

WSM

WORKSHOP MANUAL

**T1570•T1670
T1770•T1870**

Kubota

TO THE READER

This Workshop Manual has been prepared to provide servicing personnel with information on the mechanism, service and maintenance of KUBOTA T1570, T1670, T1770 and T1870. It is divided into two parts, "Mechanism" and "Servicing" for each section.

■ Mechanism

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

■ Servicing

Under the heading "General" section comes 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 production information available at the time of publication.

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

January 2002

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SAFETY FIRST

This symbol, the industry's "Safety Alert Symbol", is used throughout this manual and decals 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

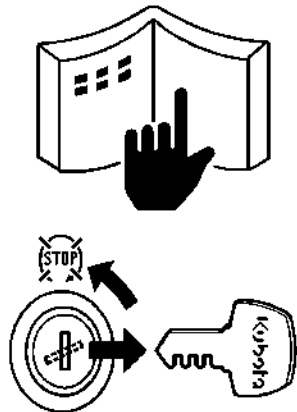
: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

■ IMPORTANT

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

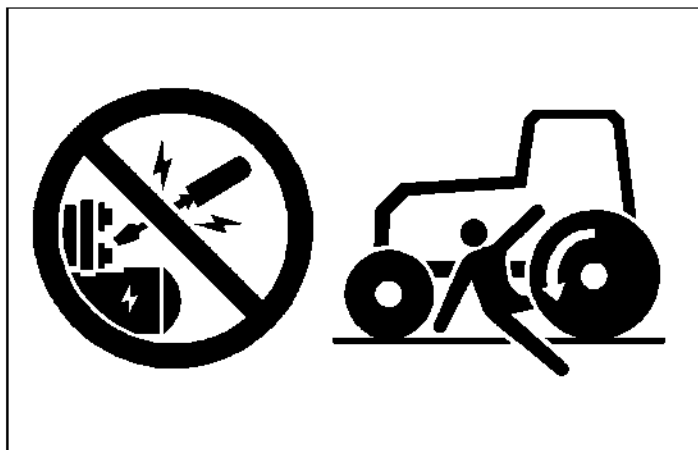
■ NOTE

: Gives helpful information.



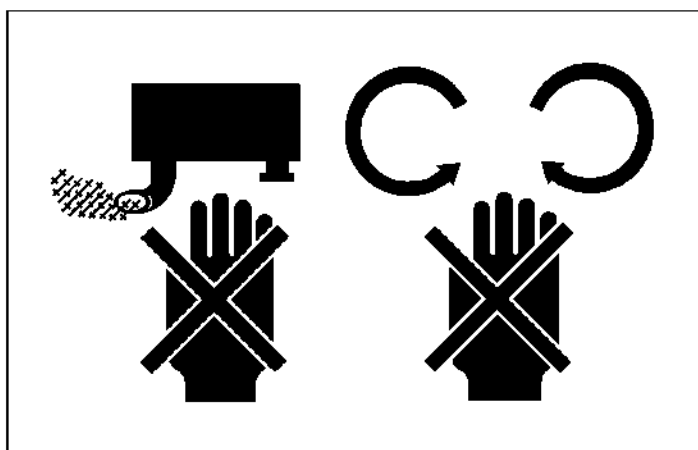
BEFORE SERVICING AND REPAIRING

- 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.



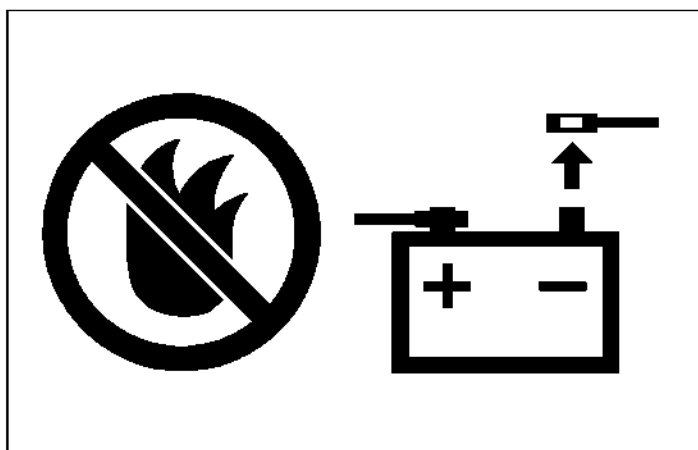
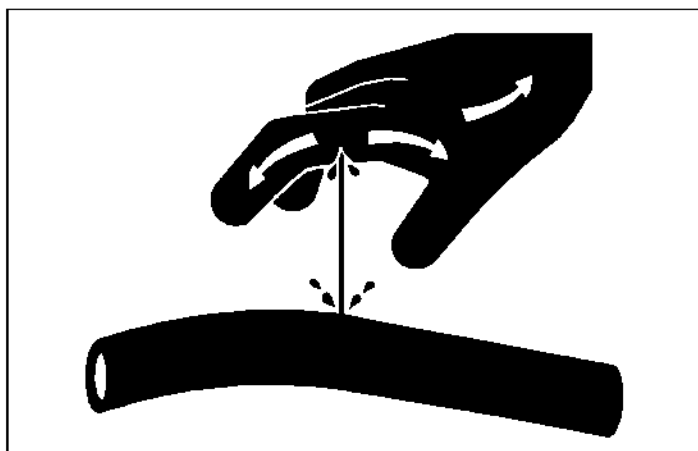
SAFETY STARTING

- 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.



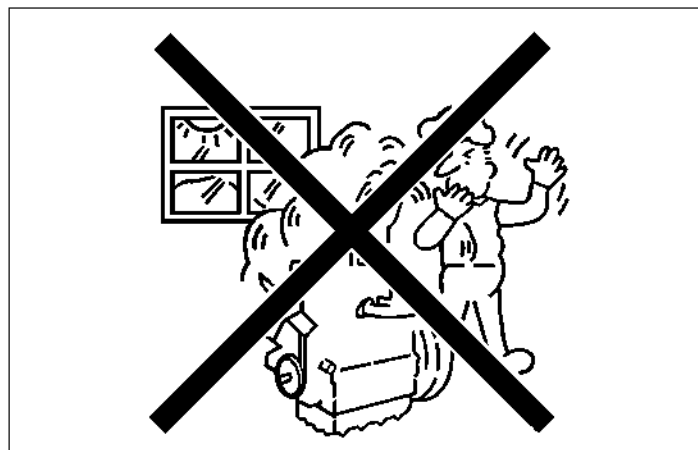
SAFETY WORKING

- 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.



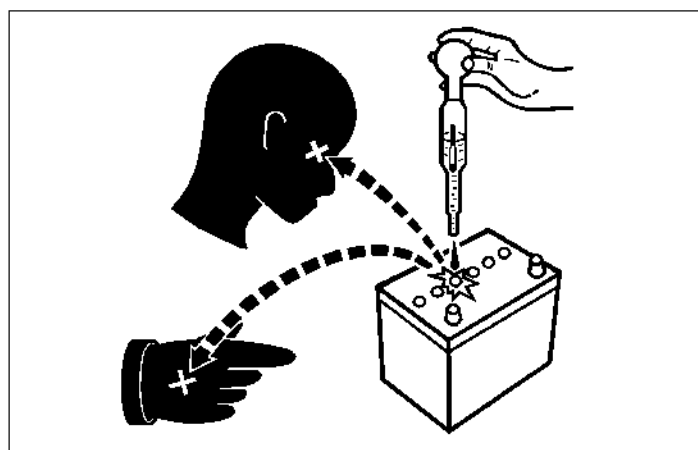
AVOID FIRES

- 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.



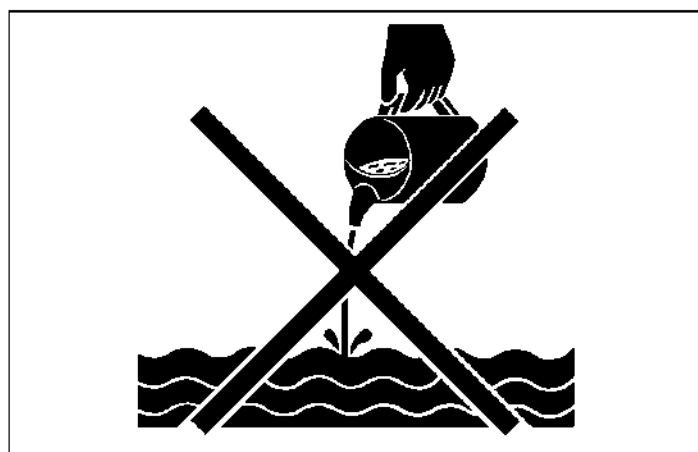
VENTILATE WORK AREA

- 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.



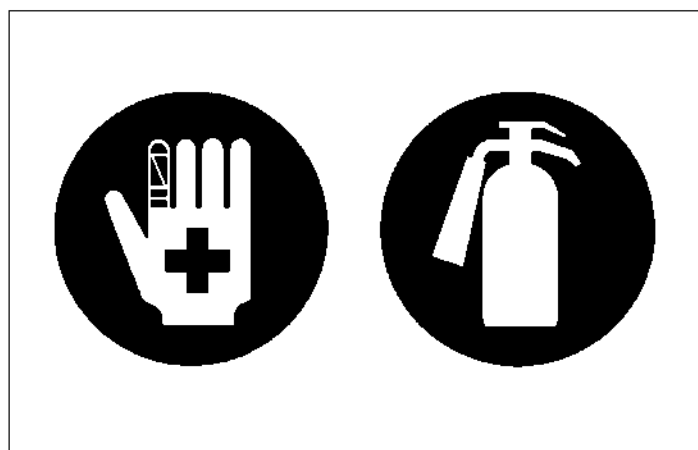
PREVENT ACID BURNS

- 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

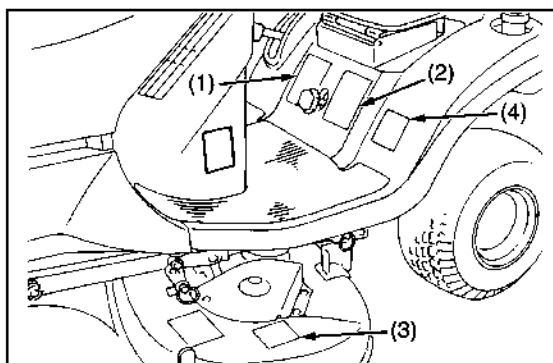
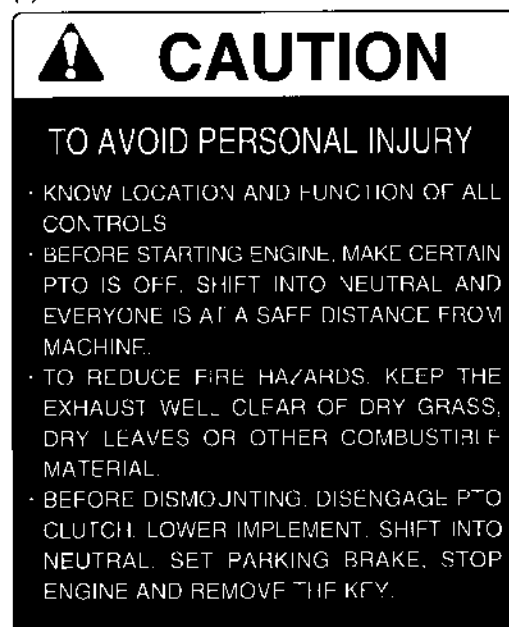
The following safety decals are installed on the machine.

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. K1211-6581-1



(2) Part No. K1211-6582-1

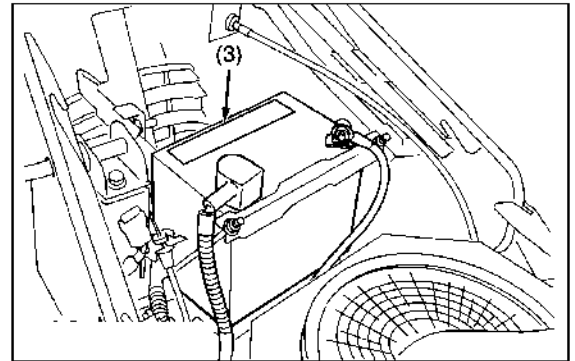
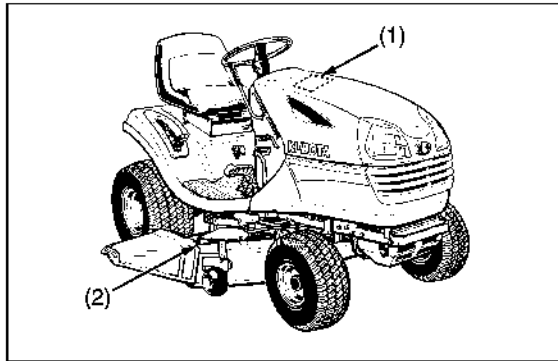


(3) Part No. K5112-7312-2

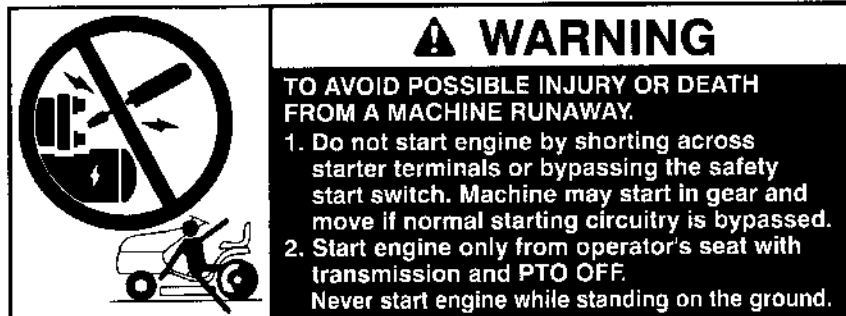


(4) Part No. K1122-6584-1





(1) Part No. K1122-6583-1 (Under Hood)

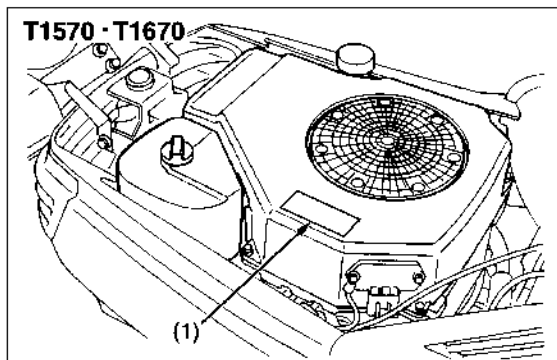


(2) Part No. K5112-7311-1

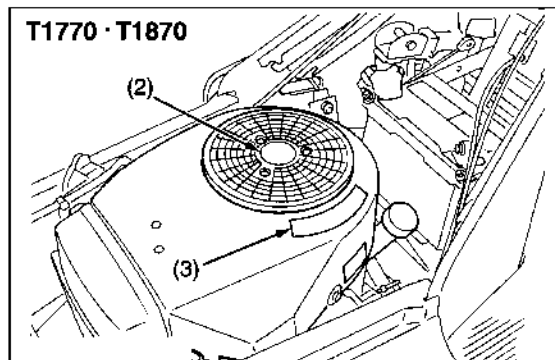
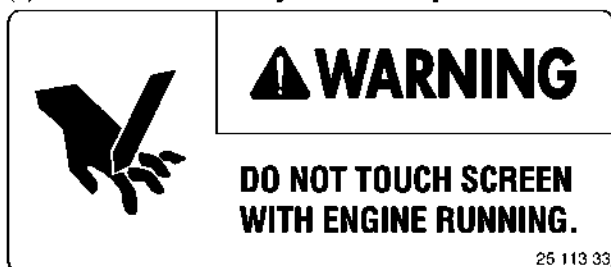


(3) Part No. K1221-6117-1

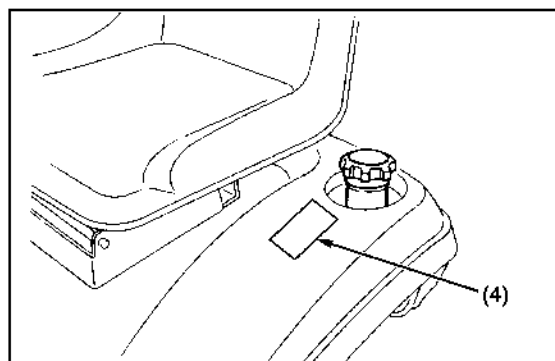




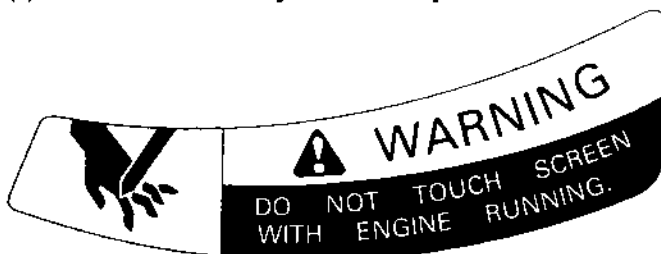
(1) Part No. E7194-4719-1 [T1570 - T1670]



(2) Part No. E7195-4714-1 [T1770 - T1870]



(3) Part No. E7195-4719-1 [T1770 - T1870]



(4) Part No. K1122-6585-1
Gasoline fuel No fire
only



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 Dealer.
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.

T15140ZZ00301

SPECIFICATIONS

Model			T1570	T1670	T1770		T1870
Engine	Model		GH430V		GH500V		GH531V
	Type		Forced air-cooled, Vertical shaft OHV, 4-stroke gasoline engine				
	Number of cylinders		1		2 (V-Twin)		
	Bore and stroke		90 mm × 67 mm (3.55 in. × 2.64 in.)		68 mm × 68 mm (2.68 in. × 2.68 in.)		
	Total displacement		426 cm ³ (26.0 cu.in.)		494 cm ³ (30.1 cu.in.)		
	Maximum horsepower		11.19 kW / 3600 min ⁻¹ (15 HP / 3600 rpm)		17 HP / 3600 rpm		18 HP / 3600 rpm
	Maximum torque		33.22 N·m / 2400 min ⁻¹ (3.39 kgf·m / 2400 rpm, 24.6 ft-lbs / 2400 rpm)		N / A		
	Maximum bare speed		3350 ± 50 mim ⁻¹ (3350 ± 50 rpm)				
	Minimum bare idling speed		1550 ± 50 mim ⁻¹ (1550 ± 50 rpm)		1550 mim ⁻¹ (1550 rpm)		
	Direction of rotation		Counterclockwise facing the PTO shaft				
	Compression ratio		8.5 : 1				
	Ignition system		Flywheel magnet transistor type				
	Spark plug		Champion Premium Gold 2071		Champion RCJ8Y		
	Carburetor		Float type with fixed main jet				
	Air cleaner		Semi-cyclone type with dual element		Dual stage element, dry type		
	Governor		Mechanical flyweight type				
	Lubricating system		Forced lubrication by oil pump				
	Cooling system		Forced air cooling				
	Starting system		Electric starter (12 V, 0.6 kW)				
	Charging system		Charging coil (12 V, 15 A)		Charging coil (12 V, 13 A)		
	Battery		U1L-9 (12 V, 300 CCA)				
	Throttle system		Manual				
	Engine stop system		Key stop				
Capacities	Fuel tank		11.0 L (2.9 U.S.gals., 2.4 Imp.gals.)	15.0 L (3.9 U.S.gals., 1.7 Imp.gals.)			
	Engine crankcase		1.9 L (2.0 U.S.qts., 1.7 Imp.qts.)		1.7 L (1.8 U.S.qts., 1.6 Imp.qts.)		
	Hydrostatic transmission case		2.3 L (2.4 U.S.qts., 2.0 Imp.qts.)	3.6 L (3.8 U.S.qts., 3.2 Imp.qts.)			
Dimensions	Overall length		1720 mm (67.7 in.)	1747 mm (68.8 in.)			
	Overall width		1320 mm (52.0 in.)	1320 mm (52.0 in.)	1444 mm (56.9 in.)		1544 mm (60.8 in.)
	Overall height		1065 mm (41.9 in.)	1115 mm (43.9 in.)			
	Wheel base		1195 mm (47.0 in.)	1209 mm (47.6 in.)			
	Tread	Front	710 mm (28.0 in.)	723 mm (28.5 in.)			
		Rear	660 mm (26.0 in.)	655 mm (25.8 in.)			
Weight (with mower)			250 kg (551 lbs) 40 inch	270 kg (595 lbs) 40 inch 280 kg (617 lbs) 44 inch	280 kg (617 lbs) 44 inch		285 kg (628 lbs) 48 inch

W1028323

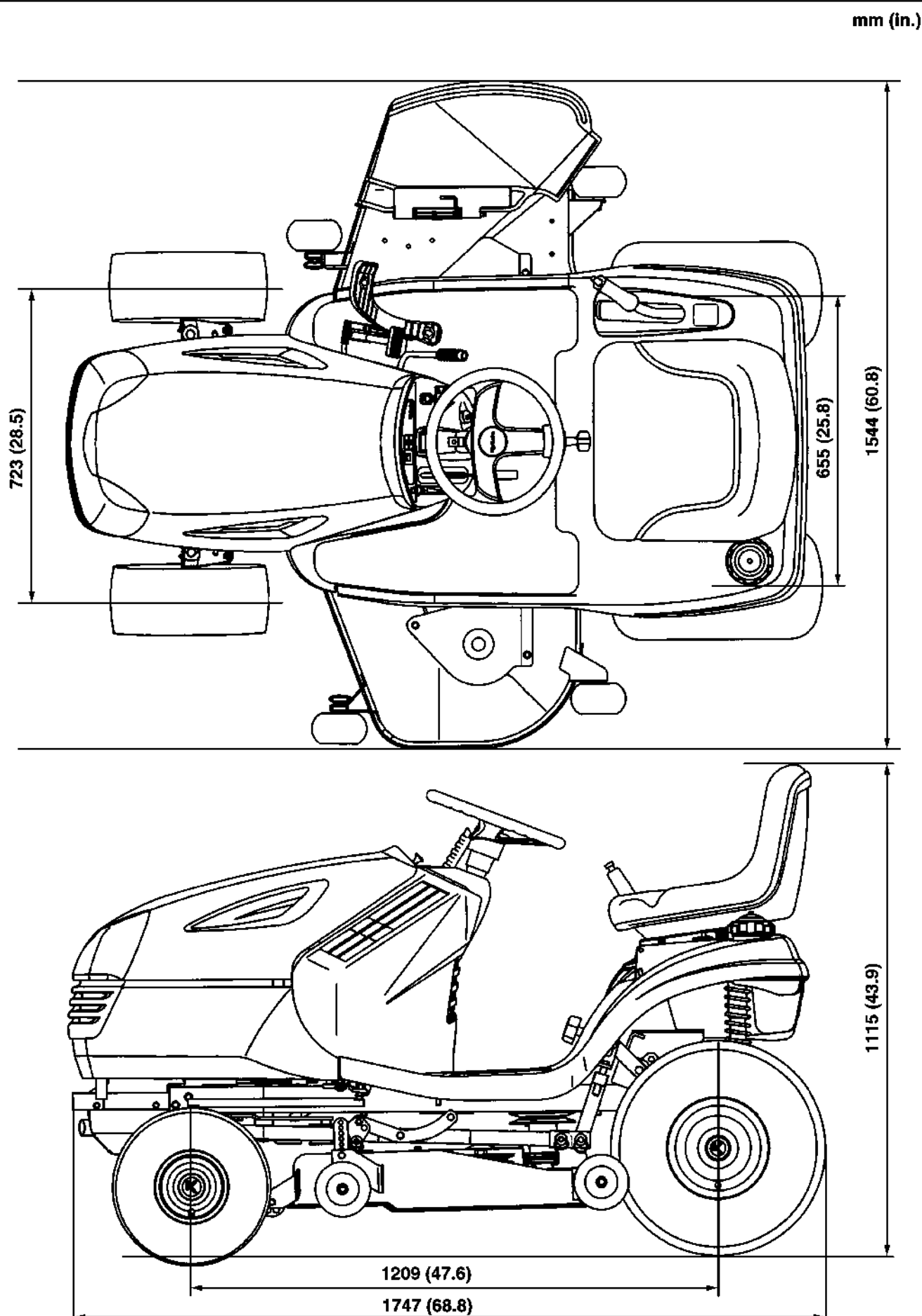
Model		T1570	T1670	T1770	T1870
Tire size	Front	15 × 6.00–6			
	Rear	18 × 9.50–8	20 × 10.00–8		
Steering system		Sector gear type			
Transmission		Hydrostatic transmission			
Brake		Disk type			
Traveling speed	Forward	0 to 9.0 km / h (0 to 5.6 mph)			
	Reverse	0 to 5.0 km / h (0 to 3.1 mph)			
PTO clutch		Belt tension			

W1034130

Model		T1570	T1670	T1770	T1870	
Mower	Model	RCK40LTB		RCK44LTB		RCK48LT17B
	Overall length	835 mm (32.9 in.)		793 mm (31.2 in.)		863 mm (34.0 in.)
	Overall width	1320 mm (52.0 in.)		1444 mm (56.9 in.)		1544 mm (60.8 in.)
	Overall height	260 mm (10.2 in.)		271 mm (10.7 in.)		289 mm (11.4 in.)
	Mounting method	Parallel linkage				
	Adjustment of cutting height	Dial gauge				
	Cutting width	1016 mm (40 in.)		1118 mm (44 in.)		1219 mm (48 in.)
	Cutting height	25 to 102 mm (1.0 to 4.0 in.)				
	Number of blades	2		3		
	Weight (Approx.)	40 kg (88.2 lbs)		50 kg (110.2 lbs)		55 kg (121 lbs)
	Discharge	Right side				

W1036385

DIMENSIONS



T15140ZZ00401

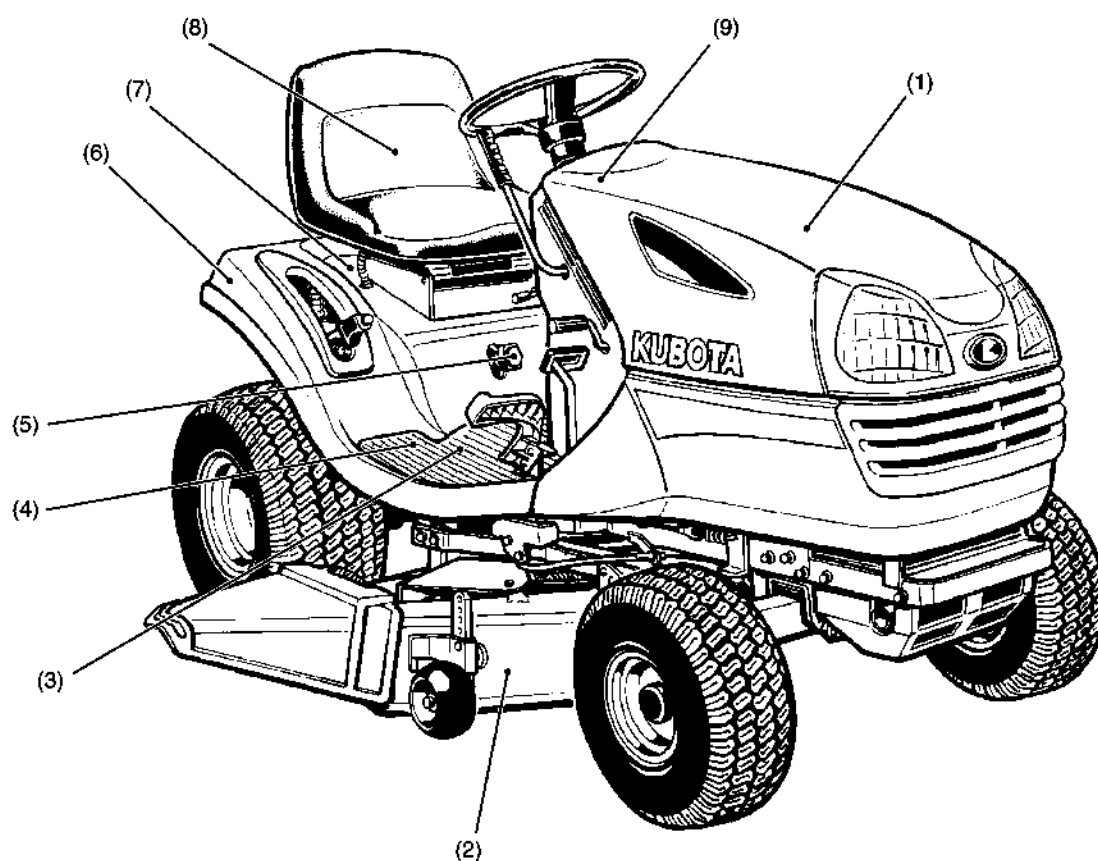
G GENERAL

GENERAL

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1. FEATURES

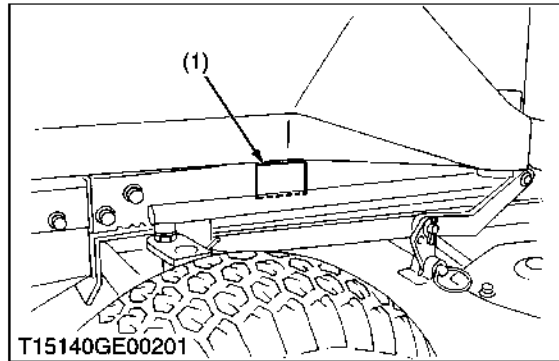


T15140GE00101

1. High powered OHV gasoline engine
2. Mid-mount mower decks
3. Smooth hydrostatic transmission
4. Full-flat operator's deck
5. Simple-dial type cutting adjustment
6. Fender suspension "Cushion Ride" system
7. Large fuel tank
8. Easy-adjust high-back seat
9. KRA (Kubota Reverse Awareness) system

2. IDENTIFICATION

[1] MACHINE

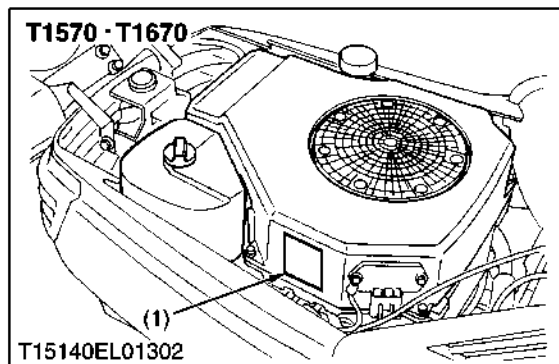


When contacting your local KUBOTA distributor, always specify machine serial number.

(1) Machine Serial Number

W1011087

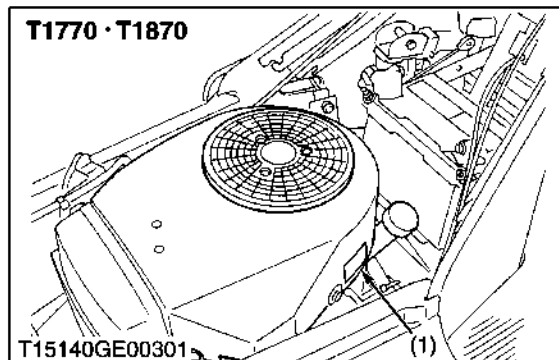
[2] ENGINE



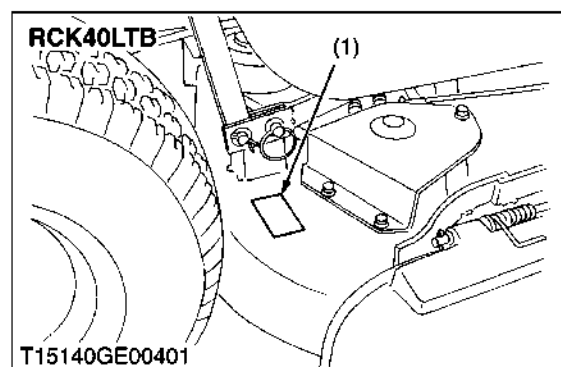
When contacting your local KUBOTA distributor, always specify engine serial number.

(1) Engine Serial Number

W1011231



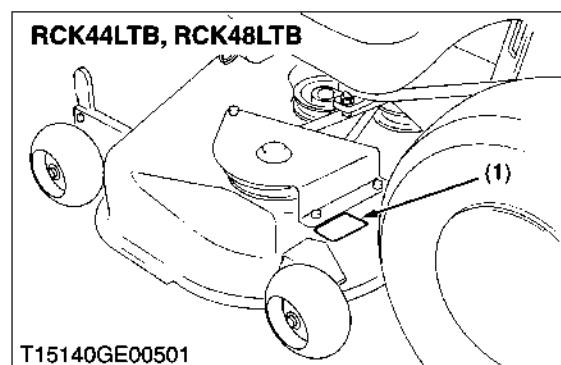
[3] MOWER



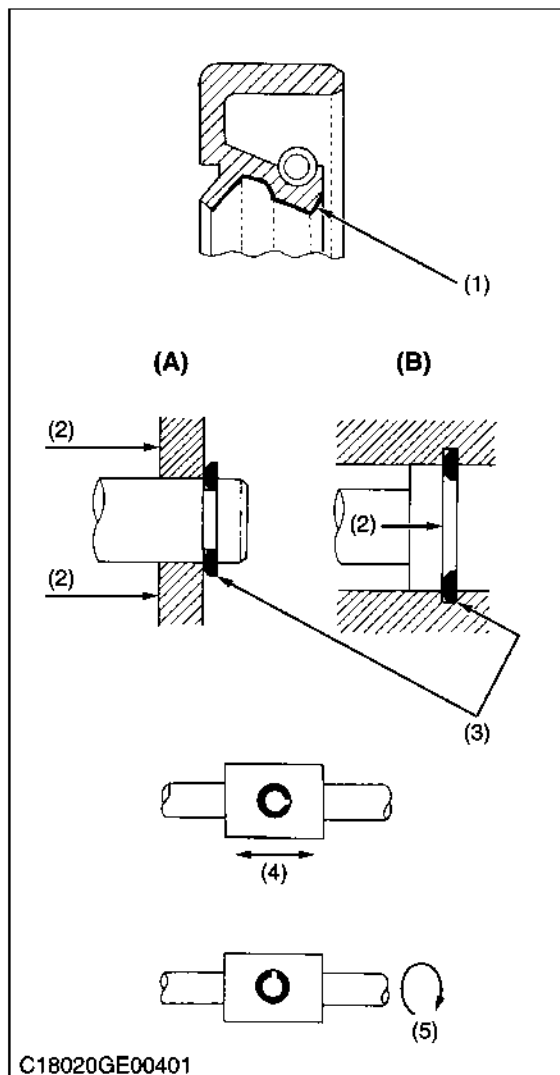
When contacting your local KUBOTA distributor, always specify mower serial number.

(1) Mower Serial Number

W1011300



3. GENERAL PRECAUTIONS



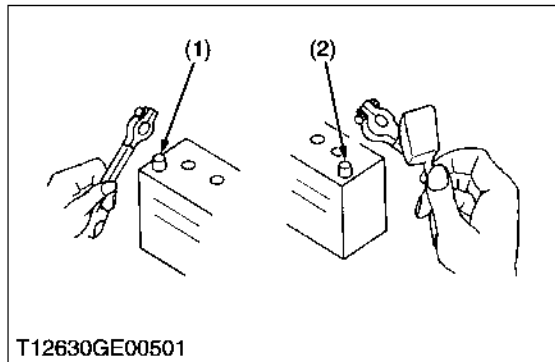
- During disassembly, carefully arrange removed parts in a clean area to prevent confusion later. Screws, bolts and nuts should be installed in their original position to prevent reassembly errors.
- When special tools are required, use KUBOTA genuine special tools. Special tools which are not frequently 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

W1011376

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

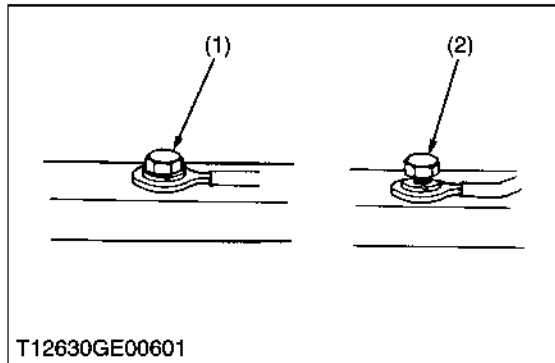
- Check electrical wiring for damage and loosened connection every year. To this end, educate the customer to do his or her own check and at the same time recommend the dealer to perform periodic check for a fee.
- Do not attempt to modify or remodel any electrical parts and wiring.
- When removing the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

(1) Negative Terminal

(2) Positive Terminal

W1011502

[1] WIRING

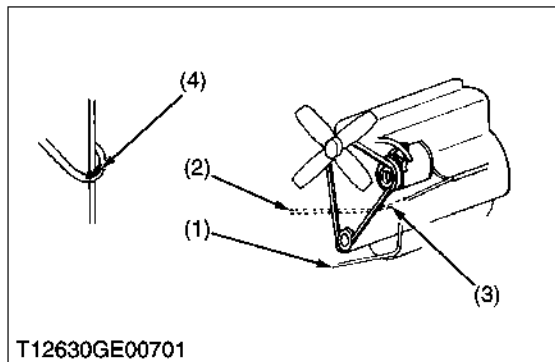


- Securely tighten wiring terminals.

(1) Correct
(Securely tighten)

(2) Incorrect
(Loosening leads to faulty contact)

W1011582

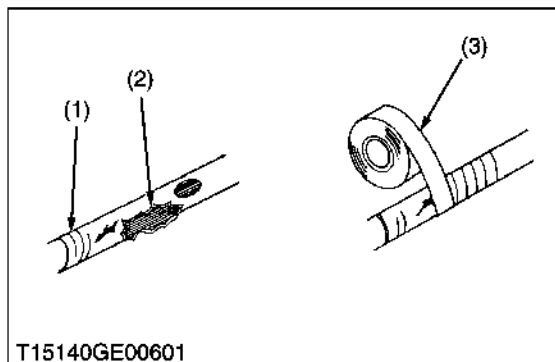


- Do not let wiring contact dangerous part.

(1) Wiring (Correct)
(2) Wiring (Incorrect)

(3) Dangerous Part
(4) Dangerous Part

W1011667

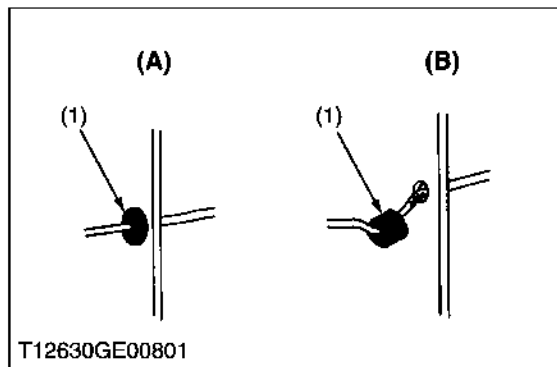


- Repair or change torn or aged wiring immediately.

(1) Aged
(2) Torn

(3) Insulating Vinyl Tape

W1011748



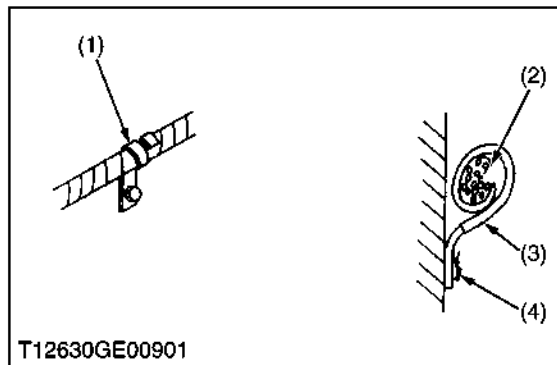
- Securely insert grommet.

(1) Grommet

(A) Correct

(B) Incorrect

W1011823



- Securely clamp, being careful not to damage wiring.

(1) Clamp

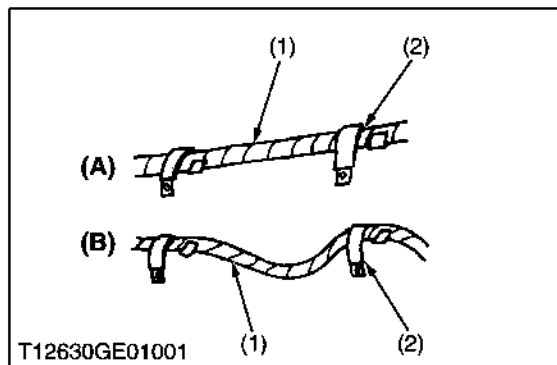
(3) Clamp

- Wind Clamp Spirally

(4) Welding Dent

(2) Wire Harness

W1011951



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

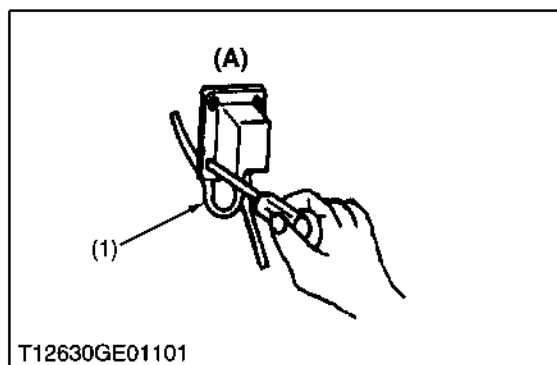
(1) Wiring

(A) Correct

(2) Clamp

(B) Incorrect

W1012047

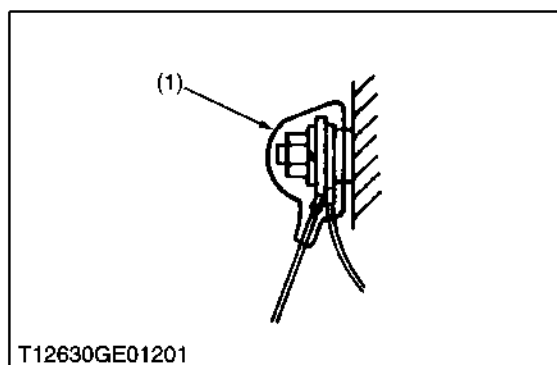


- In installing a part, take care not to get wiring caught by it.

(1) Wiring

(A) Incorrect

W1012126



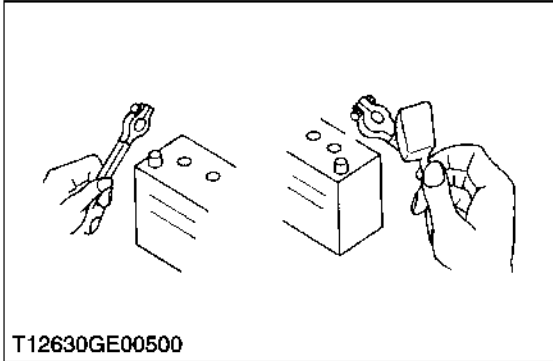
- After installing wiring, check protection of terminals and clamped condition of wiring, only connect battery.

(1) Cover

- Securely Install Cover

W1012193

[2] BATTERY



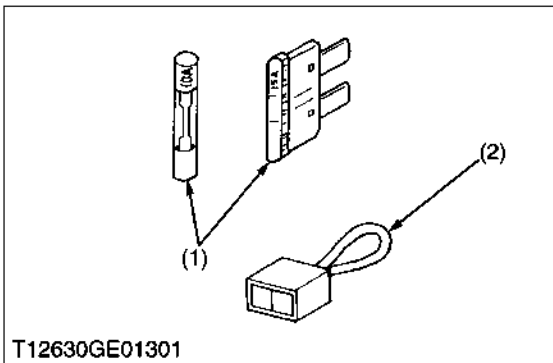
- Take care not to confuse positive and negative terminal posts.
- When removing battery cables, disconnect negative cable first. When installing battery cables, check for polarity and connect positive cable first.
- Do not install any battery with capacity other than is specified (Ah).
- After connecting 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.

W1012283

[3] FUSE



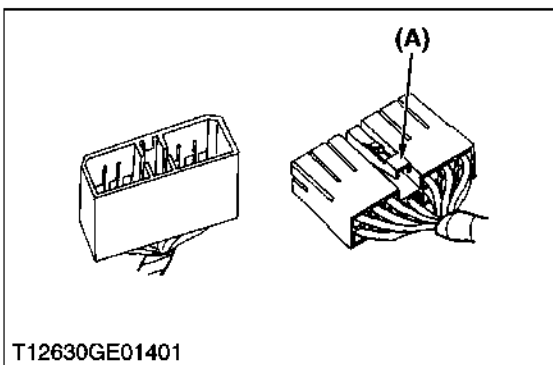
- Use fuses with specified capacity. Neither too large or small capacity fuse is acceptable.
- Never use steel or copper wire in place of fuse.
- Do not install working light, radio set, etc. on machine which is not provided with reserve power supply.
- Do not install accessories if fuse capacity of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

(1) Fuse

(2) Slow Blow Fuse

W1012431

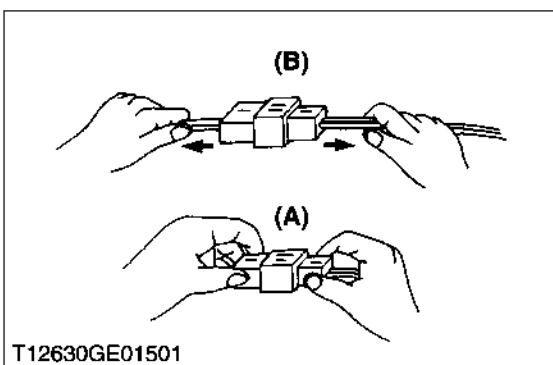
[4] CONNECTOR



- For connector with lock, push lock to separate.

(A) Push

W1012558

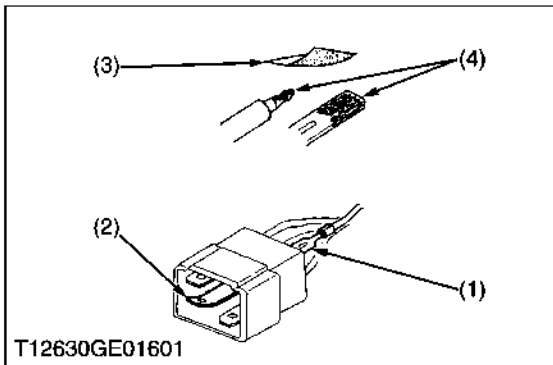


- In separating connectors, do not pull wire harnesses.
- Hold connector bodies to separate.

(A) Correct

(B) Incorrect

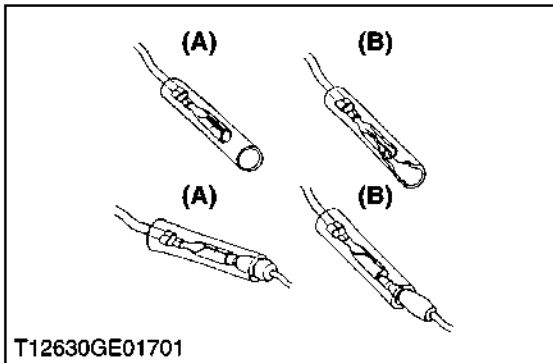
W1012975



- 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

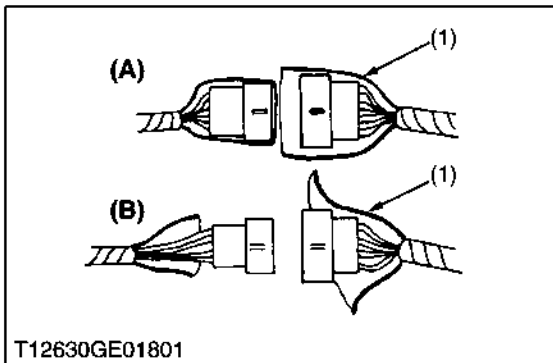
W1013108



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

(A) Correct (B) Incorrect

W1013281

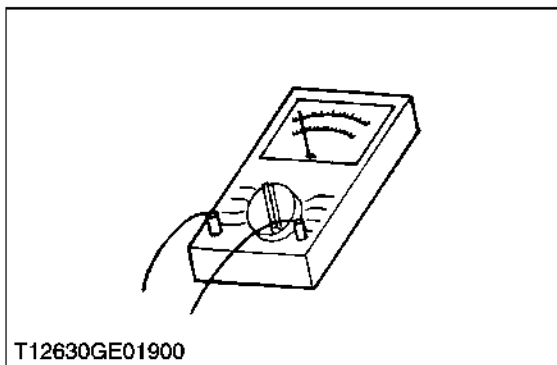


- Make certain plastic cover is large enough to cover whole connector.

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

W1013360

[5] HANDLING OF CIRCUIT TESTER



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

W1013437

5. FUEL AND LUBRICANTS

	Place	Capacity				Lubricants
		T1570	T1670	T1770	T1870	
1	Fuel	11 L 2.9 U.S.gals. 2.5 Imp.gals.	15 L 3.9 U.S.gals. 3.3 Imp.gals.			Automobile unleaded or regular gasoline Unleaded gasoline 87 octane or higher (T1570, T1670)
2	Engine crankcase	1.9 L 2.0 U.S.qts. 1.7 Imp.qts.		1.7 L 1.8 U.S.qts. 1.5 Imp.qts.		[T1570 · T1670] Engine oil : API service classification SG, SH, SJ or higher Below 0 °C (32 °F) : SAE 5W-20 or 5W-30 Above -18 °C (0 °F) : SAE 10W-30, 10W-40 [T1770 · T1870] Engine oil : API service classification SF, SG, SH or SJ Below 0 °C (32 °F) : SAE 5W-20 -20 to 35 °C (-4 to 95 °F) : SAE 10W-30 or 10W-40 0 to 35 °C (32 to 95 °F) : SAE 30 Above 20 °C (68 °F) : SAE 40
3	Hydrostatic transmission	2.3 L 2.4 U.S.qts. 2.0 Imp.qts.	3.6 L 3.8 U.S.qts. 3.2 Imp.qts.			Engine oil : API service classification SH, SJ or CD SAE 20W-50
4	King pin (Left and right)	Until grease overflows				SAE multipurpose type grease
	Tension arm					
5	Front axle pivot pin	Moderate amount				Oil or spray type grease
	Brake pedal shaft					
	Seat adjuster					
	Speed control pedal shaft					
	Throttle cable					
	PTO clutch cable					
	Mower brake cable					
	Mower link					

W1013563

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	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
Diameter															
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 NUT

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.	Items			Period	Indication on hour meter												Since then	Refer- ence page		
					25	50	100	150	200	250	300	350	400	450	500	550				
1	Air cleaner (T1570 · T1670)	Precleaner element	Clean	☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	every 25 Hrs	G-20	* 1		
		Air cleaner element	Replace			☞		☞		☞		☞		☞		☞	every 100 Hrs	G-29		
2	Air cleaner (T1770 · T1870)	Foam element	Clean	☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	every 25 Hrs	G-20	* 1		
		Paper element	Clean		☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	every 50 Hrs	G-21		* 1
			Replace					☞				☞				☞	every 200 Hrs	G-31		
3	Belt tension		Adjust	★	☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	every 50 Hrs	G-22	* 2	
4	Brake		Check	★	☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	every 50 Hrs	G-23	* 2	
5	Greasing		—	★	☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	every 50 Hrs	G-23		
7	Tire		Check		☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	☞	every 50 Hrs	G-17		
8	Engine oil		Change		★	☞		☞		☞		☞		☞		☞	every 100 Hrs	G-24		
9	Engine shroud		Clean			☞		☞		☞		☞		☞		☞	every 100 Hrs	G-25		
10	Battery condition		Check			☞		☞		☞		☞		☞		☞	every 100 Hrs	G-27		
11	Spark plug condition and gap		Check			☞		☞		☞		☞		☞		☞	every 100 Hrs	G-26		
12	Fuel line		Check			☞		☞		☞		☞		☞		☞	every 100 Hrs	G-27	Ⓒ	
			Replace														every 2 years	G-33		
13	Fuel filter		Check			☞		☞		☞		☞		☞		☞	every 100 Hrs	G-27	* 2	Ⓒ
			Replace							☞					☞	every 300 Hrs	G-32			
14	Cable		Check Adjust			☞		☞		☞		☞		☞		☞	every 100 Hrs	G-27		
15	Engine oil filter		Replace		★			☞				☞				☞	every 200 Hrs	G-30 G-31		
16	Valve clearance [T1770 · T1870]		Check Readjust							☞						☞	every 300 Hrs	—	* 2	
17	Solenoid shift starter		Clean											☞			every 500 Hrs or annually	11- S12	* 2	
18	Fuse		Replace														Service as required	—		
19	Light bulb		Replace																	
20	Mower blade		Check Replace																	

■ IMPORTANT

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

*1 Air cleaner should be cleaned more often in dusty conditions than in normal conditions.

*2 Consult your local KUBOTA Dealer for this service.

- The items listed above (@ marked) are registered as emission related critical parts by KUBOTA in the U.S.EPA nonroad emission regulation. As the engine owner, you are responsible for the performance of the required maintenance on the engine according to the above instruction. Please see the Warranty Statement in detail.

W1019800

8. CHECK AND MAINTENANCE



CAUTION

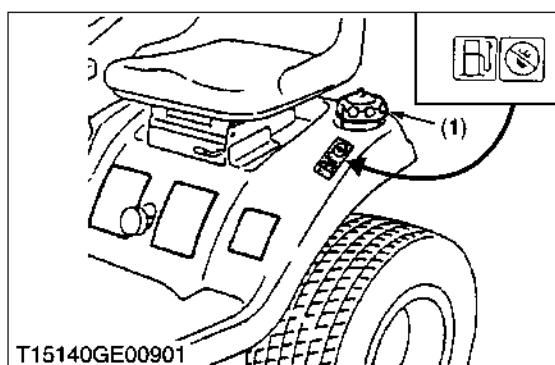
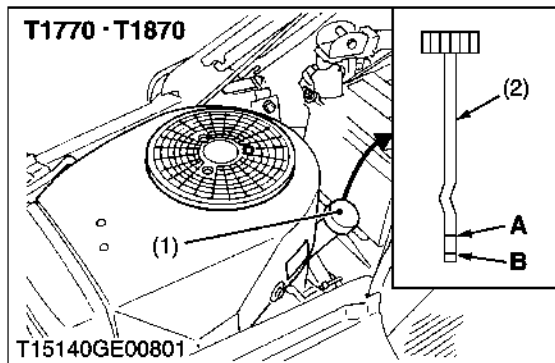
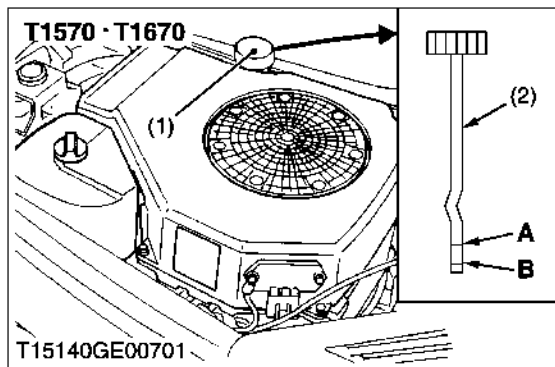
- Be sure to check and service the machine on a flat place with engine shut off, the parking brake on and chock the wheels.

[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 leak
 2. Engine oil level
 3. Damage of machine body, tightness of all bolts and nuts
 4. Air intake screen
 5. Panel screen
 6. Air cleaner
 7. 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 without screwing it in, and draw it out again. Check to see that the oil level is between the two marks.
 4. Add new oil to the prescribed level at the engine oil port (1) if necessary.

IMPORTANT

- Use the specified engine oil. Refer to "FUEL AND LUBRICANTS". (See page PG-10.)
- 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) Engine Oil Port
(2) Dipstick

A: Upper Level
B: Lower Level

W1025974

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	T1570	11 L 2.9 U.S.gals. 2.4 Imp. gals.
	T1670	15 L
	T1770	3.9 U.S.gals.
	T1870	3.3 Imp. gals.

IMPORTANT

- Use gasoline fuel only.
- Do not mix oil with gasoline.

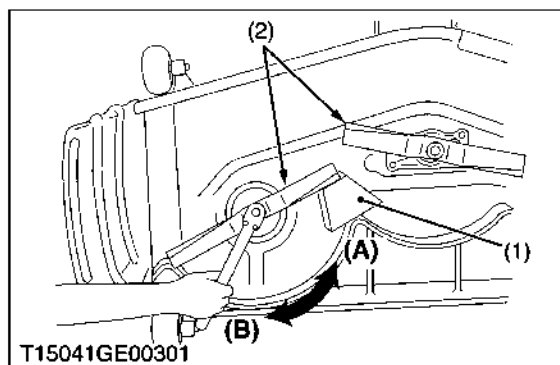
Unleaded fuel is recommended. Regular leaded gasoline with an octane rating index of 87 or higher may be used. Avoid switching from unleaded to regular gasoline to prevent engine damage.

[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

W1026221



Retightening Mower Blade Screw



CAUTION

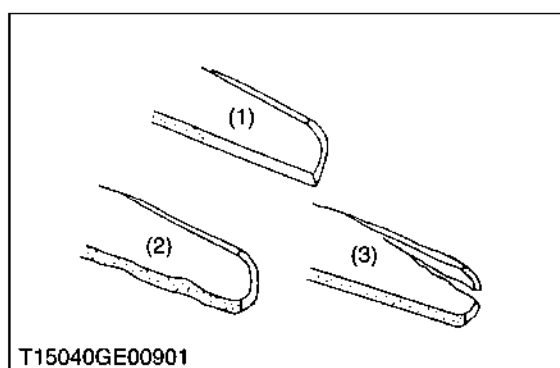
- **To avoid injury, always handle the mower blade with care.**
- 1. Dismount the mower and turn it over to expose the mower blades.
- 2. Wedge a wooden block (1) securely between the mower blade and mower deck.
- 3. Retighten the mower blade screw to the specified torque.
- 4. If the mower blade screw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

Tightening torque	Mower blade screw	102.9 to 117.6 N·m 10.5 to 12.0 kgf·m 75.6 to 86.8 ft-lbs
-------------------	-------------------	---

- (1) Wooden Block
(2) Mower Blade Screw

- (A) Loosen
(B) Tighten

W1026531



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).

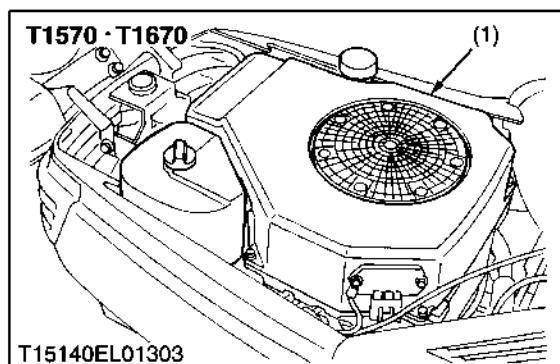
NOTE

- **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



Checking Cooling Air Intake Screen



CAUTION

To avoid personal injury:

- **Be sure to stop the engine before checking or cleaning air intake screens.**

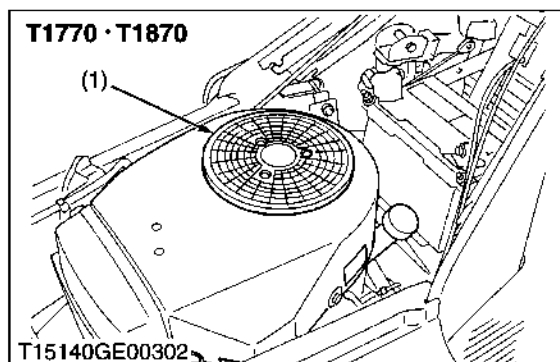
IMPORTANT

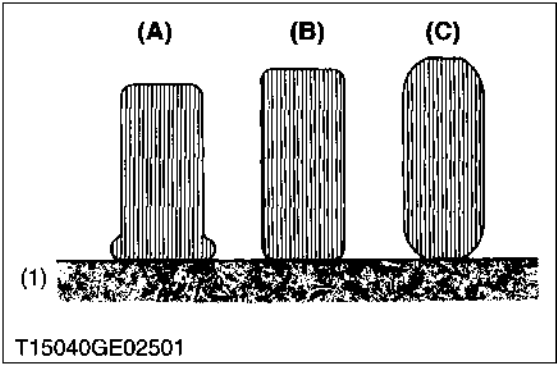
- **Air intake screens must be clear of debris to prevent engine from overheating.**

1. Lift hood and check that the pedestal and air intake screens are clear of grass clippings and debris.
2. If screens are dirty, clean screens with a brush or cloth.
3. If the dust or chaff is accumulated inside of the panel, clean the inside of the panel completely.
After cleaning, place the air intake screen properly.

- (1) Air Intake Screen

W1026832





Checking Tire Pressure, Wear and Damage

 WARNING

- To avoid personal injury:
- Do not attempt to mount a tire on a rim. This should be done by a qualified person with the proper equipment.
 - Always maintain the correct tire pressure. Do not inflate tires above the recommended pressure shown in the Operator's Manual.

 IMPORTANT

- Do not use tires larger than specified.

Normal wheel tire pressures cold	
Front	Rear
100 kPa 14 psi 1.0 kgf/cm ²	70 kPa 10 psi 0.7 kgf/cm ²

(1) Ground

(A) "INSUFFICIENT"
(B) "NORMAL"
(C) "EXCESSIVE"

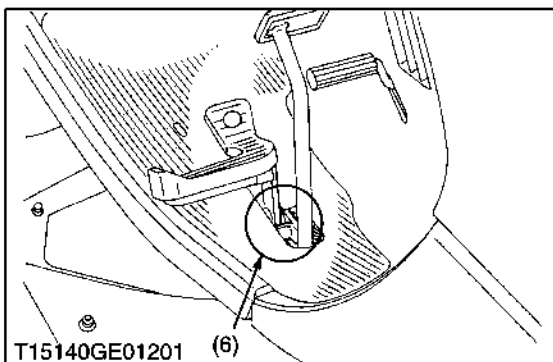
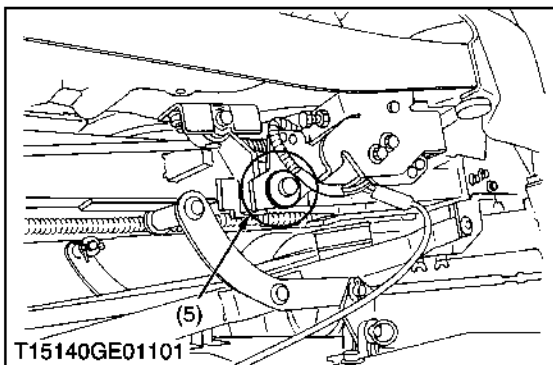
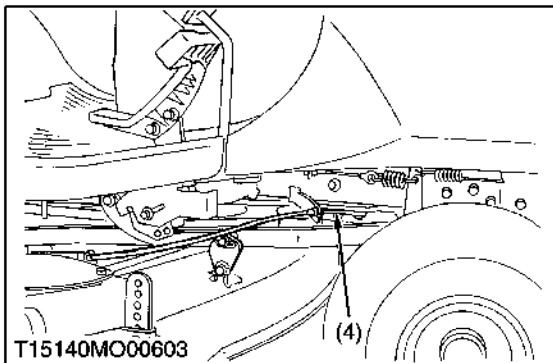
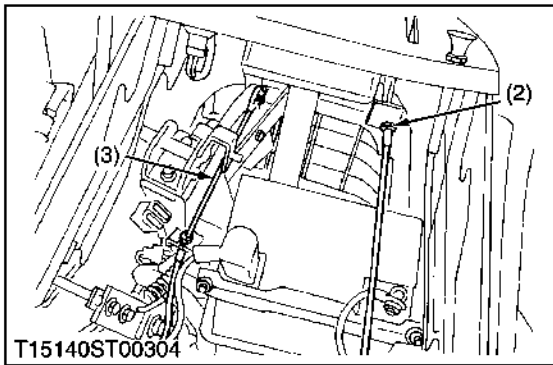
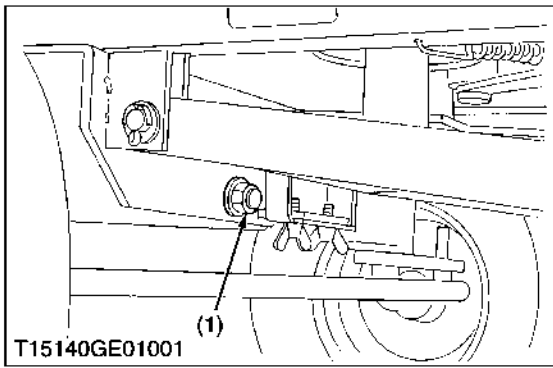
W1026964

Oiling

1. Oil the front axle pivot pin (1), the ends of outer wires of the throttle cable (2), PTO clutch cable (3) and mower brake cable (4), and other oiling points shown in Figures.

- | | |
|--------------------------|-------------------------------|
| (1) Front Axle Pivot Pin | (4) Mower Brake Cable |
| (2) Throttle Cable | (5) Brake Pedal |
| (3) PTO Clutch Cable | (6) Speed Control Pedal Shaft |

W1027159

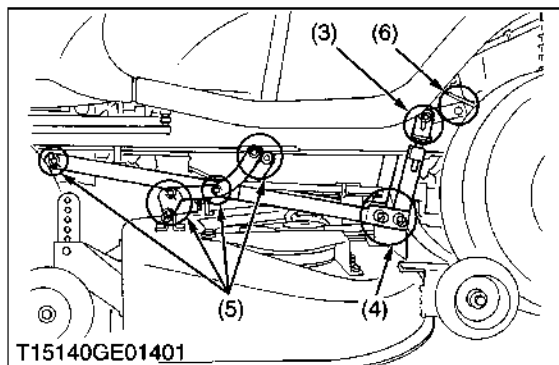
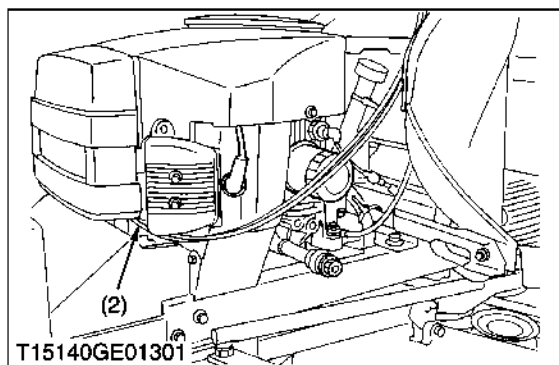
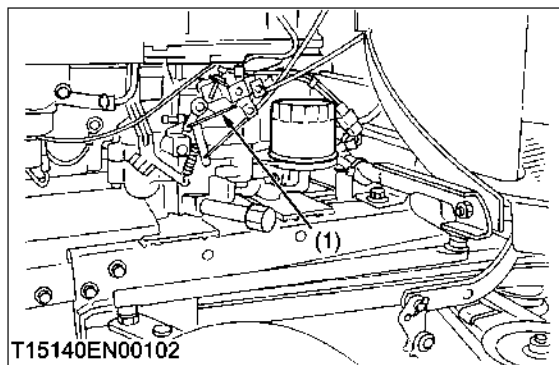


Oiling (Continued)

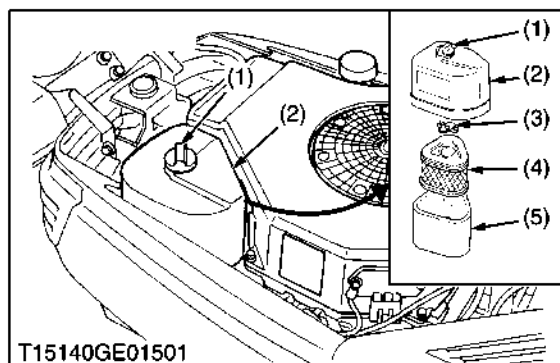
1. Oil the throttle cable (1) (2), and other oiling points shown in Figures.

- | | |
|---------------------------------------|-------------------------|
| (1) Throttle Cable | (4) Around the Pin |
| (2) Throttle Cable | (5) Pivot of Mower Link |
| (3) Around the Hole of the Mower Link | (6) Pivot of Liftarm |

W1035633



[2] CHECK POINTS OF EVERY 25 HOURS



Cleaning Air Cleaner [T1570 · T1670]

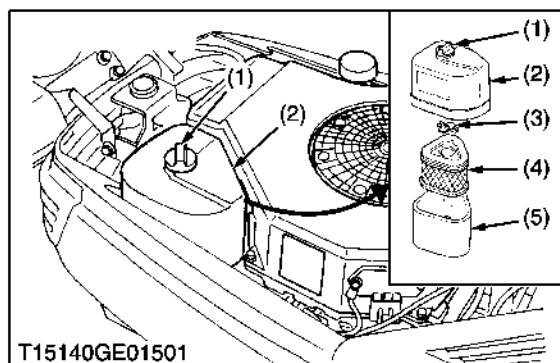
1. Check the air cleaner **daily or before starting the engine**. Check for a buildup of dirt and debris around the air cleaner system. Keep this area clean. Also check for loose or damaged components. Replace all bent or damaged air cleaner components.

■ NOTE

- Operating the engine with loose or damaged air cleaner components could allow unfiltered air into the engine causing premature wear and failure.

- | | |
|----------------------------|-------------------|
| (1) Air Cleaner Cover Knob | (4) Paper Element |
| (2) Air Cleaner Cover | (5) Precleaner |
| (3) Wing Nut | |

W1027594



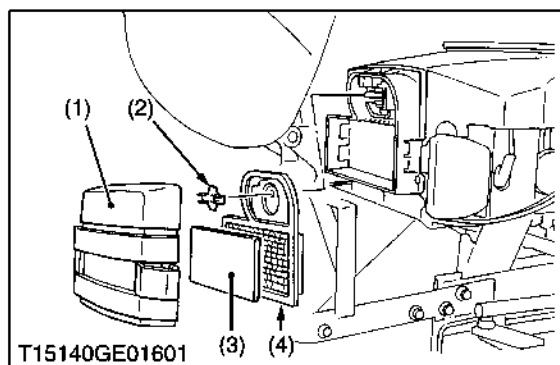
Cleaning Precleaner [T1570 · T1670]

Wash and reoil the precleaner every **25 hours** of operation if equipped (more often under extremely dusty or dirty conditions).

1. Loosen the air cleaner cover knob and remove the cover.
2. Remove the precleaner from the paper element.
3. Wash the precleaner in warm water with detergent. Rinse the precleaner thoroughly until all traces of detergent are eliminated. Squeeze out excess water (do not wring). Allow the precleaner to air dry.
4. Saturate the precleaner with new engine oil. Squeeze out all excess oil.
5. Reinstall the precleaner over the paper element.
6. Reinstall the air cleaner cover and tighten the knob securely.

- | | |
|----------------------------|-------------------|
| (1) Air Cleaner Cover Knob | (4) Paper Element |
| (2) Air Cleaner Cover | (5) Precleaner |
| (3) Wing Nut | |

W1027721



Cleaning Foam Element [T1770 · T1870]

1. Remove the air cleaner cover.
2. Remove the foam element from the paper element. Clean every 25 hours. Wash the element in detergent and water, and dry thoroughly.

■ IMPORTANT

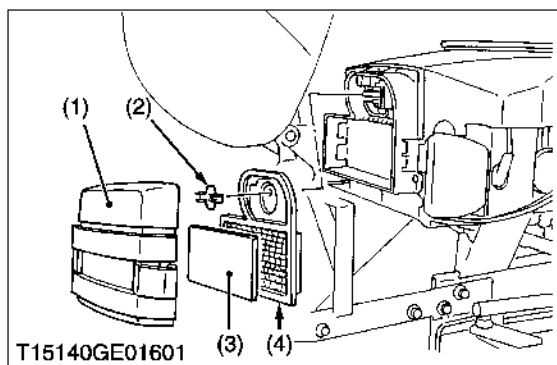
- Do not oil foam element.

■ NOTE

- Operating in dusty condition may require more frequent maintenance than above.

- | | |
|-----------------------|-------------------|
| (1) Air Cleaner Cover | (3) Foam-element |
| (2) Wing Nut | (4) Paper-element |

W1027852



Cleaning Air Cleaner Paper Element [T1770 · T1870]

1. Remove the air cleaner cover.
2. Remove the wing nut and remove the paper element. Clean every 50 hours. Clean the element by tapping gently to remove dust. If very dirty, replace the element with a new one.

■ IMPORTANT

- Do not wash paper-element. Do not oil paper-element. Do not use pressurized air to clean paper-element.

■ NOTE

- Operating in dusty condition may require more frequent maintenance than above.

(1) Air Cleaner Cover

(2) Wing Nut

(3) Foam-element

(4) Paper-element

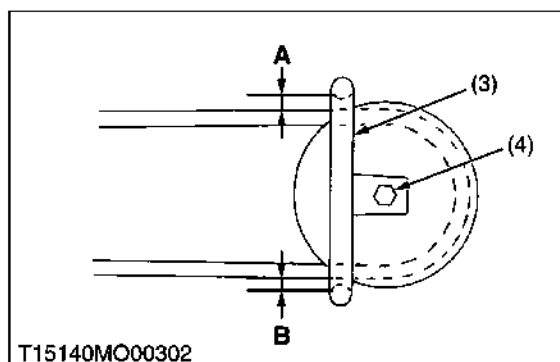
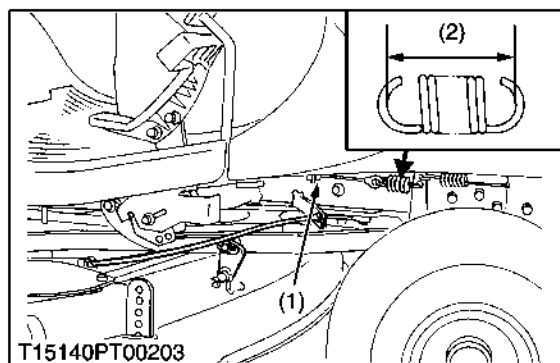
W1028936

Checking Tire Pressure

1. See page G-17.

W1029073

[3] CHECK POINTS OF EVERY 50 HOURS



Adjusting PTO Belt Tension and Replacing PTO Belt

⚠ CAUTION

To avoid personal injury:

- Always stop the engine, set the parking brake, remove the key, and disengage PTO.

If the PTO belt slips while the PTO is operating under load, check the PTO spring length and adjust the tension spring length, as explained below.

1. Push down the PTO lever to the "ENGAGED" position.
2. If spring tension (2) is shorter than 67 mm (2.64 in.) adjust it with the tension clutch cable adjusting nut.
 - Spring tension (2) should be 69 to 72 mm (2.72 to 2.84 in.).
3. After adjustment tighten the nut securely.
 - When replacing the PTO belt, spring tension (2) should be 73 to 75 mm (2.87 to 2.95 in.) at 51 mm (2 in.) cutting height.
4. Remove the belt support and PTO belt.
5. To install a new belt reverse the above procedure.

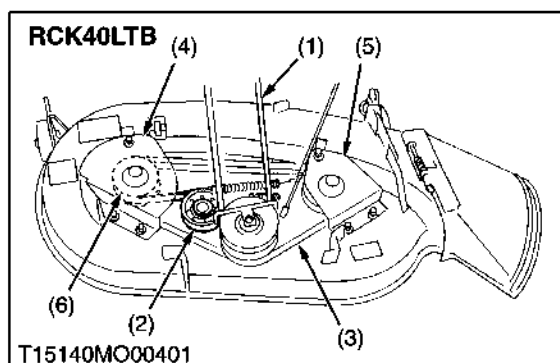
When the mower belt has been replaced or if the mower belt support has come off position, set the PTO lever to the "ENGAGED" position, adjust the belt support position to the specifications below and tighten up the belt support bolt.

■ NOTE

- The clearance A and B should be same.

- | | |
|--|---|
| (1) Tension Clutch Cable Adjusting Nut | A, B: Clearance between belt support and belt. |
| (2) Spring Tension | 3 to 4 mm (0.118 to 0.157 in.) |
| (3) Belt Support | |
| (4) Bolt | |

W1028000



Replacing Mower Belt

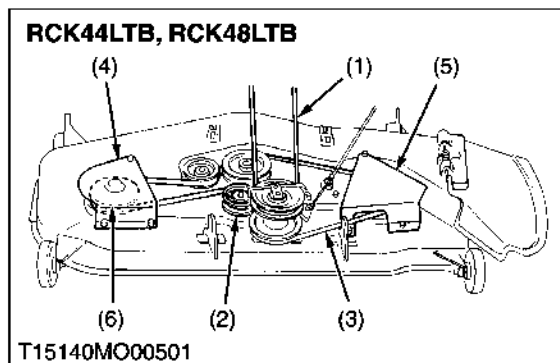
1. Remove the mower from the machine.
2. Remove the left and right hand shield from the mower deck.
3. Clean around the pulleys to remove the belt from the pulley. Slip the belt over the top of the left side pulley.
4. To install a new belt, reverse the above procedure.

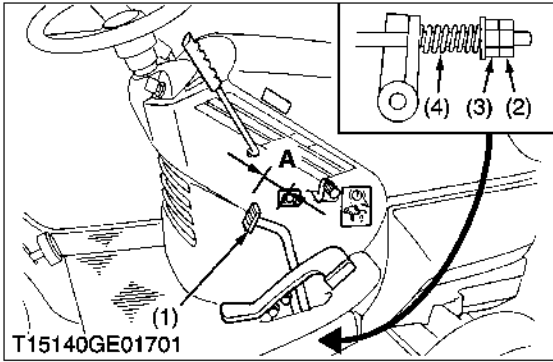
■ NOTE

- Tighten cover bolts securely.

- | | |
|--------------------|-----------------------|
| (1) PTO Belt | (4) Left Hand Shield |
| (2) Tension Pulley | (5) Right Hand Shield |
| (3) Belt | (6) Left Side Pulley |

W1028304





Checking Brake Pedal Play

⚠ CAUTION

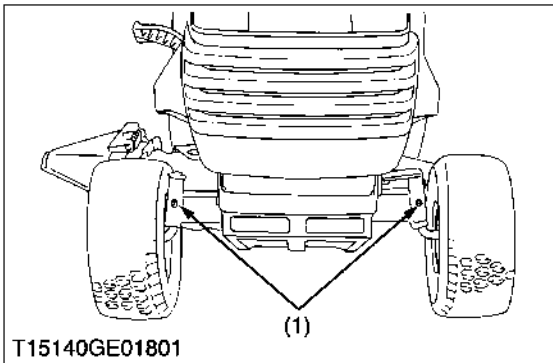
To avoid personal injury:

- When making adjustments, park the machine on flat area, block wheels, stop engine and remove the key.
1. Correct play ranges from 15 to 25 mm (0.59 to 0.98 in.).
 2. If it is not correct, loosen the lock nut (2) and turn the nut (3) in the desired direction until the proper play is achieved.
 3. After adjustment, retighten lock nut securely.

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

A: Play 15 to 25 mm (0.59 to 0.98 in.)

W1028455



Lubricating All Grease Nipples

⚠ CAUTION

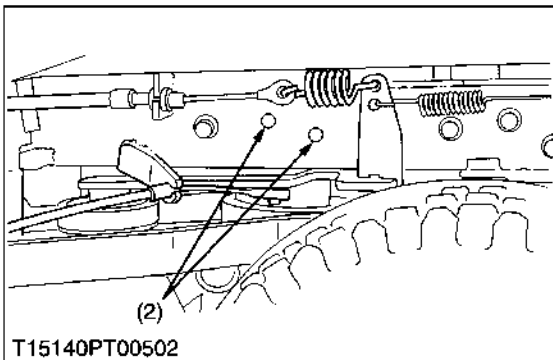
To avoid personal injury:

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

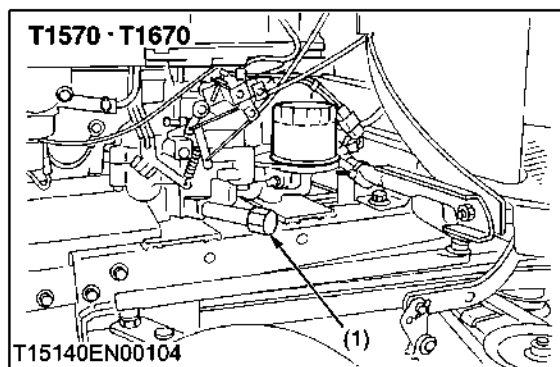
1. Grease the king pins and tension arms nipples.

- (1) King Pins (Grease) (2) Tension Arms (Grease)

W1028692



[4] CHECK POINTS OF EVERY 100 HOURS



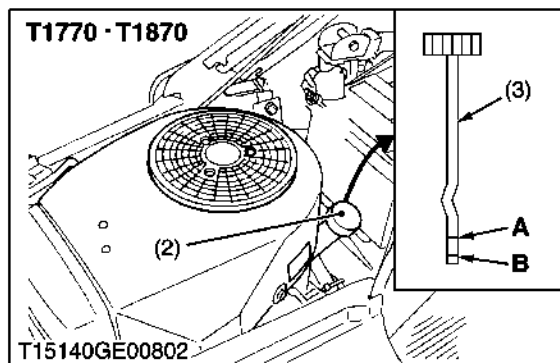
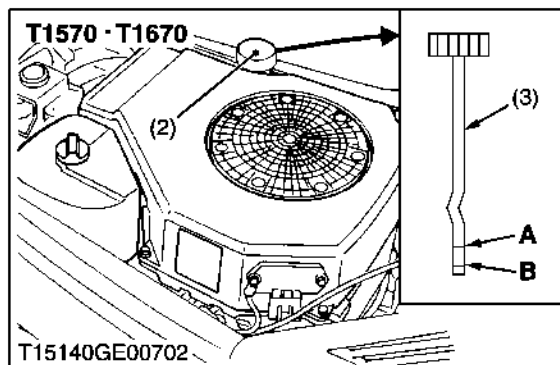
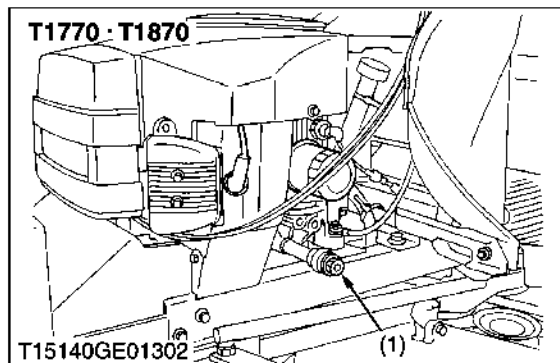
Changing Engine Oil

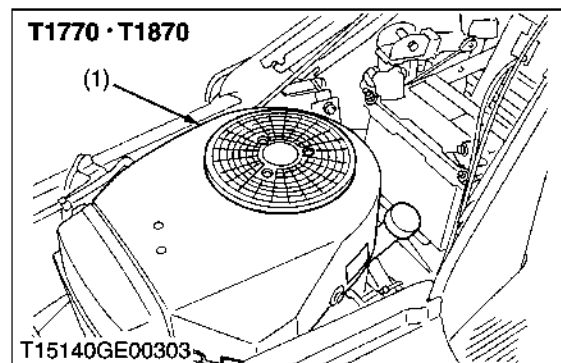
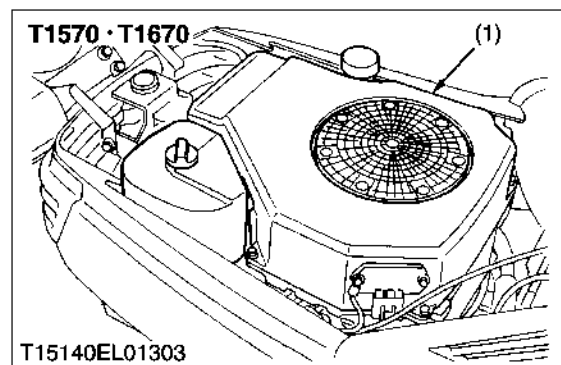
1. To change the engine oil, remove the drain plug (1) from the side (Bottom, Right) of the engine and drain the oil completely. All the used oil can be drained out easily while the engine is still warm.
2. Fill with the new oil up to the full level on the oil dipstick (3). Do not overfill.
3. To check the oil level. Remove the oil dipstick (3), wipe it clean, replace it without screwing it in, and draw it out again. Check to see the oil level is between the two marks.

- (1) Drain Plug
(2) Engine Oil Port
(3) Oil Dipstick

A: Upper Level
B: Lower Level

W1029209





Cleaning Engine Shroud



CAUTION

To avoid personal injury:

- **Make sure engine is cool to the touch before removing shrouds.**
1. Remove the engine shroud mounting bolts and detach the shroud.
 2. Check to see if the engine's cooling fins are blocked with dust and dirt. Clean them with compressed air if required.



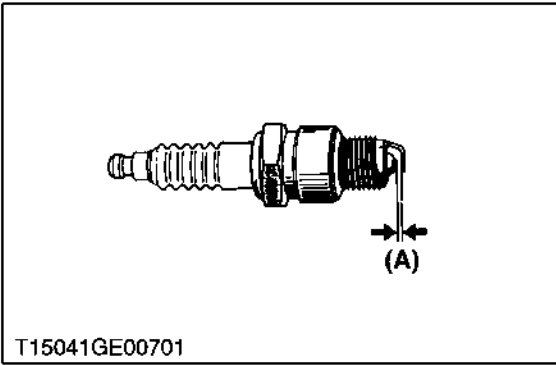
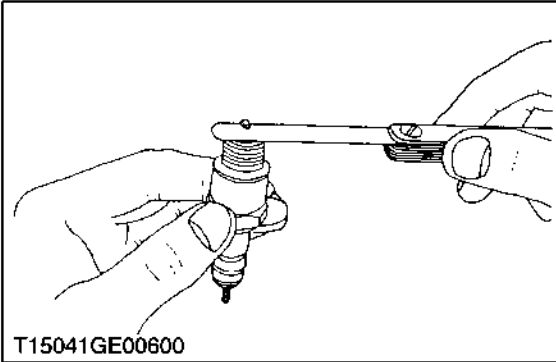
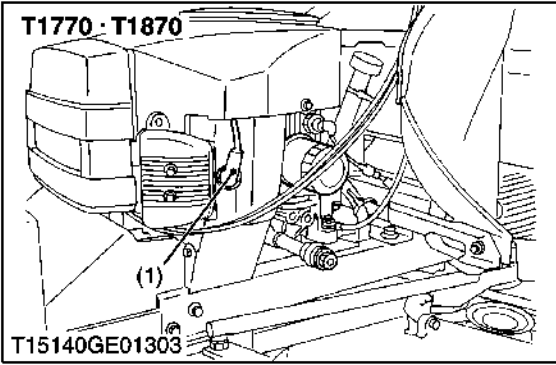
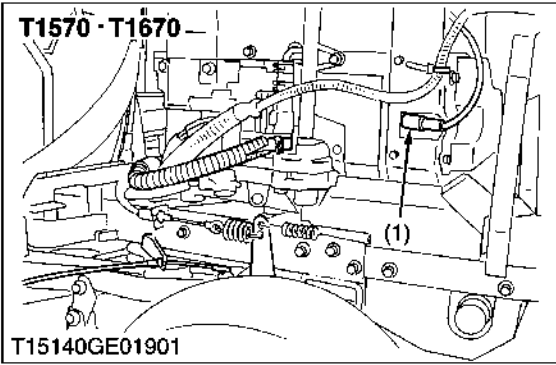
CAUTION

To avoid personal injury:

- **Always shield eyes and face from air deposits and objects.**

(1) Shrouds

W1029366



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

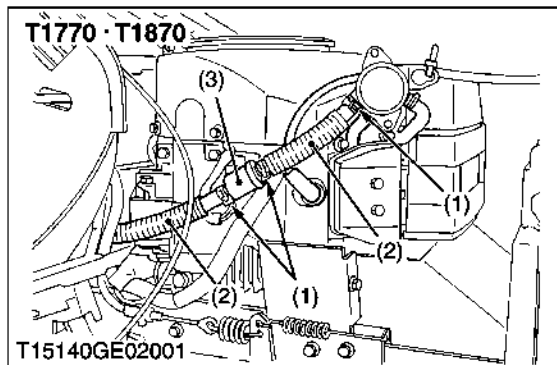
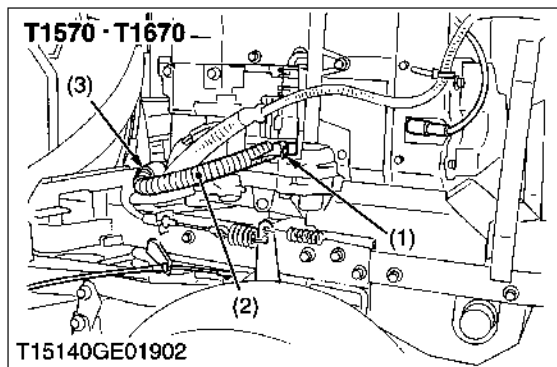
- This engine is equipped with resistor-type spark plugs.
- 4. Inspect spark plugs (1) for cracked porcelain, pitted electrodes, or other wear and damage. Replace spark plugs if necessary.
- 5. Check spark plug gap (A) with a feeler gauge.
- 6. If the spark plug gap (A) is not factory specification, adjust the spark plug gap (A).
- 7. Recommended spark plug
CHAMPION Premium Gold 2071 [T1570 · T1670]
RCJ8Y [T1770 · T1870]

Spark plug gap (A)	Factory spec.	T1570 T1670	1.0 mm 0.04 in.
		T1770 T1870	0.75 mm 0.03 in.

(1) Spark Plug

(A) Spark Plug Gap

W1029682



Checking Fuel Line and Fuel Filter

⚠ CAUTION

To avoid personal injury:

- Stop the engine when attempting to make the following checks and changes.
- Never fail to check the fuel line periodically. The fuel line is subject to wear and aging. 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 occurs first.

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

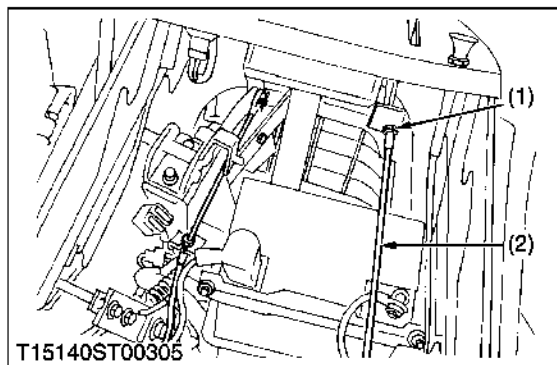
■ IMPORTANT

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

(1) Pipe Clamps
(2) Fuel Line

(3) Fuel Filter

W1030078



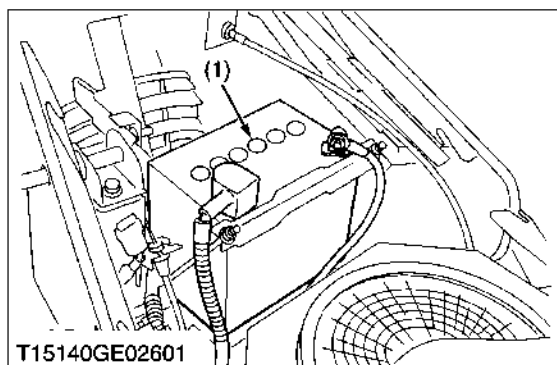
Checking Throttle Cables

1. If the throttle lever fails to accelerate the engine speed, look for loose nuts. If they are loose, tighten them.

(1) Lock Nut

(2) Throttle Cable

W1030359



Checking Battery Electrolyte Level and Charging Battery

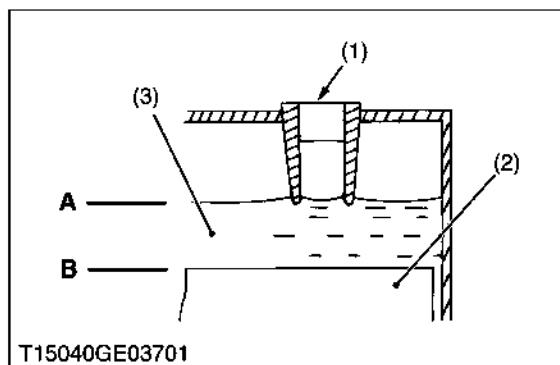
Mishandling the battery shortens the service life and adds to maintenance costs.

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) Vent Cap

W1030441



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

T15040GE06300

! WARNING

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.)

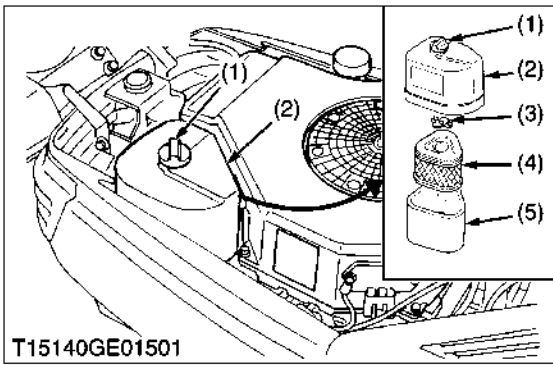
1. Make sure each electrolyte level is at the bottom of vent wells, if necessary add distilled water in a well-ventilated area.
2. The water in the electrolyte evaporates during recharging. Liquid shortage damages the battery. Excessive liquid spills over and damages the machine body.
3. To slow charge 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 so 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

W1030715



Replacing Air Cleaner Paper Element [T1570 · T1670]

Every **100 hours** of operation replace the paper element if equipped with a precleaner. Check every **25 hours** of operation if not equipped with a precleaner. (More often under extremely dusty or dirty conditions.)

1. Loosen the air cleaner cover knob and remove the cover. Remove the wing nut and remove the air cleaner element with precleaner (if so equipped). Remove the precleaner from the element and service as necessary.
2. Do not wash the paper element or **use pressurized air**, as this will damage the element. Replace a dirty, bent or damaged element with a **genuine Kohler element**. Handle new elements carefully; do not use if the sealing surfaces are bent or damaged.
3. When servicing the air cleaner, check the air cleaner base. Make sure it is secured and not damaged. Also check the air cleaner cover for damage or improper fit. Replace all damaged air cleaner components.
4. If any loose dirt or debris fell on the air cleaner base when the element was removed, carefully remove it and wipe the base clean. Be careful that none of it drops into the intake throat. Check the condition of the rubber seal on the air cleaner stud. If condition is questionable in any way, replace it with the new seal packaged with the replacement element.
5. Install the precleaner over the element. Install the element with precleaner on the base and secure it with the wing nut. Reinstall the cover and tighten the knob securely.

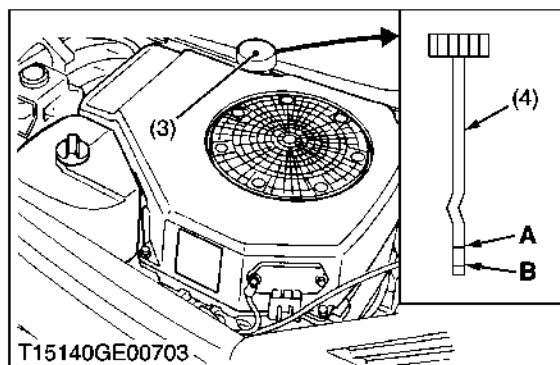
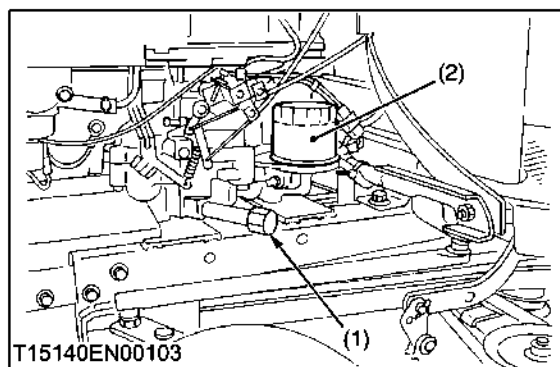
■ NOTE

- **Operating the engine with loose or damaged air cleaner components could allow unfiltered air into the engine causing premature wear and failure.**

- | | |
|----------------------------|-------------------|
| (1) Air Cleaner Cover Knob | (4) Paper Element |
| (2) Air Cleaner Cover | (5) Precleaner |
| (3) Wing Nut | |

W1031498

[5] CHECK POINTS OF EVERY 200 HOURS



Changing Engine Oil Filter Cartridge [T1570 · T1670]

⚠ WARNING

To avoid personal injury:

- Engine oil is a toxic substance. Dispose of used oil properly. Contact your local authorities for approved disposal methods or possible recycling.

⚠ CAUTION

To avoid personal injury:

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

The oil filter cartridge must be changed every 200 service hours.

1. Drain the oil from the engine drain plug (1).
2. Remove the oil filter drain plug located at the base of the oil filter adapter (if so equipped). Allow the oil filter to drain.
3. Remove the old engine oil filter cartridge (2) and wipe off the filter adapter. Reinstall the oil filter drain plug (if so equipped).
4. Place a new replacement filter in a shallow pan with the open end up. Pour new oil of the proper type, in through the threaded center hole. Stop pouring when the oil reaches the bottom of the threads. Allow a minute or two for the oil to be absorbed by the filter material.
5. Put a drop of oil on your fingertip and wipe it on the rubber gasket.
6. Install the replacement oil filter to the filter adapter. Turn the oil filter clockwise until the rubber gasket contacts the filter adapter, then tighten the filter an additional **2/3 to 1 turn**.
7. Fill the crankcase with new oil of the proper type, to the "F" mark on the oil dipstick (4).
8. Test run the engine to check for leaks. Stop the engine, allow a minute for the oil to drain down, and recheck the level on the dipstick. Add more oil, as necessary, so the oil level is up to but not over the "F" mark on the dipstick.

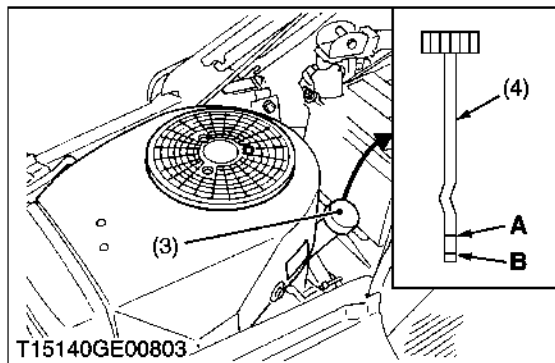
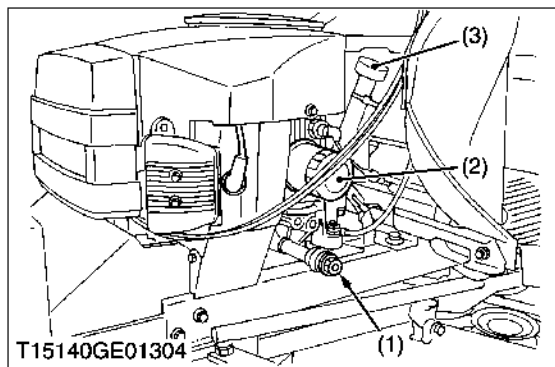
■ IMPORTANT

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

- (1) Drain Plug
(2) Engine Oil Filter Cartridge
(3) Engine Oil Port
(4) Oil Dipstick

A: Upper Level
B: Lower Level

W1031729



Changing Engine Oil Filter Cartridge [T1770 · T1870gt70]

⚠ WARNING

To avoid personal injury:

- Engine oil is a toxic substance. Dispose of used oil properly. Contact your local authorities for approved disposal methods or possible recycling.

⚠ CAUTION

To avoid personal injury:

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

The oil filter cartridge must be changed every 200 service hours.

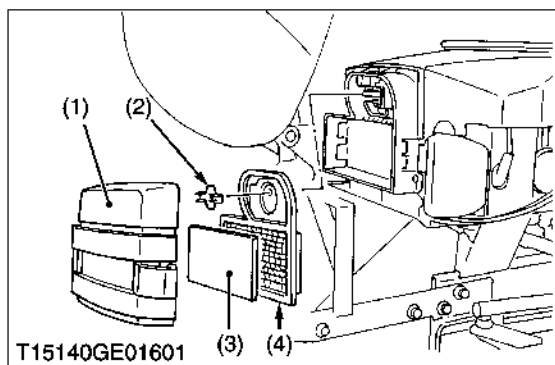
1. Rotate the engine oil filter cartridge (2) counterclockwise to remove it.
2. Coat a film of clean engine oil on seal of new filter.
3. Install new filter rotating it clockwise until seal contacts mounting surface. Then rotate filter 3/4 turn more by hand.
4. Supply engine oil as specified.
5. Run the engine for about 3 minutes, stop engine, and check oil leakage around the engine oil filter cartridge (2).
6. Add oil to compensate oil level down due to oil filter capacity.

■ IMPORTANT

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

- | | |
|---------------------------------|----------------|
| (1) Drain Plug | A: Upper Level |
| (2) Engine Oil Filter Cartridge | B: Lower Level |
| (3) Engine Oil Port | |
| (4) Oil Dipstick | |

W1032035



Replacing Air Cleaner Paper Element [T1770 · T1870]

1. Remove the air cleaner cover (1).
2. Remove the wing nut (2) and remove the paper-element (4).
3. Replace with new paper-element annually or 200 hours.

■ NOTE

- Operating in dusty condition may require more frequent maintenance than above.

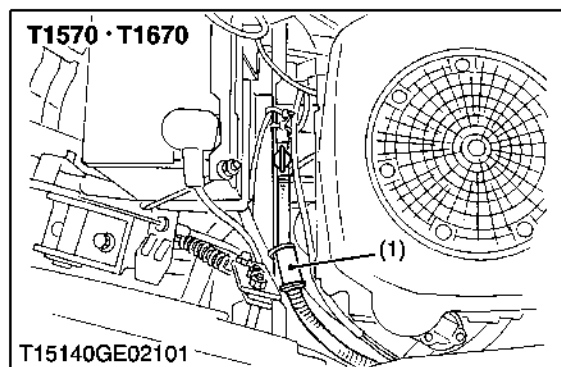
■ IMPORTANT

- Do not wash paper-element. Do not oil paper-element. Do not use pressurized air to clean paper-element.

- | | |
|-----------------------|-------------------|
| (1) Air Cleaner Cover | (3) Foam-element |
| (2) Wing Nut | (4) Paper-element |

W1032416

[6] CHECK POINTS OF EVERY 300 HOURS

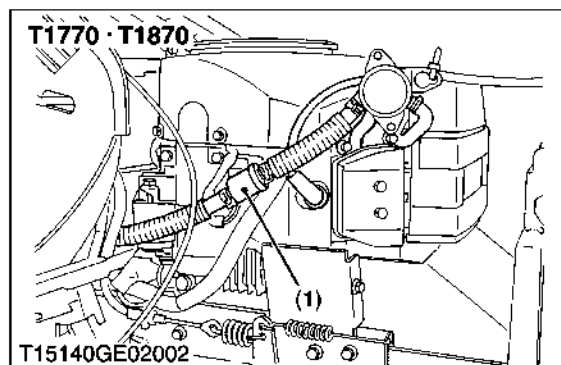


Changing Fuel Filter

1. Change fuel filter every 300 hours. This should be done by your KUBOTA Dealer.

(1) Fuel Filter

W1032593



[7] CHECK POINTS OF EVERY 2 YEARS

Replacing Fuel Line [T1570 · T1670]

1. Replace fuel hoses (1) from fuel tank (2) to carburetor.

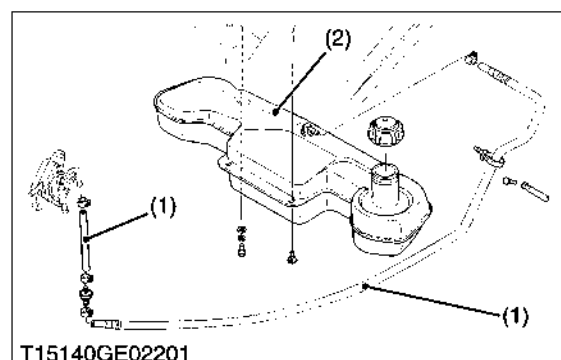
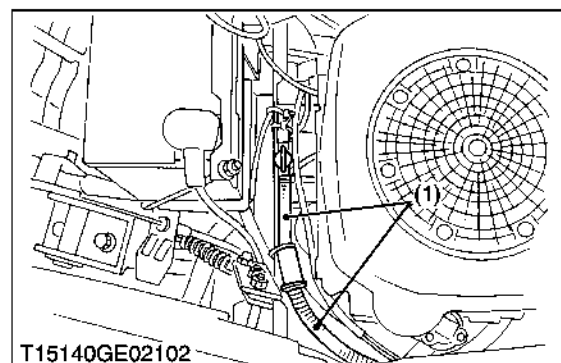
■ IMPORTANT

- Replacement of fuel line should be done by KUBOTA Dealer.

(1) Fuel Hose

(2) Fuel Tank

W1032685



Replacing Fuel Line [T1770 · T1870]

1. Replace fuel hoses (1) from fuel tank (2) to carburetor.

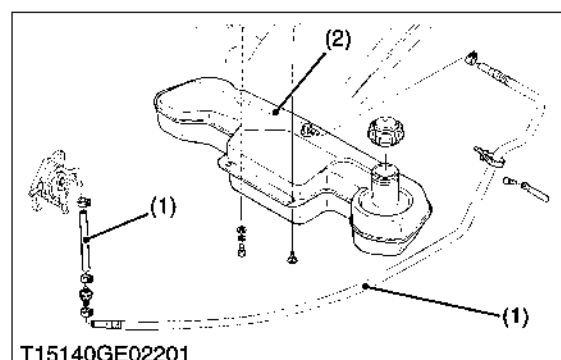
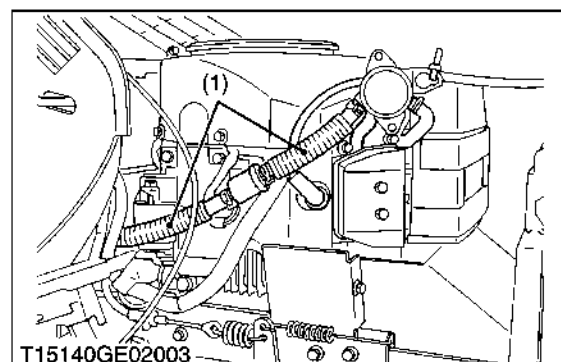
■ IMPORTANT

- Replacement of fuel line should be done by KUBOTA Dealer.

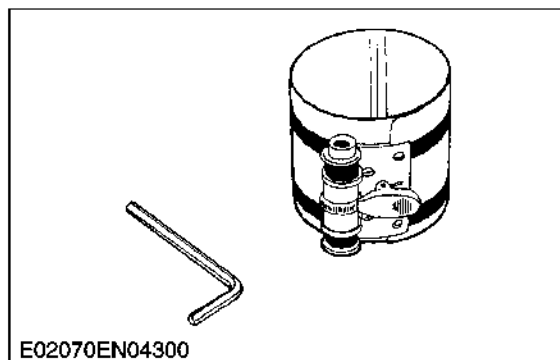
(1) Fuel Hose

(2) Fuel Tank

W1032823



9. SPECIAL TOOLS

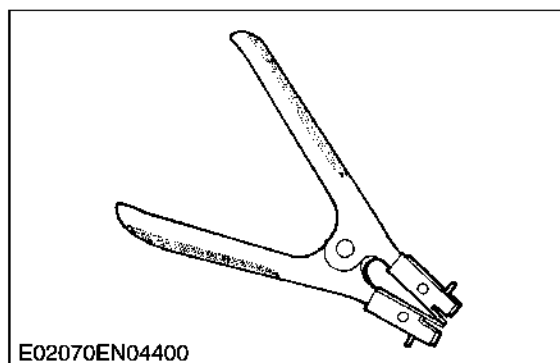


Piston Ring Compressor

Code No: 07909-32111

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

W1032936

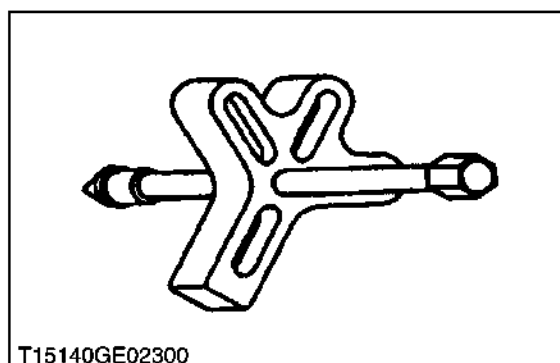


Piston Ring Tool

Code No: 07909-32121

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

W1032990

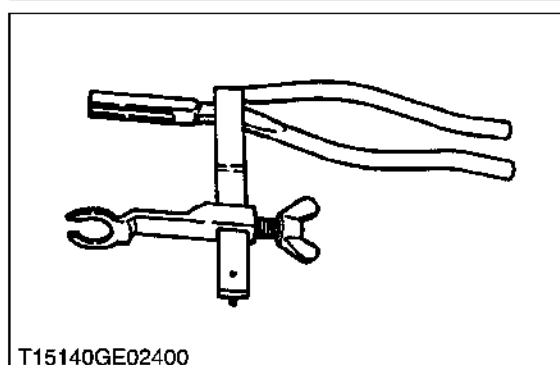


Flywheel Puller

Application: Use to remove the flywheel for GH431V.

Remarks: KOHLER TOOL No. NU-3226

W1033044

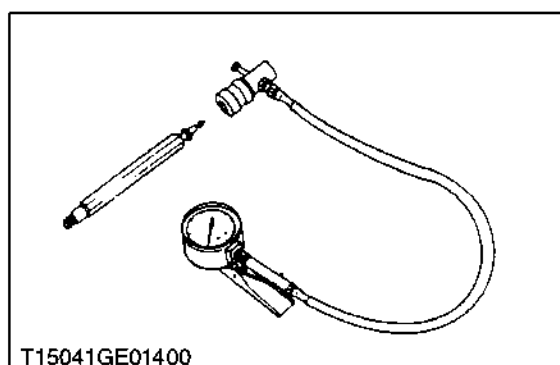


Valve Lifter

Code No: 07916-32001

Application: Use exclusively for removing or installing the valve spring collet with ease.

W1033093



Air Cooled Compression Tester

Code No: 07909-30251

Application: Use to measure air cooled engine compression and diagnosis of need for major overhaul.

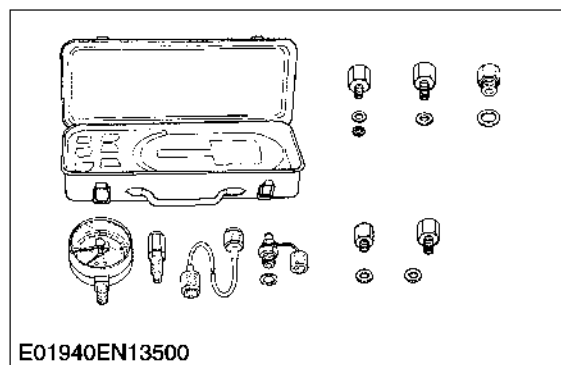
W1033151

Oil Pressure Tester

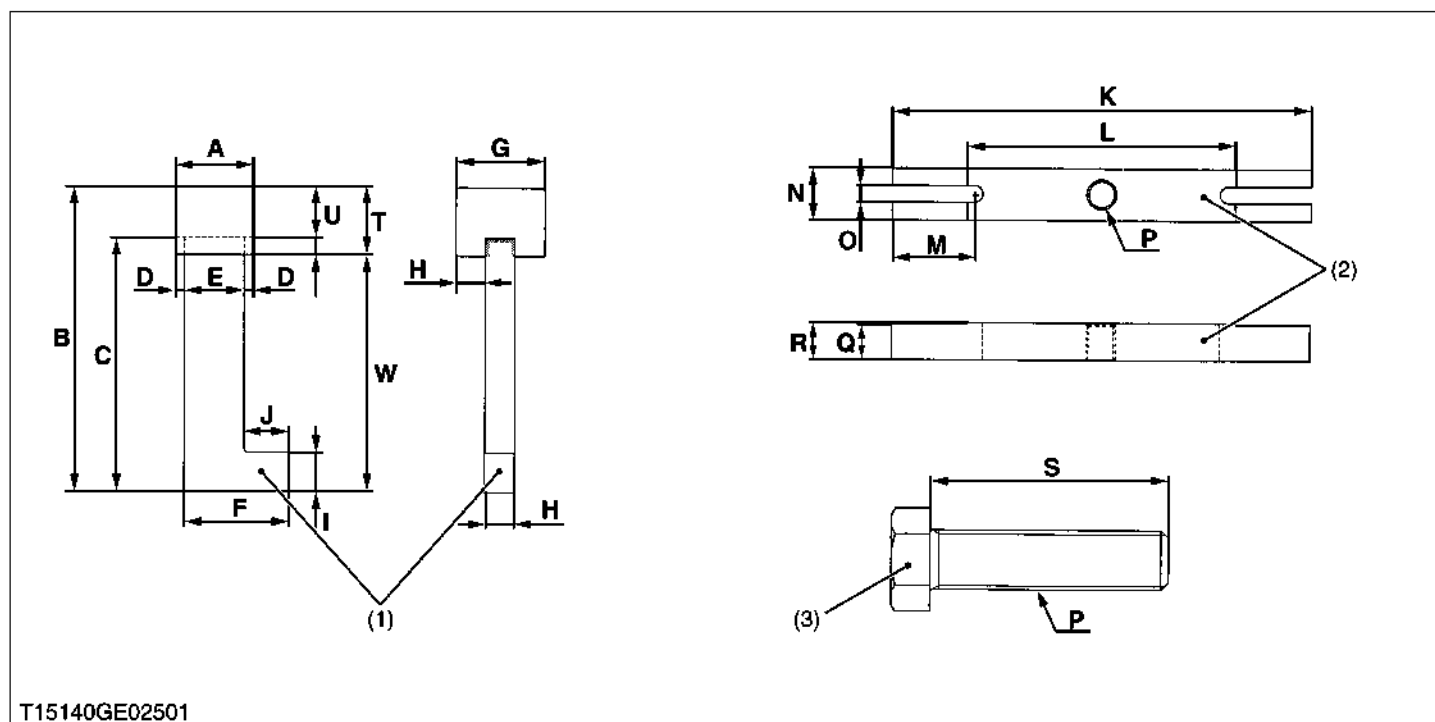
Code No: 07916-32032

Application: Use for measuring lubricating oil pressure.

W1033329

**Flywheel Puller****NOTE**

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



(1) Hook

(2) Support

(3) Bolt

Application: Use to remove the flywheel for GH500V and GH531V.

Flywheel puller consists of hook (1), support (2) and bolt (3).

A	26 mm (1.02 in.)	I	13 mm (0.51 in.)	Q	24 mm (0.94 in.)
B	103 mm (4.06 in.)	J	15 mm (0.59 in.)	R	25 mm (0.98 in.)
C	86 mm (3.39 in.)	K	280 mm (11.02 in.)	S	80 mm (3.15 in.)
D	3 mm (0.12 in.)	L	180 mm (7.09 in.)	T	23 mm (0.91 in.)
E	20 mm (0.79 in.)	M	55 mm (2.17 in.)	U	17 mm (0.67 in.)
F	35 mm (1.38 in.)	N	35 mm (1.38 in.)	V	6 mm (0.24 in.)
G	30 mm (1.18 in.)	O	11 mm (0.43 in.)	W	80 mm (3.15 in.)
H	10 mm (0.04 in.)	P	M20 × 2.5		

W1047528

1 ENGINE 1

SERVICING

CONTENTS

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1. TROUBLESHOOTING

Symptom	Probable Cause	Solution	Reference Page
Excessive Vibration	Loosen engine mounting nuts	Retighten mounting nuts.	1-S12
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	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.	— G-28 9-S9 to 9-S12 — 9-S8 9-S18 — 9-S19 9-S18 —
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.	G-28 1-S10 — G-10

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 - 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. Check valve moving parts. Replace ignition coil. 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.	– – G-27 1-S23, G-26, 1-S34, 35, 40,43 1-S44 – 1-S20 G-26 G-27 1-S49, 50 G-26 1-S50 G-20, 29
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. Check valve moving parts.	1-S20 G-26 9-S16 – 1-S48 –
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.	1-S20 G-26 10-S16 1-S48
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.	1-S20 1-S48 9-S16 G-26
Either White or Blue Exhaust Gas Is Observed	- Excessive engine oil - Piston ring worn or stuck	Reduce to specified level. Replace piston ring.	G-10 1-S44

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.	– G-10 G-27 G-20, 29
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. Check valve moving parts. 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.	1-S20 – 1-S37 – 1-S23 G-26 1-S34, 35,40,43 G-26 1-S31 G-20, 29
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-S33 1-S44 1-S35 1-S33, 45 46
Water Mixed into Lubricating Oil	• Head gasket defective • Cylinder block or cylinder head flawed	Replace head gasket. Replace cylinder block or cylinder head.	1-S22, 23 1-S22, 23, 34
Low Oil Pressure	• Engine oil insufficient • 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. 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.	G-15 G-30 – – 1-S33, 45, 46 1-S22 – G-10 1-S48

Symptom	Probable Cause	Solution	Reference Page
High Oil Pressure	• Different type of oil	Use specified type of oil.	G-10
	• Relief valve defective	Replace relief valve.	—
Engine Overheated	• Engine oil insufficient	Replenish engine oil.	G-15
	• Overload running	Lessen load.	—
	• Head gasket defective	Replace head gasket.	1-S23
	• Incorrect ignition timing	Adjust ignition timing.	1-S20
	• Unsuitable fuel used	Use specified fuel.	G-10

W1012359

2. SERVICING SPECIFICATIONS

[1] ENGINE BODY

CYLINDER HEAD

Item		Factory Specification	Allowable Limit
Cylinder Head Surface	Flatness	—	0.076 mm 0.003 in.

W1013874

VALVES

Valve Stem	O.D. (Intake)	6.982 / 7.000 mm 0.275 / 0.276 in.	—
	O.D. (Exhaust)	6.970 / 6.988 mm 0.274 / 0.275 in.	—
Valve Guide	I.D. (Intake)	—	7.134 mm 0.2809 in.
	I.D. (Exhaust)	—	7.159 mm 0.2819 in.
Valve Seat	Angle (Intake)	0.785 rad. 45°	—
	Angle (Exhaust)	0.785 rad. 45°	—
Valve Face	Angle (Intake and Exhaust)	0.79 rad. 45°	—

W1014199

PUSH ROD

Push Rod	Runout	—	0.30 mm 0.0118 in.
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W1014448

CYLINDER LINER

Cylinder Liner	I.D. (STD)	90.000 to 90.025 mm 3.5433 to 3.5443 in.	90.63 mm 3.5685 in.
Oversize Cylinder Liner (Honing Size)	I.D. (0.25 OS)	90.250 to 90.275 mm 3.553 to 3.554 in.	—
	I.D. (0.50 OS)	90.500 to 90.525 mm 3.563 to 3.564 in.	—

W1014788

ENGINE BODY (Continued)**PISTON · PISTON RING**

Item		Factory Specification	Allowable Limit
Piston Skirt	O.D. (STD)	—	89.824 mm 3.5363 in.
Oversize Piston Skirt	O.D. (0.25 OS)	—	90.074 mm 3.546 in.
	O.D. (0.50 OS)	—	90.324 mm 3.556 in.
Piston Pin Hole	I.D.	—	19.025 mm 0.7490 in.
Piston Pin	O.D.	—	18.994 mm 0.74779 in.
Top Compression Ring to Ring Groove	Clearance	—	0.105 mm 0.041 in.
Second Compression Ring to Ring Groove	Clearance	—	0.085 mm 0.0033 in.
Oil Ring to Ring Groove	Clearance	—	0.176 mm 0.0069 in.
Piston Ring in a Used Cylinder Bore	Ring End Gap	—	0.77 mm 0.030 in.
Piston Ring in a New Cylinder Bore	Ring End Gap	0.3 to 0.5 mm 0.012 to 0.020 in.	—

W1014916

CONNECTING ROD

Connecting Rod Small End	I.D.	—	19.036 mm 0.7494 in.
Connecting Rod Big End	Running Clearance	—	0.07 mm 0.0025 in.
Connecting Rod Big End	Side Clearance	—	0.41 mm 0.016 in.

W1015297

CRANKSHAFT

Crankshaft Journal	O.D. (Flywheel Side)	—	44.84 mm 1.765 in.
	O.D. (PTO Side)	—	41.86 mm 1.648 in.
Crankshaft	Runout (PTO Side)	—	0.15 mm 0.0059 in.
Crankshaft	Side Clearance	0.0023 mm 0.0194 in.	—

W1015410

CAMSHAFT

Camshaft Bearing	I.D. (Flywheel Side)	—	20.038 mm 0.7889 in.
	I.D. (PTO Side)	—	20.038 mm 0.7889 in.

W1015669

[2] LUBRICATING SYSTEM

OIL PUMP

Item	Factory Specification	Allowable Limit
Engine Oil Pressure Condition • Engine Speed : 3600 min ⁻¹ (3600 rpm)	412 kPa 4.2 kgf/cm ² 60 psi	—
Engine Oil Pressure Condition • Engine Speed : 1500 min ⁻¹ (1500 rpm)	110 kPa 1.1 kgf/cm ² 16 psi	—

W1015891

[3] IGNITION SYSTEM

SPARK PLUG · IGNITION MODULE

Item		Factory Specification	Allowable Limit
Spark Plug	Gap	1.02 mm 0.040 in.	—
Ignition Module	Air Gap	0.20 to 0.30 mm 0.008 to 0.12 in.	—
Ignition Module Secondary Coil	Resistance	7900 to 10850 Ω	—

W1016484

3. TIGHTENING TORQUES

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

Item	N·m	kgf·m	ft-lbs
Muffler cover mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Front bumper mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Engine mounting nut	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Engine pulley mounting screw	48.1 to 55.9	4.9 to 5.7	35.6 to 41.4
Air cleaner mounting nut	9.9	1.0	7.3
Fuel pump mounting screw	9.0	0.9	6.6
(First time installation on a new short block)			
Fuel pump mounting screw (All reinstallations)	7.3	0.7	5.4
Ignition module screw	6.2	0.6	4.5
(First time installation on a new short block)			
Ignition module screw (All installations)	4.0	0.4	2.9
Cylinder head cover screw	10.7	1.1	7.9
(First time installation on a new cylinder head)			
Cylinder head cover screw (All reinstallations)	7.3	0.7	5.4
Rocker arm ball pivot screw	14	1.4	10.3
Cylinder head bolt	40.7	4.2	30.0
Spark plug	38.0 to 43.4	3.9 to 4.4	28.8 to 32.0
Fan screw	9.9	1.0	7.3
Flywheel mounting bolt	66.4	6.8	49.0
Stator screw	4.0	0.4	3.0

W1012736

4. CHECKING, DISASSEMBLING AND SEVICING

[1] SEPARATING ENGINE

(1) Disassembling and Assembling

Dismounting Mower

1. See page "MOWER" section.

W1018318

Draining Engine Oil

1. Place an oil pan underneath the drain plug.
2. Unscrew the drain plug (1), and drain engine oil.

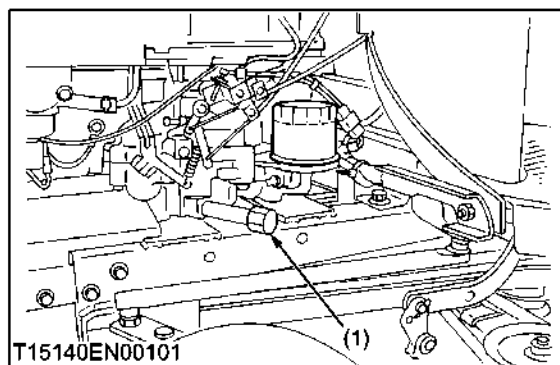
(When reassembling)

■ IMPORTANT

- Use the specified engine oil.
Refer to "LUBRICATING AND FUEL". (See page G-10.)

- (1) Drain Plug

W1018363



Fuel Cock, Battery Cable and High Tension Cord



CAUTION

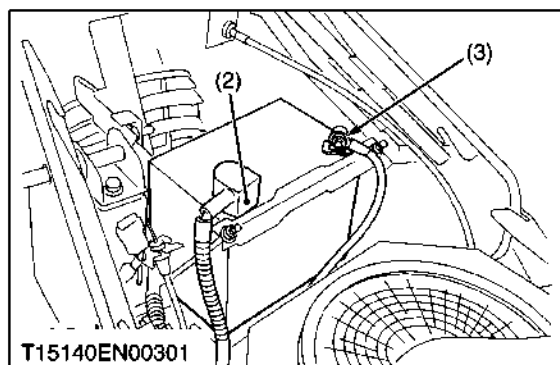
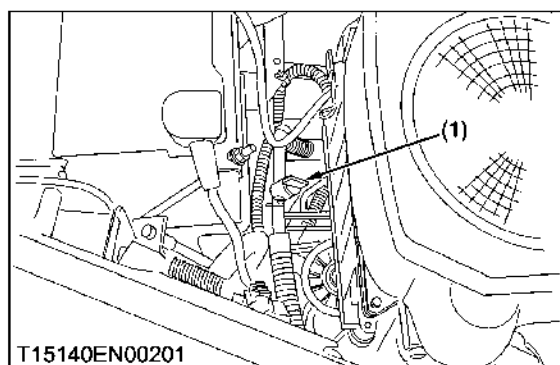
- When disconnecting the battery cables, disconnect the negative cable from the battery first.
When connecting, connect the positive cable to the battery first.

1. Close the fuel cock (1).
2. Turn the main switch off, and open the upper bonnet.
3. Disconnect the negative cable (3) from the battery.
4. Disconnect the positive cable (2) from the battery.

- (1) Fuel Cock
- (2) Positive Cable

- (3) Negative Cable

W1018489



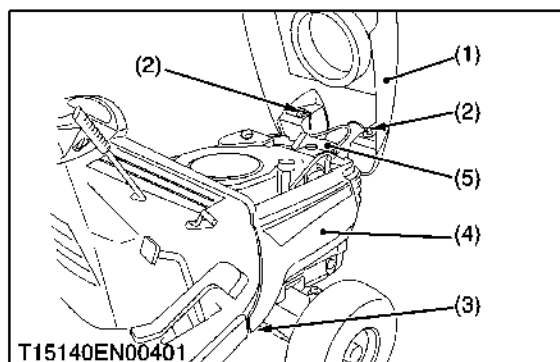
Bonnet

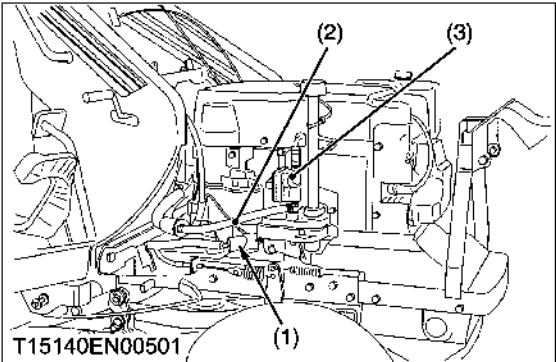
1. Disconnect four 1P connectors (2) from the head lights.
2. Unscrew the nuts and spring washers (5) and remove the upper bonnet (1) with the bracket.
3. Unscrew four knob screws (3), and remove the lower bonnet (4).

- (1) Upper Bonnet
- (2) 1P Connector
- (3) Knob Screw

- (4) Lower Bonnet
- (5) Nuts and Spring Washers

W1018648





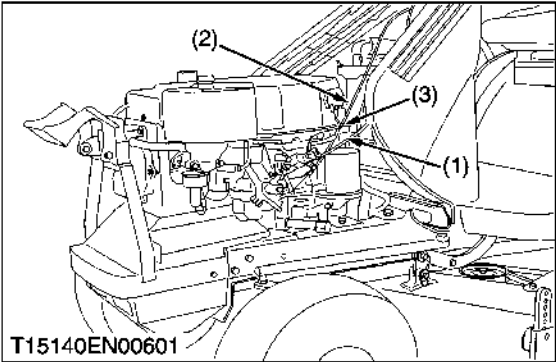
Wiring and Pipes (Engine Right Side)

1. Disconnect the positive cable (1) and wiring from the starter **B** terminal.
2. Disconnect the 1P connector from the starter **ST** terminal.
3. Remove the fuel hose (2) from fuel pump (3).

(When reassembling)

- (1) Positive Cable
- (3) Fuel Pump
- (2) Fuel Hose

W1018771



Throttle Cable and Wiring (Engine Left Side)

 CAUTION

- Gasoline is extremely flammable. Do not smoke or allow flames or sparks in your working area.
Clean up any spilled gasoline immediately.

1. Disconnect the throttle cable (1) and choke cable (2).
2. Disconnect the ground cable (3) at engine hook.

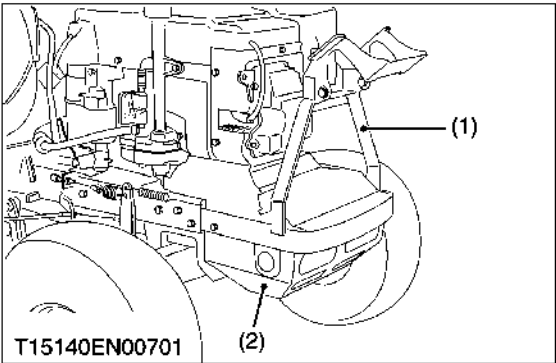
(When reassembling)

■ IMPORTANT

- After assembling the throttle cable, be sure to adjust the cable. (See page 1-S49.)

- (1) Throttle Cable
- (3) Ground Cable
- (2) Choke Cable

W1018986



Muffler Cover, Front Bumper and Muffler

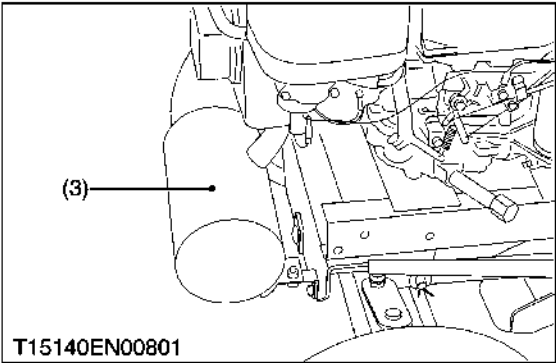
1. Remove the muffler cover (2).
2. Remove the front bumper (1).
3. Remove the muffler (3).

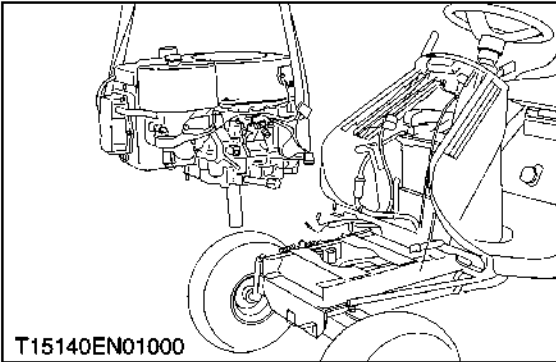
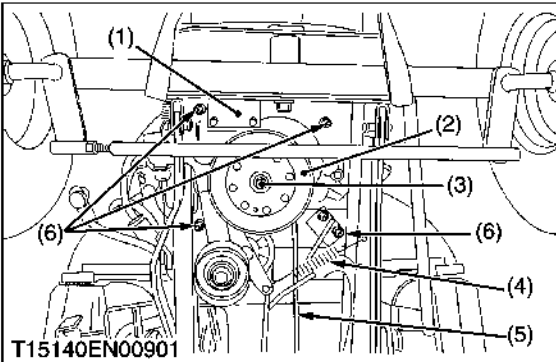
(When reassembling)

Tightening torque	Muffler cover mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
	Front bumper mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs

- (1) Front Bumper
- (3) Muffler
- (2) Muffler Cover

W1019159





Separating Engine

1. Remove the HST tension spring (4), belt retainer (1), and then remove the HST belt (5) from the engine pulley (2).
2. Remove engine pulley bolt (3) and remove the engine pulley (2) from engine.
3. Unscrew four engine mounting nuts (6), and separate the engine.

(When reassembling)

- Apply grease to the engine PTO shaft.

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
	Engine pulley mounting screw	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.6 to 41.4 ft-lbs

- (1) Belt Retainer

(2) Engine Pulley

(3) Engine Pulley Screw
- (4) HST Tension Spring

(5) HST Belt

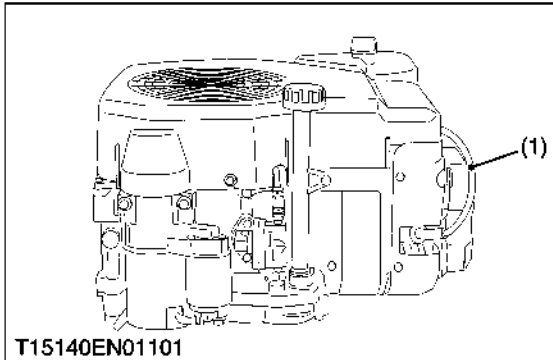
(6) Engine Mounting Nut

W1019359

[2] ENGINE BODY

(1) Disassembling and Assembling

(A) External Components



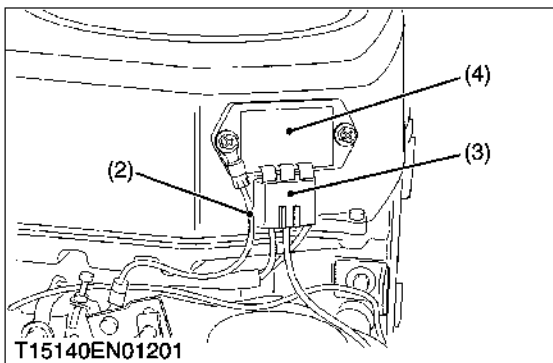
Spark Plug Lead and Regulator Lead

1. Disconnect spark plug lead (1) from plug.
2. Disconnect the 3P connector (3) and ground lead (2) from regulator (4).

(1) Spark Plug Lead
(2) Ground Lead

(3) Connector
(4) Regulator

W1019698



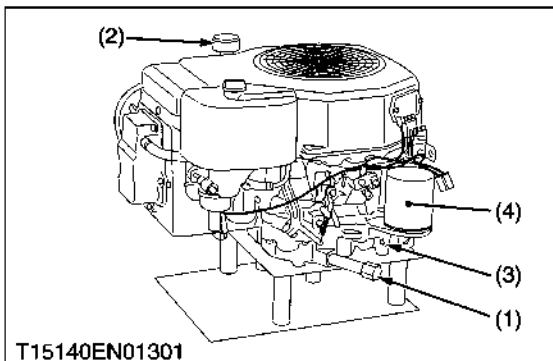
Engine Oil Filter Cartridge

1. Remove the engine oil drain plug (1) and oil fill cap / dipstick (2).
2. Remove the engine oil drain plug (3) located at the base of the engine oil filter adapter.
3. Allow ample time for the engine oil to drain from the crankcase and engine oil filter cartridge (4).
4. Remove and discard the engine oil filter cartridge (4).

(1) Engine Oil Drain Plug
(2) Oil Fill Cap / Dipstick

(3) Engine Oil Drain Plug
(4) Engine Oil Filter Cartridge

W1019804



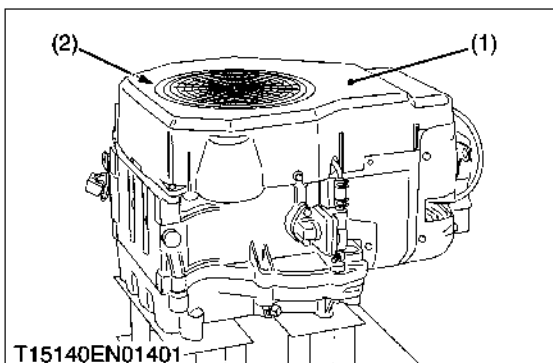
Blower Housing and Regulator

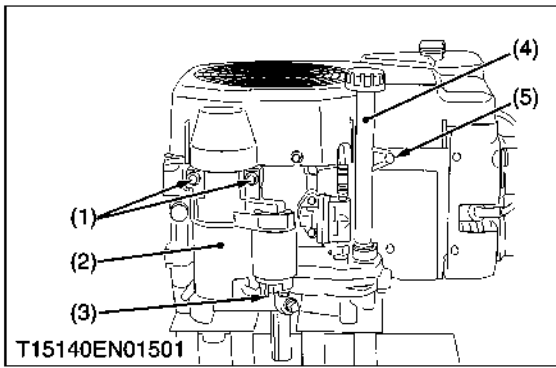
1. Remove regulator (2) from blower housing (1).
2. Remove blower housing (1) from engine body.

(1) Blower Housing

(2) Regulator

W1019927





Starter and Oil Fill Tube

1. Disconnect the lead from the stud terminal (3) on the starter (2).
Disconnect both leads on starter (2).
Remove the two hex. flange screws (1) and starter assembly (2).
2. Remove oil fill tube (4).
3. Remove the hex. flange screw (5) securing the oil fill tube (4) to the blower housing / crankcase. See Figure.
4. Remove the oil fill tube (4) from the crankcase.

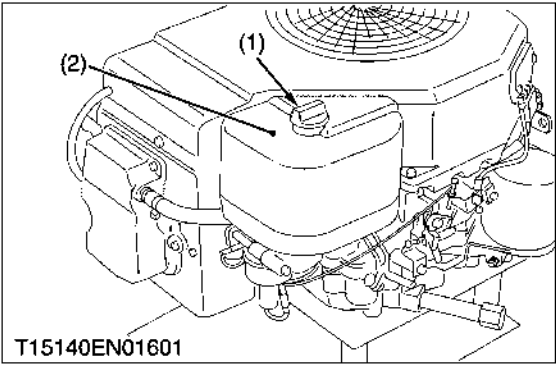
(When reassembling)

- Make sure the two O-rings on the oil fill tube and the O-ring in the oil fill cap are in place.
- Install the oil fill tube into the hole in crankcase.
- Secure the oil fill tube to the crankcase with the hex. flange screw.

- (1) Hex. Flange Screw
(2) Starter
(3) Stud Terminal

- (4) Oil Fill Tube
(5) Hex. Flange Screw

W1020052



Air Cleaner

1. Remove the knob (1) and air cleaner cover (2).
2. Remove the wing nut (3), air cleaner element (5), and precleaner (3).
3. Loosen the hose clamps (7) and disconnect the breather hose (8) from air cleaner base (6) and gasket (9) from studs.

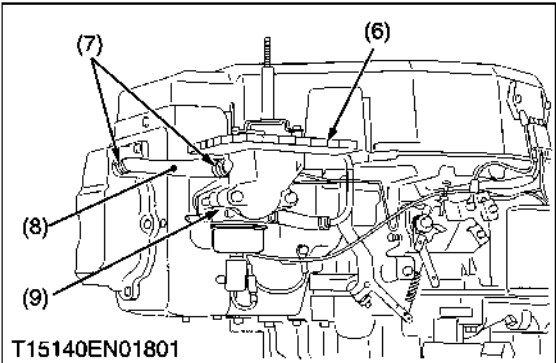
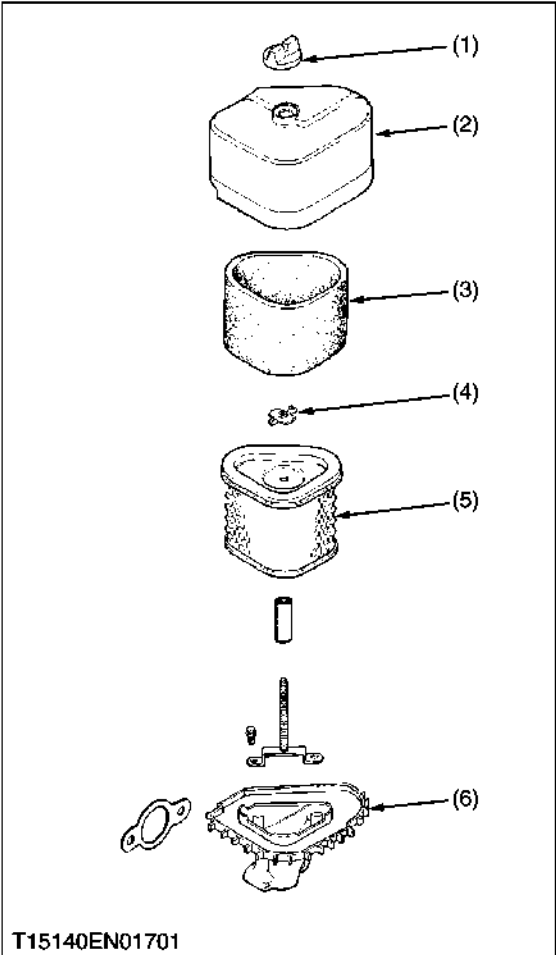
(When reassembling)

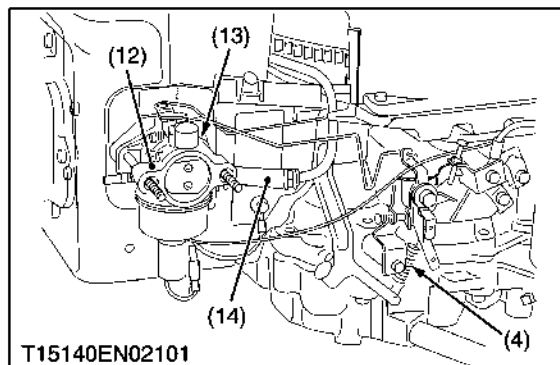
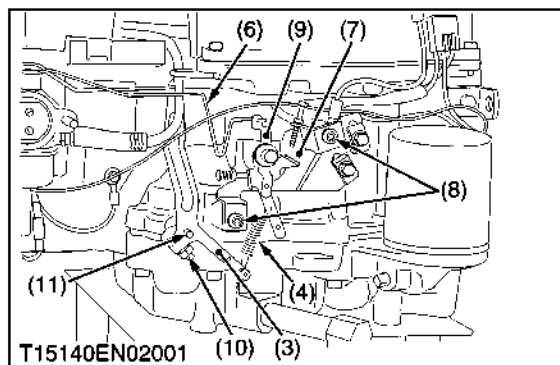
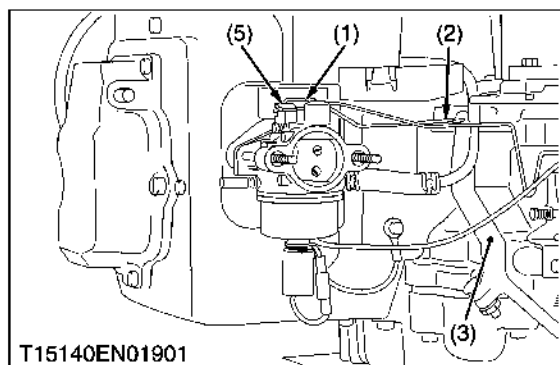
- Clean precleaner and air cleaner element.
- Make sure the metal bushings in the air cleaner base mounting are in place.
- Install the gasket, air cleaner hose, and hex. flange nuts.

Tightening torque	Air cleaner mounting nut	9.9 N·m 1.0 kgf·m 7.3 ft·lbs
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- | | |
|-------------------------|----------------------|
| (1) Knob | (6) Air Cleaner Base |
| (2) Air Cleaner Cover | (7) Clamp |
| (3) Precleaner | (8) Breather Hose |
| (4) Wing Nut | (9) Gasket |
| (5) Air Cleaner Element | |

W1020723





Removing External Governor Components and Carburetor



WARNING

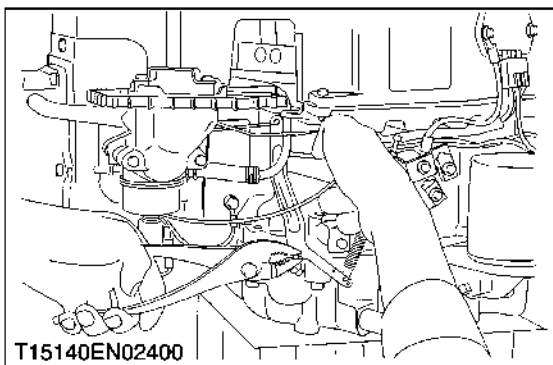
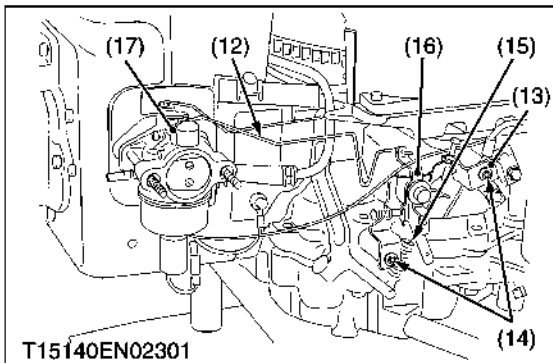
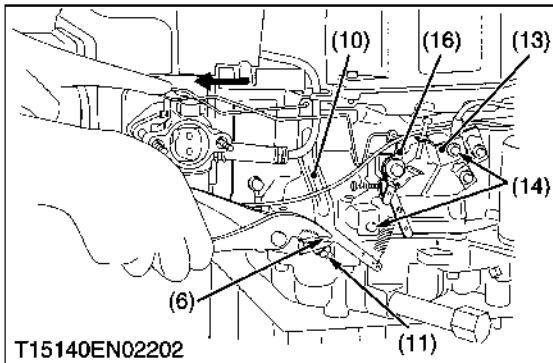
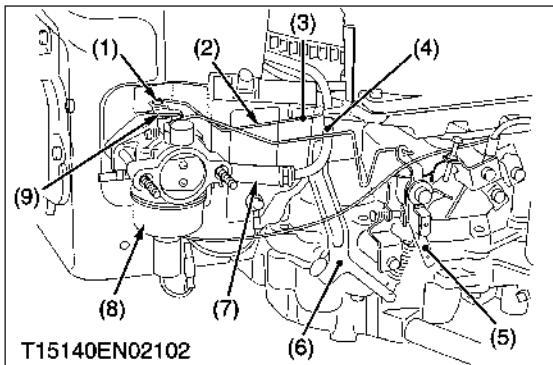
Explosive Fuel !

- Gasoline is extremely flammable and its vapors can explode if ignited. Store gasoline only in approved containers, in well ventilated, unoccupied buildings, away from sparks or flames. Do not fill the fuel tank while the engine is hot or running, since spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition. Do not start the engine near spilled fuel. Never use gasoline as a cleaning agent.

- Remove the throttle linkage (1) from bushing (2) in governor lever (3). See the first figure. Reattach bushing (2) to throttle linkage (1).
Remove the other end of throttle linkage (1) from the bushing (2) in carburetor throttle lever (5).
- Disconnect the governor spring (4) from the governor lever (3) and throttle control lever of speed control bracket (7).
- Remove the two hex. flange screws (8) and speed control bracket (7). See the second figure.
- Disconnect the choke linkage (6) from the choke control lever of speed control bracket (7).
- Loosen the hex. flange nut (10) and remove the governor arm from cross shaft (11).
- Disconnect the fuel line from the inlet fitting of the carburetor (12). See the third figure.
- Remove the carburetor (12) and gasket (13) from intake studs.

- | | |
|-------------------------------|---------------------------------|
| (1) Throttle Linkage | (8) Hex. Flange Screws |
| (2) Bushing | (9) Choke Control Lever |
| (3) Governor Lever | (10) Hex. Flange Nut |
| (4) Governor Spring | (11) Cross Shaft |
| (5) Carburetor Throttle Lever | (12) Carburetor |
| (6) Choke Linkage | (13) Gasket |
| (7) Speed Control Bracket | (14) Carburetor Inlet Fuel Line |

W1021054

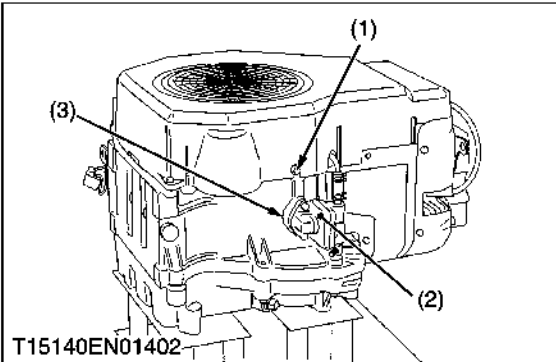


Installing and Adjusting Carburetor and External Governor Components

1. Install the rubber fuel line and two hose clamps to the metal fuel line. Secure the rubber fuel line to the metal fuel line (4) with one of the hose clamps. See the first figure.
2. Install the bushing (1), (3) and the throttle linkage (2) to the carburetor throttle lever (9).
3. Install the gasket and carburetor (8) over the intake studs. Install the free end of the rubber fuel line to the carburetor fuel inlet fitting as the carburetor (8) is inserted over the studs. Secure the fuel line (7) with the other hose clamp.
4. Install the governor lever (10) to governor cross shaft. Do not tighten the hex. nut (11) on the governor lever (10) until the lever is adjusted (step 6).
5. Install the throttle linkage (2) and bushing (1), (3) to governor lever (10).
6. Adjust the governor lever (10) / governor gear. See the second figure.
 - a. Pull the governor lever **towards the carburetor** (8) (wide open throttle).
 - b. Grasp the cross shaft (6) with a pliers and turn the shaft (6) **COUNTERCLOCKWISE** as far as it will go. Or insert a nail into the hole in the end of the cross shaft (6) and rotate the shaft (6) **COUNTERCLOCKWISE** as far as it will turn, then tighten hex. nut (11) securely.
 - c. Tighten the hex. nut (11) securely.
7. Install the choke linkage (12) to the choke lever (16) on speed control bracket (13). See the third figure.
8. Install the long end of the choke linkage (12) to the carburetor choke lever (17).
9. Install a speed control bracket assembly with two hex. flange screws (14).
10. Install the governor spring (15) in hole #2 in the governor arm (5), and in the hole in the throttle lever on governor bracket assembly.

- | | |
|-------------------------------|-----------------------------|
| (1) Bushing | (10) Governor Lever |
| (2) Throttle Linkage | (11) Hex. Nut |
| (3) Bushing | (12) Choke Linkage |
| (4) Metal Fuel Line | (13) Speed Control Bracket |
| (5) Governor Arm | (14) Hex. Flange Screws |
| (6) Cross Shaft | (15) Governor Spring |
| (7) Fuel Line | (16) Choke Lever |
| (8) Carburetor | (17) Carburetor Choke Lever |
| (9) Carburetor Throttle Lever | |

W1021534



Fuel Pump

! WARNING
Explosive Fuel !

- Gasoline is extremely flammable and its vapors can explode if ignited. Store gasoline only in approved containers, in well ventilated, unoccupied buildings, away from sparks or flames. Do not fill the fuel tank while the engine is hot or running, since spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition. Do not start the engine near spilled fuel. Never use gasoline as a cleaning agent.

- Disconnect the fuel line from the outlet and inlet fittings of the fuel pump (2).
- Remove the two hex. flange screws (1), fuel pump (2), and gasket (3).

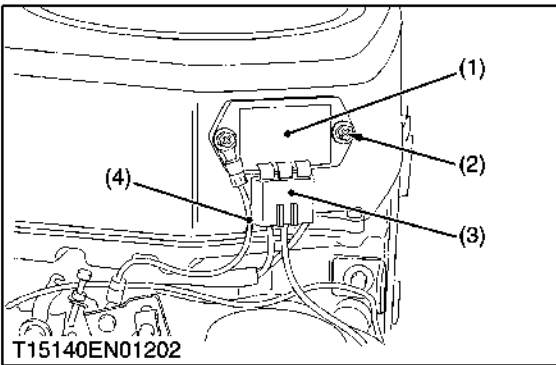
(When reassembling)

- Install the rubber line and two hose clamps to the fuel pump end of the metal fuel line. Secure the rubber fuel line to the steel fuel line with one of the clamps.
- Install the gasket, fuel pump and two hex. flange screws. Torque the screws as follows:
- Install the opposite end of the rubber line to the outlet fitting of the fuel pump. Secure the fuel line to the outlet fitting with the other hose clamp.

Tightening torque	Fuel pump mounting screw (First time installation on a new short block)	9.0 N·m 0.9 kgf·m 6.6 ft-lbs
	Fuel pump mounting screw (All reinstallations)	7.3 N·m 0.7 kgf·m 5.4 ft-lbs

- (1) Hex. Flange Screw
- (2) Fuel Pump
- (3) Gasket

W1022715



Regulator

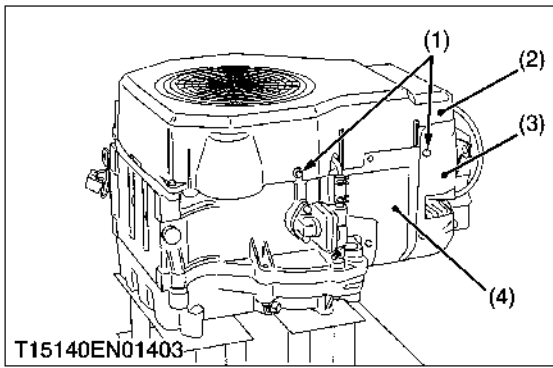
- Remove the connector (3) and ground lead (4) from the rectifier-regulator (1).
- Remove the two hex. flange screws (2) and rectifier-regulator (1).

(When reassembling)

- Install the rectifier-regulator and hex. flange screws.
- Install the connector to the rectifier-regulator.

- (1) Regulator
- (2) Hex. Flange Screw
- (3) Connector
- (4) Ground Lead

W1022938



Blower Housing and Baffles

1. Remove the hex. flange screws (1) securing the blower housing (2) to the crankcase. Remove the blower housing (2).
2. Remove the hex. flange screws (7) and cylinder head baffle (3).
3. Remove the hex. flange screw and the carburetor side baffle.
4. Remove the heat deflector and gasket from intake studs.
5. Remove the hex. flange screws and starter side cylinder barrel baffle.
6. Remove the two hex. flange screws and blower housing back plate (8).

(When reassembling)

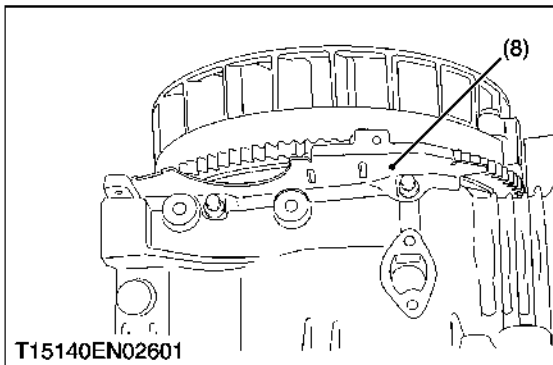
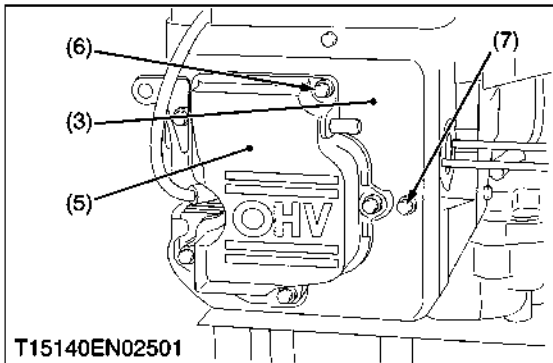
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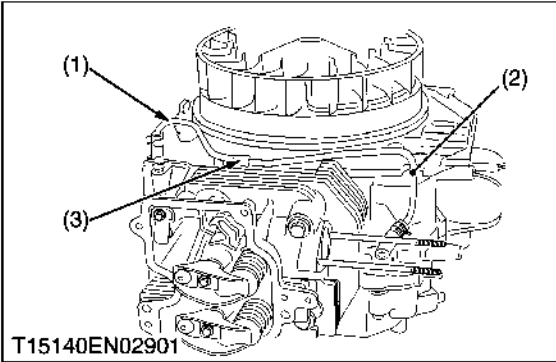
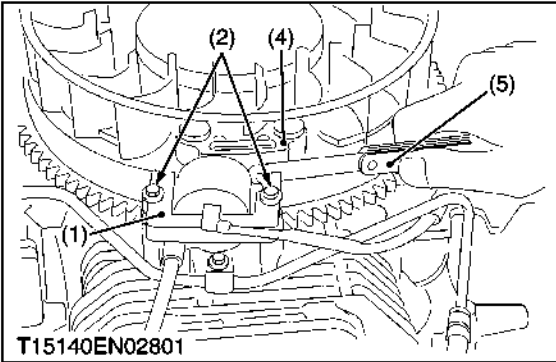
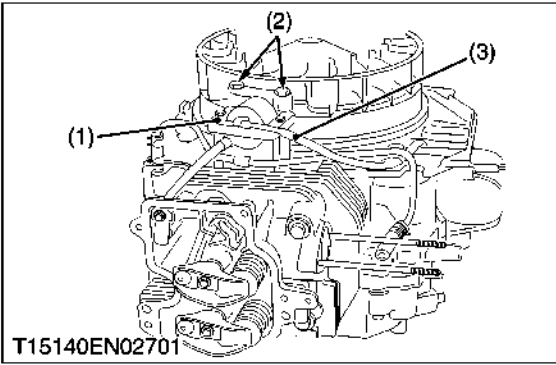
- Leave all hardware slightly loose until all sheet metal pieces are in position.

1. Install the blower housing back plate and two hex. flange screws.
2. Install the starter side cylinder barrel baffle and one hex. flange screw.
3. Install gasket and heat deflector to the intake studs. Install the carburetor side baffle and one hex. flange screw.
4. Install the cylinder head baffle and two hex. flange screws.
5. Install the grommet around the high tension lead. Insert the grommet into the slot in the blower housing. Install the blower housing and six hex. flange screws.
6. Tighten all hardware securely when all sheet metal pieces are in position.

- | | |
|----------------------------|-------------------------------|
| (1) Hex. Flange Screw | (5) Cylinder Head Cover |
| (2) Blower Housing | (6) Cylinder Head Cover Screw |
| (3) Cylinder Head Baffle | (7) Hex. Flange Screw |
| (4) Cylinder Barrel Baffle | (8) Blower Housing Back Plate |

W1023193





Ignition Module

- 1. Disconnect the kill lead (3) from the ignition module (1). See the first figure.
- 2. Rotate flywheel magnet (4) away from ignition module (1).
- 3. Remove the two hex. flange screws (2) and ignition module (1).

(When reassembling)

- Rotate the flywheel so the magnet is away from the ignition module basses. Install the ignition module and hex. flange screws to the bosses on crankcase. Move the module as far from the flywheel as possible. Tighten the hex. flange screws slightly.
- Insert a **0.25 mm (0.010 in.)** flat feeler gauge or shim stock between the magnet and ignition module. Loosen the hex. flange screws so the magnet pulls the module against the feeler gauge.
- Tighten the hex. flange screws as follows:

Tightening torque	Ignition module screw (First time installation on a new short block)	6.2 N·m 0.6 kgf·m 4.5 ft-lbs
	Ignition module screw (All reinstallations)	4.0 N·m 0.4 kgf·m 2.9 ft-lbs

- 4. Rotate the flywheel back and forth; check to make sure the magnet does not strike the module. Check the gap with feeler gauge and readjust if necessary.

Ignition module air gap	Factory spec.	0.203 to 0.305 mm 0.008 to 0.012 in.
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- 5. Connect the kill lead to the tab terminal on ignition module.
- (1) Ignition Module

(2) Hex. Flange Screws

(3) Kill Lead

(4) Magnet

(5) Flat Feeler Gauge

W1023779

Fuel Line

- 1. Remove the hex. flange screw, clamp (3), fuel line (1) and rubber grommet (2).

(When reassembling)

- 1. Install the grommet (2) to the carburetor side of fuel line (1).
- 2. Install the fuel line (1), hex. flange screw and clamp (3). Make sure the grommet (2) is inserted in the notch in the cylinder block.

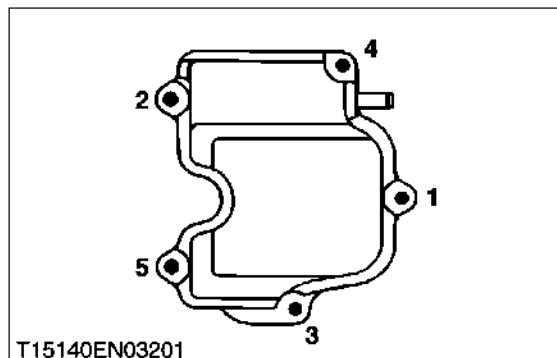
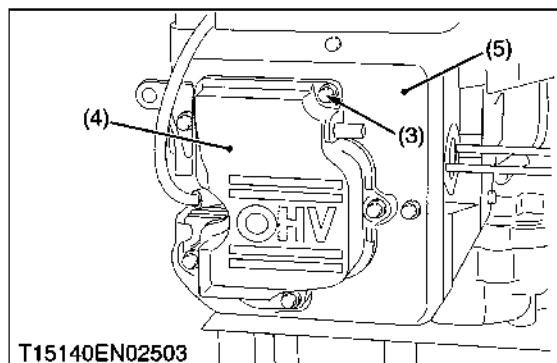
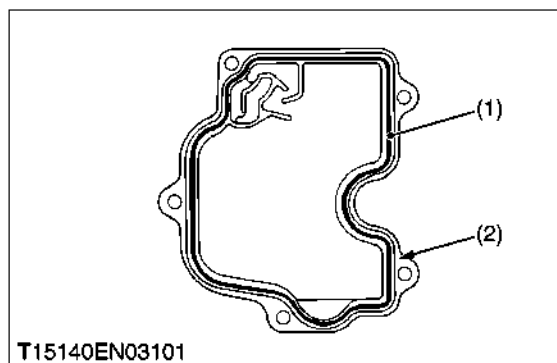
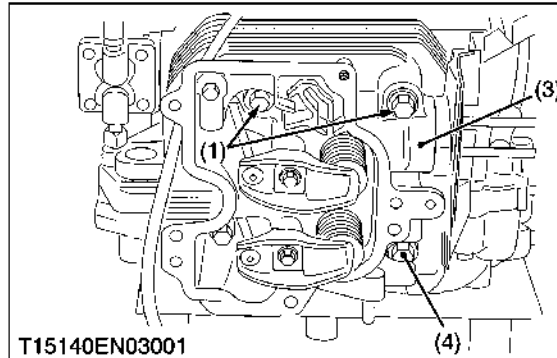
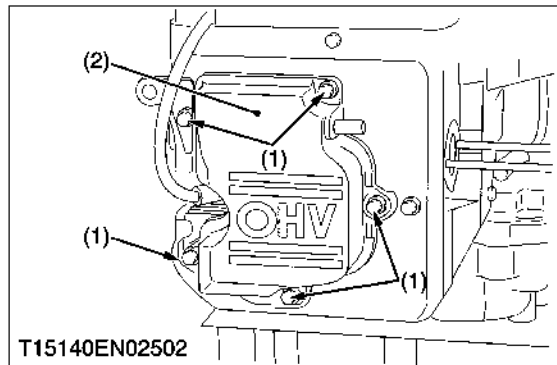
- (1) Fuel Line

(2) Rubber Grommet

(3) Hex. Flange Screw and Clamp

W1024244

(B) Cylinder Head and Valve



Cylinder Head Cover Disassembling

1. Remove the hex. flange screws (1) from cylinder head cover. Remove the cylinder head cover (2) from the cylinder head assembly (3).

■ NOTE

- The valve cover is sealed to the cylinder head using RTV silicone sealant. When removing valve cover, use care not to damage the gasket surfaces of cover and cylinder head. To break the RTV seal, hold a block of wood against one of the flat faces of the valve cover. Strike the wood firmly with a mallet. If the seal doesn't break loose after 1 or 2 attempts, repeat procedure on other side.

2. Remove the hex. flange screws (4), spacer (from the screw between the intake and exhaust ports), cylinder head, push rods, and cylinder head gasket.

- (1) Hex. Flange Screw (3) Cylinder Head Assembly
(2) Cylinder Head Cover (4) Hex. Flange Screw

W1024450

Cylinder Head Cover Reassembling

■ NOTE

- Always use fresh sealant. Using outdated sealant can result in leakage.

RTV silicone sealant is used as a gasket between the valve cover and crankcase.

1. Prepare the sealing surfaces of the cylinder head and valve cover as directed by the sealant manufacturer.

■ NOTE

- Do not scrape surfaces when cleaning as this will damage the surface and could cause leaks. The use of a gasket removing solvent is recommended.

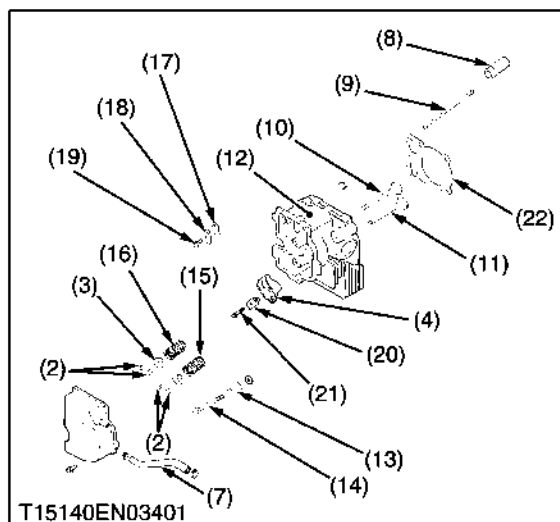
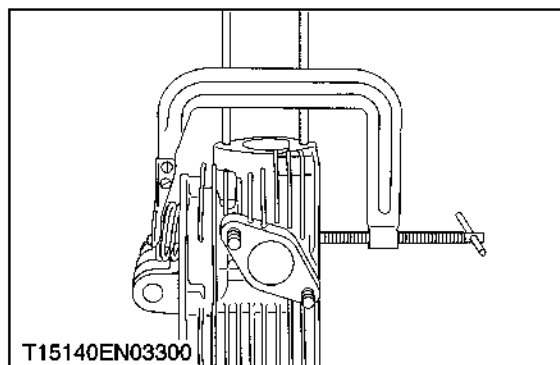
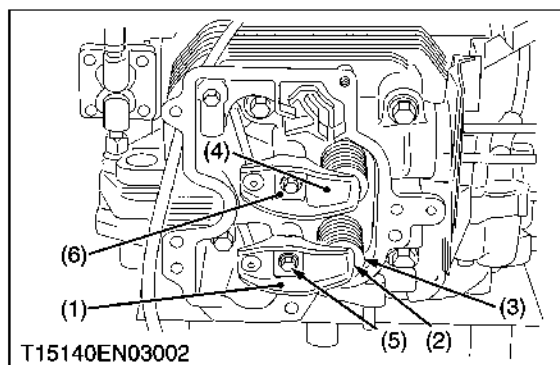
2. Apply a 1/16" bead of sealant (1) to the cylinder head (2) as shown in Figure.
3. Install the cylinder head cover (4), and two hex. flange screws. Install the remaining hex. flange screws.
4. Torque the screws in the sequence shown in Figure.

Tightening torque	Cylinder head cover screw (First time installation on a new cylinder head)	10.7 N·m 1.1 kgf·m 7.9 ft-lbs
	Cylinder head cover screw (All reinstallations)	7.3 N·m 0.7 kgf·m 5.4 ft-lbs

- (1) Sealant (4) Cylinder Head Cover
(2) Cylinder Head (5) Cylinder Head Baffle
(3) Cylinder Head Cover Screw

1 to 5 : Tightning Sequence

W1024877



Cylinder Head

NOTE

- Before disassembly, mark all valve train components to assure they are reassembled in same side if reused.

- Remove the spark plug.
- Remove the hex. flange screw, breather reed retainer and breather reed.
- Remove the hex. flange screw, rocker pivot ball (5) and rocker arm (1) from both intake and exhaust valve sides. The push rods can now be removed.
- Remove the valves:
 - Compress the valve springs using a valve spring compressor as shown in Figure.
 - Remove the collet (2), valve spring cap (3) and valve spring on intake and exhaust side.

NOTE

- This type head does not use exhaust valve rotator or intake valve stem seal.

(When reassembling valves)

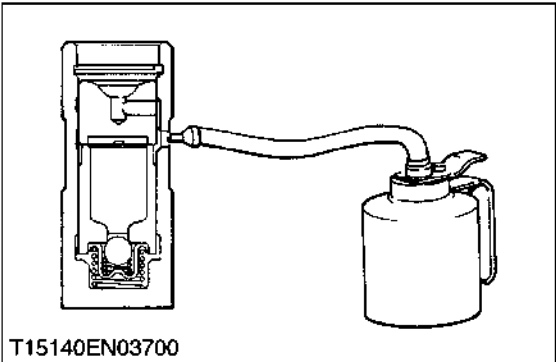
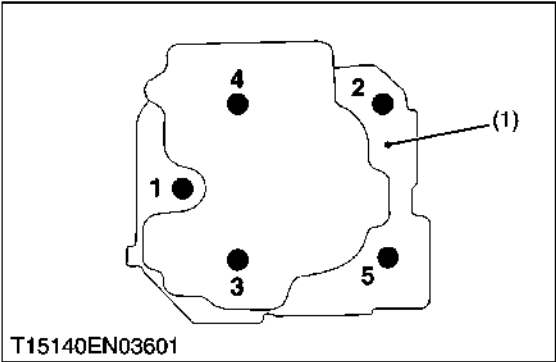
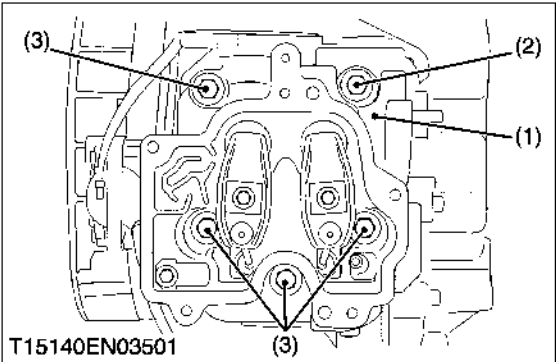
- With the alternate type head, secure rocker arm (4), rocker arm pivot (23) to the cylinder head with two M6 × 1.0 × 34 screws (21). Torque rocker arm pivot screws (21).
- Insert intake valve through guide. Install intake valve spring (18) and valve spring retainer (3), compress the intake valve spring (16) with a valve spring compressor tool then insert collets (2).
- Insert exhaust valve stem through guide. Install exhaust valve spring (15) valve spring retainer (3) then compress the exhaust valve spring (15) and insert collets (2) to lock in place.
- Install breather reed (17), breather reed retainer (18) and secure with a M5 × 0.8 × 10 screw (19).

The cylinder head (12) is now ready to install.

Tightening torque	Rocker arm ball pivot screw	14 N·m 1.4 kgf·m 10.3 ft·lbs
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- | | |
|-------------------------------|-----------------------------|
| (1) Rocker Arm | (14) Cylinder Head Bolt |
| (2) Collet | (15) Exhaust Valve Spring |
| (3) Valve Spring Retainer | (16) Intake Valve Spring |
| (4) Rocker Arm | (17) Breather Reed |
| (5) Pivot Ball | (18) Breather Reed Retainer |
| (6) Guide Plate | (19) Breather Reed Screw |
| (7) Breather Reed Parts | (20) Rocker Arm Pivot |
| (8) Tappet (Hydraulic Lifter) | (21) Rocker Arm Screw |
| (9) Push Rod | (22) Cylinder Head Gasket |
| (10) Intake Valve | |
| (11) Exhaust Valve | |
| (12) Cylinder Head | |
| (13) Spacer | |

W1025322



Cylinder Head (Continued)
(When installing cylinder head)

- **NOTE**
- Proper care and procedure must be taken to avoid damage to tappets (hydraulic lifters) or push rods. Before proceeding, rotate piston to top dead center (TDC) on the compression stroke of the engine. Crankshaft PTO keyway will be in the 12 o'clock position.
1. Install a new cylinder head gasket.
 2. Install the cylinder head **spacer** (on boss next to exhaust port) and install five head bolts (3). See Figure.
Torque the bolts initially to 40 % to 50 % of final torque (20.35 mm or 15 ft-lbs) in the sequence shown in Figure then final torque to **40.7 N·m (30 ft-lbs)**.
 3. Install the push rods and compress the valve springs. Snap the push rods underneath the rocker arms.
 4. Install the spark plug into the cylinder head (1).
Torque the spark plug to **38.0 / 43.4 N·m (28 / 32 ft-lbs)**.

Tightening torque	Cylinder head bolt	40.7 N·m 4.2 kgf·m 30.0 ft-lbs
	Spark plug	38.0 to 43.4 N·m 3.9 to 4.4 kgf·m 28.0 to 32.0 ft-lbs

- (1) Cylinder Head
(2) Cylinder Head Bolt and Spacer
(3) Cylinder Head Bolt
- 1 ~ 5: Tightening Sequence**

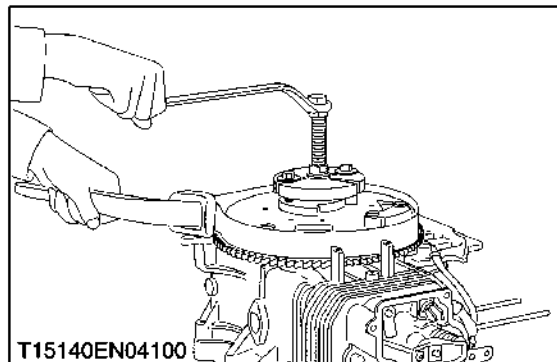
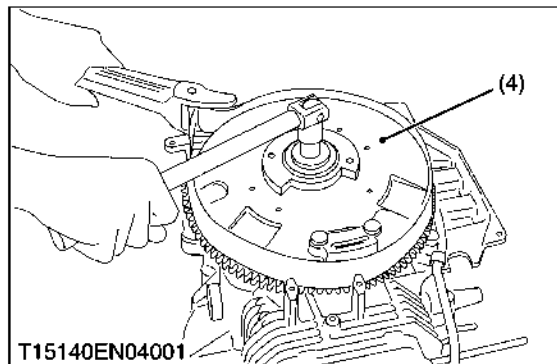
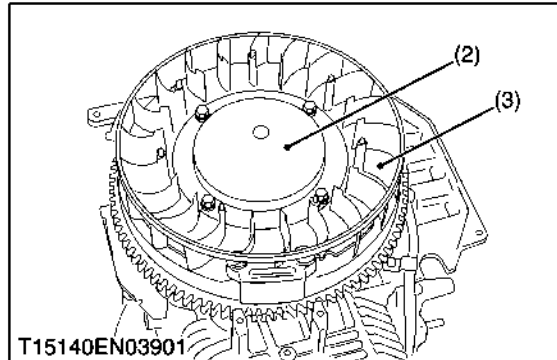
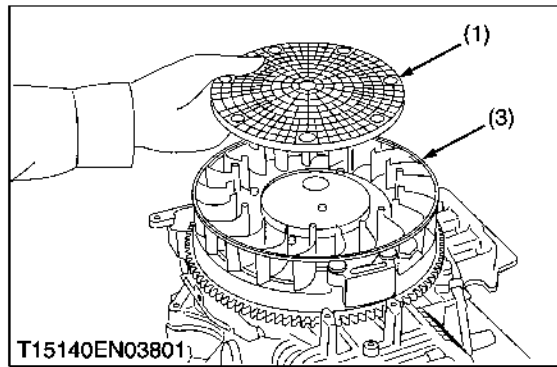
W1026087

Hydraulic Lifters

- Whenever an engine has been disassembled, before reassembly of the engine, the hydraulic lifters should be primed. Use the following procedure.
1. Place hydraulic lifter in a vertical position on a clean, flat surface.
 2. Use a lever-operated oil can filled with SAE 5W-30 oil, and insert nozzle into oil feed hole of the lifter body.
 3. Pump oil into lifter body until oil level fills body and seeps out socket. Oil is to be level with the top of lifter body.
 4. Place push rod on top of lifter socket. Push down, lifter should feel solid. If socket can be pushed down into lifter body, repeat step 3, and retest as above.

W1026509

(C) Flywheel and Stator



Fan and Flywheel

■ NOTE

- Always use the flywheel strap wrench to hold the flywheel when loosening or tightening the flywheel and fan retaining fasteners. Do not use any type of bar or wedge between the fins of cooling fan as the fins could become cracked or damaged.

1. Unsnap the grass screen (1) from fan (3).
2. Remove the fan cover (2) from fan (3).
3. Remove M10 × 1.5 × 45 hex. flange bolt and plain washer.
4. Remove the flywheel (4) from the crankshaft using a puller.

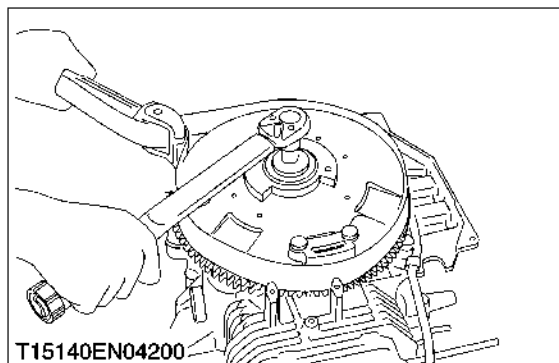
■ NOTE

- Always use a puller to remove the flywheel from the crankshaft. Do not strike the crankshaft or flywheel, as these parts could become cracked or damaged.

- (1) Grass Screen
(2) Fan Cover

- (3) Fan
(4) Flywheel

W1026696



Fan and Flywheel (Continued)

(When installing)



WARNING

Damaging Crankshaft and Flywheel can Cause Personal Injury !

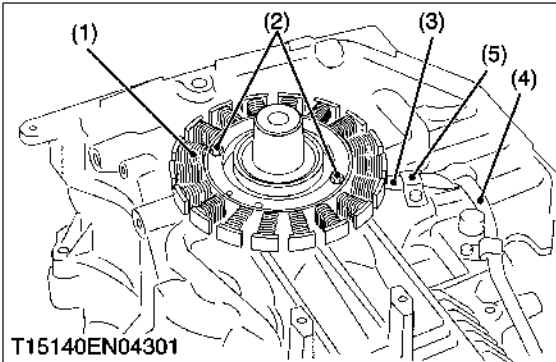
- Using improper procedures to install the flywheel can crack or damage the crankshaft and/or flywheel. This not only causes extensive engine damage, but can also cause personal injury, since broken fragments could be thrown from the engine. Always observe and use the following precautions and procedures when installing the flywheel.

NOTE

- Before installing the flywheel make sure the crankshaft taper and flywheel hub are clean, dry and completely free of lubricants. The presence of lubricants can cause the flywheel to be over-stressed and damaged when the flange screw is torqued to specification.
 - Make sure the flywheel key is installed properly in the keyway. The flywheel can become cracked or damaged if the key is not installed properly in the keyway.
 - Always use a flywheel strap wrench to hold the flywheel when tightening the flywheel fastener. Do not use any type of bar wedge between the cooling fins or flywheel ring gear, as these parts could become cracked or damaged.
1. Install the fan, spacers and hex. flange screws to the flywheel. Torque the hex. flange screws to **9.9 N·m (7.3 ft-lbs)**.
 2. Install the woodruff key into the keyway in the crankshaft.
 3. Place the flywheel over the keyway / crankshaft. Install grass screen, drive cup, plain washer (flat side of plain washer towards the drive cup), and the hex. flange screw.
 4. Hold the flywheel with a strap wrench and torque the hex. flange screw to **66.4 N·m (49 ft-lbs)**.

Tightening torque	Fan screw	9.9 N·m 1.0 kgf·m 7.3 ft-lbs
	Flywheel mounting bolt	66.4 N·m 6.8 kgf·m 49.0 ft-lbs

W1026896



Stator and Wiring Harness

- 1. Remove the stator leads (3) from connector body.
- 2. Remove the hex. flange screw and clip (5) securing the stator leads (3) to the crankcase.
- 3. Remove the hex. flange screw and clip (5) securing the kill lead (4) to the crankcase. Remove the four hex. socket head screws (2) and stator (1).

(When installing)

- 1. Position the stator leads (3) towards the hole in the crankcase. Insert the stator leads (3) through the hole to the outside of the crankcase.
- 2. Install the stator using four hex. socket head crews (2). Torque the screws (2) to **4.0 N·m (3.0 ft-lbs)**.
- 3. Secure the stator leads (3) to the crankcase with the clip and hex. flange screw (5).
- 4. Install the connector body to the stator leads (3).
- 5. Install the kill lead (4) through the same hole as the stator lead (3) from the outside of the crankcase. Secure the kill lead (4) to the crankcase with the clip and hex. flange screw (5).

Tightening torque	Stator screw	4.0 N·m 0.4 kgf·m 3.0 ft-lbs
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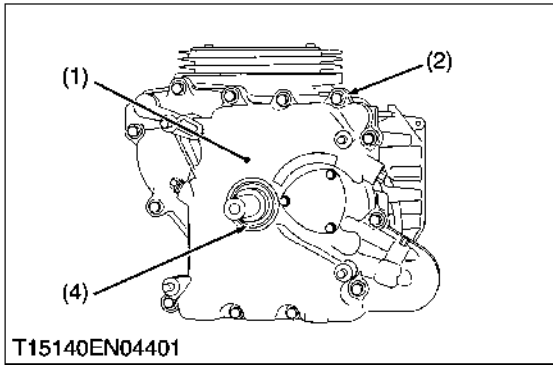
- (1) Stator

(2) Hex. Socket Screws

(3) Stator Leads
- (4) Kill Lead

(5) Hex. Flange Screw and Clip

W1027499

(D) Oil Pan**Oil Pan**

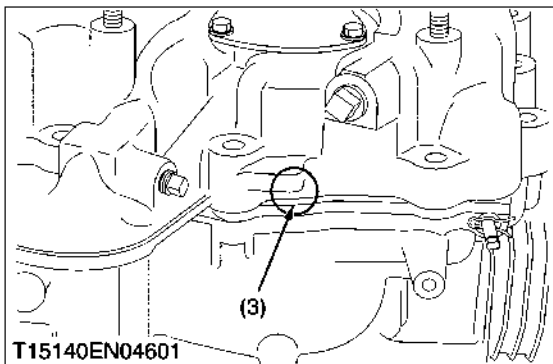
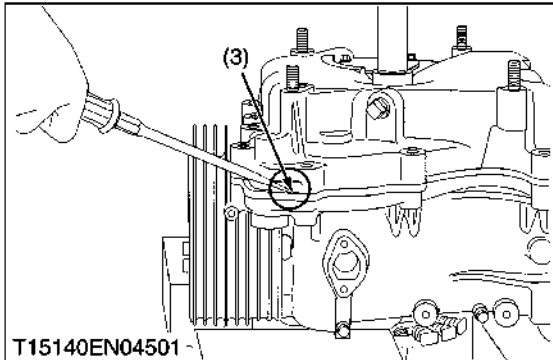
1. Insert the engine so that the engine pulley side of crankshaft is up.
2. Remove the twelve hex. flange screws (2) securing the oil pan (1) to the crankcase.
3. Locate the splitting tabs in the seam of the oil pan (1) and crankcase. Pry splitting notch (3) the oil pan (1) from the crankcase using the large, flat-blade screwdriver.

NOTE

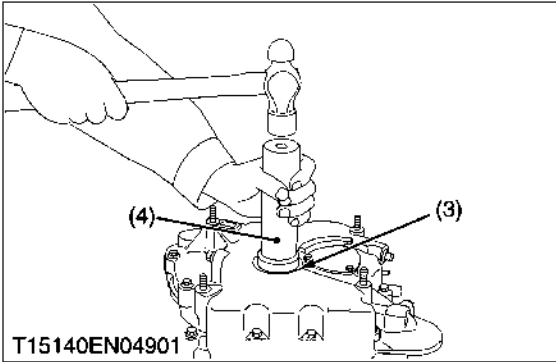
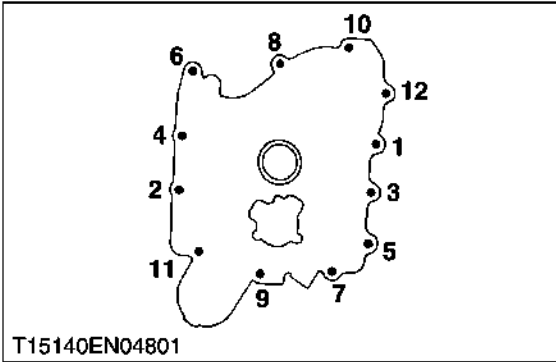
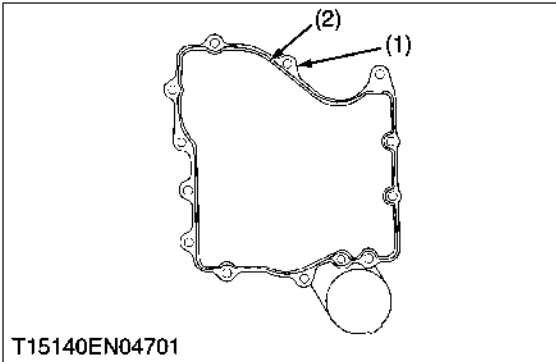
- **Insert the screwdriver only in the splitting tabs. Do not pry on the gasket surfaces of the crankcase or oil pan as this can cause leaks.**

4. Remove the oil seal from the oil pan.

- | | |
|-----------------------|---------------------|
| (1) Oil Pan | (3) Splitting Notch |
| (2) Hex. Flange Screw | (4) Oil Seal |



W1027941



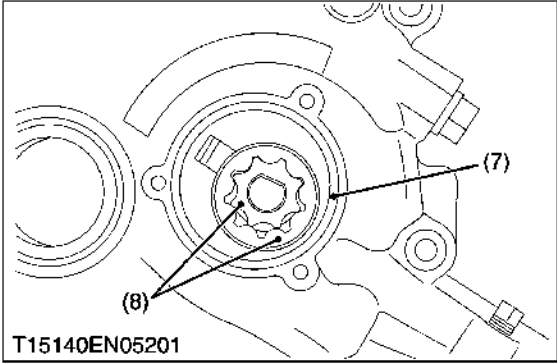
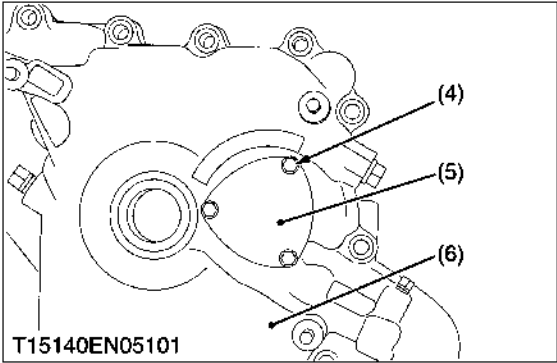
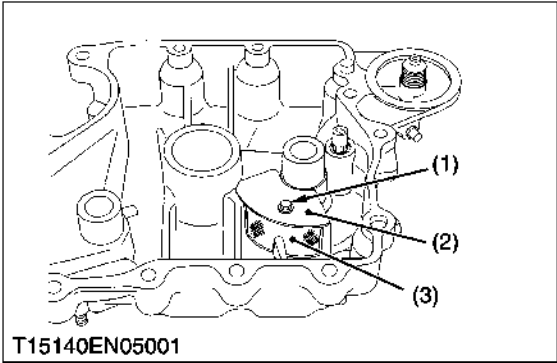
- Oil Pan (Continued)**
(When installing)
- **NOTE**
- RTV silicone sealant is used as a gasket between the oil pan and crankcase.
Always use fresh sealant. Using outdated sealant can result in leakage.
1. Prepare the sealing surfaces of the crankcase and oil pan as directed by the sealant manufacturer.
- **NOTE**
- Do not scrape the surfaces when cleaning as this will damage the surfaces. This could result in leaks. The use of a gasket removing solvent is recommended.
2. Apply a 1/16" bead of sealant to the oil pan as shown in Figure.
 3. Install the oil pan to the crankcase and install the twelve hex. flange screws. Tighten the screws hand tight.
 4. Torque the fasteners, in the sequence shown in Figure to **24.4 N·m (18.0 ft-lbs)**.
 5. Slide the seal protector sleeve over the crankshaft. Generously lubricate the lips of oil seal (3) with light grease. Slide the oil seal (3) over the sleeve.
 6. Use handle and seal driver (4). Install the seals until the driver bottoms against the crankcase or oil pan.

Tightening torque	Oil pan screw	24.4 N·m 2.5 kgf·m 18.0 ft-lbs
-------------------	---------------	--------------------------------------

- (1) Oil Pan
(2) Sealant
(3) Oil Seal
(4) Oil Seal Handle
- 1~12:Oil Pan Screw Torque Sequence

W1028294

(E) Oil Pump



Oil Pickup and Oil Pump

- 1. Remove the hex. flange screw (1), oil pickup screen cover (2), and oil pickup screen (3).

(When assembling oil pump)

- 1. Lubricate the oil pump cavity and oil pump rotors with engine oil. Install the outer and inner oil pump rotors.
 - 2. Install the O-ring in the groove in the oil pan.
 - 3. Install the oil pump cover (machined side towards O-ring). Secure with three hex. flange screws.
- Torque the screws as follows:
First Time Installation on a New Oil Pan: **6.2 N·m (4.6 ft-lbs)**.
Reinstallation on a Used Oil Pan: **4.0 N·m (3.0 ft-lbs)**.

Tightening torque	Oil pump cover screw (New oil pan)	6.2 N·m 0.63 kgf·m 4.6 ft-lbs
	Oil pump cover screw (Used oil pan)	4.0 N·m 0.41 kgf·m 3.0 ft-lbs

- (1) Hex. Flange Screw

(2) Oil Pickup Screen Cover

(3) Oil Pickup Screen

(4) Hex. Flange Screw
- (5) Oil Pump Cover

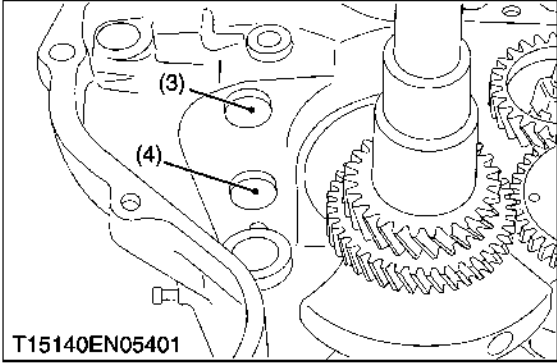
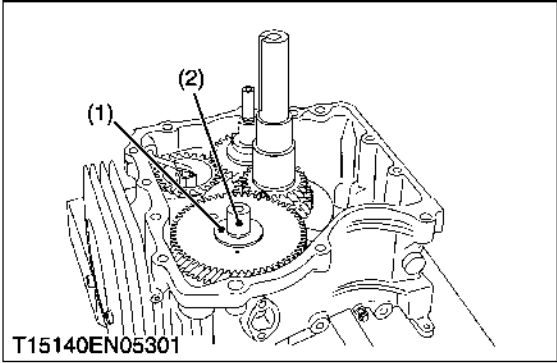
(6) Oil Pan

(7) O-ring

(8) Oil Pump Rotors

W1028731

(F) Camshaft and Balance Shaft



Camshaft and Tappet (Hydraulic Lifter)

- 1. From cylinder head side, pull lifters away from the camshaft.
- 2. Remove the camshaft (2) and shim (1).* See the first figure.
- 3. Mark or identify the tappet (hydraulic lifters) (3), (4) as either intake or exhaust (See the second figure.). Remove the tappets (hydraulic lifters) (3), (4) from the crankcase.

NOTE

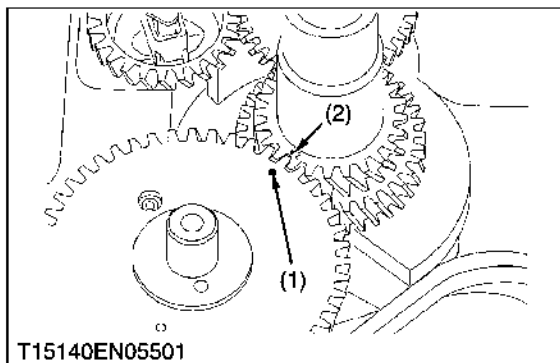
- The intake valve tappet (hydraulic lifter) is farthest from the crankcase gasket surface. The exhaust valve tappet (hydraulic lifter) is nearest to the crankcase gasket surface.
- *Not on all models.

- (1) Shim

(2) Camshaft
- (3) Exhaust Valve Tappet
(Exhaust Valve Hydraulic Lifter)

(4) Inlet Valve Tappet
(Inlet Valve Hydraulic Lifter)

W1029615

**(When installing)**

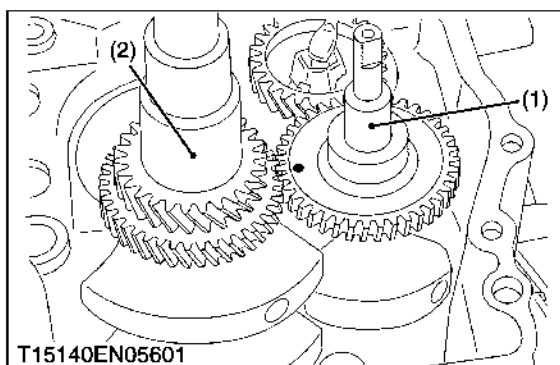
1. Lubricate the camshaft bearing surfaces of crankcase and camshaft with engine oil.
2. Align the timing marks on the camshaft gear and the smaller gear on crankshaft. Lower the camshaft into the bearing surface in crankcase.

Make sure the camshaft gear and smaller gear on crankshaft mesh and the timing marks are aligned.

(1) Camshaft Timing Mark

(2) Crankshaft Timing Mark
(Small Crankgear)

W1029945

**Balance Shaft**

1. Remove the balance shaft (1) from the crankcase.

(When installing)

1. Lubricate the balance shaft bearing surfaces of crankcase and balance shaft (1) with engine oil.
2. Align the timing marks on the balance shaft gear and the larger gear on crankshaft. Lower the balance shaft into the bearing surface in the crankcase.

Make sure the balance shaft gear, large crankshaft gear and the governor gear teeth mesh and the timing marks are aligned.

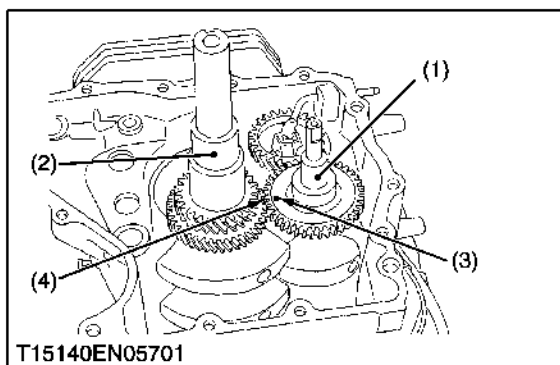
(1) Balance Shaft

(3) Balance Shaft Timing Mark

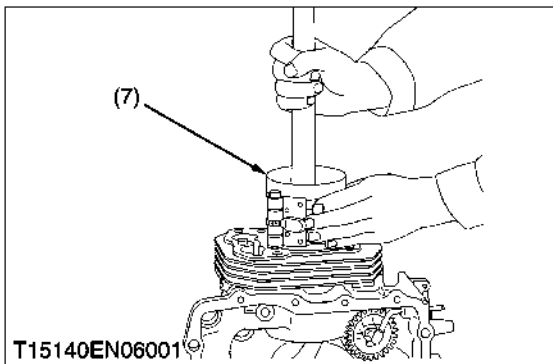
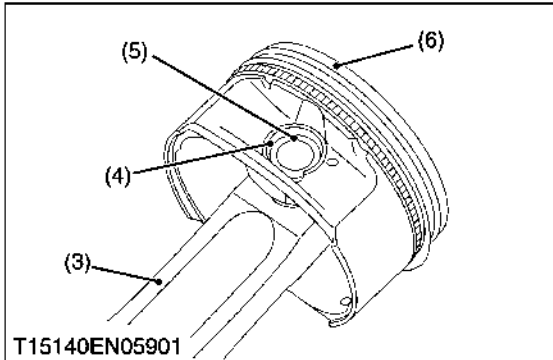
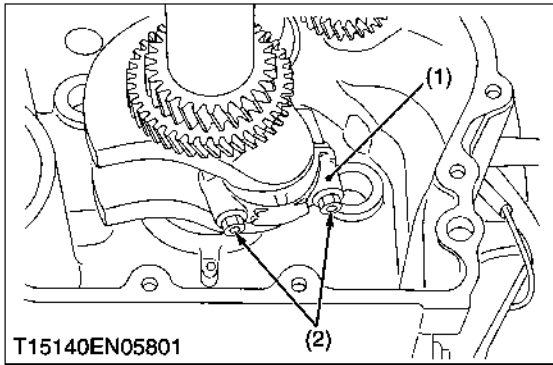
(2) Crankshaft

(4) Crankshaft Timing Mark
(Large Crankgear)

W1030168



(G) Connecting Rod, Piston and Crankshaft



Connecting Rod and Piston

1. Remove the two hex. flange screws (2) and connecting rod cap (1).

■ NOTE

- If a carbon ridge is present at the top of the bore, use a ridge reamer tool to remove it before attempting to remove the piston.
2. Carefully push the connecting rod (3) and the piston (6) away from the crankshaft and out of the cylinder bore.
 3. Remove the piston pin retainer (4) and piston pin. Separate the piston (6) from the connecting rod (3).

(When installing)

- Install the piston (6), connecting rod (3), piston pin (5), and piston pin retainers (4).

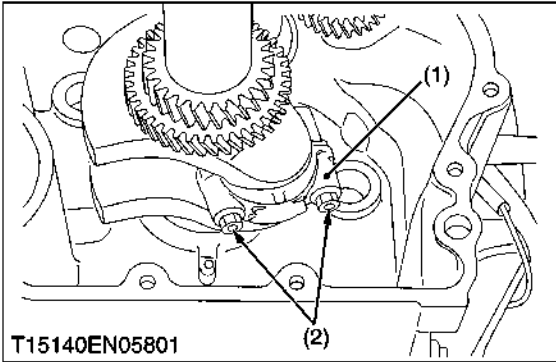
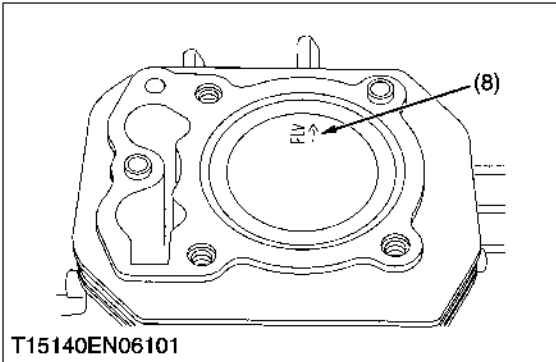
■ NOTE

- Proper orientation of the piston / connecting rod inside the engine is extremely important. Improper orientation can cause extensive wear or damage.
- Stagger the piston rings in the grooves until the end gaps are 120° apart.
- Lubricate the cylinder bore, piston, and rings with engine oil. Compress the piston rings using a piston ring compressor. Push the piston through the piston ring compressor (7) so the oil control (bottom) ring is just above the lower edge of the piston ring compressor (7).
- Place the piston ring compressor (7) on the top surface of the crankcase and make certain it is seated down around the entire circumference. Orient the "FLY" mark on the piston toward the flywheel side of the crankcase. Use a soft, rubber grip hammer handle and tap the piston (6) / connecting rod (3) into the bore. The first tap should be rather firm, so the oil ring moves from the compressor into the bore in one smooth, quick motion. Otherwise the oil ring rails may spring out and jam between the ring compressor and the top of the bore.

- (1) Connecting Rod Cap
(2) Hex. Flange Screws
(3) Connecting Rod
(4) Piston Pin Retainer

- (5) Piston Pin
(6) Piston
(7) Piston Ring Compressor

W1030371



Connecting Rod and Piston (Continued)

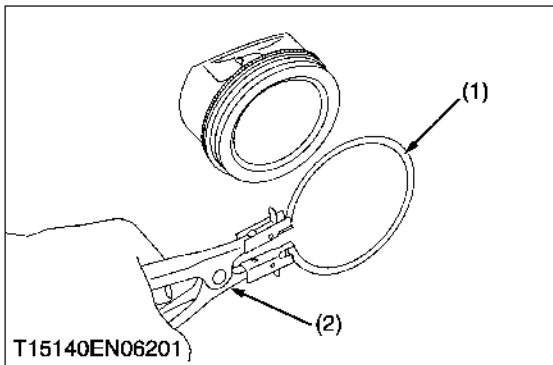
- Lubricate the crankshaft journal and connecting rod bearing surfaces with engine oil. Install the connecting rod cap (2) to connecting rod.
- Three different types of connecting rod screw are in use which must be tightened to different torque values. If the type used is an 8 mm straight shank, torque in increments to **22.7 N·m (16.7 ft-lbs)**. On those bolts having step-down design, torque to **14.7 N·m (10.8 ft-lbs)**. If straight shank 6 mm, tighten to **11.3 N·m (8.3 ft-lbs)**.
- Rotate the crankshaft until the piston is at top dead center in the cylinder bore.

Tightening torque	Connecting rod screw (8 mm straight shank)	22.7 N·m 2.3 kgf·m 16.7 ft-lbs
	Connecting rod screw (Step-down design)	14.7 N·m 1.5 kgf·m 10.8 ft-lbs
	Connecting rod screw (6 mm straight shank)	11.3 N·m 1.2 kgf·m 8.3 ft-lbs

(1) Connecting Rod Cap
(2) Hex. Flange Screw

(3) Arrow Mark

W1031427



Piston Ring

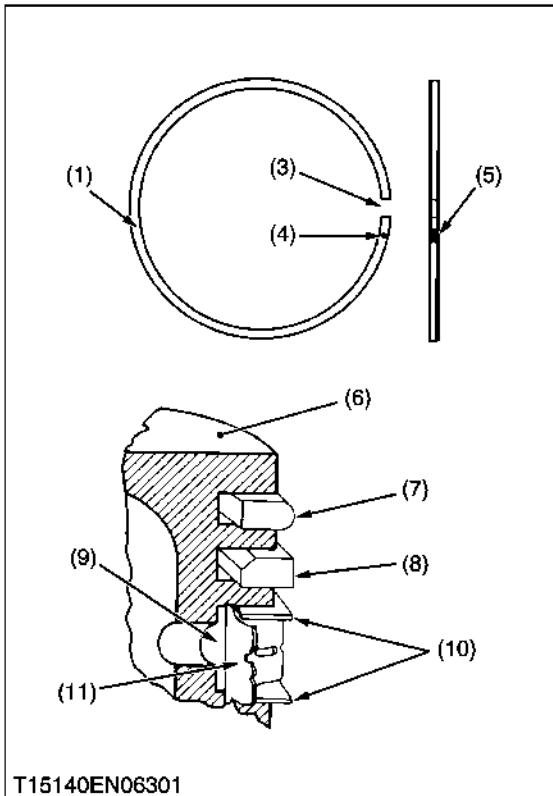
1. Remove the top and center compression rings using a ring expander.
 2. Remove the oil control ring rails, then remove the rails spacer.
- (When installing)**

NOTE

- **Piston rings must be installed correctly. Piston ring installation instructions are usually included with new ring sets. Follow instructions carefully. Use a piston ring expander to install piston rings. Install the bottom (oil control) ring first and the top compression ring last.**
- **Oil Ring (9) (Oil Control Ring) (Bottom Groove):** Install the expander and then the rails. Make sure the ends of expander are not overlapped.
- **Compression Ring 2 (8) (Compression Ring) (Center Groove):** Install the compression ring 2 (8) (center ring) using a piston ring installation tool. Make sure the "pip" mark (4) is up and the **PINK** dykem stripe (5) is to the left of end gap (3).
- **Compression Ring 1 (7) (Compression Ring) (Top Groove):** Install the compression ring 1 (top compression ring) using a piston ring installation tool. Make sure the "pip" mark (4) is up and the **BLUE** dykem stripe (5) is to the left of end gap (3).

- | | |
|--------------------------|---------------------------------|
| (1) Piston Ring | (8) Compression Ring 2 |
| (2) Piston Ring Expander | (Center Compression Ring) |
| (3) End Gap | (9) Oil Ring |
| (4) "Pip" Mark | (Oil Control Ring, Three-piece) |
| (5) Dykem Stripe | (10) Rails |
| (6) Piston | (11) Expander |
| (7) Compression Ring 1 | |
| (Top Compression Ring) | |

W1031706



Crankshaft, Flywheel End Oil Seal

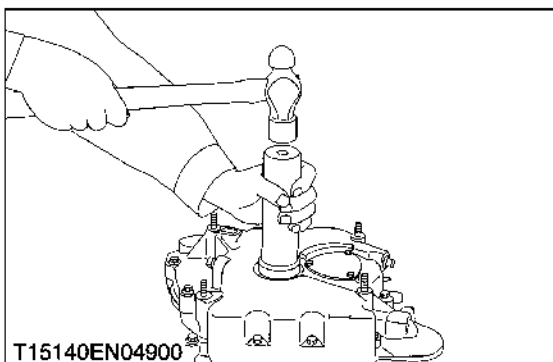
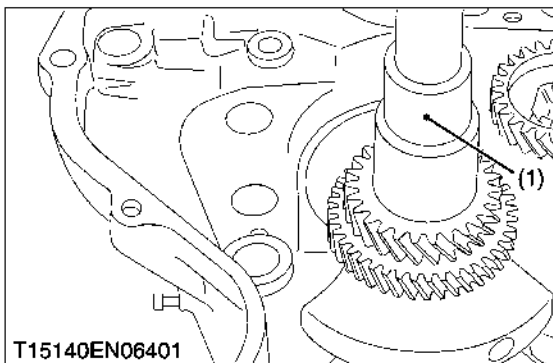
1. Remove the woodruff key from the flywheel taper end of crankshaft (1).
2. Remove the crankshaft from the crankcase.
3. Remove the oil seal from crankcase.

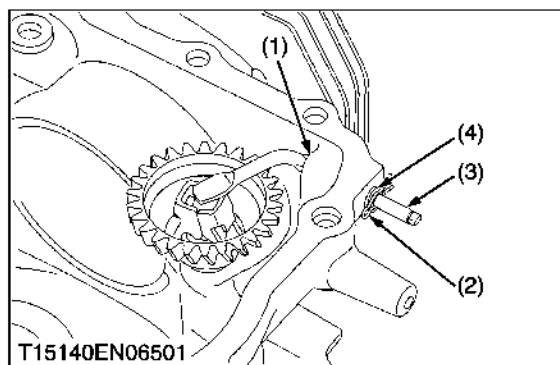
(When installing)

1. Lubricate the flywheel end bearing surfaces of the crankshaft and crankcase with engine oil.
2. Insert the crankshaft through the flywheel end bearing.

- (1) Crankshaft

W1032004





Governor Cross Shaft and Governor Gear

1. Remove the hitch pin (2) and plain washer (1) from governor cross shaft (3).
2. Remove the governor cross shaft (3) and plain washer (1) from the crankcase.
3. Remove the governor cross shaft oil seal (5) from the crankcase.
4. If necessary, remove the governor gear (7) and regulating pin (8).

NOTE

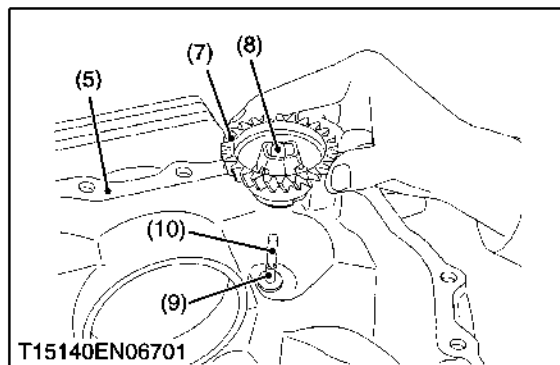
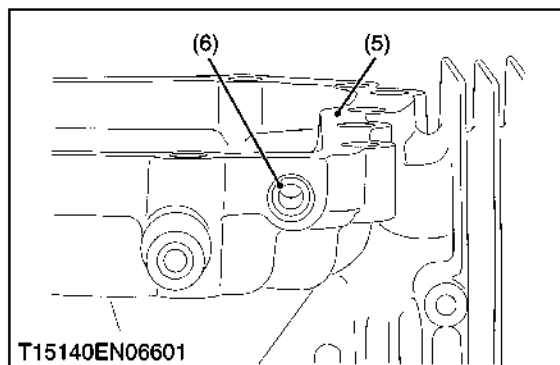
- The governor gear is held onto the governor gear shaft by small molded tabs in the gear. When the gear is removed from the shaft these tabs are destroyed. This will require replacement of the gear; therefore, remove the gear only if absolutely necessary (such as when reboring, doing major engine rebuilding, etc.).

(When installing)

NOTE

- Do not reuse an old (removed) governor gear.
1. Install the thrust washer (9) to governor gear shaft (10).
 2. Position the regulating pin to governor gear (7) / flyweights (11) (as shown in the third figure). Slide the governor gear (7) / regulating pin (8) over the governor gear shaft (10).
 3. Using the **(KO-1030) oil seal installer**, install a new governor cross shaft oil seal (6) into the crankcase (5).
 4. Install smaller plain washer (1) to the cross shaft and insert the cross shaft (1) (from inside crankcase) through the crankcase (5) and cross shaft oil seal (6).
 5. Install larger plain washer (4) and hitch pin (2).

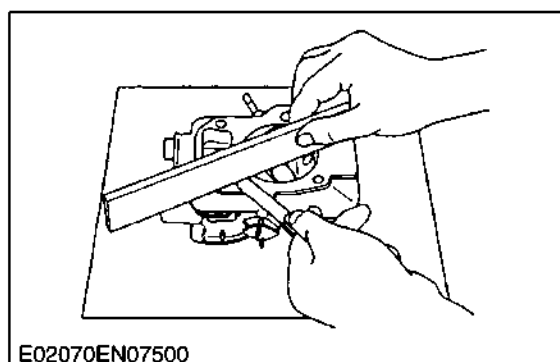
- | | |
|--------------------------|--------------------------|
| (1) Plain Washer | (6) Cross Shaft Oil Seal |
| (2) Hitch Pin | (7) Governor Gear |
| (3) Governor Cross Shaft | (8) Regulating Pin |
| (4) Plain Washer | (9) Thrust Washer |
| (5) Crankcase | (10) Governor Gear Shaft |



W1032237

(2) Servicing

(A) Cylinder Head and Valves

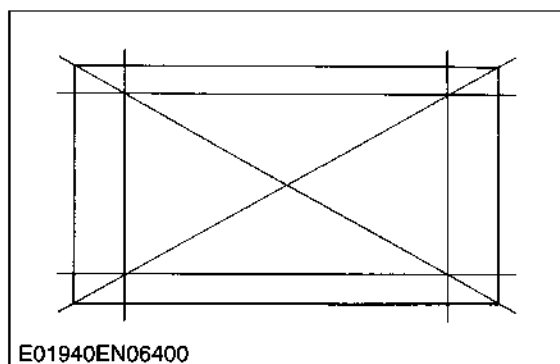


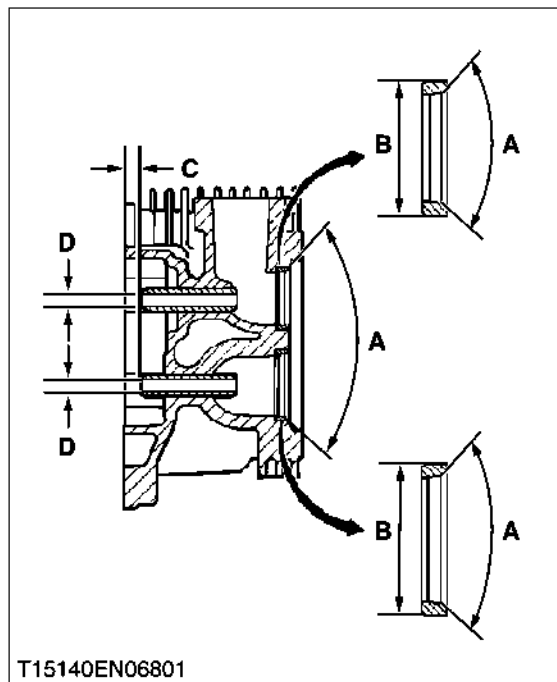
Cylinder Head Surface Flatness

1. Clean the cylinder head surface.
2. Place a straight edge on the cylinder head's four sides and two diagonal as shown in the figure.
3. Measure the clearance with a feeler gauge.

Cylinder head surface flatness	Allowable limit	0.076 mm 0.003 in.
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W1032784





Cylinder Head Inspection

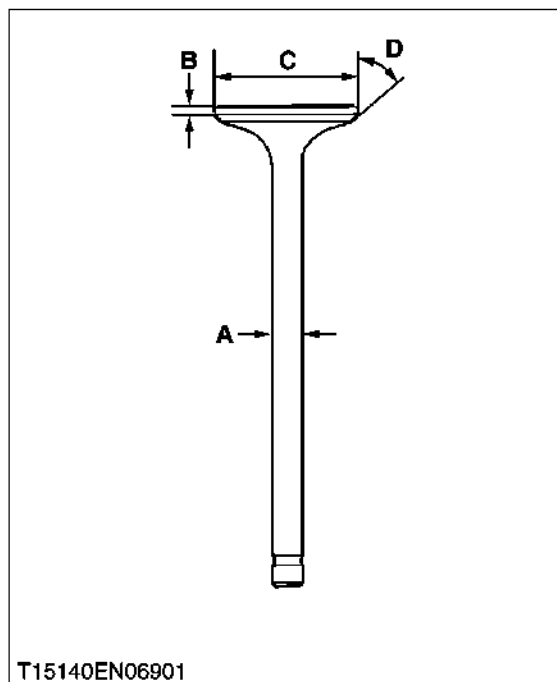
1. Check the dimensions.
2. If the measurement exceeds the allowable limit, replace the part.

Intake and exhaust seal angle	Factory spec.	89°
Intake insert O.D.	Factory spec.	37.987 to 38.013 mm 1.496 to 1.497 in.
Exhaust insert O.D.	Factory spec.	33.987 to 34.013 mm 1.338 to 1.339 in.
Intake and exhaust valve guide depth	Factory spec.	6.5 mm 0.256 in.
Intake and exhaust valve guide I.D.	Factory spec.	7.033 to 7.058 mm 0.277 to 0.278 in.
Intake valve guide I.D.	Allowable limit	7.134 mm 0.2809 in.
Exhaust valve guide O.D.	Allowable limit	7.159 mm 0.2819 in.

A : Seat Angle
B : Insert O.D.

C : Guide Depth
D : Guide I.D.

W1033031



Valve Stem O.D., Valve Head Diameter and Valve Face Angle

1. Measure the valve stem O.D. and valve head diameter with an outside micrometer.
2. If the measurement is less than the allowable limit, replace the valve.
3. Measure the valve margin and valve face angle.

Intake valve O.D.	Factory spec.	6.982 to 7.000 mm 0.275 to 0.276 in.
Exhaust valve O.D.	Factory spec.	6.970 to 6.988 mm 0.274 to 0.275 in.
Intake and exhaust valve margin (min.)	Factory spec.	1.5 mm 0.059 in.
Intake valve head diameter	Factory spec.	35.37 to 35.63 mm 1.393 to 1.403 in.
Exhaust valve head diameter	Factory spec.	31.37 to 31.63 mm 1.235 to 1.245 in.
Intake and exhaust valve surface angle	Factory spec.	45°

A : Valve Stem Diameter
B : Valve Margin

C : Valve Head Diameter
D : Valve Face Angle

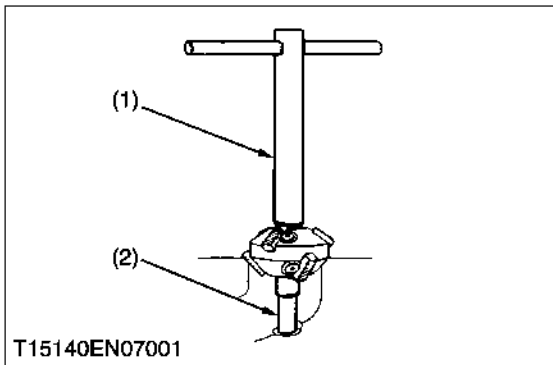
W1033608

Valve Guides Clearance

1. If a valve guide is worn beyond specifications, it will not guide the valve in a straight line. This may result in burnt valve faces or seats, loss of compression, and excessive oil consumption.
2. To check valve guide-to-valve stem clearance, thoroughly clean the valve guide and, using a split-ball gauge, measure the inside diameter. Then, using an outside micrometer, measure the diameter of the valve stem at several points on the stem where it moves in the valve guide. Use the largest stem diameter to calculate the clearance. If the **intake** clearance exceeds **0.038 / 0.076 mm (0.0015 / 0.003 in.)** or the **exhaust** clearance exceeds **0.050 / 0.088 mm (0.0020 / 0.0035 in.)**, determine whether the valve stem or guide is responsible for the excessive clearance. Maximum (I.D.) wear on the **intake** valve guide is **7.134 mm (0.2809 in.)** while **7.159 mm (0.2819 in.)** is the maximum allowed on the exhaust guide. The guides are not removable but can be reamed **0.25 mm (0.010 in.)** oversize. Valves with **0.25 mm** oversize stems must then be used. If the guides are within limits but the valve stems are worn beyond limits, replace with new valves.

Intake valve guide clearance	Allowable limit	0.038 to 0.076 mm 0.0015 to 0.003 in.
Exhaust valve guide clearance	Allowable limit	0.050 to 0.088 mm 0.0020 to 0.0035 in.
Intake valve guide I.D.	Allowable limit	7.134 mm 0.2809 in.
Exhaust valve guide I.D.	Allowable limit	7.159 mm 0.2819 in.

W1033933



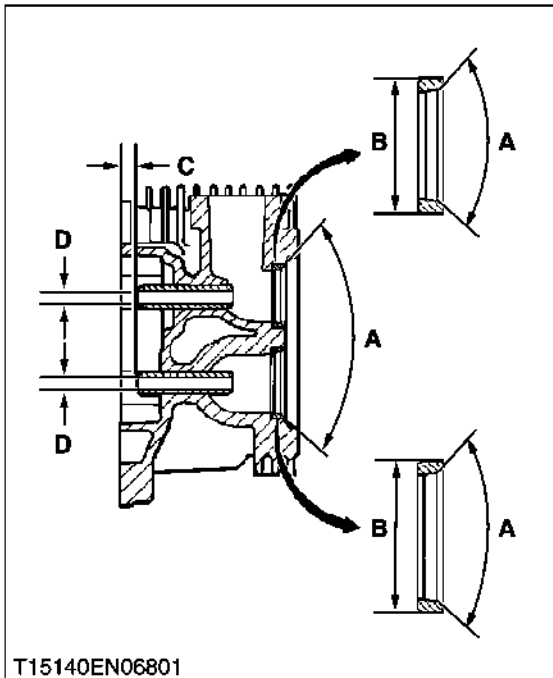
Valve Inserts

1. Hardened steel alloy intake and exhaust valve seat inserts are press fitted into the cylinder head (3). The inserts are not replaceable on the engines but can be reconditioned if not too badly pitted or distorted. If cracked or badly warped, the cylinder head (3) should be replaced.
2. Recondition the valve seat inserts following the instructions provided with the valve seat cutter (1) being used.
3. A typical cutter (1) is shown in Figure. The final cut should be made with an 89° cutter as specified for the valve seat angle in Figure. With the proper 45° valve face angle as specified and the valve set cut properly (44.5° as measured from centerline when cut 89°) this would result in the desired 0.5° (1.0° full cut) interference angle where the maximum pressure occurs on the outside diameters of valve face and seat.

- (1) Valve Seat Cutter (Typical)
 (2) Pilot
 (3) Cylinder Head

- A : Seat Angle
 B : Insert O.D.
 C : Guide Depth
 D : Guide I.D.

W1034238



Lapping Valves

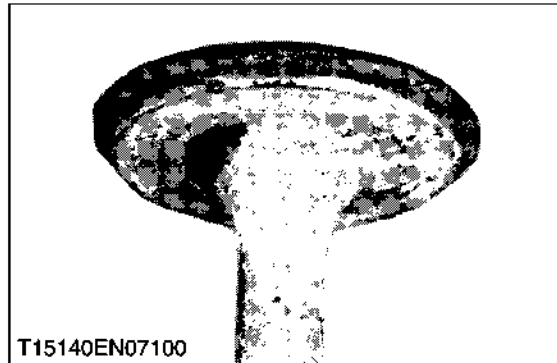
Reground or new valves must be lapped in, to provide fit. Use a hand valve grinder with suction cup for final lapping. Lightly coat valve face with "fine" grade of grinding compound, then rotate valve on seat with grinder. Continue grinding until smooth surface is obtained on seat and on valve face. Thoroughly clean cylinder head in soap and hot water to remove all traces of grinding compound. After drying cylinder head, apply a light coating of **SAE 10** oil to prevent rusting.

W1034551

Intake Valve Stem Seal

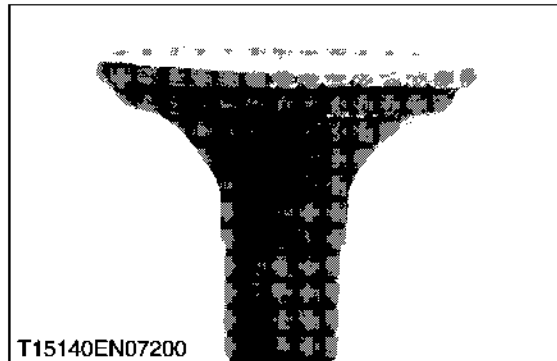
These engines use valve stem seals on the intake valves. Always use a new seal when valves are removed from cylinder head. The seals should also be replaced if deteriorated or damaged in any way. **Never reuse an old seal.**

W1034617

(B) Valve Inspection**Case 1: Normal Valve**

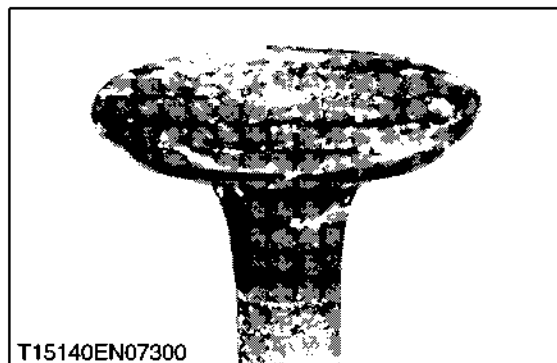
1. Even after long hours of operation a valve can be reconditioned and reused if the face and margin are in good shape (2).
2. If a valve is worn to where the margin is less than 1/32" do not reuse it.
3. The valve shown was in operation for almost 1000 hours under controlled test conditions.

W1034665

**Case 2: Leakage**

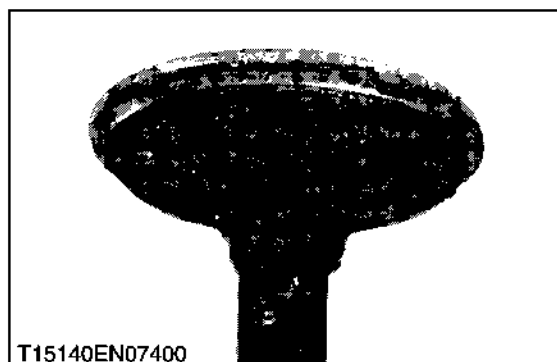
1. A poor grind on face or seat of valve will allow leakage resulting in a burned valve on one side only.

W1035280

**Case 3: Bad Condition**

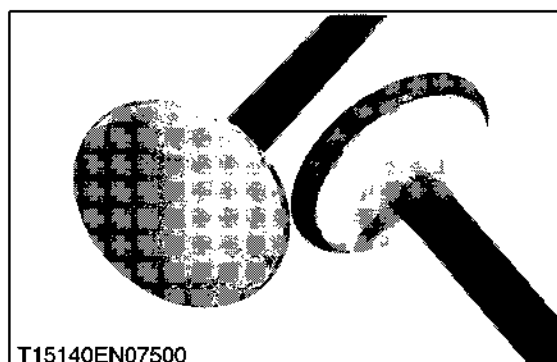
1. The valve depicted here should be replaced. Note the warped head; margin damaged and too narrow.
2. These conditions could be attributed to excessive hours or a combination of poor operating conditions.

W1035386

**Case 4: Coking**

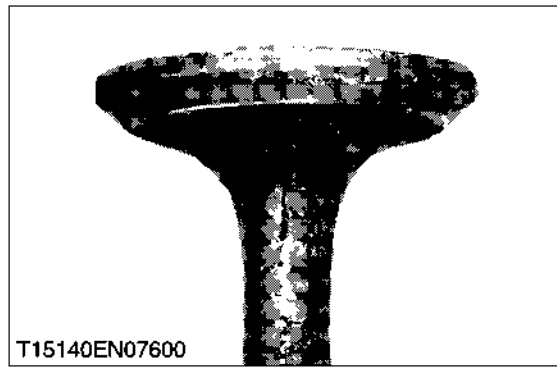
1. Coking is normal on intake valves and is not harmful. If the seat is good, the valve could be reused after cleaning.

W1035469

**Case 5: Excessive Combustion Temperatures**

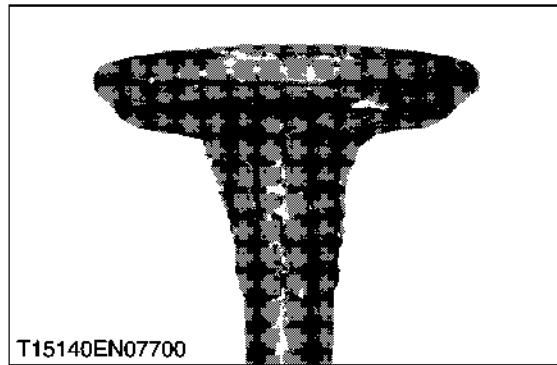
1. The white deposits seen here indicate very high combustion temperatures, usually due to a lean fuel mixture.

W1035522

**Case 6: Stem Corrosion**

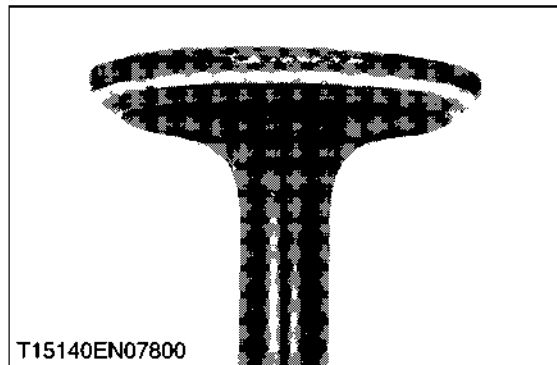
1. Moisture in fuel or from condensation are the most common causes of valve stem corrosion.
2. Condensation occurs from improper preservation during storage and when engine is repeatedly stopped before it has a chance to reach normal operating temperatures.
3. Replace corroded valves.

W1035571

**Case 7: Gum**

1. Gum deposits usually result from using stale gasoline. This condition is often noted in applications where fuel is not drained out of tank during the off season. Gum is a prevalent cause of valve sticking. The cure is to ream the valve guides and clean or replace the valves, depending on their condition.

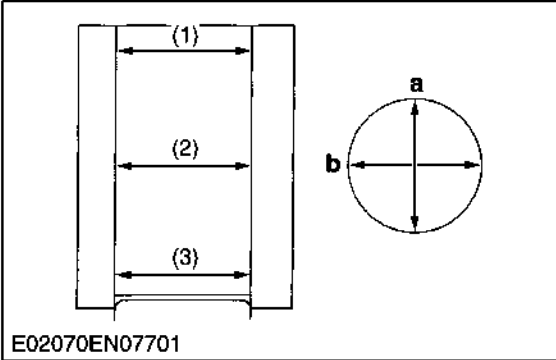
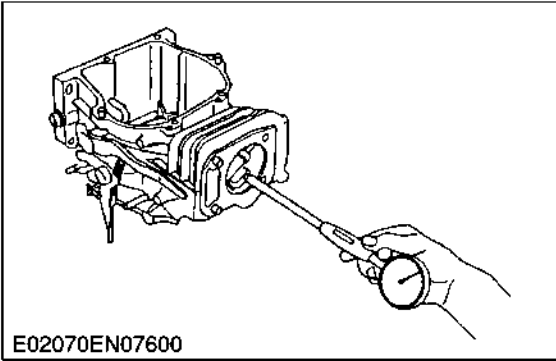
W1035642

**Case 8: Overheating**

1. An exhaust valve subject to overheating will have a dark discoloration in the area above the valve guide. Worn guides and faulty valve springs may cause this condition. Also check for clogged air intake, and blocked fins when this condition is noted.

W1035752

(C) Crankcase and Cylinder Liner



Cylinder Liner I.D.

Check all gasket surfaces to make sure they are free of gasket fragments. Gasket surfaces must also be free of deep scratches or nicks.

Check the cylinder bore wall for scoring. In severe cases, unburned fuel can cause scuffing and scoring of the cylinder wall. It washes the necessary lubricating oils off the piston and cylinder wall. As raw fuel seeps down the cylinder wall, the piston rings make metal to metal contact with the wall. Scoring of the cylinder wall can also be caused by localized hot spots resulting from blocked cooling fins or from inadequate or contaminated lubrication.

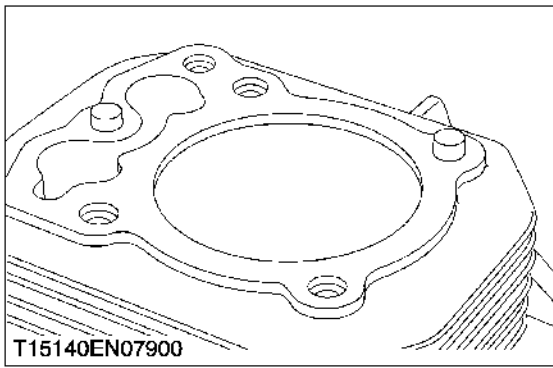
If the cylinder bore is badly scored, excessively worn, tapered, or out-of-round, resizing is necessary. Use an cylinder gauge to determine amount of wear (refer to the "Specifications, Tolerances, and Special Torque Values", in Section 1), then select the nearest suitable oversize of either **0.25 mm (0.010 in.)** or **0.50 mm (0.020 in.)**. Resizing to one of these oversizes will allow usage of the available oversize piston and ring assemblies. Initially, resize using a boring bar, then use the following procedures for honing the cylinder.

Cylinder liner I.D.	Factory spec.	90.000 to 90.025 mm 3.5433 to 3.5443 in.
	Allowable limit	90.63 mm 3.5681 in.

- (1) Top
- (2) Middle
- (3) Bottom (Skirt)

- a: Right-angled to Piston Pin
- b: Piston Pin Direction

W1035825



Honing

While most commercially available cylinder hones can be used with either portable drills or drill presses, the use of a low speed drill press is preferred as it facilitates more accurate alignment of the bore in relation to the crankshaft crossbore. Honing is best accomplished at a drill speed of about **250 rpm** and **60 strokes** per minute. After installing coarse stones in hone, proceed as follows:

1. Lower hone into bore and after centering, adjust so that the stones are in contact with the cylinder wall. Use of a commercial cutting-cooling agent is recommended.
2. With the lower edge of each stone positioned even with the lowest edge of the bore, start drill and honing process. Move the hone up and down while resizing to prevent the formation of cutting ridges. Check the size frequently.

■ **NOTE**

- **Measure the piston diameter and resize the bore to the piston to obtain the specified running clearances. Keep in mind the temperatures caused by honing may cause inaccurate measurements. Make sure the bore is cool when measuring.**
3. When the bore is within **0.064 mm (0.0025 in.)** of desired size, remove the coarse stones and replace with burnishing stones. Continue with the burnishing stones until within **0.013 mm (0.0005 in.)** of desired size and then use finish stones (220 – 280 grit) and polish to final size. A crosshatch should be observed if honing is done correctly. The crosshatch should intersect at approximately 23 – 33° off the horizontal. Too flat an angle could cause the rings to skip and wear excessively, too steep an angle will result in high oil consumption.
 4. After resizing, check the bore for roundness, taper, and size. Use an inside micrometer, telescoping gauge, or bore gauge to take measurements. The measurements should be taken at three locations in the cylinder – at the top, middle, and bottom. Two measurements should be taken (perpendicular to each other) at each of the three locations.

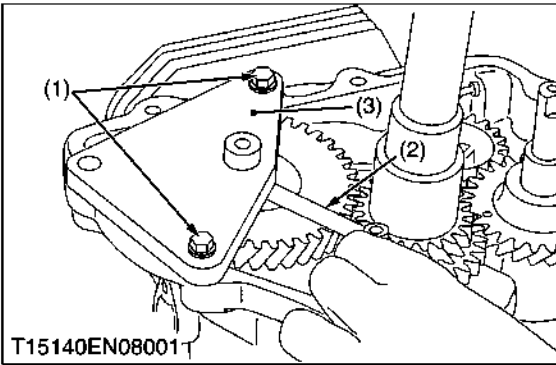
W1035983

Clean Cylinder Bore after Honing

1. Proper cleaning of the cylinder walls following boring and/or honing is very critical to a successful overhaul. Machining grit left in the cylinder bore can destroy an engine in less than one hour of operation after a rebuild.
2. The final cleaning operation should always be a thorough scrubbing with a brush and hot, soapy water. Use a strong detergent that is capable of breaking down the machining oil while maintaining a good level of suds. If the suds break down during cleaning, discard the dirty water and start again with more hot water and detergent. Following the scrubbing, rinse the cylinder with very hot, clear water, dry it completely, and apply a light coating of engine oil to prevent rusting.

W1036383

(D) Camshaft



Adjusting Camshaft End Play

1. Install the shim* spacer, removed during disassembly, to the camshaft.
2. Install the camshaft end play checking tool (3) to the crankcase and camshaft. Secure the tool (3) to the crankcase with the hex. flange screws (1) provided.
3. Using a flat feeler gauge (2), measure the camshaft end play between camshaft end and the end play checking tool.
Camshaft end play should be **0.076 / 0.127 mm (0.003 / 0.005 in.)**.
4. If the camshaft end play is not within the specified range, remove the end play checking tool (3) and add, remove, or replace shims* as necessary.

Several color coded shims* are available:

- White:** 0.69215 / 0.73025 mm (0.02725 / 0.02875 in.)
- Blue:** 0.74295 / 0.78105 mm (0.02925 / 0.03075 in.)
- Red:** 0.79375 / 0.83185 mm (0.03125 / 0.3275 in.)
- Yellow:** 0.84455 / 0.88265 mm (0.03325 / 0.3475 in.)
- Green:** 0.89535 / 0.99345 mm (0.3525 / 0.03675 in.)
- Gray:** 0.94615 / 0.98425 mm (0.03725 / 0.3875 in.)
- Black:** 0.99695 / 1.03505 mm (0.03925 / 0.04075 in.)

5. Reinstall the end play checking tool (3) and recheck end play.
6. Repeat steps 4 and 5 until the end play is within the specified range.

*Not on all models.

Camshaft end play	Factory spec.	0.076 to 0.127 mm 0.003 to 0.005 in.
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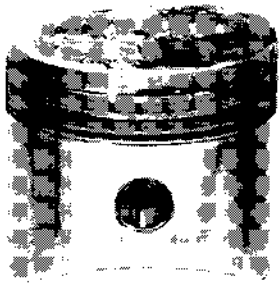
- (1) Hex. Flange Screw

(2) Feeler Gauge
- (3) Camshaft End Play Checking Tool

W1036453

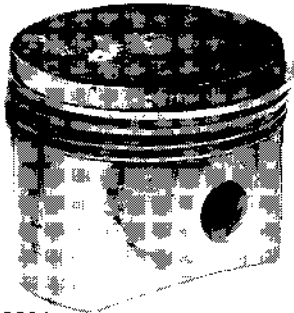
(E) Piston and Piston Rings Inspection

(A)



T15140EN08101

(B)



T15140EN08201

(C)



T15140EN08301

(D)



T15140EN08401

Piston and Piston Ring Damage Inspection

Scuffing and scoring of pistons and cylinder walls occurs when internal temperatures approach the welding point of the piston. Temperatures high enough to do this are created by friction, which is usually attributed to improper lubrication, and/or overheating of the engine.

Normally, very little wear takes place in the piston boss-piston pin area. If the original piston and connecting rod can be reused after new rings are installed, the original pin can also be reused but new piston pin retainers are required. The piston pin is included as part of the piston assembly – if the pin boss in piston or the pin, are worn or damaged, a new piston assembly is required.

Ring failure is usually indicated by excessive oil consumption and blue exhaust smoke. When rings fail, oil is allowed to enter the combustion chamber where it is burned along with the fuel. High oil consumption can also occur when the piston ring end gap is incorrect because the ring cannot properly conform to the cylinder wall under this condition. Oil control is also lost when ring gaps are not staggered during installation.

When cylinder temperatures get too high, lacquer and varnish collect on pistons causing rings to stick which results in rapid wear. A worn ring usually takes on a shiny or bright appearance.

Scratches on rings and pistons are caused by abrasive material such as carbon, dirt, or pieces of hard metal.

Detonation damage occurs when a portion of the fuel charge ignites spontaneously from heat and pressure shortly after ignition. This creates two flame fronts which meet and explode to create extreme hammering pressures on a specific area of the piston. Detonation generally occurs from using low octane fuels.

Preignition or ignition of the fuel charge before the timed spark can cause damage similar to detonation. Preignition damage is often more severe than detonation damage. Preignition is caused by a hot spot in the combustion chamber from sources such as: glowing carbon deposits, blocked fins, improperly seated valve, or wrong spark plug.

See Figure for some common types of piston and ring damage.

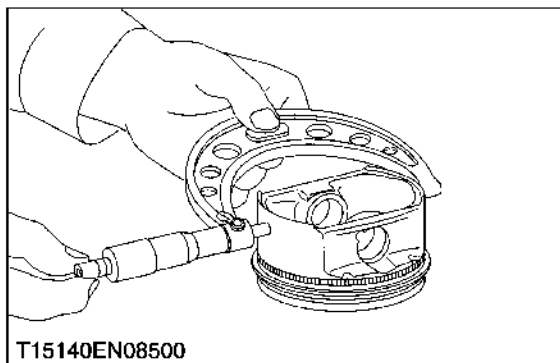
(A) Stuck, Broken Rings

(C) Abrasive Worn Rings

(B) Abrasive Scratched Rings

(D) Scored Piston and Rings

W1037868



Piston and Piston Ring Inspection

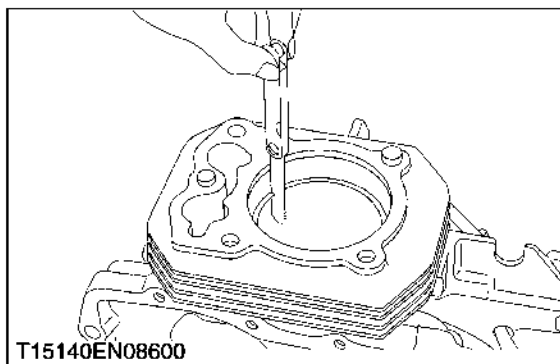
Replacement pistons are available in STD bore size, and in **0.25 mm (0.010 in.)**, and **0.50 mm (0.020 in.)** oversizes. Replacement pistons include new piston ring sets and new piston pins.

Service replacement piston ring sets are also available separately for STD, **0.25 mm (0.010 in.)**, and **0.50 mm (0.020 in.)** oversized pistons. Always use new piston rings when installing pistons. **Never reuse old rings.**

The cylinder bore must be deglazed before service ring sets are used.

Standard size piston skirt O.D.	Allowable limit	89.824 mm 3.5363 in.
0.25 mm oversize piston skirt O.D.	Allowable limit	90.074 mm 3.546 in.
0.50 mm oversize piston skirt O.D.	Allowable limit	90.324 mm 3.556 in.

W1038442



Piston Ring End Gap

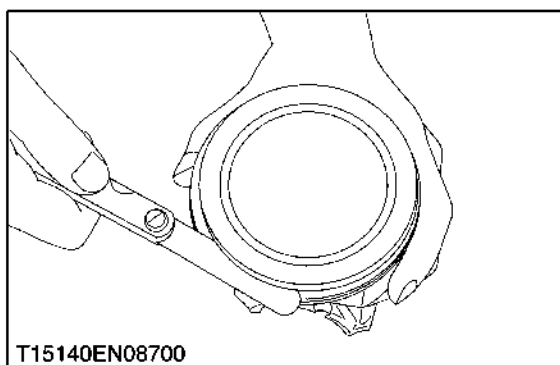
■ NOTE

- **Some important points to remember when servicing piston rings:**
 - If the cylinder bore does not need reboring and if the old piston is within wear limits and free of score or scuff marks, the old piston may be reused.
 - Remove old rings and clean up grooves. **Never reuse old rings.**

1. Before installing the rings on piston, place the top two rings, each in turn, in its running area in cylinder bore and check end gap (see figure). This gap should be 0.77 mm (0.030 in.) max. in a used cylinder bore and 0.3 / 0.5 mm (0.012 / 0.020 in.) in a new cylinder bore.

Piston ring end gap in a used cylinder bore	Allowable limit	0.77 mm 0.030 in.
Piston ring end gap in a new cylinder bore	Factory spec.	0.3 to 0.5 mm 0.012 to 0.020 in.

W1038696

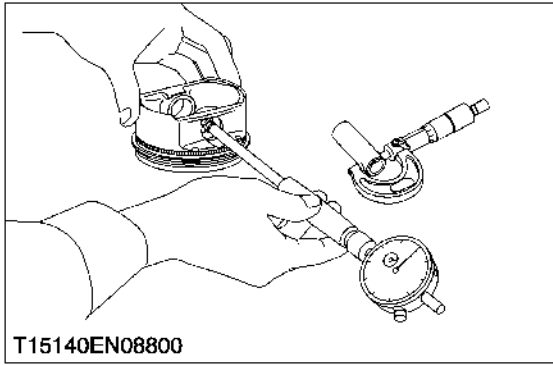


Piston Ring Side Clearance

1. After installing the new compression (compression ring 1 and compression ring 2) rings on piston, check piston-to-ring side clearance. Maximum recommended clearance is **0.060 / 0.105 mm (0.0023 / 0.0041 in.)**.
2. If side clearance is greater than specified, a new piston **must** be used.

Compression ring 1 and compression ring 2 side clearance	Allowable limit	0.060 to 0.105 mm 0.0023 to 0.0041 in.
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W1080182

**Piston Pin Hole I.D.**

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

Piston pin hole I.D.	Allowable limit	19.025 mm 0.7490 in.
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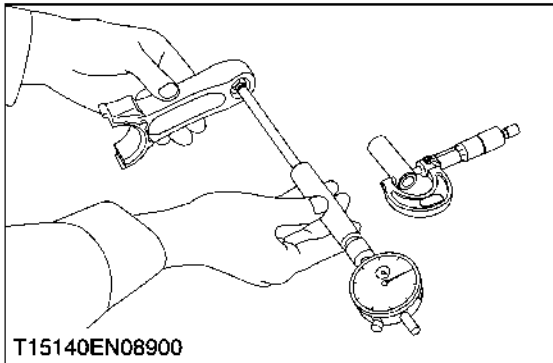
W1038982

Piston Pin O.D.

1. Measure the piston pin O.D. with an outside micrometer.
2. If the measurement is less than the allowable limit, replace it.

Piston pin O.D.	Allowable limit	18.994 mm 0.74779 in.
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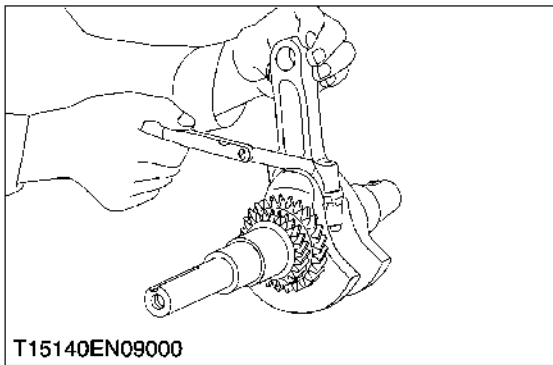
W1039067

(F) Connecting Rod and Crankshaft**Connecting Rod Small End I.D.**

1. Measure the connecting rod small end I.D. with a cylinder gauge.
2. If the measurement exceeds the allowable limit, replace the connecting rod assembly.

Connecting rod small end I.D.	Allowable limit	19.036 mm 0.7494 in.
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W1039316

**Connecting Rod Big End Running Clearance and Side Clearance**

1. Tighten the connecting rod screws to the specified torque.
2. Measure the connecting rod big end I.D. with a cylinder gauge.
3. If the measurement exceeds the allowable limit, replace the connecting rod assembly.

Connecting rod big end max. running clearance	Allowable limit	0.07 mm 0.0025 in.
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Connecting rod big end max. side clearance	Allowable limit	0.41 mm 0.016 in.
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(Reference)

- Undersize connecting rod

Undersize connecting rod big end I.D. (0.25 US)	Allowable limit	0.07 mm 0.0025 in.
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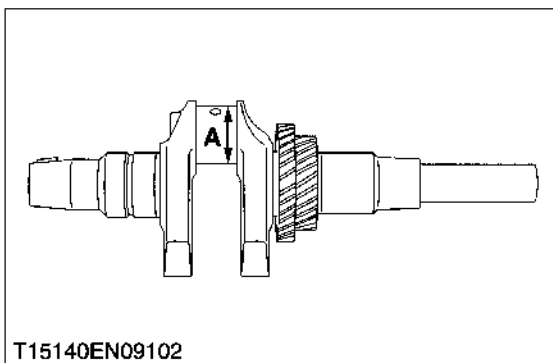
W1039437

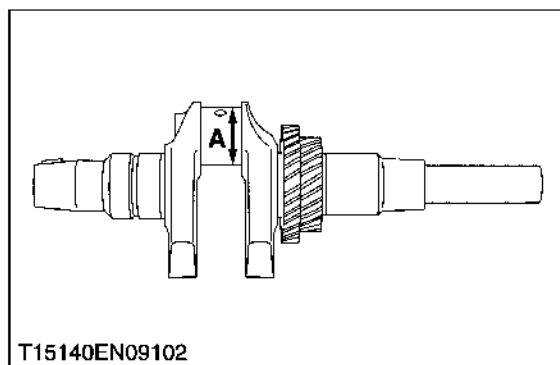
Crankpin O.D.

1. Measure the crankpin O.D. with an outside micrometer.
2. If the measurement is less than the allowable limit, correct the crankpin.

Crankpin O.D. (A)	Allowable limit	38.94 mm 1.5328 in.
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W1039894





Correcting Crankpin

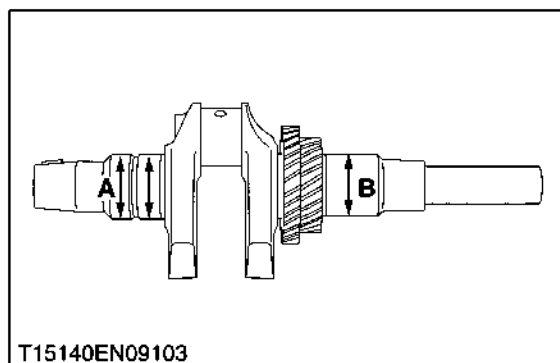
If the standard size connecting rod cannot be employed due to excessive wear of the crankpin, use an undersize connecting rod.

For undersize connecting rod use, be sure to correct the crankpin.

1. Grind the crankpin to specified undersize.
2. Grind the corner radius of the crankpin precisely.
3. Be sure the chamfer the oil hole circumference with an oil stone. 1.6S
4. The crankpin surface must be fine-finished to higher than $\nabla\nabla\nabla$.

Crankpin O.D. (A)	Allowable limit	38.958 to 38.970 mm 1.5338 to 1.5343 in.
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W1039612

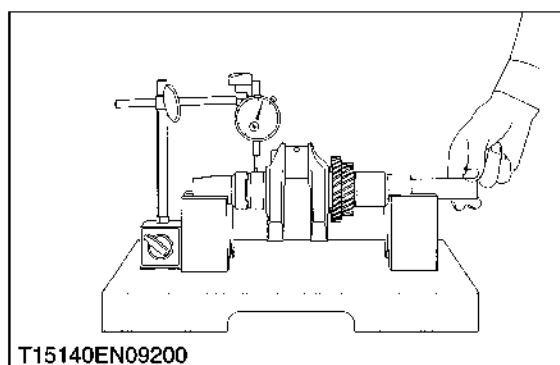


Crankshaft Journal O.D.

1. Measure the crankshaft journal O.D. with an outside micrometer.
2. If the measurement is less than the allowable limit, replace the crankshaft.

Crankshaft journal O.D. [Flywheel side (A)]	Allowable limit	44.84 mm 1.765 in.
Crankshaft journal O.D. [PTO side (B)]	Allowable limit	41.86 mm 1.648 in.

W1040059

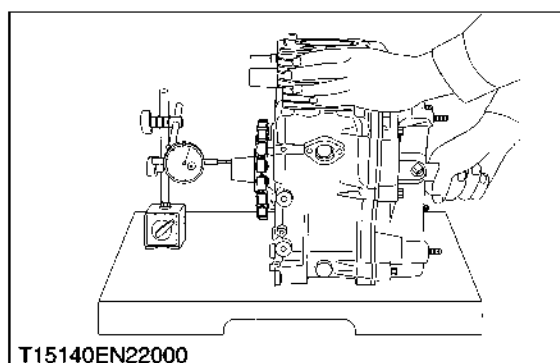


Crankshaft Runout

1. Check the runout of crankshaft at PTO side bearing journals with a dial indicator, setting the crankshaft to alignment jig.
2. If the measurement exceeds the allowable limit, replace the crankshaft.

Crankshaft runout (PTO side)	Allowable limit	0.15 mm 0.0059 in.
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W1040171



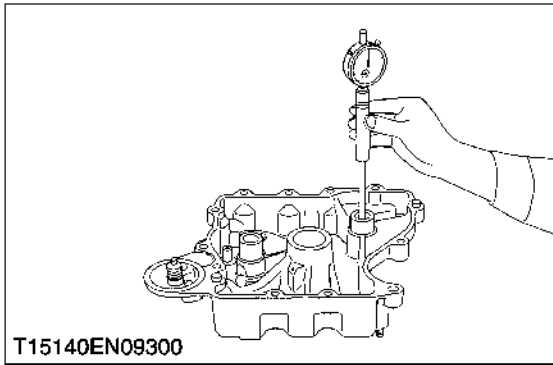
Side Clearance of Crankshaft

1. Attach a metal plate to the crankcase.
2. Set a dial indicator to the crankshaft.
3. Measure the side clearance by moving the crankshaft.

Side clearance of crankshaft	Factory spec.	0.0023 mm 0.0194 in.
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W1040260

(G) Crankcase Cover and Crankcase

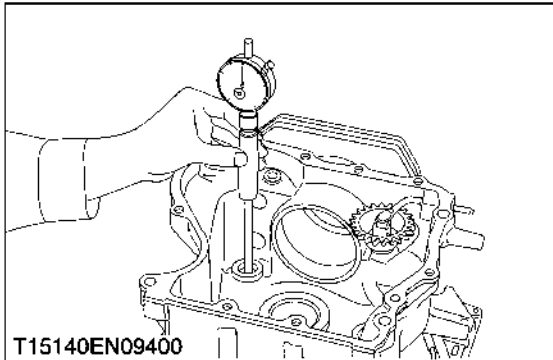


Camshaft Bearing I.D. (Oil Pan Side)

1. Check the camshaft bearing I.D. (oil pan side) with a dial gauge.

Camshaft bearing I.D. (oil pan side)	Factory spec.	20.038 mm 0.7889 in.
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W1040368



Camshaft Bearing I.D. (Crankcase Side)

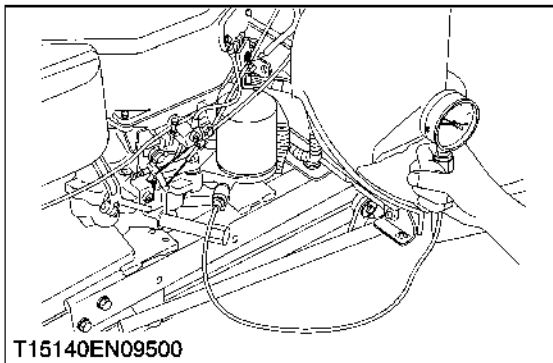
1. Check the camshaft bearing I.D. (crankcase side) with a dial gauge.

Camshaft bearing I.D. (crankcase side)	Factory spec.	20.038 mm 0.7889 in.
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W1040567

[3] LUBRICATING SYSTEM

(1) Checking



Engine Oil Pressure

1. Remove the lower bonnet.
2. Unscrew the plug, and install the engine oil pressure tester.
3. Start the engine. After warming up, measure the oil pressure.
4. If the oil pressure is less than the allowable limit, check the following.
 - Engine oil insufficient
 - Oil pump defective
 - Oil screen clogged
 - Oil gallery clogged
 - Excessive oil clearance
 - Relief valve defective

Condition

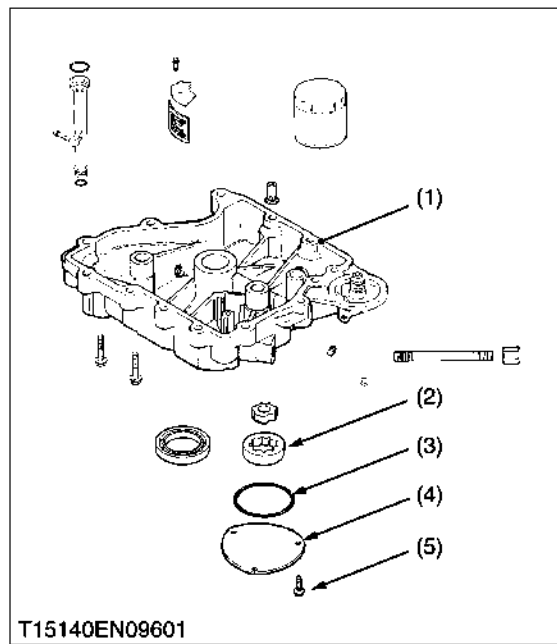
- Engine speed Approx. 3600 min⁻¹
Approx. 3600 rpm

Maximum engine oil pressure at 3600 rpm	Factory spec.	412 kPa or more 4.2 kgf/cm ² or more 60 psi or more
Maximum engine oil pressure at 1500 rpm	Factory spec.	110 kPa 1.1 kgf/cm ² 16 psi

W1040681

(2) Disassembling and Assembling

(A) Oil Pump



Oil Pump

1. Unscrew the oil pump cover mounting screw (4), and remove the oil pump gear (2).

(When reassembling)

■ IMPORTANT

- Apply engine oil to each section.
- After assembling the oil pump, be sure to check the engine oil pressure.

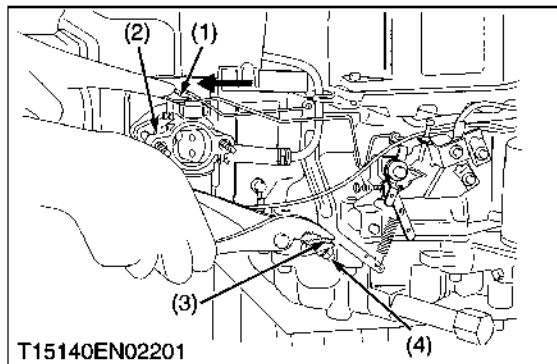
- | | |
|-------------------|-----------------------|
| (1) Oil Pan | (4) Mounting Screw |
| (2) Oil Pump Gear | (5) Hex. Flange Screw |
| (3) O-ring | |

W1040987

[4] FUEL SYSTEM

(1) Checking and Adjusting

(A) Initial Adjustment



Initial Adjustment

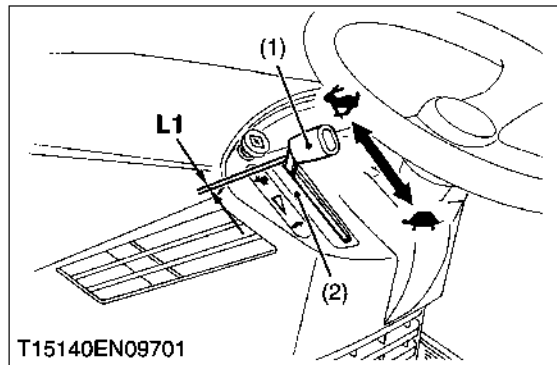
Make this initial adjustment whenever the governor arm is loosened or removed from the cross shaft. To ensure proper setting, make sure the throttle linkage is connected to the governor arm and throttle lever on the carburetor. (See figure.)

1. Pull the governor lever (1) towards the carburetor (2) (wide open throttle).
2. Grasp the cross shaft (3) with a pliers and turn the shaft counterclockwise as far as it will go. Or insert a nail into the hole in the end of the cross shaft and rotate shaft counterclockwise as far as it will turn, then tighten hex. nut (4) securely.
3. Torque the hex nut to 9.9 N·m (7.3 ft-lbs).

- | | |
|--------------------|-----------------|
| (1) Governor Lever | (3) Cross Shaft |
| (2) Carburetor | (4) Hex. Nut |

W1041772

(B) Unitized Throttle (and Choke) Control



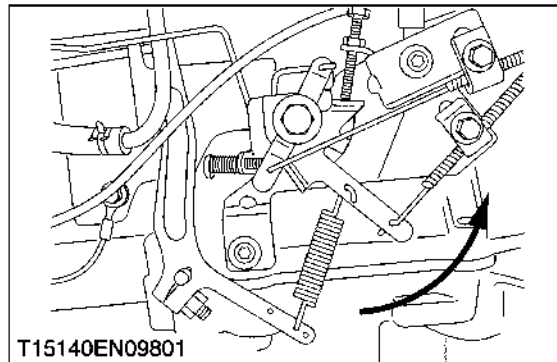
Throttle Cable Adjustment

1. Check and adjust the reference dimension L1 (10 mm, 0.4 in.) of the accelerator lever (1).
2. Install the throttle cable on the accelerator lever (1).
3. Fix the throttle cable on the steering support.
4. Set the accelerator lever to the Max. position, then pull back the lever 5 mm.
5. Move the throttle lever until it attacks the bolt.
6. Connect the engine cable to the throttle lever and tighten the mount bolt.

- (1) Accelerator Lever
(2) Accelerator Lever Guide

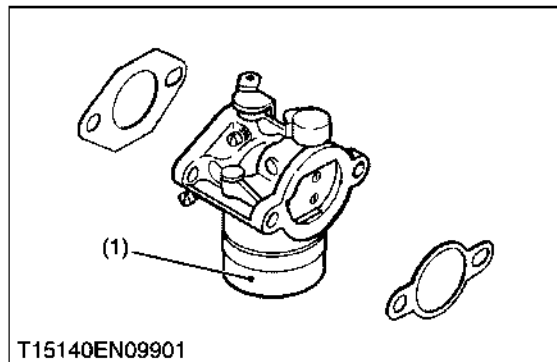
L1 : Clearance between accelerator
lever guide and accelerator lever

W1041934



(2) Servicing

(A) Carburetor



Cleaning Carburetor



WARNING

- Carburetor cleaners and solvents are extremely flammable. Keep sparks, flames and other sources of ignition away from the area. Follow the cleaner manufacturer's warnings and instructions on its proper and safe use. Never use gasoline as a cleaning agent.

All parts should be cleaned thoroughly using a carburetor cleaner (such as acetone). Make sure all gum deposits are removed from the following areas :

- Carburetor body and bore; especially the areas where the throttle plate, choke plate and shafts are seated.
- Idle fuel and idle ports in carburetor bore, main jet, bowl vent, and fuel inlet needle and seat.

NOTE

- These areas can be cleaned with a piece of fine wire in addition to cleaners. Be careful not to enlarge the ports, or break the wire inside the ports. Blow out all passages with compressed air.

1. Clean float and float hinge.
2. Clean fuel bowl (1).

NOTE

- Do not submerge the carburetor in cleaner or solvent when fiber, rubber, or foam seals or gaskets are installed. The cleaner may damage these components.

- (1) Fuel Bowl

W1042124

Inspecting Carburetor

1. Carefully inspect all components and replace those that are worn or damaged.
2. Inspect the carburetor body for cracks, holes, and other wear or damage.
3. Inspect the float for cracks, holes, and missing or damaged float tabs. Check the float hinge and shaft for wear or damage.
4. Inspect the fuel inlet needle and seat for wear or damage.
5. Inspect the tip of the low idle fuel adjusting needle for wear or grooves.
6. Inspect the throttle and choke shaft and plate assemblies for wear or excessive play.

W1043205

(3) High Altitude Kit

This kit is used to convert certain fixed main jet Walbro carburetors on GH430V engine, to ensure correct engine operation at altitudes above 1525 m (5000 ft.). The kit includes a smaller size main jet to provide the correct carburetor air / fuel mixture ratio with the lower air density at those elevations. Without the kit, the engine may run rich, resulting in poor performance and elevated exhaust emissions.

If the customer wants to use the engine below 1525 m (5000 ft.) at a future time, the carburetor must be reconverted back to the original jet size. If the jet is not changed, the carburetor air / fuel mixture ratio will be too lean for proper operation and may cause engine overheating and damage.



WARNING

- **Disabling engine. Accidental starting can cause severe injury or death. Before working on the engine or equipment, disable the engine as follows :**

1) Disconnect the spark plug lead(s). 2) Disconnect negative (–) battery cable from battery.

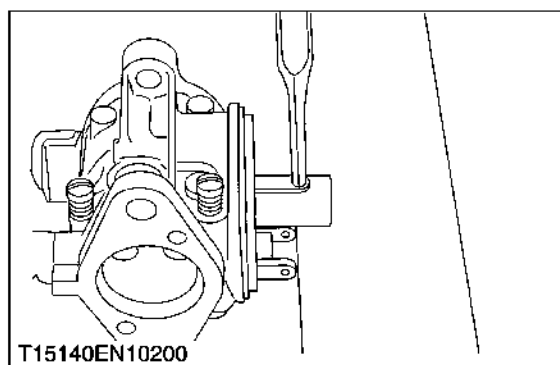
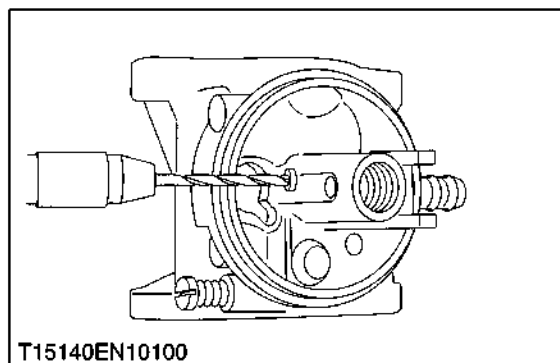
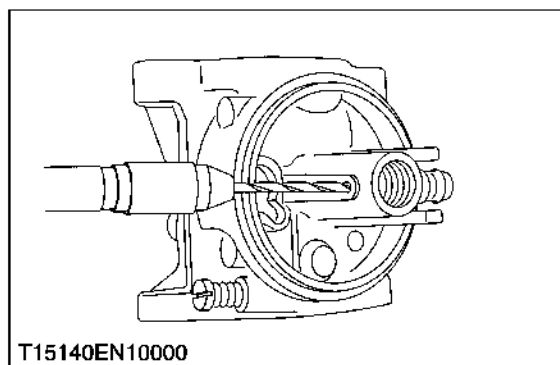
The kit contains items shown in the table :

This Kit Contains

Q'ty.	Description
1	Gasket, carburetor
1	Gasket, air cleaner base
1	Gasket, bowl
1	Gasket, bowl screw
1	Main jet, high-altitude (0.039)
1	Installation Instructions

Tools required are shown in the table :

Q'ty.	Description
1	#46 HSS Drill Bit
1	Drill Chuck, Pin Vice, or "T" collet (not a power drill), into which the drill bit can be secured and turned by hand
1	1/4 in. Flat Drift Punch
1	1/2 in. Box End or Open End Wrench
1	Small Hammer



Installing High Altitude Kit

■ NOTE

- Installation of this kit requires removal of the carburetor from the engine. The instructions provided and tools required apply to the servicing of the carburetor after it has been removed from the engine.

1. Access the carburetor as required by the specific application. Disconnect or remove the attached linkages, fuel line, and mounting hardware. Slide the air cleaner base and carburetor off the mounting studs. Remove and discard the old carburetor and air cleaner base gaskets.
2. Remove the bowl screw and gasket with the 1/2 in. wrench. Remove the fuel bowl and bowl gasket from the carburetor. Discard only the old gasket.
3. Remove the float pin, float, and inlet valve. Save all the parts.
4. Locate the main jet, pressed into the side of the tower, 3/8 in. from the bottom.

■ NOTE

- The old jet must be removed without causing damage or enlarging the opening in the tower. Do not attempt to drill out the old jet.
5. Mount the drill bit into the chosen hand held tool. Slowly, screw the drill clockwise into the jet until it grabs and twists the jet, or it bottoms out on the counterbore. Continue to slowly twist the drill bit clockwise while pulling outward at the same time to unseat the jet.
 6. Remove and discard the old jet. If the drill bit slips out of the jet, go to the next larger number drill size. After the jet is removed, blow out main jet and tower area thoroughly with compressed air.
 7. Support the tower on a block of wood. Using the float drift punch, press or tap the new jet into place, so it is flush with the tower casting.
 8. Reinstall the inlet valve, float and float pin.
 9. Invert the carburetor, then install the new fuel bowl gasket and original fuel bowl. Place the new bowl screw gasket onto the original bowl screw and install into carburetor. Torque the fuel bowl screw to 5.1 to 6.2 N·m (45 to 55 in.lb.)
 10. Reinstall the carburetor as outlined in the service manual. Reconnect the linkages and fuel line. Reinstall the air cleaner components. Torque the carburetor / air cleaner hex. flange mounting nuts to 9.9 N·m (7.3 ft-lbs).
 11. Reconnect the spark plug leads, negative (–) battery cable, and test run the engine.

Tightening torque	Fuel bowl screw	5.1 to 6.2 N·m 0.52 to 0.63 kgf·m 3.7 to 4.5 ft-lbs
	Carburetor / air cleaner hex. flange mounting nut	9.9 N·m 1.0 kgf·m 7.3 ft-lbs

W1043768

2 ENGINE 2

SERVICING

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1. TROUBLESHOOTING

Symptom	Probable Cause	Solution	Reference Page
Excessive Vibration	Loosen engine mounting nuts	Retighten mounting nuts.	2-S11
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	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.	— G-28 11-S10 to S15 — 11-S9 11-S19 11-S20 11-S19 —
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.	G-28 11-S8 — G-10

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 - 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. 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.	G-15 G-15, 27 G-27 2-S18, 27, 32, 35 2-S24, 25 2-S12 11-S16 G-26, 11-S16 G-27 G-26 2-S47 G-20, 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.	11-S16 G-26, 11-S16 11-S17 2-S45 2-S16 2-S12
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.	11-S16 G-26, 11-S16 11-S17 2-S16
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.	11-S16 2-S16 11-S16, 17 G-26, 11-S16
Either White or Blue Exhaust Gas Is Observed	- Excessive engine oil - Piston ring worn or stuck	Reduce to specified level. Replace piston ring.	G-24 2-S24

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.	– G-10 G-27 G-20, 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 .	11-S16 – 2-S29 2-S12 2-S18, 27, 32, 35 G-26, 11-S16 2-S27 G-20, 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.	2-S24 2-S23 2-S28 2-S37, 38
Water Mixed into Lubricating Oil	• Head gasket defective • Cylinder block or cylinder head flawed	Replace head gasket. Replace cylinder block or cylinder head.	2-S18 2-S18, 32
Low Oil Pressure	• Engine oil insufficient • 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. 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.	G-24 G-31 2-S43 2-S43 2-S37, 38 2-S20 – G-10 2-S42

Symptom	Probable Cause	Solution	Reference Page
High Oil Pressure	• Different type of oil • Relief valve defective	Use specified type of oil. Replace relief valve.	G-10 2-S42
Engine Overheated	• Engine oil insufficient • Overload running • Head gasket defective • Incorrect ignition timing • Unsuitable fuel used	Replenish engine oil. Loosen load. Replace head gasket. Adjust ignition timing. Use specified fuel.	G-24 – 2-S18 11-S16 G-10

W1012359

2. SERVICING SPECIFICATIONS

[1] ENGINE BODY

Cylinder Head

Item		Factory Specification	Allowable Limit
Compression Pressure (When Cranking with Electric Starter)		—	390 kPa 3.98 kgf/cm ² 57 psi
Valve Clearance (Intake and Exhaust)		0.10 to 0.15 mm 0.004 to 0.006 in.	—
Cylinder Head Surface	Flatness	—	0 to 0.05 mm 0 to 0.0020 in.
Rocker Arm	I.D.	—	13.068 mm 0.51449 in.
Rocker Arm Shaft	O.D.	—	12.936 mm 0.50929 in.

W1013874

Valves

Valve Stem	O.D. (Intake)	—	5.95 mm 0.234 in.
	O.D. (Exhaust)	—	5.93 mm 0.233 in.
Valve Stem	Runout	—	0.05 mm 0.002 in.
Valve Guide	I.D. (Intake and Exhaust)	—	6.08 mm 0.239 in.
Valve Spring	Free Length	—	31.0 mm 1.22 in.
Valve Seat	Width (Intake and Exhaust)	—	0.6 to 0.9 mm 0.024 to 0.035 in.
Valve Seat	Angle (Intake)	1.047 rad. 60 °	—
	Angle (Exhaust)	0.785 rad. 45 °	—
Valve Face	Angle (Intake and Exhaust)	0.79 rad. 45 °	—

W1012038

Push Rod

Push Rod	Runout	—	0.30 mm 0.0118 in.
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W1012101

Cylinder Liner

Item		Factory Specification	Allowable Limit
Cylinder Liner	I.D. (STD)	67.98 to 68.00 mm 2.676 to 2.677 in.	68.10 mm 2.681 in.
Oversize Cylinder Liner	I.D. (0.50 OS)	68.48 to 68.50 mm 2.696 to 2.697 in.	68.60 mm 2.701 in.
Fine Boring Bore	I.D. (0.50 OS)	68.46 to 68.48 mm 2.695 to 2.696 in.	—
Final Bore	I.D. (0.50 OS)	68.48 to 68.50 mm 2.696 to 2.697 in.	—

W1013874

Piston · Piston Ring

Piston Skirt	O.D. (STD)	—	67.79 mm 2.669 in.
Oversize Piston Skirt	O.D. (0.50 OS)	—	68.29 mm 2.689 in.
Piston Pin Hole	I.D.	—	16.08 mm 0.633 in.
Piston Pin	O.D.	—	15.96 mm 0.628 in.
Top Compression Ring	Thickness	—	1.40 mm 0.055 in.
Second Compression Ring	Thickness	—	1.40 mm 0.055 in.
Top Compression Ring to Ring Groove	Clearance	—	0.15 mm 0.006 in.
Second Compression Ring to Ring Groove	Clearance	—	0.12 mm 0.005 in.
Top Compression Ring	Ring Gap	—	0.70 mm 0.028 in.
Second Compression Ring	Ring Gap	—	0.78 mm 0.031 in.
Oil Ring	Ring Gap	—	1.05 mm 0.041 in.

W1012164

Connecting Rod

Connecting Rod Small End	I.D. (STD)	—	16.05 mm 0.632 in.
Connecting Rod Big End	I.D. (STD)	—	35.055 mm 1.380 in.
Crankpin	O.D. (STD)	—	34.94 mm 1.3756 in.

W1012359

Crankshaft

Item		Factory Specification	Allowable Limit
Crankshaft Journal	O.D. (Flywheel Side)	—	34.93 mm 1.375 in.
	O.D. (PTO Side)	—	34.90 mm 1.374 in.
Crankshaft	Runout	—	0.05 mm 0.0020 in.

W1012038

Camshaft

Camshaft Journal	O.D. (PTO Side)	—	15.985 mm 0.6293 in.
	O.D. (Flywheel Side)	—	15.985 mm 0.6293 in.
Cam Lobe	Height (Intake and Exhaust)	—	29.131 mm 1.1469 in.
Camshaft Bearing	I.D. (Crankcase Side)	—	16.136 mm 0.6352 in.
	I.D. (Crankcase Cover Side)	—	16.136 mm 0.6352 in.

W1013454

[2] LUBRICATING SYSTEM

Engine Oil Pressure Condition • Engine Speed : Fast idle speed • No Load		241 to 310 kPa or more 2.46 to 3.16 kgf/cm ² or more 35 to 45 psi or more	—
Relief Valve Spring	Free Length	—	19.50 mm 0.77 in.
Pump Shaft	O.D.	—	10.923 mm 0.4300 in.
Pump Shaft Bearing	I.D.	—	11.072 mm 0.4359 in.
Rotor Lobe	Clearance	—	0.2 mm 0.008 in.
Outer Rotor	O.D.	—	40.470 mm 1.5933 in.
Outer Rotor	Thickness	—	9.830 mm 0.3870 in.
Pump Housing	I.D.	—	40.801 mm 1.6063 in.
Pump Housing	Depth	—	10.230 mm 0.4028 in.

W1012516

[3] IGNITION SYSTEM

Spark Plug · Ignition Coil

Item		Factory Specification	Allowable Limit
Spark Plug	Gap	0.75 mm 0.030 in.	—
Ignition Coil	Air Gap	0.2 to 0.4 mm 0.008 to 0.016 in.	—
Ignition Coil Primary Coil (Stop Switch Lead Connector - Ignition Core Unit) Secondary Coil (High Tension Cord - Ignition Core Unit)	Resistance	10 to 30 k Ω	—
	Resistance	2 to 18 k Ω	—

W1012422

3. TIGHTENING TORQUES

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

Item	N·m	kgf·m	ft-lbs
Lock nut (Valve clearance adjusting screw)	6.9	0.7	5.1
Muffler mounting nut	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Flywheel mounting nut	56.0	5.7	41
Governor lever mounting nut	5.88 to 7.84	0.60 to 0.80	4.35 to 5.75
Spark plug	22	2.2	16
Cylinder head bolt	25	2.6	19
Crankcase cover mounting bolt	25	2.6	19
* Connecting rod big end cap bolt	5.9	0.6	3
Choke valve screw	0.7	0.07	0.52
Throttle valve screws	1.0	0.10	0.74
Pilot jet	1.7	0.17	1.48
Main jet	0.7	0.07	0.52
Main air jet	0.7	0.07	0.52
Main nozzle	2.0	0.20	1.48
Pilot air jet	0.7	0.07	0.52
Drain screw (Carburetor)	1.3	0.13	0.96
Earth lead screw (Carburetor side)	3.4	0.35	2.51
Fuel shut off solenoid valve (Carburetor)	7	0.70	5
Float chamber mounting screw (Carburetor)	8.8	0.90	6.49

■ NOTE

- For * marked screws, bolts and nuts on the table, apply engine oil to their threads and seats before tightening.

W1014074

4. CHECKING, DISASSEMBLING AND SERVICING

[1] SEPARATING ENGINE

(1) Disassembling and Assembling

Dismount Mower

1. See to "MOWER" section.

W1014200

Battery Cable



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. Turn the main switch off.
2. Disconnect the negative cable (1).
3. Disconnect the positive cable (2).
4. Close the fuel cock.

(1) Negative Cable

(2) Positive Cable

W1014246

Bonnet

1. Disconnect the 1P connectors (2) from the head lights.
2. Remove the wiring from the bonnet.
3. Unscrew the nuts and spring washers (5) and remove the upper bonnet.
4. Unscrew the knob screw (3) and remove the lower bonnet.

(1) Upper Bonnet

(4) Lower Bonnet

(2) 1P Connector

(5) Nuts and Spring Washers

(3) Knob Screw

W1014377

Wiring, Throttle Cable and Muffler

1. Disconnect the positive cable (2) and wiring from the starter **B** terminal.
2. Disconnect the 1P connector (1) from the starter **ST** terminal.
3. Remove the fuel hose (3) from the fuel pump (4).
4. Remove the throttle cable (6) and the choke cable (5).
5. Remove the muffler (7).

(1) 1P Connector

(5) Choke Cable

(2) Positive Cable

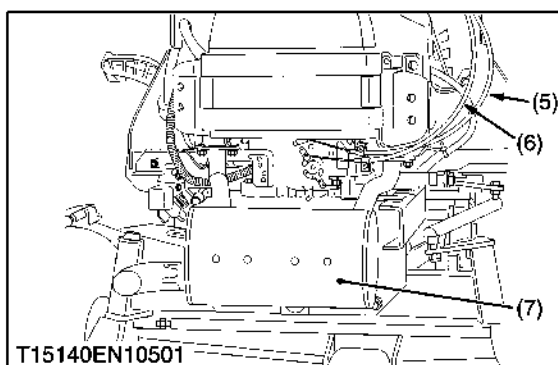
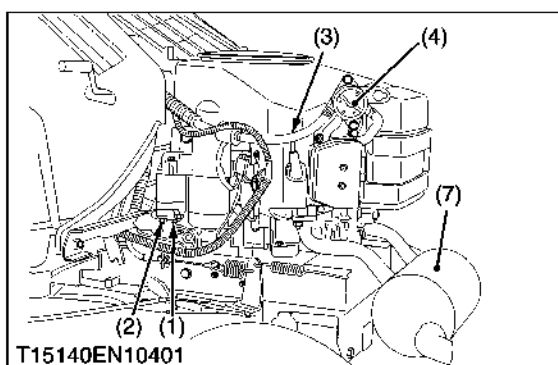
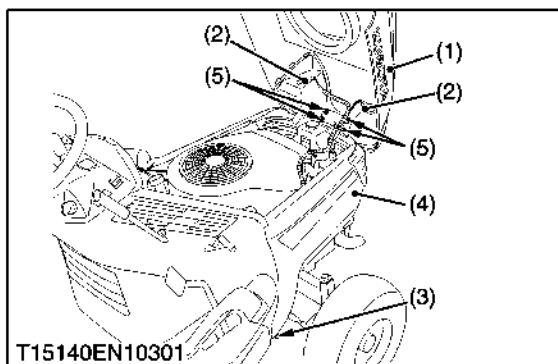
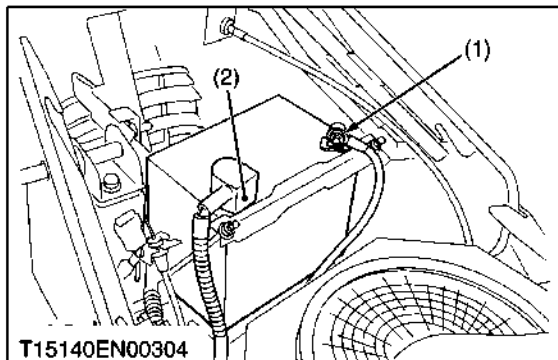
(6) Throttle Cable

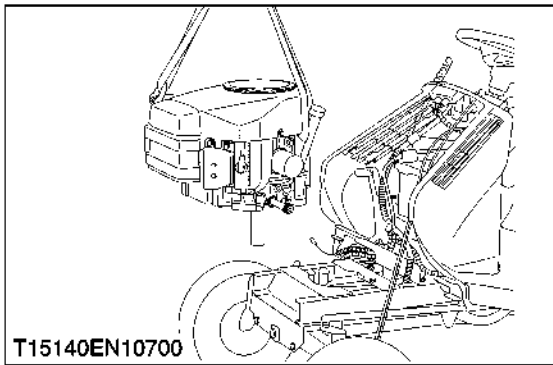
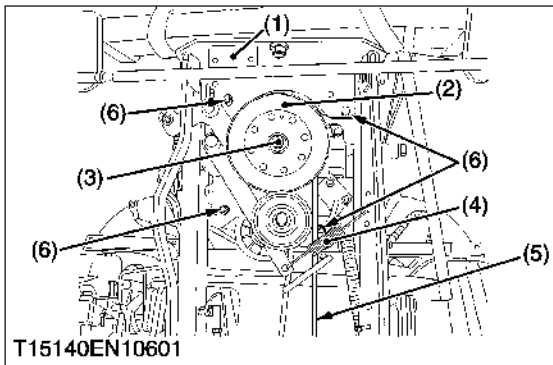
(3) Fuel Hose

(7) Muffler

(4) Fuel Pump

W1014511





Separating Engine

1. Remove the HST tension spring (4), belt retainer (1) and then remove the HST belt (5) from the engine pulley (2).
2. Remove the engine pulley screw (3) and remove the engine pulley (2) from engine.
3. Unscrew four engine mounting nuts (6), and separate the engine.

(When reassembling)

- Apply grease to the engine PTO shaft.

Tightening torque	Engine mounting nut	23.5 to 27.5 N·m 2.40 to 2.81 kgf·m 17.4 to 20.3 ft-lbs
	Engine pulley mounting screw	48.1 to 54.1 N·m 4.91 to 5.52 kgf·m 35.5 to 39.9 ft-lbs

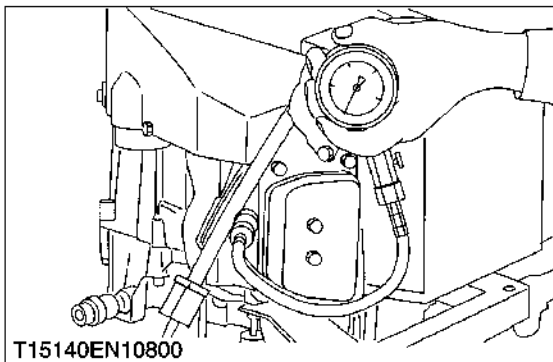
- (1) Belt Retainer
(2) Engine Pulley
(3) Engine Pulley Screw

- (4) HST Tension Spring
(5) HST Belt
(6) Engine Mounting Nut

W1014682

[2] ENGINE BODY

(1) Checking and Adjusting



Compression Pressure

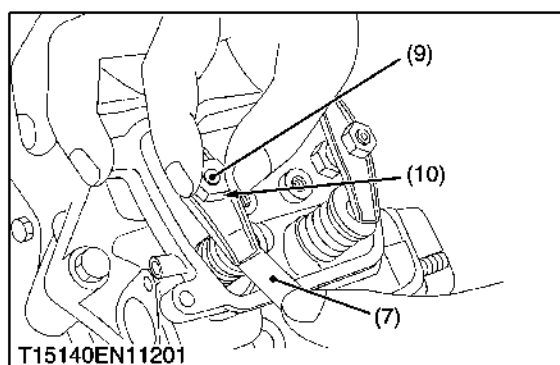
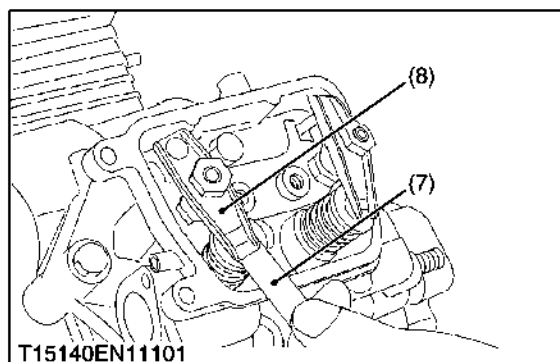
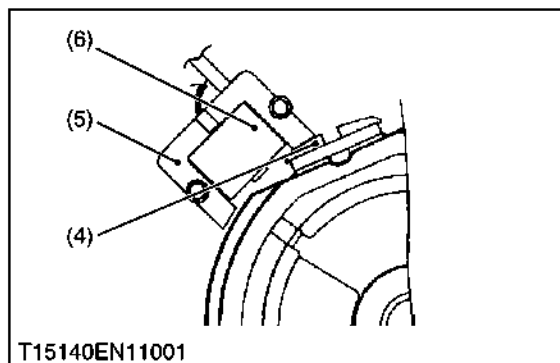
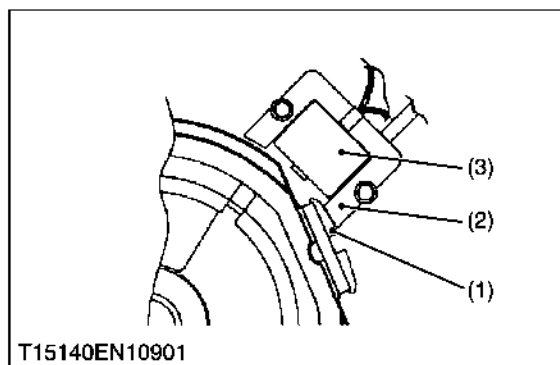
1. Remove the bonnet.
2. Start and warm up the engine for approx. 5 minutes.
3. Stop the engine.
4. Remove the spark plugs of each cylinder and set the air cooled compression tester (Code No. 07909-30251) to the one plug hole.
5. Disconnect the 1P connector from the fuel cut off solenoid.
6. Close the fuel cock under the fender.
7. Crank the engine by electric starter and read the gauge.
8. Measure the compression pressure several times.
9. Repeat the measurement to the other cylinder.
10. If the measurement is below the factory specification, check the following :
 - Gas leakage around the cylinder head – damaged gasket or cylinder head warp.
 - Condition of the valve seating.
 - Piston or cylinder wear.
 - Piston ring and piston ring groove.
 - Valve clearance.

■ NOTE

- Check the compression pressure with the specified valve clearance.
- Always use a fully charged battery for performing this test.

Compression pressure	Allowable limit	390 kPa 3.98 kgf/cm ² 57 psi
Tightening torque	Spark plug	22 N·m 2.2 kgf·m 16 ft-lbs

W1014955



Valve Clearance

■ IMPORTANT

- The valve clearance must be checked and adjusted when engine is cold.

■ NOTE

- Let No. 1 cylinder (2) be right-hand viewed from operator's seat.
- Let No. 2 cylinder (6) be left-hand viewed from operator's seat.

[Preparations]

1. Remove the cylinder head cover.
2. Place the piston at top dead center (TDC) of the compression stroke turning the crankshaft clockwise facing the flywheel.

[No. 1 Cylinder Checking]

1. The left projection (1) on the flywheel is faced with the right leg (2) on the #1 ignition oil (3) as shown.
2. Check the intake and exhaust valves are closed completely, if not turn the flywheel one turn 6.28 rad. (360 °) clockwise and face the left projection with the right leg again.
3. Then check the valve clearance.
4. Using a thickness gauge (7), measure the valve clearance between the rocker arm (8) and the valve stem end.
5. If the valve clearance is incorrect, adjust it.

[No. 2 Cylinder Checking]

1. The left projection (4) on the flywheel is faced with the right leg (5) on the #2 ignition coil (6) as shown. Follow No. 1 cylinder alignment.

Intake and exhaust valve clearance (Cold)	Factory spec.	0.10 to 0.15 mm 0.004 to 0.006 in.
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■ NOTE

- After adjusting the valve clearance, secure the adjusting screw with the lock nut.

Tightening torque	Lock nut	6.9 N·m 0.7 kgf·m 5.1 ft-lbs
	Cylinder head cover mounting screw	5.9 N·m 0.6 kgf·m 4.3 ft-lbs

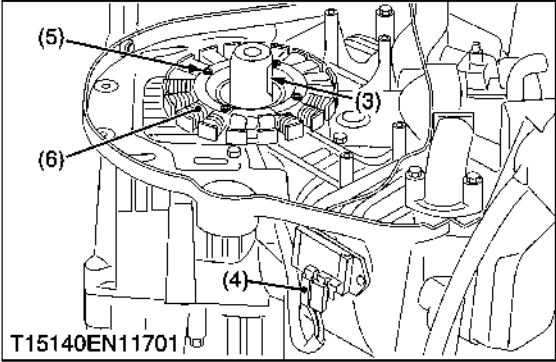
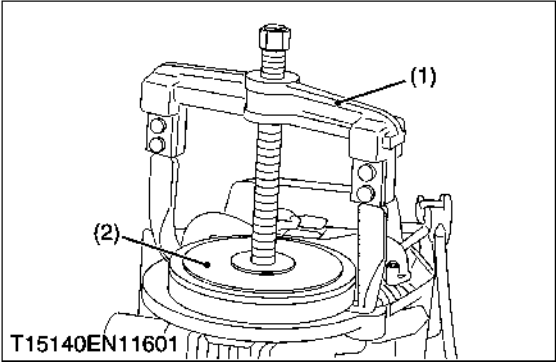
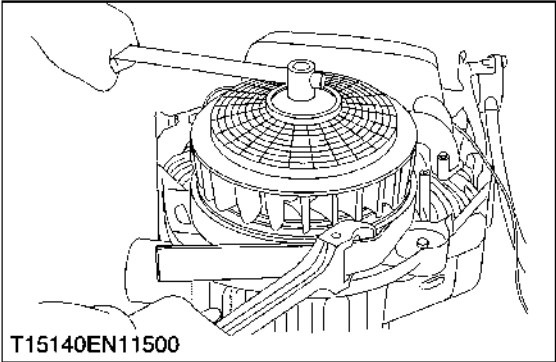
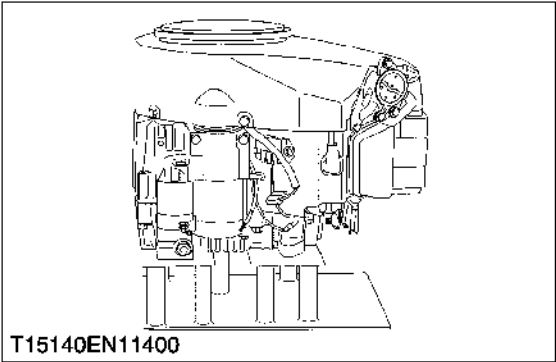
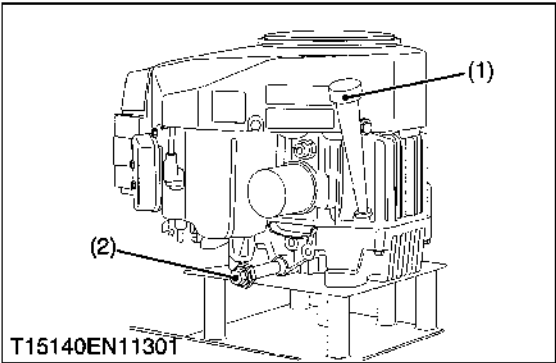
- (1) Left Projection
(2) Right Leg
(3) No. 1 Ignition Coil
(4) Left Projection
(5) Left Leg

- (6) No. 2 Ignition Coil
(7) Thickness Gauge
(8) Rocker Arm
(9) Lock Screw
(10) Adjusting Nut

W1015273

(2) Disassembling and Assembling

(A) External Components



Draining Engine Oil and External Components

CAUTION

- Be careful with hot oil being drained. If may be hot enough to burn you severely.
1. Place an oil pan under the engine.
 2. Remove the dipstick (1) and drain plug (2) to drain oil.
 3. After draining, screw in the drain plug (2).
 4. Remove the external components.

(When refilling)

- Fill the engine oil up to the upper line on the dipstick (1).

Engine oil	Capacity	1.8 L 1.9 U.S.qts. 1.6 Imp.qts.
------------	----------	---------------------------------------

IMPORTANT

- Never mix two different types of oil.
 - Use the specified engine oil and coolant.
- Refer to “FUEL AND LUBRICANTS”. (See page G-10.)

(1) Dipstick (2) Drain Plug

W1016006

Flywheel and Stator Coil Removal

1. Hold the flywheel with a suitable tool, remove the flywheel bolt and washer.
2. Using a suitable puller, remove the flywheel (2).

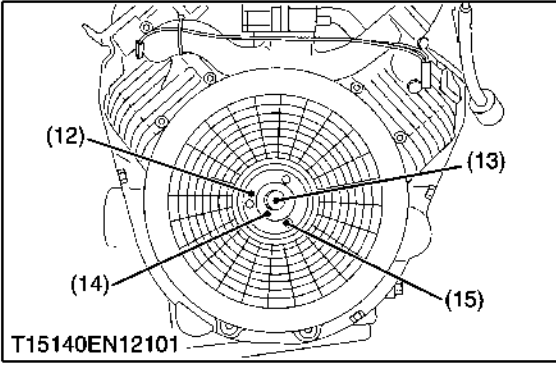
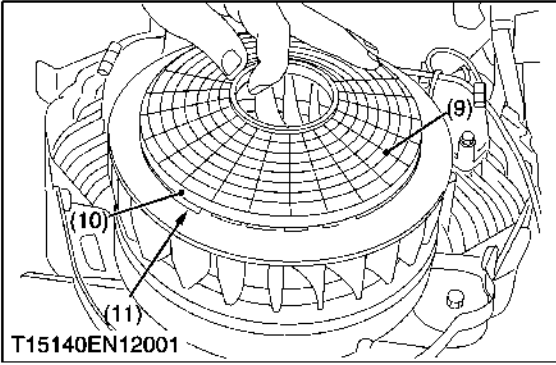
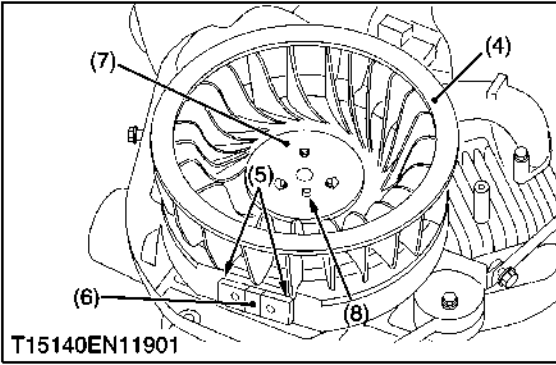
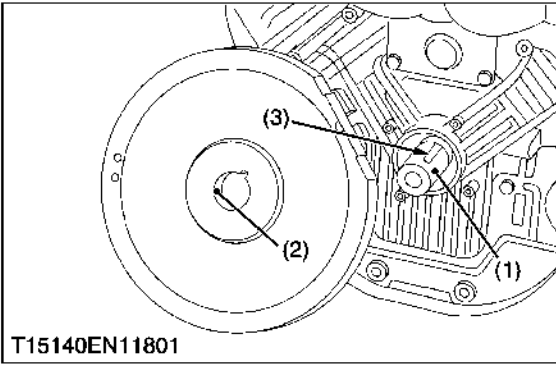
CAUTION

- Always use flywheel puller.

Tightening torque	Flywheel mounting bolt	56 N·m 5.7 kgf·m 41 ft-lbs
	Stator Coil screws	3.4 N·m 0.35 kgf·m 2.5 ft-lbs

(1) Flywheel Puller (4) Stator Coil Lead Connector
(2) Flywheel (5) Stator Coil Screw
(3) Woodruff Key (6) Stator Coil

W1016334



Flywheel and Stator Coil Installation

1. Install the stator coil and tighten the screws.
2. Using a cleaning fluid, clean off any oil or dirt on the following portions and dry them with a clean cloth.
3. Fit the woodruff key (3) securely in the slot in the crankshaft before installing the flywheel.
4. Install the fan (4) so that two positioning bosses (5) fit around flywheel magnet (6).
5. Install the plate (7) so that the notch (8) inserts into the slot in the flywheel.
6. Install the screen (9) so that the projections (10) fit into the recess (11) of the fan.
7. Install the pulley (12) or bracket so that the tabs of the plate fit into holes (13) in the pulley.
8. Put the washer (14) as shown.
9. Tighten the flywheel bolt (15).

Tightening torque	Flywheel bolt	56 N·m 5.7 kgf·m 41 ft·lbs
	Stator coil	3.4 N·m 0.35 kgf·m 2.5 ft·lbs

- (1) Crankshaft Tapered Portion

(2) Flywheel Tapered Portion

(3) Woodruff Key

(4) Fan

(5) Positioning Bosses

(6) Flywheel Ignition Magnet

(7) Plate

(8) Notch
- (9) Screen

(10) Projection

(11) Recess

(12) Pulley

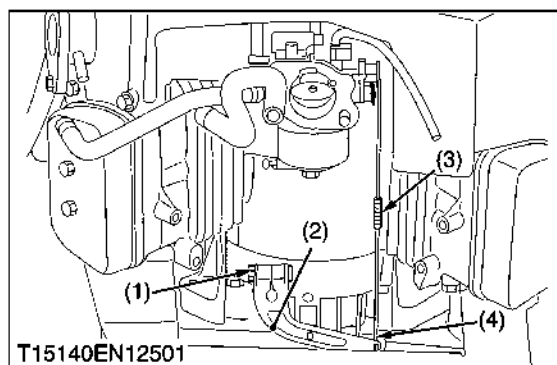
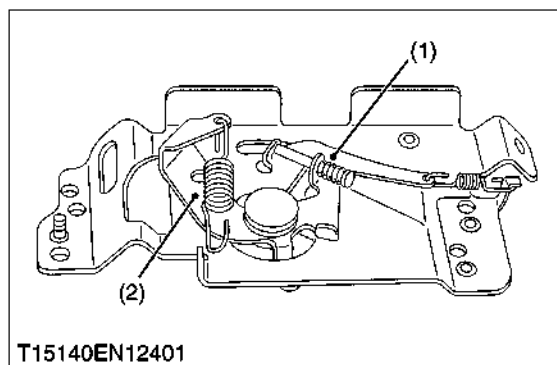
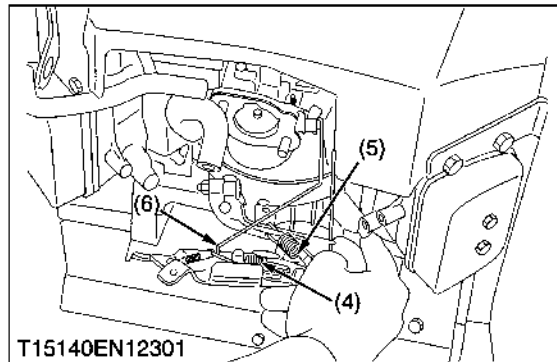
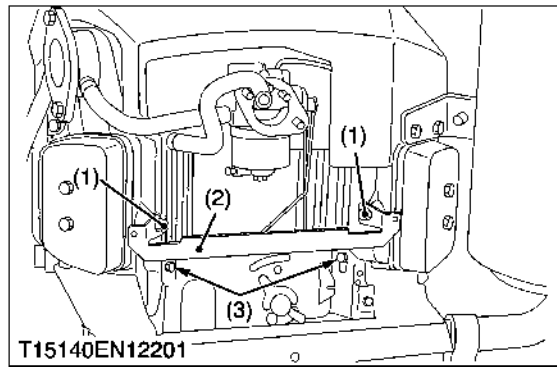
(13) Hole

(14) Washer

(15) Flywheel Bolt

W1016506

(B) Carburetor and Governor Lever



Control Panel Assembly

⚠ CAUTION

- Gasoline is extremely flammable. Do not smoke or allow flames or sparks in your working area.
Clean up any spilled gasoline immediately.

- Remove the air cleaner, air cleaner mounting bracket bolts (1), air cleaner mount bracket (2), earth lead (starter model), and control panel mounting bolts (3).
- Remove the control panel assembly (4) while unhooking the governor spring (5) end loop at the panel bracket.
- Clear the choke link rod lower end (6) from the choke lever.

- | | |
|---------------------------------------|------------------------------|
| (1) Air Cleaner Mounting Bracket Bolt | (4) Control Panel Assembly |
| (2) Air Cleaner Mounting Bracket | (5) Governor Spring |
| (3) Control Panel Mounting Bolts | (6) Choke Link Rod Lower End |

W1016972

Control Panel Assembly Installation

- Before installing the control panel assembly, check to see that the choke lever (1) and engine speed control lever (2) move smoothly in all directions.
If any part is worn or damaged, replace the control panel assembly.
- After installation, adjust the low idle speeds and high idle speeds to the specifications (see Low Idle Speed and High Idle Speed adjustment).

- | | |
|-----------------|-------------------------|
| (1) Choke Lever | (2) Speed Control Lever |
|-----------------|-------------------------|

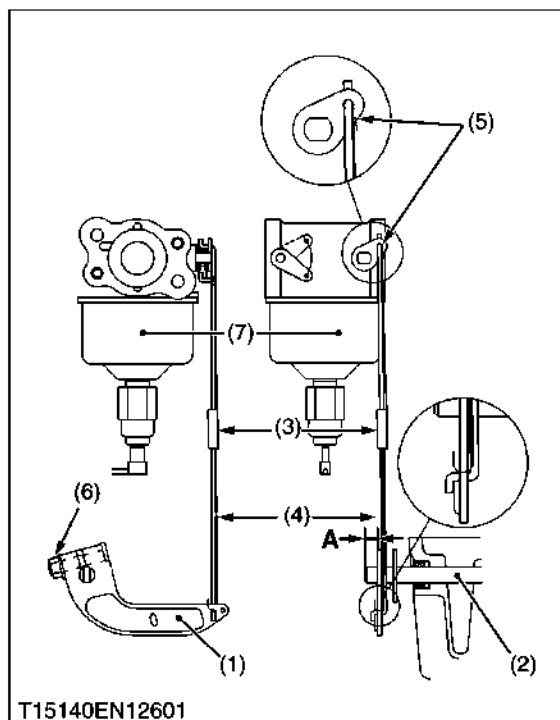
W1017080

Governor Arm

- Remove the control panel assembly.
- Loosen the clamp nut (1) and take off the governor arm (2).
- Unhooking the throttle link rod spring (3) end loop and clear the throttle link rod lower end (4).

- | | |
|------------------|---------------------------------|
| (1) Clamp Nut | (3) Throttle Link Rod Spring |
| (2) Governor Arm | (4) Throttle Link Rod Lower End |

W1017158



Governor Arm Installation

1. Install the governor arm (1) onto the governor shaft (2) temporarily.
2. Be sure the link spring (3) around the throttle link rod (4) is in place and that it pulls the governor arm and throttle lever (5) each other.
3. Loosen the clamp nut (6) on the governor arm enough to move the governor shaft.
4. Turn the top end of the governor arm counterclockwise to fully open the carburetor (7) throttle valve and hold it there.
5. Turn the governor shaft counterclockwise, fully turn the shaft to end of its travel.
6. Tighten the clamp nut.
7. Be sure the governor shaft extend from the governor arm is approximately, 7 mm (0.3 in.) as shown.
8. Install the control panel assembly, and connect the governor spring.

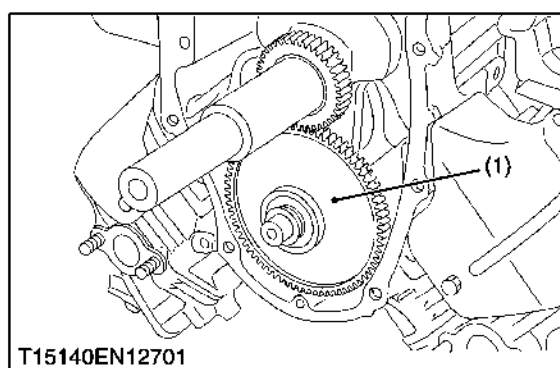
Tightening torque	Governor arm clamp nut	7.8 N·m 0.80 kgf·m 5.75 ft-lbs
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- (1) Governor Arm
(2) Governor Shaft
(3) Link Spring
(4) Throttle Link Rod
(5) Throttle Lever

- (6) Clamp Nut
(7) Carburetor

A: 7 mm

W1017350



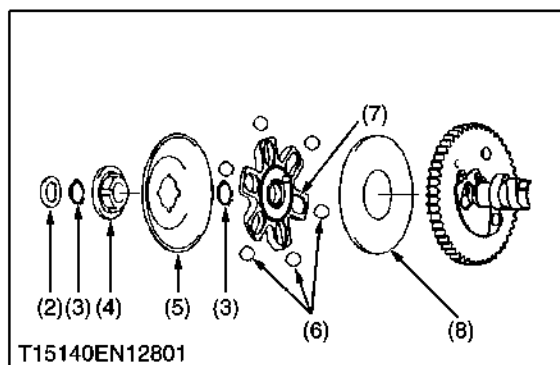
Governor

1. Remove the crankcase cover.
2. Remove the push rod.
3. Upside down the engine.
4. Remove the camshaft (1).
5. Remove the washer (2), snap ring (3), sleeve (4), governor plate (5), steel balls (6), ball guide (7) and ball plate (8).

- (1) Camshaft
(2) Washer
(3) Snap Ring
(4) Sleeve

- (5) Governor Plate
(6) Steel Ball
(7) Ball Guide
(8) Ball Plate

W1017521

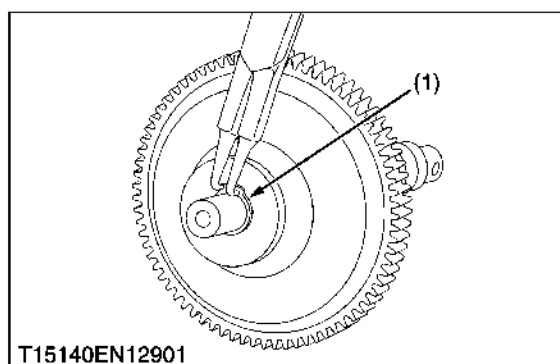


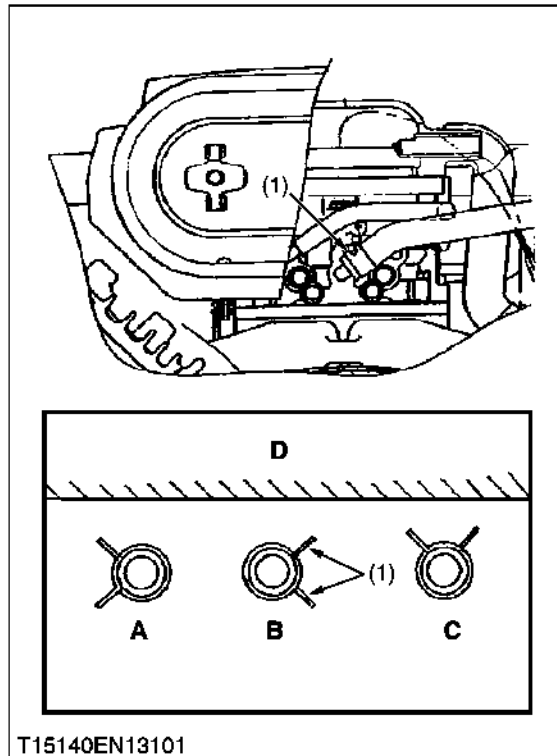
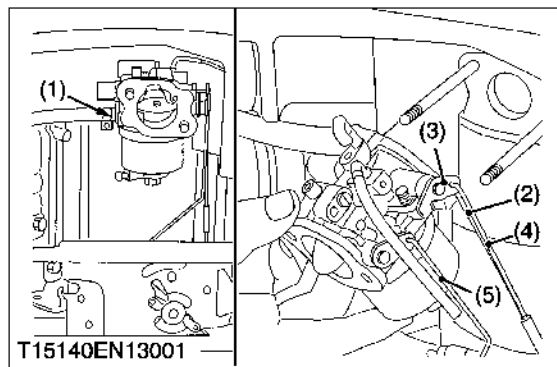
Governor Assembly Installation

1. Fit the snap ring (1) into the grooves securely.
2. Spin the governor plate by hand and check that the steel balls and governor plate operate freely.

- (1) Snap Ring

W1017664





Carburetor

⚠ CAUTION

- Gasoline is extremely flammable and can be explosive under certain conditions. Turn the ignition switch OFF. Do not smoke. Make sure the area is well-ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light.

- Remove the air cleaner and related parts.
- Turn the fuel shut off valve to the **OFF** position.
- Drain the carburetor.
- Disconnect the fuel tube at the fuel inlet joint (1) of the carburetor.
- Disconnect the solenoid valve lead terminal and remove the earth terminal.
- Unhook the throttle link spring (2) at the throttle shaft lever (3) top end with a long nose plier.
- Unhook the throttle (4) and choke link rods (5) at the top ends of their arms while pull off the carburetor.
- Unhook the throttle link spring (2) at the link clip with a long nose plier.

(When reinstalling)

- Clean the mating surfaces of the carburetor and intake manifold, and fit the new gaskets.
- Take care not to bend the throttle and choke link rods during installation. Make sure the link spring around the throttle link rod is in place and that it pulls the governor arm and carburetor throttle shaft lever toward each other.
- Be sure the fuel tube clip end face horizontal direction.

⚠ CAUTION

- Improper installation of the fuel intake hose clamp can result in gasoline leakage and potential fire hazard.

Be sure the clip ends of the hose clamp face in a horizontal direction. In a vertical position (see illustration), the clip ends can come into contact with the intake pipe and become loose.

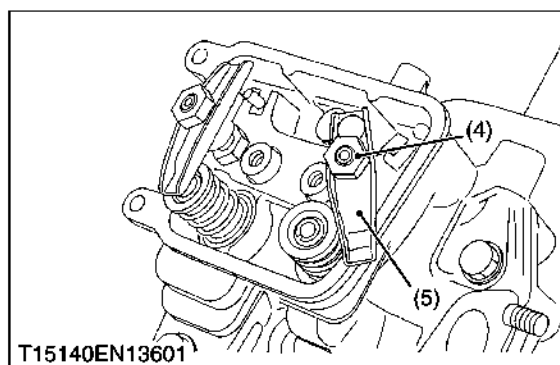
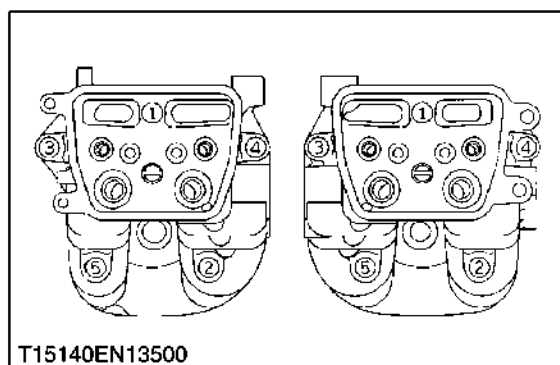
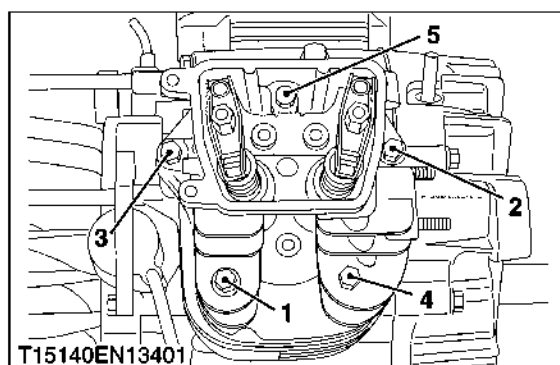
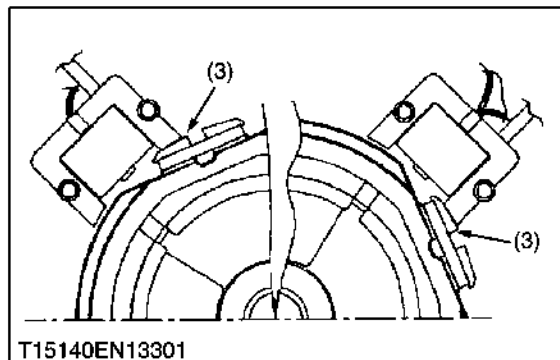
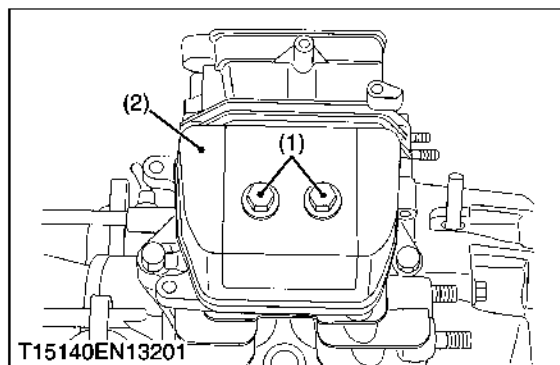
- Adjust the carburetor pilot screw and idle speed.

- (1) Fuel Inlet Joint
(2) Throttle Link Spring
(3) Throttle Shaft Lever
(4) Throttle
(5) Choke Link Rod

- A : Good
B : Good
C : Bad
D : Intake Pipe

W1017803

(C) Cylinder Head and Valves



Cylinder Head

1. Remove the air cleaner and carburetor, muffler, intake manifold, and spark plug.
2. Unscrew the cylinder head cover bolt (1), and remove the cylinder head cover (2) and gasket.
3. When remove the #1, #2 cylinder head, set each cylinder at T.D.C. (3) of power stroke in.
4. Loosen the cylinder head bolts 1/4 turn in the sequence shown.



CAUTION

- If the above procedure is not followed, the cylinder head may be warped during removal.
5. Repeat the sequence until all bolts are removed and lift off the cylinder head assembly.

NOTE

- Mark the push-rods so they can be installed in their original position during assembly.

(When reassembling)

- Clean the mating surfaces of the cylinder heads and cylinder.
- Install the push rods in their original positions on each cylinder. (see Push Rod Installation)
- Install the knock pins.
- Set each cylinder at T.D.C. (3) of power stroke in.
- Put a new gaskets and the cylinder head assemblies on each cylinder, then let the cylinder heads with push rods aligned under the rocker arms.

NOTE

- As the head gaskets are coated with sealing agents, be careful not to damage the surfaces.

Tightening torque	Head cover mounting screw	5.9 N·m 0.60 kgf·m 4.3 ft-lbs
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(When reassembling)

- Tighten the cylinder head bolts following the tightening sequence.



CAUTION

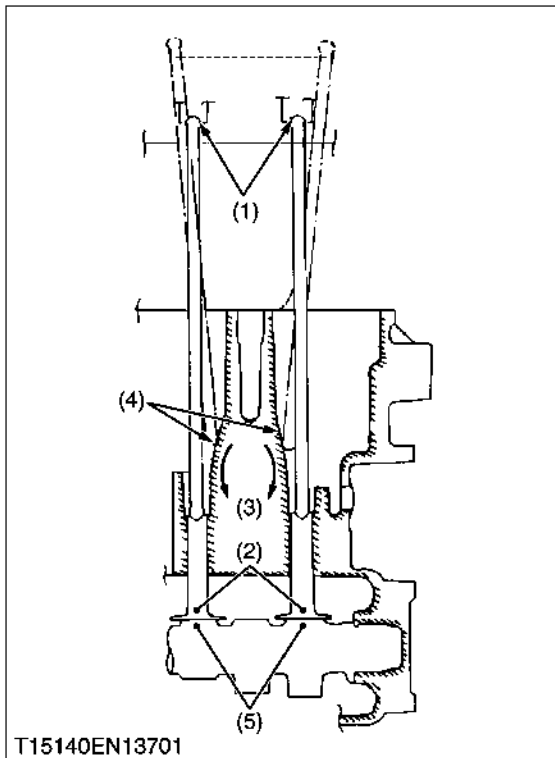
- A torque wrench must be used to assure proper torque. Improper tightening of the head bolts can result in warping of the cylinder head.
- Check and adjust the valve clearance.
- Install the gasket and rocker cover.
- Install the other removed parts.

Tightening torque	Cylinder head bolt	25 N·m 2.6 kgf·m 19.0 ft-lbs
	Cylinder head cover mounting bolt	5.9 N·m 0.6 kgf·m 4.3 ft-lbs

- (1) Cylinder Head Cover Mounting Bolts (4) Adjusting Nut
(2) Cylinder Head Cover (5) Rocker Arm
(3) T.D.C. (Top Dead Center)

1 to 5 : Cylinder Head Bolt Tightening Sequence

W1020180



Push Rod

1. Set each cylinder at T.D.C. of power stroke.
2. Remove the rocker covers. (see Cylinder Head Assembly Removal.)
3. Loosen the valve clearance adjusting nuts.
4. Move the rocker arms to clear the push rod upper ends.
5. Pull out the push rods (1).

■ NOTE

- **Mark the push rods so they can be installed in their original position during assembly.**

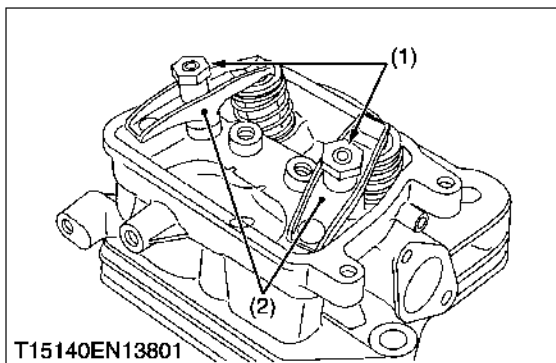
(When reassembling)

- Set each cylinder at T.D.C. of power stroke.
- Install the push rods (1) in their original positions on each cylinder.
- To install the push rod in a correct position on the tappet (2), insert the push rod so end of the push rod is sliding down (3) along inside wall (4) of the crankcase and position the push rod end on to the tappet.
- Check that both intake and exhaust push rods on each cylinder are at lowest position on the cam lobes (5), if not turn the flywheel clockwise one turn (360 °) and reset each cylinder at T.D.C. of power stroke in.
- Be sure the end of the push rods are correctly seated on the tappets.
- Tighten the valve clearance adjusting nuts.
- Check and adjust the valve clearance.

- (1) Push Rods
(2) Tappet
(3) Sliding Down

- (4) Inside Wall
(5) Cam Lobes

W1021140



Rocker Arm and Valve

1. Remove the cylinder head assembly. (see Cylinder Head Assembly Removal.)

■ NOTE

- When removing the valve mechanism parts, note their position so that they may be reinstalled in their original position during assembly.
2. Remove the valve clearance adjusting nuts (1) and rocker arms (2).
 3. Support the valve head in the combustion chamber with a suitable block.
 4. To remove the collets (3), push down the valve retainer (4) with thumbs and remove the collets.
 5. Remove the valve spring (5) and valve (6).
 6. Remove the stem seals (7).

■ NOTE

- It is not necessary to remove the stem seal unless it is being replaced.

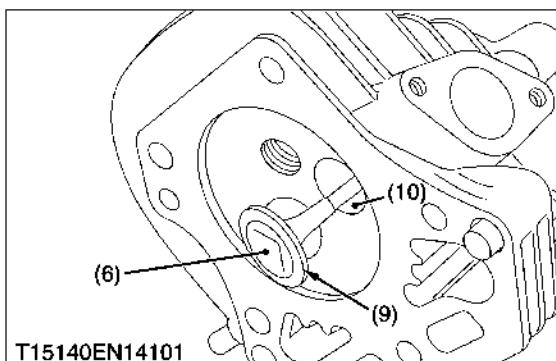
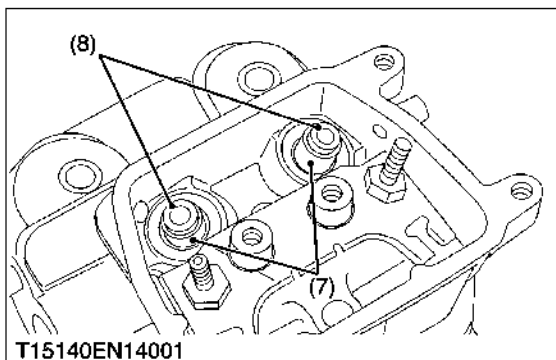
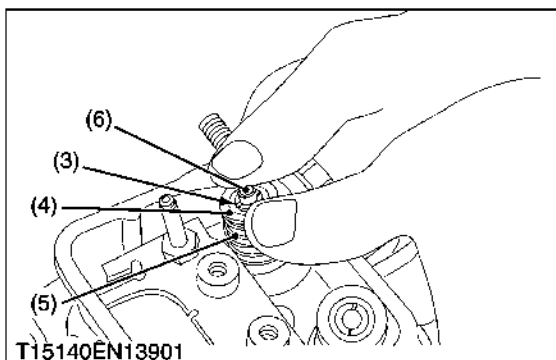
- Valve guide (8) is not replaceable, do not remove it.

(When reassembling)

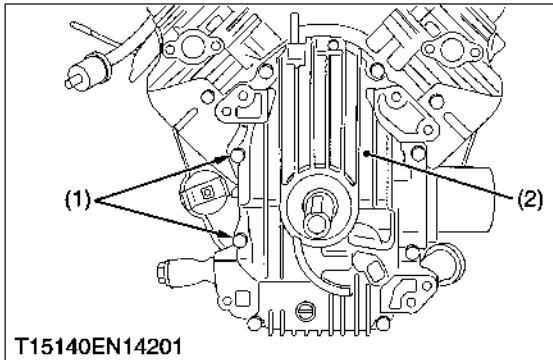
1. Valve installation.
 - Apply engine oil to the valve stem to avoid damaging the stem seal.
 - Check to see that the valve moves smoothly up and down in the guide.
 - Check the valve seating surface (9) between the valve (6) and valve seat (10).
2. Rocker Arm Installation
 - Soak the valve clearance adjusting nuts and rocker arm in the engine oil.
 - Install the rocker arm.

- (1) Adjusting Nuts
(2) Rocker Arm
(3) Collets
(4) Retainer
(5) Valve Spring

- (6) Valve
(7) Stem Seals
(8) Valve Guide
(9) Valve Seating Surface
(10) Valve Seat



W1021588

(D) Crankcase Cover and Camshaft**Crankcase Cover**

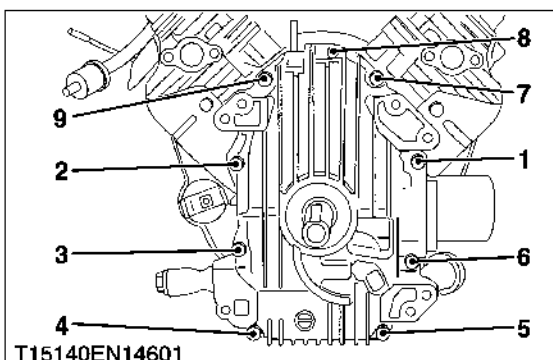
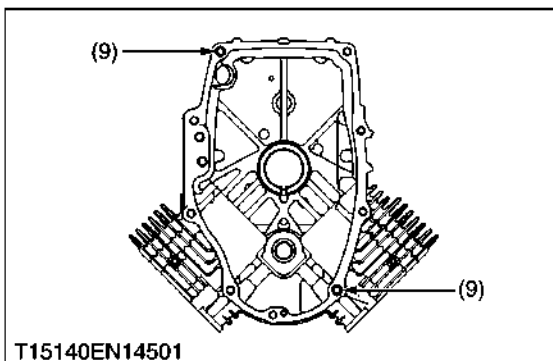
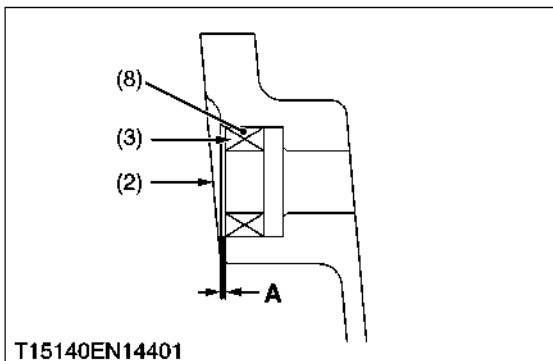
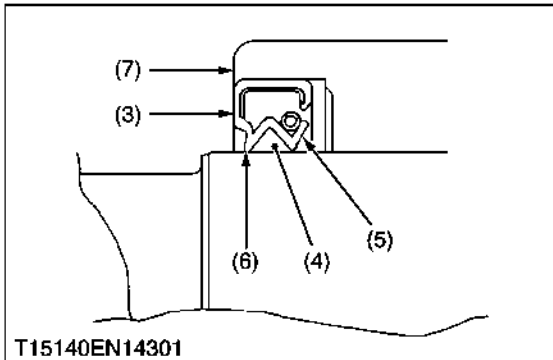
1. Set the engine on a clean surface while parts are being removed.
2. Drain the oil (see Lubrication System chapter).
3. Remove the exhaust pipe and muffler and control panel.
4. Unscrew the mounting bolts (1) and remove the crankcase cover (2) from the crankcase.
5. There are two knock pins on the crankcase mating surface. A wooden or plastic mallet may be used to gently tap loose the crankcase cover.

(When reassembling)

- off the old gasket from the matting surfaces of the crankcase and cover.
- Using compressed air, blow out the oil passage in the crankcase cover.
- With a high flash-point solvent, clean off the mating surfaces of the crankcase and cover, and wipe dry.

■ IMPORTANT

- **Clean the crankcase and cover in a well-ventilated area, and take care that there are no sparks or flame anywhere near the working area; this includes any appliance with a pilot light. Do not use gasoline or a low flash-point solvent to clean parts. A fire or explosion could result.**
- Be sure to replace any oil seal removed with a new one.
- Install the oil seal so that the marks (3) face out.
- Pack some amount of a high temperature grease (4) into the space between the seal lip (5) and dust lip (6). Press in the new oil seal using a press or suitable tools until it is flush with flange surface (7). Do not damage the seal lips.
- When replacing the oil seal (8) of the governor shaft, note the following.
- Install the oil seal into the crankcase cover (2) after the governor shaft is inserted in the cover, and so that the marks (3) face out.
- The depth is 0 to 1 mm (0 to 0.04 in.) (A).
- When installing the governor shaft and plate in the crankcase cover, see Fuel System chapter.
- Check to see that the crankcase dowel pins (1) are in place on the crankcase.
- Install the gasket on the crankcase.
- Install the crankcase cover the tighten the crankcase cover bolts.
- Do not turn one screw down completely before the others, as it may cause the crankcase cover to warp.

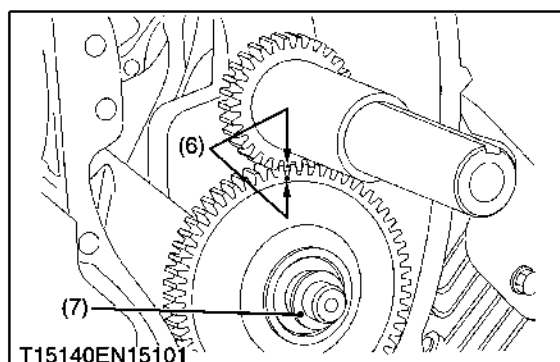
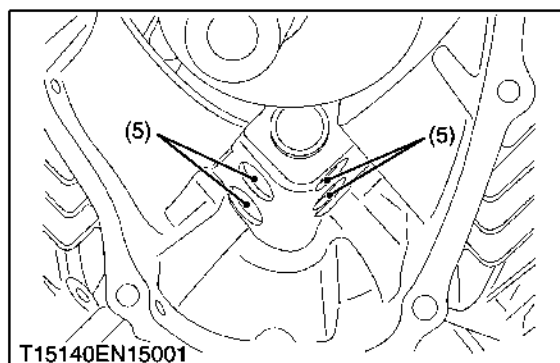
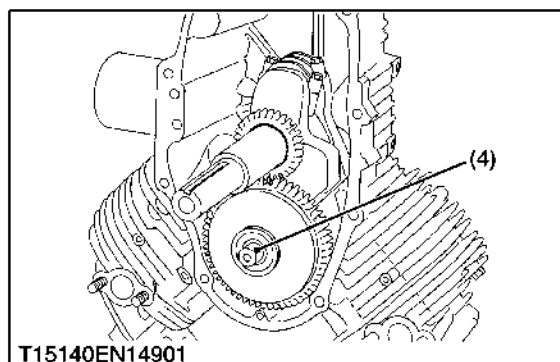
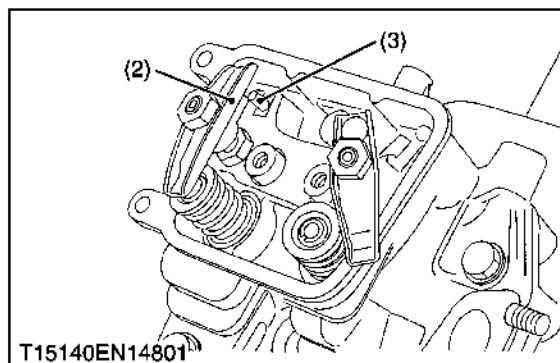
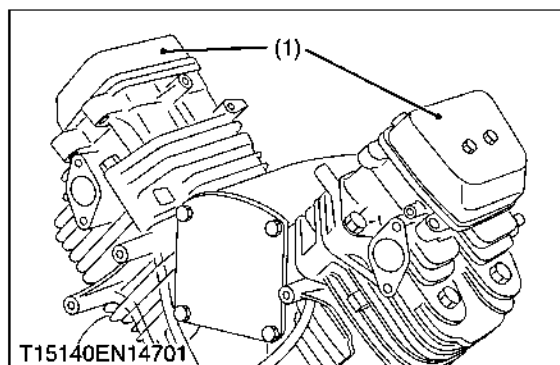


Tightening torque	Crankcase cover bolt	25 N·m 2.6 kgf·m 19.0 ft-lbs
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- | | |
|-----------------------------|-------------------------|
| (1) Mounting Bolt | (7) Flange Surface |
| (2) Crankcase Cover | (8) Oil Seal |
| (3) Mark | (9) Crankcase Dowel Pin |
| (4) High Temperature Grease | |
| (5) Seal Lip | |
| (6) Dust Lip | |

A : 0 to 1 mm (0 to 0.04 in.)
1 to 9 : Cover Bolt Tightening Sequence

W1022257



Camshaft and Tappet

1. Set the engine on a clean surface while parts are being removed.
2. Drain the oil (see Lubrication System chapter).
3. Remove the muffler, throttle control panel, carburetor, intake manifold, crankcase cover and cylinder head covers (1).
4. Position the piston TDC at the end of the compression stroke.
5. Push down the spring side of the rocker arm (2) and move it to clear the push rod (3).
6. Remove the push rods and mark them so they can be installed in their original positions during assembly.
7. Turn the crankcase up side down so that the tappets will fall away from the cam lobes.
8. Pull the camshaft (4) out of the crankcase.
9. Remove the tappets (5) and mark them so they can be installed in their original positions during assembly.

(When reassembling)

- Apply engine oil to the following.
 - Tappet Journal
 - Camshaft Journal
 - Cam Lobe Surface
 - Camshaft Gear
- Align the punch marks (6) on the crankshaft gear and camshaft gear.
- Install the shim (7) on the camshaft.

(1) Cylinder Head Cover

(2) Rocker Arm

(3) Push Rod

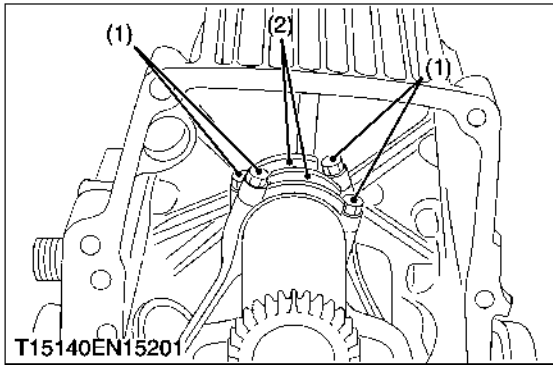
(4) Camshaft

(5) Tappet

(6) Punch Mark

(7) Shim

W1023171

(E) Piston and Crankshaft**Piston**

1. Split the crankcase (see Camshaft / Crankshaft chapter).
2. Remove the camshaft (see Camshaft / Crankshaft chapter).
3. Turn the crankshaft to expose the connecting rod cap bolts (1).
4. Remove the bolts and take off the connecting rod caps (2).

NOTE

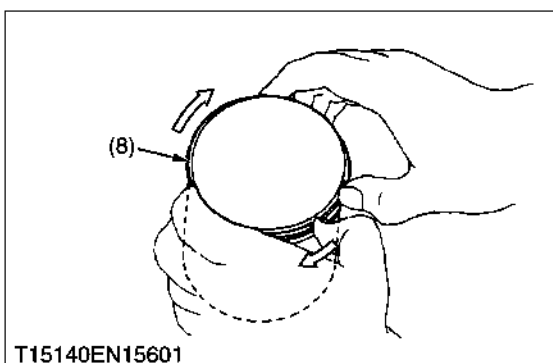
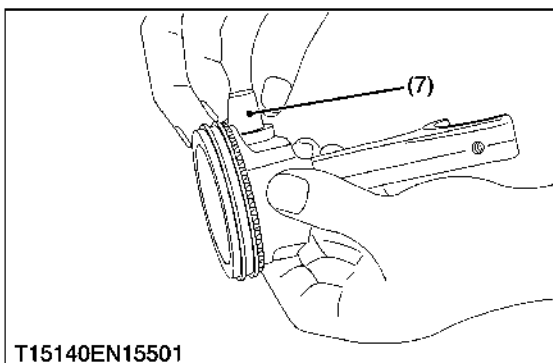
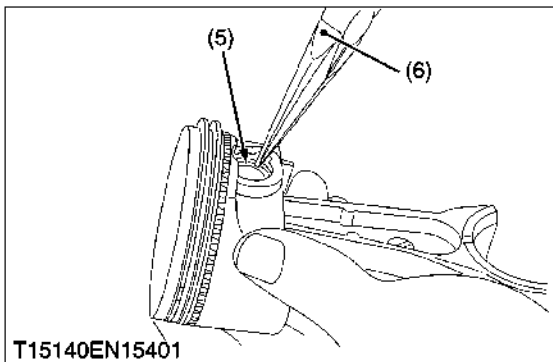
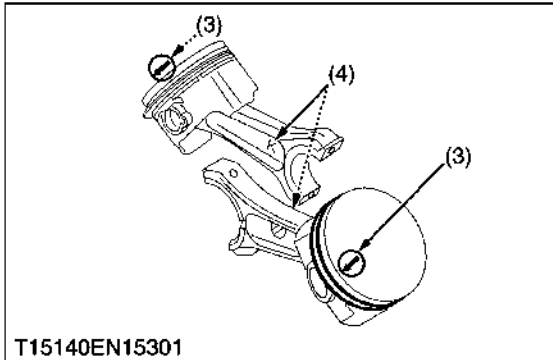
- Note the position of the connecting rod caps for reinstalling the caps.
- Push the connecting rod end into the cylinder, and pull the piston and connecting rod out of the cylinder.

**CAUTION**

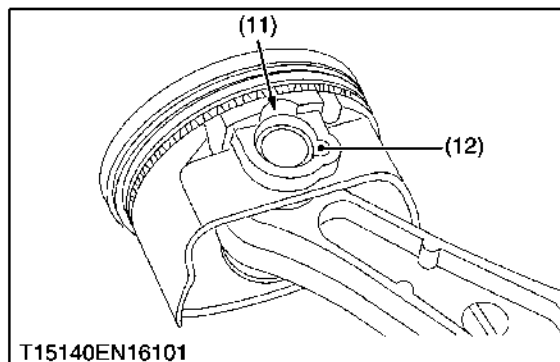
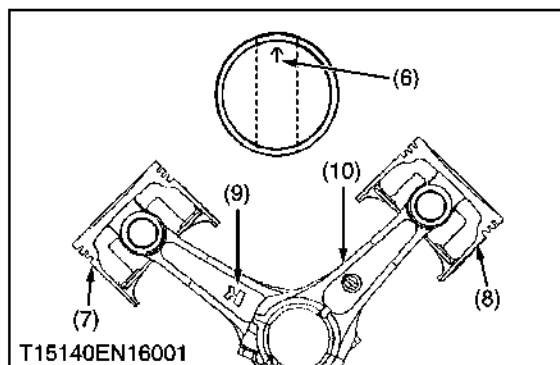
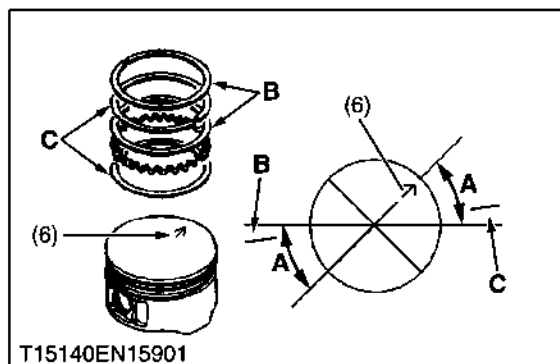
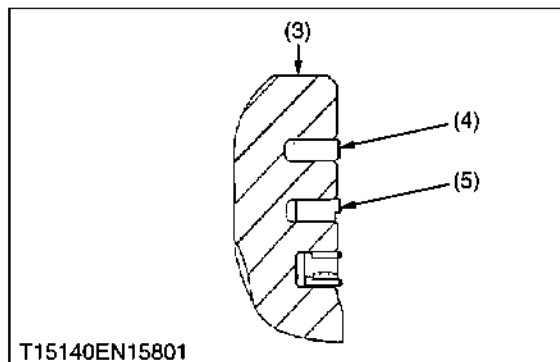
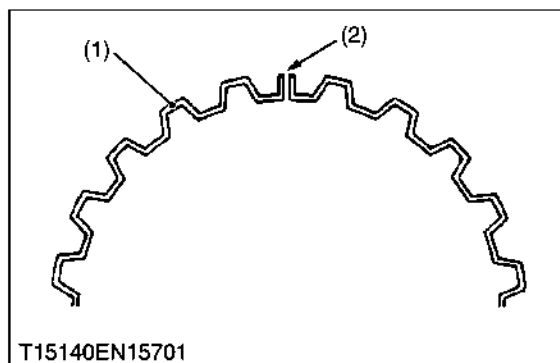
- Note a location of the arrow match mark (3) on the piston head in relation to K mark (4) on the connecting rod.
No. 1 cyl. K mark on the connecting rod is face to face with No. 2 cyl. K mark on the connecting rod.
Keep parts together as a set.
5. Remove one of the piston pin snap rings (5) with needle nose pliers (6).
 6. Remove the piston by pushing the piston pin (7) out the side from which the snap ring was removed.
 7. Remove the top and second rings with piston ring pliers.
 8. If the special too is not available, carefully spread the ring opening with your thumbs and then push up on the opposite side of the ring (8) to remove it.
 9. Remove the 3-piece oil ring with your thumbs in the same manner.

- (1) Connecting Rod Cap Bolt
(2) Connecting Rod Cap
(3) Arrow Match Mark
(4) K Mark

- (5) Piston Pin Snap Ring
(6) Needle Nose Plier
(7) Piston Pin
(8) Ring



W1023764

**(When reassembling)**

1. Install the expander (1) in the piston oil ring groove so that the expander ends (2) touch together, never overlap.
2. Install the upper and lower steel rails. There is no **UP** or **Down** to the rails. They can be installed either way.
3. Do not mix up the top and second rings. Install the second and top rings as shown. The rings should turn freely in the grooves.
4. Align the piston and rings with the piston ring end gap as shown.
 - Apply engine oil to the piston pins. Assemble the pistons onto the connecting rods as follow:
 - No. 1 cyl. piston, align the arrow match mark on the piston head with opposite the raised letters (K Mark) on the connecting rod.
 - No. 2 cyl. piston, align the arrow match mark on the piston head with K Mark on the connecting rod.
 - When installing a piston pin snap ring, compress it only enough to install it and no more. Fit a new piston pin snap ring into the side of the piston so that the ring opening (11) does not coincide with the notch (12) in the edge of the piston pin hole.

**CAUTION**

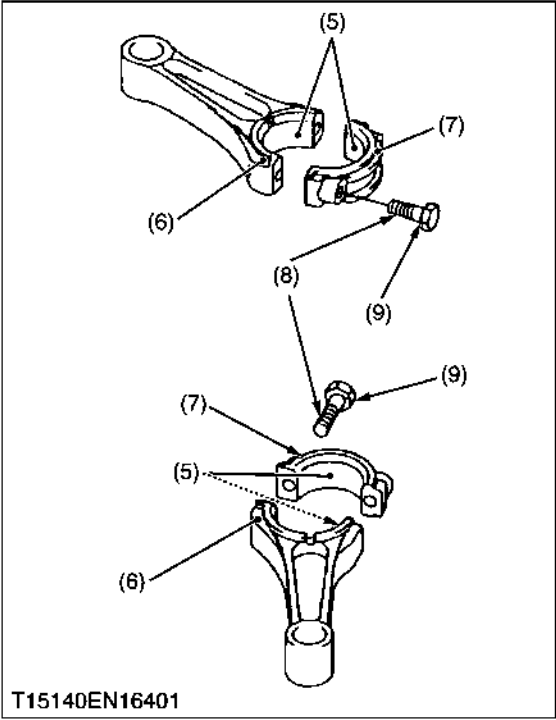
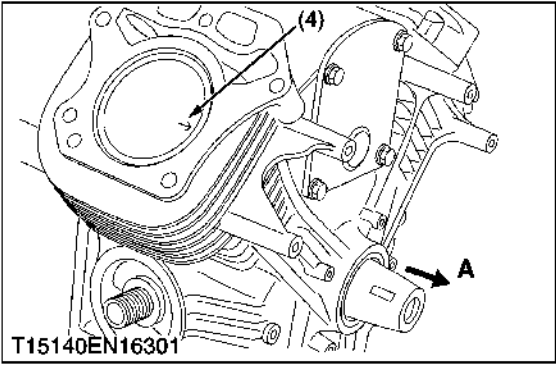
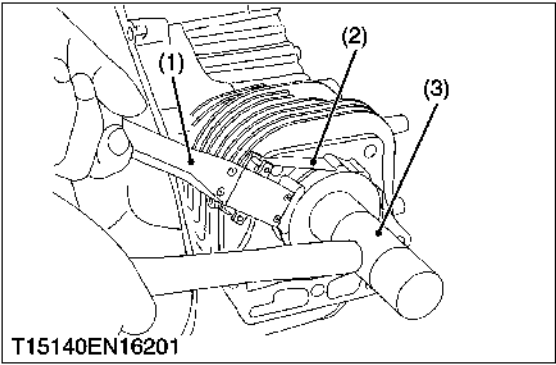
- Do not reuse the snap rings, as removal weakens and deforms them. They could fall out and score the cylinder wall.

- (1) Expander
 (2) Expander End
 (3) Piston Head
 (4) Top Ring
 (5) Second Ring
 (6) Arrow Match Mark
 (7) No. 1 Cyl. Piston
 (8) No. 2 Cyl. Piston

- (9) K Mark
 (10) Opposite K Mark
 (11) Ring Opening
 (12) Notch

- A : 0.53 to 0.79 rad. (30 to 45 °)**
B : Top Ring End Gap
C : Second Ring End Gap

W1024483



(When reassembling) (Continued)

- Apply engine oil to the piston skirt and the cylinder bore.
- Using the piston ring compressor grip (1) and the belt (2), lightly tap the top of the piston with a plastic mallet (3) to insert the piston and connecting rod into the cylinder.
- Insert the piston and connecting rod so that the arrow match mark (4) on the top of the piston is facing the flywheel side (A).

CAUTION

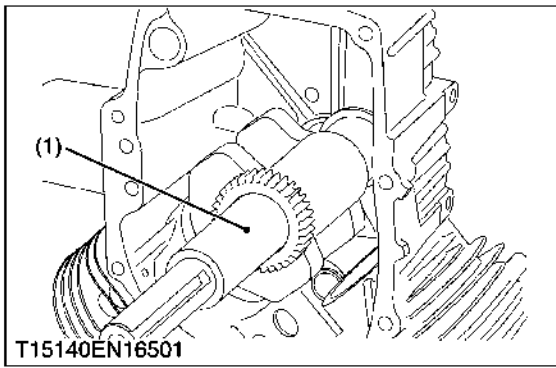
- **The connecting rod and the connecting rod big end cap are machined at the factory in the assembled state, so they must be replaced together as a set.**
- Apply engine oil to the inner surface (5) of the connecting rod big end (6) and cap (7).
- Install the connecting rod big end caps on their original position on each connecting rod big ends.
- Apply a small amount of engine oil to the thread (8) and seating surface (9) of the cap bolts.
- Tighten the cap bolts.
- Install the camshaft and the crankcase cover.

Tightening torque	Connecting rod big end cap bolt	5.9 N·m 0.6 kgf·m 4.3 ft·lbs
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- | | |
|---------------------------------|----------------------------|
| (1) Piston Ring Compressor Grip | (6) Connecting Rod Big End |
| (2) Belt | (7) End |
| (3) Plastic Mallet | (8) Thread |
| (4) Arrow Match Mark | (9) Seating Surface |
| (5) Inner Surface | |

A: Flywheel Side

W1025102

**Crankshaft**

1. Set the engine on a clean surface while parts are being removed.
2. Drain the oil (see Lubrication System chapter).
3. Remove the flywheel, the camshaft (see Camshaft, Tappet Removal), the connecting rod (1) and the piston assembly (see Engine Top End chapter).
4. Pull the crankshaft (1) out of the crankcase. Tap gently with a wooden or plastic mallet if necessary to loosen the crankshaft.

(When reassembling)

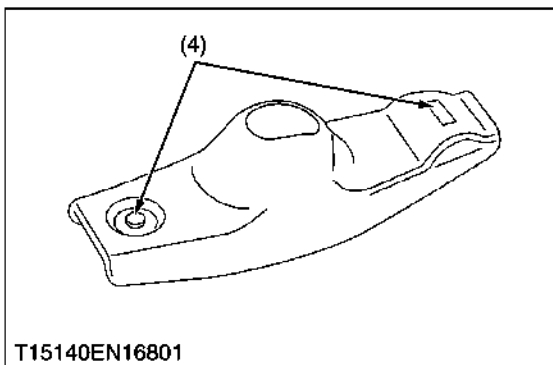
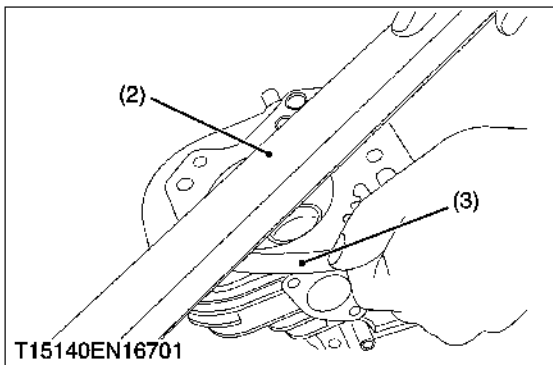
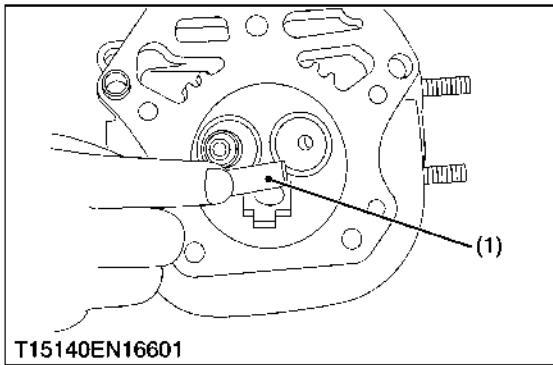
- Clean up the crankshaft and crankcase thoroughly, especially at the bearing contact surfaces.
- Pack some amount of high temperature grease into the oil seal on the crankcase.
- Apply engine oil to the journal and bearing.
- Carefully insert the crankshaft flywheel end into the main bearing and oil seal in the crankcase.

(1) Crankshaft

W1026392

(3) Servicing

(A) Cylinder Head and Valves



Cylinder Head Surface Flatness

⚠ CAUTION

- Clean the cylinder head in a well-ventilated area, and take care that there are no sparks or flame anywhere near the working area; this includes any appliance with a pilot light. Do not use gasoline or a low flash-point solvent to clean the cylinder head. A fire or explosion could result.
 - Scrape the carbon deposits from the head and exhaust port with a scraper (1).
 - To avoid gouging, use scrapers that are made of a material that will not cause damage.
 - Clean the head in a bath of high flash-point solvent and dry it with compressed air.
1. Lay a straightedge (2) across the mating surface of the head at several differential points, and measure warp by inserting a thickness gauge (3) between the straightedge and head. If warp exceeds the service limit, repair the mating surface. Replace the cylinder head if the mating surface is badly damaged.
 2. Check the cylinder head for cracks or other damage.
 3. Cracks not visible to the eye may be detected by coating the suspected area with mixture of 25 % kerosene and 75 % light engine oil.
 4. Wipe the area dry and immediately apply a coating of zinc oxide dissolved in wood alcohol. If a crack is present, the coating will become discolored at the defective area.
 5. If a crack is present in the cylinder head, replace it.
 6. Inspect the mating surface for burrs and nicks.
 7. Clean and inspect the rocker arm where it touches the push rod and valve stem.
- If the contact points (4) are worn or damaged, replace the rocker arm.

Cylinder head surface flatness	Allowable limit	0 to 5 mm 0 to 0.02 in.
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(1) Scraper
(2) Straightedge

(3) Thickness Gauge
(4) Contact Point

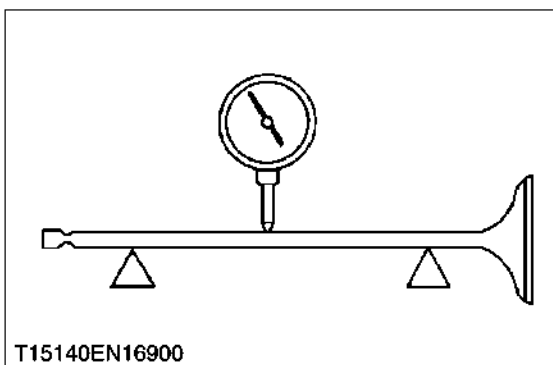
W1026587

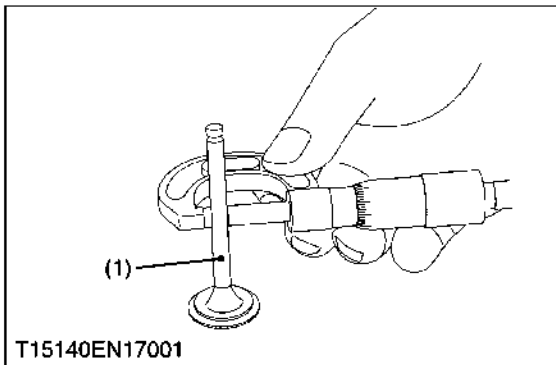
Valve Stem Runout

1. Support the valve in V blocks at each end of the stem.
 2. Position a dial gauge perpendicular to the stem.
 3. Turn the valve and read the variation on the dial gauge.
- If the stem runout is greater than service limit, replace the valve.

Valve stem runout	Allowable limit	0.05 mm 0.002 in.
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W1027446



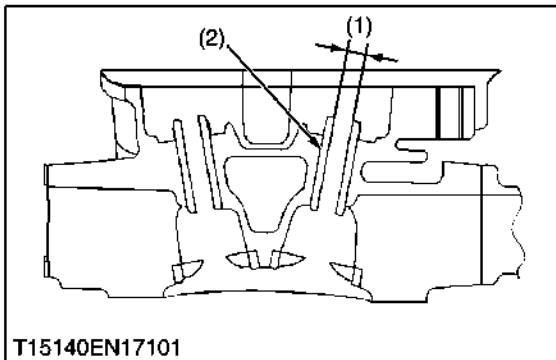
**Valve Stem O.D.**

1. Measure the outside diameter of the valve stem (1) in two directions at right angles, at four different positions on the stem.
2. If any single measurement is less than the service limit, replace the valve.

Valve stem O.D. (Intake)	Allowable limit	5.95 mm 0.234 in.
Valve stem O.D. (Exhaust)	Allowable limit	5.93 mm 0.233 in.

(1) Valve Stem

W1027588

**Valve Guide I.D.**

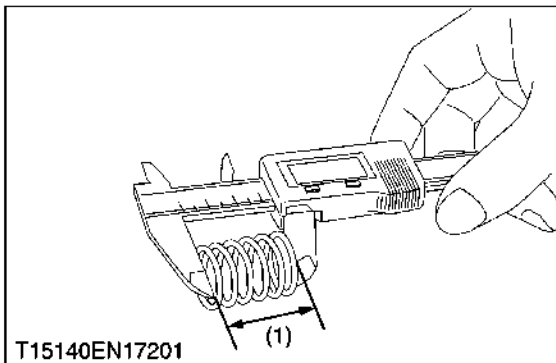
1. Use a small bore gauge or a micrometer to measure the inside diameter (1) of the valve guide (2) at three places down the length of the guide.
2. If the measurement is more than the service limit, replace the cylinder head with a new one.

Valve guide I.D. (Intake and exhaust)	Allowable limit	6.08 mm 0.239 in.
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(1) Inside Diameter

(2) Valve Guide

W1027734

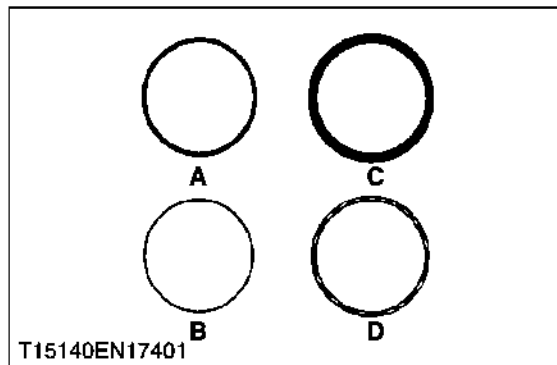
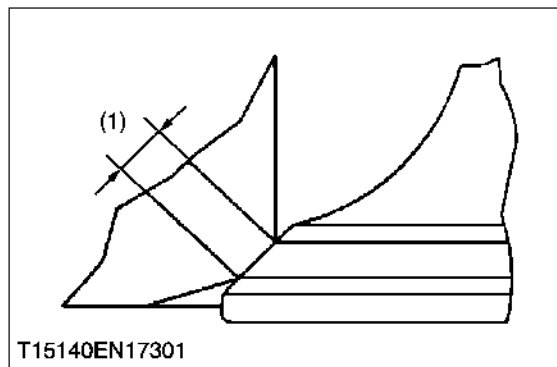
**Valve Spring Inspection**

1. Inspect the valve spring for pitting, cracks, rusting, and burns. Replace the spring if necessary.
2. Measure the free length (1) of the spring.
3. If the measurement is less than the service limit, replace the spring.

Valve spring free length	Allowable limit	31.0 mm 1.22 in.
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(1) Free Length

W1027838



Valve Seat Width

1. Remove the valve. (see Valve Mechanism Removal / Installation)
2. Inspect the valve seats for damage.
If the seats are warped or distorted beyond reconditioning, replace the cylinder head.
3. Pitted or worn valve seats can be refaced. Lap the valves to the seats after refacing.
4. Coat the valve seat with mechanic's dye.
5. Push the valve into the guide.
6. Rotate the valve against the seat with a lapping tool.
7. Pull the valve out, and check the seating pattern on the valve head. It must be the correct valve seat width (1) and even all the way around.

NOTE

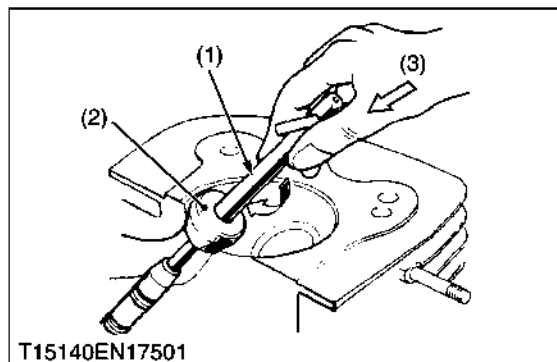
- The valve stem and guide must be in good condition or this check will not be valid.
- If the valve seating pattern is not correct, repair the seat.

Valve seat width (Inlet, exhaust)	Allowable limit	0.6 to 0.9 mm 0.024 to 0.035 in.
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(1) Valve Seat Width

A: Good
B: Too Narrow
C: Too Wide
D: Uneven

W1027949



Seat Cutter Operating Cares

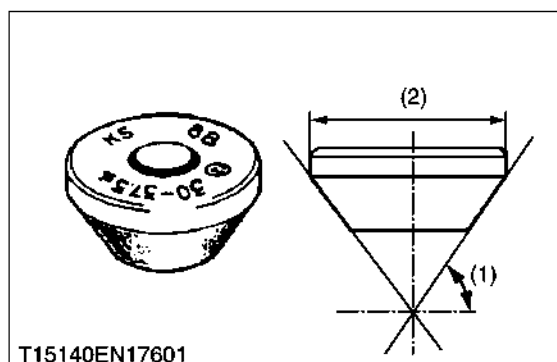
NOTE

- Do not use a wire brush to remove the metal particles from the cutter. It will take off the diamond particles.
 - Prior to grinding, apply oil to the cutter, and during the operation wash off any ground particles sticking to the cutter with washing oil.
1. This valve seat cutter is designed only for valve seat repair. Therefore the cutter must not be used for other purposes.
 2. Do not drop or hit the valve seat cutter, or the diamond particles may fall off.
 3. Do not fail to apply engine oil to the valve seat cutter before grinding the seat surface. Also wash off ground particles sticking to the cutter with washing oil.
 4. Setting the valve seat cutter holder (1) in position, operate the cutter (2) with one hand (3). Do not apply too much force to the diamond portion.
 5. After use wash the cutter with washing oil and apply a thin layer of engine oil before storing.

(1) Valve Seat Cutter Holder
(2) Cutter

(3) One Hand

W1028155



Marks Stamped on the Cutter

The marks stamped on the back of the cutter represent the following.

1 : Cutter number, selected from 1 to 12

30 ° : Cutter angle (1)

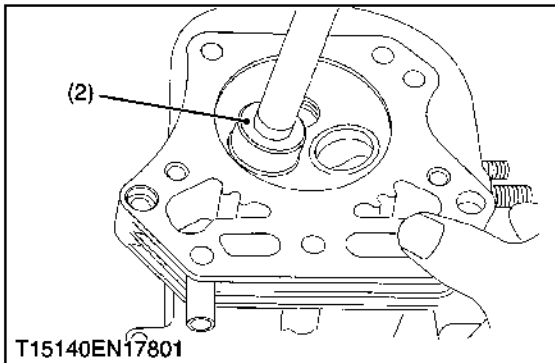
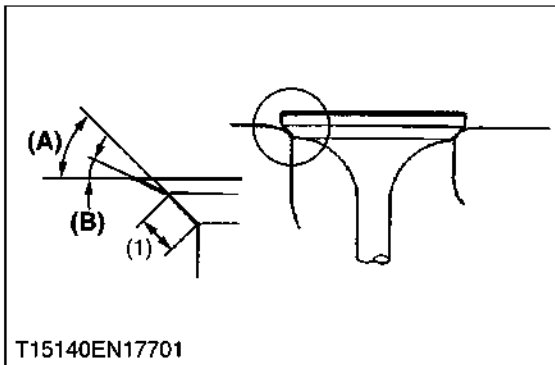
37.5 : Cutter diameter of cutter (2)

KS8B : Manufactured lot number

(1) Cutter Angle

(2) Cutter Diameter of Cutter

W1028561

**Operating Procedures:**

1. Clean the seat area carefully.
2. Recondition the valve seats with the valve seat cutters (45°, 30°) and lap the valve.
3. Check the seats for good contact all the way around with machinist's dye.
4. Measure the seat width (1). If it is more than the STD width, the seating surface should be refaced.
5. If the valve seating pattern is not correct, repair the seat.
6. Coat the seat with machinist's dye.
7. Fit a 45 ° cutter (2) to the holder and slide it into the valve guide. Resurface the valve seat with a 45 ° cutter, removing only enough material to produce a smooth and concentric seat.

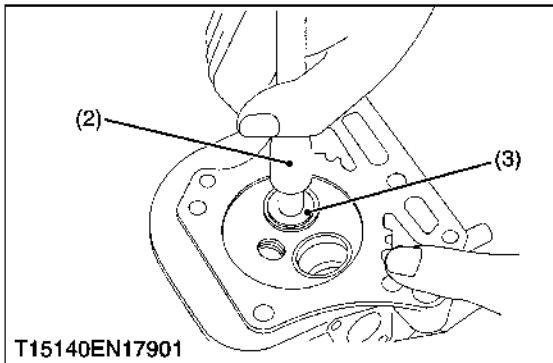
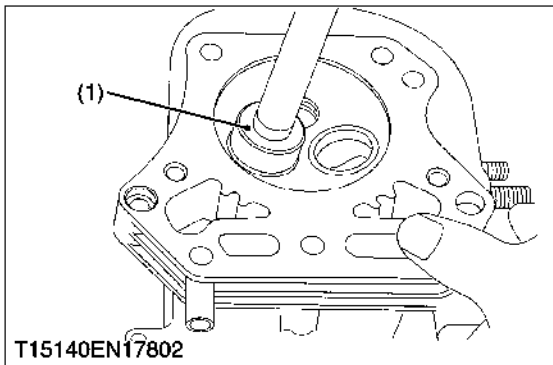
**CAUTION**

- Do not grind the seat too much. Overgrinding will reduce valve clearance by sinking the valve into the head. If the valve sinks too far into the head, it will be impossible to adjust the clearance, and the cylinder head must be replaced. Do not turn the cutter counterclockwise or drop it against the seat, or it will be dulled.

- (1) Seat Width
(2) Cutter

- (A) 30 ° (0.53 rad.)
(B) 45 ° (0.79 rad.)

W1028805



9. Use a 30 ° seat cutter (1) to narrow the seat width to the STD width.
Turn the seat cutter one turn at a time while pressing down very lightly.
Check the seat width after each turn.

⚠ CAUTION

- The 30 ° cutter removes material very quickly. Check the seat width frequently to prevent over grinding.

■ NOTE

- Keep the seat width as closely as possible to the STD width.

10. Make a light pass with the 45 ° cutter to remove any possible burrs at the edge of the seat.
11. After resurfacing the seat, inspect for even valve seating.
Apply a machinist's dye to the valve face, insert the valve, and snap it closed against the seat several times. The valve surface should show good contact all the way around. Be sure the valve seat is centered on the valve face. The position of the valve in the seat is evident after lapping the valve.
If the seat does not make proper contact, lap the valve into seat with a vacuum cap tool.
12. Coat the face of valve sparingly with a fine lapping compound.
13. Use the vacuum cup tool (2), to grip top of the valve (3). Rotate the valve in a circular motion to lap the valve to the seat.
14. Lift the valve slightly from the seat every 8 to 10 strokes, continue lapping operation until a uniform ring appears around entire surface of the valve face.
15. When lapping is completed, wash all parts in solvent to remove lapping compound. Dry the parts thoroughly.
16. Note the position of the lapping mark on the valve face. The lapping mark should appear on or near the center of the valve face.
17. When the engine is assembled, be sure to adjust the valve clearances.

(1) 30 ° Seat Cutter
(2) Vacuum Cut Tool

(3) Grip Top of the Valve

W1028976

Valve Head Thickness

1. Remove the valve (see Valve Mechanism Removal / Installation).
2. Measure the thickness of the valve head.

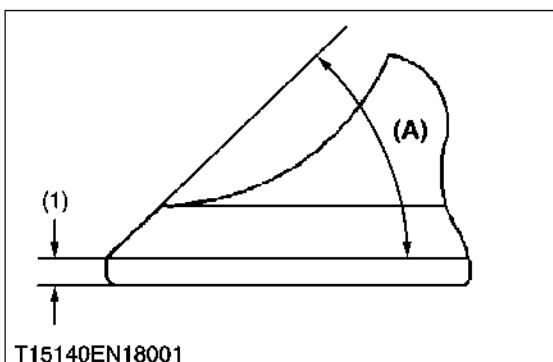
If the valve head thickness (valve margin) (1) is less than the service limit, replace the valve.

Inlet and exhaust valve head thickness	Factory spec.	0.35 mm 0.014 in.
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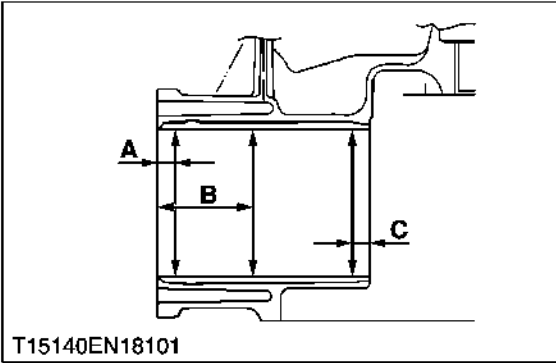
(1) Valve Head Thickness

(A) 45 ° (0.79 rad.)

W1029425



(B) Cylinder



Cylinder Wear

1. Clean and measure the cylinder inside diameter.
Use a dial bore gauge to measure front-to-back and side-to-side at the points shown figure.
If any of the cylinder bore measurements is greater than the service limit, the cylinder must be bored to the next oversize and then honed (see Cylinder Boring and Honing).

Cylinder I.D.	Factory spec.	67.98 to 68.00 mm 2.676 to 2.677 in.
Maximum wear	Allowable limit	68.10 mm 2.681 in.

(Reference)

- Oversize cylinder

Oversize cylinder I.D.	0.5 mm OS	Factory spec.	67.48 to 68.50 mm 2.696 to 2.697 in.
		Allowable limit	68.60 mm 2.701 in.

A : Top 10 mm (0.39 in.)

B : Middle 55 mm (2.2 in.)

C : Bottom (Skirt) 10 mm (0.39 in.)

W1029531

Cylinder Boring and Honing

■ NOTE

- Always resize to exactly 0.5 mm (0.02 in.) over the standard bore size.

If this is done accurately, the stock oversize rings and piston will fit perfectly and proper clearance will be maintained.

Resizing the cylinder bore can be done by reliable repair shop or by using a drill press and honing tool.

Use the stone recommended by the hone manufactures to produce correct cylinder wall finish.

Machine-bore first, the bore diameters should be shown in the table.

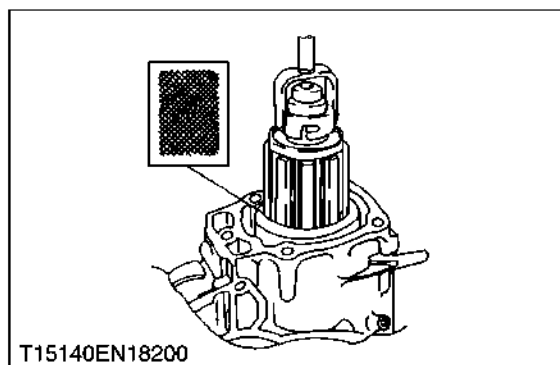
Fine boring bore diameter	0.50 OS	Factory spec.	68.46 to 68.48 mm 2.695 to 2.696 in.
Final bore diameter	0.50 OS	Factory spec.	68.48 to 68.50 mm 2.696 to 2.697 in.

Change to a honing stone for finishing, the final bore diameter should be as shown in the table.

Be sure the correct stone is used and the stone is not worn.

1. Clean the cylinder at the top and bottom of the cylinder to remove burns and pieces of the base and head gasket.
2. Anchor the cylinder (block) on the drill press table before honing.
3. Align the center of the cylinder bore to the press center. Set the press to operate from 200 to 250 rpm.
4. Connect the drive shaft to the hone and set the stop on the drill press so the hone can only extend 20 to 25 mm (3/4 to 1.0 in.) above the top or below the bottom of the cylinder liner.
5. Rotate the adjusting nut (knob) on the hone until the stones contact snugly against the cylinder wall at the narrowest point. "Do not Force".
6. Turn the stone by hand. If you cannot turn it, the stone is too tight. Loosen the hone until it can be turned by hand.
7. Be sure that the cylinder and hone are centered and aligned with the drive shaft and drill spindle.
8. Pour honing oil inside of the cylinder during the honing operation. Start the drill press. Move the hone up and down in the cylinder approximately 20 cycles-per-minute.
9. Check the diameter of the cylinder bore regularly during honing, using an inside micrometer.

W1029828



⚠ CAUTION

- Stop the drill press before measuring and remove the hone from the cylinder.

■ NOTE

- The finish should not be smooth, but have a 40 to 60 degree crosshatch pattern.

10. Hone the cylinder until it is about 0.007 to 0.009 mm (0.0003 to 0.0004 in.) large to allow for shrinkage when the cylinder cools.

■ NOTE

- Do not use gasoline, kerosene, or commercial solvent to clean the cylinder bore. These fluids only wash all the oil from the cylinder wall. They do not remove the metal particles produced during honing.

11. Clean the cylinder thoroughly. Use soap warm water and clean rags. Clean the cylinder wall for "white glove" inspection. A clean white rag should not show soil from the cylinder wall.

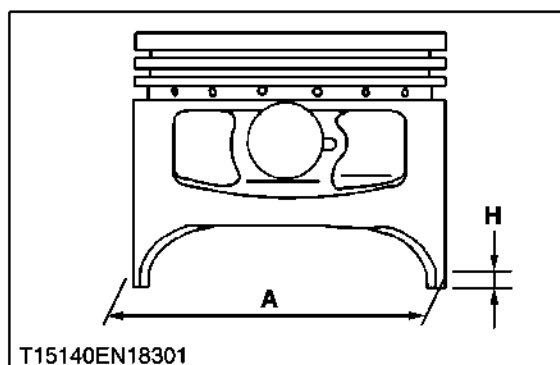
12. Dry the cylinder and coat with a engine oil.

⚠ CAUTION

- The cylinder must be thoroughly cleaned after honing to eliminate all grit.

W1030252

(C) Piston and Piston Ring



Piston Skirt O.D.

1. Measure the outside diameter of the piston 12.5 mm (0.9 in.) up from the bottom of the piston at a right angle to the direction of the piston pin hole.
2. If the measurement is less than the allowable limit, replace the piston.

Piston skirt O.D. (A)	Allowable limit	67.79 mm 2.669 in.
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(Reference)

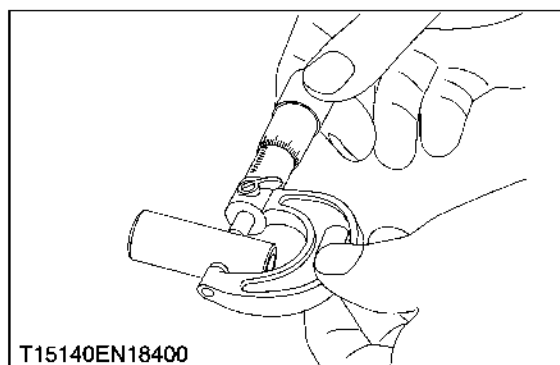
- Oversize piston

Oversize piston skirt O.D.	0.50 OS	Allowable limit	68.29 mm 2.689 in.
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A : Piston Skirt O.D.

H : 12.5 mm (0.49 in.)

W1030465

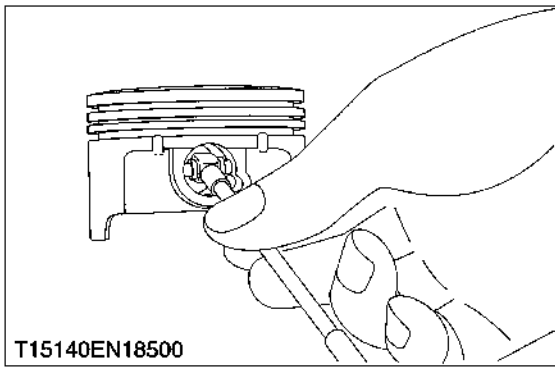


Piston Pin O.D.

1. Remove the piston pin.
2. Measure the diameter of the piston pin with a micrometer at several points.
3. If the outside diameter is less than allowable limit, replace the piston pin.

Piston pin O.D.	Allowable limit	15.96 mm 0.628 in.
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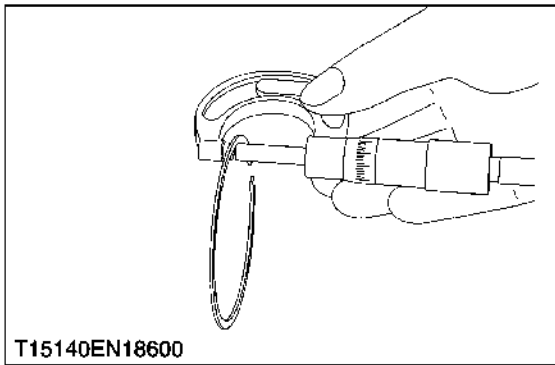
W1030639

**Piston Pin Hole I.D.**

1. Measure the inside diameter of the piston pin hole at several points on both side. Use a dial bore gauge.
2. If the inside diameter is more than the service limit, replace the piston.

Piston pin hole I.D.	Allowable limit	16.08 mm 0.633 in.
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W1030727

**Piston Ring Thickness**

1. Measure the piston ring thickness.
Use a micrometer to measure at several points around the rings.
2. If any of the measurement are less than the service limit, replace the entire set of rings.

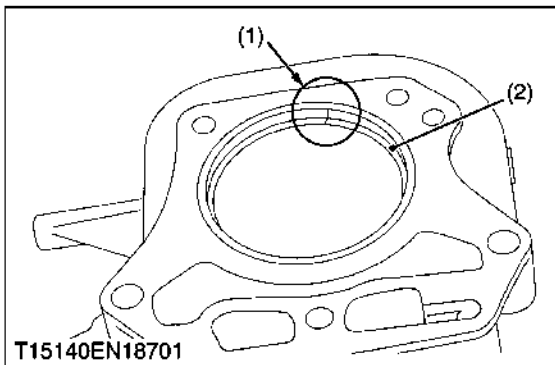
Top and second piston ring, thickness	Allowable limit	1.40 mm 0.055 in.
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NOTE

- When using new rings in a used piston, check for uneven groove wear. The rings should fit perfectly parallel to the groove sides. If not, replace the piston.

Top and second ring thickness	Allowable limit	1.40 mm 0.055 in.
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W1030809

**Piston Ring Gap**

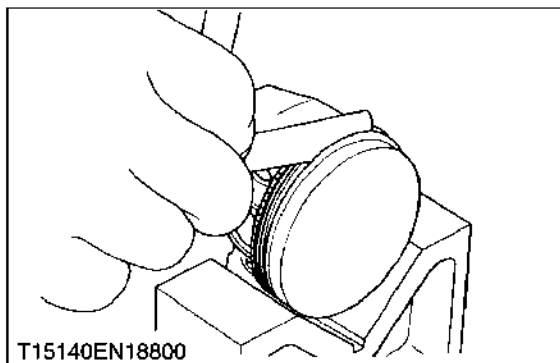
1. Remove the piston rings.
2. Push each ring (one at a time) in the cylinder bore to a point close to the bottom of the cylinder bore.
3. Use the piston to push it in to be sure it is square.
4. Measure the gap (1) between the ends of the ring (2) with a thickness gauge.
5. If the end gap of any ring is greater than the allowable limit, replace the entire set of rings.

Top ring gap	Allowable limit	0.70 mm 0.028 in.
Second ring gap	Allowable limit	0.78 mm 0.031 in.
Oil ring gap	Allowable limit	1.05 mm 0.041 in.

(1) Gap

(2) End of Ring

W1030933



Clearance between Piston Ring and Ring Groove

1. Clean the piston.
2. Visually inspect the piston rings and ring grooves.
If the piston rings are worn unevenly or damaged, replace them.
If the ring grooves are worn unevenly or damaged, replace both the piston and piston rings.
3. Check ring grooves for wear by inserting a new ring in the proper groove at several points around the piston.
4. Measure the clearance between the top and second rings and their grooves using a thickness gauge.
5. If the piston ring / groove clearance is greater than the allowable limit, replace the piston.

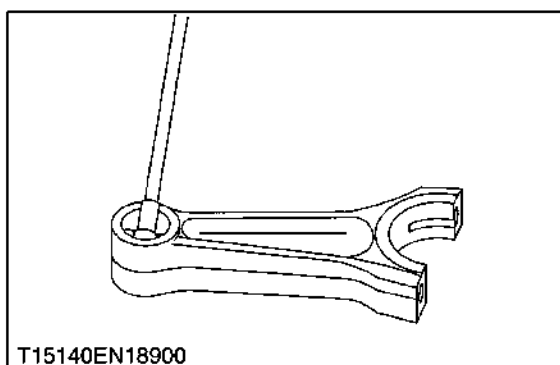
NOTE

- The oil ring is a three piece assemble ring. Difficult to measure the ring groove clearance and thickness, visually inspect only.

Clearance between top ring and piston ring groove	Allowable limit	0.15 mm 0.006 in.
Clearance between second ring and piston ring groove	Allowable limit	0.12 mm 0.005 in.

W1031095

(D) Connecting Rod, Crankshaft and Camshaft

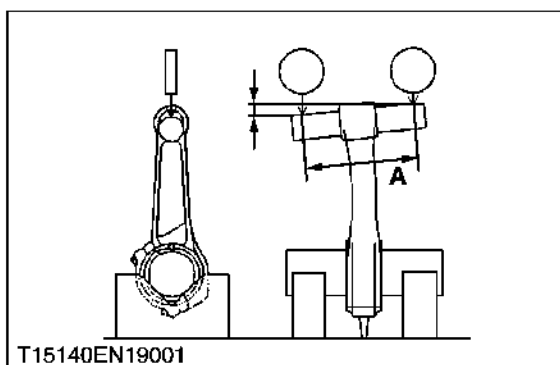


Connecting Rod Small End I.D.

1. Measure the inside diameter of the small end of the connecting rod at several points. Use a dial bore gauge.
2. If the inside diameter is more than the allowable limit, replace the connecting rod.

Connecting rod small end I.D.	Allowable limit	16.05 mm 0.632 in.
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W1031427



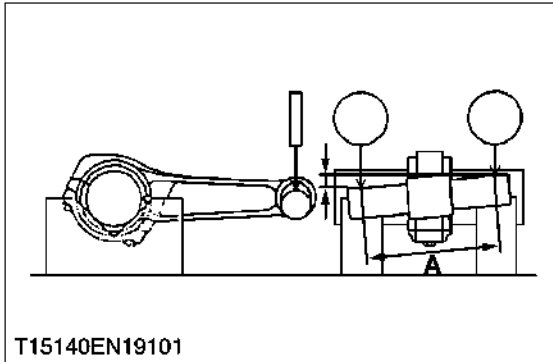
Connecting Rod Bend

1. Measure connecting rod bend.
2. Select an arbor of the same diameter as the connecting rod big end, and insert the arbor through the connecting rod big end.
3. Select an arbor of the same diameter as the piston pin and at least 100 mm long, and insert the arbor through the connecting rod small end.
4. On a surface plate, set the big-end arbor on V blocks.
5. With the connecting rod held vertically, use a height gauge to measure plate over a 100 mm length to determine the amount of connecting rod bend.
6. If connecting rod bend exceeds the allowable limit, the connecting rod must be replaced.

Connecting rod bend	Allowable limit	0.05 / 100 mm 0.006 / 3.94 in.
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A : 100 mm (3.94 in.)

W1031504



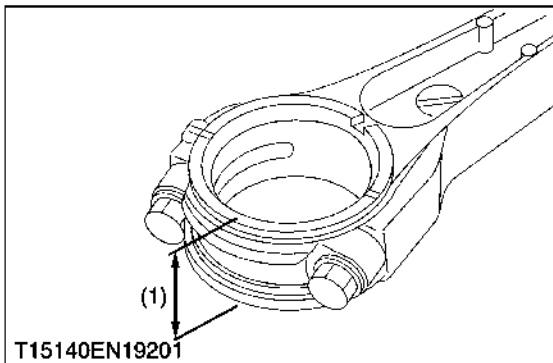
Connecting Rod Twist

1. Measure connection rod twist.
2. With the big-end arbor still on the V blocks, hold the connection rod horizontally and measure the amount that the small end arbor varies from being parallel with the surface plate over a 100 mm length of the arbor to determine the amount of connecting rod twist.
3. If connection rod twist exceeds the allowable limit, connecting rod must be replaced.

Connecting rod twist	Allowable limit	0.15 / 100 mm 0.006 / 3.94 in.
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A : 100 mm (3.94 in.)

W1031644



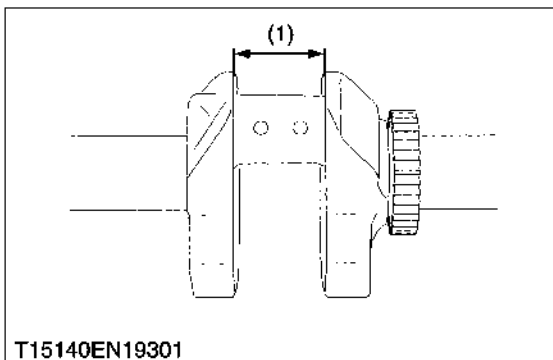
Connecting Rod Big End Width

1. Measure the connecting rod big end width (1) with a micrometer or dial caliper.
2. If the measurement is less than the allowable limit, replace the connecting rod.

Connecting rod big end width	Allowable limit	18.80 mm 0.74 in.
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(1) Connecting Rod Big End Width

W1031922



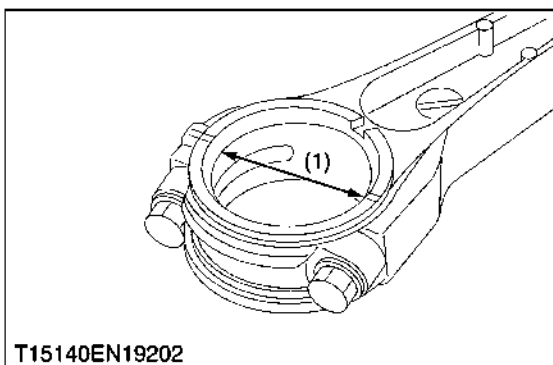
Crankpin Width

1. Measure the crankpin width (1) with a dial caliper.
2. If the crankpin width is more than the allowable limit, replace the crankshaft.

Crankpin width	Allowable limit	39.50 mm 1.56 in.
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(1) Crankpin Width

W1032013



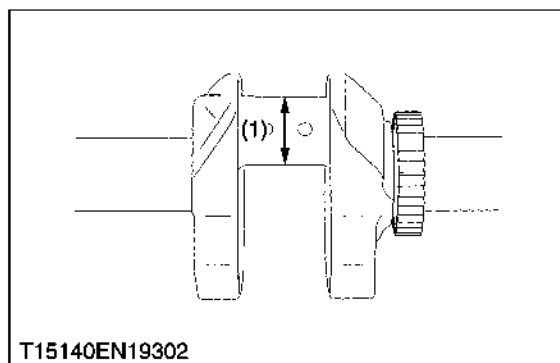
Connecting Rod Big End Bearing I.D.

1. Apply a light film of oil on the thread of the cap bolts.
2. Install the cap bolts and tighten the bolts to the specified torque (see Piston Installation in Engine Top End chapter).
3. Measure the inside diameter (1) of big end at several points with a telescoping gauge or inside micrometer.
4. If the inside diameter is more than the allowable limit, replace the connecting rod with a new one.

Connecting rod big end bearing I.D.	Allowable limit	35.055 mm 1.380 in.
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(1) Inside Diameter

W1031822

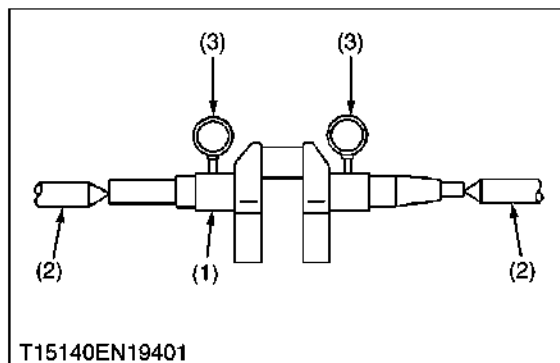
**Crankpin O.D.**

1. Measure the crankpin outside diameter (1).
Use a micrometer to measure several points around the crankpin circumference.
2. If the crankpin diameter is less than the allowable limit, replace the crankshaft with a new one.

Crankpin O.D.	Allowable limit	34.94 mm 1.3756 in.
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(1) Crankpin Outside Diameter

W1032126

**Crankshaft Runout**

1. Measure the crankshaft runout.
Set the crankshaft (1) in a flywheel alignment jig (2) or on V blocks gauge.
Set a dial gauge (3) against both bearing journals.
Turn the crankshaft (1) slowly to measure the runout. The difference between the highest and lowest dial gauge readings (TIR) is the amount of runout.
2. If the measurement exceeds the allowable limit, replace the crankshaft.

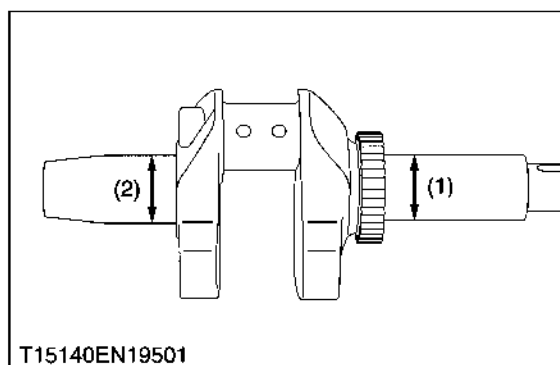
Crankshaft runout	Allowable limit	0.05 mm 0.002 in.
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(1) Crankshaft

(3) Dial Gauge

(2) Flywheel Alignment Jig

W1032207

**Crankshaft Main Journal O.D.**

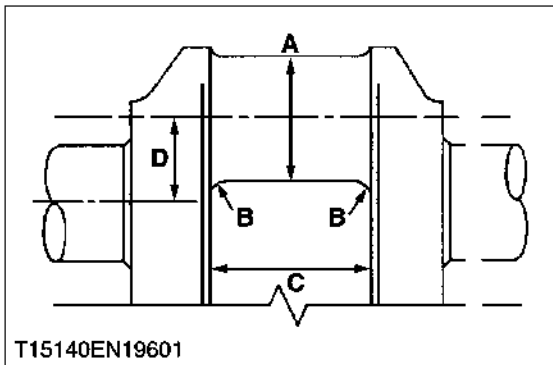
1. Measure both main journals at several points around the journal circumference.
2. If the journal diameter is less than the allowable limit, replace the crankshaft with a new one.

Crankshaft journal PTO side O.D.	Allowable limit	34.90 mm 1.374 in.
Crankshaft journal flywheel side O.D.	Allowable limit	34.93 mm 1.375 in.

(1) Crankshaft Journal PTO Side O.D.

(2) Crankshaft Journal Flywheel Side O.D.

W1032331



Crankpin Resizing

NOTE

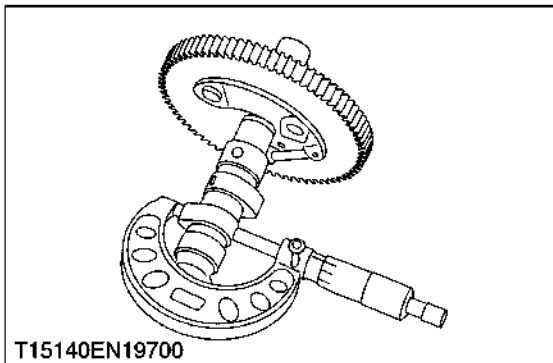
- Crankpin can be resized to accept 34.5 mm (1.3583 in.) dia under size connecting rod.
 - The crankpin should be reground if the crankpin is so much undersize and so much scored that a lapping operation will prove unsatisfactory.
 - Reground can be done by a reliable repair shop.
1. Before sending the crankshaft, inspect the crankpin for cracks.
 2. If any cracks, no matter how small, are found, the crankshaft must be rejected.
 3. The final finishing dimensions should be shown in the table.
 4. The crankpin surface should be concentric and parallel to each other within 0.006 mm (0.0002 in.) full indicator reading.
 5. Finish the crankpin surface with a super finishing stone.

Crankpin O.D. (A)	Factory spec.	34.470 to 34.457 mm 1.357 to 1.356 in.
Corner radius (B)	Factory spec.	R2.0 to 2.4 mm R0.079 to 0.094 in.
Crankpin width (C)	Factory spec.	39.50 mm MAX. 1.555 in. MAX.
Crankpin radius (D)	Factory spec.	34.050 to 33.950 mm 1.340 to 1.337 in.

A: Crankpin O.D.
B: Corner Radius

C: Crankpin Width
D: Crankpin Radius

W1033269

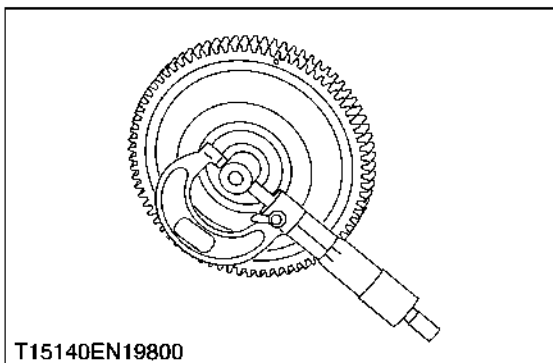


Cam Height and Camshaft Journal O.D.

1. Measure the height of each cam lobe.
2. If the cam height is less than the allowable limit for either lobe, replace the camshaft.

Cam height IN. and EX.	Allowable limit	29.131 mm 1.1469 in.
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W1033616

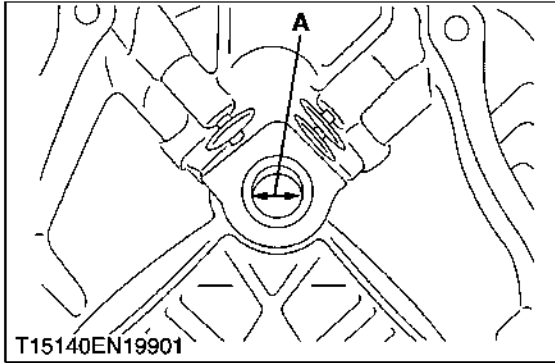


Camshaft Journal PTO Side and Flywheel Side O.D.

1. Measure both camshaft journals at several points around the journal circumference.
2. If the journal diameter is less than the allowable limit, replace the camshaft.

Camshaft journal PTO side O.D.	Allowable limit	15.985 mm 0.6293 in.
Camshaft journal flywheel side O.D.	Allowable limit	15.985 mm 0.6293 in.

W1033726

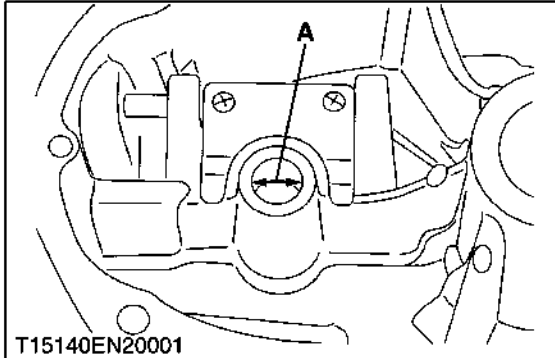
(E) Crankcase Cover and Crankcase**Camshaft Bearing I.D. (Crankcase)**

1. Measure the camshaft bearing inside diameter (A) on the crankcase at several points. This bearing is not replaceable.
2. Replace the crankcase if the inside diameter is more than the allowable limit.

Camshaft bearing I.D. (crankcase)	Allowable limit	16.136 mm 0.6352 in.
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A : Camshaft Bearing I.D.

W1034032

**Camshaft Bearing I.D. (Crankcase Cover)**

1. Measure the camshaft bearing inside diameter (A) on the crankcase cover at several points. This bearing is not replaceable.
2. Replace the crankcase cover if the inside diameter is more than the allowable limit.

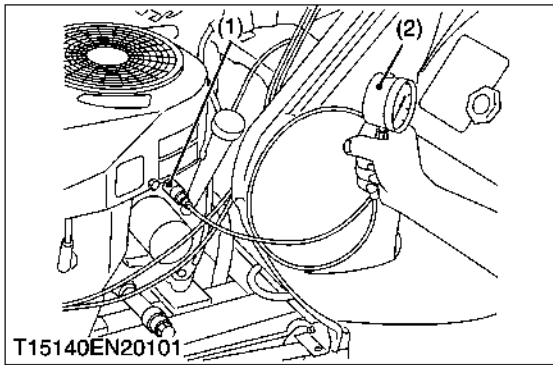
Camshaft bearing I.D. (crankcase cover)	Allowable limit	16.136 mm 0.6352 in.
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A : Camshaft Bearing I.D. (Crankcase Cover)

W1033829

[3] LUBRICATING SYSTEM

(1) Checking and Adjusting



Engine Oil Pressure

1. Remove the oil pressure switch or oil passage plug from the crankcase.
2. Install an appropriately sized oil pressure gauge adapter (1) and oil pressure gauge (2).
3. Run the engine and allow warm up completely.
4. Run the engine and fast idle speed and read the oil pressure gauge.
5. Stop the engine.
6. Remove the oil pressure gauge and adapter.
7. Apply silicone sealant to the threads of the pressure switch and tighten it, or tighten the plug.

■ NOTE

- If the oil pressure is below the specification, inspect the oil pump and relief valve.
- If the oil pump and relief valve are not at fault, inspect the rest of the lubrication system.

Tightening torque	Oil pressure switch	9.8 N·m 1.0 kgf·m 7.2 ft-lbs
	Oil passage plug	3.9 N·m 0.4 kgf·m 2.9 ft-lbs
Oil pressure	Factory spec.	241 to 310 kPa 2.46 to 3.16 kgf/cm ² 35 to 45 psi

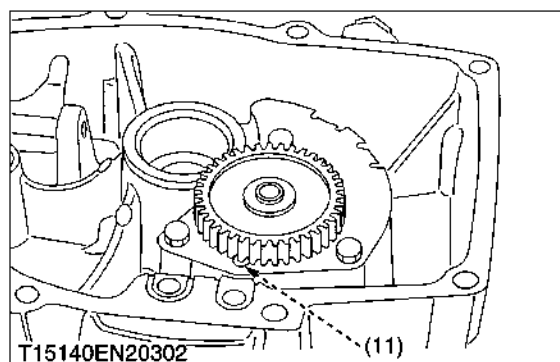
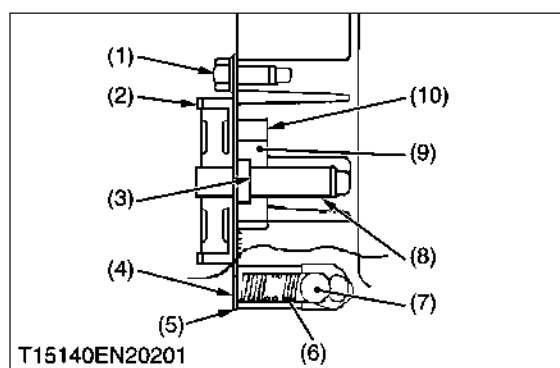
(1) Oil Pressure Gauge Adaptor

(2) Oil Pressure Gauge

W1034203

(2) Disassembling and Assembling

(A) Oil Pump



Oil Pump and Relief Valve

1. Remove the crankcase cover.
2. Unscrew the mounting bolts (1) and remove the oil pump parts assembly (pump gear (2), pump cover plate (5), pump shaft (8), pins and rotors (3), (9), (10)).
3. Take off the relief valve spring and ball.
4. Disassemble the pump parts assembly.

(When installing)

1. Fill the rotor housing with engine oil for initial lubrication.
2. Install the relief valve ball and spring in position, then install the pump parts assembly in the crankcase cover.

■ NOTE

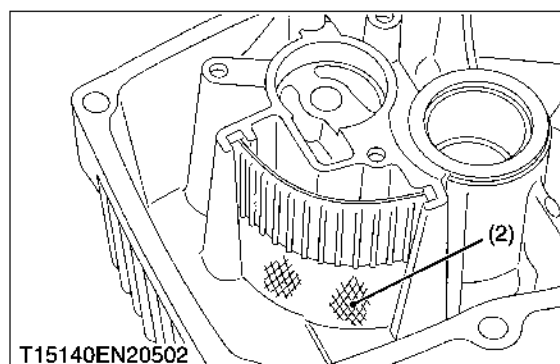
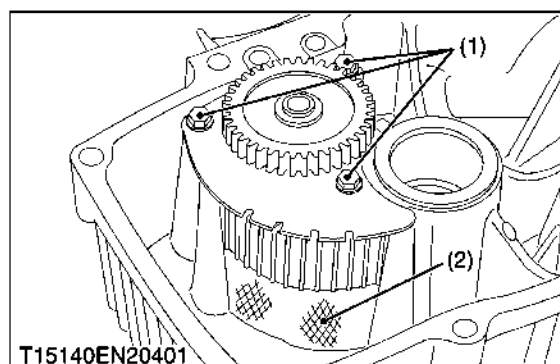
- When installing the pump parts assembly, align the 6 mm DIA hole (11) on the cover plate with center of the relief valve.
- Install the mounting bolts and tighten them.

Tightening torque	Oil pump cover plate mounting bolts	5.9 N·m 0.6 kgf·m 4.4 ft-lbs
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- | | |
|------------------------------|-------------------------------|
| (1) Mounting Bolt | (7) Relief Valve Ball |
| (2) Pump Gear | (8) Pump Shaft |
| (3) Pin | (9) Inner Rotor |
| (4) 6 mm (0.24 in.) DIA Hole | (10) Outer Rotor |
| (5) Pump Cover Plate | (11) 6 mm (0.24 in.) DIA Hole |
| (6) Spring | |

W1034477

(B) Oil Screen



Oil Screen

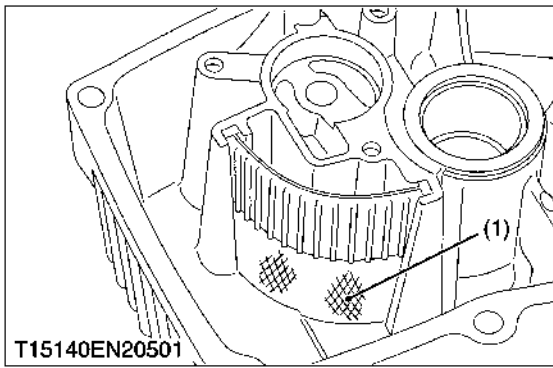
1. Remove the crankcase cover.
2. Unscrew the mounting bolts (1) and remove the oil pump parts assembly.
3. Remove the oil screen (2).

(When installing)

- Clean the oil screen thoroughly whenever it is removed for any reason.
- Insert the oil screen in position and install the oil pump parts assembly (see page 2-S44).

- | | |
|-------------------|----------------|
| (1) Mounting Bolt | (2) Oil Screen |
|-------------------|----------------|

W1034815



Cleaning and Inspecting Oil Screen

1. Clean the oil screen (1) with high flash-point solvent and remove any particles stuck to it.



WARNING

- Clean the screen in a well-ventilated area, and take care that there is no spark or flame anywhere near the working area. Because of the danger of highly flammable liquids, do not use gasoline or low flash-point solvents.

NOTE

- While cleaning the screen, check for any metal particles that might indicate internal engine damage.
2. Check the oil screen (1) carefully for any damage: holes and broken wire.
 3. If the oil screen (1) is damaged, replace it.

(1) Oil Screen

W1034958

(3) Servicing

(A) Relief Valve

Inspecting Parts

1. Visually inspect the relief valve spring, steel ball and valve seat in the crankcase cover.
2. If any rough spots are found during above inspection, wash the valve clean with a high flash-point solvent and blow out any foreign particles that may be in the valve with compressed air.



WARNING

- Clean the parts in a well ventilated area, and take care that there is no spark or flame anywhere near the working areas. Because of the danger of highly flammable liquids, do not use gasoline or low flash-point solvents.

W1035256

Relief Valve Spring Free Length

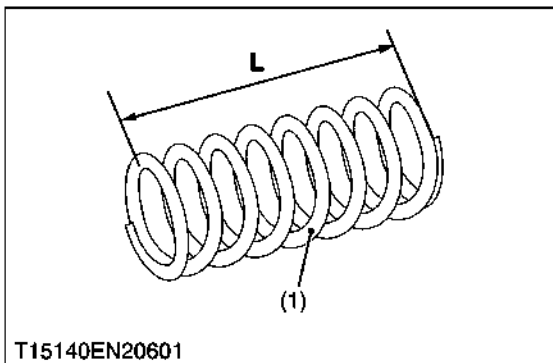
1. If cleaning does not solve the problem, replace the relief valve parts.
2. If necessary, put the ball in position and lightly tap the ball with a suitable tools to form a perfect seat.
3. Measure free length (L) of the relief valve spring (1) with a vernier caliper.
4. If the free length of the relief valve spring is less than the allowable limit, replace the relief valve spring.

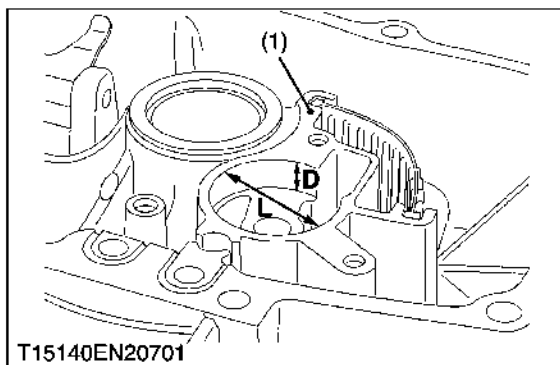
Relief valve spring free length	Allowable limit	19.50 mm 0.77 in.
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(1) Spring

L: Spring Free Length

W1035339



(B) Oil Pump**Pump Housing I.D. and Depth**

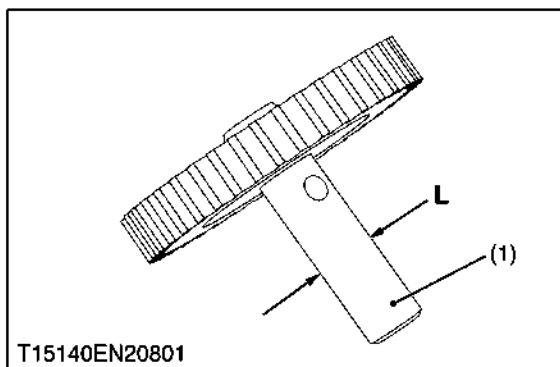
1. Measure the pump housing I.D. with a inside micrometer at several points.
2. If the I.D. is more than the allowable limit, replace the crankcase cover (1).
3. Measure the pump housing depth (D) with a depth micrometer at several points.
4. If any of measurement is more than the allowable limit, replace the crankcase cover.

Pump housing I.D. (L)	Allowable limit	40.801 mm 1.6063 in.
Pump housing depth (D)	Allowable limit	10.230 mm 0.4028 in.

(1) Crankcase Cover

L: Inside Diameter**D: Housing Depth**

W1035484

**Pump Shaft Diameter**

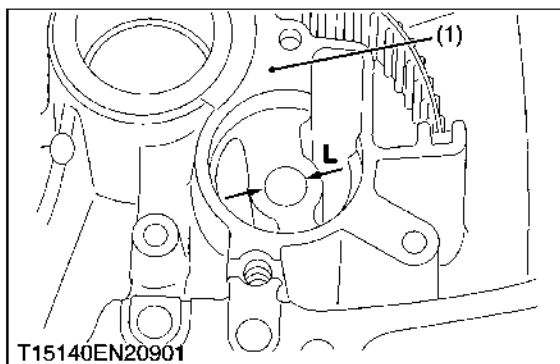
1. Measure the pump shaft O.D. (L) with a micrometer at several points.
2. If the diameter is less than the allowable limit, replace the pump shaft (1).

Pump shaft O.D.	Allowable limit	10.923 mm 0.4300 in.
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(1) Pump Shaft

L: Pump Shaft O.D.

W1035904

**Pump Shaft Bearing I.D.**

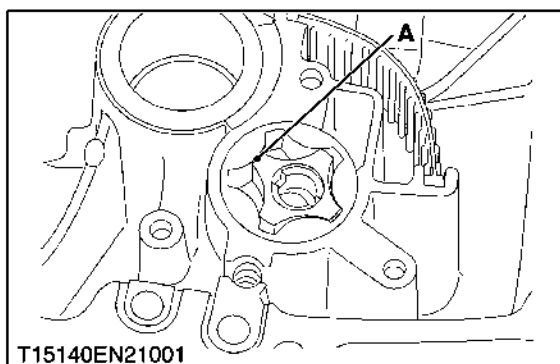
1. Measure the pump shaft bearing I.D. (L) in the crankcase cover with a inside micrometer at several points.
2. If the inside diameter is more than the service limit replace the crankcase cover (1).

Pump shaft bearing I.D. (L)	Allowable limit	11.072 mm 0.4359 in.
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(1) Crankcase Cover

L: Pump Shaft Bearing I.D.

W1035783

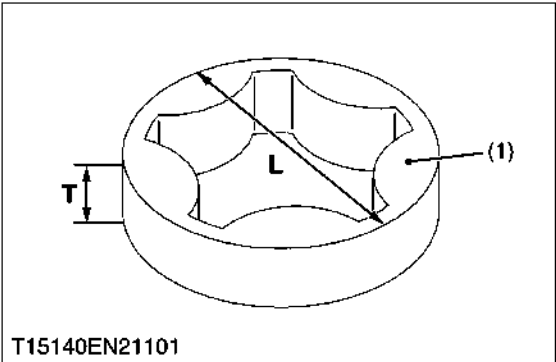
**Rotor Lobe Clearance**

1. Remove the oil pump (see Oil Pump, Relief Valve Removal).
2. Visually inspect the pump gear, outer and inner rotor, and cover plate.
3. If there is any damage or uneven wear, replace them.
4. Check the rotor lobe clearance (A) between the inner and outer rotor with a feeler gauge. Measure the clearance between the high point of the inner rotor and the high point of the outer rotor.
5. If the measurement exceeds the allowable limit, replace the rotors as a set.

Rotor lobe clearance (A)	Allowable limit	0.2 mm 0.008 in.
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A: Clearance

W1036025



Outer Rotor O.D. and Thickness

1. Measure the outer rotor O.D. (**L**) with a micrometer at several points.
2. If the rotor O.D. (**L**) is less than the allowable limit, replace both the inner and outer rotor.
3. Measure the outer rotor thickness (**T**) rotor with a micrometer at several points.
4. If the rotor thickness (**1**) less than the service limit, replace both the inner and outer rotor.

Outer rotor O.D. (L)	Allowable limit	40.470 mm 1.5933 in.
Outer rotor thickness (T)	Allowable limit	9.830 mm 0.3870 in.

(1) Outer Rotor

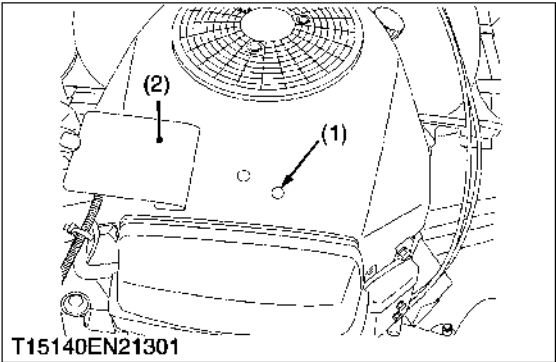
L : Outer Rotor O.D.
T : Outer Rotor Thickness

W1036154

[4] FUEL SYSTEM

(1) Checking and Adjusting

(A) Carburetor



Low Idle Speed Adjustment

1. Disconnect the possible external loads from the engine.
2. Start the engine and warm it up thoroughly.

⚠ WARNING

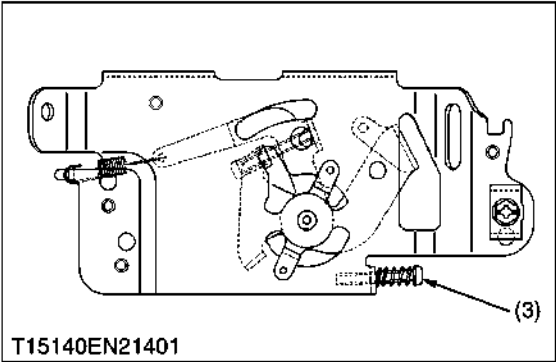
- **Always keep your hands clear of the moving parts.**
3. Move the throttle lever to the idle position, and hold the throttle lever on the carburetor in closed position (turn the governor arm clockwise all the way).
 4. Turn over the engine label and adjust the low idle speed screw (1) until the engine idles at specified speed.
 5. Release the throttle lever and adjust the low idle speed set screw (3) on the control plate to obtain the specified governed low idle speed.

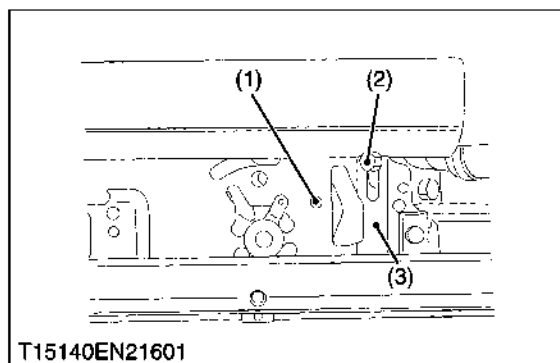
Low idle speed (governed idle rpm)	Factory spec.	1550 rpm
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(1) Idle Speed Screw
(2) Label

(3) Low Idle Speed Screw

W1036456





High Idle Speed Adjustment

■ NOTE

- High idle speed adjustment should be made after the idle speed adjustment is performed.



CAUTION

- Do not adjust high idle speed with the air cleaner removed.
1. Start and warm up the engine thoroughly.



WARNING

- Always keep your hands clear of the moving parts.
2. Move the throttle lever at a dash to the high idle position and match the lever hole position with the panel hole by inserting 6 mm dia., pin or bolt (1).
 3. Loosen two M6 control panel mounting bolts (2) enough to move the control panel assembly.
 4. Carefully move the control panel assembly right side (3) up or down to obtain the specified high idle speed.
 5. Tighten the M6 mounting bolts.
 6. Remove the 6 mm dia., pin or bolt.
 7. Check the idle speed, and readjust the idle speed if necessary.



CAUTION

- Be sure to make the idle and high idle speeds respectively correspond to those of the equipment.

(1) Bolt

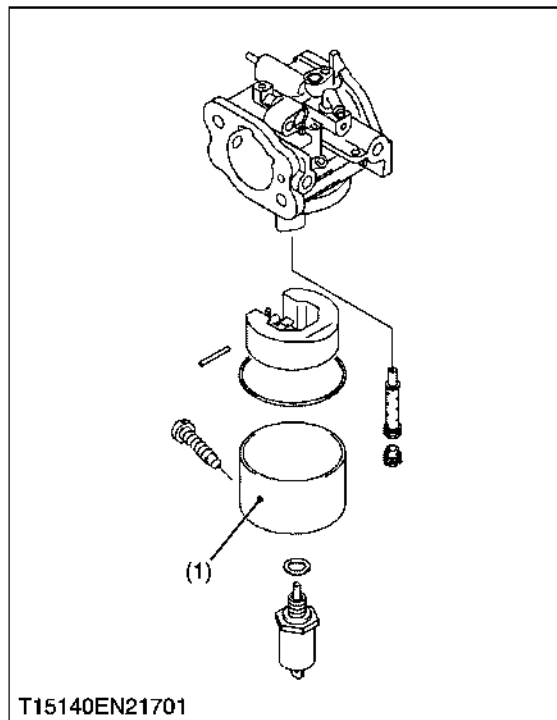
(2) Control Panel Mounting Bolts

(3) Control Panel Assembly Right Side

W1036961

(2) Servicing

(A) Carburetor



Cleaning Carburetor



WARNING

- Carburetor cleaners and solvents are extremely flammable. Keep sparks, flames, and other sources of ignition away from the area. Follow the cleaner manufacturer's warnings and instructions on its proper and safe use. Never use gasoline as a cleaning agent. All parts should be cleaned thoroughly using a carburetor cleaner (such as acetone). Make sure all gum deposits are removed from the following areas:
- Carburetor body and bore; especially the areas where the throttle plate, choke plate and shafts are seated.
- Idle fuel and idle ports in carburetor bore, main jet, bowl vent, and fuel inlet needle and seat.

■ **NOTE**

- These areas can be cleaned with a piece of fine wire in addition to cleaners. Be careful not to enlarge the ports, or break the wire inside the ports. Blow out all passages with compressed air.
1. Clean float and float hinge.
 2. Clean fuel bowl (1).

■ **NOTE**

- Do not submerge the carburetor in cleaner or solvent when fiber, rubber, or foam seals or gaskets are installed. The cleaner may damage these components.

(1) Fuel Bowl

W1037423

Inspecting Carburetor

Carefully inspect all components and replace those that are worn or damaged.

1. Inspect the carburetor body for cracks, holes, and other wear or damage.
2. Inspect the float for cracks, holes, and missing or damaged float tabs. Check the float hinge and shaft for wear or damage.
3. Inspect the fuel inlet needle and seat for wear or damage.
4. Inspect the tip of the low idle fuel adjusting needle for wear or grooves.
5. Inspect the throttle and choke shaft and plate assemblies for wear or excessive play.

W1037583

Fuel Shut-off Solenoid Valve Test

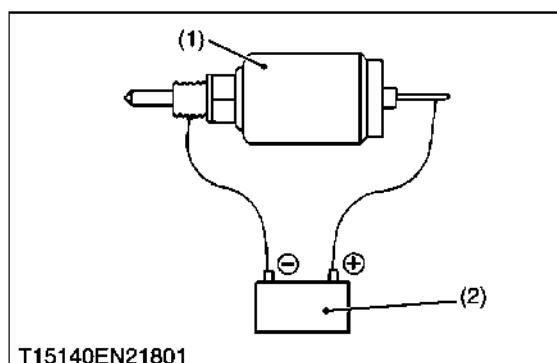
1. Unscrew the fuel shut-off valve (1) and remove the valve.
2. Connect a 12 VDC battery (2) to the solenoid as shown.
3. If the actuate solenoid plunger (needle valve) does not pop in when the test voltage is applied, replace it.

■ **NOTE**

- If may be necessary to push the plunger slightly for the plunger to withdraw.

(1) Fuel Shut-off Solenoid Valve

(2) 12 VDC Battery



W1037811

(3) High Altitude Compensation Kit

High Altitude Kit

1. At high altitude, the standard carburetor air-fuel mixture will be excessively rich. Performance will decrease, and fuel consumption will increase. High altitude performance can be improved by installing a smaller diameter main-jet in the carburetor and correct idle speed.

■ NOTE

- The main jet high altitude kits are available if the equipment is to be used in the high altitudes. The main jet numbers are stamped on ends of the main jets.
High altitude main jet is shown the table.

Altitude	Main Jet Parts No.	
	GH500V	GH531V
0 to 1000 m (0 to 3000 ft)	E7195-44261 JET, MAIN #106.3	E7196-44261 JET, MAIN #116.3
1000 to 2000 m (3000 to 6000 ft)	E7195-44401 JET, MAIN #103.8	E7196-44401 JET, MAIN #113.8
2000 m (6000 ft) and higher	E7195-44411 JET, MAIN #101.3	E7196-44411 JET, MAIN #111.3

W1037960

3 HYDROSTATIC TRANSAXLE

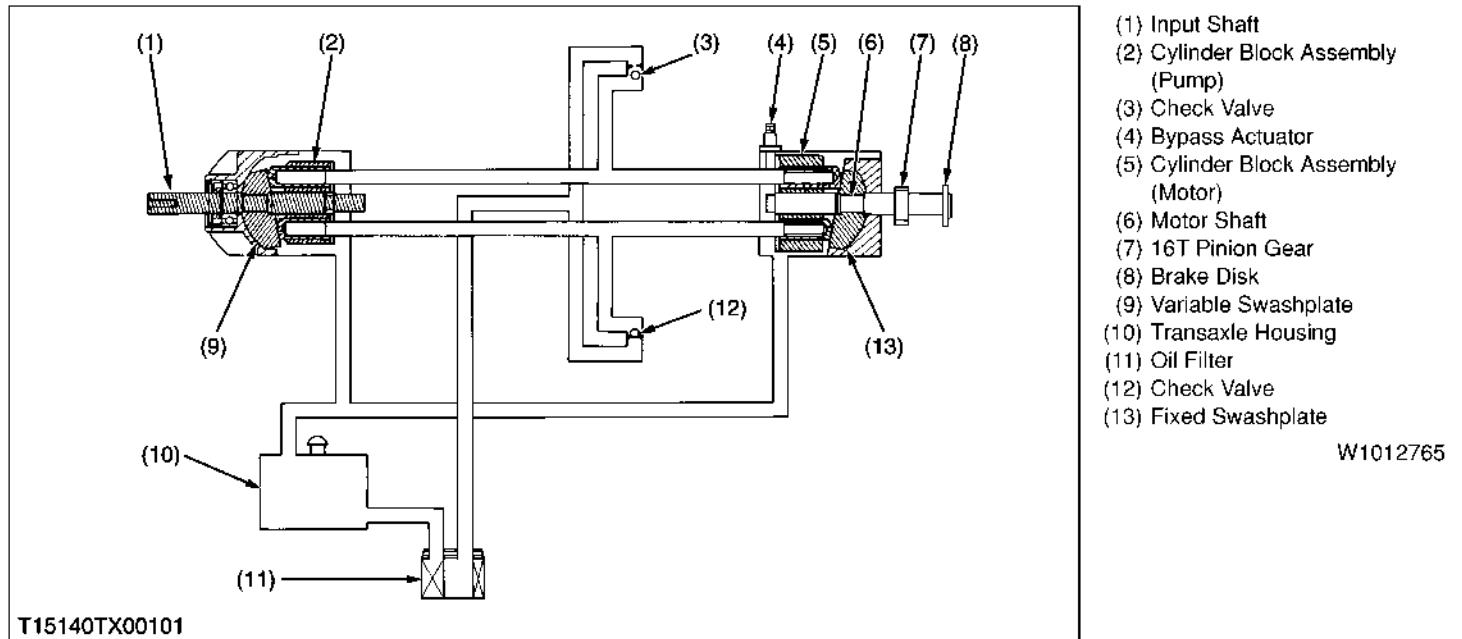
MECHANISM

CONTENTS

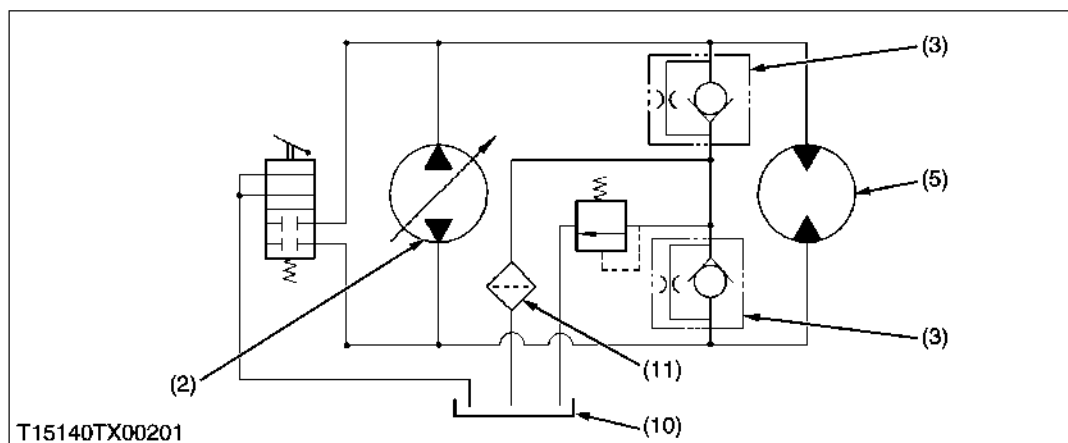
1. STRUCTURE	3-M1
[1] HYDROSTATIC TRANSAXLE	3-M1

1. STRUCTURE

[1] HYDROSTATIC TRANSAXLE



W1012765



The cylinder transaxle is a self-contained unit designed for the transfer and control of power.

It provides an infinitely variable speed range between zero and maximum in both forward and reverse modes of operation.

The hydrostatic transaxle uses a variable pump (2) with a maximum displacement of 10 cc (0.011 U.S. qts., 0.009 Imp.qts.) per revolution, and a motor (5) with a fixed displacement of 21 cc (0.022 U.S.qts., 0.018 Imp.qts.) per revolution. The variable displacement pump features a cradle swashplate (variable swashplate) (9) with a direct-proportional displacement control. Reversing the direction of tilt of the swashplate reverses the direction of the pump to the motor and thus reverses the direction of the motor output rotation. The fixed displacement motor uses a fixed swashplate (13). The pump and motor are of the axial piston design, and both utilize spherical nosed pistons which are held against a thrust race by internal compression springs.

The hydrostatic transaxle has a self-contained fluid supply and an integral filter. The fluid is forced through the oil filter (11).

Charge check valves (3), (12) in the center section are used to control the makeup flow of fluid to the low pressure side of the loop.

The hydrostatic transaxle is filled and tested at the factory and should not require fluid or filter changes unless the fluid becomes contaminated.

A cam style, block lifting bypass is utilized in the hydrostatic transaxle to permit moving the vehicle for short distance at a maximum of 3.22 km/h (2 mps, 2.00 mile/h) without starting the engine.

The hydrostatic transaxle includes an integral differential.

A "cam" style arm is utilized to actuate an in line floating multidisk parking brake.

**CAUTION**

- **Actuating the bypass will result in the loss of hydrostatic braking capacity. The machine must be stationary and on a level surface and in neutral when actuating the bypass.**

SERVICING

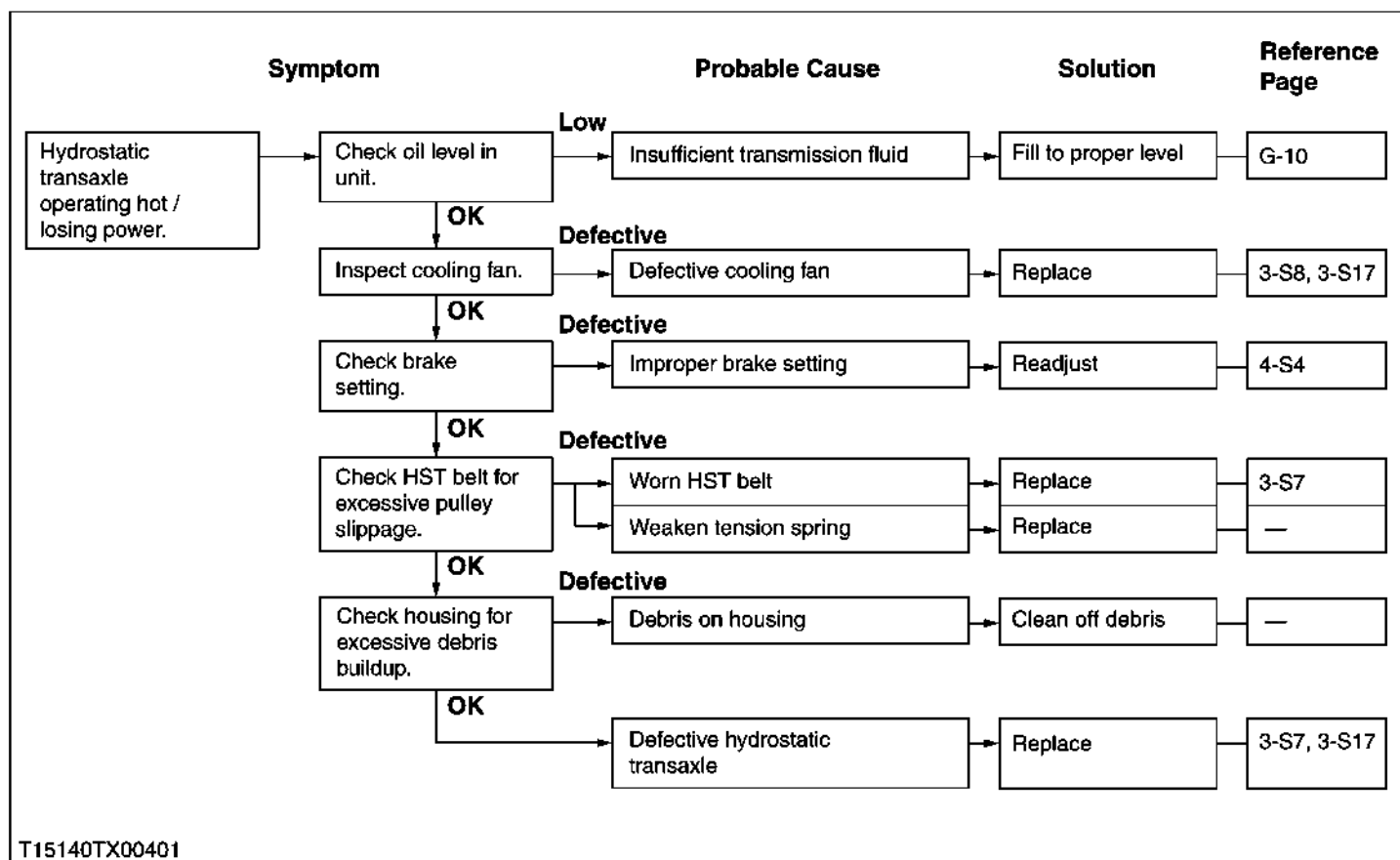
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1. TROUBLESHOOTING

[1] HYDROSTATIC TRANSMISSION

Symptom	Probable Cause	Solution	Reference Page
Hydrostatic transaxle will not operate in either direction.	Low Insufficient transmission fluid	Full transmission fluid to proper level	G-10
	Defective Defective control linkage	Repair or replace	—
	Defective Defective bevel gear case	Repair or replace	3-S9
	Defective Worn HST belt Weaken tension spring	Replace Replace	3-S7 —
	Defective Improper brake setting	Readjust	4-S4
	Defective hydrostatic transaxle	Replace	3-S7, 3-S17
	Low Insufficient transmission fluid	Full transmission fluid to proper level	G-10
Hydrostatic transaxle jerkey when starting.	Defective Defective control linkage	Repair or replace	—
	Defective Improper brake setting	Readjust	4-S4
	Defective hydrostatic transaxle	Replace	3-S7, 3-S17
	Low Insufficient transmission fluid	Full transmission fluid to proper level	G-10



2. SERVICING SPECIFICATIONS

Item	Factory Specification	Allowable Limit
Clearance between pedal stopper bolt (Forward) and speed change pedal pin (L ₁) (T1570, T1670)	9.5 mm 0.37 in.	—
Clearance between pedal stopper bolt (Reverse) and speed change pedal pin (L ₂) (T1570, T1670)	4.5 mm 0.18 in.	—
Clearance between pedal stopper bolt (forward) and speed change pedal pin (L ₁) (T1770, T1870)	8 mm 0.31 in.	—
Clearance between pedal stopper bolt (Reverse) and speed change pedal pin (L ₂) (T1770, T1870)	12 mm 0.47 in.	—

W1013874

3. TIGHTENING TORQUES

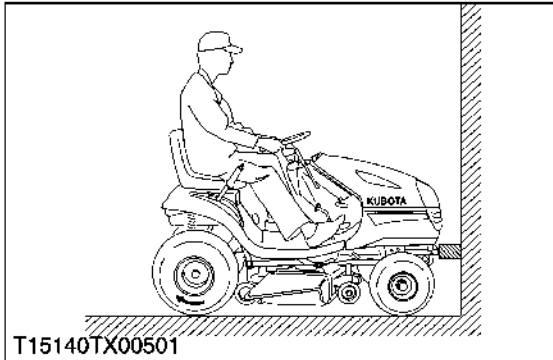
Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts : See page G-11.)

Item	N·m	kgf·m	ft-lbs
Center section assembly screw	59.3 to 79.1	6.1 to 8.1	43.8 to 58.3
Lower cover mounting screw	15.3 to 20.9	1.6 to 2.1	11.3 to 15.4
Differential side gear mounting nut	74.6 to 90.4	7.6 to 9.2	55.0 to 66.7
Housing mounting screw	22.6 to 29.4	2.3 to 3.0	16.7 to 21.7
Hub assembly retaining nut	271.2 to 400.0	27.7 to 40.8	200.0 to 295.0
Breather tube clamp	1.7 to 2.6	0.17 to 0.27	1.2 to 2.0
Speed change arm set screw	17.6 to 20.6	1.8 to 2.1	12.9 to 15.2
Cooling fan mounting screw	3.50	0.36	2.58
HST pulley mounting nut	40.7 to 58.4	4.2 to 6.0	30.0 to 43.1

W1012736

4. CHECKING, DISASSEMBLEING AND SERVICING (T1670, T1770 and T1870)

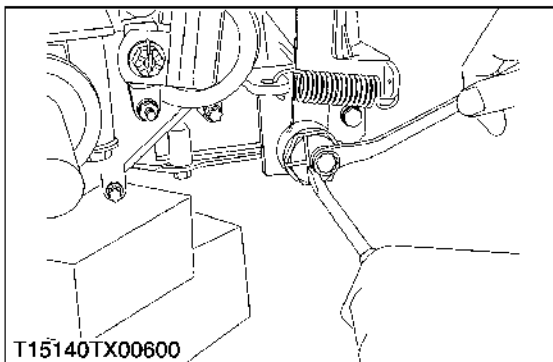
[1] CHECKING AND ADJUSTING



Checking Hydrostatic Transaxle

1. Bring the machine on the ground or on the grassland (not on the asphalt or concrete surface).
2. Attach a wooden piece to the bumper and touch the front of machine to the wall.
3. Start the engine and run it at the maximum speed.
4. Depress the speed change pedal forward, and check to see that rear wheel slip.
5. If rear wheels do not slip, replace the hydrostatic transaxle assembly.

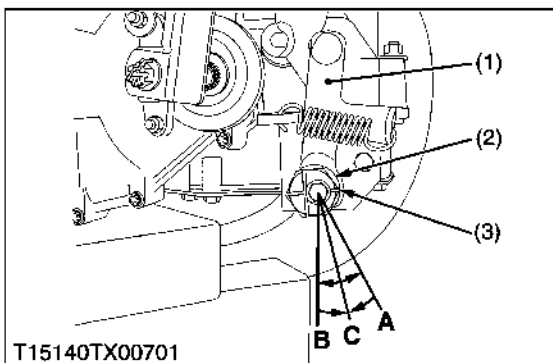
W1011187



Adjusting Neutral Position

1. Block the front wheels with stoppers, and lift up the rear of machine with a jack.
2. Remove the right rear wheel.
3. Start the engine, and set at approx. 1500 to 3000 min⁻¹ (1500 to 3000 rpm).
4. Slightly loosen the holder shaft mounting screw (3).
5. Rotate the holder shaft (2) counterblockwise 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)

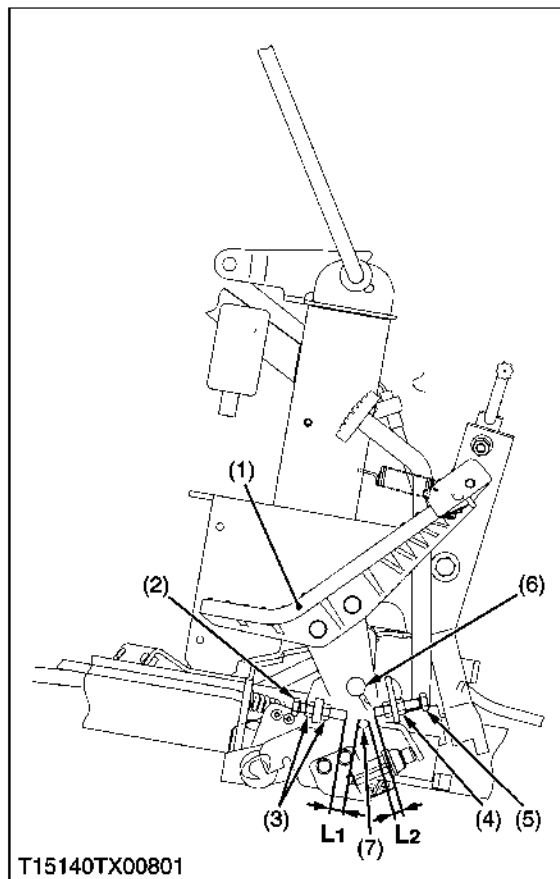


Tightening torque	Holder shaft mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
-------------------	-----------------------------	---

(1) Neutral Arm
(2) Holder Shaft

(3) Holder Shaft Mounting Screw

W1011272



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

(Reference)

T1570 · T1670

- Clearance "L1" (when the pedal is in neutral) : 9.5 mm
(0.37 in.)

T1770 · T1870

- Clearance "L1" (when the pedal is in neutral) : 8 mm
(0.31 in.)

(Reference)

T1570 · T1670

- Clearance "L2" (when the pedal is in neutral) : 4.5 mm
(0.18 in.)

T1770 · T1870

- Clearance "L2" (when the pedal is in neutral) : 12 mm
(0.47 in.)

(1) Speed Change Pedal

(2) Adjusting Screw

(3) Lock Nut

(4) Lock Nut

(5) Adjusting Screw

(6) Fulcrum

(7) Speed Change Pedal Pin

F : Forward

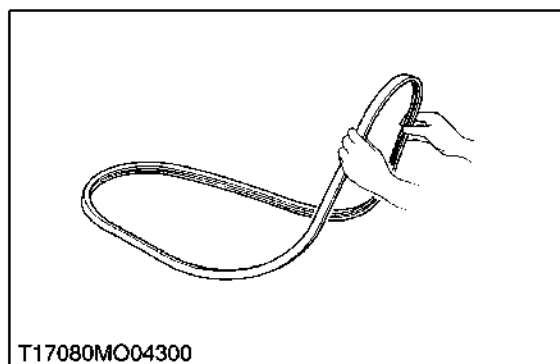
R : Reverse

W1011484

Checking HST Belt

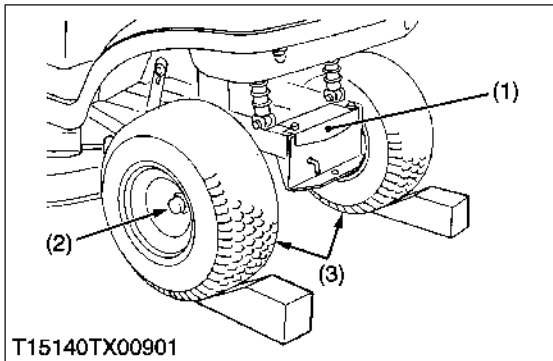
1. Check to see the HST belt.
2. Replace the HST belt with a new one, if there is found surface split at more than 3 positions.

W1012039



[2] DISASSEMBLING AND ASSEMBLING

(1) Separating Hydrostatic Transaxle



Rear Wheel and Rear Cover

1. Support the frame and hydrostatic transaxle.
2. Remove the rear wheel cap (2) and retainer ring.
3. Remove the rear wheels (3).
4. Remove the rear cover (1).

(When reassembling)

- Check the clearance between retainer ring and rear tire wheel.

■ NOTE

- Do not use any retainer ring that has already been used.
- (Reference)

Adjusting Washer (T1570)

Washer 2	3.25 mm	t = 0.128 in.
Washer 3	0.76 mm	t = 0.030 in.
Washer 4	2.26 mm	t = 0.089 in.

Adjusting Washer (T1670 · T1770 · T1870)

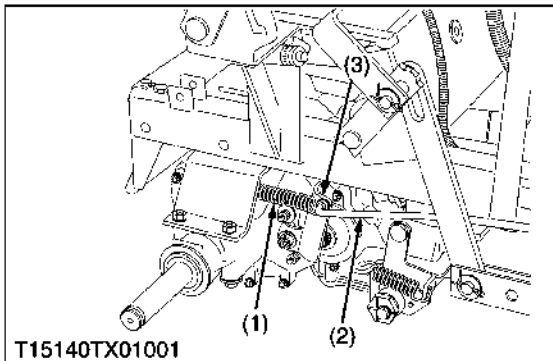
Washer 1	0.64 mm	t = 0.025 in.
Washer 2	1.22 mm	t = 0.048 in.
Washer 3	1.90 mm	t = 0.075 in.
Washer 4	2.95 mm	t = 0.116 in.

Clearance between retainer ring and tire wheel	Factory spec.	Less than 0.76 mm 0.030 in.
--	---------------	--------------------------------

- (1) Rear Cover
(2) Rear Wheel Cap

- (3) Rear Wheel

W1012131



Brake Plate

1. Remove the tension spring (1).
2. Pull out the cotter pins (3), and remove the brake rod (2).

(When reassembling)

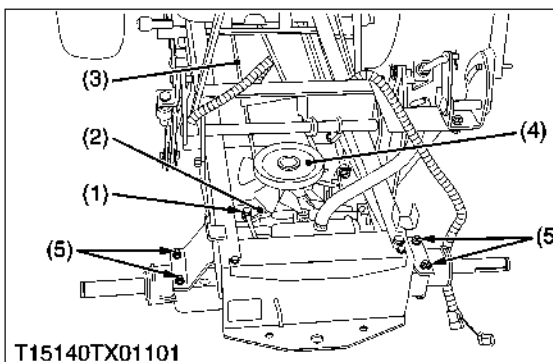
■ IMPORTANT

- After reassembling the brake plate, be sure to adjust the brake pedal play. (See page 4-S4)

- (1) Tension Spring
(2) Brake Rod

- (3) Cotter Pin

W1012426



Separating Hydrostatic Transaxle

1. Remove the HST belt (3) from the HST pulley (4).
2. Pull out the rule ring cotter (1), and remove the speed change plate (2).
3. Remove the hydrostatic transaxle mounting bolts (5).
4. Separate the hydrostatic transaxle.

(When reassembling)

■ IMPORTANT

- After reassembling hydrostatic transaxle, be sure to adjust the neutral. (See page 3-S5)

- (1) Rue Ring Cotter
(2) Speed Change Plate
(3) HST Belt

- (4) HST Pulley
(5) Hydrostatic Transaxle Mounting Bolt

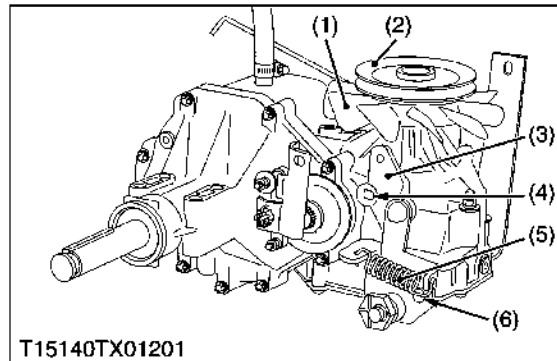
W1012553

(2) Disassembling Hydrostatic Transaxle

T1570 : Refer to WSM T1460, T1560 (97897-11741).

■ 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 at reassemble.



HST Pulley, Speed Change Arm and Neutral Arm Assembly

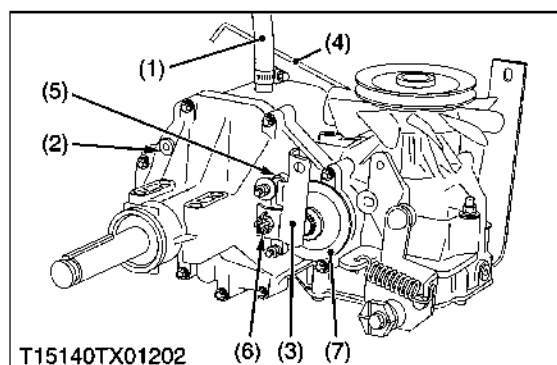
1. Remove the HST pulley (2) with the cooling fan (1) from the input shaft.
2. Remove the neutral spring (5).
3. Remove the speed change arm set screw (4).
4. Remove the speed change arm (3).
5. Remove the neutral arm holder mounting screw (6) and neutral arm assembly.

■ IMPORTANT

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

- | | |
|----------------------|---------------------------------------|
| (1) Cooling Fan | (4) Speed Change Arm Set Screw |
| (2) HST Pulley | (5) Neutral Spring |
| (3) Speed Change Arm | (6) Neutral Arm Holder Mounting Screw |

W1012803

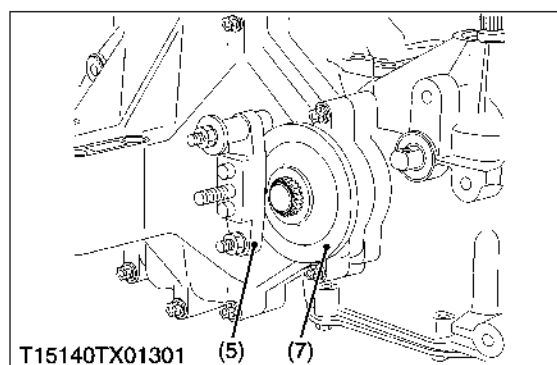


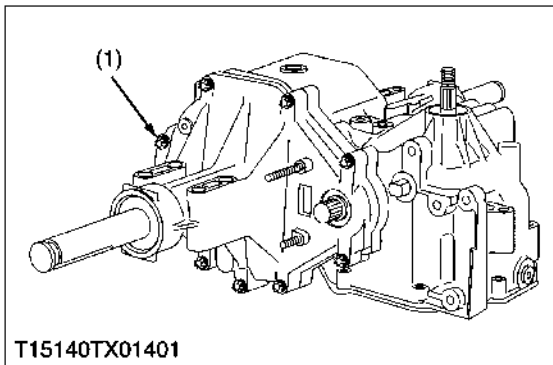
Brake Assembly and Draining the Transmission Fluid

1. Pull out the cotter pin, and remove the slotted nut (6) and brake arm (3).
2. Remove the brake holder (5) and brake pad.
3. Remove the brake disk (7).
4. Remove the brake pad from the housing.
5. Remove the external snap ring and bypass arm (4).
6. Drain the fluid by removing the breather tube (1) and oil plug (2), and positioning the hydrostatic transaxle so that the breather port is down to allow the fluid to drain thoroughly.

- | | |
|-------------------|------------------|
| (1) Breather Tube | (5) Brake Holder |
| (2) Oil Plug | (6) Slotted Nut |
| (3) Brake Arm | (7) Brake Disk |
| (4) Bypass Arm | |

W1012952





Separating Housing

1. Position and secure the hydrostatic transaxle to allow access to the housing mounting screws.
2. Using the appropriate tool (5/16" socket), remove the housing mounting screws (1).
3. Separate the two housing halves by applying pressure with two large straight blade screw drivers.



CAUTION

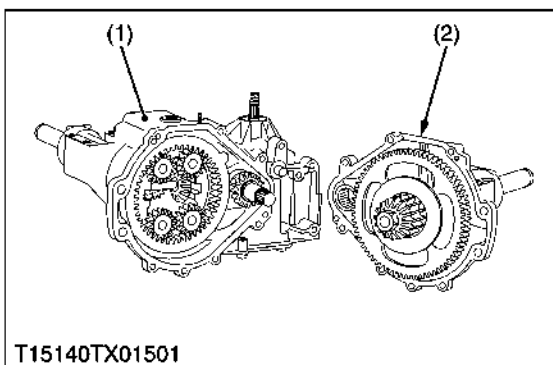
- Take care not to let the parts drop inside the housing when separating the housing.

NOTE

- The sealant will make the two halves difficult to separate. Use caution to prevent damage to the mating sealing surfaces as you separate the two halves.

(1) Housing Mounting Screw

W1013192



Axle Shaft (R.H.) Assembly

1. Remove the axle shaft (R.H.) assembly (2) assembly from hydrostatic transaxle assembly (1).
2. Remove the planetary gear thrust plate (9).
3. Remove the differential side gear (5), washer (4), sleeve bearing (3), 21T sun gear (10) and 67T spur gear (8).
4. Pull out the axle shaft (R.H.) (7).
5. Remove the oil seal and ball bearing.
6. Remove the seal and needle bearing (6).

(1) Hydrostatic Transaxle Assembly

(7) Axle Shaft (R.H.)

(2) Axle Shaft (R.H.) Assembly

(8) 67T Spur Gear

(3) Sleeve Bearing

(9) Planetary Gear Thrust Plate

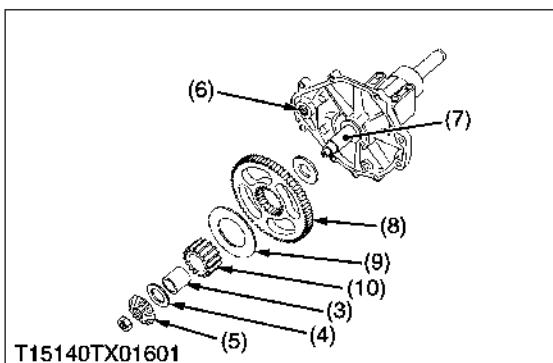
(4) Washer

(10) 21T Sun Gear

(5) Differential Side Gear

(6) Needle Bearing

W1013312



Differential Pinions and Planetary Gears

1. Remove the 15T planetary gears (4) and carrier pins (5).
2. Remove the differential shaft (1) with differential pinions (2).
3. Remove the planetary carrier (3) and 51T ring gear (6).

(1) Differential Shaft

(4) 15T Planetary Gear

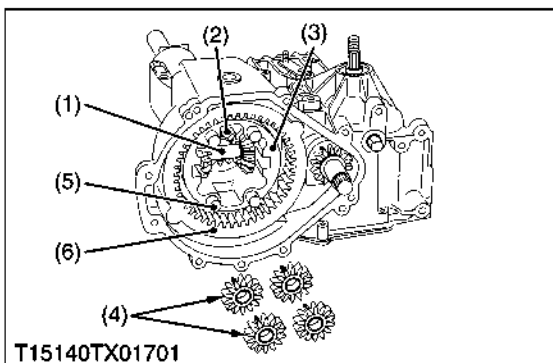
(2) Differential Pinion

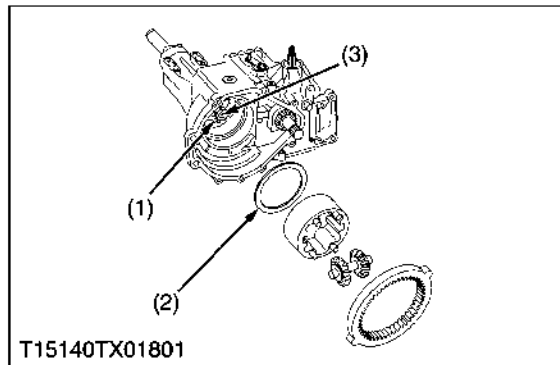
(5) Carrier Pin

(3) Planetary Carrier

(6) 51T Ring Gear

W1013582



**Axle Shaft (L.H.) Assembly**

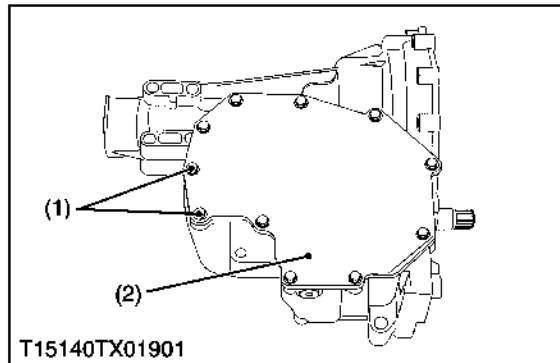
1. Remove the differential side gear (1), and differential thrust plate (2).
2. Pull out the axle shaft (L.H.) (3).
3. Remove the oil seal and ball bearing.

(1) Differential Side Gear

(3) Axle Shaft (L.H.) Assembly

(2) Differential Thrust Plate

W1013790

**Oil Filter, Lower Cover and Motor Shaft Assembly**

1. Using the appropriate tool (1/4" socket), remove the lower cover mounting screws (1).
2. Remove the lower cover (2).
3. Remove the oil filter (3) and charge manifold (4).
4. Remove the motor shaft assembly (5) from the center section.
5. Remove the external snap ring and 16T pinion gear (6).

(1) Lower Cover Mounting Screw

(4) Charge Manifold

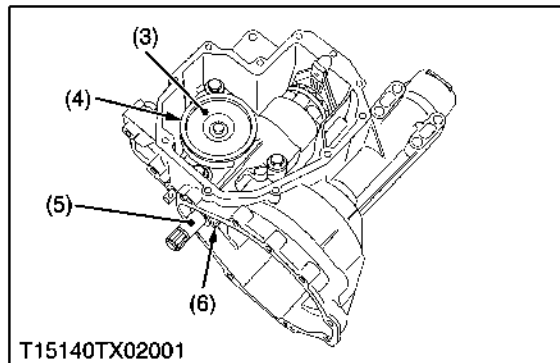
(2) Lower Cover

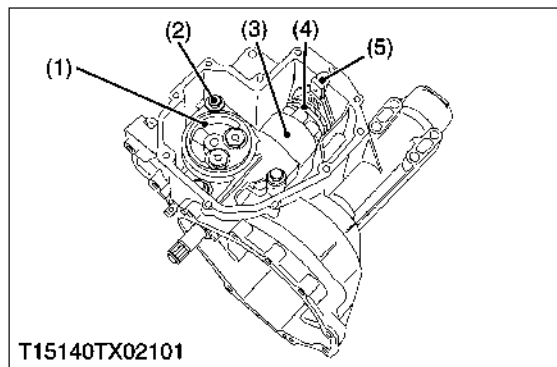
(5) Motor Shaft Assembly

(3) Oil Filter

(6) 16T Pinion Gear

W1013922





Motor Cylinder Block Assembly, Thrust Bearing and Center Section Assembly

CAUTION

- The motor piston springs may push the thrust bearing out of piston while you remove the motor cylinder block assembly and thrust bearing.

1. Remove the motor bearing retainer (5).
2. Remove the motor cylinder block assembly (3) and thrust bearing (4).
3. Remove the three assembly screws (2).
4. Remove the center section assembly (1).

IMPORTANT

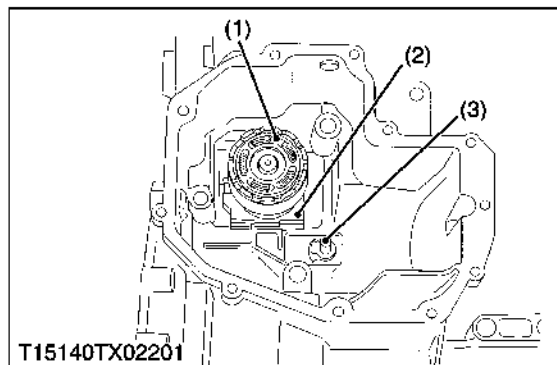
- The aligning the motor cylinder block and thrust bearing are not retained to the center section assembly or the main housing and may become separated from the assembly during removal.
- Once removed, the assembly bolts are not reusable.

NOTE

- The pump cylinder block assembly should remain in the main housing on the input shaft, but may stick to the center section assembly.

- | | |
|-----------------------------------|----------------------------|
| (1) Center Section Assembly | (4) Thrust Bearing |
| (2) Assembly Screw | (5) Motor Bearing Retainer |
| (3) Motor Cylinder Block Assembly | |

W1014069

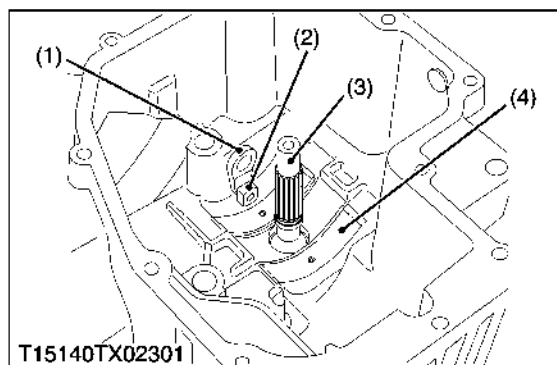


Pump Cylinder Block Assembly and Bypass Actuator

1. Remove the pump cylinder block assembly (1), block spring and block thrust washer.
2. Remove the thrust bearing and variable swashplate (2).
3. Remove the bypass actuator (3).

- | | |
|----------------------------------|---------------------|
| (1) Pump Cylinder Block Assembly | (3) Bypass Actuator |
| (2) Variable Swashplate | |

W1014451



Input Shaft Assembly and Trunnion Arm

1. Remove the cradle bearing (4).
2. Remove the slot guide (2) and trunnion arm (1).
3. Remove the internal snap ring, and tap out the input shaft (3).

IMPORTANT

- Care must be taken to avoid damage to housing bore, shaft sealing surface of bearing.

- | | |
|------------------|--------------------|
| (1) Trunnion Arm | (3) Input Shaft |
| (2) Slot Guide | (4) Cradle Bearing |

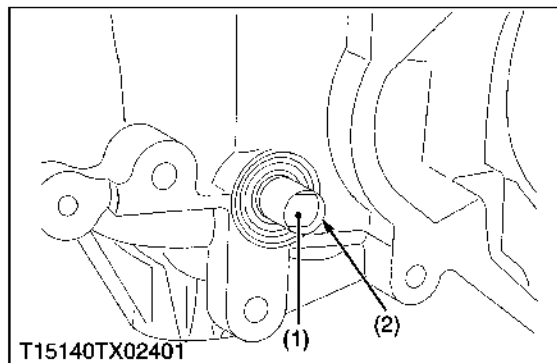
W1014587

(3) Assembling Hydrostatic Transaxle

T1570 : Refer to WSM T1460, T1560 (97897-11741).

■ IMPORTANT

- Most parts have critical high tolerance surface. Care must be exercised to prevent damage to these surface during assembly. Protect exposed surfaces, opening and ports from damage or foreign material.
- Replace all seals whenever a transaxle is disassembled.
- Lubricate the new seals with petroleum jelly before installation.
- After disassembly, wash all parts inside the housing with clean solvent and blow the parts dry with air.
- All Sealant material must be removed from the housing halves prior to assembly.
- Inspect all parts for damage, nicks or unusual wear patterns.
- Replace all parts having unusual, excessive wear or discoloration.
- The running surfaces of the cylinder blocks must be flat and free from scratches or wear are found on the running surface of the cylinder block or center section, replace the parts.
- Before mounting the hydrostatic transaxle to the vehicle, be sure to check the hydrostatic transaxle.



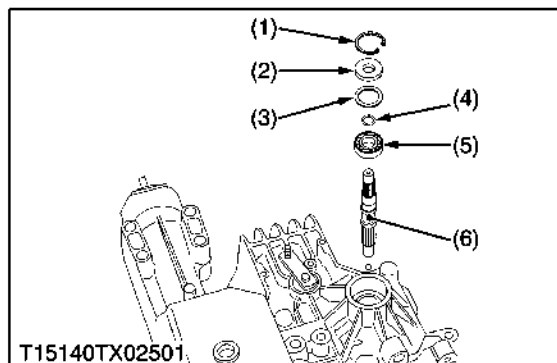
Trunnion Arm

1. Inspect the sealing surface, and metal bearing surface. Polish the sealing are as on the shaft if necessary.
2. Apply clean fluid to trunnion arm.
3. Install the trunnion arm.
4. Wrap the shaft with a thin plastic or cellophane tape to prevent damage to new seal lip during installation.
5. Slide the seal over the shaft and press it into the housing bore.

(1) Trunnion Arm

(2) Plastic Tape

W1014901



Input Shaft Assembly

1. Inspect the sealing surface, bearing surface and shaft splines. Polish the sealing are as on the shaft if necessary.
2. Inspect the ball bearing.
3. Apply clean fluid to input shaft (6) and ball bearing (5).
4. Install the ball bearing (5), wire retaining ring (4), spacer (3) and seal (2) onto the input shaft (6).
5. Install the input shaft assembly and internal snap ring (1).

(1) Internal Snap Ring

(4) Wire Retaining Ring

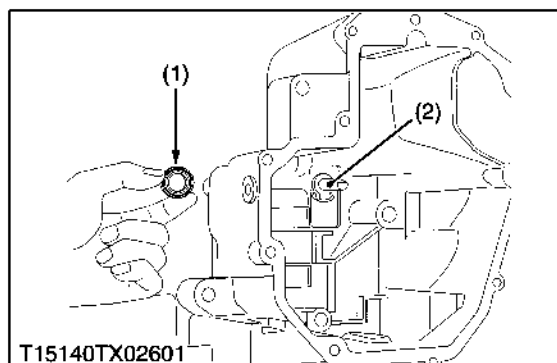
(2) Seal

(5) Ball Bearing

(3) Spacer

(6) Input Shaft

W1014986



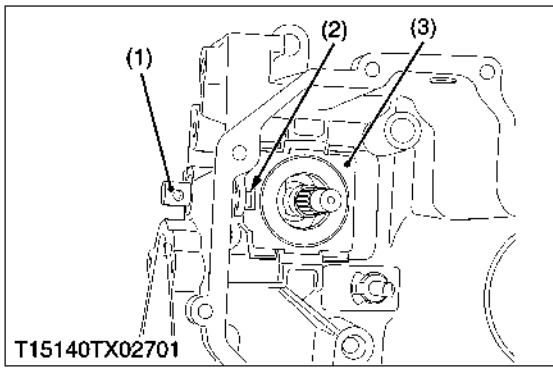
Bypass Actuator

1. Install the bypass actuator (2).
2. Slide the seal (1) over the bypass actuator and press it into the main housing bore.

(1) Seal

(2) Bypass Actuator

W1015130



Cradle Bearing and Variable Swashplate

1. Inspect the cradle bearings, variable swashplate and thrust bearing surface.
2. Apply clean fluid to cradle bearings and thrust bearing.
3. Install the cradle bearings.
4. Install the slot guide (2) onto the trunnion arm (1).
5. Install the variable swashplate (3), keeping the slot guide (2) from moving with a screwdriver.
6. Install the thrust bearing.

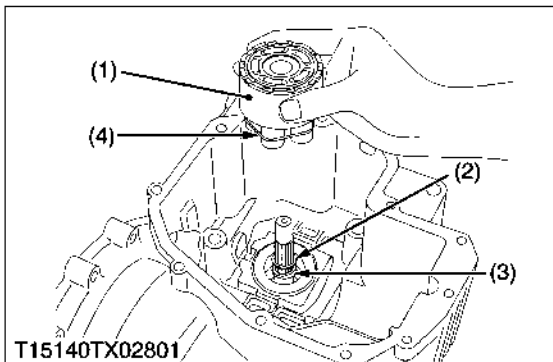
■ IMPORTANT

- **Thick race must be towards pistons.**

(1) Trunnion Arm
(2) Slot Guide

(3) Variable Swashplate

W1015282



Pump Cylinder Block Assembly

1. Visually inspect the pump cylinder block bore I.D. and piston O.D..
2. Inspect the block thrust washer, pump cylinder block and pistons.
3. Apply clean fluid to pump cylinder block and pistons.
4. Install the block thrust washer (3) and block spring (2) onto the input shaft.
5. With the variable swashplate in neutral (0 angle) position, and install the pump cylinder block assembly (1).
6. Make sure the splines engage properly.

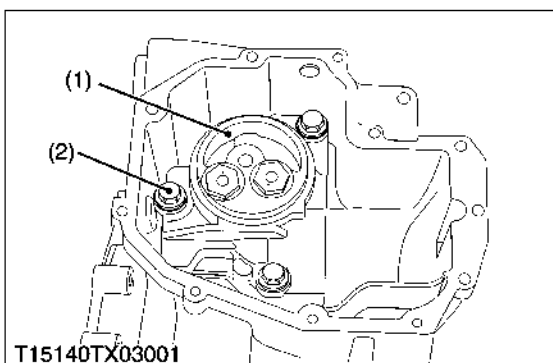
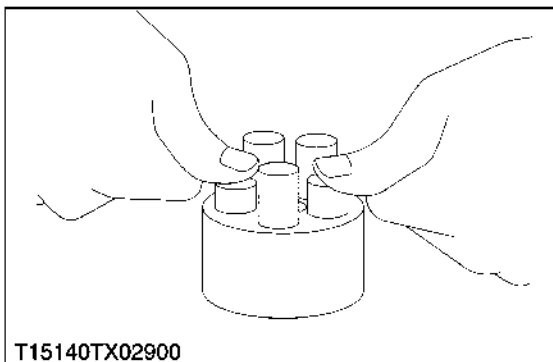
■ IMPORTANT

- **The pistons should fit with very little side clearance in the block bores, but must slide freely.**
- **To simplify the installation of the pump block assembly, wrap a rubber band snugly around the pistons. This is intended to hold the pistons in their bores as the block assembly is handled during installation.**

(1) Pump Cylinder Block Assembly
(2) Block Spring

(3) Block Thrust Washer
(4) Rubber Band

W1015489



Center Section Assembly

1. Inspect the center section assembly.
2. Apply clean fluid to the running surface.
3. Insert the new assembly screws (2) into the center section assembly (1) and press the center section assembly (1) down onto the aligning pins and the input shaft until seated on mounting bosses.
4. While holding the center section assembly (1) in position, tighten the assembly screws (2).
5. Put the key in the center section assembly.

■ IMPORTANT

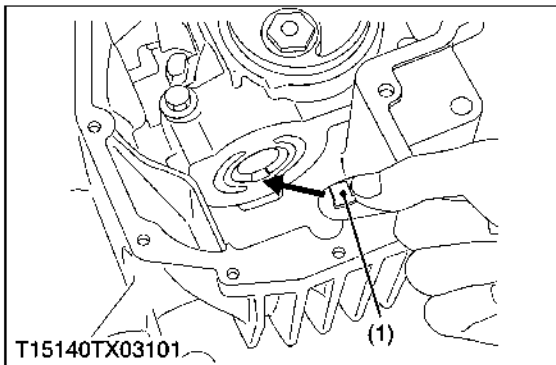
- **Replace the assembly screws with new ones.**

Tightening torque	Assembly screw	59.3 to 79.1 N·m 6.1 to 8.1 kgf·m 43.8 to 58.3 ft-lbs
-------------------	----------------	---

(1) Center Section Assembly

(2) Assembly Screw

W1015682



Motor Cylinder Block Assembly and Motor Thrust Bearing

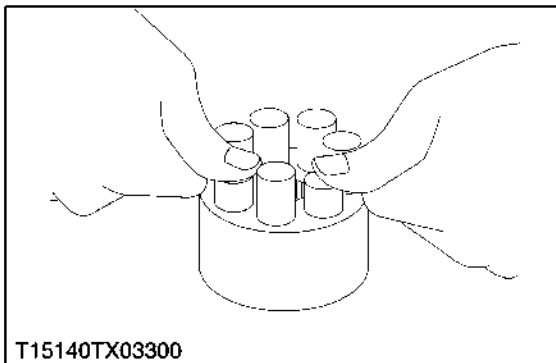
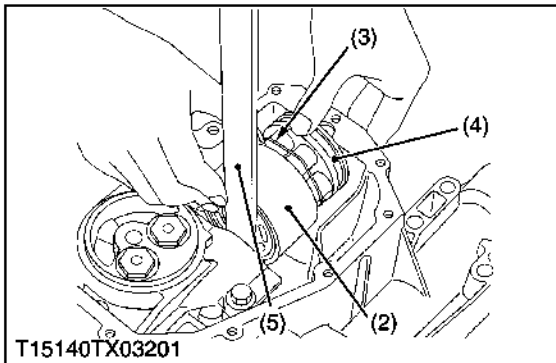
1. Put the key (1) in the center section.
2. Visually inspect the motor cylinder block bore I.D. and piston O.D..
3. Inspect the motor cylinder block, pistons and thrust bearing surface.
4. Apply clean fluid to the motor cylinder block, pistons and thrust bearing (2).
5. Install the motor cylinder block assembly (1) and the thrust bearing (2) by compressing the piston springs and sliding the thrust bearing into place with a steel scale.
6. Install the motor bearing retainer.

■ IMPORTANT

- The pistons should fit with very little side clearance in the block bores, but must slide freely.
- To simplify the installation of the pump block assembly, wrap a rubber band snugly around the pistons. This is intended to hold the pistons in their bores as the block assembly is handled during installation.
- Thick race must be towards pistons.

- | | |
|-----------------------------------|--------------------|
| (1) Key | (4) Thrust Bearing |
| (2) Motor Cylinder Block Assembly | (5) Steel Scale |
| (3) Rubber Band | |

W1015877

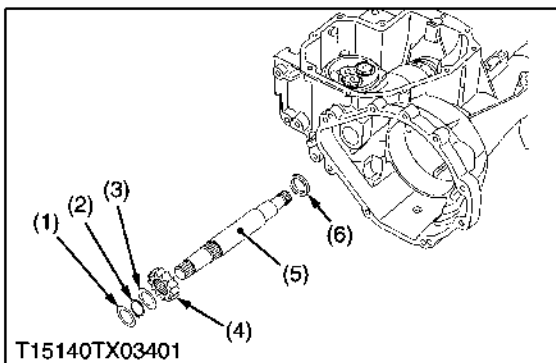


Motor Shaft Assembly

1. Apply clean fluid to motor shaft (5).
2. Install the spacer (6), 16T pinion gear (4), washer (3), external snap ring (2) and washer (1) into the motor shaft (5).
3. Install the motor shaft assembly into the center section.

- | | |
|------------------------|---------------------|
| (1) Washer | (4) 16T Pinion Gear |
| (2) External Snap Ring | (5) Motor Shaft |
| (3) Washer | (6) Spacer |

W1016124



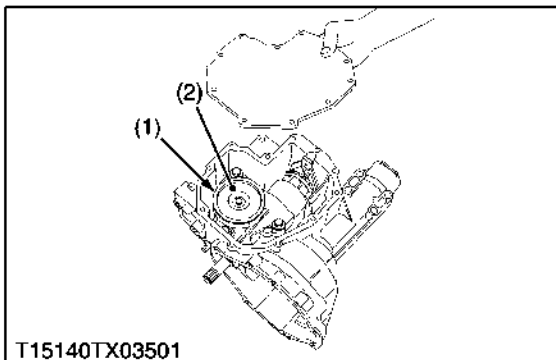
Oil Filter and Lower Cover

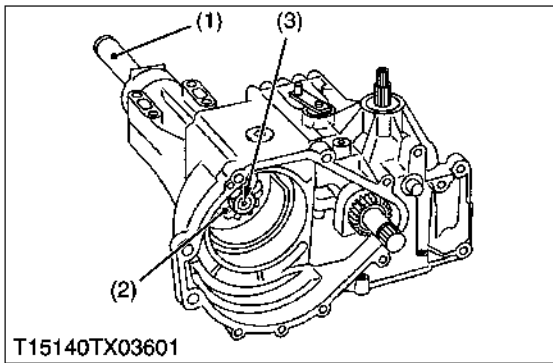
1. Inspect the oil filter and O-ring.
2. Install the charge manifold (2) and new oil filter (1).
3. Fit the new lower gasket with correct direction.
4. Tighten the lower cover mounting screws with even force on the diagonal line.

Tightening torque	Lower cover mounting screw	15.3 to 20.9 N·m 1.6 to 2.1 kgf·m 11.3 to 15.4 ft·lbs
-------------------	----------------------------	---

- | | |
|----------------|---------------------|
| (1) Oil Filter | (2) Charge Manifold |
|----------------|---------------------|

W1016263





Axle Shaft (L.H.) Assembly

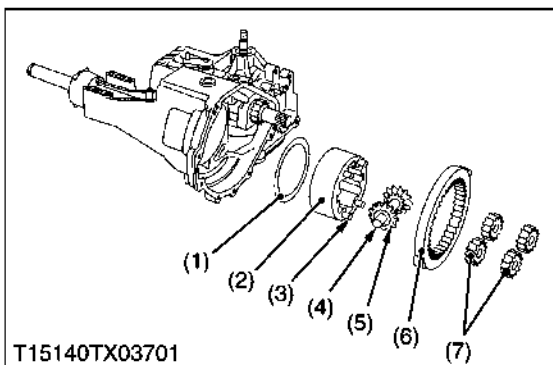
1. Reposition the main housing.
2. Inspect the ball bearing and flange bearing.
3. Inspect the sealing surface and bearing surface.
Polish the sealing area on the shaft if necessary.
4. Apply clean fluid to the bearings and axle shaft (L.H.).
5. Install the ball bearing, internal snap ring and oil seal into the main housing.
6. Insert the axle shaft (L.H.) (1).
7. Install the washer (4), differential side gear (5) and nut (6).

Tightening torque	Differential side gear mounting nut	74.6 to 90.4 N·m 7.6 to 9.2 kgf·m 55.0 to 66.7 ft-lbs
-------------------	-------------------------------------	---

- (1) Axle Shaft (L.H.)
(2) Differential Side Gear

(3) Nut

W1016401



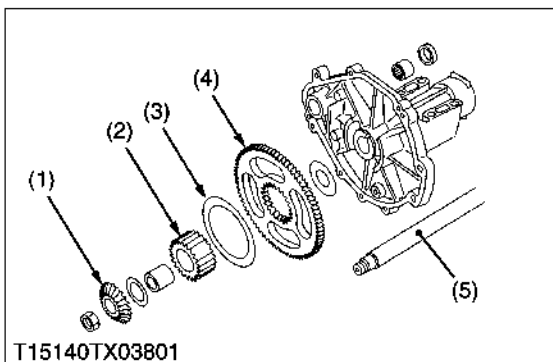
Differential Pinions and Planetary Shafts

1. Inspect the differential shaft, differential pinions and carrier pins.
2. Apply clean fluid to them.
3. Insert the 51T ring gear (6) to transmission case.
4. Insert the differential thrust plate (1) and planetary carrier (2).
5. Insert the differential shaft (4), differential pinions (5) and carrier pin (3).

- (1) Differential Thrust Plate
(2) Planetary Carrier
(3) Carrier Pin
(4) Differential Shaft

- (5) Differential Pinion
(6) 51T Ring Gear
(7) Planetary Gear

W1016767



Axle Shaft (R.H.) Assembly

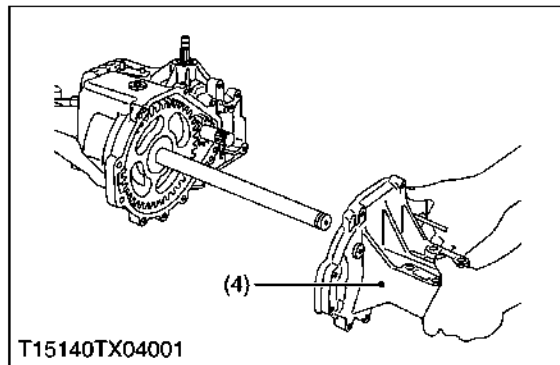
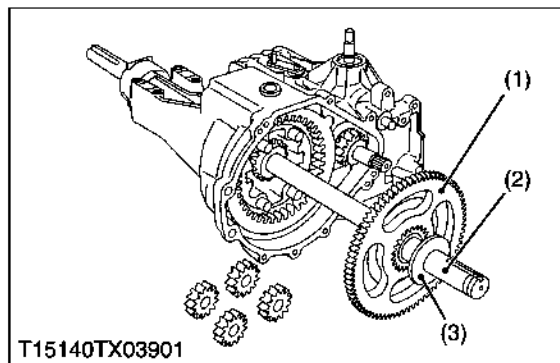
1. Inspect the sealing surface and bearing surface.
Polish the sealing area on the shaft if necessary.
2. Apply clean fluid to the axle shaft (R.H.) (5) and sleeve bearing.
3. Install 21T sun gear (2), washer (3), differential side gear (1) and nut onto the axle shaft (R.H.) (5).
4. Install the axle shaft (R.H.) assembly and 15T planetary gears .

Tightening torque	Differential side gear mounting nut	74.6 to 90.4 N·m 7.6 to 9.2 kgf·m 55.0 to 66.7 ft-lbs
-------------------	-------------------------------------	---

- (1) Differential Side Gear
(2) 21T Sun Gear
(3) Washer

- (4) 67T Spur Gear
(5) Axle Shaft (R.H.)

W1016907



Assembling Housing

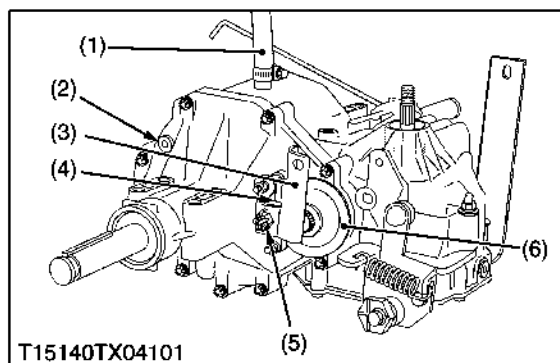
1. Inspect the ball bearing, needle bearing and flange bearing.
2. Install the planetary thrust plate, 67T spur gear (1) and washer (3) into the axle shaft (R.H.) (2).
3. Put the bond to the main housing.
4. Apply clean fluid to the ball bearing, flange bearing and needle bearing.
5. Install the ball bearing, internal snap ring and oil seal into the R.H. housing (3).
6. Install the needle bearing and seal into the R.H. housing (4).
7. Insert axle shaft (R.H.) into the R.H. housing assembly. Install ball bearing and oil seal, and fix the cir clip.
8. Tighten the housing mounting screws.
9. Install the bypass arm and external snap ring onto the bypass actuator.
10. Check the bypass actuator and axle shafts for freedom of movement.
11. The axle shafts should not lock up but may be tight, while the bypass actuator must rotate freely.

Tightening torque	Housing mounting screw	22.6 to 29.4 N·m 2.3 to 3.0 kgf·m 16.7 to 21.7 ft-lbs
	Hub assembly retaining nut	271.2 to 400.0 N·m 27.7 to 40.8 kgf·m 200.0 to 295.0 ft-lbs

- (1) 67T Spur Gear
(2) Axle Shaft (R.H.)

- (3) Washer
(4) R.H. Housing

W1017106



Brake Assembly and Breather Tube

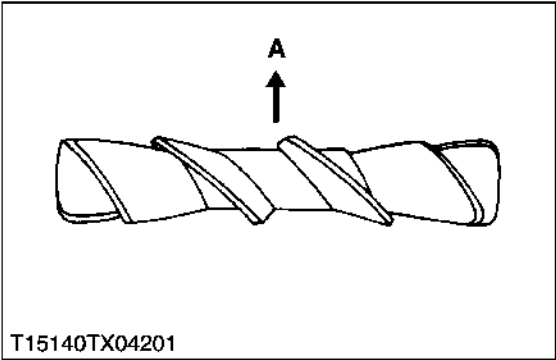
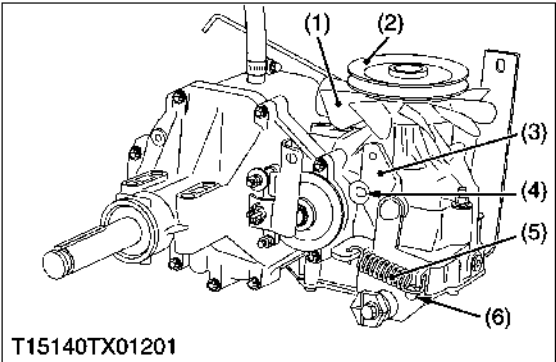
1. Insert the brake pad into the R.H. housing.
2. Insert the brake disk (6) into the motor shaft.
3. Insert the shim and brake pad into the brake holder (4).
4. Install the actuating pins, spring and brake arm (3).
5. Install the plain washer, slotted nut (5) and cotter pin.
6. Install the brake spring.
7. Install the breather tube (1) and oil plug (2).

Tightening torque	Breather tube clamp	1.7 to 2.6 N·m 0.17 to 0.27 kgf·m 1.2 to 2.0 ft-lbs
-------------------	---------------------	---

- (1) Breather Tube
(2) Oil Plug
(3) Brake Arm

- (4) Brake Holder
(5) Slotted Nut
(6) Brake Disk

W1017560



Neutral Arm, Speed Change Arm, HST Pulley and Cooling Fan

1. Inspect the cooling fan.
2. Install the neutral arm assembly (6).
3. Apply grease to the holder shaft.
4. Install the speed change arm (3) using a new set screw (4).
5. Install the neutral spring (5).
6. Apply molybdenum lubricants (Molytherm No.2 or equivalent) to the input shaft.
7. Install the cooling fan (1) and HST pulley (2).

■ IMPORTANT

- Replace the speed change arm set screw with a new one.
- When installing the cooling fan, take care of the vertical direction as shown in the figure.

Tightening torque	Speed change arm set screw	17.6 to 20.6 N·m 1.8 to 2.1 kgf·m 12.9 to 15.2 ft-lbs
	Cooling fan mounting screw	3.50 N·m 0.36 kgf·m 2.58 ft-lbs
	HST pulley mounting nut	40.7 to 58.4 N·m 4.2 to 6.0 kgf·m 30.0 to 43.1 ft-lbs

- (1) Cooling Fan

(2) HST Pulley

(3) Speed Change Arm

(4) Speed Change Arm Set Screw
- (5) Neutral Spring

(6) Neutral Arm Assembly

A : Upside

W1017746

(4) Checking Hydrostatic Transaxle

Checking Brake Operation

1. See to "BRAKE" section.

W1018144

Checking for Leaks

1. Prior to adding fluid to the hydrostatic transaxle, it is recommended that you check for leaks.
2. To locate a leak, apply a soap mixture around the housing seam and at all oil seals.
3. Apply a pressure with a small hand pump or by using compressed air, and check the hydrostatics transaxle for leaks.
4. If the air leaks from hydrostatics transaxle, repair and reassemble it.

■ IMPORTANT

- Do not allow more than 34 kPa (0.35 kgf/cm², 5 psi) to be applied or seal damage may occur.

W1018195

Start-Up Procedures

It is recommended that the unit should be purged prior to installing into the vehicle frame. The following is the suggested purging procedures for repaired transaxle.

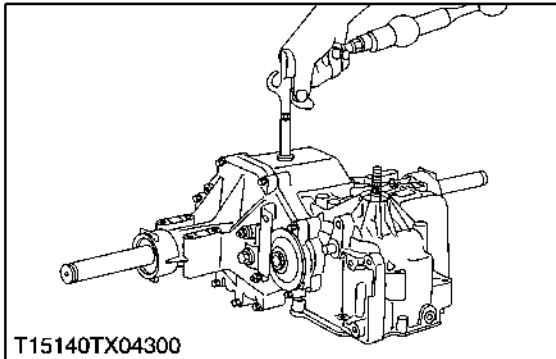
1. Fill the hydrostatic transaxle with a 20W-50 engine oil.
2. Spin the input shaft in a clockwise direction at 3000 to 3600 rpm. This may be performed in drill press (or equivalent).
3. Engage (actuate) the bypass.
4. Stroke the control lever (trunnion arm) forward for 5 seconds and then reverse for 5 seconds. Do this two times in each direction.
5. Return the control lever (trunnion arm) to neutral.
6. Disengage the bypass.
7. Stroke the control lever (trunnion arm) forward for 5 seconds and then reverse for 5 seconds. Do this two times in each direction.
8. Check the oil level after fully purging the unit of air.

■ NOTE

- It may be necessary to repeat these steps in the vehicle to fully purge the hydrostatic transaxle.

Transmission fluid (T1570)	Capacity	2.3 L 2.4 U.S.qts. 2.0 Imp.qts.
Transmission fluid (T1670, T1770, T1870)		3.6 L 3.8 U.S.qts. 3.2 Imp.qts.

W1018296



T15140TX04300

4 BRAKES

SERVICING

CONTENTS

1. TROUBLESHOOTING	4-S1
2. SERVICING SPECIFICATIONS	4-S2
3. TIGHTENING TORQUES	4-S3
4. CHECKING, DISASSEMBLING AND SERVICING.....	4-S4
[1] CHECKING AND ADJUSTING	4-S4
[2] DISASSEMBLING AND ASSEMBLING.....	4-S5

1. TROUBLESHOOTING

Symptom		Probable Cause	Solution	Reference Page	
Indufficient braking force	Is brake pedal play normal ?	NO	Excessive brake pedal play	Adjust	4-S4
		YES	Weaken or broken brake spring	Replace	4-S4, 4-S6
		Excessive brake disk clearance	Adjust	4-S4	
		Grease or oil on brake disk	Replace	4-S4	
Brake drags	Is brake pedal play normal ?	NO	Too small brake pedal play	Adjust	4-S4
		YES	Weaken or broken brake spring	Replace	4-S6
		Inadequate brake disk clearance	Adjust	4-S4	
Heavy brakes		Rusted brake pedal arm	Repair or replace	—	
		Rusted brake actuating arm	Repair or replace	—	

T15140BR00101

T15140BR00101

2. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
Brake Spring to Plain Washer	Clearance	1.0 to 2.0 mm 0.039 to 0.079	—
Brake Disk to Brake Pad	Clearance	0.76 mm 0.030 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-11.)

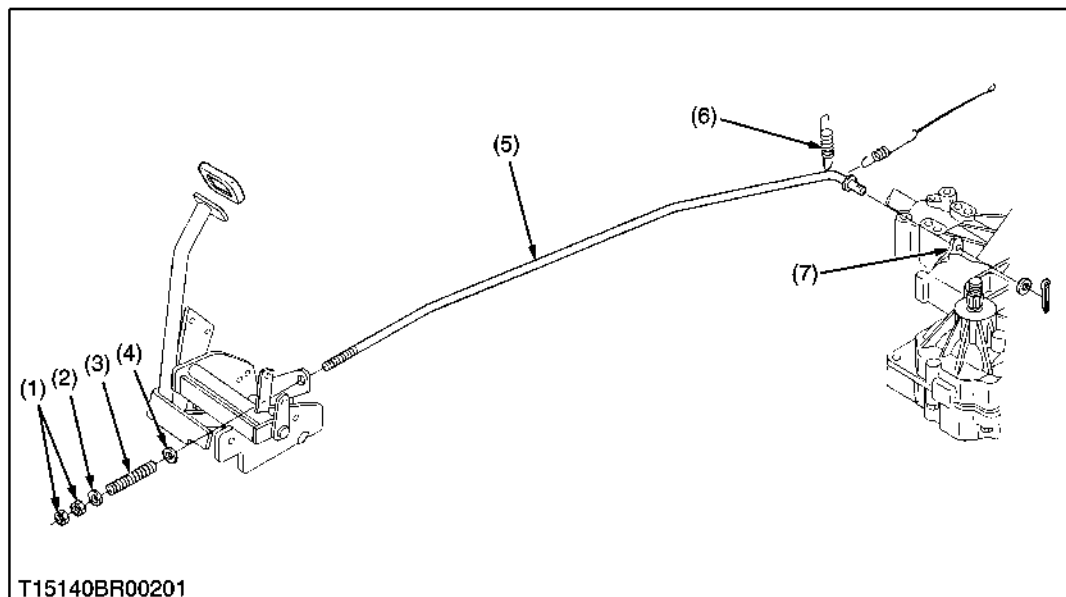
Item	N·m	kgf·m	ft-lbs
Parking lock pedal mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Brake lock mounting bolt	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Speed change rod mounting nut	28.6 to 31.2	2.9 to 3.2	21.1 to 23.0
Brake pedal assembly mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3

W1010769

4. CHECKING, DISASSEMBLING AND SERVICING

[1] CHECKING AND ADJUSTING

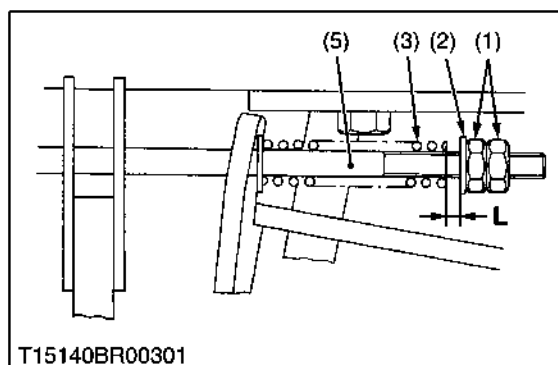
Brake Pedal Play



- (1) Nut
- (2) Plain Washer
- (3) Brake Spring
- (4) Plain Washer
- (5) Brake Rod
- (6) Brake Return Spring
- (7) Brake Actuating Arm

L: Clearance between brake spring and plane washer

W1011497



1. Remove the rear cover, and then remove the brake return spring (6).
2. Keep the brake pedal in return position.
3. Measure the clearance (L) between the brake spring (3) and plain washer (2) while turning the brake actuating arm (7) clockwise all the way.
4. If the measurement is not within the factory specifications, adjust with the nut (1).

Clearance (L) between brake spring and plain washer	Factory spec.	1.0 to 2.0 mm 0.039 to 0.079 in.
---	---------------	-------------------------------------

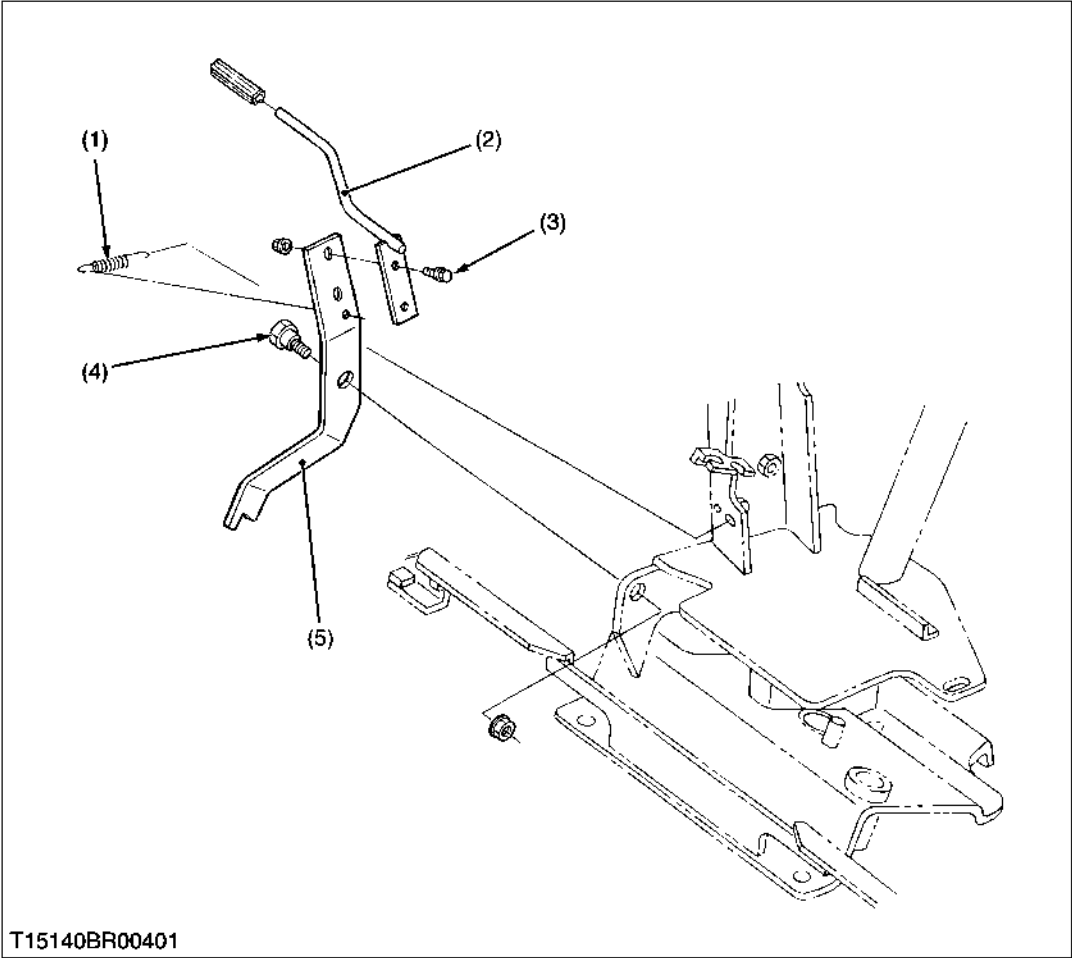
(Reference)

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

W1010868

[2] DISASSEMBLING AND ASSEMBLING

Parking Brake System



- (1) Parking Lock Spring
- (2) Parking Lock Pedal
- (3) Parking Lock Pedal Mounting Screw
- (4) Brake Lock Mounting Bolt
- (5) Brake Lock
- W1012114

T15140BR00401

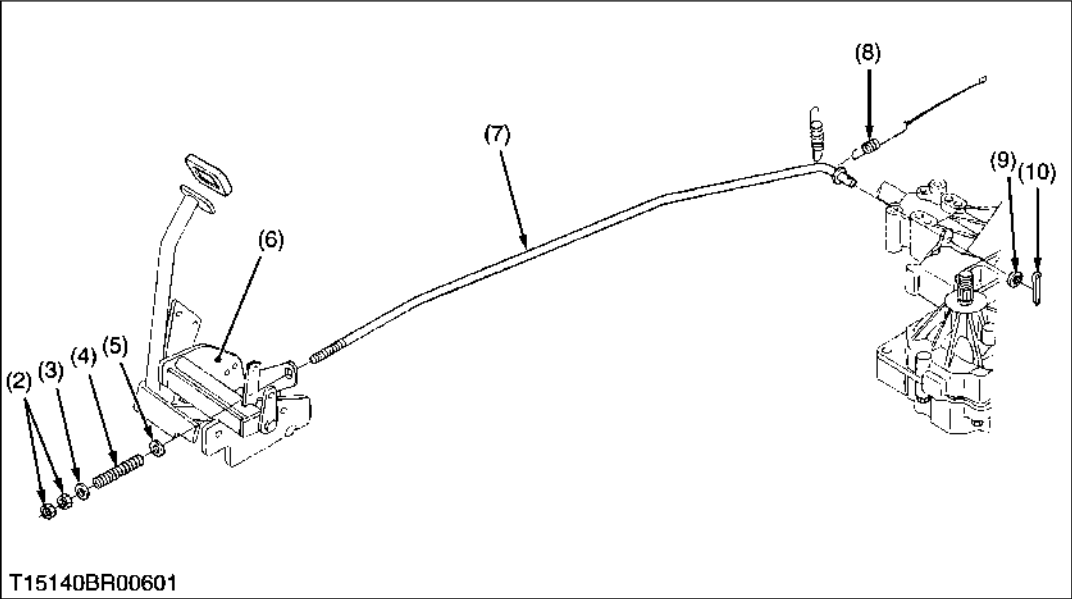
1. Open the upper bonnet.
2. Unscrew the parking lock pedal mounting screws (3), and remove the parking lock pedal (2).
3. Remove the parking lock spring (1).
4. Unscrew the brake lock mounting bolt (4), and remove the brake lock (5).

(When reassembling)

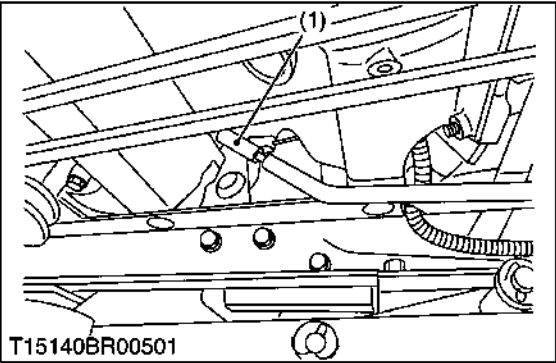
Tightening torque	Parking lock pedal mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
	Brake lock mounting bolt	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs

W1014161

Brake Pedal Assembly



- (1) Speed Change Rod
(2) Nut
(3) Plain Washer
(4) Brake Spring
(5) Plain Washer
(6) Brake Pedal Assembly
(7) Brake Rod
(8) Brake Return Spring
(9) Plain Washer
(10) Cotter Pin
- W1012650



1. Remove the speed change pedal.
2. Disconnect the 4P connector from the brake switch.
3. Remove the speed change rod (1) from the speed change pedal.
4. Unscrew the nuts (2), and remove the brake spring (4) and plain washers (3), (5).
5. Remove the rear cover, and then remove the brake return spring (8).
6. Pull out the cotter pin (10), and remove the brake rod (7).
7. Unscrew the brake pedal assembly mounting screws, and remove the brake pedal assembly (6).

- (When reassembling)
- Apply grease to the fulcrum of the brake pedal arm.
- IMPORTANT
- After assembling the brake rod, be sure to adjust the brake pedal play. (See page 4-S4.)
 - After assembling the speed change rod, be sure to adjust the length of rod.

Tightening torque	Speed change rod mounting nut	28.6 to 31.2 N·m 2.9 to 3.2 kgf·m 21.1 to 23.0 ft-lbs
	Brake pedal assembly mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs

W1014339

Brake Assembly

1. See to “HYDROSTATIC TRANSAXLE” section.

W1014796

5 FRONT AXLE

SERVICING

CONTENTS

1. TROUBLESHOOTING	5-S1
2. SERVICING SPECIFICATIONS	5-S2
3. TIGHTENING TORQUES	5-S3
4. CHECKING, DISASSEMBLING AND SERVICING.....	5-S4
[1] CHECKING AND ADJUSTING	5-S4
[2] DISASSEMBLING AND ASSEMBLING.....	5-S4
(1) Separating Front Axle Assembly.....	5-S4
(2) Disassembling Front Axle	5-S5

1. TROUBLESHOOTING

Symptom		Probable Cause	Solution	Reference Page
Front wheels wander to right or left.	Is toe-in normal ?	NO	Adjust	5-S4
	YES	Improper toe-in adjustment	Adjust	5-S4
		Uneven tire pressure	Adjust	G-17
		Worn kingpin	Replace front axle assembly	5-S5
		Loosen locking nut	Tighten	5-S5
Front wheels shimmy	Is toe-in normal ?	NO	Adjust	5-S4
	YES	Improper toe-in adjustment	Adjust	5-S4
		Worn center pin	Replace	5-S5
		Worn kingpin	Replace front axle assembly	5-S5
		Loosen or worn steering linkage	Tighten or replace	5-S5

T15140FA00101

T15140FA00101

2. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
Front Wheel Alignment	Toe-in	0 to 10 mm 0 to 0.394 in.	—

W1013874

3. TIGHTENING TORQUES

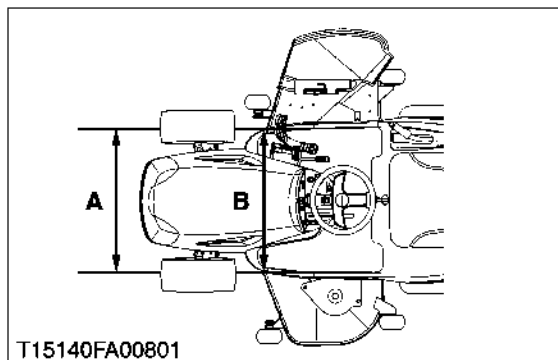
Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts : See page G-11.)

Item	N·m	kgf·m	ft-lbs
Rod end mounting nut	108.5 to 130.2	11.1 to 13.3	80.0 to 96.0
Locking nut	78.4 to 88.2	8.0 to 9.0	57.9 to 65.1
Tie-rod mounting locking 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.
--------------	---------------	------------------------------

■ **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

[2] DISASSEMBLING AND ASSEMBLING

(1) Separating Front Axle Assembly

Dismount Mower

1. See to "MOWER" section.

W1013639

Bonnet

1. Unscrew four knob screws (3), and remove the lower bonnet (4).
2. Disconnect four 1P connectors (2) from the head lights.
3. Remove the upper bonnet (1) with the bracket.

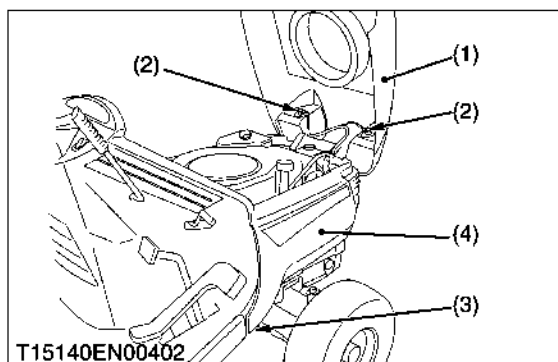
(1) Upper Bonnet

(3) Knob Screw

(2) 1P Connector

(4) Lower Bonnet

W1013841



Muffler Cover, Front Bumper and Muffler

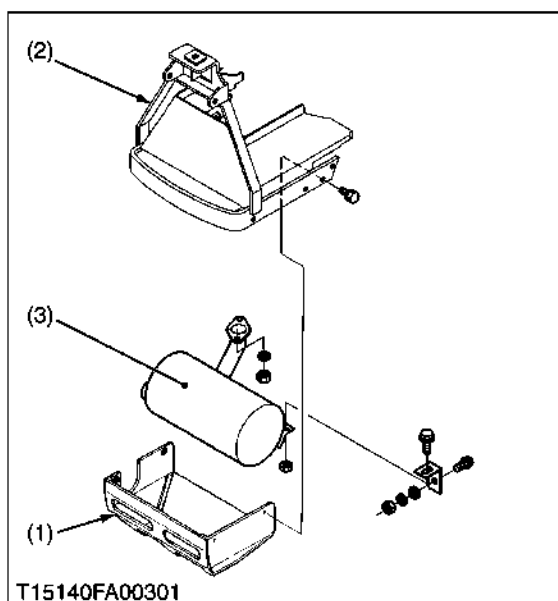
1. Unscrew the muffler cover mounting screws, and remove the muffler cover (1).
2. Unscrews the front bumper mounting screws, and remove the front bumper (2).
3. Unscrews the muffler mounting nuts, and remove the muffler (3).

Tightening torque	Muffler cover mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
	Front bumper mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
	Muffler mounting nut	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs

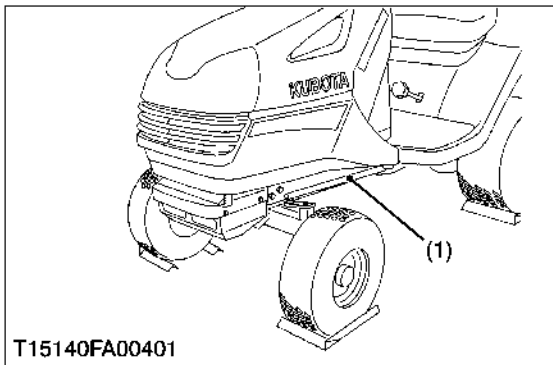
(1) Muffler Cover

(3) Muffler

(2) Front Bumper



W1014027



Separating front Axle Assembly

1. Support the frame with jacks.
2. Unscrew the drag link mounting nut, and remove the drag link (1).
3. Unscrew the locking nut (5).
4. Pull out the bolt (2), and separate the front axle assembly from the frame.
5. Pull out the center pin collar (3) from the front axle.

(When reassembling)

- Apply molybdenum lubricants (Molytherm No.2 or equivalent) to the center pin collar (3).
- Replace the drag link mounting nut with a new one.
- Replace the drag link mounting nut with a new one.
- Replace the locking nut with a new one, and tighten it to the specified torque.

■ NOTE

- Do not use any locking nut that has once been used.

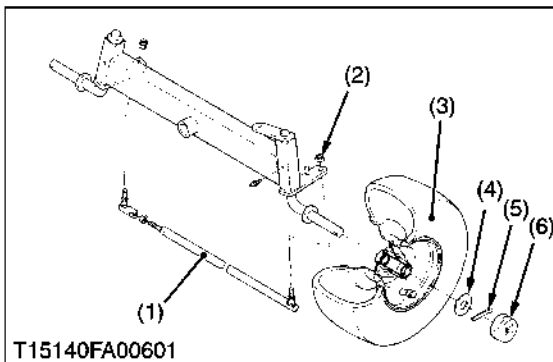
Tightening torque	Drag link mounting nut	74.8 to 81.3 N·m 7.6 to 8.3 kgf·m 55.2 to 60.0 ft·lbs
	Locking nut	49.9 to 54.2 N·m 5.1 to 5.5 kgf·m 36.8 to 40.0 ft·lbs

- (1) Drag Link
(2) Bolt
(3) Center Pin Collar

- (4) Plain Washer
(5) Locking Nut

W1014281

(2) Disassembling Front Axle



Front Wheel and Tie-rod

1. Remove the front wheel cap (6).
2. Pull out the cotter pins (5), and remove the front wheels (3).
3. Unscrews the tie-rod mounting nuts (2), and remove the tie-rod (1).

(When reassembling)

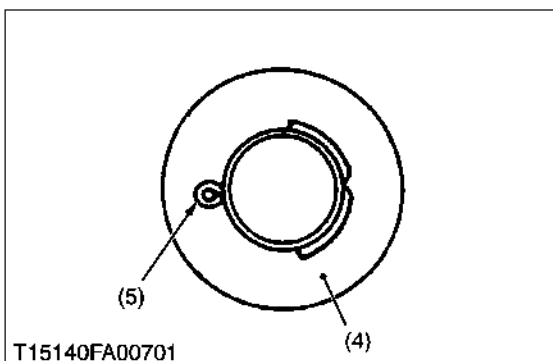
- Inject grease into the kingpin until it comes out.
- Replace the tie-rod mounting nut (2) with a new one.
- After installing the cotter pin (5), bend it as shown in the rod (1).

Tightening torque	Tie-rod mounting nut	49.9 to 54.2 N·m 5.1 to 5.5 kgf·m 36.8 to 40.0 ft·lbs
	Locking nut (Tie-rod)	49.9 to 54.2 N·m 5.1 to 5.5 kgf·m 36.8 to 40.0 ft·lbs

- (1) Tie-rod
(2) Tie-rod Mounting Nut
(3) Front Wheel

- (4) Flat Washer
(5) Cotter Pin
(6) Front Wheel Cap

W1015021



6 STEERING

SERVICING

CONTENTS

1. TROUBLESHOOTING	6-S1
2. SERVICING SPECIFICATIONS	6-S2
3. TIGHTENING TORQUES	6-S3
4. CHECKING, DISASSEMBLING AND SERVICING.....	6-S4
[1] CHECKING	6-S4
[2] DISASSEMBLING AND ASSEMBLING.....	6-S4
[3] SERVICING	6-S6

1. TROUBLESHOOTING

Symptom	Probable Cause	Solution	Reference Page
Cannot steer	Broken steering shaft and sector gear.	Replace	6-S6
	Broken steering linkage.	Replace	—
Hard steering.	Stuck steering shaft and sector gear.	Replace	6-S6
	Stuck bearing.	Replace	—
	Improper front alignment.	Adjust	5-S4
	Insufficient tire pressure.	Inflate	G-17

T15140ST00101

2. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
Steering Wheel	Play	20 to 30 mm 0.79 to 1.18 in.	50 mm 1.97 in.

W1013874

3. TIGHTENING TORQUES

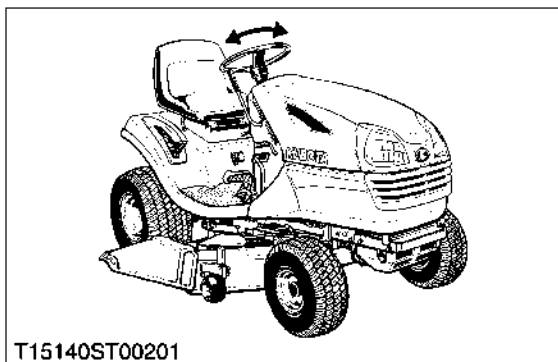
Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts : See page G-11.)

Item	N·m	kgf·m	ft-lbs
PTO clutch lever mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Parking lock pedal mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Steering wheel nut	20.0 to 25.0	2.0 to 2.5	14.8 to 18.5
Panel mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Steering support mounting screw	48.1 to 55.9	4.9 to 5.7	35.5 to 41.2
Drag link mounting nut	74.8 to 81.3	7.6 to 8.3	55.2 to 60.0
Shaft retainer mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Sector gear mounting screw	48.1 to 55.9	4.9 to 5.7	35.5 to 41.2

W1012161

4. CHECKING, DISASSEMBLING AND SERVICING

[1] CHECKING



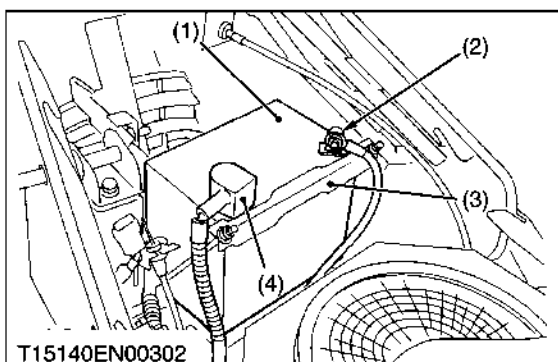
Steering Wheel Play

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 allowable limit, replace the steering shaft and sector gear.

Steering wheel play	Factory spec.	20 to 30 mm 0.79 to 1.18 in.
	Allowable limit	50 mm 1.97 in.

W1017981

[2] DISASSEMBLING AND ASSEMBLING



Battery



CAUTION

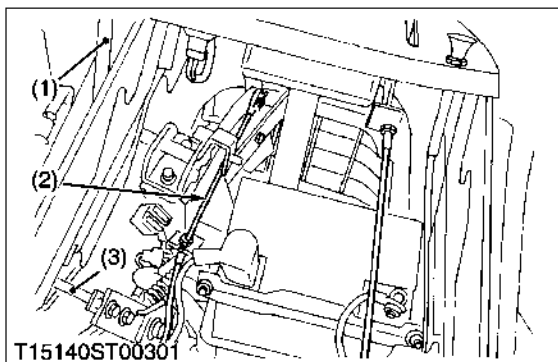
- When disconnecting the battery cables, disconnect the negative cable from the battery first. When connecting, connect the positive cable to the battery first.

1. Turn the main switch off, and open the upper bonnet.
2. Disconnect the negative cable (2) from the battery.
3. Disconnect the positive cable (4) from the battery.
4. Remove the battery retainer (3), and then dismount the battery (1) from the frame.

- (1) Battery
(2) Negative Cable

- (3) Battery Retainer
(4) Positive Cable

W1018091



PTO Clutch Lever and Parking Lock Pedal

1. Remove the grip of PTO clutch lever.
2. Pull out the cotter pin, and remove the PTO clutch wire (2).
3. Unscrew the PTO clutch lever mounting screws, and remove the PTO clutch lever (1).
4. Unscrew the parking lock pedal mounting screws, and remove the parking lock pedal (3).

(When reassembling)

- Apply oil to the PTO clutch wire.

■ IMPORTANT

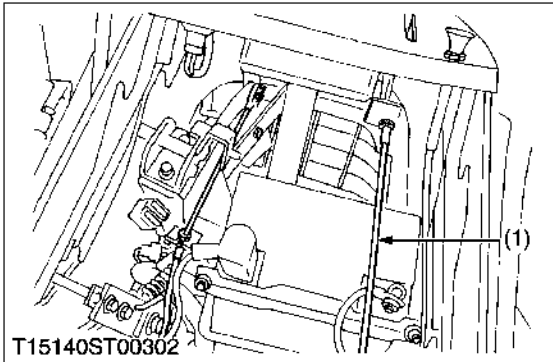
- After assembling the PTO clutch wire, be sure to adjust the PTO belt tension. (See page 8-S4.)

Tightening torque	PTO clutch lever mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
	Parking lock pedal mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs

- (1) PTO Clutch Lever
(2) PTO Clutch Wire

- (3) Parking Lock Pedal

W1018235



Throttle Cable Wiring

1. Remove the lower bonnet.
2. Disconnect the 5P connector from the main switch.
3. Disconnect two 1P connectors from the light switch.
4. Remove the grip of throttle lever.
5. Loosen the retaining screw, and remove the throttle cable (1) from the control plate.

(When reassembling)

■ IMPORTANT

- After assembling the throttle cable, be sure to adjust the cable.

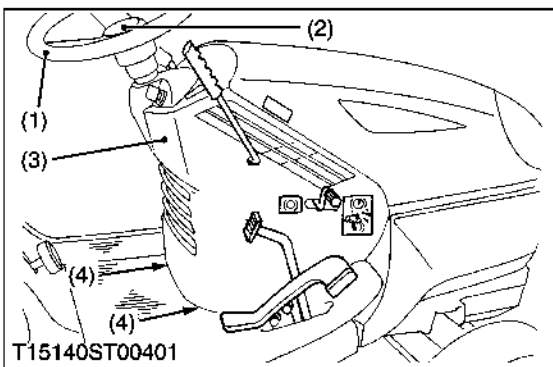
(1) Throttle Cable

W1018432

Fender

1. See page 7-S6, 7-S7.

W1018576



Steering Wheel and Panel

1. Remove the steering pad (2).
2. Unscrew the steering wheel mounting nut, and remove the steering wheel (1).
3. Unscrew the panel mounting screws (4), and remove the panel (3).

(When reassembling)

Tightening torque	Panel mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft·lbs
	Steering wheel nut	20.0 to 25.0 N·m 2.0 to 2.5 kgf·m 14.8 to 18.5 ft·lbs

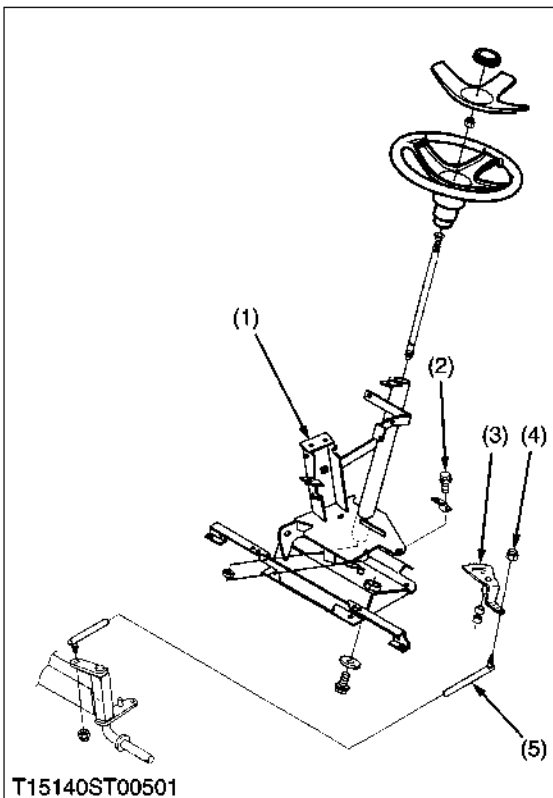
(1) Steering Wheel

(3) Panel

(2) Steering Pad

(4) Panel Mounting Screw

W1018761



Steering Support

1. Remove the fuse from the steering support.
2. Disconnect the 3P connector from the regulator.
3. Disconnect the 5P connector from the engine stop relay.
4. Disconnect the 4P connector from the PTO switch.
5. Remove the wiring harness from the steering support.
6. Unscrew the drag link mounting nut (4), and remove the drag link (5).
7. Remove the parking lock spring and brake lock.
8. Unscrew the steering support mounting screws (2), and remove the steering support (1).

(When reassembling)

- Replace the drag link mounting nut with a new one.

Tightening torque	Steering support mounting screw	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 ft·lbs
	Drag link mounting nut	74.8 to 81.3 N·m 7.64 to 8.30 kgf·m 55.2 to 60.0 ft·lbs

(1) Steering Support

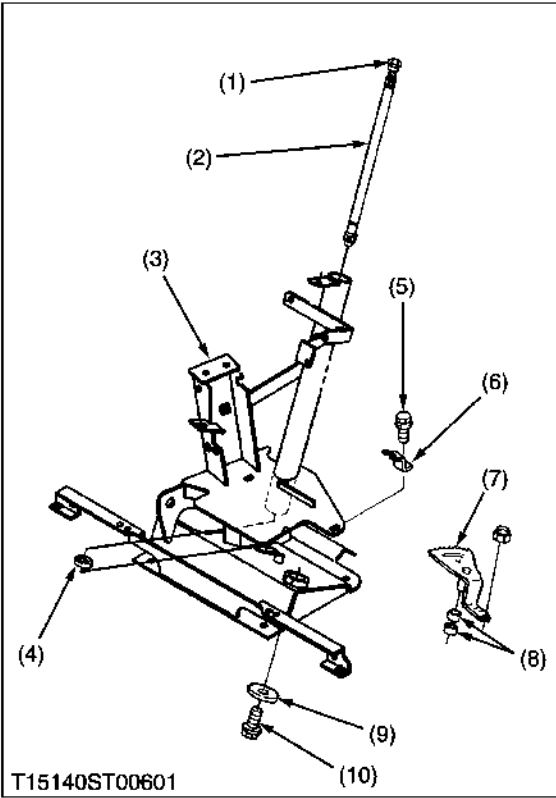
(4) Drag Link Mounting Nut

(2) Steering Support Mounting Screw

(5) Drag Link

(3) Sector Gear

W1019015



Steering Shaft and Sector Gear

1. Unscrew the shaft retainer mounting screw (5), and remove the shaft retainer (6).
2. Unscrew the sector gear mounting screw (10), and remove the sector gear (7).
3. Remove the post bushing (1) and bearing (4), and pull out the steering shaft (2).

(When reassembling)

- Apply to grease to the sector gear teeth.
- Apply to grease to the gear teeth of steering shaft.
- Apply to grease to the steering support bushing (8).
- Apply to grease to the bearing (4).
- Apply to grease to the post bushing (1).

Tightening torque	Shaft retainer mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft·lbs
	Sector gear mounting screw	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 ft·lbs

- (1) Post Bushing

(2) Steering Shaft

(3) Steering Support

(4) Bearing

(5) Shaft Retainer Mounting Screw
- (6) Shaft Retainer

(7) Sector Gear

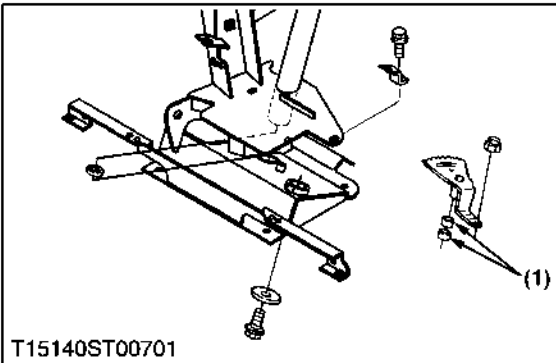
(8) Steering Support Bushing

(9) Plain Washer

(10) Sector Gear Mounting Screw

W1019259

[3] SERVICING



Steering Support Bushing Wear

1. Visually inspect the steering support bushing (1) for signs of wear or damage.
2. If defect are found, replace it.

- (1) Steering Support Bushing

W1019747

7 FENDER AND LIFT SYSTEM

SERVICING

CONTENTS

1. TROUBLESHOOTING	7-S1
2. SERVICING SPECIFICATIONS	7-S2
3. TIGHTENING TORQUES	7-S3
4. CHECKING, DISASSEMBLING AND SERVICING.....	7-S4
[1] CHECKING AND ADJUSTING	7-S4
[2] DISASSEMBLING AND ASSEMBLING.....	7-S6
(1) Separating Fender	7-S6
(2) Lift Linkage.....	7-S8
(3) Lift Lever	7-S8

1. TROUBLESHOOTING

Symptom	Probable Cause	Solution	Reference Page
Hard lifting	Gas spring defective	Replace	7-S8
	Stuck lift link	Repair	—
Operator will experience bottoming and / or topping of seat suspension.	Suspension defective	Replace	7-S4

T15140FE00101

2. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
Link 1 to Collar	Clearance	2.0 to 4.0 mm 0.08 to 0.16 in.	—

W1013874

3. TIGHTENING TORQUES

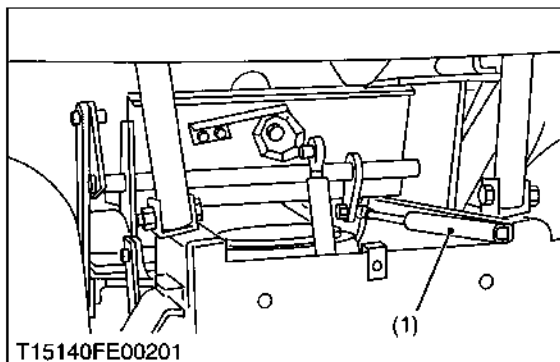
Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts : See page G-11.)

Item	N·m	kgf·m	ft-lbs
Lock nut (Seat support)	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Cam mounting nut	39.2 to 45.1	4.0 to 4.6	28.9 to 33.3
Step support mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Suspension mounting nut and bolt	48.1 to 55.9	4.9 to 5.7	35.4 to 41.2
Pipe mounting bolt	48.1 to 55.9	4.9 to 5.7	35.4 to 41.2
Fuel tank mounting nut and screw	13.5 to 20.3	1.4 to 2.1	10.0 to 15.0
Gas spring mounting nut	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Lift lever mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3

W1012736

4. CHECKING, DISASSEMBLING AND SERVICING

[1] CHECKING AND ADJUSTING



Inspecting Gas Spring

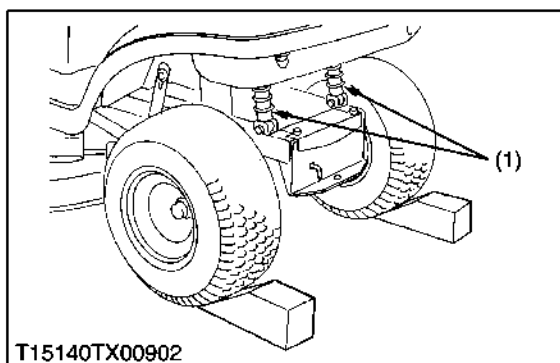
1. Remove the rear cover.
2. Visually check to see if the gas spring rod is deformed or damaged.
If defects are found, replace the gas spring (1).
3. Move the lift lever to make sure the spring force is as specified.
(For easy checkup, it is advisable to keep the mower off the lift link and move the lift lever.)
If the gas spring does not work, replace the gas spring (1).

(Reference)

- If the inner high-pressure gas leaks, the rod's pushing force becomes zero.
- The specified spring force is about 400 N·m (40.8 kgf·m, 90.0 ft·lbs) with the rod being extended.

(1) Gas Spring

W1012414

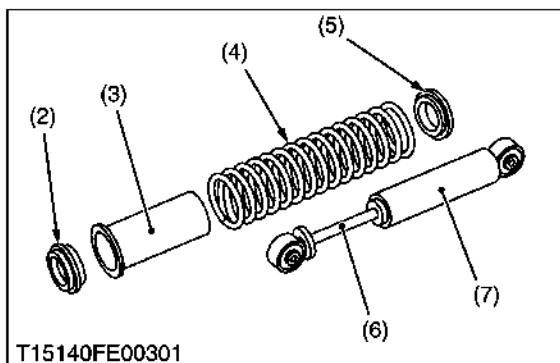


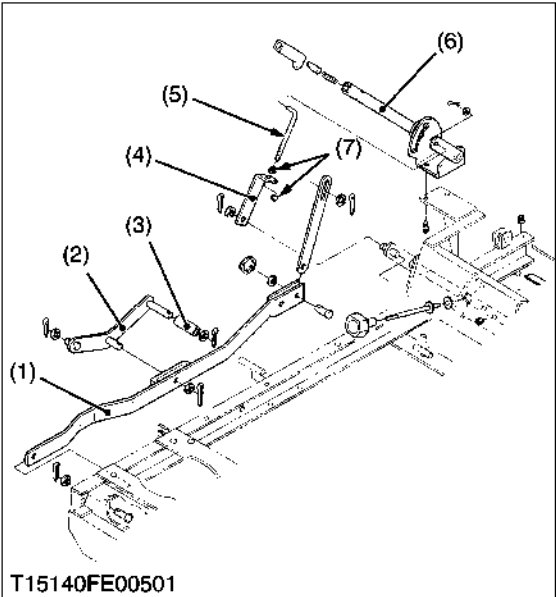
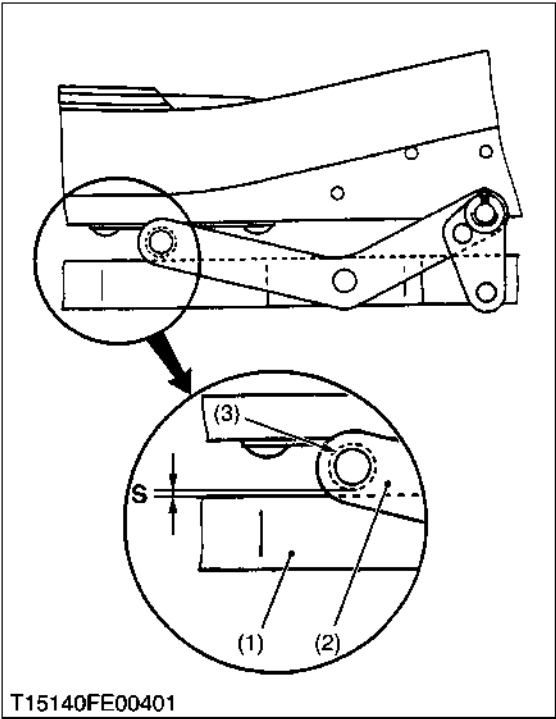
Inspecting Suspension

1. Visually check to see if there is no oil leak at the cylinder.
If any oil leak is found, replace the suspension assembly (1).
2. Check to see if the bushings at both ends are worn out or damaged.
If excessive wear or damage is found, replace the suspension assembly (1).
3. Shake the fender up and down to make sure there is no noticeable difference between the right and left suspension movements.
If the movement is not equal right and left, remove the suspensions and reinspect them.

- | | |
|-------------------------|--------------------|
| (1) Suspension Assembly | (5) Lower Retainer |
| (2) Upper Retainer | (6) Damper Rod |
| (3) Dust Shield | (7) Cylinder |
| (4) Spring | |

W1012548





- Adjusting Lift Link**
1. Mount the mower to the vehicle, and set the lift lever (6) to “**LIFT**” position.
 2. Measure the clearance (**S**) between the link 1 (1) and collar (3) with a feeler gauge.
 3. If the clearance is not within the factory specifications, loosen the lock nuts (7) and adjust the lift link length.
- **NOTE**
- After adjusting the lift link length, secure the lift link 1 (5) and 2 (4) with lock nuts (7).

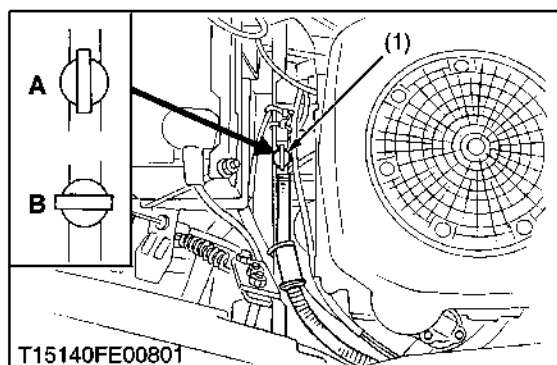
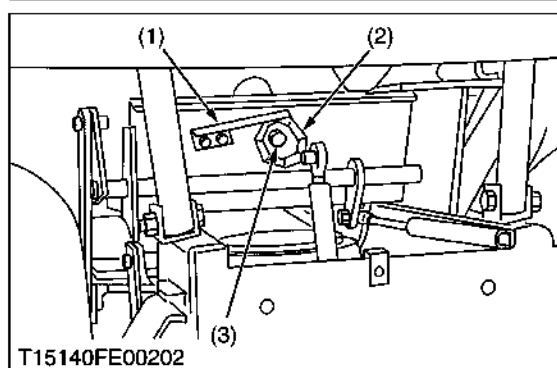
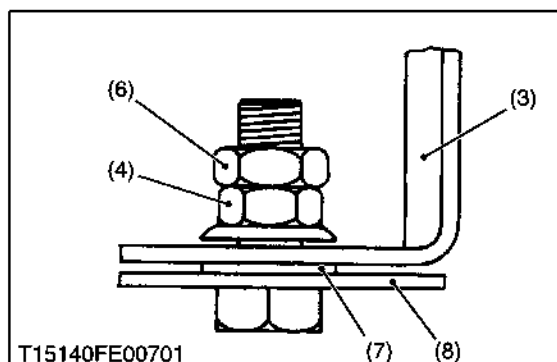
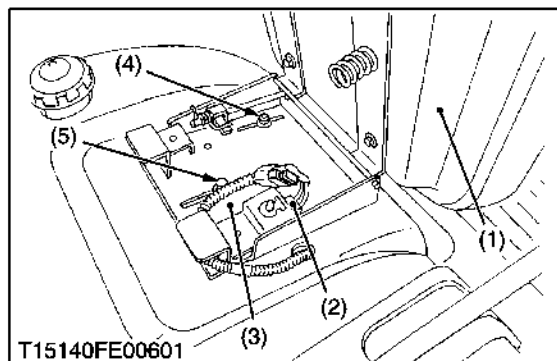
Clearance (S) between link 1 and collar	Factory spec.	2.0 to 4.0 mm 0.08 to 0.16 in.
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- | | |
|-----------------|-----------------|
| (1) Link 1 | (5) Lift Link 1 |
| (2) Link 3 | (6) Lift Lever |
| (3) Collar | (7) Lock Nut |
| (4) Lift Link 2 | |

W1012797

[2] DISASSEMBLING AND ASSEMBLING

(1) Separating Fender



Dismounting mower

1. See to "MOWER" section.

W1013193

Seat

1. Disconnect the 2P connector (2) from the seat switch.
2. Unscrew the seat adjusting nut (5) and seat support mounting nuts (4).
3. Remove the seat (1) with the seat support (3).

(When reassembling)

- Turn the seat support nut (4) all the way until it seats lightly. Then, turn seat support mounting nut counterclockwise by a half turn, and secure it in that position with the lock nut (6).

Tightening torque	Lock nut	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
-------------------	----------	---

- | | |
|-------------------------------|------------------------|
| (1) Seat | (5) Seat Adjusting Nut |
| (2) 2P Connector | (6) Lock Nut |
| (3) Seat Support | (7) Plain Washer |
| (4) Seat Support Mounting Nut | (8) Fender |

W1013238

Cutting Height Adjusting Dial

1. Remove the rear cover.
2. Remove the spring retainer (1).
3. Set the lift lever to "LIFT" position.
4. Unscrew the cam mounting nut (3), and remove the cutting height adjusting dial 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) Spring Retainer | (3) Cam Mounting Nut |
| (2) Cam | |

W1013446

Fuel Pipe

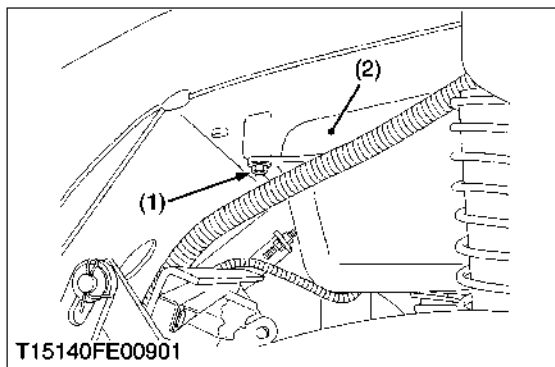
CAUTION

- Gasoline is extremely flammable. Do not smoke or allow flames or sparks in your working area.
Clean up any spilled gasoline immediately.

1. Close the fuel cock.
2. Remove the fuel pipe clamp.
3. Disconnect the fuel pipe from the fuel cock (1).

- | | |
|---------------|-----------------------|
| (1) Fuel Cock | A : Open
B : Close |
|---------------|-----------------------|

W1013665



Fuel Tank

1. Unscrew the suspension mounting bolts, and remove the suspension from the fender.
2. Unscrew the fuel tank mounting nuts (1), and separate the fuel tank (2) from the fender.

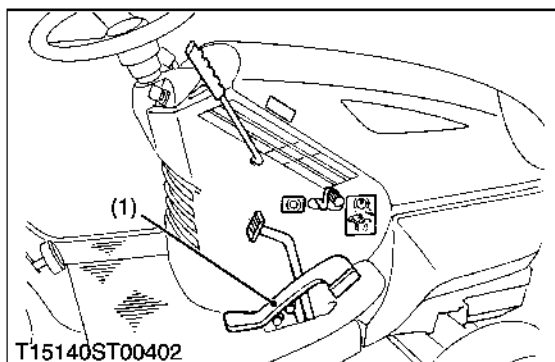
(When reassembling)

Tightening torque	Suspension mounting bolt	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.4 to 41.2 ft-lbs
	Pipe mounting bolt	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.4 to 41.2 ft-lbs
	Fuel tank mounting nut	13.5 to 20.3 N·m 1.4 to 2.1 kgf·m 10.0 to 15.0 ft-lbs

(1) Nut

(2) Fuel Tank

W1013778



Separating Fender

1. Remove the speed change pedal (1).
2. Unscrew the step support mounting screws (2), and remove the step support (3) and rubber bushing(4).
3. Unscrew the suspension mounting bolts, and remove the suspension from the frame.
4. Separate the fender (5).

(When reassembling)

- Apply grease to the inside of rubber bushing.

Tightening torque	Step support mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
	Suspension mounting bolt	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.4 to 41.2 ft-lbs
	Pipe mounting bolt	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.4 to 41.2 ft-lbs

(1) Speed Change Pedal

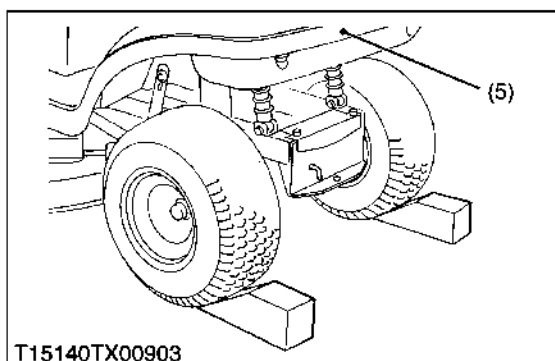
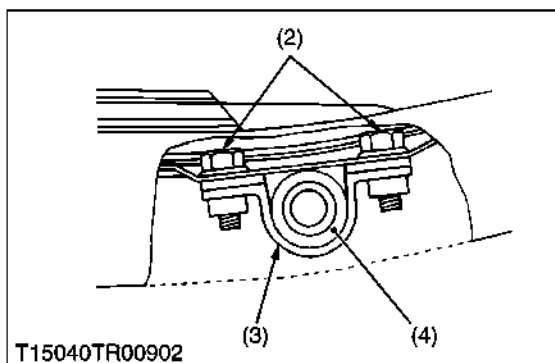
(4) Rubber Bushing

(2) Step Support Mounting Screw

(5) Fender

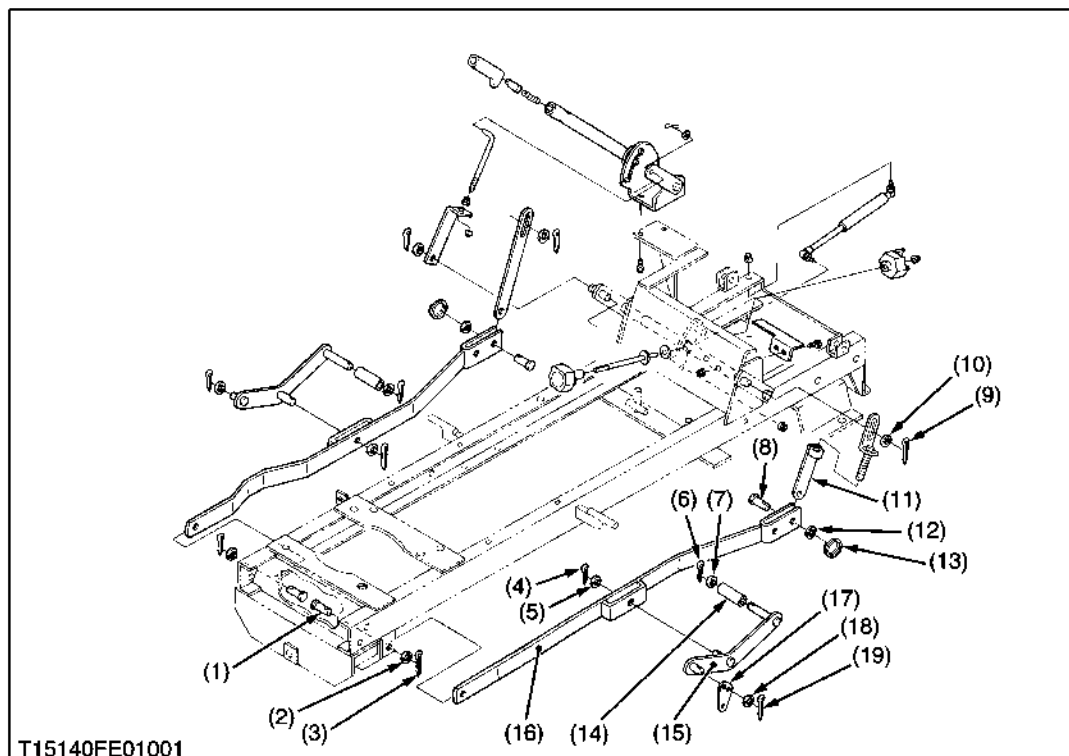
(3) Step Support

W1014040



(2) Lift Linkage

Link Assembly



- (1) Clevis Pin
- (2) Plain Washer
- (3) Cotter Pin
- (4) Cotter Pin
- (5) Plain Washer
- (6) Cotter Pin
- (7) Plain Washer
- (8) Clevis Pin
- (9) Cotter Pin
- (10) Plain Washer
- (11) Link 2
- (12) Plain Washer
- (13) Rue Ring
- (14) Collar
- (15) Link 3
- (16) Link 1
- (17) Link 4
- (18) Plain Washer
- (19) Cotter Pin

W1014295

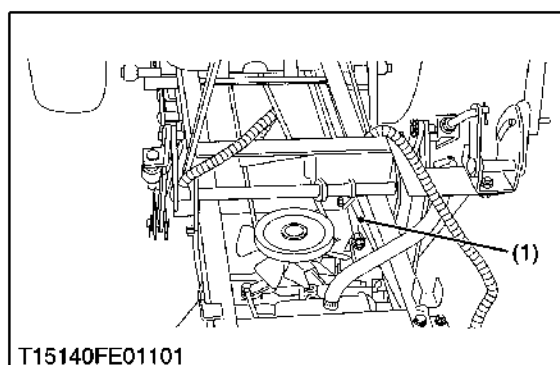
1. Pull out the cotter pins (3), and rue ring (13).
2. Remove the plain washers (2), (12) and clevis pins (1), (8), and then remove the link assembly (link 1, link 3, and link 4).
3. Pull out the cotter pin (4), and remove the plain washer (5) and link 3 (15) from the link 1 (16).
4. Pull out the cotter pin (19), and remove the plain washer (18) and link 4 (17) from the link 3 (15).
5. Pull out the cotter pin (9), and remove the plain washer (10) and link 2 (11).

(When reassembling)

- Apply grease to the collar (14).
- Be sure to pay attention to how to assemble the link 4.
- Be sure to pay attention to how to assemble the link 1.

W1013618

(3) Lift Lever



Gas Spring

1. Set the lift lever to "LIFT" position.
2. Unscrew the gas spring mounting nuts, and remove the gas spring (1).

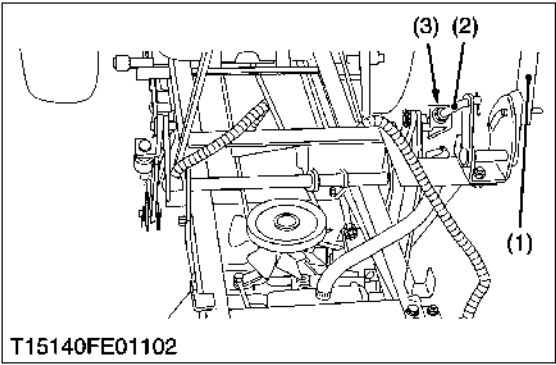
(When reassembling)

- Before installing the gas springs, set the lift lever to "LIFT" position.

Tightening torque	Gas spring mounting nut	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft·lbs
-------------------	-------------------------	---

- (1) Gas Spring

W1014996



Lift Link and Lift Lever

- 1. Pull out the cotter pins and remove the lift link assembly (lift link 1 and lift link 2).
- 2. Unscrew the lift lever mounting screws, and remove the lift lever (1).

(When reassembling)

■ **IMPORTANT**

- After assembling the lift link assembly, be sure to adjust the lift link length. (See page 7-S5.)

Tightening torque	Lift lever mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
-------------------	---------------------------	---

(1) Lift Lever
(2) Lift Link 1

(3) Lift Link 2

W1015132

8 PTO SYSTEM

SERVICING

CONTENTS

1. TROUBLESHOOTING	8-S1
2. SERVICING SPECIFICATIONS	8-S2
3. TIGHTENING TORQUES	8-S3
4. CHECKING, DISASSEMBLING AND SERVICING.....	8-S4
[1] CHECKING AND ADJUSTING	8-S4
[2] DISASSEMBLING AND ASSEMBLING.....	8-S5

1. TROUBLESHOOTING

Symptom		Probable Cause	Solution	Reference Page
Loss of power	Is PTO belt tension normal ?	NO Weakened or broken PTO tension spring	Replace	8-S4
	YES	Worn or damaged PTO belt	Replace	8-S4, 8-S6
Noise from PTO system		Worn tension pulley bearing	Replace	8-S6
		Worn or damaged PTO belt	Repair or replace	8-S4, 8-S6
Blade does not rotate.	Is PTO belt tension normal ?	NO Weakened or broken PTO tension spring	Adjust	8-S4
	YES	Worn or damaged PTO belt	Repair or replace	8-S4, 8-S6

T15140PT00101

2. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
PTO Tension Spring	Length	69 to 72 mm 2.72 to 2.84 in.	—

W1013874

3. TIGHTENING TORQUES

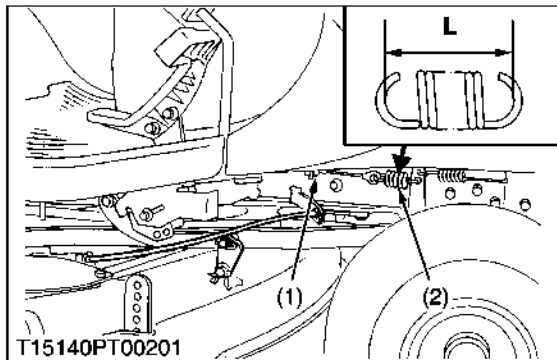
Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts : See page G-11.)

Item	N·m	kgf·m	ft-lbs
Adjusting nut (Mower brake wire)	9.8 to 11.3	1.00 to 1.15	7.3 to 8.3
PTO clutch lever mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Tension arm 2 mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Engine pulley mounting screw	48.1 to 55.9	4.9 to 5.7	35.5 to 41.2
Tension bracket mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Tension holder mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
PTO tension pulley mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
HST tension pulley mounting nut	108.5 to 130.2	11.1 to 13.3	80 to 96

W1012736

4. CHECKING, DISASSEMBLING AND SERVICING

[1] CHECKING AND ADJUSTING



PTO Belt Tension

1. After mounting the mower on the vehicle, stop the engine.
2. Set the cutting height adjusting dial to “2.0” position, and lower the mower.
3. Set the PTO clutch lever to “ENGAGE” position, and measure the length (L) of PTO tension spring (2).
4. If the measurement is not within the factory specifications, adjust the length with the adjusting nuts (1).

Length (L) of PTO clutch spring	Factory spec.	69 to 72 mm 2.72 to 2.84 in.
---------------------------------	---------------	---------------------------------

■ IMPORTANT

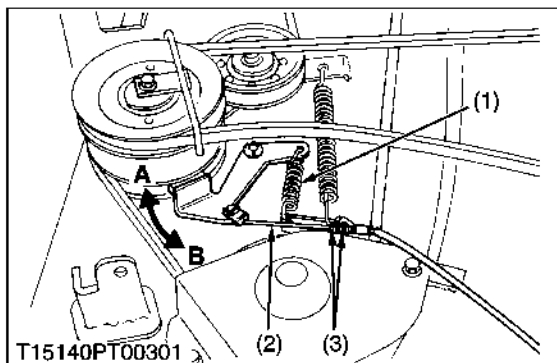
- When replace the PTO belts with a new one, the length (L) of PTO clutch spring (2) should be 73 to 75 mm (2.87 to 2.95 in.).

After working for 50 hours, be sure to readjust the length (L) to the factory specifications.

(1) Adjusting Nuts

(2) PTO Clutch Spring

W1010891



Mower Brake Operation

1. After mounting the mower on the vehicle, stop the engine.
2. Check to see that the mower brake contacts with the pulley completely when the PTO clutch lever is set to “DISENGAGE” position.
3. Check to see that the mower brake is released when the PTO clutch lever is set to “ENGAGE” position.
4. If the mower brake operation is defective, adjust the length of mower brake wire (2) with the adjusting nuts (3) or replace the return spring (1).

Tightening torque	Adjusting nut	9.8 to 11.3 N·m 1.00 to 1.15 kgf·m 7.3 to 8.3 ft-lbs
-------------------	---------------	--

(1) Return Spring

(2) Mower Brake Wire

(3) Adjusting Nut

A: PTO Clutch Lever “DISENGAGE”

B: PTO Clutch LEver “ENGAGE”

W1012731

[2] DISASSEMBLING AND ASSEMBLING

Dismounting Mower

1. See to "MOWER" section.

W1012974

PTO Clutch Lever

1. Remove the grip (1) of PTO clutch lever.
2. Pull out the cotter pin, and remove the PTO clutch wire (3).
3. Unscrew the PTO clutch lever mounting screws, and remove the PTO clutch lever (2).

(When reassembling)

- Apply oil to the PTO clutch wire.

■ IMPORTANT

- After assembling the PTO clutch wire, be sure to adjust the PTO belt tension. (See above.)

Tightening torque	PTO clutch lever mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft·lbs
-------------------	---------------------------------	---

(1) Grip

(3) PTO Clutch Wire

(2) PTO Clutch Lever

W1013025

Tension Bracket

1. Remove the lower bonnet.
2. Remove the HST tension spring (2), and then remove the HST belt (1) from the engine pulley.
3. Remove the PTO tension spring (5) and return spring (6) from the tension arm 2 (8).
4. Unscrew the tension arm 2 mounting screw, and remove the tension arm 2 (8) from the tension arm 1 (7).
5. Unscrew the engine pulley mounting screw, and remove the engine pulley (3).
6. Unscrew the tension bracket mounting screws, and remove the tension bracket (4) with the PTO tension arm (10) and HST tension arm (11).

(When reassembling)

- Install the tension bracket as shown in the figure.

Tightening torque	Tension arm 2 mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft·lbs
	Engine pulley mounting screw	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 ft·lbs
	Tension bracket mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft·lbs

(1) HST Belt

(2) HST Tension Spring

(3) Engine Pulley

(4) Tension Bracket

(5) PTO Tension Spring

(6) Return Spring

(7) Tension Arm 1

(8) Tension Arm 2

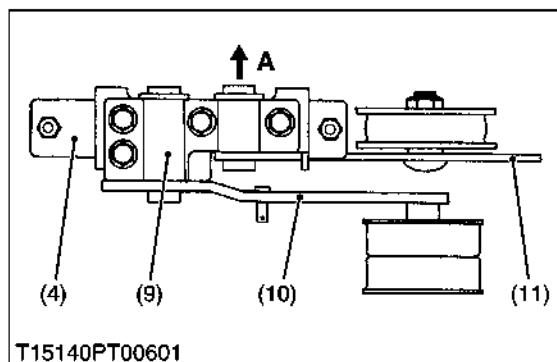
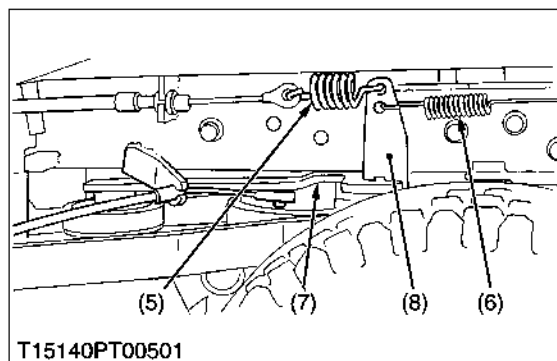
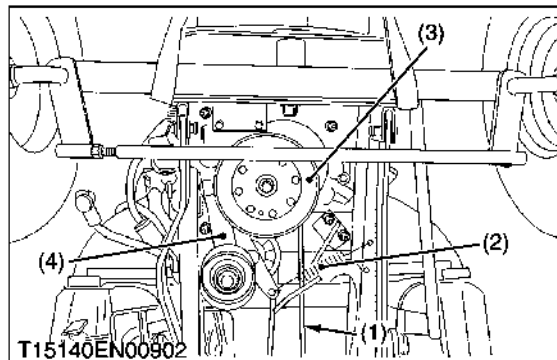
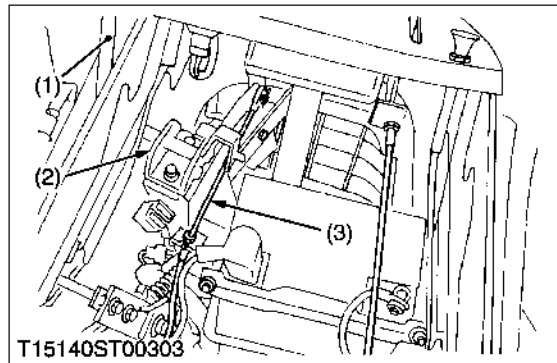
(9) Tension Holder

(10) PTO Tension Arm

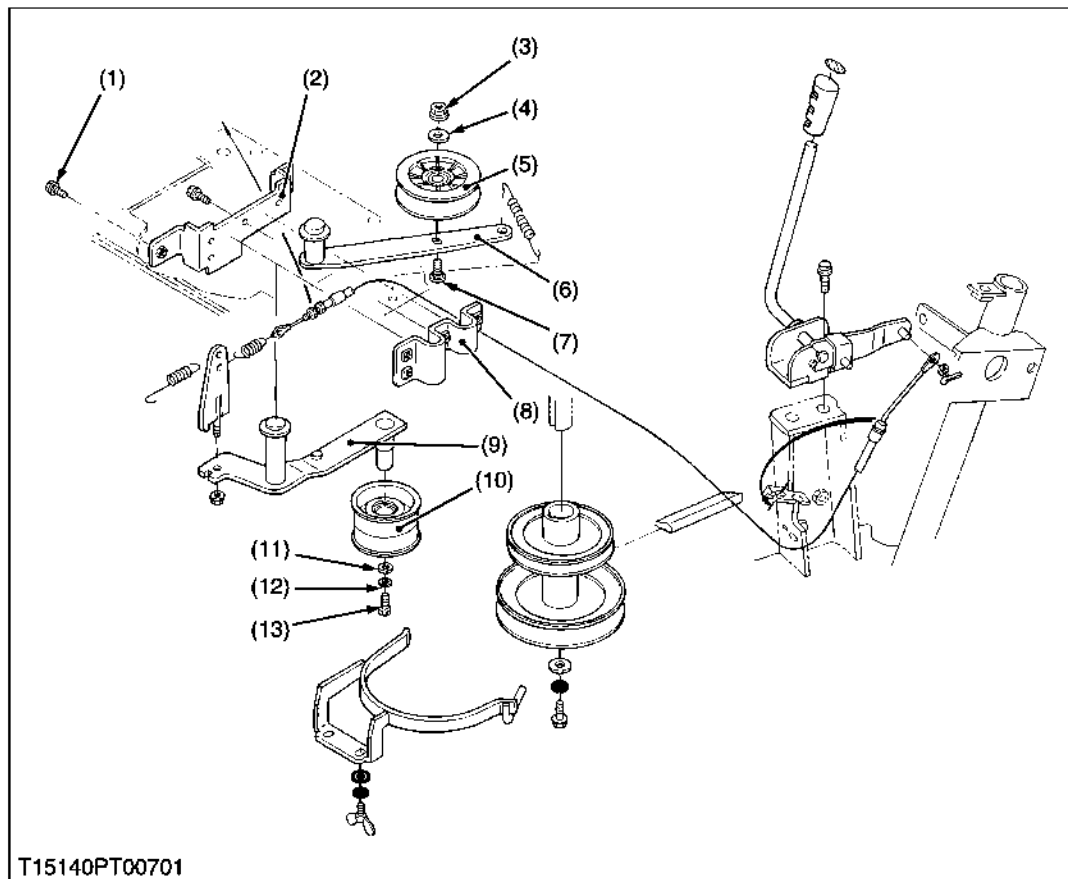
(11) HST Tension Arm

A : Upside

W1013209



Tension Pulley



- (1) Tension Holder Mounting Screw
- (2) Tension Bracket
- (3) HST Tension Pulley Mounting Nut
- (4) Plain Washer
- (5) HST Tension Pulley
- (6) HST Tension Arm
- (7) Bolt
- (8) Tension Holder
- (9) PTO Tension Arm
- (10) PTO Tension Pulley
- (11) Plain Washer
- (12) Spring Washer
- (13) PTO Tension Pulley Mounting Screw

W1012104

T15140PT00701

1. Unscrew the tension holder mounting screws (1), and remove the PTO tension arm and HST tension arm.
2. Unscrew the pulley mounting screw (13), and remove the PTO tension pulley (10) from the PTO tension arm (9).
3. Unscrew the pulley mounting nut (3), and remove the HST tension pulley (5) from the HST tension arm (6).

(When reassembling)

- Apply grease to the shafts of PTO tension arm and HST tension arm.
- Apply grease to the bearings of PTO tension pulley and HST tension pulley.

Tightening torque	Tension holder mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
	PTO tension pulley mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
	HST tension pulley mounting nut	108.5 to 130.2 N·m 11.1 to 13.3 kgf·m 80 to 96 ft-lbs

W1013598

9 ELECTRICAL SYSTEM 1

MECHANISM

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[2] WIRING DIAGRAM (with KRA system)	9-M2
2. KRA (Kubota Reverse Awareness) system (If Equipped)	9-M3

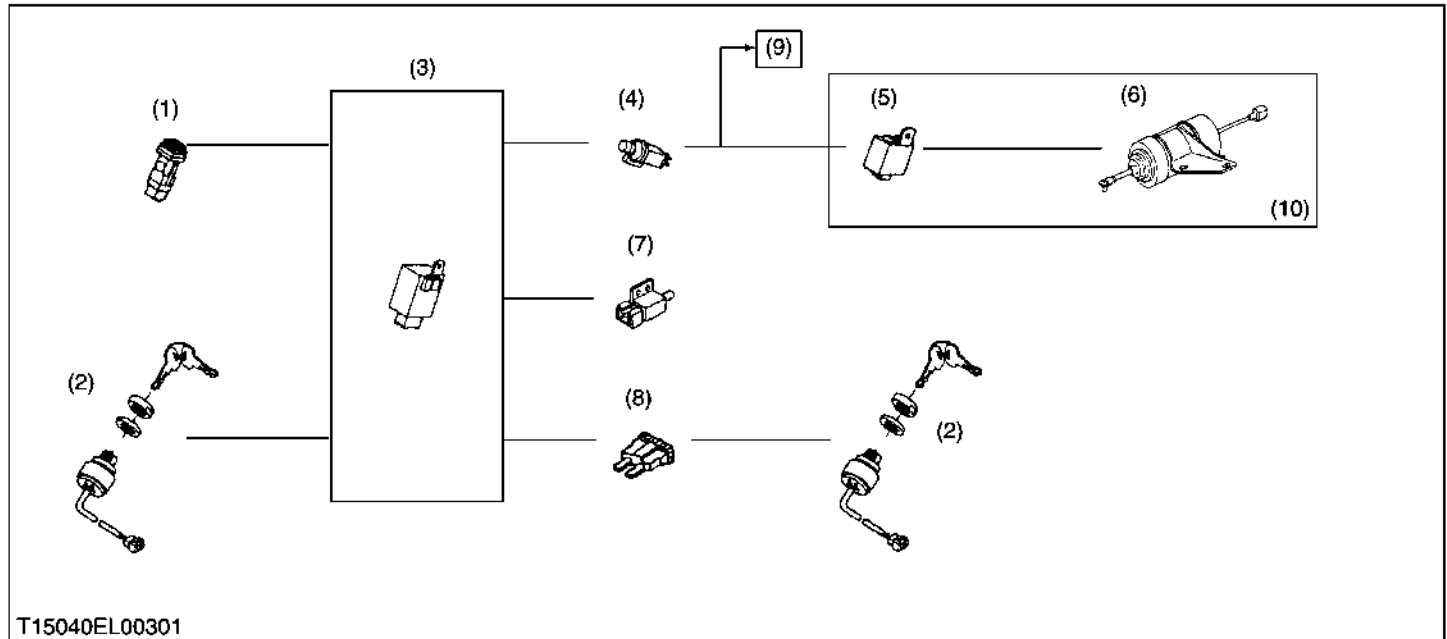
1. WIRING DIAGRAM

[1] COLOR OF WIRING

R Red	Br Brown
G Green	BY Black / Yellow
B Black	BW Black / White
W White	Or Orange
Y Yellow	Bor Black / Orange
L Blue	YW Yellow / White
RW Red / White	LR Blue / Red
RB Red / Black	Pi Pink
GY Green / Yellow	BR Black / Red

W1014151

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

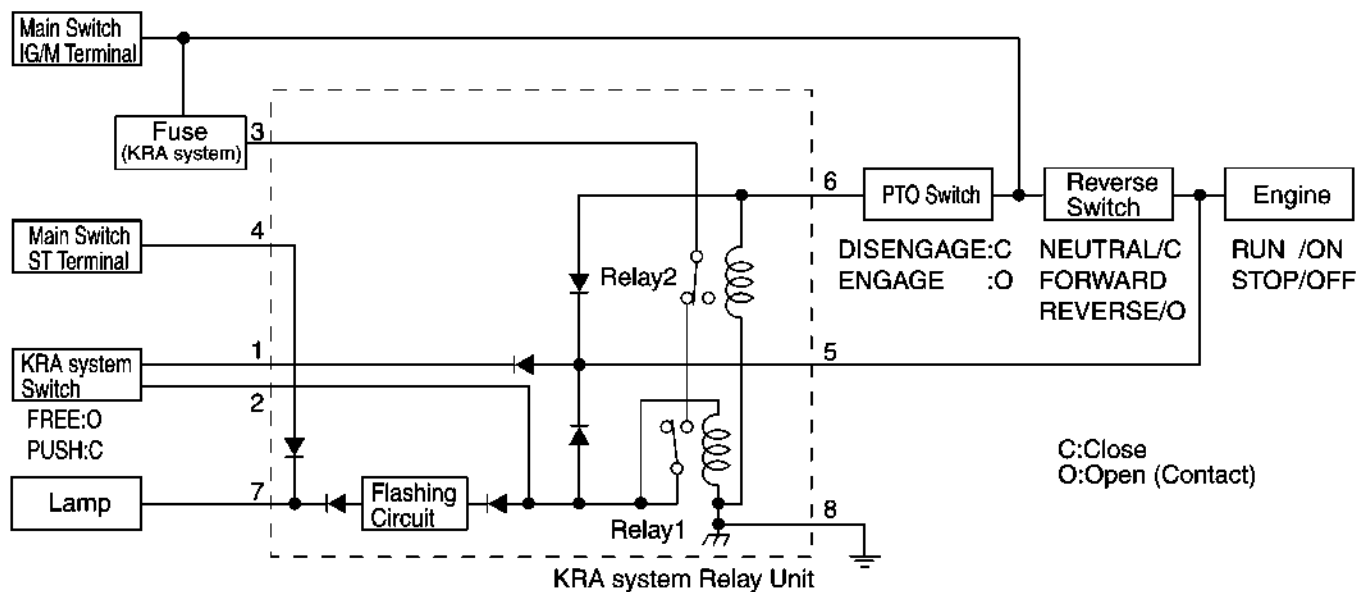
- While engine is running, current from main switch flows to the third contact point of the key stop timer. Current charges the timer circuit in the key stop timer. When the main switch is turned to “**OFF**” position, the stop solenoid is supplied current from the key stop timer. After that, the stop 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

KRA system Electrical Circuit

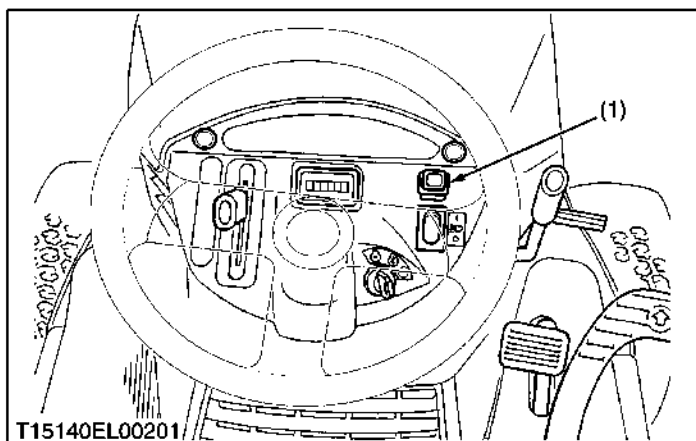


T15040EL05501

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



T15140EL00201

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)

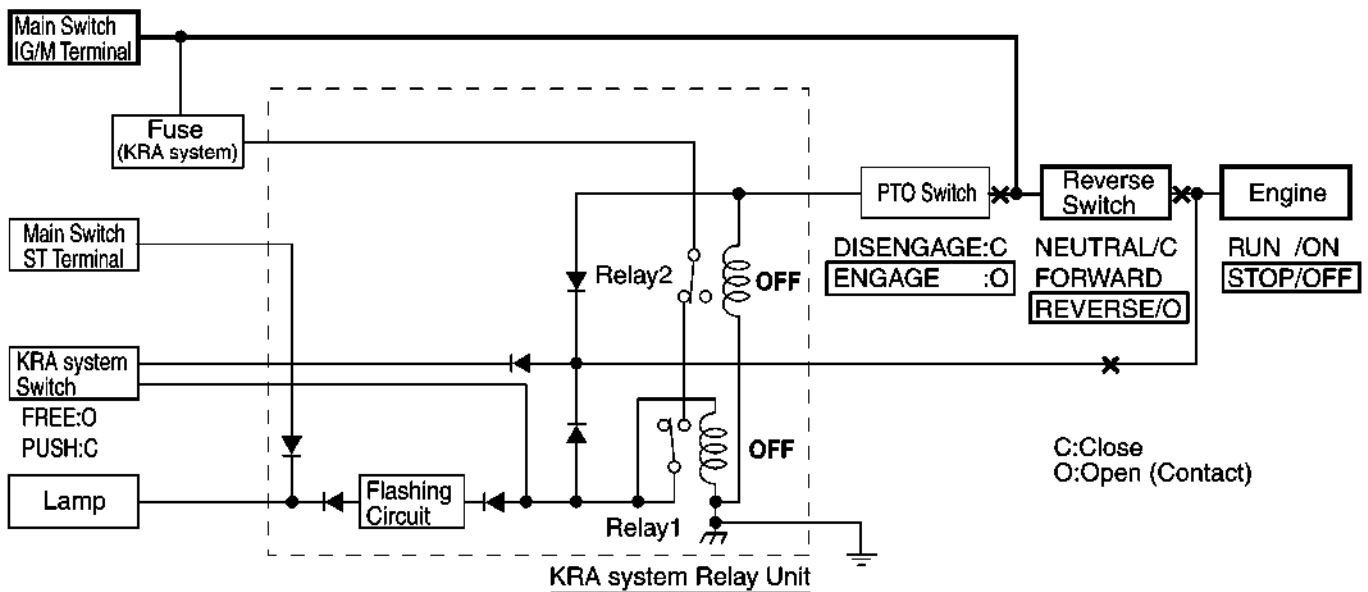
W1012973

KRA system Electrical Circuit

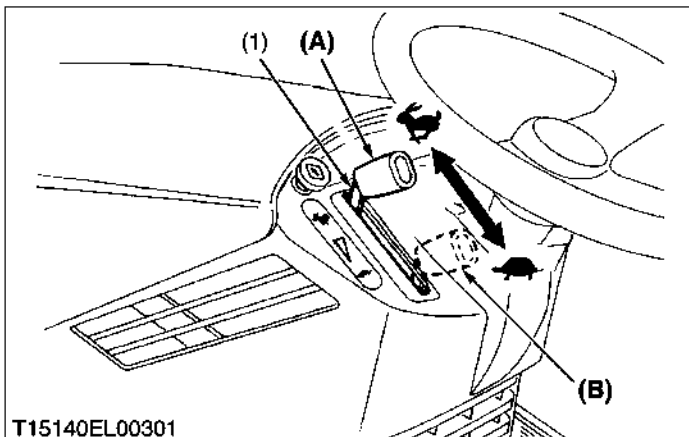
- In KRA system, engine stopping is mainly controlled by two parts, that is, PTO switch and reverse switch. The parts shown in the figure are connected in the electrical circuit.
- For engine stopping, electrical current should be supplied to key stop timer in diesel engine or ignition unit in gasoline engine.

W1018724

KRA system Operating Mode



T15040EL05601



T15140EL00301

■ 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

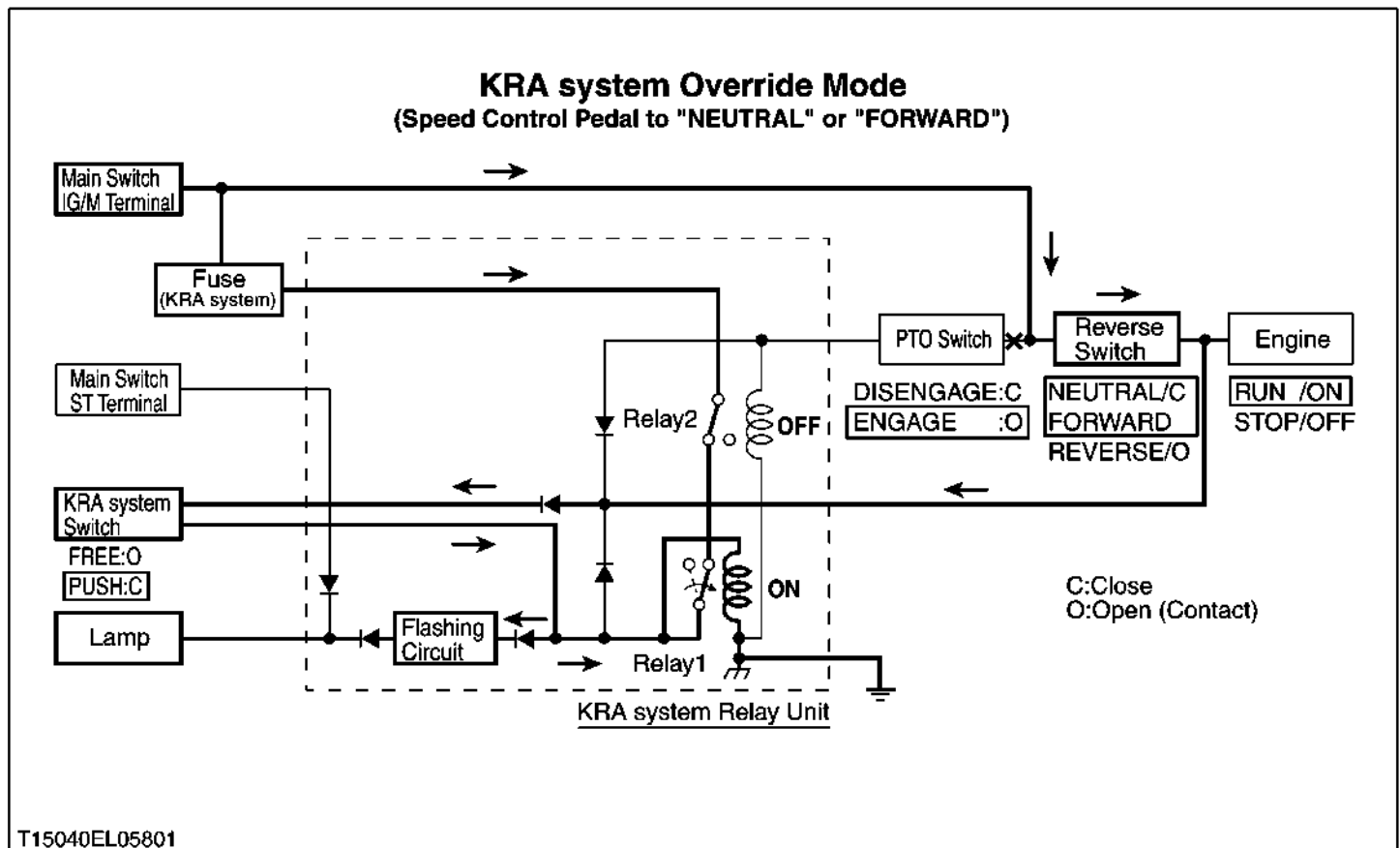
(B) “SLOW” Position

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.

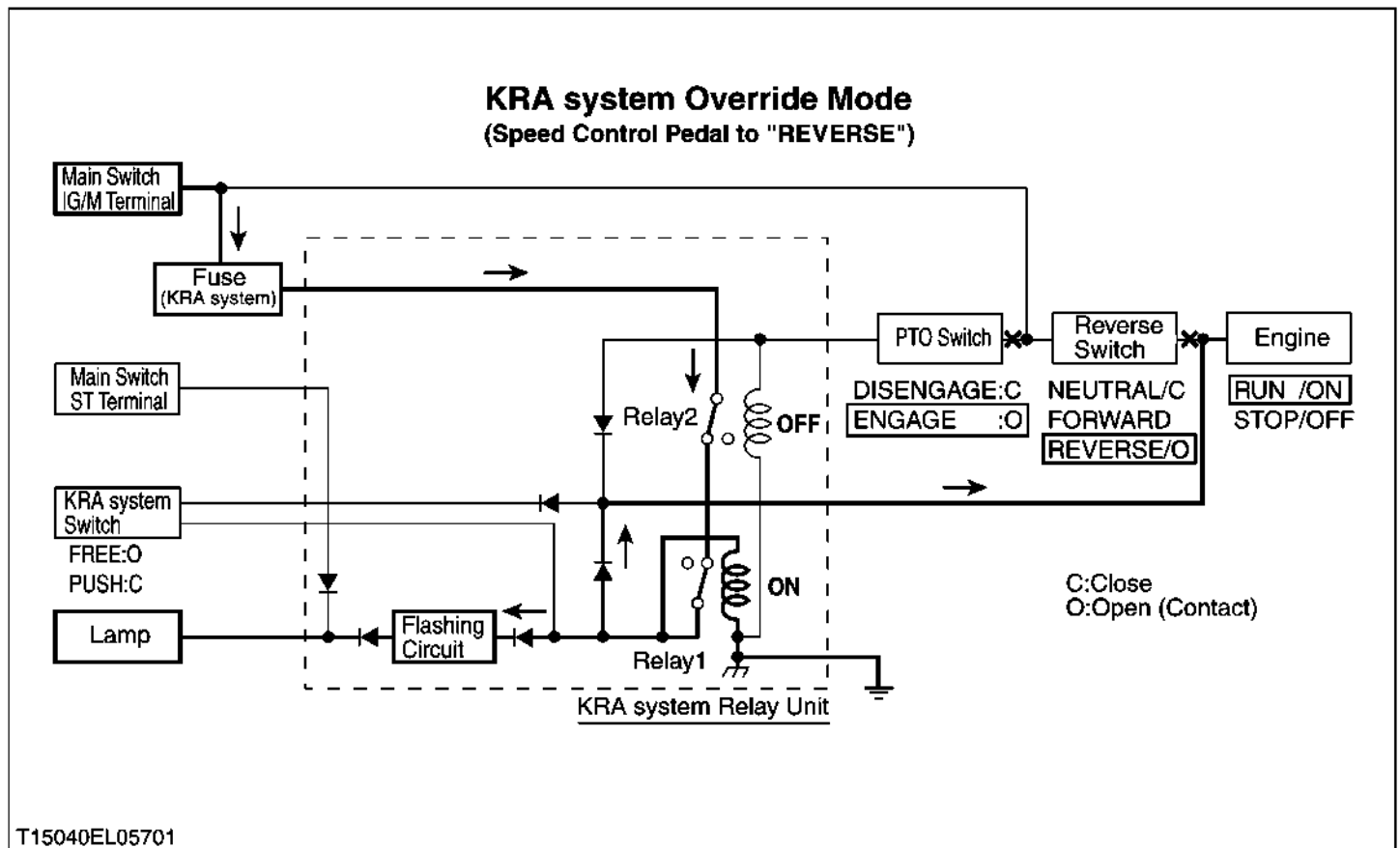
- And current flows to both flashing circuit and relay 1 in the KRA system relay unit.

- 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.

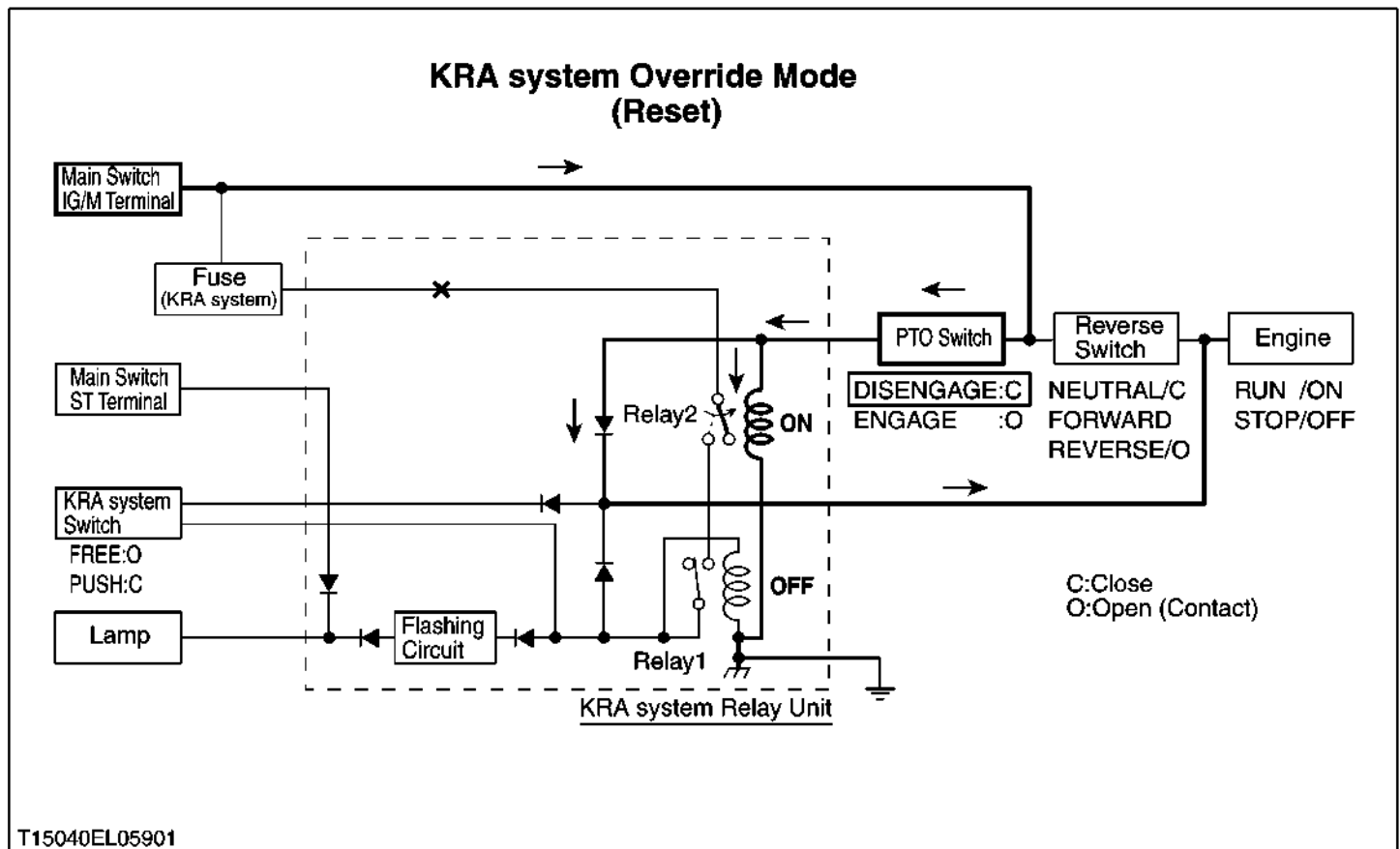
The above electrical circuit is a circuit at the moment of depressing speed control pedal to “REVERSE”.

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

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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	9-S7
	NO		
	Battery discharged or defective	Charge or replace	G-28

[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.	Seat	9-S8
	YES			
	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.	Set PTO clutch lever at "DISENGAGE" position.	8-S4, S6
	YES			
		Fuse blown	Replace	—
		Main switch defective	Replace	9-S8
		Seat switch defective	Replace	9-S18
		Brake switch defective	Replace	—
		Engine stop relay defective	Replace	—
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	9-S18
		Engine stop relay defective	Replace	—
Engine stops when operator leaves seat. (PTO clutch lever is set at "DISENGAGE" position. Parking brake is not applied.)		PTO switch defective	Replace	9-S18
		Brake switch defective	Replace	—
		Seat switch defective	Replace	9-S18

T15140EL03301

[Starting System]

Symptom	Probable Cause	Solution	Reference Page
Starter does not function.	Is click sound from magnet switch ?		
	YES		
	Weak battery	Charge	G-28
	Faulty lead or connection (Magnet switch to motor)	Repair or replace	—
	Starter motor defective	Repair or replace	9-S9, S10, S11, S12
	NO		
	Battery discharged or defective	Charge or replace	G-28
	Fuse blown	Replace	—
	Wiring harness disconnected or improperly connected	Repair or replace	—
	Starter defective	Repair or replace	9-S9, S10, S11, S12
Engine does not stop when main switch is turned "OFF" position.	Main switch defective	Replace	9-S8
	PTO clutch lever is set at "ENGAGE" position.	Set PTO clutch lever at "DISENGAGE" position.	9-S18
	Brake switch defective	Repair or replace	—

[Engine Key Switch Shut-off System]

Engine does not stop when main switch is turned "OFF" position.	Is wiring harness connection normal ?		
	YES		
	E/G stop relay defective	Replace	—
	Main switch defective	Replace	9-S8
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.	9-S18
Engine does not restart.	NO		
	Engine stop solenoid defective	Replace	2-S47
Engine does not restart.	Wiring harness disconnected or improperly connected	Repair or replace	—

T15140EL00401

[Charging System]

Symptom		Probable Cause	Solution	Reference Page
Battery discharges too quickly.	Is battery normal ?	YES		
		Charging coil defective	Repair or replace	1-S20
		Regulator defective	Replace	9-S13, S14
		Wiring harness disconnected or improperly connected	Repair or replace	—
	NO	Battery discharged or defective	Replace	G-28

[Lighting System]

Head light does not light.	Is wiring harness connection normal ?	YES		
		Fuse blown	Replace	—
		Bulb blown	Replace	—
		Main switch defective	Replace	9-S8
		Light switch defective	Replace	—
	NO	Wiring harness disconnected or improperly connected	Repair or replace	—

T15140EL00501

[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	9-S20
Engine stops when moving forward or at neutral position with engaging PTO lever.	Reverse switch gap adjustment improper	Reverse switch gap adjustment	9-S19
	Reverse switch defective	Reverse switch gap adjustment	9-S19
	Wiring harness defective	Wiring harness replacement	—
KRA system switch lamp does not flash when starting engine.	Bulb blown	Bulb replacement	—
	KRA system unit defective	KRA system unit replacement as an unit	9-S20
	Wiring harness defective	Wiring harness replacement	—
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	9-S20
	Wiring harness defective	Wiring harness replacement	—
	PTO switch adjustment improper	PTO switch adjustment	9-S18
	PTO switch defective	PTO switch replacement	9-S18
	KRA system switch defective	KRA system switch replacement	9-S20
	KRA system fuse blown	KRA system fuse replacement	—

T15140EL03401

2. SERVICING SPECIFICATIONS

REGULATOR

Item		Factory Specification	Allowable Limit
Regulated Output	Voltage	Battery voltage to 12.5 V DC	—
Regulator	Resistance	See the table in page 9-S14	—

W1013874

STATOR COIL

Item		Factory Specification	Allowable Limit
Stator Coil	Resistance	Approximately 0.1 to 0.2 Ω	—
Unregulated Stator Output (Min.)	Voltage	28 VAC / 3600 rpm	—

W1019594

SPARK PLUG

Item		Factory Specification	Allowable Limit
Spark Plug CHAMPION RC12YC (or equivalent)	Gap	1.02 mm 0.040 in.	—

W1020306

IGNITION COIL

Item		Factory Specification	Allowable Limit
Ignition module	Gap	0.20 to 0.30 mm 0.008 to 0.012 in.	—
Secondary Coil	Resistance	7900 to 10850 Ω	—

W1020384

3. TIGHTENING TORQUES

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

Item	N·m	kgf·m	ft-lbs
Starter			
• B terminal nut	9.8 to 13.7	1.0 to 1.4	7.2 to 10.1
Magnetic switch mounting nut	7.8	0.8	5.8

W1012736

4. CHECKING, DISASSEMBLING AND SERVICING

⚠ CAUTION

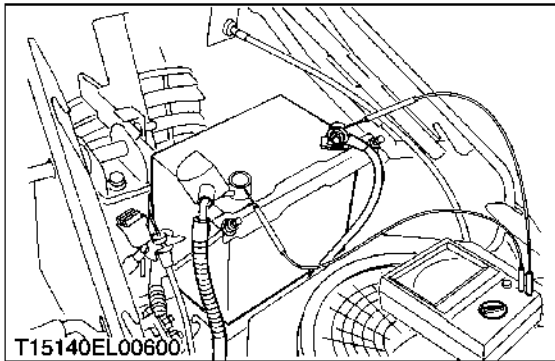
- To avoid accidental short circuit, be sure to attach the positive cable to the positive terminal before the negative cable is attached to the negative terminal.
- Never remove the battery cap while the engine is running.
- Keep electrolyte away from eyes, hands and clothes. If you are splattered with it, wash it away completely with water immediately.
- Keep open sparks and flames away from the battery at all times. Hydrogen gas mixed with oxygen becomes very explosive.

■ IMPORTANT

- If the machine is to be operated for 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

(1) CHECKING

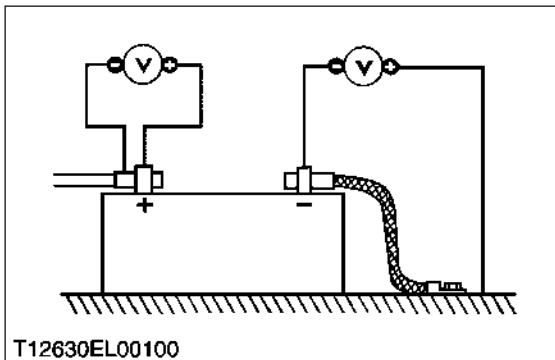


Battery Voltage

1. Stop the engine and turn the main switch off.
2. Connect the COM (–) lead of the voltmeter to the battery's negative terminal post and the 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

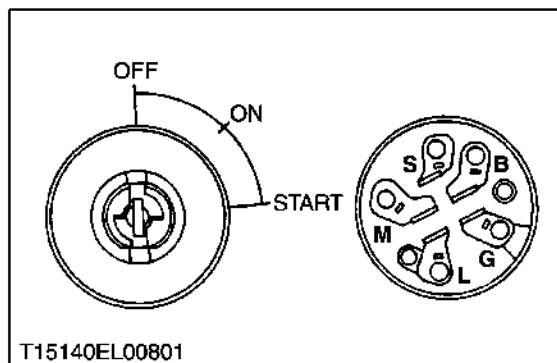
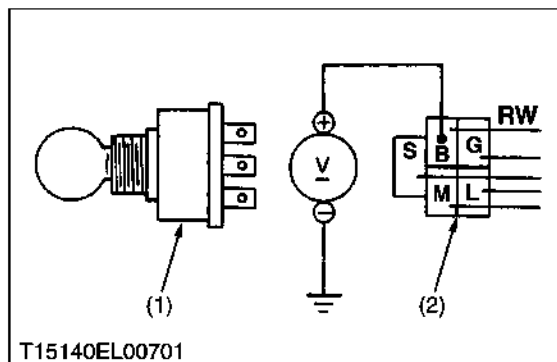
1. Turn the main switch on, and turn on the head light.
2. Measure the voltage with a voltmeter across the battery's positive terminal post and the cable terminal, and the voltage across the battery's negative terminal post and the chassis.
3. If the measurement exceeds the factory specification, clean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

(1) Checking



Main Switch

1) Connector Voltage

1. Turn the main switch off.
2. Open the bonnet and disconnect the 5P connector (2) from the main switch (1).
3. Measure the voltage with a voltmeter across the connector **B** terminal and chassis.
4. If the voltage differs from battery voltage, the wiring harness is faulty.

Voltage (B terminal-Chassis)	Factory spec.	Battery voltage
---------------------------------	---------------	-----------------

2) Terminal Continuity

1. Remove the main switch from the main panel.
2. Measure the resistance with an ohmmeter across terminals when the main switch is set at "OFF" position.
3. Measure the resistance with an ohmmeter across terminals when the main switch is set at "ON" position.
4. Measure the resistance with an ohmmeter across terminals when the main switch is set at "START" position.
5. If the resistance values specified below are not indicated, the main switch is faulty.

■ Main switch is set at "OFF" position.

	G terminal	M terminal	B terminal	L terminal	S terminal
G terminal		Continuity	Infinity	Infinity	Infinity
M terminal	Continuity		Infinity	Infinity	Infinity
B terminal	Infinity	Infinity		Infinity	Infinity
L terminal	Infinity	Infinity	Infinity		Infinity
S terminal	Infinity	Infinity	Infinity	Infinity	

■ Main switch is set at "ON" position.

	G terminal	M terminal	B terminal	L terminal	S terminal
G terminal		Infinity	Infinity	Infinity	Infinity
M terminal	Infinity		Infinity	Infinity	Infinity
B terminal	Infinity	Infinity		Continuity	Infinity
L terminal	Infinity	Infinity	Continuity		Infinity
S terminal	Infinity	Infinity	Infinity	Infinity	

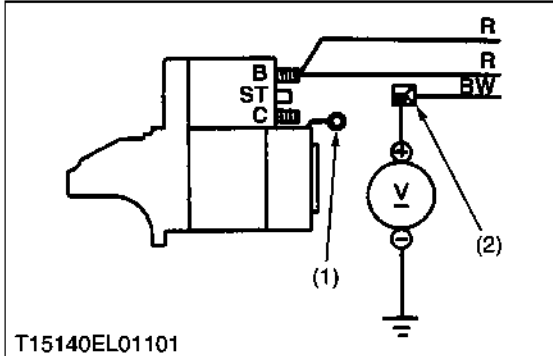
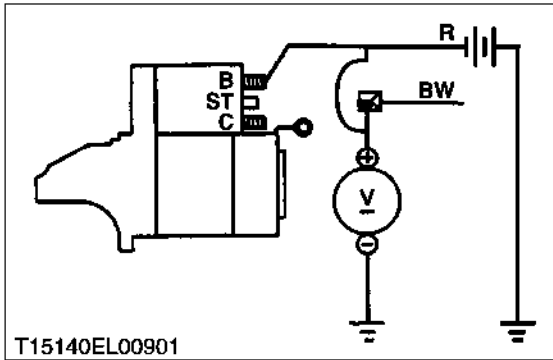
■ Main switch is set at "START" position.

	G terminal	M terminal	B terminal	L terminal	S terminal
G terminal		Continuity	Infinity	Infinity	Infinity
M terminal	Continuity		Infinity	Infinity	Infinity
B terminal	Infinity	Infinity		Continuity	Continuity
L terminal	Infinity	Infinity	Continuity		Continuity
S terminal	Infinity	Infinity	Continuity	Continuity	

(1) Main Switch

(2) 5P Connector

W1020774

(A) Starter**B Terminal Voltage**

1. Measure the voltage with a voltmeter between the B 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	B terminal	9.8 N·m 1.0 kgf·m 7.2 ft·lbs

Connector Voltage to Pull-in Coil

1. Disconnect the connecting lead (1) between starter motor and magnet switch, and keep the lead away from terminal of magnet.
2. Disconnect the **1P** connector (2) from the magnet switch.
3. Connect the positive jumper lead of a voltmeter with the **1P** connector (2) and negative jumper lead with chassis.
4. Make sure that the PTO switch is in the **"DISENGAGE"** position, depress the brake pedal and turn the main switch to **"START"** position.
5. If the voltage is the same as the battery voltage, the wiring harness, PTO switch, brake switch and main switch are correct.

Voltage (1P connector-Chassis)	Factory spec.	Battery voltage
--------------------------------	---------------	-----------------

NOTE

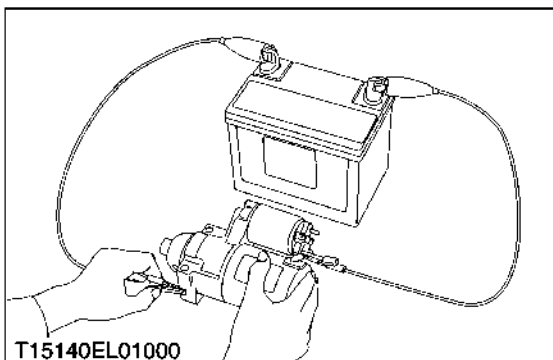
- **Wire color**
R : Red, RB : Red / Black, BW : Black / White

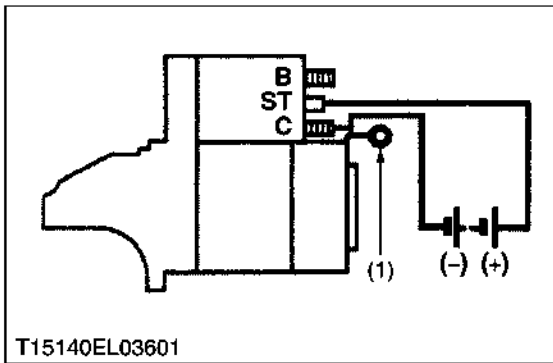
(1) Connecting Lead

(2) 1P Connector

Motor Test**CAUTION**

- **This test room must be free from any flammable object. Keep your body away from pinion.**
 - **Hold the starter by hand to prevent it from jumping up and down while testing the motor.**
1. Disconnect the ground cable clamp from the battery negative terminal post.
 2. Disconnect the battery positive cable and the leads from the starter.
 3. Remove the starter motor from the engine.
 4. Disconnect the connecting lead from the starter **C** terminal.
 5. Connect a jumper lead from the connecting lead 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.





Magnet Switch Test

1. Remove the starter from the engine.
2. Disconnect the connecting lead (1) from the starter **C** terminal.
3. Connect a jumper lead from the starter **ST** terminal to the battery positive terminal post.
4. Connect a jumper lead momentarily between the starter **C** terminal and the battery negative terminal post.
5. If the pinion gear does not pop out, check the magnet switch.

■ NOTE

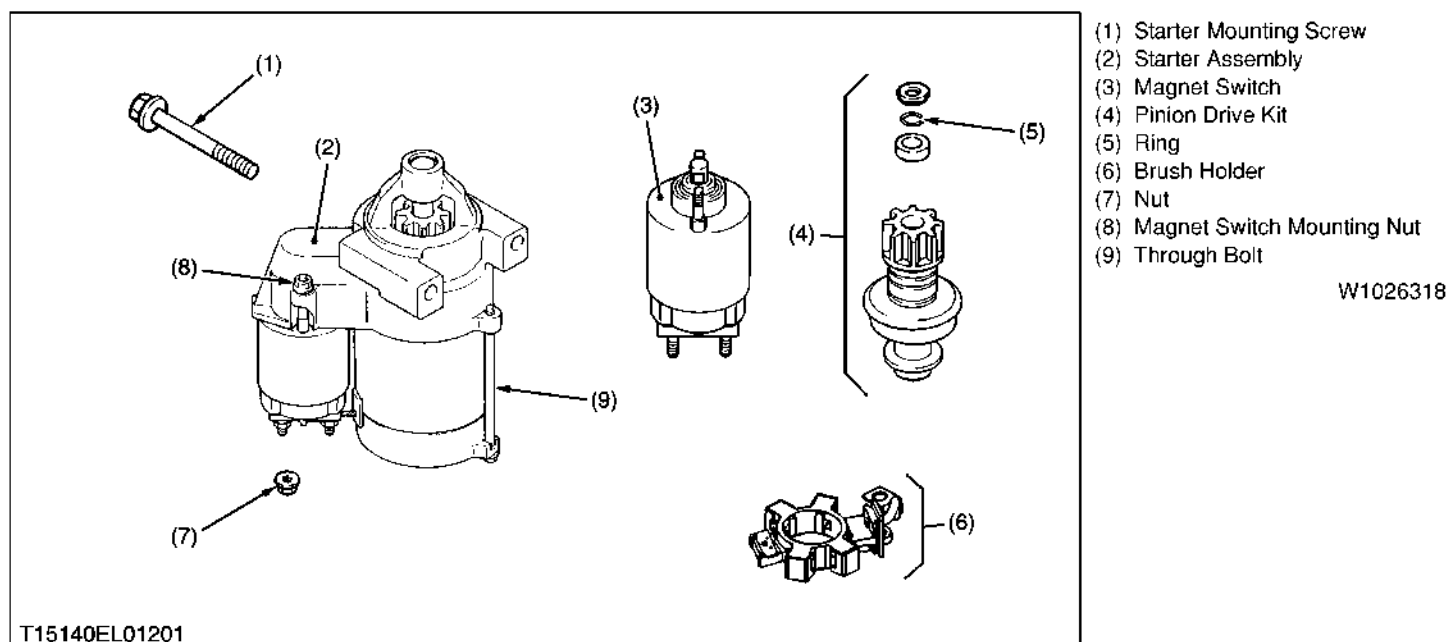
- **This test should be carried out for a short time, about 3 to 5 seconds.**

(1) Connecting Lead

W1027319

(2) Disassembling and Assembling

(A) Starter



1. Remove the magnet switch mounting screw (1).
2. Remove the magnet switch (3) by sliding it up so that it is disconnected from the drive lever.
3. Unscrew the two through bolts (9).
4. Remove the rear end frame (7).
5. Remove the insulator.
6. Remove the brushes and brush springs, and pull out the brush holder (6).
7. Draw out the yoke from the cover assembly.
8. Draw out the armature with the drive lever.

■ NOTE

- Do not damage to the brush holder.

(When reassembling)

- Apply grease (NIPPONDENSO No.50 or equivalent) to the parts indicated in the figure.
 - (a) Joint of magnet switch.
 - (b) Teeth of pinion
 - (c) Armature Shaft

Tightening torque	Magnet switch mounting nut	7.8 N·m 0.8 kgf·m 5.8 ft-lbs
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(3) Servicing

(A) Starter

Starter

1. After disassembling starter and finding the broken parts, replace the parts as an assembly.

W1028315

Brush Holder

1. Remove brushes from brush holder, and remove brush holder from frame.
2. Cut the brush lead wire at the edge of the post with a pair of nippers.
3. Fire off burrs on the post.
4. The replacement brushes have a solid portion on them which should be crimped on the post.
5. Solder the crimped portion to the post.
6. Replace the brush holder in the frame and place the brushes in the brush holder. Reinstall the spring.

[3] CHARGING SYSTEM

(1) Checking

Regulated Output Voltage

1. Warm up the engine.
2. Connect a voltmeter across the battery terminals, and measure the output voltage at various engine speeds.
3. If the output voltage is much higher than the specifications, the regulator is defective, or the regulator leads are loose or open.
4. If the output voltage does not rise as the engine speed increase, the regulator is defective.

Regulated output voltage	Factory spec.	Battery voltage to 12.5 V
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W1032006

Starter Coil Resistance

1. Disconnect the connector (1) from regulator.
2. Connect an ohmmeter between stator pins (AC terminal) (2).
3. Measure the stator coil resistance.
4. If resistance is infinity ohms, stator is open. Replace it.

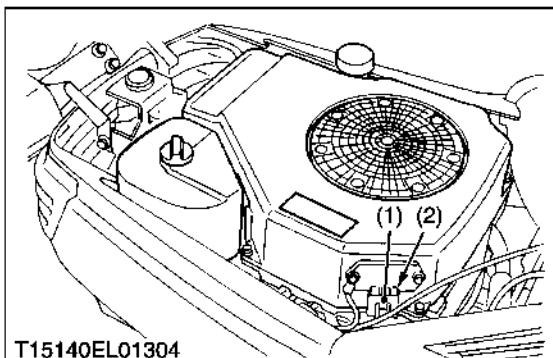
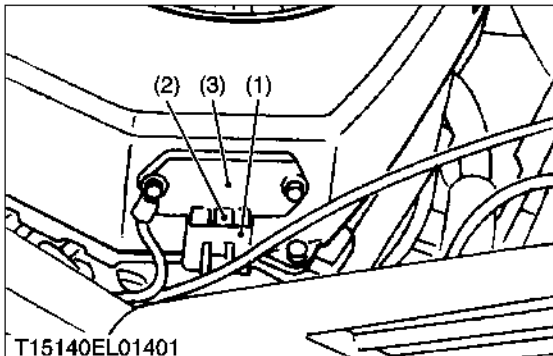
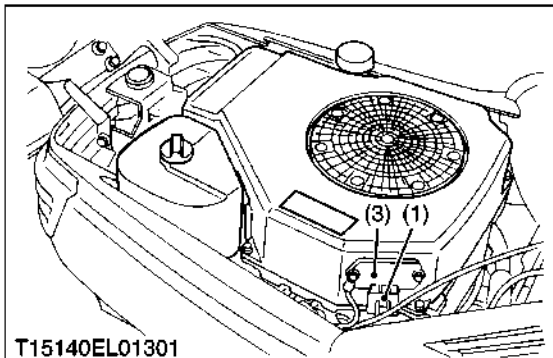
Stator coil resistance : AC-AC terminal	Factory spec.	Approximately 0.1 to 0.2 ohms
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(1) Connector

(3) Regulator

(2) Stator Pin (AC Terminal)

W1032129



Unregulated Stator Output

1. Disconnect the connector (1) from regulator.
2. Connect AC voltmeter to the stator pins (2).
3. Start the engine. Run the engine at 3600 rpm and measure the voltage.
4. Voltage reading should be minimum 28 VAC / 3600 rpm.
5. If the AV voltage reading is less than the specification, replace the stator.

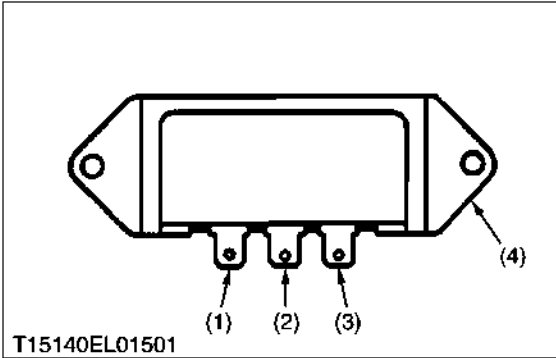
Unregulated stator output	Factory spec.	28 VAC / 3600 rpm
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(1) Connector

(2) Stator Pin

W1032291

(2) Servicing



Regulator Terminal Continuity

- 1. Disconnect the regulator connector.
- 2. Connect the test leads to the terminals shown on the chart.
- 3. Measure resistance across terminals as indicated in the chart below.

NOTE

- The resistance value shown is in an approximation only. The tested valued may vary depending on ohmmeter battery condition.
- Resistance values may vary with individual meters.

+lead -lead	1	2	3	4
1		—	—	infinity
2	—		infinity	41-46k ohms
3	—	infinity		—
4	infinity	41-46k ohms	—	

- (1) Terminal

(2) Terminal
- (3) Terminal

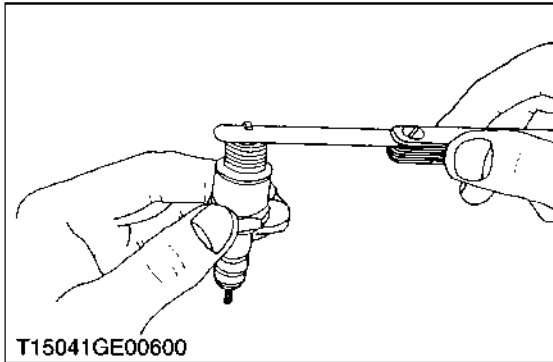
(4) Case

W1032467

[4] IGNITION SYSTEM

(1) Checking, Adjusting and Inspection

(A) Spark Plug



Spark Plug Gap

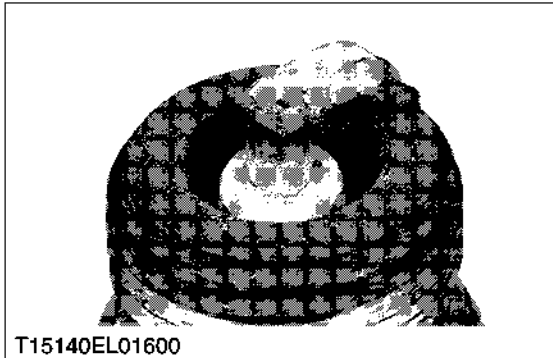
1. Remove the lower bonnet.
2. Remove the spark plug, and clean carbon from the electrode with a wire brush.
3. Measure the spark plug gap with a feeler gauge.
4. If the measurement is not within the factory specifications, repair or replace it.
5. If the electrode or insulator is deformed or cracked, replace the spark plug.
6. If the spark plug cap is defective, replace it.

Spark plug gap	Factory spec.	1.02 mm 0.040 in.
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(Reference)

- Recommended spark plug : CHAMPION Premium Gold 2071 (or equivalent)

W1033004



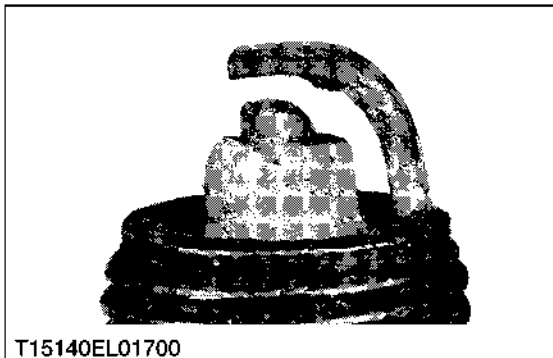
Spark Plug Inspection (Normal Condition)

Inspect the spark plug as soon as it is removed from the cylinder head. The deposits on the tip are an indication of the general condition of the piston rings, valves, and carburetor.

Normal :

A plug taken from an engine operating under normal conditions will have light tan or gray colored deposits. If the center electrode is not worn, a plug in this condition could be regapped and reused.

W1033145

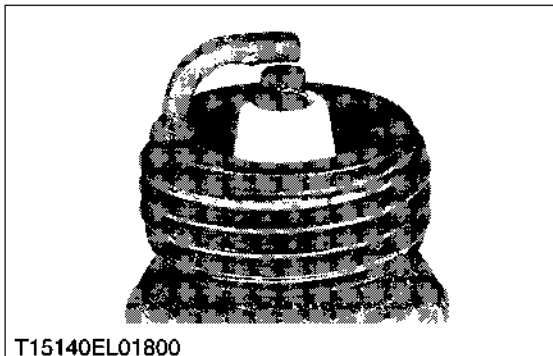


Spark Plug Inspection (Worn Condition)

Worn :

On a worn plug, the center electrode will be rounded and the gap will be eroded 0.10 inch or more than the correct gap. Replace a worn spark plug immediately.

W1033248

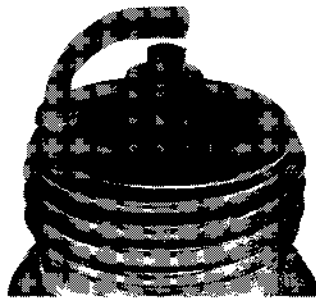


Spark Plug Inspection (Chalky White Deposit Condition)

Chalky White Deposits :

Chalky white colored deposits indicate overheating. This condition is usually accompanied by excessive gap erosion. A clogged grass screen, clogged cooling fins, and lean carburetion are some caused of overheating.

W1033342



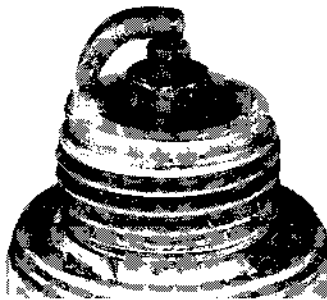
T15140EL01900

Spark Plug Inspection (Carbon Fouled Condition)

Carbon Fouled :

Soft, sooty, back deposits indicate incomplete combustion. Incomplete combustion is usually caused by overrich carburetion, weak ignition, or poor compression.

W1033404



T15140EL02000

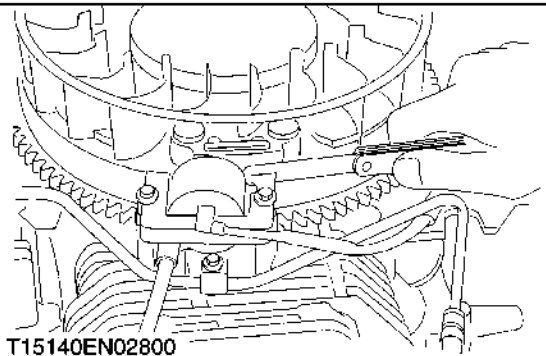
Spark Plug Inspection (Wet Fouled Condition)

Wet Fouled :

A wet plug is caused by excess fuel, or oil in the combustion chamber. Excess fuel could be caused by operating the engine with too much choke. Oil in the combustion chamber is usually caused by worn piston rings or valve guides.

W1033491

(B) Ignition Model



T15140EN02800

Ignition Module Air Gap

1. Measure the ignition module air gap with a feeler gauge.
2. If the measurement is not within the factory specification, loosen the ignition module mounting screws and reinstall the ignition module.

Ignition module (air gap)	Factory spec.	0.20 to 0.30 mm 0.008 to 0.012 in.
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W1033565

Ignition Module Coil Test (Simplified Test with Ohmmeter)

Measure the resistance of module secondary coil using an ohmmeter.

1. Connect one ohmmeter lead to lamination (1) of ignition module.
2. Connect the other lead to the spark plug terminal of high-tension lead (3).
3. Replace the ignition module if the factory specification are not indicated.

■ NOTE

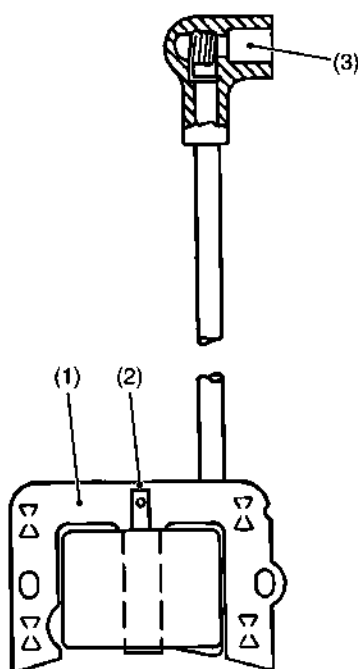
- This test cannot be performed unless ignition module has been fired at least once.

Secondary coil resistance (between lamination of ignition module and spark plug terminal of high tension lead)	Factory spec.	7900 to 10850 Ω
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(1) Lamination
(2) Kill Terminal

(3) High-Tension Lead

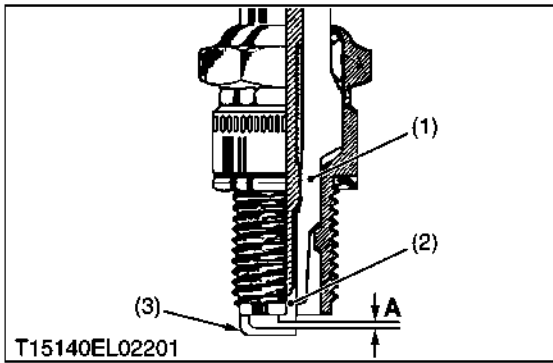
W1033645



T15140EL02101

(2) Checking and Adjusting

(A) Spark Plug



Spark Plug Cleaning, Inspection and Gap

- Carefully pull the plug cap from the spark plug, and remove the spark plug.
 - If the plug is oily or has carbon built up on it, clean the plug using a high flash-point solvent and a wire brush or other suitable tool.
 - If the spark plug electrodes (2), (3) are corroded or damaged, or if the insulator (1) is cracked replace the plug. Use the standard spark plug or its equivalent.
- Measure the spark plug gap (A) with a wire-type thickness gauge.
 - If the gap is incorrect, carefully bend the side electrode with a suitable tool to obtain the correct gap.

(Reference)

- Recommended spark plug: CHAMPION Premium Gold 2071 (or equivalent)

Spark plug gap	Factory spec.	1.02 mm 0.040 in.
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- (1) Insulator
(2) Center Electrode
(3) Side Electrode

A: Spark Plug Gap

W1019119

Spark Test



WARNING

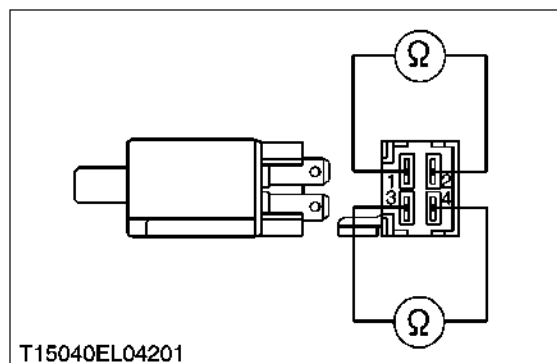
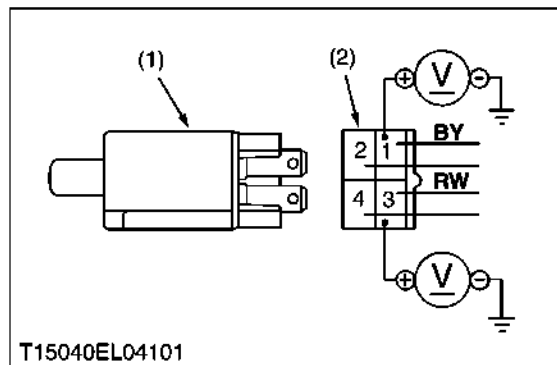
- Never hold the spark plug cap with wet hands while performing this test.
 - Make sure that no fuel has been spilled on the engine.
 - To avoid fire hazards, do not allow sparks near the plug hole.
- Open the bonnet.
 - Remove the spark plug from engine.
 - Put the spark plug inside the high voltage cord cap firmly.
 - Ground the threaded section to the engine body (not to painted or resin parts).
 - Disconnect **1P** connector from the fuel cut off solenoid.
 - Close the fuel cock under the fender.
 - Turn a crank by electric starter, and check the sparks.
 - If the plug does not spark or has a very weak spark, check the spark plug and ignition system.

W1019435

[5] ELECTRICAL EQUIPMENT

(1) Checking

(A) 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.

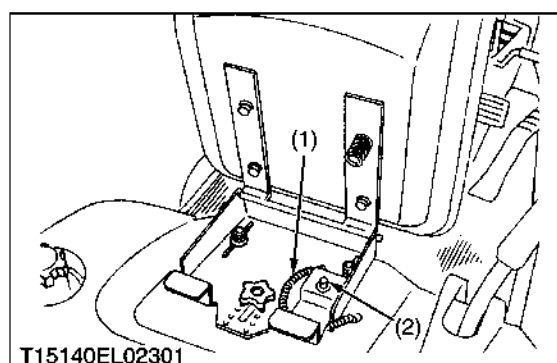
Resistance (1 terminal-2 terminal)	Factory spec.	Infinity
Resistance (3 terminal-4 terminal)	Factory spec.	Infinity

(1) PTO Switch

(2) 4P Connector

W1029375

(B) Seat Switch



Seat Switch Continuity

1. Disconnect the **2P** connector (1) for the seat switch (2).
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).

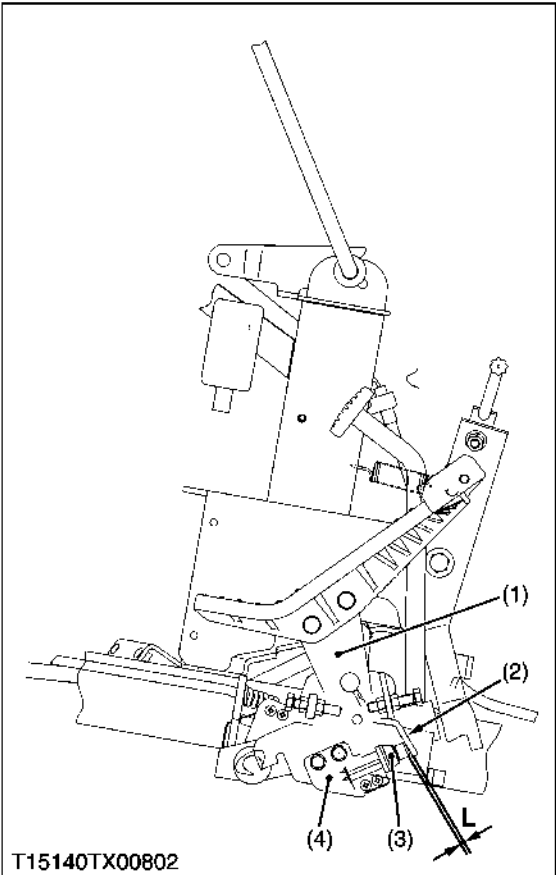
(1) 2P Connector

(2) Seat Switch

W1030037

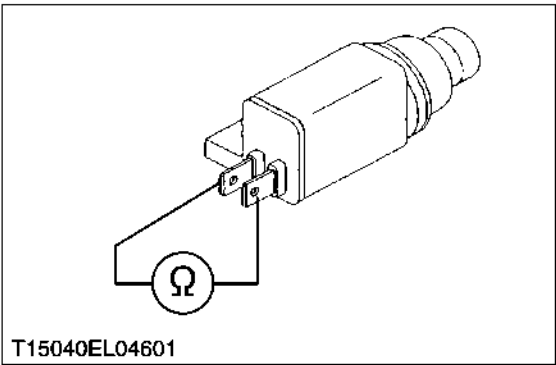
[6] KRA system (If Equipped)

- (1) Servicing
- (A) Reverse Switch



■ NOTE

- The gap adjustment should be done at the condition to have no play at reverse position.



Adjusting of Reverse Switch Gap

1. Check and adjust gap between reverse switch (3) and reverse switch lever (2).

Reverse switch gap (L)	Factory spec.	0 mm 0 in.
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- (1) Pedal System Comp.

(2) Reverse Switch Lever

(3) Reverse Switch
- (4) Reverse Switch Plate

L : Reverse Switch Gap

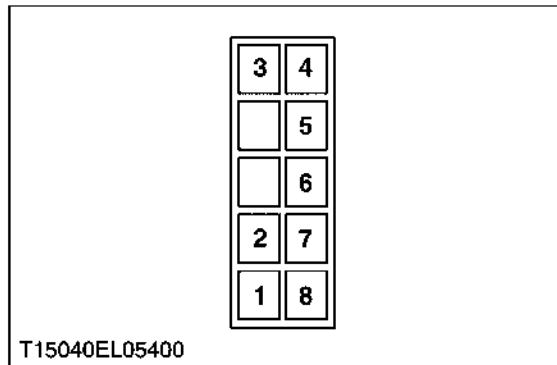
W1030362

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

(B) KRA system Unit (Harness connector side)**KRA system Unit Connector Battery Voltage**

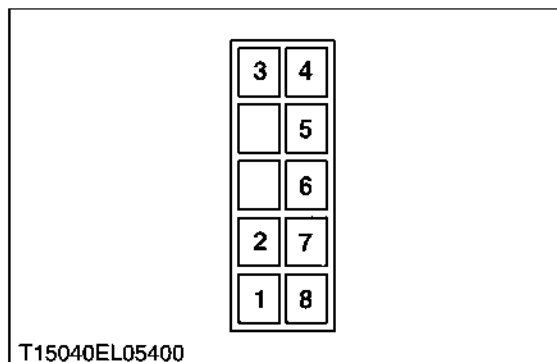
1. Turn the main switch to “ON” position. But do not start the engine.
2. Measure voltage with a voltmeter.

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

10 ELECTRICAL SYSTEM 2

MECHANISM

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1. WIRING DIAGRAM	10-M1
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2. KRA (Kubota Reverse Awareness) system (If Equipped)	10-M3

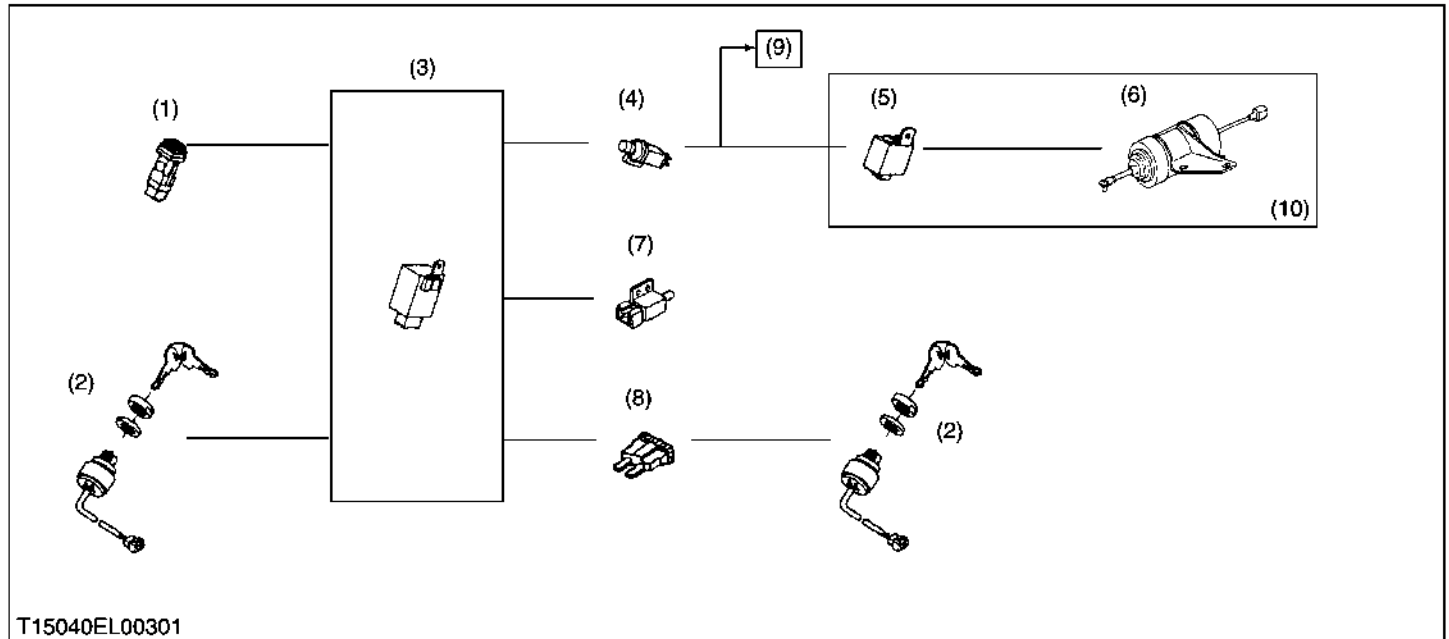
1. WIRING DIAGRAM

[1] COLOR OF WIRING

R Red	Br Brown
G Green	BY Black / Yellow
B Black	BW Black / White
W White	Or Orange
Y Yellow	Bor Black / Orange
L Blue	YW Yellow / White
RW Red / White	LR Blue / Red
RB Red / Black	Pi Pink
GY Green / Yellow	BR Black / Red

W1014099

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

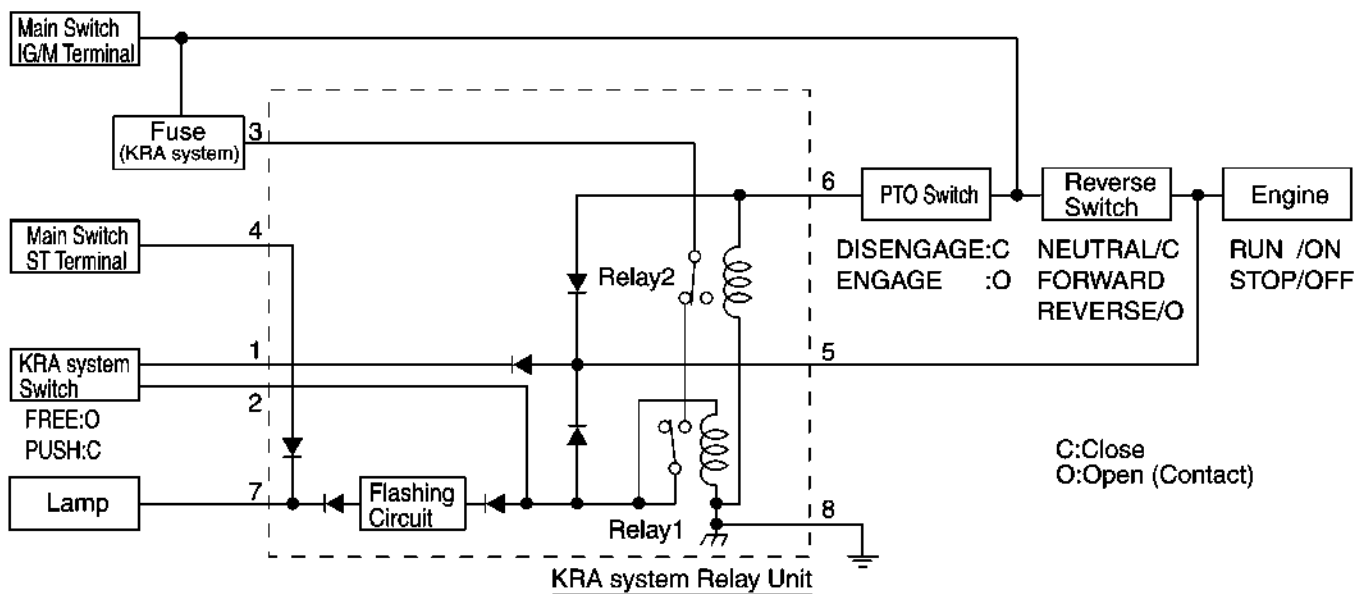
- While engine is running, current from main switch flows to the third contact point of the key stop timer. Current charges the timer circuit in the key stop timer. When the main switch is turned to “**OFF**” position, the stop solenoid is supplied current from the key stop timer. After that, the stop 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

KRA system Electrical Circuit

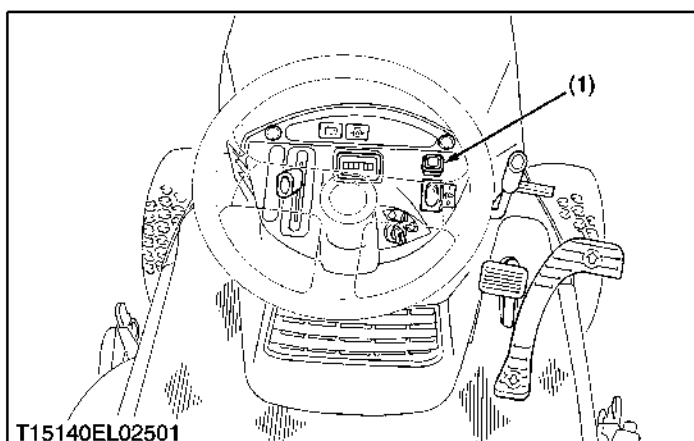


T15040EL05501

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



T15140EL02501

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)

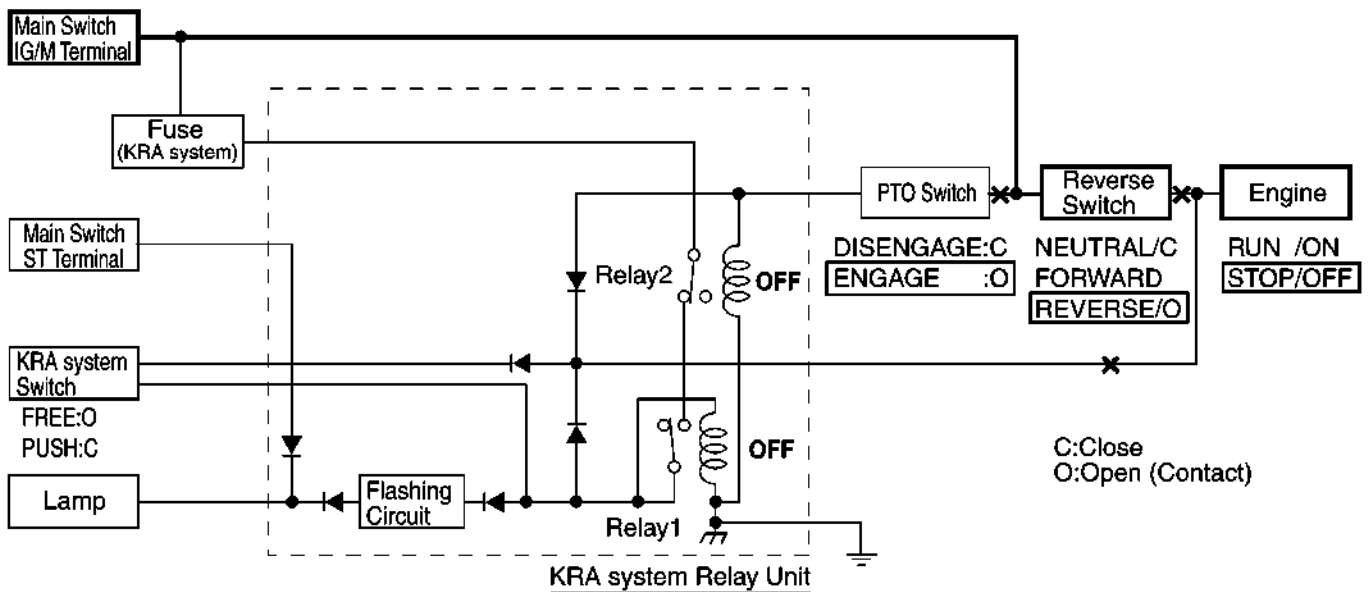
W1012973

KRA system Electrical Circuit

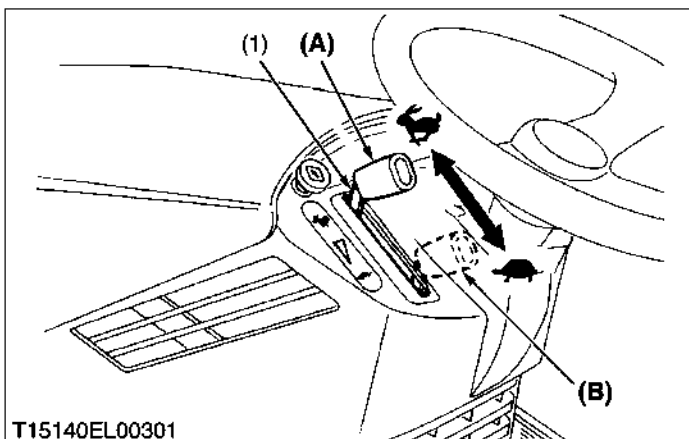
- In KRA system, engine stopping is mainly controlled by two parts, that is, PTO switch and reverse switch. The parts shown in the figure are connected in the electrical circuit.
- For engine stopping, electrical current should be supplied to key stop timer in diesel engine or ignition unit in gasoline engine.

W1018724

KRA system Operating Mode



T15040EL05601



T15140EL00301

■ 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

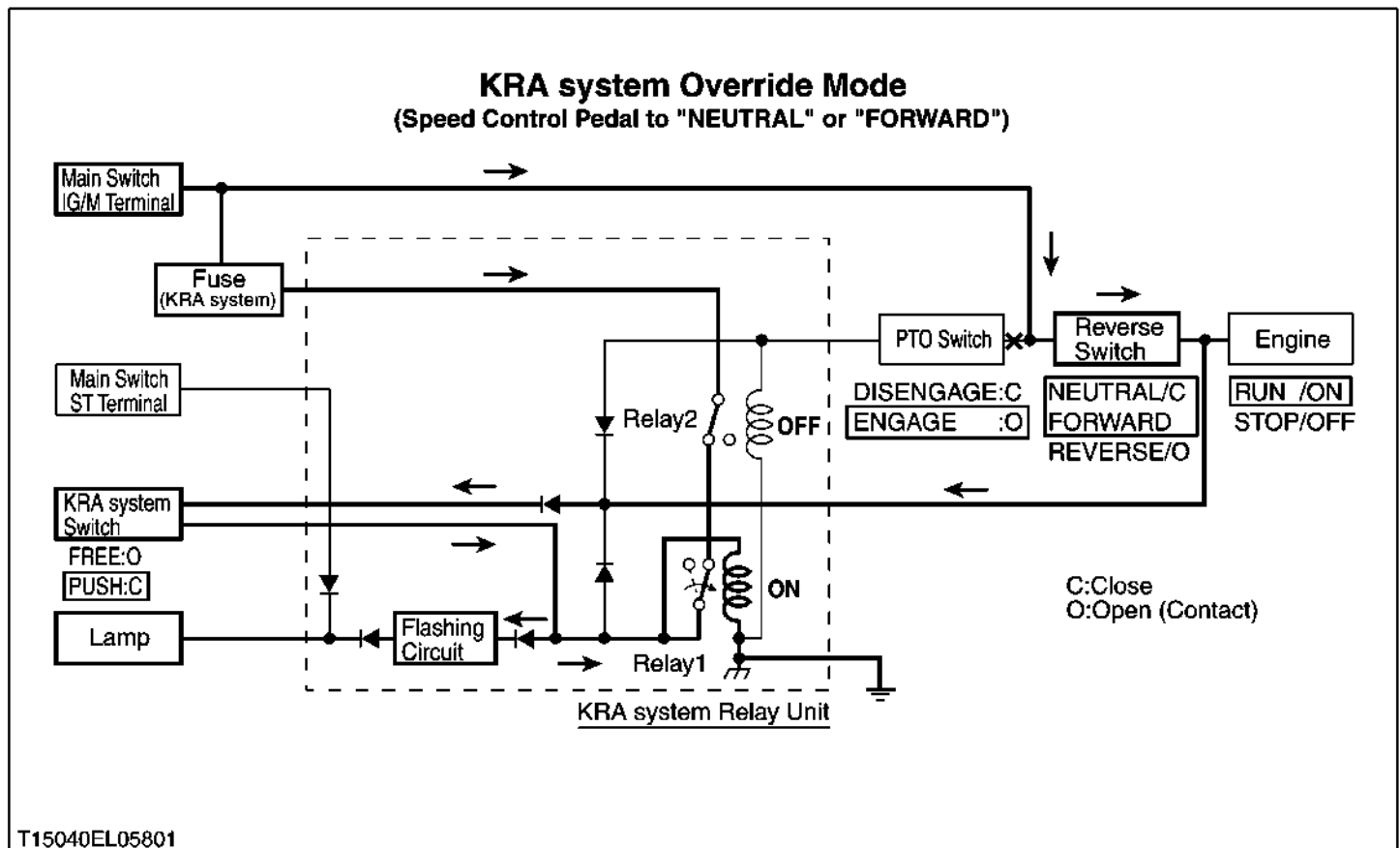
(B) “SLOW” Position

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.

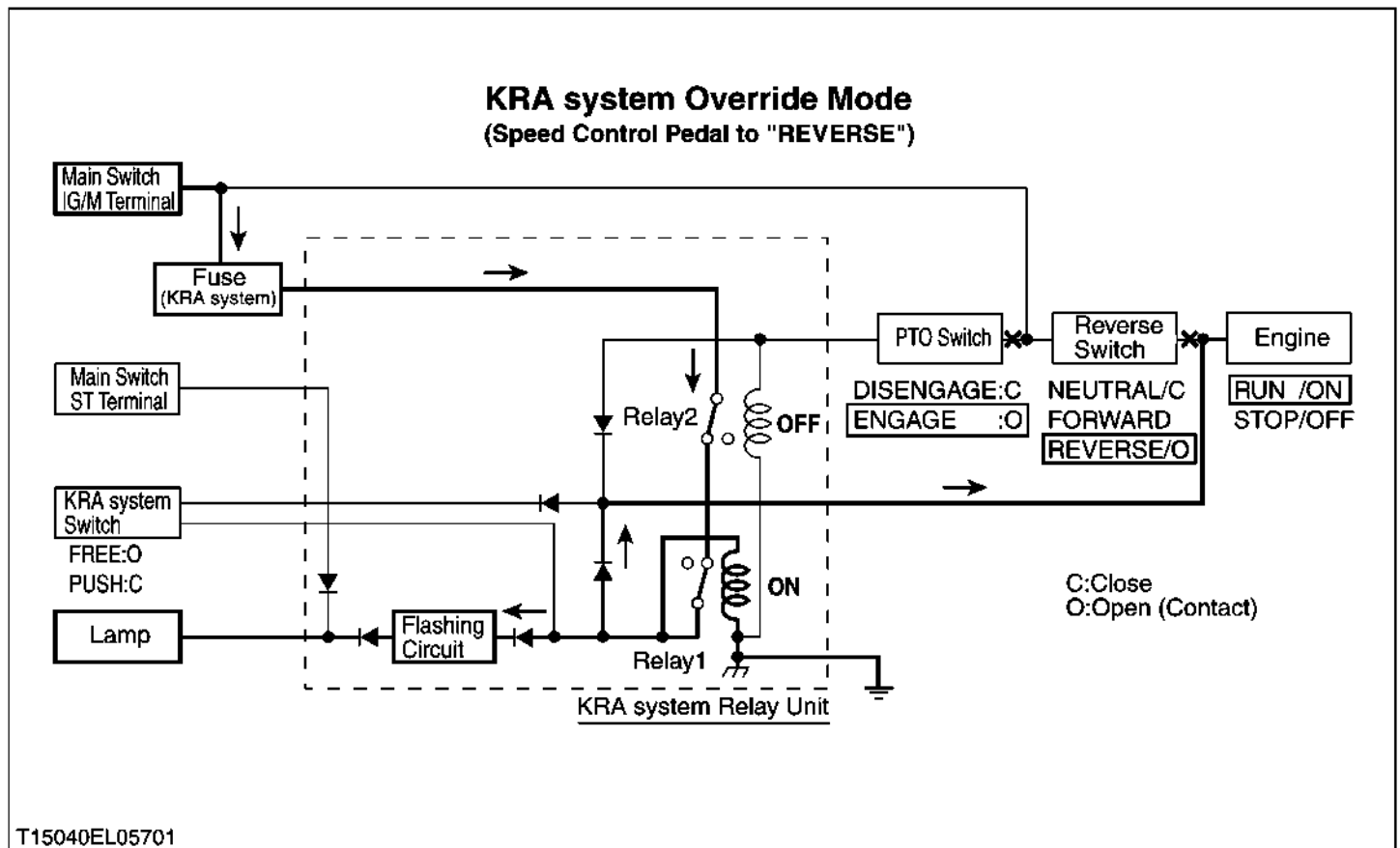
- And current flows to both flashing circuit and relay 1 in the KRA system relay unit.

- 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.

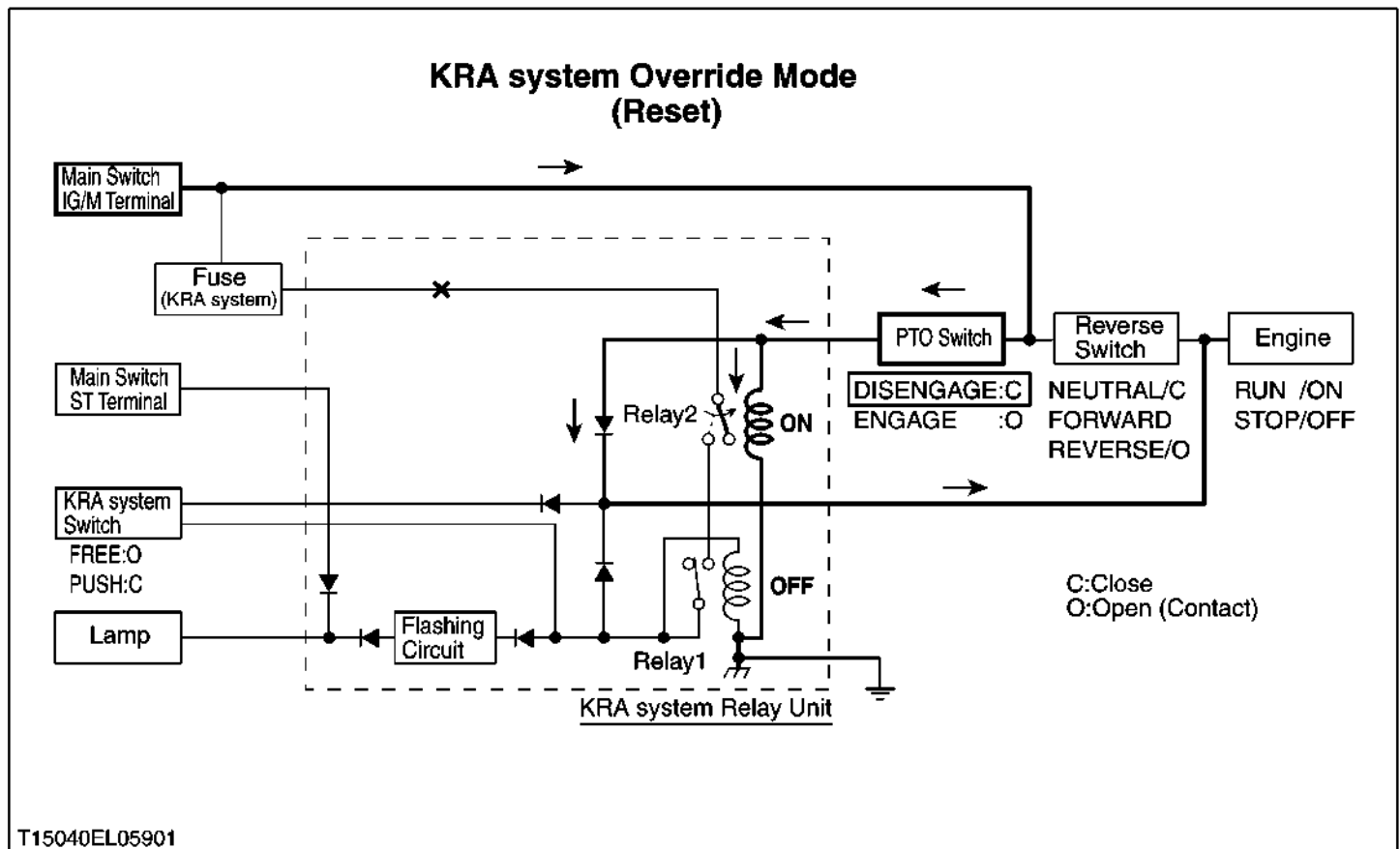
The above electrical circuit is a circuit at the moment of depressing speed control pedal to “REVERSE”.

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

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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	10-S8
	NO		
	Battery discharged or defective	Charge or replace	G-28

[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.	Seat	10-S19
	YES			
	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.	Set PTO clutch lever at "DISENGAGE" position.	10-S19
	YES			
		Fuse blown	Replace	—
		Main switch defective	Replace	10-S9
		Seat switch defective	Replace	10-S19
		Brake switch defective	Replace	—
		Engine stop relay defective	Replace	—
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	10-S19
		Engine stop relay defective	Replace	—
Engine stops when operator leaves seat. (PTO clutch lever is set at "DISENGAGE" position. Parking brake is not applied.)		PTO switch defective	Replace	10-S19
		Brake switch defective	Replace	—
		Seat switch defective	Replace	10-S19

T15140EL03302

[Starting System]

Symptom	Probable Cause	Solution	Reference Page
Starter does not function.	Is click sound from magnet switch ?		
	YES		
	Weak battery	Charge	G-28
	Faulty lead or connection (Magnet switch to motor)	Repair or replace	10-S11
	Starter motor defective	Repair or replace	10-S12, S13, S14
	NO		
	Battery discharged or defective	Charge or replace	G-28
	Fuse blown	Replace	—
	Wiring harness disconnected or improperly connected	Repair or replace	—
	Starter defective	Repair or replace	10-S12, S13, S14
Engine does not stop when main switch is turned "OFF" position.	Main switch defective	Replace	10-S9
	PTO clutch lever is set at "ENGAGE" position.	Set PTO clutch lever at "DISENGAGE" position.	8-S4, S6
	Brake switch defective	Repair or replace	—

[Engine Key Switch Shut-off System]

Engine does not stop when main switch is turned "OFF" position.	Is wiring harness connection normal ?		
	YES		
	E/G stop relay defective	Replace	—
	Main switch defective	Replace	10-S9
	Fuse blown	Replace	—
Engine does not restart.	NO		
	Wiring harness disconnected or improperly connected	Repair or replace	—
	Is wiring harness connection normal ?		
	YES		
Engine does not restart.	PTO clutch lever is set at "ENGAGE" position.	Set PTO clutch lever at "DISENGAGE" position.	8-S4, S6
	Engine stop solenoid defective	Replace	2-S47
	NO		
Engine does not restart.	Wiring harness disconnected or improperly connected	Repair or replace	—

T15140EL00402

[Charging System]

Symptom		Probable Cause	Solution	Reference Page
Battery discharges too quickly.	Is battery normal ?	YES		
		Charging coil defective	Repair or replace	10-S16
		Regulator defective	Replace	10-S15
		Wiring harness disconnected or improperly connected	Repair or replace	—
	NO	Battery discharged or defective	Replace	G-28

[Lighting System]

Head light does not light.	Is wiring harness connection normal ?	YES		
		Fuse blown	Replace	—
		Bulb blown	Replace	—
		Main switch defective	Replace	10-S9
		Light switch defective	Replace	—
	NO	Wiring harness disconnected or improperly connected	Repair or replace	—

T15140EL00502

[Easy Checker™]

Symptom	Probable Cause	Solution	Reference Page
Charging indicator lamp does not light when main switch is turned "ON" position.	Is wiring harness connection normal ?		
	YES		
	Fuse blown.	Replace	—
	Bulb blown.	Replace	—
	NO		
	Main switch defective	Replace	10-S9
	Wiring harness disconnected or improperly connected.	Repair or replace	—
Charging indicator lamp does not go off when engine is running.	Short circuit between stator coil lead and regulator	Repair or replace	10-S15
	Regulator defective.	Repair or replace	10-S15
Oil pressure indicator lamp lights up when engine is running.	Engine oil at specified level ?		
	YES		
	Engine oil pressure too low	Check and repair	10-S18
	Oil pressure switch defective	Replace	10-S18
	NO		
	Short circuit between oil pressure switch lead (1P connector) and chassis	Repair	10-S18
	Engine oil insufficient.	Replenish	G-31
Oil pressure indicator lamp does not light when main switch is turned "ON" position and engine is not running.	Is wiring harness connection normal ?		
	YES		
	Fuse blown.	Replace	—
	Bulb blown.	Replace	—
	NO		
	Main switch defective	Replace	10-S9
	Wiring harness disconnected or improperly connected.	Repair or replace	—

T15140EL03501

[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	10-S21
Engine stops when moving forward or at neutral position with engaging PTO lever.	Reverse switch gap adjustment improper	Reverse switch gap adjustment	10-S20
	Reverse switch defective	Reverse switch gap adjustment	10-S20
	Wiring harness defective	Wiring harness replacement	—
KRA system switch lamp does not flash when starting engine.	Bulb blown	Bulb replacement	—
	KRA system unit defective	KRA system unit replacement as an unit	10-S21
	Wiring harness defective	Wiring harness replacement	—
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	10-S21
	Wiring harness defective	Wiring harness replacement	—
	PTO switch adjustment improper	PTO switch adjustment	10-S19
	PTO switch defective	PTO switch replacement	10-S19
	KRA system switch defective	KRA system switch replacement	10-S21
	KRA system fuse blown	KRA system fuse replacement	—

T15140EL03402

2. SERVICING SPECIFICATIONS

BATTERY

Item		Factory Specification	Allowable Limit
Battery Voltage		More than 12 V	—
Potential difference		Less than 0.1 V	

W1013874

STATOR

Item		Factory Specification	Allowable Limit
Commutator	O.D.	—	27.0 mm 1.063 in.
Mica	Undercut	—	0.20 mm 0.079 in.
Brush	Length	10 mm 0.394 in.	6.0 mm 0.24 in.

W1019594

REGULATOR

Item		Factory Specification	Allowable Limit
Regulated Output	Voltage	Battery voltage to 15 V DC	—
Regulator	Resistance	See the table in page 10-S15	—

W1013874

STATOR COIL (CHARGING COIL)

Item		Factory Specification	Allowable Limit
Stator Coil (Charging coil)	Resistance	0.01 to 0.1 Ω	—
Unregulated Stator Output (Min.)	Voltage	26 VAC / 3000 rpm	—

W1019594

SPARK PLUG

Item		Factory Specification	Allowable Limit
Spark Plug	Gap	0.75 mm 0.030 in.	—

W1020306

IGNITION COIL

Item		Factory Specification	Allowable Limit
Ignition Coil	Gap	0.2 to 0.4 mm 0.008 to 0.016 in.	—
Secondary Coil	Resistance	See the table in page 10-S17	—

W1024502

3. TIGHTENING TORQUES

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

Item	N·m	kgf·m	ft-lbs
Starter			
• B terminal nut	9.8 to 13.7	1.0 to 1.4	7.2 to 10.1
• C terminal nut	5.9 to 9.8	0.6 to 1.0	4.3 to 7.2
• Through bolt	6.9 to 11.8	0.7 to 1.2	5.1 to 8.7
Ignition coil			
• Bolt (Stud bolt)	7.9	0.80	5.8
• Bolt (Flange bolt)	5.9	0.6	4.3

W1012736

4. CHECKING, DISASSEMBLING AND SERVICING



CAUTION

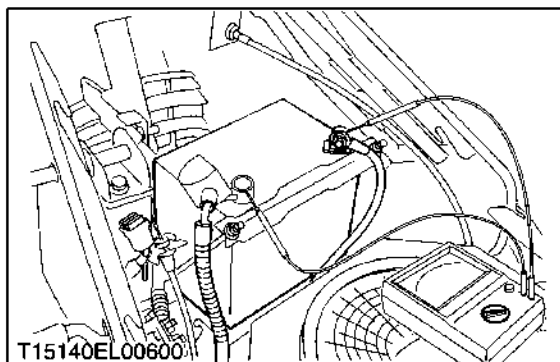
- To avoid accidental short circuit, be sure to attach the positive cable to the positive terminal before the negative cable is attached to the negative terminal.
- Never remove the battery cap while the engine is running.
- Keep electrolyte away from eyes, hands and clothes. If you are splattered with it, wash it away completely with water immediately.
- Keep open sparks and flames away from the battery at all times. Hydrogen gas mixed with oxygen becomes very explosive.

■ IMPORTANT

- If the machine is to be operated for 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

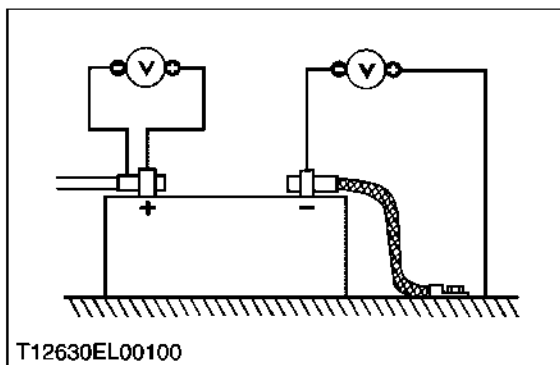
(1) CHECKING



Battery Voltage

1. Stop the engine and turn the main switch off.
2. Connect the COM (–) lead of the voltmeter to the battery's negative terminal post and the 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
-----------------	---------------	----------------



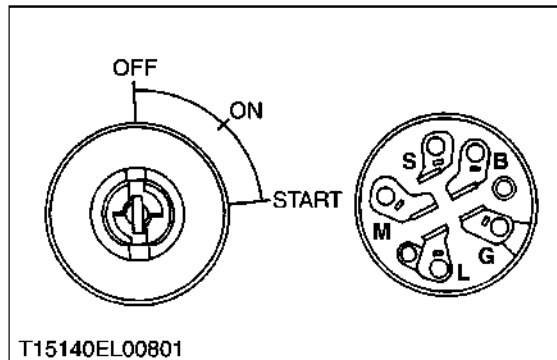
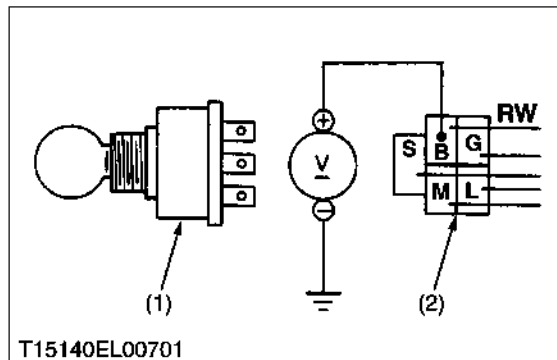
Battery Terminal Connection

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
----------------------	---------------	-----------------

[2] STARTING SYSTEM

(1) Checking



Main Switch

1) Connector Voltage

1. Turn the main switch off.
2. Open the bonnet and disconnect the 5P connector (2) from the main switch (1).
3. Measure the voltage with a voltmeter across the connector **B** terminal and chassis.
4. If the voltage differs from battery voltage, the wiring harness is faulty.

Voltage (B terminal-Chassis)	Factory spec.	Battery voltage
---------------------------------	---------------	-----------------

2) Terminal Continuity

1. Remove the main switch from the main panel.
2. Measure the resistance with an ohmmeter across terminals when the main switch is set at “OFF” position.
3. Measure the resistance with an ohmmeter across terminals when the main switch is set at “ON” position.
4. Measure the resistance with an ohmmeter across terminals when the main switch is set at “START” position.
5. If the resistance values specified below are not indicated, the main switch is faulty.

■ Main switch is set at “OFF” position.

	G terminal	M terminal	B terminal	L terminal	S terminal
G terminal		Continuity	Infinity	Infinity	Infinity
M terminal	Continuity		Infinity	Infinity	Infinity
B terminal	Infinity	Infinity		Infinity	Infinity
L terminal	Infinity	Infinity	Infinity		Infinity
S terminal	Infinity	Infinity	Infinity	Infinity	

■ Main switch is set at “ON” position.

	G terminal	M terminal	B terminal	L terminal	S terminal
G terminal		Infinity	Infinity	Infinity	Infinity
M terminal	Infinity		Infinity	Infinity	Infinity
B terminal	Infinity	Infinity		Continuity	Infinity
L terminal	Infinity	Infinity	Continuity		Infinity
S terminal	Infinity	Infinity	Infinity	Infinity	

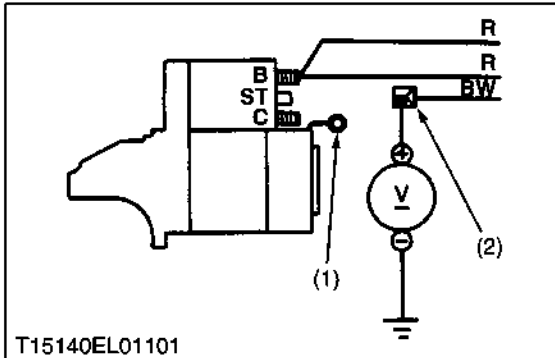
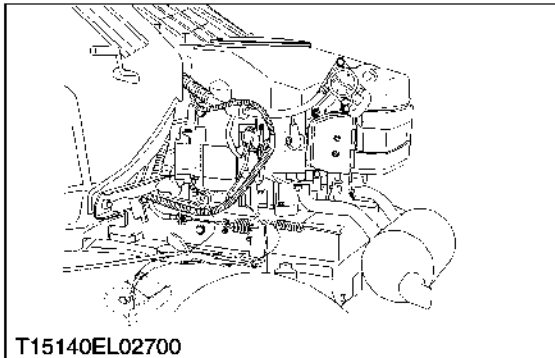
■ Main switch is set at “START” position.

	G terminal	M terminal	B terminal	L terminal	S terminal
G terminal		Continuity	Infinity	Infinity	Infinity
M terminal	Continuity		Infinity	Infinity	Infinity
B terminal	Infinity	Infinity		Continuity	Continuity
L terminal	Infinity	Infinity	Continuity		Continuity
S terminal	Infinity	Infinity	Continuity	Continuity	

(1) Main Switch

(2) 5P Connector

W1020774

(A) Starter**B Terminal Voltage**

1. Measure the voltage with a voltmeter between the **B** 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	B terminal	9.8 N·m 1.0 kgf·m 7.2 ft-lbs

Connector Voltage to Pull-in Coil

1. Disconnect the connecting lead (1) between starter motor and magnet switch, and keep the lead away from terminal of magnet.
2. Disconnect the **1P** connector (2) from the magnet switch.
3. Connect the positive jumper lead of a voltmeter with the **1P** connector (2) and negative jumper lead with chassis.
4. Make sure that the PTO switch is in the "**DISENGAGE**" position, depress the brake pedal and turn the main switch to "**START**" position.
5. If the voltage is the same as the battery voltage, the wiring harness, PTO switch, brake switch and main switch are correct.

Voltage (1P connector-Chassis)	Factory spec.	Battery voltage
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NOTE• **Wire color**

R : Red, RB : Red / Black, BW : Black / White

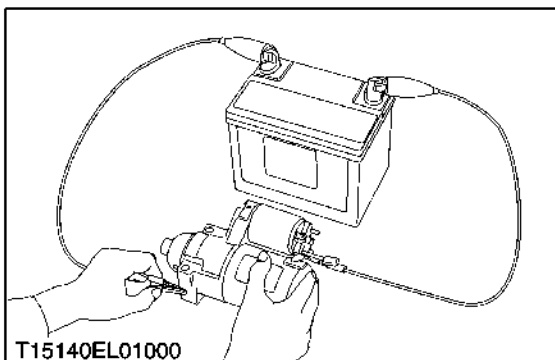
(1) Connecting Lead

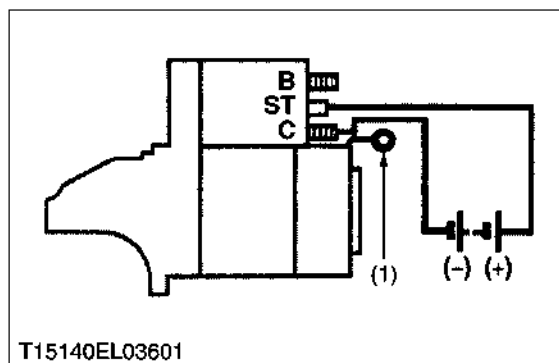
(2) 1P Connector

Motor Test**CAUTION**

- **This test room must be free from any flammable object. Keep your body away from pinion.**
- **Hold the starter by hand to prevent it from jumping up and down while testing the motor.**

1. Disconnect the ground cable clamp from the battery negative terminal post.
2. Disconnect the battery positive cable and the leads from the starter.
3. Remove the starter motor from the engine.
4. Disconnect the connecting lead from the starter **C** terminal.
5. Connect a jumper lead from the connecting lead 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.





Magnet Switch Test

1. Remove the starter from the engine.
2. Disconnect the connecting lead (1) from the starter **C** terminal.
3. Connect a jumper lead from the starter **ST** terminal to the battery positive terminal post.
4. Connect a jumper lead momentarily between the starter **C** terminal and the battery negative terminal post.
5. If the pinion gear does not pop out, check the magnet switch.

■ NOTE

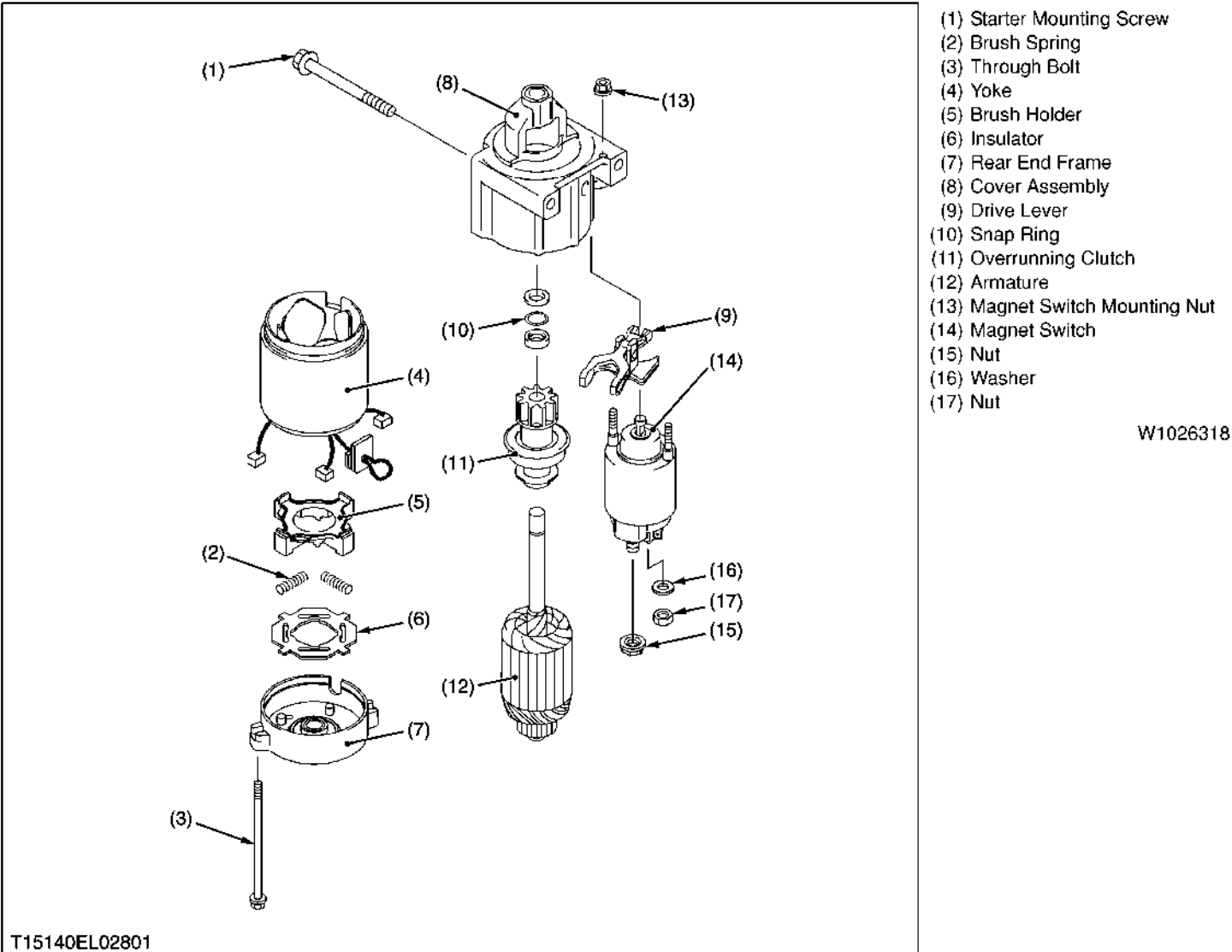
- **This test should be carried out for a short time, about 3 to 5 seconds.**

(1) Connecting Lead

W1027319

(2) Disassembling and Assembling

(A) Starter



1. Remove . magnet switch mounting nuts (13).
2. Remove the magnet switch (3) by sliding it up so that it is disconnected from the drive lever (10).
3. Unscrew the two through bolts (10).
4. Remove the rear end frame (7).
5. Remove the insulator.
6. Remove the brushes and brush springs, and pull out the brush holder (6).
7. Draw out the yoke from the cover assembly.
8. Draw out the armature with the drive lever.

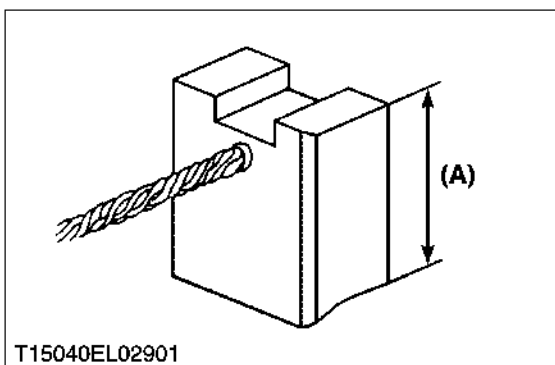
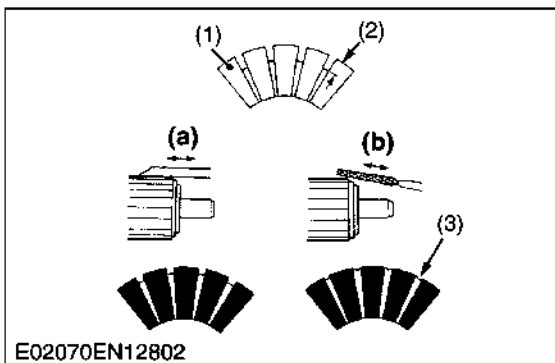
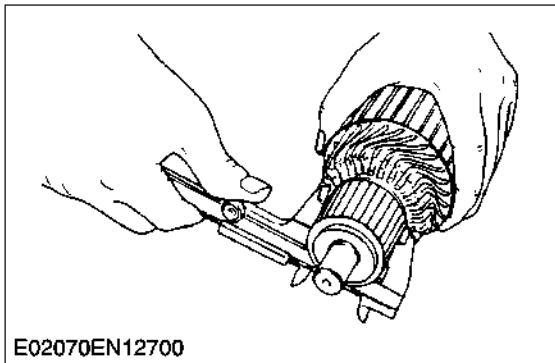
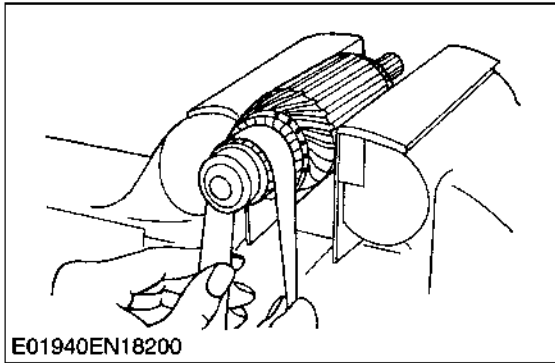
■ NOTE

- Do not damage to the brush and commutator.

(When reassembling)

- Apply grease (NIPPONDENSO No.50 or equivalent) yo the parts indicated in the figure.
(a) Joint of magnet switch.
(b) Teeth of pinion
(c) Armature Shaft

Tightening torque	Magnet switch mounting nut	7.8 N·m 0.8 kgf·m 5.8 ft-lbs
	Through bolt	5.9 N·m 0.6 kgf·m 4.3 ft-lbs

(3) Servicing**(A) Starter****Commutator and Mica**

1. Inspect 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 vernier calipers at several points.
3. If the minimum O.D. is less than the allowable limit, replace the armature.
4. Measure the mica undercut (2).
5. If the undercut is less than the allowable limit, correct it with a saw blade and chamfer the segment edges.

Commutator O.D.	Allowable limit	27.0 mm 1.06 in.
Mica undercut	Allowable limit	0.20 mm 0.0079 in.

- (1) Segment
(2) Undercut
(3) Mica

- (a) **Correct**
(b) **Incorrect**

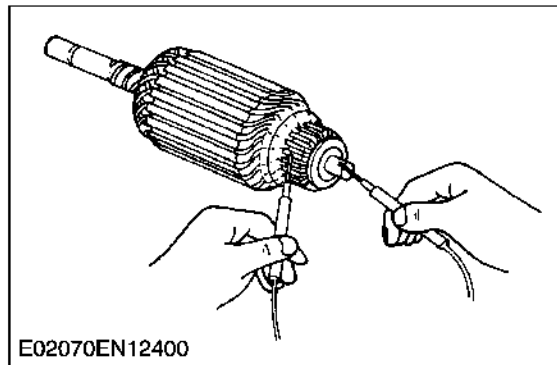
W1026148

Brush Wear and Brush Spring

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.
4. Inspect the brush spring for putting, cracks, rusting and burrs. Replace the spring if necessary.

Brush length (A)	Factory spec.	10 mm 0.394 in.
	Allowable limit	6.0 mm 0.24 in.

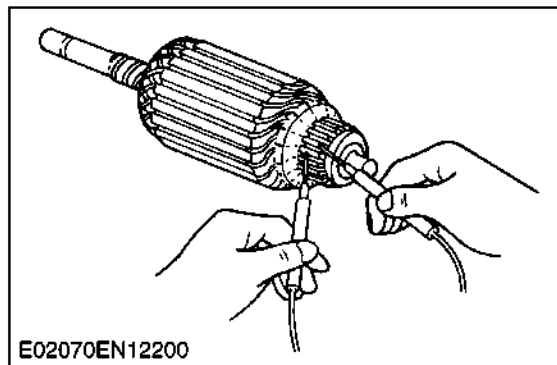
W1026848



Armature Coil

1. Check the continuity between the commutator and armature's shaft with an ohmmeter.
2. If there is continuity, replace the armature.
3. Check the continuity between the segments of the commutator with an ohmmeter.
4. If there is no continuity, replace the armature.

W1028687



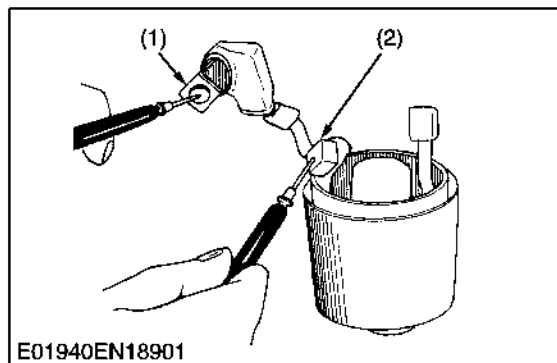
Field Coil

1. Check the continuity between the positive brushes (1) with and ohmmeter.
2. If there is no continuity, replace the yoke assembly.
3. Check the continuity between the positive brush (1) and yoke case with an ohmmeter.
4. If there is continuity, replace the yoke assembly.
5. Check the continuity between the negative brush (2) and yoke case with an ohmmeter.
6. If there is no continuity, replace the yoke assembly.

(1) Positive Brush

(2) Negative Brush

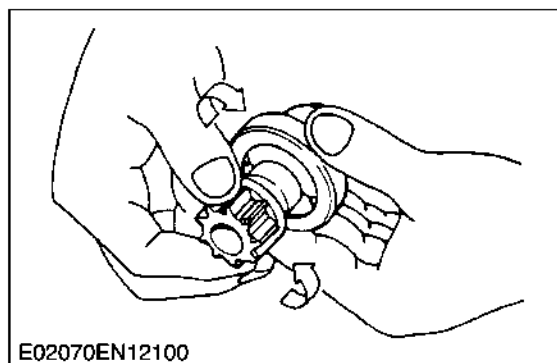
W1029894



Overrunning Clutch

1. Inspect the pinion and spline teeth for wear or damage. Replace the overrunning clutch if necessary.
2. Rotate the pinion by hand.
3. The pinion should turn counterclockwise freely, but should not turn clockwise.
4. If the pinion does not rotate normally, or if it makes noise, replace the overrunning clutch.

W1030033



[3] CHARGING SYSTEM

(1) Checking

Regulated Output Voltage

1. Warm up the engine.
2. Connect a voltmeter across the battery terminals, and measure the output voltage at various engine speeds.
3. If the output voltage is much higher than the specifications, the regulator is defective, or the regulator leads are loose or open.
4. If the output voltage does not rise as the engine speed increase, the regulator is defective.

Regulated output voltage	Factory spec.	Battery voltage to 15 V
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W1032006

Starter Coil (Charging Coil) Resistance

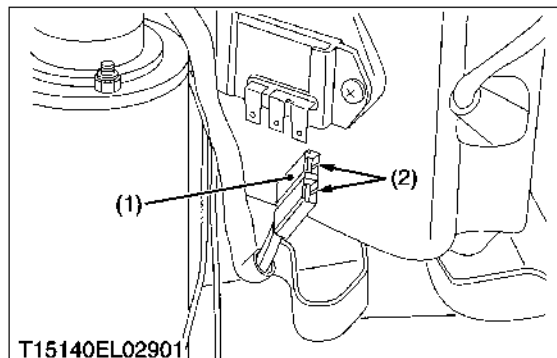
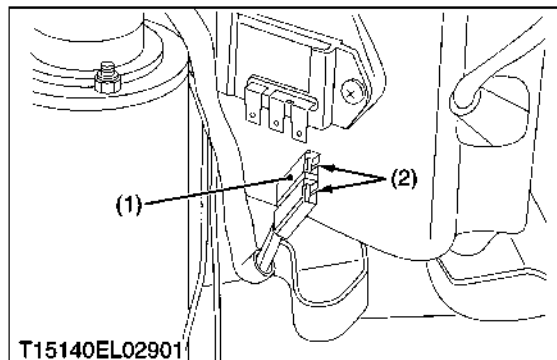
1. Disconnect the connector (1) from regulator.
2. Connect an ohmmeter between stator pins (2).
3. Measure the stator coil resistance.

Stator coil resistance	Factory spec.	0.01 to 0.1 ohms
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(1) Connector

(2) Stator Pin (AC Terminal)

W1032129



Unregulated Stator Output

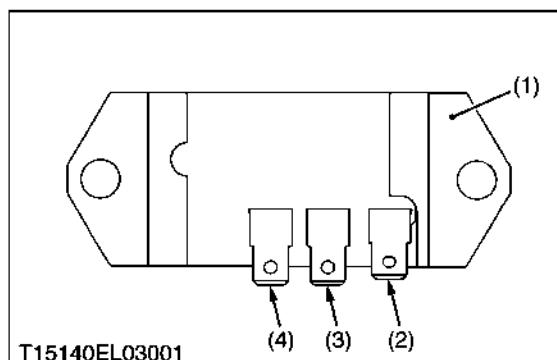
1. Disconnect the connector (1).
2. Connect AC voltmeter to the stator pins (2).
3. Start the engine. Run the engine at 3000 rpm.
4. Voltage reading should be minimum 26 VAC / 3600 rpm.
5. If the AV voltage reading is less than the specification, replace the stator.

Unregulated stator output (Min.)	Factory spec.	26 VAC / 3000 rpm
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(1) Connector

(2) Stator Pins

W1032291



Regulator Terminal Continuity

1. Connect the test leads to the points shown on the chart and read the resistance.

■ NOTE

- Resistance value may vary with individual meters.
2. If the specified values are not indicated, replace the regulator.

+lead -lead	1	2	3	4
1		infinity	infinity	infinity
2	infinity		0	500 Ω to infinity
3	infinity	0		500 Ω to infinity
4	7.8k Ω to infinity	800k Ω to infinity	800 Ω to infinity	

(1) Case

(3) Point

(2) Point

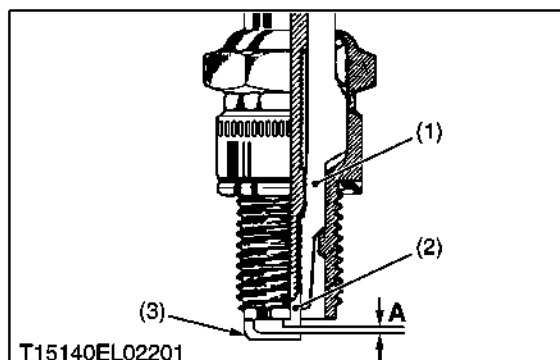
(4) Point

W1030338

[4] IGNITION SYSTEM

(1) Checking and Inspection

(A) Spark Plug



Spark Plug Cleaning, Inspection and Gap

1. Carefully pull the plug cap from the spark plug, and remove the spark plug.
 - If the plug is oily or has carbon built up on it, clean the plug using a high flash-point solvent and a wire brush or other suitable tool.
 - If the spark plug electrodes (2), (3) are corroded or damaged, or if the insulator (1) is cracked replace the plug. Use the standard spark plug or its equivalent.
2. Measure the spark plug gap (A) with a wire-type thickness gauge.
 - If the gap is incorrect, carefully bend the side clearance with a suitable tool to obtain the correct gap.

(Reference)

- Recommended spark plug : CHAMPION RCJ8Y

Spark plug gap	Factory spec.	0.75 mm 0.030 in.
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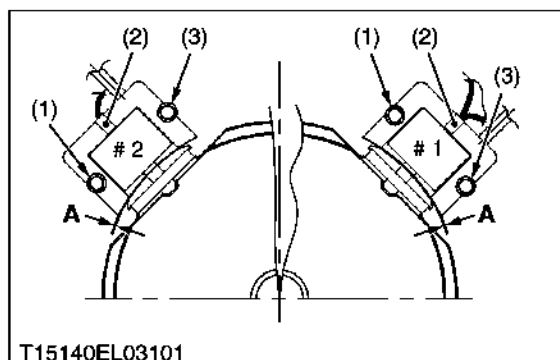
- (1) Insulator
(2) Center Electrode
(3) Side Electrode

A : Spark Plug Gap

W1031534

(2) Servicing

(A) Ignition Coil



Ignition Coil Air Gap (Clearance between Ignition Coil and Magnet)

Install ignition coil on crankcase so that the stop switch lead connector (2) face the screen, and tighten bolt (1) first, then tighten bolt (3).

While tightening bolts, adjust the ignition air gap (A) between the three legs of ignition coil and the two pole-plates of magnet to the specified gap value as shown.

■ NOTE

- Above procedure must be used to insure proper coil air gap is not too large.

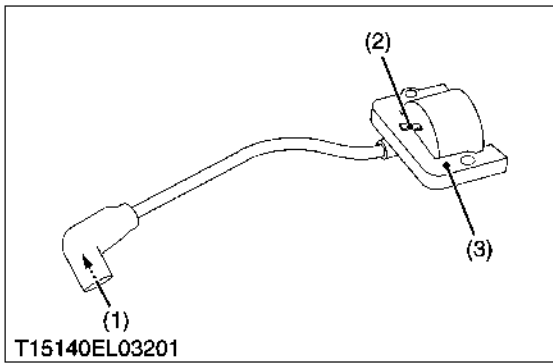
Ignition coil air gap	Factory spec.	0.2 to 0.4 mm 0.008 to 0.016 in.
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Tightening torque	Ignition coil bolt (Stud bolt)	7.9 N·m 0.80 kgf·m 5.8 ft-lbs
	Ignition coil bolt (Flange bolt)	5.9 N·m 0.6 kgf·m 4.3 ft-lbs

- (1) Tighten Bolt
(2) Stop Switch Lead Connector
(3) Tighten Bolt

A : Ignition Coil Air Gap

W1032345



Ignition Coil Inspection

- Remove the ignition coils (see Ignition Coil Removal).
- Measure the winding resistance as follows.

Set the hand tester to the $R \times 1k \Omega$

Special Tool - Hand Tester : Kawasaki 57001-1394

Make the measurement shown in the table.

Ignition Coil Winding Resistance

	+lead	(1)	(2)	(3)
-lead				
(1)			2 to 18k Ω	2 to 18k Ω
(2)		infinity		infinity
(3)		2 to 18k Ω	10 to 30k Ω	



CAUTION

- Use only Kawasaki Tester 57001-1394 with new battery at room temperature for this test. A tester other than the Kawasaki Hand tester should show different readings. If a megger or a meter with a large-capacity battery is used, the ignition coil will be damaged.

★If the tester does not read as specified, replace the coil.

(1) High Tension Cord

(3) Ignition Core Unit

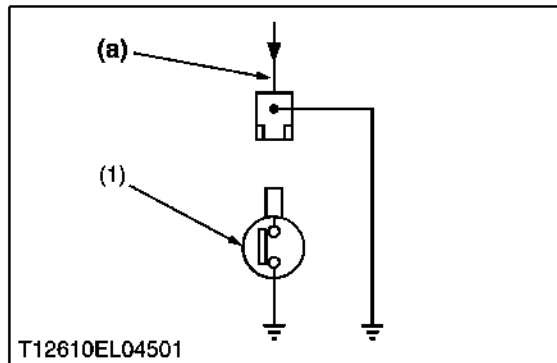
(2) Stop Switch Lead Connector

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[5] ELECTRICAL EQUIPMENT

(1) Checking

(A) Oil Pressure Switch (T1870 Only)



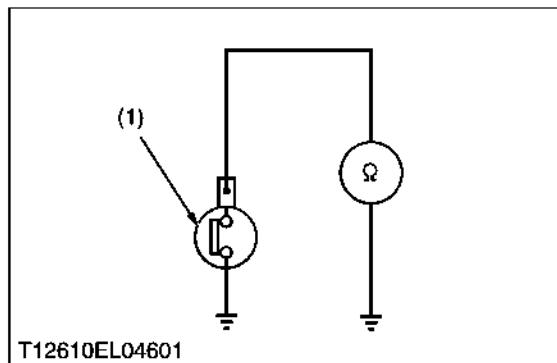
Oil Pressure Indicator Lamp

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

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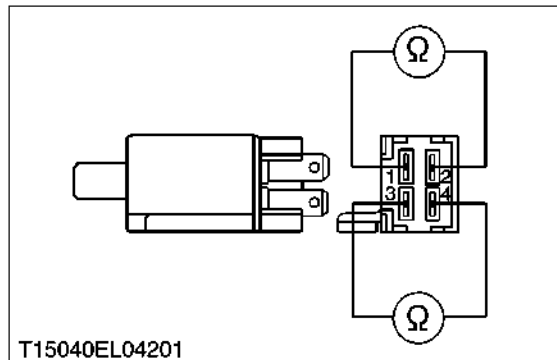
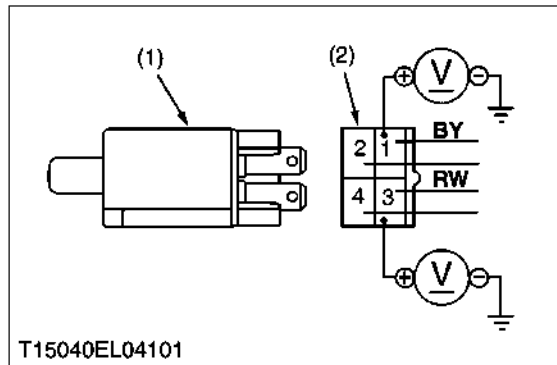
Engine oil Pressure Switch Continuity

1. Measure the resistance with an ohmmeter across the switch terminal and the chassis.
2. If 0 ohm is not indicated in the normal state, the switch is faulty.
3. If infinity is not indicated at pressure over 4.9 kPa (0.5 kgf/cm², 7 psi), the switch is faulty.

Resistance (Switch terminal – Chassis)	In normal state	0 Ω
	At pressure over approx. 4.9 kPa (0.5 kgf/cm ² , 7 psi)	Infinity

(1) Engine Oil Pressure Switch

W1026084

(B) 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.

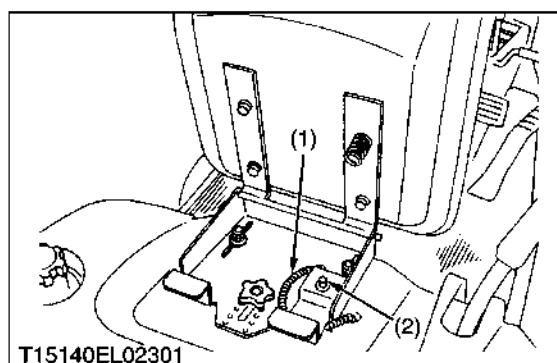
Resistance (1 terminal-2 terminal)	Factory spec.	Continuity
Resistance (3 terminal-4 terminal)	Factory spec.	Continuity

■ 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

(C) Seat Switch**Seat Switch Continuity**

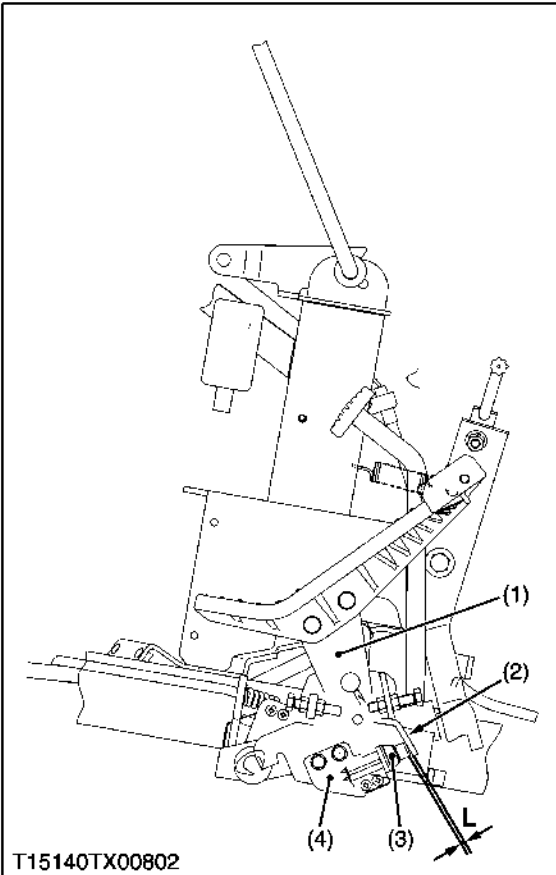
1. Disconnect the **2P** connector (1) for the seat switch (2).
2. Using an ohmmeter, check for continuity between the connector terminals.
There should be continuity when the seat switch is depressed (seated) and no continuity when the seat switch is released (standing).

(1) 2P Connector

(2) Seat Switch

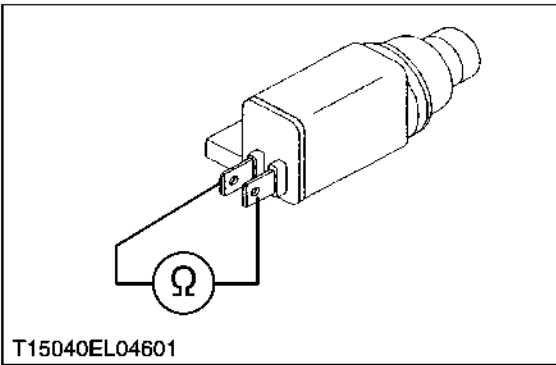
[6] KRA system (If Equipped)

- (1) Servicing
- (A) Reverse Switch



■ NOTE

- The gap adjustment should be done at the condition to have no play at reverse position.



Adjusting of Reverse Switch Gap

1. Check and adjust gap between reverse switch (3) and reverse switch lever (2).

Reverse switch gap (L)	Factory spec.	0 mm 0 in.
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- (1) Pedal System Comp.

(2) Reverse Switch Lever
- (3) Reverse Switch

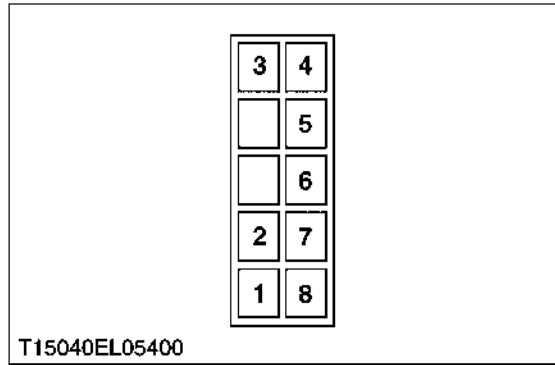
(4) Reverse Switch Plate

W1021083

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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(B) 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

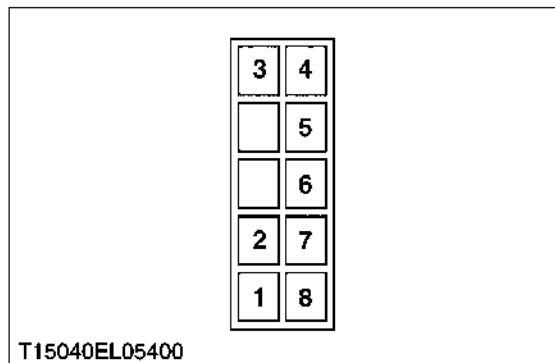
3. If 3 terminal - 8 terminal voltage is not battery voltage check the KRA system fuse blown and wire harness disconnected.
4. If 5 terminal - 8 terminal, 6 terminal - 8 terminal voltage are not battery voltage, check wire harness disconnected.
5. Continuity is not 0 Ω , harness or KRA system switch 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. |

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



11 MOWER

SERVICING

CONTENTS

1. TROUBLESHOOTING	11-S1
2. SERVICING SPECIFICATIONS	11-S3
3. TIGHTENING TORQUES	11-S4
4. CHECKING, DISASSEMBLING AND SERVICING.....	11-S5
[1] CHECKING AND ADJUSTING	11-S5
[2] DISASSEMBLING AND ASSEMBLING.....	11-S8

1. TROUBLESHOOTING

Symptom	Probable Cause	Solution	Reference Page
Blade does not rotate.	Is PTO system normal ?		
	NO	Weakened or broken PTO tension spring	Replace 8-S6
	YES	Damaged PTO belt	Replace 8-S5
Mower belt slipping		Damaged mower belt	Replace
		Weaken tension spring	Replace 8-S5
		Worn mower belt	Replace 11-S6
		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. 11-S7
		Cutting too low	Raise cutting height. 11-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. 11-S7
		Blades dull or damaged	Replace blades or have blades sharpened. 11-S5, 11-S10
		Debris in mower deck	Clean mower deck. —
Uneven cut		Mower deck not level	Level mower deck. 11-S6, 11-S7
		Ground speed too fast	Slow down. —
		Blades dull or damaged	Have blades sharpened. 11-S7
		Blades worn	Replace blades. 11-S10
		Low tire inflation	Add air to correct. G-10

T15140MO00101

Symptom	Probable Cause	Solution	Reference Page
Blades scalping grass	Cutting height too low	Raise cutting height.	11-S9
	Turning speed too fast	Reduce speed on turns.	—
	Ridges in terrain	Change mowing pattern.	—
	Bend blades	Replace blades.	11-S10
Excessive vibration	Debris on mower deck or in pulleys	Clean mower deck and pulleys.	—
	Damaged mower belt.	Replace mower belt.	11-S6, S8
	Damaged pulleys	Replace pulleys.	11-S9, S10 S11
	Pulleys out of alignment	Check pulleys.	11-S9, S10 S11
	Blades out of balance	Have blades balanced.	—

T15140MO00201

2. SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
Front Tip Blade to Rear Tip of Blade	Difference	Less than 5 mm 0.20 in.	—
Pulley Shaft to tension Arm Bushing	Clearance	0.020 to 0.062 mm 0.008 to 0.0024 in.	0.30 mm 0.0118 in.
Pulley Shaft	O.D.	24.959 to 24.980 mm 0.9826 to 0.9835 in.	—
Tension Pulley Bushing	I.D.	25.000 to 25.021 mm 0.9843 to 0.9851 in.	—

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3. TIGHTENING TORQUES

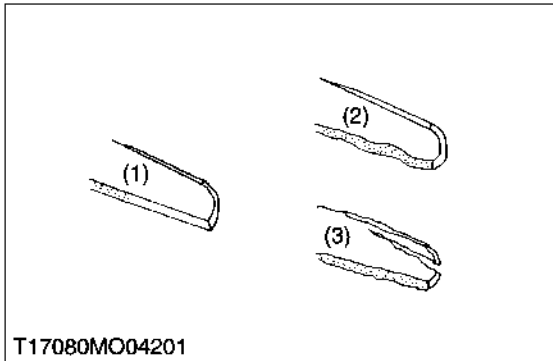
Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts : See page G-11.)

Item	N·m	kgf·m	ft-lbs
Belt retainer mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Tension pulley mounting nut	49.9 to 54.2	5.1 to 5.5	36.8 to 40.0
Blade screw	102.9 to 117.6	10.5 to 12.0	75.9 to 86.8
Blade pulley mounting nut	102.9 to 117.6	10.5 to 12.0	75.9 to 86.8
Pulley holder mounting bolt	49.9 to 54.2	5.1 to 5.5	36.8 to 40.0

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 same as worn blade (2) as shown in figure.
3. Replace the mower blades, if they are same as cracked blade (3) as shown in figure.

■ IMPORTANT

- Never forget to set the spring plate between mower blade and spline boss, when reassembling the mower blades.

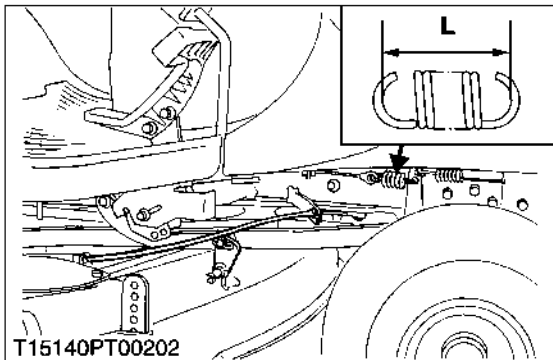
■ NOTE

- 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



Adjusting PTO Belt Tension



CAUTION

To avoid personal injury :

- Always stop the engine, set the parking brake, remove the key, and disengage PTO.

If the PTO belt slips while the PTO is operating under load, check the PTO spring length and adjust the tension spring length, as explained below.

1. Remove the belt support and PTO belt.
2. To install a new belt reverse the above procedure.
3. If "L" is shorter than 67 mm (2.64 in.) adjust it with the tension clutch cable adjusting nut.
 - "L" should be 69 to 72 mm (2.72 to 2.84 in.).
4. After adjustment tighten the nut securely.
 - When replacing the PTO belt, "L" should be 73 to 75 mm (2.87 to 2.95 in.) at 51 mm (2 in.) cutting height.

PTO belt tension spring length (L)	Factory spec.	69 to 72 mm 2.72 to 2.84 in.
------------------------------------	---------------	---------------------------------

L : PTO Belt Tension Spring Length

W1014877

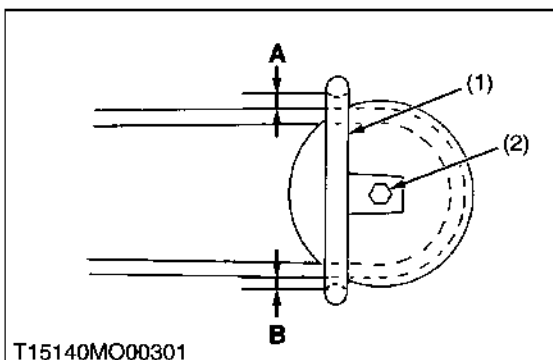
Adjusting PTO Belt Support

When the mower belt has been replaced or if the mower belt support has comes off position, set the PTO lever to the "ENGAGED" position, adjust the belt support position to the specifications below and tighten up the belt support bolt.

Clearance between PTO belt support and belt (A), (B)	Factory spec.	69 to 72 mm 2.72 to 2.84 in.
--	---------------	---------------------------------

(1) Belt Support
(2) Bolt

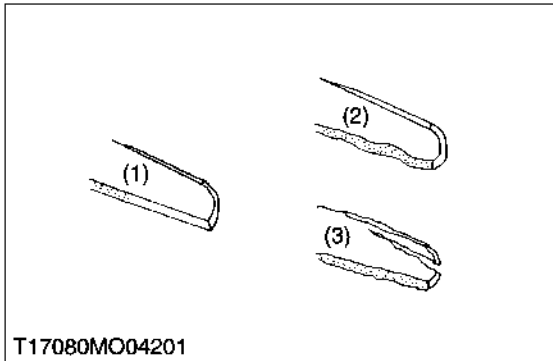
A, B : Clearance between belt support and belt. 3 to 4 mm (0.118 to 0.157 in.)



W1015604

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 same as worn blade (2) as shown in figure.
3. Replace the mower blades, if they are same as cracked blade (3) as shown in figure.

■ IMPORTANT

- Never forget to set the spring plate between mower blade and spline boss, when reassembling the mower blades.

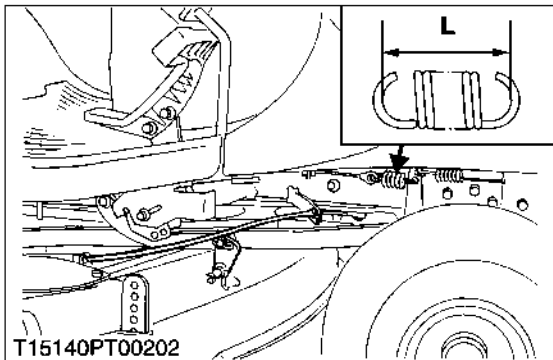
■ NOTE

- 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



Adjusting PTO Belt Tension

⚠ CAUTION

To avoid personal injury :

- Always stop the engine, set the parking brake, remove the key, and disengage PTO.

If the PTO belt slips while the PTO is operating under load, check the PTO spring length and adjust the tension spring length, as explained below.

1. Remove the belt support and PTO belt.
2. To install a new belt reverse the above procedure.
3. If "L" is shorter than 67 mm (2.64 in.) adjust it with the tension clutch cable adjusting nut.
 - "L" should be 69 to 72 mm (2.72 to 2.84 in.).
4. After adjustment tighten the nut securely.
 - When replacing the PTO belt, "L" should be 73 to 75 mm (2.87 to 2.95 in.) at 51 mm (2 in.) cutting height.

PTO belt tension spring length (L)	Factory spec.	69 to 72 mm 2.72 to 2.84 in.
------------------------------------	---------------	---------------------------------

L : PTO Belt Tension Spring Length

W1014877

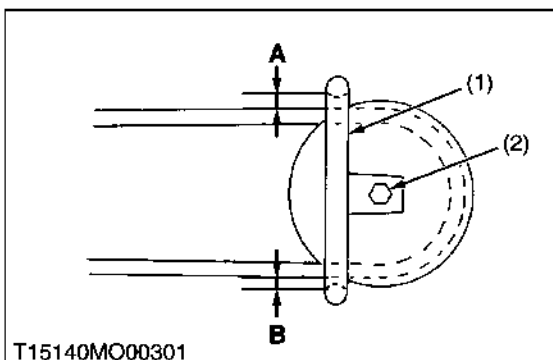
Adjusting PTO Belt Support

When the mower belt has been replaced or if the mower belt support has comes off position, set the PTO lever to the "ENGAGED" position, adjust the belt support position to the specifications below and tighten up the belt support bolt.

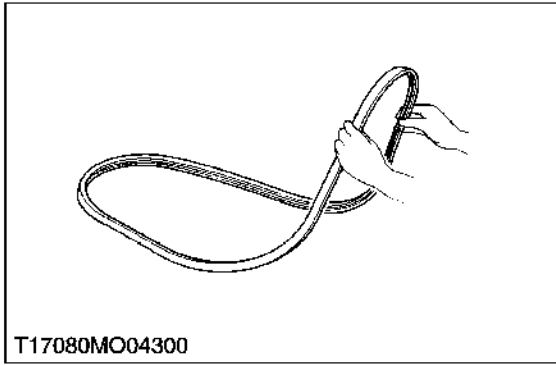
Clearance between PTO belt support and belt (A), (B)	Factory spec.	69 to 72 mm 2.72 to 2.84 in.
--	---------------	---------------------------------

(1) Belt Support
(2) Bolt

A, B : Clearance between belt support and belt. 3 to 4 mm (0.118 to 0.157 in.)



W1015604



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)

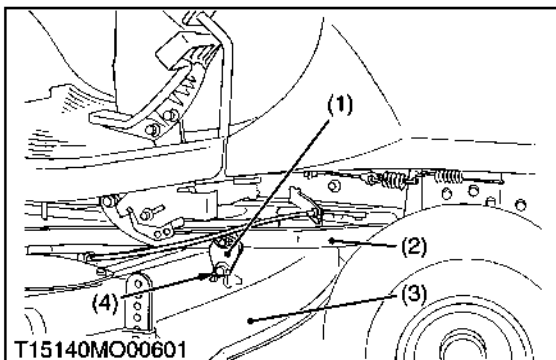
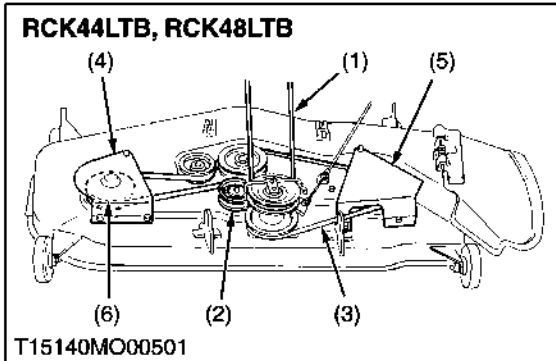
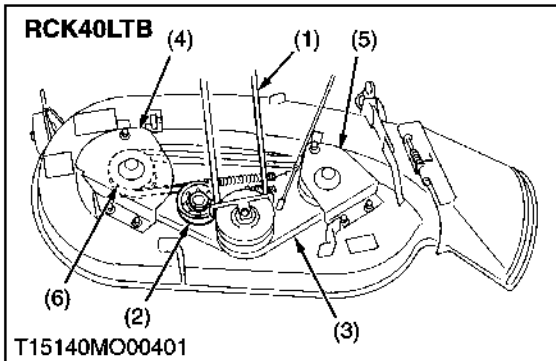
1. remove the mower from the machine.
2. Remove the left and right hand shield from the mower deck.
3. Clean around the pulleys to remove the belt from the pulley. Slip the belt over the top of the left side pulley.
4. To install a new belt, reverse the above procedure.

■ NOTE

- Tighten cover bolts securely.

- | | |
|--------------------|-----------------------|
| (1) PTO Belt | (4) Left Hand Shield |
| (2) Tension Pulley | (5) Right Hand Shield |
| (3) Belt | (6) Left Side Pulley |

W1011170

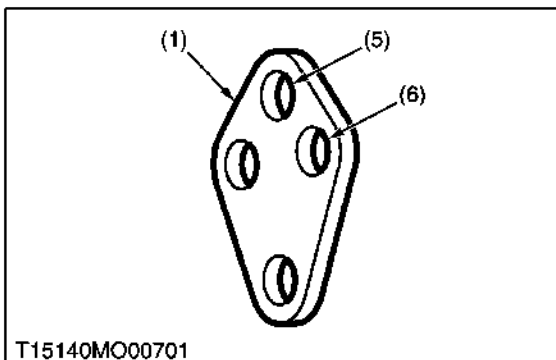


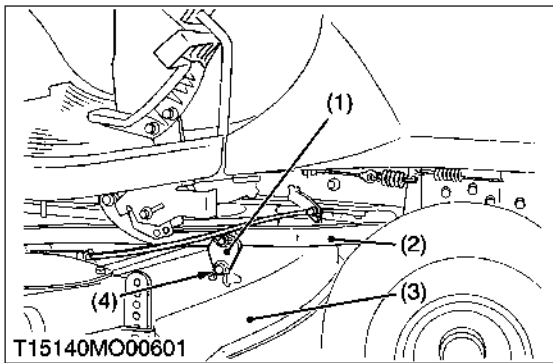
Checking Mower Link (T1570 / RCK40LTB, T1670 / RCK40LTB)

1. Check the mower link hole (5), (6) shown in the figure.
2. Upper hole (5) of the mower link (1) is used for link 3 (2).
3. Lower hole (6) of mower link (1) is used for mower deck (3).

- | | |
|----------------|----------------|
| (1) Mower Link | (4) Clevis Pin |
| (2) Link 3 | (5) Upper Hole |
| (3) Mower Deck | (6) Lower Hole |

W1016962





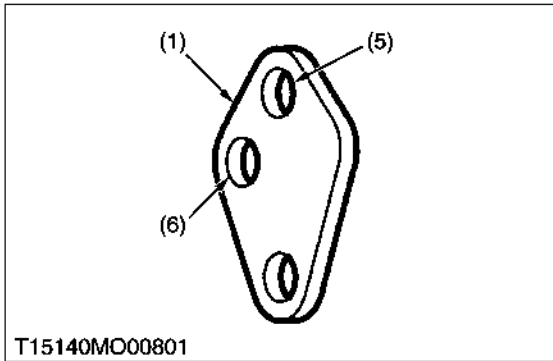
Checking Mower Link

(T1670 / RCK44LTB, T1770 / RCK44LTB, T1870 / RCK48LTB)

1. Check the mower link hole (5), (6) shown in the figure.
2. Upper hole (5) of the mower link (1) is used for link 3 (2).
3. Lower hole (6) of the mower link (1) is used for mower deck (3).

- | | |
|----------------|----------------|
| (1) Mower Link | (4) Clevis Pin |
| (2) Link 3 | (5) Upper Hole |
| (3) Mower Deck | (6) Lower Hole |

W1013632



Adjusting Cutting Height

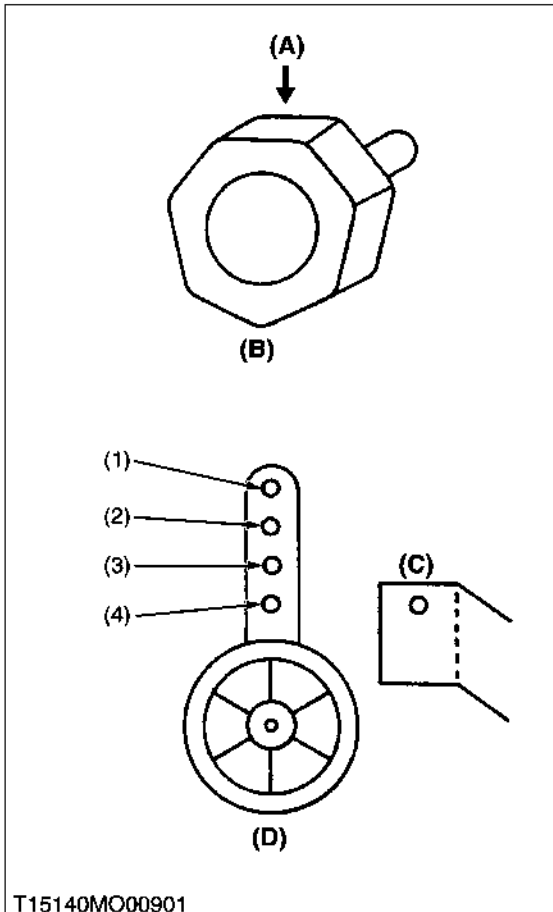
1. To set the cutting height, raise the lift lever to "LIFT" position and turn the cutting height adjusting dial to a desired cutting height. Now lower the lift lever and the mower will be set to cutting height.
2. Set the anti-scalp roller's height as to keep clearance between roller and ground more than 5 mm (0.2 in.).
3. Lower the mower deck by pushing the lift lever downward. This lowers the mower deck from the transport position to the operating position.
4. Use the higher setting for moving in a rough area or where mowing tall grass. Lower setting should be used only for smooth lawns where short grass is desired.

Cutting height	Cutting height adjusting dial position	Hole of anti-scalp roller
25 mm (Approx. 1.0 in.)	1.0	4
38 mm (Approx. 1.5 in.)	1.5	4
51 mm (Approx. 2.0 in.)	2.0	3
64 mm (Approx. 2.5 in.)	2.5	3
76 mm (Approx. 3.0 in.)	3.0	2
89 mm (Approx. 3.5 in.)	3.5	2
102 mm (Approx. 4.0 in.)	4.0	1

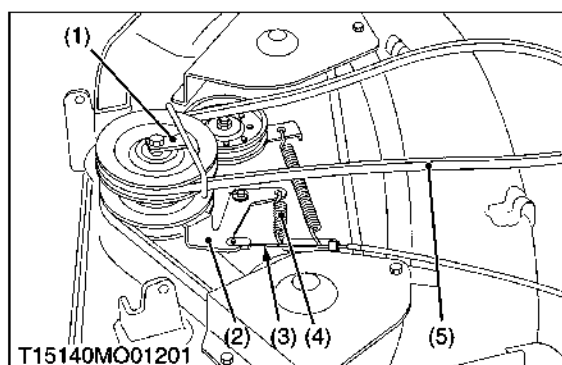
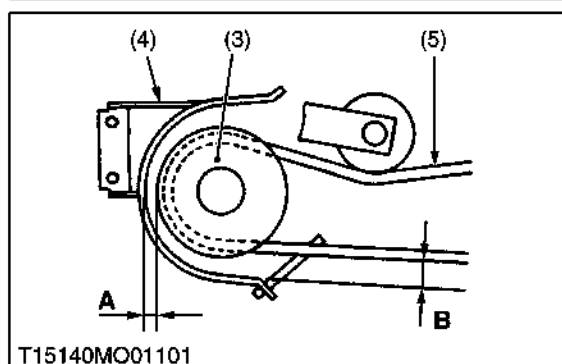
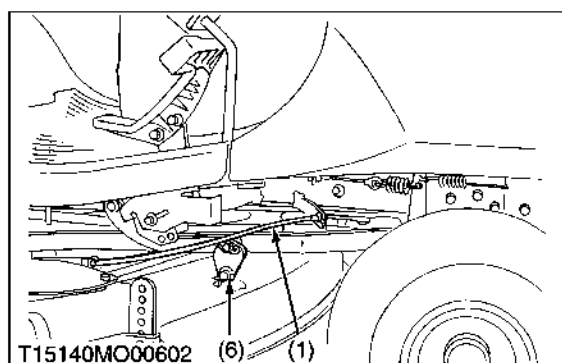
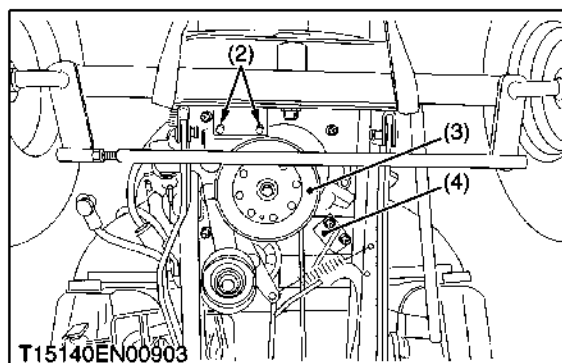
- (1) Anti-scalp Roller Hole
- (2) Anti-scalp Roller Hole
- (3) Anti-scalp Roller Hole
- (4) Anti-scalp Roller Hole

- (A) Dial Position
- (B) Cutting Height Adjusting Dial
- (C) Mower Deck
- (D) Anti-scalp Roller

W1017163



[2] DISASSEMBLING AND ASSEMBLING



Dismounting Mower

1. Place the vehicle on level ground, and stop the engine.
2. Set the cutting height adjusting dial to "1.0" position, and down the mower.
3. Unscrew two screws (2), and remove the belt retainer (4).
4. Remove the PTO belt (5) from the engine pulley (3).
5. Pull out the spring lock pin, and disconnect the mower brake wire (1) from the PTO tension arm.
6. Remove the split pin (6) and clevis pins, and disconnect the links from the mower deck.
7. Set the lift lever to "LIFT" position.
8. Turn the front wheel to the right, and pull out the mower to the left.

(When reassembling)

- Install the belt retainer (4) after adjusting it with the PTO clutch lever in engaged position.

Clearance (A) between belt retainer and pulley	Factory spec.	1 to 2 mm 0.04 to 0.08 in.
Clearance (B) between belt retainer and belt	Factory spec.	6 to 7 mm 0.24 to 0.28 in.

- (1) Mower Brake Wire
- (2) Screw
- (3) Engine Pulley
- (4) Belt Retainer
- (5) PTO Belt
- (6) Split Pin

A : Clearance between belt retainer and pulley

B : Clearance between belt retainer and belt

W1017723

PTO Belt and Mower Brake

1. Unscrew the belt retainer mounting screw, and remove the belt retainer (1).
2. Remove the PTO belt (5).
3. Remove the mower brake wire (3) and return spring (4).
4. Pull out the cotter pin, and remove the mower brake (2)

(When reassembling)

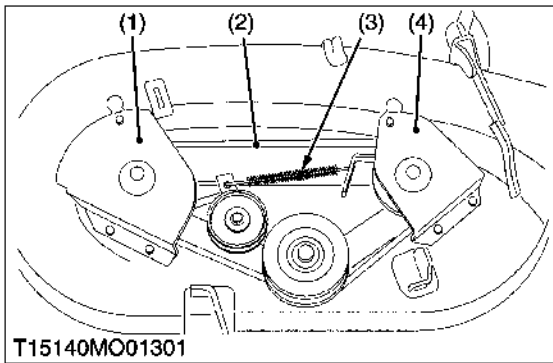
■ IMPORTANT

- After mounting the mower on the vehicle, check to see that the belt retainer does not contact with PTO belt when the PTO clutch lever is set to "ENGAGE" position.
- After mounting the mower on the vehicle, be sure to check the mower brake operation. (See page 8-S4.)

Tightening torque	Belt retainer mounting screw	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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- (1) Belt Retainer
- (2) Mower Brake
- (3) Mower Brake Wire
- (4) Return Spring
- (5) PTO Belt

W1017983



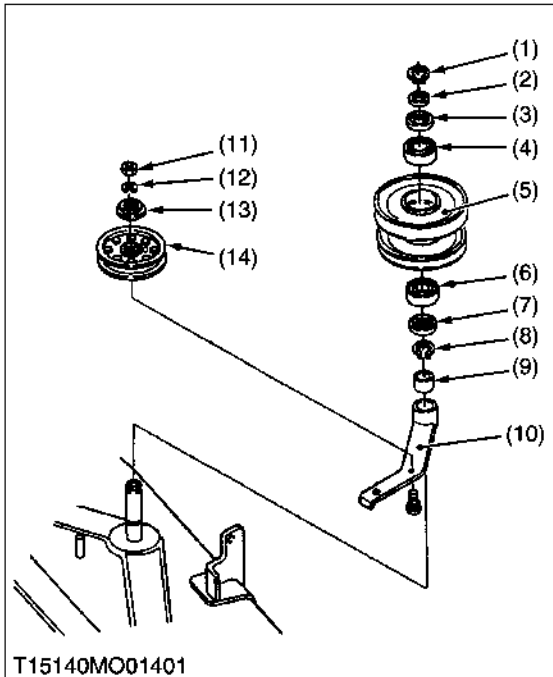
Pulley Cover and Mower Belt

1. Remove the left pulley cover (1) and right pulley cover (4).
2. Remove the tension spring (3).
3. Remove the mower belt (2).

(1) Pulley Cover (Left)
(2) Mower Belt

(3) Tension Spring
(4) Pulley Cover (Right)

W1018317



5.5-6.0 Pulley and Tension Arm

1. Remove the external snap ring (1) and plain washer (2).
2. Remove the 5.5-6.0 pulley (5) from the pulley shaft.
3. Remove the bearing covers (3), (7) and bearings (4), (6) from the 5.5-6.0 pulley.
4. Remove the external snap ring (8), and then remove the tension arm (10) with the tension pulley (14).
5. Unscrew the tension pulley mounting nut (11), and remove the spring washer (12), tension pulley cover (13) and tension pulley (14).

(When reassembling)

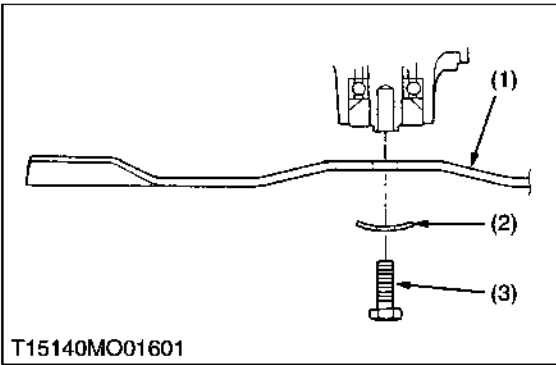
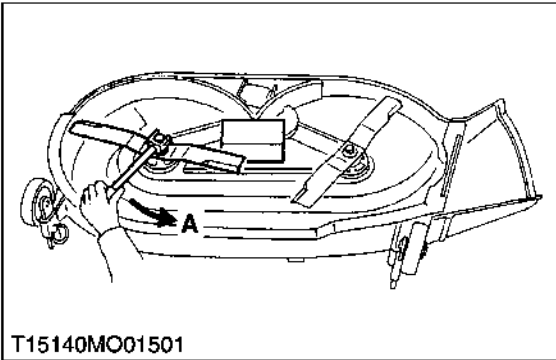
- Apply grease to the tension arm bushing (9).
- Apply grease to the bearings (4), (6).
- Be sure to pay attention to how to assemble the bearing cover (3), (7).
- Be sure to pay attention to how to assemble the tension pulley cover (13).

Tightening torque	Tension pulley mounting nut	49.9 to 54.2 N·m 5.1 to 5.5 kgf·m 36.8 to 40.0 ft-lbs
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(1) External Snap Ring
(2) Plain Washer
(3) Bearing Cover
(4) Bearing
(5) 5.5-6.0 Pulley
(6) Bearing
(7) Bearing Cover

(8) External Snap Ring
(9) Tension Arm Bushing
(10) Tension Arm
(11) Tension Pulley Mounting Nut
(12) Spring Washer
(13) Tension Pulley Cover
(14) Tension Pulley

W1018488



Blades

- 1. Turn over the mower.
- 2. Loosen the blade screws (3).
- 3. Remove the blade screws (3), spring plates (2) and blades (1).

NOTE

- To remove the blades 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.
- When the blade shaft is removed, loosen the blade pulley mounting nuts for stopping the blades by a wooden block before the blades are detached.

(When reassembling)

- Be sure to pay attention to how to assemble the spring plates.

Tightening torque	Blade screw	102.9 to 117.6 N·m 10.5 to 12.0 kgf·m 75.9 to 86.8 ft-lbs
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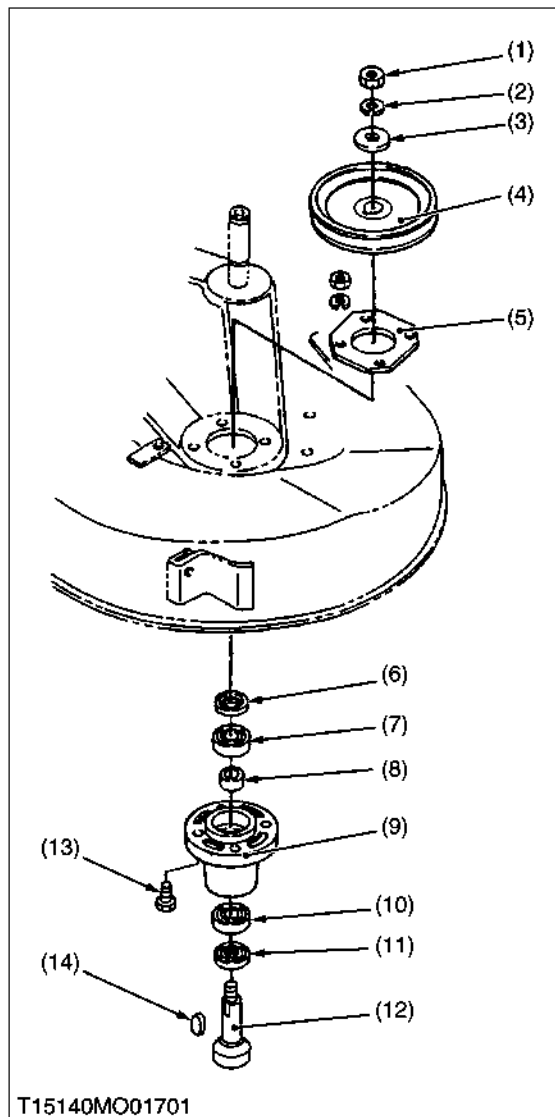
NOTE

- After reassembling the blade (1), 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.

- (1) Blade
- (2) Spring Plate
- (3) Blade Screw

A: Loosen

W1018794



Blade Pulley and Blade Shaft

1. Remove the blade pulley mounting nut (1), spring washer (2) and plain washer (3).
2. Remove the blade pulley (4).
3. Unscrew the pulley holder mounting bolt (13), and remove the pulley holder (9) and pulley holder plate (5) from the mower deck.
4. Remove the blade pulley key (14) and bearing cover (6).
5. Tap out the blade shaft (12) from the pulley holder.
6. Remove the bearing cover (11), bearings (7), (10) and collar (8).

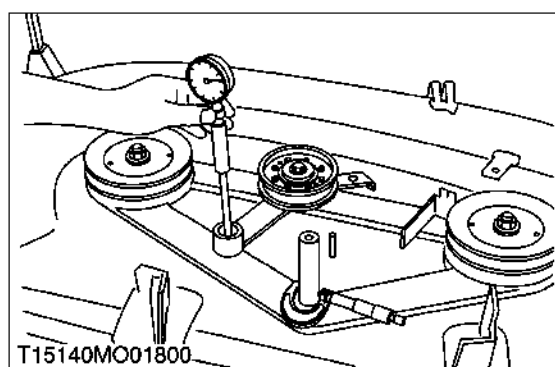
(When reassembling)

- Apply grease to the inside of collar (8) and bearings (7), (10).
- Be sure to pay attention to how to assemble the bearing cover (6), (11).

Tightening torque	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
	Pulley holder mounting bolt	49.9 to 54.2 N·m 5.1 to 5.5 kgf·m 36.8 to 40.0 ft-lbs

- | | |
|-------------------------------|----------------------------------|
| (1) Blade Pulley Mounting Nut | (8) Collar |
| (2) Spring Washer | (9) Pulley Holder |
| (3) Plain Washer | (10) Bearing |
| (4) Blade Pulley | (11) Bearing Cover |
| (5) Pulley Holder Plate | (12) Blade Shaft |
| (6) Bearing Cover | (13) Pulley Holder Mounting Bolt |
| (7) Bearing | (14) Blade Pulley Key |

W1019138



Clearance between Pulley Shaft and Tension Arm Bushing

1. Measure the pulley shaft O.D. with an outside micrometer.
2. Measure the tension pulley bushing I.D. with a cylinder gauge, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the tension pulley bushing.

Clearance between pulley shaft and tension arm bushing	Factory spec.	0.020 to 0.062 mm 0.0008 to 0.0024 in.
	Allowable limit	0.30 mm 0.0118 in.
Pulley shaft O.D.	Factory spec.	24.959 to 24.980 mm 0.9826 to 0.9835 in.
Tension pulley bushing I.D.	Factory spec.	25.000 to 25.021 mm 0.9843 to 0.9851 in.

W1019478

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