

WSM

WORKSHOP MANUAL **TRACTOR**

G2160, G2160-R48S, G2460G

Kubota

TO THE READER

This WORKSHOP MANUAL has been prepared to provide servicing personnel with information on the mechanism, service and maintenance of KUBOTA G2160. It is divided into two parts, "MECHANISM" and "SERVICING" for each section except "ENGINE" section.

■ MECHANISM

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

■ SERVICING

The heading "GENERAL" includes general precautions, check and maintenance and special tools. Other section, there are troubleshooting, servicing specification lists, checking and adjusting, disassembling and assembling, and servicing which cover procedures, precautions, factory specifications and allowable limits.

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

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

December 2000

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SAFETY FIRST

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

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



DANGER

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



WARNING

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



CAUTION

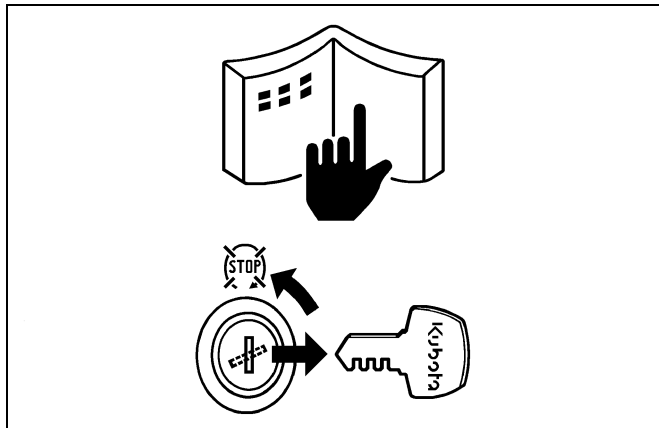
: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

■ IMPORTANT

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

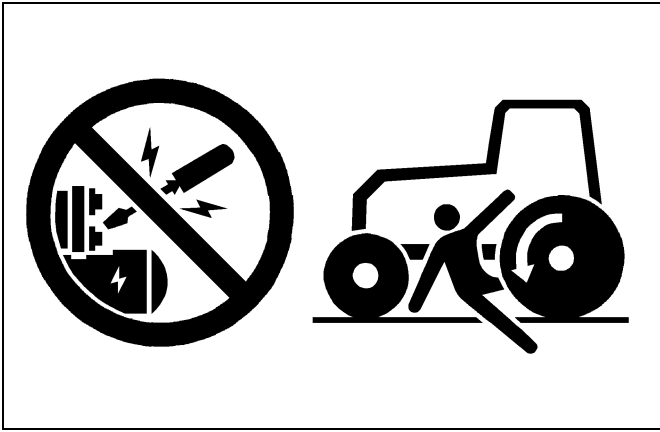
■ NOTE

: Gives helpful information.



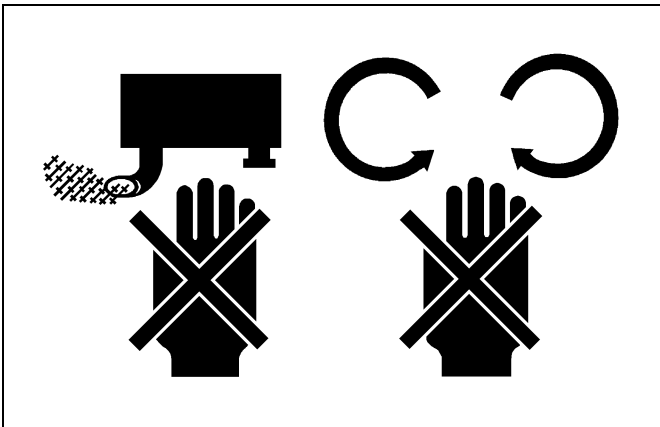
BEFORE SERVICING AND REPAIRING

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



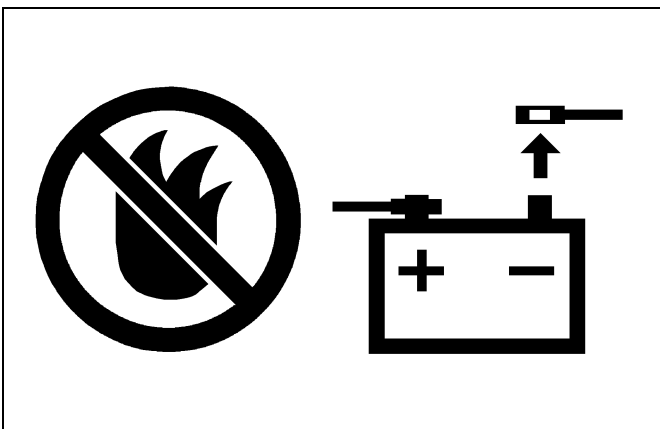
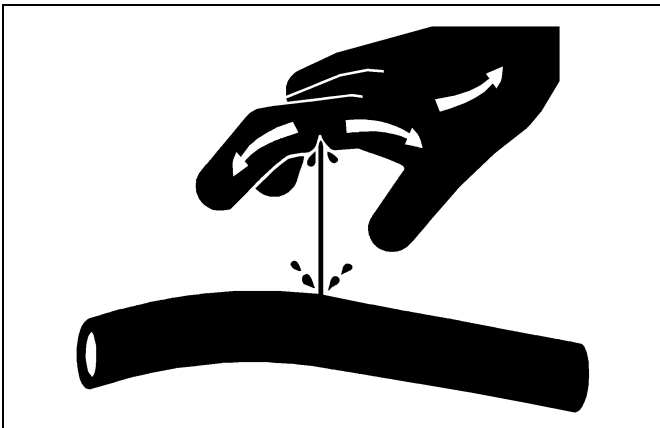
SAFETY STARTING

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



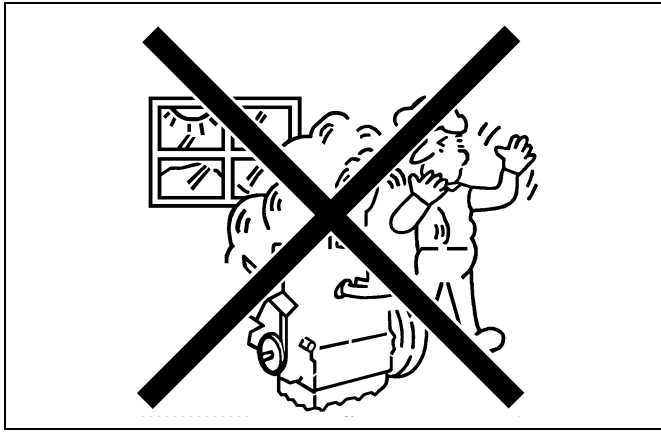
SAFETY WORKING

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

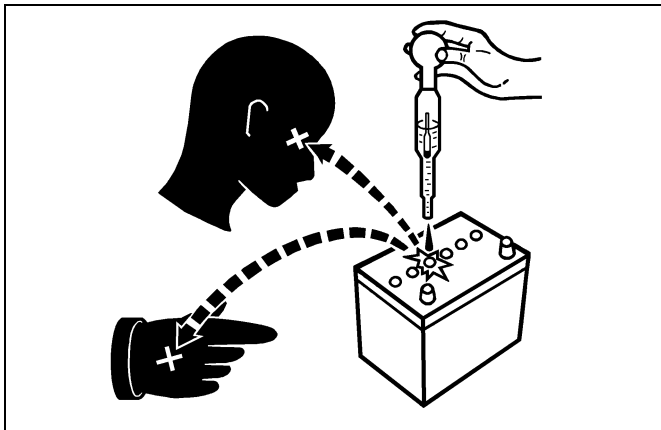


AVOID FIRES

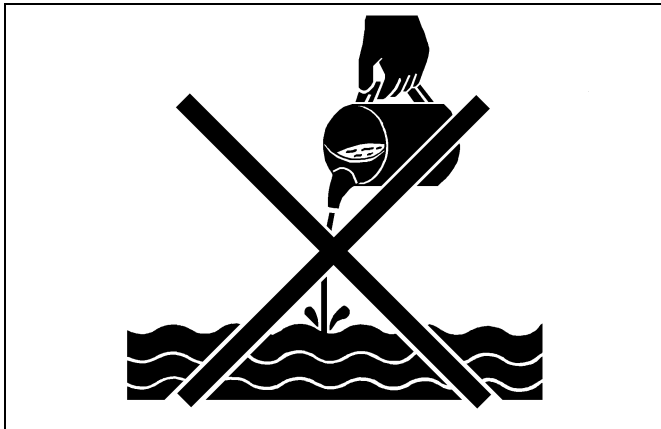
- Fuel is extremely flammable and explosive under certain conditions. Do not smoke or allow flames or sparks in your working area.
- To avoid sparks from an accidental short circuit, always disconnect the battery negative cable first and connect it last.
- Battery gas can explode. Keep sparks and open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

**VENTILATE WORK AREA**

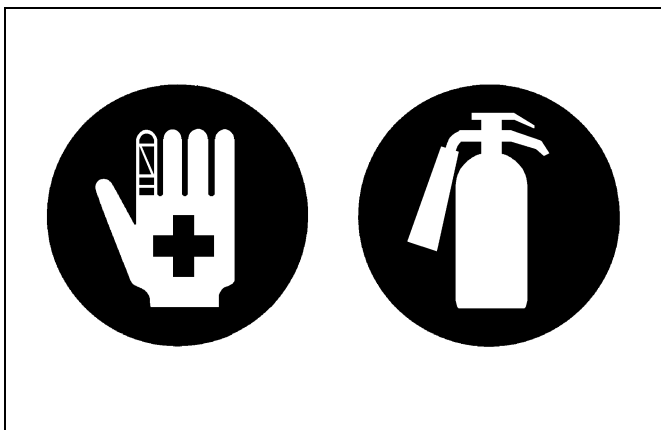
- If the engine must be running to do some work, make sure the area is well ventilated. Never run the engine in a closed area. The exhaust gas contains poisonous carbon monoxide.

**PREVENT ACID BURNS**

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

**DISPOSE OF FLUIDS PROPERLY**

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

**PREPARE FOR EMERGENCIES**

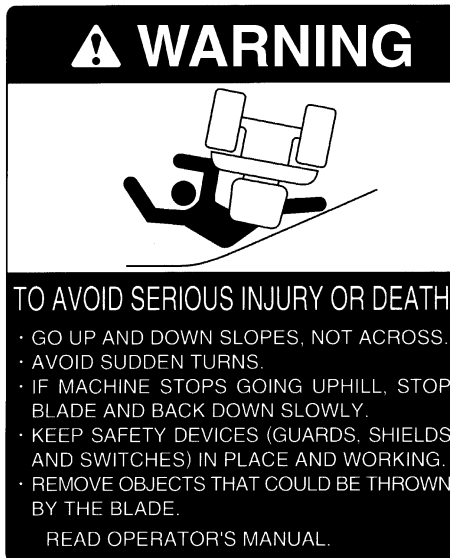
- Keep a first aid kit and fire extinguisher handy at all times.
- Keep emergency numbers for doctors, ambulance service, hospital and fire department near your telephone.

SAFETY DECALS

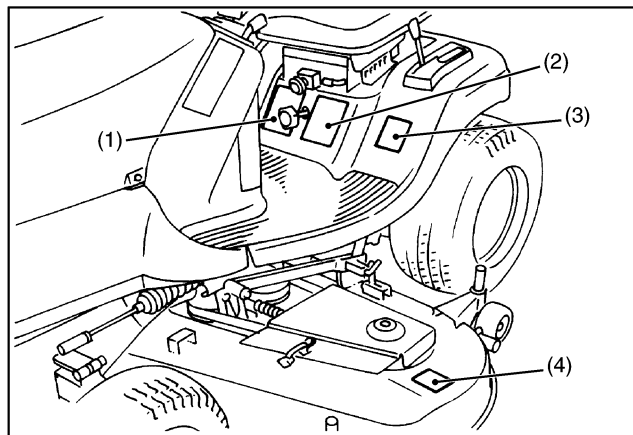
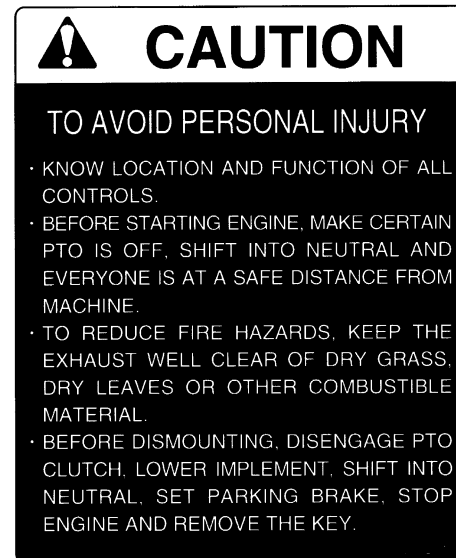
- The following safety decals are installed on the machine.

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

(1) Part No. K1211-6581-1



(2) Part No. K1211-6582-1

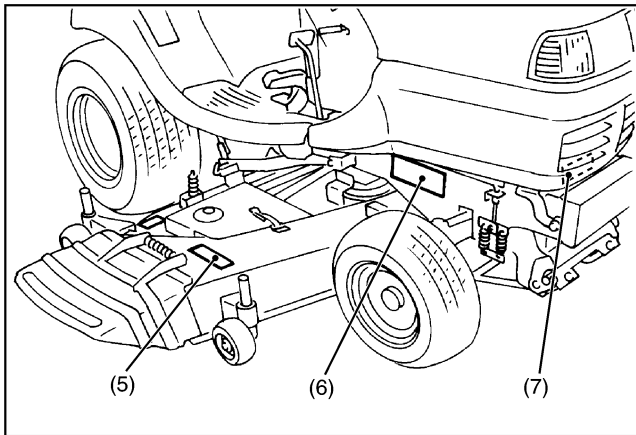


(3) Part No. K1122-6584-2

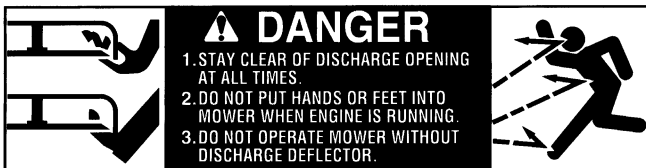


(4) Part No. K5112-7312-2





(5) Part No. K5112-7311-2

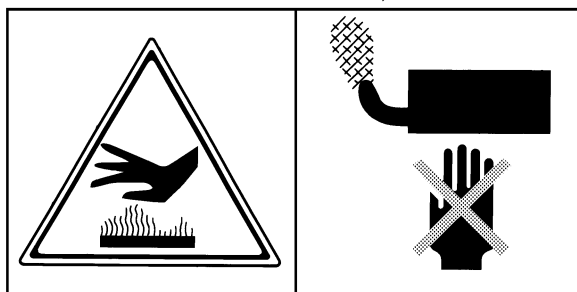


(6) Part No. K1122-6583-1

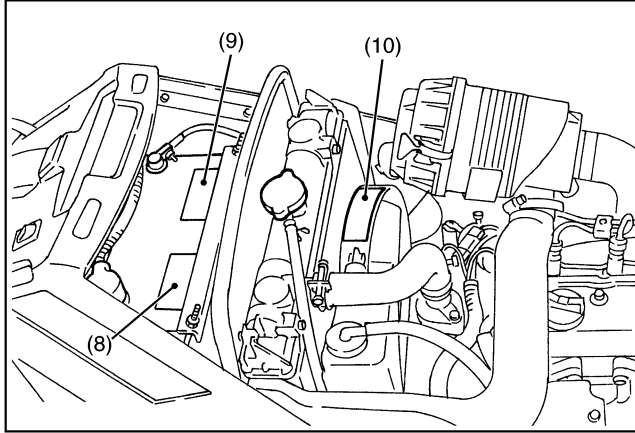


(7) Part No. K2561-6542-1

Do not touch hot surface like muffler, etc..



3GGAAACCP002A



(8) Part No. K1211-6115-1



(9) Part No. K1211-6116-1

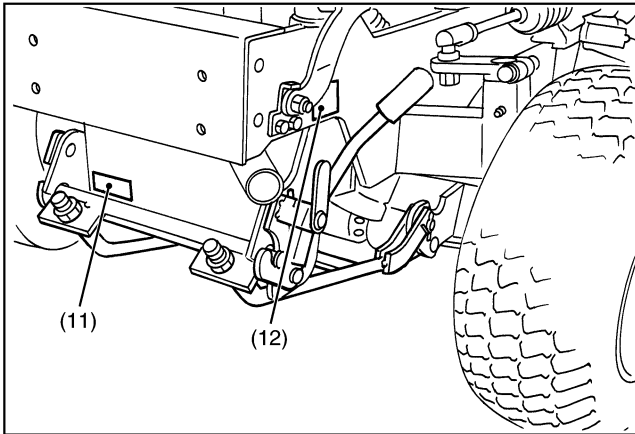


(10) Part No. K1213-6586-1

Stay clear of engine fan and fan belt

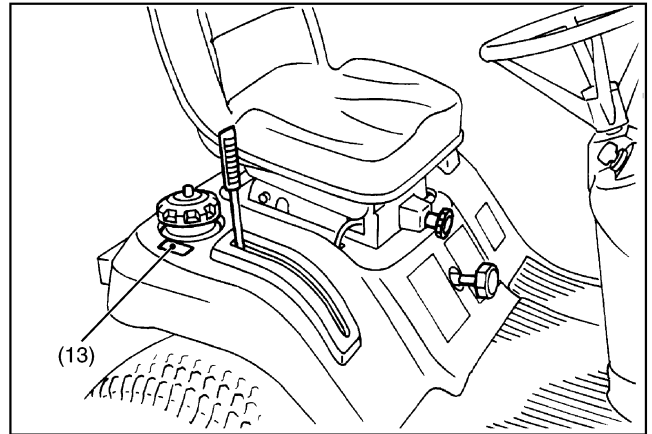


3GGAAACCP003A



(11) Part No. K1213-6532-1

Do not touch hot surface like muffler, etc..



(13) Part No. K1211-6585-1

Diesel fuel
only

No fire



(12) Part No. K2110-6574-1

**CARE OF DANGER, WARNING AND CAUTION LABELS**

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

3GGAAACCP004A

SPECIFICATIONS

Model			G2160
Maximum gross power			15.6 kW (21 HP)
Engine	Model		D782-E-G21
	Type		Indirect injection, vertical, water cooled, 4-cycle diesel engine
	Number of cylinders		3
	Bore and stroke		67.0 × 73.6 mm (2.64 × 2.90 in.)
	Total displacement		778 cm ³ (47.48 cu.in.)
	Rated revolution		3000 rpm
	Combustion chamber		Spherical type (E-TVCS)
	Fuel injection pump		Bosch MD type mini pump
	Governor		Centrifugal ball mechanical governor
	Injection nozzle		Bosch throttle type
	Injection timing		0.33 to 0.37 rad. (19° to 21°) before T.D.C.
	Injection order		1-2-3
	Injection pressure		13.73 MPa (140 kgf/cm ² , 1990 psi)
	Compression ratio		23 : 1
	Lubricating system		Forced lubrication by gear pump
	Cooling system		Pressurized radiator, forced circulation with water pump
	Lubricating oil		API Service classification CCor CD, Below 0°C (32 °F) : SAE 10W or 10W-30, 0 to 25 °C (32 °F to 77 ° F) : SAE 20 or 10W-30, Above 25 °C (77 °F) : SAE 30 or 10W-30
	Starting system		Electric starter (12 V, 1.0 kW)
	Battery		51R (12V, 450CCA)
	Fuel		No.2-D Diesel fuel (ASTM D975) [No.1-D diesel fuel, if temperature is below - 10 °C (14 °F)]
Capacities	Fuel tank		22L (5.8U.S.gals., 4.8 Imp. gals.)
	Engine crankcase		2.8L (2.95 U.S.qts., 2.4 Imp.qts.)
	Engine coolant		2.1L (2.2 U.S.qts., 1.8 Imp.qts.)
	Recovery tank		0.25 L (0.26 U.S.qts., 0.22 Imp.qts.)
	Transmission (Including HST and cylinder)		4.5L (4.75 U.S.qts., 3.86 Imp.qts.)
	Mower gear case oil		0.40L (0.42 U.S.qts., 0.35 Imp.qts.)
Tires	Front		16 × 6.50-8 (4PR) Turf
	Rear		23 × 10.5-12 (4PR) Turf
Travelling speeds	Forward		0 to 15.0 km/h (0 to 9.3 mph)
	Reverse		0 to 6.0 km/h (0 to 3.8 mph)
Dimensions	Overall length		1885 mm (74.2 in.)
	Overall width (With mower)		1843 mm (72.6 in.)
	Overall height		1280 mm (50.4 in.)
	Wheel base		1290 mm (50.8 in.)
	Treads	Front	825 mm (32.5 in.)
		Rear	780 mm (30.7 in.)
Weight (Without mower deck and grass collector)			430 kg (948 lbs)
PTO			Belt drive
PTO clutch			Belt tension
Revolution (PTO speed)			2576 rpm
PTO brake			Available

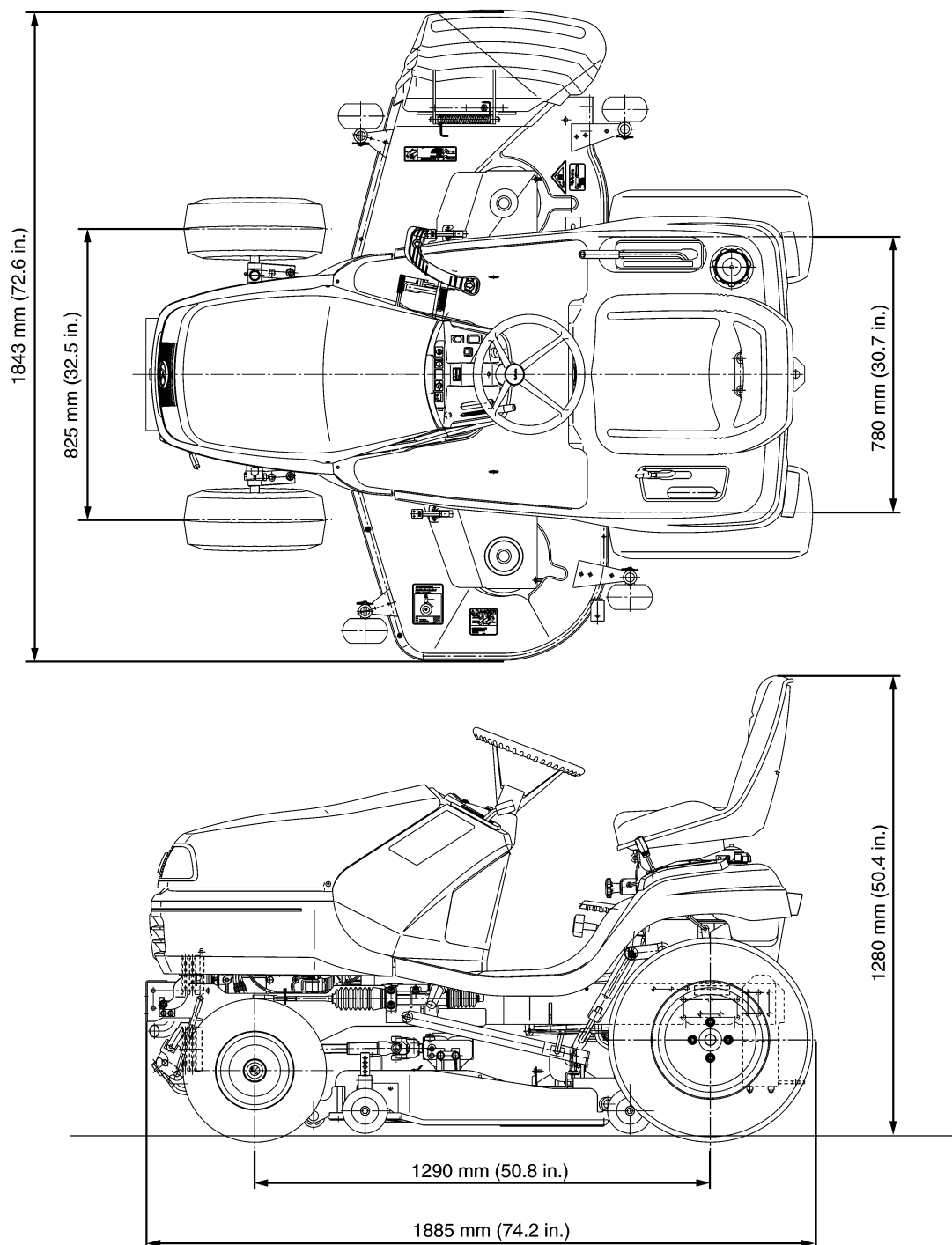
W1028929

Model		G2160	
Steering		Electric power steering (EPS)	
Transmission		Hydrostatic transmission	
Brake		Internal expanding brake	
Mower	Model	RCK54-24G	RCK60B-24G
	Total length	946 mm (37.2 in.)	992 mm (39.1 in.)
	Total width	1690 mm (66.5 in.)	1843 mm (72.5 in.)
	Total height	273 mm (10.7 in.)	
	Mounting method	Quick joint, parallel linkage	
	Adjustment of cutting height	Dial gauge	
	Cutting width	1372 mm (54 in.)	1524 mm (60 in.)
	Cutting height	25 to 102 mm (1.0 to 4.0 in.)	
	Number of blades	3	
	Weight (Approx.)	95 kg (209 lbs)	110 kg (243 lbs)
	Discharge	Right side	

The company reserves the right to change the specifications without notice.

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DIMENSIONS



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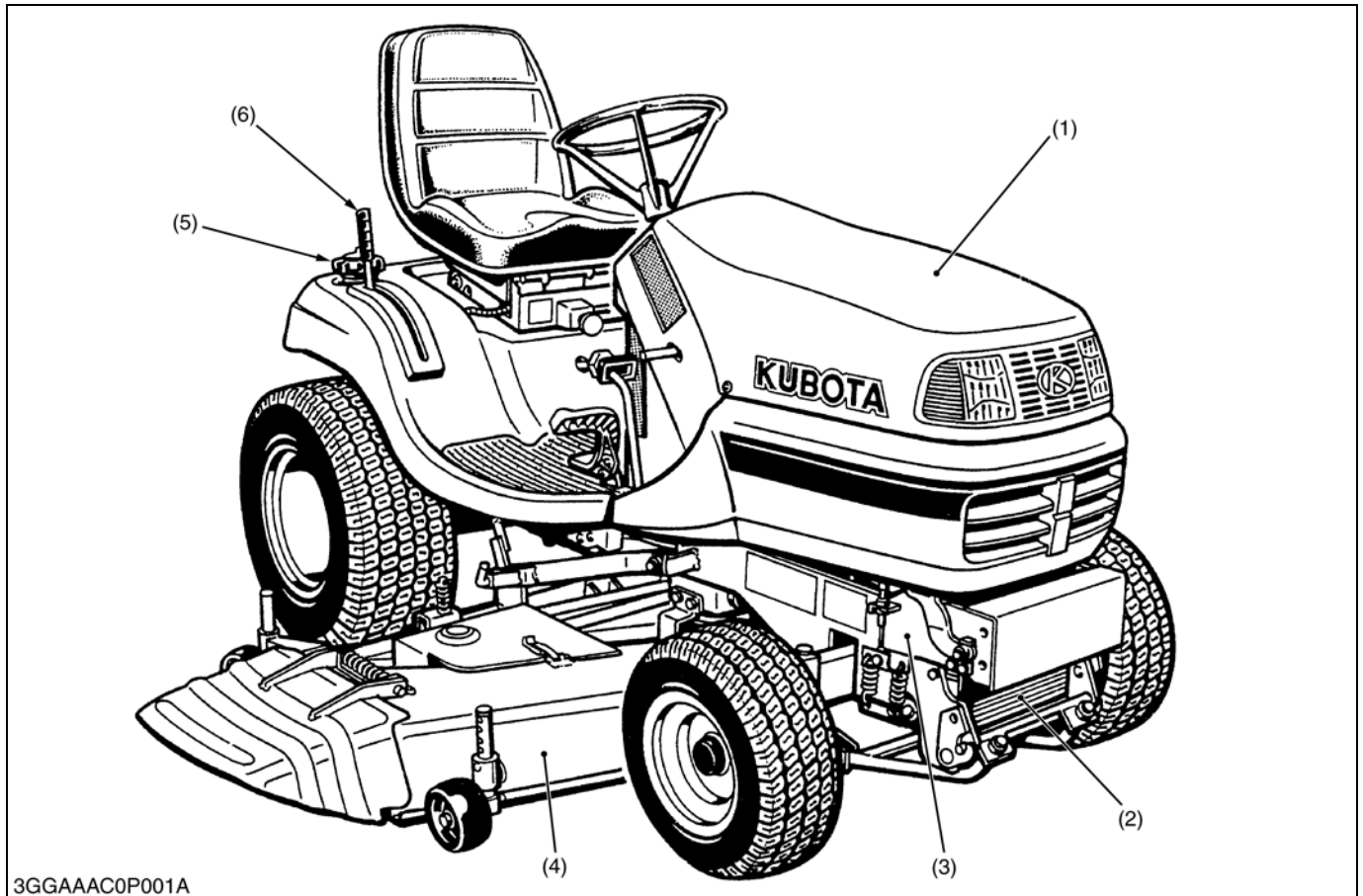
G GENERAL

GENERAL

CONTENTS

1. FEATURES	G-1
2. IDENTIFICATION.....	G-2
3. GENERAL PRECAUTIONS	G-3
4. HANDLING PRECAUTIONS FOR ELECTRICAL PARTS AND WIRING ..	G-4
[1] WIRING.....	G-4
[2] BATTERY.....	G-6
[3] FUSE.....	G-6
[4] CONNECTOR.....	G-6
[5] HANDLING OF CIRCUIT TESTER.....	G-7
5. LUBRICANTS, FUEL AND COOLANT	G-8
6. TIGHTENING TORQUES	G-9
[1] GENERAL USE SCREWS, BOLTS AND NUTS.....	G-9
[2] METRIC SCREWS, BOLTS AND NUTS	G-9
[3] AMERICAN STANDARD SCREWS, BOLTS AND NUTS WITH UNC OR UNF THREADS	G-10
7. MAINTENANCE CHECK LIST	G-11
8. CHECK AND MAINTENANCE.....	G-12
[1] DAILY CHECK	G-12
[2] CHECK POINTS OF INITIAL 50 HOURS.....	G-17
[3] CHECK POINTS OF EVERY 50 HOURS.....	G-19
[4] CHECK POINTS OF EVERY 100 HOURS.....	G-23
[5] CHECK POINTS OF EVERY 150 HOURS	G-25
[6] CHECK POINTS OF EVERY 200 HOURS.....	G-25
[7] CHECK POINTS OF EVERY 300 HOURS.....	G-26
[8] CHECK POINTS OF EVERY 500 HOURS.....	G-27
[9] CHECK POINTS OF EVERY 1 YEAR	G-28
9. SPECIAL TOOLS.....	G-33
[1] SPECIAL TOOLS FOR ENGINE	G-33
[2] SPECIAL TOOLS FOR MACHINE.....	G-39
10. IMPLEMENT LIMITATIONS.....	G-43

1. FEATURES



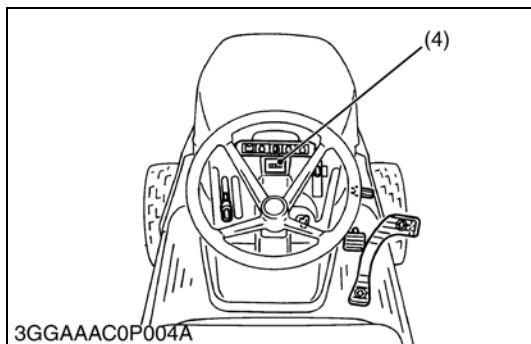
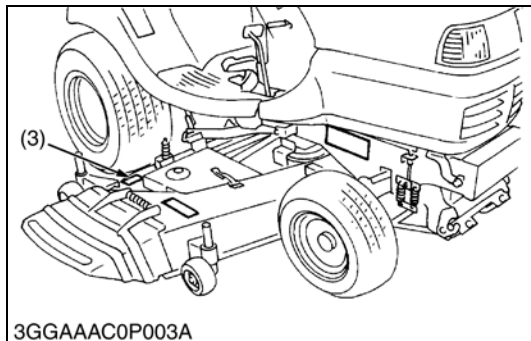
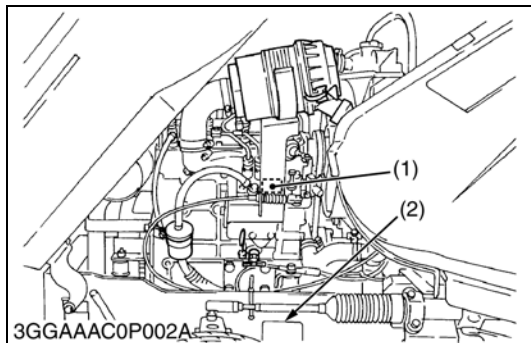
1. E-TVCS engine
2. Front PTO (option)
3. Rugged ladder type chassis
4. Low-noise, high-performance mower
5. Large-capacity fuel tank
6. Hydraulic mower lift

2. IDENTIFICATION

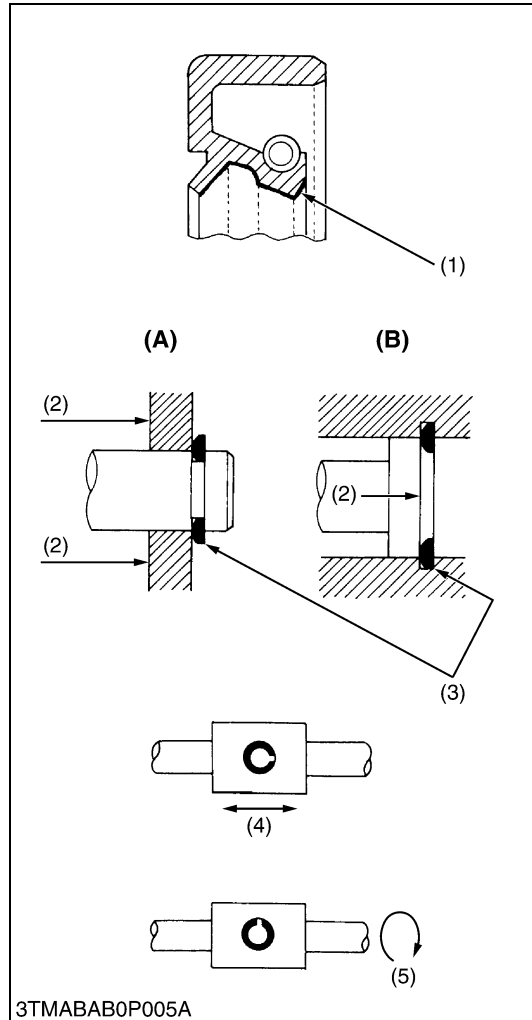
When contacting your local KUBOTA distributor, always specify engine serial number (1), machine serial number (2), mower serial number (3) and hour meter reading.

- | | |
|---------------------------|-------------------------|
| (1) Engine Serial Number | (3) Mower Serial Number |
| (2) Machine Serial Number | (4) Hour Meter |

W1010714



3. GENERAL PRECAUTIONS



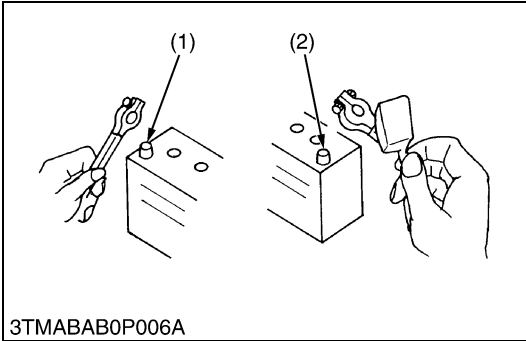
- During disassembly, carefully arrange removed parts in a clean area to prevent confusion later. Screws, bolts and nuts should be installed in their original position to prevent reassembly errors.
- When special tools are required, use KUBOTA genuine special tools. Special tools which are not frequently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

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

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

W1010904

4. HANDLING PRECAUTIONS FOR ELECTRICAL PARTS AND WIRING



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

■ IMPORTANT

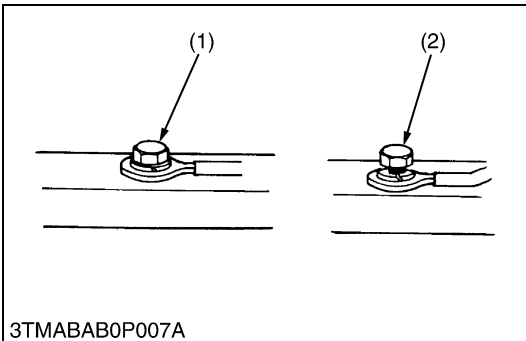
- Check electrical wiring for damage and loosened connection every year. To this end, educate the customer to do his or her own check and at the same time recommend the dealer to perform periodic check for a fee.
- Do not attempt to modify or remodel any electrical parts and wiring.
- When removing the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

(1) Negative Terminal

(2) Positive Terminal

W1011114

[1] WIRING

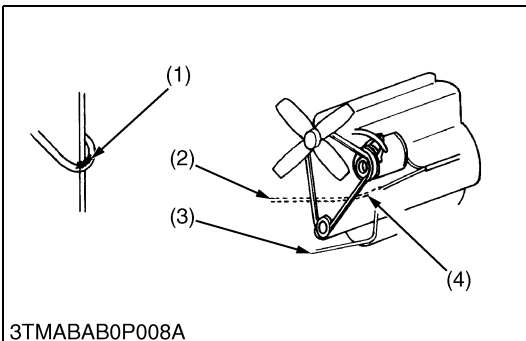


- Securely tighten wiring terminals.

(1) Correct
(Securely tighten)

(2) Incorrect
(Loosening leads to faulty contact)

W1011216

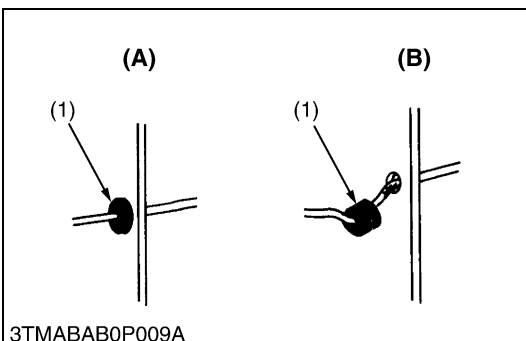


- Do not let wiring contact dangerous part.

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

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

W1011313

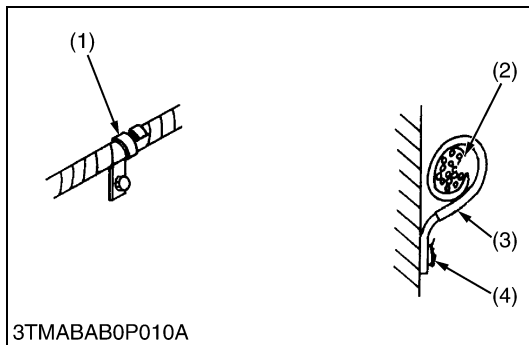


- Securely insert grommet.

(1) Grommet

(A) Correct
(B) Incorrect

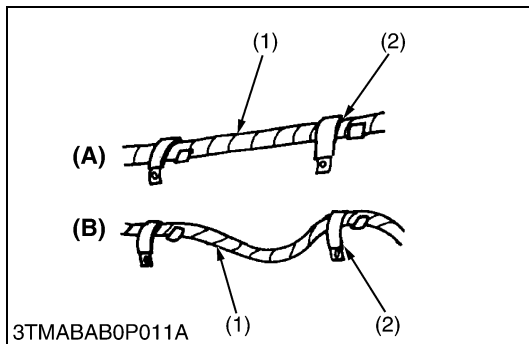
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- Securely clamp, being careful not to damage wiring.

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

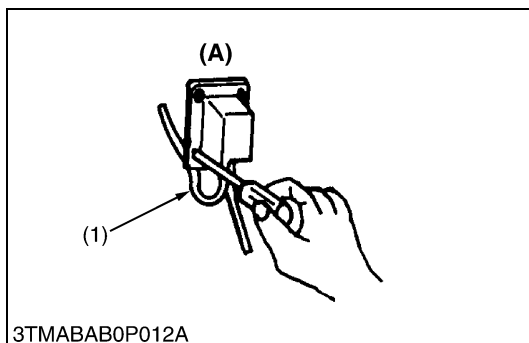
W1011458



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

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

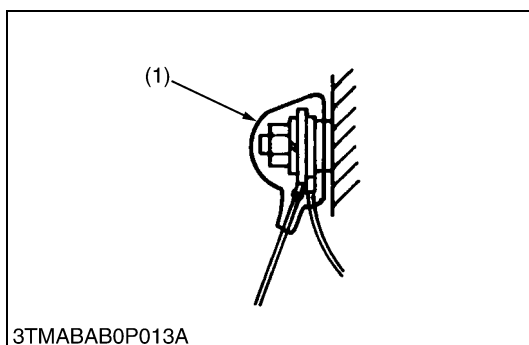
W1011587



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

- (1) Wiring
 (A) Incorrect

W1011670

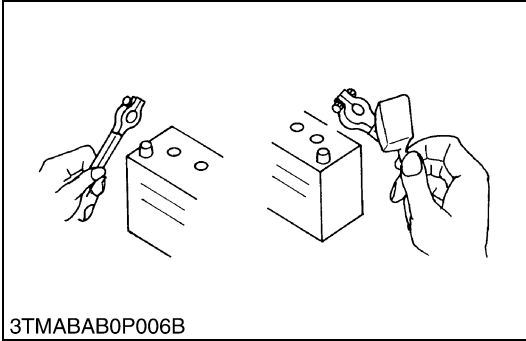


- After installing wiring, check protection of terminals and clamped condition of wiring, only connect battery.

- (1) Cover
 • Securely Install Cover

W1011735

[2] BATTERY



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

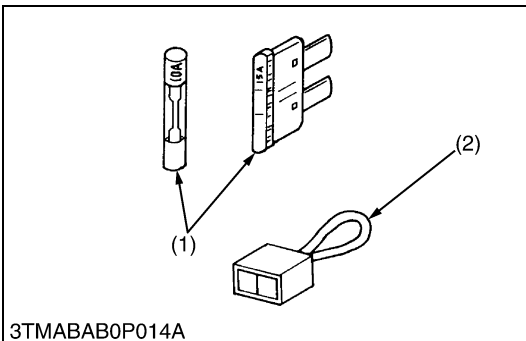


CAUTION

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

W1011816

[3] FUSE



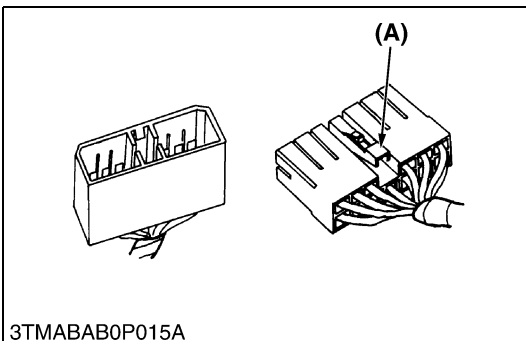
- Use fuses with specified capacity. Neither too large or small capacity fuse is acceptable.
- Never use steel or copper wire in place of fuse.
- Do not install working light, radio set, etc. on machine which is not provided with reserve power supply.
- Do not install accessories if fuse capacity of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

(1) Fuse

(2) Slow Blow Fuse

W1012092

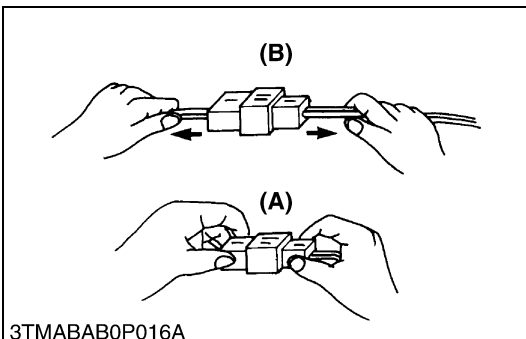
[4] CONNECTOR



- For connector with lock, push lock to separate.

(A) Push

W1012211

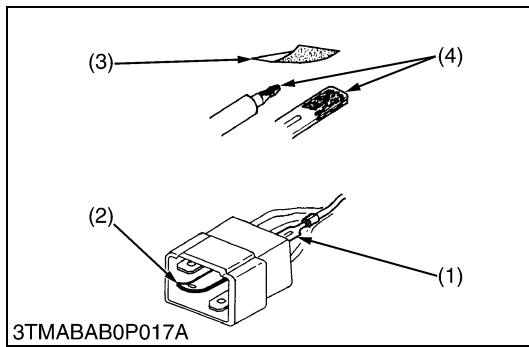


- In separating connectors, do not pull wire harnesses.
- Hold connector bodies to separate.

(A) Correct

(B) Incorrect

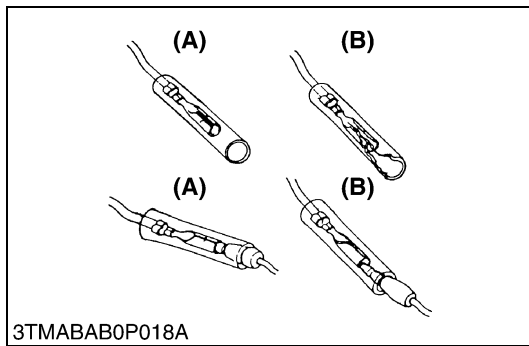
W1012272



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

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

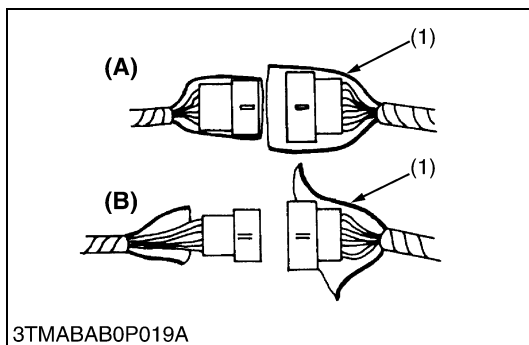
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- Make certain that there is no female connector being too open.

(A) Correct (B) Incorrect

W1012430

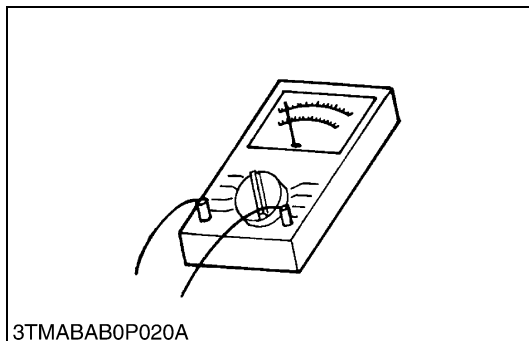


- Make certain plastic cover is large enough to cover whole connector.

(1) Cover (A) Correct (B) Incorrect

W1054624

[5] HANDLING OF CIRCUIT TESTER



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

W1012684

5. LUBRICANTS, FUEL AND COOLANT

	Place		Capacity	Lubricants
			G2160	
1	Fuel		22 L 5.8 U.S.gals 4.8 Imp.gals	[ASTM D975] No. 2-D diesel fuel No. 1-D diesel fuel if temperature is below –10 °C (14 °F)
2	Coolant	Cooling system	2.1 L 2.2 U.S.qts 1.8 Imp.qts	Fresh clean water (soft water) with anti-freeze
		Recovery tank	0.25 L 0.26 U.S.qts 0.22 Imp.qts	
3	Engine crankcase		2.8 L 2.95 U.S.qts 2.4 Imp.qts	Engine oil : MIL-L-46152, MIL-L-2104C, API Service Classification CC or CD Below 0 °C (32 °F) : SAE10W or 10W-30 0 to 25 °C (32 to 77 °F): SAE20 or 10W-30 Above 25 °C (77 °F): SAE30 or 10W-30
4	Transmission (Including HST & cylinder)		4.5 L 4.75 U.S.qts 3.86 Imp.qts	KUBOTA UDT or SUPER UDT fluid
5	Mower gear case		0.40 L 0.42 U.S.qts 0.35 Imp.qts	SAE #90 gear oil
6	King pin (Left and right)		Until grease overflows	SAE multipurpose type grease
	Center pin			
	PTO tension arm			
	Universal joint			
	Side blade shaft			
	Center blade shaft			
	Mower tension arm			
7	Speed control pedal shaft		Moderate amount	Oil or spray type grease
	Lift lever shaft			
	Brake pedal shaft			
	PTO lever fulcrum			
	Anti-scalp roller			
	Speed control link			
	Accelerator cable			

6. TIGHTENING TORQUES

[1] GENERAL USE SCREWS, BOLTS AND NUTS

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

Indication on top of bolt	 No-grade or 4T						 7T						 9T		
Material of bolt	SS400, S20C						S43C, S48C						SCr435, SCM435		
Material of opponent part	Ordinariness			Aluminum			Ordinariness			Aluminum			Ordinariness		
Unit Diameter	N·m	kgf·m	ft-lbs	N·m	kgf·m	ft-lbs	N·m	kgf·m	ft-lbs	N·m	kgf·m	ft-lbs	N·m	kgf·m	ft-lbs
M6 (6 mm, 0.24 in.)	7.85 to 9.31	0.80 to 0.95	5.79 to 6.87	7.85 to 8.82	0.80 to 0.90	5.79 to 6.50	9.81 to 11.2	1.00 to 1.15	7.24 to 8.31	7.85 to 8.82	0.80 to 0.90	5.79 to 6.50	12.3 to 14.2	1.25 to 1.45	9.05 to 10.4
M8 (8 mm, 0.31 in.)	17.7 to 20.5	1.8 to 2.1	13.1 to 15.1	16.7 to 19.6	1.7 to 2.0	12.3 to 14.4	23.6 to 27.4	2.4 to 2.8	17.4 to 20.2	17.7 to 20.5	1.8 to 2.1	13.1 to 15.1	29.5 to 34.3	3.0 to 3.5	21.7 to 25.3
M10 (10 mm, 0.39 in.)	39.3 to 45.1	4.0 to 4.6	29.0 to 33.2	31.4 to 34.3	3.2 to 3.5	23.2 to 25.3	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2	39.3 to 44.1	4.0 to 4.5	29.0 to 32.5	60.9 to 70.6	6.2 to 7.2	44.9 to 52.0
M12 (12 mm, 0.47 in.)	62.8 to 72.5	6.4 to 7.4	46.3 to 53.5	—	—	—	77.5 to 90.2	7.9 to 9.2	57.2 to 66.5	62.8 to 72.5	6.4 to 7.4	46.3 to 53.5	103 to 117	10.5 to 12.0	76.0 to 86.7
M14 (14 mm, 0.55 in.)	108 to 125	11.0 to 12.8	79.6 to 92.5	—	—	—	124 to 147	12.6 to 15.0	91.2 to 108	—	—	—	167 to 196	17.0 to 20.0	123 to 144
M16 (16 mm, 0.63 in.)	167 to 191	17.0 to 19.5	123 to 141	—	—	—	197 to 225	20.0 to 23.0	145 to 166	—	—	—	260 to 304	26.5 to 31.0	192 to 224
M18 (18 mm, 0.71 in.)	246 to 284	25.0 to 29.0	181 to 209	—	—	—	275 to 318	28.0 to 32.5	203 to 235	—	—	—	344 to 402	35.0 to 41.0	254 to 296
M20 (20 mm, 0.79 in.)	334 to 392	34.0 to 40.0	246 to 289	—	—	—	368 to 431	37.5 to 44.0	272 to 318	—	—	—	491 to 568	50.0 to 58.0	362 to 419

W1034542

[2] METRIC SCREWS, BOLTS AND NUTS

Grade Unit Nominal Diameter	Property class 8.8 			Property class 10.9 		
	N·m	kgf·m	ft-lbs	N·m	kgf·m	ft-lbs
M 8	23.6 to 27.4	2.4 to 2.8	17.4 to 20.2	29.4 to 34.3	3.0 to 3.5	21.7 to 25.3
M 10	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2	60.8 to 70.5	6.2 to 7.2	44.9 to 52.1
M 12	77.5 to 90.1	7.9 to 9.2	57.2 to 66.5	103.0 to 117.0	10.5 to 12.0	76.0 to 86.8
M 14	124.0 to 147.0	12.6 to 15.0	91.2 to 108.0	167.0 to 196.0	17.0 to 20.0	123.0 to 144.0
M 16	196.0 to 225.0	20.0 to 23.0	145.0 to 166.0	260.0 to 303.0	26.5 to 31.0	192.0 to 224.0

W1016172

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

Grade Unit Nominal Diameter	SAE GR.5 			SAE GR.8 		
	N·m	kgf·m	ft-lbs	N·m	kgf·m	ft-lbs
5/16	23.1 to 27.8	2.35 to 2.84	17.0 to 20.5	32.5 to 39.3	3.31 to 4.01	24.0 to 29.0
3/8	47.5 to 57.0	4.84 to 5.82	35.0 to 42.0	61.0 to 73.2	6.22 to 7.47	45.0 to 54.0
1/2	108.5 to 130.2	11.07 to 13.29	80.0 to 96.0	149.2 to 179.0	15.22 to 18.27	110.0 to 132.0
9/16	149.2 to 179.0	15.22 to 18.27	110.0 to 132.0	217.0 to 260.4	22.14 to 26.57	160.0 to 192.0
5/8	203.4 to 244.1	20.75 to 24.91	150.0 to 180.0	298.3 to 358.0	30.44 to 36.53	220.0 to 264.0

W1022485

7. MAINTENANCE CHECK LIST

No.	Period Item		Every 50 Hr	Hour meter reading									Reference page
				50	100	150	200	300	400	450	500	After	
1	Tires	Check	☆									Every 50 Hr	G-19
2	Battery condition	Check			☆		☆	☆	☆		☆	Every 100 Hr	G-24
3	Engine oil	Change		★	☆		☆	☆	☆		☆	Every 100 Hr	G-17
4	Engine oil filter cartridge	Change		★			☆		☆			Every 200 Hr	G-18
5	Transmission fluid	Change					☆				☆	Every 300 Hr	G-26
6	Transmission oil filter cartridge	Replace		★			☆				☆	Every 300 Hr	G-18
7	Transmission oil strainer	Clean					☆				☆	Every 300 Hr	G-27
8	Hydraulic hose	Check					☆		☆			Every 200 Hr	G-26
		Replace										Every 2 Years*	G-30
9	Fuel lines	Check			☆		☆	☆	☆		☆	Every 100 Hr	G-23
		Replace ¹										Every 2 Years*	G-30
10	Fuel filter	Check			☆		☆	☆	☆		☆	Every 100 Hr	G-23
		Replace ¹									☆	Every 500 Hr	G-27
11	Radiator hose and clamp	Check					☆		☆			Every 200 Hr	G-25
		Replace ¹										Every 2 Years*	G-30
12	Radiator core	Clean			☆		☆	☆	☆		☆	Every 100 Hr**	G-23
13	Cooling system	Clean										Every 1 Year	G-28
14	Coolant	Change										Every 1 Year	G-28
15	Air cleaner element	Clean	☆**										G-21
		Replace										Every 1 Year**	G-28
16	Fan belt tension	Adjust	☆										G-20
17	Front PTO belt tension	Adjust	☆***										G-22
18	Brake play	Adjust ¹	☆										G-19
19	Greasing	—	☆										G-20
20	Mower gear box oil	Change		★		☆		☆		☆		Every 150 Hr	G-18
21	Mower gear box oil seal	Replace										Every 2 Years*	G-31

■ IMPORTANT

★ : The maintenance indicated by ★ must be done initially.

* : Replace only if necessary.

** : This maintenance should be done more often in dusty conditions than in normal conditions.

*** : Initial elongation of the front PTO belt may occur prior to 25 hours. Adjust the tension spring length as needed to maintain belt tension.

¹ : These items should be serviced by an authorized KUBOTA Dealer, unless the owner has the proper tools and is mechanically proficient.

W1035769

8. CHECK AND MAINTENANCE



CAUTION

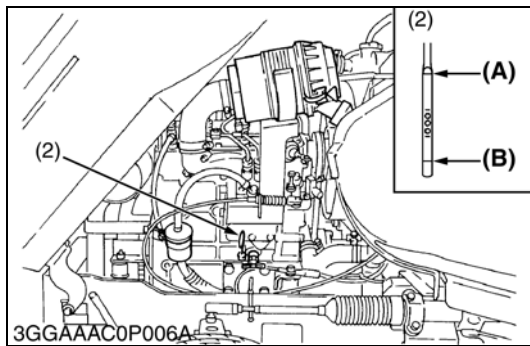
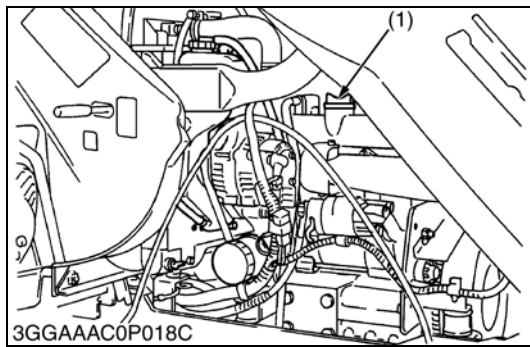
- Be sure to check and service the machine on a flat place with engine shut off, the parking brake on and chock the wheels.

[1] DAILY CHECK

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

Checking

- Check areas where previous trouble was experienced.
- Walk around the machine.
 1. Oil and water leak
 2. Engine oil level
 3. Coolant level in the recovery tank
 4. Damage of machine body, tightness of all bolts and nuts
 5. Radiator screen
 6. Panel screen
 7. Air cleaner
 8. Oiling
- Mower
 1. Make sure blade bolts are tight.
 2. Check blades for wear or damage.
 3. Check all hardware.
 4. Make sure all pins are in place.
- While sitting in the operator's seat,
 1. Speed control pedal
 2. Brake pedal
 3. Parking brake
- Turning the key switch "ON"
 1. Head lights
- Starting the engine,
 1. Color of the exhaust fumes
 2. If either of safety start switch and seat safety control do not operate properly, contact your KUBOTA Dealer immediately.
 3. Check for abnormal noise and vibration.
 4. Check Easy checkerTM.



Checking Engine Oil Level

⚠ CAUTION

- **To avoid personal injury : Always stop the engine and remove the key before checking oil.**
1. Check engine oil before starting and 5 minutes or more after the engine has stopped.
 2. Wipe dipstick area clean.
 3. To check the oil level, remove the dipstick (2), wipe it clean, replace it, and draw it out again. Check to see that the oil level is between the two notches.
 4. Add new oil to the prescribed level at the oil port if necessary.

■ IMPORTANT

- **Use the specified engine oil.**
Refer to “LUBRICANTS, FUEL AND COOLING WATER”.
(See page G-8)
- **When using new oil of a different maker or viscosity from the previous one, drain all used oil.**
Never mix two different types of oil.

- (1) Oil Inlet Plug
(2) Dipstick

- (A) Upper Level
(B) Lower Level

W1021025



Checking Amount of Fuel and Refueling

⚠ CAUTION

- Handle fuel carefully. If the engine is running, do not fill the fuel tank. If engine is hot, let engine cool several minutes before adding fuel. Do not smoke while filling the fuel tank or servicing the fuel system. Fill fuel tank only to bottom of filler neck.

1. Check the fuel level.
2. Take care that the fuel tank does not become empty.

Fuel tank capacity	22 L (5.8 U.S.gal.)
--------------------	---------------------

■ IMPORTANT

- **Use diesel fuel only**

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

■ NOTE

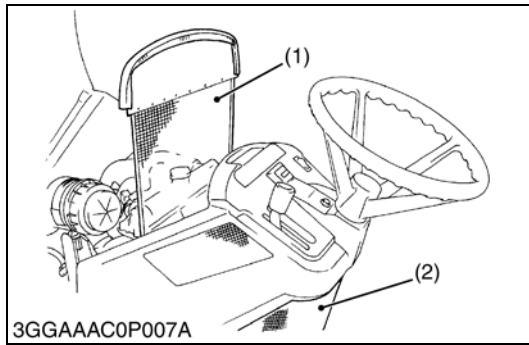
- **No.2-D is a distillate fuel of lower volatility for engines in industrial and heavy mobile service.**
(SAE J313 JUN87)

Grade of diesel fuel oil according to ASTM D975

Flash Point $^{\circ}\text{C}$ ($^{\circ}\text{F}$)	Water and Sediment, volume %	Carbon Residue on, 10 percent Residuum, %	Ash, weight %
Min	Max	Max	Max
52 (125)	0.05	0.35	0.01

Distillation Temperatures $^{\circ}\text{C}$ ($^{\circ}\text{F}$) 90 % Point		Viscosity Kinematic cSt or mm^2/s at 40°C		Viscosity saybolt, SUS at 100°F		Sulfur, weight %	Copper strip Corrosion	Catane Number
Min	Max	Min	Max	Min	Max	Max	Max	Min
282 (540)	338 (640)	1.9	4.1	32.6	40.1	0.50	No.3	40

W1021324



Radiator Screen and Panel Screen

Daily or after every 5 hours of operation, check to be sure the radiator screen (1) and panel screen (2) are clean. Dirt or chaff on the radiator screen (1) or radiator core decrease cooling performance.

1. Remove the radiator screen (1) and remove all foreign material.
2. Remove the dust from between the fins and the tube.
3. If scale forms in the tube, clean with scale inhibitor or its equivalent.
4. Each time the panel screen is covered with grass during operation, wipe off the screen with hand. Check the radiator screen (1) from time to time if grass often gets on it.
5. If dust or chaff is accumulated inside of the panel, clean the inside of the panel.

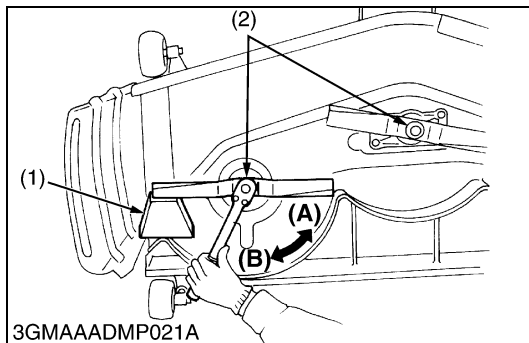
■ IMPORTANT

- **Be sure to stop the engine before cleaning the radiator screen.**

(1) Radiator Screen

(2) Panel Screen

W1022263



Retightening Mower Blade Screw



CAUTION

- **To avoid injury, always handle the mower blade with care.**
1. Dismount the mower and turn it over to expose the mower blades.
 2. Wedge a wooden block (1) securely between the mower blade and mower deck.
 3. Retighten the mower blade screw to the specified torque.
 4. If the mower blade screw (2) is worn or broken, replace it.

Tightening torque	Mower blade screw	88.2 to 117.6 N·m 9.0 to 12.0 kgf·m 65.1 to 86.8 ft-lbs
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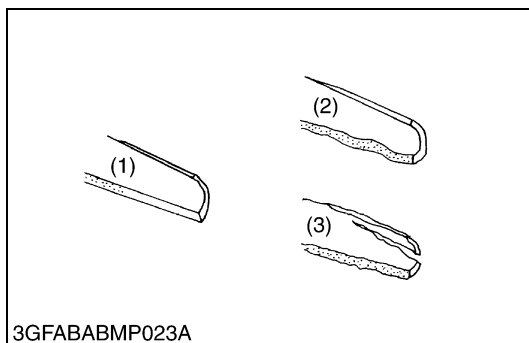
(1) Wooden Block

(2) Mower Blade Screw

(A) "LOOSEN"

(B) "TIGHTEN"

W1022525



Checking Mower Blade

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

■ NOTE

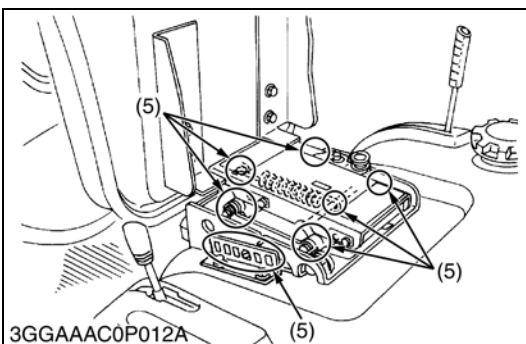
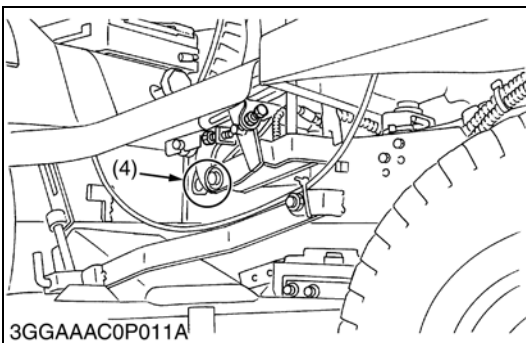
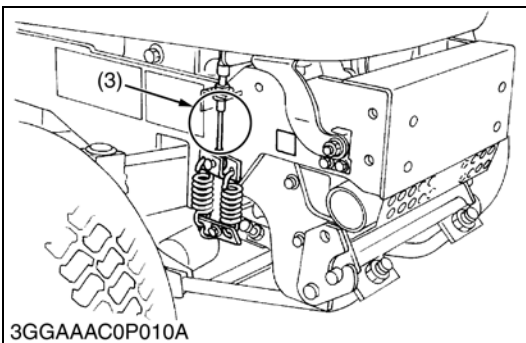
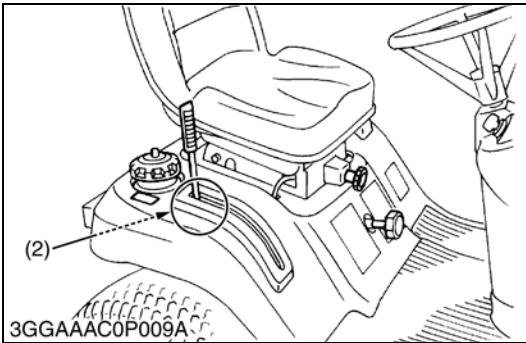
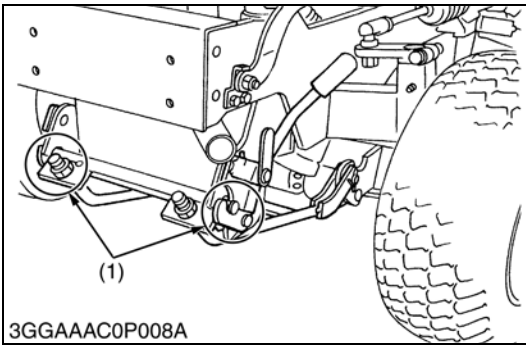
- **To sharpen the mower blades by yourself, clamp the mower blade securely in a vise and use a large mill file along the original bevel.**
- **To balance the mower blade, place a small rod through the center hole and check to see if the blade balances evenly. File heavy side of the blade until it balance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

(1) New Blade

(2) Worn Blade

(3) Cracked Blade

W1022841



Oiling



CAUTION

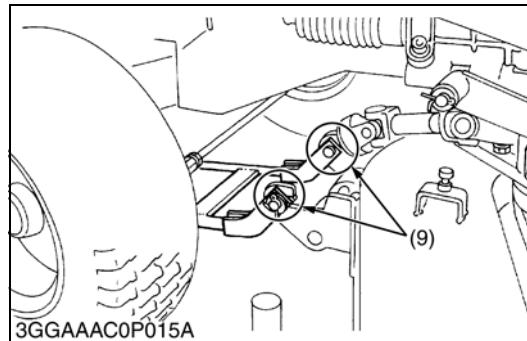
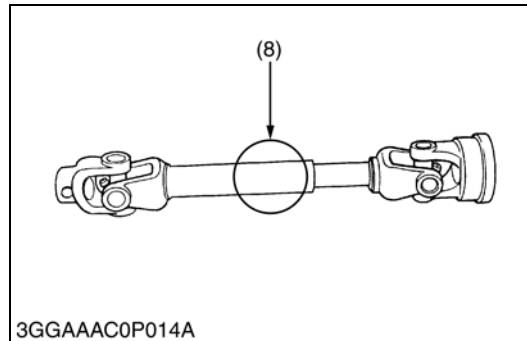
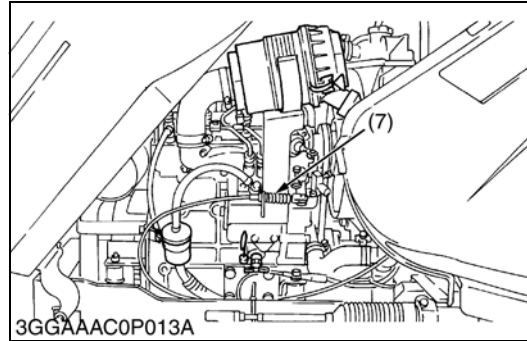
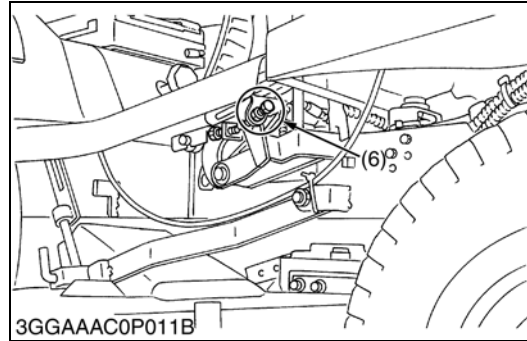
- Be sure to stop the engine and remove the key before oiling. Oil the following points before starting.

NOTE

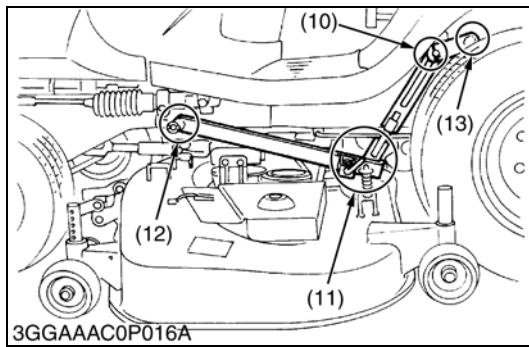
- Oil these points on both sides of the machine.

1. Apply oil to the following points.

- | | |
|---------------------------------------|-------------------------------|
| (1) Link Fulcrum | (6) Speed Control Pedal Shaft |
| (2) PTO Lever (Fulcrum) and PTO cable | (7) Throttle Cable |
| (3) Front PTO Cable | (8) Mower Universal Joint |
| (4) Brake Pedal | (9) Front Link |
| (5) Seat Adjuster | |



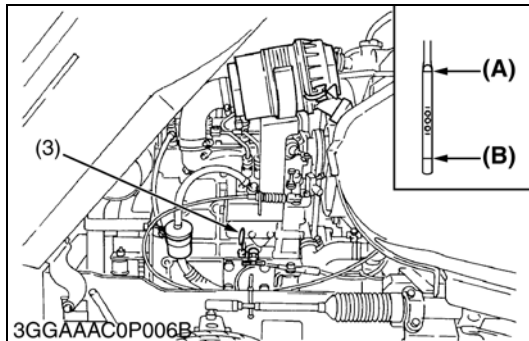
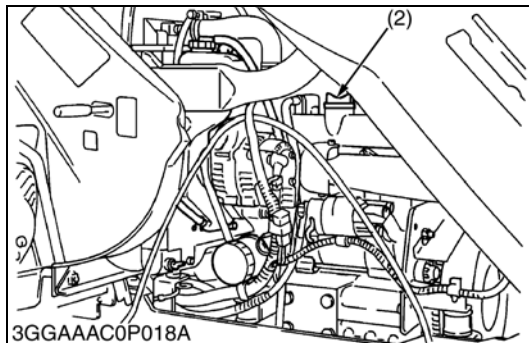
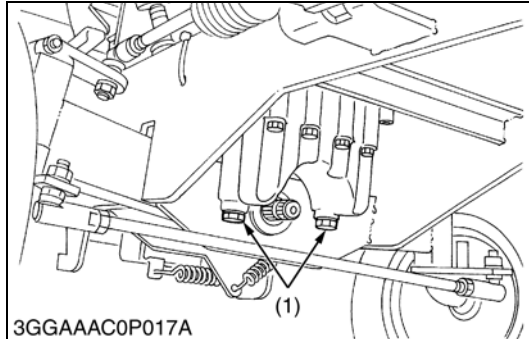
W1030315



- (10) Around the hole of the Mower Link (12) Pivot of Mower Link
(11) Around the Link (13) Pivot of Liftarm

W1066546

[2] CHECK POINTS OF INITIAL 50 HOURS



Changing Engine Oil

⚠ CAUTION

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

■ IMPORTANT

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

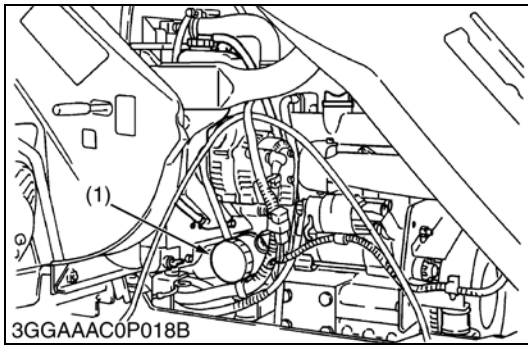
Refer to "LUBRICANTS, FUEL AND COOLANT".

(See page G-8)

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

- (A) Upper Level
(B) Lower Level

W1030749



Replacing Engine Oil Filter Cartridge

⚠ CAUTION

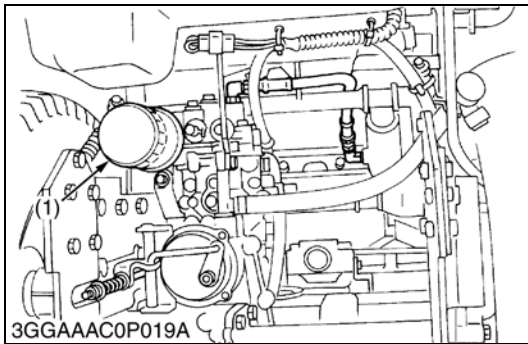
- Be sure to stop the engine before changing the oil filter cartridge.
- Allow engine to cool down sufficiently, oil can be hot and may cause burns.

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

■ IMPORTANT

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

W1030949



Replacing Transmission Oil Filter

⚠ CAUTION

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

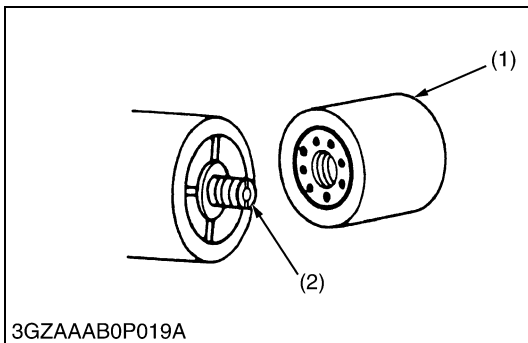
1. The oil filter cartridge must be changed every 300 service hours.
2. Remove the oil filter cartridge with the filter wrench.
3. Lightly tighten the screw (2) by using a screwdriver.
4. Apply a slight coat of oil onto the cartridge gasket.
5. To install the new cartridge, screw it in by hand. Over tightening may cause deformation of rubber gasket.
6. After the new cartridge has been replaced, the transmission fluid level normally lowers a little. Add fluid to proper level. Check for oil leaks around filter gasket.

■ IMPORTANT

- To prevent serious damage to hydraulic system, the replacement filter must be a highly efficient, 10 μ m filter. Use only a genuine KUBOTA filter or its equivalent.

(1) Transmission Oil Filter Cartridge (2) Screw

W1031068



Changing Mower Gear Box Oil

1. Dismount the mower, and place the mower on level ground.
2. Remove the oil inlet plug (2).
3. Remove the drain plug (1), and drain the used oil completely.
4. After draining the used oil, reinstall the drain plug (1).
5. Fill with new oil up to the specified level.

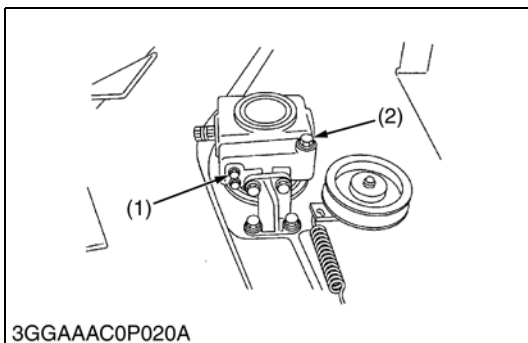
■ IMPORTANT

- Use the proper SAE Gear Oil.
- Refer to "LUBRICANTS, FUEL AND COOLANT". (See page G-8)

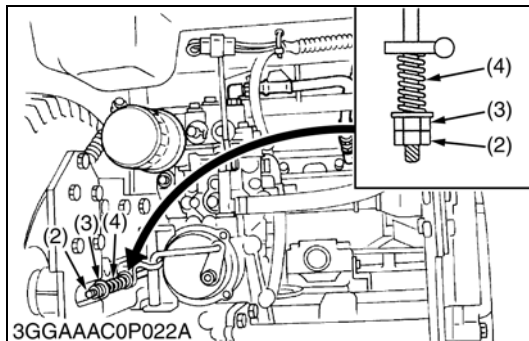
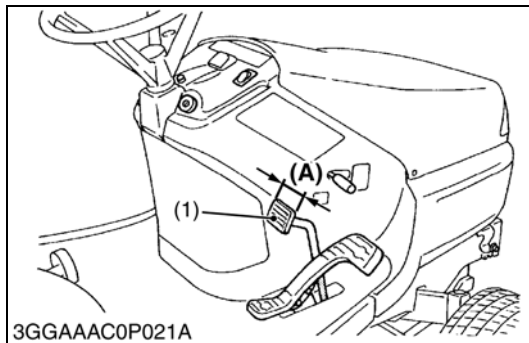
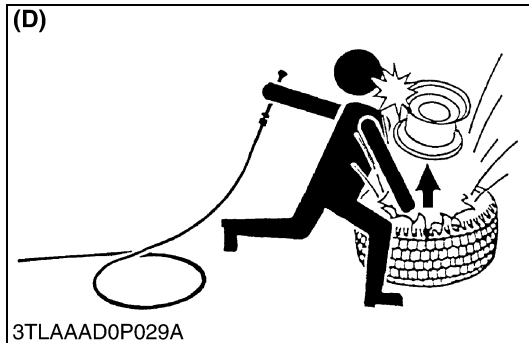
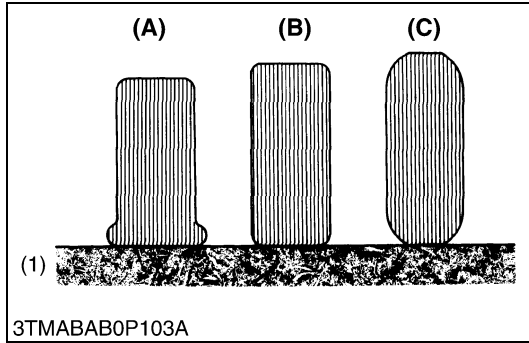
(1) Drain Plug

(2) Oil Inlet Plug

W1031440



[3] CHECK POINTS OF EVERY 50 HOURS



Checking Tire Pressure

1. Check the wear and damage of tires.
2. Check the tire pressure.
3. If insufficient, add air. If excessive, reduce air.

Tire pressure	Front	200 kPa 2.0 kgf/cm ² 28 psi
	Rear	140 kPa 1.4 kgf/cm ² 20 psi

CAUTION

- Always maintain the correct tire pressure. Do not inflate tires above the recommended pressure.

(1) Ground

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

W1068933

Adjusting Brake Play

CAUTION

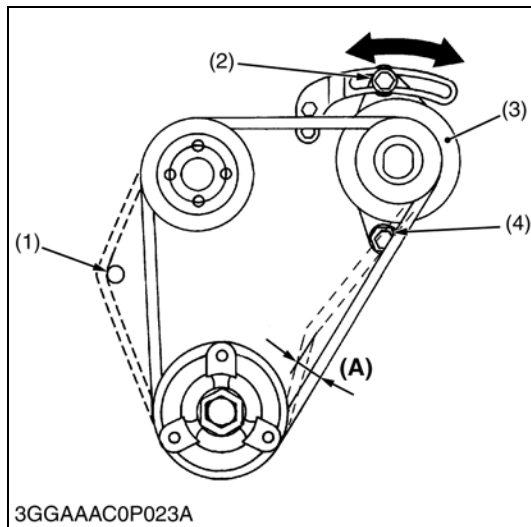
- When making adjustments, park the machine on a flat area, block wheels, stop engine and remove the key.
1. If brake play is not correct, loose the lock nut (2) and turn the nut (3) in the desired direction until the proper play is achieved.
 2. After adjustment, retighten lock nut securely.

Brake play	15 to 25 mm (0.59 to 0.98 in.)
------------	--------------------------------

- (1) Brake Pedal
(2) Lock Nut
(3) Nut
(4) Spring

(A) Brake Play

W1069219



Adjusting Fan Belt Tension

⚠ CAUTION

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

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

Moderate belt tension :

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

Fan belt tension	Approx. 10mm (0.4 in.)
------------------	------------------------

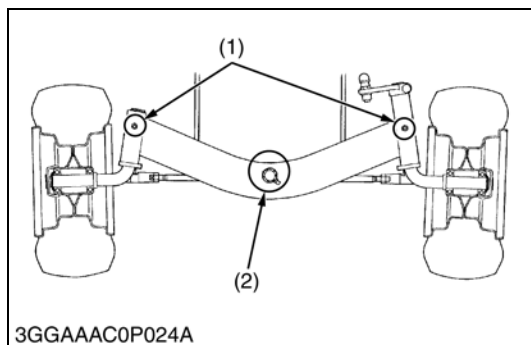
■ IMPORTANT

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

- (1) Cap
- (2) Tension bolt
- (3) Alternator
- (4) Adjustment bolt

(A) Approx. 10 mm (0.4 in.)

W1069477



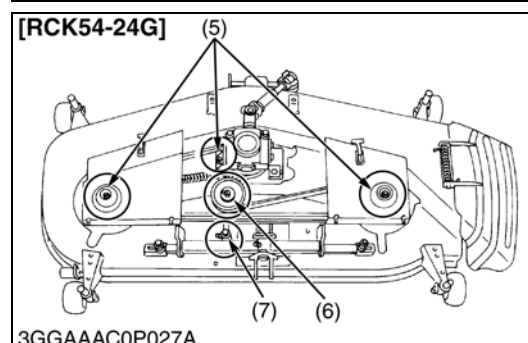
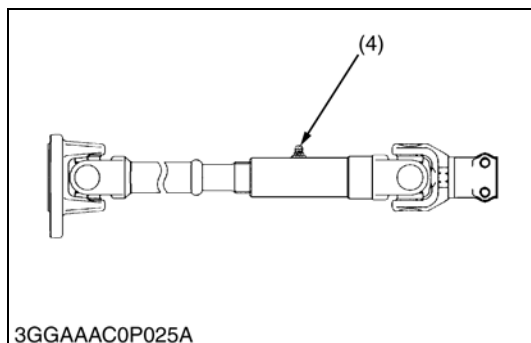
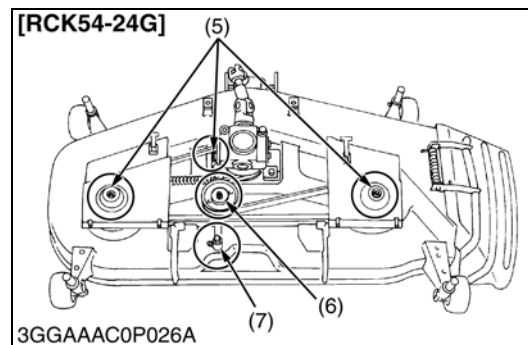
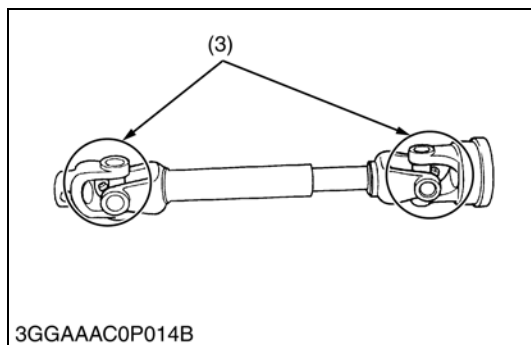
Greasing

⚠ CAUTION

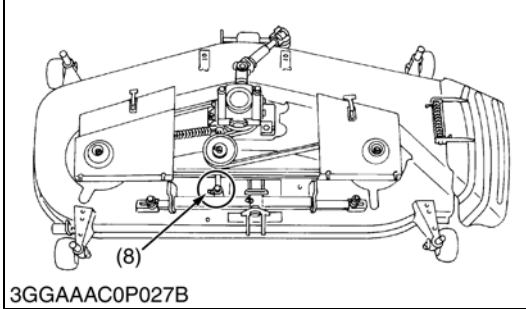
- Be sure to stop the engine and remove the key before greasing.

1. Apply grease to the following points.

- (1) King Pin
- (2) Center Pin
- (3) Mower Universal Joint
- (4) Machine Universal Joint
- (5) Grease Nipple (Spindle Shaft)
- (6) Grease Nipple (Belt Tension Pulley)
- (7) Grease Nipple (Belt Tension Pivot)

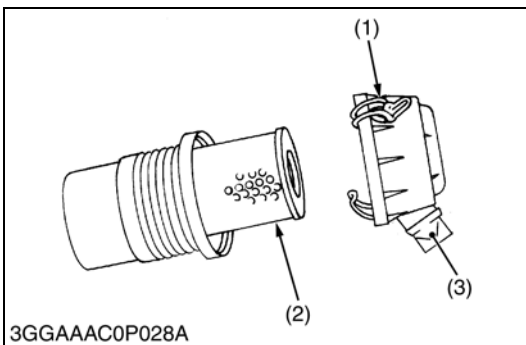
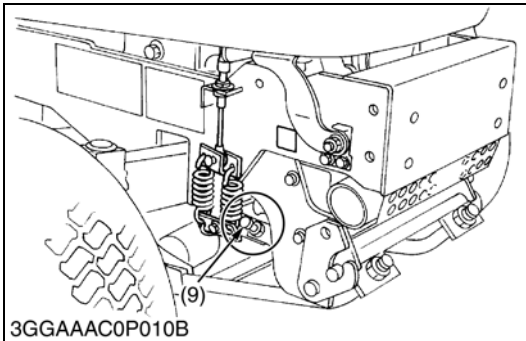


W1069765

[RCK54-24G]

- (8) Grease Nipple (Balance Shaft)
(RCK60B-24G Only)
- (9) Tension Lever

W1045060

**Cleaning Air Cleaner Element**

1. The air cleaner uses a dry element, never apply oil.
2. Do not touch the filter element except where cleaning is required.
To clean the element, use clean and dry compressed air on the inside of the element. Air pressure should not exceed 205 kPa (2.1 kgf/cm², 30 psi).

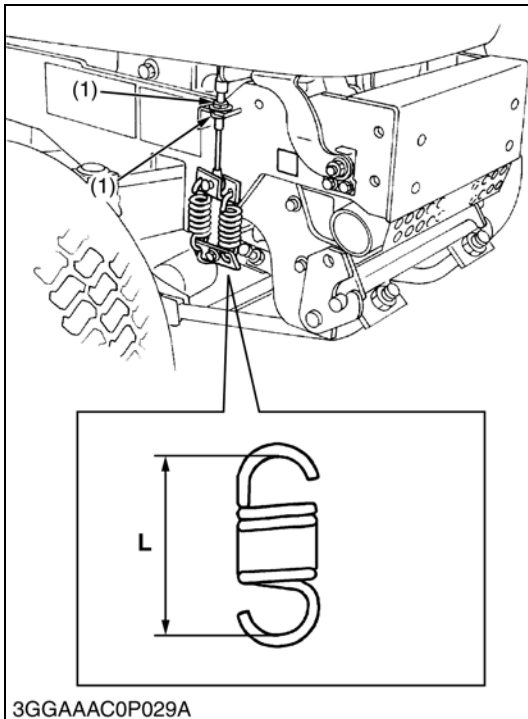
■ NOTE

- **Operating in dusty conditions requires frequent maintenance.**

(1) Air Cleaner Cover

(2) Air Cleaner Element

W1070714



Checking and Adjusting Front PTO Belt Tension

! CAUTION

- Always stop the engine, set the parking brake, remove the key, and disengage the PTO lever before working on the front PTO.

If the front PTO belts slip when the PTO is operating under load, check the front PTO belt tension and adjust the tension spring length, as explained below.

1. Engage the PTO lever.
2. Measure tension spring length **L**.
3. If **L** is shorter than 87 mm (3.43 in.), adjust it with the tension clutch cable adjusting nut.
 - **L** should be 88 to 90 mm (3.47 to 3.54 in.).
4. After adjustment, tighten the nut securely.
 - When replacing the new front PTO belts, **L** should be 91 to 92 mm (3.58 to 3.62 in.).

■ IMPORTANT

- When replacing the front PTO belts, be sure to replace the complete set. These belts are a matched set.

Front PTO belt tension (L)	88 to 90 mm (3.47 to 3.54 in.)
-------------------------------------	--------------------------------

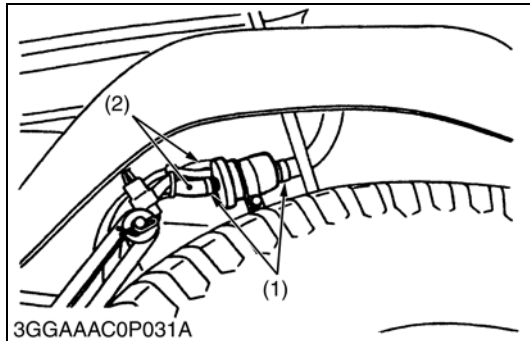
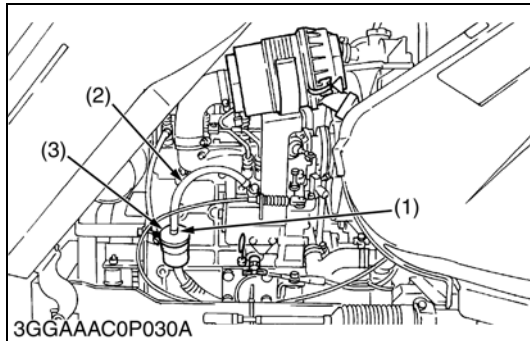
W1034175

[4] CHECK POINTS OF EVERY 100 HOURS

Changing Engine Oil

1. See page G-17.

W1034674



Checking Fuel Lines And Fuel Filter

CAUTION

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

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

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

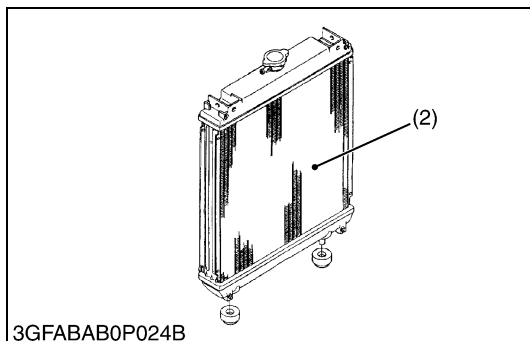
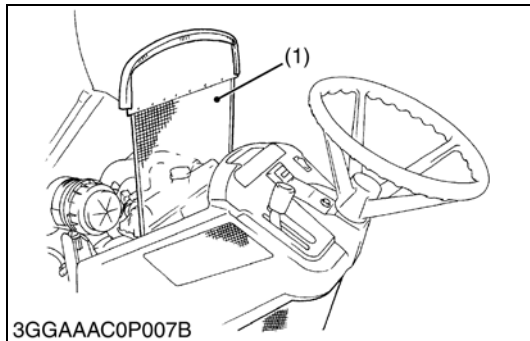
IMPORTANT

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

- (1) Pipe Clamps
(2) Fuel Line

- (3) Fuel Filter

W1034725



Checking Radiator Core

CAUTION

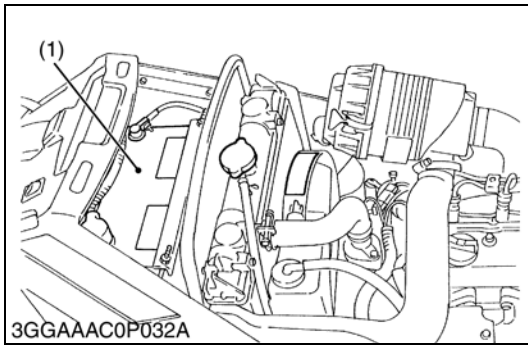
- Be sure to stop the engine before removing the screen.

1. Remove the radiator screen (1).
2. Check the radiator core (2) for the dust and chaff.
3. If the dust or chaff is accumulated, clean the radiator core completely. After cleaning, place the screens properly.

- (1) Radiator Screen

- (2) Radiator Core

W1034897



Checking Battery Condition

! CAUTION

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

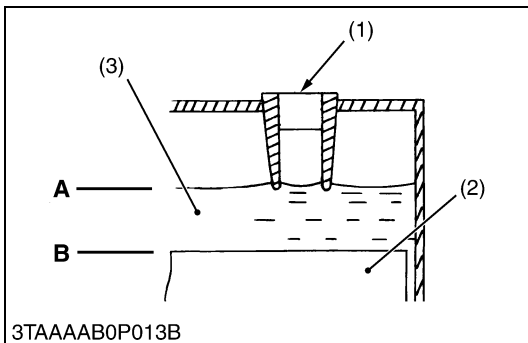
Mishandling the battery shortens the service life and adds to maintenance costs.

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

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

(1) Battery

W1035046



Battery Charging

! DANGER

To avoid serious injury or death :

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

! CAUTION

- When charging battery, ensure that the vent caps are securely in place (if equipped).
- When disconnecting the cables from the battery, start with the negative terminal first.

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

- Never check battery charge by placing a metal object across the posts.

Use a voltmeter or hydrometer.

(For accessible maintainable type batteries with removable vent caps.)

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

(A) HIGHEST LEVEL
(B) LOWEST LEVEL

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

3GGAAAC0P033A

1. Make sure each electrolyte level is at the bottom of vent wells, if necessary add distilled water in a well-ventilated area.
2. The water in the electrolyte evaporates during recharging. Liquid shortage damages the battery. Excessive liquid spills over and damages the machine body.
3. To slow charge the battery, connect the battery positive terminal to the charger positive terminal and the negative to the negative, then recharge in the standard fashion.
4. A boost charge is only for emergencies. It will partially charge the battery at a higher rate and in a short time.
When using a boost-charged battery, it is necessary to recharge the battery as soon as possible.
Failure to do this will shorten the battery's service life.

W1062448

5. When the specific gravity of electrolyte reaches 1.27 to 1.29, charge has completed.
6. When exchanging an old battery with new one, use a battery of equal specification shown in "SPECIFICATIONS".
(For non-accessible maintenance-free type batteries.) Maintenance-free, non-accessible batteries are designed to eliminate the need to add water. Yet the volume of electrolyte above plates may eventually become depleted due to abnormal conditions such as high heat or improper regulator setting. Use a voltmeter to check the state of charge. (See reference chart to determine if charging is necessary.)

W1064359

[5] CHECK POINTS OF EVERY 150 HOURS

Changing Mower Gear Box Oil

1. See page G-18.

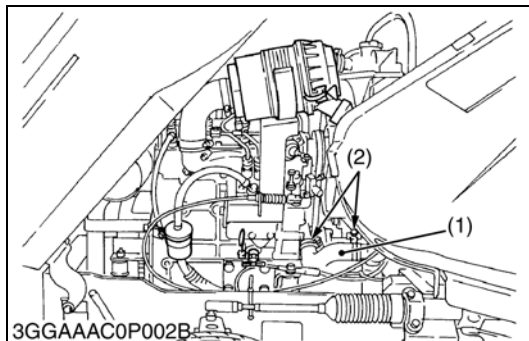
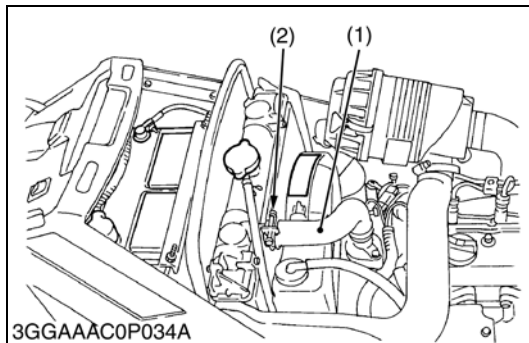
W1036280

[6] CHECK POINTS OF EVERY 200 HOURS

Changing Engine Oil Filter Cartridge

1. See page G-18.

W1036341



Checking Radiator Hose and Clamp

■ NOTE

- Check to see if the radiator hoses are properly fixed every 200 hours of operation or 6 months, whichever comes first.
1. If clamp bands (2) are loose or water leaks, tighten clamp band (2) securely.
 2. Replace radiator hoses (1) and tighten clamp bands (2) securely, if radiator hoses (1) are swollen, hardened or cracked.
Replace radiator hoses (1) and clamp bands (2) every 2 years or earlier if checked and found that hoses are swollen, hardened or cracked.

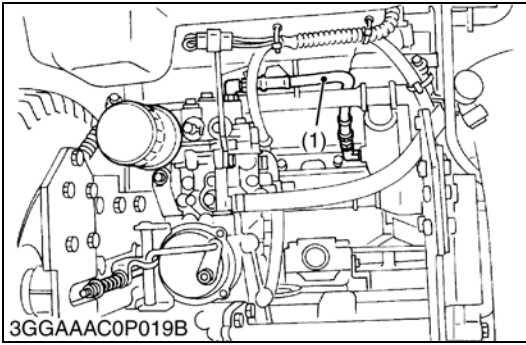
■ NOTE

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

(1) Radiator Hose

(2) Clamp Band

W1036392



Checking Hydraulic Hose

⚠ CAUTION

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

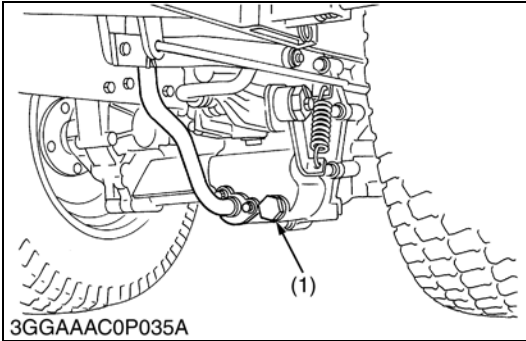
Check to see if hydraulic hoses are properly fixed every 200 hours of operation.

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

(1) Mower Lift Cylinder Hose

W1036641

[7] CHECK POINTS OF EVERY 300 HOURS



Changing Transmission Fluid

⚠ CAUTION

- 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 the machine on level ground.
2. Remove the drain plug (1) and oil inlet plug (2), and drain the used oil completely.
3. After draining the oil, reinstall the drain plug (1).
4. Fill with new oil up to the upper level (A) on the oil level dipstick (3).
5. After draining, disassemble and clean the strainers and change the oil filter cartridge. After reassembling, fill with UDT or SUPER UDT hydraulic transmission fluid, or its equivalent.
6. After running the engine for a few minutes, stop it and check the oil level again; add oil to the prescribed level.

■ IMPORTANT

- Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.
Keep the engine at medium speed for a few minutes to insure proper lubrication of all parts so there is no damage to transmission.

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

- (A) Upper Level
(B) Lower Level

W1036772

Changing Transmission Oil Filter Cartridge

1. See page G-18.

W1036964

Cleaning Transmission Oil Strainer**CAUTION**

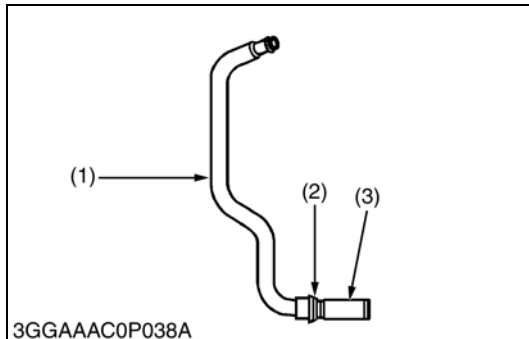
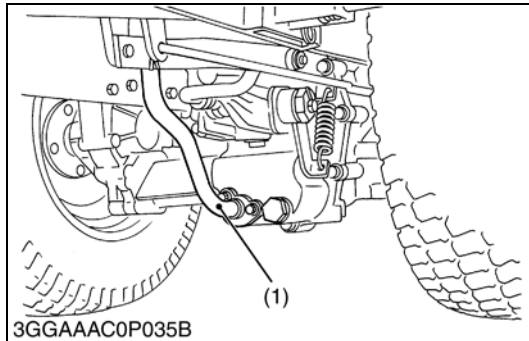
- Be sure to stop the engine and remove the key before cleaning the transmission oil strainer.
- Allow transmission case to cool down sufficiently; oil can be hot and may cause burns.

1. Remove 2-M8 bolts.
2. Remove the suction pipe (1) with O ring (2).
3. Clean completely the oil strainer (3) with kerosene.
4. Install the suction pipe (1) with O ring (2).
5. Install the bolts.

- (1) Suction Pipe
(2) O-ring

- (3) Oil Strainer

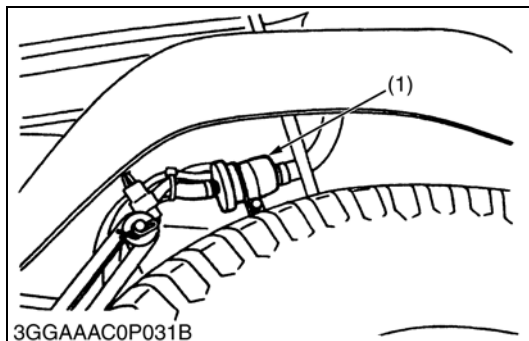
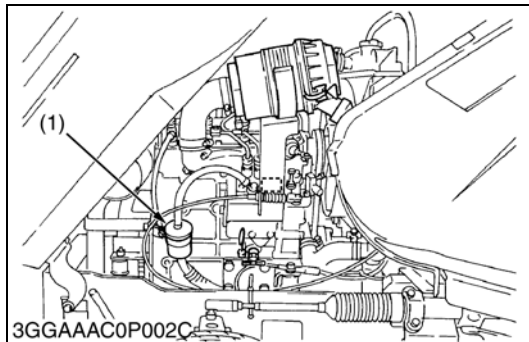
W1037015

**[8] CHECK POINTS OF EVERY 500 HOURS****Replacing Fuel Filter**

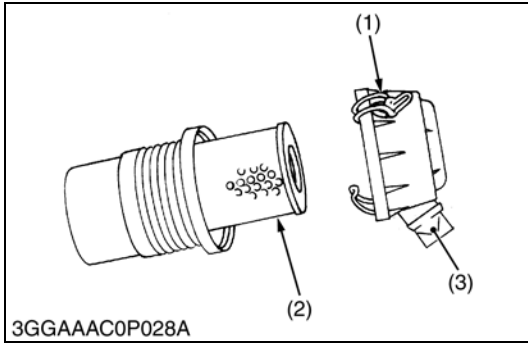
1. Replace the fuel filters (1).

- (1) Fuel Filter

W1037174



[9] CHECK POINTS OF EVERY 1 YEAR



Replacing Air Cleaner Element

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

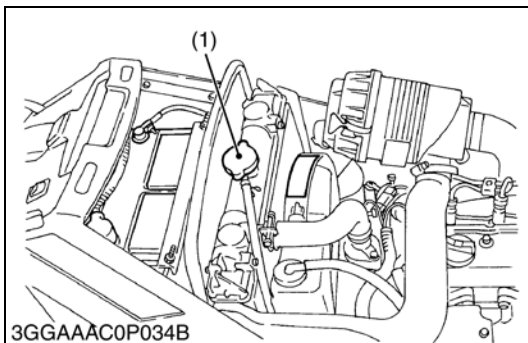
■ IMPORTANT

- The air cleaner uses a dry element, never apply oil.
- Do not run the engine with filter element removed.
- Be sure to refit the air cleaner cover (1) as shown in the figure. If the air cleaner cover (1) is improperly fitted, evacuator valve (3) will not function and dust will adhere to the element.
- If it is loose, dust and dirt may be sucked in, wearing down the cylinder and piston rings earlier and thereby resulting in poor power output.

- (1) Air Cleaner Cover
(2) Air Cleaner Element

- (3) Evacuator Valve

W1037268



Flushing Cooling System and Changing Coolant

⚠ CAUTION

- Never open radiator cap when engine is hot.
- When opening, loosen cap slightly to the stop to relieve any excess pressure before removing radiator cap completely.

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

■ IMPORTANT

- Do not start engine without coolant.
- Use clean, fresh water and anti-freeze to fill the radiator and recovery tank.

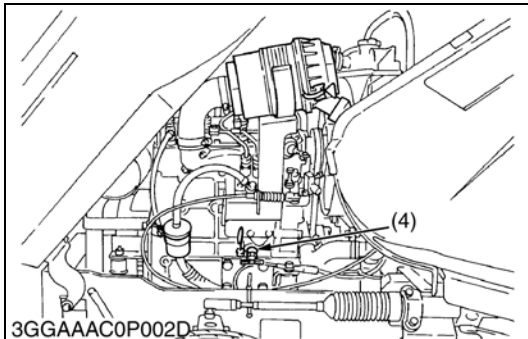
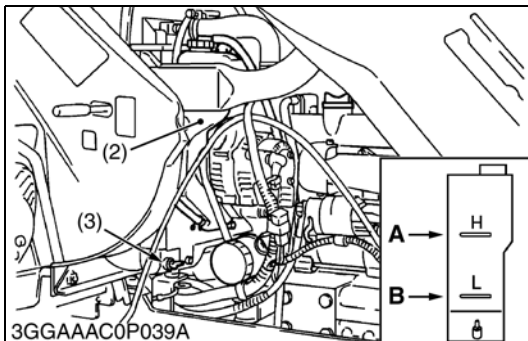
Refer to "LUBRICANTS, FUEL AND COOLANT".
(See page G-8)

- When the anti-freeze is mixed with water, the anti-freeze mixing ratio must be less than 50 %.
- Securely tighten the radiator cap (1). If the cap is loose or improperly fitted, water may lead out and the engine could overheat.

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

- (A) Highest Level
(B) Lowest Level

W1037402



Flushing Cooling System and Changing Coolant (Continued)**■ Anti-Freeze**

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

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

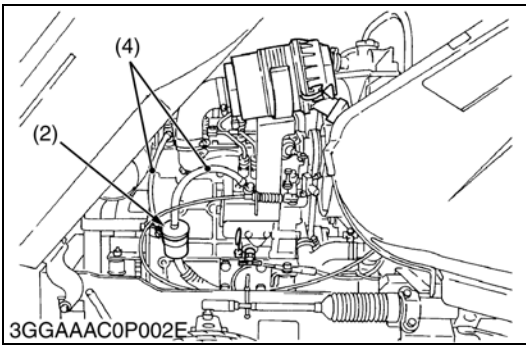
Vol % Anti-freeze	Freezing Point		Boiling Point*	
	°C	°F	°C	°F
40	-24	-12	106	222
50	-37	-34	108	226

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

■ NOTE

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

W1037674



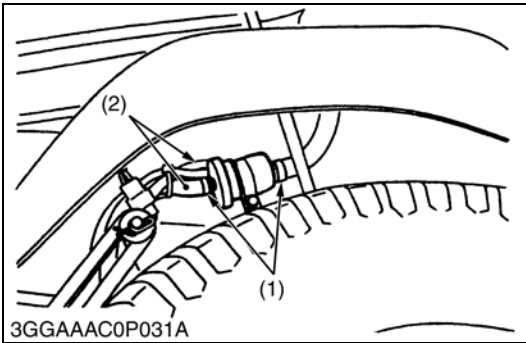
Replacing Fuel Line

1. Replace the fuel hoses (1) and hose clamps (2).
Refer to “**Checking Fuel Line**”. (See page G-23.)

(1) Fuel Hose

(2) Hose Clamp

W1038053



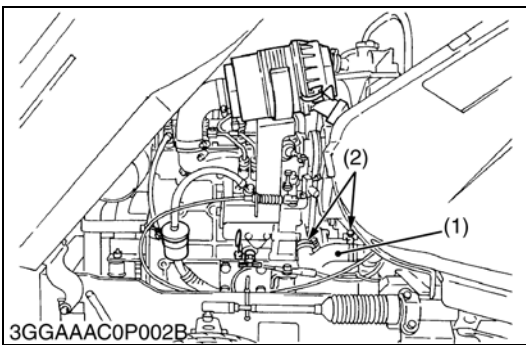
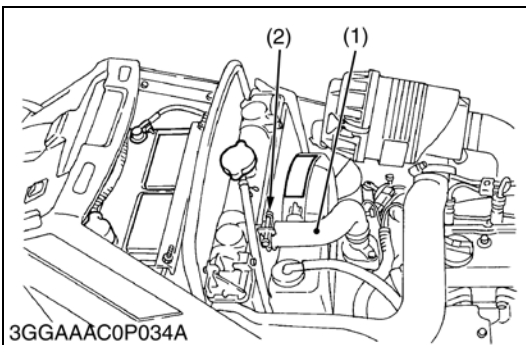
Replacing Radiator Hose and Clamp Band

1. Replace the radiator hoses (1) and clamp bands (2).
Refer to “**Checking Radiator Hose and Hose Clamp**”.
(See page G-25.)

(1) Radiator Hose

(2) Clamp Band

W1038187

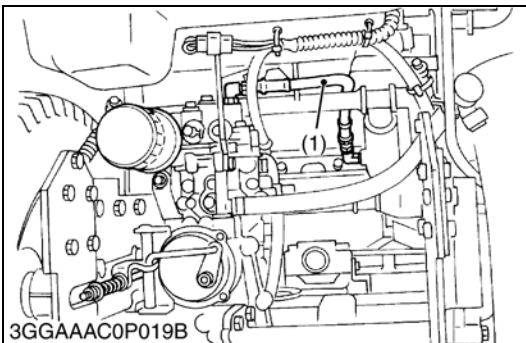


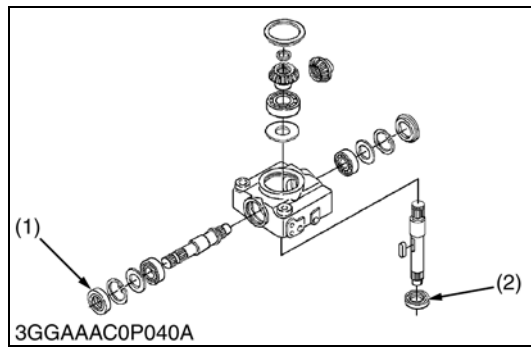
Replacing Hydraulic Hoses

1. Replace hydraulic hoses (1) and clamp bands every 2 years or earlier if checked and found that hydraulic hoses (1) are swollen, hardened or cracked.

(1) Hydraulic Hose

W1038289





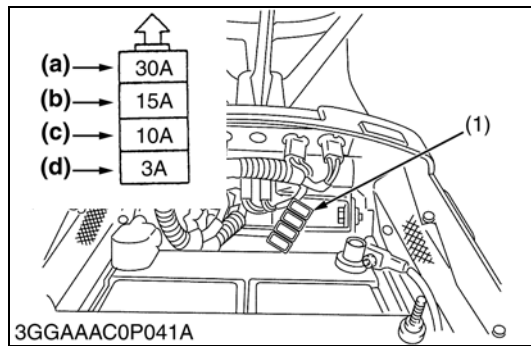
Replacing Mower Gear Box Seals

1. Replace the mower gear box oil seals (1), (2).
Refer to “Disassembling Gear Box Assembly” (See page 9-S11).

(1) Oil Seal

(2) Oil Seal

W1038357



Replacing Fuses

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

■ IMPORTANT

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

■ Protected Circuit

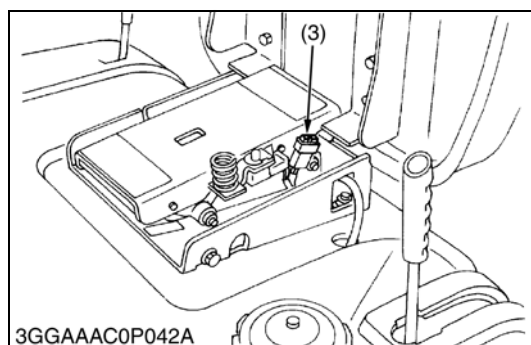
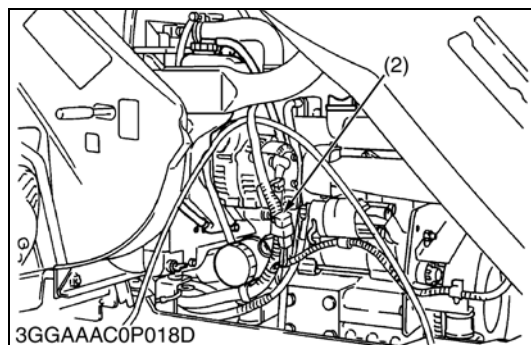
FUSE NO. (ID LABEL)		CAPACITY (A)	Protected circuit
1	(a) EPS MT	30	Electric power steering moter circuit
	(b) E/G STOP	15	Engine stop timer relay
	(c) IG/M	10	Fuel pump, head light, power steering control unit, etc.
	(d) OPC	3	Engine running circuit
2	—	Slow blow fuse 40	Check circuit against wrong battery connection
3	—	3	KRA system

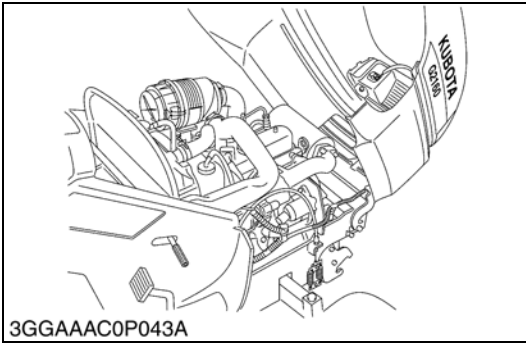
(1) Fuse

(3) KRA system Fuse

(2) Slow Blow Fuse

W1038470





Replacing Bulbs

(A) Replacing the head light bulb

1. Open hood.
2. Turn bulb socket to remove socket from headlight housing.
3. Push bulb down and turn one quarter turn to remove bulb from the socket.
4. Install new bulb to the socket.
5. Install the socket in housing.
6. Close hood.

Head light bulb	Capacity	1.04A / 12.8 Rated voltage
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(B) Replacing the indicator light bulb

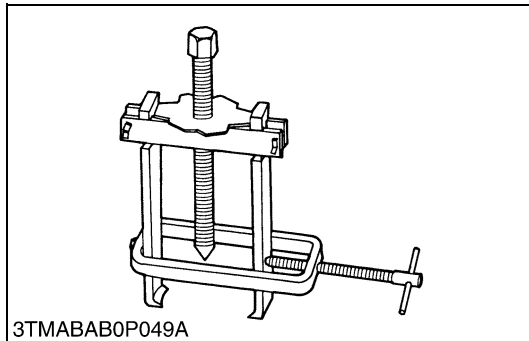
1. Open hood.
2. Turn bad bulb socket to the left.
3. Pull bulb from the socket.
4. Push new bulb into the socket.
5. Install the socket.
6. Close hood.

Indicator light bulb	Capacity	0.27A / 14.0 Rated voltage
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W1047730

9. SPECIAL TOOLS

[1] SPECIAL TOOLS FOR ENGINE

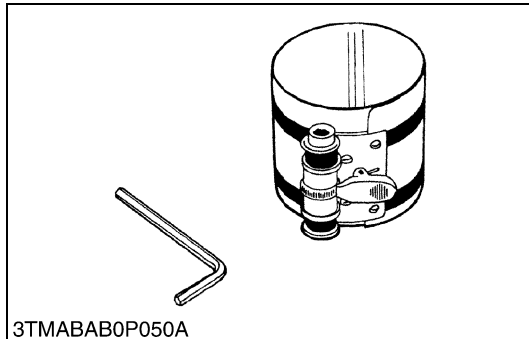


Special Use Puller Set

Code No: 07916-09032

Application: Use exclusively for pushing out bearing, gears and other parts with ease.

W1048293

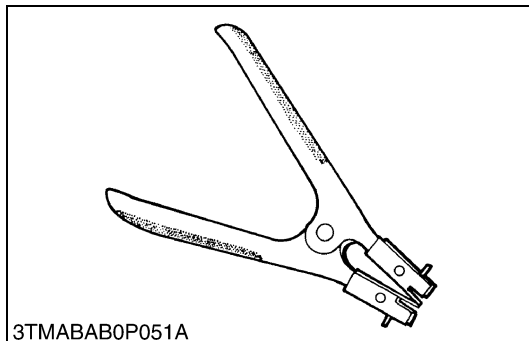


Piston Ring Compressor

Code No: 07909-32111

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

W1048361

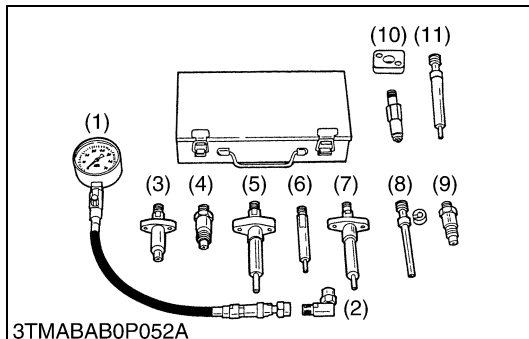


Piston Ring Tool

Code No: 07909-32121

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

W1048421



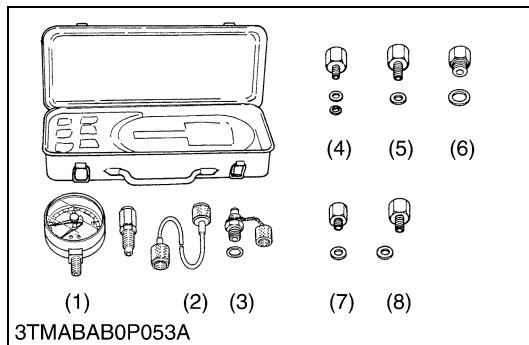
Diesel Engine Compression Tester

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

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

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

W1048481



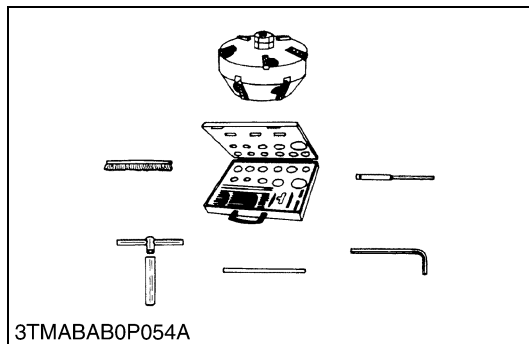
Oil Pressure Tester

Code No: 07916-32032

Application: Use to measure lubricating oil pressure.

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

W1048722



Valve Seat Cutter

Code No: 07909-33102

Application: Use to reseal valves.

Angle: 0.785 rad (45 °)
0.262 rad (15 °)

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

W1048944



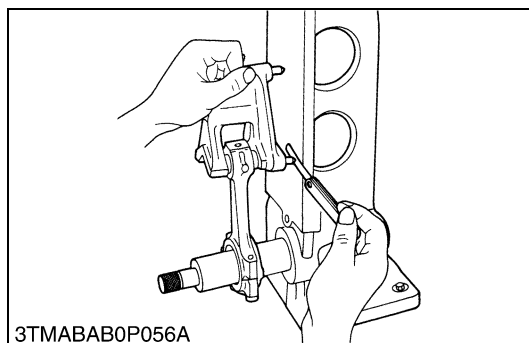
Radiator Tester

Code No: 07909-31551

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

Remarks: Adapter (1) BANZAI Code No. RCT-2A-30S

W1049045



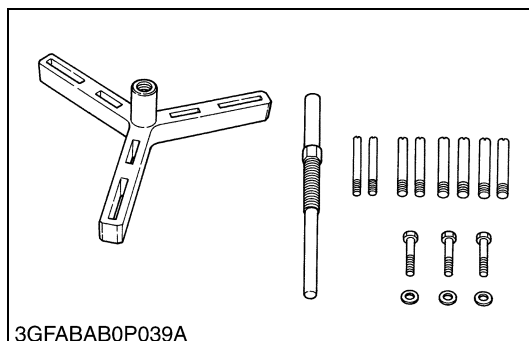
Connecting Rod Alignment Tool

Code No: 07909-31661

Application: Use to check the connecting rod alignment.

Applicable: Connecting rod big end I.D.
range 30 to 75 mm (1.18 to 2.95 in.) dia.
Connecting rod length
65 to 300 mm (2.57 to 11.81 in.)

W1049118

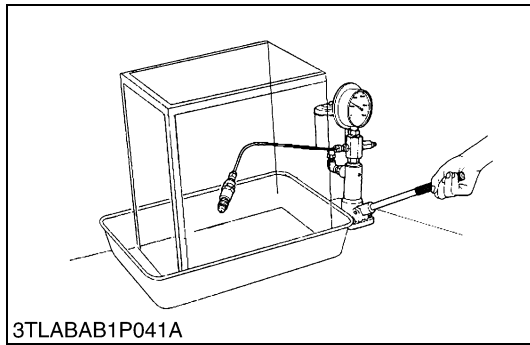


Flywheel Puller

Code No: 07916-32011

Application: Use exclusively for removing the flywheel with ease.

W1049723

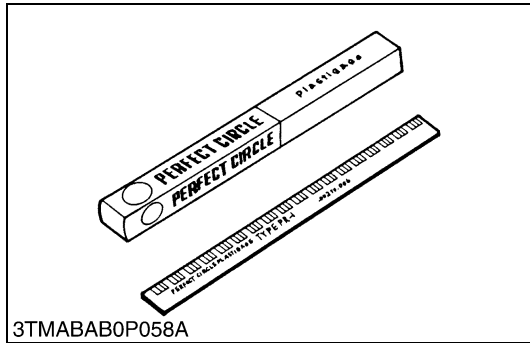
**Nozzle Tester**

Code No: 07909-31361

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

Measuring: 0 to 50 MPa
range (0 to 500 kgf/cm², 0 to 7000 psi)

W1049783

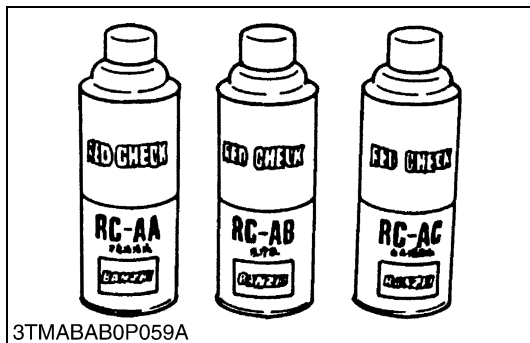
**Plastigage**

Code No: 07909-30241

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

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

W1049942

**Red Check**

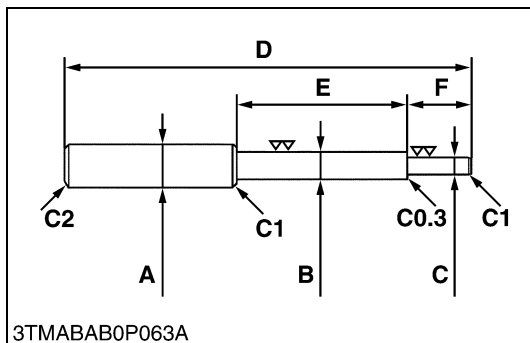
Code No: 07909-31371

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

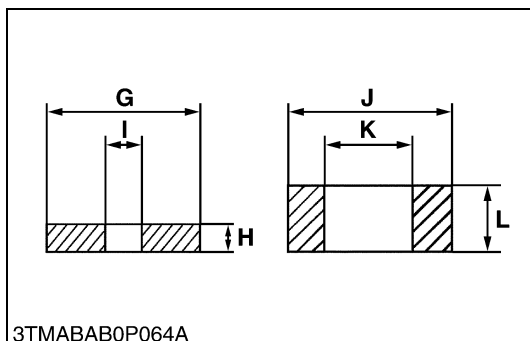
W1050024

NOTE

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

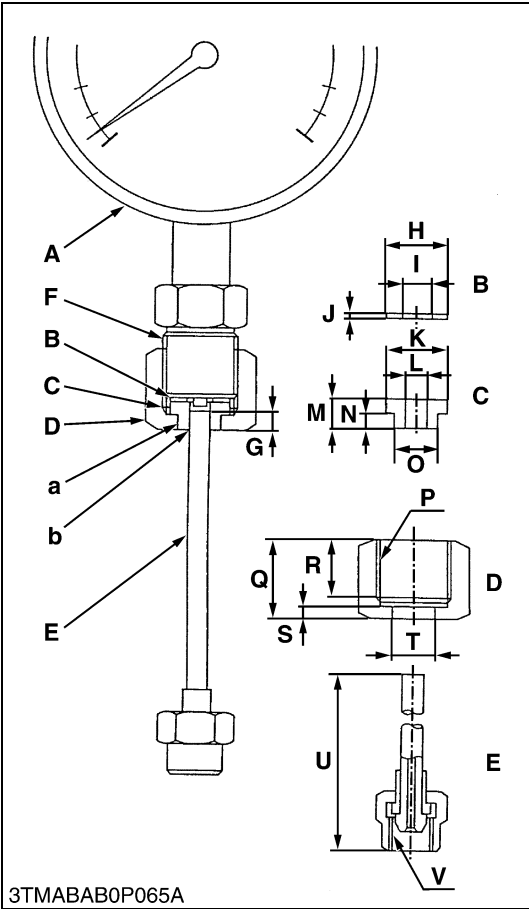
**Valve Guide Replacing Tool**

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



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

W1050106

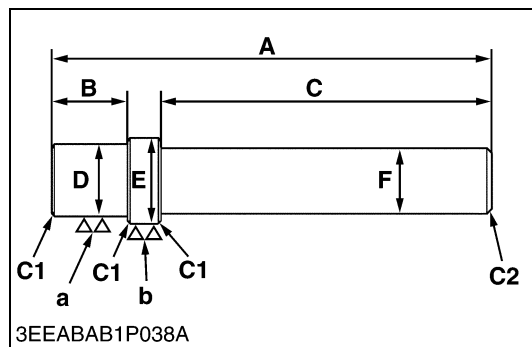


Injection Pump Pressure Tester

Application: Use to check fuel tightness of injection pumps.

A	Pressure gauge full scale: More than 29.4 MPa (300 kgf/cm ² , 4267 psi)
B	Copper gasket
C	Flange (Material: Steel)
D	Hex. nut 27 mm (1.06 in.) across the plat
E	Injection pipe
F	PF1/2
G	5 mm (0.20 in.)
H	17 mm dia. (0.67 in. dia.)
I	8 mm dia. (0.31 in. dia.)
J	1.0 mm (0.039 in.)
K	17 mm dia. (0.67 in. dia.)
L	6.10 to 6.20 mm dia. (0.2402 to 0.2441 in. dia.)
M	8 mm (0.31 in.)
N	4 mm (0.16 in.)
O	11.97 to 11.99 mm dia. (0.4713 to 0.4721 in. dia.)
P	PF1/2
Q	23 mm (0.91 in.)
R	17 mm (0.67 in.)
S	4 mm (0.16 in.)
T	12.00 to 12.02 mm dia. (0.4724 to 0.4732 in. dia.)
U	100 mm (3.94 in.)
V	M12 × P1.5
a	Adhesive application
b	Fillet welding on the enter circumference

W1050289



Bushing Replacing Tool

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

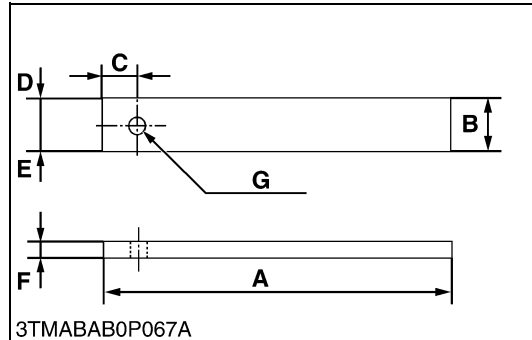
1. For small end bushing

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

2. For idle gear bushing

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

W1050660

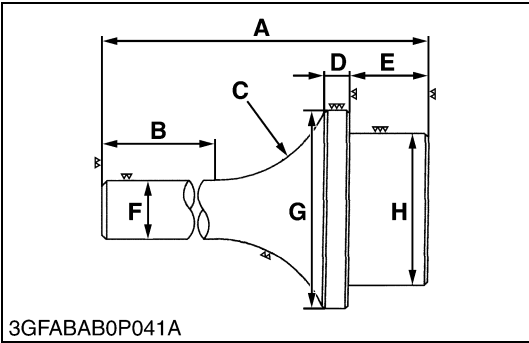


Flywheel Stopper

Application: Use to loosen and tighten the flywheel screw.

A	200 mm (7.87 in.)
B	30 mm (1.18 in.)
C	20 mm (0.79 in.)
D	15 mm (0.59 in.)
E	15 mm (0.59 in.)
G	8 mm (0.31 in.)
F	10 mm dia. (0.39 in. dia.)

W1050819



Crankshaft Bearing 1 Replacing Tool

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

[Press Out]

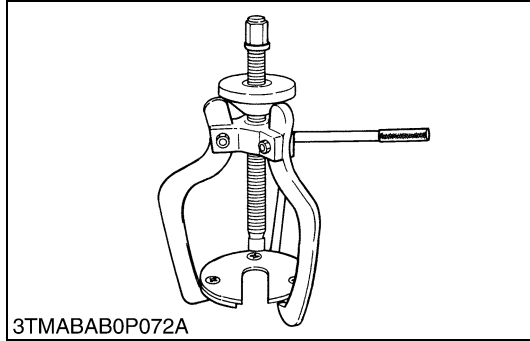
A	135 mm (5.31 in.)
B	72 mm (2.83 in.)
C	40° (1.57 rad)
D	10 mm (0.39 in.)
E	22 mm (0.87 in.)
F	20 mm dia. (0.79 in.dia.)
G	48.90 to 48.95 mm dia. (1.9251 to 1.9271 in. dia.)
H	43.90 to 43.95 mm dia. (1.7283 to 1.7303 in. dia.)

[Press Fit]

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

W1051113

[2] SPECIAL TOOLS FOR MACHINE



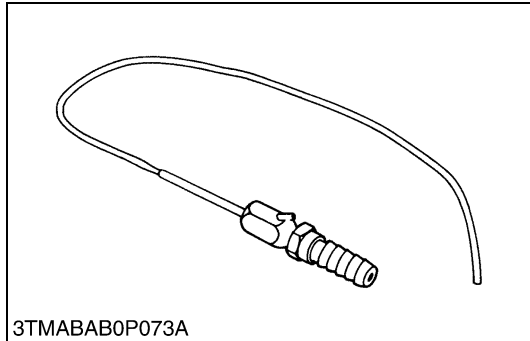
3TMABAB0P072A

Steering Wheel Puller

Code No: 07916-51090

Application: Use for removing the steering wheel without damaging the steering shaft.

W1051779



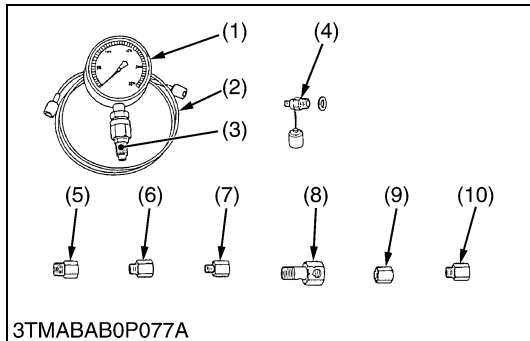
3TMABAB0P073A

Toe-in Gauge

Code No: 07909-31681

Application: This allows easy measurement of toe-in for all machine models.

W1051843



3TMABAB0P077A

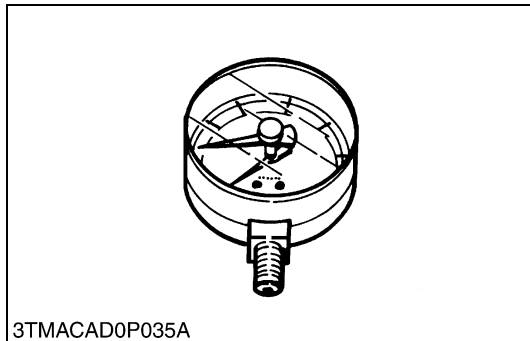
Relief Valve Pressure Tester

Code No: 07916-50045

Application: This allows easy measurement of relief set pressure.

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

W1051907



3TMACAD0P035A

Pressure Gauge 50

Code No: 07916-52961

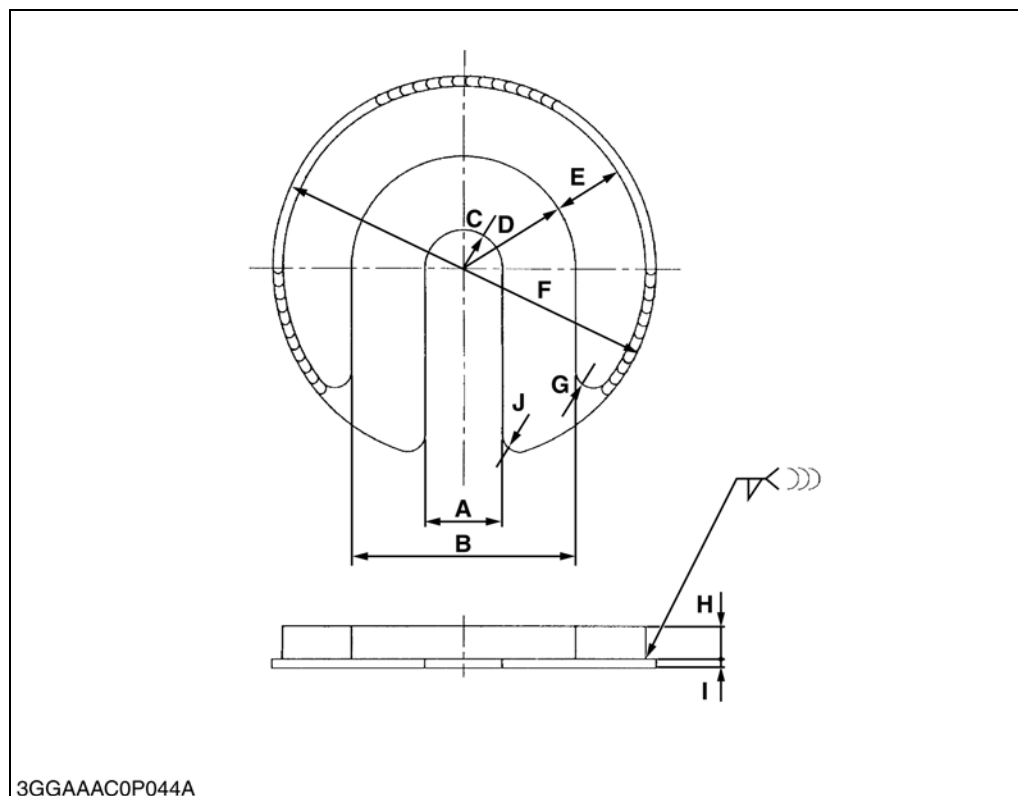
Application: This pressure gauge is used to measure the low oil pressure.

W1052218

■ **NOTE**

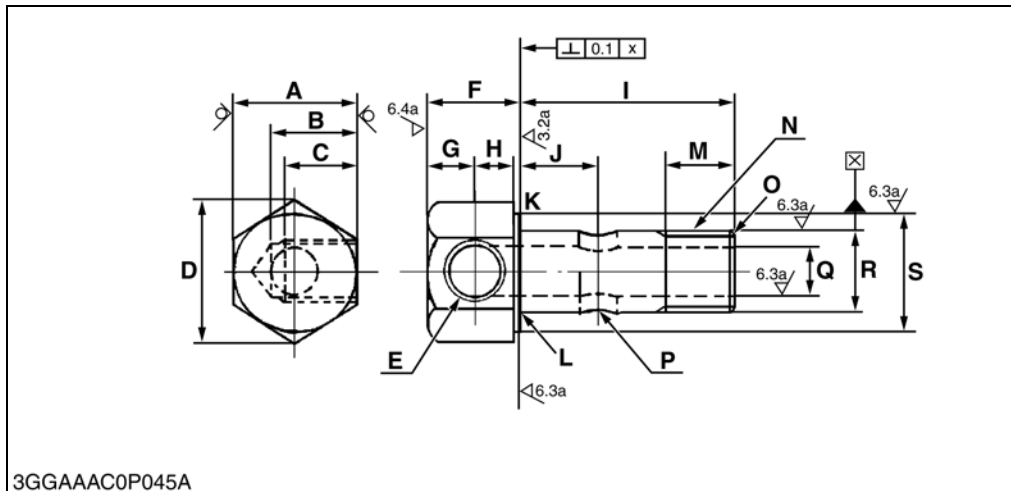
- The following special tool is not provided, so make it referring to the figure.

Steering Wheel Puller Adaptor



Application: Use for removing the steering wheel with steering wheel

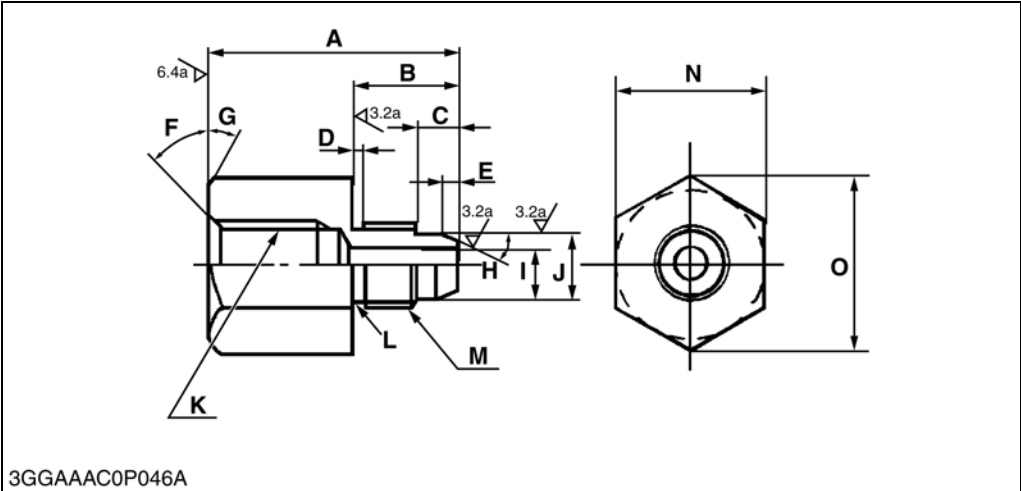
A	22 mm (0.87 in.)	F	116 mm (4.57 in.)
B	64 mm (2.52 in.)	G	5 mm (0.20 in.)
C	11 mm (0.43 in.)	H	9.5 mm (0.38 in.)
D	32 mm (1.26 in.)	I	3 mm (0.12 in.)
E	20 mm (0.79 in.)	J	5 mm (0.20 in.)

Adaptor Bolt for HST

Application: Use for checking the charge relief valve setting pressure.

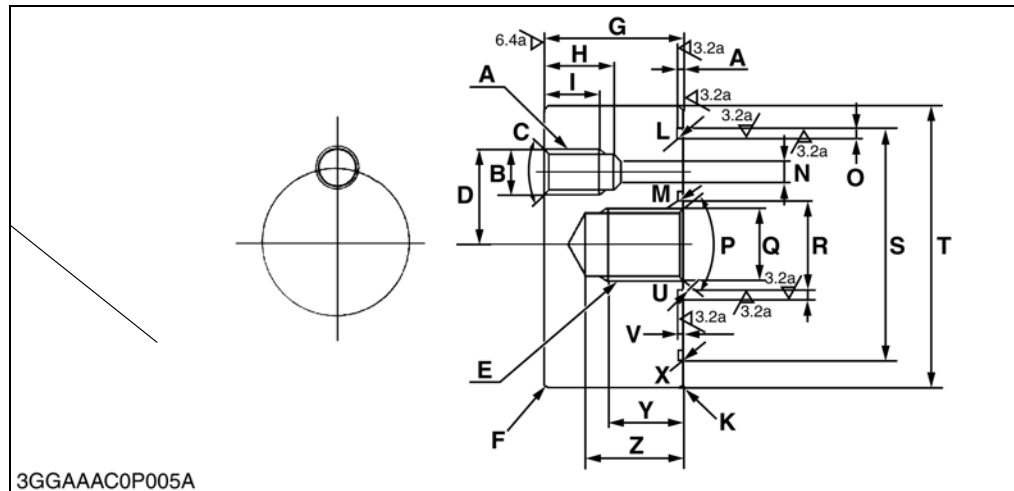
A	26 mm (1.02 in.)	K	0.4 mm (0.02 in.)
B	18 mm (0.71 in.)	L	0.5 mm (0.02 in.)
C	15 mm (0.59 in.)	M	15 mm (0.59 in.)
D	30 mm (1.18 in.)	N	G 3/8
E	RP 1/4	O	Chamfer 1 mm (0.04 in.)
F	22 mm (0.87 in.)	P	8 mm (0.31 in.) dia. drill thru Chamfer 0.5 mm (0.02 in.) (Both ends)
G	10 mm (0.39 in.)	Q	10 mm dia. (0.39 in. dia.)
H	0.8 mm (0.03 in.)	R	16.8 mm dia. (0.66 in. dia.)
I	46.5 mm (1.83 in.)	S	24.5 mm dia. (0.96 IN. dia.)
J	17 mm (0.67 in.)		

Adaptor for Control Valve



Application: Use for checking the main relief valve setting pressure.

A	40 mm (1.57 in.)	I	4.5 mm dia. (0.18 in. dia.)
B	18 mm (0.71.)	J	9 mm dia. (0.18 in. dia.)
C	6 mm (0.24 in.)	K	RP 1/4 thread depth 15 mm (0.59 in.) Drill depth 20 mm (0.79 in.)
D	3 mm (0.12 in.)	L	0.5 mm (0.02 in.)
E	3 mm (0.12 in.)	M	7/16-20 SAE 37 ° flare
F	0.785 rad (45 °)	N	21 mm (0.83 in.)
G	0.523 rad (30 °)	O	24.2 mm (0.95 in.)
H	0.645 rad (37 °)		

Flange for Control Valve

1. Use for checking the relief valve setting pressure.

NOTE

- When using , attach with following parts.

1. O-ring: 04811-10240
2. O-ring: 04811-10600.

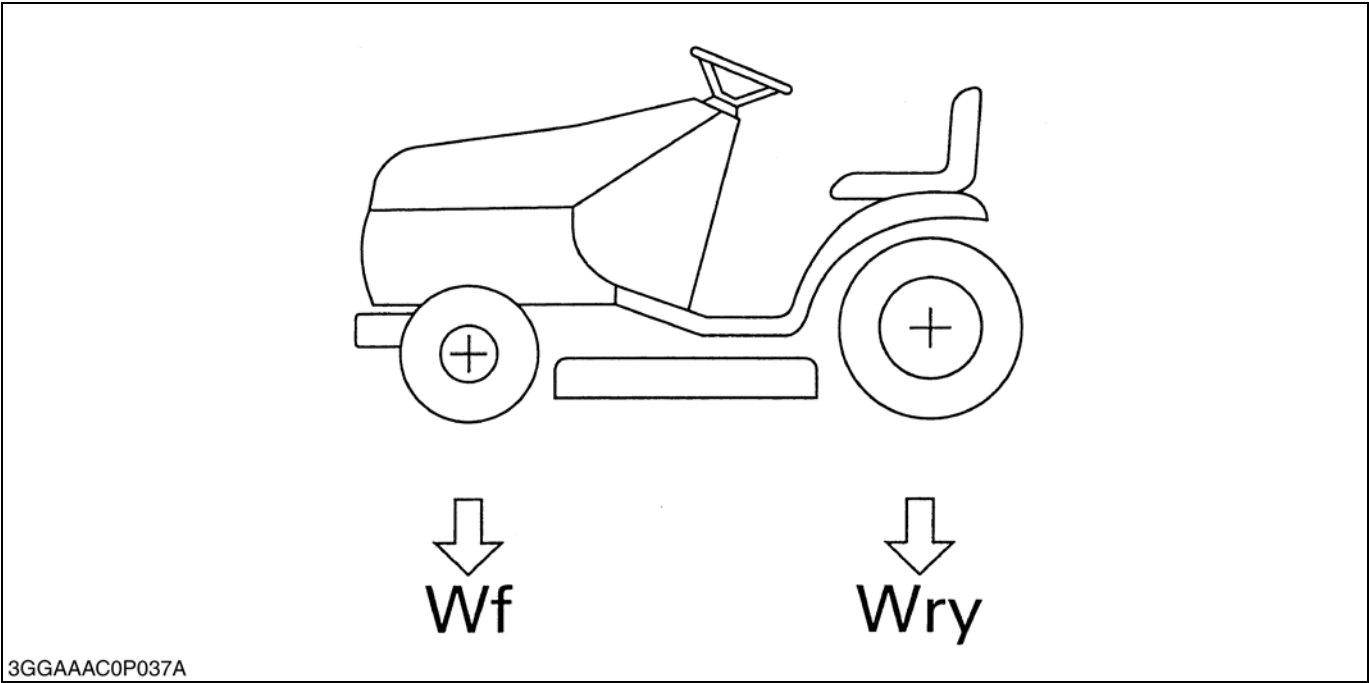
A	RP 1/4	N	5 mm dia. (0.20 in. dia.)
B	14.5 mm dia. (0.59 in. dia.)	O	2.70 to 2.95 mm (0.106 to 0.116 in.)
C	2.09 rad (120 °)	P	2.09 rad (120 °)
D	20 mm (0.79 in.)	Q	20 mm dia. (0.79 in. dia.)
E	3/4-16 UNF	R	23.95 to 24.00 mm dia. (0.9429 to 0.9449 in. dia.)
F	Chamfer 1mm (0.04 in.)	S	63.00 to 63.05 mm dia. (2.4803 to 2.4823 in. dia.)
G	38 mm (1.50 in.)	T	76 mm dia. (2.99 in. dia.)
H	18 mm (0.71 in.)	U	R 0.5 mm (0.02 in.)
I	15 mm (0.59 in.)	V	1.4 to 1.5 mm (0.055 to 0.059 in.)
J	1.4 to 1.5 mm (0.055 to 0.059 in.)	W	2.70 to 2.95 mm (0.106 to 0.116 in.)
K	Chamfer 1mm (0.04 in.)	X	R 0.5mm (0.02 in.)
L	R 0.5 mm (0.02 in.)	Y	20 mm (0.79 in.)
M	R 0.5 mm (0.02 in.)	Z	26 mm (1.02 in.)

10. IMPLEMENT LIMITATIONS

The KUBOTA Machine has been thoroughly tested for proper performance with implements sold or approved by KUBOTA. Use of implements which exceed the maximum loading weight listed below, or which are not recommended for use with the KUBOTA Machine may result in malfunctions or failures of the machine, damage to other property and injury to the operator or others.
(Any malfunctions or failures of the machine resulting from use with improper implements are not covered by the warranty.)

	Maximum axle loading weight		
	Front axle Wf	Rear axle Wry	Total gross machine weight
G2160	350 kg (772 lbs)	550 kg (1213 lbs)	700 kg (1540 lbs)

W1054384



1 ENGINE

SERVICING

CONTENTS

1. TROUBLESHOOTING	1-S1
2. SERVICING SPECIFICATIONS	1-S5
[1] ENGINE BODY	1-S5
[2] LUBRICATING SYSTEM	1-S9
[3] COOLING SYSTEM	1-S9
[4] FUEL SYSTEM	1-S10
3. TIGHTENING TORQUES	1-S11
4. CHECKING, DISASSEMBLING AND SERVICING	1-S12
[1] SEPARATING ENGINE	1-S12
(1) Disassembling and Assembling	1-S12
[2] ENGINE BODY	1-S17
(1) Checking and Adjusting	1-S17
(2) Disassembling and Assembling	1-S20
(3) Servicing	1-S31
[3] LUBRICATING SYSTEM	1-S46
(1) Checking	1-S46
(2) Servicing	1-S46
[4] COOLING SYSTEM	1-S48
(1) Checking and Adjusting	1-S48
(2) Disassembling and Assembling	1-S50
[5] FUEL SYSTEM	1-S51
(1) Checking and Adjusting	1-S51
(2) Disassembling and Assembling	1-S54

1. TROUBLESHOOTING

Symptom	Probable Cause	Solution	Reference Page
Engine Does Not Start	- No fuel - Air in the fuel system - Water in the fuel system	Replenish fuel. Bleed fuel system. Change fuel and replace fuel system.	– – –
	- Fuel pipe clogged - Fuel filter clogged - Excessively high viscosity of fuel or engine oil at low temperature - Fuel with low cetane number - Fuel leak due to loose injection pipe retaining nut - Incorrect injection timing - Fuel camshaft worn - Injection nozzle clogged - Injection pump malfunctioning - Seizure of crankshaft, camshaft, piston, cylinder or bearing - Compression leak from cylinder	Clean fuel pipe. Replace fuel filter. Use specified fuel or engine oil. Use specified fuel. Tighten retaining nut. Adjust injection timing. Replace fuel camshaft. Clean injection nozzle. Repair or replace injection pump. Replace crankshaft, camshaft, piston, cylinder or bearing. Replace head gasket, tighten cylinder head screw, glow plug and nozzle holder.	– G-27 G-8 G-8 1-S54 1-S51 1-S25 1-S53 1-S52 1-S28 1-S30 1-S21 1-S22
(Starter Does Not Run)	- Battery discharged - Starter malfunctioning	Charge battery. Repair or replace starter	G-24 8-S16
	- Slow blow fuse blown - Main switch malfunctioning - PTO switch defective - Brake switch defective - Reverse switch defective - Seat switch defective - Wiring harness disconnected	Replace slow blow fuse. Repair or replace main switch. Replace PTO switch. Replace brake switch. Replace reverse switch or adjust reverse switch gap. Replace seat switch. Connect wiring harness.	– 8-S12 8-S28 8-S27 8-S30 8-S28 –

W1066187

Symptom	Probable Cause	Solution	Reference Page
Engine Revolution Is Not Smooth	- Fuel filter clogged or dirty - Air cleaner clogged - Fuel leak due to loose injection pipe retaining nut - Injection pump malfunctioning - Incorrect nozzle injection pressure - Injection nozzle stuck or clogged - Governor malfunctioning	Replace fuel filter. Clean or replace air cleaner element. Tighten retaining nut. Repair or replace injection pump. Adjust nozzle injection pressure. Repair or replace injection nozzle. Repair governor.	G-27 G-28 1-S20 1-S23 1-S53 1-S53 1-S23 1-S25
Either White or Blue Exhaust Gas Is Observed	- Excessive engine oil - Piston ring and cylinder worn or stock - Incorrect injection timing - Deficient compression	Reduce to specified engine oil level. Repair piston ring and bore oversize piston. Adjust injection timing. Adjust top clearance	– 1-S28 1-S30 1-S45 1-S51 1-S18
Either Black or Dark Gray Exhaust Gas Is Observed	- Overload - Low grade fuel used - Fuel filter clogged - Air cleaner clogged - Deficient nozzle injection	Lessen load. Use specified fuel. Replace fuel filter. Clean or replace air cleaner element. Repair or replace nozzle	– – G-27 G21 G28 1-S53
Deficient Output	- Incorrect injection timing - Engine's moving parts seem to be seized. - Uneven fuel injection - Deficient nozzle injection - Compression leak from cylinder	Adjust injection timing. Repair or replace engine's moving parts. Repair or replace injection pump. Repair or replace nozzle. Replace head gasket, tighten cylinder head screws, glow plugs and nozzle holders.	1-S51 – 1-S53 1-S53 1-S21 1-S22
Excessive Lubricant Oil Consumption	- Piston ring's gap facing the same direction - Oil ring worn or stuck - Piston ring groove worn - Valve stem and valve guide worn - Oil leaking due to defective seals or packing	Shift ring gap direction. Replace oil ring. Replace piston. Replace valve stem and valve guide. Replace defective seals or packing.	1-S27 1-S28 1-S28 1-S28 1-S33 –

W1010717

Symptom	Probable Cause	Solution	Reference Page
Fuel Mixed into Lubricant Oil	- Injection pump's plunger worn - Deficient nozzle injection - Injection pump broken	Replace pump element or injection pump. Repair or replace nozzle. Replace injection pump.	1-S52 1-S51 1-S52 1-S52
Water Mixed into Lubricant Oil	- Head gasket defective - Cylinder block or cylinder head flawed	Replace head gasket. Replace cylinder block or cylinder head.	1-S22 1-S22
Low Oil Pressure	- Engine oil insufficient - Oil strainer clogged - Engine oil filter cartridge clogged - Relief valve stuck with dirt - Relief valve spring weaken or broken - Excessive oil clearance of crankshaft bearing - Excessive oil clearance of crankpin bearing - Excessive oil clearance of rocker arm - Oil passage clogged - Different type of oil - Oil pump defective	Replenish engine oil. Clean oil strainer. Change engine oil filter cartridge. Replace relief valve. Replace relief valve spring. Replace main bearings, metals or crankshaft. Replace crankpin bearings. Replace rocker arms, rocker arm brackets or rocker arm shaft. Clean oil passage. Use specified type of oil. Repair or replace oil pump.	G-17 G-27 G-18 1-S46 – 1-S43 1-S44 1-S42 1-S35 – – 1-S46 1-S47
High Oil Pressure	- Different type of oil - Relief valve defective	Use specified type of oil. Replace relief valve.	– 1-S46

W1012734

Symptom	Probable Cause	Solution	Reference Page
Engine Overheated	• Engine oil insufficient • Fan belt broken or tensioned improperly	Replenish engine oil. Replace fan belt or adjust fan belt tension.	G-17 G-20 1-S48
	• Cooling water insufficient	Replenish cooling water.	—
	• Radiator net and radiator fin clogged with dust	Clean radiator net and radiator fin.	—
	• Inside of radiator corroded	Clean inside of radiator or replace radiator.	G-28
	• Cooling water flow route corroded	Clean or replace cooling water flow route.	G-28
	• Radiator cap defective	Replace radiator cap.	1-S49
	• Overload running	Loosen load.	—
	• Head gasket defective	Replace head gasket.	1-S19 1-S22
	• Incorrect injection timing	Adjust injection timing.	1-S51
	• Unsuitable fuel used	Use specified fuel.	—

W1013908

2. SERVICING SPECIFICATIONS

[1] ENGINE BODY

Cylinder Head

Item	Factory Specification	Allowable Limit
Cylinder Head Surface Flatness	—	0.05 mm 0.0020 in.
Top Clearance	0.50 to 0.70 mm 0.0197 to 0.0276 in.	—
Compression Pressure	2.84 to 3.24 MPa 29.0 to 33.0 kgf/cm ² 412 to 469 psi	2.26 MPa 23.0 kgf/cm ² 327 psi
Variance Among Cylinders	—	10 % or less

W1013874

Valves

Valve Clearance (Cold)	0.145 to 0.185 mm 0.00571 to 0.00728 in.	—
Valve Seat Width	2.12 mm 0.0835 in.	—
Valve Seat Angle	0.79 rad 45°	—
Valve Face Angle	0.79 rad 45°	—
Valve Recessing	−0.10 to 0.10 mm −0.0039 to 0.0039 in.	0.3 mm 0.0118 in.
Clearance between Valve Stem and Valve Guide	0.030 to 0.057 mm 0.00118 to 0.00224 in.	0.10 mm 0.0039 in.
Valve Stem O.D.	5.968 to 5.980 mm 0.23496 to 0.23543 in.	—
Valve Guide I.D.	6.010 to 6.025 mm 0.23661 to 0.23720 in.	—

W1014656

Valve Timing

Intake Valve	Open	0.35 rad (20°) before T.D.C.	—
	Close	0.79 rad (45°) after B.D.C.	—
Exhaust Valve	Open	0.89 rad (50°) before B.D.C.	—
	Close	0.26 rad (15°) after T.D.C.	—

W1013874

Valve Spring

Item	Factory Specification	Allowable Limit
Free Length	31.3 to 31.8 mm 1.232 to 1.252 in.	28.4 mm 1.118 in.
Setting Load / Setting Length	64.7 N / 27.0 mm 6.6 kgf / 27.0 mm 14.6 lbs / 1.063 in.	54.9 N / 27.0 mm 5.6 kgf / 27.0 mm 12.3 lbs / 1.063 in.
Tilt	—	1.2 mm 0.047 in.

W1014987

Rocker Arm

Clearance between Rocker Arm Shaft and Rocker Arm	0.016 to 0.045 mm 0.00063 to 0.00177 in.	0.15 mm 0.0059 in.
Rocker Arm Shaft O.D.	10.473 to 10.484 mm 0.41232 to 0.41276 in.	—
Rocker Arm I.D.	10.500 to 10.518 mm 0.41339 to 0.41410 in.	—

W1015094

Push Rod

Push Rod Runout	—	0.50 mm 0.0196 in.
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W1015197

Tappet

Clearance between Tappet and Guide	0.016 to 0.052 mm 0.00063 to 0.00205 in.	0.10 mm 0.0039 in.
Tappet O.D.	17.966 to 17.984 mm 0.70732 to 0.70803 in.	—
Tappet Guide I.D.	18.000 to 18.018 mm 0.70866 to 0.70937 in.	—

W1013874

Camshaft

Camshaft Side Clearance	0.15 to 0.31 mm 0.0059 to 0.0122 in.	0.50 mm 0.0197 in.
Camshaft Runout	—	0.02 mm 0.0008 in.
Cam Height of Intake and Exhaust	26.88 mm 1.0583 in.	26.83 mm 1.0563 in.
Oil Clearance of Camshaft	0.050 to 0.091 mm 0.00197 to 0.00358 in.	0.15 mm 0.0059 in.
Camshaft Journal O.D.	32.934 to 32.950 mm 1.29661 to 1.29724 in.	—
Camshaft Bearing I.D.	33.000 to 33.025 mm 1.29921 to 1.30020 in.	—

W1016577

Timing Gear

Item	Factory Specification	Allowable Limit
Timing Gear Backlash Crank Gear- Idle Gear	0.043 to 0.124 mm 0.00169 to 0.00488 in.	0.15 mm 0.0059 in.
Idle Gear-Cam Gear	0.047 to 0.123 mm 0.00185 to 0.00484 in.	0.15 mm 0.0059 in.
Idle Gear-Injection Pump Gear	0.041 to 0.124 mm 0.00161 to 0.00488 in.	0.15 mm 0.0059 in.
Crank Gear-Oil Pump Drive Gear	0.041 to 0.123 mm 0.00161 to 0.00484 in.	0.15 mm 0.0059 in.
Clearance between Idle Gear Shaft and Idle Gear Bushing	0.020 to 0.084 mm 0.00079 to 0.00331 in.	0.10 mm 0.0039 in.
Idle Gear Shaft O.D.	19.967 to 19.980 mm 0.78610 to 0.78661 in.	—
Idle Gear Bushing I.D.	20.000 to 20.051 mm 0.78740 to 0.78941 in.	—
Idle Gear Side Clearance	0.20 to 0.51 mm 0.0079 to 0.0201 in.	0.60 mm 0.0236 in.

W1013874

Piston • Piston Ring

Piston Pin Bore I.D.		20.000 to 20.013 mm 0.78740 to 0.78791 in.	20.05 mm 0.7894 in.
Piston Ring Clearance	Second Ring	0.090 to 0.120 mm 0.00354 to 0.00472 in.	0.15 mm 0.0059 in.
	Oil Ring	0.04 to 0.08 mm 0.0016 to 0.0031 in.	0.15 mm 0.0059 in.
Piston Ring Gap	Top Ring Oil Ring	0.15 to 0.30 mm 0.0059 to 0.0118 in.	1.25 mm 0.0492 in.
	Second Ring	0.30 to 0.45 mm 0.0118 to 0.0177 in.	1.25 mm 0.0492 in.
Oversize of Piston Rings		+0.25 mm +0.0098 in.	—

W1016812

Connecting Rod

Connecting Rod Alignment		—	0.05 mm 0.0020 in.
Clearance between Piston Pin and Small End Bushing		0.014 to 0.038 mm 0.00055 to 0.00150 in.	0.10 mm 0.0039 in.
Piston Pin O.D.		20.002 to 20.011 mm 0.78748 to 0.78783 in.	—
Small End Bushing I.D.		20.025 to 20.040 mm 0.78839 to 0.78897 in.	—

W1016985

Crankshaft

Item	Factory Specification	Allowable Limit
Crankshaft Runout	—	0.04 mm 0.0016 in.
Oil Clearance between Crankshaft Journal and Crankshaft Bearing 1	0.034 to 0.106 mm 0.00134 to 0.00417 in.	0.20 mm 0.0079 in.
Crankshaft Journal O.D.	39.934 to 39.950 mm 1.57221 to 1.57284 in.	—
Crankshaft Bearing 1 I.D.	39.984 to 40.040 mm 1.57417 to 1.57638 in.	—
Oil Clearance between Crankshaft Journal and Crankshaft Bearing 2 (Flywheel Side)	0.034 to 0.092 mm 0.00134 to 0.00362 in.	0.20 mm 0.0079 in.
Crankshaft Journal O.D.	43.934 to 43.950 mm 1.72969 to 1.73032 in.	—
Crankshaft Bearing 2 I.D.	43.984 to 44.026 mm 1.73165 to 1.73331 in.	—
Oil Clearance between Crankshaft Journal and Crankshaft Bearing 3 (Intermediate)	0.034 to 0.092 mm 0.00134 to 0.00362 in.	0.20 mm 0.0079 in.
Crankshaft Journal O.D.	39.934 to 39.950 mm 1.57221 to 1.57284 in.	—
Crank bearing 3 I.D.	39.984 to 40.026 mm 1.57417 to 1.57583 in.	—
Oil Clearance between Crankpin and Crankpin Bearing	0.020 to 0.051 mm 0.00079 to 0.00201 in.	0.15 mm 0.0059 in.
Crankpin O.D.	33.959 to 33.975 mm 1.33697 to 1.33760 in.	—
Crankpin Bearing I.D.	33.995 to 34.010 mm 1.33839 to 1.33898 in.	—
Crankshaft Side Clearance	0.15 to 0.31 mm 0.0059 to 0.0122 in.	0.50 mm 0.0197 in.

W1017094

Cylinder Liner

Cylinder Liner I.D.	67.000 to 67.019 mm 2.63779 to 2.63854 in.	+0.15 mm 0.0059 in.
Oversized Cylinder Liner I.D.	67.250 to 67.269 mm 2.64764 to 2.64839 in.	+0.15 mm 0.0059 in.

W1017278

[2] LUBRICATING SYSTEM

Oil Pump

Item	Factory Specification	Allowable Limit
Engine Oil Pressure At Idle Speed	98 kPa 1.0 kgf/cm ² 14 psi	—
At Rated Speed	196 to 441 kPa 2.0 to 4.5 kgf/cm ² 28 to 64 psi	98 kPa 1.0 kgf/cm ² 14 psi
Clearance between Inner Rotor and Outer Rotor	0.03 to 0.14 mm 0.0012 to 0.0055 in.	—
Clearance between Outer Rotor and Pump Body	0.07 to 0.15 mm 0.0028 to 0.0059 in.	—
End Clearance between Inner Rotor and Cover	0.075 to 0.135 mm 0.00295 to 0.00531 in.	—

W1017384

[3] COOLING SYSTEM

Thermostat

Thermostat's Valve Opening Temperature	80.5 to 83.5 °C 176.9 to 182.3 °F	—
Temperature at Which Thermostat Completely Opens	95 °C 203 °F	—

W1017547

Radiator

Radiator Water Tightness	Water tightness at specified pressure 147 kPa 1.5 kgf/cm ² , 21 psi	—
Radiator Cap Air Leakage	10 seconds or more 88 → 59 kPa 0.9 → 0.6 kgf/cm ² 13 → 9 psi	—
Fan Belt Tension	Approx. 10 mm / 98 N 0.4 in. / 98 N (10 kgf, 22 lbs)	—

W1013874

[4] FUEL SYSTEM

Injection Pump

Item	Factory Specification	Allowable Limit
Injection Timing	0.31 to 0.34 rad (19.0 to 21.0 °) Before T.D.C.	—
Fuel Tightness of Pump Element	—	14.7 MPa 150 kgf/cm ² 2130 psi
Fuel Tightness of Delivery Valve	—	5 seconds 14.7 → 13.7 MPa 150 → 140 kgf/cm ² 2130 → 1990 psi

W1013874

Injection Nozzle

Fuel Injection Pressure	13.7 to 14.7 MPa 140 to 150 kgf/cm ² 1990 to 2130 psi	—
Fuel Tightness of Nozzle Valve Seat	When the pressure is 12.7 MPa (130 kgf/cm ² , 1850 psi), the valve seat must be fuel tightness.	—

W1013973

3. TIGHTENING TORQUES

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

Item	Size x Pitch	N·m	kgf·m	ft-lbs
Starter M terminal nut	M6 × 1.0	9.8 to 13.7	1.0 to 1.4	7.2 to 10.1
Alternator B terminal nut	M6 × 1.0	7.8 to 9.3	0.80 to 0.95	5.8 to 6.9
Glow plug terminal mounting nut		1.0 to 1.8	0.10 to 0.18	0.74 to 1.33
Universal joint mounting screw	M8 × 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Engine mounting nut	M8 × 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Cylinder head bolt	M8 × 1.25	37.2 to 42.1	3.8 to 4.3	28.0 to 31.7
* Cylinder head cover cap nut	M6 × 1.0	3.9 to 5.9	0.4 to 0.6	2.9 to 4.3
Injection pipe retaining nut	M12 × 1.5	24.5 to 34.3	2.5 to 3.5	18.1 to 25.3
Nozzle holder assembly	M20 × 1.5	49.0 to 68.6	5.0 to 7.0	36.2 to 50.6
Overflow pipe assembly retaining nut (nozzle)	M12 × 1.5	19.6 to 24.5	2.0 to 2.5	14.5 to 18.1
Glow plug	M8 × 1.0	7.8 to 14.7	0.8 to 1.5	5.8 to 10.8
* Rocker arm bracket nut	M6 × 1.0	9.8 to 11.3	1.00 to 1.15	7.2 to 8.3
* Fan drive pulley retaining screw	M12 × 1.5	117.6 to 127.4	12.0 to 13.0	86.8 to 94.0
* Idle gear shaft mounting screw	M6 × 1.0	9.8 to 11.3	1.00 to 1.15	7.2 to 8.3
* Connecting rod screw	M7 × 0.75	26.5 to 30.4	2.7 to 3.1	19.5 to 22.4
* Flywheel bolt	M10 × 1.25	53.9 to 58.8	5.5 to 6.0	39.8 to 43.4
* Main bearing case screw 2	M7 × 1.0	26.5 to 30.4	2.7 to 3.1	19.5 to 22.4
* Main bearing case screw 1	M6 × 1.0	12.7 to 15.7	1.3 to 1.6	9.4 to 11.6
Oil pressure switch	PT 1/8	14.7 to 19.6	1.5 to 2.0	10.8 to 14.5
Nozzle holder		34.3 to 39.2	3.5 to 4.0	25.3 to 28.9

■ NOTE

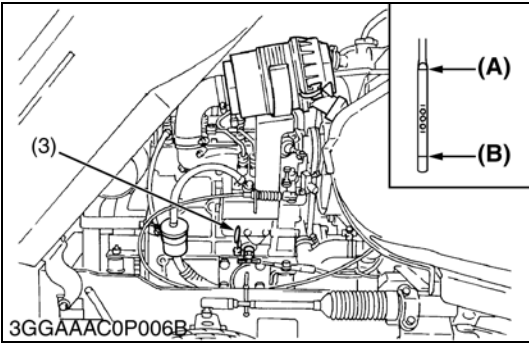
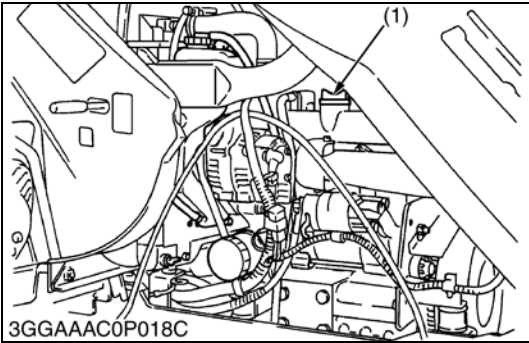
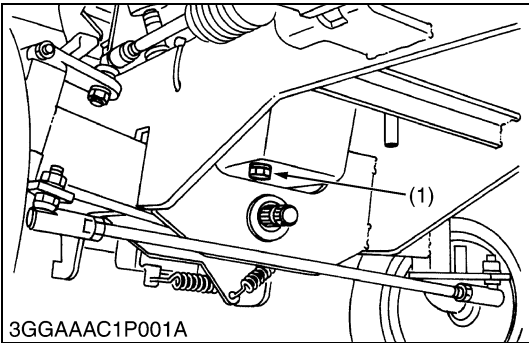
- For * marked screws, bolts and nuts on the table, apply engine oil to their threads and seats before tightening.
- The letter "M" in Size x Pitch means that the screw, bolt or nut dimension stands for metric. The size is the nominal outside diameter in mm of the threads. The pitch is the nominal distance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

W1013236

4. CHECKING, DISASSEMBLING AND SERVICING

[1] SEPARATING ENGINE

(1) Disassembling and Assembling



Dismount Mower

- 1. See to “MOWER” section.

W1019171

Draining Engine Oil

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

(When refilling)

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

Engine oil	Capacity	
		2.8 L
		2.95 U.S.qts
		2.4 Imp.qts

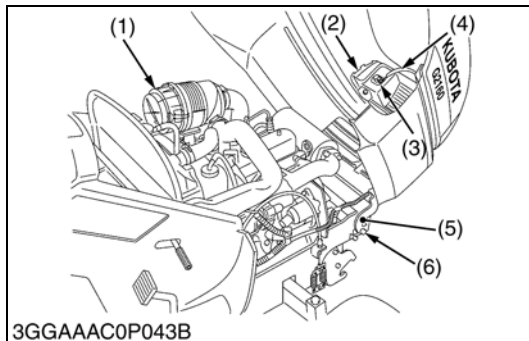
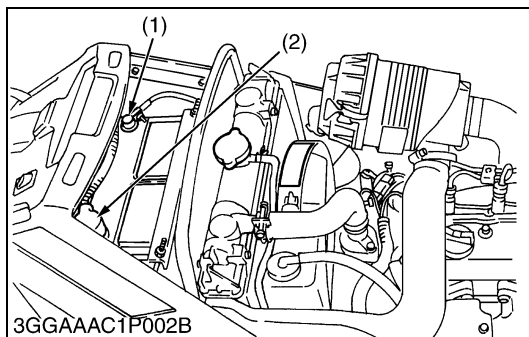
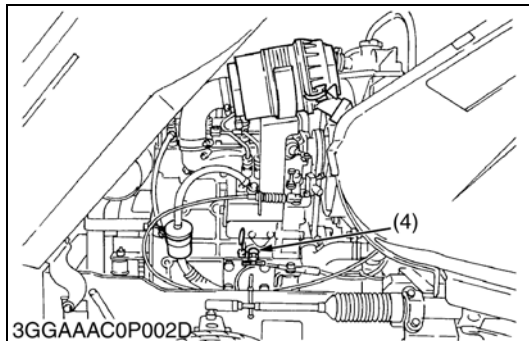
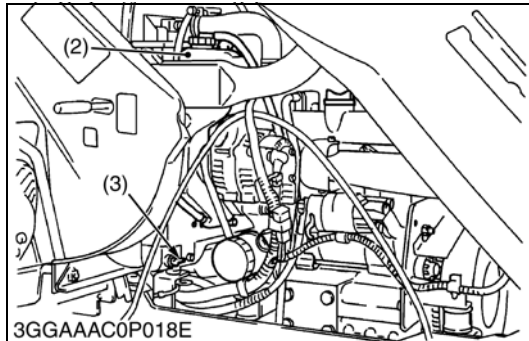
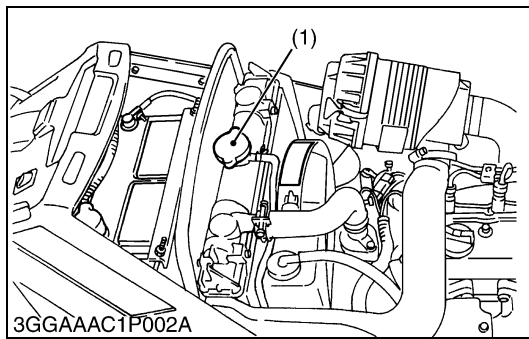
■ IMPORTANT

- Never mix two different type of oil.
 - Use the proper SAE Engine Oil according to ambient temperatures.
- Refer to "LUBRICANTS, FUEL AND COOLING WATER".(See page G-8.)

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

- (A) Upper Level
- (B) Lower Level

W1019220



Draining Coolant



CAUTION

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

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

Coolant	Capacity	Radiator	2.1 L 2.2 U.S.qts 1.8 Imp.qts
		Recovery tank	0.25 L 0.26 U.S.qts 0.22 Imp.qts

- (1) Radiator Cap
(2) Recovery Tank

- (3) Radiator Coolant Drain Plug
(4) Engine Coolant Drain Plug

W1019510

Battery



CAUTION

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

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

- (1) Negative Cable

- (2) Positive Cable

W1019788

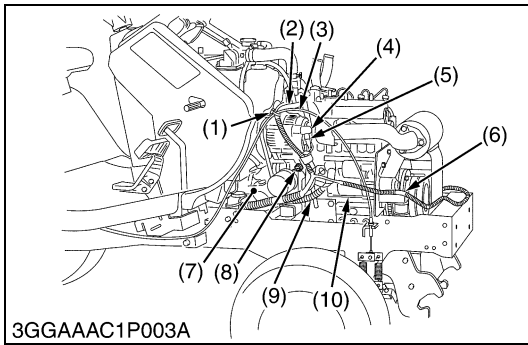
Bonnet and Air Cleaner

1. Disconnect the **1P** connectors (3) from the head light (2).
2. Remove the wiring (4) from the bonnet.
3. Remove the bonnet stay mounting screws (6).
4. Remove the bonnet with the bonnet bracket (5) from the frame.
5. Loosen the air cleaner hose clamp.
6. Remove the air cleaner (1) with air cleaner hose.

- (1) Air Cleaner
(2) Head Light
(3) **1P** Connectors

- (4) Wiring
(5) Bonnet Bracket
(6) Bonnet Stay Mounting Screws

W1019921



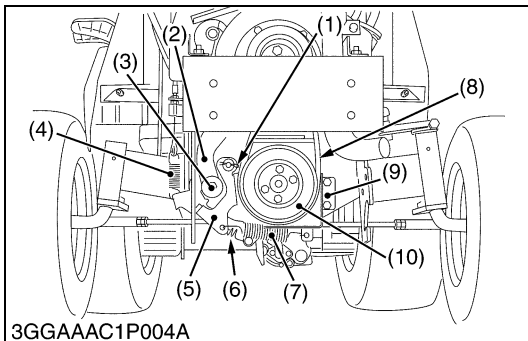
Wiring

1. Disconnect the tie (1) from the alternator, and remove the PTO cable (3) and wiring (2).
2. Disconnect **2P** connector (5) and wiring (4) from the alternator.
3. Disconnect **1P** connector (8) from the oil pressure switch.
4. Disconnect **1P** connector (10) and wiring (9) from the starter.
5. Disconnect the tie (6) from the rear end plate.
6. Disconnect the ground cable (7).

Tightening torque	Starter M terminal nut	9.8 to 13.7 N·m 1.0 to 1.4 Kgf·m 7.2 to 10.1 ft·lbs
	Alternator B terminal nut	7.8 to 9.3 N·m 0.80 to 0.95 Kgf·m 5.8 to 6.9 ft·lbs

- | | |
|-------------------------|--------------------------|
| (1) Tie | (6) Tie |
| (2) Wiring | (7) Ground Cable |
| (3) PTO Cable | (8) 1P Connector |
| (4) Wiring | (9) Wiring |
| (5) 2P Connector | (10) 1P Connector |

W1020275



Front Cover and PTO Assembly

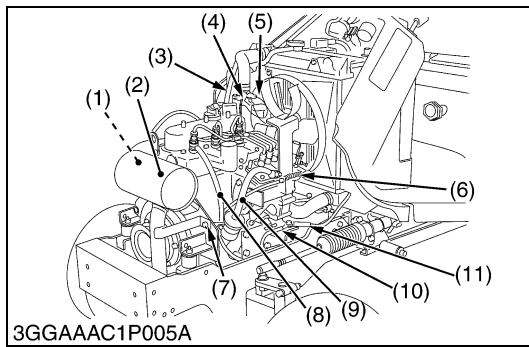
1. Remove the front PTO cover.
2. Remove the PTO clutch spring (4), brake spring (7) and return spring (6).
3. Remove the belt stay (9).
4. Remove the pulley (10).
5. Remove the front PTO belts (8).
6. Remove the cotter pin and flange bolt (3).
7. Pull out the PTO brake assembly (5) and tension arm (2) with tension pulley.

(When reassembling)

- Apply grease to the tension arm bushings and the PTO brake bushing.
- After reassembling the PTO clutch spring, be sure to adjust the front PTO belt tension. (See page 7-S3)
- After reassembling the belt stay, be sure to adjust the clearance between the belt stay and front PTO belt. (See page 7-S3)
Clearance (L) :1.0 to 2.5 mm (0.04 to 0.10 in.)

- | | |
|------------------------|---------------------|
| (1) Cotter Pin | (6) Return Spring |
| (2) Tension Arm | (7) Brake Spring |
| (3) Flange Bolt | (8) Front PTO Belts |
| (4) PTO Clutch Spring | (9) Belt Stay |
| (5) PTO Brake Assembly | (10) Pulley |

W1020759



Muffler, Wiring, Accelerator and Hose

1. Remove the muffler mounting screws (1), (7).
2. Remove the muffler (2).
3. Disconnect **1P** connector (5) from the coolant temperature sensor.
4. Disconnect the wiring (3) from the glow plug.
5. Disconnect 1P connector (4) from the engine stop solenoid.
6. Disconnect the accelerator wire (6).
7. Loosen the hose clamps.
8. Remove the return hose 1 (8) and fuel hose 1 (9).
9. Disconnect the ground cables (10), (11).

■ IMPORTANT

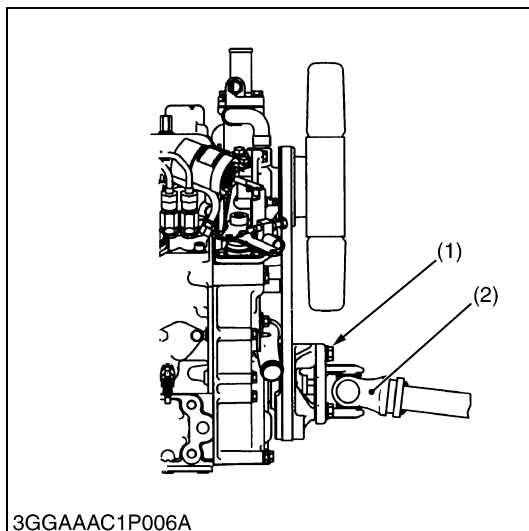
- When disconnecting the fuel hose 1 and return hose 1, be careful not to let the fuel spill out of the hoses.

(When reassembling)

Tightening torque	Glow plug terminal mounting nut	1.0 to 1.8 N·m 0.10 to 0.18 Kgf·m 0.74 to 1.33 ft-lbs
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- | | |
|-----------------------------|----------------------------|
| (1) Muffler Mounting Screws | (7) Muffler Mounting Screw |
| (2) Muffler | (8) Return Hose 1 |
| (3) Wiring | (9) Fuel Hose 1 |
| (4) 1P Connector | (10) Ground Cable |
| (5) 1P Connector | (11) Ground Cable |
| (6) Accelerator Wire | |

W1021263



Universal Joint

1. Remove the universal joint mounting screws (1).
2. Disconnect the universal joint (2) from the fun drive pulley.

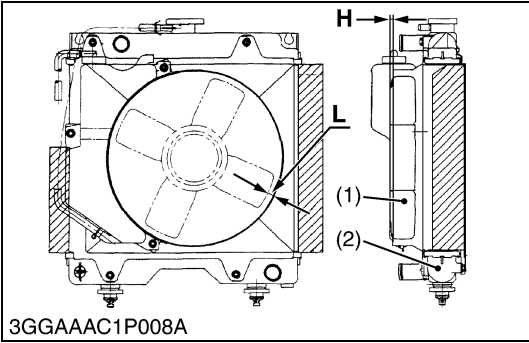
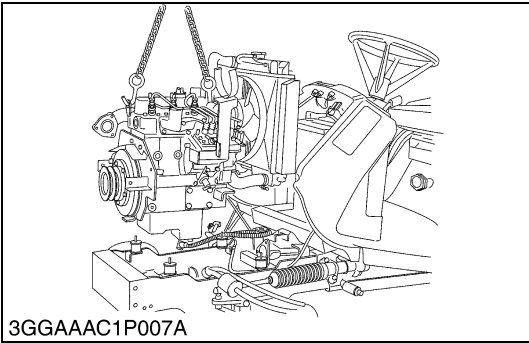
(When reassembling)

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

Tightening torque	Universal joint mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 Kgf·m 17.4 to 20.3 ft-lbs
-------------------	--------------------------------	---

- | | |
|------------------------------------|---------------------|
| (1) Universal Joint Mounting Screw | (2) Universal Joint |
|------------------------------------|---------------------|

W1021776



Separating Engine

- 1. Pull out the hairpin cotters from the radiator.
- 2. Remove the engine mounting nuts, and support the engine with an engine lift hook and hoist.
- 3. Separate the engine with the radiator from the frame, taking care not to damage the radiator.

(When reassembling)

- Fit the radiator to the frame, adjusting the clearance between the radiator and the fan as shown in the figure.

Tightening torque	Engine mounting nut	23.5 to 27.5 N·m 2.4 to 2.8 Kgf·m 17.4 to 20.3 ft-lbs
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(Reference)

Clearance between fan and radiator	Factory spec.	L	9.0 mm 0.35 in.
		H	2.0 mm 0.08 in.

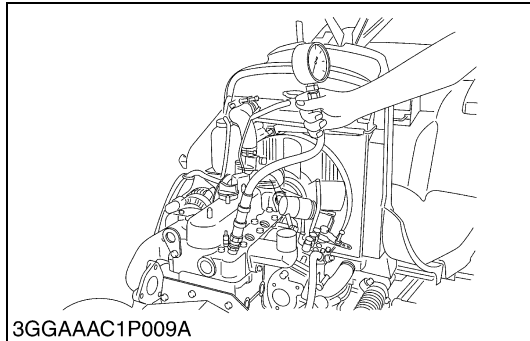
- (1) Fan
- (2) Radiator

L : Circumferential clearance between fan and radiator
H : Longitudinal clearance between fan and radiator

W1021955

[2] ENGINE BODY

(1) Checking and Adjusting



Compression Pressure

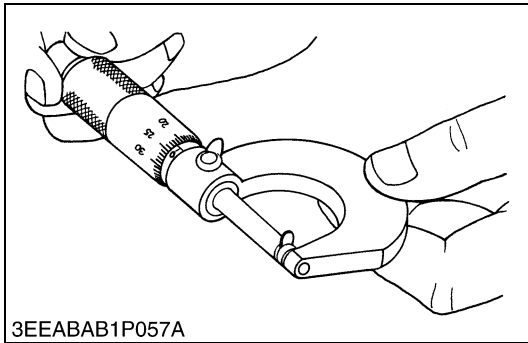
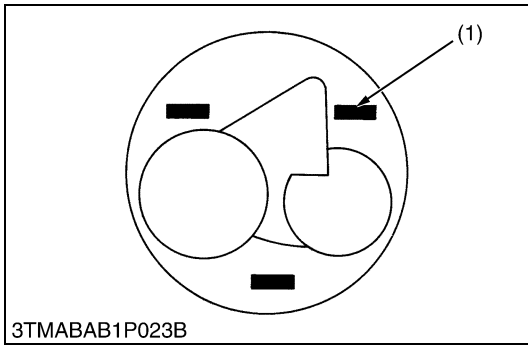
1. Run the engine until it is warmed up.
2. Stop the engine.
3. Disconnect the **2P** connector from the fuel pump.
4. Remove the air cleaner, the muffler and all injection nozzles.
5. Disconnect the accelerator wire.
6. Remove the air cleaner stay.
7. Remove the glow plugs and return hose 1.
8. Engage the parking brake.
9. Set a compression tester (Code No. 07909-30208) with the adaptor (Adaptor H, Code No. 07909-31231) to the nozzle hole.
10. While cranking the engine with the starter, measure the compression pressure.
11. Repeat steps 9 and 10 for each cylinder.
12. If the measurement is below the allowable limit, apply a small amount of oil to the cylinder wall through the nozzle hole and measure the compression pressure again.
13. If the compression pressure is still less than the allowable limit, check the top clearance, valve and cylinder head.
14. If the compression pressure increases after applying oil, check the cylinder wall and piston rings.

■ NOTE

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

Compression pressure	Factory spec.	2.84 to 3.24 MPa 29.0 to 33.0 kgf/cm ² 412 to 469 psi
	Allowable limit	2.26 MPa 23.0 kgf/cm ² 327 psi

W1022478



Top Clearance

1. Remove the cylinder head (Do not attempt to remove the cylinder head gasket completely).
2. Bring the piston to its top dead center fasten 1.5 mm dia. 5 to 7 mm long fuse wires to 3 to 4 spots on the piston top with grease so as to avoid the intake and exhaust valves and the combustion chamber ports.
3. Bring the piston to its middle position, install the cylinder head, and tighten the cylinder head screws to specification. (Head gasket must be changed to new one.)
4. Turn the crank shaft until the piston exceeds its top dead center.
5. Remove the cylinder head, and measure the thickness of the squeezed fuses.
6. If the measurement is not within the factory specifications, check the oil clearance of between the crankpin and crankpin bearing and between the piston pin and small end bushing.

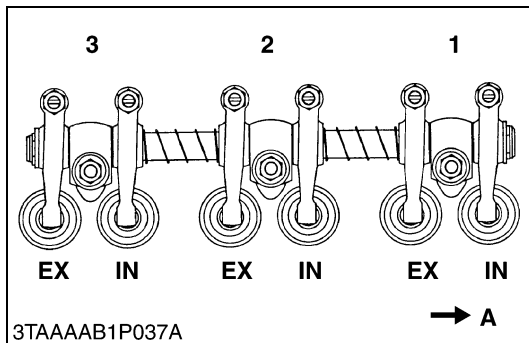
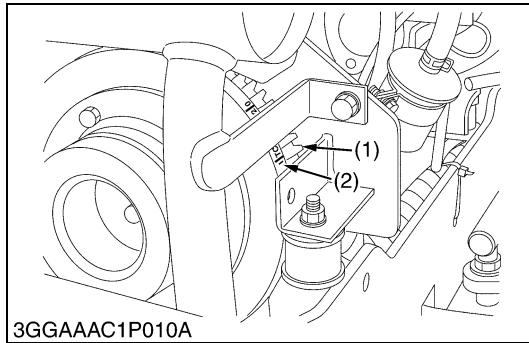
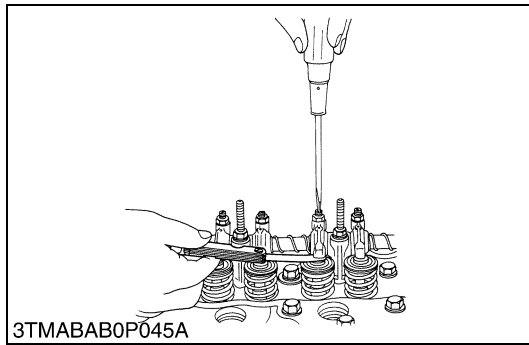
NOTE

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

Top clearance	Factory spec.	0.50 to 0.70 mm 0.0197 to 0.0276 in.
Tightening torque	Cylinder head bolt	37.2 to 42.1 N·m 3.8 to 4.3 kgf·m 28.0 to 31.7 ft·lbs

(1) Fuse

W10107670



Valve Clearance

■ IMPORTANT

- The valve clearance must be checked and adjusted when engine is cold.
1. Remove the cylinder head cover and the glow plugs.
 2. Align the "1TC" mark (1) on the flywheel and alignment mark (2) on the rear end plate so that the No. 1 piston comes to the compression top dead center.
 3. Check the following valve clearance marked with "☆" using a feeler gauge.

[When No. 1 piston comes to the compression top dead center]

Cylinder No.	No.1	No.2	No.3
Intake valve	★		★
Exhaust valve	★	★	

4. If the clearance is not within the factory specifications, adjust with the adjusting screw.
5. Then turn the flywheel 6.28 rad (360°), and align the "1TC" mark (1) on the flywheel and alignment mark (2) on the rear end plate so that the No.1 piston comes to the overlap position.
6. Check the following valve clearance marked with "☆" using a feeler gauge.

[When No. 1 piston comes to the overlap position]

Cylinder No.	No.1	No.2	No.3
Intake valve		☆	
Exhaust valve			☆

7. If the clearance is not within the factory specifications, adjust with the adjusting screw.

Intake and exhaust valve clearance (Cold)	Factory spec.	0.145 to 0.185 mm 0.00571 to 0.00728 in.
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■ NOTE

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

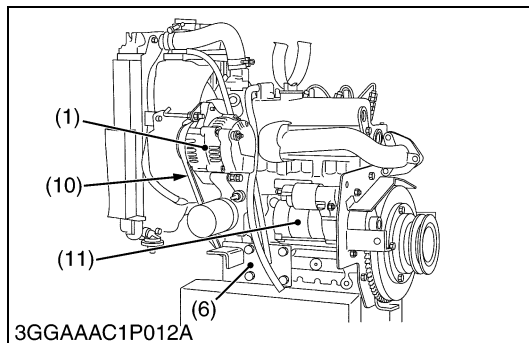
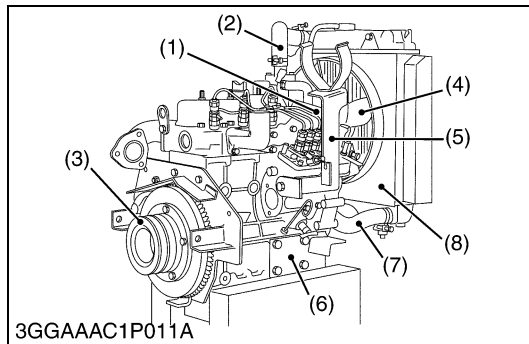
- (1) "1TC" Mark
(2) Alignment Mark

A : Gear Case Side

W10113200

(2) Disassembling and Assembling

(A) Cylinder Head and Valves



External Components

1. Remove the air cleaner stay (5).
2. Remove the water pipe 1 (2), water pipe 2 (7) and radiator (8) with the recovery tank.
3. Remove the alternator (9) and fan belt (10).
4. Remove the cooling fan (4) and fan pulley.
5. Remove the starter (11).
6. Remove the engine stop solenoid (1).
7. Remove the engine mounting stays (6).
8. Remove the PTO pulley.

(When reassembling)

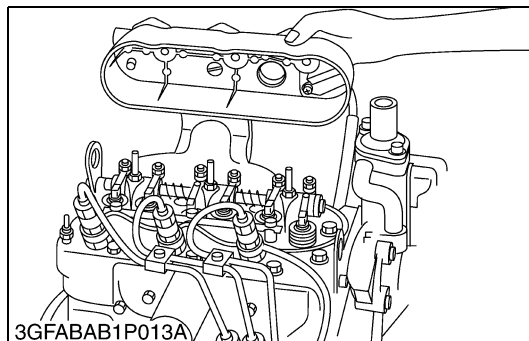
- Connect the water pipe 1 with the white marking facing upward.
- Connect the water pipe 2 with the yellow marking facing upward.
- Install the engine stop solenoid so that the plunger moves smoothly.

■ IMPORTANT

- After reassembling the fan belt, be sure to adjust the fan belt tension. (See page 1-S48)

- | | |
|--------------------------|------------------|
| (1) Engine Stop Solenoid | (7) Water Pipe 2 |
| (2) Water Pipe 1 | (8) Radiator |
| (3) PTO Pulley | (9) Alternator |
| (4) Cooling Fan | (10) Fan Belt |
| (5) Air Cleaner Stay | (11) Starter |
| (6) Engine Mounting Stay | |

W1024919



Cylinder Head Cover

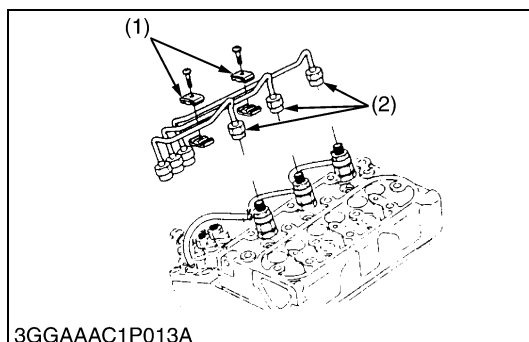
1. Remove the head cover cap nuts.
2. Remove the cylinder head cover.

(When reassembling)

- Check to see if the cylinder head cover gasket is not defective.
- Apply engine oil to the cylinder head cover cap nuts. And tighten them.

Tightening torque	Cylinder head cover cap nut	3.9 to 5.9 N·m 0.4 to 0.6 kgf·m 2.9 to 4.3 ft-lbs
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W10147380



Injection Pipes

1. Loosen the screws on the pipe clamps (1).
2. Detach the injection pipes (2).

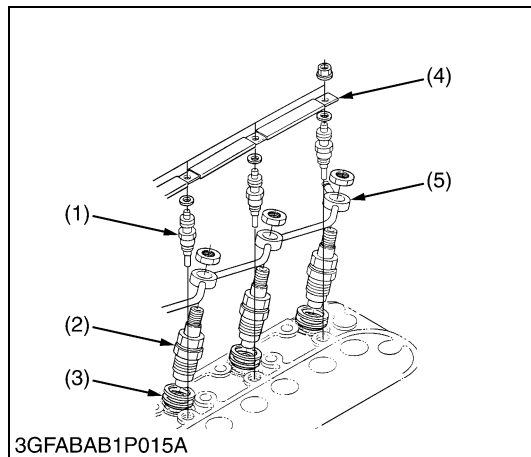
(When reassembling)

- Blow out dust from the pipes with compressed air. Then reassemble the pipes in the reverse order..

Tightening torque	Injection pipe retaining nut	24.5 to 34.3 N·m 2.5 to 3.5 kgf·m 18.1 to 25.3 ft-lbs
-------------------	------------------------------	---

- | | |
|----------------|--------------------|
| (1) Pipe Clamp | (2) Injection Pipe |
|----------------|--------------------|

W10150780



Nozzle Holder Assembly and Glow Plug

1. Remove the overflow pipe assembly (5).
2. Remove the nozzle holder assemblies (2) using a 21 mm deep socket wrench.
3. Remove the copper gasket and heat seal (3).
4. Remove the lead (4) from the glow plugs.
5. Remove the glow plugs (1).

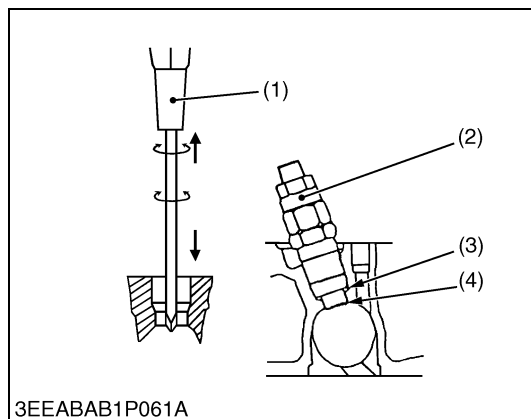
(When reassembling)

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

Tightening torque	Nozzle holder assembly	49.0 to 68.6 N·m 5.0 to 7.0 kgf·m 36.2 to 50.6 ft-lbs
	Overflow pipe assembly retaining nut	19.6 to 24.5 N·m 2.0 to 2.5 kgf·m 14.5 to 18.1 ft-lbs
	Glow plug	7.8 to 14.7 N·m 0.8 to 1.5 kgf·m 5.8 to 10.8 ft-lbs

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

W10259700



Removal Procedure for Nozzle Heat Seal Service

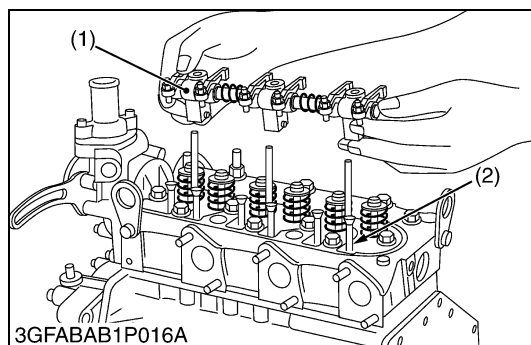
■ IMPORTANT

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

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

- (1) Screw driver (Plus) (3) Copper Gasket
(2) Nozzle Holder (4) Heat Seal

W10154410



Rocker Arm and Push Rod

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

(When reassembling)

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

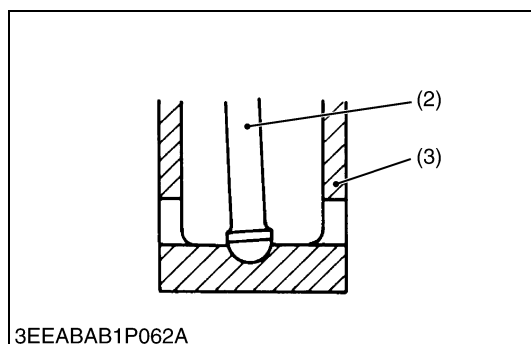
■ IMPORTANT

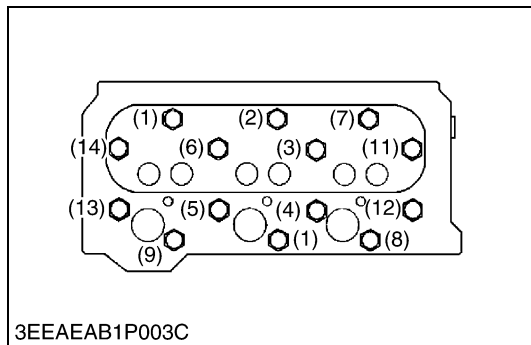
- After installing the rocker arm, be sure to adjust the valve clearance.
- Apply engine oil to the rocker arm bracket nuts. And tighten them.

Tightening torque	Rocker arm bracket nut	9.8 to 11.3 N·m 1.00 to 1.15 kgf·m 7.2 to 8.3 ft-lbs
-------------------	------------------------	--

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

W10155810





Cylinder Head

1. Loosen the pipe clamp, and remove the water return pipe.
2. Remove the cylinder head bolt in the order of (14) to (1).
3. Lift up the cylinder head to detach.
4. Remove the cylinder head gasket and O-ring.

(When reassembling)

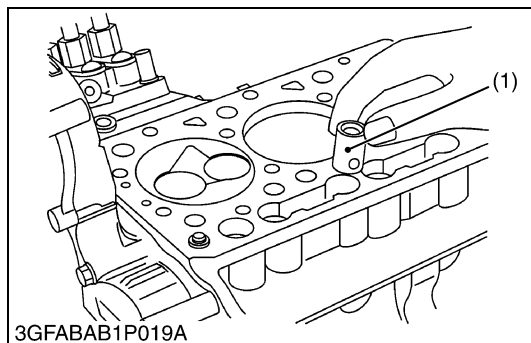
- Replace the cylinder head gasket with a new one.
- Securely fit the O-ring to the pipe pin.
- Tighten the cylinder head bolts after applying sufficient oil.
- Tighten the cylinder head bolts in diagonal sequence starting from the center. (Refer to figure left.)
- Tighten them uniformly, or the cylinder head may deform in the long run.
- Retighten the cylinder head bolts after running the engine for 30 minutes.

■ NOTE

- **To Loosen : 14 to 1**
- **To Tighten : 1 to 14**

Tightening torque	Cylinder head screw	37.2 to 42.1 N·m 3.8 to 4.3 kgf·m 28.0 to 31.7 ft-lbs
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W10159710



Tappets

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

(When reassembling)

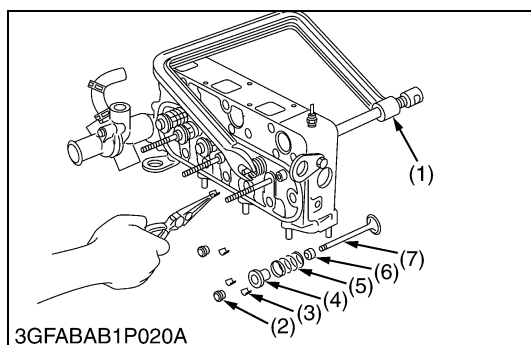
- Before installing the tappets, apply engine oil thinly around them.

■ IMPORTANT

- **Mark the cylinder number to the tappets to prevent interchanging.**

(1) Tappet

W1027457



Valves

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

(When reassembling)

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

■ IMPORTANT

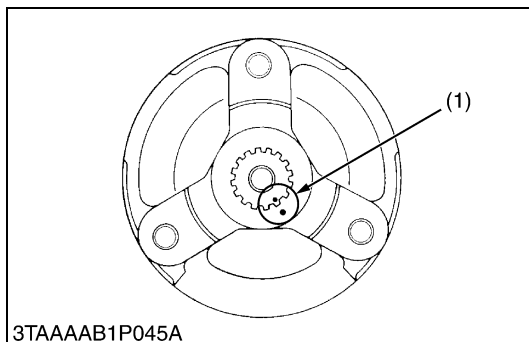
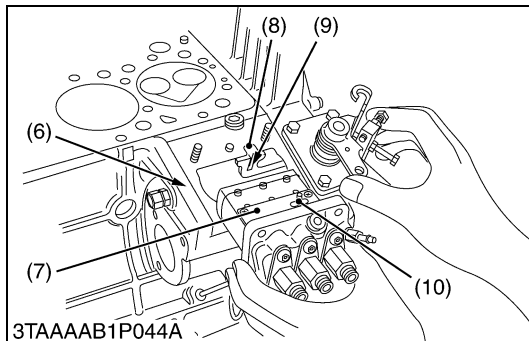
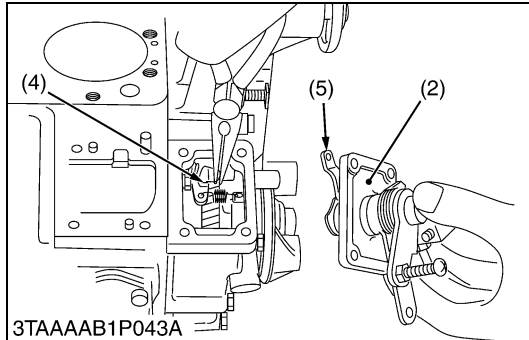
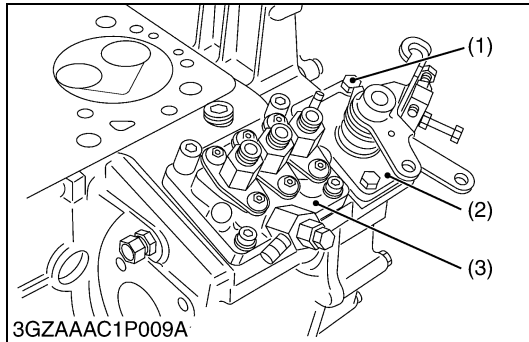
- **Don't change the combination of valve and valve guide.**

- (1) Valve Spring Replacer
- (2) Valve Cap
- (3) Valve Spring Collet
- (4) Valve Spring Retainer

- (5) Valve Spring
- (6) Valve Stem Seal
- (7) Valve

W10162820

(B) Timing Gears and Camshaft



Injection Pump and Speed Control Plate

1. Remove the socket head screws and nuts, and remove the injection pump (3).
2. Remove the screws and separate the speed control plate (2), taking care not to damage the spring (4).
3. Disconnect the spring (4) and remove the speed control plate (2).

(When reassembling)

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

NOTE

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

- | | |
|-------------------------------|----------------------------|
| (1) Screws and Copper Washers | (6) Spring |
| (2) Speed Control Plate | (7) Control Rod |
| (3) Injection Pump | (8) Slot (Crankcase Side) |
| (4) Spring | (9) Slot (Fork Lever Side) |
| (5) Lever | (10) Pin |

W10167080

Fan Drive Pulley

1. Set the stopper to the flywheel.
2. Remove the fan drive pulley retaining screw.
3. Draw out the fan drive pulley with a puller.

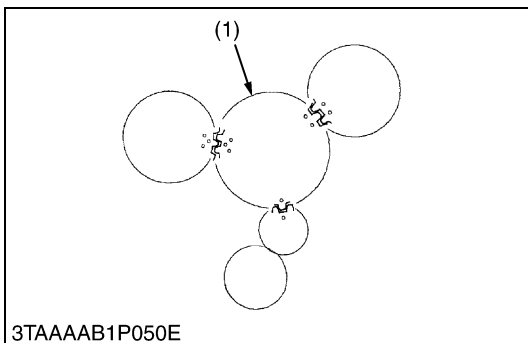
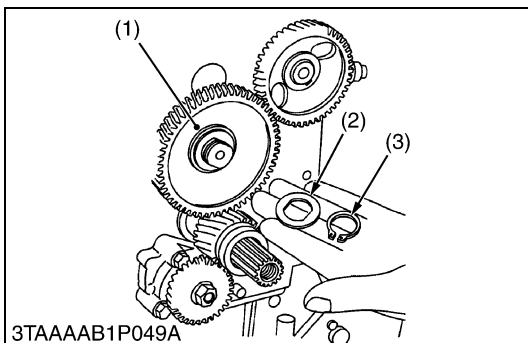
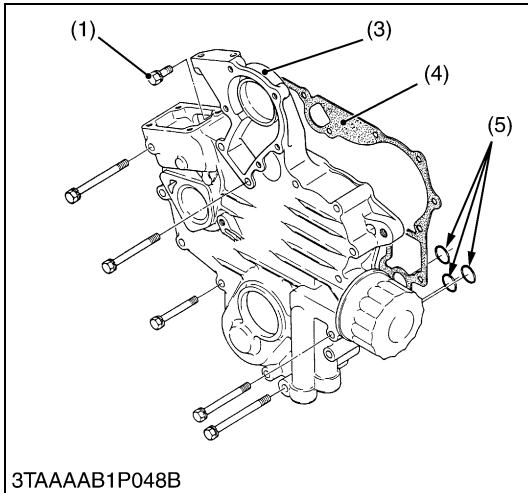
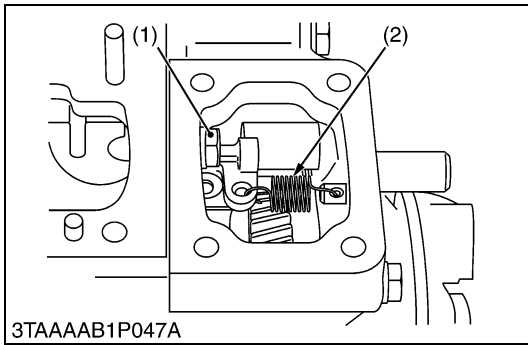
(When reassembling)

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

Tightening torque	Fan drive pulley retaining screw	117.6 to 127.4 N·m 12.0 to 13.0 kgf·m 86.8 to 94.0 ft-lbs
-------------------	----------------------------------	---

- (1) Aligning Mark

W10172470



Gear Case

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

(When reassembling)

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

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

W10174840

Idle Gear

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

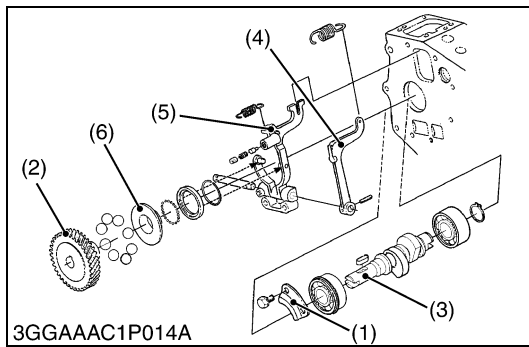
(When reassembling)

- Install the idle gear, aligning the mark on the gears referring to the figure.
- Apply engine oil to the idle gear shaft mounting screws. And tighten them.

Tightening torque	Idle gear shaft mounting screw	9.8 to 11.3 N·m 1.00 to 1.15 kgf·m 7.2 to 8.3 ft-lbs
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- | | |
|----------------------|------------------------|
| (1) Idle Gear | (3) External Snap Ring |
| (2) Idle Gear Collar | |

W1028418



Fuel Camshaft

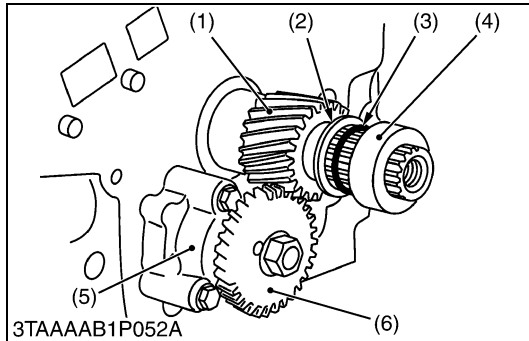
1. Remove the screws and draw out the camshaft with the gear on it.
2. Remove the retaining plate (1).
3. Remove the screws, then draw out the injection pump gear (2) and fuel camshaft (3) with the governor fork assembly.

(When reassembling)

- Hook the spring to the fork lever 2 (4) as shown in the figure before installing the fork lever assembly to the crankcase.

- | | |
|-------------------------|---------------------|
| (1) Retaining Plate | (4) Fork Lever 2 |
| (2) Injection Pump Gear | (5) Fork Lever 1 |
| (3) Fuel Camshaft | (6) Governor Sleeve |

W10178820



Oil Pump and Crankshaft Gear

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

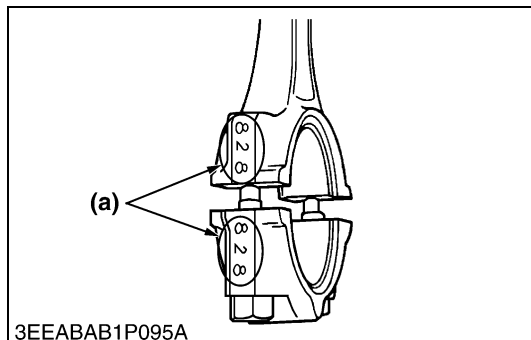
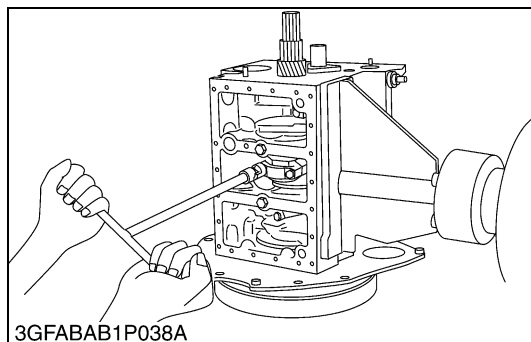
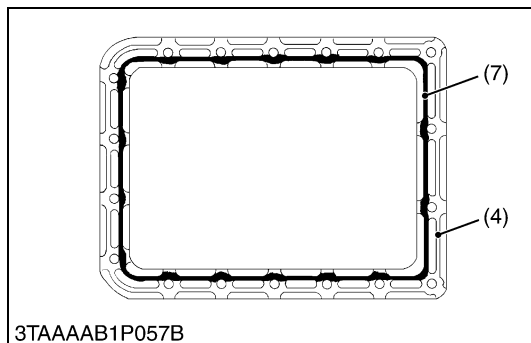
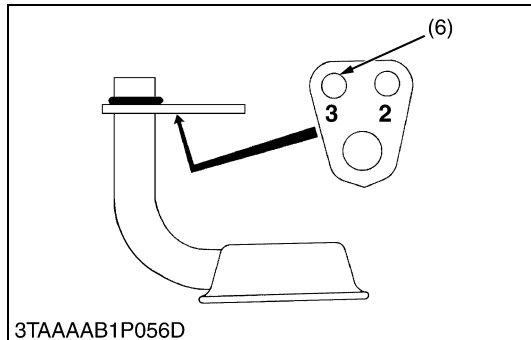
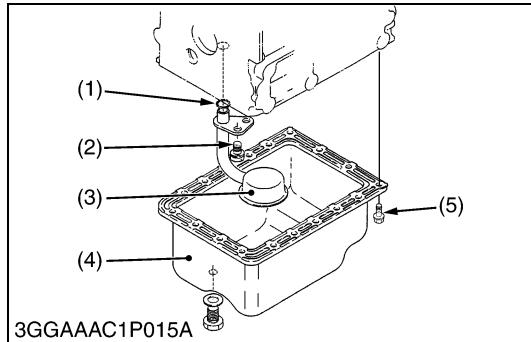
(When reassembling)

- Install the collar after aligning the marks on the gears. (See the figure at "Idle Gear".)

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

W10180290

(C) Connecting Rod and Piston



Oil Pan and Oil Strainer

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

(When reassembling)

- Install the oil strainer, using care not to damage the O-ring (1).
- Using the hole (6) numbered "3", install the oil strainer by mounting screw.
- Apply liquid gasket (Three Bond 1270D or 1270C) to the oil pan as shown in the figure.

■ IMPORTANT

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

- | | |
|------------------|-----------------------------|
| (1) O-ring | (5) Oil Pan Mounting Screws |
| (2) Screw | (6) Hole |
| (3) Oil Strainer | (7) Fluid Sealant |
| (4) Oil Pan | |

W10265670

Connecting Rod Cap

1. Remove the connecting rod screws from connecting rod cap.
2. Remove the connecting rod caps.

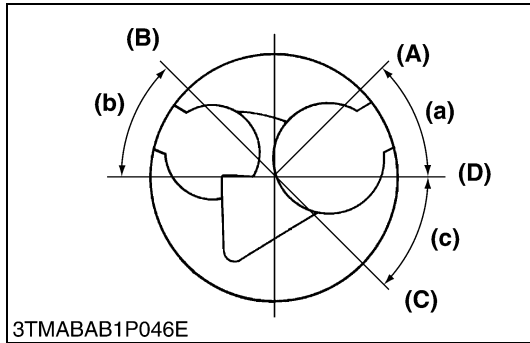
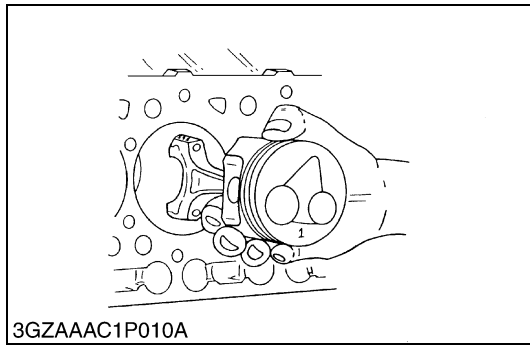
(When reassembling)

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

Tightening torque	Connecting rod screw	26.5 to 30.4 N·m 2.7 to 3.1 kgf·m 19.5 to 22.4 ft·lbs
-------------------	----------------------	---

(a) Mark

W10275480



Piston

1. Turn the flywheel and bring the No.1 piston to the top dead center.
2. Pull out the piston upward by lightly tapping it from the bottom of the crankcase with the grip of a hammer.

(When reassembling)

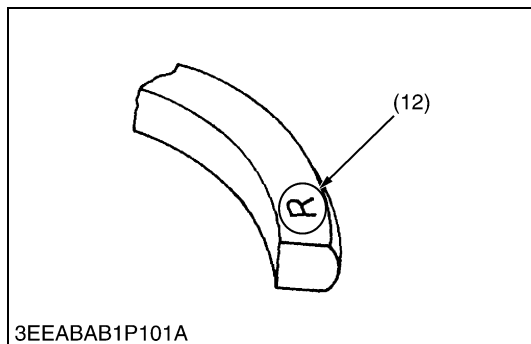
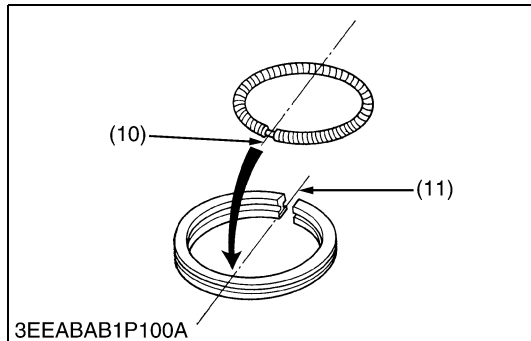
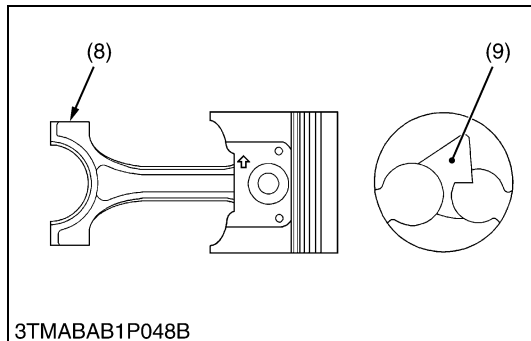
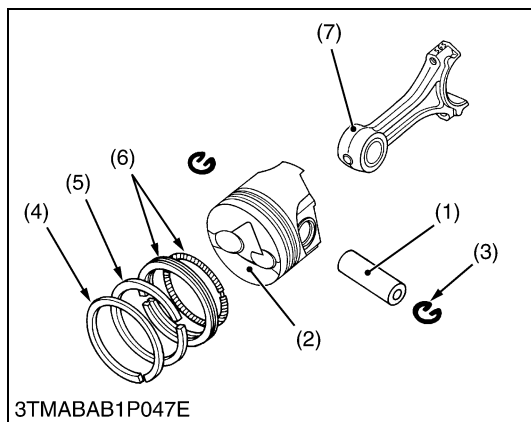
- Before inserting the piston into the cylinder, apply enough engine oil to the cylinder.
- When inserting the piston into the cylinder, face the mark on the connecting rod to the injection pump.

■ IMPORTANT

- Do not change the combination of cylinder and piston. Make sure of the position of each piston by marking. For example, mark "1" on the No.1 piston.
- When inserting the piston into the cylinder, place the gap of the compression ring 1 on the opposite side of the combustion chamber and stagger the gaps of the compression ring 2 and oil ring making a right angle from the gap of the compression ring 1.
- Carefully insert the pistons using a piston ring compressor. Otherwise, their chrome-plated section may be scratched, causing trouble inside the cylinder.

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

W10277450



Piston Ring and Connecting Rod

1. Remove the piston rings using a piston ring tool.
2. Put the casting mark (↑) (8) on the piston as shown in figure.
3. Remove the piston pin (1), and separate the connecting rod (7) from the piston (2).

(When reassembling)

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

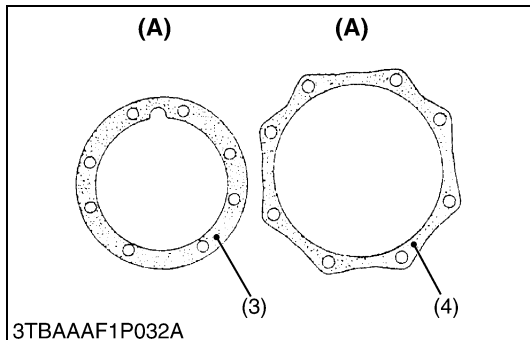
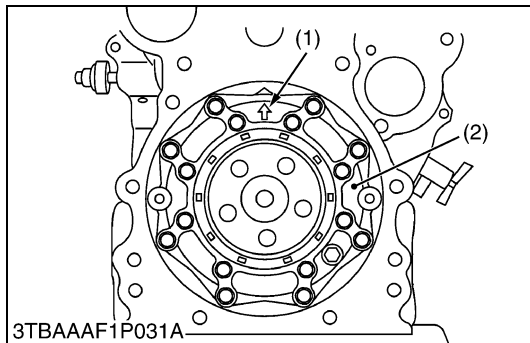
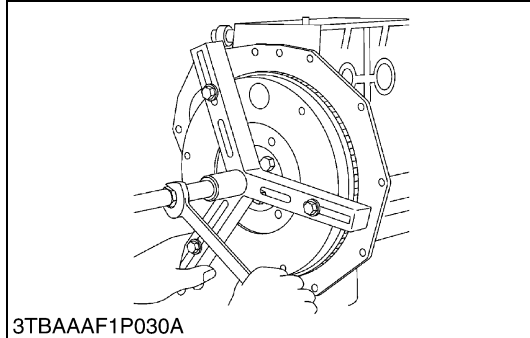
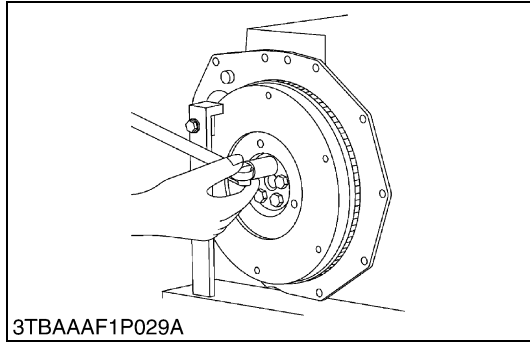
■ IMPORTANT

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

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

W10281670

(D) Crankshaft



Flywheel

1. Lock the flywheel not to turn using flywheel stopper.
2. Remove the flywheel screws, except for two which must be loosened and left as they are.
3. Set a flywheel puller (Code No: 07916-32011), and remove the flywheel.

(When reassembling)

- Apply engine oil to the flywheel screws. And tighten them.

Tightening torque	Flywheel bolt	53.9 to 58.8 N·m 5.5 to 6.0 kgf·m 39.8 to 43.4 ft-lbs
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W1030810

Bearing Case Cover

1. Remove the bearing case cover mounting screws. First, remove inside screws and then outside screws.

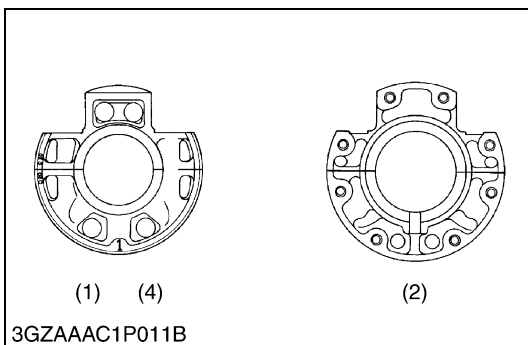
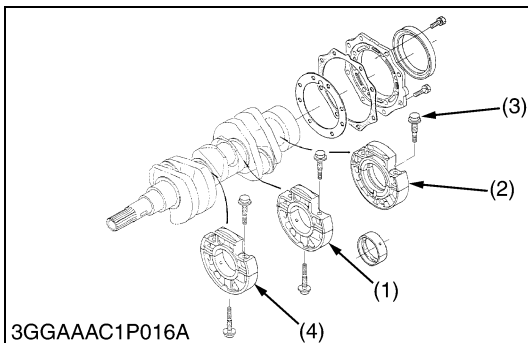
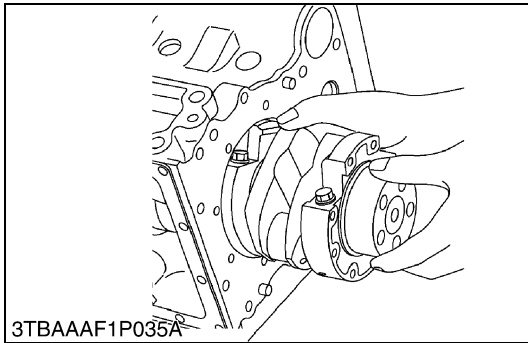
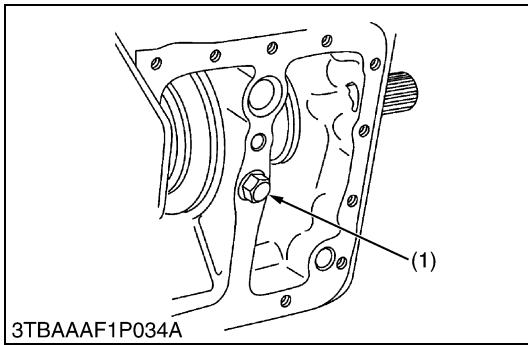
(When reassembling)

- Fit the bearing case gasket (3) and the bearing case cover gasket (4) with correct directions.
- Apply liquid-type gasket (Three Bond 1215 or its equivalent) to both sides of a new bearing case cover gasket.
- Install the bearing case cover to position the casting mark “↑” (1) on it upward.
- Apply engine oil to the oil seal lip and take care that it is not rolled when installing.
- Tighten the bearing case cover mounting screws with even force on the diagonal line.

- (1) Mark
- (2) Mark Bearing Case Cover
- (3) Bearing Case Gasket
- (4) Bearing Case Cover Gasket

(A) Upside

W1031168



Crankshaft

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

(When reassembling)

- Install the crankshaft sub assembly, aligning the screw hole of main bearing case 2 with the screw hole of cylinder block.
- Apply engine oil to the main bearing case screw 2. And tighten it.

Tightening torque	Main bearing case screw 2	26.5 to 30.4 N·m 2.7 to 3.1 kgf·m 19.5 to 22.4 ft-lbs
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(1) Main Bearing Case Screw 2

W1031360

Main Bearing Case Assembly

1. Remove the two main bearing case screws 1 (3), and remove the main bearing case assembly 1 (2), being careful with crankshaft bearing 2.
2. Remove the main bearing case assembly 2 (1) and 3 (4) as above.

(When reassembling)

- Clean the oil passage in the main bearing case.
- Apply clean engine oil on the bearings.
- Install the main bearing case assemblies in the original positions. Since diameters of main bearing case vary, install them in order of makings (1, 2) from the gear case side.
- Match the alignment numbers (1 or 2) on the main bearing case.
- When installing the main bearing case 2 and 3, face the mark "FLYWHEEL" to the flywheel.
- Apply engine oil to the bearing case screw 1.
- Confirm that the main bearing case moves smoothly after tightening the main bearing case screw 1 to the specified torque.

Tightening torque	Bearing case screw 1	12.7 to 15.7 N·m 1.3 to 1.6 kgf·m 9.4 to 11.6 ft-lbs
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(1) Main Bearing Case Assembly 2

(3) Main Bearing Case Screw 1

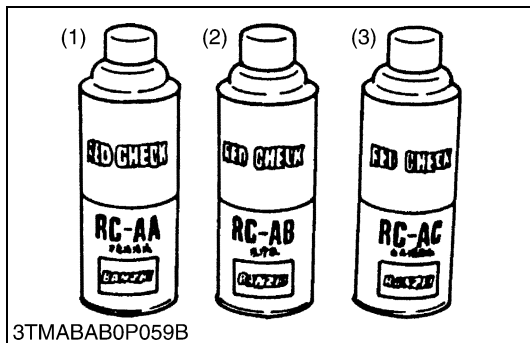
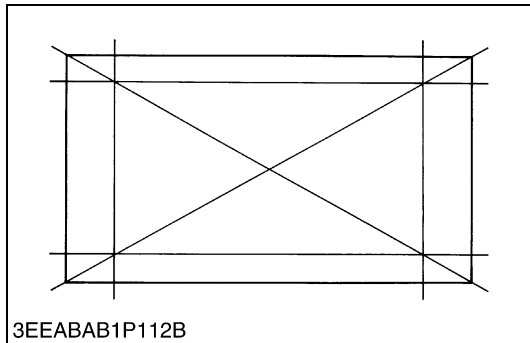
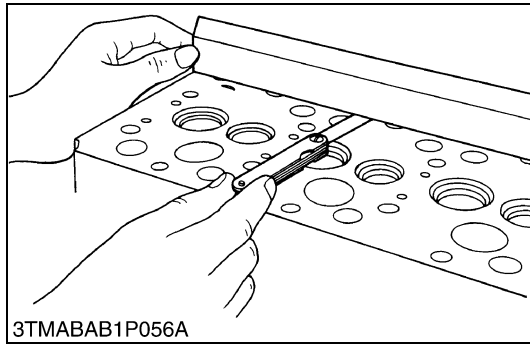
(2) Main Bearing Case Assembly 1

(4) Main Bearing Case Assembly 3

W1031597

(3) Servicing

(A) Cylinder Head and Valve



Cylinder Head Surface Flatness

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

■ IMPORTANT

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

Cylinder head surface flatness	Allowable limit	0.05 mm 0.0020 in.
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W10301620

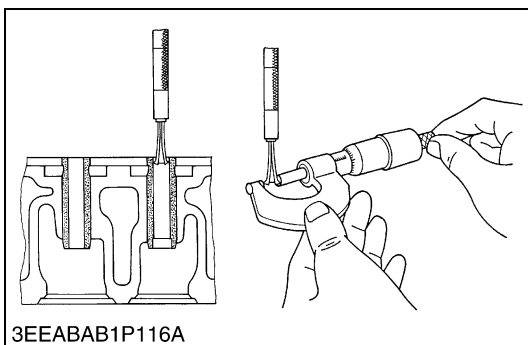
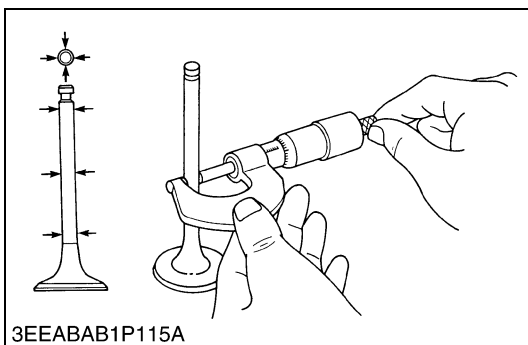
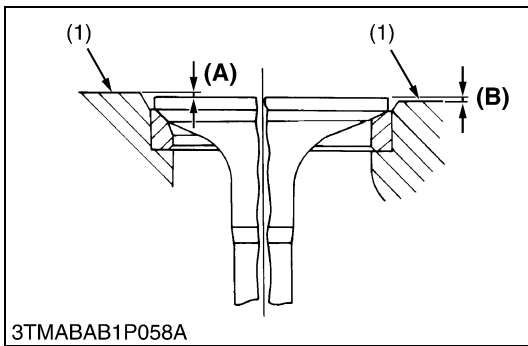
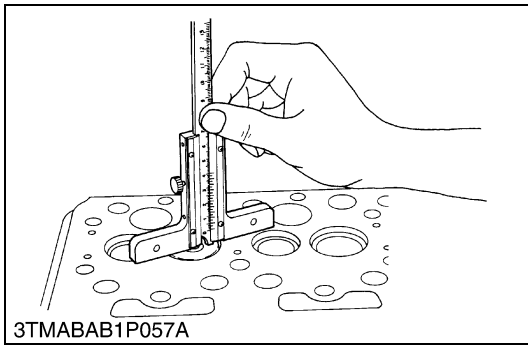
Cylinder Head Flaw

1. Prepare an air spray red check (Code No. 07909-31371).
2. Clean the surface of the cylinder head with detergent (2).
3. Spray the cylinder head surface with the red permeative liquid (1). Leave it five to ten minutes after spraying.
4. Wash away the red permeative liquid on the cylinder head surface with the detergent (2).
5. Spray the cylinder head surface with white developer (3).
6. If flawed, it can be identified as red marks.

- (1) Red Permeative Liquid
(2) Detergent

- (3) White Developer

W10303200



Valve Recessing

1. Clean the cylinder head surface, valve face and valve seat.
2. Insert the valve into the valve guide.
3. Measure the valve recessing with a depth gauge.
4. If the measurement exceeds the allowable limit, replace the valve.
5. If it still exceeds the allowable limit after replacing the valve, correct the valve seat face of the cylinder head with a valve seat cutter (Code No. 07909-33102) or valve seat grinder.
6. Then, correct the cylinder head surface with a surface grinder, or replace the cylinder head.

Valve recessing	Factory spec.	0.10 (protrusion) to 0.10 (recessing) mm 0.0039 (protrusion) to 0.0039 (recessing) in.
	Allowable limit	0.30 (recessing) mm 0.0118 (recessing) in.

(1) Cylinder Head Surface

(A) Recessing

(B) Protrusion

W10305870

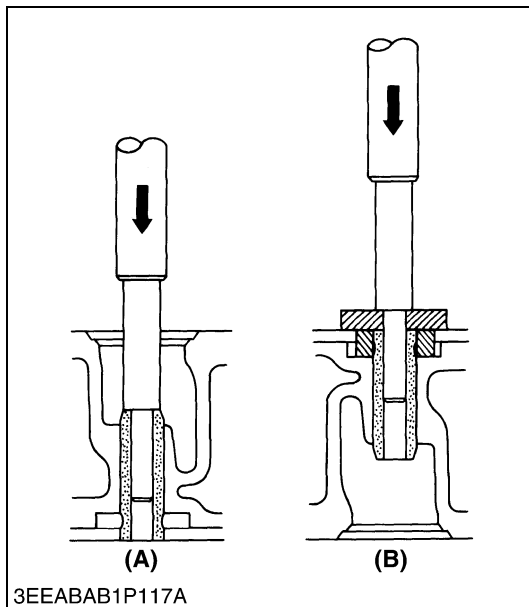
Clearance between Valve Stem and Valve Guide

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

Clearance between valve stem and valve guide	Factory spec.	0.030 to 0.057 mm 0.00118 to 0.00224 in.
	Allowable limit	0.10 mm 0.0039 in.

Valve stem O.D.	Factory spec.	5.968 to 5.980 mm 0.23496 to 0.23543 in.
Valve guide I.D.	Factory spec.	6.010 to 6.025 mm 0.23661 to 0.23720 in.

W10311740



Replacing Valve Guide

(When removing)

1. Press out the used valve guide using a valve guide replacing tool.

(When installing)

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

Valve guide I.D. (Intake and exhaust)	Factory spec.	6.010 to 6.025 mm 0.23661 to 0.23720 in.
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■ IMPORTANT

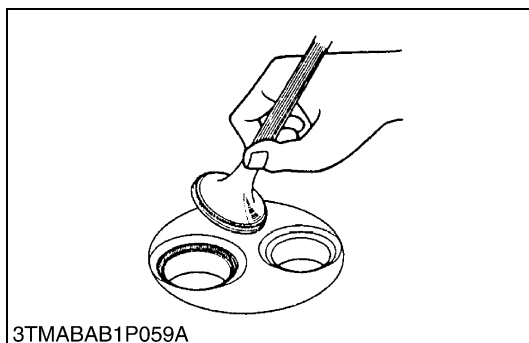
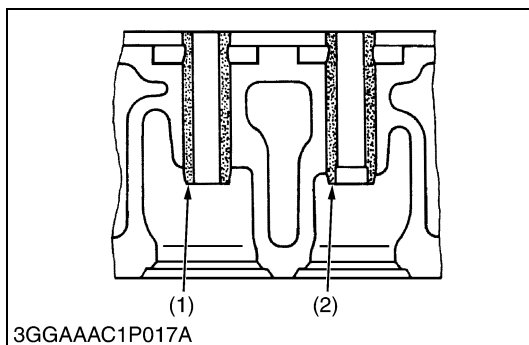
- Do not hit the valve guide with a hammer during replacement.

- (1) Intake Valve Guide
- (2) Exhaust Valve Guide

(A) When Removing

(B) When Installing

W10314690



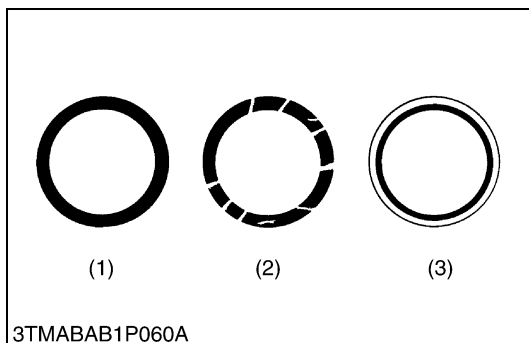
Valve Seating

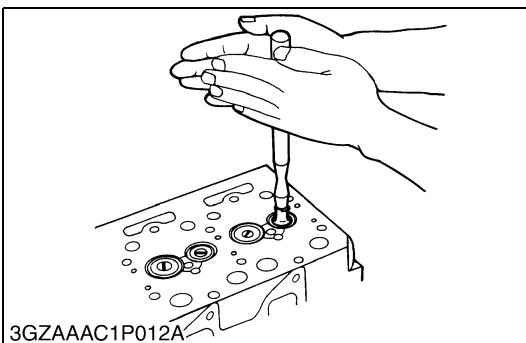
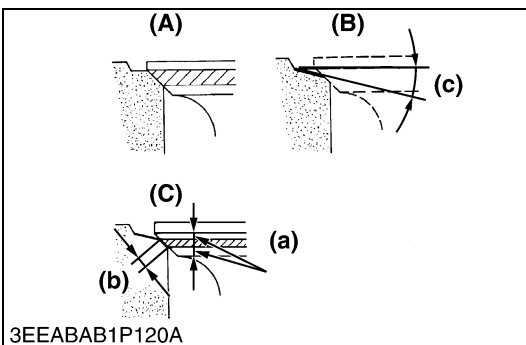
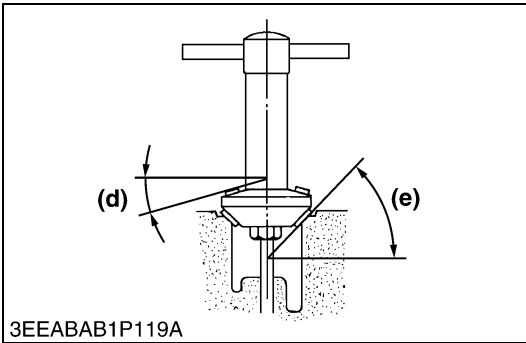
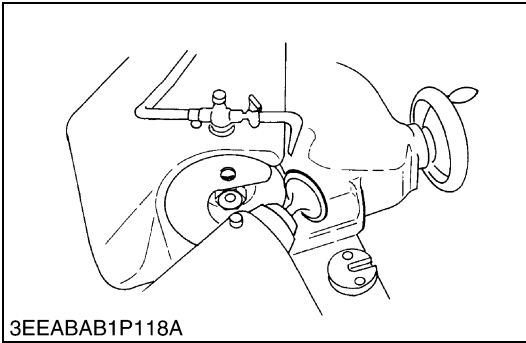
1. Coat the valve face lightly with prussian blue and put the valve on its seat to check the contact.
2. If the valve does not seat all the way around the valve seat or the valve contact is less than 70 %, correct the valve seating as follows.
3. If the valve contact does not comply with the reference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

- (1) Correct
- (2) Incorrect

(3) Incorrect

W1033143





Correcting Valve and Valve Seat

NOTE

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

1) Correcting Valve

1. Correct the valve with a valve refacer.

Valve face angle	Factory spec.	0.79 rad 45.0°
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2) Correcting Valve Seat

1. Slightly correct the seat surface with a 0.79 rad (45°) valve seat cutter (Code No. 07909-33102).
2. Fitting the valve, check the contact position of the valve face and seat surface with red lead. (Visual check) [If the valve has been used for a long period, the seat tends to come in contact with the upper side of the valve face.]
3. Grind the upper surface of the valve seat with a 0.26 rad (15°) valve seat cutter until the valve seat touches to the center of the valve face (so that **a** equals **b** as shown in the figure).
4. Grind the seat with a 0.79 rad (45°) valve seat cutter again, and visually recheck the contact between the valve and seat.
5. Repeat steps 3 and 4 until the correct contact is achieved.
6. Continue lapping until the seated rate becomes more than 70 % of the total contact area.

Valve seat angle	Factory spec.	0.79 rad 14.0°
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(a) Identical Dimensions

(b) Valve Seat Width

(c) 0.26 rad (15°)

(d) 0.26 rad (15°)

(e) 0.79 rad (45°)

(A) Check Contact

(B) Correct Seat Width

(C) Check Contact

W10319540

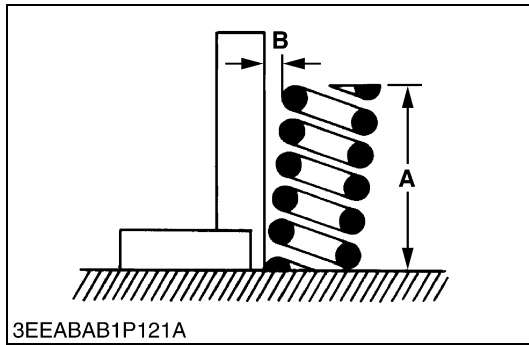
Valve Lapping

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

IMPORTANT

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

W10309820

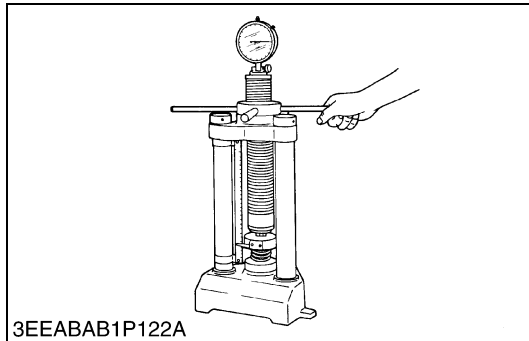


Free Length and Tilt of Valve Spring

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

Tilt (B)	Allowable limit	1.2 mm 0.047 in.
Free length (A)	Factory spec.	31.3 to 31.8 mm 1.232 to 1.252 in.
	Allowable limit	28.4 mm 1.118 in.

W11157830

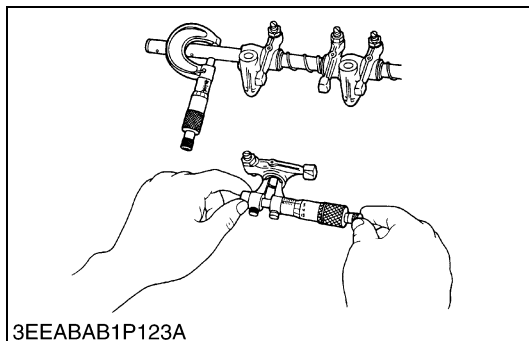


Valve Spring Setting Load

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

Setting load / Setting length	Factory spec.	64.7 N / 27.0 mm 6.6 kgf / 27.0 mm 14.6 lbs / 1.063 in.
	Allowable limit	54.9 N / 27.0 mm 5.6 kgf / 27.0 mm 12.3 lbs / 1.063 in.

W11177330



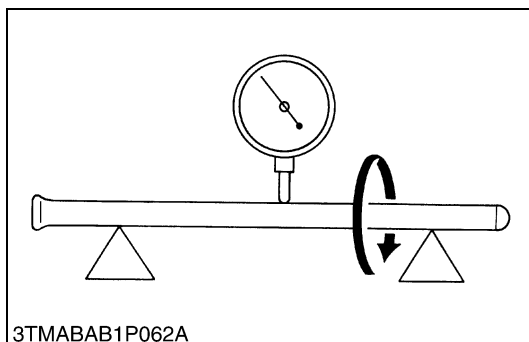
Oil Clearance between Rocker Arm and Rocker Arm Shaft

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

Oil clearance between rocker arm and rocker arm shaft	Factory spec.	0.016 to 0.045 mm 0.00063 to 0.00177 in.
	Allowable limit	0.15 mm 0.0059 in.

Rocker arm shaft O.D.	Factory spec.	10.473 to 10.484 mm 0.41232 to 0.41276 in.
Rocker arm I.D.	Factory spec.	10.500 to 10.518 mm 0.41339 to 0.41410 in.

W11199710

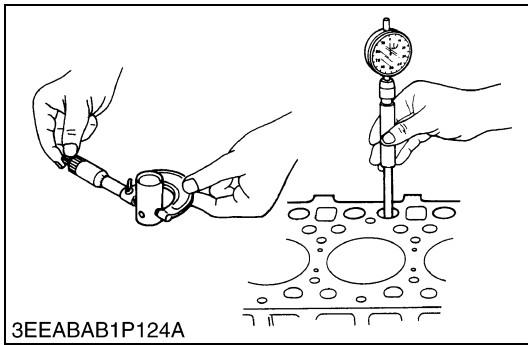


Push Rod Runout

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

Push rod runout	Allowable limit	0.50 mm 0.0196 in.
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W11220210



Oil Clearance between Tappet and Tappet Guide Bore

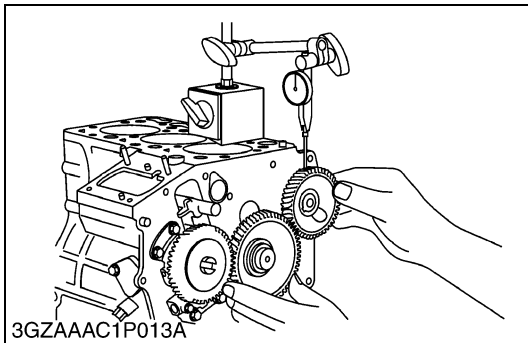
1. Measure the tappet O.D. with an outside micrometer.
2. Measure the I.D. of the tappet guide bore with a cylinder gauge, and calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit or the tappet is damaged, replace the tappet.

Oil clearance between tappet and tappet guide bore	Factory spec.	0.016 to 0.052 mm 0.00063 to 0.00205 in.
	Allowable limit	0.10 mm 0.0039 in.

Tappet O.D.	Factory spec.	17.966 to 17.984 mm 0.70732 to 0.70803 in.
Tappet guide bore I.D.	Factory spec.	18.000 to 18.018 mm 0.70866 to 0.70937 in.

W11231410

(B) Timing Gears, Camshaft and Fuel Camshaft



Timing Gear Backlash

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

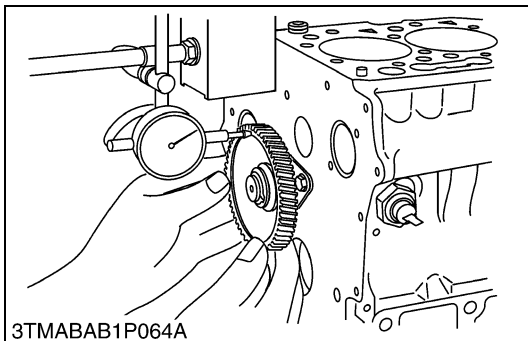
Backlash between idle gear and crank gear	Factory spec.	0.043 to 0.124 mm 0.00169 to 0.00484 in.
	Allowable limit	0.15 mm 0.0059 in.

Backlash between idle gear and cam gear	Factory spec.	0.047 to 0.123 mm 0.00185 to 0.00484 in.
	Allowable limit	0.15 mm 0.0059 in.

Backlash between idle gear and injection pump gear	Factory spec.	0.041 to 0.124 mm 0.00161 to 0.00488 in.
	Allowable limit	0.15 mm 0.0059 in.

Backlash between oil pump drive gear and crank gear	Factory spec.	0.041 to 0.123 mm 0.00161 to 0.00484 in.
	Allowable limit	0.15 mm 0.0059 in.

W11264830

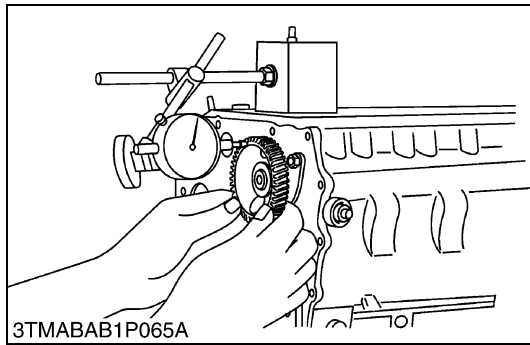


Idle Gear Side Clearance

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

Idle gear side clearance	Factory spec.	0.20 to 0.51 mm 0.0079 to 0.0201 in.
	Allowable limit	0.60 mm 0.0236 in.

W11286770

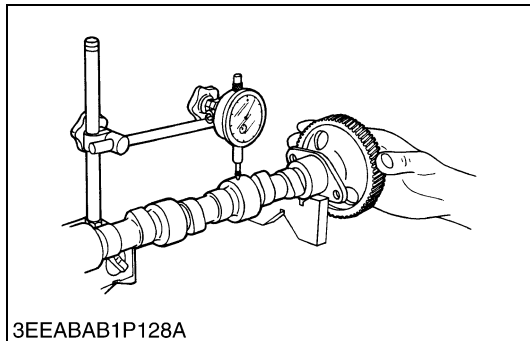


Camshaft Side Clearance

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

Camshaft side clearance	Factory spec.	0.15 to 0.31 mm 0.0059 to 0.0122 in.
	Allowable limit	0.50 mm 0.0197 in.

W11299720

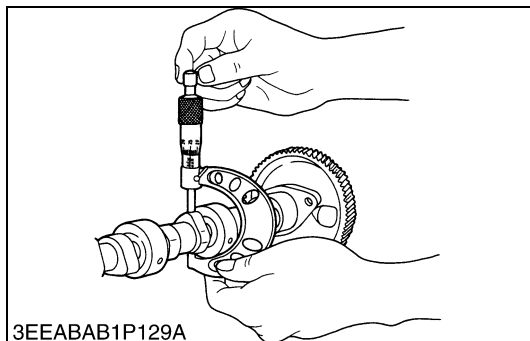


Camshaft Runout

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

Camshaft runout	Allowable limit	0.02 mm 0.0008 in.
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W11312720

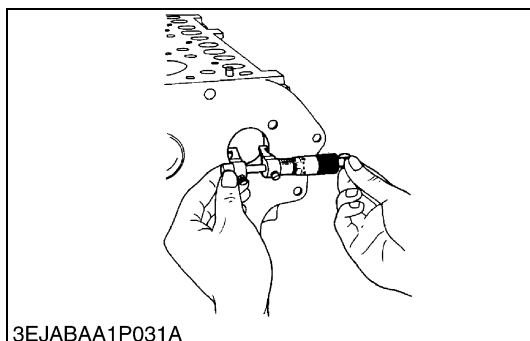


Cam Height

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

Cam height of intake and exhaust	Factory spec.	26.88 mm 1.0583 in.
	Allowable limit	26.83 mm 1.0563 in.

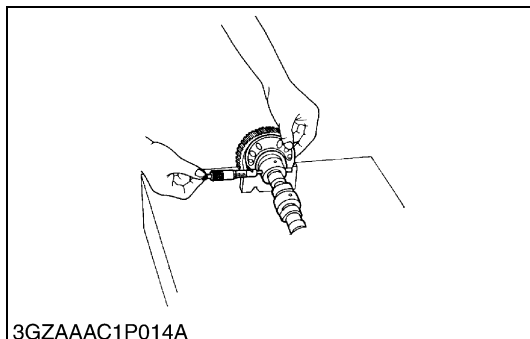
W11324040



Oil Clearance of Camshaft Journal

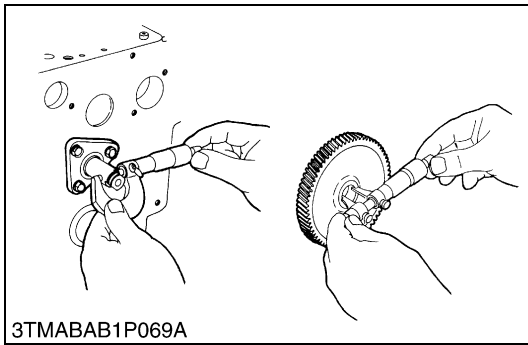
1. Measure the camshaft journal O.D. with an outside micrometer.
2. Measure the camshaft bearing I.D. (cylinder block bore I.D.) for camshaft with an inside micrometer.
Calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit, replace the camshaft.

Oil clearance of camshaft journal	Factory spec.	0.050 to 0.091 mm 0.00197 to 0.00358 in.
	Allowable limit	0.15 mm 0.0059 in.



Camshaft journal O.D.	Factory spec.	32.934 to 32.950 mm 1.29661 to 1.29724 in.
Camshaft Bearing I.D. (Cylinder block bore I.D.)	Factory spec.	33.000 to 33.025 mm 1.29921 to 1.30020 in.

W11335580



Oil Clearance between Idle Gear Shaft and Idle Gear Bushing

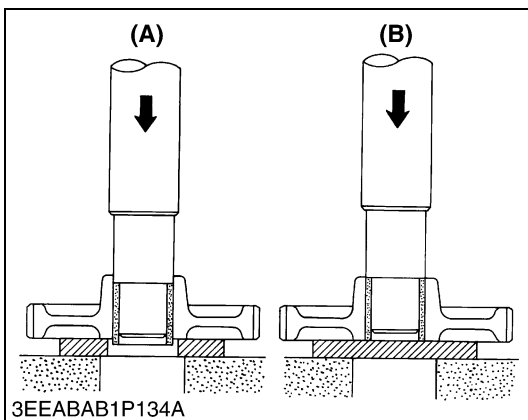
1. Measure the idle gear shaft O.D. with an outside micrometer.
2. Measure the idle gear bushing I.D. with an inside micrometer, and calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit, replace the bushing.

If it still exceeds the allowable limit, replace the idle gear shaft.

Oil clearance between idle gear shaft and idle gear bushing	Factory spec.	0.020 to 0.084 mm 0.00079 to 0.00331 in.
	Allowable limit	0.10 mm 0.0039 in.

Idle gear shaft O.D.	Factory spec.	19.967 to 19.980 mm 0.78610 to 0.78661 in.
Idle gear bushing I.D.	Factory spec.	20.000 to 20.051 mm 0.78740 to 0.78941 in.

W11356150



Replacing Idle Gear Bushing

(When removing)

1. Press out the used idle gear bushing using an idle gear bushing replacing tool.

(When installing)

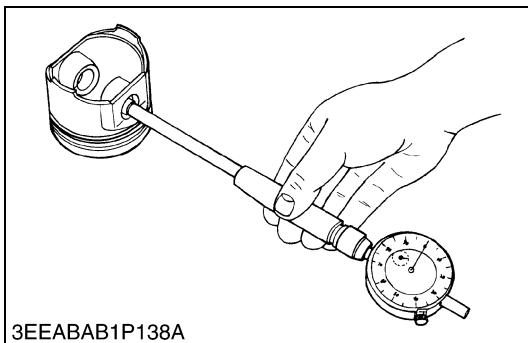
1. Clean a new idle gear bushing and idle gear bore, and apply engine oil to them.
2. Press in a new bushing using an idle gear bushing replacing tool, until it is flush with the end of the idle gear.

(A) When Removing

(B) When Installing

W11373220

(C) Piston and Connecting Rod

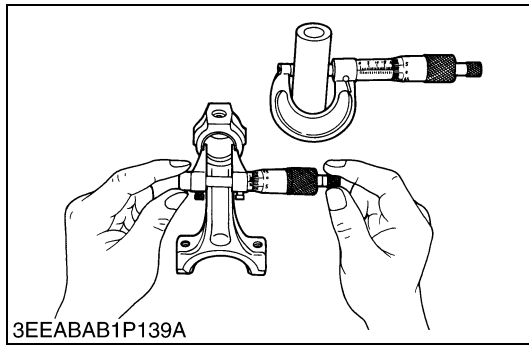


Piston Pin Bore I.D.

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

Piston pin bore I.D.	Factory spec.	20.000 to 20.013 mm 0.78740 to 0.78791 in.
	Allowable limit	20.05 mm 0.7894 in.

W11406200



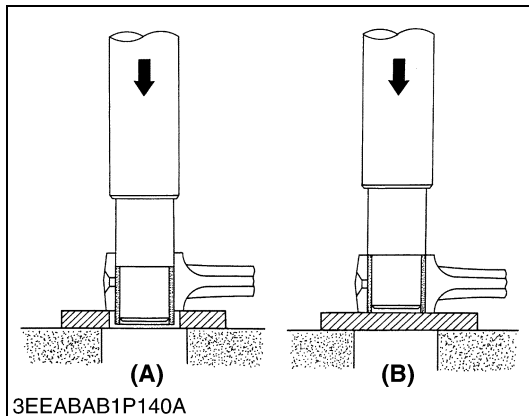
Oil Clearance between Piton Pin and Small End Bushing

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

Oil clearance between piston pin and small end bushing	Factory spec.	0.014 to 0.038 mm 0.00055 to 0.00150 in.
	Allowable limit	0.10 mm 0.0039 in.

Piston pin O.D.	Factory spec.	20.002 to 20.011 mm 0.78748 to 0.78783 in.
Small end bushing I.D.	Factory spec.	20.025 to 20.040 mm 0.78839 to 0.78897 in.

W11420110



Replacing Small End Bushing

(When removing)

1. Press out the used bushing using a small end bushing replacing tool.

(When installing)

1. Clean a new small end bushing and bore, and apply engine oil to them.
2. Insert a new bushing onto the tool and press-fit it with a press so that the seam (1) of bushing positions as shown in the figure, until it is flash with the connecting rod.
3. Drill a hole to the bushing with aligning the oil hole (2) of connecting rod using 4.0 mm dia. (0.157 in. dia.) drill.

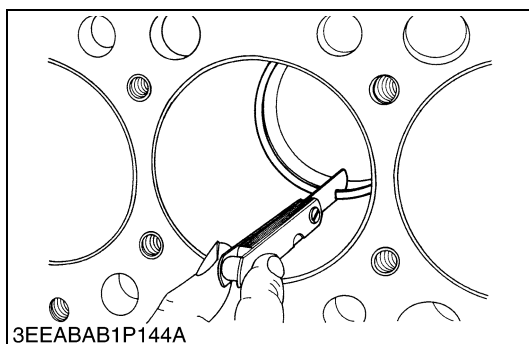
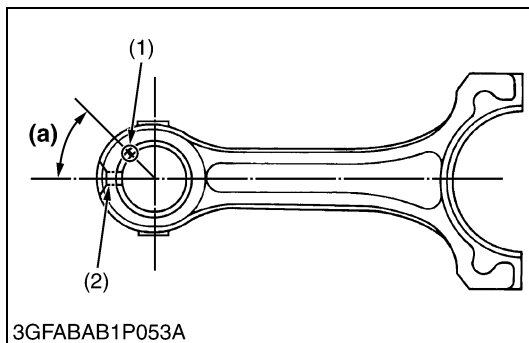
NOTE

- Be sure to chamfer the oil hole circumference with an oil stone.

- (1) Seam
(2) Oil Hole

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

W11437590

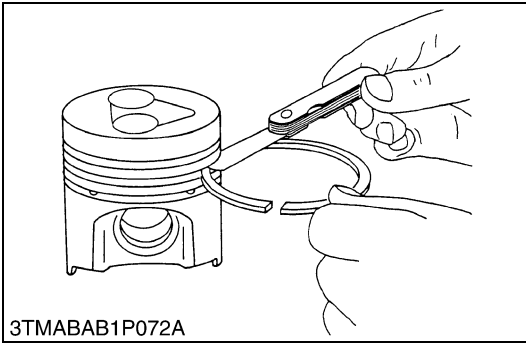


Piston Ring Gap

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

Piston ring gap	Top ring Oil ring	Factory spec.	0.15 to 0.30 mm 0.0059 to 0.0118 in.
		Allowable limit	1.25 mm 0.0492 in.
	Second ring	Factory spec.	0.30 to 0.45 mm 0.0118 to 0.0177 in.
		Allowable limit	1.25 mm 0.0492 in.

W11466710

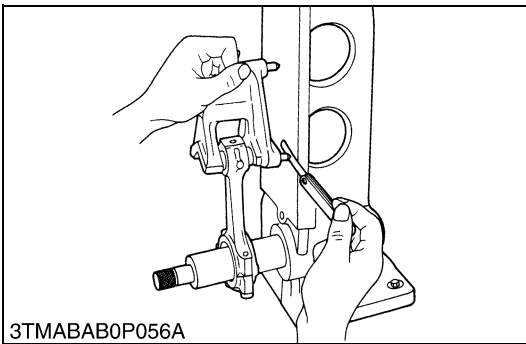


Clearance between Piston Ring and Piston Ring Groove

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

Clearance between piston ring and piston ring groove	Second ring	Factory spec.	0.090 to 0.120 mm 0.00354 to 0.00472 in.
		Allowable limit	0.15 mm 0.0059 in.
	Oil ring	Factory spec.	0.04 to 0.08 mm 0.0016 to 0.0031 in.
		Allowable limit	0.15 mm 0.0059 in.

W11485500



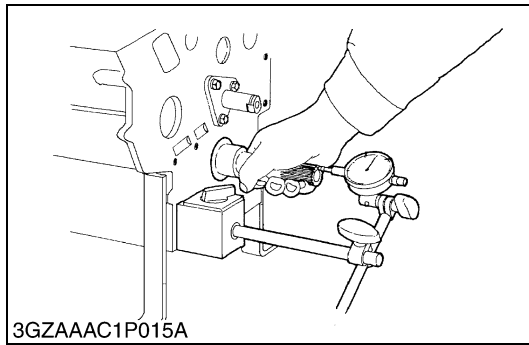
Connecting Rod Alignment

■ NOTE

- Since the I.D. of the connecting rod small end bushing is the basis of this check, check the bushing for wear beforehand.
1. Remove the crankpin bearing, and install the connecting rod cap.
 2. Install the piston pin in the connecting rod.
 3. Install the connecting rod on the connecting rod alignment tool (Code No. 07909-31661).
 4. Put a gauge over the piston pin, and move it against the face plate.
 5. If the gauge does not fit squarely against the face plate, measure the space between the pin of the gauge and the face plate.
 6. If the measurement exceeds the allowable limit, replace the connecting rod.

Space between gauge pin and face plate	Allowable limit	0.05 mm 0.0020 in.
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W11499650



Crankshaft Side Clearance

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

Crankshaft side clearance	Factory spec.	0.15 to 0.31 mm 0.0059 to 0.0122 in.
	Allowable limit	0.50 mm 0.0197 in.

(Reference)

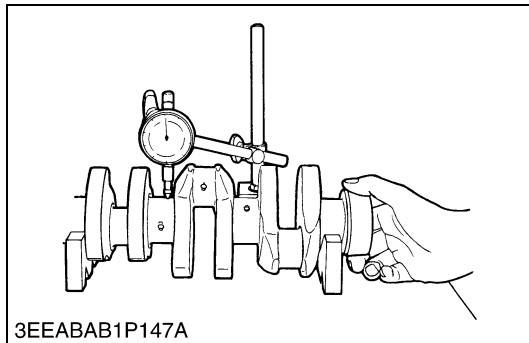
- Oversize main bearing case assembly

Oversize	Bearing	Code Number	Marking
0.2 mm 0.008 in.	Thrust bearing 1 02	15261-23951	020 OS
	Thrust bearing 2 02	15261-23971	020 OS
0.4 mm 0.016 in.	Thrust bearing 1 04	15261-23961	040 OS
	Thrust bearing 2 04	15261-23981	040 OS

- Oversize dimensions of crankshaft journal

Oversize	0.2 mm 0.008 in.	0.4 mm 0.016 in.
Dimension A	23.40 to 23.45 mm 0.9134 to 0.9154 in.	23.80 to 23.85 mm 0.9213 to 0.9232 in.
Dimension B	46.1 to 46.3 mm 1.815 to 1.823 in.	46.3 to 46.5 mm 1.823 to 1.831 in.
Dimension C	1.8 to 2.2 mm radius 0.071 to 0.087 in. radius	1.8 to 2.2 mm radius 0.071 to 0.087 in. radius
(0.8-S) The crankshaft journal must be fine-finished to higher than $\nabla \nabla \nabla \nabla$.		

W11586190

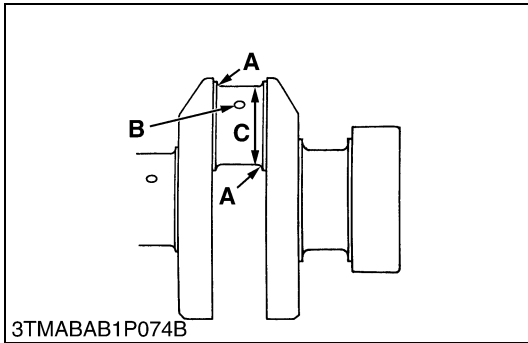
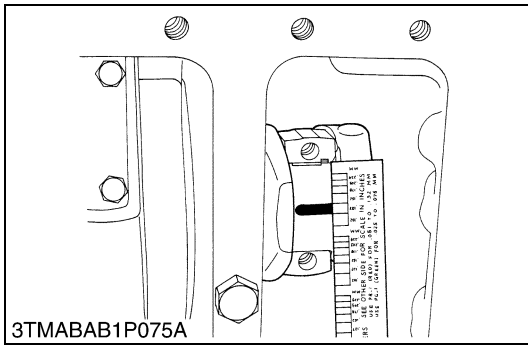


Crankshaft Alignment

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

Crankshaft alignment	Allowable limit	0.02 mm 0.0008 in.
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W11613530



Oil Clearance between Crankpin and Crankpin Bearing

1. Clean the crankpin and crankpin bearing.
2. Put a strip of plastigage (Code No. 07909-30241) on the center of the crankpin.
3. Install the connecting rod cap and tighten the connecting rod screws to the specified torque, and remove the cap again.
4. Measure the amount of the flattening with the scale, and get the oil clearance.
5. If the oil clearance exceeds the allowable limit, replace the crankpin bearing.
6. If the same size bearing is useless because of the crankpin wear, replace it with an undersize one referring to the table and the figure.

NOTE

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

Oil clearance between crankpin and crankpin bearing	Factory spec.	0.020 to 0.051mm 0.0008 to 0.0020 in.
	Allowable limit	0.15 mm 0.0059 in.

Crankpin O.D.	Factory spec.	33.959 to 33.975 mm 1.3370 to 1.3376 in.
Crankpin bearing I.D.	Factory spec.	33.995 to 34.010 mm 1.3384 to 1.3389 in.

(Reference)

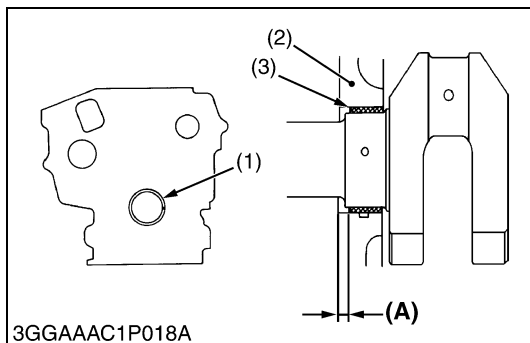
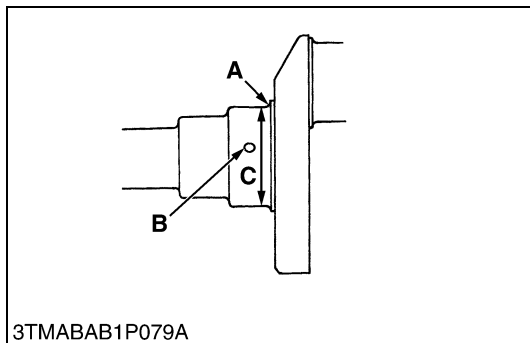
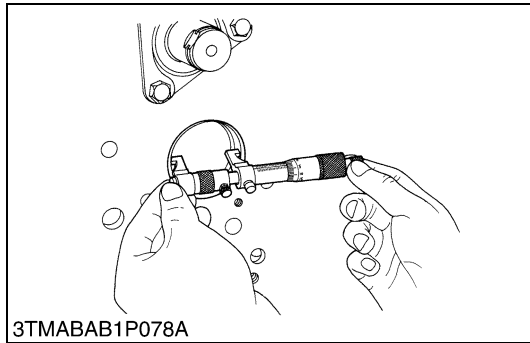
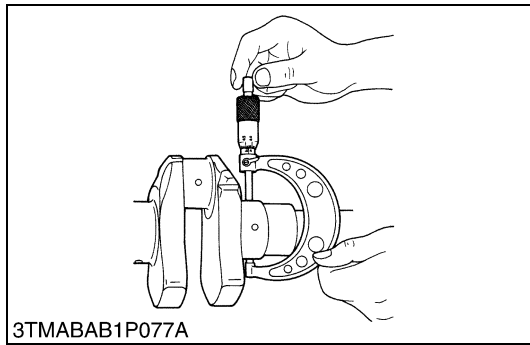
- Undersize crankpin crankpin

Undersize	Bearing	Code Number	Marking
0.2 mm 0.008 in.	Crankshaft bearing 02	15861-22971	020 US
0.4 mm 0.016 in.	Crankshaft bearing 04	15861-20981	040 US

- Undersize dimensions of crankpin

Undersize Dimension	0.2 mm 0.008 in.	0.4 mm 0.016 in.
A	2.3 to 2.7 mm radius 0.091 to 0.106 in.radius	2.3 to 2.7 mm radius 0.091 to 0.106 in.radius
B	4.0 mm dia. 0.16 in. dia.	4.0 mm dia. 0.16 in. dia
C	39.759 to 39.775 mm 1.32910 to 1.32973 in.	33.559 to 33.575 mm 1.32122 to 1.32185 in.
(0.8-S) The crankshaft journal must be fine-finished to higher than $\nabla\nabla\nabla\nabla$.		

W11625390



Oil Clearance between Crankshaft Journal and Crankshaft Bearing 1

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

Oil Clearance between crankshaft journal and crankshaft bearing 1	Factory spec.	0.034 to 0.106 mm 0.00134 to 0.00417 in.
	Allowable limit	0.20 mm 0.0079 in.

Crankshaft journal O.D.	Factory spec.	39.934 to 39.950 mm 1.57221 to 1.57284 in.
Crankshaft bearing 1 I.D.	Factory spec.	39.984 to 40.040 mm 1.57417 to 1.57638 in.

(Reference)

- Undersize crankshaft bearing 1

Undersize	Bearing	Code Number	Marking
0.2 mm 0.008 in.	Crankshaft bearing 1 02	15861-23911	020 US
0.4 mm 0.016 in.	Crankshaft bearing 1 04	15861-23921	040 US

- Undersize dimensions of crankshaft journal

Undersize Dimension	0.2 mm 0.008 in.	0.4 mm 0.016 in.
A	1.8 to 2.2 mm radius 0.071 to 0.087 in. radius	1.8 to 2.2 mm radius 0.071 to 0.087 in. radius
B	5.0 mm dia. 0.20 in. dia.	5.0 mm dia. 0.20 in. dia.
C	39.734 to 39.750 mm 1.56433 to 1.56496 in.	39.534 to 39.550 mm 1.55646 to 1.55709 in.
(0.8-S) The crankshaft journal must be fine-finished to higher than ▽▽▽▽.		

W10323470

Replacing Crankshaft Bearing 1

(When removing)

1. Press out the used crankshaft bearing 1 using a crankshaft bearing 1 replacing tool.

(When installing)

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

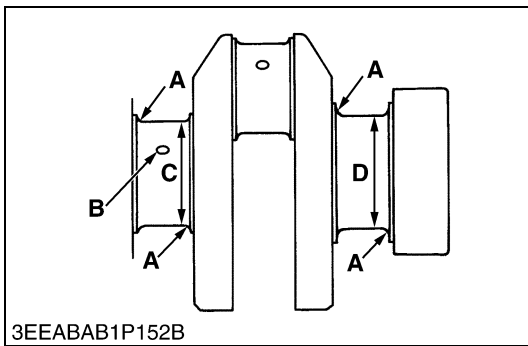
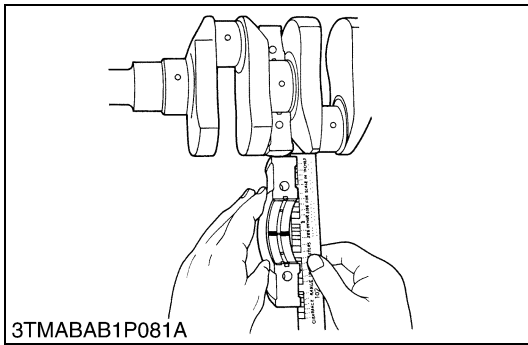
Dimension (A)	Factory spec.	0.0 to 0.3 mm 0.000 to 0.012 in.
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(1) Seam

(3) Cylinder Block

(2) Crankshaft Bearing 1

W10342000



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

1. Put a strip of plastigage (Code No. 07909-30241) on the center of the journal.
2. Install the bearing case and tighten the bearing case screws 1 to the specified torque, and remove the bearing case again.
3. Measure the amount of the flattening with the scale, and get the oil clearance.
4. If the oil clearance exceeds the allowable limit, replace the crankshaft bearing 2 or 3.
5. If the same size bearing is useless because of the crankshaft journal wear, replace it with an undersize one referring to the table and figure.

■ NOTE

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

Oil clearance between crankshaft journal and crankshaft bearing 2 and crankshaft bearing 3	Factory spec.	0.028 to 0.059 mm 0.0011 to 0.0023 in.
	Allowable limit	0.20 mm 0.0079 in.

Crankshaft journal O.D. (Intermediate)	Factory spec.	39.934 to 39.950 mm 1.5722 to 1.5728 in.
Crankshaft bearing 3 I.D.	Factory spec.	39.978 to 39.993 mm 1.5739 to 1.5745 in.

Crankshaft journal O.D. (Flywheel side)	Factory spec.	43.978 to 43.993 mm 1.7314 to 1.7320 in.
Crankshaft bearing 2 I.D.	Factory spec.	43.984 to 44.026 mm 1.7317 to 1.7333 in.

(Reference)

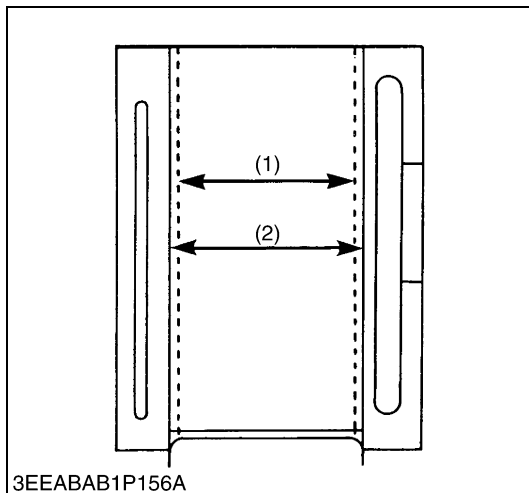
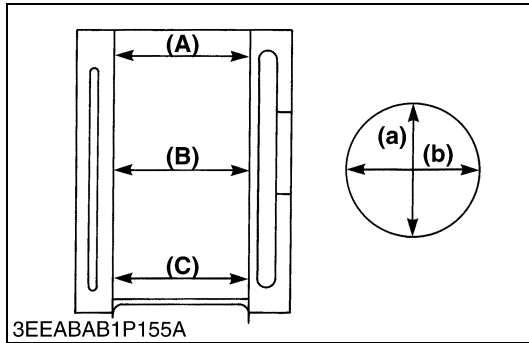
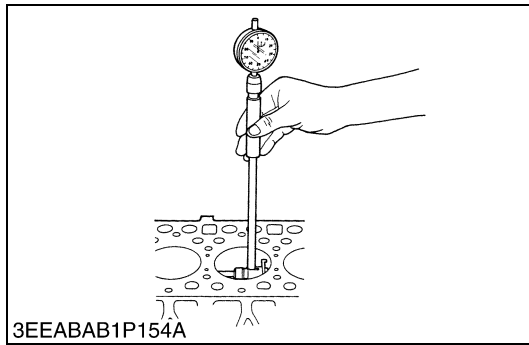
- Undersize crankshaft bearing 2 and 3

Undersize	Bearing	Code Number	Marking
0.2 mm 0.008 in.	Crankshaft bearing 2 02	15694-23931	020 US
	Crankshaft bearing 3 02	15861-23861	020 US
0.4 mm 0.016 in.	Crankshaft bearing 2 04	15694-23941	040 US
	Crankshaft bearing 3 04	15861-23871	040 US

- Undersize dimensions of crankshaft journal

Undersize Dimension	0.2 mm 0.008 in.	0.4 mm 0.016 in.
A	1.8 to 2.2 mm radius 0.071 to 0.087 in. radius	1.8 to 2.2 mm radius 0.071 to 0.087 in. radius
B	3.0 mm dia. 0.12 in. dia.	3.0 mm dia. 0.12 in. dia.
C	39.734 to 39.750 mm 1.56433 to 1.56496 in.	39.534 to 39.550 mm 1.55646 to 1.55709 in.
D	43.734 to 43.750 mm 1.72181 to 1.72244 in.	43.534 to 43.550 mm 1.71394 to 1.71457 in.
(0.8-S) The crankshaft journal must be fine-finished to higher than ▽▽▽▽.		

W10344030



Cylinder Wear

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

Cylinder liner I.D.	Factory spec.	67.000 to 67.019 mm 2.63779 to 2.63854 in.
Maximum wear	Allowable limit	+0.15 mm 0.0059 in.

(A) Top
(B) Middle
(C) Bottom (Skirt)

(a) Right-angled to Piston Pin
(b) Piston Pin Direction

W10360060

Correcting Cylinder

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

Cylinder liner I.D.	Factory spec.	67.250 to 67.269 mm 2.64764 to 2.64839 in.
Maximum wear	Allowable limit	+0.15 mm 0.0059 in.
Finishing	Hone to 1.2 to 2.0 mR max. ▽▽▽ (0.000047 to 0.0079 in.R max.)	

2. Replace the piston and piston rings with oversize ones.

Oversize	Part Name	Code Number	Marking
0.25 mm 0.0098 in.	Piston	1E051-21901	025 OS
	Piston ring assembly	16853-21091	025 OS

NOTE

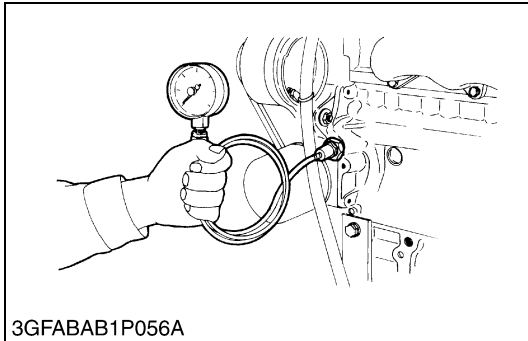
- When the oversize cylinder is worn beyond the allowable limit, replace the cylinder block with a new one.

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

W10367470

[3] LUBRICATING SYSTEM

(1) Checking



Engine Oil Pressure

1. Remove the engine oil pressure switch, and set a oil pressure tester (Code No. 07916-32032). (Adapter screw size : PT 1/8)
2. Start the engine. After warming up, measure the oil pressure of both idling and rated speeds.
3. If the oil pressure is less than the allowable limit, check the following.
 - Engine oil insufficient
 - Oil pump defective
 - Oil strainer clogged
 - Oil filter cartridge clogged
 - Oil gallery clogged
 - Excessive oil clearance
 - Foreign matter in the relief valve

Engine oil pressure	At idle speed	Factory spec.	More then 68 kPa 0.7 kgf/cm ² 10.0psi
	At rated speed	Factory spec.	196 to 441 kPa 2.0 to 4.5 kgf/cm ² 28 to 64 psi
		Allowable limit	98 kPa 1.0 kgf/cm ² 14 psi

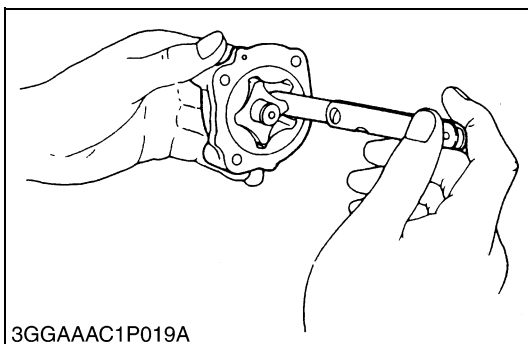
(When reassembling)

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

Tightening torque	Oil switch	14.7 to 19.6 N·m 1.5 to 2.0 kgf·m 10.8 to 14.5 ft-lbs
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W10373890

(2) Servicing

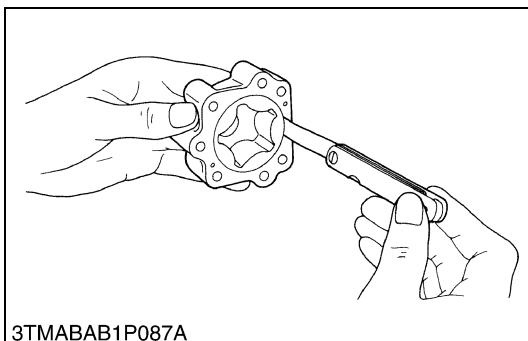


Rotor Lobe Clearance

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

Rotor lobe clearance	Factory spec.	0.03 to 0.14 mm 0.0012 to 0.0055 in.
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W10378950

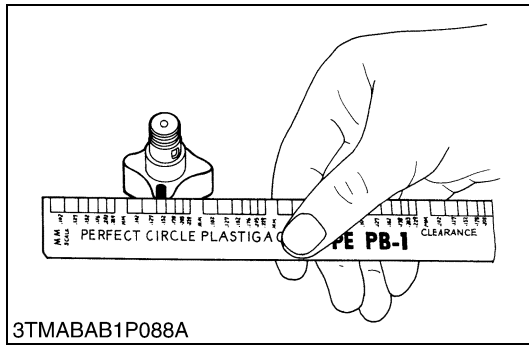


Clearance between Outer Rotor and Pump Body

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

Clearance between outer rotor and pump body	Factory spec.	0.07 to 0.15 mm 0.0028 to 0.0059 in.
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W10381420

**Clearance between Rotor and Cover**

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

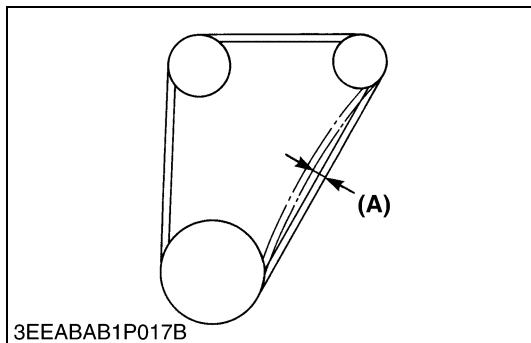
Clearance between rotor and cover	Factory spec.	0.075 to 0.135 mm 0.00295 to 0.00531 in.
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W10382660

[4] COOLING SYSTEM

(1) Checking and Adjusting

(A) Fan Belt



Fan Belt Tension

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

Deflection (A)	Factory spec.	Approx. 10 mm 0.4 in.
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(A) Deflection

W10384280



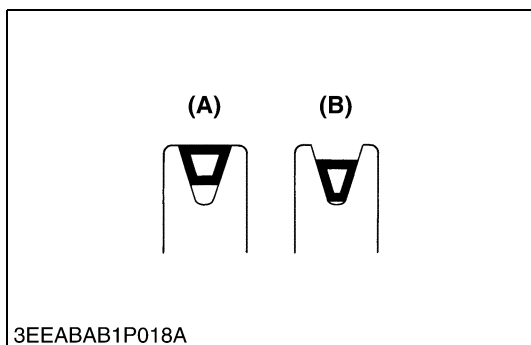
Fan Belt Damage and Wear

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

(A) Good

(B) Bad

W10385490

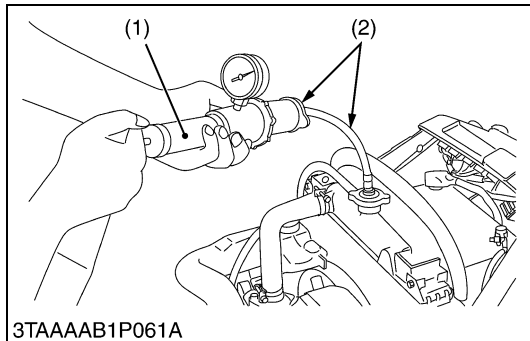


(B) Radiator



CAUTION

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



Radiator Water Leakage

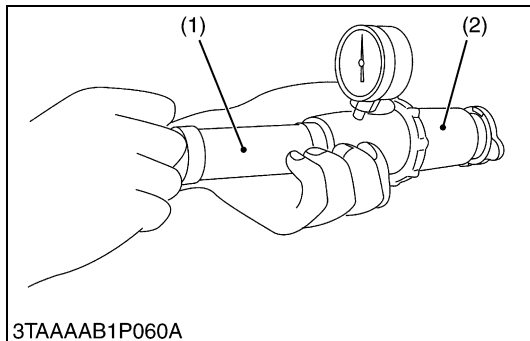
- Pour a specified amount of water into the radiator.
- Set a radiator tester (1) (Code No. 07909-31551) and an adaptor (2) (BANZAI Code No.RCT-2A-30S) and raise the water pressure to the specified pressure.
- Check the radiator for water leaks.
- For water leak from the pinhole, repair with the radiator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

Radiator water leakage test pressure	Factory spec.	132 kPa 1.3 kgf/cm ² 19 psi
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(1) Radiator Tester

(2) Adaptor

W10387530



Radiator Cap Air Leakage

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

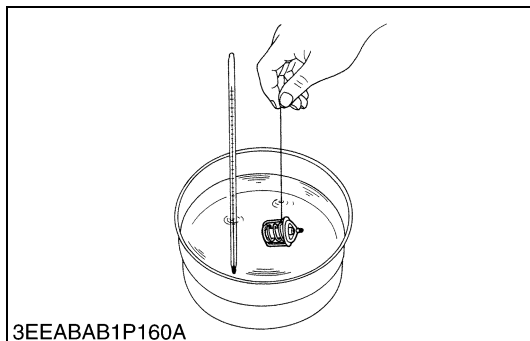
Pressure falling time	Factory spec.	More than 10 seconds for pressure fall from 88 to 59 kPa (from 0.9 to 0.6 kgf/cm ² , from 13 to 9 psi)
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(1) Radiator Tester

(2) Adaptor

W1054156

(C) Thermostat



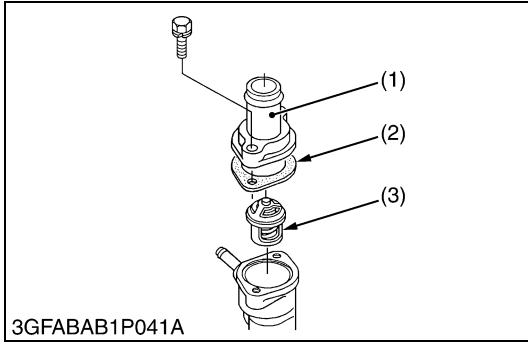
Thermostat Valve Opening Temperature

- Suspend the thermostat in the water by a string with its end inserted between the valve and seat.
- Heating the water gradually, read the temperature when the valve opens and leaves the string.
- Continue heating and read the temperature when the valve opens approx. 6 mm (0.236 in.).
- If the measurement is not within the factory specifications, replace the thermostat.

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

W10390350

(2) Disassembling and Assembling



Thermostat Assembly

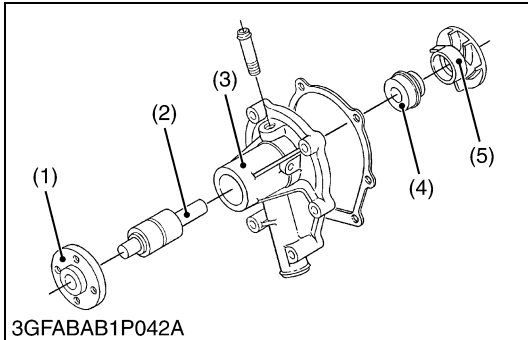
1. Remove the thermostat cover mounting screws, and remove the thermostat cover (1).
2. Remove the thermostat assembly (3).

(When reassembling)

- Apply a liquid gasket (Three Bond 1215 or equivalent) only at the thermostat cover side of the gasket (2).

- | | |
|-----------------------------|-------------------------|
| (1) Thermostat Cover | (3) Thermostat Assembly |
| (2) Thermostat Cover Gasket | |

W10393690



Water Pump Assembly

1. Loosen the alternator mounting bolts, and remove the fan belt.
2. Remove the fan and fan pulley.
3. Remove the water pump assembly from the gear case cover.
4. Remove the water pump flange (1).
5. Press out the water pump shaft (2) with the impeller (5) on it.
6. Remove the impeller from the water pump shaft (2).
7. Remove the mechanical seal (4).

(When reassembling)

- Apply a liquid gasket (Three Bond 1215 or equivalent) to the both sides of gasket.
- Replace the mechanical seal with new one.

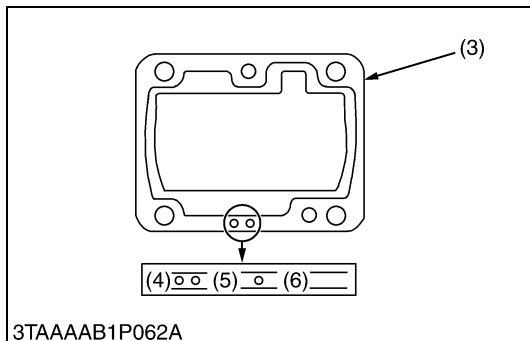
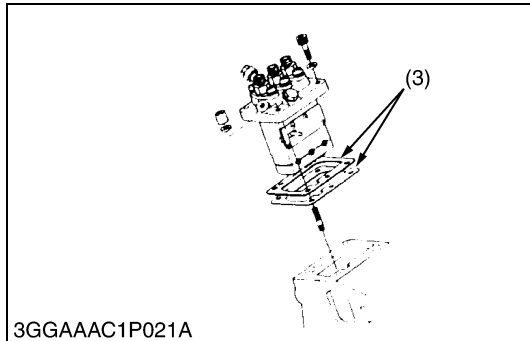
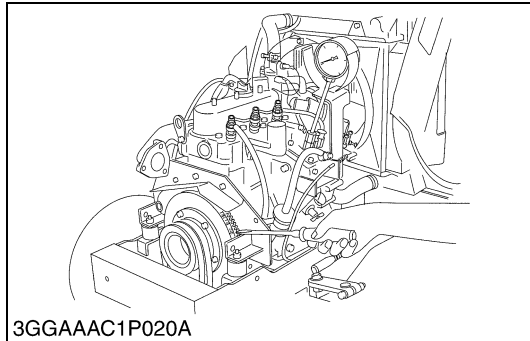
- | | |
|-----------------------|---------------------|
| (1) Water Pump Flange | (4) Mechanical Seal |
| (2) Water Pump Shaft | (5) Impeller |
| (3) Water Pump Body | |

W10395040

[5] FUEL SYSTEM

(1) Checking and Adjusting

(A) Injection Pump



Injection Timing

1. Remove the bonnet and air cleaner.
2. Remove the muffler.
3. Remove the injection pipes and glow plugs.
4. Engage the parking brake.
5. Set the throttle lever to the maximum engine speed.
6. Turn on the key switch.
7. Turn the flywheel counterclockwise (facing the flywheel) until fuel flows from the delivery valve holder (1).
8. Continue to turn the flywheel slowly, and stop it as soon as the fuel level at the tip of the delivery valve holder begins to increase.
9. Check to see if the timing angle lines on the flywheel is aligned with the alignment mark (2).
10. If the injection timing is out of adjustment, readjust the timing with shims (3).

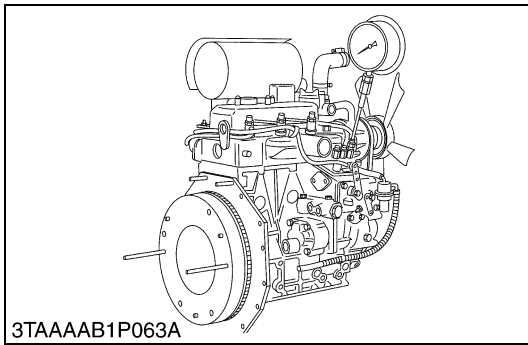
Injection timing	Factory spec.	0.33 to 0.37 rad (19 to 21 °) before T.D.C.
------------------	---------------	--

■ NOTE

- The sealant is applied to both sides of the shim (soft metal gasket shim). The liquid gasket is not required for assembling.
- Shims are available in thickness of 0.20 mm (0.0079 in.), 0.25 mm (0.0098 in.) and 0.30 mm (0.0118 in.). Combine these shims for adjustments.
- Addition or reduction of shim (0.05 mm, 0.0020 in.) delays or advances the injection timing by approx. 0.0087 rad (0.5 °).
- In disassembling and replacing the injection pump, be sure to use the same number of new shims with the same thickness.
- Refer to figure left to check the thickness of the shims.

- | | |
|---------------------------|-----------------------------------|
| (1) Delivery Valve Holder | (4) Shim with Two-holes : 0.20 mm |
| (2) Alignment Mark | (0.0079 in.) |
| (3) Shim | (5) Shim with One-hole : 0.25 mm |
| | (0.0098 in.) |
| | (6) Shim with No hole : 0.30 mm |
| | (0.0118 in.) |

W10397720



Fuel Tightness of Pump Element

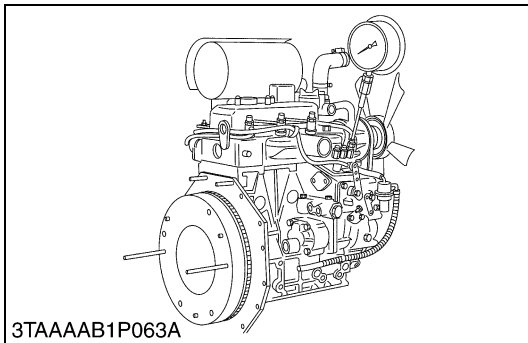
1. Remove the bonnet and air cleaner.
2. Remove the muffler.
3. Disconnect the accelerator wire.
4. Remove the air cleaner stay.
5. Remove the injection pipes and glow plugs.
6. Install the air cleaner stay.
7. Connect the accelerator wire.
8. Install the injection pump pressure tester to the fuel injection pump.
9. Set the speed control lever to the maximum speed position.
10. Turn the flywheel ten times or more to increase the pressure.
11. If the pressure can not reach the allowable limit, replace the pump element or injection pump assembly.

Fuel tightness of pump element	Allowable limit	14.7 MPa 150 kgf/cm ² 2130 psi
--------------------------------	-----------------	---

NOTE

- Apply a liquid gasket (Three Bond 1215 or equivalent) to both sides of the solenoid cover gasket.

W10401760



Fuel Tightness of Delivery Valve

1. Remove the bonnet and air cleaner..
2. Remove the muffler.
3. Remove the injection pipes and glow plugs.
4. Install the injection pump pressure tester to the fuel injection pump.
5. Set the throttle lever to the maximum engine speed.
6. Turn the flywheel and raise the pressure to approx. 14.7 MPa (150 kgf/cm², 2130 psi).
7. Now turn the flywheel back about half a turn (to keep the plunger free). Maintain the flywheel at this position and clock the time taken for the pressure to drop from 14.7 to 13.7 MPa (from 150 to 140 kgf/cm², 2130 to 1990 psi).
8. Measure the time needed to decrease the pressure from 14.7 to 13.7 MPa (from 150 to 140 kgf/cm², from 2130 to 1990 psi).
9. If the measurement is less than allowable limit, replace the delivery valve.

Fuel tightness of delivery valve	Allowable limit	5 seconds 14.7 → 13.7 MPa 150 → 140 kgf/cm ² 2130 → 1990 psi
----------------------------------	-----------------	--

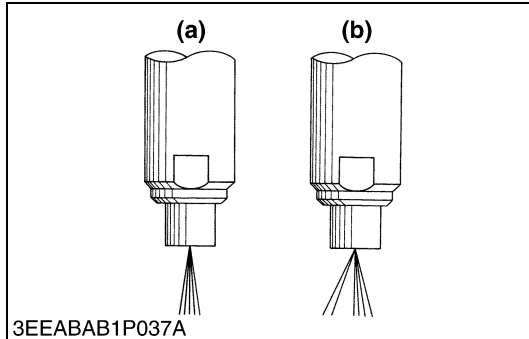
W10403300

(B) Injection Nozzle



CAUTION

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



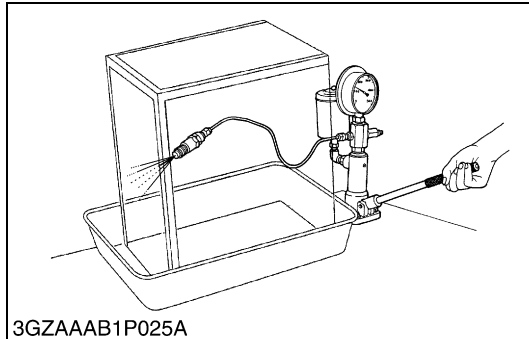
Nozzle Spraying Condition

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

(a) Good

(b) Bad

W10411400



Fuel Injection Pressure

- Set the injection nozzle to a nozzle tester (Code No. 07909-31361).
- Slowly move the tester handle to measure the pressure at which fuel begins to jet out from the nozzle.
- If the measurement is not within the factory specifications, replace the adjusting washer (1) in the nozzle holder to adjust it.

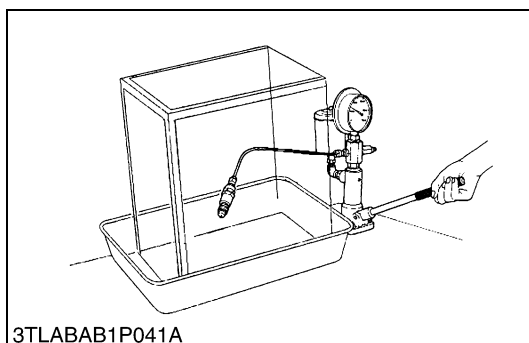
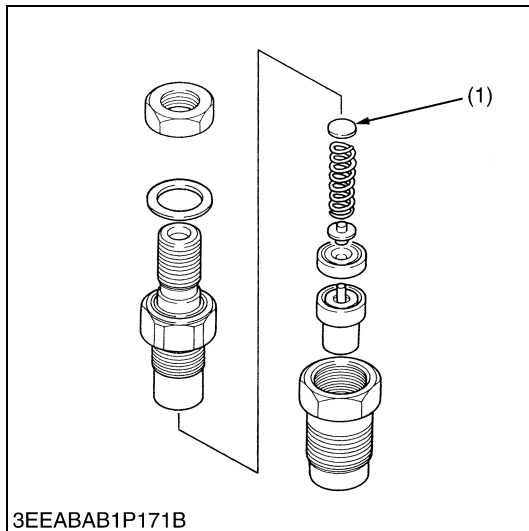
Fuel injection pressure	Factory spec.	13.7 to 14.7 MPa 140 to 150 kgf/cm ² 1990 to 2130 psi
-------------------------	---------------	--

(Reference)

- Pressure variation with 0.025 mm (0.001 in.) difference of adjusting washer thickness.
Approx. 59 kPa (0.6 kgf/cm², 8.5 psi)

(1) Adjusting Washer

W10408820



Valve Seat Tightness

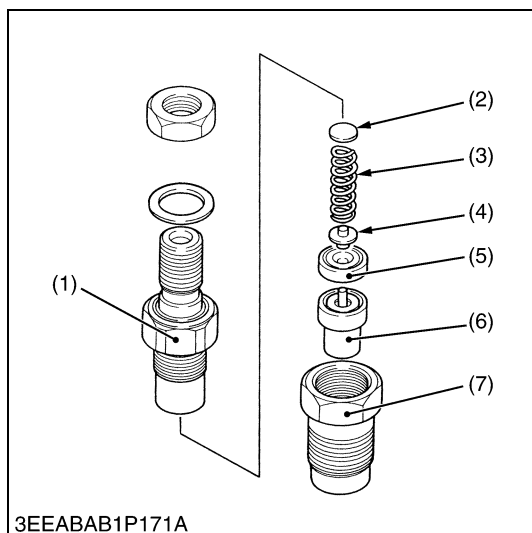
- Set the injection nozzle to a nozzle tester (Code No. 07909-31361).
- Raise the fuel pressure, and keep at 12.7 MPa (130 kgf/cm², 1850 psi) for 10 seconds.
- If any fuel leak is found, replace the nozzle piece.

Valve seat tightness	Factory spec.	No fuel leak at 12.7 MPa 130 kgf/cm ² 1850 psi
----------------------	---------------	--

W10412730

(2) Disassembling and Assembling

(A) Injection Nozzle



Nozzle Holder

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

(When reassembling)

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

Tightening torque	Nozzle holder	34.3 to 39.2 N·m 3.5 to 4.0 kgf·m 25.3 to 28.9 ft-lbs
	Overflow pipe nut	19.6 to 24.5 N·m 2.0 to 2.5 kgf·m 14.5 to 18.1 ft-lbs
	Nozzle holder assembly	49.0 to 68.6 N·m 5.0 to 7.0 kgf·m 36.2 to 50.6 ft-lbs

- (1) Nozzle Holder
(2) Adjusting Washer
(3) Nozzle Spring
(4) Push Rod

- (5) Distance Piece
(6) Nozzle Piece
(7) Nozzle Retaining Nut

W10415210

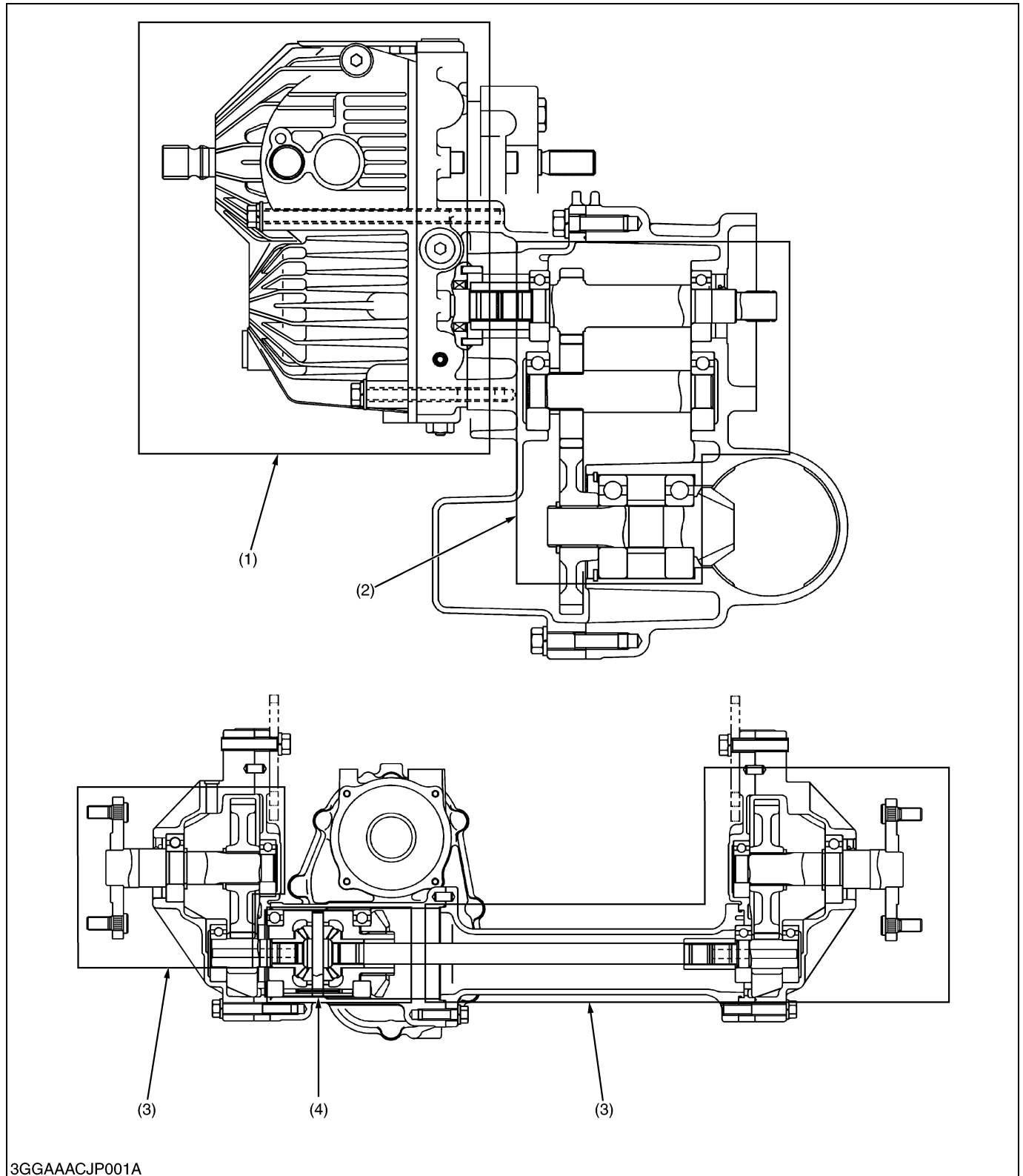
2 TRANSMISSION AND REAR AXLE

MECHANISM

CONTENTS

1. STRUCTURE	2-M1
2. HYDROSTATIC TRANSMISSION	2-M2
[1] STRUCTURE	2-M2
[2] OIL FLOW	2-M3
[3] BY-PASS VALVE	2-M4
[4] CHARGE PUMP	2-M5

1. STRUCTURE



(1) Hydrostatic Transmission Section

(2) Gear Section

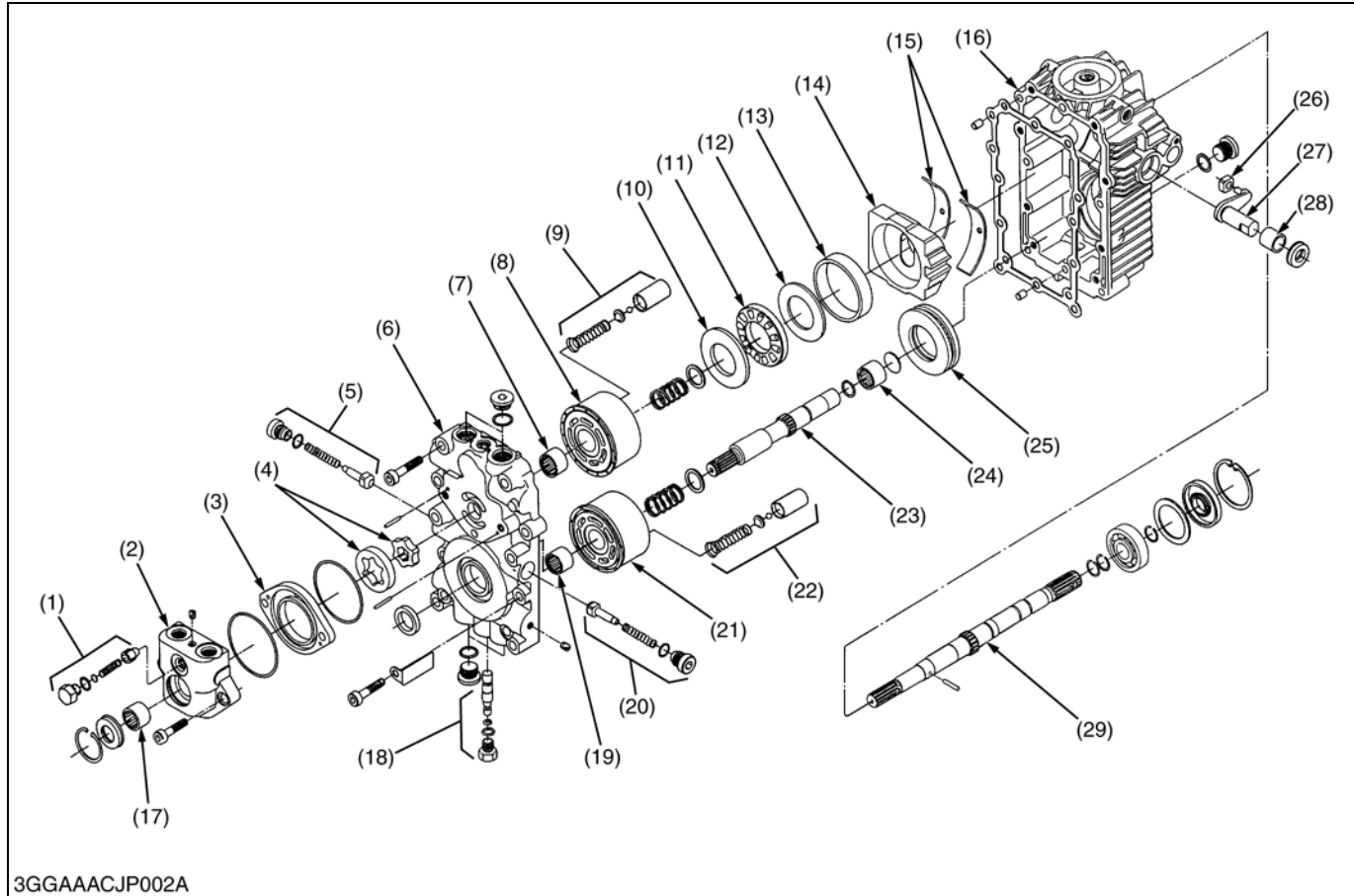
(3) Rear Axle Section

(4) Differential Gear Section

W1013364

2. HYDROSTATIC TRANSMISSION

[1] STRUCTURE



- | | | | |
|---------------------------|----------------------------|-----------------------------|--------------------------|
| (1) Charge Relief Valve | (9) Piston Assembly | (17) Needle Bearing | (25) Thrust Ball Bearing |
| (2) Charge Pump Housing | (10) Thrust Plate | (18) By-pass Valve | (26) Slot Guide |
| (3) Charge Pump Spacer | (11) Thrust Roller Bearing | (19) Needle Bearing | (27) Trunnion Arm |
| (4) Gerotor | (12) Thrust Washer | (20) Check Valve | (28) Journal Bearing |
| (5) Check Valve | (13) Bearing Guide | (21) Cylinder Block (Motor) | (29) Pump Shaft |
| (6) Center Section | (14) Swashplate | (22) Piston Assembly | |
| (7) Needle Bearing | (15) Cradle Bearing | (23) Motor Shaft | |
| (8) Cylinder Block (Pump) | (16) Housing | (24) Needle Bearing | |

The hydrostatic transmission consists of a variable displacement piston pump and a fixed displacement piston motor.

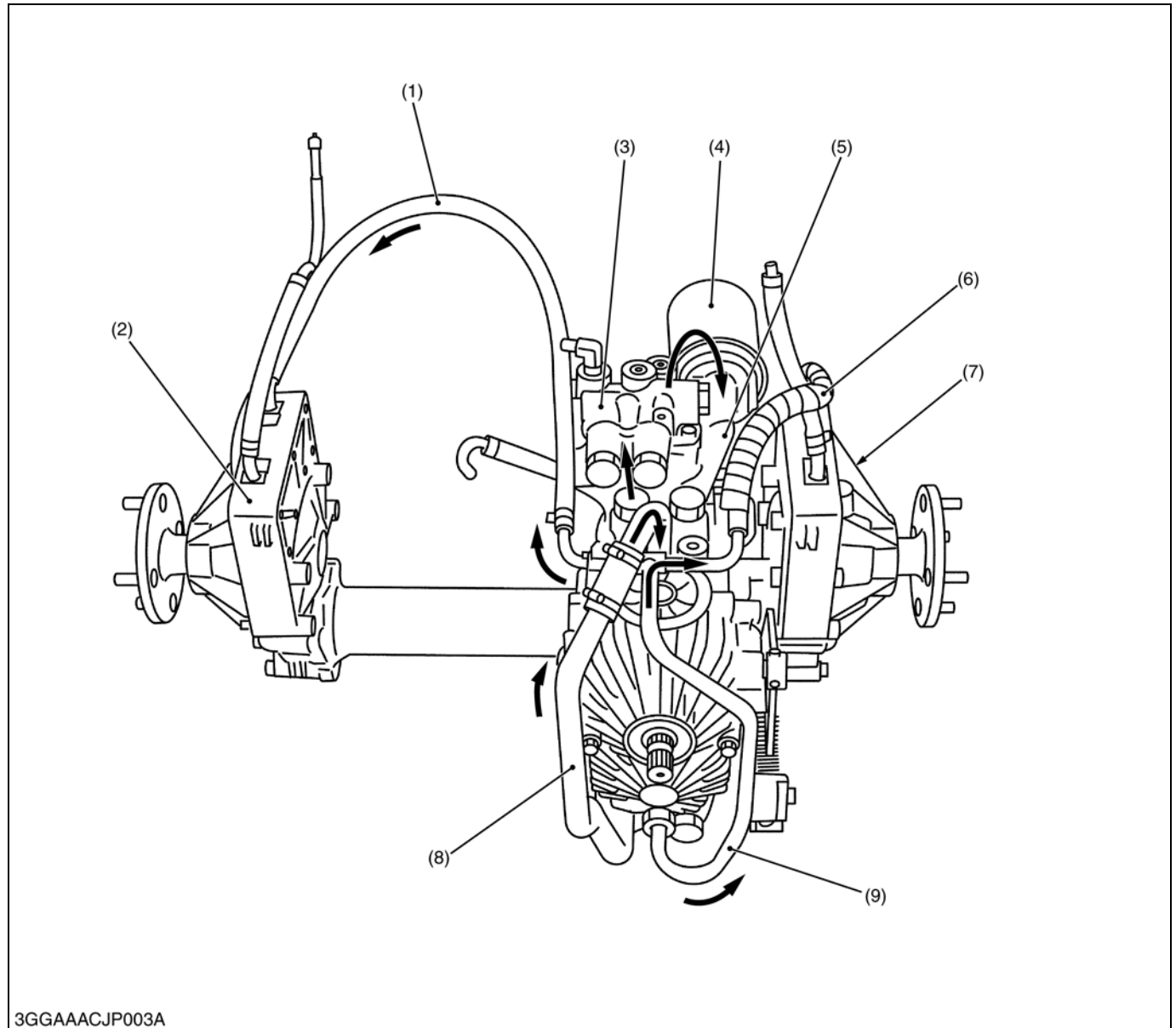
A fan is used to cool the hydrostatic transmission, eliminating the need for an oil cooler.

Convenient single lever control permits simple operation of the machine, starting, stopping, increasing or decreasing speeds, changing direction of travel, and even going up or down hills.

As for operation of the hydrostatic transmission, refer to Workshop Manual for G1700 · G1800 · G1900 · G2000 (Code No.9Y021-10834).

W1013294

[2] OIL FLOW

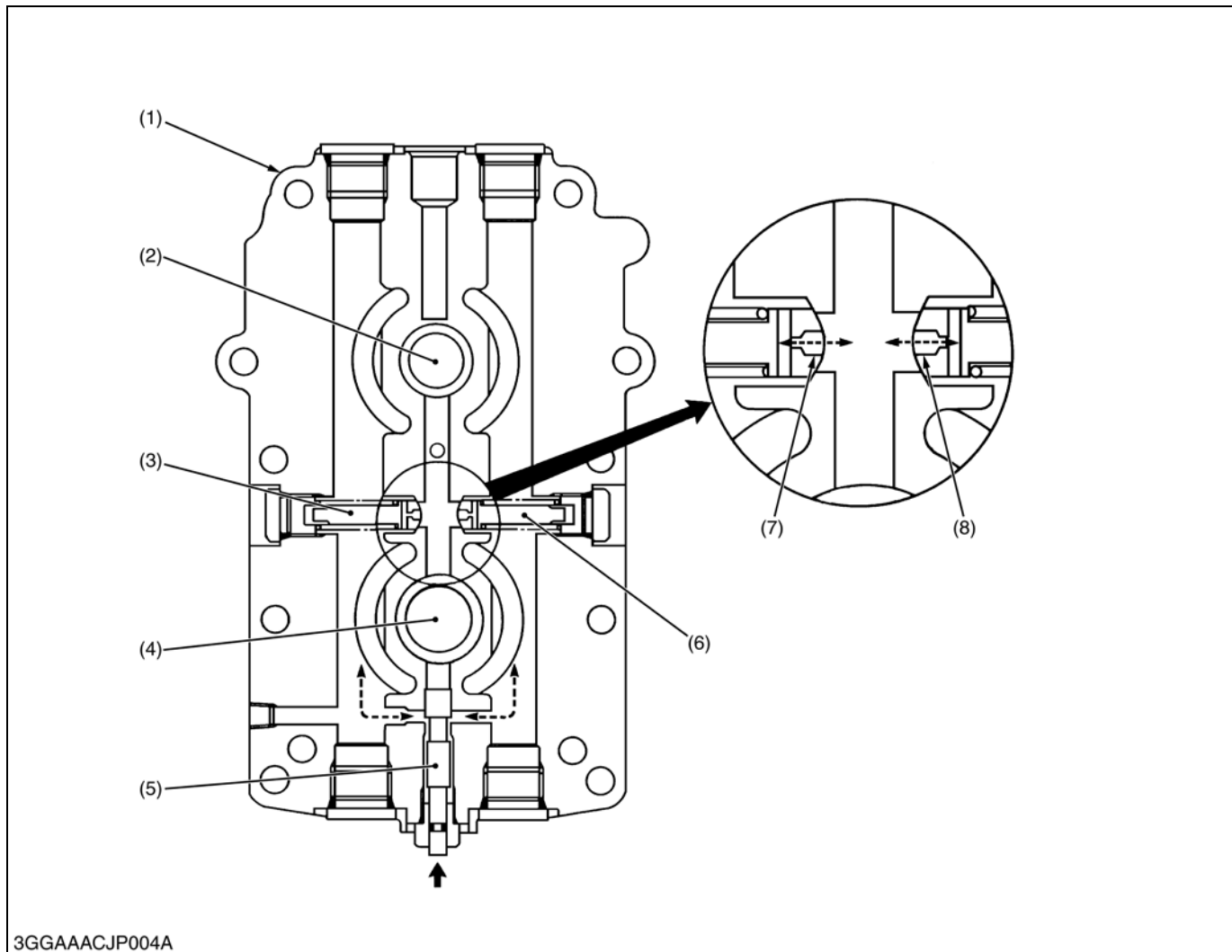


- | | | | |
|--------------------|---------------------------|--------------------|------------------|
| (1) Drain Hose | (4) Oil Filter Cartridge | (6) Drain Hose | (8) Suction Pipe |
| (2) Rear Axle Case | (5) Control Valve Adaptor | (7) Rear Axle Case | (9) Drain Pipe |
| (3) Control Valve | | | |

1. When the engine is started, the charge pump is rotated to suck oil from the transmission case through the suction pipe (8).
2. When the oil is sucked, it is filtered by the oil stainer.
3. Filtered oil is forced out by the charge pump to the control valve through the control valve adaptor (5).
4. With the control valve (3) in neutral position, the oil is delivered to the hydrostatic transmission through the control valve adaptor (5) and oil filter cartridge (4).
5. The oil used to charge a leak of the closed circuit in the hydrostatic transmission.
6. A portion of oil is drained into the rear axle cases (2), (7) through drain pipe (9) and drain hoses (1), (6) after flushing and cooling the cylinder blocks.

W1013278

[3] BY-PASS VALVE



(1) Center Section
(2) Pump Shaft

(3) Check Valve
(4) Motor Shaft

(5) By-Pass Valve
(6) Check Valve

(7) Orifice
(8) Orifice

The by-pass valve (5) is used to connect the two sides of the closed loop in the center section (1).

The motor shaft (4) does not rotate when the engine is stopped or pump is not driven. This means the machine usually can not be moved by pushing.

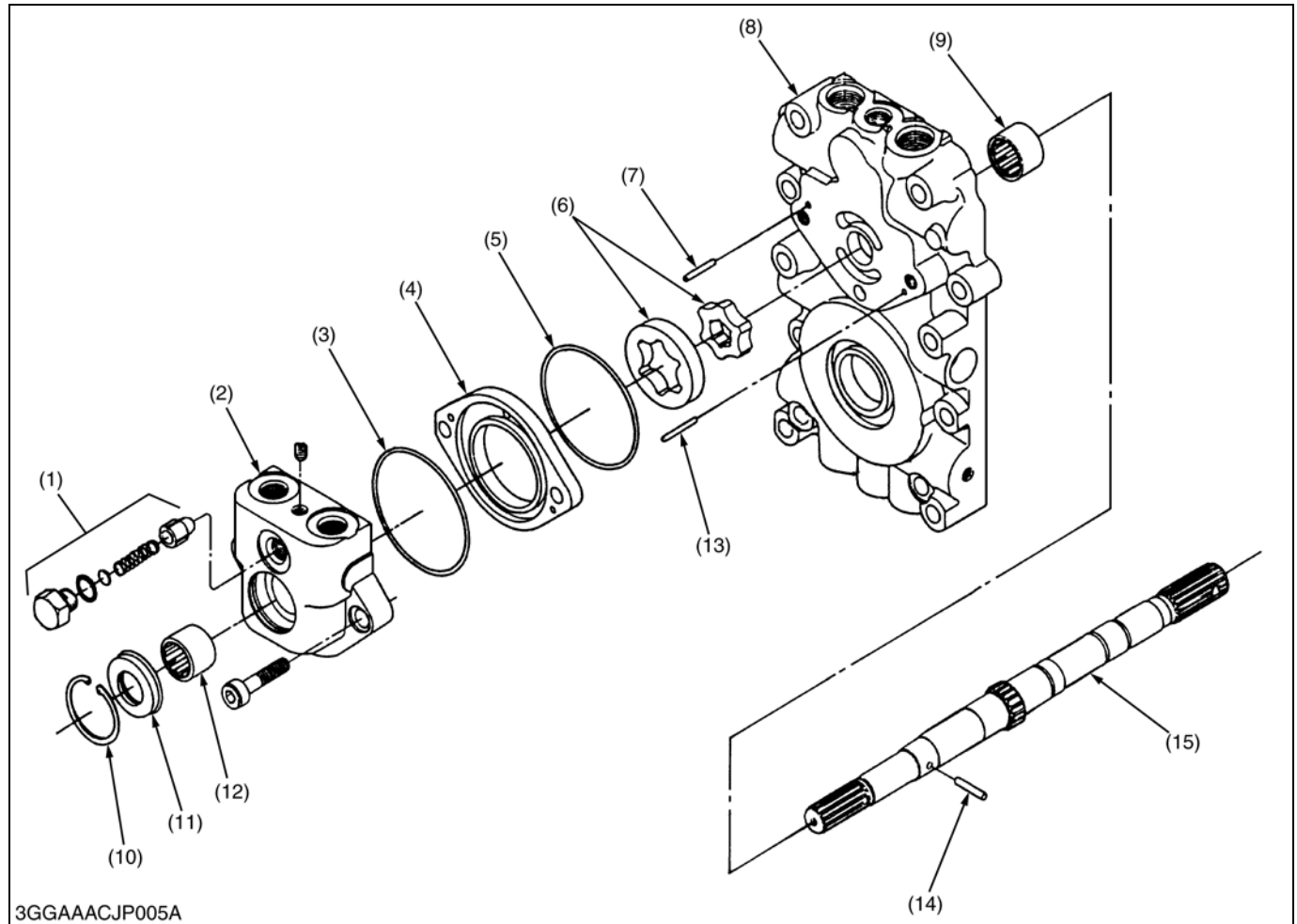
If moving the machine by pushing is desired, depress the by pass valve to connect the two sides of the loop and defeat the dynamic braking feature.

However, this hydrostatic transmission is equipped with a means of slightly by-passing higher and lower pressures all the time from the orifice (7), (8) of the check valve (3), (6).

Without having to open the by-pass valve (5), therefore, the machine can be moved by pushing.

W1013630

[4] CHARGE PUMP



- | | | | |
|-------------------------|--------------------|-------------------------|-----------------|
| (1) Charge Relief Valve | (5) O-ring | (9) Needle Bearing | (13) Dowel Pin |
| (2) Charge Pump Housing | (6) Gerotor | (10) Internal Snap Ring | (14) Drive Pin |
| (3) O-ring | (7) Dowel Pin | (11) Oil Seal | (15) Pump Shaft |
| (4) Charge Pump Spacer | (8) Center Section | (12) Needle Bearing | |

The charge pump is necessary to make up for leakage from the pump and motor, preventing cavitation.

This charge pump always revolves in combination with the pump shaft to draw oil from the transmission case, and feeds oil to the implement lifting circuit and charge circuit.

[Charge Pump Displacement]

Displacement	Engine speed	Oil pressure	Oil temperature
2.8 to 5.0 L/min. 3.0 to 5.4 U.S.qts./min. 2.4 to 4.49 Imp.qts./min.	1800 min ⁻¹ (rpm)	3.43 MPa 35 kgf/cm ² 498 psi	Approx. 50 °C 122 °F

As for charge circuit of the charge pump, refer to Workshop Manual for G1700 · G1800 · G1900 · G2000 (code No. 9Y021-10834).

[Charge Relief Valve]

Engine speed	Oil temperature	Valve operating pressure
1800 min ⁻¹ (rpm)	Approx. 50 °C 122 °F	0.32 to 0.4 MPa 3.3 to 4.2 kgf/cm ² 47 to 60 psi

W1014384

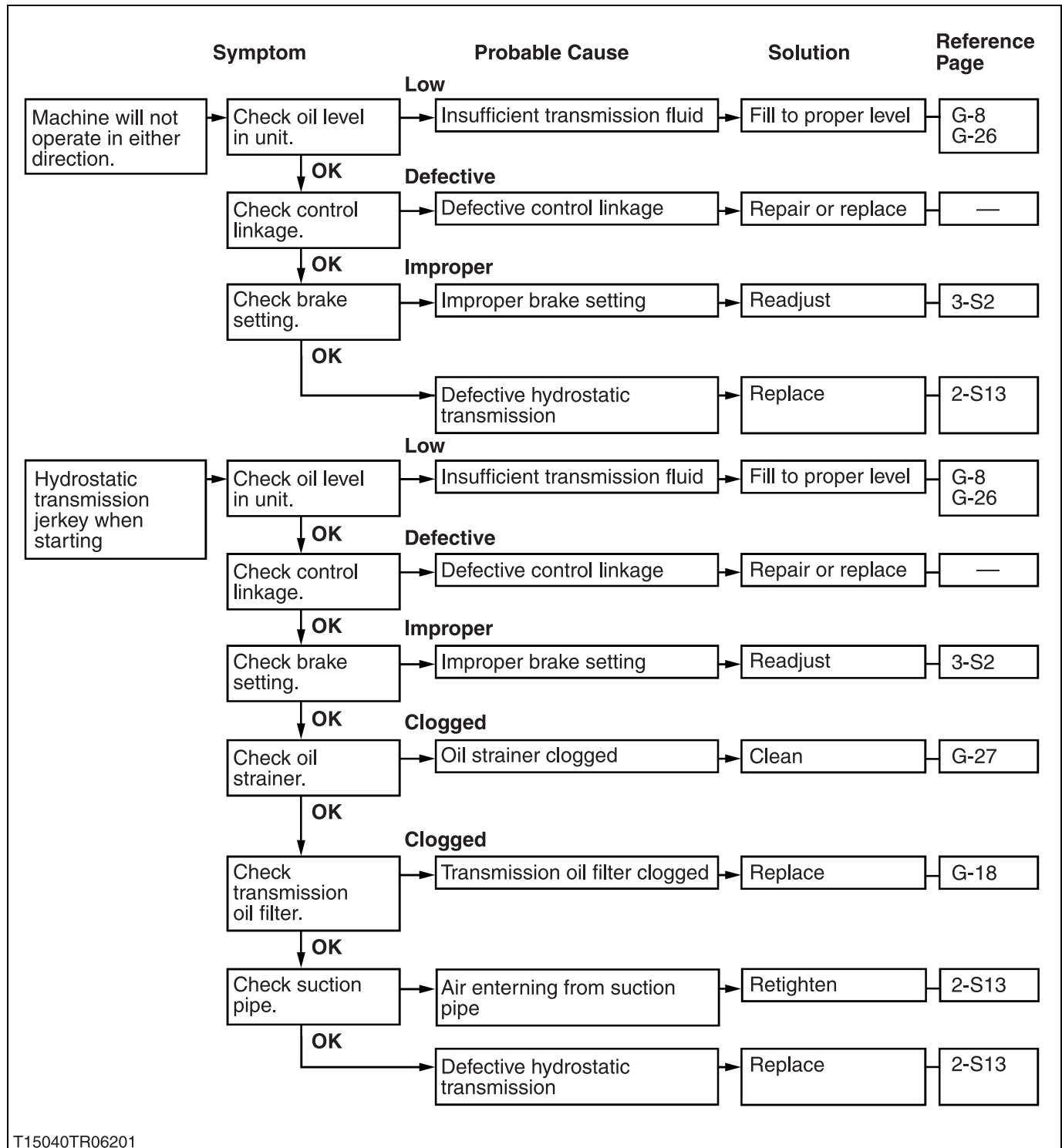
SERVICING

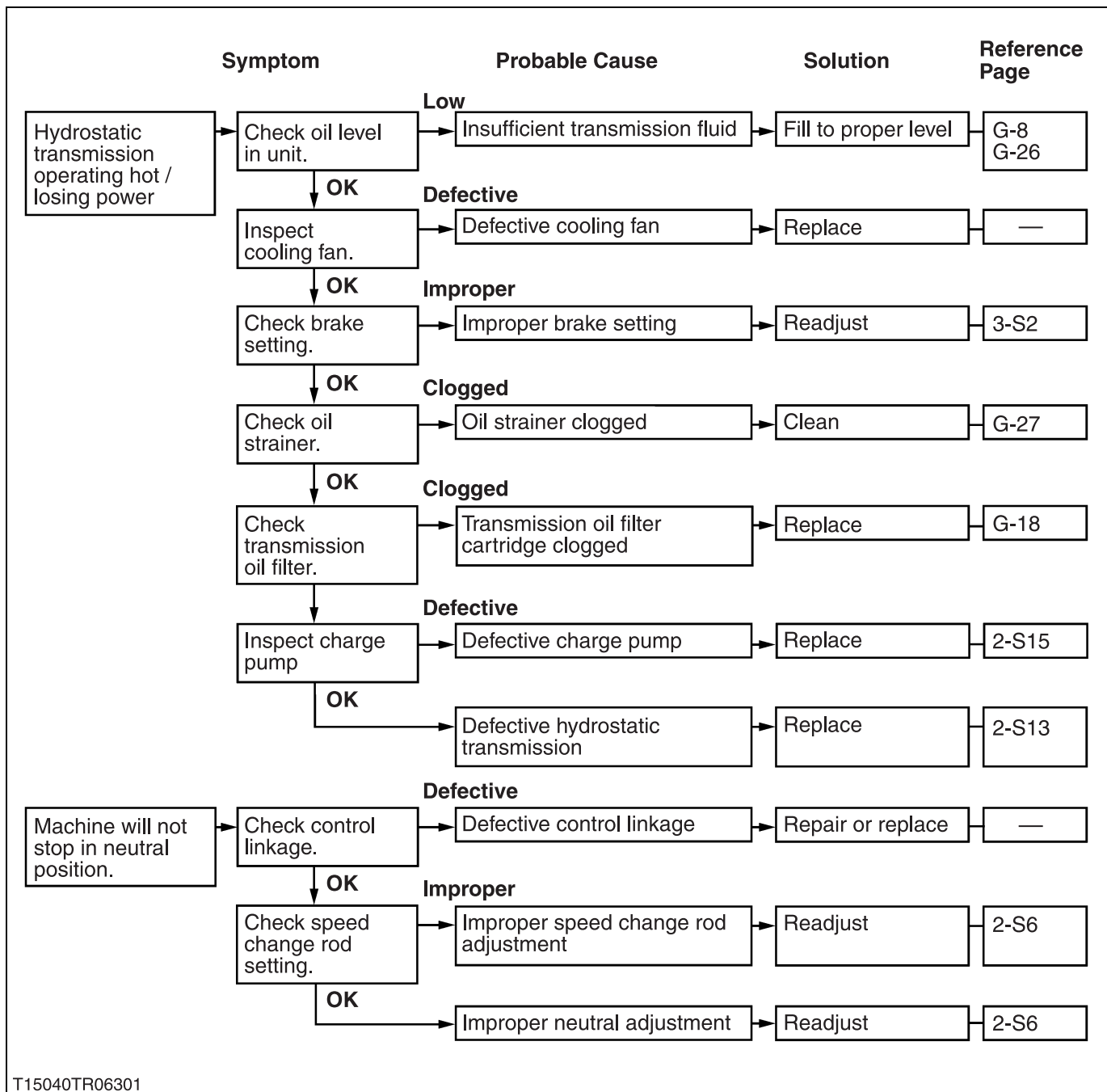
CONTENTS

1. TROUBLESHOOTING	2-S1
[1] HYDROSTATIC TRANSMISSION	2-S1
[2] TRANSMISSION	2-S3
2. SERVICING SPECIFICATIONS	2-S4
3. TIGHTENING TORQUES	2-S5
4. CHECKING, DISASSEMBLING AND SERVICING	2-S6
[1] CHECKING AND ADJUSTING	2-S6
[2] DISASSEMBLING AND ASSEMBLING	2-S8
(1) Separating Transmission	2-S8
(2) Separating Hydrostatic Transmission	2-S13
(3) Separating Transmission	2-S14
(4) Disassembling Transmission	2-S14
(5) Disassembling Rear Axle	2-S20
(6) Disassembling Differential Gear Case	2-S21
[3] SERVICING	2-S22
(1) Hydrostatic Transmission	2-S22
(2) Transmission	2-S24
(3) Differential Gear	2-S24

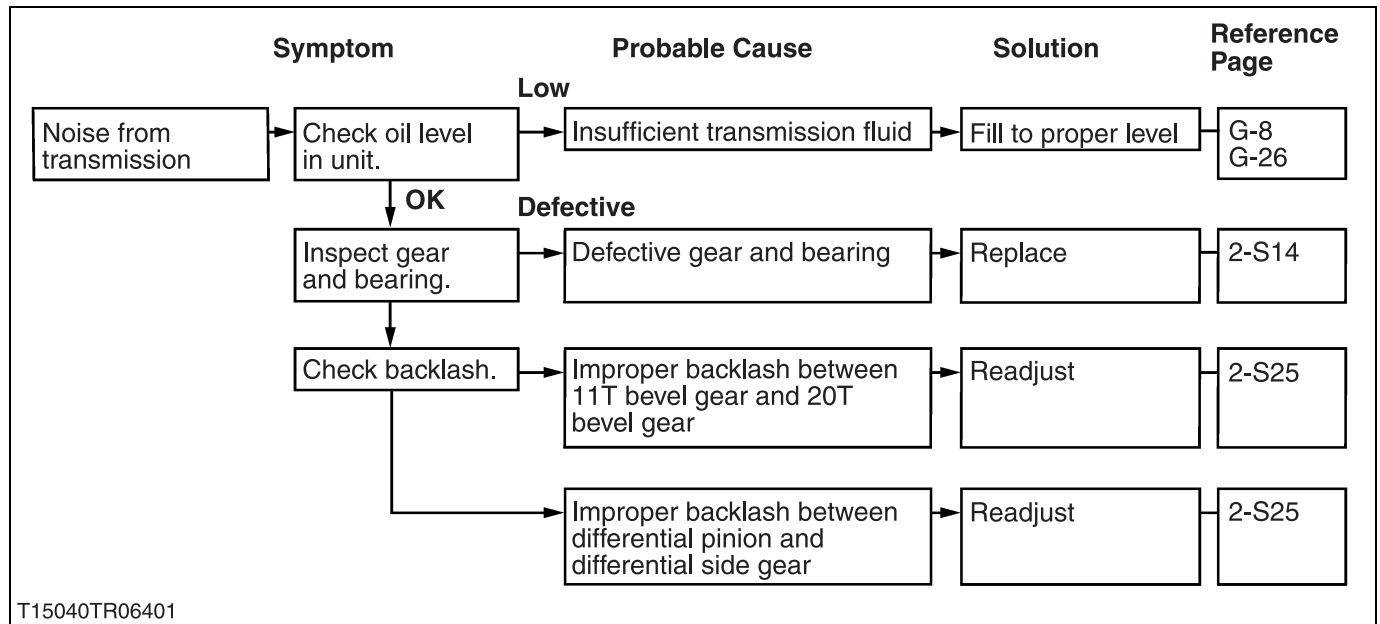
1. TROUBLESHOOTING

[1] HYDROSTATIC TRANSMISSION





[2] TRANSMISSION



2. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
Charge Relief Valve	Setting pressure	0.32 to 0.41 MPa 3.3 to 4.2 kgf/cm ² 47 to 60 psi	—
Transmission Fluid (Including HST and Cylinder)	Capacity	4.5 L 4.75 U.S.qts 3.86 Imp.qts	—
Differential Case to Differential Side Gear	Clearance	0.040 to 0.082 mm 0.00157 to 0.00323 in.	0.17 mm 0.0067 in.
Differential Case	I.D.	26.000 to 26.021 mm 1.02362 to 1.02445 in.	—
Differential Side Gear	O.D.	25.939 to 25.960 mm 1.02122 to 1.02205 in.	—
Differential Pinion Shaft to Differential Pinion	Clearance	0.025 to 0.055 mm 0.00098 to 0.00216 in.	0.10 mm 0.0039 in.
Differential Pinion Shaft	O.D.	9.960 to 9.975 mm 0.39213 to 0.39272 in.	—
Differential Pinion Gear	I.D.	10.000 to 10.015 mm 0.39370 to 0.39429 in.	—
Differential Pinion to Differential Side Gear	Backlash	0.10 to 0.20 mm 0.004 to 0.008 in.	—
11T Shaft Bevel Gear to 20T Bevel Gear	Backlash	0.10 to 0.30 mm 0.004 to 0.012 in.	—

W1011151

3. TIGHTENING TORQUES

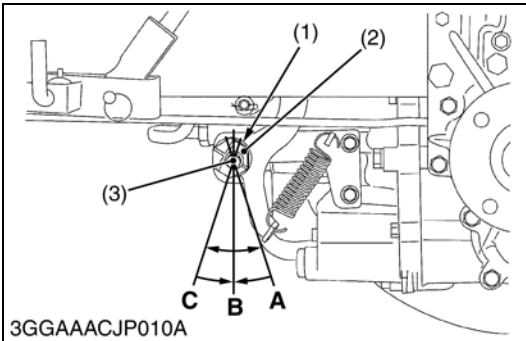
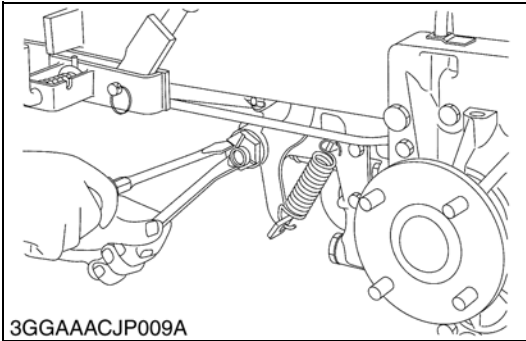
Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts : See page G-9.)

Item	N·m	kgf·m	ft-lbs
Cam mounting nut	39.2 to 45.1	4.0 to 4.6	28.9 to 33.3
Rear wheel mounting nut	107.8 to 130.3	11.0 to 13.3	79.6 to 96.2
Mower lift cylinder hose	14.7	1.5	10.8
Universal joint mounting screw	23.5 to 27.4	2.4 to 2.8	17.4 to 20.3
Rear axle case mounting screw			
M12 7T Aluminum	62.7 to 72.5	6.4 to 7.4	46.3 to 53.5
M10 7T Aluminum	39.2 to 44.1	4.0 to 4.5	28.9 to 32.5
M12 7T	77.4 to 90.2	7.9 to 9.2	57.1 to 66.5
M10 7T	48.0 to 55.9	4.9 to 5.7	35.4 to 41.2
Drain pipe retaining bolt (9/16-18 UNF)	27.4	2.8	20.3
Speed control arm set screw	17.6 to 20.6	1.8 to 2.1	13.0 to 15.2
Neutral arm assembly mounting screw	17.6 to 20.6	1.8 to 2.1	13.0 to 15.2
Drain plug	36.3	3.7	26.8
Adapter bolt (PS3/8)	80.4	8.2	59.3
Charge pump housing mounting hex. socket head screw	24.5 to 29.4	2.5 to 3.0	18.1 to 21.7
Center section mounting hex. socket head screw	22.5 to 24.5	2.3 to 2.5	16.6 to 18.1

W1011397

4. CHECKING, DISASSEMBLING AND SERVICING

[1] CHECKING AND ADJUSTING



Adjusting Neutral

1. Block the front wheels with stoppers, and lift up the rear of machine with a jack.
 2. Remove the left rear wheel.
 3. Start the engine, and set at approx. 1500 to 3000 min⁻¹ (rpm).
 4. Loosen the holder shaft mounting screw (3).
 5. Rotate the holder shaft (2) counterclockwise so the rear wheels turn forward.
 6. Then rotate it clockwise until the rear wheels stop completely.
 7. Put a mark on the neutral arm (1). (Position B)
 8. Rotate the holder shaft (2) clockwise so the rear wheels turn in reverse.
 9. Then rotate it counterclockwise until the rear wheels stop completely.
 10. Put a mark on the neutral arm (1). (Position A)
 11. Set the holder shaft (2) where it is right in the center between position A and B and tighten the holder shaft mounting screw (3) firmly.
- This means the hydrostatic transaxle is fully in neutral. (Position C)



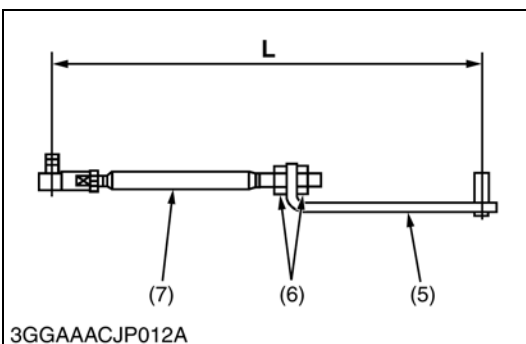
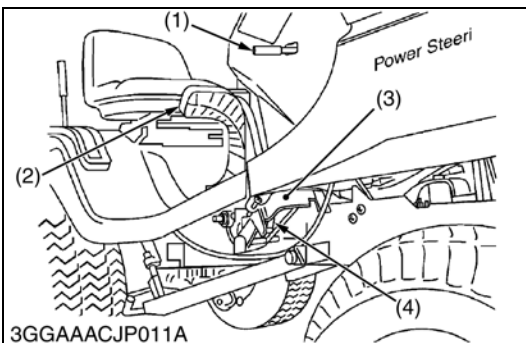
WARNING

- Use buddy system in adjusting the neutral position.
- One of you should sit on the operator's seat, adjust the engine rpm and step on the speed change pedal. The other should adjust the neutral position.

- (1) Neutral Arm
(2) Holder Shaft

- (3) Holder Shaft Mounting Screw

W1011896



Checking Speed Change Pedal Restriction

NOTE

- This adjustment should be performed after completing the adjustment of neutral.

1. Set the speed change pedal (2) to "NEUTRAL" position, and apply the parking brake (1).
2. Check that the pin (4) of speed change arm locks with the brake pedal arm (3).
3. If it is improper, adjust with the adjusting nuts (6) on speed change rod (7).

NOTE

- After adjustment, be sure to check that the speed change rod (7) doesn't touch the frame.

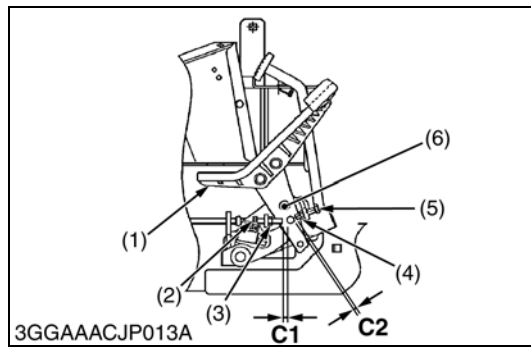
(Reference)

- L: 300mm (11.8 in.)

- (1) Parking Brake
(2) Speed Change Pedal
(3) Brake Pedal Arm
(4) Pin

- (5) Speed Change Plate 2
(6) Adjusting Nuts
(7) Speed Change Rod

W1012200



Pedal Stopper (Adjusting Maximum Forward and Reverse Travelling Speed)

■ NOTE

- This adjustment should be performed after completing the adjustment of neutral.

[Forward Operation]

1. Loosen the lock nut (3) and screw back the adjusting screw (2).
2. Lightly depress the speed change pedal (1) forward to the stroke end.
3. Screw the adjusting screw (2) until it touches the pedal.
4. Then further screw the adjusting screw (2) 1/2 turn, and tighten the lock nut (3).

(Reference)

- Clearance "C1" (when the pedal is in neutral) : 5.0 mm (0.20 in.)
- Traveling speed : 0.0 to 15.0 km/h (0.0 to 9.3 mph)

[Reverse Operation]

(Reference)

- Clearance "C2" (when the pedal is in neutral) : 11.5 mm (0.456 in.)
- Traveling speed : 0.0 to 6.0 km/h (0.0 to 3.7 mph)

(1) Speed Change Pedal

(2) Adjusting Screw

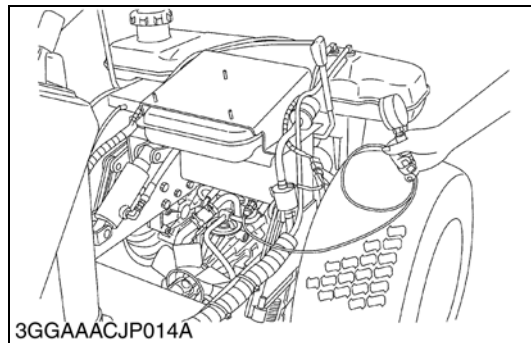
(3) Lock Nut

(4) Lock Nut

(5) Adjusting Screw

(6) Fulcrum

W1012533



Charge Relief Pressure

⚠ CAUTION

- When checking, park the machine on level ground, apply the parking brake.

1. Remove the adaptor bolt (return port) from the control valve adaptor.
2. Set the adaptor bolt for HST (See page G-39), thread joint (Code No. 07916-50341), cable (Code No. 07916-50331), thread joint (Code No. 07916-50401) and pressure gauge (Code No. 07916-51301).
3. Start the engine and run the engine speed at rated speed.
4. Read the pressure gauge to measure the charge relief pressure.
5. If the pressure is not within the factory specification, adjust the pressure with the adjusting shims.

Relief valve setting pressure	Factory spec.	0.32 to 0.41 MPa 3.3 to 4.2 kgf/cm ² 47 to 60 psi
-------------------------------	---------------	--

Condition

- Engine Speed.....Rated Speed
- Oil Temperature.....50 °C (122 °F)

■ IMPORTANT

- Measure quickly so that the relief valve may not be in operation more than 10 seconds.
- Replace the adaptor bolt of the charge pump return port with the measuring adaptor bolt for HST.

(Reference)

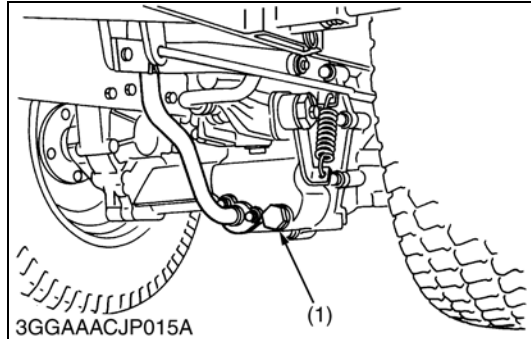
- Thickness of adjusting shims:
0.1 mm (0.004 in.) (Part No.: 66101-36950)
0.2 mm (0.008 in.)
0.4 mm (0.016 in.)
0.5 mm (0.020 in.)

W1013238

[2] DISASSEMBLING AND ASSEMBLING

(1) Separating Transmission

(A) Dismounting Mower



Dismounting Mower

1. See to "MOWER" section.

W1013684

Draining Transmission Fluid

1. Place an oil pan underneath the drain plug (1).
2. Remove the drain plug (1).
3. Remove the oil inlet plug (2) to completely drain the transmission fluid.
4. After draining, screw in the drain plug (1) and the oil inlet plug (2).

(When refilling)

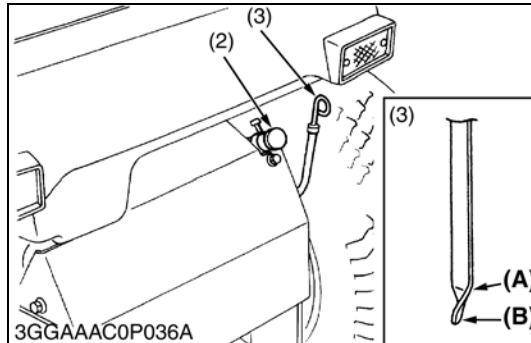
- Use the specified transmission fluid.
- Refer to "**LUBRICANTS, FUEL AND COOLANT**" (See Page G-8).
- Never work the machine immediately after changing the transmission fluid. Keep the engine at medium speed for a few minutes to prevent damage to the transmission.

Transmission fluid (Including HST and cylinder)	Capacity	4.5 L 4.75 U.S.qts 3.86 Imp.qts
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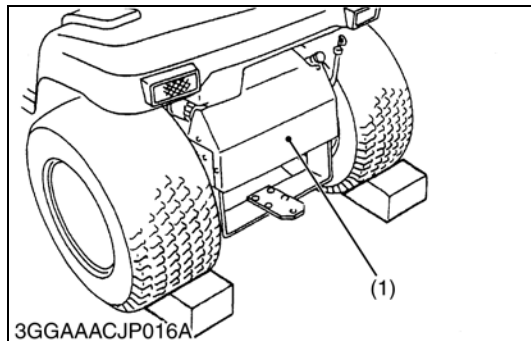
- (1) Drain Plug
- (2) Oil Inlet Plug
- (3) Oil Level Dipstick

(A) Upper Level
(B) Lower Level

W1040303



(B) Separating Rear Cover

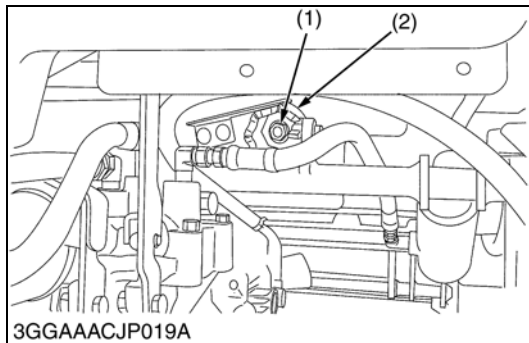
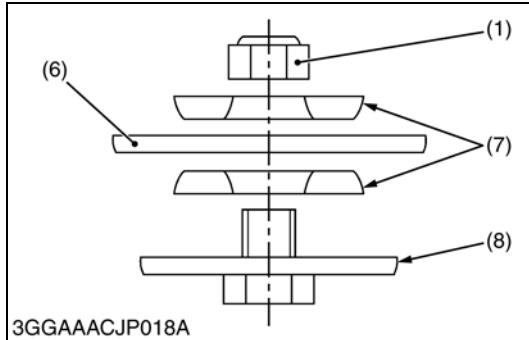
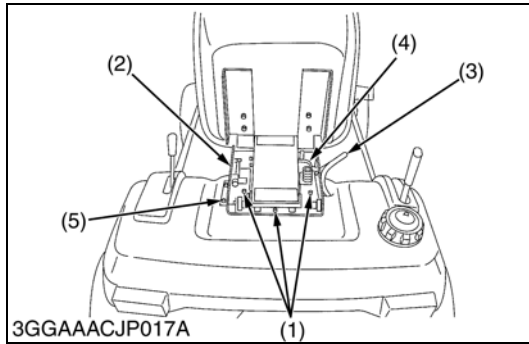


Rear Cover

1. Remove the rear cover (1) from rear axle support.
- (1) Rear Cover

W1014079

(C) Separating Fender



Seat

1. Disconnect the **2P** connector (3) from the seat switch and fuse (4).
2. Remove the seat support mounting lock nut (1).
3. Remove the screws (5).
4. Remove the seat with seat support.
5. Remove the seat bracket (2).

(When reassembling)

- Turn the seat support mounting lock nuts all the way until it seats lightly.
Then, turn seat support mounting lock nuts counterclockwise by a half turn.
- Apply oil to the seat support.
- Face smooth side the plane washers (6) to the seat support.

- | | |
|-------------------------------------|-------------------|
| (1) Seat Support Mounting Lock Nuts | (5) Screws |
| (2) Seat Bracket | (6) Seat Support |
| (3) 2P Connector | (7) Plane Washers |
| (4) Fuse | (8) Fender |

W1014173

Cutting Height Adjusting Dial

1. Lift the mower to the highest position.
2. Remove the cam mounting nut (1).
3. Remove the cutting height adjusting dial, plain washer and cam (2).

(When reassembling)

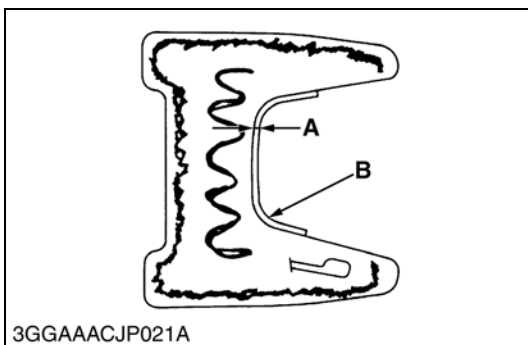
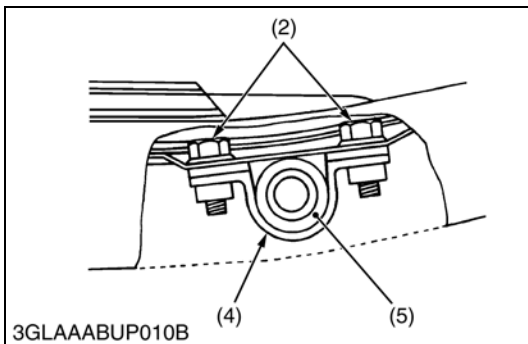
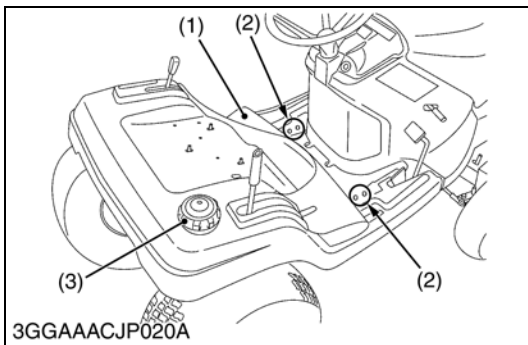
- Apply grease to the outside of cam.

Tightening torque	Cam mounting nut	39.2 to 45.1 N·m 4.0 to 4.6 kgf·m 28.9 to 33.3 ft·lbs
-------------------	------------------	---

(1) Cam Mounting Nut

(2) Cam

W1014754



Separating Fender

1. Remove the speed change pedal.
2. Peel the step sheet (1) halfway.
3. Remove the step support mounting screws (2).
4. Remove the step support (5) and rubber bushing (6).
5. Remove the fuel cap (4).
6. Separate the fender from the frame.

(When reassembling)

- Apply grease to the inside of rubber bushing.
- Clean up the step sheet and the step. Apply instantaneous adhesive on the step sheet as shown in the figure.
- Position the step sheet so that the clearance between the step sheet and the panel is less than 2.0 mm (0.079 in.) as shown in the figure.

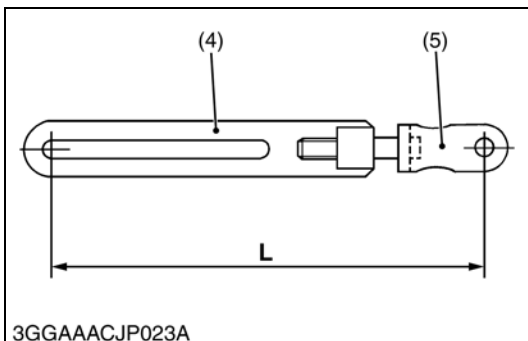
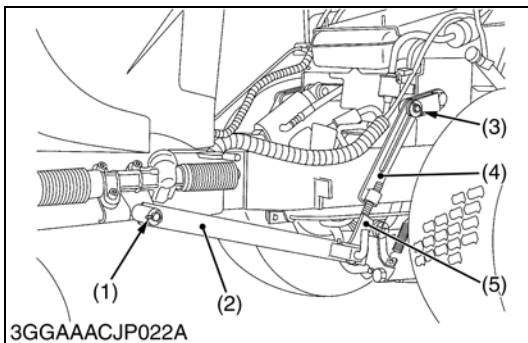
- (1) Step Sheet
(2) Step Support Mounting Screws
(3) Fuel Cap
(4) Step Support
(5) Rubber Bushing

(A) Less than 2.0mm (0.079 in.)

(B) Panel

W1018335

(D) Separating Transmission



Upper Lift Link and Link Assembly

1. Pull out the rue ring cotters (3) and plain washers.
2. Remove the upper lift links (4).
3. Pull out the cotter pin (1) and plain washer.
4. Remove the L.H. rear link assembly (2).
5. Remove the R.H. rear link assembly retaining lock nut and bolt.
6. Remove the R.H. rear link assembly.

(When reassembling)

- Apply the grease to the rotary sliding surface.
- Adjust the upper lift link and lower lift link referring to the "MOWER" section.

■ IMPORTANT

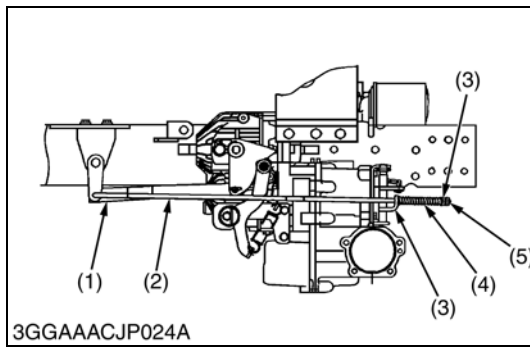
- Tighten the R.H. rear link assembly lock nut and bolt, leaving as little gap as possible between the frame and the lock nut. Also be sure that the rear link assembly turns smoothly.

(Reference)

- L : 350mm (13.8 in.)

- (1) Cotter Pin
(2) L.H. Rear Link Assembly
(3) Rue Ring Cotter
(4) Upper Lift Link
(5) Lower Lift Link

W1015243



Brake spring, Brake Rod and Speed Change Plate

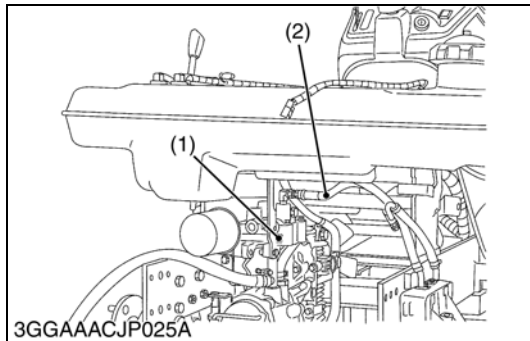
1. Remove the lock nut (5), plane washers (3), and brake spring (4).
2. Remove the brake rod (2).
3. Remove the speed change plate (1) from the speed control arm.

■ IMPORTANT

- **After assembling the brake rod and brake spring, be sure to adjust the brake pedal play (See page G-19).**

- | | |
|------------------------|------------------|
| (1) Speed Change Plate | (4) Brake Spring |
| (2) Brake Rod | (5) Lock Nut |
| (3) Plane Washers | |

W1015689



Rear Wheel, Levers and Mower Lift Cylinder Hose

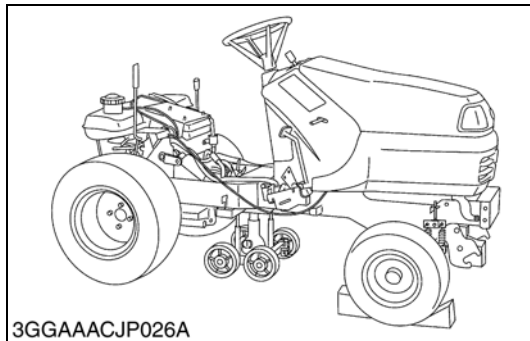
1. Block the front wheels with stoppers, and lift up the frame.
2. Remove the rear wheel mounting nuts.
3. Remove the rear wheels
4. Remove the mower lift lever (1) from the control valve.
5. Disconnect the mower lift cylinder hose (2) from the control valve.

■ NOTE

- **Jack up the machine by applying jacks on spots forward from the rear axle (toward the machine center) of the machine frame.**

(When reassembling)

- Tighten the lever lock nut and bolt, leaving gap between the control valve adaptor and lock nut as little as possible. Also be sure that the lever moves smoothly.
- Once removed, the rear wheel mounting nuts and spring washers are not reusable. Replace them with new ones.

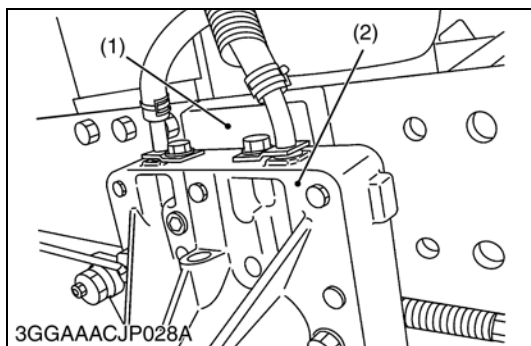
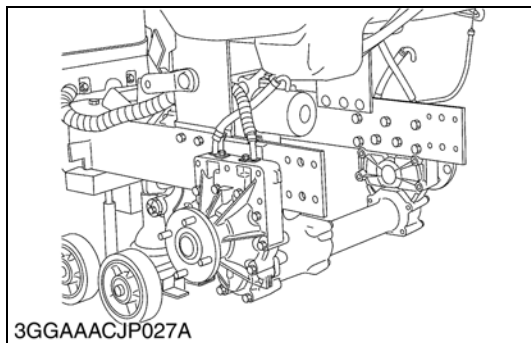


Tightening torque	Rear wheel mounting nuts	107.8 to 130.3 N·m 11.0 to 13.3 kgf·m 79.6 to 96.2 ft-lbs
	Mower cylinder hose	14.7 N·m 1.5 kgf·m 10.8 ft-lbs

(1) Mower Lift Lever

(2) Mower Lift Cylinder Hose

W1015952



Separating Transmission

1. Remove the universal joint mounting screws.
2. Disconnect the universal joint.
3. Remove the rear axle case mounting screws.
4. Separating the transmission from the frame.

(When reassembling)

- Apply grease to the splines of universal joint.
- Fit the rear axle case onto the frame with the rear axle case top in tight contact all over the plate.

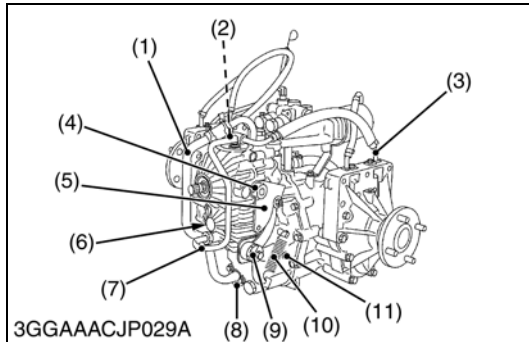
Tightening torque	Universal joint mounting screw	23.5 to 27.4 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
	Rear axle case mounting screw (M12 7T Aluminum)	62.7 to 72.5 N·m 6.4 to 7.4 kgf·m 46.3 to 53.5 ft-lbs
	Rear axle case mounting screw (M10 7T Aluminum)	39.2 to 44.1 N·m 4.0 to 4.5 kgf·m 28.9 to 32.5 ft-lbs
	Rear axle case mounting screw (M12 7T)	77.4 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft-lbs
	Rear axle case mounting screw (M10 7T)	48.0 to 55.9 N·m 4.9 to 5.7 kgf·m 35.4 to 41.2 ft-lbs

(1) Plate

(2) Rear Axle Case

W1016209

(2) Separating Hydrostatic Transmission



Neutral Arm, Speed Control Arm and Hydraulic Pipes

1. Remove the neutral spring (10).
2. Remove the neutral arm assembly mounting screws (11).
3. Remove the neutral arm assembly (9).
4. Remove the speed control arm set screw (4).
5. Remove the speed control arm (5).
6. Remove the stopper plate (8).
7. Remove the suction pipe (1) with the oil strainer.
8. Remove the adaptor plates (3).
9. Remove the drain pipe retaining bolt (2).
10. Remove the drain pipe (7) with the hydraulic hoses.
11. Remove the drain plug (6).

(When reassembling)

- Take care not to damage the O-ring.

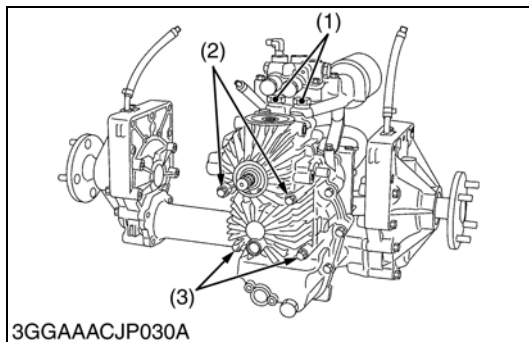
Tightening torque	Drain pipe retaining bolt (9/16-18 UNF)	27.4 N·m 2.8 kgf·m 20.3 ft-lbs
	Speed control arm set screw	17.6 to 20.6 N·m 1.8 to 2.1 kgf·m 13.0 to 15.2 ft-lbs
	Neutral arm assembly mounting screw	17.6 to 20.6 N·m 1.8 to 2.1 kgf·m 13.0 to 15.2 ft-lbs
	Drain plug	36.3 N·m 3.7 kgf·m 26.8 ft-lbs

■ IMPORTANT

- Once removed, the speed change arm set screw is not reusable.

- | | |
|---------------------------------|--|
| (1) Suction Pipe | (7) Drain Pipe |
| (2) Drain Pipe Retaining Bolt | (8) Stopper Plates |
| (3) Adaptor Plates | (9) Neutral Arm Assembly |
| (4) Speed Control Arm Set Screw | (10) Neutral Spring |
| (5) Speed Control Arm | (11) Neutral Arm Assembly Mounting Screw |
| (6) Drain Plug | |

W1026369



Separating Hydrostatic Transmission

1. Remove the adaptor bolts (1) with the gaskets.
2. Remove the hydrostatic transmission mounting screws (2), (3).
3. Separate the hydrostatic transmission from the front cover.

(When reassembling)

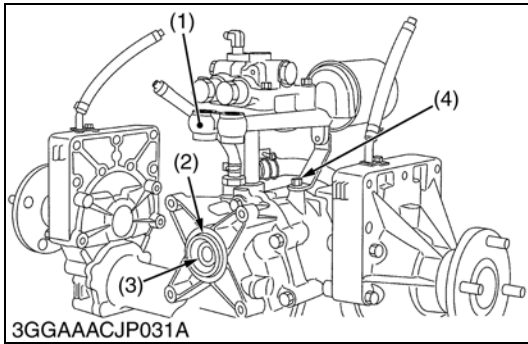
- First tighten the adapter bolts into the control valve assembly. Then tighten up control valve assembly stay mounting screw.

Tightening torque	Adapter bolt (PS3/8)	80.4 N·m 8.2 kgf·m 59.3 ft-lbs
-------------------	----------------------	--------------------------------------

- | | |
|---|--|
| (1) Adaptor Bolts | (3) Hydrostatic Transmission Mounting Screws |
| (2) Hydrostatic Transmission Mounting Screw | |

W1026829

(3) Separating Transmission



Separating Control Valve Assembly

1. Remove the control valve assembly stay mounting screw (4).
2. Separating the control valve assembly (1) from the transmission.
3. Remove the collar (3) and O-ring (2) on the front cover.

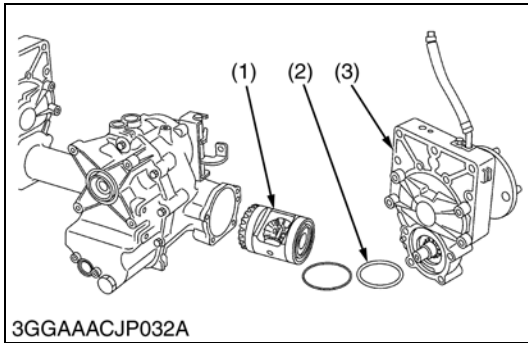
(When reassembling)

- Take care not to damage the O-ring.
- Temporarily tighten the control valve assembly stay mounting screw.
- First tighten the adapter bolts into the control valve assembly. Then tighten up the control valve assembly stay mounting screw.

- (1) Control Valve Assembly
(2) O-ring

- (3) Collar
(4) Control Valve Assembly Stay Mounting Screw

W1027118



Separating Transmission

1. Separating the left rear axle case (3) from the transmission case.
2. Take out the differential assembly (1), noting the number of left and right shims (2).
3. Separate the rear axle support (5) and the right rear axle case (4) from the transmission.
4. Take out the yoke shaft (7) and spline boss (6).

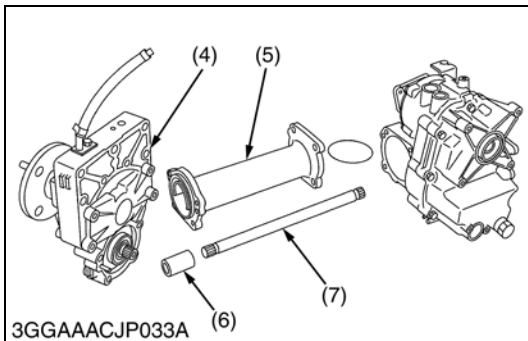
(When reassembling)

- Take care not to damage the O-ring.
- Install the adjusting shims to their original position.

- (1) Differential Assembly
(2) Shims
(3) Left Rear Axle Case
(4) Right Rear Axle Case

- (5) Rear Axle Support
(6) Spline Boss
(7) Yoke Shaft

W1027308

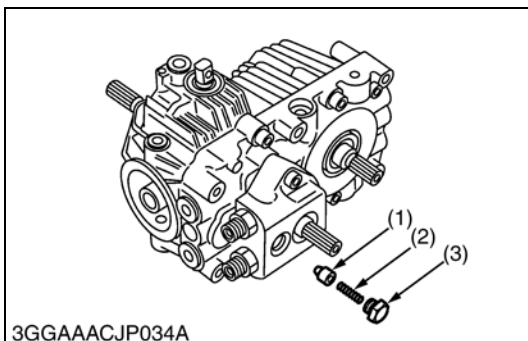


(4) Disassembling Transmission

(A) Hydrostatic Transmission

■ NOTE

- Work in a clean area.
- Replace any damaged parts that could cause internal leakage.
- Do not use grit paper, files or grinders on finished surface.
- Use only clean, recommended fluid on the finished surface in reassembling.



Charge Relief Valve

1. Remove the relief plug (3).
2. Remove the spring (2) and charge relief cone (1).

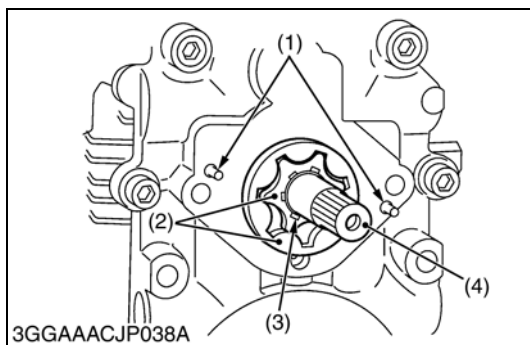
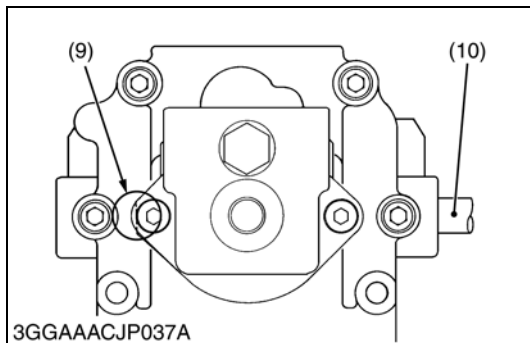
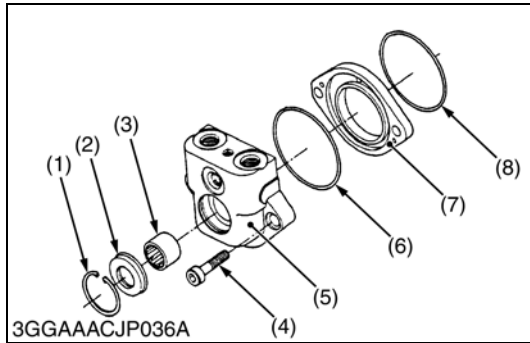
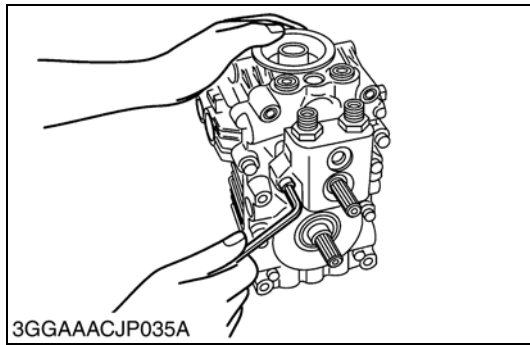
■ NOTE

- If shims are placed at the bottom of the relief plug bore, keep them.
- Take care not to damage the O-ring.

- (1) Charge Relief Cone
(2) Spring

- (3) Relief Plug

W1027643



Charge Pump Housing and Charge Pump Spacer

1. Remove the charge pump housing mounting hex. socket head screws (4).
2. Remove the charge pump housing (5).
3. Remove the O-ring (6) from the housing.
4. Remove the charge pump spacer (7).
5. Remove the O-ring (8) from the spacer.
6. Remove the internal snap ring (1), and pry the oil seal (2) off with a screw driver.

NOTE

- When removing the oil seal (2), take care not to damage the housing.
- Take care not to damage the O-rings.

(When reassembling)

- When installing the charge pump spacer, place the flat portion (9) of the spacer on the opposite side of the trunnion arm (10).

Tightening torque	Charge pump housing mounting hex, socket head screw	24.5 to 29.4 N·m 2.5 to 3.0 kgf·m 18.1 to 21.7 ft·lbs
-------------------	---	---

- | | |
|----------------------------|-----------------------|
| (1) Internal Snap Ring | (6) O-ring |
| (2) Oil Seal | (7) Charge Pump Space |
| (3) Needle Bearing | (8) O-ring |
| (4) Hex. Socket Head Screw | (9) Flat Portion |
| (5) Charge Pump Housing | (10) Trunnion Arm |

W1027788

Gerotor

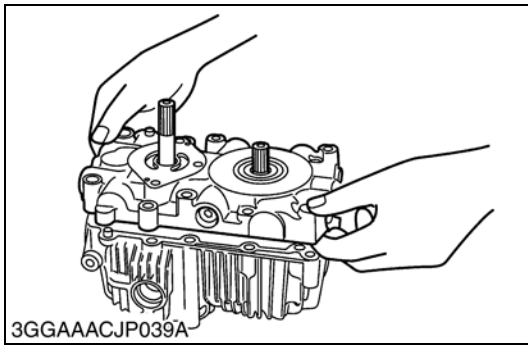
1. Remove the gerotors (2).
2. Draw out the drive pin (3) on the pump shaft (4).
3. Draw out the dowel pins (1).

(When reassembling)

- Apply clean fluid to the both sides of the gerotor.

- | | |
|----------------|----------------|
| (1) Dowel Pins | (3) Drive Pin |
| (2) Gerotors | (4) Pump Shaft |

W1028457



Center Section

1. Remove the center section mounting hex. socket head screws.
2. Lift the center section off the housing.
3. Remove the gasket.
4. Draw out the dowel pins.

NOTE

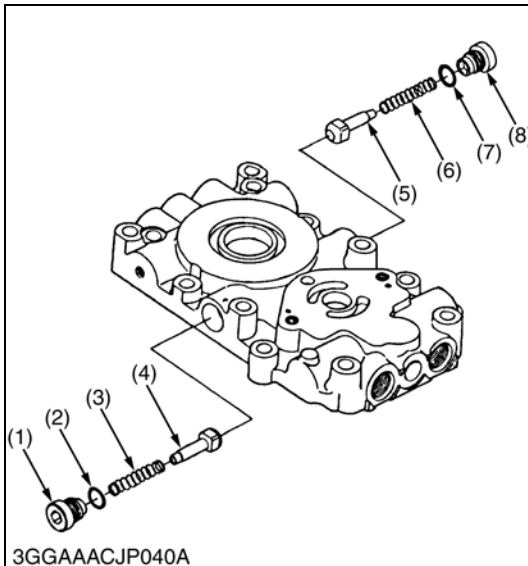
- Take care not to damage the surface of the center section and cylinder blocks.

(When reassembling)

- Replace the gasket with a new one.
- Replace the seal with a new one.

Tightening torque	Center section mounting hex. socket head screw	22.5 to 24.5 N·m 2.3 to 2.5 kgf·m 16.6 to 18.1 ft-lbs
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W1028699



Check Valve

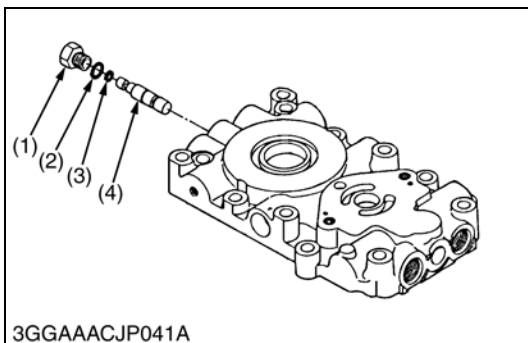
1. Remove the plugs (1), (8).
2. Remove the check valve (4), (5) and springs (3), (6).

NOTE

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

- | | |
|-----------------|-----------------|
| (1) Plug | (5) Check Valve |
| (2) O-ring | (6) Spring |
| (3) Spring | (7) O-ring |
| (4) Check Valve | (8) Plug |

W1028889



By-pass Valve

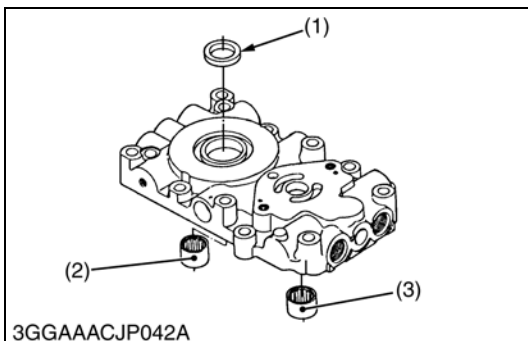
1. Remove the plug (1).
2. Remove the by-pass valve (4).

NOTE

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

- | | |
|------------|-------------------|
| (1) Plug | (3) O-ring |
| (2) O-ring | (4) By-pass Valve |

W1029069



Oil Seal and Needle Bearing

1. Pry the oil seal (1) off with a screwdriver.
2. Remove the needle bearings (2), (3).

NOTE

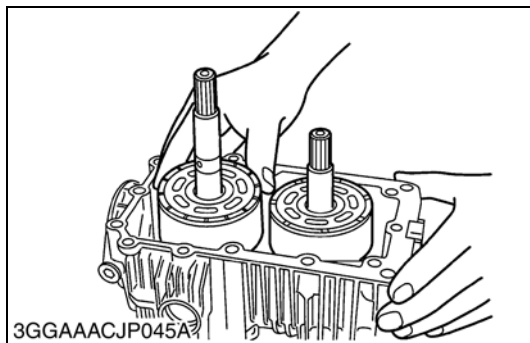
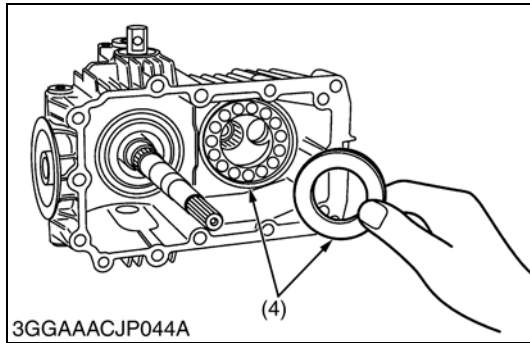
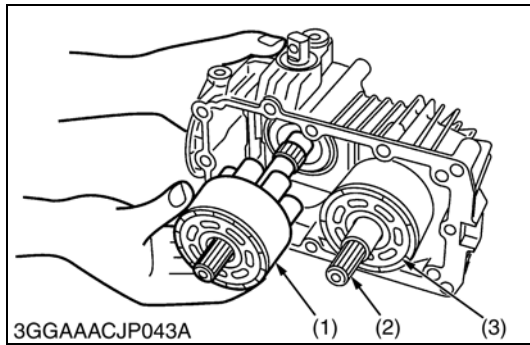
- Take care not to damage the center section.

(When reassembling)

- Replace the oil seal with a new one.

- | | |
|--------------------|--------------------|
| (1) Oil Seal | (3) Needle Bearing |
| (2) Needle Bearing | |

W1029240



Cylinder Block Assembly and Thrust Ball Bearing

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

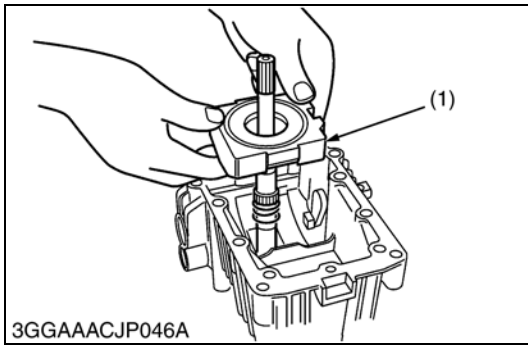
■ NOTE

- **Take care not to damage the surface of the cylinder blocks.**
- (When reassembling)**
- Apply clean fluid to the surface of cylinder block.
 - After installing the cylinder block assembly, check it to rotate lightly.

- (1) Cylinder Block Assembly (Pump)
(2) Motor Shaft

- (3) Cylinder Block Assembly (Motor)
(4) Thrust Ball Bearing

W1030609

**Swashplate**

1. Remove the swashplate (1) from the housing.
2. Remove the thrust plate (4), thrust roller bearing (3) and thrust washer (2) from the Swashplate.

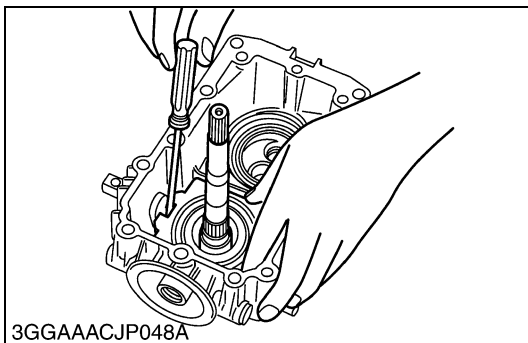
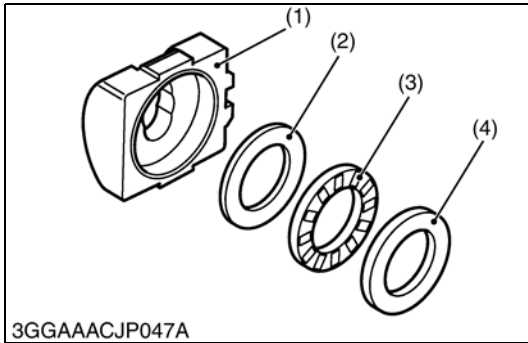
(When reassembling)

- Apply clean fluid to the thrust washer and thrust plate.
- Install the swashplate, keeping the slot guide from moving with a screwdriver.

- (1) Swashplate
(2) Thrust Washer

- (3) Thrust Roller Bearing
(4) Thrust Plate

W1030852

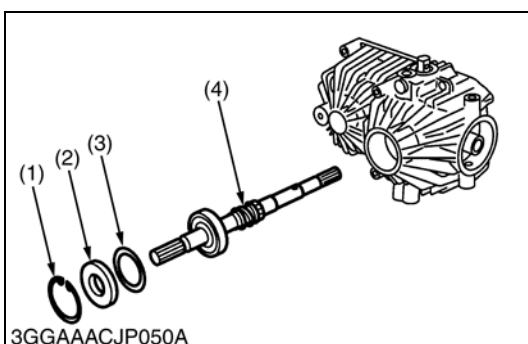
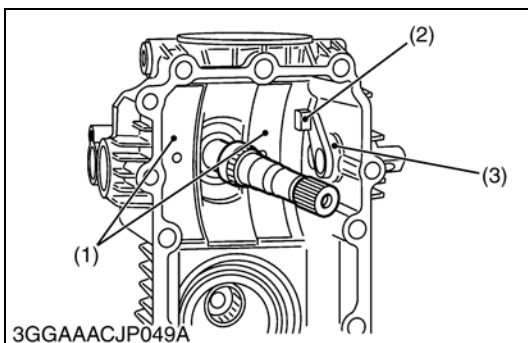
**Slot Guide and Cradle Bearing**

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

- (1) Cradle Bearing
(2) Slot Guide

- (3) Trunnion Arm

W1031110

**Pump Shaft**

1. Remove the internal snap ring (1).
2. Tap the pump shaft (4) with a plastic hammer slightly to side out it from the housing with the oil seal (2) and spacer.

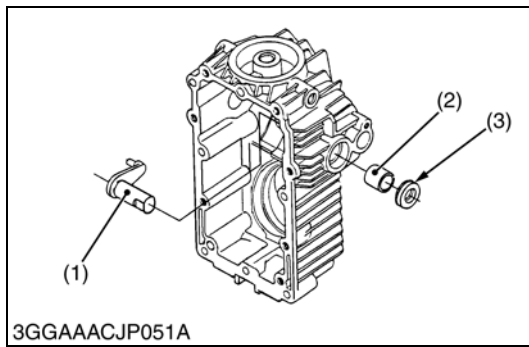
(When reassembling)

- Replace the oil seal with a new one.
- Wrap the pump shaft with a thin plastic or cellophane tape to prevent damage to new seal lip during installation.

- (1) Internal Snap Ring
(2) Oil Seal

- (3) Spacer
(4) Pump Shaft

W1031231



Trunnion Arm and Journal Bearing

1. Remove the trunnion arm (1).
2. Pry the oil seal (3) off with a screwdriver.
3. Press out the journal bearing (2).

(When reassembling)

- Apply clean field to the journal bearing.

■ NOTE

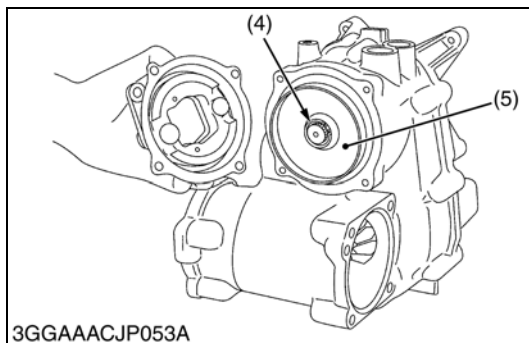
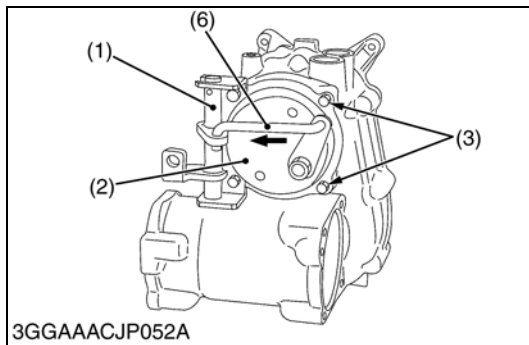
- **Take care not to damage the housing.**

- (1) Trunnion Arm
(2) Journal Bearing

- (3) Oil Seal

W1031388

(B) Transmission



Brake Assembly

1. Remove the brake assembly mounting screws (3).
2. Remove the brake assembly (2) with the fulcrum support assembly (1).
3. Remove the external snap ring (4).
4. Pull out the brake drum (5).

(When reassembling)

- Apply liquid gasket (Three Bond 1208D or its equivalent) to face of the flange.
- Pushing the brake lever (6) as shown in the figure, tighten the brake assembly mounting screws.

■ NOTE

- **After assembling the brake assembly, be sure to adjust the brake pedal play (See page G-19).**

- (1) Fulcrum Support Assembly

- (4) External Snap Ring

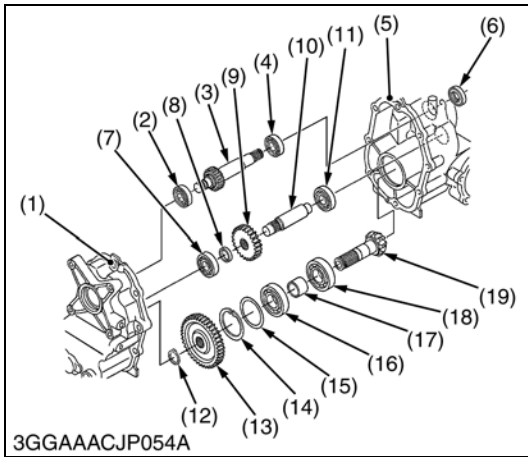
- (2) Brake Assembly

- (5) Brake Drum

- (3) Brake Assembly Mounting Screws

- (6) Brake Lever

W1031669



Brake Shaft, Idle Gear Shaft and Bevel Pinion Shaft

1. Separate the front cover (1) from the transmission case (5).
2. Remove the brake shaft assembly.
3. Remove the idle gear shaft assembly.
4. Remove the external snap ring (12).
5. Remove the bevel gear shaft assembly, noting the number of front and rear shims (15).

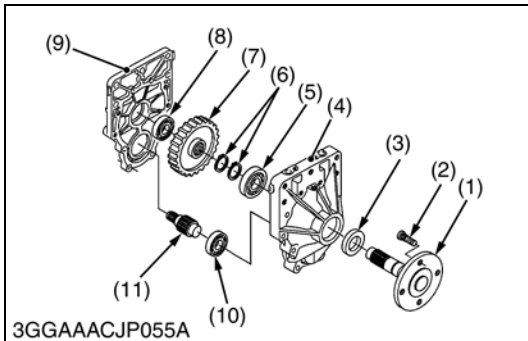
(When reassembling)

- Be sure to check the backlash between the 11T bevel gear shaft (19) and 20T bevel gear.
- Replace the oil seal with a new one.
- Apply grease to the oil seal lip, and take care that it is not rolled when installing the front cover.
- Apply liquid gasket (Three Bond 1208D or its equivalent) to the front cover.

(1) Front Cover	(11) Ball Bearing
(2) Ball Bearing	(12) External Snap Ring
(3) Brake Shaft (15T)	(13) 39T Gear
(4) Ball Bearing	(14) Internal Snap Ring
(5) Transmission Case	(15) Shim
(6) Oil Seal	(16) Ball Bearing
(7) Ball Bearing	(17) Collar
(8) Collar	(18) Ball Bearing
(9) 24T Gear	(19) 11T Bevel Gear Shaft
(10) Idle Shaft	

W1031901

(5) Disassembling Rear Axle



Rear Axle

1. Remove the rear axle cover (9).
2. Remove the 49T gear (7).
3. Remove the external snap ring (6).
4. Draw out the rear axle (1).
5. Remove the 12T gear shaft (11).

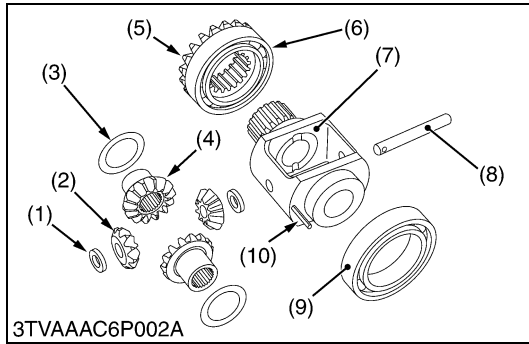
(When reassembling)

- The gauge hole is located in the left-hand rear axle cover.
- Replace the oil seals with new ones.
- Apply liquid gasket (Three Bond 1208D or its equivalent) to the rear axle cover.

(1) Rear Axle	(7) 49T Gear
(2) Wheel Bolt	(8) Ball Bearing
(3) Oil Seal	(9) Rear Axle Cover
(4) Rear Axle Case	(10) Ball Bearing
(5) Ball Bearing	(11) 12T Gear Shaft
(6) External Snap Rings	

W1032296

(6) Disassembling Differential Gear Case



Differential Gear

1. Remove the 20T spiral bevel gear (5) with ball bearing (6) and ball bearing (9) by puller.
2. Tap out the spring pin (10) from 20T bevel gear side.
3. Remove the differential pinion shaft (8).
4. Remove the differential pinions (2), differential side gears (4) and shims (1), (3).

■ NOTE

- **Arrange the parts to know their original position.**

(When reassembling)

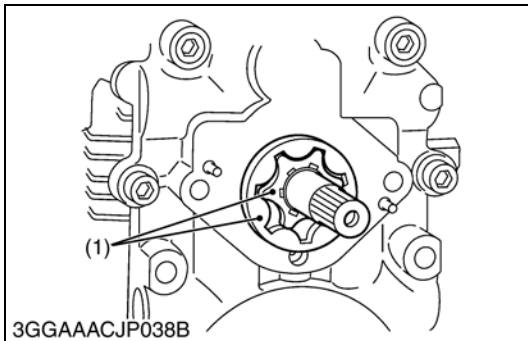
- Apply molybdenum disulfide (Three Bond 1901 or equivalent) to the inner circumferential surface of the differential side gears, differential pinions and shims.

- | | |
|----------------------------|-------------------------------|
| (1) Shim | (6) Ball Bearing |
| (2) Differential Pinion | (7) Differential Gear Case |
| (3) Shim | (8) Differential Pinion Shaft |
| (4) Differential Side Gear | (9) Ball Bearing |
| (5) 20T Spiral Bevel Gear | (10) Spring Pin |

W1032615

[3] SERVICING

(1) Hydostatic Transmission



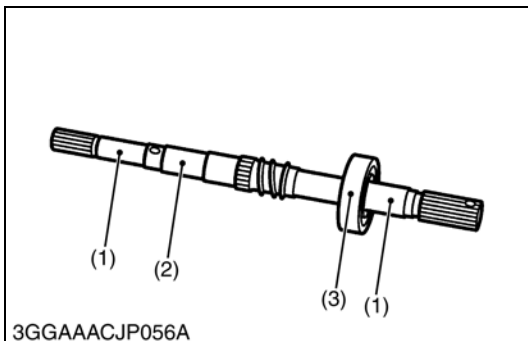
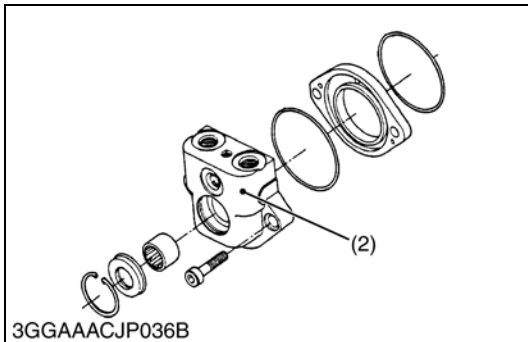
Auxiliary Pump

1. Check the charge pump housing (2) and the gerotor assembly (1) for scratches and wear.
2. If scratch or worn, replace the charge pump complete assembly.

(1) Gerotor Assembly

(2) Charge Pump Housing

W1047558



Pump Shaft and Motor Shaft

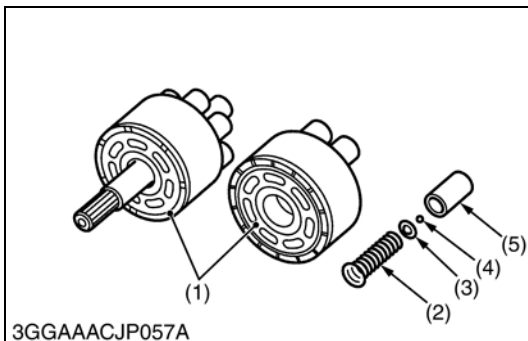
1. Check the seal surface (1), the bearing surface (2) and the ball bearing (3).
2. If the shaft is rough or groove, replace it.
3. If the ball bearing is worn, replace it.

(1) Seal Surface

(3) Ball Bearing

(2) Bearing Surface

W1033016



Cylinder Block Assembly

1. Check the cylinder blocks (1) and piston (5) for scratches and wear.
2. If scratch or worn, replace the cylinder block assembly.
3. Check that the piston (5), spring (2) spring seat (3) and ball (4) 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 of cylinder block for scoring.
7. If scored, replace the cylinder block assembly.

■ IMPORTANT

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

(1) Cylinder Block

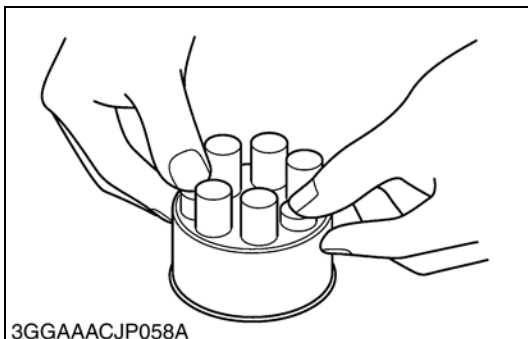
(4) Ball

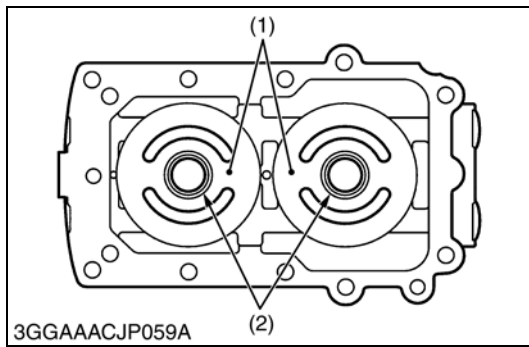
(2) Spring

(5) Piston

(3) Spring Seat

W1033158





Center Section

1. Check the surface of center section (1) for scratches and wear.
2. If scratch or wear, replace the HST assembly.
3. Check the needle bearing (2) for wear.
4. If worn, replace the needle bearing.

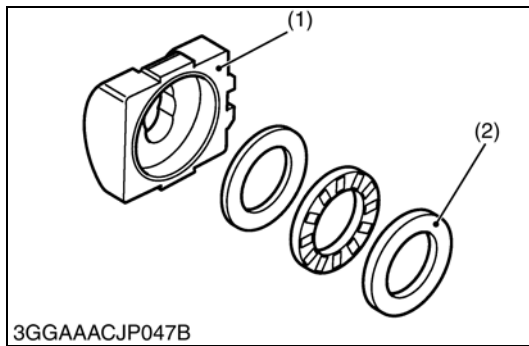
NOTE

- After checking, coat them with hydrostatic transmission fluid.

(1) Surface of Center Section

(2) Needle Bearing

W1033416



Thrust plate, Swashplate and Cradle Bearing

1. Check the thrust plate (2) for scratches and excessive wear.
2. If worn or scored, replace the thrust plate.
3. Check the piston contact face of the swashplate (1) for scratches and excessive wear.
4. If worn or scored, replace the swashplate.
5. Check the surface of the cradle bearings (3) for scratches and excessive wear.
6. If worn or scored, replace the cradle bearings.

NOTE

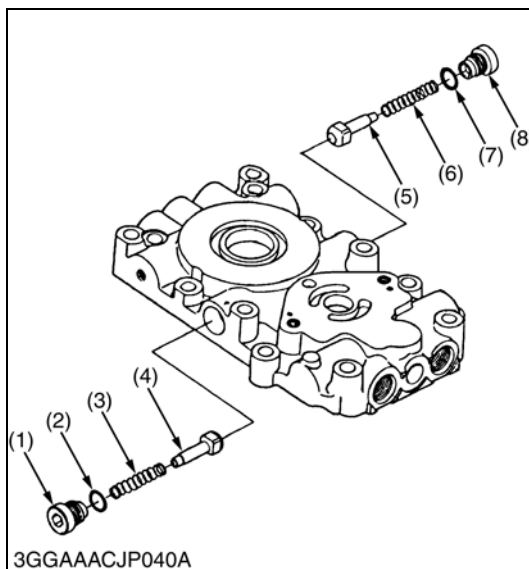
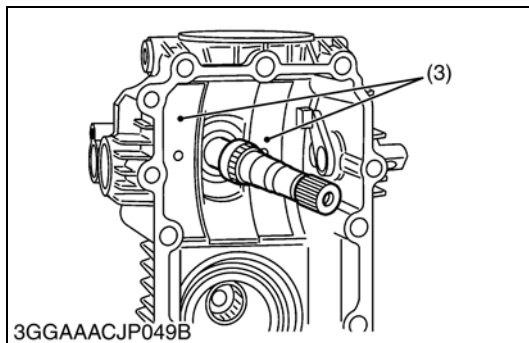
- After checking, coat them with hydrostatic transmission fluid.

(1) Swashplate

(3) Cradle Bearing

(2) Thrust Plate

W1033654



Check Valve

1. Check the check valves (4), (5) and the seat in the center section for damage.
2. Check the O-rings (2), (7) for scratches and damage.
3. Check the springs (3), (6) for breakage and wear.
4. If anything unusual, replace them.

(1) Plug

(5) Check Valve

(2) O-ring

(6) Spring

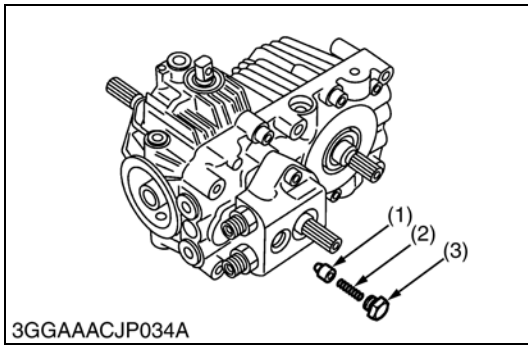
(3) Spring

(7) O-ring

(4) Check Valve

(8) Plug

W1033851



Charge Relief Valve

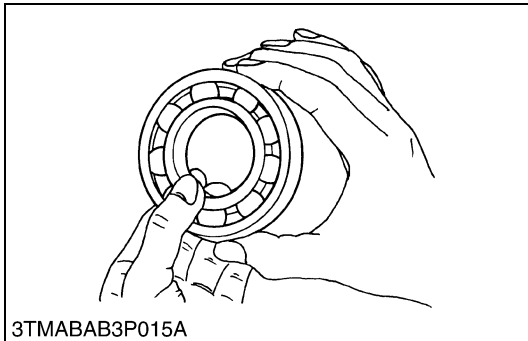
1. Check the charge relief cone and the seat in the auxiliary pump housing for damage.
2. Check the spring for breakage and wear.
3. If anything unusual, replace them.

(1) Charge Relief Cone
(2) Spring

(3) Relief Plug

W1034033

(2) Transmission

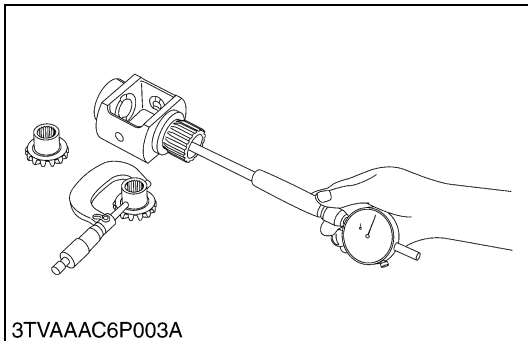


Checking Bearing

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

W1048891

(3) Differential Gear



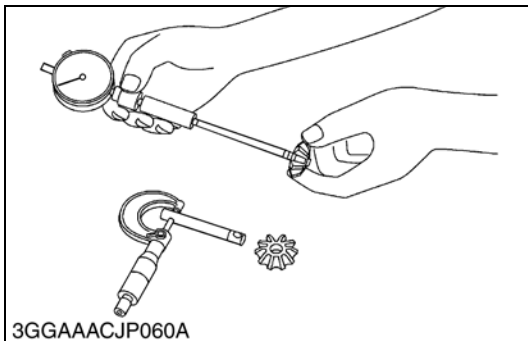
Clearance between Differential Case and Differential Side Gear

1. Measure the differential side gear boss O.D..
2. Measure the differential case bore I.D., and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace faulty parts.

Clearance between differential case and differential side gear	Factory spec.	0.040 to 0.082 mm 0.00157 to 0.00323 in.
	Allowable limit	0.17 mm 0.0067 in.

Differential case bore I.D.	Factory spec.	26.000 to 26.021 mm 1.02362 to 1.02445 in.
Differential side gear O.D.	Allowable limit	25.939 to 25.960 mm 1.02122 to 1.02205 in.

W1034423



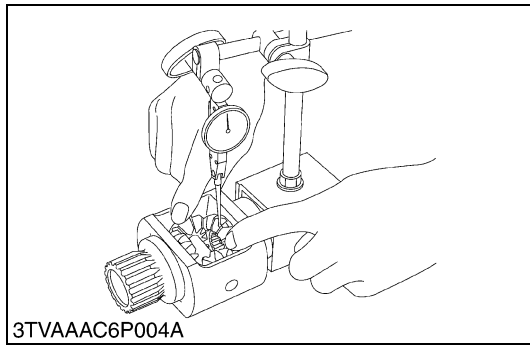
Clearance between Differential Pinion Shaft and Differential Pinion

1. Measure the differential pinion shaft O.D..
2. Measure the differential pinion I.D., and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace faulty parts.

Clearance between differential pinion shaft and differential pinion	Factory spec.	0.025 to 0.055 mm 0.00098 to 0.00216 in.
	Allowable limit	0.10 mm 0.0039 in.

Differential pinion shaft O.D.	Factory spec.	9.960 to 9.975 mm 0.39213 to 0.39272 in.
Differential pinion gear I.D.	Allowable limit	10.000 to 10.015 mm 0.39370 to 0.39429 in.

W1034586



Backlash between Differential Pinion and Differential Side Gear

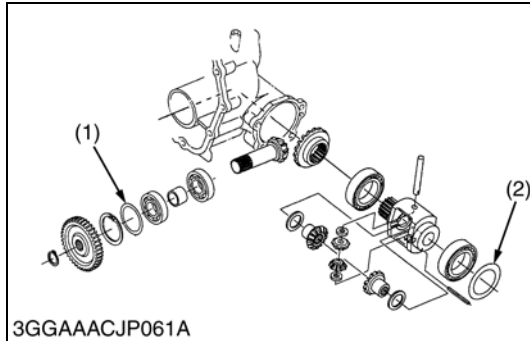
1. Set a dial gauge (lever type) on a tooth of the differential pinion.
2. Fix the differential side gear, and move the differential pinion to measure the backlash.
3. If the measurement exceeds the factory specification, adjust with the differential side gears shims.

Backlash between differential pinion and differential side gear	Factory spec.	0.10 to 0.20 mm 0.004 to 0.008 in.
---	---------------	---------------------------------------

(Reference)

- Thickness of differential side shims :
0.8 mm (0.031 in.), (Part No. : 37410-56920)
1.0 mm (0.039 in.), (Part No. : 37410-56930)
1.2 mm (0.047 in.), (Part No. : 37410-56940)
- Thickness of differential Pinion shims:
3.3 mm (0.130 in.), (Part No.: K2561-16060)
3.5 mm (0.138 in.), (Part No.: K2561-16050)
3.7 mm (0.146 in.), (Part No.: K2561-16070)
3.9 mm (0.154 in.), (Part No.: K2561-16080)
- Tooth contact : More than 35%

W1034854



Backlash between 11T Shaft Bevel Gear and 20T Bevel Gear

1. Remove the rear axle case, and place fuses between 11T shaft bevel gear and 20T bevel gear. (Several points on the circumferential)
2. Assemble the rear axle case, and turn the brake shaft.
3. Remove the rear axle case again, and take out the fuses.
4. Measure the thickness of fuses with an outside micrometer.
5. If the backlash is not within the factory specification, change the adjusting shims (1), (2).

Backlash between 11T shaft Bevel gear and 20T bevel gear	Factory spec.	0.10 to 0.30 mm 0.004 to 0.012 in.
--	---------------	---------------------------------------

(Reference)

- Thickness of adjusting shims (1) :
0.2 mm(0.008 in.),(Part No. : 66621-15240)
0.3 mm(0.012 in.),(Part No. : 67211-14990)
0.5 mm(0.020 in.),(Part No. : 66621-15250)
- Tooth contact : More than 35%
- Thickness of adjusting shims (2) :
0.8 mm(0.031 in.),(Part No. : 31353-43770)
1.0 mm(0.039 in.),(Part No. : 31353-43780)
1.2 mm(0.047 in.),(Part No. : 31353-43790)
- Put the thick shim (2) at the rear axle

(1) Shims

(2) Shims

W1035123

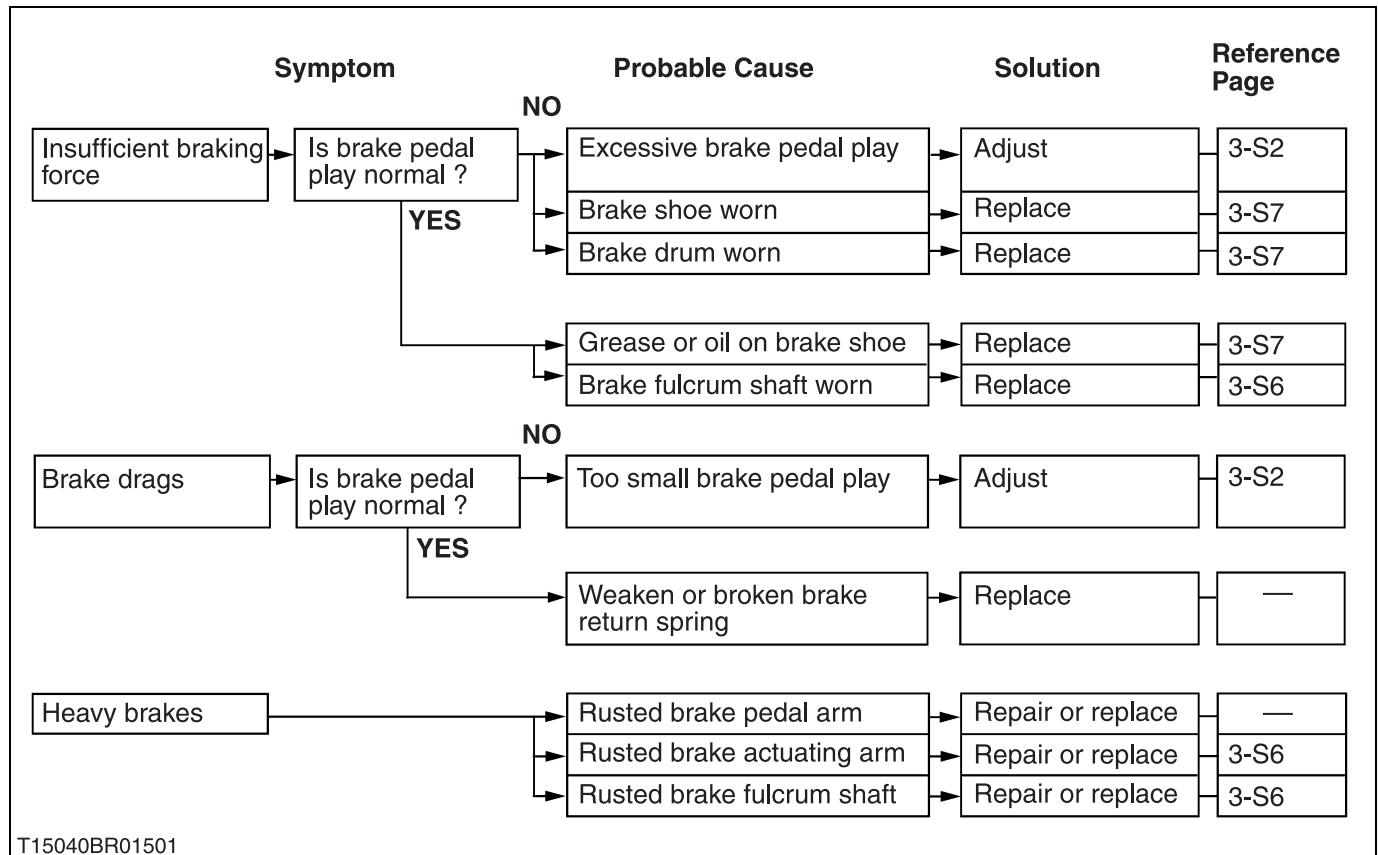
3 BRAKE

SERVICING

CONTENTS

1. TROUBLESHOOTING	3-S1
2. SERVICING SPECIFICATIONS	3-S1
3. TIGHTENING TORQUES	3-S1
4. CHECKING, DISASSEMBLING AND SERVICING.....	3-S2
[1] CHECKING AND ADJUSTING	3-S2
[2] DISASSEMBLING AND ASSEMBLING.....	3-S2
(1) Parking Brake	3-S2
(2) Brake Assembly	3-S6
[3] SERVICING	3-S7

1. TROUBLESHOOTING



2. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
Brake Spring to Plane Washer	Clearance	−1.0 to 0.0 mm −0.04 to 0.00 in.	—
Brake Lining	Thickness	9.0 mm 0.35 in.	7.5 mm 0.30 in.
Brake Drum	I.D.	81.2 to 81.4 mm 3.197 to 3.205 in.	82.0 mm 3.228 in.

W1010643

3. TIGHTENING TORQUES

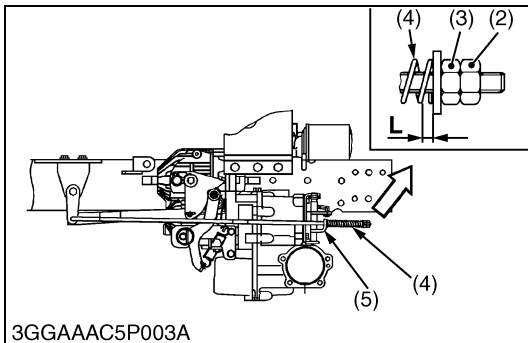
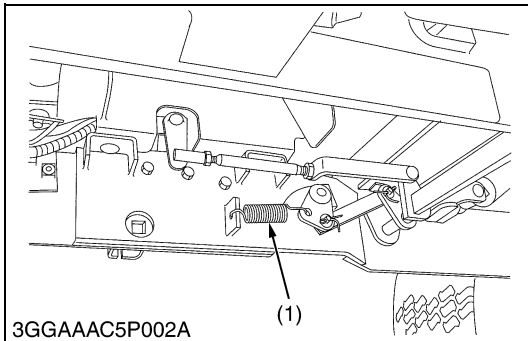
Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts : See page G-9.)

Item	N·m	kgf·m	ft-lbs
Steering wheel mounting nut	19.6 to 24.5	2.0 to 2.5	14.5 to 18.1
Cam mounting nut	39.2 to 45.1	4.0 to 4.6	28.9 to 33.3
Pedal system complete mounting screw	23.5 to 27.4	2.4 to 2.8	17.4 to 20.3

W1010769

4. CHECKING, DISASSEMBLING AND SERVICING

[1] CHECKING AND ADJUSTING



Brake Pedal Play

1. Keep the brake return spring (1) off position.
2. Keep the brake pedal in return position.
3. Gently press the tip of the transaxle's brake actuating arm (5) toward the pedal.
4. Set the brake spring (4) so as to be -1.0 to 0.0 mm (-0.04 to 0.00 in.) shorter than free length.
5. If the measurement is not within the factory specifications, adjust with the nut (3).
6. Tighten up the lock nut (2).

Clearance between brake spring and plain washer (L)	Factory spec.	-1.0 to 0.0 mm -0.04 to 0.00 in.
---	---------------	-------------------------------------

(Reference)

- Brake Pedal Play : 15 to 25 mm (0.59 to 0.98 in.)

- | | |
|-------------------------------------|---|
| (1) Brake Return Spring | (A) Forward |
| (2) Lock Nut | (L) Clearance between brake spring and plane washer |
| (3) Nut | |
| (4) Brake Spring | |
| (5) Transaxle's Brake Actuating Arm | |

W1010868

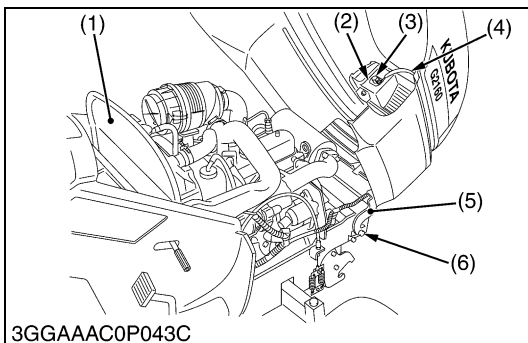
[2] DISASSEMBLING AND ASSEMBLING

(1) Parking Brake

Dismount Mower

1. See to "MOWER" section.

W1011157

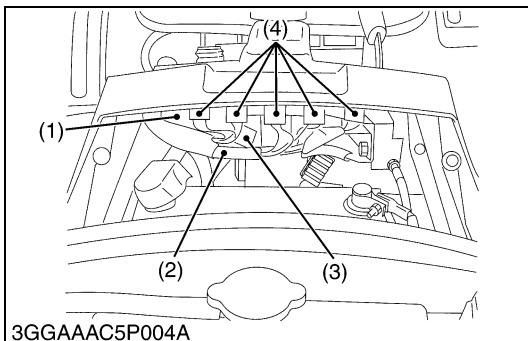


Battery and Bonnet

1. Turn the main switch off.
2. Remove the radiator screen (2)
3. Disconnect the negative cable (1) from the battery.
4. Disconnect the **1P** connectors (4) from the head light (3).
5. Remove the wiring (5) from the bonnet.
6. Remove the bonnet stay mounting screws (7), and remove the bonnet with the bonnet bracket (6) from the frame.

- | | |
|--------------------------|---------------------------------|
| (1) Negative Cable | (5) Wiring |
| (2) Radiator Screen | (6) Bonnet Bracket |
| (3) Head Light | (7) Bonnet Stay Mounting Screws |
| (4) 1P Connectors | |

W1011210

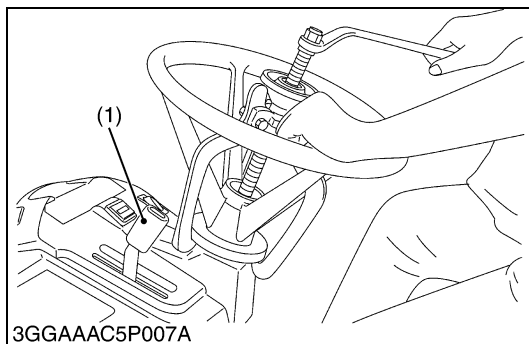
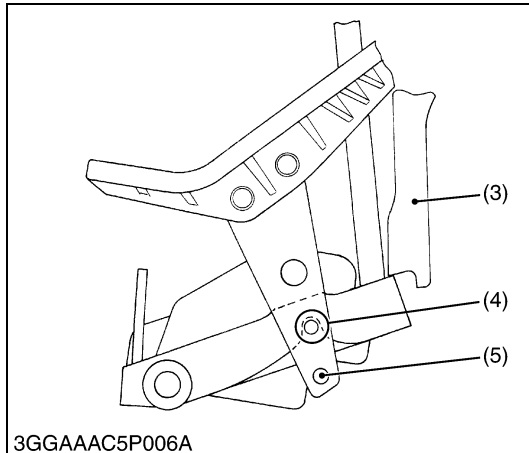
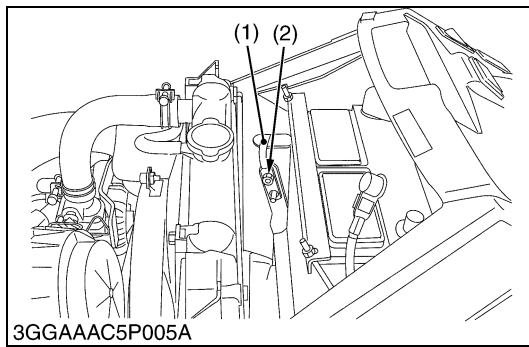


Wiring

1. Remove the indicator lamps (4).
2. Disconnect **1P** connector (3) from the hour meter.
3. Disconnect **1P** connector (1) from the light switch.
4. Disconnect **4P** connector (2) from the main switch.
5. Disconnect **P** connector (5) from the KRA system switch.

- | | |
|-------------------------|------------------------|
| (1) 1P Connector | (4) Indicator Lamps |
| (2) 4P Connector | (5) P connector |
| (3) 1P Connector | |

W1011427



Parking Lock Pedal

1. Remove the parking lock pedal mounting nut (2).
2. Remove the parking lock pedal (1) from the brake lock.

(When reassembling)

■ IMPORTANT

- Using the oval hole, make such adjustment that the parking lock pedal be kept out of contact with the panel over the entire stroke.
- Step on the brake pedal and parking lock pedal at once, and make sure that the speed change pedal gets locked.
- If the speed change pedal fails to get locked, set this pedal to the neutral position and readjust the brake lock (3) so that the lock pin (5) comes into the notch (4).

- | | |
|-------------------------------------|--------------|
| (1) Parking Lock Pedal | (4) Notch |
| (2) Parking Lock Pedal Mounting Nut | (5) Lock Pin |
| (3) Brake Lock | |

W1011595

Steering Wheel

1. Remove the grip of the throttle lever (1).
2. Remove the steering pad and remove the steering wheel mounting nut.
3. Remove the steering wheel using the steering wheel puller (Code, No. 07916-51090) and steering wheel puller adaptor (See page G-40.)

■ IMPORTANT

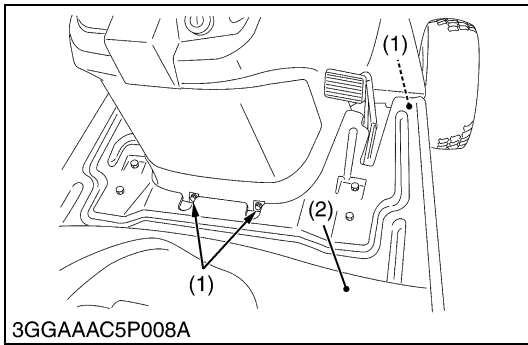
- When removing steering wheel, use steering wheel puller. Do not use the hammer to prevent electric power steering from damaging.
- Remove the steering wheel after setting it to the straight-ahead position.

(When reassembling)

Tightening torque	Steering wheel mounting nut	19.6 to 24.5 N·m 2.0 to 2.5 kgf·m 14.5 to 18.1 ft-lbs
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- (1) Throttle Lever

W1011912



Separating Panel

1. Remove the speed change pedal.
2. Peel the step sheet (2) halfway.
3. Remove the panel mounting screws (1).
4. Separate the panel (3).

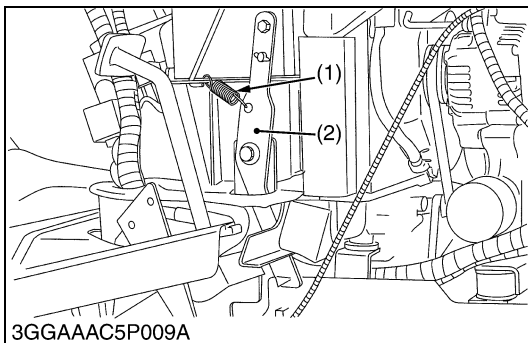
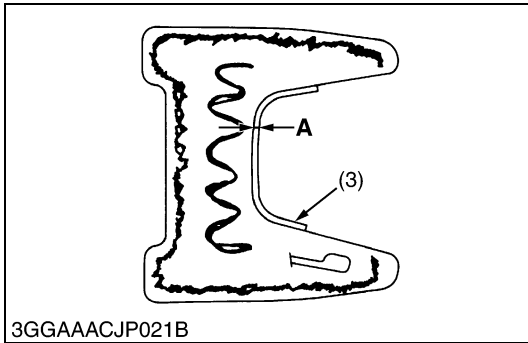
(When reassembling)

- Clean up the step sheet and the step. Apply instantaneous adhesive on the step sheet as shown in the figure.
- Position the step sheet so that the clearance between the step sheet and the panel is less than 2.0 mm (0.079 in.) as shown in the figure.

- (1) Panel Mounting Screw
(2) Step Sheet
(3) Panel

(A) Less than 2.0 mm (0.079 in.)

W1012197



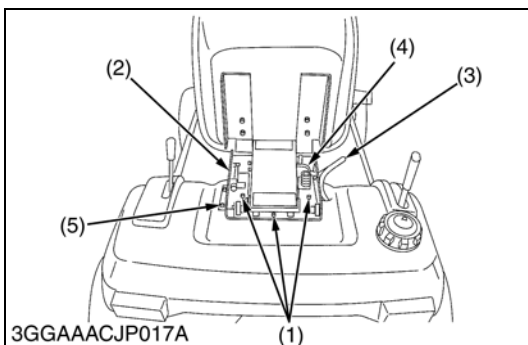
Brake Lock

1. Remove the parking lock spring (1).
2. Remove the brake lock (2).

- (1) Parking Lock Spring

- (2) Brake Lock

W1012574



Seat

1. Disconnect the **2P** connector (3) from the seat switch.
2. Remove the seat support mounting lock nuts (1).
3. Remove the guide washers, spring washers and screws (4).
4. Remove the seat with seat support (5).
5. Remove the seat bracket (2).

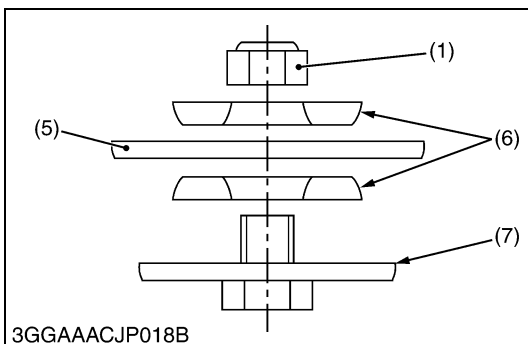
(When reassembling)

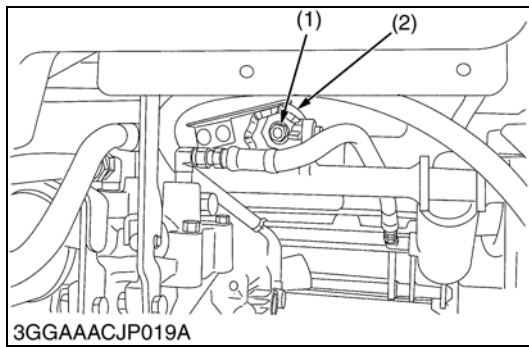
- Turn the seat support mounting lock nuts all the way until it seats lightly.
Then, turn seat support mounting lock nuts counterclockwise by a half turn.
- Apply oil to the seat support.
- Face smooth side the plane washers (6) to the seat support.

- (1) Seat Support Mounting Lock Nuts
(2) Seat Bracket
(3) **2P** Connector
(4) Screws

- (5) Seat Support
(6) Plane Washers
(7) Fender

W1012683





Cutting Height Adjusting Dial

1. Lift the mower to the highest position.
2. Remove the cam mounting nut (1).
3. Remove the cutting height adjusting dial, plane washer and cam (2).

(When reassembling)

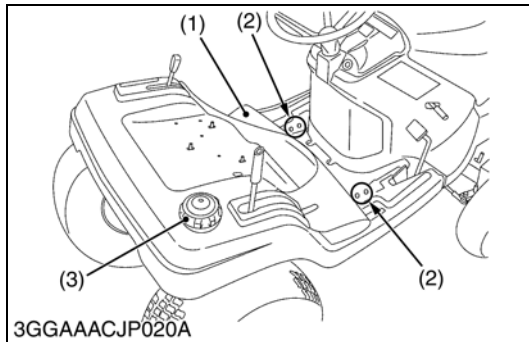
- Apply grease to the outside of cam.

Tightening torque	Cam mounting nut	39.2 to 45.1 N·m 4.0 to 4.6 kgf·m 28.9 to 33.3 ft-lbs
-------------------	------------------	---

(1) Cam Mounting Nut

(2) Cam

W1012925



Separating Fender

1. Remove the speed change pedal.
2. Peel the step sheet (1) halfway.
3. Remove the step support mounting screws (2).
4. Remove the step support (4) and rubber bushing (5).
5. Remove the fuel cap (3).
6. Separate the fender from the frame.

(When reassembling)

- Apply grease to the inside of rubber bushing.

(1) Step Sheet

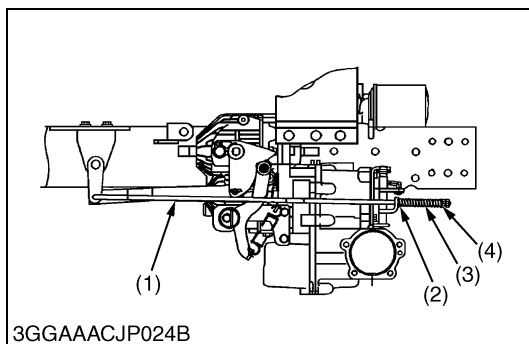
(4) Step Support

(2) Step Support Mounting Screw

(5) Rubber Bushing

(3) Fuel Cap

W1013181



Brake Spring and Brake Rod 1

1. Remove the lock nut, nut and plane washers (2), (4).
2. Remove the brake spring (3).
3. Pull out the cotter pin.
4. Remove the brake rod 1 (1).

(When reassembling)

■ IMPORTANT

- After assembling the brake rod and brake spring, be sure to adjust the brake pedal play. (See page 3-S2).

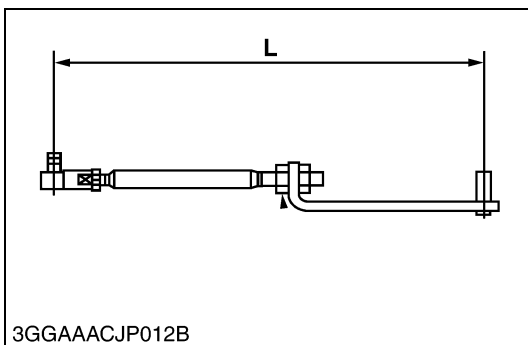
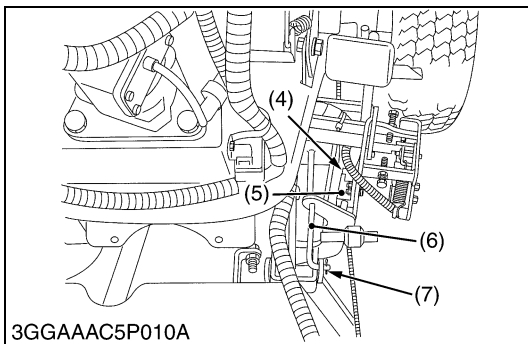
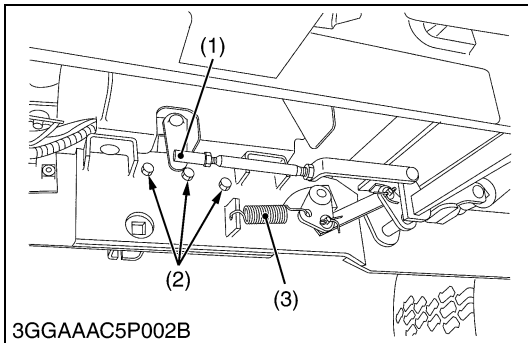
(1) Brake Rod 1

(3) Brake Spring

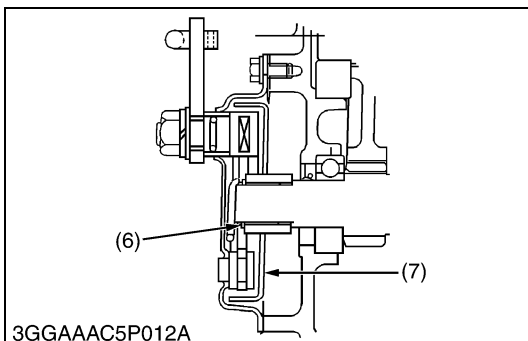
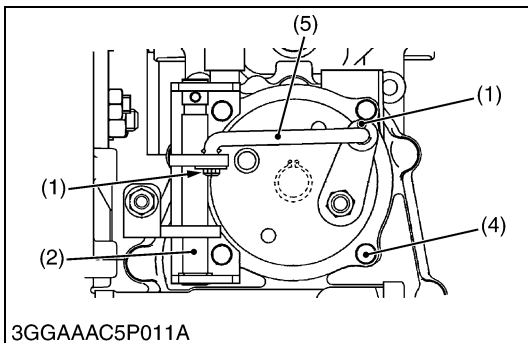
(2) Plane Washer

(4) Plane Washer

W1013398



(2) Brake Assembly



Separating Pedal System Complete

1. Remove the return spring (3).
2. Pull out the cotter pin (7).
3. Remove the brake rod 2 (6) and plain washer.
4. Disconnect **4P** connector (5) from the brake switch (4).
5. Remove the wiring from the pedal system complete.
6. Disconnect the speed change rod (1) from the lever of the pedal system complete.
7. Remove the pedal system complete mounting screws (2).
8. Remove the pedal system complete.

(When reassembling)

■ IMPORTANT

- Apply grease to the fulcrum of the pedal system complete.
- Adjust the clearance to be between the brake switch and brake pedal at off position.

PEDAL	BRAKE SWITCH
OFF (FREE)	OFF
ON (DEPRESSED)	ON

- After assembling the speed change rod, be sure to adjust the length of rod. (See page 2-S5.)

(Reference)

- L : 300 mm (11.8 in.)

Tightening torque	Pedal system complete mounting screw	23.5 to 27.4 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
-------------------	--------------------------------------	---

- | | |
|---|-------------------------|
| (1) Speed Change Rod | (4) Brake Switch |
| (2) Pedal System Complete Mounting Screws | (5) 4P Connector |
| (3) Return Spring | (6) Brake Rod 2 |
| | (7) Cotter Pin |

W1013572

Separating Brake Assembly

1. Pull out the cotter pins (1).
2. Remove the brake rod 3 (5).
3. Remove the brake assembly mounting screws (4).
4. Remove the brake assembly (3) and fulcrum support assembly (2).
5. Remove the external snap ring (6).
6. Pull out the brake drum (7).

(When reassembling)

- Apply liquid gasket (Three Bond 1208D or its equivalent) to face of the flange.
- Pushing the brake lever as shown in the figure, tighten the brake assembly mounting screws.

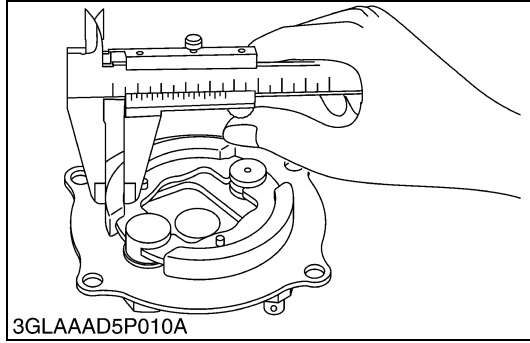
■ NOTE

- After assembling the brake assembly, be sure adjust the brake pedal play (See page 3-S2).

- | | |
|------------------------------------|------------------------|
| (1) Cotter Pins | (5) Brake Rod 3 |
| (2) Fulcrum Support Assembly | (6) External Snap Ring |
| (3) Brake Assembly | (7) Brake Drum |
| (4) Brake Assembly Mounting Screws | |

W1014378

[3] SERVICING



Brake Lining Wear

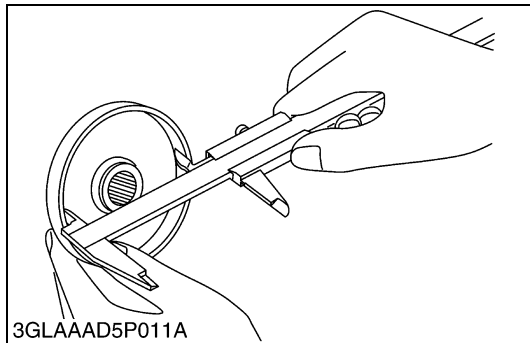
1. Measure the brake lining thickness with vernier caliper.
2. If the measurement is less than the allowable limit, replace the brake shoes.

Brake lining thickness	Factory spec.	9.0 mm 0.35 in.
	Allowable limit	7.5 mm 0.30 in.

■ **NOTE**

- If the lining is carbonized or soaked with oil, replace the shoes.

W1014697



Brake Drum Wear

1. Measure the brake drum I.D. with vernier caliper.
2. If the measurement exceeds the allowable limit, replace it.

Brake drum I.D.	Factory spec.	81.2 to 81.4 mm 3.197 to 3.205 in.
	Allowable limit	82.0 mm 3.228 in.

W1014861

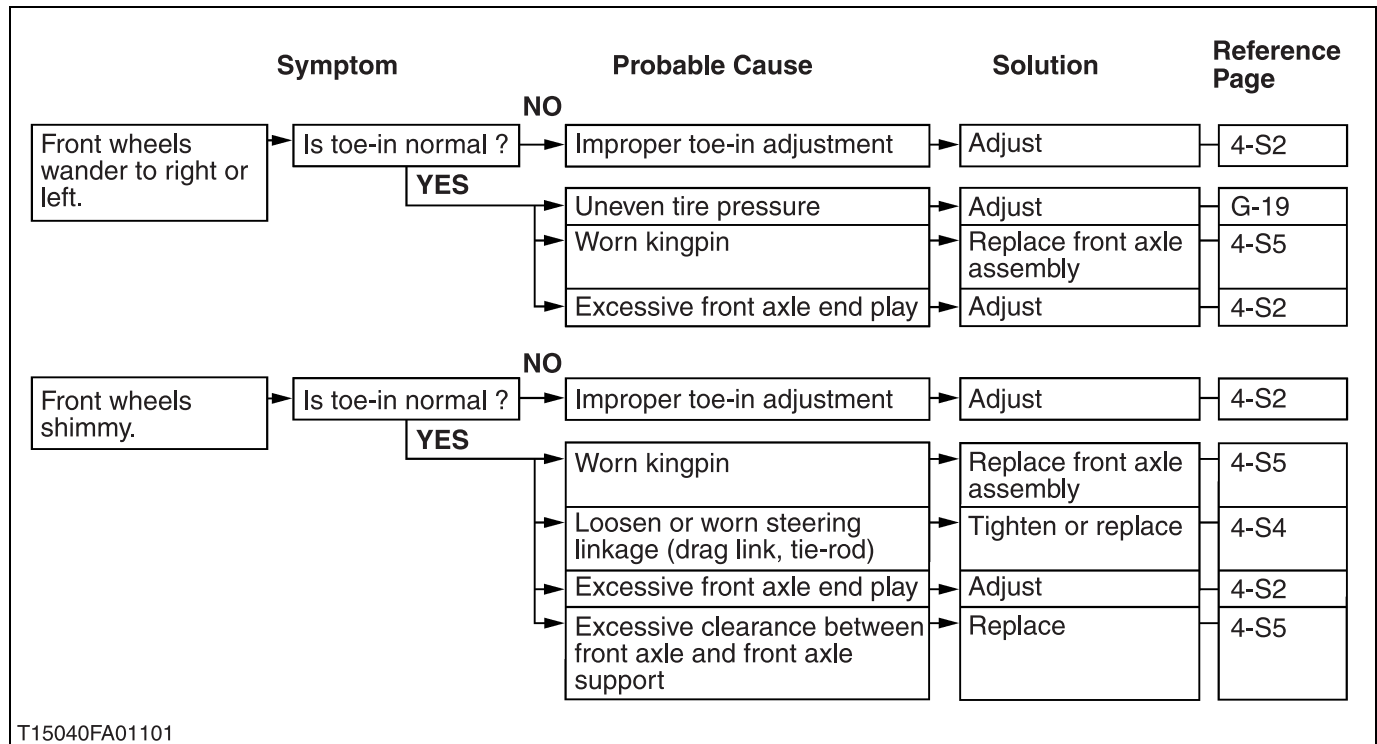
4 FRONT AXLE

SERVICING

CONTENTS

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

1. TROUBLESHOOTING



2. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
Front Wheel Alignment	Toe-in	0 to 10 mm 0 to 0.394 in.	—
Front Axle	End Play	0.1 to 0.4 mm 0.004 to 0.016 in.	1.0 mm 0.039 in.
Front Axle to Front Axle Support	Clearance	0.025 to 0.089 mm 0.00098 to 0.00350 in.	0.30 mm 0.0118 in.
Front Axle	I.D.	40.000 to 40.039 mm 1.57480 to 1.57634 in.	—
Front Axle Support	O.D.	39.950 to 39.975 mm 1.57283 to 1.57382 in.	—

W1013874

3. TIGHTENING TORQUES

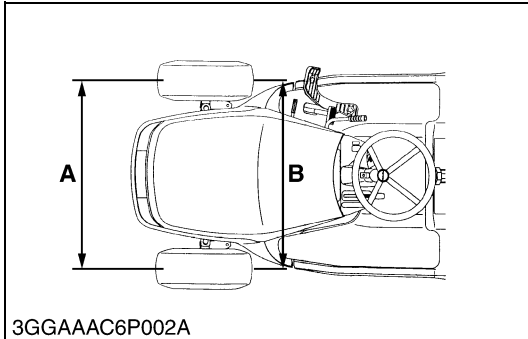
Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts : See page G-9.)

Item	N·m	kgf·m	ft-lbs
Rod end mounting nut	108.8 to 130.3	11.1 to 13.3	80.3 to 96.2
Front axle support mounting screws	48.0 to 55.9	4.9 to 5.7	35.4 to 41.2
Tie-rod mounting lock nut	45.1 to 55.9	4.6 to 5.7	33.4 to 41.2
Knuckle arm mounting bolt	48.0 to 55.9	4.9 to 5.7	35.4 to 41.2

W1010938

4. CHECKING, DISASSEMBLING AND SERVICING

[1] CHECKING AND ADJUSTING



Toe-in

1. Inflate the front tires to the specified pressure.
2. Turn the front wheels straight ahead, and measure the toe-in (B-A).
3. If the measurement is not within the factory specifications, change the tie-rod length to adjust.

Toe-in (B-A)	Factory spec.	0 to 10 mm 0 to 0.394 in.
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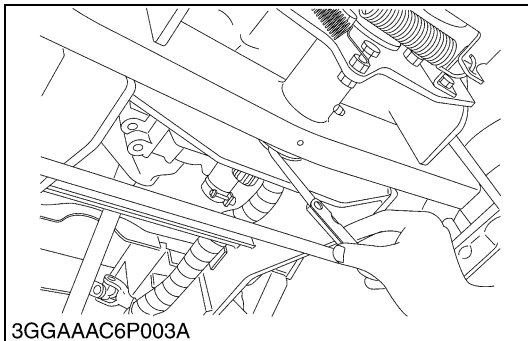
■ IMPORTANT

- After adjusting the toe-in, secure the tie-rod with the lock nut.

(A) Wheel to Wheel Distance at Front

(B) Wheel to Wheel Distance at Rear

W1011030



Front Axle End Play

1. Jack up the front of frame.
2. Measure the clearance between the front axle (1) and adjusting shims (2).
3. If the measurement exceeds the allowable limit, replace the adjusting shims (2).

Front axle end play	Factory spec.	0.1 to 0.4 mm 0.004 to 0.016 in.
	Allowable limit	1.0 mm 0.039 in.

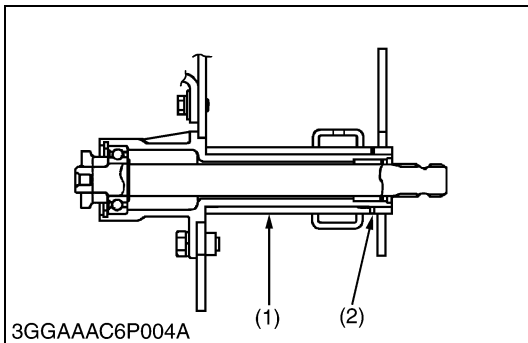
(Reference)

- Thickness of adjusting shims:
 - 1.5 mm (0.059 in.) (Part No. K1310-1512-0)
 - 1.9 mm (0.075 in.) (Part No. K1310-1513-0)
 - 2.3 mm (0.091 in.) (Part No. K1310-1514-0)
 - 3.0 mm (0.118 in.) (Part No. K1310-1515-0)

(1) Front Axle

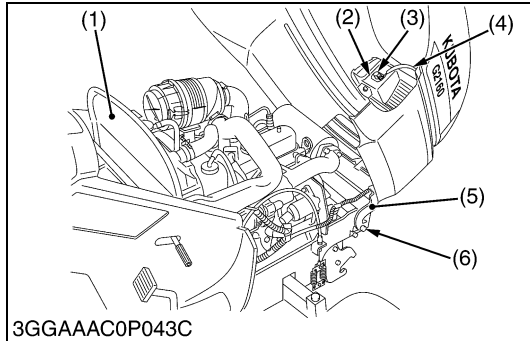
(2) Adjusting Shims

W1011222



[2] DISASSEMBLING AND ASSEMBLING

(1) Separating Front Axle Assembly



Dismount Mower

1. See to "MOWER" section.

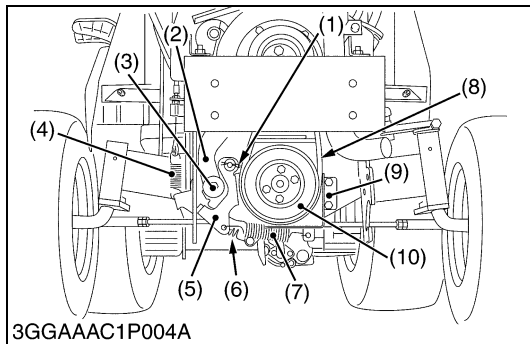
W1011444

Battery and Bonnet

1. Turn the main switch off.
2. Remove the radiator screen (2).
3. Disconnect the negative cable (1) from the battery.
4. Disconnect the **1P** connectors (4) from the head light (3).
5. Remove the wiring (5) from the bonnet.
6. Remove the bonnet stay mounting screws (7), and remove the bonnet with the bonnet bracket (6) from the frame.

- | | |
|--------------------------|---------------------------------|
| (1) Negative Cable | (5) Wiring |
| (2) Radiator Screen | (6) Bonnet Bracket |
| (3) Head Light | (7) Bonnet Stay Mounting Screws |
| (4) 1P Connectors | |

W1011497



Front Cover and PTO Assembly

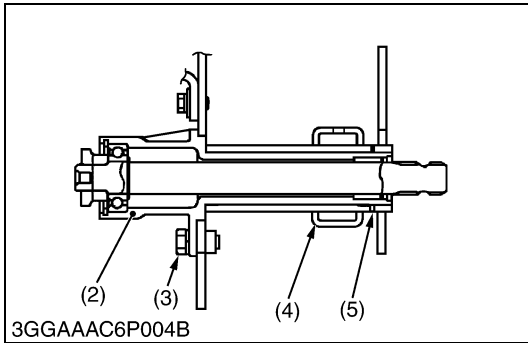
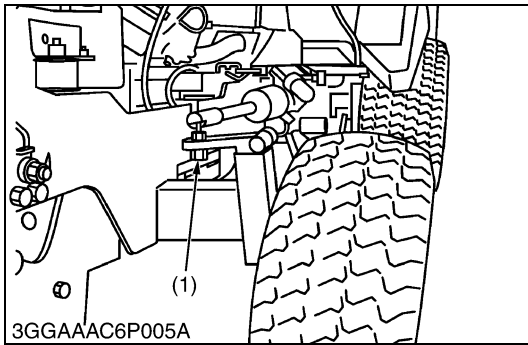
1. Remove the front PTO cover.
2. Remove the PTO clutch spring (4), brake spring (7) and return spring (6).
3. Remove the belt stay (9).
4. Remove the pulley (10).
5. Remove the front PTO belts (8).
6. Remove the cotter pin and flange bolt (3).
7. Pull out the PTO brake assembly (5) and tension arm (2) with tension pulley.

(When reassembling)

- Apply grease to the tension arm bushings and the PTO brake bushing.
- After reassembling the PTO clutch spring, be sure to adjust the front PTO belt tension. (See page 7-S3.)
- After reassembling the belt stay, be sure to adjust the clearance between the belt stay and front PTO belt. (See page 7-S4.)
Clearance (L): 1.0 to 2.5 mm (0.04 to 0.10 in.)

- | | |
|------------------------|---------------------|
| (1) Cotter Pin | (6) Return Spring |
| (2) Tension Arm | (7) Brake Spring |
| (3) Flange Bolt | (8) Front PTO Belts |
| (4) PTO Clutch Spring | (9) Belt Stay |
| (5) PTO Brake Assembly | (10) Pulley |

W1011729



Separating Front Axle Assembly

1. Remove the rod end mounting nut (1).
2. Support the frame with jacks.
3. Remove the front axle support mounting screws (3).
4. Draw out the front axle support assembly (2) forward.
5. Separate the front axle assembly (4), noting the adjusting shims (5) between the frame and front axle assembly (4).

(When reassembling)

- Be sure to install the adjusting shims.
- After reassembling the front axle assembly, inject grease until it comes out.
- Replace the rod end mounting nut with a new one.

■ IMPORTANT

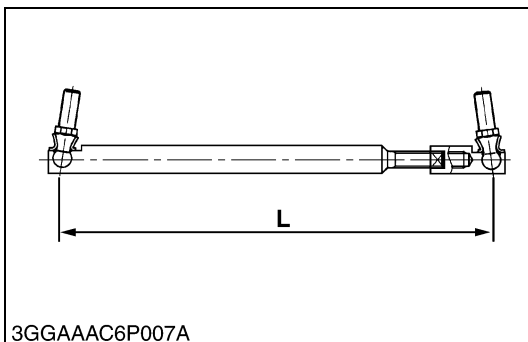
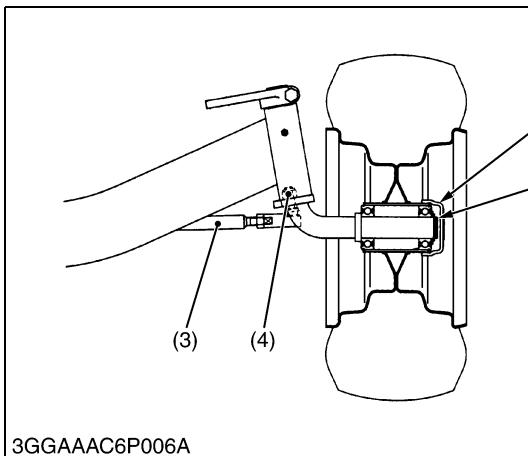
- After assembling the front axle assembly, be sure to adjust the toe-in.

Tightening torque	Rod end mounting nut	108.8 to 130.3 N·m 11.1 to 13.3 kgf·m 80.3 to 96.2 ft-lbs
	Front axle support mounting screws	48.0 to 55.9 N·m 4.9 to 5.7 kgf·m 35.4 to 41.2 ft-lbs

- (1) Rod End Mounting Nut (4) Front Axle Assembly
(2) Front Axle Support Assembly (5) Shims
(3) Front Axle Support Mounting Screws

W1012044

(2) Disassembling Front Axle



Front Wheel and Tie Rod

1. Remove the front wheel cap (1).
2. Remove the external snap ring and plane washer (2).
3. Remove the front wheels.
4. Remove the tie-rod mounting lock nuts (4).
5. Remove the tie-rod (3).

(When reassembling)

- Replace the tie-rod mounting lock nut with a new one.

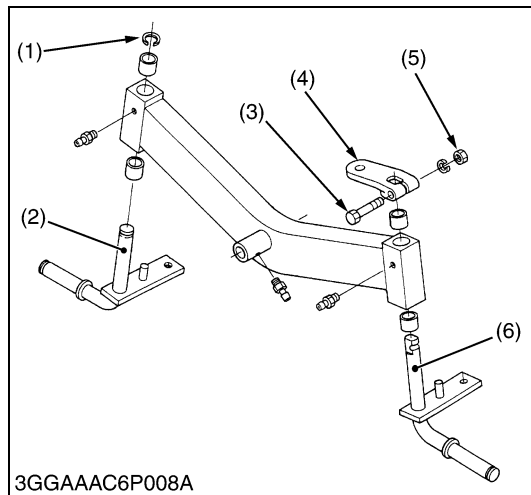
(Reference)

- L : 584 mm (23.1 in.)

Tightening torque	Tie-rod mounting lock nut	45.1 to 55.9 N·m 4.6 to 5.7 kgf·m 33.4 to 41.2 ft-lbs
-------------------	---------------------------	---

- (1) Front Wheel Cap (3) Tie-rod
(2) External Snap Ring and Plane Washer (4) Tie-rod Mounting Lock Nut

W1012423



Knuckle Arm and Kingpin

1. Remove the knuckle arm mounting bolt (3), spring washer and nut (5).
2. Remove the knuckle arm (4) and the kingpin (L.H.) (6).
3. Remove the external snap ring (1) and kingpin (R.H.) (2).

(When reassembling)

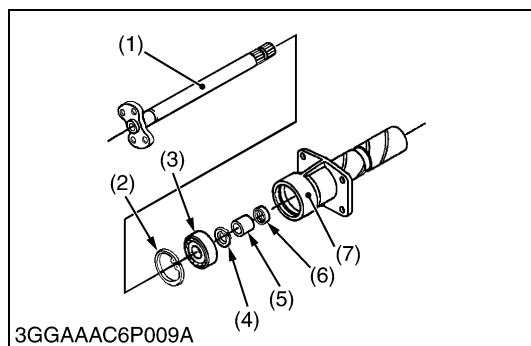
- Apply grease to the kingpins.

Tightening torque	Knuckle arm mounting bolt	48.0 to 55.9 N·m 4.9 to 5.7 kgf·m 35.4 to 41.2 ft-lbs
-------------------	---------------------------	---

- | | |
|-------------------------------|------------------------------|
| (1) External Snap Ring | (4) Knuckle Arm |
| (2) Kingpin (R.H.) | (5) Knuckle Arm Mounting Nut |
| (3) Knuckle Arm Mounting Bolt | (6) Kingpin (L.H.) |

W1012736

(3) Disassembling Front Axle Support Assembly



Front Axle Support Assembly

1. Remove the internal snap ring (2).
2. Tap out the PTO shaft (1) forward.

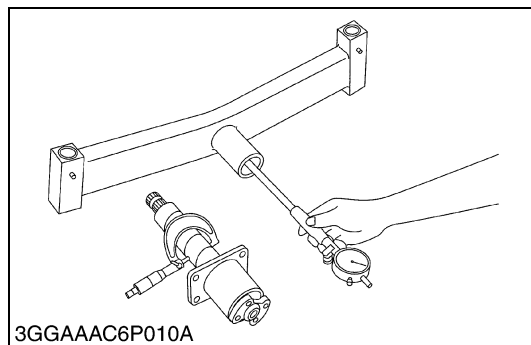
(When reassembling)

- Replace the oil seal with a new one.
- Apply grease to the oil seal lip, and take care that it is not rolled when installing the PTO shaft.

- | | |
|------------------------|------------------------|
| (1) PTO Shaft | (5) Needle Bearing |
| (2) Internal Snap Ring | (6) Oil Seal |
| (3) Ball Bearing | (7) Front Axle Support |
| (4) External Snap Ring | |

W1013054

[3] SERVICING



Clearance between Front Axle and Front Axle Support

1. Measure the front axle I.D. with a cylinder gauge.
2. Measure the front axle support O.D. with an outside micrometer, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace them.

Clearance between front axle and front axle support	Factory spec.	0.025 to 0.089 mm 0.00098 to 0.00350 in.
	Allowable limit	0.30 mm 0.0118 in.

Front axle I.D.	Factory spec.	40.000 to 40.039 mm 1.57480 to 1.57634 in.
Front axle support O.D.	Factory spec.	39.950 to 39.975 mm 1.57283 to 1.57382 in.

W1013254

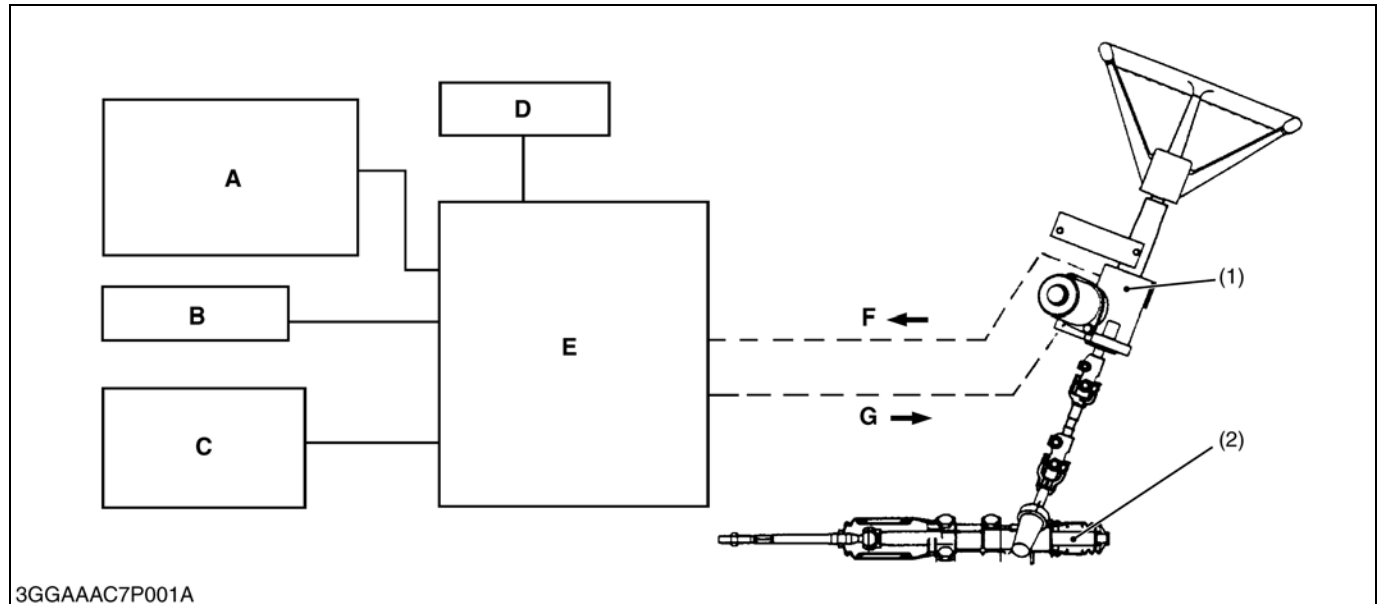
5 STEERING

MECHANISM

CONTENTS

1. SYSTEM CONFIGURATION	5-M1
2. CONSTRUCTION AND FUNCTION OF MAIN COMPONENTS	5-M2
[1] POWER STEERING ASSEMBLY	5-M2
(1) Construction of Power Steering Assembly	5-M2
(2) Torque Sensor	5-M3
(3) Motor	5-M4
[2] EPS CONTROLLER	5-M5
(1) Basic Control	5-M5
(2) Fool Proof	5-M5
(3) Failure Diagnosis Function	5-M6

1. SYSTEM CONFIGURATION



- (1) Power Steering Assembly
(2) Power Steering Gear Case

A : Engine Revolution Signal
(Oil Switch)
B : Warning Lamp
C : Connector for Servicing

D : Battery
E : EPS Controller
F : Steering Torque Signal
G : Motor Driving Current

The steering system employs an electric power steering (EPS). The EPS system has recently been developed as an alternative to the hydrostatics power steering system. In this system, an electric motor is used to reduce the power necessary for steering. As compared with the hydrostatics power steering, the electric power steering has the following features.

1. Eliminating the need for using a hydraulic pump, it is an electric-power-saving system in which the motor is energized only when the steering wheel is operated. Therefore it causes no engine power loss, enhancing fuel economy.
2. Needing no hydraulic pump or tank, it is light and compact.

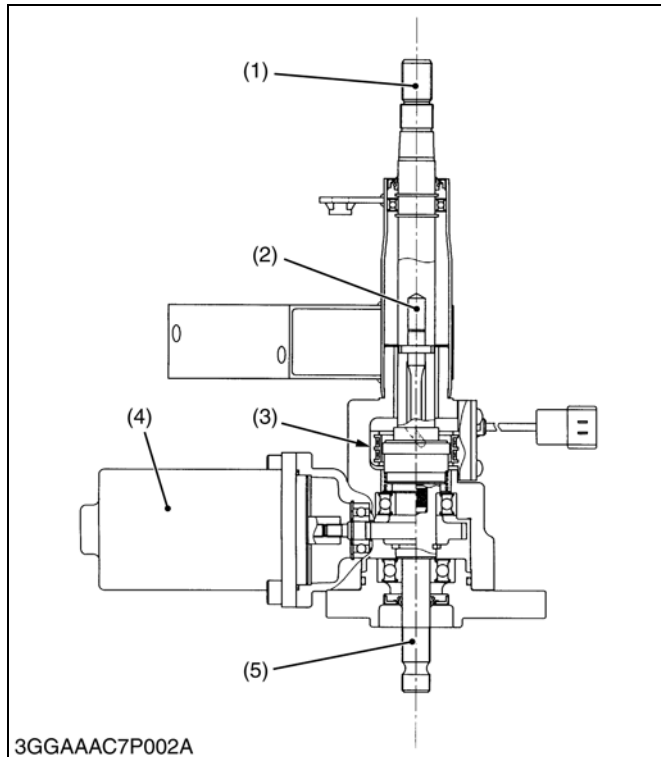
The three main components of the electric power steering are a power steering assembly, EPS controller and power steering gear case.

W1013078

2. CONSTRUCTION AND FUNCTION OF MAIN COMPONENTS

[1] POWER STEERING ASSEMBLY

(1) Construction of Power Steering Assembly



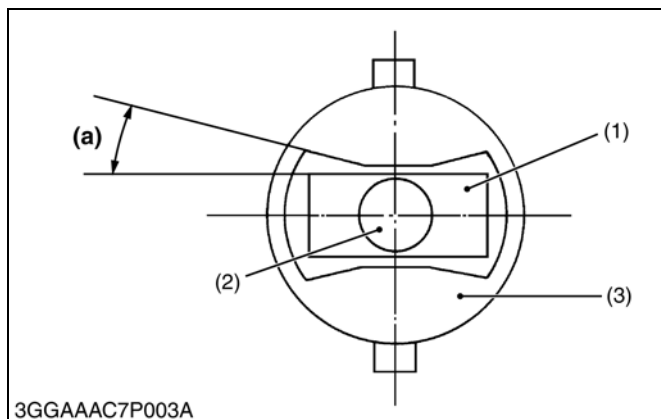
The power steering assembly is mainly composed of an input shaft (1), output shaft (in the gear case side) (5), torsion bar (2) for connecting these shafts, torque sensor (3) for detecting the twisting of the torsion bar, and motor (4) for generating assisting power. A stopper is provided for the input shaft (1) and output shaft (5) in order to prevent twisting beyond setting at the time of steering.

If the torsion bar (2) should be damaged, steering can be performed with the steering wheel attached as it is.

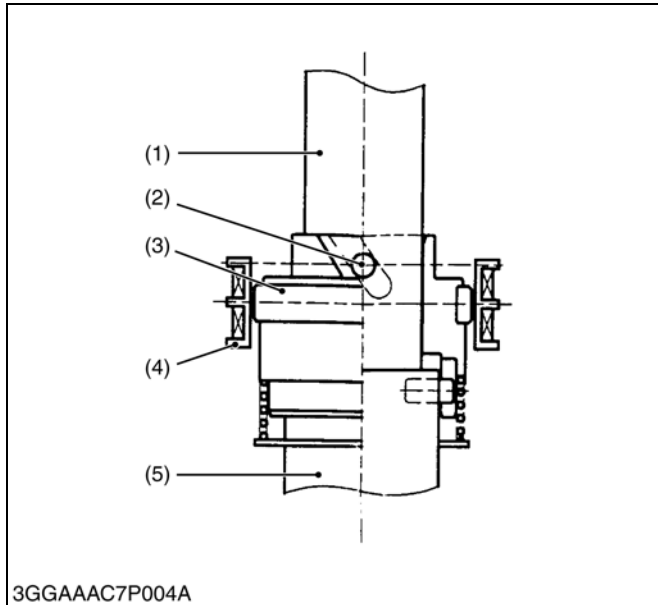
- (1) Input Shaft
- (2) Torsion Bar
- (3) Torque sensor
- (4) Motor
- (5) Output shaft

(a) Torsion bar maximum twisting angle

W1013131



(2) Torque Sensor



■ Construction

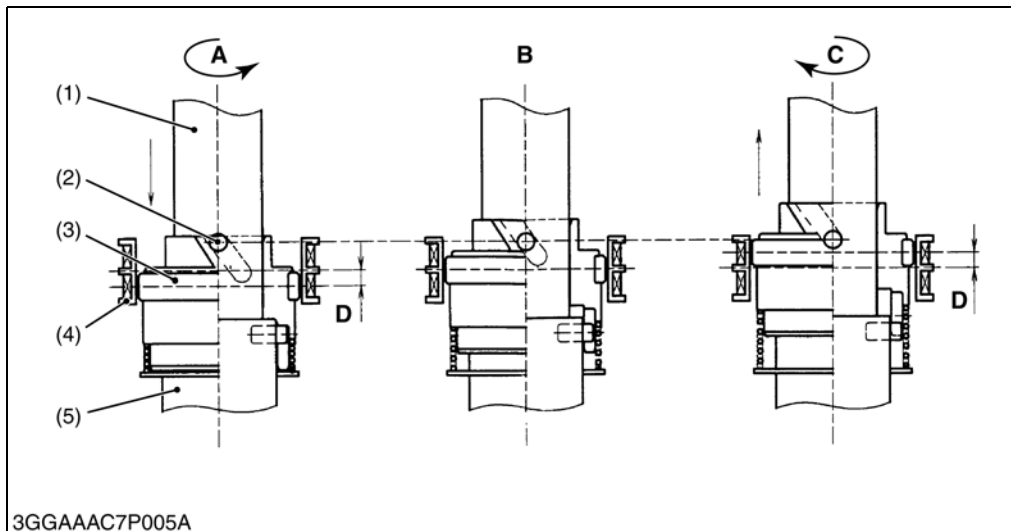
The torque sensor senses the steering power and rotating direction, convert them into a voltage signal and outputs the signal to the EPS controller. The torque sensor section is composed of a slider (3), detecting ring and detecting coil (4) (slider and detecting ring are combined). The slider (3) is held by the slider pin (2) connected to the input shaft (1) and output shaft (5).

A thread groove and longitudinal groove (in the axial direction) are provided on the inside of the slider. The relative change of the rotating direction of the input shaft (1) and output shaft (5) is converted into a movement in the slider axial direction.

- | | |
|-----------------|---------------------------------------|
| (1) Input shaft | (4) Detecting Ring and Detecting Coil |
| (2) Slider Pin | (5) Output Shaft |
| (3) Slider | |

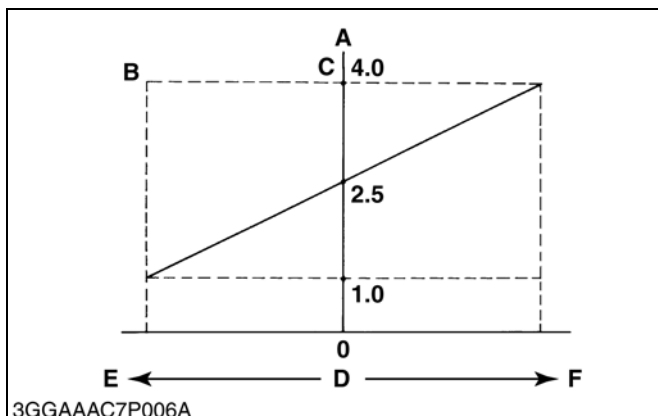
W1013290

■ Operation



- | | |
|---------------------------------------|--|
| (1) Input Shaft | A : Steering wheel turned counterclockwise |
| (2) Slider Pin | B : Steering wheel in neutral position |
| (3) Slider | C : Steering wheel turned clockwise |
| (4) Detecting Ring and Detecting Coil | D : 1 mm (0.04 in.) |
| (5) Output Shaft | |

W1013543

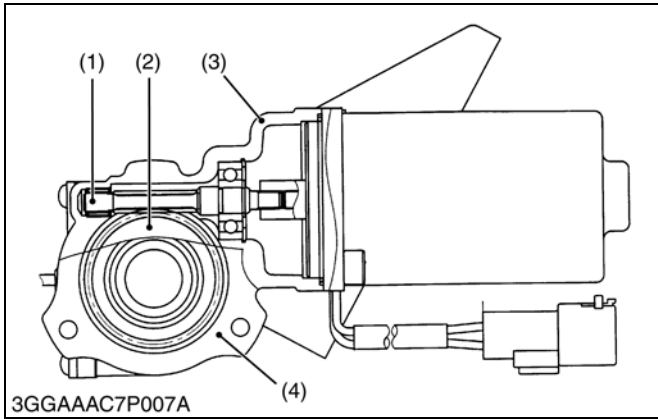


When a torsion torque is generated via the torsion bar between the input shaft (1) and output shaft (5) as a result of the steering wheel being turned, the input-shaft-side slider pin moves along the thread groove of the slider and makes the slider shift in the axial direction. The slider shifting direction and distance are detected as the amount of electrical change between the detecting ring and detecting coil and transmitted to the EPS controller.

- | | |
|--------------------------|------------------------|
| A : Torque Sensor Output | D : Steering Direction |
| B : Output Voltage (V) | E : Left |
| C : Voltage | F : Right |

W1013984

(3) Motor



The motor is installed on the steering column (4). It is composed of a worm gear (1) and direct current motor (3). The worm gear (1) is engaged with the helical gear of the worm wheel (2), reducing and transmitting the motor revolution to the worm wheel.

- | | |
|--------------------------------|--------------------------|
| (1) Worm Gear | (3) Direct Current Motor |
| (2) Helical Gear of Worm Wheel | (4) Steering Column |

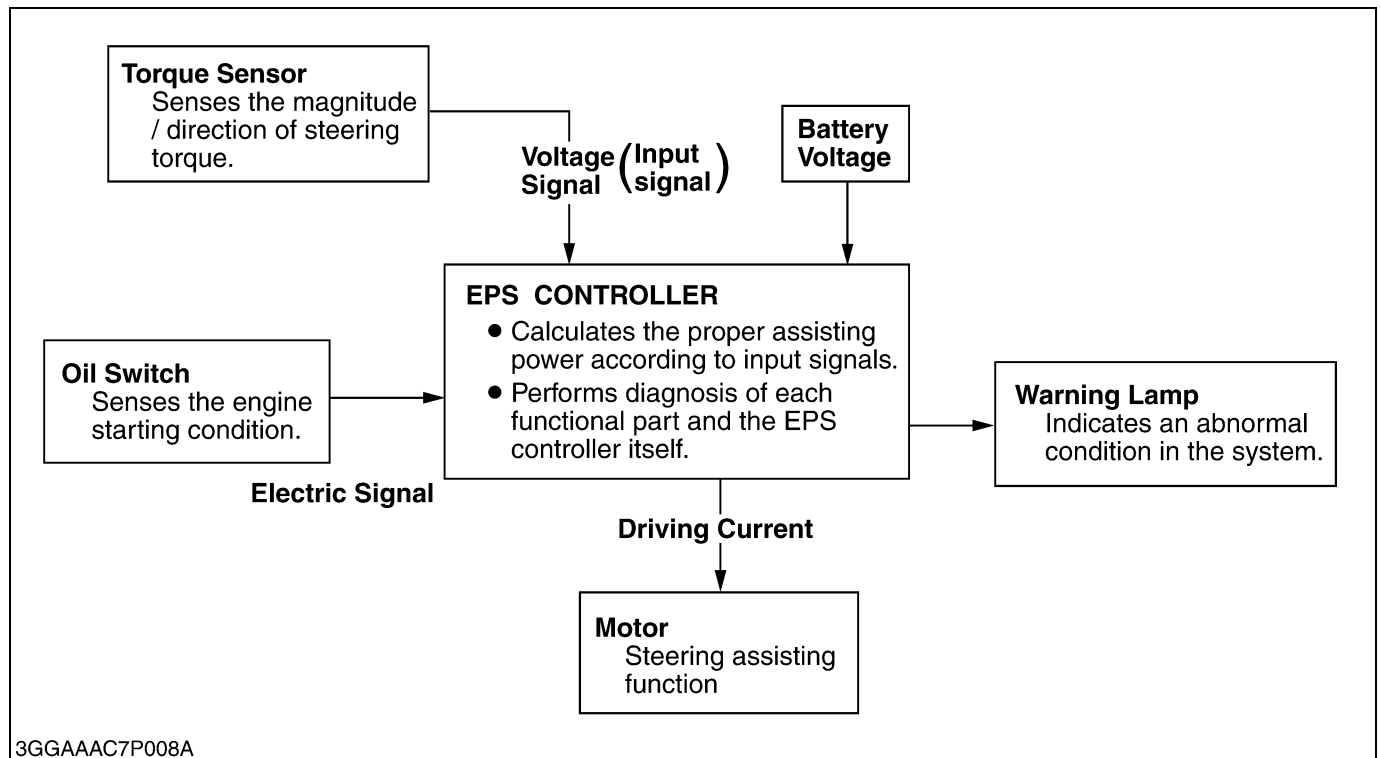
W1014140

[2] EPS CONTROLLER

The EPS controller detects an electric signal from the oil switch, activates the system after the engine starting and controls the motor according to an input signal from the torque sensor.

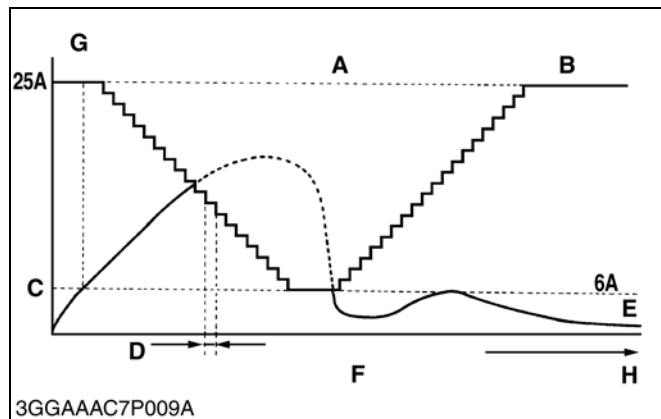
The EPS controller has a self-diagnosis function.

(1) Basic Control



1. It receives a voltage signal from the torque sensor and converts the magnitude and direction of torque into data.
2. According to the steering torque and direction data, it determines the current to be applied to the motor based on the specified assisting power map.

(2) Fool Proof



When the steering wheel is kept fully turned (end reaching), the maximum current at the time of full assisting is applied to the motor in spite of the motor not rotating. As a result, all the energy is converted into heat. If this state is maintained, the motor or EPS controller may be heated abnormally and damaged.

In order to prevent such damage, if a large current is passed for a certain time, the EPS controller gradually decreases the maximum current applied to the motor.

1. Decreases the current each time a large current is passed for 2.5 seconds.
2. Increases the current by 0.15 A every 2.5 seconds after getting out of the end reaching state.

A : CUR MAX
B : IM MAX
C : CURS
D : CIMF

E : IM
F : 0.15 A/2.5 Sec.
G : Motor Current
H : Time

W1014462

(3) Failure Diagnosis Function

The EPS controller monitors the input/output data and motor driving current. If an abnormal condition occurs in the system, the EPS controller stops the system and makes the warning lamp go on. In this case, the normal manual steering operation is applied and the abnormal condition is coded and stored in the failure diagnosis circuit. The failure position can be estimated based on flashing times of the warning lamp attached to the EPS controller.

W1015203

SERVICING

CONTENTS

1. CAUTIONARY INSTRUCTIONS BEFORE STARTING FAILURE DIAGNOSIS	5-S1
2. TROUBLESHOOTING	5-S2
[1] TROUBLESHOOTING BASED ON EACH SYMPTOM	5-S2
[2] TROUBLESHOOTING BASED ON ERROR CODE	5-S6
(1) Error code 02	5-S6
(2) Error code 03	5-S7
(3) Error code 05	5-S7
(4) Error code 06	5-S8
(5) Error code 11	5-S8
(6) Error code 12 and 13	5-S9
(7) Error code 15	5-S9
(8) Error code 17	5-S10
(9) Error code 19 and 22	5-S10
(10) Error code 23	5-S11
(11) Error code 32	5-S12
(12) Error code 34	5-S12
(13) Error code 35	5-S13
3. SERVICING SPECIFICATIONS	5-S14
4. TIGHTENING TORQUES	5-S14
5. CHECKING, DISASSEMBLING AND SERVICING	5-S15
[1] CHECKING AND ADJUSTING	5-S15
(1) Warning Lamp	5-S15
(2) Torque Sensor Cable	5-S17
(3) Torque Sensor 3P Connector	5-S18
(4) Torque sensor 3P Connector Terminal	5-S19
(5) Wire Harness	5-S20
(6) Checking Voltage	5-S21
(7) Error Codes and Defective Sections	5-S23
(8) Steering Wheel Play	5-S24
(9) Throttle Lever Operating Force	5-S24
[2] DISASSEMBLING AND ASSEMBLING	5-S25
(1) Separating Power Steering Assembly and EPS Controller	5-S25
(2) Power Steering Gear Case	5-S28
6. SERVICING	5-S29

1. CAUTIONARY INSTRUCTIONS BEFORE STARTING FAILURE DIAGNOSIS

1. Self-diagnosis function

The EPS controller has a self-diagnosis function. If the EPS controller detects an abnormal condition in the system, it performs the following.

- Making the warning lamp go on.
- Turning **OFF** the motor current.
- Storing the error code.
- When the system recovers from the failure, the EPS controller automatically makes the warning lamp go off. Depending on the position of self-diagnosis, however, there may be cases where resetting cannot be made without turning **OFF** the main switch and performing fail-safe history erasing.

2. Warning lamp

- If the system is normal, the warning lamp glows for 5 seconds after the engine starting and goes off.
- The warning lamp has a function to indicate an abnormal condition in the system and to display the error code.

3. Error code

- When an abnormal condition is detected and the warning lamp goes on, the error code is stored.
- The stored code may be lost if the power of the EPS controller is turned off or the coupler is disconnected.

4. Cautions in the EPS system

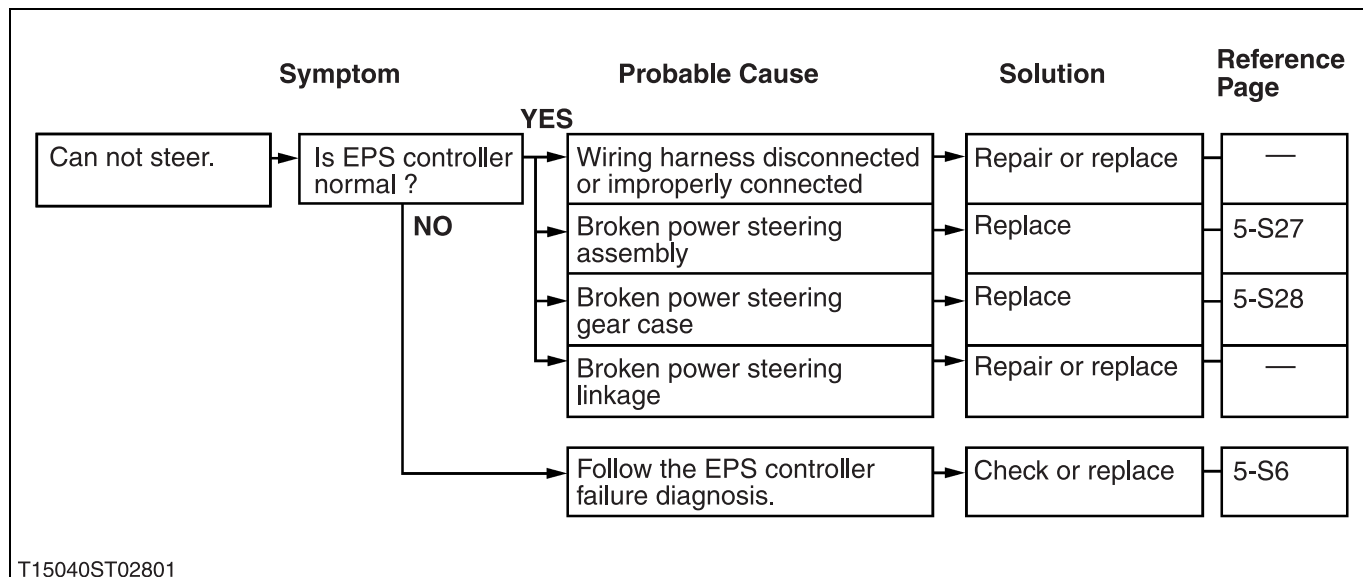
- If the steering wheel is kept fully turned for a long time with the machine stopped, it may become hard to operate the steering wheel. It is not a failure: it is caused because the EPS controller decreases the current applied to the motor in order to protect the EPS system. To restore the normal steering wheel state, wait for about 5 seconds and start the engine.
- When removing the steering wheel, take care not to shock the power steering assembly.
- When replacing the power steering assembly, replace it as a whole assembly and do not disassemble motor, torque sensor, etc..
- When replacing the power steering gear case, replace it as a whole assembly.

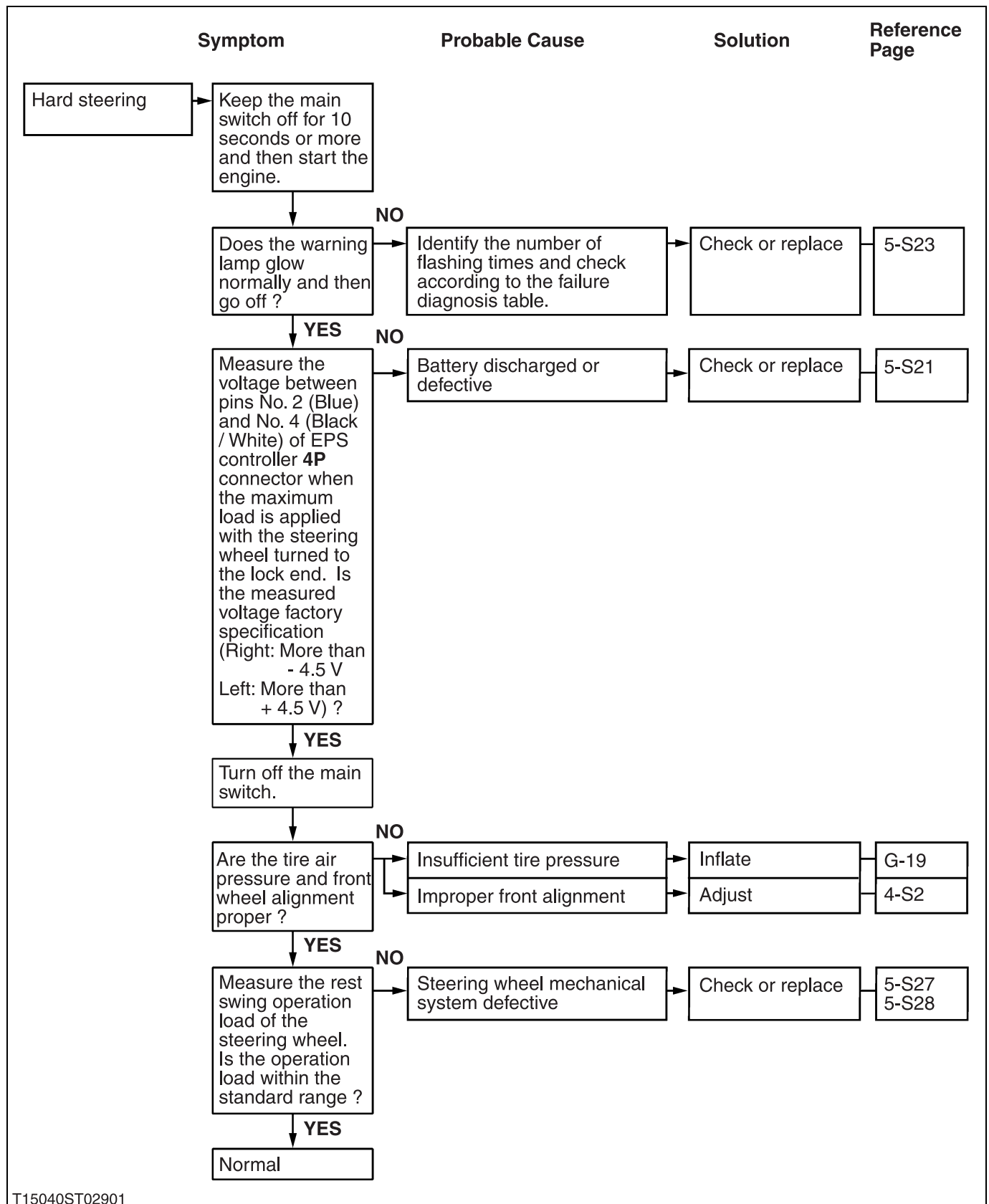
5. Cautions in servicing

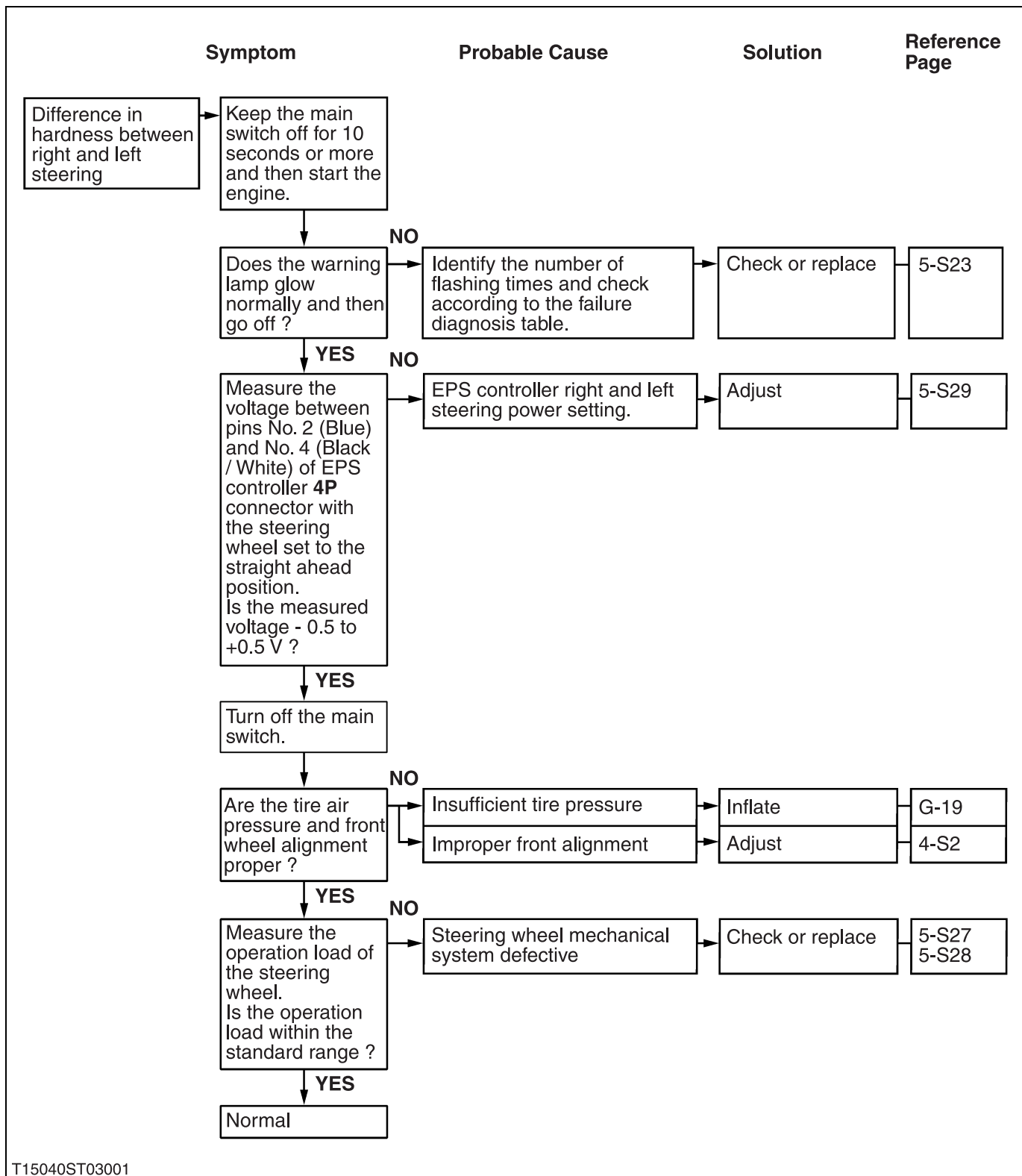
- If two or more error codes are stored, perform failure diagnosis starting from the error code displayed first (whose flashing time is lowest).
- When performing failure diagnosis based on the error code because the symptom complained of by the customer has no repeatability, obtain from the customer's detailed information about the conditions at the time of warning lamp going on and perform a test under the same conditions as much as possible. If the warning lamp does not go on in the test running, check for imperfect contact, etc. by shaking the harness or connector while following the failure diagnosis chart.
- Do not connect or disconnect the connector with main switch turned **ON**.
- The number indicating the coupler pin is shown viewed from the cord side for the female pin and male pin.

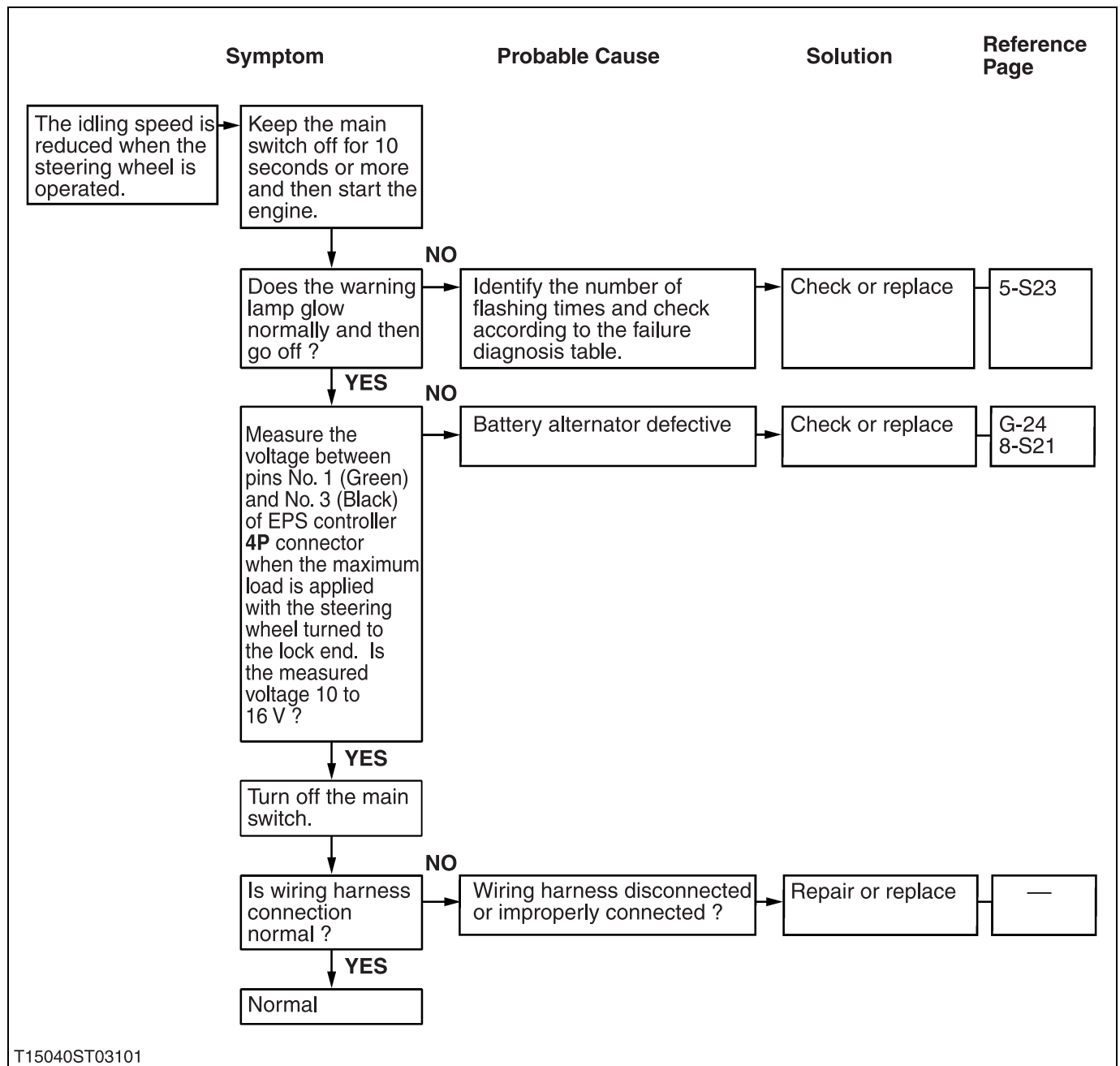
2. TROUBLESHOOTING

[1] TROUBLESHOOTING BASED ON EACH SYMPTOM





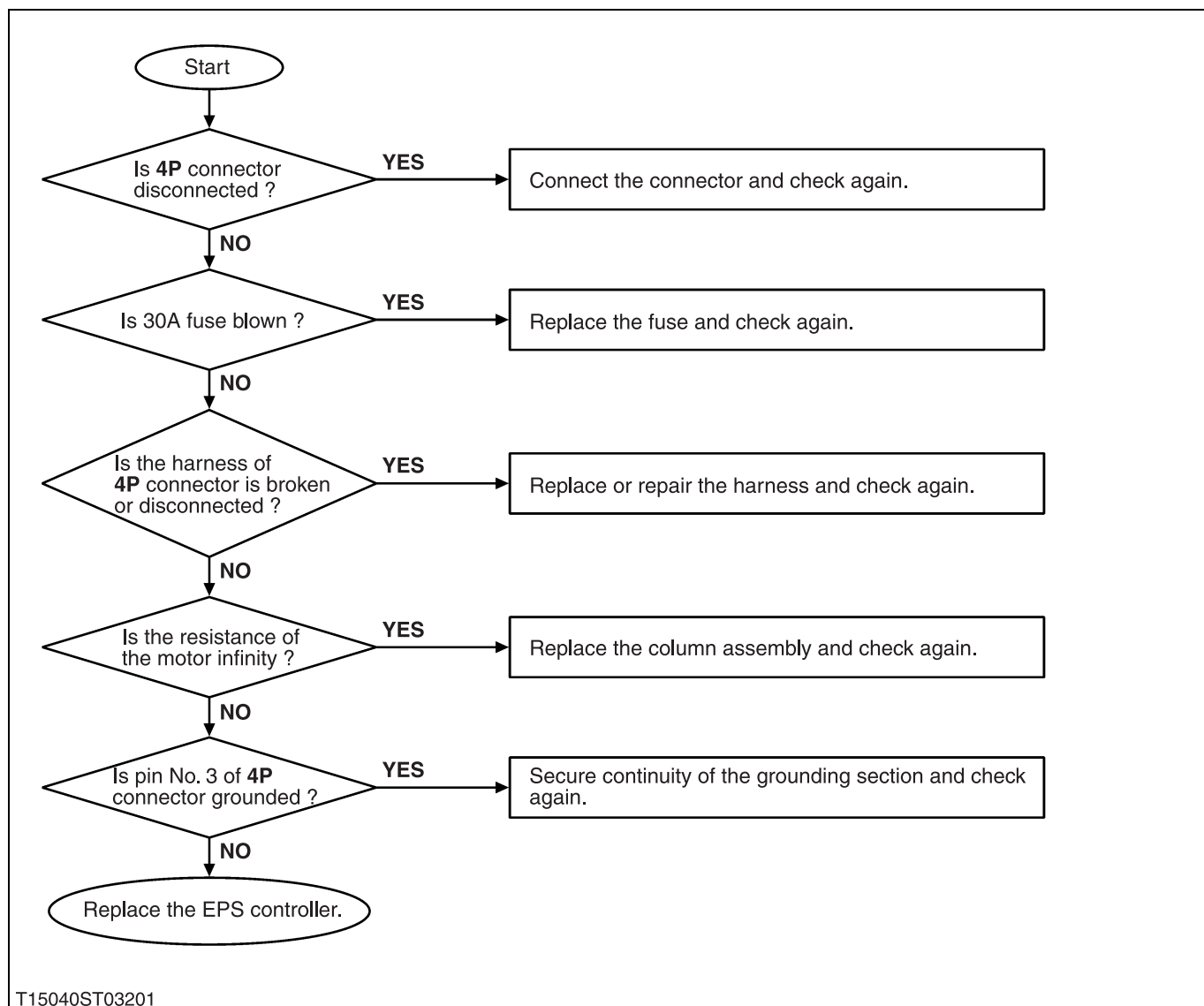


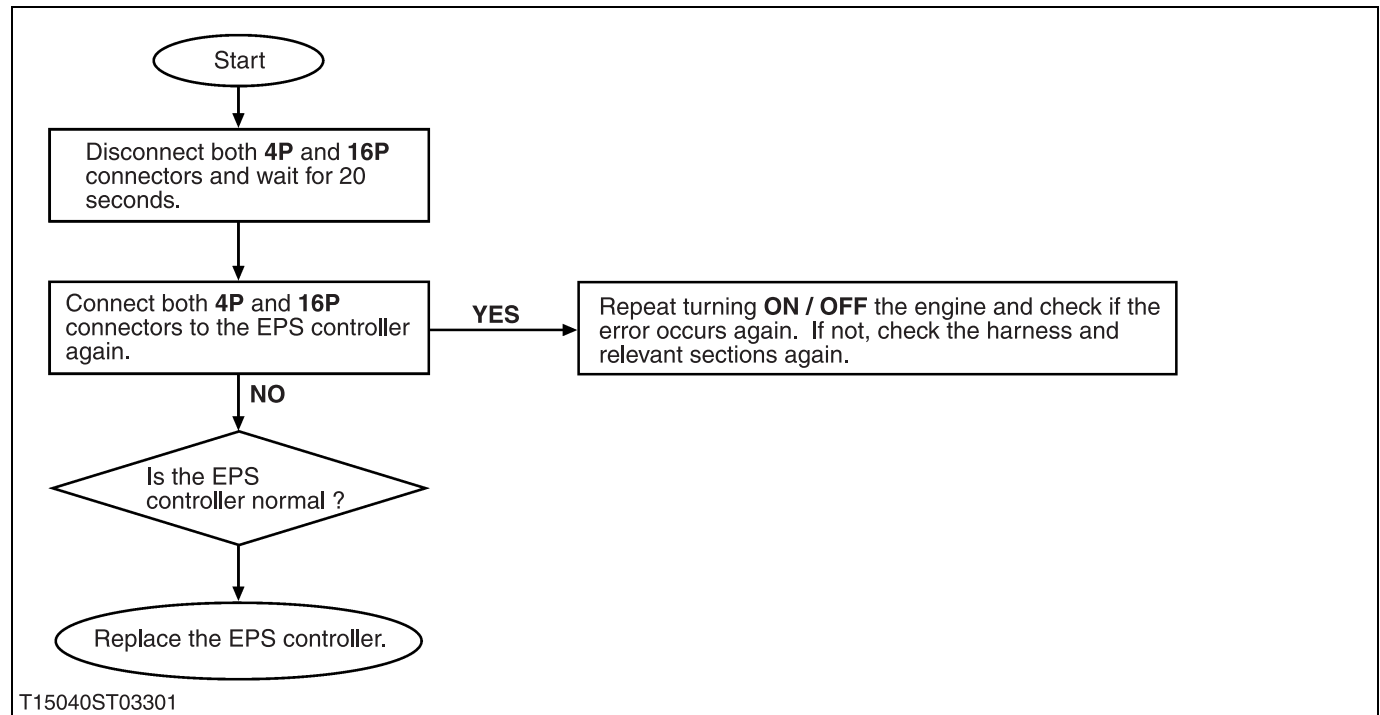
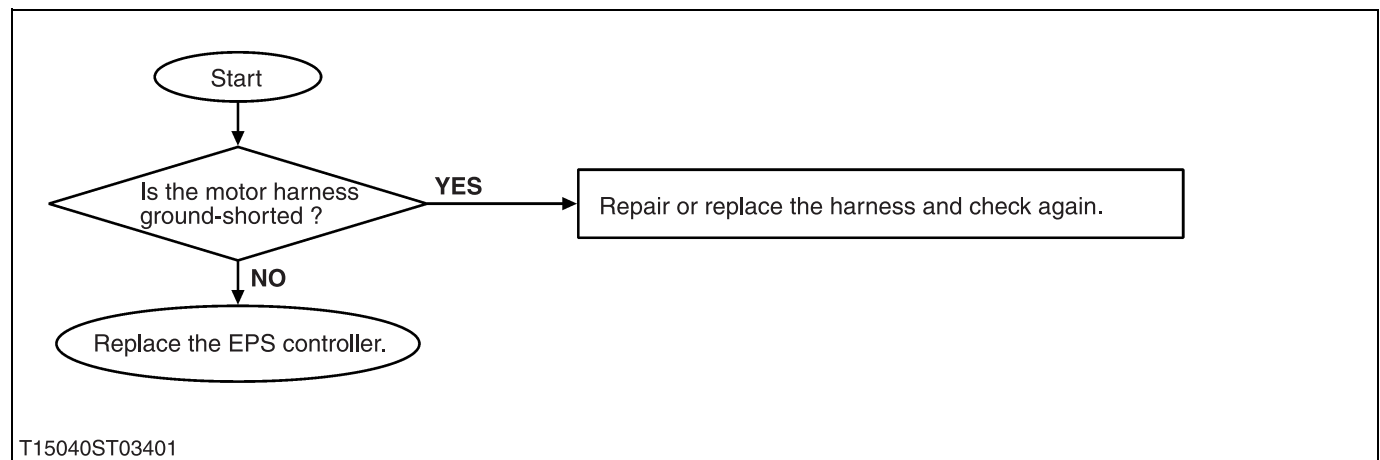


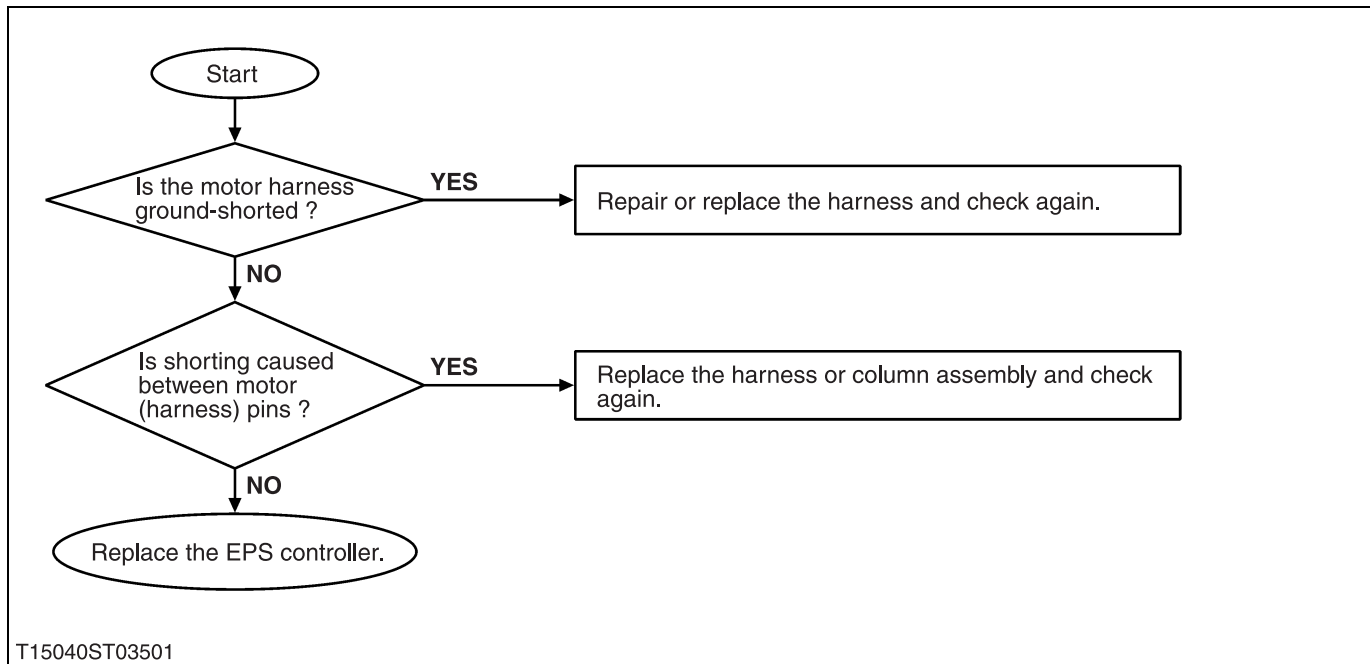
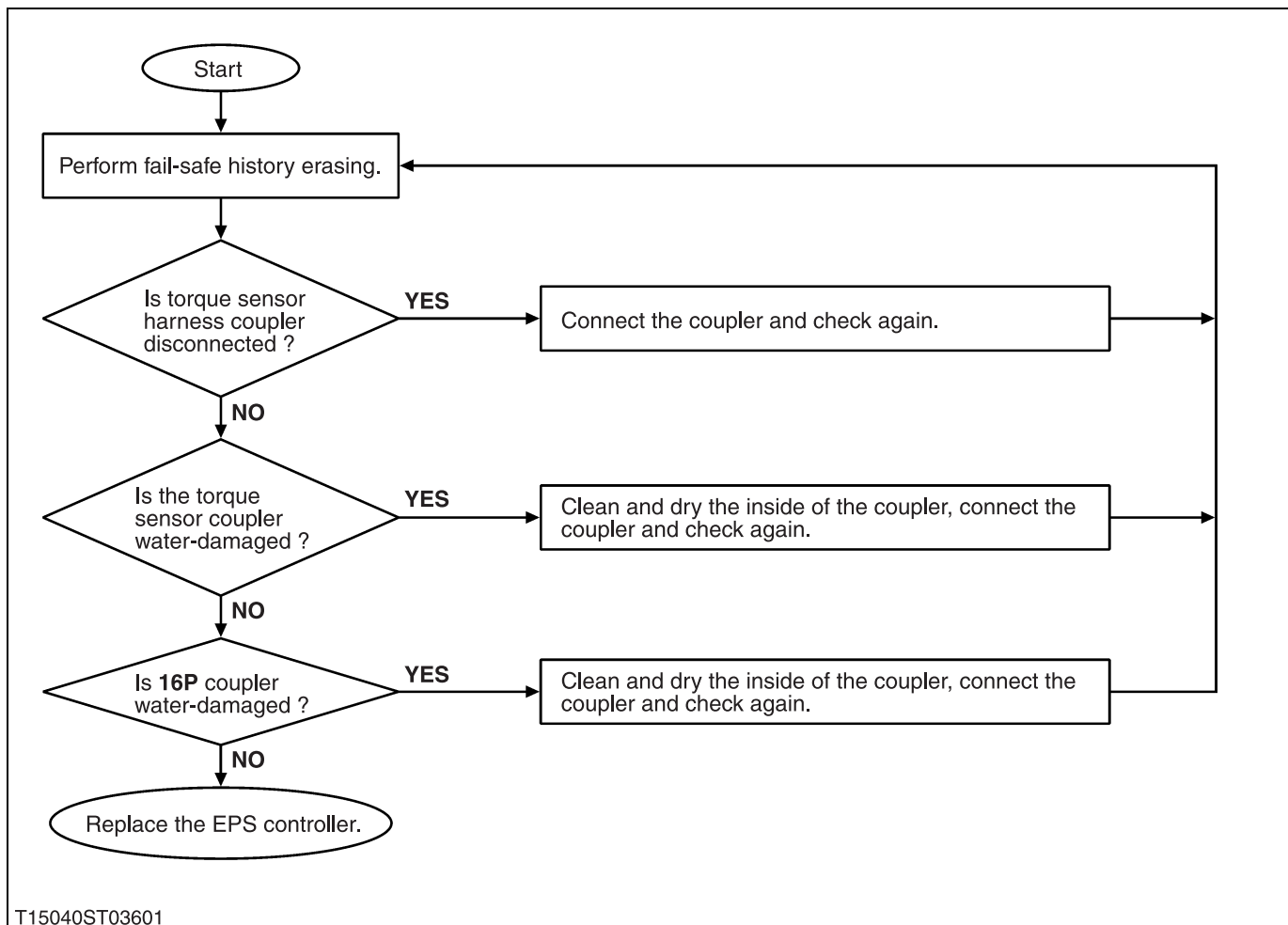
[2] TROUBLESHOOTING BASED ON ERROR CODE

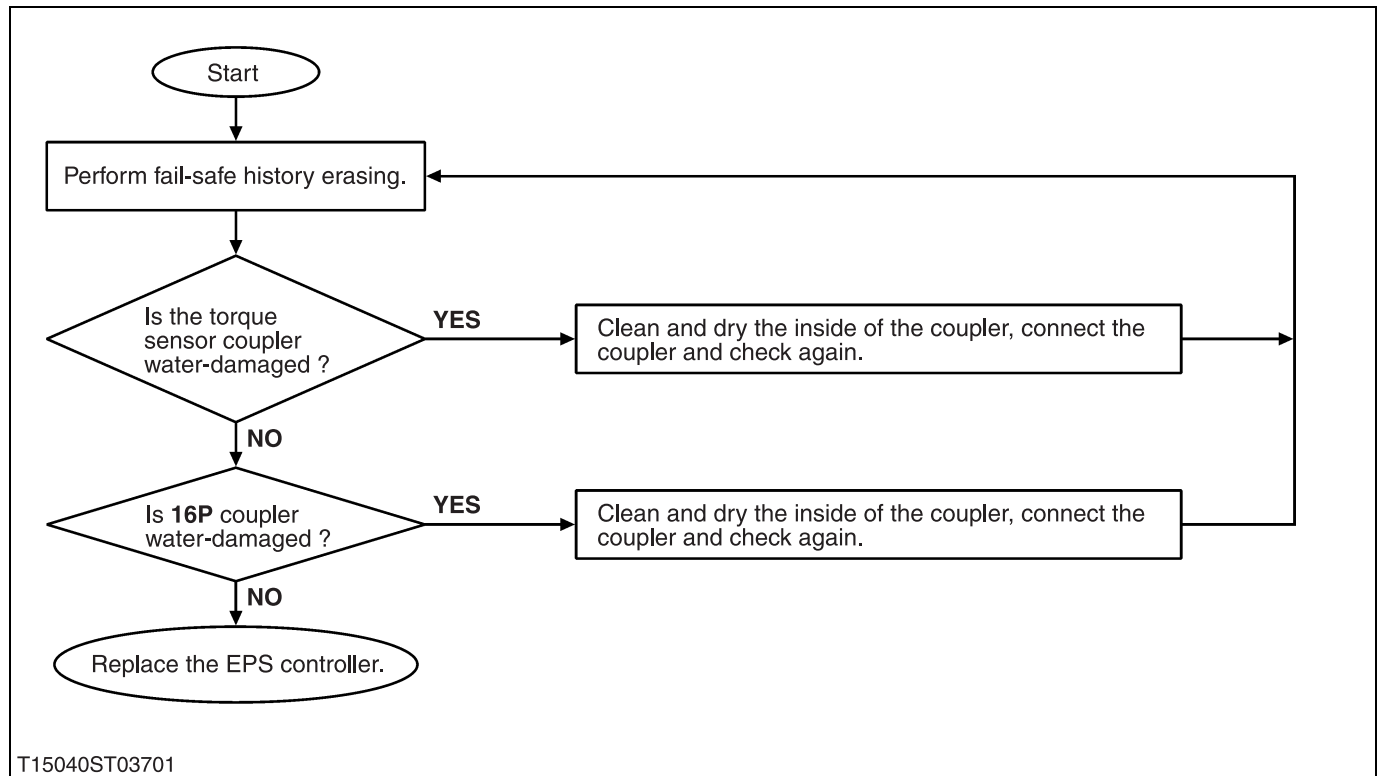
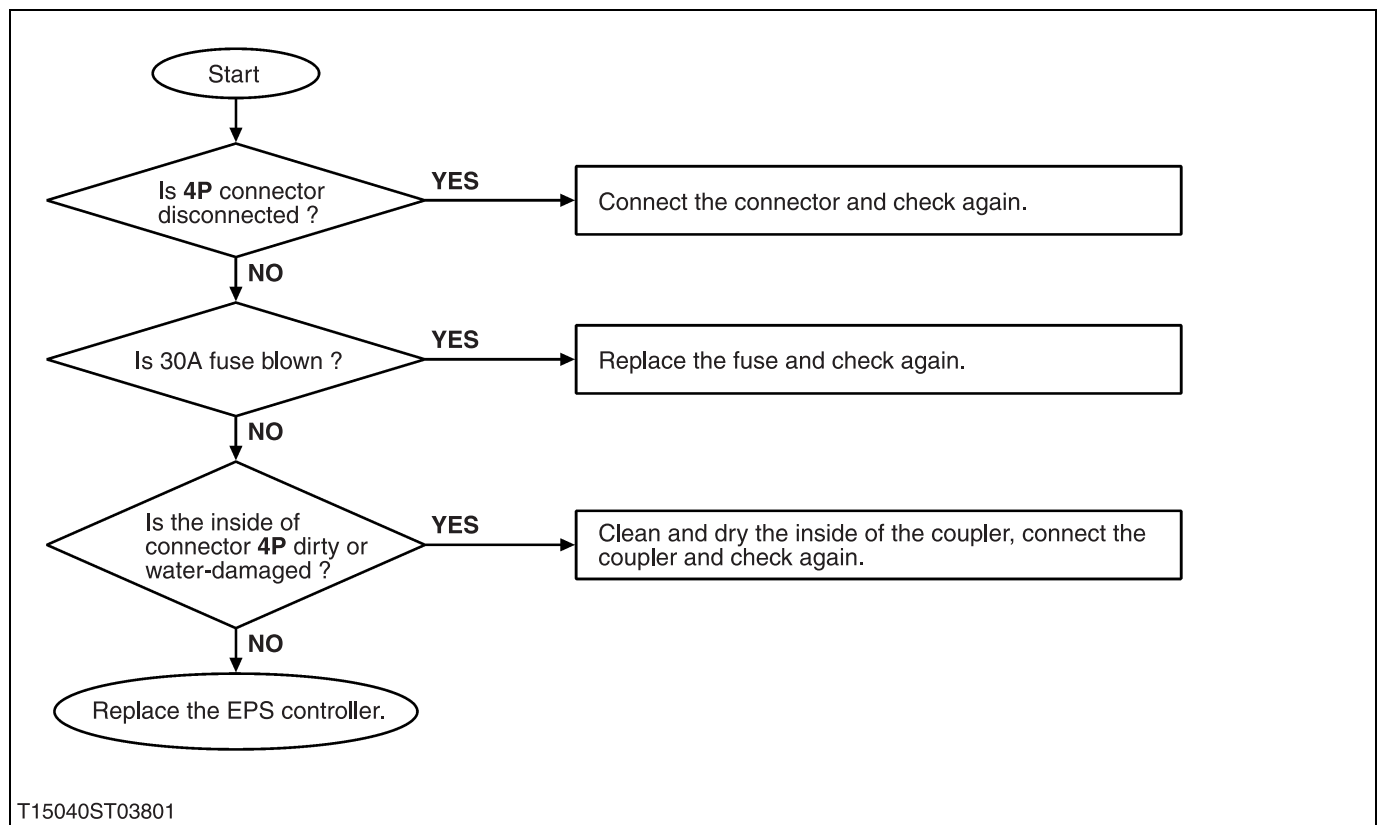
(1) Error code 02

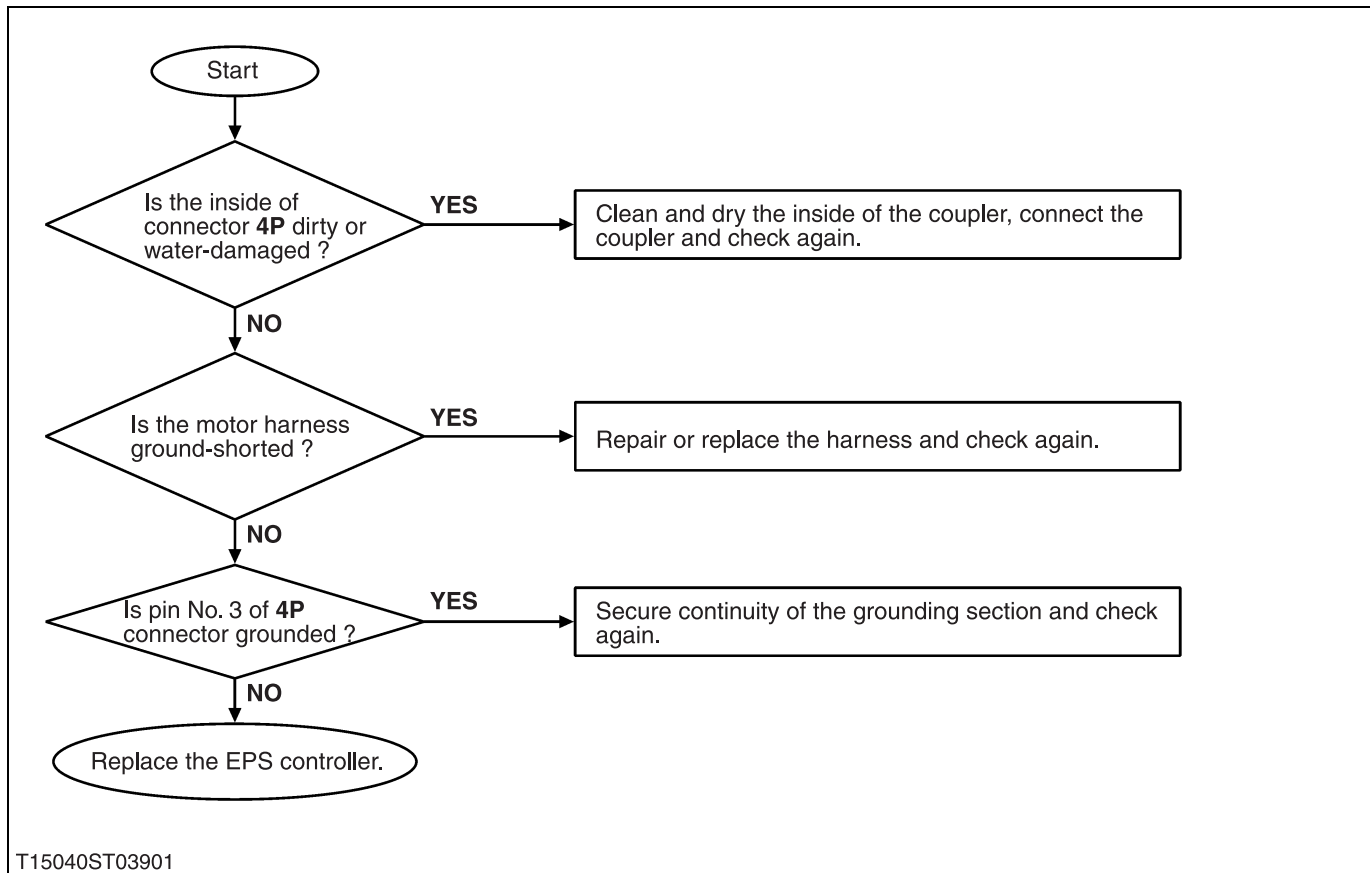
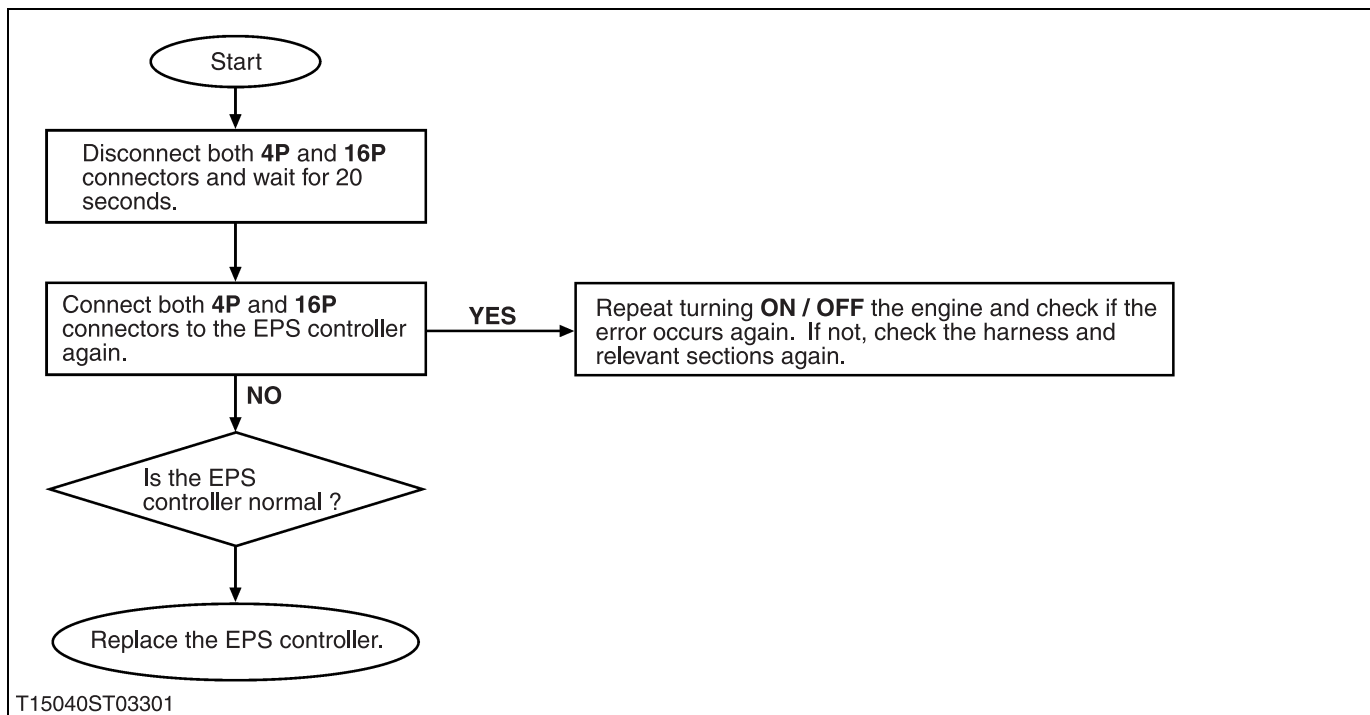
[EPS System Troubleshooting Procedure]

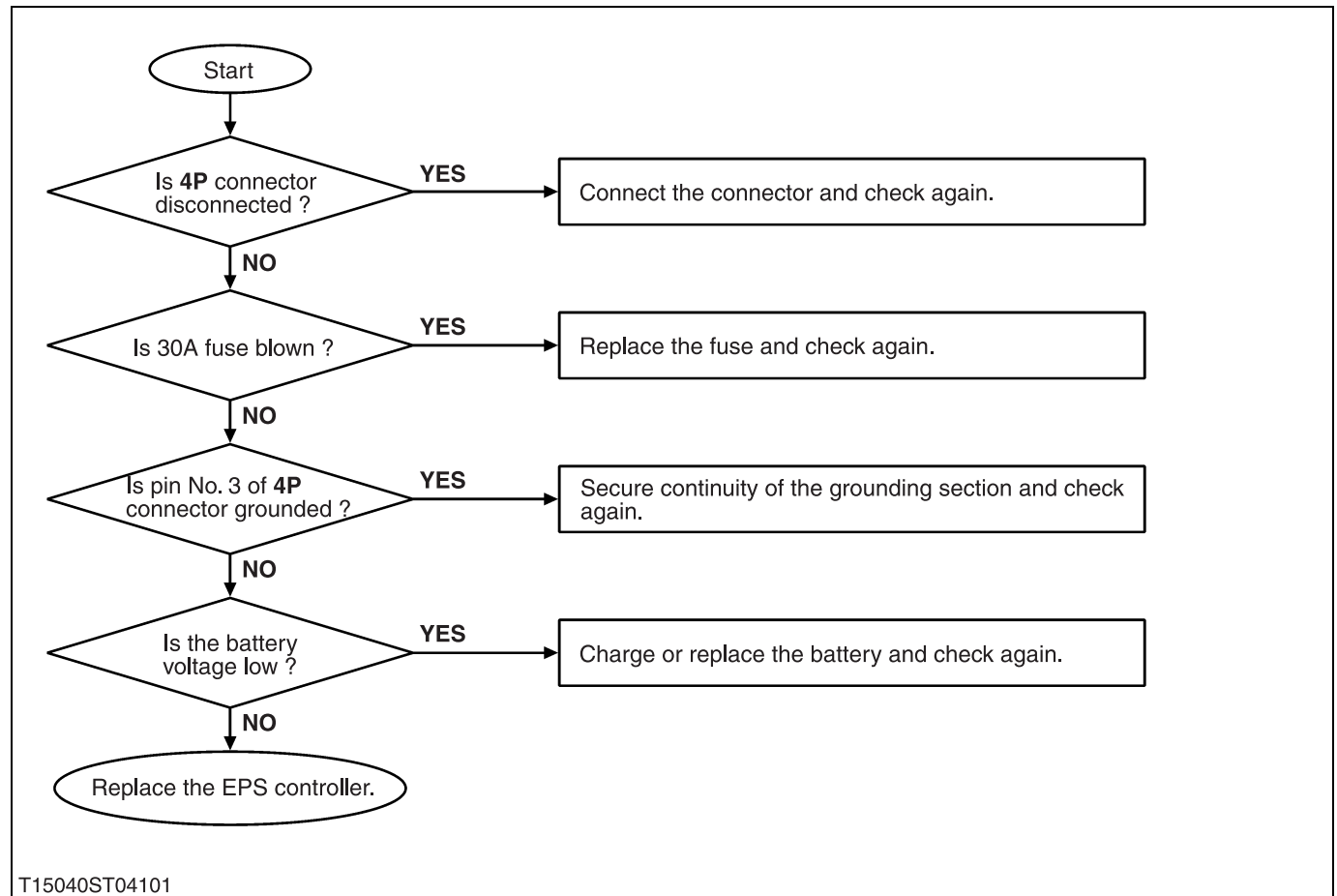


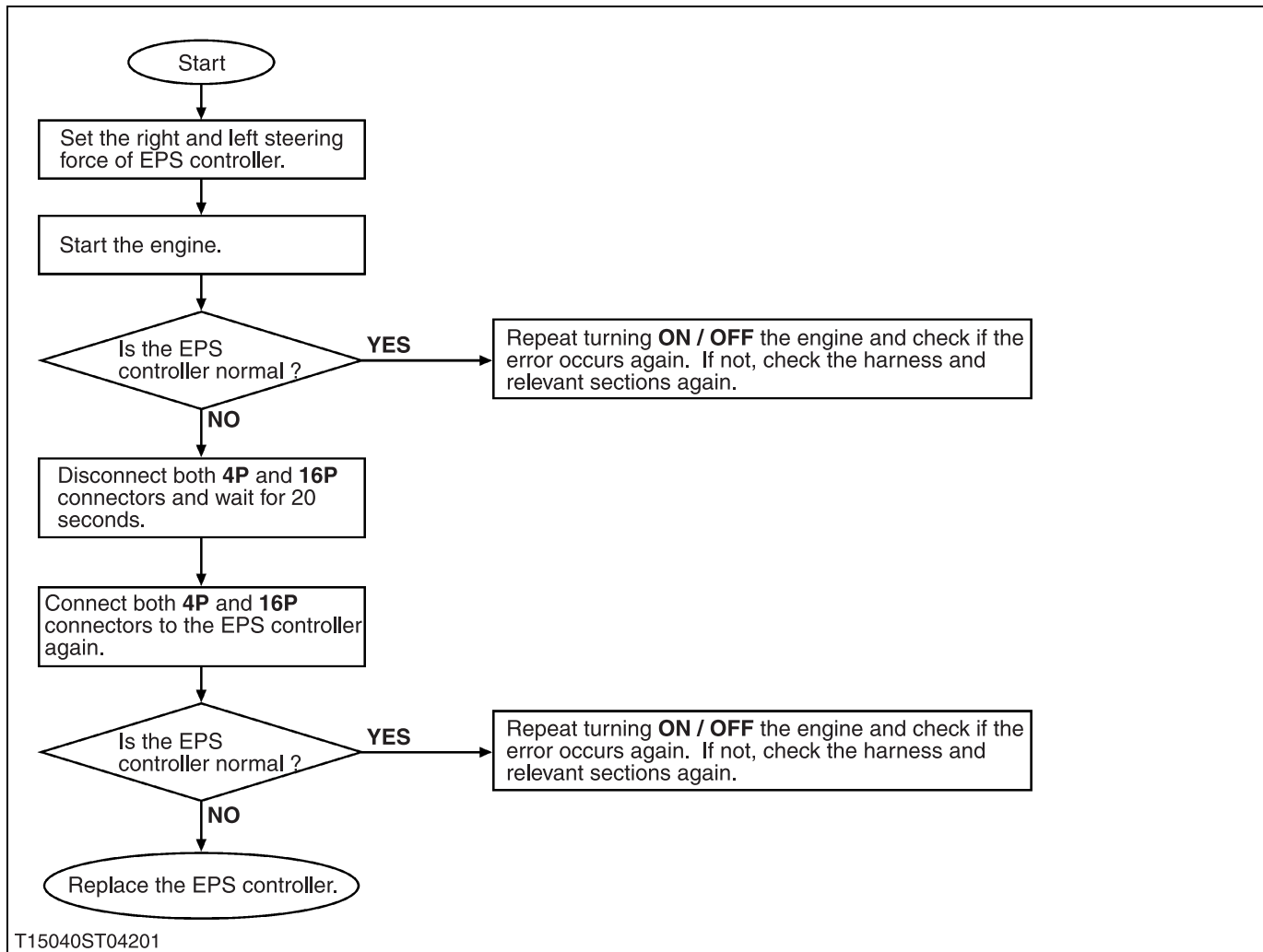
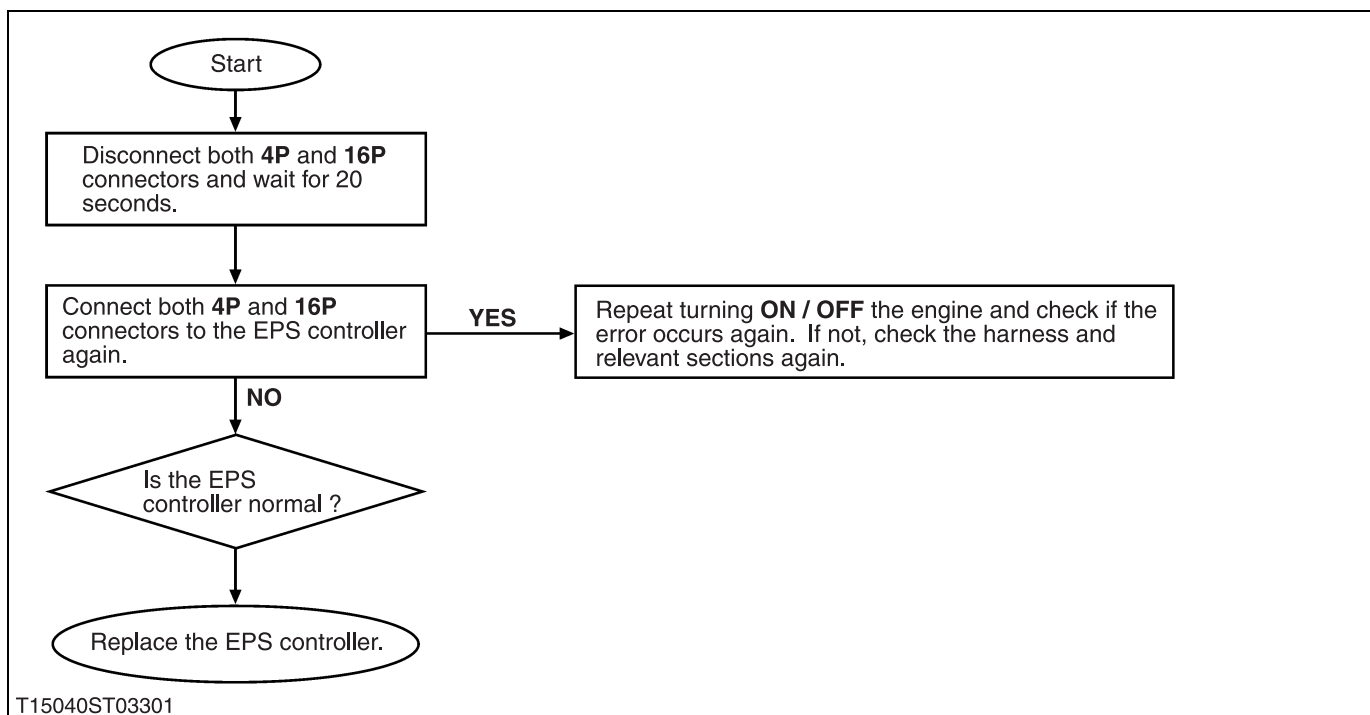
(2) Error code 03**(3) Error code 05**

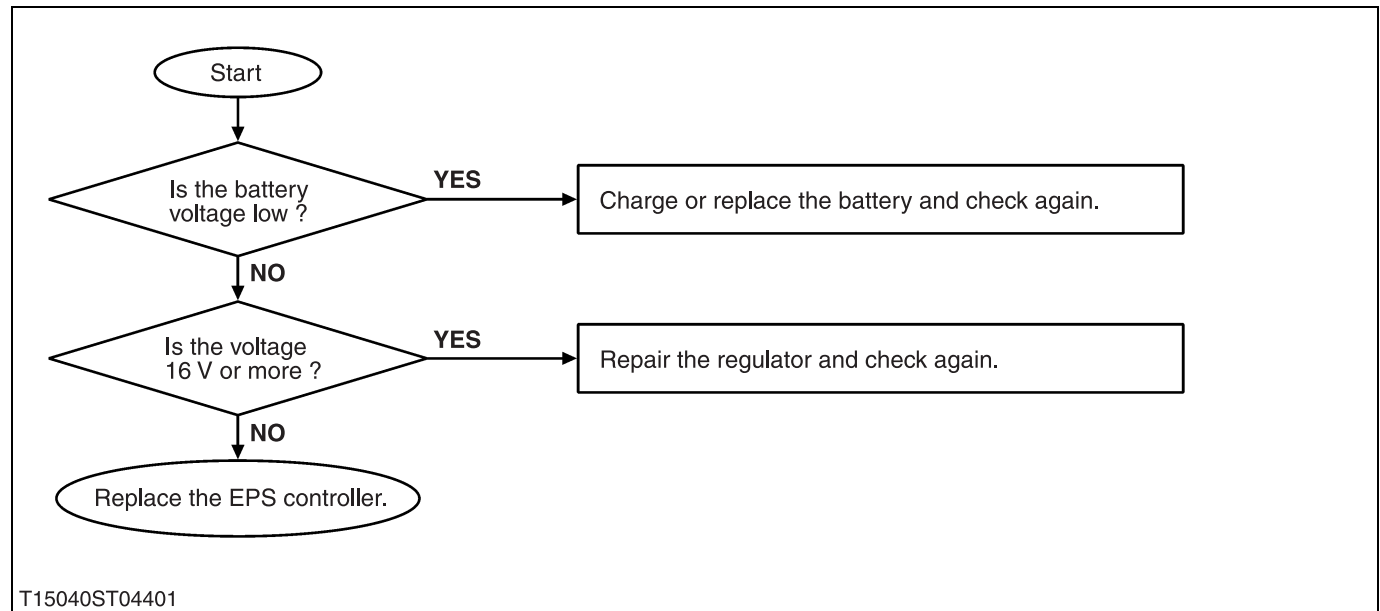
(4) Error code 06**(5) Error code 11**

(6) Error code 12 and 13**(7) Error code 15**

(8) Error code 17**(9) Error code 19 and 22**

(10) Error code 23

(11) Error code 32**(12) Error code 34**

(13) Error code 35

3. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
Steering Wheel Play		Less than 15 mm Less than 0.59 in.	—
Throttle Lever Operating Force		30 to 50 N 3.1 to 5.1 kgf 66 to 110 lbs	—
Difference in Steering Force of Steering Wheel between Right and Left		Less than 25 %	—
Steering Load	Engine stopped (Without power assisting)	Less than 150 N Less than 15 kgf Less than 33 lbs	—
	Engine started (With power assisting)	Less than 30 N Less than 3 kgf Less than 6.6 lbs	—
Turning Torque (Steering Mechanical System)	Without power assisting	Less than 2.0 N·m Less than 0.20 kgf·m Less than 1.4 ft-lbs	—
Turning Torque (Power Steering Gear Case)	Without power assisting	Less than 3.6 N·m Less than 0.37 kgf·m Less than 2.7 ft-lbs	—

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4. TIGHTENING TORQUES

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

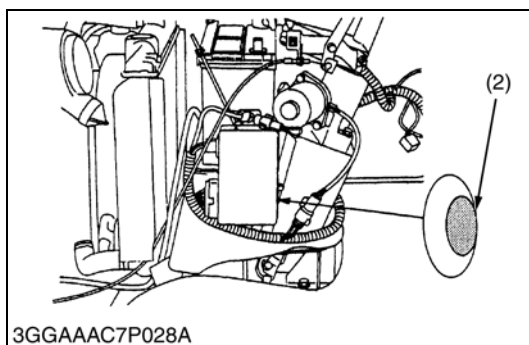
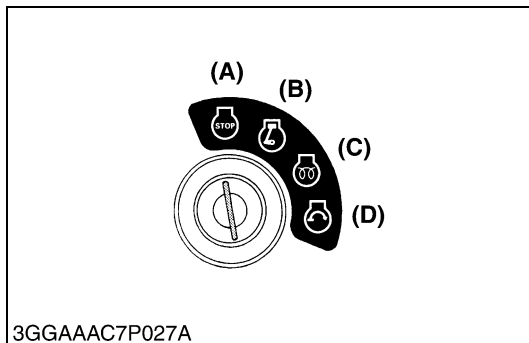
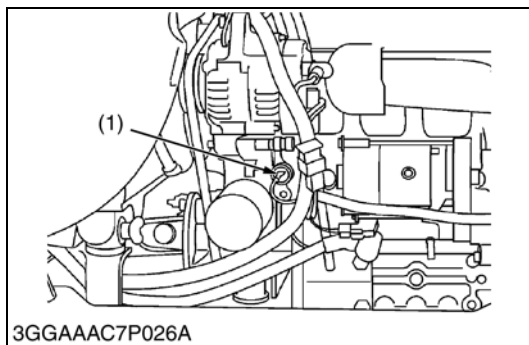
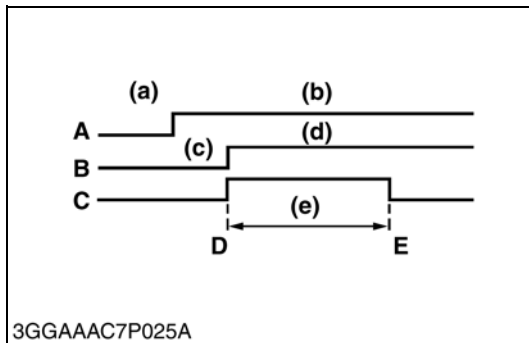
Item	N·m	kgf·m	ft-lbs
Steering wheel mounting nut	19.6 to 24.5	2.0 to 2.5	14.5 to 18.1
Rod end mounting nut	108.8 to 130.3	11.1 to 13.3	80.3 to 96.2
Lock nut	62.7 to 72.5	6.4 to 7.4	46.3 to 53.5
Power steering gear case mounting screw	40.2 to 47.0	4.1 to 4.8	29.7 to 34.7

W1012161

5. CHECKING, DISASSEMBLING AND SERVICING

[1] CHECKING AND ADJUSTING

(1) Warning Lamp



Checking of EPS System

When the main switch is set to the **ON** position **(B)**, the EPS controller detects the voltage signal from the oil switch (1) and makes the warning lamp (2) glow for 5 seconds.

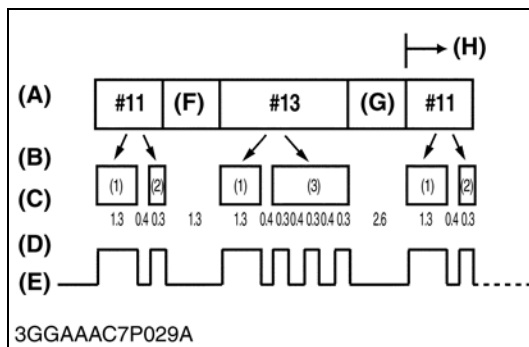
■ Check Test

1. Start the engine.
2. Check that the warning lamp glows for 5 seconds and then goes off.
3. If the warning lamp does not go on, check if the harness is connected properly.
4. If the warning lamp does not stop glowing, replace the EPS controller and check again.

- (1) Oil Switch
(2) Warning Lamp

- (A) MAIN SWITCH
(B) OIL SWITCH
(C) WARNING LAMP
(D) Going on
(E) Going off
(a) Off
(b) On
(c) Close
(d) Open
(e) 5 sec.

W1012253



Checking of Warning Lamp

- The fail-safe codes recorded in the controller start flashing in the ascending order.
(There may be just one code.)
- After one cycle of the flashing codes, there is a longer period of no-flash time.

Example: Fail-safe codes #11, #12 and #13 flashing

List of flashing fail-safe codes (torque sensor in trouble)

Problem	White wire	Red wire	Black wire
Wire broken before engine started	#11	#11	#13
Wire broken during engine running	#11, #12	#11	#11, #13

■ IMPORTANT

- Suppose that there is no fail-safe code recorded. Just when the main switch is set at ON position and the oil switch's 1P connector disconnected, the warning lamp lights up and stays on for 5 seconds, it then goes out. This means there is no problem with the EPS controller. Check the power steering assembly, gear case's turning torque, and the hydraulic switch performance.

■ Action

If the code #11, #12 or #13 flashes, the torque sensor harness may have poor contact or broken wire. Carry out "Checking the power steering assembly" and "Checking the wire harness", and erase the codes referring to the instructions. If there is no flashing, take the steps of "Checking the voltages".

(A) Display

(B) Flashing Displayed

(C) Flashing Time (sec.)

(D) ON

(E) OFF

(F) Between Codes

(G) After one Cycle

(H) Example : Codes #11 and #13

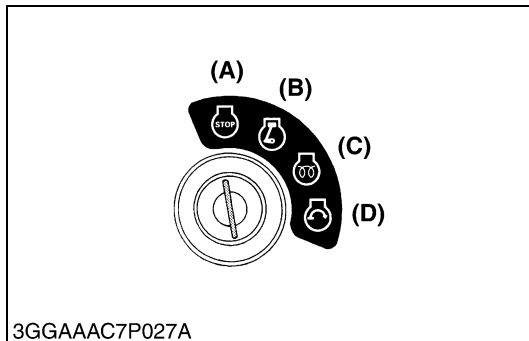
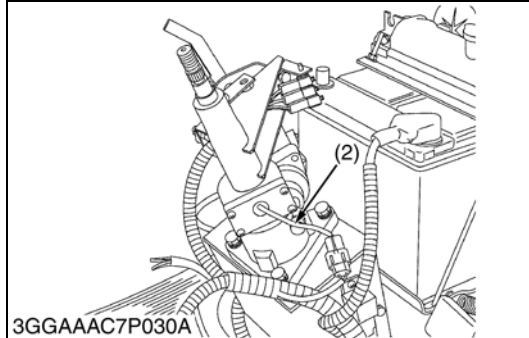
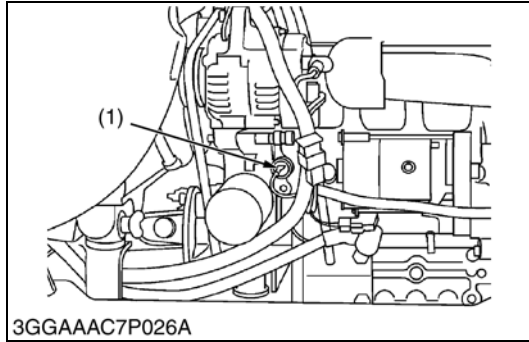
(1) Low Time Flashing (1 time)

(2) Short Time Flashing (1 time)

(3) Short Time Flashing (1 time)

W1012533

(2) Torque Sensor Cable



Checking Torque Sensor Cable

1. Keep the main switch at **ON** position **(B)** and disconnect the **1P** connector (1) from the oil switch. Check to see if the power steering system works. (Do not start the engine.)
2. Lightly bend the root of the torque sensor cable to see if the steering wheel turns unexpectedly or unstably.



CAUTION

- Be careful not to get yourself caught by the steering wheel or tire.
- Do not pull the cable too much.

■ IMPORTANT

- If the steering wheel turns unexpectedly or unstably, detach the panel and check the connector and power steering assembly. If they are okay, go to "Checking the wire harness."

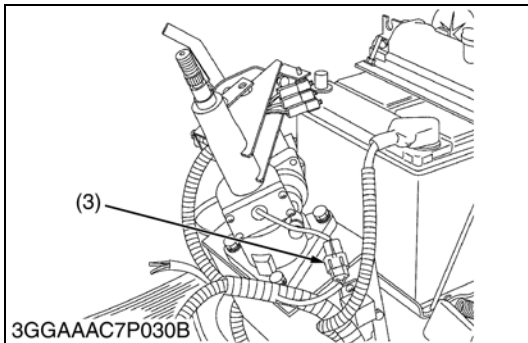
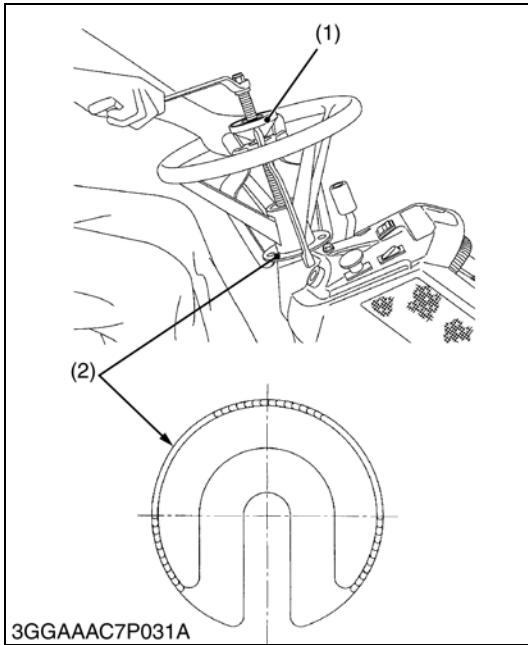
(1) 1P Connector

(2) Torque Sensor Cable

(2) Torque Sensor Cable

W1013061

(3) Torque Sensor 3P Connector



Checking Torque Sensor 3P Connector

■ IMPORTANT

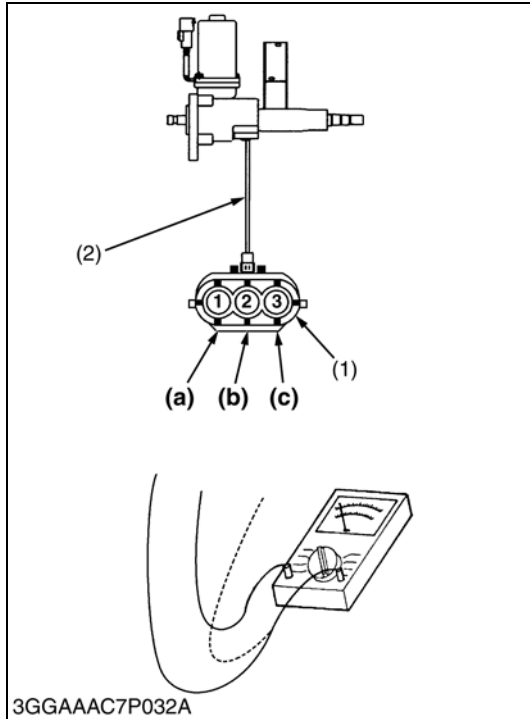
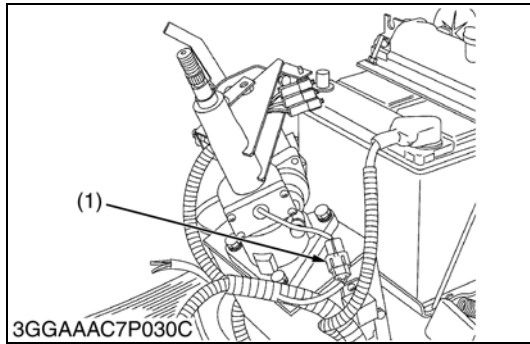
- While disassembling, handle the power steering assembly, controller and wire harness with enough care. To disconnect the steering wheel, be sure to use the steering wheel puller (1) and puller adaptor (2), never any hammer. Excessive load or impact on the parts may result in trouble.
 - To disconnect the connector, press the connector's lock and hold the connector itself. Never pull the cable.
1. Check the torque sensor **3P** connector (3) and related parts for the following defects.
 - Terminal off position
 - Terminal deformed or crushed
 - Female terminal too open
 - Entry of foreign matters, water, etc.
 - Rubber sealing missing
 - Broken wire or sheath
 2. If any of the above problems is found, repair the trouble spot or replace the power steering assembly with new one. If there is no problem, go to the following check point.

(1) Steering Wheel Puller
(2) Puller Adaptor

(3) Torque Sensor **3P** Connector

W1013417

(4) Torque sensor 3P Connector Terminal



Checking the Resistance of the Torque Sensor 3 Connector Terminal

1. Using a circuit tester, measure the terminal resistance between the red and black wires, as well as that between the white and black wires of torque sensor **3P** connector (1).
2. If out of specification replace the power steering assembly with new one. If the resistance is okay, go to "checking the wire harness".

Resistance red-black white-black	Factory spec.	13.0 to 15.0 Ω
--	---------------	-----------------------

■ IMPORTANT

- Before measuring the resistance, lightly bend the root of the cable and gently pull it for easy, reliable checking. Be careful to keep the circuit tester probes tight at the terminals.

■ NOTE

- The steering wheel turns in different directions on the broken wires.

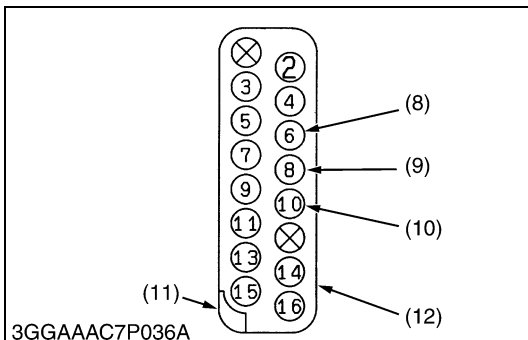
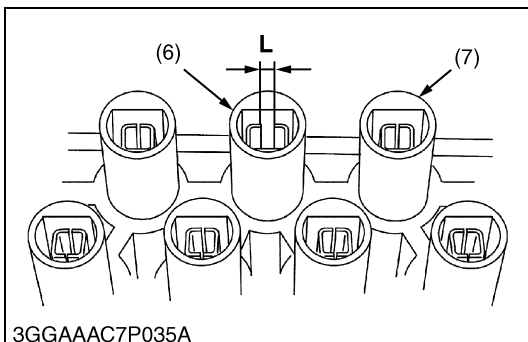
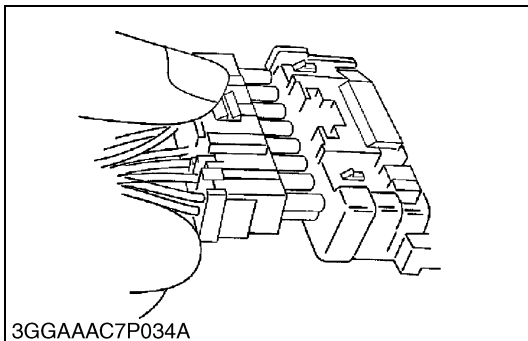
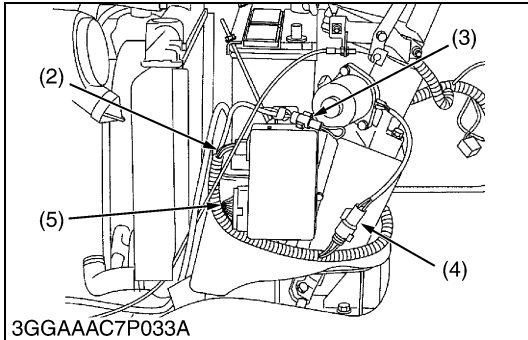
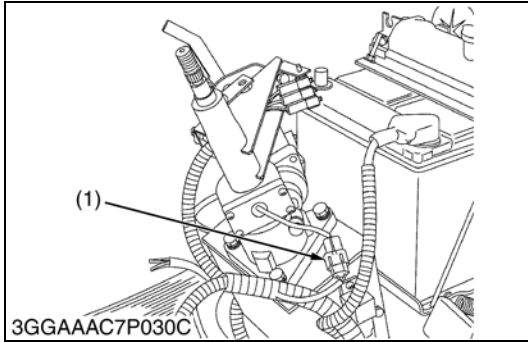
Problem	Defect
Unexpected turn clockwise	Red or black wire in poor contact Black/white wire in poor contact (Harness side)
Unexpected turn counterclockwise	White wire in poor contact

- (1) Torque Sensor **3P** Connector
(2) Cable

- (a) Red
(b) Black
(c) White

W1013879

(5) Wire Harness

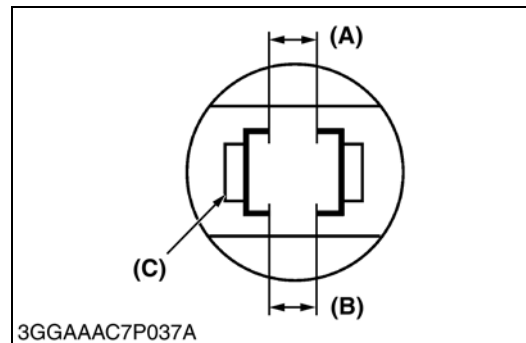


Checking the Torque Sensor Connectors for Poor Contact

1. Check the torque sensor **3P** connector (1) and related parts for the following defects.
 - Terminal off position
 - Terminal deformed or crushed
 - Female terminal too open: Improper connection (6)
 - Rubber sealing missing
 - Broken wire or sheath

■ IMPORTANT

- **To disconnect the connector, press the connector's lock and hold the connector itself. Never pull the cable.**
2. Visually check to see if the 3 terminals (8), (9) and (10), as shown below, are open as specified. Compare these terminals with the other ones for equal clearance. If any of them is too open, correct as follows.
 3. Correction
Put a precision regular screwdriver (0.9 mm (0.035 in.) or thinner tip) in the opening. Adjust the clearance to the specified value.



Coupler Pin Inside Clearance (L)	Factory spec.	0 to 0.1 mm 0 to 0.0039 in.
----------------------------------	---------------	--------------------------------

4. If any of the above problems is found, repair the trouble spot or replace the wire harness with new one. If there is no problem, go to "Checking the harness for continuity"

- | | |
|--------------------------------------|--|
| (1) Torque Sensor 3 Connector | (7) Proper Connection |
| (2) 4P Connector (ECU) | (8) Black/White Wire (Torque Sensor) |
| (3) 3P Connector (Service) | (9) Red Wire (Torque Sensor) |
| (4) 2P Connector (Motor) | (10) White Wire (Torque Sensor) |
| (5) 16P Connector (ECU) | (11) Notch |
| (6) Improper Connection | (12) EPS Controller 16P Connector
(As view from the wire-connected side) |

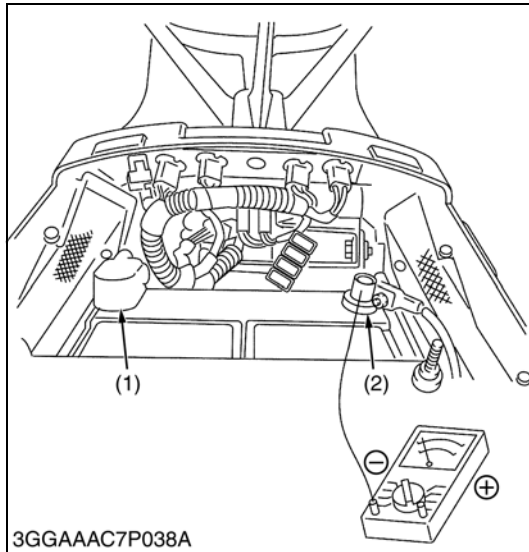
(A) Clearance : L

(B) Clearance : L

(C) Put a Screwdriver

W1014281

(6) Checking Voltage



Checking the Battery Terminal Voltage

1. Measure the voltage between the positive (+) and negative (-) battery terminals (1), (2).
2. If the voltage is out of factory specification, recharge the battery and go to the following checking.

Battery voltage	Factory spec.	More than 12V
-----------------	---------------	---------------

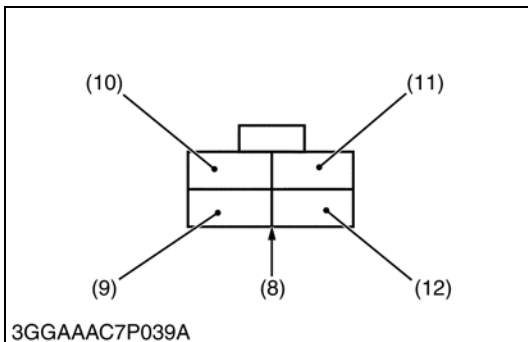
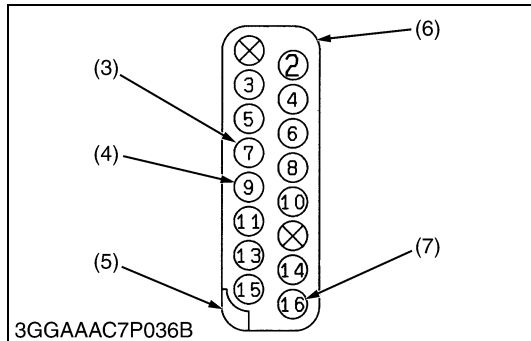
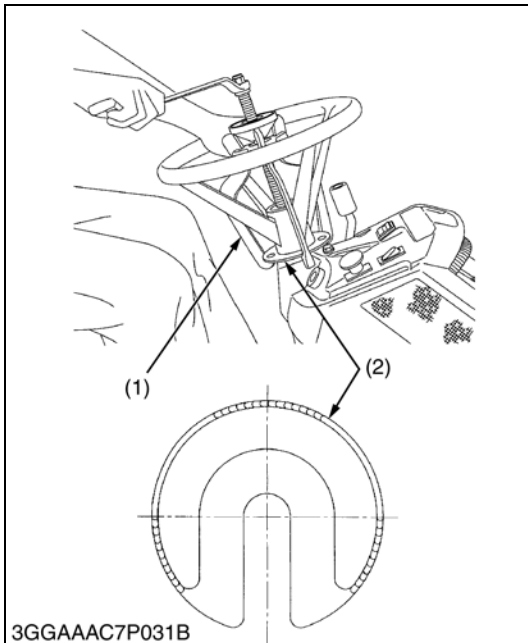
■ IMPORTANT

- After jump-starting the machine's engine, keep the support vehicle's engine also running for 5 minutes or longer. Then disconnect the booster cables (after the battery voltage is restored).

(1) Positive Terminal

(2) Negative Terminal

W1016318



Checking 16P and 4P Connectors to EPS Controller

1. Disconnect the steering wheel with the steering wheel puller (1) and puller adaptor (2) carefully. Do not use any hammer.
2. Detach panel and make the following check. with the main switch at **ON** position (do not start the engine), measure the voltages between following terminals.
3. Measuring the voltage at the **16P** connector (6) with the main switch at **ON** position (do not start the engine), measure the voltage between the black (3), (4) and red/white (7) terminals.
4. Measuring the voltage at the **4P** connector (8) with the main switch at **OFF** position, measure the voltage between the green (11) and black (12) terminals.

■ IMPORTANT

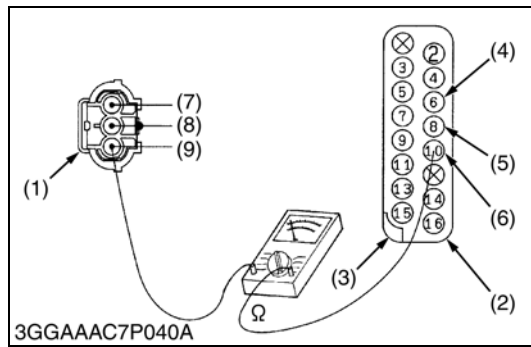
- While disassembling, handle the power steering assembly, controller and wire harness with enough care. To disconnect the steering wheel, be sure to use the steering wheel puller, never any hammer. Excessive load or impact on the parts may result in trouble.
- To disconnect the connector, press the connector's lock and hold the connector itself. Never pull the cable.

Controller 4P Connector

(11)	Green	Battery (+)
(10)	Blue	Motor (+)
(12)	Black	GND
(9)	Black / white	Motor (-)

- | | |
|---|--|
| (1) Steering Wheel Puller | (7) Red/white Terminal |
| (2) Puller Adaptor | (8) Controller 4P Connector (view from the wire-connected side) |
| (3) Black Terminal (GND) | (9) Black/white Terminal |
| (4) Black Terminal (GND) | (10) Blue Terminal |
| (5) Notch | (11) Green Terminal |
| (6) EPS Controller 16P Connector (view from the wire-connected side) | (12) Black Terminal |

W1016611



Checking Continuity between the Torque Sensor 3P Connector and EPS Controller 16P Connector

- Using a circuit tester, check continuity between the terminals. Refer to the figure below.

Resistance (between same color terminal)	Factory spec.	0 Ω
Resistance (between different color terminal)	Factory spec.	$\infty \Omega$

- If the resistance is out of factory specification, repair or replace the wire harness with new one. If the resistance is okay, replace the power steering assembly with new one.

■ IMPORTANT

- In checking continuity, also swing the cable behind the connector.
Be very careful to keep the circuit tester probes tight at the terminals.

- | | |
|---|--------------------|
| (1) Torque Sensor 3P Connector | (5) Red Terminal |
| (2) EPS Controller 16P Connector (view from the wire connected side) | (6) White Terminal |
| (3) Notch | (7) Red Terminal |
| (4) Black/White Terminal | (8) Black Terminal |
| | (9) White Terminal |

W1017512

(7) Error Codes and Defective Sections

Read the error code on the warning lamp display and take measures as shown in the table below. For the procedures for taking measures, refer to page 5-S6.

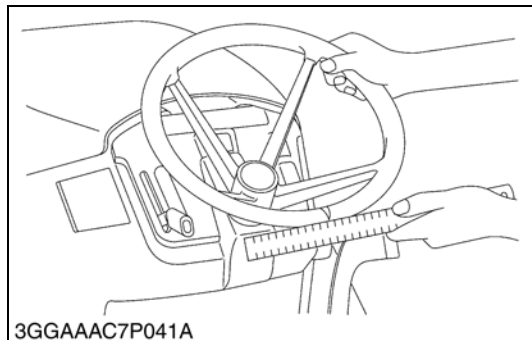
System name	Error code	Estimated defective section						Reset	Reference section
		Power source	Fuse 30A	Sensor	Motor	EPS Controller			
						4P	16P		
Power system	02	☆	☆		☆	☆		#1	5-S6
	03					☆	☆		5-S7
	05				☆	☆			5-S7
	06				☆	☆			5-S8
	15	☆	☆			☆			5-S9
	17				☆	☆			5-S10
	19					☆	☆		5-S10
	22					☆	☆		5-S10
Torque sensor system	11			☆			☆	#2	5-S8
	12			☆			☆		5-S9
	13			☆			☆		5-S9
EPS controller inside	23	☆	☆			☆		#1	5-S11
	32					☆	☆		5-S12
	34					☆	☆		5-S12
	35	☆							5-S13

W1018006

■ NOTE

- Resetting method (Reset after performing checking based on the error code.)
 #1: Turn off the main switch and then turn it on.
 #2: Perform fail-safe history erasing.

(8) Steering Wheel Play



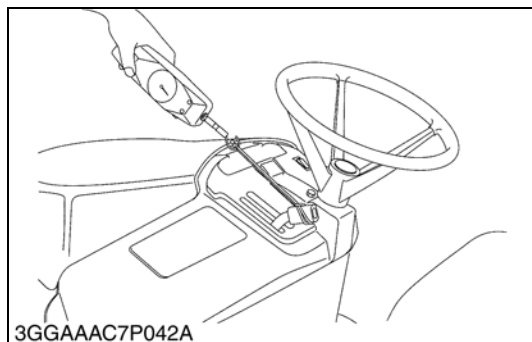
Steering Wheel Play

1. Turn the front wheels straight ahead.
2. Rotate the steering wheel lightly by hand, and measure the play.
3. If the measurement exceeds the factory specification, replace the steering shaft and sector gear.

Steering wheel play	Factory spec.	Less than 15 mm Less than 0.59 in.
---------------------	---------------	---------------------------------------

W1019944

(9) Throttle Lever Operating Force



Throttle Lever Operating Force

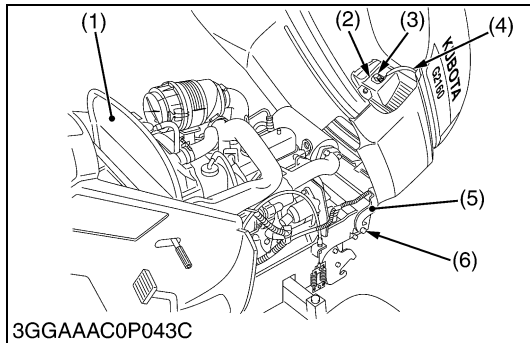
1. Set a spring balance at 20 mm (0.79 in.) below the tip of the throttle lever, and measure the operating force.
2. If the operating force is not within the factory specifications, turn the flange nut to adjust.

Throttle lever operating force	Factory spec.	30 to 50 N 3.1 to 5.1 kgf 66 to 110 lbs
--------------------------------	---------------	---

W1020146

[2] DISASSEMBLING AND ASSEMBLING

(1) Separating Power Steering Assembly and EPS Controller

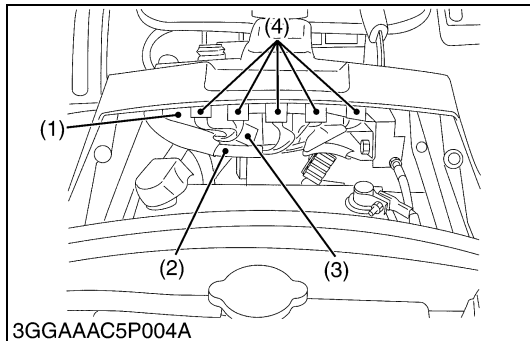


Battery and Bonnet

1. Turn the main switch off.
2. Remove the radiator screen (1).
3. Disconnect the negative cable from the battery.
4. Disconnect the **1P** connectors (3) from the head light (2).
5. Remove the wiring (4) from the bonnet.
6. Remove the bonnet stay mounting screws (6), and remove the bonnet with the bonnet bracket (5) from the frame.

- | | |
|--------------------------|---------------------------------|
| (1) Radiator Screen | (4) Wiring |
| (2) Head Light | (5) Bonnet Bracket |
| (3) 1P Connectors | (6) Bonnet Stay Mounting Screws |

W1020278

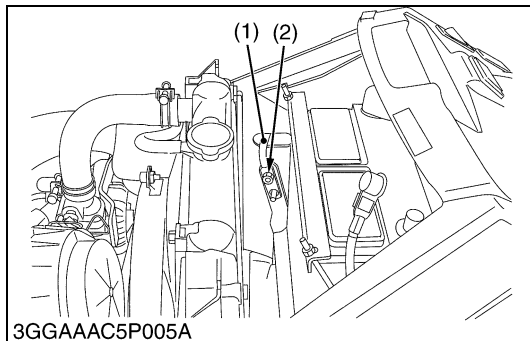


Wiring

1. Remove the indicator lamps (4).
2. Disconnect **1P** connector (3) from the hour meter.
3. Disconnect **1P** connector (1) from the light switch.
4. Disconnect **4P** connector (2) from the main switch.

- | | |
|-------------------------|-------------------------|
| (1) 1P Connector | (3) 1P Connector |
| (2) 4P Connector | (4) Indicator Lamp |

W1020553



Parking Lock Pedal

1. Remove the parking lock pedal mounting nut (2).
2. Remove the parking lock pedal (1) from the brake lock.

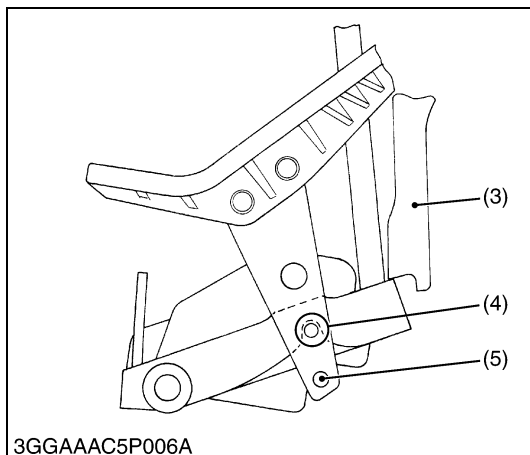
(When reassembling)

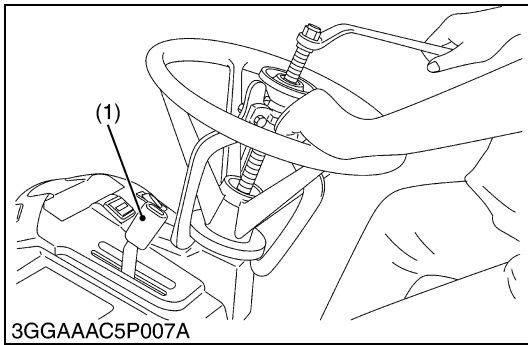
■ IMPORTANT

- Using the oval hole, make such adjustment that the parking lock pedal be kept out of contact with the panel over the entire stroke.
- Step on the brake pedal and parking lock pedal at once, and make sure that the speed change pedal gets locked.
- If the speed change pedal fails to get locked, set this pedal to the neutral position and readjust the brake lock (3) so that the lock pin (5) comes into the notch (4).

- | | |
|-------------------------------------|--------------|
| (1) Parking Lock Pedal | (4) Notch |
| (2) Parking Lock Pedal Mounting Nut | (5) Lock Pin |
| (3) Brake Lock | |

W1020703





Steering Wheel

1. Remove the grip of the throttle lever (1).
2. Remove the steering pad and remove the steering wheel mounting nut.
3. Remove the steering wheel using the steering wheel puller (Code. No. 07916-51090) and steering wheel puller adaptor.

■ IMPORTANT

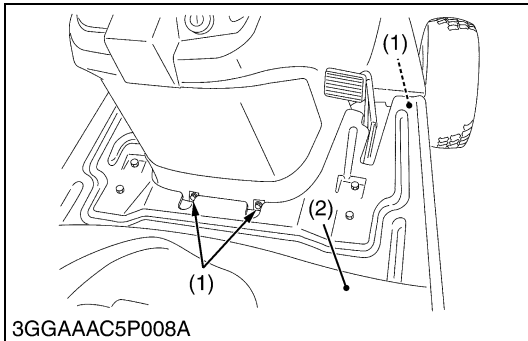
- When removing steering wheel, to use steering wheel puller. Not to use the hammer to prevent electric power steering from damaging.
- Remove the steering wheel after setting it to the straight ahead position.

(When reassembling)

Tightening torque	Steering wheel mounting nut	19.6 to 24.5 N·m 2.0 to 2.5 kgf·m 14.5 to 18.1 ft-lbs
-------------------	-----------------------------	---

(1) Throttle Lever

W1020923



Separating Panel

1. Remove the speed change pedal.
2. Peel the step sheet (2) halfway.
3. Remove the panel mounting screws (1).
4. Separate the panel.

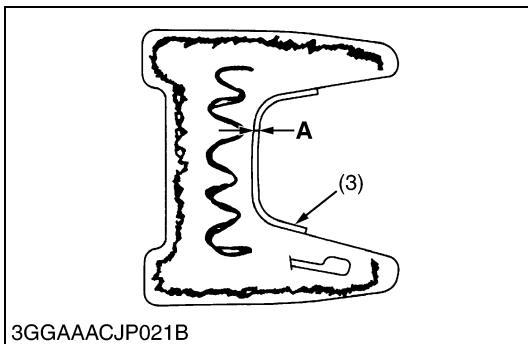
(When reassembling)

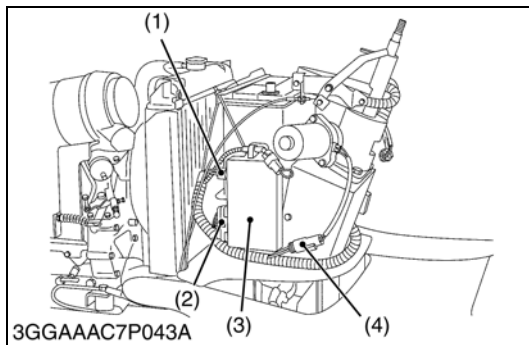
- Clean up the step sheet and the step. Apply instantaneous adhesive on the step sheet as shown in the figure.
- Position the step sheet so that the clearance between the step sheet and the panel is less than 2.0 mm (0.079 in.) as shown in the figure.

- (1) Panel Mounting Screw
(2) Step Sheet
(3) Panel

A : Less than 2.0 mm (0.079 in.)

W1022194





Wiring and EPS controller

1. Disconnect **2P** connector (4) from the motor.
2. Disconnect **3P** connector from the torque sensor.
3. Disconnect **4P** connector (1) and **16P** connector (2) from the EPS controller.
4. Remove the EPS controller (3).

(When reassembling)

■ IMPORTANT

- Be sure to perform right and left steering power setting (See page 5-S29).

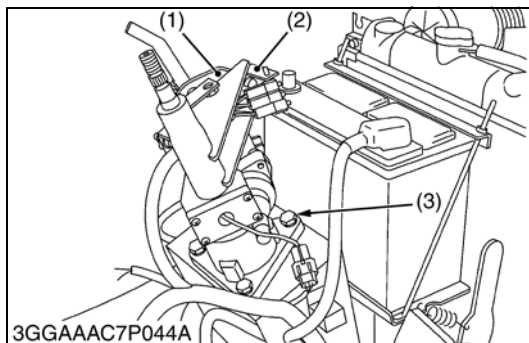
■ NOTE

- Take care not to drop the EPS controller.
- When installing the EPS controller, take care not to pinch the wire or interfere with other parts.

- (1) **4P** Connector
(2) **16P** Connector

- (3) EPS Controller
(4) **2P** Connector

W1022449



Throttle Lever Assembly and Power Steering Assembly

1. Remove the throttle lever assembly (1).
2. Remove the fuse plate (2).
3. Remove the universal joint mounting screw.
4. Remove the power steering assembly mounting screws (3).
5. Remove the power steering assembly with universal joint.

(When reassembling)

- There is a yoke at the center of the universal joint. Loosen the screw to let the center yoke (7) slide itself smoothly.
- Install the power steering assembly with universal joint.
- To reconnect the universal joint, tighten the lower and upper yoke screws (6), (9) first and then the center yoke screw (8).

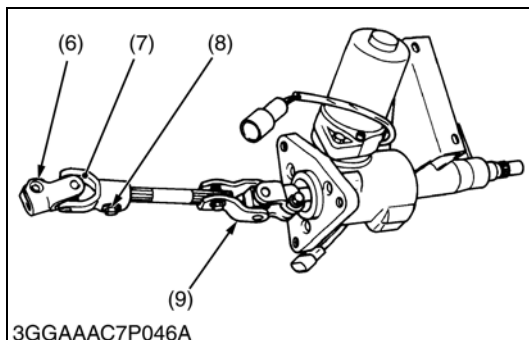
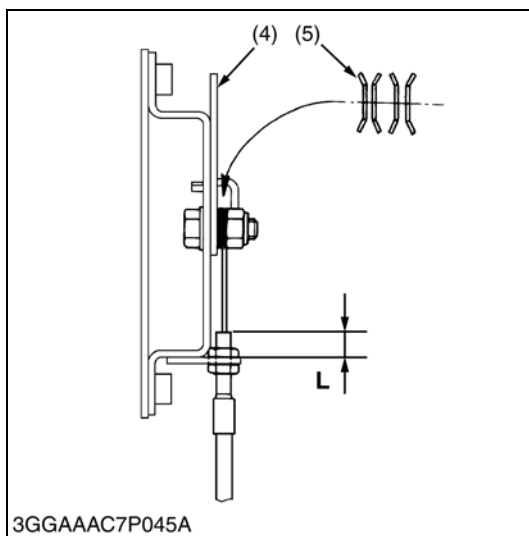
■ IMPORTANT

- Apply grease to the sliding parts.
- Apply oil to the throttle cable.
- Pay attention to the combination of the disk springs as shown in the figure.

(Reference)

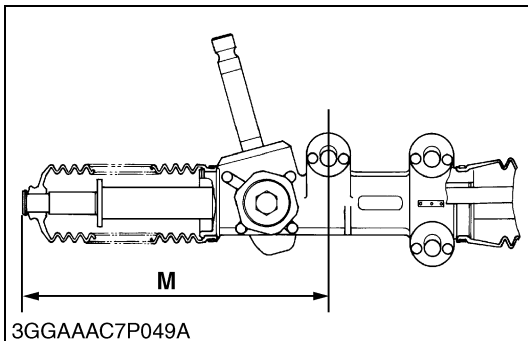
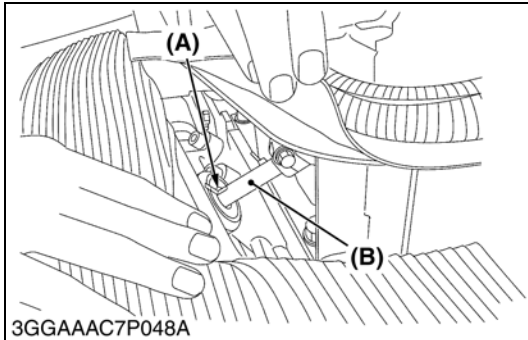
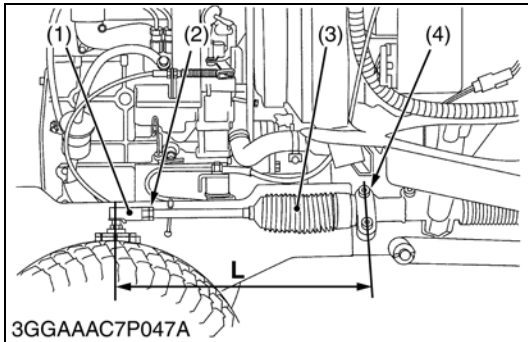
- Setting length "L": 10 mm (0.39 in.)

- | | |
|---|-----------------------|
| (1) Throttle Lever Assembly | (5) Disk Springs |
| (2) Fuse Plate | (6) Lower Yoke Screw |
| (3) Power Steering Assembly Mounting Screws | (7) Center Yoke |
| (4) Throttle Lever | (8) Center Yoke Screw |
| | (9) Upper Yoke Screw |



W1022705

(2) Power Steering Gear Case



Power Steering Gear Case

1. Remove the rod end mounting nut.
2. Remove the rod end (1).
3. Remove the power steering gear case mounting screws (4).
4. Remove the power steering gear case (3) with the rod end.

(When reassembling)

- Set the toe-in properly.
- Turn the front wheels straight ahead (neutral).
- As shown in the figure, align the center (A) of the power steering gear case with the center (B) of the power steering gear case shaft.

■ IMPORTANT

- After assembling the power steering gear case, be sure to adjust the toe-in.
- Replace the rod end mounting nut with a new one.

(Reference)

- Setting length "L": 382 mm (15.04 in.)
- Stroke center position "M": 206 mm (8.11 in.)

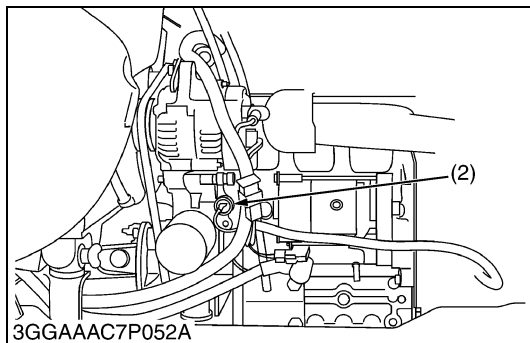
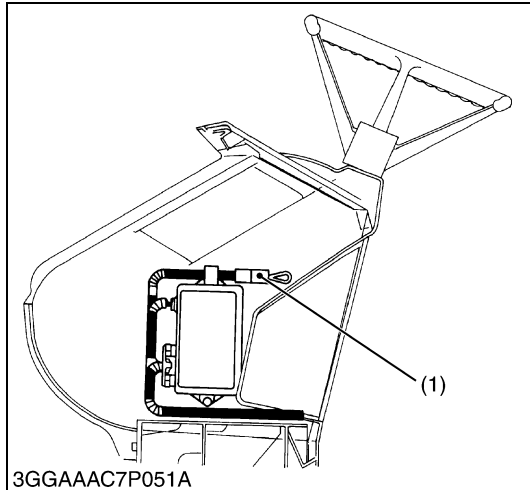
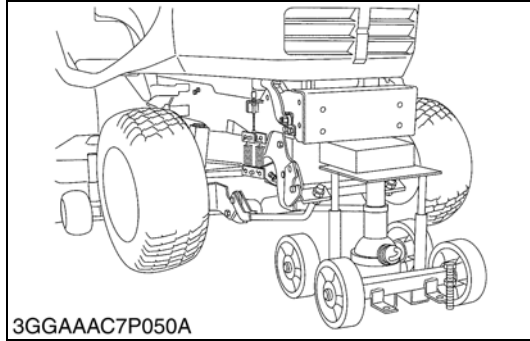
Tightening torque	Rod end mounting nut	108.8 to 130.3 N·m 11.1 to 13.3 kgf·m 80.3 to 96.2 ft-lbs
	Lock nut	62.7 to 72.5 N·m 6.4 to 7.4 kgf·m 46.3 to 53.5 ft-lbs
	Power steering gear case mounting screw	40.2 to 47.0 N·m 4.1 to 4.8 kgf·m 29.7 to 34.7 ft-lbs

- (1) Rod End
(2) Lock Nut

- (3) Power Steering Gear Case
(4) Power Steering Gear Case Mounting Screws

W1023119

[3] SERVICING



EPS Controller Right and Left Steering Force Setting at Neutral Position

■ IMPORTANT

- If this setting procedure is wrongly taken, the neutral position cannot be programmed in the controller. To take the procedure over again, be sure to go back to Setting Method No. 4 (with the main switch at off and the service connector (1) fit in position).

■ Setting Method

1. Park the machine on level ground.
2. Jack up or lift up the front frame.
3. Using a wooden wedge, etc., prevent the front axle assembly from oscillating.
4. Turn the steering wheel clockwise and counterclockwise one-quarter turn each.
5. Turn the front wheels and steering wheel straight ahead (neutral).
6. Turn on the main switch.
7. Disconnect the connector for servicing (1).
8. Turn off the main switch.
9. Connect the connector for servicing (1).
10. Lower the front frame.

■ IMPORTANT

- Do not start the engine while setting.
- Correct setting cannot be made if external force is applied to the steering wheel during setting.

Therefore take care not to apply external force to the steering wheel.

■ Check Test

1. Turn on the main switch.
2. Disconnect 1P connector (2) from the oil switch.
3. Turn the steering wheel clockwise and counterclockwise to check for difference in steering force.
4. If difference in steering force is found, make setting again.
5. Connect the connector to the oil switch.

■ IMPORTANT

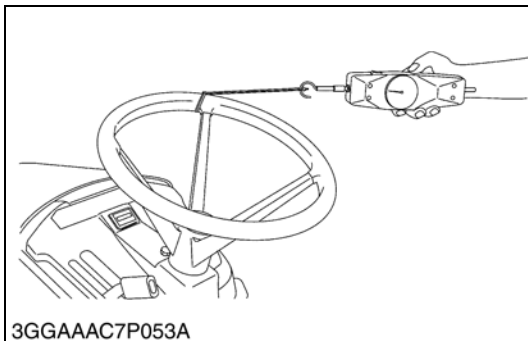
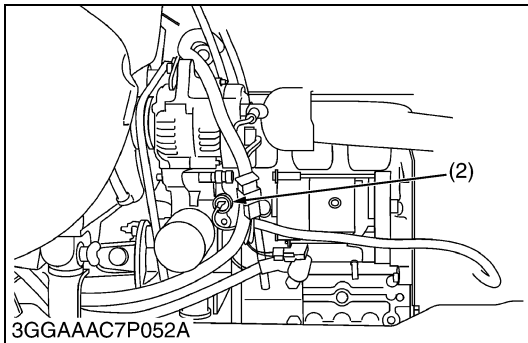
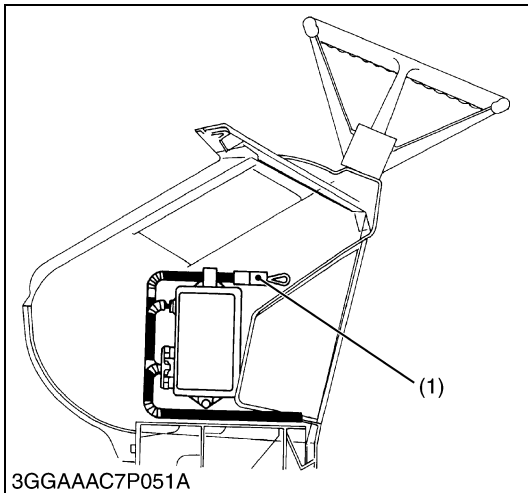
- When making setting again, turn off the main switch and wait or 10 seconds or more before doing so.
- If the connector (2) of the oil switch is left disconnected, a malfunction could be ceased after starting the engine.

Difference in steering force of steering wheel between right and left	Factory spec.	Less than 25 %
---	---------------	----------------

(1) Connector for Servicing

(2) 1P Connector

W1023981



Erasing Fail Safe History

■ IMPORTANT

- Do not start the engine while erasing.
- If the code erasing procedure is wrongly taken, the code cannot be erased. To take the procedure over again, go back to Setting Method No. 3 (with the main switch at OFF and the service connector fit in position).
- In case of the occurrence of error code 11, 12 or 13, be sure to perform history erasing according to the following procedure.

■ Setting Method

1. Park the machine on level ground.
2. Turn the front wheels and steering wheel straight ahead (neutral).
3. Turn on the main switch.
4. Disconnect the connector for servicing (1).
5. Disconnect **1P** connector (2) from the oil switch.
6. Turn off the main switch.
7. Connect the connector for servicing (1).
8. Connect **1P** connector (2) to the oil switch of the engine.

■ Check Test

1. Comply with the check test for right and left steering force setting.

(1) Connector for Servicing

(2) **1P** Connector

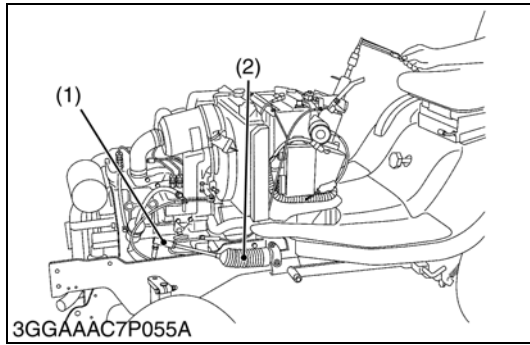
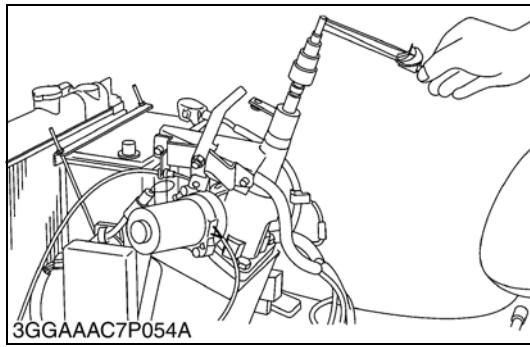
W1024460

Measurement of Steering Wheel Operation Load

1. Park the machine on level concrete surface.
2. Turn the front wheels and steering wheel straight ahead (neutral).
3. Attach a spring scale to the steering wheel.
4. Pull the spring scale in the direction tangent to the steering wheel.
5. Read the operation load on the scale at the time of the tire starting to move.
6. If the operation load is out of the factory specification, check the steering mechanical system.

Operation load (engine stopped) (without power assisting)	Factory spec.	Less than 150 N 15 kg 33 lbs
Operation load (engine started) (with power assisting)	Factory spec.	Less than 30 N 3 kg 6.6 lbs

W1025007



Checking of Steering Mechanical System

■ Checking of Power Steering Assembly

1. Remove the steering wheel.
2. Remove the power steering assembly.
3. Remove the universal joint.
4. Install the power steering assembly.
5. Attach a torque wrench to the steering shaft.
6. Measure the turning torque of the steering shaft.
7. If the measurement is not within the factory specification, replace the power steering assembly.

Turning torque (without power assisting)	Factory spec.	Less than 2.0 N·m 0.20 kgf·m 1.4 ft-lbs
--	---------------	---

■ Checking of Power Steering Gear Case

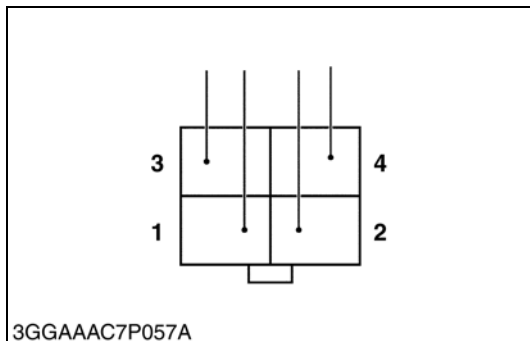
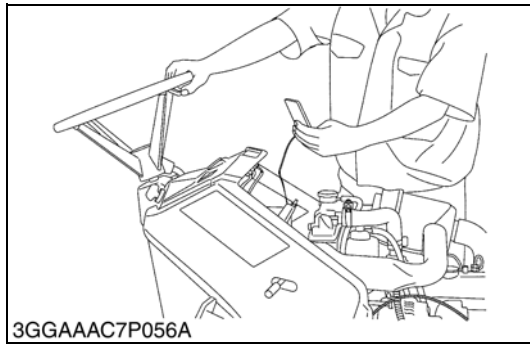
1. Remove the steering wheel.
2. Remove the rod end (1).
3. Attach a torque wrench to the steering shaft.
4. Measure the turning torque of the steering shaft.
5. If the measurement is not within the factory specification, replace the power steering gear case (2).

Turning torque (without power assisting)	Factory spec.	Less than 3.6 N·m 0.37 kgf·m 2.7 ft-lbs
--	---------------	---

(1) Rod End

(2) Power Steering Gear Case

W1025253



Voltage Measurement of 4P Connector of EPS Controller

1. Connect the leads of circuit tester to pins No. 2 (Blue) and No. 4 (Black/White) of EPS controller **4P** connector from behind.
2. Turn on the main switch.
3. Disconnect **1P** connector from the oil switch.
4. Measure the voltage between pins No. 2 (Blue) and No. 4 (Black/White) with the steering wheel set to the straight ahead position.

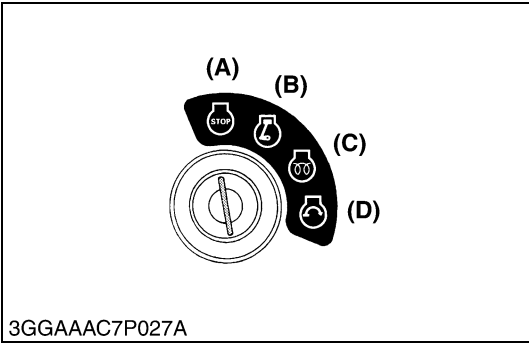
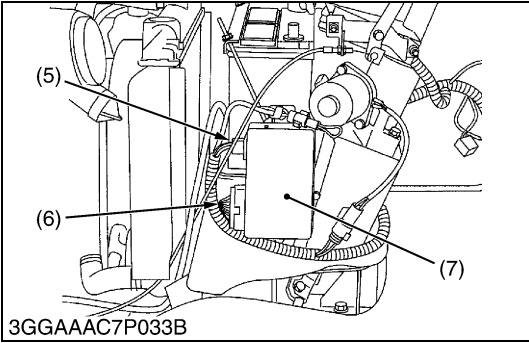
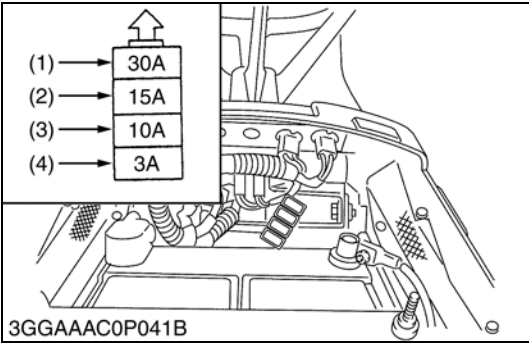
■ IMPORTANT

- Use a digital-type tester.

An analog-type tester could be damaged if used for this measurement.

PIN No.	WIRING COLOR	PIN SYMBOL	PIN NAME
1	Green	VBU	BATTERY VOLTAGE(+)
2	Blue	M+	MOTOR(+)
3	Black	P-GND	POWER GROUND
4	Black / White	M-	MOTOR(-)

W1025709



Checking EPS Controller for Trouble

- 1. To see if the EPS controller is in trouble, disconnect the **4P** (5) and **16P** (6) connectors from the controller. Without the controller, set the main switch to “**ON**” position **(B)** and see if the IG/M fuse (10A) (3) blows out.
- 2. When the IG/M fuse (3) does not blow out, replace the controller (7) with new one.
Make sure also that the battery cable terminals are tight enough. If the IG/M fuse (3) blows out, check the wire harness for defect. Repair as required.

Protected circuit

FUSE NO. (ID LABEL)		CAPACITY (A)	Protected circuit
(1)	EPS MT	30	Electric power steering moter circuit
(2)	E/G STOP	15	Engine stop timer relay
(3)	IG/M	10	Fuel pump, head light power steering control unit, etc.
(4)	OPC	3	Engine running circuit

- (1) EPS MT Fuse
 - (2) E/G STOP Fuse
 - (3) IG/M Fuse
 - (4) OPC Fuse
 - (5) **4P** Connector
 - (6) **16P** Connector
 - (7) EPS Controller
- (A)** Key Switch “OFF”
 - (B)** Key Switch “ON”
 - (C)** Key Switch “PREHEAT”
 - (D)** Key Switch “START”

W1026098

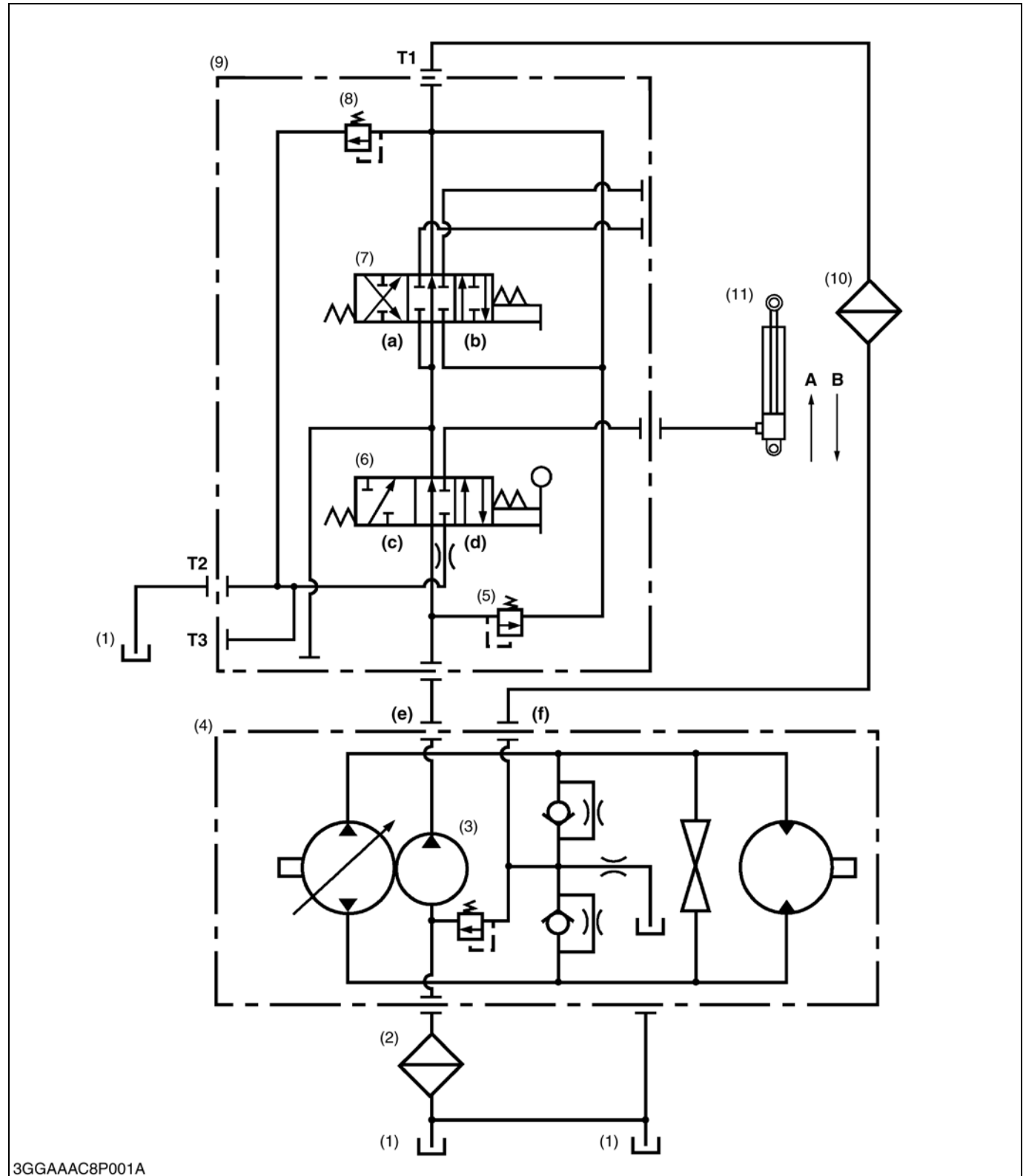
6 HYDRAULIC SYSTEM

MECHANISM

CONTENTS

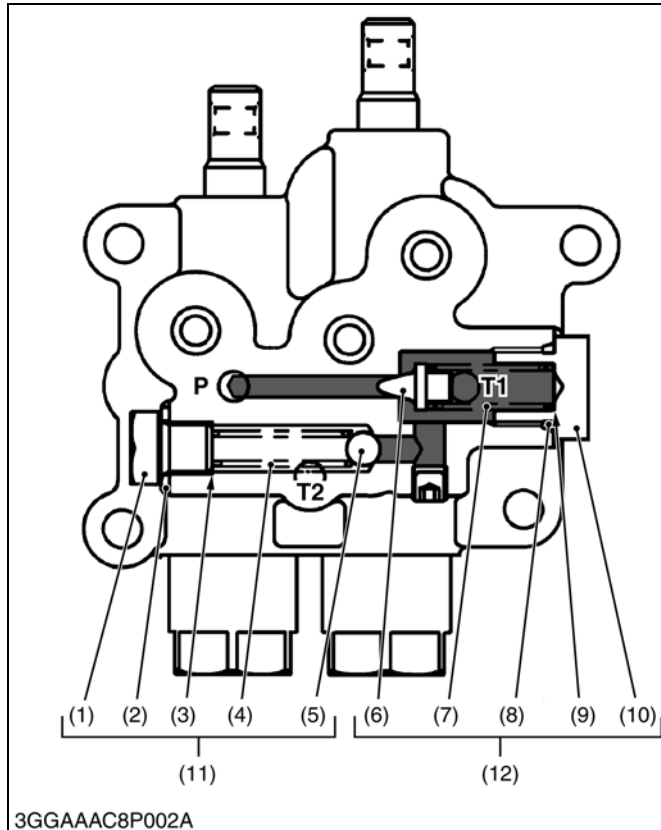
1. HYDRAULIC CIRCUIT (LOW DUMP).....	6-M1
2. RELIEF VALVE	6-M2
3. CONTROL VALVE	6-M2
[1] MOWER LIFTING CIRCUIT.....	6-M2

1. HYDRAULIC CIRCUIT (LOW DUMP)



- | | | | |
|-------------------------------------|--|------------------|-------------------|
| (1) Transmission Case | (7) Valve (for Grass Collector Cylinder) | A : Up | (c) Up |
| (2) Oil Strainer | | B : Down | (d) Down |
| (3) Charge Pump | (8) Filter Relief Valve | (a) Open | (e) Out |
| (4) Hydrostatic Transmission (HST) | (9) Control Valve | (b) Close | (f) Return |
| (5) Relief Valve | (10) Oil Filter Cartridge | | |
| (6) Valve (for Mower Life Cylinder) | (11) Mower Lift Cylinder | | |

2. RELIEF VALVE



This machine is equipped with two direct-acting relief valves (11), (12).

The main relief valve (12) serves to control the pressures of the mower lift cylinder and grass collector cylinder and to protect the entire hydraulic system against damage.

The filter relief valve (11) is used to protect the entire hydraulic system from an excessive pressure that would be caused by a clogged oil filter.

These relief valves consist of poppet valve, spring, shims and plug.

When the oil pressure in the circuit is lower than the setting pressure of the relief valve, the poppet is closed by the spring.

When the oil pressure rises above the valve setting pressure and overcomes the spring force, the valve opens. The oil then flows out to the transmission case, preventing any further rise in pressure. The relief valve closes again when enough oil is released to drop pressure below the valve setting pressure.

- | | |
|------------------------|--------------------------|
| (1) Bolt | (9) Shims |
| (2) Washer with Rubber | (10) Plug |
| (3) Shims | (11) Filter Relief Valve |
| (4) Spring | (12) Main Relief Valve |
| (5) Steel Ball | |
| (6) Poppet | |
| (7) Spring | |
| (8) O-ring | |

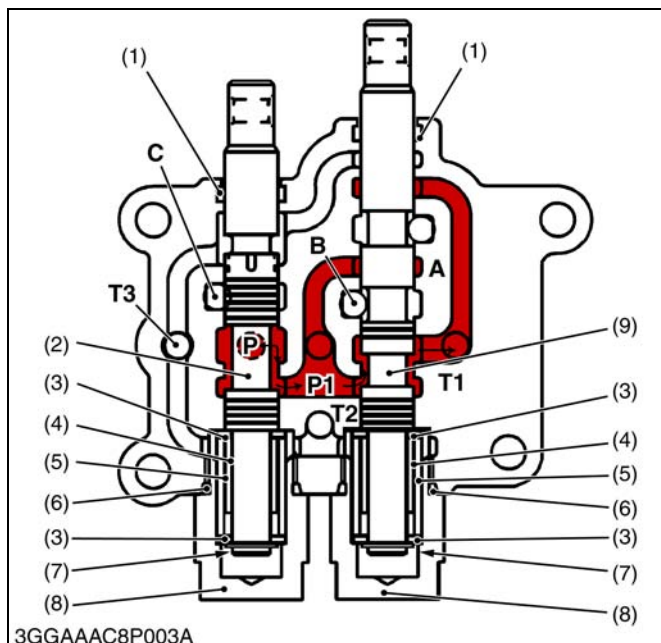
P : Pump Port
T1, T2: Tank Port

W1012822

3. CONTROL VALVE

In this hydraulic system, the mower lifting circuit is given priority to the grass collector dumping circuit.

[1] MOWER LIFTING CIRCUIT



Suppose that the grass collector dumping spool (spool 2) (9) is in the neutral position.

■ Neutral

The oil coming from port **P** flows to the port **T1**.

The oil then flows through the oil filter and back to the hydrostatic transmission (HST).

The port **C**, which is connected with the mower lift cylinder, stays closed by the spool 1 (for mower cylinder) (1). In this way, the mower is held at a certain level.

- | | |
|--|---|
| (1) Seat | A : Grass Collector Cylinder Port |
| (2) Spool 1 (for Mower Cylinder) | B : Grass Collector Cylinder Port |
| (3) Plain Washer | C : Mower Lift Cylinder Port |
| (4) Collar | P : Pump Port |
| (5) Return Spring | T1, T2 : Tank Port |
| (6) O-ring | P1, T3 : These ports are blocked the control valve adaptor. These ports are designed to activate the relief valves. Actually no oil flows in and out of these ports. |
| (7) Snap Ring | |
| (8) Plug | |
| (9) Spool 2 (for Grass Collector Cylinder) | |

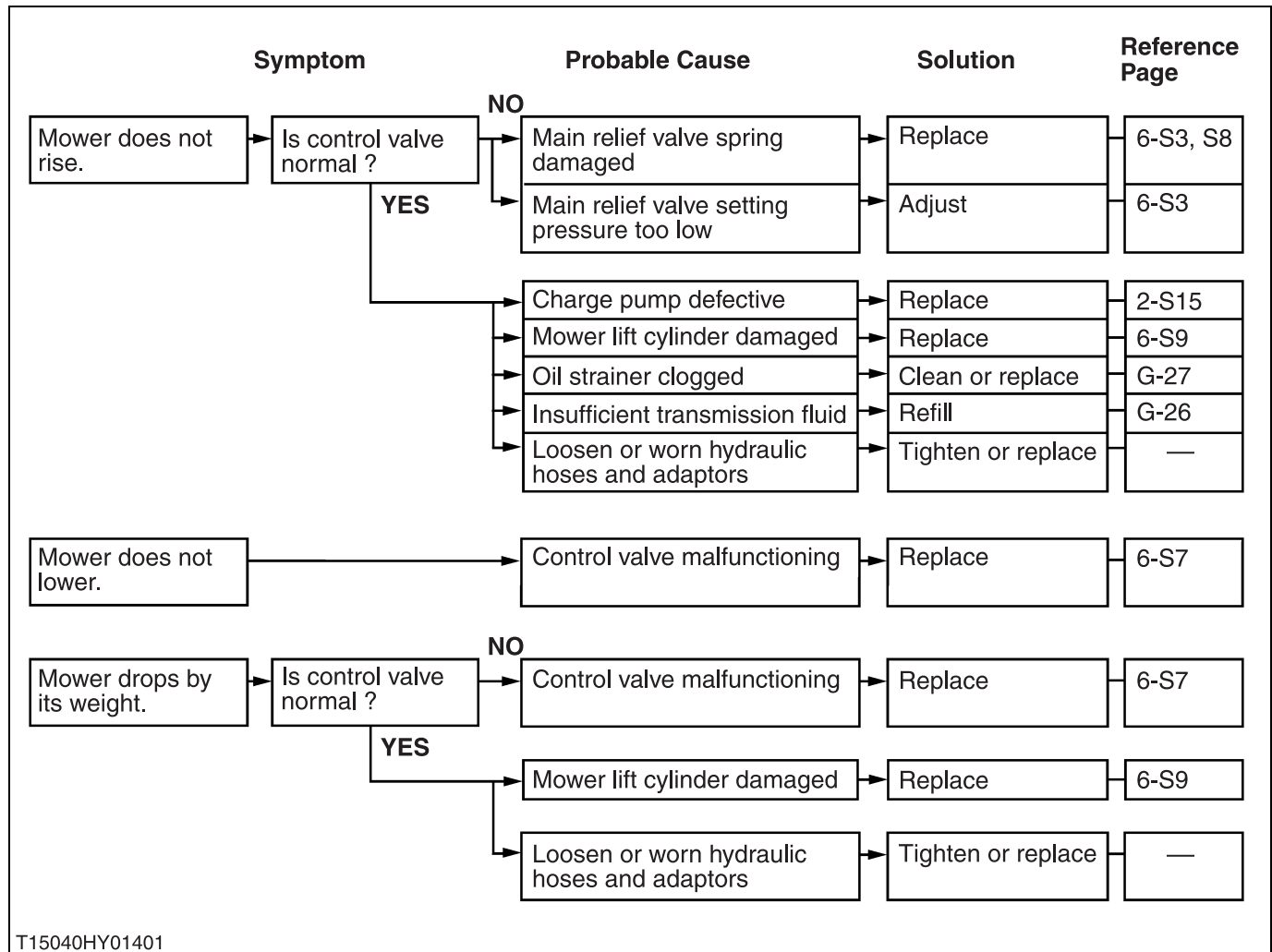
W1013046

SERVICING

CONTENTS

1. TROUBLESHOOTING	6-S1
2. SERVICING SPECIFICATIONS	6-S1
3. TIGHTENING TORQUES	6-S2
4. CHECKING, DISASSEMBLING AND SERVICING.....	6-S3
[1] CONTROL VALVE	6-S3
(1) Checking and Adjusting	6-S3
(2) Disassembling and Assembling	6-S5
[2] CYLINDER	6-S9
(1) Disassembling and Assembling	6-S9
[3] MOWER LIFT LINKAGE	6-S10
(1) Checking and Adjusting	6-S10
(2) Disassembling and Assembling	6-S10

1. TROUBLESHOOTING



2. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
Main Relief Valve	Setting Pressure	2.94 to 3.43 MPa 30.0 to 35.0 kgf/cm ² 426 to 497 psi	—
Filter Relief Valve	Setting Pressure	1.96 to 2.45 MPa 20.0 to 25.0 kgf/cm ² 284 to 356 psi	—
Transmission Fluid (Including HST & cylinder)	Capacity	4.5 L 4.75 U.S.qts. 3.86 Imp.qts.	—
Rear Link to Frame Stopper	Clearance	1.0 to 2.0 mm 0.04 to 0.08 in.	—

W1010648

3. TIGHTENING TORQUES

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

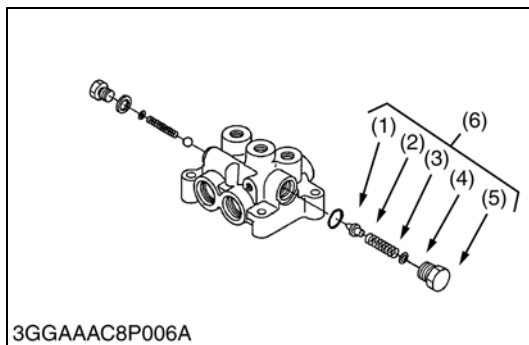
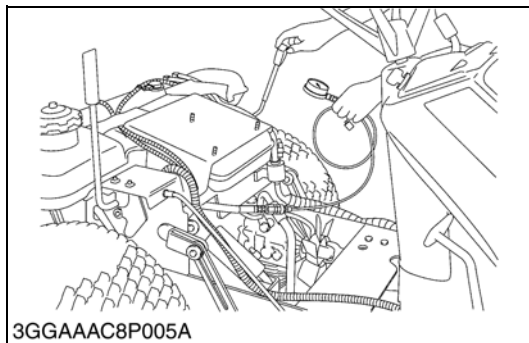
Item	N·m	kgf·m	ft-lbs
Cam mounting nut	39.2 to 45.1	4.0 to 4.6	28.9 to 33.3
Adaptor bolt (PS 3/8)	80.4	8.2	59.3
Drain pipe retaining bolt (9/16-18 UNF)	27.4	2.8	20.3
Adaptor (on the control valve)	35.3	3.6	26.0
Mower lift cylinder hose	14.7	1.5	10.8
Adaptor (mower lift cylinder)	35.3	3.6	26.0
Cylinder head	250 to 300	25.5 to 30.6	184 to 221
Cylinder piston mounting lock nut	300 to 350	30.6 to 35.7	221 to 258

W1012736

4. CHECKING, DISASSEMBLING AND SERVICING

[1] CONTROL VALVE

(1) Checking and Adjusting



Main Relief Valve Setting Pressure



CAUTION

- **When checking, park the tractor on flat ground, apply the parking brake.**
1. Disconnect the cylinder hose from the mower lift cylinder.
 2. Set the adaptor for control valve (see page G-39.), thread joint (Code No.: 07916-50341), cable (Code No.: 07916-50331), thread joint (Code No.: 07916-50401) and pressure gauge 50 (Code No.: 07916-52961).
 3. Start the engine and run the engine speed at rated speed.
 4. Move the mower control lever to "**LIFT**" position to operate the main relief valve.
 5. Read the pressure gauge.
 6. If the pressure is not within the factory specifications, adjust with the adjusting shims.

Main relief valve setting pressure	Factory spec.	2.94 to 3.43 MPa 30.0 to 35.0 kgf/cm ² 426 to 497 psi
------------------------------------	---------------	--

Condition

- Engine Speed.....Rated speed
- Oil Temperature..40 to 50 °C (104 to 122 °F)

■ IMPORTANT

- **Measure quickly so that the man relief valve may not be in operation more than 10 seconds.**

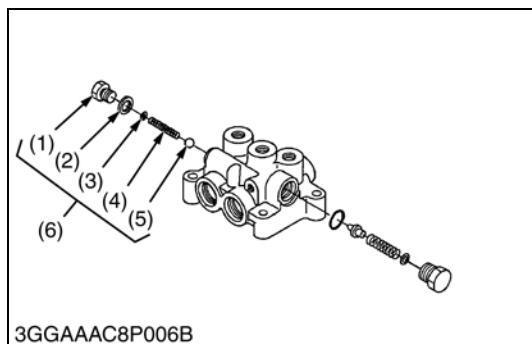
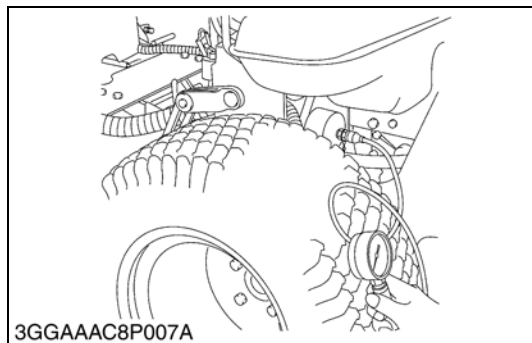
(Reference)

- Thickness of adjusting shims:
0.2 mm (0.008 in.) (Part No.: 48100-36280)
0.3 mm (0.012 in.) (Part No.: 48100-36270)

- (1) O-ring
- (2) Poppet
- (3) Spring

- (4) Shims
- (5) Plug
- (6) Main Relief Valve

W1010979



Filter Relief Valve Setting Pressure



CAUTION

- **When checking, park the tractor on flat ground, apply the parking brake.**
1. Remove the oil filter cartridge.
 2. Set the flange for control valve (see page G-42), O-rings, thread joint (Code No.: 07916-50341), cable (Code No.: 07916-50331), thread joint (Code No.: 07916-50401) and pressure gauge 50 (Code No.: 07916-52961).
 3. Start the engine and run the engine speed at rated speed.
 4. Read the pressure gauge.
 5. If the pressure is not within the factory specifications, adjust with the adjusting shims.

Filter relief valve setting pressure	Factory spec.	1.96 to 2.45 MPa 20.0 to 25.0 kgf/cm ² 284 to 356 psi
--------------------------------------	---------------	--

Condition

- Engine Speed.....Rated speed
- Oil Temperature..40 to 50 °C
104 to 122 °F

IMPORTANT

- **Measure quickly so that the filter relief valve may not be in operation more than 10 seconds.**

(Reference)

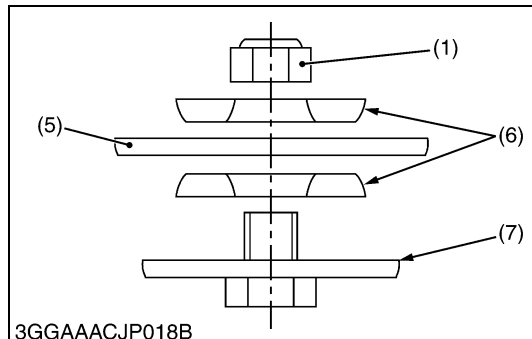
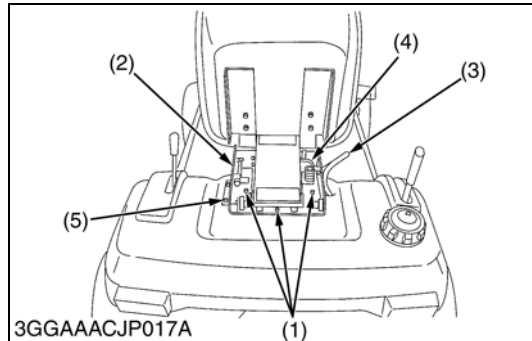
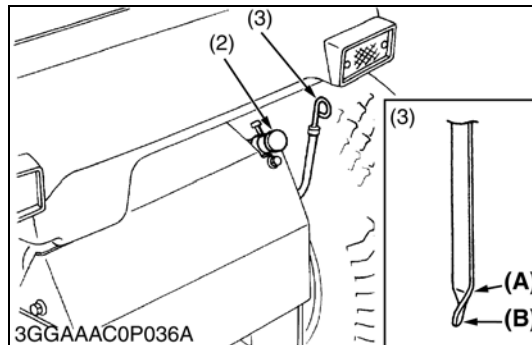
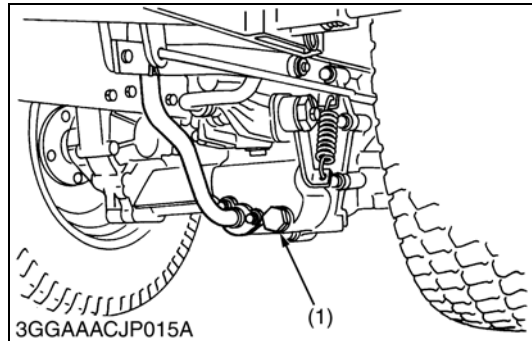
- Thickness of adjusting shims:
0.3 mm (0.012 in.) (Parts No.: 66101-36240)
0.5 mm (0.020 in.) (Parts No.: 66101-36230)

- | | |
|------------------------|-------------------------|
| (1) Plug | (4) Spring |
| (2) Washer with Rubber | (5) Steel Ball |
| (3) Shims | (6) Filter Relief Valve |

W1011453

(2) Disassembling and Assembling

(A) Separating Control Valve



Dismount Mower

1. See to "MOWER" section.

W1011842

Draining Transmission Fluid

1. Place an oil pan underneath the drain plug (1).
2. Remove the drain plug (1).
3. Remove the oil inlet plug (2) to completely drain the transmission fluid.
4. After draining, screw in the drain plug (1) and the oil inlet plug (2).

(When refilling)

- Use the specified transmission fluid.
- Refer to "**LUBRICANTS, FUEL AND COOLING WATER**" (See Page G-8).
- Never work the machine immediately after changing the transmission fluid. Keep the engine at medium speed for a few minutes to prevent damage to the transmission.

Transmission fluid (Including HST cylinder)	Capacity	4.5 L 4.8 U.S.qts. 4.0 Imp.qts.
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- (1) Drain Plug
- (2) Oil Inlet Plug
- (3) Oil Level Dipstick

(A) Upper Level

(B) Lower Level

W1011896

Seat

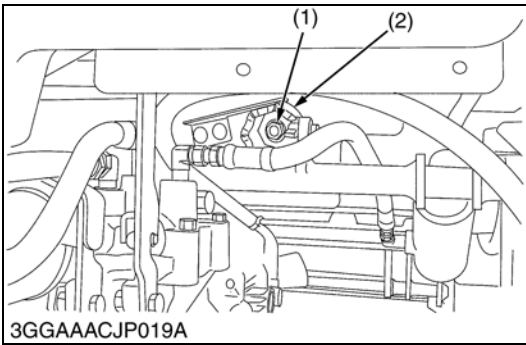
1. Disconnect the **2P** connector (3) from the seat switch.
2. Remove the seat support mounting lock nuts (1).
3. Remove the guide washers, spring washers and screws (4).
4. Remove the seat bracket (2).
5. Remove the seat with seat support (5).

(When reassembling)

- Turn the seat support mounting lock nuts all the way until it seats lightly. Then, turn seat support mounting lock nuts counterclockwise by a half turn.
- Apply oil to the seat support.
- Face smooth side the plane washers (6) to the seat support.

- (1) Seat Support Mounting Lock Nuts
- (2) Seat Bracket
- (3) **2P** Connector
- (4) Screws
- (5) Seat Support
- (6) Plane Washers
- (7) Fender

W1012174

**Cutting Height Adjusting Dial**

1. Lift the mower to the highest position.
2. Remove the cam mounting nut (1).
3. Remove the cutting height adjusting dial, plain washer and cam (2).

(When reassembling)

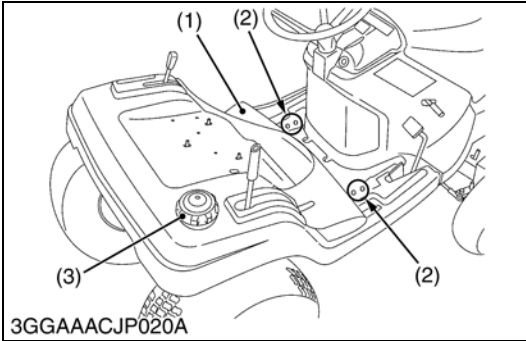
- Apply grease to the outside of cam.

Tightening torque	Cam mounting nut	39.2 to 45.1 N·m 4.0 to 4.6 kgf·m 28.9 to 33.3 ft-lbs
-------------------	------------------	---

(1) Cam Mounting Nut

(2) Cam

W1012416

**Separating Fender**

1. Remove the speed change pedal.
2. Peel the step sheet (1) halfway.
3. Remove the step support mounting screws (2).
4. Remove the step support (5) and rubber bushing (6).
5. Remove the fuel cap (4).
6. Separate the fender from the frame.

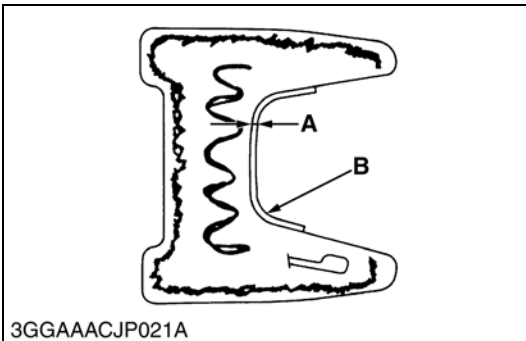
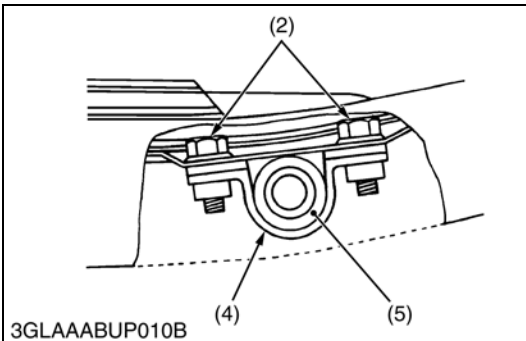
(When reassembling)

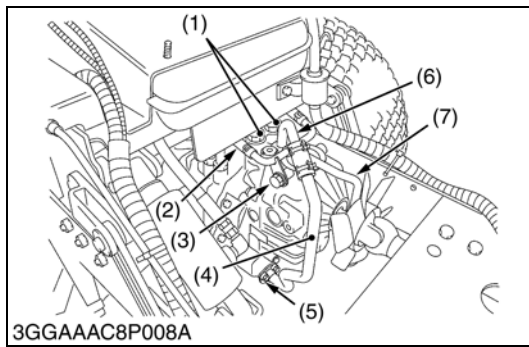
- Apply grease to the inside of rubber bushing.
- Clean up the step sheet and the step. Apply instantaneous adhesive on the step sheet as shown in the figure.
- Position the step sheet so that the clearance between the step sheet and the panel is less than 2.0 mm (0.079 in.) as shown in the figure.

- (1) Step Sheet
- (2) Step Support Mounting Screws
- (3) Fuel Cap
- (4) Step Support
- (5) Rubber Bushing

- (A) Less than 2.0 mm
(0.079 in.)
- (B) Panel

W1012693





Separating Control Valve Assembly

1. Remove the Mower lift lever from the control valve assembly.
2. Remove the stopper plate (5).
3. Remove the suction pipe (4) with the oil strainer.
4. Disconnect the hydraulic hoses (2), (6) from the drain pipe (7).
5. Remove the drain pipe retaining bolt (3).
6. Remove the drain pipe (7).
7. Remove the control valve assembly stay mounting screw.
8. Remove the adaptor bolts (1) with the gaskets.
9. Remove the control valve assembly with the filter from the transmission.

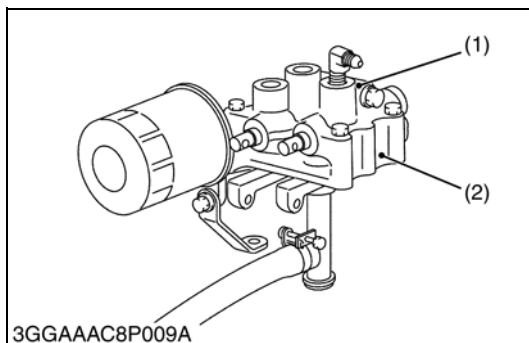
(When reassembling)

- First tighten the adaptor bolts into the control valve assembly. Then tighten up the control valve assembly stay mounting screw.

Tightening torque	Adaptor bolt	80.4 N·m 8.2 kgf·m 59.3 ft-lbs
	Drain pipe retaining bolt	27.4 N·m 2.8 kgf·m 20.3 ft-lbs

- | | |
|-------------------------------|--------------------|
| (1) Adaptor Bolts | (5) Stopper Plate |
| (2) Hydraulic Hose | (6) Hydraulic Hose |
| (3) Drain Pipe Retaining Bolt | (7) Drain Pipe |
| (4) Suction Pipe | |

W1013013



Separating Control Valve

1. Separate the control valve (1) with the adaptors from the control valve adaptor (2).

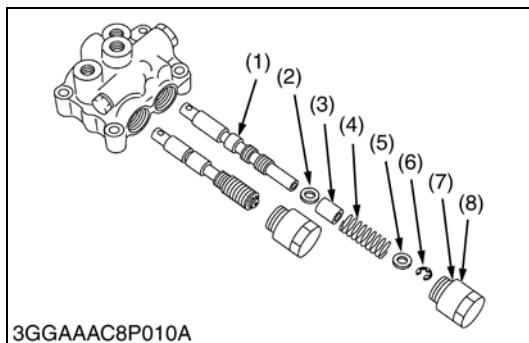
(When reassembling)

- Take care not to damage the O-rings.

- | | |
|-------------------|---------------------------|
| (1) Control Valve | (2) Control Valve Adaptor |
|-------------------|---------------------------|

W1013384

(B) Disassembling Control Valve



Plug and Spool

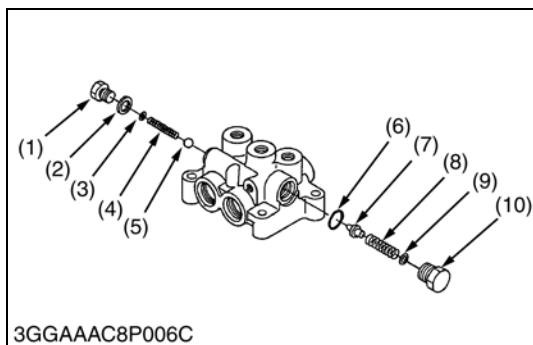
1. Remove the plug.
2. Draw out the spool assembly.

(When reassembling)

- Take care not to damage the O-rings.

- | | |
|------------------|------------------|
| (1) Spool | (5) Plane Washer |
| (2) Plane Washer | (6) Snap Ring |
| (3) Collar | (7) O-ring |
| (4) Spring | (8) Plug |

W1013554



Relief Valve

1. Remove the bolt (1).
2. Remove the shims (3), washer with rubber (2), spring (4) and steel ball (5).
3. Remove the plug (10).
4. Remove the shims (9), O-ring (6), spring (8) and poppet (7).

(When reassembling)

- Take care not to damage the O-rings.
- Install the relief valve, noting the number of shims.

■ IMPORTANT

- **After reassembling the relief valve, be sure to adjust its setting pressure. (See page 6-S3.)**

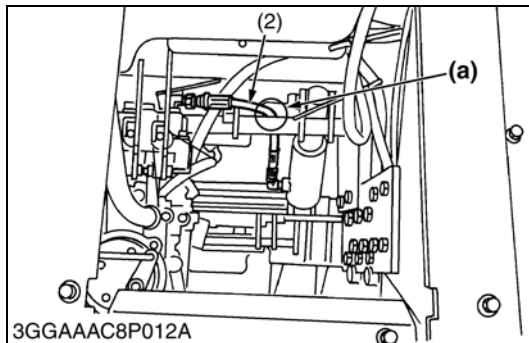
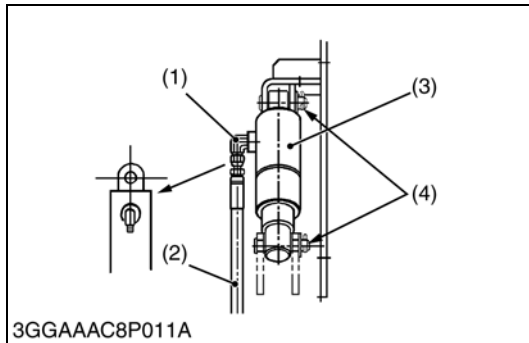
- | | |
|------------------------|------------|
| (1) Bolt | (6) O-ring |
| (2) Washer with Rubber | (7) Poppet |
| (3) Shims | (8) Spring |
| (4) Spring | (9) Shims |
| (5) Steel Ball | (10) Plug |

W1013734

[2] CYLINDER

(1) Disassembling and Assembling

(A) Mower Lift Cylinder



Separating Mower Lift Cylinder

1. Disconnect the mower lift cylinder hose (2).
2. Pull out the cotter pins (4).
3. Separate the mower lift cylinder (3) from the frame.
4. Remove the adaptor (1).

(When reassembling)

- Install the adaptor as shown in the figure.
- Keep the clearance between the mower lift cylinder hose and other parts.

Tightening torque	Mower lift cylinder hose	14.7 N·m 1.5 kgf·m 10.8 ft-lbs
	Adaptor (Mower lift cylinder)	35.3 N·m 3.6 kgf·m 26.0 ft-lbs

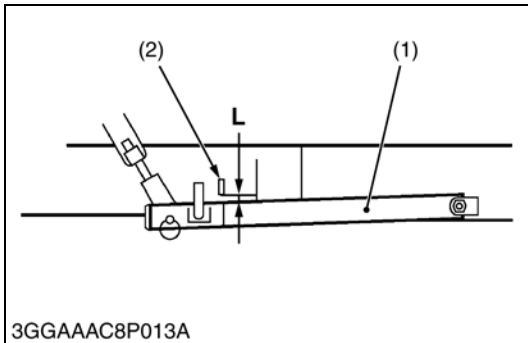
- (1) Adaptor (Mower Lift Cylinder)
- (2) Mower Lift Cylinder Hose
- (3) Mower Lift Cylinder
- (4) Cotter Pins

(a) Keep Clearance

W1017880

[3] MOWER LIFT LINKAGE

(1) Checking and Adjusting



Clearance between Rear Link and Frame Stopper

1. Lift the rear link assembly (1) to the highest position.
2. Measure the clearance (**L**) between the rear link assembly and frame stopper (2).
3. If the measure is not within the factory specifications, adjust the length (**L1**) of upper lift link (4) and lower lift link (3).

Clearance (L) between rear link and frame stopper	Factory spec.	1.0 to 2.0 mm 0.04 to 0.08 in.
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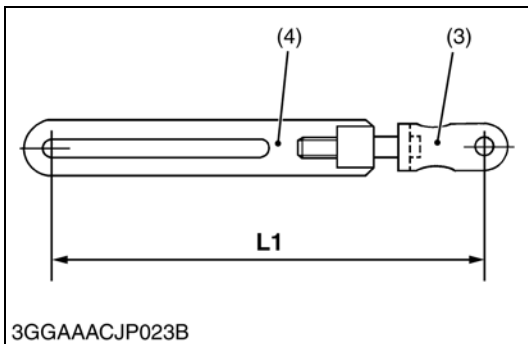
(Reference)

- **L1** :350mm (13.8in.)

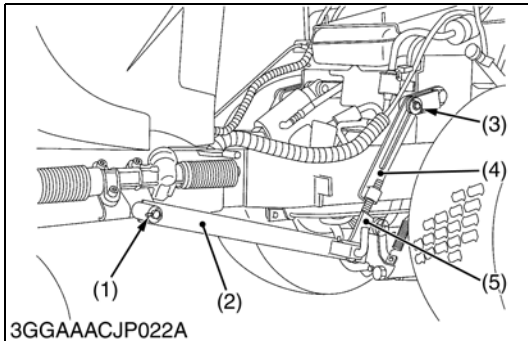
- (1) Rear Link Assembly
(2) Frame Stopper

- (3) Lower Lift Link
(4) Upper Lift Link

W1018142



(2) Disassembling and Assembling



Upper Lift Link and Rear Link Assembly

1. Pull out the rue ring cotters (3) and plane washers.
2. Remove the upper lift links (4).
3. Pull out the cotter pin (1) and plane washer.
4. Remove the L.H. rear link assembly (2).
5. Remove the R.H. rear link assembly retaining lock nut and bolt.
6. Remove the R.H. rear link assembly.

(When reassembling)

- Apply the grease to the rotary sliding surface.
- Adjust the upper lift link and lower lift link referring to the "MOWER" section.

■ IMPORTANT

- **Tighten the R.H. rear link assembly lock nut and bolt, leaving gap between the frame and the lock nut as little as possible. Also be sure that the rear link assembly turns smoothly.**

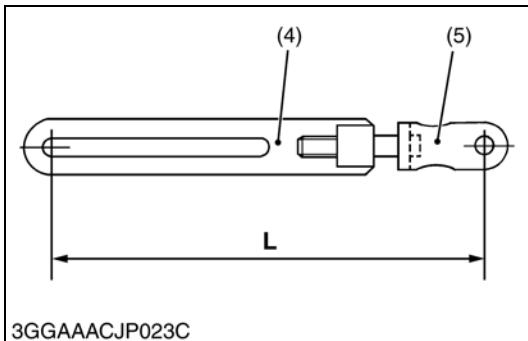
(Reference)

- **L** : 350mm (13.8 in.)

- (1) Cotter Pin
(2) L.H. Rear Link Assembly
(3) Rue Ring Cotter

- (4) Upper Lift Link
(5) Lower Lift Link

W1018593



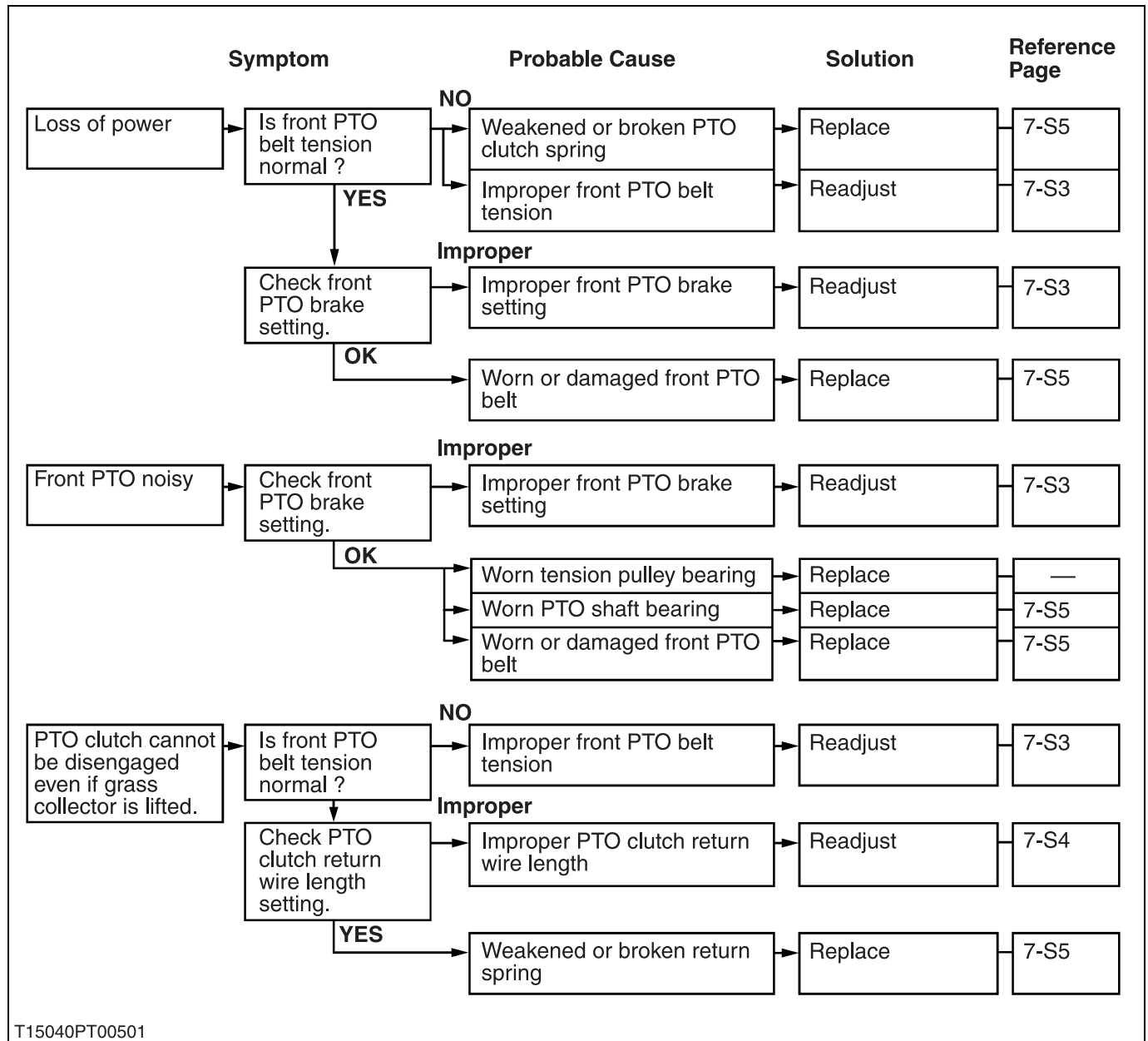
7 PTO SYSTEM

SERVICING

CONTENTS

1. TROUBLESHOOTING	7-S1
2. SERVICING SPECIFICATIONS	7-S2
3. CHECKING, DISASSEMBLING AND SERVICING.....	7-S3
[1] CHECKING AND ADJUSTING	7-S3
[2] DISASSEMBLING AND ASSEMBLING.....	7-S5
[3] SERVICING	7-S6

1. TROUBLESHOOTING



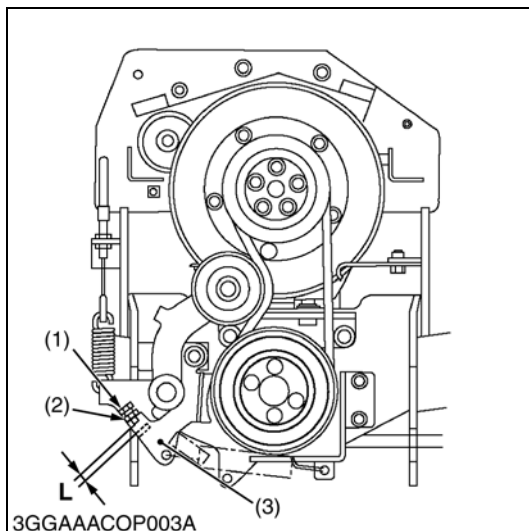
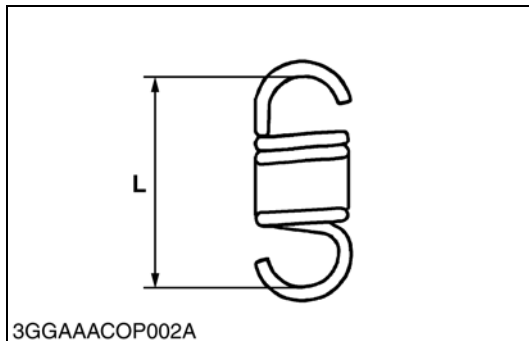
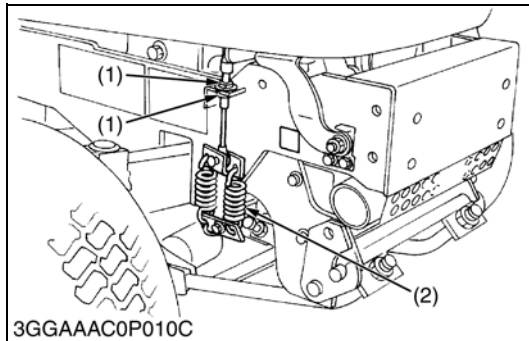
2. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
PTO Clutch Spring	Length	88.0 to 89.0 mm 3.47 to 3.54 in.	—
Tension Arm to Tip of Adjusting Screw	Clearance	3.0 to 4.0 mm 0.12 to 0.16 in.	—
Belt Stay to Front PTO Belt	Clearance	1.0 to 2.5 mm 0.04 to 0.10 in.	—
Belt Retainer to Front PTO Belt	Clearance	2.0 mm 0.08 in.	—
Tension Collar to Tension Arm Bushing	Clearance	0.002 to 0.114 mm 0.0001 to 0.0045 in.	0.30 mm 0.0118 in.
Tension Collar	O.D.	19.000 to 19.030 mm 0.7480 to 0.7492 in.	—
Tension Arm Bushing	I.D.	19.032 to 19.114 mm 0.7493 to 0.7525 in.	—
Brake Lining	Thickness	5.7 to 6.3 mm 0.224 to 0.248 in.	4.0 mm 0.157 in.
Front PTO Pulley	O.D.	123.9 to 124.0 mm 4.878 to 4.882 in.	123.0 mm 4.843 in.

W1013874

3. CHECKING, DISASSEMBLING AND SERVICING

[1] CHECKING AND ADJUSTING



PTO Belt Tension

1. Place the machine on level ground, and stop the engine.
2. Set the PTO clutch lever to “**ENGAGE**” position.
3. Measure the length (L) of PTO clutch spring (2).
4. If the measurement is not within the factory specifications, adjust with the adjusting nuts (1).

Length (L) of PTO clutch spring	Factory spec.	88.0 to 89.0 mm 3.47 to 3.54 in.
---------------------------------	---------------	-------------------------------------

■ **IMPORTANT**

- When replace the front PTO belts with new ones, the length (L) of PTO clutch spring (2) should be 91 to 92 mm (3.58 to 3.62 in.).

After working for 50 hours, be sure to readjust the length (L) to the factory specifications.

(1) Adjusting Nuts

(2) PTO Clutch Spring

W1010891

Adjusting Front PTO Brake

1. Place the machine on level ground, and stop the engine.
2. Set the PTO clutch lever to “**DISENGAGE**” position.
3. Measure the clearance (L) between the tension arm (3) and tip of adjusting screw (1).
4. If the measurement is not within the factory specifications, loosen the lock nut (2) and turn the adjusting screw (1) to adjust.

Clearance (L) between the tension arm and tip of adjusting screw	Factory spec.	3.0 to 4.0 mm 0.12 to 0.16 in.
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■ **IMPORTANT**

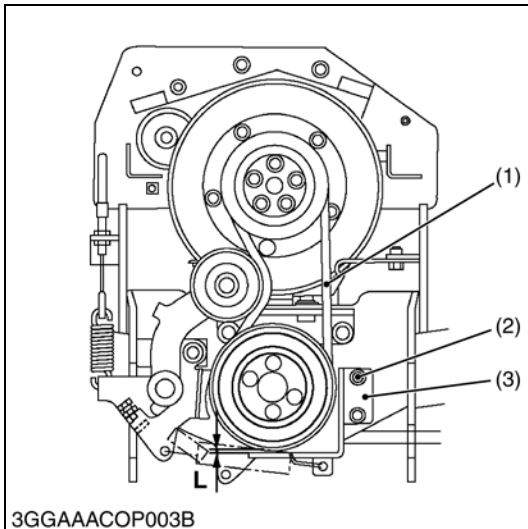
- After adjustment, check to see that the PTO brake is released when the PTO clutch is engaged.

(1) Adjusting Screw

(3) Tension Arm

(2) Lock Nut

W1011087



Adjusting Belt Stay

1. Place the machine on level ground, and stop the engine.
2. Set the PTO clutch lever to “**ENGAGE**” position.
3. Measure the clearance (**L**) between the belt stay (3) and front PTO belt (1).
4. If the measurement is not within the factory specifications, loosen the belt stay mounting screws (2) and move the belt stay (3) to adjust.

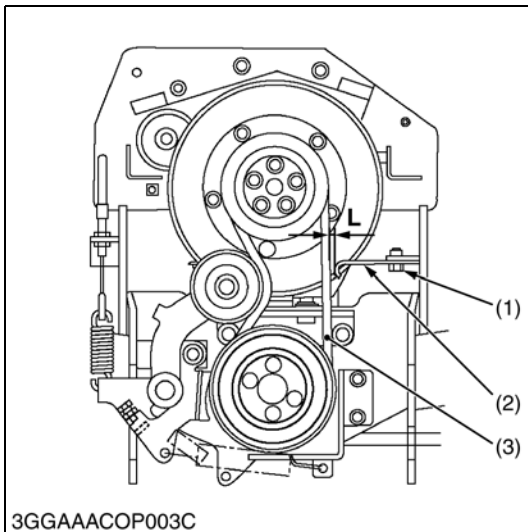
Clearance (L) between belt stay and front PTO belt	Factory spec.	1.0 to 2.5 mm 0.04 to 0.10 in.
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(1) PTO Belt

(3) Belt Stay

(2) Belt Stay Mounting Screws

W1011294



Adjusting Belt Retainer

1. Place the machine on level ground, and stop the engine.
2. Set the PTO clutch lever to “**ENGAGE**” position.
3. Measure the clearance (**L**) between the belt retainer (2) and front PTO belt (3).
4. If the measurement is not within the factory specifications, loosen the belt retainer mounting screws (1) and move the belt retainer (2) to adjust.

Clearance (L) between belt retainer and front PTO belt	Factory spec.	2.0 mm 0.08 in.
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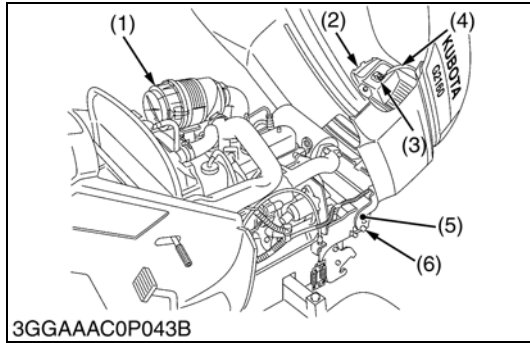
(1) Belt Retainer Mounting Screws

(3) PTO Belt

(2) Belt Retainer

W1011549

[2] DISASSEMBLING AND ASSEMBLING

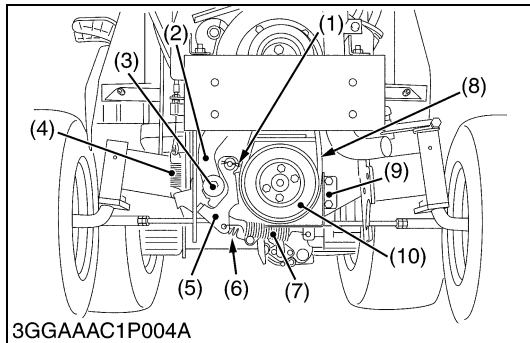


Battery and Bonnet

1. Turn the main switch off.
2. Remove the radiator screen (1).
3. Disconnect the negative cable from the battery.
4. Disconnect the **1P** connectors (3) from the head light (2).
5. Remove the wiring (4) from the bonnet.
6. Remove the bonnet stay mounting screws (6). and remove the bonnet with the bonnet bracket (5) from the frame.

- | | |
|--------------------------|---------------------------------|
| (1) Radiator Screen | (4) Wiring |
| (2) Head Light | (5) Bonnet Bracket |
| (3) 1P Connectors | (6) Bonnet Stay Mounting Screws |

W1011761



Front Cover and PTO Assembly

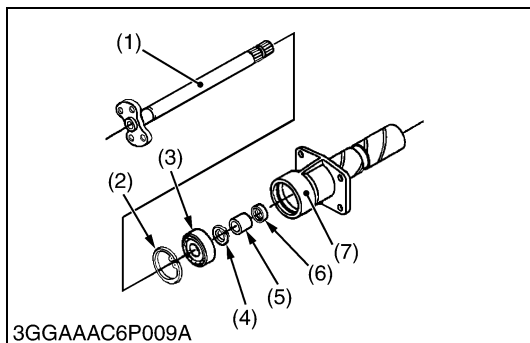
1. Remove the front PTO cover.
2. Remove the PTO clutch spring (4), brake spring (7) and return spring (6).
3. Remove the belt stay (9).
4. Remove the pulley (10).
5. Remove the front PTO belts (8).
6. Remove the cotter pin and flange bolt (3).
7. Pull out the PTO brake assembly (5) and tension arm (2) with tension pulley.

(When reassembling)

- Apply grease to the tension arm bushings and the PTO brake bushing.
- After reassembling the PTO clutch spring, be sure to adjust the front PTO belt tension. (See page 7-S3.)
- After reassembling the belt stay, be sure to adjust the clearance between the belt stay and front PTO belt.
Clearance (L): 1.0 to 2.5 mm (0.039 to 0.098 in.)
(See page 7-S4.)

- | | |
|------------------------|---------------------|
| (1) Cotter Pin | (6) Return Spring |
| (2) Tension Arm | (7) Brake Spring |
| (3) Flange Bolt | (8) Front PTO Belts |
| (4) PTO Clutch Spring | (9) Belt Stay |
| (5) PTO Brake Assembly | (10) Pulley |

W1011950



PTO Shaft

1. Remove the internal snap ring (2).
2. Tap out the PTO Shaft (1) forward.

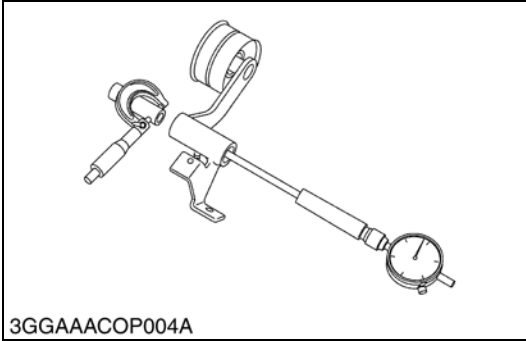
(When reassembling)

- Apply grease to the oil seal lip (6), and take care that it is not rolled when installing the PTO shaft.
- Be sure to install the adjusting shims.

- | | |
|------------------------|------------------------|
| (1) PTO shaft | (5) Needle Bearing |
| (2) Internal Snap Ring | (6) Oil Seal |
| (3) Ball Bearing | (7) Front Axle Support |
| (4) External Snap Ring | |

W1012277

[3] SERVICING



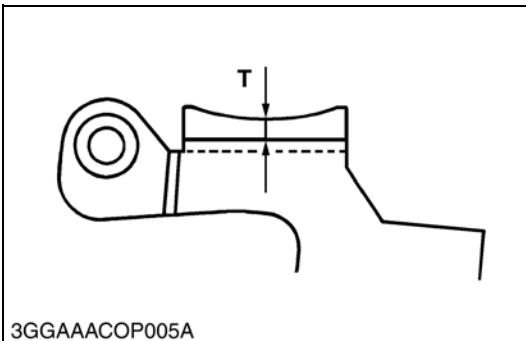
Clearance between Tension Collar and Tension Arm Bushing

1. Measure the tension collar O.D. with an outside micrometer.
2. Measure the tension arm bushing I.D. with an inside micrometer, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the tension arm bushing.
4. If the clearance still exceeds the allowable limit after replacing the bushing, replace the tension collar.

Clearance between tension collar and tension arm bushing	Factory spec.	0.002 to 0.114 mm 0.0001 to 0.0045 in.
	Allowable limit	0.30 mm 0.0118 in.

Tension collar O.D.	Factory spec.	19.000 to 19.030 mm 0.7480 to 0.7492 in.
Tension arm bushing I.D.	Factory spec.	19.032 to 19.114 mm 0.7493 to 0.7525 in.

W1012489



Brake Lining Wear

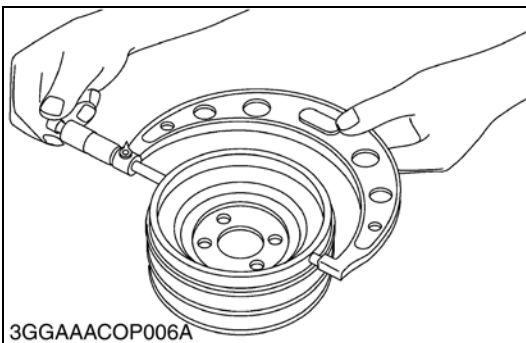
1. Measure the brake lining thickness (**T**) with a depth gauge.
2. If the measurement is less than the allowable limit, replace the PTO brake.

Brake lining thickness (T)	Factory spec.	5.7 to 6.3 mm 0.224 to 0.248 in.
	Allowable limit	4.0 mm 0.157 in.

■ NOTE

- If the lining is carbonized or soaked with oil, replace the PTO brake.

W1012662



Front PTO Pulley Wear

1. Measure the front PTO pulley O.D. with an outside micrometer.
2. If the measurement is less than the allowable limit, replace it.

Front PTO pulley O.D.	Factory spec.	123.9 to 124.0 mm 4.878 to 4.882 in.
	Allowable limit	123.0 mm 4.843 in.

W1012789

8 ELECTRICAL SYSTEM

MECHANISM

CONTENTS

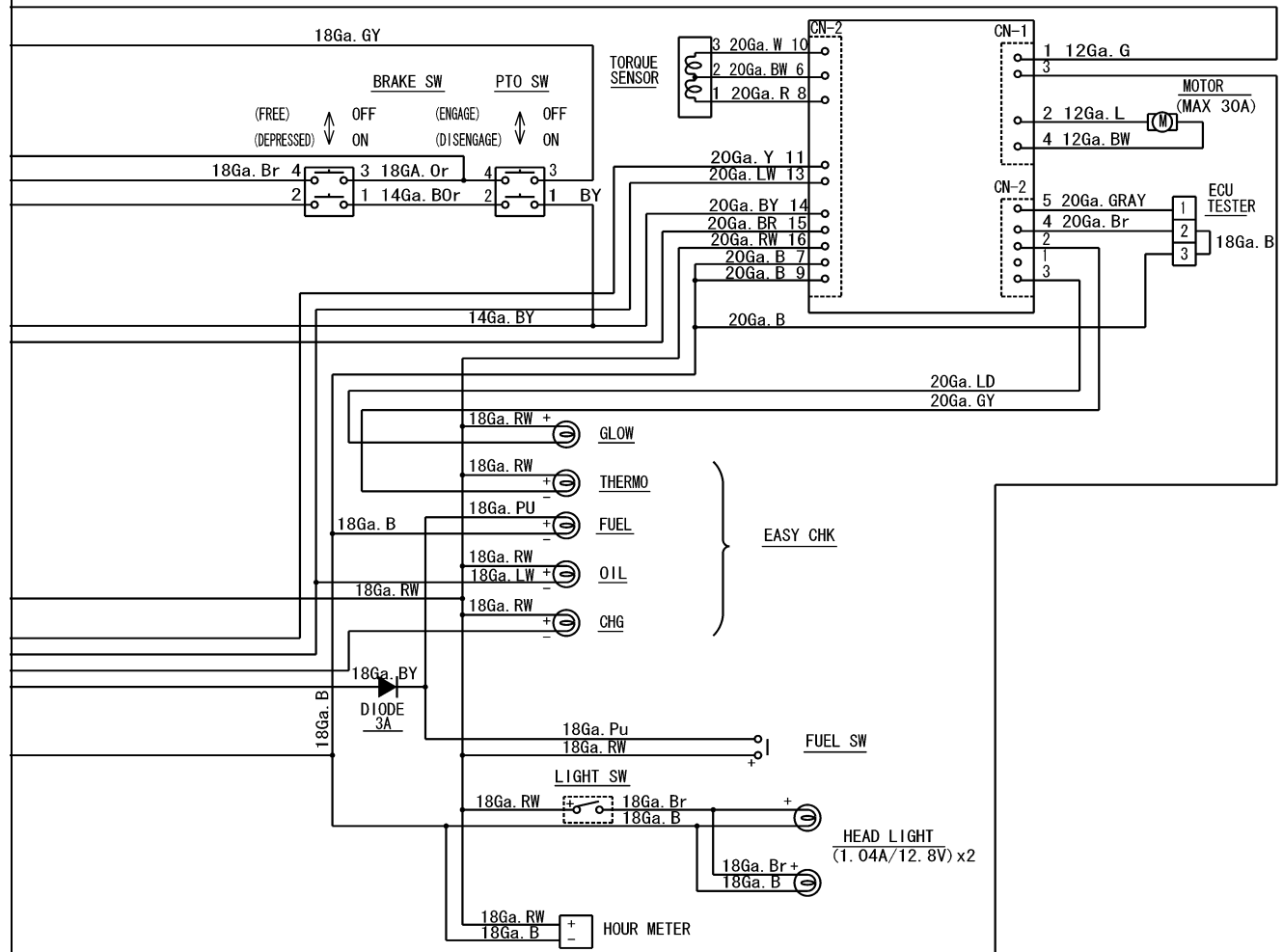
1. WIRING DIAGRAM	8-M1
[1] WIRING DIAGRAM (with KRA system)	8-M1
[2] WIRING DIAGRAM (without KRA system)	8-M3
2. KRA (Kubota Reverse Awareness) SYSTEM (If Equipped).....	8-M5

[1] WIRING DIAGRAM (with KRA system)

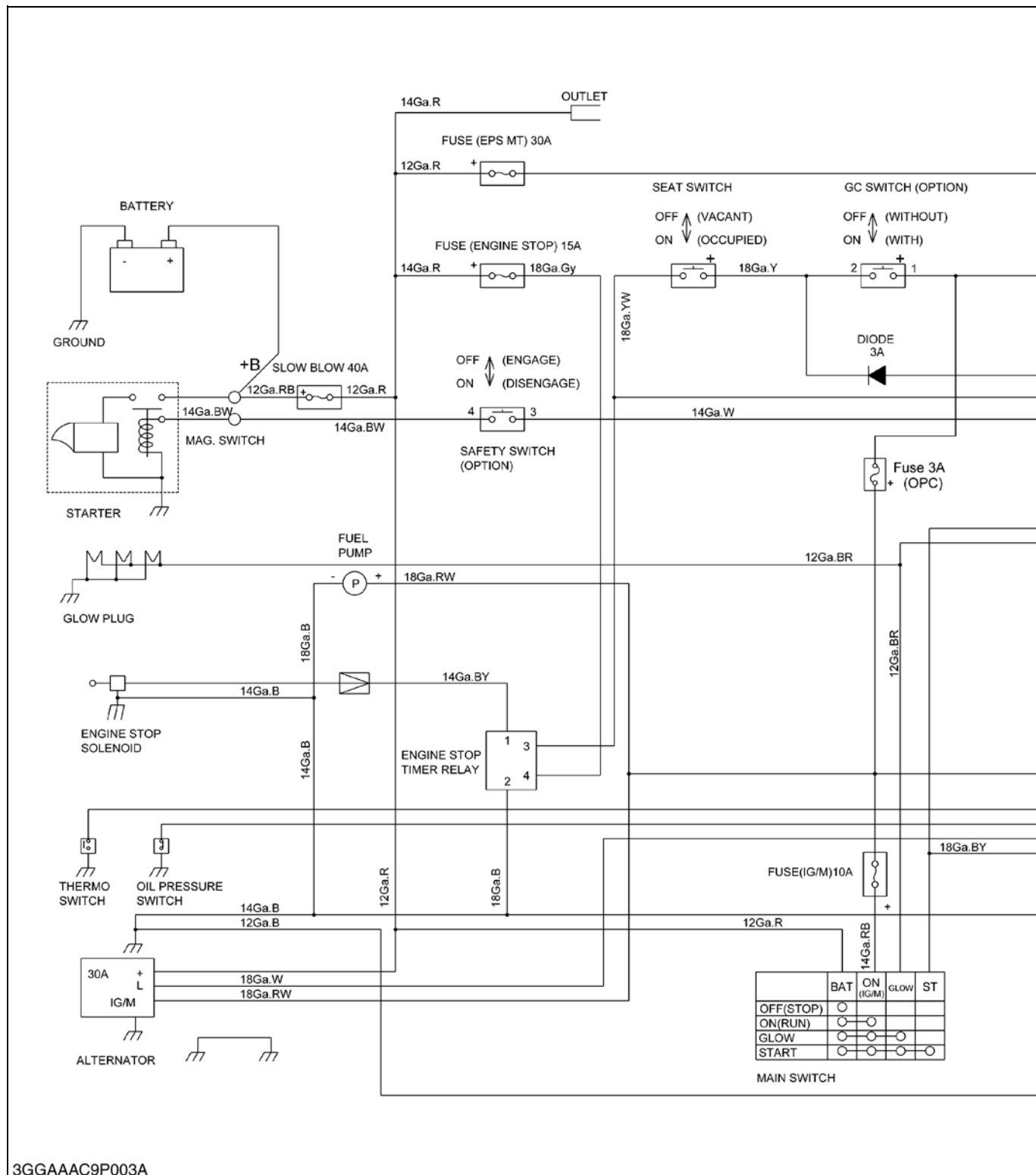


• Color of Wiring

B ----- Black	Br ----- Brown	L ----- Blue	Pi ----- Pink	RW ----- Red / White
BOr ----- Black / Orange	G ----- Green	LD ----- Blue Dk	Pu ----- Purple	W ----- White
BR ----- Black / Red	GY ----- Green / Yellow	LW ----- Blue / White	R ----- Red	Y ----- Yellow
BW ----- Black / White	GW ----- Green / White	Or ----- Orange	RB ----- Red / Black	YW ----- Yellow / White
BY ----- Black / Yellow	Gy ----- Gray			

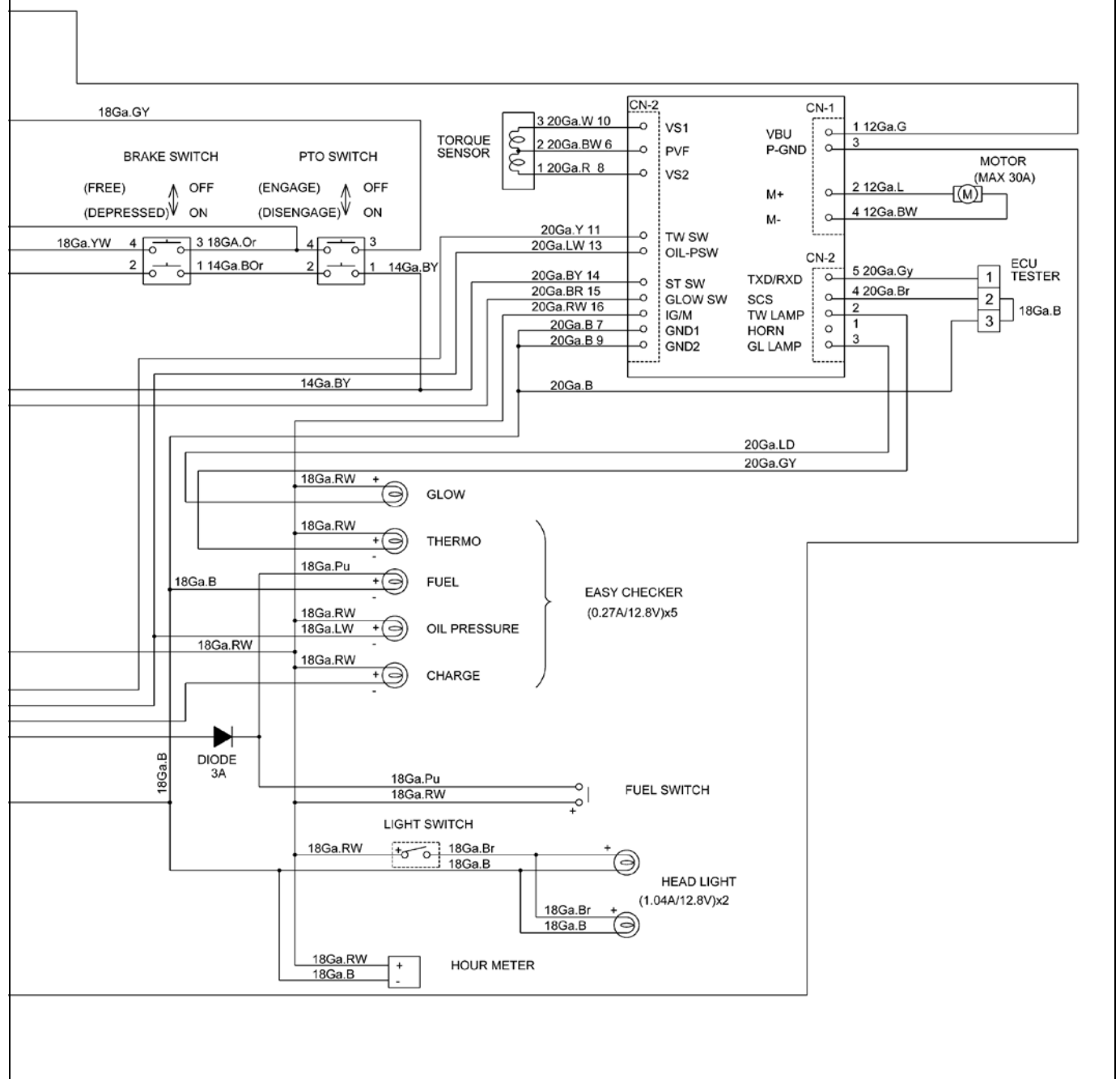


[2] WIRING DIAGRAM (without KRA system)

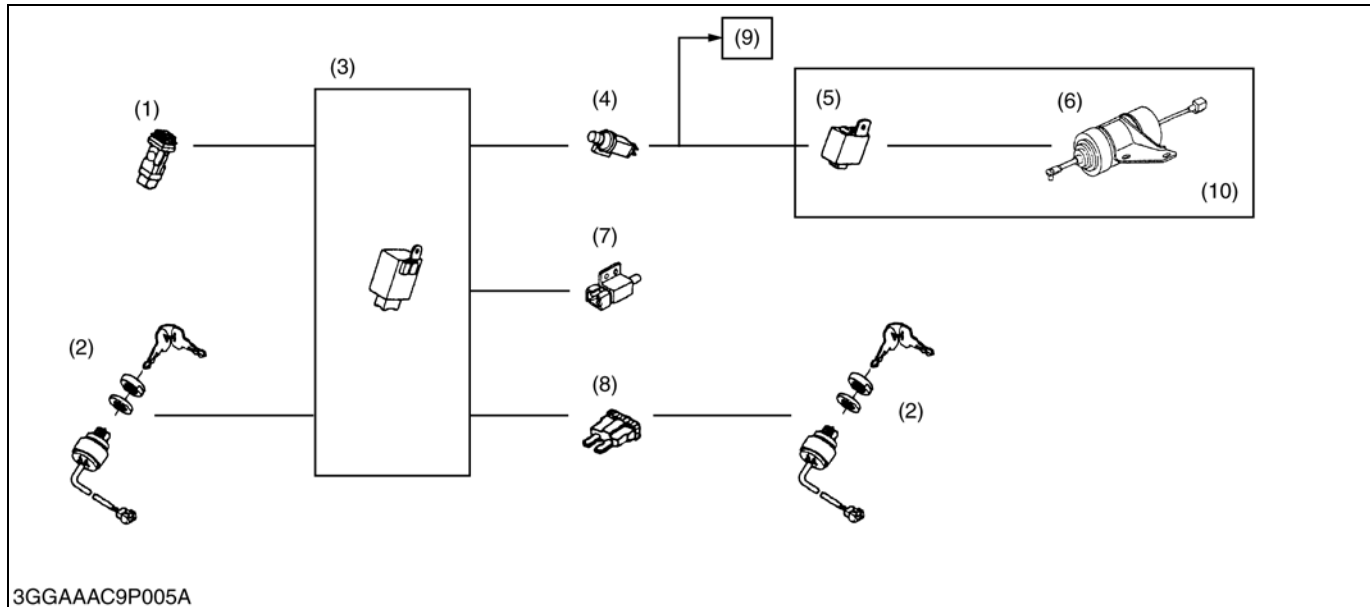


• Color of Wiring

BBlack	BY ... Black / Yellow	GyGray	Or Orange	RW .. Red / White
BOr ..Black / Orange	Br Brown	L Blue	PuPurple	WWhite
BR ... Black / Red	G Green	LDBlue DK	R Red	Y Yellow
BW .. Black / White	GY ... Green / Yellow	LW ... Blue / White	RB ... Red / Black	YW .. Yellow / White



2. KRA (Kubota Reverse Awareness) SYSTEM (If Equipped)



(1) KRA system Switch (Override Switch)

(2) Main Switch

(3) KRA system Relay Unit

(4) Reverse Switch

(5) Key Stop Timer

(6) Stop Solenoid

(7) PTO Switch

(8) Fuse (KRA system)

(9) Engine Running Circuit

(10) Engine Stopping Circuit

Tractor is configured with a KRA (Kubota Reverse Awareness) system to prevent the operator from attempting to mow in reverse. However, the operator may choose to override the system by pushing an override switch on panel board. A flashing warning lamp reminds the operator that the mow in reverse has been selected.

Operator awareness is enhanced by the KRA system, which prevents mowing in reverse. For those operators who require full mowing potential, the system may be overridden when the operator actively pushes an override switch.

KRA system mainly consists of parts showed in figure.

1. KRA system switch (override switch)

- KRA system switch (override switch) is a momentary switch to start KRA system.
- To cancel KRA system, two conditions are required. One condition is to engage PTO lever. Other condition is to keep speed control pedal to **"NEUTRAL"** or **"FORWARD"** position. And at the main switch's starting position, operator can check flashing lamp function.

2. KRA system Relay Unit

- KRA system relay unit consists of three parts of circuits, that is, inter-lock circuit (relay circuit), reverse switch short circuit and lamp flashing circuit. (See page 8-M6.)

3. Reverse Switch

- Reverse switch is a switch to detect the speed control pedal position.

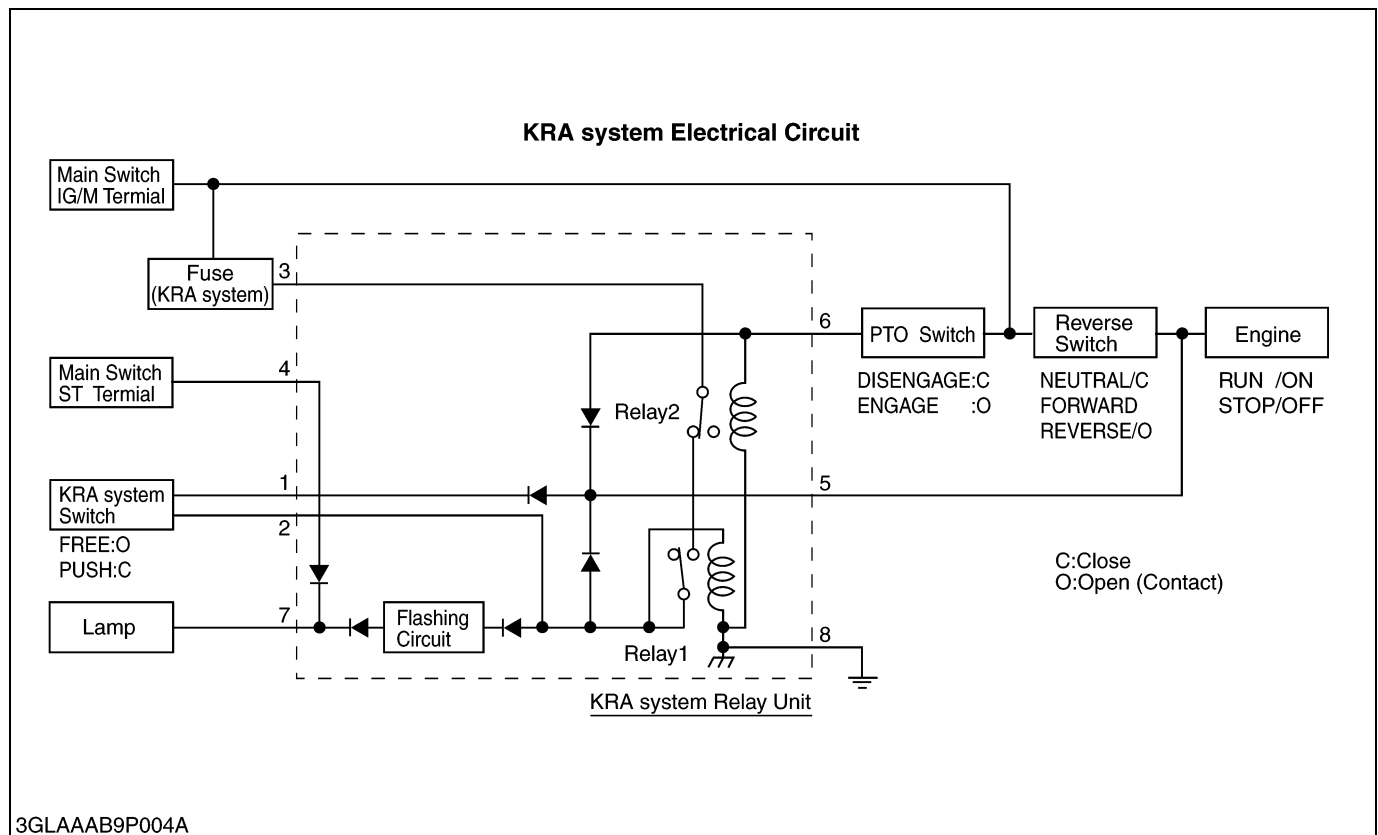
4. Key Stop Timer and Stop Solenoid

- While engine is running, current from main switch flows to the third contact point of the key stop timer. Current charges the timer circuit in the key stop timer. When the main switch is turned to **"OFF"** position, the stop solenoid is supplied current from the key stop timer. After that, the stop solenoid cuts off fuel injection from injection pump of the engine.

5. Fuse (KRA system)

- Fuse to be used in KRA system has two functions. The first function is to protect the electrical circuit of KRA system same as fuses to be used in the common electrical circuits. The second function is to cancel the detection of **"REVERSE"** signal from reverse switch (speed control pedal).

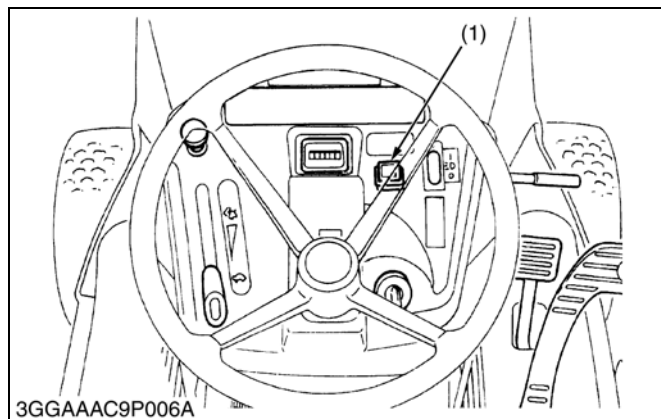
W1018712



PTO LEVER AND SPEED CONTROL PEDAL MOVEMENT

The operation equipment	PTO lever		Speed control pedal		Seat
The condition	Disengage	Engage	Neutral Forward	Reverse	Occupied
The operation of the switch	Push	Free	Free	Push	Push
The condition of contact in electrical	Close	Open	Close	Open	Close

W1017028



NOTE:

- The KRA system incorporates a KRA system switch (1) that allows the operator to keep the PTO engaged during reverse travel when he seems it absolutely necessary and safe to do so. This KRA system switch lamp (1) flashes while activated as a reminder to the operator that the PTO (i.e. mower, tiller, etc.) remains engaged during reverse travel. The system will return to initial operating mode each time the PTO is disengaged.

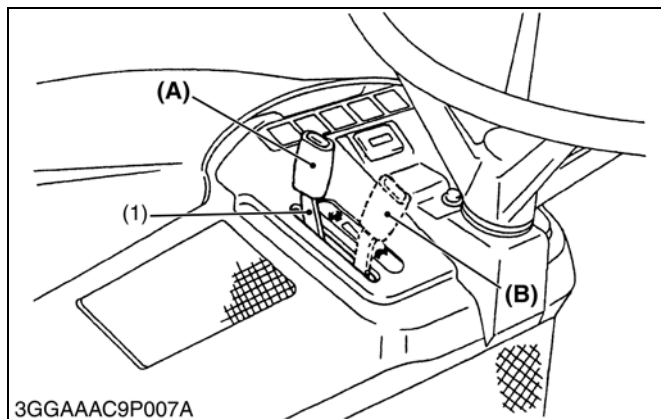
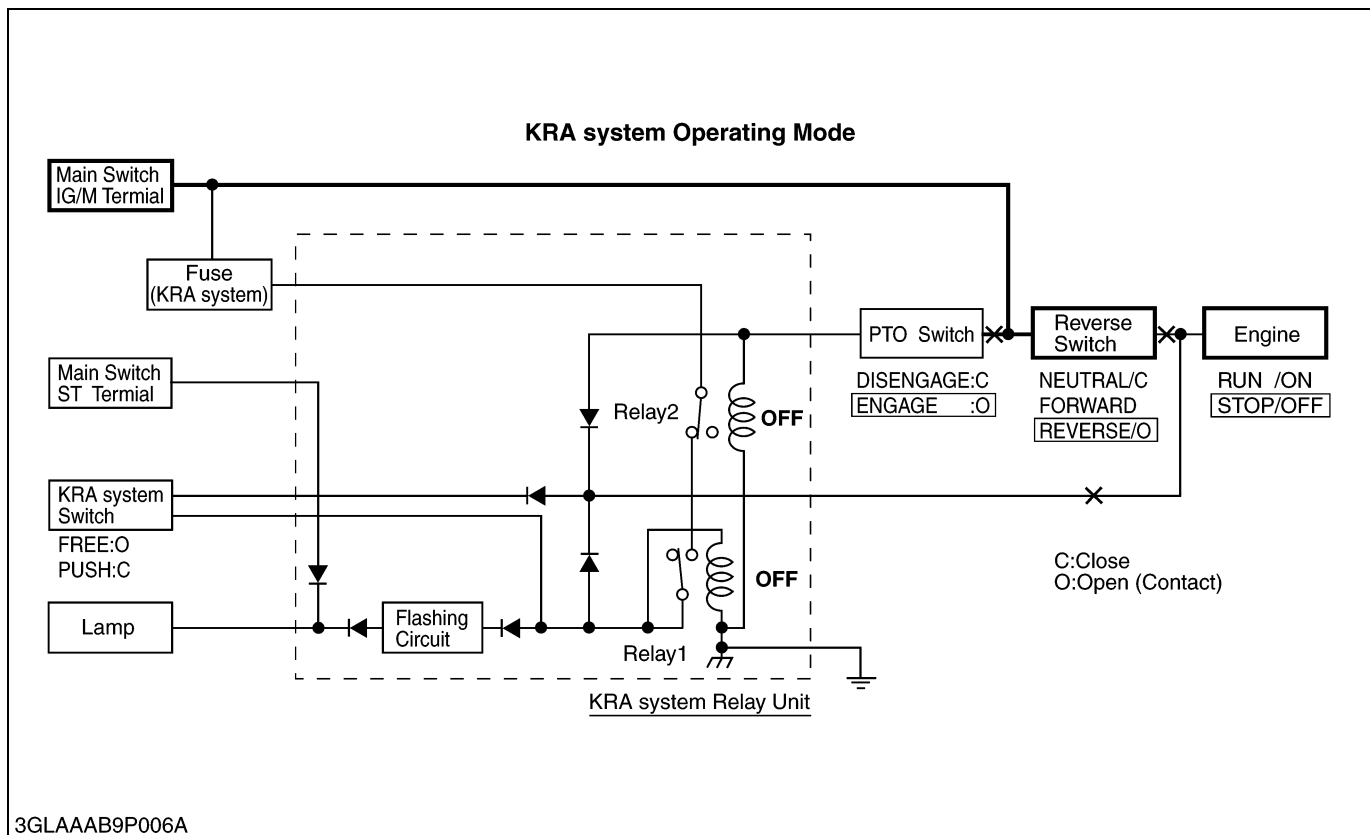
(1) KRA system Switch (lamp)

W1012973

KRA system Electrical Circuit

- In KRA system, engine stopping is mainly controlled by two parts, that is, PTO switch and reverse switch. The parts shown in the figure are connected in the electrical circuit.
- For engine stopping, electrical current should be supplied to key stop timer in diesel engine or ignition unit in gasoline engine.

W1018724



■ KRA system Operating Mode

“Operating mode” is set up as follows:

1. Start the engine.
2. Set the throttle lever to the “FAST” position (A).
3. Push down the PTO lever to the “ENGAGED” position.

(1) Throttle Lever

(A) “FAST” Position

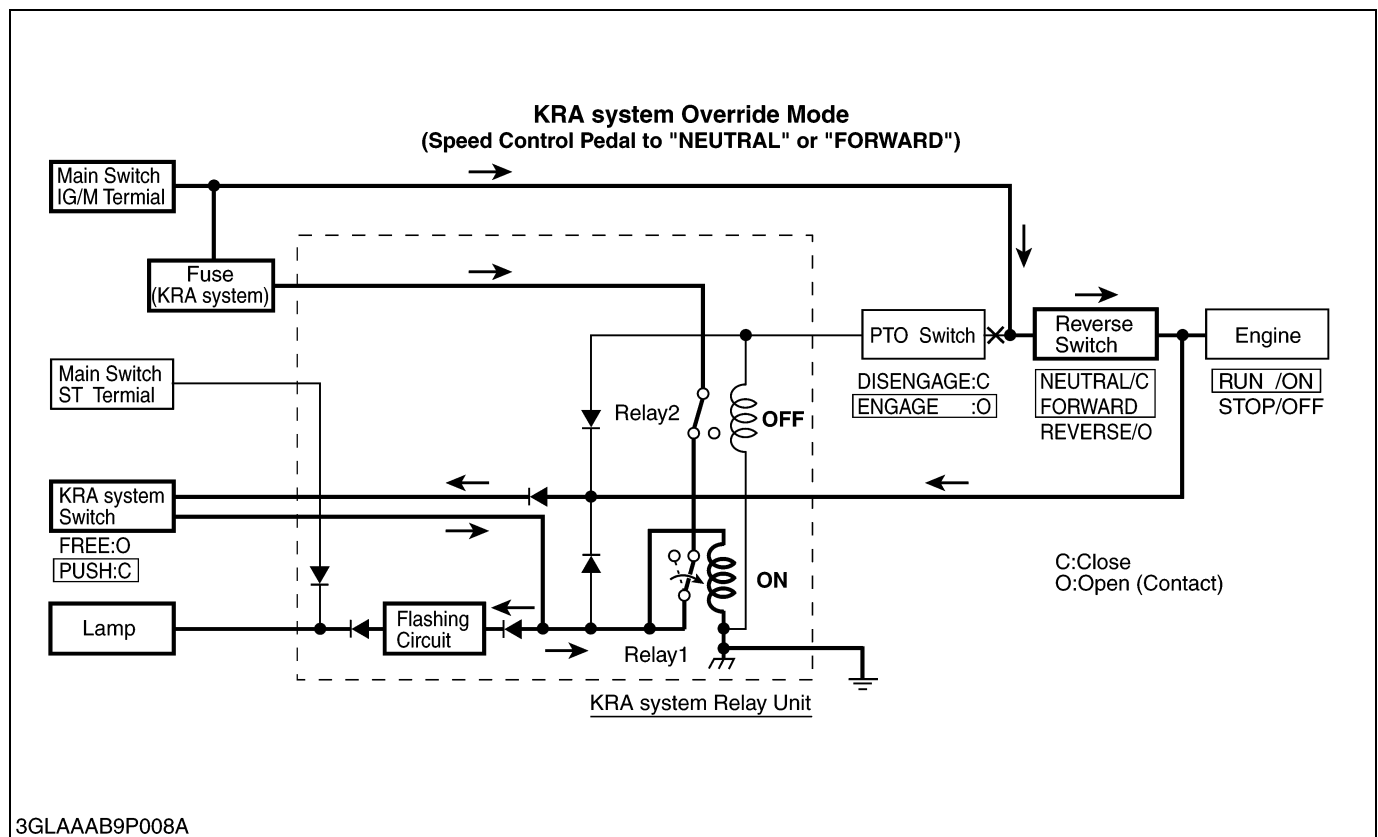
(B) “SLOW” Position

W1013204

KRA system Operating Mode

- In KRA system operating mode, engine is stopped by depressing speed control pedal to “REVERSE”.
- This engine stopping is controlled by current flow to key stop timer in diesel engine or ignition unit in gasoline engine.
- In PTO works such as mowing, while mowing and depressing speed control pedal to “NEUTRAL” or “REVERSE”, PTO switch’s contact point is contacted.
At this moment, electrical current flows as the above figure.
- Since the electrical circuit between main switch and PTO switch is cut off, electrical current from main switch does not flow to PTO switch.
Reverse switch keeps “ON”, and electrical circuit between main switch and engine is cut off as shown in the above figure. Current from main switch does not flow to key stop timer through reverse switch.
- On the other hand, electrical current from main switch flows to engine stop solenoid through key stop timer.
Current from battery directly flows to key stop timer and engine is stopped.

W1018740



The above electrical circuit is a circuit at the position of speed control pedal to **"NEUTRAL"** or **"FORWARD"**.

Condition 1:

First, PTO lever is selected **"ENGAGED"** position.

At this moment, electrical circuit between main switch and PTO switch is cut off.

Keeping the speed control pedal to **"NEUTRAL"** or **"FORWARD"** position, reverse switch is closed and this PTO switch keeps **"OFF"** in electrical.

Current from main switch flows to the reverse switch in electrical.

That is, electrical current from main switch flows to engine stop timer through reverse switch, and engine does not stop and runs.

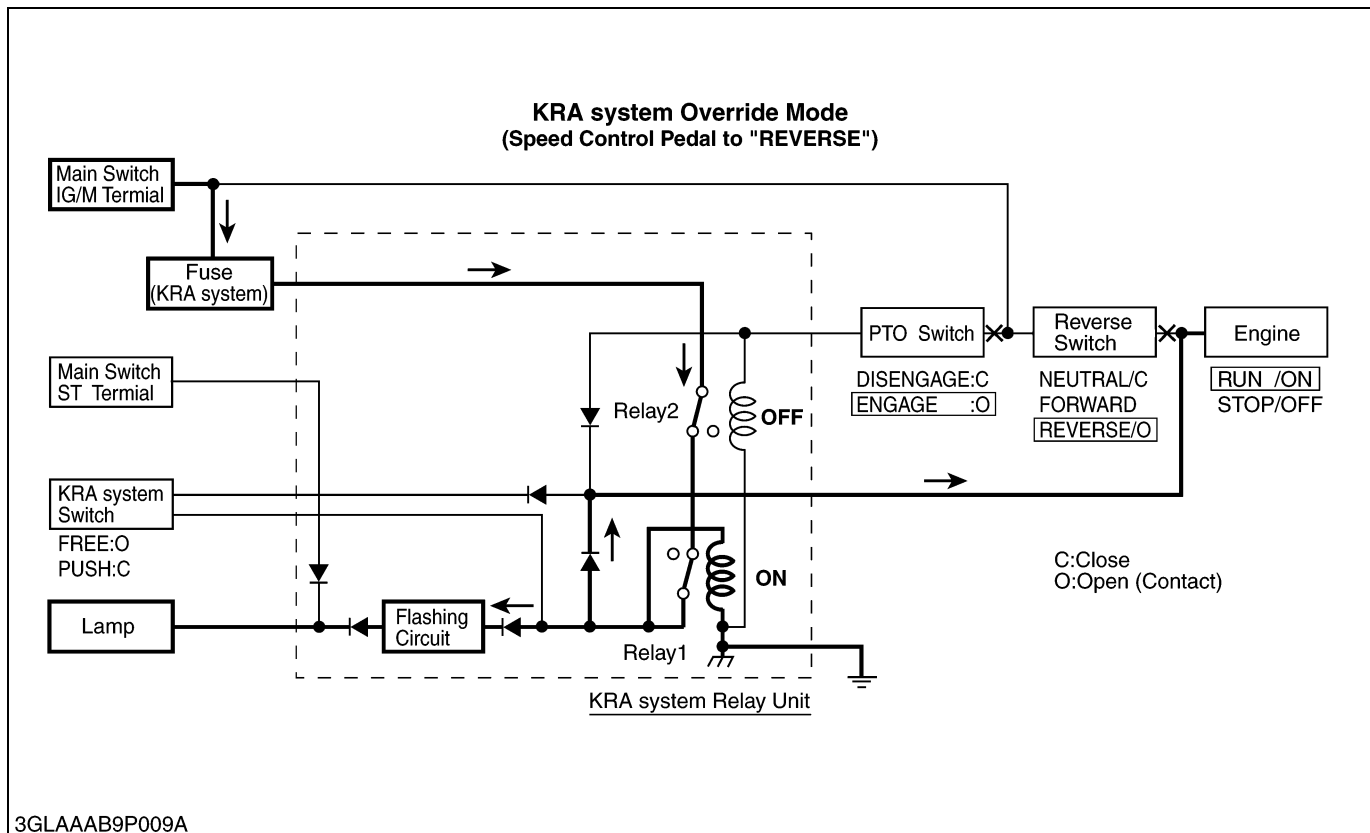
Condition 2:

On the other hand, pushing KRA system switch, current from main switch flows to KRA system relay unit.

- And current flows to both flashing circuit and relay 1 in the KRA system relay unit.
- Current to the flashing circuit flows to lamp in the KRA system switch and flashes the lamp.
- In the other direction, current to the relay 1 makes the coil magnetize.

This magnetized coil attracts the switch contact to the coil side.

After the switch contacts to the contact point, current from main switch flows to the relay 1, and this relay maintains this condition of the switch itself.



■ KRA system Override Mode

“Override mode” is set up as follows:

1. Start and run the engine at 1/4 throttle.
2. Engage the PTO lever.
3. Push the KRA system override switch.
4. The KRA system lamp flashes.
5. Depress slightly on the reverse side of speed control pedal.
6. Engine should not shut off.

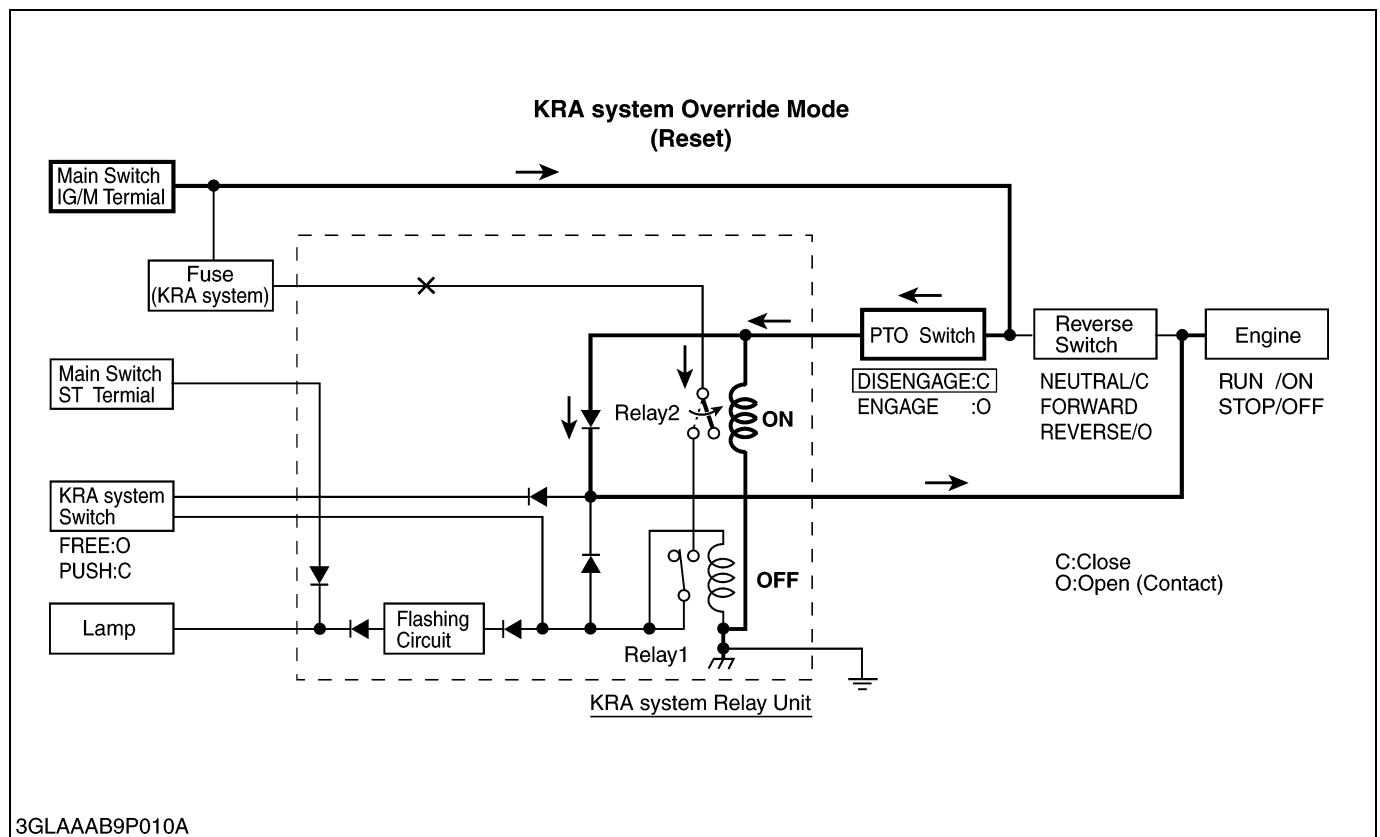
The above electrical circuit is a circuit at the moment of depressing speed control pedal to “**REVERSE**”.

Condition:

Depress speed control pedal to “**REVERSE**”.

- The reverse switch is opened, and electrical circuit between reverse switch and key stop timer is cut off. Current from main switch does not flow to key stop timer.
 - On the other hand, current from main switch flows to KRA system relay unit through the fuse. In the KRA system relay unit, current flows from relay 2 to relay 1. Relay 1 maintains the contact point to contact as mentioned already.
 - Current from relay 1 flows to two directions. That is, the first current flows to the lamp in the KRA system switch through flashing circuit, and this flashes the lamp.
- Another current flows to the engine stop solenoid.
- As a result, current from main switch flows to the key stop timer through the fuse and KRA system relay unit. Current flows to the key stop timer and engine is not stopped under the PTO works.

W1018800



The above electrical circuit is a circuit at the position of “**Override mode**” resetting.

Condition:

Disengage the PTO lever.

Current from main switch flows to KRA system through PTO switch.

Speed control pedal position is free. Operator can always select the speed control pedal to “**FORWARD**” and “**NEUTRAL**”. PTO lever should be disengaged.

- Since the coil of the relay 2 is magnetized in the KRA system relay unit, the contact switch is attracted to the coil side by the magnetized coil.
- On the other hand, current from the fuse does not flow to the relay 1 because the contact point of the relay 2 is released to “**OFF**” position.
- Current from main switch flows to the stop time relay through KRA system relay unit as showed in the above figure.

W1018827

SERVICING

CONTENTS

1. TROUBLESHOOTING	8-S1
2. SERVICING SPECIFICATIONS	8-S9
3. TIGHTENING TORQUES	8-S10
4. CHECKING, DISASSEMBLING AND SERVICING.....	8-S11
[1] BATTERY.....	8-S11
(1) CHECKING	8-S11
[2] STARTING SYSTEM	8-S12
(1) CHECKING	8-S12
(2) Main Switch.....	8-S12
(3) Starter	8-S14
(4) Glow Plug.....	8-S15
(5) DISASSEMBLING AND ASSEMBLING.....	8-S16
(6) Starter	8-S16
(7) SERVICING	8-S17
(8) Starter	8-S17
[3] ENGINE KEY SWITCH SHUT-OFF SYSTEM	8-S19
(1) CHECKING	8-S19
[4] CHARGING SYSTEM.....	8-S20
(1) CHECKING	8-S20
(2) Alternator	8-S20
(3) DISASSEMBLING AND ASSEMBLING.....	8-S21
(4) Alternator	8-S21
(5) SERVICING	8-S23
(6) Alternator	8-S23
[5] ELECTRICAL EQUIPMENT.....	8-S24
(1) CHECKING	8-S24
(2) Oil Pressure Switch.....	8-S24
(3) Thermo Switch	8-S25
(4) Fuel Pump.....	8-S25
(5) Head Light Switch	8-S26
(6) Brake Switch	8-S27
(7) PTO Switch	8-S28
(8) Seat Switch	8-S28
(9) Fuel Switch	8-S29
[6] KRA SYSTEM (If Equipped)	8-S30
(1) Reverse Switch	8-S30
(2) KRA system Unit (Harness connector side)	8-S31

1. TROUBLESHOOTING

[All Electrical Equipments]

Symptom	Probable Cause	Solution	Reference Page
All electrical equipments do not operate.	Is battery normal and well charged?		
	YES	Fuse blown	Replace
		Battery cable disconnected or improperly connected	Replace
	NO	Battery discharged or defective	Charge or replace

[Safety Control System]

Engine does not start.	Is wiring harness connection normal ?	NO	Wiring harness disconnected or improperly connected	Repair or replace	—
		YES	Are you seated ?	NO	Seat switch is "OFF" position.
				YES	Seat
	Is brake pedal depressed ?	NO	Brake switch is "OFF" position.	Depress brake pedal.	—
		YES	Is PTO clutch lever set at "DISENGAGE" position ?	NO	PTO switch is "OFF" position.
Engine does not stop when operator leaves seat. (PTO clutch lever is set at "ENGAGE" position. Parking brake is not applied.)		YES	Fuse blown	Replace	G-31
			Main switch defective	Replace	8-S12
			Seat switch defective	Replace	8-S22
			Brake switch defective	Replace	8-S27
			Engine stop solenoid defective	Replace	8-S19
Engine does not stop when operator leaves seat. (PTO clutch lever is set at "ENGAGE" position. Parking brake is not applied.)			PTO switch defective	Replace	8-S28
			Engine stop solenoid defective	Replace	8-S19
Engine stops when operator leaves seat. (PTO clutch lever is set at "DISENGAGE" position. Parking brake is applied.)			PTO switch defective	Replace	8-S28
			Brake switch defective	Replace	8-S27
			Seat switch defective	Replace	8-S22

T15040EL01101

[Starting System]

Symptom	Probable Cause	Solution	Reference Page
Starter does not function.	YES Is click sound from magnet switch ?	Weak battery	G-24
		Faulty lead or connection (Magnet switch to motor)	8-S16
		Starter motor defective	8-S16
	NO	Battery discharged or defective	G-24
		Fuse blown	G-31
		Wiring harness disconnected or improperly connected	—
		Starter defective	8-S16
		Main switch defective	8-S12
		PTO clutch lever is set at "ENGAGE" position.	8-S28
		Brake switch defective	8-S27
Glow plug does not glow.	YES Is wiring harness connection normal ?	Weak battery	G-24
		Main switch defective	8-S12
		Slow blow fuse blown	G-31
		Glow plug defective	8-S15
	NO	Wiring harness disconnected or improperly connected	—

T15040EL01201

[Engine Key Switch Shut-off System]

Symptom	Probable Cause	Solution	Reference Page
Engine does not stop when main switch is turned "OFF" position.	Is wiring harness connection normal ?		
	YES		
	E/G stop timer relay defective	Replace	8-S19
	Main switch defective	Replace	8-S12
	Engine stop solenoid defective	Replace	8-S19
	Fuse blown	Replace	G-31
NO	Wiring harness disconnected or improperly connected	Repair or replace	—
Engine does not restart.	Is wiring harness connection normal ?		
	YES		
	PTO clutch lever is set at "ENGAGE" position.	Set PTO clutch lever at "DISENGAGE" position.	—
	Engine stop solenoid defective	Replace	8-S19
	NO	Wiring harness disconnected or improperly connected	Repair or replace

T15040EL01301

[Charging System]

Symptom	Probable Cause	Solution	Reference Page
Battery discharges too quickly.	Is battery normal ?		
	YES		
	Cooling fan belt slipping	Adjust tension	1-S48
	Alternator defective	Repair or replace	1-S23 1-S24
	Wiring harness disconnected or improperly connected	Repair or replace	—
	NO		
	Battery discharged or defective	Charge or replace	G-24

T15040EL01401

[Lighting System]

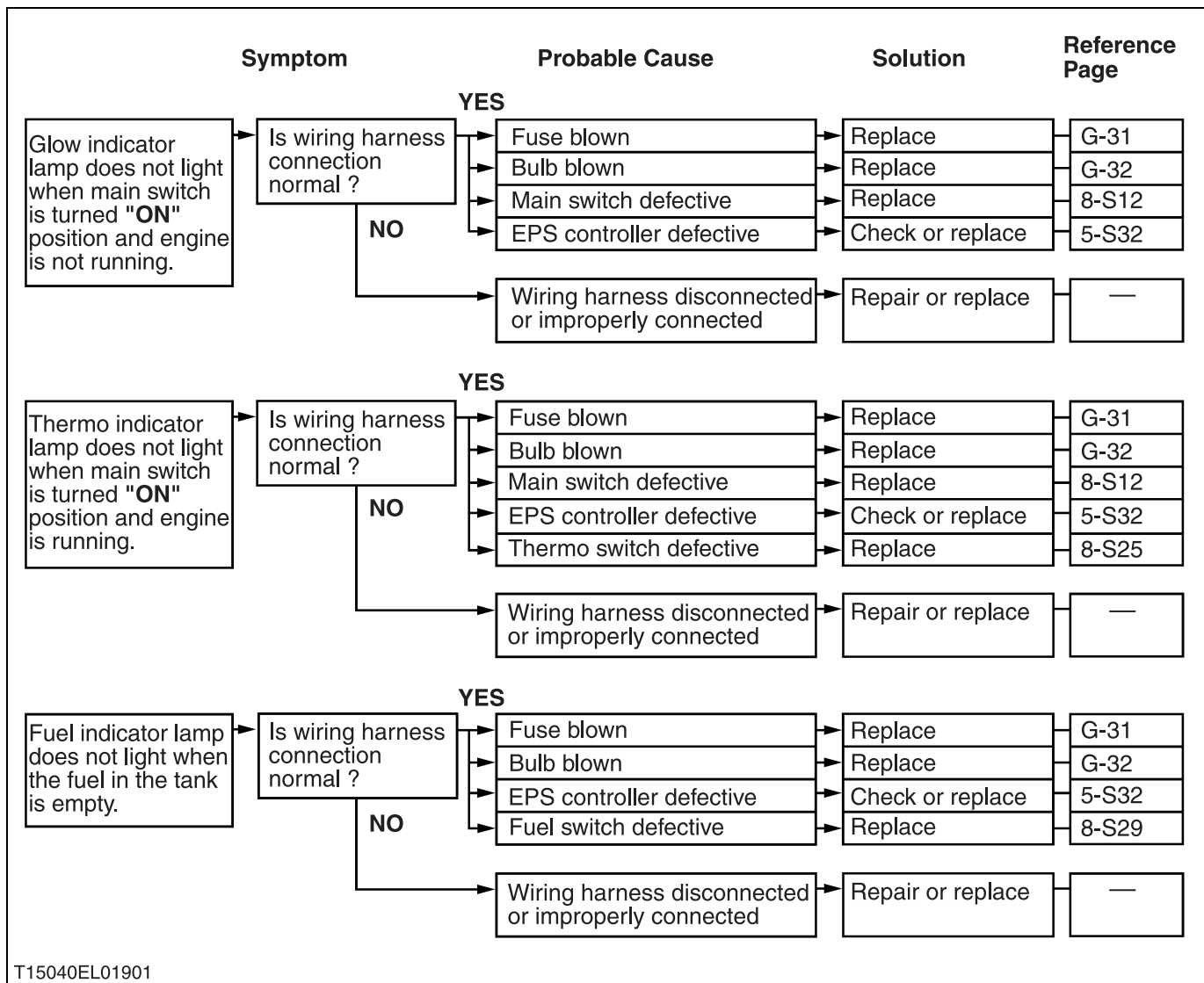
Symptom	Probable Cause	Solution	Reference Page
Head light does not light.	Is wiring harness connection normal ?		
	YES		
	Fuse blown	Replace	G-31
	Bulb blown	Replace	G-32
	Main switch defective	Replace	8-S12
	Light switch defective	Replace	8-S26
	NO		
	Wiring harness disconnected or improperly connected	Repair or replace	—

T15040EL01501

[Easy Checker™]

	Symptom	Probable Cause	Solution	Reference Page
	Charging indicator lamp does not light when main switch is turned "ON" position.	YES Is wiring harness connection normal ?	Fuse blown.	Replace G-31
			Bulb blown.	Replace G-32
			Main switch defective	Replace 8-S12
		NO	Wiring harness disconnected or improperly connected.	Repair or replace —
	Charging indicator lamp does not go off when engine is running.	Short circuit between alternator L terminal lead and chassis	Repair or replace	8-S21 8-S22 8-S23
		Alternator defective.	Repair or replace	8-S21 8-S22 8-S23
	Oil pressure indicator lamp lights up when engine is running.	YES Engine oil at specified level ?	Engine oil pressure too low	Check and repair 1-S46
			Oil pressure switch defective	Replace 8-S24
			Short circuit between oil pressure switch lead (1P connector) and chassis	Repair 8-S24
			EPS controller defective	Check or replace 5-S32
		NO	Engine oil insufficient.	Replenish G-17
	Oil pressure indicator lamp does not light when main switch is turned "ON" position and engine is not running.	YES Is wiring harness connection normal ?	Fuse blown.	Replace G-31
			Bulb blown.	Replace G-32
			Main switch defective	Replace 8-S12
			EPS controller defective	Check or replace 5-S32
		NO	Wiring harness disconnected or improperly connected	Repair or replace —

T15040EL01601



T15040EL01901

[KRA System] (If Equipped)

Symptom	Probable Cause	Solution	Reference Page
Engine stops when moving in reverse with disengaging PTO lever.	Wiring harness defective	Wiring harness replacement	—
	KRA system unit defective	KRA system unit replacement as an unit	8-S31
Engine stops when moving forward or at neutral position with engaging PTO lever.	Reverse switch gap adjustment improper	Reverse switch gap adjustment	8-S30
	Reverse switch defective	Reverse switch replacement	8-S30
	Wiring harness defective	Wiring harness replacement	—
KRA system switch lamp does not flash when starting engine.	Bulb blown	Bulb replacement	G-31
	KRA system unit defective	KRA system unit replacement as an unit	8-S31
	Wiring harness defective	Wiring harness replacement	—

T15040EL01701

Symptom	Probable Cause	Solution	Reference Page
KRA system does not operate when pushing on KRA system switch under the condition of "engine stopping in reverse" or "no bulb flashing", or "no switch lamp going off".	KRA system unit defective	KRA system unit replacement as an unit	8-S31
	Wiring harness defective	Wiring harness replacement	—
	PTO switch adjustment improper	PTO switch adjustment	8-S28
	PTO switch defective	PTO switch replacement	8-S28
	KRA system switch defective	KRA system switch replacement	8-S31
	KRA system fuse blown	KRA system fuse replacement	8-S31

T15040EL01801

2. SERVICING SPECIFICATIONS

BATTERY

Item	Factory Specification	Allowable Limit
Battery Voltage	More than 12 V	—
Potential difference	Less than 0.1 V	—

W1010878

STARTER

Commutator	O.D.	28.0 mm 1.102 in.	27.0 mm 1.063 in.
	Difference of O.D.'s	Less than 0.02 mm Less than 0.0008 in.	0.05 mm 0.0020 in.
Mica	Undercut	0.60 mm 0.0236 in.	0.20 mm 0.0079 in.
Brush	Length	14.0 mm 0.551 in.	11.1 mm 0.437 in.

W1010973

ALTERNATOR

Stator	Resistance	Less than 1.0 ohms	—
Rotor	Resistance	2.9 ohms	—
Slip Ring	O.D.	14.4 mm 0.567 in.	12.8 mm 0.504 in.
Brush	Length	10.5 mm 0.413 in.	8.4 mm 0.331 in.

W1011055

GLOW PLUG

Glow Plug	Resistance	Approx. 0.9 ohms	—
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W1011149

3. TIGHTENING TORQUES

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

Item	N·m	kgf·m	ft-lbs
Starter			
• M terminal nut	9.8 to 13.7	1.0 to 1.4	7.2 to 10.1
• C terminal nut	7.9 to 11.8	0.8 to 1.2	5.8 to 8.7
• Magnetic switch mounting nut	5.9 to 10.8	0.6 to 1.1	4.4 to 7.9
• Through bolt	4.42 to 7.35	0.45 to 0.75	3.26 to 5.42
Alternator			
• Pulley nut	93.1 to 127.4	9.5 to 13.0	68.7 to 94.0

W1012736

4. CHECKING, DISASSEMBLING AND SERVICING



CAUTION

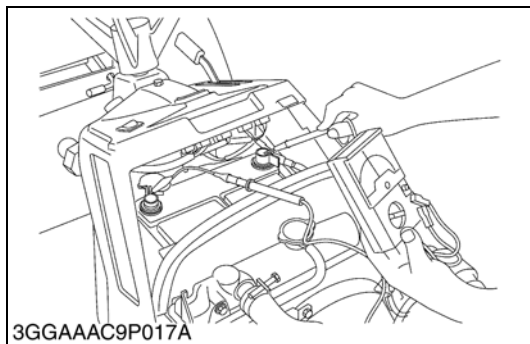
- To avoid accidental short circuit, be sure to attach the positive cable to the positive terminal before the negative cable is attached to the negative terminal.
- Never remove the battery cap while the engine is running.
- Keep electrolyte away from eyes, hands and clothes. If you are spattered with it, wash it away completely with water immediately.
- Keep open sparks and flames away from the battery at all times. Hydrogen gas mixed with oxygen becomes very explosive.

■ IMPORTANT

- If the machine is to be operated for short time without battery (using a slave battery for starting), use additional current (lights) while engine is running and insulate terminal of battery. If this advice is disregarded, damage to alternator and regulator may result.

[1] BATTERY

CHECKING

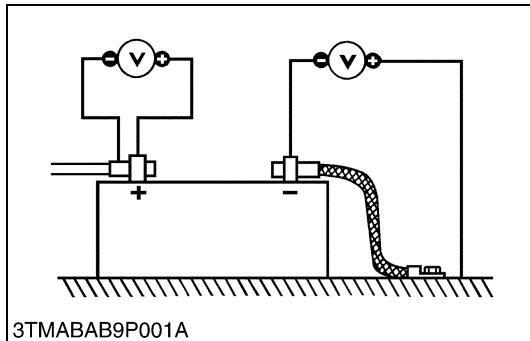


Battery Voltage

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 positive (+) lead to the positive terminal post, and measure the battery voltage.
3. If the battery voltage is less than the factory specification, recharge the battery.

Battery voltage	Factory spec.	More than 12 V
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W1011541



Battery Terminal Connection

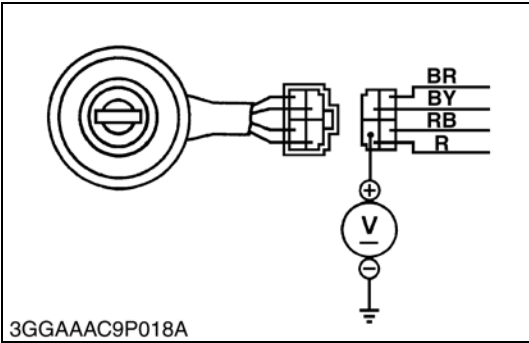
1. Turn the main switch on, and turn on the head light.
2. Measure the voltage with a voltmeter across the battery's positive terminal post and the cable terminal, and the voltage across the battery's negative terminal post and the chassis.
3. If the measurement exceeds the factory specification, clean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

Potential difference	Factory spec.	Less than 0.1 V
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W1011657

[2] STARTING SYSTEM
CHECKING

(1) Main Switch

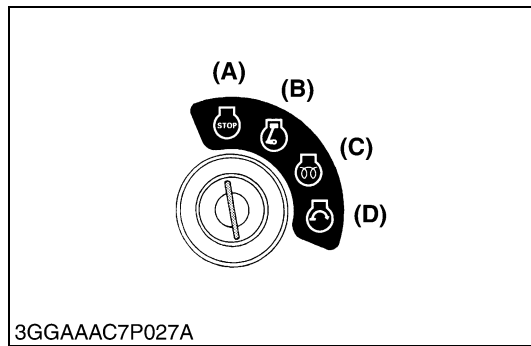
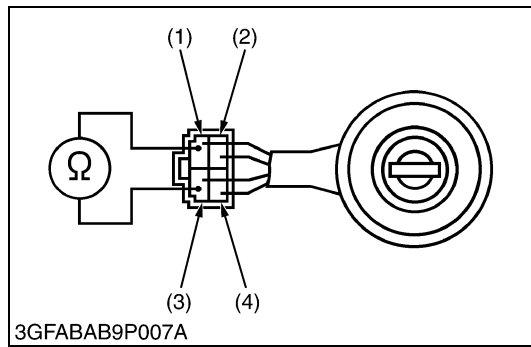


Connector Voltage

- 1. Open the bonnet.
- 2. Disconnect the **4P** connector from the main switch.
- 3. Measure the voltage with a voltmeter between the connector terminal and chassis.
- 4. If the voltage differs from battery voltage, the wiring harness is faulty.

Voltage (Connector terminal-Chassis)	Factory spec.	Approx. battery voltage
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W1011831



Main Switch Continuity

1. Open the bonnet.
2. Disconnect the **4P** connector from the main switch.
3. Remove the main switch from the panel.
4. Measure the resistance with an ohmmeter across the connector terminals when the main switch key is set at **"A"** position.
5. Measure the resistance with an ohmmeter across the connector terminals when the main switch key is set at **"B"** position.
6. Measure the resistance with an ohmmeter across the connector terminals when the main switch key is set at **"C"** position.
7. Measure the resistance with an ohmmeter across the connector terminals when the main switch key is set at **"D"** position.
8. If the resistance values specified below are not indicated, the main switch is faulty.

■ Main switch key is set at **"A"** position.

Resistance	30 terminal-19 terminal	Infinity
	30 terminal-50 terminal	Infinity
	30 terminal-AC terminal	Infinity
	AC terminal-19 terminal	Infinity
	AC terminal-50 terminal	Infinity
	50 terminal-19 terminal	Infinity

■ Main switch key is set at **"B"** position.

Resistance	30 terminal-19 terminal	Infinity
	30 terminal-50 terminal	Infinity
	30 terminal-AC terminal	Continuity
	AC terminal-19 terminal	Infinity
	AC terminal-50 terminal	Infinity
	50 terminal-19 terminal	Infinity

■ Main switch key is set at **"C"** position.

Resistance	30 terminal-19 terminal	Continuity
	30 terminal-50 terminal	Infinity
	30 terminal-AC terminal	Continuity
	AC terminal-19 terminal	Continuity
	AC terminal-50 terminal	Infinity
	50 terminal-19 terminal	Infinity

■ Main switch key is set at **"D"** position.

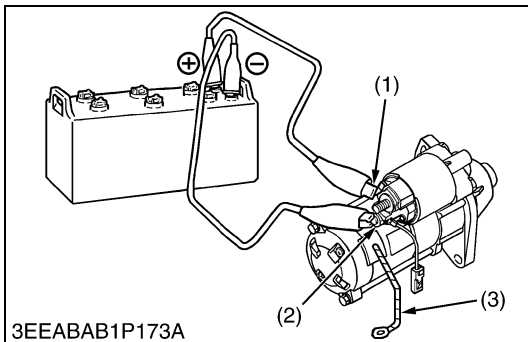
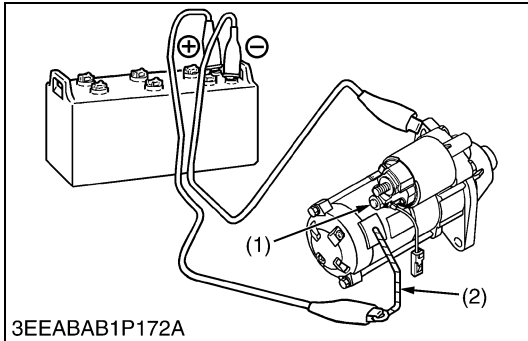
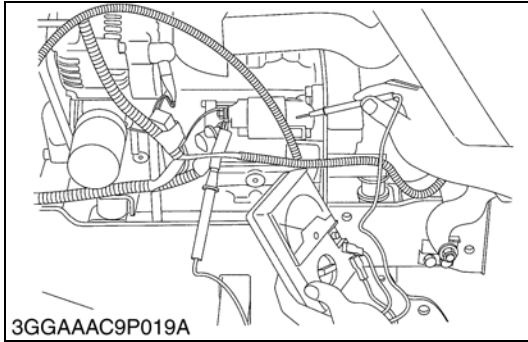
Resistance	30 terminal-19 terminal	Continuity
	30 terminal-50 terminal	Continuity
	30 terminal-AC terminal	Continuity
	AC terminal-19 terminal	Continuity
	AC terminal-50 terminal	Continuity
	50 terminal-19 terminal	Continuity

- (1) 30 Terminal
 (2) AC Terminal
 (3) 50 Terminal
 (4) 19 Terminal

- (A) "OFF"
 (B) "ON"
 (C) "PREHEAT"
 (D) "START"

W1011967

(2) Starter



M Terminal Voltage

1. Measure the voltage with a voltmeter between the **M** terminal and the chassis.
2. If the voltage differs from the battery voltage, the battery's positive cable or the battery negative cable is faulty.

Voltage	Factory spec.	Approx. battery voltage
Tightening torque	M terminal nut	9.8 to 13.7 N·m 1.0 to 1.4 kgf·m 7.2 to 10.1 ft-lbs

W1012958

Motor Test



CAUTION

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

1. Disconnect the battery negative cable from the battery.
2. Disconnect the battery positive cable and the leads from the starter **M** terminal.
3. Remove the starter from the engine.
4. Disconnect the connecting lead (2) from the starter **C** terminal (1).
5. Connect a jumper lead from the connecting lead (2) to the battery positive terminal post.
6. Connect a jumper lead momentarily between the starter motor housing and the battery negative terminal post.
7. If the motor does not run, check the motor.

(1) **C** Terminal

(2) Connecting Lead

W1013277

Magnetic Switch Test

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

NOTE

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

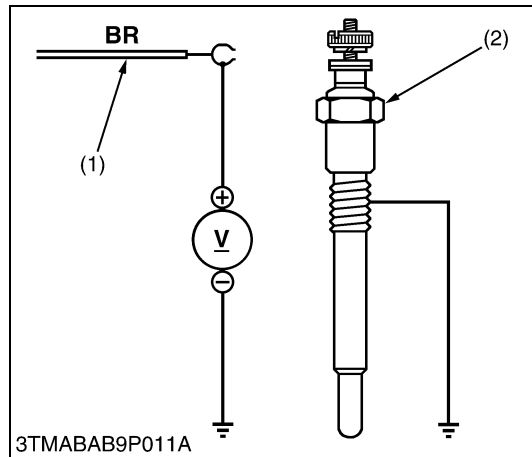
(1) **S** Terminal

(3) Connecting Lead

(2) **C** Terminal

W1013480

(3) Glow Plug



Lead Terminal Voltage

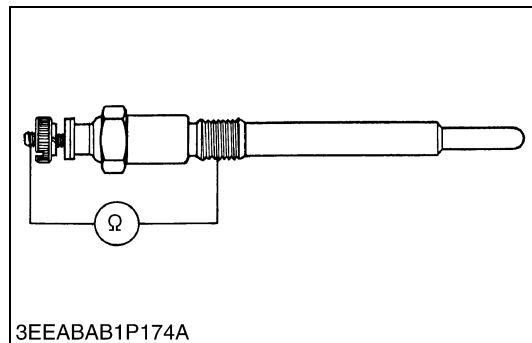
1. Disconnect the **1P** connector (1) from the glow plug (2) after turning the main switch off.
2. Turn the main switch key to the **"PREHEAT"** position, and measure the voltage between the lead terminal and the chassis.
3. Make sure that the PTO switch is in the **"DISENGAGE"** position and apply the parking brake.
4. Turn the main switch key to the **"START"** position, and measure the voltage with a voltmeter between the lead terminal and the chassis.
5. If the voltage at either position differs from the battery voltage, the wiring harness or main switch is faulty.

Voltage (Lead terminal-Chassis)	Main switch key at "PREHEAT"	Approx. battery voltage
	Main switch key at "START"	Approx. battery voltage

(1) **1P** Connector

(2) Glow Plug

W1013693



Glow Plug Continuity

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

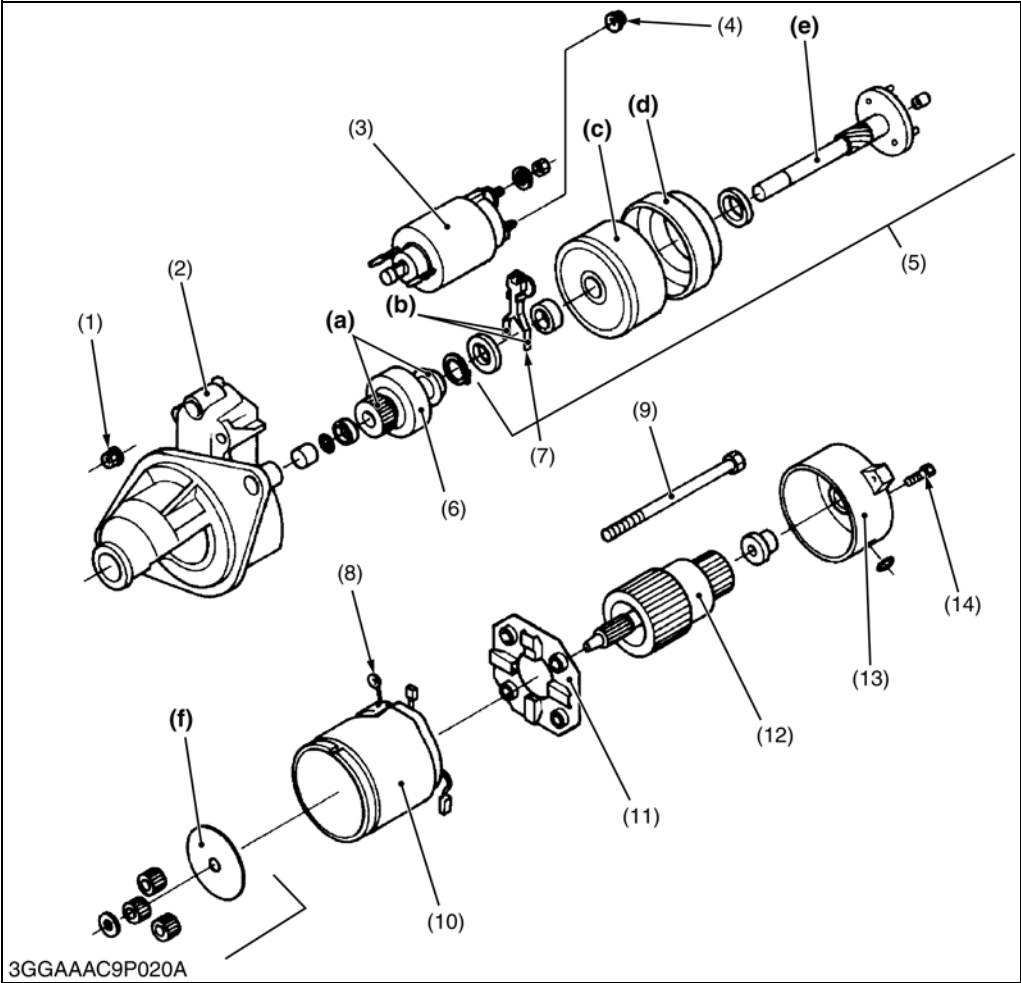
Glow plug resistance	Factory spec.	Approx. 0.9 ohms
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W1014109

DISASSEMBLING AND ASSEMBLING

(1) Starter

Disassembling Starter



- (1) Magnetic Switch Mounting Nut
- (2) Housing
- (3) Magnetic Switch
- (4) C Terminal Nut
- (5) Shaft Assembly
- (6) Overrunning Clutch
- (7) Drive Lever
- (8) Connecting Lead
- (9) Through Bolt
- (10) Yoke
- (11) Brush Holder
- (12) Armature
- (13) Read End Frame
- (14) Mounting Screw
- (a) Teeth of Pinton Gear
- (b) Drive Lever
- (c) Center Bearing
- (d) Internal Gear
- (e) Shaft
- (f) Planetary Gear

W1015174

1. Unscrew the C terminal nut (4), and disconnect the connecting leads (8).
2. Unscrew the magnetic switch mounting nuts (1), and remove the magnetic switch (3) from the housing (2).
3. Unscrew the through bolts (9) and mounting screws (14), and remove the rear end frame (13).
4. Remove the brush from the brush holder while holding the spring up.
5. Remove the brush holder (11).
6. Draw out the armature (12) and yoke (10) from the housing.
7. Draw out the shaft assembly (5) with the drive lever (7) and overrunning clutch (6) from the housing.

NOTE

- Do not damage to the brush and commutator.

(When reassembling)

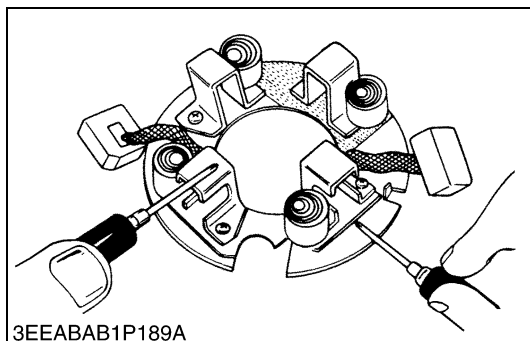
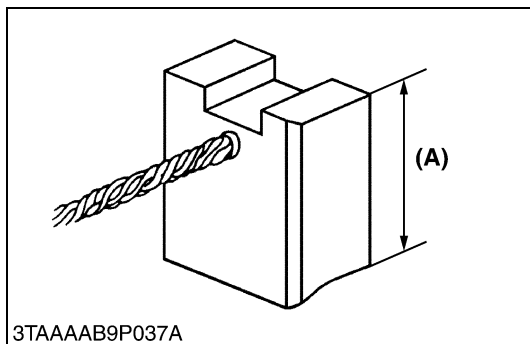
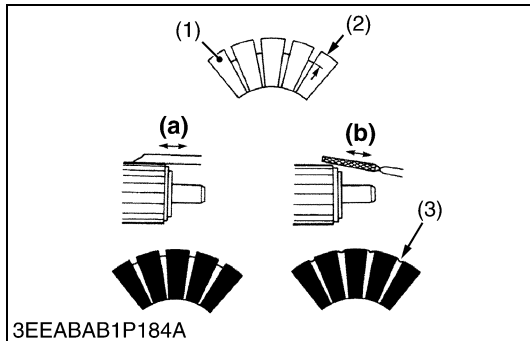
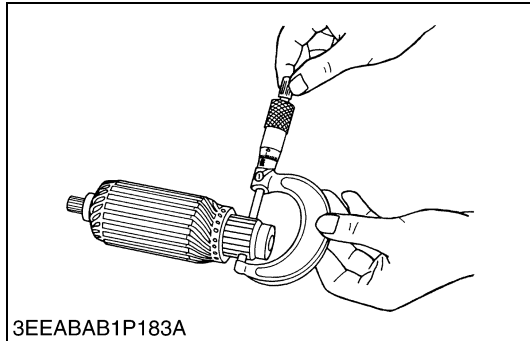
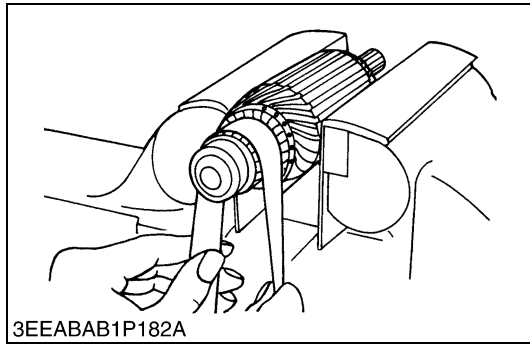
- Apply grease (NIPPONDENSO No.50 or equivalent) to the parts indicated in the figure.

Tightening torque	C terminal nut	7.9 to 11.8 N·m 0.8 to 1.2 kgf·m 5.8 to 8.7 ft·lbs
	Magnetic switch mounting nut	5.9 to 10.8 N·m 0.6 to 1.1 kgf·m 4.4 to 7.9 ft·lbs
	Through bolt	4.42 to 7.35 N·m 0.45 to 0.75 kgf·m 3.25 to 5.42 ft·lbs

W1015003

SERVICING

(1) Starter



Commutator and Mica

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

Commutator O.D	Factory spec.	28.0 mm 1.102 in.
	Allowable limit	27.0 mm 1.063 in.

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

Mica undercut	Factory spec.	0.60 mm 0.0236 in.
	Allowable limit	0.20 mm 0.0079 in.

- (1) Segment
(2) Undercut
(3) Mica

- (a) Correct
(b) Incorrect

W1015371

Brush Wear

1. If the contact face of the brush is dirty or dusty, clean it with emery paper.
2. Measure the brush length **(A)** with vernier calipers.
3. If the length is less than the allowable limit, replace the yoke assembly and brush holder.

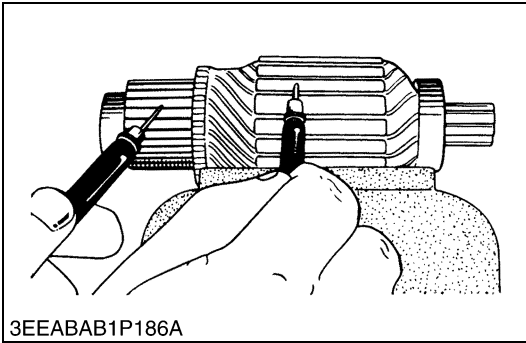
Brush length (A)	Factory spec.	14.0 mm 0.551 in.
	Allowable limit	11.1 mm 0.437 in.

W1015798

Brush Holder

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

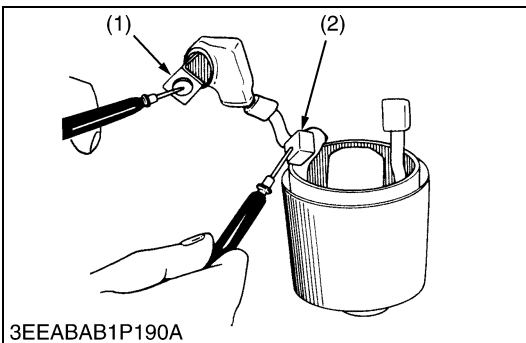
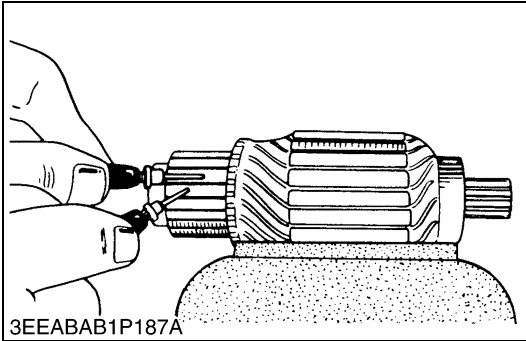
W1015919



Armature Coil

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

W1016056



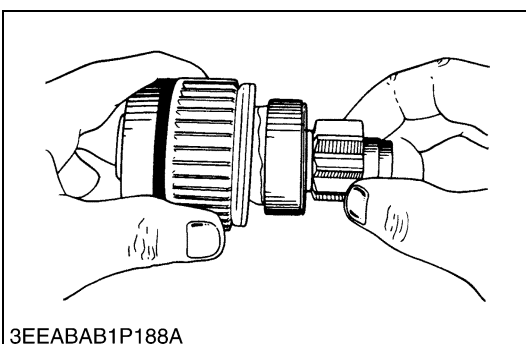
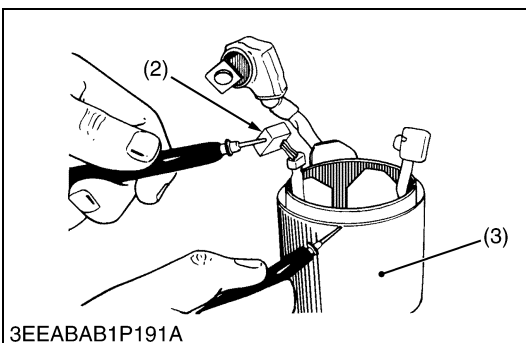
Field Coil

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

(1) Lead
(2) Brush

(3) Yoke

W1016179

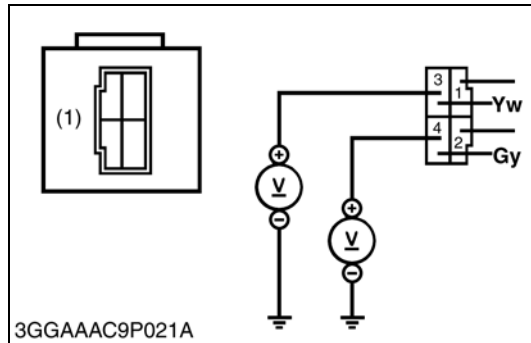


Overrunning Clutch

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

W1016321

[3] ENGINE KEY SWITCH SHUT-OFF SYSTEM CHECKING



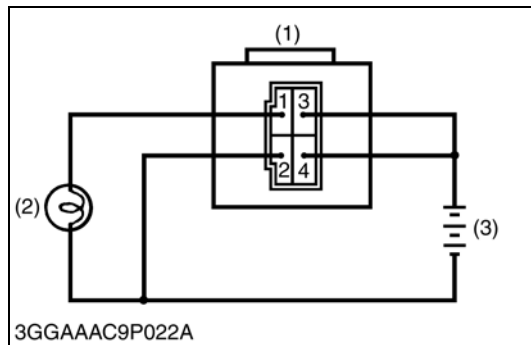
Timer Relay Connector Voltage

1. Disconnect the connector from the timer relay after turning the main switch off.
2. Measure the voltage with a voltmeter across the connector 4 terminal and chassis.
3. Turn the main switch on, and measure the voltage across the connector 3 terminal and chassis.
4. If these voltages differ from the battery voltage, the wiring harness or main switch is faulty.

Voltage	Connector 4 terminal-chassis	Approx. battery voltage
	Connector 3 terminal-chassis	Approx. battery voltage

(1) Timer Relay

W1016544



Test of Timer Relay

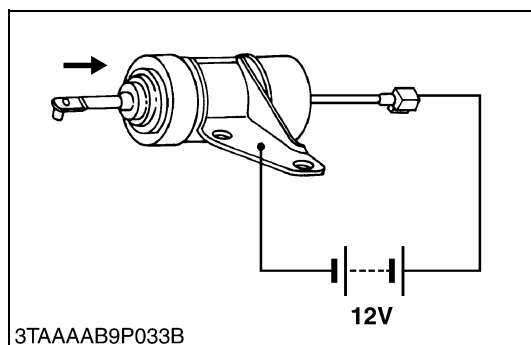
1. Remove the timer relay (1) from the tractor.
2. Connect jumper leads across the battery positive terminal and the timer relay 3 terminal, and across the battery positive terminal and the timer relay 4 terminal.
3. Connect jumper leads across the battery negative terminal and the timer relay 2 terminal, and across the battery negative terminal and the bulb terminal.
4. Connect jumper lead across the timer relay 1 terminal and the bulb terminal.
5. The bulb lights up when disconnecting a jumper lead from the 3 terminal and goes off 6 to 13 seconds later, the timer relay is proper.

(1) Timer Relay

(3) Battery (12V)

(2) Load (Lamp)

W1016721



Engine Stop Solenoid Test

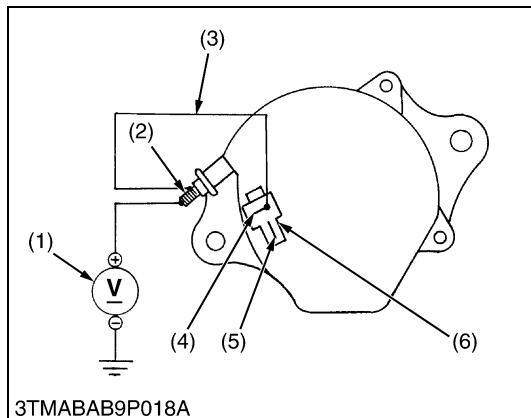
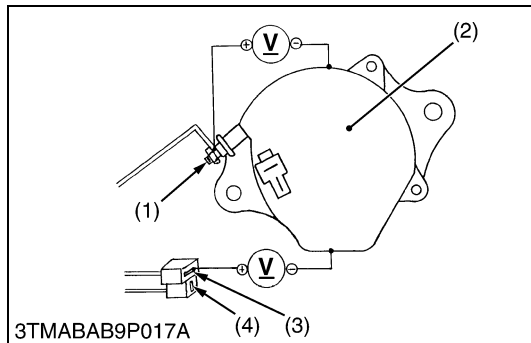
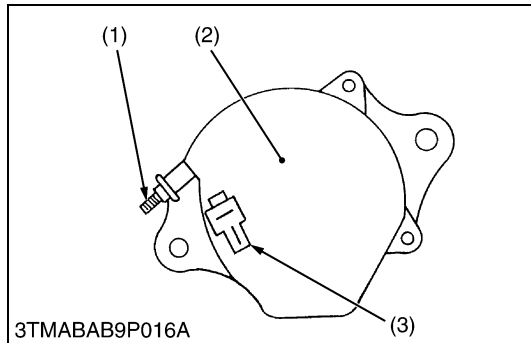
1. Disconnect the 1P connector from the engine stop solenoid.
2. Remove the engine stop solenoid from the engine.
3. Connect the jumper leads from the battery positive terminal to the 1P connector, and from the battery negative terminal to the engine stop solenoid body.
4. If the solenoid plunger is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

W1016870

[4] CHARGING SYSTEM

CHECKING

(1) Alternator



Alternator

1. Disconnect the **2P** connector (3) from alternator (2) after tuning the main switch **OFF**.
2. Perform the following checkings.

- (1) **B** Terminal (3) **2P** Connector
(2) Alternator

W1017030

Connector Voltage

1. Turn the main switch **OFF**. Measure the voltage between the **B** terminal (1) and the chassis.
2. Turn the main switch **ON**. Measure the voltage between the **IG** terminal (3) and the chassis.

Voltage (Main switch at OFF)	B Terminal - Chassis	Approx. battery voltage
Voltage (Main Switch at ON)	IG terminal - Chassis	Approx. battery voltage

- (1) **B** Terminal (3) **IG** Terminal
(2) Alternator (4) **L** Terminal

W1017151

No-Load Test

1. Connect the **2P** connector (6) to previous positions of the alternator after turning the main switch **OFF**.
2. Connect the jumper lead (3) between **IG** terminal (4) and **B** terminal (2).
3. Start the engine and then set the idling speed.
4. Disconnect the negative cable from the battery.
5. Measure the voltage between the **B** terminal (2) and the chassis.
6. If the measurement is less than the factory specification, disassemble the alternator and check the **IC** regulator.

Voltage	Factory spec.	More than 14V
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(Reference)

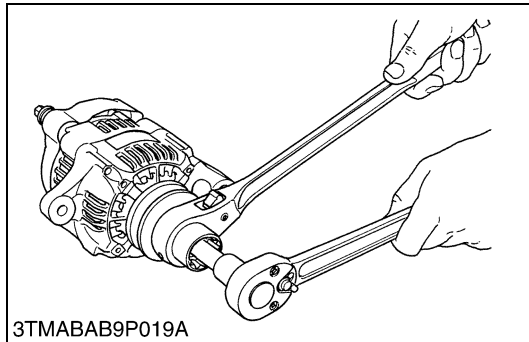
- Once the engine has started, the altinator temperature rises quickly up to an ambient temperature of 70 to 90 °C (158 to 194 °F). As the temperature goes higher than 50 °C (122 °F), the alternator voltage slowly drops; at higher than 100 °C (212 °F), it drops by about 1 V.

- (1) Voltmeter (4) **IG** Terminal
(2) **B** Terminal (5) **L** Terminal
(3) Jumper Lead (6) **2P** Connector

W1017349

DISASSEMBLING AND ASSEMBLING

(1) Alternator



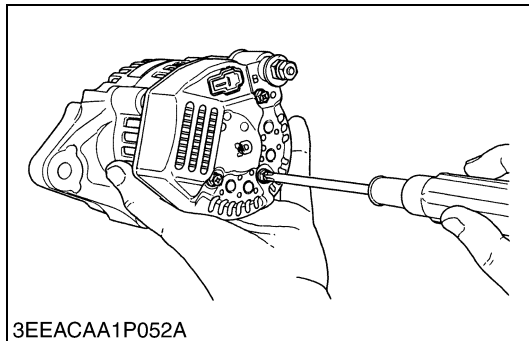
Pulley

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

(When reassembling)

Tightening torque	Pulley nut	93.1 to 127.4 N·m 9.5 to 13.0 kgf·m 68.7 to 94.0 ft-lbs
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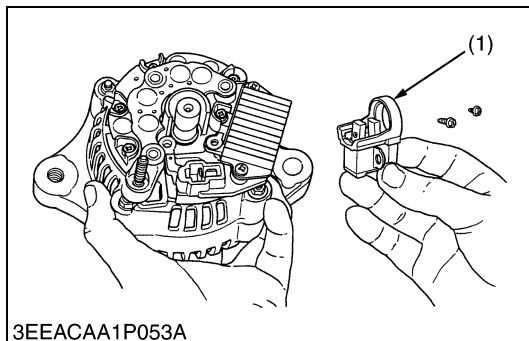
W1017643



Rear End Cover

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

W1017960

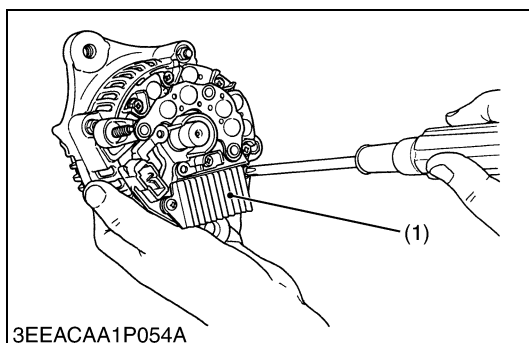


Brush Holder

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

(1) Brush Holder

W1018041

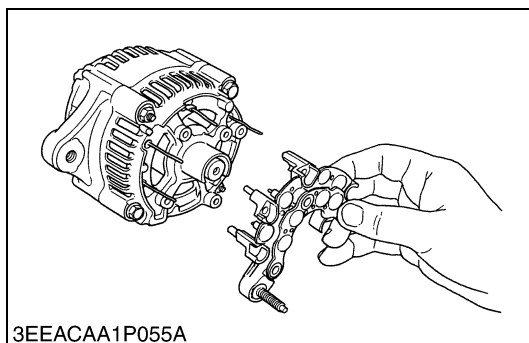


IC Regulator

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

(1) IC Regulator

W1018137

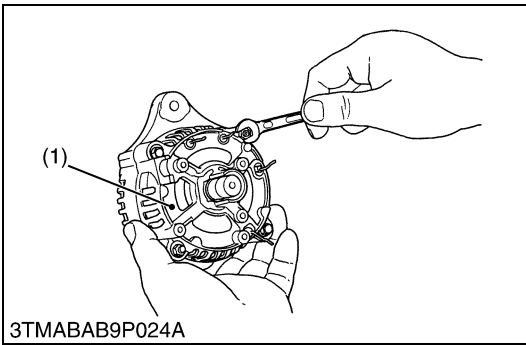


Rectifier

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

(1) Rectifier

W1018229

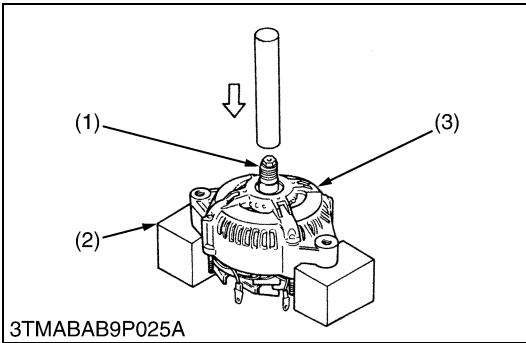


Rear End Frame

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

(1) Rear End Frame

W1018366



Rotor

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

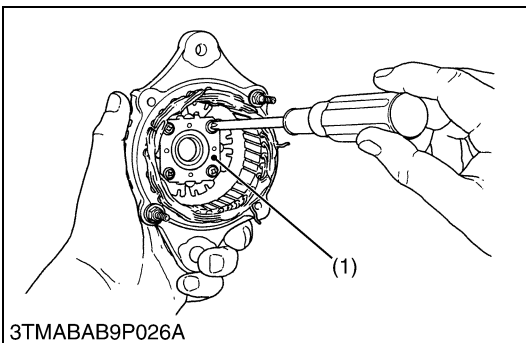
■ IMPORTANT

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

(1) Rotor
(2) Block

(3) Drive End Frame

W1018524

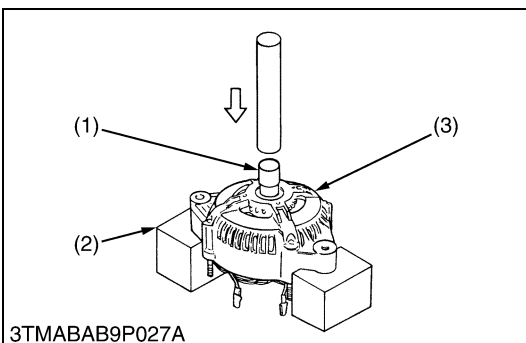


Retainer plate

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

(1) Retainer Plate

W1018671



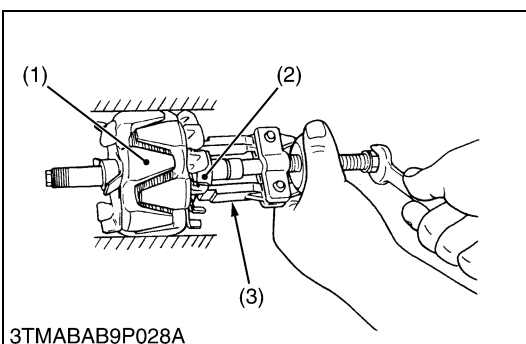
Bearing on Drive End Side

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

(1) Jig
(2) Block

(3) Drive End Frame

W1018752



Bearing at Slip Ring Side

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

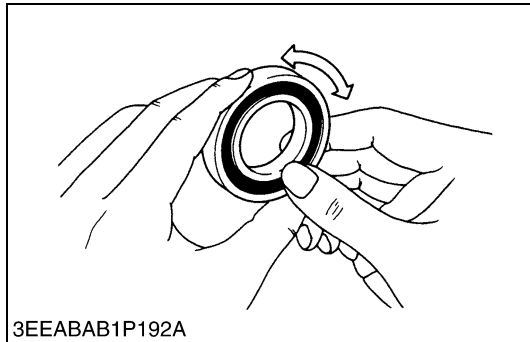
(1) Rotor
(2) Bearing

(3) Puller

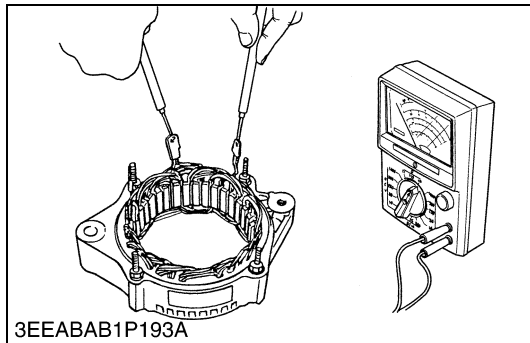
W1018849

SERVICING

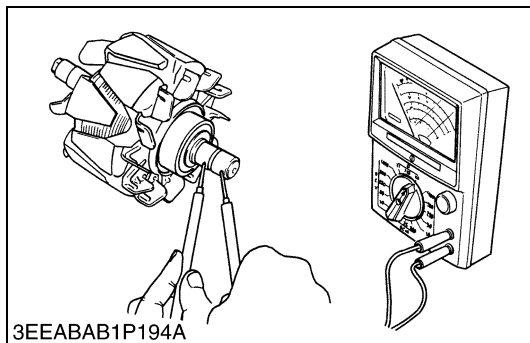
(1) Alternator



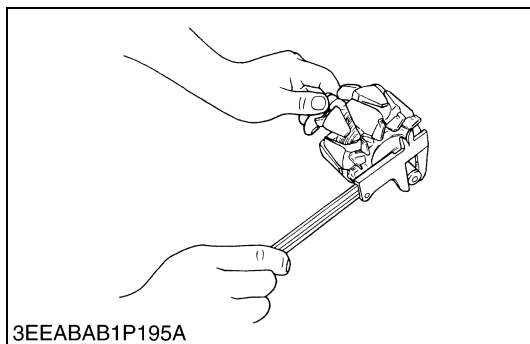
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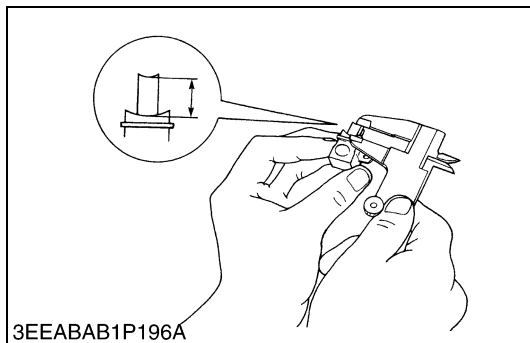
3EEABAB1P193A



3EEABAB1P194A



3EEABAB1P195A



3EEABAB1P196A

Bearing

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

W1018966

Stator

1. Measure the resistance across each lead of the stator coil with an ohmmeter.
2. If the measurement is not within factory specification, replace it.
3. Check the continuity across each stator coil lead and core with an ohmmeter.
4. If infinity is not indicated, replace it.

Resistance	Factory spec.	Less than 1.0 ohms
------------	---------------	--------------------

W1019167

Rotor

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

Resistance	Factory spec.	2.9 ohms
------------	---------------	----------

W1019305

Slip Ring

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

Slip ring O.D.	Factory spec.	14.4 mm 0.567 in.
	Allowable limit	12.8 mm 0.504 in.

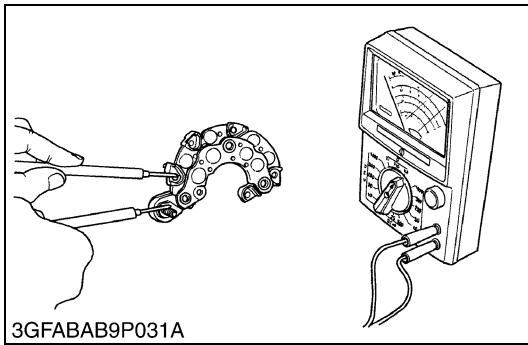
W1019427

Brush Wear

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

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

W1019560

**Rectifier**

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

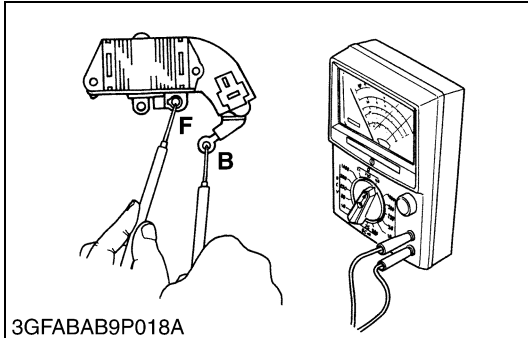
IMPORTANT

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

NOTE

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

W1019720

**IC Regulator**

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

IMPORTANT

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

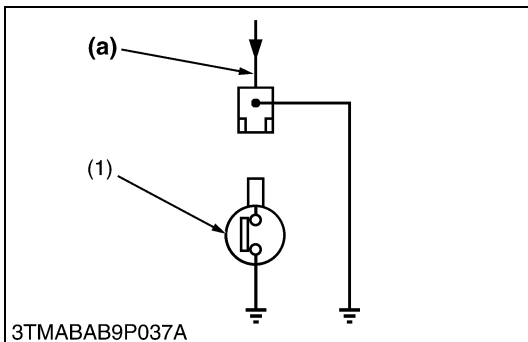
NOTE

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

W1019909

[5] ELECTRICAL EQUIPMENT CHECKING

(1) Oil Pressure Switch

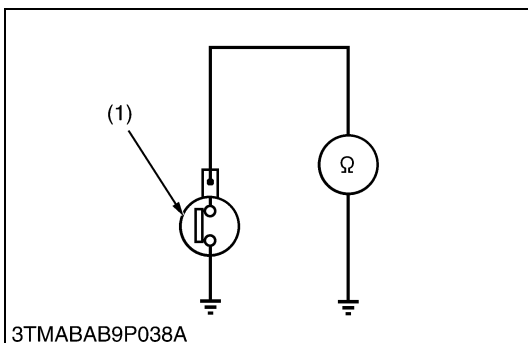
**Oil Pressure Indicator Lamp**

1. Disconnect the 1P connector from the oil pressure switch (1).
2. Turn the main switch key to the "ON" position, and connect a jumper lead from the 1P connector terminal to the chassis.
3. If the oil pressure indicator lamp does not light, the bulb or wiring harness is faulty.

(1) Oil Pressure Switch

(a) From Oil Pressure indicator Lamp

W1020070

**Oil Pressure Switch Continuity**

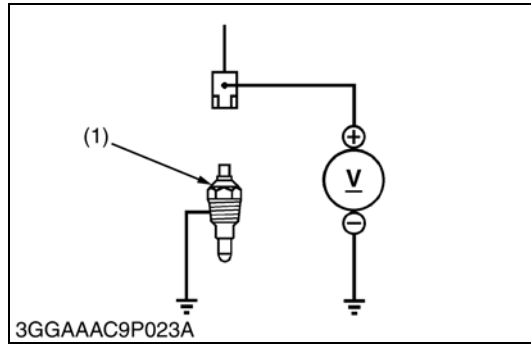
1. Disconnect the 1P connector from the oil pressure switch (1).
2. Measure the resistance with an ohmmeter between the switch terminal and the chassis.
3. If 0 ohm is not indicated in the normal state, the switch is faulty.
4. If infinity is not indicated at pressure over 4.9 kPa (0.5 kgf/cm², 7 psi), the switch is faulty.

Resistance (Switch terminal- Chassis)	In normal state	0 ohm
	At pressure over approx. 4.9 kPa (0.5kgf/cm ² , 7 psi)	Infinity

(1) Oil Pressure Switch

W1020184

(2) Thermo Switch



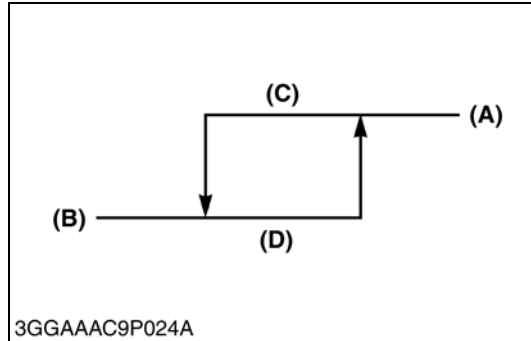
Connector Voltage

1. Disconnect the **1P** connector from the thermo switch (1).
2. Turn the main switch key to the “**ON**” position, and measure the voltage with a voltmeter between the connector terminal and the chassis.
3. If a certain voltage is not indicated, the wiring harness or coolant temperature gauge is faulty.

Voltage (Connector terminal - Chassis)	Factory spec.	A certain voltage is indicated
--	---------------	--------------------------------

(1) Thermo Switch

W1020374



Thermo Switch Continuity

1. Disconnect the **1P** connector, and remove the thermo switch.
2. Using an ohmmeter, check for continuity between the switch terminal and the chassis as shown in the figure.
3. If infinity is indicated at temperature over factory specifications, the switch is faulty.

Working temperature	Factory spec.	120 to 126 °C 248.0 to 258.8 °F
---------------------	---------------	------------------------------------

(A) ON

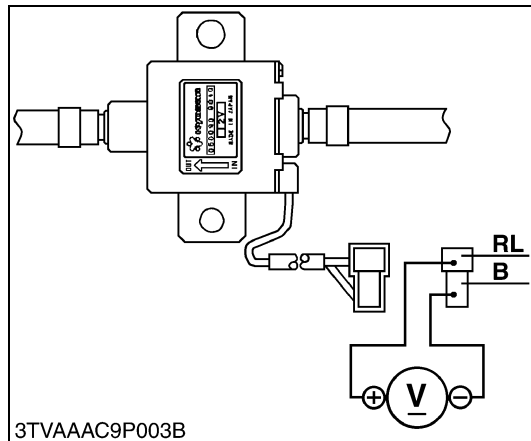
(C) 116 °C (240.8 °F) or more

(B) OFF

(D) 120 to 126 °C (248.0 to 258.8 °F)

W1020510

(3) Fuel Pump

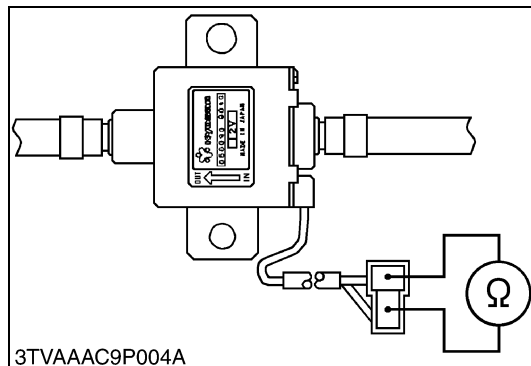


Connector Voltage

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

Connector voltage	Factory spec.	Approx. battery voltage
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W1028106

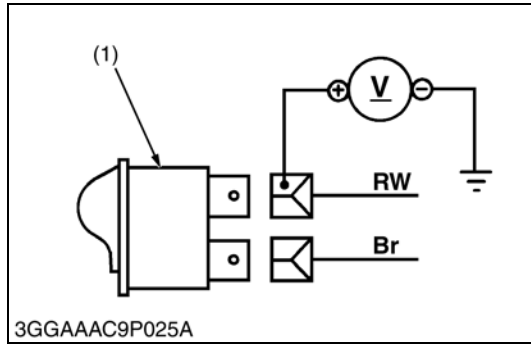


Fuel Pump Continuity

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

W1028246

(4) Head Light Switch



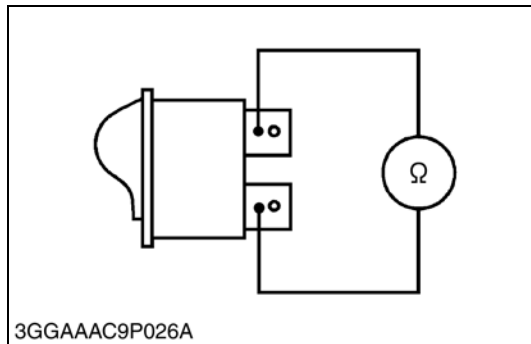
Connector Voltage

1. Disconnect the **1P** connectors from the head light switch (1).
2. Turn the main switch key to the **"ON"** position, and measure the voltage with a voltmeter between the connector terminal (Red / White) and the chassis.
3. If the voltage differs from the battery voltage, the wiring harness or main switch is faulty.

Voltage (Connector terminal - Chassis)	Factory spec.	Approx. battery voltage
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(1) Head Light Switch

W1028370



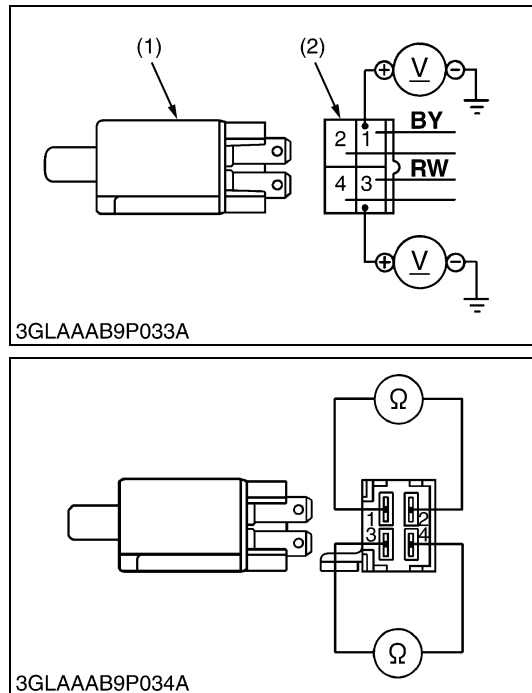
Head Light Switch Continuity

1. Disconnect the **1P** connectors from the head light switch (1).
2. Using an ohmmeter, check for continuity between the connector terminals.
There should be no continuity when the head light switch is set at **"OFF"** position, and continuity when the head light switch is set at **"ON"** position.

(1) Head Light Switch

W1029219

(5) Brake Switch



Brake Switch

1) Connector Voltage

1. Turn the main switch off.
2. Disconnect the **4P** connectors from the brake switch (1).
3. Set the PTO clutch lever at **"DISENGAGE"** position.
4. Turn the main switch to **"ON"** position.
5. Measure the voltage with a voltmeter across the connector **3** terminal and chassis.
6. If the voltage differs from battery voltage, the wiring harness is faulty.
7. Turn the main switch to **"START"** position.
8. Measure the voltage with a voltmeter across the connector **1** terminal and chassis.
9. If the voltage differs from battery voltage, the wiring harness is faulty.

Voltage (3 terminal - Chassis)	Factory spec.	Battery voltage
Voltage (1 terminal - Chassis)	Factory spec.	Battery voltage

2) Terminal Continuity

1. Measure the resistance with an ohmmeter between the terminal while pressing the brake pedal.
2. Measure the resistance with an ohmmeter between the terminal while the brake pedal is released.
3. If the resistance values specified below are not indicated, the brake switch is faulty.

■ Brake Pedal is pressed

Resistance (1 terminal-2 terminal)	Factory spec.	Continuity
Resistance (3 terminal-4 terminal)	Factory spec.	Continuity

■ Brake Pedal is released

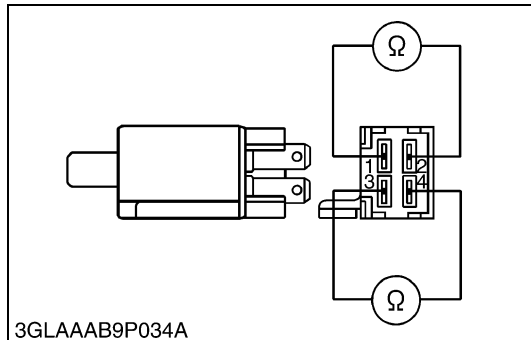
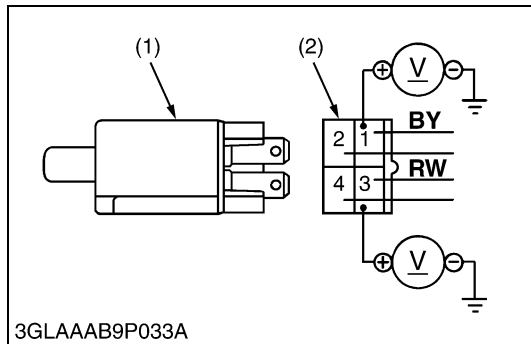
Resistance (1 terminal-2 terminal)	Factory spec.	Infinity
Resistance (3 terminal-4 terminal)	Factory spec.	Infinity

(1) Brake Switch

(2) **4P** Connector

W1031630

(6) PTO Switch



PTO Switch

1) Connector Voltage

1. Turn the main switch off.
2. Disconnect the **4P** connector from the PTO switch (1).
3. Turn the main switch to “**ON**” position.
4. Measure the voltage with a voltmeter across the connector **3** terminal and chassis.
5. If the voltage differs from battery voltage, the wiring harness is faulty.
6. Turn the main switch to “**START**” position.
7. Measure the voltage with a voltmeter across the connector **1** terminal and chassis.

If the voltage differs from battery voltage, the wiring harness is faulty.

Voltage (1 terminal - Chassis)	Factory spec.	Battery voltage
Voltage (3 terminal - Chassis)	Factory spec.	Battery voltage

2) Terminal Continuity

1. Measure the resistance with an ohmmeter between the terminals when the PTO clutch lever is set at “**DISENGAGE**” position.
2. Measure the resistance with an ohmmeter between the terminal when the PTO clutch lever is set at “**ENGAGE**” position.
3. If the resistance values specified below are not indicated, the PTO switch is faulty.

■ PTO clutch lever is set at “DISENGAGE” position.

Resistance (1 terminal-2 terminal)	Factory spec.	Continuity
Resistance (3 terminal-4 terminal)	Factory spec.	Continuity

■ PTO clutch lever is set at “ENGAGE” position.

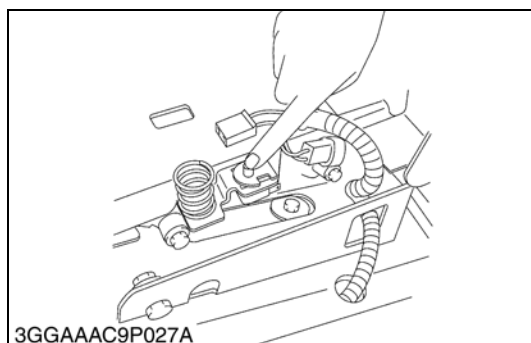
Resistance (1 terminal-2 terminal)	Factory spec.	Infinity
Resistance (3 terminal-4 terminal)	Factory spec.	Infinity

(1) PTO Switch

(2) **4P** Connector

W1029375

(7) Seat Switch

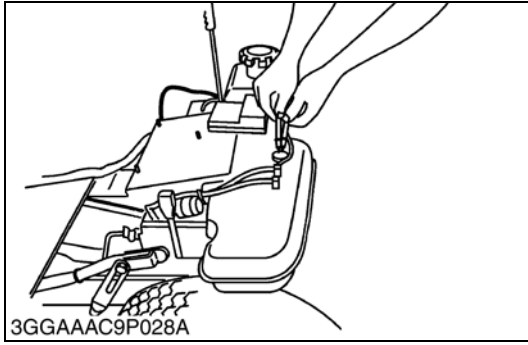


Seat Switch Continuity

1. Disconnect the **2P** connector for the seat switch.
2. Using an ohmmeter, check for continuity between the connector terminals.
There should be continuity when the seat switch is depressed (seated) and no continuity when the seat switch is released (standing).

W1030037

(8) Fuel Switch



Fuel Switch Continuity

1. Disconnect the **2P** connector from the fuel switch.
2. Using an ohmmeter, check for continuity between the connector terminals.

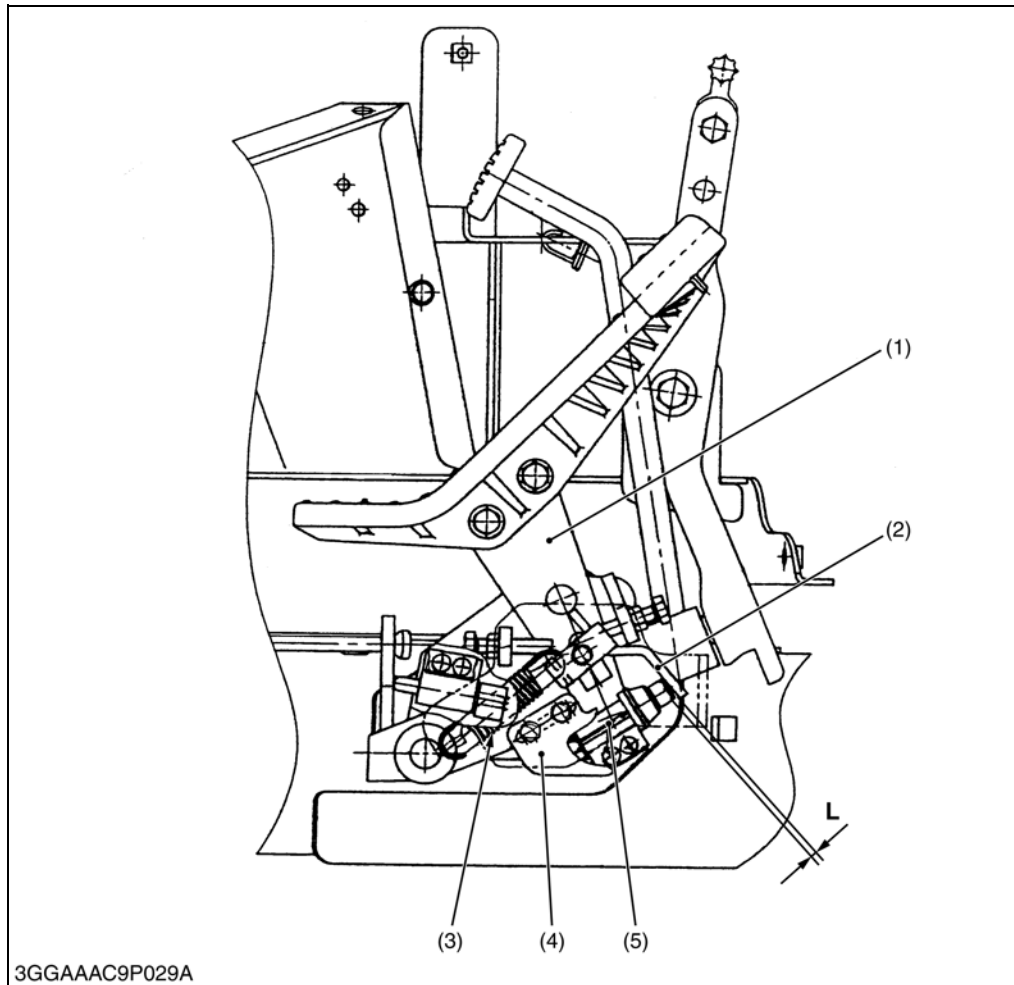
There should be continuity when the fuel in the tank is empty, and no continuity when the fuel in the tank is full.

W1030121

[6] KRA SYSTEM (If Equipped)

(1) Reverse Switch

Adjusting of Reverse Switch Gap



- (1) Pedal System Comp.
- (2) Reverse Switch Lever
- (3) Parking Lock Spring
- (4) Reverse Switch Plate
- (5) Reverse Switch

W1030362

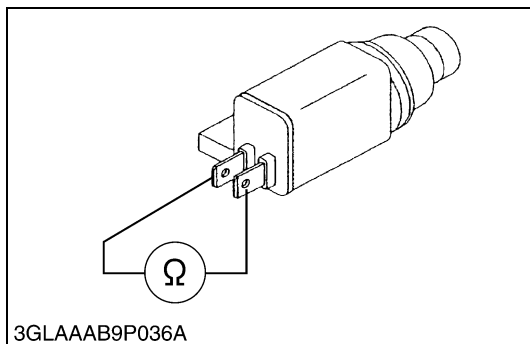
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1. Check and adjust gap between reverse switch (5) and reverse switch lever (2).

Reverse switch gap (L)	Factory spec.	0 mm 0 in.
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■ NOTE

- The gap adjustment should be done at the condition to have no play at reverse position.



3GLAAB9P036A

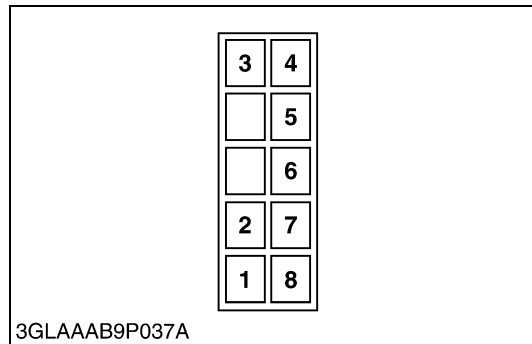
Reverse Switch Continuity

1. Disconnect the reverse switch from the wiring harness.
2. Push the switch, and check the continuity between the terminals with an ohmmeter.
3. If the continuity is 0 ohm, the reverse switch is faulty. Replace the reverse switch.

Continuity between the terminals in pushing switch	Factory spec.	Infinity ohm
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W1030593

(2) KRA system Unit (Harness connector side)



KRA system Unit Connector Battery Voltage

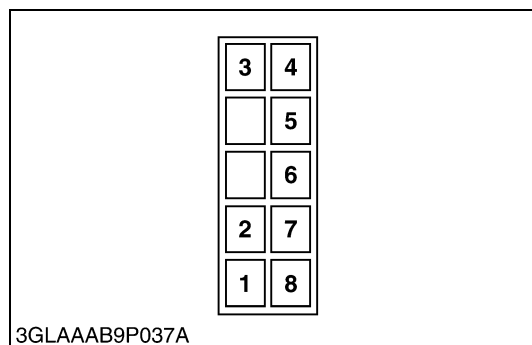
1. Turn the main switch to “ON” position. But do not start the engine.
2. Measure voltage with a voltmeter.

Voltage (3 terminal- 8 terminal)	Factory spec.	Battery Voltage
Voltage (5 terminal- 8 terminal) HST pedal “Neutral” or “Forward”	Factory spec.	Battery Voltage
Voltage (6 terminal- 8 terminal) PTO lever “Disengage”	Factory spec.	Battery Voltage

3. If 3 terminal - 8 terminal voltage is not battery voltage check the KRA system fuse blown and wire harness disconnected.
4. If 5 terminal - 8 terminal, 6 terminal - 8 terminal voltage are not battery voltage, check wire harness disconnected.
5. Continuity is not 0 Ω , harness or KRA system switch is defective.
6. If KRA system fuse is not blown and wire harness is connected, the KRA system unit is defective, and replace the KRA system unit as an unit.

- | | |
|-----------------------|--------------------|
| (1) KRA System Switch | (5) Reverse Switch |
| (2) KRA System Switch | (6) PTO Switch |
| (3) Fuse | (7) Lamp |
| (4) Start Switch | (8) GND. |

W1030717



KRA system Unit Connector Terminal Continuity

1. Measure the resistance with an ohmmeter when the main switch is “OFF” position.
2. Push on the KRA system switch on panel board, and measure the resistance between 1 terminal and 2 terminal.

Resistance- (1 Terminal - 2 Terminal)	Factory spec.	0 Ω
Resistance- (8 Terminal - Chassis)	Factory spec.	0 Ω

W1031477

9 MOWER

SERVICING

CONTENTS

1. TROUBLESHOOTING	9-S1
2. SERVICING SPECIFICATIONS	9-S2
3. TIGHTENING TORQUES	9-S3
4. CHECKING, DISASSEMBLING AND SERVICING.....	9-S4
[1] CHECKING AND ADJUSTING	9-S4
[2] DISMOUNTING AND MOUNTING	9-S8
[3] DISASSEMBLING AND ASSEMBLING.....	9-S10
[4] SERVICING	9-S15

1. TROUBLESHOOTING

Symptom	Probable Cause	Solution	Reference Page
Blade does not rotate.	Is PTO system normal ?		
	NO Weaken or broken front PTO belt	Replace	7-S3, S4, S5
	YES Damaged mower belt	Replace	9-S4, S10 S11
Mower belt slipping	Weaken tension spring	Replace	9-S11
	Damaged mower belt	Replace	9-S4, S10 S11
	Mower plugged	Unplug and clean mower deck.	—
	Debris in pulleys	Clean	—
Discharge chute plugged	Grass too wet	Wait for grass to dry.	—
	Grass too long	Raise cutting height and cut grass twice.	9-S7
	Cutting too low	Raise cutting height.	9-S7
	Engine speed too low	Mow at full throttle.	—
	Ground speed too fast	Slow down.	—
Streaking of grass uncut	Ground speed too fast	Slow down.	—
	Engine speed too low	Mow at full throttle.	—
	Grass too long	Cut grass twice.	9-S7
	Blades dull or damaged	Replace blades or have blades sharpened.	9-S4, S10
	Debris in mower deck	Clean mower deck.	—
Uneven cut	Mower deck not level	Level mower deck.	9-S5, S6
	Ground speed too fast	Slow down.	—
	Blades dull or damaged	Have blades sharpened.	9-S4, S10
	Blades worn	Replace blades.	9-S10
	Low tire inflation	Add air to correct.	G-#

T15040MO03201

Symptom	Probable Cause	Solution	Reference Page
Blades scalping grass	Cutting height too low	Raise cutting height.	9-S7
	Turning speed too fast	Reduce speed on turns.	—
	Ridges in terrain	Change mowing pattern.	—
	Bend blades	Replace blades.	9-S10
Excessive vibration	Debris on mower deck or in pulleys	Clean mower deck and pulleys.	—
	Damaged mower belt	Replace mower belt.	9-S4, S10 S11
	Damaged pulleys	Replace pulleys.	9-S11 S10, S11
	Pulleys out of alignment	Check pulleys.	—
	Blades out of balance	Have blades balanced.	—

T15040MO03301

2. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
Front Tip of Blade to Rear Tip of Blade	Difference	Less than 5 mm 0.20 in.	—
Left Tip of Blade to Right Tip of Blade	Difference	Less than 4 mm 0.16 in.	—
Mower Gear Case Oil	Capacity	0.40 L 0.42 U.S.qts. 0.35 Imp.qts.	—
Bevel Gears	Backlash	0.13 to 0.25 mm 0.0052 to 0.0098 in.	—
Tension collar to Tension Arm Bushing	Clearance	0.005 to 0.117 mm 0.0002 to 0.0046 in.	0.30 mm 0.0118 in.
Tension Collar	O.D.	18.997 to 19.027 mm 0.7479 to 0.7491 in.	—
Tension Arm Bushing	I.D.	19.032 to 19.114 mm 0.7493 to 0.7525 in.	—

W1013874

3. TIGHTENING TORQUES

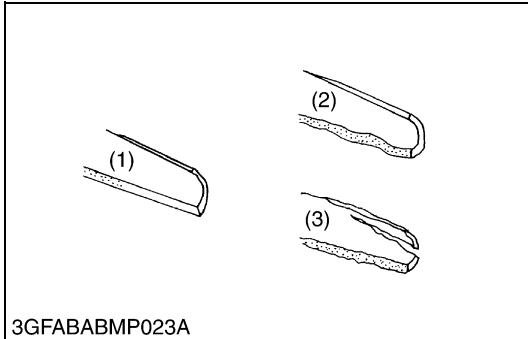
Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts : See page G-9.)

Item	N·m	kgf·m	ft-lbs
Reamer bolt	77.4 to 90.2	7.9 to 9.2	57.1 to 66.5
Mower blade screw	98.0 to 117.6	10.0 to 12.0	72.3 to 86.7
Breather plug	15	1.5	11
Center pulley holder mounting screw	77.4 to 90.2	7.9 to 9.2	57.1 to 66.5
Side blade pulley holder mounting nut and bolt	77.4 to 90.2	7.9 to 9.2	57.1 to 66.5
Side blade pulley mounting nut	102.9 to 117.6	10.5 to 12.0	75.9 to 86.8
L.H. tension pulley mounting bolt and nut	47.0 to 56.8	4.8 to 5.8	34.7 to 42.0
L.H. tension arm mounting bolt and nut	77.4 to 90.2	7.9 to 9.2	57.1 to 66.5
R.H. tension pulley mounting bolt and nut	108.8 to 130.3	11.1 to 13.3	80.3 to 96.2
R.H. tension arm mounting bolt and nut	77.4 to 90.2	7.9 to 9.2	57.1 to 66.5

W1012736

4. CHECKING, DISASSEMBLING AND SERVICING

[1] CHECKING AND ADJUSTING



Checking Mower Blade

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

■ IMPORTANT

- Never forget to set the spring plate between mower blade and spline boss, when reassembling the mower blades.

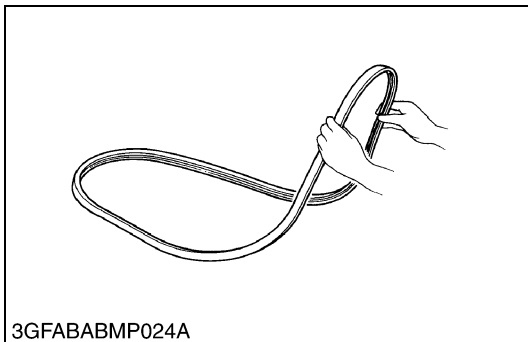
■ NOTE

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

- (1) New Blade
(2) Worn Blade

- (3) Cracked Blade

W1010988



Checking Mower Belts

1. Check to see the mower belts.
2. Replace the mower belt with a new one, if there is found surface split at more than 3 positions.

(When replacing mower belt)

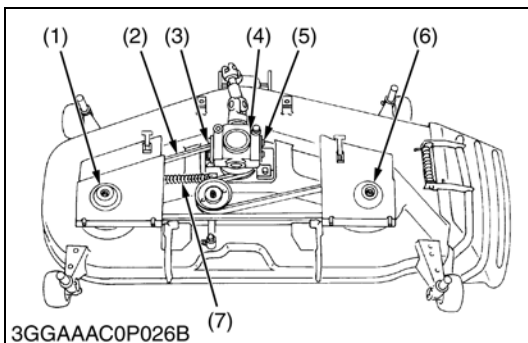
1. Dismount the mower from the machine.
2. Remove the left and right hand cover (1), (7) from the mower deck.
3. Clean around the gear case (4) and pulley.
4. Remove the tension springs (7).
5. Remove the L.H. case stay (3) and R.H. case stay (5) which mounts the gear case to the mower deck.
6. Remove the mower belts (2). Slip the mower belts over the top of the gear case (4).
7. To install new belts, reverse the above procedure.

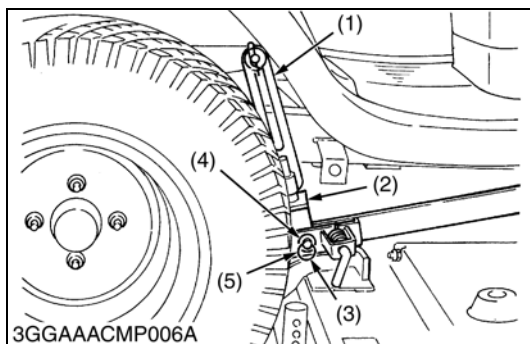
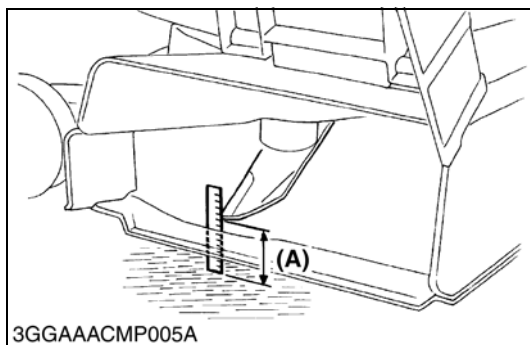
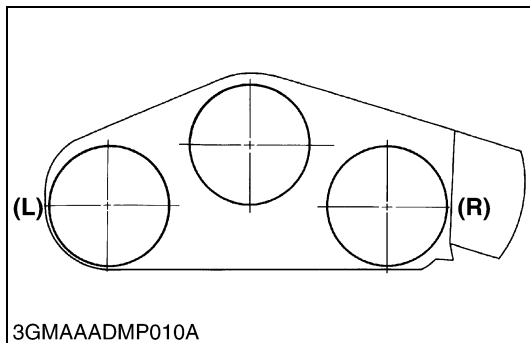
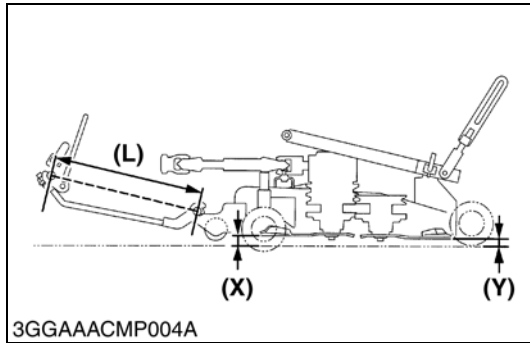
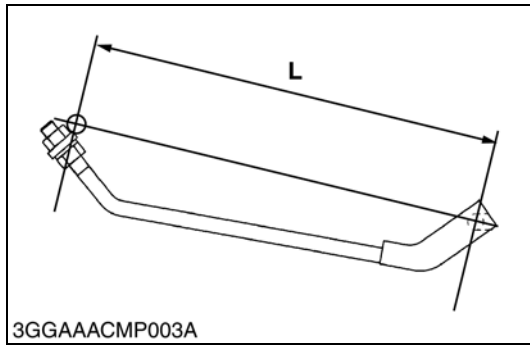
Tightening torque	Reamer bolt	77.4 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft-lbs
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- (1) L.H. Cover
(2) Mower Belt
(3) L.H. Case Stay
(4) Gear Case

- (5) R.H. Case Stay
(6) R.H. Cover
(7) Tension Spring

W1011170





Adjusting the Parallel Linkage

1. Park the machine on a level surface.
2. Make sure the mower blades are level in the way mentioned below. Then tighten the lock nuts securely.
Adjust (L) of front links with lock nut so that (A) is 0~5 mm (0~0.2 in.). $A=(Y)-(X)$



CAUTION

- Shut off the engine and remove the key.
- Set parking brake.
- Allow the blades to stop before making adjustments.
- Blades may be sharp, when you handle blades, wear heavy gloves or wrap end of blade with rag.

W1011500

Adjusting the Mower Deck (Side-to-Side)

1. Park the machine on a level surface.
2. Tire inflation pressure must be correct.
(See "TIRE" section.)
3. Raise the hydraulic lift lever to the top position. Turn the cutting height control dial to adjust height to the desired height.
4. Lower the mower deck by pushing the hydraulic lift lever forward.
5. Turn the left blade so that it is parallel to rear axle.
Hold drive belt and turn the right blade so that it is parallel to axle.
6. Measure from each outside blade tip (L) to (R) to the level surface. The difference between measurements should be less than 1/8 in. (3 mm).
7. Remove the snap ring, plain washer and clevis pin. Adjust the lift link length so that the difference between measurement (L) and (R) is less than 1/8 in. (3 mm).
8. Reinstall the snap ring, plain washer and clevis pin.



CAUTION

- Shut off the engine and remove the key.
- Set parking brake.
- Allow the blades to stop before making adjustments.
- Blades may be sharp. When you handle blades, wear heavy gloves or wrap end of blade with a rag.

(1) Lift Link (Upper)

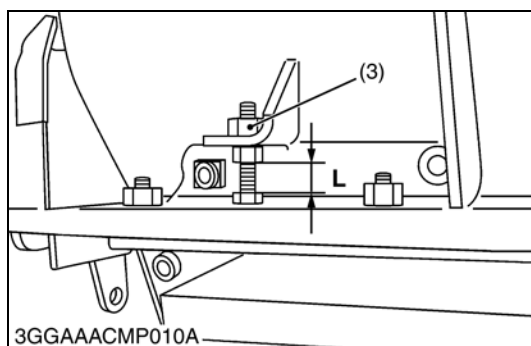
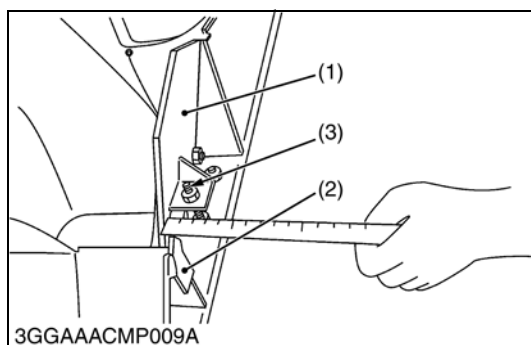
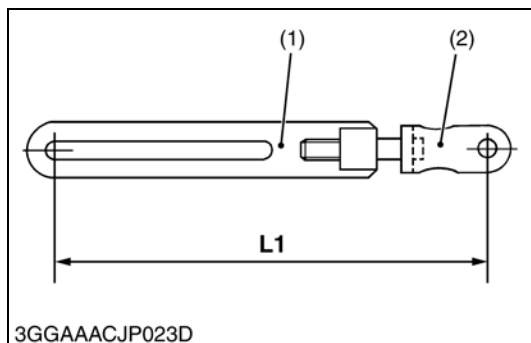
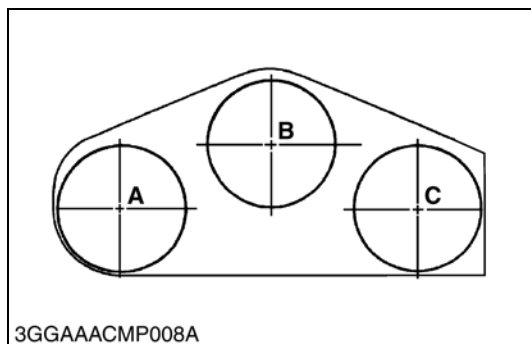
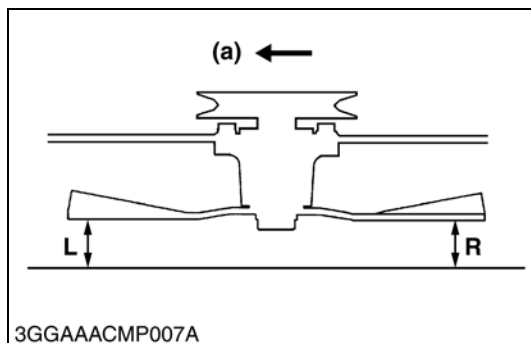
(2) Lift Link (Lower)

(3) Snap Ring

(4) Plane Washer

(5) Clevis Pin

W1011782



Adjusting Left and Right Cutting Height

1. Mount the mower to the machine, and place the machine on a level ground.
2. Set the cutting height to "2" position.
3. Measure the heights **(L)**, **(R)** of the blade.
4. If the difference between left tip of blade and right tip of blade exceeds the factory specification, adjust the length **(L1)** of upper lift link (1) and lower lift link (2).

(Reference)

- **L1** : 350 mm (13.8 in.)

Difference (L-R) between left tip of blade and right tip of blade (on blades A , B and C)	Factory spec.	Less than 4 mm 0.16 in.
--	---------------	----------------------------

- (1) Upper Lift Link
(2) Lower Lift Link

(a) Left

W1012173

Adjusting Rotation Plate

1. Park the machine on level ground, and stop the engine.
2. Dismount the mower.
3. Turn over the mower.
4. Turn the adjusting screw (3) until the rotation plate (1) and the performance plate end (2) come into contact with each other.

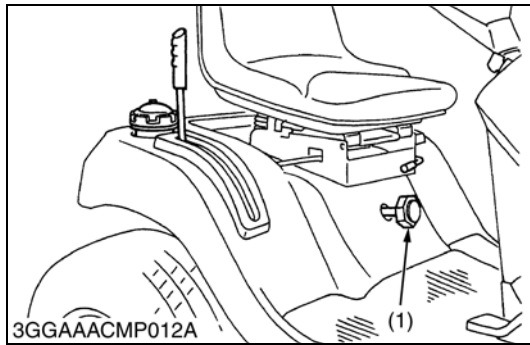
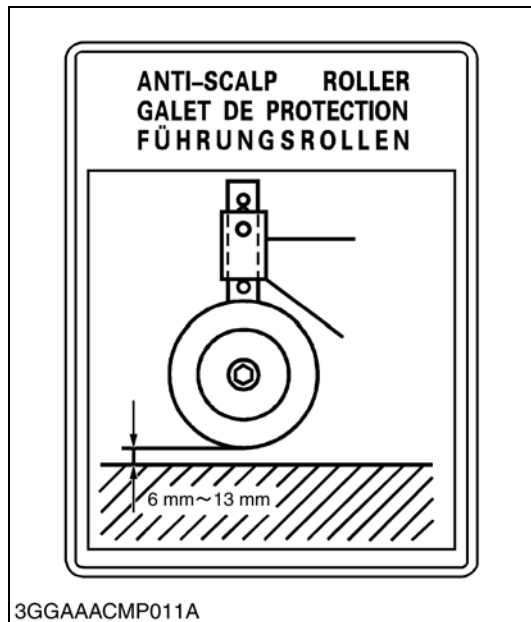
(Reference)

- **L** : 26 mm (1.02 in.)

- (1) Rotation Plate
(2) Performance Plate End

(3) Adjusting Screw

W1012598



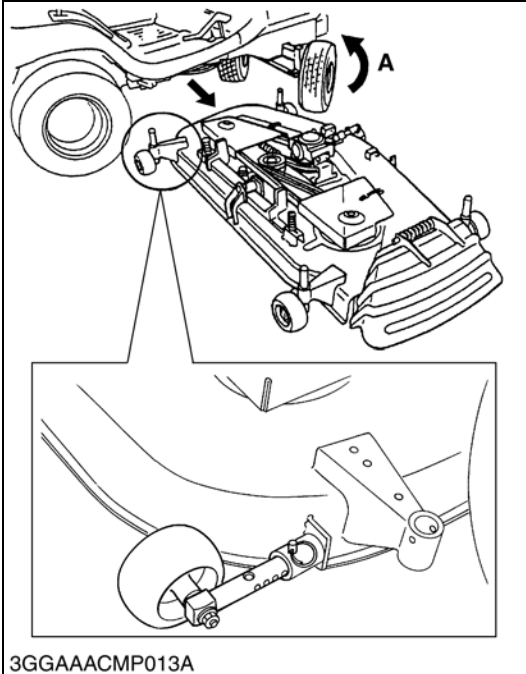
Adjusting Cutting Height

1. To set the cutting height, pull the mower lift lever backward to raise the mower deck to the top position. Turn the cutting height control dial to adjust height.
2. Set the anti-scalp roller's height as shown to keep clearance between rollers and ground more than 6 mm (0.24 in.).

(1) Cutting Height Control Dial

W1012775

[2] DISMOUNTING AND MOUNTING

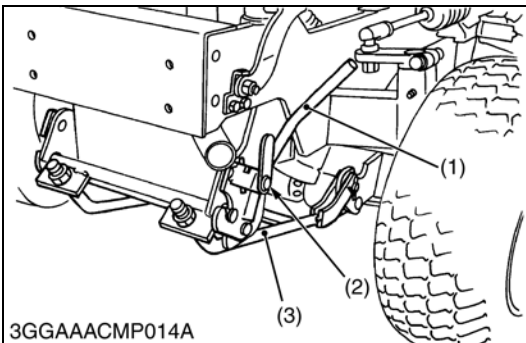


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Anti-scalp Rollers and Cutting Height Adjusting Dial

1. Park the machine on level ground, and stop the engine.
2. Set the front anti-scalp rollers sideways and at the topmost position.
3. Set the cutting height adjusting dial to “1” position, and down the mower.

W1013013



3GGAAACMP014A

Front Link

1. Pull the lever fulcrum fixing pin (2) and turn it clockwise to release the lock.
2. Push down the link fixing lever (1).
3. Remove the front link (3) from the mower deck.

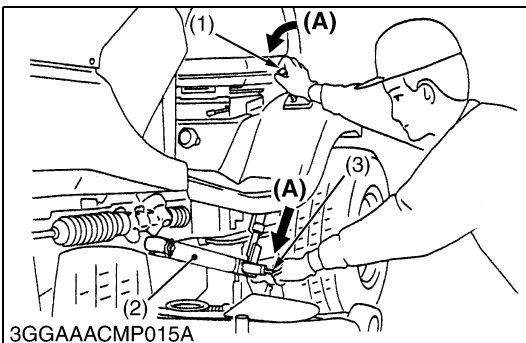
(When reassembling)

- When attach the front link, make sure the length of the front link. (See page 9-S5.)

- (1) Link Fixing Lever
(2) Lever Fulcrum Fixing Pin

(3) Front Link

W1013166



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Rear Links and Universal Joint

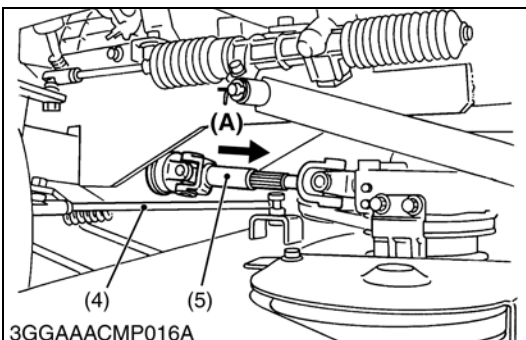
1. Place the hydraulic lift lever (1) in the “**DOWN**” position. Push down the rear links (2) to align with the mower bracket.
2. Disconnect the rear links (2) from the mower deck, pulling the L-pins (3).
3. Pull back the coupler (4) to unlock.
4. Remove the universal joint (5) from the PTO shaft.
5. Start the engine, and lift the rear links (2).
6. Stop the engine.

(When reassembling)

- Apply grease to the splines and grease nipples of the universal joint.
- Slide the universal joint back and forward to make sure the universal joint is locked securely.
- When attach the lift links, make sure the length of the lift links. (See page 9-S6.)

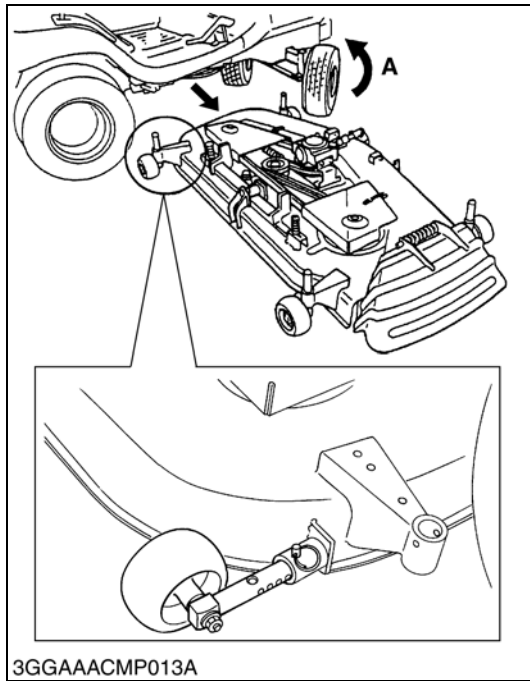
- (1) Hydraulic Lift Lever
(2) Rear Links
(3) L-Pins
(4) Coupler
(5) Universal Joint

(A) PULL



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W1013384

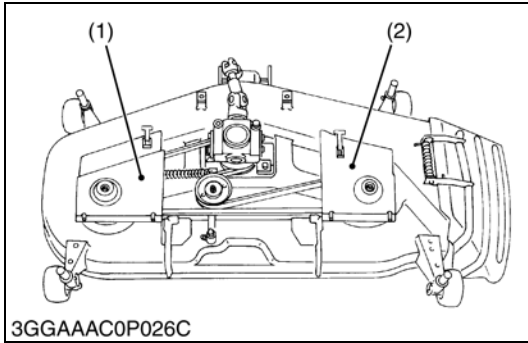
**Dismounting Mower**

1. Turn the front wheel to the left.
2. Pull out the mower deck to the right.
3. Return wheels to straight ahead position.
4. Reset the front anti-scalp rollers to straight ahead position.

(A) LEFT

W1013629

[3] DISASSEMBLING AND ASSEMBLING



Universal Joint and Covers

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

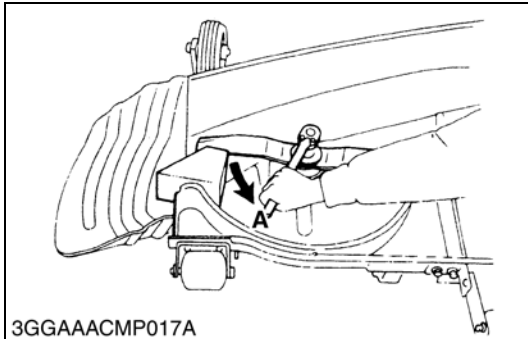
(When reassembling)

- Apply grease to the splines and grease nipples of the universal joint.

(1) L.H. Cover

(2) R.H. Cover

W1013857



Mower Blades (Center Blade and Outer Blades)

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

■ NOTE

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

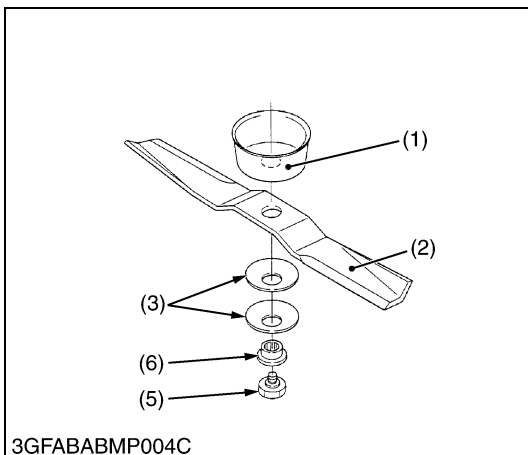
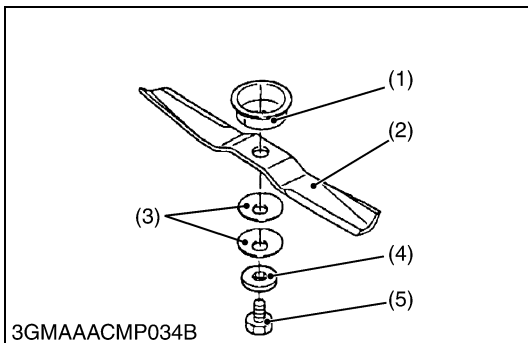
(When reassembling)

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

■ IMPORTANT

- Make sure the cup washer is not flattened out or worn, causing blade to slip easily.

Replace two cup washers if either is damaged.



Tightening torque	Mower blade screw	98.1 to 117.7 N·m 10.0 to 12.0 kgf·m 72.3 to 86.8 ft-lbs
-------------------	-------------------	--

(1) Dust Cover

(2) Mower Blade

(3) Cup Washer

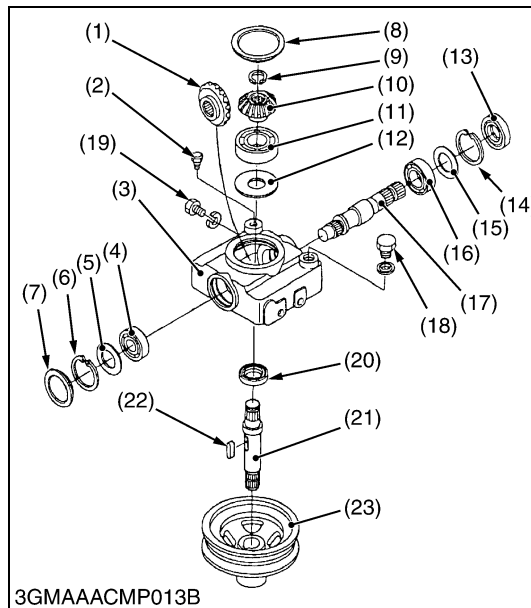
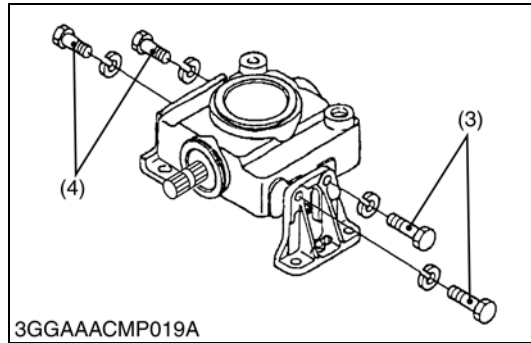
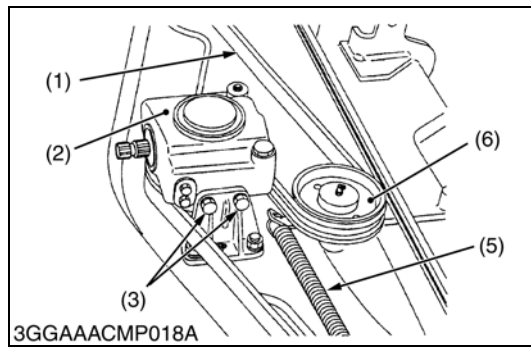
(4) Lock Washer

(5) Mower Blade Screw

(6) Spline Boss

(A) Loosen

W1013987



Gear Box and Mower Belt

1. Turn over the mower.
2. Remove the mower belt (1) from the tension pulley (6).
3. Unscrew the left and right gear box mounting screws (3), (4) and remove the gear box (2) from the mower deck.

(When reassembling)

- Install the reamer screws (3) at their original positions as shown in the figure.

Tightening torque	Gear box mounting screw	RCK54-24G RCK60-24G	78.5 to 88.2 N·m 8.0 to 9.0 kgf·m 57.9 to 65.1 ft-lbs
-------------------	-------------------------	------------------------	---

- | | |
|--|-----------------------------|
| (1) Mower Belt | (4) Gear Box Mounting Screw |
| (2) Gear Box | (5) Tension Spring |
| (3) Gear Box Mounting Screw (Reamer Screw) | (6) Tension Pulley |

W1014340

Disassembling Gear Box

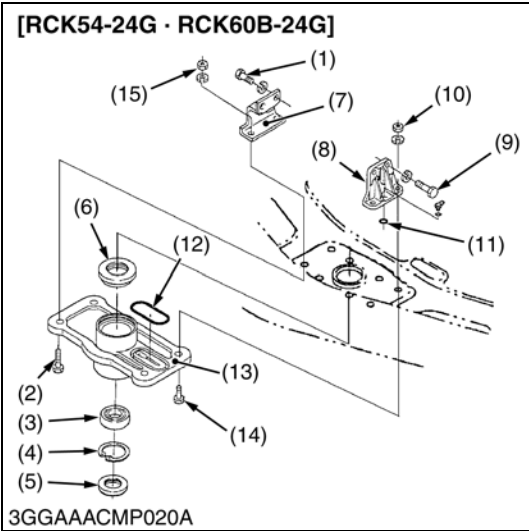
1. Unscrew the drain plug (19), and drain gear box oil.
2. Remove the center pulley (23) with a pulley, and remove the feather key (22) on the bevel gear shaft.
3. Remove the gear box caps (7), (8).
4. Remove the oil seal (13), internal snap ring (14) and shim (15).
5. Tap out the pinion shaft (17) with the ball bearing (16), and remove the bevel gear (1).
6. Remove the internal snap ring (6), shim (5) and ball bearing (4).
7. Remove the external snap ring (9), and draw out the bevel gear shaft (21).
8. Remove the bevel gear (10), ball bearing (11), shim (12) and oil seal (20).

(When reassembling)

- Replace the oil seals (13), (20) and gear box caps (7), (8) with new Ones.
- Check the backlash and turning torque.
If not proper, adjust with the shims (5), (12), (15).
(See page 9-S15.)

- | | |
|--|----------------------------|
| (1) 19T Bevel Gear (RCK54-24G)
18T Bevel Gear (RCK60B-24G) | (12) Shim
(13) Oil Seal |
| (2) Breather | (14) Internal Snap Ring |
| (3) Gear Box | (15) Shim |
| (4) Ball Bearing | (16) Ball Bearing |
| (5) Shim | (17) Pinion Shaft |
| (6) Internal Snap Ring | (18) Oil Filler Plug |
| (7) Gear Box Cap | (19) Drain Plug |
| (8) Gear Box Cap | (20) Oil Seal |
| (9) External Snap Ring | (21) Bevel Gear Shaft |
| (10) 16T Bevel Gear (RCK54-24G)
17T Bevel Gear (RCK60B-24G) | (22) Feather Key |
| (11) Ball Bearing | (23) Center Pulley |

W1014776



Center Pulley Holder

- 1. Unscrew the center pulley holder screws (2), (14) and / center pulley nuts (10), (15).
- 2. Remove the upper oil seal (6) and lower oil seal (5).
- 3. Remove the internal snap ring (4) and ball bearing (3).

(When reassembling)

- Replace the oil seals (5), (6) with new ones.
- Install the reamer bolt (14) at their original positions as shown in the figure.
- Be sure to fix the O-rings (11), (12) to the original position.

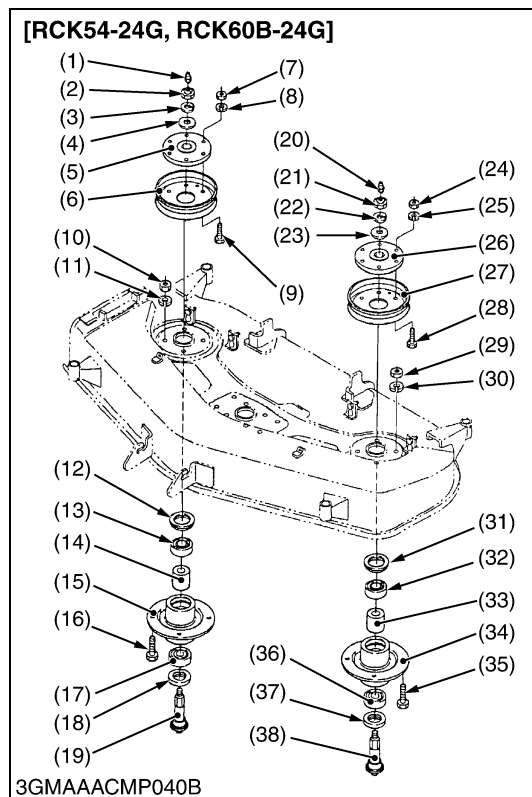
■ NOTE

- **When reassembling the center pulley holder (13), gear box and gear box stays (7), (8), screw the all screws and nuts by hand temporary.**
- **Tighten the screws and nuts in the order as below, to prevent the incline the gear box.**
- **Tighten the reamer screws (9) to the gear box first, then tighten the reamer bolt and nut (10) to the center pulley holder (13) with specified torque.**
- **Tighten the gear box screws (1) to the gear box, then tighten the center pulley holder screws (2), bolt and nut (15) with specified torque.**

Tightening torque	Center pulley holder screw and bolt	77.4 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft-lbs
-------------------	-------------------------------------	---

- | | |
|--------------------------------|---------------------------------------|
| (1) Gear Box Screw | (9) Gear Box Reamer Screw |
| (2) Center Pulley Holder Screw | (10) Nut |
| (3) Ball Bearing | (11) O-Ring |
| (4) Snap Ring | (12) O-Ring |
| (5) Oil Seal | (13) Center Pulley Holder |
| (6) Oil Seal | (14) Center Pulley Holder Reamer Bolt |
| (7) Gear Box Stay RH | (15) Nut |
| (8) Gear Box Stay LH | |

W1015291



Outer Pulley and Blade Shaft

1. Unscrew the outer pulley mounting nut (21), and remove the outer pulley (27).
2. Unscrew the pulley holder mounting nut (29) and remove the left pulley holder (35),
3. Remove the oil seal (37) and tap out the left blade shaft (38) with the ball bearings (36), (32) taking care not to damage the grease nipple (20).
4. Remove the oil seal (31).
5. Remove the ball bearings (36), (32) and collar (33) from the blade shaft(38).
6. Remove the right pulley holder (15) and blade shaft (19) as above.

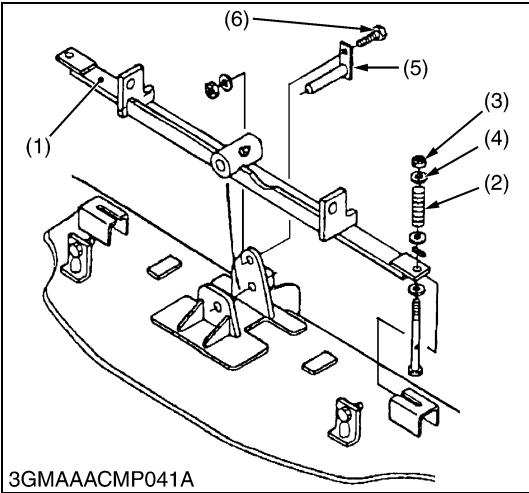
(When reassembling)

- Replace the oil seals (31), (37), (12) and (18) with new ones.

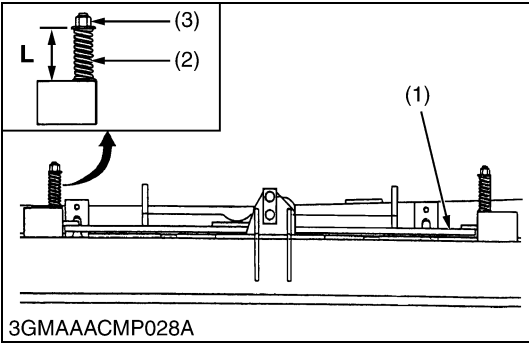
Tightening torque	Outer pulley mounting nut		196.1 to 225.6 N·m 20.0 to 23.0 kgf·m 144.7 to 166.4 ft-lbs
	Pulley boss mounting nut		23.5 to 27.4 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
	Pulley holder mounting nut	RCK54-24G RCK60B-24G	77.4 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft-lbs

- | | |
|----------------------------------|----------------------------------|
| (1) Grease Nipple | (20) Grease Nipple |
| (2) Outer Pulley Mounting Nut | (21) Outer Pulley Mounting Nut |
| (3) Spring Washer | (22) Spring Washer |
| (4) Plain Washer | (23) Plain Washer |
| (5) Outer Pulley Boss (Right) | (24) Pulley Boss Mounting Nut |
| (6) Outer Pulley (Right) | (25) Spring Washer |
| (7) Pulley Boss Mounting Nut | (26) Outer Pulley Boss (Left) |
| (8) Spring Washer | (27) Outer Pulley (Left) |
| (9) Pulley Boss Mounting Bolt | (28) Pulley Boss Mounting Bolt |
| (10) Pulley Holder Mounting Nut | (29) Pulley Holder Mounting Nut |
| (11) Spring Washer | (30) Spring Washer |
| (12) Oil Seal | (31) Oil Seal |
| (13) Ball Bearing | (32) Ball Bearing |
| (14) Collar | (33) Collar |
| (15) Pulley Holder (Right) | (34) Pulley Holder (Left) |
| (16) Pulley Holder Mounting Bolt | (35) Pulley Holder Mounting Bolt |
| (17) Ball Bearing | (36) Ball Bearing |
| (18) Oil Seal | (37) Oil Seal |
| (19) Blade Shaft (Right) | (38) Blade Shaft (Left) |

W1015887



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3GMAAACMP028A

Balancer

- 1. Unscrew the lock nut (3) both side.
- 2. Remove the plane washer (4) and balancer spring (2).
- 3. Unscrew the center pin bolt (6).
- 4. Remove the center pin (5) and balancer plate (1).

(When reassembling)

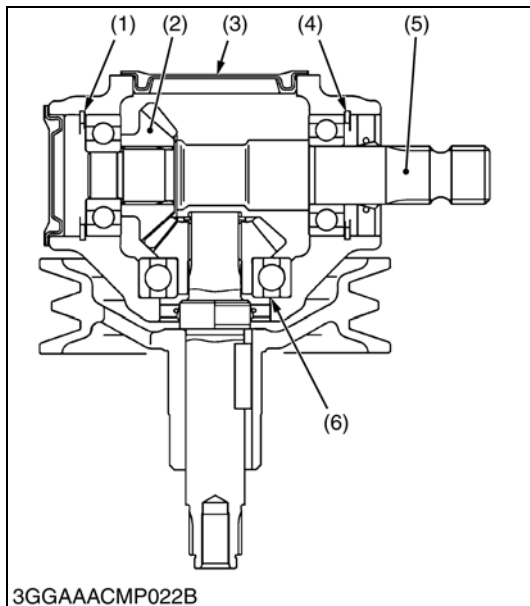
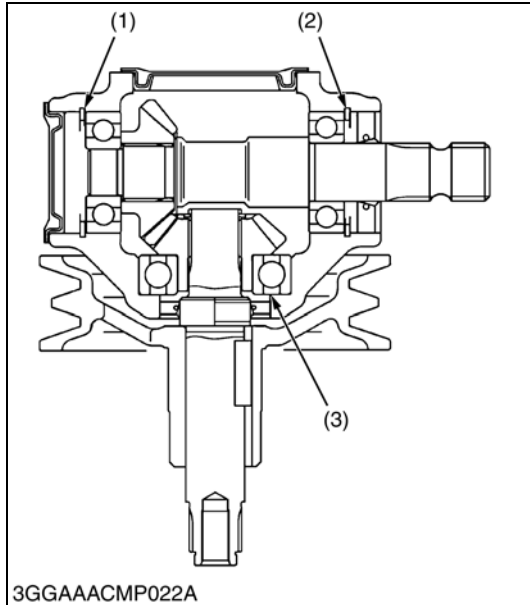
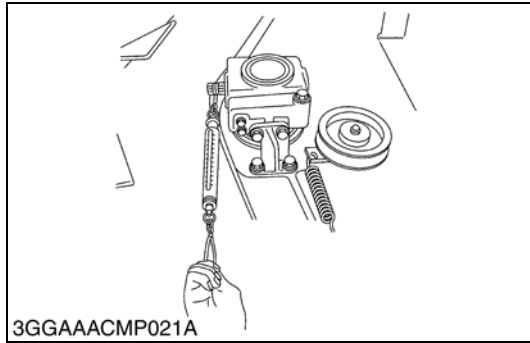
- Apply grease to the center pin (5).
- Adjust the balancer spring (2) length to the factory specification, with lock nut (3).

Balancer spring length (L) (Right and left)	Factory spec.	55.0 mm 2.1653 in.
---	---------------	-----------------------

- (1) Balancer Plate
- (2) Balancer Spring
- (3) Lock Nut
- (4) Plane Washer
- (5) Center Pin
- (6) Center Pin Bolt

W1016791

[4] SERVICING



Turning Torque of Pinion Shaft

1. Remove the mower belt, and reassemble the gear box to the mower deck.
2. Wind a string around the pinion shaft and set a spring balance (or push-pull gauge) to the tip of the string, and then slowly pull the spring balance horizontally to measure the turning force.
3. If the measurement exceeds the factory specification, check the bearing and gears and adjust the adjusting shims (1), (2), (3).

Turning force	Factory spec.	Less than 117.7 N 12.0 kgf 26.5 lbs
Turning torque	Factory spec.	Less than 1.47 N-m 0.15 kgf-m 1.08 ft-lbs

(Reference)

- Thickness of adjusting shims (1), (2): 0.2 mm (0.0079 in.)
0.3 mm (0.0118 in.)
- Thickness of adjusting shims (3): 0.1 mm (0.0039 in.)
0.2 mm (0.0079 in.)

(1) Adjusting Shim
(2) Adjusting Shim

(3) Adjusting Shim

W1017109

Backlash between Bevel Gears

1. Remove the gear box cap (3).
2. Place fuses the bevel gear (2) on the pinion shaft (5).
3. Turn the pinion shaft.
4. Take out the fuses, and measure the thickness of fuses with an outside micrometer. (Backlash equals thickness of fuse.)
5. If the backlash exceeds the allowable limit, adjust with shims (1), (4), (6).

Backlash between bevel gears	Factory spec.	0.10 to 0.20 mm 0.0039 to 0.0079 in.
	Allowable limit	0.4 mm 0.0157 in.

(Reference)

- Thickness of adjusting shims (1), (4): 0.2 mm (0.0079 in.)
0.3 mm (0.0118 in.)
- Thickness of adjusting shams (6): 0.1 mm (0.0039 in.)
0.2 mm (0.0079 in.)

(1) Shim
(2) 19T Bevel Gear (RCK54-24G)
18T Bevel Gear (RCK60B-24G)
(3) Gear Box Cap

(4) Shim
(5) Pinion Shaft
(6) Shim

W1017344

P G2460G (Supplement)

CONTENTS

SAFETY INSTRUCTIONS	P-1
SPECIFICATIONS	P-6
 1. GENERAL	 PG-1
 2. ENGINE	
Servicing	P1-S1
 3. ELECTRICAL SYSTEM	
Mechanism	P8-M1
Servicing	P8-S1

TO THE READER

In this section, the main additional functions and altered points of G2460G from G2160 are explained separately in two items, "Mechanism" and "Servicing" for each section. Gasoline engine is mounted on G2460G. And G2460G's body is basically same as G2160's body.

As for the items which are not explained in this section, refer to G2160 Workshop Manual (9Y021-15044).

■ Mechanism

Information on the construction and function in all sections except "General" and "Engine" section are mainly included for G2160. This part should be understood before proceeding with troubleshooting, disassembling and servicing.

■ Servicing

For G2460G's altered points, there are troubleshooting, servicing specification lists, checking and adjusting, disassembling and assembling, and servicing which cover procedures, precautions, factory specifications and allowable limits.

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

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

February 2001

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SAFETY FIRST

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

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



DANGER

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



WARNING

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



CAUTION

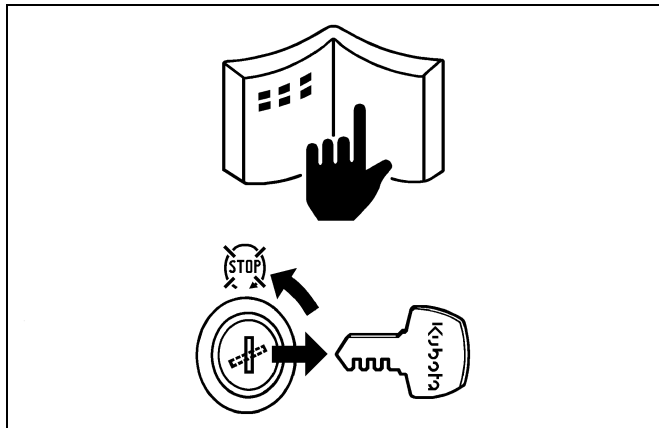
: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

■ IMPORTANT

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

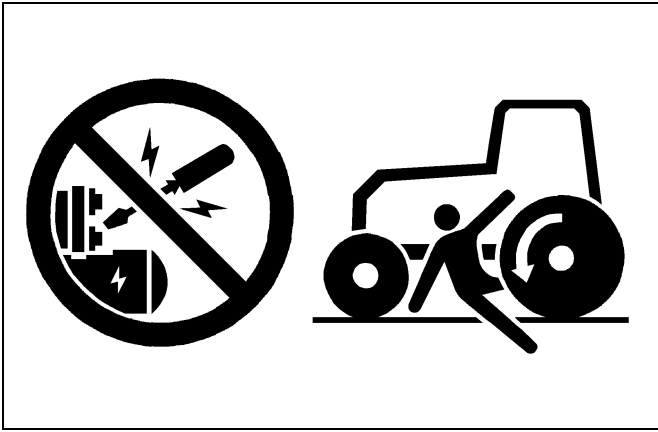
■ NOTE

: Gives helpful information.



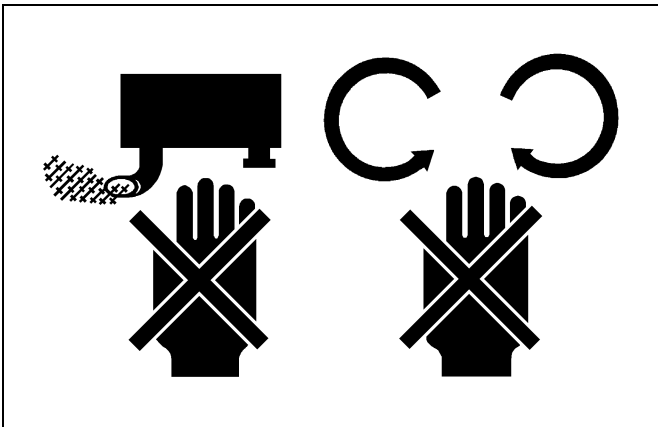
BEFORE SERVICING AND REPAIRING

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



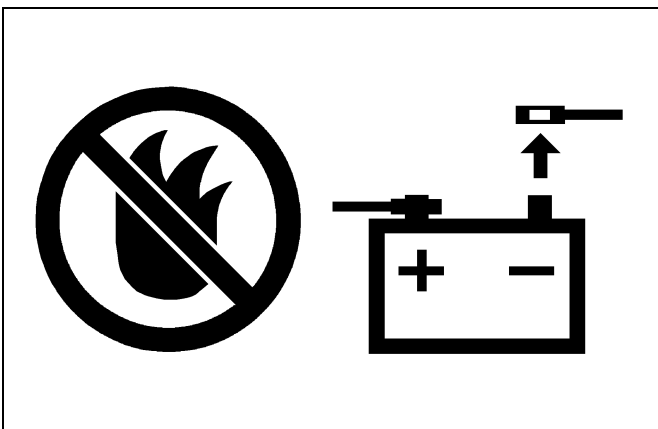
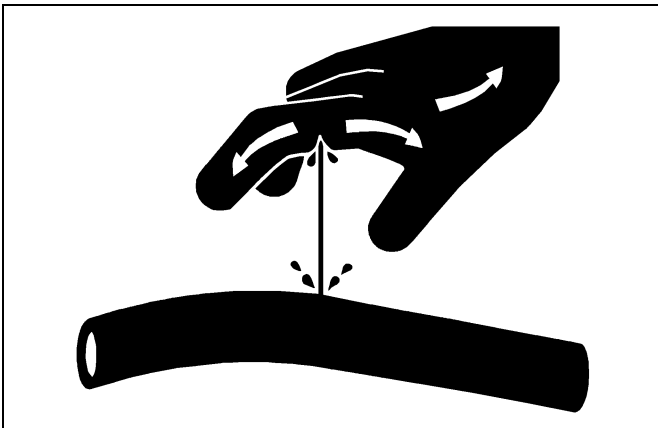
SAFETY STARTING

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



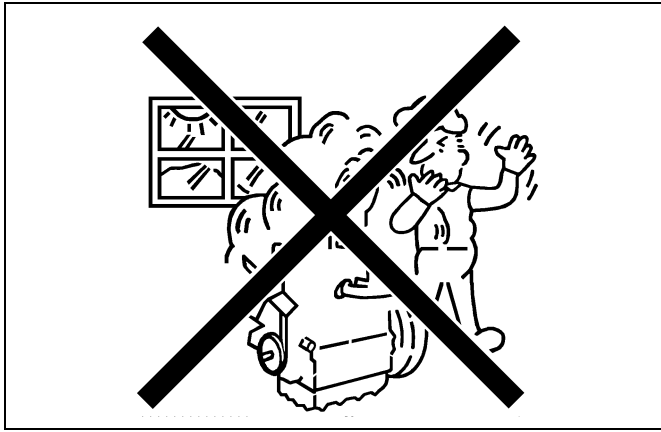
SAFETY WORKING

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

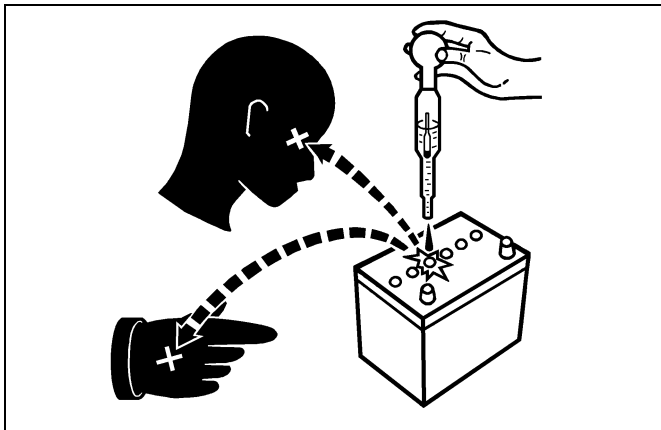


AVOID FIRES

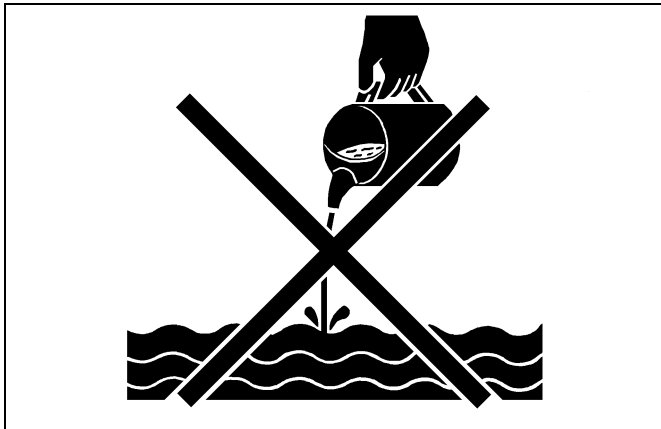
- Fuel is extremely flammable and explosive under certain conditions. Do not smoke or allow flames or sparks in your working area.
- To avoid sparks from an accidental short circuit, always disconnect the battery negative cable first and connect it last.
- Battery gas can explode. Keep sparks and open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

**VENTILATE WORK AREA**

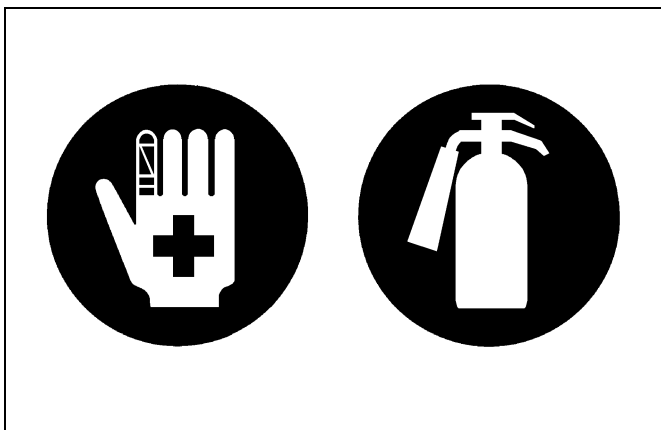
- If the engine must be running to do some work, make sure the area is well ventilated. Never run the engine in a closed area. The exhaust gas contains poisonous carbon monoxide.

**PREVENT ACID BURNS**

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

**DISPOSE OF FLUIDS PROPERLY**

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

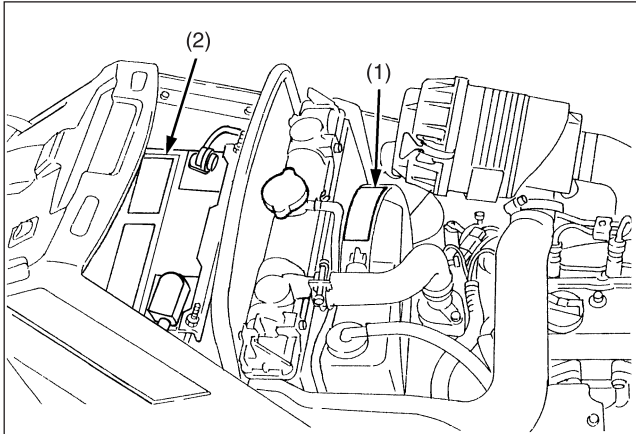
**PREPARE FOR EMERGENCIES**

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

SAFETY DECALS

- The following safety decals are installed on the machine.

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



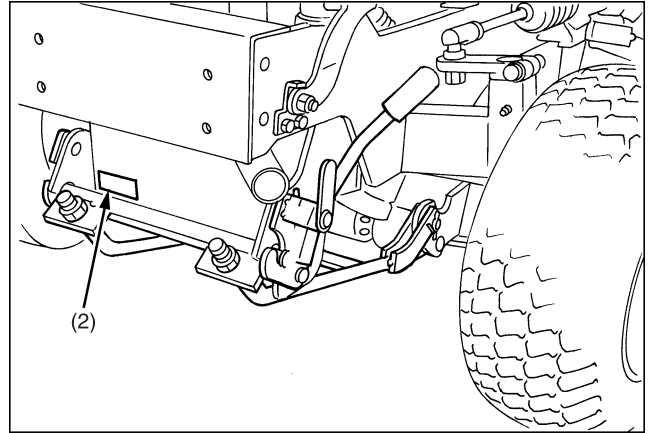
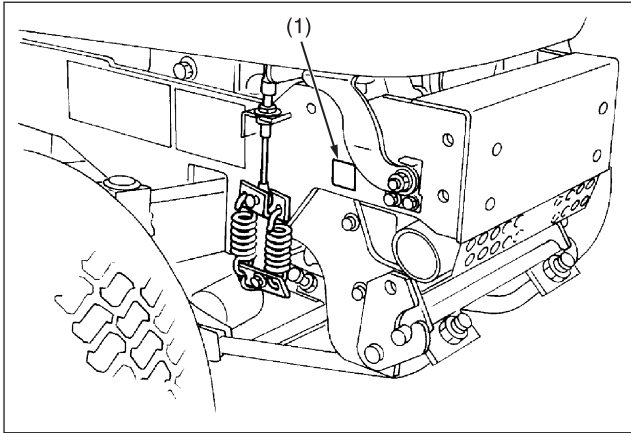
- (1) Part No. K1213-6586-1
Stay clear of engine
fan and fan belt



- (2) Part No. K1221-6117-1

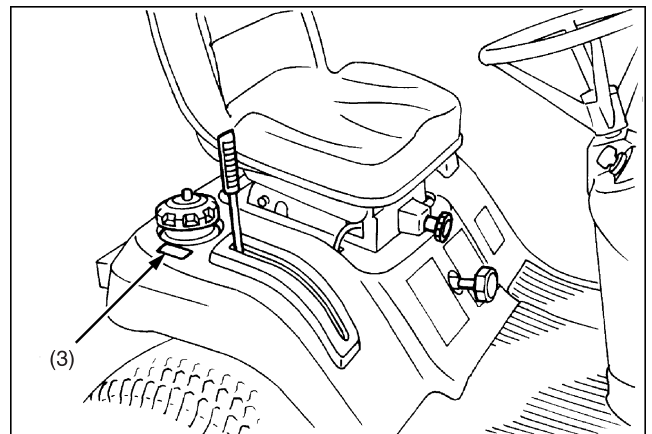


T15041ZZ00101



(1) Part No. K1213-6532-1

Do not touch hot surface like muffler, etc.



(3) Part No. K1221-6585-1

Gasoline fuel
only

No fire

(2) Part No. K2110-6574-1



CARE OF DANGER, WARNING, AND CAUTION LABELS

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

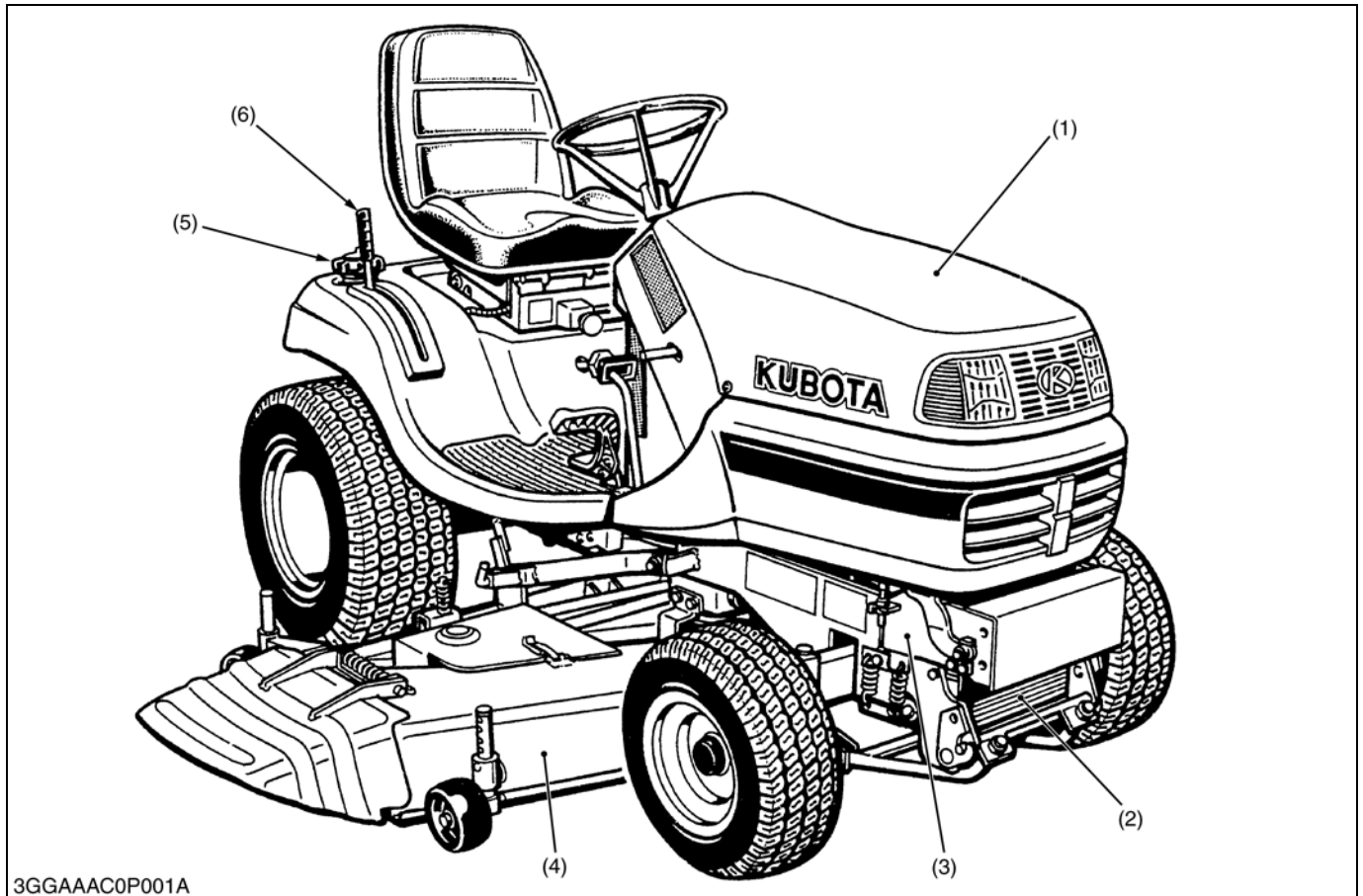
T15041ZZ00201

SPECIFICATIONS

Model		G2460G
Maximum gross power		15.6 kW (21 HP)
Engine	Model	WG752-ES-24G
	Type	Vertical, water cooled, 4-cycle gasoline engine
	Number of cylinders	3
	Bore and stroke	68.0 × 68.0 mm (2.68 × 2.68 in.)
	Total displacement	740 cm ³ (45.2 cu.in.)
	Rated revolution	3000 rpm
	Governor	Centrifugal ball mechanical governor
	Ignition system	Full-transistor
	Carburetor	Butterfly valves
	Spark plug	NGK BKR4E-11
	Ignition timing	0.30 to 0.33 rad (17 ° to 19 °) before T.D.C.
	Firing order	1-2-3
	Compression ratio (Engine serial No. : below YY8644)	9.0 : 1
	Compression ratio (Engine serial No. : above 1A0001)	9.2 : 1
	Lubricating system	Forced lubrication by gear pump
	Cooling system	Pressurized radiator, forced circulation with water pump
	Lubricating oil	API Service classification SF, Below 0 °C (32 °F) : SAE 10W or 10W-30, 0 to 25 °C (32 °F to 77 °F) : SAE 20 or 10W-30, Above 25 °C (77 °F) : SAE 30 or 10W-30
	Starting system	Electric starter (12 V, 0.7 kW)
	Battery	51R (12 V, 450 CCA)
	Fuel	Automobile unleaded or regular gasoline
Capacities	Engine crankcase	2.6 L (2.7 U.S.qts., 2.3 Imp.qts.)

W1030609

1. FEATURES



3GGAAAC0P001A

1. Gasoline engine
2. Front PTO (option)
3. Rugged ladder type chassis
4. Low-noise, high-performance mower
5. Large-capacity fuel tank
6. Hydraulic mower lift

2. LUBRICANTS, FUEL AND COOLANT

	Place		Capacity	Lubricants
			G2460G	
1	Fuel		22 L 5.8 U.S.gals 4.8 Imp.gals	Automobile unleaded or regular gasoline
2	Coolant	Cooling system	2.1 L 2.2 U.S.qts 1.8 Imp.qts	Fresh clean water (soft water) with anti-freeze
		Recovery tank	0.25 L 0.26 U.S.qts 0.22 Imp.qts	
3	Engine crankcase		2.6 L 2.7 U.S.qts 2.3 Imp.qts	Engine oil : API Service classification SF Below 0 °C (32 °F) : SAE10W or 10W-30 0 to 25 °C (32 to 77 °F): SAE20 or 10W-30 Above 25 °C (77 °F): SAE30 or 10W-30
4	Transmission (Including HST and cylinder)		4.5 L 4.75 U.S.qts 3.86 Imp.qts	KUBOTA UDT or SUPER UDT fluid
5	Mower gear case		0.40 L 0.42 U.S.qts 0.35 Imp.qts	SAE #90 gear oil
6	King pin (Left and right)		Until grease overflows	SAE multipurpose type grease
	Center pin			
	PTO tension arm			
	Universal joint			
	Side blade shaft			
	Center blade shaft			
	Mower tension arm			
7	Speed control pedal shaft		Moderate amount	Oil or spray type grease
	Lift lever shaft			
	Brake pedal shaft			
	PTO lever fulcrum			
	Anti-scalp roller			
	Speed control link			
	Accelerator cable			

W1011209

3. MAINTENANCE CHECK LIST

No.	Period Item		Every 50 Hr	Hour meter reading								After	Reference page
				50	100	150	200	300	400	450	500		
1	Tires	Check	☆									Every 50Hr	PG-19
2	Battery condition	Check			☆		☆	☆	☆		☆	Every 100Hr	PG-24
3	Engine oil	Change		★	☆		☆	☆	☆		☆	Every 100Hr	PG-17
4	Engine oil filter cartridge	Change		★			☆		☆			Every 200Hr	PG-18
5	Transmission fluid	Change					☆				☆	Every 300Hr	PG-26
6	Transmission oil filter cartridge	Replace		★			☆				☆	Every 300Hr	PG-18
7	Transmission oil strainer	Clean					☆				☆	Every 300Hr	PG-27
8	Hydraulic hose	Check					☆		☆			Every 200Hr	PG-26
		Replace										Every 2 Years*	PG-30
9	Fuel lines	Check			☆		☆	☆	☆		☆	Every 100Hr	PG-23
		Replace ¹										Every 2 Years*	PG-30
10	Fuel filter	Check			☆		☆	☆	☆		☆	Every 100Hr	PG-23
		Replace ¹									☆	Every 500Hr	PG-27
11	Radiator hose and clamp	Check					☆		☆			Every 200Hr	PG-25
		Replace ¹										Every 2 Years*	PG-30
12	Radiator core	Clean			☆		☆	☆	☆		☆	Every 100Hr**	PG-23
13	Cooling system	Clean										Every 1 Year	PG-28
14	Coolant	Change										Every 1 Year	PG-28
15	Air cleaner element	Clean	☆**										PG-21
		Replace										Every 1 Year**	PG-28
16	Fan belt tension	Adjust	☆										PG-20
17	Front PTO belt tension	Adjust	☆***										PG-22
18	Brake play	Adjust ¹	☆										PG-19
19	Greasing	—	☆										PG-20
20	Spark plug	Check			☆		☆	☆	☆		☆	Every 100Hr	PG-9
21	Mower gear box oil	Change		★		☆		☆		☆		Every 150Hr	PG-18
22	Mower gear box oil seal	Replace										Every 2 Years*	PG-31

■ IMPORTANT

★ : The maintenance indicated by ★ must be done initially.

* : Replace only if necessary.

** : This maintenance should be done more often in dusty conditions than in normal conditions.

*** : Initial elongation of the front PTO belt may occur prior to 25 hours. Adjust the tension spring length as needed to maintain belt tension.

¹ : These items should be serviced by an authorized KUBOTA Dealer, unless the owner has the proper tools and is mechanically proficient.

W1019049

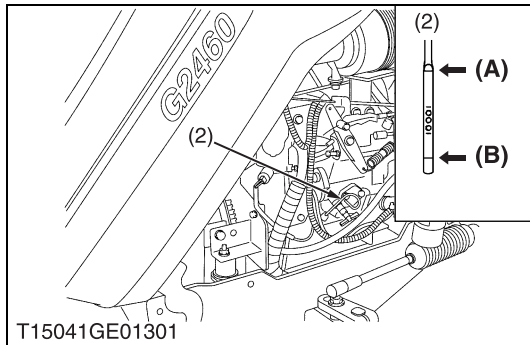
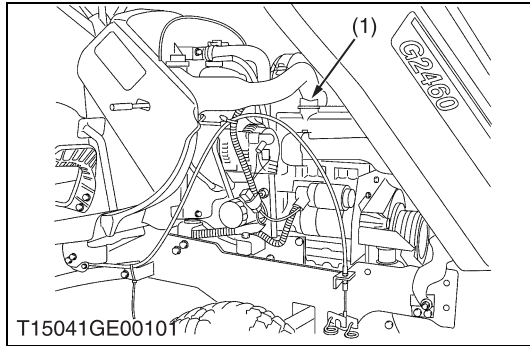
4. CHECK AND MAINTENANCE



CAUTION

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

[1] DAILY CHECK



Checking Engine Oil Level



CAUTION

- To avoid personal injury : Always stop the engine and remove the key before checking oil.
1. Check engine oil before starting and 5 minutes or more after the engine has stopped.
 2. Wipe dipstick area clean.
 3. To check the oil level, remove the dipstick (2), wipe it clean, replace it, and draw it out again. Check to see that the oil level is between the two notches.
 4. Add new oil to the prescribed level at the oil port if necessary.

■ IMPORTANT

- Use the specified engine oil.
Refer to "LUBRICANTS, FUEL AND COOLANT". (See page PG-2)
- When using new oil of a different maker or viscosity from the previous one, drain all used oil.
Never mix two different types of oil.

- (1) Oil Inlet Plug
(2) Dipstick

- (A) Upper Level
(B) Lower Level

W1021026



Checking Amount of Fuel and Refueling



CAUTION

- Handle fuel carefully. If the engine is running, do not fill the fuel tank. If engine is hot, let engine cool several minutes before adding fuel. Do not smoke while filling the fuel tank or servicing the fuel system. Fill fuel tank only to bottom of filler neck.
1. Check the fuel level.
 2. Take care that the fuel tank does not become empty.

Fuel tank capacity	22 L 5.8 U.S.gals 4.8 Imp.gals
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■ IMPORTANT

- Use gasoline fuel only.
- Do not mix oil with gasoline.

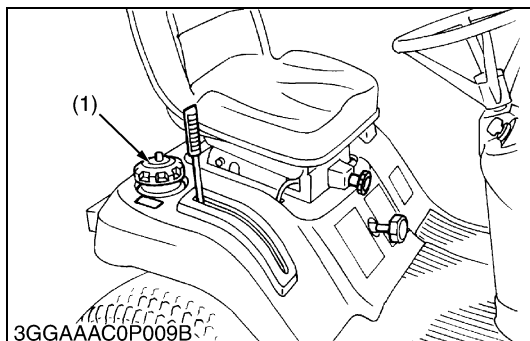
Unleaded fuel is recommended. Regular leaded gasoline with an octane rating index of 87 or higher may be used. Avoid switching from unleaded to regular gasoline to prevent engine damage.

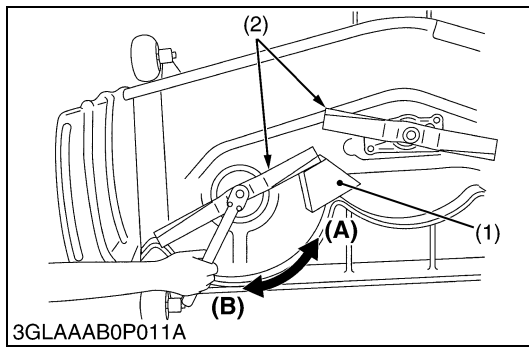
[Use of alcohol mixed gasoline (Gasohol)]

Use "gasohol" only when the ethanol additive is less than 10 % of the fuel. The use of methanol additive is not recommended. Warranty does not apply to mechanical or performance problems arising from the use of "gasohol". For best results use unleaded fuel with a minimum of 87 octane.

- (1) Fuel Tank Cap

W1021325





Retightening Mower Blade Screw

⚠ CAUTION

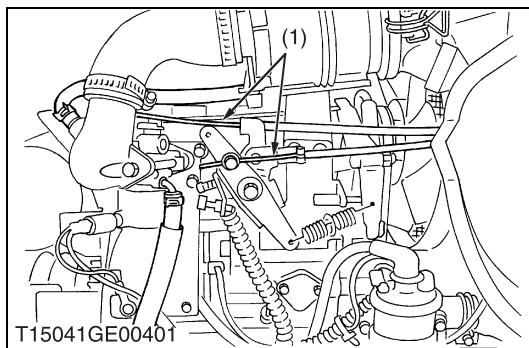
- To avoid injury, always handle the mower blade with care.
1. Dismount the mower and turn it over to expose the mower blades.
 2. Wedge a wooden block (1) securely between the mower blade and mower deck.
 3. Retighten the mower blade screw to the specified torque.
 4. If the mower blade screw (2) is worn or broken, replace it.

Tightening torque	Mower blade screw	98.1 to 117.7 N·m 10.0 to 12.0 kgf·m 72.3 to 86.7 ft-lbs
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- (1) Wooden Block
(2) Mower Blade Screw

(A) Loosen
(B) Tighten

W1022526



Oiling

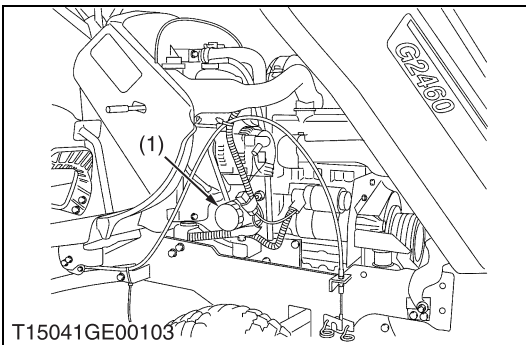
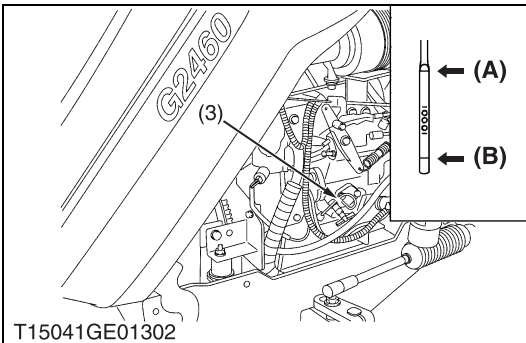
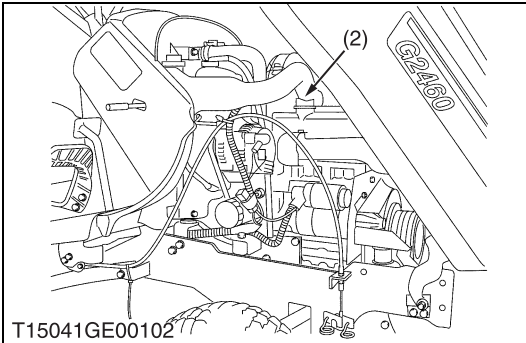
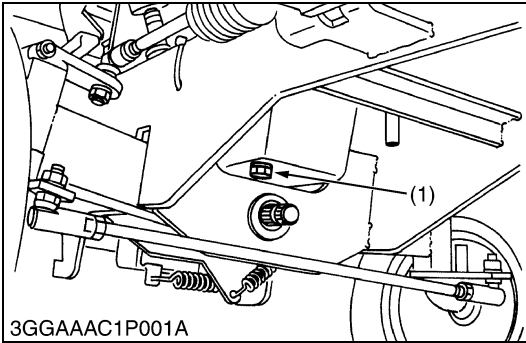
⚠ CAUTION

- Be sure to stop the engine and remove the key before oiling.
- Oil the following points before starting.
1. Apply oil to the following points.

- (1) Throttle Cable

W1030316

[2] CHECK POINTS OF INITIAL 50 HOURS



Changing Engine Oil

⚠ CAUTION

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

■ IMPORTANT

- **When using an oil of different manufacture or viscosity from the previous one, remove all of the old oil.**
 - **Never mix two different type of oil.**
 - **Use the proper SAE engine oil according to ambient temperatures.**
- Refer to "LUBRICANTS, FUEL AND COOLANT".**
(See page PG-2.)

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

- (A) Upper Level
(B) Lower Level

W1030749

Replacing Engine Oil Filter Cartridge

⚠ CAUTION

- **Be sure to stop the engine before changing the oil filter cartridge.**
 - **Allow engine to cool down sufficiently, oil can be hot and may cause burns.**
1. Remove the engine oil filter cartridge (1) with the filter wrench.
 2. Apply a slight coat of oil onto the rubber gasket of new cartridge.
 3. To install the new cartridge, screw it in by hand. Over tightening may cause deformation of rubber gasket.
 4. After the cartridge has been replaced, the engine oil level normally lowers a little. Add engine oil to proper level. Check for oil leaks around filter gasket.

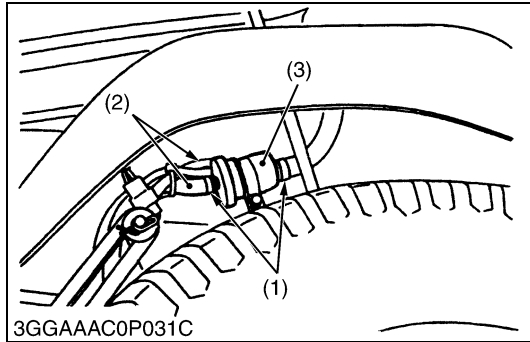
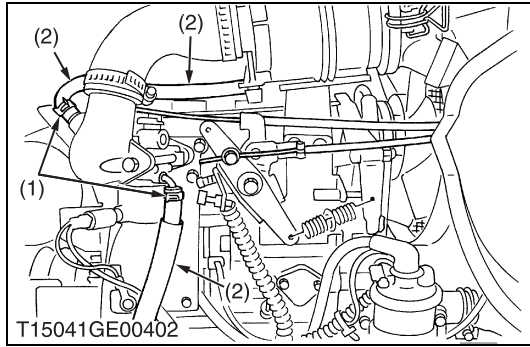
■ IMPORTANT

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

- (1) Engine Oil Filter Cartridge

W1030950

[3] CHECK POINTS OF EVERY 100 HOURS



Checking Fuel Lines And Fuel Filter

⚠ CAUTION

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

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

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

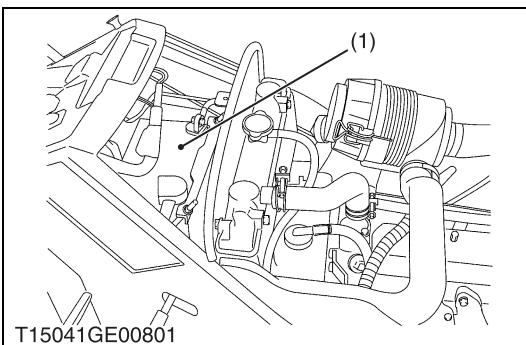
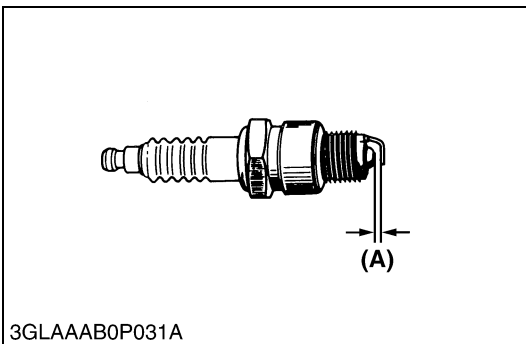
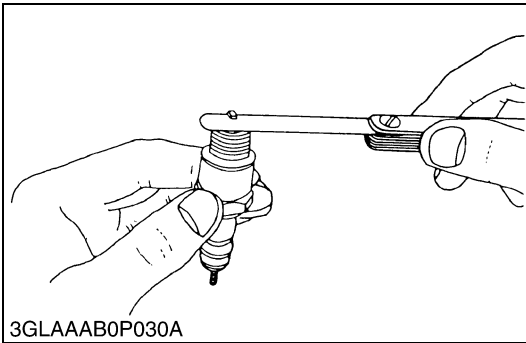
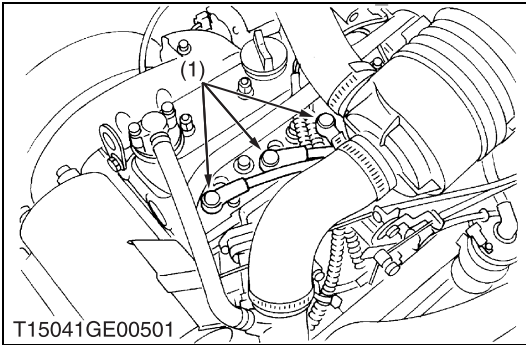
■ IMPORTANT

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

(1) Pipe Clamps
(2) Fuel Line

(3) Fuel Filter

W1034725



Checking Spark Plugs

1. Lift hood.
2. Remove the spark plug wire from spark plug (1).
3. Use a spark plug wrench to remove plug (1).

NOTE

- **This engine is equipped with resistor-type spark plugs.**
4. Inspect spark plugs (1) for cracked porcelain, pitted electrodes, or other wear and damage. Replace spark plugs if necessary.
 5. Check spark plug gap (A) with a feeler gauge.
 6. If the spark plug gap (A) is not factory specification, adjust the spark plug gap (A).
 7. NGK BKR4E-11 spark plug is recommended.

Spark plug gap (A)	Factory spec.	1.1 mm 0.043 in.
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(1) Spark Plug

(A) Spark Plug Gap

W1022501

Checking Battery Condition



CAUTION

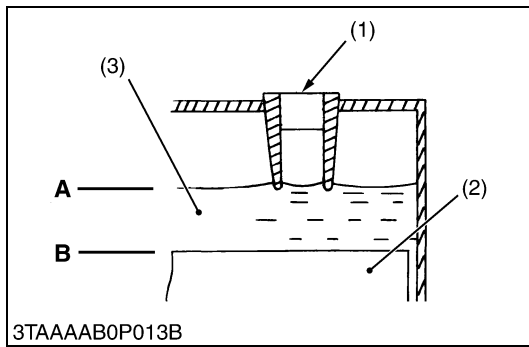
- **Never remove the vent cap while the engine is running. Keep electrolyte away from eyes, hands and clothes. If you are spattered with it, wash it away completely with water immediately and get medical attention.**
- **Wear eye protection and rubber gloves when working around battery.**

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

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

(1) Battery

W1027816



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

3GGAAAC0P033A

Battery Charging

DANGER

To avoid serious injury or death :

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

CAUTION

- When charging battery, ensure that the vent caps are securely in place (if equipped).
- When disconnecting the cables from the battery, start with the negative terminal first.
- When connecting the cables to the battery, start with the positive terminal first.
- Never check battery charge by placing a metal object across the posts.

Use a voltmeter or hydrometer.

(For accessible maintainable type batteries with removable vent caps.)

1. Make sure each electrolyte level is at the bottom of vent wells, if necessary add distilled water in a well-ventilated area.
2. The water in the electrolyte evaporates during recharging. Liquid shortage damages the battery. Excessive liquid spills over and damages the machine body.
3. To slow charge the battery, connect the battery positive terminal to the charger positive terminal and the negative to the negative, then recharge in the standard fashion.
4. A boost charge is only for emergencies. It will partially charge the battery at a higher rate and in a short time.
When using a boost-charged battery, it is necessary to recharge the battery as soon as possible. Failure to do this will shorten the battery's service life.
5. When the specific gravity of electrolyte reaches 1.27 to 1.29, charge has completed.
6. When exchanging an old battery with new one, use a battery of equal specification shown in "SPECIFICATIONS".

(For non-accessible maintenance-free type batteries.)

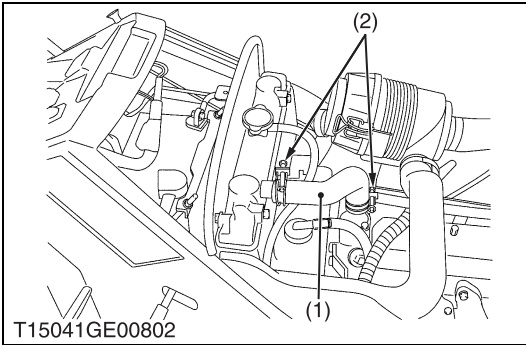
Maintenance-free, non-accessible batteries are designed to eliminate the need to add water. Yet the volume of electrolyte above plates may eventually become depleted due to abnormal conditions such as high heat or improper regulator setting. Use a voltmeter to check the state of charge. (See reference chart to determine if charging is necessary.)

- (1) Vent Well
(2) Separator
(3) Electrolyte

A : Highest Level
B : Lowest Level

W1035047

[4] CHECK POINTS OF EVERY 200 HOURS



Checking Radiator Hose and Clamp

■ NOTE

- Check to see if the radiator hoses are properly fixed every **200 hours of operation or 6 months, whichever comes first.**
1. If clamp bands (2) are loose or water leaks, tighten clamp band (2) securely.
 2. Replace radiator hoses (1) and tighten clamp bands (2) securely, if radiator hoses (1) are swollen, hardened or cracked.
Replace radiator hoses (1) and clamp bands (2) every 2 years or earlier if checked and found that hoses are swollen, hardened or cracked.

■ NOTE

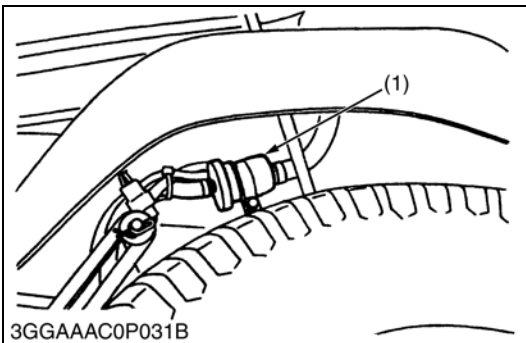
- Take the following actions in the event the coolant temperature be nearly or more than the boiling point, what is called "Overheating".
- Park the machine in a safe place and keep the engine unloaded idling.
- Don't stop the engine suddenly, but stop it after about 5 minutes of unloaded idling
- Keep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

(1) Radiator Hose

(2) Clamp Band

W1036393

[5] CHECK POINTS OF EVERY 500 HOURS



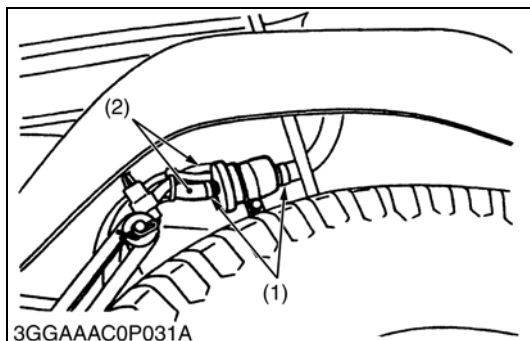
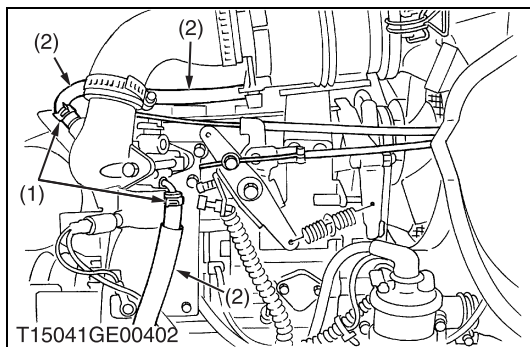
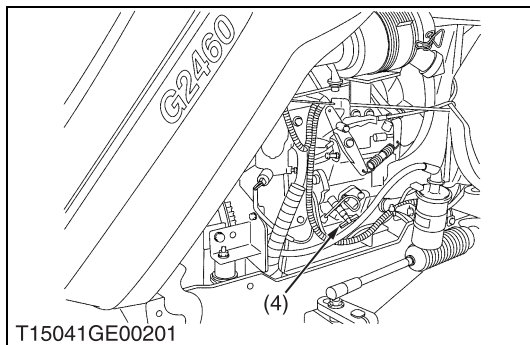
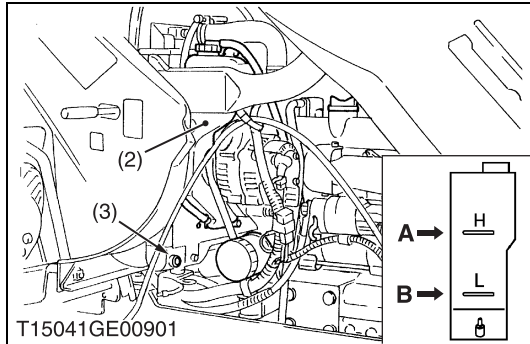
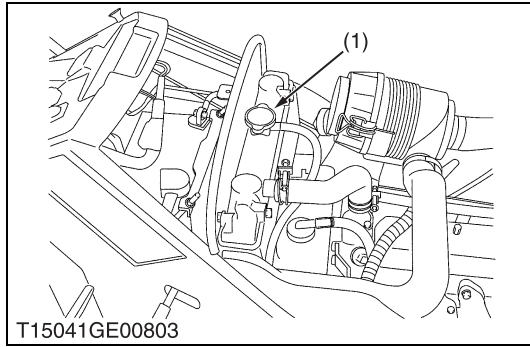
Replacing Fuel Filter

1. Replace the fuel filter (1).

(1) Fuel Filter

W1037175

[6] CHECK POINTS OF EVERY 1 YEAR



Flushing Cooling System and Changing Coolant

CAUTION

- Never open radiator cap when engine is hot.
- When opening, loosen cap slightly to the stop to relieve any excess pressure before removing radiator cap completely.

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

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

A : Highest Level
B : Lowest Level

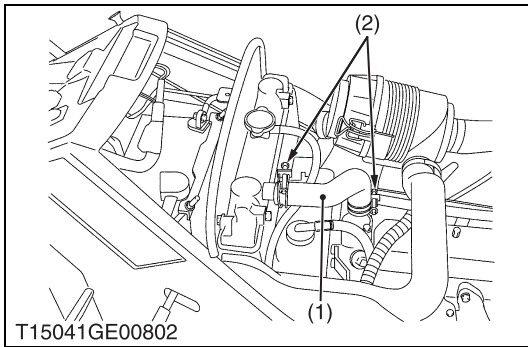
W1037404

Replacing Fuel Line

1. Replace the fuel hoses (2) and hose clamps (1). Refer to "Checking Fuel Line". (See page PG-7.)

- (1) Hose Clamp
- (2) Fuel Hose

W1038054



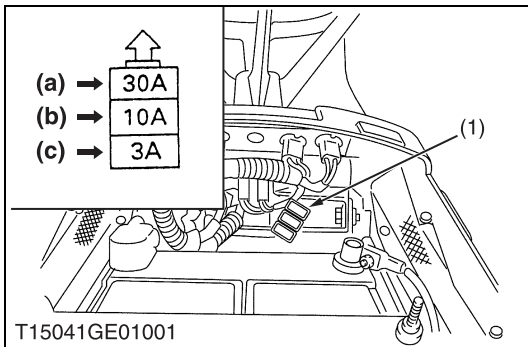
Replacing Radiator Hose and Clamp Band

1. Replace the radiator hoses (1) and clamp bands (2).

(1) Radiator Hose

(2) Clamp Band

W1038188



Replacing Fuses

1. The electrical system is protected from potential damage by fuses.

A blown fuse indicates that there is an overload or short somewhere in the electrical system.

2. If any of the fuses should blow, replace with a new one of the same capacity.

■ IMPORTANT

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

■ Protected Circuit

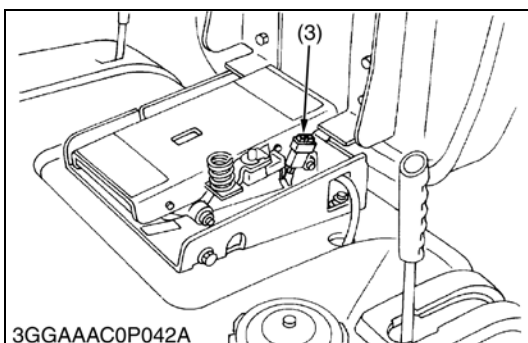
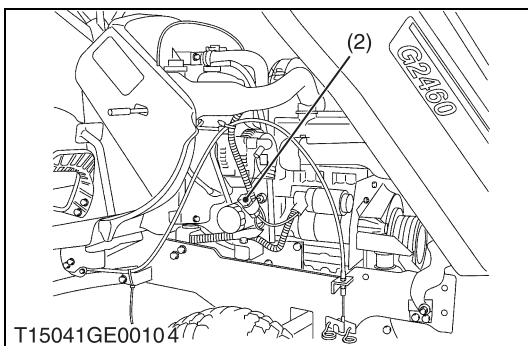
FUSE NO. (ID LABEL)		CAPACITY (A)	Protected circuit
1	(a) EPS MT	30	Electric power steering motor circuit
	(b) IG/M	10	Fuel pump, head light, power steering control unit, etc.
	(c) OPC	3	Engine running circuit
2	—	Slow blow fuse 40	Check circuit against wrong battery connection
3	—	3	KRA system

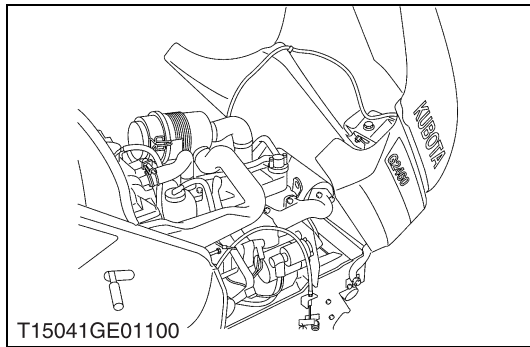
(1) Fuse

(2) Slow Blow Fuse

(3) KRA system Fuse

W1038471





Replacing Bulbs

(A) Replacing the head light bulb

1. Open hood.
2. Turn bulb socket to remove socket from headlight housing.
3. Push bulb down and turn one quarter turn to remove bulb from the socket.
4. Install new bulb to the socket.
5. Install the socket in housing.
6. Close hood.

Head light bulb	Capacity	1.04 A / 12.8 Rated voltage
-----------------	----------	-----------------------------

(B) Replacing the indicator light bulb

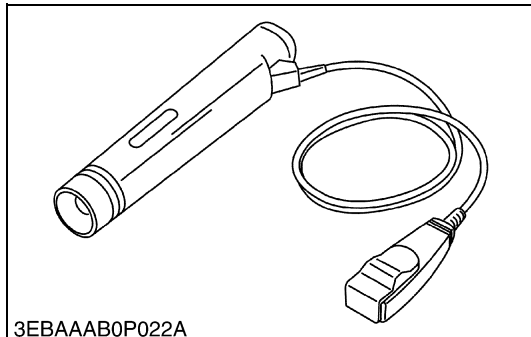
1. Open hood.
2. Turn bad bulb socket to the left.
3. Pull bulb from the socket.
4. Push new bulb into the socket.
5. Install the socket.
6. Close hood.

Indicator light bulb	Capacity	0.27 A / 14.0 Rated voltage
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W1047730

5. SPECIAL TOOLS

[1] SPECIAL TOOLS FOR ENGINE

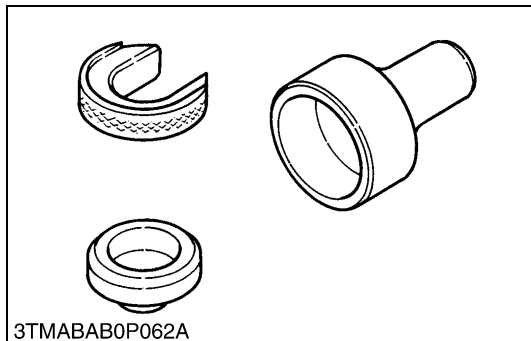


3EBAAAB0P022A

Timing Light

Application : Use to adjust the ignition timing.

W1024318



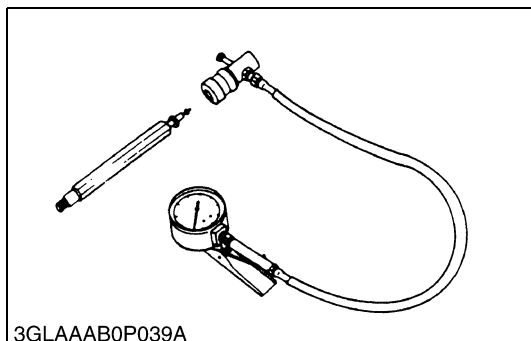
3TMABAB0P062A

Auxiliary Socket for Fixing Crankshaft Sleeve

Code No: 07916-34041

Application: Use exclusively for fixing the crankshaft sleeve.

W1041415



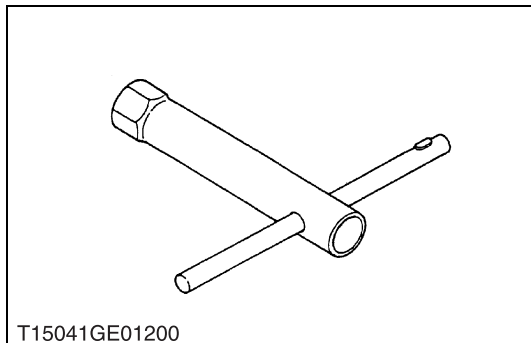
3GLAAAB0P039A

Air Cooled Compression Tester

Code No: 07909-30251

Application: Use for measuring gasoline engine compression pressure.

W1026967



T15041GE01200

Spark Plug Wrench

Code No: 12581-8620-0

Application: Use to remove spark plug.

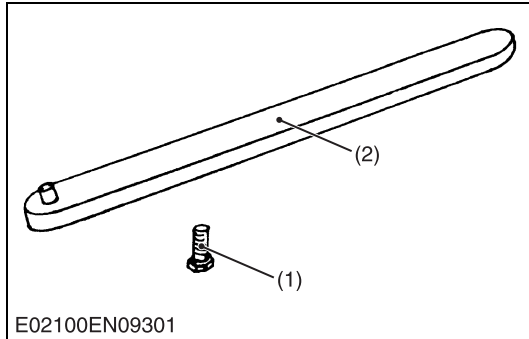
W1027045

[2] SPECIAL TOOLS FOR EMISSION PARTS

■ IMPORTANT

- Any modifications to the fuel system or any adjustments made on this engine will cause this engine to be in non-compliance with emission regulation.
- Distributor is tamper resistant ; the ignition timing adjustment screw has been covered after adjustment at the factory. So, except the authorized KUBOTA dealers, you **CAN NOT** adjust the ignition timing.

The special tool is only for using in order to recover the factory original adjustment. So, without any reason, adjustment, disassembly and assembly for Emission Parts **MUST NOT** be done.



Tamper Plug Jig

For removing and fitting distributor tamper resistance.

Application: Remove the tamper plug.

Install the tamper plug in the mounting bolt.

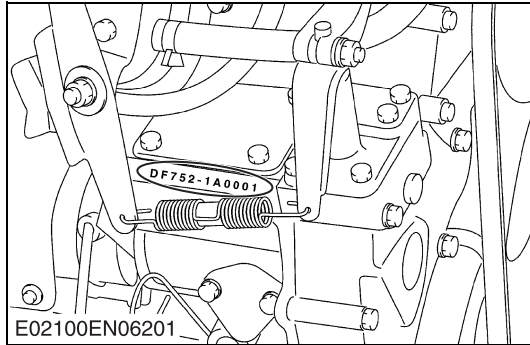
(1) Plug Draw-out Bolt

(2) Fitting Jig

W1051907

1. GENERAL

[1] ENGINE IDENTIFICATION



When contacting your local KUBOTA dealer, always specify the engine serial number.

■ NOTE

- The serial number is marked on specified position shown in the figure.

■ Engine Serial Number

The engine serial number is an identified number for the engine. It is marked after the engine model number.

It indicates month and year of manufacture as follows.

- **Year of manufacture**

Alphabet or Number	Year	Alphabet or Number	Year
1	2001	6	2006
2	2002	7	2007
3	2003	8	2008
4	2004	9	2009
5	2005		

- **Month of manufacture**

Month	Engine Serial Number	
	0001 ~ 9999	10000 ~
January	A0001 ~ A9999	B0001 ~
February	C0001 ~ C9999	D0001 ~
March	E0001 ~ E9999	F0001 ~
April	G0001 ~ G9999	H0001 ~
May	J0001 ~ J9999	K0001 ~
June	L0001 ~ L9999	M0001 ~
July	N0001 ~ N9999	P0001 ~
August	Q0001 ~ Q9999	R0001 ~
September	S0001 ~ S9999	T0001 ~
October	U0001 ~ U9999	V0001 ~
November	W0001 ~ W9999	X0001 ~
December	Y0001 ~ Y9999	Z0001 ~

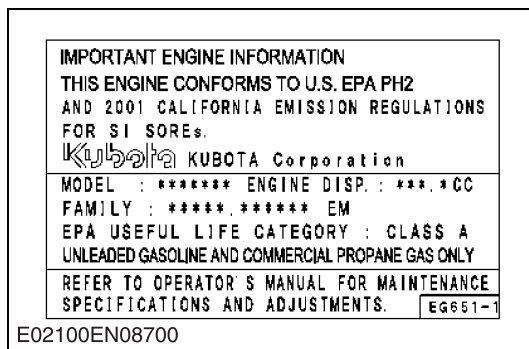
e.g. WG752-1A0001

“WG” indicates Water Cooled and Gasoline Engine.

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

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

W1010477

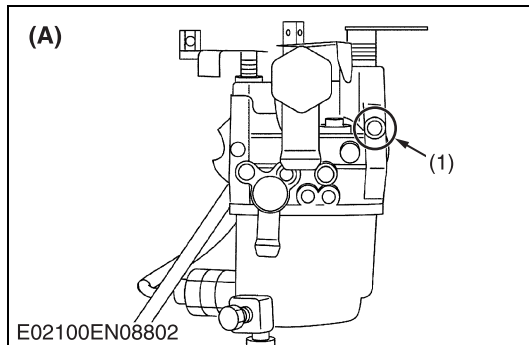


Emission Label

This label is attached on the cylinder head cover of the engine certified to the requirements of EPA / CARB Emission regulations.

The content of the label is approved officially by EPA / CARB.

W1091012



Tamper Resistance

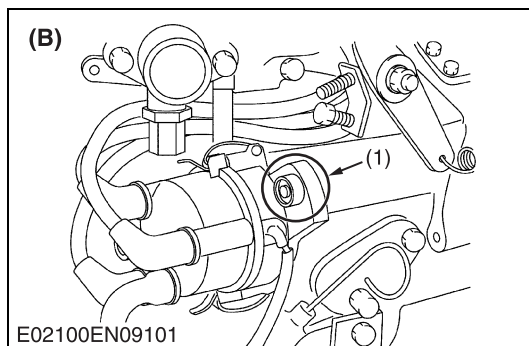
KUBOTA corporation provides safeguards for the parts where never to be adjusted, and is approved by EPA / CARB for the purpose of this engine to be in compliance with EPA / CARB Emission Regulations through its useful life. Intentional removable and adjustment of such tamper resistance are subject to the penalty.

(1) Tamper Resistance

(A) Carburetor

(B) Distributor

W1091543



2. TROUBLESHOOTING

Symptom	Probable Cause	Solution	Reference Page
Excessive Vibration	Loosen engine mounting nuts	Retighten mounting nuts.	P1-S16
Engine Will Not Crank	- Engine jammed - Battery discharged - Starter malfunctioning - Slow blow fuse blown - Main switch defective - PTO switch defective - Brake switch defective - Reverse switch defective - Seat switch defective - Wiring harness disconnected - Wiring harness disconnected	Check engine to find trouble and repair. Check battery specific gravity, and charge or replace battery. Repair or replace starter. Replace slow blow fuse. Repair or replace main switch. Replace PTO switch. Replace brake switch. Replace reverse switch or adjust reverse switch gap. Replace seat switch. Connect wiring harness. Connect wiring harness.	– PG-8 PG-9 8-S11 8-S16 G-13 8-S12 8-S13 8-S28 8-S27 8-S30 8-S28 – –
Engine Cranks Slowly but Does Not Start	- Battery charge low - Battery cables loose, corroded or worn - Increased resistance of moving parts - Excessively high viscosity of fuel or engine oil at low temperature	Check battery specific gravity, and charge or replace battery. Repair or replace cables. Repair or replace moving parts. Use specified fuel or engine oil.	PG-8 PG-9 8-S11 8-S11 – PG-2

W1012093

Symptom	Probable Cause	Solution	Reference Page
Engine Cranks at Normal Speed but Does Not Start	- No fuel - Water or dirt in fuel system - Fuel pipe or fuel filter clogged or damaged - Compression leak from cylinder (Compression pressure too low) - Piston ring and cylinder worn - Improper valve clearance - Ignition coil defective - Distributor defective - Spark plug defective - Fuel system defective - Overchoking - Flooding from carburetor - Clogged air cleaner	Replenish fuel. Replace fuel and repair fuel system. Clean or replace fuel pipe or fuel filter. Replace head gasket and tighten cylinder head screw and spark plug, or check cylinder and piston ring. Replace piston ring and bore oversize cylinder. Adjust valve clearance. Replace ignition coil. Replace distributor. Adjust spark plug gap or replace spark plug. Check fuel line and carburetor, and repair fuel system. Wipe spark plug. Check or repair carburetor. Clean or replace air cleaner.	– – PG-10 PG-11 1-S27 1-S28 P1-S20 PG-8 P1-S9 P1-S10 P1-S18 P8-S2 P1-S22, 23 PG-8 PG-7 PG-10 PG-11 – – G-21
Rough Low-speed Running and Idling	- Ignition coil defective - Spark plug defective - High tension cord defective - Incorrect carburetor idle adjustment - Incorrect governor adjustment - Improper valve clearance	Replace ignition coil. Adjust spark plug gap or replace spark plug. Replace high tension cord. Adjust idle speed. Adjust governor. Adjust valve clearance.	P8-S2 PG-8 P8-S3 P1-S28 P1-S27 P1-S18
Rough High-speed Running	- Ignition coil defective - Spark plug defective - High tension cord defective - Incorrect governor adjustment	Replace ignition coil. Adjust spark plug gap or replace spark plug. Replace high tension cord. Adjust governor.	P8-S2 PG-8 P8-S3 P1-S27
Engine Speed Does Not Increase	- Ignition coil defective - Incorrect governor adjustment - Spark plug cord defective - Spark plug defective	Replace ignition coil. Adjust governor. Replace spark plug cord. Replace spark plug.	P8-S2 P1-S25 P8-S3 PG-8
Either White or Blue Exhaust Gas Is Observed	- Excessive engine oil - Piston ring worn or stuck	Reduce to specified level. Replace piston ring.	PG-6 1-S28

W1012225

Symptom	Probable Cause	Solution	Reference Page
Either Black or Dark Gray Exhaust Gas Is Observed	• Overload • Low grade fuel used • Fuel filter clogged • Air cleaner clogged	Lessen load. Use specified fuel. Replace fuel filter. Clean or replace air cleaner element.	– PG-2 PG-7, 10 G-21
Deficient Output	• Incorrect ignition timing • Engine's moving parts seem to be seized. • Improper intake or exhaust valve sealing • Improper valve clearance • Compression leak from cylinder • Spark plug defective • Excessive carbon in engine	Adjust ignition timing. Repair or replace engine's moving parts. Repair valve seat. Adjust valve clearance. Replace head gasket and tighten cylinder head screw and spark plug, or check cylinder and piston ring. Adjust spark plug gap or replace spark plug. Remove carbon. Clean or replace air element	P8-S3 – 1-S34 P1-S18 1-S27 1-S28 P1-S20 PG-8 PG-8 G-21
Excessive Lubricant Oil Consumption	• Oil ring worn or stuck • Piston ring groove worn • Valve stem and guide worn • Crankshaft bearing, and crank pin bearing worn	Replace oil ring. Replace the piston. Replace valve stem and guide. Replace crankshaft bearing and crank pin bearing.	1-S28 1-S27 1-S22 1-S36
Water Mixed into Lubricating Oil	• Head gasket defective • Cylinder block or cylinder head flawed	Replace head gasket. Replace cylinder block or cylinder head.	1-S31 P1-S17 1-S31 1-S45
Low Oil Pressure	• Engine oil insufficient • Oil strainer clogged • Oil filter cartridge clogged • Relief valve stuck with dirt • Relief valve spring weaken or broken • Excessive oil clearance of crankshaft bearing • Excessive oil clearance of rocker arm boss • Oil passage clogged • Different type of oil • Oil pump defective	Replenish engine oil. Clean oil strainer. Replace oil filter cartridge. Clean relief valve. Replace relief valve spring. Replace crankshaft, main bearings or metals. Replace rocker arms, rocker arm brackets or rocker arm shaft. Clean oil passage. Use specified type of oil. Repair or replace oil pump.	PG-2, 4 1-S26 PG-6 – – 1-S30 1-S21 – PG-2 P1-S25 1-S46

W1012330

Symptom	Probable Cause	Solution	Reference Page
High Oil Pressure	- Different type of oil - Relief valve defective	Use specified type of oil. Replace relief valve.	PG-2 –
Engine Overheated	- Engine oil insufficient - Fan belt broken or tensioned improperly - Cooling water insufficient - Radiator net and radiator fin clogged with dust - Inside of radiator corroded - Cooling water flow route corroded - Radiator cap defective - Overload running - Head gasket defective - Incorrect ignition timing - Unsuitable fuel used	Replenish engine oil. Replace fan belt or adjust fan belt tension. Replenish cooling water. Clean radiator net and radiator fin. Clean or replace radiator. Clean or replace cooling water flow route. Replace radiator cap. Loosen load. Replace head gasket. Adjust ignition timing. Use specified fuel.	PG-2, 4 G-20 PG-2, 11 G-15 G-23 PG-11 PG-11 PG-12 1-S49 – 1-S31 P1-S17 P8-S3 PG-2, 4

W1012359

3. SERVICING SPECIFICATIONS

[1] ENGINE BODY

Item		Factory Specification	Allowable Limit
Cylinder Head Surface	Flatness	—	0.05 mm 0.0020 in.
Top Clearance (Serial No.: above 1A0001)		0.85 to 1.30 mm 0.0335 to 0.0512 in.	—
(Serial No.: below YY8644)		1.45 to 1.75 mm 0.0570 to 0.0690 in.	—
Compression Pressure		1.27 MPa 13.0 kgf/cm ² 185 psi	0.88 MPa 9.0 kgf/cm ² 128 psi
Difference Among Cylinders			10 % or less
Valve Clearance (Cold)		0.145 to 0.185 mm 0.00571 to 0.00728 in.	—
Valve Seat	Width	2.12 mm 0.0835 in.	—
Valve Seat	Angle	0.79 rad 45 °	—
Valve Face	Angle	0.79 rad 45 °	—
Valve Recessing		0.75 to 0.95 mm 0.0295 to 0.0374 in.	1.2 mm 0.047 in.
Valve Stem to Valve Guide	Clearance	0.030 to 0.057 mm 0.00118 to 0.00224 in.	0.10 mm 0.0039 in.
Valve Stem	O.D.	5.968 to 5.980 mm 0.23496 to 0.23543 in.	—
Valve Guide	I.D.	6.010 to 6.025 mm 0.23661 to 0.23720 in.	—
Valve Timing (Intake Valve)	Open	0.35 rad (20 °) before T.D.C.	—
	Close	0.79 rad (45 °) after B.D.C.	—
Valve Timing (Exhaust Valve)	Open	0.87 rad (50 °) before B.D.C.	—
	Close	0.26 rad (15 °) after T.D.C.	—

W1018012

Engine Body (Continued)

Item		Factory Specification	Allowable Limit
Valve Spring	Free Length	31.3 to 31.8 mm 1.23 to 1.25 in.	28.4 mm 1.12 in.
	Setting Load	64.7 N 6.6 kgf 14.6 lbs	54.9 N 5.6 kgf 12.3 lbs
	Setting Length	27.0 mm 1.063 in.	27.0 mm 1.063 in.
	Tilt	—	1.2 mm 0.047 in.
Rocker Arm Shaft to Rocker Arm	Clearance	0.016 to 0.045 mm 0.00063 to 0.00177 in.	0.15 mm 0.0059 in.
Rocker Arm Shaft	O.D.	10.473 to 10.484 mm 0.41232 to 0.41276 in.	—
Rocker Arm	I.D.	10.500 to 10.518 mm 0.41339 to 0.41410 in.	—
Push Rod	Alignment	—	0.25 mm 0.0098 in.
Tappet to Tappet Guide Bore	Clearance	0.016 to 0.052 mm 0.00063 to 0.00205 in.	0.10 mm 0.0039 in.
Tappet	O.D.	17.966 to 17.984 mm 0.70732 to 0.70803 in.	—
Tappet Guide Bore	I.D.	18.000 to 18.018 mm 0.70866 to 0.70937 in.	—
Camshaft	Side Clearance	0.15 to 0.31 mm 0.0059 to 0.0122 in.	0.5 mm 0.0197 in.
	Alignment	—	0.01 mm 0.0004 in.
Cam Height	Intake	26.88 mm 1.0583 in.	26.83 mm 1.0563 in.
	Exhaust	26.88 mm 1.0583 in.	26.83 mm 1.0563 in.
Camshaft Journal to Camshaft Bearing	Oil Clearance	0.050 to 0.091 mm 0.00197 to 0.00358 in.	0.12 mm 0.0047 in.
Camshaft Journal	O.D.	32.934 to 32.950 mm 1.29661 to 1.29724 in.	—
Camshaft Bearing	I.D.	33.000 to 33.025 mm 1.29921 to 1.30020 in.	—

W1018157

Engine Body (Continued)

Item		Factory Specification	Allowable Limit
Timing Gear Crank Gear to Idle Gear	Backlash	0.043 to 0.124 mm 0.00169 to 0.00488 in.	0.15 mm 0.0059 in.
	Idle Gear to Cam Gear	0.047 to 0.123 mm 0.00185 to 0.00484 in.	0.15 mm 0.0059 in.
	Idle Gear to Distributor Drive Gear	0.046 to 0.124 mm 0.00181 to 0.00488 in.	0.15 mm 0.0059 in.
	Crank Gear to Oil Pump Drive Gear	0.041 to 0.123 mm 0.00161 to 0.00484 in.	0.15 mm 0.0059 in.
Idle Gear	Side Clearance	0.20 to 0.51 mm 0.0079 to 0.0201 in.	0.60 mm 0.0236 in.
Idle Gear Shaft to Idle Gear Bushing	Clearance	0.020 to 0.084 mm 0.00079 to 0.00331 in.	0.10 mm 0.0039 in.
Idle Gear Shaft	O.D.	19.967 to 19.980 mm 0.78610 to 0.78661 in.	—
Idle Gear Bushing	I.D.	20.000 to 20.051 mm 0.78740 to 0.78941 in.	—
Piston Pin Bore	I.D.	18.000 to 18.011 mm 0.70866 to 0.70910 in.	18.05 mm 0.7106 in.
Piston Ring Clearance	Compression Ring 1, 2	0.04 to 0.08 mm 0.0016 to 0.0031 in.	0.15 mm 0.0059 in.
	Oil Ring	0.06 to 0.15 mm 0.0024 to 0.0059 in.	—
Ring Gap	Compression Ring 1, 2	0.15 to 0.35 mm 0.0059 to 0.0138 in.	1.25 mm 0.0492 in.
	Oil Ring	0.25 to 0.45 mm 0.0098 to 0.0177 in.	1.25 mm 0.0492 in.
Connecting Rod	Alignment	—	0.05 mm 0.0020 in.
Piston Pin to Small End Bushing	Clearance	0.02 to 0.04 mm 0.0008 to 0.0016 in.	0.10 mm 0.0039 in.
Piston Pin	O.D.	18.000 to 18.005 mm 0.7087 to 0.7089 in.	—
Small End Bushing	I.D.	18.025 to 18.040 mm 0.70965 to 0.71024 in.	—
Crankshaft	Alignment	—	0.20 mm 0.0008 in.

W1018186

Engine Body (Continued)

Item		Factory Specification	Allowable Limit
Crankshaft Journal to Crankshaft Bearing 1	Oil Clearance	0.034 to 0.106 mm 0.00134 to 0.00417 in.	0.20 mm 0.0079 in.
Crankshaft Journal	O.D.	39.934 to 39.950 mm 1.57221 to 1.57284 in.	—
Crankshaft Bearing 1	I.D.	39.984 to 40.040 mm 1.57417 to 1.57638 in.	—
Crankshaft Journal to Crankshaft Bearing 2 (Flywheel Side)	Oil Clearance	0.034 to 0.092 mm 0.00134 to 0.00362 in.	0.20 mm 0.0079 in.
Crankshaft Journal	O.D.	43.934 to 43.950 mm 1.72969 to 1.73032 in.	—
Crankshaft Bearing 2	I.D.	43.984 to 44.026 mm 1.73166 to 1.73331 in.	—
Crankshaft Journal to Crankshaft Bearing 3 (Intermediate)	Oil Clearance	0.034 to 0.092 mm 0.00134 to 0.00362 in.	0.20 mm 0.0079 in.
Crankshaft Journal	O.D.	39.934 to 39.950 mm 1.57221 to 1.57284 in.	—
Crankshaft Bearing 3	I.D.	39.984 to 40.026 mm 1.57418 to 1.57583 in.	—
Crankpin to Crankpin Bearing	Oil Clearance	0.019 to 0.081 mm 0.00075 to 0.00319 in.	0.15 mm 0.0059 in.
Crankpin	O.D.	33.959 to 33.975 mm 1.33697 to 1.33760 in.	—
Crankpin Bearing	I.D.	33.994 to 34.040 mm 1.33835 to 1.34016 in.	—
Crankshaft	Side Clearance	0.15 to 0.31 mm 0.0059 to 0.0122 in.	0.50 mm 0.0197 in.
Cylinder Liner [Standard]	I.D.	68.000 to 68.019 mm 2.67716 to 2.67791 in.	68.169 mm 2.68381 in.
Cylinder Liner [Oversize: 0.50 mm (0.0196 in.)]	I.D.	68.500 to 68.519 mm 2.69685 to 2.69759 in.	68.669 mm 2.7035 in.

W1018215

[2] LUBRICATING SYSTEM

Item		Factory Specification	Allowable Limit
Engine Oil Pressure	At Idle Speed	More than 69 kPa 0.7 kgf/cm ² 10 psi	—
	At Rated Speed	196 to 441 kPa 2.0 to 4.5 kgf/cm ² 28 to 64 psi	69 kPa 0.7 kgf/cm ² 10 psi
Inner Rotor to Outer Rotor	Clearance	—	0.25 mm 0.0098 in.
Outer Rotor to Pump Body	Clearance	0.07 to 0.15 mm 0.0028 to 0.0059 in.	0.30 mm 0.0118 in.
Inner Rotor to Cover	End Clearance	0.075 to 0.135 mm 0.0029 to 0.0053 in.	0.20 mm 0.0079 in.

W1019454

[3] COOLING SYSTEM

Thermostat	Valve Opening Temperature (At Beginning)	69.5 to 72.5 °C 157 to 162.5 °F	—
	Valve Opening Temperature (Opened Completely)	85 °C 185 °F	—
Radiator	Water Leakage Test Pressure	No leaks at specified pressure 157 kPa 1.6 kgf/cm ² 23 psi	—
Radiator Cap	Pressure Falling Time	10 seconds or more 88 → 59 kPa 0.9 → 0.6 kgf/cm ² 13 → 9 psi	—
Fan Belt	Tension	10 mm / 98 N 0.4 in. / 98 N (10kgf, 22 lbs)	—

W1019483

4. TIGHTENING TORQUES

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

Item	Size x Pitch	N·m	kgf·m	ft-lbs
Starter M terminal nut	M6 × 1.0	9.8 to 13.7	1.0 to 1.4	7.2 to 10.1
Alternator B terminal nut	M6 × 1.0	7.8 to 9.3	0.80 to 0.95	5.8 to 6.9
Universal joint mounting screw	M8 × 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Engine mounting nut	M8 × 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Cylinder head bolt	M8 × 1.25	37.2 to 42.1	3.8 to 4.3	28.0 to 31.7
* Cylinder head cover cap nut	M6 × 1.0	3.9 to 5.9	0.4 to 0.6	2.9 to 4.3
Spark plug		19.6 to 24.5	2.0 to 2.5	14.5 to 18.1
* Rocker arm bracket nut	M6 × 1.0	9.8 to 11.3	1.00 to 1.15	7.2 to 8.3
* Fan drive pulley retaining screw	M12 × 1.5	117.6 to 127.4	12.0 to 13.0	86.8 to 94.0
* Idle gear shaft mounting screw	M6 × 1.0	9.8 to 11.3	1.00 to 1.15	7.2 to 8.3
* Connecting rod screw	M7 × 0.75	26.5 to 30.4	2.7 to 3.1	19.5 to 22.4
* Flywheel screw	M10 × 1.25	53.9 to 58.8	5.5 to 6.0	39.8 to 43.4
* Bearing case cover mounting screw	M8 × 1.25	9.8 to 11.3	1.0 to 1.15	7.2 to 8.3
* Main bearing case screw 2	M7 × 1.0	26.5 to 30.4	2.7 to 3.1	19.5 to 22.4
* Main bearing case screw 1	M6 × 1.0	12.7 to 15.7	1.3 to 1.6	9.4 to 11.6
Oil pressure switch	PT 1/8	14.7 to 19.6	1.5 to 2.0	10.8 to 14.5
Drain plug		32.4 to 37.3	3.3 to 3.8	23.9 to 27.5

■ NOTE

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

W1019799

5. CHECKING, DISASSEMBLING AND SERVICING

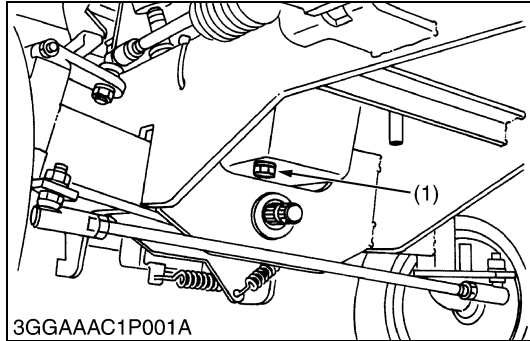
[1] SEPARATING ENGINE

(1) Disassembling and Assembling

Dismount Mower

1. See to "MOWER" section.

W1019171



Draining Engine Oil

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

(When refilling)

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

Engine oil	Capacity	
		2.6 L
		2.7 U.S.qts
		2.3 Imp.qts

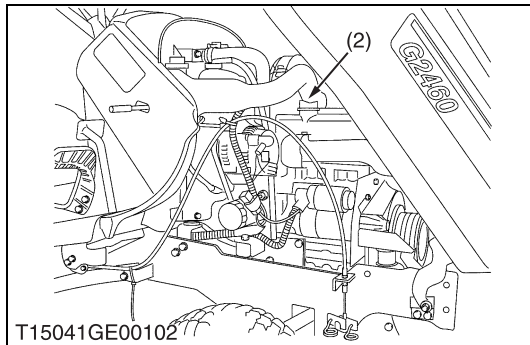
■ IMPORTANT

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

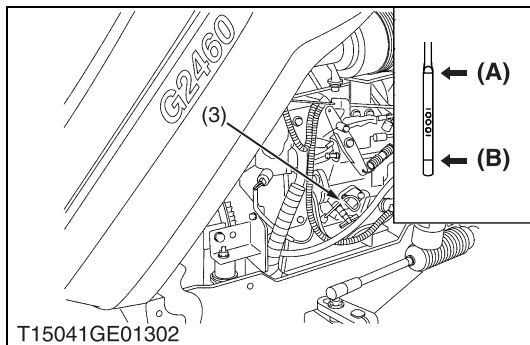
Refer to "LUBRICANTS, FUEL AND COOLANT".(See page PG-2.)

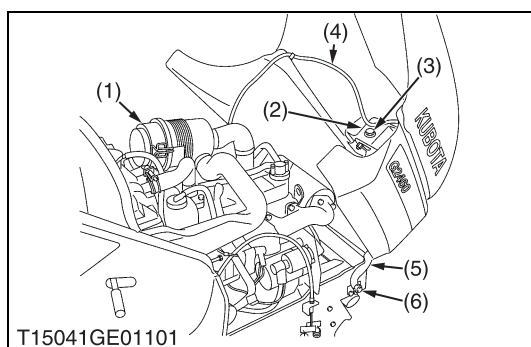
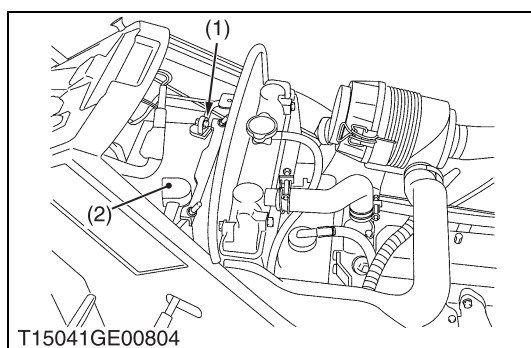
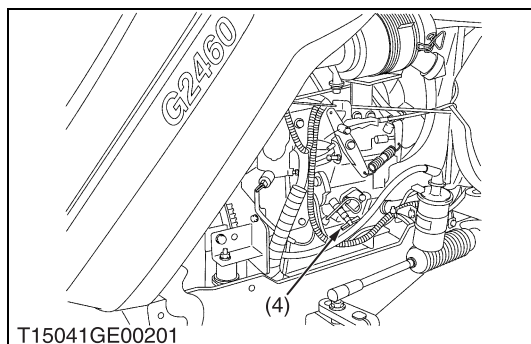
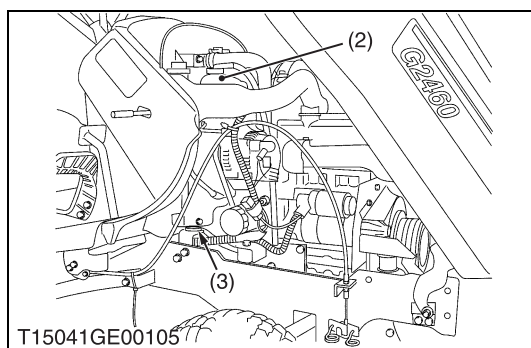
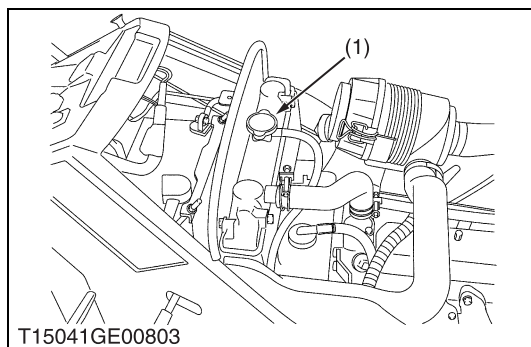
- (1) Drain Plug
- (2) Oil Inlet Plug
- (3) Dipstick

- (A) Upper Level
- (B) Lower Level



W1019221





Draining Coolant



CAUTION

- **Never open the radiator cap while operating or immediately after stopping. Otherwise, hot water will spout out from the radiator. Wait for more than ten minutes to cool the radiator, before opening the cap.**
1. Stop the engine and let cool down.
 2. Remove the radiator coolant drain plug (3) and engine coolant drain plug (4) to drain the coolant.
 3. Remove the radiator cap (1) to completely drain the coolant.
 4. After all coolant is drained, close the drain cock (4).

Coolant	Capacity	Radiator	2.1 L 2.2 U.S.qts 1.8 Imp.qts
		Recovery tank	0.25 L 0.26 U.S.qts 0.22 Imp.qts

- (1) Radiator Cap
(2) Recovery Tank

- (3) Radiator Coolant Drain Plug
(4) Engine Coolant Drain Cock

W1019511

Battery



CAUTION

- **When disconnecting the battery cables, disconnect the negative cable from the battery first. When connecting, connect the positive cable to the battery first.**
1. Disconnect the negative cable (1) from the battery.
 2. Disconnect the positive cable (2) from the battery.

- (1) Negative Cable

- (2) Positive Cable

W1019789

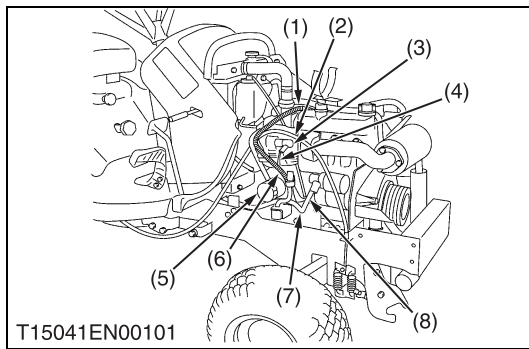
Bonnet and Air Cleaner

1. Disconnect the 1P connectors (3) from the head light (2).
2. Remove the wiring (4) from the bonnet.
3. Remove the bonnet stay mounting screws (6).
4. Remove the bonnet with the bonnet bracket (5) from the frame.
5. Loosen the air cleaner hose clamp.
6. Remove the air cleaner (1) with air cleaner hose.

- (1) Air Cleaner
(2) Head Light
(3) 1P Connector

- (4) Wiring
(5) Bonnet Bracket
(6) Bonnet Stay Mounting Screws

W1019922



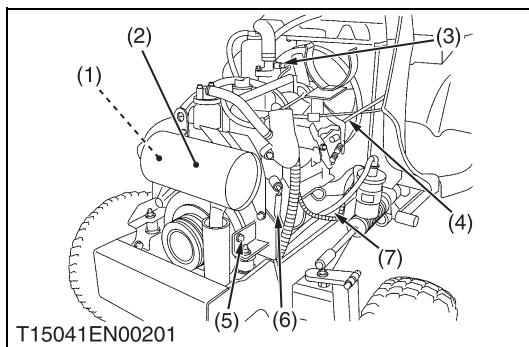
Wiring

1. Remove the PTO cable (2) and wiring (1).
2. Disconnect **2P** connector (3) and wiring (4) from the alternator.
3. Disconnect **1P** connector (6) from the oil pressure switch.
4. Disconnect **1P** connector (8) and wiring (7) from the starter.
5. Disconnect the ground cable (5).

Tightening torque	Starter M terminal nut	9.8 to 13.7 N·m 1.0 to 1.4 kgf·m 7.2 to 10.1 ft-lbs
	Alternator B terminal nut	7.8 to 9.3 N·m 0.80 to 0.95 kgf·m 5.8 to 6.9 ft-lbs

- | | |
|-------------------------|-------------------------|
| (1) Wiring | (5) Ground Cable |
| (2) PTO Cable | (6) 1P Connector |
| (3) 2P Connector | (7) Wiring |
| (4) Wiring | (8) 1P Connector |

W1020276

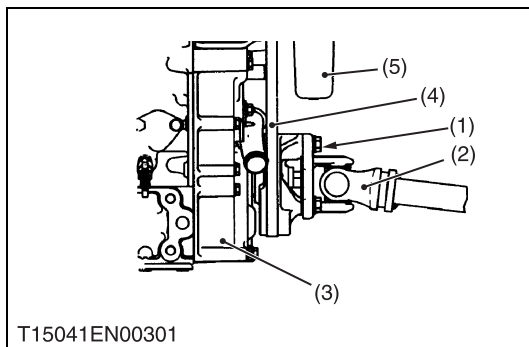


Muffler, Wiring, Accelerator and Hose

1. Remove the muffler mounting screws (1), (5).
2. Remove the muffler (2).
3. Disconnect **1P** connector (3) from the coolant temperature sensor.
4. Disconnect the accelerator wire (4).
5. Remove the high tension code from distributor.
6. Disconnect the carburetor cable (6).

- | | |
|----------------------------|----------------------------|
| (1) Muffler Mounting Screw | (5) Muffler Mounting Screw |
| (2) Muffler | (6) Carburetor |
| (3) 1P Connector | (7) High Tension Code |
| (4) Accelerator Wire | |

W1021264



Universal Joint

1. Remove the universal joint mounting screws (1).
2. Disconnect the universal joint (2) from the fan drive pulley.

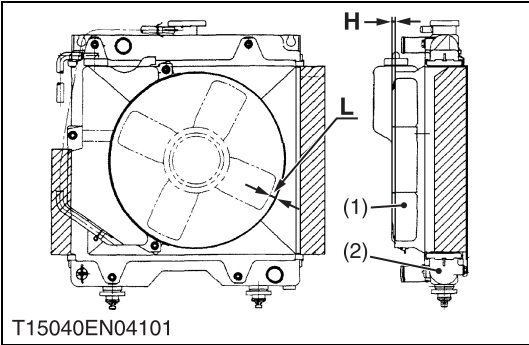
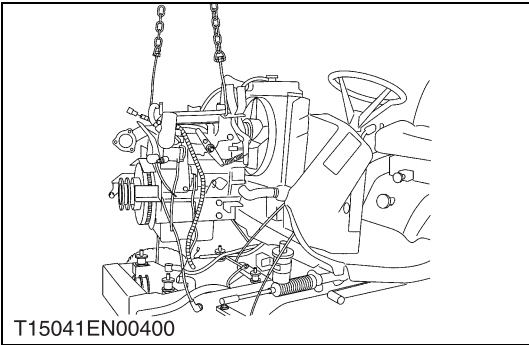
(When reassembling)

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

Tightening torque	Universal joint mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 Kgf·m 17.4 to 20.3 ft-lbs
-------------------	--------------------------------	---

- | | |
|------------------------------------|--------------|
| (1) Universal Joint Mounting Screw | (4) Fan Belt |
| (2) Universal Joint | (5) Fan |
| (3) Gear Case | |

W1021777



Separating Engine

- 1. Pull out the hairpin cotters from the radiator.
- 2. Remove the engine mounting nuts, and support the engine with an engine lift hook and hoist.
- 3. Separate the engine with the radiator from the frame, taking care not to damage the radiator.

(When reassembling)

- Fit the radiator to the frame, adjusting the clearance between the radiator and the fan as shown in the figure.

Tightening torque	Engine mounting nut	23.5 to 27.5 N·m 2.4 to 2.8 Kgf·m 17.4 to 20.3 ft-lbs
-------------------	---------------------	---

(Reference)

Clearance between fan and radiator	Factory spec.	L	9.0 mm 0.35 in.
		H	2.0 mm 0.08 in.

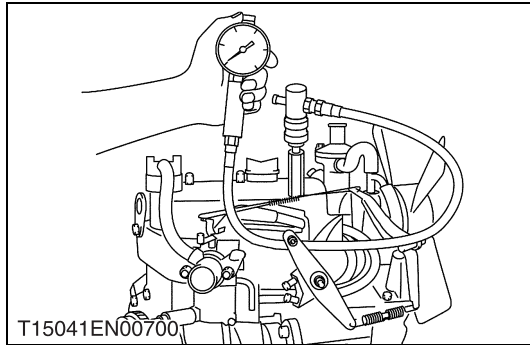
- (1) Fan
- (2) Radiator

L : Circumferential clearance between fan and radiator
H : Longitudinal clearance between fan and radiator

W1021956

[2] ENGINE BODY

(1) Checking and Adjusting



Compression Pressure

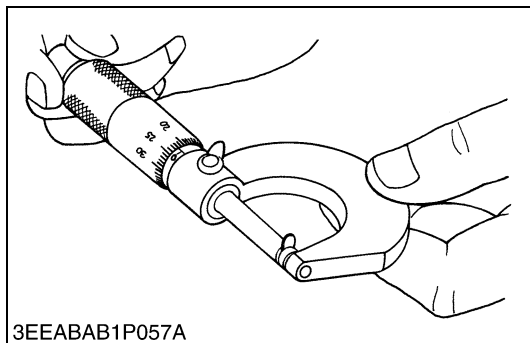
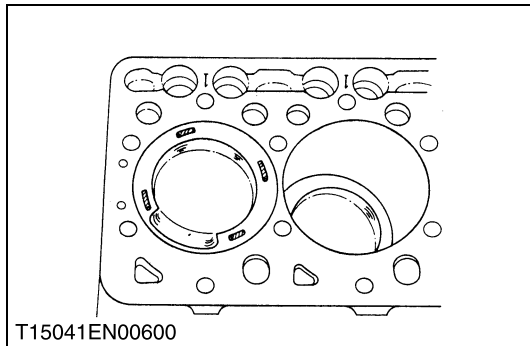
1. After warming up the engine, stop it and remove the air cleaner, the muffler and all spark plugs.
2. Install a compression tester (Code No: 07909-30251) for gasoline engines to spark plug hole.
3. Run the engine at 7.5 S^{-1} (450 rpm) with the starter for 5 to 10 seconds keeping throttle valve fully open.
4. Read the maximum pressure. Measure the pressure more than twice.
5. If the measurement is below the allowable limit, apply a small amount of oil to the cylinder wall through the spark plug holes and measure the compression pressure again.
6. If the compression pressure is still less than the allowable limit, check the top clearance, valve and cylinder head.
7. If the pressure increases after applying oil, check the cylinder wall and piston rings.

NOTE

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

Compression pressure	Factory spec.	1.27 MPa 13.0 kgf/cm ² 185 psi
	Allowable limit	0.88 MPa 9.0 kgf/cm ² 128 psi

W1022479



Top Clearance

1. Remove the cylinder head and the head gasket completely.
2. Bring the piston to it TDC, and fasten 1.5 mm dia. 5 to 7 mm long fuse wires to 3 to 4 spots on the piston top with grease so as to avoid the intake and exhaust valve and the combustion chamber ports.
3. Bring the piston to its middle position, install the cylinder head, and tighten the cylinder head bolts to specification. (Head gasket must be changed to new one.)
4. Turn the flywheel until the piston passes through the TDC.
5. Remove the cylinder head, and measure the thickness of the fuses.
6. If the measurement is not within the factory specifications, check the oil clearance between the crankpin and bearing and between the piston pin and bushing.

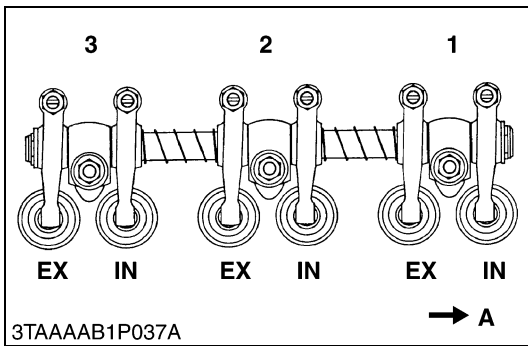
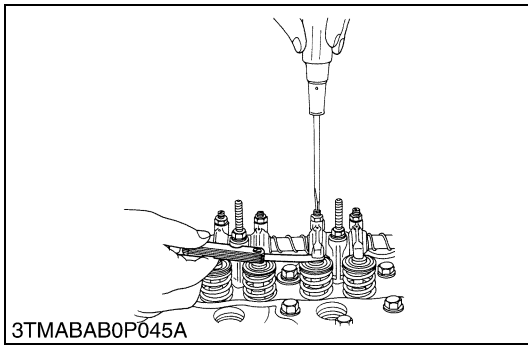
NOTE

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

Top clearance (Engine serial No.: above 1A0001)	Factory spec.	0.85 to 1.30 mm 0.0335 to 0.0512 in.
Top clearance (Engine serial No.: below YY8644)		1.45 to 1.75 mm 0.057 to 0.0690 in.

Tightening torque	Cylinder head bolt	37.2 to 42.1 N·m 3.8 to 4.3 kgf·m 28.0 to 31.7 ft-lbs
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W10107680



Valve Clearance

■ IMPORTANT

- The valve clearance must be checked and adjusted when engine is cold.

- Remove the cylinder head cover and the glow plugs.
- Align the "1TC" mark on the flywheel and alignment mark on the rear end plate so that the No. 1 piston comes to the compression top dead center.
- Check the following valve clearance marked with "☆" using a feeler gauge.

[When No. 1 piston comes to the compression top dead center]

Cylinder No.	No.1	No.2	No.3
Intake valve	★		★
Exhaust valve	★	★	

- If the clearance is not within the factory specifications, adjust with the adjusting screw.
- Then turn the flywheel 6.28 rad (360°), and align the "1TC" mark on the flywheel and alignment mark on the rear end plate so that the No.1 piston comes to the overlap position.
- Check the following valve clearance marked with "☆" using a feeler gauge.

[When No. 1 piston comes to the overlap position]

Cylinder No.	No.1	No.2	No.3
Intake valve		☆	
Exhaust valve			☆

- If the clearance is not within the factory specifications, adjust with the adjusting screw.

Intake and exhaust valve clearance (Cold)	Factory spec.	0.145 to 0.185 mm 0.00571 to 0.00728 in.
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■ NOTE

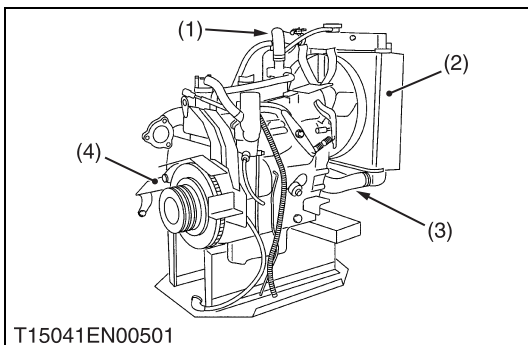
- The sequence of cylinder numbers is given as No.1, No.2 and No.3 starting from the gear case side.
- After adjusting the valve clearance, secure the adjusting screw with the lock nut.

(A) Gear Case Side

W10113210

(2) Disassembling and Assembling

(A) External Components



Radiator and Flywheel Cover

- Remove the engine support from the cylinder block, and install the disassembly stands.
- Loosen the radiator hose clamps, and remove the radiator (2) and radiator hose (1), (3) from the engine.
- Remove the flywheel cover (4).

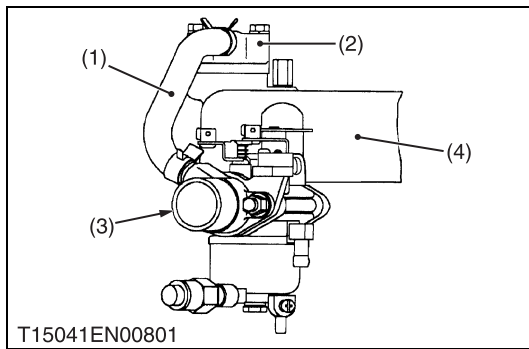
(When reassembling)

Tightening torque	Engine support mounting screw	39.2 to 53.9 N·m 4.0 to 5.5 kgf·m 28.9 to 39.8 ft·lbs
-------------------	-------------------------------	---

- (1) Radiator Hose
(2) Radiator

- (3) Radiator Hose
(4) Flywheel Cover

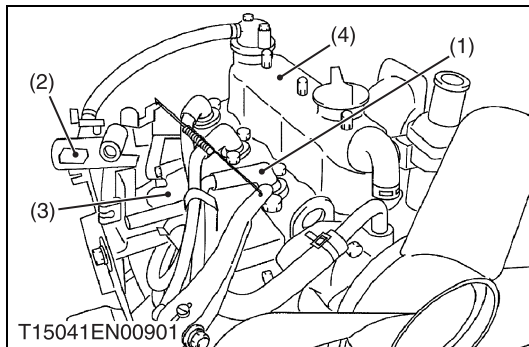
W1024920

**Closed Breather**

1. Disconnect the breather hose (1).

- | | |
|------------------------------|------------------------|
| (1) Closed Breather Hose | (3) Air Cleaner Flange |
| (2) Closed Breather Assembly | (4) Head Cover |

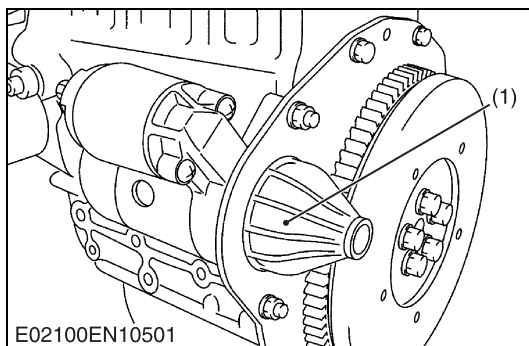
W1045993

**Ignition Cords, Inlet Manifold and Cylinder Head Cover**

1. Remove the spark plug cap and the spark plug (1).
2. Remove the carburetor (2).
3. Remove the inlet manifold (3).
4. Remove the cylinder head cover (4).

- | | |
|----------------|-------------------------|
| (1) Spark Plug | (3) Inlet Manifold |
| (2) Carburetor | (4) Cylinder Head Cover |

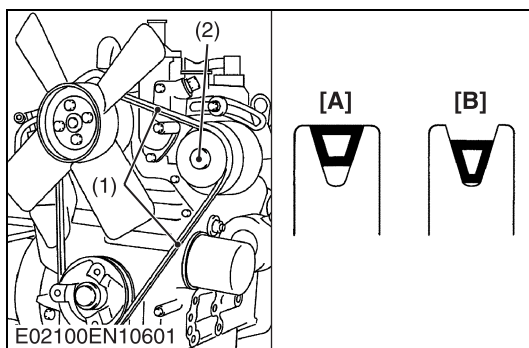
W1046078

**Starter**

1. Remove the starter (1).

- (1) Starter

W1046195

**Alternator and Fan Belt**

1. Remove the alternator (1).
2. Remove the fan.
3. Remove the fan belt (2).

(When reassembling)

- Check to see that there are no cracks on the belt surface.
- See page 1-S48.

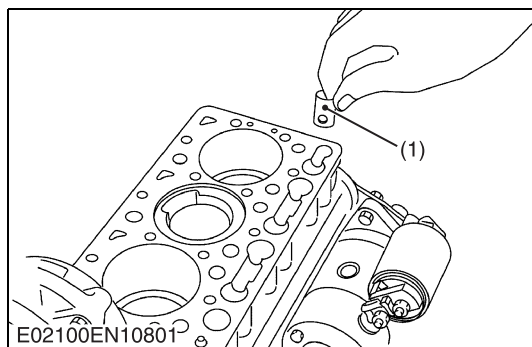
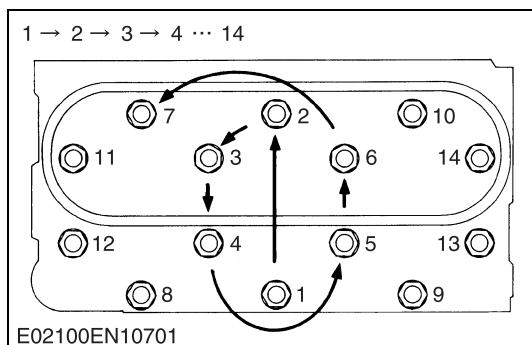
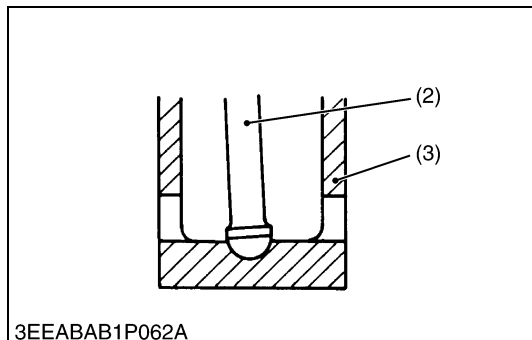
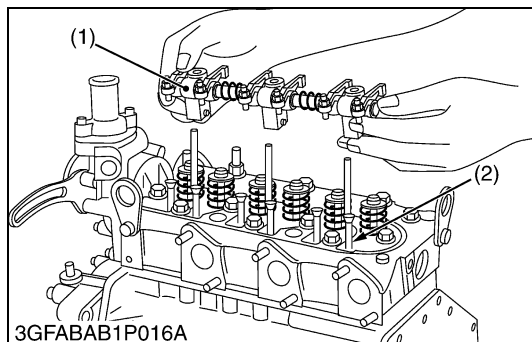
■ IMPORTANT

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

- | | |
|----------------|----------|
| (1) Fan Belt | [A] Good |
| (2) Alternator | [B] Bad |

W1046320

(B) Cylinder Head and Valves



Rocker Arm Assembly and Push Rod

1. Remove the rocker arm bracket mounting nuts, and remove the rocker arm assembly (1).
2. Remove the push rods (2).

(When reassembling)

- Insert the push rods into the tappets securely.
- Adjust the valve clearance. (See page P1-S16.)
- Apply engine oil to the rocker arm bracket nuts. And tighten them.

Tightening torque	Rocker arm bracket nut	9.8 to 11.3 N·m 1.00 to 1.15 kgf·m 7.2 to 8.3 ft-lbs
-------------------	------------------------	--

(1) Rocker Arm Assembly

(2) Push Rod

(3) Tappet

W1046498

Cylinder Head and Tappet

1. Remove the cylinder head screws in the order of [14] to [1] (See figure) and remove the cylinder head.
2. Remove the cylinder head gasket.
3. Remove the tappets (1) from the crankcase.

(When reassembling)

- Replace the head gasket with a new one.
- Before installing the tappets, apply engine oil thinly around them.
- Install the cylinder head.
- Tighten the cylinder head screw gradually screw in the order of [1] to [14] after applying engine oil.
- Retighten the cylinder head screw after running the engine for 30 minutes.

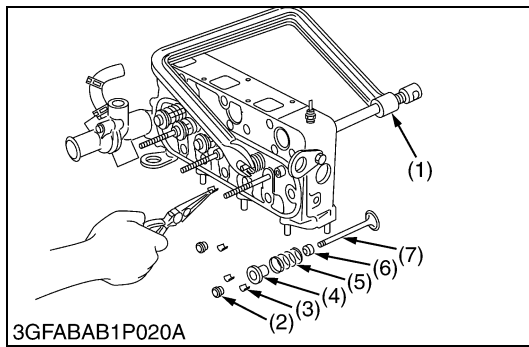
■ NOTE

- **Mark the cylinder number to the tappets to prevent interchanging.**
- **When reusing the head bolt, apply engine oil to its thread (when use a new head bolt “rust-preventive oil applied”, use it without applying engine oil to it) and seat surface before fitting it. After installing the engine, let it run for 30 minutes, and retighten the head bolt. (Before retightening it loosen it by 0.52 to 0.79 rad (30 to 90 °).)**

Tightening torque	Cylinder head screw	37.2 to 42.1 N·m 3.8 to 4.3 kgf·m 28.0 to 31.7 ft-lbs
-------------------	---------------------	---

(1) Tappet

W1046680



Valves

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

(When reassembling)

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

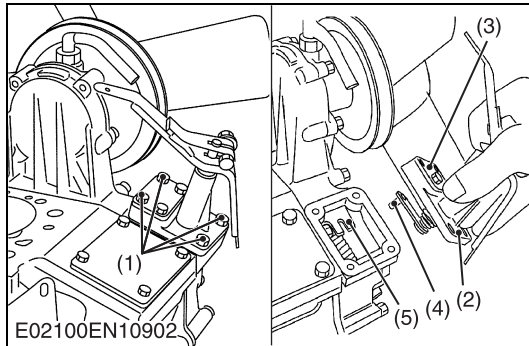
■ IMPORTANT

- **Don't change the combination of valve and valve guide.**

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

W1047054

(C) Speed Control Lever and Distributor



Speed Control Plate

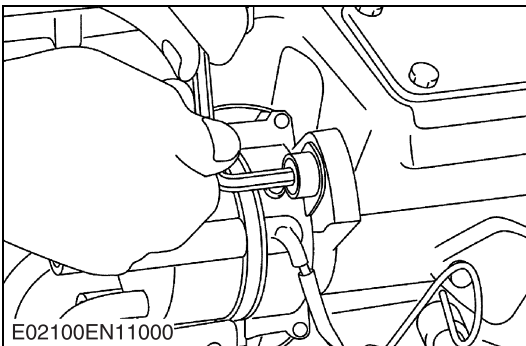
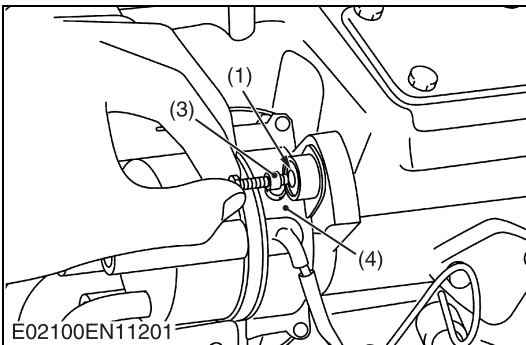
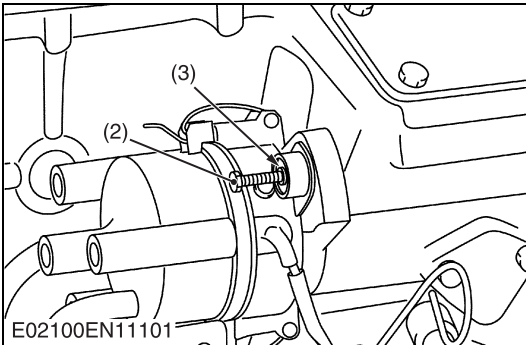
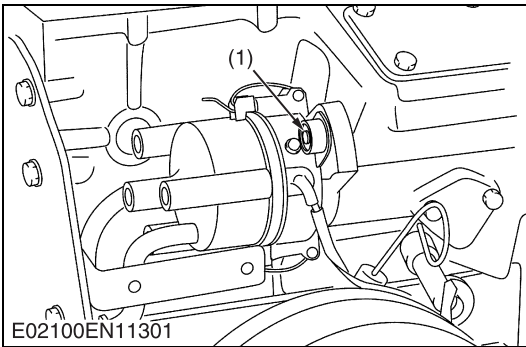
1. Remove the screws and copper washers (1) and separate the speed control plate (2).

(When reassembling)

- Remove the speed control plate (2) and make sure that the governor lever shaft (4) is correctly set in the governor fork (5).

- | | |
|-------------------------------|--------------------------|
| (1) Screws and Copper Washers | (4) Governor Lever Shaft |
| (2) Speed Control Plate | (5) Governor Fork |
| (3) Speed Control Plate Cover | |

W1047256



Distributor

■ IMPORTANT

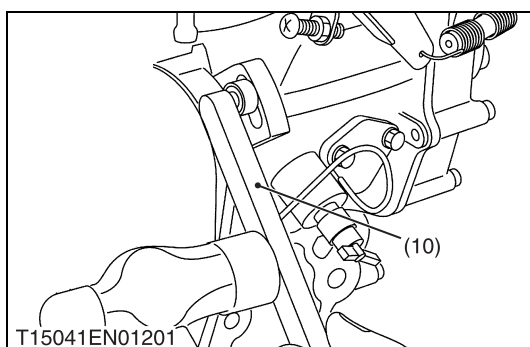
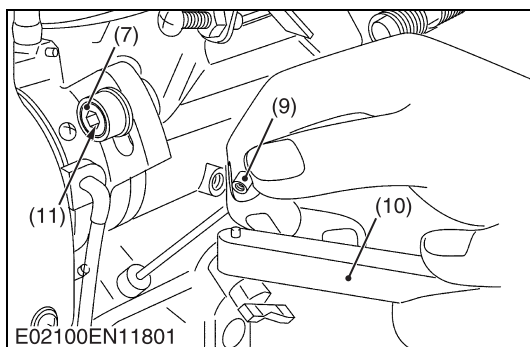
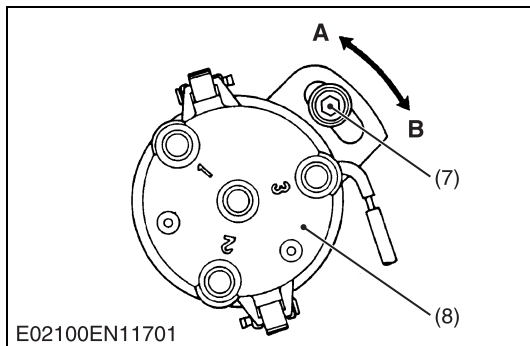
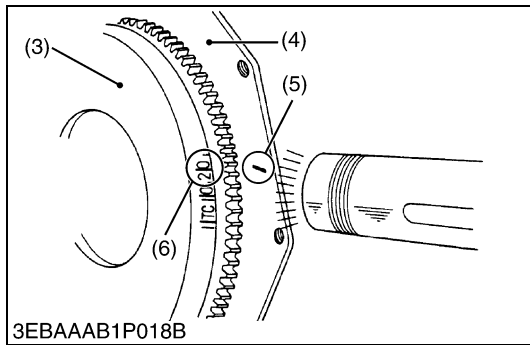
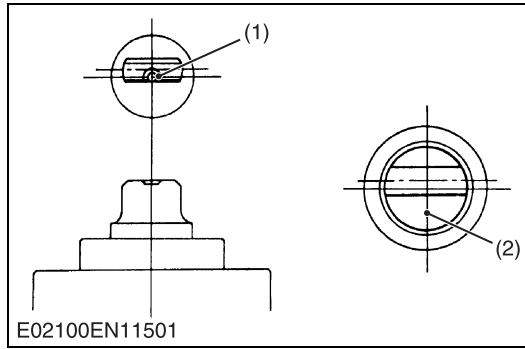
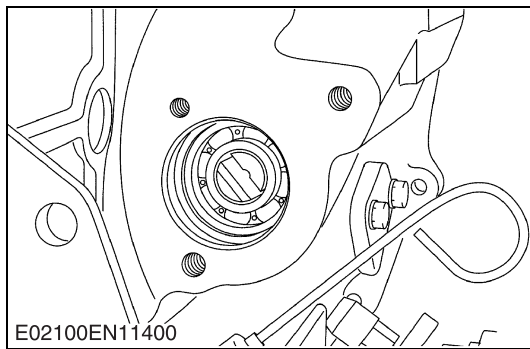
- Because adjustment of ignition timing affects the constituents of exhaust, WG752 conforming with U.S. EPA and CARB SOREs (Small Off Road Engines) emission regulations are made tamper resistant, so that operators, users or unauthorized KUBOTA repair shops can not easily tamper with the adjustments.
- If the ignition timing has to be adjusted, remove the tamper resistance from the distributor mounting screw. Reseal securely after adjusting the ignition timing.

1. Set the plug draw-out bolt (2) to the tamper plug (3), and draw out the tamper plug (3).
2. Remove the distributor mounting bolt (1) using hexagon wrench.
3. Remove the distributor (4).

(1) Distributor Mounting Bolt
(2) Plug Draw-out Bolt

(3) Tamper Plug
(4) Distributor

W1047508



(When reassembling)

■ NOTE

- When placing the distributor over the distributor drive shaft, make sure that the distributor drive groove is horizontal when No. 1 cylinder is at its T.D.C.. At this time, the mating mark should be at the bottom.

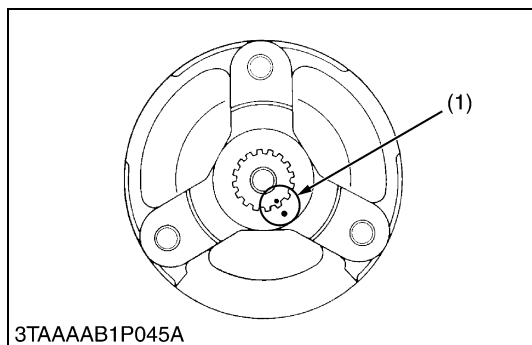
- Tighten the distributor mounting bolt (7).
- Using a timing light, check that the ignition timing (stamps on the flywheel) (6) is aligned with the mark (5) on the rear end plate (4).
- If the timing is wrong, loosen the distributor mounting screw (7) and turn the distributor (8) so that the ignition timing (stamps on the flywheel) is aligned with the mark on the rear end plate.

Ignition timing	Factory spec.	0.315 rad (18°) before T.D.C.
-----------------	---------------	----------------------------------

- Drive the plug (9) into the hexagonal hole (11) of bolt with hand.
- Insert the plug completely with fitting jig (10).

- | | |
|--|------------------------------------|
| (1) Mating Mark on the Distributor | (9) Tamper Plug |
| (2) Mating mark on the Distributor Drive | (10) Fitting Jig |
| (3) Flywheel | (11) Hexagonal Hole in Distributor |
| (4) Rear End Plate | Mounting Screw |
| (5) Mark | |
| (6) Ignition Timing Mark on Flywheel | (A) To Retard |
| (7) Distributor Mounting Screw | (B) To Advance |
| (8) Distributor | |

W1047715



Fan Drive Pulley

1. Set the stopper to the flywheel.
2. Remove the fan drive pulley retaining screw.
3. Draw out the fan drive pulley with a puller.

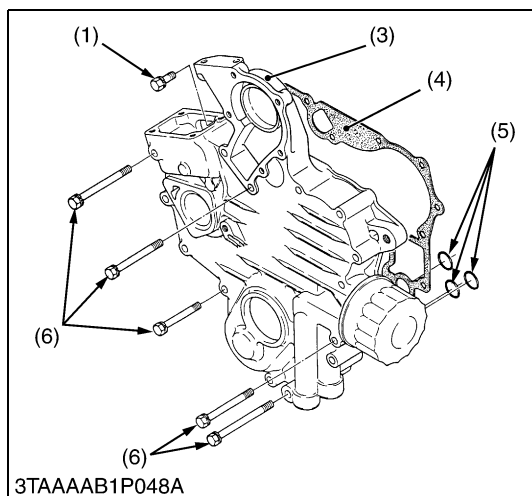
(When reassembling)

- Install the pulley to the crankshaft, aligning the aligning marks (1) on them.
- Apply engine oil to the fan drive pulley retaining screws. And tighten them.

Tightening torque	Fan drive pulley retaining screw	117.6 to 127.4 N·m 12.0 to 13.0 kgf·m 86.8 to 94.0 ft-lbs
-------------------	----------------------------------	---

(1) Aligning Marks

W1048447



Gear Case

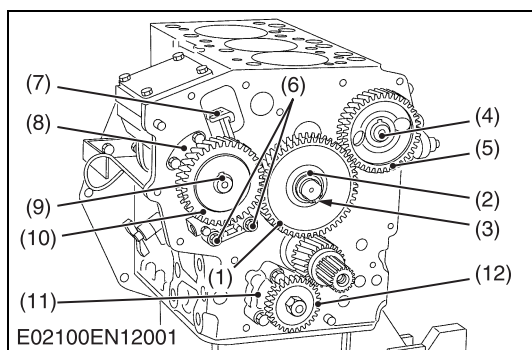
1. Remove the screw (1) of inside the gear case and outside screws.
2. Disconnect the start spring (2) in the speed control plate mounting hole.
3. Remove the gear case (3).

(When reassembling)

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

- | | |
|--------------------|----------------------|
| (1) Screw (Inside) | (4) Gear Case Gasket |
| (2) Start Spring | (5) O-ring |
| (3) Gear Case | (6) Screw |

W10174840



Idle Gear, Camshaft, Distributor Drive Shaft and Fork Lever

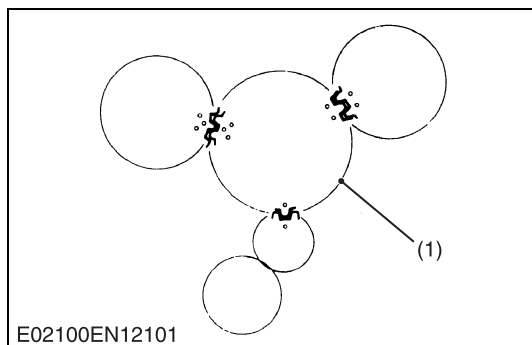
1. Remove the external snap ring (3).
2. Remove the idle collar 2 (2) and idle gear (1).
3. Remove the camshaft stopper mounting screws.
4. Remove the camshaft (4) with camgear (5).
5. Remove the fork lever mounting screws (6).
6. Remove the fork lever (7).
7. Remove the distributor drive shaft stopper (8).
8. Remove the distributor drive shaft (9).

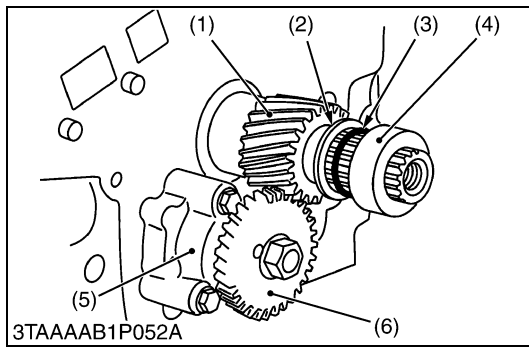
(When reassembling)

- Install the idle gear, aligning the marks on the gears referring the figure.

- | | |
|------------------------|-----------------------------|
| (1) Idle Gear | (7) Fork Lever |
| (2) Idle Collar 2 | (8) Stopper |
| (3) External Snap Ring | (9) Distributor Drive Shaft |
| (4) Camshaft | (10) Distributor Drive Gear |
| (5) Camgear | (11) Oil Pump |
| (6) Mounting Screw | (12) Oil Pump Drive Gear |

W1048876





Oil Pump and Crankshaft Gear

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

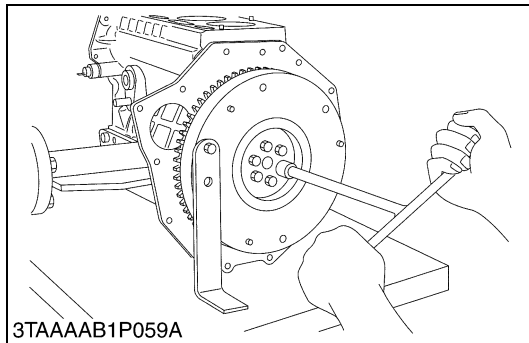
(When reassembling)

- Install the collar after aligning the marks on the gears. (See the figure at "Idle Gear and Camshaft".)

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

W10180290

(D) Crankshaft



Flywheel

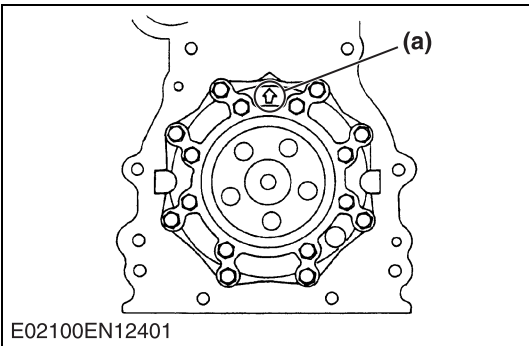
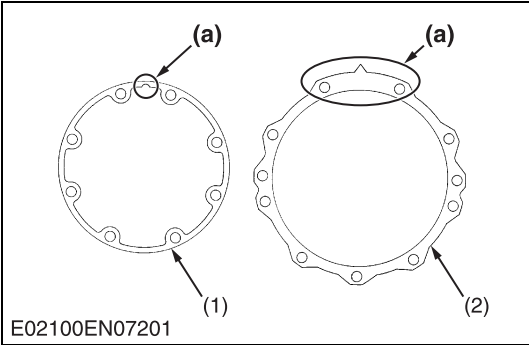
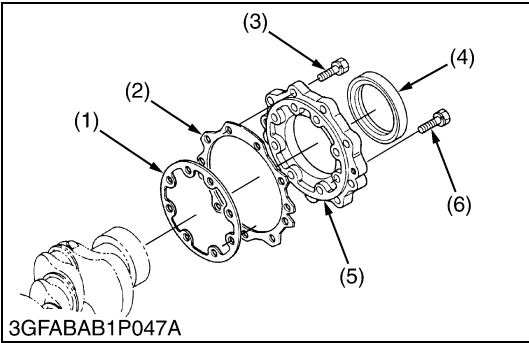
1. Fit the stopper to the flywheel.
2. At first, remove two pieces of the flywheel screws.
3. Insert two pieces of the flywheel guide screws in the holes.
4. Remove all flywheel screws.
5. Remove the flywheel slowly along the flywheel guide screws.

(When reassembling)

- Insert two pieces of the flywheel guide screws.
- Fit the flywheel giving care to the position of the knock pin.
- Apply engine oil to the threads and the undercut surface of the flywheel bolt and fit the bolt.

Tightening torque	Flywheel screw	53.9 to 58.8 N·m 5.5 to 6.0 kgf·m 39.8 to 43.4 ft-lbs
-------------------	----------------	---

W10290240



Bearing Case Cover

1. Remove the bearing case cover mounting screws. First, remove inside screws (6) and then outside screws (3).
2. Screw two removed screws into the screw hole of bearing case cover (5) to remove it.

■ **IMPORTANT**

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

(When reassembling)

- Fit the bearing case gasket (1) and the bearing case cover gasket (2) with correct directions.
- Install the bearing case cover to position the casting mark “↑” on it upward.
- Apply engine oil to the oil seal lip and take care that it is not rolled when installing.
- Tighten the bearing case cover mounting screws with even force on the diagonal line.

Tightening torque	Bearing case cover mounting screw	9.8 to 11.3 N·m 1.00 to 1.15 kgf·m 7.2 to 8.3 ft-lbs
-------------------	-----------------------------------	--

- (1) Bearing Case Gasket

(2) Bearing Case Cover Gasket

(3) Bearing Case Cover Mounting Screw

(4) Oil Seal

(5) Bearing Case Cover

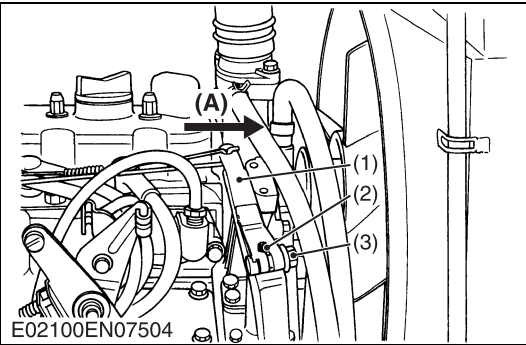
(6) Bearing Case Cover Mounting Screw
- (a) Upside

W10292140

[3] FUEL SYSTEM

(1) Checking and Adjusting

(A) Governor



Adjusting Governor

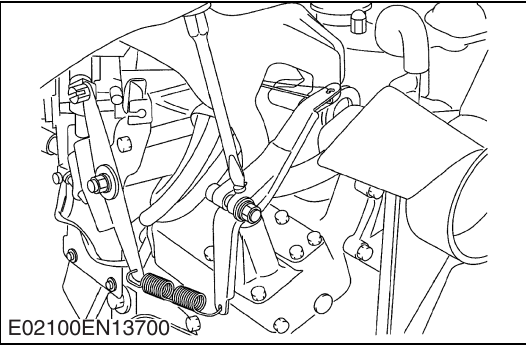
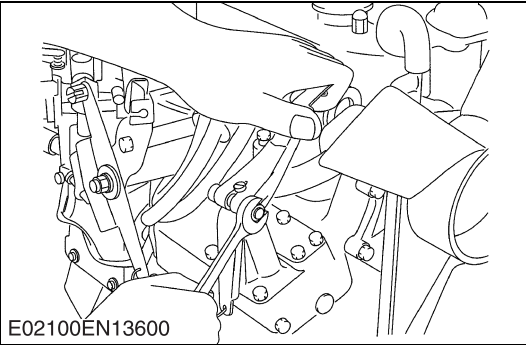
1. Loosen the governor lever nut (3).
2. Set the throttle valve to the fully “open” position (A) with the governor lever (1), turn the groove on the governor lever shaft (2) fully clockwise with a screwdriver (to open the governor completely), and then tighten the nut (3) in this position.

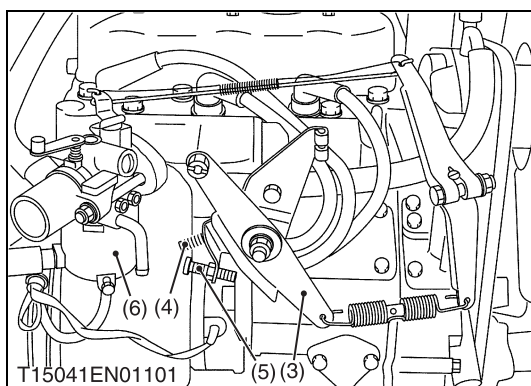
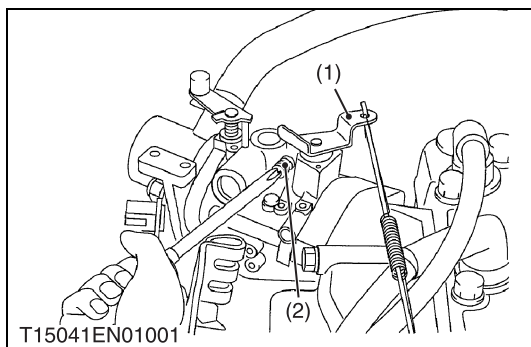
Tightening torque	Governor lever nut	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.2 ft-lbs
-------------------	--------------------	---

- (1) Governor Lever
(2) Governor Lever Shaft
(3) Governor Lever Nut

(A) Fully “Open” Position

W1076333





Adjusting Engine Speed

1. Warm up the engine at a medium speed for 10 to 15 minutes.
2. Engine speed is adjusted to approx. 1500 rpm by the speed control lever (3).
3. Throttle valve (1) is closed by hand and the rpm of the engine is adjusted with the throttle adjust screw (2) to 1200 rpm (1100 to 1300 rpm).
4. Adjust the low-idling speed adjust screw (4) until the engine rpm reaches 1500 rpm (1400 to 1600 rpm) with the speed control lever (3) in the minimum speed position.
5. Adjust the high-idling speed adjust screw (5) until the engine speed reaches 3250 rpm (3200 to 3250 rpm) with the speed control lever (3) in the maximum speed position.

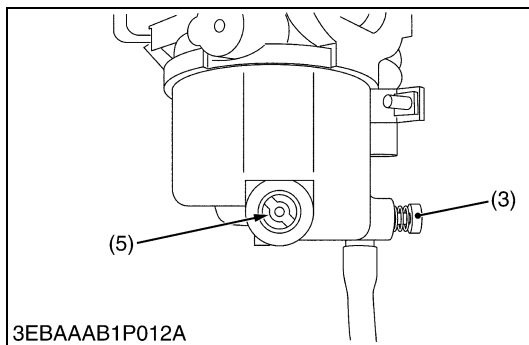
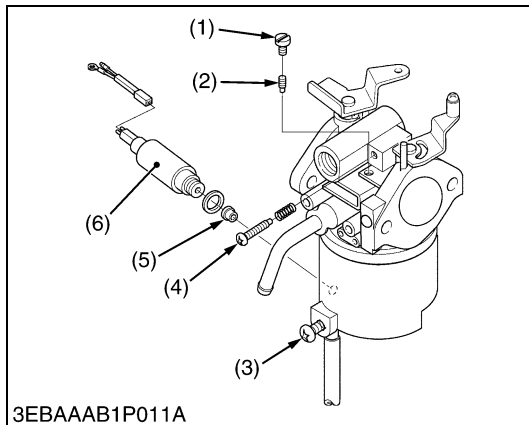
- (1) Throttle Valve
- (2) Throttle Adjust Screw
- (3) Speed Control Lever

- (4) Low-Idling Adjust Screw
- (5) High-Idling Adjust Screw
- (6) Carburetor

W1076471

(2) Carburetor

(A) Altitude Compensation Kit (Engine Serial No.: Above 1A0001)



Main Jet and Pilot Jet

1. Remove the carburetor.
2. Loosen the drain screw (3) to let fuel out.
3. Remove the gasoline solenoid (6).
4. Remove the main jet (5).
5. Install the high-altitude kit's main jet onto the carburetor.
6. Tighten the throttle adjust screw (4) and remove the screw (1).
7. Replace the existing pilot jet (2) with the high-altitude kit's pilot jet.
8. Install the gasoline solenoid (6).
9. Install the carburetor in place. (See page P1-S19.)
10. Readjust the governor. (See page P1-S27.)
11. Adjust the engine speed. (See page P1-S28.)

NOTE

- After install the carburetor, the adjustment of governor and engine speed are executed. (See page P1-S27, S28.)
- Prepare a screwdriver that fits the main jet / pilot jet screws in order not to damage the main jet and pilot jet.
- Replace the air cleaner packing and the carburetor packing with new ones.
- Make sure there is no leak at the air cleaner packing and the carburetor packing.

IMPORTANT

- Keep the carburetor inner parts which is removed from standard carburetor.

Tightening torque	Carburetor mounting nut	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.2 ft-lbs
	Gasoline solenoid	7.8 to 11.7 N·m 0.8 to 1.2 kgf·m 5.8 to 8.7 ft-lbs
	Main jet	1.0 to 2.9 N·m 0.1 to 0.29 kgf·m 5.0 to 15.2 ft-lbs
	Pilot jet	1.0 to 3.9 N·m 0.1 to 0.40 kgf·m 5.0 to 20.5 ft-lbs

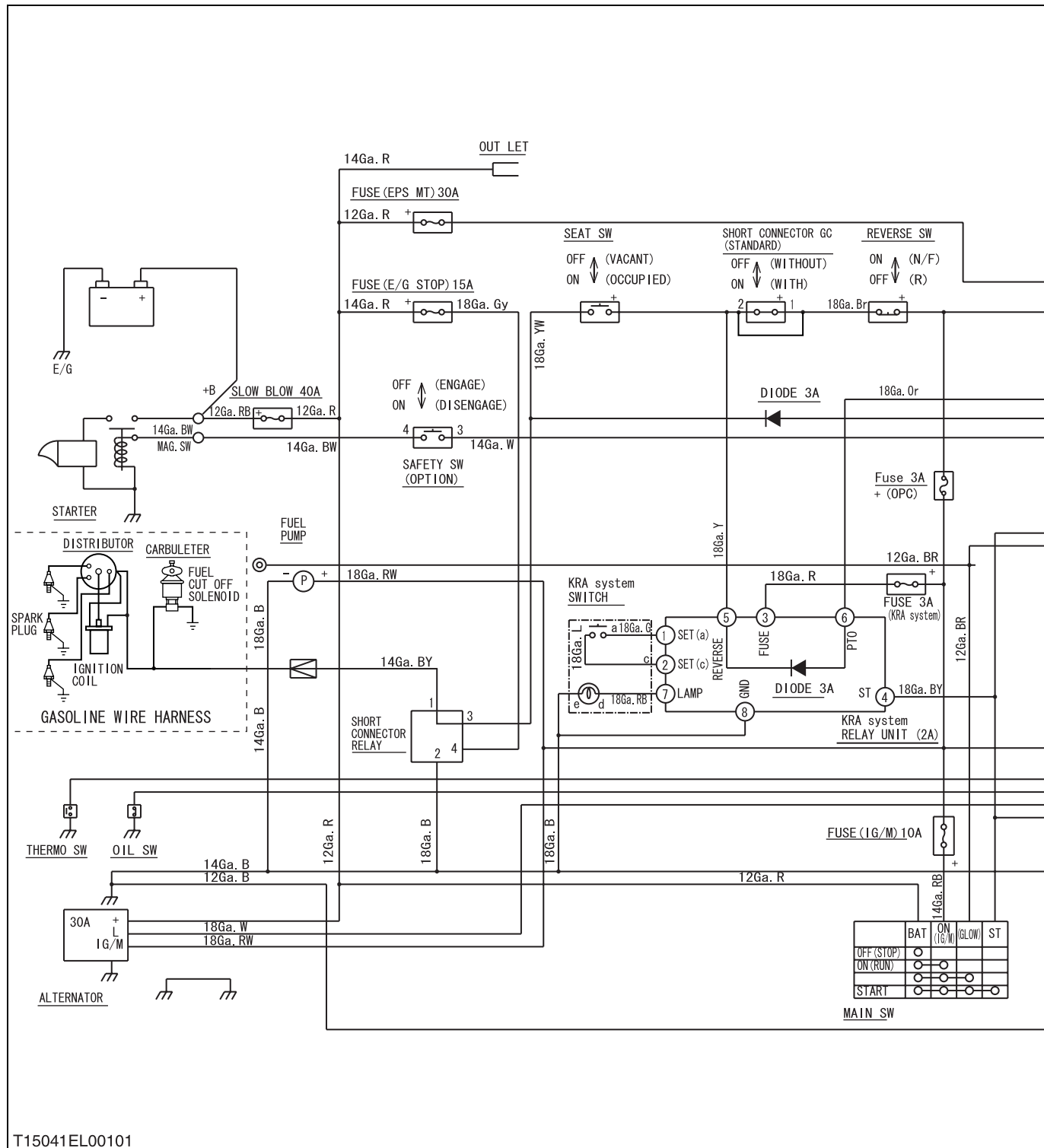
- (1) Pilot Screw
(2) Pilot Jet
(3) Drain Screw

- (4) Throttle Adjust Screw
(5) Main Jet
(6) Gasoline Solenoid

W1018491

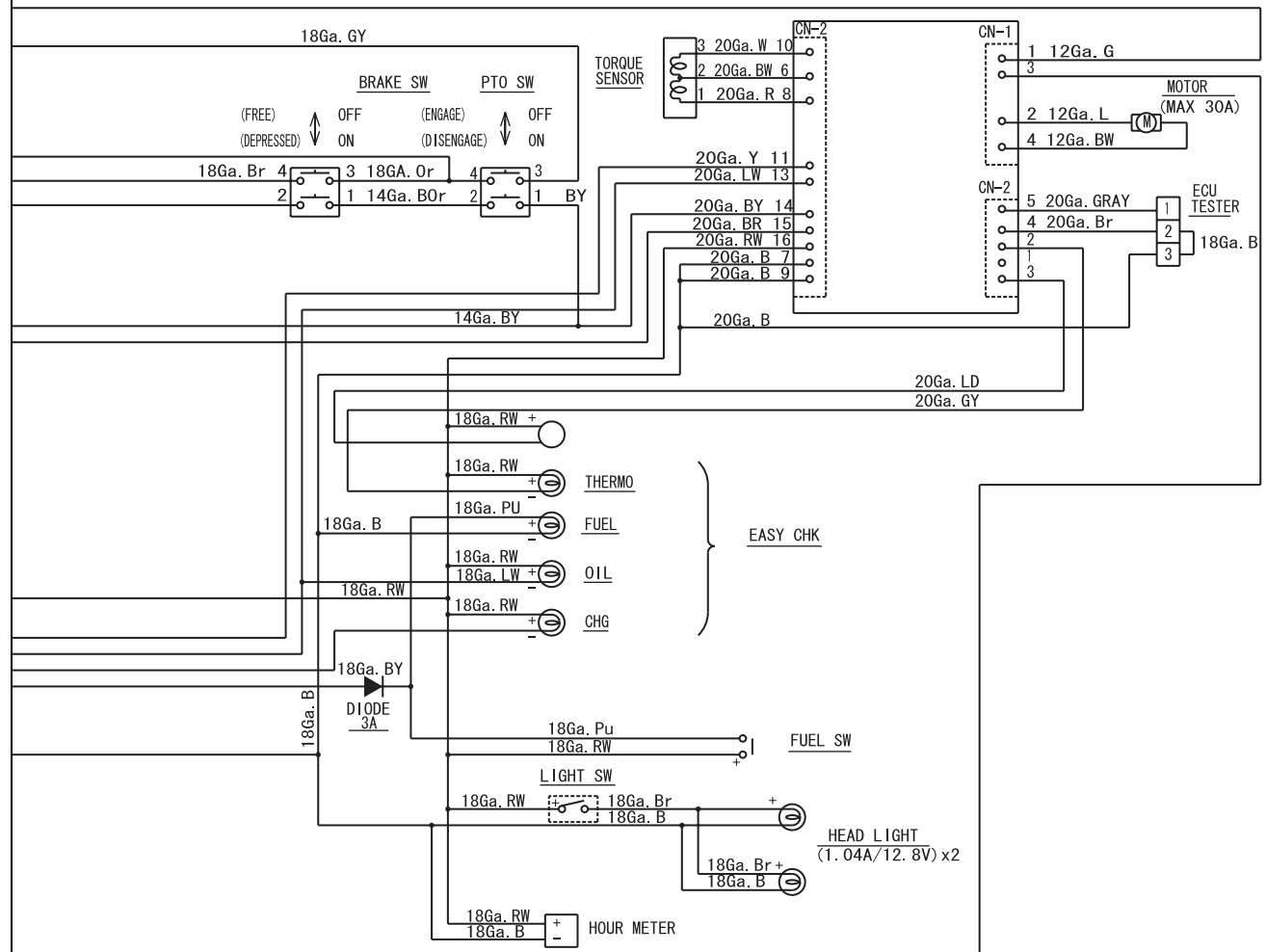
1. WIRING DIAGRAM AND ELECTRICAL CIRCUIT

[1] WIRING DIAGRAM



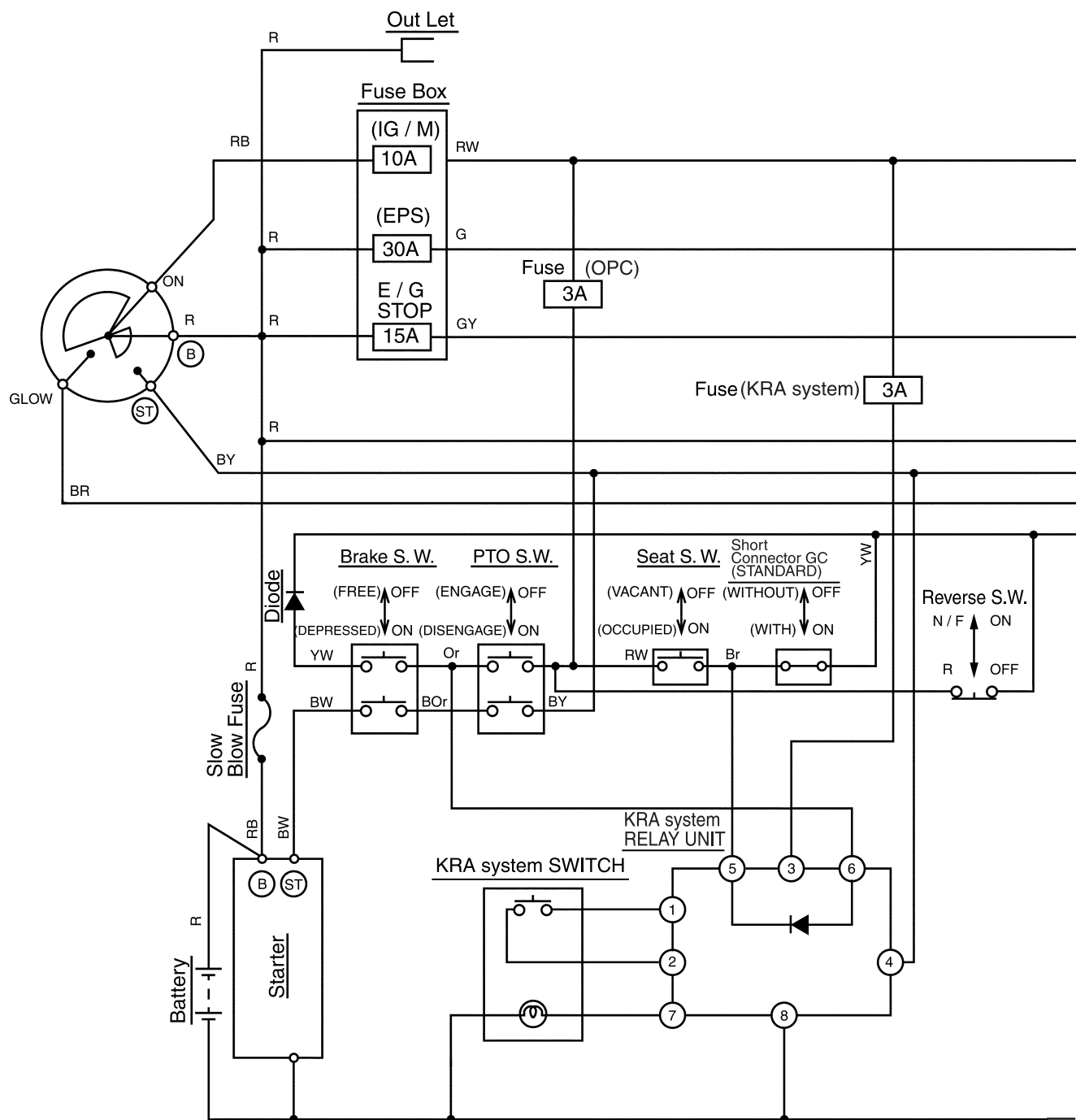
• Color of Wiring

B ----- Black	Br ----- Brown	L ----- Blue	Pi ----- Pink	RW ----- Red / White
BOr ----- Black / Orange	G ----- Green	LD ----- Blue Dk	Pu ----- Purple	W ----- White
BR ----- Black / Red	GY ----- Green / Yellow	LW ----- Blue / White	R ----- Red	Y ----- Yellow
BW ----- Black / White	GW ----- Green / White	Or ----- Orange	RB ----- Red / Black	YW ----- Yellow / White
BY ----- Black / Yellow	Gy ----- Gray			



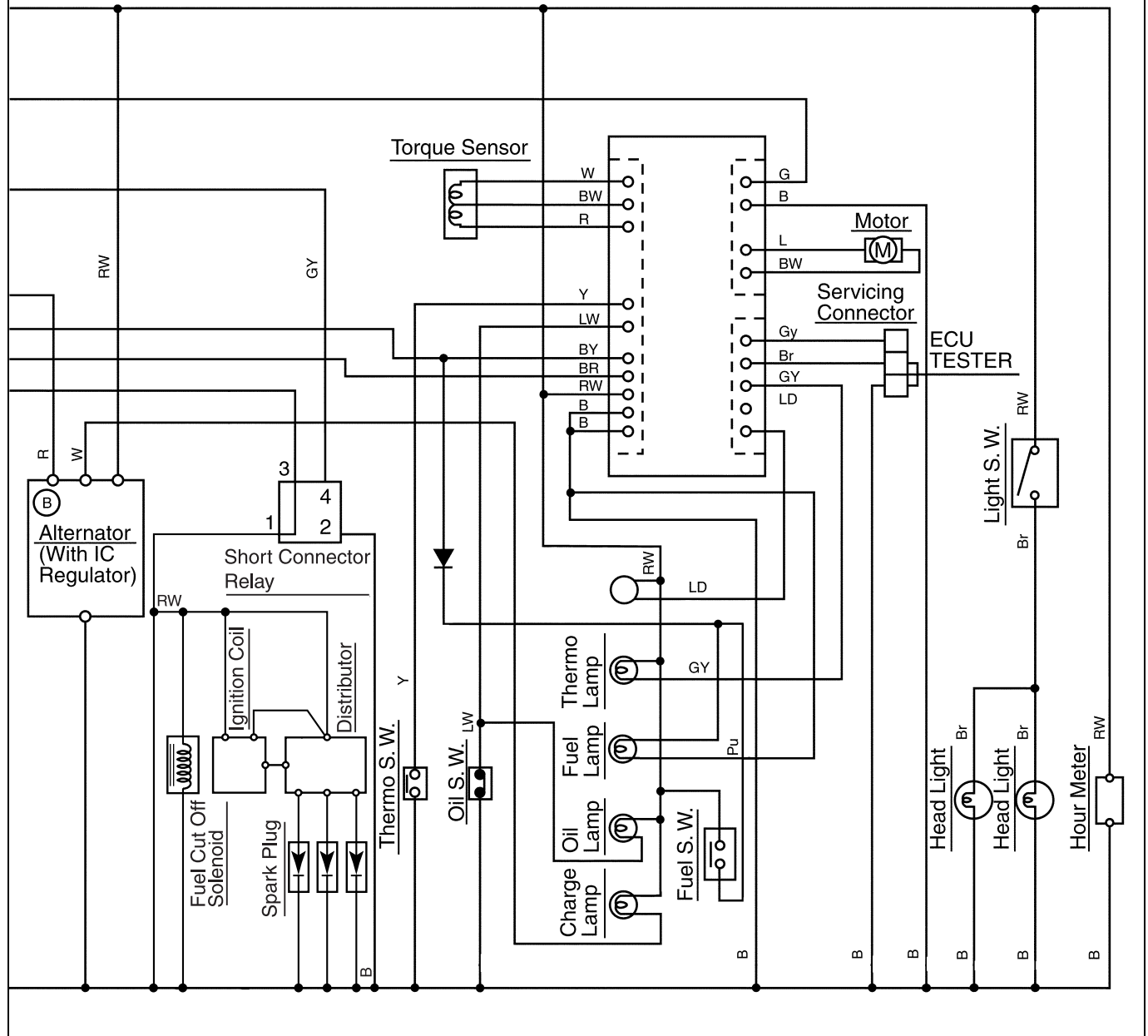
- Color of Wiring

Color of Wiring				
B ----- Black	Br ----- Brown	L ----- Blue	Pi ----- Pink	RW ----- Red / White
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BR ----- Black / Red	GY ----- Green / Yellow	LW ----- Blue / White	R ----- Red	Y ----- Yellow
BW ----- Black / White	GW ----- Green / White	Or ----- Orange	RB ----- Red / Black	YW ----- Yellow / White
BY ----- Black /Yellow	Gy ----- Gray			



• Main Switch

Terminal Key Position	BAT	ON (IG / M)	(GLOW)	ST
OFF(STOP)	●			
ON(RUN)	●	●		
	●	●	●	
START	●	●	●	●



1. SERVICING SPECIFICATIONS

SPARK PLUG

Item	Factory Specification	Allowable Limit
Spark Plug Gap	1.0 to 1.1 mm 0.039 to 0.043 in.	—

W1027540

IGNITION COIL

Primary Coil Resistance	1.3 to 1.6 Ω	—
Secondary Coil Resistance	10.7 to 14.5 k Ω	—
Power Source Line Voltage	Approx. 12 V	—

W1027594

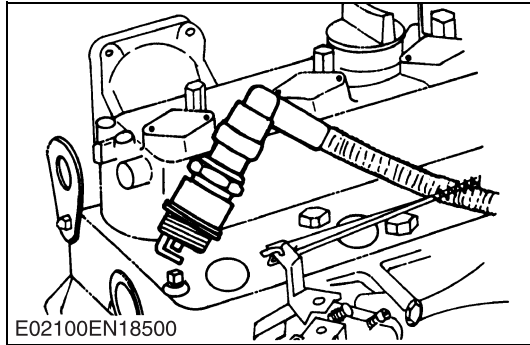
DISTRIBUTOR

Air Gap		0.2 to 0.4 mm 0.008 to 0.016 in.	—
High Tension Cord #1 Resistance	Engine serial No.: below YY8644	2.47 to 4.21 k Ω	—
	Engine serial No.: above 1A0001	2.81 to 4.79 k Ω	—
High Tension Cord #2 Resistance	Engine serial No.: below YY8644	2.98 to 5.08 k Ω	—
	Engine serial No.: above 1A0001	3.40 to 5.80 k Ω	—
High Tension Cord #3 Resistance	Engine serial No.: below YY8644	3.57 to 6.09 k Ω	—
	Engine serial No.: above 1A0001	3.06 to 5.22 k Ω	—
Center Cord Resistance		3.06 to 5.22 k Ω	—
Ignition Timing		0.35 rad. (18 °) B.T.D.C.	—

W1015878

2. CHECKING AND SERVICING

[1] SPARK PLUG AND IGNITION COIL CHECKING



Spark Test

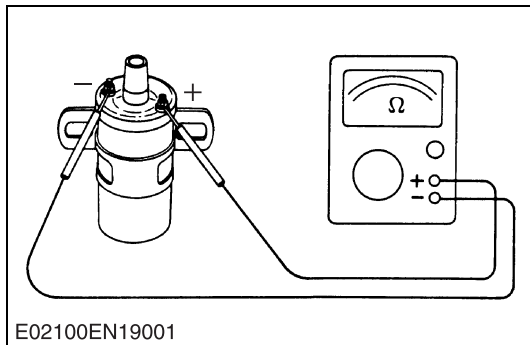
1. Remove the spark plug, put it inside the high voltage cord cap firmly, and then ground the threaded section to the engine body (not to painted or resin parts).
2. Rotate the starter with the key switch and check that the plug sparks.



CAUTION

- This test is hazardous of electric shocks. Never use hand or screwdriver to press the plug to ground it to the engine body.
- Keep inflammables away from the engine.

W1088291

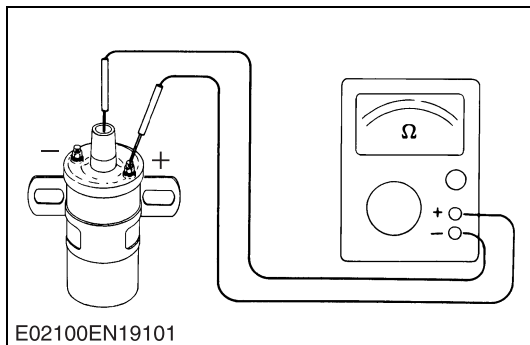


Inspect Primary Coil Resistance

1. Disconnect high-tension cord.
2. Disconnect distributor wire connector.
3. Using an ohmmeter, measure the resistance between the positive (+) and negative (-) terminals.

Resistance	Factory spec.	1.3 to 1.6 Ω
------------	---------------	---------------------

W1088375

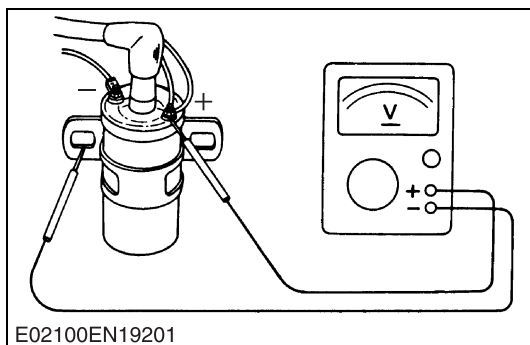


Inspect Secondary Coil Resistance

1. Using an ohmmeter, measure the resistance between the positive (+) terminal and high-tension terminal.

Resistance	Factory spec.	10.7 to 14.5 Ω
------------	---------------	-----------------------

W1088478



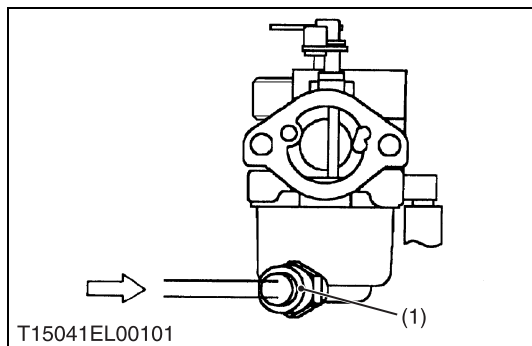
Check Power Source Line

1. With the key switch at **ON** and using a voltmeter, connect the positive (+) probe to the ignition coil (+) terminal and the negative (-) probe to the body ground.
2. If a problem is found, check the ignition switch and wire harness.

Voltage	Factory spec.	Approx. 12 V
---------	---------------	--------------

W1088558

[2] SOLENOID CHECKING



Fuel Cut Off Solenoid

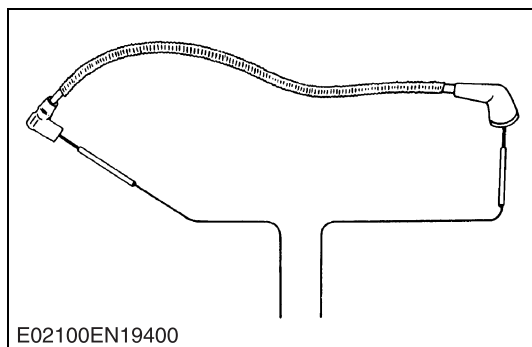
1. Disconnect the connector.
2. Measure the resistance with an ohmmeter between the connector terminals.
3. If the factory specification is not indicated the solenoid is faulty.

Resistance	Factory spec.	Approx. 38 Ω
------------	---------------	---------------------

(1) Gasoline Stop Solenoid

W1088666

[3] HIGH TENSION CORD CHECKING

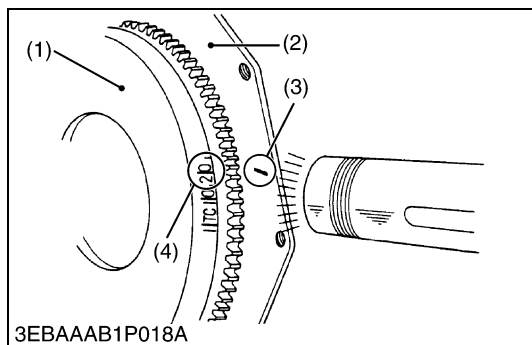


High Tension Cord

1. Using an ohmmeter, check that the resistance does not exceed the maximum.
2. If more than maximum, check the terminals, and replace the high-tension cord and / or distributor cap as required.

Resistance	High tension cord #1	Engine serial No.: below YY8644	2.47 to 4.21 k Ω
		Engine serial No.: above 1A0001	2.81 to 4.79 k Ω
	High tension cord #2	Engine serial No.: below YY8644	2.98 to 5.08 k Ω
		Engine serial No.: above 1A0001	3.40 to 5.80 k Ω
	High tension cord #3	Engine serial No.: below YY8644	3.15 to 5.37 k Ω
		Engine serial No.: above 1A0001	3.57 to 6.09 k Ω
	Center cord		3.06 to 5.22 k Ω

W1088824



Ignition Timing

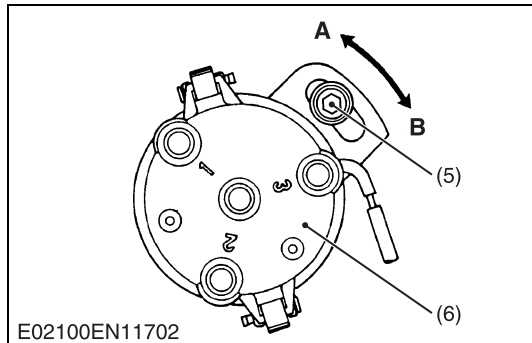
1. Using a timing light, check that the ignition timing (stamps on the flywheel) (5) is aligned with the mark (3) on the rear end plate (2).
2. If the timing is wrong, loosen the distributor mounting screw (6) and turn the distributor (7) so that the ignition timing (stamps on the flywheel) is aligned with the mark on the rear end plate. (See page P1-S22.)

Ignition timing	Factory spec.	0.32 rad. (18 °) before T.D.C.
-----------------	---------------	--------------------------------

- (1) Flywheel
- (2) Rear End Plate
- (3) Mark
- (4) Ignition Timing
- (5) Distributor Mounting Screw
- (6) Distributor

(A) To retard
(B) To advance

W1090028



Q G2160-R48S (Supplement)

Use this workshop manual together with Workshop Manual
for G2160 issued already.

CONTENTS

SAFETY INSTRUCTIONS.....	Q1
SPECIFICATIONS	Q6
DIMENSIONS	Q8
1. GENERAL	QG-1
[1] FEATURES	QG-1
[2] IDENTIFICATION.....	QG-2
[3] LUBRICANTS, FUEL AND COOLANT	QG-3
[4] MAINTENANCE CHECK LIST	QG-4
[5] CHECK AND MAINTENANCE	QG-5
2. TRANSMISSION AND REAR AXLE	Q2-M1
[1] MECHANISM	Q2-M1
[2] SERVICING.....	Q2-S1
6. HYDRAULIC SYSTEM.....	Q6-M1
[1] MECHANISM	Q6-M1
[2] SERVICING.....	Q6-S1
7. PTO SYSTEM	Q7-S1
[2] SERVICING.....	Q7-S1
8. ELECTRICAL SYSTEM.....	Q8-M1
[1] MECHANISM	Q8-M1
[2] SERVICING.....	Q8-S1
9. MOWER	Q9-S1
[2] SERVICING.....	Q9-S1

TO THE READER

This Workshop Manual has been prepared to provide servicing personnel with information on the mechanism, service and maintenance of KUBOTA G2160-R48S. It is divided into two parts, "Mechanism" and "Servicing" for each section except "ENGINE" section.

■ Mechanism

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

■ Servicing

The heading "General" includes general precautions, check and maintenance and special tools. Other section, there are troubleshooting, servicing specification lists, checking and adjusting, disassembling and assembling, and servicing which cover procedures, precautions, factory specifications and allowable limits.

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

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

March 2001

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SAFETY DECALS

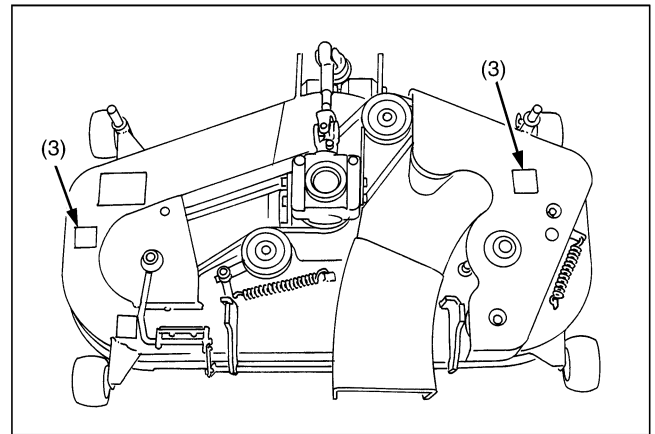
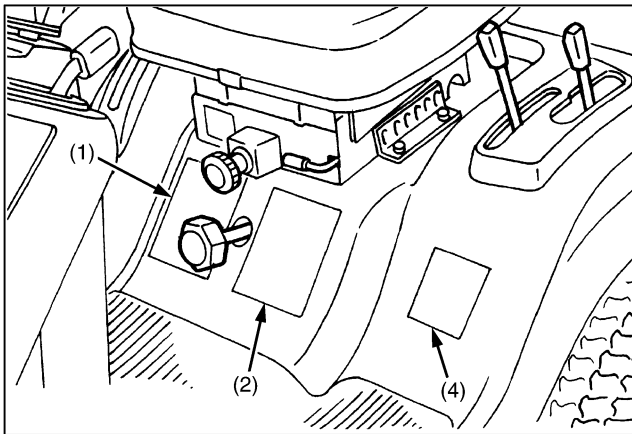
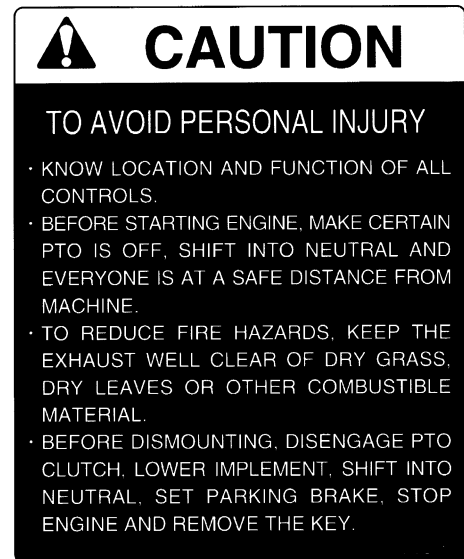
- The following safety decals are installed on the machine.

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

(1) Part No. K1211-6581-1



(2) Part No. K1211-6582-1



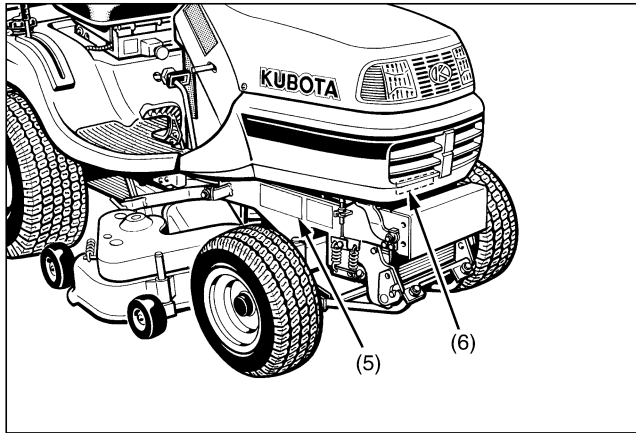
(3) Part No. K5112-7312-2



(4) Part No. K1122-6584-2



3GGAAACCP010A



(5) Part No. K1122-6583-1



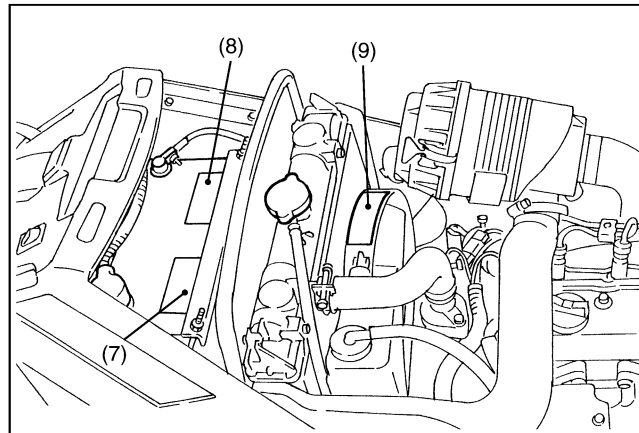
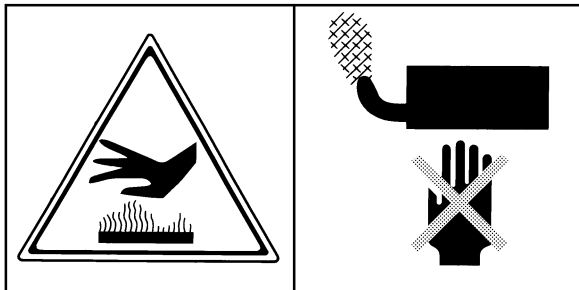
⚠ WARNING

TO AVOID POSSIBLE INJURY OR DEATH FROM A MACHINE RUNAWAY.

1. Do not start engine by shorting across starter terminals or bypassing the safety start switch. Machine may start in gear and move if normal starting circuitry is bypassed.
2. Start engine only from operator's seat with transmission and PTO OFF. Never start engine while standing on the ground.

(6) Part No. K2561-6542-1

Do not touch hot surface like muffler, etc.



(7) Part No. K1211-6115-1



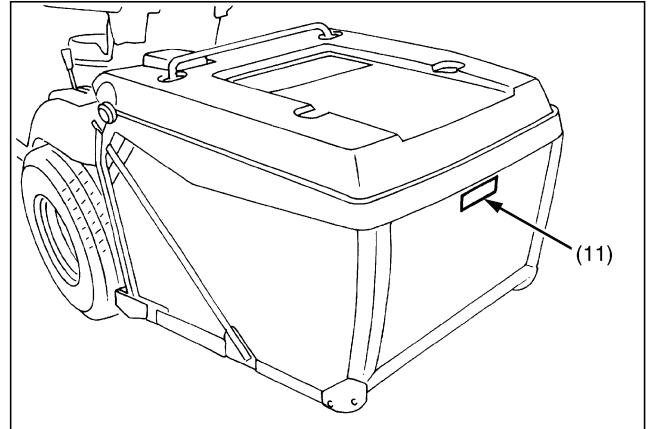
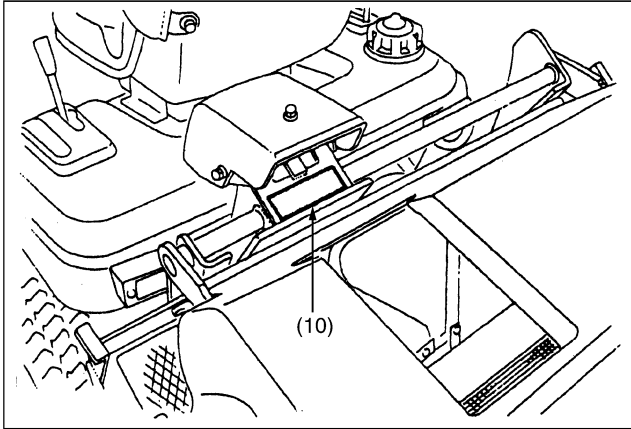
(8) Part No. K1211-6116-1



(9) Part No. K1213-6586-1

Stay clear of engine fan and fan belt





(10) Part No. K6071-6513-1

WARNING

TO AVOID PERSONAL INJURY

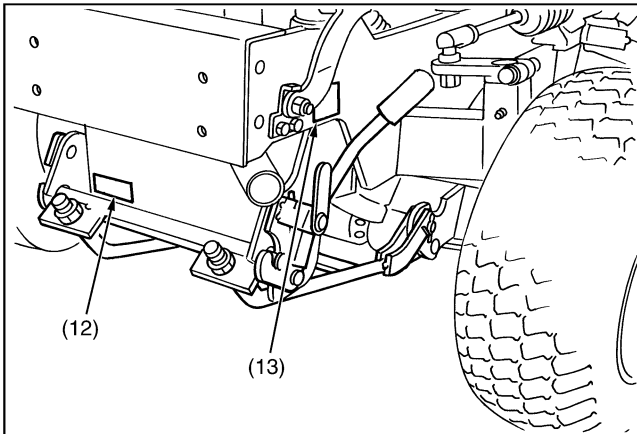
Do not operate mower without all grass catcher components properly installed.

(11) Part No. K6071-6512-1

CAUTION

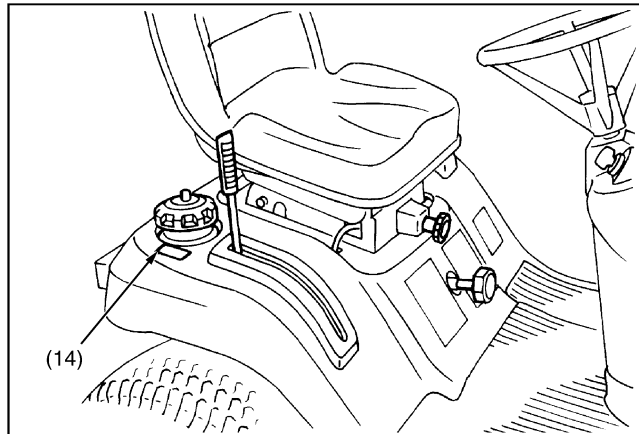
- BAG IS SUBJECT TO WEAR AND DETERIORATION. CHECK FREQUENTLY. REPLACE WHEN NECESSARY.
- USE ONLY BAG SUPPLIED BY KUBOTA.

3GGAAACCP012A



(12) Part No. K1213-6532-1

Do not touch hot surface like muffler, etc.



(13) Part No. K2110-6574-1



(14) Part No. K1211-6585-1

Diesel fuel
only

No fire

**CARE OF DANGER, WARNING AND CAUTION LABELS**

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

3GGAAACCP013A

SPECIFICATIONS

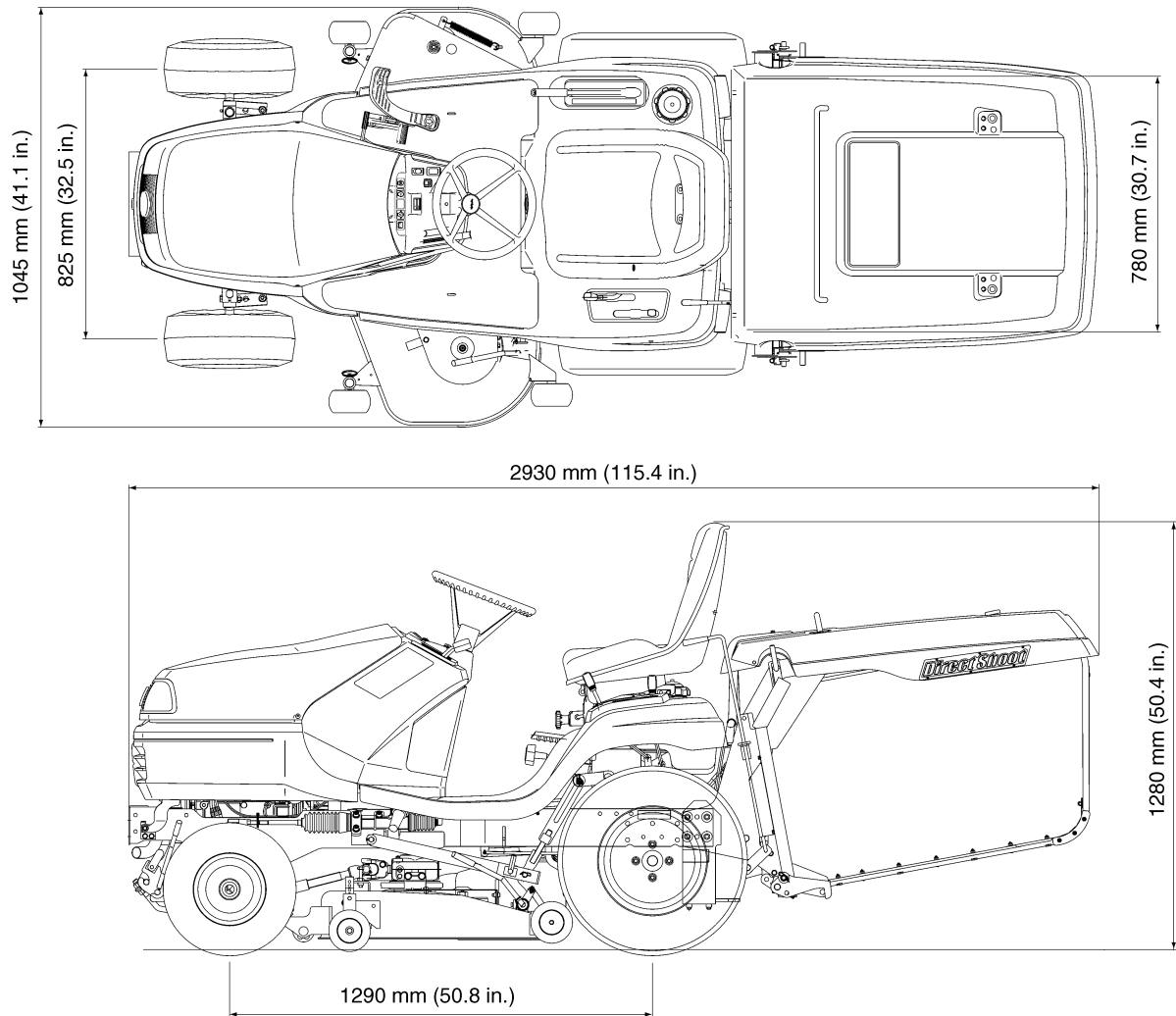
Model			G2160-R48S
Maximum gross power			15.6 kW (21 HP)
Engine	Model		D782-E-G21
	Type		Indirect injection, vertical, water cooled, 4-cycle diesel engine
	Number of cylinders		3
	Bore and stroke		67.0 × 73.6 mm (2.64 × 2.90 in.)
	Total displacement		778 cm ³ (47.48 cu.in.)
	Rated revolution		3000 rpm
	Combustion chamber		Spherical type (E-TVCS)
	Fuel injection pump		Bosch MD type mini pump
	Governor		Centrifugal ball mechanical governor
	Injection nozzle		Bosch throttle type
	Injection timing		0.33 to 0.37 rad. (19° to 21°) before T.D.C.
	Injection order		1-2-3
	Injection pressure		13.73 MPa (140 kgf/cm ² , 1990 psi)
	Compression ratio		23 : 1
	Lubricating system		Forced lubrication by gear pump
	Cooling system		Pressurized radiator, forced circulation with water pump
	Lubricating oil		API Service classification CC or CD, Below 0°C (32 °F) : SAE 10W or 10W-30, 0 to 25 °C (32 °F to 77 °F) : SAE 20 or 10W-30, Above 25 °C (77 °F) : SAE 30 or 10W-30
	Starting system		Electric starter (12 V, 1.0 kW)
	Battery		51R (12 V, 450CCA)
	Fuel		No.2-D Diesel fuel (ASTM D975) [No.1-D diesel fuel, if temperature is below –10 °C (14 °F)]
Capacities	Fuel tank		22 L (5.8 U.S.gals., 4.8 Imp.gals.)
	Engine crankcase		2.8 L (2.95 U.S.qts., 2.4 Imp.qts.)
	Engine coolant		2.1 L (2.2 U.S.qts., 1.8 Imp.qts.)
	Recovery tank		0.25 L (0.26 U.S.qts., 0.22 Imp.qts.)
	Transmission (Including HST and cylinder)		4.5 L (4.75 U.S.qts., 3.86 Imp.qts.)
	Mower gear case oil		0.40 L (0.42 U.S.qts., 0.35 Imp.qts.)
Tires	Front		16 × 6.50-8 (4PR) Turf
	Rear		23 × 10.5-12 (4PR) Turf
Travelling speeds	Forward		0 to 15.0 km/h (0 to 9.3 mph)
	Reverse		0 to 6.0 km/h (0 to 3.8 mph)
Dimensions	Overall length (With grass collector)		2930 mm (115.4 in.)
	Overall width (With mower)		1045 mm (41.1 in.)
	Overall height		1280 mm (50.4 in.)
	Wheel base		1290 mm (50.8 in.)
	Treads	Front	825 mm (32.5 in.)
		Rear	780 mm (30.7 in.)
Weight (Without mower deck and grass collector)			390 kg (860 lbs)
PTO			Belt drive
PTO clutch			Belt tension
Revolution (PTO speed)			2576 rpm
PTO brake			Available

Model		G2160-R48S
Steering		Electric power steering (EPS)
Transmission		Hydrostatic transmission
Brake		Internal expanding brake
Mower	Model	RCK48R-21G
	Total length	938 mm (36.9 in.)
	Total width	1690 mm (66.5 in.)
	Total height	255 mm (10.0 in.)
	Mounting method	Quick joint, parallel linkage
	Adjustment of cutting height	Dial gauge
	Cutting width	1219 mm (48 in.)
	Cutting height	25 to 102 mm (1.0 to 4.0 in.)
	Number of blades	3
	Weight (Approx.)	95 kg (209 lbs)
	Discharge	Rear side
Grass collector	Model	GCK500
	Hopper capacity	500 L (14.2 bu.)
	Weight (Approx.)	30 kg (66.1 lbs)

The company reserves the right to change the specifications without notice.

W1030228

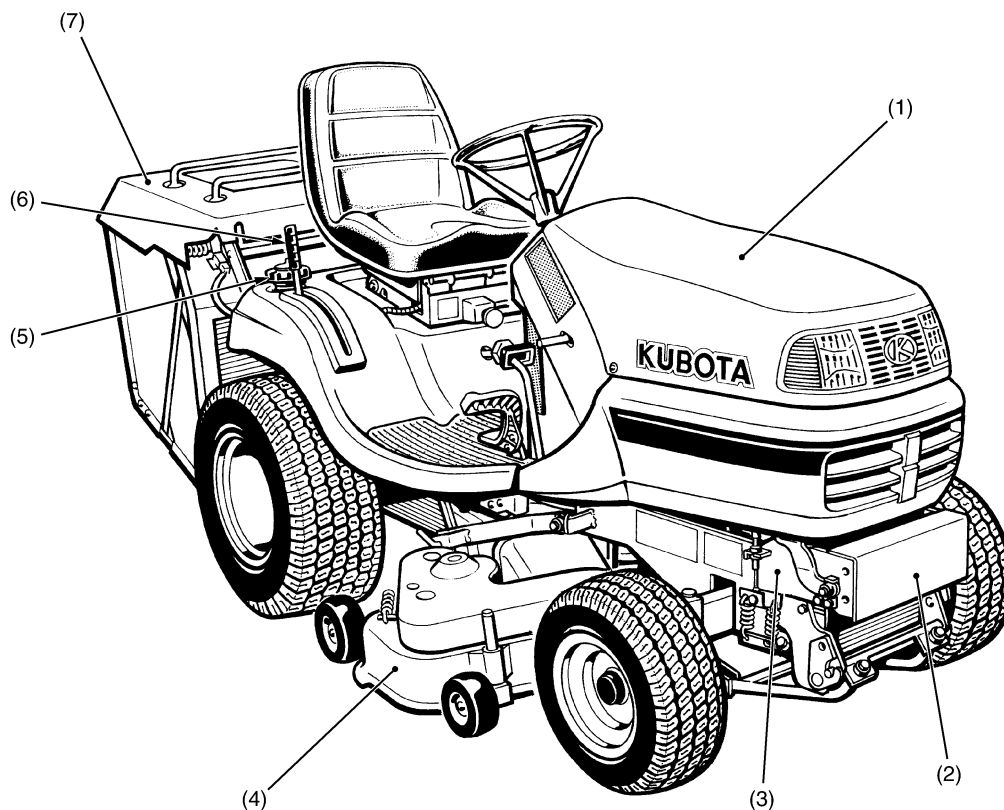
DIMENSIONS



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1. GENERAL

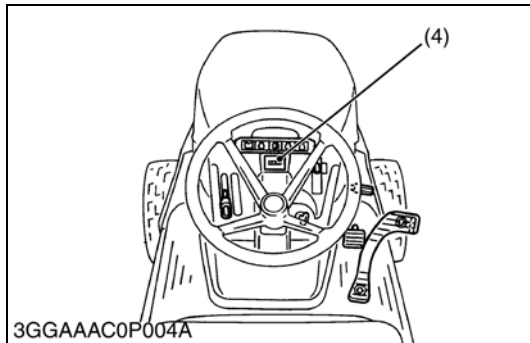
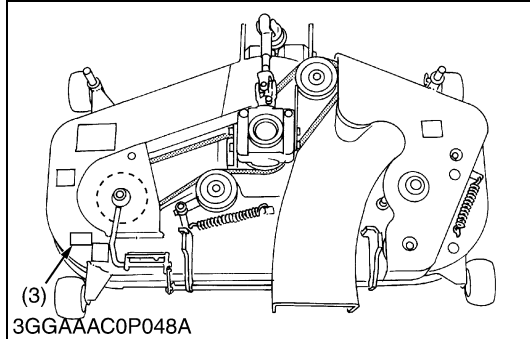
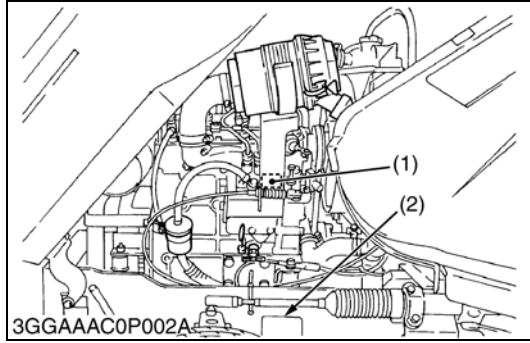
[1] FEATURES



3GGAAAC0P047A

1. E-TVCS engine
2. Front PTO (option)
3. Rugged ladder type chassis
4. Low-noise, high-performance mower
5. Large-capacity fuel tank
6. Hydraulic mower lift
7. Large-capacity grass collector bag

[2] IDENTIFICATION



When contacting your local KUBOTA distributor, always specify engine serial number (1), machine serial number (2), mower serial number (3) and hour meter reading.

- | | |
|---------------------------|-------------------------|
| (1) Engine Serial Number | (3) Mower Serial Number |
| (2) Machine Serial Number | (4) Hour Meter |

W1010715

[3] LUBRICANTS, FUEL AND COOLANT

	Place		Capacity	Lubricants
			G2160-R48S	
1	Fuel		22 L 5.8 U.S.gals. 4.8 Imp.gals.	[ASTM D975] No. 2-D diesel fuel No. 1-D diesel fuel if temperature is below −10 °C (14 °F)
2	Coolant	Cooling system	2.1 L 2.2 U.S.qts. 1.8 Imp.qts.	Fresh clean water (soft water) with anti-freeze
		Recovery tank	0.25 L 0.26 U.S.qts. 0.22 Imp.qts.	
3	Engine crankcase		2.8 L 2.95 U.S.qts. 2.4 Imp.qts.	Engine oil : MIL-L-46152, MIL-L-2104C, API Service Classification CC or CD Below 0 °C (32 °F) : SAE10W or 10W-30 0 to 25 °C (32 to 77 °F): SAE20 or 10W-30 Above 25 °C (77 °F): SAE30 or 10W-30
4	Transmission (Including HST & cylinder)		4.5 L 4.75 U.S.qts. 3.86 Imp.qts.	KUBOTA UDT or SUPER UDT fluid
5	Mower gear case		0.40 L 0.42 U.S.qts. 0.35 Imp.qts.	SAE #90 gear oil
6	King pin		Until grease overflows	SAE multi-purpose type grease
	Center pin			
	Universal joint			
	Side blade shaft			
	Center blade shaft			
	Mower tension arm			
	Tension lever			
7	Link fulcrum		Moderate amount	Oil or spray type grease
	PTO lever (fulcrum)			
	Front PTO cable			
	Grass collector cable			
	Brake pedal shaft			
	Seat adjuster			
	Grass collector linkages			
	Speed control pedal shaft			
	Throttle cable			
	Mower universal joint			
	Duct rod link			
	Front link			
	Mower link			

[4] MAINTENANCE CHECK LIST

No.	Period Item		Every 50 Hr	Hour meter reading									Reference page
				50	100	150	200	300	400	450	500	After	
1	Tires	Check	☆									Every 50Hr	G-19
2	Battery condition	Check			☆		☆	☆	☆		☆	Every 100Hr	G-24
3	Engine oil	Change		★	☆		☆	☆	☆		☆	Every 100Hr	G-17
4	Engine oil filter cartridge	Change		★			☆		☆			Every 200Hr	G-18
5	Transmission fluid	Change					☆				☆	Every 300Hr	G-26
6	Transmission oil filter cartridge	Replace		★			☆				☆	Every 300Hr	G-18
7	Transmission oil strainer	Clean					☆				☆	Every 300Hr	G-27
8	Hydraulic hose	Check					☆		☆			Every 200Hr	G-26
		Replace										Every 2 Years*	G-30
9	Fuel lines	Check			☆		☆	☆	☆		☆	Every 100Hr	G-23
		Replace ¹										Every 2 Years*	G-30
10	Fuel filter	Check			☆		☆	☆	☆		☆	Every 100Hr	G-23
		Replace ¹									☆	Every 500Hr	G-27
11	Radiator hose and clamp	Check					☆		☆			Every 200Hr	G-25
		Replace ¹										Every 2 Years*	G-30
12	Radiator core	Clean			☆		☆	☆	☆		☆	Every 100Hr**	G-23
13	Cooling system	Clean										Every 1 Year	G-28
14	Coolant	Change										Every 1 Year	G-28
15	Air cleaner element	Clean	☆**										G-21
		Replace										Every 1 Year**	G-28
16	Fan belt tension	Adjust	☆										G-20
17	Front PTO belt tension	Adjust	☆***										G-22
18	Brake play	Adjust ¹	☆										G-19
19	Greasing	—	☆										G-20
20	Hopper net	Check	☆***										QG-6
		Replace										Every 1 Year*	QG-9
21	Mower gear box oil	Change		★		☆		☆		☆		Every 150Hr	G-18
22	Mower gear box oil seal	Replace										Every 2 Years*	G-31

■ IMPORTANT

★ : The maintenance indicated by ★ must be done initially.

* : Replace only if necessary.

** : This maintenance should be done more often in dusty conditions than in normal conditions.

*** : This check should be done daily.

**** : Initial elongation of the front PTO belt may occur prior to 25 hours. Adjust the tension spring length as needed to maintain belt tension.

¹ : These items should be serviced by an authorized KUBOTA Dealer, unless the owner has the proper tools and is mechanically proficient.

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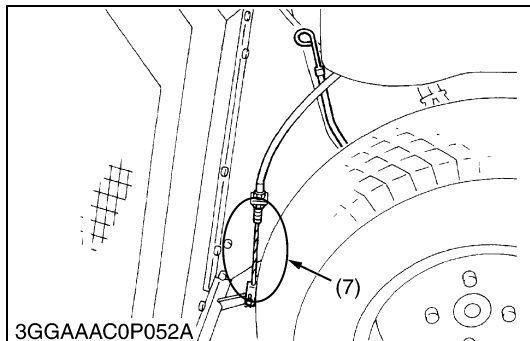
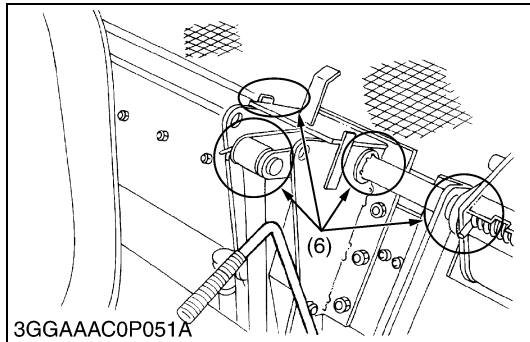
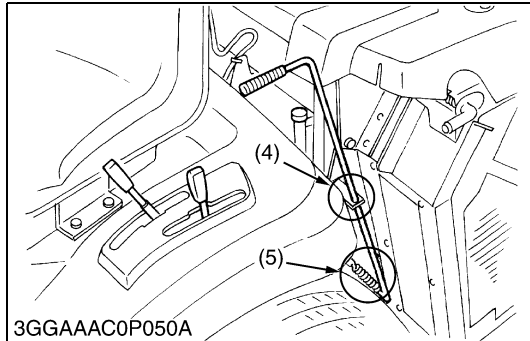
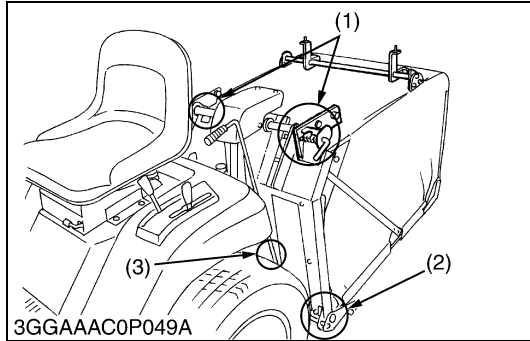
[5] CHECK AND MAINTENANCE



CAUTION

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

(1) Daily Check



Oiling

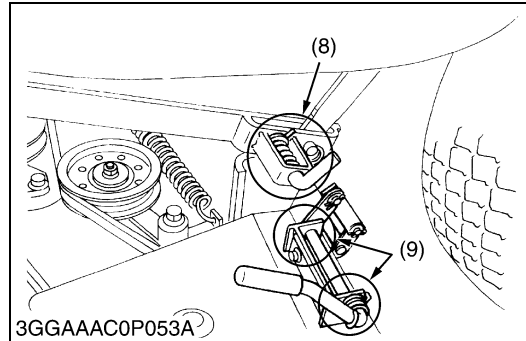


CAUTION

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

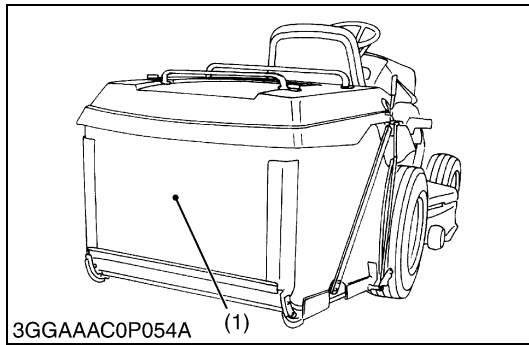
NOTE

- Oil these points on both sides of the machine.
1. Oil the following points before starting.



- | | |
|-------------------|---|
| (1) L Pin | (6) Grass Collector Linkages |
| (2) Latch | (7) Grass Collector Cable |
| (3) Linkage | (8) Around the Pin |
| (4) Guide Hole | (9) Around the Hole of the Launching Plate Link |
| (5) Duct Rod Link | |

W1013174



Checking Grass Hopper Net

⚠ CAUTION

- Be sure to stop engine before checking the grass hopper net condition.
- The grass hopper net material is subject to deterioration and wear. Check it frequently. Use only genuine replacement net from KUBOTA.
- Make sure all shields and guards are securely in place following all service, cleaning, or repair work.

1. The grass hopper net (1) is made of cloth and plastic.
2. Check grass hopper net (1) for deterioration, wear and damage.
3. After inspection, if the grass hopper net (1) is found worn or deteriorated, replace it as shown below.
4. If the grass hopper net (1) is unusually dirty or grass stained, it should be washed with a mild detergent and hung up to dry.

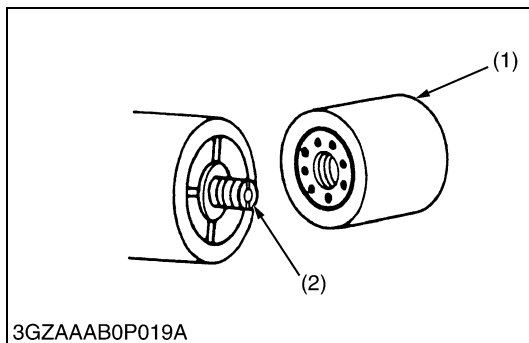
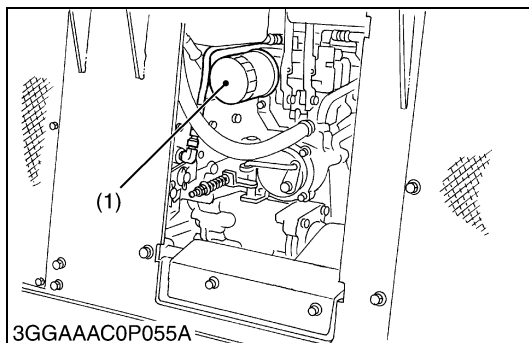
■ NOTE

- Do not attempt to dry the hopper net in clothes dryer!

(1) Grass Hopper Net

W1020458

(2) Check Points of Initial 50 Hours



Replacing Transmission Oil Filter

⚠ CAUTION

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

1. The transmission oil filter cartridge (1) must be changed every 300 service hours.
2. Remove the transmission oil filter cartridge (1) with the filter wrench.
3. Lightly tighten the screw (2) by using a screwdriver.
4. Apply a slight coat of oil onto the cartridge gasket.
5. To install the new cartridge, screw it in by hand. Over tightening may cause deformation of rubber gasket.
6. After the new cartridge has been replaced, the transmission fluid level normally lowers a little. Add fluid to proper level. Check for oil leaks around filter gasket.

■ IMPORTANT

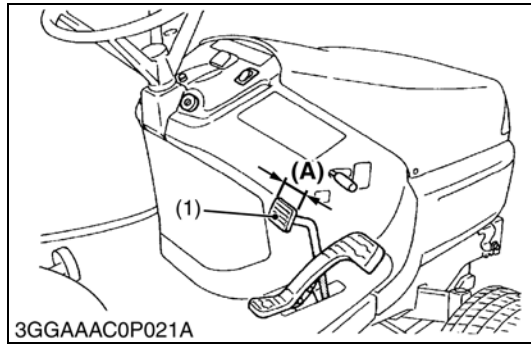
- To prevent serious damage to hydraulic system, the replacement filter must be a highly efficient, 10 μ m filter. Use only a genuine KUBOTA filter or its equivalent.

(1) Transmission Oil Filter Cartridge

(2) Screw

W1013443

(3) Check Points of Every 50 Hours



Adjusting Brake Play

CAUTION

- When making adjustments, park the machine on a flat area, block wheels, stop engine and remove the key.

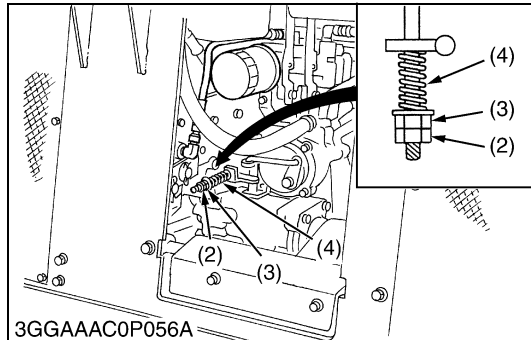
1. If brake play is not correct, loose the lock nut (2) and turn the nut (3) in the desired direction until the proper play is achieved.
2. After adjustment, retighten lock nut (2) securely.

Brake play	Factory spec.	15 to 25 mm 0.59 to 0.98 in.
------------	---------------	---------------------------------

- (1) Brake Pedal
(2) Lock Nut
(3) Nut
(4) Spring

(A) Brake Play

W1013627



Greasing

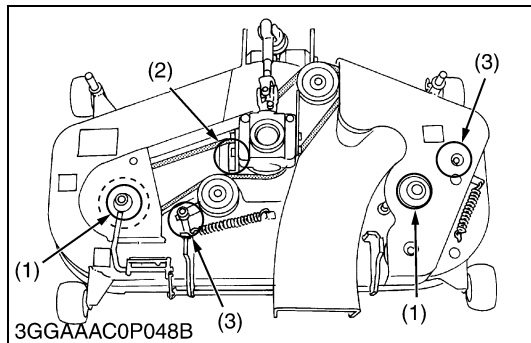
CAUTION

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

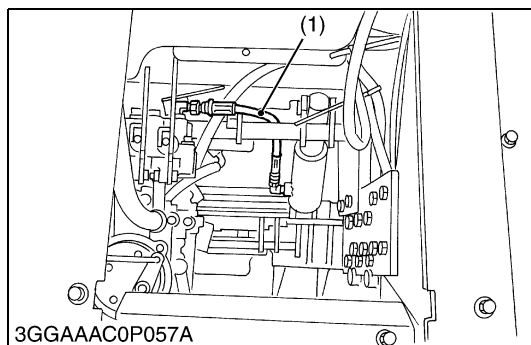
1. Apply grease to the following points.

- (1) Grease Nipple (Side Blade Shaft (LH, RH))
(2) Grease Nipple (Center Blade Shaft)
(3) Grease Nipple (Mower Tension Arm)

W1013774



(4) Check Points of Every 200 Hours



Checking Hydraulic Hose

CAUTION

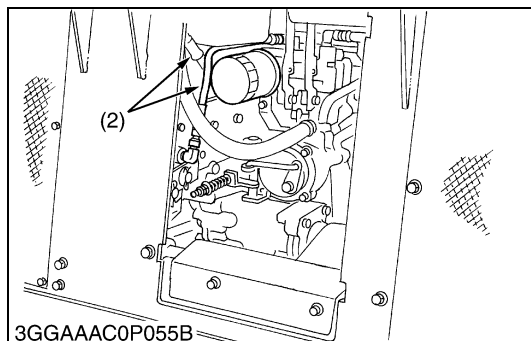
- Be sure to stop the engine and remove the key before checking and replacing hydraulic hose.
- Allow transmission case to cool down sufficiently; oil can be hot and may cause burns.

Check to see hydraulic hoses are properly fixed every 200 hours of operation.

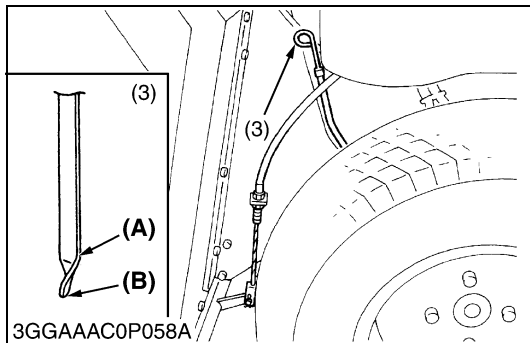
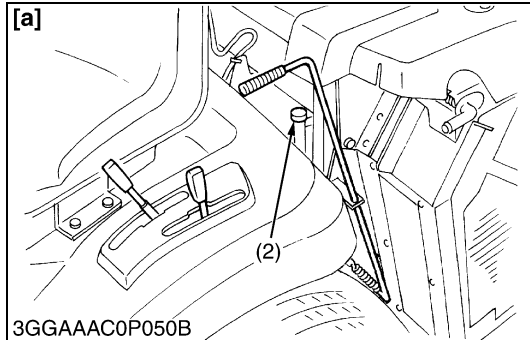
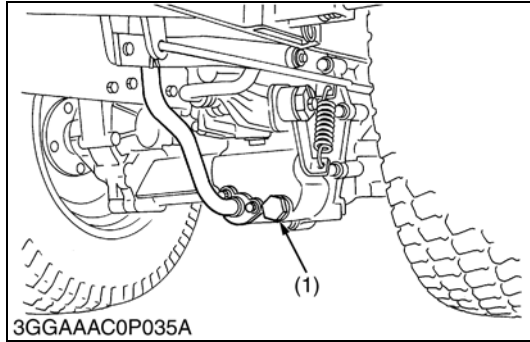
1. Check to see that all lines and hose clamps are tight and not damaged.
2. If hoses and clamp are found worn or damaged, replace or repair them at once.

- (1) Mower Lift Cylinder Hose
(2) Grass Hopper Dump Cylinder

W1013887



(5) Check Points of Every 300 Hours



Changing Transmission Fluid

⚠ CAUTION

- 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 the machine on level ground.
2. Remove the drain plug (1) and oil inlet plug (2), and drain the used oil completely.
3. After draining the oil, reinstall the drain plug (1).
4. Fill with new oil up to the upper level (A) on the oil level dipstick (3).
5. After draining, disassemble and clean the strainers and change the oil filter cartridge. After reassembling, fill with UDT or SUPER UDT hydraulic transmission fluid, or its equivalent.
6. After running the engine for a few minutes, stop it and check the oil level again; add oil to the prescribed level.

■ IMPORTANT

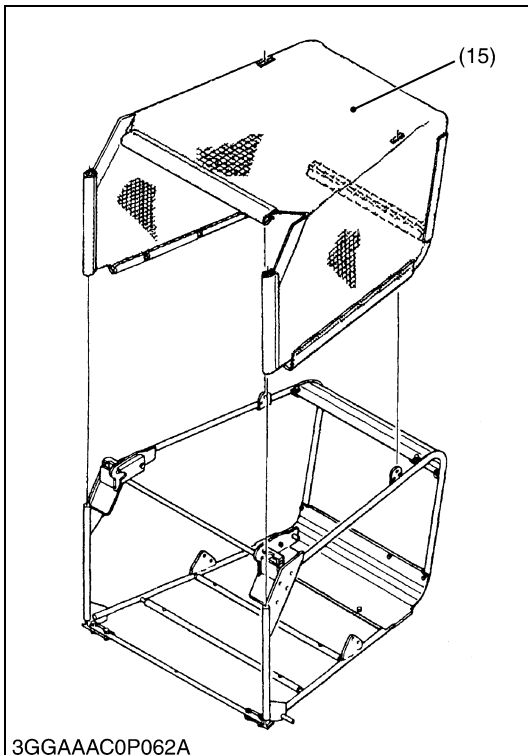
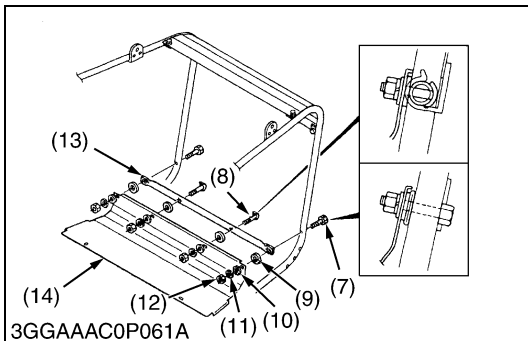
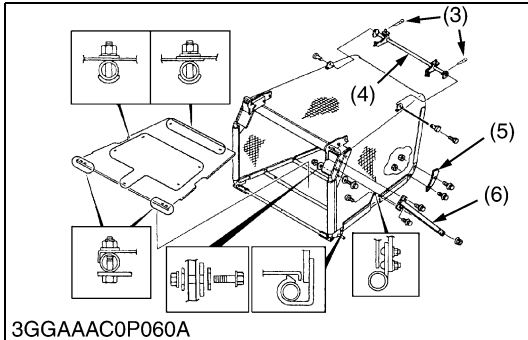
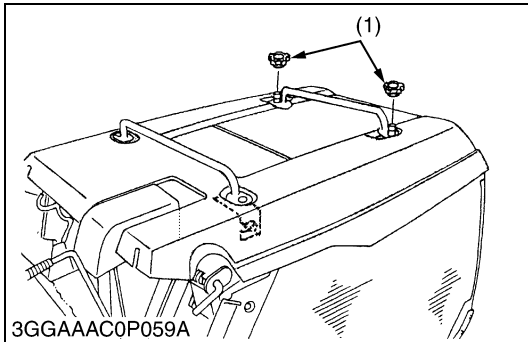
- Operate only at low RPM's immediately after changing the transmission fluid and filter cartridge.
Keep the engine at medium speed for a few minutes to insure proper lubrication of all parts so there is no damage to transmission.

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

- (A) Upper Level
(B) Lower Level

W1014029

(6) Check Points of Every 1 Year



Replacing Grass Hopper Net

1. Remove the knob nut (1) from top of grass hopper cover.
2. Remove plastic cover (2) from hopper
3. Remove the 2 clevis pins, 2 cotter-pins (3), 2 flange bolts and the height adjust stay (4) from the top of hopper frame.
4. Remove 4-1/4 hex bolts, 7-1/4 curved bolts and bottom plate from hopper frame.
5. Remove the 4-M6 bolts and 2 side beams (6) from hopper.
6. Remove the 4-M6 bolts and 2 bottom corner plates (5) from hopper frame.
7. Remove the 2 curved bolts (7), 2 hex bolts (8), 4 spacers (9), 4 plain washers (10), 4 lock washers (11), 4 hex nuts (12), bottom corner plate (14) and pipe frame bag (13) from bag frame.
8. Then remove the hopper net from frame.
9. To attach new or cleaned net (15), reverse the above procedures and be sure to install removed components.

- | | |
|-------------------------|--------------------------|
| (1) Knob Nut | (9) Spacer |
| (2) Plastic Cover | (10) Plain Washer |
| (3) Cotter-pin | (11) Lock Washer |
| (4) Height Adjust Stay | (12) Hex Nut |
| (5) Bottom Corner Plate | (13) Pipe Frame Bag |
| (6) Side Beam | (14) Bottom Corner Plate |
| (7) Curved Bolt | (15) New or Cleaned Net |
| (8) Hex Bolt | |

W1021670

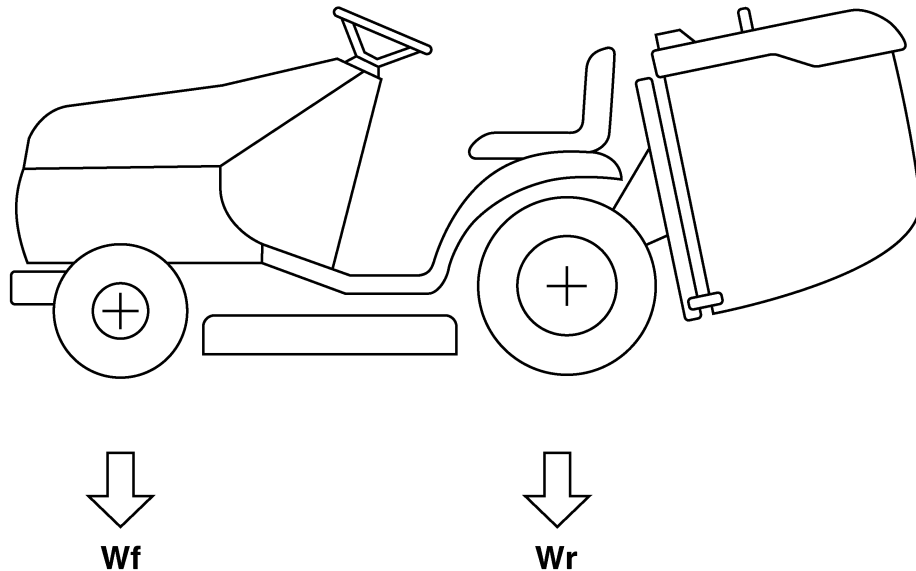
(7) Implement Limitations

The KUBOTA Machine has been thoroughly tested for proper performance with implements sold or approved by KUBOTA. Use of implements which exceed the maximum loading weight listed below, or which are not recommended for use with the KUBOTA Machine may result in malfunctions or failures of the machine, damage to other property and injury to the operator or others.

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

	Maximum axle loading weight		
	Front axle Wf	Rear axle Wr	Total gross machine weight
G2160-R48S	350 kg (772 lbs)	550 kg (1213 lbs)	700 kg (1540 lbs)

W1014299

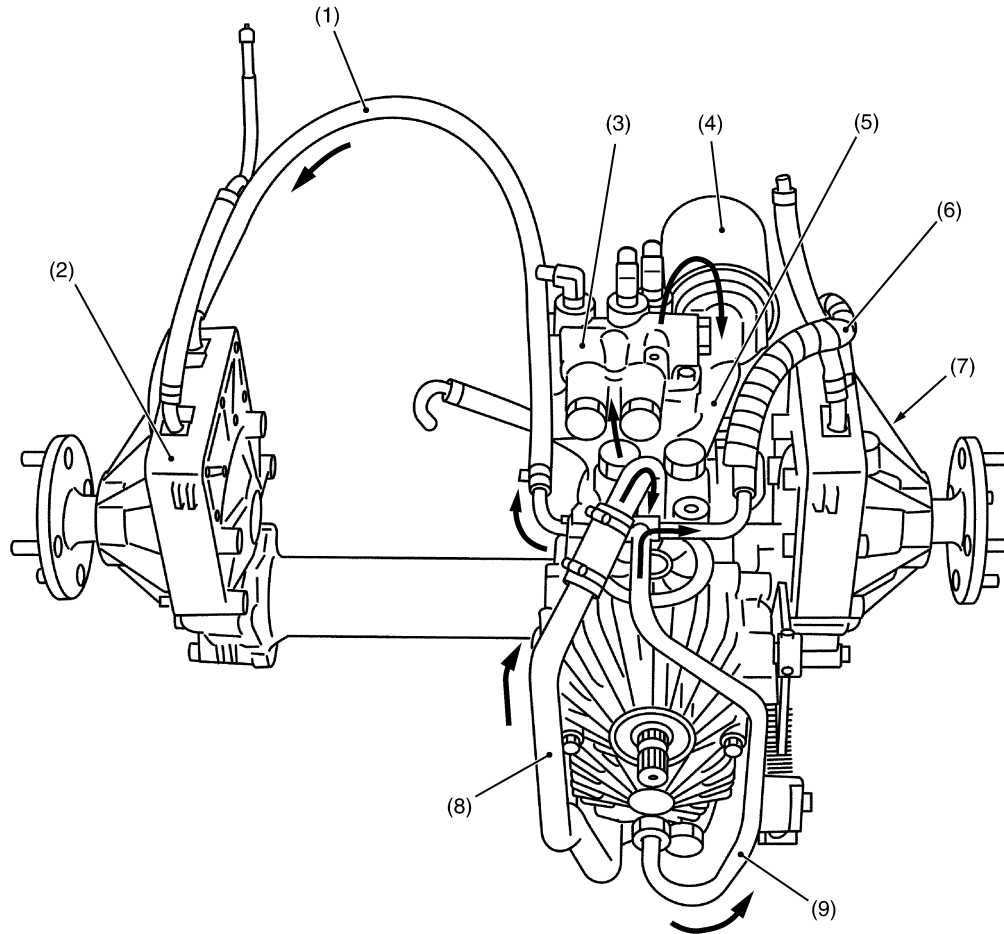


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2. TRANSMISSION AND REAR AXLE

[1] MECHANISM

(1) Hydrostatic Transmission Oil Flow



3GGAAACJP062A

(1) Drain Hose
(2) Rear Axle Case
(3) Control Valve

(4) Oil Filter Cartridge
(5) Control Valve Adaptor

(6) Drain Hose
(7) Rear Axle Case

(8) Suction Pipe
(9) Drain Pipe

1. When the engine is started, the charge pump is rotated to suck oil from the transmission case through the suction pipe (8).
2. When the oil is sucked, it is filtered by the oil stainer.
3. Filtered oil is forced out by the charge pump to the control valve through the control valve adaptor (5).
4. With the control valve (3) in neutral position, the oil is delivered to the hydrostatic transmission through the control valve adaptor (5) and oil filter cartridge (4).
5. The oil used to charge a leak of the closed circuit in the hydrostatic transmission.
6. A portion of oil is drained into the rear axle cases (2), (7) through drain pipe (9) and drain hoses (1), (6) after flushing and cooling the cylinder blocks.

[2] SERVICING

(1) Tightening Torque

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

Item	N·m	kgf·m	ft-lbs
Cam mounting nut	39.2 to 45.1	4.0 to 4.6	28.9 to 33.3
Grass collector cylinder hose	21.6	2.2	15.9
Platform mounting nut and bolt	48.0 to 55.9	4.9 to 5.7	35.4 to 41.2
Rear wheel mounting nut	107.8 to 130.3	11.0 to 13.3	79.6 to 96.2
Mower lift cylinder hose	14.7	1.5	10.8
Universal joint mounting screw	23.5 to 27.4	2.4 to 2.8	17.4 to 20.3
Rear axle case mounting screw			
M12 7T Aluminum	62.7 to 72.5	6.4 to 7.4	46.3 to 53.5
M10 7T Aluminum	39.2 to 44.1	4.0 to 4.5	28.9 to 32.5
M12 7T	77.4 to 90.2	7.9 to 9.2	57.1 to 66.5
M10 7T	48.0 to 55.9	4.9 to 5.7	35.4 to 41.2
Drain pipe retaining bolt (9/16-18 UNF)	27.4	2.8	20.3
Speed control arm set screw	17.6 to 20.6	1.8 to 2.1	13.0 to 15.2
Neutral arm assembly mounting screw	17.6 to 20.6	1.8 to 2.1	13.0 to 15.2
Drain plug	36.3	3.7	26.8
Adaptor bolt (PS3/8)	80.4	8.2	59.3
Charge pump housing mounting hex. socket head screw	24.5 to 29.4	2.5 to 3.0	18.1 to 21.7
Center section mounting hex. socket head screw	22.5 to 24.5	2.3 to 2.5	16.6 to 18.1

W1010887

(2) Separating Transmission

(A) Dismounting Mower and Grass Collector

Dismount Mower

1. See to "MOWER" section.

W1013118

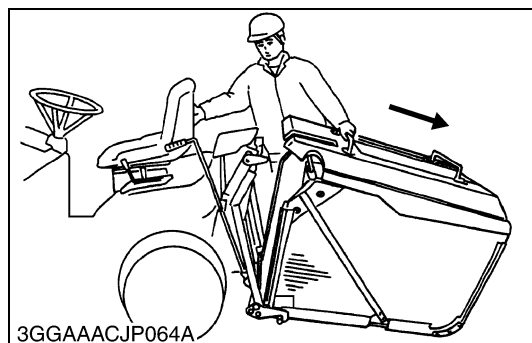
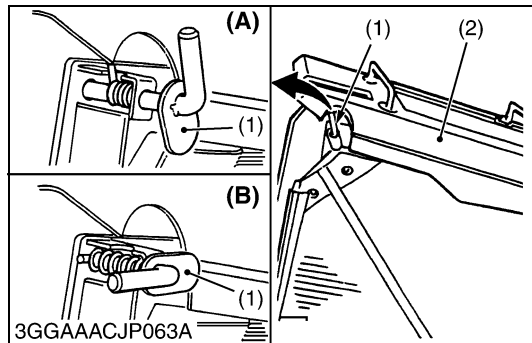
Hopper

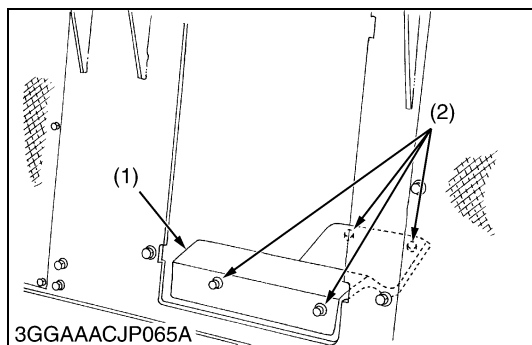
1. Pull and turn the L-pin (1) so that the spring pin can lock on the cut-out.
2. Do the same on the opposite.
3. Remove the hopper (2).

- (1) L-pin
(2) Hopper

- (A) Lock
(B) Unlock

W1010943



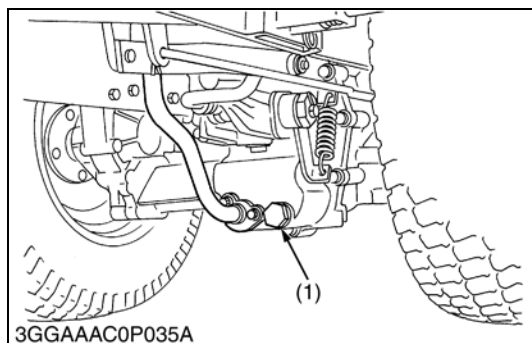
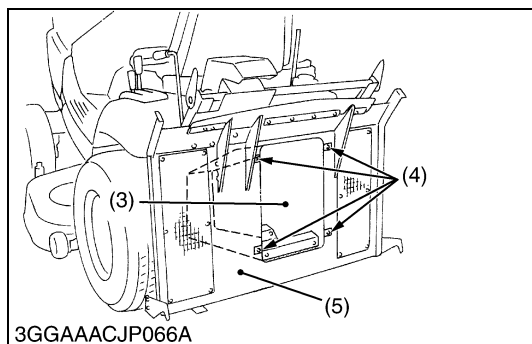


Discharging Plate and Discharge Duct

1. Remove the discharging plate (1).
2. Remove the discharge duct (3) from the platform (5).

- | | |
|-----------------------|--------------|
| (1) Discharging Plate | (4) M8 Bolt |
| (2) M6 Bolt | (5) Platform |
| (3) Discharge Duct | |

W1011082



Draining Transmission Fluid

1. Place an oil pan underneath the drain plug (1).
2. Remove the drain plug (1).
3. Remove the oil inlet plug (2) to completely drain the transmission fluid.
4. After draining, screw in the drain plug (1) and the oil inlet plug (2).

(When refilling)

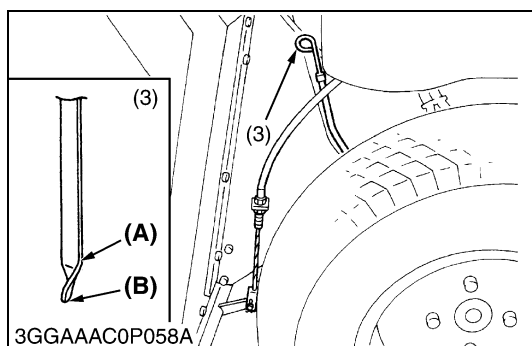
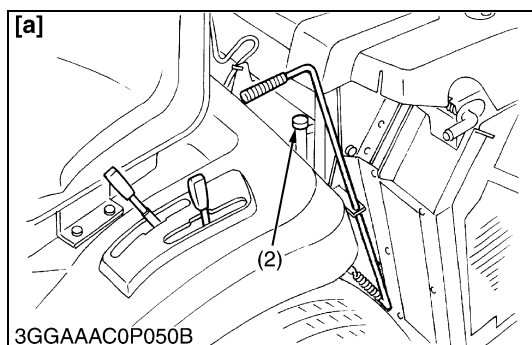
- Use the specified transmission fluid.
- Refer to “**LUBRICANTS, FUEL AND COOLANT**” (See Page QG-3).
- Never work the machine immediately after changing the transmission fluid. Keep the engine at medium speed for a few minutes to prevent damage to the transmission.

Transmission fluid (Including HST and cylinder)	Capacity	4.5 L 4.75 U.S.qts. 3.86 Imp.qts.
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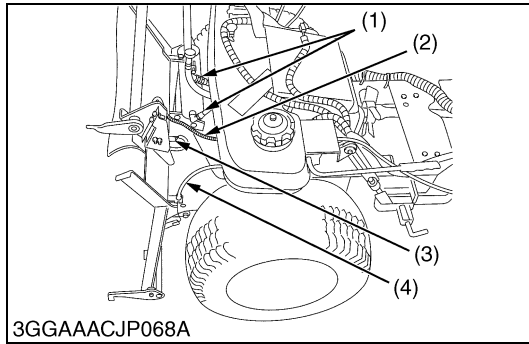
- (1) Drain Plug
- (2) Oil Inlet Plug
- (3) Oil Level Dipstick

(A) Upper Level
(B) Lower Level

W1011216



(B) Separating Platform



Connector, PTO Clutch Return Cable and Cylinder Hose

1. Disconnect the **2P** connector (3) from the grass collector switch.
2. Remove the wiring (2) from the platform.
3. Disconnect the PTO clutch return cable (4).
4. Remove the PTO clutch return cable (4) from the platform.
5. Remove the grass collector cylinder hoses (1) from the grass collector cylinder.

(When reassembling)

- After assembling the PTO clutch return cable, be sure to adjust the PTO clutch return cable (See page Q7-S1).
- Attach the center hydraulic hose of the control valve to the upper adapter of the grass collector cylinder.
- Attach the outer hydraulic hose of the control valve to the lower adaptor of the grass collector cylinder.

Tightening torque	Grass collector cylinder hose	21.6 N·m 2.2 kgf·m 15.9 ft·lbs
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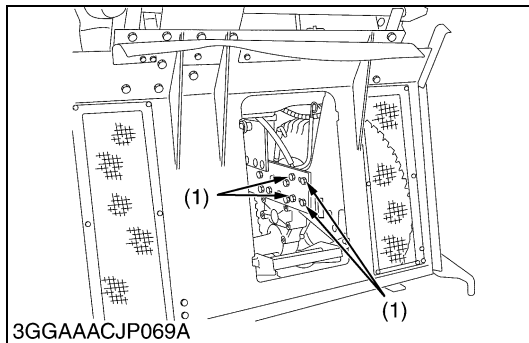
(1) Grass Collector Cylinder Hoses

(3) **2P** Connector

(2) Wiring

(4) PTO Clutch Return Cable

W1011677



Separating Platform

1. Remove the platform mounting nuts and bolts (1).
2. Remove the platform the frame.

Tightening torque	Platform mounting nut and bolt	48.0 to 55.9 N·m 4.9 to 5.7 kgf·m 35.4 to 41.2 ft·lbs
-------------------	--------------------------------	---

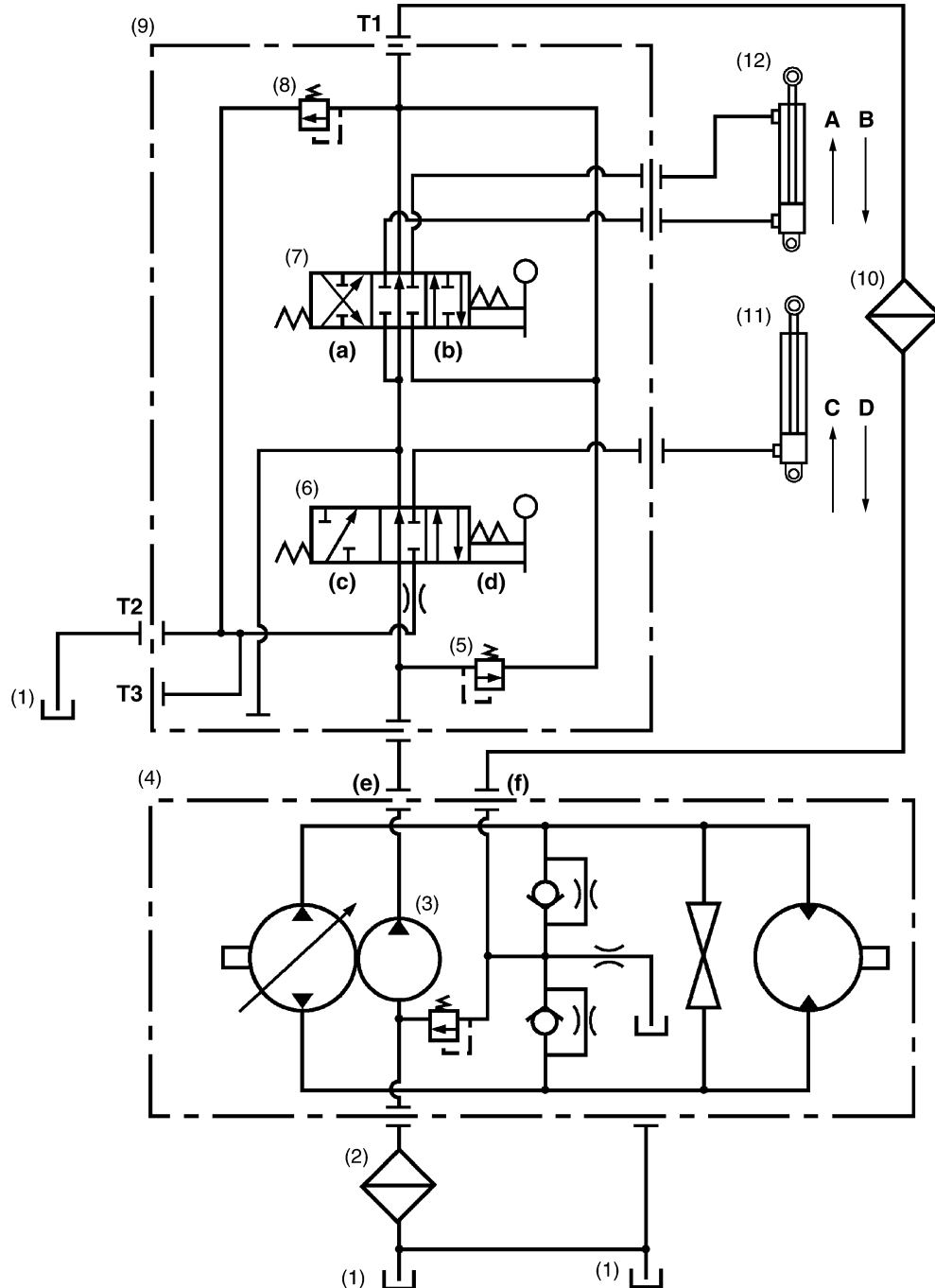
(1) Platform Mounting Nuts and Bolts

W1011920

6. HYDRAULIC SYSTEM

[1] MECHANISM

(1) Hydraulic Circuit



3GGAAAC8P014A

(1) Transmission Case

(2) Oil Strainer

(3) Charge Pump

(4) Hydrostatic Transmission (HST)

(5) Relief Valve

(6) Valve (for Mower Lift Cylinder)

(7) Valve (for Grass Collector Cylinder)

(8) Filter Relief Valve

(9) Control Valve

(10) Oil Filter Cartridge

(11) Mower Lift Cylinder

(12) Grass Collector Cylinder

A: Close

B: Open

C: Up

D: Down

(a) Open

(b) Close

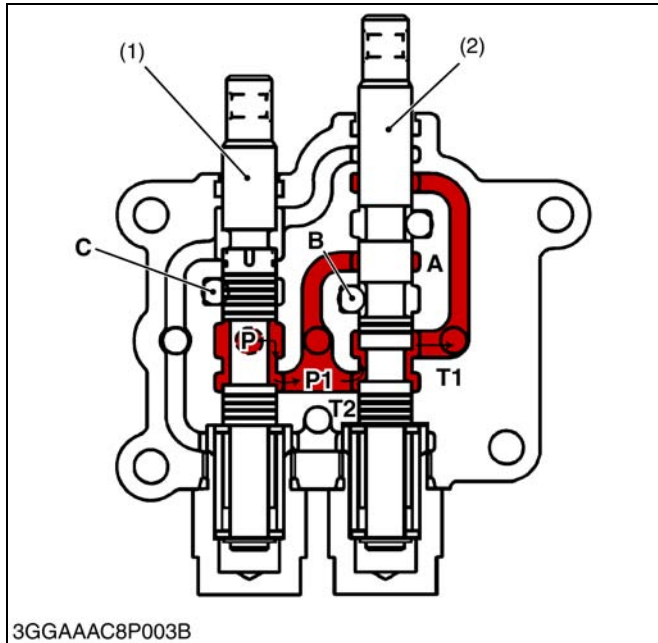
(c) Up

(d) Down

(e) Out

(f) Return

(2) Grass Collector Dumping Circuit



Suppose that the mower lifting spool (spool 1) (1) is in the neutral position.

■ Neutral

The oil coming from port **P** flows to port **T1**.

Port **A** and **B** that are connected with the grass collector cylinder are kept closed by the spool 2 (for grass collector cylinder) (2). In this way, the grass collector (container) is held at a certain level.

(1) Mower Lifting Spool

(2) Spool 2

(for Grass Collector Cylinder)

A: Grass Collector Cylinder Port

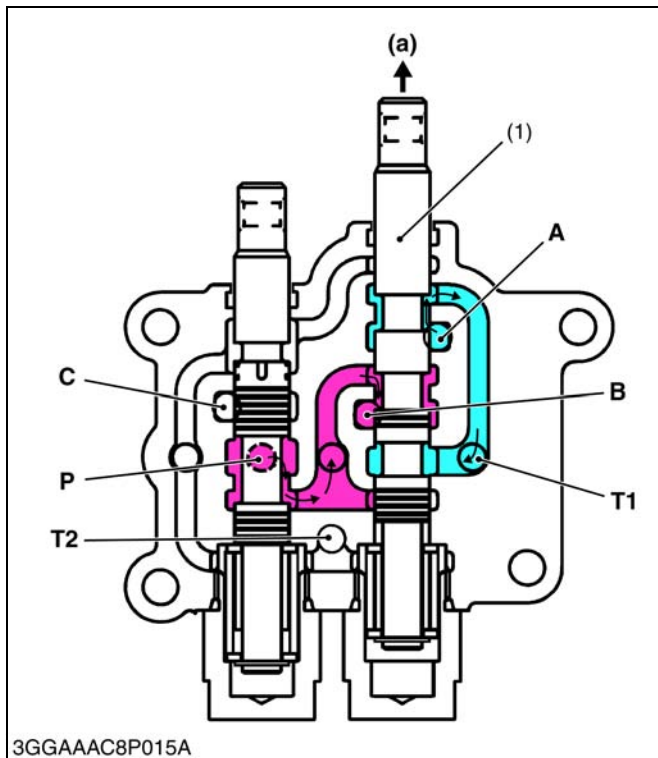
B: Grass Collector Cylinder Port

C: Mower Lift Cylinder Port

P: Pump Port

T1, T2: Tank Port

W1014005



■ Open

Move the grass collector dumping lever to the “**LIFT**” position, and the spool 2 (for grass collector cylinder) (1) is activated in the direction shown in the figure.

This cylinder is of double-acting type.

The oil coming from port **P** flows through port **B** into the grass collector cylinder.

The oil in the grass collector cylinder, on the other hand, flows through port **A** into port **T1**. In this way, the grass collector is lifted.

(1) Spool 2

(for Grass Collector Cylinder)

A: Grass Collector Cylinder Port

B: Grass Collector Cylinder Port

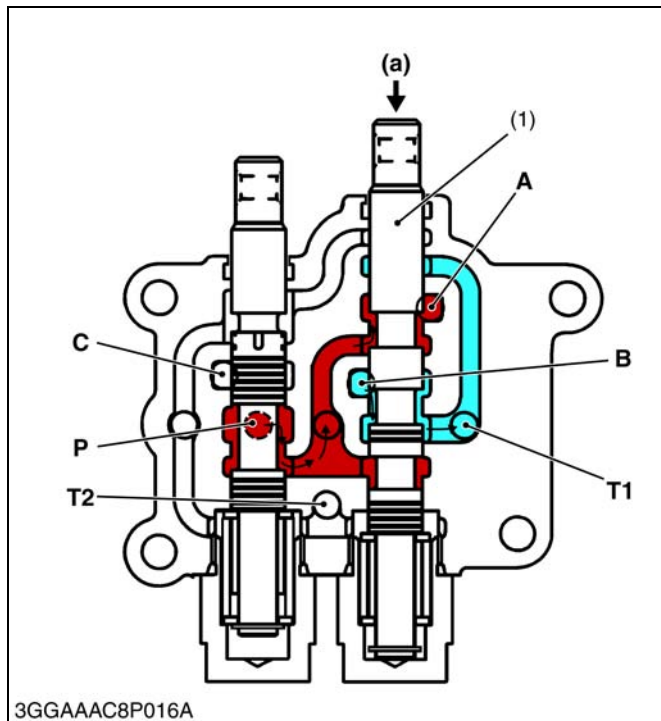
C: Mower Lift Cylinder Port

P: Pump Port

T1, T2: Tank Port

(a) Open

W1014231



■ Close

Move the grass collector dumping lever to the “**DOWN**” position, and the spool 2 (for grass collector cylinder) (1) is activated in the direction shown in the figure.

The oil coming from port **P** flows through port **A** into the grass collector cylinder.

The oil in the grass collector cylinder, on the other hand, flows through port **B** into port **T1**. In this way, the grass collector goes down.

(1) Spool 2
(for Grass Collector Cylinder)

A: Grass Collector Cylinder Port

B: Grass Collector Cylinder Port

C: Mower Lift Cylinder Port

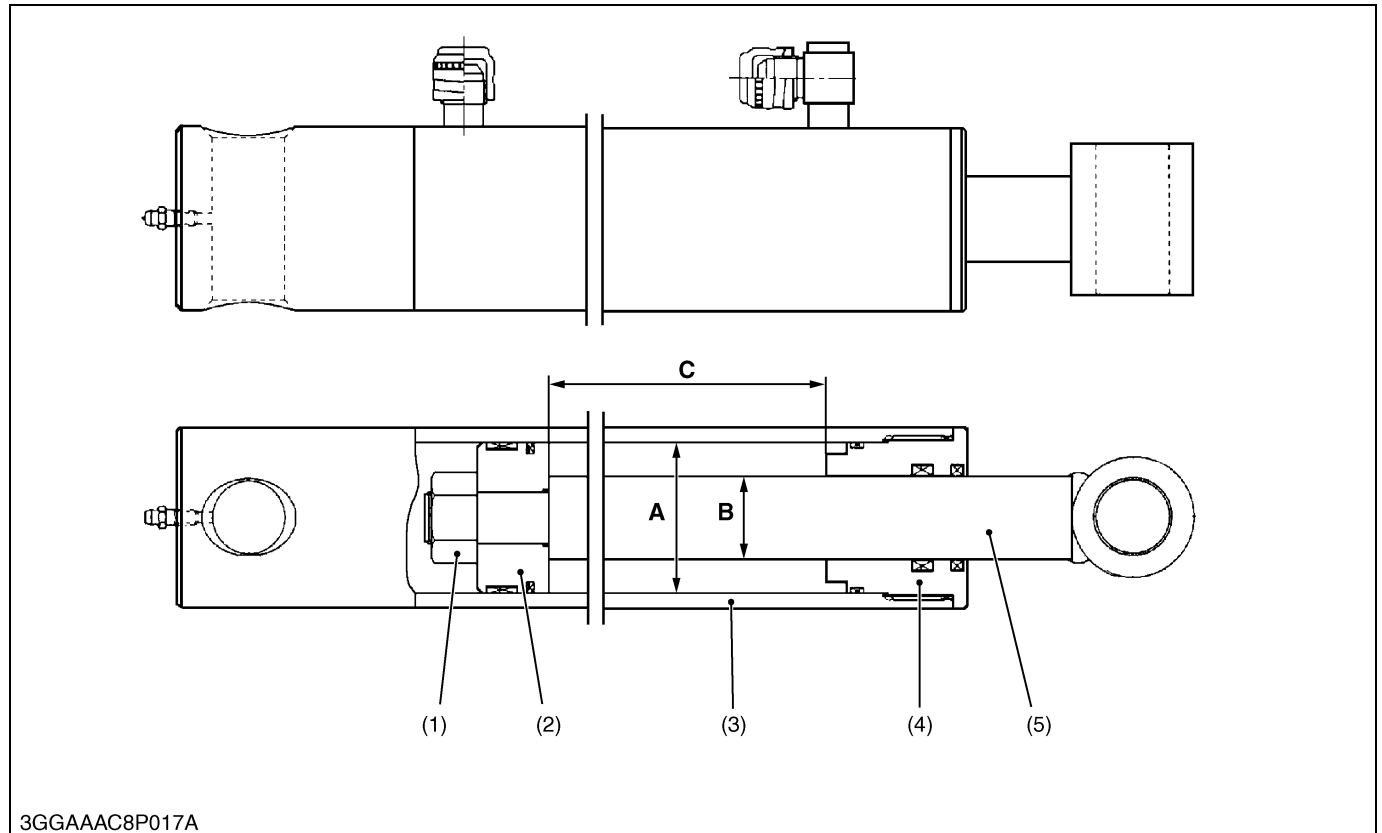
P: Pump Port

T1, T2: Tank Port

(a) Close

W1014370

(3) Grass Collector Cylinder



(1) Nut
(2) Piston

(3) Cylinder Tube
(4) Head

(5) Piston Rod
A: Cylinder I.D.

B: Rod O.D.
C: Stroke

The grass collector cylinder consists of a head (4), cylinder tube (3), piston rod (5), piston (2), and other parts as shown in the above figure.

This is single rod double acting cylinder in which the reciprocating motion of the piston is controlled by hydraulic force applied to both of its ends.

Cylinder Specifications

Grass Collector Cylinder	Cylinder I.D. (A)	60.0 mm (2.36 in.)
	Rod O.D. (B)	25.0 mm (0.98 in.)
	Stroke (C)	185.0 mm (7.28 in.)

W1013717

[2] SERVICING

(1) Troubleshooting

Symptom		Probable Cause	Solution	Reference Page	
Grass collector does not rise.	Is control valve normal ?	NO	Main relief valve spring damaged	Replace	6S-3 Q6-S3
		YES	Main relief valve setting pressure too low	Adjust	6S-3
		Charge pump defective	Replace	2-S15	
		Grass collector cylinder damaged	Repair or replace	Q6-S4 Q6-S5	
		Oil strainer clogged	Clean or replace	G-27	
		Insufficient transmission fluid	Refill	QG-8	
		Loosen or worn hydraulic hoses and adaptors	Tighten or replace	—	
Grass collector does not lower.	Is control valve normal ?	NO	Control valve malfunctioning	Replace	Q6-S3
		YES	Charge pump defective	Replace	2-S15
		Grass collector cylinder damaged	Repair or replace	Q6-S4 Q6-S5	
		Oil strainer clogged	Clean or replace	G-27	
		Insufficient transmission fluid	Refill	QG-8	
		Loosen or worn hydraulic hoses and adaptors	Tighten or replace	—	
		Grass collector drops by its weight.	Is control valve normal ?	NO	Control valve malfunctioning
YES	Grass collector cylinder damaged			Repair or replace	Q6-S3 Q6-S5
	Loosen or worn hydraulic hoses and adaptors		Tighten or replace	—	

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3GGAAAC8P018A

(2) Servicing Specifications

Item		Factory Specification	Allowable Limit
Main relief valve	Setting Pressure	2.94 to 3.43 MPa 30.0 to 35.0 kgf/cm ² 426 to 497 psi	—
Filter Relief valve	Setting Pressure	1.96 to 2.45 MPa 20.0 to 25.0 kgf/cm ² 284 to 356 psi	—
Rear link to frame stopper	Clearance	1.0 to 2.0 mm 0.04 to 0.08 in.	—

W1013874

(3) Tightening Torque

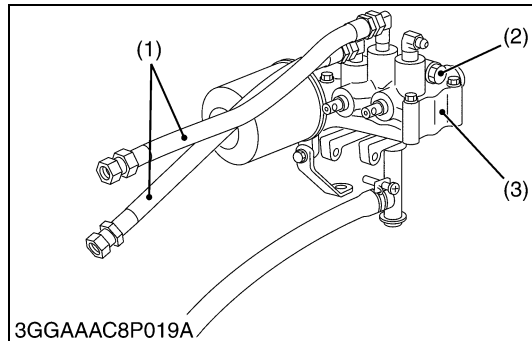
Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts : See page G-9.)

Item	N·m	kgf·m	ft-lbs
Cam mounting nut	39.2 to 45.1	4.0 to 4.6	28.9 to 33.3
Grass collector cylinder hose	21.6	2.2	15.9
Platform mounting nut and bolt	48.0 to 55.9	4.9 to 5.7	35.4 to 41.2
Adaptor bolt (PS 3/8)	80.4	8.2	59.3
Drain pipe retaining bolt (9/16-18 UNF)	27.4	2.8	20.3
Adaptor (on the control valve)	35.3	3.6	26.0
Mower lift cylinder hose	14.7	1.5	10.8
Adaptor (mower lift cylinder)	35.3	3.6	26.0
Adaptor (Grass collector cylinder)	35.3	3.6	26.0
Cylinder head	250 to 300	25.5 to 30.6	184 to 221
Cylinder piston mounting lock nut	300 to 350	30.6 to 35.7	221 to 258

W1012736

(4) Checking, Disassembling and Servicing

(A) Separating Control Valve



Separating Control Valve

1. Remove the grass collector cylinder hoses (1).
2. Separate the control valve (2) with the adaptors from the control valve adaptor (3).

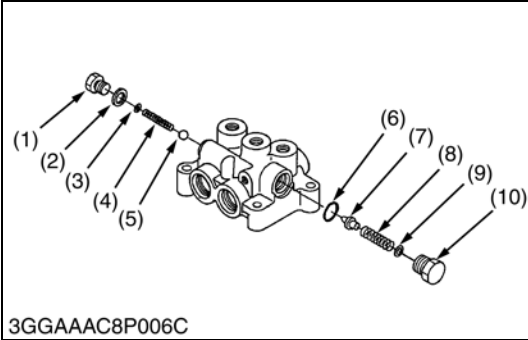
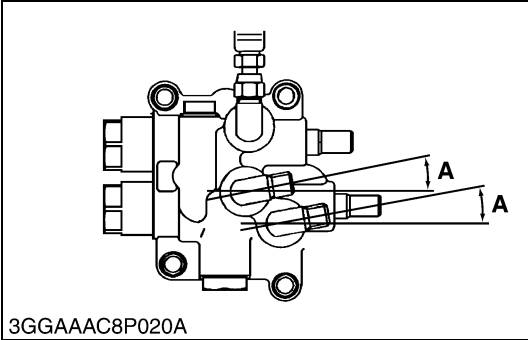
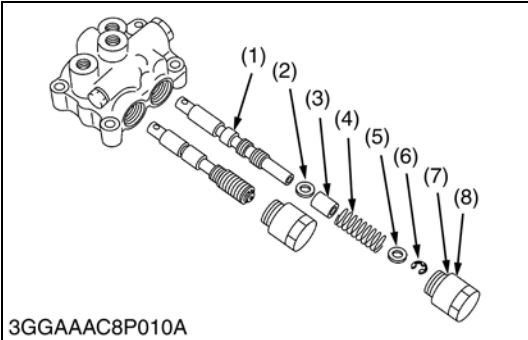
(When reassembling)

- Take care not to damage the O-rings.

- (1) Grass Collector Cylinder Hoses (3) Control Valve Adaptor
(2) Control Valve

W1010721

(B) Disassembling Control Valve



Adaptor, Plug and Spool

- 1. Remove adaptors.
- 2. Remove the plug.
- 3. Draw out the spool assembly.

(When reassembling)

- Take care not to damage the O-rings.
- Install the adaptors as shown in the figure.

Tightening torque	Adaptor	35.3 N·m 3.6 kgf·m 26.0 ft-lbs
-------------------	---------	--------------------------------------

- (1) Spool

(2) Plain Washer

(3) Collar

(4) Spring
- (5) Plain Washer

(6) Snap Ring

(7) O-ring

(8) Plug

A : 0.17 rad. (10 °)

W1010838

Relief Valve

- 1. Remove the bolt (1).
- 2. Remove the shims (3), washer with rubber (2), spring (4) and steel ball (5).
- 3. Remove the plug (10).
- 4. Remove the shims (9), O-ring (6), spring (8) and poppet (7).

(When reassembling)

- Take care not to damage the O-rings.
- Install the relief valve, noting the number of shims.

■ IMPORTANT

- **After reassembling the relief valve, be sure to adjust its setting pressure. (See page 6-S3, 6-S4.)**

- (1) Bolt

(2) Washer with Rubber

(3) Shims

(4) Spring

(5) Steel Ball
- (6) O-ring

(7) Poppet

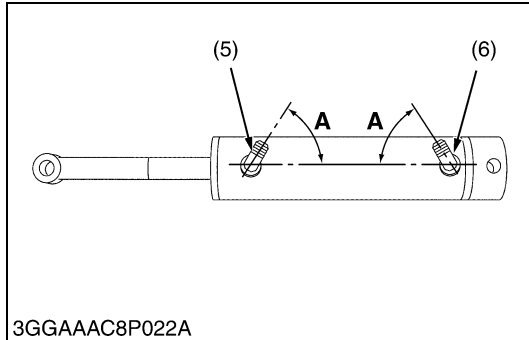
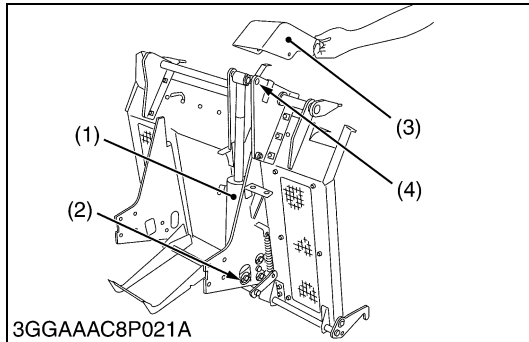
(8) Spring

(9) Shims

(10) Plug

W1013734

(C) Separating Grass Collector Cylinder



Separating Grass Collector Cylinder

1. Remove the cylinder cover (3).
2. Pull out the cotter pins (2), (4).
3. Separate the grass collector cylinder (1) from the platform.
4. Remove the adaptors (5), (6) from the grass collector cylinder.

(When reassembling)

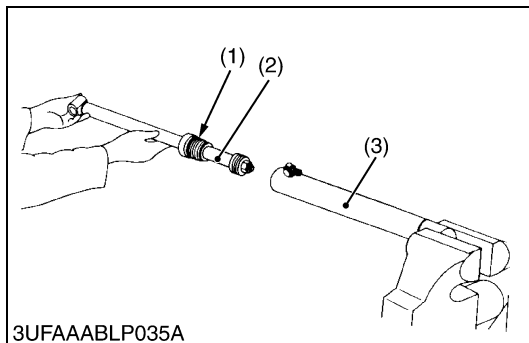
- Install the adaptors as shown in the figure.

Tightening torque	Adaptor (Grass collector cylinder)	35.3 N·m 3.6 kgf·m 26.0 ft-lbs
-------------------	------------------------------------	--------------------------------------

- | | |
|------------------------------|--|
| (1) Grass Collector Cylinder | (4) Cotter Pin |
| (2) Cotter Pin | (5) Adaptor (Grass Collector Cylinder) |
| (3) Cylinder Cover | (6) Adaptor (Grass Collector Cylinder) |
| A : 0.79 rad. (45 °) | |

W1011284

(D) Disassembling Piston Rod Assembly



Piston Rod Assembly

1. Drain hydraulic oil from the cylinder, and secure the tube end of the cylinder in a vise.
2. Push the flange of the cylinder tube out of the groove of the cylinder head.
3. Unscrew the cylinder head (1) with a pin key.
4. Pull out the piston rod assembly (2) from the cylinder tube (3).

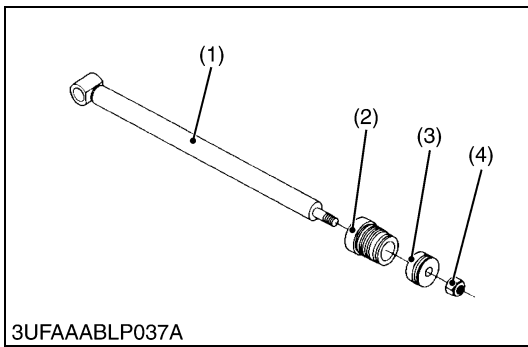
(When reassembling)

- Visually inspect the cylinder tube for signs of scoring or damage.
- Clean the cylinder tube (3) and piston rod assembly (2).
- Secure the tube end of the cylinder in a vise.
- Insert the piston rod assembly (2) to the cylinder tube (3), after covering the seal with new hydraulic oil and using care not to damage the piston seal on the piston.
- Screw the cylinder head (1).
- Push the flange of the cylinder tube inside the groove of the cylinder head (1) to avoid unlocking.

Tightening torque	Cylinder head	250 to 300 N·m 25.5 to 30.6 kgf·m 184 to 221 ft-lbs
-------------------	---------------	---

- | | |
|-------------------------|-------------------|
| (1) Cylinder Head | (3) Cylinder Tube |
| (2) Piston Rod Assembly | |

W1011558



Cylinder Head, Piston and Nut

1. Secure the rod end in a vise.
2. Unscrew the cylinder piston mounting lock nut (4).
3. Remove the piston (3) and cylinder head (2) from the piston rod (1).

(When reassembling)

- Visually inspect all parts for signs of scoring or damage.
- Secure the rod end in a vise.
- Install the cylinder head (2) with seals mounted on the piston rod (1).
- Install the piston (3) with seals mounted on the piston rod (1).
- Screw the cylinder piston mounting lock nut (4).

Tightening torque	Cylinder piston mounting lock nut	300 to 350 N·m 30.6 to 35.7 kgf·m 221 to 258 ft-lbs
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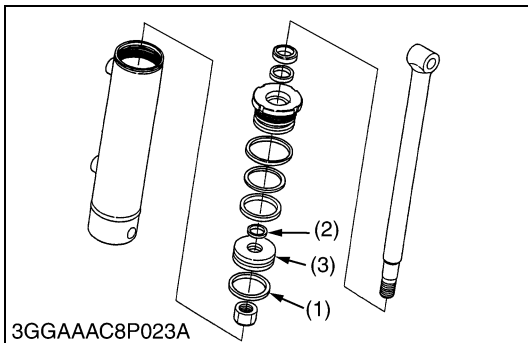
(1) Piston Rod

(3) Piston

(2) Cylinder Head

(4) Cylinder Piston Mounting Lock Nut

W1011806



Installing Piston Seal

■ NOTE

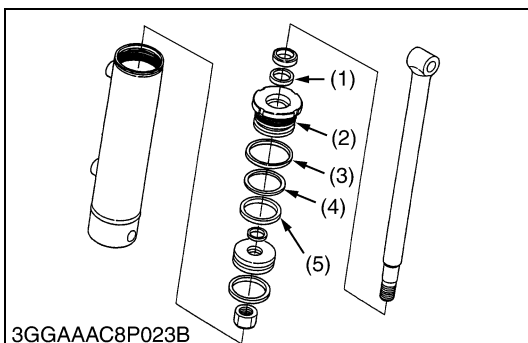
- **The piston seal doesn't need any particular tool to install.**
1. Clean all components and check if anything is inside the grooves.
 2. Check the sliding seal surfaces are clean and without damage.
 3. Install the O-ring (2) inside the internal groove of the piston (3) without twisting it.
 4. Install the internal black square part of the piston seals (1) inside the external groove of the piston (3), while checking it is not twist.
 5. Using a tool (like a screwdriver) without any sharp edges, install the blue external part of the piston seals (1) above the black part.

(1) Piston Seal

(3) Piston

(2) O-ring

W1012170



Installing Cylinder Head Seal

■ NOTE

- **The cylinder head seal doesn't need any particular tool to install.**

1. Clean all components and check if anything is inside the groove.
2. Check the sliding seal surfaces are clean and without damage.
3. Install the wiper seal (1) inside the internal groove of the cylinder head (2).

■ NOTE

- **Check the wiper seal is toward the inside of the cylinder.**

4. Install the O-ring (3) against dust between the flange stopper of the cylinder head (2) and the thread.
5. Install the O-ring (5) and anti-extrusion collar (4) in the external groove of the cylinder head (2), by respecting their position: O-ring on oil seal, and collar on thread side.

(1) Wiper Seal

(4) Anti-extrusion Collar

(2) Cylinder Head

(5) O-ring

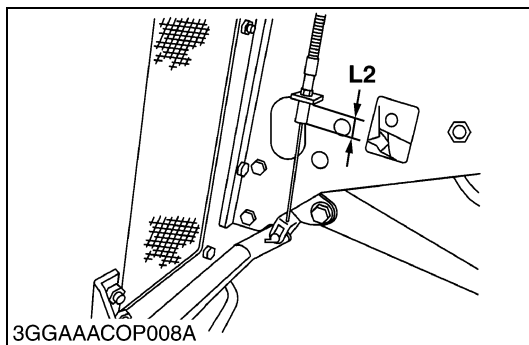
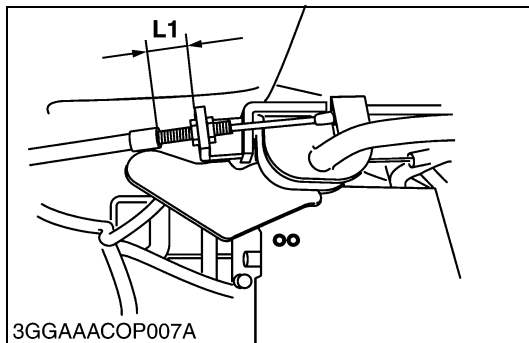
(3) O-ring

W1012369

7. PTO SYSTEM

[2] SERVICING

(1) Adjusting PTO Clutch Return Cable



Adjusting PTO Clutch Return Cable

1. Place the machine on level ground, and stop the engine.
2. Set the PTO clutch lever to “**ENGAGE**” position.
3. Adjust the PTO clutch return cable length so that it stretches slightly tight.

■ **IMPORTANT**

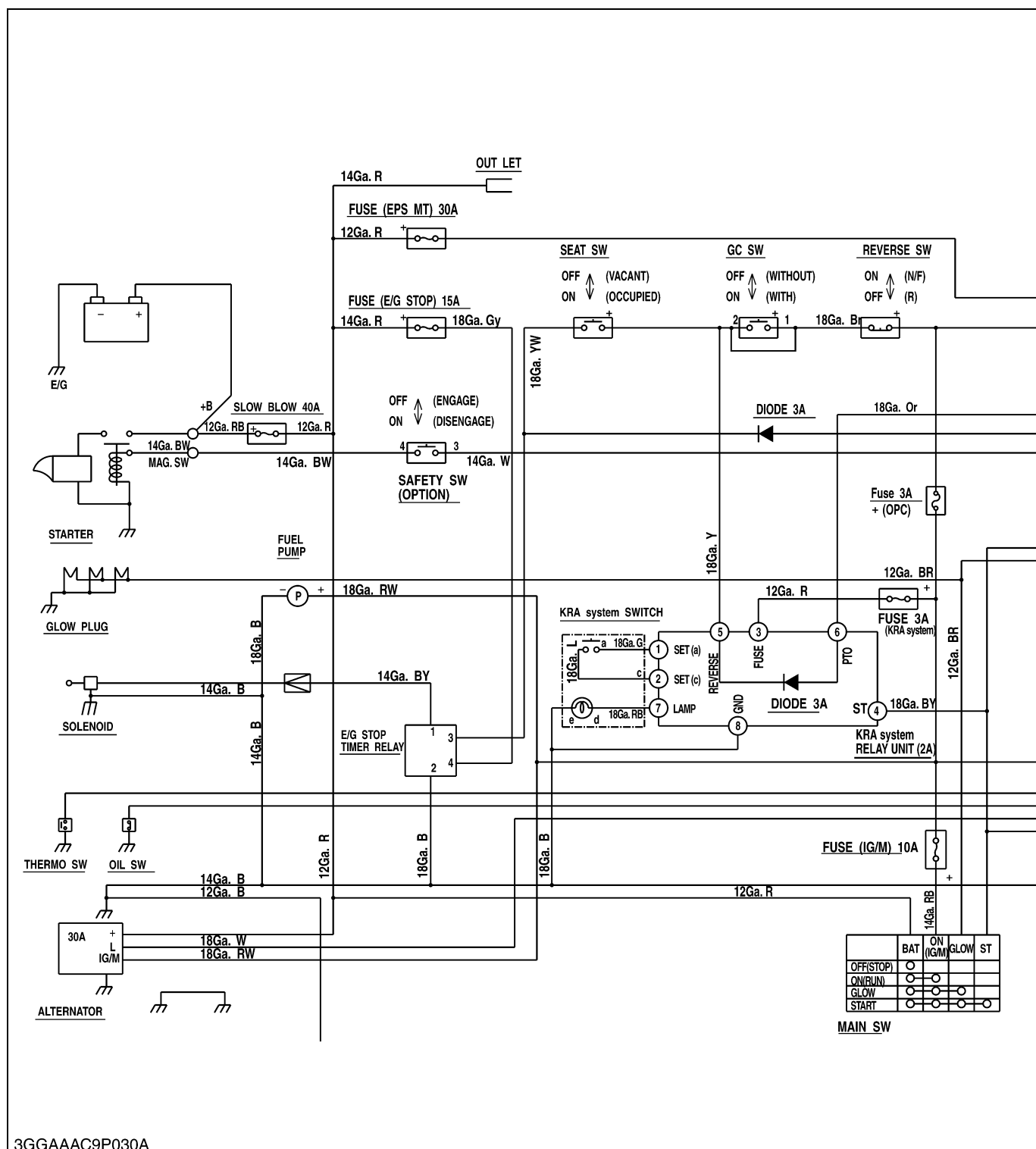
- Check the PTO clutch lever gets disengaged when the grass collector starts to open.

(Reference)

- **L1:** More than 26 mm (1.02 in.)
- **L2:** 10 mm (0.39 in.)

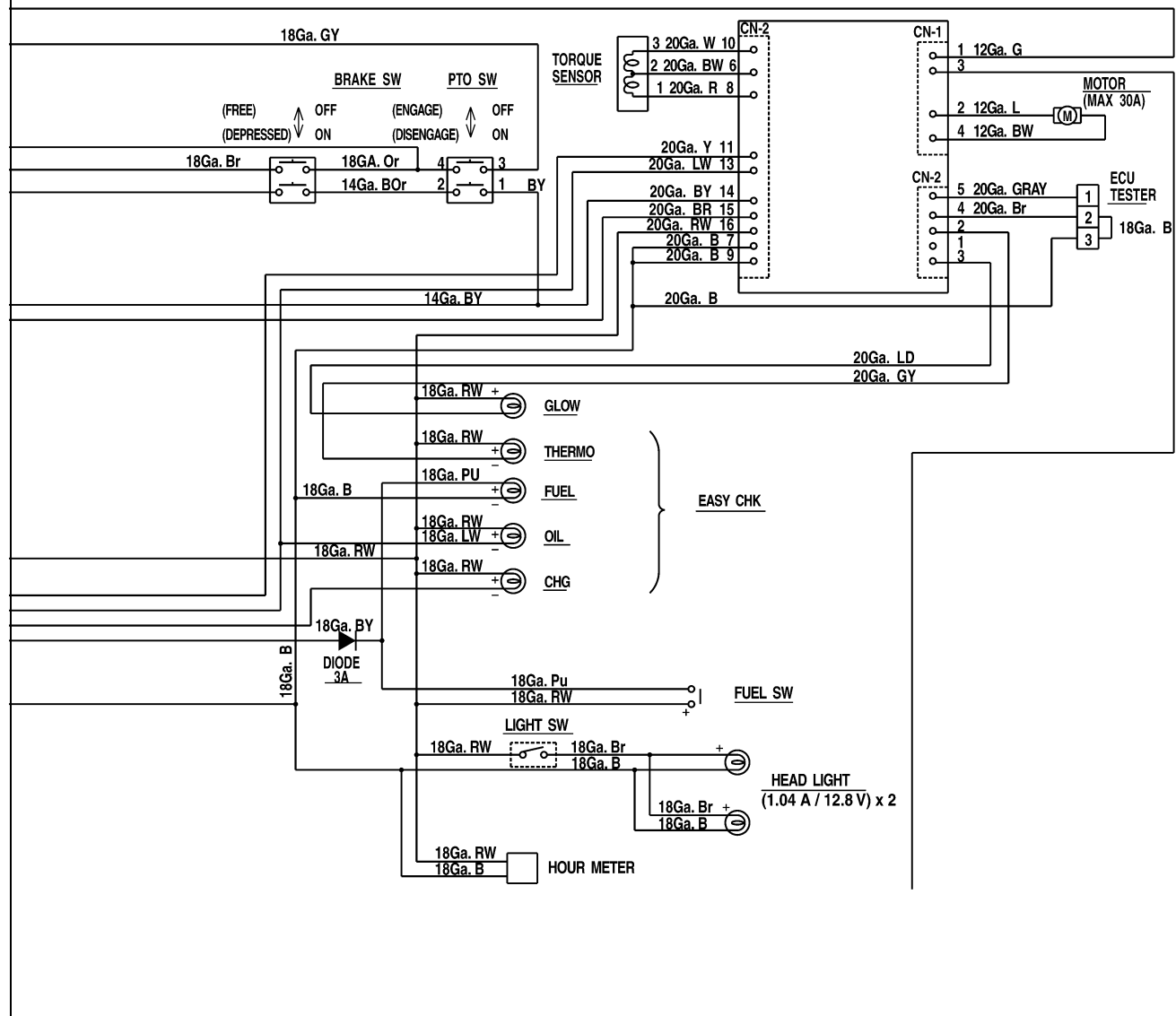
W1012635

(1) Wiring Diagram



• Color of Wiring

B ----- Black	Br ----- Brown	L ----- Blue	Pi ----- Pink	RW ----- Red / White
BOr ----- Black / Orange	G ----- Green	LD ----- Blue Dk	Pu ----- Purple	W ----- White
BR ----- Black / Red	GY ----- Green / Yellow	LW ----- Blue / White	R ----- Red	Y ----- Yellow
BW ----- Black / White	GW ----- Green / White	Or ----- Orange	RB ----- Red / Black	YW ----- Yellow / White
BY ----- Black / Yellow	Gy ----- Gray			



[2] SERVICING

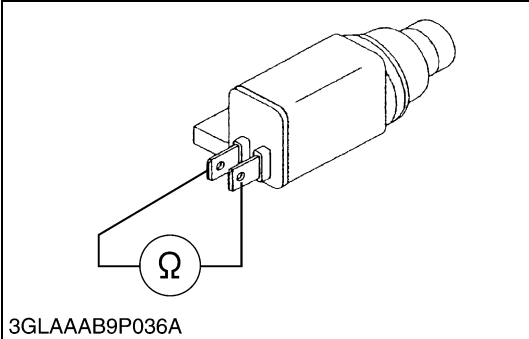
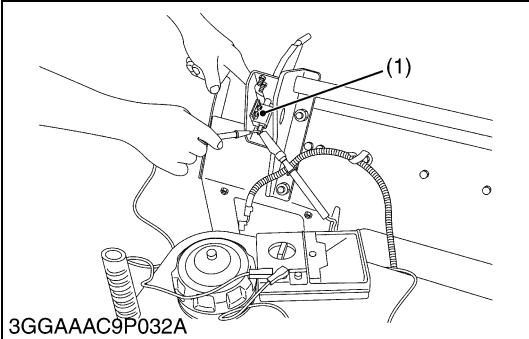
(1) Servicing Specification

GRASS CLLECTOR SWITCH

Item	Factory Specification	Allowable Limit
Resistance between the terminals in pushing switch	0 ohm	—

W1010640

(2) Grass Collector Switch



Grass Collector

1. Disconnect the grass collector switch (1) from the wiring harness.
2. Push the switch, and check the resistance between the terminals with an ohmmeter.
3. If the resistance is infinity ohms, the grass collector switch (1) is faulty. Replace the grass collector switch (1).

Resistance between the terminals in pushing switch	Factory spec.	0 ohm
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(1) Grass Collector Switch

W1010751

9. MOWER

[2] SERVICING

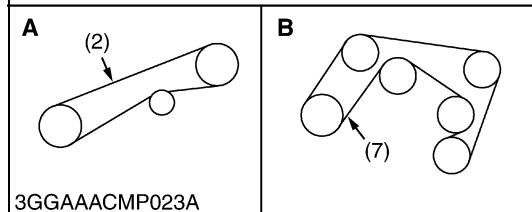
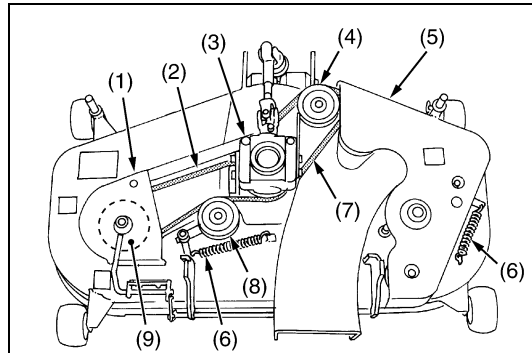
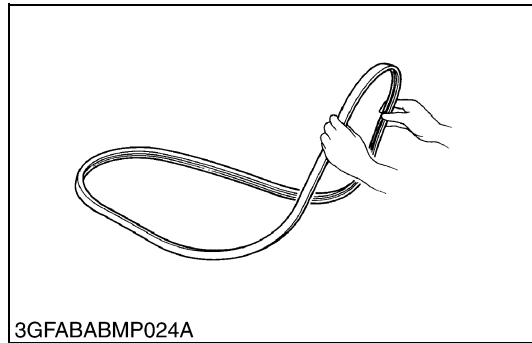
(1) Tightening Torques

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

Item	N·m	kgf·m	ft-lbs
Reamer bolt	77.4 to 90.2	7.9 to 9.2	57.1 to 66.5
Mower blade screw	103.0 to 118.0	10.5 to 12.0	76.0 to 87.0
Center pulley holder mounting screw	77.4 to 90.2	7.9 to 9.2	57.1 to 66.5
Side blade pulley holder mounting nut and bolt	77.4 to 90.2	7.9 to 9.2	57.1 to 66.5
Side blade pulley mounting nut	103.0 to 118.0	10.5 to 12.0	76 to 87
LH tension pulley mounting bolt and nut	47.0 to 56.8	4.8 to 5.8	34.7 to 42.0
LH tension arm mounting bolt and nut	77.4 to 90.2	7.9 to 9.2	57.1 to 66.5
RH tension pulley mounting bolt and nut	108.8 to 130.3	11.1 to 13.3	80.3 to 96.2
RH tension arm mounting bolt and nut	77.4 to 90.2	7.9 to 9.2	57.1 to 66.5

W1012736

(2) Checking, Disassembling and Servicing



Checking Mower Belts

1. Check to see the mower belts.
2. Replace the mower belt with a new one, if there is found surface split at more than 3 positions.

(When replacing mower belt)

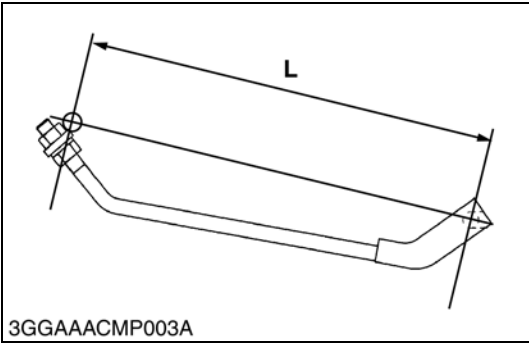
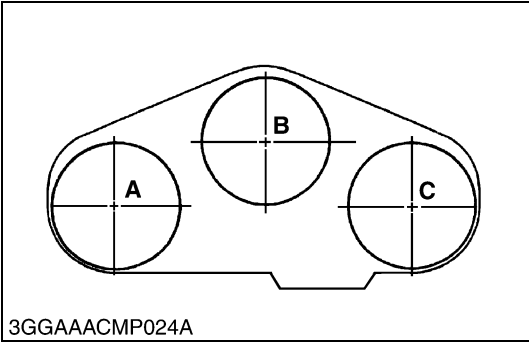
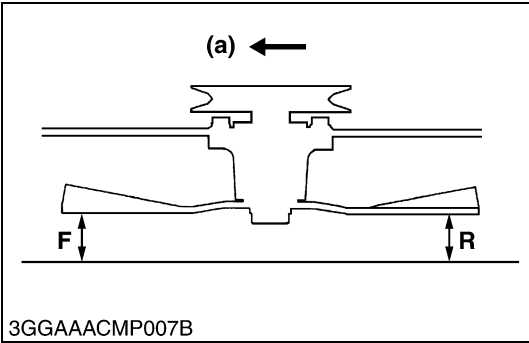
1. Remove the mower from the machine.
2. Remove the left and right hand shield (1), (5) from the mower deck.
3. Clean around the right side pulley (4) and the tension pulley (8) to remove the LH belt (2) and the RH belt (7) from the pulleys (4), (8), (9). Slip the LH belt (2) over the top of the left side pulley (9).
4. To install new belts, reverse the above procedure.

Tightening torque	Reamer bolt	77.4 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft-lbs
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- (1) LH Shield
(2) LH Belt
(3) Gear Case
(4) Right Side Pulley
(5) RH Shield
(6) Tension Spring

- (7) RH Belt
(8) Tension Pulley
(9) Left Side Pulley
A : LH belt layout
B : RH belt layout

W1010629



Adjusting Front and Rear Cutting Height

- 1. Mount the mower to the machine, and place the vehicle on a level ground.
- 2. Set the cutting height to “2” position.
- 3. Measure the heights (F), (R) of the blade.
- 4. If the difference between front tip of blade and rear tip of blade exceeds the factory specification, adjust the length (F) of front links.

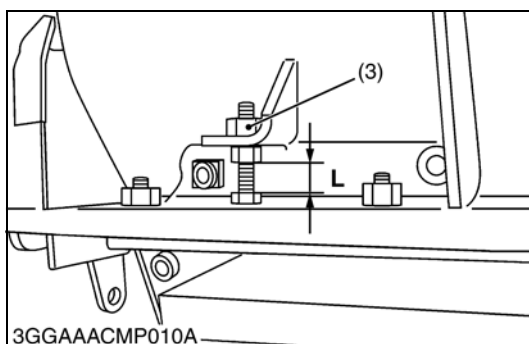
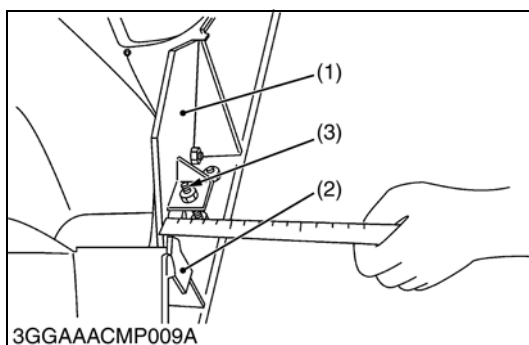
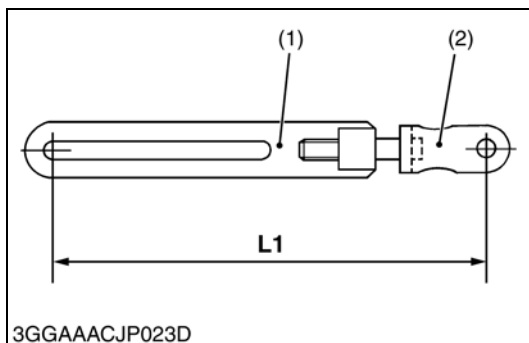
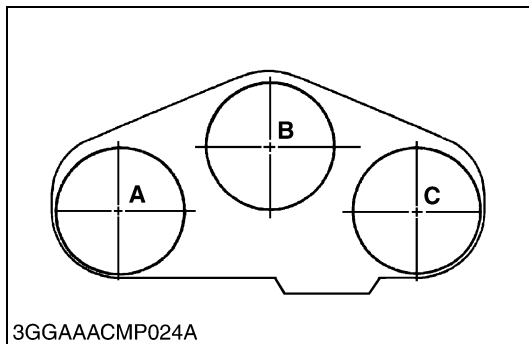
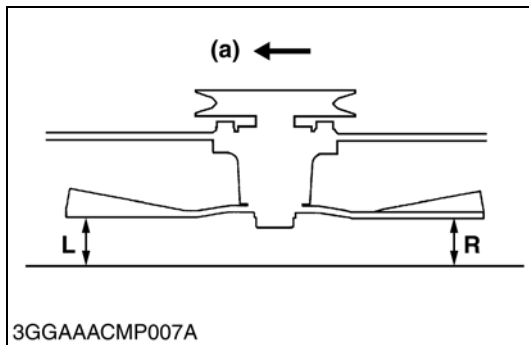
(Reference)

- L : 435 mm (17.1 in.)

Difference (F-R) between front tip of blade and rear tip of blade (on blade A, B and C)	Factory spec.	Less than 5 mm 0.20 in.
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(a) Front

W1010915



Adjusting Left and Right Cutting Height

1. Mount the mower to the machine, and place the machine on a level ground.
2. Set the cutting height to "2" position.
3. Measure the heights **(L)**, **(R)** of the blade.
4. If the difference between left tip of blade and right tip of blade exceeds the factory specification, adjust the length **(L1)** of upper lift link (1) and lower lift link (2).

(Reference)

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Difference (L-R) between left tip of blade and right tip of blade (on blades A, B and C)	Factory spec.	Less than 4 mm 0.16 in.
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- (1) Upper Lift Link
(2) Lower Lift Link

(a) Left

W1012174

Adjusting Rotation Plate

1. Park the machine on level ground, and stop the engine.
2. Dismount the mower.
3. Turn over the mower.
4. Turn the adjusting screw (3) until the rotation plate (1) and the performance plate end (2) come into contact with each other.

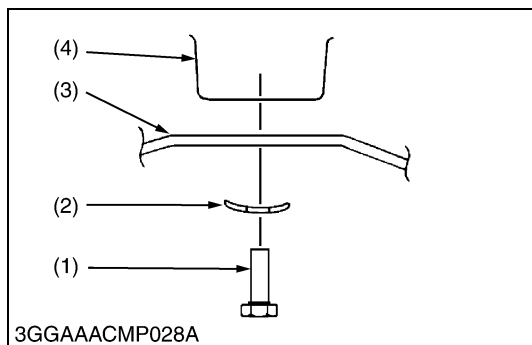
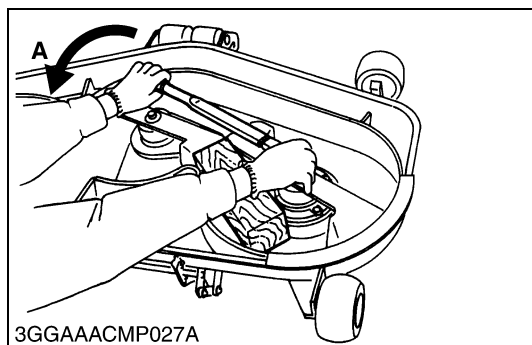
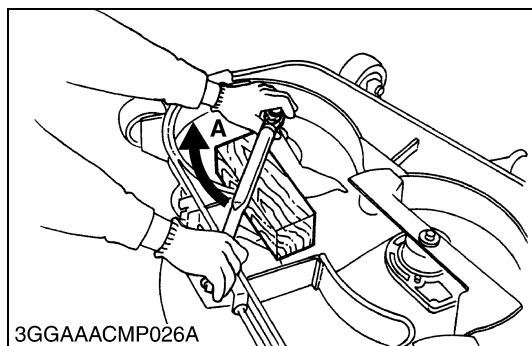
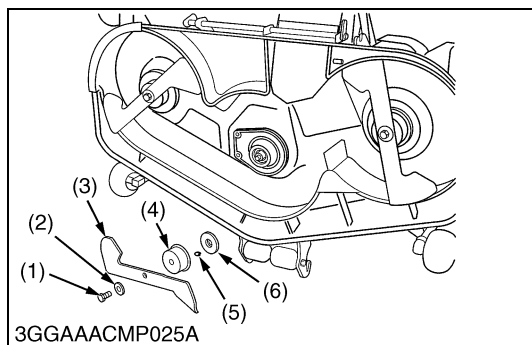
(Reference)

- L : 26 mm (1.02 in.)

- (1) Rotation Plate
(2) Performance Plate End

(3) Adjusting Screw

W1012598



Mower Blade (Center Blade and Outer Blades)

1. Turn over the mower.
2. Remove the mower blade screw (1).
3. Remove the spring plate (2), blade (3) and dust cover (4).
4. Remove the external snap ring (5) on the bevel gear shaft (only center blade).
5. Remove the spline boss (6).

■ NOTE

- To remove the blade securely, wedge a block of wood between one blade and the housing in such position that it will hold the blade safely while loosening or tightening the blade screws.
- The screw of red-painted mower blade is of inverse helical type.

(When reassembling)

- Be sure to pay attention to how to assemble the spring plate.
- Apply grease to the spline boss.

■ IMPORTANT

- Make sure the spring plate is not flattened out or worn, causing mower blade to slip easily.
- Replace the spring plate if it is damaged.

■ NOTE

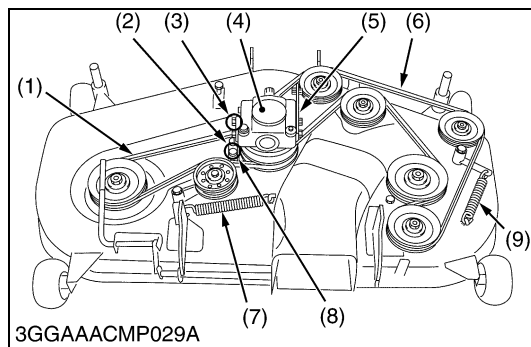
- After reassembling the blade, check the blade slippage. If the blade slips below blade slippage torque (66.7 N·m, 6.8 kgf·m, 49.2 ft-lbs), check the blade tightening torque and spring plate.

Tightening torque	Mower blade screw	103.0 to 118.0 N·m 11.0 to 12.0 kgf·m 76 to 87 ft-lbs
-------------------	-------------------	---

- (1) Mower Blade Screw
(2) Spring Plate
(3) Blade
(4) Dust Cover

- (5) External Snap Ring
(6) Spline Boss
A : Loosen

W1011598



Mower Belt, Gear Case and Center Pulley Holder

1. Turn over the mower.
2. Remove the tension springs (7), (9).
3. Remove the mower belts (1), (6).
4. Remove the RH case stay (5).
5. Remove the reamer bolts (2), (3).
6. Remove the LH case stay (8).
7. Separate the gear case (4) with the center blade pulley from the center pulley holder assembly.

(When reassembling)

- Apply grease to oil seals and bevel gear shaft.
- Apply liquid gasket (Three Bond 1208D or its equivalent) to the face of LH case stay.
- Install the reamer screws at their original position.

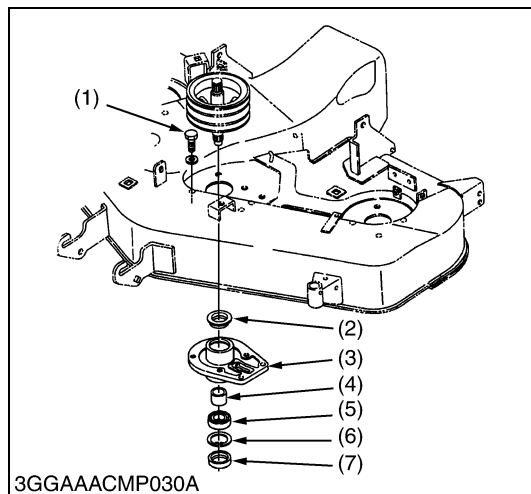
■ IMPORTANT

- **After setting the LH case stay mounting reamer bolts on the desk without tightening, then mount the other screws on the gear case. And finally tighten them.**

Tightening torque	Reamer bolt	77.4 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft-lbs
-------------------	-------------	---

- | | |
|------------------|--------------------|
| (1) Mower Belt | (6) Mower Belt |
| (2) Reamer Bolts | (7) Tension Spring |
| (3) Reamer Bolts | (8) LH Case Stay |
| (4) Gear Case | (9) Tension Spring |
| (5) RH Case Stay | |

W1012217



Disassembling Center Pulley Holder Assembly

1. Remove the center pulley holder mounting screws (1).
2. Separate the center pulley holder assembly from the mower deck.
3. Remove the lower oil seal (7).
4. Remove the internal snap ring (6), ball bearing (5) and center collar (4).
5. Remove the upper oil seal (2).

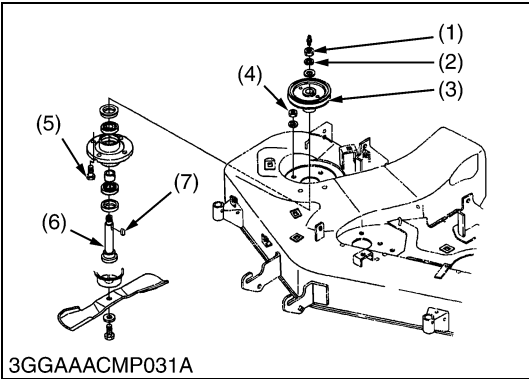
(When reassembling)

- Apply grease to the bearing and oil seal lips.
- Apply grease to the inside of center collar (4).
- Replace the oil seals with new ones.
- Be sure to pay attention to how to assemble lower oil seal (7). (Steel cover is outside.)
- Apply liquid gasket (Three Bond 1208D or its equivalent) to the face of center pulley holder (3).

Tightening torque	Center pulley holder mounting screw	77.4 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft-lbs
-------------------	-------------------------------------	---

- | | |
|--|------------------------|
| (1) Center Pulley Holder Mounting Screws | (4) Center Collar |
| (2) Upper Oil Seal | (5) Ball Bearing |
| (3) Center Pulley Holder | (6) Internal Snap Ring |
| | (7) Lower Oil Seal |

W1012645



Side Blade Pulley Holder Assembly

- 1. Remove the side blade pulley mounting nut (2).
- 2. Remove the side blade pulley (3), feather key (7) (only right side blade pulley) and grease nipple (1) from the blade shaft (6).
- 3. Remove the side blade pulley holder mounting nuts (4) and bolts (5).
- 4. Separate the side blade pulley holder assembly from the mower deck.

Tightening torque	Side blade pulley holder mounting nut and bolt	77.4 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft-lbs
	Side blade pulley mounting nut	102.9 to 117.6 N·m 10.5 to 12.0 kgf·m 75.9 to 86.8 ft-lbs

- (1) Grease Nipple

(2) Side Blade Pulley Mounting Nut

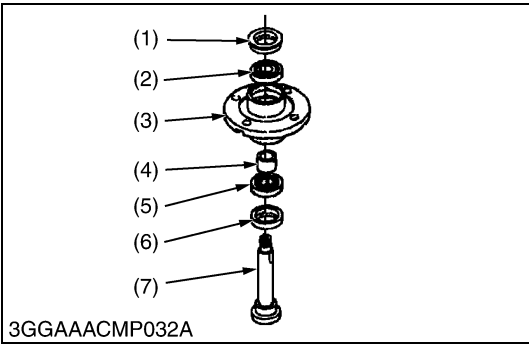
(3) Side Blade Pulley

(4) Side Blade Pulley Holder Mounting Nuts
- (5) Side Blade Pulley Holder Mounting Bolts

(6) Blade Shaft

(7) Feather Key (Only right side blade pulley)

W1012965



Disassembling Side Pulley Holder Assembly

- 1. Tap out blade shaft (7).
- 2. Remove the lower oil seal (6).
- 3. Remove the bearings (2), (5) and collar (4).
- 4. Remove the upper oil seal (1).

(When reassembling)

- Apply grease to the bearing and oil seal lips.
- Apply grease to the inside of center collar.
- Replace the oil seals with new ones.
- Be sure to pay attention to how to assemble lower oil seal. (Steel cover is outside.)

- (1) Upper Oil Seal

(2) Ball Bearing

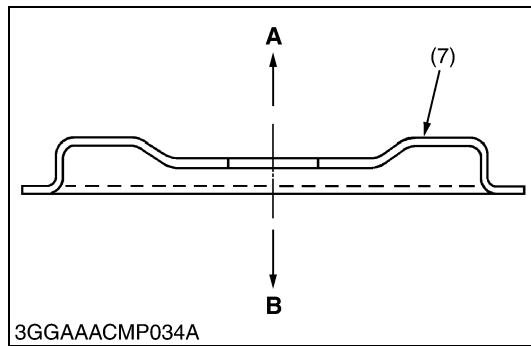
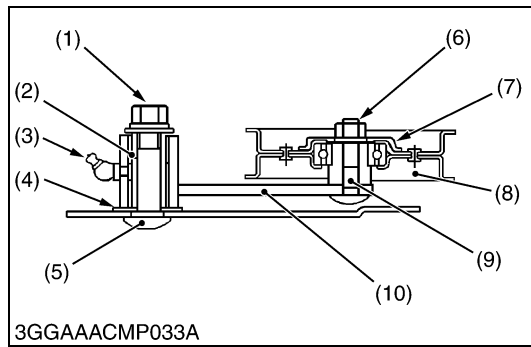
(3) Side Pulley Holder

(4) Collar
- (5) Ball Bearing

(6) Lower Oil Seal

(7) Blade Shaft

W1013296



Disassembling LH Tension Pulley

1. Remove the tension spring from the tension arm (10).
2. Remove the tension arm mounting bolt (5) and nut (1).
3. Remove the tension arm assembly, tension collar (2) and plate (4).
4. Remove the tension pulley mounting bolt (9) and nut (6).
5. Remove the tension pulley (8) and the tension cover (7) from the tension arm (10).

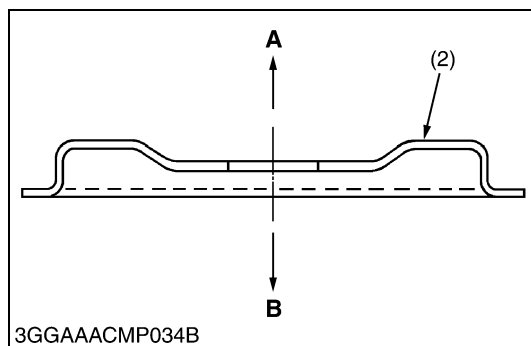
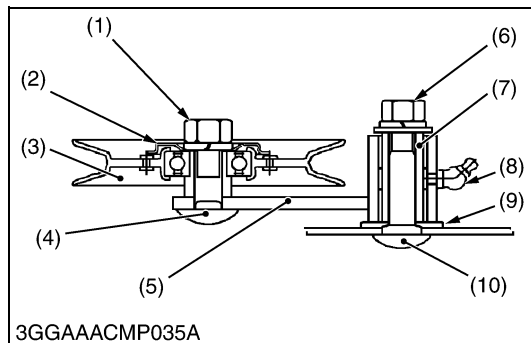
(When reassembling)

- In fitting the tension cover (7), be careful not to confuse its top and bottom as shown in the figure.
- Apply grease to the tension arm bushing.

Tightening torque	Tension pulley mounting bolt and nut	47.0 to 56.8 N·m 4.8 to 5.8 kgf·m 34.7 to 42.0 ft-lbs
	Tension arm mounting bolt and nut	77.4 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft-lbs

- | | |
|---------------------------------|---|
| (1) Tension Arm Mounting Nut | (8) Tension Pulley |
| (2) Tension Collar | (9) Tension Pulley Mounting Bolt |
| (3) Grease Nipple | (10) Tension Arm |
| (4) Plate | A : Top (Nut Side) |
| (5) Tension Arm Mounting Bolt | B : Bottom (Tension Pulley Side) |
| (6) Tension Pulley Mounting Nut | |
| (7) Tension Cover | |

W1013542



Disassembling RH Tension Pulley

1. Remove the tension spring from the tension arm (5).
2. Remove the tension arm mounting bolt (10) and nut (6).
3. Remove the tension arm assembly, tension collar (7) and plate (9).
4. Remove the tension pulley mounting bolt (4) and nut (1).
5. Remove the tension pulley (3) and the tension cover (2) from the tension arm.

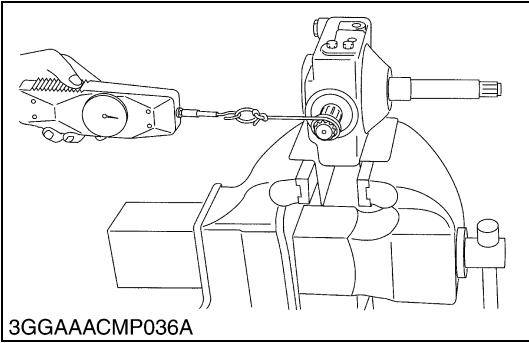
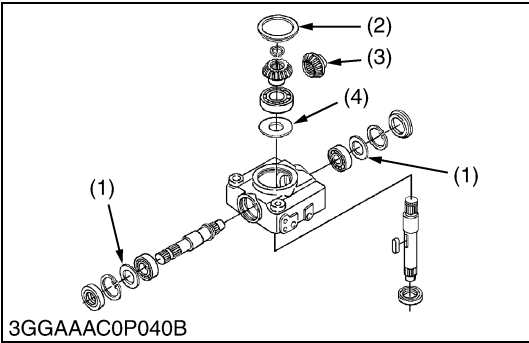
(When reassembling)

- In fitting the tension cover (2), be careful not to confuse its top and bottom as shown in the figure.
- Apply grease to the tension arm bushing.

Tightening torque	Tension pulley mounting bolt and nut	108.8 to 130.3 N·m 11.1 to 13.3 kgf·m 80.3 to 96.2 ft-lbs
	Tension arm mounting bolt and nut	77.4 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft-lbs

- | | |
|----------------------------------|---|
| (1) Tension Pulley Mounting Nut | (8) Grease Nipple |
| (2) Tension Cover | (9) Plate |
| (3) Tension Pulley | (10) Tension Arm Mounting Bolt |
| (4) Tension Pulley Mounting Bolt | A : Top (Nut Side) |
| (5) Tension Arm | B : Bottom (Tension Pulley Side) |
| (6) Tension Arm Mounting Nut | |
| (7) Tension Collar | |

W1013954



Backlash between Bevel Gears

1. Remove the gear case cap (2).
2. Place fuses the 21T bevel gear (3) on the pinion shaft.
3. Turn the pinion shaft.
4. Take out the fuses, and measure the thickness of fuses with an outside micrometer. Backlash equals thickness of fuse.
5. If the backlash is not within the factory specifications, adjust with shims (1), (4).
6. Apply red lead lightly over several teeth at three positions equally spaced on the bevel gear.
7. Turn the pinion shaft.
8. Check the tooth contact. If not proper, adjust with shims (1), (4).

■ IMPORTANT

- After checking the tooth contact, check the backlash between pinion shaft and bevel gear again.
- After the backlash has been adjusted, turn the pinion shaft by hand to make sure it moves smoothly.

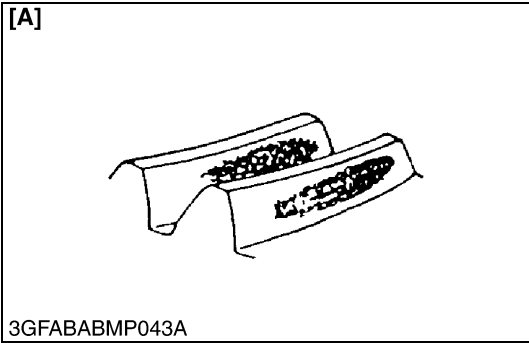
Backlash between bevel gears	Factory spec.	0.13 to 0.25 mm 0.0052 to 0.0098 in.
Turning force	Factory spec.	Less than 14 N Less than 1.4 kgf Less than 10 lbs
Turning torque	Factory spec.	Less than 0.7 N·m Less than 0.07 kgf·m Less than 0.5 ft-lbs

(Reference)

- Thickness of adjusting shims (1):
0.2 mm (0.0079 in.) (Part No. :36330-28420)
0.3 mm (0.0118 in.) (Part No. :36330-28410)
- Thickness of adjusting shims (4):
0.1 mm (0.0039 in.) (Part No. :70712-33570)
0.2 mm (0.0079 in.) (Part No. :76539-33410)

- (1) Shims
- (3) 21T Bevel Gear
- (2) Gear Case Cap
- (4) Shims

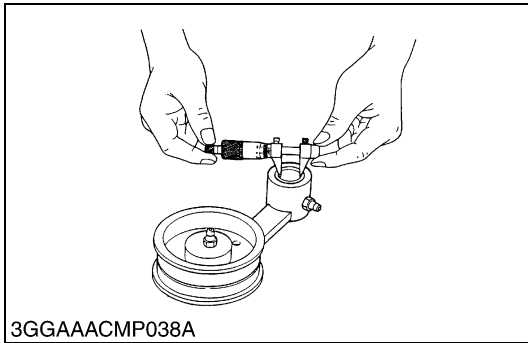
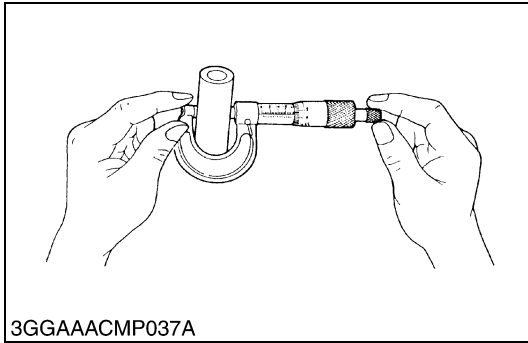
W1014294



Checking Proper Contact

More than 35 % red lead contact area on the gear tooth surface.
The center of tooth contact at 1/3 of the entire width from the small end.

W1014886



Clearance between Tension Collar and Tension Arm Bushing

1. Measure the tension collar O.D. with an outside micrometer.
2. Measure the tension arm bushing I.D. with an inside micrometer, and calculate the clearance.
3. If the clearance exceeds the factory specification, replace them.

Clearance between tension collar and tension arm bushing	Factory spec.	0.005 to 0.117 mm 0.0002 to 0.0046 in.
Tension collar O.D.	Factory spec.	18.997 to 19.027 mm 0.7479 to 0.7491 in.
Tension arm bushing I.D.	Factory spec.	19.032 to 19.114 mm 0.7493 to 0.7525 in.

W1014933

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