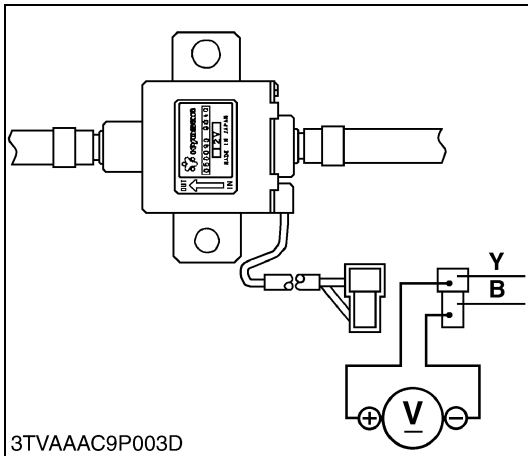
Resistance (Across switch terminal) • Parking brake pedal	When actuator is pushed	Infinity
	When actuator is released	0 Ω

- (1) Neutral Switch
- (4) Seat Switch
- (2) Parking Brake Switch
- (5) Seat Frame
- (3) PTO Lever Switch

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(7) Fuel Pump

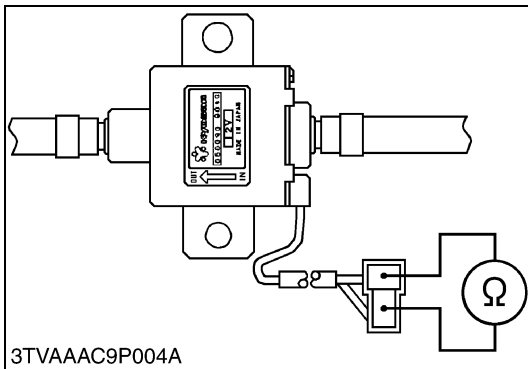


Connector Voltage

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
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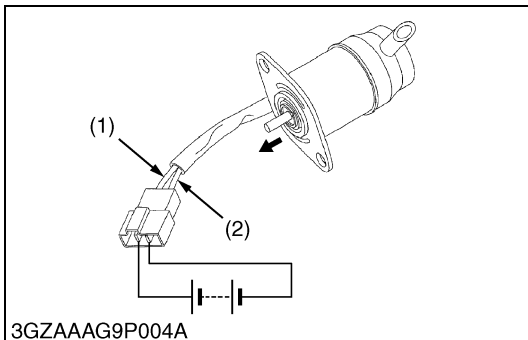


Fuel Pump Continuity

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.

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(8) Engine Stop Solenoid



Engine Stop Solenoid Test

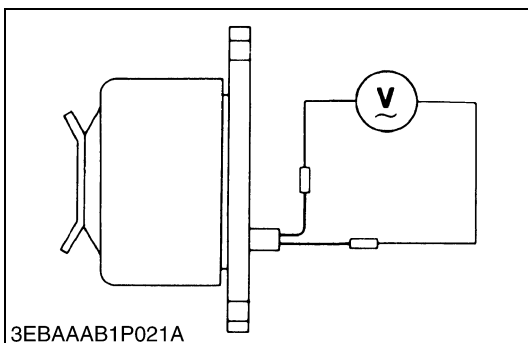
1. Disconnect the connector from the engine stop solenoid.
2. Remove the engine stop solenoid from the engine.
3. Connect the jumper leads from the battery positive terminal to the connector, and from the battery negative terminal to the engine stop solenoid body.
4. If the solenoid plunger is not attracted, the engine stop solenoid is faulty.

(1) White

(2) Black

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(9) Charging System

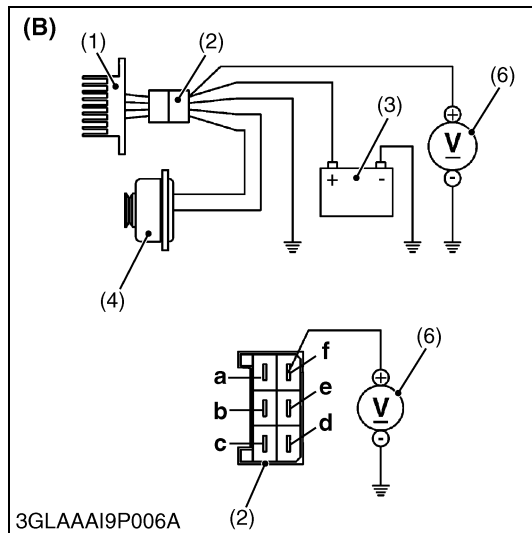
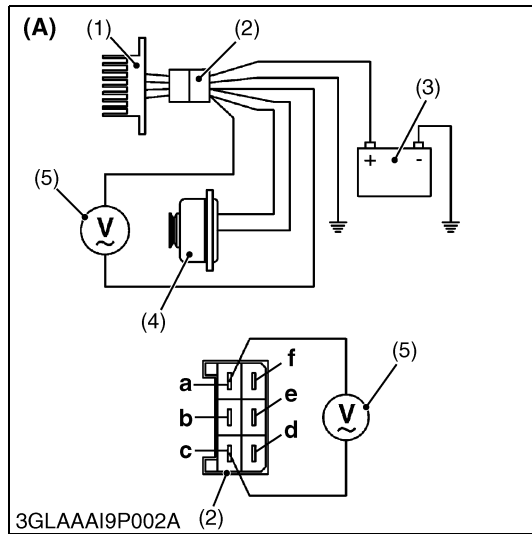


No-load Dynamo Output

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 specification	AC 20 V or more
Rate speed	Engine speed	3000 rpm

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Regulation Voltage

⚠ WARNING

To avoid serious injury

- To avoid personal injury, do not touch the rotating or hot parts while the engine is running.

■ NOTE

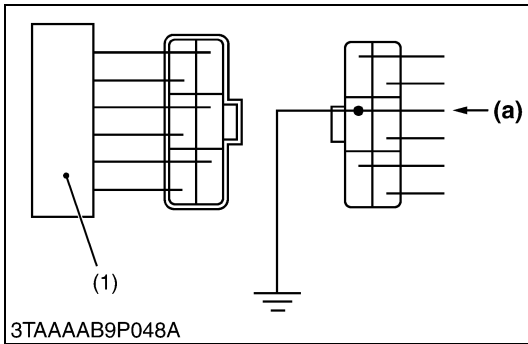
- Before performing this checking, make sure that the no-load dynamo output is proper.
 - Complete the charging circuit with fully charged battery.
1. Run the engine at the rated speed.
 2. Keeping the regulator coupler (2) connected, measure the voltage with a volt meter (5) across the terminal 1 (a) and terminal 3 (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 6 (f) and chassis. (Refer to figure (B).)
 5. If the measurement is not within specified value, replace the regulator (1).

Voltage	Terminal 1 (a) – Terminal 3 (c)	AC 20 V or more
	Terminal 6 (f) – Chassis	DC 14 to 15 V
Rate speed	Engine speed	3000 rpm

- | | |
|---------------------|---------------|
| (1) Regulator | a: Terminal 1 |
| (2) Coupler | b: Terminal 2 |
| (3) Battery | c: Terminal 3 |
| (4) Dynamo | d: Terminal 4 |
| (5) Volt Meter (AC) | e: Terminal 5 |
| (6) Volt Meter (DC) | f: Terminal 6 |

9Y1211344ELS0019US0

(10) Easy Checker™



Charge Lamp (Charging Circuit)

1. Turn main switch **OFF**.
2. Remove the under panel.
3. Disconnect the **6P** connector from the regulator.
4. Turn the main switch **ON**.
5. Connect a jumper lead from the wiring harness connector terminal (Black) to the chassis.
6. If the charge lamp does not light, the wiring harness or fuse is faulty.

(1) Regulator

(a) From Charge Lamp

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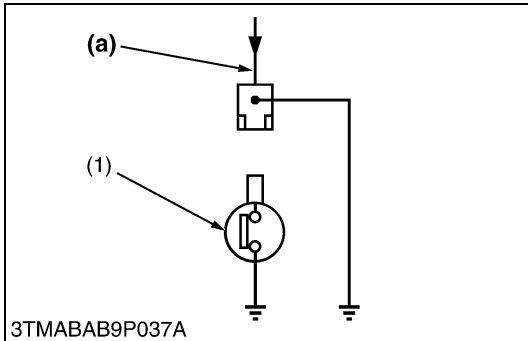
Engine Oil Pressure Lamp

1. Turn the main switch **OFF**.
2. Disconnect the lead from the engine oil pressure switch.
3. Turn the main switch **ON**.
4. Connect a jumper lead from the lead to the chassis.
5. 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

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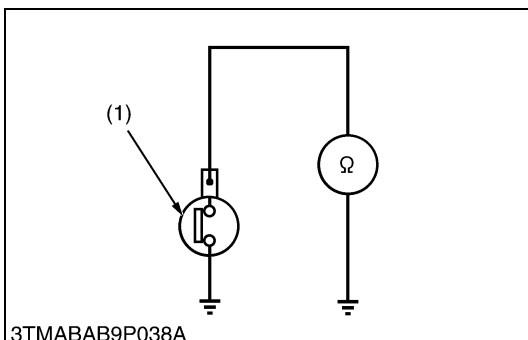
Engine Oil Pressure Switch Continuity

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/cm², 7 psi), the switch is faulty.

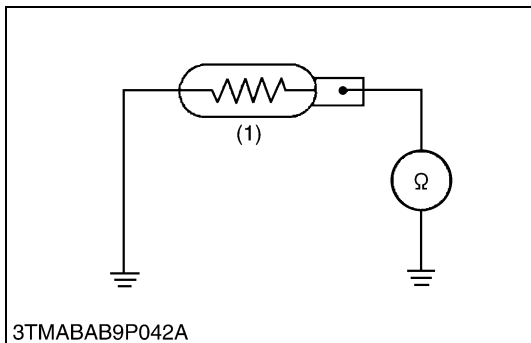
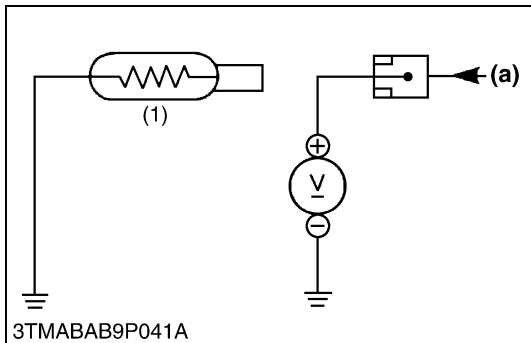
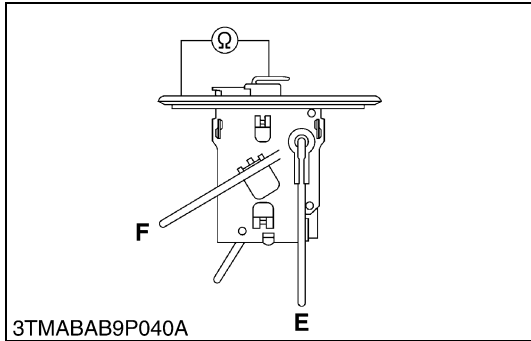
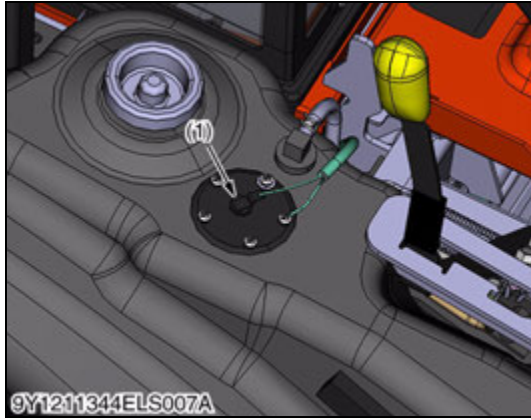
Resistance (Switch terminal – Chassis)	In normal state	0 Ω
	At pressure over approx. 4.9 kPa (0.5 kgf/cm ² , 7 psi)	Infinity

(1) Engine Oil Pressure Switch

9Y1211344ELS0022US0



(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

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Coolant Temperature Sensor

1) Lead Terminal Voltage

1. Turn the main switch **OFF**.
2. Disconnect the lead from the coolant temperature sensor.
3. Turn the main switch **ON**.
4. Measure the voltage with a voltmeter across the lead terminal and the chassis.
5. If the voltage differs from the battery voltage, the wiring harness, fuse or coolant temperature gauge is faulty.

Voltage	Lead terminal – Chassis	5 ±0.1 V
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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.

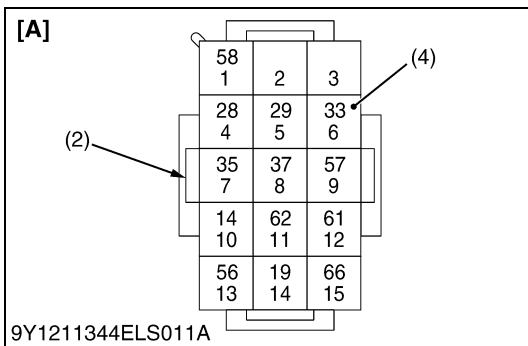
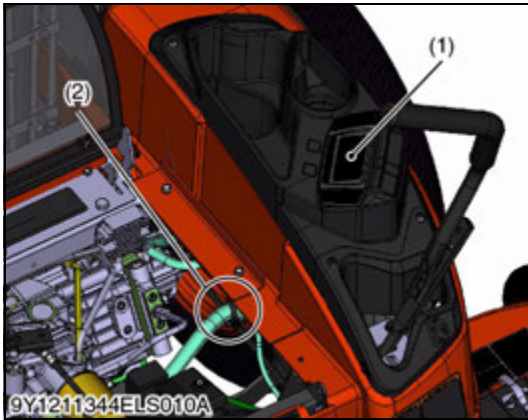
Resistance (Sensor terminal – Chassis)	Reference value	Approx. 0.110 kΩ at 120 °C (248 °F)
		Approx. 0.183 kΩ at 100 °C (212 °F)
		Approx. 0.318 kΩ at 80 °C (176 °F)
		Approx. 0.811 kΩ at 50 °C (122 °F)

(1) Coolant Temperature Sensor

(a) Wire Harness Connector

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(12) Cooling System

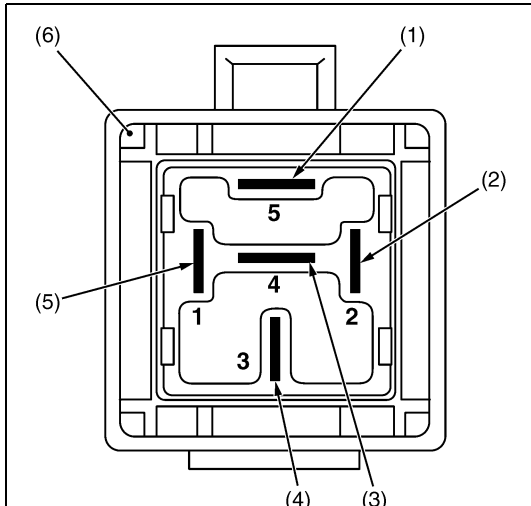


Horn Wiring Harness

1. Turn the main switch **OFF**.
2. Raise seat.
3. Disconnect the meter panel (1) from the wiring harness connector (2).
4. Turn the main switch **ON**.
5. Connect a jumper lead from the wiring harness connector (2) (Terminal **6**) to the chassis.
6. If the horn does not operate wiring harness or relay is faulty.

- (1) Meter Panel [A] TO (PANEL)
- (2) Wiring Harness Connector
- (3) Coolant Temperature Sensor
- (4) Terminal **6**

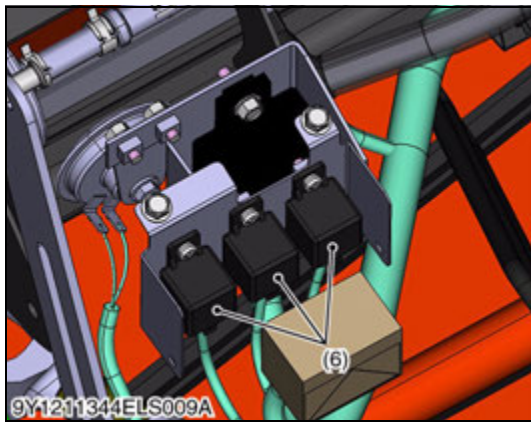
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Relay (Horn, Solenoid and Starter)

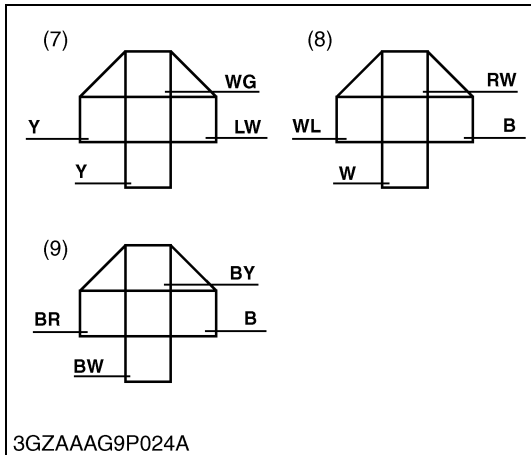
1. Disconnect the connector from relay (6) after turning the main switch off.
2. Remove the relay from bracket.
3. Measure the resistance with an ohmmeter across the terminal 2 (2) to terminal 1 (5), terminal 5 (1) to terminal 4 (3) and terminal 5 (1) to terminal 3 (4).
4. If resistance differs from the factory specification, the relay is faulty.

Resistance	Terminal 2 (2) – Terminal 1 (5)	Approx. 90 Ω
	Terminal 5 (1) – Terminal 4 (3)	Infinity
	Terminal 4 (1) – Terminal 3 (4)	0 Ω



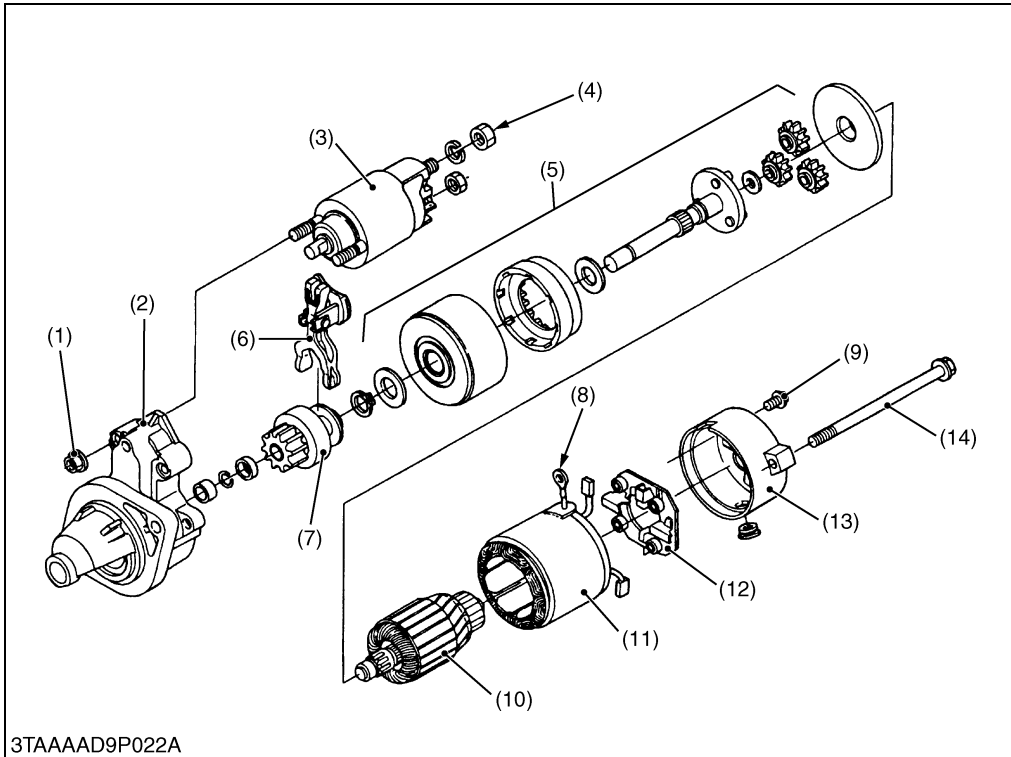
- (1) Terminal 5
- (2) Terminal 2
- (3) Terminal 4
- (4) Terminal 3
- (5) Terminal 1
- (6) Relay (Horn, Solenoid and Starter)
- (7) Horn Relay Connector
- (8) Solenoid Relay Connector
- (9) Starter Relay Connector

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[2] DISASSEMBLING AND ASSEMBLING

(1) Starter

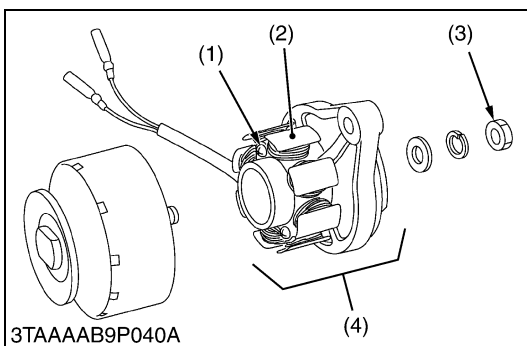


- (1) Magnetic Switch Mounting Nut
- (2) Housing
- (3) Magnetic Switch
- (4) C Terminal Nut
- (5) Shaft Assembly
- (6) Drive Lever
- (7) Overrunning Clutch
- (8) Connecting Lead
- (9) Mounting Screw
- (10) Armature
- (11) Yoke
- (12) Brush Holder
- (13) Rear End Holder
- (14) Through Bolt

1. Remove the C terminal nut (4), and disconnect the connecting lead (8).
2. Remove the magnetic switch mounting nuts (1), and remove the magnetic switch (3) from the housing (2).
3. Remove 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.

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(2) Dynamo



Stator

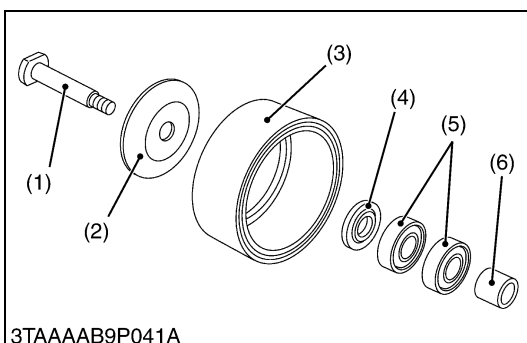
1. Remove the nut (3) and separate the stator comp. (4).
2. Remove the screws (1) and remove the stator (2).

(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.

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Rotor

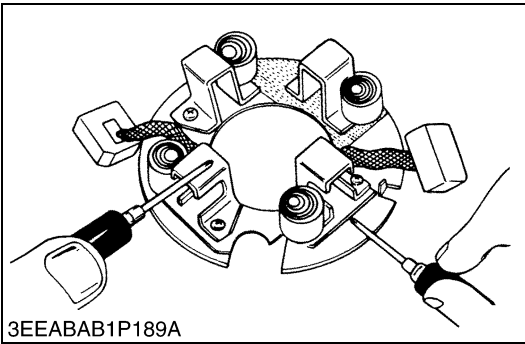
1. Tap out the shaft (1) from the rotor (3).

(When reassembling)

- Be careful 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

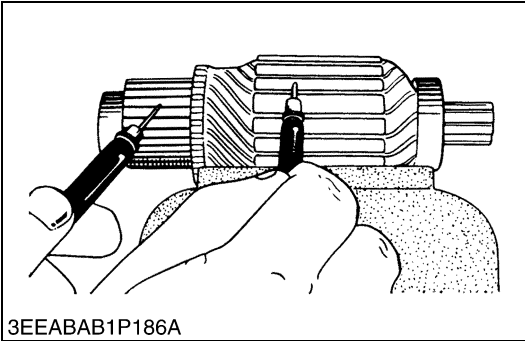
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Brush Holder

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

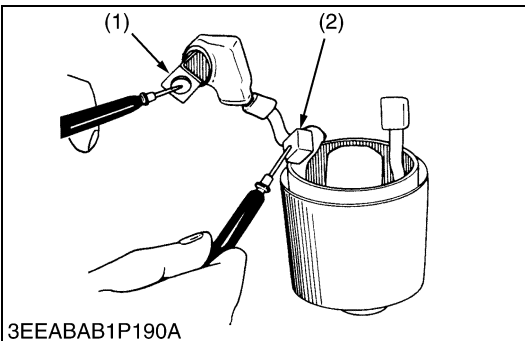
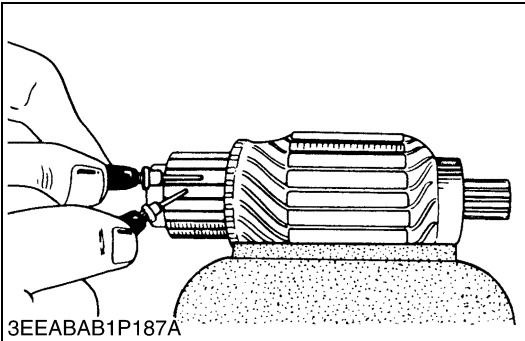
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Armature Coil

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.

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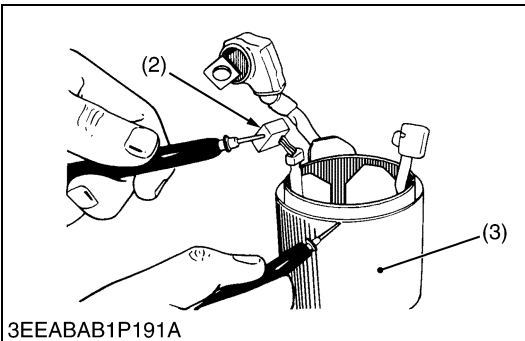


Field Coil

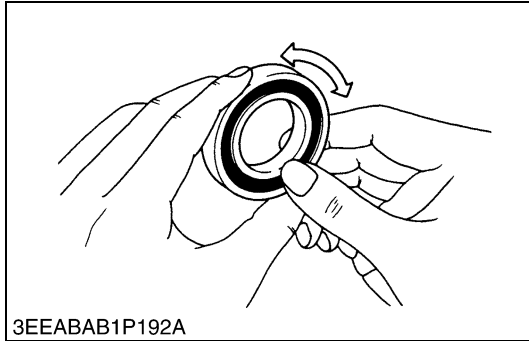
1. Check the continuity across the lead (1) and brush (2) with an ohmmeter.
2. If it does not conduct, replace the yoke assembly.
3. Check the continuity across the brush (2) and yoke (3) with an ohmmeter.
4. If it conducts, replace the yoke assembly.

- | | |
|-----------|----------|
| (1) Lead | (3) Yoke |
| (2) Brush | |

9Y1211344ELS0035US0



(2) Charging System



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Bearing

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

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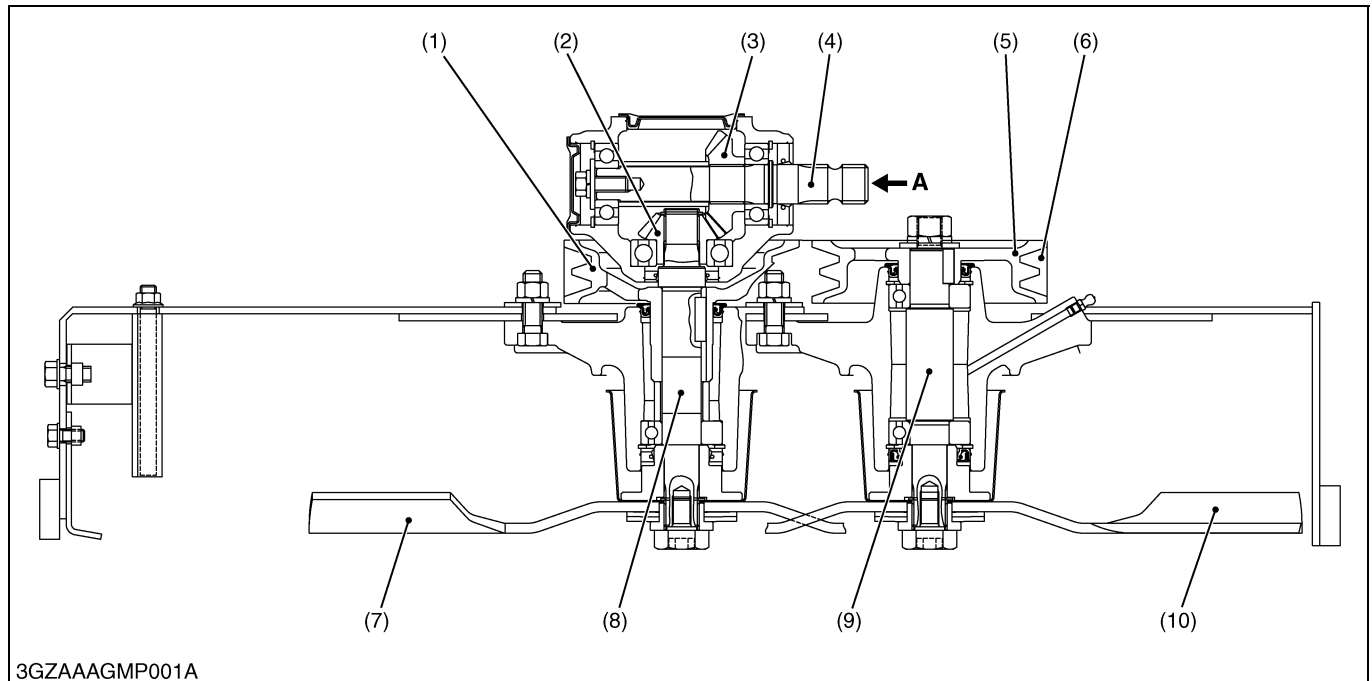
6 MOWER

MECHANISM

CONTENTS

1. POWER TRANSMISSION.....	6-M1
2. MOWER LINKAGE.....	6-M2

1. POWER TRANSMISSION



- | | | | |
|--------------------------------------|----------------------------------|----------------------|--------------------------|
| (1) Center Pulley | (3) 19T Bevel Gear | (4) Pinion Shaft | (9) Blade Shaft |
| (2) 15T Bevel Gear
(RCK60P-1200Z) | (RCK60P-1200Z) | (5) Outer Pulley | (10) Outer Blade |
| 17T Bevel Gear
(RCK72P-1200Z) | 18T Bevel Gear
(RCK72P-1200Z) | (6) Mower Belt | |
| | | (7) Center Blade | A: From PTO Shaft |
| | | (8) Bevel Gear Shaft | |

The power is transmitted from mid-PTO to blades as follows.

■ Center Blade

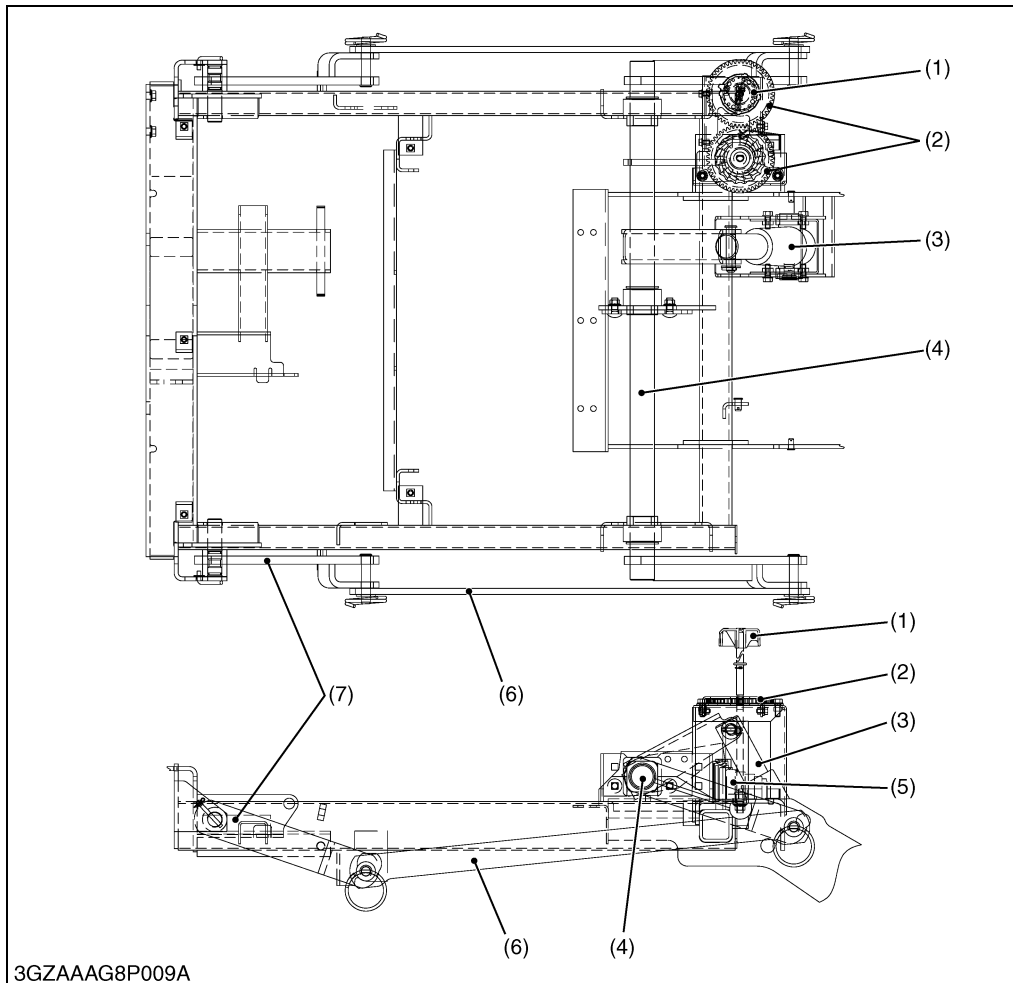
From PTO Shaft (A) → Pinion Shaft (4) → Bevel Gear (3) → Bevel Gear (2) → Bevel Gear Shaft (8) → Center Blade (7)

■ 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)

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2. MOWER LINKAGE



- (1) Cutting Height Adjusting Dial
- (2) Dial Cam Gear
- (3) Lift Cylinder
- (4) Lift Shaft
- (5) Adjusting Cam
- (6) Horizon Plate
- (7) Front Arm

3GZAAAG8P009A

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 shaft (4) 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.

9Y1211344MOM0002US0

SERVICING

CONTENTS

1. TROUBLESHOOTING.....	6-S1
2. SERVICING SPECIFICATIONS	6-S2
3. TIGHTENING TORQUES.....	6-S3
4. CHECKING, DISASSEMBLING AND ASSEMBLING	6-S4
[1] CHECKING AND ADJUSTING.....	6-S4
[2] DISASSEMBLING AND ASSEMBLING	6-S8
(1) Lifting Linkage	6-S8
(2) Mower Deck.....	6-S11

1. TROUBLESHOOTING

Symptom	Probable Cause and Checking Procedure	Solution	Reference Page
Blade Does Not Turn	1. PTO system malfunctioning	Check transmission	2-S11, 2-S23, 2-S42
	2. Broken mower belt	Replace mower belt	6-S13
Blade Speed Is Slow	1. Loosen mower belt	Replace mower belt or tension spring	6-S13
	2. Clogged grass	Remove grass	–
	3. Flattened out or worn cup washer	Replace cup washer	6-S12
	4. Engine rpm too low	Mow at full throttle, check and reset engine rpm	1-S22
Cutting Is Poor	1. Worn or bent mower blade	Sharpen or replace mower blade	6-S12
	2. Loosen mower blade screw	Retighten mower blade screw	6-S12
	3. Cutting height improper	Adjust cutting height	6-S4 to 6-S7
	4. Ground speed too fast	Slow-down	–
	5. Low wheel inflation	Add air to correct	6-S4
	6. Anti-scalp rollers not adjusted correctly	Adjust anti-scalp rollers	6-S4
Mower Is Not Lifted	1. Broken linkage system	Replace linkage system	6-S8 to 6-S10
	2. Trouble of hydraulic system	Check hydraulic system	4-S4, 4-S5

9Y1211344MOS0001US0

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.	–

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3. TIGHTENING TORQUES

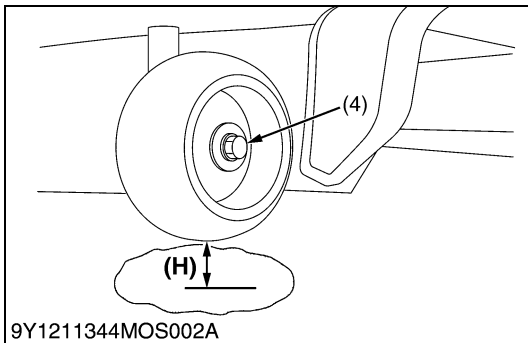
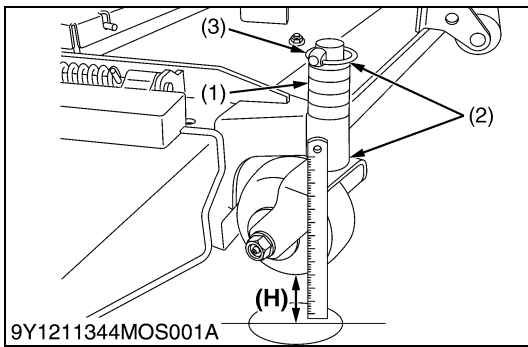
Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts: See page "6. TIGHTENING TORQUES" on page G-12.)

Item	N·m	kgf·m	lbf·ft
Mower blade screw	102.9 to 117.6	10.50 to 11.99	75.90 to 86.73
Gear box mounting screw (Standard type / Reamer type)	77.5 to 90.2	7.90 to 9.19	57.1 to 66.5
Center pulley holder screw (Standard type / Reamer type)	77.4 to 90.2	7.90 to 9.19	57.1 to 66.5
Outer pulley mounting nut	167 to 190	17.1 to 19.3	124 to 140
Pulley holder mounting screw	77.4 to 90.2	7.90 to 9.19	57.1 to 66.5

9Y1211344MOS0003US0

4. CHECKING, DISASSEMBLING AND ASSEMBLING

[1] CHECKING AND ADJUSTING



Adjusting Anti-scalp Rollers

⚠ WARNING

To avoid serious injury:

- Park the machine on a firm and level surface.
- Apply the parking brake.
- Stop the engine and remove the key.
- Wait for all moving parts to stop.

■ 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.)

	Tire Sizes	Recommended Inflation Pressure
Front	15 × 6.0 - 6, (Semi-pneumatic Non Flat Tire) Smooth	—
Rear	26 × 12.0 - 16, 4PR Turf low profile tire	83 kPa (0.84 kgf/cm ² , 12 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 of the rear side anti-scalp roller by shifting the pin or the bolt to approximately 19 mm (3/4 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 of the front side anti-scalp roller by replacing the collar (collar is raised and lowered) or shifting the pin to approximately 19 mm (3/4 in.) between rollers and ground.

9. Adjust both side rollers to the same height.
10. See Anti-scalp roller cutting height adjusting chart.

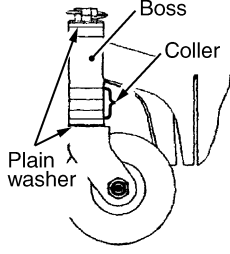
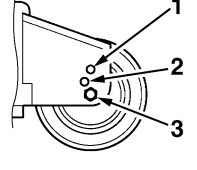
- (1) Collar
 - (2) Washer
 - (3) Set Pin
 - (4) Bolt
- (H) 19 mm (3/4 in.)**

(To be continued)

(Continued)

(Reference)

- Set position for recommended ground clearance 19 mm (0.75 in.).

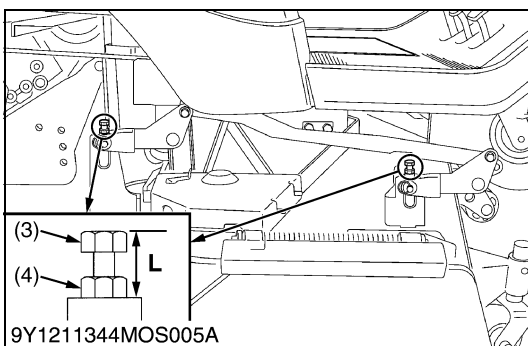
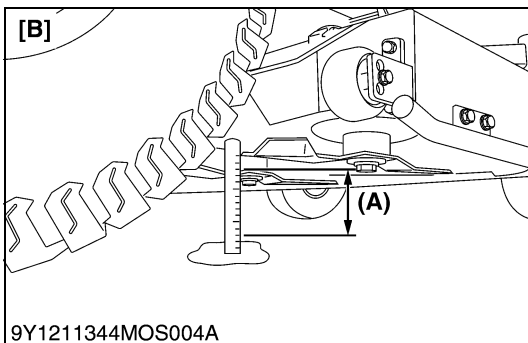
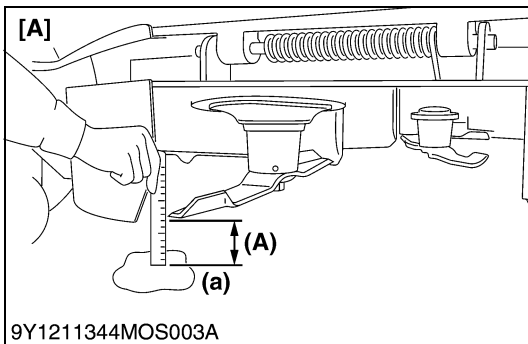
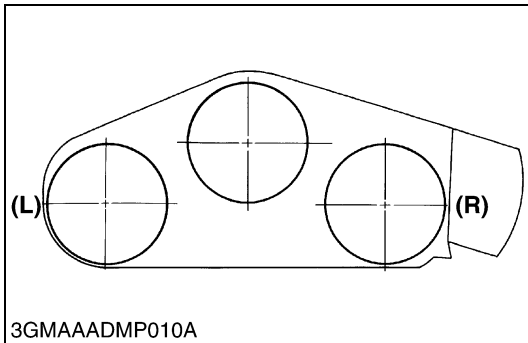
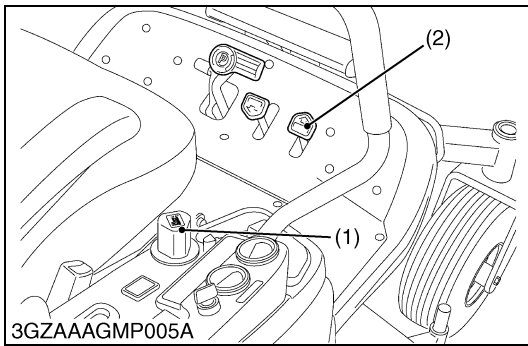
Anti-scalp roller cutting height adjusting chart				
Cutting height inch (mm)	The number of collars under the boss	Position of bolts	Ground clearance mm (Ref.)	
	 9Y1211344MOS021US	 9Y1211344MOS022A	Rear anti-scalp roller	
			Pin shift type	Bolt shift type
1.00" (25)	0	1	6	6
1.25" (32)	0		13	12
1.50" (38)	0		19	19
1.75" (44)	1	2	13	25
2.00" (50)	1		19	19
2.25" (58)	2	3	13	25
2.50" (64)	2		19	19
2.75" (70)	3		13	25
3.00" (76)	3		19	(31) *2
3.25" (83)	4		13	(38) *3
3.50" (89)	4		19 *3	(44) *3
3.75" (95)	4		13 *3	(51) *3
4.00" (102)	4		19 *3	(57) *3
4.25" (108)	4		13 *3	(63) *3
4.50" (114)	4		19 *3	(70) *3
4.75" (121)	4	25 *3	(76) *3	
5.00" (127)	4	31 *3	(83) *3	

*1. For cutting heights above 3.5". The anti-scalp rollers will still be effective against scalping.

*2. For cutting heights above 3.0". The anti-scalp rollers will still be effective against scalping.

*3. Use it if necessary.

9Y1211344MOS0004US0



Adjusting Left and Right Cutting Height

⚠ WARNING

To avoid serious injury:

- Park the machine on a firm and level surface.
- Engage the parking brake.
- Disengage PTO.
- Stop the engine, remove the key and remove the mower universal joint while checking or adjusting the level of the mower deck.

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 76 mm (3 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).

■ NOTE

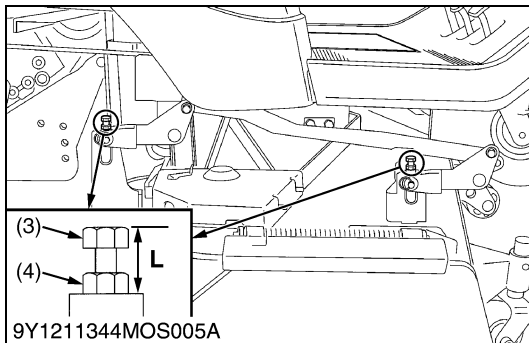
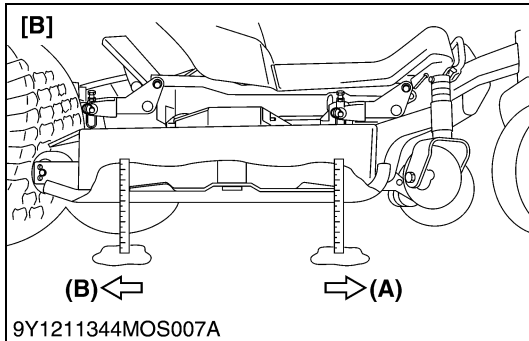
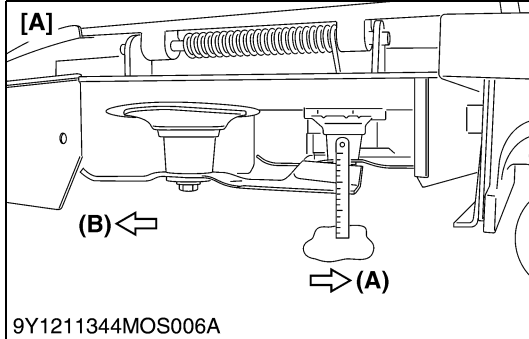
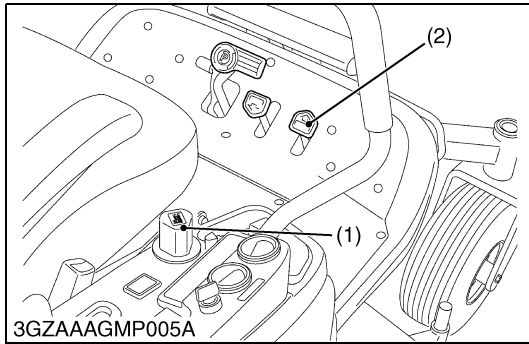
- There is a difference of the blade height between on the concrete and ground.

Difference ((L) - (R)) between left tip and right tip of blade	Factory specification	Less than 3 mm 0.12 in.
--	-----------------------	----------------------------

- | | |
|-------------------------------------|---|
| (1) Cutting Height Control Dial | L: Length of Cutting Height Fine Tuning Bolt |
| (2) Hydraulic Lift Control Pedal | (A) Blade Height |
| (3) Cutting Height Fine Tuning Bolt | (a) Side |
| (4) Lock Nut | |

- | | |
|---|---------------------------|
| (L) Left Blade Measurement Position | [A] RCK60P, RCK72P |
| (R) Right Blade Measurement Position | [B] RCK60R, RCK72R |

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Adjusting Front and Rear Cutting Height

⚠ WARNING

To avoid serious injury:

- Park the machine on a firm and level surface.
- Engage the parking brake.
- Disengage PTO.
- Stop the engine, remove the key and remove the mower universal joint while checking or adjusting the level of the mower deck.

1. Wheel pressure must be correct.
2. Raise 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 76 mm (3 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 L of cutting height fine tuning bolt with lock nut (4). The height of rear blade tip (B) should be bigger than the front.

■ IMPORTANT

- Check the machine tire pressure.
- The difference between both measurements must be less than 6 mm (1/4 in.).
Front side must be lower than rear side.

Difference ((B) - (A)) ((B) ≥ (A)) between front tip and rear tip of blade	Factory specification	0 to 6.0 mm 0 to 0.24 in.
--	-----------------------	------------------------------

- | | |
|--|---------------------------------|
| (1) Cutting Height Control Dial | (A) Height of Blade Tip (Front) |
| (2) Hydraulic Lift Control Pedal | (B) Height of Blade Tip (Rear) |
| (3) Cutting Height Fine Tuning Bolt | |
| (4) Lock Nut | [A] RCK60P, RCK72P |
| L: Length of Cutting Height Fine Tuning Bolt | [B] RCK60R, RCK72R |

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[2] DISASSEMBLING AND ASSEMBLING

(1) Lifting Linkage



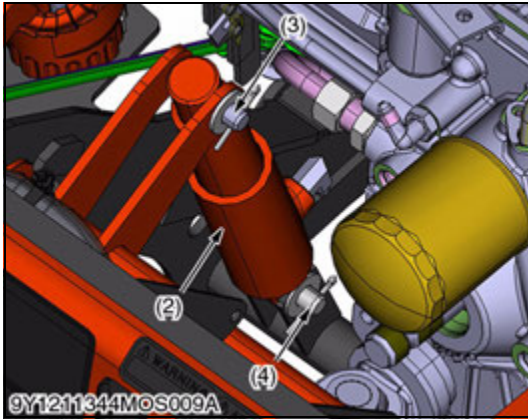
Removing Lift Cylinder

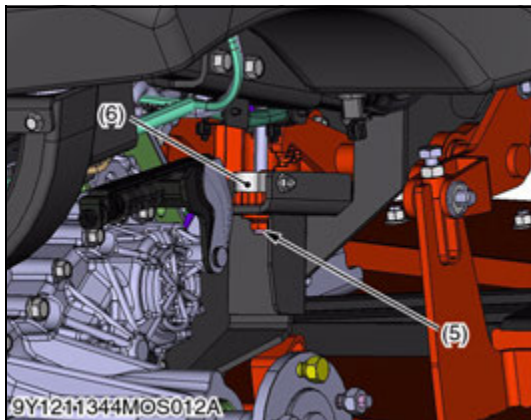
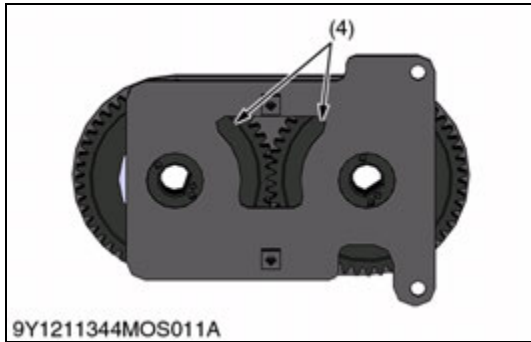
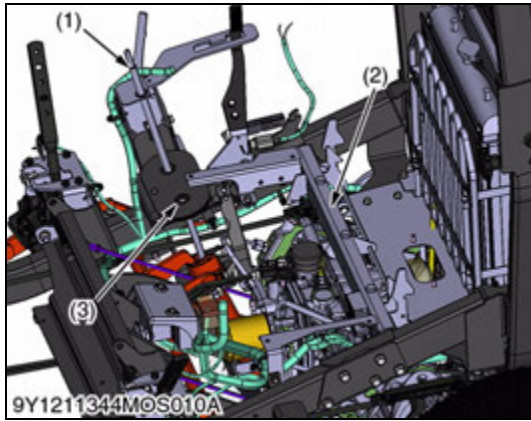
1. Disconnect the cylinder hose (1).
2. Remove the clevis pin top (3).
3. Remove the clevis pin bottom (4).
4. Remove the lift cylinder (2) with cylinder hose (1).

- (1) Cylinder Hose
(2) Lift Cylinder

- (3) Clevis Pin (Top)
(4) Clevis Pin (Bottom)

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Dial Cam Gear

1. Remove RH and LH fender.
2. Remove bonnet lock assembly (2).
3. Remove cam rod (1).
4. Remove dial cam gear assembly (3).
5. Remove dial cam gears (4).
6. Remove dial cam nut (5).
7. Remove cam (6).

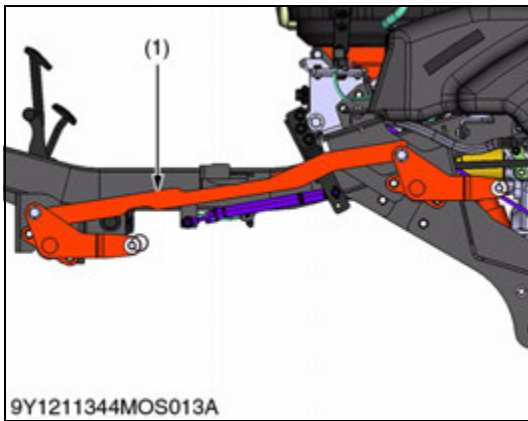
(When reassembling)

■ NOTE

- When assembling the dial cam gear, align the gear notch as shown in photo.

- | | |
|----------------------------|-------------------|
| (1) Cam Rod | (4) Dial Cam Gear |
| (2) Bonnet Lock Assembly | (5) Cam Nut |
| (3) Dial Cam Gear Assembly | (6) Cam |

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Mower Linkage

1. Remove mower deck.
2. Remove RH and LH link plates (1).
3. Remove RH and LH joint plates (2).
4. Remove rear lift link (3).
5. Remove front lift link (4).

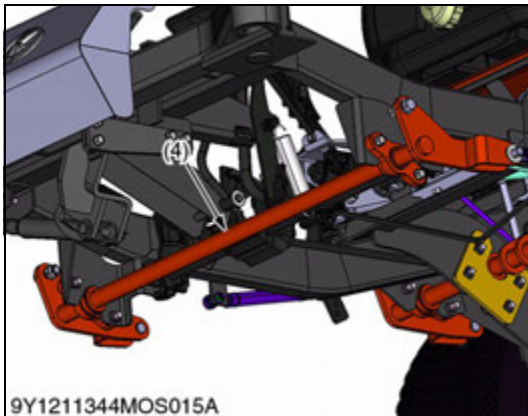
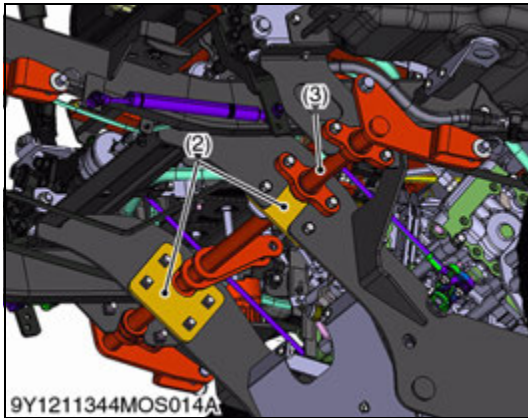
(When reassembling)

- Apply grease to front pins (4).

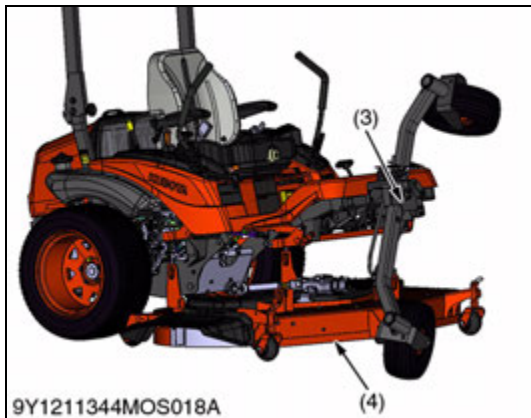
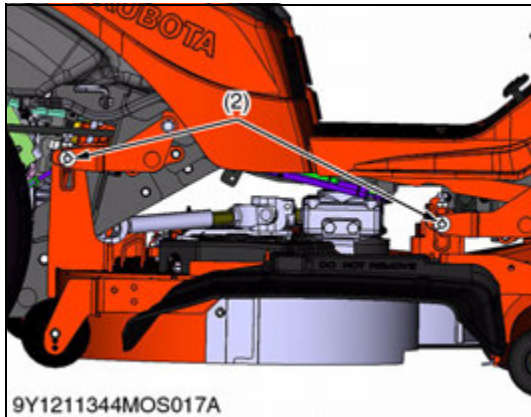
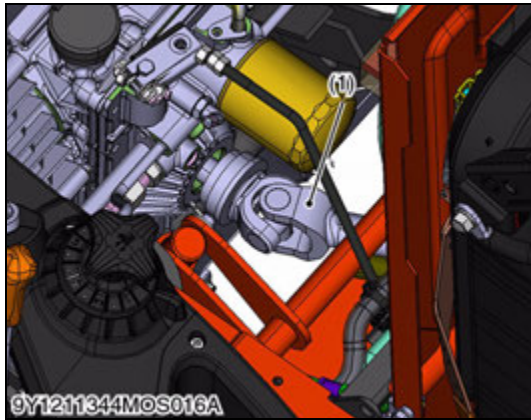
- (1) Link Plate
(2) Joint Plates

- (3) Rear Lift Shaft
(4) Front Lift Link

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(2) Mower Deck



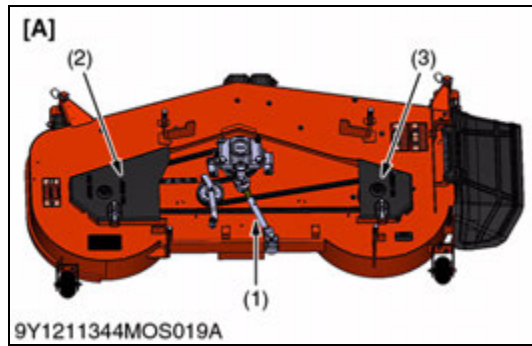
Mower

1. Raise seat and disconnect PTO Shaft (1).
2. Start engine and set mower at lowest cutting position.
3. Turn off engine.
4. Remove clevis pins (2) from mounting links LH and RH.
5. Tilt up machine with maintenance lift system (3).
6. Slide mower (4) out from under machine.
7. Lower machine with maintenance lift system.

- (1) PTO Shaft
(2) Clevis Pins

- (3) Maintenance Lift System
(4) Mower

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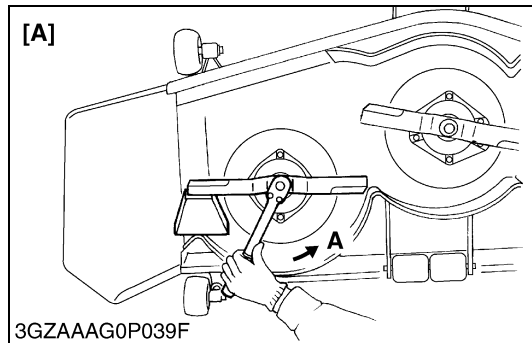
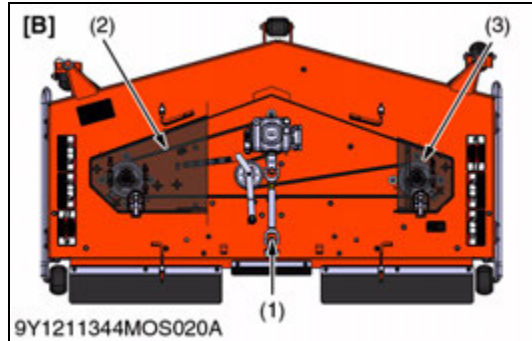


Universal Joint and Belt Covers

1. Remove the universal joint (1).
2. Remove the left and right belt covers (2), (3).

- | | |
|------------------------|------------|
| (1) Universal Joint | [A] RCK60P |
| (2) Belt Cover (Left) | RCK72P |
| (3) Belt Cover (Right) | [B] RCK60R |
| | RCK72R |

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Mower Blades (Center Blade and Outer Blades)

1. Turn over the mower.
2. Remove the mower blade bolt (5), and remove the spline boss (4), two cup washers (3), mower blade (2) and dust cover (1).

■ **NOTE**

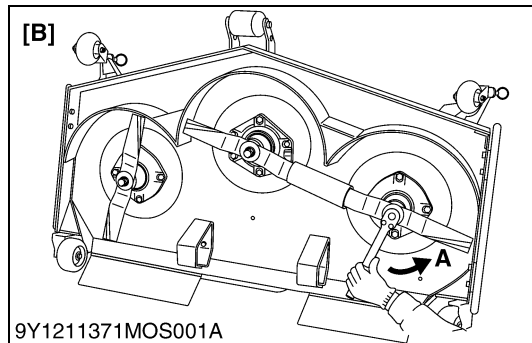
- To remove the blade, wedge a block of wood between one blade and the mower deck in such position that it will hold the blade safely while loosening or tightening the blade bolt.

(When reassembling)

- Be sure to assemble the two cup washers between the mower blade and spline boss.

■ **IMPORTANT**

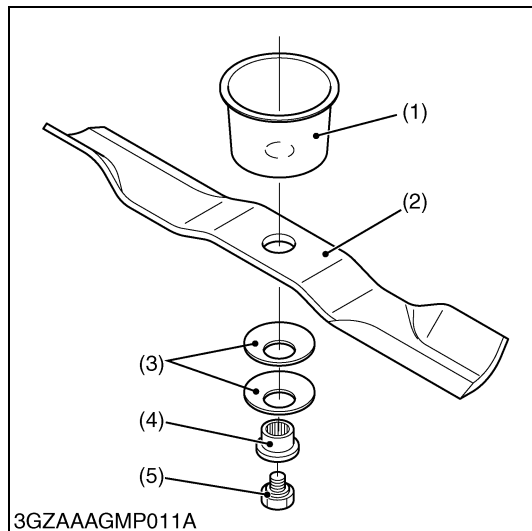
- Make sure the cup washer is not flattened or worn out, this will cause blade to slip easily.
- Replace both cup washers if either is damaged.**

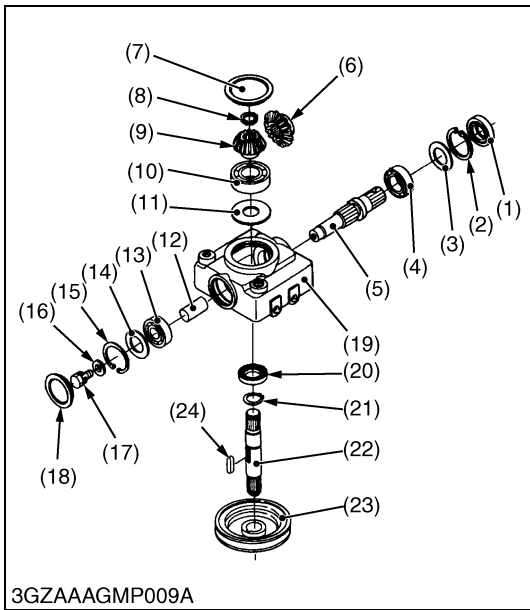


Tightening torque	Mower blade bolt	102.9 to 117.6 N·m
		10.50 to 11.99 kgf·m
		75.90 to 86.73 lbf·ft

- | | |
|----------------------|------------------|
| (1) Dust Cover | A: Loosen |
| (2) Mower Blade | |
| (3) Cup Washer | [A] RCK60P |
| (4) Spline Boss | RCK72P |
| (5) Mower Blade Bolt | [B] RCK60R |
| | RCK72R |

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Disassembling Gear Box

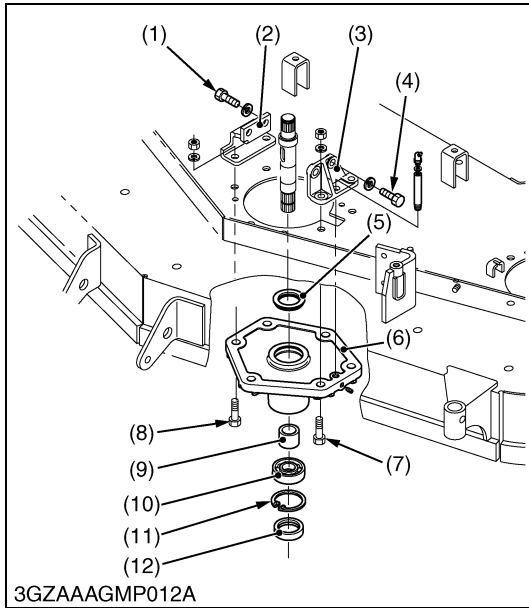
1. Remove the drain plug, and drain the gear box oil.
2. Remove the center pulley (23) with a puller, and remove the feather key (24) on the bevel gear shaft.
3. Remove the gear box caps (7), (18).
4. Remove the oil seal (1), internal snap ring (2) and shim (3).
5. Remove the screw (17), washer (16) 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 it is not proper, adjust with the shims (3), (11) and (14). (See page 6-S18.)

- | | |
|-----------------------------------|--------------------------|
| (1) Oil Seal | (11) Shim |
| (2) Internal Snap Ring | (12) Pinion Shaft Collar |
| (3) Shim | (13) Ball Bearing |
| (4) Ball Bearing | (14) Shim |
| (5) Pinion Shaft | (15) Internal Snap Ring |
| (6) 19T Bevel Gear (RCK60P-1200Z) | (16) Washer |
| 18T Bevel Gear (RCK72P-1200Z) | (17) Screw |
| (7) Gear Box Cap | (18) Gear Box Cap |
| (8) External Snap Ring | (19) Gear Box |
| (9) 15T Bevel Gear (RCK60P-1200Z) | (20) Oil Seal |
| 17T Bevel Gear (RCK72P-1200Z) | (21) External Snap Ring |
| (10) Ball Bearing | (22) Bevel Gear Shaft |
| | (23) Center Pulley |
| | (24) Feather Key |

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Center Pulley Holder

1. Remove 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 (4), (7) at their original positions as shown in the figure.

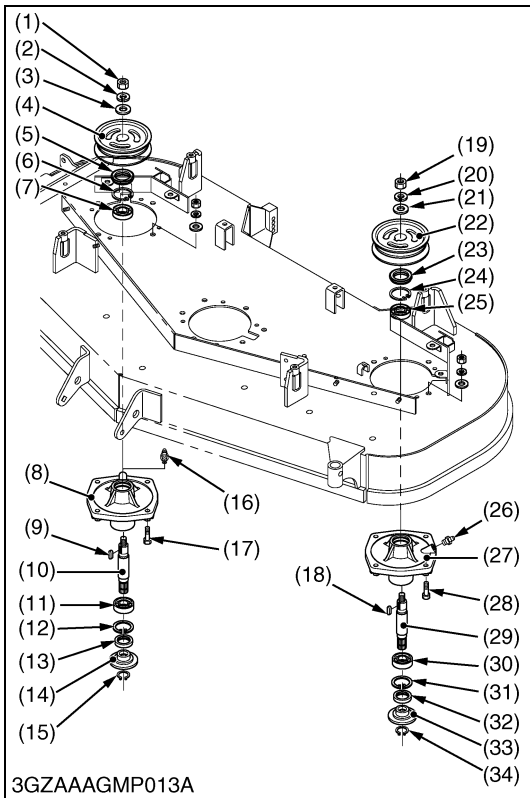
NOTE

- **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-S13 for tightening torque of gear box screw.**

Tightening torque	Center pulley holder screw (Standard type / Reamer type)	77.4 to 90.2 N·m 7.90 to 9.19 kgf·m 57.1 to 66.5 lbf·ft
-------------------	---	---

- | | |
|---------------------------|---------------------------------------|
| (1) Gear Box Screw | (7) Center Pulley Holder Reamer Screw |
| (2) Gear Box Stay RH | (8) Center Pulley Holder Screw |
| (3) Gear Box Stay LH | (9) Collar |
| (4) Gear Box Reamer Screw | (10) Ball Bearing |
| (5) Oil Seal | (11) Internal Snap Ring |
| (6) Center Pulley Holder | (12) Oil Seal |

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Outer Pulley and Blade Shaft

1. Remove the outer pulley mounting nut (19), and remove the outer pulley (22) and feather key (18).
2. Remove the pulley holder mounting bolts (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). Be careful not to damage the grease fitting (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.

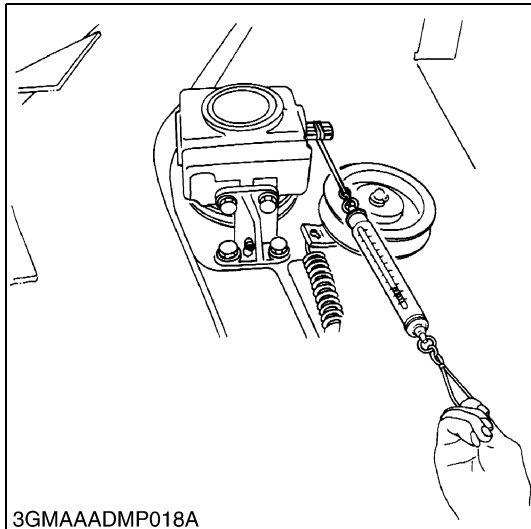
(When reassembling)

- Replace the oil seals (32), (23), (13) and (5) with new ones.

Tightening torque	Outer pulley mounting nut	167 to 190 N·m 17.1 to 19.3 kgf·m 124 to 140 lbf·ft
	Pulley holder mounting bolt	77.4 to 90.2 N·m 7.90 to 9.19 kgf·m 57.1 to 66.5 lbf·ft

- | | |
|----------------------------------|----------------------------------|
| (1) Outer Pulley Mounting Nut | (18) Feather Key |
| (2) Spring Washer | (19) Outer Pulley Mounting Nut |
| (3) Plain Washer | (20) Spring Washer |
| (4) Outer Pulley (Right) | (21) Plain Washer |
| (5) Oil Seal | (22) Outer Pulley (Left) |
| (6) Internal Snap Ring | (23) Oil Seal |
| (7) Ball Bearing | (24) Internal Snap Ring |
| (8) Pulley Holder (Right) | (25) Ball Bearing |
| (9) Feather Key | (26) Grease Fitting |
| (10) Blade Shaft (Right) | (27) Pulley Holder (Left) |
| (11) Ball Bearing | (28) Pulley Holder Mounting Bolt |
| (12) Internal Snap Ring | (29) Blade Shaft (Left) |
| (13) Oil Seal | (30) Ball Bearing |
| (14) Spline Boss | (31) Internal Snap Ring |
| (15) External Snap Ring | (32) Oil Seal |
| (16) Grease Fitting | (33) Spline Boss |
| (17) Pulley Holder Mounting Bolt | (34) External Snap Ring |

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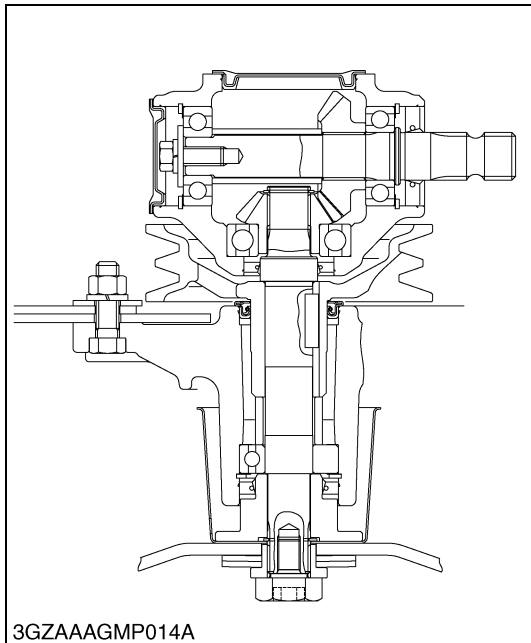
Turning Torque of Pinion Shaft

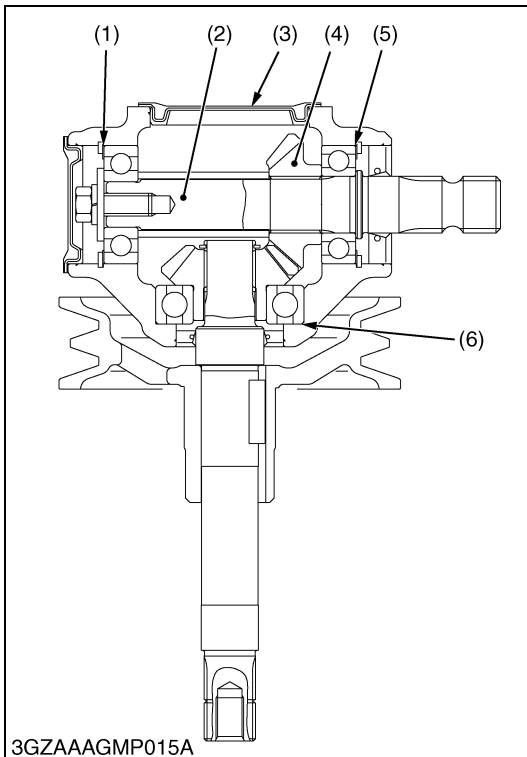
1. Remove the mower belt, and reassemble the gear box to the mower deck.
2. Wind a string around the pinion shaft and set a spring balance (or push-pull gauge) to the tip of the string, and then slowly pull the spring balance horizontally to measure the turning force.
3. If the measurement exceeds the factory specification, check the bearings and gears.

Turning force	Factory specification	Less than 117.7 N 12.0 kgf 26.5 lbf
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Turning torque	Factory specification	Less than 0.7 N·m 0.07 kgf·m 0.5 lbf·ft
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Backlash between Bevel Gears

1. Remove the gear box cap (3).
2. Attach plastigauge on the bevel gear (4) on the pinion shaft (2).
3. Turn the pinion shaft (2).
4. Remove the plastigauge, and measure the plastigauge. (Backlash equal the measurement)
5. If the backlash exceeds the allowable limit, adjust with shims (1), (5), (6).

Backlash between bevel gears	Factory specification	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 | (4) Bevel Gear |
| (2) Pinion Shaft | (5) Shim |
| (3) Gear Box Cap | (6) Shim |

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Editor : Farm Machinery International Service Department
Address : 64, Ishizu-Kitamachi, Sakai-Ku, Sakai-City, Osaka, 590-0823, Japan
Phone : +81-72-241-1129
Fax : +81-72-245-2484
E-mail : kbt_g.ag-sv@kubota.com
