# WSM

## WORKSHOP MANUAL

# ZD326-EU

Kubota

KiSC issued 07, 2011 A

# TO THE READER

This Workshop Manual tells the servicing personnel about the mechanism, servicing and maintenance of the ZD326-EU. It contains 4 parts: **"Information"**, **"General"**, **"Mechanism"** and **"Servicing"**.

■ **Information**

This section contains information below.

- Safety First
- Safety Label
- Specification
- Dimension

■ **General**

This section 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 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.

**February, 2009**

# I INFORMATION

# INFORMATION

## CONTENTS

# 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 attempt to repair or use this unit.**

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

**⚠ WARNING**
- **Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.**

**⚠ CAUTION**
- **Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.**

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

**■ NOTE**
- **Gives helpful information.**

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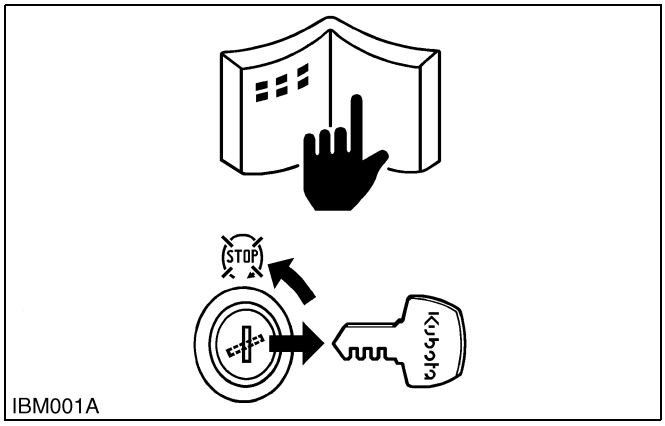

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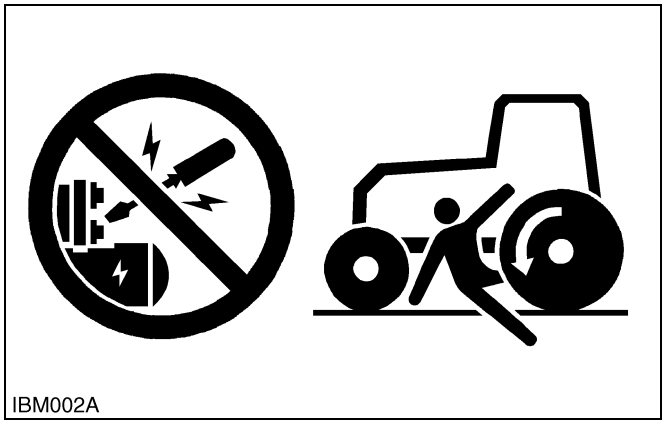
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## BEFORE YOU START SERVICE

- 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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## 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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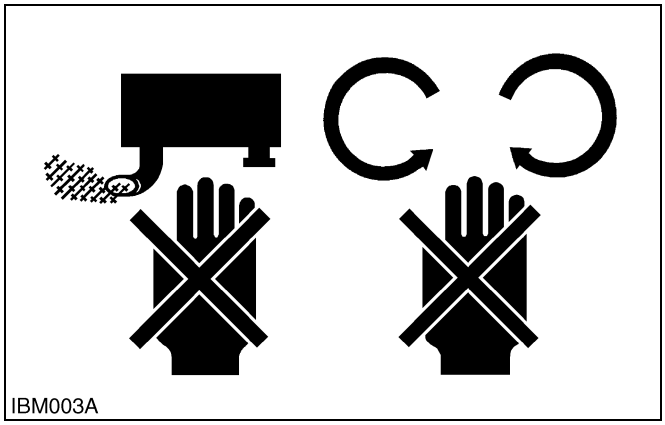
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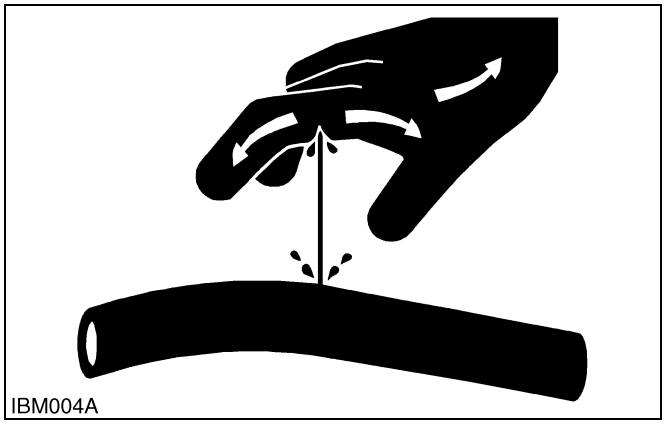
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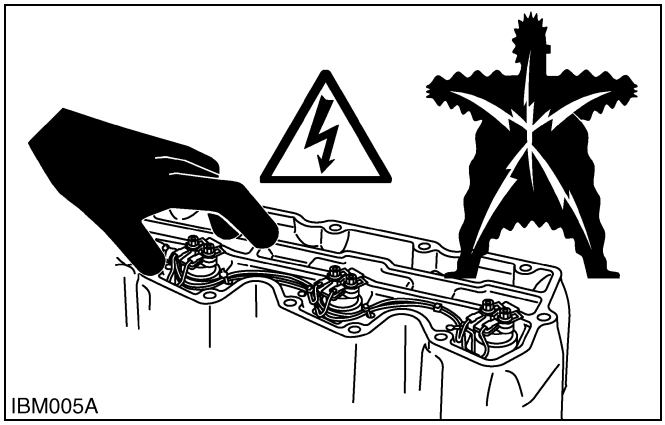
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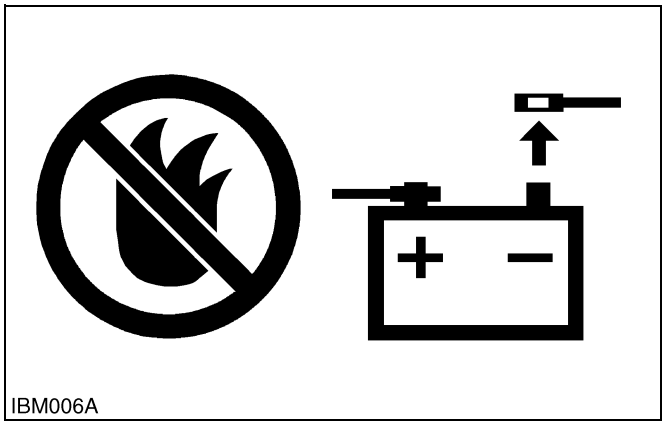
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## OPERATE SAFELY

- 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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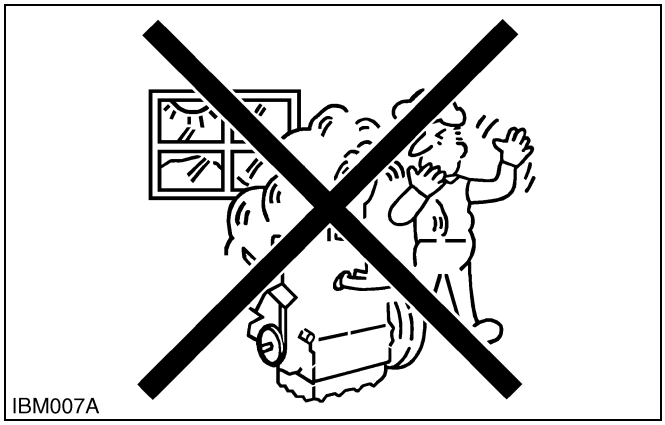
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## KEEP A GOOD AIRFLOW IN THE WORK AREA

- 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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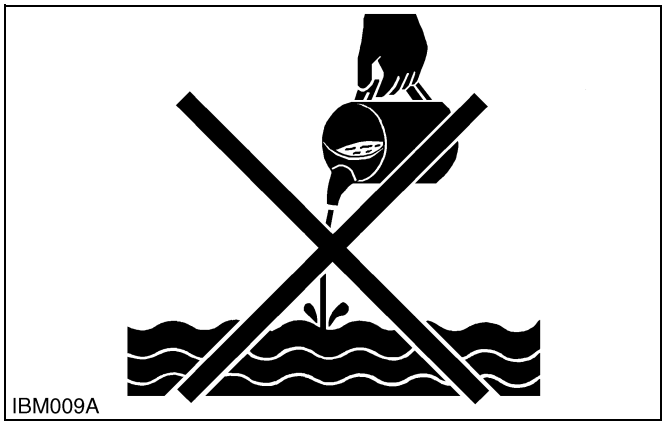
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## DISCARD FLUIDS CORRECTLY

- 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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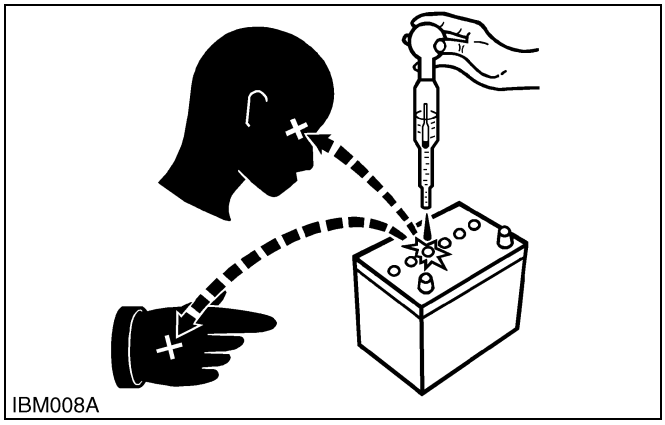
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## PREVENT ACID BURNS

- 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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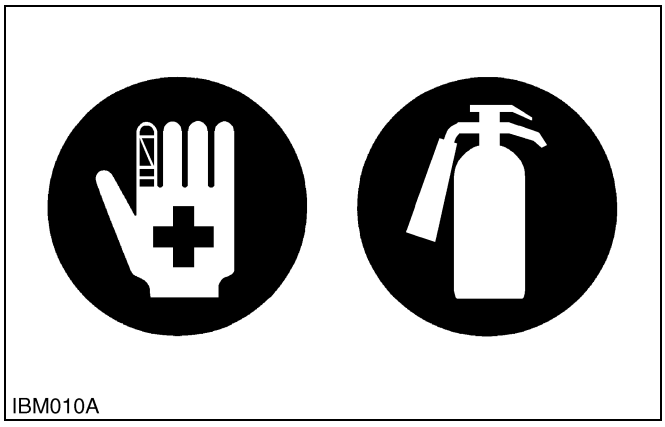
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## PREPARE FOR EMERGENCIES

- 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 (pictorial safety labels) 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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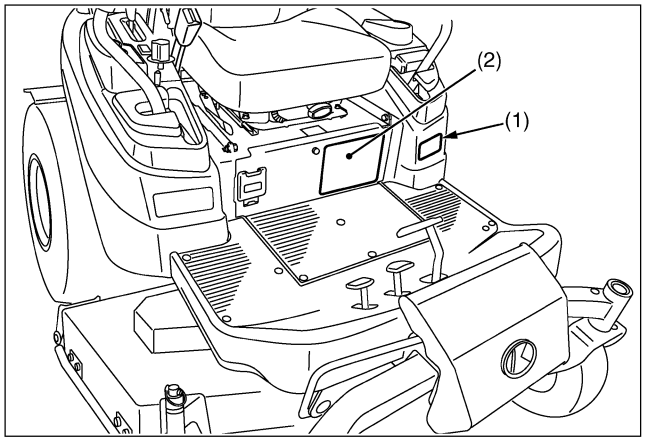
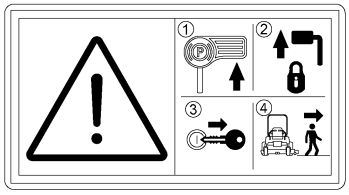



(1) Part No. K3173-6585-2

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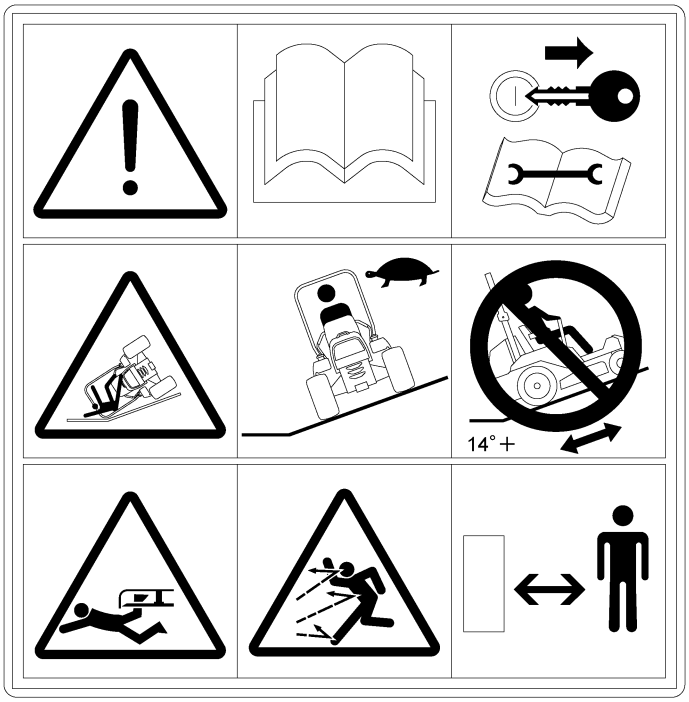
- Park the machine on level ground.
- If necessary to park on an incline,
  (1) Stop the machine,
  (2) Apply the parking brake, then
  (3) Stop the engine.
- If you stop the engine on an incline without applying the parking brake, the machine could move and run away.

(2) Part No. K3173-6581-2

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**TO AVOID INJURY OR DEATH:**

- Read and understand operator's manual.
- Stop the engine and remove key before servicing.
- DO NOT operate where machine could slip or tip.
- Mow across slopes, not up and down. Use slow speed on slopes.
- DO NOT operate on slopes of more than 14˚.
- DO NOT allow any bystanders or children around or near machine at any time when the engine is running.

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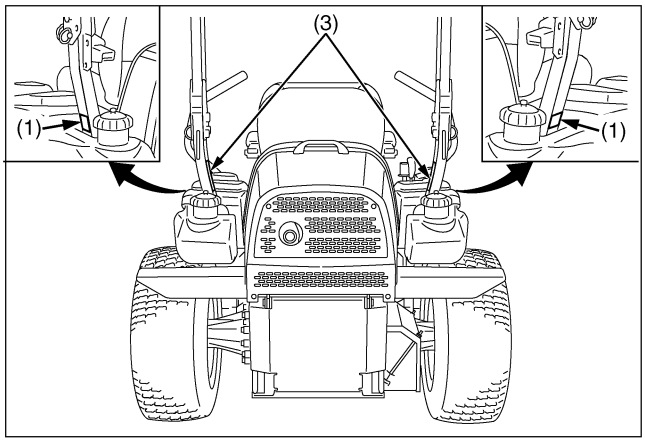
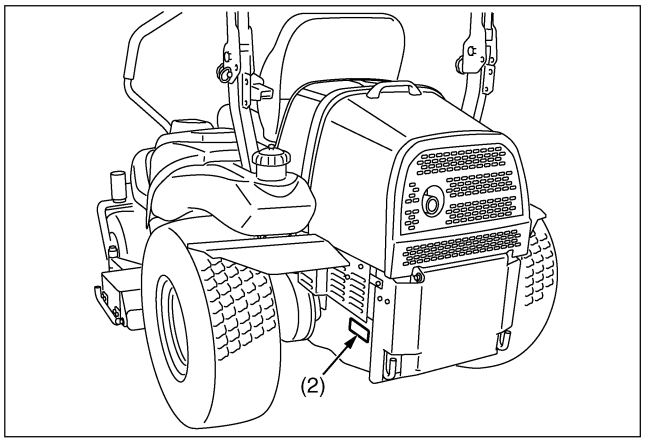
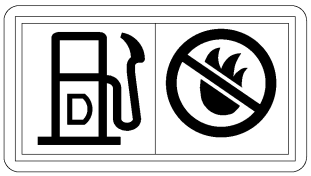



(1) Part No. K3173-6587-1
- Diesel fuel only
- No fire



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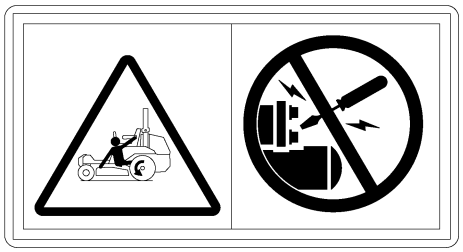
(2) Part No. K3173-6583-2
- Machine may start in gear and move
- Start engine only from operator's seat with motion control levers in neutral lock position and PTO OFF. Never start engine while standing on the ground.
- Do not start engine by shorting across starter terminals or bypassing the safety start switch.



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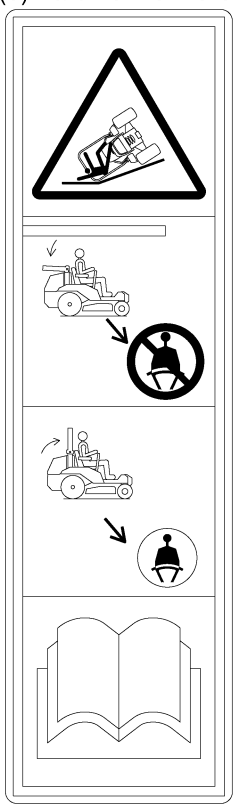
(3) Part No. K3173-6590-2



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- Machine rollover - Crush
- Do not use the seat belt if the ROPS is folded. Fold the ROPS down only when absolutely necessary and fold it up and lock it again as soon as vertical clearance allows.
- Always use the seat belt when the ROPS is in the upright position. Keep the ROPS in the upright and locked position.
- Never modify or repair the ROPS because welding, bending, drilling, grinding, or cutting any portion may weaken the structure.

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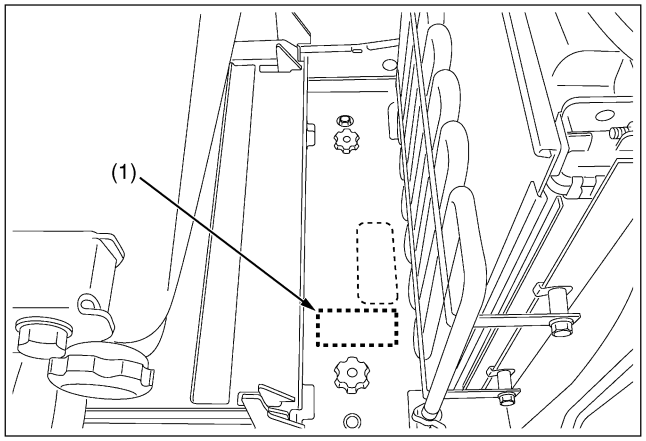
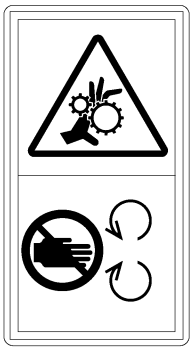



(1) Part No. K3173-6591-2

- Do not get your hands close to fan belt.



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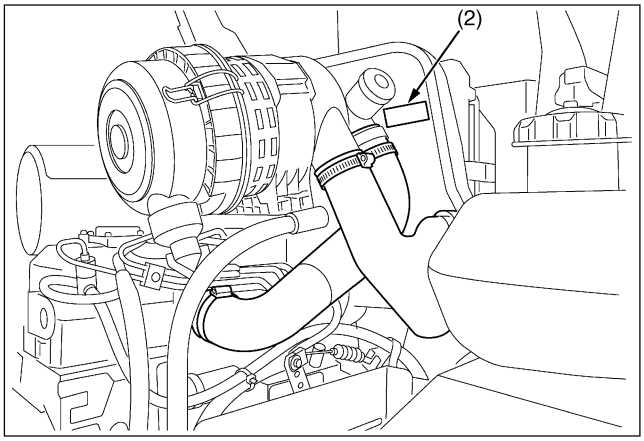
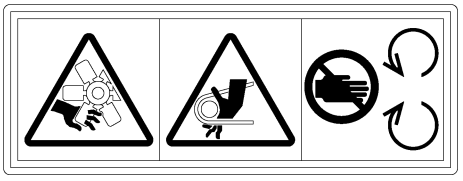



(2) Part No. K3173-6586-2

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



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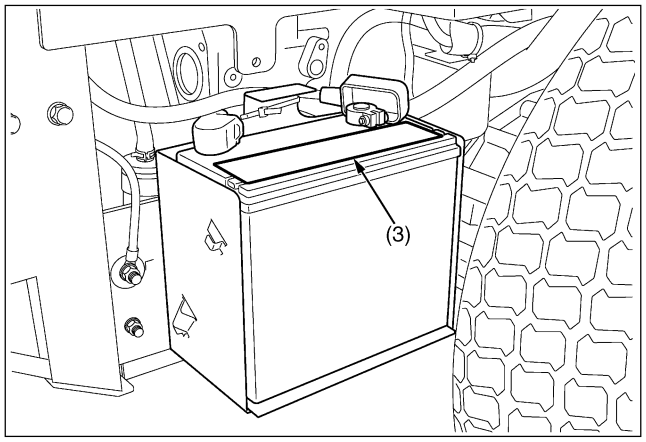


(3) Part No. K3181-6115-1


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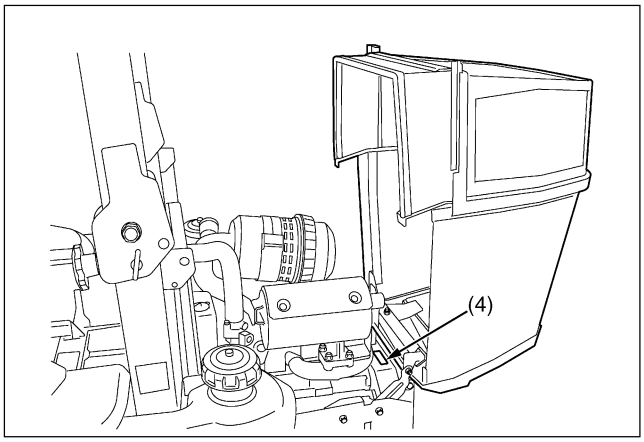
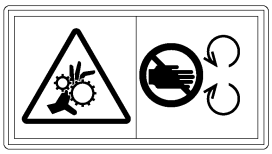



(4) Part No. K3173-6594-2

- Do not get your hands close to flywheel.



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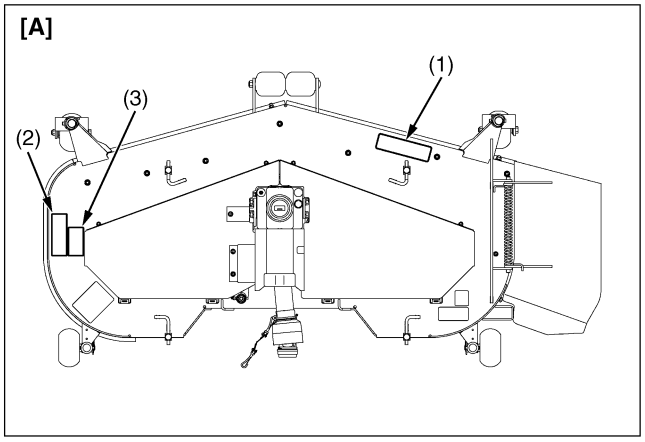
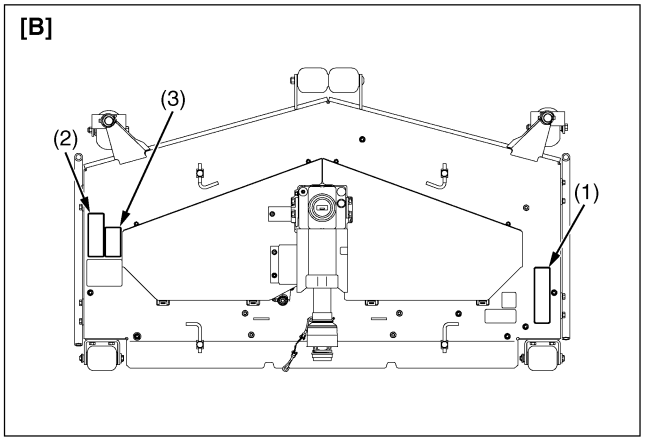
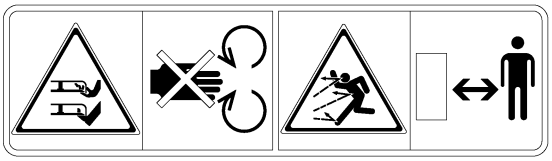



[A] RCK60P- 326Z-EU




[B] RCK60R- 326Z-EU

(1) Part No. K5652-4178-2
- Severing of hands or feet - blade
- Do not put hands or feet into mower when engine is running.
- Thrown or flying objects - Full body exposure
- Stay clear of discharge opening at all times.
- Do not operate mower without discharge deflector.



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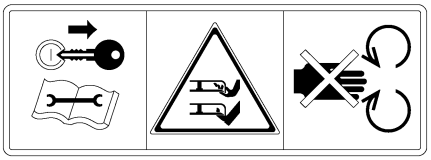
(2) Part No. K5652-4179-3
- Severing of hands or feet - blade
- Shut off engine and remove key before performing maintenance or repair work
- Do not put hands or feet into mower when engine is running.



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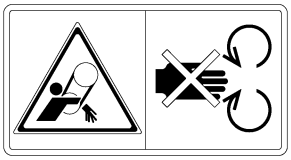
(3) Part No. K5652-4180-2
- Hand and arm entanglement - Belt drive
- Do not get your hands close to driving belt.



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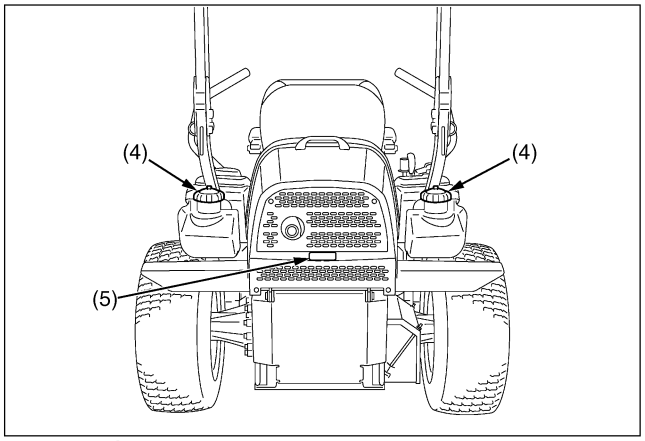


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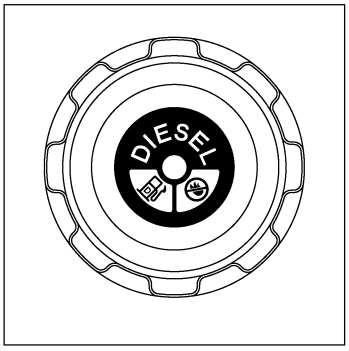
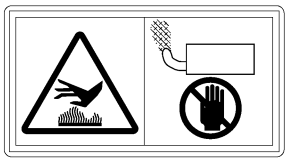
(4) Part No. K3181-2481-1




(5) Part No. K3173-6532-2
- Hot surface - Burn to finger or hand
- Do not touch muffler.



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## CARE OF PICTORIAL SAFETY LABELS

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

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# 3. SPECIFICATIONS

| Model | | | ZD326-60-EU | ZD326-60R-EU |
|---|---|---|---|---|
| Engine | Model | | D1005-E3-ZD-2 | |
| | Max. engine power (Gross) | | 19.4 kW (26 HP)*1 | |
| | Type | | Liquid-cooled | |
| | Number of cylinders | | 3 | |
| | Bore and stroke | | 76.0 x 73.6 mm (2.99 x 2.90 in.) | |
| | Total displacement | | 1001 $cm^3$ (61.1 cu.in.) | |
| | Rated revolution | | 3200 $min^{-1}$ (rpm) | |
| | Low idling revolution | | 1250 to 1350 $min^{-1}$ (rpm) | |
| | Fuel | | Diesel fuel No. 1 [below -10°C (14°F)]<br>Diesel fuel No. 2 [above -10°C (14°F)] | |
| | Starter | | Electric starter with battery, glow plug, 12 V, 1.1kW | |
| | Lubrication | | Forced lubrication by gear pump | |
| | Cooling | | Liquid with pressurized radiator | |
| | Battery | | 51 R (12 V, RC: 70 min, CCA: 475 A) | |
| Capacities | Fuel tank | | 49 L (13 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 (3.7 U.S.qts, 3.1 Imp.qts) | |
| | Recovery tank | | 0.25 L (0.26 U.S.qts, 0.22 Imp.qts) | |
| | Transmission including rear axle gear case | | 12.1 L (12.8 U.S.qts, 10.6 Imp.qts)*2 | |
| Dimensions | Overall length | | 2220 mm (87.4 in.) | |
| | Overall width without mower deck | | 1460 mm (57.5 in.) | |
| | Overall height | With ROPS upright | 1915 mm (75.4 in.) | |
| | | With ROPS folded | 1555 mm (61.2 in.) | |
| | Wheel base | | 1410 mm (55.5 in.) | |
| | Minimum ground clearance | | 130 mm (5.12 in.)<br>w/RCK60P, w/RCK60R | |
| | Tread | Front | 975 mm (38.4 in.) | |
| | | Rear | 1150 mm (45.3 in.) | |
| Weight (w/o fuel, w/ mower deck) | | | 808 kg (1782 lbs) with RCK60P, RCK60R | |
| Traveling system | Tires | Front | 15 x 6.0 - 6 (4PR) Rib | |
| | | Rear | 26 x 12.0 - 12 (4PR) Turf | |
| | Traveling speeds | Forward | 0 to 9.3 mph (0 to 15.0 km/h)*3 | |
| | | Reverse | 0 to 5.2 mph (0 to 8.3 km/h)*3 | |
| | 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 (2530 $min^{-1}$ (rpm) at 3200 engine $min^{-1}$ (rpm)) | |
| | Drive system | | Shaft drive, KUBOTA 10 tooth involute spline | |
| | Clutch type | | Wet multi disks | |
| | PTO brake | | Wet single disk | |

(Specifications and design are subject to change without notice)

■ **NOTE**

- ***1: Manufacturer's estimate**
- ***2: Oil amount when the oil level is at the upper level.**
- ***3: At 3200 engine $min^{-1}$ (rpm)**

| Mower Model | | | RCK60P-326Z-EU | RCK60R-326Z-EU |
|---|---|---|---|---|
| PRO Commercial Deck (Fabricated deck) | Suitable machine | | ZD326-EU | |
| | Mounting method | | Quick joint, Parallel linkage | |
| | Adjustment of cutting height | | Dial gauge | |
| | Cutting width | | 1524 mm (60.0 in.) | |
| | Cutting height | | 25 to 127mm (1.0 to 5.0 in.) | |
| | Weight (Apptox.) | | 146 kg (322 lbs.) | |
| | Blade spindle speed | | 56.0 r/s (3360 $min^{-1}$ (rpm))*1 | |
| | Blade tip velocity | | 76.6 m/s (15100 fpm.)*1 | |
| | Blade length | | 523 mm (20.6 in.) | |
| | Number of blades | | 3 | |
| | Dimensions | Total length | 980 mm (38.6 in.) | |
| | | Total width | 1854 mm (73.0 in.) | 1604 mm (63.1 in.) |
| | | Total height | 383 mm (15.1 in.) | 380 mm (15.0 in.) |

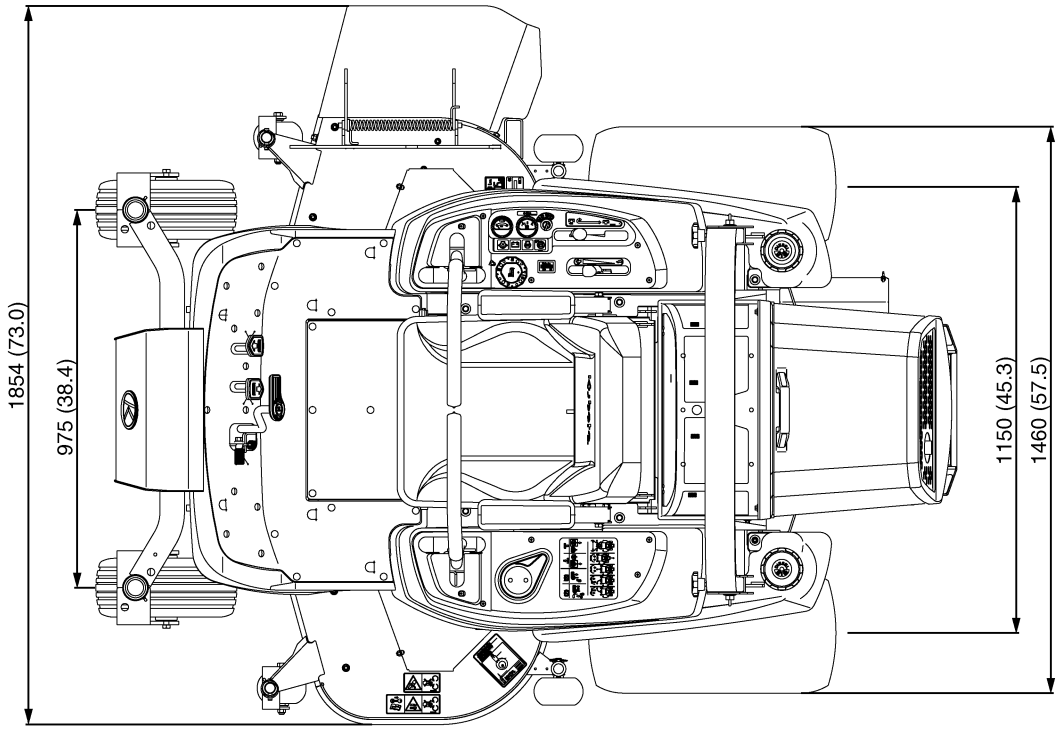
*1: Engine Max $min^{-1}$ (rpm)

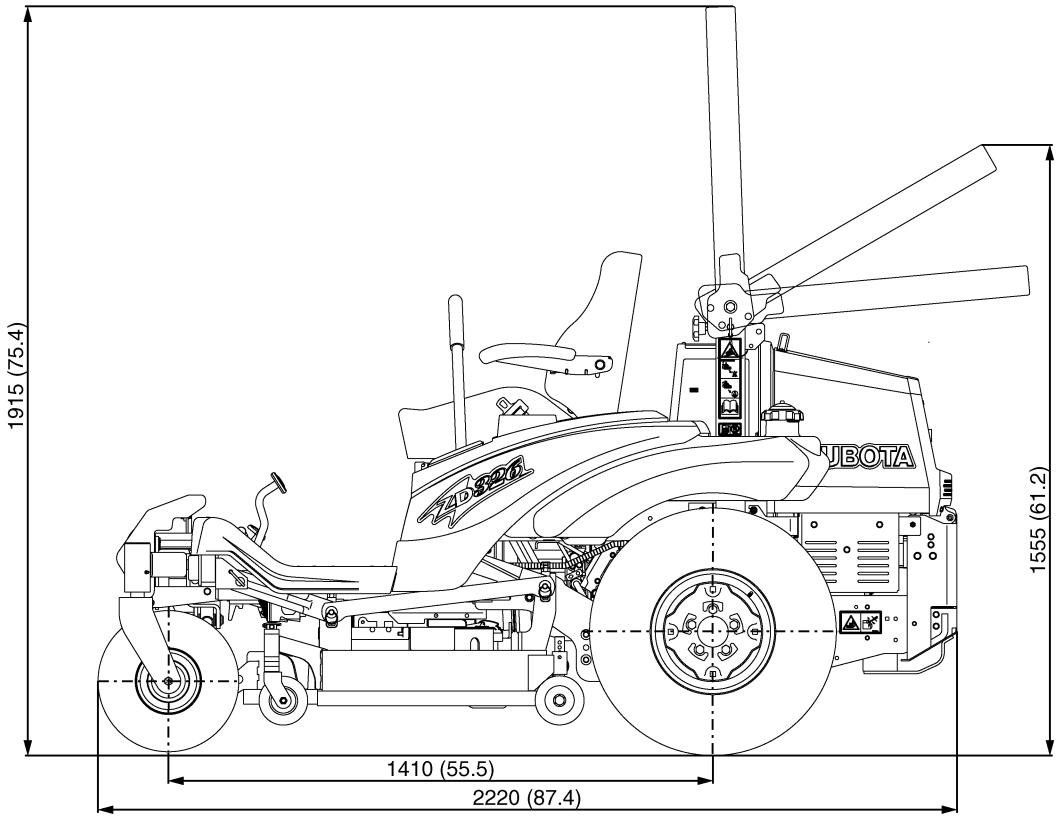
9Y1210301INI0013US0

# 4. DIMENSIONS

**ZD326-60P-EU with RCK60P-326Z-EU**

Unit : mm (in.)

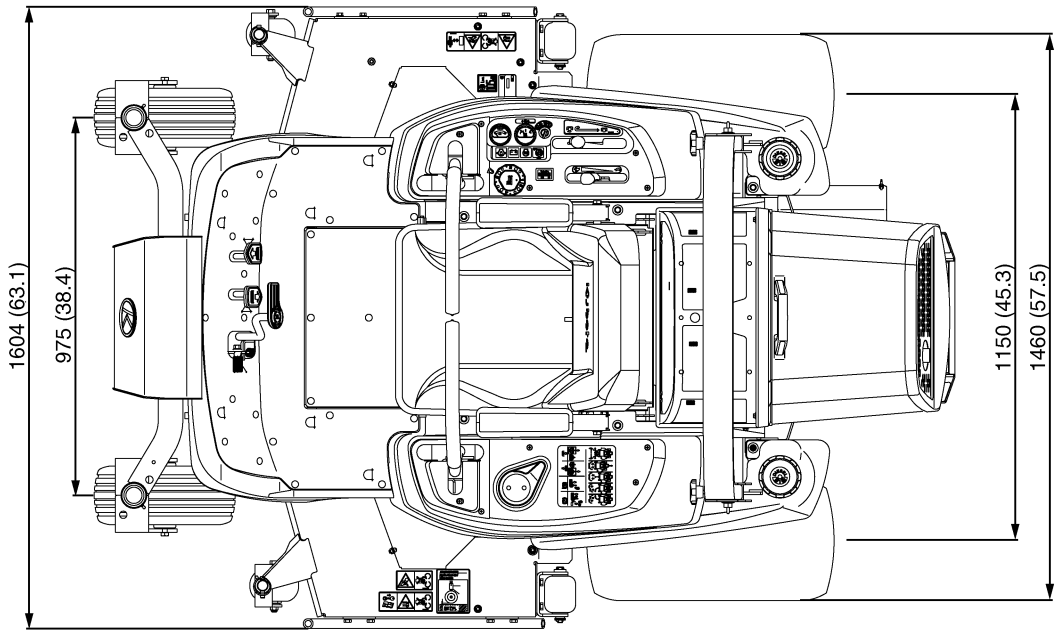


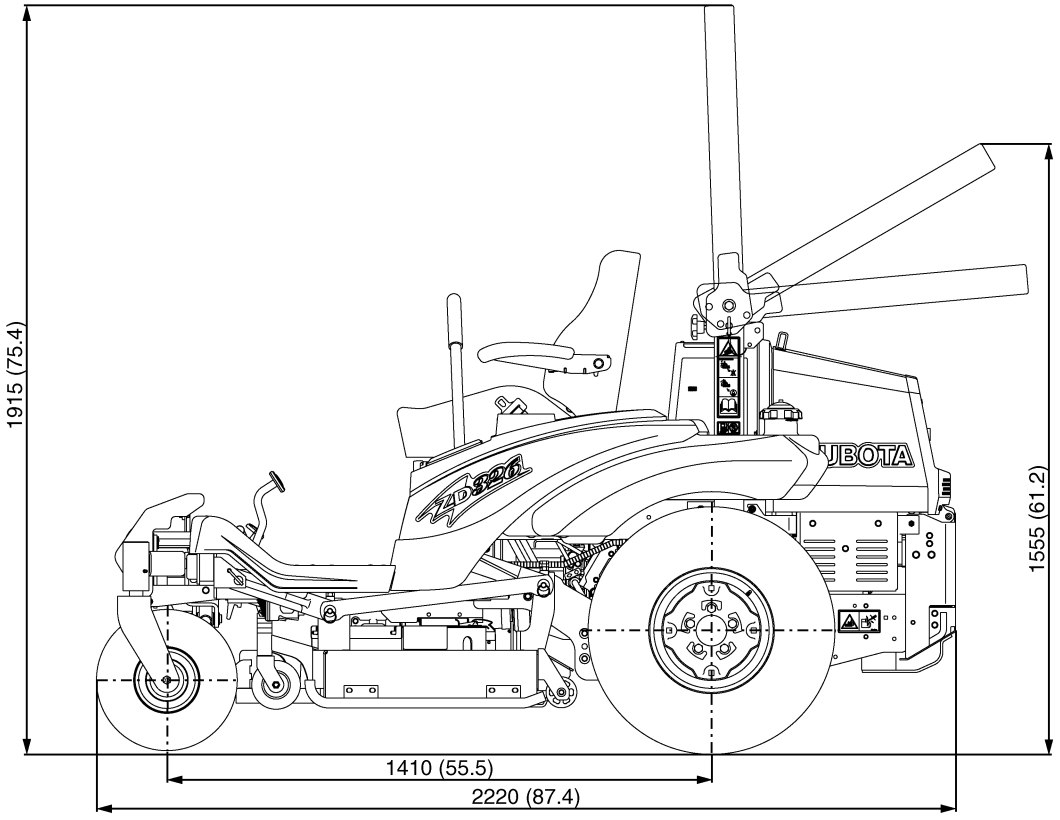




9Y1210301IFI001A

## ZD326-60R-EU with RCK60R-326Z-EU

Unit : mm (in.)




9Y1210301IFI002A

9Y1210301INI0014US0

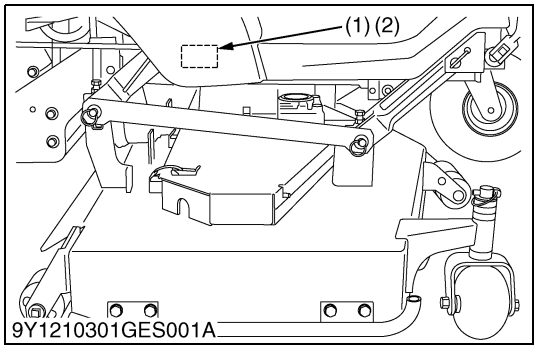
# G GENERAL

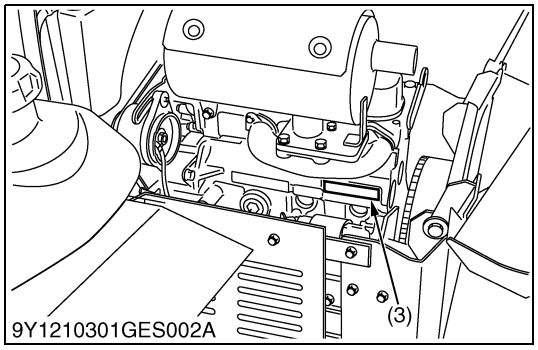
# GENERAL

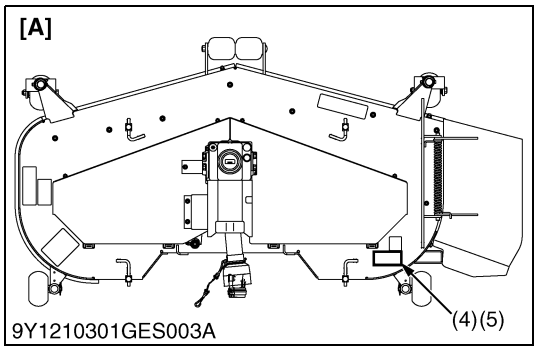
## CONTENTS

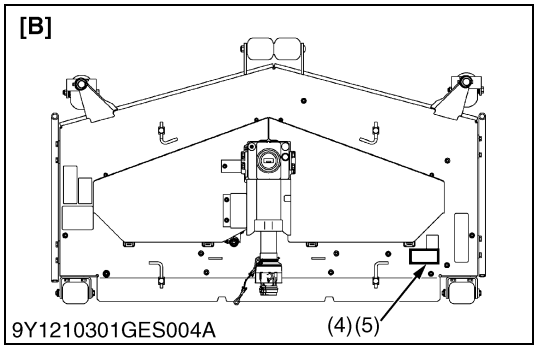
# 1. IDENTIFICATION

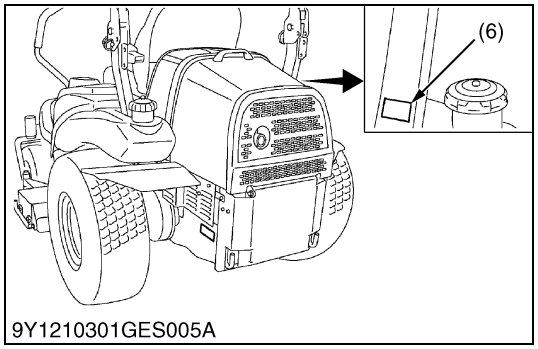
## [1] MODEL NAME AND SERIAL NUMBER



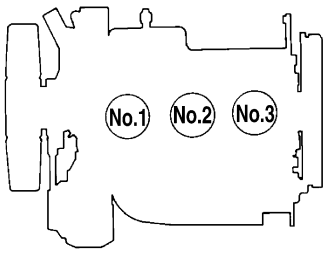

When contacting your local KUBOTA distributor, always specify engine serial number (3), machine serial number (2), mower serial number (4) and hour meter reading.

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

**[A] RCK60P-326Z-EU**
**[B] RCK60R-326Z-EU**

9Y1210301GEG0016US0

# [2] CYLINDER NUMBER



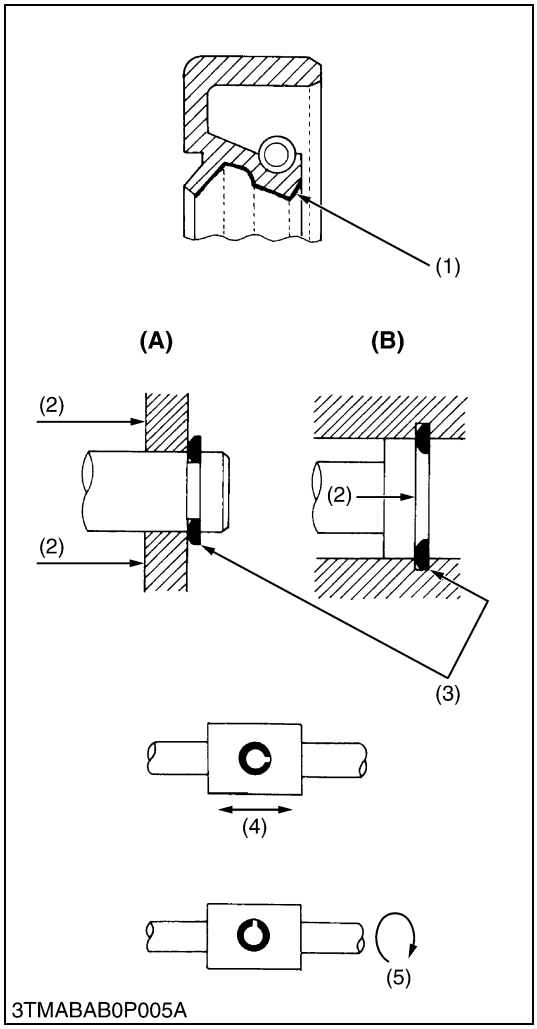

3EEACAA1P067A

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.

9Y1210301GEG0017US0

# 2. GENERAL PRECAUTIONS



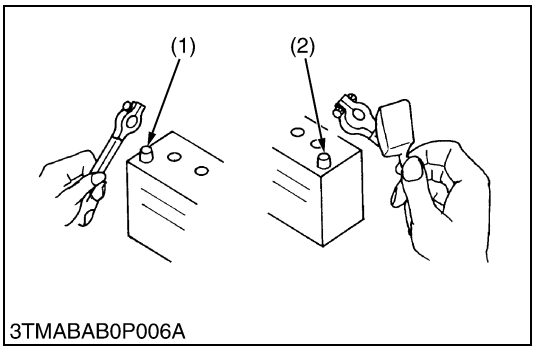

- During disassembly, carefully arrange removed parts in a clean area to prevent confusion later. Screws, bolts and nuts should be installed in their original position to prevent reassembly errors.
- When special tools are required, use KUBOTA genuine special tools. Special tools which are not frequently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

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

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

9Y1210301GEG0018US0

# 3. HANDLING PRECAUTIONS FOR ELECTRICAL PARTS AND WIRING



3TMABAB0P006A

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

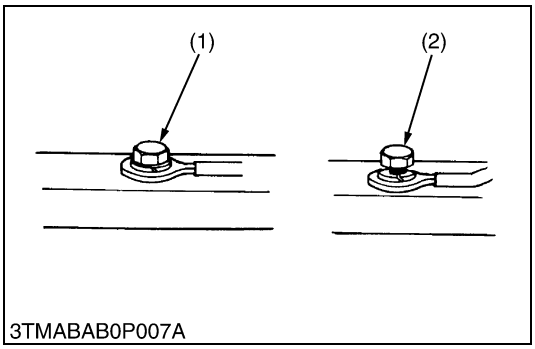
■ **IMPORTANT**

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

(1) Negative Terminal (2) Positive Terminal

9Y1210301GEG0019US0

## [1] WIRING

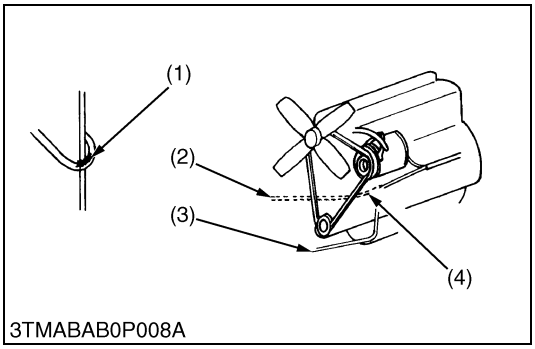


3TMABAB0P007A

- Securely tighten wiring terminals.

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

9Y1210301GEG0020US0

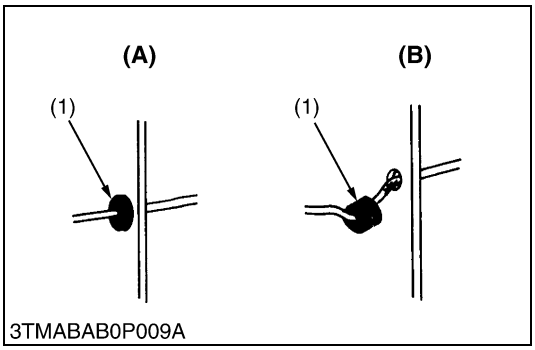


3TMABAB0P008A

- Do not let wiring contact dangerous part.

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

9Y1210301GEG0021US0

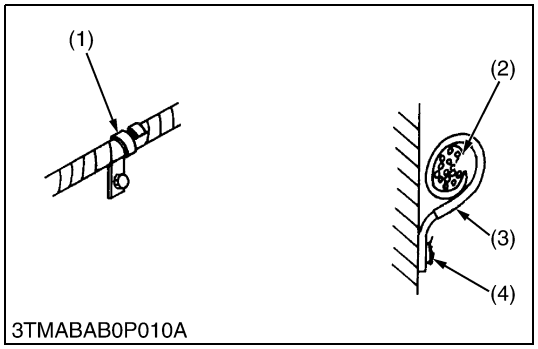


3TMABAB0P009A

- Securely insert grommet.

(1) Grommet **(A) Correct** **(B) Incorrect**

9Y1210301GEG0022US0

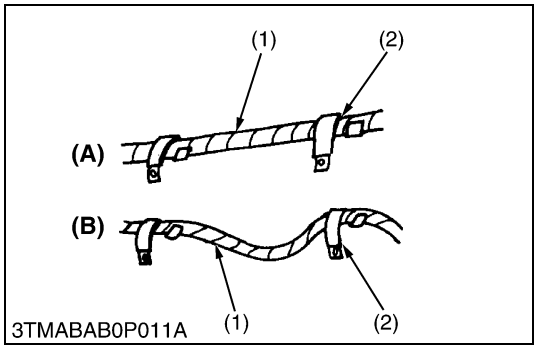


3TMABAB0P010A

- Securely clamp, being careful not to damage wiring.

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

9Y1210301GEG0023US0

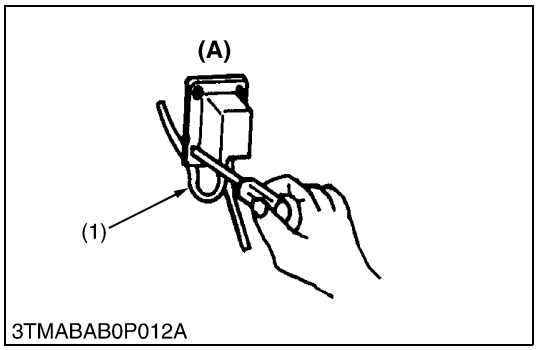


3TMABAB0P011A

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

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

9Y1210301GEG0024US0

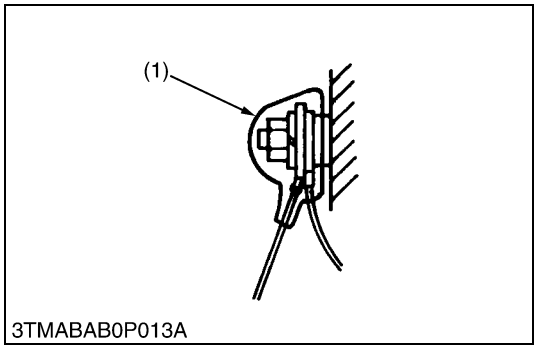


3TMABAB0P012A

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

(1) Wiring
**(A) Incorrect**

9Y1210301GEG0025US0



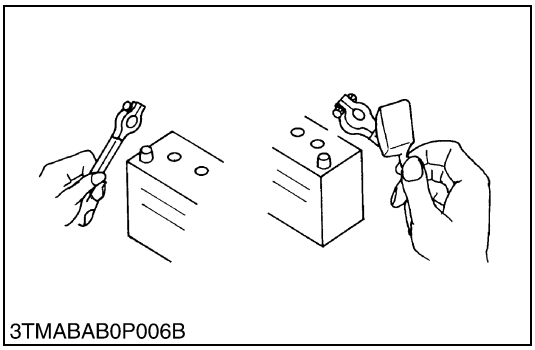
3TMABAB0P013A

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

(1) Cover (Securely Install Cover)

9Y1210301GEG0026US0

# [2] BATTERY


3TMABAB0P006B

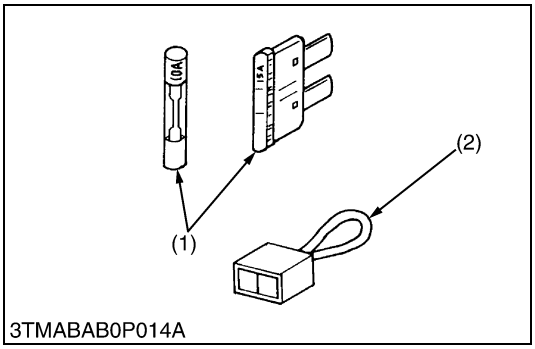
- Take care not to confuse positive and negative terminal posts.
- When removing battery cables, disconnect negative cable first. When installing battery cables, check for polarity and connect positive cable first.
- Do not install any battery with capacity other than is specified (Ah).
- After connecting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

**CAUTION**

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

9Y1210301GEG0027US0

# [3] FUSE



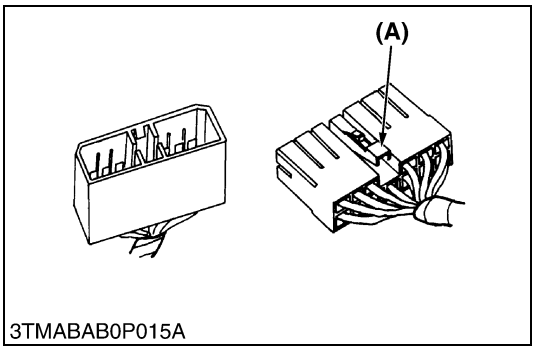
3TMABAB0P014A

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

(1) Fuse (2) Slow Blow Fuse

9Y1210301GEG0028US0

# [4] CONNECTOR

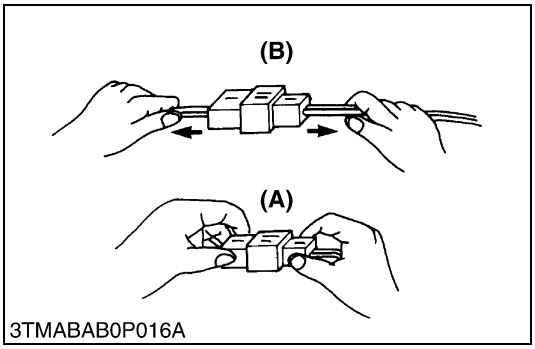


3TMABAB0P015A

- For connector with lock, push lock to separate.

**(A) Push**

9Y1210301GEG0029US0

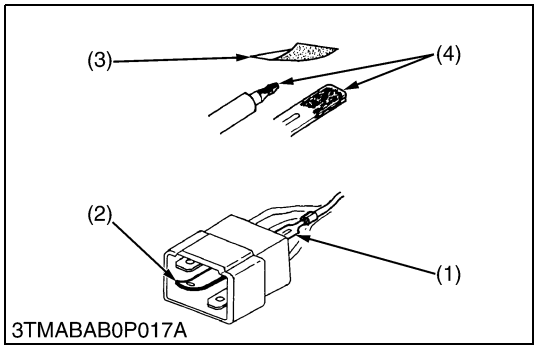


3TMABAB0P016A

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

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

9Y1210301GEG0030US0

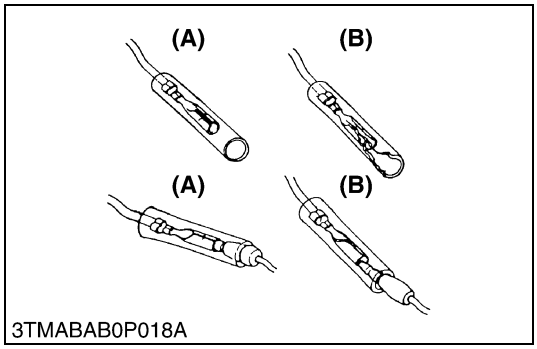


3TMABAB0P017A

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

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

9Y1210301GEG0031US0



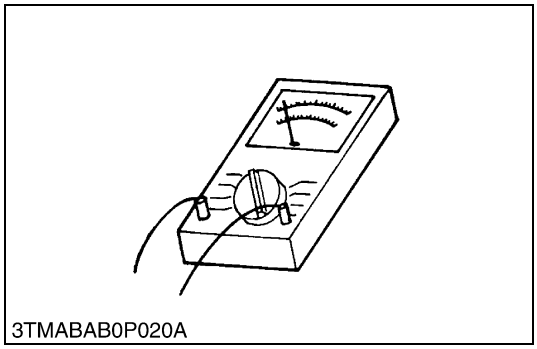
3TMABAB0P018A

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

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

9Y1210301GEG0032US0

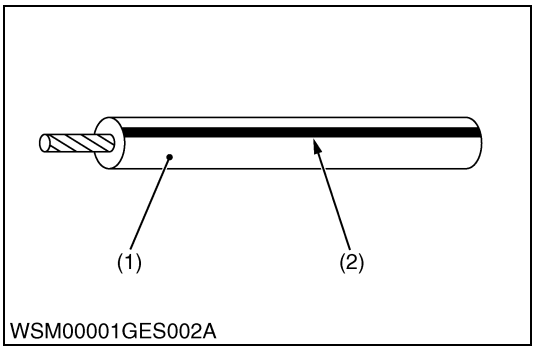
# [5] HANDLING OF CIRCUIT TESTER


3TMABAB0P020A

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

9Y1210301GEG0033US0

# [6] COLOR OF WIRING



WSM00001GES002A

- 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

# 4. LUBRICANT, FUEL AND COOLANT

| Place | Capacities | | Grade | |
|---|---|---|---|---|
| | ZD326-60-EU | ZD326-60R-EU | | |
| Fuel | 49 L<br>13 U.S.gals<br>11 Imp.gals | | • No. 2-D diesel fuel<br>• No. 1-D diesel fuel if temperature is below –10 °C (14 °F) | |
| Coolant | 3.5 L<br>3.7 U.S.qts<br>3.1 Imp.qts | | Fresh clean water (soft water) with anti-freeze | |
| Recovery tank | 0.25 L<br>0.26 U.S.qts<br>0.22 Imp.qts | | | |
| Engine crankcase | 3.9 L*<br>4.1 U.S.qts<br>3.4 Imp.qts | | Engine oil: API Service Classification CF or better<br>• Below 0 °C (32 °F)<br>SAE10, SAE10W-30 or 15W-40<br>• 0 to 25 °C (32 to 77 °F)<br>SAE20, SAE10W-30 or 15W-40<br>• Above 25 °C (77 °F)<br>SAE30W, SAE10W-30 or 15W-40 | |
| Transmission case with filter & hose and rear axle gear case (RH and LH) | 12.1 L<br>12.8 U.S.qts<br>10.6 Imp.qts | | KUBOTA UDT or SUPER UDT fluid*1 | |
| Mower gear box | 0.4 L<br>0.4 U.S.qts<br>0.4 Imp.qts | | SAE 90 gear oil<br>(API service classification: more than GL-3) | |
| **Greasing** | **No. of greasing points** | | **Capacity** | **Type of grease** |
| Motion control lever pivot bushing, and contact position | 6 | | Until grease overflows | • Multipurpose EP2 Grease (NLGI Grade No. 2) |
| King pin | 2 | | | |
| Center pin | 1 | | | |
| Front wheel | 2 | | | |
| Front lift arm | 2 | | | |
| Universal joint | 3 | | | |
| Seat adjuster | 2 | | | |
| Cable (throttle) | 2 | | Moderate amount | • Oil |
| **[MOWER]** | | | | |
| Universal joint | 3 | | Until grease overflows | • Multipurpose EP2 Grease (NLGI Grade No. 2) |
| Three spindle shafts | 3 | | | |
| Belt tension pulley | 1 | | | |
| Belt tension pivot | 1 | | | |
| Front anti-scalp roller | 2 | | | |
| Front anti-scalp roller pivot boss | 2 | | | |

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

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

9Y1210301GEG0034US0

■ **NOTE**

**Fuel**

- **Cetane number of 45 minimum. Cetane number greater than 50 is preferred, especially for temperatures below −20 °C or elevations above 1500 m.**
- **If diesel fuel with sulfur content greater than 0.5% sulfur content is used, reduce the service interval for engine oil and filter by 50%.**
- **DO NOT use diesel fuel with sulfur content greater than 1.0%.**
- **Diesel fuels specified to EN 590 or ASTM D975 are recommended.**
- **No.2-D is a distillate fuel of lower volatility for engine in industrial and heavy mobile service. (SAE J313JUB87)**
- **Since this engine adopts EPA Tier 4 and Interim Tier 4 standards, the use of low sulfur fuel or ultra low sulfur fuel is mandatory in EPA regulated area (North America). Therefore , please use No.2-D S500 or S15 diesel fuel as an alternative to No.2-D, or use No.1-D S500 or S15 diesel fuel as an alternative to No.1-D if outside air temperature is below −10°C.**

**Engine Oil**

- **Oil used in the engine should have an American Petroleum Institute (API) service classification and Proper SAE Engine Oil according to the ambient temperatures as shown above:**
- **With the emission control now in effect, the CF-4 and CG-4 lubricating oils have been developed for use of a low-sulfur fuel on on-road vehicle engines. When an off-road vehicle engine runs on a high-sulfur fuel, it is advisable to employ the "CF or better" lubricating oil with a high Total Base Number (TBN). If the "CF-4, CG-4, CH-4 or CI-4" lubricating oil is used with a high-sulfur fuel, change the lubricating oil at shorter intervals. (approximately half)**
- **Lubricating oil recommended when a low-sulfur or high-sulfur fuel is employed.**

| Lubricants class | Fuel | | Remarks |
|---|---|---|---|
| | Low sulfur (0.5 % ≥) | High sulfur | |
| CF | ❍ | ❍ | TBN ≥ 10 |
| CF-4 | ❍☆ | X | |
| CG-4 | ❍☆ | X | |
| CH-4 | ❍☆ | X | |
| CI-4 | ❍ | X | |

❍: Recommendable X: Not recommendable

☆: Class CF-4, CG-4 and CH-4 engine oils cannot be used on EGR (Exhaust Gas Re-circulation) type engines.

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

**Transmission oil**

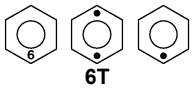
- **The oil used to lubricate the transmission is also used as hydraulic fluid. To insure proper operation of the hydraulic system and to complete lubrication of the transmission, it is important that a multi-grade transmission fluid is used in this system. We recommend the use of KUBOTA UDT or SUPER UDT fluid for optimum protection and performance.**
  **Do not mix different brands together.**
- **Indicated capacities of water and oil are manufacturer's estimate.**

9Y1210301GEG0035US0

# 5. TIGHTENING TORQUES

## [1] GENERAL USE SCREWS, BOLTS AND NUTS

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

| Indication on top of bolt |  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 to 9.3 | 0.80 to 0.95 | 5.8 to 6.8 | 7.9 to 8.8 | 0.80 to 0.90 | 5.8 to 6.5 | 9.81 to 11.2 | 1.00 to 1.15 | 7.24 to 8.31 | 7.9 to 8.8 | 0.80 to 0.90 | 5.8 to 6.5 | 12.3 to 14.2 | 1.25 to 1.45 | 9.05 to 10.4 |
| M8 | 18 to 20 | 1.8 to 2.1 | 13 to 15 | 17 to 19 | 1.7 to 2.0 | 13 to 14 | 24 to 27 | 2.4 to 2.8 | 18 to 20 | 18 to 20 | 1.8 to 2.1 | 13 to 15 | 30 to 34 | 3.0 to 3.5 | 22 to 25 |
| M10 | 40 to 45 | 4.0 to 4.6 | 29 to 33 | 32 to 34 | 3.2 to 3.5 | 24 to 25 | 48 to 55 | 4.9 to 5.7 | 36 to 41 | 40 to 44 | 4.0 to 4.5 | 29 to 32 | 61 to 70 | 6.2 to 7.2 | 45 to 52 |
| M12 | 63 to 72 | 6.4 to 7.4 | 47 to 53 | – | – | – | 78 to 90 | 7.9 to 9.2 | 58 to 66 | 63 to 72 | 6.4 to 7.4 | 47 to 53 | 103 to 117 | 10.5 to 12.0 | 76.0 to 86.7 |
| M14 | 108 to 125 | 11.0 to 12.8 | 79.6 to 92.5 | – | – | – | 124 to 147 | 12.6 to 15.0 | 91.2 to 108 | – | – | – | 167 to 196 | 17.0 to 20.0 | 123 to 144 |
| M16 | 167 to 191 | 17.0 to 19.5 | 123 to 141 | – | – | – | 197 to 225 | 20.0 to 23.0 | 145 to 166 | – | – | – | 260 to 304 | 26.5 to 31.0 | 192 to 224 |
| M18 | 246 to 284 | 25.0 to 29.0 | 181 to 209 | – | – | – | 275 to 318 | 28.0 to 32.5 | 203 to 235 | – | – | – | 344 to 402 | 35.0 to 41.0 | 254 to 296 |
| M20 | 334 to 392 | 34.0 to 40.0 | 246 to 289 | – | – | – | 368 to 431 | 37.5 to 44.0 | 272 to 318 | – | – | – | 491 to 568 | 50.0 to 58.0 | 362 to 419 |

WSM000001GEG0001US1

## [2] STUD BOLTS

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

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# [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 |

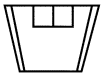
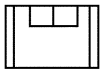
WSM000001GEG0003US1

# [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 | 1.19 to 1.61 | 8.61 to 11.6 | 16.3 to 19.7 | 1.66 to 2.01 | 12.0 to 14.6 |
| 5/16 | 23.1 to 27.7 | 2.35 to 2.83 | 17.0 to 20.5 | 33 to 39 | 3.4 to 4.0 | 24 to 29 |
| 3/8 | 48 to 56 | 4.9 to 5.8 | 35.0 to 42.0 | 61 to 73 | 6.3 to 7.4 | 45 to 54 |
| 1/2 | 110 to 130 | 11 to 13 | 80 to 96 | 150 to 178 | 15.2 to 18.2 | 110 to 132 |
| 9/16 | 150 to 178 | 15.2 to 18.2 | 110 to 132 | 217 to 260 | 22.2 to 26.5 | 160 to 192 |
| 5/8 | 204 to 244 | 20.8 to 24.8 | 150 to 180 | 299 to 357 | 30.5 to 36.4 | 220 to 264 |

WSM000001GEG0004US0

# [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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# 6. MAINTENANCE CHECK LIST

| No. | Item | | | Service Interval | | | | | | | | | | | | After since | Reference page | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 550 | 600 | | | |
| 1 | Engine oil | | Change | ★ | | | ☆ | | | | ☆ | | | | ☆ | every 200 Hr | G-21 | |
| 2 | Engine oil filter | | Replace | ★ | | | ☆ | | | | ☆ | | | | ☆ | every 200 Hr | G-21 | |
| 3 | Transmission oil filter [HST] | | Replace | ★ | | | ☆ | | | | ☆ | | | | ☆ | every 200 Hr | G-22 | |
| 4 | Front axle pivot | | Adjust | | ★ | | ☆ | | | | ☆ | | | | ☆ | every 200 Hr | G-22 | |
| 5 | Safety device | | Check | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | every 50 Hr | G-23 | |
| 6 | King pin, Center pin etc. | | Greasing | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | every 50 Hr | G-25 | |
| | Throttle cable | | Oil | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | every 50 Hr | G-26 | |
| 7 | Mower gear box oil | | Check | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | ☆ | every 50 Hr | G-26 | |
| | | | Change | | | ☆ | | | ☆ | | | ☆ | | | ☆ | every 150 Hr | G-26 | |
| 8 | Air cleaner | Primary element | Clean | | ☆ | | ☆ | | ☆ | | ☆ | | ☆ | | ☆ | every 100 Hr | G-27 | *1 |
| | | | Replace | | | | | | | | | | | | | every 1 years | G-27 | |
| | | Secondary element | Replace | | | | | | | | | | | | | every 1 years | G-35 | |
| 9 | Battery condition | | Check | | ☆ | | ☆ | | ☆ | | ☆ | | ☆ | | ☆ | every 100 Hr | G-27 | |
| 10 | Fuel line | | Check | | ☆ | | ☆ | | ☆ | | ☆ | | ☆ | | ☆ | every 100 Hr | G-29 | |
| | | | Replace | | | | | | | | | | | | | every 2 years | G-29 | *2 |
| 11 | Fuel filter element | | Check | | ☆ | | ☆ | | ☆ | | ☆ | | ☆ | | ☆ | every 100 Hr | G-29 | |
| | | | Replace | | | | | | | | ☆ | | | | | every 400 Hr | G-29 | *2 |
| 12 | Fan belt | | Adjust | | ☆ | | ☆ | | ☆ | | ☆ | | ☆ | | ☆ | every 100 Hr | G-29 | |
| 13 | Parking brake | | Adjust | | ☆ | | ☆ | | ☆ | | ☆ | | ☆ | | ☆ | every 100 Hr | G-30 | *2 |
| 14 | Radiator hose and clamp | | Check | | | | ☆ | | | | ☆ | | | | ☆ | every 200 Hr | G-31 | |
| | | | Replace | | | | | | | | | | | | | every 2 years | G-31 | *2 |
| 15 | Hydraulic hose | | Check | | | | ☆ | | | | ☆ | | | | ☆ | every 200 Hr | G-32 | |
| | | | Replace | | | | | | | | | | | | | every 2 years | G-32 | *2 |
| 16 | Motion control lever pivot | | Adjust | | | | ☆ | | | | ☆ | | | | ☆ | every 200 Hr | G-32 | |
| 17 | Intake air line | | Check | | | | ☆ | | | | ☆ | | | | ☆ | every 200 Hr | G-32 | |
| | | | Replace | | | | | | | | | | | | | every 2 years | G-32 | *4 |
| 18 | Transmission fluid and rear axle gear case (RH & LH) fluid | | Change | | | | | | | | ☆ | | | | | every 400 Hr | G-34 | |
| 19 | Hydraulic oil filter | | Replace | | | | | | | | ☆ | | | | | every 400 Hr | G-33 | |
| 20 | Fuel injection nozzle injection pressure | | Check | | | | | | | | | | | | | every 1500Hr | 1-S17 | *3 |
| 21 | Injection pump | | Check | | | | | | | | | | | | | every 3000Hr | 1-S16 | *3 |

| No. | Item | | Service Interval | | | | | | | | | | | | After since | Reference page | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 550 | 600 | | | |
| 22 | Radiator | Clean | | | | | | | | | | | | | every 1 years | G-36 | |
| 23 | Flushing and coolant | Change | | | | | | | | | | | | | every 1 years | G-36 | |
| 24 | Mower gear box oil seal | Replace | | | | | | | | | | | | | every 2 years | G-38 | *2 |
| 25 | Fuel system | Bleed | | | | | | | | | | | | | Service as required | G-41 | |
| 26 | Fuse | Replace | | | | | | | | | | | | | | G-39 | |
| 27 | Blade | Replace | | | | | | | | | | | | | | G-40 | |
| 28 | Mower belt | Replace | | | | | | | | | | | | | | G-41 | |

■ **IMPORTANT**

- **The jobs indicated by ★ must be done initially.**

***1 This maintenance should be done daily more often in dusty condition than in normal conditions. Suggested cleaning interval is every 100 hours in normal conditions.**

***2 These items should be serviced by an authorized KUBOTA Dealer, unless the owner has the proper tools and is mechanically proficient.**

***3 Consult your local KUBOTA Dealer for this service.**

***4 Replace only if necessary.**

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# 7. PERIODIC SERVICE CHART LABEL

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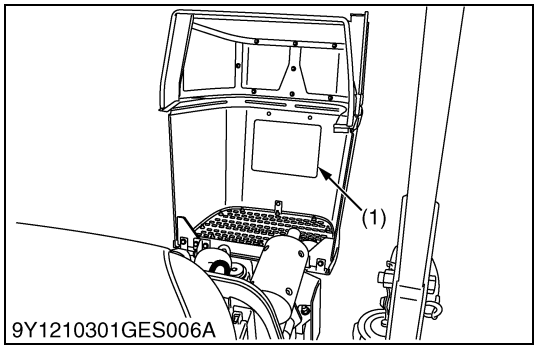


(1) Part No. K3191-6552-2 (ENGLISH)

## PERIODIC SERVICE CHART

| INTERVAL | | RECOMMENDED SERVICE ※ |
|---|---|---|
| DAILY | CHECK | 1. Tire pressure, wear, or damage.<br>2. Oil and water leakage from machine and mower.<br>3. Engine and transmission oil, radiator and recovery tank coolant and fuel level.<br>4. Damage to machine body, tightness of all bolts, nuts and pins, etc.<br>5. Mower blades and belt for wear or damage.<br>6. Parking brake, speed control levers, all safety switches and easy checker functions.<br>7. Color of the exhaust fumes, abnormal noise and vibrations. |
| | CLEAN | ・Radiator screen and core, panel screen, air cleaner primary element and mower deck. |
| | GREASE | ・Mower U-joint(3 places)/Spindle shaft(3 places)/ Belt tension pulley(1 place)/ Belt tension pivot(1 place) |
| FIRST 50 Hr. 【BREAK-IN】(MUST BE DONE.) | REPLACE | ・Engine & HST Transmission oil filters（2 places） |
| | CHANGE | ・Engine oil |
| FIRST 100 Hr. (MUST BE DONE.) | ADJUST | ・Front axle pivot |
| FIRST 400 Hr. (MUST BE DONE.) | REPLACE | ・Hydraulic oil filter |
| | CHANGE | ・Transmission & Rear axle gear case(RH & LH) fluid |

| INTERVAL | | | RECOMMENDED SERVICE ※ |
|---|---|---|---|
| EVERY | 50 Hr. | CHECK | ・Mower gear box oil / Safety device |
| | | OIL | ・Throttle cable(2 places) / Motion control lever pivot bushing and contact position(2 places each) |
| | | GREASE | ・Front axle and wheel(5 places) / Universal joint(3 places) / Seat adjuster(2 places) |
| | 100 Hr. | CHECK | ・Fuel filter element / Fuel line / Battery condition |
| | | CLEAN | ・Air cleaner primary element ★ |
| | | ADJUST | ・Fan belt / Parking brake ☆ |
| | 150 Hr. | CHANGE | ・Mower gear box oil |
| | 200 Hr. | CHECK | ・Radiator hose and clamp / Hydraulic hose / Intake Air Line |
| | | REPLACE | ・Engine oil filter / HST transmission oil filter |
| | | CHANGE | ・Engine oil |
| | | ADJUST | ・Front axle pivot / Motion control lever pivot |
| | 400 Hr. | REPLACE | ・Fuel filter element / Hydraulic oil filter |
| | | CHANGE | ・Transmission & Rear axle gear case(RH & LH) fluid |
| | 1500 Hr.☆ | CHECK | ・Fuel Injection Nozzle Injection Pressure |
| | 3000 Hr.☆ | CHECK | ・Injection Pump |
| | 1 year | CLEAN | ・Radiator |
| | | REPLACE | ・Air cleaner both elements |
| | | CHANGE | ・Coolant |
| | 2 year | REPLACE ☆ | ・Radiator hose and clamp / Hydraulic hose / Fuel line / Mower gear box oil seal / Intake Air Line (if necessary) |

※ : See Operator's Manual in details.
☆ : Should be serviced by KUBOTA Dealer.
★ : Required more often in dusty conditions.

Approximate fluid capacities. unit:L(qts.)

| | ZD321(D782) | ZD323(D902) | ZD326(D1005) | ZD331(D1305) |
|---|---|---|---|---|
| Engine | 3.5(3.70) | | 3.9(4.1) | 5.7(6.0) |
| Radiator | 2.7(2.85) | | 3.5(3.70) | |
| Transmission | 12.1(12.8) | | | |
| Reserve tank | 0.25(0.26) | | | |
| Mower gear box | 0.4(0.42) | | | |

Tire pressure and tightening torque recommendation.

| | | | |
|---|---|---|---|
| Front | 15x 6.0- 6 | 160 KPa (23 psi) | Ensure smooth rotation of wheel.<Do not over tighten.> |
| | 15x 6.0- 6(NO FLAT) | NO NEED | |
| Rear | 26x10.5-12 | 120 KPa (17 psi) | 108.5-130.2 Nm(80.0-96.0 ft・lbs) |
| | 26x12.0-12 | | |

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# 8. CHECK AND MAINTENANCE

**CAUTION**

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

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## [1] DAILY CHECK

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

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**Checking**

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

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

- Mower

1. Oil leak
2. Make sure blade cap screws are tight.
3. Check blades for wear or damage.
4. Check all hardware.
5. Make sure all pins are in place.
6. Mower deck cleaning
7. Greasing (Universal joint, three spindle shafts, belt tension pulley, belt tension pivot, front anti-scalp roller, front anti-scalp roller bracket boss)

- While sitting in the operator's seat,

1. Motion control lever
2. Parking brake

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

1. Performance of the Easy Checker ™ light

- Starting the engine,

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

- Others

1. Check the areas where previous trouble was experienced.

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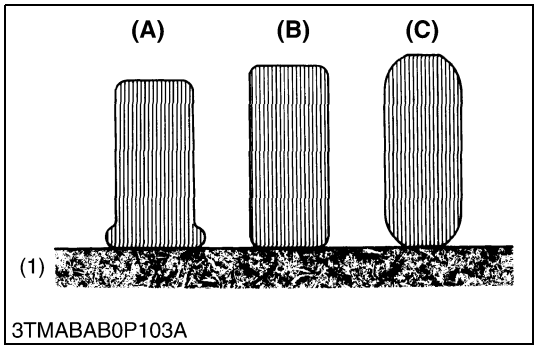

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## Checking Tire Pressure

**WARNING**

**To avoid personal injury:**

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

**■ IMPORTANT**

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

**■ Inflation Pressure**

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

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

(1) Ground

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

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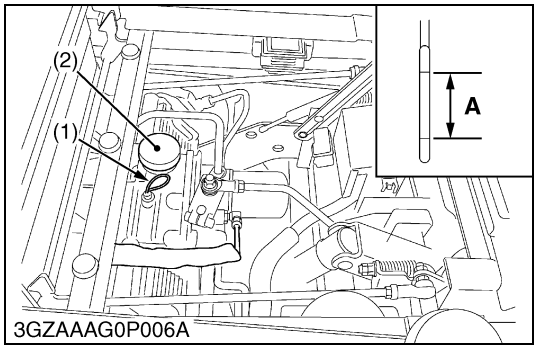

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## Checking Transmission Fluid Level

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

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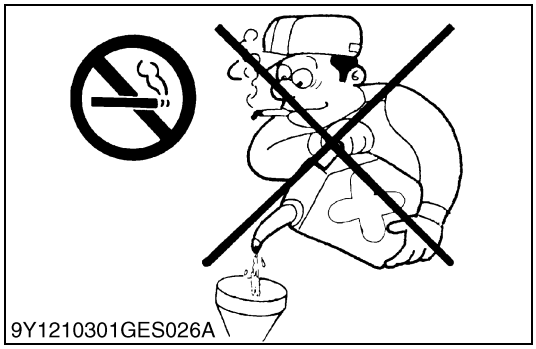
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## Checking Amount of Fuel and Refueling

**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. Take care that the fuel tank does not become empty.

| | |
|---|---|
| Fuel tank capacity | 46 L (13 U.S.gals 11 Imp.gals) |

**IMPORTANT**

- **Use Diesel Fuel Only**

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

**NOTE**

- **No.2-D is a distillate fuel of lower volatility for engines in industrial and heavy mobile service. (SAE J313 JUN87) Grade of Diesel Fuel Oil according to ASTM D975.**

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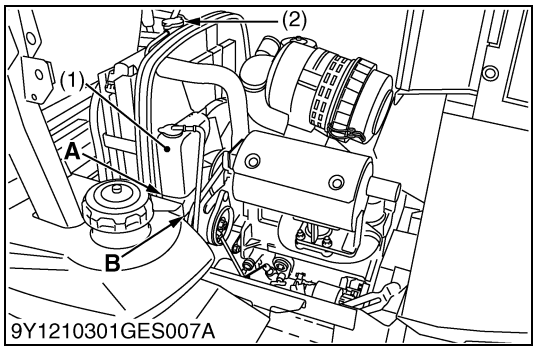

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## Checking Coolant Level

**CAUTION**

**To avoid personal injury:**

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

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

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

(1) Recovery Tank
(2) Radiator Cap

**A: FULL**
**B: LOW**

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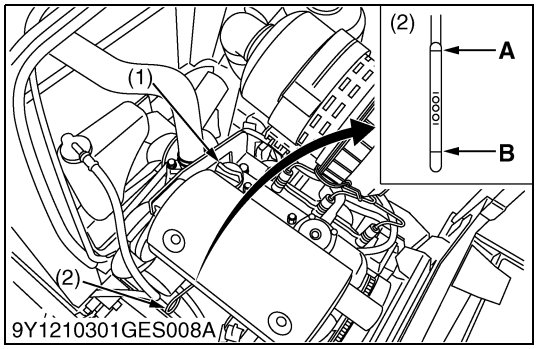


## Checking Engine Oil Level

**CAUTION**

**To avoid personal injury:**

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

1. Check engine oil before starting and 5 minutes or more after the engine has stopped.
2. Wipe dipstick area clean.
3. To check the oil level, remove the dipstick, wipe it clean, replace it, and draw it out again. Check to see that the oil level is between the two lines.
4. Add new oil to the prescribed level at the oil port if necessary.
5. When using a different brand or viscosity oil from the previous one, remove all of the old oil and oil filter. Never mix two different types of oil.
6. Use the proper Engine Oil SAE according to the ambient temperatures. (See page G-9.)

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

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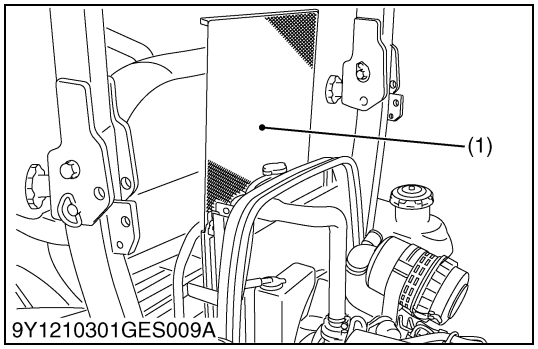


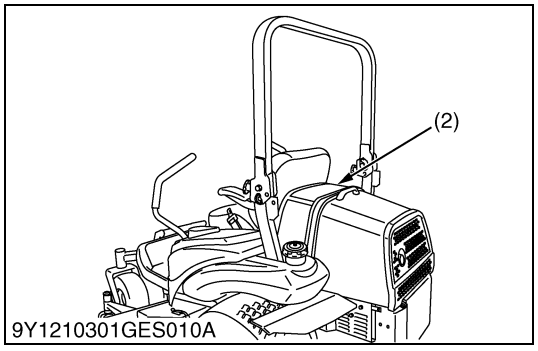


## Checking and Cleaning Radiator to Prevent Overheating

**CAUTION**

**To avoid personal injury:**

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

**IMPORTANT**

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

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

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

**NOTE**

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

(1) Radiator Screen
(2) Bonnet Screen

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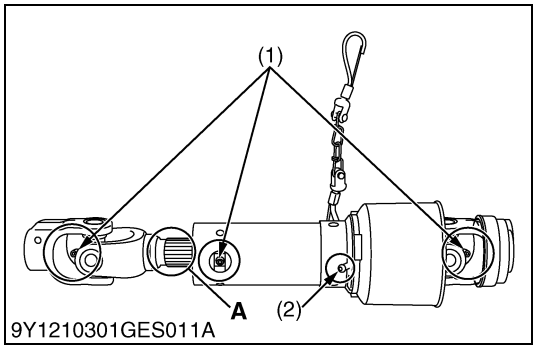

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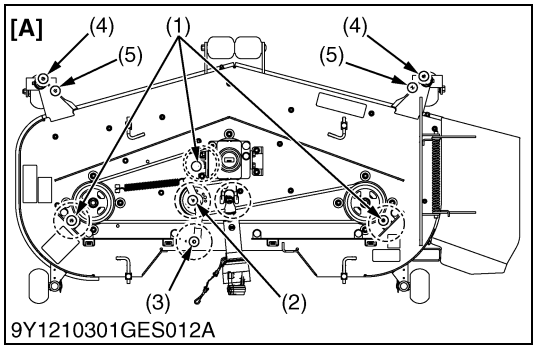

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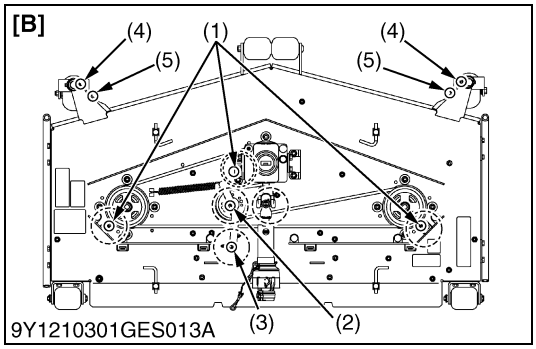

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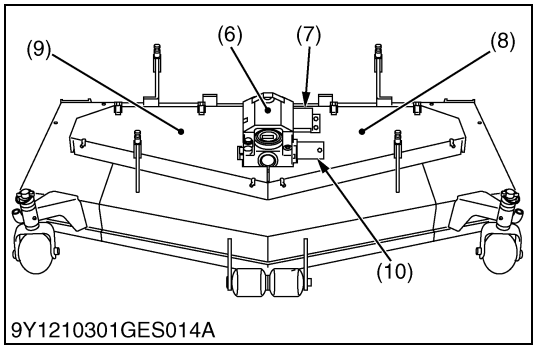

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## Greasing Universal Joint

**CAUTION**

**To avoid personal injury:**

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

1. Apply grease to the following position as figures.

(1) Mower Universal Joint
(2) Grease Nipple

**A: Apply grease to the Spline with the brush.**

9Y1210301GEG0049US0

## Greasing Mower

- Apply grease to the following positions.

■ **NOTE**

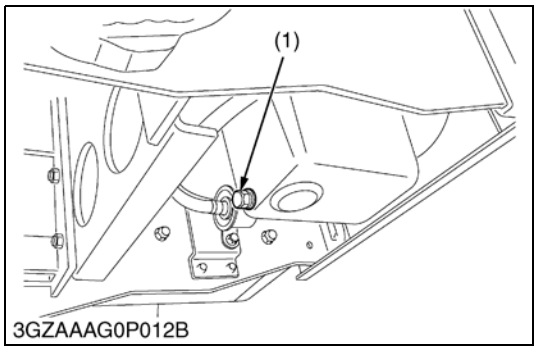
- **For areas marked with double dotted line, remove the bolt and grease up plate (10).**
- **For areas marked with dotted line, remove the bolt, center cover (6) and grease up cover (7).**
- **For areas marked with chain line, no removing the cover.**
- **For areas in the belt cover, remove the belt cover (8),(9).**

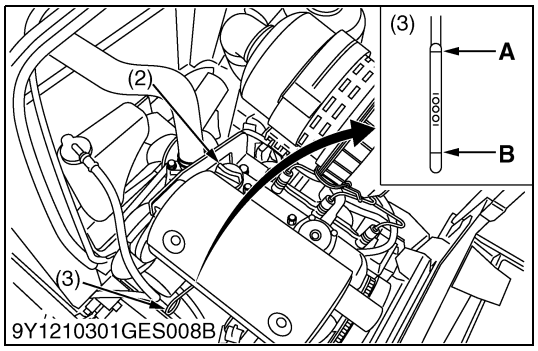
(1) Spindle shaft
(2) Belt tension pulley
(3) Belt tension pivot
(4) Front side anti-scalp roller bracket
(5) Front side anti-scalp roller
(6) Center cover
(7) Grease up cover
(8) Left belt cover
(9) Right belt cover
(10) Grease up plate

**[A] RCK 60P-326Z-EU**
**[B] RCK 60R-326Z-EU**

9Y1210301GEG0050US0

# [2] CHECK POINTS OF INITIAL 50 HOURS




## Changing Engine Oil

**CAUTION**

**To avoid personal injury:**

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

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

**IMPORTANT**

- **When using 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<br>4.1 U.S.qts<br>3.4 Imp.qts |

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

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

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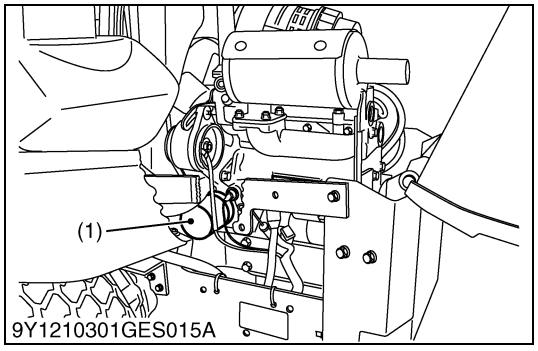


## Replacing Engine Oil Filter Cartridge

**CAUTION**

**To avoid personal 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. 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

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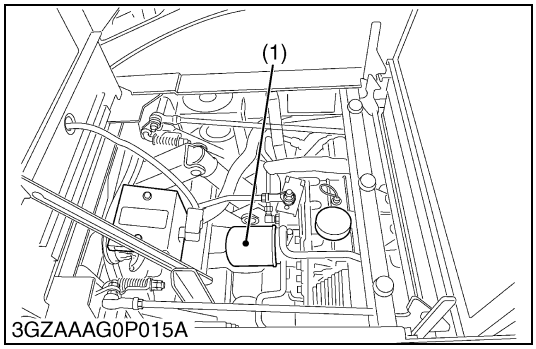

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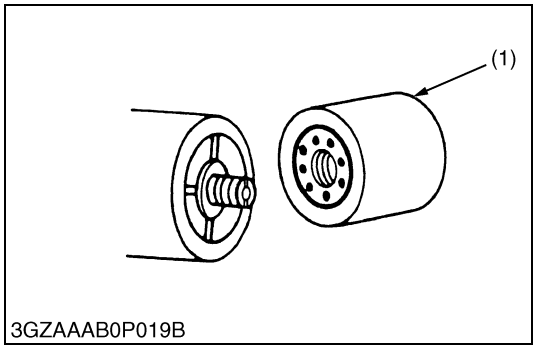

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**Replacing HST Transmission Oil Filter Cartridge**

**CAUTION**

**To avoid personal 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 (1) 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.

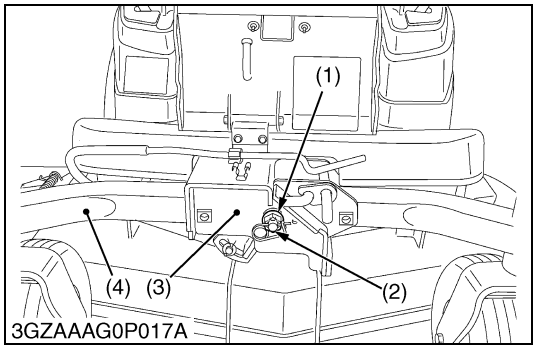
■ **IMPORTANT**

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

(1) HST Transmission Oil Filter Cartridge

9Y1210301GEG0053US0

# [3] CHECK POINT OF INITIAL 100 HOURS



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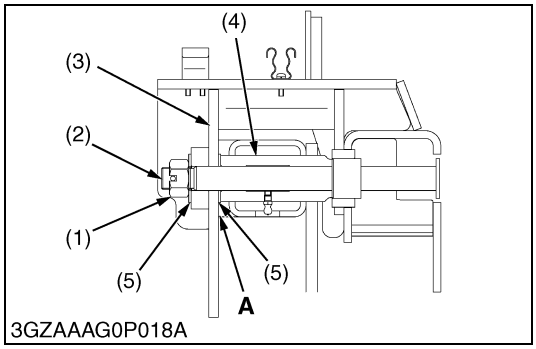

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**Adjusting Front Axle Pivot**

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).

■ **NOTE**

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

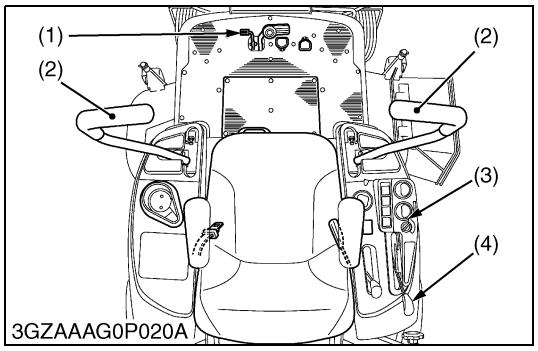
| | | |
|---|---|---|
| Front axle end play **"A"** | Factory specification | 0 to 0.2 mm<br>0 to 0.008 in. |
| | Allowable limit | 0.5 mm<br>0.02 in. |

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

**A: Front Axle End Play**

9Y1210301GEG0054US0

# [4] CHECK POINTS OF EVERY 50 HOURS




**Checking Safety Device**

**⚠ CAUTION**

**To avoid personal injury:**

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

**■ IMPORTANT**

- **Check the following tests before operating the machine.**

**■ 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 then inward from **"NEUTRAL LOCK"** position to **"NEUTRAL"** position and then release the levers.
4. Turn the key switch (3) to **"START"** position.
5. The engine must not crank.

**■ Test 4 (OPERATOR ON THE SEAT)**

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

**■ Test 5 (OPERATOR ON THE SEAT)**

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

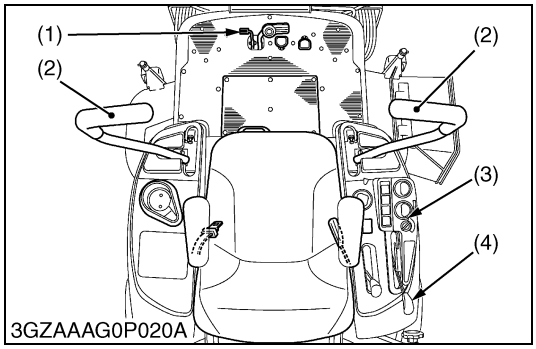
**■ IMPORTANT**

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

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

**(To be continued)**

**(Continued)**




■ **Test 6 (OPERATOR ON THE SEAT)**

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

■ **Test 7 (OPERATOR ON THE SEAT)**

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

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

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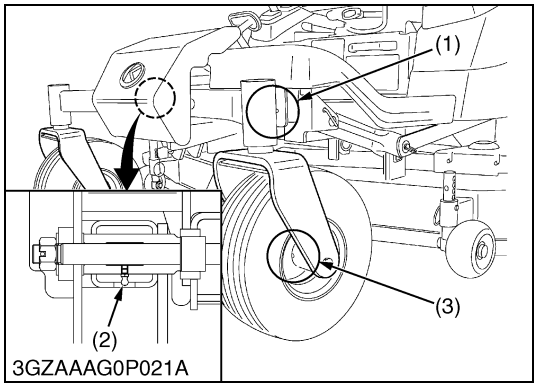

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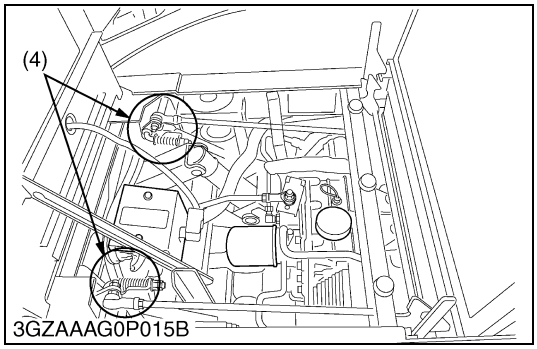

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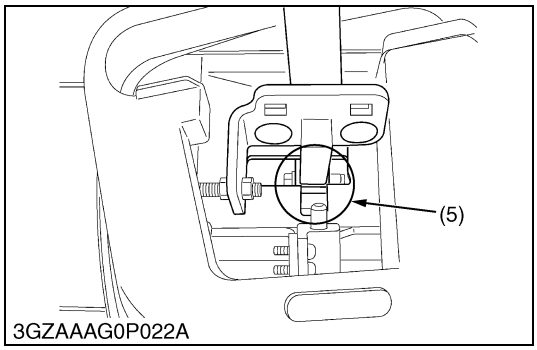

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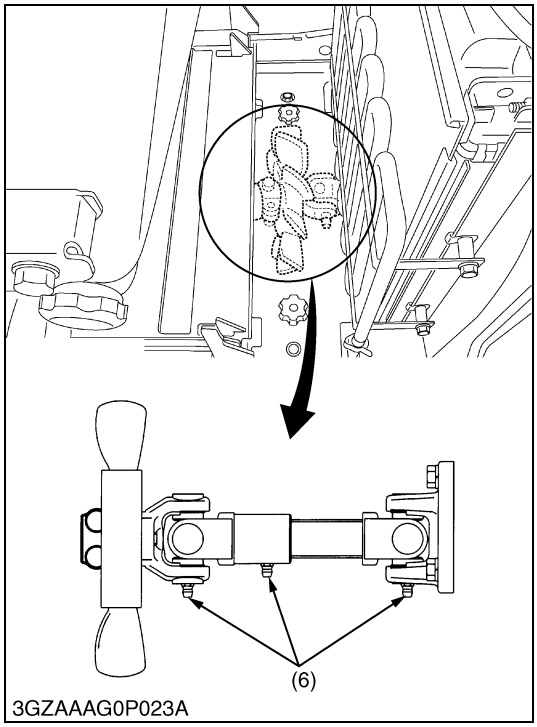

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**Greasing**

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

**CAUTION**

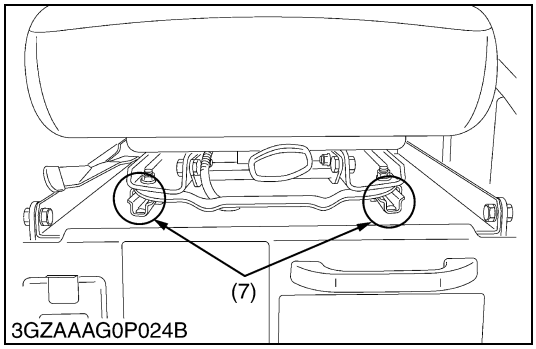
**To avoid personal injury:**

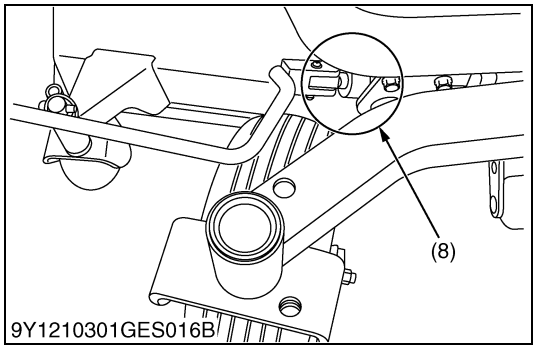
- **Be sure to stop the engine and remove the key before greasing.**

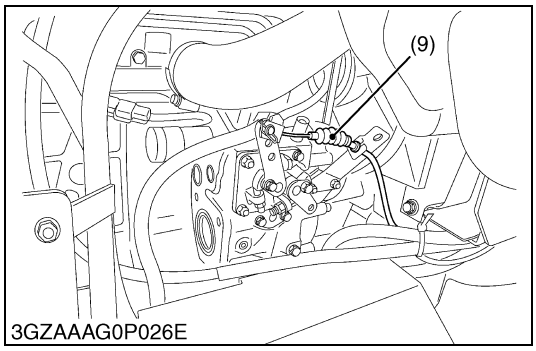
(1) King Pin (LH, RH)
(2) Center Pin
(3) Front Wheel (LH, RH)
(4) Motion Control Lever Pivot Bushing (LH, RH)
(5) Motion Control Levers (LH, RH)
(6) Machine Universal Joint

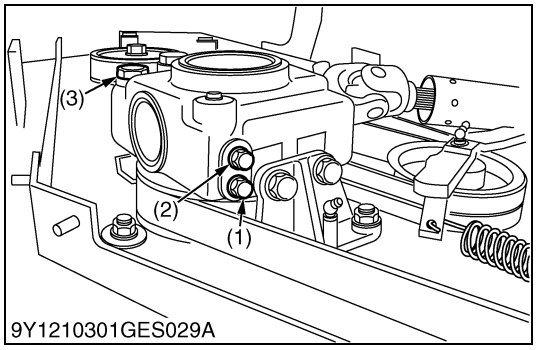
**(To be continued)**

**(Continued)**




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

**⚠ CAUTION**
**To avoid personal injury:**
- **Be sure to stop the engine and remove the key before greasing.**

(7) Seat Adjuster
(8) Front Lift -Arm
(9) Throttle Cable (Oil)

9Y1210301GEG0056US0

**Checking Gear Box Oil Level**

**⚠ CAUTION**
**To avoid personal injury:**
- **Always stop the engine and remove the key before checking oil.**

1. Park the machine on a flat surface and lower the mower to the ground.
2. To check the oil level, remove the belt cover, loosen check plug bolt (2) and check to see that the oil level is just below the check plug port.
3. If the level is too low, add new oil to the prescribed level at the oil inlet.
   (See page G-9.)

| | |
|---|---|
| Gear box oil capacity | 0.4 L<br>0.4 U.S.qts<br>0.4 Imp.qts |

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

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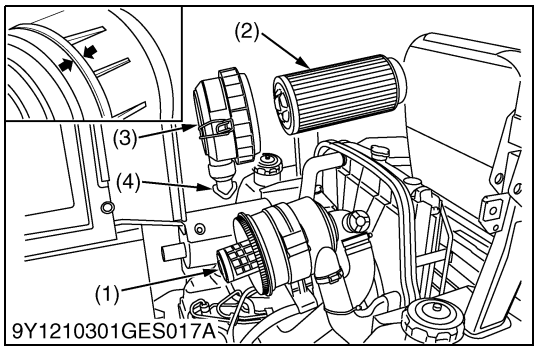
# [5] CHECK POINTS OF EVERY 100 HOURS




**Cleaning Air Cleaner Primary Element**

1. Remove the air cleaner cover and primary element (2).
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/cm$^2$, 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.**
- **The air cleaner uses a dry element, never apply oil.**
- **Do not run the engine with filter element removed.**
- **Operating in dusty conditions requires more frequent maintenance.**
- **Align the arrow marks when reinstalling the air cleaner cover.**
- **Do not touch the secondary element except in cases where replacing is required.**
  **(See "Replacing Air Cleaner Secondary Element" in "EVERY 1 YEAR" in "PERIODIC SERVICE" section.)**

**[Evacuator Valve]**

Open the evacuator 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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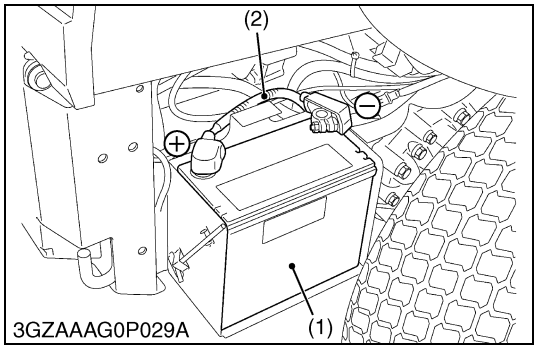


**Checking Battery Condition**

**⚠ CAUTION**

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

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

■ **NOTE**

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

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

(1) Battery
(2) Ground Cable

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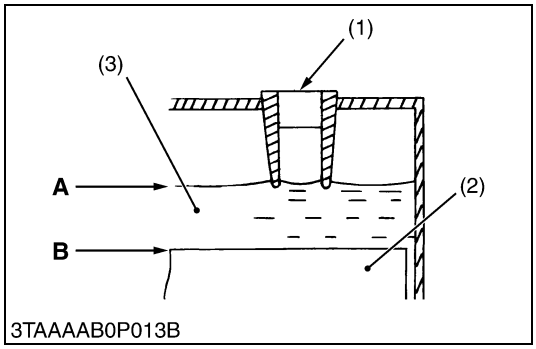

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## Battery Charging

**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.**

**CAUTION**

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

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

| Battery type | Volts (V) | Reserve capacity (min) | Cold cranking Amps |
|---|---|---|---|
| U1L-9 | 12 | 30 | 285 |

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

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

**A: Highest Level**
**B: Lowest Level**

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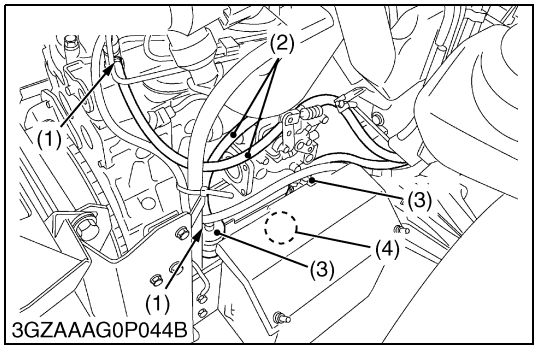


## Checking Fuel Lines and Fuel Filter

**CAUTION**

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

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

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

**IMPORTANT**

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

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

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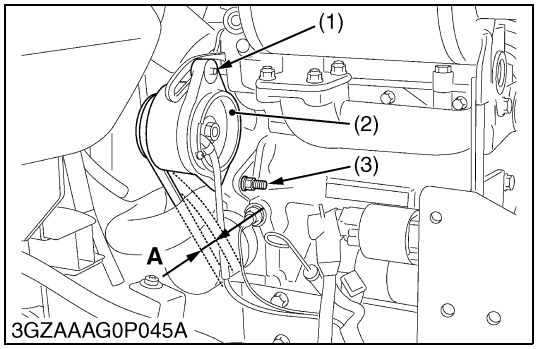


## Adjusting Fan Belt Tension

**CAUTION**

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

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

**Moderate belt tension:**

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

| | | |
|---|---|---|
| Fan belt tension **"A"** | Factory specification | Approx.<br>10 mm<br>0.4 in. |

**IMPORTANT**

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

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

**A: Fan belt tension**

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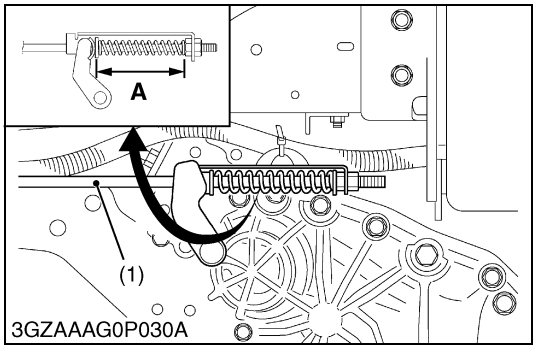


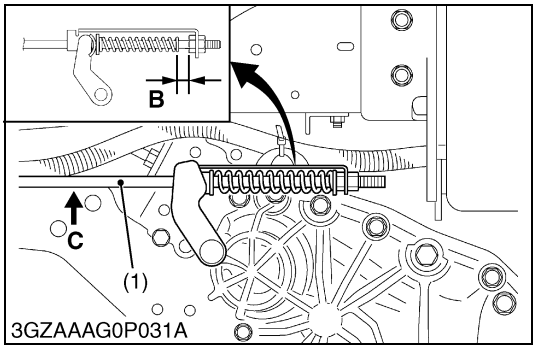


## Checking and Adjusting Parking Brake

**CAUTION**

**To avoid personal injury:**

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

**IMPORTANT**

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

**Check brake spring**

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

| | | |
|---|---|---|
| Proper brake spring length **"A"** with the brake applied to the lock position | Factory specification | 115 to 117 mm<br>4.53 to 4.61 in. |

| | | |
|---|---|---|
| Proper brake spring play **"B"** | Factory specification | The spring must have play<br>Reference:<br>0.5 to 1.0 mm<br>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 (1) by hand.
6. Tighten the nut to the correct space between the end of the spring and the nut.
7. Lock the nuts.
8. Adjust the other side spring to the same dimension.

**Adjustment of brake 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

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

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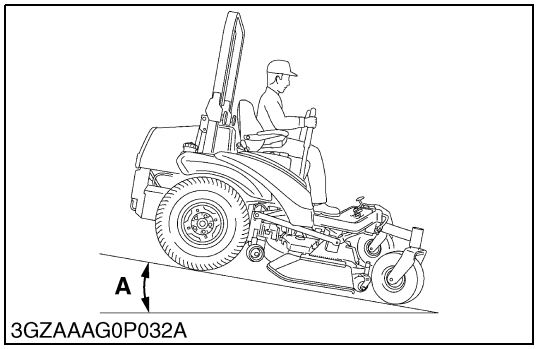

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**Checking Parking Brake on the Slope**

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**

9Y1210301TXS0036US0

# [6] CHECK POINTS OF EVERY 150 HOURS

**Changing Mower Gear Box Oil**

- See page G-26.

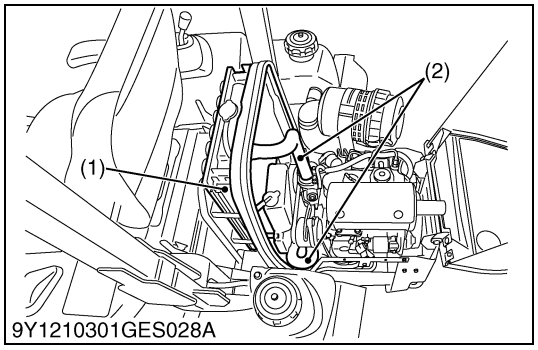
9Y1210301GEG0064US0

# [7] CHECK POINTS OF EVERY 200 HOURS

**Adjusting Front Axle Pivot**

- See page G-22.

9Y1210301GEG0065US0



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**Checking Radiator Hose and Clamp**

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

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

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

(1) Radiator Core (2) Radiator Hose

9Y1210301GEG0066US0

**Changing Engine Oil**

- See page G-21.

9Y1210301GEG0067US0

**Changing Engine Oil Filter Cartridge**

- See page G-21.

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**Changing HST Transmission Oil Filter Cartridge**

- See page G-22.

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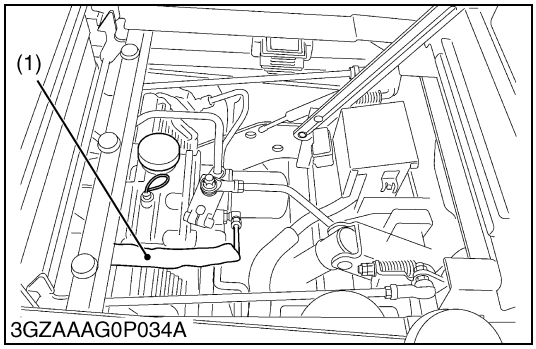


## Checking Hydraulic Hose

**CAUTION**

**To avoid personal injury:**

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

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

(1) Mower Lift Cylinder Hose

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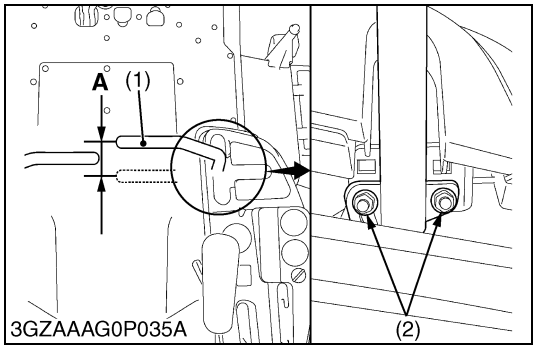


## Adjusting the Motion Control Lever Pivot

**CAUTION**

**To avoid personal injury:**

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

| | | |
|---|---|---|
| Lever free travel **"A"** | Factory specification | 2 to 15 mm<br>0.08 to 0.59 in. |

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

■ **NOTE**

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

| | | |
|---|---|---|
| Tightening torque | Pivot bolt | 18.6 to 20.6 N·m<br>1.9 to 2.1 kgf·m<br>13.7 to 15.2 lbf·ft |

(1) Motion Control Lever
(2) Bolt
**A: Free Travel**

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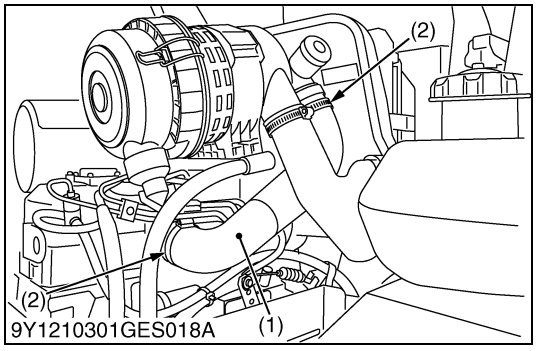


## Checking Intake Air Line

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

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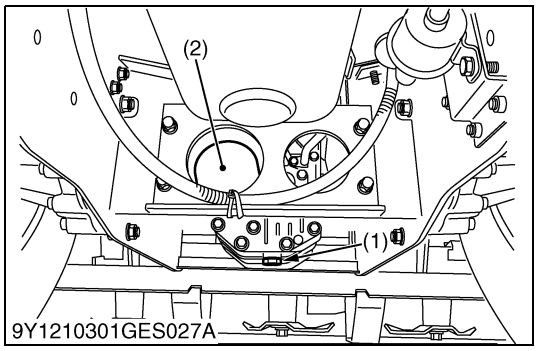
# [8] CHECK POINT OF EVERY 400 HOURS



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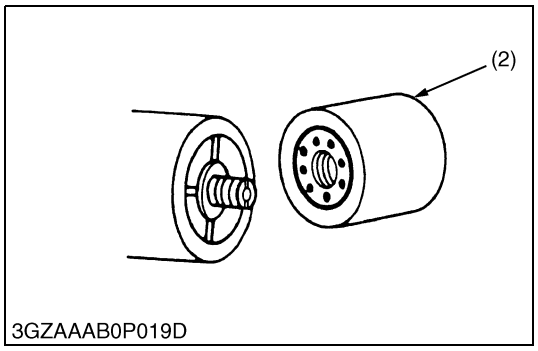

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## Replacing Fuel Filter

• See page G-29.

9Y1210301GEG0073US0

## Replacing Hydraulic Oil Filter Cartridge

**CAUTION**

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

**IMPORTANT**

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

(1) Drain Plug (2) Hydraulic Oil Filter Cartridge

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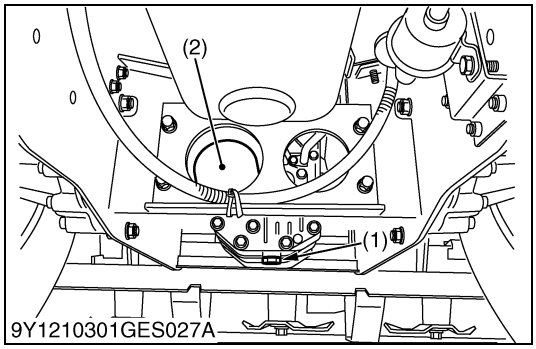
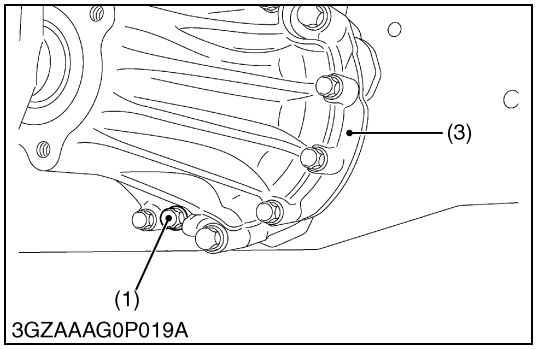
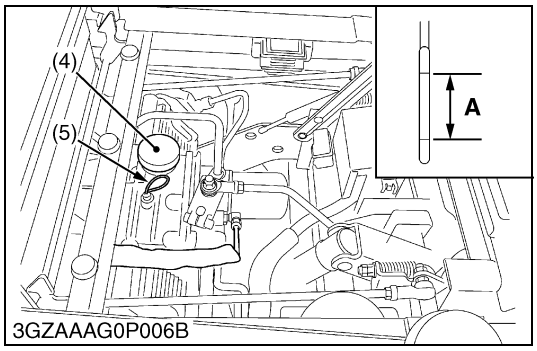



**Changing Transmission Fluid and Rear Axle Gear Case Oil (RH and LH)**

**⚠ CAUTION**

**To avoid personal injury:**

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

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

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

■ **IMPORTANT**

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

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

■ **IMPORTANT**

- **Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.**
  **Keep the engine at medium speed for a few minutes to insure proper lubrication of all parts so there is no damage to transmission.**
- **Use only multi-grade transmission oil. Use of other oils may damage the transmission or hydraulic system.**
  **Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-9.)**
- **Do not mix different brands oil together.**

| | |
|---|---|
| Transmission fluid capacity (with filter and hose) | 12.1 L<br>12.8 U.S.qts<br>10.6 Imp.qts |

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

**A: Oil level acceptable within this range.**

9Y1210301GEG0075US0

# [9] CHECK POINTS OF EVERY 1500 HOURS

**Checking Fuel Injection Nozzle (Injection Pressure)**

• See page 1-S17.

9Y1210301GEG0076US0

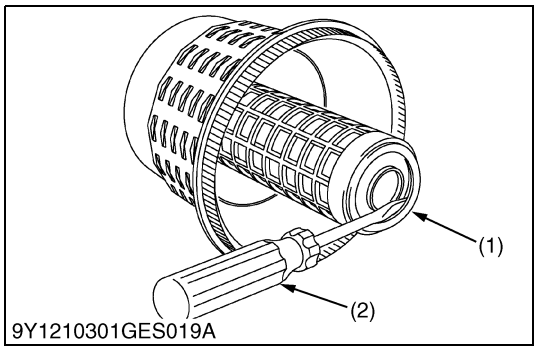
# [10] CHECK POINTS OF EVERY 3000 HOURS

**Checking Injection Pump**

• See page 1-S16.

9Y1210301GEG0077US0

# [11] CHECK POINTS OF EVERY 1 YEAR



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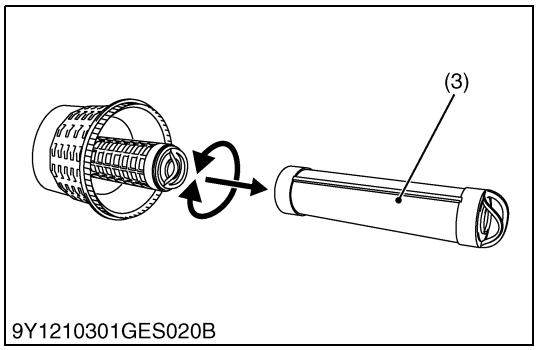

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**Replacing Air Cleaner Secondary Element**

1. Pull out the two tabs (1) of the secondary element (3) using a suitable tool (e.g. Flat-blade screwdriver) as shown in the figure.
2. While turning slightly, pull out the secondary element (3).

■ **IMPORTANT**

- **To prevent serious damage to the engine, use only a KUBOTA genuine filter.**
- **Pull out the tabs (1) only when replacing the secondary element (3).**
- **The air cleaner uses a dry element, never apply oil.**
- **Do not run the engine with filter element removed.**
- **Be sure to refit the air cleaner cover. If the air cleaner cover is improperly fitted, evacuator valve will not function and dust will adhere to the element.**
- **If it is loose, dust and dirt may be sucked in, wearing down the cylinder and piston rings earlier and thereby resulting in poor power output.**

(1) Tab
(2) Flat-blade Screwdriver
(3) Secondary Element

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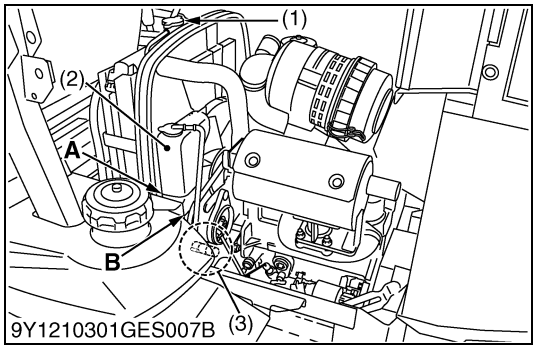


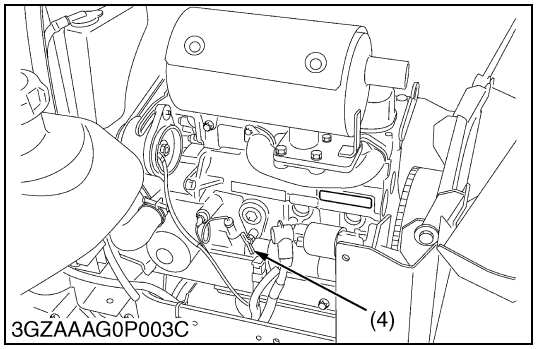


## Flushing Cooling System and Changing Coolant

**CAUTION**

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

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

**IMPORTANT**

- **Do not start engine without coolant.**
- **Use clean, fresh water and anti-freeze to fill the radiator and recovery tank.**
- **When the anti-freeze is mixed with water, the anti-freeze mixing ratio must be less than 50 %.**
- **Securely tighten radiator cap. If the cap is loose or improperly fitted, water may leak out and the engine could overheat.**
- **Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-9.)**

| | | |
|---|---|---|
| Coolant capacity | Cooling system | 2.6 L<br>2.7 U.S.qts<br>2.3 Imp.qts |
| | Recovery tank | 0.25 L<br>0.26 U.S.qts<br>0.22 Imp.qts |

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

**A: FULL**
**B: LOW**

**(To be continued)**

**(Continued)**

■ **Anti-Freeze**

**CAUTION**

**To avoid personal injury:**

- **When using anti-freeze, put on some protection such as rubber gloves (Anti-freeze contains poison.).**
- **If should drink antifreeze, throw up at once and take medical attention.**
- **When anti-freeze comes in contact with the skin or clothing, wash it off immediately.**
- **Do not mix different types of Antifreeze. The mixture can produce chemical reaction causing harmful substances.**
- **Anti-freeze is extremely flammable and explosive under certain conditions. Keepdire and children away from anti-freeze.**
- **When draining fluids from the engine, place some container underneath the engine body.Ifswallowed anti-freeze is harmful.**
- **Do not pour waste onto the grounds, down a drain, or into any water source.**
- **Also, observe the relevant environmental protection regulations when disposing of anti-freeze.**

If it freezes, coolant can damage the cylinders and radiator. If the ambient temperature falls below 0 °C (32 °F) or before a long-term storage, let out cooling water completely, or mix fresh water with long-life coolant and fill the radiator and reserve tank with the mixture.

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
   Put the LLC in cooling water in the percentage (%) for a target temperature. 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.

■ **IMPORTANT**

- **When the antifreeze 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 |
| 40 | –24 | –12 | 106 | 222 |
| 50 | –37 | –34 | 108 | 226 |

* At 1.013 x $10^5$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 mixture reduces in amount by evaporation.
   (2) If there is a mixture leak, add the LLC of the same manufacturer and type in the same mixture percentage. (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 2 years.

■ **NOTE**

- **The above date represent industry standards that necessitate a minimum glycol content in the concentrates anti-freeze.**
- **When the coolant level drops due to evaporation, add water only to keep the anti-freeze mixing ratio less than 50 %. In case of leakage, add anti-freeze and water in the specified mixing ratio before filling in to the radiator.**

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# [12] CHECK POINT OF EVERY 2 YEARS

**Replacing Hydraulic Hose**

1. Replace the hose.
   Refer to "Checking Hydraulic Hose". (See page G-32.)

9Y1210301GEG0080US0

**Replacing Radiator Hose**

1. Replace the hoses and clamps.
   Refer to "Checking Radiator Hose and Hose Clamp". (See page G-31.)

9Y1210301GEG0081US0

**Replacing Fuel Lines**

1. Replace the fuel line.
   Refer to "Checking Fuel Lines and Fuel Filter". (See page G-29.)

9Y1210301GEG0082US0

**Replacing Intake Air Line**

1. Replace the intake air line.
   Refer to "Checking Intake Air Line". (See page G-32.)

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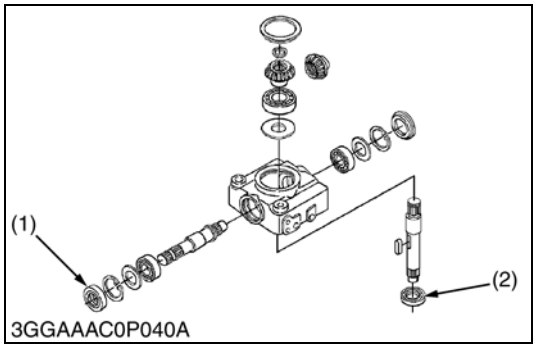


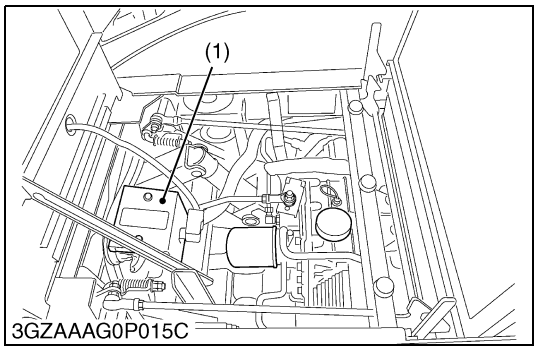

**Replacing Mower Gear Box Seals**

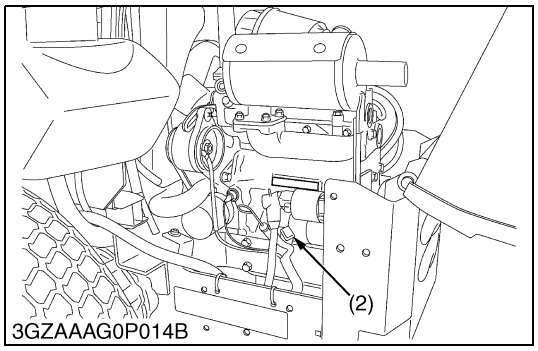
1. Replace the mower gear box oil seals (1), (2).
   Refer to "Disassembling Gear Box Assembly". (See page 6-S12.)

(1) Oil Seal (2) Oil Seal

9Y1210301GEG0084US0

# [13] SERVICE AS REQUIRED




## Replacing Fuses

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

■ **IMPORTANT**

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

■ **Protected Circuit**

| Fuse No. (ID LABEL) | Capacity (A) | Protected circuit |
|---|---|---|
| 1 | 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

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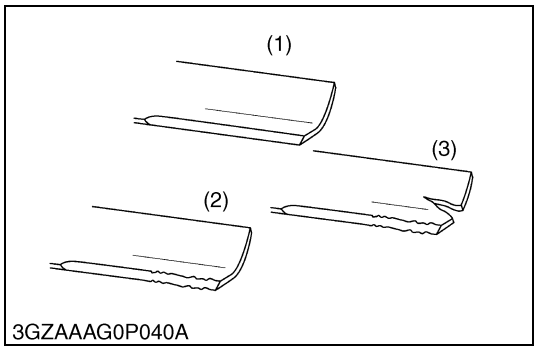


## Checking Mower Blade

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

(1) New Blade (3) Cracked Blade
(2) Worn Blade

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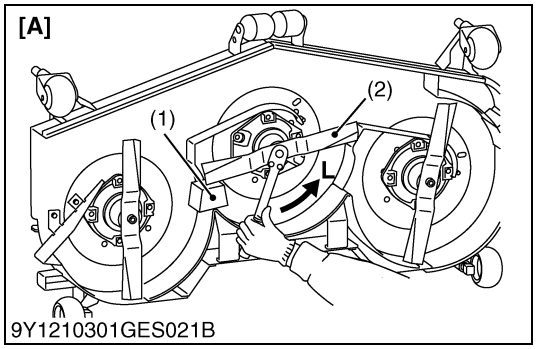
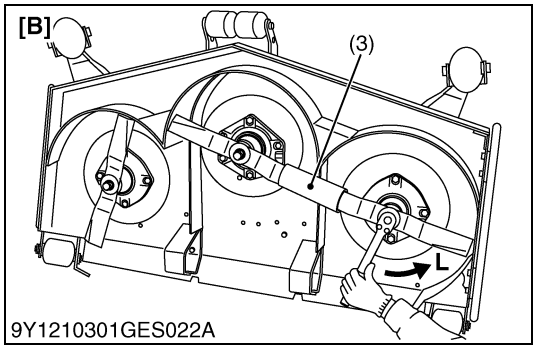
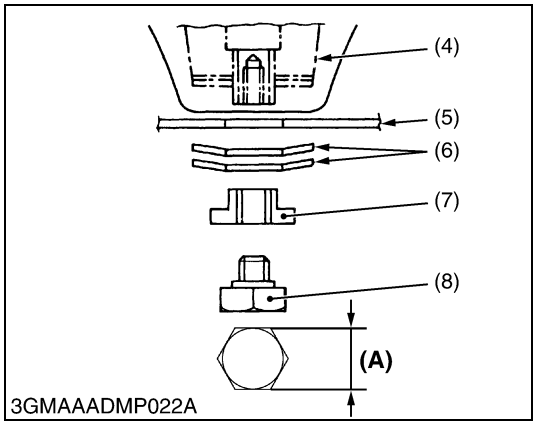
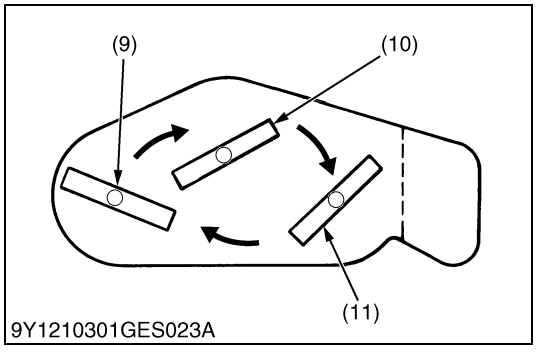



## Replacing and Sharpening Mower Blades

1. Tilt up the mower deck.
   (See "HOW TO TILT UP THE MACHINE" at page 6-S9.)
2. **[RCK60P]**
   Wedge a block of wood (1) between the blade (2) and mower housing or use a box wrench over the pulley nut to prevent the spindle from rotating while removing the blade bolts.
   **[RCK60R]**
   Set a pipe (3) 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.
3. Loosen the blade bolt as illustrated.

■ **IMPORTANT**

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

4. To sharpen the blades yourself, clamp the blade securely in a vise.
5. 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.
6. Pass the spline boss through the blade (5) and 2 cup washers (6), 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 washer if either is damaged.**

7. 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.

■ **IMPORTANT**

- **Tighten the three blade bolts to 98 to 117.6 N·m (10 to 12 kgf·m, 72 to 87 lbf·ft) of torque.**
- **The blade bolts have Right hand threads. Turn then counterclockwise to loosen.**
- **To prolong the service life of the blades, reposition them as shown in the figure below periodically.**

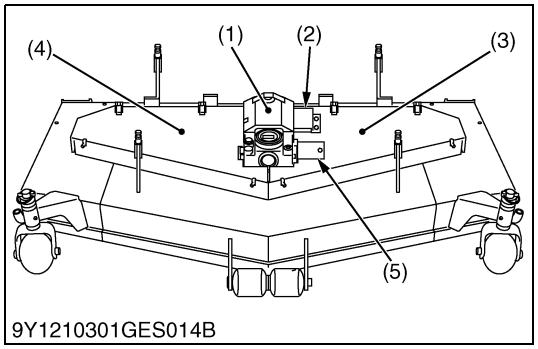
(1) Block Wood
(2) Blade
(3) Pipe
(4) Spindle Holder
(5) Blade
(6) 2 Cup Washer
(7) Lock Washer
(8) Bolt
(9) LH blade
(10) Center Blade
(11) RH blade

**[A] RCK60P-326Z-EU**
**[B] RCK60R-326Z-EU**

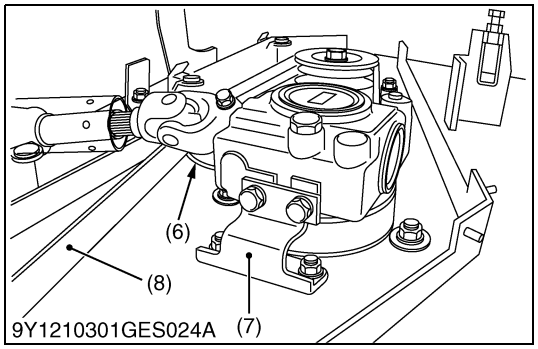
**L: Loosen**

**(A) 30 mm (1-3/16 in)**

9Y1210301GEG0087US0



9Y1210301GES014B



9Y1210301GES024A

## Replacing Mower Belt

1. Remove the mower deck from the machine.
   See "DISMOUNTING THE MOWER DECK" at page 6-S7.
2. Remove the center cover (1) and the grease up cover (2) from the mower deck.
3. Remove the left and right hand shield (3), (4) from the mower deck.
4. Clean around the gear box.
5. Remove the belt (8) from the tension pulley (6).
6. Remove the right hand bracket (7) which mounts the top of the gear box.
7. To install a new belt, reverse the above procedure.

■ **NOTE**

- **Tighten bracket bolts securely 77.6 to 90.2 N·m (8.0 to 9.2 kgf·m, 57.1 to 66.5 lbf·ft).**

(1) Center Cover
(2) Grease Up Cover
(3) Left Shield
(4) Right Shield
(5) Grease Up Plate
(6) Tension Pulley
(7) Bracket (RH)
(8) Belt

9Y1210301GEG0088US0

## 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 machine has not been used for a long period of time.

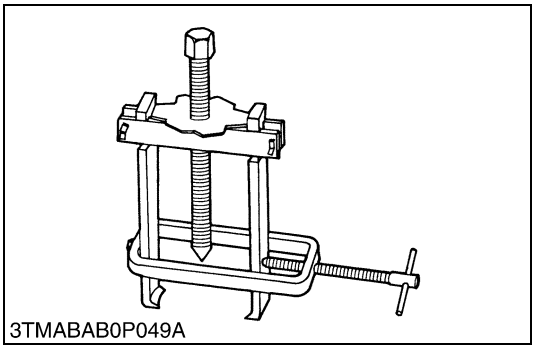
■ **Bleeding**

1. Fill the fuel tank with fuel.
2. Start the engine and run for about 30 seconds, and then stop the engine.

9Y1210301GEG0089US0

# 9. SPECIAL TOOLS

## [1] SPECIAL TOOLS FOR ENGINE

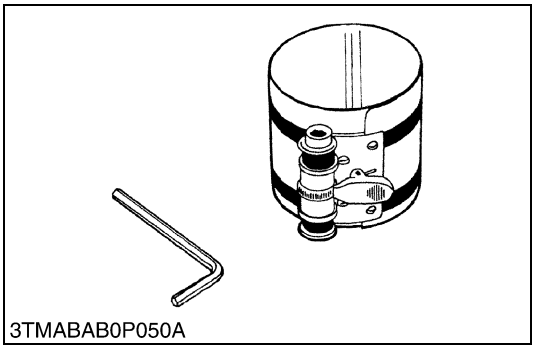

3TMABAB0P049A

**Special Use Puller Set**

**Code No.**
- 07916-09032

**Application**
- Use exclusively for pulling out bearing, gears and other parts with ease.

9Y1210301GEG0003US0

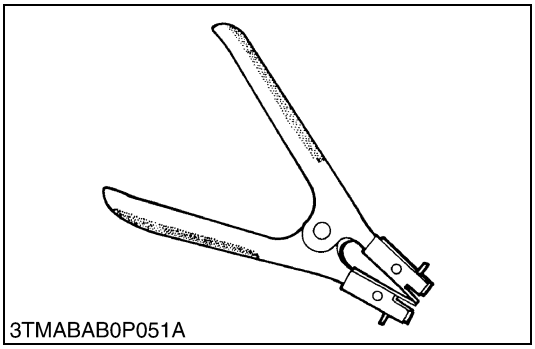

3TMABAB0P050A

**Piston Ring Compressor**

**Code No.**
- 07909-32111

**Application**
- Use exclusively for pushing in the piston with piston rings into the cylinder.

9Y1210301GEG0004US0

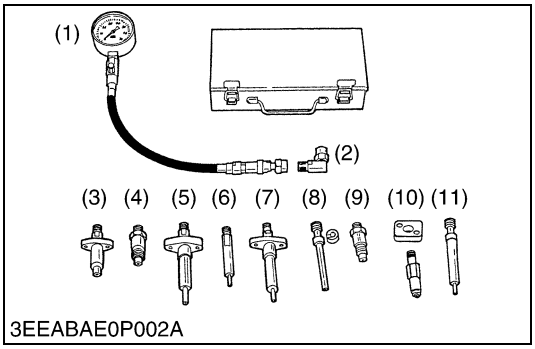

3TMABAB0P051A

**Piston Ring Tool**

**Code No.**
- 07909-32121

**Application**
- Use exclusively for removing or installing the piston ring with ease.

9Y1210301GEG0005US0



3EEABAE0P002A

**Diesel Engine Compression Tester (for Nozzle Hole)**

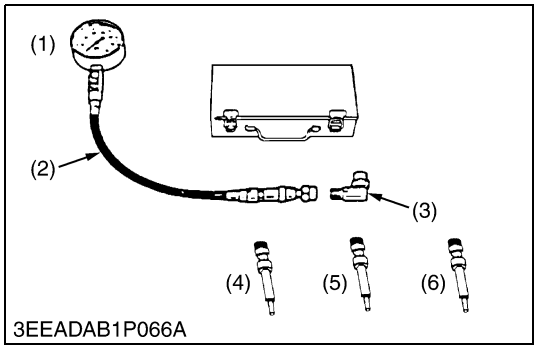
**Code No.**
- 07909-30208 (Assembly)
- 07909-30934 (**A** to **F**)
- 07909-31211 (**E** and **F**)
- 07909-31231 (**H**)
- 07909-31251 (**G**)
- 07909-31271 (**I**)
- 07909-31281 (**J**)

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

**Adaptor**
- **H** for 05 series.

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

9Y1210301GEG0090US0




## Diesel Engine Compression Tester (for Glow Plug Hole)

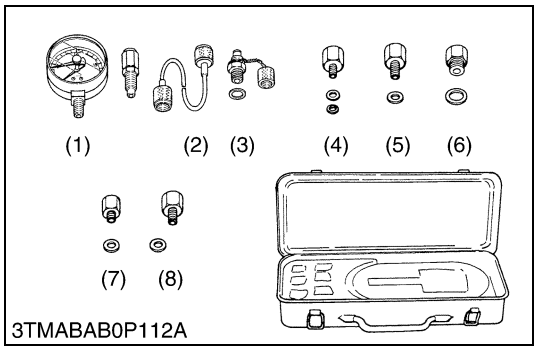
**Code No.**
- 07909-39081 (Assembly)
- 07909-31291 (**K**)
- 07909-31301 (**L**)
- 07909-31311 (**M**)

**Application**
- Use to measure diesel engine compression and diagnosis of need for major overhaul.

**Adaptor**
- **H** for 05 series.

(1) Gauge
(2) Hose Assembly
(3) **L** Joint
(4) Adaptor **K**
(5) Adaptor **L**
(6) Adaptor **M**

9Y1210301GEG0091US0



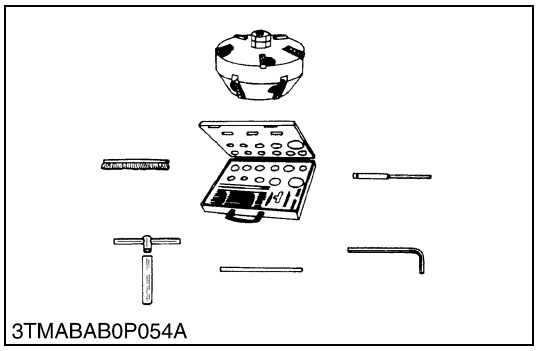

## Oil Pressure Tester

**Code No.**
- 07916-32032

**Application**
- Use to measure lubricating oil pressure.

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

9Y1210301GEG0006US0




## Valve Seat Cutter

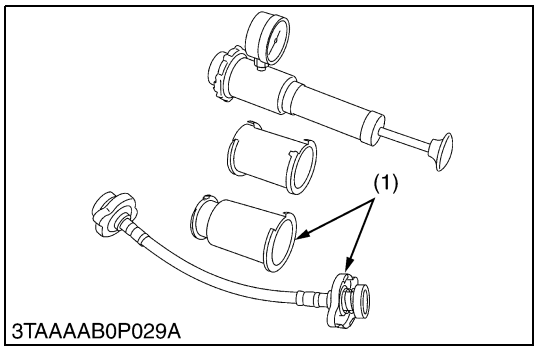
**Code No.**
- 07909-33102

**Application**
- Use to reseat valves.

**Angle**
- 0.785 rad (45 °)
- 0.262 rad (15 °)

**Diameter**
- 28.6 mm (1.126 in.)
- 31.6 mm (1.244 in.)
- 35.0 mm (1.378 in.)
- 38.0 mm (1.496 in.)
- 41.3 mm (1.626 in.)
- 50.8 mm (2.000 in.)

9Y1210301GEG0007US0




## Radiator Tester

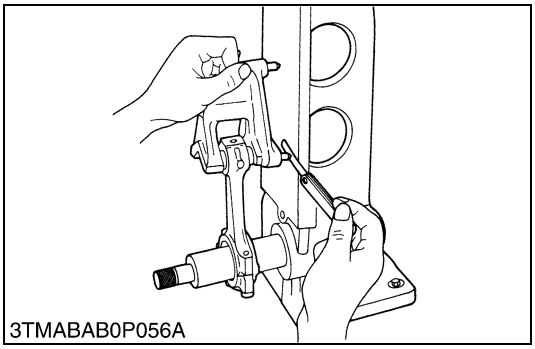
**Code No.**
- 07909-31551

**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

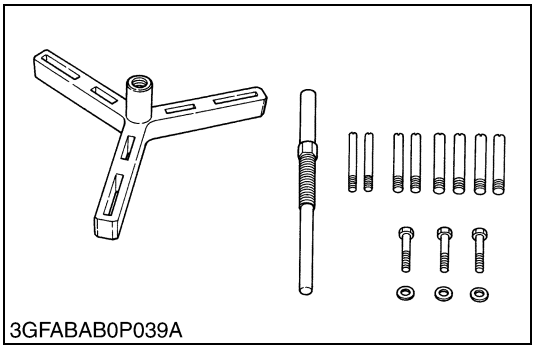
## Connecting Rod Alignment Tool

**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. (1.18 to 2.95 in. dia.)
- Connecting rod length
  65 to 300 mm (2.57 to 11.81 in.)

9Y1210301GEG0009US0

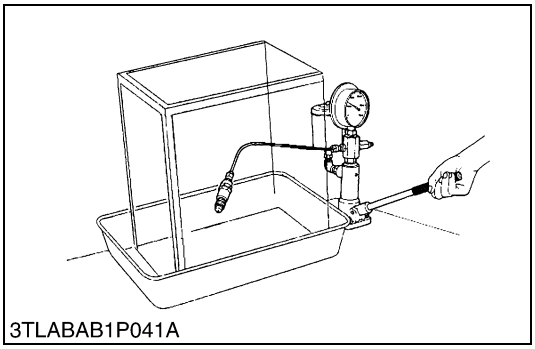

3GFABAB0P039A

## Flywheel Puller

**Code No.**
- 07916-32011

**Application**
- Use exclusively for removing the flywheel with ease.

9Y1210301GEG0010US0


3TLABAB1P041A

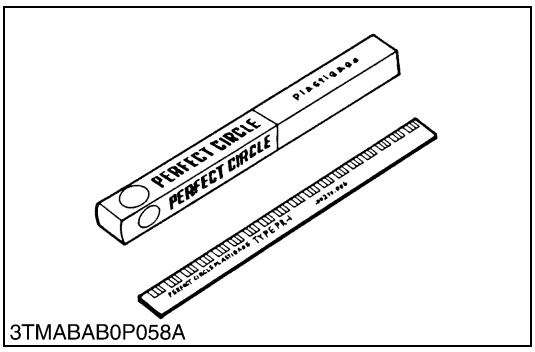
## Nozzle Tester

**Code No.**
- 07909-31361

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

**Measuring range**
- 0 to 50 MPa (0 to 500 kgf/cm$^2$, 0 to 7000 psi)

9Y1210301GEG0011US0



3TMABAB0P058A

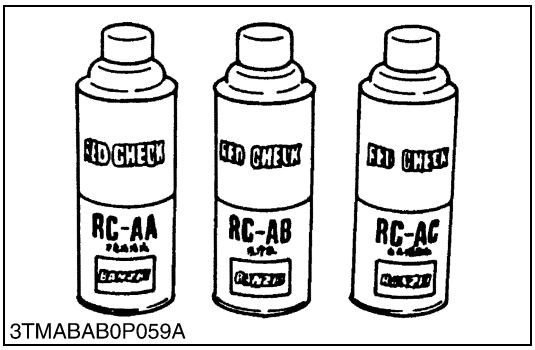
## Plastigage

**Code No.**
- 07909-30241

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

**Measuring range**
- Green: 0.025 to 0.076 mm (0.001 to 0.003 in.)
- Red: 0.051 to 0.152 mm (0.002 to 0.006 in.)
- Blue: 0.102 to 0.229 mm (0.004 to 0.009 in.)

9Y1210301GEG0012US0



3TMABAB0P059A

## Red Check

**Code No.**
- 07909-31371

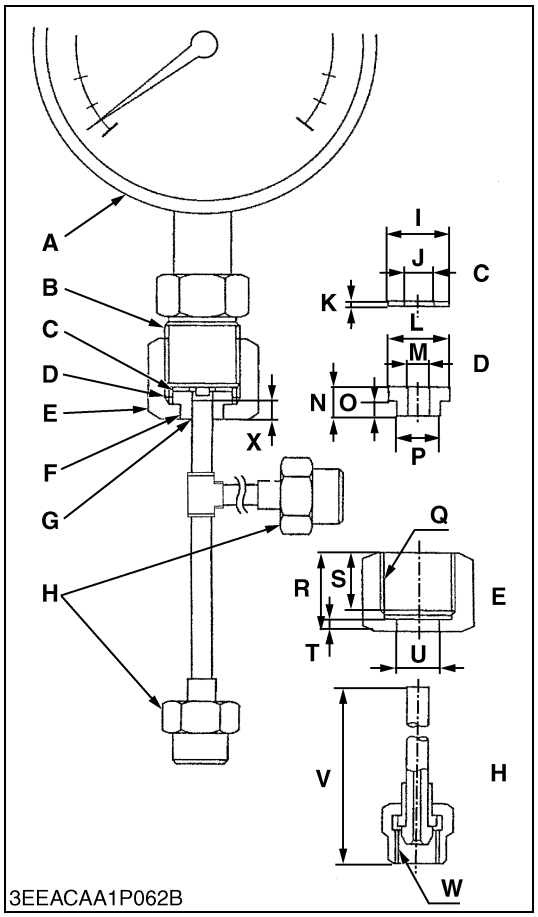
**Application**
- Use to check cracks on cylinder head, cylinder block, etc..

9Y1210301GEG0013US0

■ **NOTE**

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

9Y1210301GEG0092US0



3EEACAA1P062B

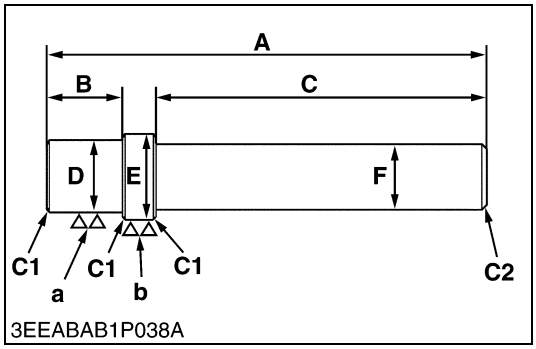
## Injection Pump Pressure Tester

### Application

- Use to check fuel tightness of injection pumps.

| | |
|---|---|
| **A** | Pressure gauge full scale:<br>More than 29.4 MPa (300 kgf/cm$^2$, 4267 psi) |
| **B** | PF 1/2 |
| **C** | Copper gasket |
| **D** | Flange (Material: Steel) |
| **E** | Hex. nut 27 mm (1.1 in.) across the plat |
| **F** | Adhesive application |
| **G** | Fillet welding on the enter circumference |
| **H** | Retaining nut |
| **I** | 17 mm dia. (0.67 in. dia.) |
| **J** | 8.0 mm dia. (0.31 in. dia.) |
| **K** | 1.0 mm (0.039 in.) |
| **L** | 17 mm dia. (0.67 in. dia.) |
| **M** | 6.10 to 6.20 mm dia. (0.241 to 0.244 in. dia.) |
| **N** | 8.0 mm (0.31 in.) |
| **O** | 4.0 mm (0.16 in.) |
| **P** | 11.97 to 11.99 mm dia. (0.4713 to 0.4720 in. dia.) |
| **Q** | PF 1/2 |
| **R** | 23 mm (0.91 in.) |
| **S** | 17 mm (0.67 in.) |
| **T** | 4.0 mm (0.16 in.) |
| **U** | 12.00 to 12.02 mm dia. (0.472 to 0.4732 in. dia.) |
| **V** | 100 mm (3.94 in.) |
| **W** | M12 × P1.5 |
| **X** | 5.0 mm (0.20 in.) |

9Y1210301GEG0093US0



3EEABAB1P038A

## Bushing Replacing Tool

### Application

- Use to press out and press fit the bushing.

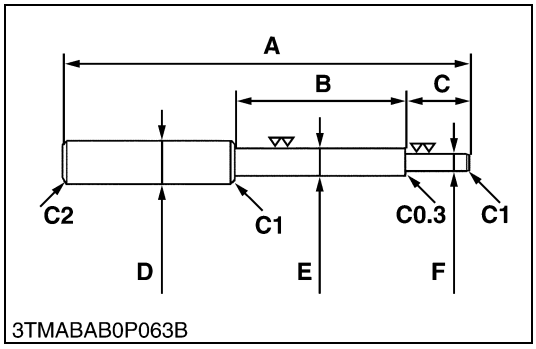
**[For small end bushing]**

| | |
|---|---|
| **A** | 157 mm (6.18 in.) |
| **B** | 24 mm (0.94 in.) |
| **C** | 120 mm (4.72in.) |
| **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.) |

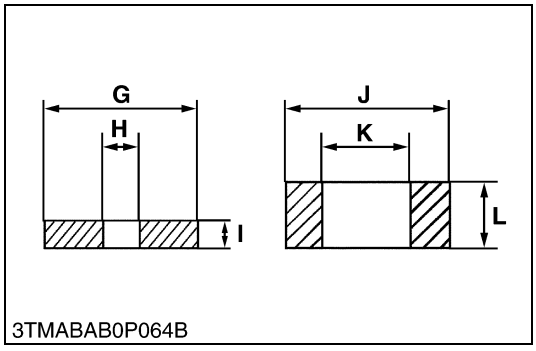
**[For idle gear bushing]**

| | |
|---|---|
| **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.) |

9Y1210301GEG0094US0



3TMABAB0P063B



3TMABAB0P064B

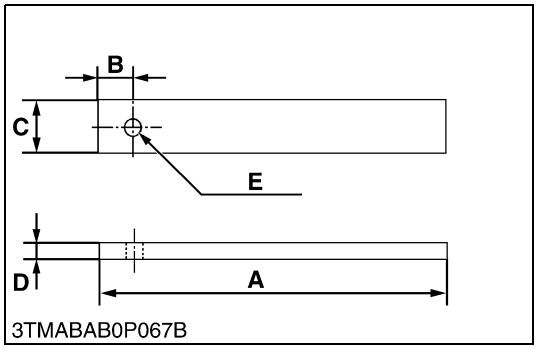
## Valve Guide Replacing Tool

### Application

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

| | |
|---|---|
| **A** | 225 mm (8.86 in.) |
| **B** | 70 mm (2.8 in.) |
| **C** | 45 mm (1.8 in.) |
| **D** | 20 mm dia. (0.79 in. dia.) |
| **E** | 11.7 to 11.9 mm dia. (0.461 to 0.468 in. dia.) |
| **F** | 6.50 to 6.60 mm dia. (0.256 to 0.259 in. dia.) |
| **G** | 25 mm dia. (0.98 in. dia.) |
| **H** | 6.70 to 7.00 mm dia. (0.264 to 0.275 in. dia.) |
| **I** | 5.0 mm (0.20 in.) |
| **J** | 20 mm dia. (0.79 in. dia.) |
| **K** | 12.5 to 12.8 mm dia. (0.493 to 0.503 in. dia.) |
| **L** | 8.90 to 9.10 mm (0.351 to 358 in.) |
| **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.) |

9Y1210301GEG0095US0



3TMABAB0P067B

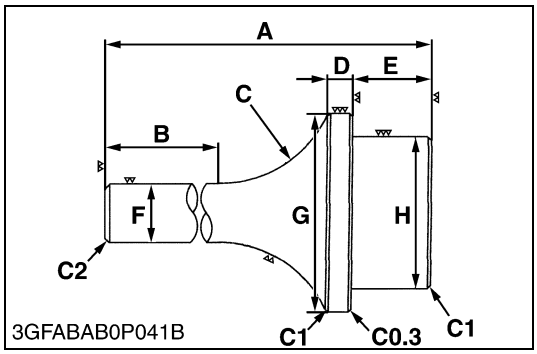
## Flywheel Stopper

### Application

- Use to loosen and tighten the flywheel screw.

| | |
|---|---|
| **A** | 20 mm (0.79 in.) |
| **B** | 15 mm (0.59 in.) |
| **C** | 10 mm dia. (0.39 in. dia.) |
| **D** | 30 mm (1.2 in.) |
| **E** | 8.0 mm (0.31 in.) |
| **F** | 200 mm (7.87 in.) |

9Y1210301GEG0096US0



3GFABAB0P041B

## Crankshaft Bearing 1 Replacing Tool

### Application

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

**[Press Out]**

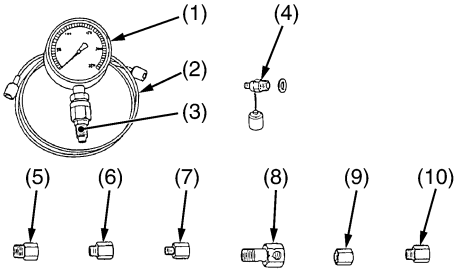
| | |
|---|---|
| **A** | 135 mm (5.31 in.) |
| **B** | 72 mm (2.8 in.) |
| **C** | 40 mm radius (1.6 in. radius) |
| **D** | 10 mm (0.39 in.) |
| **E** | 24 mm (0.94 in.) |
| **F** | 20 mm dia. (0.79 in. dia.) |
| **G** | 51.20 to 51.40 mm dia. (2.016 to 2.023 in. dia.) |
| **H** | 47.30 to 47.50 mm 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]**

| | |
|---|---|
| **A** | 135 mm (5.31 in.) |
| **B** | 72 mm (2.8 in.) |
| **C** | 40 mm radius (1.6 in. radius) |
| **D** | 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** | 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.) |

9Y1210301GEG0097US0

# [2] SPECIAL TOOLS FOR MACHINE




3TMABAB0P077A

## Relief Valve Pressure Tester

**Code No.**

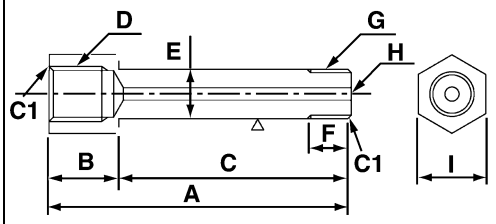
- 07916-50045

**Application**

- This allows easy measurement of relief set pressure.

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

9Y1210301GEG0014US0

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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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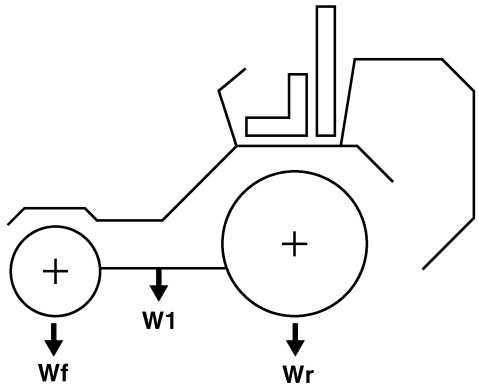
# 10. IMPLEMENT LIMITATIONS

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

| | Maximum loading weight | | Implement weight $W_1$ | Maximum total weight |
|---|---|---|---|---|
| | Front axle Wf | Rear axle Wr | | |
| ZD326-EU | 190 kg (419 lbs) | 618 kg (1363 lbs) | 146 kg (322 lbs) | 808 kg (1782 lbs) |

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# 1 ENGINE

# SERVICING

## CONTENTS

# 1. TROUBLESHOOTING

| Symptom | Probable Cause | Solution | Reference Page |
|---|---|---|---|
| **Engine Does Not Start** | No fuel | Fill fuel | G-9 |
| | Air in the fuel system | Bleed | G-41 |
| | Water in the fuel system | Change fuel and repair or replace fuel system | G-18 |
| | Fuel pipe clogged | Clean or replace | G-29 |
| | Fuel filter clogged | Replace | G-29 |
| | Excessively high viscosity of fuel or engine oil at low temperature | Use specified fuel or engine oil | G-9 |
| | Fuel with low cetane number | Use specified fuel | G-10 |
| | Fuel leak due to loose injection pipe retaining nut | Tighten retaining nut | 1-S23 |
| | Incorrect injection timing | Adjust | 1-S15, 1-S27, 1-S28 |
| | Fuel camshaft worn | Replace | 1-S29 |
| | Injection nozzle clogged | Clean or replace | 1-S24 |
| | Injection pump malfunctioning | Replace | 1-S28 |
| | Seizure of crankshaft, camshaft, piston, cylinder or bearing | Repair or replace | 1-S30 to 1-S35 |
| | Compression leak from cylinder | Replace head gasket, tighten cylinder head screw, glow plug and nozzle holder | 1-S24 to 1-S25 |
| | Improper valve timing | Correct or replace timing gear | 1-S29 |
| | Piston ring and cylinder worn | Replace | 1-S32, 1-S46, 1-S50 |
| | Excessive valve clearance | Adjust | 1-S11 |
| | Stop solenoid malfunctioning | Replace | 1-S23 |
| **Starter Does Not Run** | Battery discharged | Charge | G-27 |
| | Starter malfunctioning | Repair or replace | 1-S23, 5-S9, 5-S18 |
| | Key switch malfunctioning | Replace | 5-S19 |
| | Wiring disconnected | Connect | – |
| **Engine Revolution Is Not Smooth** | Fuel filter clogged or dirty | Replace | G-29 |
| | Air cleaner clogged | Clean or replace | G-27, G-35 |
| | Fuel leak due to loose injection pipe retaining nut | Tighten retaining nut | 1-S23, 1-S27 |
| | Injection pump malfunctioning | Replace | 1-S28 |
| | Incorrect nozzle opening pressure | Adjust | 1-S17 |
| | Injection nozzle stuck or clogged | Replace | 1-S24 |
| | Governor malfunctioning | Repair | 1-S27 |


(EU)
KiSC issued 07, 2011 A

| Symptom | Probable Cause | Solution | Reference Page |
|---|---|---|---|
| **Either White or Blue Exhaust Gas Is Observed** | Excessive engine oil | Reduce to specified level | G-21, 1-S19 |
| | Piston ring and cylinder worn or stuck | Replace | 1-S32, 1-S46, 1-S50 |
| | Incorrect injection timing | Adjust | 1-S15, 1-S27, 1-S28 |
| **Either Black or Dark Gray Exhaust Gas Is Observed** | Overload | Decrease the load | – |
| | Low grade fuel used | Use specified fuel | G-9 |
| | Fuel filter clogged | Replace | G-29 |
| | Air cleaner clogged | Clean or replace | G-27, G-35 |
| | Deficient nozzle injection | Replace nozzle | 1-S24 |
| **Deficient Output** | Incorrect injection timing | Adjust | 1-S15, 1-S27, 1-S28 |
| | Engine's moving parts seem to be seizing | Repair or replace | – |
| | Injection pump malfunctioning | Replace | 1-S28 |
| | Deficient nozzle injection | Replace nozzle | 1-S24 |
| | Compression leak | Check the compression pressure and repair | 1-S10, 1-S24 to 1-S25 |
| | Gas leak from exhaust system | Repair or replace | – |
| **Excessive Lubricant Oil Consumption** | Piston ring's gap facing the same direction | Shift ring gap direction | 1-S31 |
| | Oil ring worn or stuck | Replace | 1-S32 |
| | Piston ring groove worn | Replace piston | 1-S46 |
| | Valve stem and valve guide worn | Replace | 1-S37, 1-S38 |
| | Crankshaft bearing and crank pin bearing worn | Replace | 1-S47 to 1-S49 |
| | Oil leaking due to defective seals or packing | Replace | – |
| **Fuel Mixed into Lubricant Oil** | Injection pump's plunger worn | Replace | 1-S28 |
| | Deficient nozzle injection | Replace nozzle | 1-S24 |
| | Injection pump broken | Replace | 1-S28 |
| **Water Mixed into Lubricant Oil** | Head gasket defective | Replace | 1-S25 |
| | Cylinder block or cylinder head flawed | Replace | 1-S36, 1-S37 |

| Symptom | Probable Cause | Solution | Reference Page |
|---|---|---|---|
| **Low Oil Pressure** | Engine oil insufficient | Fill | G-9 |
| | Oil strainer clogged | Clean | 1-S30 |
| | Relief valve stuck with dirt | Clean | – |
| | Relief valve spring weaken or broken | Replace | – |
| | Excessive oil clearance of crankshaft bearing | Replace | 1-S48 |
| | Excessive oil clearance of crankpin bearing | Replace | 1-S47 |
| | Excessive oil clearance of rocker arm | Replace | 1-S25 |
| | Oil passage clogged | Clean | – |
| | Different type of oil | Use specified type of oil | G-9 |
| | Oil pump defective | Replace | 1-S51 |
| **High Oil Pressure** | Different type of oil | Use specified type of oil | G-9 |
| | Relief valve defective | Replace | – |
| **Engine Overheated** | Engine oil insufficient | Fill | G-9 |
| | Fan belt broken or elongated | Replace or adjust | 1-S12, 1-S13 |
| | Coolant insufficient | Fill | G-9 |
| | Radiator net and radiator fin clogged with dust | Clean | G-36 |
| | Inside of radiator corroded | Clean or replace | G-36 |
| | Coolant flow route corroded | Clean or replace | G-36 |
| | Radiator cap defective | Replace | G-36 |
| | Overload running | Reduce the load | – |
| | Head gasket defective | Replace | 1-S25 |
| | Incorrect injection timing | Adjust | 1-S15, 1-S27, 1-S28 |
| | Unsuitable fuel used | Use specified fuel | G-9, G-10 |
| **Battery Quickly Discharged** | Battery electrolyte insufficient | Fill distilled water and charge | G-27 |
| | Fan belt slips | Adjust belt tension or replace | 1-S12, 1-S13 |
| | Wiring disconnected | Connect | – |
| | Regulator defective | Replace | 5-S12 |
| | Dynamo defective | Replace | 5-S12, 5-S18 |
| | Battery defective | Replace | G-27 |

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# 2. SERVICING SPECIFICATIONS

**ENGINE BODY**

| Item | | Factory Specification | Allowable Limit |
|---|---|---|---|
| Valve Clearance (Cold) | | 0.145 to 0.185 mm<br>0.00571 to 0.00728 in. | – |
| Compression Pressure | | 3.73 to 4.11 MPa<br>38.0 to 42.0 kgf/cm$^2$<br>541 to 597 psi | 2.26 MPa<br>23.0 kgf/cm$^2$<br>327 psi |
| • Difference among Cylinders | | – | 10 % or less |
| Top Clearance | | 0.55 to 0.75 mm<br>0.022 to 0.029 in. | – |
| Cylinder Head Surface | Flatness | – | 0.05 mm<br>0.002 in. |
| Valve Recessing | Intake and Exhaust | −0.05 to 0.25 mm<br>−0.0020 to 0.0098 in. | 0.40 mm<br>0.016 in. |
| Valve Stem to Valve Guide | Clearance | 0.035 to 0.065 mm<br>0.0014 to 0.0025 in. | 0.10 mm<br>0.0039 in. |
| • Valve Stem | O.D. | 6.960 to 6.975 mm<br>0.2741 to 0.2746 in. | – |
| • Valve Guide | I.D. | 7.010 to 7.025 mm<br>0.2760 to 0.2765 in. | – |
| Valve Face | Angle (Intake) | 1.0 rad<br>60 ° | – |
| | Angle (Exhaust) | 0.79 rad<br>45 ° | – |
| Valve Seat | Angle (Intake) | 1.0 rad<br>60 ° | – |
| | Angle (Exhaust) | 0.79 rad<br>45 ° | – |
| | Width | 2.12 mm<br>0.0835 in. | – |
| Valve Spring | Free Length | 37.0 to 37.5 mm<br>1.46 to 1.47 in. | 36.5 mm<br>1.44 in. |
| | Tilt | – | 1.0 mm<br>0.039 in. |
| | Setting Load | 117.4 N / 31.0 mm<br>11.97 kgf / 31.0 mm<br>26.39 lbf / 1.22 in. | 100.0 N / 31.0 mm<br>10.20 kgf / 31.0 mm<br>22.48 lbf / 1.22 in. |
| Rocker Arm Shaft to Rocker Arm | Clearance | 0.016 to 0.045 mm<br>0.00063 to 0.0017 in. | 0.10 mm<br>0.0039 in. |
| • Rocker Arm Shaft | O.D. | 11.973 to 11.984 mm<br>0.47138 to 0.47181 in. | – |
| • Rocker Arm | I.D. | 12.000 to 12.018 mm<br>0.47244 to 0.47314 in. | – |

| Item | | Factory Specification | Allowable Limit |
|---|---|---|---|
| Push Rod | Alignment | – | 0.25 mm<br>0.0098 in. |
| Tappet to Tappet Guide | Clearance | 0.020 to 0.062 mm<br>0.00079 to 0.0024 in. | 0.07 mm<br>0.003 in. |
| • Tappet | O.D. | 19.959 to 19.980 mm<br>0.78579 to 0.78661 in. | – |
| • Tappet Guide | I.D. | 20.000 to 20.021 mm<br>0.78740 to 0.78822 in. | – |
| Timing Gear<br>• Crank Gear to Idle Gear 1 | Backlash | 0.0320 to 0.115 mm<br>0.00126 to 0.00452 in. | 0.15 mm<br>0.0059 in. |
| • Idle Gear 1 to Cam Gear | Backlash | 0.0360 to 0.114 mm<br>0.00142 to 0.00448 in. | 0.15 mm<br>0.0059 in. |
| • Idle Gear 1 to Injection Pump Gear | Backlash | 0.0340 to 0.116 mm<br>0.00134 to 0.00456 in. | 0.15 mm<br>0.0059 in. |
| Governor Gear<br>• Governor Gear to Injection Pump Gear | Backlash | 0.0300 to 0.117 mm<br>0.00119 to 0.00460 in. | 0.15 mm<br>0.0059 in. |
| Idle Gear Shaft to Gear Bushing<br>• Idle Gear 1 | Clearance | 0.020 to 0.054 mm<br>0.00079 to 0.0021 in. | 0.10 mm<br>0.0039 in. |
| • Idle Gear Bushing | I.D. | 26.000 to 26.021 mm<br>1.0237 to 1.0244 in. | – |
| • Idle Gear Shaft 1 | O.D. | 25.967 to 25.980 mm<br>1.0224 to 1.0228 in. | – |
| Idle Gear<br>• Idle Gear 1 | Side Clearance | 0.20 to 0.51 mm<br>0.0079 to 0.020 in. | 0.80 mm<br>0.031 in. |
| Camshaft | Side Clearance | 0.070 to 0.22 mm<br>0.0028 to 0.0086 in. | 0.30 mm<br>0.012 in. |
| | Alignment | – | 0.01 mm<br>0.0004 in. |
| Cam Height | Intake | 28.80 mm<br>1.134 in. | 28.75 mm<br>1.132 in. |
| | Exhaust | 29.00 mm<br>1.142 in. | 28.95 mm<br>1.140 in. |
| Camshaft Journal to Cylinder Block Bore | Clearance | 0.050 to 0.091 mm<br>0.0020 to 0.0035 in. | 0.15 mm<br>0.0059 in. |
| • Camshaft Journal | O.D. | 35.934 to 35.950 mm<br>1.4148 to 1.4153 in. | – |
| • Cylinder Block Bore | I.D. | 36.000 to 36.025 mm<br>1.4174 to 1.4183 in. | – |
| Piston Pin Bore | I.D. | 22.000 to 22.013 mm<br>0.86615 to 0.86665 in. | 22.03 mm<br>0.8673 in. |

| Item | | Factory Specification | Allowable Limit |
|---|---|---|---|
| Piston Pin to Small End Bushing | Clearance | 0.014 to 0.038 mm<br>0.00056 to 0.0014 in. | 0.15 mm<br>0.0059 in. |
| • Piston Pin | O.D. | 22.002 to 22.011 mm<br>0.86622 to 0.86657 in. | – |
| • Small End Bushing | I.D. | 22.025 to 22.040 mm<br>0.86713 to 0.86771 in. | – |
| Piston Ring Gap | | | |
| • Top Ring | | 0.30 to 0.45 mm<br>0.012 to 0.017 in. | 1.25 mm<br>0.0492 in. |
| • Second Ring | | 0.30 to 0.45 mm<br>0.012 to 0.017 in. | 1.25 mm<br>0.0492 in. |
| • Oil Ring | | 0.25 to 0.40 mm<br>0.0098 to 0.015 in. | 1.25 mm<br>0.0492 in. |
| Piston Ring to Piston Ring Groove | | | |
| • Second Ring | Clearance | 0.0850 to 0.112 mm<br>0.00335 to 0.00440 in. | 0.2 mm<br>0.008 in. |
| • Oil Ring | Clearance | 0.020 to 0.055 mm<br>0.00079 to 0.0021 in. | 0.15 mm<br>0.0059 in. |
| Connecting Rod | Alignment | – | 0.05 mm<br>0.002 in. |
| Crankshaft | Alignment | – | 0.2 mm<br>0.008 in. |
| Crankshaft to Crankshaft Bearing 1 | Oil Clearance | 0.0340 to 0.114 mm<br>0.00134 to 0.00448 in. | 0.20 mm<br>0.0079 in. |
| • Crankshaft | O.D. | 47.934 to 47.950 mm<br>1.8872 to 1.8877 in. | – |
| • Crankshaft Bearing 1 | I.D. | 47.984 to 48.048 mm<br>1.8892 to 1.8916 in. | – |
| Crankshaft to Crankshaft Bearing 2 | Oil Clearance | 0.034 to 0.095 mm<br>0.0014 to 0.0037 in. | 0.20 mm<br>0.0079 in. |
| • Crankshaft Journal | O.D. | 47.934 to 47.950 mm<br>1.8872 to 1.8877 in. | – |
| • Crankshaft Bearing 2 | I.D. | 47.984 to 48.029 mm<br>1.8892 to 1.8909 in. | – |
| Crankshaft to Crankshaft Bearing 3 | Oil Clearance | 0.0340 to 0.1030 mm<br>0.00134 to 0.00405 in. | 0.20 mm<br>0.0079 in. |
| • Crankshaft Journal | O.D. | 51.921 to 51.940 mm<br>2.0442 to 2.0448 in. | – |
| • Crankshaft Bearing 3 | I.D. | 51.974 to 52.019 mm<br>2.0463 to 2.0481 in. | – |

| Item | | Factory Specification | Allowable Limit |
|---|---|---|---|
| Crankpin to Crankpin Bearing | Oil Clearance | 0.029 to 0.091 mm<br>0.0012 to 0.0035 in. | 0.20 mm<br>0.0079 in. |
| • Crankpin | O.D. | 39.959 to 39.975 mm<br>1.5732 to 1.5738 in. | – |
| • Crankshaft Bearing | I.D. | 40.040 to 40.050 mm<br>1.5764 to 1.5767 in. | – |
| Crankshaft | Side Clearance | 0.15 to 0.31 mm<br>0.0059 to 0.012 in. | 0.50 mm<br>0.020 in. |
| Cylinder Liner I.D. | | 76.000 to 76.019 mm<br>2.9922 to 2.9928 in. | 76.15 mm<br>2.998 in. |
| Cylinder (Oversized) | | 76.500 to 76.519 mm<br>3.0119 to 3.0125 in. | 76.65 mm<br>3.015 in. |

**LUBRICATING SYSTEM**

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

**COOLING SYSTEM**

| Item | | Factory Specification | Allowable Limit |
|---|---|---|---|
| Fan Belt | Tension | 7.0 to 9.0 mm / 98 N<br>0.28 to 0.35 in. / 98 N<br>(10 kgf, 22 lbf) | – |
| Thermostat | Valve Opening Temperature (At Beginning)<br><br>Valve Opening Temperature (Opened Completely) | 69.5 to 72.5 °C<br>157.1 to 162.5 °F<br><br>85 °C<br>185 °F | –<br><br>– |
| Radiator Cap | Pressure Falling Time | 10 seconds or more<br>88 → 59 kPa<br>0.90 → 0.60 kgf/cm$^2$<br>13 → 8.5 psi | – |
| Radiator | Water Leakage Test Pressure | No leak at specified pressure<br>177 kPa<br>1.8 kgf/cm$^2$<br>25.7 psi | – |

**FUEL SYSTEM**

| Item | | Factory Specification | Allowable Limit |
|---|---|---|---|
| Injection Pump | Injection Timing | 0.3360 to 0.3621 rad<br>(19.25 to 20.75°)<br>before T.D.C. | – |
| Pump Element | Fuel Tightness | – | 13.73 MPa<br>140.0 kgf/cm$^2$<br>1991 psi |
| Delivery Valve | Fuel Tightness | 10 seconds<br>13.73 → 12.75 MPa<br>140.0 →130.0 kgf/cm$^2$<br>1991 → 1849 psi | 5 seconds<br>13.73 → 12.75 MPa<br>140.0 →<br>130.0 kgf/cm$^2$<br>1991 → 1849 psi |
| Injection Nozzle | Injection Pressure | 13.73 to 14.70 MPa<br>140.0 to 150.0 kgf/cm$^2$<br>1991 to 2133 psi | – |
| Injection Nozzle Valve Seat | Valve Seat Tightness | When the pressure is 12.75 MPa (130.0 kgf/cm$^2$, 1849 psi), the valve seat must be fuel tightness. | – |

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# 3. TIGHTENING TORQUES

Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts: See page G-11.)

| Item | Size x Pitch | N·m | kgf·m | lbf·ft |
|---|---|---|---|---|
| Cylinder head cover screw | M7 x 1.0 | 7 to 8 | 0.7 to 0.9 | 5 to 6 |
| *Cylinder head screw | M10 x 1.25 | 64 to 68 | 6.5 to 7.0 | 47 to 50 |
| *Main bearing case screw 1 | M8 x 1.25 | 30 to 34 | 3.0 to 3.5 | 22 to 25 |
| *Main bearing case screw 2 | M9 x 1.25 | 49 to 53 | 5.0 to 5.5 | 37 to 39 |
| *Flywheel screw | M10 x 1.25 | 54 to 58 | 5.5 to 6.0 | 40 to 43 |
| *Connecting rod screw | M8 x 1.0 | 42 to 46 | 4.2 to 4.7 | 31 to 33 |
| *Rocker arm bracket nuts | M7 x 1.0 | 22 to 26 | 2.2 to 2.7 | 16 to 19 |
| *Idle gear shaft screws | M6 x 1.0 | 9.81 to 11.2 | 1.00 to 1.15 | 7.23 to 8.31 |
| *Fan drive pulley screw | M14 x 1.5 | 236 to 245 | 24.0 to 25.0 | 174 to 180 |
| *Bearing case cover mounting screw | M6 x 1.0 | 9.81 to 11.2 | 1.00 to 1.15 | 7.23 to 8.31 |
| Glow plugs | M8 x 1.0 | 8 to 14 | 0.8 to 1.5 | 6 to 10 |
| Nozzle holder assembly | M20 x 1.5 | 49 to 68 | 5.0 to 7.0 | 37 to 50 |
| Nozzle holder | – | 35 to 39 | 3.5 to 4.0 | 26 to 28 |
| Oil pressure switch | PT 1/8 | 15 to 19 | 1.5 to 2.0 | 11 to 14 |
| Injection pipe retaining nuts | M12 x 1.5 | 25 to 34 | 2.5 to 3.5 | 18 to 25 |
| Overflow pipe assembly retaining nut | M12 x 1.5 | 20 to 24 | 2.0 to 2.5 | 15 to 18 |
| Drain plug with copper gasket | M12 x 1.25 | 33 to 37 | 3.3 to 3.8 | 24 to 27 |
| Drain plug with rubber coated gasket | M22 x 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 x Pitch means that the screw, bolt or nut dimension stands for metric. The size is the nominal outside diameter in mm of the threads. The pitch is the nominal distance in mm between two threads.**

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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 with air cleaner support, muffler and all glow plugs (or nozzles).
4. Set a compression tester with the adaptor to the glow plug hole (or nozzle hole).
   Nozzle hole: Adaptor **H** (07909-31231)
   Glow plug hole: Adaptor **L** (07909-31301)
5. After making sure that the stop lever is set at the stop position (non-injection), run the engine with the starter and measure the compression pressure.
6. Repeat steps 4 and 5 for each cylinder.
7. If the measurement is less than 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<br>38.0 to 42.0 kgf/cm$^2$<br>541 to 597 psi |
| | Allowable limit | 2.26 MPa<br>23.0 kgf/cm$^2$<br>327 psi |

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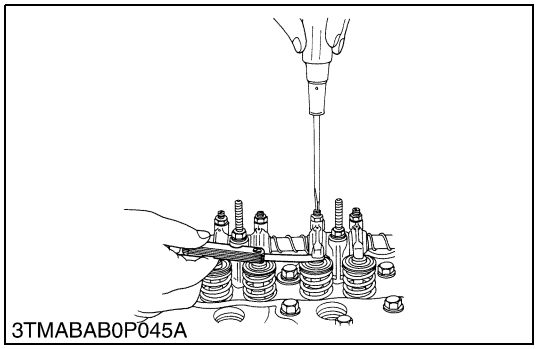
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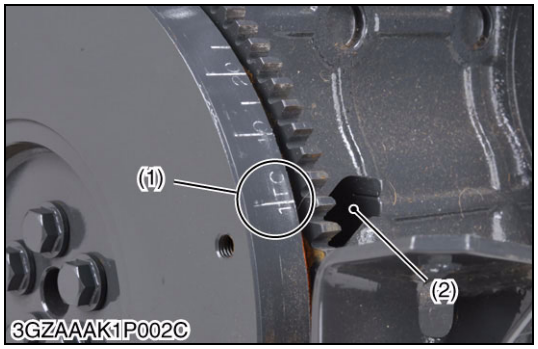

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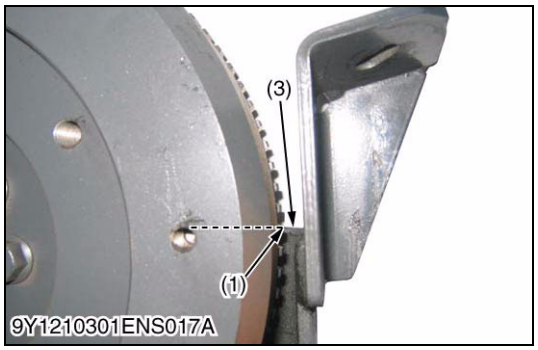

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## Valve Clearance

■ **IMPORTANT**

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

1. Remove the cylinder head cover and the glow plugs.
2. To get No.1 piston at the compression top dead center,
   **[Machine with alignment mark plate (2): Serial number from 30000]**
   align the **"1TC"** mark (1) on the flywheel to the alignment mark.
   **[Machine without alignment mark plate (2)]**
   align the **"1TC"** mark (1) on the flywheel to the level of the top edge of the engine support (3).
3. Check the following valve clearance marked with "☆" using a thickness gauge.
4. If the clearance is not within the factory specifications, adjust with the adjusting screw.
5. Then turn the flywheel 6.28 rad (360 °), and align the **"1TC"** mark (1) on the flywheel and alignment mark so that the No. 1 piston comes to the overlap position.
6. Check the following valve clearance marked with "☆" using a feeler gauge.

| 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<br>0.00571 to 0.00728 in. |

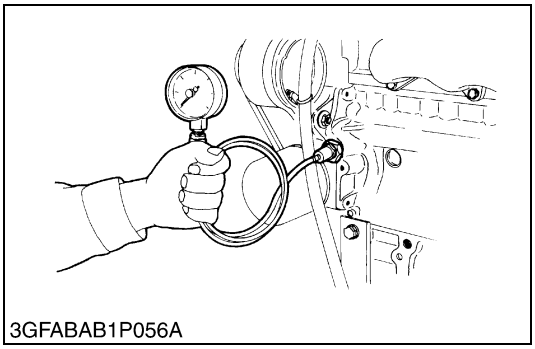
■ **NOTE**

- **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
(2) Alignment Mark Plate
(3) Top Edge of Engine Support

9Y1210301ENS0007US0

## (2) Lubricating System


3GFABAB1P056A

**Engine Oil Pressure**

1. Remove the engine oil pressure switch, and set an oil pressure tester.
2. Start the engine. After warming up, measure the oil pressure of both idling and rated speeds.
3. If the oil pressure is less than the allowable limit, check the following.
   - Engine oil insufficient
   - Oil pump defective
   - Oil strainer clogged
   - Oil filter cartridge clogged
   - Oil gallery clogged
   - Excessive oil clearance
   - Foreign matter in the relief valve

| | | | |
|---|---|---|---|
| Engine oil pressure | At idle speed | Factory specification | More than<br>49 kPa<br>0.50 kgf/cm$^2$<br>7.1 psi |
| | At rated speed | Factory specification | 197 to 441 kPa<br>2.00 to 4.50 kgf/cm$^2$<br>28.5 to 64.0 psi |
| | | Allowable limit | 147 kPa<br>1.50 kgf/cm$^2$<br>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<br>1.5 to 2.0 kgf·m<br>11 to 14 lbf·ft |

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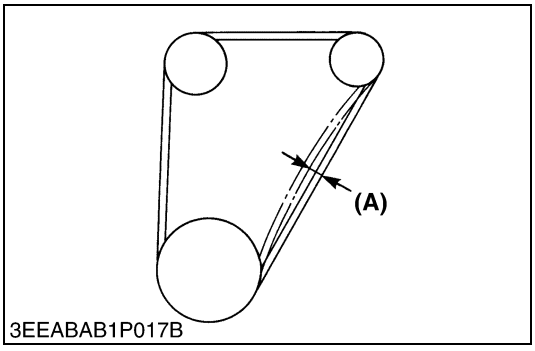
## (3) Cooling System



3EEABAB1P017B

**Fan Belt Tension**

1. Measure the deflection **(A)**, depressing the belt halfway between the fan drive pulley and alternator pulley at specified force 98 N (10 kgf, 22 lbf).
2. If the measurement is not within the factory specifications, loosen the alternator mounting screws and relocate the alternator to adjust.

| | | |
|---|---|---|
| Deflection **(A)** | Factory specification | 7.0 to 9.0 mm<br>0.28 to 0.35 in. |

**(A) Deflection**

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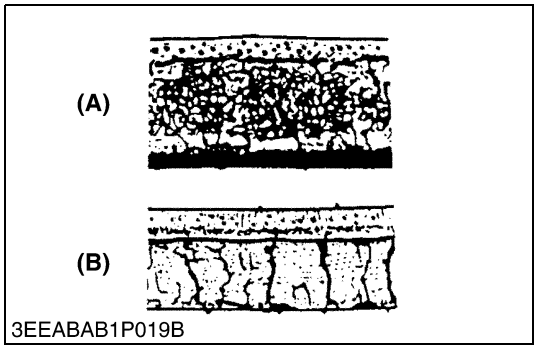

3EEABAB1P019B

## 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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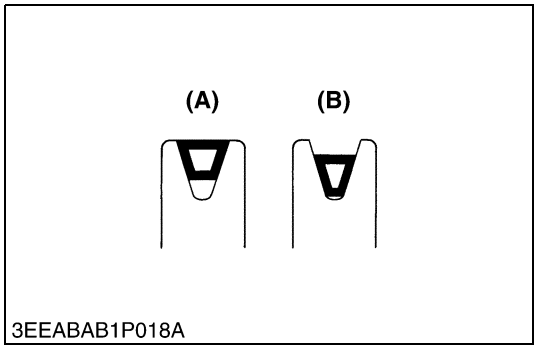

3EEABAB1P018A

**CAUTION**

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

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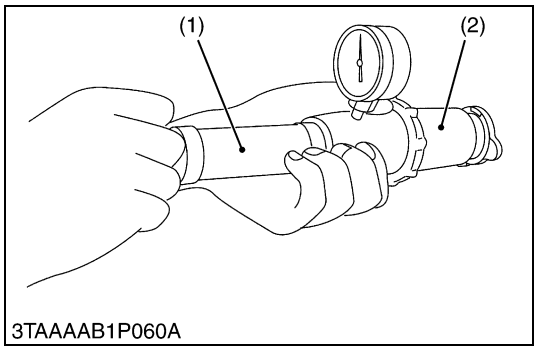

3TAAAAB1P060A

## Radiator Cap Air Leakage

1. Set a radiator tester (1) and an adaptor (2) on the radiator cap.
2. Apply the specified pressure 88 kPa (0.9 kgf/cm$^2$, 13 psi), and measure the time for the pressure to fall to 59 kPa (0.6 kgf/cm$^2$, 9 psi).
3. If the measurement is less than the factory specification, replace the radiator cap.

| | | |
|---|---|---|
| Pressure falling time | Factory 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 8.5 psi) |

(1) Radiator Tester (2) Adaptor

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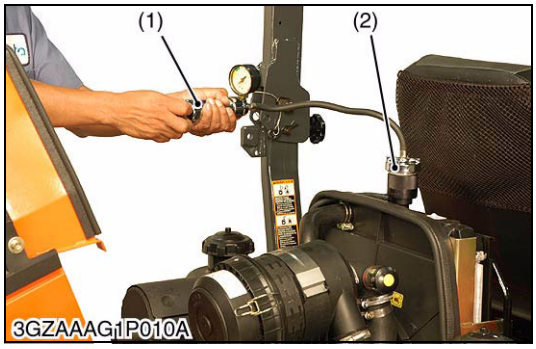


3GZAAAG1P010A

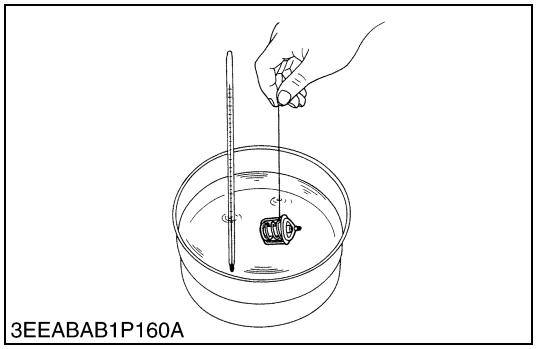
## Radiator Water Leakage

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 1.8 kgf/cm$^2$ 25.7 psi |

(1) Radiator Tester (2) Adaptor

9Y1210301ENS0013US0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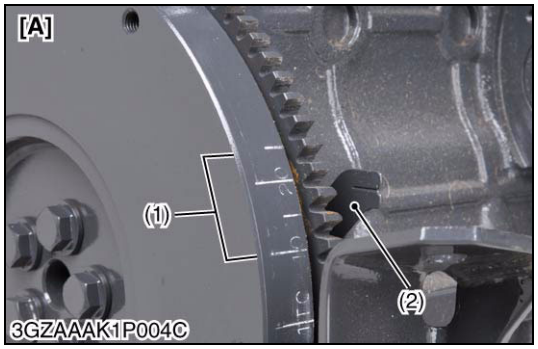
**Thermostat Valve Opening Temperature**

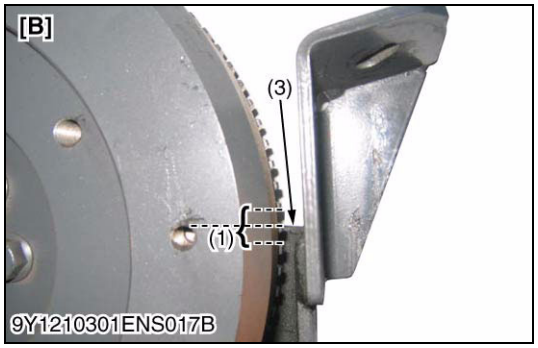
1. Suspend the thermostat in the water by a string with its end inserted between the valve and seat.
2. Heating the water gradually, read the temperature when the valve opens and leaves the string.
3. Continue heating and read the temperature when the valve opens approx. 8 mm (0.3 in.).
4. If the measurement is not within the factory specifications, replace the thermostat.

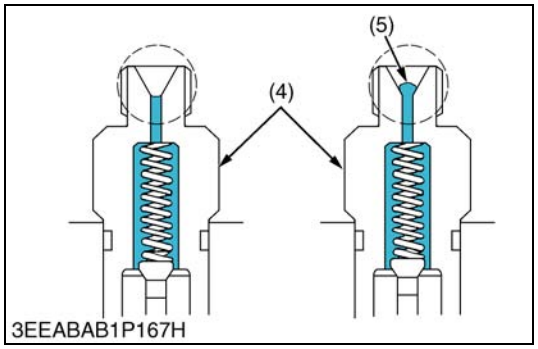
| | | |
|---|---|---|
| Thermostat's valve opening temperature | Factory specification | 69.5 to 72.5 °C<br>157.1 to 162.5 °F |
| Temperature at which thermostat completely opens | Factory specification | 85 °C<br>185 °F |

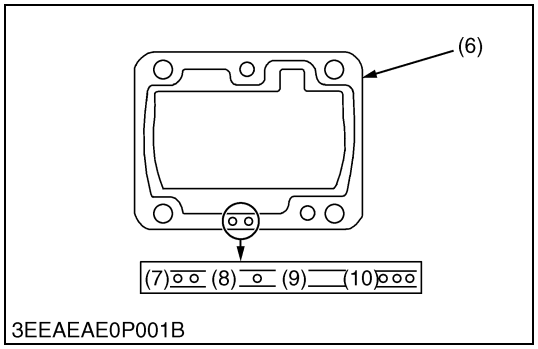
9Y1210301ENS0014US0

# (4) Fuel System




**Injection Timing**

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

| | | |
|---|---|---|
| Injection timing | Factory specification | 0.3360 to 0.3621 rad (19.25 to 20.75 °) before T.D.C. |

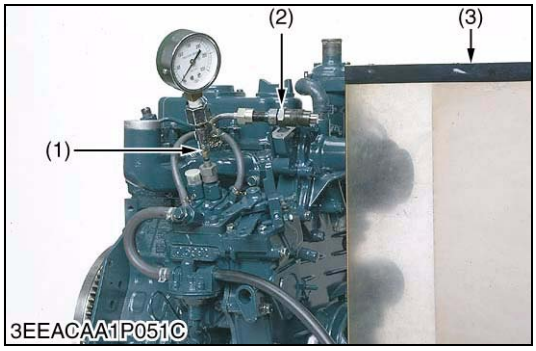
■ **NOTE**

- **The liquid gasket is not required for assembling.**
- **Shims are available in thickness of 0.20 mm (0.0079 in.), 0.25 mm (0.0098 in.), 0.30 mm (0.012 in.) and 0.35 mm (0.014 in.) and 0.175 mm (0.00689 in.). Combine these shims for adjustments.**
- **Addition or reduction of shim (0.025 mm, 0.00098 in.) delays or advances the injection timing by approx. 0.0044 rad (0.25 °).**
- **In disassembling and replacing the injection pump, be sure to use the same number of new shims with the same thickness.**
- **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 can cause oil leakage.**

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

**[A] Machine with alignment mark plate (2)**
**[B] Machine without alignment mark plate (2)**

9Y1210301ENS0015US0




## 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.

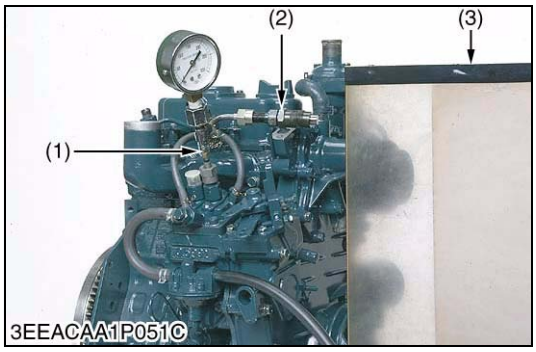
| | | |
|---|---|---|
| Fuel tightness of pump element | Allowable limit | 13.73 MPa<br>140.0 kgf/cm$^2$<br>1991 psi |

■ **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

9Y1210301ENS0016US0




## Fuel Tightness of Delivery Valve

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

| | | |
|---|---|---|
| Fuel tightness of delivery valve | Factory specification | 10 seconds<br>13.73 → 12.75 MPa<br>140.0 → 130.0 kgf/cm$^2$<br>1991 → 1849 psi |
| | Allowable limit | 5 seconds<br>13.73 → 12.75 MPa<br>140.0 → 130.0 kgf/cm$^2$<br>1991 → 1849 psi |

■ **NOTE**

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

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

9Y1210301ENS0017US0

**CAUTION**

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

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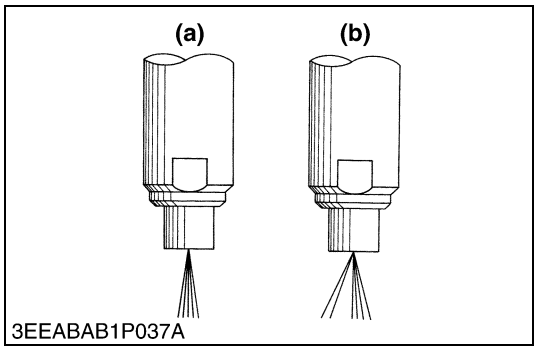

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## Nozzle Spraying Condition

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

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

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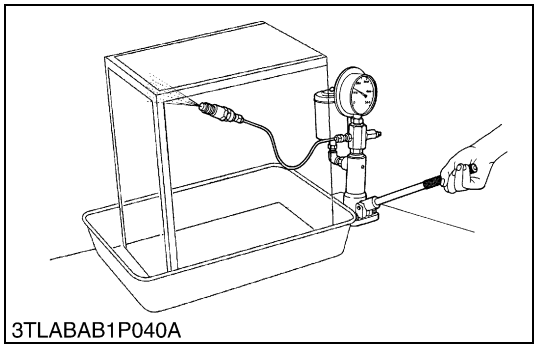

3TLABAB1P040A

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

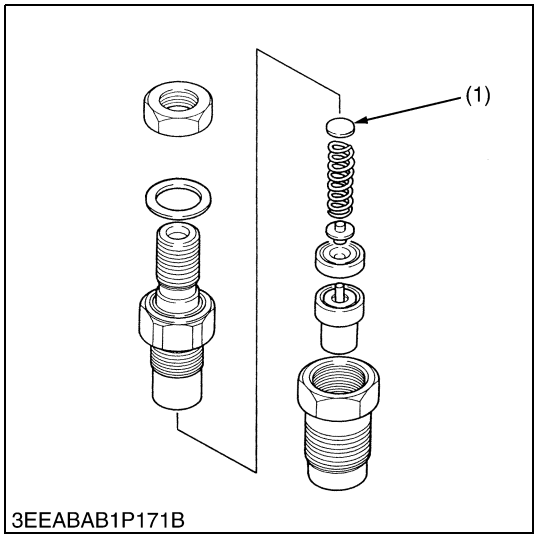
**(Reference)**

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

| | | |
|---|---|---|
| Fuel injection pressure | Factory specification | 13.73 to 14.70 MPa<br>140.0 to 150.0 kgf/cm$^2$<br>1992 to 2133 psi |

(1) Adjusting Washer

9Y1210301ENS0020US0



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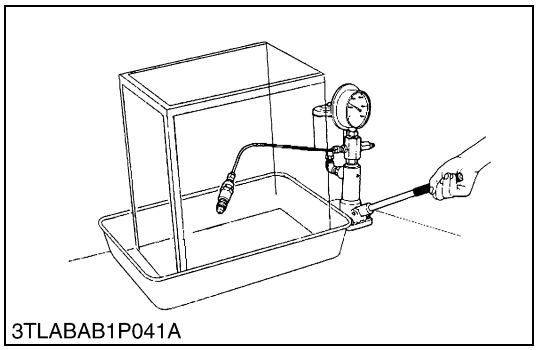
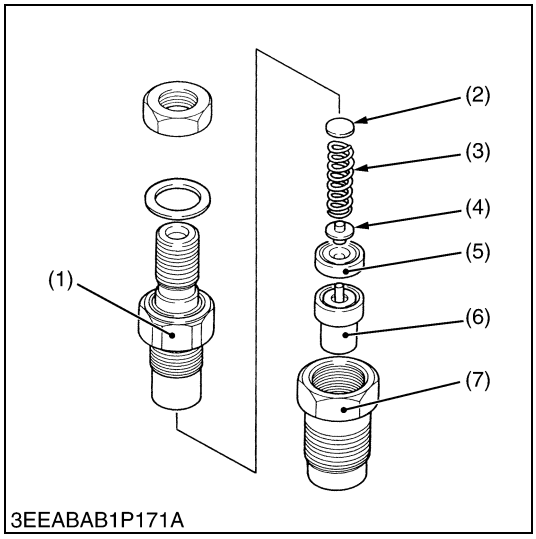

3TLABAB1P041A

## Valve Seat Tightness

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

| | | |
|---|---|---|
| Valve seat tightness | Factory specification | No fuel leak at<br>12.75 MPa<br>130.0 kgf/cm$^2$<br>1849 psi |

9Y1210301ENS0021US0



3EEABAB1P171A

## Nozzle Holder

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

**(When reassembling)**

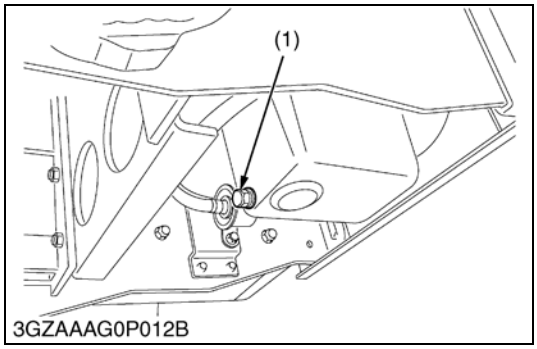
- Assemble the nozzle in clean fuel oil.
- Install the push rod (4), noting its direction.
- After assembling the nozzle, be sure to adjust the fuel injection pressure.

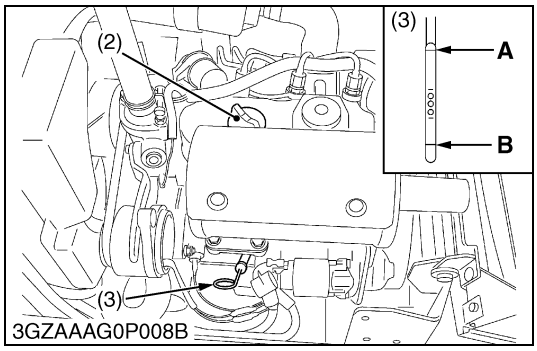
| | | |
|---|---|---|
| Tightening torque | Nozzle holder | 35 to 39 N·m<br>3.5 to 4.0 kgf·m<br>26 to 28 lbf·ft |
| | Overflow pipe retaining nut | 20 to 24 N·m<br>2.0 to 2.5 kgf·m<br>15 to 18 lbf·ft |
| | Nozzle holder assembly | 49 to 68 N·m<br>5.0 to 7.0 kgf·m<br>36 to 50 lbf·ft |

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

9Y1210301ENS0022US0

# [2] SEPARATING ENGINE




## Draining Engine Oil

1. If you do not disassemble the engine, skip this draining procedure.
2. Park the machine on level ground.
3. Start and warm up the engine for approx. 5 minutes.
4. Place an oil pan underneath the engine.
5. Remove the drain plug (1) to drain oil.
6. 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<br>4.1 U.S.qts<br>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
(2) Oil Inlet Plug
(3) Dipstick

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

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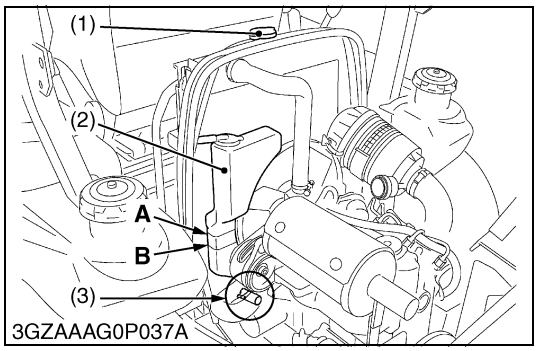
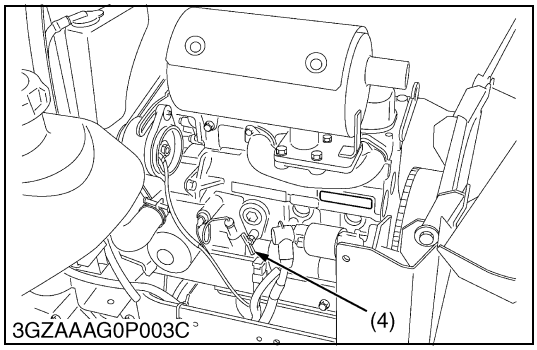



## Draining Coolant

**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 ten minutes to cool the radiator, before opening the cap.**

1. If you do not disassemble the engine, skip this draining procedure.
2. Stop the engine and let cool down.
3. Remove the radiator coolant drain plug (3) and engine coolant drain plug (4) to drain the coolant.
4. Remove the radiator cap (1) to completely drain the coolant.
5. After all coolant is drained, close the drain plugs.

| | | | |
|---|---|---|---|
| Coolant | Capacity | Radiator | 2.7 L<br>2.85 U.S.qts<br>2.38 Imp.qts |
| | | Recovery tank | 0.25 L<br>0.26 U.S.qts<br>0.22 Imp.qts |

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

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

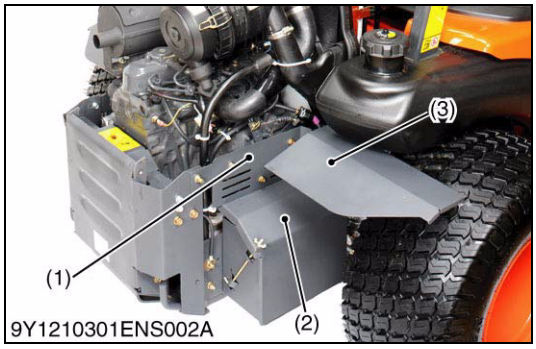
9Y1210301ENS0024US0


## Bonnet

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

(1) Bonnet

9Y1210301ENS0025US0

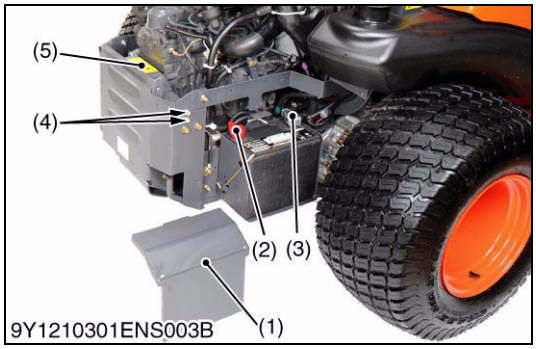



## Battery Cover

1. Remove the side covers L, R (1) and the rear fenders L, R (3).
2. Remove the battery cover (2).

(1) Side cover
(2) Battery cover
(3) Rear Fender

9Y1210301ENS0001US0




## Battery and Flywheel Cover

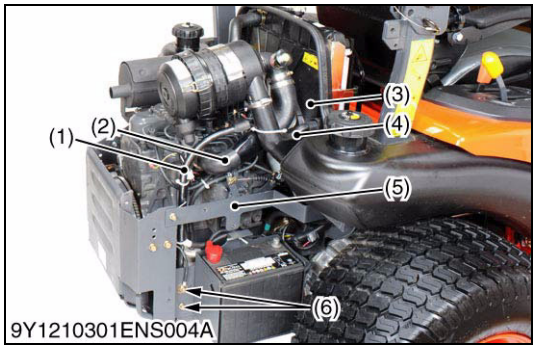
**CAUTION**

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

1. Disconnect the negative cable (3) from the battery.
2. Disconnect the positive cable (2) from the battery.
3. Remove the bolts (4) and flywheel cover (5).

(1) Battery Cover
(2) Positive Cable
(3) Negative Cable
(4) Bolt
(5) Flywheel Cover

9Y1210301ENS0096US0

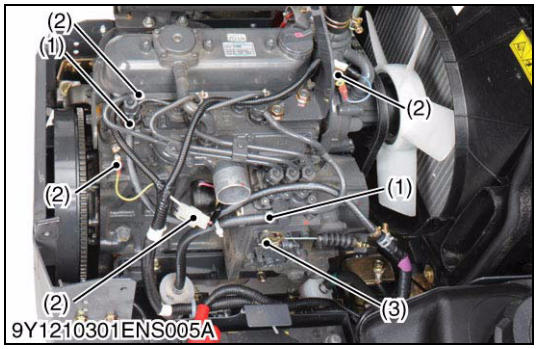



## Air Cleaner

1. Remove the side cover stays L, R (5).
2. Remove the bolts (6) for air cleaner support (1).
3. Disconnect the inlet hose (2) from engine.
4. Pull out the intake pipe (4) from the shroud (3).
5. Remove the air cleaner.

(1) Air Cleaner Support
(2) Inlet Hose
(3) Shroud
(4) Intake Pipe
(5) Side Cover Stay
(6) Bolt

9Y1210301ENS0026US0




## Electric Wiring and Fuel Hoses

1. Disconnect the wiring connectors (2) for engine stop solenoid, glow plug, coolant temperature sensor, and coolant temperature switch.
2. Disconnect the accelerator wire (3).
3. Disconnect the fuel hoses (1) from engine.

**(When reassembling)**

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

(1) Fuel Hose
(2) Wiring Connectors
(3) Accelerator Wire (Throttle Cable)

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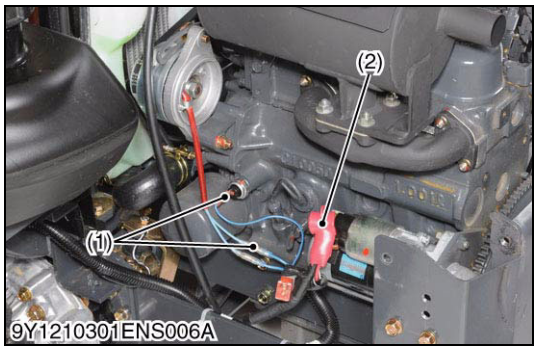


## Electric Wiring

1. Disconnect the wiring connectors (1) for dynamo and engine oil pressure switch.
2. Remove the positive cable (2) from the starter motor.

(1) Wiring Connectors
(2) Positive Cable

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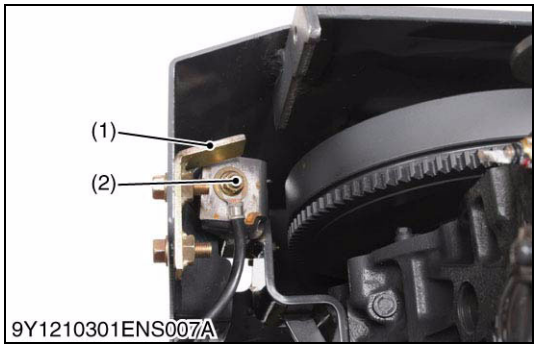


## Engine Stopper and Mounting Nuts

1. Remove the engine stoppers (1).
2. Remove the engine mounting nuts (2).
3. Remove the bolts (3) for shroud.

**(When reassembling)**

- To get a good contact of the ground, attach the ground wire (5) to the specified position (separate position from that of the battery negative cable (4)). (Right side front only)

(1) Engine Stopper
(2) Engine Mounting Nut
(3) Bolt
(4) Battery Negative Cable
(5) Ground Wire

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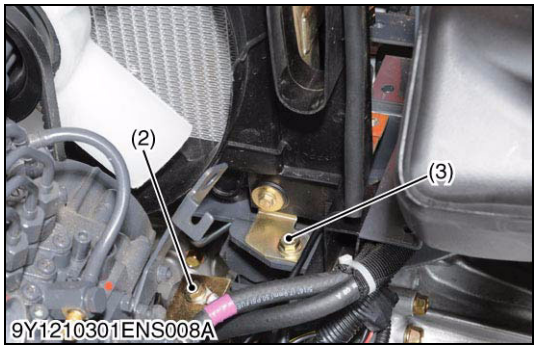


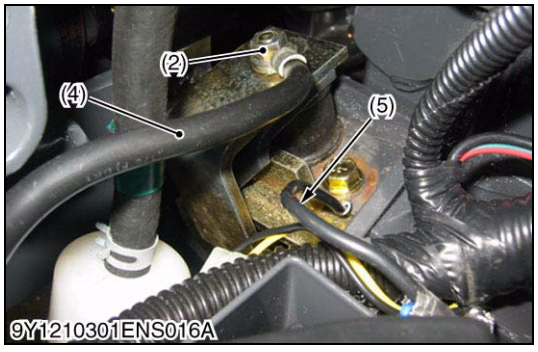

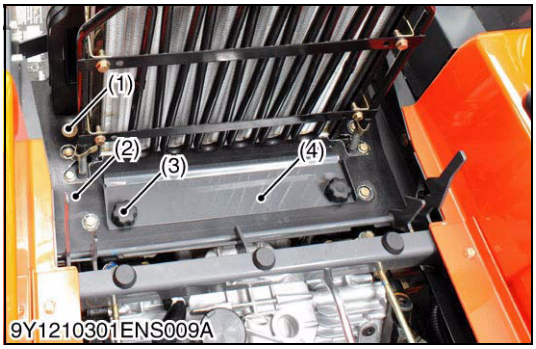



## Plate

1. Raise the seat.
2. Remove the knobs (3) and the plate (4).
3. Remove the 2 bolts (1) and the rubber sheet (2).
4. Remove the plate (5).

(1) Bolt
(2) Rubber Sheet
(3) Knob
(4) Plate
(5) Plate

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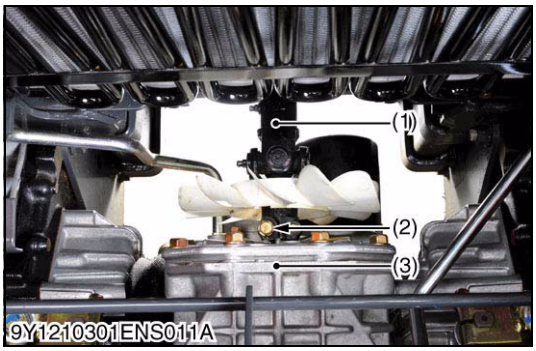


## Universal Joint

1. Remove the 2 bolts (2).
2. Lift up the engine and separate the universal joint (1) from transmission (3).

**(When reassembling)**

- Apply grease to the all splines on the drive shaft.
- Set the engine on the rubber cushion. Before fastening the engine mounting nuts, connect the universal joint.
- Make sure to align all the grease nipples. Only this one position meets the spline.

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


(1) Universal Joint
(2) Bolt
(3) Transmission
(4) Grease Nipple

**A: Fixed to the fan drive pulley.**

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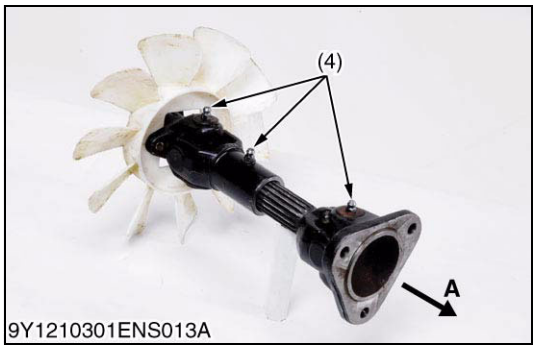

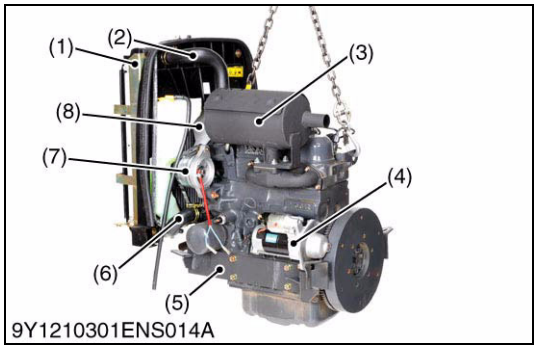

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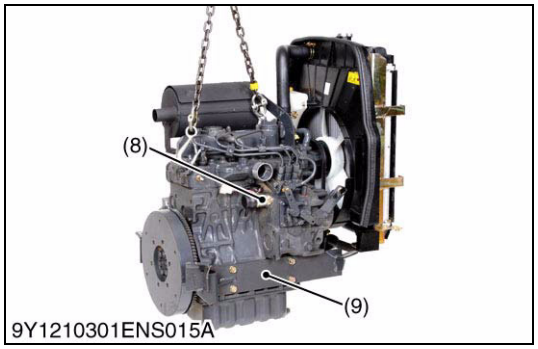

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**Dynamo, Fan Belt and Muffler**

1. Remove the radiator hoses (2), (6) and radiator (1).
2. Remove the cooling fan (8) and fan pulley.
3. Remove the dynamo (7) and fan belt.
4. Remove the muffler (3).
5. Remove the starter (4).
6. Remove the engine support LH (5) and RH (9). Then remove the engine stop solenoid (8).

**(When reassembling)**

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

■ **IMPORTANT**

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

| | | |
|---|---|---|
| Tightening torque | Engine support mounting screw | 48.1 to 55.9 N·m<br>4.9 to 5.7 kgf·m<br>35.4 to 41.2 lbf·ft |

(1) Radiator
(2) Radiator Hose
(3) Muffler
(4) Starter
(5) Engine Support LH
(6) Radiator Hose
(7) Dynamo
(8) Engine Stop Solenoid
(9) Engine Support RH

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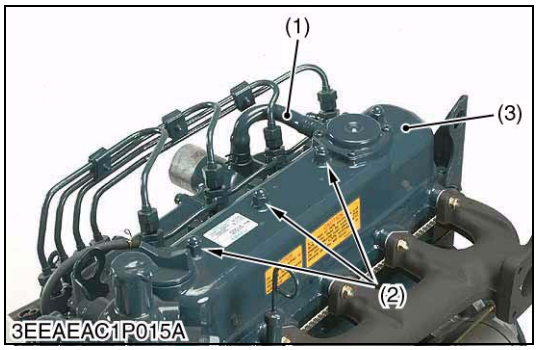
# [3] DISASSEMBLING AND ASSEMBLING

## (1) Cylinder Head and Valve



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**Cylinder Head Cover**

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

**(When reassembling)**

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

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

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

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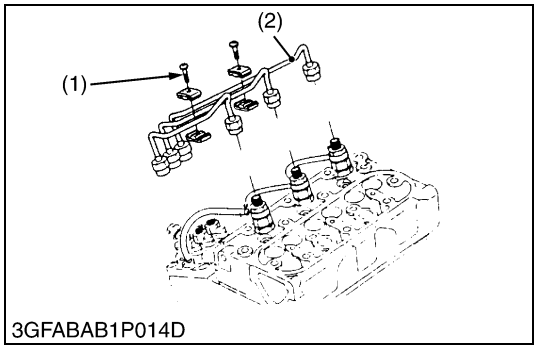

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**Injection Pipes**

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

**(When reassembling)**

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

| | | |
|---|---|---|
| Tightening torque | Injection pipe retaining nut | 25 to 34 N·m<br>2.5 to 3.5 kgf·m<br>18 to 25 lbf·ft |

(1) Pipe Clamp
(2) Injection Pipe

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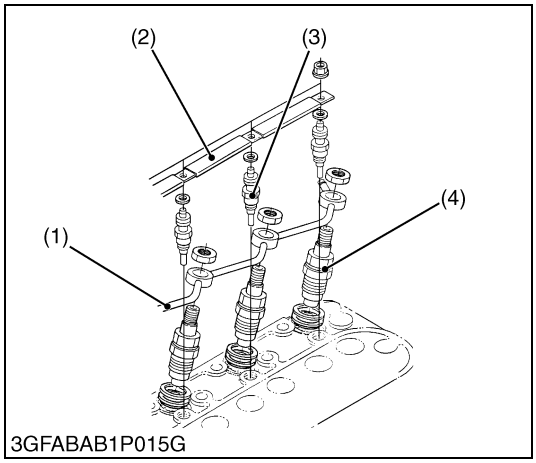

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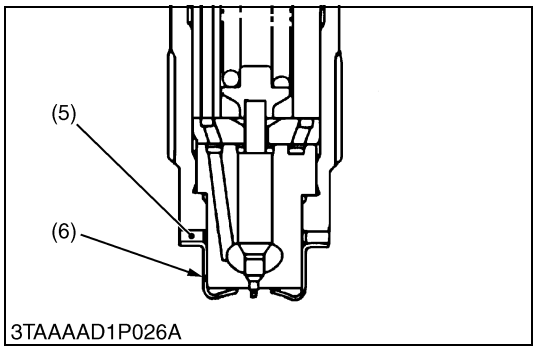

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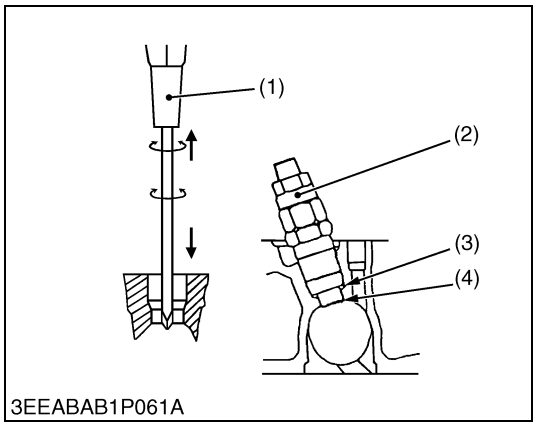

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## Nozzle Holder Assembly and Glow Plug

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

**(When reassembling)**

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

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

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

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

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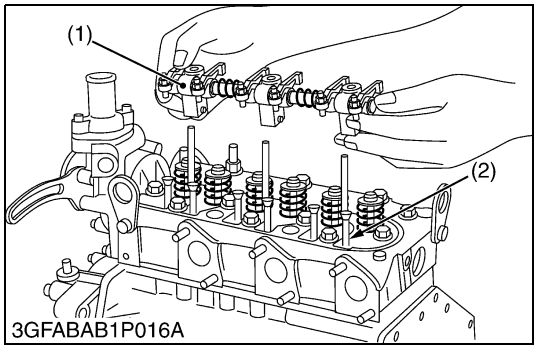

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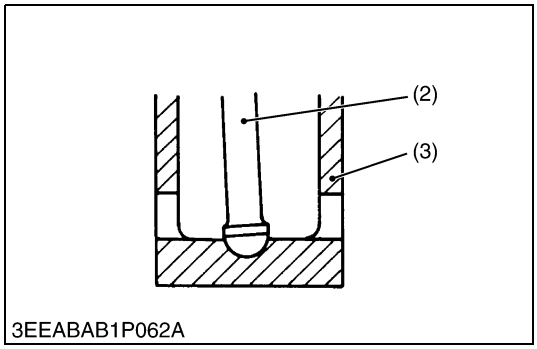

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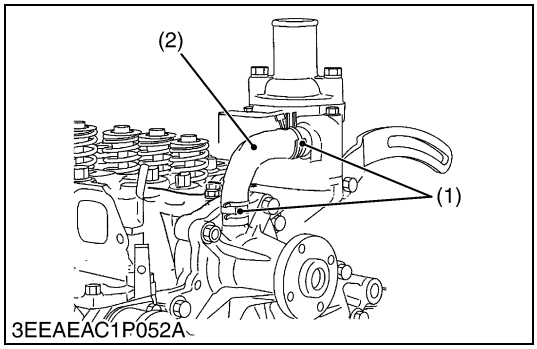

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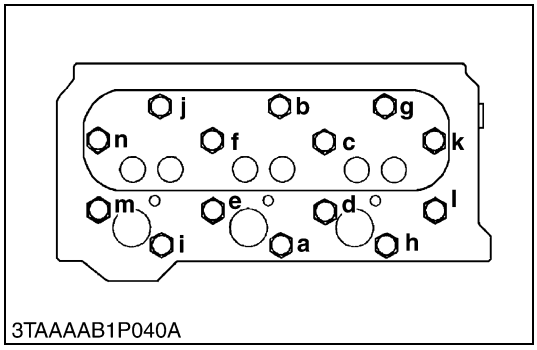

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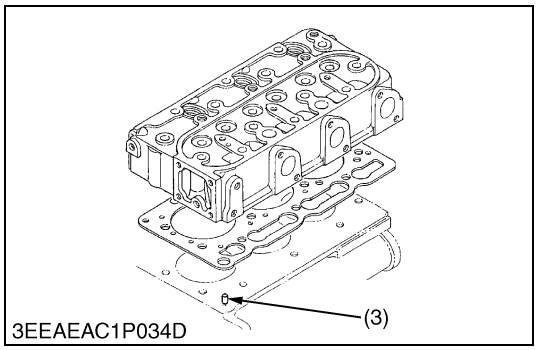

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## Rocker Arm and Push Rod

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

**(When reassembling)**

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

■ **IMPORTANT**

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

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

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

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## Cylinder Head and Cylinder Head Gasket

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

**(When reassembling)**

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

■ **NOTE**

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

| | | |
|---|---|---|
| Tightening torque | Cylinder head screw | 64 to 68 N·m<br>6.5 to 7.0 kgf·m<br>47 to 50 lbf·ft |

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

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

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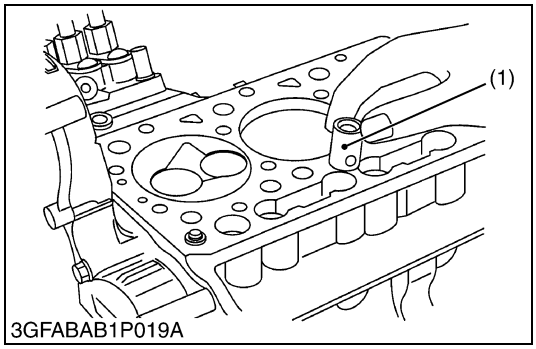


## Tappets

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

**(When reassembling)**

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

■ **IMPORTANT**

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

(1) Tappet

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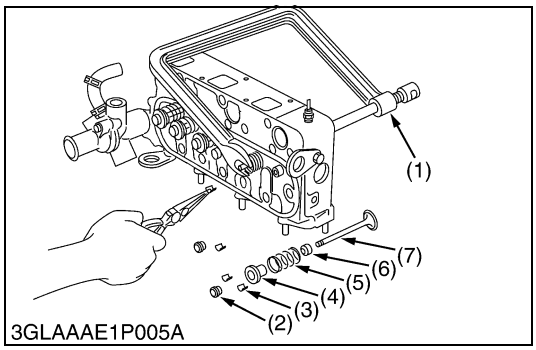


## Valves

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

**(When reassembling)**

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

■ **IMPORTANT**

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

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

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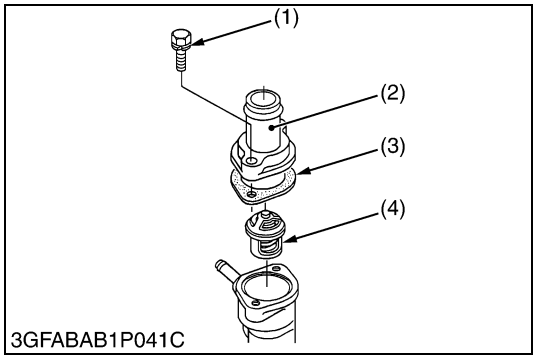


## Thermostat Assembly

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

**(When reassembling)**

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

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

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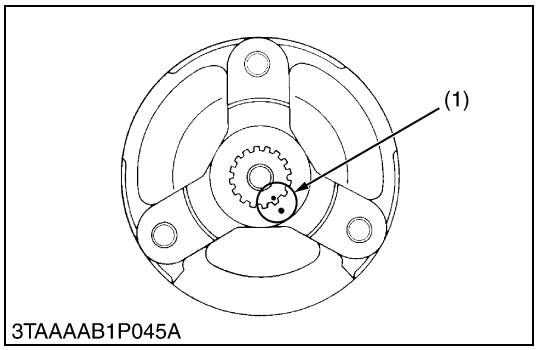
# (2) Gear Case and Timing Gears




## 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<br>24.0 to 25.0 kgf·m<br>174 to 180 lbf·ft |

(1) Aligning Mark

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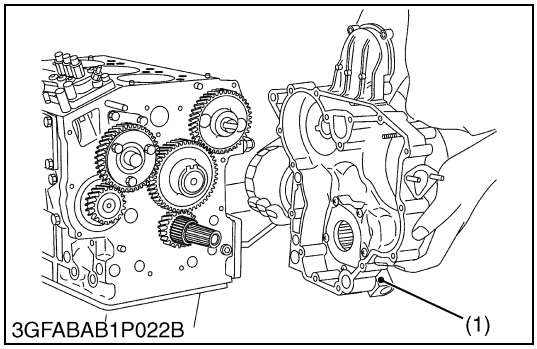


## Gear Case

1. Remove the gear case.

**(When reassembling)**

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

(1) Gear Case

**a: Bolt Length = 45 mm (1.8 in.)**
**b: Bolt Length = 50 mm (2.0 in.)**
**c: Bolt Length = 55 mm (2.2 in.)**
**d: Bolt Length = 65 mm (2.6 in.)**
**e: Bolt Length = 68 mm (2.7 in.)**
**f: Bolt Length = 70 mm (2.8 in.)**
**g: Bolt Length = 85 mm (3.3 in.)**
**h: Nut**

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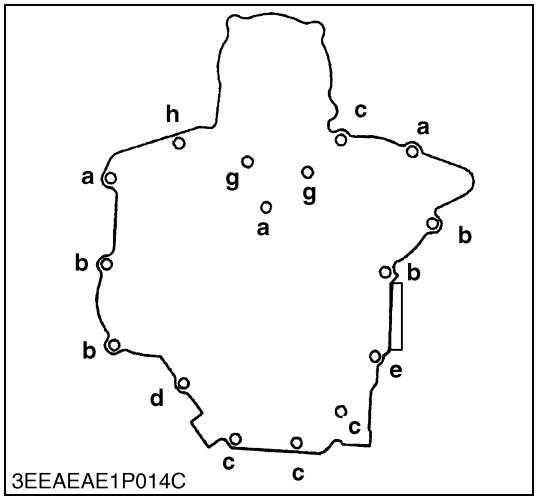


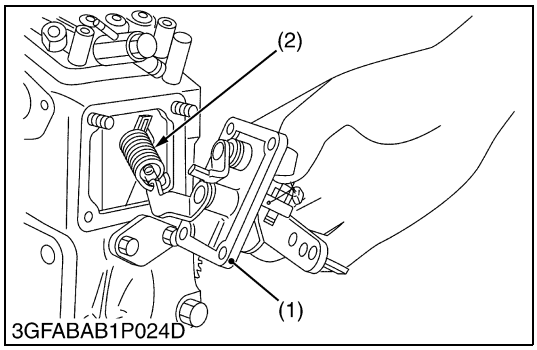


## Speed Control Plate

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

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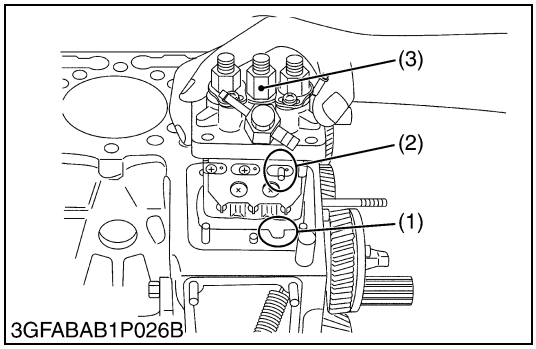


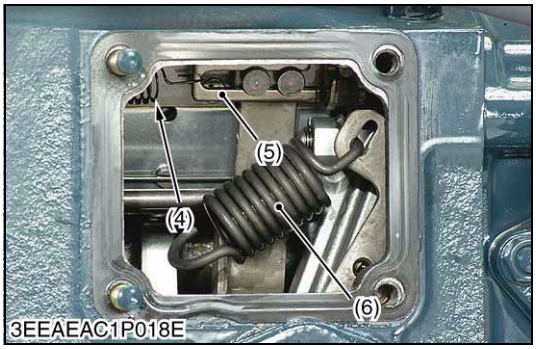


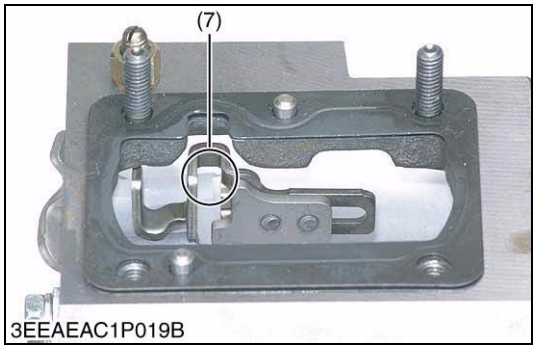


## Injection Pump

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

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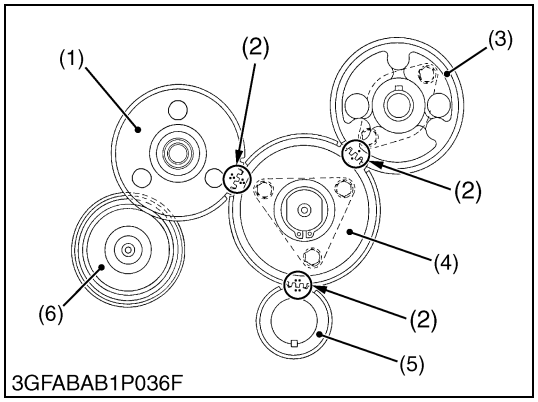

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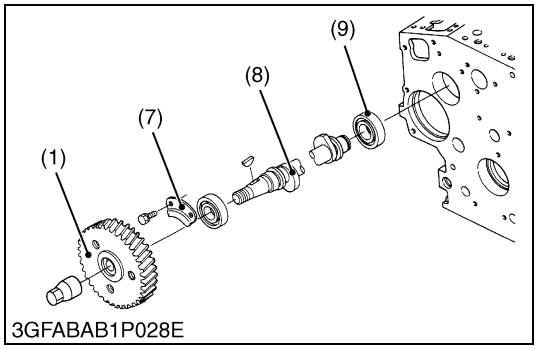

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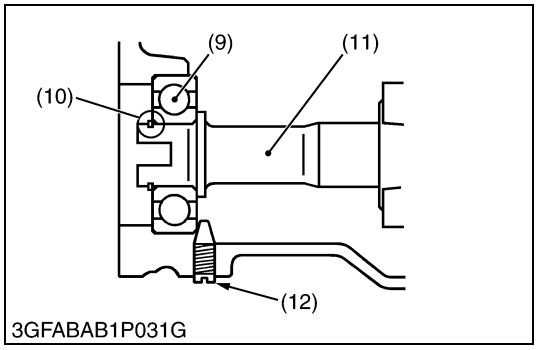

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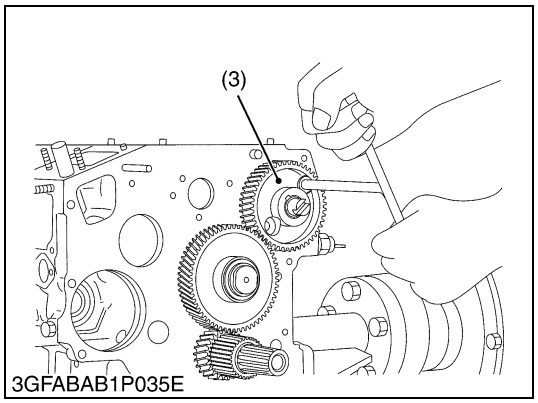

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## Cam Gear, Idle Gear 1 and Governor Gear

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

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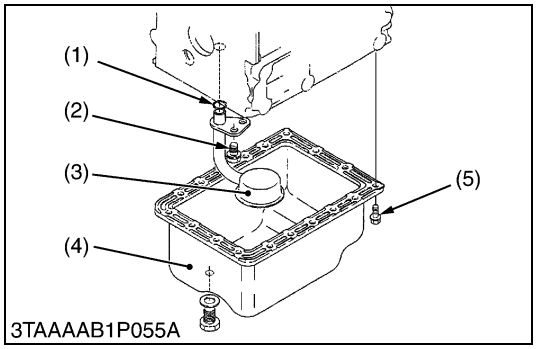
# (3) Piston and Connecting Rod



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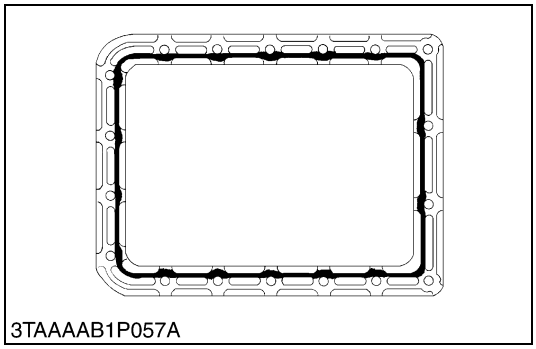
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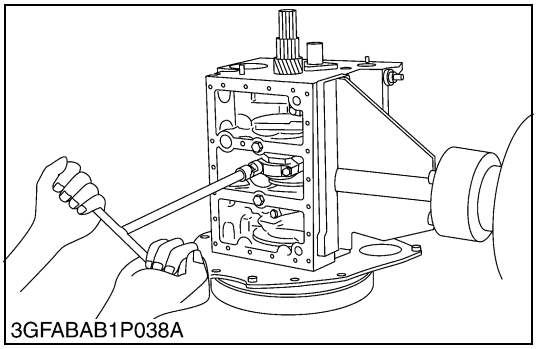
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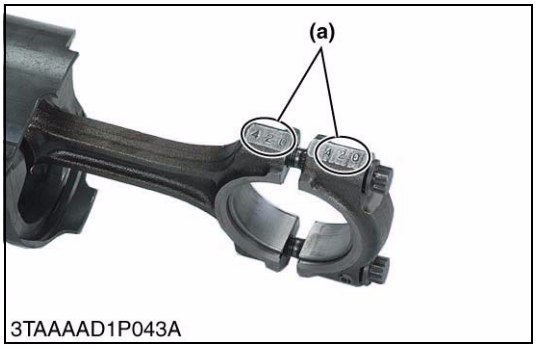

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## Oil Pan and Oil Strainer

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

**(When reassembling)**

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

■ **IMPORTANT**

- **Scrape off the old adhesive completely. Wipe the sealing surface clean using waste cloth soaked with gasoline.**
- **Apply "liquid gasket" about 5 mm (0.20 in.) thick. Within 20 minutes after the application of fluid sealant, reassemble the components.**

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

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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<br>4.2 to 4.7 kgf·m<br>31 to 33 lbf·ft |

**(a) Mark**

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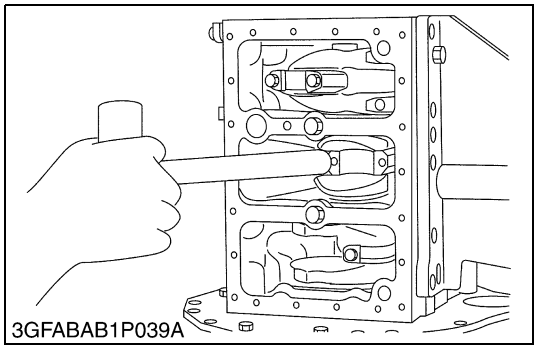
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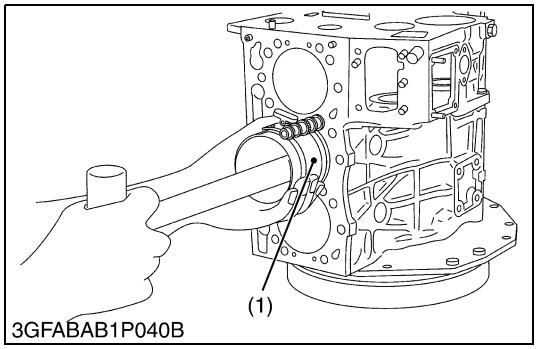

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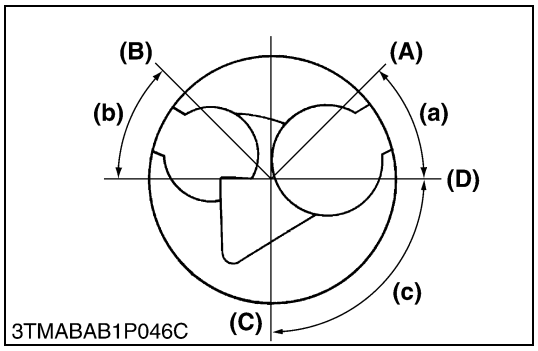

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**Pistons**

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

**(When reassembling)**

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

■ **IMPORTANT**

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

(1) Piston Ring Compressor

**(a) 0.79 rad (45 °)**
**(b) 0.79 rad (45 °)**
**(c) 1.6 rad (90 °)**

**(A) Top Ring Gap**
**(B) Second Ring Gap**
**(C) Oil Ring Gap**
**(D) Piston Pin Hole**

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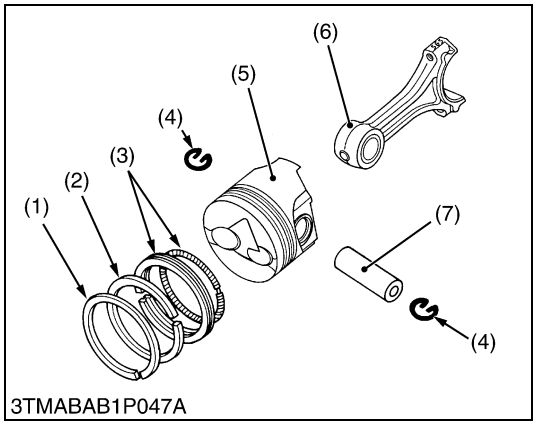

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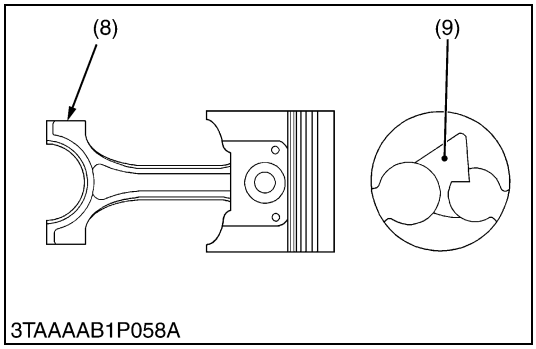

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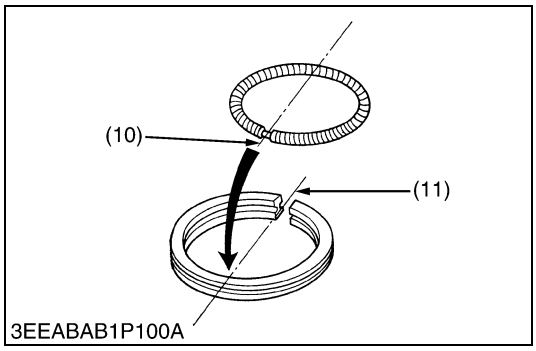

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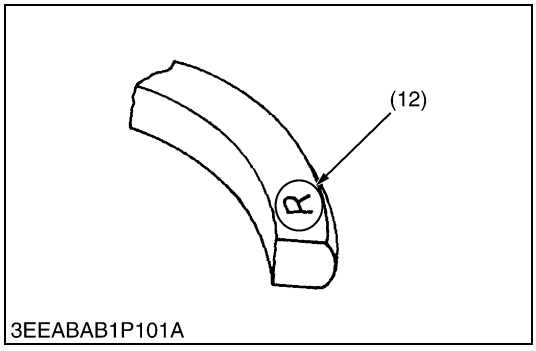

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## Piston Ring and Connecting Rod

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

**(When reassembling)**

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

■ **NOTE**

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

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

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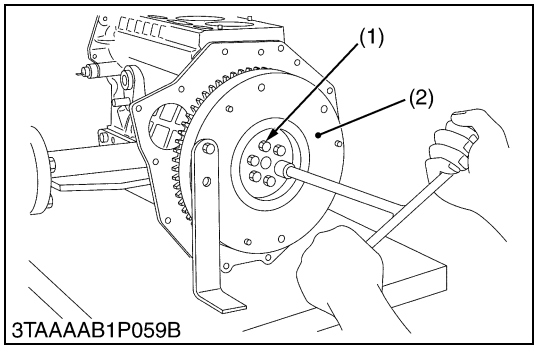
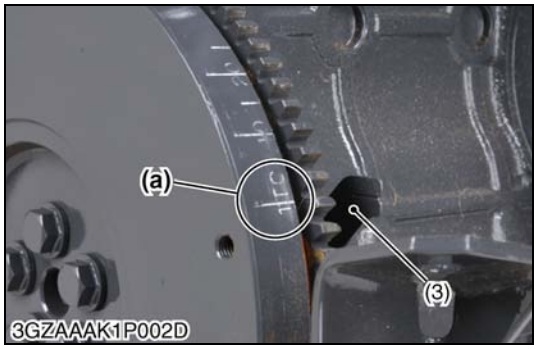
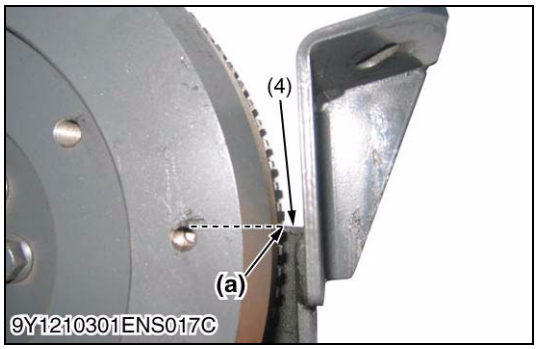
# (4) Flywheel and Crankshaft




**Flywheel**

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

**(When reassembling)**

- **[Machine with alignment mark plate (2)]**
  Align the **"1TC"** mark **(a)** on the flywheel to the alignment mark (3).
  **[Machine without alignment mark plate (2)]**
  Align the **"1TC"** mark **(a)** on the flywheel to the level of the top edge of the engine support (4).
- 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<br>5.5 to 6.0 kgf·m<br>40 to 43 lbf·ft |

(1) Flywheel Screw
(2) Flywheel
(3) Alignment Mark Plate
(4) Top Edge of Engine Support
**(a) 1TC Mark**

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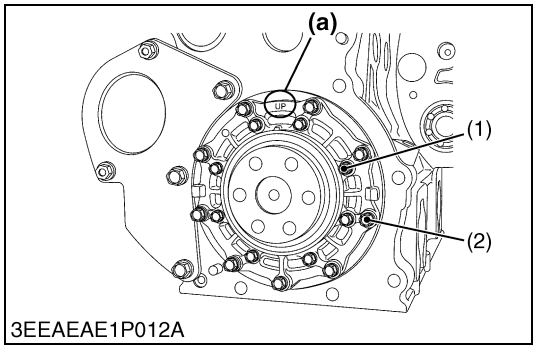

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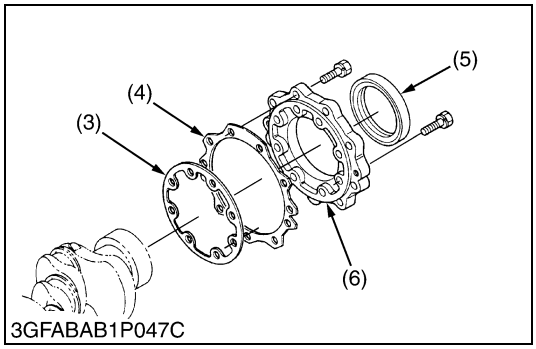

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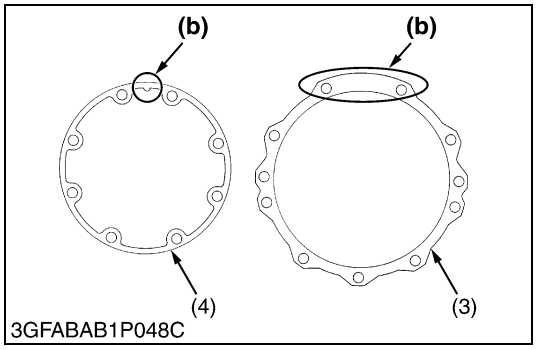

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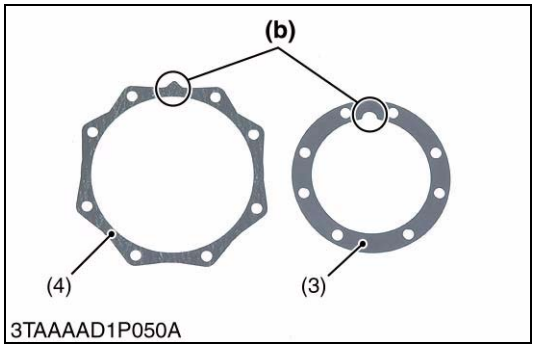

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## Bearing Case Cover

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

**(When reassembling)**

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

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

(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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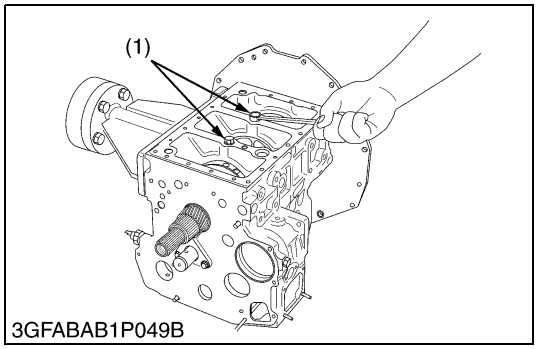


## Crankshaft Assembly

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

■ **IMPORTANT**

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

**(When reassembling)**

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

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

(1) Main Bearing Case Screw 2

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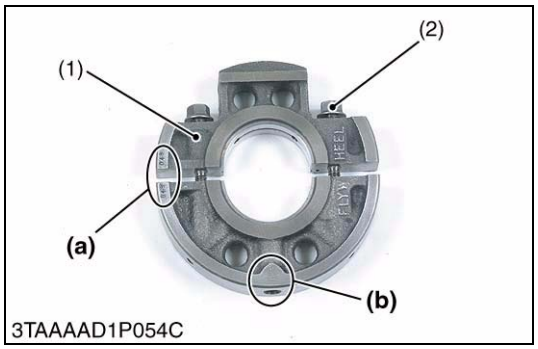


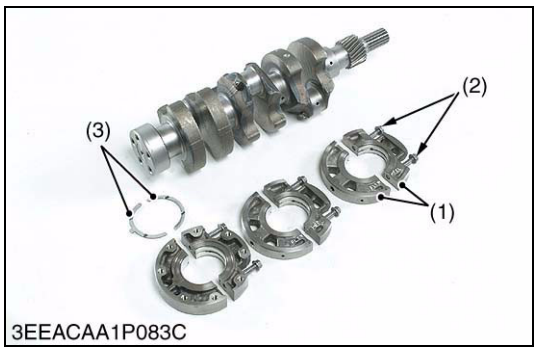


## Main Bearing Case Assembly

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

**(When reassembling)**

- Clean the oil passage in the main bearing cases.
- Apply clean engine oil to the bearings.
- Install the main bearing case assemblies in the original positions. Since diameters of main bearing cases vary, install them in order of marking **(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.
- Confirm 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<br>3.0 to 3.5 kgf·m<br>22 to 25 lbf·ft |

(1) Main Bearing Case Assembly 1
(2) Main Bearing Case Screw 1
(3) Thrust Bearing
**(a) Alignment Number**
**(b) Marking (A, B, C)**

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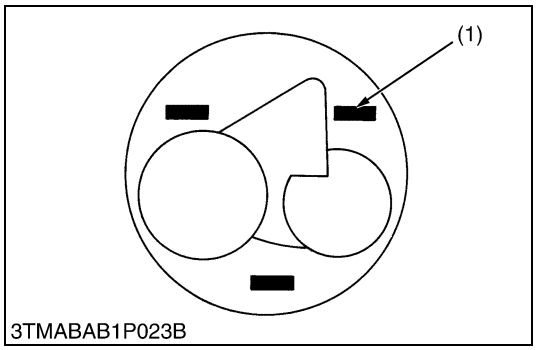
# [4] SERVICING
## (1) Cylinder Head and Valves



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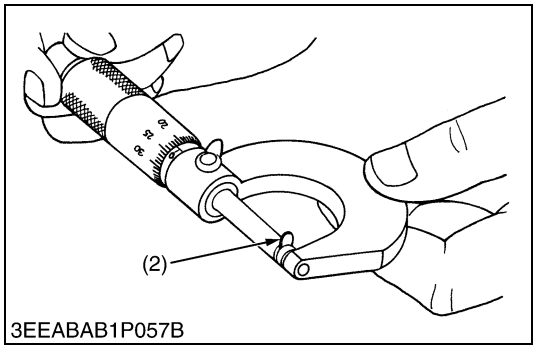

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### Top Clearance

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

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

| | | |
|---|---|---|
| Top clearance | Factory specification | 0.55 to 0.75 mm<br>0.022 to 0.029 in. |

| | | |
|---|---|---|
| Tightening torque | Cylinder head screw | 64 to 68 N·m<br>6.5 to 7.0 kgf·m<br>47 to 50 lbf·ft |

(1) Fuse (2) Fuse

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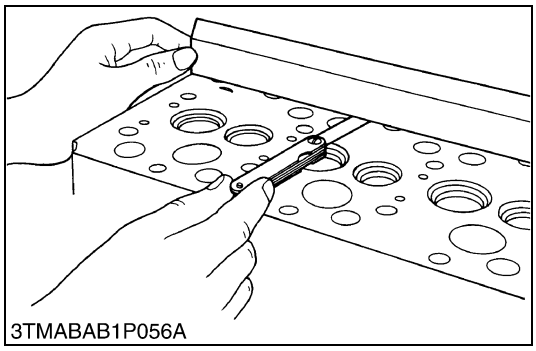
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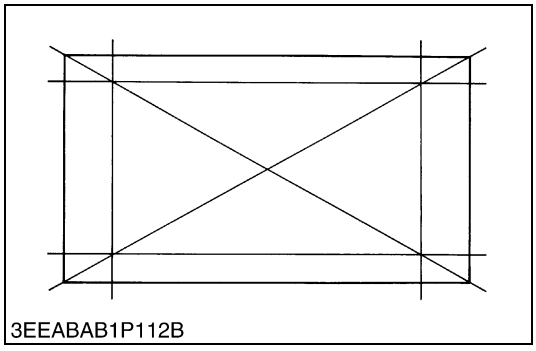
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### Cylinder Head Surface Flatness

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

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

| | | |
|---|---|---|
| Cylinder head surface flatness | Allowable limit. | 0.05 mm<br>0.002 in. |

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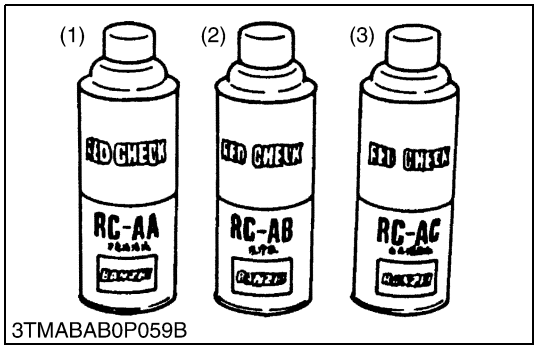

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## Cylinder Head Flaw

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

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

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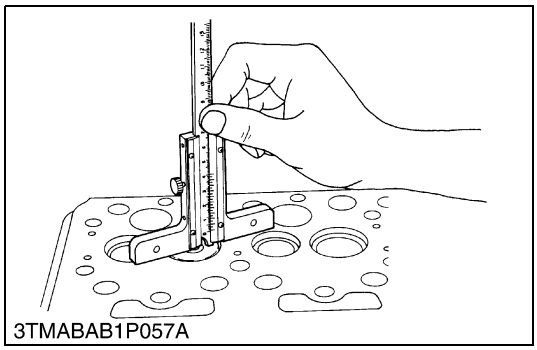
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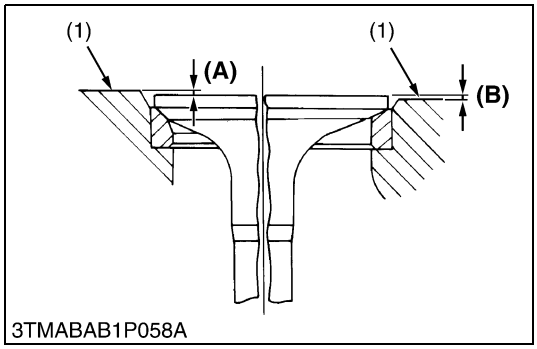
## Valve Recessing

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

| | | |
|---|---|---|
| Valve recessing | Factory specification | 0.050 (protrusion) to 0.25 (recessing) mm<br>0.0020 (protrusion) to 0.0098 (recessing) in. |
| | Allowable limit | 0.40 (recessing) mm<br>0.016 (recessing) in. |



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

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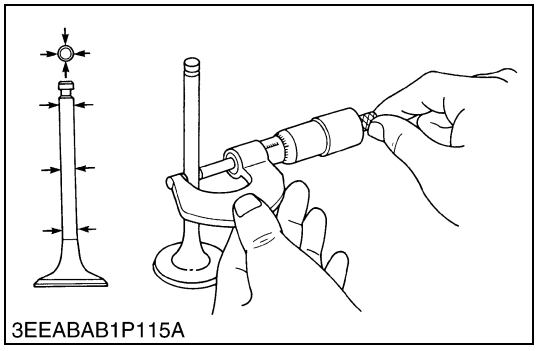
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## Clearance between Valve Stem and Valve Guide

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

| | | |
|---|---|---|
| Clearance between valve stem and valve guide | Factory specification | 0.035 to 0.065 mm<br>0.0014 to 0.0025 in. |
| | Allowable limit | 0.10 mm<br>0.0039 in. |

| | | |
|---|---|---|
| Valve stem O.D. | Factory specification | 6.960 to 6.975 mm<br>0.2741 to 0.2746 in. |
| Valve guide I.D. | Factory specification | 7.010 to 7.025 mm<br>0.2760 to 0.2765 in. |

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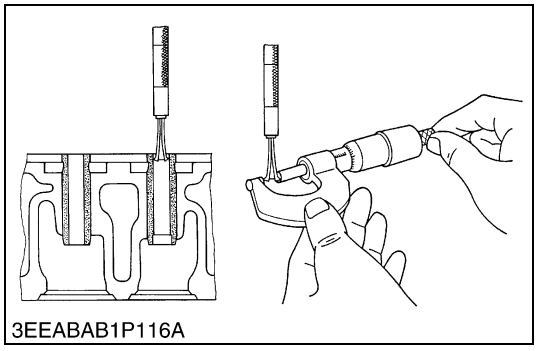
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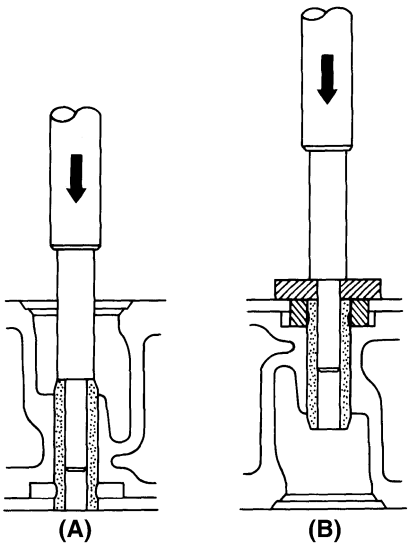

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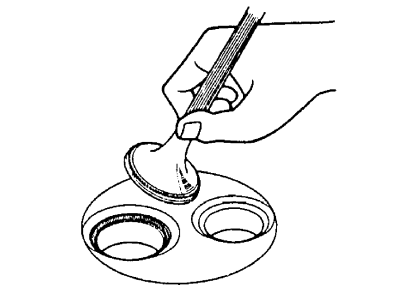
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## Replacing Valve Guide

**(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.<br>(Intake and exhaust) | Factory specification | 7.010 to 7.025 mm<br>0.2760 to 0.2765 in. |

■ **IMPORTANT**

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

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

9Y1210301ENS0060US0

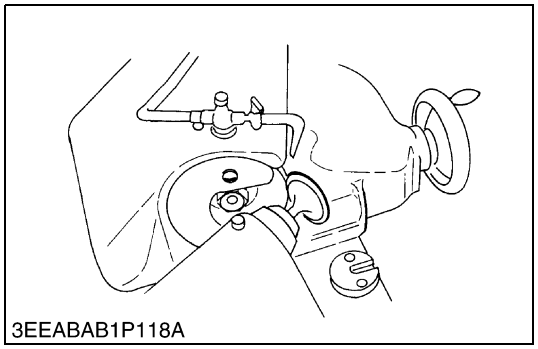
## Valve Seating

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<br>0.0835 in. |

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

9Y1210301ENS0061US0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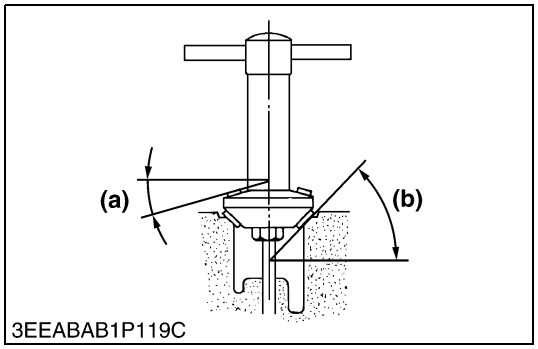

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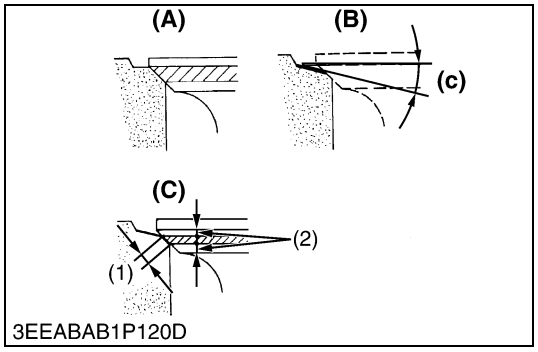

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## Correcting Valve and Valve Seat

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

**1) Correcting Valve**

1. Correct the valve with a valve refacer.

| | | | |
|---|---|---|---|
| Valve face angle | Factory specification | IN. | 1.0 rad<br>60 ° |
| | | EX. | 0.79 rad<br>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<br>60 ° |
| | | EX. | 0.79 rad<br>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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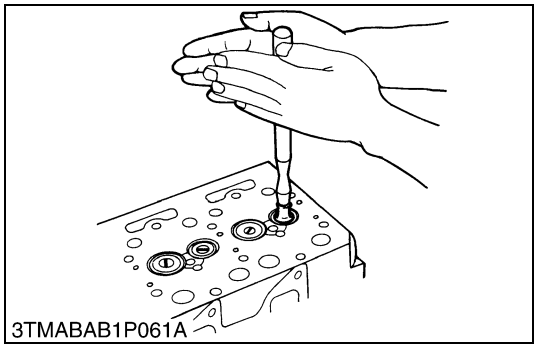
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## Valve Lapping

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

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

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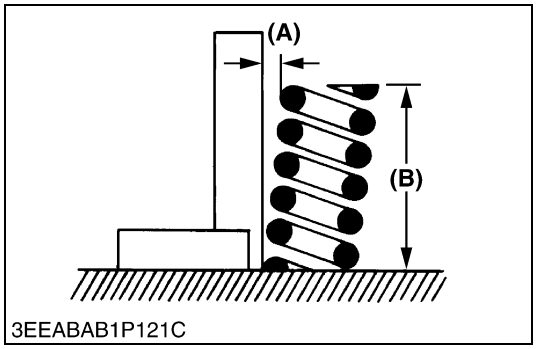

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## Free Length and Tilt of Valve Spring

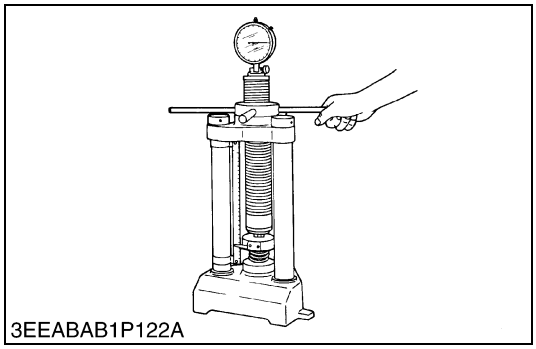
1. Measure the free length **(B)** of valve spring with vernier calipers. If the measurement is less than the allowable limit, replace it.
2. Put the valve spring on a surface plate, place a square on the side of the valve spring.
3. Check to see if the entire side is in contact with the square. Rotate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

| | | |
|---|---|---|
| Tilt **(A)** | Allowable limit | 1.0 mm<br>0.039 in. |

| | | |
|---|---|---|
| Free length **(B)** | Factory specification | 37.0 to 37.5 mm<br>1.46 to 1.47 in. |
| | Allowable limit | 36.5 mm<br>1.44 in. |

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

9Y1210301ENS0064US0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## Valve Spring Setting Load

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

| | | |
|---|---|---|
| Setting load /<br>Setting length | Factory specification | 117.4 N / 31.0 mm<br>11.97 kgf / 31.0 mm<br>26.39 lbf / 1.22 in. |
| | Allowable limit | 100.0 N / 31.0 mm<br>10.20 kgf / 31.0 mm<br>22.48 lbf / 1.22 in. |

9Y1210301ENS0065US0


3TAAAAD1P060A

## 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<br>0.00063 to 0.0017 in. |
| | Allowable limit | 0.10 mm<br>0.0039 in. |

| | | |
|---|---|---|
| Rocker arm shaft O.D. | Factory specification | 11.973 to 11.984 mm<br>0.47138 to 0.47181 in. |
| Rocker arm I.D. | Factory specification | 12.000 to 12.018 mm<br>0.47244 to 0.47314 in. |

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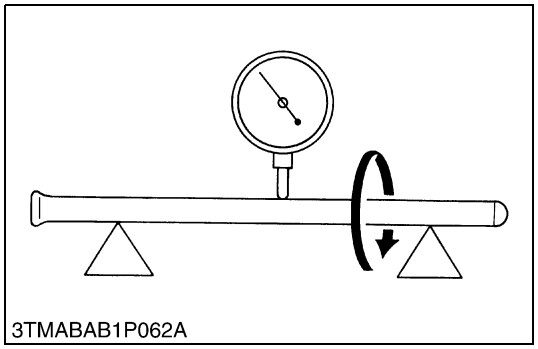
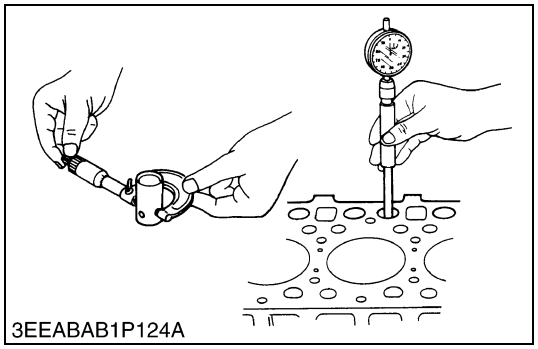

3TMABAB1P062A

**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<br>0.0098 in. |

9Y1210301ENS0067US0


3EEABAB1P124A

**Oil Clearance between Tappet and Tappet Guide Bore**

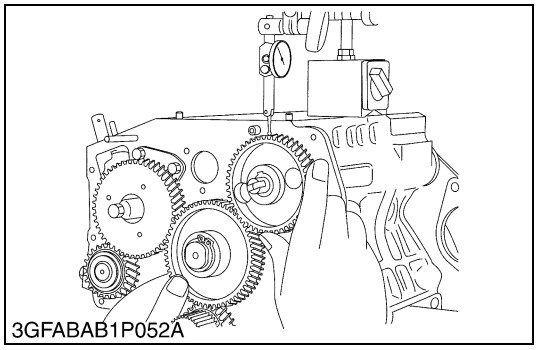
1. Measure the tappet O.D. with an outside micrometer.
2. Measure the I.D. of the tappet guide bore with a cylinder gauge, and calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit or the tappet is damaged, replace the tappet.

| | | |
|---|---|---|
| Oil clearance between tappet and tappet guide bore | Factory specification | 0.020 to 0.062 mm<br>0.00079 to 0.0024 in. |
| | Allowable limit | 0.07 mm<br>0.003 in. |

| | | |
|---|---|---|
| Tappet O.D. | Factory specification | 19.959 to 19.980 mm<br>0.78579 to 0.78661 in. |
| Tappet guide bore I.D. | Factory specification | 20.000 to 20.021 mm<br>0.78740 to 0.78822 in. |

9Y1210301ENS0068US0

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

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

| | | |
|---|---|---|
| Backlash between idle gear 1 and crank gear | Factory specification | 0.0320 to 0.115 mm<br>0.00126 to 0.00452 in. |
| | Allowable limit | 0.15 mm<br>0.0059 in. |

| | | |
|---|---|---|
| Backlash between idle gear 1 and cam gear | Factory specification | 0.0360 to 0.114 mm<br>0.00142 to 0.00448 in. |
| | Allowable limit | 0.15 mm<br>0.0059 in. |

| | | |
|---|---|---|
| Backlash between idle gear 1 and injection pump gear | Factory specification | 0.0340 to 0.116 mm<br>0.00134 to 0.00456 in. |
| | Allowable limit | 0.15 mm<br>0.0059 in. |

9Y1210301ENS0069US0

**Governor Gear Backlash**

| | | |
|---|---|---|
| Backlash between injection pump gear and governor gear | Factory specification | 0.0300 to 0.117 mm<br>0.00119 to 0.00460 in. |
| | Allowable limit | 0.15 mm<br>0.0059 in. |

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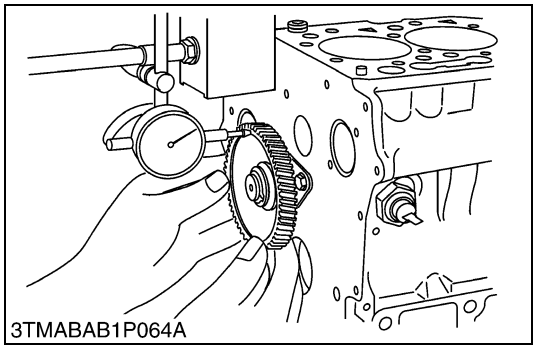
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## Idle Gear and Gear 1 Side Clearance

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<br>0.0079 to 0.020 in. |
| | Allowable limit | 0.80 mm<br>0.031 in. |

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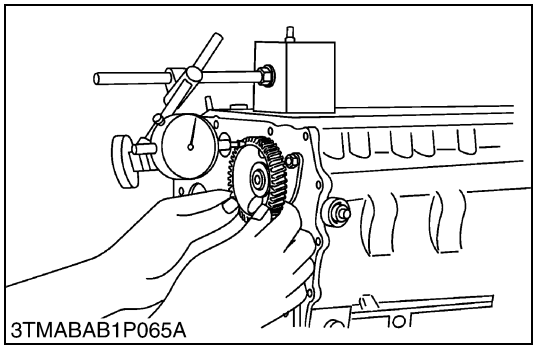
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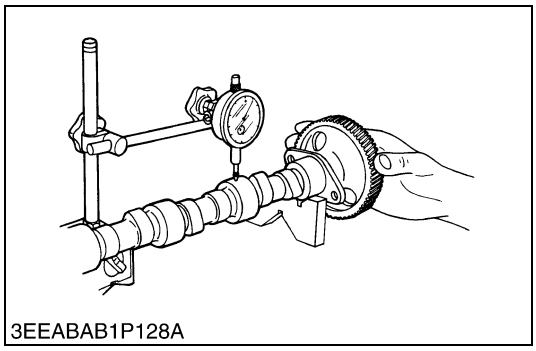
## Camshaft Side Clearance

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

| | | |
|---|---|---|
| Camshaft side clearance | Factory specification | 0.070 to 0.22 mm<br>0.0028 to 0.0086 in. |
| | Allowable limit | 0.30 mm<br>0.012 in. |

9Y1210301ENS0072US0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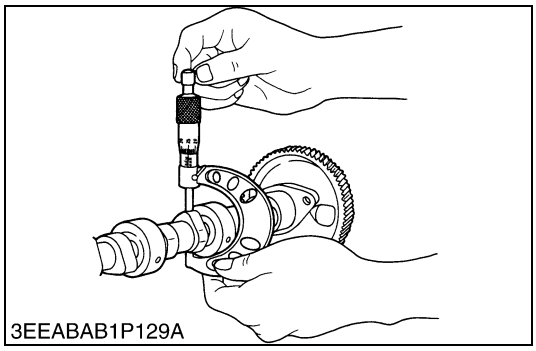
## Camshaft Alignment

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<br>0.0004 in. |

9Y1210301ENS0073US0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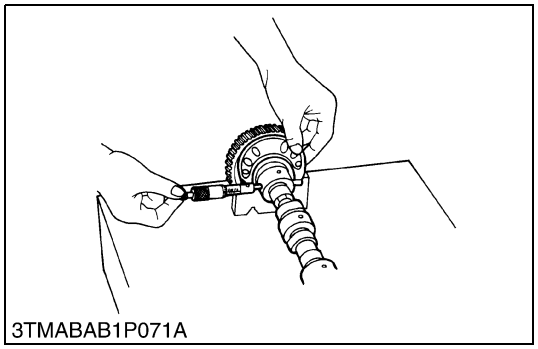
## Cam Height

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

| | | |
|---|---|---|
| Cam height of intake | Factory specification | 28.80 mm<br>1.134 in. |
| | Allowable limit | 28.75 mm<br>1.132 in. |

| | | |
|---|---|---|
| Cam height of exhaust | Factory specification | 29.0 mm<br>1.142 in. |
| | Allowable limit | 28.95 mm<br>1.140 in. |

9Y1210301ENS0074US0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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<br>0.0020 to 0.0035 in. |
| | Allowable limit | 0.15 mm<br>0.0059 in. |

| | | |
|---|---|---|
| Camshaft journal O.D. | Factory specification | 35.934 to 35.950 mm<br>1.4147 to 1.4153 in. |
| Camshaft bearing I.D. (Cylinder block bore I.D.) | Factory specification | 36.000 to 36.025 mm<br>1.4173 to 1.4183 in. |

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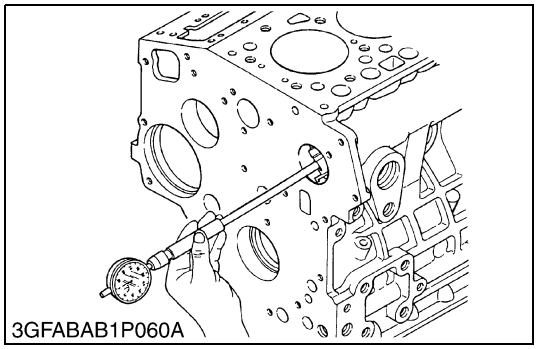
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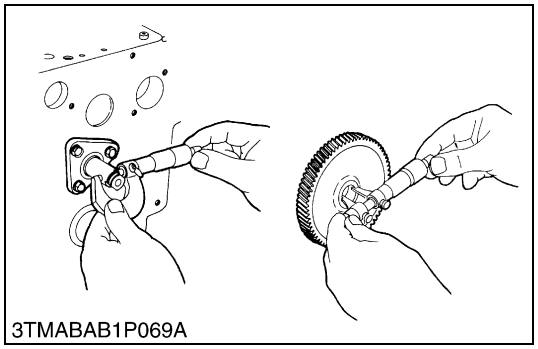
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## Oil Clearance between Idle Gear Shaft1 and Idle Gear Bushing

1. Measure the idle gear shaft1 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 shaft1.

| | | |
|---|---|---|
| Oil clearance between idle gear shaft and idle gear bushing | Factory specification | 0.020 to 0.054 mm<br>0.00079 to 0.0021 in. |
| | Allowable limit | 0.10 mm<br>0.0039 in. |

| | | |
|---|---|---|
| Idle gear shaft 1 O.D. | Factory specification | 25.967 to 25.980 mm<br>1.0223 to 1.0228 in. |
| Idle gear bushing 1 I.D. | Factory specification | 26.000 to 26.021 mm<br>1.0237 to 1.0244 in. |

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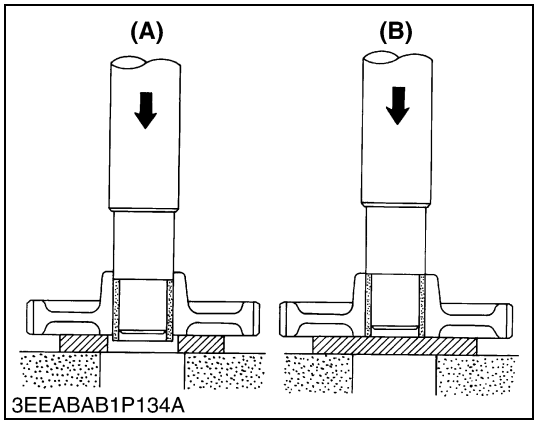

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## Replacing Idle Gear Bushing

**(When removing)**

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

**(When installing)**

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

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

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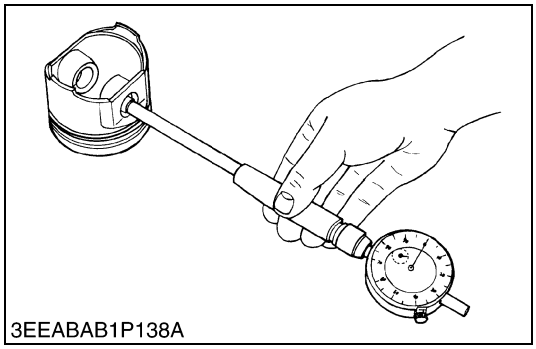
# (3) Piston and Connecting Rod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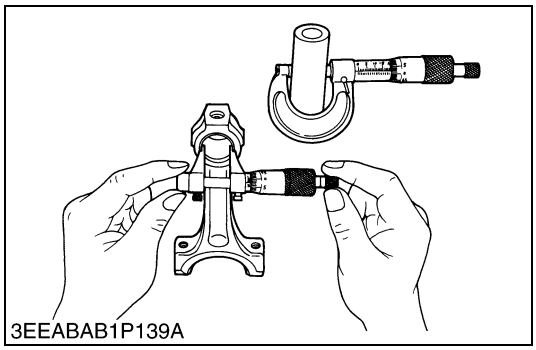
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**Piston Pin Bore I.D.**

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

| | | |
|---|---|---|
| Piston pin bore I.D. | Factory specification | 22.000 to 22.013 mm<br>0.86615 to 0.86665 in. |
| | Allowable limit | 22.03 mm<br>0.8673 in. |

9Y1210301ENS0078US0

**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<br>0.00055 to 0.0014 in. |
| | Allowable limit | 0.15 mm<br>0.0059 in. |

| | | |
|---|---|---|
| Piston pin O.D. | Factory specification | 22.002 to 22.011 mm<br>0.86622 to 0.86657 in. |
| Small end bushing I.D. | Factory specification | 22.025 to 22.040 mm<br>0.86713 to 0.86771 in. |

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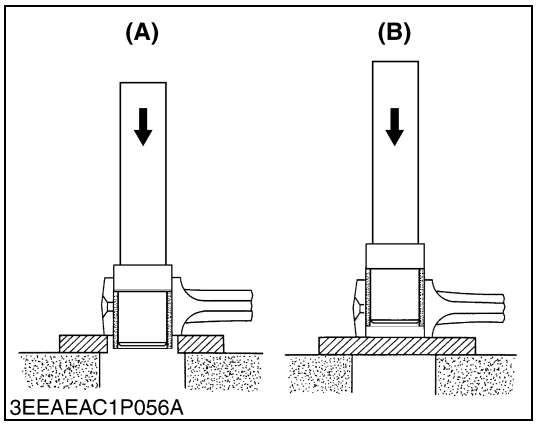

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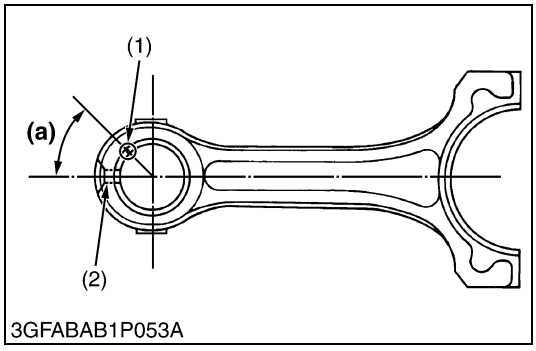

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**Replacing Small End Bushing**

**(When removing)**

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

**(When installing)**

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

| | | |
|---|---|---|
| Oil clearance between piston pin and small end bushing (Spare parts) | Factory specification | 0.015 to 0.038 mm<br>0.00056 to 0.0014 in. |
| | Allowable limit | 0.15 mm<br>0.0059 in. |

| | | |
|---|---|---|
| Small end bushing I.D. (Spare parts) | Factory specification | 22.025 to 22.040 mm<br>0.86713 to 0.86771 in. |

(1) Seam
(2) Oil Hole

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

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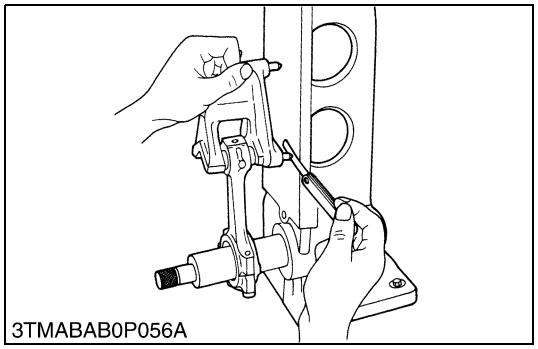
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## Connecting Rod Alignment

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

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

| | | |
|---|---|---|
| Connecting rod alignment | Allowable limit | 0.05 mm<br>0.002 in. |

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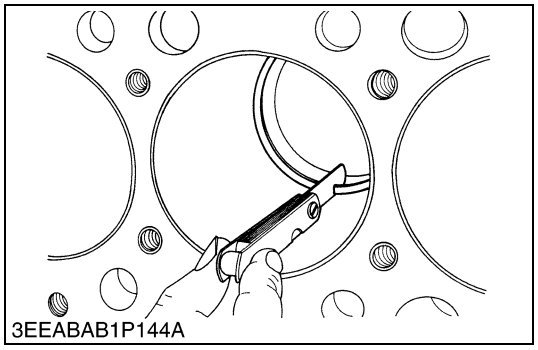
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## Piston Ring Gap

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

| | | | |
|---|---|---|---|
| Piston ring gap | Top ring | Factory specification | 0.30 to 0.45 mm<br>0.012 to 0.017 in. |
| | | Allowable limit | 1.25 mm<br>0.0492 in. |
| | Second ring | Factory specification | 0.30 to 0.45 mm<br>0.012 to 0.017 in. |
| | | Allowable limit | 1.25 mm<br>0.0492 in. |
| | Oil ring | Factory specification | 0.25 to 0.40 mm<br>0.0099 to 0.015 in. |
| | | Allowable limit | 1.25 mm<br>0.0492 in. |

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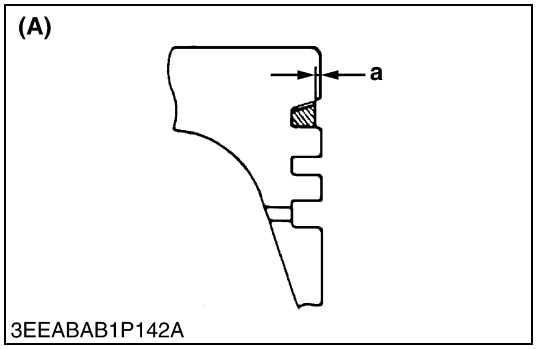


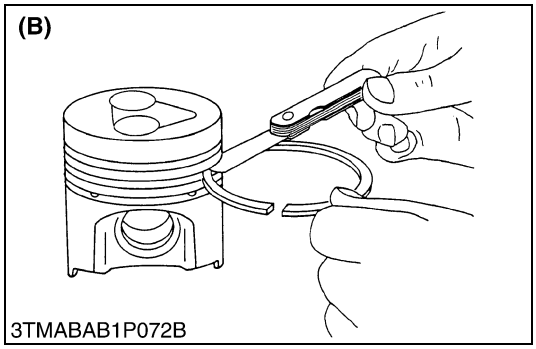


**Clearance between Piston Ring and Piston Ring Groove**

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

| | | | |
|---|---|---|---|
| Clearance between piston ring and piston ring groove | Second ring | Factory specification | 0.0850 to 0.112 mm<br>0.00335 to 0.00440 in. |
| | | Allowable limit | 0.2 mm<br>0.008 in. |
| | Oil ring | Factory specification | 0.020 to 0.055 mm<br>0.00079 to 0.0021 in. |
| | | Allowable limit | 0.15 mm<br>0.0059 in. |

| | |
|---|---|
| Factory specification: **a** | More than<br>0.2 mm<br>0.008 in. |

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

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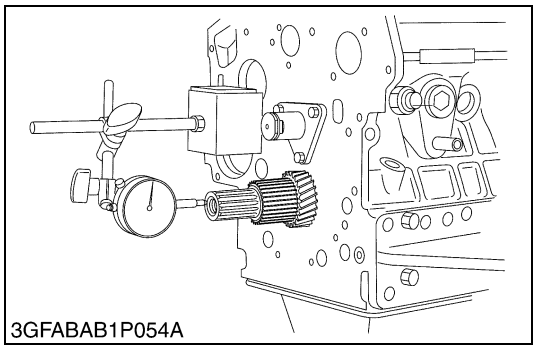
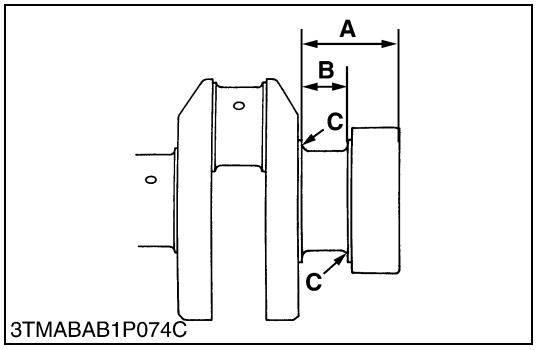
## (4) Crankshaft




**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<br>0.0059 to 0.012 in. |
| | Allowable limit | 0.50 mm<br>0.020 in. |

**(Reference)**

- Oversize dimensions of crankshaft journal

| Oversize | 0.20 mm<br>0.0079 in. | 0.40 mm<br>0.016 in. |
|---|---|---|
| Dimension **A** | 51.50 to 51.70 mm<br>2.028 to 2.035 in. | 51.60 to 51.80 mm<br>2.032 to 2.039 in. |
| Dimension **B** | 28.20 to 28.25 mm<br>1.111 to 1.112 in. | 28.40 to 28.45 mm<br>1.119 to 1.120 in. |
| Dimension **C** | 2.3 to 2.7 mm radius<br>0.091 to 0.10 in. radius | 2.3 to 3.7 mm radius<br>0.091 to 0.10 in. radius |
| The crankshaft journal must be fine-finished to higher than Rmax=0.8S. | | |

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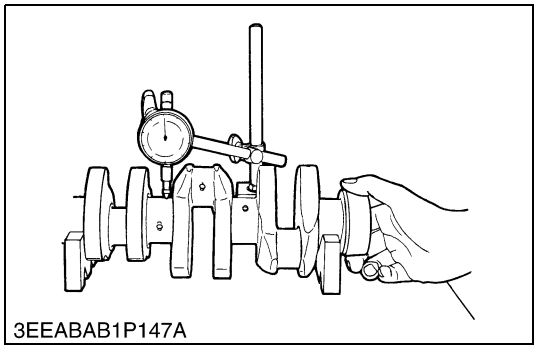
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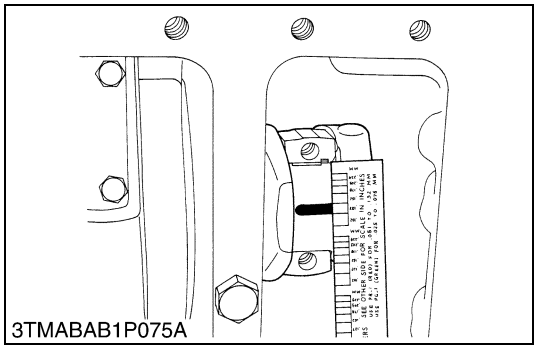
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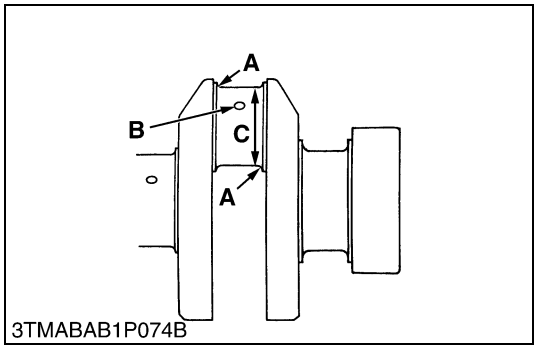

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## Crankshaft Alignment

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

| | | |
|---|---|---|
| Crankshaft alignment | Allowable limit | 0.02 mm<br>0.0008 in. |

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## Oil Clearance between Crankpin and Crankpin Bearing

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

■ **NOTE**

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

| | | |
|---|---|---|
| Oil clearance between crankpin and crankpin bearing | Factory specification | 0.029 to 0.091 mm<br>0.0011 to 0.0036 in. |
| | Allowable limit | 0.20 mm<br>0.0079 in. |

| | | |
|---|---|---|
| Crankpin O.D. | Factory specification | 39.959 to 39.975 mm<br>1.5732 to 1.5738 in. |
| Crankpin bearing I.D. | Factory specification | 40.040 to 40.050 mm<br>1.5764 to 1.5767 in. |

**(Reference)**

- Undersize dimensions of crankpin

| Undersize | 0.20 mm<br>0.0079 in. | 0.40 mm<br>0.016 in. |
|---|---|---|
| Dimension **A** | 2.8 to 3.2 mm radius<br>0.11 to 0.12 in. radius | 2.8 to 3.2 mm radius<br>0.11 to 0.12 in. radius |
| *Dimension **B** | 1.0 to 1.5 mm relief<br>0.040 to 0.059 in. relief | 1.0 to 1.5 mm relief<br>0.040 to 0.059 in. relief |
| Dimension **C** | 39.759 to 39.775 mm dia.<br>1.5654 to 1.5659 in. dia. | 39.559 to 39.575 mm dia.<br>1.5575 to 1.5580 in. dia. |
| The crankpin must be fine-finished to higher than Rmax=0.8S.<br>*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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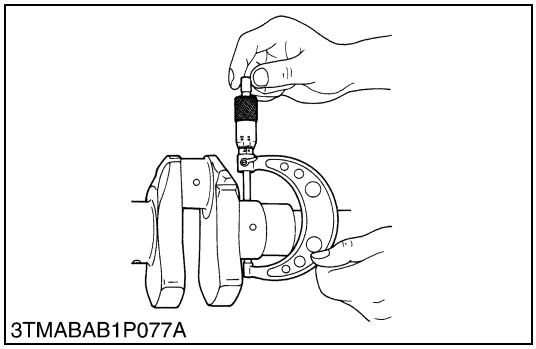
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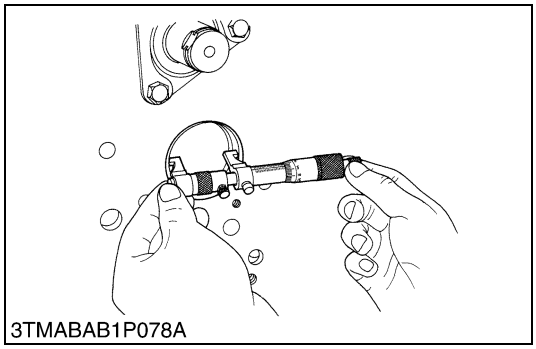
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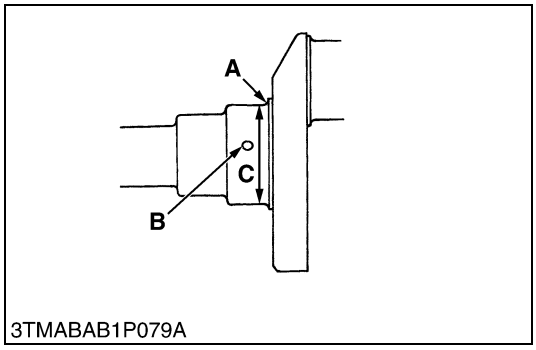

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## Oil Clearance between Crankshaft Journal and Crankshaft Bearing 1

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

| | | |
|---|---|---|
| Oil Clearance between crankshaft journal and crankshaft bearing 1 | Factory specification | 0.0340 to 0.114 mm<br>0.00134 to 0.00448 in. |
| | Allowable limit | 0.20 mm<br>0.0079 in. |

| | | |
|---|---|---|
| Crankshaft journal O.D. | Factory specification | 47.934 to 47.950 mm<br>1.8872 to 1.8877 in. |
| Crankshaft bearing 1 I.D. | Factory specification | 47.984 to 48.048 mm<br>1.8892 to 1.8916 in. |

**(Reference)**

- Undersize dimensions of crankshaft journal

| Undersize | 0.20 mm<br>0.0079 in. | 0.40 mm<br>0.016 in. |
|---|---|---|
| Dimension **A** | 2.3 to 2.7 mm radius<br>0.091 to 0.10 in. radius | 2.3 to 2.7 mm radius<br>0.091 to 0.10 in. radius |
| *Dimension **B** | 1.0 to 1.5 mm relief<br>0.040 to 0.059 in. relief | 1.0 to 1.5 mm relief<br>0.040 to 0.059 in. relief |
| Dimension **C** | 47.734 to 47.750 mm dia.<br>1.8793 to 1.8799 in. dia. | 47.534 to 47.550 mm dia.<br>1.8715 to 1.8720 in. dia. |
| The crankshaft journal must be fine-finished to higher than Rmax=0.8S.<br>*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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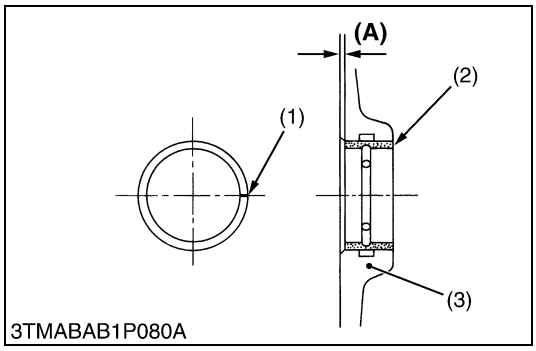

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## Replacing Crankshaft Bearing 1

**(When removing)**

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

**(When installing)**

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

| | | |
|---|---|---|
| Dimension **(A)** | Factory specification | 0 to 0.3 mm<br>0 to 0.01 in. |

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

**(A) Dimension**

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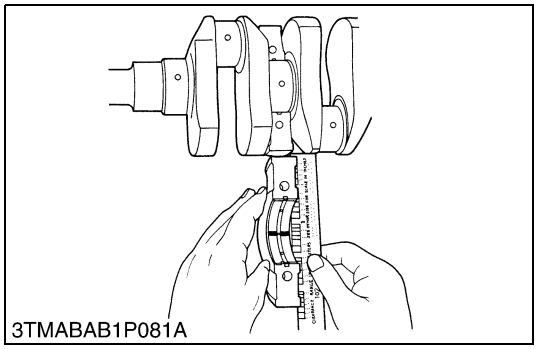
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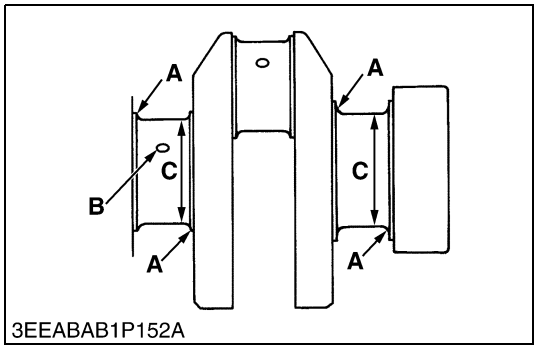

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**Oil Clearance between Crankshaft Journal and Crankshaft Bearing 2 (Crankshaft Bearing 3)**

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

■ **NOTE**

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

| | | |
|---|---|---|
| Oil clearance between crankshaft journal and crankshaft bearing 2 | Factory specification | 0.034 to 0.095 mm<br>0.0014 to 0.0037 in. |
| | Allowable limit | 0.20 mm<br>0.0079 in. |

| | | |
|---|---|---|
| Crankshaft journal O.D. (Intermediate) | Factory specification | 47.934 to 47.950 mm<br>1.8872 to 1.8877 in. |
| Crankshaft bearing 2 I.D. | Factory specification | 47.984 to 48.029 mm<br>1.8892 to 1.8909 in. |

| | | |
|---|---|---|
| Oil clearance between crankshaft journal and crankshaft bearing 3 | Factory specification | 0.0340 to 0.1030 mm<br>0.00134 to 0.00405 in. |
| | Allowable limit | 0.20 mm<br>0.0079 in. |

| | | |
|---|---|---|
| Crankshaft journal O.D. (Flywheel side) | Factory specification | 51.921 to 51.940 mm<br>2.0442 to 2.0448 in. |
| Crankshaft bearing 3 I.D. | Factory specification | 51.974 to 52.024 mm<br>2.0463 to 2.0481 in. |

**(Reference)**

- Undersize dimensions of crankshaft journal

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

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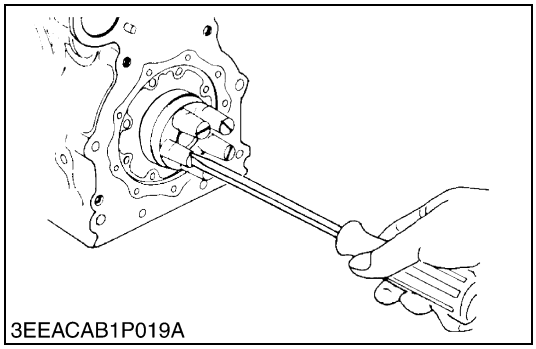
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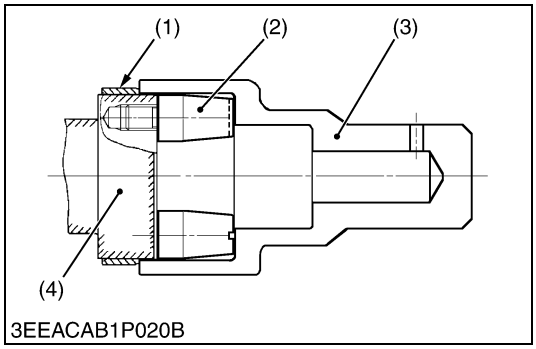

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**Replacing Crankshaft Sleeve**

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

■ **NOTE**

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

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

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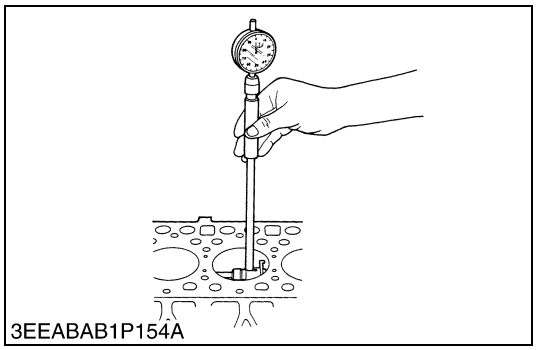
## (5) Cylinder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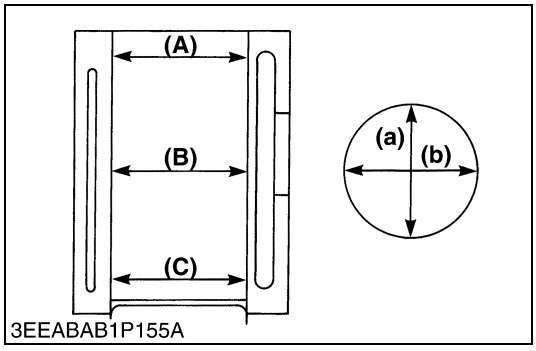

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**Cylinder Wear**

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

| | | |
|---|---|---|
| Cylinder I.D. | Factory specification | 76.000 to 76.019 mm<br>2.9922 to 2.9929 in. |
| | Allowable limit | 76.15 mm<br>2.998 in. |

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

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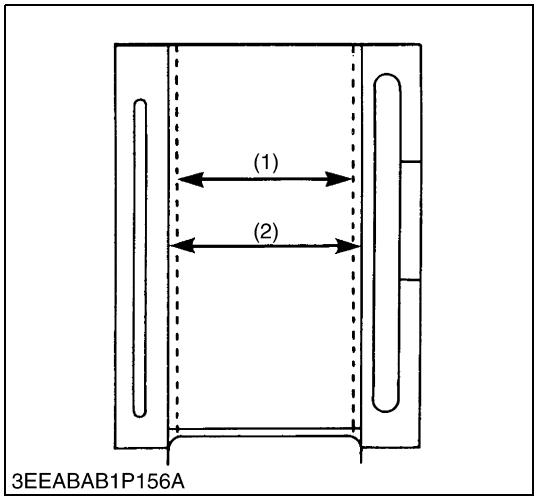

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**Correcting Cylinder**

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 | 76.500 to 76.519 mm<br>3.0119 to 3.0125 in. |
| | Allowable limit | 76.65 mm<br>3.018 in. |
| Finishing | Hone to 1.2 to 2.0 mm μR max.<br>(0.000048 to 0.000078 μin. 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 more than 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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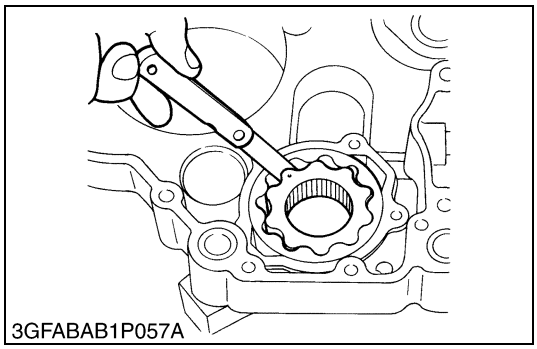
## (6) Oil Pump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**Rotor Lobe Clearance**

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

| | | |
|---|---|---|
| Rotor lobe clearance | Factory specification | 0.060 to 0.18 mm<br>0.0024 to 0.0071 in. |

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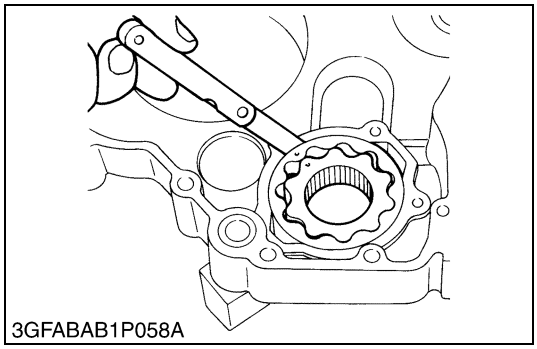
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**Clearance between Outer Rotor and Pump Body**

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

| | | |
|---|---|---|
| Clearance between outer rotor and pump body | Factory specification | 0.100 to 0.180 mm<br>0.00394 to 0.00708 in. |

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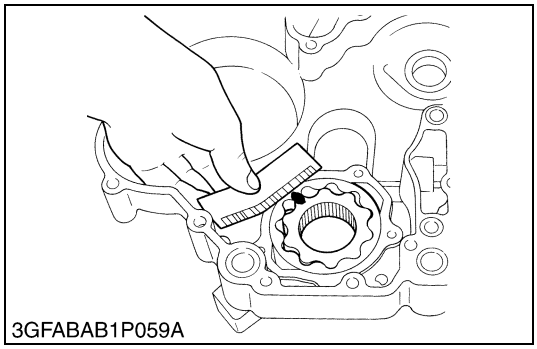
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**Clearance between Rotor and Cover**

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

| | | |
|---|---|---|
| Clearance between rotor and cover | Factory specification | 0.025 to 0.075 mm<br>0.00099 to 0.0029 in. |

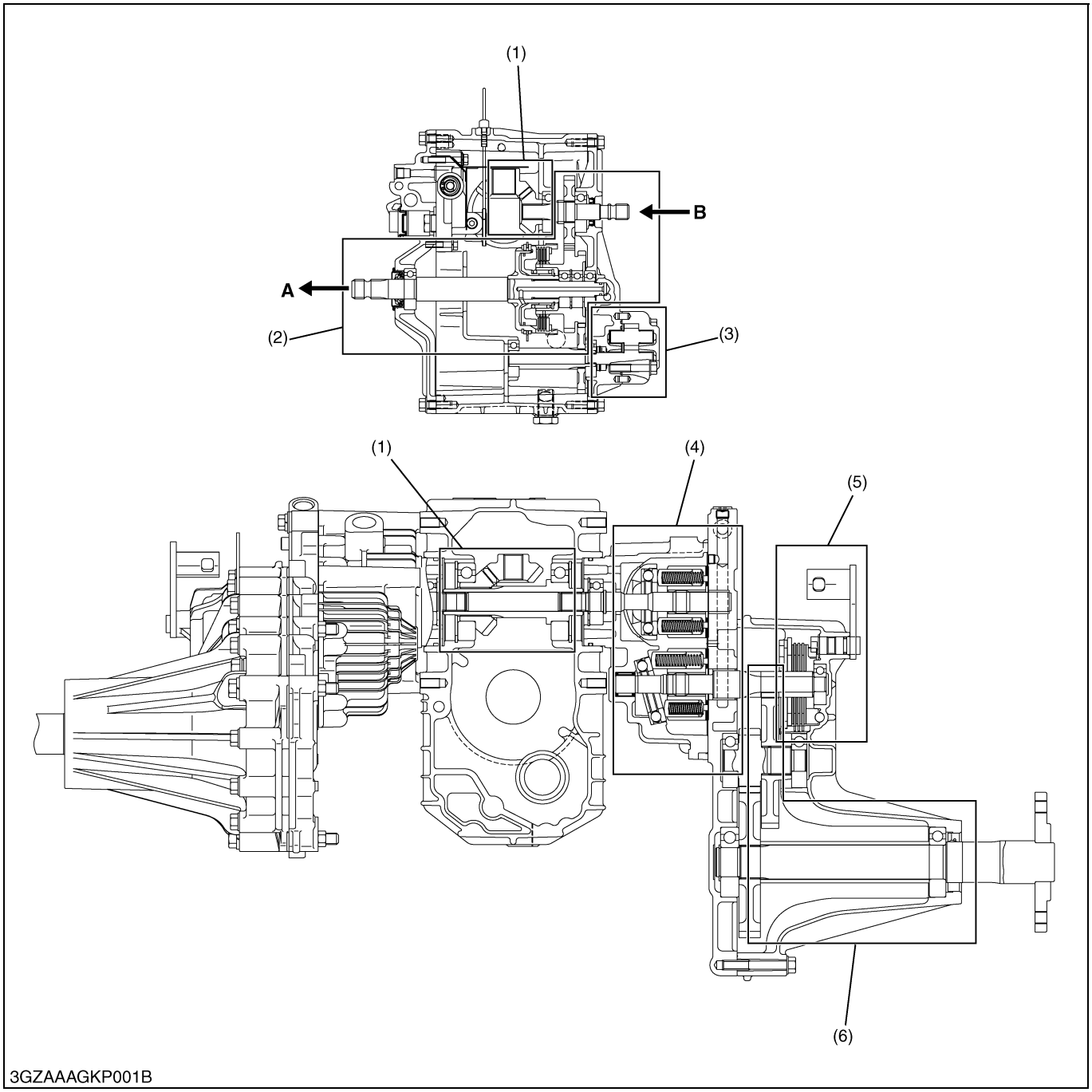
9Y1210301ENS0095US0

# 2 TRANSAXLE

# MECHANISM

## CONTENTS

# 1. STRUCTURE

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(1) Bevel Gear Section
(2) PTO Section (Side View)
(3) Hydraulic Pump
(4) Hydrostatic Transmission
(5) Brake Section
(6) Final Reduction Gear Section
**A: To Mower**
**B: From Engine**

Transmission consists of a bevel gear section (1), hydraulic pump (3), hydrostatic transmission RH and LH (4), brake section (5), final reduction gear section (6), and PTO section (2).

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

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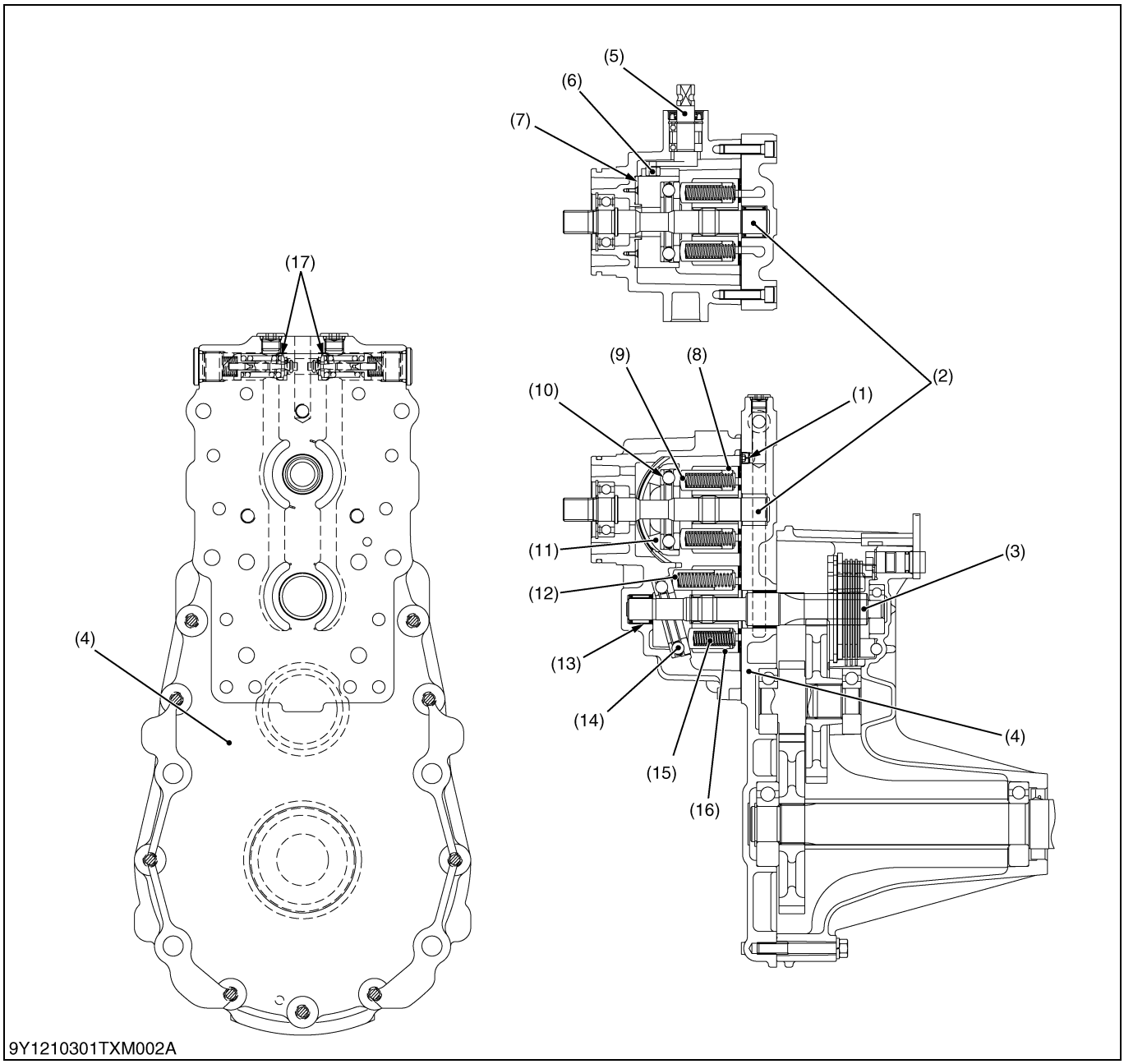
# 2. TRAVELING SYSTEM

## [1] HYDROSTATIC TRANSMISSION

### (1) Structure




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

The hydrostatic transmission consists of a trunnion arm (5), variable displacement piston pump (8) - (11), fixed displacement piston motor (12) - (16) and check and high pressure relief valve (17).

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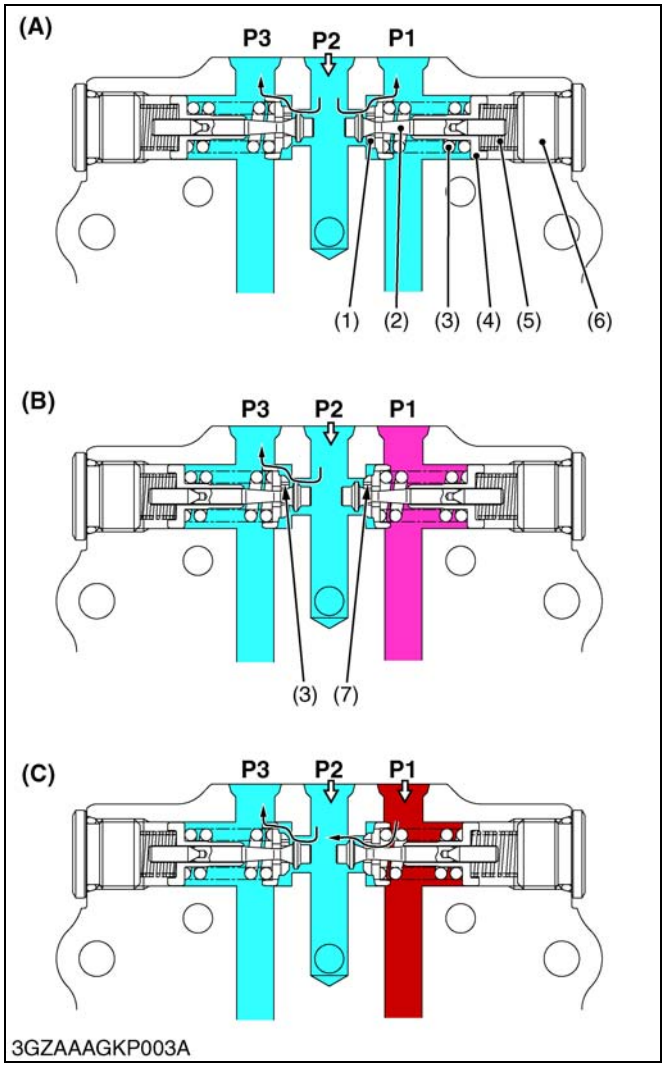
## (2) Check and High Pressure Relief Valve




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 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 | Valve operating pressure |
|---|---|
| 50 °C (122 °F) | 19.5 to 22.5 MPa<br>199 to 229 kgf/cm$^2$<br>2830 to 3260 psi |

**Condition**

- At engine speed 1800 min$^{-1}$ (rpm)

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

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

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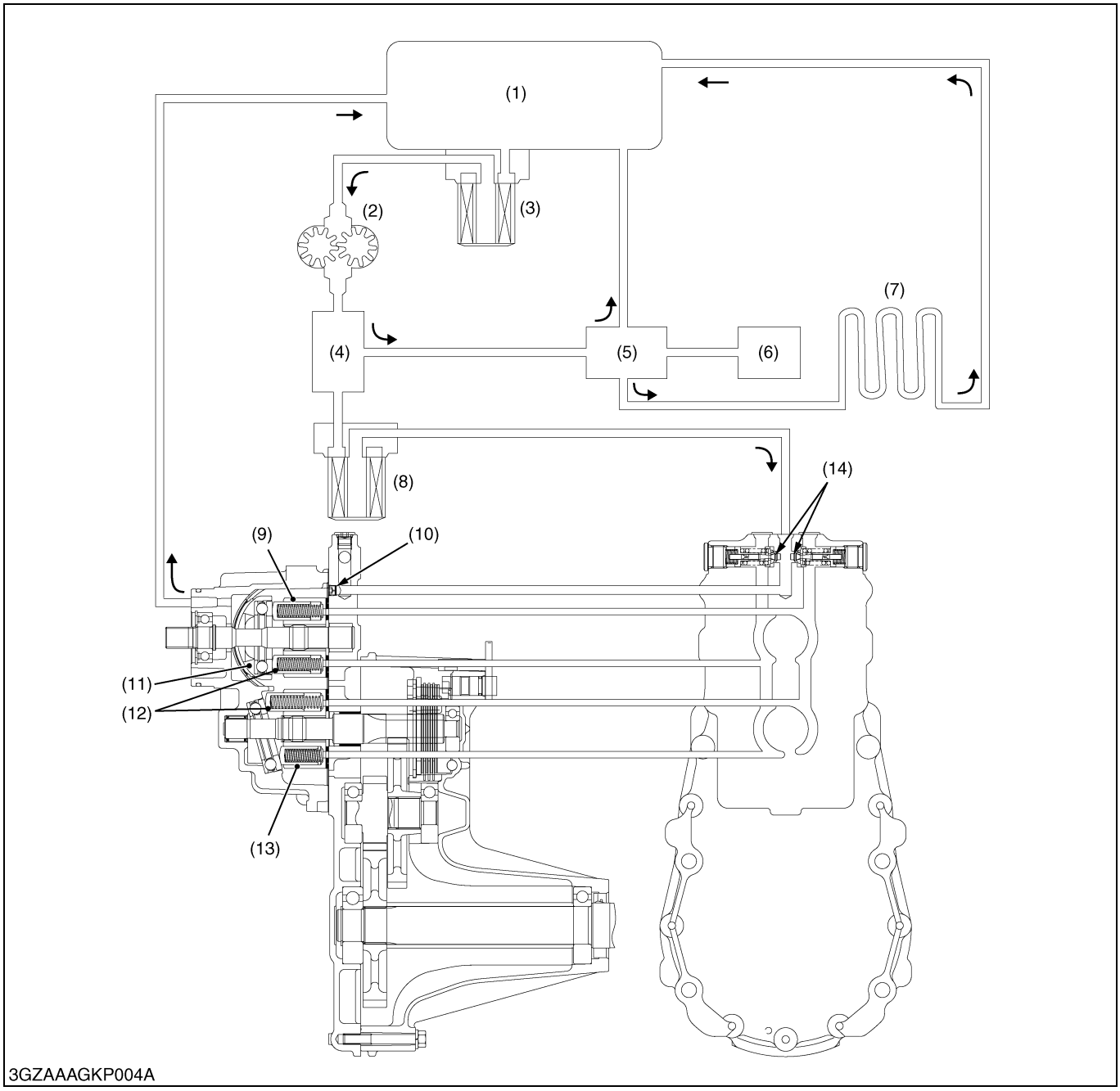
## (3) Oil Flow




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

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

The charge oil is sent to the HST housing after the control valve (4) and TM oil filter cartridge (8) pass by the hydraulic pump (2). And, pressure is always controlled to the charge oil with the regulator valve (5).

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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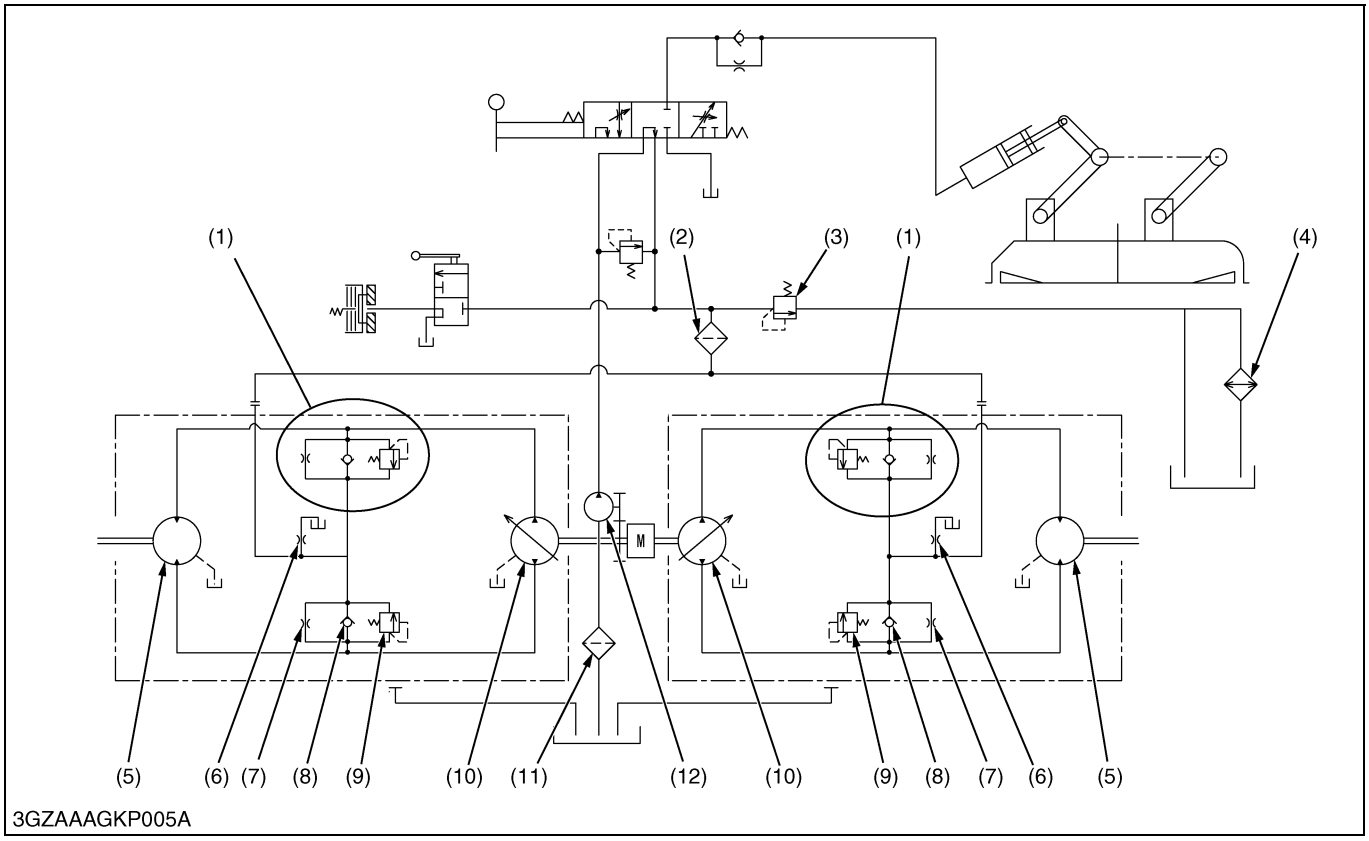
# (4) Power Trains Operation

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(1) Check and High Pressure Relief Valve
(2) TM 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) Hydraulic 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)
  0.65 to 0.75 MPa (6.7 to 7.6 kgf/cm$^2$, 95 to 100 psi) at engine speed 1800 min$^{-1}$ (rpm)

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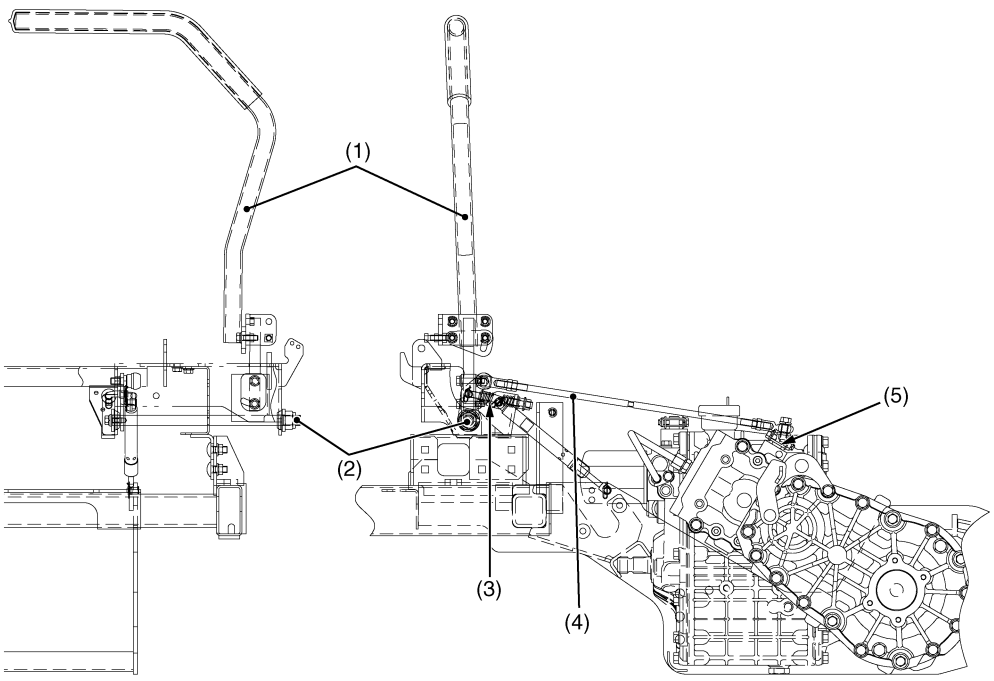
## (5) Control Linkage

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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.

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

■ **Steering**

The Zero-Turn Mower does not have a separate steering system. Steering is 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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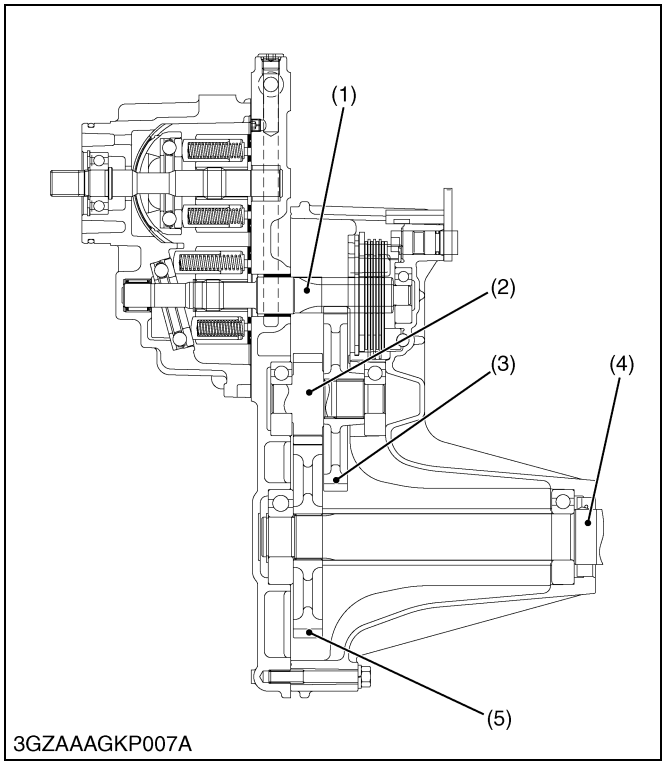
## (6) Final Reduction Gear Section



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

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

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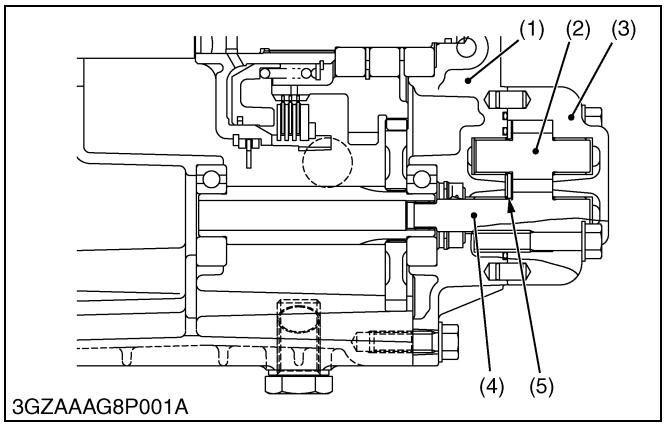
## (7) Hydraulic Pump



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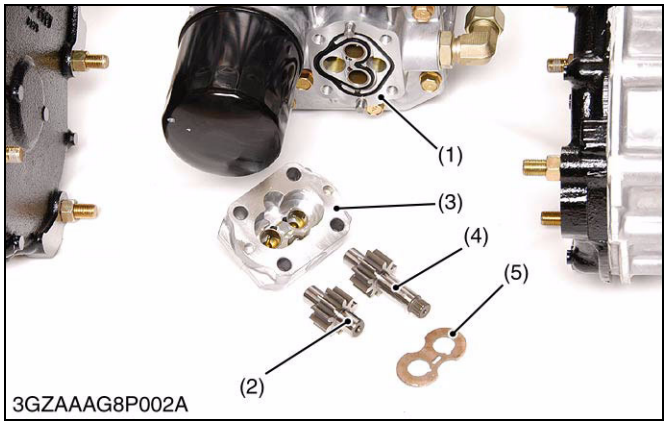

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The hydraulic pump consists of the casing (1), cover (3), side plate (5), and two spur gears (drive gear (4) and driven gear (2)) that are in mesh.

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

Maximum displacement is as follows.

| Displacement | Engine speed | Condition |
|---|---|---|
| 21.0 L/min.<br>5.5 U.S.gals/min.<br>4.6 Imp.gals/min. | At 3200 $min^{-1}$ (rpm) | at no load |

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

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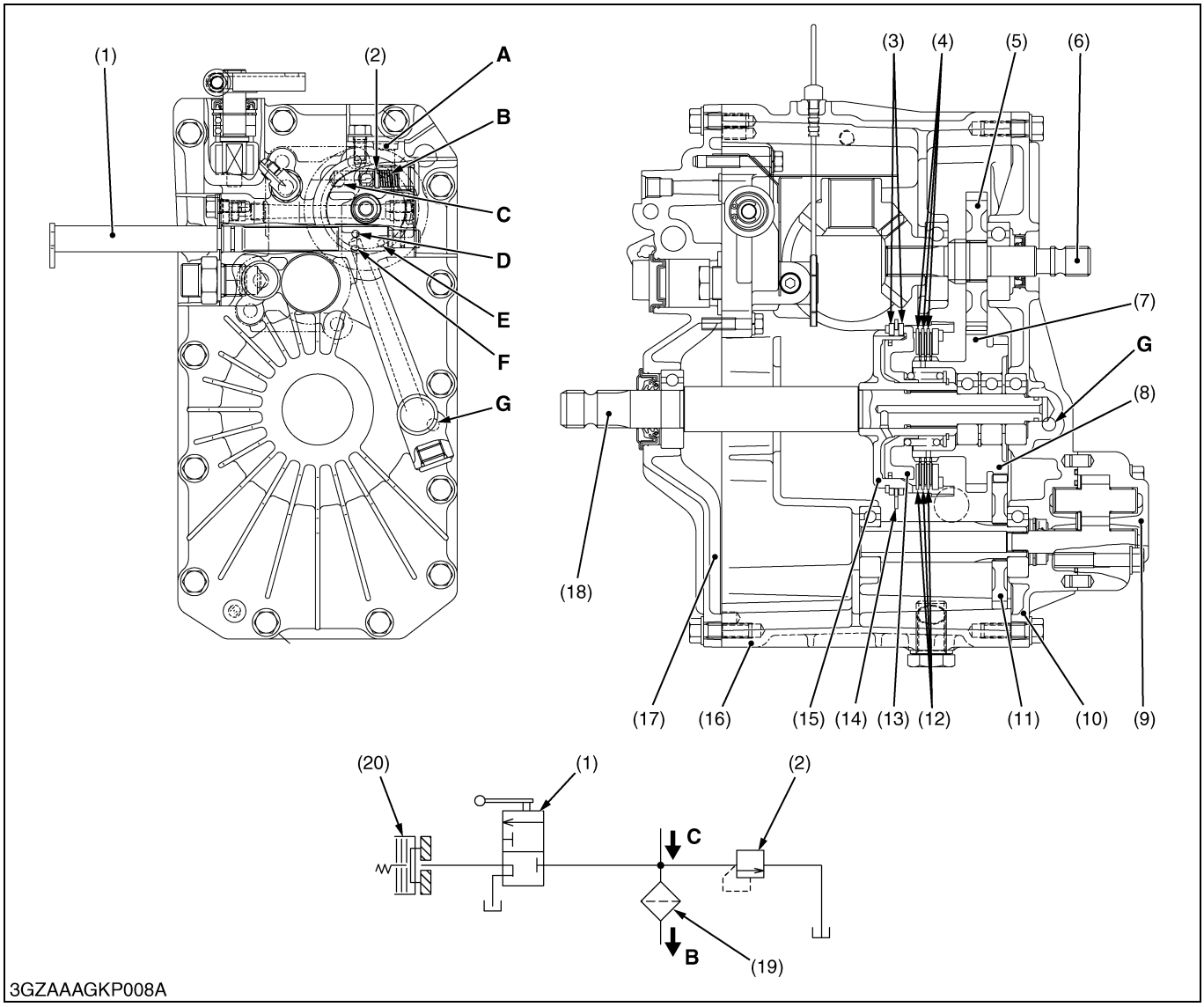
# (8) PTO System

## PTO Clutch and Valve




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

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

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

The PTO clutch (20) has three PTO clutch discs (12), three PTO 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).

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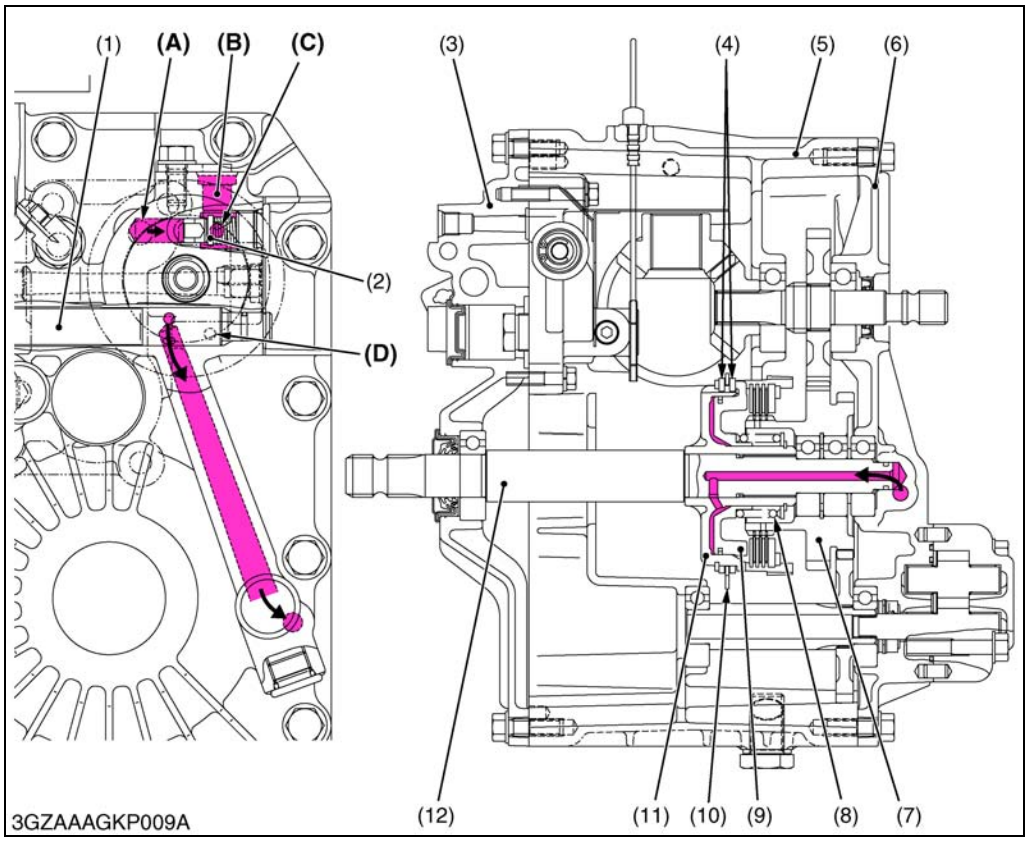
## PTO Clutch "Engaged"




(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.

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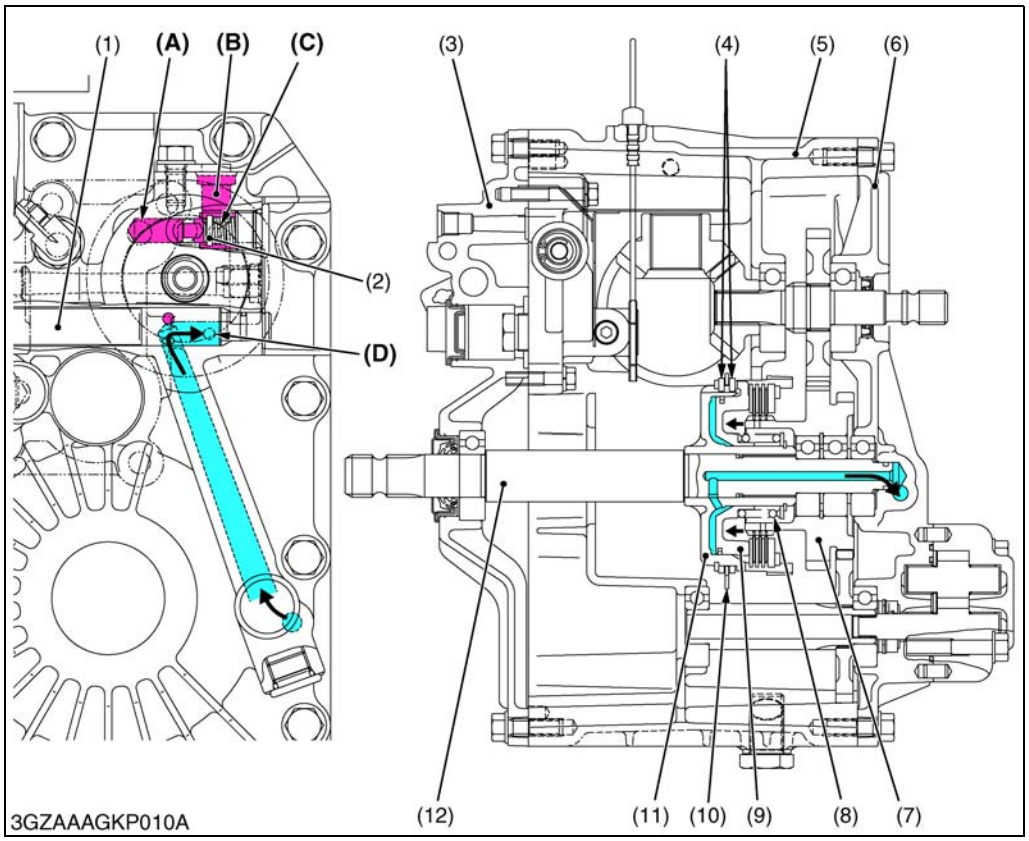
**PTO Clutch "Disengaged"**




(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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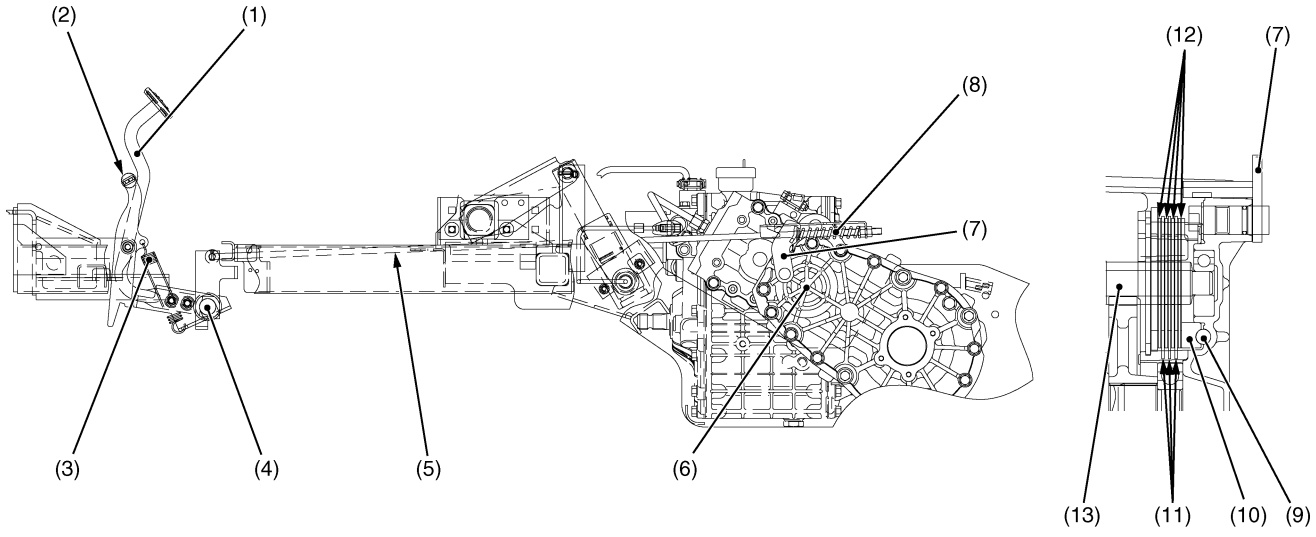
## (9) Parking Brake

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

The parking brake 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.

9Y1210301TXM0012US0

# SERVICING

## CONTENTS

# 1. TROUBLESHOOTING

| Symptom | Probable Cause | Solution | Reference Page |
|---|---|---|---|
| **Vehicle Will Not Stop in Neutral Position** | Improper neutral adjustment | Adjust neutral | 2-S6 |
| | Improper speed control rod adjustment | Adjust | 2-S6 |
| **Vehicle Jerky and Noisy When Starting** | Transmission oil insufficient | Replenish | 2-S14 |
| | Air entering from suction pipe | Retighten | – |
| | Transmission oil filter cartridge clogged | Replace | G-22 |
| | Hydrostatic transmission defective | Replace | 2-S30 |
| **Loss of Power** | Control linkage defective | Repair or replace | 2-M6 |
| | Transmission oil insufficient | Replenish | 2-S14 |
| | Transmission oil filter cartridge clogged | Replace | G-22 |
| | Hydraulic pump defective | Replace | 2-S26 |
| | Hydrostatic transmission defective | Replace | 2-S30 |
| **System Operates in One Direction Only** | Check valve defective | Replace | 2-S31 |
| | Control linkage defective | Repair | 2-M6 |
| **System Operating Hot** | Transmission oil insufficient | Replenish | 2-S14 |
| | Transmission oil filter cartridge clogged | Replace | G-22 |
| | HST fan defective | Replace | 2-S25 |
| | Overload working | Decrease load | – |
| **Noise from Transmission** | Transmission oil insufficient | Replenish | 2-S14 |
| | Gear worn | Replace | – |
| | Improper backlash between 15T bevel gear and 21T bevel gear | Adjust | 2-S39 |
| | Bearing worn | Replace | – |

**TRAVELLING GEAR SHIFT SECTION**

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

**PTO SECTION**

| Symptom | Probable Cause | Solution | Reference Page |
|---|---|---|---|
| **PTO Clutch Slip** | Operating pressure is low | Check | 2-S11 |
| | PTO clutch valve malfunctioning | Repair or replace | 2-S21 |
| | Clutch disc or drive plate excessively worn | Replace | 2-S27 |
| **PTO Shaft Does Not Rotate** | PTO clutch malfunctioning | Repair or replace | 2-S27 |
| **PTO Clutch Operating Pressure Is Low** | Transmission oil improper or insufficient | Replenish or change | 2-S14 |
| | Regulator valve malfunctioning | Check or replace | 2-S21 |
| **PTO Clutch Drags** | Brake plate excessively worn | Replace | 2-S27 |
| | Clutch spring weaken or broken | Replace | 2-S27 |
| | Deformation of pressure plate or steel plate | Replace | 2-S27 |

**PARKING BRAKE SECTION**

| Symptom | Probable Cause | Solution | Reference Page |
|---|---|---|---|
| **Brake Drags** | Brake spring play too small | Adjust | G-30 |
| | Brake return spring weaken or broken | Replace | – |
| **Poor Braking Force** | Brake spring play excessive | Adjust | G-30 |
| | Brake disc worn | Replace | 2-S36 |

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# 2. SERVICING SPECIFICATIONS

| Item | | Factory Specification | Allowable Limit |
|---|---|---|---|
| Regulator Valve<br>(HST Charge Relief Valve) | Setting pressure<br>[at engine speed<br>3200 $min^{-1}$ (rpm)] | 0.75 to 0.95 MPa<br>7.7 to 9.6 $kgf/cm^2$<br>110 to 130 psi | – |
| PTO Clutch | Operating pressure<br>[at engine speed<br>1800 $min^{-1}$ (rpm)] | 0.65 to 0.75 MPa<br>6.7 to 7.6 $kgf/cm^2$<br>95 to 100 psi | – |
| Check and High Pressure Relief Valve | Relief valve setting pressure<br>[at engine speed<br>1800 $min^{-1}$ (rpm)] | 20.0 to 22.0 MPa<br>204 to 224 $kgf/cm^2$<br>2900 to 3190 psi | |
| Maximum Speed<br>• At Maximum Engine rpm | Wheel rotation | 133 to 135 $min^{-1}$ (rpm) | – |
| Motion Control Lever Alignment | Gap | 0 to 2 mm<br>0 to 0.08 in. | – |
| | Space | 10 to 20 mm<br>0.4 to 0.8 in. | – |
| 15T Bevel Gear to 21T Bevel Gear | Backlash | 0.25 to 0.30 mm<br>0.0099 to 0.011 in. | – |

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# 3. TIGHTEINIG TORQUES

Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts: See page G-11.)

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

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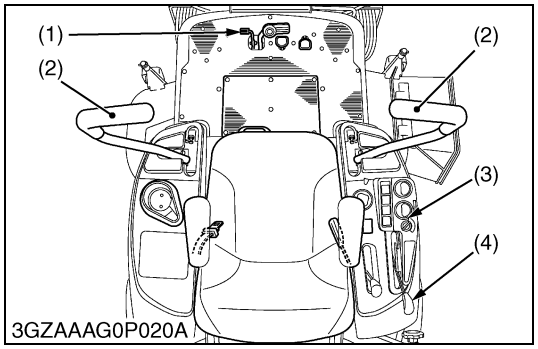
# 4. CHECKING AND ADJUSTING




**Checking Neutral**

1. Park machine safely.
2. Set the motion control levers (2) in the **"NEUTRAL"** position.
3. Move the PTO lever (4) to **"OFF"** position and apply the parking brake (1).
4. With the operator on the seat, start the engine (3).
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.

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

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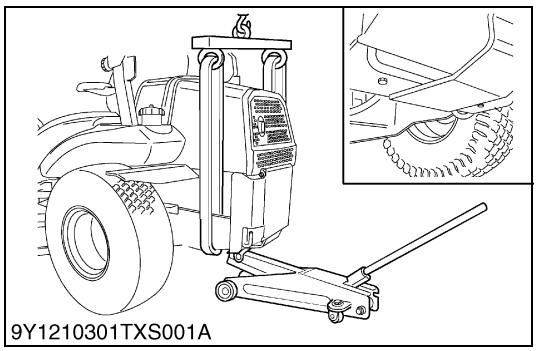


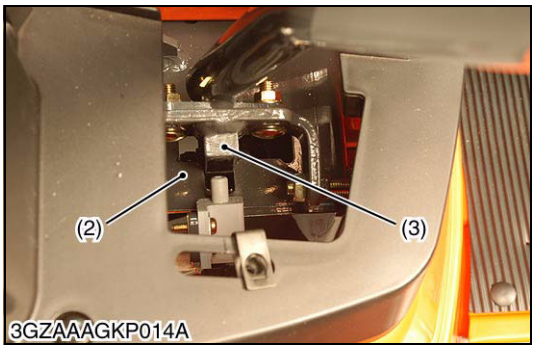


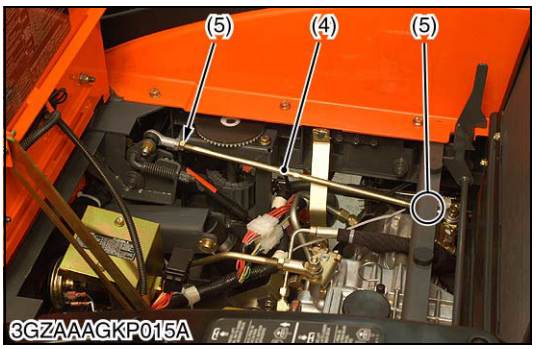


## Adjusting Neutral

**CAUTION**

**To avoid personal injury:**

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

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

**IMPORTANT**

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

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

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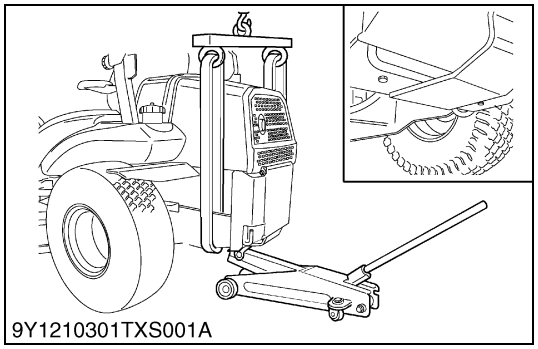


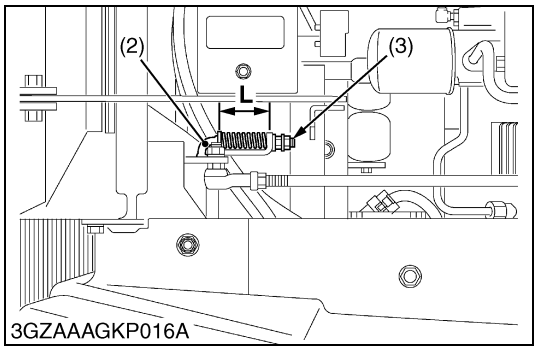


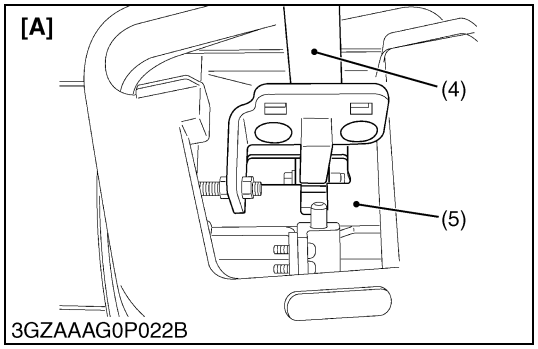


## Checking Motion Control Lever Neutral Position

**CAUTION**

**To avoid personal injury:**

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

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

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

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

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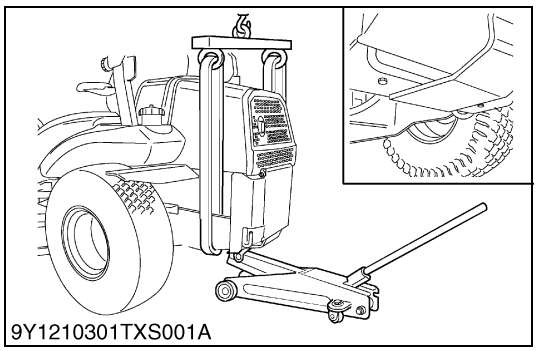


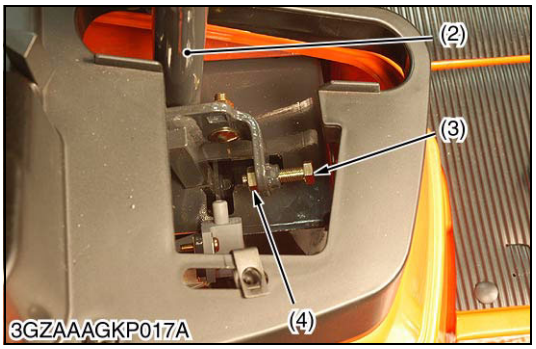


## Adjusting Maximum Speed

**CAUTION**

**To avoid personal injury:**

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

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

**NOTE**

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

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

| | | |
|---|---|---|
| Max. speed:<br>Wheel rotation | Factory specification | 133 to 135 $min^{-1}$ (rpm)<br>at max. engine speed |

**NOTE**

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

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

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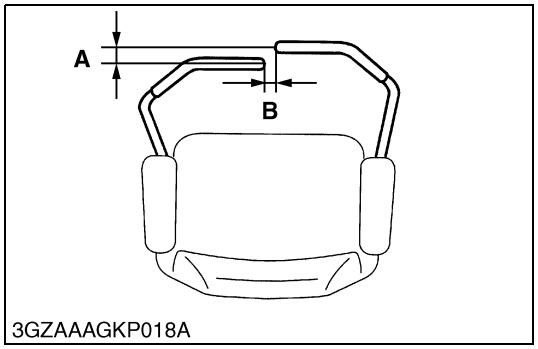

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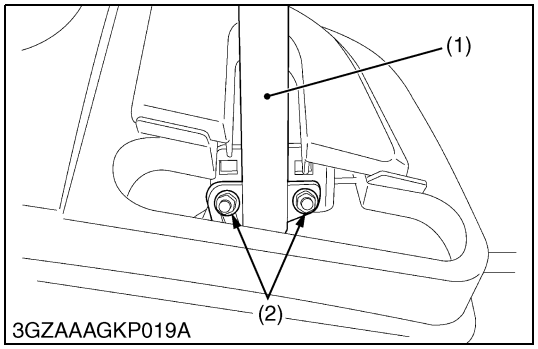

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## Checking Motion Control Lever Alignment

**CAUTION**

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

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

**When adjusting alignment**

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

■ **Lever position (High or Low)**

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

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

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

| | | |
|---|---|---|
| Gap **"A"** | Factory specification | 0 to 2 mm<br>0 to 0.08 in. |
| Space **"B"** | Factory specification | 10 to 20 mm<br>0.4 to 0.8 in. |

■ **NOTE**

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

(1) Motion Control Lever
(2) Motion Control Lever Mounting Screw
**A: Gap**
**B: Space**

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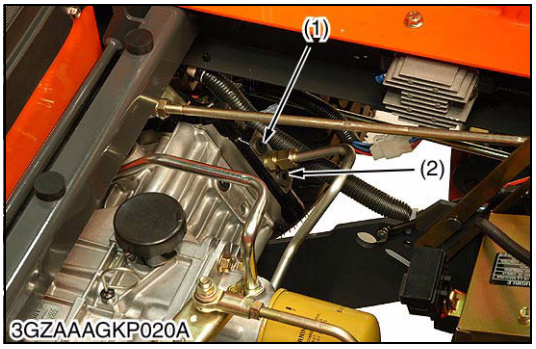




## Checking Hydrostatic Transmission

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

**(Reference)**

| | | |
|---|---|---|
| Check and high pressure relief valve pressure | Factory specification | 20.0 to 22.0 MPa<br>204 to 224 $kgf/cm^2$<br>2900 to 3190 psi |

**IMPORTANT**

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

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

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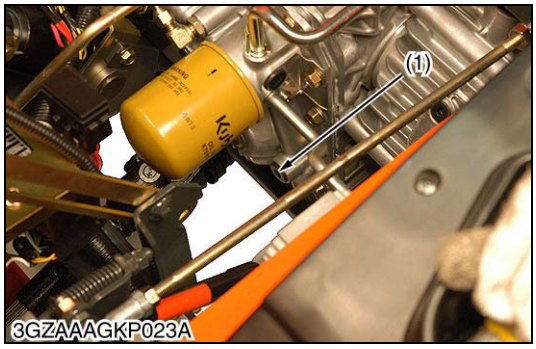


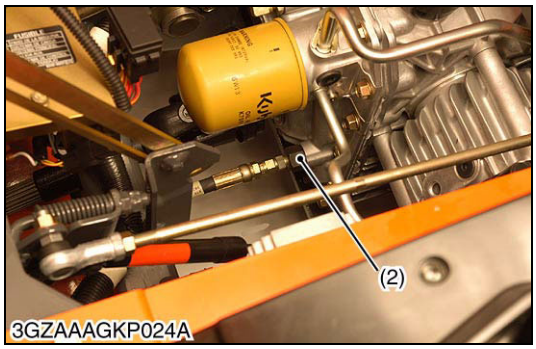



## PTO Clutch Operating Pressure (Hydrostatic Transmission Charge Pressure)

**CAUTION**

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

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

| | | |
|---|---|---|
| PTO clutch operating pressure | Factory specification | 0.65 to 0.75 MPa<br>6.7 to 7.6 $kgf/cm^2$<br>95 to 100 psi |

**Condition**

- Engine speed
  1800 $min^{-1}$ (rpm)
- Oil temperature
  45 to 55 °C (113 to 131 °F)

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

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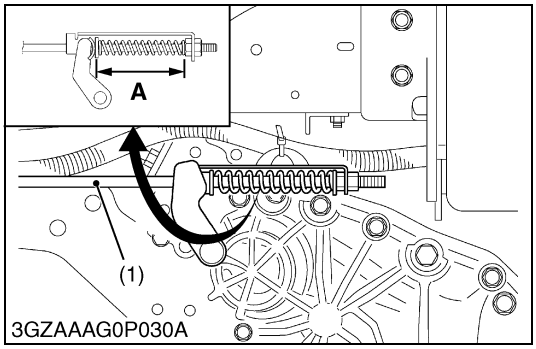

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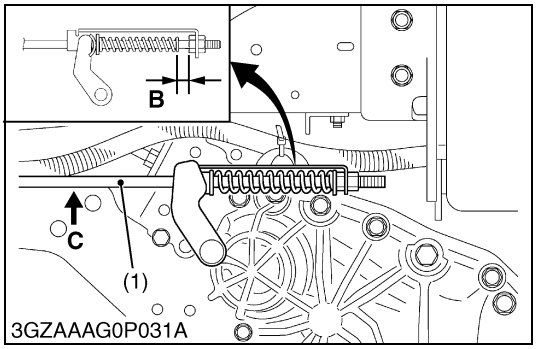

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## Checking and Adjusting Parking Brake

**CAUTION**

**To avoid personal injury:**

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

■ **IMPORTANT**

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

■ **Check brake spring**

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

| | | |
|---|---|---|
| Proper brake spring length **"A"** with the brake applied to the lock position | Factory specification | 115 to 117 mm<br>4.53 to 4.61 in. |

| | | |
|---|---|---|
| Proper brake spring play **"B"** | Factory specification | The spring must have play<br>Reference:<br>0.5 to 1.0 mm<br>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 (1) by hand.
6. Tighten the nut to the correct space between the end of the spring and the nut.
7. Lock the nuts.
8. Adjust the other side spring to the same dimension.

■ **Adjustment of brake 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

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

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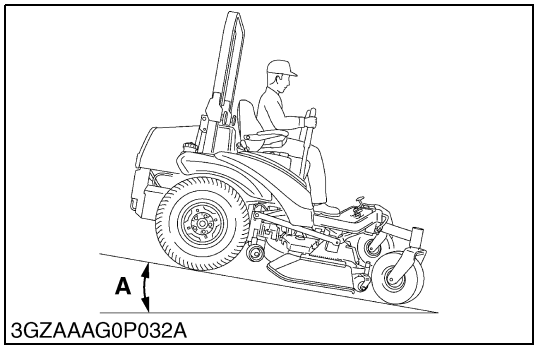

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**Checking Parking Brake on the Slope**

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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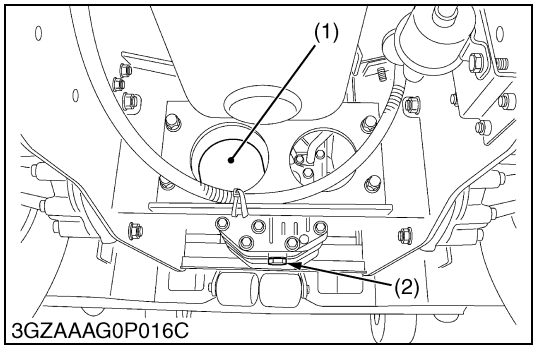
# 5. DISASSEMBLING AND ASSEMBLING

## [1] SEPARATING TRANSAXLE ASSEMBLY



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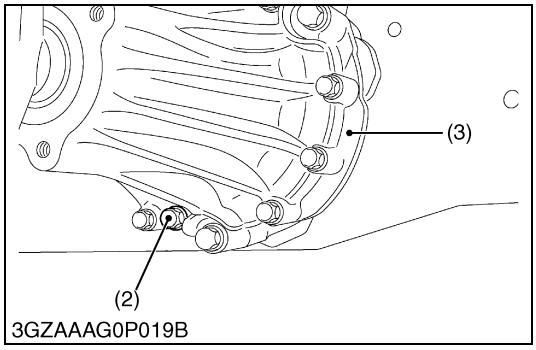

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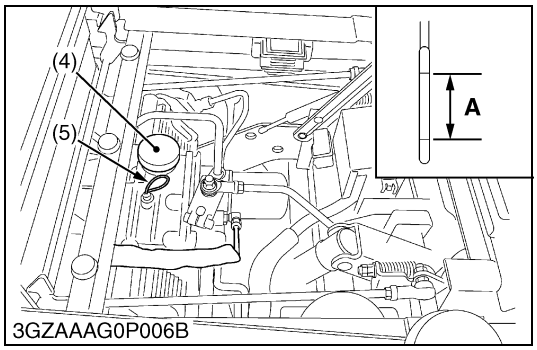

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### Draining Transmission Fluid

**CAUTION**

**To avoid personal injury:**

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

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

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

**IMPORTANT**

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

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

**IMPORTANT**

- **Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.**
  **Keep the engine at medium speed for a few minutes to insure proper lubrication of all parts so there is no damage to transmission.**
- **Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system.**
  **Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-9.)**
- **Do not mix different brands oil together.**

| | |
|---|---|
| Transmission fluid capacity | 12.1 L<br>12.8 U.S.qts<br>10.6 Imp.qts |

(1) Hydraulic 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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### Bonnet

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

(1) Bonnet

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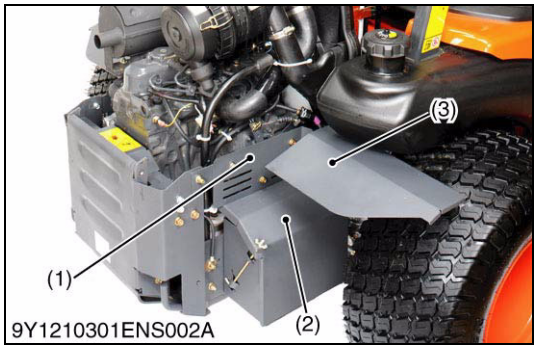


## Battery Cover

1. Remove the side covers L, R (1) and the rear fenders L, R (3).
2. Remove the battery cover (2).

(1) Side cover
(2) Battery cover
(3) Rear Fender

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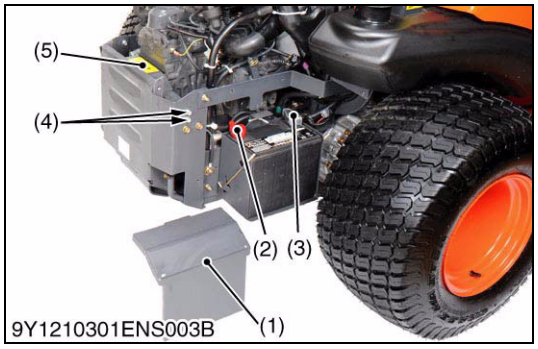


## Battery and Flywheel Cover

**CAUTION**

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

1. Disconnect the negative cable (3) from the battery.
2. Disconnect the positive cable (2) from the battery.
3. Remove the bolts (4) and flywheel cover (5).

(1) Battery Cover
(2) Positive Cable
(3) Negative Cable
(4) Bolt
(5) Flywheel Cover

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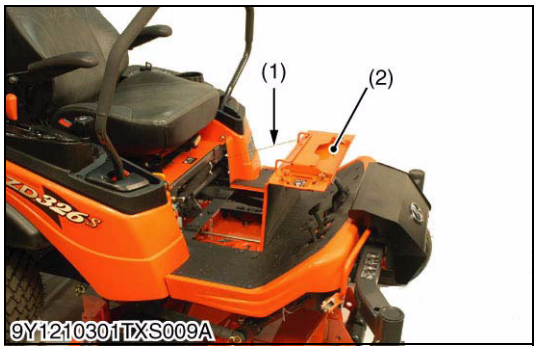


## Step Center and Step

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

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

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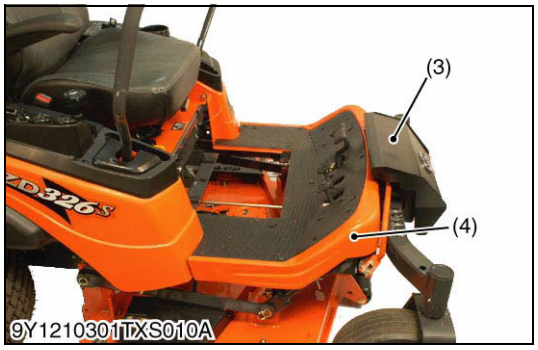



## Seat Assembly and Fender

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

(1) Seat Assembly
(2) Seat Base
(3) Fender (LH)
(4) Fender (RH)

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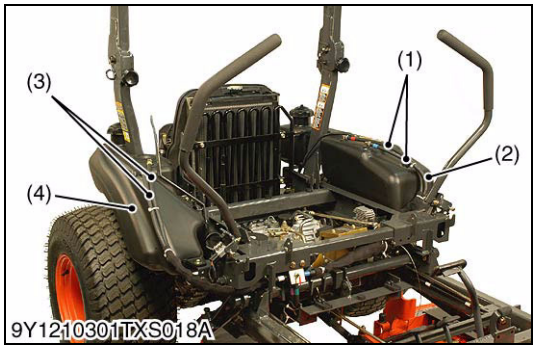


## Fuel Tank

1. Disconnect the wiring connectors for fuel gauge and fuel hoses (1).
2. Remove the fuel tank (LH) (2).
3. Disconnect the fuel hoses (3), and remove the fuel tank (4).

(1) Fuel Hose
(2) Fuel Tank (LH)
(3) Fuel Hose
(4) Fuel Tank (RH)

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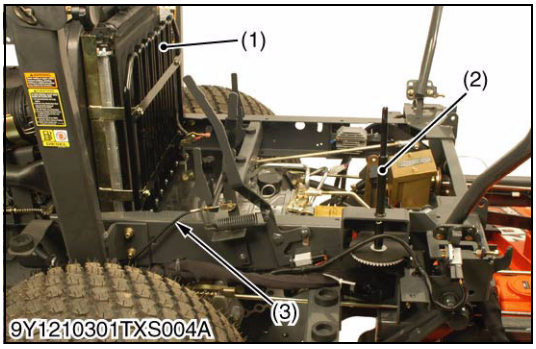
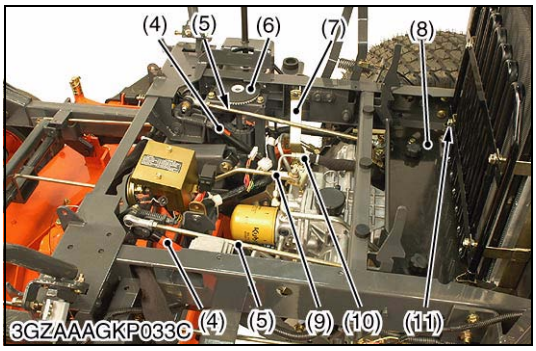



## Upper Frame, Oil Cooler and Others

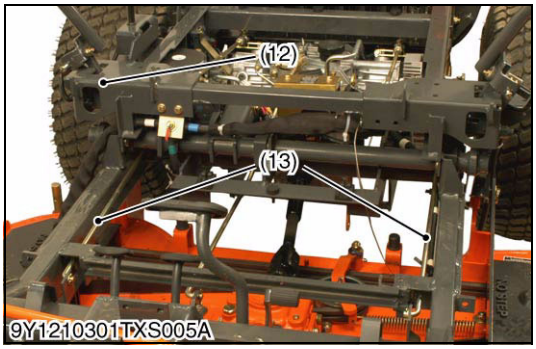
1. Remove the stopper (11) and remove the oil cooler (1).
2. Remove the throttle cable (3).
3. Remove the rod (2).
4. Disconnect the wiring connectors for safety switches and regulator.
5. Remove the speed control rods (5).
6. Remove the dampers (4).
7. Remove the cutting height adjusting gear with stay (6).
8. Remove the hydraulic lift link (7).
9. Remove the bonnet cover (8) and ROPS connecting plate.
10. Remove the hydraulic lift rod (9).
11. Disconnect the hydraulic hose (10).
12. Remove the upper frame (12).
13. Remove the parking brake rods (13).

**(When reassembling)**




■ **NOTE**

- **After assembling the parking brake rods, be sure check the parking brake spring length and play. If the measurement is not within the factory specifications, adjust the spring length and play. (See page 2-S12.)**




(1) Oil Cooler
(2) Rod
(3) Throttle Cable
(4) Damper
(5) Speed Control Rod
(6) Cutting Height Adjusting Gear with Stay
(7) Hydraulic Lift Link
(8) Bonnet Cover
(9) Hydraulic Lift Rod
(10) Hydraulic Hose
(11) Stopper (Leaf Spring)
(12) Upper Frame
(13) Parking Brake Rod

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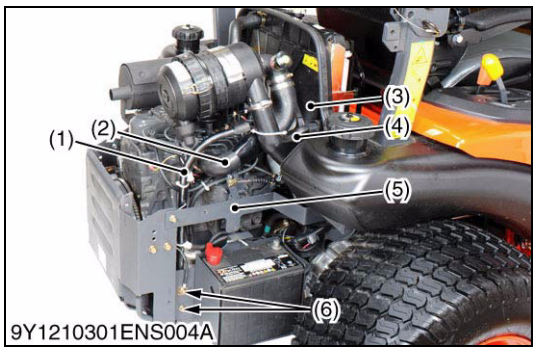


## Air Cleaner

1. Remove the side cover stays L, R (5).
2. Remove the bolts (6) for air cleaner support (1).
3. Disconnect the inlet hose (2) from engine.
4. Pull out the intake pipe (4) from the shroud (3).
5. Remove the air cleaner.

(1) Air Cleaner Support
(2) Inlet Hose
(3) Shroud
(4) Intake Pipe
(5) Side Cover Stay
(6) Bolts

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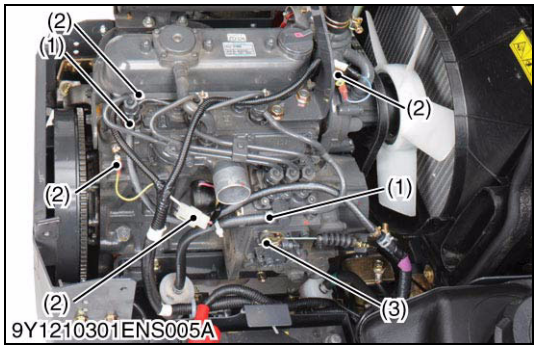


## Electric Wiring and Fuel Hoses

1. Disconnect the wiring connectors (2) for engine stop solenoid, glow plug, coolant temperature sensor, and coolant temperature switch.
2. Disconnect the accelerator wire (3).
3. Disconnect the fuel hoses (1) from engine.

**(When reassembling)**

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

(1) Fuel Hose
(2) Wiring Connectors
(3) Accelerator Wire (Throttle Cable)

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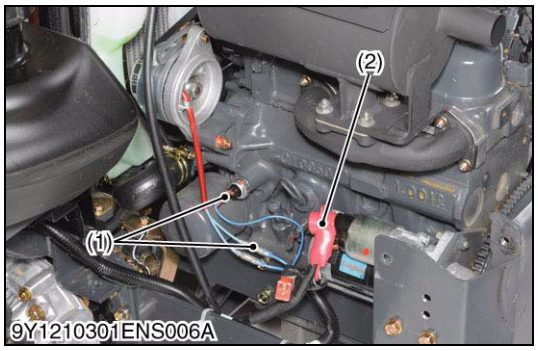
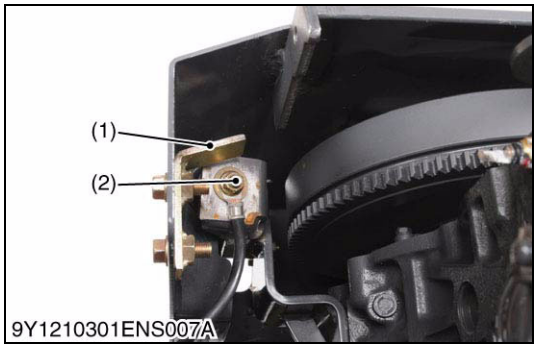


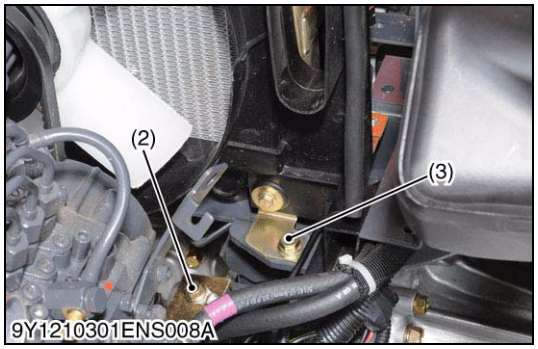

## Electric Wiring

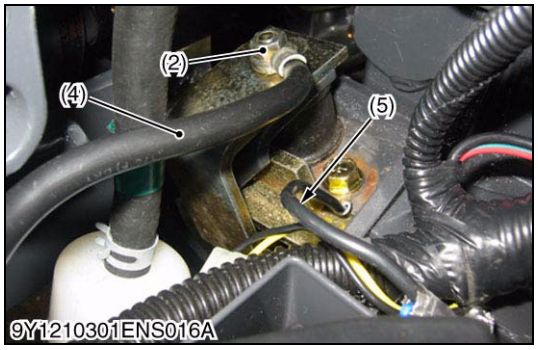
1. Disconnect the wiring connectors (1) for dynamo and engine oil pressure switch.
2. Remove the positive cable (2) from the starter motor.

(1) Wiring Connectors
(2) Positive Cable

9Y1210301TXS0011US0




## Engine Stopper and Mounting Nuts

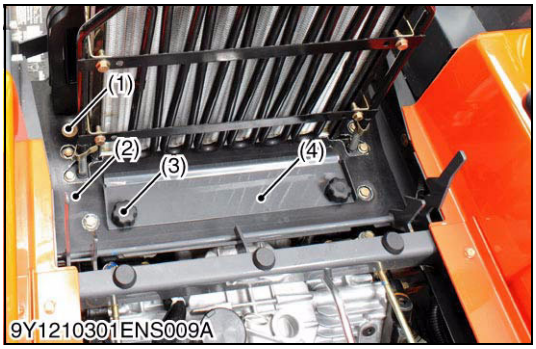
1. Remove the engine stoppers (1).
2. Remove the engine mounting nuts (2).
3. Remove the bolts (3) for shroud.

**(When reassembling)**

- To get a good contact of the ground, attach the ground wire (5) to the specified position (separate position from that of the battery negative cable (4)). (Right side front only)

(1) Engine Stopper
(2) Engine Mounting Nut
(3) Bolt
(4) Battery Negative Cable
(5) Ground Wire

9Y1210301ENS0029US0



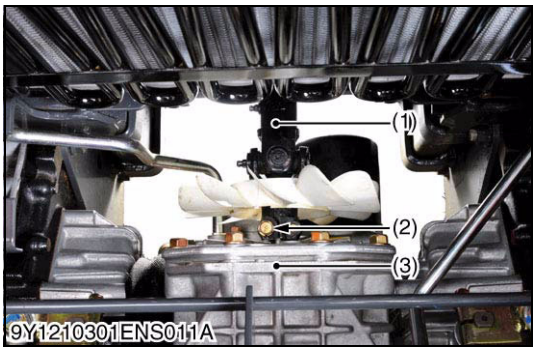


## Plate

1. Raise the seat.
2. Remove the knobs (3) and the plate (4).
3. Remove the 2 bolts (1) and the rubber sheet (2).
4. Remove the plate (5).

(1) Bolt
(2) Rubber Sheet
(3) Knob
(4) Plate
(5) Plate

9Y1210301TXS0013US0




## Universal Joint

1. Remove the 2 bolts (2).
2. Lift up the engine and separate the universal joint (1) from transmission (3).

**(When reassembling)**

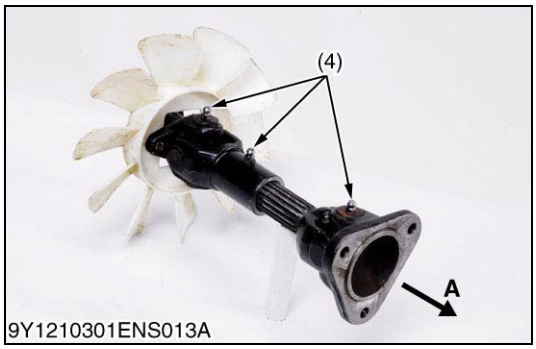
- Apply grease to the all splines on the drive shaft.
- Set the engine on the rubber cushion. Before fastening the engine mounting nuts, connect the universal joint.
- Make sure to align all the grease nipples. Only this one position meets the spline.

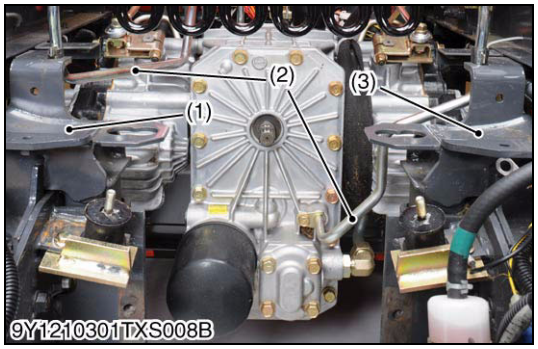
| | | |
|---|---|---|
| Tightening torque | Universal joint mounting screw | 26.0 to 28.0 N·m<br>2.7 to 2.9 kgf·m<br>19.2 to 20.7 lbf·ft |
| | Engine mounting nut | 23.5 to 27.5 N·m<br>2.4 to 2.8 kgf·m<br>17.4 to 20.3 lbf·ft |

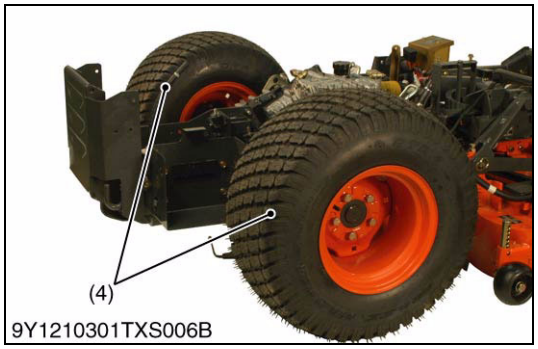

(1) Universal Joint
(2) Bolt
(3) Transmission
(4) Grease Nipple

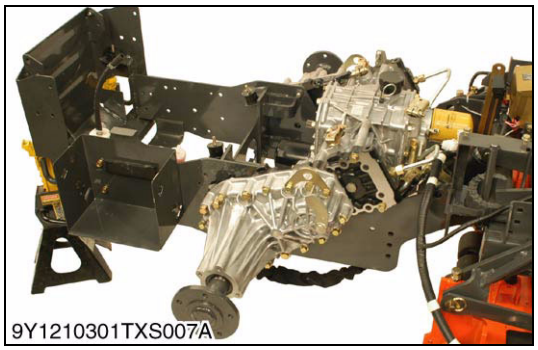
**A: Fixed to the fan drive pulley.**

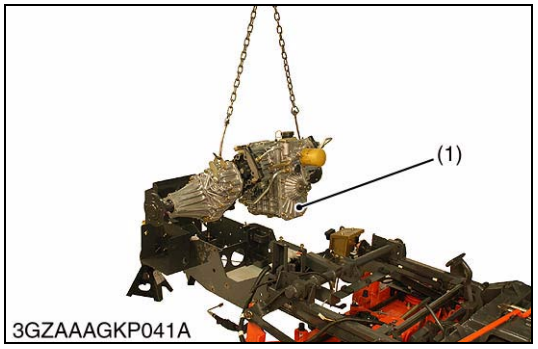
9Y1210301TXS0014US0






## 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. Unscrew the rear wheel mounting.
4. Lift up and secure with jack stands or blocking the rear of the machine frame, and remove the rear wheels (4).

**(When reassembling)**

■ **NOTE**

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

| | | |
|---|---|---|
| Tightening torque | ROPS mounting screw (M10, 7T) | 48 to 55 N·m<br>4.9 to 5.7 kgf·m<br>36 to 41 lbf·ft |
| | Rear wheel mounting screw | 108.5 to 130.2 N·m<br>11.1 to 13.3 kgf·m<br>80 to 96 lbf·ft |

(1) ROPS Lower (LH)
(2) Oil Cooler Pipe
(3) ROPS Lower (RH)
(4) Rear Wheel

9Y1210301TXS0041US0

## Separating Transaxle Assembly

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

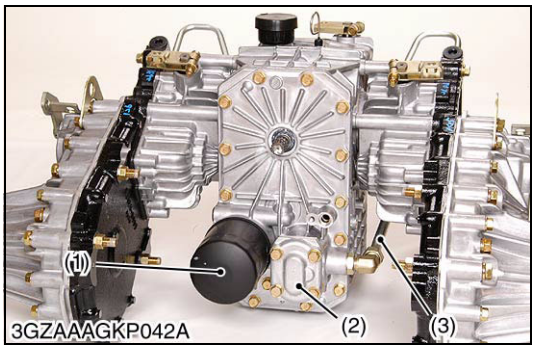
**(When reassembling)**

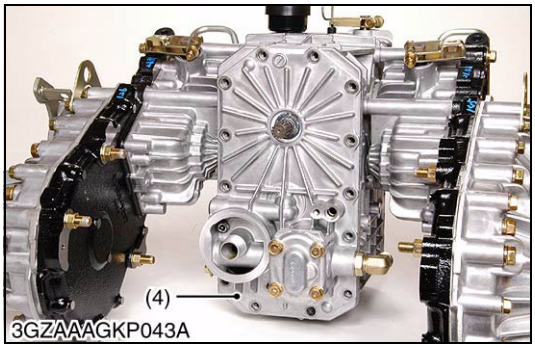
| | | |
|---|---|---|
| Tightening torque | Rear axle gear case mounting screw (M12) | 78 to 90 N·m<br>7.9 to 9.2 kgf·m<br>58 to 66 lbf·ft |

(1) Transaxle Assembly

9Y1210301TXS0042US0

# [2] DISASSEMBLING TRANSAXLE CENTER CASE




## Center Case Rear Cover

1. Remove the oil filter cartridge (1).
2. Remove the delivery pipe (3).
3. Remove the center case rear cover (4).

■ **NOTE**

- **Remember to remove the hex. socket head screw hidden behind the filter cartridge (1)**
- **To remove the center case rear cover (4) mounted on the machine, also remove the hydraulic pump (2). This makes fitting the spline between pump shaft and the pump drive shaft easy.**

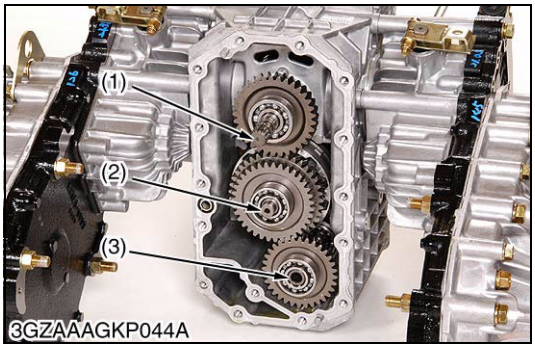
**(When reassembling)**

- Apply liquid gasket (Three Bond 1208D or equivalent) to joint face of the center case and center case rear cover.
- Take care not to damage the oil seal.

| | | |
|---|---|---|
| Tightening torque | Center case rear cover mounting screw | 40 to 44 N·m<br>4.0 to 4.5 kgf·m<br>29 to 32 lbf·ft |

(1) Oil Filter Cartridge
(2) Hydraulic Pump
(3) Delivery Pipe
(4) Center Case Rear Cover

9Y1210301TXS0043US0




## PTO Clutch Shaft Assembly and Pump Gear Shaft

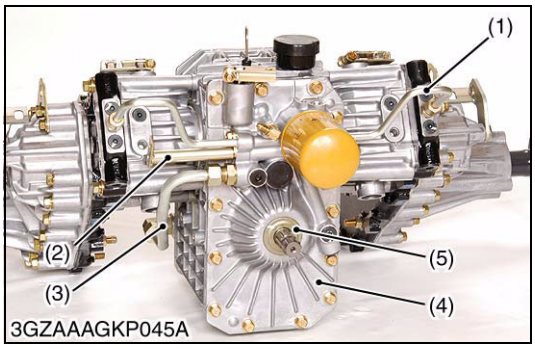
1. Remove the input shaft assembly (1).
2. Remove the PTO clutch shaft assembly (2) and pump shaft assembly (3).

**(When reassembling)**

- Take care not to damage the PTO shaft oil seal.

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

9Y1210301TXS0044US0




## Center Case Front Cover

■ **NOTE**

- **To remove the center case front cover (4) mounted on the machine, remove the PTO shaft oil seal (5) first.**

1. Remove the HST Pipe (1).
2. Remove the delivery pipe (3).
3. Remove the PTO clutch lever (2).
4. Remove the center case front cover (4).

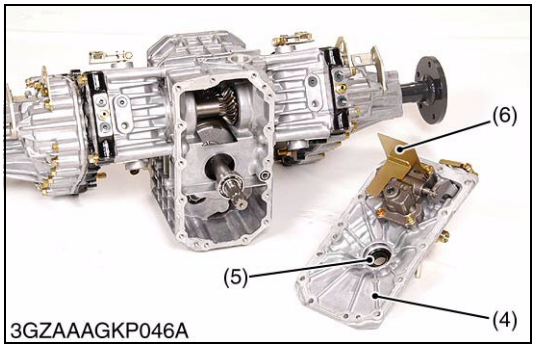
**(When reassembling)**

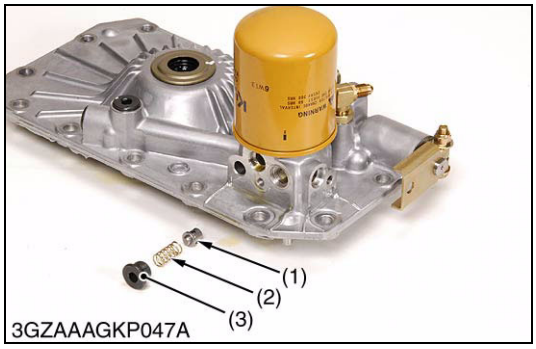
- Take care not to damage the oil seal (5).
- Apply liquid gasket (Three Bond 1208D or equivalent) to joint face of the center case and center case front cover (4).

| | | |
|---|---|---|
| Tightening torque | Center case front cover mounting screw | 40 to 44 N·m<br>4.0 to 4.5 kgf·m<br>29 to 32 lbf·ft |

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

9Y1210301TXS0045US0



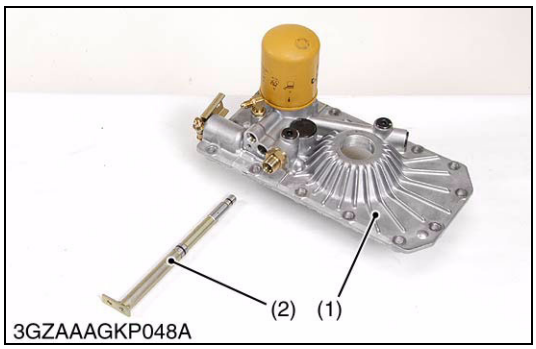



## Regulator Valve (HST Charge Pressure Relief Valve)

1. Remove the plug (3).
2. Remove the spring (2) and poppet (1).

(1) Poppet
(2) Spring
(3) Plug

9Y1210301TXS0046US0




## PTO Clutch Lever

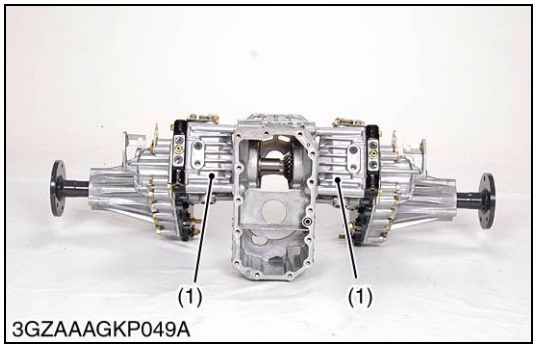
1. Remove the lever stopper and remove the PTO clutch lever (2).

**(When reassembling)**

- Take care not to damage the O-rings.

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

9Y1210301TXS0047US0




## Separating Hydrostatic Transmission and Rear Axle Gear Case Assembly

1. Remove the hydrostatic transmission and rear axle gear case assembly mounting screws.
2. Separate the hydrostatic transmission and rear axle gear case assembly (1).

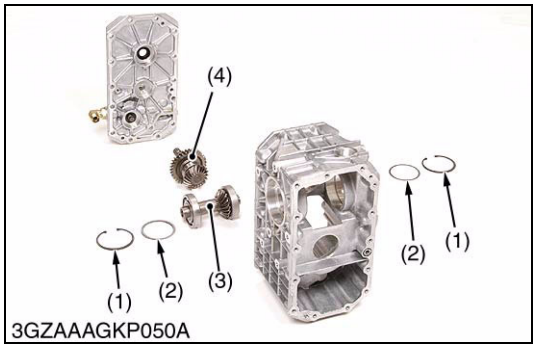
**(When reassembling)**

- Take care not to damage the O-ring.

| | | |
|---|---|---|
| Tightening torque | Hydrostatic transmission and rear axle gear case assembly mounting screw | 40 to 44 N·m<br>4.0 to 4.5 kgf·m<br>29 to 32 lbf·ft |

(1) Hydrostatic Transmission and Rear Axle Gear Case Assembly

9Y1210301TXS0048US0




## 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).

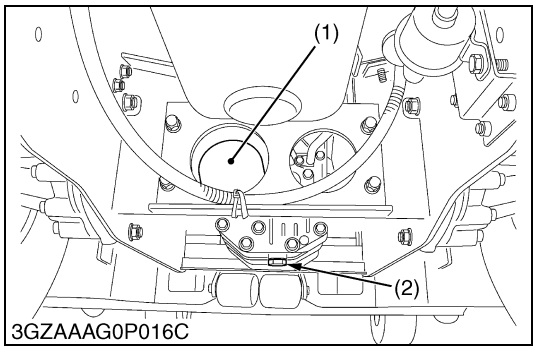
**(When reassembling)**

- Use same thickness of shims as before disassembling.

(1) Internal Snap Ring
(2) Shim
(3) Joint Shaft Assembly
(4) Spiral Bevel Gear

9Y1210301TXS0049US0

# [3] DISASSEMBLING PTO CLUTCH SHAFT ASSEMBLY



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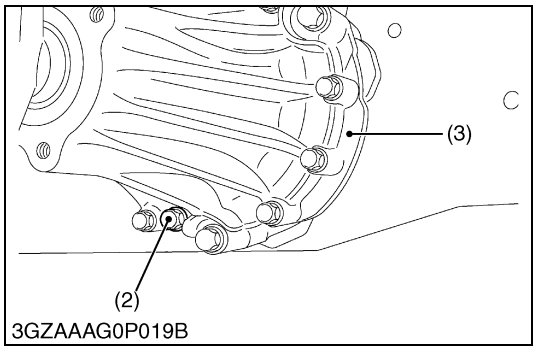

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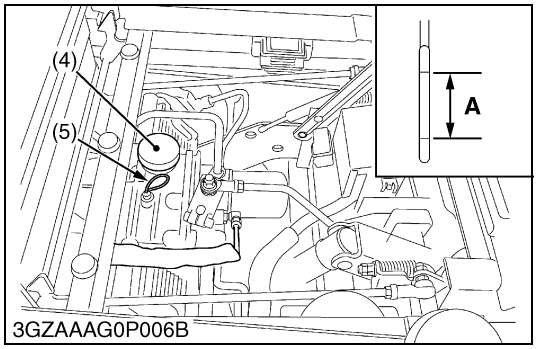


3GZAAAG0P006B

## Draining Transmission Fluid

**CAUTION**

**To avoid personal injury:**

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

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

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

**IMPORTANT**

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

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

**IMPORTANT**

- **Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.**
  **Keep the engine at medium speed for a few minutes to insure proper lubrication of all parts so there is no damage to transmission.**
- **Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system.**
  **Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-9.)**
- **Do not mix different brands oil together.**

| | |
|---|---|
| Transmission fluid capacity | 12.1 L<br>12.8 U.S.qts<br>10.6 Imp.qts |

(1) Hydraulic 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**

9Y1210301TXS0025US0

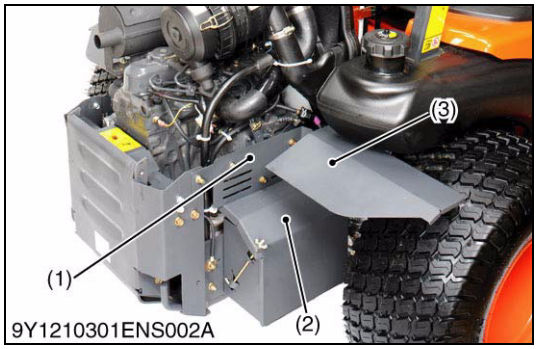
9Y1210301ENS001A

## Bonnet

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

(1) Bonnet

9Y1210301TXS0015US0

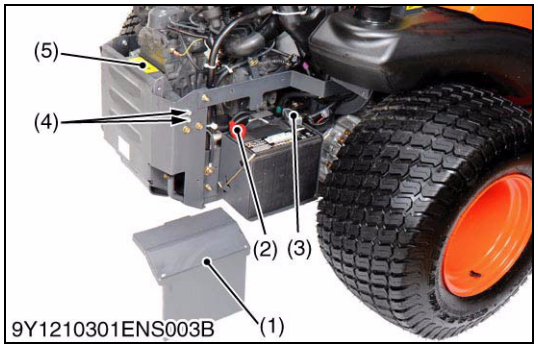



## Battery Cover

1. Remove the side covers L, R (1) and the rear fenders L, R (3).
2. Remove the battery cover (2).

(1) Side cover
(2) Battery cover
(3) Rear Fender

9Y1210301TXS0016US0




## Battery and Flywheel Cover

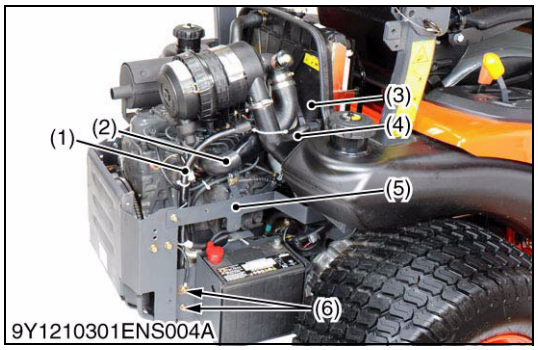
**CAUTION**

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

1. Disconnect the negative cable (3) from the battery.
2. Disconnect the positive cable (2) from the battery.
3. Remove the bolts (4) and flywheel cover (5).

(1) Battery Cover
(2) Positive Cable
(3) Negative Cable
(4) Bolt
(5) Flywheel Cover

9Y1210301TXS0004US0

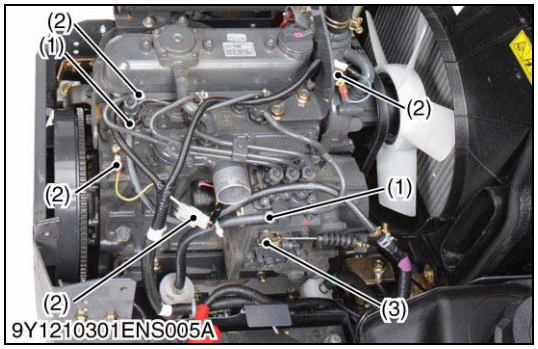



## Air Cleaner

1. Remove the side cover stays L, R (5).
2. Remove the bolts (6) for air cleaner support (1).
3. Disconnect the inlet hose (2) from engine.
4. Pull out the intake pipe (4) from the shroud (3).
5. Remove the air cleaner.

(1) Air Cleaner Support
(2) Inlet Hose
(3) Shroud
(4) Intake Pipe
(5) Side Cover Stay
(6) Bolts

9Y1210301TXS0017US0




## Electric Wiring and Fuel Hoses

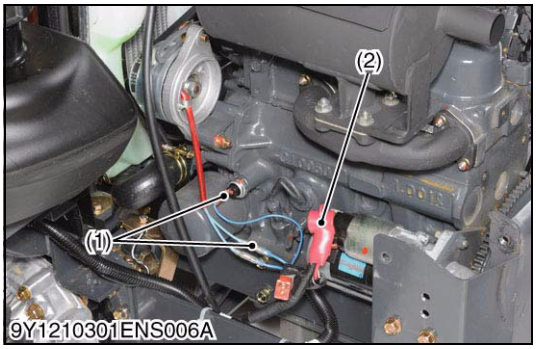
1. Disconnect the wiring connectors (2) for engine stop solenoid, glow plug, coolant temperature sensor, and coolant temperature switch.
2. Disconnect the accelerator wire (3).
3. Disconnect the fuel hoses (1) from engine.

**(When reassembling)**

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

(1) Fuel Hose
(2) Wiring Connectors
(3) Accelerator Wire (Throttle Cable)

9Y1210301TXS0018US0

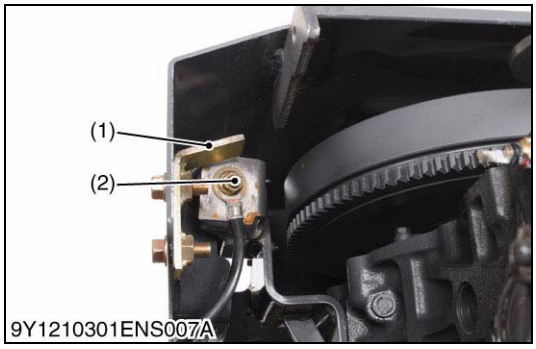



## Electric Wiring

1. Disconnect the wiring connectors (1) for dynamo and engine oil pressure switch.
2. Remove the positive cable (2) from the starter motor.

(1) Wiring Connectors
(2) Positive Cable

9Y1210301TXS0019US0




## Engine Stopper and Mounting Nuts

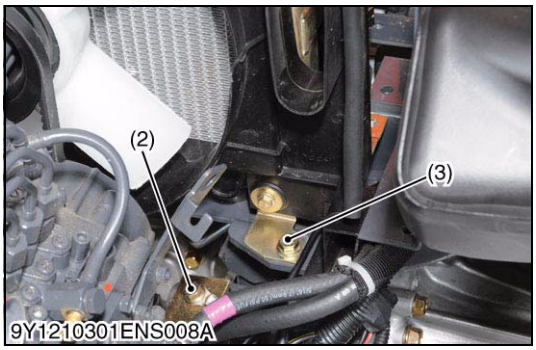
1. Remove the engine stoppers (1).
2. Remove the engine mounting nuts (2).
3. Remove the bolts (3) for shroud.

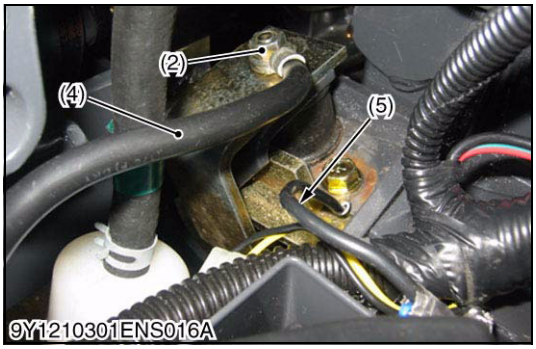
**(When reassembling)**

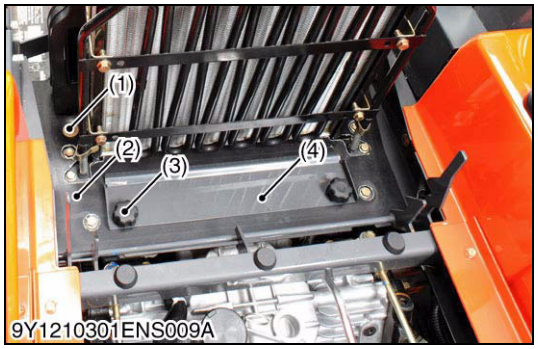
- To get a good contact of the ground, attach the ground wire (5) to the specified position (separate position from that of the battery negative cable (4)). (Right side front only)

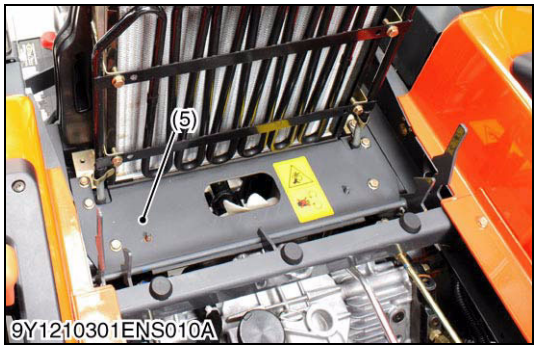
(1) Engine Stopper
(2) Engine Mounting Nut
(3) Bolt
(4) Battery Negative Cable
(5) Ground Wire

9Y1210301ENS0029US0





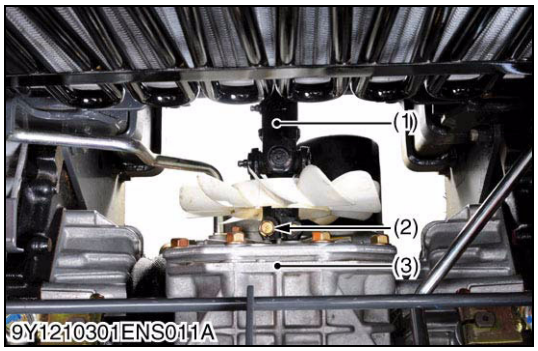



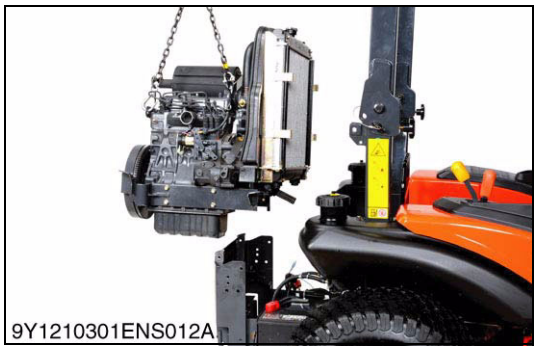

## Plate

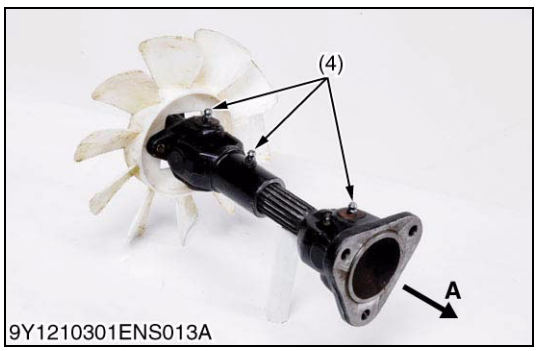
1. Raise the seat.
2. Remove the knobs (3) and the plate (4).
3. Remove the 2 bolts (1) and the rubber sheet (2).
4. Remove the plate (5).

(1) Bolt
(2) Rubber Sheet
(3) Knob
(4) Plate
(5) Plate

9Y1210301TXS0021US0




## Universal Joint

1. Remove the 2 bolts (2).
2. Lift up the engine and separate the universal joint (1) from transmission (3).

**(When reassembling)**

- Apply grease to the all splines on the drive shaft.
- Set the engine on the rubber cushion. Before fastening the engine mounting nuts, connect the universal joint.
- Make sure to align all the grease nipples. Only this one position meets the spline.

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

(1) Universal Joint
(2) Bolt
(3) Transmission
(4) Grease Nipple

**A: Fixed to the fan drive pulley.**

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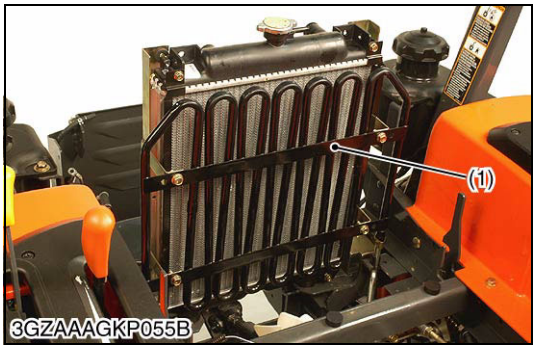


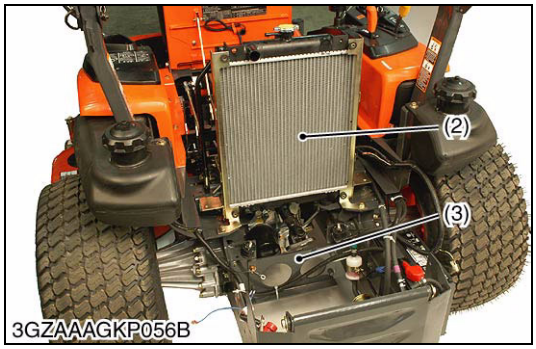


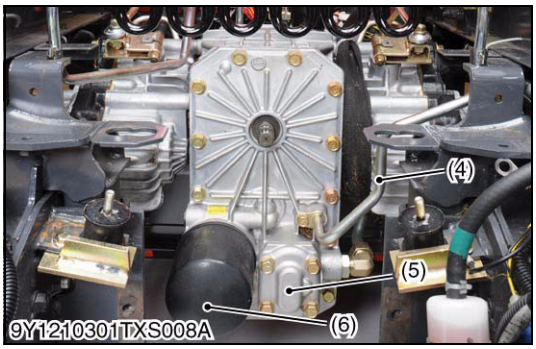


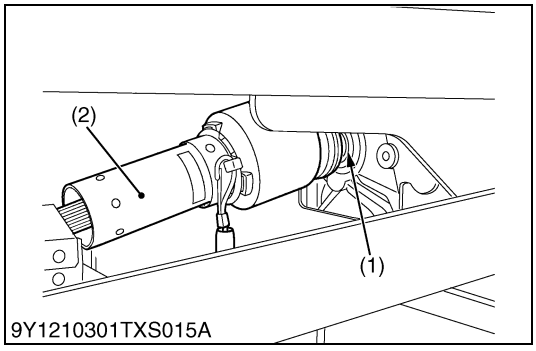


## Oil Cooler, Radiator and Others

1. Remove the oil cooler (1).
2. Remove the radiator (2).
3. Remove the ROPS connecting plate under (3).
4. Remove the oil cooler pipe (4).
5. Remove the hydraulic pump assembly (5).
6. Remove the oil filter cartridge (6).

**(When reassembling)**

■ **NOTE**

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

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

(1) Oil Cooler
(2) Radiator
(3) ROPS Connecting Plate, Under
(4) Oil Cooler Pipe
(5) Hydraulic Pump Assembly
(6) Oil Filter Cartridge

9Y1210301TXS0050US0

## 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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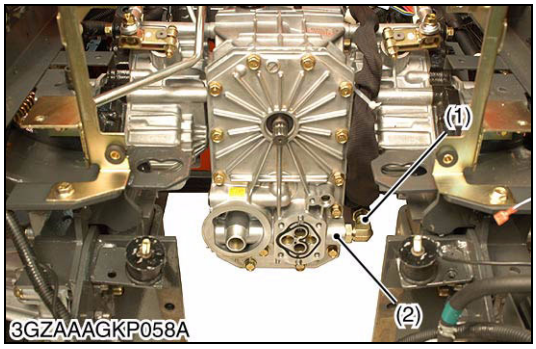


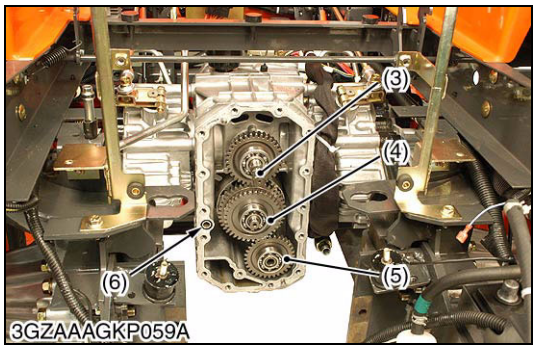


## Center Case Rear Cover and PTO Clutch Shaft Assembly

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 falling off of the bevel gear from the input shaft (3).**

**(When reassembling)**

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

| | | |
|---|---|---|
| Tightening torque | Center case rear cover mounting screw | 40 to 44 N·m<br>4.0 to 4.5 kgf·m<br>29 to 32 lbf·ft |

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

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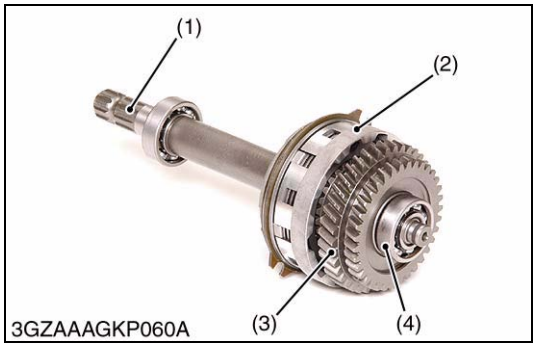


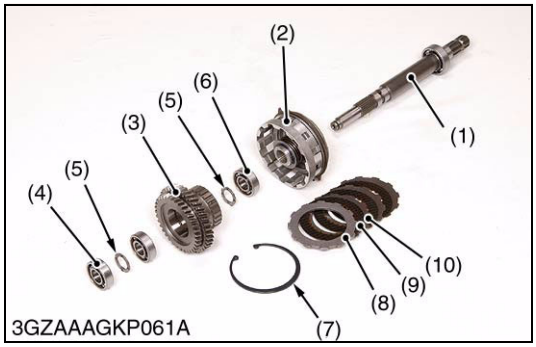


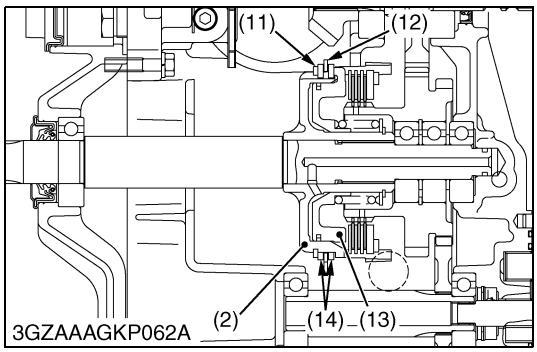


## Disassembling PTO Clutch Assembly

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

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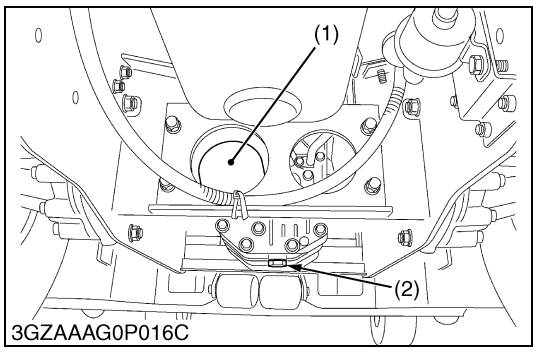
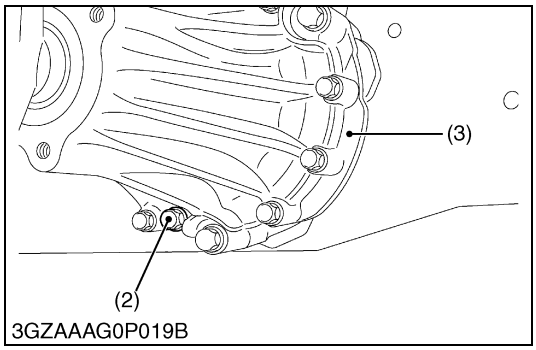
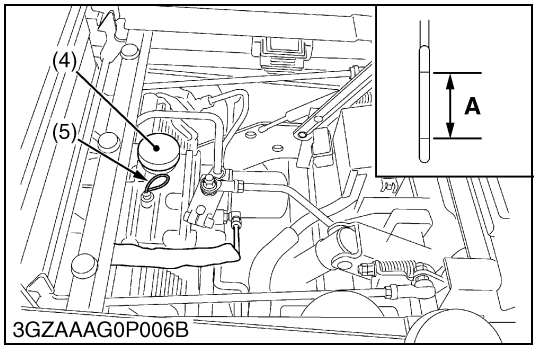
# [4] DISASSEMBLING HYDROSTATIC TRANSMISSION AND REAR AXLE GEAR CASE ASSEMBLY




## Draining Transmission Fluid

**CAUTION**

**To avoid personal injury:**

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

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

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

**■ IMPORTANT**

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

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

**■ IMPORTANT**

- **Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.**
  **Keep the engine at medium speed for a few minutes to insure proper lubrication of all parts so there is no damage to transmission.**
- **Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system.**
  **Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-9.)**
- **Do not mix different brands oil together.**

| | |
|---|---|
| Transmission fluid capacity | 12.1 L<br>12.8 U.S.qts<br>10.6 Imp.qts |

(1) Hydraulic 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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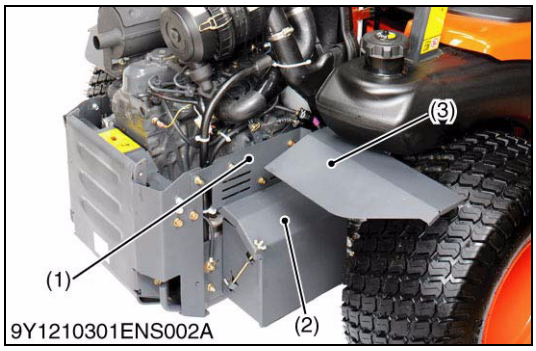


## Battery Cover

1. Remove the side covers L, R (1) and the rear fenders L, R (3).
2. Remove the battery cover (2).

(1) Side cover
(2) Battery cover
(3) Rear Fender

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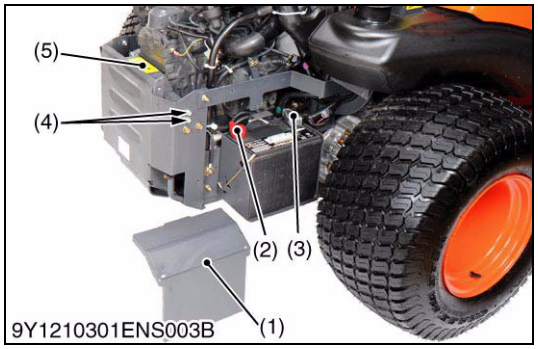


## Battery and Flywheel Cover

**CAUTION**

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

1. Disconnect the negative cable (3) from the battery.
2. Disconnect the positive cable (2) from the battery.
3. Remove the bolts (4) and flywheel cover (5).

(1) Battery Cover
(2) Positive Cable
(3) Negative Cable
(4) Bolt
(5) Flywheel Cover

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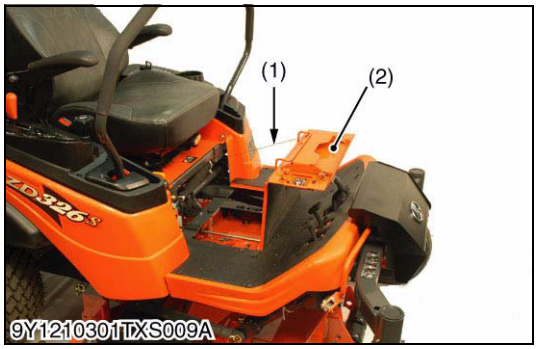


## Step Center and Step

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

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

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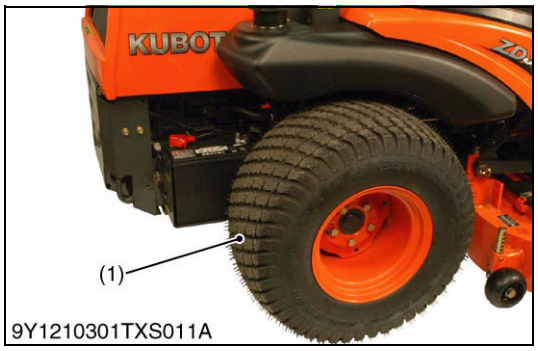


## Rear Wheel

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

**(When reassembling)**

| | | |
|---|---|---|
| Tightening torque | Rear wheel mounting screw | 108.5 to 130.2 N·m<br>11.1 to 13.3 kgf·m<br>80 to 96 lbf·ft |

(1) Rear Wheel

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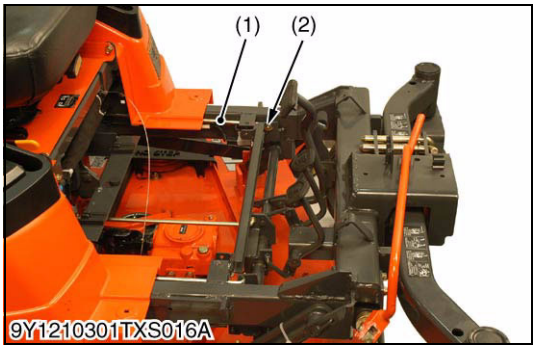


## Parking Brake Rod

1. Remove the parking brake rods (1).

**(When reassembling)**

■ **NOTE**
- **Replace the cotter pin (2) with new one.**
- **After assembling the parking brake rods, be sure check the parking brake spring length and play. If the measurement is not within the factory specifications, adjust the spring length and play. (See page 2-S12.)**

(1) Parking Brake Rod (2) Cotter Pin

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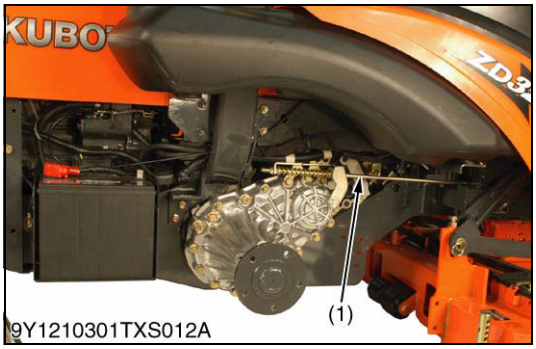


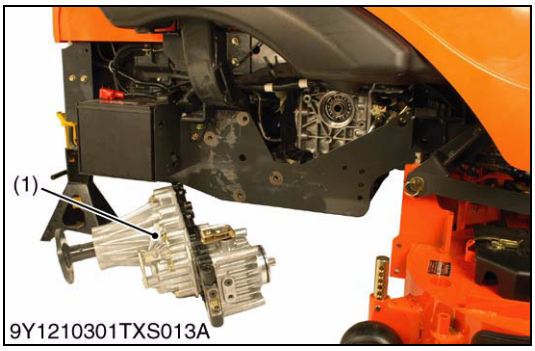


## Hydrostatic Transmission and Rear Axle Gear Case Assembly

■ **NOTE**
- **The hydrostatic transmission and rear axle gear case assembly weighs approximately 35 kg (77 lbs). Take extra care in handling.**

1. Loosen the delivery pipe.
2. Remove the hydrostatic transmission mounting screws.
3. Remove the rear axle gear case mounting screws.
4. Separate the hydrostatic transmission and rear axle gear case assembly (1) and the transmission center case.

**(When reassembling)**
- Take care 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<br>4.9 to 5.7 kgf·m<br>36 to 41 lbf·ft |
| | Rear axle gear case mounting screw (M12) | 78 to 90 N·m<br>7.9 to 9.2 kgf·m<br>58 to 66 lbf·ft |

(1) Hydrostatic Transmission and Rear Axle Gear Case Assembly

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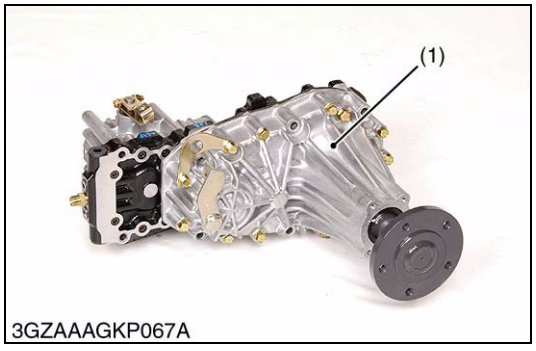



## Rear Axle Gear Case

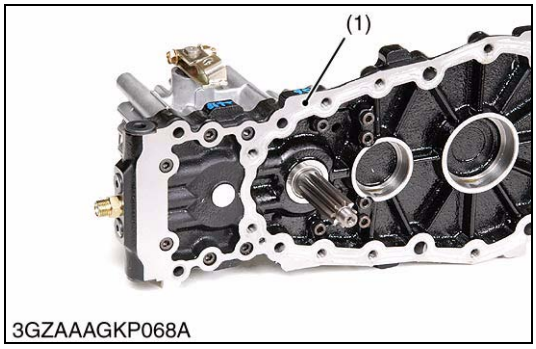
1. Remove the rear axle gear case (1).

**(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 | 48 to 56 N·m<br>4.9 to 5.7 kgf·m<br>36 to 41 lbf·ft |

(1) Rear Axle Gear Case

9Y1210301TXS0058US0



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## Center Section (Port Block)

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

■ **NOTE**

- **Take care not to damage the surface of cylinder blocks pistons and center section.**

| | | |
|---|---|---|
| Tightening torque | Center section mounting hex. socket head screw | 25 to 29 N·m<br>2.6 to 2.9 kgf·m<br>19 to 21 lbf·ft |

(1) Center Section

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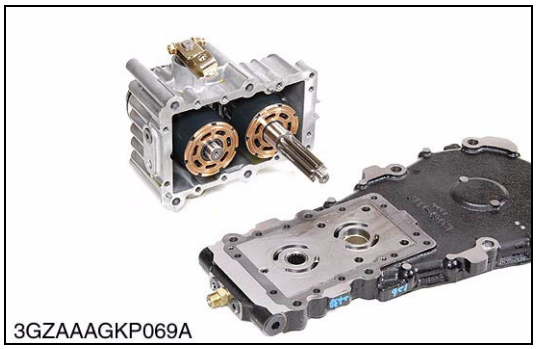
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## Check and High Pressure Relief Valve Assembly

1. Remove the plug (1) and draw out the spring (2) and check and high pressure relief valve assembly (3).

**(When reassembling)**

- Take care not to damage the O-ring on the plug.

| | | |
|---|---|---|
| Tightening torque | Check and high pressure relief valve plug | 59 to 78 N·m<br>6.1 to 7.9 kgf·m<br>44 to 58 lbf·ft |

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

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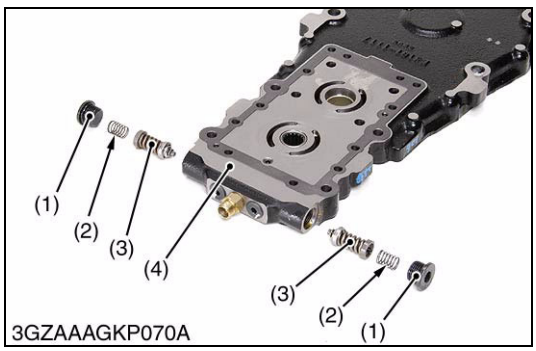

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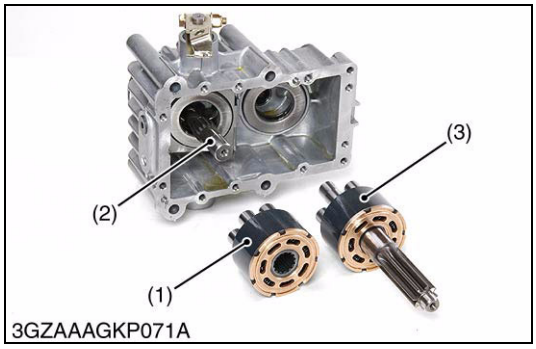

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## Cylinder Block Assembly and Thrust Ball Bearing

1. Lay the housing on its side.
2. Slide out the cylinder block assembly (pump) (1).
3. Slide out the cylinder block assembly (motor) (3).
4. Remove the thrust ball bearing (4).

■ **NOTE**

- **Take care not to damage the surface of the cylinder blocks.**

**(When reassembling)**

- Apply clean fluid to the surface of cylinder block.

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

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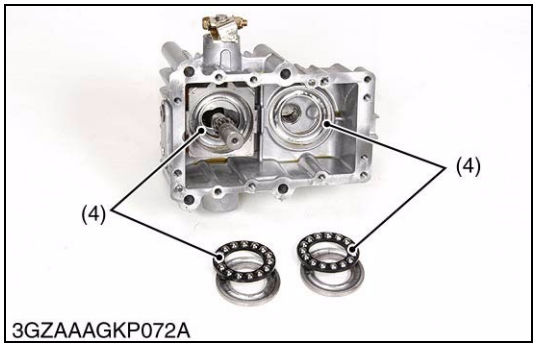

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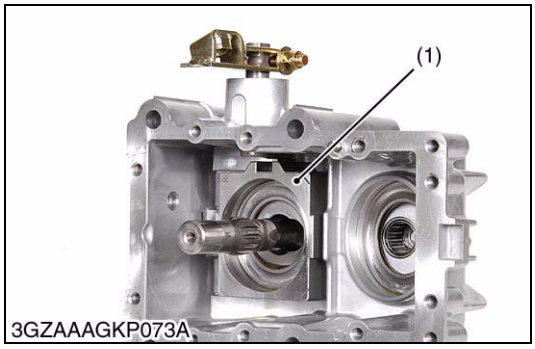


## Swashplate

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

(1) Swashplate

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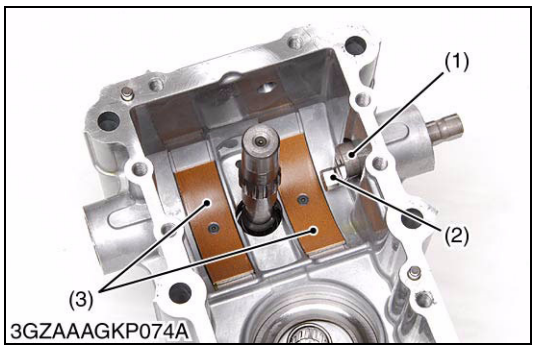


## Slot Guide and Cradle Bearing

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

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

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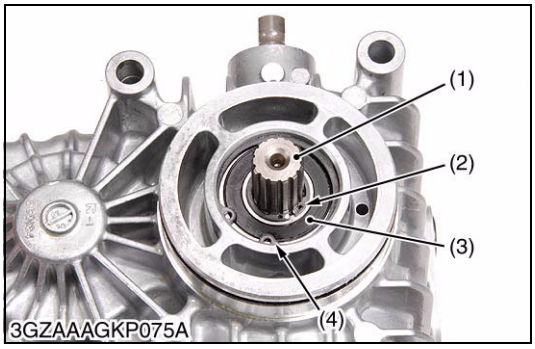


## Pump Shaft

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

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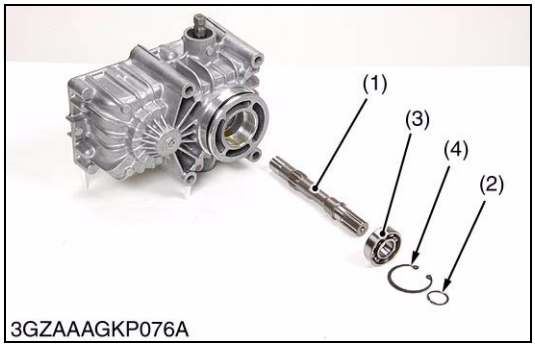
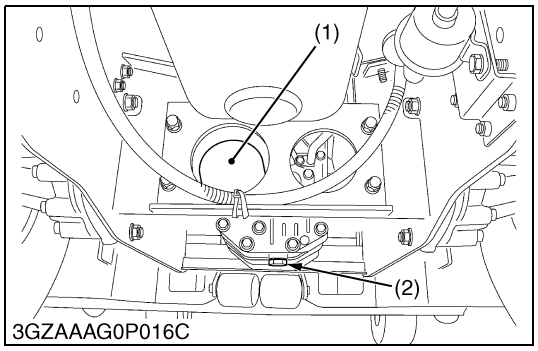
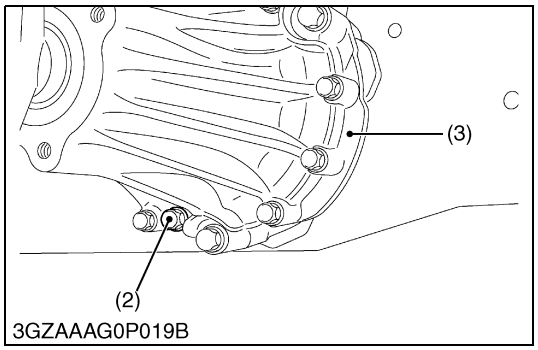
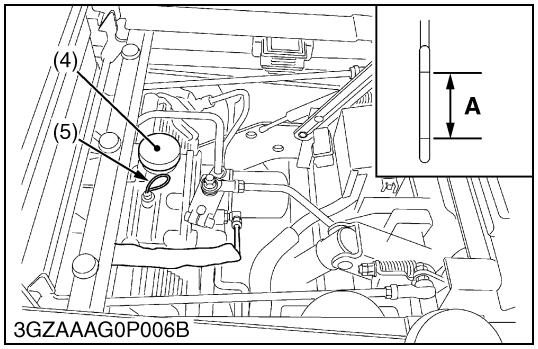


# [5] DISASSEMBLING REAR AXLE GEAR CASE




## 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. Fill with new fluid from filling port after removing the filling plug (4) up the upper notch on the dipstick.

**IMPORTANT**

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

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

**IMPORTANT**

- **Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.**
  **Keep the engine at medium speed for a few minutes to insure proper lubrication of all parts so there is no damage to transmission.**
- **Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system.**
  **Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-9.)**
- **Do not mix different brands oil together.**

| | |
|---|---|
| Transmission fluid capacity | 12.1 L<br>12.8 U.S.qts<br>10.6 Imp.qts |

(1) Hydraulic 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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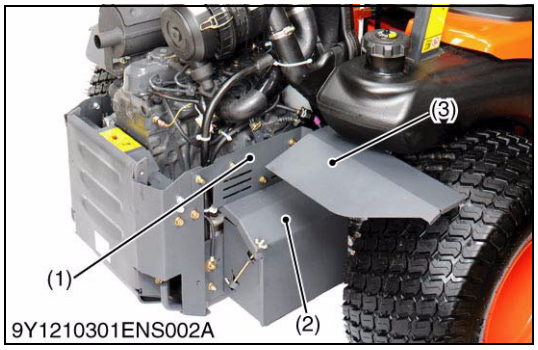
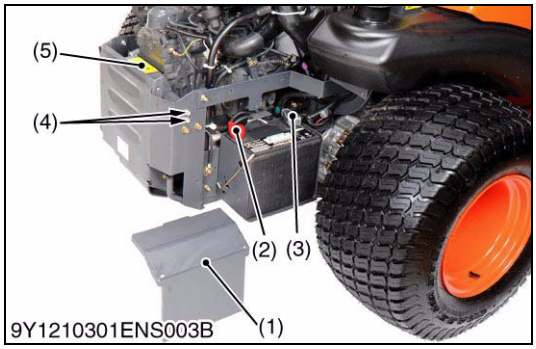



## Battery Cover

1. Remove the side covers L, R (1) and the rear fenders L, R (3).
2. Remove the battery cover (2).

(1) Side cover
(2) Battery cover
(3) Rear Fender

9Y1210301TXS0024US0




## Battery and Flywheel Cover

**CAUTION**

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

1. Disconnect the negative cable (3) from the battery.
2. Disconnect the positive cable (2) from the battery.
3. Remove the bolts (4) and flywheel cover (5).

(1) Battery Cover
(2) Positive Cable
(3) Negative Cable
(4) Bolt
(5) Flywheel Cover

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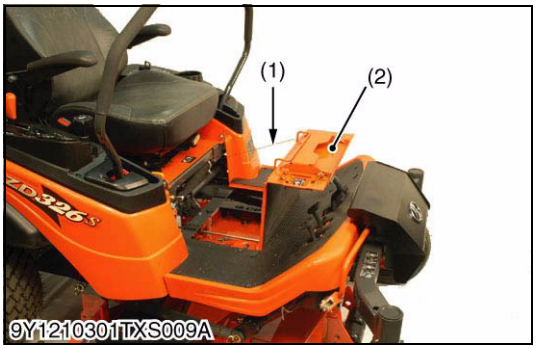


## Step Center and Step

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

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

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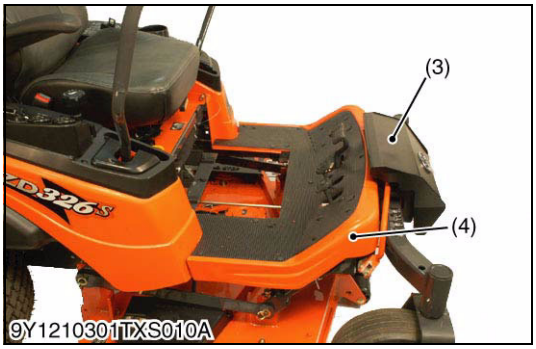


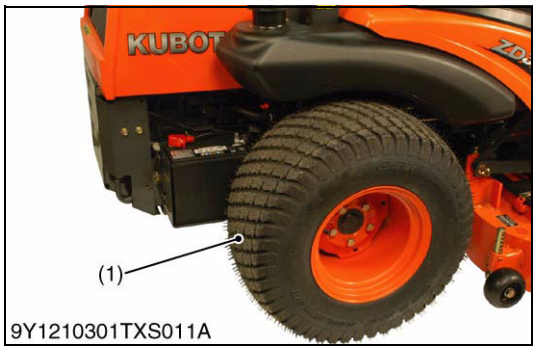


## Rear Wheel

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

**(When reassembling)**

| | | |
|---|---|---|
| Tightening torque | Rear wheel mounting screw | 108.5 to 130.2 N·m<br>11.1 to 13.3 kgf·m<br>80 to 96 lbf·ft |

(1) Rear Wheel

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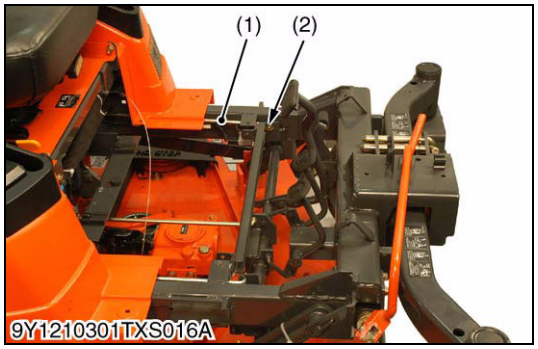
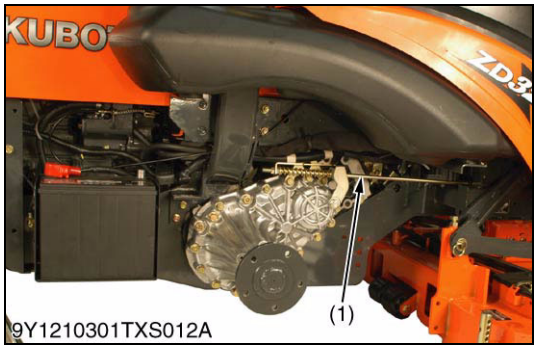



## Parking Brake Rod

1. Remove the parking brake rods (1).

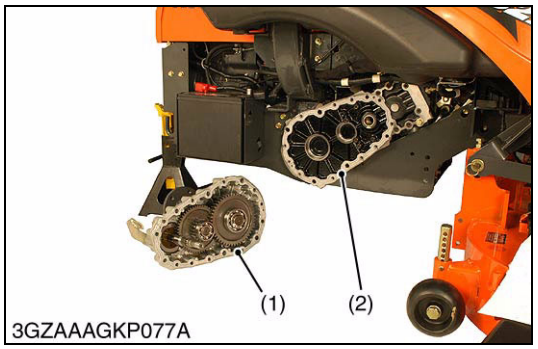
**(When reassembling)**

■ **NOTE**

- **Replace the cotter pin (2) with new one.**
- **After assembling the parking brake rods, be sure check the parking brake spring length and play. If the measurement is not within the factory specifications, adjust the spring length and play. (See page 2-S12.)**

(1) Parking Brake Rod (2) Cotter Pin

9Y1210301TXS0067US0





## Removing Rear Axle Gear Case

1. Remove the rear axle gear case mounting screws.
2. Separate the rear axle gear case assembly (1) and center section (2).

**(When reassembling)**

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

■ **NOTE**

- **If impulse or vibration is applied to the center section after the rear axle gear case assembly (1) was removed, the HST motor-side cylinder block (3) may possibly be deviated as shown in the photo.**
  **If this cylinder block (3) should deviate up to the position shown in the photo, it will be unable to be returned to the original position.**
  **At this time, the center section (2) must be separated for servicing or repair. When the rear axle gear case assembly (1) is removed, therefore, watchful care must be taken so as not to give any impulse and shocks to the center section (2).**

| | | |
|---|---|---|
| Tightening torque | Rear axle gear case mounting screw | 40 to 44 N·m<br>4.0 to 4.5 kgf·m<br>29 to 32 lbf·ft |

(1) Rear Axle Gear Case Assembly (3) Cylinder Block (Motor)
(2) Center Section

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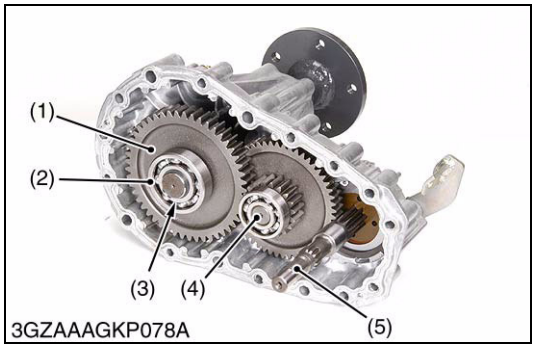
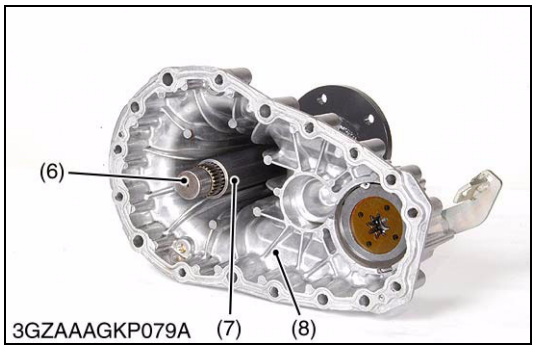
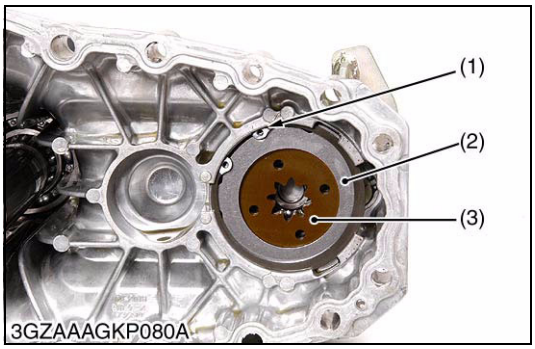
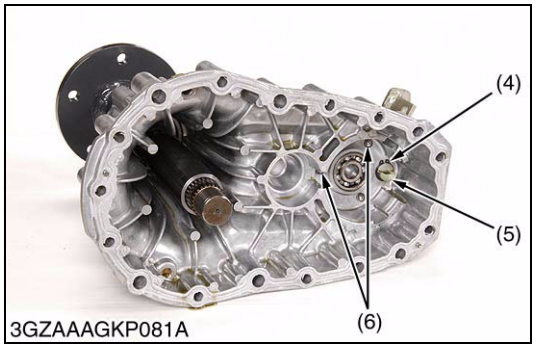



## Rear Axle

1. Remove the brake shaft (HST motor shaft) (5).
2. Remove the external snap ring (3) and remove the ball bearing (2) with puller.
3. Remove the final reduction gear (1) and gear shaft (4).
4. Remove the collar (7) and tap out the rear axle (6) from rear axle gear case (8).

**(When reassembling)**

- Do not damage oil seal.

(1) Final Reduction Gear
(2) Ball Bearing
(3) External Snap Ring
(4) Gear Shaft
(5) Brake Shaft (HST Motor Shaft)
(6) Rear Axle
(7) Collar
(8) Rear Axle Gear Case

9Y1210301TXS0069US0

## Parking Brake

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

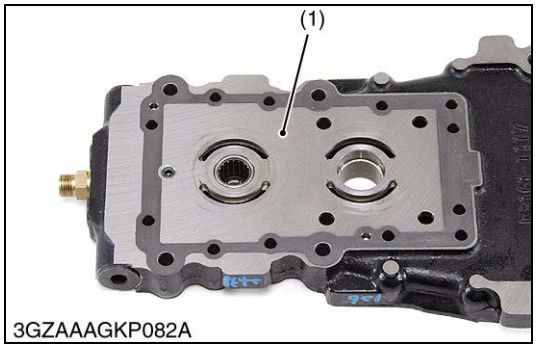
**(When reassembling)**

- Align splines of brake shaft and brake discs (3).
- Do not damage brake discs (3).
- Apply transmission fluid to brake discs (3).

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

9Y1210301TXS0070US0

# 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

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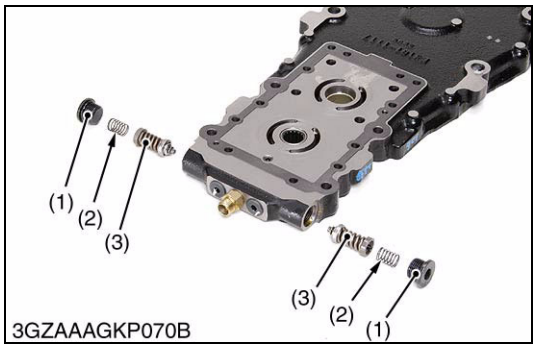


### Check and High Pressure Relief Valve

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

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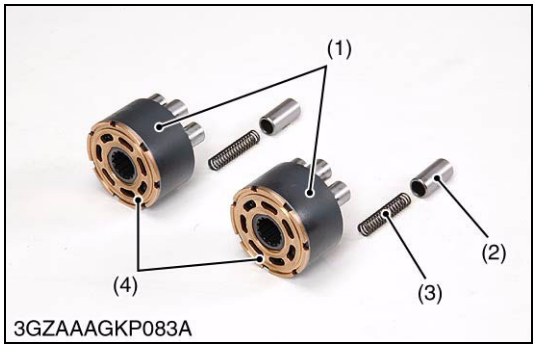


### Cylinder Block Assembly

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

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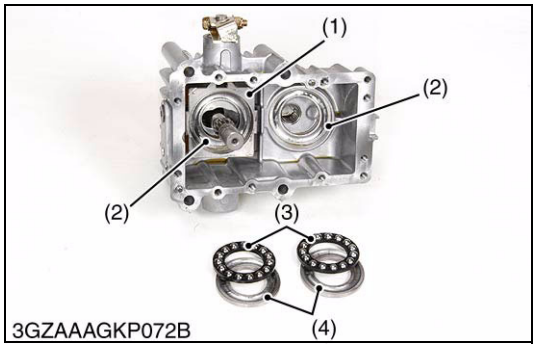


### Thrust Washer, Thrust Ball Bearing and Thrust Plate

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

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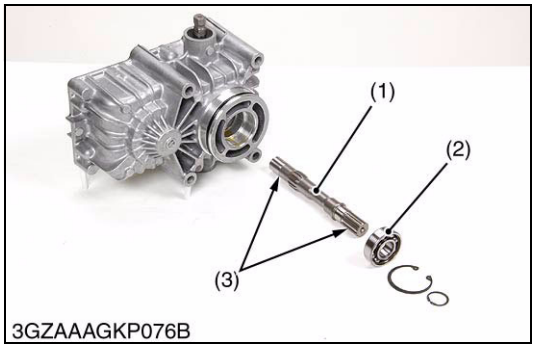

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## Pump Shaft

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

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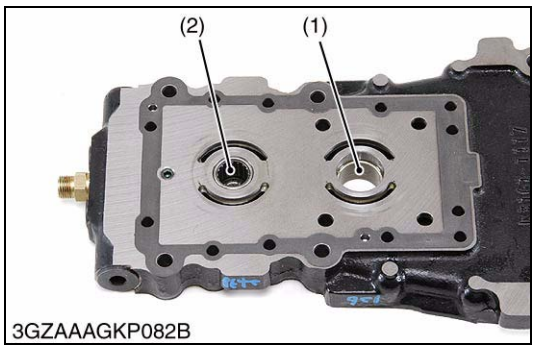

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## Bush and Needle Bearing

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

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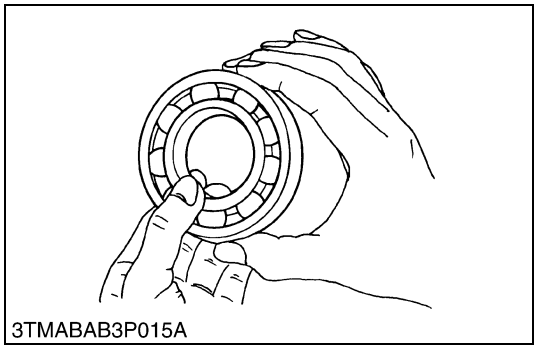
# [2] TRANSMISSION CASE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**Checking Bearing**

1. Hold the inner race, and push and pull the outer race in all directions to check for wear and roughness.
2. Apply transmission fluid to the bearing, and hold the inner race. Then, turn the outer race to check rotation.
3. If there is any defect, replace it.

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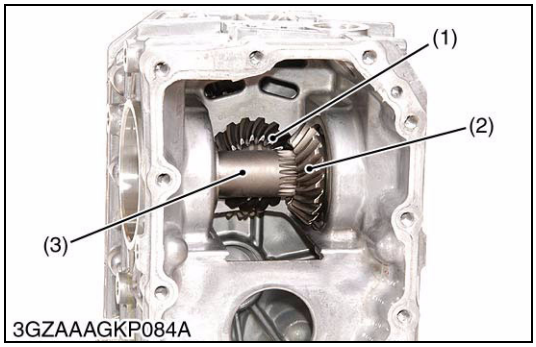

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**Backlash and Tooth Contact between 15T Bevel Gear and 21T Bevel Gear**

1. Measure the backlash between the 15T bevel gear (1) and 21T bevel gear (1).
2. When the backlash is too large, decrease the number of shims in the side of the spiral bevel gear, and insert the removed shims in the opposite side. When the backlash is too small, decrease the number of shims in the side of the differential case, and insert the removed shims in the opposite side.
3. Adjust the backlash properly by repeating the above procedure.
4. Apply red lead lightly over several teeth at three positions equally spaced on the hypoid ring gear.
5. Turn the 15T 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 15T bevel gear and 21T bevel gear | Factory specification | 0.25 to 0.30 mm<br>0.0099 to 0.011 in. |
| Tooth contact | Factory specification | More than 25 % read lead contact area on the gear tooth surface |
| The position of tooth contact point | Factory specification | The center of tooth contact at 3/10 of the entire width from the small end |

(1) 15T Bevel Gear
(2) 21T Bevel Gear
(3) Joint Shaft

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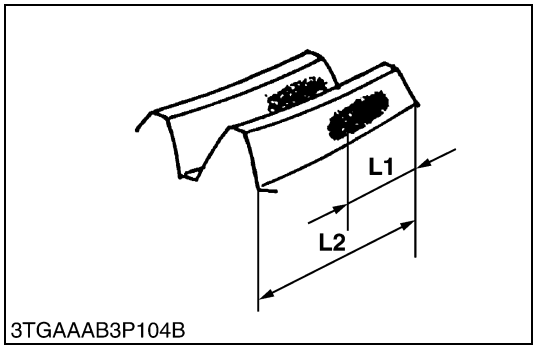

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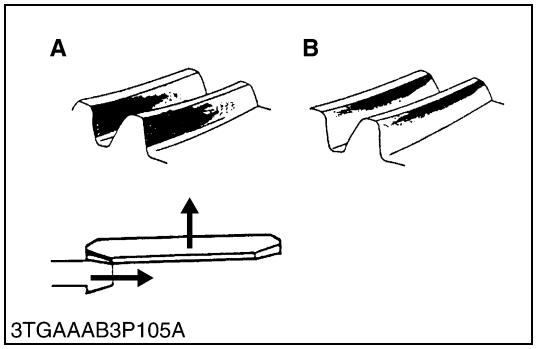

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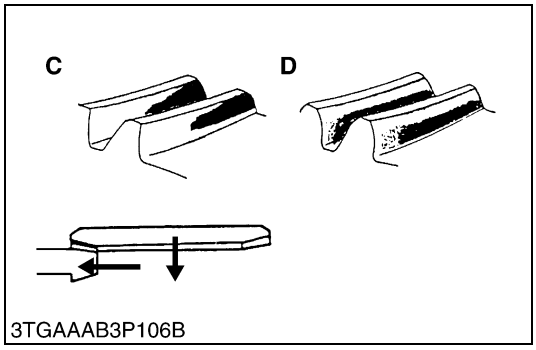

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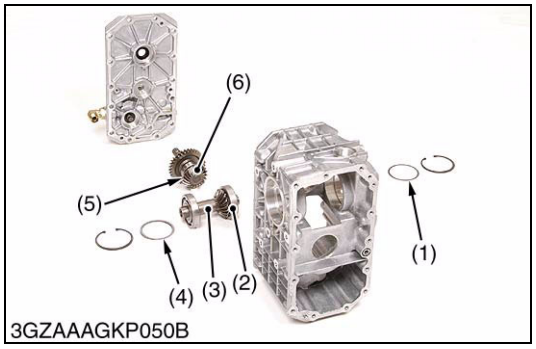

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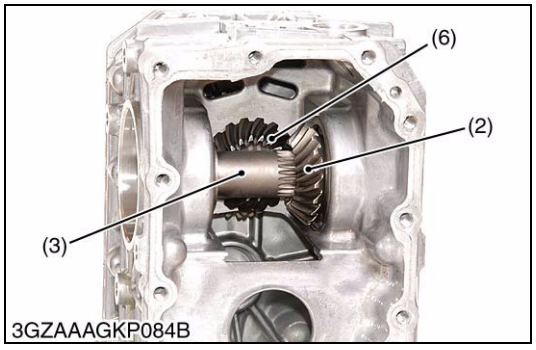

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## Correcting Tooth Contact

1. Proper contact
   – No adjustment.
2. Correcting of the heel contact and shallow contact
   – It is confirmed whether there is a shim (5).
   – The 15T 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 21T bevel gear (2) side shim to the shim (1) to move the 21T bevel gear outside.
   – Repeat above until the proper tooth contact and backlash are achieved.
3. Correcting of the toe contact and deep contact
   – It is confirmed whether there is a shim (5).
   – The 15T 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 21T bevel gear inside.
   – Repeat above until the proper tooth contact and backlash are achieved.

(1) Shim
(2) 21T Bevel Gear
(3) Joint Shaft
(4) Shim
(5) Shim
(6) 15T Bevel Gear

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

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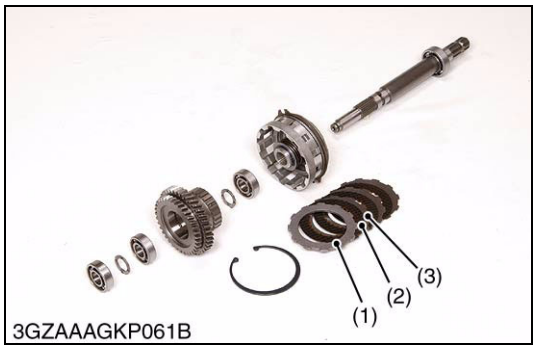
# [3] PTO CLUTCH




**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.

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

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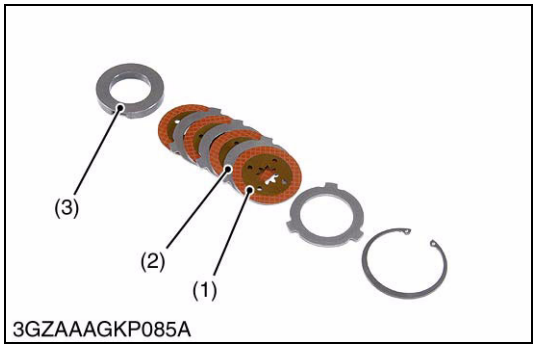
# [4] BRAKE




**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.

(1) Friction Plate
(2) Brake Disc
(3) Actuator

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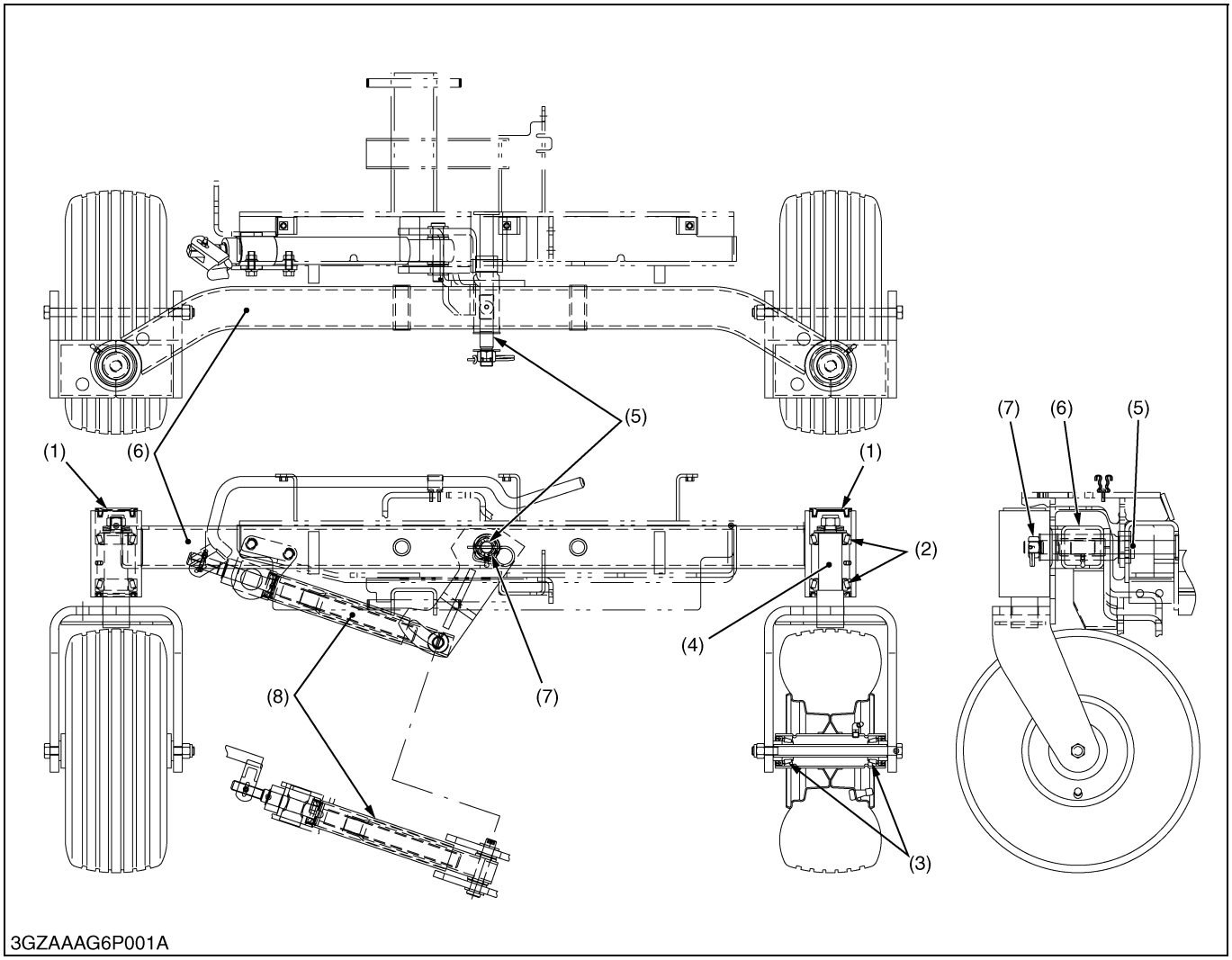
# 3 FRONT AXLE

# MECHANISM

## CONTENTS

# 1. STRUCTURE

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(1) Cap
(2) Taper Roller Bearing
(3) Taper Roller Bearing
(4) Wheel Bracket
(5) Center Pin
(6) Front Axle
(7) Slotted Nut
(8) Lift Up Adjuster

The front axle is constructed as shown above. The shape of the front axle is relatively simple, and the front axle is supported at its center with the center pin (5), so that steering operation is stable even on uneven grounds in a grass field. And this time, the structure that the front axle can be fixed is adopted.

9Y1210301FAM0001US0

# SERVICING

## CONTENTS

# 1. TROUBLESHOOTING

| Symptom | Probable Cause | Solution | Reference Page |
|---|---|---|---|
| **Front Wheels Wander to Right or Left** | Clearance between center pin and front axle excessive | Replace | 3-S7 |
| | Force of the lock nut which tighten the wheel bracket has become down | Adjust | 3-S5 |
| | Clearance between front axle and front axle support excessive | Adjust | 3-S4 |

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# 2. SERVICING SPECIFICATIONS

| Item | | Factory Specification | Allowable Limit |
|---|---|---|---|
| Front Axle End Play | Clearance **A** | 0 to 0.2 mm<br>0 to 0.008 in. | 0.5 mm<br>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 G-11.)

| 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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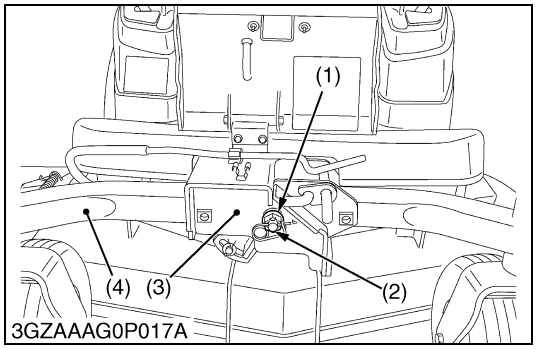
# 4. CHECKING, DISASSEMBLING AND SERVICING

## [1] CHECKING AND ADJUSTING



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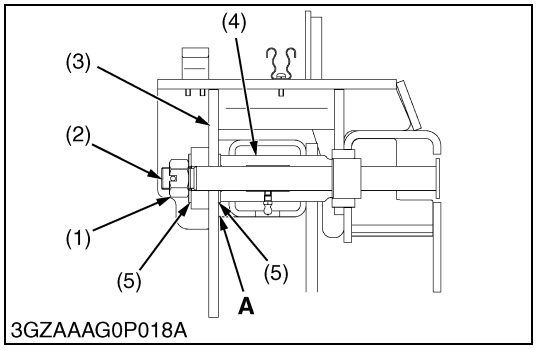

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**Adjusting Front Axle Pivot**

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<br>4.1 to 8.1 kgf·m<br>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<br>0 to 0.008 in. |
| | Allowable limit | 0.5 mm<br>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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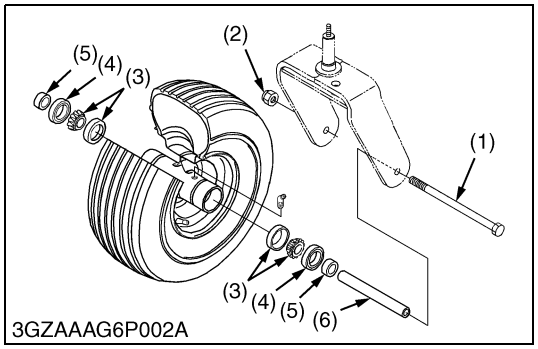
# [2] DISASSEMBLING AND ASSEMBLING

## (1) Separating Front Wheel and Wheel Bracket



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### Remove the Front Wheel

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

**(When reassembling)**

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

| | | |
|---|---|---|
| Tightening torque | Front wheel mounting bolt and locking nut | 20 to 25 N·m<br>2.1 to 2.5 kgf·m<br>15 to 18 lbf·ft |

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

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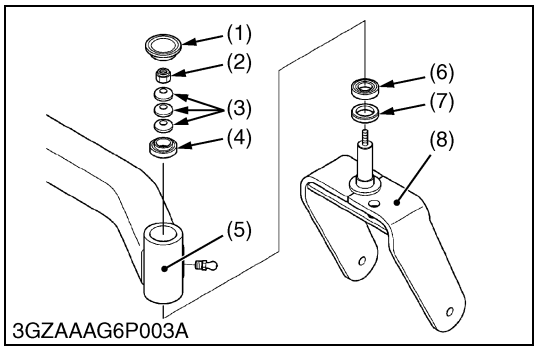

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### Remove the Wheel Bracket

1. Remove the cap (1).
2. Remove the locking nut (2) and wheel bracket (8).
3. Inspect all parts for wear or damage. Replace the parts as needed.

**(When reassembling)**

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

| | | |
|---|---|---|
| Tightening torque | Locking nut tightening torque | 45 to 55 N·m<br>4.6 to 5.6 kgf·m<br>34 to 40 lbf·ft |

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

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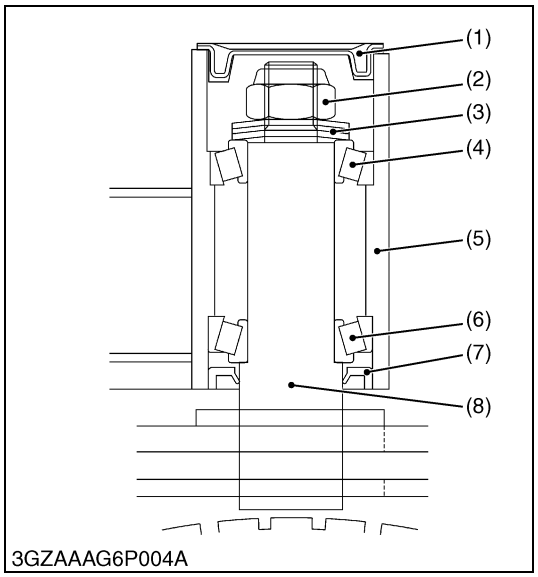

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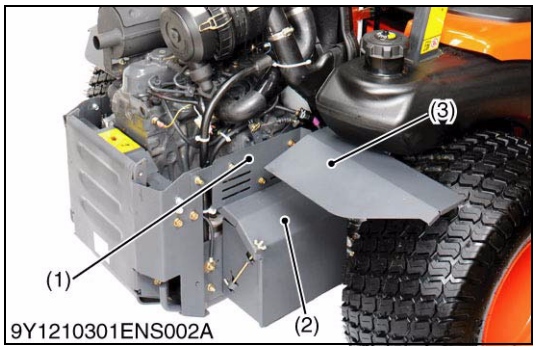
# (2) Separating Front Axle Assembly




## Battery Cover

1. Remove the side covers L, R (1) and the rear fenders L, R (3).
2. Remove the battery cover (2).

(1) Side Cover
(2) Battery Cover
(3) Rear Fender

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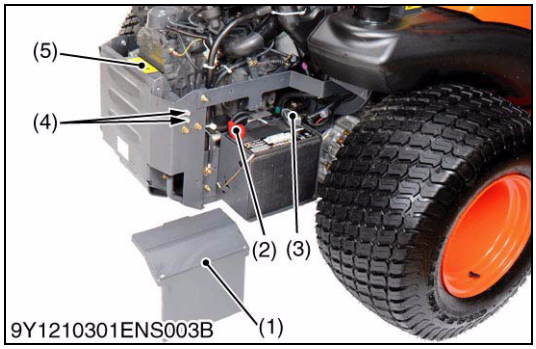


## Battery and Flywheel Cover

**CAUTION**

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

1. Disconnect the negative cable (3) from the battery.
2. Disconnect the positive cable (2) from the battery.
3. Remove the bolts (4) and flywheel cover (5).

(1) Battery Cover
(2) Positive Cable
(3) Negative Cable
(4) Bolt
(5) Flywheel Cover

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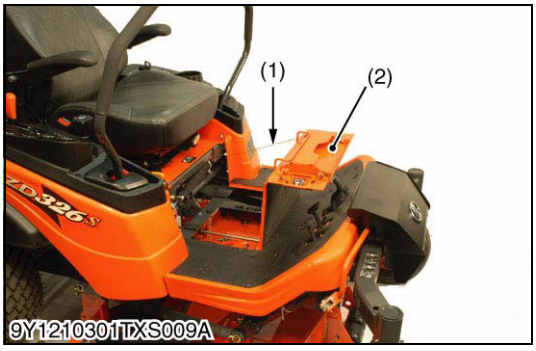


## Step Center and Step

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

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

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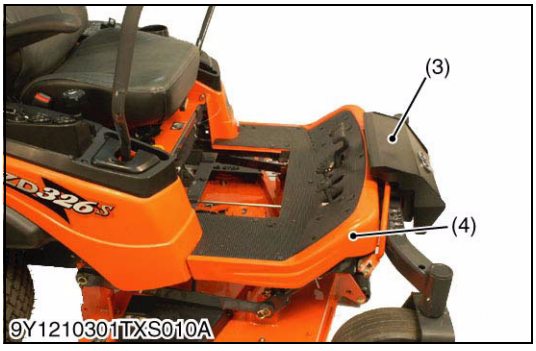

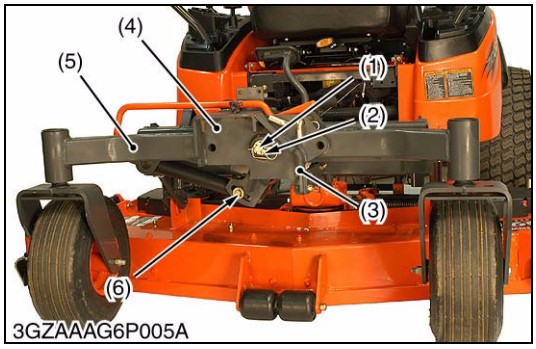

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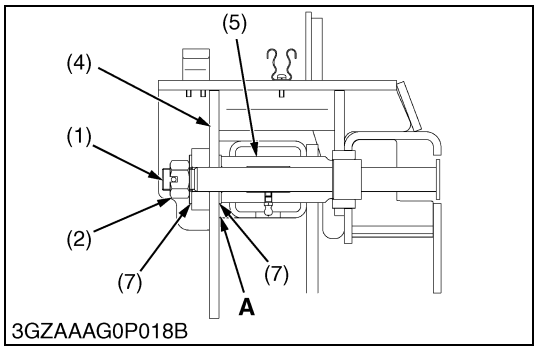

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## Separating Front Axle Assembly

1. Remove the set spring and slotted nut (2).
2. Remove the cotter pin and clevis pin (6).
3. Remove the connecting plate (3).
4. Lift up and secure with jack stands or blocking the front of machine frame.
5. Remove the center pin (1), and separate the front axle assembly (5).

**(When reassembling)**

■ **NOTE**

- **Do not hit the center pin.**
- **After assembling the front axle assembly, be sure check the front axle end play "A". If the measurement is not within the factory specifications, adjust the front axle end play "A".**

| | | |
|---|---|---|
| Tightening torque | Center pin lock nut (slotted nut) | 40 to 80 N·m<br>4.1 to 8.1 kgf·m<br>30 to 59 lbf·ft |
| | Connecting plate mounting screw | 48 to 55 N·m<br>4.9 to 5.7 kgf·m<br>36 to 41 lbf·ft |

| | | |
|---|---|---|
| Front Axle End Play | Factory specification | 0 to 0.2 mm<br>0 to 0.008 in. |

(1) Center Pin
(2) Center Pin Lock Nut (Slotted Nut)
(3) Connecting Plate
(4) Front Axle Support
(5) Front Axle Assembly
(6) Clevis Pin
(7) Plain Washer

**A: Front Axle End Play**

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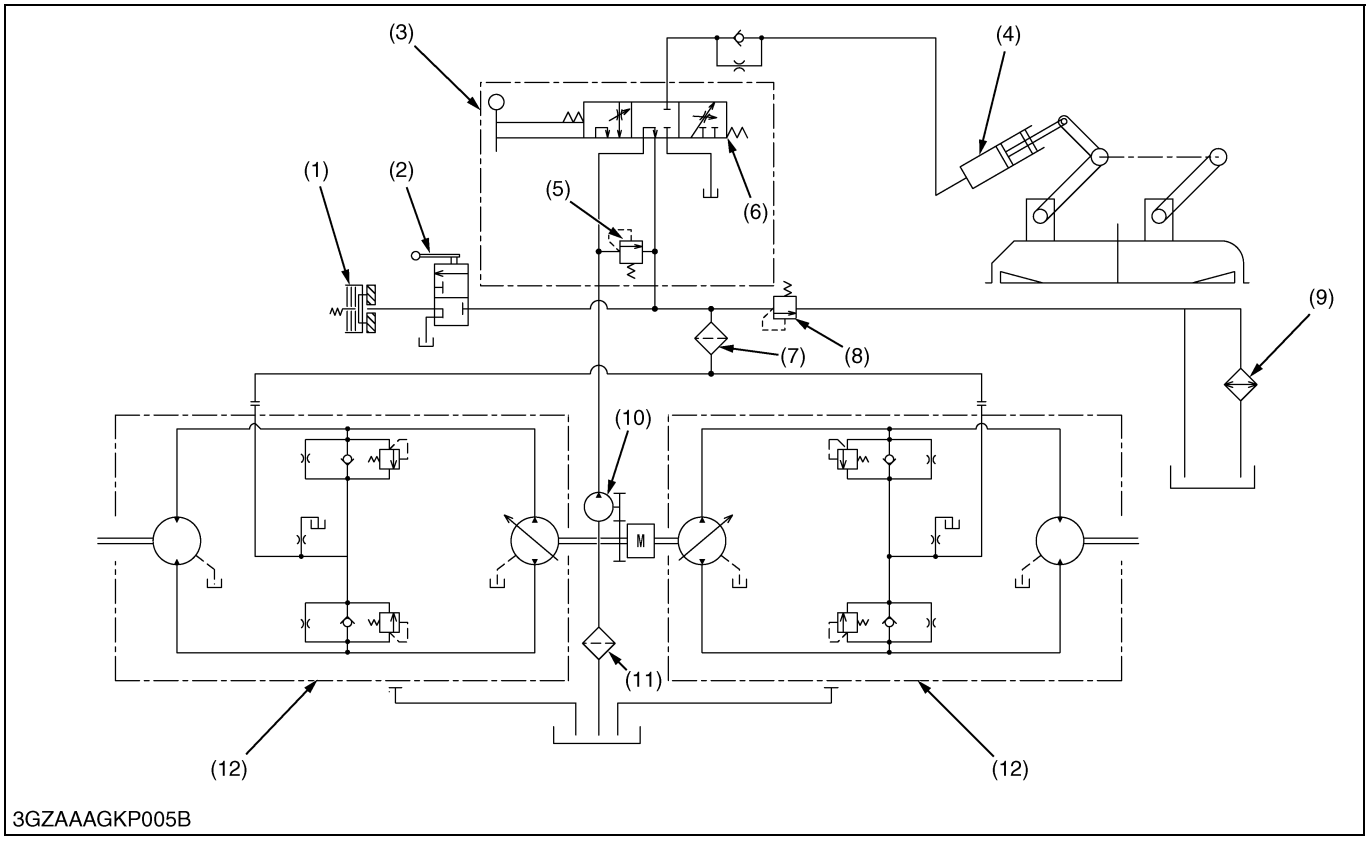
# 4 HYDRAULIC SYSTEM

# MECHANISM

## CONTENTS

# 1. HYDRAULIC CIRCUIT

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(1) PTO Clutch
(2) PTO Clutch Valve
(3) Hydraulic Control Valve Assembly
(4) Hydraulic Cylinder
(5) Relief Valve
(6) Control Valve
(7) TM Oil Filter (HST)
(8) Regulator Valve
(9) Oil Cooler
(10) Hydraulic Pump
(11) Hydraulic Oil Filter
(12) Hydrostatic Transmission

The hydraulic system of this machine consists of a hydraulic pump (10), control valve (6), hydraulic cylinder (4) and other components.

This system has the following functions.

Hydraulic pump (10) supplies oil to hydraulic cylinder (4), PTO clutch (1) and HST (12).

Power from the input shaft (pump shaft) is distributed to 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 (6). On the other hand, oil is regulated by the regulator valve (8) to constant pressure and is sent to the hydrostatic transmission (12) and PTO clutch (1).

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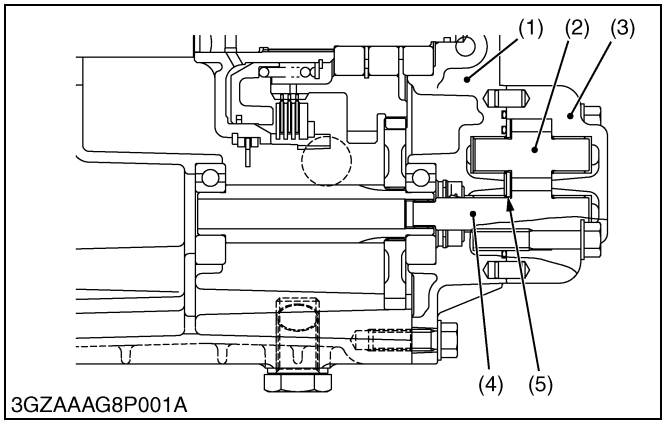
# 2. HYDRAULIC PUMP



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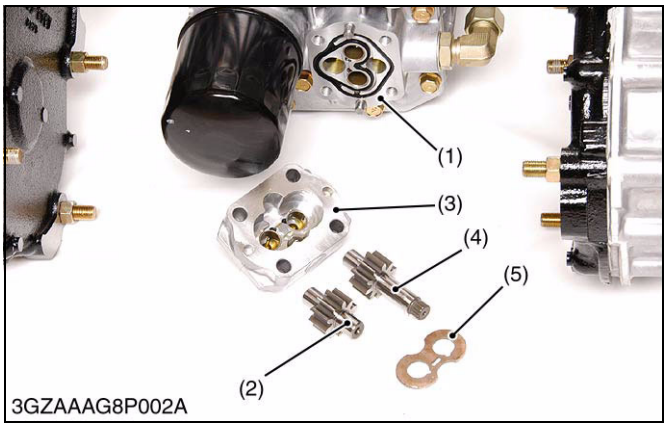

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The hydraulic pump consists of the casing (1), cover (3), side plate (5), and two spur gears (drive gear (4) and driven gear (2)) that are in mesh.

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

Maximum displacement is as follows.

| Displacement | Engine speed | Condition |
|---|---|---|
| 21.0 L/min.<br>5.5 U.S.gals/min.<br>4.6 Imp.gals/min. | At 3200 $min^{-1}$ (rpm) | at no load |

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

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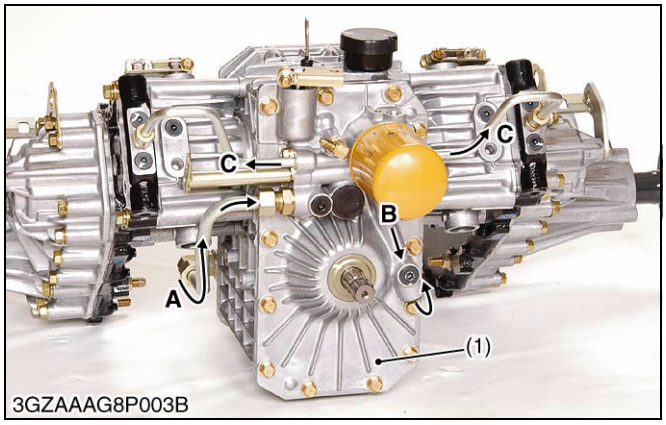
# 3. HYDRAULIC CONTROL VALVE



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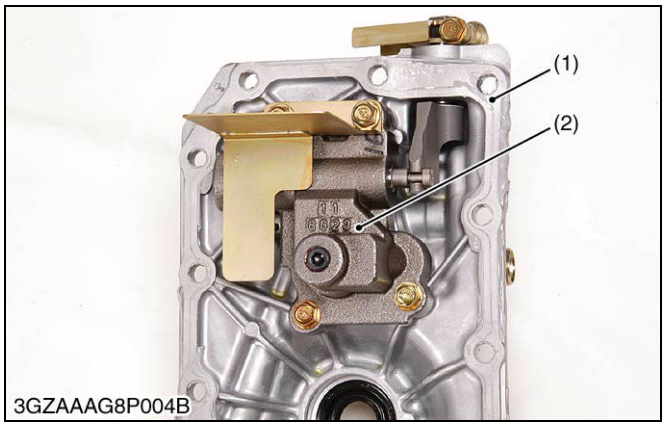

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The hydraulic system consists of the transmission center case (oil tank), cushion oil filter, hydraulic pump, control valve, hydraulic cylinder and etc..

The new series product is provided with a built-in control valve (2) in the center cover (1).

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) Center Cover
(2) Control Valve

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

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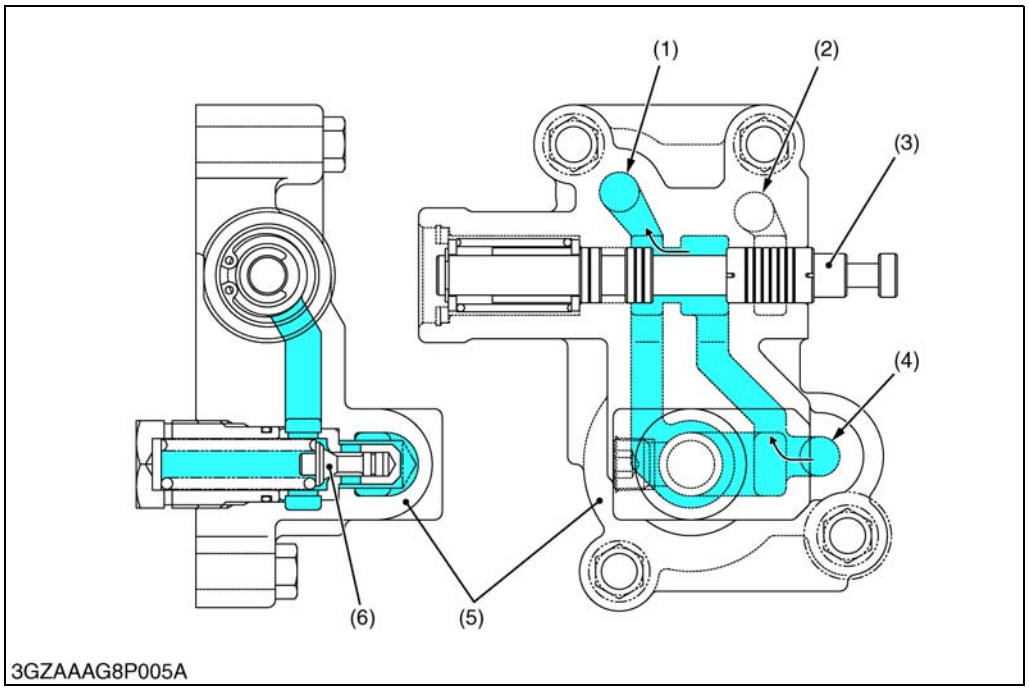
# [1] OPERATION

## 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).

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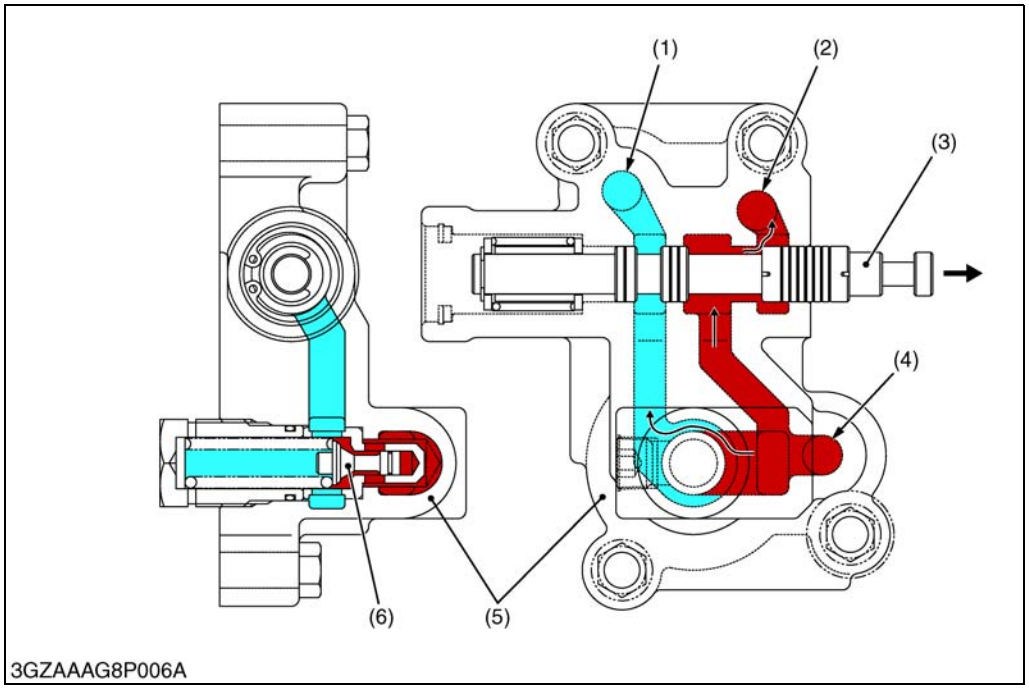
## Lift and Overloaded




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

**(Reference)**

- Relief valve setting pressure
  5.5 to 7.0 MPa (56 to 71 kgf/cm$^2$, 800 to 1000 psi)
- Engine speed
  1800 min$^{-1}$ (rpm)

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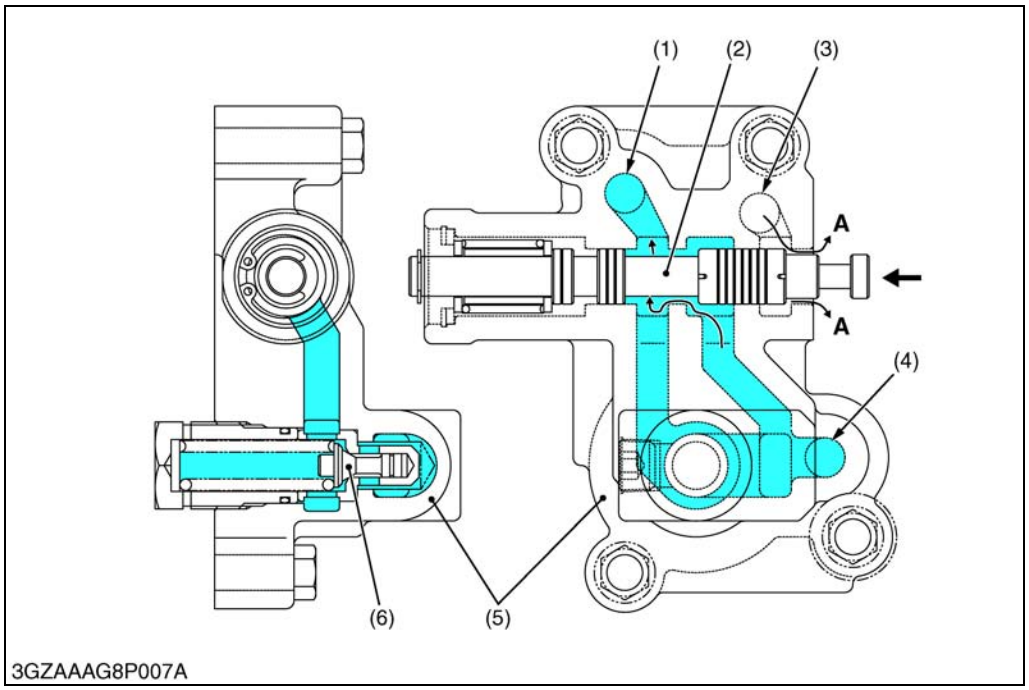
**Down**

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

**A: Drain directly to the Transmission Center Case**

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

The mower-lifting cylinder circuit, which has been interrupted by the spool, is returned to the transmission center case by the pressed-in spool, and a new circuit if formed.

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

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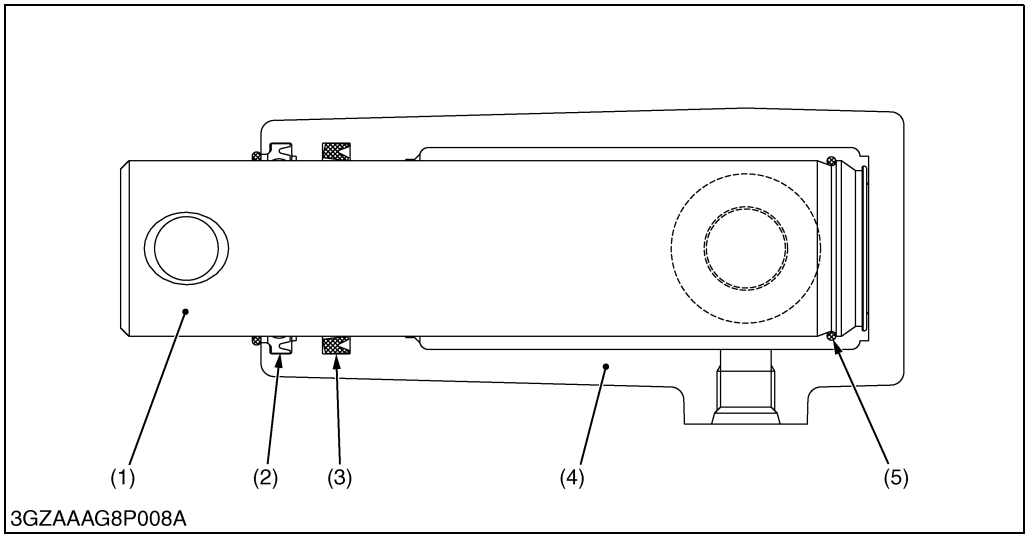
# 4. LIFT CYLINDER



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(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.

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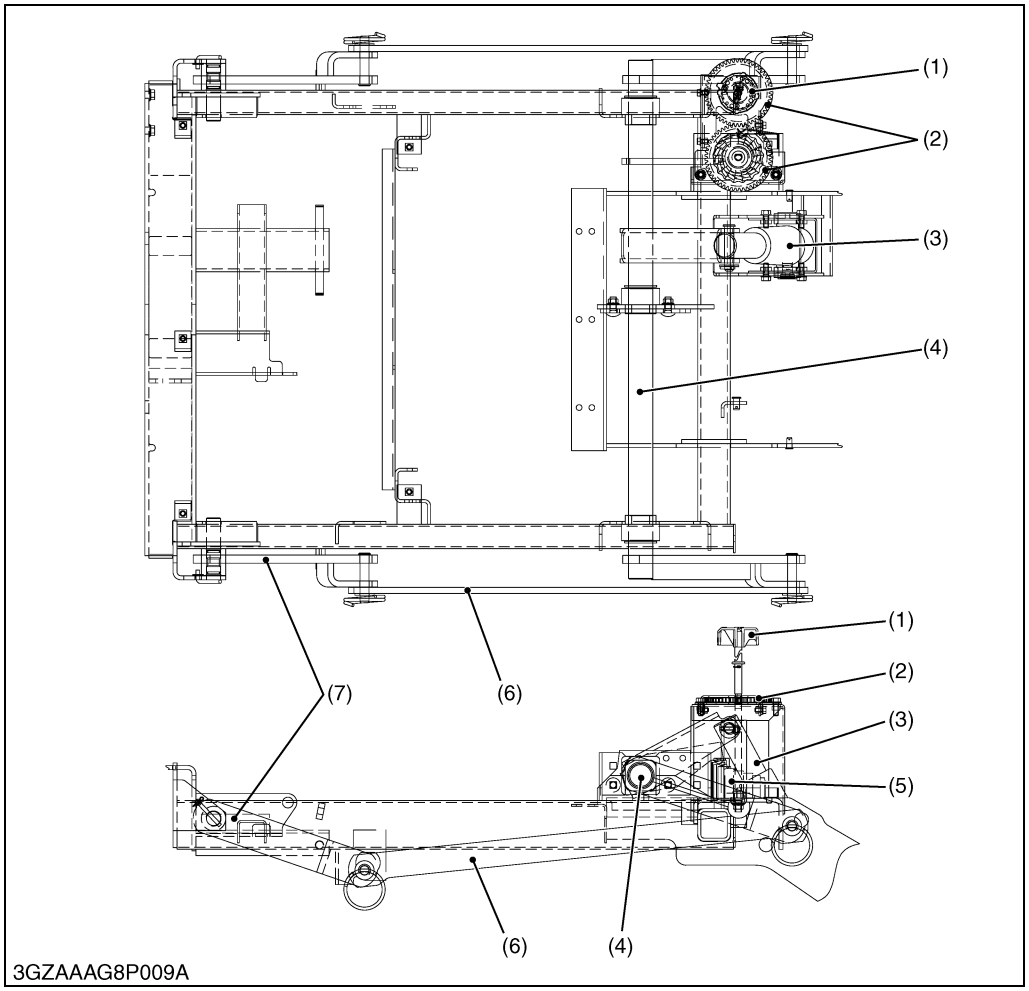
# 5. MOWER LINKAGE



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(1) Cutting Height Adjusting Dial
(2) Dial Cam Gear
(3) Lift Cylinder
(4) Lift Shaft
(5) Adjusting Cam
(6) Horizon Plate
(7) Front Arm

The lifting of mower is controlled by the hydraulic system on the machine.

Front arm (7) and lift shaft (4) are linked with horizon plate (6). When the position control lever is moved to **"LIFT"** position, the horizon plate (6) 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 the cutting height of mower by rotating the adjusting cam (5).

**CAUTION**

- **Never operate mower in transport position.**

9Y1210301HYM0008US0

# SERVICING

## CONTENTS

# 1. TROUBLESHOOTING

| Symptom | Probable Cause | Solution | Reference Page |
|---|---|---|---|
| **Mower Does Not Rise** | Control valve malfunctioning | Repair or replace | 4-S4, 4-S7 |
| | Lift cylinder damaged | Replace | 4-S15 |
| | Relief valve spring damaged | Replace | 4-S7 |
| | Relief valve setting pressure too low | Adjust | 4-S4 |
| | Hydraulic pump defective | Replace | 4-S9, 4-S13, 4-S14 |
| | Oil filter clogged | Clean or replace | G-33 |
| | Suction pipe loosened or broken | Repair or replace | – |
| | Insufficient transmission oil | Refill | G-9 |
| **Mower Does Not Lower** | Control valve malfunctioning | Repair or replace | 4-S4, 4-S7 |
| **Mower Drops by Its Weight** | Lift cylinder worn or damaged | Replace | 4-S15 |
| | Control valve malfunctioning | Replace | 4-S4, 4-S7 |

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# 2. SERVICING SPECIFICATIONS

| Item | | Factory Specification | Allowable Limit |
|---|---|---|---|
| Relief Valve (Control Valve) | Setting Pressure [at engine speed 1800 $min^{-1}$ (rpm)] | 5.5 to 7.0 MPa<br>56 to 71 $kgf/cm^2$<br>800 to 1000 psi | – |

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# 3. TIGHTENING TORQUES

Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts: See page G-11.)

| Item | N·m | kgf·m | lbf·ft |
|---|---|---|---|
| Center case front cover mounting screw | 40 to 44 | 4.0 to 4.5 | 29 to 32 |
| Hydraulic control valve mounting screw | 18 to 20 | 1.8 to 2.1 | 13 to 15 |
| Relief valve plug | 49 to 68 | 5.0 to 7.0 | 37 to 50 |
| ROPS connecting plate mounting screw (M8) | 24 to 27 | 2.4 to 2.8 | 18 to 20 |
| ROPS connecting plate, under mounting screw (M10) | 48 to 55 | 4.9 to 5.7 | 36 to 41 |
| Hydraulic pump mounting screw | 40 to 44 | 4.0 to 4.5 | 29 to 32 |
| Cover mounting screw | 35 to 39 | 3.5 to 4.0 | 26 to 28 |
| Universal joint mounting screw | 26.5 to 28.4 | 2.7 to 2.9 | 19.6 to 20.9 |
| Engine mounting nut | 24 to 27 | 2.4 to 2.8 | 18 to 20 |

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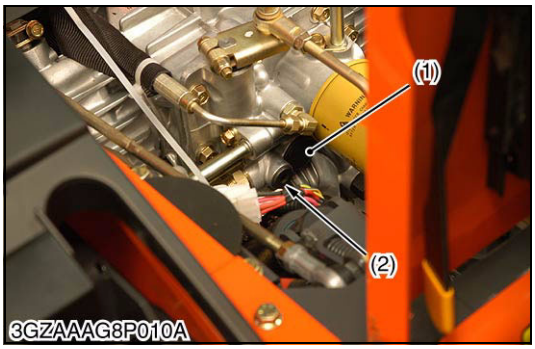
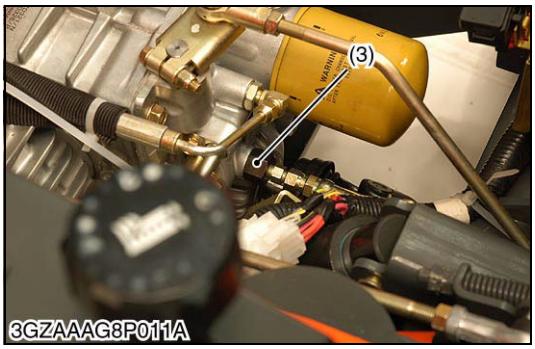
# 4. CHECKING, DISASSEMBLING AND SERVICING

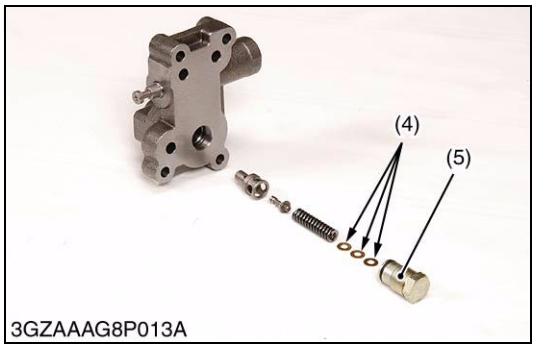
## [1] HYDRAULIC CONTROL VALVE, PUMP AND CYLINDER

### (1) Checking and Adjusting








**Relief Valve Setting Pressure**

1. Remove the plug (2) from the front cover of transmission center case.
2. Install the adaptor (3/8 in., straight thread), cable and pressure gauge.
3. Start the engine and set at maximum speed.
4. Move the control pedal to **"LIFT"** position to operate the relief valve and read the gauge.
5. If the pressure is not within the factory specifications, adjust with the adjusting shims (4).

**(Adjusting procedure)**

- Remove the plug (1), and remove the plug (5) of relief valve. Then, adjust the thickness of shims.

| | | |
|---|---|---|
| Relief valve setting pressure | Factory specification | 5.5 to 7.0 MPa<br>56 to 71 kgf/cm$^2$<br>800 to 1000 psi |

**Condition**

- Engine speed
  1800 min$^{-1}$ (rpm)
- Oil temperature
  45 to 55 °C (113 to 131 °F)

**(Reference)**

- Replace the hydraulic pump if pressure does not rise in 5 MPa (50 kgf/cm$^2$, 700 psi) or more.
- Thickness of shims (4):
  0.2 mm (0.0079 in.)
  0.3 mm (0.0118 in.)
  0.8 mm (0.0315 in.)

(1) Plug
(2) Plug (3/8 in., straight thread)
(3) Adaptor
(4) Shim
(5) Plug

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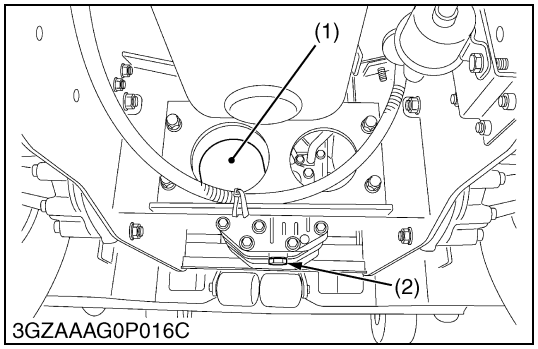
# (2) Disassembling and Assembling the Hydraulic Control Valve



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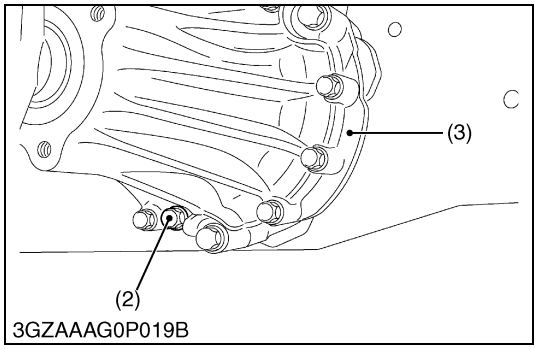

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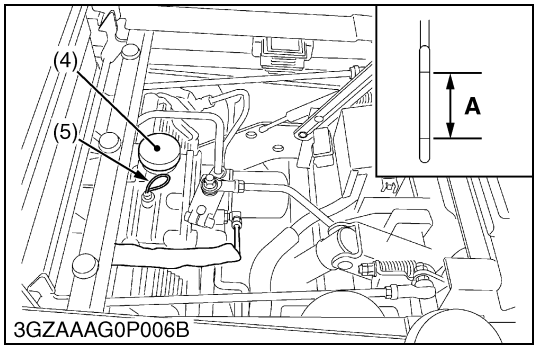

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**Draining Transmission Fluid**

**CAUTION**

**To avoid personal injury:**

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

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

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

**IMPORTANT**

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

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

**IMPORTANT**

- **Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.**
  **Keep the engine at medium speed for a few minutes to insure proper lubrication of all parts so there is no damage to transmission.**
- **Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system.**
  **Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-9.)**
- **Do not mix different brands oil together.**

| | |
|---|---|
| Transmission fluid capacity | 12.1 L<br>12.8 U.S.qts<br>10.6 Imp.qts |

(1) Hydraulic 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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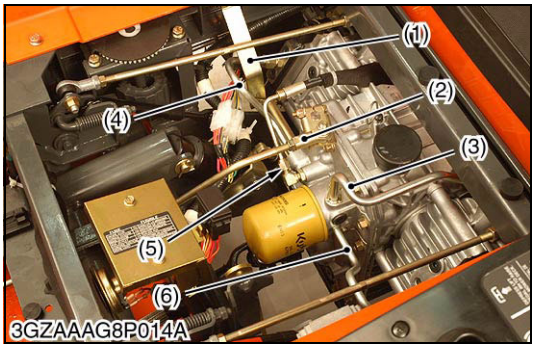



## PTO Clutch Link, Cylinder Hose, Oil Cooler Pipe and HST Charge Pipes

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 delivery pipe (5).

**(When reassembling)**

- Take care not to damage O-ring on the pipes.

(1) PTO Clutch Link
(2) Lift Rod
(3) Oil Cooler Pipe
(4) HST Pipe
(5) Delivery Pipe
(6) HST Pipe

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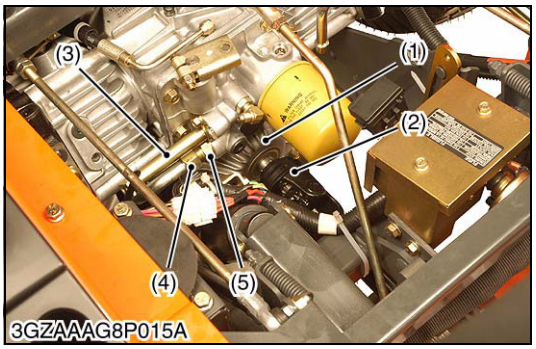


## PTO Clutch Lever, Delivery Pipe, Pipe Fitting, Universal Joint and PTO Shaft Oil Seal

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

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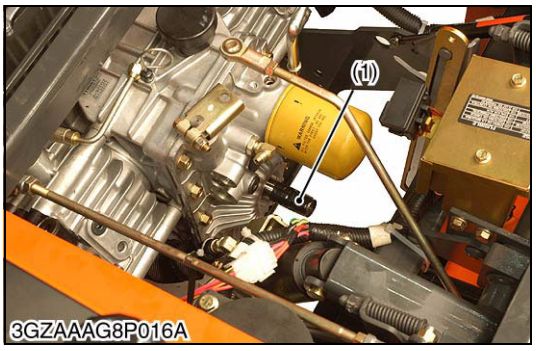


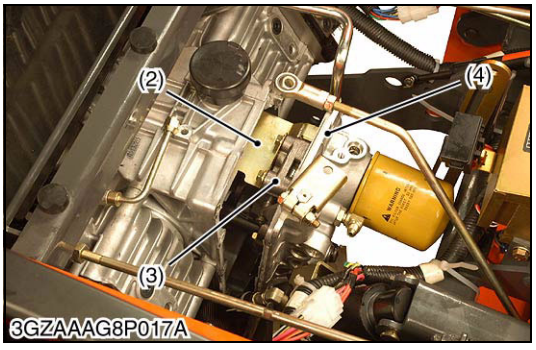


## Center Case Front Cover Assembly

1. Wrap the tape (1) around the PTO shaft to prevent it from damaging internally of the center case front cover.
2. Remove the center case front cover mounting screw, and separate the center case and center case front cover.
3. Remove the plate (2) from hydraulic control valve (3).
4. Remove the center case front cover assembly (4).

**(When reassembling)**

■ **NOTE**

- **Assemble the plate (2) as shown in the photo. If the plate (2) is mounted onto the valve first, the front cover (4) cannot be mounted onto the transmission center case.**
- **Apply liquid gasket (Three Bond 1208D or equivalent) to joint face of center case and center case front cover.**

| | | |
|---|---|---|
| Tightening torque | Center case front cover mounting screw | 40 to 44 N·m<br>4.0 to 4.5 kgf·m<br>29 to 32 lbf·ft |

(1) Tape
(2) Plate
(3) Hydraulic Control Valve
(4) Front Cover Assembly

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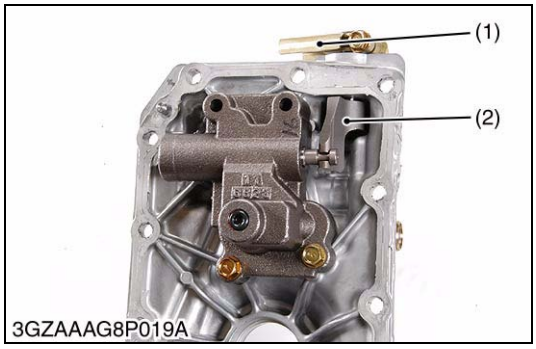


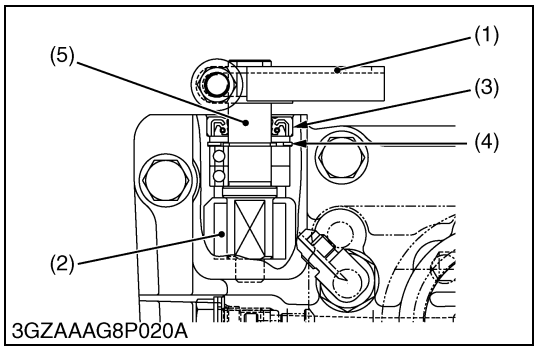


## Lift Shaft and Arm

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

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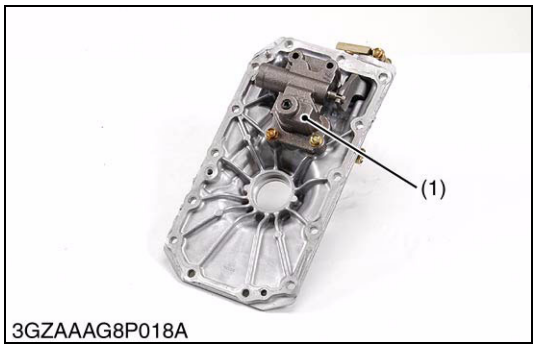


## Removing Hydraulic Control Valve

1. Remove the hydraulic control valve (1).

**(When reassembling)**

| | | |
|---|---|---|
| Tightening torque | Hydraulic control valve mounting screw | 18 to 20 N·m<br>1.8 to 2.1 kgf·m<br>13 to 15 lbf·ft |

(1) Hydraulic Control Valve

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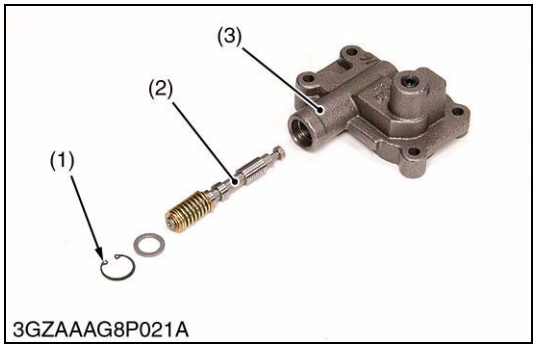


## Spool

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

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

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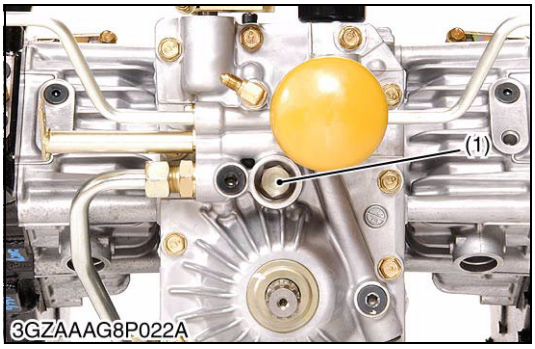


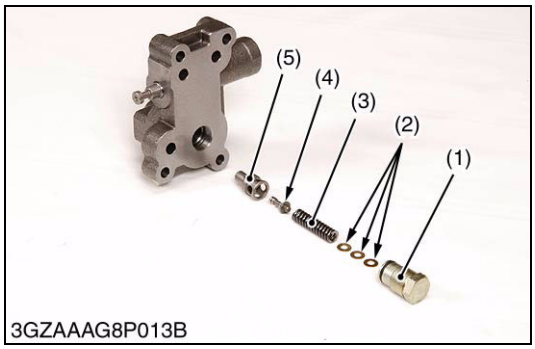


## Relief Valve

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

**(When reassembling)**

- Take care not to damage the O-ring on plug.

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

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

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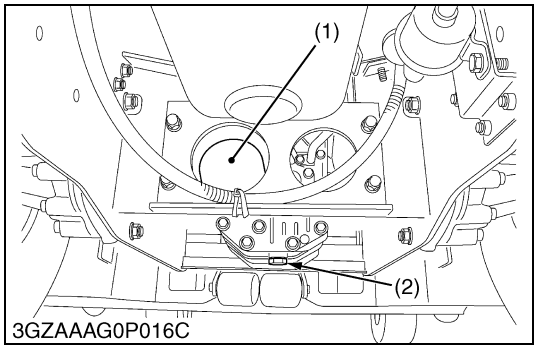
# (3) Disassembling and Assembling the Hydraulic Pump



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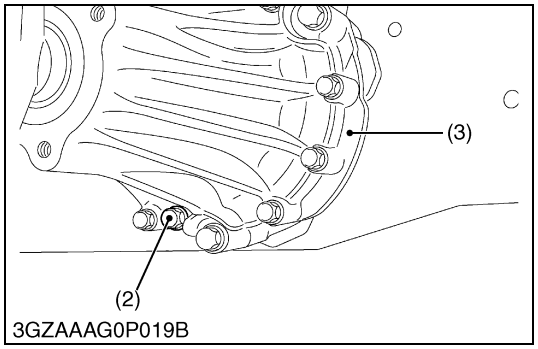

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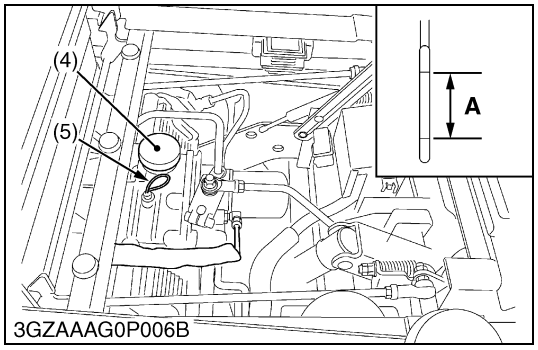

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## Draining Transmission Fluid

**CAUTION**

**To avoid personal injury:**

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

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

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

**IMPORTANT**

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

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

**IMPORTANT**

- **Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.**
  **Keep the engine at medium speed for a few minutes to insure proper lubrication of all parts so there is no damage to transmission.**
- **Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system.**
  **Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-9.)**
- **Do not mix different brands oil together.**

| | |
|---|---|
| Transmission fluid capacity | 12.1 L<br>12.8 U.S.qts<br>10.6 Imp.qts |

(1) Hydraulic 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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9Y1210301ENS001A

## Bonnet

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

(1) Bonnet

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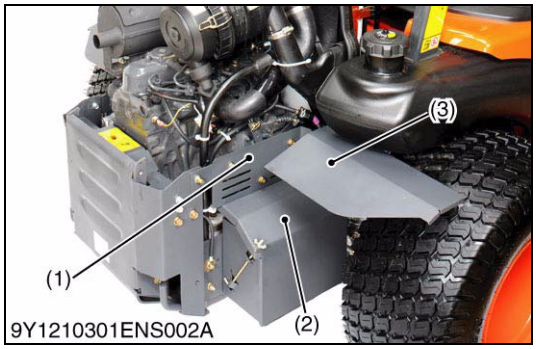


## Battery Cover

1. Remove the side covers L, R (1) and the rear fenders L, R (3).
2. Remove the battery cover (2).

(1) Side cover
(2) Battery cover
(3) Rear Fender

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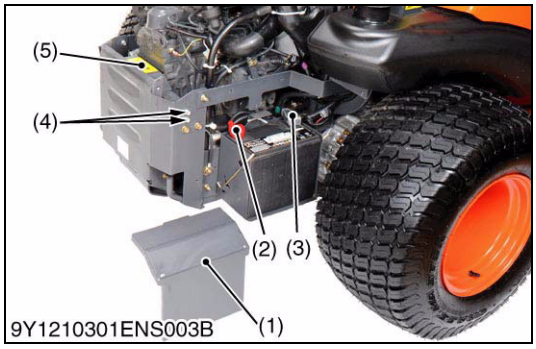


## Battery and Flywheel Cover

**CAUTION**

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

1. Disconnect the negative cable (3) from the battery.
2. Disconnect the positive cable (2) from the battery.
3. Remove the bolts (4) and flywheel cover (5).

(1) Battery Cover
(2) Positive Cable
(3) Negative Cable
(4) Bolt
(5) Flywheel Cover

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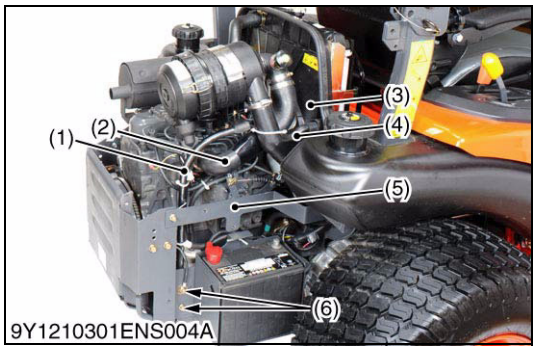


## Air Cleaner

1. Remove the side cover stays L, R (5).
2. Remove the bolts (6) for air cleaner support (1).
3. Disconnect the inlet hose (2) from engine.
4. Pull out the intake pipe (4) from the shroud (3).
5. Remove the air cleaner.

(1) Air Cleaner Support
(2) Inlet Hose
(3) Shroud
(4) Intake Pipe
(5) Side Cover Stay
(6) Bolts

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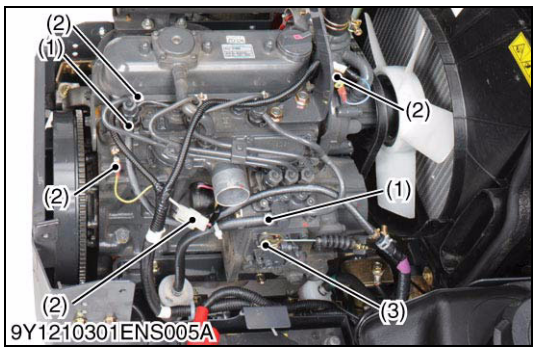


## Electric Wiring and Fuel Hoses

1. Disconnect the wiring connectors (2) for engine stop solenoid, glow plug, coolant temperature sensor, and coolant temperature switch.
2. Disconnect the accelerator wire (3).
3. Disconnect the fuel hoses (1) from engine.

**(When reassembling)**

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

(1) Fuel Hose
(2) Wiring Connectors
(3) Accelerator Wire (Throttle Cable)

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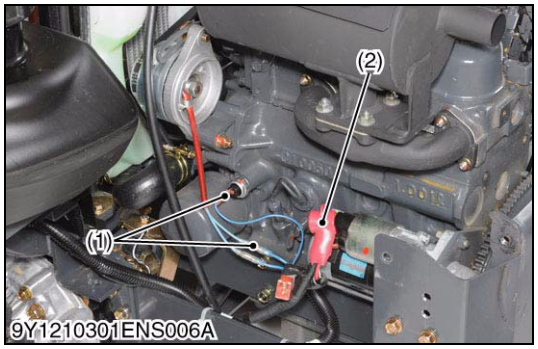


## Electric Wiring

1. Disconnect the wiring connectors (1) for dynamo and engine oil pressure switch.
2. Remove the positive cable (2) from the starter motor.

(1) Wiring Connectors
(2) Positive Cable

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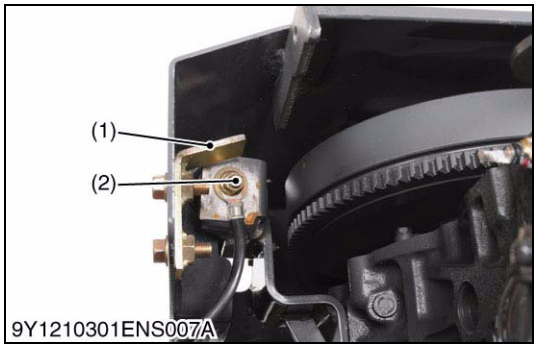


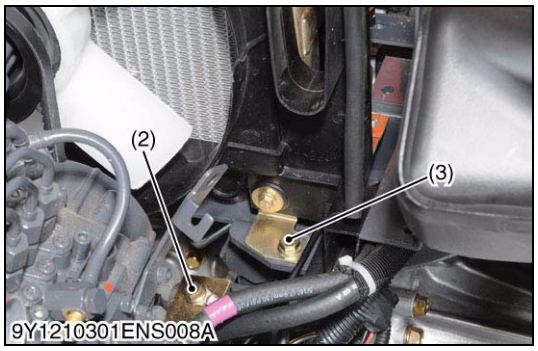


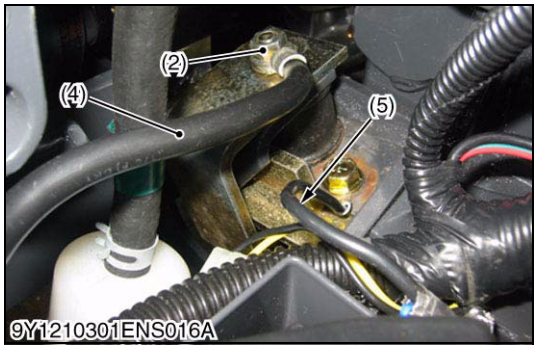


## Engine Stopper and Mounting Nuts

1. Remove the engine stoppers (1).
2. Remove the engine mounting nuts (2).
3. Remove the bolts (3) for shroud.

**(When reassembling)**

- To get a good contact of the ground, attach the ground wire (5) to the specified position (separate position from that of the battery negative cable (4)). (Right side front only)

(1) Engine Stopper
(2) Engine Mounting Nut
(3) Bolt
(4) Battery Negative Cable
(5) Ground Wire

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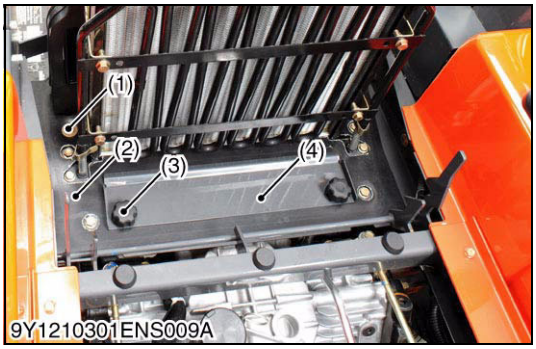



## Plate

1. Raise the seat.
2. Remove the knobs (3) and the plate (4).
3. Remove the 2 bolts (1) and the rubber sheet (2).
4. Remove the plate (5).

(1) Bolt
(2) Rubber Sheet
(3) Knob
(4) Plate
(5) Plate

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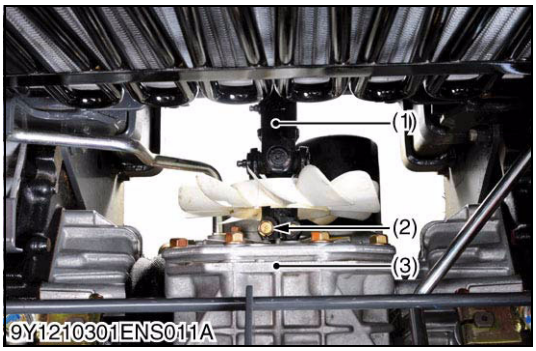


## Universal Joint

1. Remove the 2 bolts (2).
2. Lift up the engine and separate the universal joint (1) from transmission (3).

**(When reassembling)**

- Apply grease to the all splines on the drive shaft.
- Set the engine on the rubber cushion. Before fastening the engine mounting nuts, connect the universal joint.
- Make sure to align all the grease nipples. Only this one position meets the spline.

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


(1) Universal Joint
(2) Bolt
(3) Transmission
(4) Grease Nipple

**A: Fixed to the fan drive pulley.**

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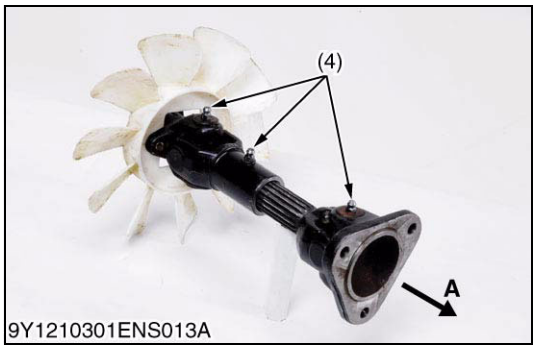

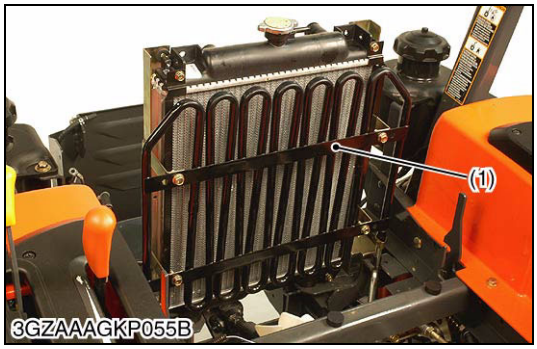


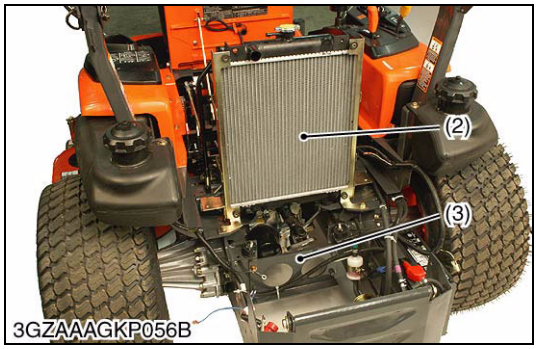


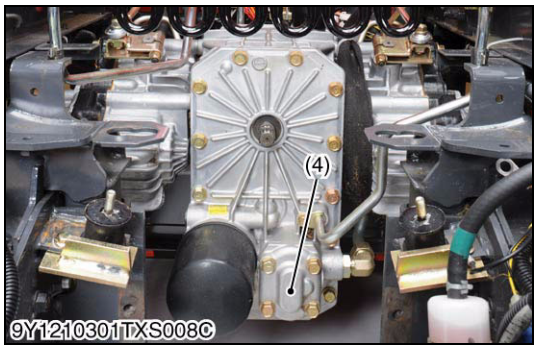


## Oil Cooler, Radiator and Removing Hydraulic Pump

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

**(When reassembling)**

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

(1) Oil Cooler
(2) Radiator
(3) ROPS Connecting Plate, Under
(4) Hydraulic Pump

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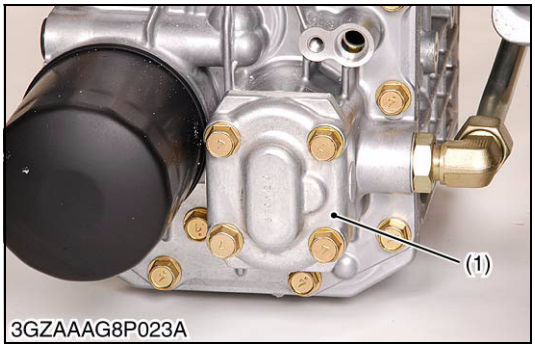


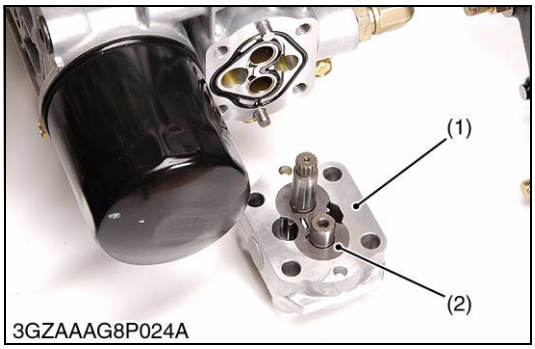


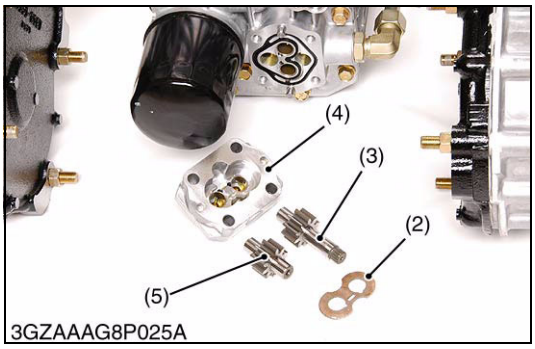


## Hydraulic Pump

1. Remove the hydraulic pump assembly (1).
2. Remove the side plate (2).
3. Remove the drive gear (3) and the driven gear (5) from the casing (4).

**(When reassembling)**

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

| | | |
|---|---|---|
| Tightening torque | Cover mounting screw | 35 to 39 N·m<br>3.5 to 4.0 kgf·m<br>26 to 28 lbf·ft |

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

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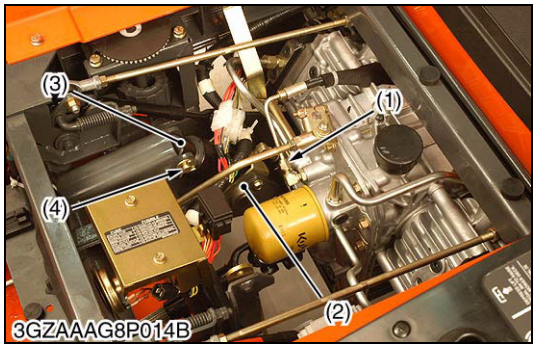
# [2] LIFTING LINKAGE

## (1) Disassembling and Assembling




### Removing Lift Cylinder

1. Disconnect the cylinder hose (1).
2. Remove the clevis pin (4).
3. Remove the cylinder bracket (2), and remove the bushings.
4. Remove the lift cylinder (3) with cylinder hose (1).

(1) Cylinder Hose
(2) Cylinder Bracket
(3) Lift Cylinder
(4) Clevis Pin

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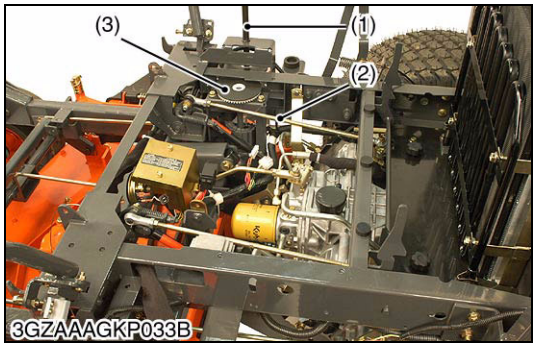


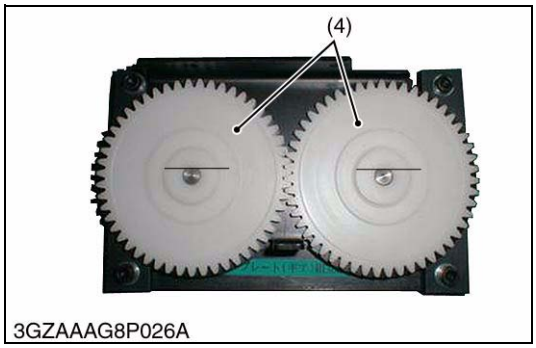

### Dial Cam Gear

1. Remove the cam rod (1).
2. Remove the dial cam gear assembly (2).
3. Remove the gear cover (3).
4. Remove the dial cam gears (4).

**(When reassembling)**

■ **NOTE**

- **When assembling the dial cam gear, align the gear notch as shown in photo.**




(1) Cam Rod
(2) Cam Gear Assembly
(3) Gear Cover
(4) Dial Cam Gear

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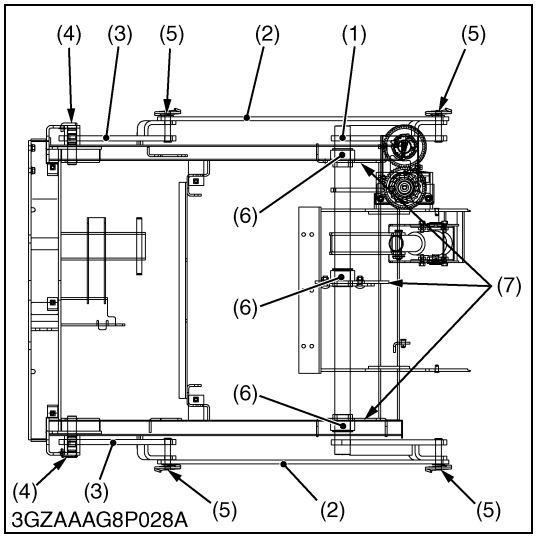

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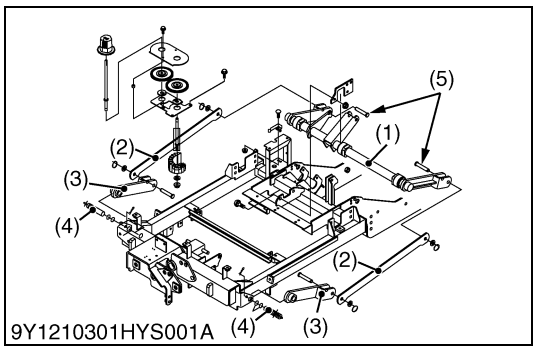

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**Mower Linkage**

1. Remove the clevis pins (5) and horizon plate (2).
2. Remove the front pin (4) and front arm (3).
3. Remove the clevis pin, and disconnect the lift shaft (1) and lift cylinder.
4. Remove the plates (7) and lift shaft (1) with bushings (6).

**(When reassembling)**

- Apply grease to front pins (4).

(1) Lift Shaft
(2) Horizon Plate
(3) Front Arm
(4) Front Pin
(5) Clevis Pin
(6) Bushing
(7) Plate

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# 5 ELECTRICAL SYSTEM

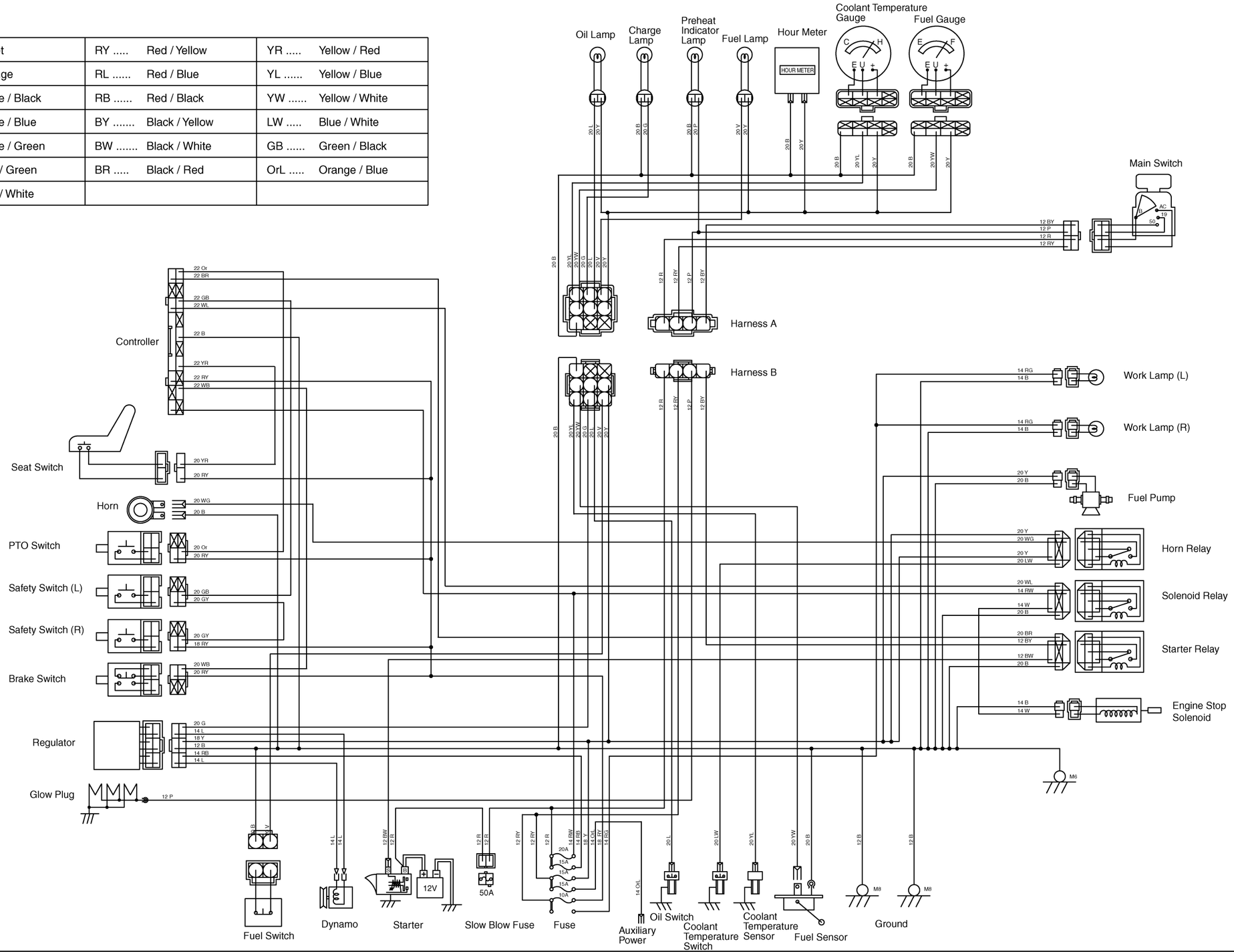
# MECHANISM

## CONTENTS

# 1. WIRING DIAGRAM

Color of Wiring

| | | | |
|---|---|---|---|
| W .....White | V ..... Violet | RY ..... Red / Yellow | YR ..... Yellow / Red |
| R ..... Red | Or ..... Orange | RL ..... Red / Blue | YL ..... Yellow / Blue |
| L ..... Blue | WB ..... White / Black | RB ..... Red / Black | YW ..... Yellow / White |
| P ..... Pink | WL ..... White / Blue | BY ..... Black / Yellow | LW ..... Blue / White |
| B ..... Black | WG ..... White / Green | BW ..... Black / White | GB ..... Green / Black |
| G ..... Green | RG ..... Red / Green | BR ..... Black / Red | OrL ..... Orange / Blue |
| Y ..... Yellow | RW ..... Red / White | | |

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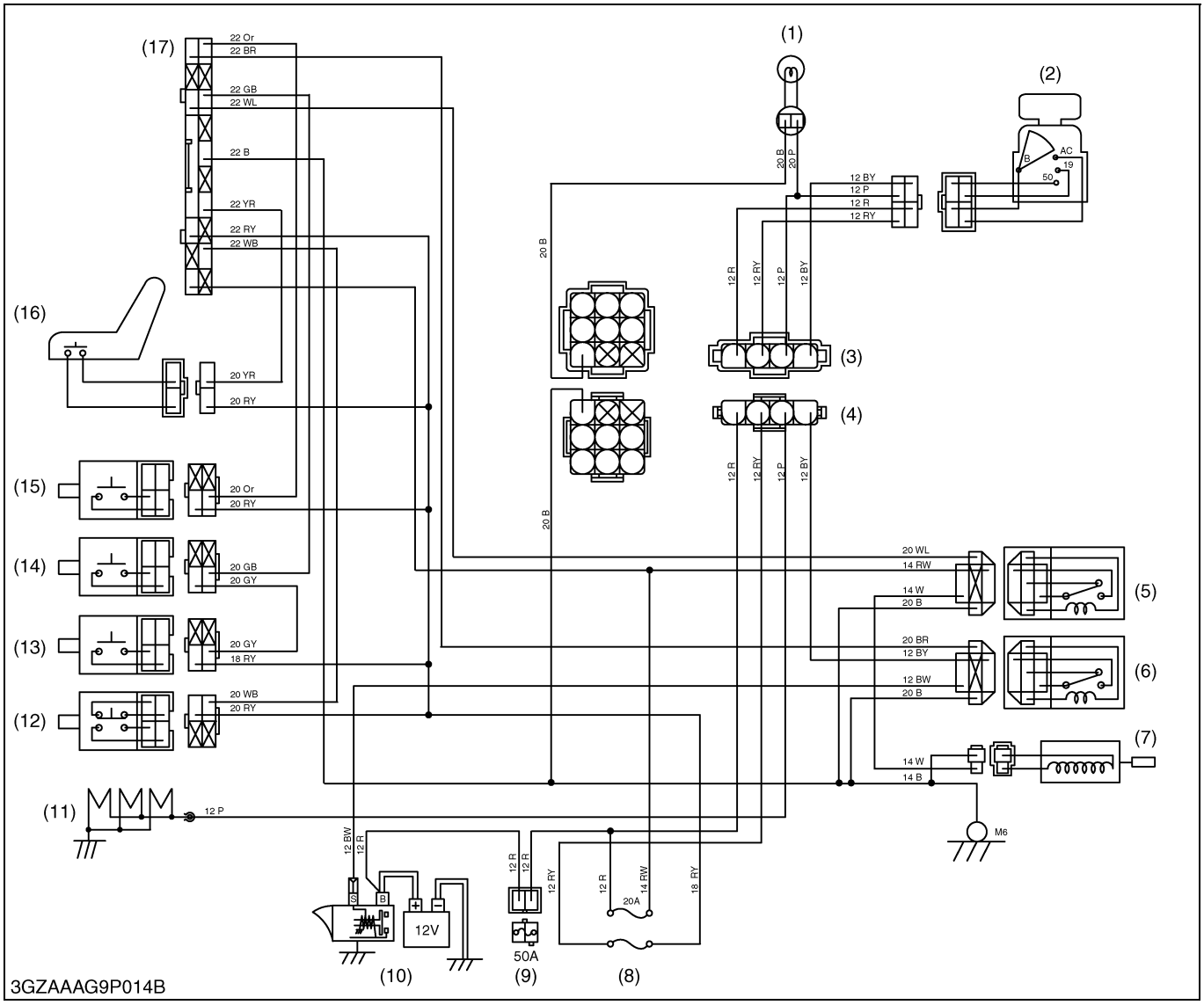
# 2. STARTING SYSTEM

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(1) Preheat Indicator Lamp
(2) Main Switch
(3) Harness A
(4) Harness B
(5) Solenoid Relay
(6) Starter Relay
(7) Engine Stop Solenoid
(8) Fuse
(9) Slow Blow Fuse
(10) Starter
(11) Glow Plug
(12) Brake Switch
(13) Safety Switch (RH)
(14) Safety Switch (LH)
(15) PTO Switch
(16) Seat Switch
(17) Controller

When the main switch (2) is turned to the **PREHEAT** position, the terminal **B** is connected to the terminals **19** and **AC**. The glow plugs (11) become red-hot, and the preheat indicator lamp (1) 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 **50** and **AC**. Consequently, battery current flows to the starter motor and start the engine.

The main switch automatically returns to the **ON** position, the terminal **B** is connected only to the terminal **AC**, thereby causing the starting circuit to be opened, stopping the starter motor.

When the main switch turned from the **ON** position to the **OFF** position, the engine stop solenoid (7) moves the fuel injection pump control rack to the **"No Fuel Injection"** position and stop the engine.

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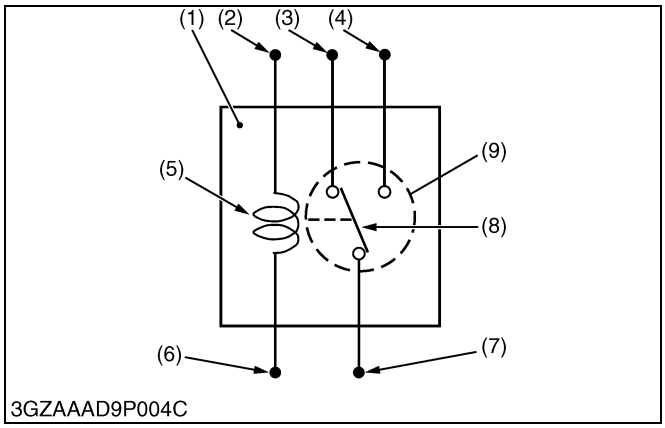
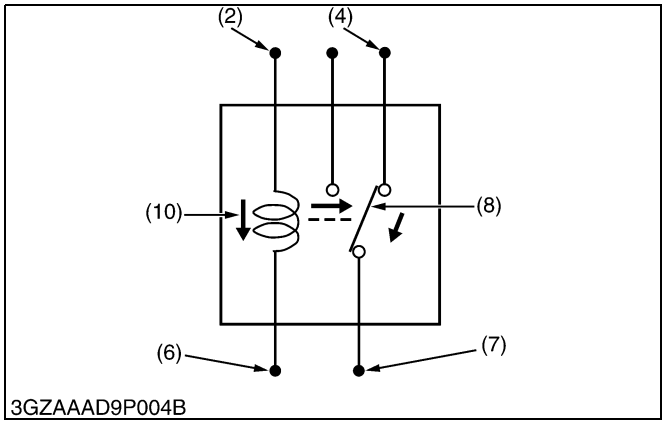
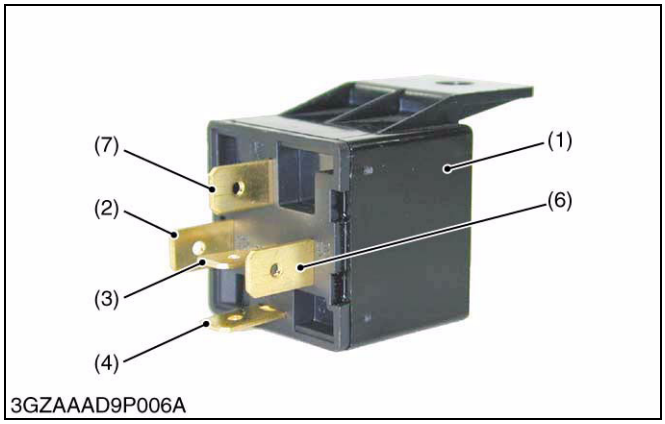
# [1] RELAY



3GZAAAD9P004C



3GZAAAD9P004B



3GZAAAD9P006A

**Solenoid Relay, Starter Relay, Horn Relay**

Relay (1) basically consists of a relay winding (5) and mechanical contact points (9).

A current flowing from switch to relay winding (5) causes **"ON (Close)"** or **"OFF (Open)"** of mechanical contact points (9).

When a current is applied to the winding (energized) (10), a magnetic field pushes the contact lever (8) and normally open terminal is connected.

A function of relay (1) is to control a current in a circuit from a distant place (switch location place).

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

Function of each relay are as follows.

- Relay 1: Relay to horn (overheat alarm relay)
- Relay 2: Relay to start engine (starter relay)
- Relay 3: Relay to stop engine (solenoid relay)

(1) Relay
(2) **85** Terminal
(3) **87a** Terminal
(4) **87** Terminal
(5) Relay Winding
(6) **86** Terminal
(7) **30** Terminal
(8) Contact Lever
(9) Mechanical Contact Points
(10) Winding (Energized)

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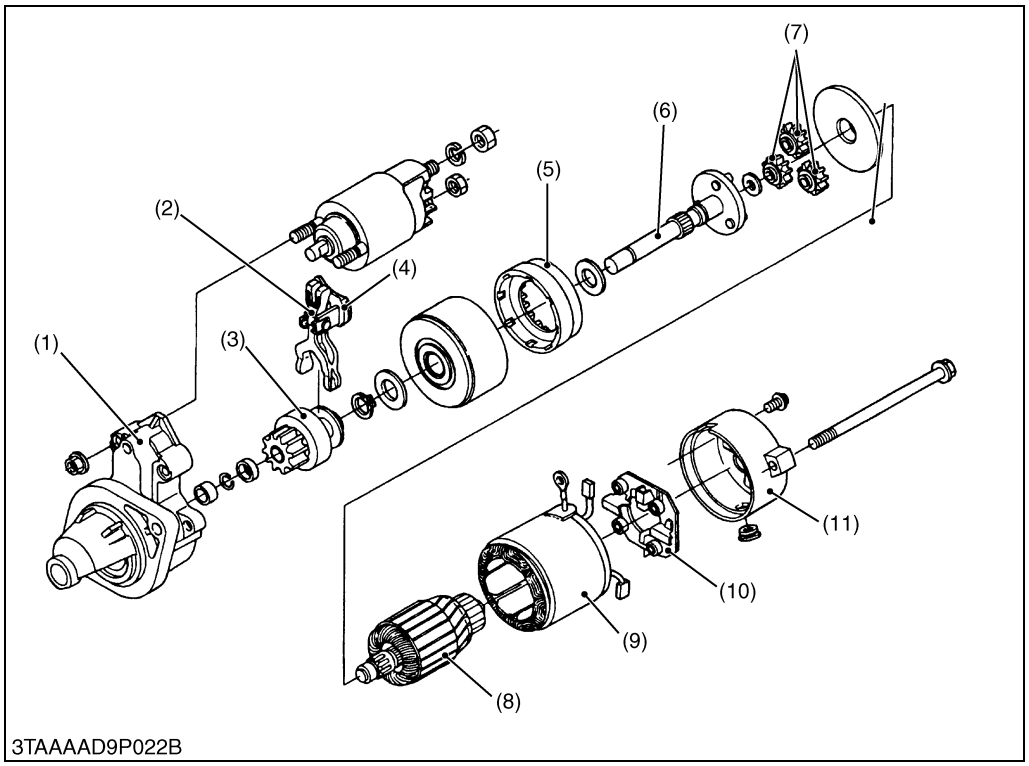
# [2] STARTER




(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

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

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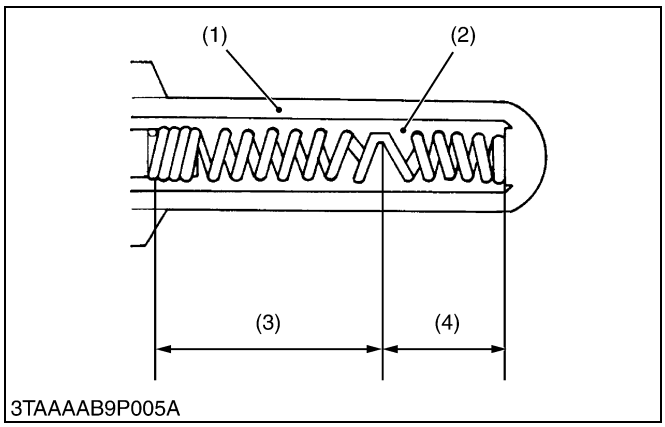
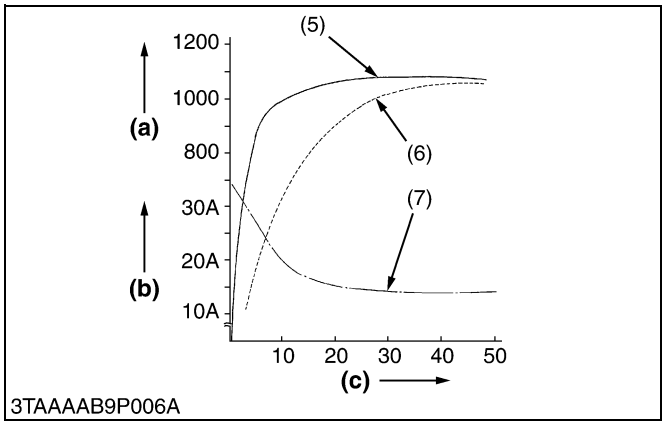
# [3] GLOW PLUG



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 reduces to prevent the heater (4) from being heated.

The ignition point is in the area of 2 to 3 mm (0.079 to 0.118 in.) from the tip of the plug in order to reduce its projection into the combustion chamber.

(1) Sheath Tube
(2) Insulation Powder
(3) Heater also functioning as a Resistor
(4) Heater
(5) Super Glow Plug
(6) Conventional Quick-heating type Glow Plug
(7) Glow Plug Current

**(a) Glow Plug Temperature (°C)**
**(b) Current (A)**
**(c) Time (Sec.)**

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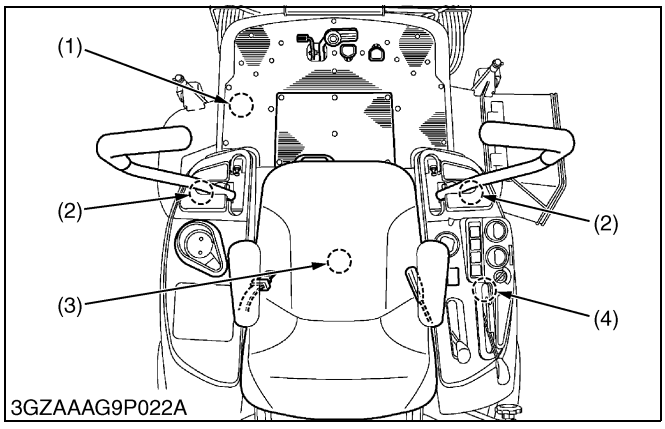
# [4] SAFETY SWITCH



3GZAAAG9P022A

Switches are located at the motion control levers, at the parking brake pedal, at the PTO lever and under the operator's seat.

A 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

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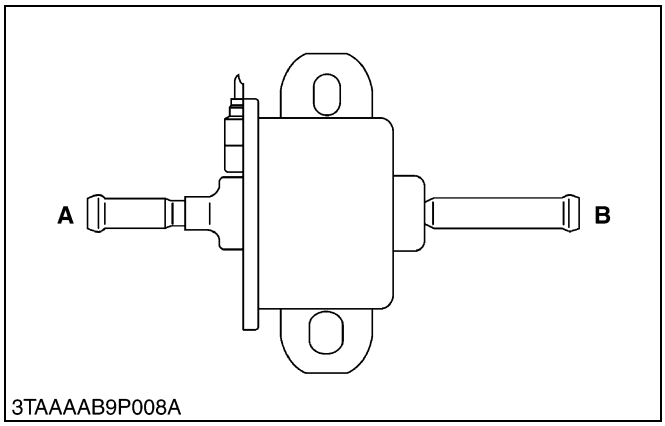
# [5] FUEL PUMP



3TAAAAB9P008A

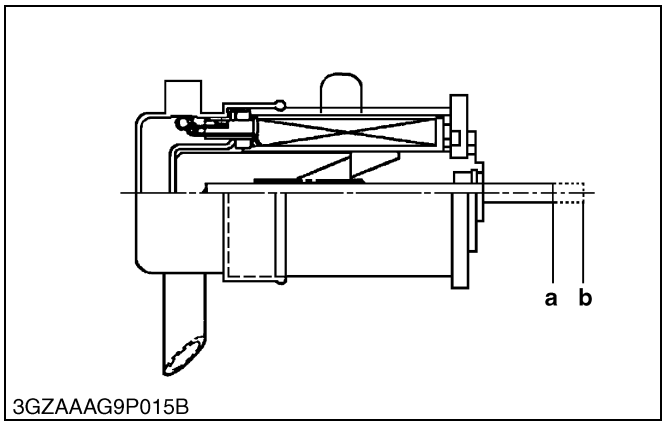
An electro magnetic fuel pump uses a transistor that causes the pump to start pumping fuel when the main switch is turned to the **"ON"** position.

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

**A: Inlet** **B: Outlet**

9Y1210301ELM0007US0

# [6] ENGINE STOP SOLENOID



3GZAAAG9P015B

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**

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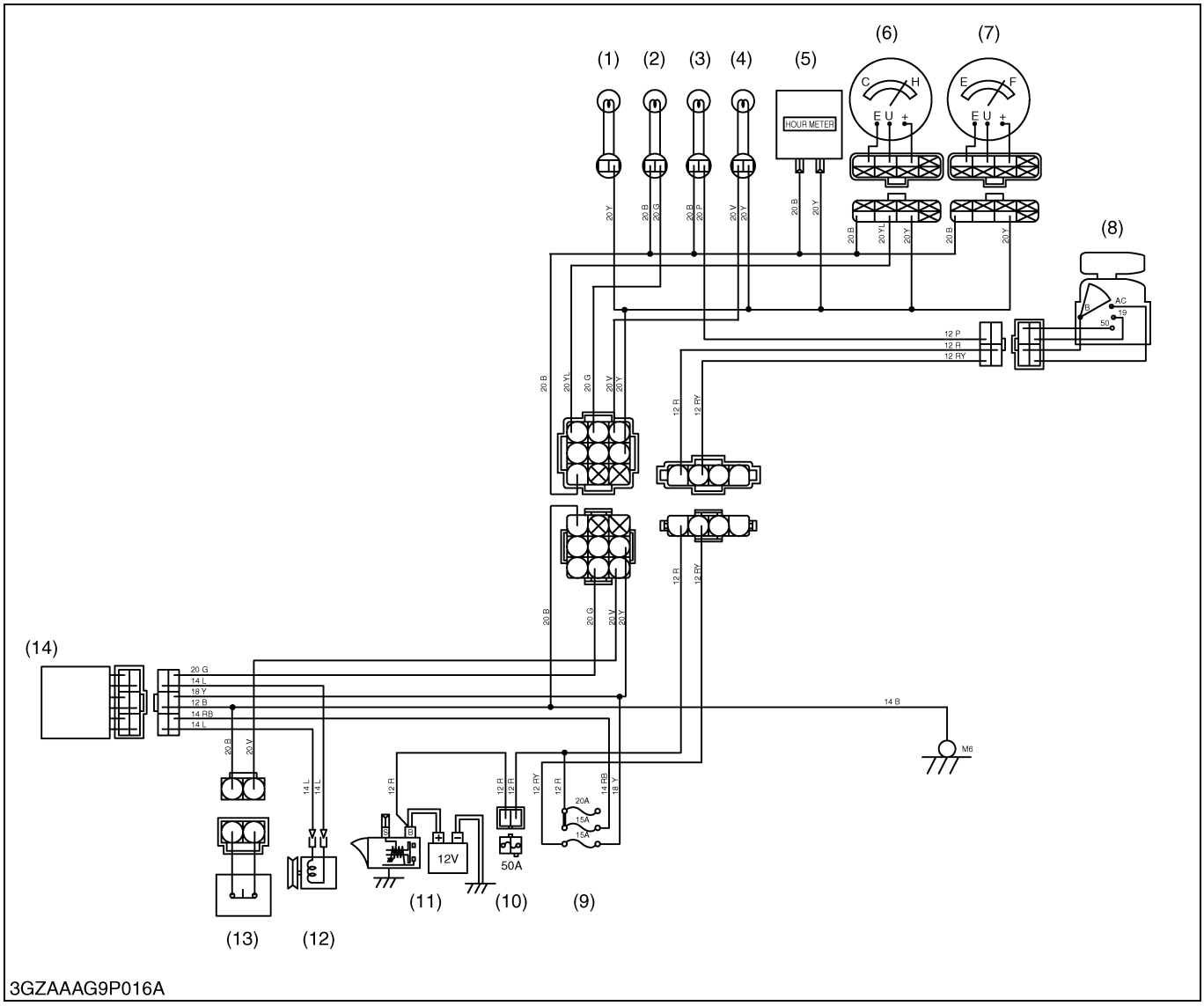
# 3. CHARGING SYSTEM



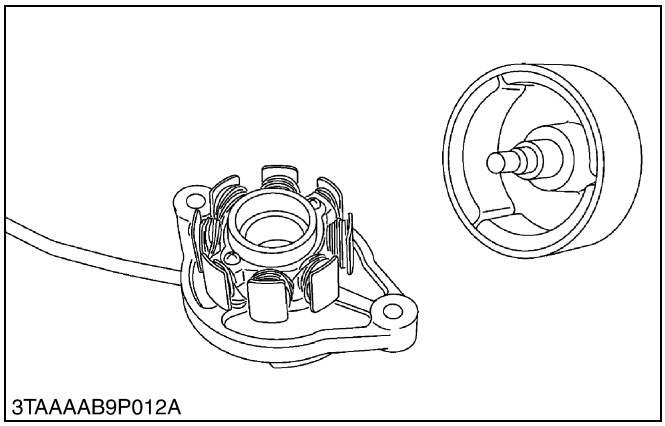

(1) Oil Lamp
(2) Charge Lamp
(3) Glow Lamp
(4) Fuel Lamp
(5) Hour Meter
(6) Coolant Temperature Gauge
(7) Fuel Gauge
(8) Main Switch
(9) Fuse
(10) Slow Blow Fuse
(11) Starter
(12) AC Dynamo
(13) Fuel Switch
(14) Regulator

The charging system supplies electric power for various electrical devices and also charges the battery while the engine runs.

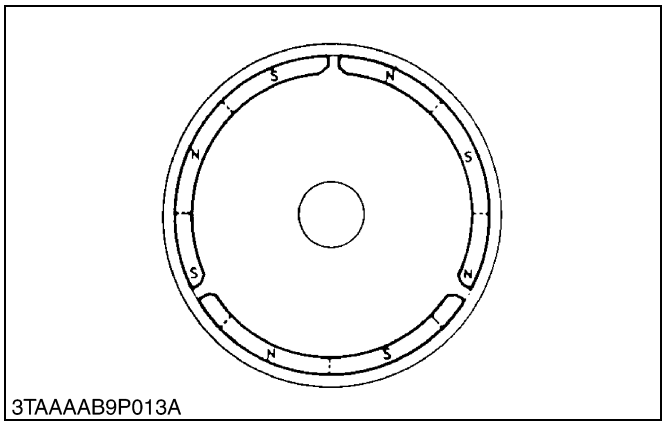
It consists of a AC dynamo (12) and a regulator (14).

9Y1210301ELM0009US0

# [1] AC DYNAMO



3TAAAAB9P012A




3TAAAAB9P013A

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

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

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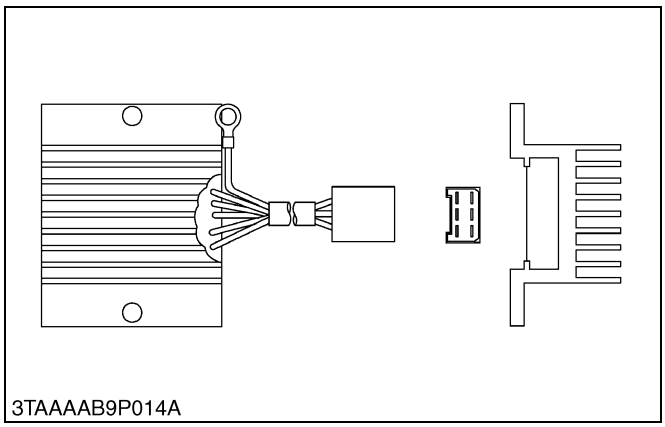
# [2] REGULATOR



3TAAAAB9P014A

The regulator performs rectification and voltage regulation.

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

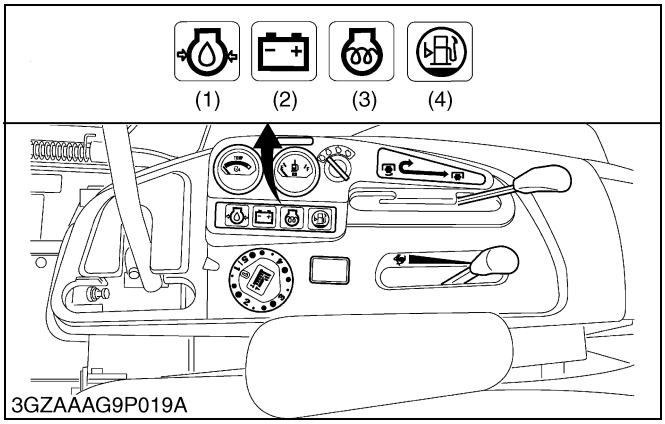
If however, the battery voltage exceeds a certain level, the DC current is cut off from the charging circuit to prevent overcharging.

9Y1210301ELM0011US0

# [3] EASY CHECKER™

To check the conditions of tractor easily before and during operation, easy checker™ combination of lamps on the easy checker™ board is provided.

9Y1210301ELM0012US0



3GZAAAG9P019A

**Indication Items**

**(1) Oil Pressure Lamp**

When the engine oil pressure is low, this lamp illuminates.

**(2) Charge Lamp**

When the charging system is not functioning properly, this lamp illuminates.

**(3) Pre-heat Indicator Lamp**

When the key switch is in the **"Pre-heat"** position, the pre-heat indicator lamp illuminates.

**(4) Fuel Lamp**

When the fuel in the RH tank goes below the prescribed level, the fuel level warning lamp illuminates.

(1) Oil Pressure Lamp
(2) Charge Lamp
(3) Pre-heat Indicator Lamp
(4) Fuel Lamp

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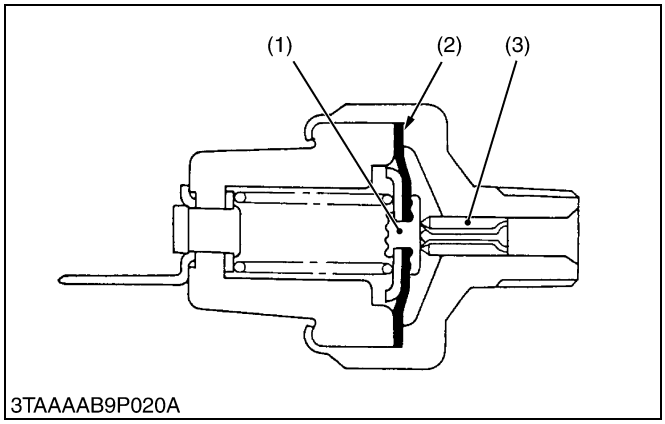

3TAAAAB9P020A

**Oil Pressure Switch**

While oil pressure is high and the force applied to the diaphragm (2) is larger than the spring tension, the terminal contact (1) is open separated from the body contact (3). If the pressure drops below approx. 49 kPa (0.5 kgf/cm$^2$, 7.1 psi), the contact closes.

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

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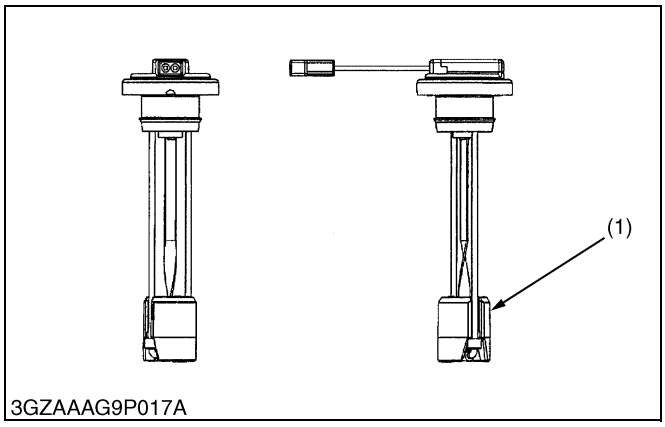

3GZAAAG9P017A

**Fuel (Lamp) Switch**

The switch is close when falling more than the prescribed level with the float (1).

When the amount of the remainder in the RH fuel tank becomes 9.0 L (2.38 U.S.gals, 1.98 Imp.gals) or less, the switch is turned on.

(1) Float

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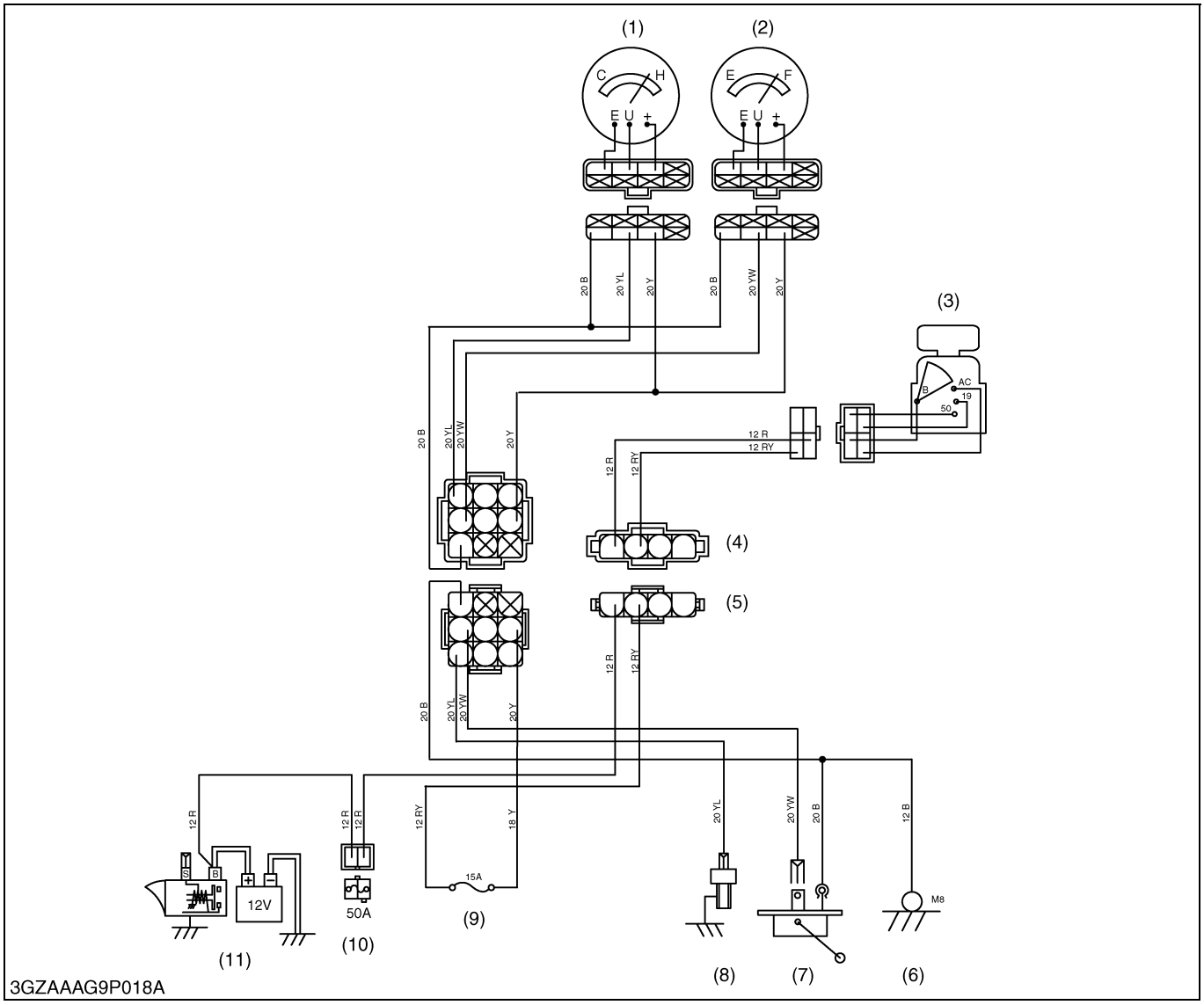
# 4. GAUGES




(1) Coolant Temperature Gauge
(2) Fuel Gauge
(3) Main Switch
(4) Harness A
(5) Harness B
(6) Ground
(7) Fuel Sensor
(8) Coolant Temperature Sensor
(9) Fuse
(10) Slow Blow Fuse
(11) Starter

The fuel quantity and coolant temperature are indicated by the ammeters. The ammeters indicate each amperage flowing through the fuel level sensor for the fuel quantity detection and through the coolant temperature sensor for the coolant temperature detection.

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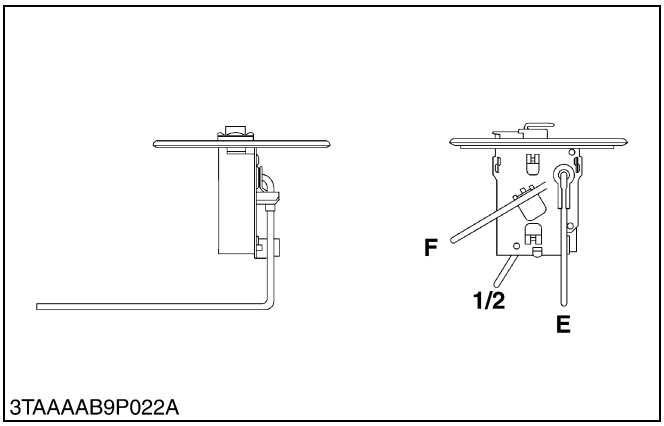
# [1] FUEL QUANTITY



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## Fuel Level Sensor

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

As the float lowers, the resistance of the variable resistor varies. The relation between the amount of fuel and the resistance is as follows.

| F | 1/2 | E (Remaining fuel of approx. 5.0 L, 1.32 U.S.gal., 1.10 Imp.gal.) |
|---|---|---|
| 1 to 5 Ω | 28.5 to 36.5 Ω | 103 to 117 Ω |

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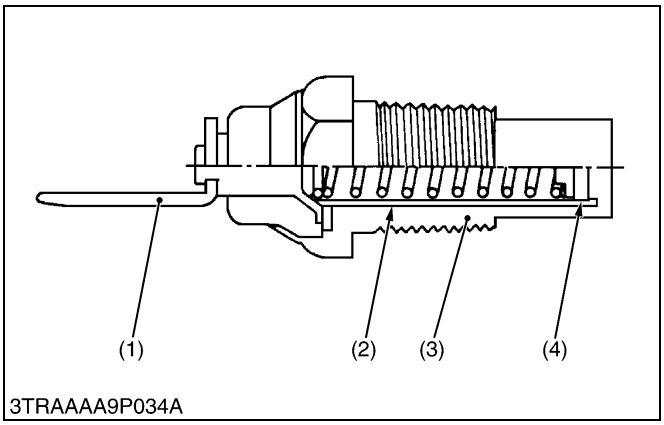
# [2] COOLANT TEMPERATURE



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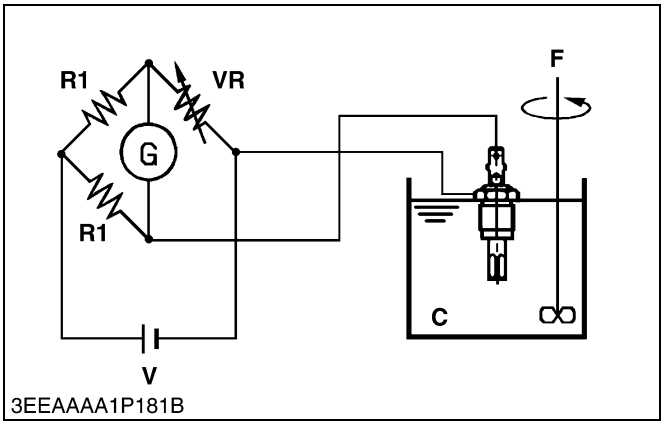

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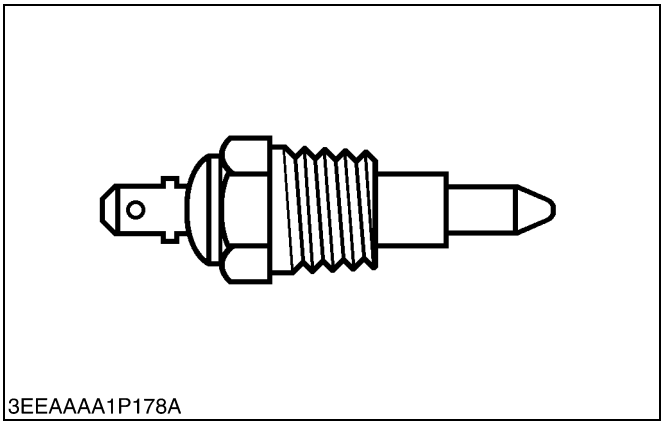
3EEAAAA1P178A

## Coolant Temperature Sensor

The coolant temperature sensor is installed to the cylinder head of engine, and its tip is in touch with the coolant. It contains a thermistor (4) whose electrical resistance decreases as the temperature increases.

Current varies with changes in the coolant temperature, and the increases or decreases in the current move the pointer of gauge.

| Characteristics of Thermistor | | |
|---|---|---|
| **Temperature** | **Resistance of VR : ★** | **Condition** |
| 50 °C (122 °F) | 153.9 Ω | (A) |
| 80 °C (176 °F) | 51.9 Ω | |
| 100 °C (212 °F) | 27.4 Ω | |
| 120 °C (248 °F) | 16.1 Ω | |

★ When galvarnometer shows 0 (Zero).

| Condition | Setting Value |
|---|---|
| (A) | **R1**: 54.945 to 55.055 Ω<br>**V**: DC 6.9 to 7.1 V |

(1) Terminal
(2) Insulator
(3) Body
(4) Thermistor

**C: Coolant or Silicon Oil**
**G: Galvanometer**
**VR: Variable Resistor**
**F: Flow Velocity (0.14 to 0.15 m/s)**

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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) |

9Y1210301ELM0019US0

# SERVICING

## CONTENTS

# 1. TROUBLESHOOTING

| Symptom | Probable Cause | Solution | Reference Page |
|---|---|---|---|
| **All Electrical Equipments Do Not Operate** | Battery discharged or defective | Recharge or replace | G-27 |
| | Battery positive cable disconnected or improperly connected | Repair or replace | 5-S5 |
| | Battery negative cable disconnected or improperly connected | Repair or replace | 5-S5 |
| | Slow blow fuse blown | Replace | G-39 |
| **Fuse Blown Frequently** | Short-circuited | Repair or replace | G-39 |

**BATTERY**

| Symptom | Probable Cause | Solution | Reference Page |
|---|---|---|---|
| **Battery Discharges Too Quickly** | Battery defective | Replace | G-27 |
| | Dynamo defective | Replace | 5-S12, 5-S18 |
| | Regulator defective | Replace | 5-S12 |
| | Wiring harness disconnected or improperly connected (between battery positive terminal and regulator **B** terminal) | Repair or replace | – |
| | Cooling fan belt slipping | Adjust tension | G-29 |

**STARTING SYSTEM**

| Symptom | Probable Cause | Solution | Reference Page |
|---|---|---|---|
| **Starter Motor Does Not Operate** | Battery discharged or defective | Recharge or replace | G-27 |
| | Slow blow fuse blown | Replace | G-39 |
| | Safety switch defective | Replace | G-23, 5-S7, 5-S10 |
| | Wiring harness disconnected or improperly connected (between main switch **50** terminal and safety switches, between safety switches and starter motor, between battery positive terminal and starter motor) | Repair or replace | 5-M1 |
| | Starter motor defective | Repair or replace | 5-S9, 5-S18 |
| | Main switch defective | Replace | 5-S8 |
| **Engine Does Not Stop When Main Switch Is Turned OFF** | Fuse blown (20 A) | Replace | G-39 |
| | Wiring harness disconnected or improperly connected (between main switch **AC** terminal and engine stop solenoid) | Repair or replace | 5-M1 |
| | Engine stop solenoid defective | Replace | 5-S11 |
| | Controller defective | Replace | 5-M2 |
| **Engine Does Not Start** | Engine stop solenoid defective | Replace | 5-S11 |
| | Controller defective | Replace | 5-M2 |

**CHARGING SYSTEM**

| Symptom | Probable Cause | Solution | Reference Page |
|---|---|---|---|
| **Charging Lamp Does Not Light When Main Switch Is Turned ON** | Fuse blown (15 A) | Replace | G-39 |
| | Wiring harness disconnected or improperly connected (between main switch **AC** terminal and panel board, between panel board and dynamo) | Repair or replace | 5-M1 |
| | Dynamo defective | Repair or replace | 5-S12, 5-S18 |
| | Regulator defective | Replace | 5-S12 |
| **Charging Lamp Does Not Go Off When Engine Is Running** | Wiring harness disconnected or improperly connected (between main switch **B** terminal and dynamo, between panel board and dynamo) | Repair or replace | 5-M1 |
| | Dynamo defective | Repair or replace | 5-S12, 5-S18 |
| | Regulator defective | Replace | 5-S12 |

**SENSORS AND GAUGES**

| Symptom | Probable Cause | Solution | Reference Page |
|---|---|---|---|
| **Fuel Gauge Does Not Function** | Fuel gauge defective | Replace | 5-M11, 5-S16 |
| | Fuel level sensor defective | Replace | 5-M11, 5-S14 |
| | Wiring harness disconnected or improperly connected (between fuel gauge and fuel level sensor) | Repair or replace | 5-M1 |
| **Coolant Temperature Gauge Does Not Function** | Coolant temperature gauge defective | Replace | 5-M10, 5-M11 |
| | Coolant temperature sensor defective | Replace | 5-M10, 5-M11, 5-S15, 5-S16 |
| | Wiring harness disconnected or improperly connected (between coolant temperature gauge and coolant temperature sensor) | Repair or replace | 5-M1 |

9Y1210301ELS0001US0

# 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<br>• Commutator | O.D. | 30.0 mm<br>1.181 in. | 29.0 mm<br>1.142 in. |
| | Difference of O.D.'s | Less than<br>0.02 mm<br>0.0008 in. | 0.05 mm<br>0.0020 in. |
| • Mica | Undercut | 0.50 to 0.80 mm<br>0.0197 to 0.0315 in. | 0.20 mm<br>0.0079 in. |
| • Brush | Length | 14.0 mm<br>0.551 in. | 9.0 mm<br>0.354 in. |
| AC Dynamo | Charging Current / Dynamo Speed | 4 to 15 A / 5200 rpm | – |
| | Charging Voltage / Dynamo Speed | 4 to 15 A / 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 G-10.)

| 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

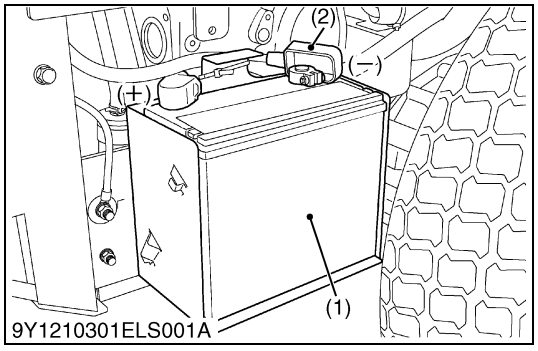
**CAUTION**
- **To avoid accidental short circuit, be sure to attach the positive cable to the positive terminal before the negative cable is attached to the negative terminal.**
- **Never remove the battery cap while the engine is running.**
- **Keep electrolyte away from eyes, hands and clothes. If you are spattered with it, wash it away completely with water immediately.**
- **Keep open sparks and flames away from the battery at all times. Hydrogen gas mixed with oxygen becomes very explosive.**

■ **IMPORTANT**
- **If the machine is to be operated for a short time without battery (using a slave battery for starting), use additional current (lights) while engine is running and insulate terminal of battery. If this advice is disregarded, damage to alternator and regulator may result.**

9Y1210301ELS0004US0

## [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 |
|---|---|---|

(1) Battery
(2) Ground Cable
(+) Positive Terminal
(–) Negative Terminal

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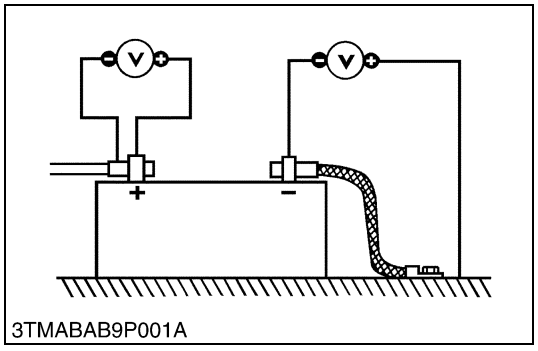


**Battery Terminal Connection**

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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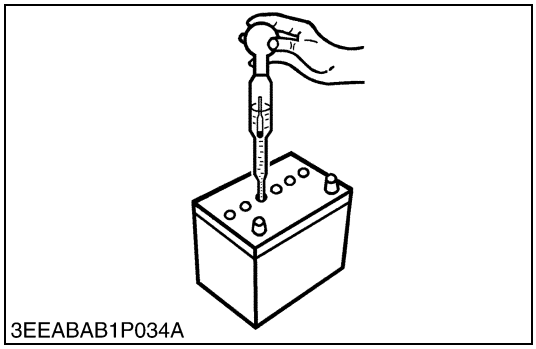
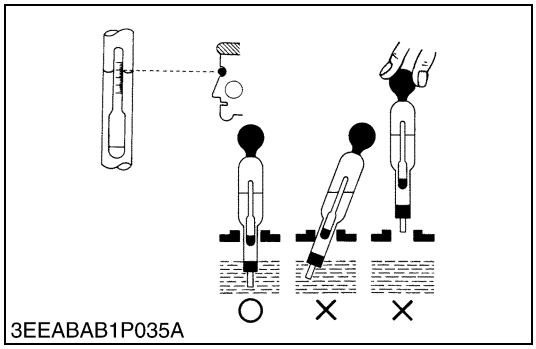

3EEABAB1P034A


3EEABAB1P035A

**Battery Specific Gravity**

1. Check the specific gravity of the electrolyte in each cell with a hydrometer.
2. When the electrolyte temperature differs from that at which the hydrometer was calibrated, correct the specific gravity reading following the formula mentioned in **(Reference)**.
3. If the specific gravity is less than 1.215 (after it is corrected for temperature), charge or replace the battery.
4. If the specific gravity differs between any two cells by more than 0.05, replace the battery.

■ **NOTE**

- **Hold the hydrometer tube vertical without removing it from the electrolyte.**
- **Do not suck too much electrolyte into the tube.**
- **Allow the float to move freely and hold the hydrometer at eye level.**
- **The hydrometer reading must be taken at the highest electrolyte level.**

**(Reference)**

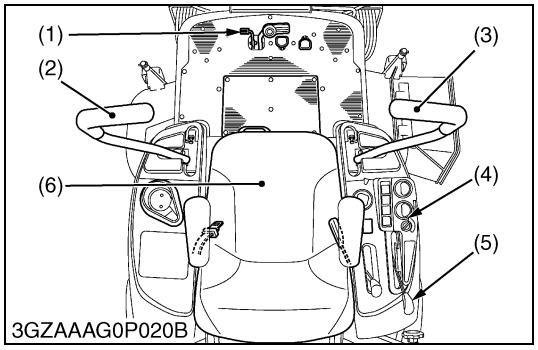
- Specific gravity slightly varies with temperature. To be exact, the specific gravity decreases by 0.0007 with an increase of 1 °C (0.0004 with an increase of 1 °F) in temperature, and increases by 0.0007 with a decreases of 1 °C (0.0004 with a decrease of 1 °F).
  Therefore, using 20 °C (68 °F) as a reference, the specific gravity reading must be corrected by the following formula:
  – Specific gravity at 20 °C = Measured value + 0.0007 × (electrolyte temperature –20 °C)
  – Specific gravity at 68 °F = Measured value + 0.0004 × (electrolyte temperature –68 °F)

| Specific Gravity | State of Charge |
|---|---|
| 1.260 Sp. Gr. | 100 % Charged |
| 1.230 Sp. Gr. | 75 % Charged |
| 1.200 Sp. Gr. | 50 % Charged |
| 1.170 Sp. Gr. | 25 % Charged |
| 1.140 Sp. Gr. | Very Little Useful Capacity |
| 1.110 Sp. Gr. | Discharged |

At an electrolyte temperature of 20 °C (68 °F)

9Y1210301ELS0007US0

## (2) Safety Switches




**Method of Inspecting Each Control**

A defective location can be judged 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) Main Switch
(5) PTO Lever
(6) Operator Seat

9Y1210301ELS0008US0

| 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 lock) | Parking position (Neutral lock) | 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.

9Y1210301ELS0009US0

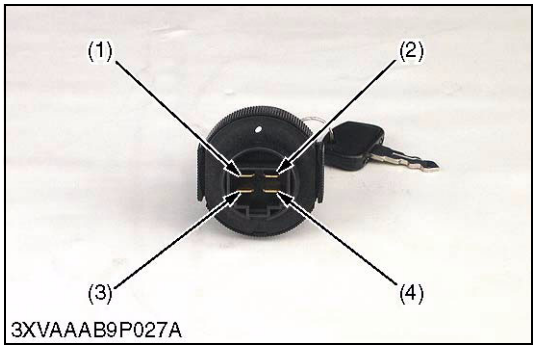
■ **How to read meaning from table above.**

1. If the engine starts in combination 2 when leaving the seat, the seat safety switch is bad.
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.

■ **If the engine does not start in combination 1, Do the continuity test of each switch.**

9Y1210301ELS0010US0

# (3) Main Switch




**Main Switch Continuity**

**1) Main Switch Key at OFF Position**

1. Set the main switch **OFF** position.
2. Measure the resistance with an ohmmeter across the **B** terminal and the **ACC** terminal, **B** terminal and **ST** terminal, **B** terminal and **G** terminal.
3. If infinity is not indicated, the contacts of the main switch are faulty.

| | | |
|---|---|---|
| Resistance | **B** terminal – **ACC** terminal | Infinity |
| | **B** terminal – **ST** terminal | |
| | **B** terminal – **G** terminal | |

**2) Main Switch Key at ON Position**

1. Set the main switch **ON** position.
2. Measure the resistance with an ohmmeter across the **B** terminal and the **ACC** terminal.
3. If 0 ohm is not indicated, the **B** – **ACC** contact of the main switch are faulty.

| | | |
|---|---|---|
| Resistance | **B** terminal – **ACC** terminal | 0 Ω |

**3) Main Switch Key at PREHEAT Position**

1. Set and hold the main switch key at the **PREHEAT** position.
2. Measure the resistance with an ohmmeter across the **B** terminal and the **G** terminal, and measure the resistance across the **B** terminal and the **ACC** terminal.
3. If 0 ohm is not indicated, these contacts of the main switch are faulty.

| | | |
|---|---|---|
| Resistance | **B** terminal – **G** terminal | 0 Ω |
| | **B** terminal – **ACC** terminal | |

**4) Main Switch Key at START Position**

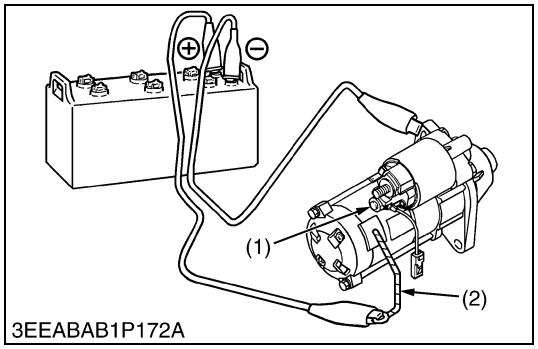
1. Set and hold the main switch key at the **START** position.
2. Measure the resistance with an ohmmeter across the **B** terminal and the **G** terminal, across the **B** terminal and the **ST** terminal, and across the **B** terminal and the **ACC** terminal.
3. If 0 ohm is not indicated, these contacts of the main switch are faulty.

| | | |
|---|---|---|
| Resistance | **B** terminal – **G** terminal | 0 Ω |
| | **B** terminal – **ST** terminal | |
| | **B** terminal – **ACC** terminal | |

(1) **G** Terminal
(2) **ACC** Terminal
(3) **ST** Terminal
(4) **B** Terminal

9Y1210301ELS0011US0

# (4) Starter



3EEABAB1P172A

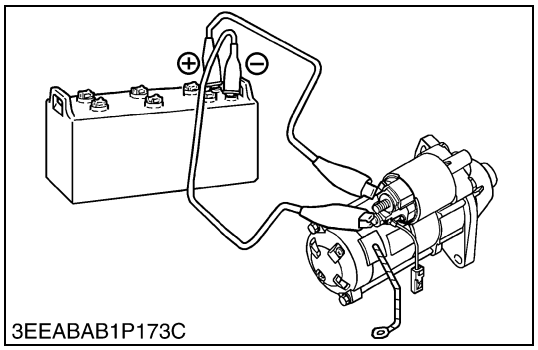
**Motor Test**

**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

9Y1210301ELS0012US0


3EEABAB1P173C

**Magnet Switch Test (Pull-in, Holding Coils)**

■ **NOTE**
- **Each test should be carried out for a start time (3 to 5 seconds), and at half of the rated voltage (6V)**

**1) Checking Pull-in Coil**

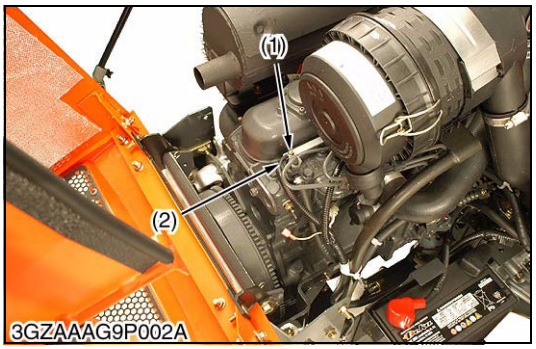
1. Connect jumper lead from the battery's negative terminal post to the **C** terminal.
2. The plunger should be attached strongly when a jumper lead is connected from the battery positive terminal to the **S** terminal.

**2) Checking Holding Coil**

1. Connect jumper leads from the battery's negative terminal post to the body and the battery's positive terminal post to the **S** terminal.
2. Push the plunger in by hand and release it. Then, the plunger should remain being attracted.

9Y1210301ELS0013US0

## (5) Glow Plug



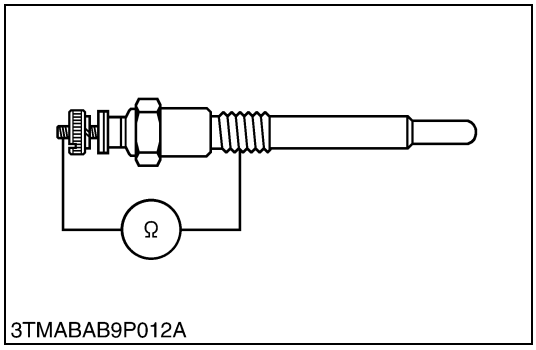

### Lead Terminal Voltage

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

9Y1210301ELS0014US0



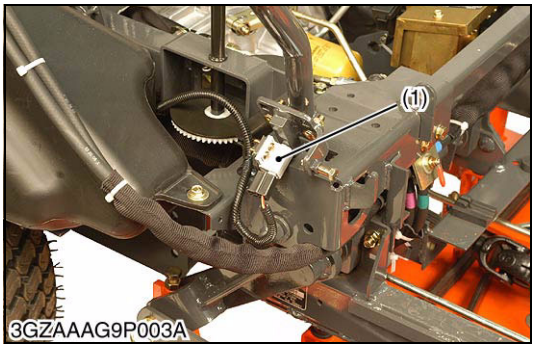

### Glow Plug Continuity

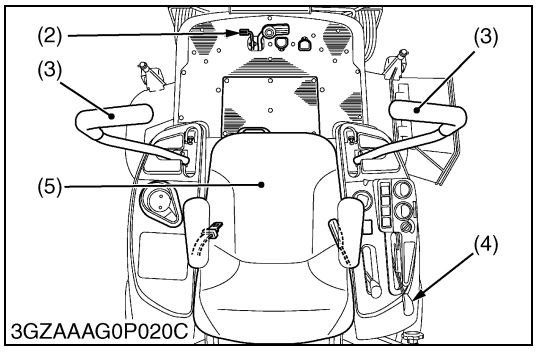
1. Disconnect the lead from the glow plugs.
2. Measure the resistance with an ohmmeter between the glow plug terminal and the chassis.
3. If 0 ohm is indicated, the screw at the tip of the glow plug and the housing are short-circuited.
4. If the factory specification is not indicated, the glow plug is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

| | | |
|---|---|---|
| Glow plug resistance | Factory specification | Approx. 0.9 Ω |

9Y1210301ELS0015US0

## (6) Safety Switch




### Safety Switch Continuity

1. Remove the safety switch leads.
2. Connect the circuit tester to the safety switch leads.
3. Measure the resistance between leads.
4. If the safety switch is defective, replace it.

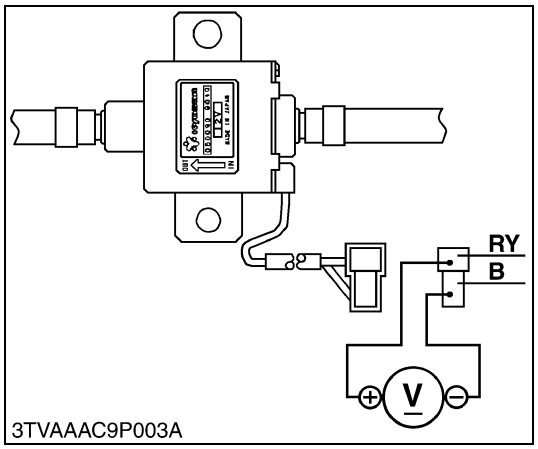
| | | |
|---|---|---|
| Resistance (Across switch terminal)<br>• Motion control lever<br>• PTO lever<br>• Operator seat | When switch push is pushed | 0 Ω |
| | When switch push is released | Infinity |

| | | |
|---|---|---|
| Resistance (Across switch terminal)<br>• Parking brake pedal | When actuator is pushed | Infinity |
| | When actuator is released | 0 Ω |

(1) Safety Switch
(2) Parking Brake Lock Pedal
(3) Motion Control Lever
(4) PTO Lever
(5) Operator Seat

9Y1210301ELS0016US0

## (7) Fuel Pump



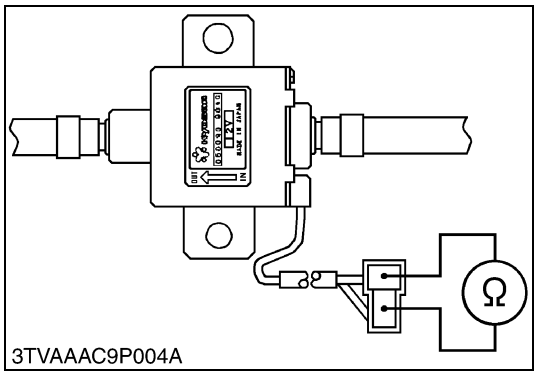
3TVAAAC9P003A

**Connector Voltage**

1. Disconnect the **2P** connector from the fuel pump.
2. Turn the main switch key to the **"ON"** position, and measure the voltage with a voltmeter between the connector terminals.
3. If the voltage differs from the battery voltage, the wiring harness or main switch is faulty.

| | | |
|---|---|---|
| Voltage | Between connector terminals | Approx. battery voltage |

9Y1210301ELS0017US0



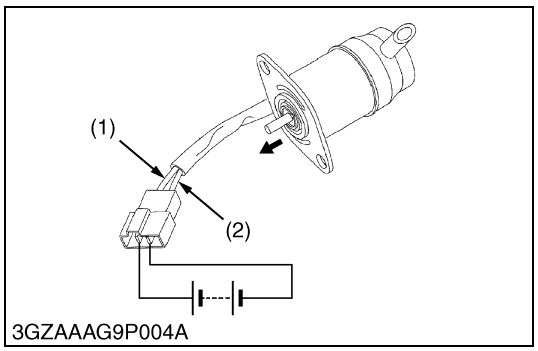
3TVAAAC9P004A

**Fuel Pump Continuity**

1. Disconnect the **2P** connector from the fuel pump.
2. Check the continuity between the connector terminals with an ohmmeter.
3. If it does not conduct, the fuel pump is faulty.

9Y1210301ELS0018US0

## (8) Engine Stop Solenoid



3GZAAAG9P004A

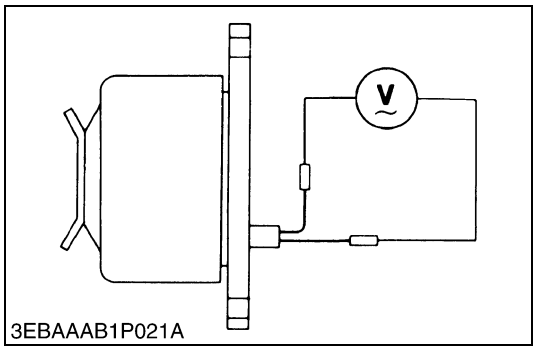
**Engine Stop Solenoid Test**

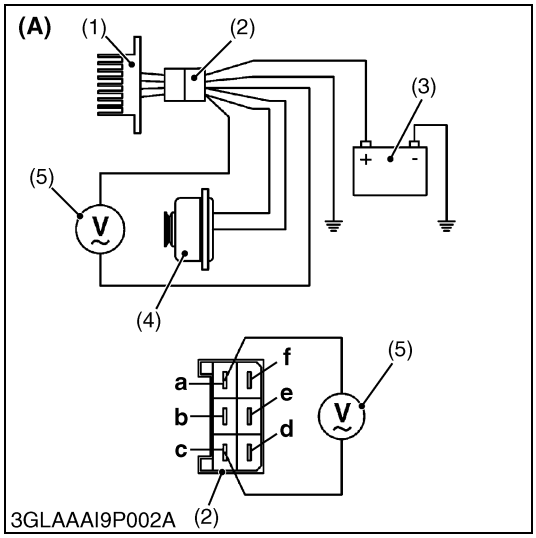
1. Disconnect the connector from the engine stop solenoid.
2. Remove the engine stop solenoid from the engine.
3. Connect the jumper leads from the battery positive terminal to the connector, and from the battery negative terminal to the engine stop solenoid body.
4. If the solenoid plunger is not attracted,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

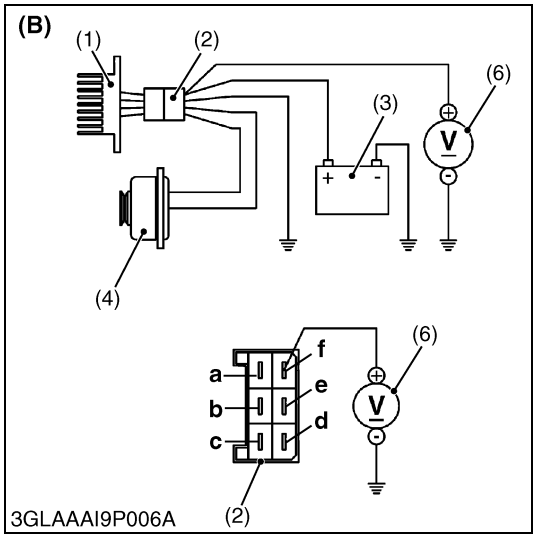
(1) White (2) Black

9Y1210301ELS0019US0

# (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 |

9Y1210301ELS0020US0

**Regulation Voltage**

**CAUTION**

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

■ **NOTE**

- **Before performing this checking, make sure that the no-load dynamo output is proper.**
- **Complete the charging circuit with fully charged battery.**

1. Rum the engine at the rated speed.
2. Keeping the coupler (2) of regulator being connected, measure the voltage with a volt meter (5) across the terminal blue **"a"** and terminal blue **"c"**. (Refer to figure **(A)**.)
3. If the measurement is not within the specified value, replace the wire harness between the dynamo (4) and regulator (1).
4. If the measurement is within the specified value, measure the voltage with a volt meter (6) across the terminal red **"f"** and chassis. (Refer to figure **(B)**.)
5. If the measurement is not within specified value, replace the regulator (1).

| | | |
|---|---|---|
| Voltage | Terminal blue **"a"** – Terminal blue **"c"** | AC 20 V or more |
| | Terminal red **"f"** – Chassis | DC 14 to 15 V |

(1) Regulator
(2) Coupler
(3) Battery
(4) Dynamo
(5) Volt Meter (AC)
(6) Volt Meter (DC)

**a: Terminal Blue**
**b: Terminal Black**
**c: Terminal Blue**
**d: Terminal Green**
**e: Terminal Yellow**
**f: Terminal Red**

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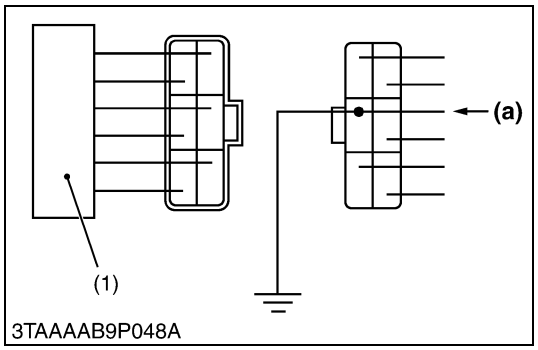
# (10) Lighting System



3TAAAAB9P048A

## Charge Lamp (Charging Circuit)

1. Remove the under panel.
2. Disconnect the **6P** connector from the regulator after turning the main switch **OFF**.
3. Turn the main switch **ON** and connect a jumper lead from the wiring harness connector terminal (Black) to the chassis.
4. If the charge lamp does not light, the wiring harness or fuse is faulty.

(1) Regulator **(a) From Charge Lamp**

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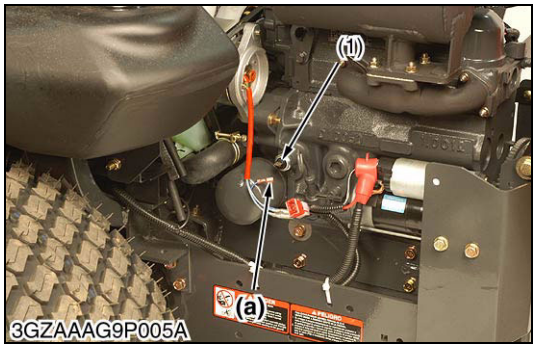

3GZAAAG9P005A

## Engine Oil Pressure Lamp

1. Disconnect the lead from the engine oil pressure switch after turning the main switch **OFF**.
2. Turn the main switch **ON** and connect a jumper lead from the lead to the chassis.
3. If the engine oil pressure indicator lamp does not light, the wiring harness is faulty.

(1) Engine Oil Pressure Switch **(a) From Oil Pressure Lamp**

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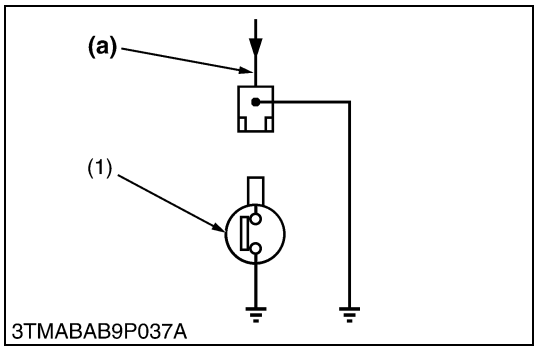


3TMABAB9P037A

3GZAAAG9P006A

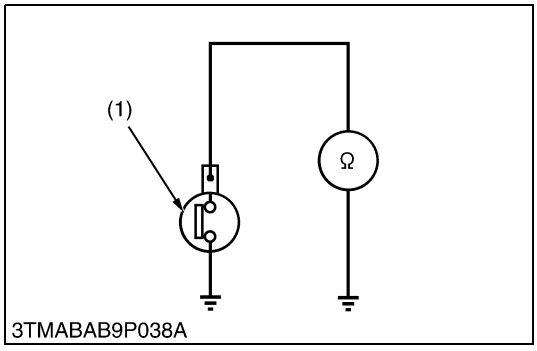
## Engine Oil Pressure Switch Continuity

1. Measure the resistance with an ohmmeter across the switch terminal and the chassis.
2. If 0 ohm is not indicated in the normal state, the switch is faulty.
3. If infinity is not indicated at pressure over 4.9 kPa (0.5 kgf/cm$^2$, 7 psi), the switch is faulty.

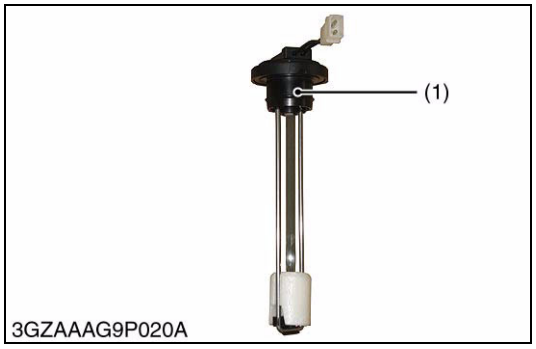
| | | |
|---|---|---|
| Resistance (Switch terminal – Chassis) | In normal state | 0 Ω |
| | At pressure over approx. 4.9 kPa (0.5 kgf/cm$^2$, 7 psi) | Infinity |

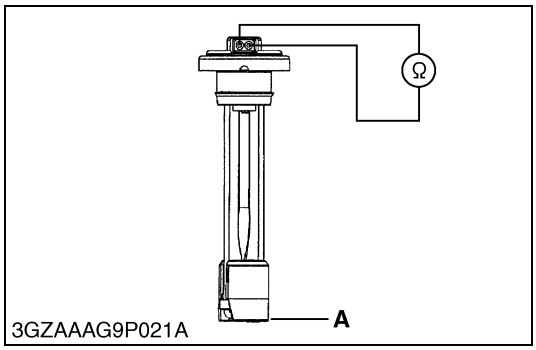
(1) Engine Oil Pressure Switch

9Y1210301ELS0024US0

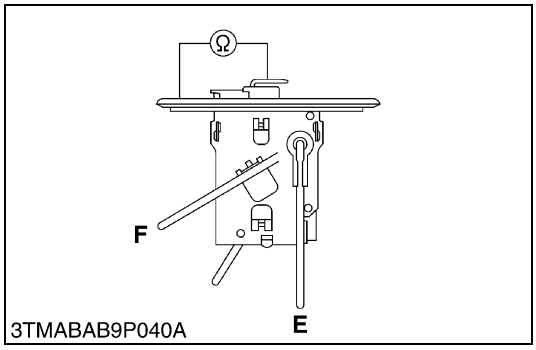


3TMABAB9P038A




## (11) Sensors for Gauges


### Fuel Lamp (Fuel Switch)

**1) Switch Continuity**

1. Remove the fuel switch from the RH fuel tank.
2. Measure the resistance with an ohmmeter across the sensor terminals.
3. If the reference values are not indicated, the sensor is faulty.

| | | | |
|---|---|---|---|
| Resistance | Reference value | Float at not lower-most position | Infinity |
| | | Float at lower-most position | Approx. 5 Ω |

(1) Fuel Level Sensor
**A: Lower-most Position**

9Y1210301ELS0025US0

### Fuel Level Sensor

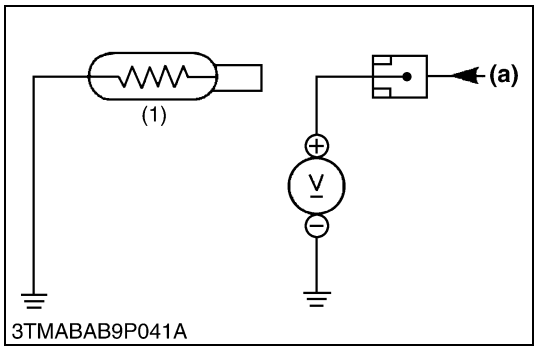
**1) Sensor Continuity**

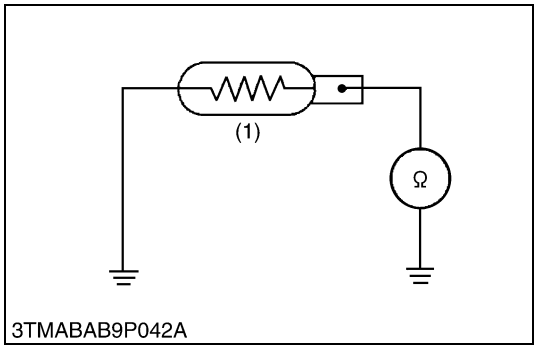
1. Remove the fuel level sensor from the fuel tank.
2. Measure the resistance with an ohmmeter across the sensor terminal and its body.
3. If the reference values are not indicated, the sensor is faulty.

| | | | |
|---|---|---|---|
| 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**

9Y1210301ELS0026US0


## Coolant Temperature Sensor

### 1) Lead Terminal Voltage

1. Disconnect the lead from the coolant temperature sensor (1) after turning the main switch **OFF**.
2. Turn the main switch **ON** and measure the voltage with a voltmeter across the lead terminal and the chassis.
   If the voltage differs from the battery voltage, the wiring harness, fuse or coolant temperature gauge is faulty.

| | | |
|---|---|---|
| Voltage | Lead terminal – Chassis | Approx. battery voltage |

### 2) Sensor Continuity

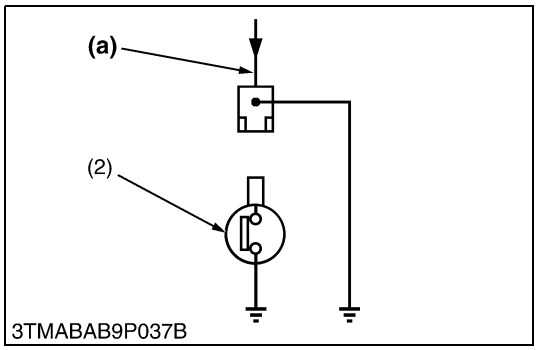
1. Measure the resistances with an ohmmeter across the sensor terminal and the chassis.
2. If the reference value is not indicated, the sensor is faulty.

| | | |
|---|---|---|
| Resistance (Sensor terminal – Chassis) | Reference value | Approx. 16.1 Ω at 120 °C (248 °F)<br>Approx. 27.4 Ω at 100 °C (212 °F)<br>Approx. 51.9 Ω at 80 °C (176 °F)<br>Approx. 153.9 Ω at 50 °C (122 °F) |

(1) Coolant Temperature Sensor
**(a) From Temperature Gauge**

9Y1210301ELS0027US0

# (12) Cooling System and Gauges

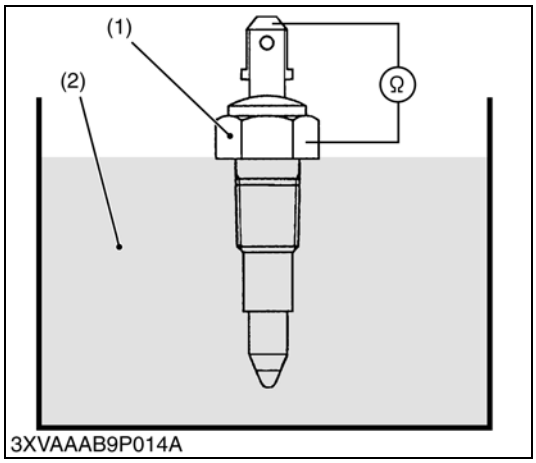




## Horn Wiring Harness

1. Disconnect the wiring lead (1) from the coolant temperature switch (2) after turning the main switch **OFF**.
2. Turn the main switch **ON** and connect a jumper lead from lead to the chassis.
3. If the horn does not operate, wiring harness or relay is faulty.

(1) Wiring Lead
(2) Coolant Temperature Switch
**(a) From Fan Motor Relay**

9Y1210301ELS0028US0


## Coolant Temperature Switch

1. Measure the resistance with an ohmmeter across the switch terminal and the switch body.
2. If 0 ohm is not indicated in the coolant temperature at 194 °C (201 °F) or more, the sensor is faulty.
3. If infinity is not indicated in the coolant temperature at lower than 90 °C (194 °F), the sensor is faulty.

| | | |
|---|---|---|
| Resistance (Switch terminal – Switch body) | At coolant temperature lower than 116 °C (241 °F) | Infinity |
| | At coolant temperature more than 120 to 126 °C (248 to 258 °F) | 0 Ω |

(1) Coolant Temperature Switch (2) Coolant

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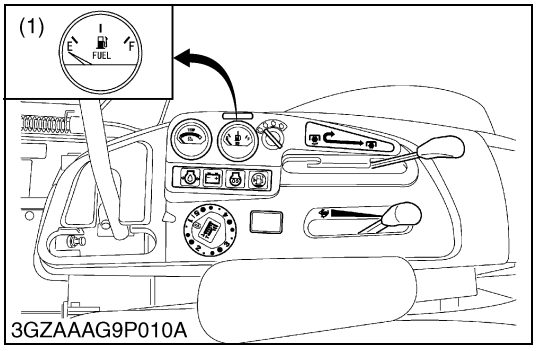


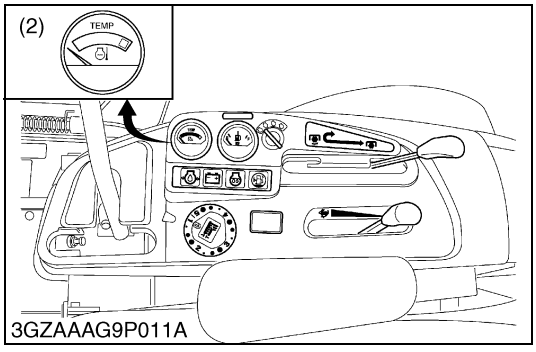


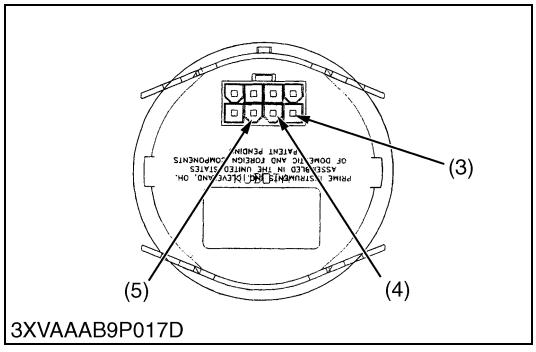


## Fuel Gauge and Coolant Temperature Gauge Operation

1. Remove the fender cover.
2. Turn the main switch to **ON** position. Measure the voltage with a voltmeter across the **I** terminal (5) and **GND** terminal (3) of the gauge.
3. If approx. battery voltage is indicated, the ignition and ground lead connections are good.
4. Turn the main switch to **OFF** position. Connect a jumper lead between **S** terminal (4) and **GND** terminal (3) of the gauge.
5. Turn the main switch to **ON** position. If the gauge resisters a full scale reading under those conditions, the gauge is good. If less than full scale reading is indicated, the gauge is defective and should be replaced.

(1) Fuel Gauge
(2) Temperature Gauge
(3) **GND** Terminal
(4) **S** Terminal
(5) **I** Terminal

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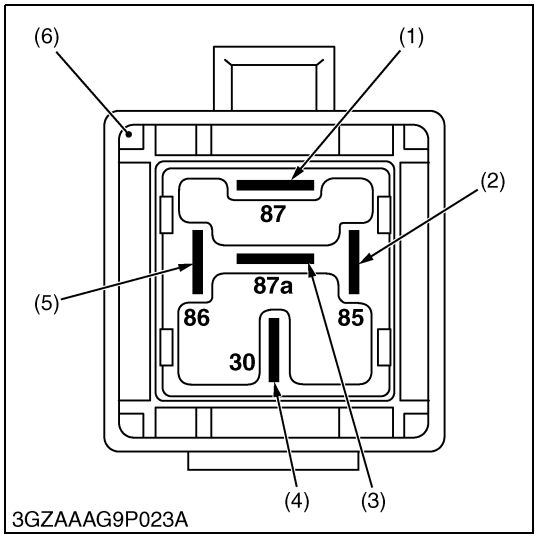
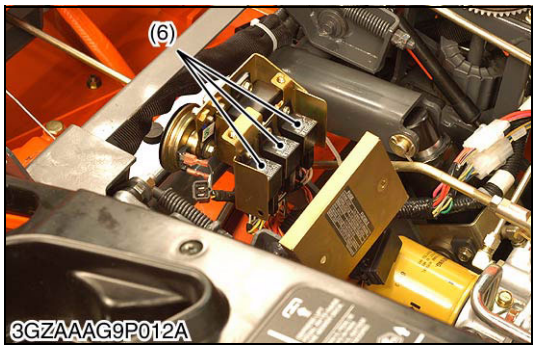


3GZAAAG9P023A



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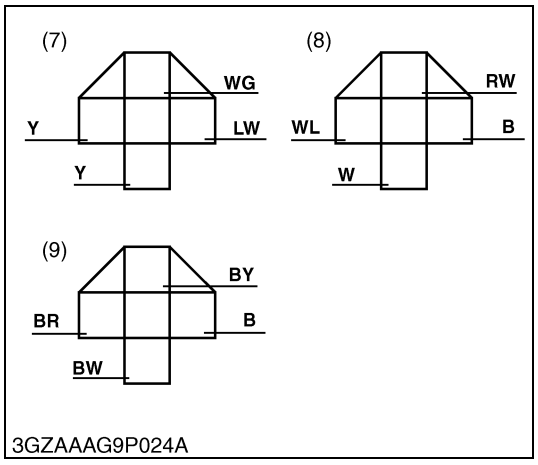

3GZAAAG9P024A

## Relay (Horn, Solenoid and Starter)

1. Disconnect the connector from relay (6) after turning the main switch off.
2. Remove the relay from bracket.
3. Measure the resistance with an ohmmeter across the terminal **85** (2) to terminal **86** (5), terminal **87** (1) to terminal **87a** (3) and terminal **87** (1) to terminal **30** (4).
4. If resistance differs from the factory specifications, the relay is faulty.

| | | |
|---|---|---|
| Resistance | Terminal **85** (2) – Terminal **86** (5) | Approx. 90 Ω |
| | Terminal **87** (1) – Terminal **87a** (3) | 0 Ω |
| | Terminal 87 (1) – Terminal **30** (4) | Infinity |

(1) Terminal **87**
(2) Terminal **85**
(3) Terminal **87a**
(4) Terminal **30**
(5) Terminal **86**
(6) Relay (Horn, Solenoid and Starter)
(7) Horn Relay Connector
(8) Solenoid Relay Connector
(9) Starter Relay Connector

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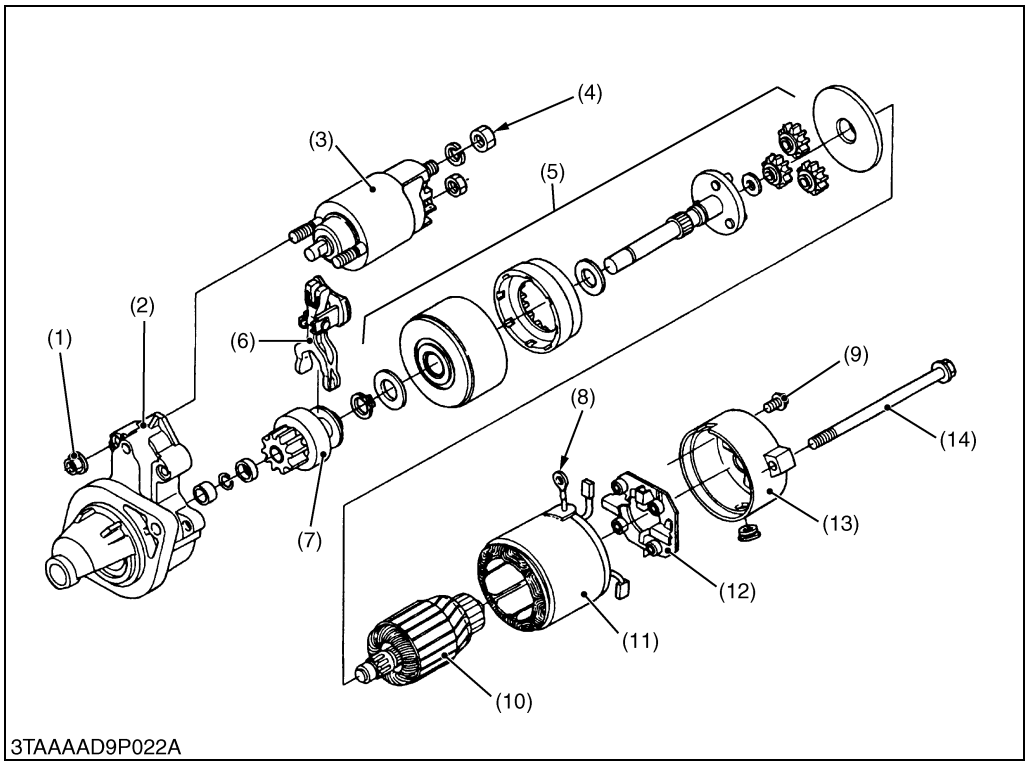
# [2] DISASSEMBLING AND ASSEMBLING

## (1) Starting System (Starter)



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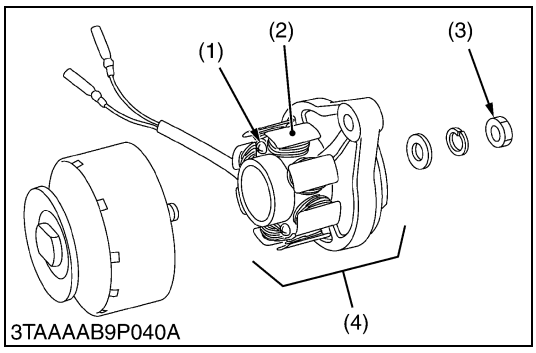
(1) Magnetic Switch Mounting Nut
(2) Housing
(3) Magnetic Switch
(4) C Terminal Nut
(5) Shaft Assembly
(6) Drive Lever
(7) Overrunning Clutch
(8) Connecting Lead
(9) Mounting Screw
(10) Armature
(11) Yoke
(12) Brush Holder
(13) Rear End Holder
(14) Through Bolt

1. Unscrew the **C** terminal nut (4), and disconnect the connecting lead (8).
2. Unscrew the magnetic switch mounting nuts (1), and remove the magnetic switch (3) from the housing (2).
3. Unscrew the through bolts (14) and mounting screw (9), and remove the rear end frame (13).
4. Remove the brush from the brush holder while holding the spring up.
5. Remove the brush holder (12).
6. Draw out the armature (10) and yoke (11) from the housing.
7. Draw out the shaft assembly (5) with the drive lever (6) and overrunning clutch (7) from the housing.

9Y1210301ELS0032US0

## (2) Charging System (Dynamo)



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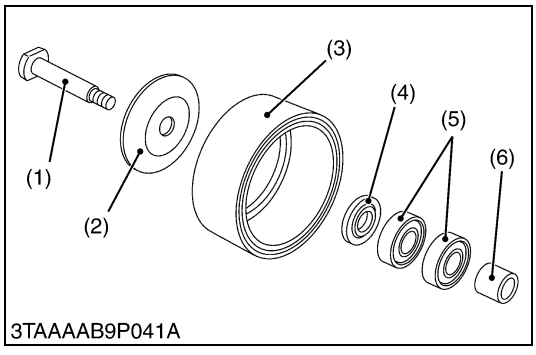


3TAAAAB9P041A

**Stator**

1. Remove the nut (3) and separate the stator comp. (4).
2. Unscrew the screws (1) and remove the stator (2).

**(When reassembling)**

| | | |
|---|---|---|
| Tightening torque | Nut | 39.2 to 44.1 N·m<br>4.0 to 4.5 kgf·m<br>28.9 to 32.5 lbf·ft |

(1) Screw
(2) Stator
(3) Nut
(4) Stator Comp

9Y1210301ELS0033US0

**Rotor**

1. Tap out the shaft (1) from the rotor (3).

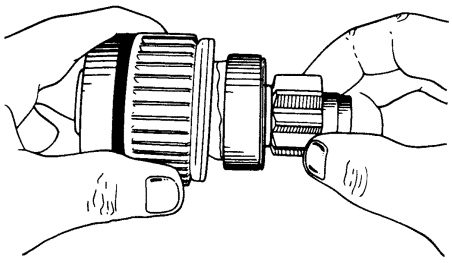
**(When reassembling)**

- Take care the direction of the collar (4), the flat side should face to the pulley (2) side.

(1) Shaft
(2) Pulley
(3) Rotor
(4) Collar
(5) Bearings
(6) Collar

9Y1210301ELS0034US0

# [3] SERVICING
## (1) Starting System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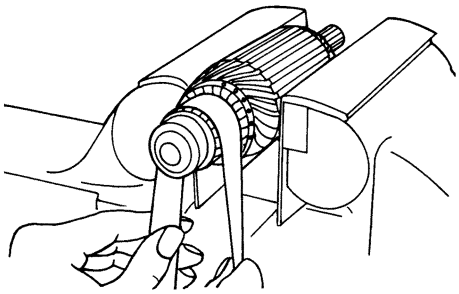
### Overrunning Clutch

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

9Y1210301ELS0035US0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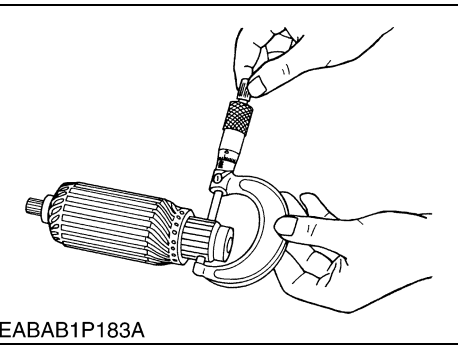
### Commutator and Mica

1. Check the contact face of the commutator for wear, and grind the commutator with emery paper if it is slightly worn.
2. Measure the commutator O.D. with an outside micrometer at several points.
3. If the minimum O.D. is less than the allowable limit, replace the armature.
4. If the difference of the O.D.'s exceeds the allowable limit, correct the commutator on a lathe to the factory specification.
5. Measure the mica undercut.
6. If the undercut is less than the allowable limit, correct it with a saw blade and chamfer the segment edges.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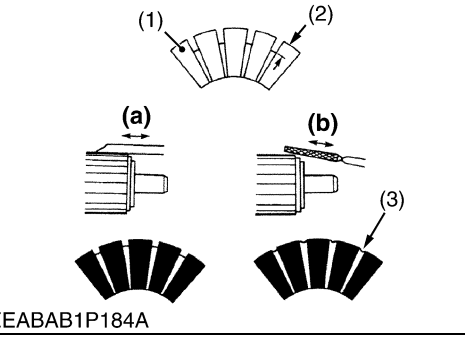
| | | |
|---|---|---|
| Commutator O.D. | Factory specification | 30.0 mm<br>1.181 in. |
| | Allowable limit | 29.0 mm<br>1.142 in. |

| | | |
|---|---|---|
| Difference of O.D.'s | Factory specification | Less than 0.02 mm<br>Less than 0.0008 in. |
| | Allowable limit | 0.05 mm<br>0.0020 in. |

| | | |
|---|---|---|
| Mica undercut | Factory specification | 0.50 to 0.80 mm<br>0.0197 to 0.0315 in. |
| | Allowable limit | 0.20 mm<br>0.0079 in. |



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(1) Segment
(2) Undercut
(3) Mica
**(a) Correct**
**(b) Incorrect**

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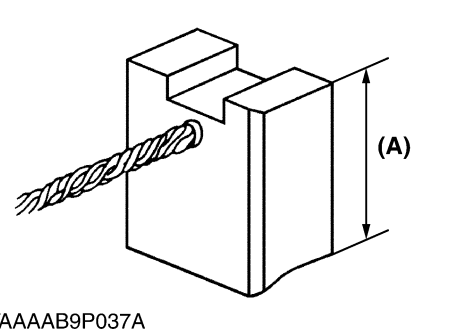

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### Brush Wear

1. If the contact face of the brush is dirty or dusty, clean it with emery paper.
2. Measure the brush length **(A)** with vernier calipers.
3. If the length is less than the allowable limit, replace the yoke assembly and brush holder.

| | | |
|---|---|---|
| Brush length **(A)** | Factory specification | 14.0 mm<br>0.551 in. |
| | Allowable limit | 9.0 mm<br>0.354 in. |

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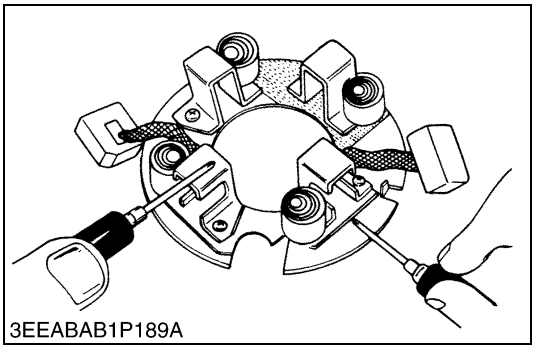
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**Brush Holder**

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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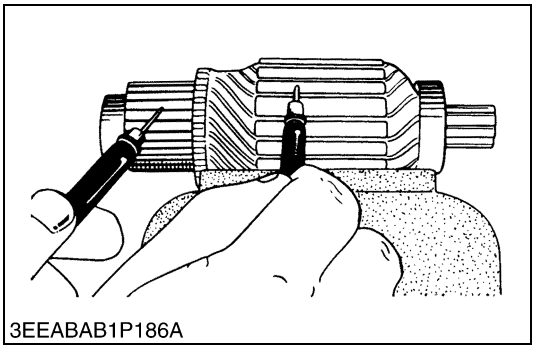
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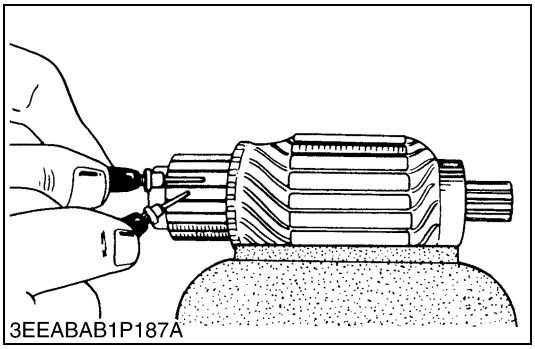
**Armature Coil**

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.

9Y1210301ELS0039US0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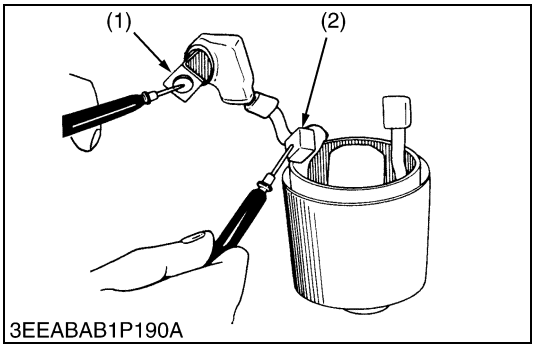

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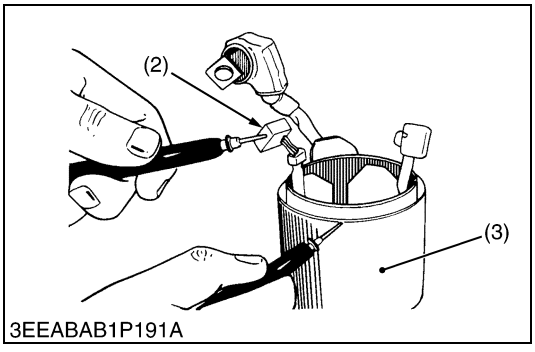
**Field Coil**

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

(1) Lead
(2) Brush
(3) Yoke

9Y1210301ELS0040US0



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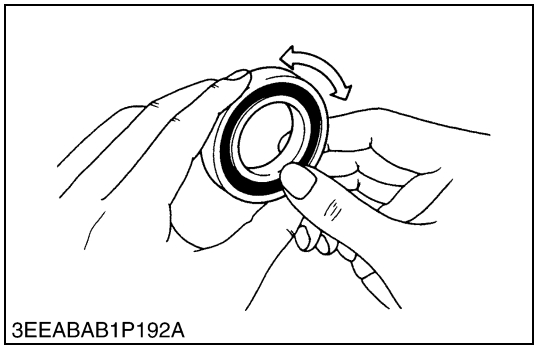
## (2) Charging System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**Bearing**

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

9Y1210301ELS0041US0

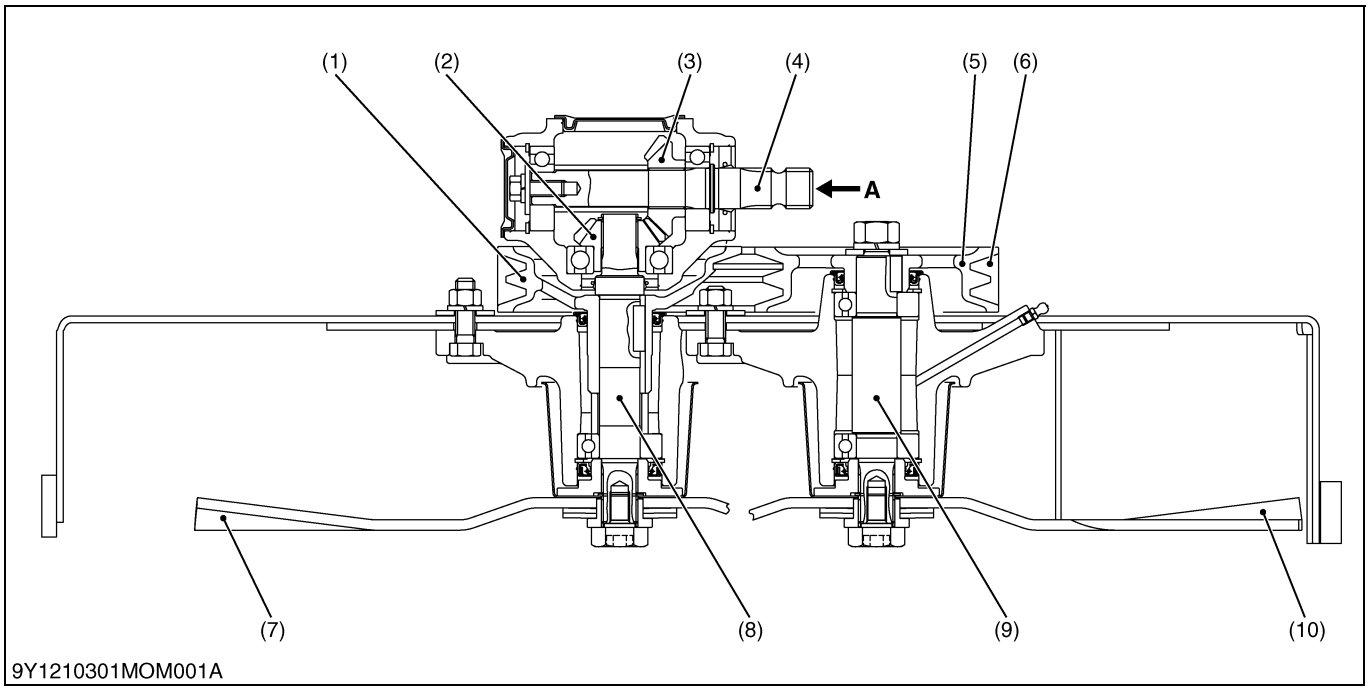
# 6 MOWER

# MECHANISM

## CONTENTS

# 1. POWER TRANSMISSION

**[RCK60P-326Z-EU]**

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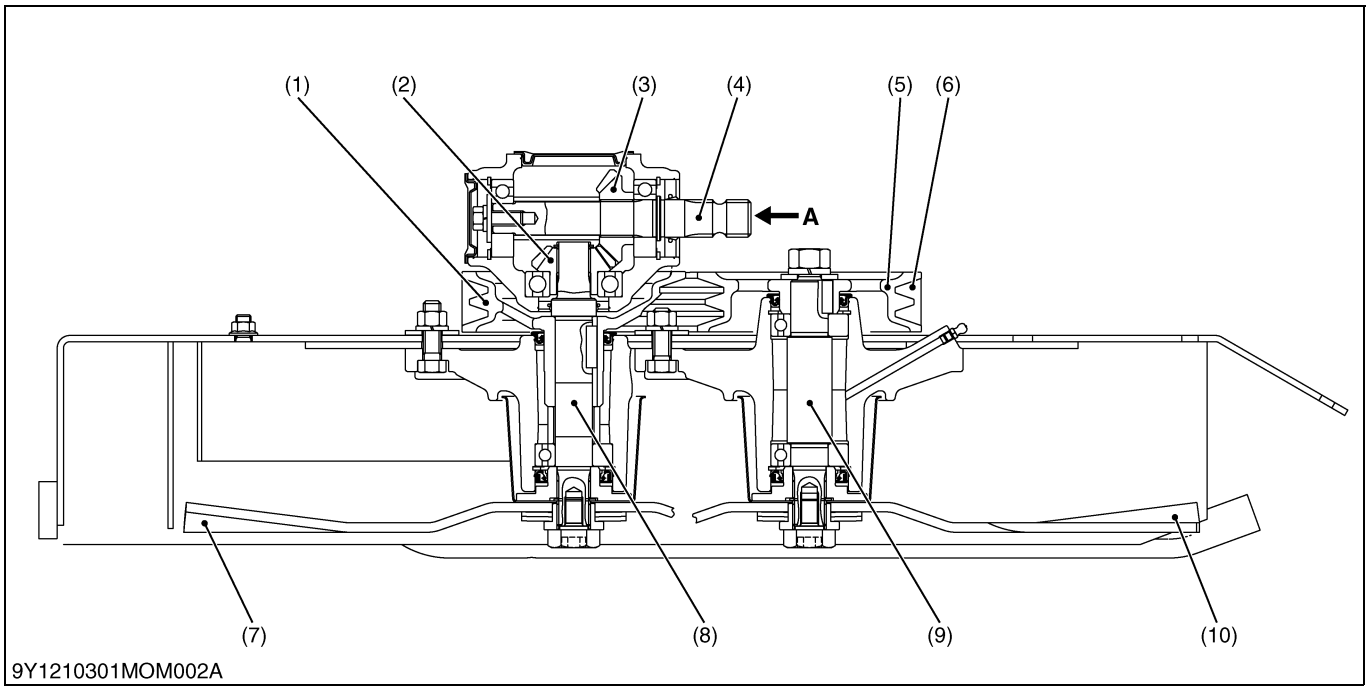
**[RCK60R-326Z-EU]**




9Y1210301MOM002A

(1) Center Pulley
(2) 17T Bevel Gear
(3) 18T Bevel Gear
(4) Pinion Shaft
(5) Outer Pulley
(6) Mower Belt
(7) Center Blade
(8) Bevel Gear Shaft
(9) Blade Shaft
(10) Outer Blade

**A: From PTO Shaft**

The power is transmitted from mid-PTO to blades as follows.

■ **Center Blade**

From PTO Shaft **"A"** → Pinion Shaft (4) → Bevel Gear (3) → Bevel Gear (2) → Bevel Gear Shaft (8) → Center Blade (7)

■ **Outer Blade**

From PTO Shaft **"A"** → Pinion Shaft (4) → Bevel Gear (3) → Bevel Gear (2) → Bevel Gear Shaft (8) → Center Pulley (1) → Mower Belt (6) → Outer Pulley (5) → Blade Shaft (9) → Outer Blade (10)

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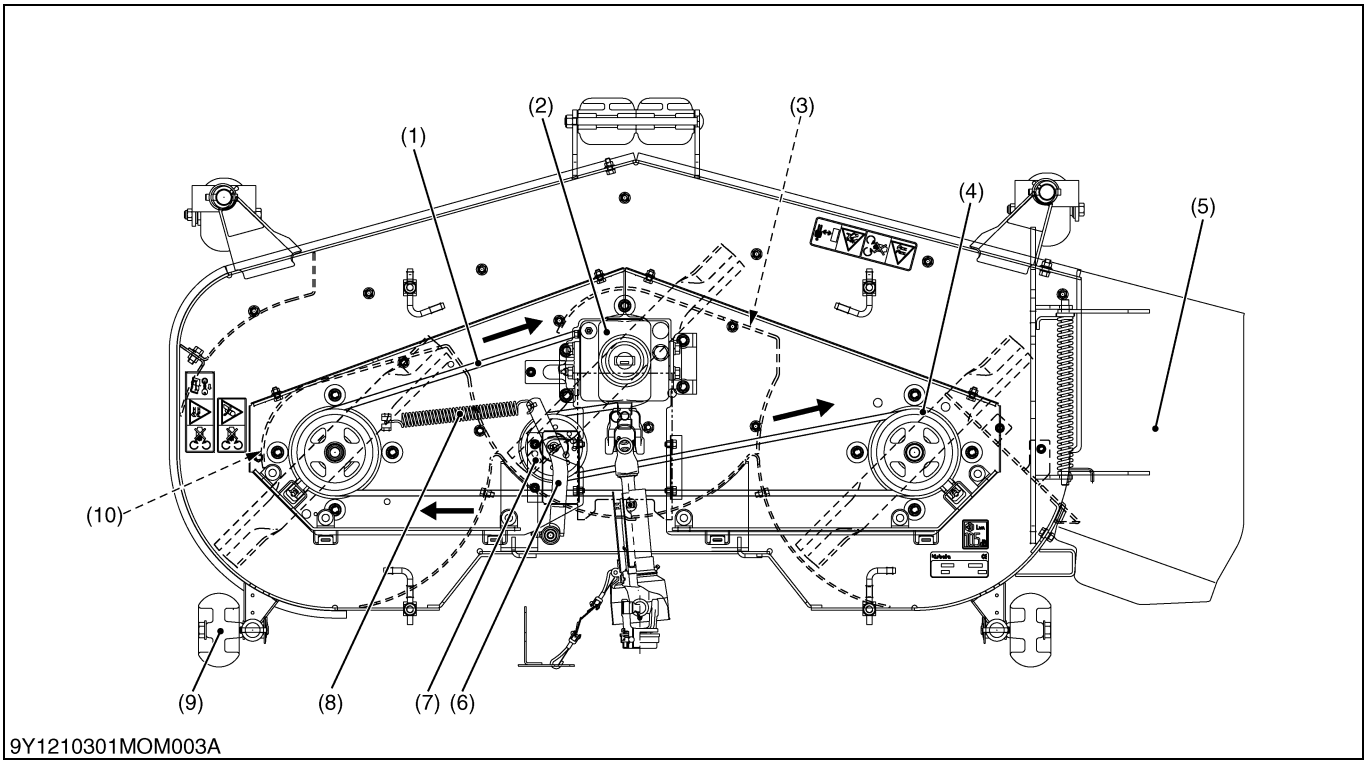
**[RCK60P-326Z-EU]**




9Y1210301MOM003A

(1) Mower Belt
(2) Gear Box
(3) Baffle Plate
(4) Pulley
(5) Discharge Cover
(6) Tension Arm
(7) Tension Pulley
(8) Tension Spring
(9) Anti-Scalp Roller
(10) Baffle Plate

The method of power transmission is the same between the side discharge type and rear discharge type.

The mower belt(1) and all blades turn clockwise. There are baffle plates(3)(10) in the mower deck. They make discharge channels of cut grass according to the discharge directions.

9Y1210301MOM0002US0

# SERVICING

## CONTENTS

# 1. TROUBLESHOOTING

| Symptom | Probable Cause | Solution | Reference Page |
|---|---|---|---|
| **Blade Does Not Turn** | PTO system malfunctioning | Check transmission | 2-S1 |
| | Broken mower belt | Replace mower belt | 6-S12 |
| **Blade Speed Is Slow** | Loosen mower belt | Replace mower belt or tension spring | 6-S12 |
| | Clogged grass | Remove grass | – |
| | Flattened out or worn cup washer | Replace cup washer | 6-S11 |
| | Engine rpm too low | Mow at full throttle, check and reset engine rpm | |
| **Cutting Is Poor** | Worn or bent mower blade | Sharpen or replace mower blade | G-40, 6-S11 |
| | Loosen mower blade screw | Retighten mower blade screw | 6-S11 |
| | Cutting height improper | Adjust cutting height | 6-S4 to 6-S6 |
| | Ground speed too fast | Slow-down | – |
| | Low wheel inflation | Add air to correct | G-17 |
| | Anti-scalp rollers not adjusted correctly | Adjust anti-scalp rollers | 6-S4 |
| **Mower Is Not Lifted** | Broken linkage system | Replace linkage system | 4-M7 |
| | Trouble of hydraulic system | Check hydraulic system | 4-S1 |

9Y1210301MOS0001US0

# 2. SERVICING SPECIFICATIONS

| Item | | Factory Specification | Allowable Limit |
|---|---|---|---|
| Pinion Shaft (without Mower Belt) | Turning Force | Less than<br>117.7 N<br>12.0 kgf<br>26.5 lbf | – |
| | Turning Torque | Less than<br>1.47 N·m<br>0.15 kgf·m<br>1.08 lbf·ft | – |
| Bevel Gears in Gear Box | Backlash | 0.1 to 0.2 mm<br>0.0039 to 0.0078 in. | 0.4 mm<br>0.157 in. |
| Front Tip of Blade to Rear Tip of Blade | Difference | 0 to 6.0 mm<br>0 to 0.24 in. | – |
| Left Tip of Blade to Right Tip of Blade | Difference | Less than<br>3 mm<br>0.1 in. | – |

9Y1210301MOS0002US0

# 3. TIGHTENING TORQUES

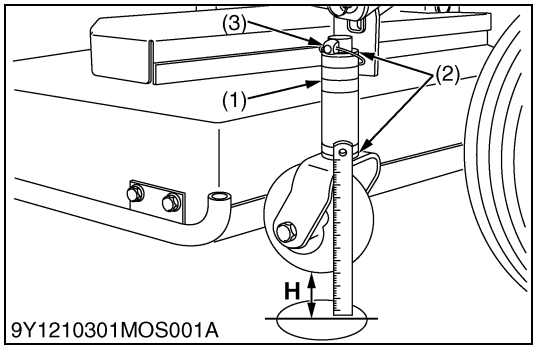
Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts: See page G-11.)

| Item | N·m | kgf·m | lbf·ft |
|---|---|---|---|
| Mower blade screw | 98.1 to 117 | 10.0 to 12.0 | 72.4 to 86.7 |
| Gear box mounting screw (Standard type / Reamer type) | 79 to 90 | 8.0 to 9.2 | 58 to 66 |
| Center pulley holder screw (Standard type / Reamer type) | 79 to 90 | 8.0 to 9.2 | 58 to 66 |
| Outer pulley mounting nut | 167 to 186 | 17.0 to 19.0 | 123 to 137 |
| Pulley holder mounting screw | 78 to 90 | 7.9 to 9.2 | 58 to 66 |

9Y1210301MOS0003US0

# 4. CHECKING, DISASSEMBLING AND ASSEMBLING

## [1] CHECKING AND ADJUSTING



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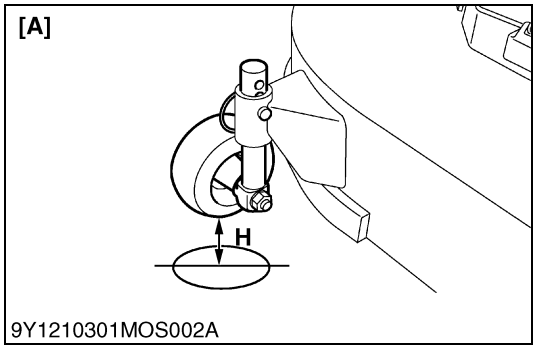

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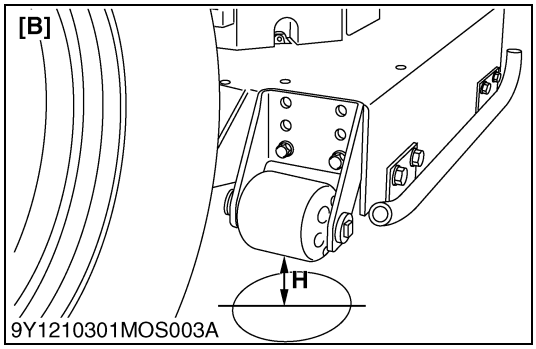


9Y1210301MOS003A

**Adjusting Anti-scalp Rollers**

**⚠ CAUTION**

**To avoid personal 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 adjusting the anti-scalp rollers to be off the ground.**
- **Check anti-scalp roller adjustments each time the mower deck cutting height is changed.**
- **It is recommended that all the anti-scalp rollers be kept off the ground to minimize scuffing.**

1. Check the machine wheel pressure.
   Inflate wheels to the correct pressure. (See table below.)

| | Inflation Pressure |
|---|---|
| Front wheel | 160 kPa, 1.6 kgf/cm$^2$, 23 psi |
| Rear wheel | 120 kPa, 1.2 kgf/cm$^2$, 17 psi |

2. Start the engine.
3. Raise up the mower deck to the transport position.
   (Also the top end of the lift.)
4. Turn the cutting height control dial to adjust height.
5. Lower the mower deck.

■ **Front side anti-scalp roller**

6. Adjust the height **"H"** of the front side anti-scalp roller by adding or removing the collar (1) to approximately 19 mm (0.75 in.) between rollers and ground. Adjust both side rollers to the same height.
7. Install the roller with attaching hardware.

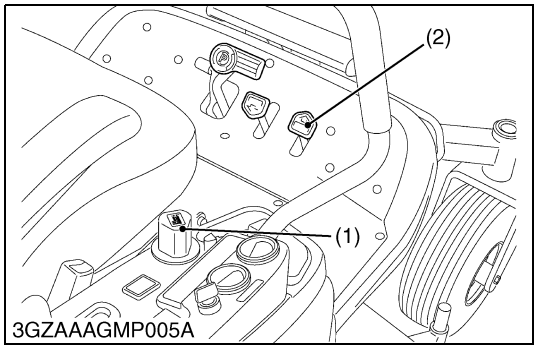
■ **Rear side anti-scalp roller**

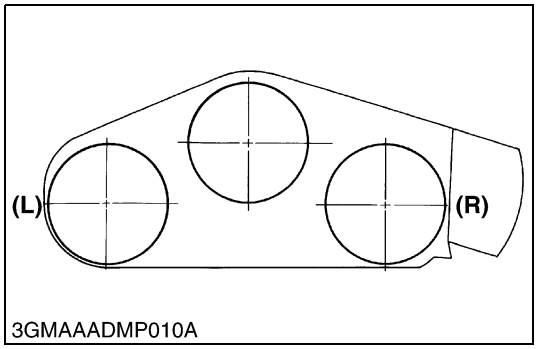
8. Adjust height **"H"** of the rear side anti-scalp roller to one of hole positions to approximately 19 mm (0.75 in.) between rollers and ground. Adjust both side rollers to the same height.
9. Install the roller with attaching hardware.

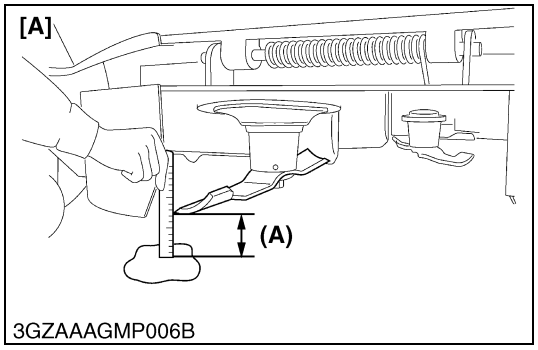
(1) Collar
(2) Washer
(3) Set Pin

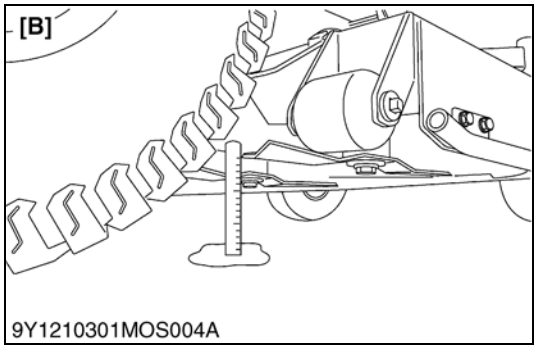
**[A] RCK60P-326Z-EU**
**[B] RCK60R-326Z-EU**
**H: Height**

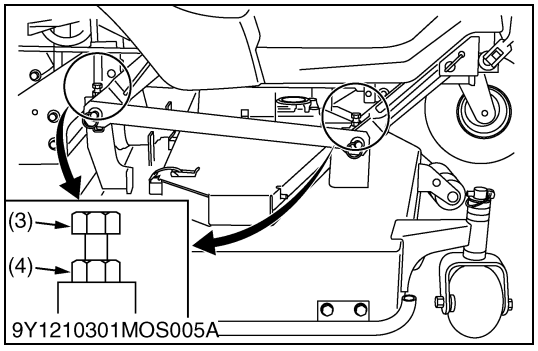
9Y1210301MOS0004US0




## Leveling Mower Deck (Side to Side)

**CAUTION**

**To avoid personal injury ;**

- **Park the machine on a firm and level surface.**
- **Apply the parking brake.**
- **Disengage PTO (OFF).**
- **Stop the engine, remove the key.**
- **Remove the mower u-joint while checking or adjusting the level of the mower deck.**

1. Tire 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 for safety.
   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.) blade height **(A)**.
   Front and rear side bolts must be adjusted.
9. Lock the lock nuts (4).
10. Adjust the left side equally.
11. **At the measurement positions (L)** and **(R)**, measure the blade height **(A)** from the ground surface and calculate the difference.
12. If the difference between left tip and right tip of blade is not within the factory specification, adjust the length of cutting height fine tuning bolt (3).

| | | |
|---|---|---|
| Difference **(L)** - **(R)** between left tip and right tip of blade | Factory specification | Less than 3 mm 0.1 in. |

(1) Cutting Height Control Dial
(2) Hydraulic Lift Control Pedal
(3) Cutting Height Fine Tuning Bolt
(4) Lock Nut

**(L) Left Blade Measurement Position**
**(R) Right Blade Measurement Position**
**(A) Blade Height**

**[A] RCK60P-326Z-EU**
**[B] RCK60R-326Z-EU**

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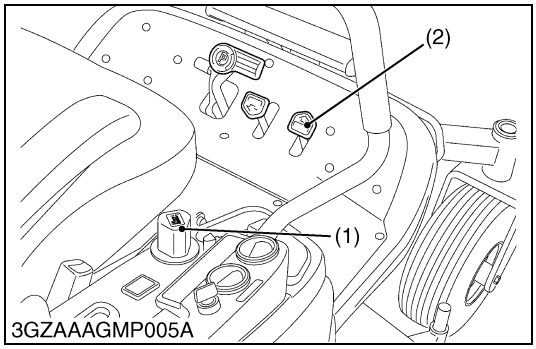


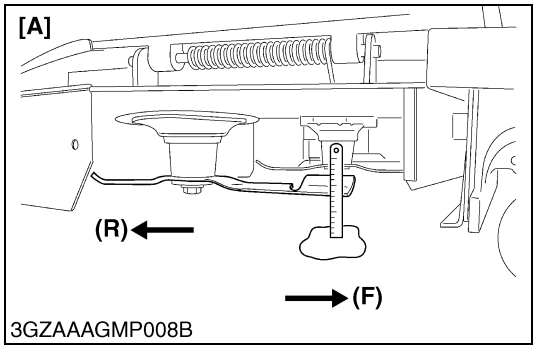


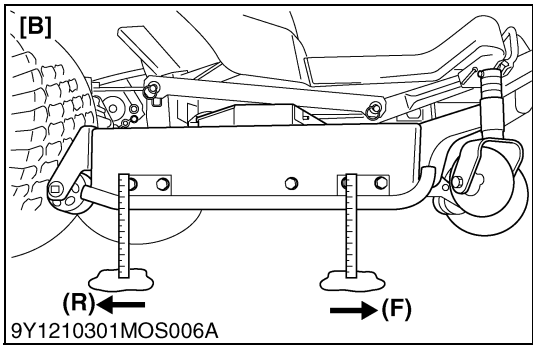


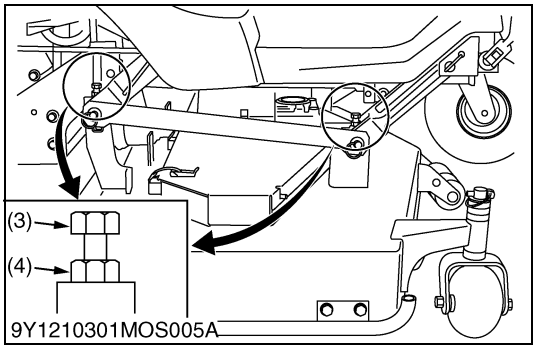


## Leveling Mower Deck (Front to Rear)

**CAUTION**

**To avoid personal injury:**

- **Park the machine on a firm and level surface.**
- **Engage the parking brake.**
- **Disengage PTO.**
- **Stop the engine, remove the key.**
- **Remove the mower u-joint while checking or adjusting the level of the mower deck.**

1. Tire 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 for safety. 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.) blade height. Both front side bolts (3) must be adjusted.
8. Lock the lock nuts (4).
9. Adjust the other side equally.
10. Measure the heights of blade **(F)** and **(R)** 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 of cutting height fine tuning bolt (3) with lock nut (4). The height of rear blade tip **(R)** should be bigger than the front.

| | | |
|---|---|---|
| Difference **(R)** – **(F)**<br>**(R)** ≥ **(F)** between front tip and rear tip of blade | Factory specification | 0 to 6.0 mm<br>0 to 0.24 in. |

(1) Cutting Height Control Dial
(2) Hydraulic Lift Control Pedal
(3) Cutting Height Fine Tuning Bolt
(4) Lock Nut

**(F) Height of Blade Tip (Front)**
**(R) Height of Blade Tip (Rear)**

**[A] RCK60P-326Z-EU**
**[B] RCK60R-326Z-EU**

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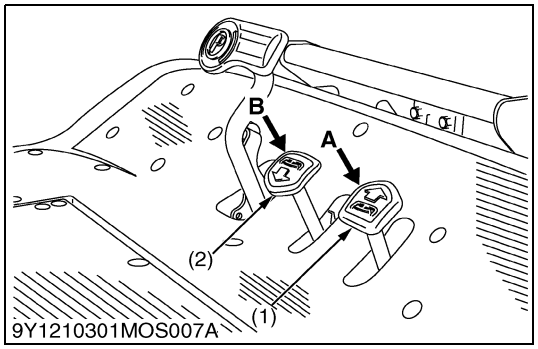
# [2] DISASSEMBLING AND ASSEMBLING

## (1) Dismounting Mower




**Raising Mower**

**CAUTION**

**To avoid personal injury:**

- **Park the machine on a firm and level surface.**
- **Apply the parking brake.**
- **Stop the engine, remove the key.**

1. To raise the mower to the full up position, start the engine, depress the hydraulic lift control pedal (UP) (1).
2. Stop engine.

(1) Hydraulic Lift Control Pedal (UP) **A: UP**
(2) Hydraulic Lift Control Pedal (DOWN) **B: DOWN**

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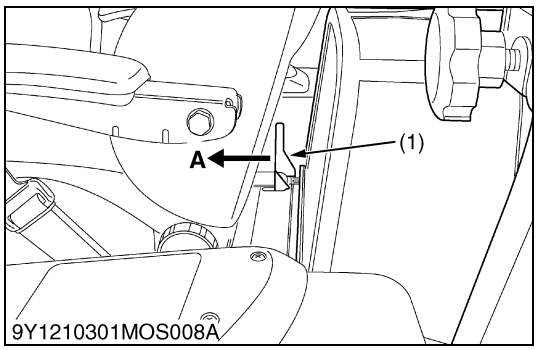


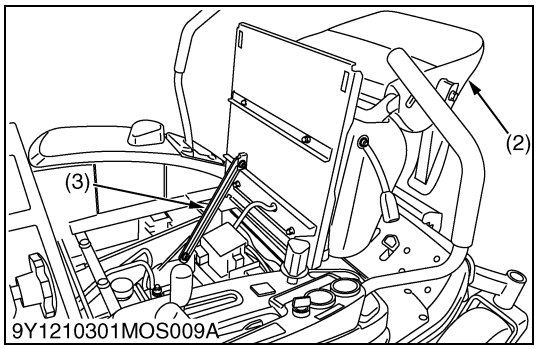


**Raising Seat**

**CAUTION**

**To avoid personal injury:**

- **Fully raise the operator's seat.**
  **(To the locked position)**
  **Do not keep the seat halfway.**

1. Seat must be all the way back before raising.
2. Pull the latch lever (1) on the seat panel frontward.
3. Raise the operator's seat to the "LOCK" position.

(1) Latch Lever **A: "PULL"**
(2) Operator's Seat
(3) Seat Support Rod

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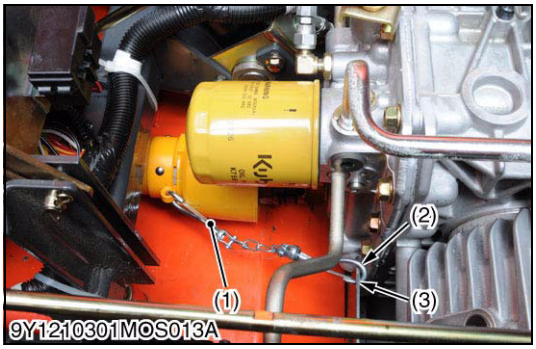


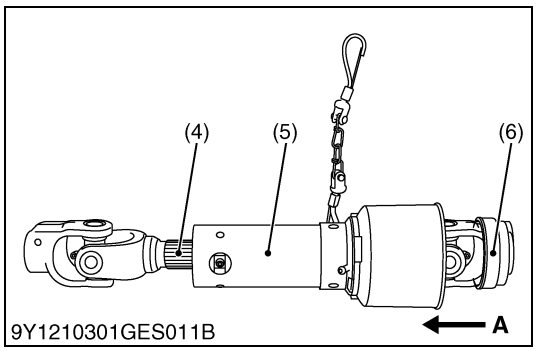


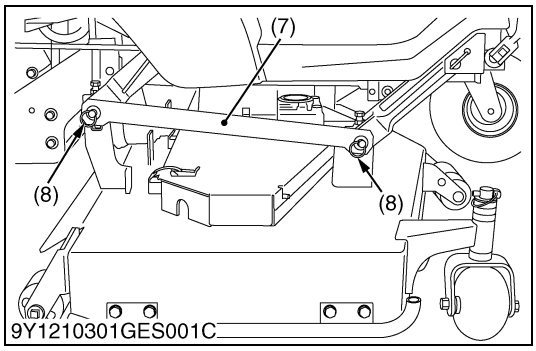


## Uninstalling Universal Joint

1. Unhook the chain (1) from the hole (3) of the stay.
2. Push the coupler (6) of the universal joint (4).
3. Remove the universal joint from PTO shaft.
4. Place 50 mm (2 in.) wood block under each side of the mower deck.
5. Lower the mower.
6. Remove clevis pins from lift links LH, RH (7).
7. Remove lift links LH, RH (7).

(1) Chain
(2) Hook
(3) Hole
(4) Universal Joint
(5) Coupler
(6) Universal Joint Cover
(7) Lift Link
(8) Clevis Pin, Plain Washer, Snap Ring

**A: "PUSH"**

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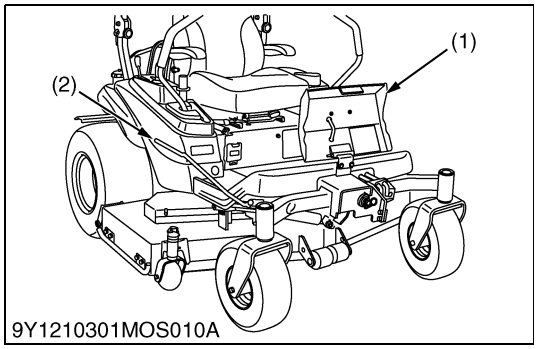


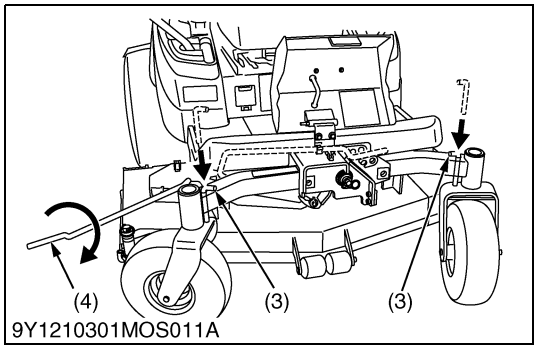


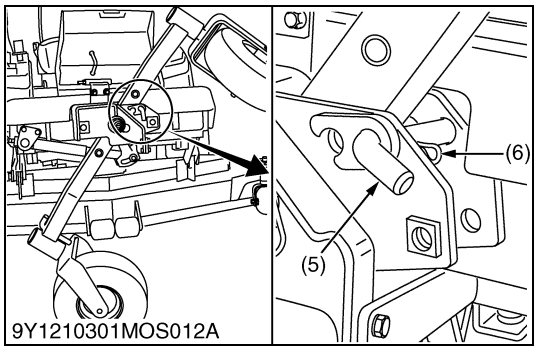


**Tilting up Machine**

**WARNING**

**To avoid personal injury or death:**

- **Park the machine on a firm and level surface.**
- **Set the mower deck height to 5 inch.**
- **Stop the engine, remove the key and engage the parking brake.**
- **Be sure to chock the wheels.**
- **Lock the raised axle with an L-pin and hairpin cotter before working under the machine.**

1. Lower the forward right anti-scalp roller to the lowest position.
2. Fully open the front cover (1).
3. Unfold the tilt lever (2).
4. Keep the front cover open.
5. Remove two L-pins (3).
6. Insert L-pins to both sides of the front axle to position the front wheels. See picture.
7. Turn the tilt lever (4) clockwise to raise the axle to the stop.
8. Remove the L-pin of the raised wheel and insert it to the outside hole of the frame.
9. Insert the hairpin cotter (6).
10. Slide out the mower deck from the machine.

■ Return to the normal position.
Reverse the above steps.

(1) Front Cover
(2) Tilt Lever
(3) L-Pin
(4) Tilt Lever
(5) L-Pin
(6) Hairpin Cotter

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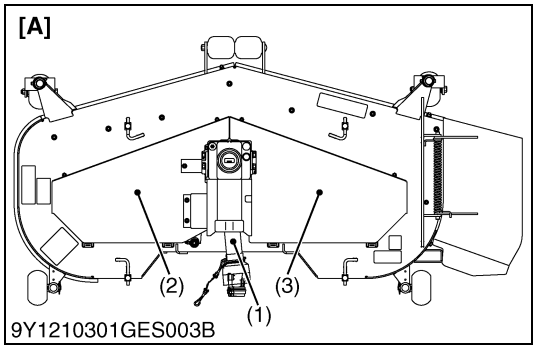
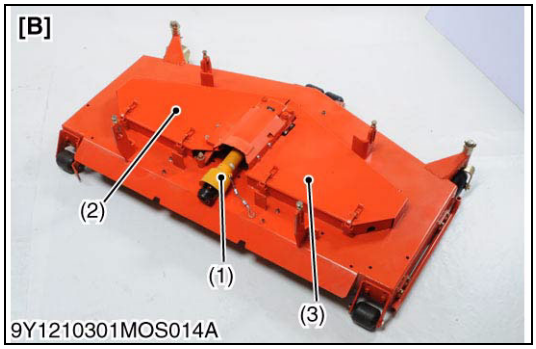
# (2) Disassembling and Assembling





## Universal Joint and Belt Covers

1. Remove the universal joint (1).
2. Remove the left and right belt covers (2), (3).

(1) Universal Joint
(2) Belt Cover (Left)
(3) Belt Cover (Right)

**[A] RCK60P-326Z-EU**
**[B] RCK60R-326Z-EU**

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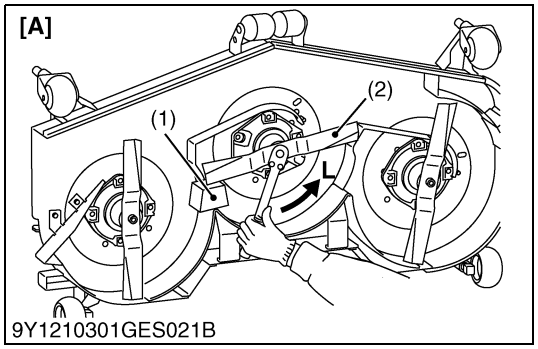


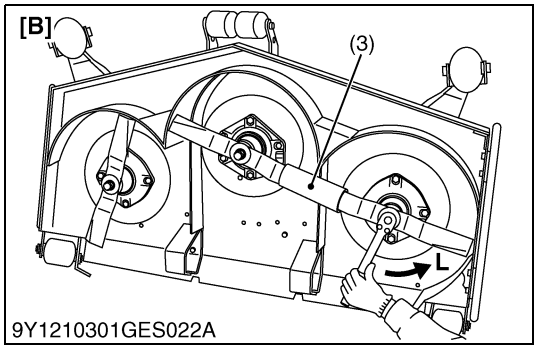


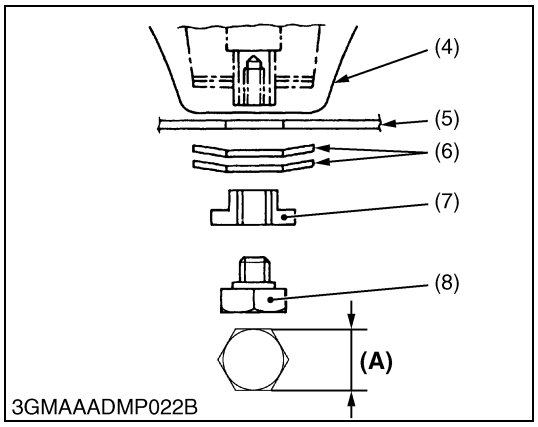


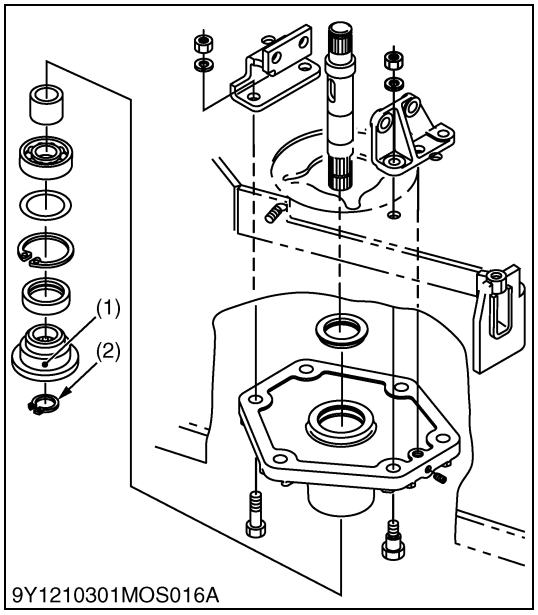


## Mower Blades (Center Blade and Outer Blades)

1. Turn over the mower.
2. **[RCK60P]**
   Wedge a block of wood (1) between the blade (2) and mower housing or use a box wrench over the pulley nut to prevent the spindle from rotating while removing the blade screws.
   **[RCK60R]**
   Set the pipe (3) 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 screws.
3. Loosen the blade screws as illustrated.

■ **IMPORTANT**

- **Use the proper metric size box or socket wrench to tighten or loosen the blade screws.**

4. Remove the blade screw (8), the spline boss (7), two cup washers (6), mower blade (5) and dust cover (4).

**(When reassembling)**

- Be sure to assemble the two cup washers (6) between the mower blade and spline boss.

■ **IMPORTANT**

- **Make sure the cup washer is not flattened out or worn, causing blade to slip easily.**
  **Replace two cup washers if either is damaged.**

| | | |
|---|---|---|
| Tightening torque | Mower blade screw | 98.1 to 117 N·m<br>10.0 to 12.0 kgf·m<br>72.4 to 86.7 lbf·ft |

(1) Wood Block
(2) Blade
(3) Pipe
(4) Dust Cover
(5) Mower Blade
(6) Cup Washer
(7) Spline Boss
(8) Blade Screw

**L: Loosen**

**[A] RCK60P-326Z-EU**
**[B] RCK60R-326Z-EU**

**(A) 30mm (1-3/16 in.)**

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## Blade Boss

1. Remove the external snap ring (2).
2. Remove the blade boss (1).

(1) Blade Boss
(2) External Snap Ring

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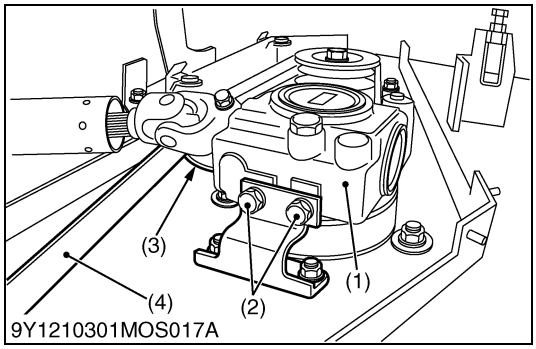

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## Gear Box and Mower Belt Replacing

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

**(When reassembling)**

- Install the reamer screws at their original positions as shown in the figure.

| | | |
|---|---|---|
| Tightening torque | Gear box mounting screw | 79 to 90 N·m<br>8.0 to 9.2 kgf·m<br>58 to 66 lbf·ft |

(1) Gear Box
(2) Gear Box Mounting Screw
(3) Tension Pulley
(4) Mower Belt

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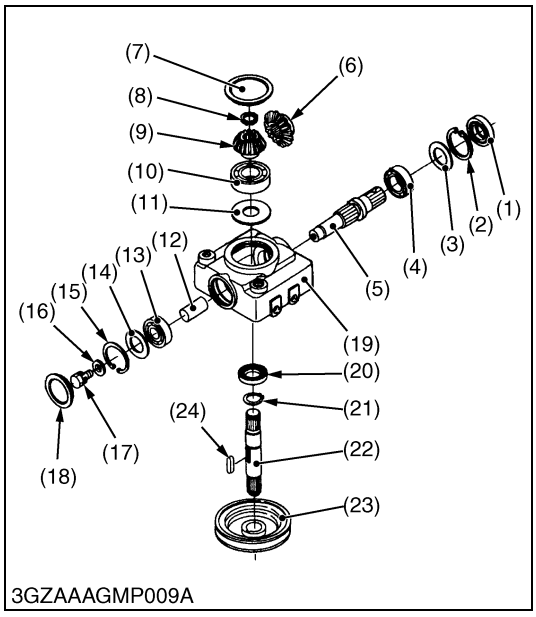

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## Disassembling Gear Box

1. Unscrew the drain plug, and drain the gear box oil.
2. Remove the center pulley (23) with a puller, and remove the feather key (24) on the bevel gear shaft.
3. Remove the gear box caps (7), (18).
4. Remove the oil seal (1), external snap ring (2) and shim (3).
5. Remove the screw (17), washer (16) and tap out the pinion shaft (5) with ball bearing (4).
6. Remove the bevel gear (6) and pinion shaft collar (12).
7. Remove the internal snap ring (15) and shims (14).
8. Remove the ball bearing (13).
9. Remove the external snap ring (8), and draw out the bevel gear shaft (22).
10. Remove the bevel gear (9) with ball bearing (10).

**(When reassembling)**

- Replace the oil seals (1), (20) and gear box caps (7), (18) with new ones
- Check the backlash and turning torque.
  If not proper, adjust with the shims (3), (11) and (14). (See page 6-S11, 6-S12.)

(1) Oil Seal
(2) Internal Snap Ring
(3) Shim
(4) Ball Bearing
(5) Pinion Shaft
(6) 18T Bevel Gear
(7) Gear Box Cap
(8) External Snap Ring
(9) 17T Bevel Gear
(10) Ball Bearing
(11) Shim
(12) Pinion Shaft Collar
(13) Ball Bearing
(14) Shim
(15) Internal Snap Ring
(16) Washer
(17) Screw
(18) Gear Box Cap
(19) Gear Box
(20) Oil Seal
(21) External Snap Ring
(22) Bevel Gear Shaft
(23) Center Pulley
(24) Feather Key

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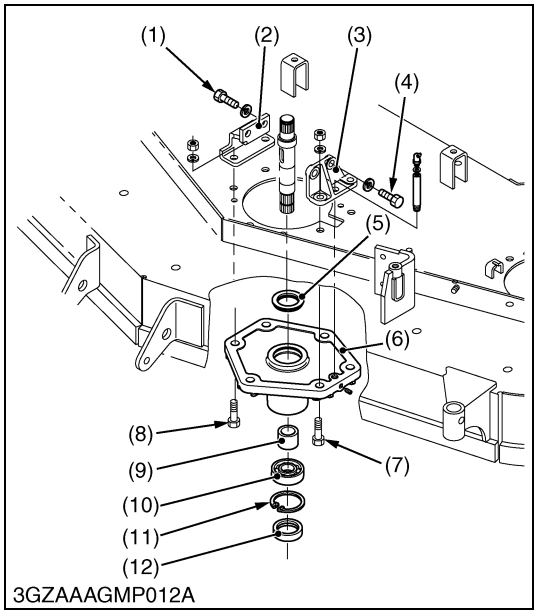

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**Center Pulley Holder**

1. Unscrew the center pulley holder screws (8) and reamer screws (7).
2. Remove the upper oil seal (5) and lower oil seal (12).
3. Remove the internal snap ring (11) and ball bearing (10).

**(When reassembling)**

- Replace the oil seals (5), (12) with new ones.
- Install the reamer screws (10) at their original positions as shown in the figure.

■ **NOTE**

- **When reassembling the center pulley holder (6), gear box and gear box stays (2), (3), screw the all screws by hand temporary.**
- **Tighten the screws in the order as below, to prevent the incline the gear box.**
- **Tighten the reamer screws (4) to the gear box first, then tighten the reamer screws (7) to the center pulley holder (6) with specified torque.**
- **Tighten the gear box screws (1) to the gear box, then tighten the center pulley holder screws (8) with specified torque.**
- **See page 6-S12 for tightening torque of gear box screw.**

| | | |
|---|---|---|
| Tightening torque | Center pulley holder screw (Standard type / Reamer type) | 79 to 90 N·m<br>8.0 to 9.2 kgf·m<br>58 to 66 lbf·ft |

(1) Gear Box Screw
(2) Gear Box Stay RH
(3) Gear Box Stay LH
(4) Gear Box Reamer Screw
(5) Oil Seal
(6) Center Pulley Holder
(7) Center Pulley Holder Reamer Screw
(8) Center Pulley Holder Screw
(9) Collar
(10) Ball Bearing
(11) Internal Snap Ring
(12) Oil Seal

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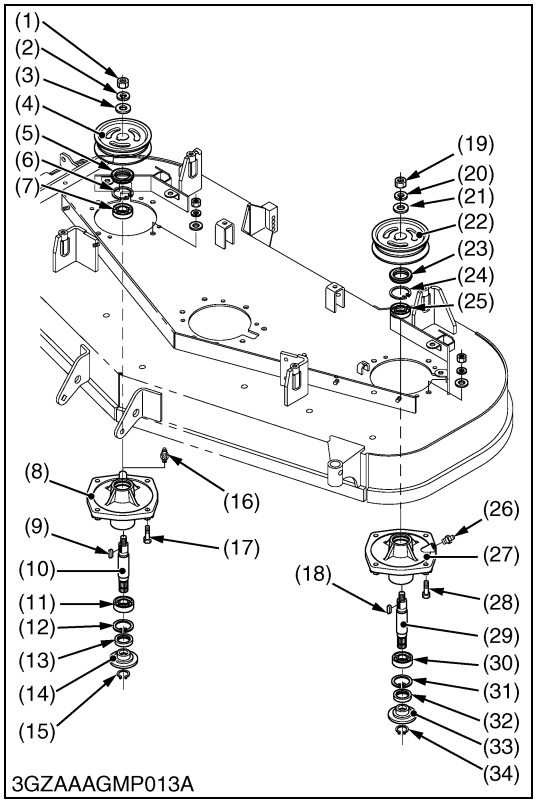

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## Outer Pulley and Blade Shaft

1. Unscrew the outer pulley mounting nut (19), and remove the outer pulley (22) and feather key (18).
2. Unscrew the pulley holder mounting screws (28), and separate the left pulley holder (27) from the mower deck.
3. Remove the external snap ring (34) on the left blade shaft (29).
4. Remove the spline boss (33) and oil seal (32).
5. Remove the internal snap ring (31) and tap out the left blade shaft (29) with the ball bearings (25), (30), taking care not to damage the grease nipple (26).
6. Remove the oil seal (23) and internal snap ring (24).
7. Remove the ball bearings (25), (30) from the blade shaft (29).
8. Remove the right pulley holder (8) and blade shaft (10) as above.

**(When reassembling)**

- Replace the oil seals (32), (23), (13) and (5) with new ones.

| | | |
|---|---|---|
| Tightening torque | Outer pulley mounting nut | 167 to 186 N·m<br>17.0 to 19.0 kgf·m<br>123 to 137 lbf·ft |
| | Pulley holder mounting screw | 78 to 90 N·m<br>8.0 to 9.2 kgf·m<br>58 to 66 lbf·ft |

(1) Outer Pulley Mounting Nut
(2) Spring Washer
(3) Plain Washer
(4) Outer Pulley (Right)
(5) Oil Seal
(6) Internal Snap Ring
(7) Ball Bearing
(8) Pulley Holder (Right)
(9) Feather Key
(10) Blade Shaft (Right)
(11) Ball Bearing
(12) Internal Snap Ring
(13) Oil Seal
(14) Spline Boss
(15) External Snap Ring
(16) Grease Nipple
(17) Pulley Holder Mounting Screw
(18) Feather Key
(19) Outer Pulley Mounting Nut
(20) Spring Washer
(21) Plain Washer
(22) Outer Pulley (Left)
(23) Oil Seal
(24) Internal Snap Ring
(25) Ball Bearing
(26) Grease Nipple
(27) Pulley Holder (Left)
(28) Pulley Holder Mounting Screw
(29) Blade Shaft (Left)
(30) Ball Bearing
(31) Internal Snap Ring
(32) Oil Seal
(33) Spline Boss
(34) External Snap Ring

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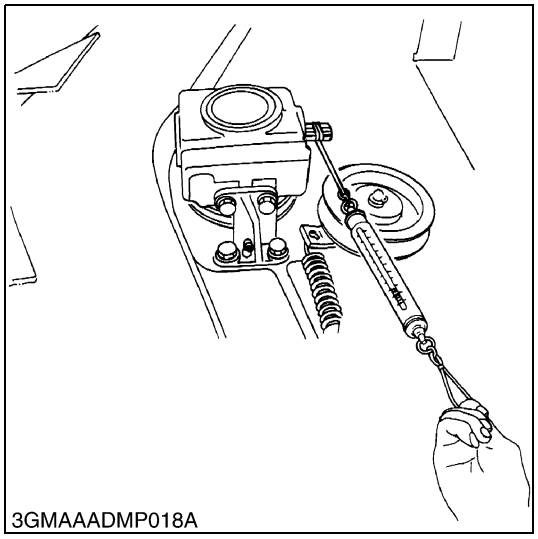
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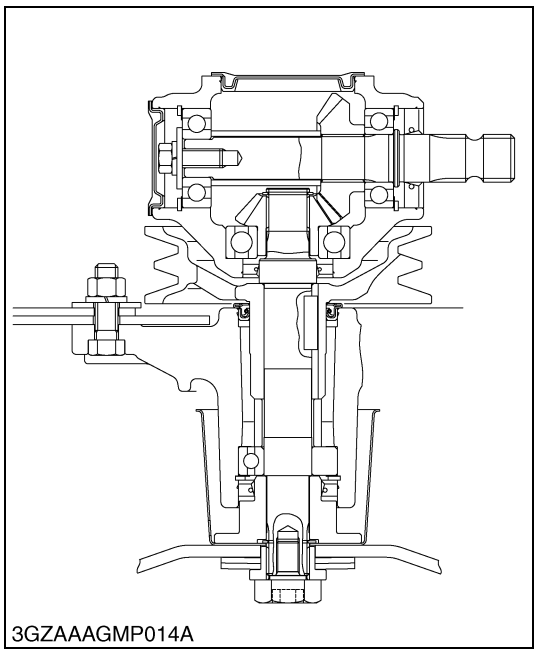
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**Turning Torque of Pinion Shaft**

1. Remove the mower belt, and reassemble the gear box to the mower deck.
2. Wind a string around the pinion shaft and set a spring balance (or push-pull gauge) to the tip of the string, and then slowly pull the spring balance horizontally to measure the turning force.
3. If the measurement exceeds the factory specification, check the bearings and gears.

| | | |
|---|---|---|
| Turning force | Factory specification | Less than<br>117.7 N<br>12.0 kgf<br>26.5 lbf |

| | | |
|---|---|---|
| Turning torque | Factory specification | Less than<br>1.47 N·m<br>0.15 kgf·m<br>1.08 lbf·ft |

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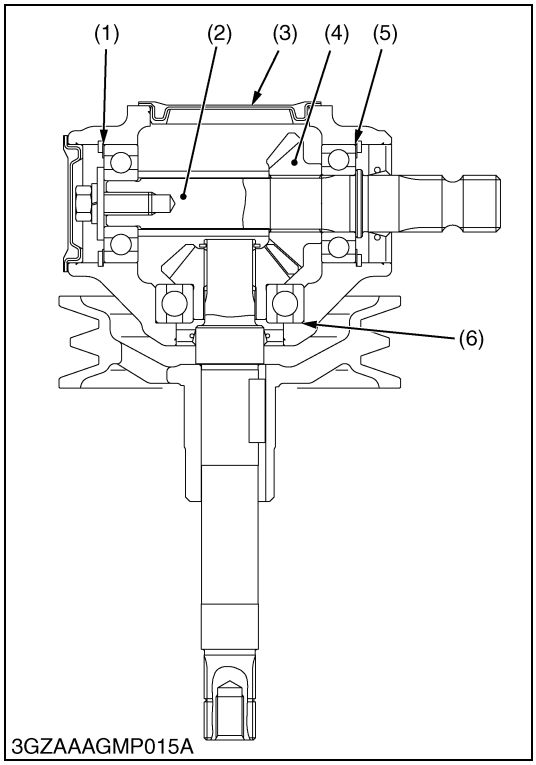


**Backlash between Bevel Gears**

1. Remove the gear box cap (3).
2. Place fuses the bevel gear (4) on the pinion shaft (2).
3. Turn the pinion shaft (2).
4. Take out the fuses, and measure the thickness of fuses with an outside micrometer. (Backlash equal thickness of fuse)
5. If the backlash exceeds the allowable limit, adjust with shims (1), (5), (6).

| | | |
|---|---|---|
| Backlash between bevel gears | Factory specification | 0.13 to 0.25 mm<br>0.0051 to 0.0098 in. |
| | Allowable limit | 0.40 mm<br>0.0157 in. |

**(Reference)**

- Thickness of adjusting shims (1), (4)
  0.2 mm (0.008 in.)
  0.3 mm (0.012 in.)
- Thickness of adjusting shims (6)
  0.1 mm (0.004 in.)
  0.2 mm (0.008 in.)

(1) Shim
(2) Pinion Shaft
(3) Gear Box Cap
(4) Bevel Gear
(5) Shim
(6) Shim

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