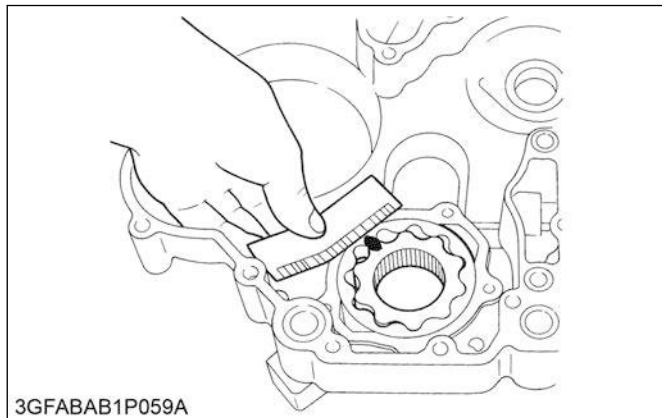


6.6.3 Checking clearance between rotor and cover



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

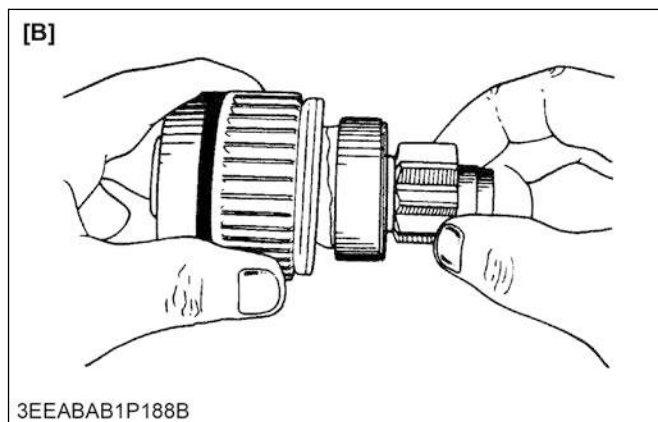
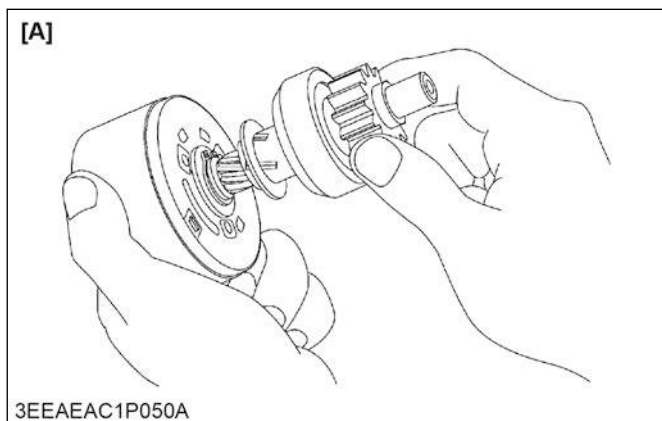
Clearance between rotor and cover	Factory specification	0.025 to 0.075 mm 0.00099 to 0.0029 in.
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6.7 Starter

6.7.1 Checking overrunning clutch

NOTE

- Do not wash off the grease in the overrunning clutch with the chemicals or oils.

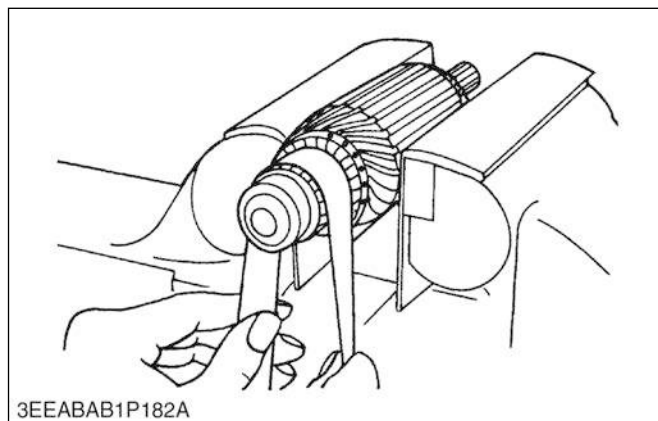


[A] Electromagnetic drive type [B] Planetary gear reduction type

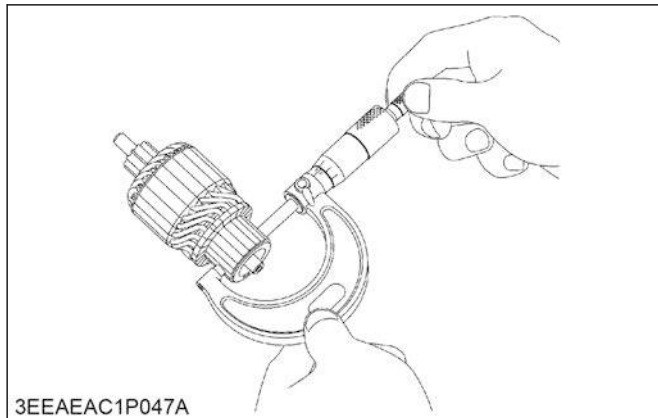
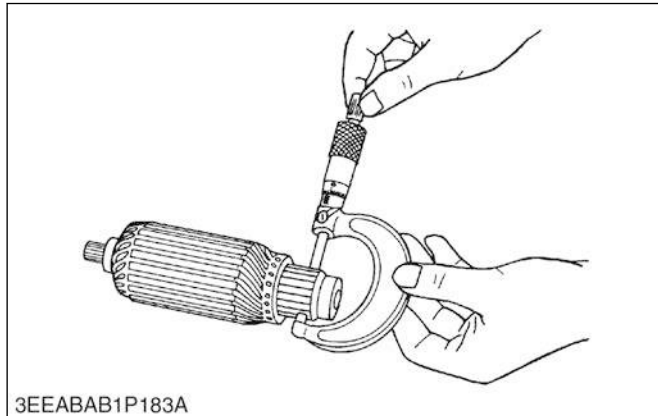
1. Check the pinion and if worn or damaged, replace the clutch assembly.
2. Check that the pinion turns freely and smoothly in the overrunning direction and does not slip in the cranking direction.
3. If the pinion slips or does not turn in both directions, replace the overrunning clutch assembly.

6.7.2 Checking commutator and mica

1. Check the contact of the commutator for wear, and grind the commutator with emery paper if it is slightly worn.



- Measure the commutator O.D. with an outside micrometer at several points.



- If the minimum O.D. is less than the allowable limit, replace the armature.

Electromagnetic drive type

Commutator O.D.	Factory specification	28.0 mm 1.10 in.
	Allowable limit	27.0 mm 1.06 in.

Gear reduction type

Commutator O.D.	Factory specification	30.0 mm 1.18 in.
	Allowable limit	29.0 mm 1.14 in.

- If the difference of the O.D.'s exceeds the allowable limit, correct the commutator on a lathe to the factory specification.

Electromagnetic drive type

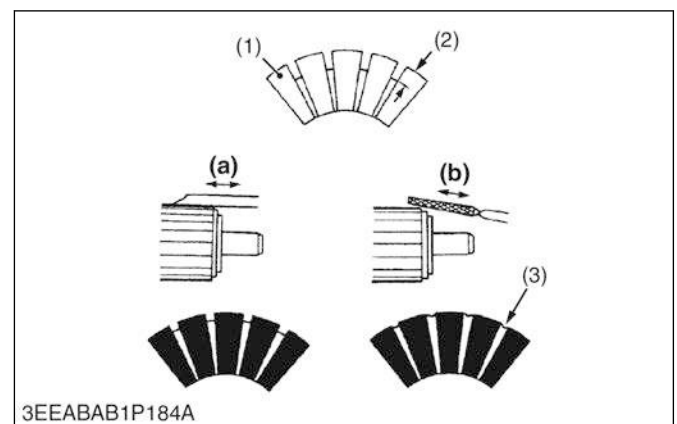
Difference of O.D.'s	Factory specification	Less than 0.05 mm 0.002 in.
	Allowable limit	0.4 mm 0.02 in.

Gear reduction type

Difference of O.D.'s	Factory specification	Less than 0.02 mm 0.0008 in.
	Allowable limit	0.05 mm 0.002 in.

- Measure the mica undercut.
- If the undercut is less than the allowable limit, correct it with a saw blade and chamfer the segment edges.

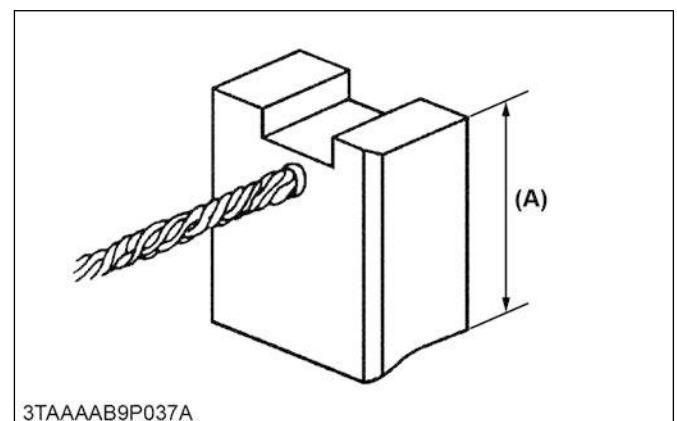
Mica undercut	Factory specification	0.50 to 0.80 mm 0.020 to 0.031 in.
	Allowable limit	0.20 mm 0.0079 in.



- Segment
 - Depth of mica
 - Mica
- Correct
 - Incorrect

6.7.3 Checking brush wear

- If the connect face of the brush is dirty or dusty, clean it with emery paper.
- Measure the brush length (A) with vernier caliper.



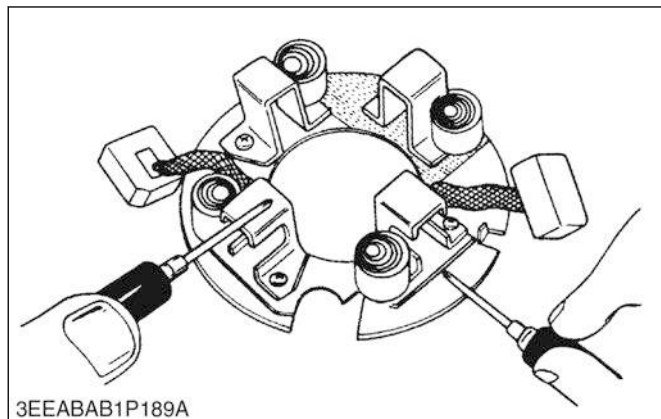
- Brush length

3. If the length is than the allowable limit, replace the yoke assembly and brush holder.

Brush length (A)	Factory speci- fication	16.0 mm 0.630 in.
	Allowable limit	10.5 mm 0.413 in.

6.7.4 Checking brush holder

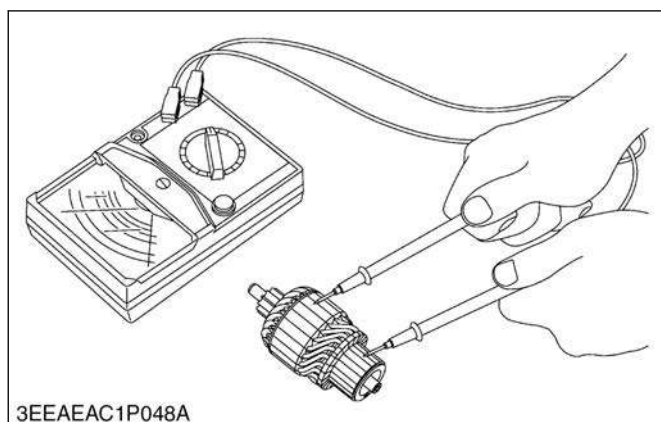
1. Check the continuity across the brush holder and the holder support with a circuit tester.



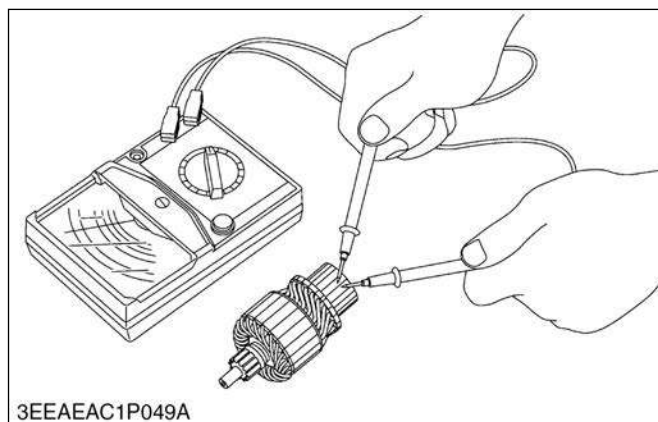
2. If it conducts, replace the brush holder.

6.7.5 Checking armature coil

1. Check the continuity across the commutator and armature coil core with resistance range of circuit tester.



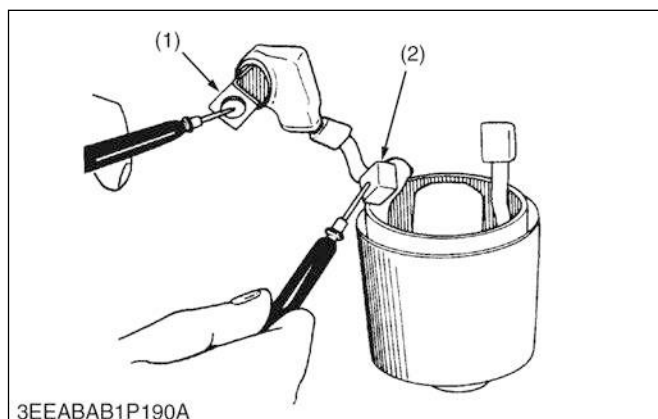
2. If it conducts, replace the armature.
3. Check the continuity across the segments of the commutator with resistance range of circuit tester.



4. If it dose not conduct, replace the armature.

6.7.6 Checking field coil

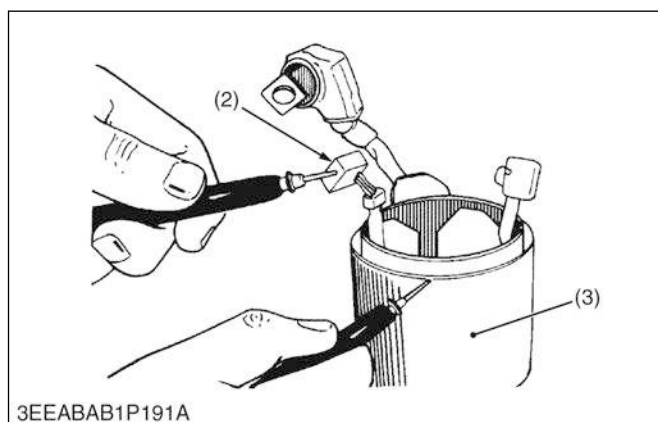
1. Check the continuity across the lead (1) and brush (2) with a circuit tester.



(1) Lead

(2) Brush

2. If it dose not conduct, replace the yoke assembly.
3. Check the continuity across the brush (2) and yoke (3) with a circuit tester.



(2) Brush

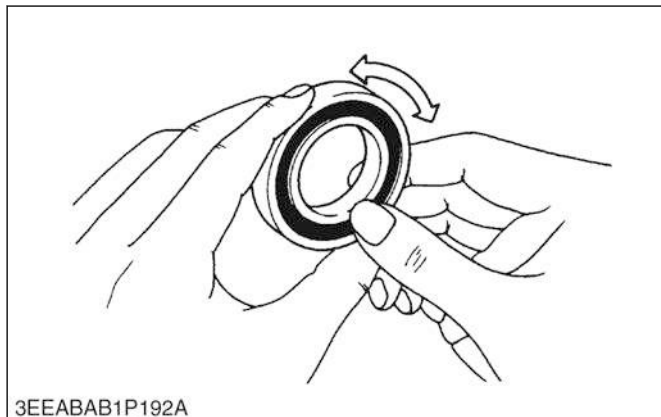
(3) Yoke

4. If it conducts, replace the yoke assembly.

6.8 Alternator

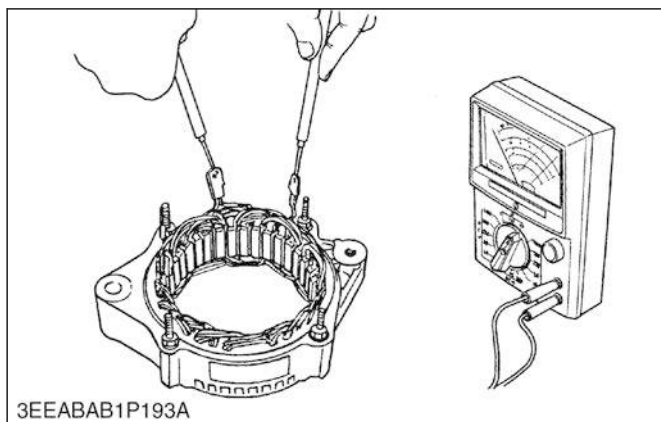
6.8.1 Checking bearing

1. Check the bearing for smooth rotation.



2. If it does not rotate smoothly, replace it.

6.8.2 Checking stator

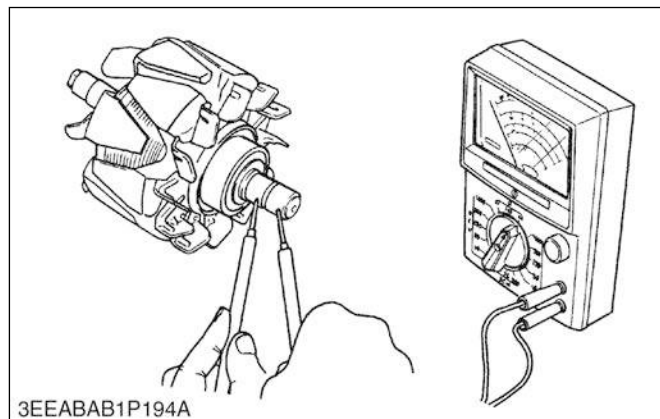


1. Measure the resistance across each lead of the stator coil with resistance range of circuit tester.
2. If the measurement is not within factory specification, replace it.

Resistance	Factory specification	Less than 1.0 Ω
------------	-----------------------	------------------------

3. Check the continuity across each stator coil lead and core with resistance range of circuit tester.
4. If infinity is not indicated, replace it.

6.8.3 Checking rotor

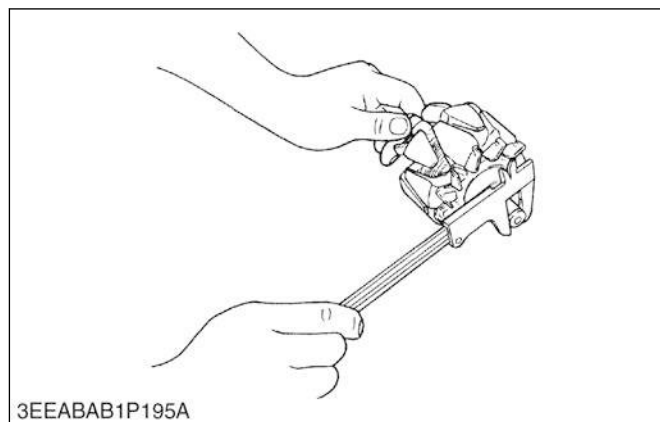


1. Measure the resistance across the slip rings.
2. If the resistance is not the factory specification, replace it.

Resistance	Factory specification	2.9 Ω
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3. Check the continuity across the slip ring and core with resistance range of circuit tester.
4. If infinity is not indicated, replace it.

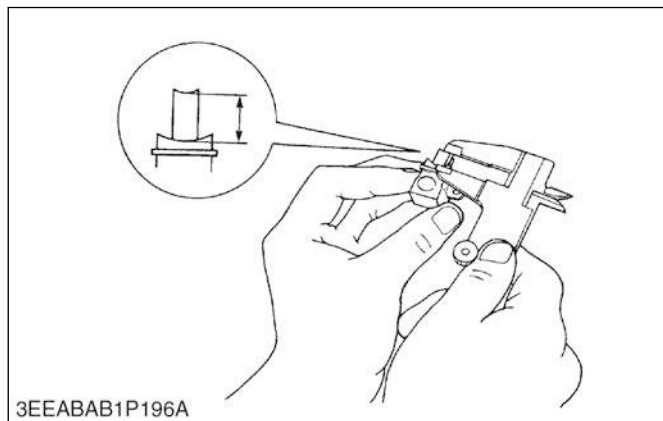
6.8.4 Checking slip ring



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

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

6.8.5 Checking brush wear



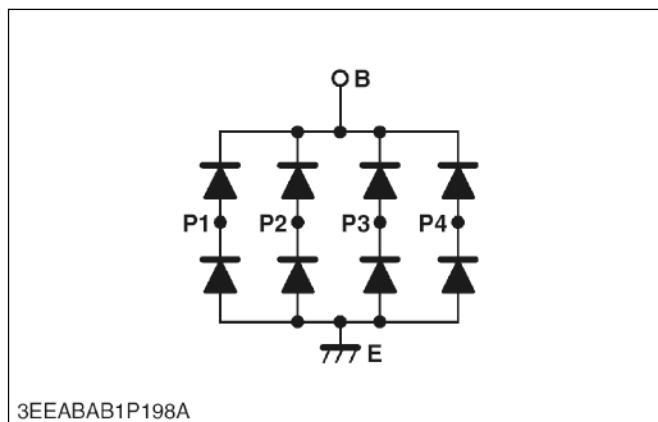
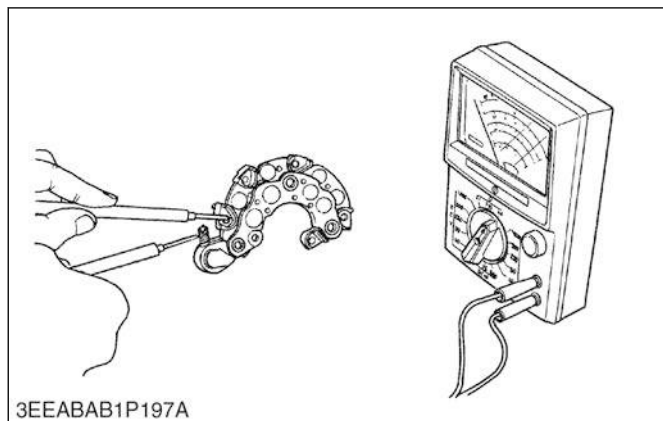
1. Measure the brush length with vernier calipers.
2. If the measurement is less than allowable limit, replace it.

Brush length	Factory specification	10.0 mm 0.394 in.
	Allowable limit	8.4 mm 0.33 in.

3. Make sure that the brush moves smoothly.
4. If the brush is damaged, replace it.

6.8.6 Checking rectifier

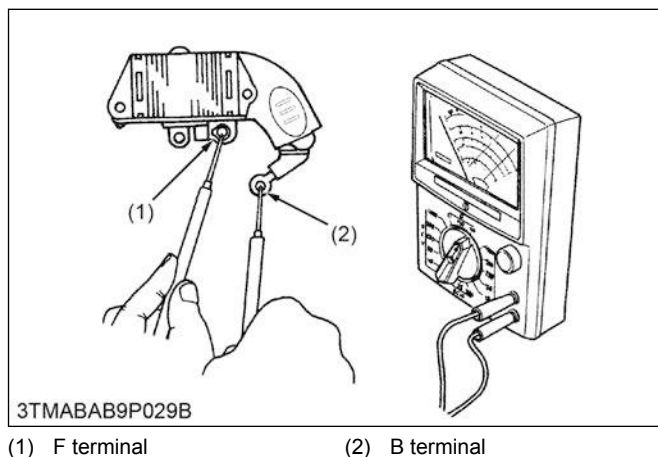
1. Check the continuity across each diode of rectifier with resistance range of circuit tester.



2. The rectifier is normal if the diode in the rectifier conducts in one direction and does not conduct in the reverse direction.

6.8.7 Checking IC regulator continuity

1. Check the continuity across the B terminal (2) and the F terminal (1) of IC regulator with resistance range of circuit tester.



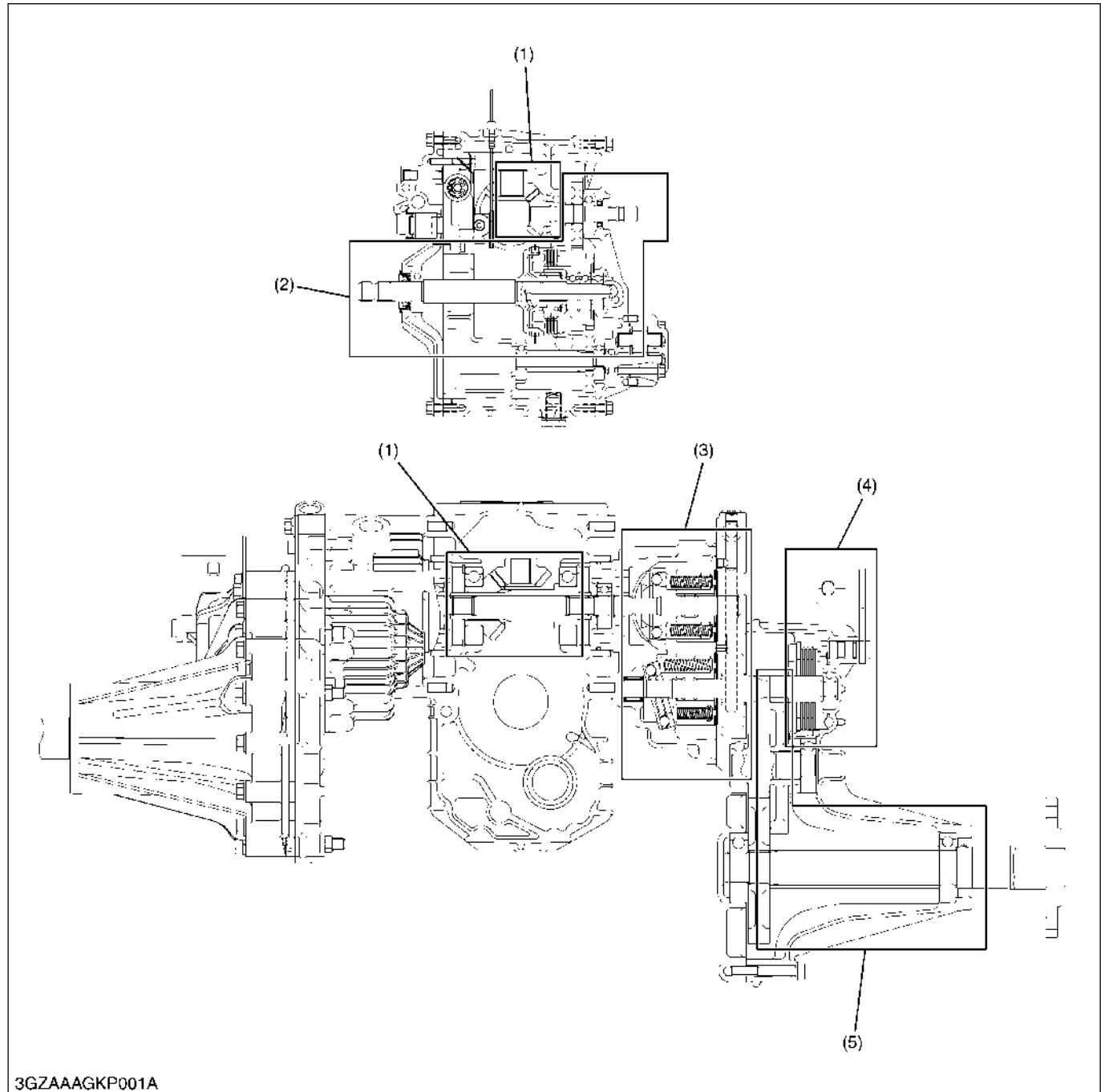
2. The IC regulator is normal if it conducts in one direction and does not conduct in the reverse direction.

4. TRANSAXLE

MECHANISM

1. Structure of transaxle

Transmission consists of bevel gear section (1) hydrostatic transmission (3), brake section (4), final reduction gear section (5), and PTO section (2). Power from engine is transmitted through transmission to mower and rear wheels.



(1) Bevel gear section
(2) PTO section

(3) Hydrostatic transmission
(4) Brake section

(5) Final reduction gear section

1.1 Hydraulic transmission section

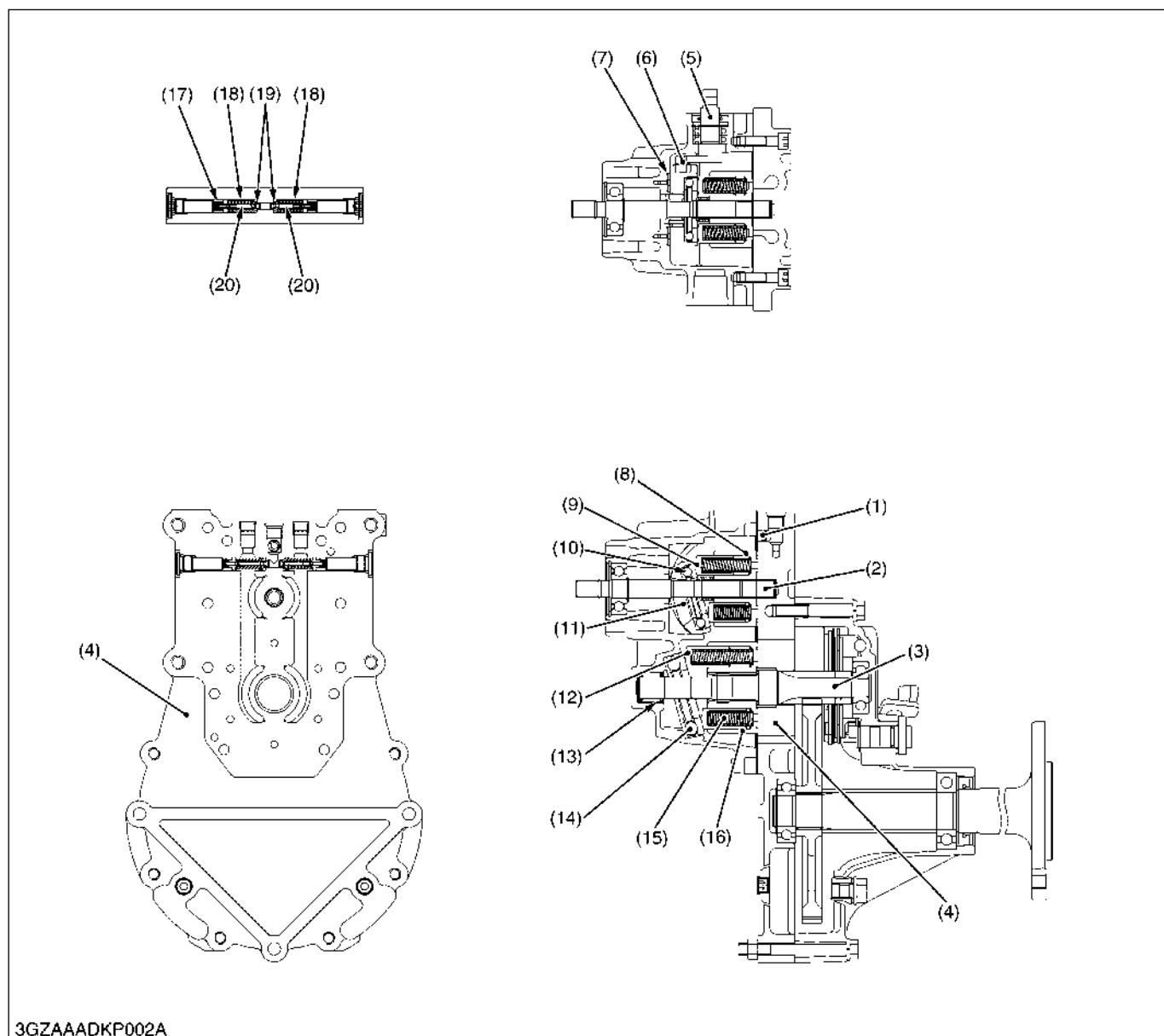
1.1.1 Hydrostatic transmission

1.1.1.1 Function of hydrostatic transmission

Hydrostatic transmissions transmit all power hydraulically, using hydraulic fluid as the power distribution system. It works by converting energy harnessed from the movement of fluid through hydraulic pumps to the drive train of a vehicle.

1.1.1.2 Structure of hydrostatic transmission

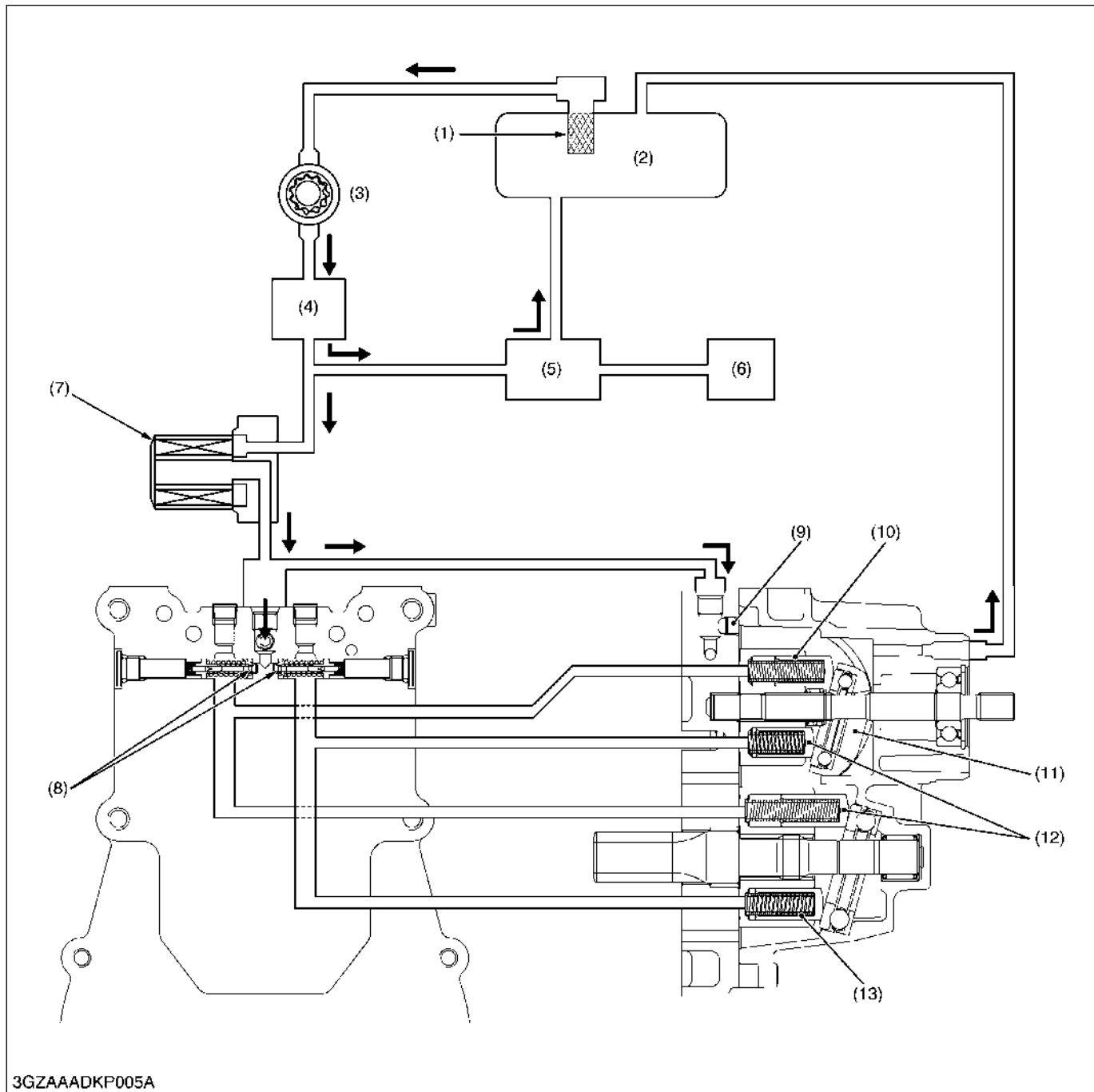
The hydrostatic transmission consists of variable displacement piston pump, fixed displacement piston motor and valve system



- | | | | |
|-------------------------|---------------------------|--------------------------|---------------------------------|
| (1) Lubricating orifice | (6) Slot guide | (11) Swashplate | (16) Cylinder block (Motor) |
| (2) Pump shaft | (7) Cradle bearing | (12) Piston (motor) | (17) Check valve spring |
| (3) Brake shaft (8T) | (8) Cylinder block (pump) | (13) Needle bearing | (18) Relief valve spring |
| (4) Center section | (9) Piston (pump) | (14) Thrust ball bearing | (19) Check valve |
| (5) Trunnion arm | (10) Thrust ball bearing | (15) Piston spring | (20) High pressure relief valve |

1.1.2 HST oil flow

1.1.2.1 Structure of HST oil flow

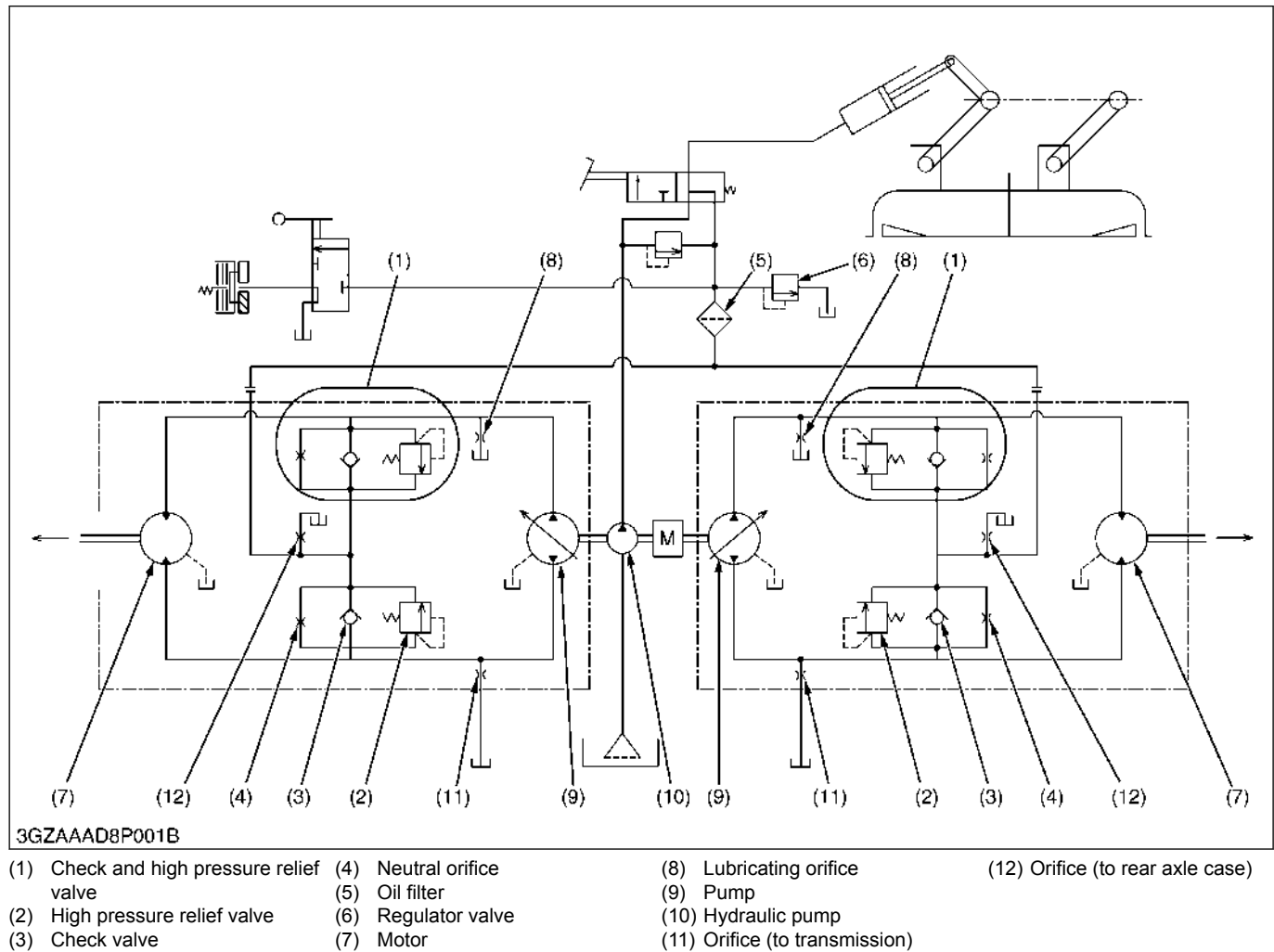


- | | | | |
|-----------------------|--------------------------|--|-----------------------------|
| (1) Oil strainer | (5) Regulator valve | (8) Check and high pressure relief valve | (11) Swashplate |
| (2) Transmission case | (6) PTO clutch | (9) Lubricating orifice | (12) Piston |
| (3) Hydraulic pump | (7) Oil filter cartridge | (10) Cylinder block (pump) | (13) Cylinder block (motor) |
| (4) Control valve | | | |

The pump and motor are joined in a closed hydraulic loop and most of oil circulates within the main oil circuit. A little oil lubricates and oozes out from the clearance between the moving parts of the case. Then oil in the main oil circuit of the HST needs to be supplied a want. The charge oil is sent to the HST housing after the control valve and oil filter pass with the hydraulic pump. The charge oil aids smooth operation of pistons for pump and motor. And overflow oil from HST housing return to the transmission case.

1.1.3 Power transmission operation

1.1.3.1 Structure of power transmission operation



4. TRANSAXLE

1.1.3.2 Neutral

With the 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.

1.1.3.3 Forward

As the 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.

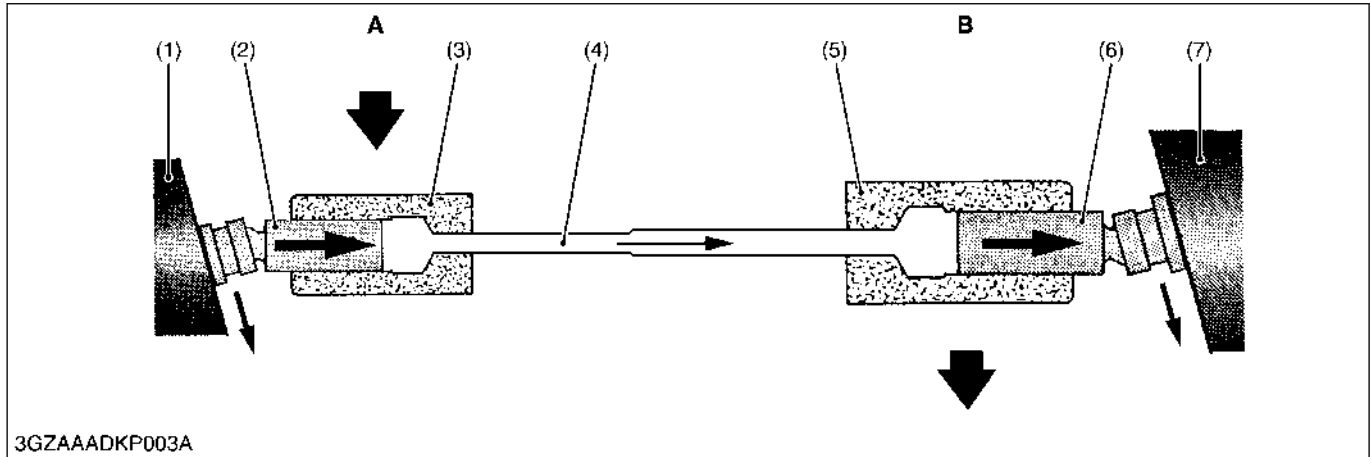
1.1.3.4 Reverse

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

1.1.4 Pump and motor

1.1.4.1 Structure of pump and motor

Pump and motor cylinder, each containing pistons, are connected by lines. Cylinders and lines are filled with oil. Pistons ride against swashplates located in pump and motor. Diameter of pump cylinder block is smaller than motor cylinder block. Number of piston in pump cylinder block are five pieces. Seven pieces of piston are in motor cylinder block.



(1) Swashplate
(2) Piston
(3) Cylinder

(4) Oil
(5) Cylinder
(6) Piston

(7) Swashplate
A Pump
B Motor

1.1.4.2 Function of pump and motor

In the pump, as the cylinder rotates, pistons move across the sloping face of swashplate and slide in or out of their cylinder bores. The oil, forced out by the pump pistons, cause the motor pistons to slide out of their cylinder bores. In the motor, sliding out of the cylinder and moving across the sloping face of swashplate, the pistons rotate the cylinder.

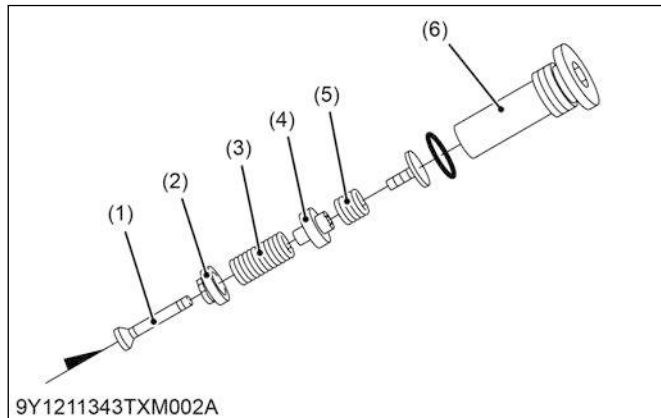
1.1.4.3 Torque rise

Since oil charged per one revolution from pump cylinder block is less than oil per one revolution from motor cylinder block, pump speeds at pump shaft is reduced at motor shaft and the torque is risen at motor shaft.

1.1.5 Check and high pressure relief valve

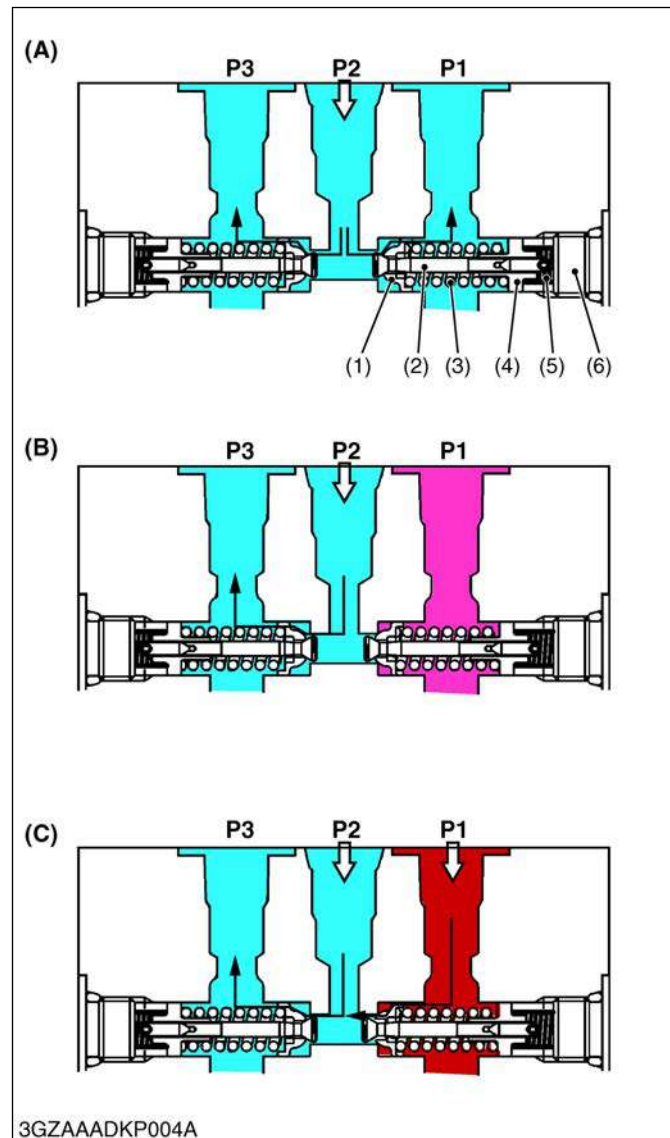
1.1.5.1 Structure of check and high pressure relief valve

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 valve protects engines, pumps, motors, gears and even the machine itself from overload. The check and high-pressure relief valve consists of pressure poppet (1), check valve seat (2), relief valve spring (3), spring guide (4) and check valve spring (5). The check and high-pressure relief valves are laid out facing each other as shown in the figure.



- | | |
|-------------------------|------------------------|
| (1) Pressure poppet | (4) Spring guide |
| (2) Check valve seat | (5) Check valve spring |
| (3) Relief valve spring | (6) Valve plug |

1.1.5.2 Function of check and high pressure relief valve



- | | |
|-------------------------|--|
| (1) Pressure poppet | (B) When check valve activating (normal operation) |
| (2) Check valve seat | (C) When high pressure relief valve activating |
| (3) Relief valve spring | P1: Forward |
| (4) Spring guide | P2: Change |
| (5) Check valve spring | P3: Reverse |
| (6) Valve plug | |
| (A) In neutral (stop) | |

(A)

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

(B)

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

(C)

The check and high-pressure relief valve along the high-pressure line serves as a high-pressure relief valve. If the pressure exceeds a high-pressure

limit level, the pressure poppet opens itself against the relief valve spring (3) force and opens the valve seat that is located between the check valve seat (2) and the pressure poppet (1). 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.

1.1.5.3 Specification of check and high pressure relief valve

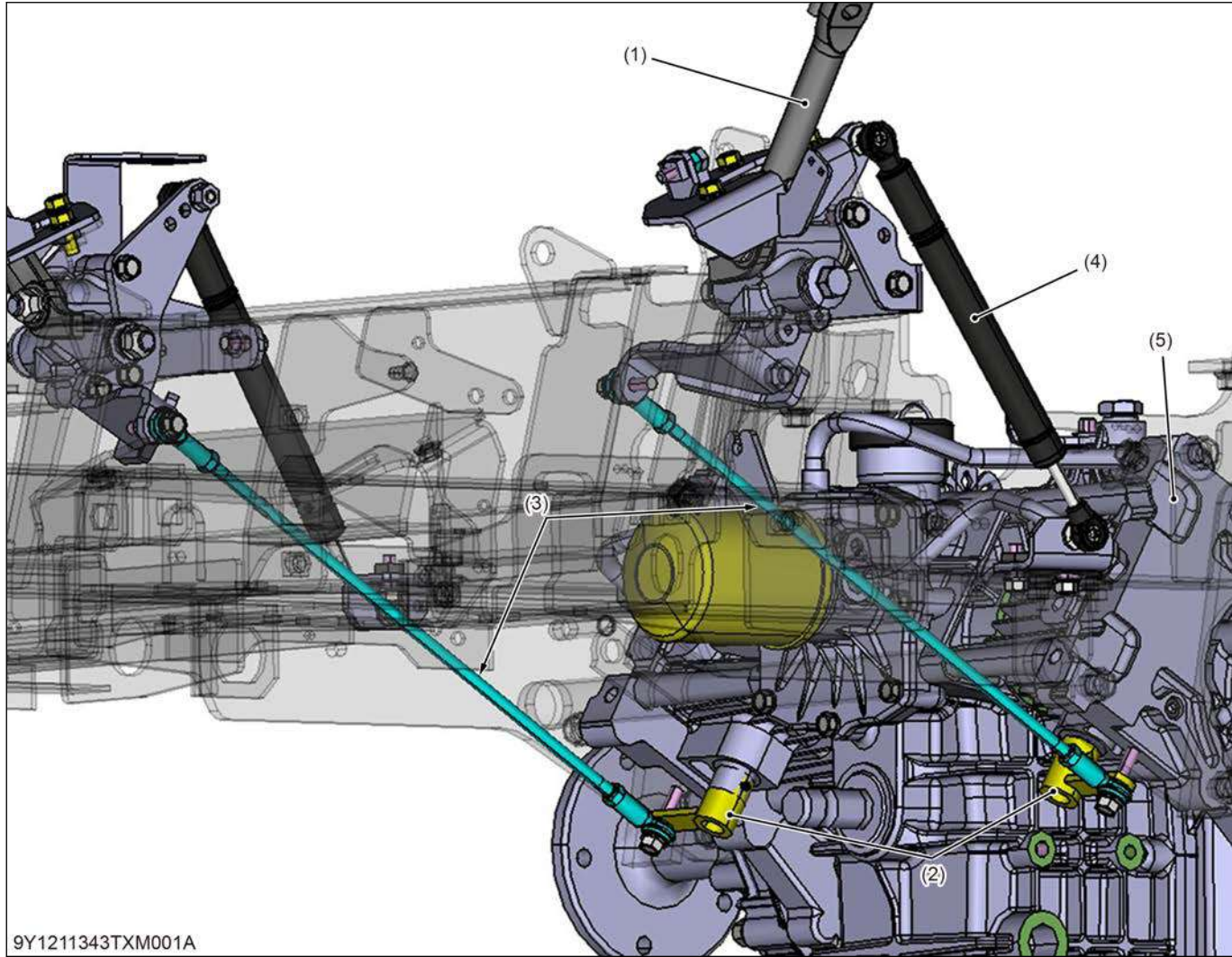
High pressure relief setting pressure

Oil temperature	Valve operating pressure
50 °C (122 °F)	23.50 to 25.50 MPa 240.0 to 260.0 kgf/cm ² 3408 to 3698 psi

1.1.6 Hydrostatic control linkage

1.1.6.1 Function of hydrostatic control linkage

The motion control lever (1) and the trunnion shaft of variable swash-plate are linked with the speed control rod (3) and the trunnion arm (2). As the motion control lever (1) is pushed, the swash-plate rotates and forward traveling speed increases. Pulling the motion control lever (1) increases reverse speed. A Neutral position can be reached by placing the motion control levers (1) into the neutral lock position. The damper connected to the speed shaft restricts the movement of the linkage to prevent abrupt operation or reversing. As the motion control levers (1) 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.



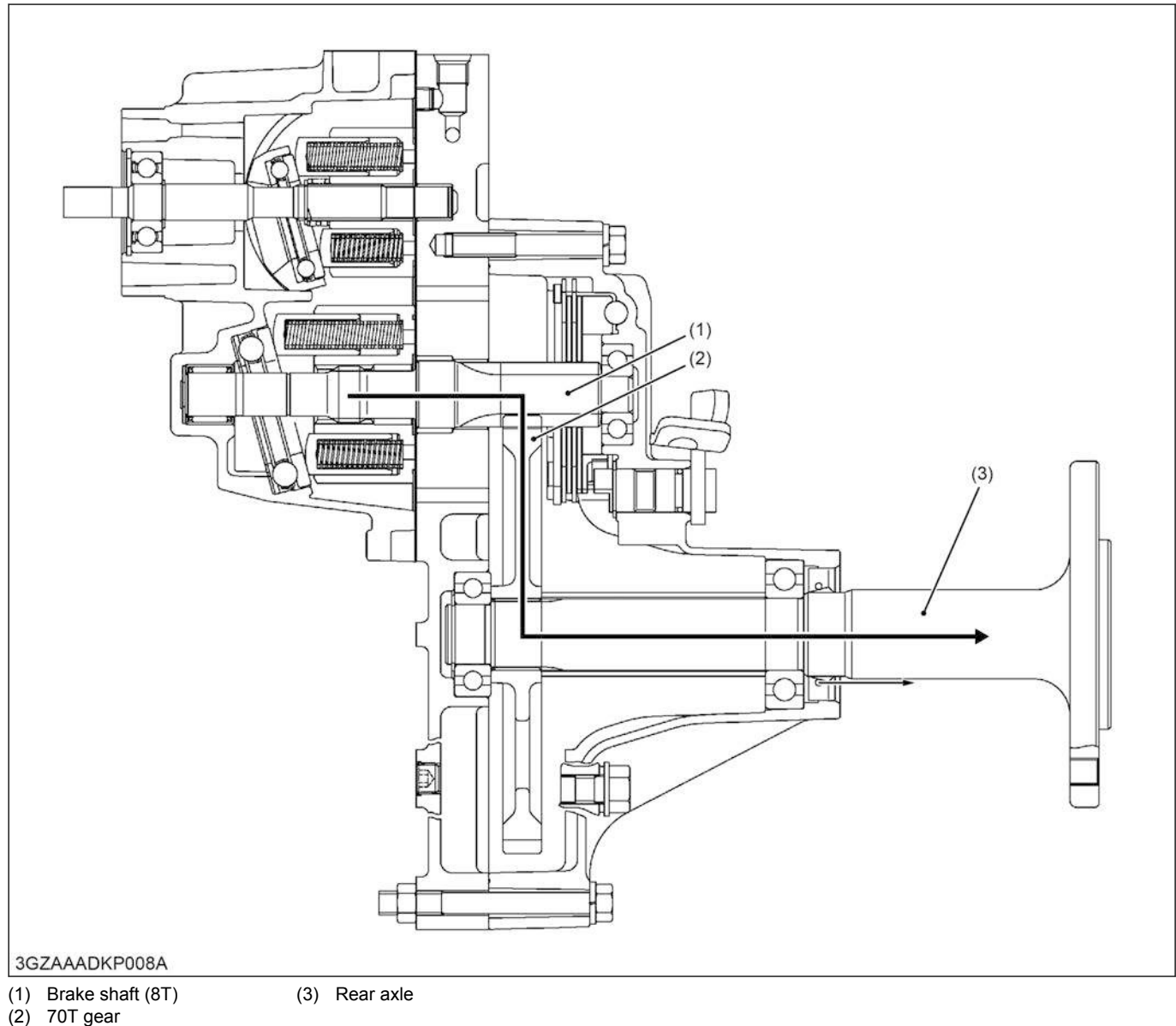
9Y1211343TXM001A

- | | | |
|--------------------------|-----------------------|---------|
| (1) Motion control lever | (3) Speed control rod | (5) HST |
| (2) Trunnion arm | (4) Damper | |

1.2 Final reduction gear section

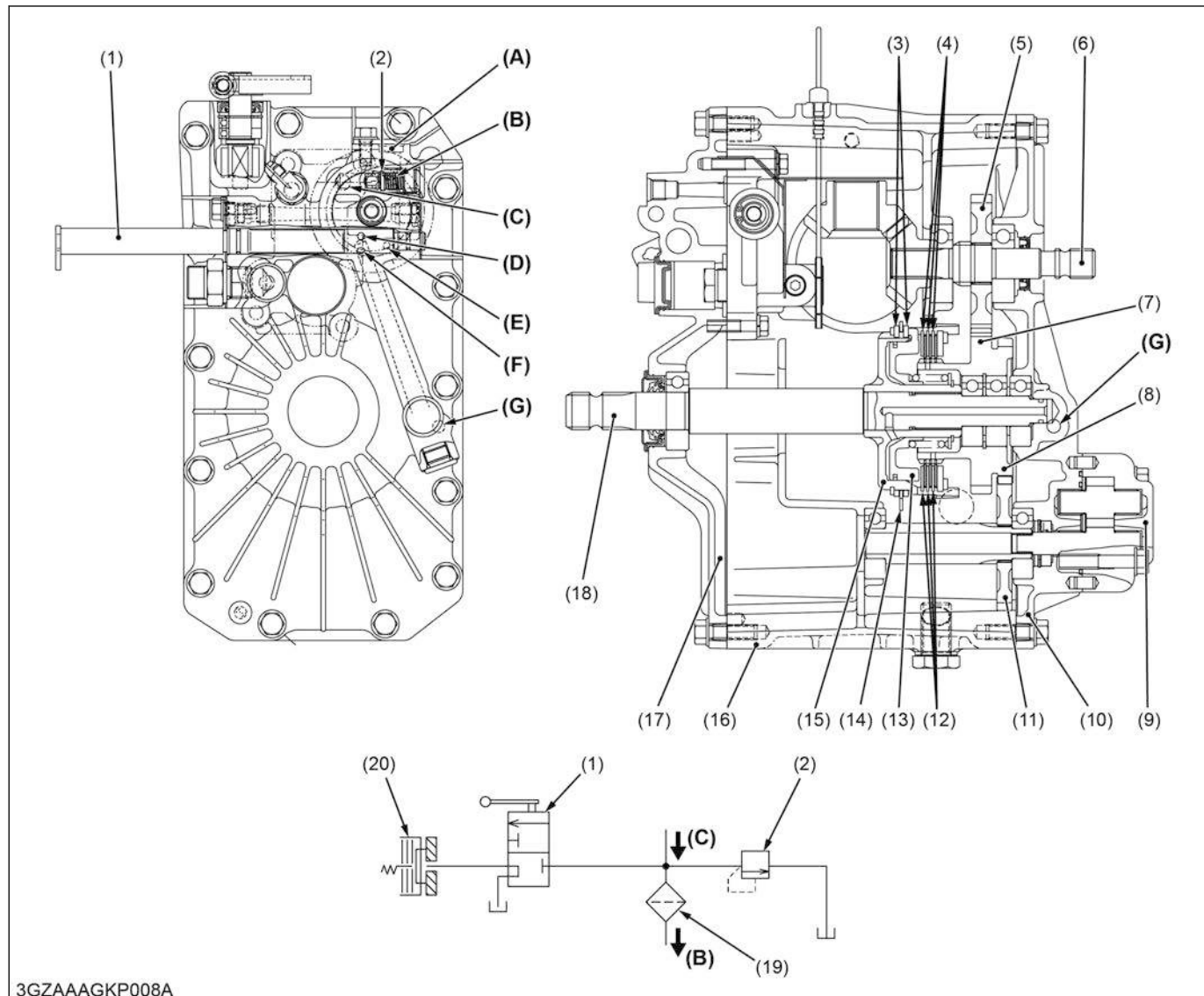
1.2.1 Function of final reduction gear

A combination of gears used to reduce the input speed to a lower output speed. As for this machine, power is transmitted from the gear on the brake shaft (1) to the rear axle (3) through 70T gear (2).



1.3 PTO section

1.3.1 Structure of PTO



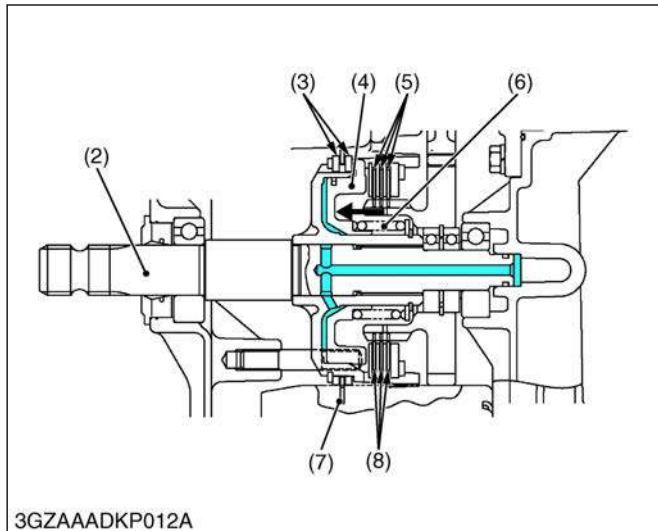
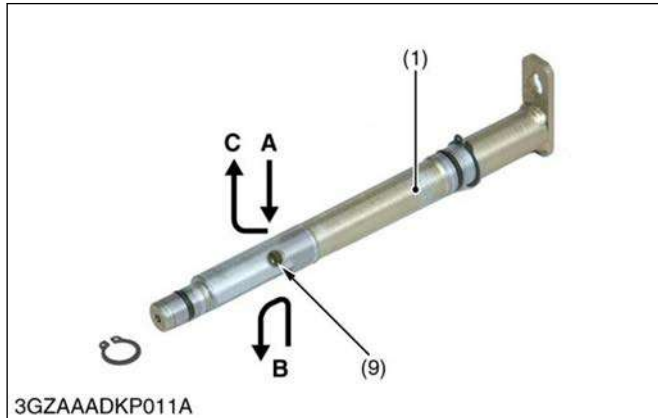
- | | | | |
|----------------------|------------------------------|---------------------------------|--|
| (1) PTO valve lever | (9) Hydraulic pump | (17) Center case, front cover | (D) From hydraulic pump to valve lever |
| (2) Regulator valve | (10) Center case, rear cover | (18) PTO shaft | (E) From PTO shaft to center case (drain port) |
| (3) PTO brake plate | (11) 32T gear | (19) Oil filter cartridge | (F) From PTO valve lever to PTO shaft |
| (4) PTO clutch plate | (12) PTO clutch disk | (20) PTO clutch | (G) To PTO shaft |
| (5) Input gear | (13) Piston | (A) To oil cooler | |
| (6) Input shaft | (14) PTO brake disk | (B) To hydrostatic transmission | |
| (7) PTO gear | (15) PTO case | (C) From hydraulic pump | |
| (8) 35T gear | (16) Center case | | |

The ZD series is equipped with hydraulic independent PTO clutch (wet multi-plates type). Therefore, the engine power can engage or disengage to the PTO shaft (18) without stopping the machine movement. The PTO clutch (20) has clutch discs (12), clutch plates (4), clutch piston (13) and so on. The clutch piston (13) is actuated by hydraulic oil flow the hydraulic pump through regulator valve (2).

1.3.2 PTO clutch "Disengaged"

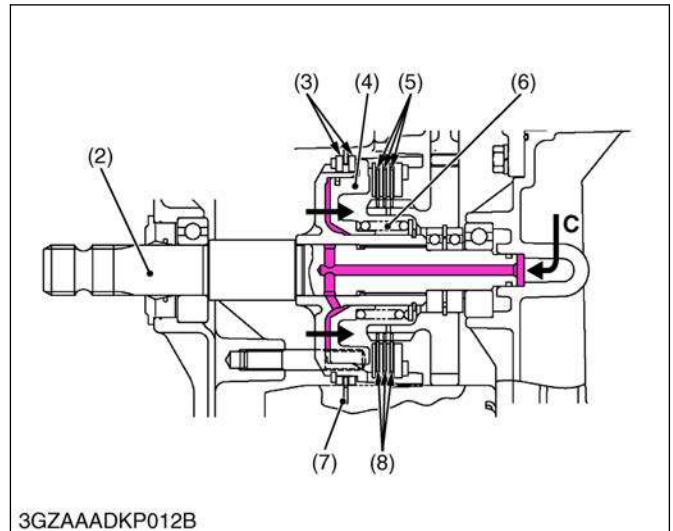
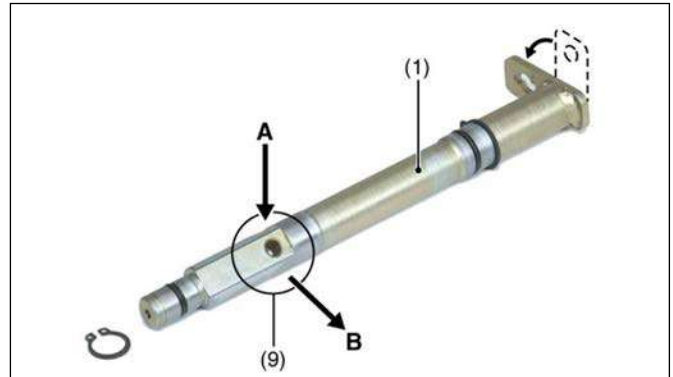
After starting the engine, when the PTO clutch lever is set at the "Disengaged" position, the hole (9) of PTO valve lever (1) does not face to hydraulic pump port. Since oil from hydraulic pump is blocked at the PTO valve lever (1), oil does not flow to the PTO shaft. Blocked oil flows to the oil filter cartridge or to the regulator valve.

Oil in the clutch pack drained through the PTO valve lever into the transmission case. Thus the clutch piston (4) is pushed back by the spring (6). When the piston (4) is pushed back, the piston pushed the brake plate (3) and brake disk, the rotation and drag of the PTO shaft (2) stop.



- | | |
|----------------------|--|
| (1) PTO valve lever | (8) PTO clutch disk |
| (2) PTO shaft | (9) Hole |
| (3) PTO brake plate | A: From hydraulic pump |
| (4) Piston | B: To transmission case |
| (5) PTO clutch plate | C: To oil filter cartridge or regulator valve |
| (6) Spring | |
| (7) PTO brake disk | |

the clutch pack pushes the clutch piston (4) to engage the clutch pack.



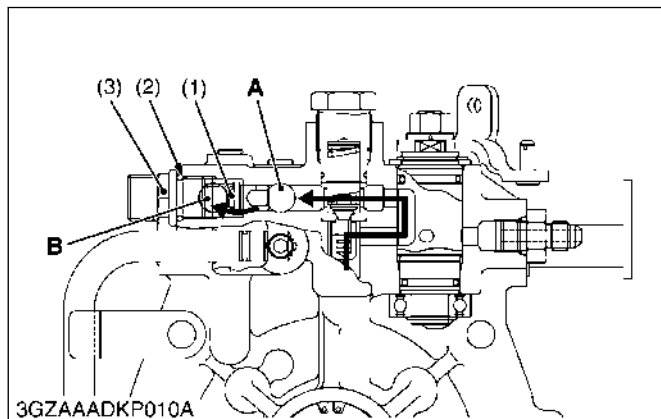
- | | |
|----------------------|-------------------------------|
| (1) PTO valve lever | (7) PTO brake disk |
| (2) PTO shaft | (8) PTO clutch disk |
| (3) PTO brake plate | (9) Oil inner passage |
| (4) Piston | A: From hydraulic pump |
| (5) PTO clutch plate | B: To PTO shaft |
| (6) Spring | C: To PTO pipe |

1.3.3 PTO clutch "Engaged"

When the PTO clutch lever is set at the **Engaged** position, the PTO clutch valve rotates.

L shape oil inner passage in the PTO clutch valve forms the oil line to the PTO clutch pack. Oil entering

1.3.4 Function of regulator valve



- (1) Poppet
 (2) Spring
 (3) Plug
 A: From hydraulic pump to oil filter cartridge, PTO clutch and hydrostatic transmission
 B: To transmission case

This machine is controlled with the regulator valve so that the oil sent from the hydraulic pump may become the setting pressure. And the oil flows into oil filter cartridge PTO clutch and hydrostatic transmission.

Regulator valve setting pressure
0.50 to 0.70 MPa 5.00 to 7.00 kgf/cm ² 71.2 to 101 psi

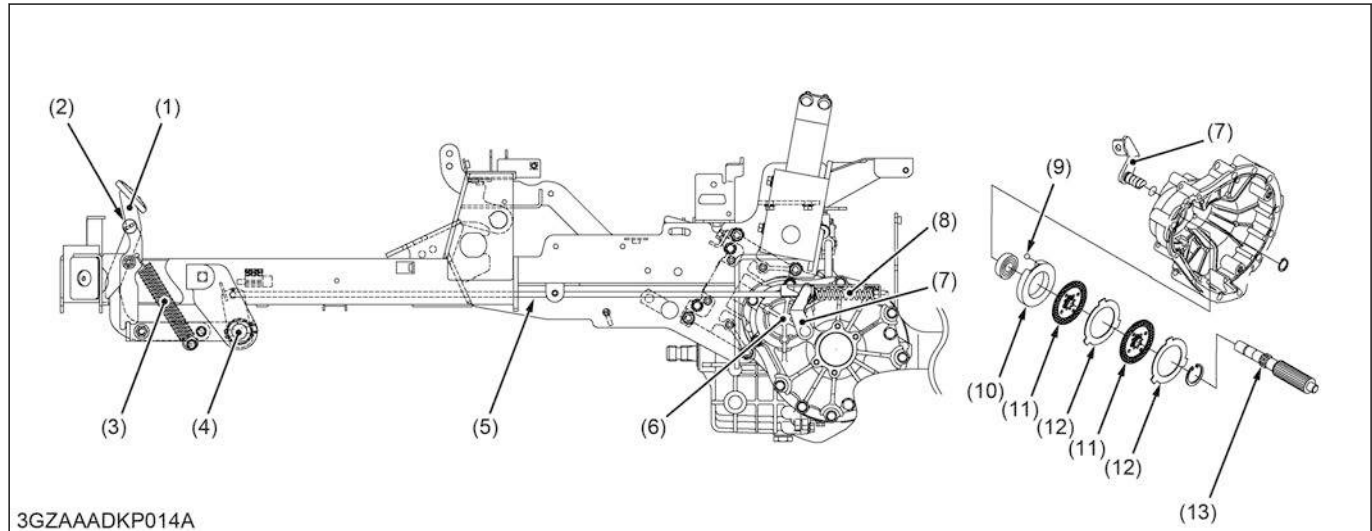
1.4 Parking brake section

1.4.1 Function of parking brake

The parking brake is usually used to keep the vehicle stationary and prevent machine roll back while machine is not in use.

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) are 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.



- (1) Brake pedal
- (2) Parking lock pedal
- (3) Brake pedal return spring
- (4) Brake shaft

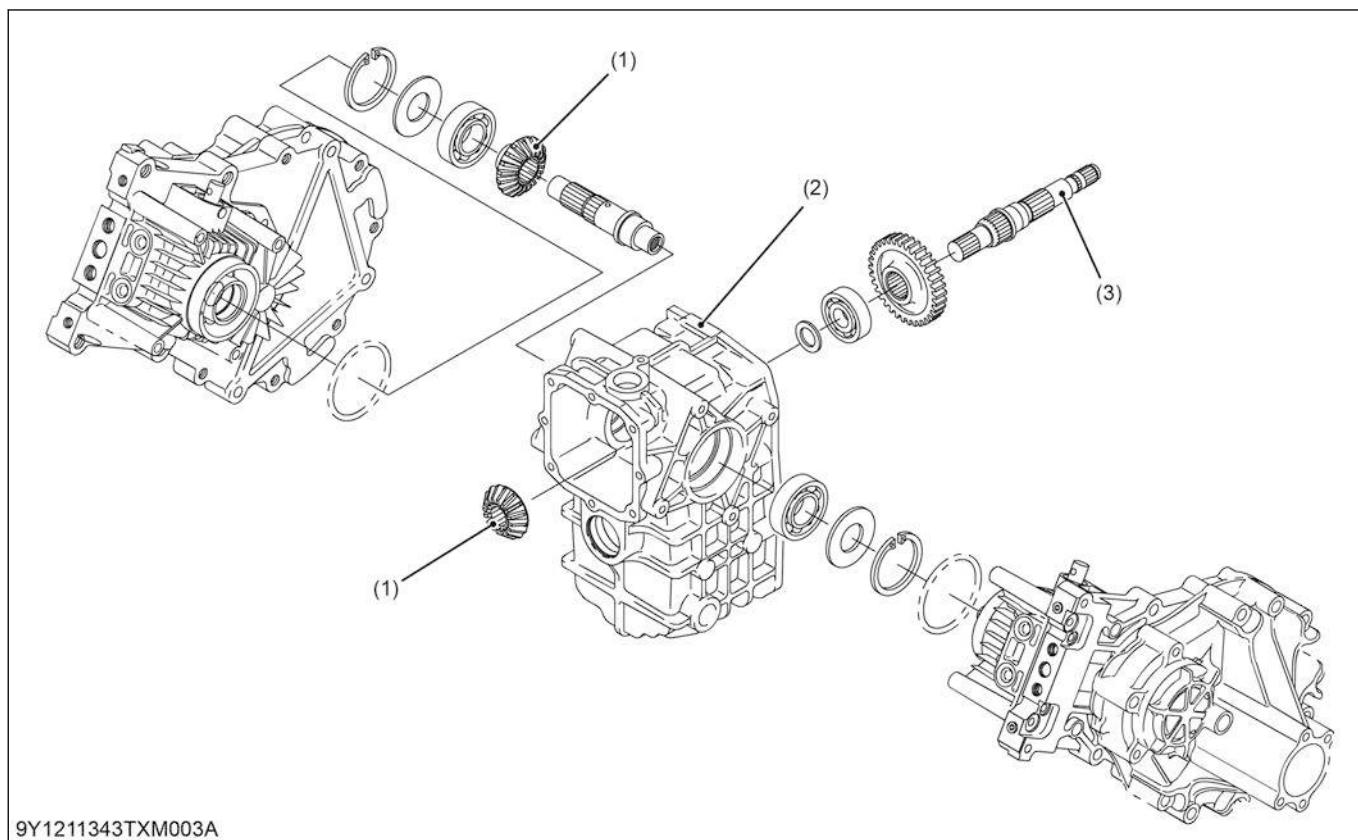
- (5) Brake rod
- (6) Brake assembly
- (7) Brake arm
- (8) Brake spring

- (9) Ball
- (10) Actuator
- (11) Brake disk
- (12) Brake plate

- (13) HST motor shaft (brake)

1.5 Bevel gear section

1.5.1 Function of bevel gears



(1) Bevel gears

(2) Transmission case

(3) Input shaft

Bevel gears are gears where the axes of the two shafts intersect and the tooth-bearing faces of the gears themselves are conically shaped. Bevel gears are most often mounted on shafts that are 90 degrees apart, but can be designed to work at other angles as well. Bevel gears are useful when the direction of a shaft's rotation needs to be changed.

SERVICING

1. Troubleshooting for transaxle

Symptom	Probable cause and checking procedure	Solution	Reference page
Vehicle will not stop in neutral position	1. Improper neutral adjustment	Adjust Neutral	4-20
	2. Improper speed control rod adjustment	Adjust	4-20
Vehicle jerky and noisy when starting	1. Transmission oil insufficient	Fill	4-26
	2. Air entering from suction pipe	Retighten	—
	3. Transmission oil filter cartridge clogged	Replace	2-24
	4. Hydrostatic transmission damaged	Replace	4-26
Loss of power	1. Control linkage damaged	Repair or replace	4-57
	2. Transmission oil insufficient	Fill	4-26
	3. Transmission oil filter cartridge clogged	Replace	2-24
	4. Hydraulic pump damaged	Check and replace	6-24
	5. Hydrostatic transmission damaged	Check and replace	4-26
System operates in one direction only	1. Check valve damaged	Check and replace	4-23
	2. Control linkage damaged	—	4-57
System operation hot	1. Transmission oil insufficient	Fill	4-26
	2. Transmission oil filter cartridge clogged	Replace	2-24
	3. HST fan damaged	Check and replace	4-37
	4. Overload working	Decrease load	—
Noise from transmission	1. Transmission oil insufficient	Fill	4-26
	2. Gear worn	Replace	4-49
	3. Improper backlash between 16T or 18T bevel gear and 19T bevel gear	Adjust	4-61
	4. Bearing worn	Replace	4-49

2. Servicing specifications for transaxle

Item		Factory specifications	Allowable limit
Regulator valve (HST Charge Relief Valve) at engine speed: 3000 min ⁻¹ (rpm)	Setting pressure	0.75 to 0.95 MPa 7.7 to 9.6 kgf/cm ² 110 to 130 psi	—
PTO clutch at engine speed: 1600 min ⁻¹ (rpm)	Operating pressure	0.65 to 0.75 MPa 6.7 to 7.6 kgf/cm ² 95 to 100 psi	—
Check and high pressure relief valve at engine speed: 1600 min ⁻¹ (rpm)	Relief valve setting pressure	19.5 to 22.5 MPa 199 to 229 kgf/cm ² 2830 to 3260 psi	—
Maximum speed • At maximum engine rpm	Forward	158 min ⁻¹ (rpm) or Over	—
	Reverse	149 min ⁻¹ (rpm) or Over	—
Motion control lever alignment	Gap	0 to 2 mm 0 to 0.08 in.	—
	Space	10 to 20 mm 0.4 to 0.8 in.	—
18T bevel gear to 19T bevel gear	Backlash	0.25 to 0.30 mm 0.0099 to 0.011 in.	—

3. Tightening torques for transaxle

Tightening torques of screws, bolts and nuts on the table below are especially specified.

Item	Dimension × Pitch	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	40 to 44	4.0 to 4.5	29 to 32
Universal joint mounting screw	—	26.5 to 28.4	2.70 to 2.90	19.6 to 20.9
Rear axle gear case mounting assembly screw	M12	77.4 to 90.2	7.90 to 9.19	57.1 to 66.5
Rear axle gear case mounting screw	M10	40 to 44	4.0 to 4.5	29 to 32
Hydraulic pump mounting screw	—	40 to 44	4.0 to 4.5	29 to 32
Center case rear cover mounting screw	—	40 to 44	4.0 to 4.5	29 to 32
Center section mounting hex. socket head screw	—	25 to 29	2.6 to 3.0	18 to 21
Check and high pressure relief valve plug	—	59 to 78	6.0 to 8.0	44 to 58
Engine mounting nut	—	24 to 27	2.4 to 2.8	18 to 20
ROPS mounting screw	M12	77.4 to 90.2	7.90 to 9.19	57.1 to 66.5
Rear wheel mounting screw	—	109 to 131	11.10 to 13.30	80.3 to 96.1
Center case front cover mounting screw	M10	40 to 44	4.0 to 4.5	29 to 32
Hydrostatic transmission and rear axle gear case assembly mounting screw	M10	48 to 56	4.9 to 5.7	35 to 41
ROPS connecting plate upper mounting screw	M8	24 to 27	2.4 to 2.8	18 to 20
ROPS connecting plate lower mounting screw	M10	48 to 55	4.9 to 5.7	36 to 41

RELATED PAGE

1. [General use screws, bolts and nuts on page 2-15](#)

4. Checking and adjusting

4.1 Checking neutral



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

4.2 Adjusting neutral



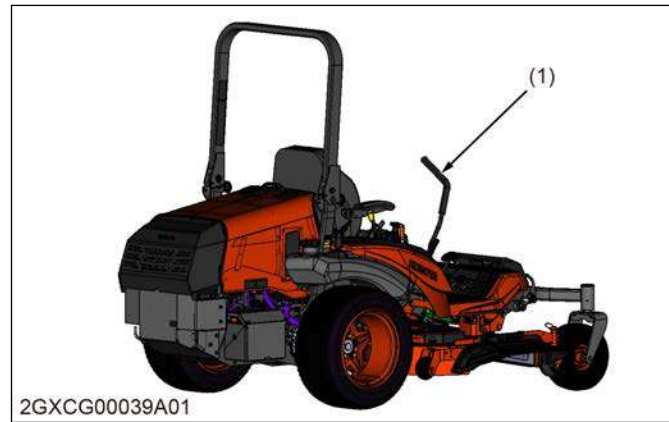
WARNING

To avoid serious injury or death:

- 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.

IMPORTANT

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



- (1) Motion control lever
(2) Speed control rod
(3) Lock nut

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

16. After taking steps 12. and 14. above, fix the speed control rod (2) length at the midpoint between the two position.
17. Adjust a speed control rod (2) length to be the center of the HST neutral range.
18. Shut off the machine.
19. Remove jumper wire from wire harness connector and plug connector or into seat safety switch.

4.3 Checking motion control lever neutral position



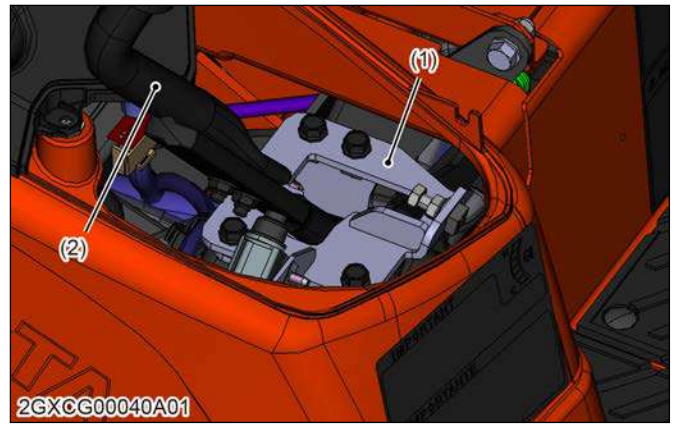
WARNING

To avoid serious injury or death:

- 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.

IMPORTANT

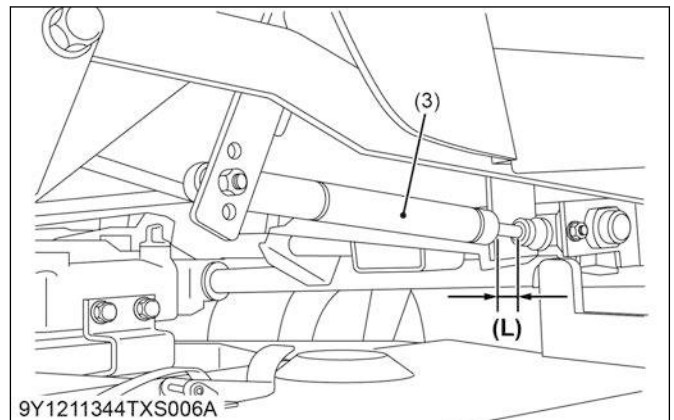
- Right and left motion control levers can be adjusted independently.
1. Lift up and secure with jack stands or blocking the rear of the machine frame.
 2. Remove both rear wheels.
 3. Set the engine speed to max. speed position.
 4. Remove the motion control lever cover.
 5. Move motion control lever (2) forward and backward.
 6. After forward and backward operation, tighten the guide control (1) at the position when wheel axis stops.



(1) Guide control

(2) Motion control lever

7. Adjust the rod length (L) of the damper (3) 28 to 30 mm (1.1 to 1.2 in.) and tighten.



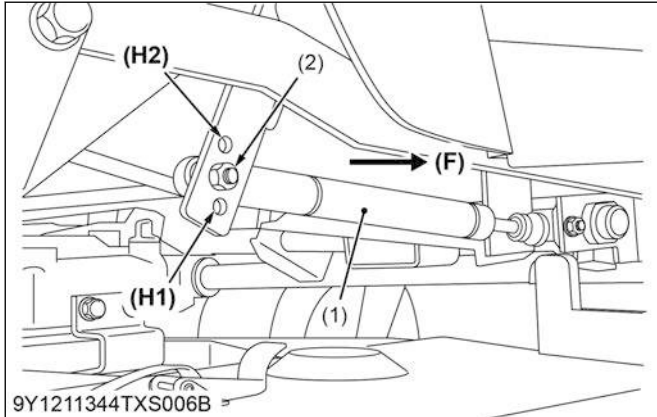
(3) Damper

(L) 28 to 30 mm (1.1 to 1.2 in.)

4.4 Adjusting motion control lever operating force

■ IMPORTANT

- Adjust the dampers after adjusting HST neutral.
- Adjusting the motion control lever force will affect the maneuverability.
- For adjustment of L.H. and R.H., use the same hole location.



- (1) Damper
(2) Damper nut
(F) Front
(H1) Hole for lighter setting
(H2) Hole for heavier setting

1. Change the rear side of the damper to the desired hole location.
2. Tighten the rear side damper nut.

4.5 Checking motion control lever alignment



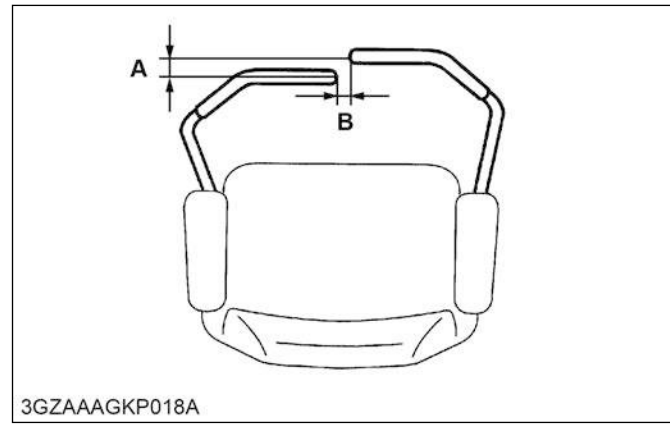
WARNING

To avoid serious injury or death:

- Park the machine on a firm and level surface.
- Stop the engine, remove the key and apply the parking brake.

■ NOTE

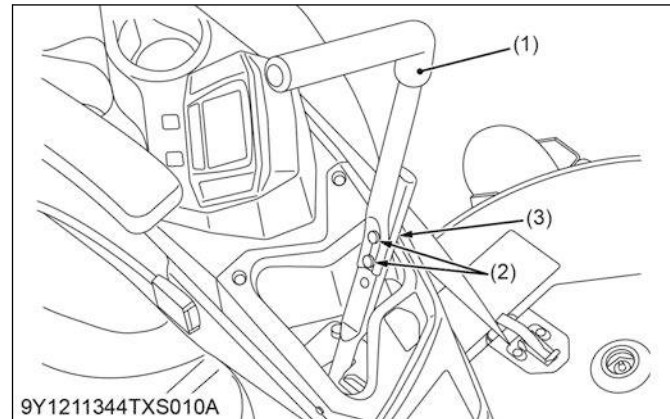
- If the ends of the levers strike against each other while in the NEUTRAL position, move the levers outward to the NEUTRAL LOCK position and carefully bend them outward. Move them back to the NEUTRAL position and check for the recommended space.



A: Gap

B: Space

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.



- (1) Motion control lever
(2) Motion control lever mounting bolt
(3) Nut, washer

(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)

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

Lever alignment (Right and Left)

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

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

4.6 Adjusting maximum speed



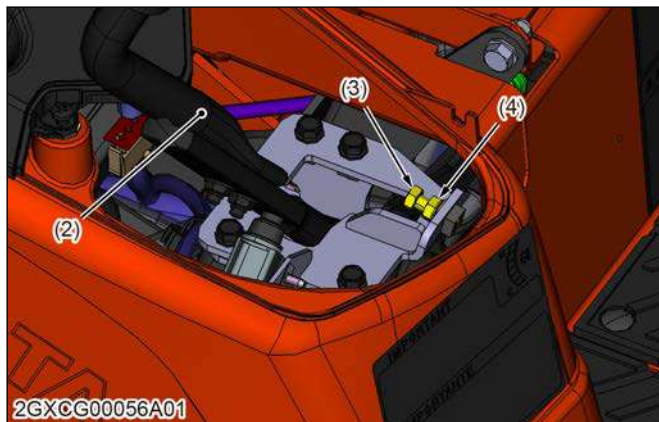
WARNING

To avoid serious injury or death:

- 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; they are relative each other.

IMPORTANT

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



- (1) Motion control cover (3) Speed set bolt
(2) Motion control lever (4) Lock nut

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

4.7 Checking high pressure relief valve pressure



CAUTION

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

IMPORTANT

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



- (1) Plug, 1/4 straight thread (Forward side) (2) Plug, 1/4 straight thread (Reverse side)

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 adapter.
3. Install the pressure gauge.
4. Turned on the neutral safety switch. Remove the connector from neutral switch, then temporarily install a jumper wire across the terminals in the connector of the wiring harness.
5. Start the engine.
6. Move the throttle lever to the engine speed specified below.

Condition

Engine speed
1600 min ⁻¹ (rpm)

7. Grasp the motion control lever and move then inward from neutral lock position to position and then slowly push forward.
8. Measure the pressure of HST.

Check and high pressure relief valve pressure	Factory specification	19.5 to 22.5 MPa 199 to 229 kgf/cm ² 2830 to 3260 psi
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If the operation pressure does not rises to 17.0 MPa (173 kgf/cm², 2470 psi), repair or replace the HST.

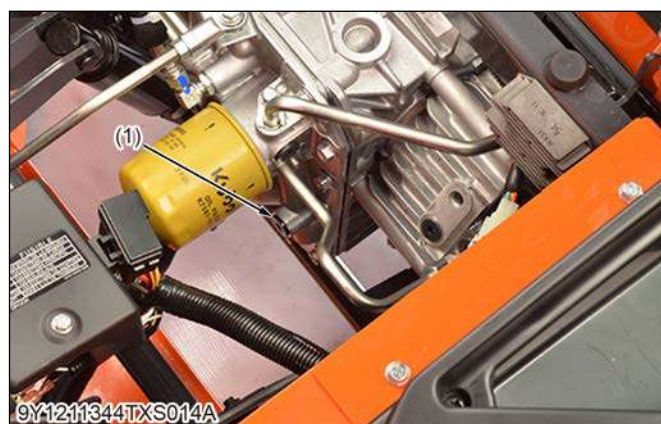
4.8 Checking PTO clutch operating pressure (hydrostatic transmission charge pressure)

**WARNING**

To avoid serious injury or death:

- When checking, park the tractor on flat ground, apply the parking brake.
- Be careful when engaging PTO.

1. Remove the plug (1), then install the adapter (2) cable and pressure gauge.



- (1) Plug, 3/8 straight thread (2) Adapter

2. Start the engine and set speed at specified one in the table below.

Condition

Oil temperature	Engine speed
45 to 55 °C 113 to 131 °F	1600 min ⁻¹ (rpm)

3. Read the pressure gauge.

PTO clutch operating pressure	Factory specification	0.65 to 0.75 MPa 6.7 to 7.6 kgf/cm ² 95 to 100 psi
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If the pressure is not within the factory specifications, check the regulator valve and related hydraulic components.

4.9 Adjusting parking brake



WARNING

To avoid serious injury or death:

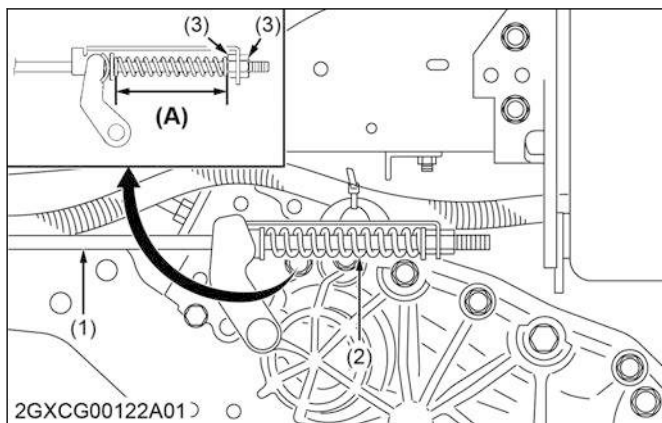
- Park the machine on a hard and level surface.
- Stop the engine and chock the wheels before checking or adjusting.

IMPORTANT

- Wrong adjustment may cause machine damage.

Check brake spring

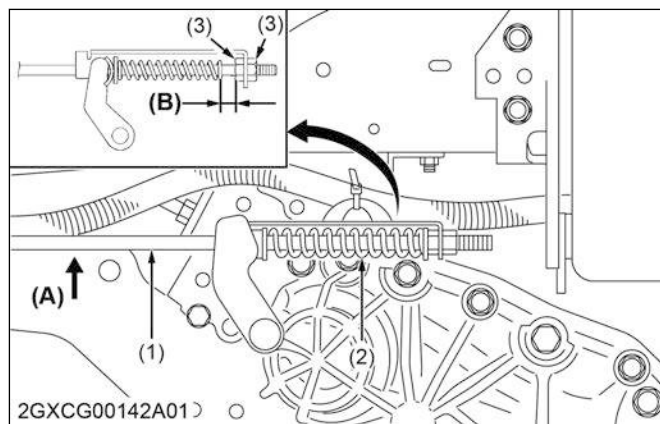
1. Place the motion control levers to **NEUTRAL LOCK** position.
2. Be sure to chock the rear wheels.
3. Apply the parking brake to the lock position.
4. Check the length of the brake springs on both sides.



- (1) Brake rod
(2) Brake spring
(3) Lock nut
(A) Parking brake spring length

Proper brake spring length with the brake applied to the lock position	Factory specification	115 to 117 mm 4.53 to 4.61 in.
--	-----------------------	-----------------------------------

5. If the length of the brake spring is not correct, adjust it.
6. Release the parking brake completely.
7. Hold the brake rod lightly.
8. Check the brake spring play.



- (1) Brake rod
(2) Brake spring
(3) Lock nut
(A) Hold the brake rod
(B) Parking brake spring play

Proper brake spring play	Factory specification	0.5 to 1.0 mm 0.02 to 0.04 in.
--------------------------	-----------------------	-----------------------------------

Adjustment of brake spring play

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

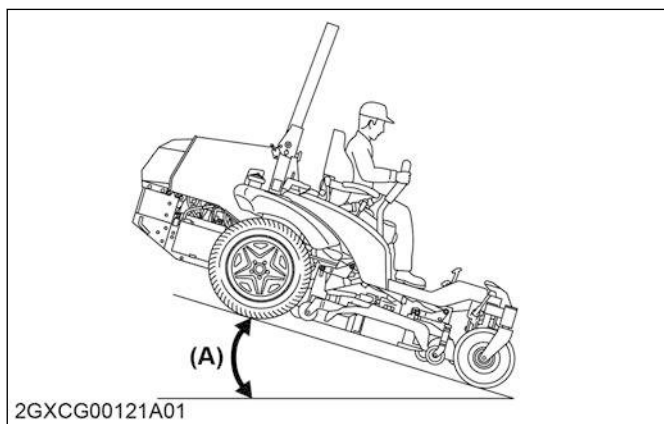
Adjustment of brake spring length

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

4.10 Check on slope

NOTE

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



(A) Under 17° ramp

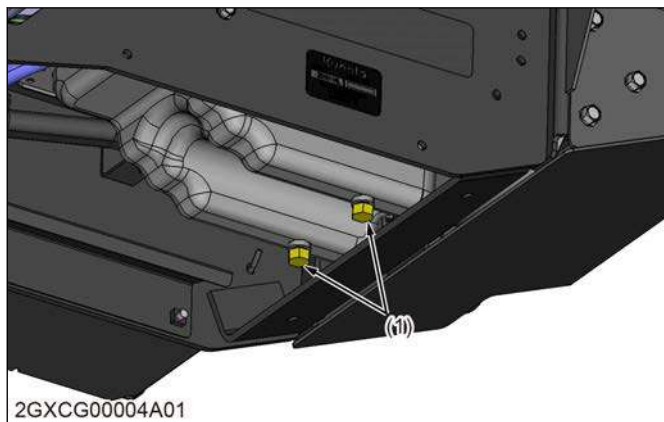
1. Place the machine on a 17° ramp.
2. Apply the parking brake.
3. Place the motion control levers in "NEUTRAL LOCK" position and shut off the engine.
4. Check that the machine does not move.

5. Disassembling and assembling

5.1 Separating transaxle assembly

5.1.1 Draining engine oil

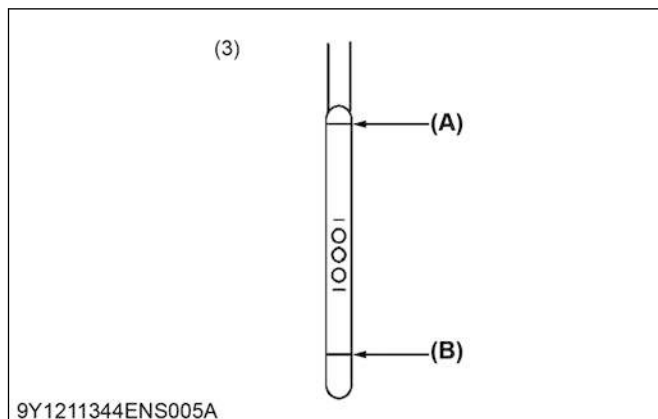
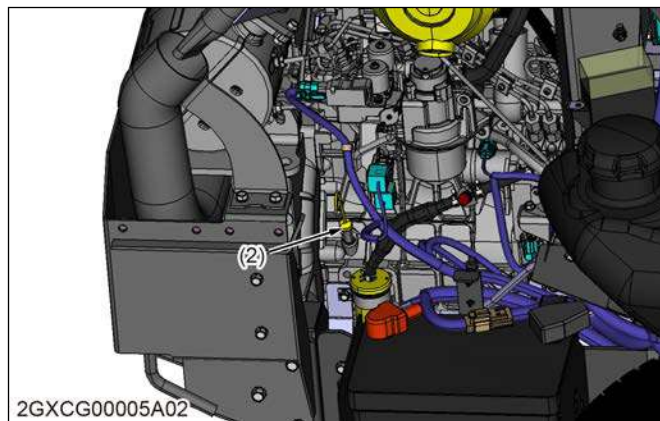
1. Park the machine on level ground.
2. Start and warm up the engine for approx. 5 minutes.
3. Place an oil pan underneath the engine.



(1) Drain plug

4. Remove the drain plug (1) to drain oil and drain the oil completely.
5. After draining, screw in the drain plug (1).

(When refilling)



(2) Dipstick

(3) Engine oil range

(A) Upper level

(B) Lower level

■ IMPORTANT

- Fill the engine oil up to the upper line (A) on the dipstick.
- Never mix two different types of oil.
- Use the proper SAE Engine Oil according to ambient temperatures.

Engine oil	Capacity	6.7 L 7.1 U.S.qts 5.9 Imp.qts
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5.1.2 Draining transmission fluid

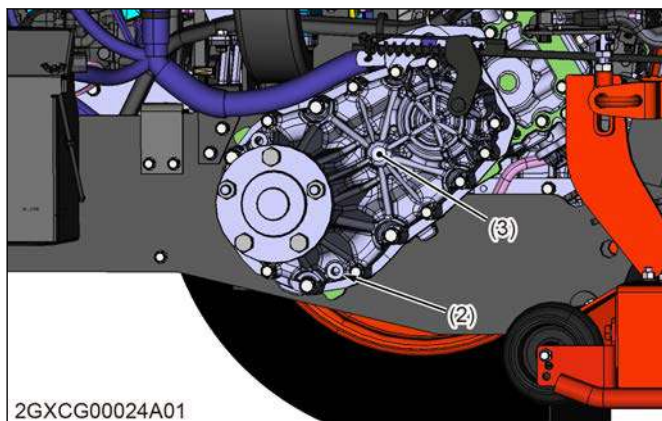
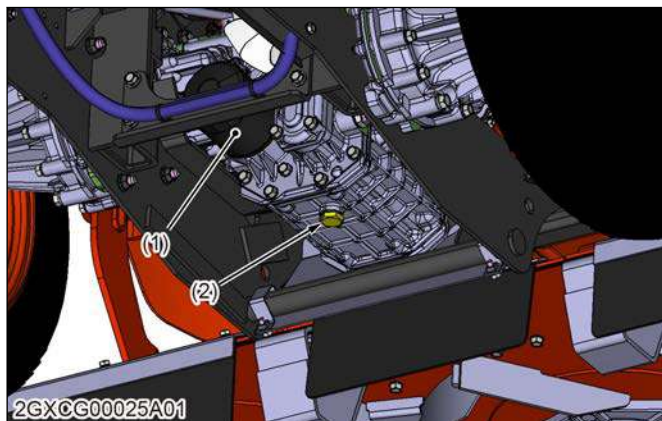
⚠ CAUTION

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.

1. Place oil pans underneath the transmission case and the rear axle gear case (R.H. and L.H.).
2. Remove the drain plug (2) at the bottom of the transmission case and the rear axle gear case (R.H. and L.H.) to drain the oil.

3. After draining reinstall the drain plugs (2).

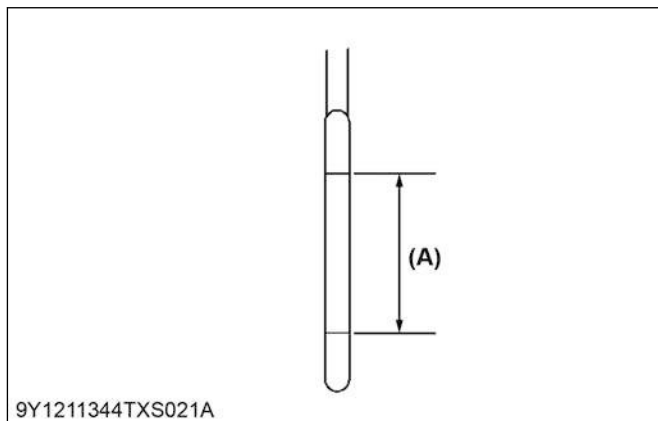
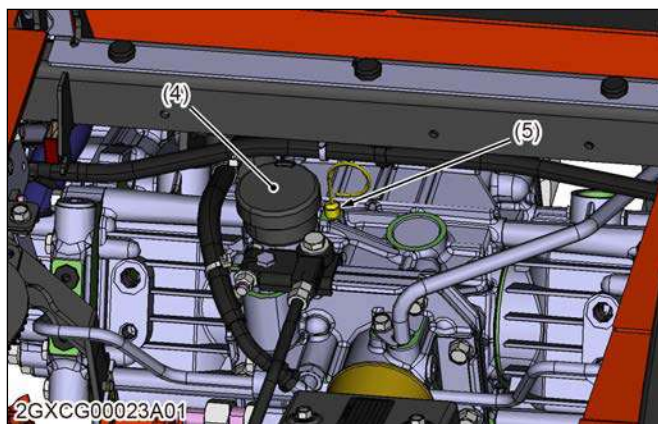


- (1) Transmission oil filter (3) Rear axle gear case L.H.
(2) Drain plug

(When refilling)

■ IMPORTANT

- After running the engine for a few minutes, stop it and check the oil level again; add oil to the prescribed level (A).
 - It takes time to pour the oil from the transmission case to the rear axle case R.H. and L.H. Pour the regulated amount of oil slowly.
 - Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system.
 - The fluid in the transmission case is also used for the hydrostatic drive system.
 - Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.
 - Keep the engine at medium speed for a few minutes to ensure proper lubrication of all parts so there is no damage to transmission.
1. Remove the filling plug (4) and fill with oil.
 2. After running the engine for a few minutes, stop it and check the oil level again; add oil to the prescribed level (A).



- (4) Oil filling plug and breather (A) Oil level acceptable within this range.
(5) Dipstick

Transmission fluid	Capacity	12.1 L 12.8 U.S.qts 10.6 Imp.qts
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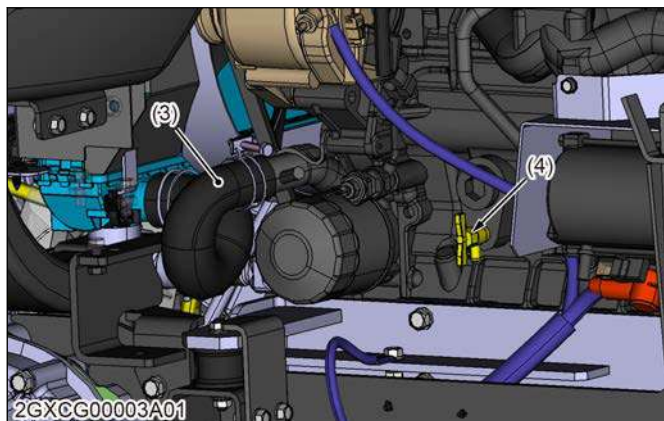
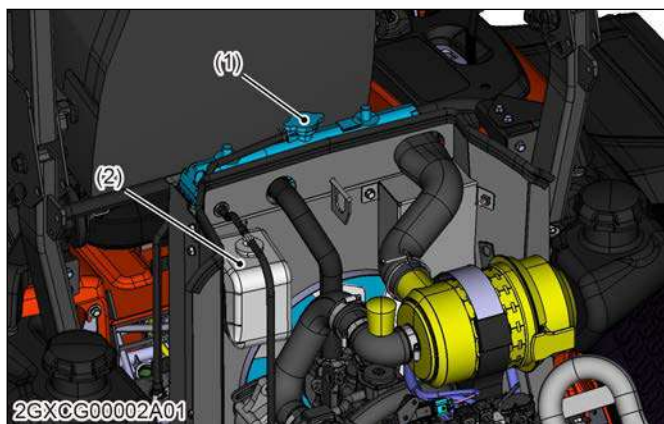
— RELATED PAGE —
[LUBRICANTS, FUEL AND COOLANT on page 2-11](#)

5.1.3 Draining coolant

⚠ WARNING

To avoid serious injury or death:

- 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) Radiator cap
(2) Recovery tank
(3) Lower radiator hose
(4) Engine coolant drain valve

1. Stop the engine and let cool down.
2. Open the engine coolant drain valve (4) to drain the coolant from the engine.
3. Remove the lower radiator hose (3) from the engine side to drain the coolant from the radiator.
4. Remove the radiator cap (1) to completely drain the coolant.
5. After all coolant is drained, close the engine coolant drain valve (4).

(When refilling)

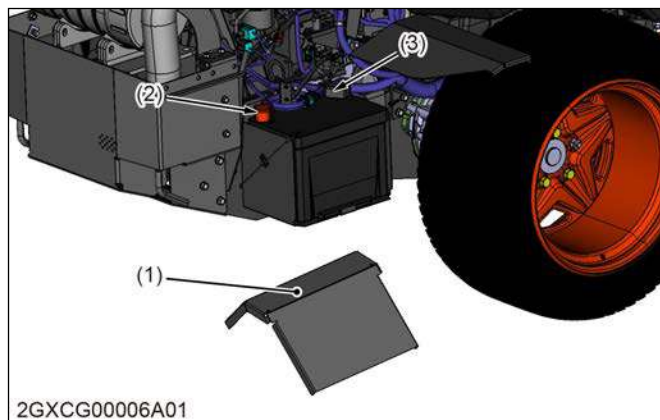
Coolant capacity	Radiator	4.6 L 4.9 U.S.qts 4.0 Imp.qts
	Recovery tank	1.1 L 1.2 U.S.qts 0.97 Imp.qts

5.1.4 Removing the battery**WARNING**

To avoid serious injury or death:

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

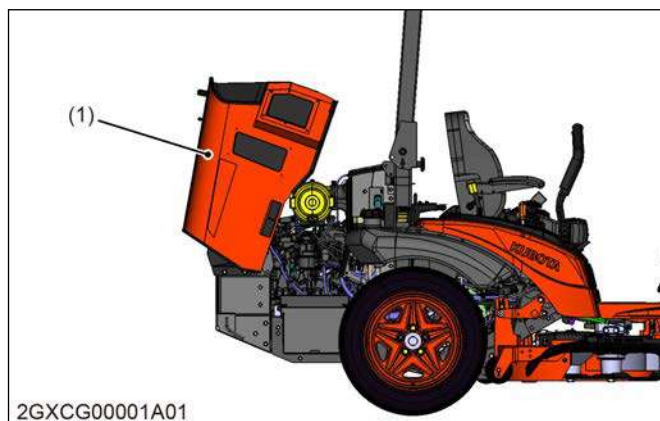
1. Remove the battery cover (1).
2. Disconnect the negative cable (3) from the battery.
3. Disconnect the positive cable (2) from the battery.
4. Remove the battery.



- (1) Battery cover
(2) Positive cable
(3) Negative cable

5.1.5 Removing the bonnet

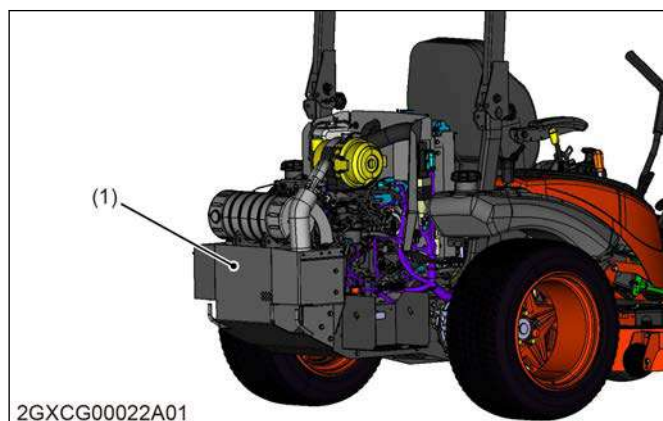
1. Remove the bonnet mounting bolts.
2. Remove the bonnet (1).



- (1) Bonnet

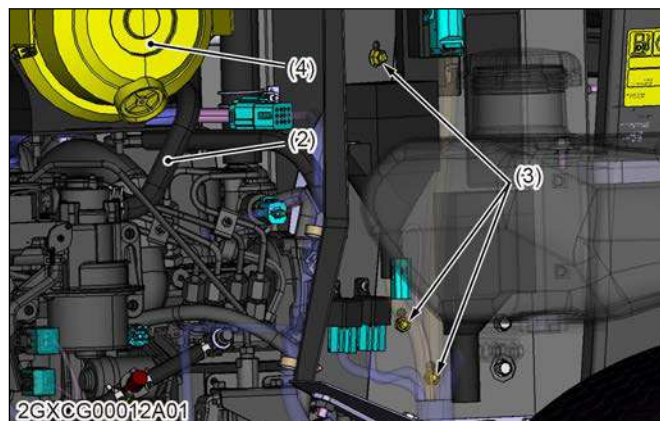
5.1.6 Removing rear engine frame

1. Remove rear engine frame (1).



- (1) Rear engine frame

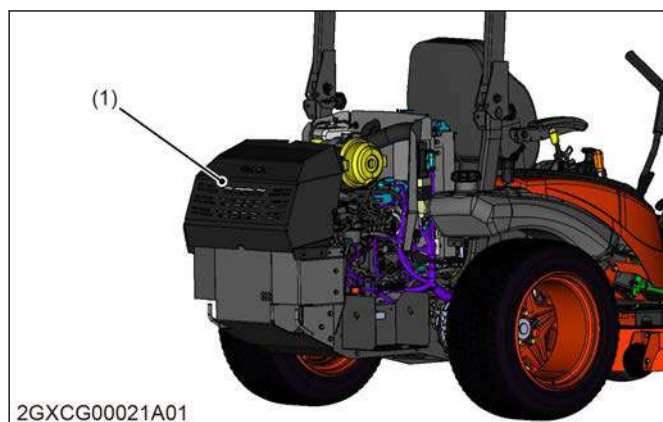
3. Remove air cleaner stay bolts (3).
4. Remove air cleaner assembly (4).



- (2) Air cleaner hose (blower) (4) Air cleaner assembly
(3) Air cleaner stay bolts

5.1.7 Removing DPF cover

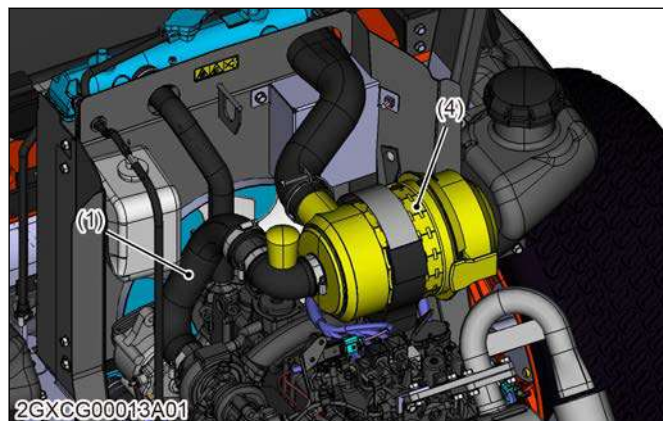
1. Remove DPF cover (1).



- (1) DPF cover

5.1.8 Removing air cleaner assembly

1. Disconnect air cleaner hose from turbocharger (1).

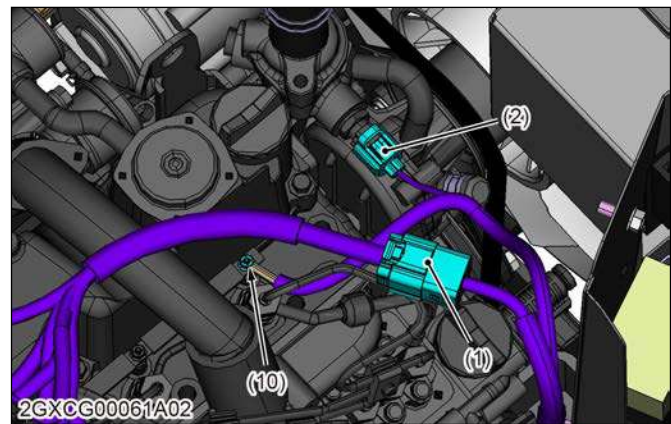
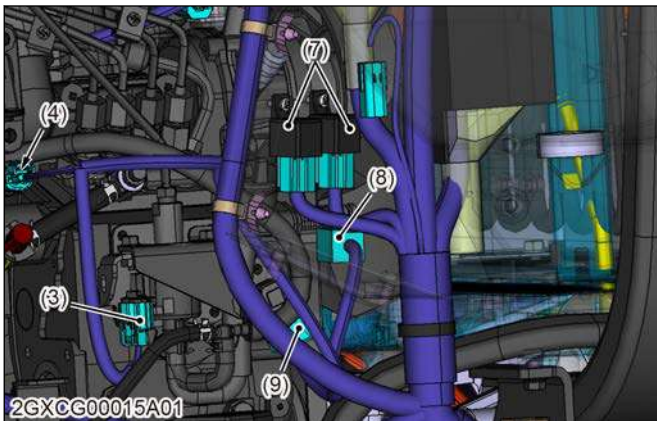
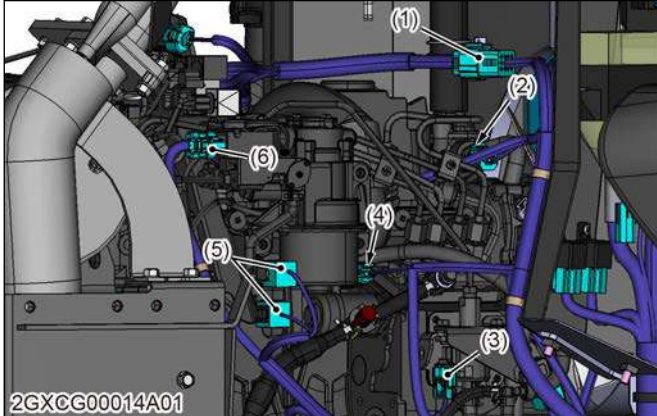


- (1) Air cleaner hose (turbo- (4) Air cleaner assembly
charger)

2. Disconnect air cleaner hose from blower (2).

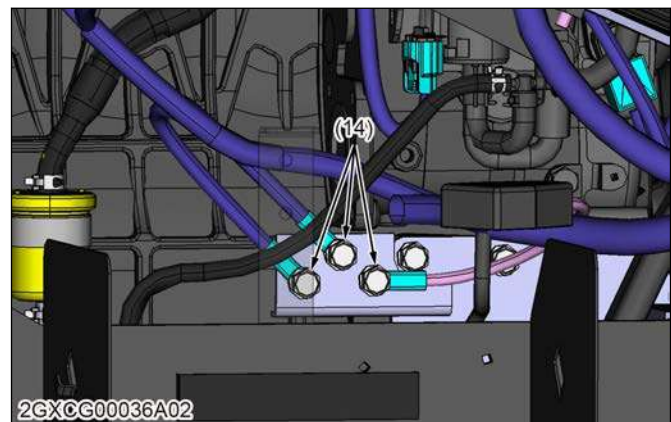
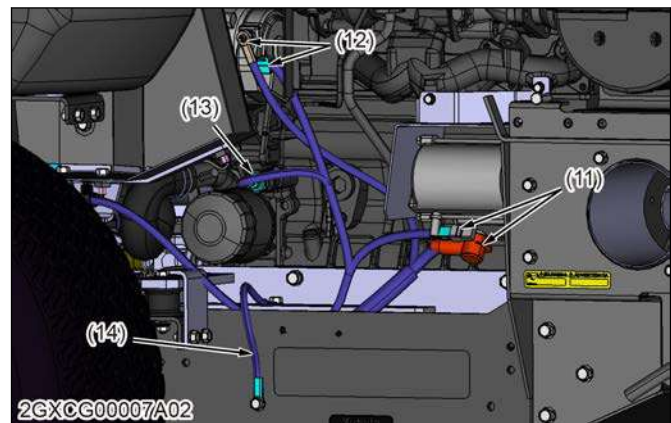
5.1.9 Disconnecting engine wiring harness

1. Disconnect each wiring connector.
 - DPF harness connector (1)
 - Water temperature sensor (2)
 - Doser fuel pump connector (3)
 - Engine stop solenoid connector (4)
 - Blower connectors (5)
 - Pressure sensor (6)
 - Relays (7)
 - Rack position sensor (8)
 - Rotation sensor (9)
 - Glow plug (10)



- | | |
|------------------------------------|--------------------------|
| (1) DPF harness connector | (6) Pressure sensor |
| (2) Water temperature sensor | (7) Relays |
| (3) Doser fuel pump connector | (8) Rack position sensor |
| (4) Engine stop solenoid connector | (9) Rotation sensor |
| (5) Blower connectors | (10) Glow plug |

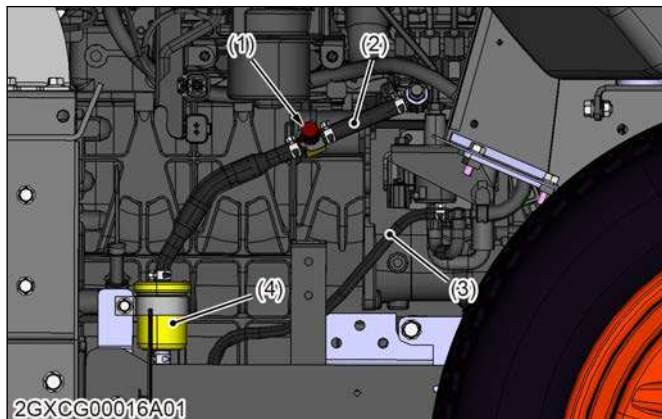
2. Remove positive cable and connector from starter motor (11).
3. Disconnect alternator connectors (12).
4. Disconnect oil switch (13).
5. Disconnect all ground cables (14).



- | | |
|----------------------------|--------------------|
| (11) Starter motor | (14) Ground cables |
| (12) Alternator connectors | |
| (13) Oil switch | |

5.1.10 Disconnecting engine fuel hoses

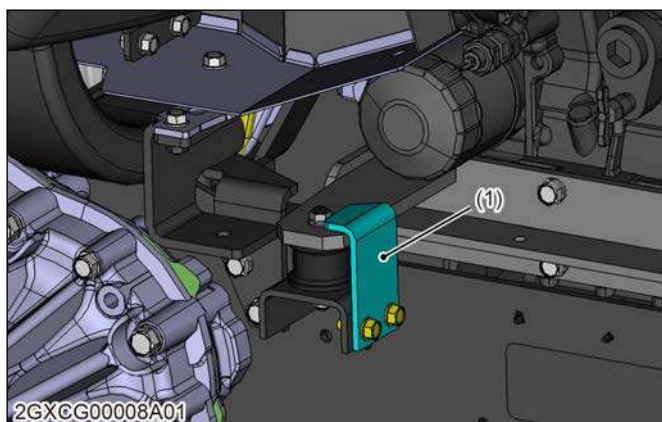
1. Turn off fuel cut off valve (1).
2. Disconnect fuel hose from engine (2).
3. Disconnect fuel hose from doser fuel pump (3).
4. Remove fuel filter assembly (4).



- (1) Fuel cut off valve
- (2) Fuel hose (Engine)
- (3) Fuel hose (Doser fuel pump)
- (4) Fuel filter assembly

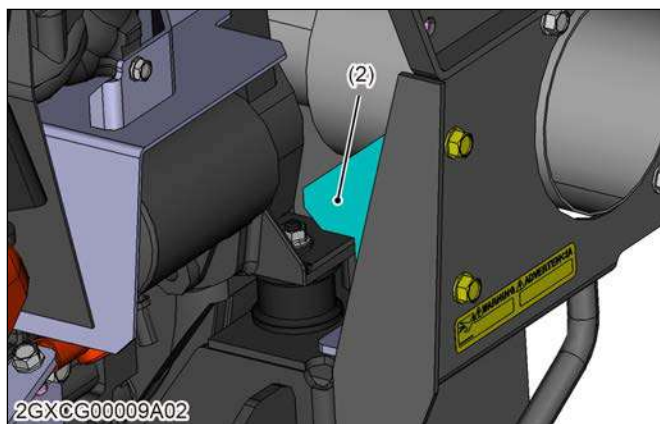
5.1.11 Removing engine stoppers

1. Remove front engine stoppers (1) on both sides of engine.



- (1) Front engine stopper

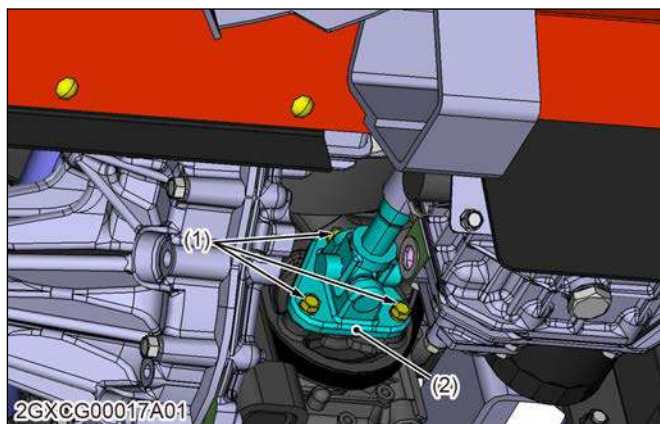
2. Remove rear engine stoppers (2) on both sides of engine.



- (2) Rear engine stopper

5.1.12 Removing universal joint from engine

1. Remove universal joint mounting bolts from engine (1).
2. Remove universal joint (2).



- (1) Universal joint mounting bolts (engine)
- (2) Universal joint

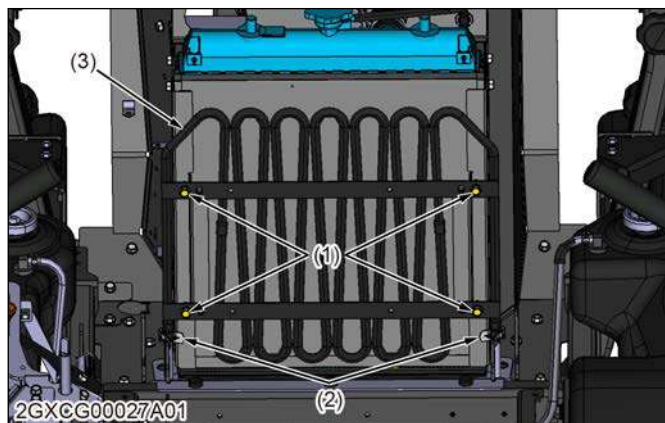
(When reassembling)

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

Tightening torque	Universal joint mounting bolt	26.0 to 28.0 N · m 2.70 to 2.90 kgf · m 19.2 to 20.7 lbf · ft
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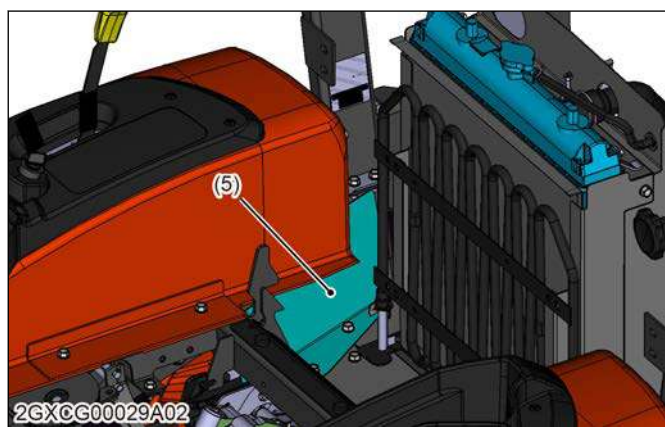
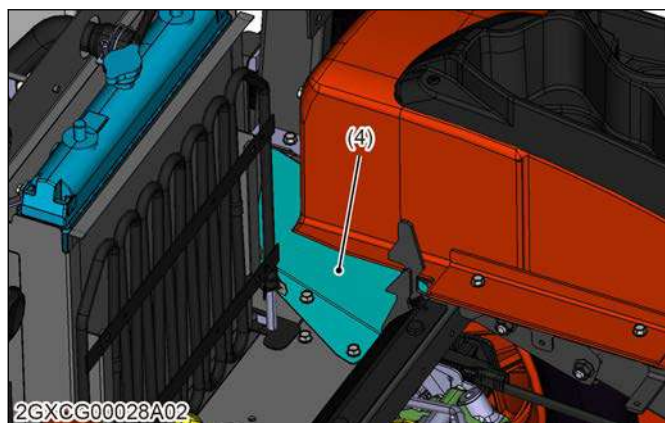
5.1.13 Disconnecting radiator assembly

1. Remove the oil cooler mounting bolts (1).



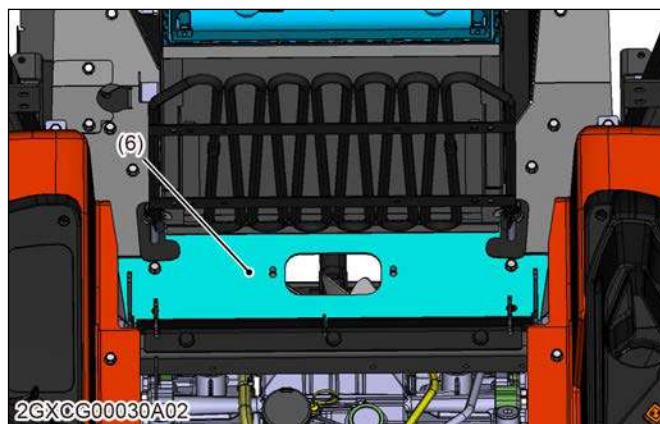
- (1) Oil cooler mounting bolts (3) Oil cooler
(2) Oil cooler clips

2. Remove L.H. and R.H. radiator plates (4), (5).



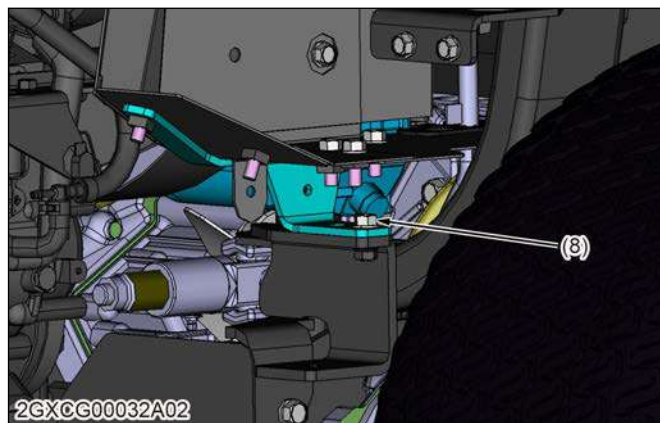
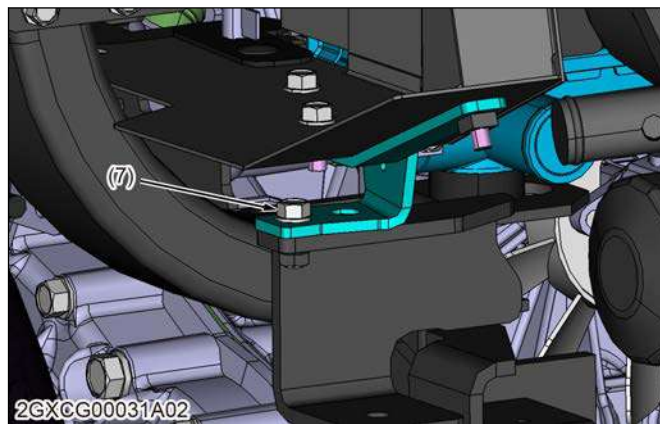
- (4) L.H. radiator plate (5) R.H. radiator plate

3. Remove center radiator plate (6).



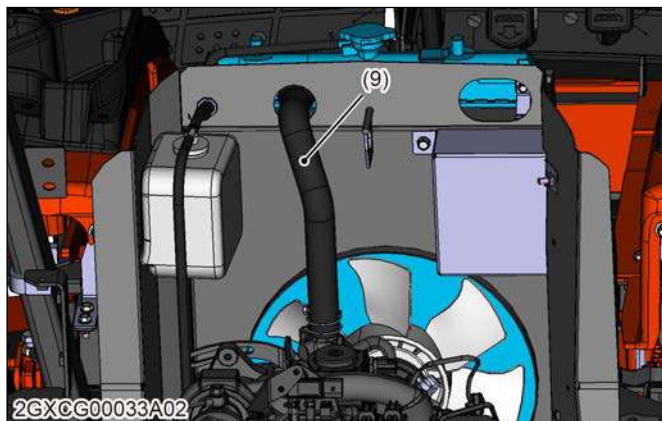
- (6) Center radiator plate

4. Remove radiator bracket mounting bolts (7), (8).



- (7) Radiator bracket mounting bolt L.H. (8) Radiator bracket mounting bolt R.H.

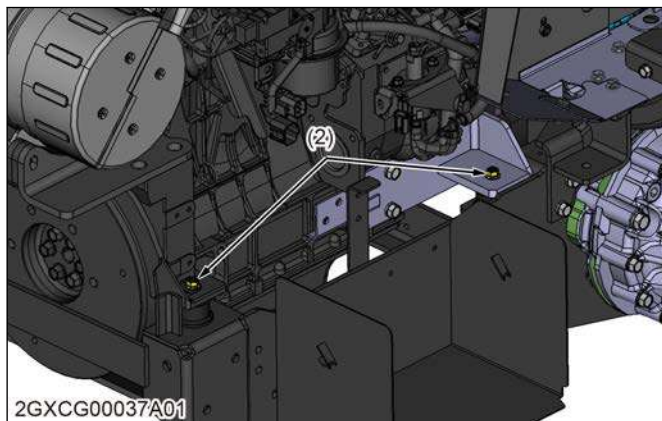
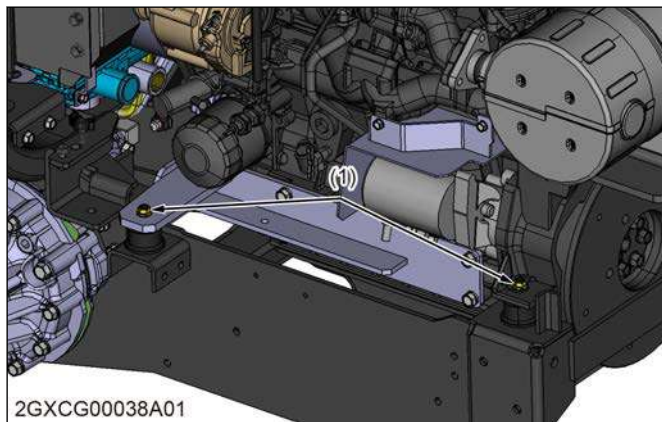
5. Remove upper radiator hose (9).



(9) Upper radiator hose

5.1.14 Separating the engine

1. Remove engine mounting nuts L.H. (1).
2. Remove engine mounting nuts R.H. (2).



(1) Engine mounting nuts L.H. (2) Engine mounting nuts R.H.

3. Attach hoist to engine.
4. Separate the engine.



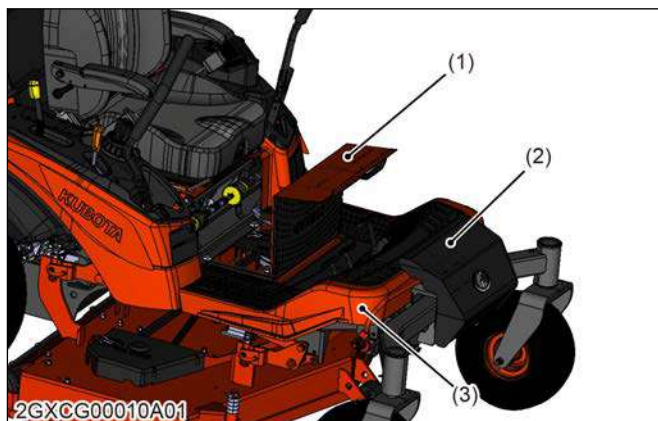
(When reassembling)

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

Tightening torque	Engine mounting nut	23.5 to 27.5 N·m 2.40 to 2.80 kgf·m 17.4 to 20.3 lbf·ft
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5.1.15 Removing step and center step

1. Remove the step center (1).
2. Remove the front mask (2).
3. Remove the step (3).



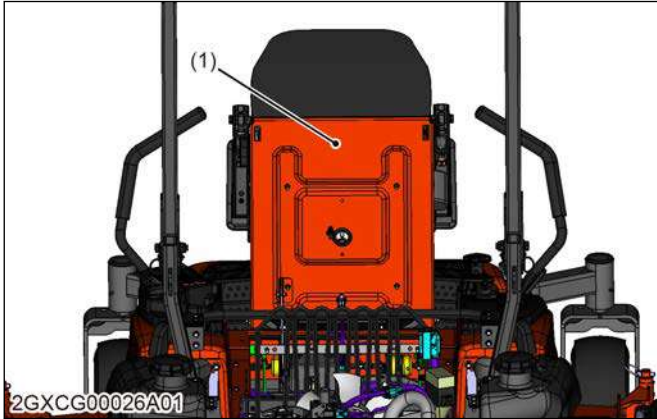
(1) Step center
(2) Front mask

(3) Step

5.1.16 Removing seat assembly

1. Raise the seat and disconnect the wiring connector for seat safety switch.

2. Remove the seat assembly (1).



(1) Seat assembly

5.1.17 Removing fuel stabilizer

1. Remove fuel stabilizer guard (1) on both sides.



(1) Fuel stabilizer guard

2. Disconnect fuel vapor hose (2) on both sides.
3. Remove fuel stabilizer bar (3) with fuel vapor hose (2).



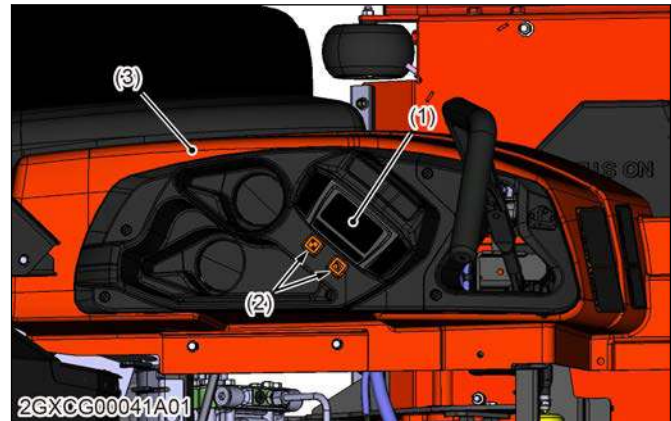
(2) Fuel vapor hose

(3) Fuel stabilizer bar

5.1.18 Removing fenders

1. Disconnect LCD panel (1).

2. Disconnect regeneration switches (2).
3. Remove fender L.H. (3).

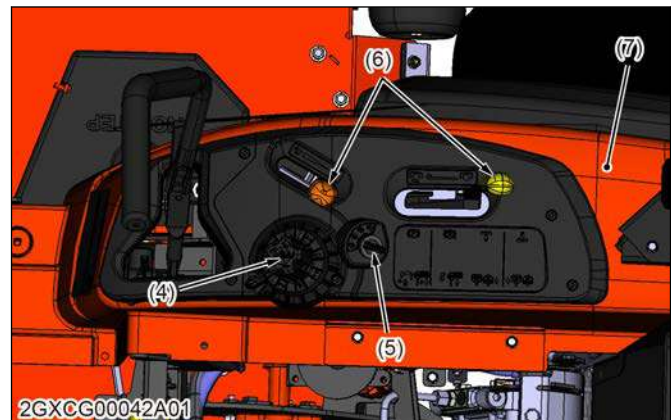


(1) LCD panel

(2) Regeneration switches

(3) Fender (L.H.)

4. Remove mower cutting height adjusting dial (4).
5. Disconnect key switch (5).
6. Remove lever grips (6).
7. Remove fender R.H. (7).



(4) Mower cutting height adjusting dial

(5) Key switch

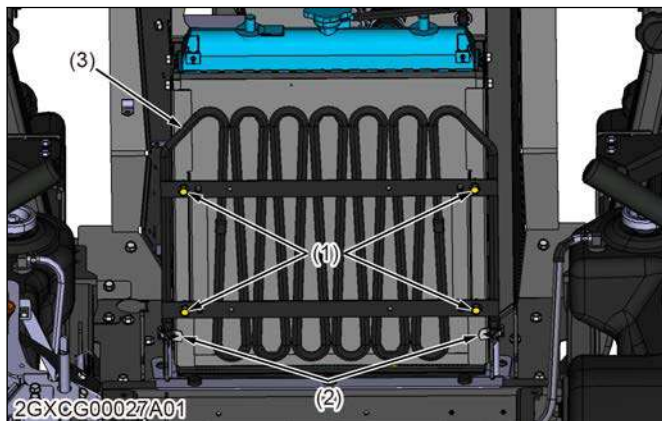
(6) Lever grips

(7) Fender (R.H.)

5.1.19 Removing oil cooler

1. Remove oil cooler bolts (1).
2. Remove clips (2).

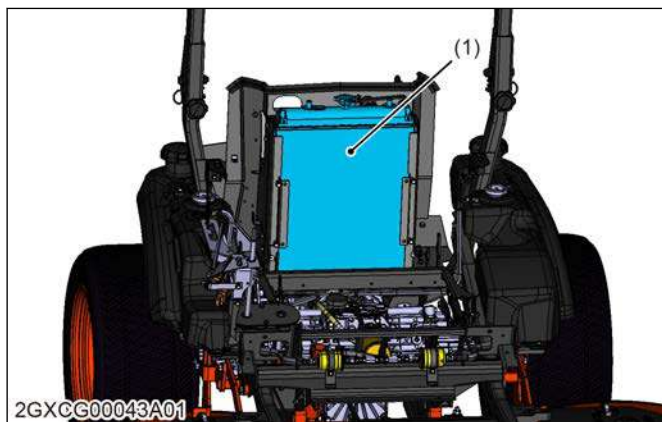
3. Remove oil cooler (3).



- (1) Oil cooler bolts
(2) Oil cooler clips
(3) Oil cooler

5.1.20 Removing radiator

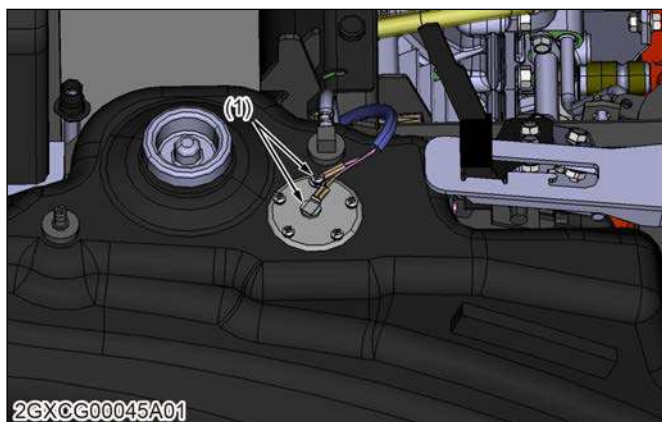
1. Remove radiator assembly (1).



- (1) Radiator assembly

5.1.21 Removing fuel tanks

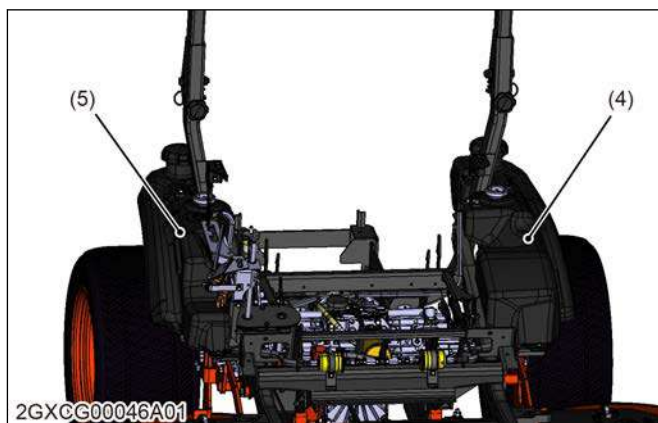
1. Disconnect the wiring connectors for fuel gauge (1).
2. Switch off fuel flow by turning fuel cutoff switches (2) (one on each tank).
3. Remove fuel hose (3) from both sides.



- (1) Fuel gauge
(2) Fuel cutoff switch
(3) Fuel hose

4. Remove fuel tank L.H. (4).

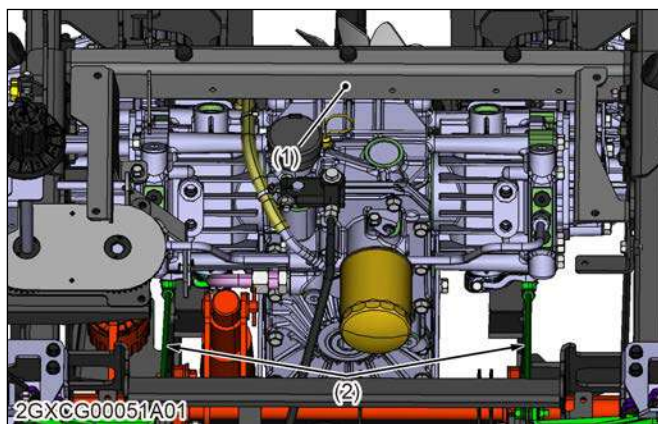
5. Remove fuel tank R.H. (5).



- (4) Fuel tank (L.H.)
(5) Fuel tank (R.H.)

5.1.22 Removing speed control rods

1. Remove bonnet lock assembly (1).
2. Remove speed control rods (2).

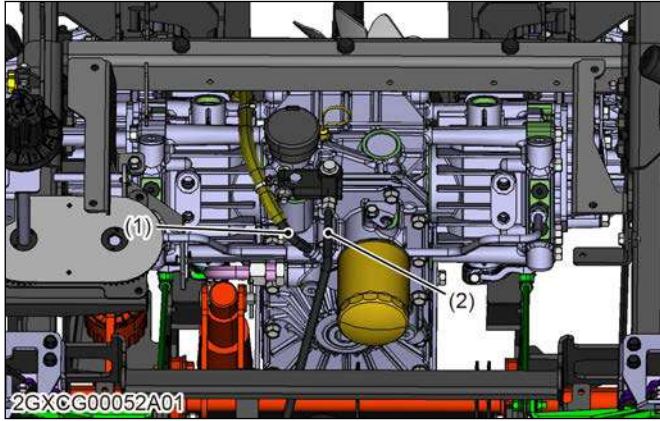


- (1) Bonnet lock assembly
(2) Speed control rods

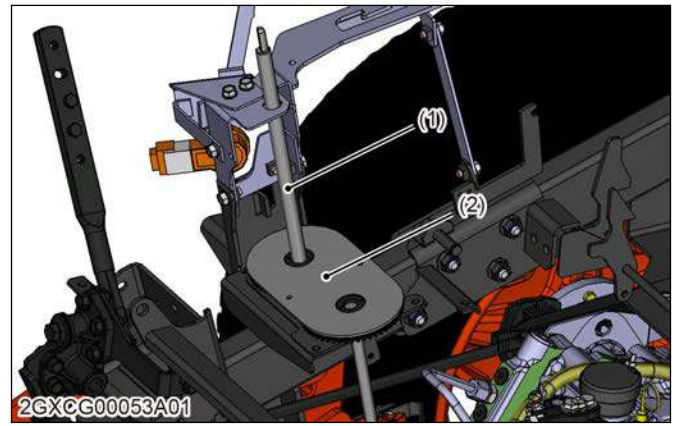
5.1.23 Removing hydraulic lift rod

1. Disconnect hydraulic lift hose (1).

2. Remove hydraulic lift rod (2).



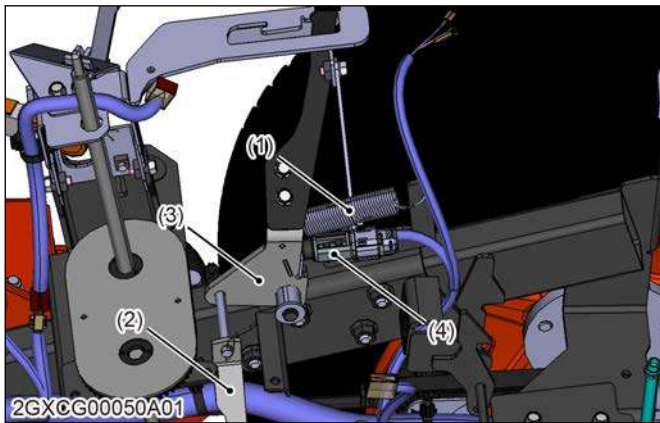
(1) Hydraulic lift hose (2) Hydraulic lift rod



(1) Dial rod (2) Cutting height adjusting gear

5.1.24 Removing PTO lever assembly

1. Remove spring (1).
2. Remove PTO link (2).
3. Remove PTO lever (3).
4. Remove PTO safety switch (4).

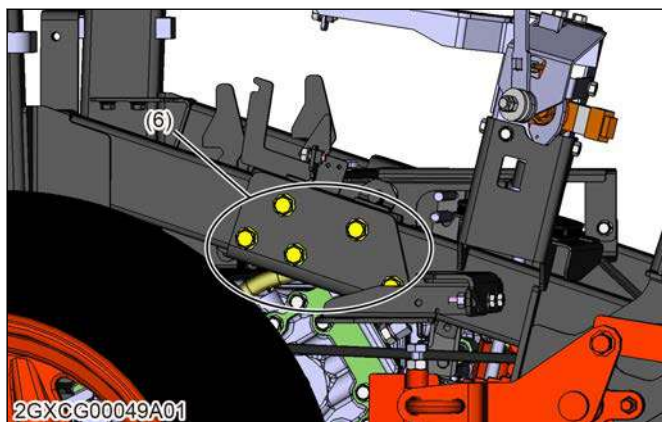
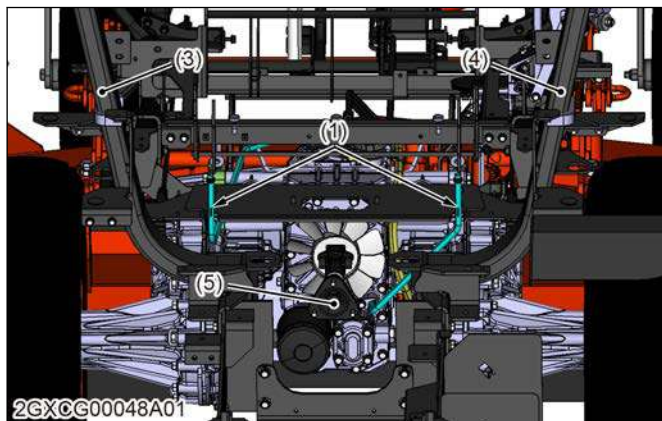


(1) Spring (2) PTO link (3) PTO lever (4) PTO safety switch

5.1.25 Removing cutting height adjusting gear

1. Remove dial rod (1).
2. Remove cutting height adjusting gear (2).

5.1.26 Removing ROPS



- | | |
|-----------------------|-------------------------|
| (1) Oil cooler pipe | (4) ROPS lower (R.H.) |
| (2) ROPS upper | (5) Universal joint |
| (3) ROPS lower (L.H.) | (6) ROPS mounting bolts |

1. Remove the oil cooler pipes (1).
2. Remove the ROPS upper (2).
3. Remove ROPS mounting bolts (6).
4. Remove the ROPS lower (L.H.) (3) and ROPS lower (R.H.) (4).
5. Remove the universal joint (5) from the transaxle.

(When reassembling)

NOTE

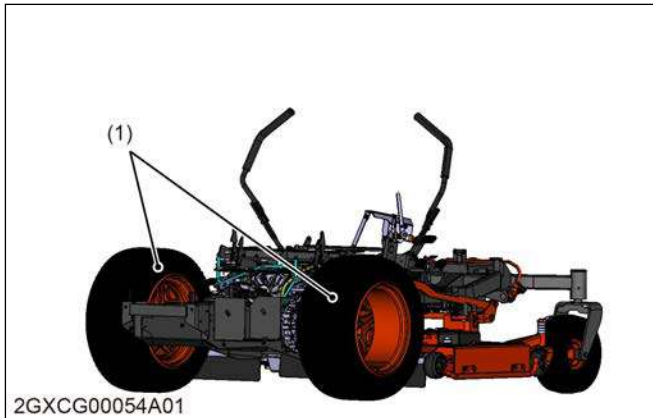
- Make sure to mount the cushion rubber on the oil cooler pipe.

- When tightening ROPS mounting bolts (6), begin with top right bolt and tighten counterclockwise two laps.

Tightening torque	ROPS mounting screw (M12)	77.4 to 90.2 N · m 7.90 to 9.19 kgf · m 57.1 to 66.5 lbf · ft
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5.1.27 Removing rear wheel

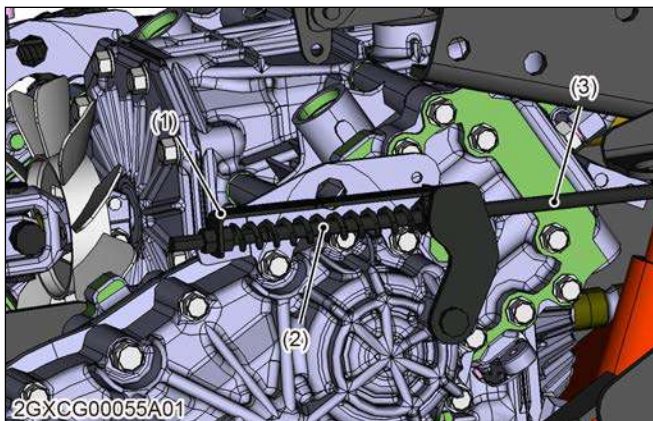
1. Lift and secure machine with jack stands.
2. Remove rear wheel (1) on both sides.



- (1) Rear wheel

5.1.28 Removing parking brake

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



- (1) Parking brake return plate (3) Parking brake rod
(2) Parking brake spring

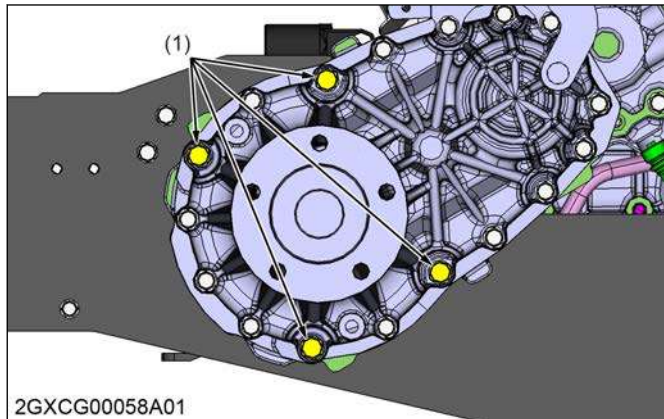
(When reassembling)

- Replace the cotter pin with new one.
- After assembling the parking brake rods, be sure to check the parking brake spring length and play. If the measurement is not within the factory specifications, adjust the spring length and play.

— RELATED PAGE —
6.4 Adjusting parking brake on page 2-31

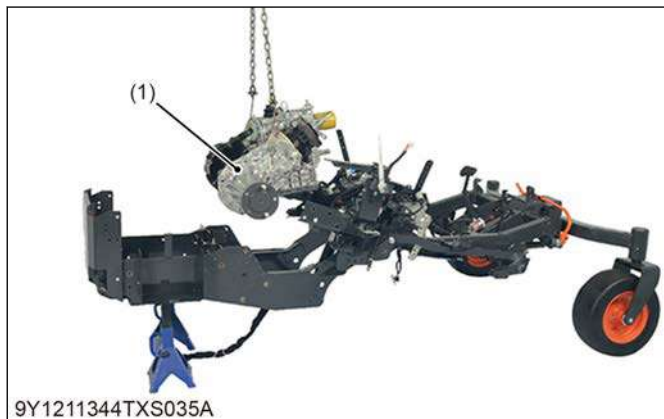
5.1.29 Separating transaxle assembly

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



- (1) Rear axle gear case mounting bolts

2. Separate the transaxle assembly (1) from main frame.



- (1) Transaxle assembly

(When reassembling)

Tightening torque	Rear axle gear case mounting bolt	78 to 90 N · m 7.9 to 9.2 kgf · m 58 to 66 lbf · ft
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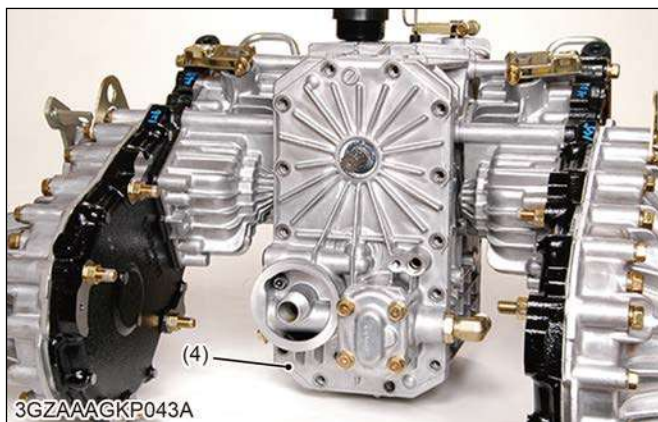
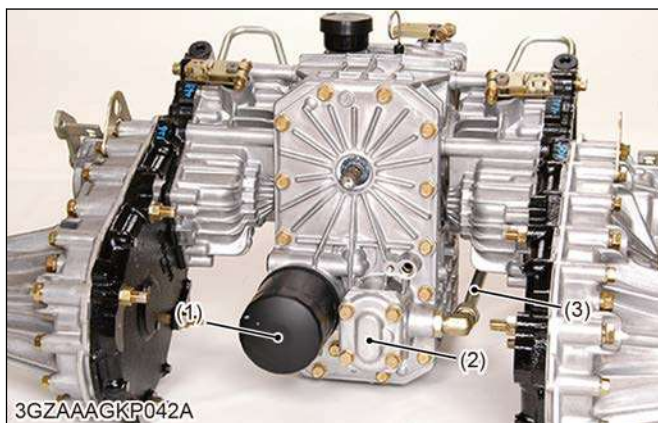
5.2 Disassembling transaxle center case

5.2.1 Removing center case rear cover

NOTE

- Make sure to remove the hex. socket head screw hidden behind the filter cartridge (1).
- To remove the center case rear cover (4) mounted on the machine, also remove the hydraulic pump (2). This makes fitting the spline

between pump shaft and the pump drive shaft easy.



- (1) Oil filter cartridge
- (2) Hydraulic pump
- (3) Delivery pipe
- (4) Center case rear cover

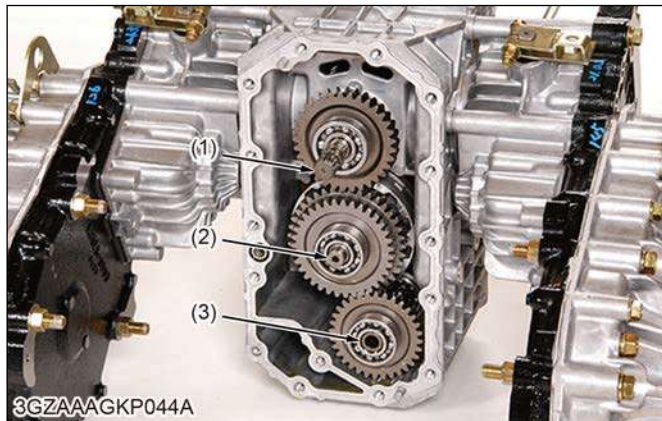
1. Remove the oil filter cartridge (1).
2. Remove the delivery pipe (3).
3. Remove the center case rear cover (4).

(When reassembling)

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

Tightening torque	Center case rear cover mounting screw	40 to 44 N · m 4.0 to 4.5 kgf · m 29 to 32 lbf · ft
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5.2.2 Removing PTO clutch shaft assembly and pump gear shaft



- (1) Input shaft assembly (3) Pump shaft assembly
(2) PTO clutch shaft assembly

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

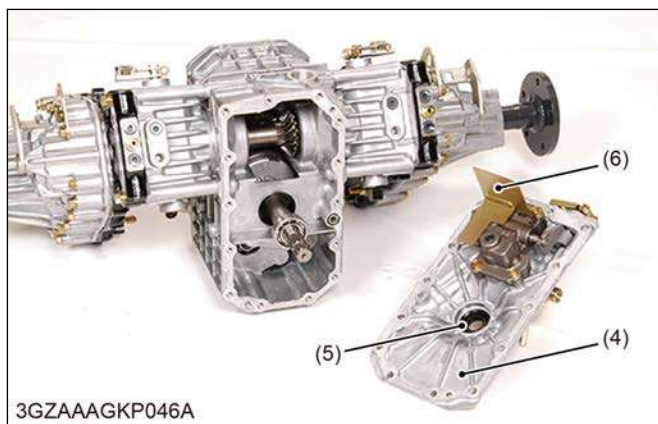
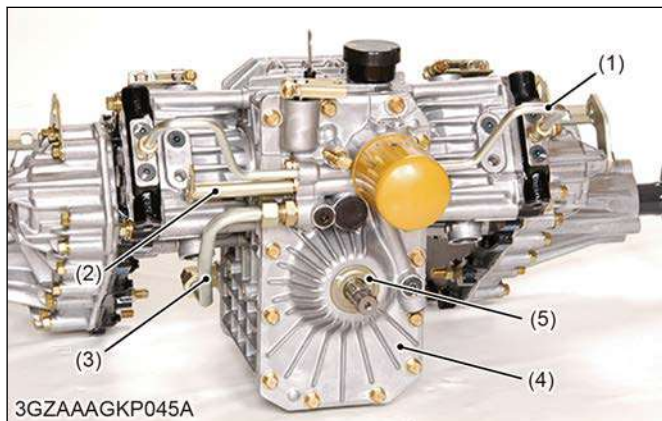
(When reassembling)

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

5.2.3 Removing 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) HST pipe (4) Center case front cover
(2) PTO clutch lever (5) PTO shaft oil seal
(3) Delivery pipe (6) Plate

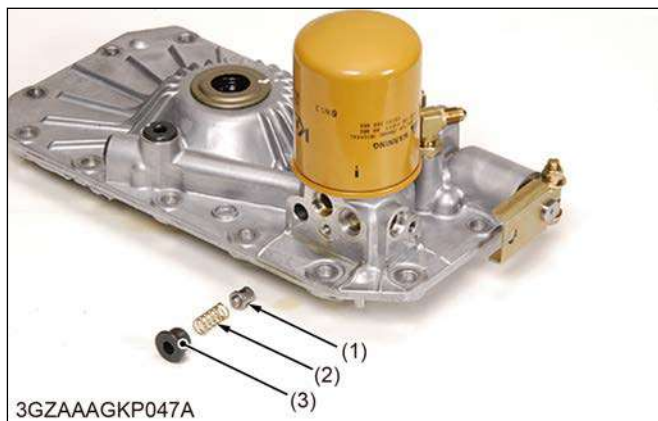
1. Remove the HST pipe (1).
2. Remove the delivery pipe (3).
3. Remove the PTO clutch lever (2).
4. Remove the center case front cover (4).

(When reassembling)

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

Tightening torque	Center case front cover mounting screw	40 to 44 N·m 4.0 to 4.5 kgf·m 29 to 32 lbf·ft
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5.2.4 Removing regulator valve (HST charge pressure relief valve)

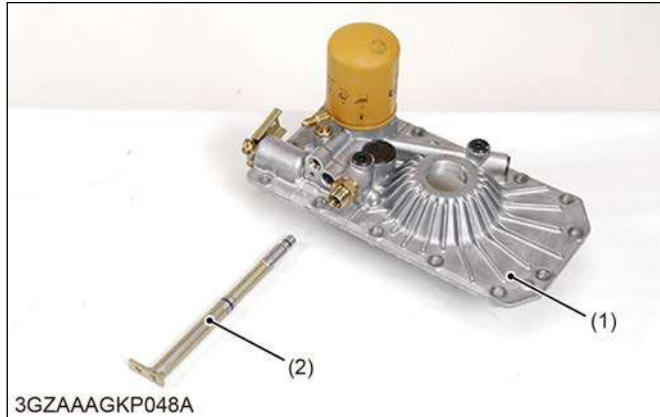


- (1) Poppet (3) Plug
(2) Spring

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

5.2.5 Removing PTO clutch lever

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



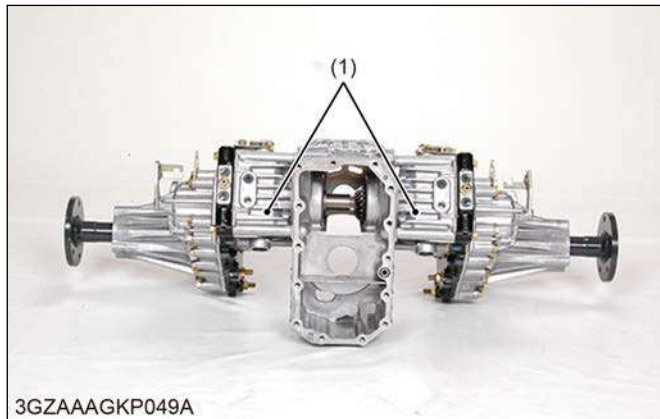
(1) Center case front cover (2) PTO clutch lever

(When reassembling)

- Be careful not to damage the O-rings.

5.2.6 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).

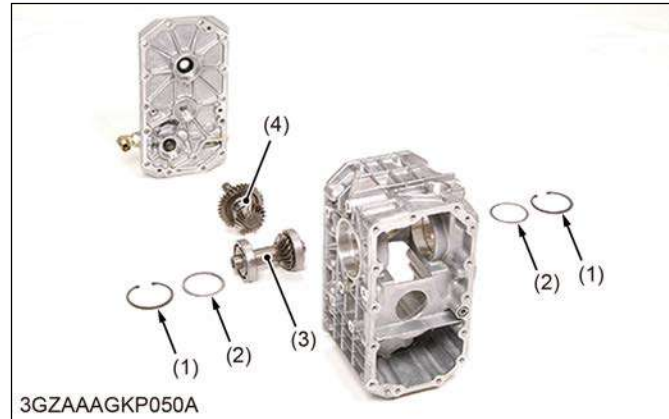


(1) Hydrostatic transmission and rear axle gear case assembly

(When reassembling)

- Be careful not to damage the O-ring.

Tightening torque	Hydrostatic transmission and rear axle gear case assembly mounting screw	40 to 44 N·m 4.0 to 4.5 kgf·m 29 to 32 lbf·ft
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5.2.7 Removing input shaft, spiral bevel gear and joint shaft

(1) Internal snap ring (3) Joint shaft assembly
(2) Shim (4) Spiral bevel gear

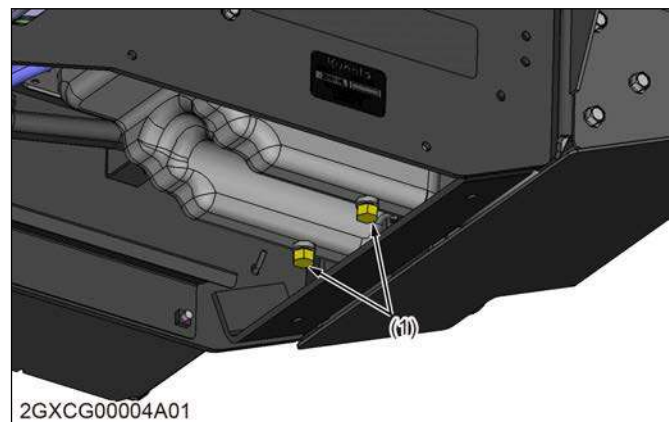
1. Remove the input shaft and spiral bevel gear (4).
2. Remove the internal snap ring (1).

(When reassembling)

- Use same thickness of shims as before disassembling.

5.3 Disassembling PTO clutch shaft assembly**5.3.1 Draining engine oil**

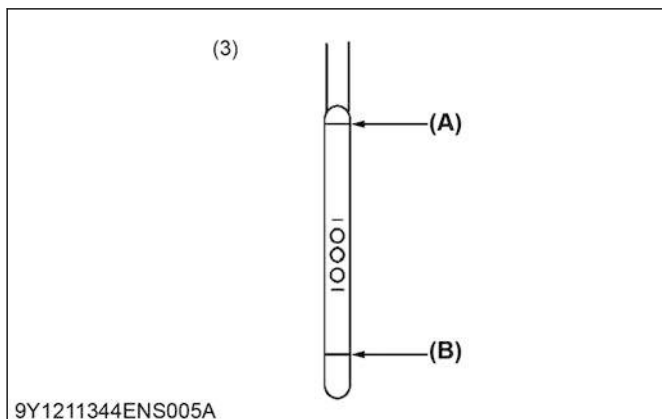
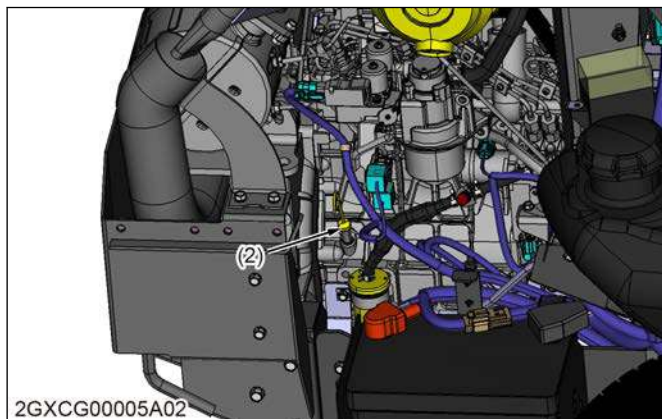
1. Park the machine on level ground.
2. Start and warm up the engine for approx. 5 minutes.
3. Place an oil pan underneath the engine.



(1) Drain plug

4. Remove the drain plug (1) to drain oil and drain the oil completely.
5. After draining, screw in the drain plug (1).

(When refilling)



- (2) Dipstick
(3) Engine oil range
(A) Upper level
(B) Lower level

IMPORTANT

- Fill the engine oil up to the upper line (A) on the dipstick.
- Never mix two different types of oil.
- Use the proper SAE Engine Oil according to ambient temperatures.

Engine oil	Capacity	6.7 L 7.1 U.S.qts 5.9 Imp.qts
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5.3.2 Draining transmission fluid

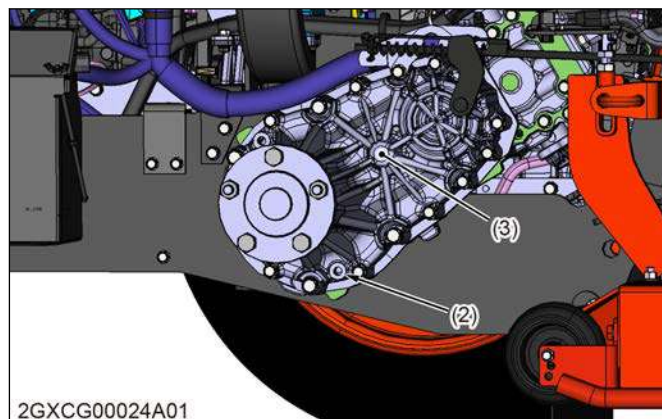
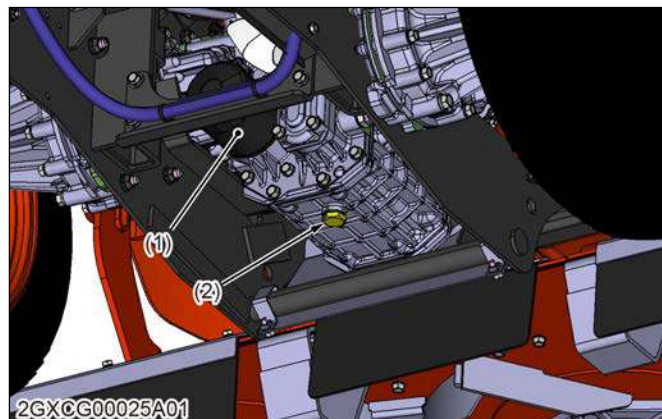
CAUTION

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.

1. Place oil pans underneath the transmission case and the rear axle gear case (R.H. and L.H.).
2. Remove the drain plug (2) at the bottom of the transmission case and the rear axle gear case (R.H. and L.H.) to drain the oil.

3. After draining reinstall the drain plugs (2).



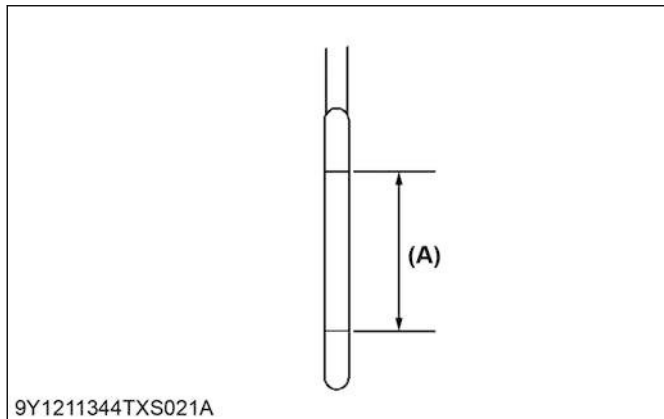
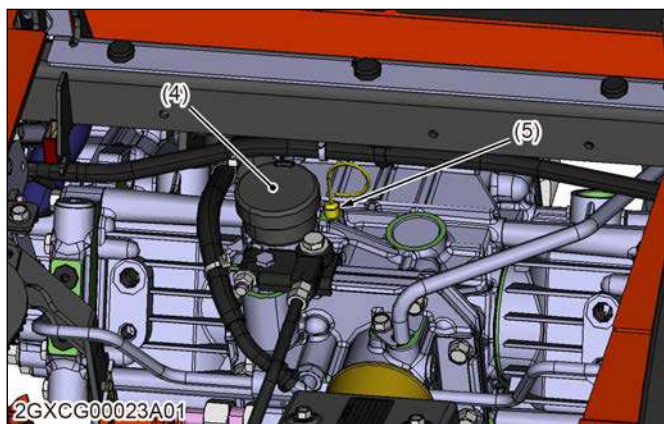
- (1) Transmission oil filter
(2) Drain plug
(3) Rear axle gear case L.H.

(When refilling)

IMPORTANT

- After running the engine for a few minutes, stop it and check the oil level again; add oil to the prescribed level (A).
- It takes time to pour the oil from the transmission case to the rear axle case R.H. and L.H. Pour the regulated amount of oil slowly.
- Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system.
- The fluid in the transmission case is also used for the hydrostatic drive system.
- Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.
- Keep the engine at medium speed for a few minutes to ensure proper lubrication of all parts so there is no damage to transmission.

1. Remove the filling plug (4) and fill with oil.
2. After running the engine for a few minutes, stop it and check the oil level again; add oil to the prescribed level (A).



- (4) Oil filling plug and breather cup
(5) Dipstick
(A) Oil level acceptable within this range.

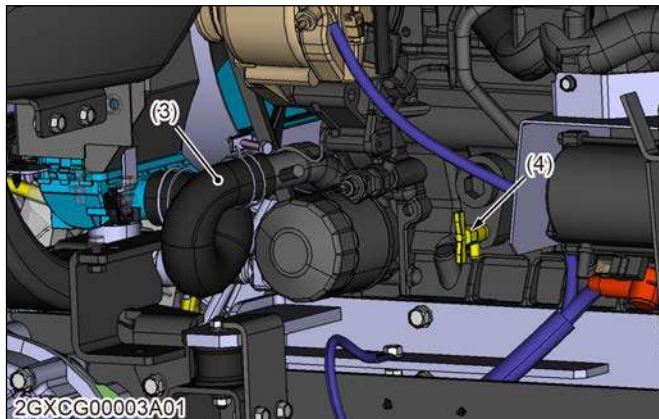
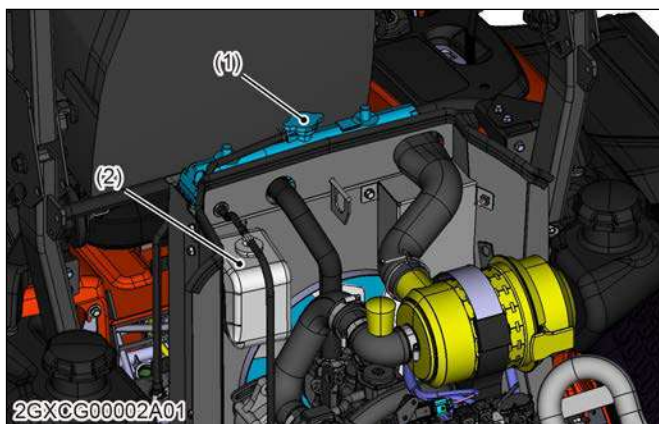
Transmission fluid	Capacity	12.1 L 12.8 U.S.qts 10.6 Imp.qts
--------------------	----------	--

5.3.3 Draining coolant

WARNING

To avoid serious injury or death:

- 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) Radiator cap
(2) Recovery tank
(3) Lower radiator hose
(4) Engine coolant drain valve

- Stop the engine and let cool down.
- Open the engine coolant drain valve (4) to drain the coolant from the engine.
- Remove the lower radiator hose (3) from the engine side to drain the coolant from the radiator.
- Remove the radiator cap (1) to completely drain the coolant.
- After all coolant is drained, close the engine coolant drain valve (4).

(When refilling)

Coolant capacity	Radiator	4.6 L 4.9 U.S.qts 4.0 Imp.qts
	Recovery tank	1.1 L 1.2 U.S.qts 0.97 Imp.qts

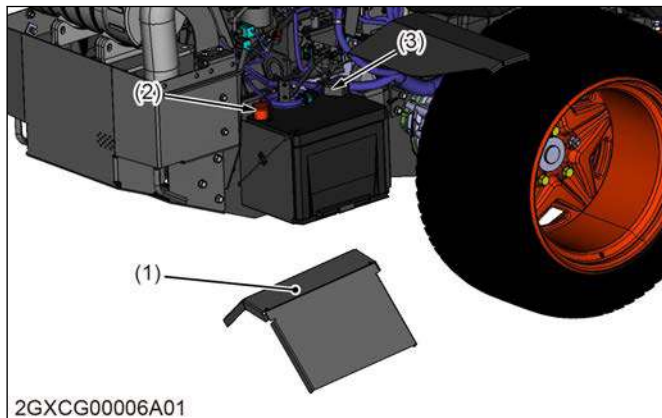
5.3.4 Removing the battery

WARNING

To avoid serious injury or death:

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

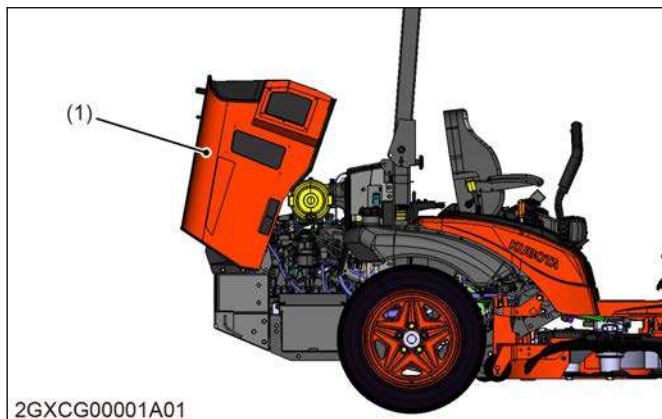
1. Remove the battery cover (1).
2. Disconnect the negative cable (3) from the battery.
3. Disconnect the positive cable (2) from the battery.
4. Remove the battery.



- (1) Battery cover
(2) Positive cable
(3) Negative cable

5.3.5 Removing the bonnet

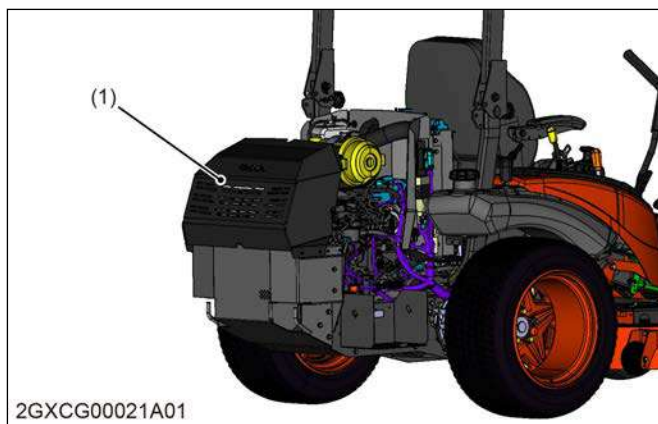
1. Remove the bonnet mounting bolts.
2. Remove the bonnet (1).



- (1) Bonnet

5.3.6 Removing DPF cover

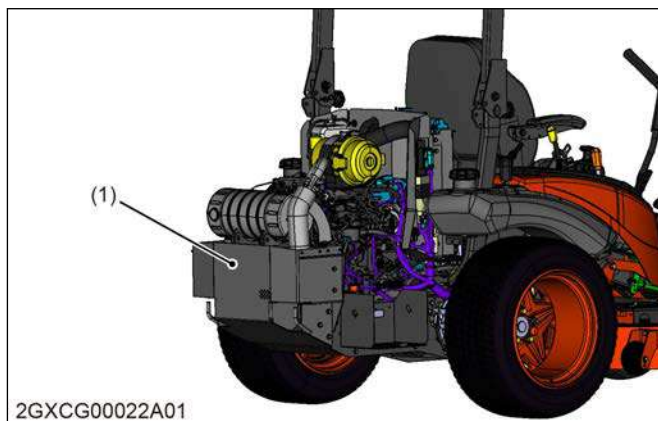
1. Remove DPF cover (1).



- (1) DPF cover

5.3.7 Removing rear engine frame

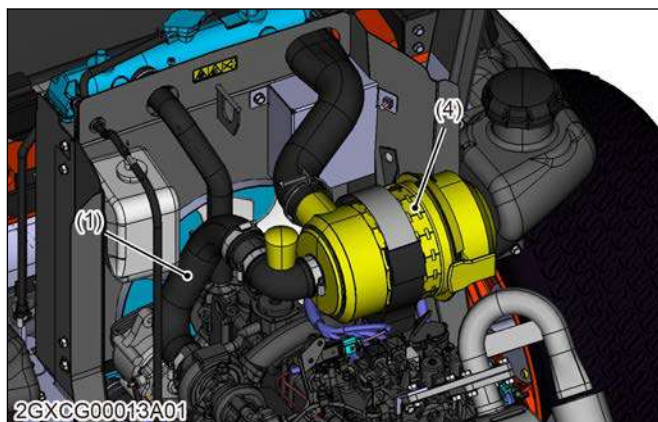
1. Remove rear engine frame (1).



- (1) Rear engine frame

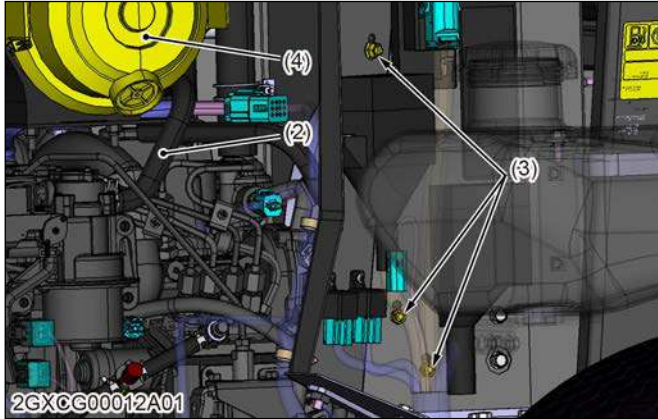
5.3.8 Removing air cleaner assembly

1. Disconnect air cleaner hose from turbocharger (1).



- (1) Air cleaner hose (turbo-charger)
(4) Air cleaner assembly
2. Disconnect air cleaner hose from blower (2).
 3. Remove air cleaner stay bolts (3).

4. Remove air cleaner assembly (4).

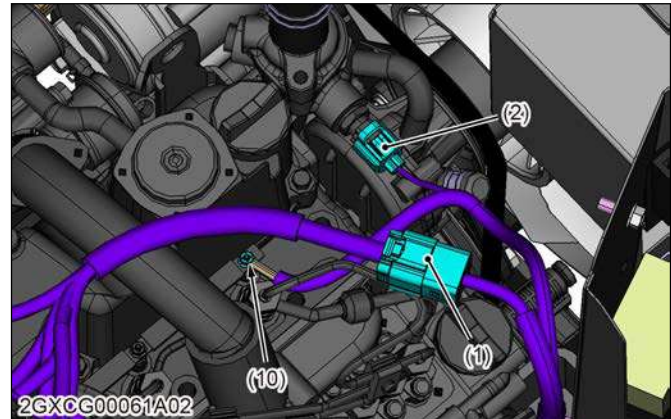
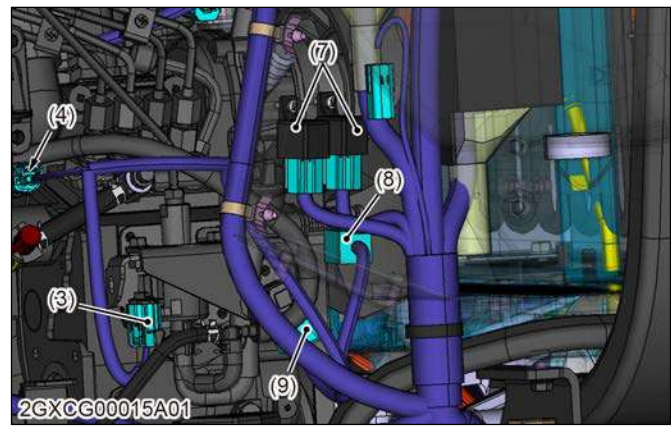
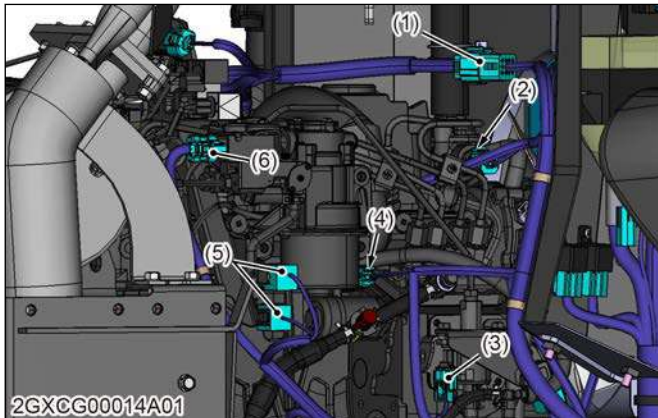


(2) Air cleaner hose (blower) (4) Air cleaner assembly
(3) Air cleaner stay bolts

5.3.9 Disconnecting engine wiring harness

1. Disconnect each wiring connector.

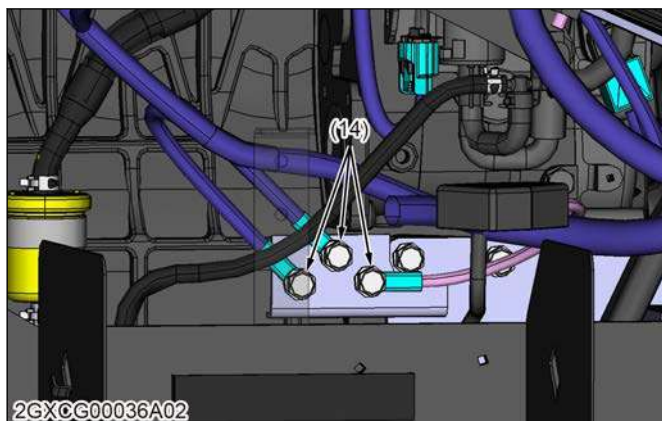
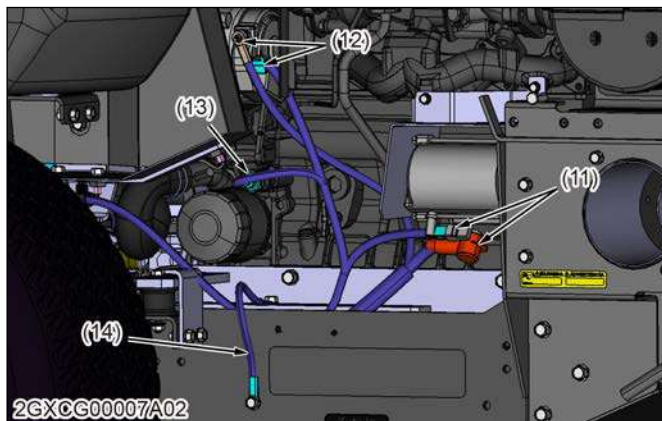
- DPF harness connector (1)
- Water temperature sensor (2)
- Doser fuel pump connector (3)
- Engine stop solenoid connector (4)
- Blower connectors (5)
- Pressure sensor (6)
- Relays (7)
- Rack position sensor (8)
- Rotation sensor (9)
- Glow plug (10)



(1) DPF harness connector (6) Pressure sensor
(2) Water temperature sensor (7) Relays
(3) Doser fuel pump connector (8) Rack position sensor
(4) Engine stop solenoid connector (9) Rotation sensor
(5) Blower connectors (10) Glow plug

2. Remove positive cable and connector from starter motor (11).
3. Disconnect alternator connectors (12).
4. Disconnect oil switch (13).

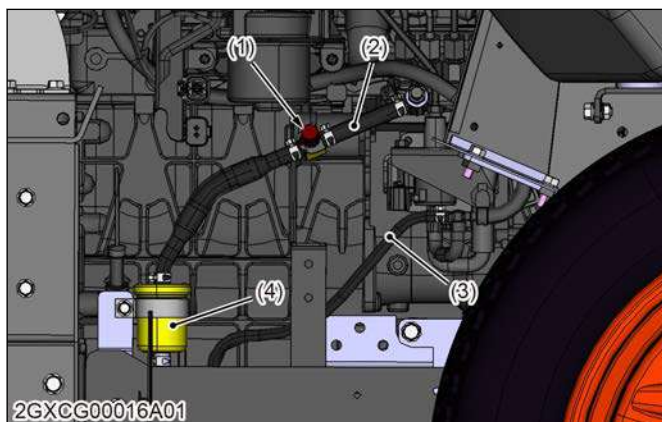
5. Disconnect all ground cables (14).



- (11) Starter motor
(12) Alternator connectors
(13) Oil switch
(14) Ground cables

5.3.10 Disconnecting engine fuel hoses

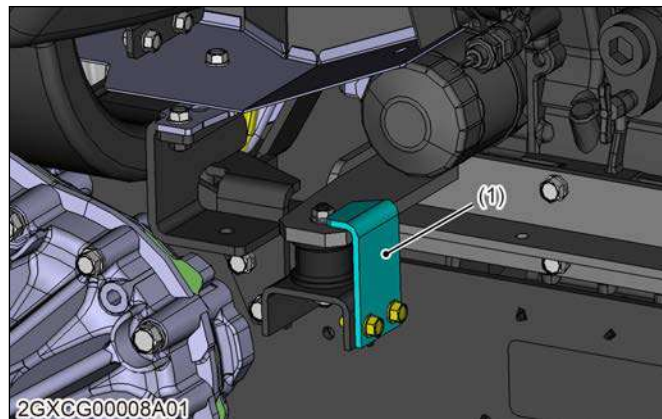
1. Turn off fuel cut off valve (1).
2. Disconnect fuel hose from engine (2).
3. Disconnect fuel hose from doser fuel pump (3).
4. Remove fuel filter assembly (4).



- (1) Fuel cut off valve
(2) Fuel hose (Engine)
(3) Fuel hose (Doser fuel pump)
(4) Fuel filter assembly

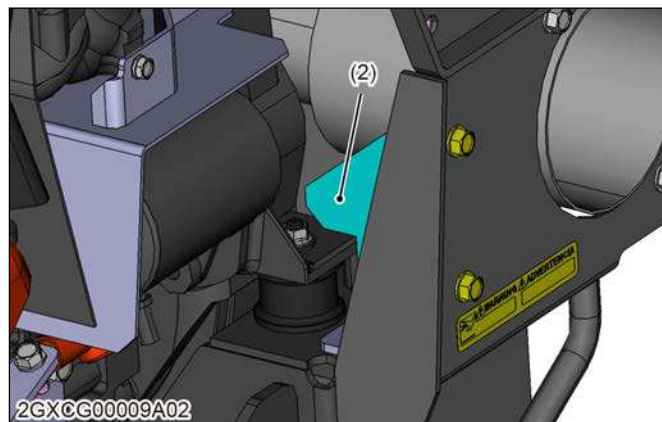
5.3.11 Removing engine stoppers

1. Remove front engine stoppers (1) on both sides of engine.



- (1) Front engine stopper

2. Remove rear engine stoppers (2) on both sides of engine.

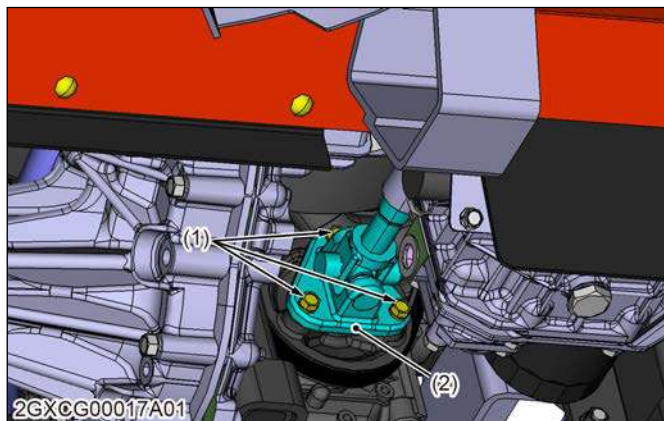


- (2) Rear engine stopper

5.3.12 Removing universal joint from engine

1. Remove universal joint mounting bolts from engine (1).

2. Remove universal joint (2).



- (1) Universal joint mounting bolts (engine)
(2) Universal joint

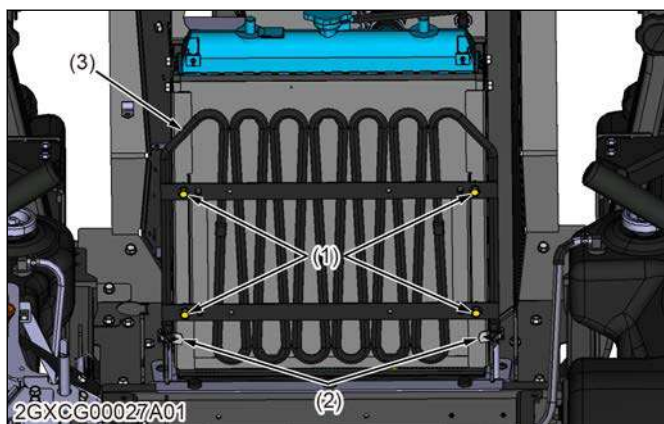
(When reassembling)

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

Tightening torque	Universal joint mounting bolt	26.0 to 28.0 N·m 2.70 to 2.90 kgf·m 19.2 to 20.7 lbf·ft
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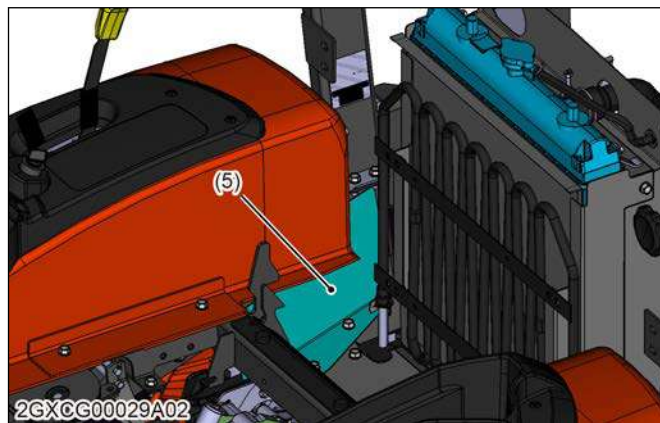
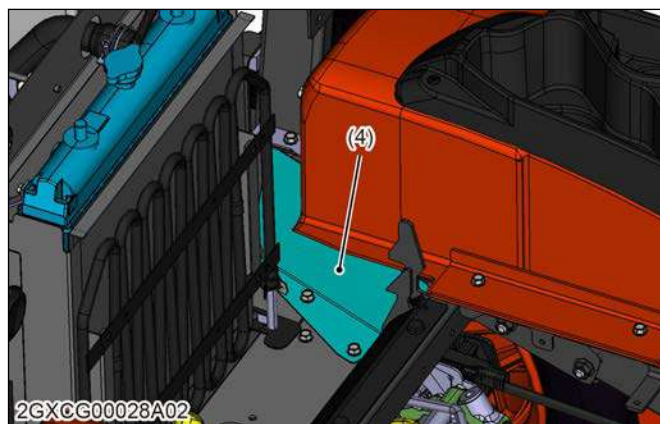
5.3.13 Disconnecting radiator assembly

1. Remove the oil cooler mounting bolts (1).



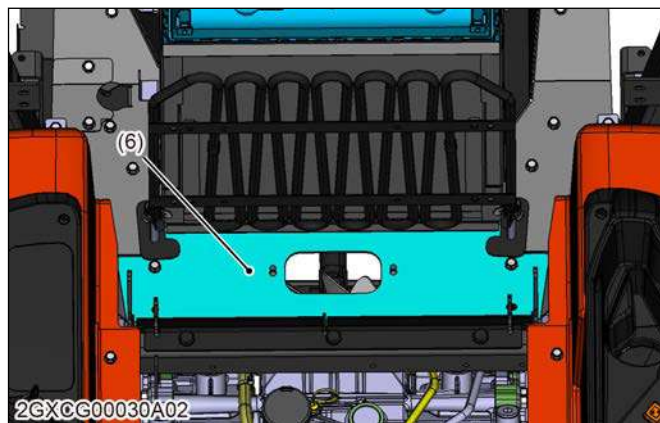
- (1) Oil cooler mounting bolts (3) Oil cooler
(2) Oil cooler clips

2. Remove L.H. and R.H. radiator plates (4), (5).



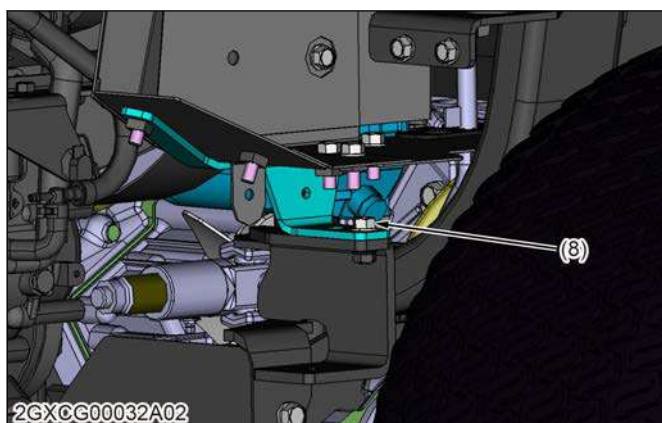
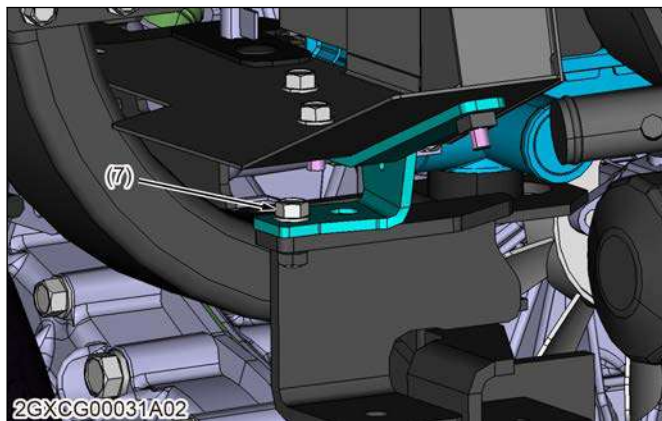
- (4) L.H. radiator plate (5) R.H. radiator plate

3. Remove center radiator plate (6).



- (6) Center radiator plate

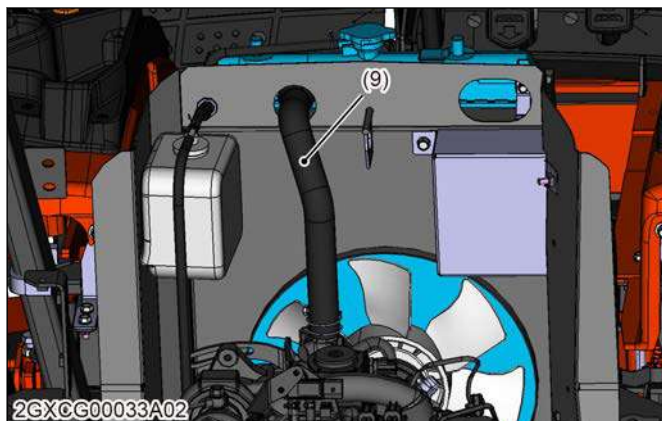
4. Remove radiator bracket mounting bolts (7), (8).



(7) Radiator bracket mounting bolt L.H.

(8) Radiator bracket mounting bolt R.H.

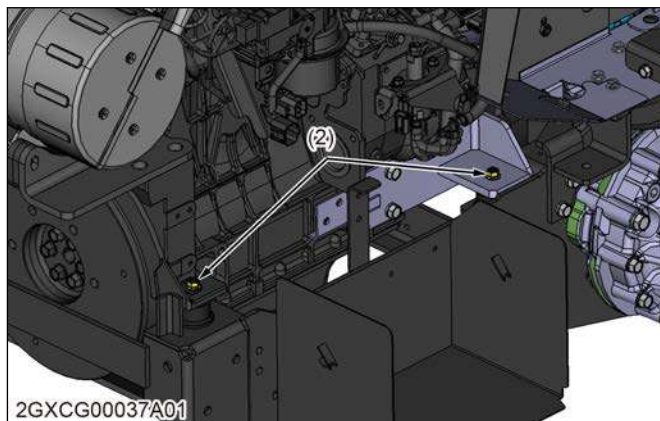
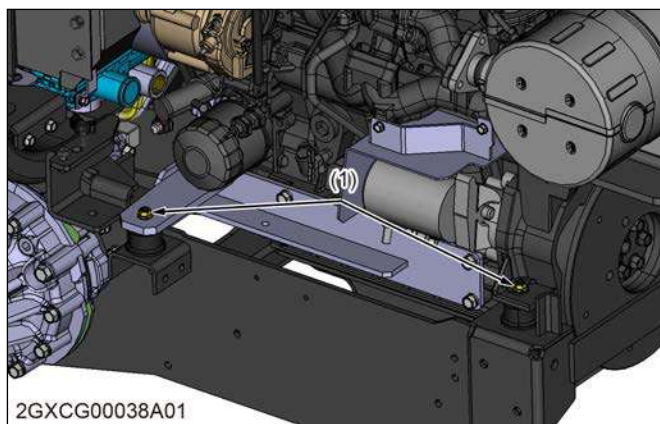
5. Remove upper radiator hose (9).



(9) Upper radiator hose

5.3.14 Separating the engine

1. Remove engine mounting nuts L.H. (1).
2. Remove engine mounting nuts R.H. (2).

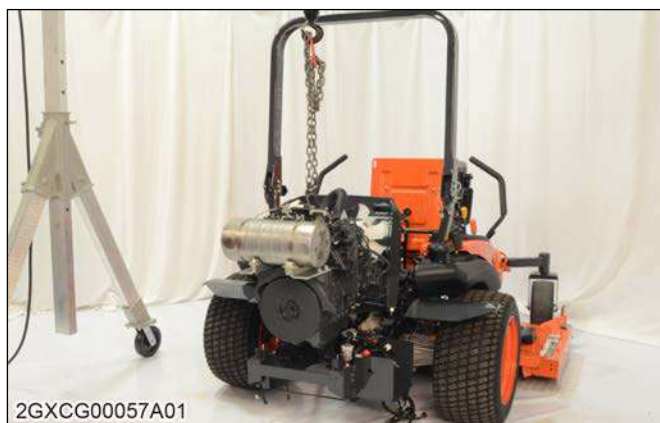


(1) Engine mounting nuts L.H.

(2) Engine mounting nuts R.H.

3. Attach hoist to engine.

4. Separate the engine.



(When reassembling)

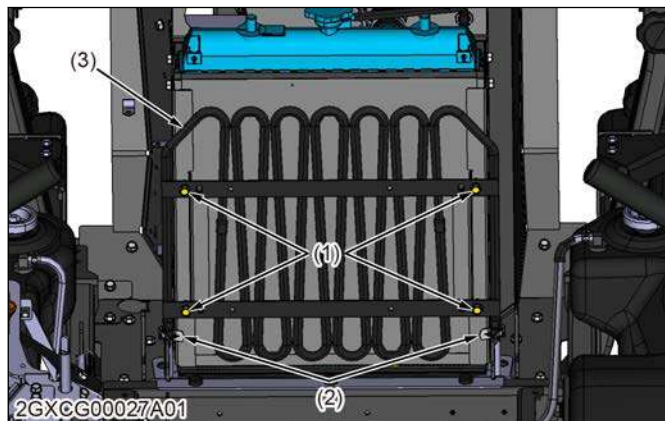
- Apply grease to the all splines on the drive shaft.

Tightening torque	Engine mounting nut	23.5 to 27.5 N·m 2.40 to 2.80 kgf·m 17.4 to 20.3 lbf·ft
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5.3.15 Removing oil cooler

1. Remove oil cooler bolts (1).
2. Remove clips (2).

3. Remove oil cooler (3).

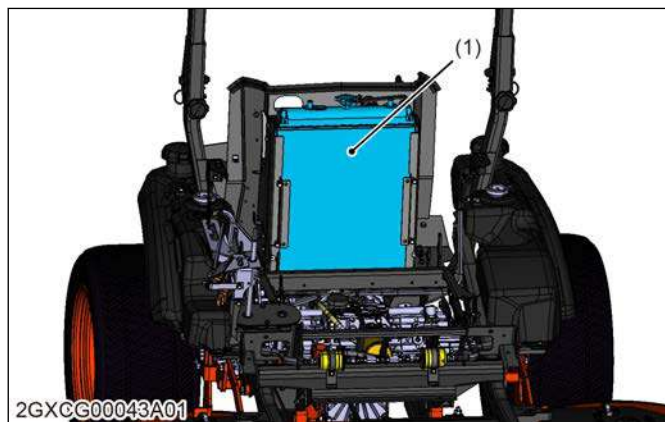


(1) Oil cooler bolts
(2) Oil cooler clips

(3) Oil cooler

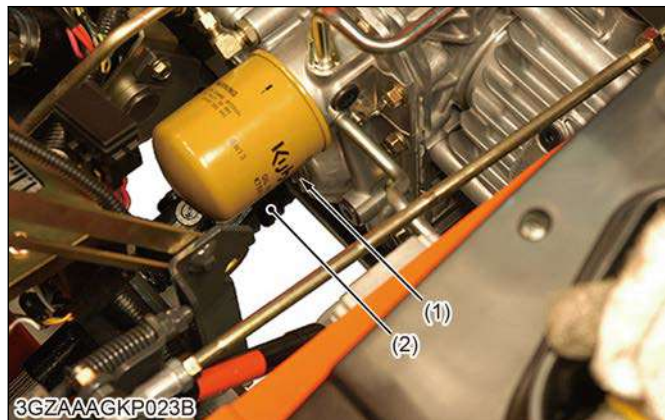
5.3.16 Removing radiator

1. Remove radiator assembly (1).



(1) Radiator assembly

5.3.17 Disconnecting universal joint and removing PTO shaft oil seal



(1) PTO shaft oil seal

(2) Universal joint

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

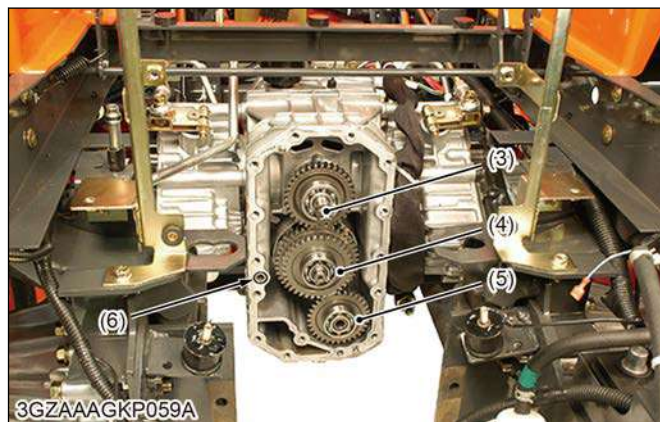
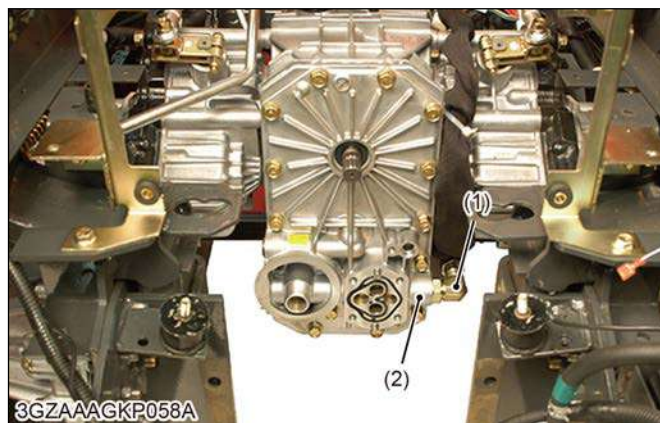
(When reassembling)

- Replace the PTO shaft oil seal with new one.

5.3.18 Removing center case rear cover and PTO clutch shaft assembly

■ 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).



(1) Delivery pipe
(2) Center case rear cover
(3) Input shaft
(4) PTO clutch shaft assembly
(5) Pump shaft assembly
(6) O-ring

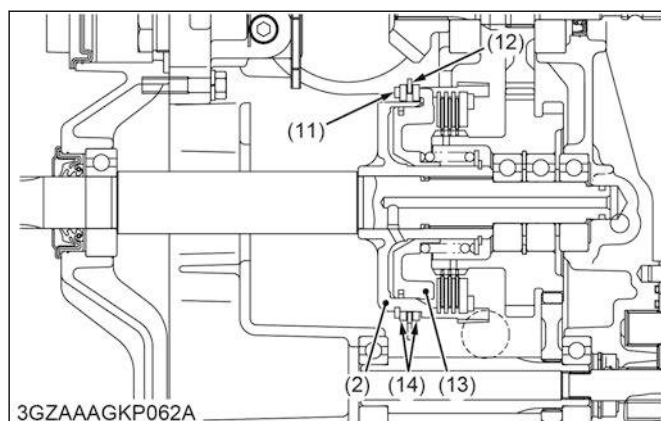
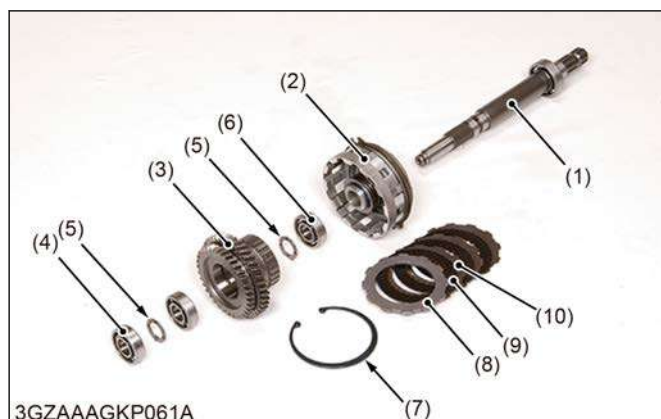
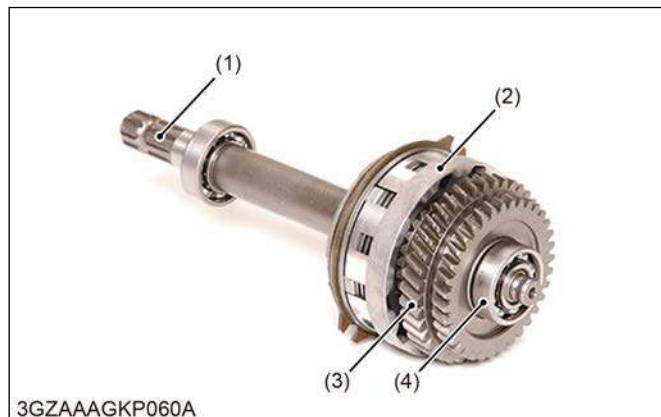
1. Disconnect the delivery pipe (1).
2. Remove the center case rear cover (2).
3. Remove the pump shaft assembly (5).
4. Remove the PTO clutch shaft assembly (4).

(When reassembling)

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

Tightening torque	Center case rear cover mounting screw	40 to 44 N·m 4.0 to 4.5 kgf·m 29 to 32 lbf·ft
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5.3.19 Disassembling PTO clutch assembly



- | | |
|------------------------|-------------------------|
| (1) PTO shaft | (8) Pressure plate |
| (2) PTO clutch case | (9) Clutch disk |
| (3) Clutch gear | (10) Clutch plate |
| (4) Bearing | (11) External snap ring |
| (5) Collar | (12) Brake disk |
| (6) Bearing | (13) Piston |
| (7) Internal snap ring | (14) Brake plate |

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).

5.4 Disassembling hydrostatic transmission and rear axle gear case assembly

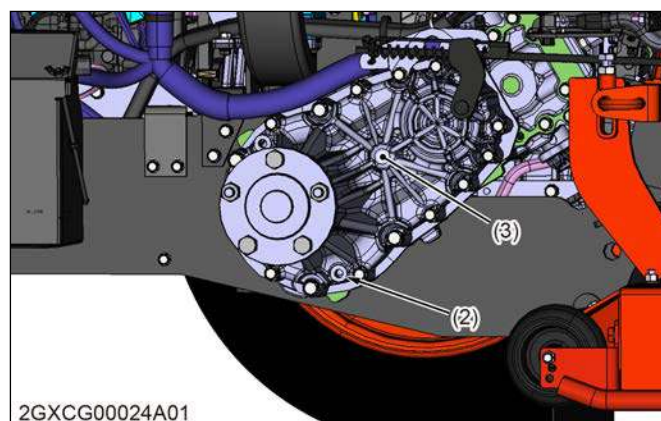
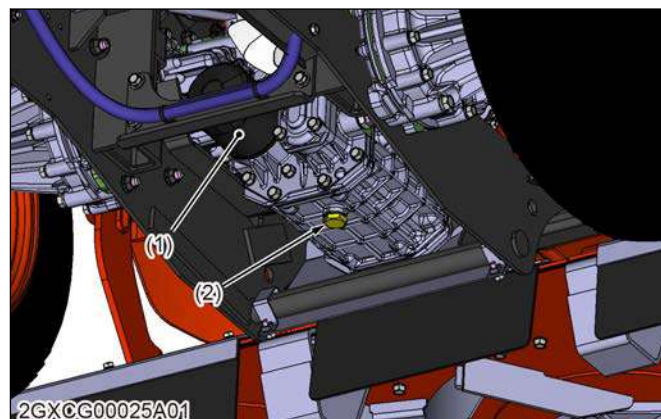
5.4.1 Draining transmission fluid

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.

1. Place oil pans underneath the transmission case and the rear axle gear case (R.H. and L.H.).
2. Remove the drain plug (2) at the bottom of the transmission case and the rear axle gear case (R.H. and L.H.) to drain the oil.
3. After draining reinstall the drain plugs (2).



- | | |
|-----------------------------|------------------------------|
| (1) Transmission oil filter | (3) Rear axle gear case L.H. |
| (2) Drain plug | |

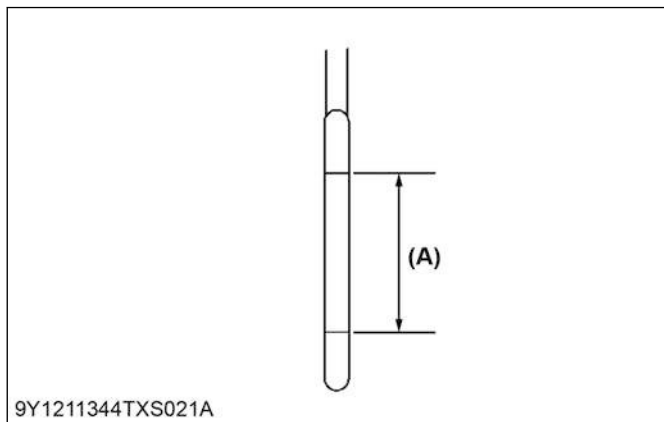
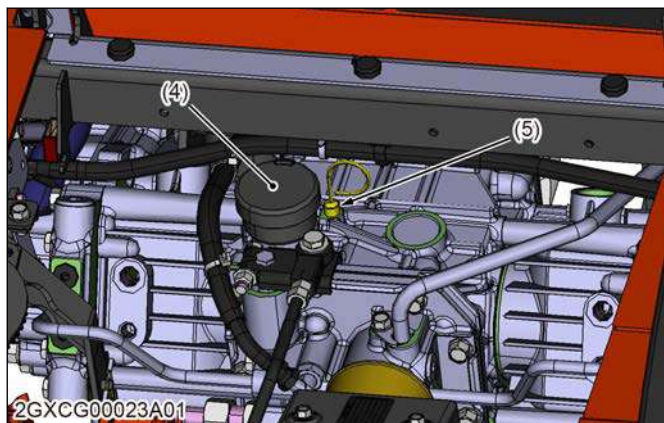
(When refilling)

IMPORTANT

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

- It takes time to pour the oil from the transmission case to the rear axle case R.H. and L.H. Pour the regulated amount of oil slowly.
- Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system.
- The fluid in the transmission case is also used for the hydrostatic drive system.
- Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.
- Keep the engine at medium speed for a few minutes to ensure proper lubrication of all parts so there is no damage to transmission.

1. Remove the filling plug (4) and fill with oil.
2. After running the engine for a few minutes, stop it and check the oil level again; add oil to the prescribed level (A).



- (4) Oil filling plug and breather cup (A) Oil level acceptable within this range.
(5) Dipstick

Transmission fluid	Capacity	12.1 L 12.8 U.S.qts 10.6 Imp.qts
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5.4.2 Removing the battery

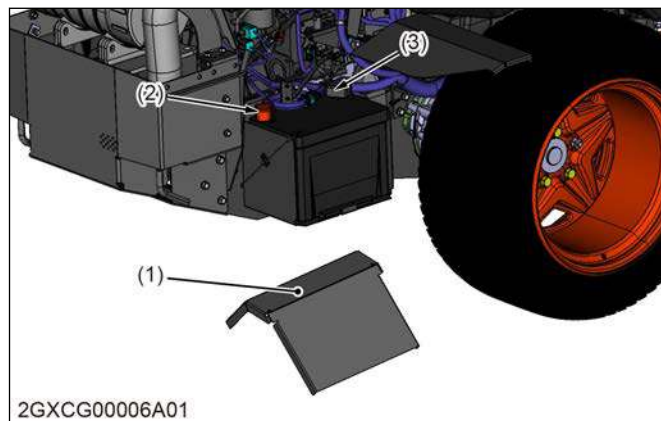


WARNING

To avoid serious injury or death:

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

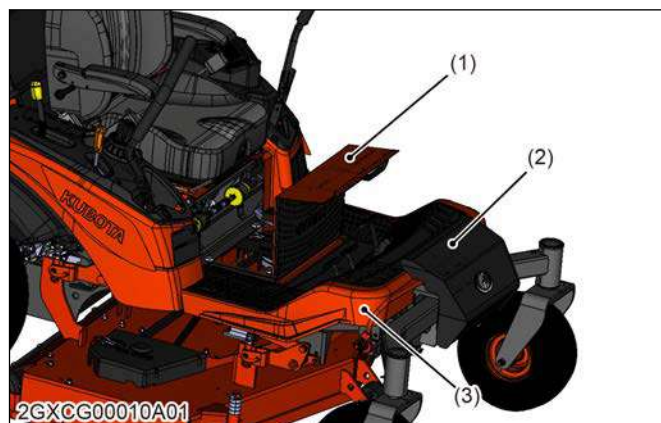
1. Remove the battery cover (1).
2. Disconnect the negative cable (3) from the battery.
3. Disconnect the positive cable (2) from the battery.
4. Remove the battery.



- (1) Battery cover (3) Negative cable
(2) Positive cable

5.4.3 Removing step and center step

1. Remove the step center (1).
2. Remove the front mask (2).
3. Remove the step (3).

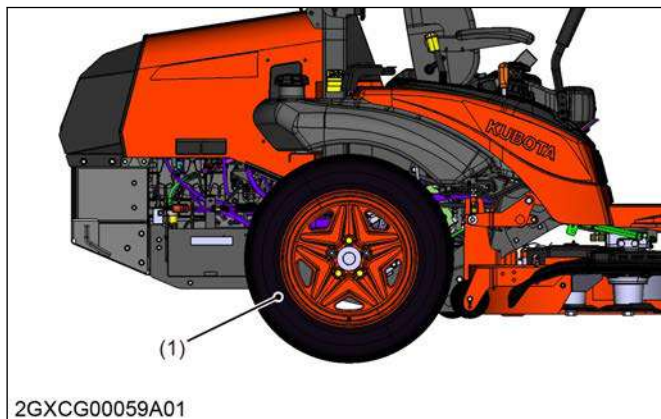


- (1) Step center (3) Step
(2) Front mask

5.4.4 Removing rear wheels

1. Lift up and secure with jack stands.

2. Remove the rear wheels (1).



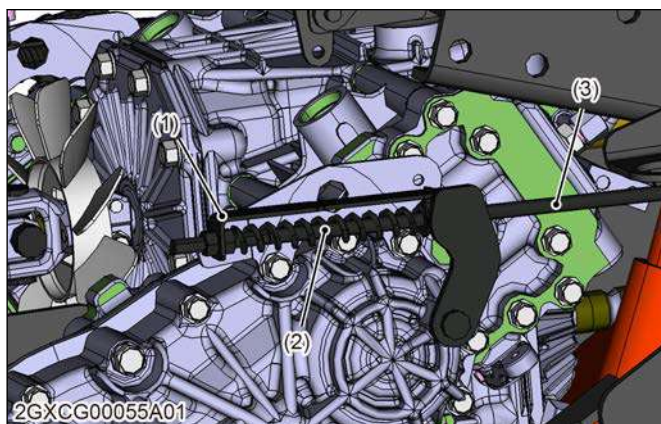
(1) Rear wheel

(When reassembling)

Tightening torque	Rear wheel mounting screw	109 to 131 N·m 11.1 to 13.3 kgf·m 80.3 to 96.1 lbf·ft
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5.4.5 Removing parking brake

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



(1) Parking brake return plate (3) Parking brake rod
(2) Parking brake spring

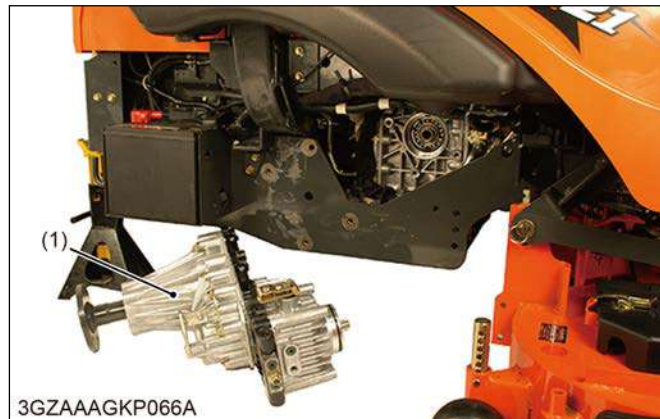
(When reassembling)

- Replace the cotter pin with new one.
- After assembling the parking brake rods, be sure to check the parking brake spring length and play. If the measurement is not within the factory specifications, adjust the spring length and play.

5.4.6 Separating hydrostatic transmission and rear axle gear case assembly

NOTE

- The hydrostatic transmission and rear axle gear case assembly is very heavy. Be very careful in handling.



(1) Hydrostatic transmission and rear axle gear case assembly

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

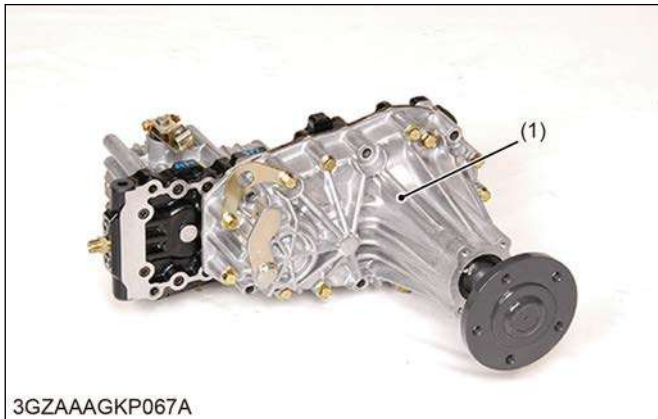
(When reassembling)

- Be careful not to damage the O-ring.
- Check the tightening torque on the removed case and other side. (Make sure the screw does not loose.)

Tightening torque	Hydrostatic transmission mounting screw (M10)	48 to 56 N·m 4.9 to 5.7 kgf·m 35 to 41 lbf·ft
	Rear axle gear case mounting screw (M12)	85 to 90 N·m 8.7 to 9.2 kgf·m 63 to 66 lbf·ft

5.4.7 Removing rear axle gear case

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



(1) Rear axle gear case

(When reassembling)

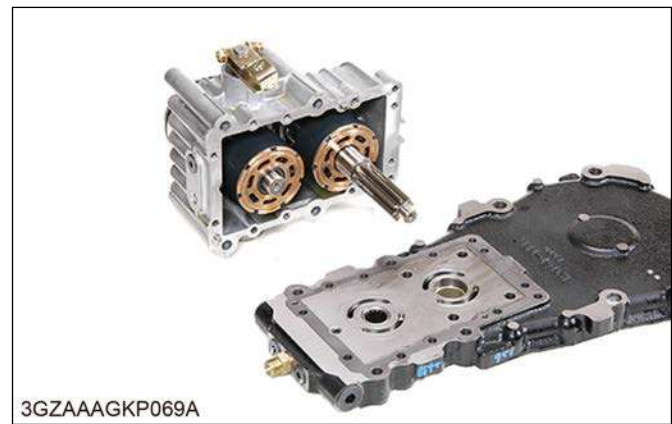
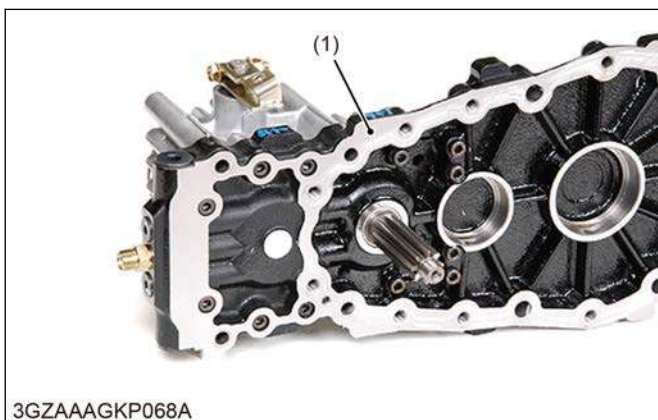
- Put in the motor shaft on the brake disc side by aligning the spline. Then mount the rear axle gear case assembly and HST.
- Apply liquid gasket (Three Bond 1208D or equivalent) to joint face of the rear axle gear case and port block (center section).

Tightening torque	Rear axle gear case mounting screw	40 to 44 N·m 4.0 to 4.5 kgf·m 29 to 32 lbf·ft
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5.4.8 Removing center section (Port block)**■ NOTE**

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

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



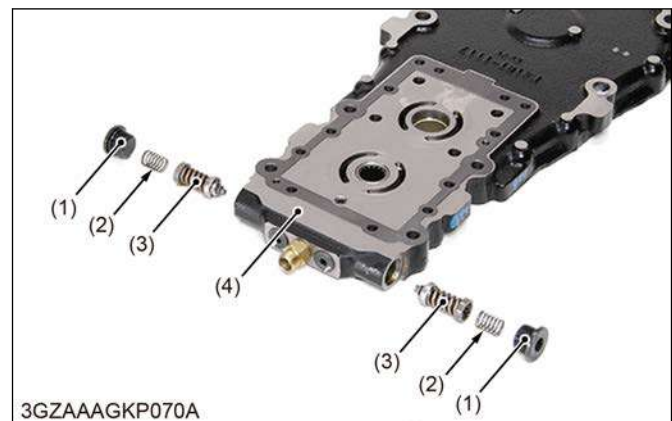
(1) Center section

(When reassembling)

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



(1) Plug
(2) Spring
(3) Check and high pressure relief valve assembly
(4) Center section

(When reassembling)

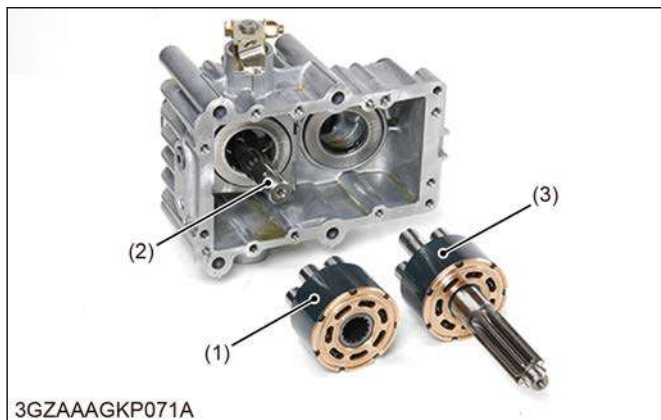
- Be careful not to damage the O-ring on the plug.

Tightening torque	Check and high pressure relief valve plug	59 to 78 N·m 6.0 to 8.0 kgf·m 44 to 58 lbf·ft
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5.4.10 Removing cylinder block assembly and thrust ball bearing

NOTE

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



- (1) Cylinder block assembly (Pump) (3) Cylinder block assembly (Motor)
(2) Pump shaft

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).



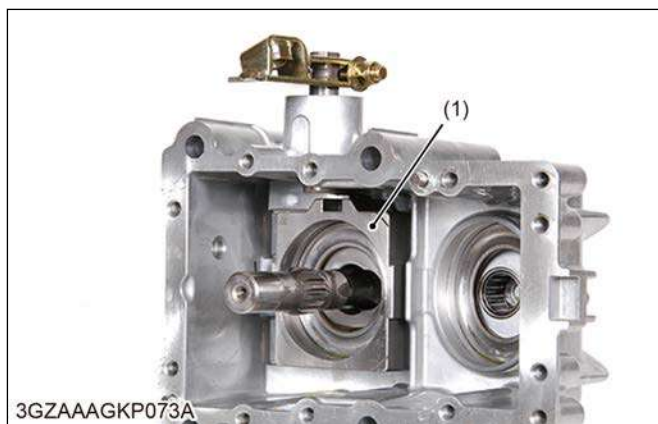
- (4) Thrust ball bearing

(When reassembling)

- Apply clean fluid to the surface of cylinder block.

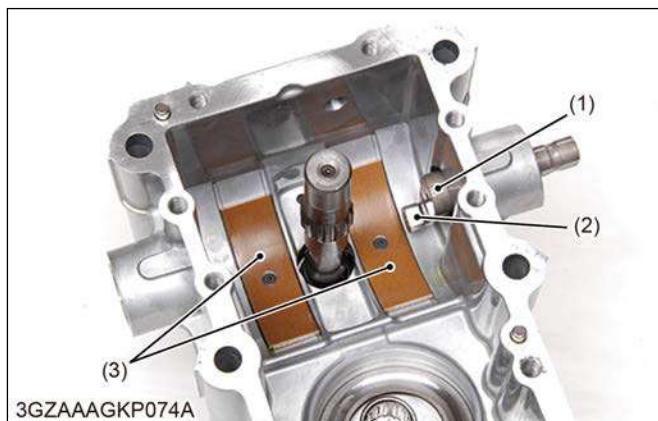
5.4.11 Removing swashplate

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



- (1) Swashplate

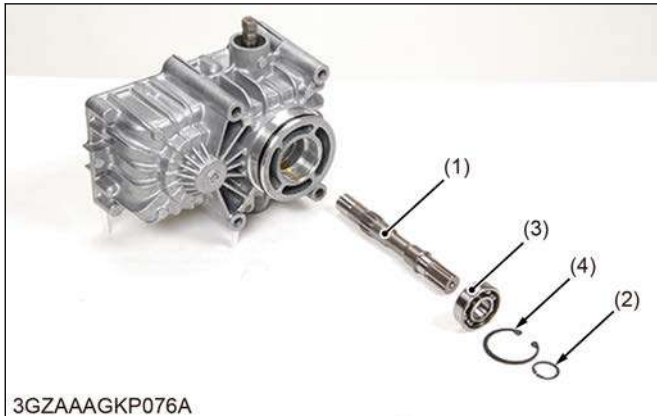
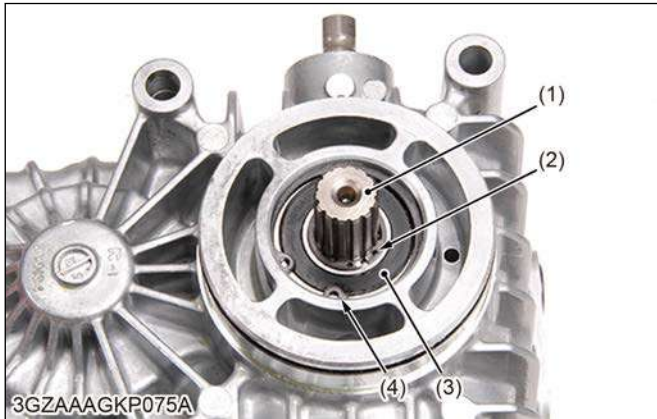
5.4.12 Removing slot guide and cradle bearing



- (1) Trunnion arm (3) Cradle bearing
(2) Slot guide

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

5.4.13 Removing pump shaft



- (1) Pump shaft
(2) External snap ring
(3) Ball bearing
(4) Internal snap ring

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).

5.5 Disassembling rear axle case

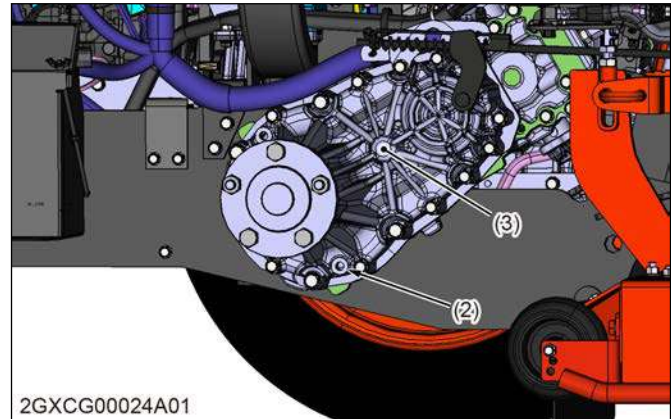
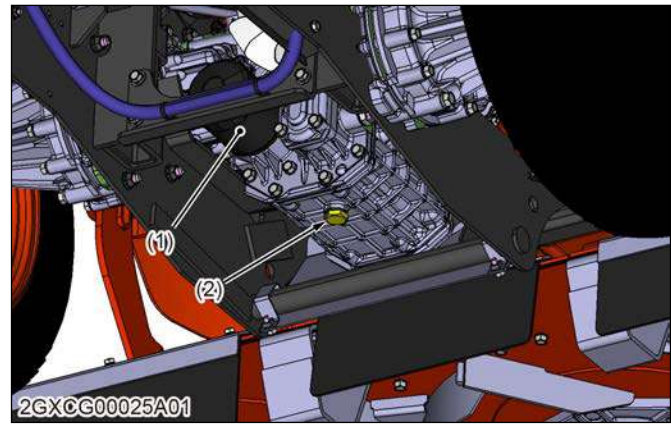
5.5.1 Draining transmission fluid

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.

1. Place oil pans underneath the transmission case and the rear axle gear case (R.H. and L.H.).
2. Remove the drain plug (2) at the bottom of the transmission case and the rear axle gear case (R.H. and L.H.) to drain the oil.
3. After draining reinstall the drain plugs (2).

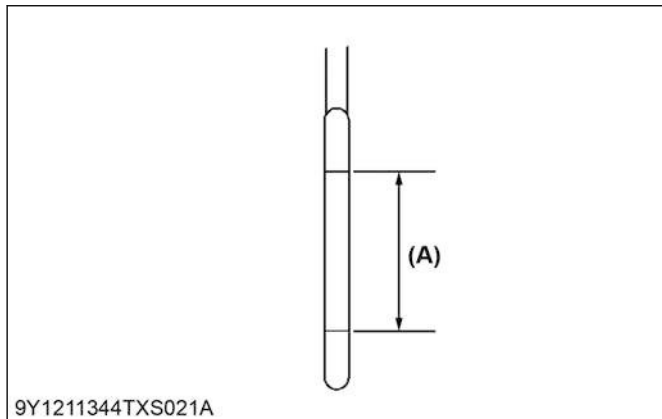
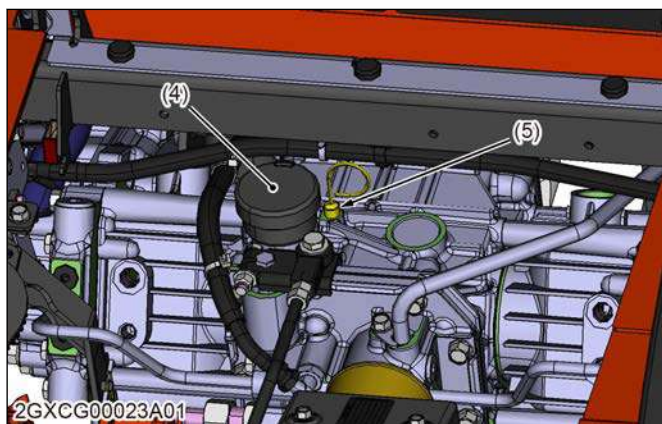


- (1) Transmission oil filter
(2) Drain plug
(3) Rear axle gear case L.H.

(When refilling)**IMPORTANT**

- After running the engine for a few minutes, stop it and check the oil level again; add oil to the prescribed level (A).
- It takes time to pour the oil from the transmission case to the rear axle case R.H. and L.H. Pour the regulated amount of oil slowly.
- Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system.
- The fluid in the transmission case is also used for the hydrostatic drive system.
- Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.
- Keep the engine at medium speed for a few minutes to ensure proper lubrication of all parts so there is no damage to transmission.

1. Remove the filling plug (4) and fill with oil.
2. After running the engine for a few minutes, stop it and check the oil level again; add oil to the prescribed level (A).



- (4) Oil filling plug and breather cup
(5) Dipstick
(A) Oil level acceptable within this range.

Transmission fluid	Capacity	12.1 L 12.8 U.S.qts 10.6 Imp.qts
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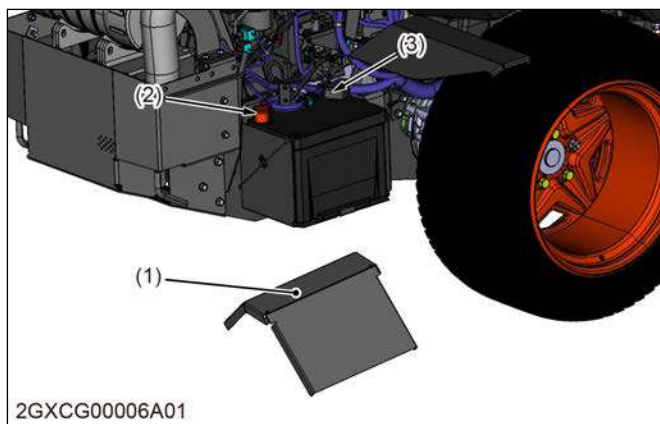
5.5.2 Removing the battery

! WARNING

To avoid serious injury or death:

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

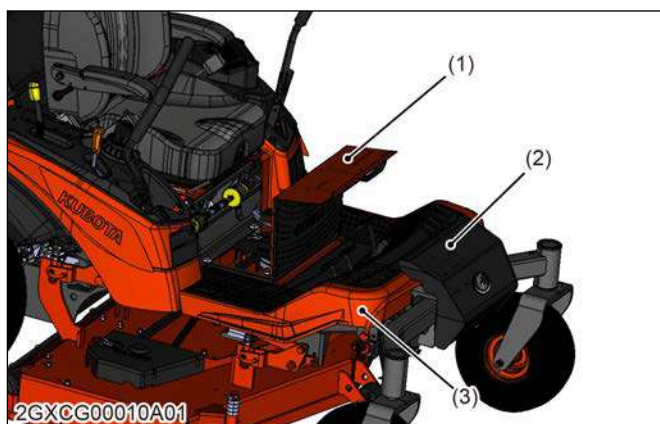
- Remove the battery cover (1).
- Disconnect the negative cable (3) from the battery.
- Disconnect the positive cable (2) from the battery.
- Remove the battery.



- (1) Battery cover
(2) Positive cable
(3) Negative cable

5.5.3 Removing step and center step

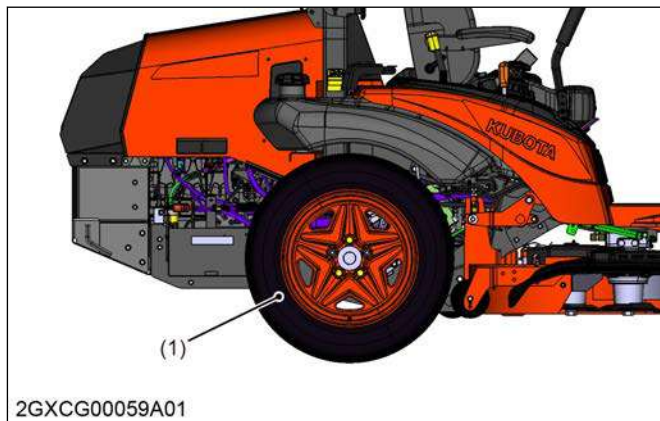
- Remove the step center (1).
- Remove the front mask (2).
- Remove the step (3).



- (1) Step center
(2) Front mask
(3) Step

5.5.4 Removing rear wheels

- Lift up and secure with jack stands.
- Remove the rear wheels (1).



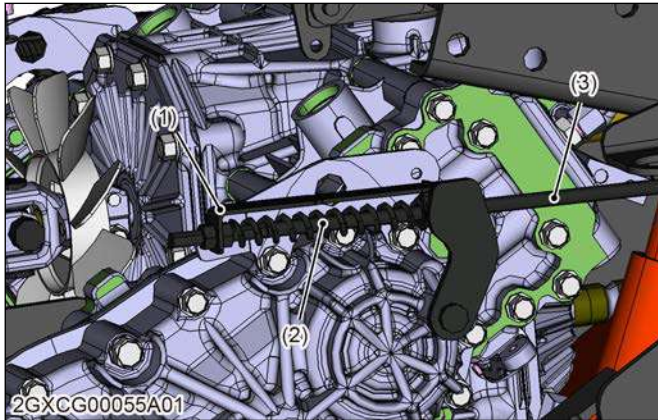
- (1) Rear wheel

(When reassembling)

Tightening torque	Rear wheel mounting screw	109 to 131 N · m 11.1 to 13.3 kgf · m 80.3 to 96.1 lbf · ft
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5.5.5 Removing parking brake

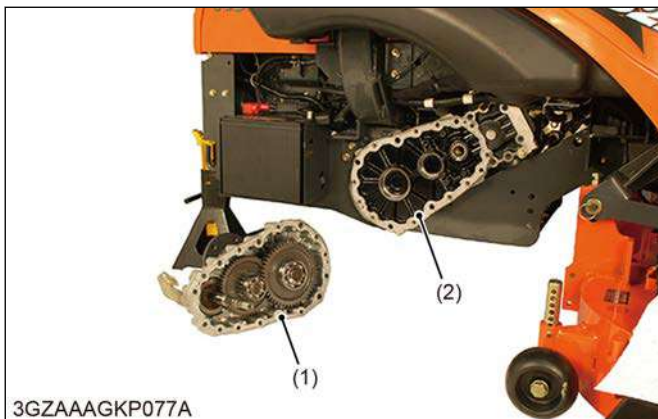
1. Remove parking brake return plate (1).
2. Remove parking brake spring (2).
3. Remove parking brake rod (3).



- (1) Parking brake return plate (3) Parking brake rod
(2) Parking brake spring

(When reassembling)

- Replace the cotter pin with new one.
- After assembling the parking brake rods, be sure to check the parking brake spring length and play. If the measurement is not within the factory specifications, adjust the spring length and play.

5.5.6 Removing rear axle gear case

- (1) Rear axle gear case assembly (2) Center section
(3) Cylinder block (Motor)

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

(When reassembling)**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.

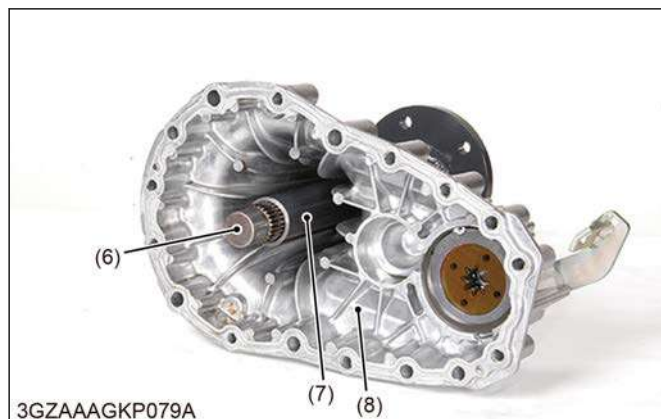
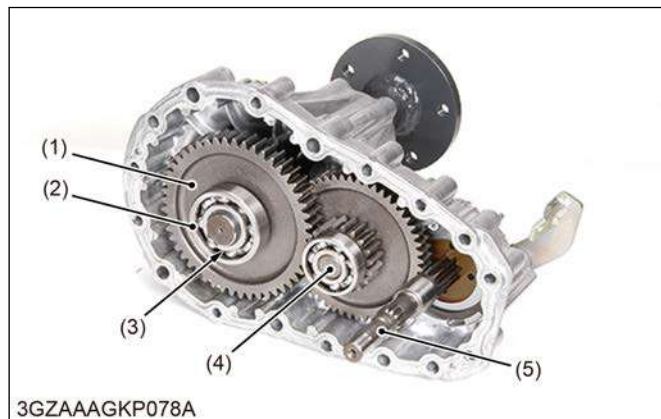
If this cylinder block (3) should deviate up to the position shown in the photo, it will be unable to be returned to the original position.

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).

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

Tightening torque	Rear axle gear case mounting screw	40 to 44 N · m 4.0 to 4.5 kgf · m 29 to 32 lbf · ft
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5.5.7 Removing rear axle



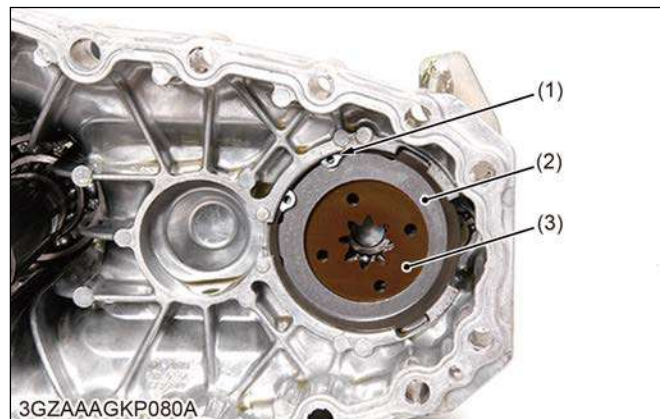
- | | |
|-----------------------------------|-------------------------|
| (1) Final reduction gear | (6) Rear axle |
| (2) Ball bearing | (7) Collar |
| (3) External snap ring | (8) Rear axle gear case |
| (4) Gear shaft | |
| (5) Brake shaft (HST motor shaft) | |

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)

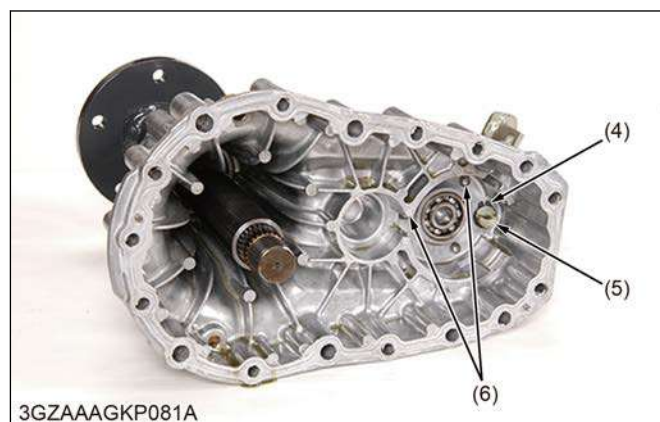
- Do not damage oil seal.

5.5.8 Removing parking brake



- | | |
|------------------------|----------------|
| (1) Internal snap ring | (3) Brake disc |
| (2) Friction plate | |

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



- | | |
|------------------------|----------|
| (4) External snap ring | (6) Ball |
| (5) Brake cam | |

(When reassembling)

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

5.6 Disassembling speed lever

5.6.1 Removing the battery

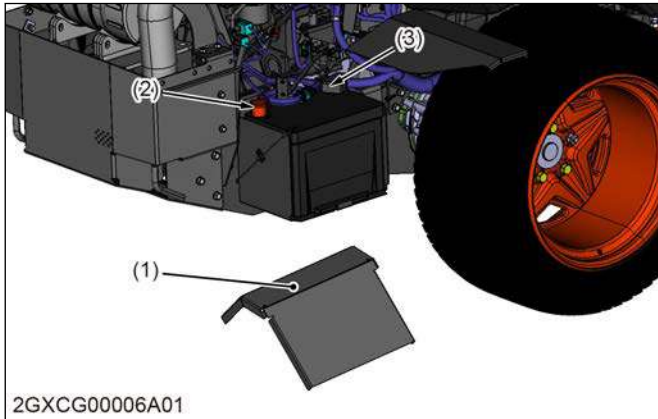
WARNING

To avoid serious injury or death:

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

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

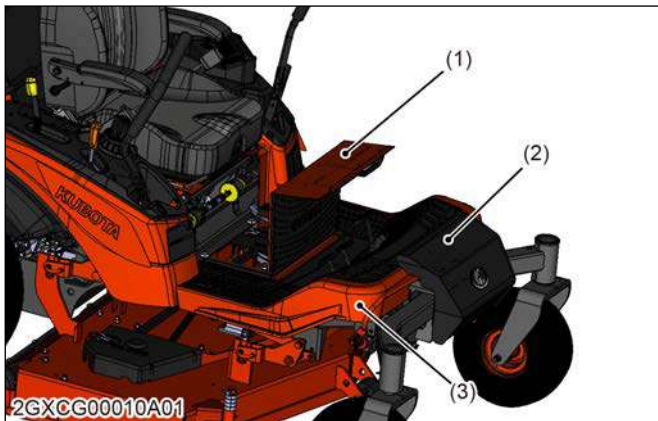
4. Remove the battery.



- (1) Battery cover
(2) Positive cable
(3) Negative cable

5.6.2 Removing step and center step

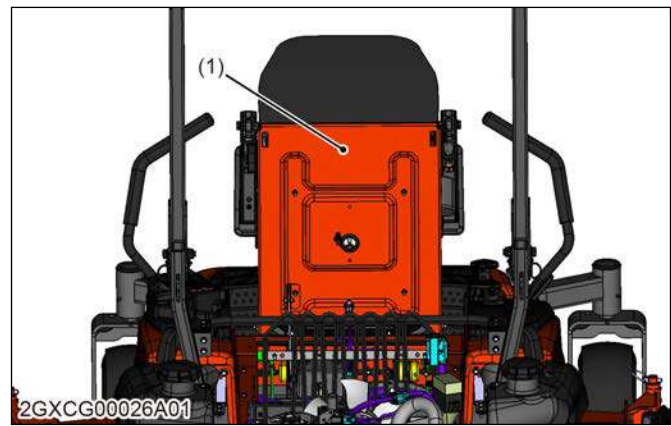
1. Remove the step center (1).
2. Remove the front mask (2).
3. Remove the step (3).



- (1) Step center
(2) Front mask
(3) Step

5.6.3 Removing seat assembly

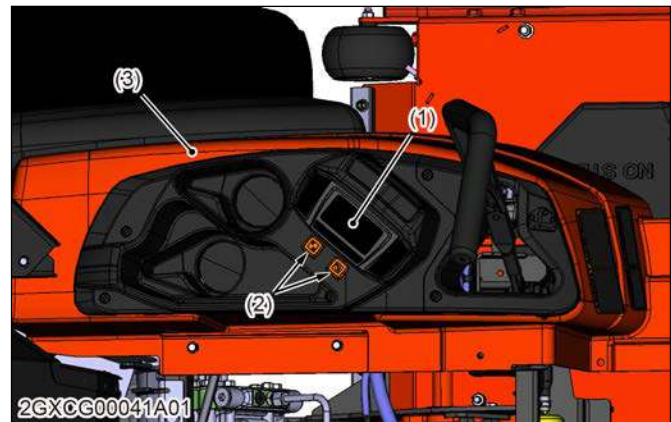
1. Raise the seat and disconnect the wiring connector for seat safety switch.
2. Remove the seat assembly (1).



- (1) Seat assembly

5.6.4 Removing fenders

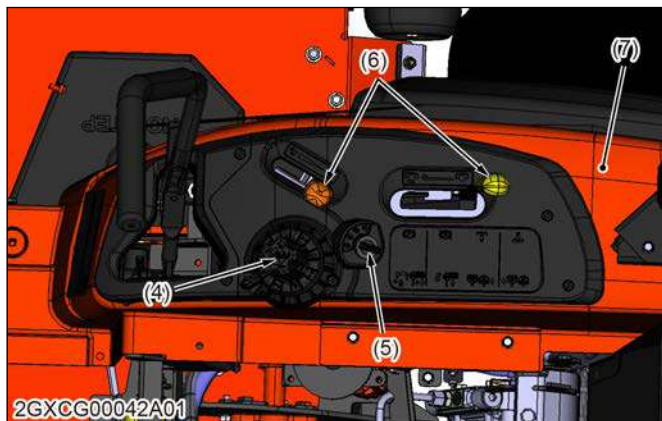
1. Disconnect LCD panel (1).
2. Disconnect regeneration switches (2).
3. Remove fender L.H. (3).



- (1) LCD panel
(2) Regeneration switches
(3) Fender (L.H.)

4. Remove mower cutting height adjusting dial (4).
5. Disconnect key switch (5).
6. Remove lever grips (6).

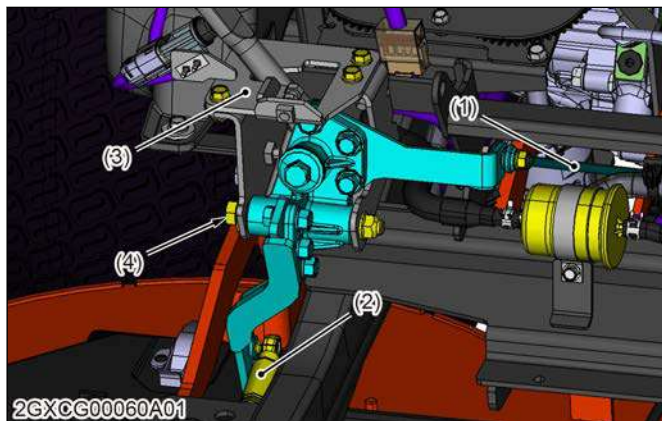
7. Remove fender R.H. (7).



- | | |
|---|-------------------|
| (4) Mower cutting height adjusting dial | (6) Lever grips |
| (5) Key switch | (7) Fender (R.H.) |

5.6.5 Removing speed lever assembly

1. Remove speed rod (1).
2. Remove damper (2).
3. Remove plate (3).
4. Remove speed lever bolt (4).
5. Remove speed lever assembly (5).



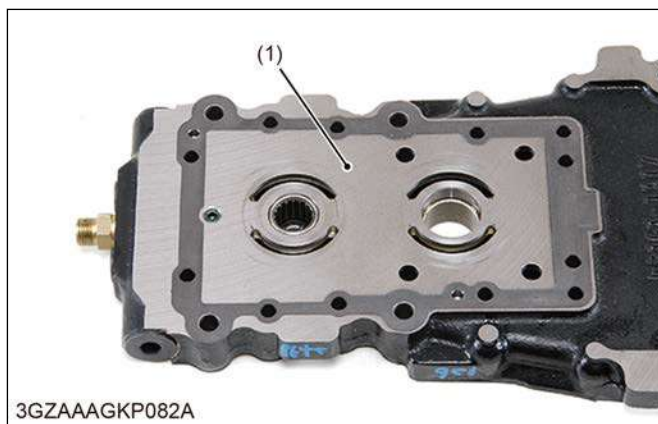
- | | |
|---------------|--------------------------|
| (1) Speed rod | (4) Speed lever bolt |
| (2) Damper | (5) Speed lever assembly |
| (3) Plate | |

6. Servicing

6.1 Hydrostatic transmission

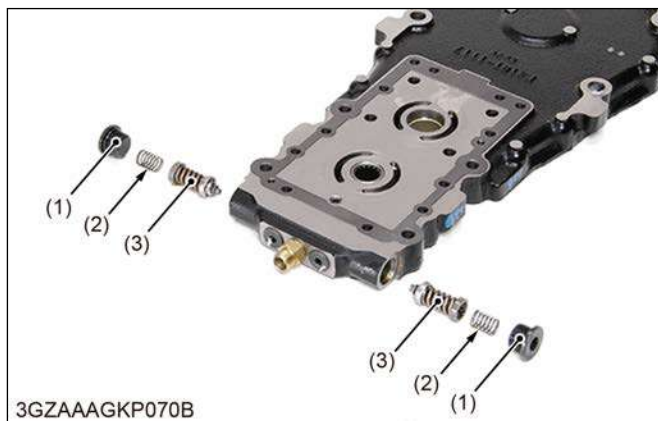
6.1.1 Checking center section

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

6.1.2 Checking check and high pressure relief valve



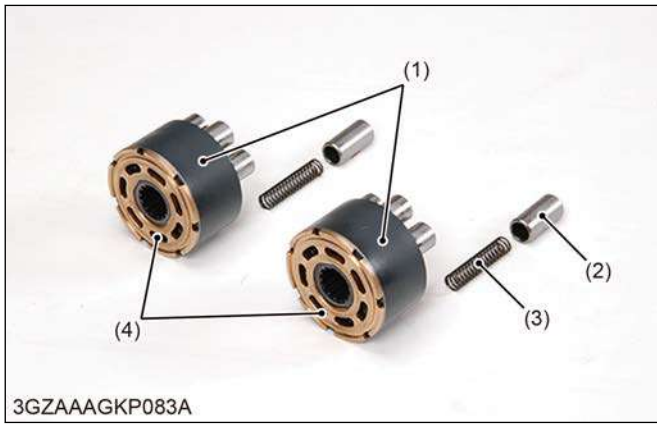
- | | |
|------------|---|
| (1) Plug | (3) Check and high pressure relief valve assembly |
| (2) Spring | |

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.

6.1.3 Checking cylinder block assembly

■ IMPORTANT

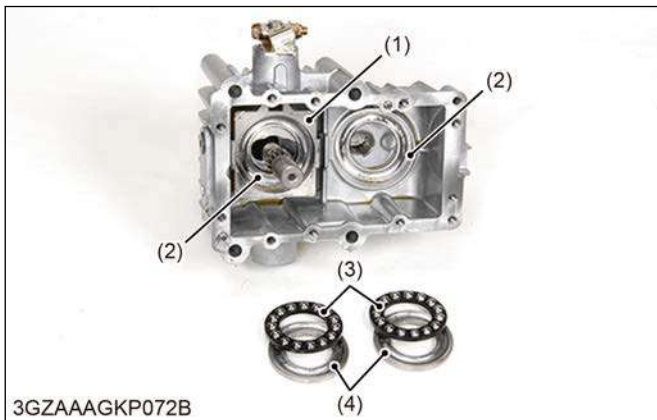
- Do not interchange pistons between pump and motor cylinder block. Pistons and cylinder blocks are matched.



- (1) Cylinder block
(2) Piston
(3) Spring
(4) Polished face

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.

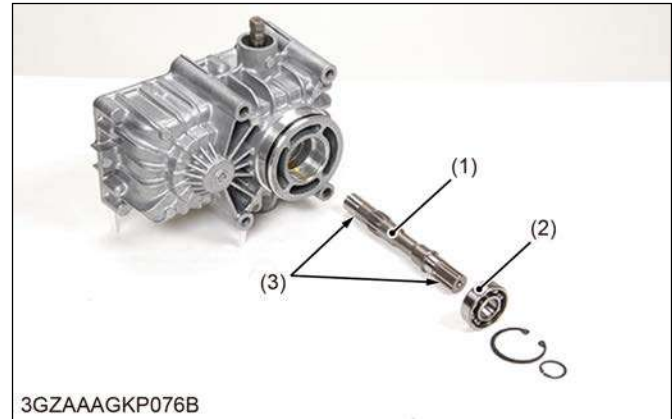
6.1.4 Checking thrust washer, thrust ball bearing and thrust plate



- (1) Swashplate
(2) Thrust washer
(3) Thrust ball bearing
(4) 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.

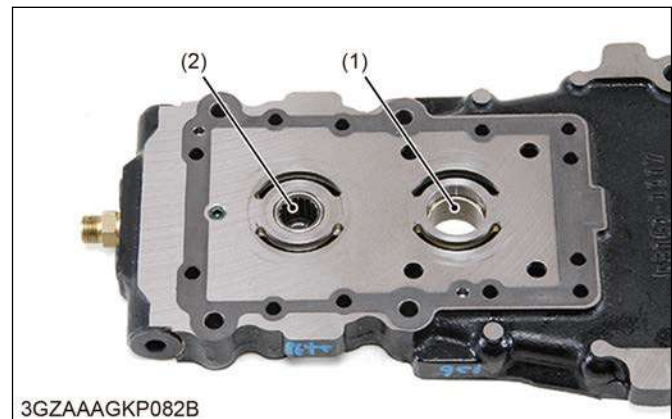
6.1.5 Checking pump shaft



- (1) Pump shaft
(2) Ball bearing
(3) Bearing surface

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.

6.1.6 Checking bush and needle bearing

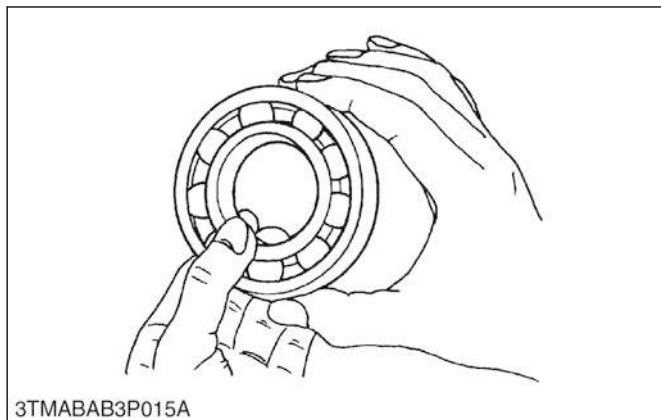


- (1) Bush
(2) Needle bearing

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.

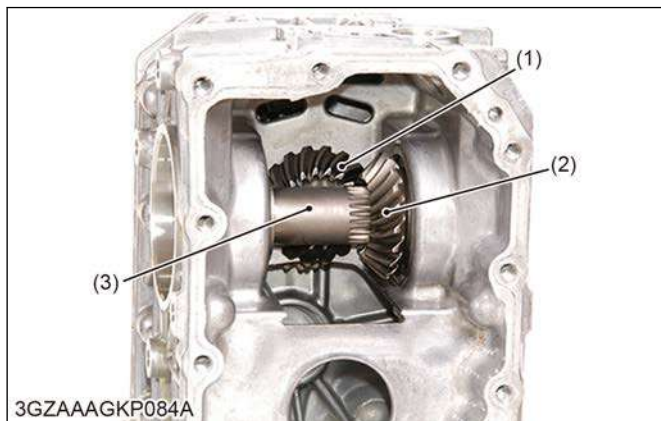
6.2 Transmission case

6.2.1 Checking bearing



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

6.2.2 Checking backlash and tooth contact between 16T or 18T bevel gear and 19T bevel gear



- (1) 18T bevel gear
(2) 19T bevel gear
(3) Joint shaft

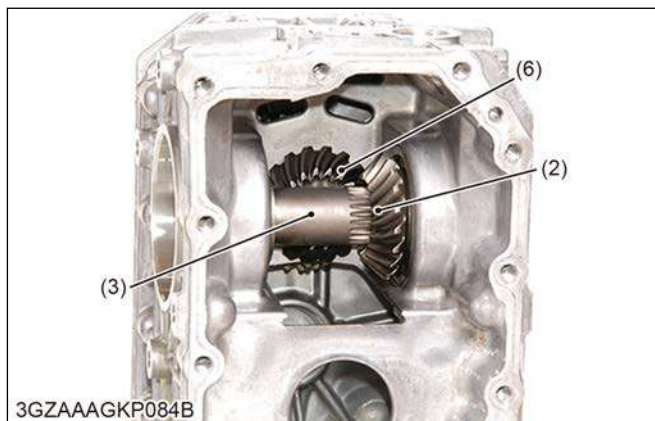
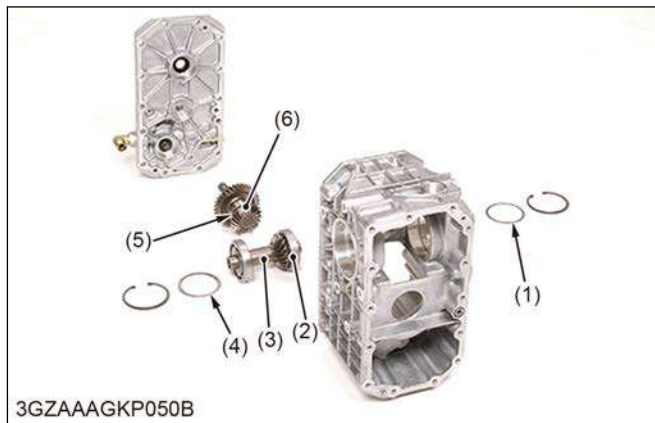
1. Measure the backlash between the 18T bevel gear (1) and 19T bevel gear (2).
2. When the backlash is too large, decrease the number of shims in the side of the spiral bevel gear, and insert the removed shims in the opposite side. When the backlash is too small, decrease the number of shims in the side of the differential case, and insert the removed shims in the opposite side.

Backlash between 19T bevel gear and 18T bevel gear	Factory specification	0.25 to 0.30 mm 0.0099 to 0.011 in.
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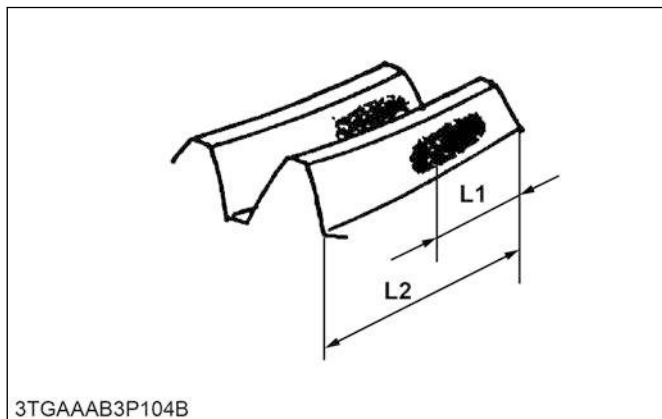
3. Adjust the backlash properly by repeating the above procedure.
4. Apply red lead lightly over several teeth at three positions equally spaced on the hypoid ring gear.
5. Turn the 18T bevel gear by input shaft while pressing a wooden piece against the periphery of the bevel gear.
6. Check the tooth contact, if not proper, adjust according to the following instruction.

Tooth contact	Factory specification	More than 25% read lead contact area on the gear tooth surface
The position of tooth contact point		The center of tooth contact at 3/10 of the entire width from the small end

6.2.3 Correcting of tooth contact



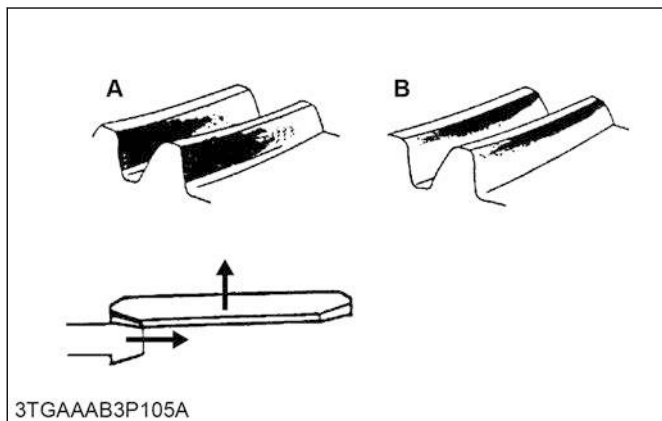
- (1) Shim
(2) 19T bevel gear
(3) Joint shaft
(4) Shim
(5) Shim
(6) 18T bevel gear

Proper contact

L1: Tooth contact

L2: Tooth bottom

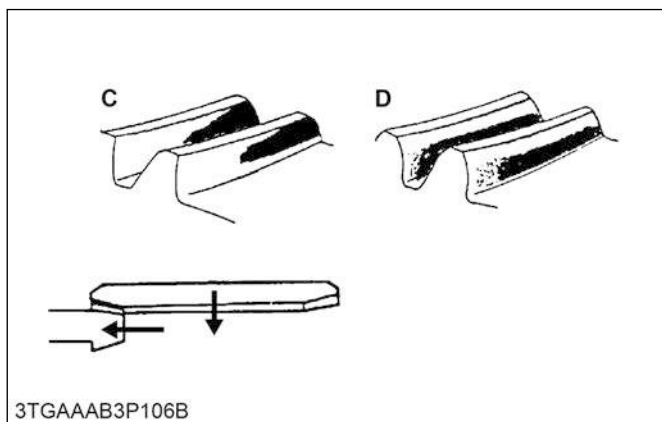
- No adjustment.

Correcting of the heel contact and shallow contact

A: Heel contact

B: Shallow contact

- Make sure that whether there is a shim (5).
- The 18T bevel gear (6) can be moved to backward by doing to add the shim (5) when not is. (The shim is made the state as it is when there is a shim (5).)
- And place the 19T bevel gear (2) side shim to the shim (1) to move the 19T bevel gear outside.
- Repeat above until the proper tooth contact and backlash are achieved.

Correcting of the toe contact and deep contact

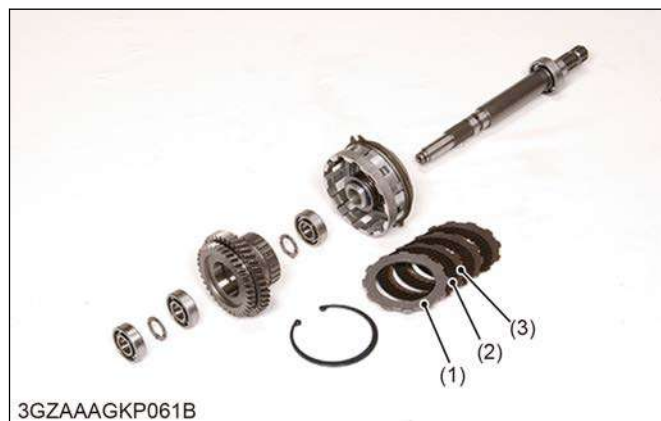
C: Toe contact

D: Deep contact

- Make sure that whether there is a shim (5).
- The 18T bevel gear (6) can be moved to backward by removing the shim (5) if there is a shim. (The shim (5) is not put when there is no shim.)
- And place the shim (1) side to the 19T bevel gear (2) side shim to move the 19T bevel gear inside.
- Repeat above until the proper tooth contact and backlash are achieved.

6.3 PTO clutch**6.3.1 Checking PTO clutch discs**

1. Check the surface of the pressure plate (1), PTO clutch discs (2) and PTO clutch plates (3).



(1) Pressure plate

(2) PTO clutch disc

(3) PTO clutch plate

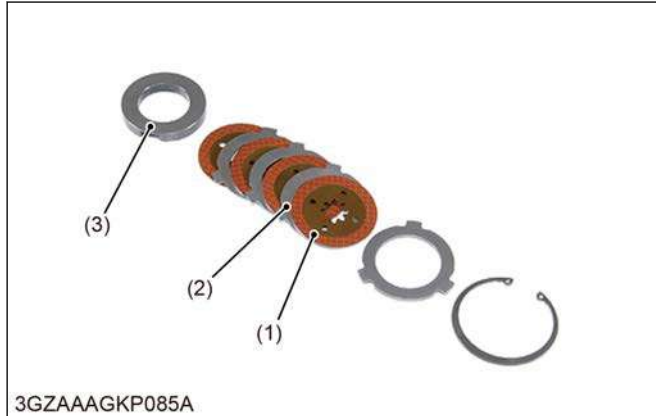
2. If excessive wear is found, replace it to a new one.

PTO Clutch Plate	PTO Clutch Disc
4	4

6.4 Brake

6.4.1 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.



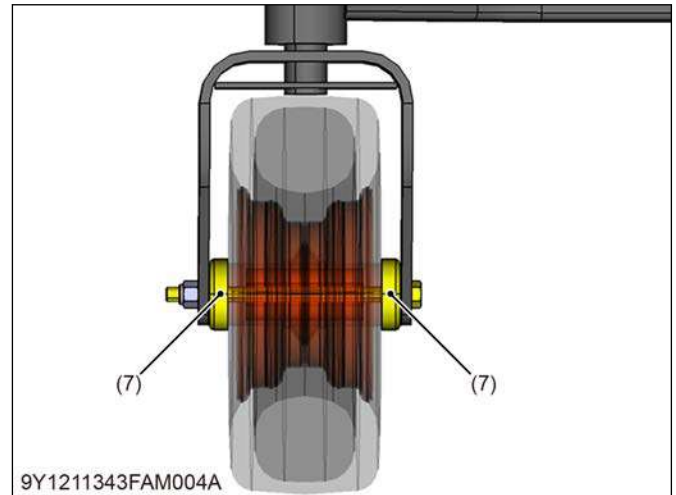
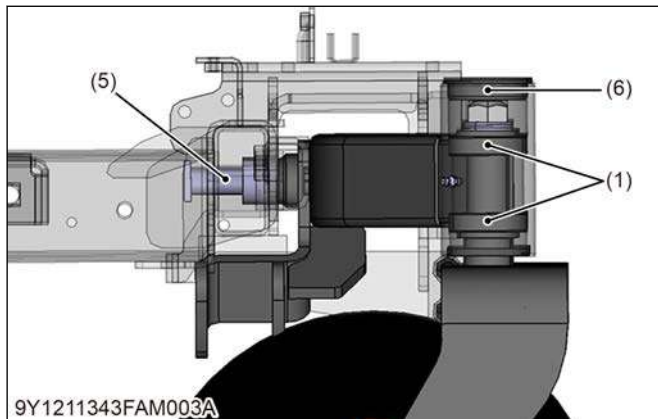
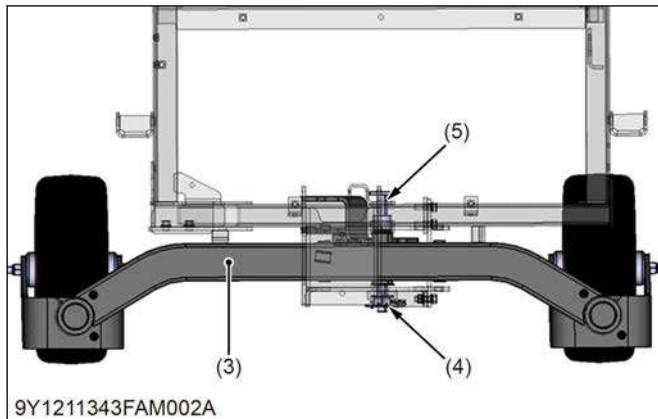
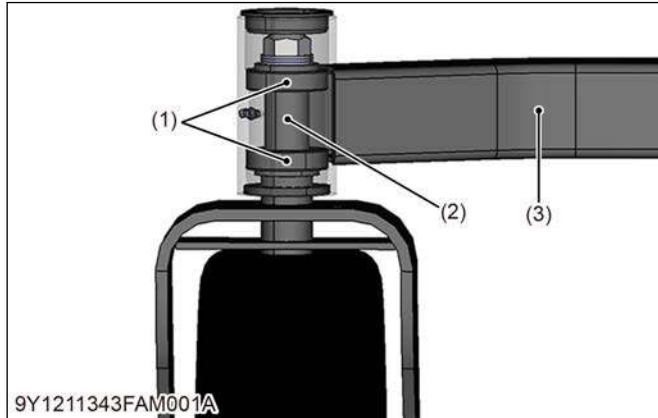
- (1) Friction plate
(2) Brake disc
(3) Actuator

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

5. FRONT AXLE

MECHANISM

1. Structure of front axle



- | | |
|--------------------------|--------------------------|
| (1) Taper roller bearing | (5) Center pin |
| (2) Wheel bracket | (6) Cap |
| (3) Front axle | (7) Taper roller bearing |
| (4) Slotted nut | |

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

SERVICING

1. Troubleshooting for front axle

Symptom	Probable cause and checking procedure	Solution	Reference page
Front wheels wander to right or left	1. Clearance between center pin and front axle excessive	Check the clearance and replace the center pin or front axle	5-7
	2. Tightening torque of locking nut for the wheel bracket weak	Adjust	5-6
	3. Clearance between front axle and front axle support excessive	Adjust	5-6

2. Servicing specifications for front axle

Item		Factory specifications	Allowable limit
Front axle end play	Clearance	0 to 0.2 mm 0 to 0.008 in.	0.5 mm 0.02 in.

3. Tightening torques for front axle

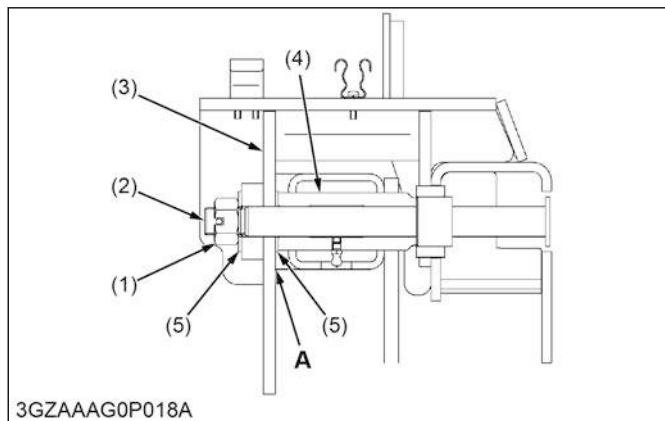
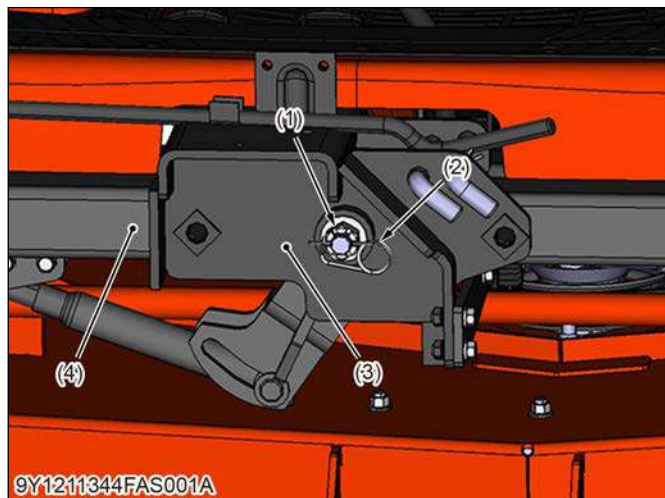
Item	Dimension x Pitch	N · m	kgf · m	lbf · ft
Wheel bolt and lock nut	—	20 to 25	2.1 to 2.5	15 to 18
Wheel bracket lock nut	—	45 to 55	4.6 to 5.6	34 to 40
Center pin lock nut (slotted nut)	—	40 to 80	4.1 to 8.1	30 to 59
Connecting plate mounting screw	—	48 to 55	4.9 to 5.7	36 to 41

— RELATED PAGE —

1. [General use screws, bolts and nuts on page 2-15](#)

4. Checking and adjusting

4.1 Adjusting front axle pivot



- (1) Slotted nut
(2) Center pin
(3) Front axle support
(4) Front axle
(5) Plain washer
A: Front axle end play

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).

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

(When reassembling)

NOTE

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

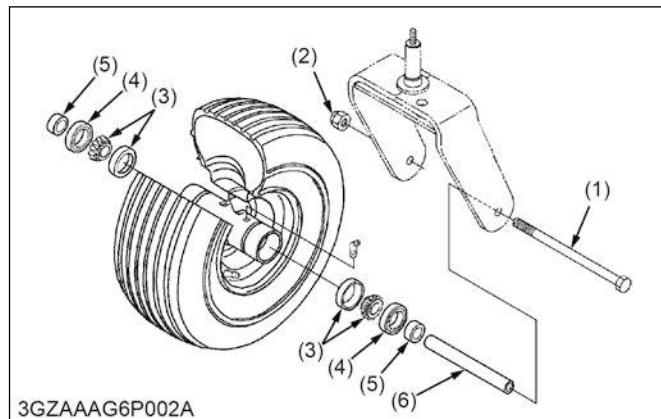
Tightening torque	Center pin lock nut (Slotted nut)	40 to 80 N·m 4.1 to 8.1 kgf·m 30 to 59 lbf·ft
-------------------	-----------------------------------	---

5. Disassembling and assembling

5.1 Separating front wheel and wheel bracket

5.1.1 Removing the front wheel

1. Lift up and secure machine with jack stands.
2. Remove wheel bolt (1).
3. Remove wheel.
4. Inspect all parts for wear or damage. Replace the parts as needed.



- (1) Bolt
(2) Locking nut
(3) Taper roller bearing
(4) Oil seal
(5) Spacer
(6) Sleeve

(When reassembling)

- Apply grease to grease fittings.

Tightening torque	Front wheel mounting bolt and locking nut	20 to 25 N·m 2.1 to 2.5 kgf·m 15 to 18 lbf·ft
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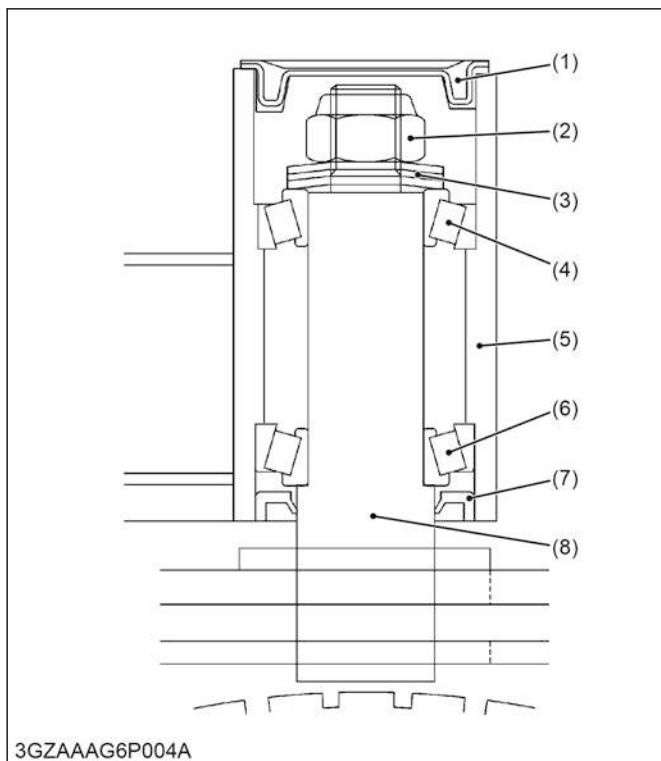
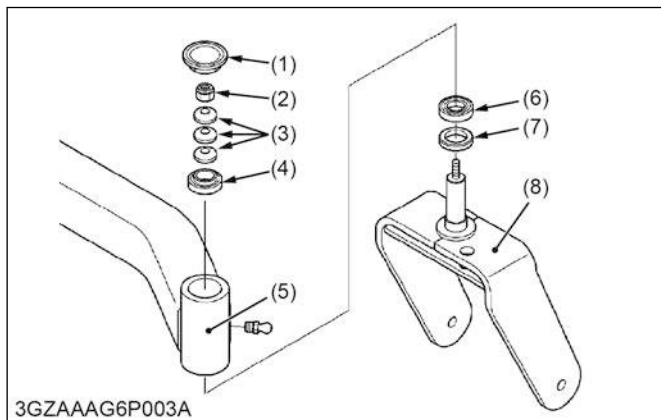
— RELATED PAGE —

[LUBRICANTS, FUEL AND COOLANT on page 2-11](#)

5.1.2 Removing the wheel bracket

1. Remove the cap (1).
2. Remove the locking nut (2) and wheel bracket (8).

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



- | | |
|--------------------------|--------------------------|
| (1) Cap | (6) Taper roller bearing |
| (2) Locking nut | (7) Oil seal |
| (3) Plate spring | (8) Bracket |
| (4) Taper roller bearing | |
| (5) Front axle | |

(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	45 to 55 N·m 4.6 to 5.6 kgf·m 34 to 40 lbf·ft
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5.2 Separating front axle assembly

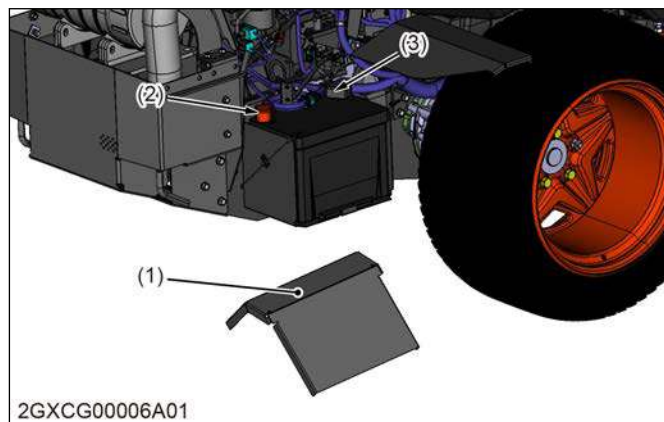
5.2.1 Removing the battery

! WARNING

To avoid serious injury or death:

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

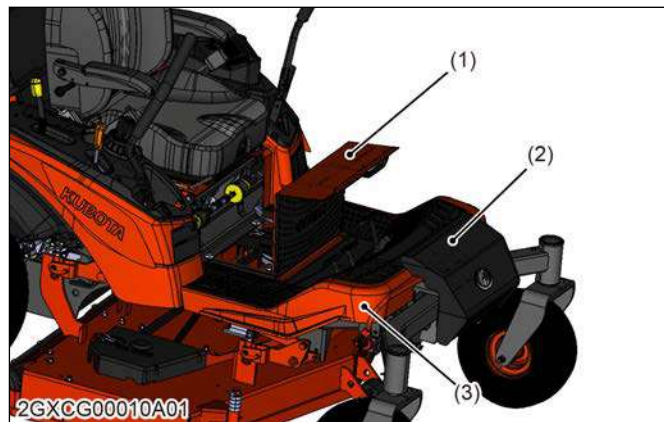
- Remove the battery cover (1).
- Disconnect the negative cable (3) from the battery.
- Disconnect the positive cable (2) from the battery.
- Remove the battery.



- | | |
|--------------------|--------------------|
| (1) Battery cover | (3) Negative cable |
| (2) Positive cable | |

5.2.2 Removing step and center step

- Remove the step center (1).
- Remove the front mask (2).
- Remove the step (3).

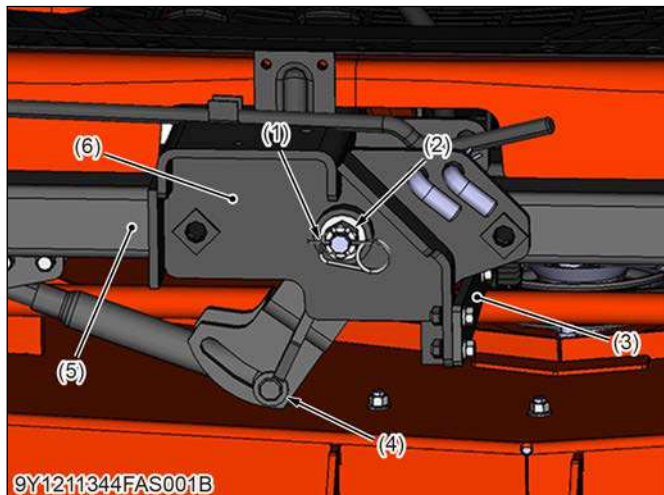


- | | |
|-----------------|----------|
| (1) Step center | (3) Step |
| (2) Front mask | |

5.2.3 Separating front axle assembly

- Remove the set spring and slotted nut (2).

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



- | | |
|---------------------------------------|-------------------------|
| (1) Center pin | (4) Clevis pin |
| (2) Center pin lock nut (Slotted nut) | (5) Front axle assembly |
| (3) Connecting plate | (6) Front axle support |

(When reassembling)**NOTE**

- Do not hit the center pin.
- After assembling the front axle assembly, be sure to check the front axle pivot. If the measurement is not within the factory specifications, adjust the front axle pivot.

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

— RELATED PAGE —

[4.1 Adjusting front axle pivot on page 5-6](#)

6. HYDRAULIC SYSTEM

MECHANISM

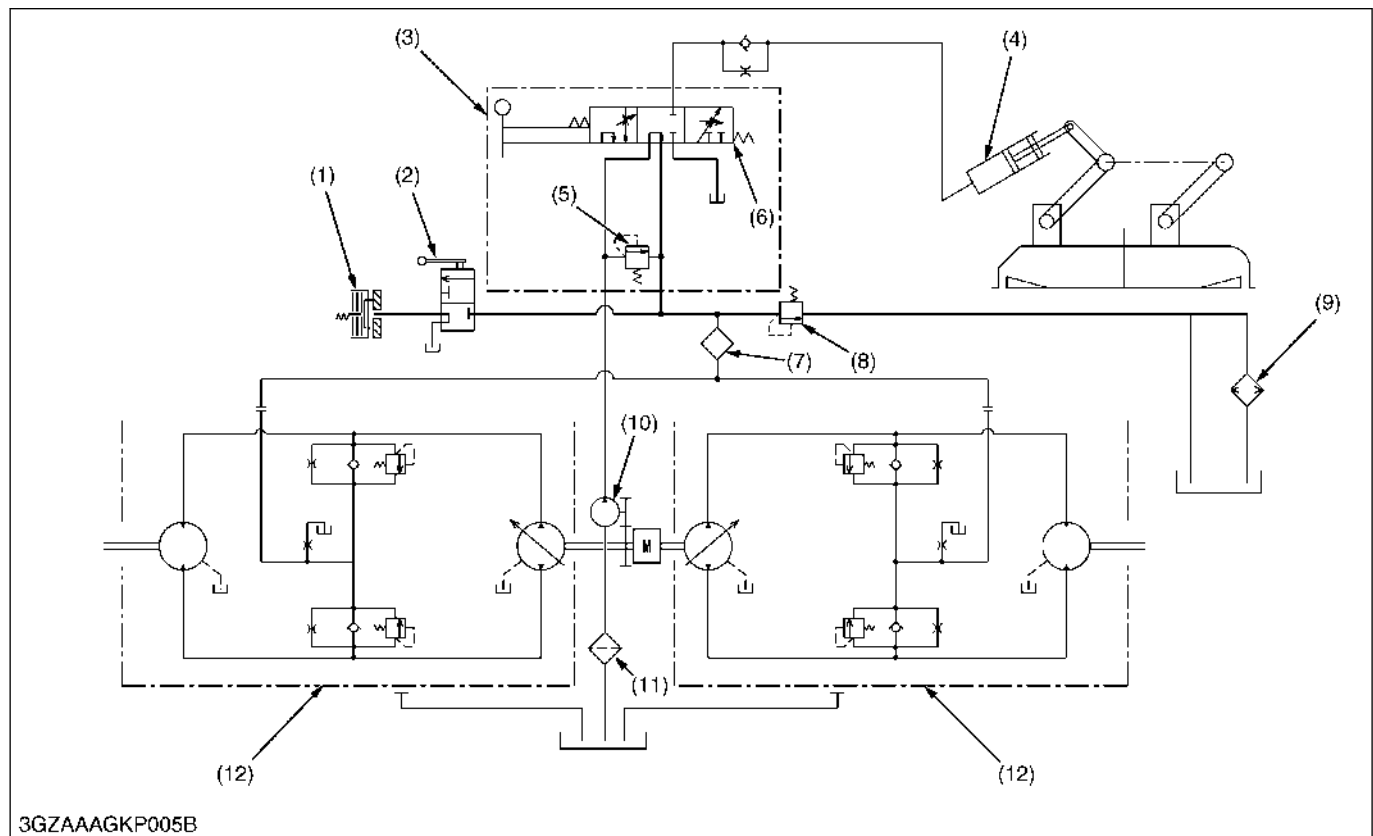
1. Function of hydraulic circuit

The hydraulic system of this machine is composed of a hydraulic pump (10), control valve (6), hydraulic cylinder (4) and other components.

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

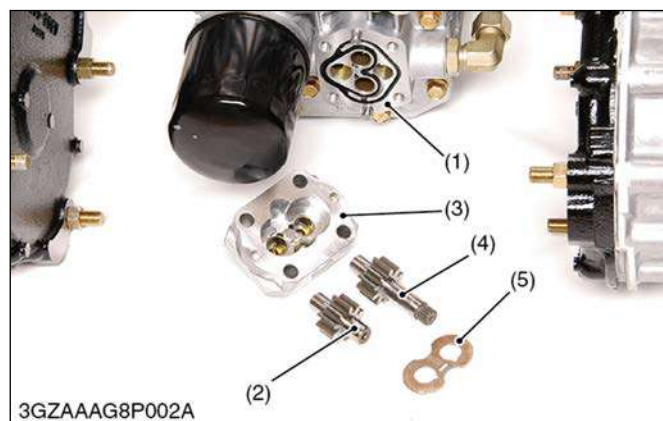
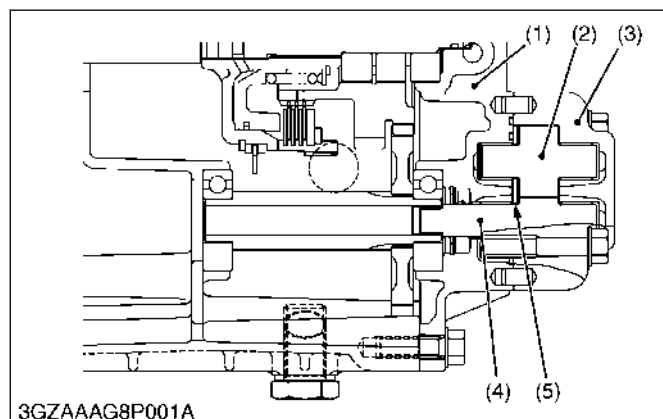
Power from the input shaft (pump shaft) is distributed right and left with the bevel gears and drives each hydrostatic transmission (12).

Moreover, oil from the hydraulic pump (10) is sent to the transmission center case through the control valve. On the other hand, oil is regulated with the regulator valve (8) to constant pressure and sent to the hydrostatic transmission (12) and PTO clutch (1).



- | | | | |
|--------------------------------------|------------------------|---------------------|-------------------------------|
| (1) PTO clutch | (4) Hydraulic cylinder | (8) Regulator valve | (12) Hydrostatic transmission |
| (2) PTO clutch valve | (5) Relief valve | (9) Oil cooler | |
| (3) Hydraulic control valve assembly | (6) Control valve | (10) Hydraulic pump | |
| | (7) Oil filter | (11) Oil filter | |

2. Hydraulic pump



- (1) Casing
(2) Driven gear
(3) Cover
(4) Drive gear
(5) Side plate

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

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

Maximum displacement is as follows.

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

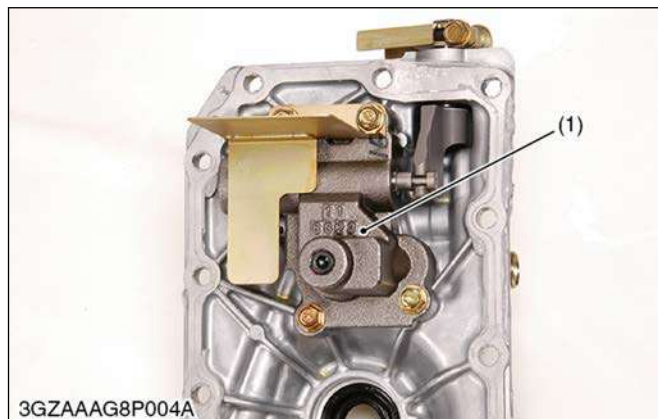
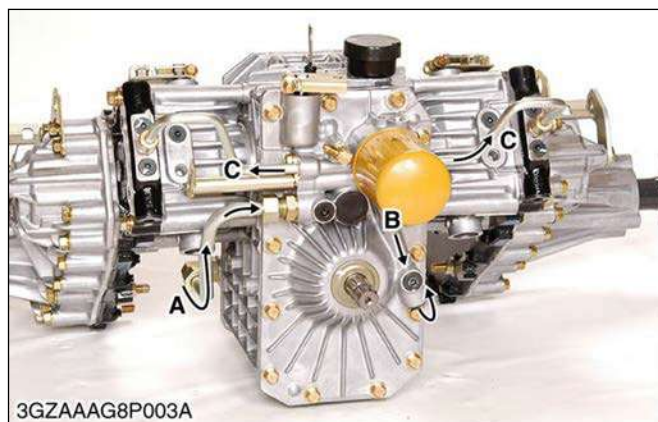
3. Definition of hydraulic control valve

The hydraulic system is composed of the transmission case (oil tank), cushion oil filter, hydraulic pump, control valve, hydraulic cylinder.

The new series product is provided with a built-in control valve in the case.

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

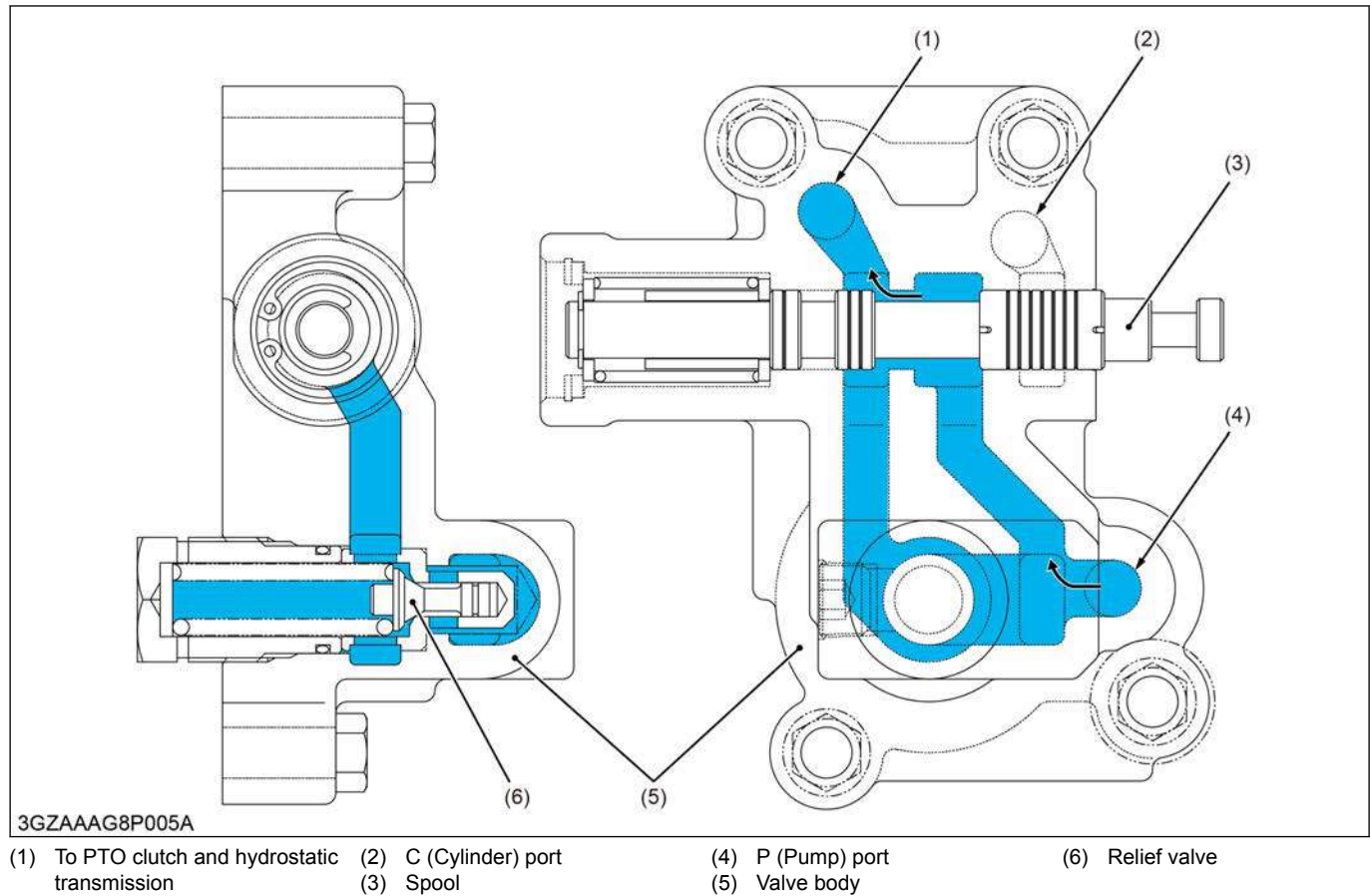
After flowing through the control valve, the oil is sent to the PTO clutch and the HST charge circuit.



- (1) Control valve
A: From hydraulic pump
B: To PTO clutch
C: To hydrostatic transmission

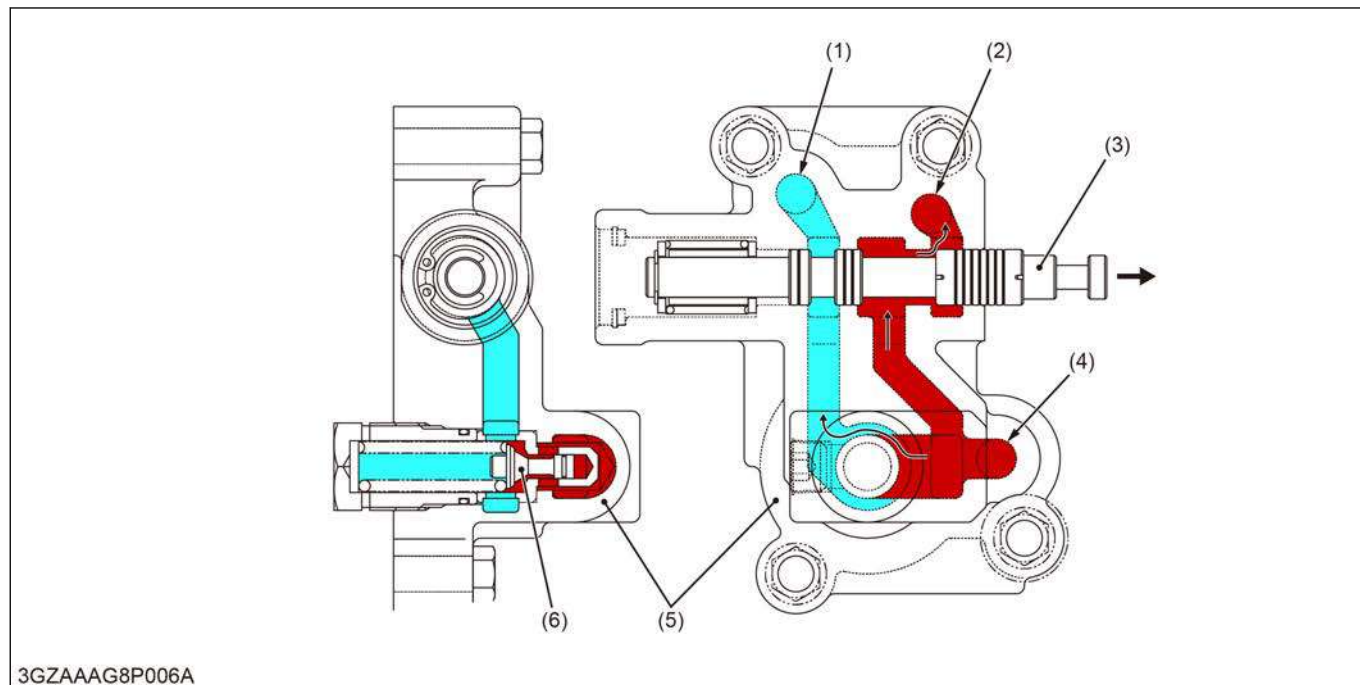
3.1 Neutral position

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).



3.2 Lift and overloaded

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



- (1) To PTO clutch and hydrostatic transmission (2) C (Cylinder) port (4) P (Pump) port (6) Relief valve
(3) Spool (5) Valve body

(Reference)

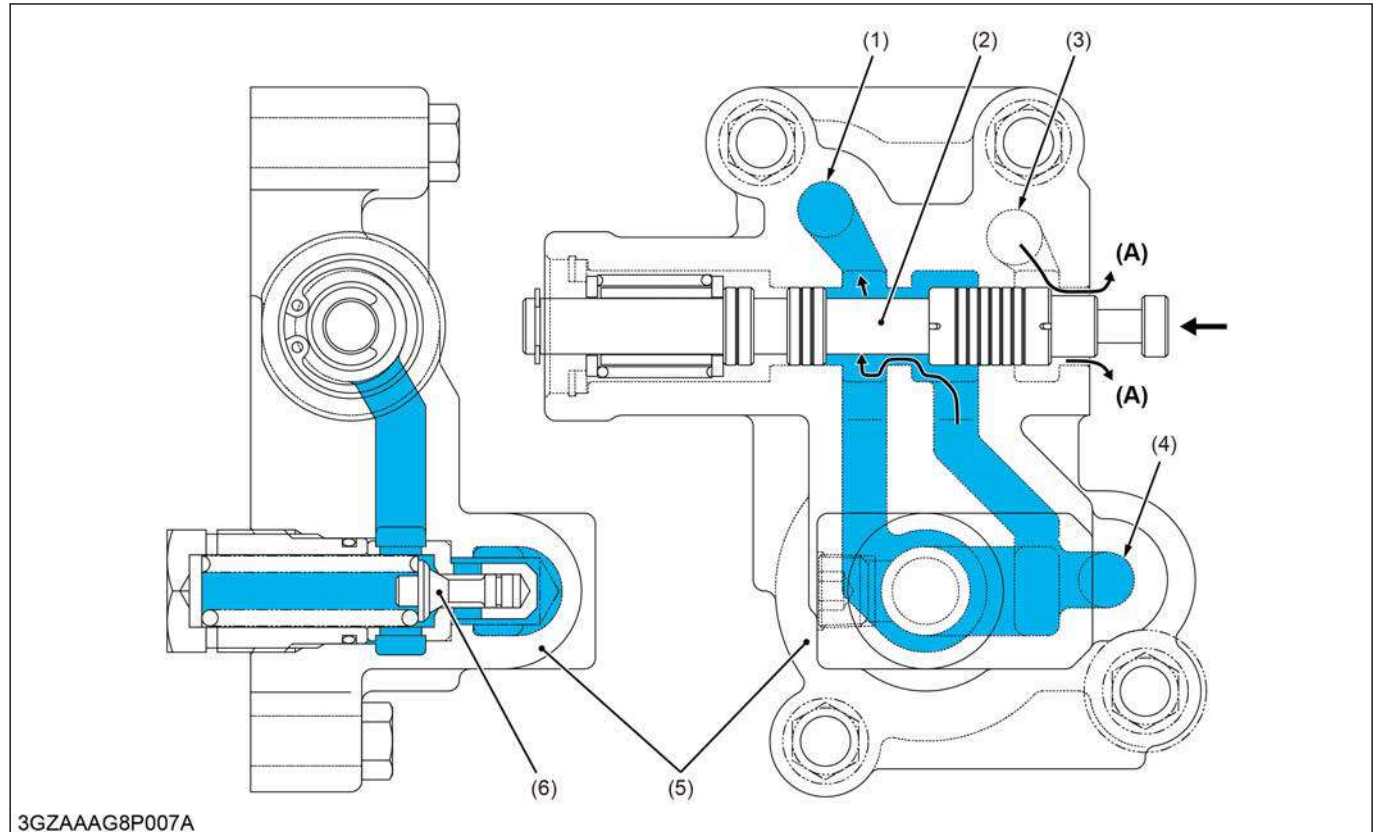
Relief valve setting pressure	Engine speed
5.5 to 7.0 MPa 56 to 71 kgf/cm ² 800 to 1000 psi	1600 min ⁻¹ (rpm)

3.3 Down position

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

The mower-lifting cylinder circuit, which has been interrupted by the spool, is returned to the transmission center case by the pressed-in spool, and a new circuit is formed.

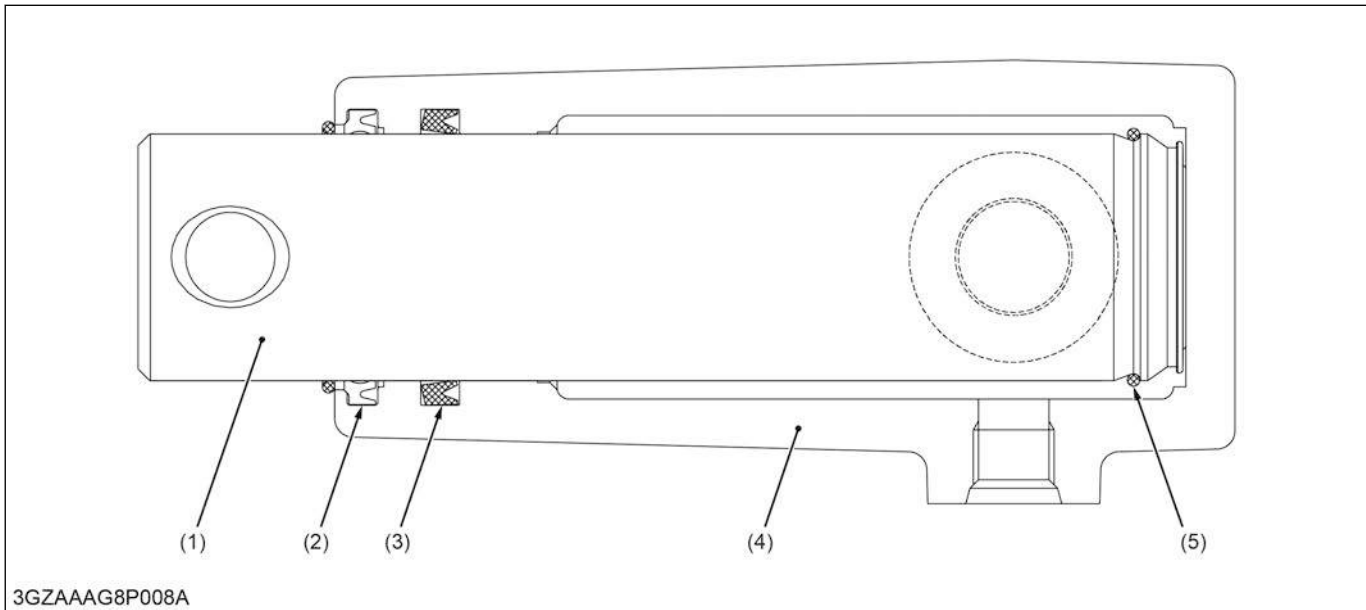
Then the oil in the mower-lifting cylinder is discharged to the transmission center case, and the mower goes down.



- | | | |
|--|-----------------------|--|
| (1) To PTO clutch and hydrostatic transmission | (3) C (Cylinder) port | (6) Relief valve |
| (2) Spool | (4) P (Pump) port | (A) Drain directly to the transmission center case |
| | (5) Valve body | |

4. Function of lift cylinder

The lift cylinder consists of the cylinder (4), piston rod (1) and other parts as shown in the figure. This cylinder is single acting type.



(1) Piston rod
(2) Scraper

(3) Packing
(4) Cylinder

(5) Snap ring

5. Function of mower linkage



CAUTION

- Never operate mower in transport position.

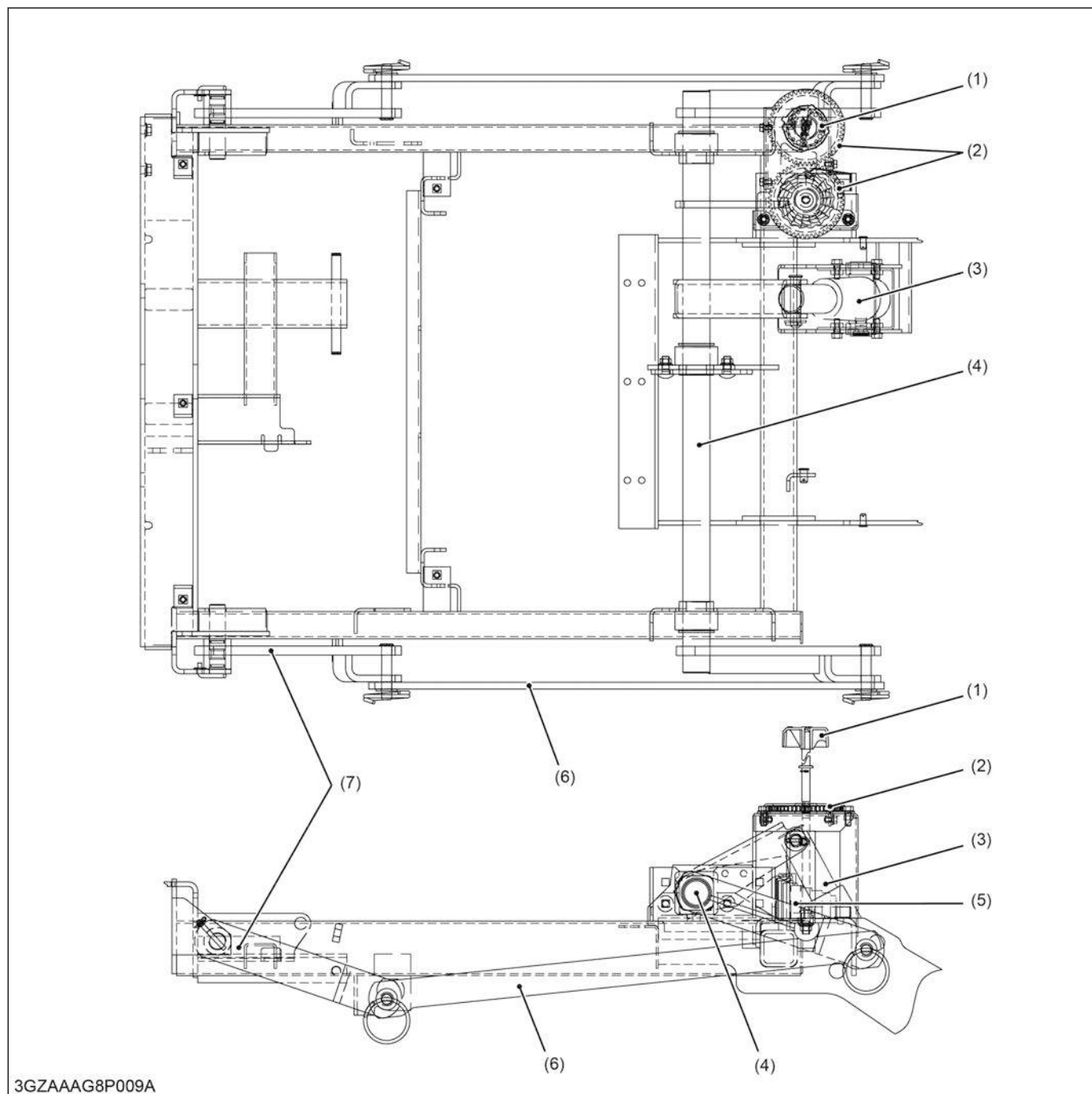
The lifting of mower is performed by the hydraulic system on the machine.

Front arm (7) and lift shaft are linked with horizon plate (6). When the position control lever is moved to **LIFT** position, the lift shaft (4) is risen by the oil pressure of hydraulic system.

Therefore, front arm (7) connected with the horizon plate (6) are lifted at the same time.

As this link system is a parallel linkage, the mower can be kept parallel at every position.

The cutting height adjusting dial (1) adjusts cutting height of mower by rotating the adjusting cam (5).



3GZAAAG8P009A

- | | | | |
|-----------------------------------|-------------------|-------------------|---------------|
| (1) Cutting height adjusting dial | (3) Lift cylinder | (5) Adjusting cam | (7) Front arm |
| (2) Dial cam gear | (4) Lift shaft | (6) Horizon plate | |

SERVICING

1. Troubleshooting for hydraulic system

Symptom	Probable cause and checking procedure	Solution	Reference page
Mower does not rise	1. Control valve malfunctioning	Check and repair or replace	6-12, 6-15
	2. Lift cylinder damaged	Check and replace	—
	3. Relief valve spring damaged	Check and replace	6-12
	4. Relief valve setting pressure too low	Check and adjust	6-12
	5. Hydraulic pump damaged	Check and replace	6-24
	6. Oil strainer clogged	Clean or replace	—
	7. Suction pipe loosened or broken	Repair or replace	6-13
	8. Insufficient transmission oil	Refill	4-26
Mower does not lower	1. Control valve malfunctioning	Check and repair or replace	6-15
Mower drops by its weight	1. Lift cylinder worn or damaged	Check and replace	—
	2. Control valve malfunctioning	Check and replace	6-15

2. Servicing specifications for hydraulic system

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

3. Tightening torques for hydraulic system

■ NOTE

- Tightening torques of screws, bolts and nuts on the table below are especially specified.

Item	Dimension × Pitch	N · m	kgf · m	lbf · ft
Center case front cover mounting screw	—	40 to 44	4.0 to 4.5	29 to 32
Hydraulic control valve mounting screw	—	18 to 20	1.8 to 2.1	13 to 15
Relief valve plug	—	49 to 68	5.0 to 7.0	37 to 50
ROPS connecting plate upper mounting screw	M8	24 to 27	2.4 to 2.8	18 to 20
ROPS connecting plate, lower mounting screw	M10	48 to 55	4.9 to 5.7	36 to 41
Hydraulic pump mounting screw	—	40 to 44	4.0 to 4.5	29 to 32
Cover mounting screw	—	39 to 44	4.0 to 4.4	29 to 32
Universal joint mounting screw	M10	26.5 to 28.4	2.70 to 2.90	19.6 to 20.9
Engine mounting nut	—	24 to 27	2.4 to 2.8	18 to 20

—— RELATED PAGE ——

1. [General use screws, bolts and nuts on page 2-15](#)

4. Checking and adjusting

4.1 Checking relief valve setting pressure

1. Remove the plug (2) from the front cover of transmission center case.
2. Install the adapter (3/8 in., straight thread), hose and pressure gauge.
3. Start the engine and set at maximum speed.

Condition

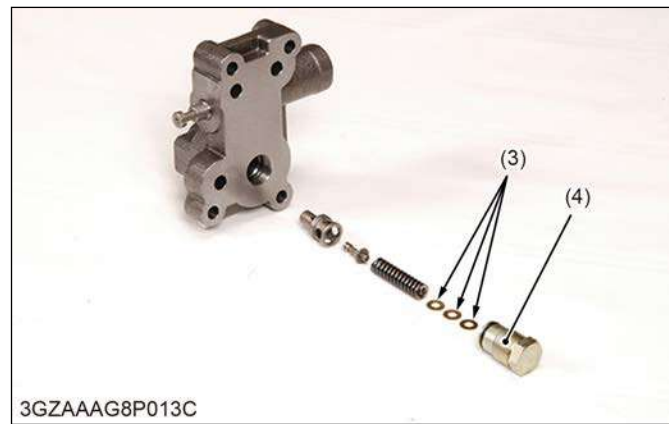
Oil temperature
45 to 55 °C 113 to 131 °F

4. Move the control pedal to "lift" position to operate the relief valve and read the gauge under the engine speed below.



(1) Plug (2) Plug (3/8 in., straight thread)

5. If the pressure is not within the factory specifications, adjust with the adjusting shims (3).



(3) Shim

(4) Plug

(Adjusting procedure)

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

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

(Reference)

- Replace the hydraulic pump if pressure does not rise in 5 MPa (50 kgf/cm², 700 psi) or more.

Thickness of shims (3):	0.20 mm 0.0079 in.
	0.30 mm 0.012 in.
	0.80 mm 0.032 in.

5. Disassembling and assembling

5.1 Hydraulic control valve

5.1.1 Draining transmission fluid

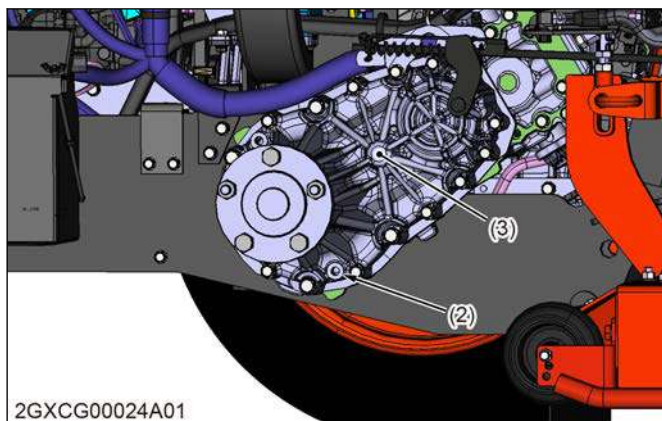
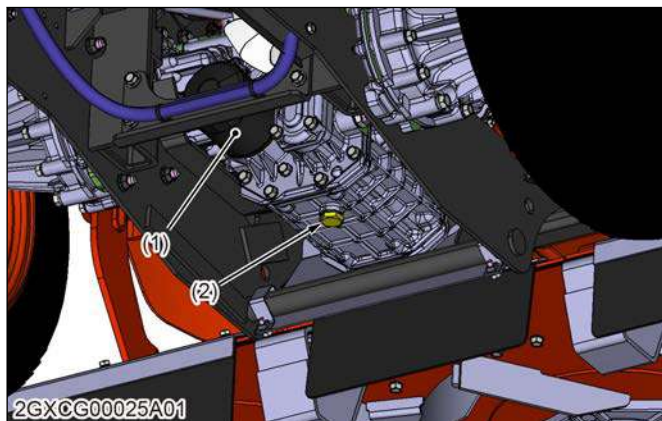
! CAUTION

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.

1. Place oil pans underneath the transmission case and the rear axle gear case (R.H. and L.H.).
2. Remove the drain plug (2) at the bottom of the transmission case and the rear axle gear case (R.H. and L.H.) to drain the oil.

3. After draining reinstall the drain plugs (2).

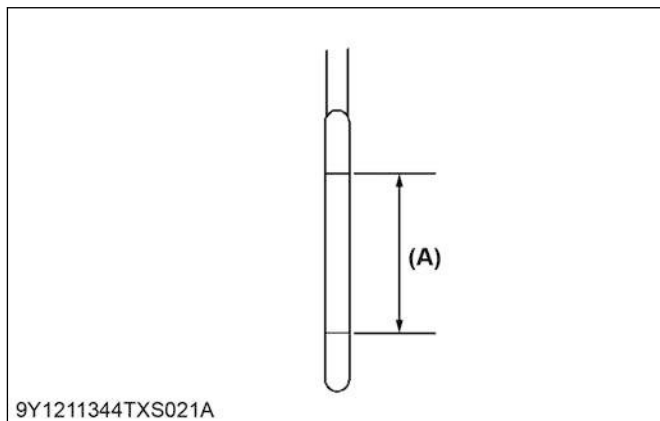
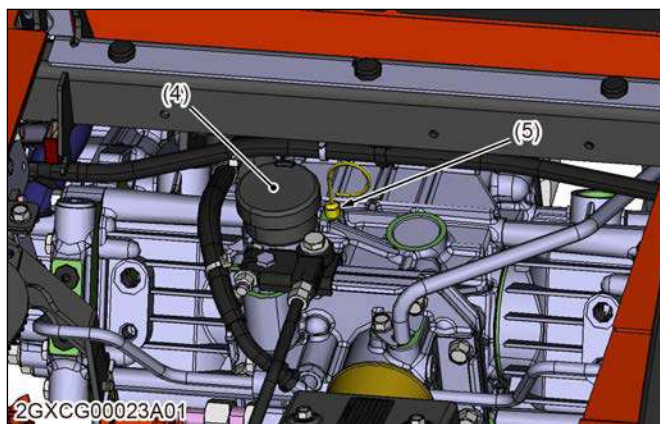


- (1) Transmission oil filter (3) Rear axle gear case L.H.
(2) Drain plug

(When refilling)

■ IMPORTANT

- After running the engine for a few minutes, stop it and check the oil level again; add oil to the prescribed level (A).
 - It takes time to pour the oil from the transmission case to the rear axle case R.H. and L.H. Pour the regulated amount of oil slowly.
 - Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system.
 - The fluid in the transmission case is also used for the hydrostatic drive system.
 - Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.
 - Keep the engine at medium speed for a few minutes to ensure proper lubrication of all parts so there is no damage to transmission.
1. Remove the filling plug (4) and fill with oil.
 2. After running the engine for a few minutes, stop it and check the oil level again; add oil to the prescribed level (A).



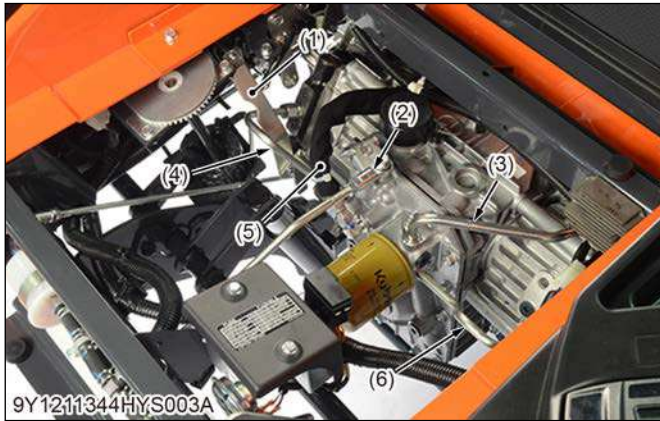
- (4) Oil filling plug and breather (A) Oil level acceptable within this range.
(5) Dipstick

Transmission fluid	Capacity	12.1 L 12.8 U.S.qts 10.6 Imp.qts
--------------------	----------	--

5.1.2 Removing PTO clutch link, cylinder hose, oil cooler pipe and HST charge pipes

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

6. Disconnect the lift cylinder hose (5).



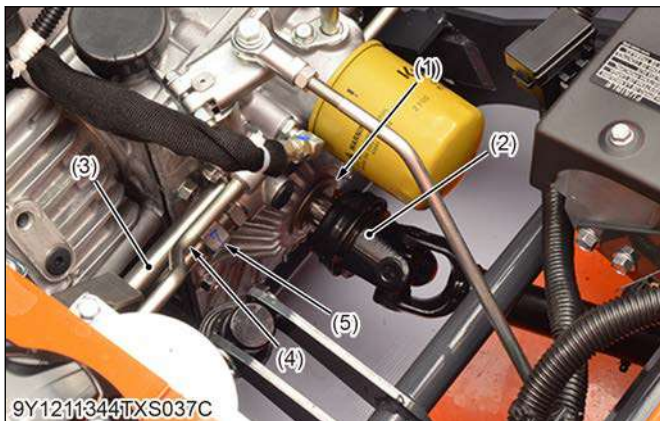
- (1) PTO clutch link
- (2) Lift rod
- (3) Oil cooler pipe
- (4) HST pipe
- (5) Lift cylinder hose
- (6) HST pipe

(When reassembling)

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

5.1.3 Removing 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).



- (1) PTO shaft oil seal
- (2) Universal joint
- (3) PTO clutch lever
- (4) Delivery pipe
- (5) Pipe fitting

(When reassembling)

- Replace the PTO shaft oil seal (1) with new one.

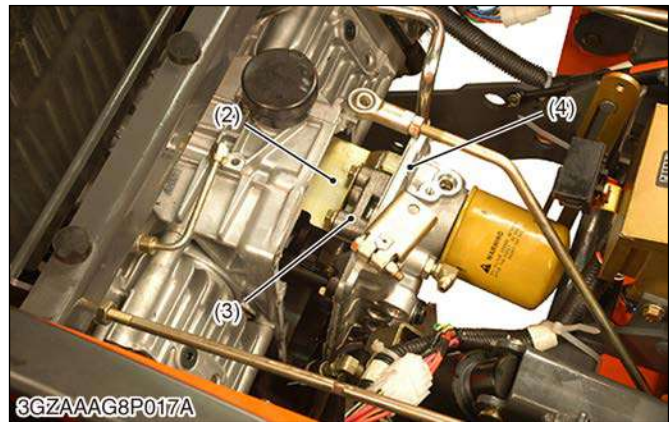
5.1.4 Removing center case front cover assembly

1. Wrap the tape (1) around the PTO shaft to prevent it from damaging internally of the center case front cover.



- (1) Tape

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).



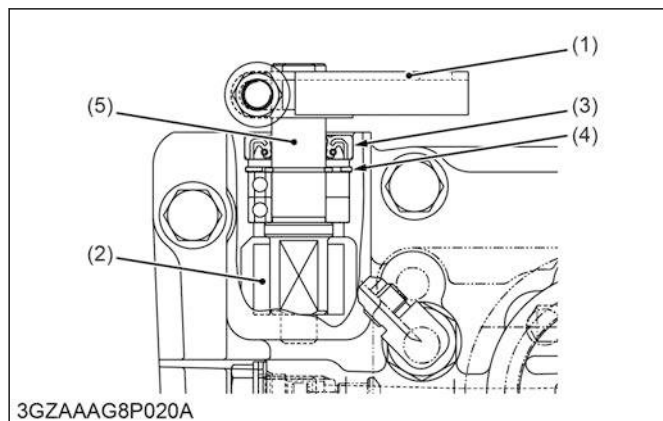
- (2) Plate
- (3) Hydraulic control valve
- (4) Front cover assembly

(When reassembling)**NOTE**

- Assemble the plate (2) as shown in the photo. If the plate (2) is mounted onto the valve first, the front cover (4) cannot be mounted onto the transmission center case.
- Apply liquid gasket (Three Bond 1208D or equivalent) to joint face of center case and center case front cover.

Tightening torque	Center case front cover mounting screw	40 to 44 N·m 4.0 to 4.5 kgf·m 29 to 32 lbf·ft
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5.1.5 Removing lift shaft and arm



- (1) Lift arm
- (2) Arm
- (3) Oil seal
- (4) Internal snap ring
- (5) Lift shaft

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.

5.1.6 Removing hydraulic control valve

1. Remove the hydraulic control valve (1).



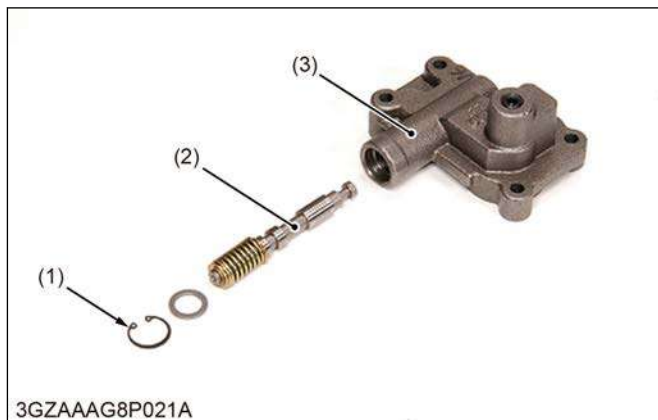
- (1) Hydraulic control valve

(When reassembling)

Tightening torque	Hydraulic control valve mounting screw	18 to 20 N·m 1.8 to 2.1 kgf·m 13 to 15 lbf·ft
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5.1.7 Removing spool

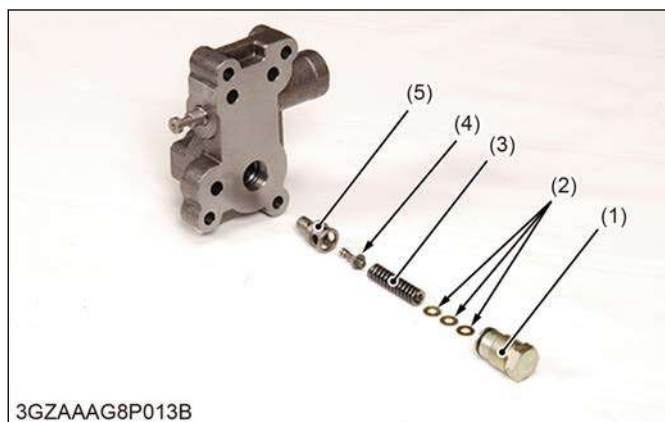
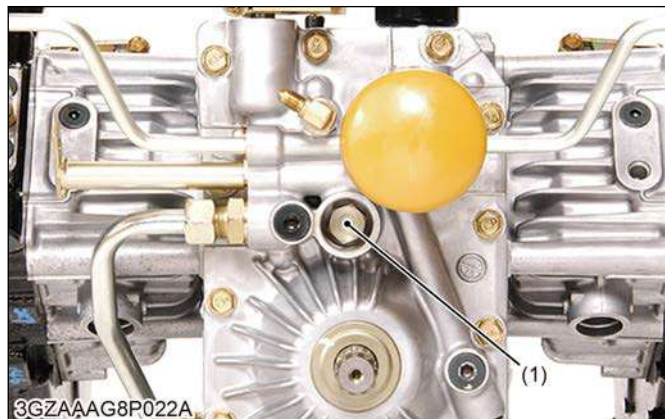
1. Remove the internal snap ring (1), and remove the spool (2).



- (1) Internal snap ring
- (2) Spool
- (3) Valve body

5.1.8 Removing relief valve

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



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

(When reassembling)

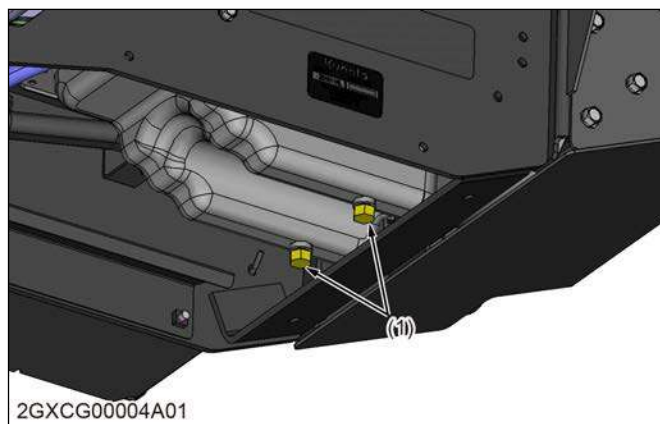
- Be careful not to damage the O-ring on plug.

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

5.2.1 Draining engine oil

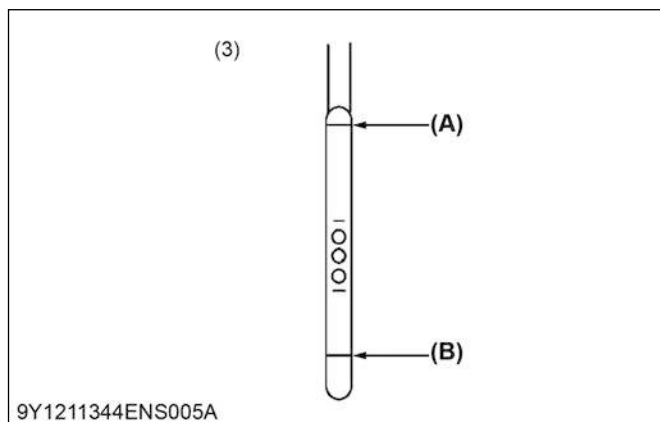
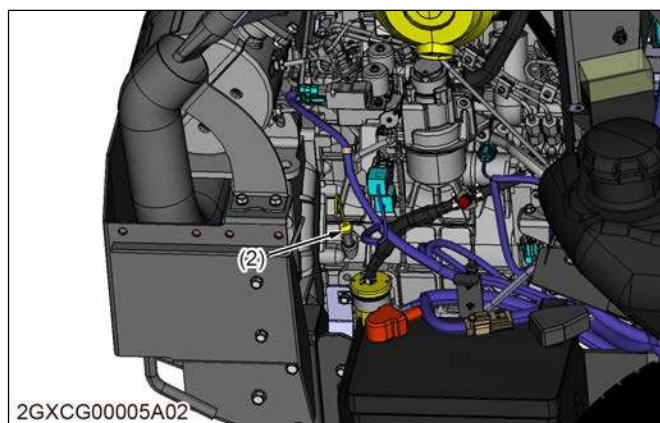
1. Park the machine on level ground.
2. Start and warm up the engine for approx. 5 minutes.
3. Place an oil pan underneath the engine.



- (1) Drain plug

4. Remove the drain plug (1) to drain oil and drain the oil completely.
5. After draining, screw in the drain plug (1).

(When refilling)



- | | |
|----------------------|-----------------|
| (2) Dipstick | (A) Upper level |
| (3) Engine oil range | (B) Lower level |

■ IMPORTANT

- Fill the engine oil up to the upper line (A) on the dipstick.
- Never mix two different types of oil.
- Use the proper SAE Engine Oil according to ambient temperatures.

Engine oil	Capacity	6.7 L 7.1 U.S.qts 5.9 Imp.qts
------------	----------	-------------------------------------

5.2.2 Draining transmission fluid

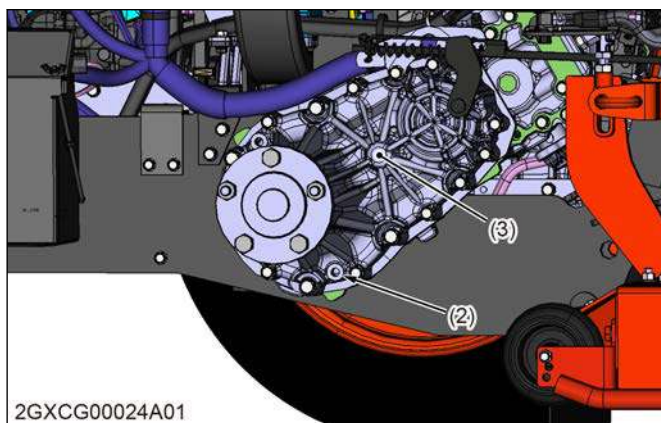
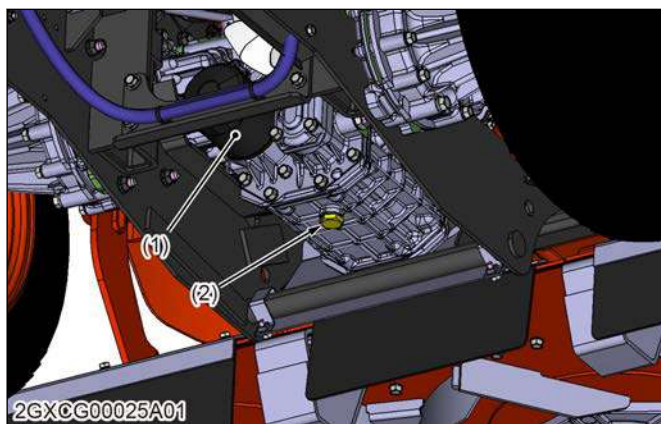


CAUTION

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.

1. Place oil pans underneath the transmission case and the rear axle gear case (R.H. and L.H.).
2. Remove the drain plug (2) at the bottom of the transmission case and the rear axle gear case (R.H. and L.H.) to drain the oil.
3. After draining reinstall the drain plugs (2).



- (1) Transmission oil filter (3) Rear axle gear case L.H.
(2) Drain plug

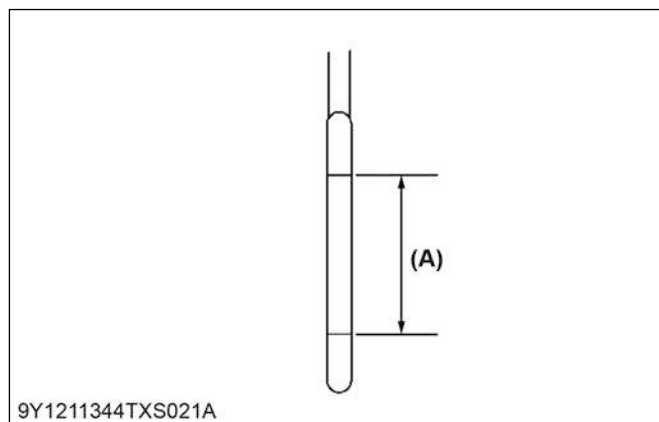
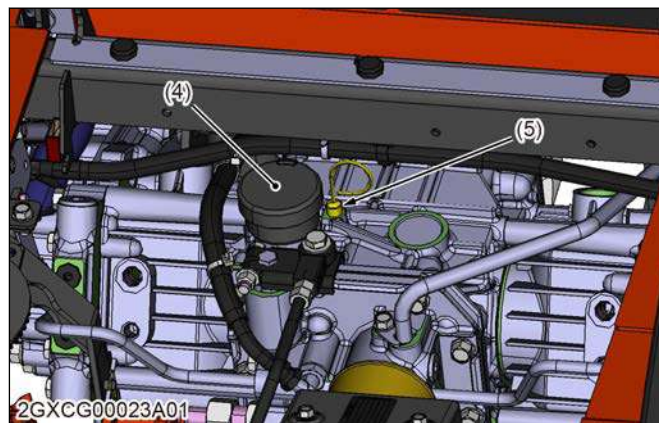
(When refilling)

■ IMPORTANT

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

- It takes time to pour the oil from the transmission case to the rear axle case R.H. and L.H. Pour the regulated amount of oil slowly.
- Use only multi-grade transmission oil. Use of other oils may damage the transmission of hydraulic system.
- The fluid in the transmission case is also used for the hydrostatic drive system.
- Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.
- Keep the engine at medium speed for a few minutes to ensure proper lubrication of all parts so there is no damage to transmission.

1. Remove the filling plug (4) and fill with oil.
2. After running the engine for a few minutes, stop it and check the oil level again; add oil to the prescribed level (A).



- (4) Oil filling plug and breather cup (A) Oil level acceptable within this range.
(5) Dipstick

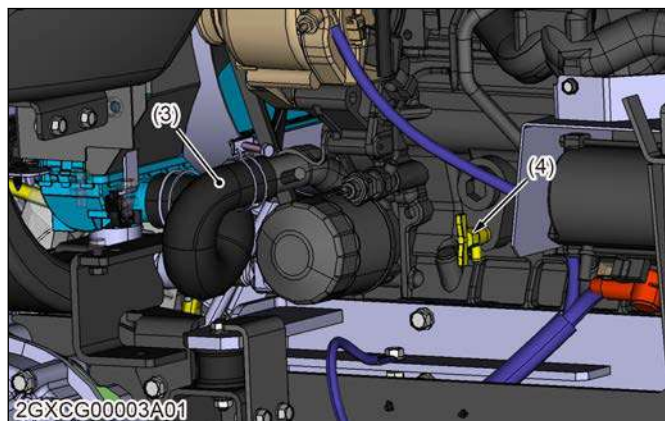
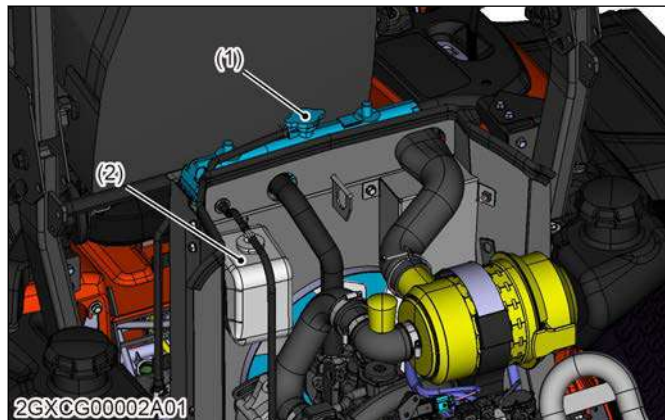
Transmission fluid	Capacity	12.1 L 12.8 U.S.qts 10.6 Imp.qts
--------------------	----------	--

5.2.3 Draining coolant

WARNING

To avoid serious injury or death:

- 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) Radiator cap
(2) Recovery tank
(3) Lower radiator hose
(4) Engine coolant drain valve

1. Stop the engine and let cool down.
2. Open the engine coolant drain valve (4) to drain the coolant from the engine.
3. Remove the lower radiator hose (3) from the engine side to drain the coolant from the radiator.
4. Remove the radiator cap (1) to completely drain the coolant.
5. After all coolant is drained, close the engine coolant drain valve (4).

(When refilling)

Coolant capacity	Radiator	4.6 L 4.9 U.S.qts 4.0 Imp.qts
	Recovery tank	1.1 L 1.2 U.S.qts 0.97 Imp.qts

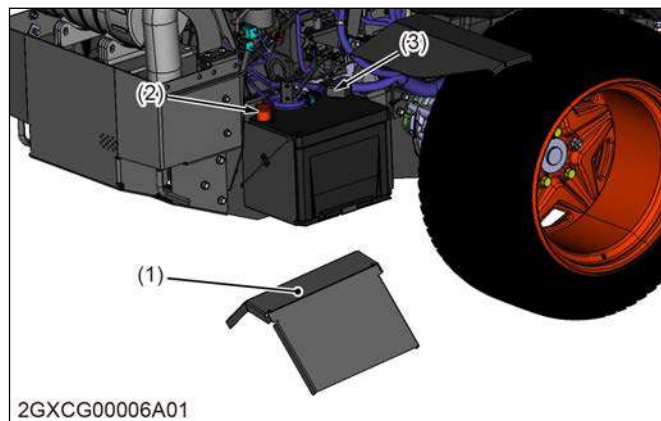
5.2.4 Removing the battery

WARNING

To avoid serious injury or death:

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

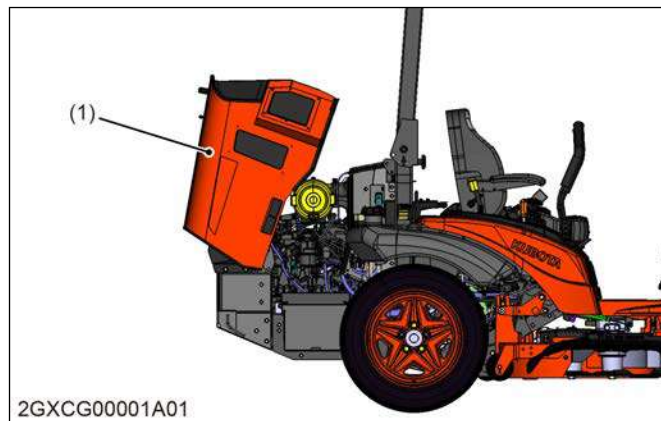
1. Remove the battery cover (1).
2. Disconnect the negative cable (3) from the battery.
3. Disconnect the positive cable (2) from the battery.
4. Remove the battery.



- (1) Battery cover
(2) Positive cable
(3) Negative cable

5.2.5 Removing the bonnet

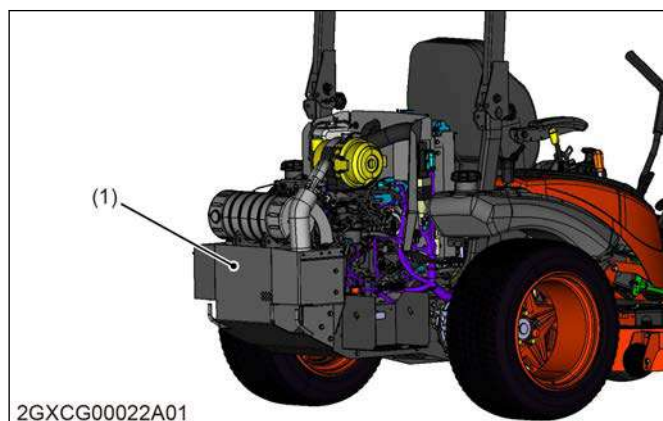
1. Remove the bonnet mounting bolts.
2. Remove the bonnet (1).



- (1) Bonnet

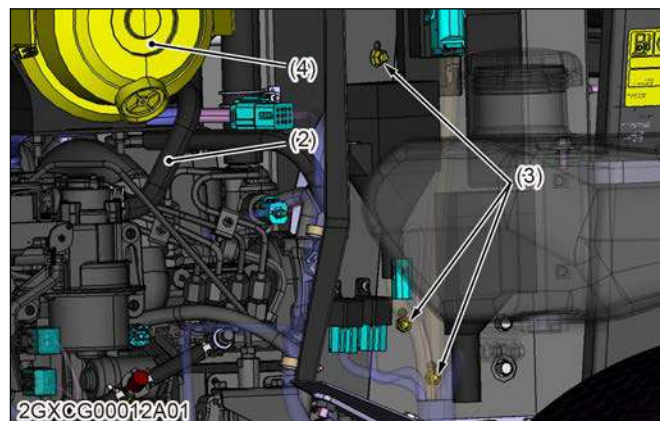
5.2.6 Removing rear engine frame

1. Remove rear engine frame (1).



(1) Rear engine frame

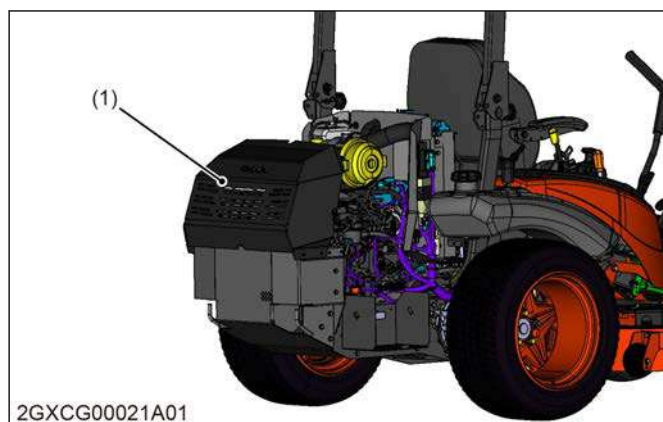
3. Remove air cleaner stay bolts (3).
4. Remove air cleaner assembly (4).



(2) Air cleaner hose (blower) (3) Air cleaner stay bolts (4) Air cleaner assembly

5.2.7 Removing DPF cover

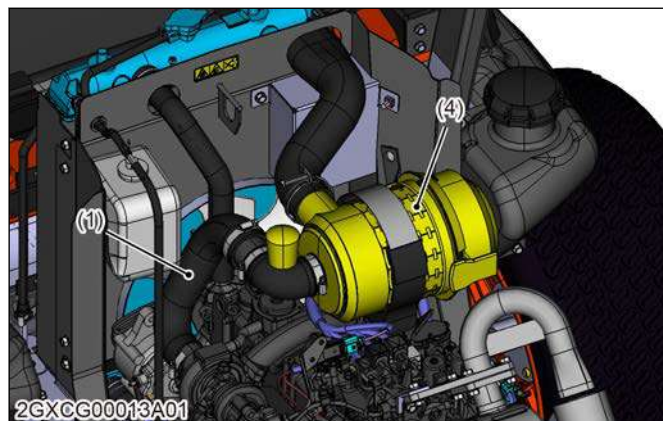
1. Remove DPF cover (1).



(1) DPF cover

5.2.8 Removing air cleaner assembly

1. Disconnect air cleaner hose from turbocharger (1).

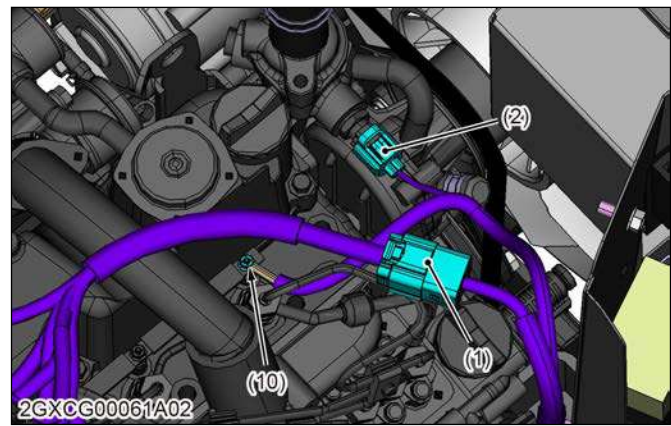
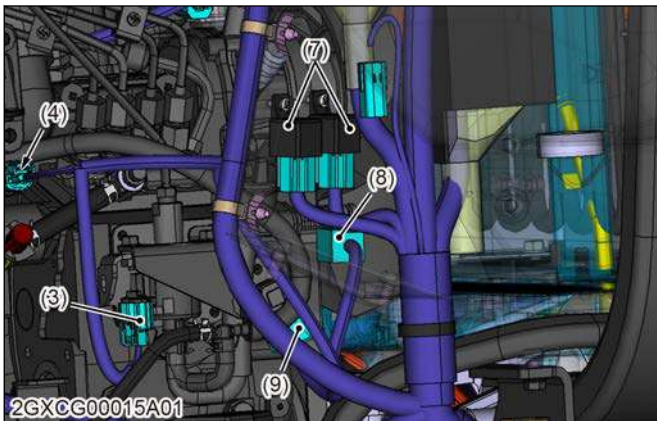
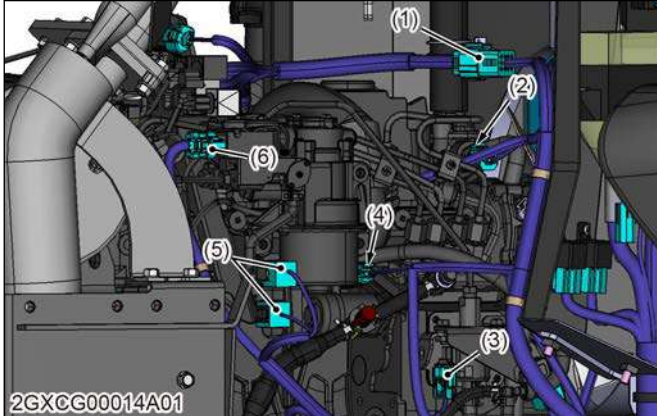


(1) Air cleaner hose (turbocharger) (4) Air cleaner assembly

2. Disconnect air cleaner hose from blower (2).

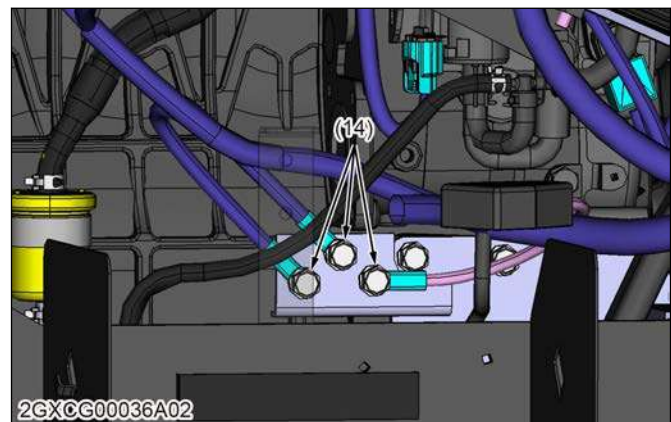
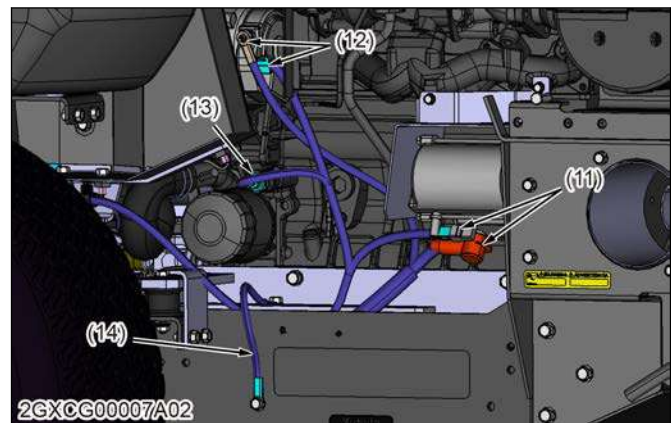
5.2.9 Disconnecting engine wiring harness

1. Disconnect each wiring connector.
 - DPF harness connector (1)
 - Water temperature sensor (2)
 - Doser fuel pump connector (3)
 - Engine stop solenoid connector (4)
 - Blower connectors (5)
 - Pressure sensor (6)
 - Relays (7)
 - Rack position sensor (8)
 - Rotation sensor (9)
 - Glow plug (10)



- | | |
|------------------------------------|--------------------------|
| (1) DPF harness connector | (6) Pressure sensor |
| (2) Water temperature sensor | (7) Relays |
| (3) Doser fuel pump connector | (8) Rack position sensor |
| (4) Engine stop solenoid connector | (9) Rotation sensor |
| (5) Blower connectors | (10) Glow plug |

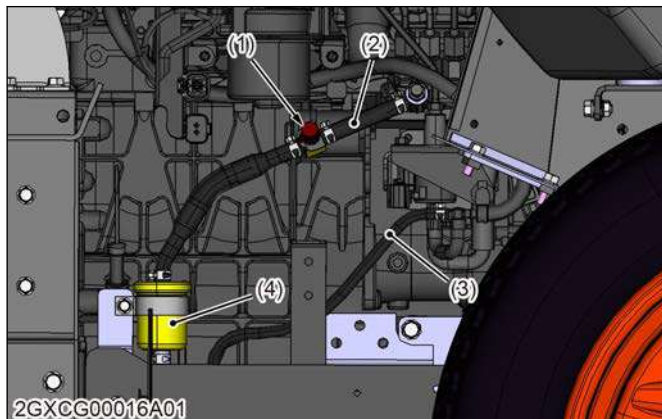
2. Remove positive cable and connector from starter motor (11).
3. Disconnect alternator connectors (12).
4. Disconnect oil switch (13).
5. Disconnect all ground cables (14).



- | | |
|----------------------------|--------------------|
| (11) Starter motor | (14) Ground cables |
| (12) Alternator connectors | |
| (13) Oil switch | |

5.2.10 Disconnecting engine fuel hoses

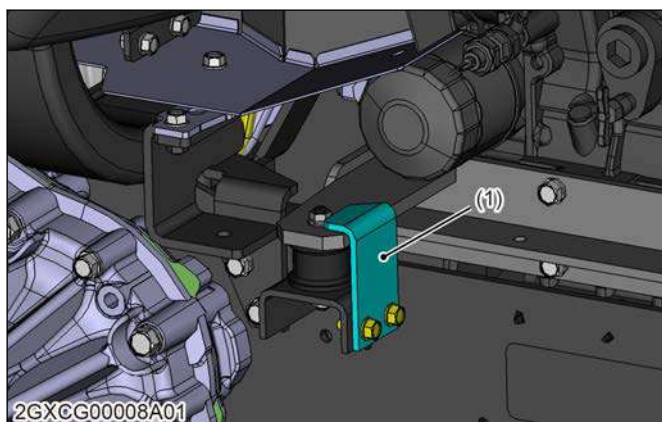
1. Turn off fuel cut off valve (1).
2. Disconnect fuel hose from engine (2).
3. Disconnect fuel hose from doser fuel pump (3).
4. Remove fuel filter assembly (4).



- (1) Fuel cut off valve
- (2) Fuel hose (Engine)
- (3) Fuel hose (Doser fuel pump)
- (4) Fuel filter assembly

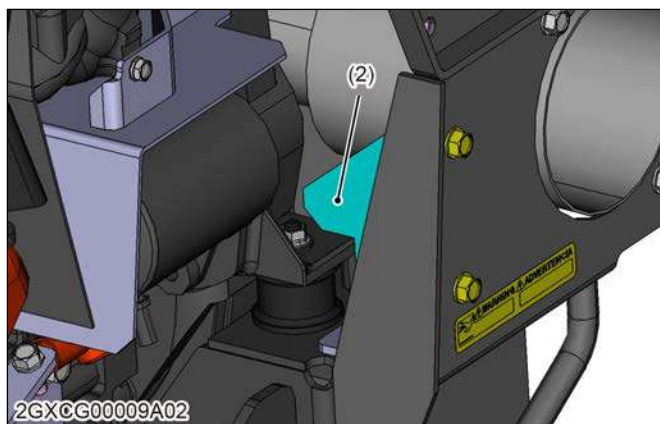
5.2.11 Removing engine stoppers

1. Remove front engine stoppers (1) on both sides of engine.



- (1) Front engine stopper

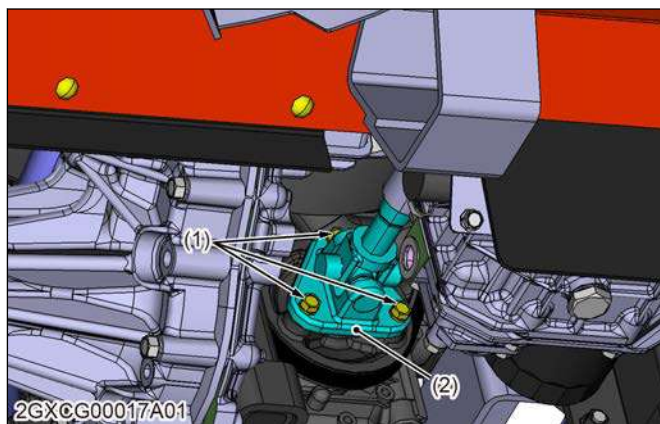
2. Remove rear engine stoppers (2) on both sides of engine.



- (2) Rear engine stopper

5.2.12 Removing universal joint from engine

1. Remove universal joint mounting bolts from engine (1).
2. Remove universal joint (2).



- (1) Universal joint mounting bolts (engine)
- (2) Universal joint

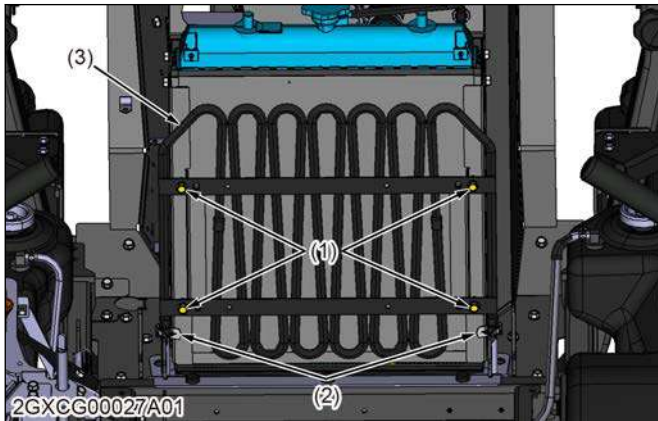
(When reassembling)

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

Tightening torque	Universal joint mounting bolt	26.0 to 28.0 N · m 2.70 to 2.90 kgf · m 19.2 to 20.7 lbf · ft
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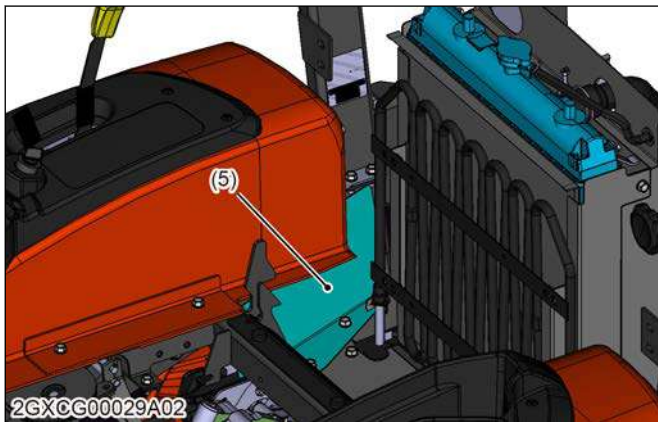
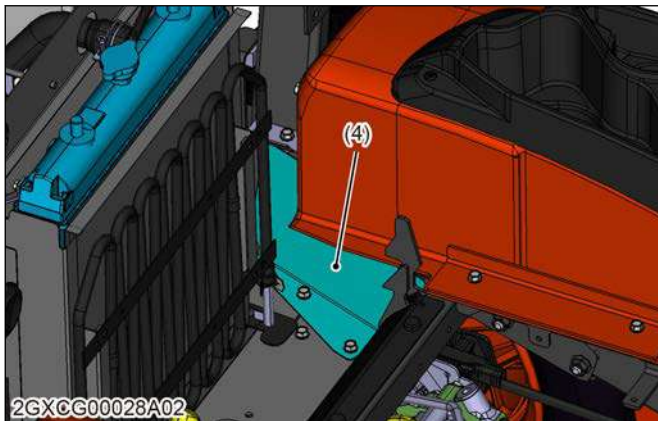
5.2.13 Disconnecting radiator assembly

1. Remove the oil cooler mounting bolts (1).



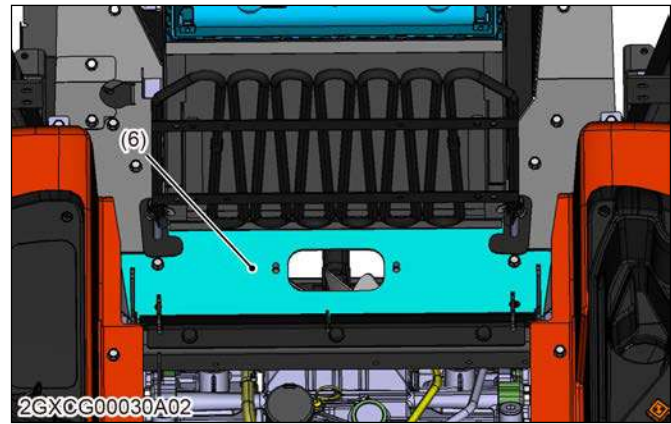
- (1) Oil cooler mounting bolts (3) Oil cooler
(2) Oil cooler clips

2. Remove L.H. and R.H. radiator plates (4), (5).



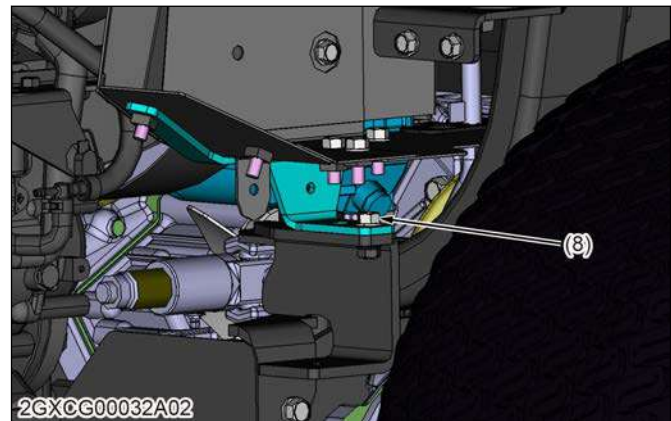
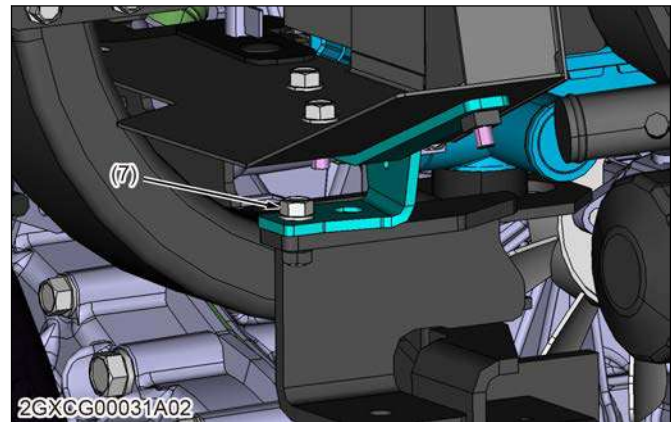
- (4) L.H. radiator plate (5) R.H. radiator plate

3. Remove center radiator plate (6).



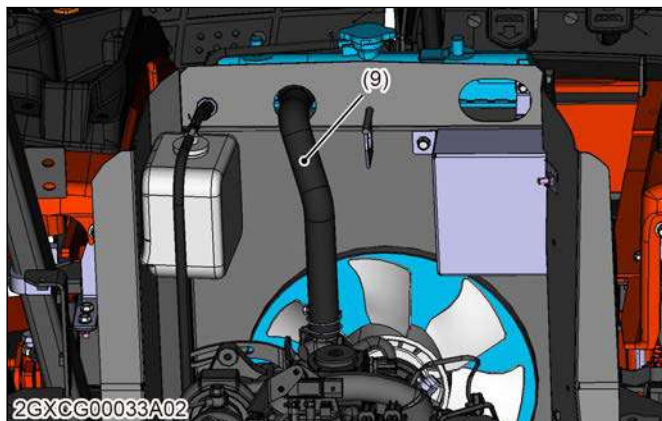
- (6) Center radiator plate

4. Remove radiator bracket mounting bolts (7), (8).



- (7) Radiator bracket mounting bolt L.H. (8) Radiator bracket mounting bolt R.H.

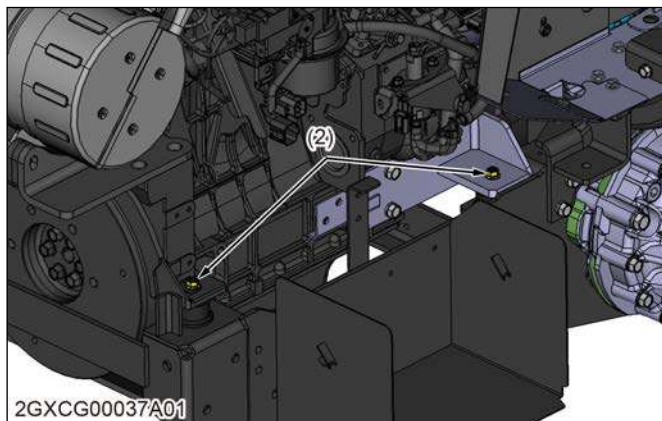
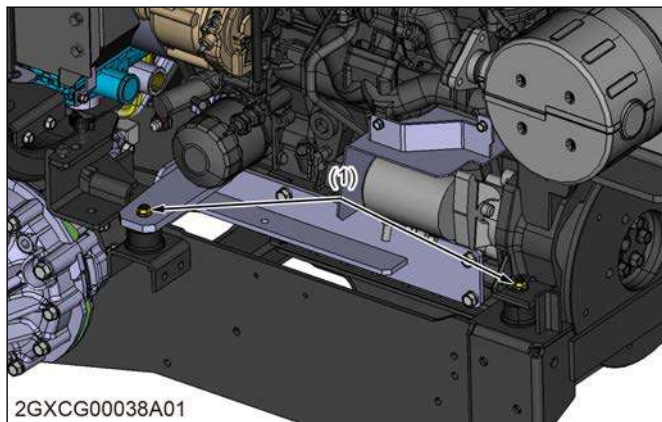
5. Remove upper radiator hose (9).



(9) Upper radiator hose

5.2.14 Separating the engine

1. Remove engine mounting nuts L.H. (1).
2. Remove engine mounting nuts R.H. (2).



(1) Engine mounting nuts L.H. (2) Engine mounting nuts R.H.

3. Attach hoist to engine.
4. Separate the engine.

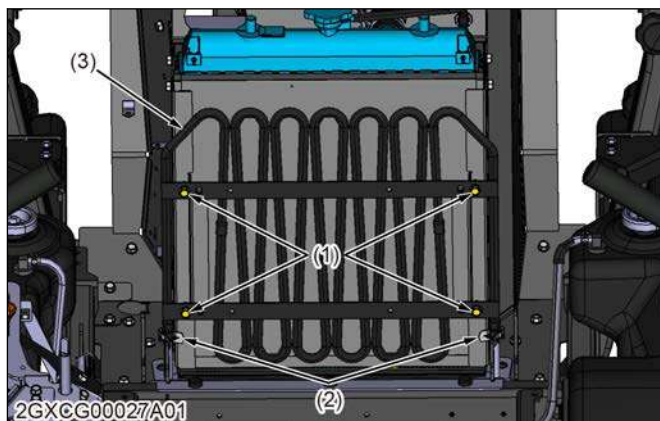
**(When reassembling)**

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

Tightening torque	Engine mounting nut	23.5 to 27.5 N·m 2.40 to 2.80 kgf·m 17.4 to 20.3 lbf·ft
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5.2.15 Removing oil cooler

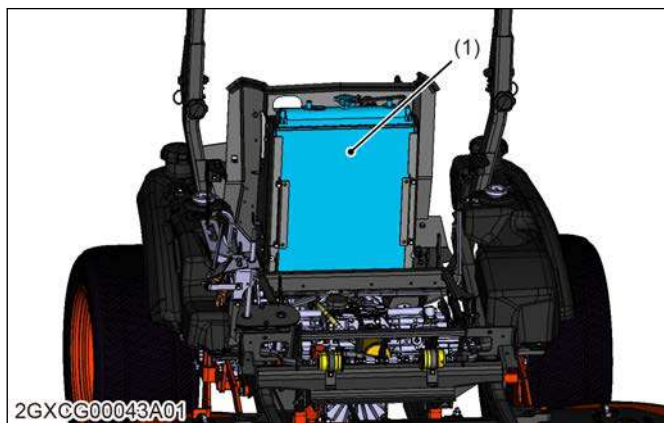
1. Remove oil cooler bolts (1).
2. Remove clips (2).
3. Remove oil cooler (3).

(1) Oil cooler bolts
(2) Oil cooler clips

(3) Oil cooler

5.2.16 Removing radiator

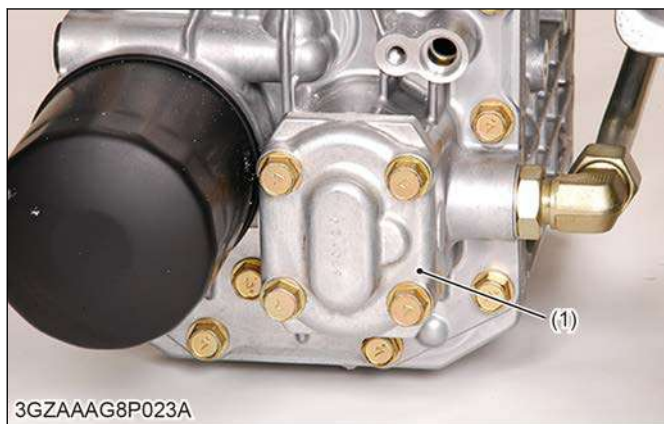
1. Remove radiator assembly (1).



(1) Radiator assembly

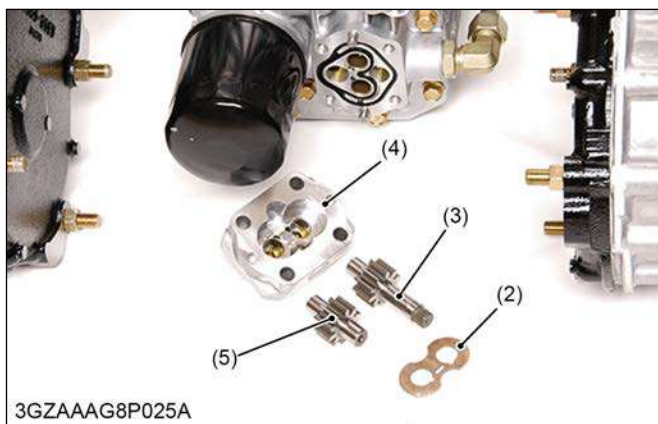
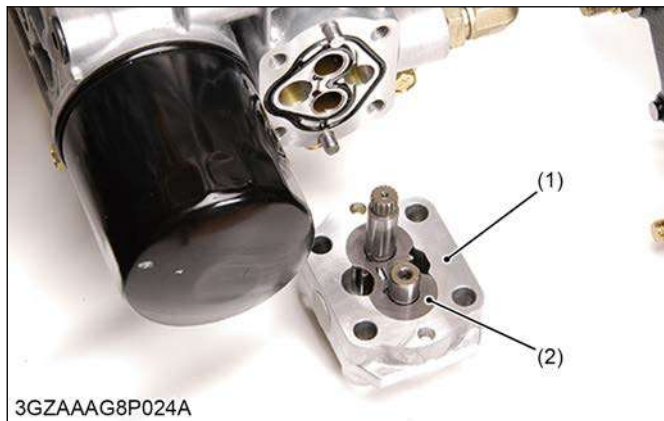
5.2.17 Disassembling hydraulic pump

1. Remove the hydraulic pump assembly (1).



(1) Hydraulic pump assembly

2. Remove the side plate (2).
3. Remove the drive gear (3) and the driven gear (5) from the casing (4).



(1) Hydraulic pump assembly (4) Casing
(2) Side plate (5) Driven gear
(3) Drive gear

(When reassembling)

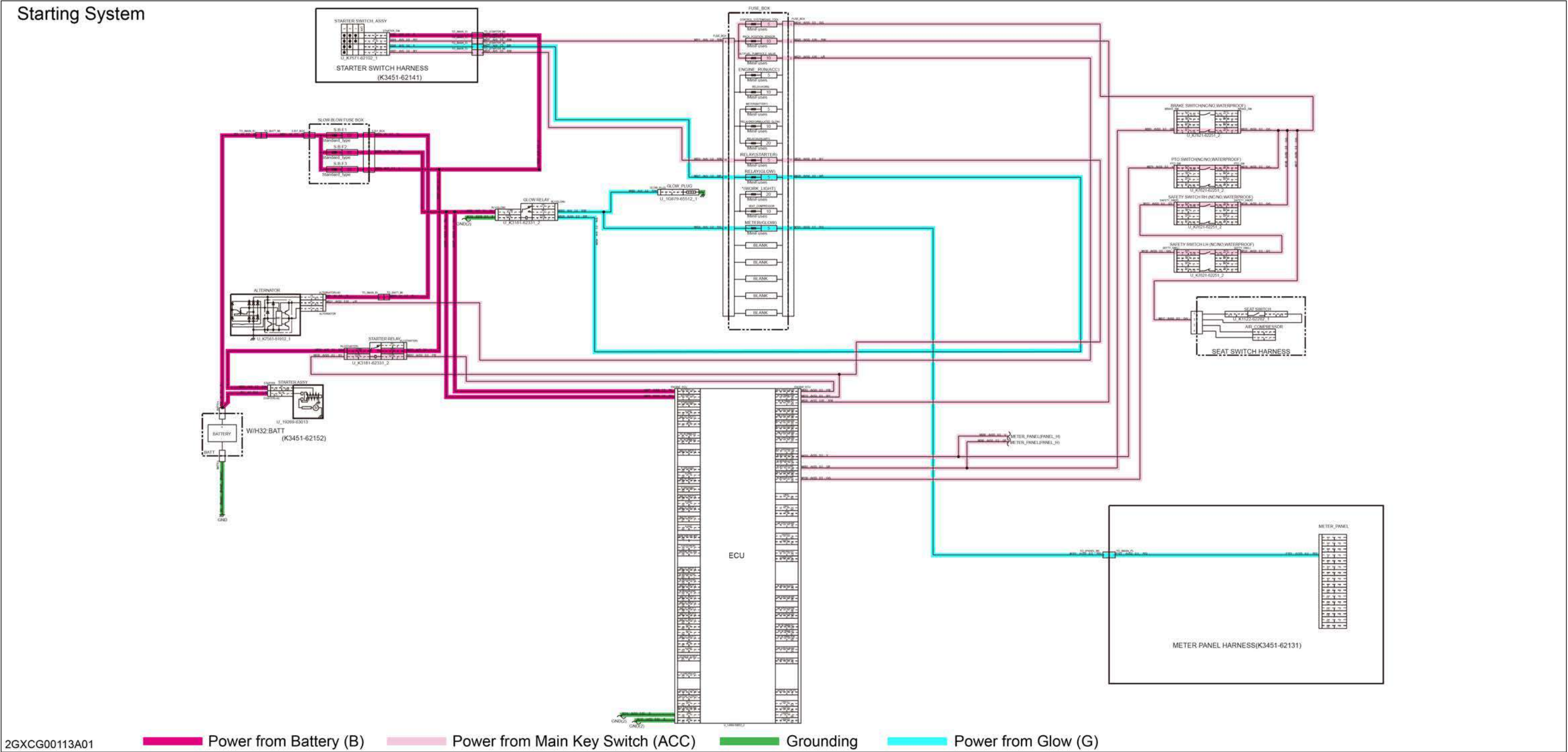
- Be careful not to damage the O-ring.
- Align the holes of the cover and casing.
- Install the side plate, noting its location and direction.
- Install the gears, noting its direction.

Tightening torque	Cover mounting screw	39 to 44 N·m 4.0 to 4.4 kgf·m 29 to 32 lbf·ft
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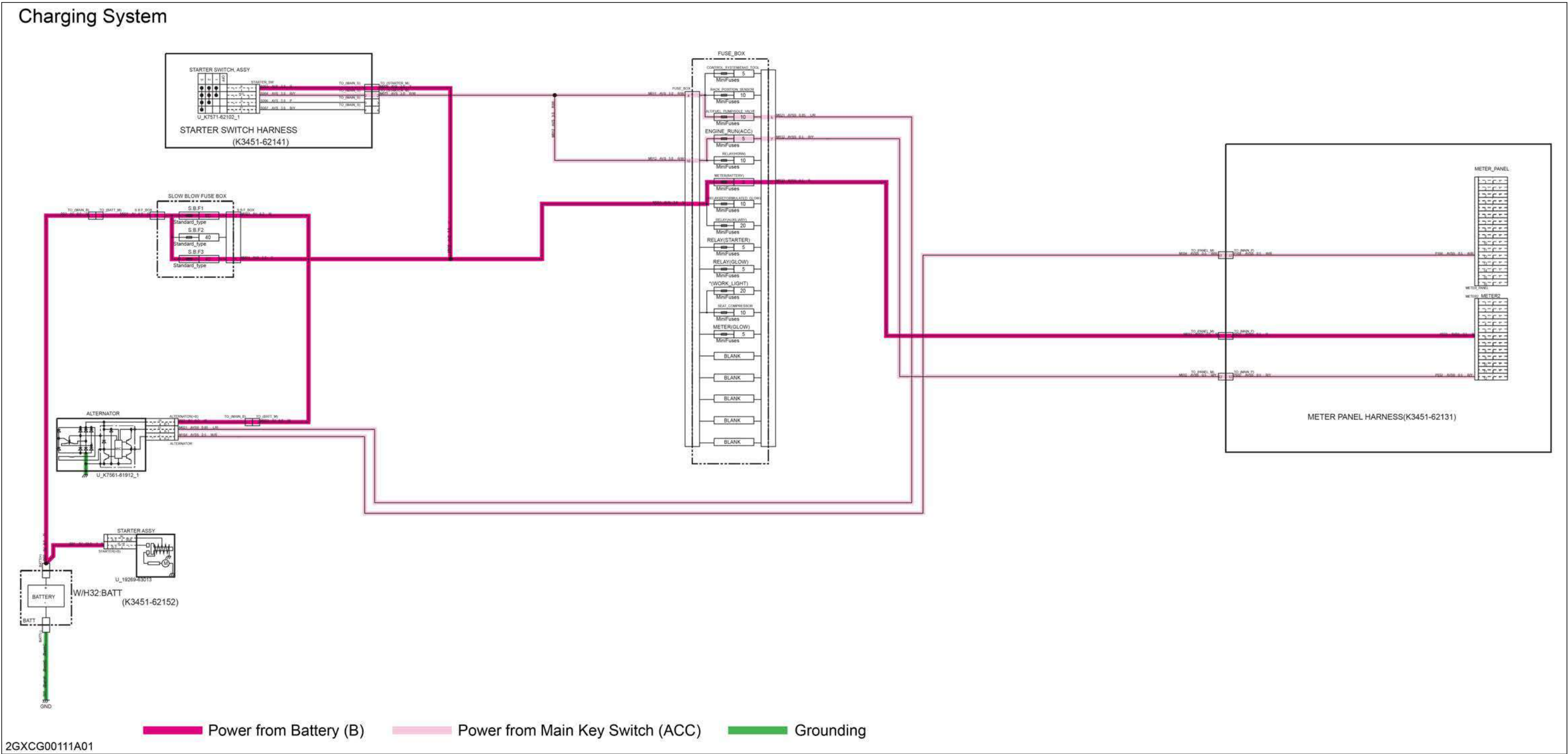
7. ELECTRICAL SYSTEM

MECHANISM

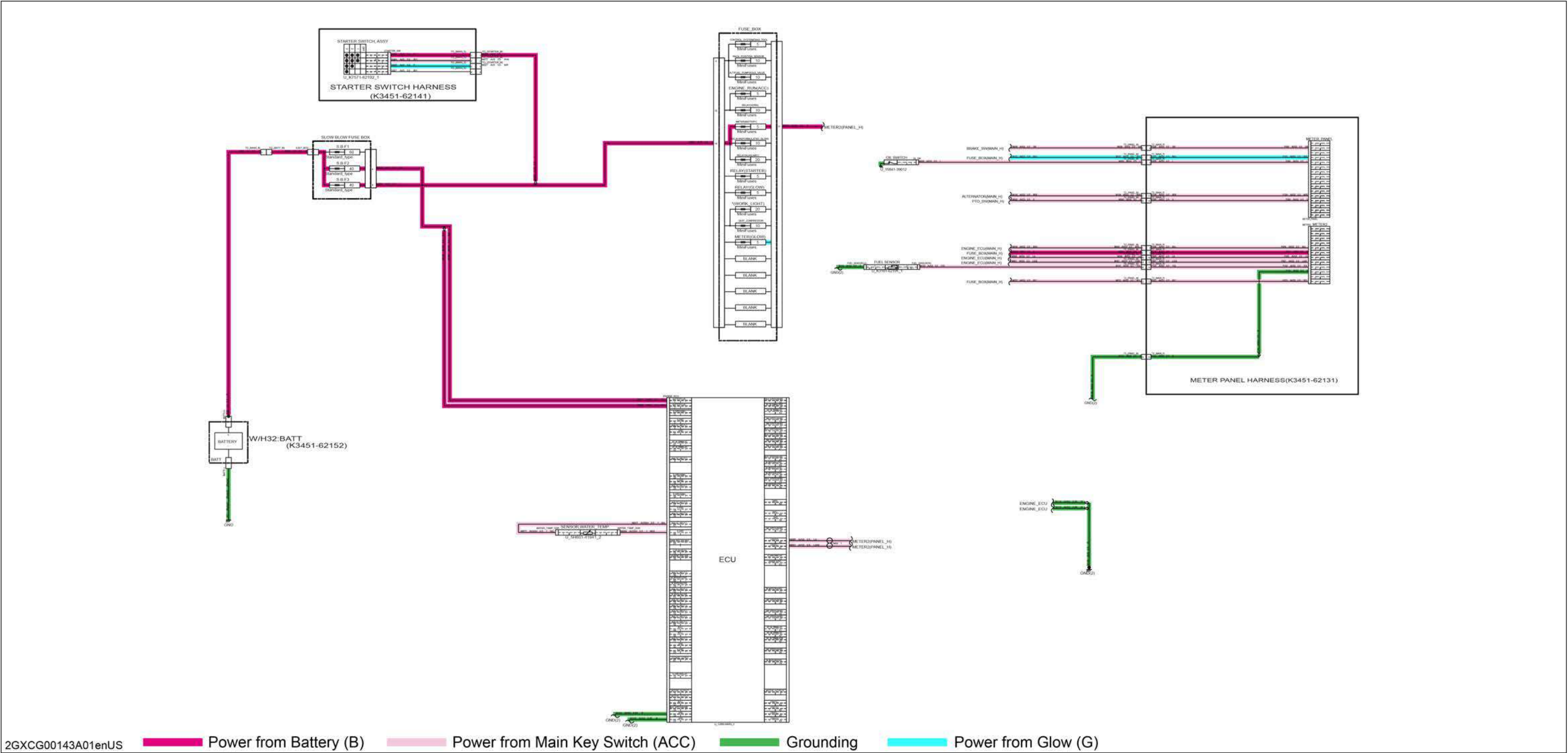
1. Electrical circuit of starting system



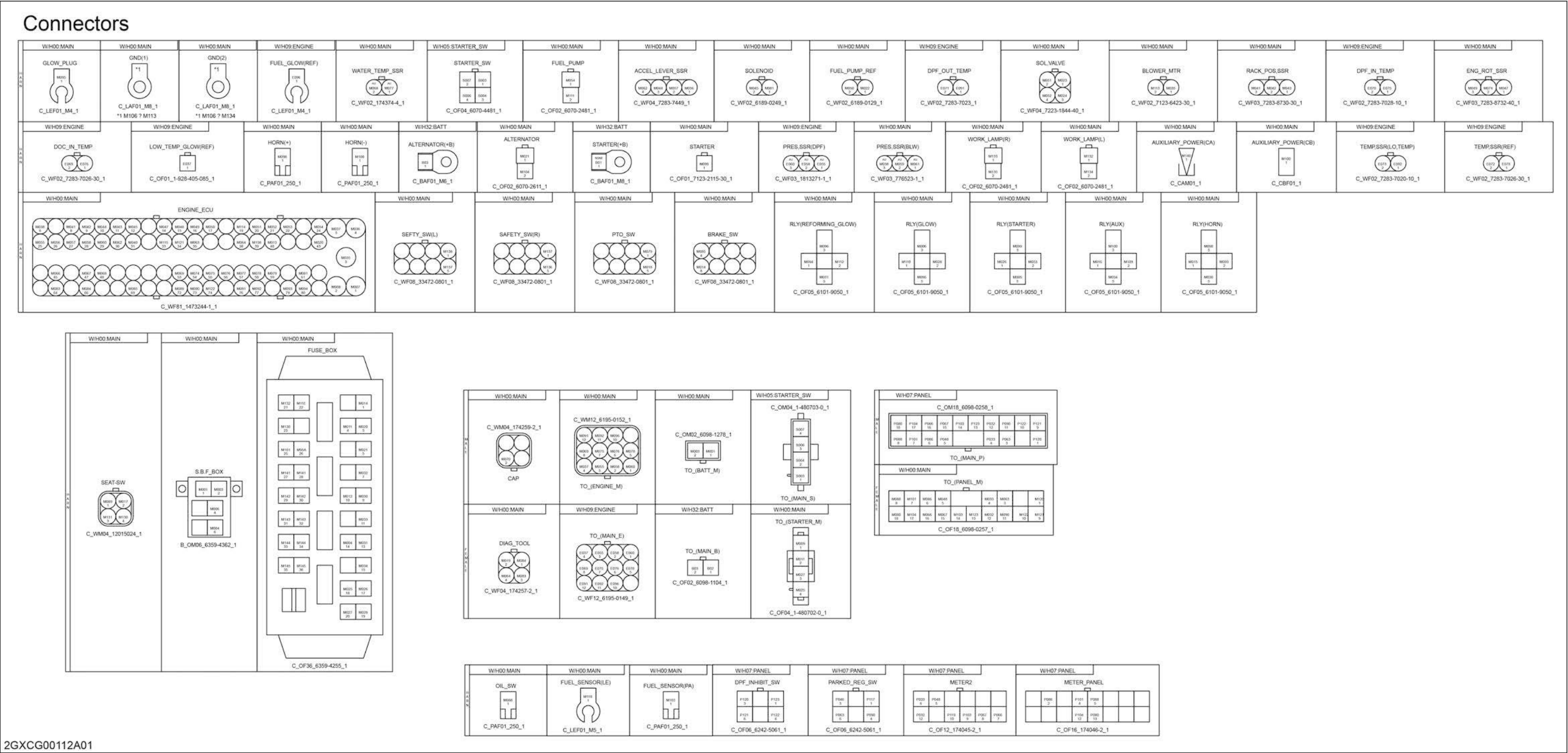
2. Electrical circuit of charging system and Easy Checker™



3. Electrical circuit of gauge system



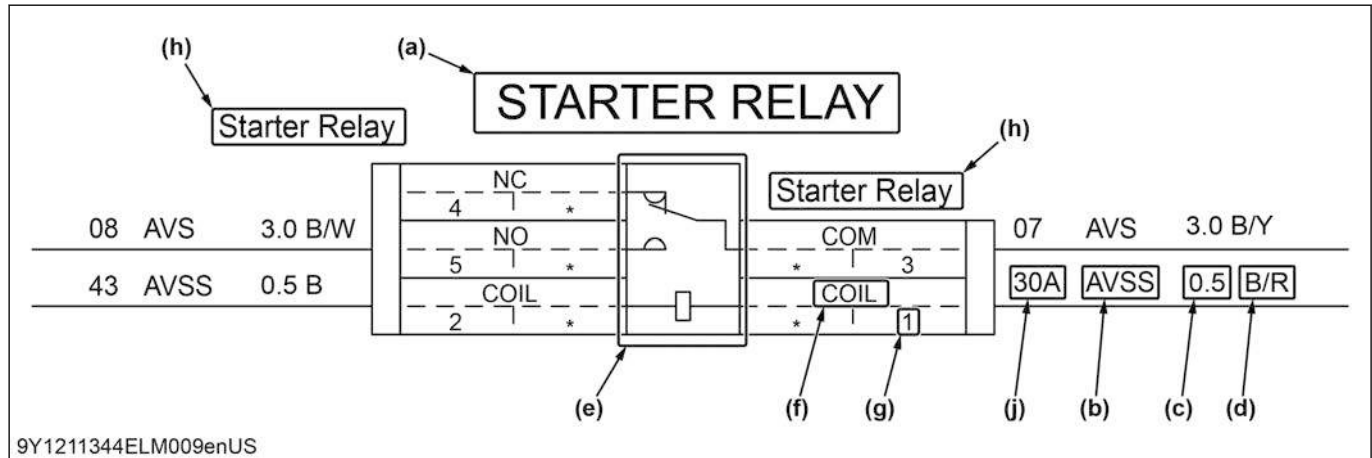
4. Electrical connector chart



5. Reading electrical circuit diagrams

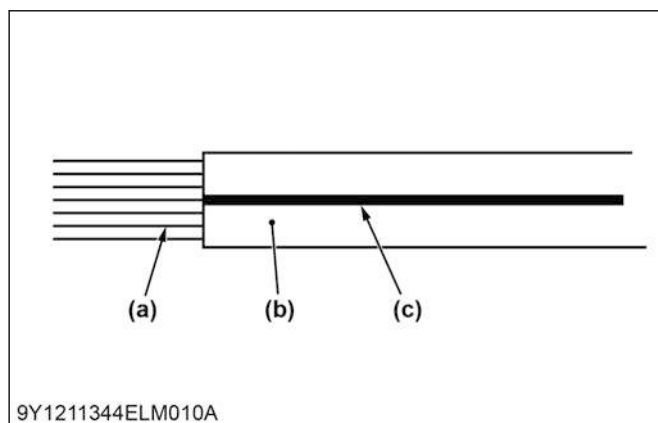
5.1 How to read wiring diagram

Electrical wiring chart symbols for harnesses and wires



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

Color of wiring



(a) Wire size (mm²)

(b) Insulation base color

(c) Stripe color

(Ex.)

1.25-Y/R means :

1.25 : Wire size (mm²)

Y : Base color (yellow)

R : Stripe color (red)

7. ELECTRICAL SYSTEM**5. Reading electrical circuit diagrams**

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

Unit symbol

	(A)	(B)
(1)		
(2)		
(3)		
(4)		
(5)		
(6)		
(7)		
(8)		
(9)		
(10)		
(11)		
(12)		
(13)		

	(A)	(B)
(14)		
(15)		
(16)		
(17)		
(18)		
(19)		
(20)		
(21)		
(22)		
(23)		
(24)		
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	(A)	(B)																
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(31)	<table><tr><td></td><td>(32)</td><td>(33)</td><td>(34)</td></tr><tr><td>1</td><td></td><td></td><td></td></tr><tr><td>2</td><td></td><td></td><td></td></tr><tr><td>3</td><td></td><td></td><td></td></tr></table>			(32)	(33)	(34)	1				2				3			
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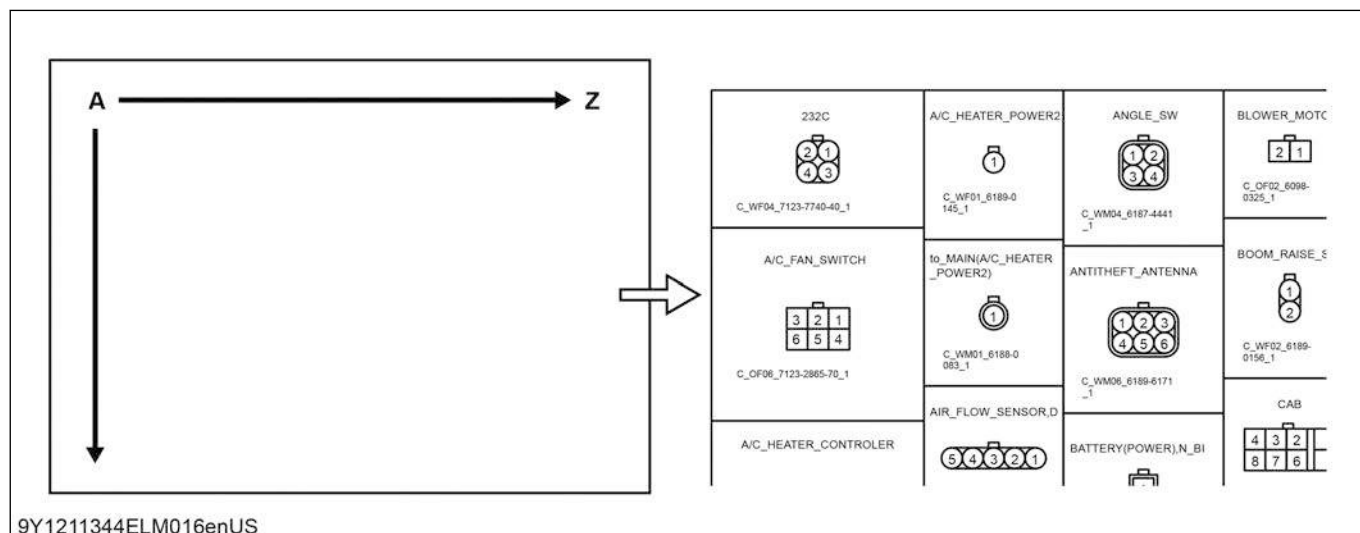
9Y1211344ELM012A

9Y1211344ELM012A

- | | | | |
|---|---------------------------------|-------------------------------|-------------------------|
| (1) Variable | (11) Heating element | (22) Auto resetting b-Contact | (33) ON |
| (2) Non-linear variable | (12) Condenser | (23) Auto-resetting a-Contact | (34) START (auto reset) |
| (3) Fixed setting | (13) Electrolytic capacitor | (24) Relay coil | (A) New symbol |
| (4) Step variable | (14) Magnetic core inductance | (25) Fuse | (B) Old symbol |
| (5) Non ionizing radiation (NIR) | (15) PNP transistor | (26) Lamp | |
| (6) Body GND | (16) NPN transistor | (27) Buzzer | |
| (7) Thermistor | (17) Semiconductor diode | (28) Horn | |
| (8) Resistor | (18) Light-emitting diode (LED) | (29) Speaker | |
| (9) Variable resistor | (19) Two-way breakdown diode | (30) AC voltage source | |
| (10) Potentiometer with sliding contact | (20) Coil | (31) Switch | |
| | (21) a-Contact | (32) OFF (no auto reset) | |

5.2 Layout of connector diagrams

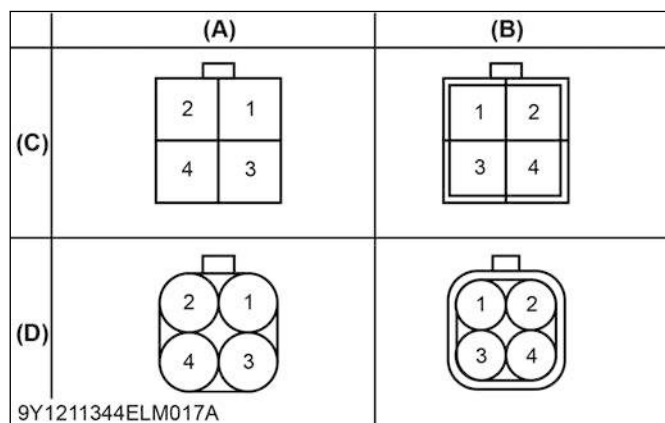
Connector arrangement sequence



Depiction of connectors

NOTE

- In principle, the connector locking part is shown on the top side.
- Female connector terminal numbers start from 1 in the top right corner, looking at the connecting face.
- Male connector terminal numbers start from 1 in the top left corner.



(A) Female connector terminal

(B) Male connector terminal

(C) Not waterproof

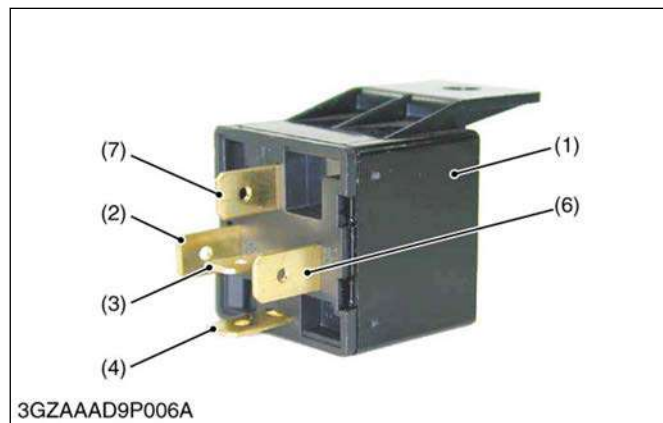
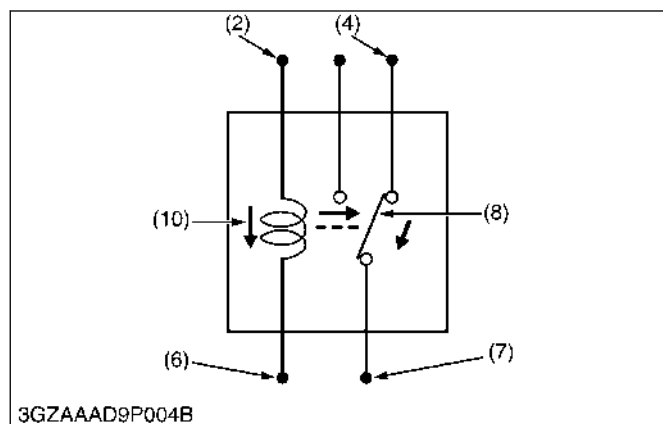
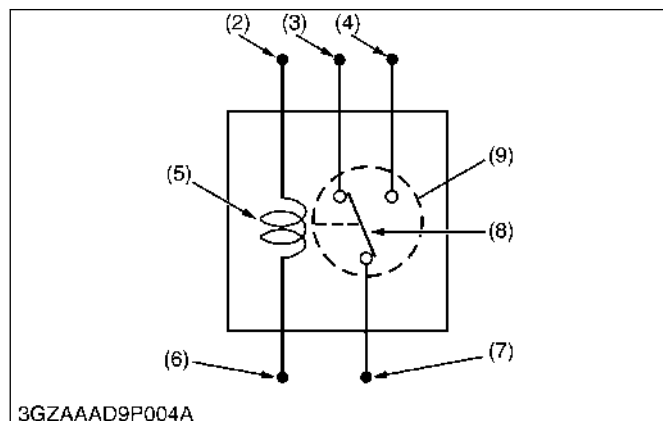
(D) Waterproof

5.3 Precautions on handling electrical connectors

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

6. Starting system

6.1 Function of relay



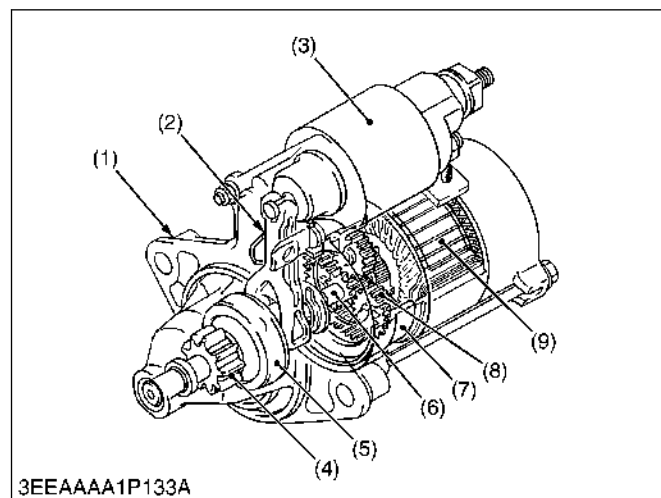
- | | |
|-------------------|-------------------------------|
| (1) Relay | (6) Terminal 1 |
| (2) Terminal 2 | (7) Terminal 3 |
| (3) Terminal 4 | (8) Contact lever |
| (4) Terminal 5 | (9) Mechanical contact points |
| (5) Relay winding | (10) Winding (Energized) |

A relay (1) is an electrically operated switch. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal.

Current flowing from switch to relay winding (5) cause **ON (Close)** or **OFF (Open)** of mechanical contact points (9).

When current is applied to the winding (energized) (10), a magnetic field pushes the contact lever (8) and normally open terminal is connected.

6.2 Function of starter



- | | |
|------------------------|--------------------|
| (1) Front bracket | (6) Gear shaft |
| (2) Drive lever | (7) Internal gear |
| (3) Magnetic switch | (8) Pinion gear |
| (4) Pinion gear | (9) Armature shaft |
| (5) Overrunning clutch | |

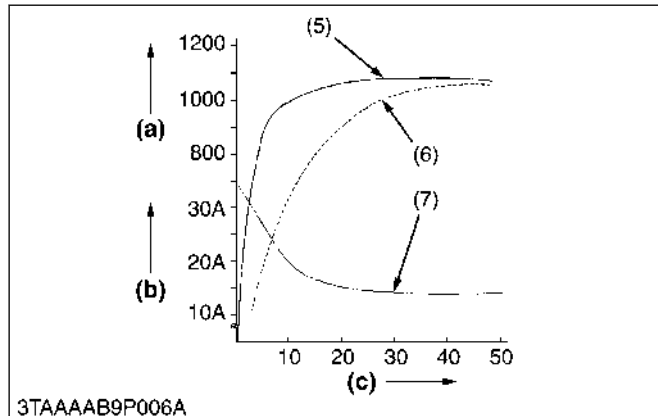
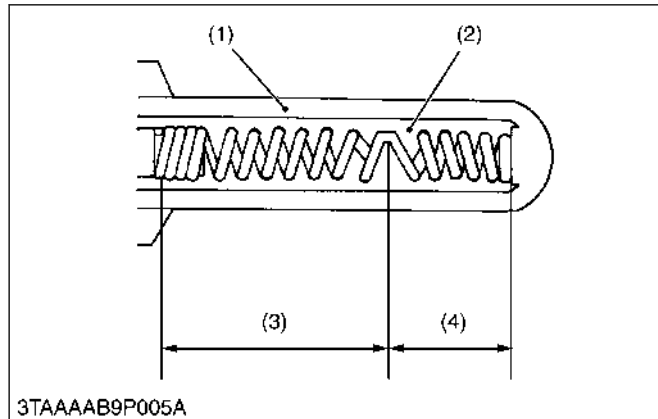
The reduction system is used planetary gears, and the speed of gear shaft (6) is reduced to approximately one-fifth of the armature shaft (9).

The pinion gear (4) is pushed against the ring gear with the overrunning clutch (5) by the drive lever (2).

— RELATED PAGE —

[5.2.7.1 Disassembling starter \(Electromagnetic drive type\) on page 3-57](#)

6.3 Function of glow plug



- | | |
|---|---|
| (1) Sheath tube | (6) Conventional quick-heating type glow plug |
| (2) Insulation powder | (7) Glow plug current |
| (3) Heater also functioning as a resistor | (a) Glow plug temperature (°C) |
| (4) Heater | (b) Current (A) |
| (5) Super glow plug | (c) Time (Sec.) |

This plug is a two-material type QGS (Quick Glow System) for quick temperature rise, and has self-controlling function as well as excellent durability.

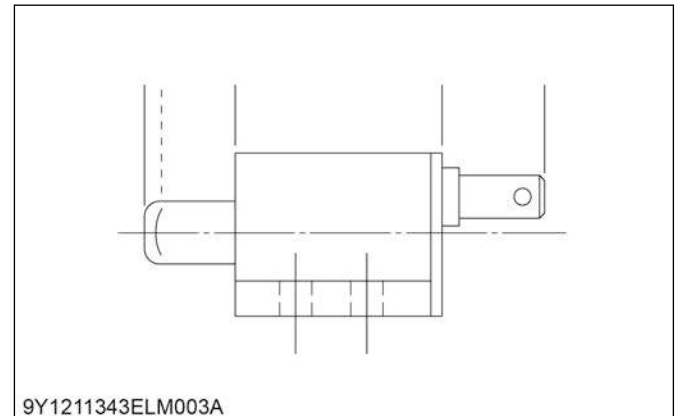
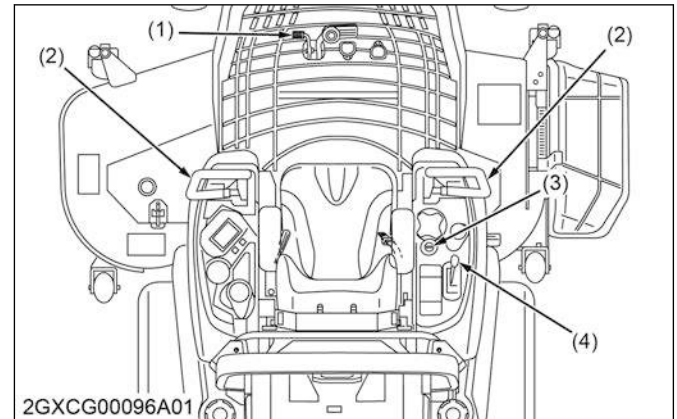
The heater (4) connected in series to the heater (3), which also functions as the resistor, is incorporated in the sheath tube (1) of the super glow plug.

The resistance of this heater (3) cum resistor is small when the temperature is low, while the resistance becomes large when the temperature rises.

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

The ignition point is in the area of 2 to 3 mm (0.079 to 0.118 in.) from the tip of the plug in order to reduce its projection into the combustion chamber.

6.4 Function of safety switch



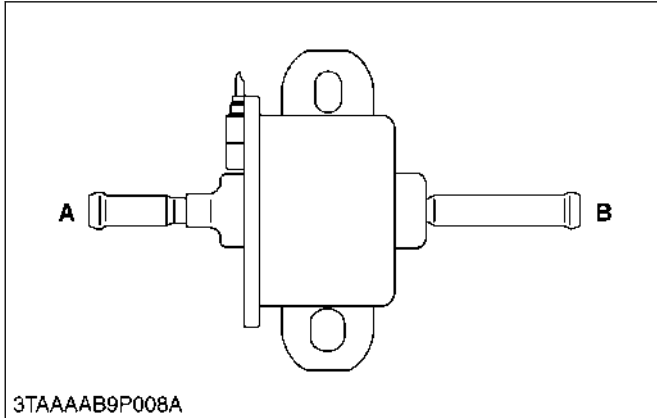
- | | |
|---------------------------------|----------------------|
| (1) Parking brake switch | (3) Seat switch |
| (2) Motion control lever switch | (4) PTO lever switch |

The safety switch prevents current from flowing to the starter when the safety switches are not engaged. This is to ensure safe starting. 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.

Switches are located at the motion control levers, at the parking brake pedal, at the PTO lever and under the operator's seat.

Safety switch	Type
Seat switch	Normally open
PTO lever switch	Normally open
Parking brake switch	Normally close
Motion control lever (L.H.) switch	Normally open
Motion control lever (R.H.) switch	Normally open

6.5 Function of fuel pump

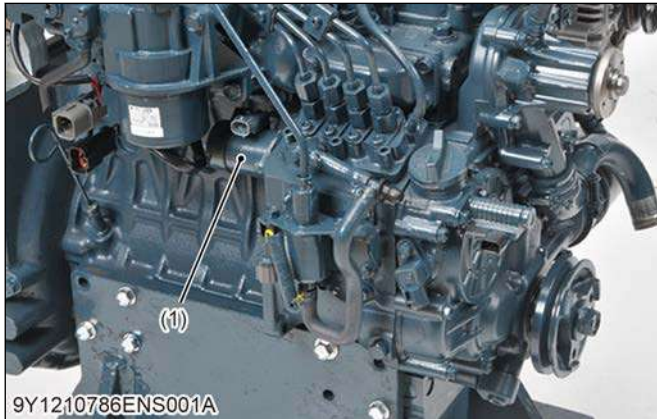


A: Inlet

B: Outlet

An electromagnetic 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.

6.6 Function of engine stop solenoid

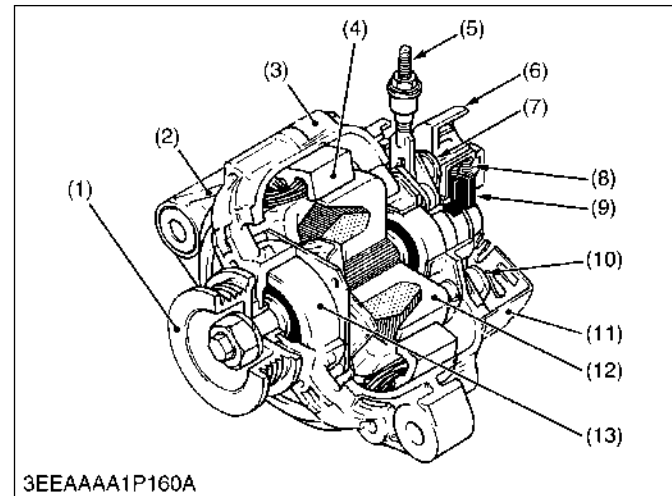


(1) Solenoid

Controller is provided to actuate the engine stop solenoid approx. 10 seconds to stop after the main switch is turned from **ON** position to **OFF** position. Flowing of the battery current into the coil while the controller's timer works attracts the plunger to actuate the stop lever or control rack of the injection pump. When the battery current stops, the plunger is returned to the original position by the spring.

7. Charging system

7.1 Function of alternator



- | | |
|---------------------|---------------------|
| (1) Pulley | (8) Spring |
| (2) Drive end frame | (9) Brush |
| (3) Rear end frame | (10) Rectifier |
| (4) Stator | (11) Rear end cover |
| (5) Terminal | (12) Rotor |
| (6) Connector | (13) Bearing |
| (7) IC regulator | |

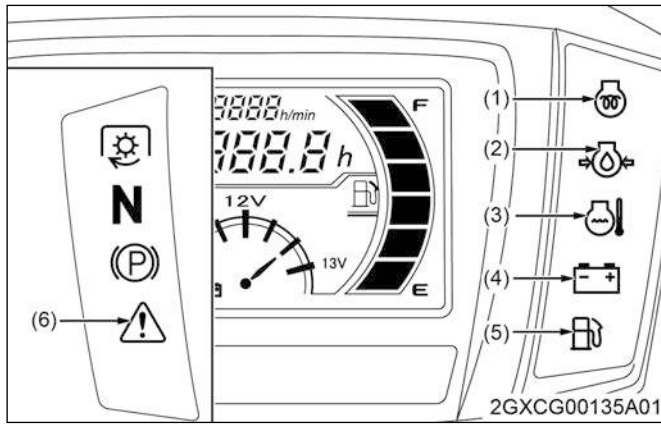
A compact alternator with an IC regulator is used, having the following characteristics :

- Cooling performance and safety have been improved by combining the cooling fan with the rotor and incorporating the fan / rotor unit inside the alternator.
- IC regulator is fitted inside the alternator.
- The rectifier, IC regulator and similar components are easy to remove, making it easier to service the alternator.

7.2 Function of Easy Checker™

■ IMPORTANT

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



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

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

(2) Engine oil pressure

If the oil pressure in the engine goes below the prescribed level, the warning lamp in the Easy Checker™ will come on. If this should happen during operation, and it does not go off when the engine is accelerated to more than 1000 rpm, check level of engine oil.

(3) Engine overheat

If the water temperature gauge reads an unusual level and the warning lamp in the Easy Checker™ comes on, the engine may be overheated.

(4) Electrical charge

If the alternator is not charging the battery, the warning lamp in the Easy Checker™ will come on. If this should happen during operation, check the electrical charging system.

(5) Fuel level

■ IMPORTANT

- When the fuel warning lamp lights up, refuel the tank as soon as possible. If the machine runs out of fuel and stalls, the engine and its components may be damaged.
- Fill the fuel tank only to bottom of the filler neck.
- Be careful not to empty the fuel tank. Otherwise air may enter the fuel system. Should this happen, you must bleed the system.
- When refueling, basically fill both fuel tanks full.
- In the case you have a small amount of fuel, if fuel is still in the fuel tank R.H., fill the fuel tank L.H. first.
- The fuel gauge shows the fuel level of fuel tank R.H. When the fuel gauge flashes, fill fuel as soon as possible.
- When the fuel gauge flashes, do not fill fuel on a slope.

- If the engine stalled with some remaining in the fuel tank R.H., close the fuel valve of fuel tank L.H. and you can operate.

If the fuel in the tank goes below the prescribed level, the warning lamp in the Easy Checker™ will come on. If this should happen during operation, refuel as soon as possible.

(6) Master system warning

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

— RELATED PAGE —

[17.5 Bleeding fuel system on page 2-51](#)

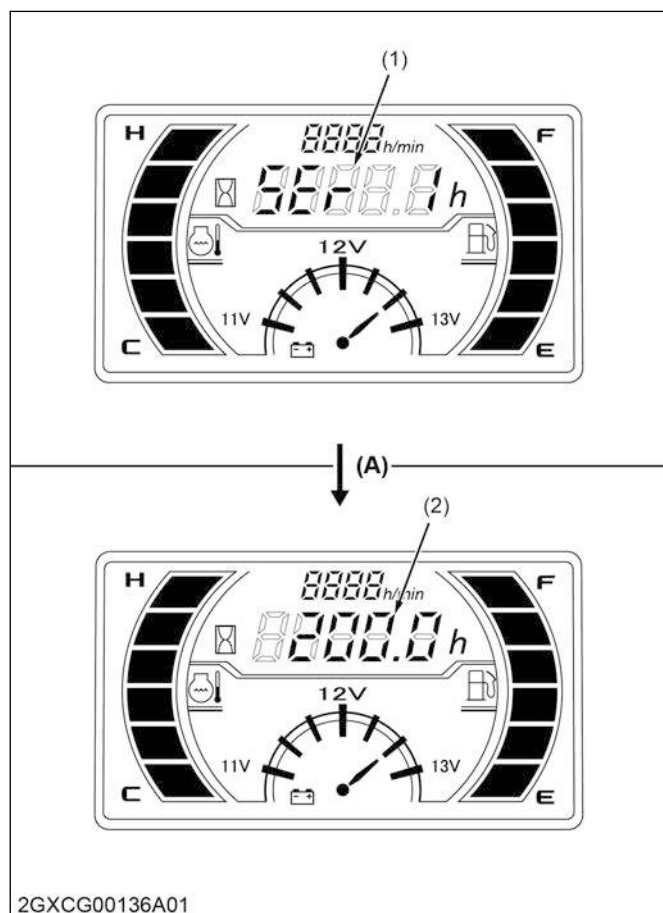
[1.2 Checking engine oil level on page 2-19](#)

[1. Troubleshooting for engine on page 3-19](#)

[1.3 Checking amount of fuel and refueling on page 2-19](#)

7.3 Service code display

The key switch is on, and if the service code ("SEr 1" or "SEr 2") shown in the figure below is displayed on the LCD monitor, you must do the servicing jobs corresponding to the indication on hour meter (displayed at 10 seconds after that) on the machine. The service code will show at meter hour: 50 hr, 200 hr, 400 hr, 600 hr, 800 hr, 1000 hr....

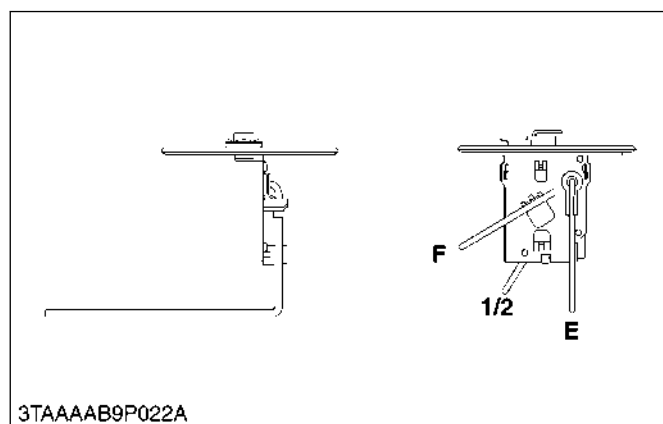


- (1) Service code
(2) Hours used
(A) At 10 seconds after the service code has displayed.

— RELATED PAGE —
[MAINTENANCE CHECK LIST on page 2-17](#)

8. Gauge system

8.1 Function of fuel level sensor

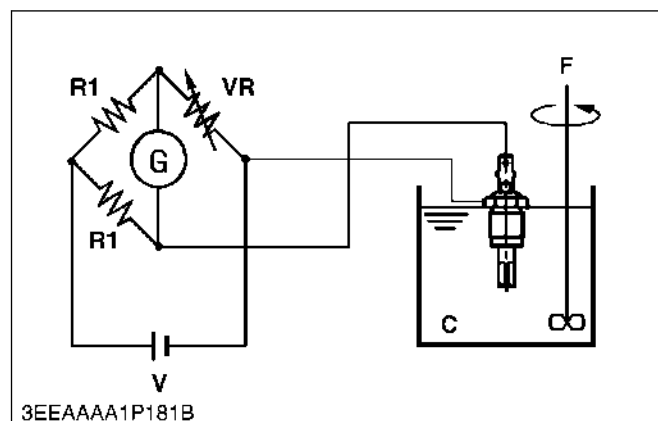
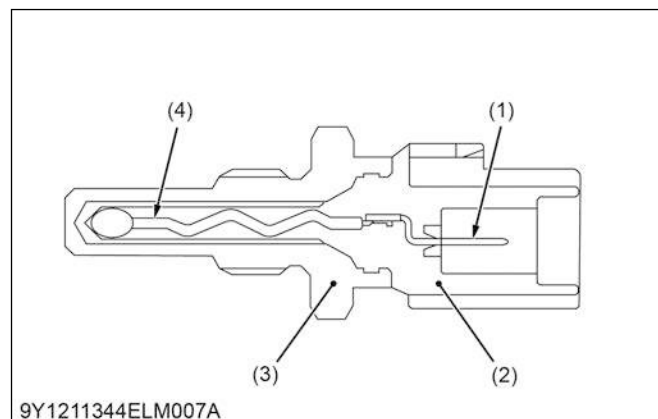


The remaining fuel quantity is detected by the fuel level sensor installed in the fuel tank and indicated on the fuel gauge. For detection, a float and a resistor are used.

As the float lowers, the resistance of the variable resistor varies. The relation between the amount of fuel and the resistance is as follows.

F	1/2	E (Remaining fuel of approx. 5.0 L, 1.32 U.S.gals, 1.10 Imp.gals)
1 to 5 Ω	28.5 to 36.5 Ω	103 to 117 Ω

8.2 Function of coolant temperature sensor



- (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)

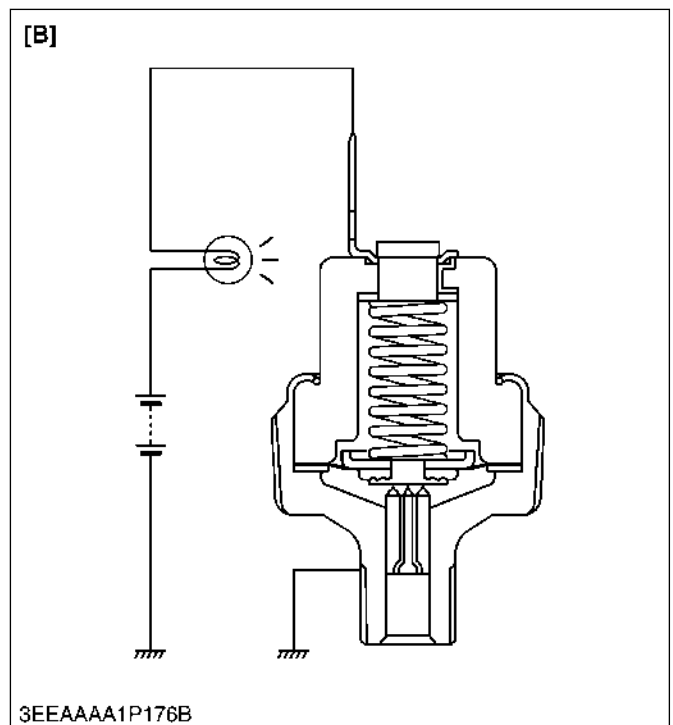
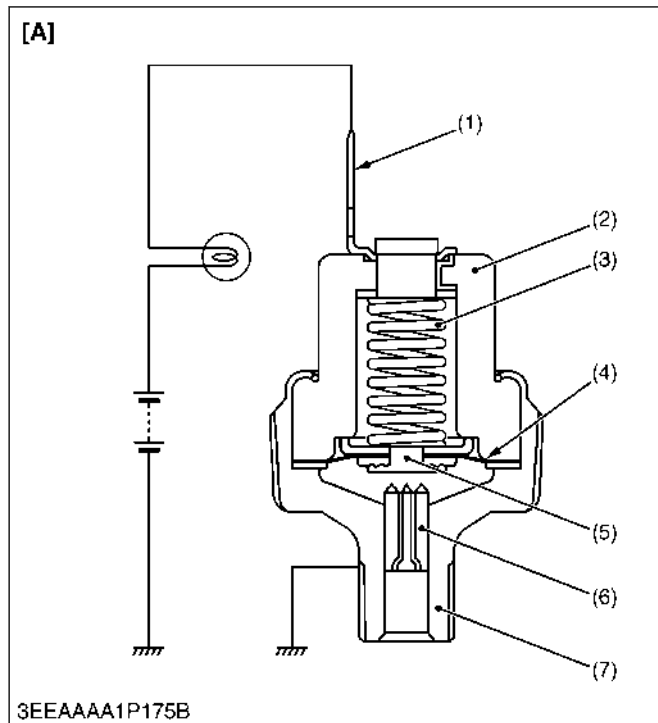
The coolant temperature sensor is installed to the cylinder head of engine, and its tip is in touch with the coolant. It contains a thermistor (4) whose electrical resistance decreases as the temperature increases. Current varies with changes in the coolant temperature. When the coolant temperature is increased, the electrical resistance will become small, and when the coolant temperature is decreased, it will become large.

Characteristics of Thermistor		
Temperature	Resistance of VR: *1	Condition
40 °C (104 °F)	1.14 kΩ	(A)
80 °C (176 °F)	0.32 kΩ	
100 °C (212 °F)	0.19 kΩ	
120 °C (248 °F)	0.12 kΩ	

*1 When galvanometer shows 0 (Zero).

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

8.3 Function of oil pressure switch



- | | |
|-------------------|----------------------------|
| (1) Terminal | (6) Contact |
| (2) Insulator | (7) Oil switch body |
| (3) Spring | [A] At proper oil pressure |
| (4) Diaphragm | [B] At lower oil pressure |
| (5) Contact rivet | |

The oil pressure switch is mounted on the cylinder block and is led to the lubricating oil passage. When the oil pressure falls below the specified value, the oil pressure-warning lamp lights.

[A] At the proper oil pressure

When the engine is started and as the proper oil pressure builds, the diaphragm (4) is pushed up. This separates the contact rivet (5) and breaks the circuit, causing the lamp to go out.

[B] At lower oil pressure, 49 kPa (0.50 kgf/cm², 7.1 psi) or less

If the oil pressure drops, the resulting deflection of the diaphragm (4) will close the contact rivet (5) and again complete the circuit. The lighted lamp warns that the pressure of the lubricating system has dropped below the pressure setting.

SERVICING

1. Troubleshooting for electrical system

Symptom	Probable cause and checking procedure	Solution	Reference page
All Electrical Equipments Do Not Operate Blade Speed Is Slow	1. Battery discharged or damaged	Recharge or replace	2-33
	2. Battery positive cable disconnected or improperly connected	Reattach	—
	3. Slow blow fuse blown	Replace	2-48
Fuse Blown Frequently	1. Short-circuited	Repair or replace	2-48

Battery

Symptom	Probable cause and checking procedure	Solution	Reference page
Battery Discharges Too Quickly	1. Battery damaged	Check and replace	3-37
	2. Alternator damaged	Check and replace	7-30
	3. Wiring harness disconnected or improperly connected (between battery positive terminal and regulator B terminal)	Repair or replace	3-37
	4. Cooling fan belt slipping	Adjust tension	2-30

Starting System

Symptom	Probable cause and checking procedure	Solution	Reference page
Starter Motor Does Not Operate	1. Battery discharged or damaged	Recharge or replace	2-33
	2. Slow blow fuse blown	Replace	2-48
	3. Safety switch damaged	Check and replace	7-26
	4. Wiring harness disconnected or improperly connected (between main switch 50 terminal and safety switches, between safety switches and starter motor, between battery positive terminal and starter motor)	Repair or replace	—
	5. Starter motor damaged	Check and repair or replace	7-24
	6. Main switch damaged	Check and replace	7-23

(Continued)

7. ELECTRICAL SYSTEM

Symptom	Probable cause and checking procedure	Solution	Reference page
Engine Does Not Stop When Main Switch Is Turned OFF	1. Fuse blown (20 A)	Replace	2-48
	2. Wiring harness disconnected or improperly connected (between main switch AC terminal and engine stop solenoid)	Repair or replace	See Electrical Diagram
	3. Engine stop solenoid damaged	Check and replace	7-30
Engine Does Not Start	1. Engine stop solenoid damaged	Check and replace	7-30

Charging System

Symptom	Probable cause and checking procedure	Solution	Reference page
Charging Lamp Does Not Light When Main Switch Is Turned ON	1. Fuse blown (15 A)	Replace	2-48
	2. Wiring harness disconnected or improperly connected (between main switch AC terminal and panel board, between panel board and dynamo)	Repair or replace	See Electrical Diagram
	3. Alternator damaged	Check and repair or replace	7-30
Charging Lamp Does Not Go Off When Engine Is Running	1. Wiring harness disconnected or improperly connected (between main switch AC terminal and panel board, between panel board and dynamo)	Repair or replace	See Electrical Diagram
	2. Alternator damaged	Check and repair or replace	7-30

Gauges

Symptom	Probable cause and checking procedure	Solution	Reference page
Fuel Gauge Does Not Function	1. Fuel gauge damaged	Replace panel	—
	2. Fuel level sensor damaged	Check and replace	7-34
	3. Wiring harness disconnected or improperly connected (between fuel gauge and fuel level sensor)	Repair or replace panel	See Electrical Diagram
Coolant Temperature Gauge Does Not Function	1. Coolant temperature gauge damaged	Replace panel	—
	2. Coolant temperature sensor damaged	Check and replace	7-35

(Continued)

Symptom	Probable cause and checking procedure	Solution	Reference page
Coolant Temperature Gauge Does Not Function	3. Wiring harness disconnected or improperly connected (between coolant temperature gauge and coolant temperature sensor)	Repair or replace panel	See Electrical Diagram

2. Servicing specifications for electrical system

Item		Factory specifications	Allowable limit
Battery)	Voltage	More than 12 V	—
	Potential Difference	Less than 0.1 V	—
Glow Plug	Resistance	Approx. 0.9 Ω	—
• Burner	Resistance	Approx. 0.8 Ω	—
• Heater	Resistance	Approx. 3.0 Ω	—
Alternator	Resistance	Less than 1.0 Ω	—
• Stator	Resistance	2.9 Ω	—
• Rotor	O.D	14.4 mm 0.567 in.	14.0 mm 0.551 in.
• Slip ring	Length	10.0 mm 0.394 in.	8.4 mm 0.33 in.
• Brush	O.D	30.0 mm 1.18 in.	29.0 mm 1.14 in.
Starter (Gear Reduction Type)	O.D	Less than 0.02 mm 0.0008 in.	0.05 mm 0.002 in.
• Commutator	Undercut	0.50 to 0.80 mm 0.020 to 0.031 in.	0.20 mm 0.0079 in.
• Difference	Length	16.0 mm 0.630 in.	10.5 mm 0.413 in.
• Mica	O.D	28.0 mm 1.10 in.	27.0 mm 1.06 in.
• Brush	O.D	Less than 0.05 mm 0.002 in.	0.5 mm 0.02 in.
Starter (Electromagnetic Drive Type)	Undercut	0.50 to 0.80 mm 0.020 to 0.031 in.	0.20 mm 0.0079 in.
• Commutator	Length	16.0 mm 0.630 in.	10.5 mm 0.413 in.
• Difference	Resistance	2.52 to 3.08 Ω at 20°C (68 °F)	—
• Mica	Resistance	More than 2 M Ω	—
• Brush	Resistance	More than 2 M Ω	—
Solenoid	Resistance	100 k Ω at 20 °C (68 °F)	—
Rack Sensor	Resistance	2.38 to 2.62 Ω at 20 °C (68 °F)	—
• Terminal 1 -Terminal 2	Resistance	—	—
• Terminal 2 -Terminal 3	Resistance	—	—
Temperature Sensor	Resistance	—	—
Doser Fuel Pump	Resistance	—	—

3. Tightening torques for electrical system

■ NOTE

- Tightening torques of screws, bolts and nuts on the table below are especially specified.
- The alphabet "M" in Dimension × Pitch shows that the screw, bolt or nut dimensions are in the metric system. The dimension is the nominal external diameter in mm of the threads. The pitch is the nominal distance in mm between 2 threads.

Item	Dimension x Pitch	N · m	kgf · m	lbf · ft
Starter (B terminal nut)	M8	5.9 to 11.8	0.6 to 1.2	4.3 to 8.7
Alternator's pulley nut	—	58.4 to 78.9	5.95 to 8.05	43.1 to 58.2
Glow plug	M8 x 1.0	7.9 to 14	0.80 to 1.5	5.8 to 10
Temperature sensor	M12 × 1.25	25 to 35	2.6 to 3.5	19 to 25

— RELATED PAGE —

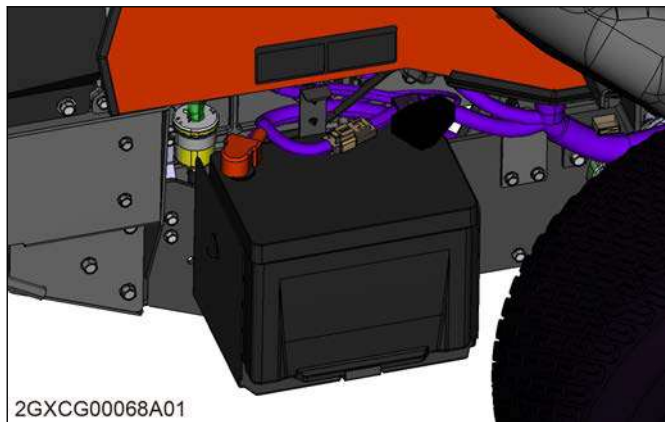
[TIGHTENING TORQUES on page 2-15](#)

[1. General use screws, bolts and nuts on page 2-15](#)

4. Checking and adjusting

4.1 Battery

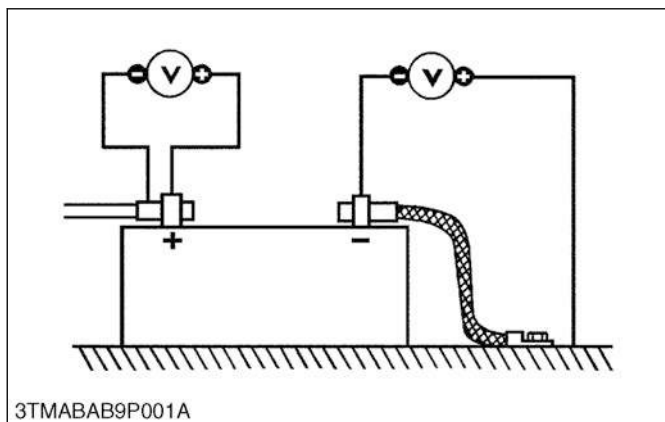
4.1.1 Checking battery voltage



1. Stop the engine and turn the main switch **OFF**.
2. Connect the COM (–) lead of the voltmeter to the battery's negative terminal post and the (+) lead to the positive terminal post, and measure the battery voltage.
3. If the battery voltage is less than the factory specification, check the battery specific gravity and recharge the battery.

Battery voltage	Factory specification	More than 12 V
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4.1.2 Checking battery terminal connection



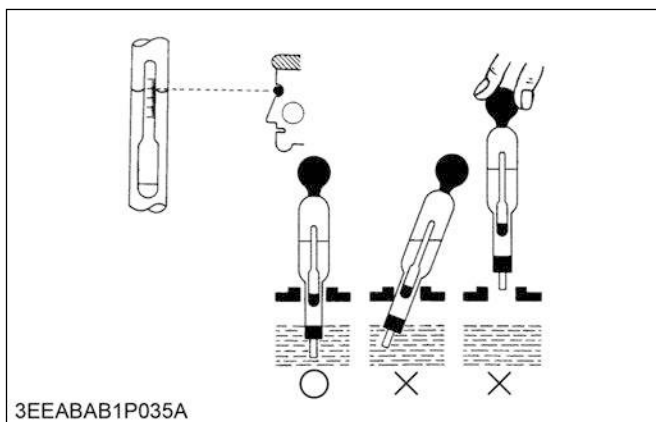
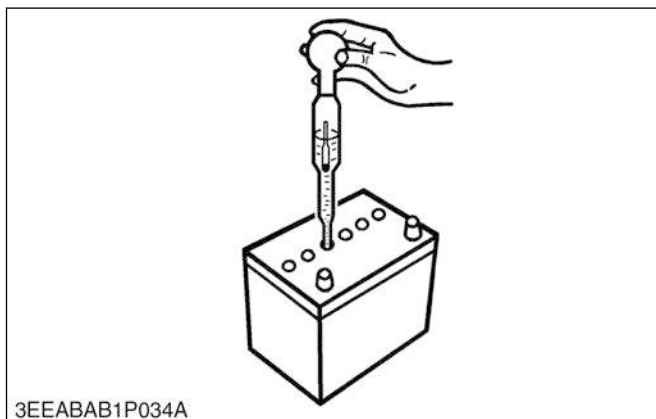
1. Turn the main switch on, and turn on the head light.
2. Measure the voltage with a voltmeter across the battery's positive terminal post and the cable terminal, and the voltage across the battery's negative terminal post and the chassis.
3. If the measurement exceeds the factory specification, clean the battery terminal posts and cable clamps, and tighten them firmly.

Potential difference	Factory specification	Less than 0.1 V
----------------------	-----------------------	-----------------

4.1.3 Checking battery specific gravity

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.



1. Check the specific gravity of the electrolyte in each cell with a hydrometer.

- When the electrolyte temperature differs from that at which the hydrometer was calibrated, correct the specific gravity reading following the formula mentioned in (Reference).

(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)

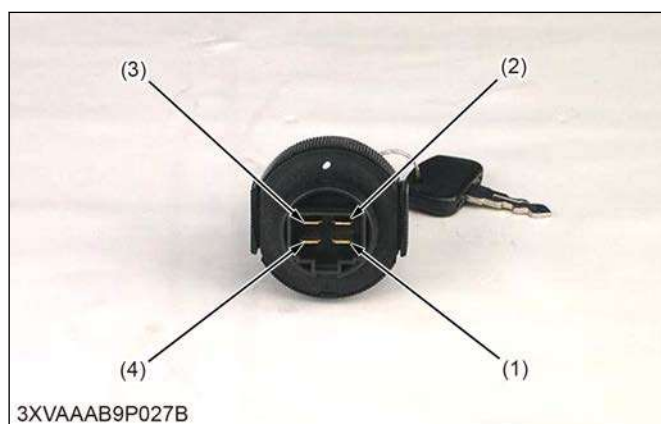
Specific Gravity	State of Charge
1.260 Sp. Gr.	100% Charged
1.230 Sp. Gr.	75% Charged
1.200 Sp. Gr.	50% Charged
1.170 Sp. Gr.	25% Charged
1.140 Sp. Gr.	Very Little Useful Capacity
1.110 Sp. Gr.	Discharged

At an electrolyte temperature of 20 °C (68 °F)

- If the specific gravity is less than 1.215 (after it is corrected for temperature), charge or replace the battery.
- If the specific gravity differs between any two cells by more than 0.05, replace the battery.

4.2 Starting system

4.2.1 Checking main switch continuity



- (1) B terminal (3) G terminal
(2) ACC terminal (4) ST terminal

Main Switch Key at OFF Position

- Set the main switch OFF position.

- Measure the resistance with an ohmmeter across the B terminal and the ACC terminal, B terminal and ST terminal, B terminal and G terminal.
- 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	

Main Switch Key at ON Position

- Set the main switch ON position.
- Measure the resistance with an ohmmeter across the B terminal and the ACC terminal.
- If 0 ohm is not indicated, the B – ACC contact of the main switch are faulty.

Resistance	B terminal – ACC terminal	0 Ω
------------	---------------------------	-----

Main Switch Key at PREHEAT Position

- Set and hold the main switch key at the PREHEAT position.
- 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.
- 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	

Main Switch Key at START Position

- Set and hold the main switch key at the START position.
- 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.
- 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	

4.2.2 Testing starter motor

**CAUTION**

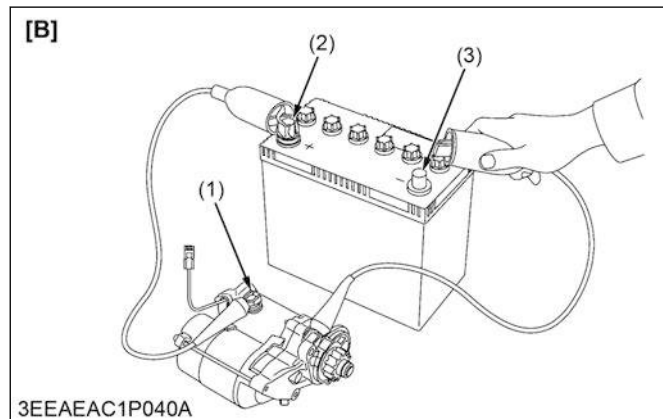
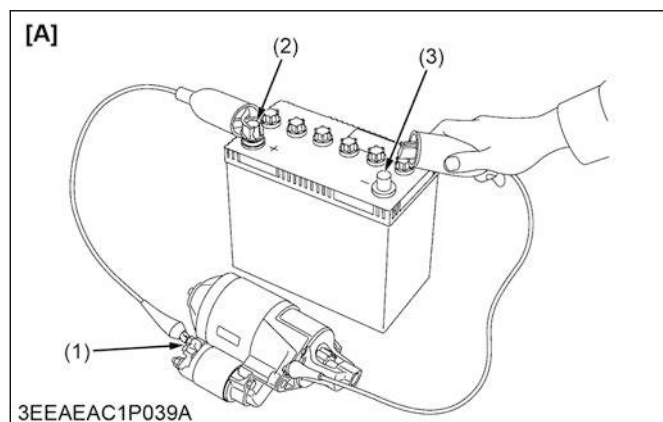
- Secure the starter to prevent it from jumping up and down while testing the motor.

NOTE**B terminal:**

It is the terminal which connects the cable from the battery to the starter.

C terminal:

It is the terminal which connects the cable from the motor to the magnet switch.



- | | |
|-----------------------|-----------------------------------|
| (1) C terminal | [A] Electromagnetic drive type |
| (2) Positive terminal | [B] Planetary gear reduction type |
| (3) Negative terminal | |

1. Disconnect the battery negative cable from the battery.
2. Disconnect the battery positive cable from the battery.
3. Disconnect the leads from the starter B terminal.
4. Remove the starter from the engine.
5. Connect a jumper lead from the starter C terminal (1) to the battery positive terminal (2).
6. Connect a jumper lead momentarily between the starter's body and the battery negative terminal (3).

7. If the motor does not run, starter is failure. Repair or replace the starter.

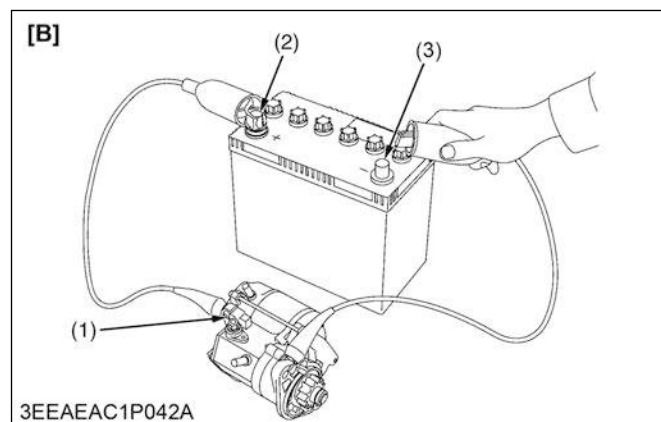
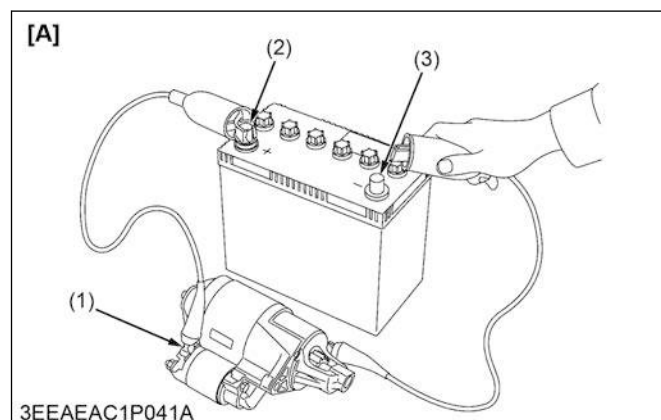
4.2.3 Testing magnetic switch

NOTE**B terminal:**

It is the terminal which connects the cable from the battery to the starter.

S terminal:

It is the terminal which connects the cable from the starter switch to the magnet switch.

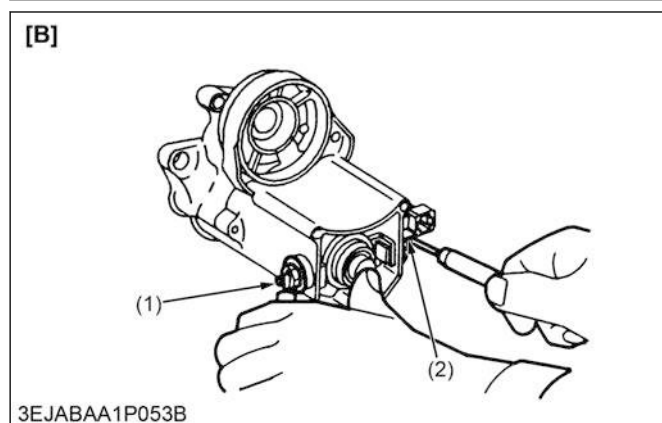
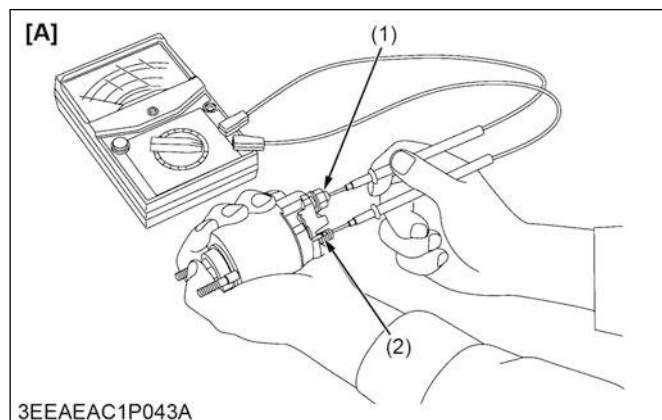


- | | |
|-----------------------|-----------------------------------|
| (1) S terminal | [A] Electromagnetic drive type |
| (2) Positive terminal | [B] Planetary gear reduction type |
| (3) Negative terminal | |

1. Disconnect the battery negative cable from the battery.
2. Disconnect the battery positive cable from the battery.
3. Disconnect the leads from the starter B terminal.
4. Remove the starter from the engine.
5. Connect a jumper lead from the starter S terminal (1) to the battery positive terminal (2).
6. Connect a jumper lead momentarily between the starter's body and the battery negative terminal (3).
7. If the pinion gear does not pop out, the magnetic switch is failure. Repair or replace the starter.

4.2.4 Checking magnet switch continuity

1. Check the continuity across the C terminal (1) and the B terminal (2) with a circuit tester, pushing in the plunger.

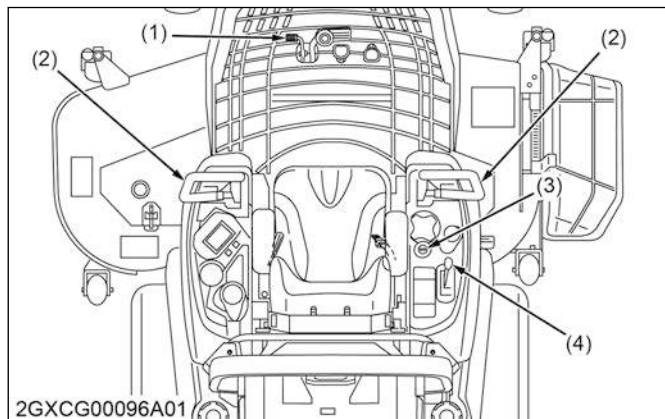


- (1) C terminal
(2) B terminal
[A] Electromagnetic drive type
[B] Gear reduction type

2. If not continuous or if a certain value is indicated, replace the magnet switch.

4.3 OPC (Operator Presence Control) system

4.3.1 Checking OPC system



(1) Parking brake lock pedal

(2) Motion control lever

(3) Key switch

(4) PTO lever

1. A damaged location can be judged by checking the function of each safety switch one by one as shown in the table below.

Combination	State of set such as operation levers					Control operation	
	Motion control lever (L.H.)	Motion control lever (R.H.)	PTO lever	Parking brake pedal	Operator seat	Automatic engine stop	Engine start (Right or wrong)
1	Parking position (Neutral)	Parking position (Neutral)	Off position		On the seat	Keep running**	Possible
2				Lock position	Leave the seat*		Impossible
3				Release position*	On the seat		
4		On position*	Lock position				
5		Operating position*			Off position	On the seat	
6	Operating position	Parking position					

** In this part, the voltage of the terminal of the engine stop solenoid is 0 V.

* In this part, the safety switch is a position of off. And it is a checked place.

How to read meaning from table above.

After the engine start, for instance,

- If the engine does not stop in combination 2 when leaving the seat, the seat safety switch is bad. Moreover, the engine cannot be started without as every sitting on the seat.
- If the engine starts with the parking brake released at combination 3, the parking brake safety switch is bad.
- If the engine starts in combination 4 when the PTO lever is **ON** position, the PTO lever switch is bad.
- If the engine starts in combinations 5 and 6 when the motion control lever is a Operating position, the motion control lever safety switch is bad. Moreover, the engine stops if the parking pedal is not released within two seconds after the engine starts.

(Reference)

- Type of OPC Switch

Parking Brake Lever:

Normal Close

Motion Control Lever:

Normal Open

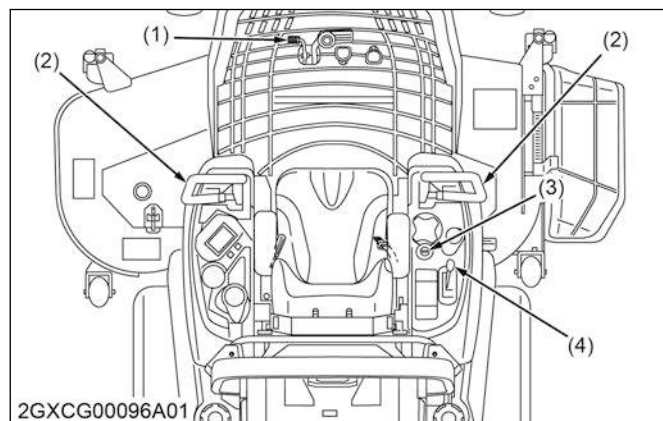
PTO Lever:

Normal Open

Operator Seat:

Normal Open

4.3.2 Checking OPC continuity



- (1) Parking brake lock pedal (3) PTO lever
(2) Motion control lever (4) Operator seat

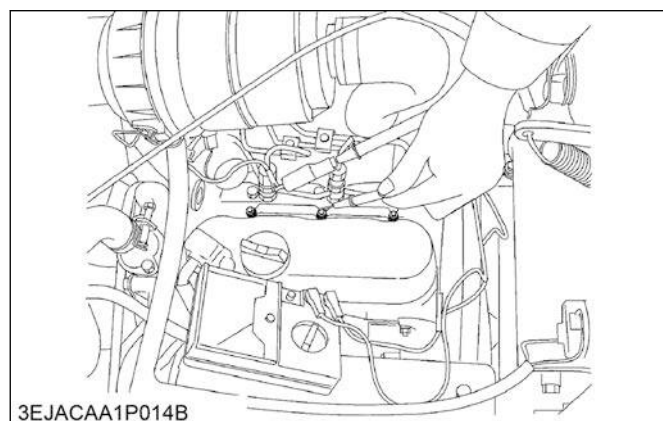
Resistance (Across switch terminal) • Motion control lever • PTO lever • Operator seat	When switch push is pushed	0 Ω
	When switch push is released	Infinity

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

1. Remove the safety switch leads.
2. Connect the circuit tester to the safety switch leads.
3. Measure the resistance between leads.
4. If the safety switch is damaged, replace it.

4.4 Glow plug

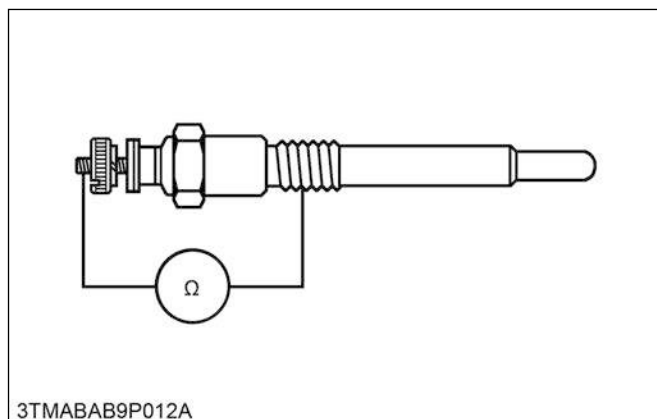
4.4.1 Checking lead terminal voltage



1. Turn the key switch to the **GLOW (or PREHEAT)** position, and measure the voltage with a circuit tester between the lead terminal and the engine body.
2. If the voltage differs from the battery voltage, the wiring harness or main switch is faulty.

Voltage (Lead terminal - Chassis)	Main switch key at PRE-HEAT	Approx. battery voltage
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4.4.2 Checking glow plug continuity



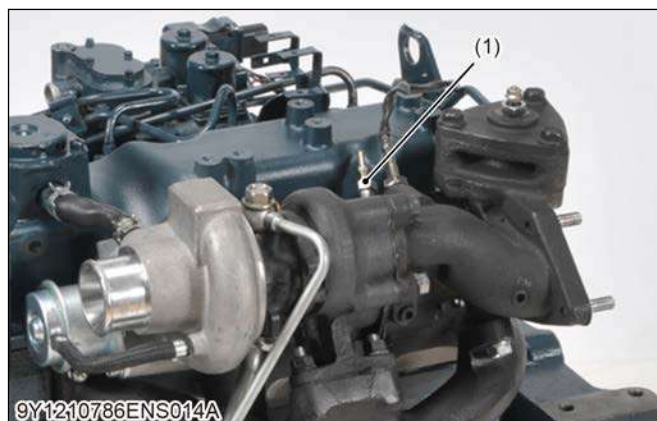
1. Disconnect the lead from the glow plugs.
2. Measure the resistance with an ohmmeter between the glow plug terminal and the chassis.
3. Check each glow plug.
4. If 0 ohm is indicated, the screw at the tip of the glow plug and the housing are short-circuited.
5. If the factory specification is not indicated,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

Glow plug resistance	Factory specification	Approx. 1.1 Ω
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4.4.3 Checking glow plug (burner) continuity

■ IMPORTANT

- Since reformer is emission related critical parts, do not remove the glow plug.



- (1) Glow plug (Burner)

1. Remove the wiring harness.

- Measure the resistance with a circuit tester between the glow plug terminal and the engine body.
- If the factory specification is not indicated, glow plug is faulty.

Resistance	Factory specification	Approx. 0.8 Ω
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4.4.4 Checking glow plug (heater) continuity

■ IMPORTANT

- Since reformer is emission related critical parts, do not remove the glow plug.



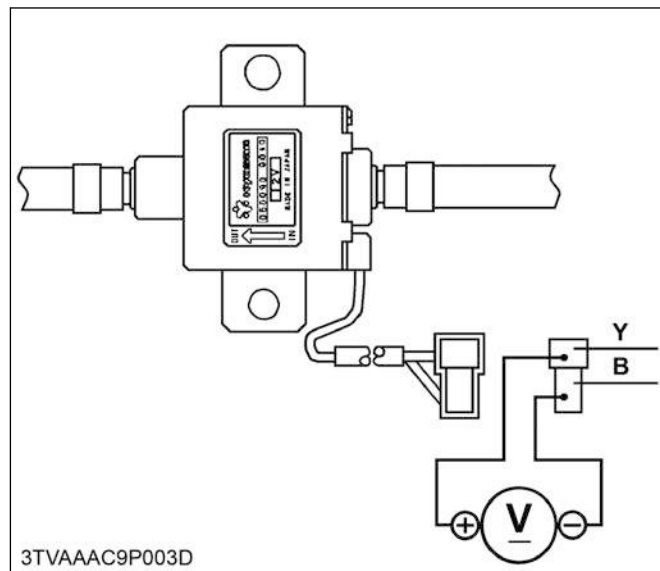
(1) Glow plug (Heater)

- Remove the wiring harness.
- Measure the resistance with a circuit tester between the glow plug terminal and the engine body.
- If the factory specification is not indicated, glow plug is faulty.

Resistance	Factory specification	Approx. 3.0 Ω
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4.5 Fuel pump

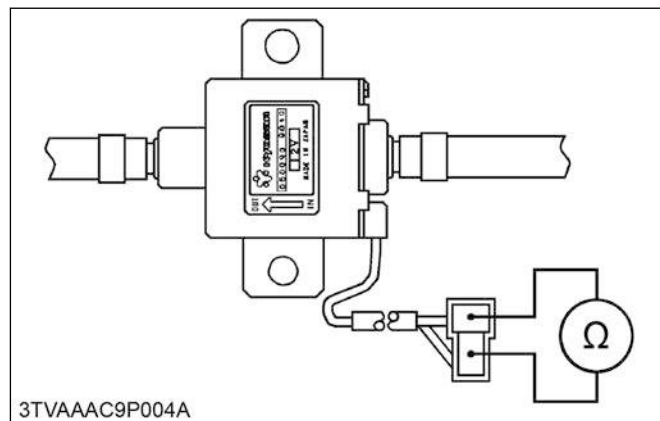
4.5.1 Checking fuel pump connector voltage



- Disconnect the 2P connector from the fuel pump.
- Turn the main switch key to the **ON** position, and measure the voltage with a voltmeter between the connector terminals.
- If the voltage differs from the battery voltage, the wiring harness or main switch is faulty.

Voltage	Between connector terminals	Approx. battery voltage
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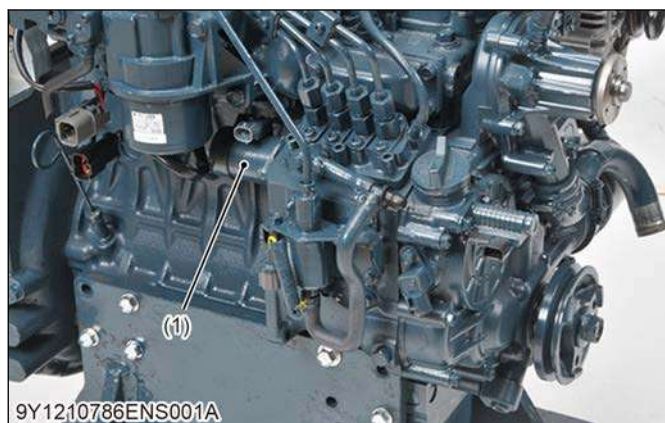
4.5.2 Checking fuel pump continuity



- Disconnect the 2P connector from the fuel pump.
- Check the continuity between the connector terminals with an ohmmeter.
- If it does not conduct, the fuel pump is faulty.

4.6 Engine stop solenoid

4.6.1 Engine stop solenoid test



(1) Solenoid

1. Remove the solenoid (1) from the engine.
2. Measure the resistance with a circuit tester between the solenoid terminals.
3. If the factory specification is not indicated, solenoid is faulty.

Resistance	Factory specification	2.52 to 3.08 Ω at 20 °C (68 °F)
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4.7 Charging system

4.7.1 Alternator on unit test



WARNING

To avoid serious injury:

- Be careful not to touch the rotating engine parts while engine is running.
- Keep safety distance from the engine rotating parts.

(Before testing)

- Before alternator on unit test, check the battery terminal connections, circuit connection, fan belt tension, charging indicator lamp, fuses on the circuit, and abnormal noise from the alternator.
 - Prepare full charged battery for the test.
1. Start the engine.
 2. When the engine is operating measure the voltage between two battery terminals. If the voltage is between 13.8 V and 14.8 V, the alternator is operating normally.
 3. If the results of alternator on unit test are not within the specifications, disassemble the alternator and check the each component part for finding out the failure.

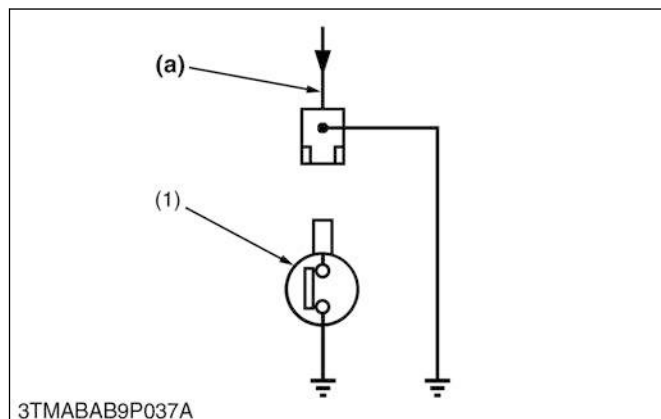
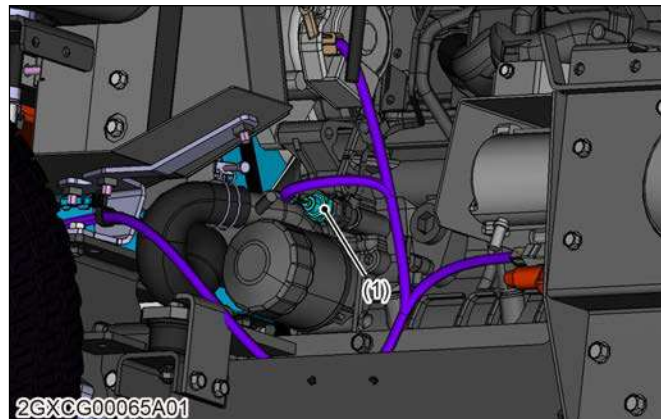
Regulating voltage at no load	Factory specification	13.8 to 14.8 V at 25 °C (77 °F)
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— RELATED PAGE —

[5.2.6.1 Disassembling alternator on page 3-55](#)

4.8 Easy Checker™

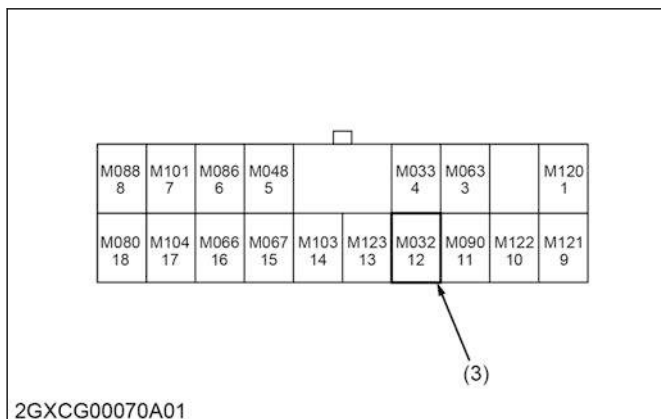
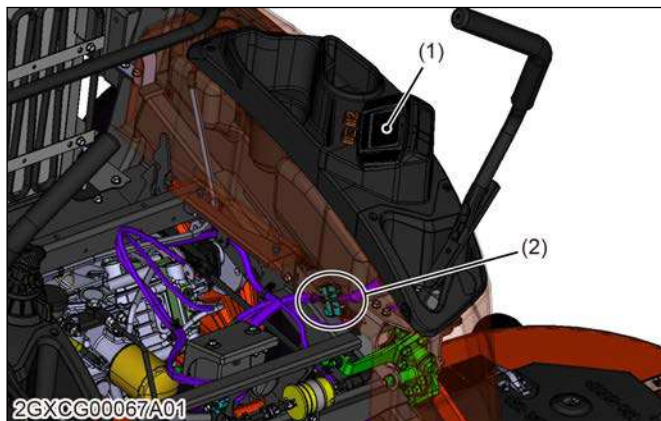
4.8.1 Checking engine oil pressure lamp



(1) Engine oil pressure switch (a) From oil pressure lamp

1. Turn the main switch **OFF**.
2. Disconnect the lead from the engine oil pressure switch.
3. Turn the main switch **ON**.
4. Connect a jumper lead from the lead to the chassis.
5. If the engine oil pressure indicator lamp does not light, the wiring harness is faulty.

4.8.2 Checking horn wiring harness



- (1) Meter panel (3) Coolant temperature sensor
(2) Wiring harness connector (4) Terminal 12

1. Turn the main switch **OFF**.
2. Raise seat.
3. Disconnect the meter panel (1) from the wiring harness connector (2).
4. Turn the main switch **ON**.
5. Connect a jumper lead from the wiring harness connector (2) (Terminal 12) to the chassis.
6. If the horn does not operate wiring harness or relay is faulty.

4.9 Engine control system

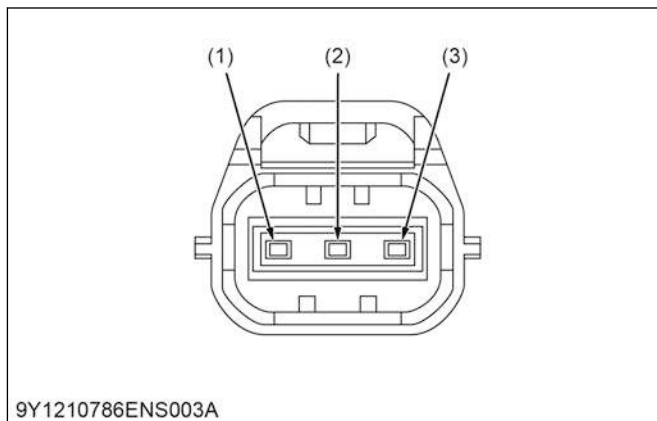
4.9.1 Checking rack sensor continuity

■ IMPORTANT

- When replacing the rack position sensor (component), use a diagnostic tool to write the "rack position sensor information (serial number)" and "rack position offset correction" information to the ECU.



1. Disconnect the connector.
2. Remove the rack sensor.
3. Measure the resistance with a circuit tester between terminal 2 and terminal 3.



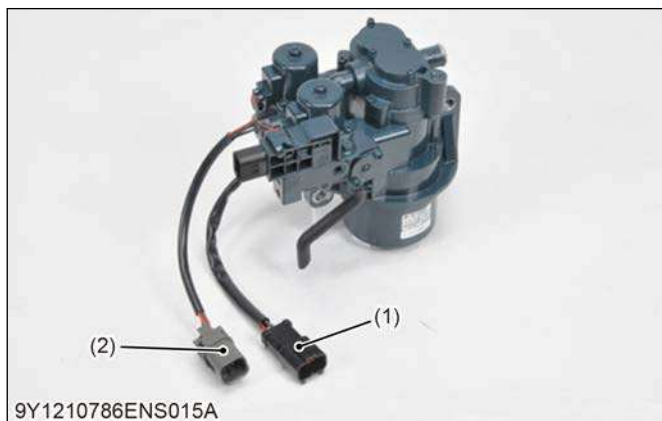
- (1) Terminal 1 (Vcc) (3) Terminal 3 (OUTPUT)
(2) Terminal 2 (GND)

4. If the resistance is not within the factory specifications, replace it.

Resistance	Factory specification	470 kΩ
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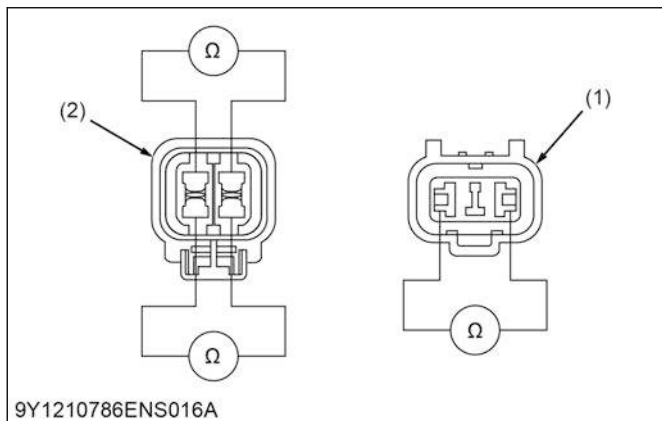
4.9.2 Checking blower

1. Disconnect the connectors.



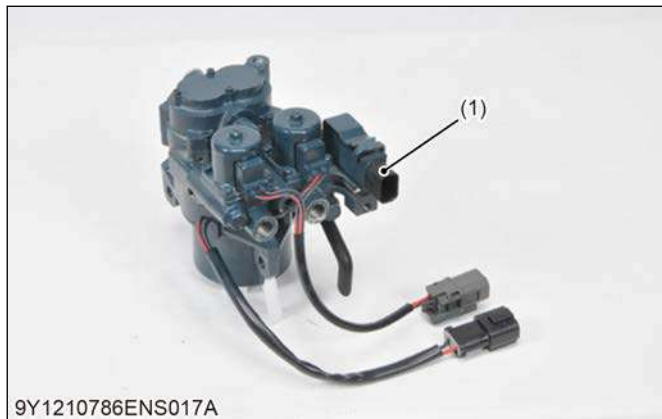
- (1) Motor connector
(2) Valve connector

2. Check the continuity between the each connector terminals with a circuit tester.



- (1) Motor connector (2) Valve connector

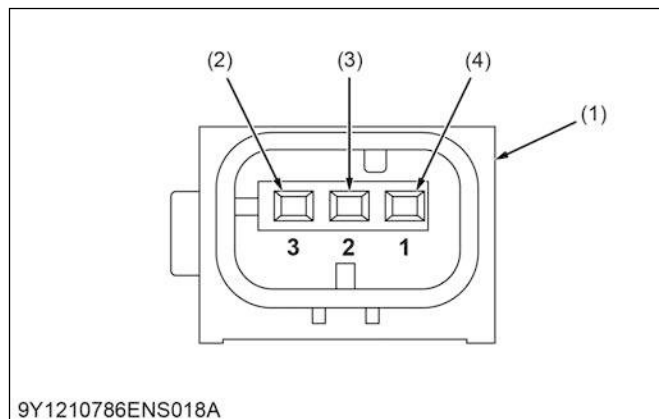
3. If not continuous, replace the blower.

4.9.3 Checking blower flow pressure sensor

- (1) Blower flow pressure sensor

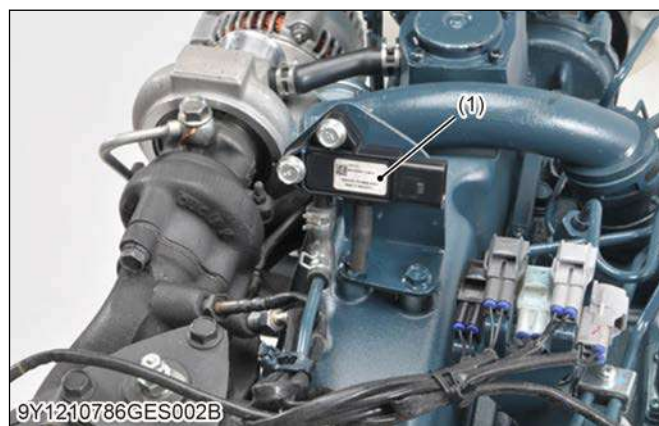
1. Disconnect the connector.

2. Check the continuity between the terminal 1 (4) and terminal 2 (3), terminal 1 (4) and terminal 3 (2) and terminal 2 (3) and terminal 3 (2) with a circuit tester.



- (1) Blower flow pressure sensor (4) Terminal 1
(2) Terminal 3
(3) Terminal 2

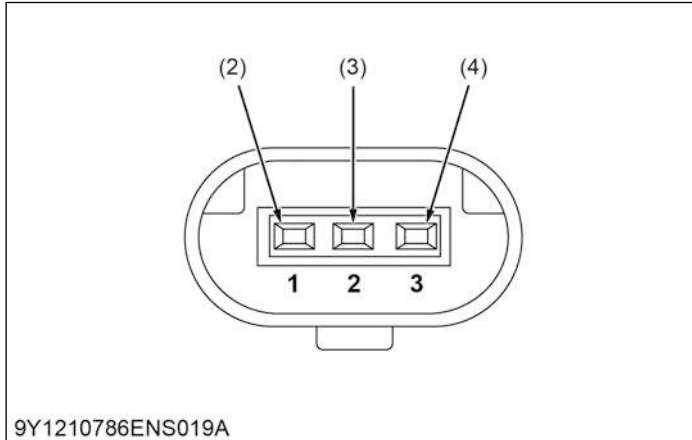
3. If continuous, replace the blower flow pressure sensor (1).

4.9.4 Checking differential pressure sensor

- (1) Differential pressure sensor

1. Disconnect the connector.

- Check the continuity between the terminal 1 (2) and terminal 2 (3), terminal 1 (2) and terminal 3 (4) and terminal 2 (3) and terminal 3 (4) with a circuit tester.



- (2) Terminal 1
(3) Terminal 2
(4) Terminal 3

- If continuous, replace the differential pressure sensor (1).

4.9.5 Checking temperature sensor



- (1) Temperature sensor

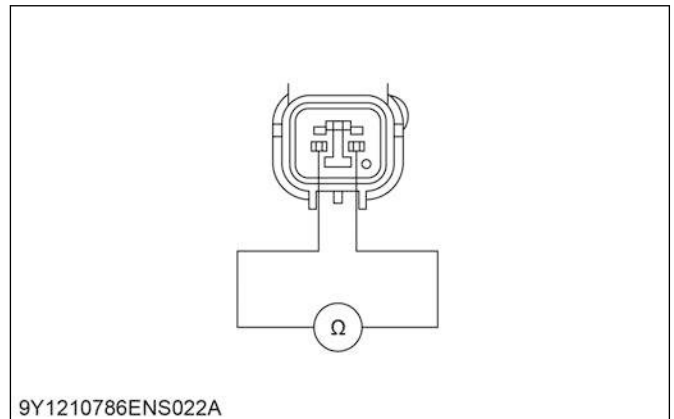
- Disconnect the connector.
- Measure the resistance with a circuit tester between terminals.
- If the resistance is not within the factory specifications, replace it.

Resistance	Factory specification	100 kΩ at 20 °C (68 °F)
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4.9.6 Checking doser fuel pump



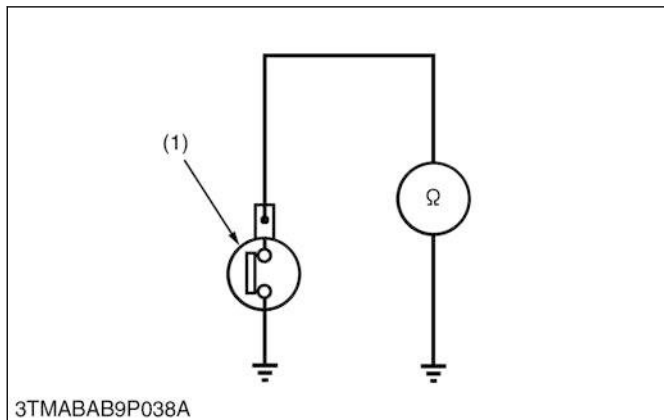
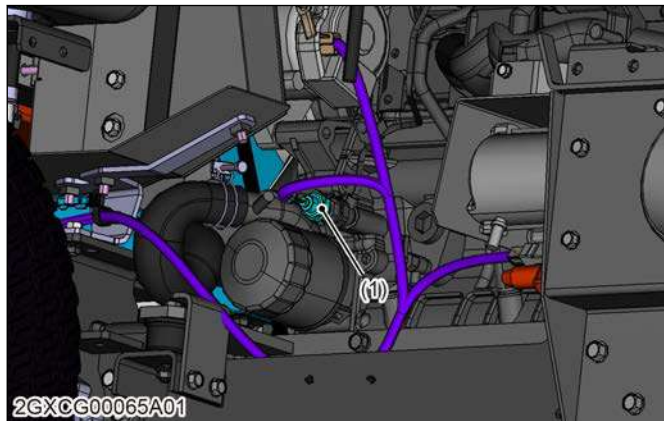
- Disconnect the connectors.
- Measure the resistance with a circuit tester between the doser fuel pump connector terminals.



- If the factory specification is not indicated, doser fuel pump is faulty.

Resistance	Factory specification	2.38 to 2.62 Ω at 20 °C (68 °F)
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4.9.7 Checking engine oil pressure switch continuity



(1) Engine oil pressure switch

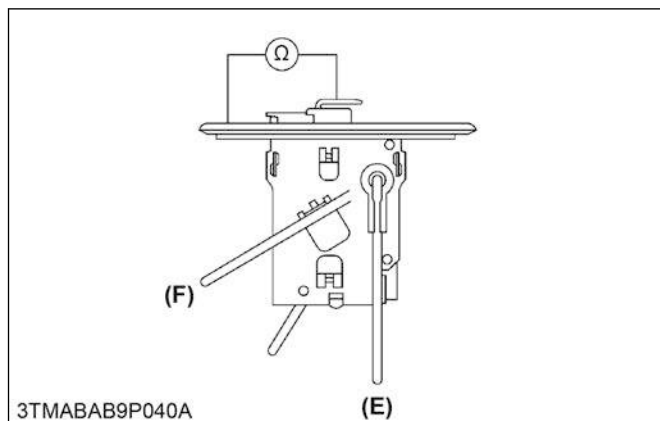
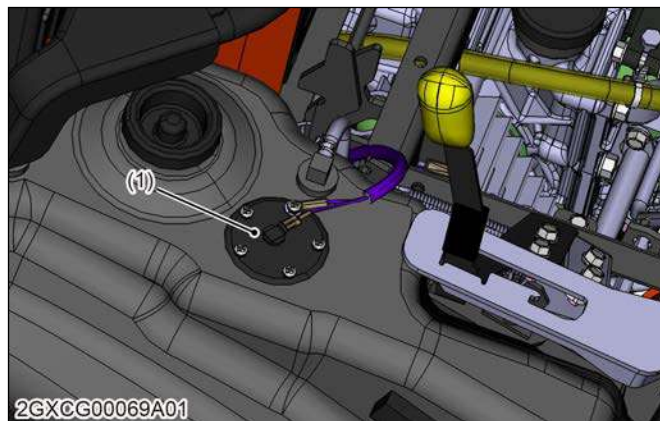
1. Measure the resistance with an ohmmeter across the switch terminal and the chassis.
2. If 0 ohm is not indicated in the normal state, the switch is faulty.

Resistance (Switch terminal – Chassis)	In normal state	0 Ω
---	-----------------	-----

3. If infinity is not indicated at pressure over 4.9 kPa (0.5 kgf/cm², 7 psi), the switch is faulty.

Resistance (Switch terminal – Chassis)	At pressure over approx. 4.9 kPa (0.5 kgf/cm ² , 7 psi)	Infinity
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4.9.8 Checking fuel level sensor



(1) Fuel level sensor

(F) Full

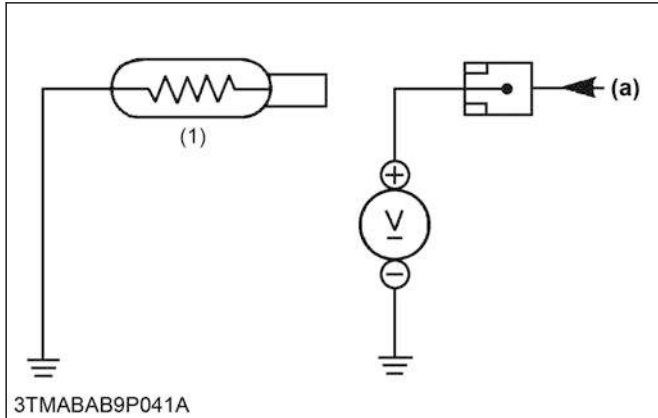
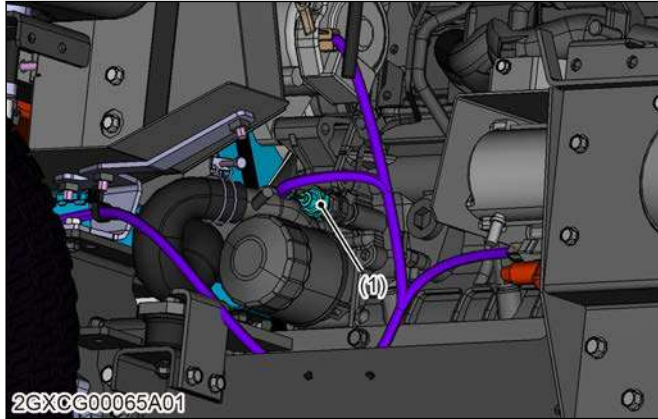
(E) Empty

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	Reference value	Float at upper-most position	1 to 5 Ω
		Float at lower-most position	103 to 117 Ω

4.9.9 Checking coolant temperature sensor voltage



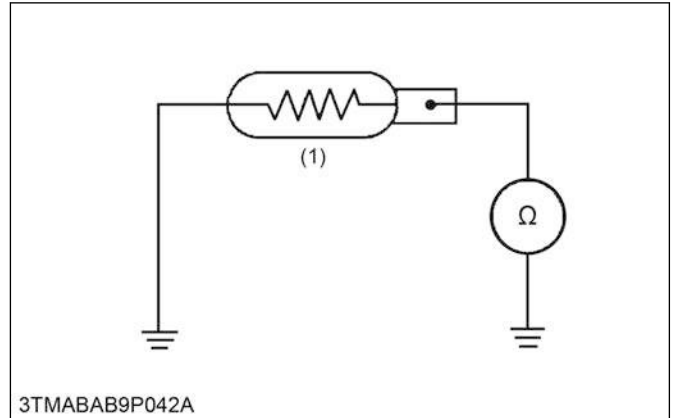
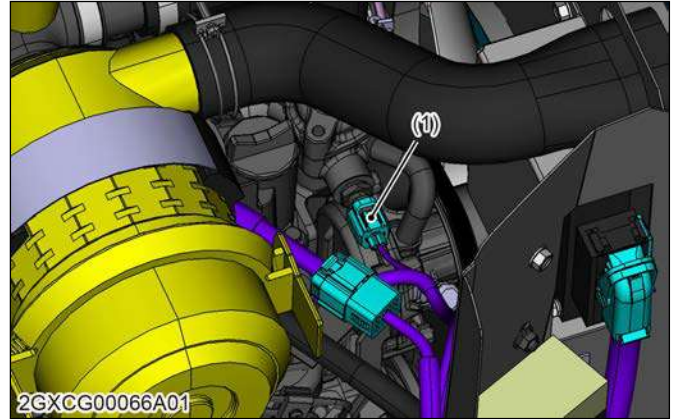
(1) Coolant temperature sensor (a) From temperature gauge

1. Disconnect the lead from the coolant temperature sensor after turning the main switch **OFF**.
2. Turn the main switch **ON** and measure the voltage with a voltmeter across the lead terminal and the chassis.

If the voltage differs from the table below, the wiring harness, fuse or coolant temperature gauge is faulty.

Voltage	Lead terminal – Chassis	5 ±0.1 V
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4.9.10 Checking coolant temperature sensor continuity



(1) Coolant temperature sensor

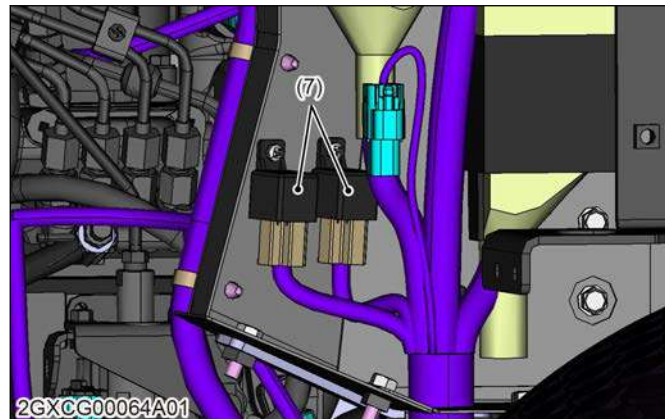
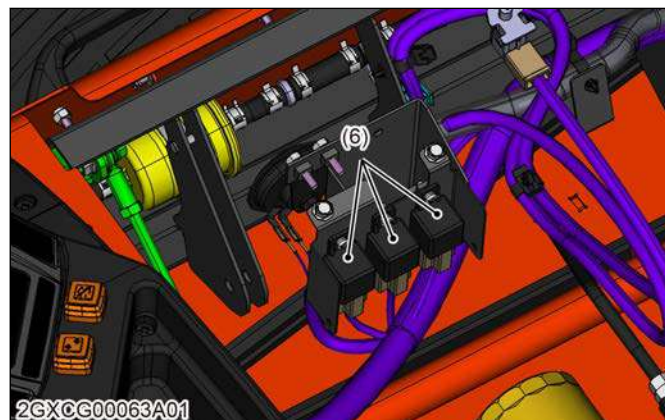
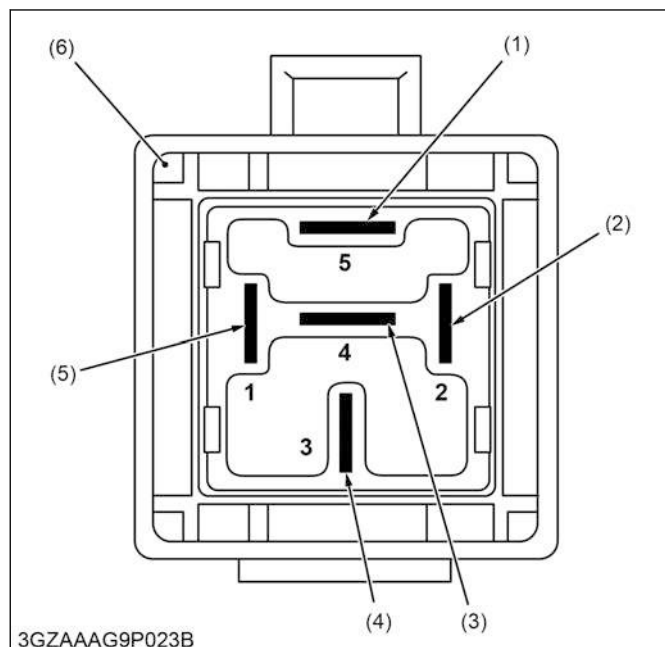
Sensor continuity

1. Measure the resistances with an ohmmeter across the sensor terminal and the chassis.
2. If the reference value is not indicated, the sensor is faulty.

Resistance (Sensor terminal – Chassis)	Reference value	Approx. 0.110 kΩ at 120 °C (248 °F) 0.183 kΩ at 100 °C (212 °F) 3.18 kΩ at 80 °C (176 °F) 8.11 kΩ at 50 °C (122 °F)
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4.10 Relays

4.10.1 Checking relay



- (1) Terminal 5
- (2) Terminal 2
- (3) Terminal 4
- (4) Terminal 3
- (5) Terminal 1
- (6) Relays (under seat)
- (7) Relays (under bonnet)

1. Turn the main switch off.
2. Disconnect the connector from relays (6),(7)
3. Remove the relay.

4. Measure the resistance with an ohmmeter across all:
 - a. Terminal 2 (2) to terminal 1 (5)
 - b. Terminal 5 (1) to terminal 4 (3)
 - c. Terminal 5 (1) to terminal 3 (4)
 - d. Terminal 4 (3) to terminal 3 (4)
5. If resistance differs from the factory specifications, the relay is faulty.

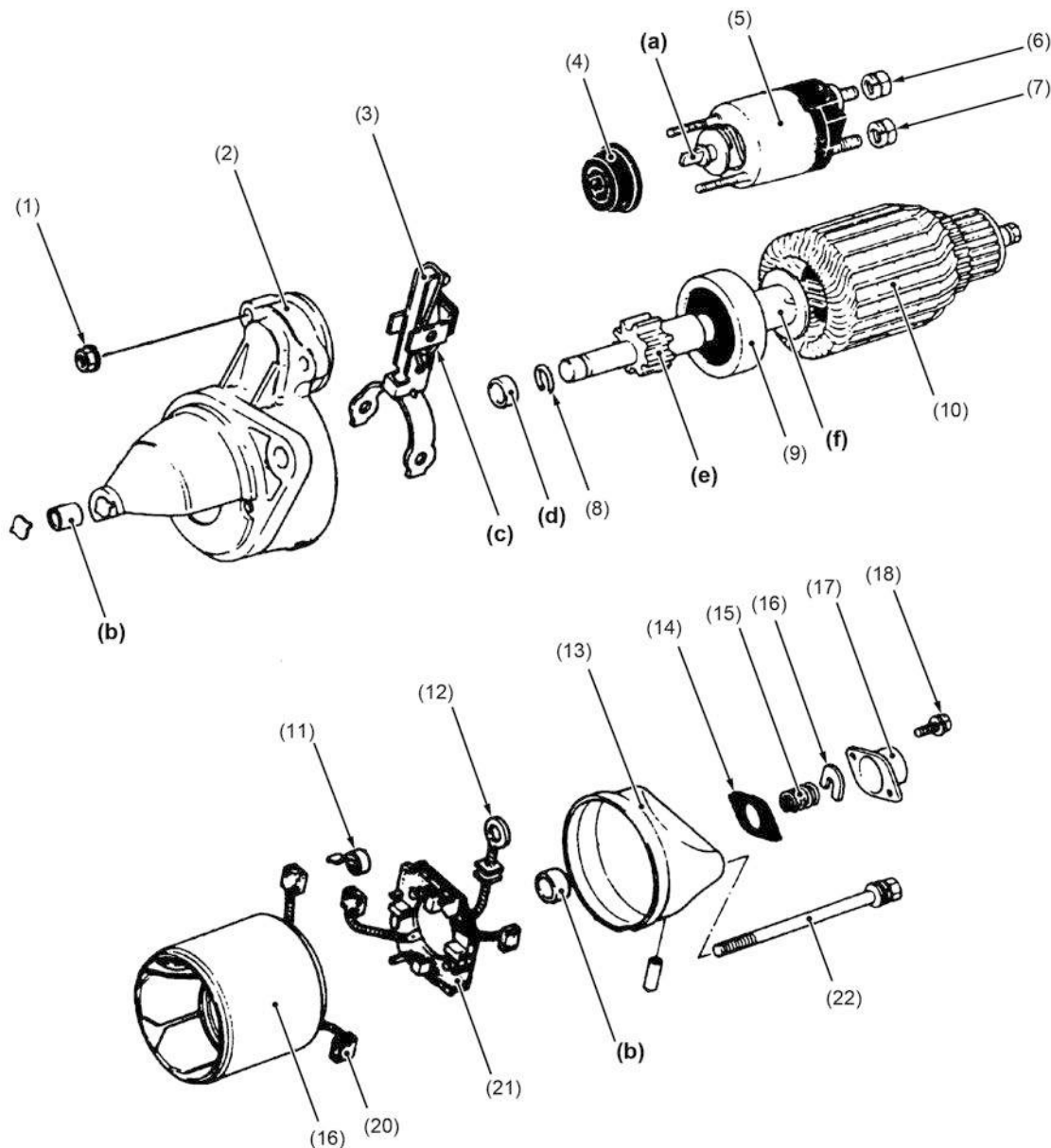
Resistance	Terminal 2 (2) – Terminal 1 (5)	Approx. 90 Ω
	Terminal 5 (1) – Terminal 4 (3)	Infinity
	Terminal 4 (1) – Terminal 3 (4)	0 Ω
	Terminal 5 (1) – Terminal 3 (4)	Infinity

5. Disassembling and assembling

5.1 Disassembling starter (Electromagnetic drive type)

■ NOTE

- Do not damage to the brush and commutator.



3EBAAAB1P045C

- | | | | |
|----------------------------------|------------------------|--------------------|------------------------------|
| (1) Solenoid switch mounting nut | (8) Snap ring | (15) Brake spring | (22) Through bolt |
| (2) Starter drive housing | (9) Overrunning clutch | (16) Brake shoe | (a) Joint of solenoid switch |
| (3) Drive lever | (10) Armature | (17) End frame cap | (b) Bushing |
| (4) Gasket | (11) Brush spring | (18) Screw | (c) Drive lever |
| (5) Solenoid switch | (12) Connecting lead | (19) Yoke | (d) Collar |
| (6) B terminal nut | (13) Rear end frame | (20) Brush | (e) Teeth of pinion gear |
| (7) C terminal nut | (14) Gasket | (21) Brush holder | (f) Armature shaft |

1. Remove the C terminal nut (7), and disconnect the connecting lead (12).
2. Remove the solenoid switch mounting nuts (1), and remove the solenoid switch (5).
3. Remove the end frame cap (17).
4. Remove the brake shoe (16), brake spring (15) and gasket (14).
5. Remove the through bolts (22), and remove the rear end frame (13).
6. Remove the brush from the brush holder while holding the spring up.
7. Remove the brush holder (21).
8. Draw out the yoke (19) from the starter drive housing (2).

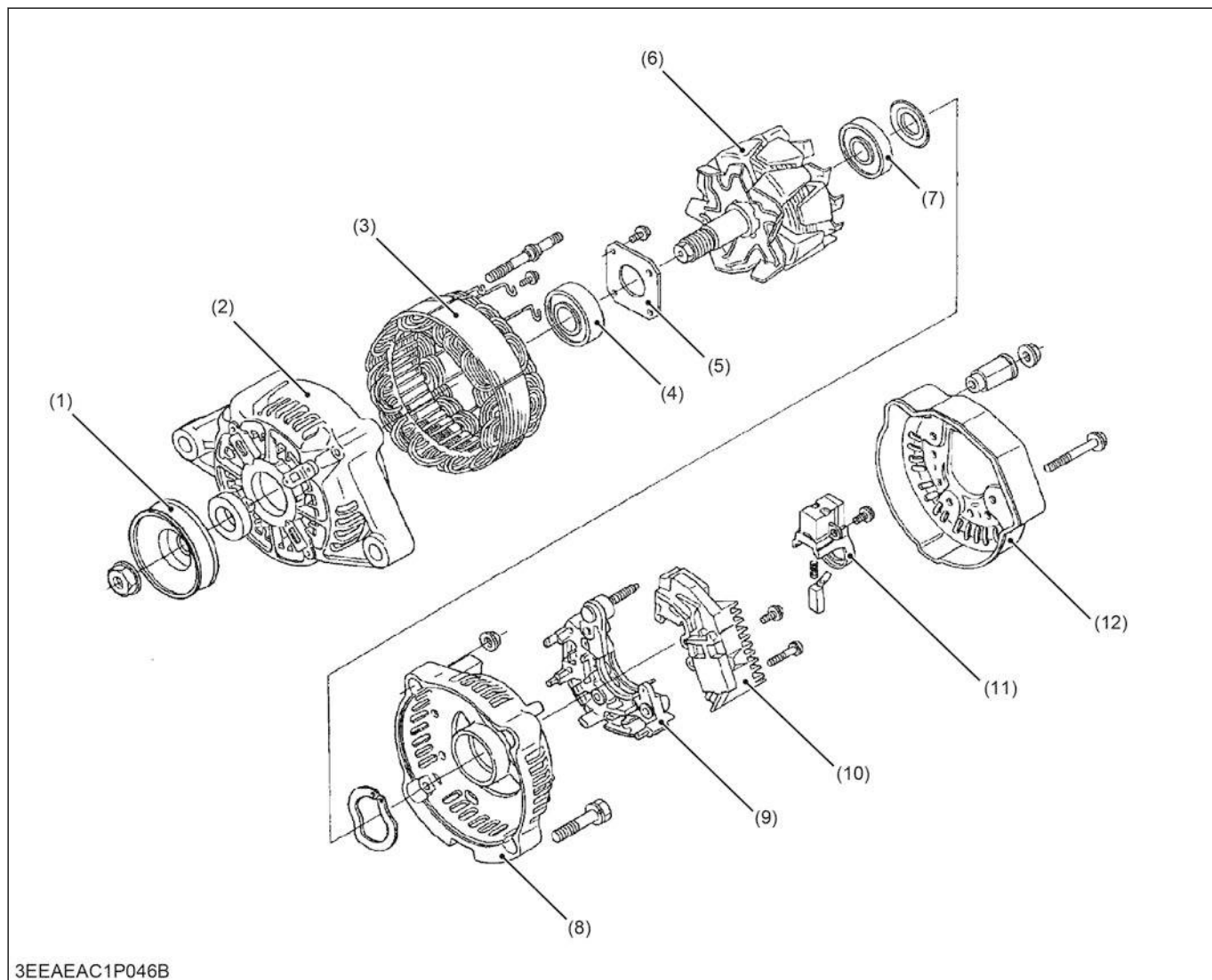
9. Draw out the armature (10) with the drive lever (3).

(When reassembling)

- Apply grease (DENSO.CO.LTD. No. 50 or equivalent) to the parts indicated in the figure.

Tightening torque	B terminal nut	5.88 to 11.8 N · m 0.600 to 1.20 kgf · m 4.34 to 8.70 lbf · ft
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5.2 Disassembling alternator



- | | | | |
|---------------------|--------------------|--------------------|---------------------|
| (1) Pulley | (4) Bearing | (7) Bearing | (10) IC regulator |
| (2) Drive end frame | (5) Retainer plate | (8) Rear end frame | (11) Brush holder |
| (3) Stator | (6) Rotor | (9) Rectifier | (12) Rear end cover |

1. Remove the pulley (1).
2. Remove the rear end cover (12).
3. Remove the brush holder (11).
4. Remove the IC regulator (10).
5. Remove the four screws holding the stator lead wires.

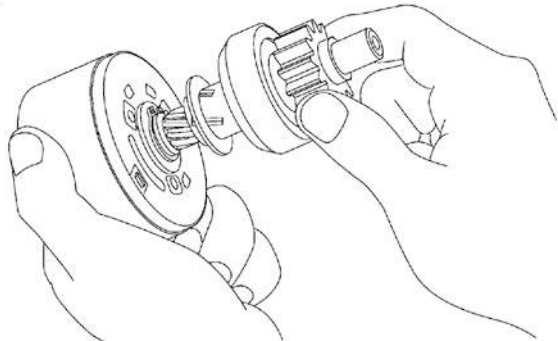
6. Remove the rectifier (9).
7. Remove the rear end frame (8).
8. Press out the rotor (6) from drive end frame (2).
9. Remove the retainer plate (5).
10. Press out the bearing (4) from drive end frame (2) with a press and jig.
11. Lightly secure the rotor with a vise to prevent damage, and remove the bearing (7) with a puller.

(When reassembling)

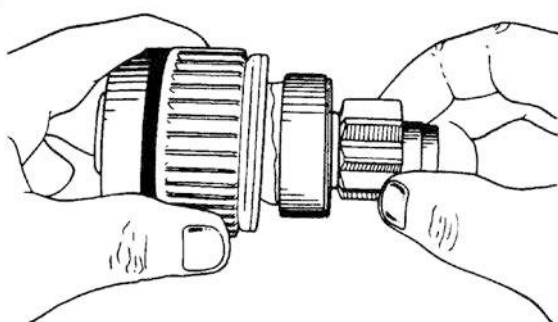
Tightening torque	Pulley nut	58.4 to 78.9 N·m 5.95 to 8.05 kgf·m 43.1 to 58.2 lbf·ft
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6. Servicing**6.1 Starter****6.1.1 Checking overrunning clutch****■ NOTE**

- Do not wash off the grease in the overrunning clutch with the chemicals or oils.

[A]

3EEAEAC1P050A

[B]

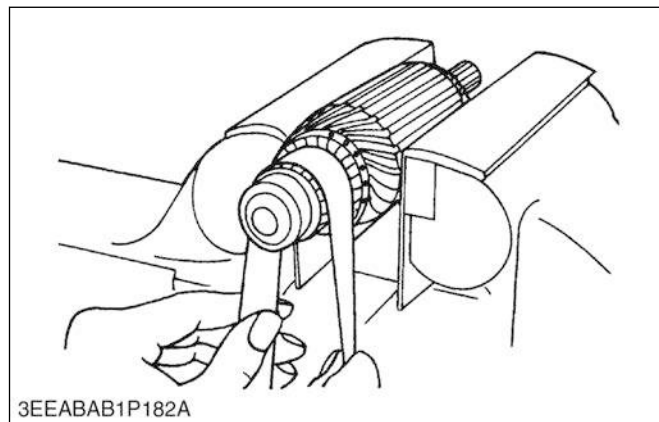
3EEABAB1P188B

[A] Electromagnetic drive type [B] Planetary gear reduction type

3. If the pinion slips or does not turn in both directions, replace the overrunning clutch assembly.

6.1.2 Checking commutator and mica

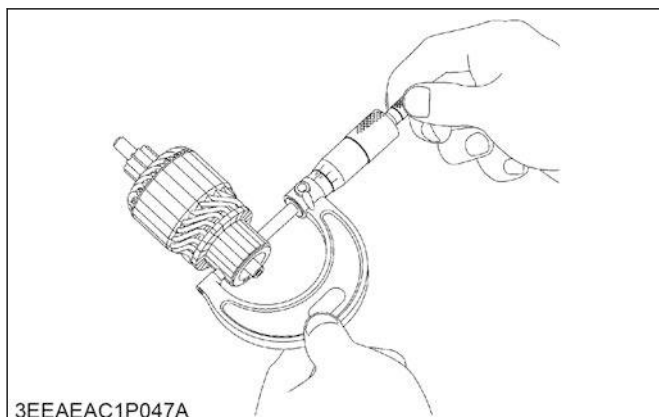
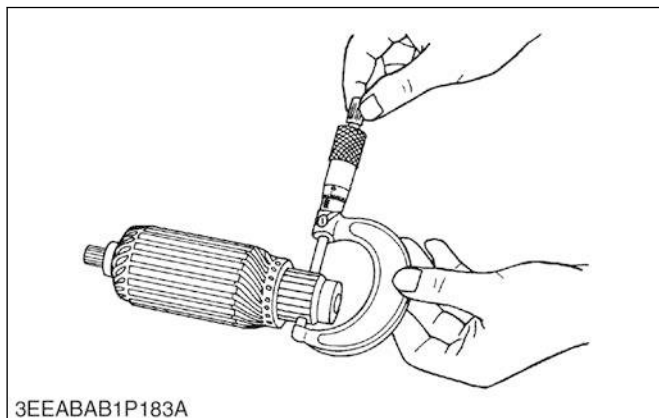
1. Check the contact of the commutator for wear, and grind the commutator with emery paper if it is slightly worn.



3EEABAB1P182A

1. Check the pinion and if worn or damaged, replace the clutch assembly.
2. Check that the pinion turns freely and smoothly in the overrunning direction and does not slip in the cranking direction.

- Measure the commutator O.D. with an outside micrometer at several points.



- If the minimum O.D. is less than the allowable limit, replace the armature.

Electromagnetic drive type

Commutator O.D.	Factory specification	28.0 mm 1.10 in.
	Allowable limit	27.0 mm 1.06 in.

Gear reduction type

Commutator O.D.	Factory specification	30.0 mm 1.18 in.
	Allowable limit	29.0 mm 1.14 in.

- If the difference of the O.D.'s exceeds the allowable limit, correct the commutator on a lathe to the factory specification.

Electromagnetic drive type

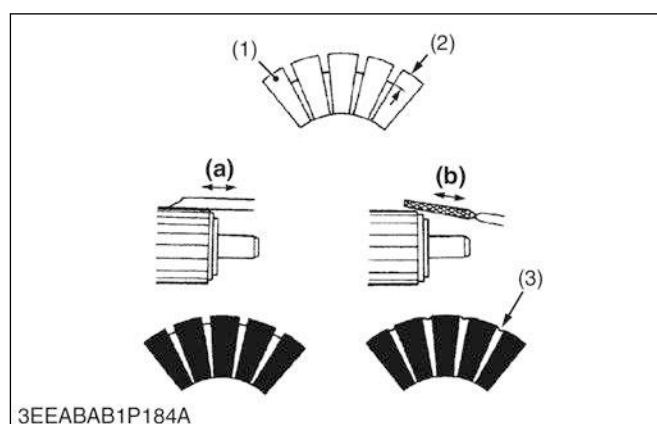
Difference of O.D.'s	Factory specification	Less than 0.05 mm 0.002 in.
	Allowable limit	0.4 mm 0.02 in.

Gear reduction type

Difference of O.D.'s	Factory specification	Less than 0.02 mm 0.0008 in.
	Allowable limit	0.05 mm 0.002 in.

- Measure the mica undercut.
- If the undercut is less than the allowable limit, correct it with a saw blade and chamfer the segment edges.

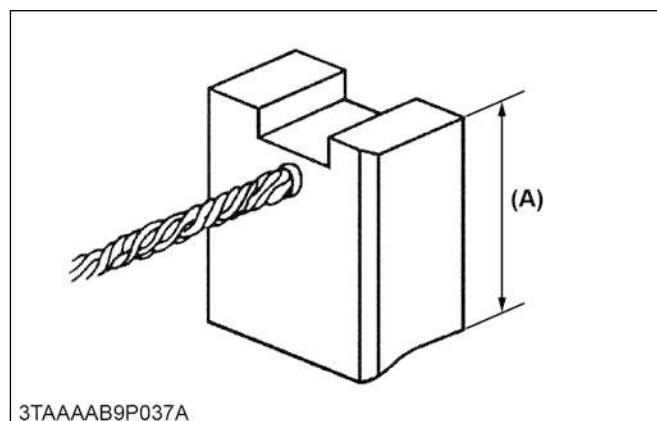
Mica undercut	Factory specification	0.50 to 0.80 mm 0.020 to 0.031 in.
	Allowable limit	0.20 mm 0.0079 in.



- Segment
 - Depth of mica
 - Mica
- Correct
 - Incorrect

6.1.3 Checking brush wear

- If the connect face of the brush is dirty or dusty, clean it with emery paper.
- Measure the brush length (A) with vernier caliper.



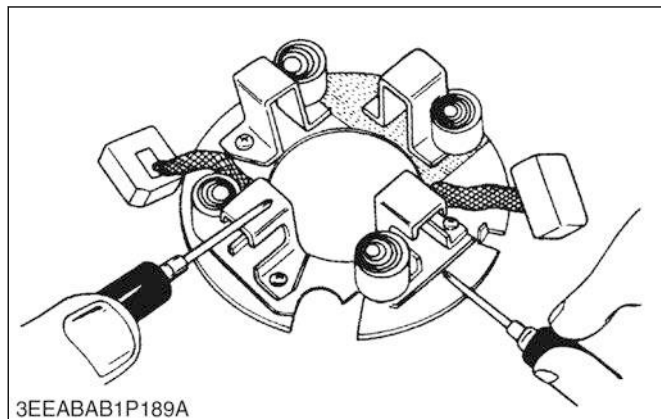
- Brush length

3. If the length is than the allowable limit, replace the yoke assembly and brush holder.

Brush length (A)	Factory specification	16.0 mm 0.630 in.
	Allowable limit	10.5 mm 0.413 in.

6.1.4 Checking brush holder

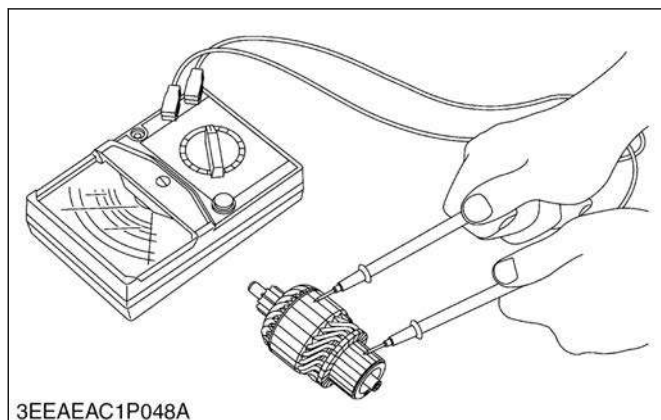
1. Check the continuity across the brush holder and the holder support with a circuit tester.



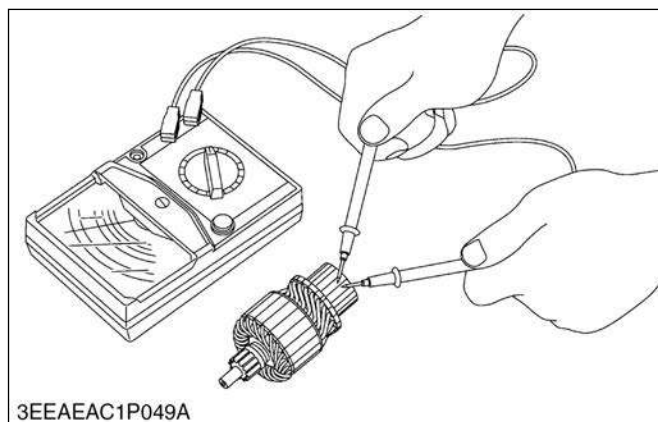
2. If it conducts, replace the brush holder.

6.1.5 Checking armature coil

1. Check the continuity across the commutator and armature coil core with resistance range of circuit tester.



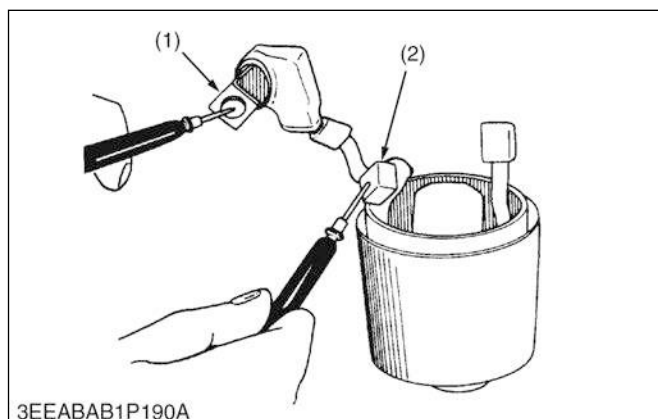
2. If it conducts, replace the armature.
3. Check the continuity across the segments of the commutator with resistance range of circuit tester.



4. If it dose not conduct, replace the armature.

6.1.6 Checking field coil

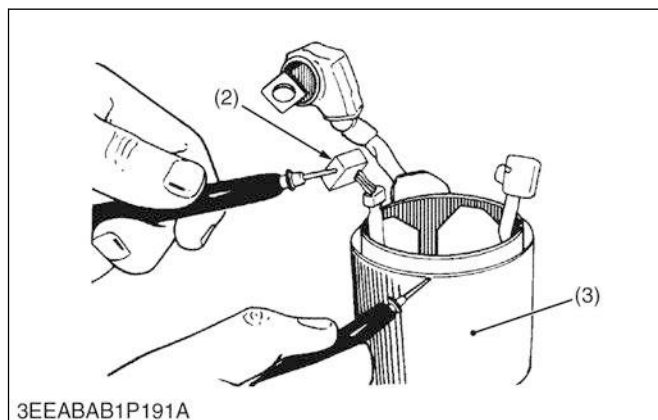
1. Check the continuity across the lead (1) and brush (2) with a circuit tester.



(1) Lead

(2) Brush

2. If it dose not conduct, replace the yoke assembly.
3. Check the continuity across the brush (2) and yoke (3) with a circuit tester.



(2) Brush

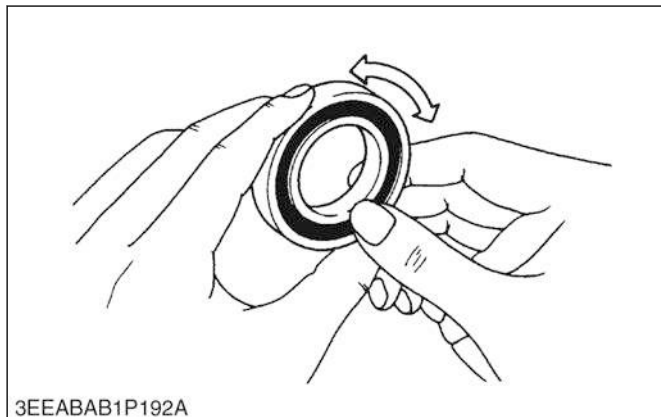
(3) Yoke

4. If it conducts, replace the yoke assembly.

6.2 Charging system

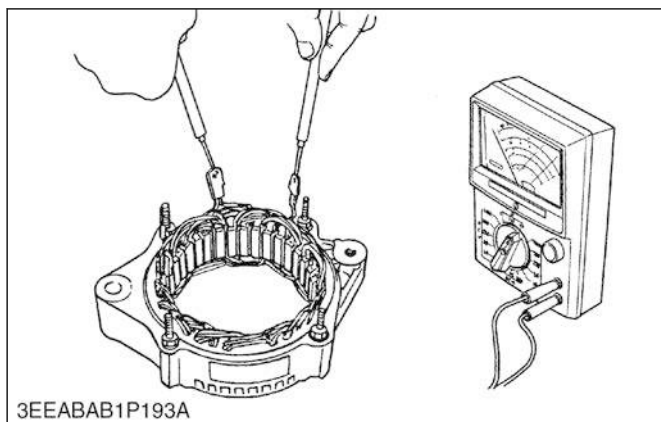
6.2.1 Checking bearing

1. Check the bearing for smooth rotation.



2. If it does not rotate smoothly, replace it.

6.2.2 Checking stator

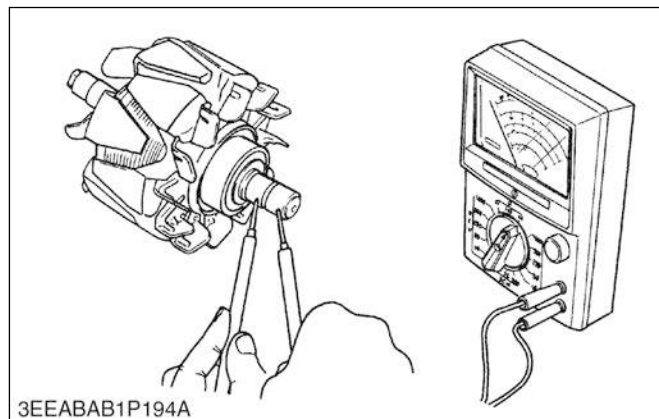


1. Measure the resistance across each lead of the stator coil with resistance range of circuit tester.
2. If the measurement is not within factory specification, replace it.

Resistance	Factory specification	Less than 1.0 Ω
------------	-----------------------	------------------------

3. Check the continuity across each stator coil lead and core with resistance range of circuit tester.
4. If infinity is not indicated, replace it.

6.2.3 Checking rotor

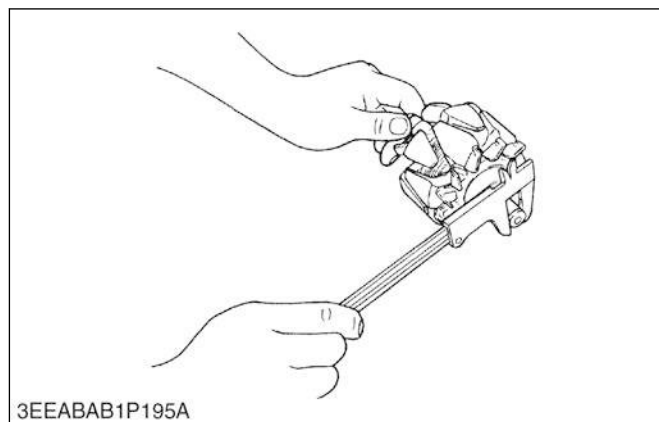


1. Measure the resistance across the slip rings.
2. If the resistance is not the factory specification, replace it.

Resistance	Factory specification	2.9 Ω
------------	-----------------------	--------------

3. Check the continuity across the slip ring and core with resistance range of circuit tester.
4. If infinity is not indicated, replace it.

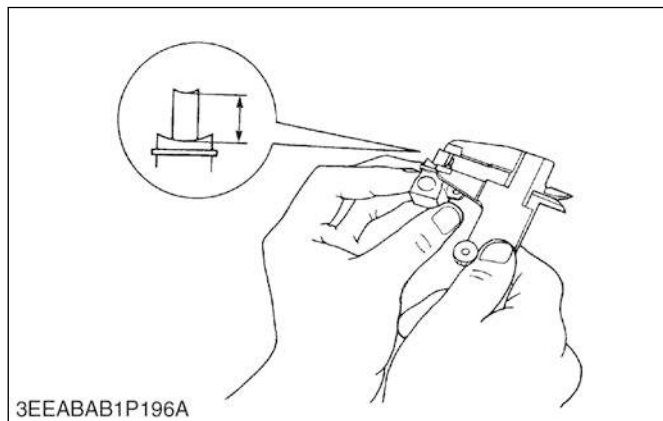
6.2.4 Checking slip ring



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

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

6.2.5 Checking brush wear



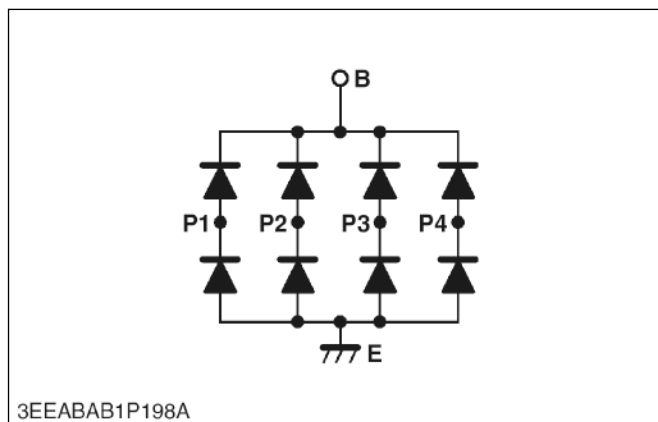
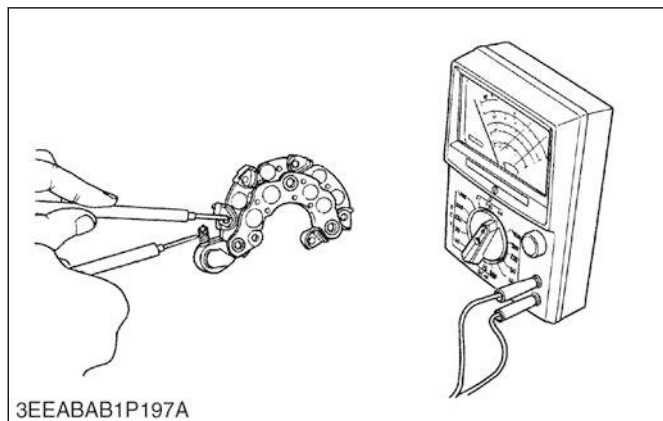
1. Measure the brush length with vernier calipers.
2. If the measurement is less than allowable limit, replace it.

Brush length	Factory specification	10.0 mm 0.394 in.
	Allowable limit	8.4 mm 0.33 in.

3. Make sure that the brush moves smoothly.
4. If the brush is damaged, replace it.

6.2.6 Checking rectifier

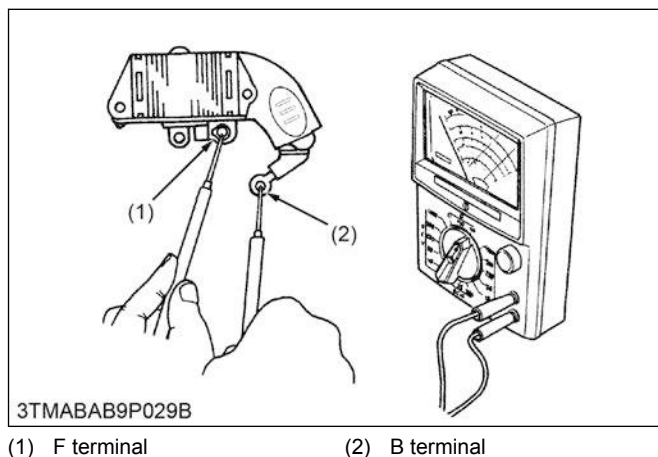
1. Check the continuity across each diode of rectifier with resistance range of circuit tester.



2. The rectifier is normal if the diode in the rectifier conducts in one direction and does not conduct in the reverse direction.

6.2.7 Checking IC regulator continuity

1. Check the continuity across the B terminal (2) and the F terminal (1) of IC regulator with resistance range of circuit tester.



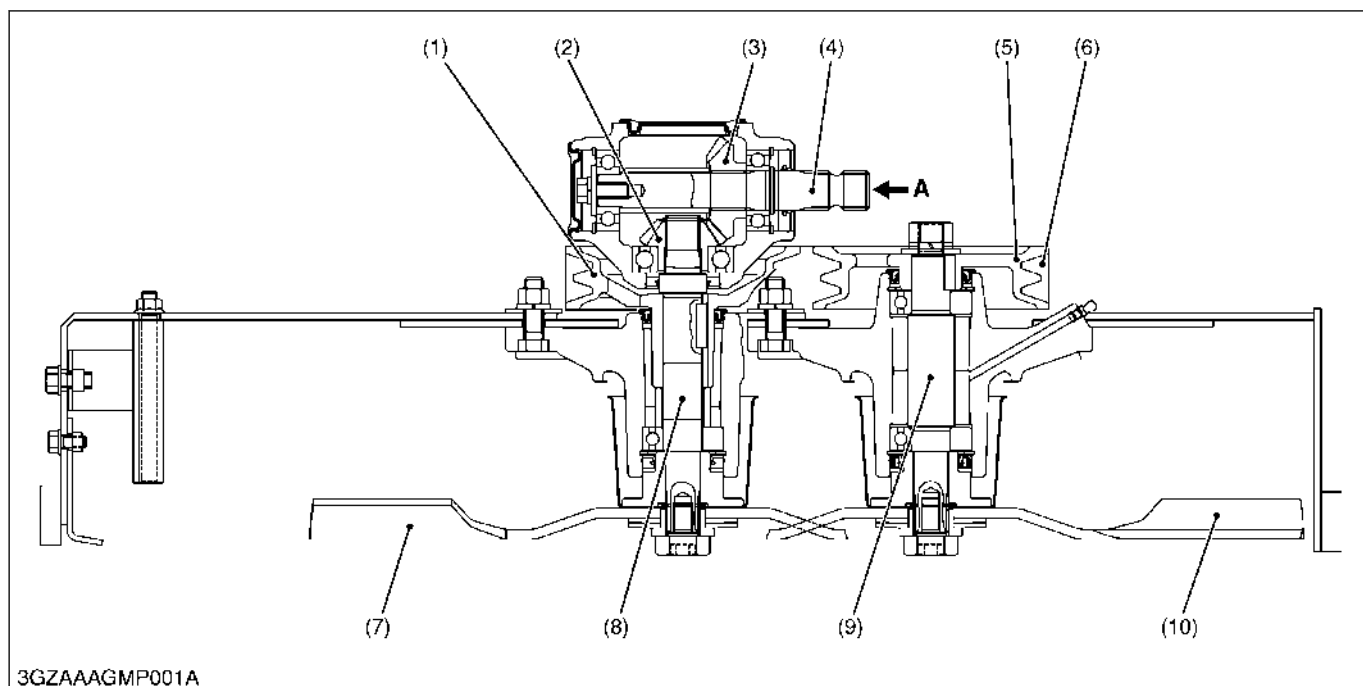
2. The IC regulator is normal if it conducts in one direction and does not conduct in the reverse direction.

8. MOWER

MECHANISM

1. Power flow of mower

The power is transmitted from mid-PTO to blades as follows.



(1) Center pulley
(2) 15T bevel gear
(RCK60RP-1200Z)
17T bevel gear
(RCK72RP-1200Z,
RCK72P-1500Z)

(3) 19T bevel gear
(RCK60P-1200Z)
18T bevel gear
(RCK72P-1200Z,
RCK72P-1500Z)
(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

Center blade

From PTO shaft (A) → Pinion shaft (4) → Bevel gear (3) → Bevel gear (2) → Bevel gear shaft (8) → Center blade (7)

Outer blade

From PTO shaft (A) → Pinion shaft (4) → Bevel gear (3) → Bevel gear (2) → Bevel gear shaft (8) → Center pulley (1) → Mower belt (6) → Outer pulley (5) → Blade shaft (9) → Outer blade (10)

SERVICING

1. Troubleshooting for mower

Symptom	Probable cause and checking procedure	Solution	Reference page
Blade does not turn	1. PTO system malfunctioning	Check transmission	4-24, 4-40
	2. Broken mower belt	Replace mower belt	8-9
Blade speed is slow	1. Loosen mower belt	Replace mower belt or tension spring	8-9
	2. Clogged grass	Remove grass	—
	3. Flattened out or worn cup washer	Replace cup washer	8-8
	4. Engine rpm too low	Mow at full throttle, check and re-set engine rpm	—
Cutting is poor	1. Worn or bent mower blade	Sharpen or replace mower blade	2-49
	2. Loosen mower blade screw	Retighten mower blade screw	8-8
	3. Cutting height improper	Adjust cutting height	—
	4. Ground speed too fast	Slow-down	—
	5. Low wheel inflation	Add air to correct	2-22
	6. Anti-scalp rollers not adjusted correctly	Adjust anti-scalp rollers	8-6
Mower is not lifted	1. Broken linkage system	Replace linkage system	—
	2. Trouble of hydraulic system	Check hydraulic system	6-12

2. Servicing specifications for mower

Item		Factory specifications	Allowable limit
Pinion Shaft (without Mower Belt)	Turning Force	Less than 118 N 12.0 kgf 26.5 lbf	—
	Turning Torque	Less than 1.5+N · m 0.15 kgf · m 1.1 lbf · ft	—
Bevel Gears in Gear Box	Backlash	0.1 to 0.2 mm 0.004 to 0.007 in.	0.4 mm 0.157 in.
Front Tip of Blade to Rear Tip of Blade	Difference	0 to 6.0 mm 0 to 0.24 in.	—
Left Tip of Blade to Right Tip of Blade	Difference	Less than 3.00 mm 0.118 in.	—

3. Tightening torques for mower

■ NOTE

- Tightening torques of screws, bolts and nuts on the table below are especially specified.

Item	Dimension × Pitch	N · m	kgf · m	lbf · ft
Mower blade screw	—	102.9 to 117.6	10.50 to 11.99	75.90 to 86.73
Gear box mounting screw (Standard type / Reamer type)	—	77.4 to 90.2	7.90 to 9.19	57.1 to 66.5
Center pulley holder screw (Standard type / Reamer type)	—	77.4 to 90.2	7.90 to 9.19	57.1 to 66.5
Outer pulley mounting nut	—	167 to 190	17.1 to 19.3	124 to 140
Pulley holder mounting screw	—	77.4 to 90.2	7.90 to 9.19	57.1 to 66.5

4. Checking and adjusting

4.1 Adjusting anti-scalp rollers

WARNING

To avoid serious injury or death:

- Park the machine on a firm and level surface.
- Apply the parking brake.
- Stop the engine and remove the key.
- Wait for all moving parts to stop.

IMPORTANT

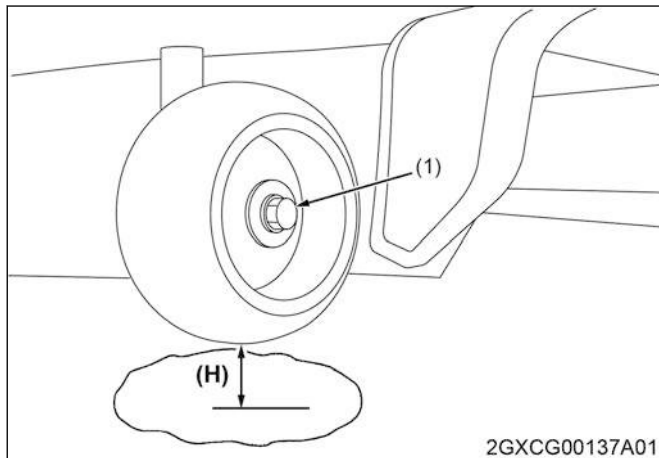
- The flattest cut can be achieved by having the anti-scalp rollers adjusted off the ground. Check anti-scalp roller adjustments each time the mower deck cutting height is changed. It is recommended that all the anti-scalp rollers be kept off the ground to minimize scuffing.

Rear side anti-scalp roller

1. Check the machine wheel pressure. Inflate wheels to the correct pressure.

	Inflation pressure
Front wheel	—
Rear wheel	83 kPa (0.84 kgf/cm ² , 12 psi)

2. Start the engine.
3. Raise up the mower deck to the transport position. (Also the top end of the lift.)
4. Turn the cutting height control dial to adjust height.
5. Lower the mower deck.
6. Adjust height H of the rear side anti-scalp roller to one of four positions to approximately 19 mm (0.75 in.) between rollers and ground. Adjust both side rollers to the same height.



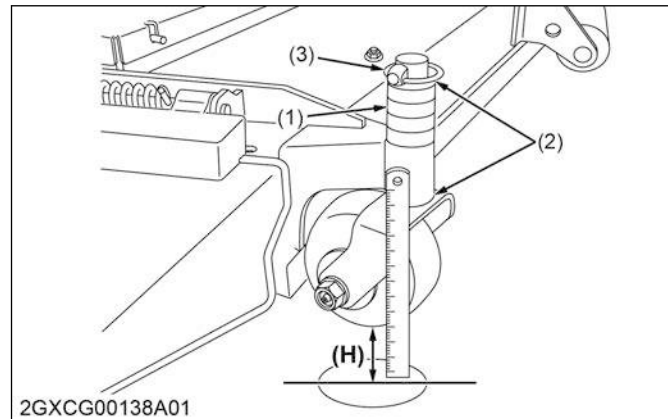
(1) Bolt (H) 19 mm (0.75 in.)

Front side anti-scalp roller

1. Check the machine wheel pressure. Inflate wheels to the correct pressure. (See table below.)

	Inflation pressure
Front wheel	
Rear wheel	83 kPa (0.84 kgf/cm ² , 12 psi)

2. Start the engine.
3. Raise up the mower deck to the transport position. (Also the top end of the lift.)
4. Turn the cutting height control dial to adjust height.
5. Lower the mower deck.
6. Adjust height of the front side anti-scalp roller by replacing the collar (collar is raised and lowered) or shifting the pin to approximately 19 mm (0.75 in.) between rollers and ground.
7. Adjust both side rollers to the same height.



(1) Collar (H) 19 mm (0.75 in.)
(2) Washer
(3) Set pin

4.2 Adjusting left and right cutting height

WARNING

To avoid serious injury or death:

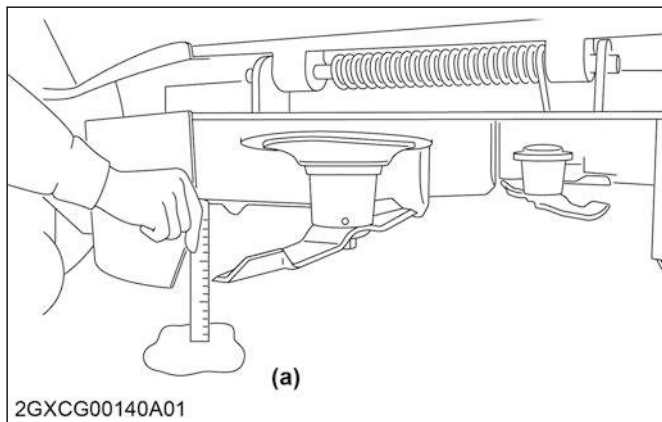
- Park the machine on a firm and level surface.
- Apply the parking brake.
- Disengage PTO (OFF).
- Stop the engine, remove the key and remove the mower universal joint while checking or adjusting the level of the mower deck.

IMPORTANT

- Check the machine tire pressure. Inflate tires to the correct pressure.
- Mower deck anti-scalp rollers must not contact the ground.

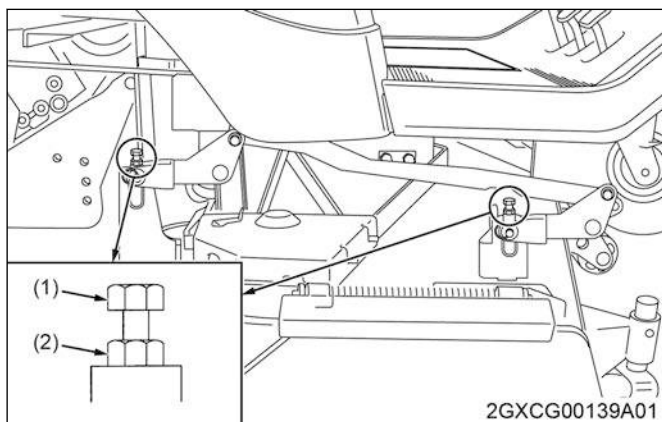
1. Wheel pressure must be correct.
2. Raise up the mower deck to the transport position. (Also the top end)
3. Turn the cutting height set dial to the 3 in. cutting height position.

4. Place 51 mm (2 in.) height wood blocks under each side of the mower deck.
Anti-scalp rollers must not rest on the wood block.
5. Lower the mower deck.
6. Position mower blade in the Side-to-Side position.



(a) Side

7. Loosen the lock nuts of the right side of the machine.
8. Adjust the cutting height fine tuning bolts to set 76 mm (3 in.) height.
Front and rear side bolts must be adjusted.
9. Lock the nuts.
10. Adjust the left side equally.
11. Check the side-to-side level and if it is not level, adjustment is necessary.
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 (1).



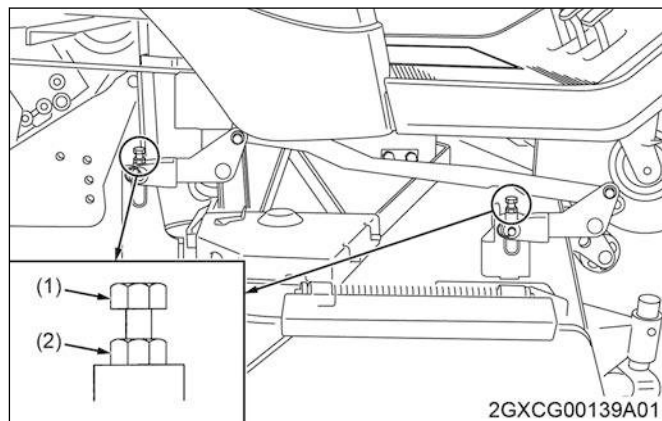
(1) Cutting height fine tuning bolt (2) Lock nut bolt

- Apply the parking brake.
- Disengage PTO (OFF).
- Stop the engine, remove the key and remove the mower universal joint while checking or adjusting the level of the mower deck.

■ IMPORTANT

- Check the machine tire pressure. Inflate tires to the correct pressure.
- Mower deck anti-scalp rollers must not contact the ground.

1. Raise up the mower deck to the transport position. (Also the top end)
2. Turn the cutting height set dial to the 3 in. cutting height position.
3. Place 51 mm (2 in.) height wood blocks under each side of the mower deck.
Anti-scalp rollers must not rest on the wood block.
4. Lower the mower deck.
5. Loosen the lock nuts of the front side of the machine.
6. Adjust the cutting height fine tuning bolts to set 76 mm (3 in.) height.
Both front side bolts must be adjusted.



(1) Cutting height fine tuning bolt (2) Lock nut bolt

7. Lock the nuts.
8. Adjust the other side equally.

4.3 Adjusting front and rear cutting height

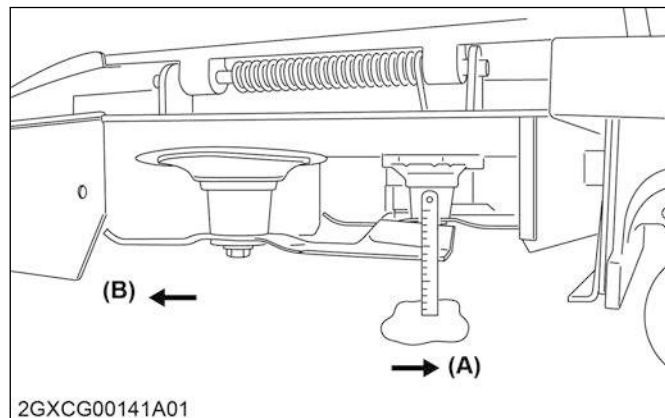


WARNING

To avoid serious injury or death:

- Park the machine on a firm and level surface.

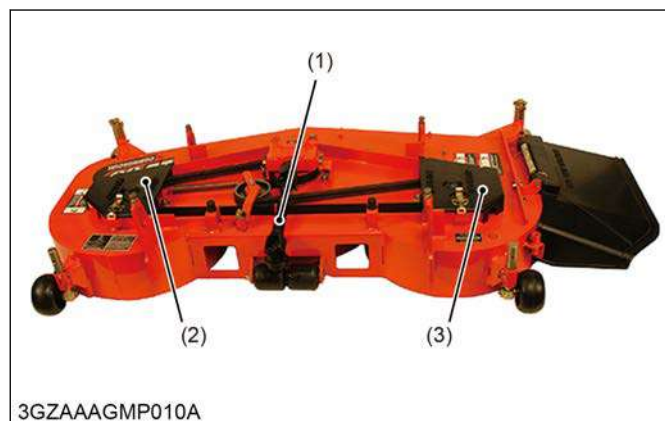
9. Check the front-to-rear level and if it is not level, adjustment is necessary.



(A) Height of blade tip (Front) (B) Height of blade tip (Rear)

5. Disassembling and assembling

5.1 Removing universal joint and belt covers



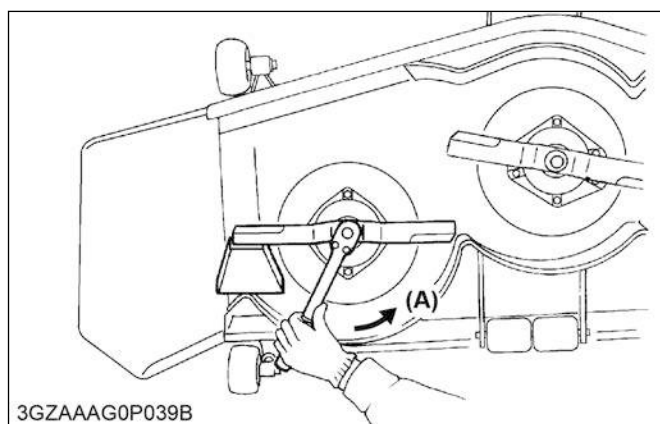
(1) Universal joint (2) Belt cover (Left) (3) Belt cover (Right)

1. Remove the universal joint (1).
2. Remove the left and right belt covers (2), (3).

5.2 Removing mower blades (center blade and outer blades)

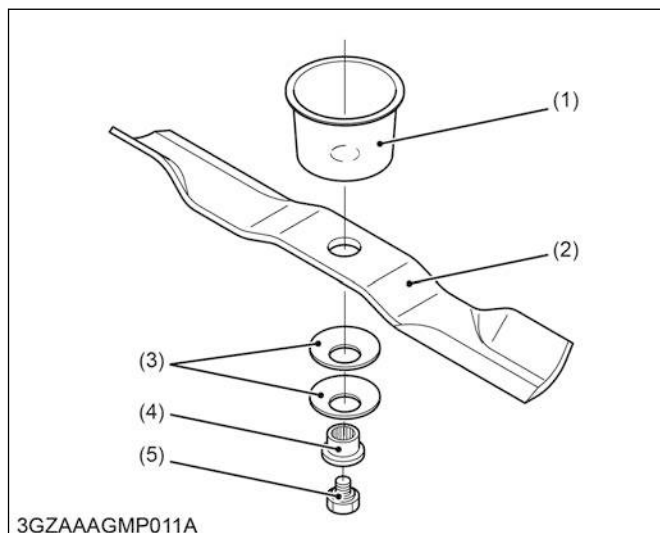
NOTE

- To remove the blade securely, wedge a block of wood between one blade and the mower deck in such position that it will hold the blade safely while loosening or tightening the blade screw.



(A) Loosen

1. Turn over the mower.
2. Remove the mower blade bolt (5), and remove the spline boss (4), two cup washers (3), mower blade (2) and dust cover (1).



(1) Dust cover (2) Mower blade (3) Cup washer (4) Spline boss (5) Mower blade bolt

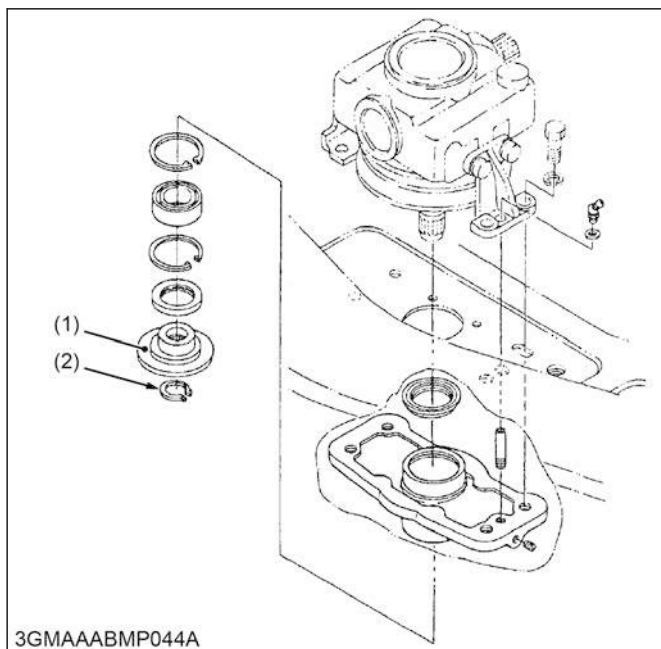
(When reassembling)

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.
- Be sure to assemble the two cup washers between the mower blade and spline boss.

Tightening torque	Mower blade bolt	102.9 to 117.6 N · m 10.50 to 11.99 kgf · m 75.90 to 86.73 lbf · ft
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5.3 Removing blade boss

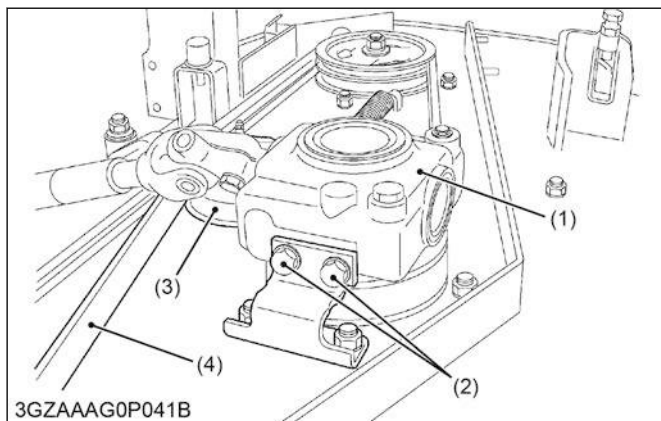


(1) Blade boss (2) External snap ring

1. Remove the external snap ring (2).
2. Remove the blade boss (1).

5.4 Removing mower belt

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



(1) Gear box (4) Mower belt
(2) Gear box mounting bolt
(3) Tension pulley

(When reassembling)

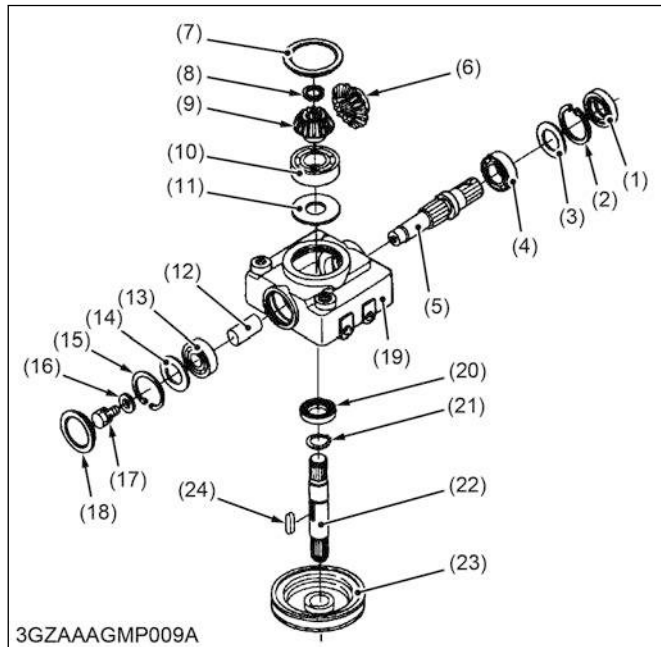
- Install the reamer bolts at their original positions as shown in the figure.

Tightening torque	Gear box mounting bolt	77.4 to 90.2 N · m 7.90 to 9.19 kgf · m 57.1 to 66.5 lbf · ft
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5.5 Disassembling gear box

1. Remove the drain plug, and drain the gear box oil.
2. Remove the center pulley (23) with a puller, and remove the feather key (24) on the bevel gear shaft.
3. Remove the gear box caps (7), (18).
4. Remove the oil seal (1), internal snap ring (2) and shim (3).
5. Remove the screw (17), washer (16) and tap out the pinion shaft (5) with ball bearing (4).
6. Remove the bevel gear (6) and pinion shaft collar (12).
7. Remove the internal snap ring (15) and shims (14).
8. Remove the ball bearing (13).
9. Remove the external snap ring (8), and draw out the bevel gear shaft (22).

10. Remove the bevel gear (9) with ball bearing (10).



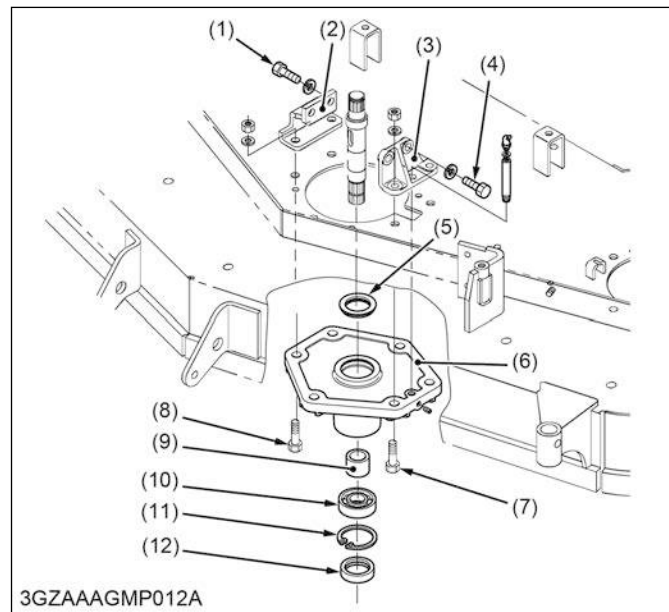
- | | |
|--|--------------------------|
| (1) Oil seal | (10) Ball bearing |
| (2) Internal snap ring | (11) Shim |
| (3) Shim | (12) Pinion shaft collar |
| (4) Ball bearing | (13) Ball bearing |
| (5) Pinion shaft | (14) Shim |
| (6) 19T bevel gear
(RCK60P-1200Z)
18T bevel gear
(RCK72RP-1200Z,
RCK72P-1500Z) | (15) Internal snap ring |
| (7) Gear box cap | (16) Washer |
| (8) External snap ring | (17) Screw |
| (9) 15T bevel gear
(RCK60P-1200Z)
17T bevel gear
(RCK72RP-1200Z,
RCK72P-1500Z) | (18) Gear box cap |
| | (19) Gear box |
| | (20) Oil seal |
| | (21) External snap ring |
| | (22) Bevel gear shaft |
| | (23) Center pulley |
| | (24) Feather key |

(When reassembling)

- Replace the oil seals (1), (20) and gear box caps (7), (18) with new ones.
- Check the backlash and turning torque.
If it is not proper, adjust with the shims (3), (11) and (14).

5.6 Disassembling center pulley holder

1. Remove the center pulley holder bolts (8) and reamer bolts (7).
2. Remove the upper oil seal (5) and lower oil seal (12).
3. Remove the internal snap ring (11) and ball bearing (10).



- | | |
|--------------------------------------|-------------------------------|
| (1) Gear box bolt | (8) Center pulley holder bolt |
| (2) Gear box stay R.H. | (9) Collar |
| (3) Gear box stay L.H. | (10) Ball bearing |
| (4) Gear box reamer bolt | (11) Internal snap ring |
| (5) Oil seal | (12) Oil seal |
| (6) Center pulley holder | |
| (7) Center pulley holder reamer bolt | |

(When reassembling)

NOTE

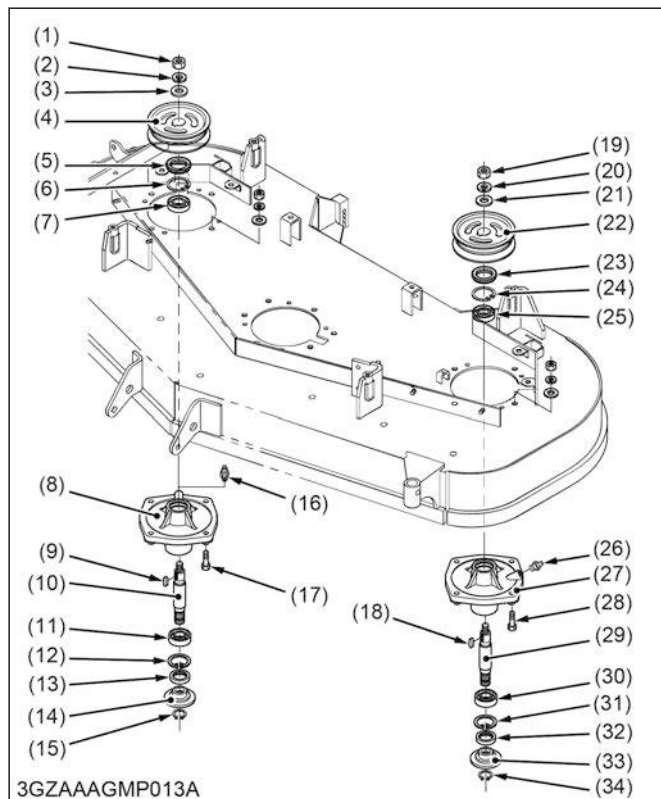
- When reassembling the center pulley holder (6), gear box and gear box stays (2), (3), install all the bolts by hand temporary.
- Tighten the bolts in the order as below, to prevent the incline the gear box.
- Tighten the reamer bolts (4) to the gear box first, then tighten the reamer bolts (7) to the center pulley holder (6) with specified torque.
- Tighten the gear box bolts (1) to the gear box, then tighten the center pulley holder bolts (8) with specified torque.
- Replace the oil seals (5), (12) with new ones.
- Install the reamer bolts (4), (7) at their original positions as shown in the figure.

Tightening torque	Center pulley holder bolt (Standard type / reamer type)	77.4 to 90.2 N·m 7.90 to 9.19 kgf·m 57.1 to 66.5 lbf·ft
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5.7 Disassembling outer pulley and blade shaft

1. Remove the outer pulley mounting nut (19), and remove the outer pulley (22) and feather key (18).
2. Remove the pulley holder mounting bolts (28), and separate the left pulley holder (27) from the mower deck.

3. Remove the external snap ring (34) on the left blade shaft (29).
4. Remove the spline boss (33) and oil seal (32).
5. Remove the internal snap ring (31) and tap out the left blade shaft (29) with the ball bearings (25), (30). Be careful not to damage the grease fitting (26).
6. Remove the oil seal (23) and internal snap ring (24).
7. Remove the ball bearings (25), (30) from the blade shaft (29).
8. Remove the right pulley holder (8) and blade shaft (10) as above.

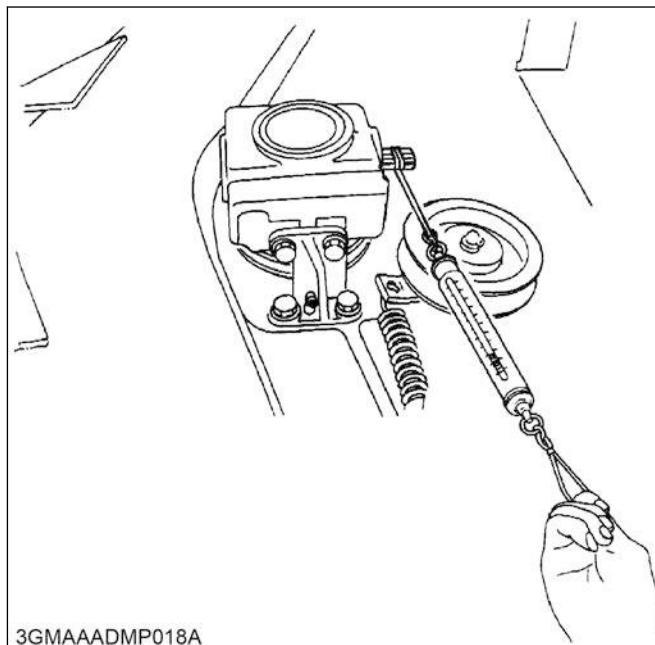


- | | |
|----------------------------------|----------------------------------|
| (1) Outer pulley mounting nut | (19) Outer pulley mounting nut |
| (2) Spring washer | (20) Spring washer |
| (3) Plain washer | (21) Plain washer |
| (4) Outer pulley (Right) | (22) Outer pulley (Left) |
| (5) Oil seal | (23) Oil seal |
| (6) Internal snap ring | (24) Internal snap ring |
| (7) Ball bearing | (25) Ball bearing |
| (8) Pulley holder (Right) | (26) Grease fitting |
| (9) Feather key | (27) Pulley holder (Left) |
| (10) Blade shaft (Right) | (28) Pulley holder mounting bolt |
| (11) Ball bearing | (29) Blade shaft (Left) |
| (12) Internal snap ring | (30) Ball bearing |
| (13) Oil seal | (31) Internal snap ring |
| (14) Spline boss | (32) Oil seal |
| (15) External snap ring | (33) Spline boss |
| (16) Grease fitting | (34) External snap ring |
| (17) Pulley holder mounting bolt | |
| (18) Feather key | |

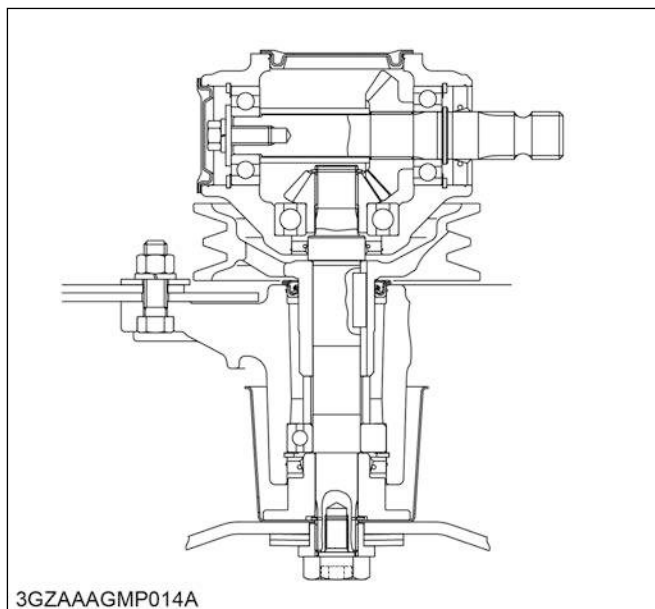
(When reassembling)

- Replace the oil seals (32), (23), (13) and (5) with new ones.

Tightening torque	Outer pulley mounting nut	167 to 190 N·m 17.0 to 19.3 kgf·m 123 to 140 lbf·ft
	Pulley holder mounting bolt	77.4 to 90.2 N·m 7.90 to 9.19 kgf·m 57.1 to 66.5 lbf·ft

5.8 Checking turning torque of pinion shaft

3GMAAADMP018A



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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.

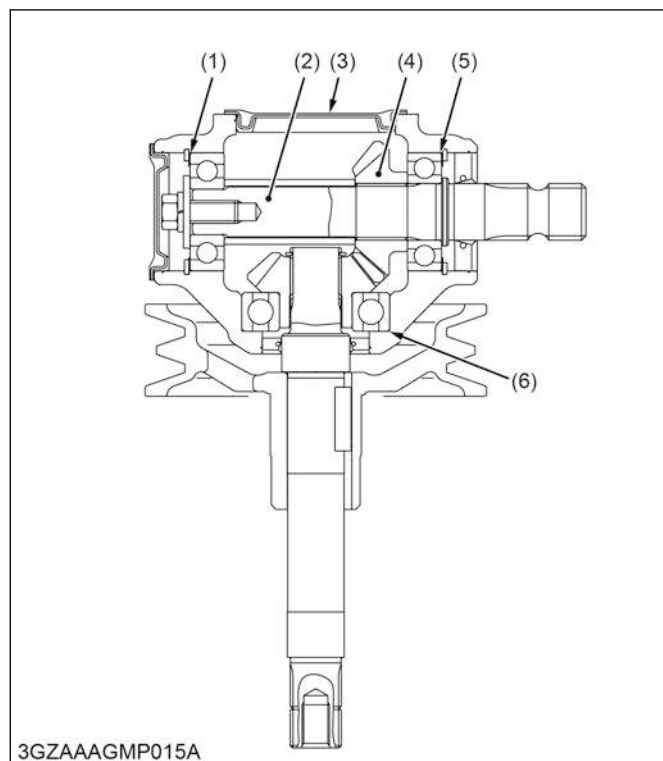
3. If the measurement exceeds the factory specification, check the bearings and gears.

Turning force	Factory specification	Less than 118 N 12.0 kgf 26.5 lbf
Turning torque		Less than 1.47 N·m 0.15 kgf·m 1.08 lbf·ft

(Reference)

Thickness of adjusting shims (1), (5)	0.20 mm (0.0079 in.)
	0.30 mm (0.012 in.)
Thickness of adjusting shims (6)	0.10 mm (0.0039 in.)
	0.20 mm (0.0079 in.)

5.9 Checking backlash between bevel gears



- (1) Shim (4) Bevel gear
(2) Pinion shaft (5) Shim
(3) Gear box cap (6) Shim

1. Remove the gear box cap (3).
2. Attach plastigauge on the bevel gear (4) on the pinion shaft (2).
3. Turn the pinion shaft (2).
4. Remove the plastigauge, and measure the plastigauge. (Backlash equal the measurement)
5. If the backlash exceeds the allowable limit, adjust with shims (1), (5), (6).

Backlash between bevel gears	Factory specification	0.13 to 0.25 mm 0.0051 to 0.0098 in.
	Allowable limit	0.40 mm 0.016 in.

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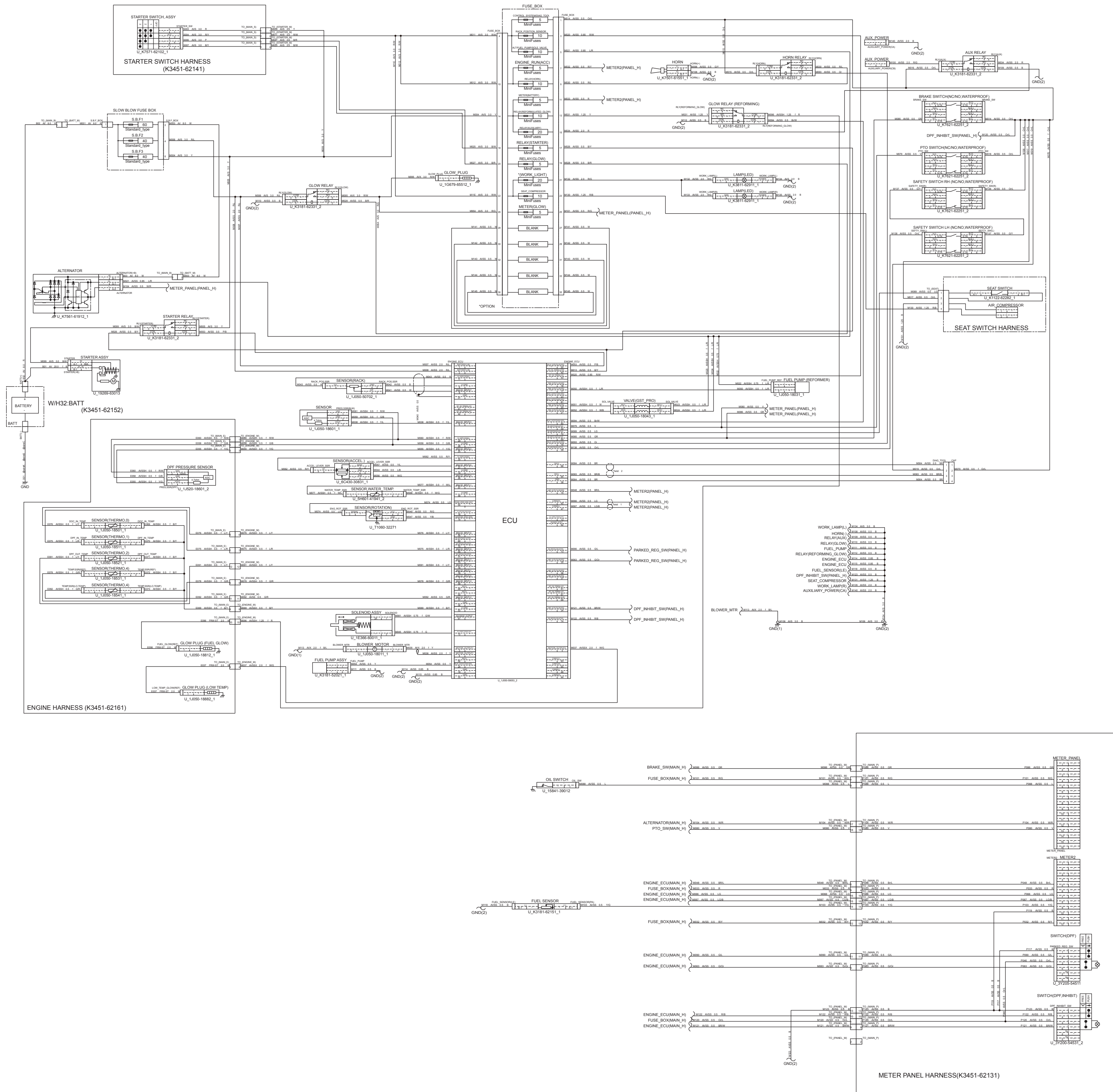
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