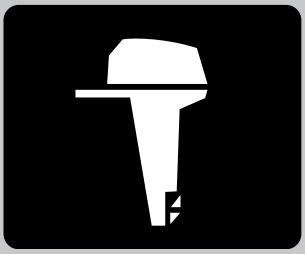
YAMAHA



200A
L200A

SERVICE MANUAL

290446

60H-28197-5E-11

NOTICE

This manual has been prepared by Yamaha primarily for use by Yamaha dealers and their trained mechanics when performing maintenance procedures and repairs to Yamaha equipment. It has been written to suit the needs of persons who have a basic understanding of the mechanical and electrical concepts and procedures inherent in the work, for without such knowledge attempted repairs or service to the equipment could render it unsafe or unfit for use.

Because Yamaha has a policy of continuously improving its products, models may differ in detail from the descriptions and illustrations given in this publication. Use only the latest edition of this manual. Authorized Yamaha dealers are notified periodically of modifications and significant changes in specifications and procedures, and these are incorporated in successive editions of this manual.

Important information

Particularly important information is distinguished in this manual by the following notations:

⚠ The Safety Alert Symbol means ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED!

⚠ WARNING

Failure to follow WARNING instructions could result in severe injury or death to the machine operator, a bystander, or a person inspecting or repairing the outboard motor.

CAUTION:

A CAUTION indicates special precautions that must be taken to avoid damage to the outboard motor.

NOTE:

A NOTE provides key information to make procedures easier or clearer.

200A, L200A
SERVICE MANUAL

Printed in Japan

Contents

General information

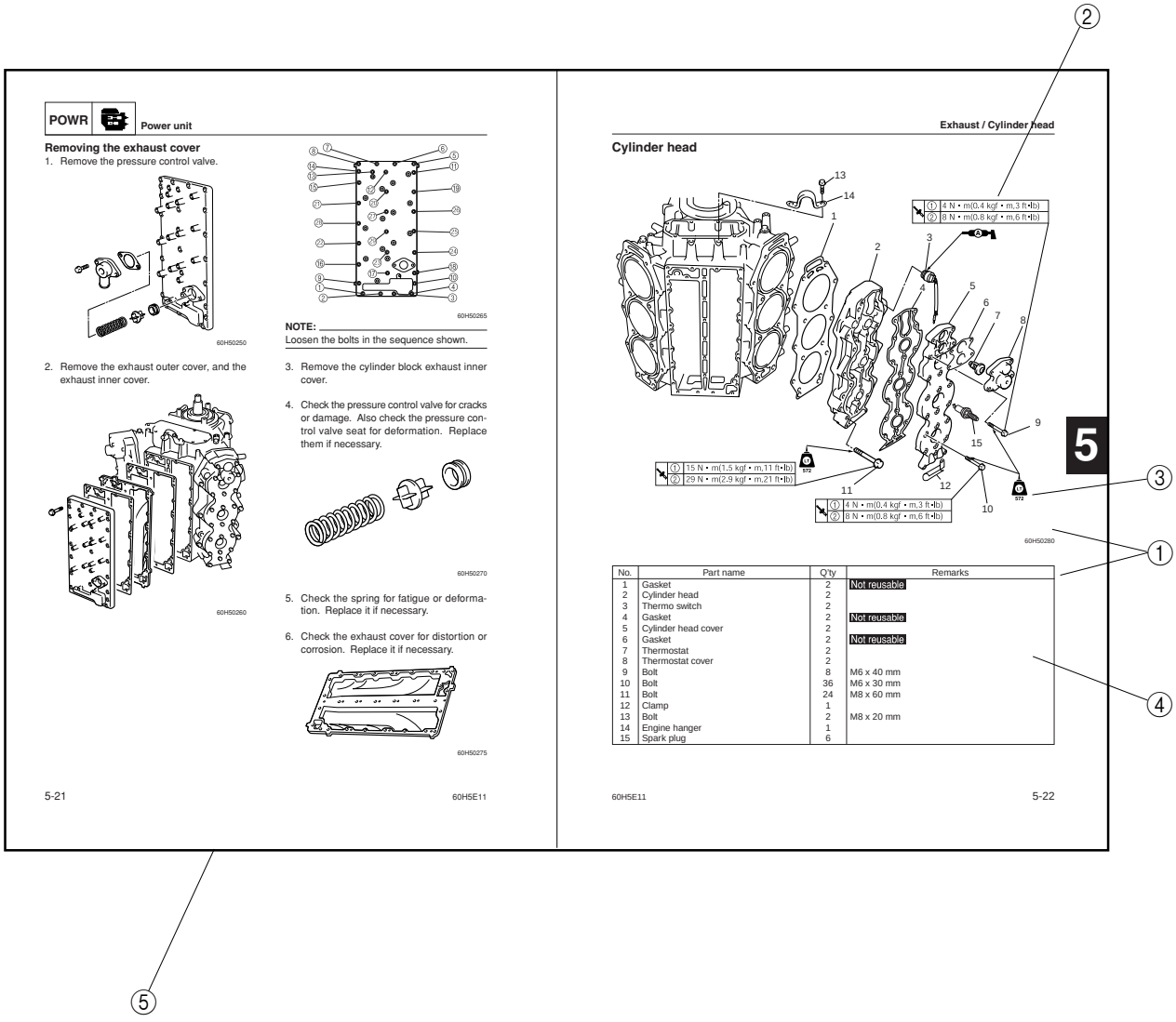
How to use this manual

Manual format

The format of this manual has been designed to make service procedures clear and easy to understand. Use the information below as a guide for effective and quality service.

① Parts are shown and detailed in an exploded diagram and are listed in the components list.
② Tightening torque specifications are provided in the exploded diagrams and after a numbered step with tightening instructions.
③ Symbols are used to indicate important aspects of a procedure, such as the grade of lubricant and lubrication point.
④ The components list consist of parts and part quantities, as well as bolt, screw, O-ring, and hose dimensions.
⑤ Service points regarding removal, checking, and installation are shown in individual illustrations to explain the relevant procedure.

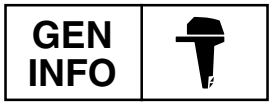
NOTE:
For troubleshooting procedures, see Chapter 9, “Troubleshooting.”



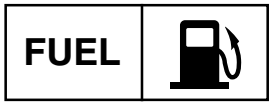
Symbols

The symbols below are designed to indicate the content of a chapter.

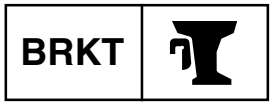
General information



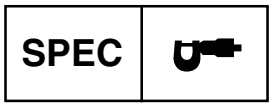
Fuel system



Bracket unit

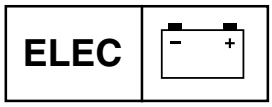


Specifications



Power unit

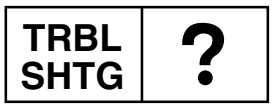
Electrical systems



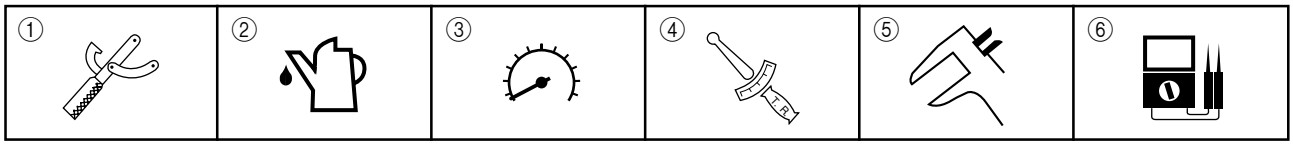
Periodic checks and adjustments

Lower unit

Troubleshooting

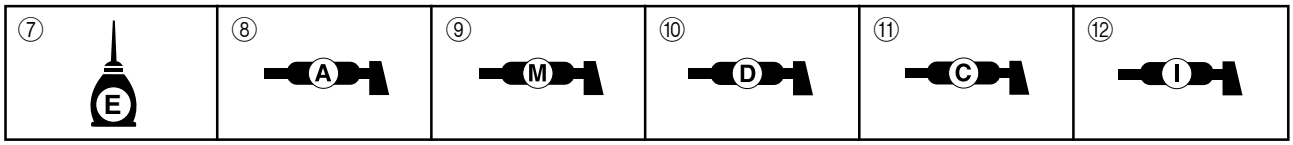


Symbols ① to ⑥ indicate specific data.



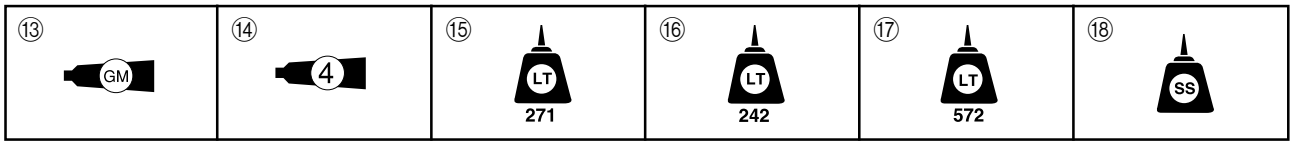
① Special tool
② Specified oil or fluid
③ Specified engine speed
④ Specified tightening torque
⑤ Specified measurement
⑥ Specified electrical value (Resistance, Voltage, Electric current)

Symbols ⑦ to ⑫ in an exploded diagram indicate the grade of lubricant and the lubrication point.



⑦ Apply Yamaha 4-stroke motor oil
⑧ Apply water resistant grease (Yamaha grease A)
⑨ Apply molybdenum disulfide grease
⑩ Apply corrosion resistant grease (Yamaha grease D)
⑪ Apply low temperature resistant grease (Yamaha grease C)
⑫ Apply injector grease

Symbols ⑬ to ⑱ in an exploded diagram indicate the type of sealant or locking agent and the application point.



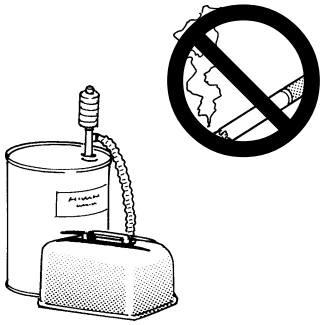
⑬ Apply Gasket Maker
⑭ Apply Yamabond 4
⑮ Apply LOCTITE 271 (Red)
⑯ Apply LOCTITE 242 (Blue)
⑰ Apply LOCTITE 572
⑱ Apply silicon sealant

Safety while working

To prevent an accident or injury and to ensure quality service, follow the safety procedures provided below.

Fire prevention

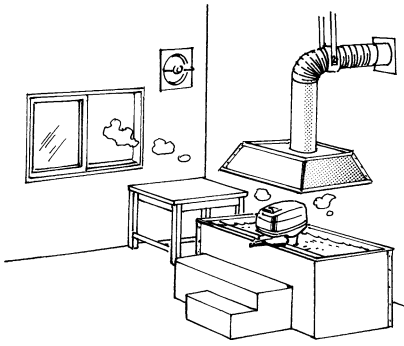
Gasoline is highly flammable.
Keep gasoline and all flammable products away from heat, sparks, and open flames.



S60C1010

Ventilation

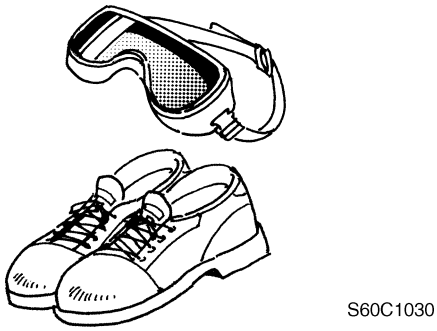
Gasoline vapor and exhaust gas are heavier than air and extremely poisonous. If inhaled in large quantities they may cause loss of consciousness and death within a short time. When test running an engine indoors (e.g., in a water tank) be sure to do so where adequate ventilation can be maintained.



S60C1020

Self-protection

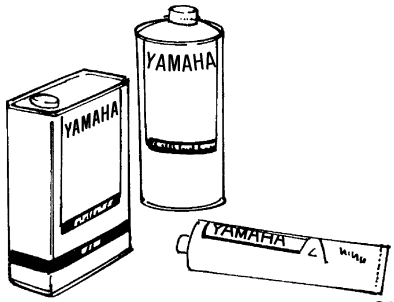
Protect your eyes by wearing safety glasses or safety goggles during all operations involving drilling and grinding, or when using an air compressor.
Protect your hands and feet by wearing protective gloves and safety shoes when necessary.



S60C1030

Parts, lubricants, and sealants

Use only genuine Yamaha parts, lubricants, and sealants or those recommended by Yamaha, when servicing or repairing the outboard motor.



S60C1040

Under normal conditions, the lubricants mentioned in this manual should not harm or be hazardous to your skin. However, you should follow these precautions to minimize any risk when working with lubricants.

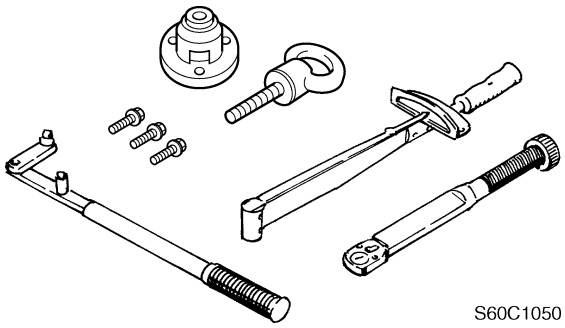
1. Maintain good standards of personal and industrial hygiene.
2. Change and wash clothing as soon as possible if soiled with lubricants.
3. Avoid contact with skin. Do not, for example, place a soiled rag in your pocket.
4. Wash hands and any other part of the body thoroughly with soap and hot water after contact with a lubricant or lubricant soiled clothing has been made.
5. To protect your skin, apply a protective cream to your hands before working on the outboard motor.

6. Keep a supply of clean, lint-free cloths for wiping up spills, etc.

Good working practices

Special tools

Use the recommended special tools to protect parts from damage. Use the right tool in the right manner-do not improvise.



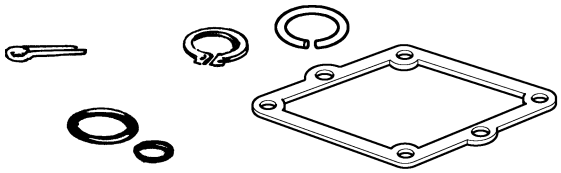
S60C1050

Tightening torques

Follow the tightening torque specifications provided throughout the manual. When tightening nuts, bolts, and screws, tighten the large sizes first, and tighten fasteners starting in the center and moving outward.

Non-reusable parts

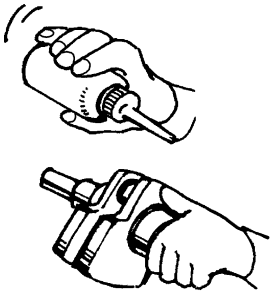
Always use new gaskets, seals, O-rings, cotter pins, circlips, etc., when installing or assembling parts.



S60C1060

Disassembly and assembly

1. Use compressed air to remove dust and dirt during disassembly.
2. Apply engine oil to the contact surfaces of moving parts before assembly.
3. Install bearings with the manufacture identification mark in the direction indicated in the installation procedure. In addition, be sure to lubricate the bearings liberally.
4. Apply a thin coat of water-resistant grease to the lip and periphery of an oil seal before installation.
5. Check that moving parts operate normally after assembly.



S60C1070

Identification

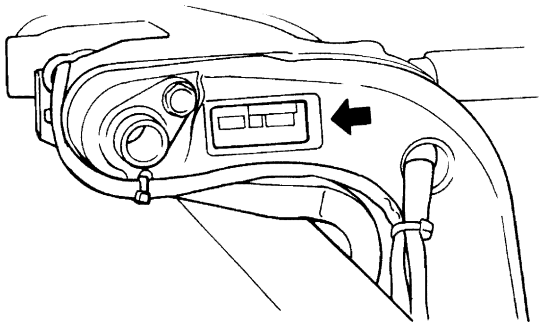
Applicable models

This manual covers the following models.

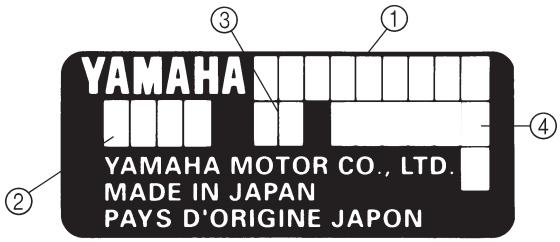
Applicable models
200AET,L200AET

Serial number

The outboard motor serial number is stamped on a label attached to the port clamp bracket.



60H10000



S60C1100

① Model name
② Approved model code
③ Transom height
④ Serial number

NOTE:

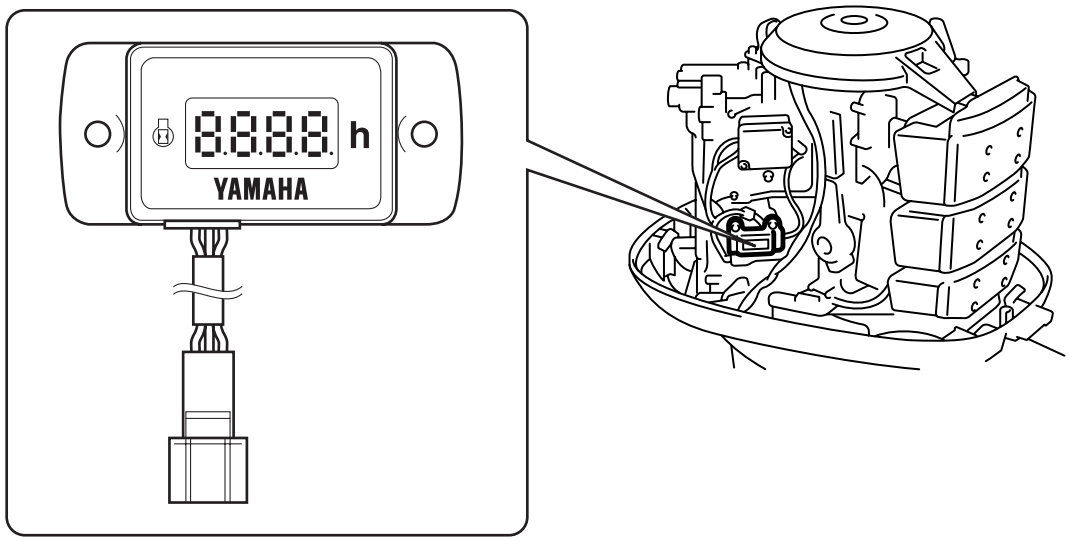
If the serial number label is removed, VOID marks will appear on the label.

Model name	Approved model code	Starting serial No.
200AET	60H	L: 800101-
		X: 850101-
L200AET	60J	X: 800101-

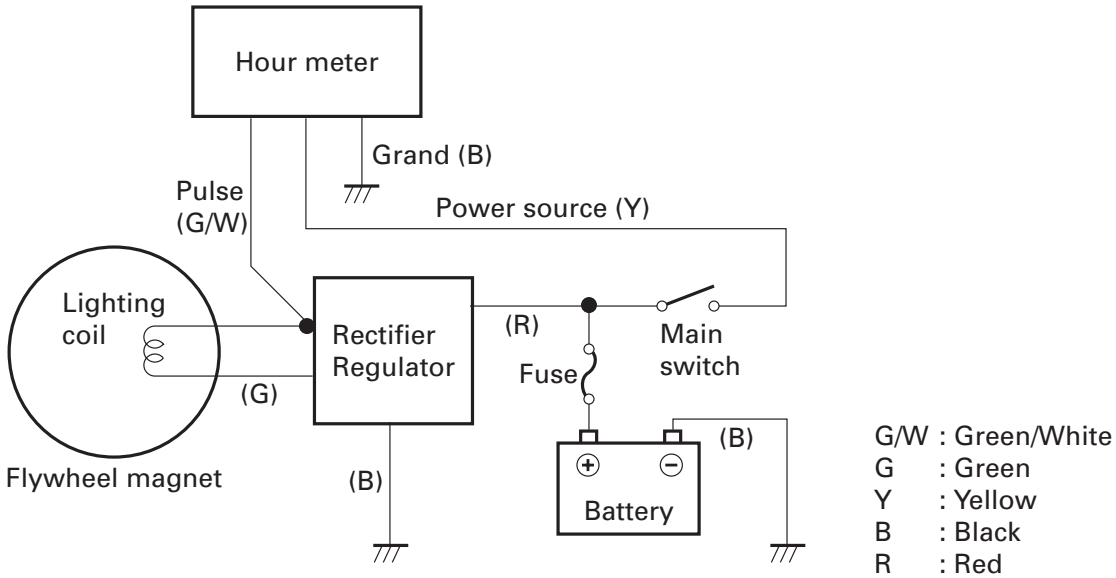
Features and benefits

Hour meter

A hour meter is incorporated for easier control of interval time for the periodic maintenance.
As the main switch is turned on, all segments light up for 2 seconds to check that the Light Emitting Diode is not failed.
Then, the meter indicates the total of hours which the engine has been run since manufacture.
The indicated hour is the accumulated time detected by the pulse signal from the lighting coil.
The accumulated hour is held forever, and cannot reset.



Hour meter

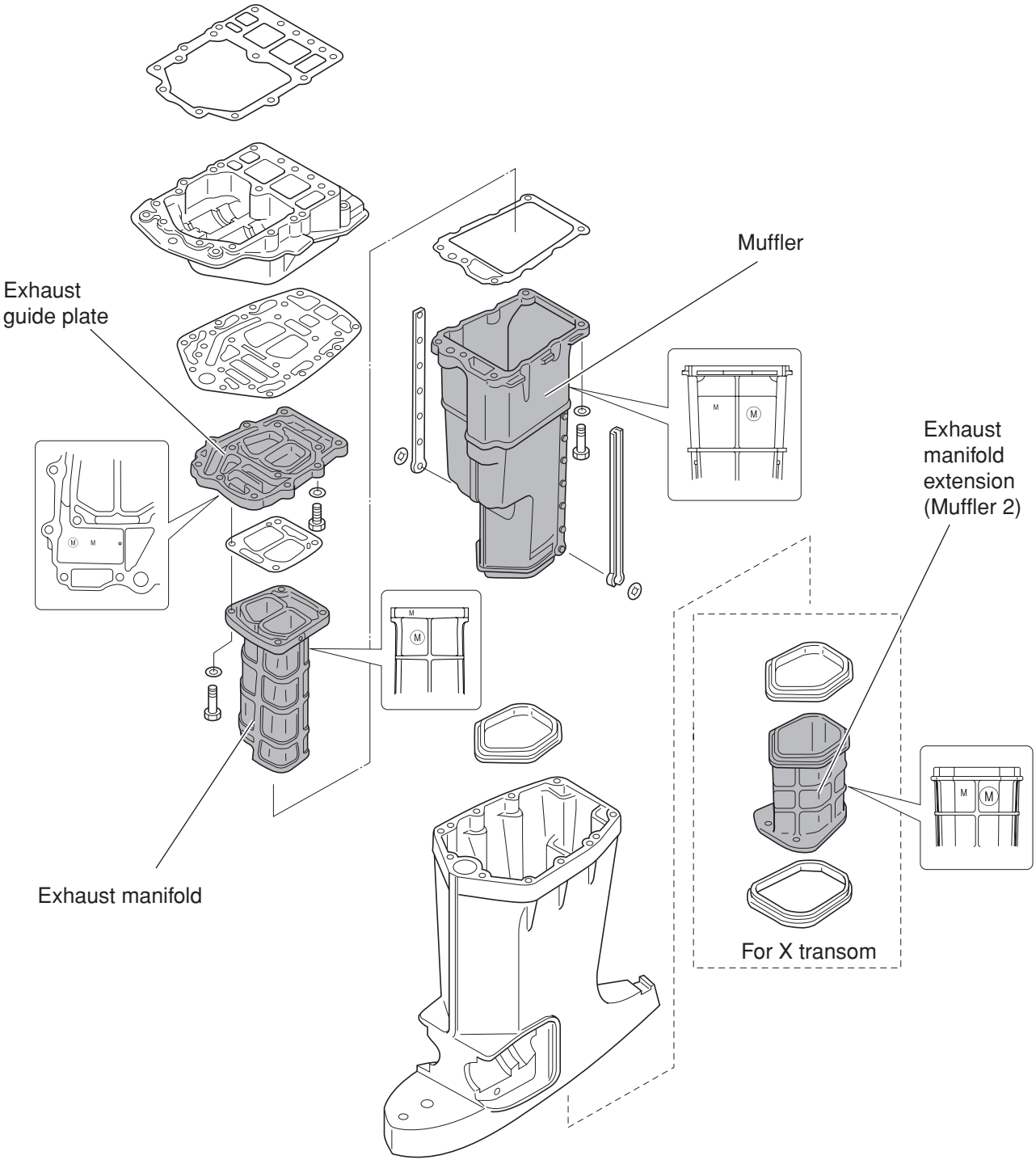


Wiring diagram

60H10010

Exhaust components (Factory option)

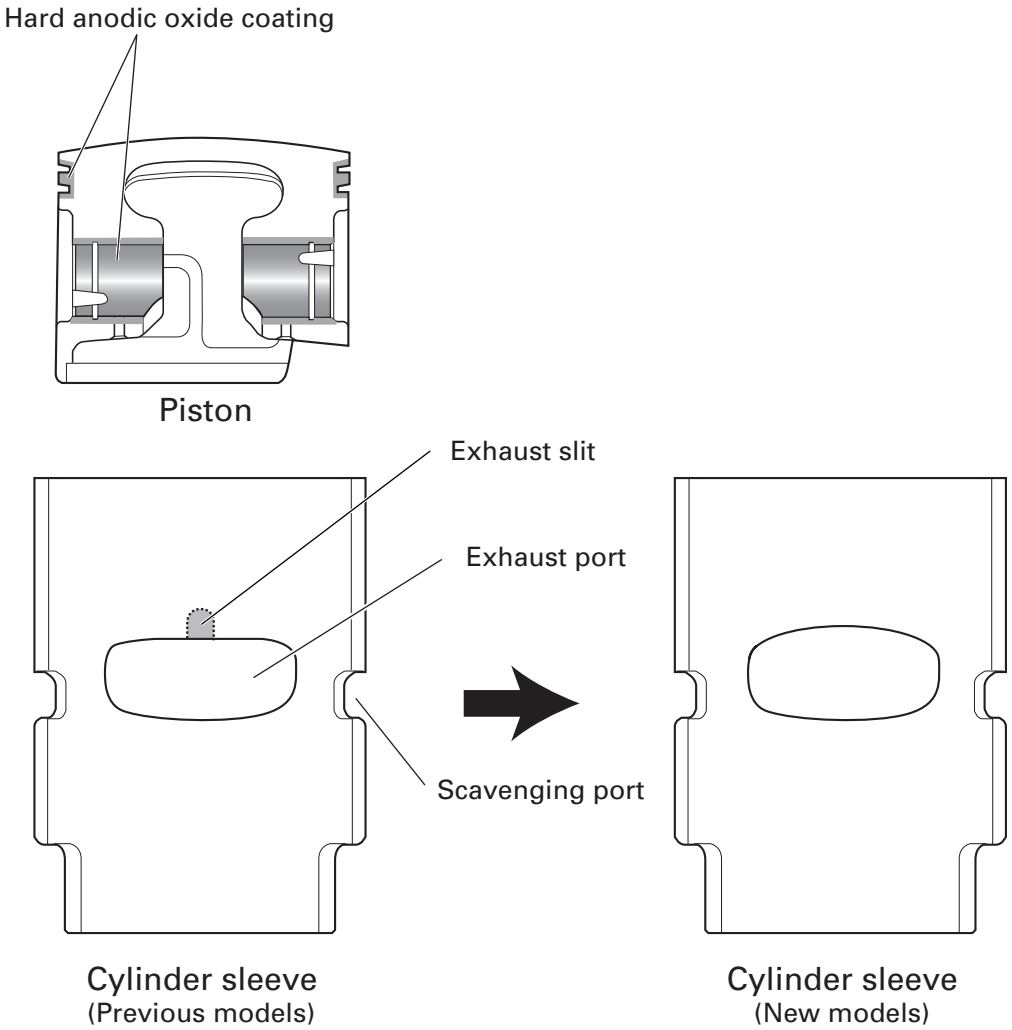
The cylindrical components have been painted externally and internally after the anodic oxide coating to make a film for additional corrosion-resistance.



60H10030

Piston and cylinder

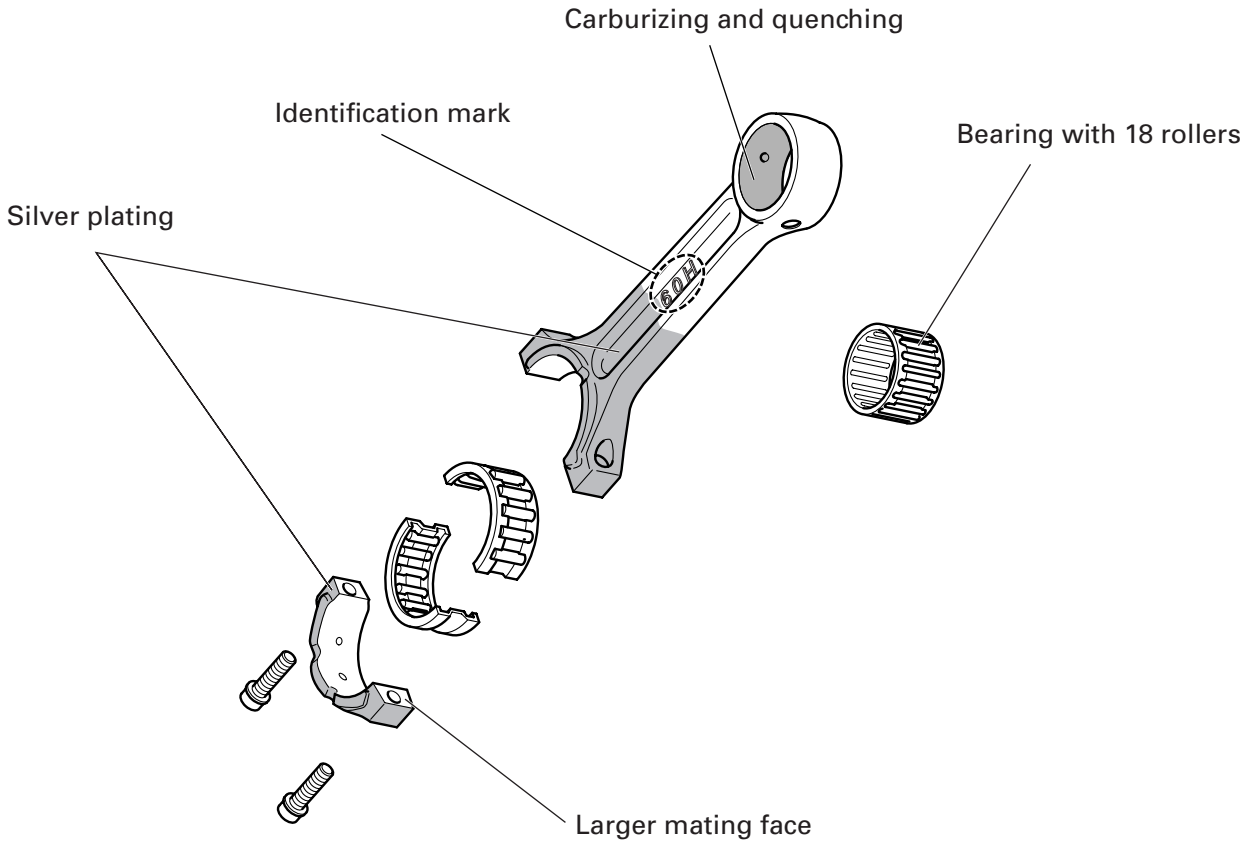
Following items have been given to improve the durability for the piston and cylinder.
A hard anodic oxide coating has been given to the piston pin boss and piston ring groove of the #1 and #2 piston.
Multilayer plating has been given to the piston ring.
The cylinder sleeve without the exhaust slit has been adopted not to accumulate some deposits, which can prevent the piston rings from entwining.
Also, the shape of the exhaust port has been given the gradual curve design to obtain the best engine performance and avoid scuffing of the piston ring.



60H10040

Connecting rod

A process of the carburizing and quenching has been given to the inside of the small end to increase the strength.
The small end bearing has been given 18 rollers, adding one roller from the previous model, to increase the durability.
The mating face of the big end bearing has been given a large area to increase the rigidity after assembling the bearing cap, which increases the rigidty.
Also, a silver plating (30-40μ) has been given to the outside portion of the big end to increase the less friction.

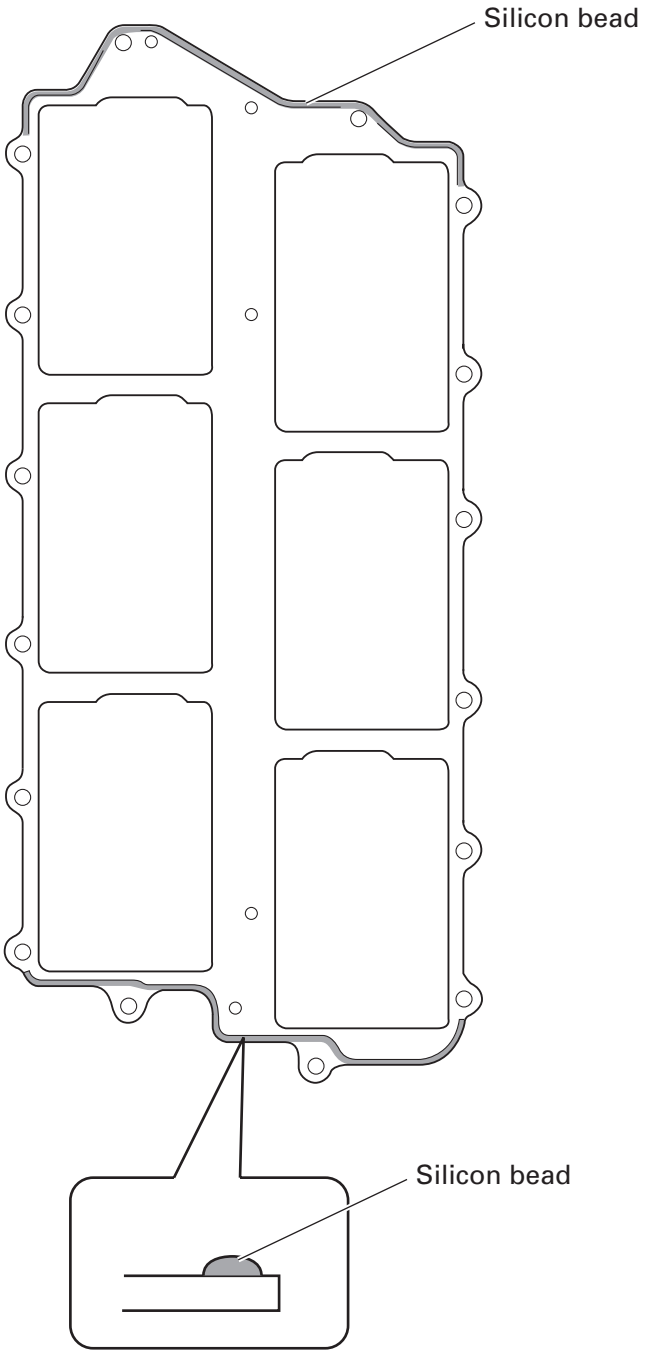


Connecting rod and bearings

60H10050

Gasket

The intake manifold gasket has been given a silicon bead to increase more sealer.

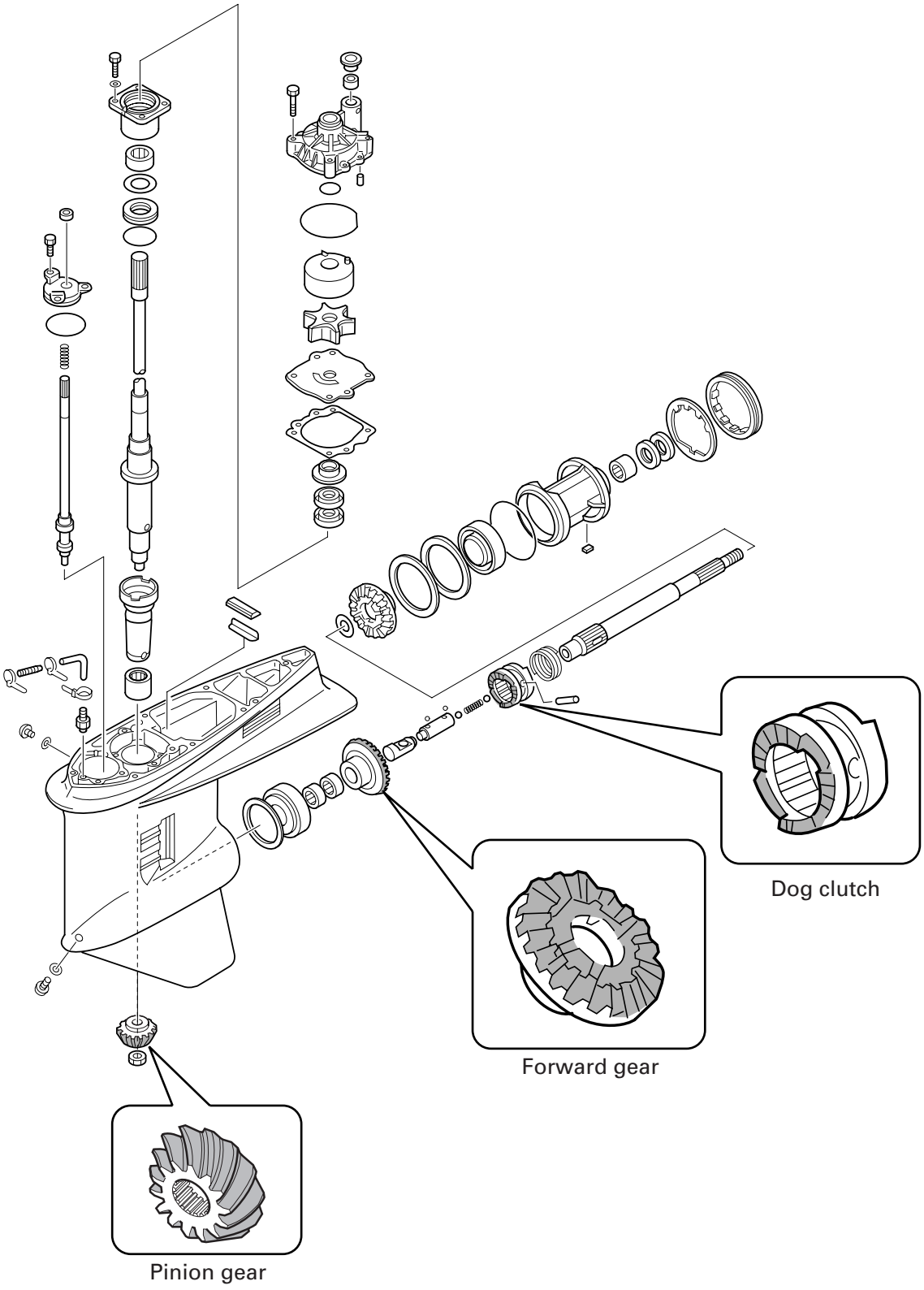


Gasket with silicon bead

60H10060

Reduction gear and clutch

The process of the double shot-peening has been given to the surface of the teeth portion of the pinion gear, forward gear and dog clutch to increase the durability.



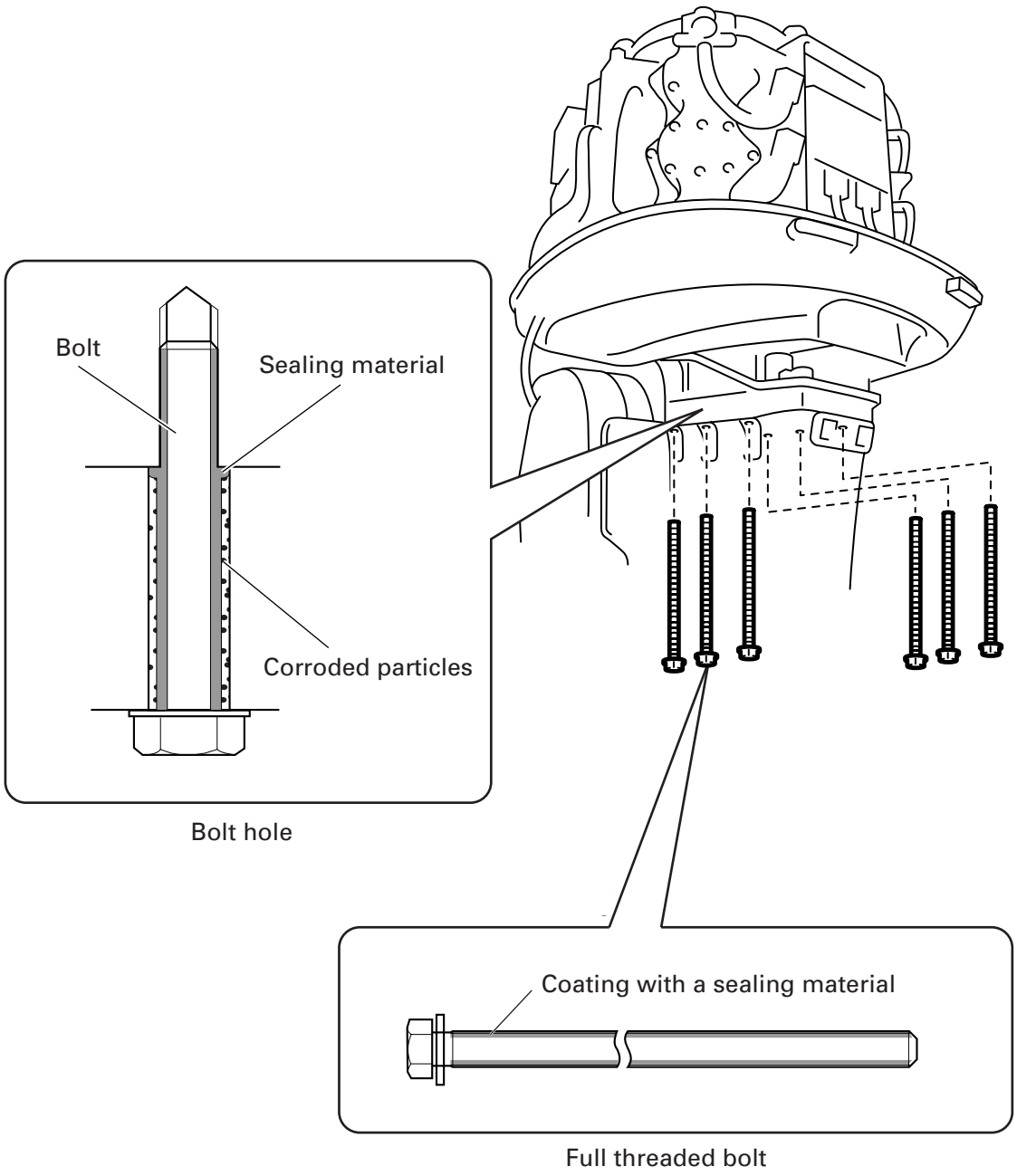
60H10070

Power unit mount bolt

A fully threaded bolt coated with a sealing material to the thread portion has been adopted for mounting the power unit.
This gives a sealing function to the bolt, which will help prevent the bolt from sticking by the salt water entering into the thread hole and crystallizing .
Also, the bolt can come out by turning, due to the full thread structure and the sealing material having a function as an insulator, even if the bolt hole has been choked with corroded particles.
Therefore, an easier servicing such as removing the power unit can be obtained.

NOTE:

Apply a sealing material such as LOCTITE 572 to the bolt thread if the bolt is reused.



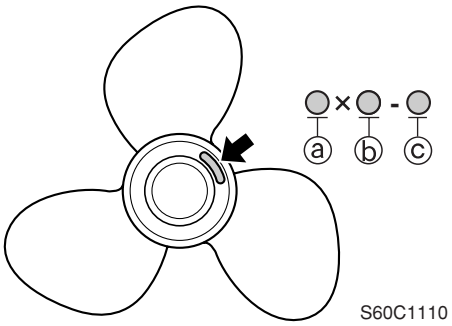
60H10080

Propeller selection

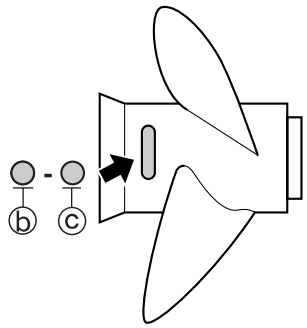
The performance of a boat and outboard motor will be critically affected by the size and type of propeller you choose. Propellers greatly affect boat speed, acceleration, engine life, fuel economy, and even boating and steering capabilities. An incorrect choice could adversely affect performance and could also seriously damage the engine.
Use the following information as a guide for selecting a propeller that meets the operating conditions of the boat and the outboard motor.

Propeller size

The size of the propeller is indicated on the propeller blade or outside of the propeller boss.



S60C1110



S60C1125

ⓐ Propeller diameter (in inches)
ⓑ Propeller pitch (in inches)
ⓒ Propeller type (propeller mark)

Selection

When the engine speed is at the full throttle operating range (4,500 – 5,500 r/min), the ideal propeller for the boat is one that provides maximum performance in relation to boat speed and fuel consumption.

Regular rotation model

Propeller size (in)	Material
13 1/2 x 23-M	Stainless steel
13 3/8 x 23-M	
13 3/8 x 25-M	
13 3/4 x 17-M	
13 3/4 x 19-M2	
13 3/4 x 21-M	
14 x 19-M	
14 1/2 x 17-M	
14 5/8 x 16-M	
15 1/4 x 15-M	
15 3/4 x 13-M	

Counter rotation model

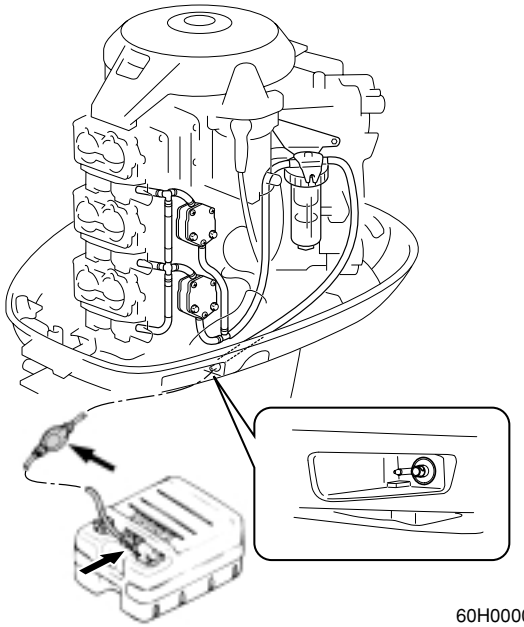
Propeller size (in)	Material
13 3/4 x 17-ML	Stainless steel
13 3/4 x 19-ML	
13 3/4 x 21-ML	
13 3/8 x 23-ML	
14 1/2 x 17-ML	

Predelivery checks

To make the delivery process smooth and efficient, the predelivery checks should be completed as explained below.

Checking the fuel system

1. Check that the fuel hoses are securely connected and that the fuel tank is full with fuel.



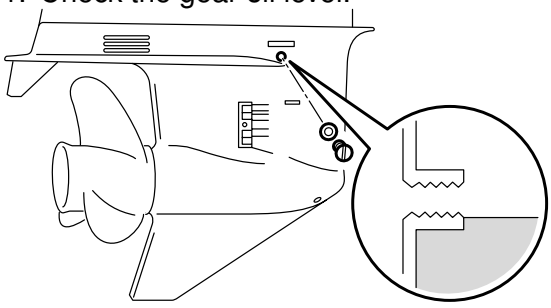
60H00000

CAUTION:

Use pre-mixed fuel only.
Fuel and oil mixing ratio is 50:1. For break-in period, 25:1 mixture shall be used.

Checking the gear oil

1. Check the gear oil level.



60H30450

Checking the battery

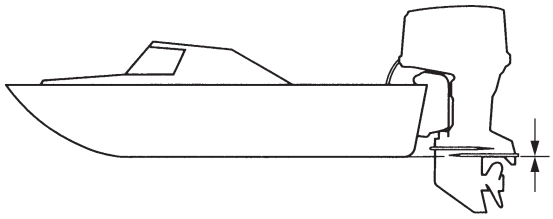
1. Check the capacity, electrolyte level, and specified gravity of the battery.

Recommend battery:
CCA / SAE (Minimum) : 380 (A)
CCA / EN (Minimum) : 430 (A)
RC (Minimum) : 124 (Minute)
20HR (Minimum) : 70 (AH)
JIS: 65D31-95E41
Electrolyte specified gravity:
1.280 at 20°C (68°F)

2. Check that the red and black battery cables are securely connected.

Checking the outboard motor mounting position

1. Check that the anti-cavitation plate is aligned with the bottom of the boat. If the mounting height is too high, cavitation will occur and propulsion will be reduced.
   Also, the engine speed will increase abnormally and cause the engine to overheat. If the mounting height is too low, water resistance will increase and reduce engine efficiency.



S60C1160

NOTE:

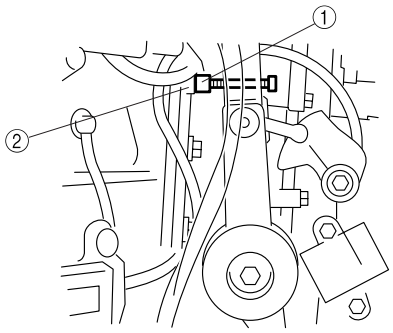
The optimum mounting height is affected by the combination of the boat and the outboard motor. To determine the optimum mounting height, test run the outboard motor at different heights.

2. Check that the clamp brackets are secured with the mounting bolts.

Checking the remote control cables

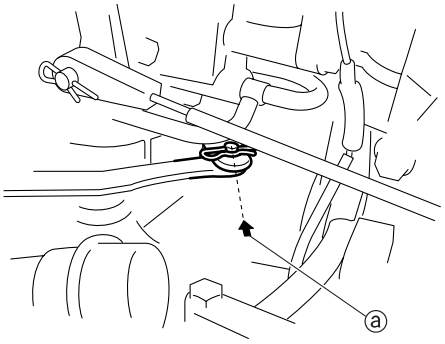
1. Set the remote control lever to the neutral position and fully close the throttle lever.

2. Check that the basic ignition timing adjusting screw ① on the magnet control lever is in contact with the stopper ② on the crankcase when the throttle lever is in the fully closed position.

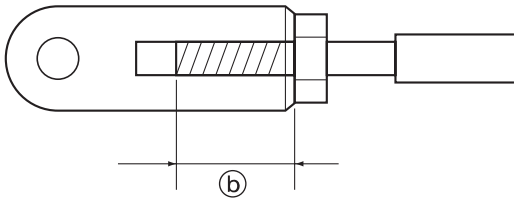


60H30110

3. Check that the set pin on the shift rod is aligned with the arrow mark ⓐ on the bottom cowling .



60H30427



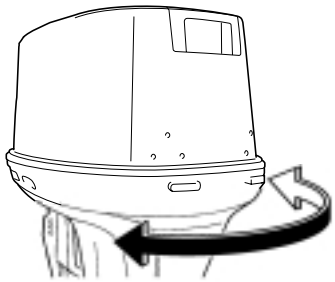
60H10420

CAUTION:

The shift/throttle cable joint must be screwed in a minimum of 8.0 mm (0.31 in) ⓑ.

Checking the steering system

1. Check that the steering operates smoothly.

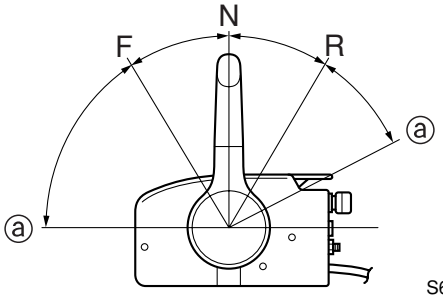

60H10090

2. Check that there is no interference with wires, hoses, or remote control cable when the outboard motor is steered.

Checking the gearshift and throttle operation

1. Check that the gearshift operates smoothly when the remote control lever is shifted from neutral into forward or reverse.

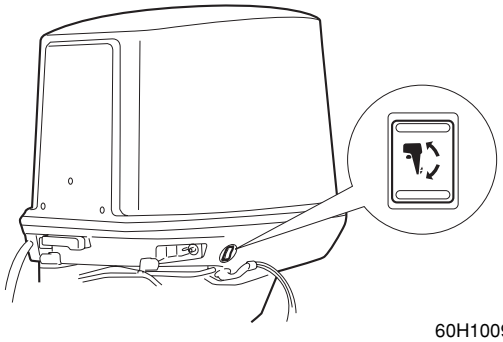
2. Check that the throttle operates smoothly when the remote control lever is shifted from the fully closed position to the fully open position ⓐ.



S60C1210

Checking the tilt system

1. Check that the outboard motor tilts up and down smoothly when operating the power trim and tilt unit.


60H10095

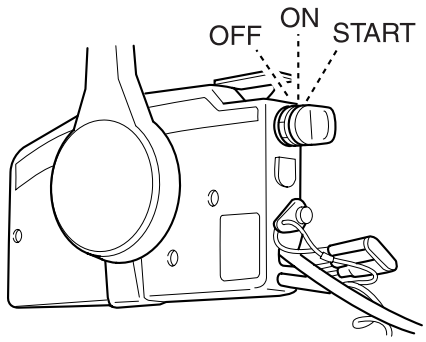
2. Check that there is no abnormal noise produced when the outboard motor is tilted up or down.

3. Check that there is no interference with wires, hoses, or remote control cable when the tilted-up outboard motor is steered.

4. Check that the trim meter points down when the outboard motor is trimmed all the way down.
   Also check that the trim meter moves toward up position when the outboard motor is trimmed up.

Checking the engine start switch and engine stop switch, engine shut-off switch

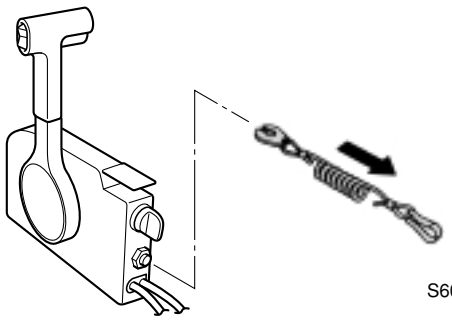
1. Check that the engine starts when the engine start switch is turned to START.



60H10097

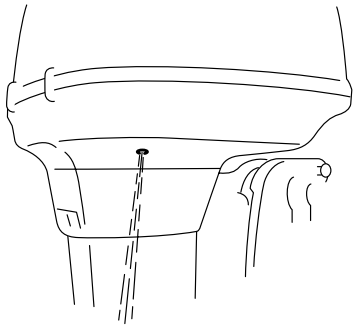
2. Check that the engine turns off when the engine start switch is turned to OFF.

3. Check that the engine turns off when the engine shut-off cord is pulled from the engine shut-off switch.


S60C1220

Checking the pilot water outlet

1. Start the engine, and check that cooling water is discharged from the pilot water outlet.


60H30100

Test run

1. Start the engine, and then check the engine idle speed after the engine has been warmed up.

2. Check that the gearshift operates smoothly.

3. Operate at trolling speed.

4. Run the outboard motor for one hour at 3,000 r/min or at half throttle, then for another hour at 4,000 r/min or at 3/4 throttle.

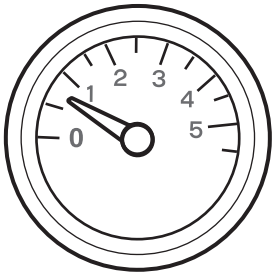
5. Check that the outboard motor does not tilt up when shifting into reverse and that water does not flow in over the transom.

NOTE:
The test run is part of the break-in operation.

Break-in

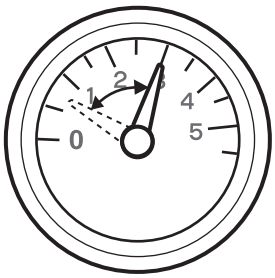
Perform the break-in operation in the following four stages.

1. Keep the engine running at idle for the initial ten minutes.



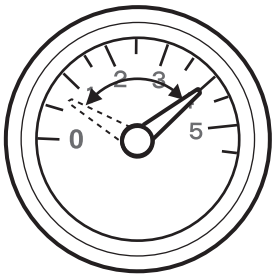
60H10100

2. Fifty minutes at 3,000 r/min. or less.



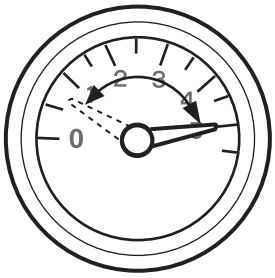
60H10110

3. One hour at 4,000 r/min. or less.



60H10120

4. For another eight hours, run at 5,000 r/min. or less, with repeated wide-open-throttle operation that lasts five minutes or less.



60H10130

After test run

1. Check for water in the gear oil.

2. Check for fuel leakage in the cowling.

3. After a test run and while the engine is at idle, flush the cooling water passage with fresh water using the flushing kit.

Specifications

Genral Specifications

Item	Unit	Model	
		200AET	L200AET
Dimension			
Overall length	mm (in)	828(32.6)	
Overall width	mm (in)	600(23.6)	
Overall height			
(L)	mm (in)	1,577(62.1)	–
(X)	mm (in)	1,703(67.0)	
Transom height			
(L)	mm (in)	516(20.3)	–
(X)	mm (in)	642(25.3)	
Weight(*1)			
(L)	kg (lb)	180(396)	–
(X)	kg (lb)	184(405)	186(410)
Performance			
Maximum output	kW(HP)	147.1(200) @ 5,000 r/min	
Full throttle operating range	r/min	4,500 - 5,500	
Maximum fuel consumption	L(US gal,Imp gal)/hr	81(21.4,17.8) @ 5,500 r/min	
Idle speed	r/min	700	
Power unit			
Type		2-stroke,90,V6	
Total displacement	cm^3 (cu. in)	2,596(158.4)	
Bore x Stroke	mm (in)	90.0(3.54) x 68.0(2.68)	
Compression ratio		5.9	
Minimum compression pressure(*2)	kPa(kg/cm^2)	520(5.2)	
Control system		Remote control	
Starting system		Electric motor	
Enrichment system		Choke valve	
Ignition control system		CDI	
Ignition timing	Degree	ATDC7-BTDC18	
Advance pick up timing	Degree	ATDC 7	
Maximum generator output	V,A	12,14 @ 5,500 r/min	
Spark plug(*3)		B8HS-10,BR8HS-10	
Cooling system		Water	
Exhaust system		Through propeller boss	
Lubrication system		Pre-mixed fuel (50:1)	

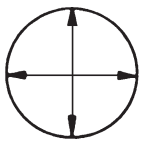
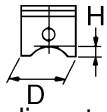
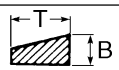
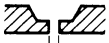
(*1) Includes a stainless steel propeller and excludes oil and rigging parts.
(*2) At 20°C(68°F) and sea level.
(*3) BR8HS-10 is for Carib and China version.

Item	Unit	Model	
		200AET	L200AET
Fuel and oil			
Fuel type		Regular unleaded gasoline	
Fuel rating	RON(*4)	84	
Engin oil type		2-stroke outboard motor oil	
Engin oil grade	NMMA-certified	TCW-3	
Gear oil type		Hypoid gear oil	
Gear oil grade	API	GL-4	
	SAE	90	
Gear oil quantity	cm^3 (oz)	980(34.5)	870(30.6)
Bracket unit			
Trim angl (At 12° boat transom)	Degree	– 4 – 16	
Tilt-up angle	Degree	70	
Steering angle	Degree	35+35	
Drive unit			
Gear shift positions		F-N-R	
Gear ratio		1.86(14/26)	
Reduction gear type		Spiral bevel gear	
Clutch type		Dog clutch	
Propeller shaft type		Spline	
Propeller direction (Rear view)		Clocklwise	Counterclockwise
Propeller ID mark		M	ML
Electrical			
Recommend battery			
CCA / SAE (Minimum)	A	380	
CCA / EN (Minimum)	A	430	
RC (Minimum)	Minute	120	
20HR (Minimum)	AH	70	
JIS		65D31-95E41	

(*4) RON; Reseach Octance Number

Maintenance specifications

Power unit

Item	Unit	Model	
		200AET	L200AET
Power unit			
Compression pressure* (reference data)	kPa (kgf/cm², psi)	700 (7.0, 101.5)	
Compression pressure* (minimum)	kPa (kgf/cm², psi)	520 (5.2, 75.4)	
Cylinder heads			
Warpage limit  (lines indicate straightedge position)	mm (in)	0.1 (0.04)	
Cylinders			
Bore size 	mm (in)	90.00 - 90.02 (3.5433 - 3.5441)	
Bore size limit	mm (in)	90.10 (3.5472)	
Taper limit	mm (in)	0.08 (0.0031)	
Out-of-round limit	mm (in)	0.05 (0.0020)	
Pistons			
Piston diameter (D) 	mm (in)	89.895 - 89.915 (3.5392 - 3.5400)	
Measuring point (H)	mm (in)	10 (0.39)	
Piston pin boss inside diameter	mm (in)	23.074-23.085 (0.9084-0.9089)	
Oversize piston			
1st	mm (in)	+ 0.25 (0.0098)	
Oversize piston diameter	mm (in)	90.145 - 90.165 (3.5490 - 3.5498)	
2nd	mm (in)	+ 0.5 (0.0196)	
Oversize piston diameter	mm (in)	90.395 - 90.415 (3.5589 - 3.5596)	
Piston pins			
Outside diameter	mm (in)	23.065 - 23.070 (0.9081 - 0.9083)	
Piston rings 			
Top ring, 2nd ring			
Dimension B 	mm (in)	1.97 - 1.99 (0.0776 - 0.0783)	
Dimension T	mm (in)	2.7 - 2.9 (0.1063 - 0.1142)	
End gap 	mm (in)	0.3 - 0.4 (0.0118 - 0.0157)	
Measuring point (H)	mm (in)	20 (0.79)	
Side clearance	mm (in)	0.02 - 0.06 (0.0008 - 0.0024)	

* Measuring conditions:
Ambient temperature 20°C (68°F), wide open the throttle valve and the choke valve, with plugs disconnected from all cylinders.
The figures are for reference only.

Item	Unit	Model	
		200AET	L200AET
Connecting rods			
Small-end inside diameter	mm (in)	28.070 - 28.082 (1.1051 - 1.1056)	
Big-end inside diameter	mm (in)	46.010 - 46.025 (1.8114 - 1.8120)	
Big-end side clearance	mm (in)	0.12 - 0.26 (0.0047 - 0.0102)	
Small-end axial play limit	mm (in)	2.0 (0.08)	
Crankshaft			
Crankshaft journal Diameter	mm (in)	53.975 - 53.991 (2.1250 - 2.1256)	
Crank pin Diameter	mm (in)	35.985 - 36.000 (1.4167 - 1.4173)	
Run-out limit	mm (in)	0.03 (0.0012)	
Thermostats			
Opening temperature	°C (°F)	50 (122)	
Fully open temperature	°C (°F)	60 (140)	
Valve open lower limit	mm (in)	3.0 (0.12)	
Carburetor			
ID mark		64E01	
Main jet	#	No.1,3:150 / No.2,4:154 / No.5:152 / No.6:158	
Main air jet	#	270	
Pilot jet	#	84	
Pilot air jet	#	60	
Pilot screw	turns out	1 1/8 ± 1/4 (7/8 - 1 3/8)	
Float height (with gasket)	mm (in)	15.5 - 16.5 (0.61 - 0.65)	
Engine idle speed	r/min	675 - 725	
Reed valves			
valve stopper height	mm (in)	6.5 (0.26)	
warpage limit	mm (in)	0.2 (0.08)	

Lower unit

Item	Unit	Model	
		200AET	L200AET
Gear backlash			
Pinion-to-forward gear	mm (in)	0.25 - 0.46 (0.0098 - 0.0181)	0.21 - 0.43 (0.0083 - 0.0169)
Pinion-to-reverse gear	mm (in)	0.74 - 1.29 (0.0291 - 0.0508)	0.98 - 1.30 (0.0386 - 0.0512)
Pinion shims	mm	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50	
Forward gear shims	mm	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50	
Reverse gear shims	mm	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50	
Propeller shaft shims	mm	—	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50
Drive shaft			
Run-out limit	mm (in)	0.1 (0.0039)	
Propeller shaft			
End play	mm (in)	—	0.25 - 0.35 (0.0098 - 0.0138)

Electrical

Item	Unit	Model	
		200AET	L200AET
Ignition system			
Ignition timing			
(standard ignition timing)	Degree	ATDC 7	
(full advance)	Degree	BTDC 18	
Piston position			
(full advance)	mm (in)	2.05 (0.0807)	
Pulser coil output peak voltage			
(W/B - W/L, W/Br - W/Y, W/G - W/R)			
at cranking 1(*1)	V	2.5	
at cranking 2(*1)	V	2.0	
at 1,500 r/min	V	9.5	
at 3,500 r/min	V	16.0	
Pulser coil resistance(*2)	Ω	256 - 384	
(W/B - W/L, W/Br - W/Y, W/G - W/R)			
Charge coil output peak voltage			
(Br - R)			
at cranking 1(*1)	V	80	
at cranking 2(*1)	V	90	
at 1,500 r/min	V	165	
at 3,500 r/min	V	165	
(L - B/R)			
at cranking 1(*1)	V	30	
at cranking 2(*1)	V	30	
at 1,500 r/min	V	160	
at 3,500 r/min	V	165	
Charge coil resistance(*2)			
(Br - R)	Ω	428 - 642	
(L - B/R)	Ω	64.4 - 96.6	
CDI unit output peak voltage			
(B/W - B)			
at cranking (loaded)	V	65	
at 1,500 r/min	V	140	
at 3,500 r/min	V	135	
Spark plug gap	mm (in)	1.0 - 1.1 mm (0.039 - 0.043 in)	
Ignition spark gap	mm (in)	6 (0.24)	
Spark plug cap resistance	Ω	4.0 - 6.0	
Ignition coil resistance			
Primary coil (B/W-B)	Ω at 20°C (68°F)	0.18 - 0.24	
Secondary coil (LEAD-B)	Ω at 20°C (68°F)	3.26 - 4.88	
Thermoswitch			
ON	°C (°F)	84 - 90 (183 - 194)	
OFF	°C (°F)	60 - 74 (140 - 165)	
Choke solenoid			
Resistance	Ω	3.4 - 4.0	

(*1) Cranking 1: unloaded Cranking 2: loaded

(*2) The figures are for reference only.

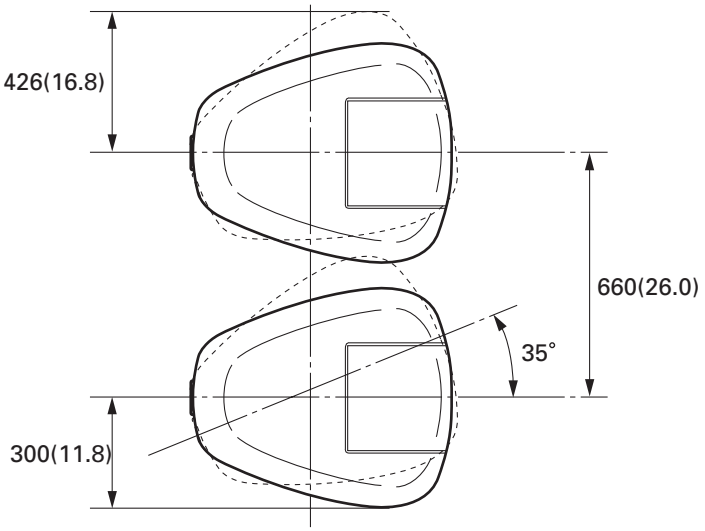
Item	Unit	Model	
		200AET	L200AET
Starter motor			
Type		Bendix	
Output	kW	1.1	
Cranking time limit	Second	30	
Brushes			
Standard length	mm (in)	17 (0.67)	
Wear limit	mm (in)	10 (0.39)	
Commutator			
Standard diameter	mm (in)	33 (1.30)	
Wear limit	mm (in)	32 (1.26)	
Mica			
Standard undercut	mm (in)	0.8 (0.031)	
Wear limit	mm (in)	0.2 (0.008)	
Charging system			
Fuse	A	20	
Lighting coil output peak voltage (G - G/W)			
at cranking(*1)	V	3	
at 1,500 r/min(*1)	V	20.0	
at 3,500 r/min(*1)	V	50.0	
Lighting coil resistance(*2) (G - G/W)	Ω	0.20 - 0.30	
Rectifier Regulator output peak voltage (R - B)			
at 1,500 r/min(*1)	V	18	
at 3,500 r/min(*1)	V	45	
Charging current	V, A at 6,000 r/min	12, 14	
Power trim and tilt system			
Trim sensor			
Setting resistance	Ω	9 - 11	
Resistance (P - B)	Ω	9 - 379	
Fluid type		ATF Dexron II	
Brushes			
Standard length	mm (in)	9.8 (0.386)	
Wear limit	mm (in)	4.8 (0.189)	
Commutator			
Standard diameter	mm (in)	22 (0.87)	
Wear limit	mm (in)	21 (0.83)	
Hydraulic pressure (UP)	MPa (kgf/cm^2)	10 - 12 (100 - 120)	
(DOWN)	MPa (kgf/cm^2)	6 - 9 (60 - 90)	

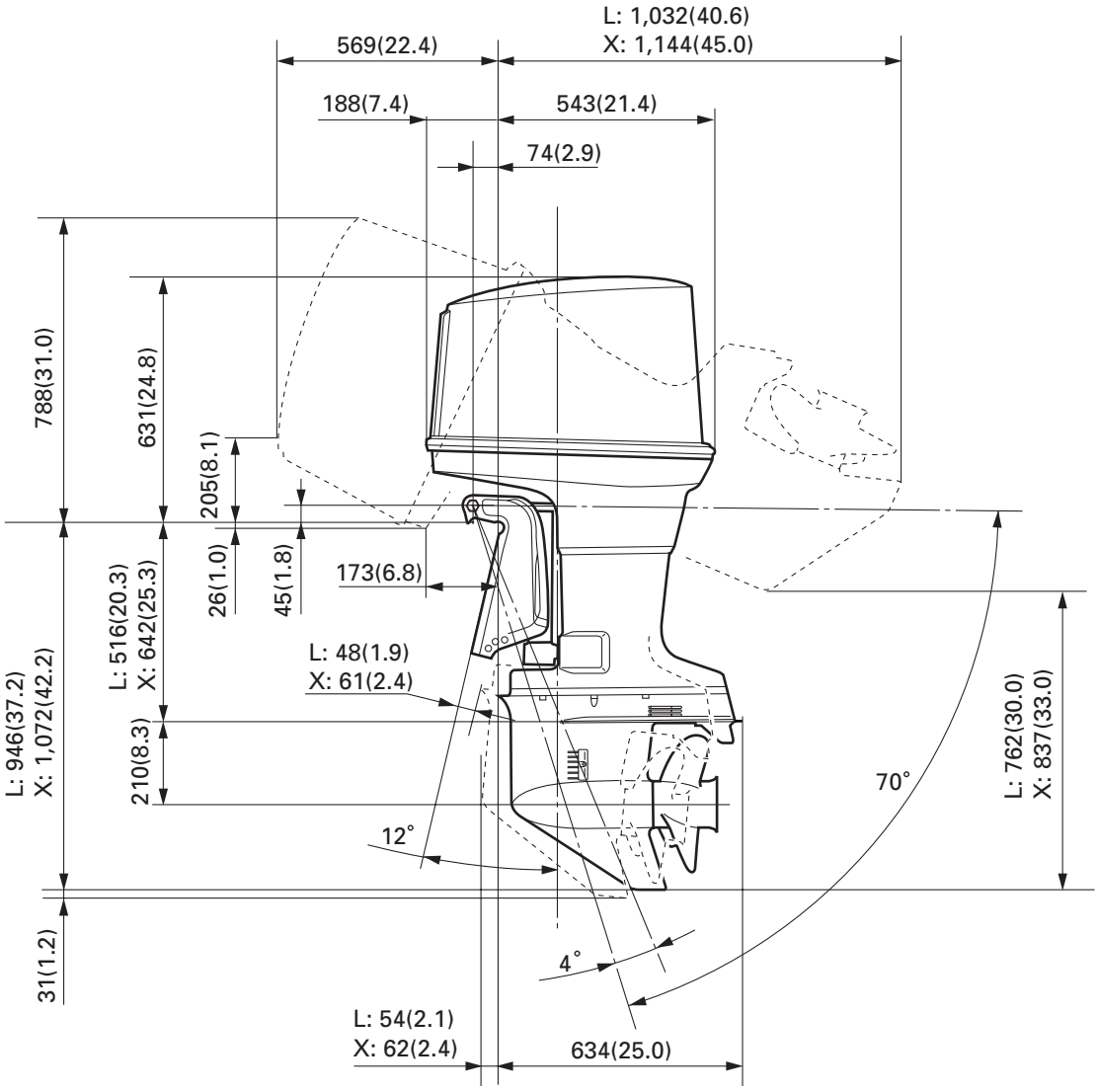
(*1) Unloaded
(*2) The figures are for reference only.

Dimensions

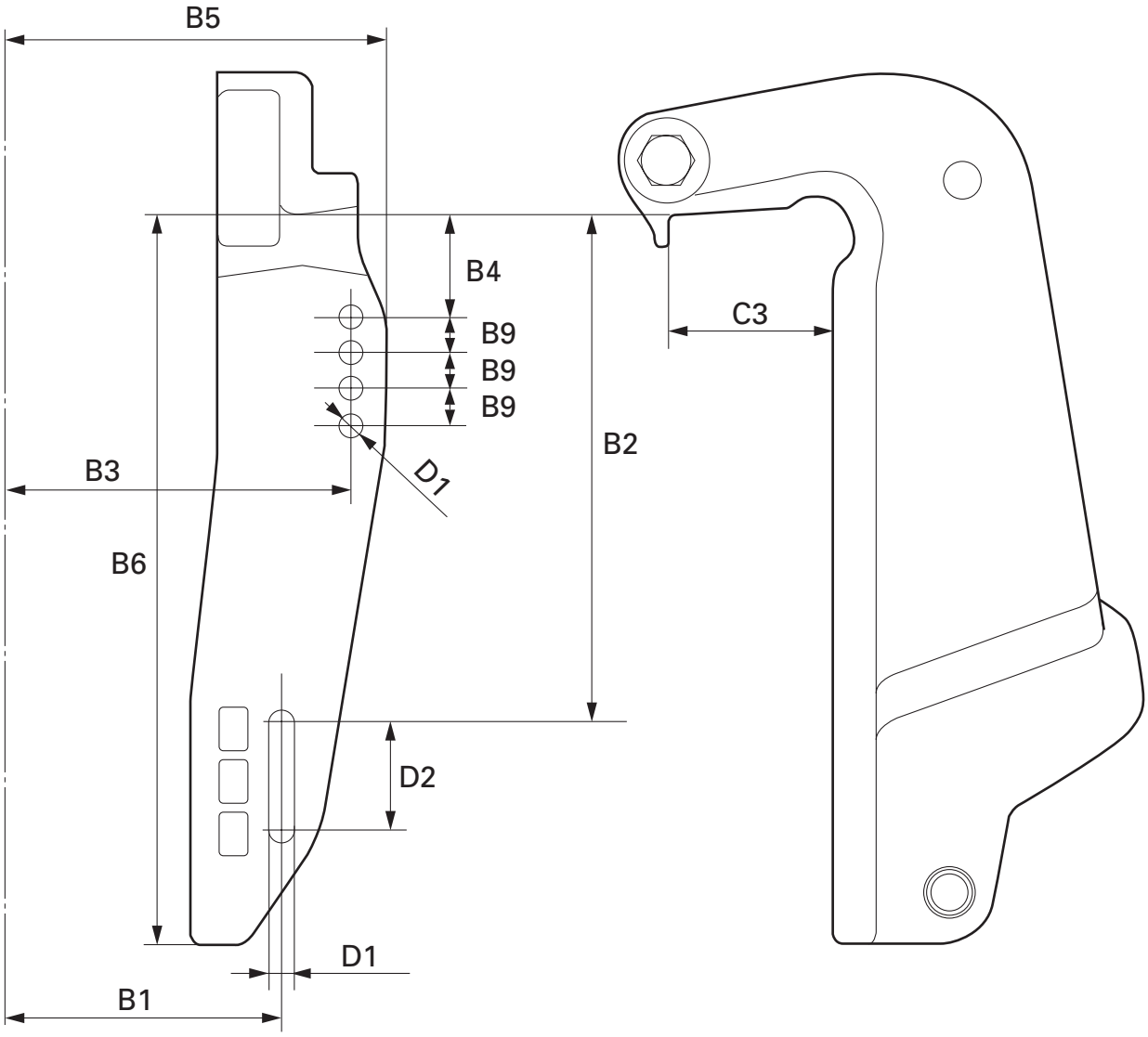
Exterior

mm(in)





Clamp bracket



Item	Unit	Model	
		200AET	L200AET
B1	mm (in)	125.4 (4.9)	
B2	mm (in)	254 (10.0)	
B3	mm (in)	163.5 (6.4)	
B4	mm (in)	50.8 (2.0)	
B5	mm (in)	180 (7.1)	
B6	mm (in)	367 (14.5)	
B9	mm (in)	18.5 (0.7)	
C3	mm (in)	82 (3.2)	
D1	mm (in)	13 (0.5)	
D2	mm (in)	55.5 (2.2)	

Tightening torques

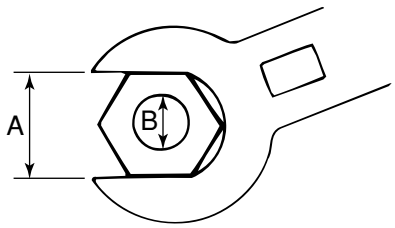
Specified torques

Part to be tightened		Thread size	Tightening torques		
			N • m	kgf • m	ft • lb
POWER UNIT					
Flywheel nut		M20	160	16	116
Crankcase bolt	1st	M10	20	2	15
	2nd		39	3.9	29
	1st	M8	10	1	7
	2nd		18	1.8	13
Intake manifold	1st	M6	4	0.4	3
	2nd		8	0.8	6
Cylinder head	1st	M8	15	1.5	11
	2nd		29	2.9	21
Cylinder head cover Thermostat cover	1st	M6	4	0.4	3
	2nd		8	0.8	6
Connecting rod cap	1st	M8	19	1.9	14
	2nd		36	3.6	27
	3rd		Loosen completely		
	4th		19	1.9	14
	5th		36	3.6	27
Exhaust outer cover	1st	M6	4	0.4	3
	2nd		8	0.8	6
PCV cover	1st	M6	4	0.4	3
	2nd		8	0.8	6
Cylinder head accessory plug		M14	23	2.3	17
Power unit mount bolt		M8	21	2.1	15
Spark plug		M14	25	2.5	18
Electric relay terminal nut		M6	4	0.4	3
Starting motor mount bolt		M8	29	2.9	22
Starting motor (+) terminal nut		M8	9	0.9	6
Ignition coil		M6	8	0.8	6
Battery cable terminal nut		M6	4	0.4	3
		M8	6	0.6	5
Hour meter		M5	2	0.2	2
LOWER UNIT					
Pinion nut		M16	93	9.3	69
Propeller nut		M18	54	5.4	40
Gear oil plug			9	0.9	6
Ring nut			145	14.5	105
Trim tab		M10	39	3.9	29
Lower case mount bolt		M10	39	3.9	29
Upper case mount bolt		M8	21	2.1	15
Exhaust manifold		M8	18	1.8	13
Muffler		M8	18	1.8	13

Part to be tightened	Thread size	Tightening torques		
		N • m	kgf • m	ft • lb
BRACKET UNIT				
Upper rubber mount nut	M12	71	7.1	52
Lower rubber mount nut	M14	51	5.1	38
Through tube nut	7/8"	15	1.5	11
Trim sender cam screw		2	0.2	2
Trim rod reciever nut	M10	36	3.6	26
PTT				
Reserver cap		0.7	0.07	0.5
Reserver mount bolt	1/4"	5	0.5	4
Motor unit mount bolt	1/4"	5	0.5	4
Gear housing case mount bolt	5/16"	8	0.8	6
Gear housing bolt	3/16"	6	0.6	4
Filter plug		6	0.6	4
Manual valve	M14	3	0.3	3
Tilt cylinder end cap		130	13	94
Trim cylinder end cap		78	7.8	57
Tilt piston nut		96	9.6	71

General torques

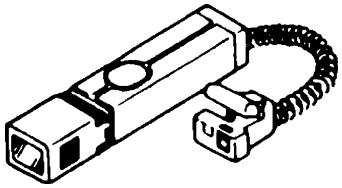
This chart specifies tightening torques for standard fasteners with a standard ISO thread pitch. Tightening torque specifications for special components or assemblies are provided in applicable sections of this manual. To avoid warpage, tighten multi-fastener assemblies in a crisscross fashion and progressive stages until the specified tightening torque is reached. Unless otherwise specified, tightening torque specifications require clean, dry threads. Components should be at room temperature.



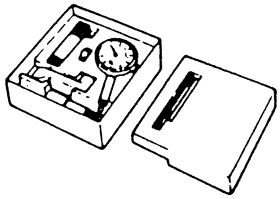
Nut(A)	Bolt (B)	General torque specifications		
		N • m	kgf• m	ft • lb
8mm	M5	5	0.5	3.6
10mm	M6	8	0.8	5.8
12mm	M8	18	1.8	13
14mm	M10	36	3.6	26
17mm	M12	43	4.3	31

Periodic checks and adjustments

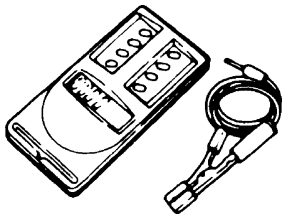
Special service tools



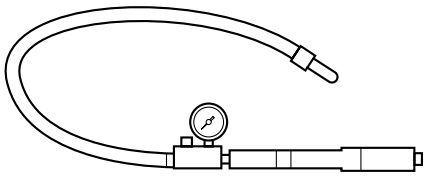
Timing light
90890-03141



Dial gauge set
90890-01252



Digital tachometer
90890-06760



Leakage tester
90890-06840

Maintenance interval chart

Use the following chart as a guideline for general maintenance.
Adjust the maintenance intervals according to the operating conditions of the outboard motor.

Item	Remarks	Initial		Every		Refer to Page
		10 hours (Break-in)	50 hours (3 months)	100 hours (6 months)	200 hours (1 year)	
Top cowling						
Top cowling fit	Check/adjust				○	3-3
Fuel system						
Fuel joint and fuel hoses	Check	○		○	○	3-3
Fuel filter	Check/replace	○	○	○		3-4
Fuel tank(*1)	Clean				○	–
Power unit						
Ignition timing	Check	○				3-6,7
Spark plugs	Clean/adjust/replace	○	○	○	○	3-4
Piston rings	Check/replace				○	5-31
Thermostat	Check				○	3-5
Pressure control valve	Check				○	–
Flywheel magnet nut	Check	○				–
Carburetor(*2)	Check				○	–
Motor exterior	Check			○		–
Cooling water passage(*3)	Clean		○	○		–
Control system						
Carburetor link	Check/adjust				○	3-12,13,15
Throttle cable	Check/adjust				○	3-6,16
Shift cable	Check/adjust				○	3-17
Engine idle speed	Check/adjust	○		○		3-14
Power trim and tilt unit						
Power trim and tilt unit	Check	○	○	○		3-17
Lower unit						
Gear oil	Change	○		○		3-19
Impeller/Woodruff key	Check/replace				○	6-8,38
Oil seals	Check/replace			○		–
Drive shaft	Check/replace				○	6-21,49
Propeller	Check	○	○	○		3-21
General						
Anodes/Trim tab	Check/replace		○	○		3-21
Battery	Check/charge	○ (every month)			○	3-21
Wiring and connectors	Adjust/reconnect	○	○	○		–
Nuts and bolts(*4)	Tighten	○	○	○		–
Lubrication points	Lubricate			○		3-22
Exhaust system deterioration	Check/replace	○	○	○		–

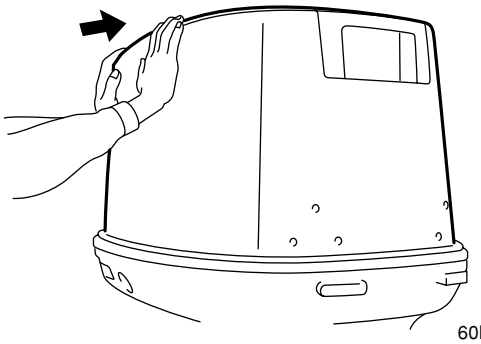
NOTE:

(*1) If equipped with a portable fuel tank.
(*2) Do not adjust the carburetor if it is operating correctly.
(*3) The engine should be flushed with fresh water after operating in salt, turbid, or muddy water.
(*4) Do not retighten the cylinder head and crankcase bolts.

Top cowling

Checking the top cowling

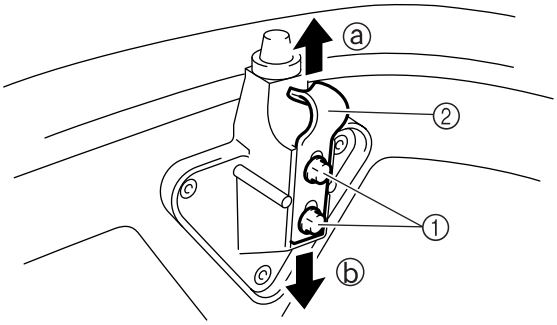
1. Check the fitting by pushing the cowling with both hands. Adjust if necessary.



60H30010

2. Loosen the bolts ①.

3. Move the hook ② up or down to adjust its position.



60H30020

NOTE:

- To loosen the fitting, pull up the hook ② in the direction of arrow ⓐ.
- To tighten the fitting, push down the hook ② in the direction of arrow ⓑ.

4. Tighten the bolts ①.

5. Check the fitting again, and repeat steps 2-4 until the proper fitting is obtained.

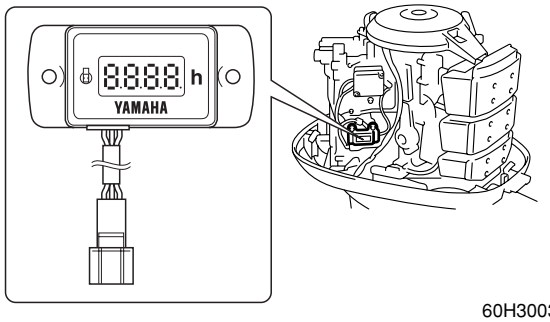
6. Check the rubber seal for cracks or damage. Replace if necessary.

Hour meter

Checking the hour meter

1. Turn the ignition switch to ON.

2. Check that the total hour of operation is displayed after the entire Light Emitting Diode has been illuminated for two seconds.

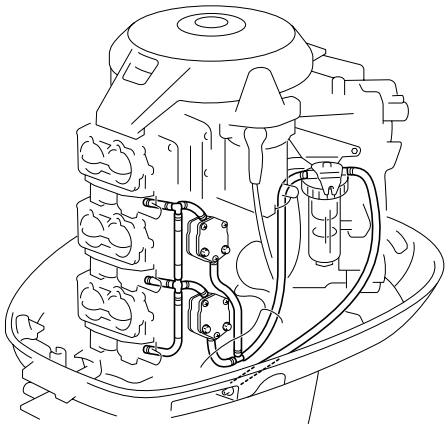


60H30030

Fuel system

Checking the fuel joint and fuel hoses (fuel joint - to - carburetor)

1. Check the fuel hose connections and the fuel hose joint for leaks.

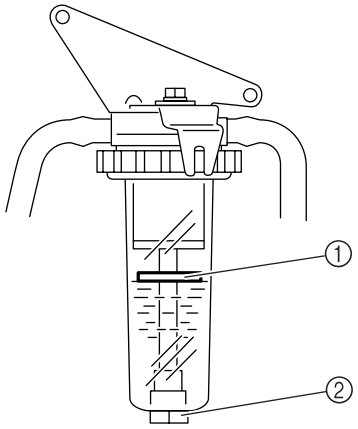


60H30035

2. Check the fuel filter, fuel pump, and carburetor for leaks. Check the fuel hoses for deterioration. Replace them if necessary.

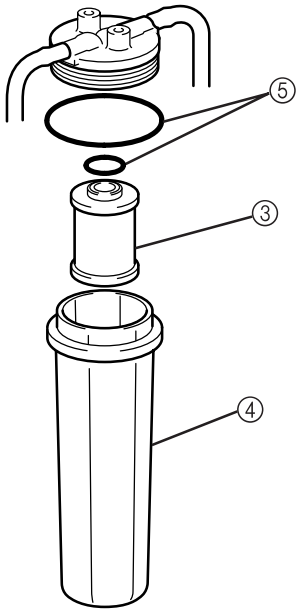
Checking the fuel filter

1. Check that the float ① is in the appropriate position. If water is accumulated, drain it by loosening the drain screw ②.



60H30040

2. Check the filter element ③ for dirt and accumulated residue, and check the filter cup ④ for foreign substances and cracks. Clean with straight gasoline, and replace the fuel filter element if necessary.



60H30050

NOTE:

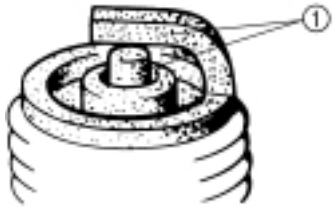
- Be sure not to spill any fuel when removing the fuel filter cup.
- Apply a thin coat of gasoline to the O-ring ⑤ before assembly.

Power unit

Checking the spark plugs

1. Disconnect the spark plug wire before removing the spark plugs.

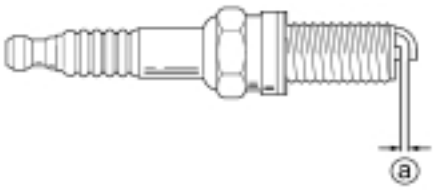
2. Clean the electrodes ① with a spark plug cleaner or wire brush. Replace the spark plug if necessary.



60H30060

3. Check the electrodes for erosion and excessive carbon deposits. Replace the spark plug if necessary.

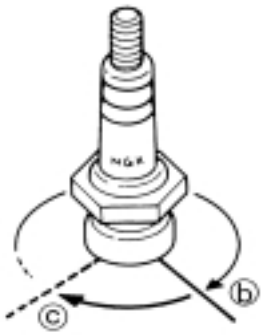
4. Check the spark plug gap ⓐ. Adjust if out of specification.



60H30065

Specified spark plug:
B8HS-10 (NGK)
BR8HS-10 (NGK)
Spark plug gap ⓐ:
1.0 - 1.1 mm (0.039 - 0.043 in)

5. Install the spark plug, tighten it finger-tight to the position ⓑ, then apply the specified torque with a spark plug wrench to the position ⓒ.



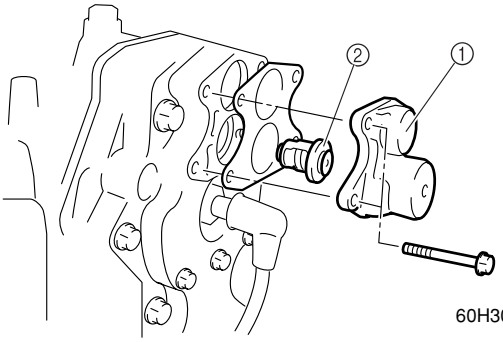
60H30070

Spark plug:
25 N • m (2.5 kgf • m, 18 ft • lb)

NOTE:
Clean the spark plug gasket and the seating face before installing the spark plug.

Checking the thermostat

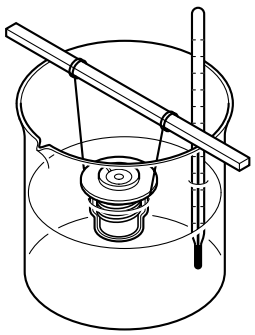
1. Remove the thermostat cover ①, and thermostat ②.



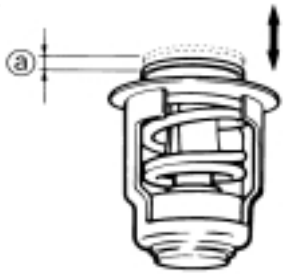
60H30072

2. Suspend the thermostat in the container with water.

3. Slowly heat the water.


60H30075

4. Check the thermostat valve lift ⓐ at the specified water temperature. Replace the thermostat if the valve lift is out of specification.



60H30080

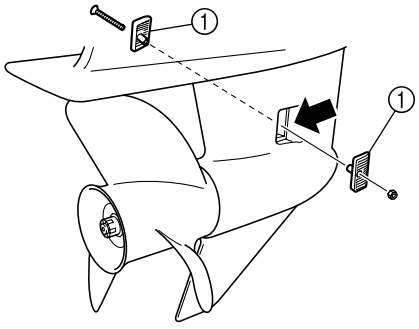
Water temperature	Valve lift ⓐ
50°C (122°F)	0 mm (0 in) – (When the valve begins to open.)
above 60°C (140°F)	more than 3.0 mm (0.12 in)

5. Install the thermostat and ② the cover ①, and new gasket.

Thermostat cover bolts
1st : 4 N • m (0.4 kgf • m, 3 ft • lb)
2nd : 8 N • m (0.8 kgf • m, 6 ft • lb)

Checking the cooling water passage

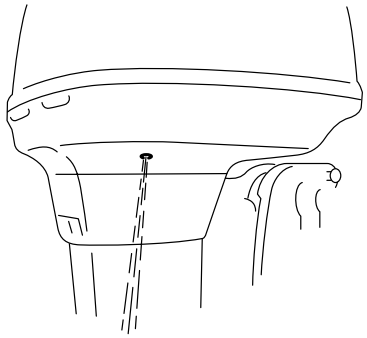
1. Check the cooling water inlet cover ①, and cooling water inlet for clogs. Clean if necessary.



60H30090

2. Place the lower unit in water, and then start the engine.

3. Check the water flowing out of the cooling water pilot hole. If there is no water flow, check the cooling water passage inside the outboard motor.



60H30100

Control system

⚠ WARNING

Whenever servicing the running engine, take precautions not to touch the rotating parts or the areas carrying the high-voltage current.

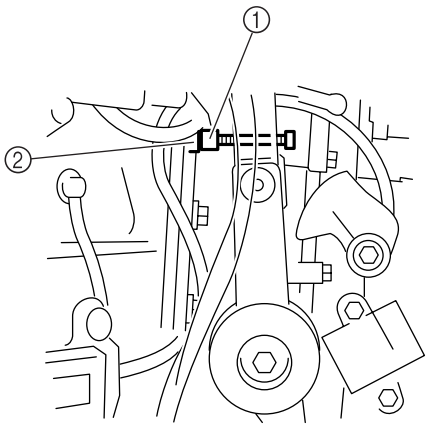
CAUTION:

The sequence of the services specified below shall be strictly followed and pursued to the end, when adjusting the ignition timing and other aspects related to the throttle system.

1. **Adjusting the ignition timing**
2. **Synchronizing the carburetor**
3. **Adjusting the carburetor pick-up**
4. **Adjusting the engine idle speed**
5. **Adjusting the throttle cable**
6. **Adjusting the choke valve**

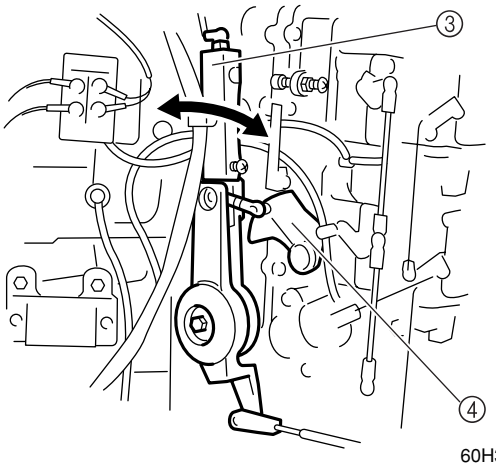
Checking the throttle cable operation

1. Check that the standard ignition timing adjusting screw ① touches the fully closed stopper ② on the cylinder block when the remote control lever is in neutral.



60H30110

2. Check that magnet control lever ③, and accelerator cam ④ move smoothly as the remote control lever is moved.



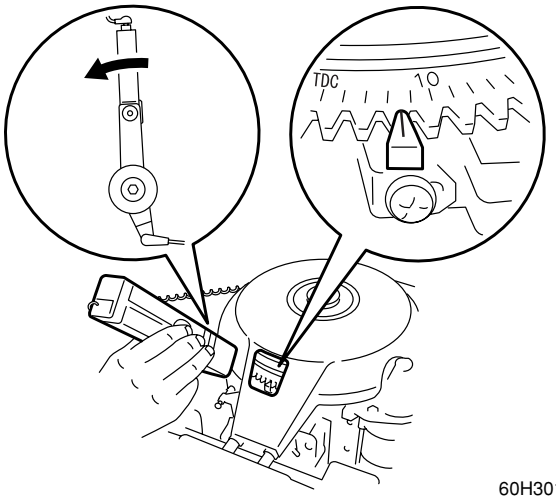
60H30120

3. If adjustment is required, adjust the ignition timing first.

Checking the ignition timing (with timing light)

1. Attach the timing light to the spark plug wire to #1 cylinder, and start the engine.

2. Check the ignition timing while engine is running at idle speed.



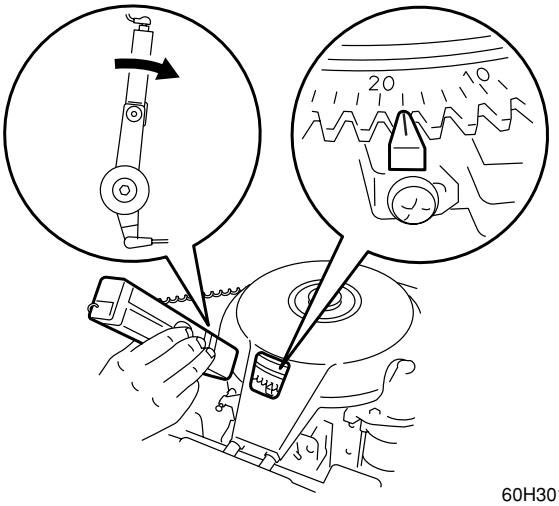
60H30130

CAUTION:

Make sure that the shift lever is in neutral position.

Ignition timing at idle speed :
ATDC 7°

3. Check the ignition timing while engine is running at wide open throttle (i.e. at fully advanced position).



60H30140

Ignition timing at wide open throttle:
BTDC 18°

Timing light:
90890-03141

Checking the ignition timing

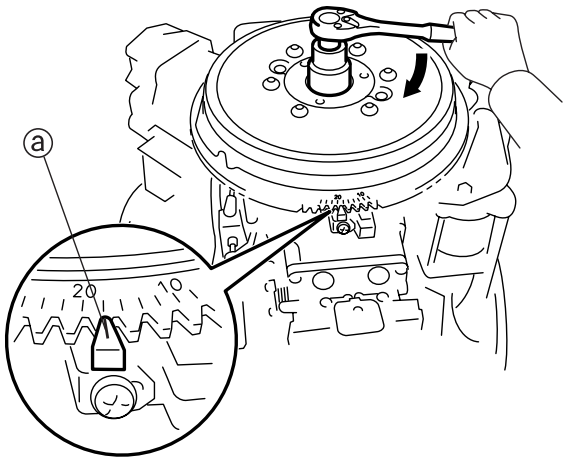
1. Disconnect the throttle cable.

2. Remove the intake silencer and flywheel cover.

3. Turn the flywheel clockwise until the ignition timing mark on the flywheel magnet is aligned with the pointer mark ⓐ on the timing plate at the full advance.

NOTE:

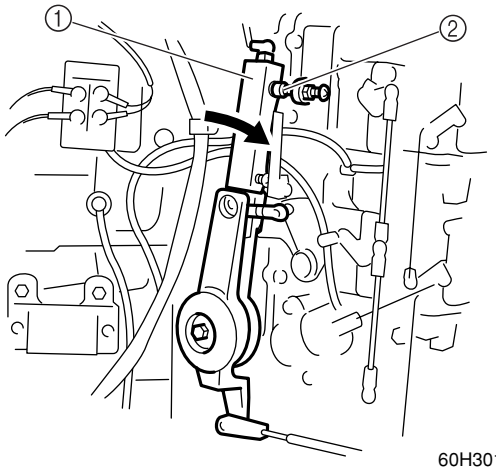
Turn the flywheel clockwise. Turning it to the opposite direction will damage the water pump impeller.



60H30150

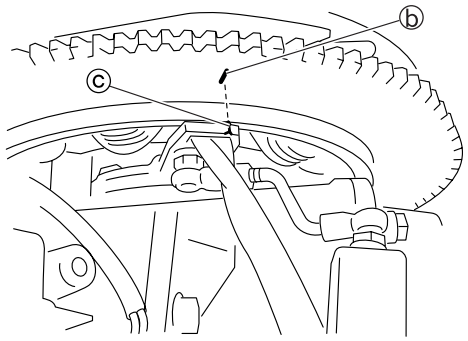
Ignition timing (full advance):
BTDC 18°

4. Move the magnet control lever ① until it touches the full advanced stop screw ②.



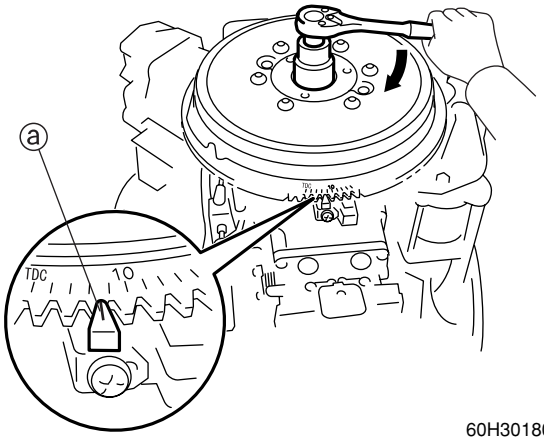
60H30160

5. Check that the mark ⓑ on flywheel magnet is aligned with the mark ⓒ on base assembly.



60H30170

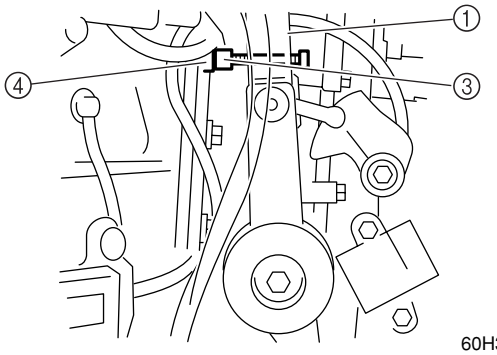
6. Turn the flywheel clockwise until the ignition mark on the flywheel magnet is aligned with the pointer mark ⓐ on the timing plate at the standard ignition timing.



60H30180

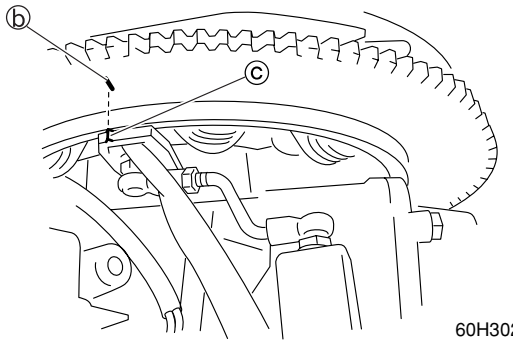
Standard ignition timing: ATDC 7°

7. Move the magnet control lever ① until the standard ignition timing adjusting screw ③ touches the fully closed stopper ④ on the cylinder block.



60H30190

8. Check that the mark ⓑ on flywheel magnet is aligned with the mark ⓒ on base assembly.

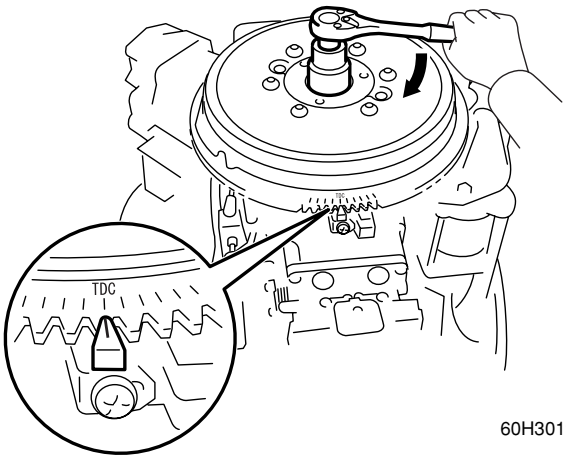


60H30200

9. Adjust the ignition timing when the alignment of the marks ⓑⓒ could not be attained for either or both of the fully advanced ignition timing and standard ignition timing.

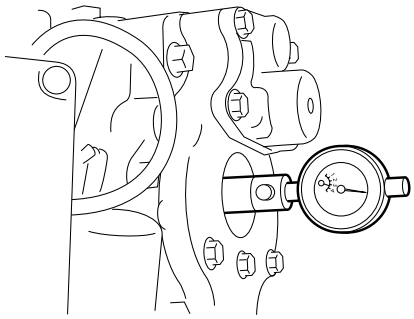
Adjusting the ignition timing

1. Disconnect the throttle cable.
2. Remove the intake silencer and flywheel cover.
3. Remove all the spark plugs.
4. Set the #1 cylinder at top dead center.



60H30195

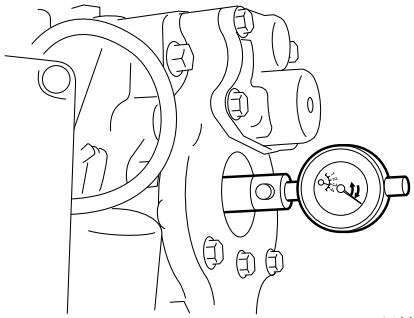
5. Mount the dial gauge in the spark plug hole on #1 cylinder.


60H30210

NOTE:
Secure the dial gauge after retracting it by approximately 3mm (0.118 in).

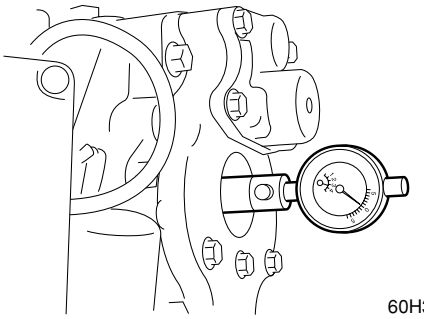
Dial gauge set: 90890-01252

6. Slowly turn the flywheel clockwise observing the dial gauge, and identify the top dead center of the #1 cylinder piston by the gauge.

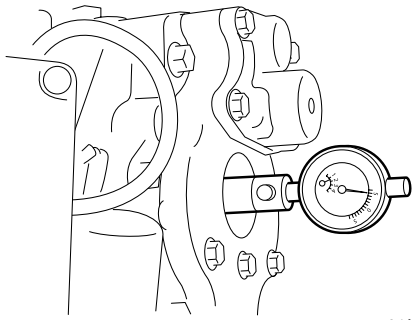

60H30220

NOTE:
Turn the flywheel clockwise. Turning it to the opposite direction will damage the water pump impeller.

7. Adjust the gauge so that the indicator points at zero at the top dead center identified above.


60H30230

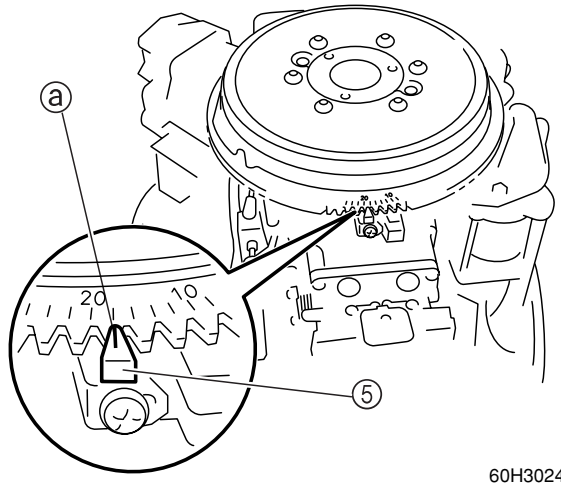
8. Slowly turn the flywheel clockwise until the #1 cylinder piston comes to the specified position.


60H30235

NOTE:
To move the piston to the specified position, flywheel should be turned almost one full revolution, and the pointer mark on the timing plate should come close to BTDC 18° marking on the flywheel.

Specified position :
2.05 mm (0.0807 in)

9. Adjust the position of timing plate ⑤ so that the pointer mark ⓐ comes to the full advance angle on the flywheel scale.

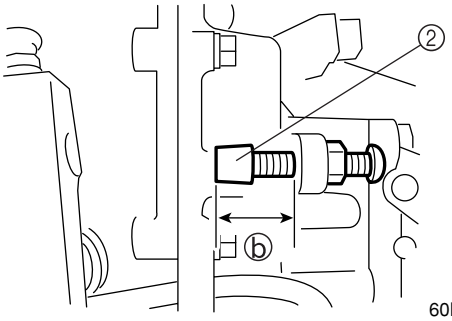


60H30240

Full advanced timing : BTDC 18°

10. Secure the timing plate ⑤ at the adjusted position and mark the position with paint.

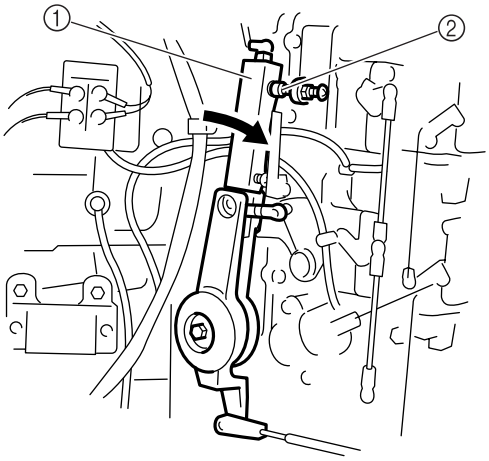
11. Adjust the fully advanced stop screw ② so that the stopper ⓑ has the specified length.



60H30250

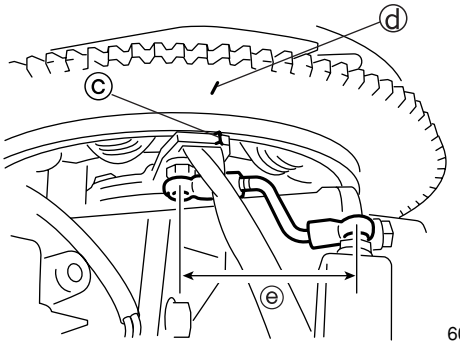
Specified length ⓑ: 25.0 mm(0.98 in)

12. Move the magnet control lever ① until it touches the fully advanced stop screw ②.



60H30160

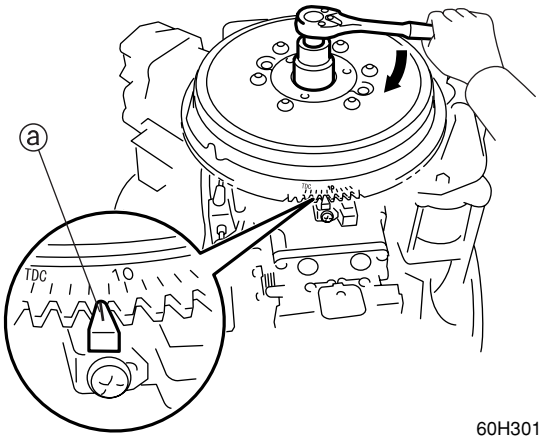
13. Adjust the length of magnet control link so that the timing mark ⓒ on the flywheel aligns with the mark ⓓ on the base assembly.



60H30260

Magnet control link length ⓔ : 65mm(2.56in) (reference)

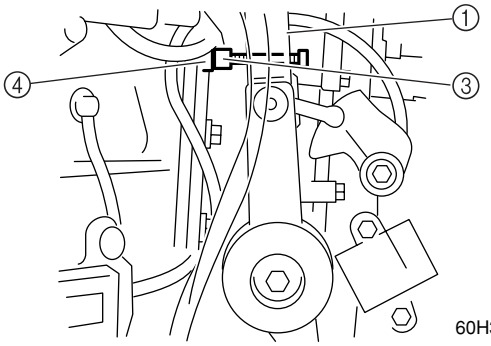
14. Turn the flywheel clockwise to align the pointer mark ⓐ on the timing plate with standard ignition angle on the flywheel scale.



60H30180

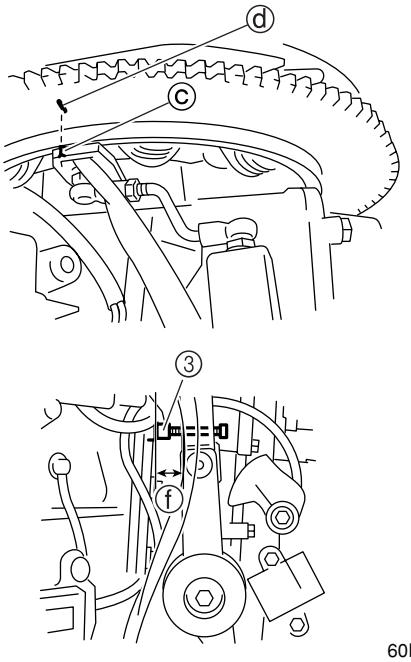
Standard ignition timing : ATDC 7°

15. Move the magnet control lever ① until the standard ignition timing adjusting screw ③ touches the fully closed stopper ④ on the cylinder block.



60H30190

16. Adjust the length of standard ignition timing adjusting screw ③ so that the timing mark ⓓ on the flywheel aligns with the mark ⓒ on the base assembly.



60H30270

Standard ignition timing adjusting screw length ⓕ :
16mm(0.63in) (reference)

17. Make sure that the carburetor pick-up timing is correct.

18. Install the spark plugs.

Spark plug:
25 N • m (2.5 kgf • m, 18 ft • lb)

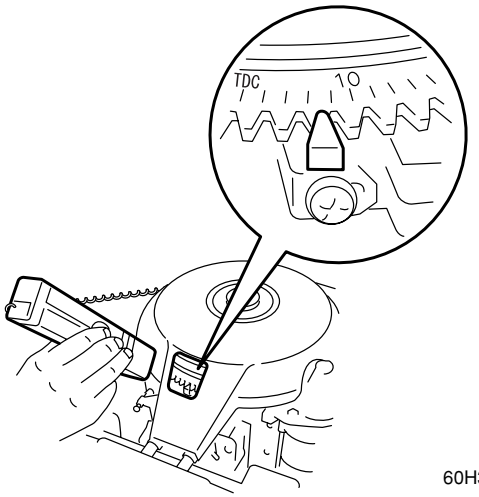
19. Install the intake silencer and flywheel cover.

20. Connect the throttle cable.

21. Start the engine, and check the engine idle speed.

Engine idle speed: 675-725 r/min

22. Check the ignition timing by means of the timing light.



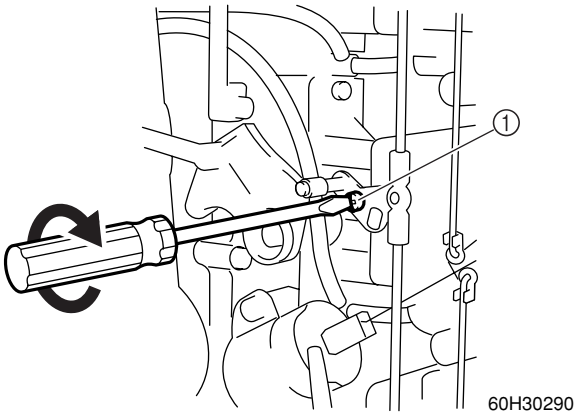
60H30280

Timing light : 90890-03141

Ignition timing at idle speed :
ATDC 7°
Ignition timing at wide open throttle :
BTDC 18°

Checking the carburetor synchronization

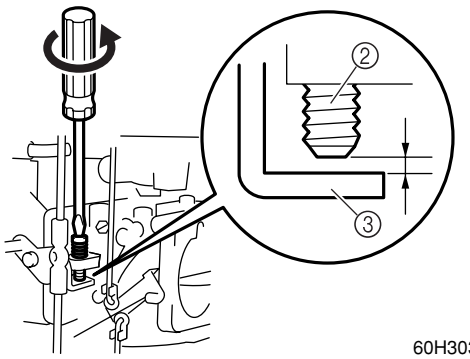
1. Disconnect the throttle cable.
2. Remove the intake silencer and flywheel cover.
3. Loosen the throttle lever tightening screw ① clockwise on the central carburetor.



60H30290

NOTE:
The throttle lever tightening screw ① has left hand threads.

4. Loosen the idle adjusting screw ② on the central carburetor to make a gap between the screw tip and the throttle arm stopper ③.

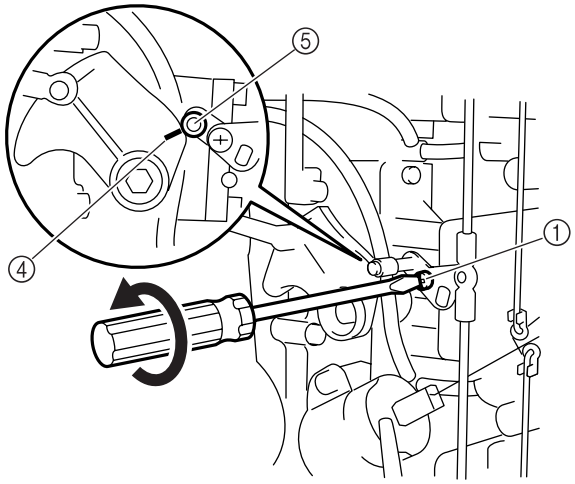


60H30300

5. Visually check that the throttle valves are all closed.

NOTE:
Move the throttle lever slightly to help the visual check.

6. Tighten the throttle lever tightening screw ① counterclockwise, to make the accelerator cam ④ aligned with the centerline of the roller ⑤.



60H30310

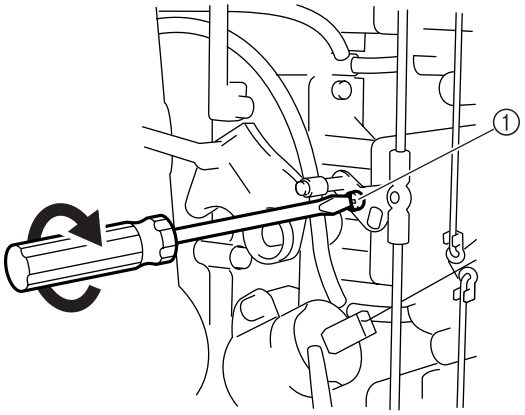
7. Connect the throttle cable.
8. Install the intake silencer and the flywheel cover.
9. Start the engine and adjust the engine idle speed by turning the idle adjusting screw.

	Engine idle speed : 675-725 r/min
	Digital tachometer : 90890-06760

Adjusting the carburetor synchronization

NOTE:
Make sure the ignition timing is properly adjusted before synchronizing the carburetor.

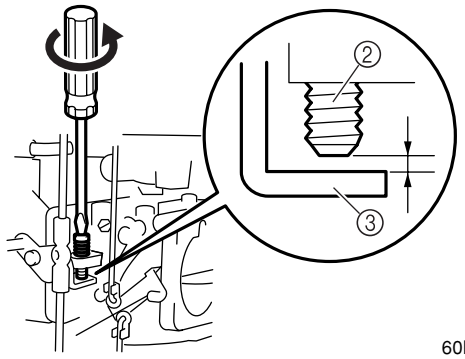
1. Disconnect the throttle cable.
2. Remove the intake silencer and flywheel cover.
3. Loosen the throttle lever tightening screw ① clockwise on the central carburetor.



60H30290

NOTE:
The throttle lever tightening screw ① has left hand threads.

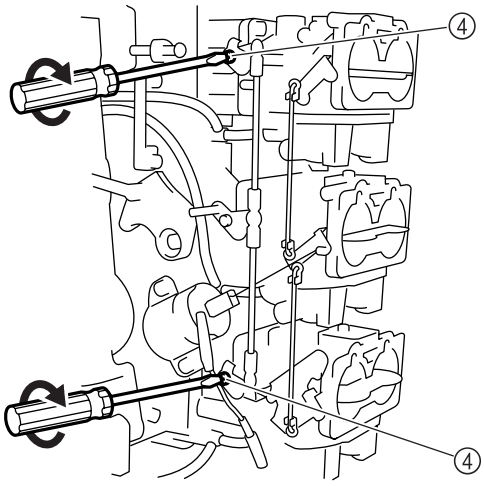
4. Loosen the idle adjusting screw ② on the central carburetor to make a gap between the screw tip and the throttle arm stopper ③.



60H30300

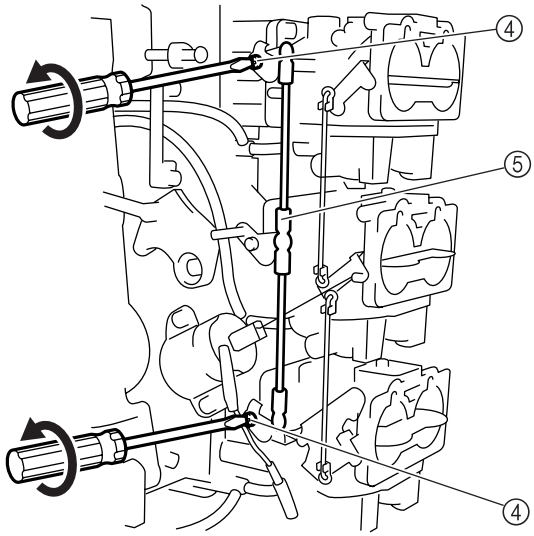
5. Loosen the throttle lever tightening screw ④ clockwise on the upper and lower carburetors.

NOTE:
The throttle lever tightening screw ④ has left hand threads.



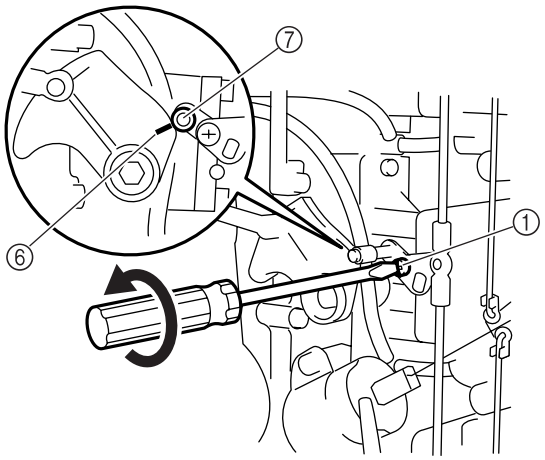
60H30320

6. On the upper and lower carburetors, tighten the throttle lever tightening screw ④ counterclockwise, while retaining the throttle lever ⑤ on the central carburetor at the fully closed position.



60H30330

7. On the central carburetor, tighten the throttle lever tightening screw ① counter-clockwise to make the accelerator cam ⑥ aligned with the centerline of the roller ⑦.



60H30335

8. Install the intake silencer and flywheel cover.

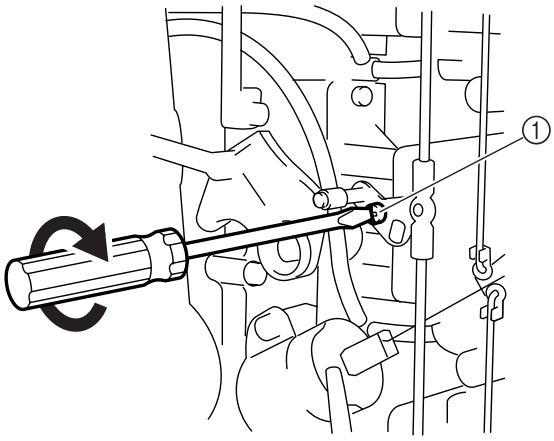
9. Start the engine and adjust the engine idle speed by turning the idle adjusting screw ②.

Engine idle speed : 675-725 r/min

Adjusting the engine idle speed

1. Start the engine, warm it up for 5 minutes, and shut it off.

2. Loosen the throttle lever tightening screw ① clockwise on the central carburetor.

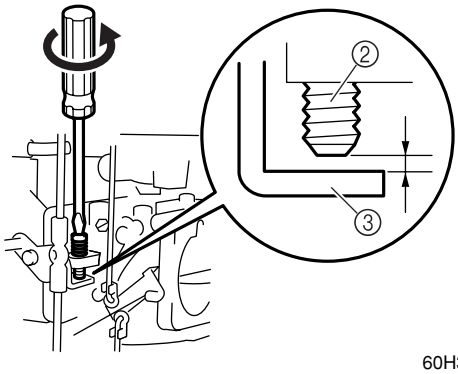


60H30290

NOTE:

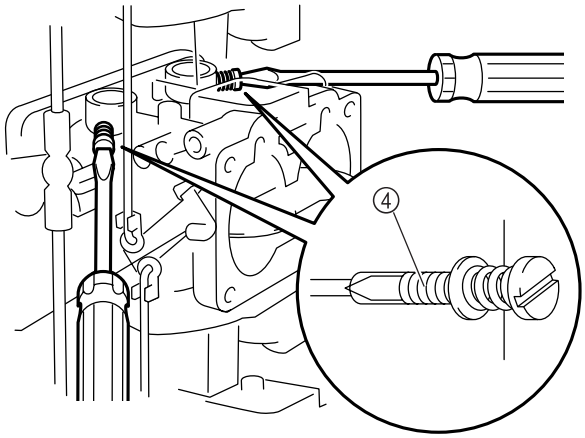
The throttle lever tightening screw ① has left hand threads.

3. Loosen the idle adjusting screw ② to make a gap between the screw tip and the throttle arm stopper ③.



60H30300

4. Turn-in the pilot screws ④ until they are lightly seated, and then turn-out the pilot screws by the specified turns.



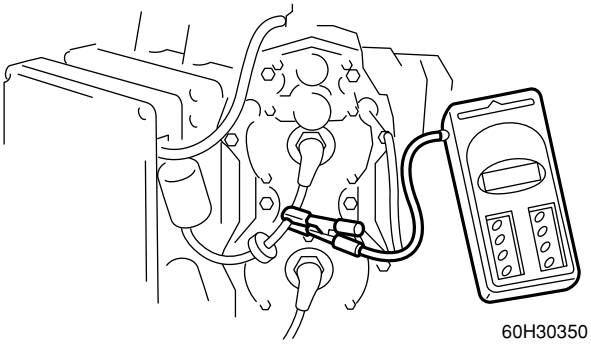
60H30340

Pilot screw turn-out :
1 1/8 ± 1/4 (7/8-1 3/8)

NOTE:

Adjust the pilot screws at every carburetor.

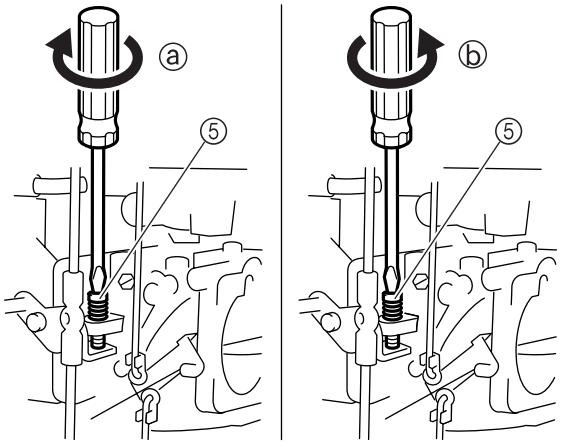
5. Install the tachometer onto the spark plug wire of #1 cylinder, and start the engine.



60H30350

Digital tachometer : 90890-06760

6. Adjust the engine idle speed by turning the idle adjusting screw ⑤.

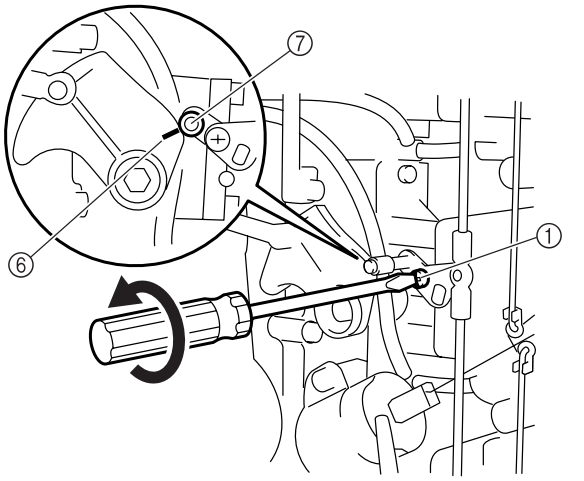


60H30360

NOTE:
- To increase the idle speed, turn the idle adjusting screw ⑤ in the direction of ⓐ.
- To decrease the idle speed, turn the idle adjusting screw ⑤ in the direction of ⓑ.

Engine idle speed : 675-725 r/min

7. Tighten the throttle lever tightening screw ① counterclockwise on the central carburetor, to make the accelerator cam ⑥ aligned with the centerline of the roller ⑦.



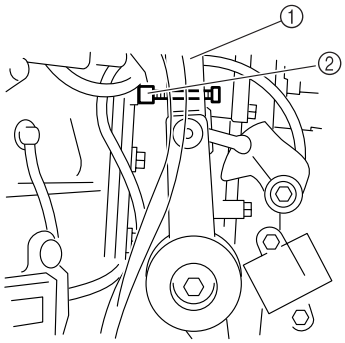
60H30370

8. Check the engine idle speed after opening and closing the throttle for several times.

Adjusting the carburetor pickup timing

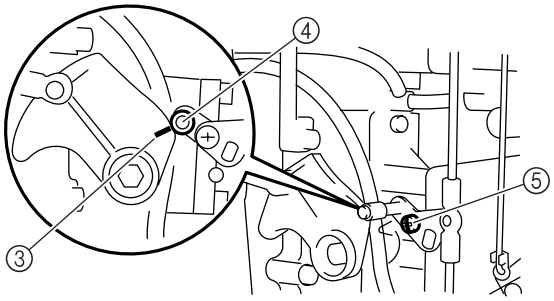
1. Disconnect the throttle cable.

2. Move the magnet control lever ① until the standard ignition timing adjusting screw ② touches the fully closed stopper on the cylinder block.



60H30380

3. Check that the accelerator cam ③ is aligned with the centerline of the roller ④.



60H30390

4. Loosen the throttle lever tightening screw ⑤ clockwise to make the accelerator cam aligned with the centerline of the roller ④.

5. Tighten the throttle lever tightening screw ⑤ counterclockwise.

NOTE:
The throttle lever tightening screw ⑤ has left hand threads.

6. Start the engine and adjust the engine idle speed by turning the idle adjusting screw.

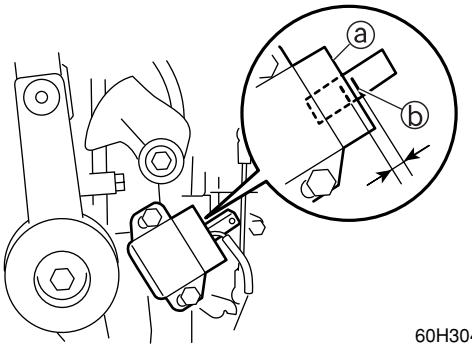
Engine idle speed : 675-725 r/min

Adjusting the choke solenoid

1. Remove the intake silencer.

2. Make sure that the choke valve is fully open.

3. Check that the choke solenoid face ⓐ is between the marking ⓑ on the plunger. Adjust the position of the choke solenoid if necessary.

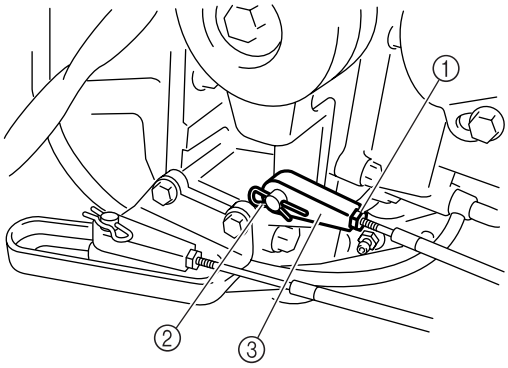


60H30400

Adjusting the throttle link and the throttle cable operation

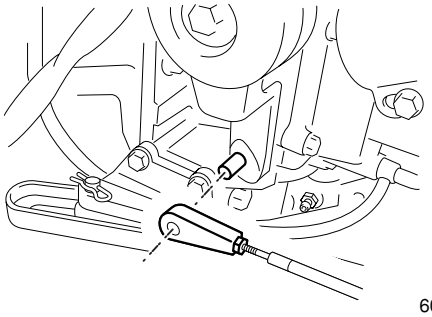
NOTE:
Complete the ignition timing adjustment, throttle valves synchronization, engine idle speed adjustment, and carburetor pickup timing adjustment prior to the throttle link adjustment.

1. Loosen the locknut ① , remove the clip ②, and disconnect the throttle cable joint ③.

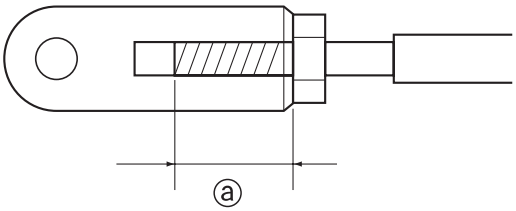


60H30410

2. Adjust the length of the throttle cable joint ③ so that its hole is aligned with the set pin on the magnet control lever.



60H30415



60H30420

CAUTION:
The throttle cable joint must be screwed in a minimum of 8.0mm (0.31in.) ⓐ.

3. Connect the cable joint, install the clip ②, and tighten the locknut ①.

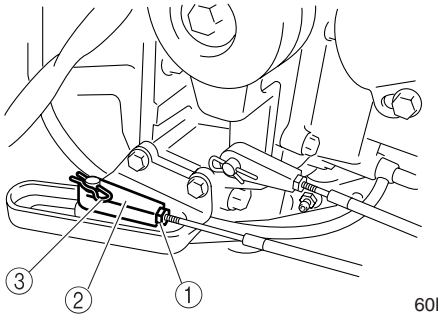
4. Check the throttle cable for smooth operation, and repeat steps 1-3 if necessary.

Checking the gearshift operation

1. Check that the gearshift operates smoothly when it is shifted from neutral into forward or reverse. Adjust the shift cable length if necessary.

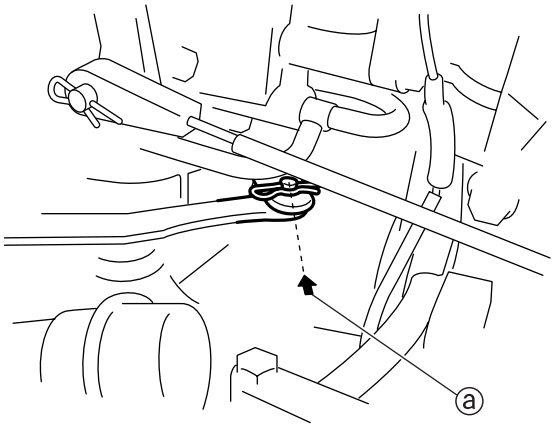
2. Shift gear into neural.

3. Loosen the locknut ①, remove the clip ③, and disconnect the shift cable joint ②.



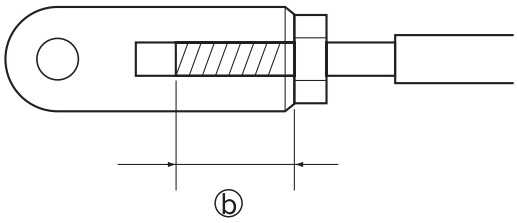
60H30425

4. Align the shift rod with the arrow ⓐ marked on the bottom cowling.



60H30427

5. Adjust the length ⓑ of the shift cable joint ② so that its hole is aligned with the set pin.



60H30428

CAUTION:

The shift cable joint ② must be screwed in a minimum of 8.0mm (0.31in.) ⓑ.

6. Connect the shift cable joint ②, install the clip ③, and tighten the locknut ①.
7. Check the shift cable for smooth operation, and repeat steps 3-6 if necessary.

Power trim and tilt unit

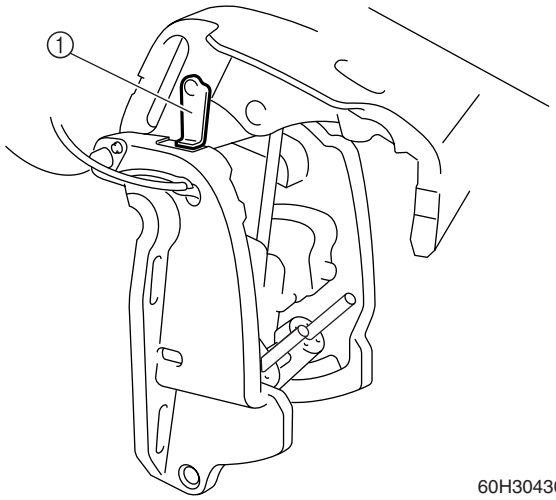
Checking the power trim and tilt operation

1. Fully tilt up and down the outboard motor for several times to check the entire trim and tilt range for smooth operation.

NOTE:

Make sure that you hear the smooth operating sound of the power trim and tilt motor.

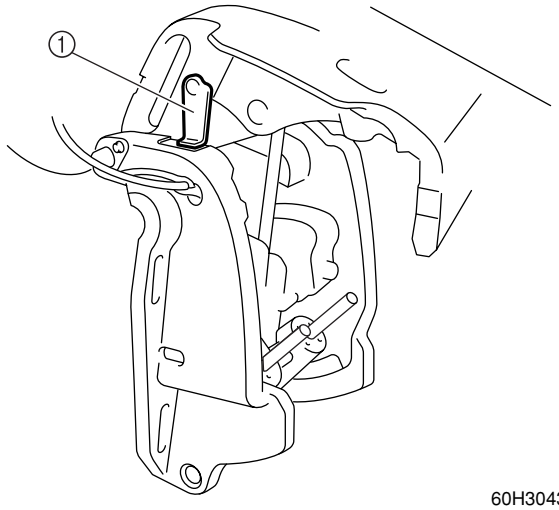
2. Fully tilt up the outboard motor, and support it with the tilt stop lever ① to check that the locking mechanism works properly.



60H30430

Checking the power trim and tilt fluid level

1. Fully tilt up the outboard motor and support it with the tilt stop lever ①.

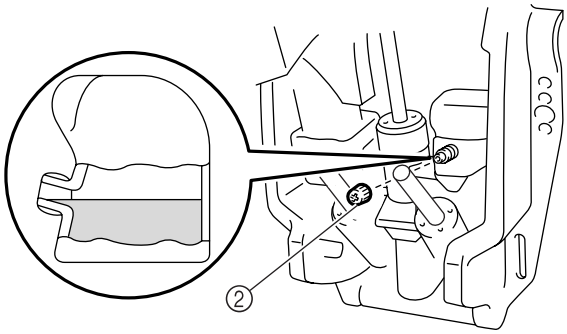


60H30430

⚠ WARNING

After tilting up the outboard motor, be sure to support it with the tilt stop lever ①. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.

2. Remove the reservoir cap ② and check the fluid level in the reservoir.



60H30440

NOTE:

If the fluid is at the correct level, the fluid should overflow out of the filler hole when the cap ② is removed.

3. If the fluid level is low, add sufficient fluid of the recommended type until it overflows out of the filler hole.

Recommended power trim and tilt fluid:
ATF Dexron II

4. Install the reservoir cap ②, and tighten it to the specified torque.

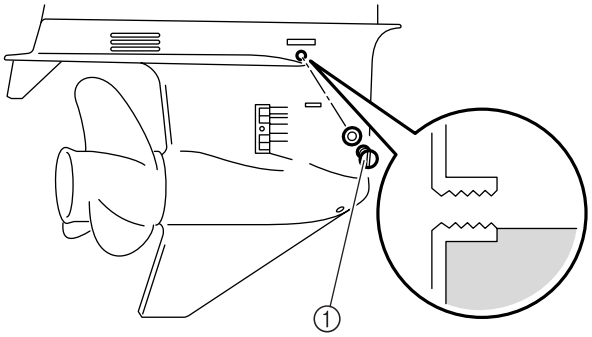
Reserver cap ②:
0.7 N•m (0.07 kgf•m, 0.5 ft•lb)

3

Lower unit

Checking the gear oil level

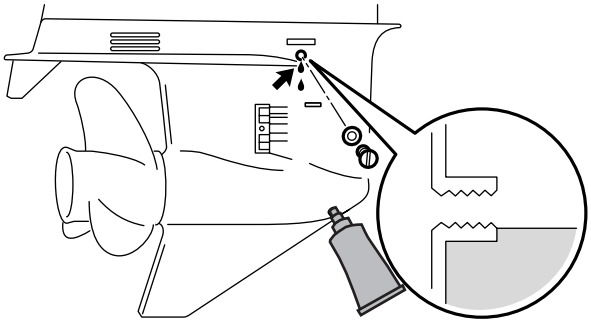
1. Fully tilt down the outboard motor.
2. Remove the check screw ① and check the gear oil level in the lower case.



60H30450

NOTE:
If the oil is at the correct level, the oil should overflow out of the check hole when the check screw ① is removed.

3. If the oil level is low, add sufficient gear oil of the recommended type until it overflows out of the check hole.



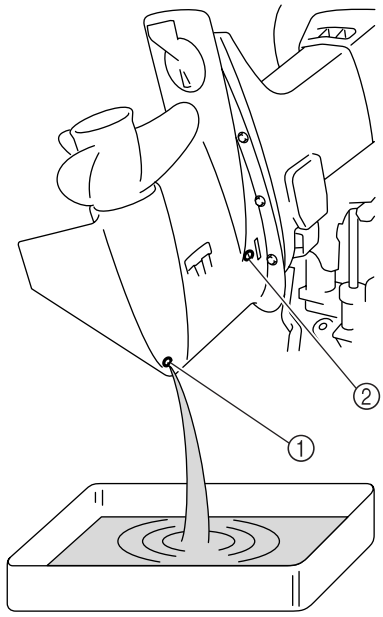
60H30455

Recommended gear oil:
Hypoid gear oil
SAE: 90

4. Install the check screw ①.

Changing the gear oil

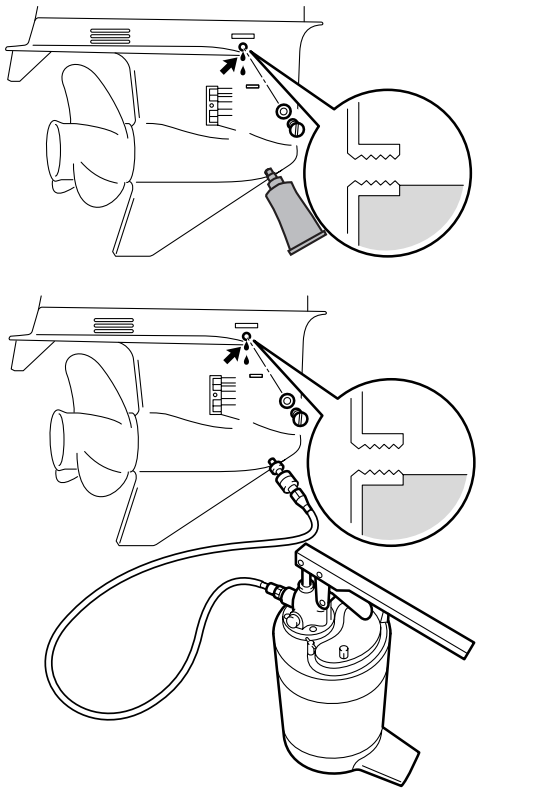
1. Fully tilt up the outboard motor.
2. Place a drain pan under the drain screw ①, remove the drain screw ① and the check screw ② to drain the oil.



60H30460

3. Check the oil for metal powder possibly mixed in it, discoloration, and viscosity. Check the internal parts of the lower case if necessary.

4. Insert the gear oil tube or gear oil pump into the drain hole and slowly fill the gear oil until oil flows out of the check hole and no air bubbles are visible.



60H30470

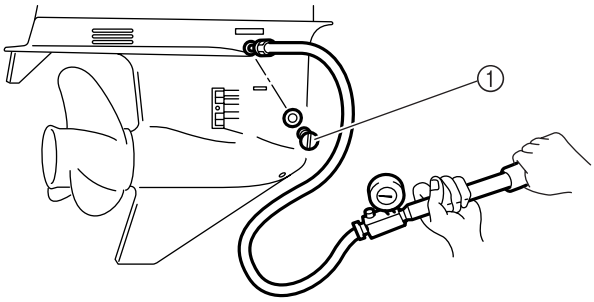
Recommended gear oil:
Hypoid gear oil
SAE: 90

Oil quantity:
Regular rotation model:
980 cm^3 (34.5 Imp qt)
Counter rotation model:
870 cm^3 (30.6 Imp qt)

5. Install the check screw ② and quickly install the drain screw ①.

Checking the lower unit (for air leakage)

1. Remove the check screw ①, and install the leakage tester.



60H30480

Leakage tester : 90890-06840

2. Apply the specified pressure to the lower unit, to check whether the pressure is retained for 10 seconds.

CAUTION:

Do not over-pressurize the lower unit, otherwise the oil seals may be damaged.

NOTE:

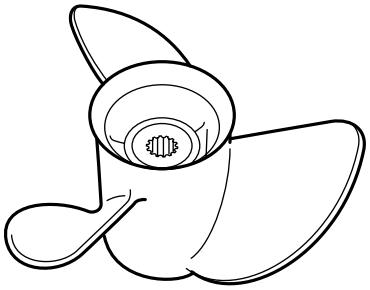
Cover the check hole with a rag while removing the leakage tester from the lower unit.

Lower unit holding pressure:
100 kPa (1.0 kgf/cm^2 , 14 psi)

3. If pressure drops below specification, check the drive shaft and propeller shaft oil seals for damage.

Checking the propeller

1. Check the propeller blades and splines for cracks, damage, or wear.

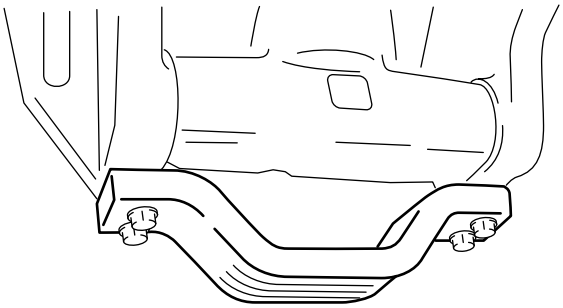


60H30490

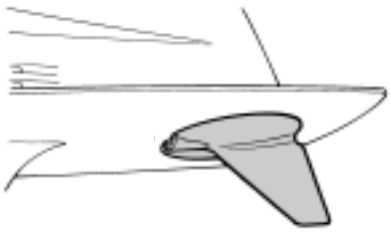
General

Checking the anodes

1. Check the anodes and trim tab for scales, grease, or oil. Clean if necessary.



60H30500



60H30505

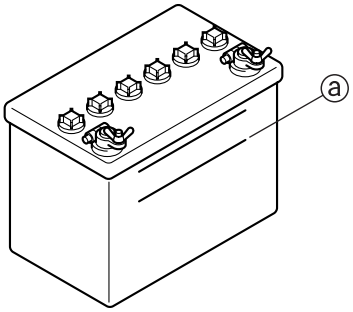
CAUTION:

Do not oil, grease, or paint the anodes, otherwise they will not be able to prevent the galvanic corrosion effectively.

2. Replace the anodes and trim tab if excessively eroded.

Checking the battery

1. Check the battery electrolyte level. If the level is at or below the minimum level mark ⓐ, add distilled water until it reaches to the level between the maximum and minimum level marks.



60H30510

2. Check the specific gravity of the electrolyte. Fully charge the battery if obtained value is out of specification.

⚠ WARNING

Battery electrolyte is dangerous; It contains sulfuric acid which is poisonous and highly caustic. Always follow these preventie measures:

- **Avoid bodily contact with electrolyte as it can cause severe burns or permanent eye injury.**
- **Wear protective eye gear when handling or working near batteries.**

Antidote (EXTERNAL):

- **SKIN - Wash with water.**
- **EYES - Flush with water for 15 minutes and get immediate medical attention.**

Antidote (INTERNAL):

- **Drink large quantities of water or milk followed with milk of magnesia, beaten egg, or vegetable oil. Get immediate medical attention.**

Batteries generate explosive, hydrogen gas. Always follow these preventive measures:

- **Charge batteries in a well-ventilated area.**
- **Keep batteries away from fire, sparks or open flame (e.g., welding equipment, lighted cigarettes).**
- **DO NOT SMOKE when charging or handling betteries.**

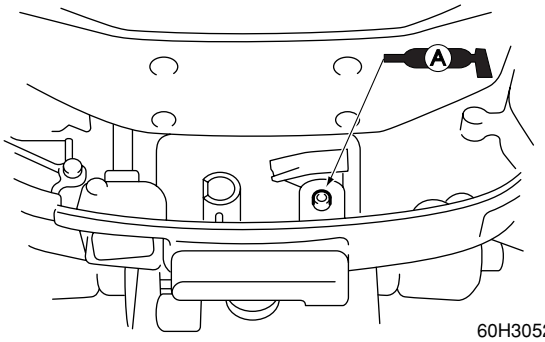
KEEP BATTERIES AND ELECTROLYTE OUT OF REACH OF CHILDREN.

NOTE:
Batteries vary per manufacturer. The procedures mentioned in this manual may not always apply, therefore, consult the instruction manual of the battery.
Disconnect the black (–) battery cable first, then the red (+) battery cable.

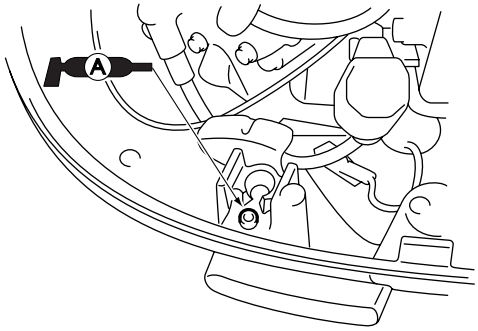
Electrolyte specific gravity:
1.280 at 20°C (68°F)

Lubrication

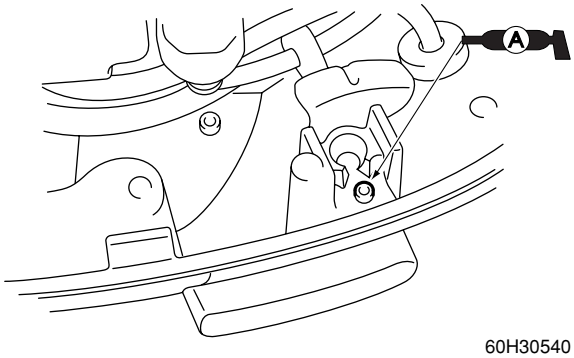
1. Apply Yamaha grease A to the areas shown.



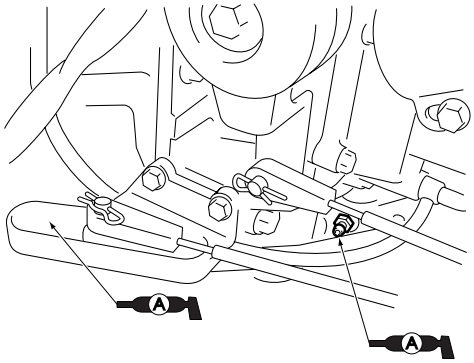
60H30520



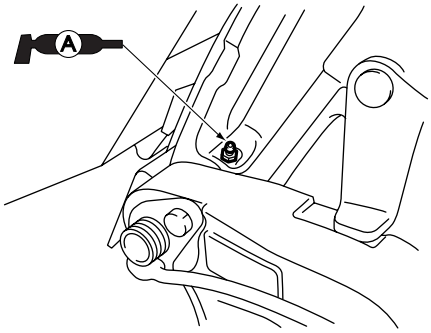
60H30530



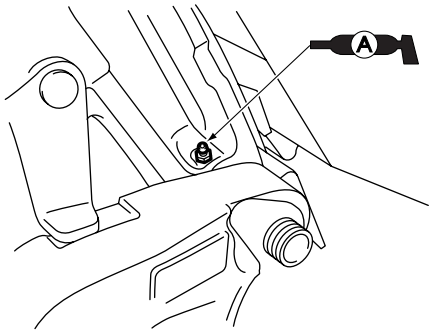
60H30540



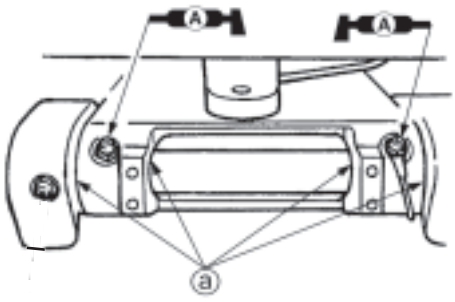
60H30550



60H30560

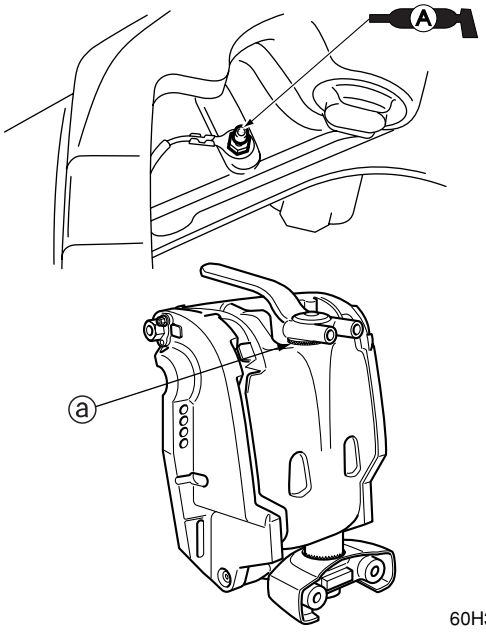


60H30570



60H30580

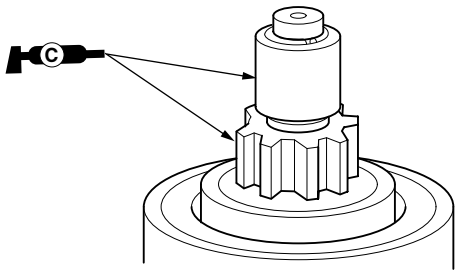
3



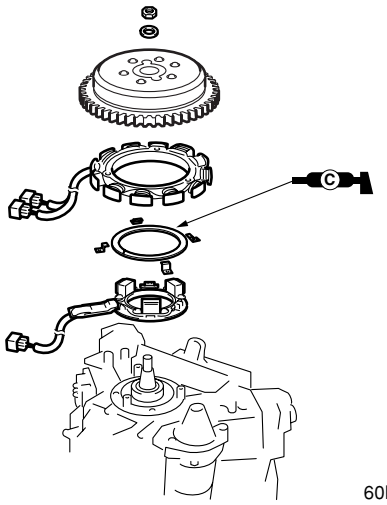
60H30590

NOTE:
Apply grease to the grease nipples until it overflows from the bushings ⓐ .

2. Apply Yamaha grease C to the areas shown.

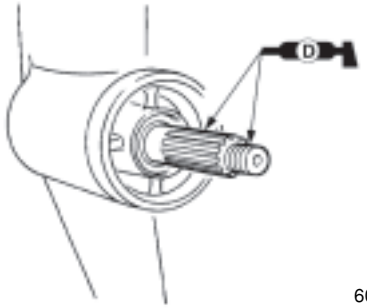


60H30600



60H30605

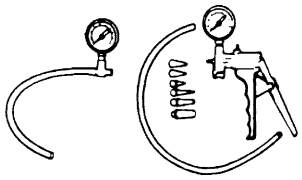
3. Apply Yamaha grease D to the areas shown.



60H30610

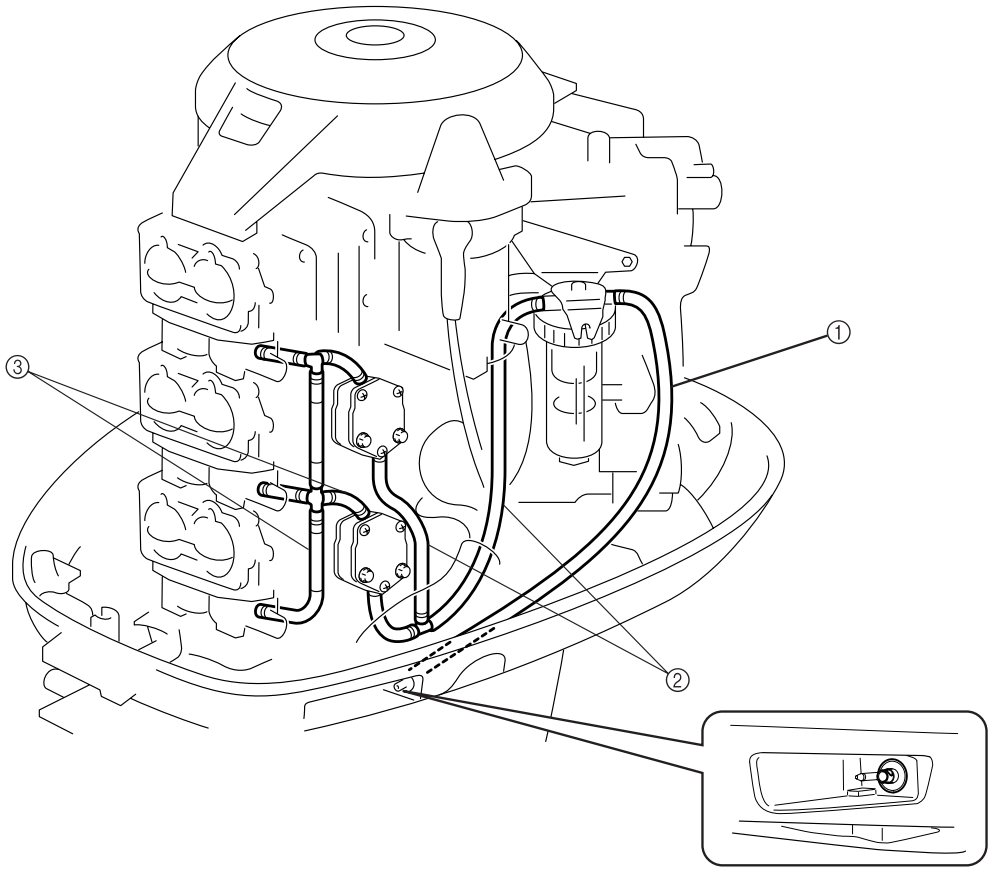
Fuel system

Special service tools



Vacuum/pressure pump gauge set
90890-06756

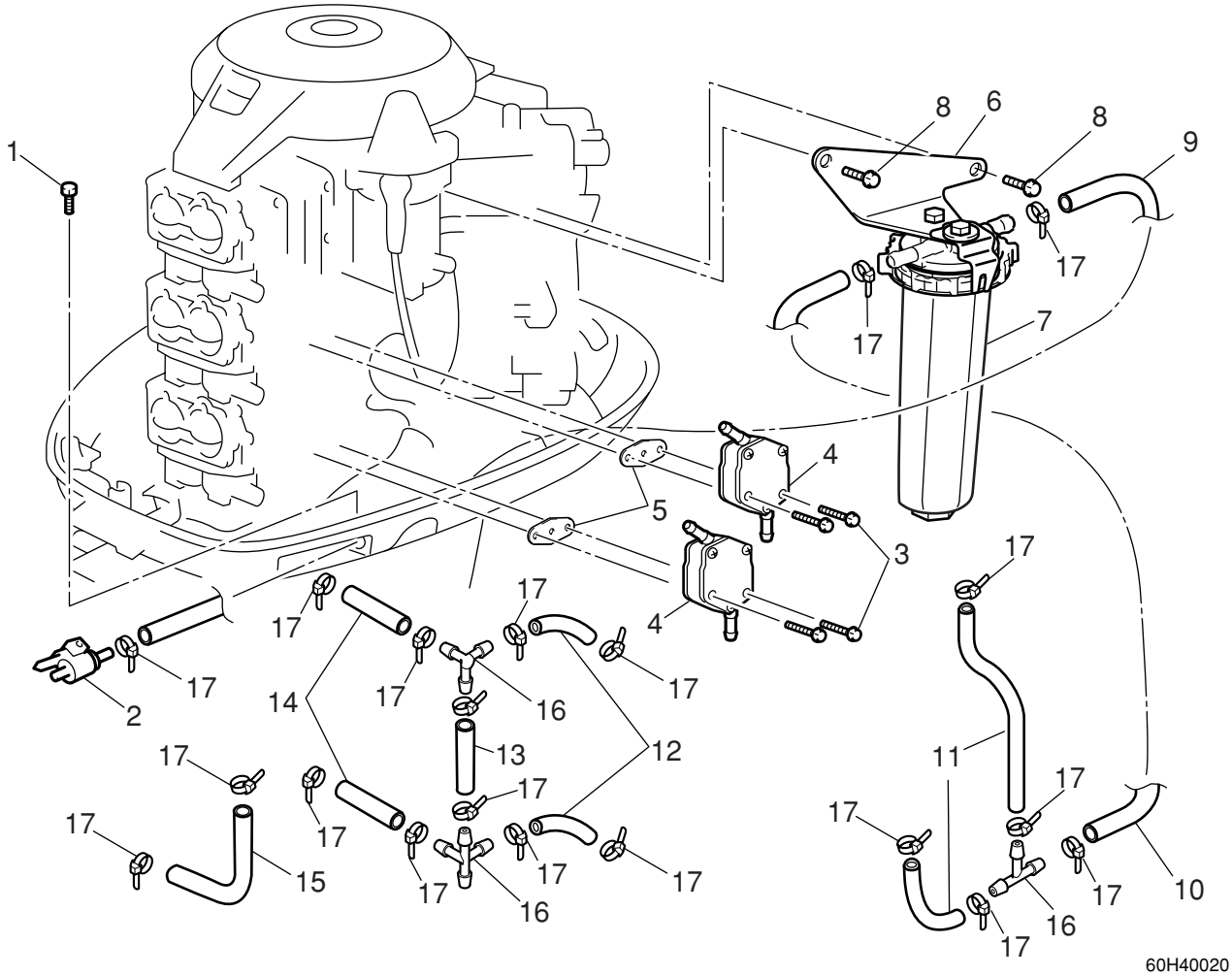
Hose routing
Fuel hoses



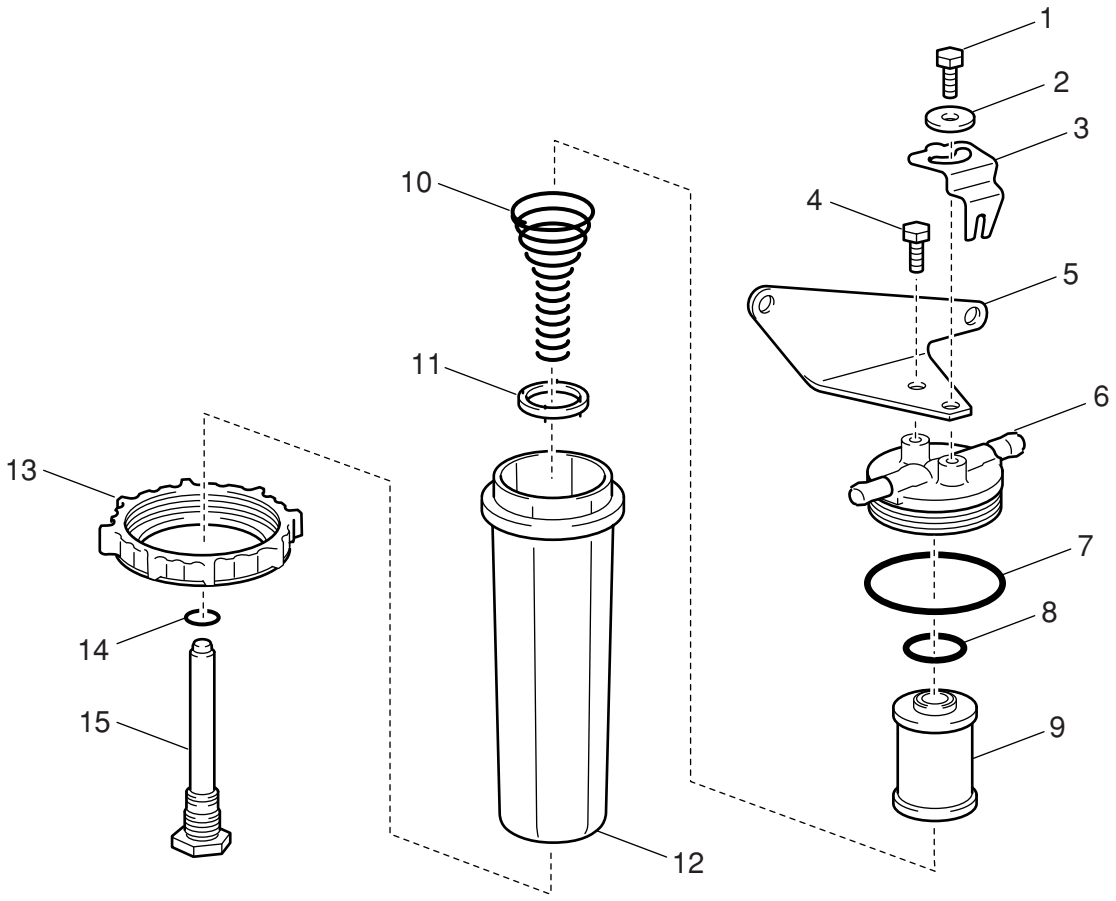
60H40010

① Fuel hose(fuel joint-to-fuel filter)
② Fuel hose(fuel filter-to-fuel pump)
③ Fuel hose(fuel pump-to-carburetor)

Fuel filter, fuel pump, fuel joint

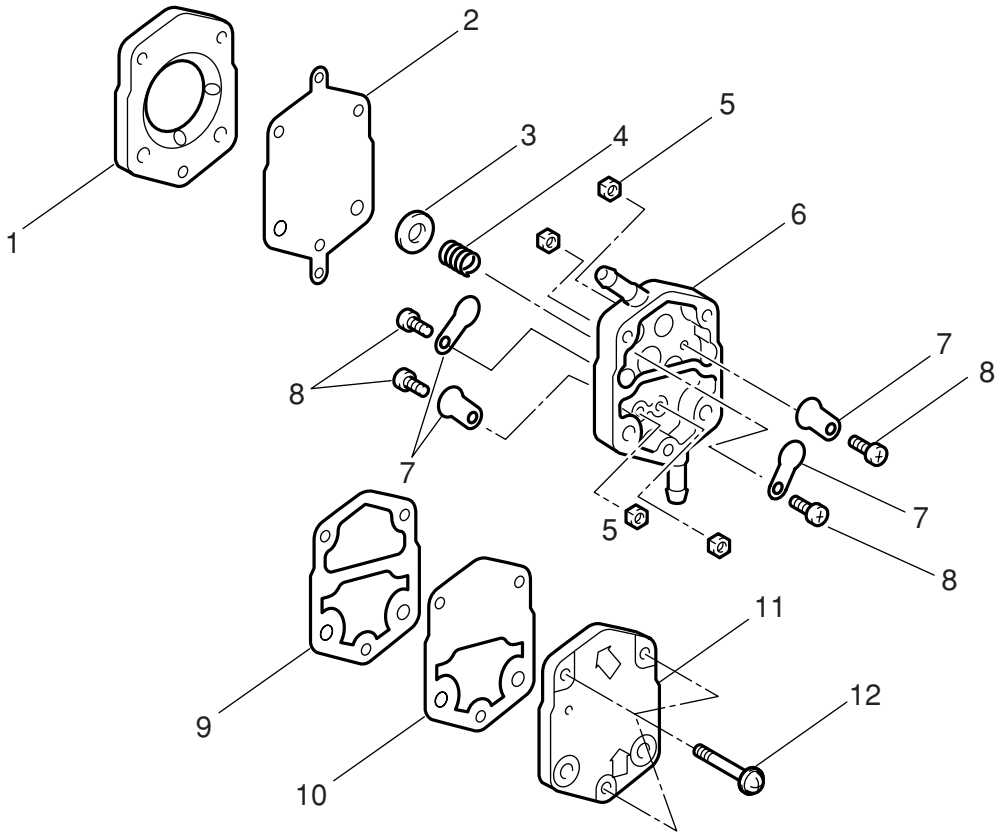


No.	Part name	Q'ty	Remarks
1	Bolt	1	M6 x 28 mm
2	Fuel joint	1	
3	Bolt	4	M6 x 50 mm
4	Fuel pump	2	
5	Gasket	2	Not reusable
6	Fuel filter bracket	1	
7	Fuel filter	1	
8	Bolt	2	M6 x 16mm
9	Fuel hose	1	Fuel joint-to-Fuel filter
10	Fuel hose	1	Fuel filter-to-Joint
11	Fuel hose	1	Joint-to-Fuel pump
12	Fuel hose	2	Fuel pump-to-Joint
13	Fuel hose	1	Joint-to-Joint
14	Fuel hose	2	Joint-to-Carburetor
15	Fuel hose	1	Joint-to-Carburetor
16	Joint	3	
17	Plastic tie	20	Not reusable



60H40030

No.	Part name	Q'ty	Remarks
1	Bolt	1	M6 x 16 mm
2	Washer	1	
3	Fuel filter nut holder	1	
4	Bolt	1	M6 x 14 mm
5	Fuel filter bracket	1	
6	Fuel filter cap	1	
7	O-ring	1	Not reusable
8	O-ring	1	Not reusable
9	Fuel filter element	1	
10	Spring	1	
11	Red ring	1	
12	Fuel filter cup	1	
13	Fuel filter nut	1	
14	O-ring	1	Not reusable
15	Drain screw	1	



60H40070

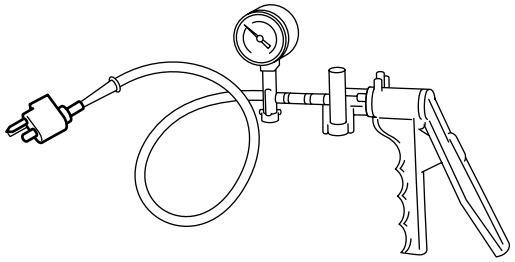
No.	Part name	Q'ty	Remarks
1	Fuel pump base	2	
2	Diaphragm	2	
3	Spring seat	2	
4	Spring	2	
5	Nut	8	
6	Fuel pump body	2	
7	Fuel pump valve	8	
8	Screw	8	M5 x 6 mm
9	Gasket	2	Not reusable
10	Diaphragm	2	
11	Diaphragm body	2	
12	Screw	6	M5 x 35 mm

Checking the fuel joint

1. Visually check the fuel hose connector for cracks or damage.

2. Connect the special service tool at the outlet of fuel hose connector.

3. Apply the specified pressure to check that the pressure is maintained for 10 seconds. Replace the fuel hose connector if necessary.



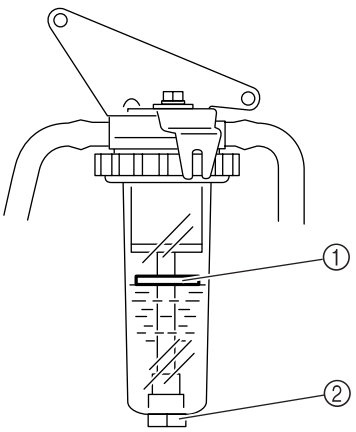
60H40040

	Vacuum/pressure pump gauge set : 90890-06756

	Fuel hose connector holding pressure: 50 kPa(0.5kgf/cm^2)

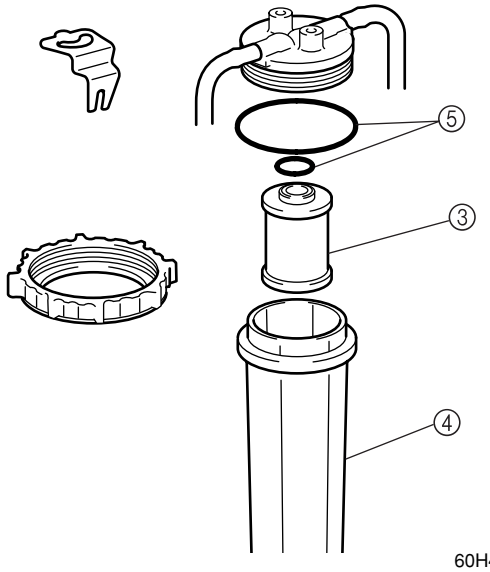
Checking the fuel filter

1. Check that the float ① is in the appropriate position. If water is accumulated, drain it by loosening the drain screw ②.



60H40050

2. Check the fuel filter element ③ for clogging, contamination, or foreign substances, and check the fuel filter cap ④ for crack or leakage. Clean with straight gasoline, or replace them if necessary.



60H40060

NOTE:

Apply a thin coat of gasoline to the O-ring ⑤ before assembling the fuel filter cap.

3. Finger-tight the ring nut to the full extent, so that the ridge on the ring nut is engaged into the stopper recess.

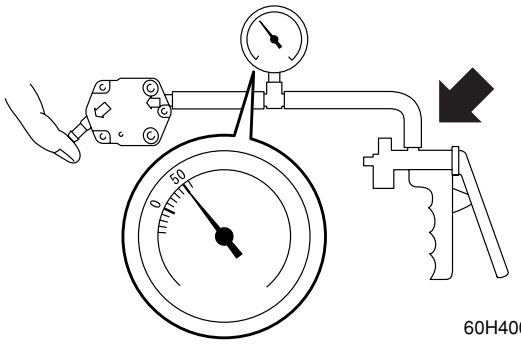
Checking the fuel pump

1. Disconnect the fuel hoses.

NOTE:
To disconnect the fuel hoses, place a drain pan below the pump-hose connection so as not to spill any fuel.

2. Mount the special service tool at the fuel pump inlet.

3. Apply the specified positive pressure while closing the pump outlet with a finger. Make sure no air leakage is detected.

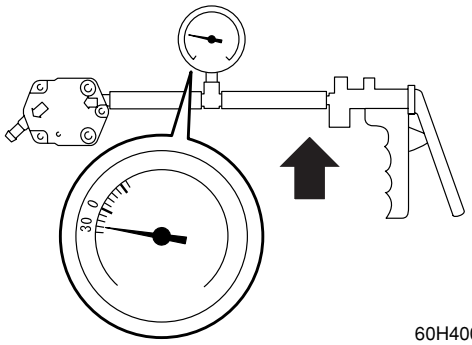


60H40080

Vacuum/pressure pump gauge set:
90890-06756

Specified pressure:
50 kPa (0.5kgf/cm²)

4. Apply the specified negative pressure to make sure that no air leakage is detected.

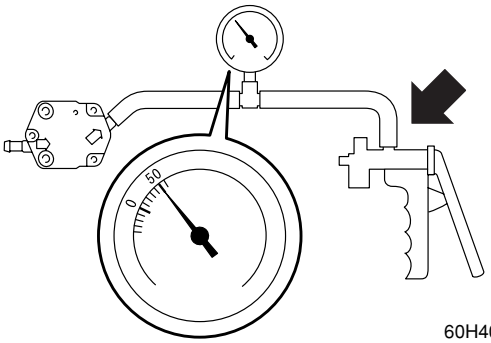


60H40090

Specified pressure:
30 kPa(0.3kgf/cm²)

5. Mount the special service tool at the fuel pump outlet.

6. Apply the specified positive pressure to make sure that no air leakage is detected. Perform disassembly inspection, if necessary.



60H40100

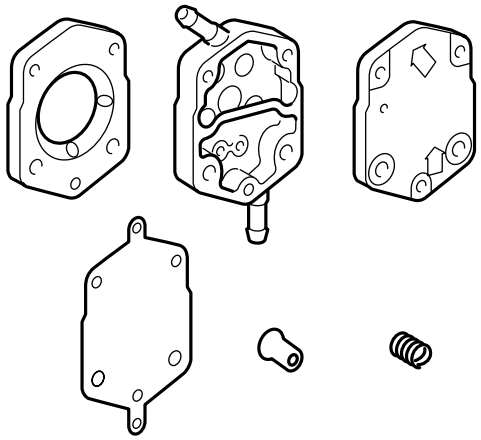
Specified pressure:
50 kPa(0.5kgf/cm²)

NOTE:
Duly assemble the fuel pump valve to the fuel pump body, and moisten the inside of fuel pump with gasoline or the like to obtain better sealing ability.

Disassembling the fuel pump

1. Remove and disassemble the fuel pump to check the diaphragm for damage or breakage.

2. Check the seat valve for bending or damage. Also check the fuel pump body and the spring for damage.



60H40110

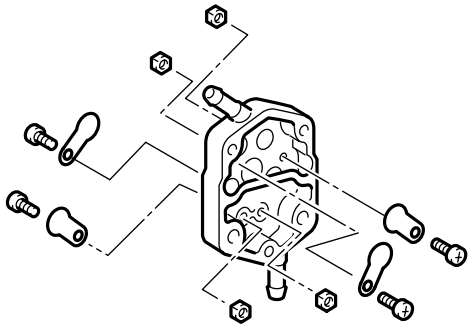
3. Clean out the fouling on the fuel pump body.

Assembling the fuel pump

NOTE:

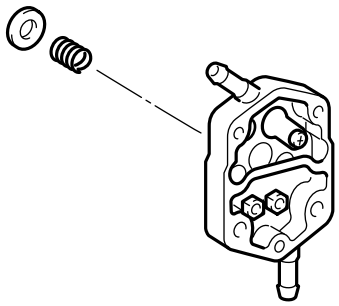
Clean the parts, and keep the seat valve and the diaphragm in the gasoline before assembly to obtain prompt operation of the pump at the engine start.

1. Mount the seat valve on the pump body.



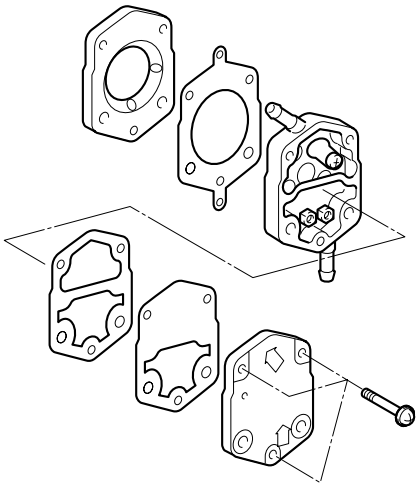
60H40115

2. Mount the spring.



60H40125

3. Mount the gasket, diaphragm, and cover.



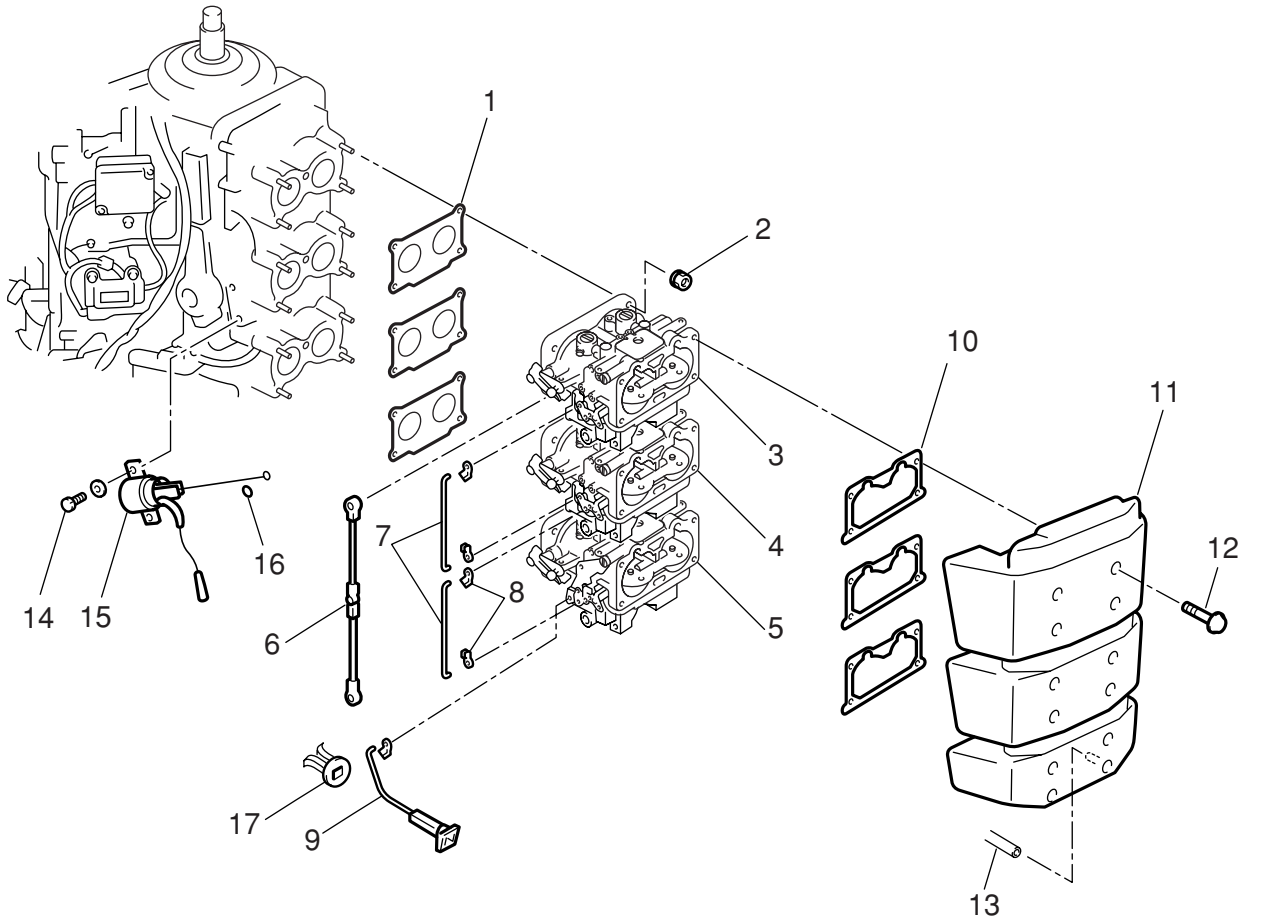
60H40127

NOTE:

Make sure that the gasket and diaphragm are kept in place through the assembly process.

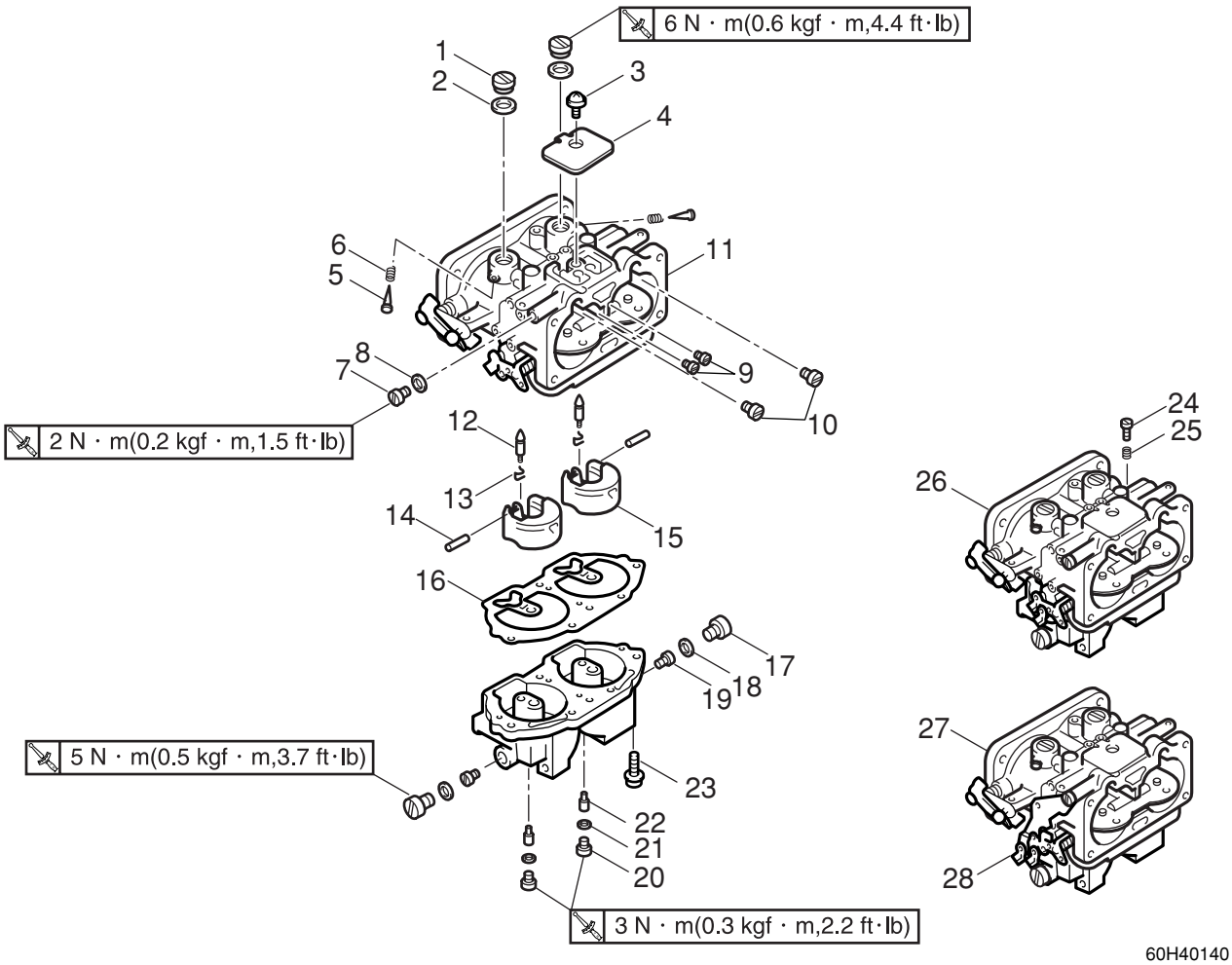
4

Carburetor

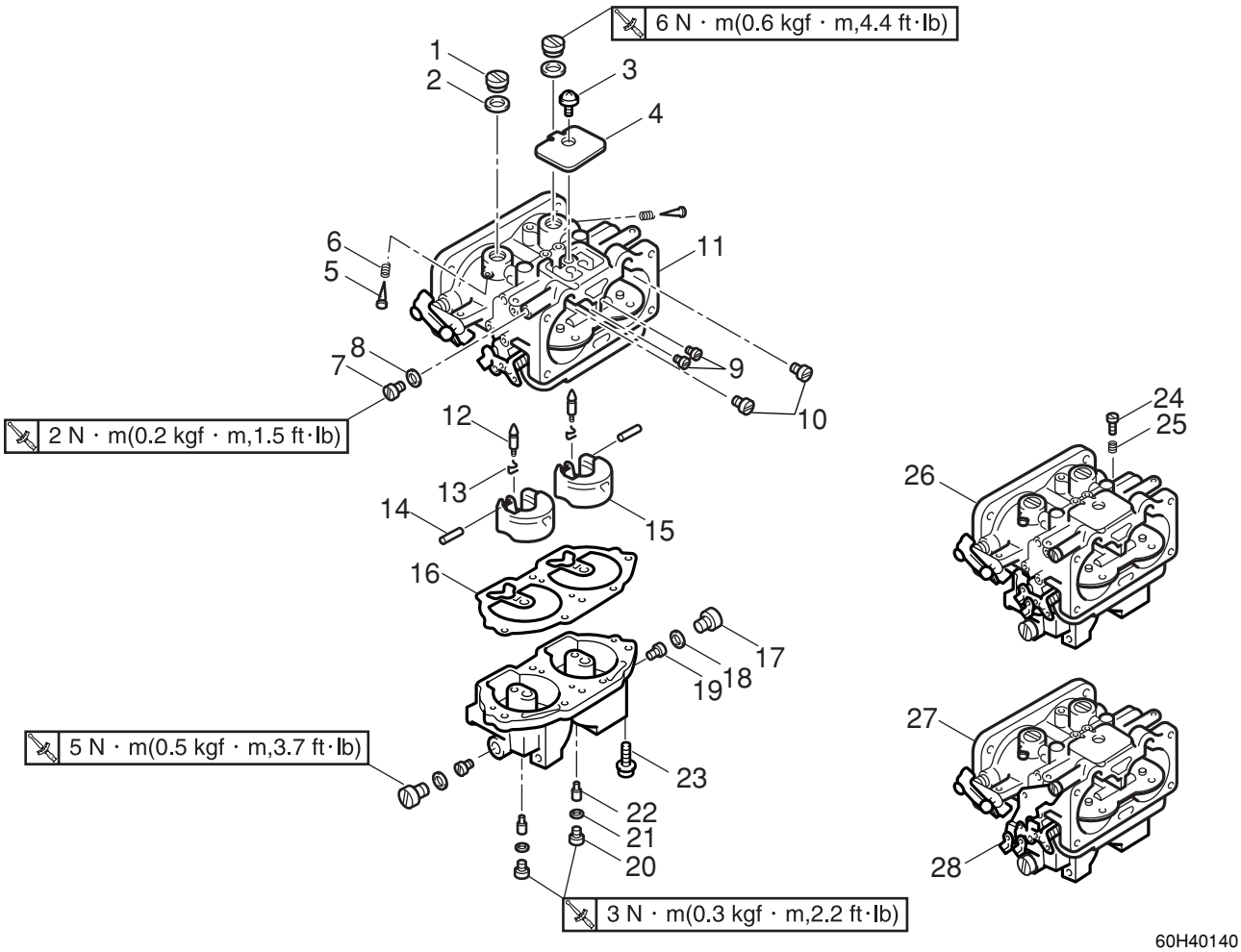


60H40130

No.	Part name	Q'ty	Remarks
1	Gasket	3	Not reusable
2	Nut	12	
3	Carburetor 1	1	
4	Carburetor 2	1	
5	Carburetor 3	1	
6	Accelerator lever rod	1	
7	Choke rod	2	
8	Joint	5	
9	Choke nob	1	
10	Gasket	3	Not reusable
11	Intake silencer	1	
12	Screw	12	M5 x 55 mm
13	Hose	1	
14	Bolt	2	M6 x 15 mm
15	Choke solenoid	1	
16	O-ring	1	Not reusable
17	Grommet	1	



No.	Part name	Q'ty	Remarks
1	Plug	6	
2	Gasket	6	Not reusable
3	Screw	3	
4	Plate	3	
5	Pilot screw	6	
6	Spring	6	
7	Screw	3	
8	Gasket	3	Not reusable
9	Air bleed plug	6	
10	Slow air jet	6	
11	Carburetor body	3	
12	Needle valve	6	
13	Clip	6	
14	Pin	6	
15	Float	6	
16	Gasket	3	Not reusable
17	Screw drain	6	



No.	Part name	Q'ty	Remarks
18	Gasket	6	Not reusable
19	Main jet	6	No. 1,3 : 150 / No. 2,4 : 154 / No. 5 : 152 / No. 6 : 158
20	Plug	6	
21	Gasket	6	Not reusable
22	Slow jet	6	
23	Screw	12	M5 x 16 mm
24	Idle adjusting screw	1	
25	Spring	1	
26	Carburetor 2	1	
27	Carburetor 3	1	
28	Choke joint	1	

Disassembling the carburetor

NOTE:
- Write down how many turns you have actually turned out the pilot screw.
- Disassembled jets and other components shall be sorted out and kept in order, so that they are re-assembled to the original position without fail.
- Do not bend the plate of the float.

Checking the carburetor

1. Clean the fuel passage, air passage and the carburetor body, and blow off any clogging with compressed air.

⚠ WARNING

Wear appropriate protective eye gear during the cleaning process to prevent any eye injury by the blown-off fractions or liquid.

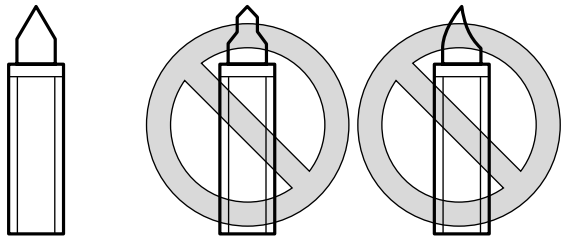
CAUTION:

Do not use steel wire and the like for cleaning the carburetor. Do not try to disassemble the main nozzle if it does not come out easily. Excessive force may impair the performance in the serious way.

NOTE:
Clean the needle valve, main jet, and pilot jet afrer removal.

2. Check the carburetor body for cracks or damage. Replace it if necessary.

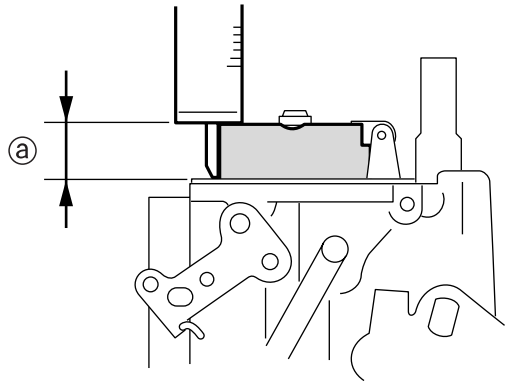
3. Check the pilot screws and needle valves for bending or stepped wear. Replace them if necessary.



60H40150

4. Check the main jet, pilot jet, main air jet, pilot air jet, and main nozzle for clogging and contamination. Clean or replace them whenever appropriate.

5. Check the float for damage, and make sure it is at the appropriate height ⓐ. Replace the float or needle or both if necessary.



60H40160

NOTE:
- Measure the float's height at the end opposite to the needle valve.
- The float should be resting on the needle valve, but not compressing it.
- Measure the distance ⓐ i.e. from carburetor mating face to the float bottom. Invert the carburetor for the measurement.

Vertical position of the float ⓐ (with gasket):
15.5 - 16.5mm (0.61-0.65 in)

4

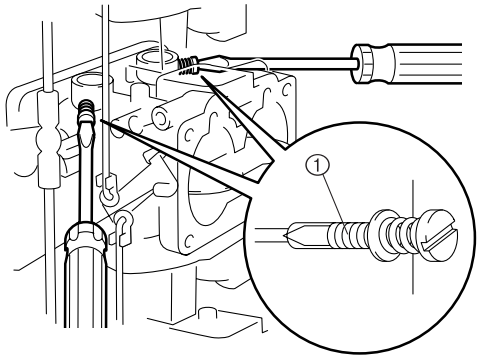
Assembling the carburetor

CAUTION:

- **Do not apply the excessive force to push-in the needle valve.**
- **Do not apply the excessive force to screw-in the pilot screw.**

NOTE:

Install the pilot screw ①, turn-in until it is lightly seated, and then turn out by the specified number of turns.

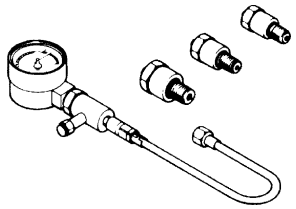


60H40170

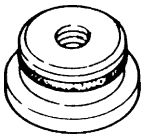
Pilot screw ① turn-out :
1 1/8 ± 1/4 (7/8 - 1 3/8)

Power unit

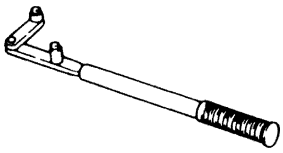
Special service tools



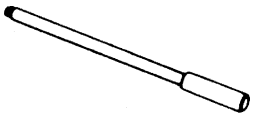
Compression gauge
90890-03160



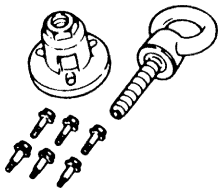
Needl bearing attachment
90890-06654



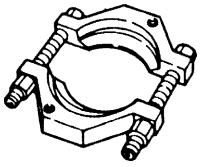
Flywheel holder
90890-06522



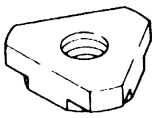
Driver rod L3
90890-06652



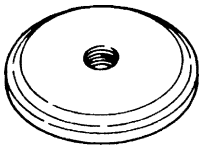
Flywheel puller
90890-06521



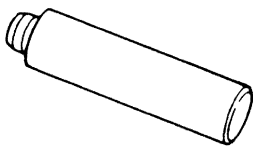
Bearing Separator
90890-06534



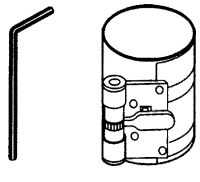
Ball bearing attachment
90890-06663, 90890-06637



Bearing outer race attachment
90890-06626,90890-06624



Driver rod LS
90890-06606



Piston ring compressor
90890-05158

Bearing inner race attachment
90890-06661, 90890-06662

Power unit

Checking the compression pressure

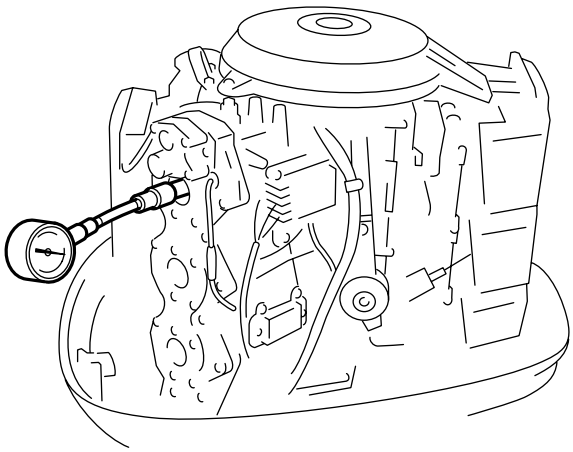
1. Start the engine, warm it up for 5 minutes, and then turn it off.
2. Remove the lock plate for the engine stop switch on the remote control box.
3. Remove all spark plugs, and mount the compression gauge on spark plug hole.

CAUTION:

Clear out the area around the spark plugs before removal, to prevent any dirt or dust from falling into the cylinder bore.

Compression gauge:
90890-03160

4. Fully open the throttle valve and the choke valve, keep cranking the engine until the reading on the compression gauge stabilizes, and then check the compression pressure.



60H50010

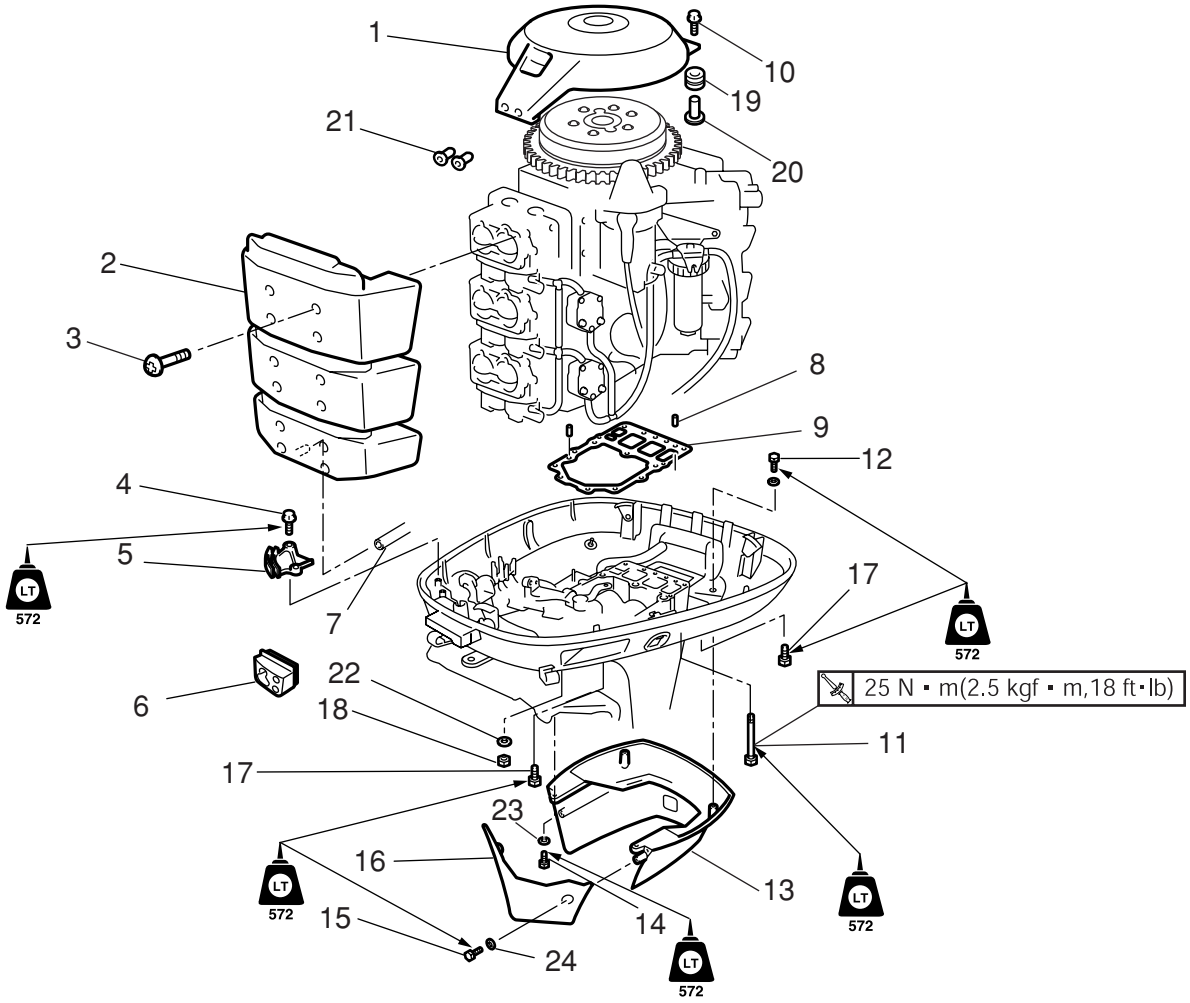
Minimum compression pressure (reference data):
520 kPa (5.2 kgf/cm^2, 75.4 psi)

5. If the measured compression pressure is below specification, or it varies among the cylinders, add a small amount of engine oil to the cylinder, and check the pressure again.

NOTE:

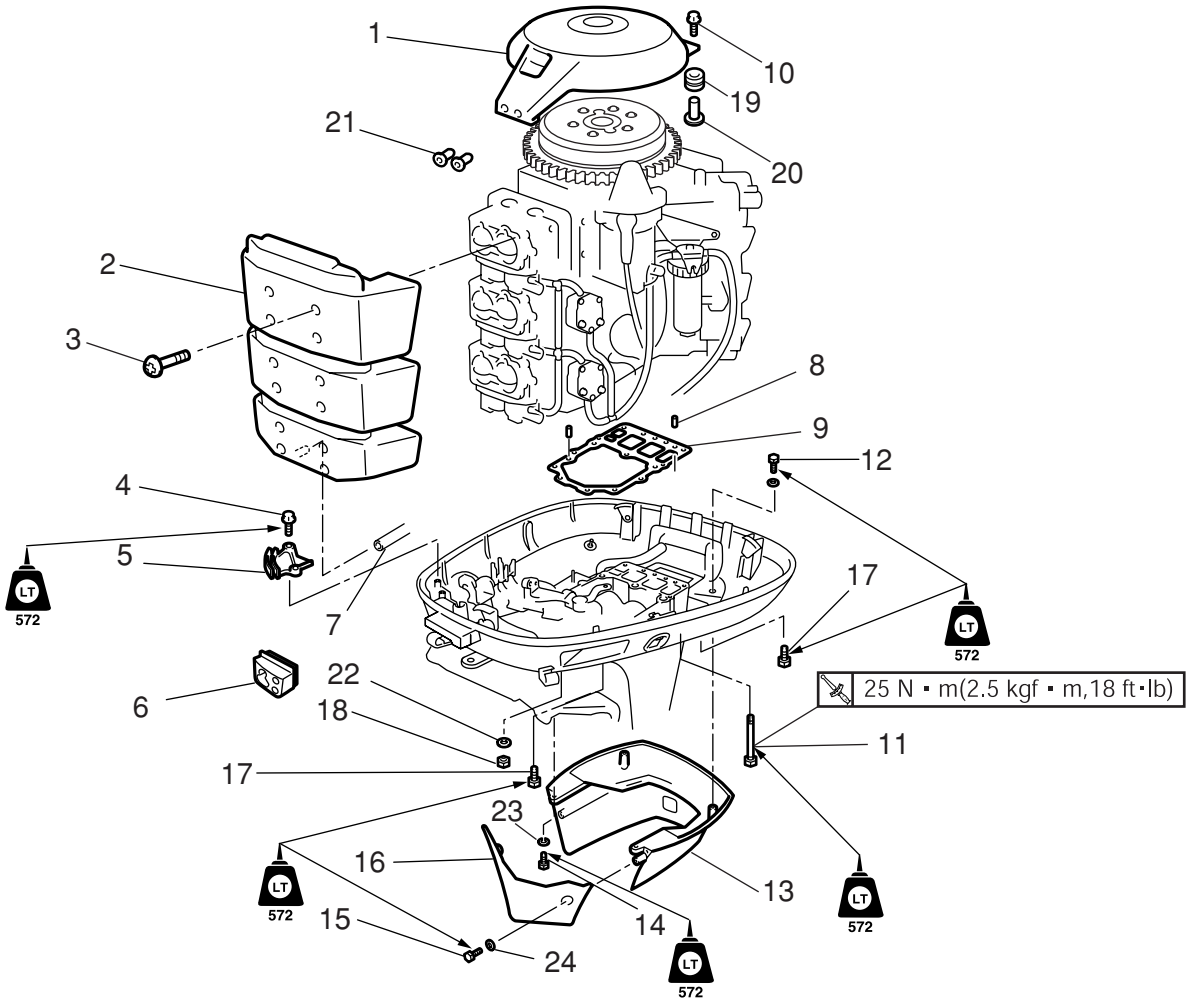
- If the compression pressure increases, check the piston, piston rings and cylinder bore for wear. Replace them if necessary.
- If the compression pressure does not change, check the cylinder head gasket and cylinder head. Correct or replace them, if necessary.

5



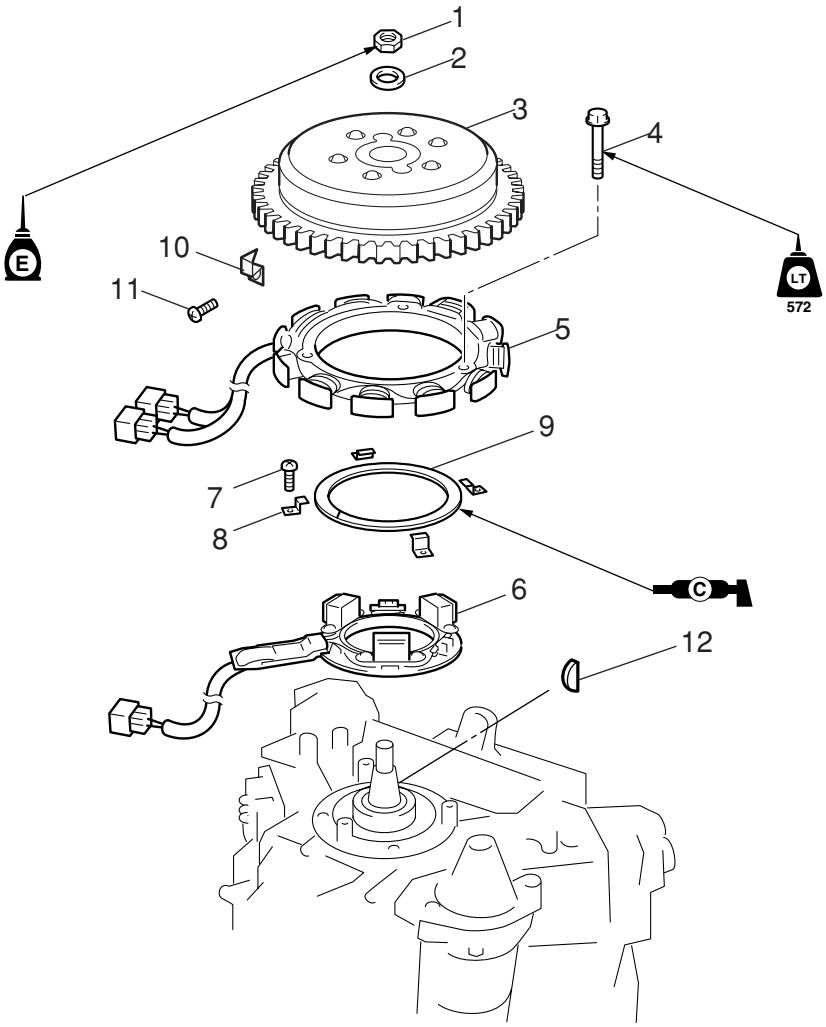
60H50020

No.	Part name	Q'ty	Remarks
1	Flywheel cover	1	
2	Intake silencer	1	
3	Screw	12	M5 x 55 mm
4	Bolt	2	M6 x 20 mm
5	Retaining plate	1	
6	Grommet	1	
7	Air vent hose	1	
8	Dowel pin	2	
9	Gasket	1	Not reusable
10	Bolt	2	M6 x 30 mm
11	Bolt	6	M8 x 135 mm
12	Bolt	2	M6 x 20 mm
13	Apron	1	
14	Bolt	2	M6 x 20 mm
15	Bolt	2	M6 x 20 mm
16	Upper case cover	1	
17	Bolt	4	M8 x 30 mm



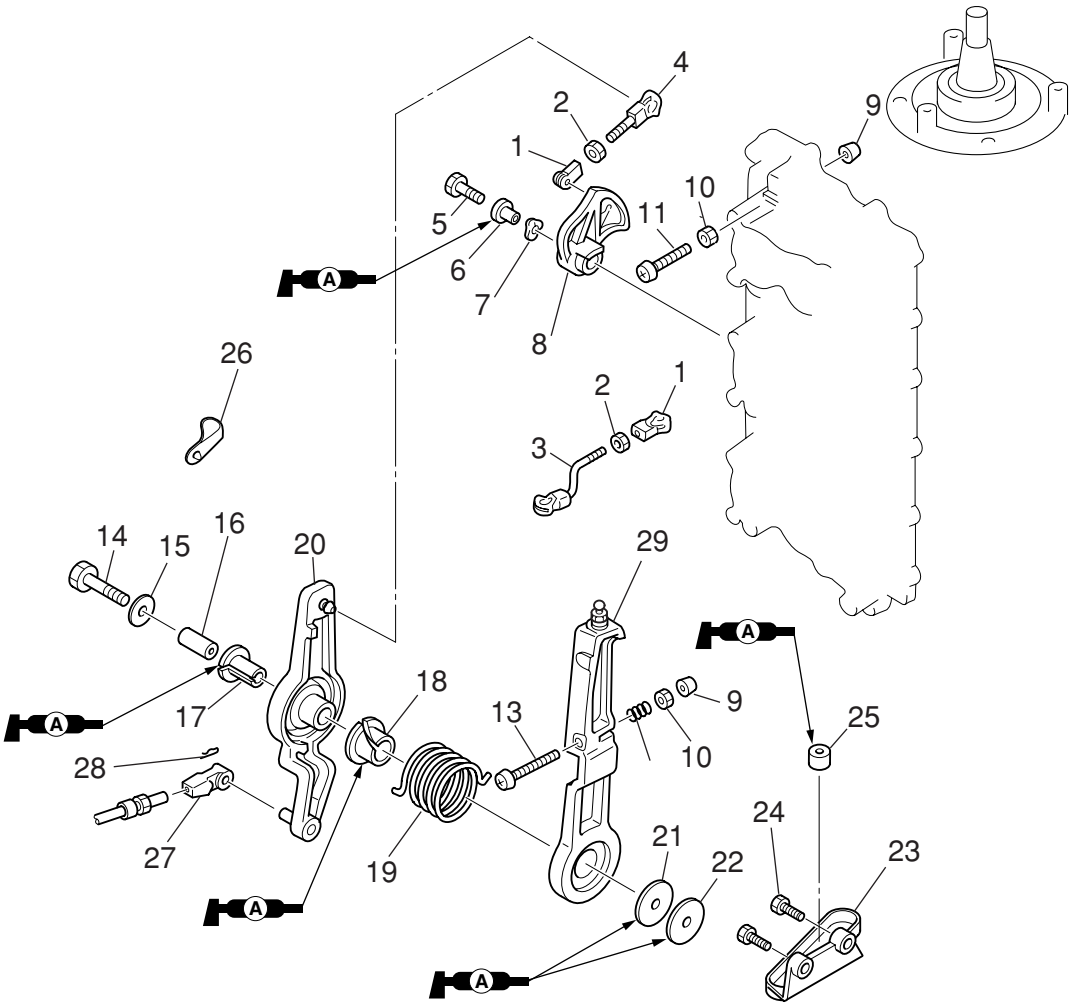
60H50020

No.	Part name	Q'ty	Remarks
18	Nut	2	
19	Grommet	2	
20	Collar	2	
21	Grommet	2	
22	Washer	2	
23	Washer	2	
24	Washer	2	



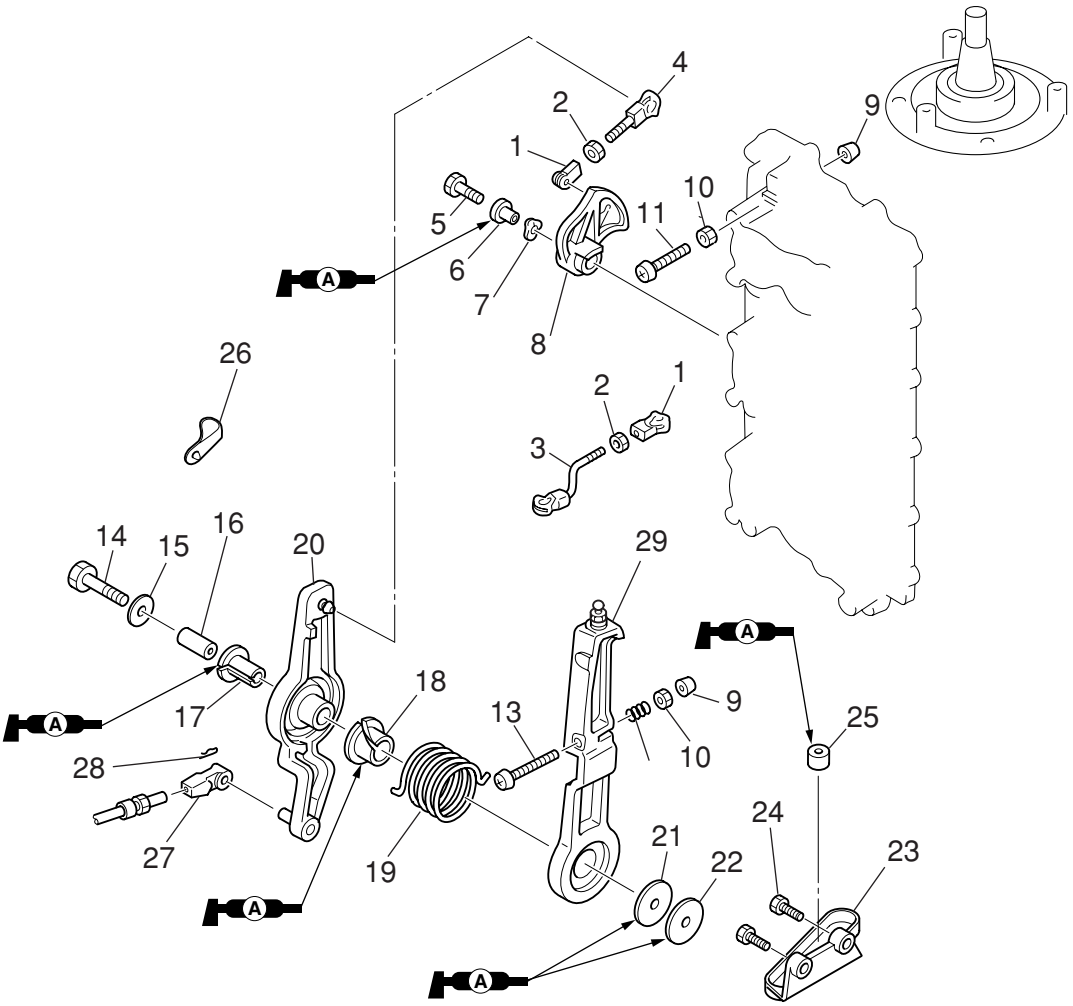
60H50030

No.	Part name	Q'ty	Remarks
1	Nut	1	□ : 30 mm
2	Washer	1	
3	Flywheel magnet assembly	1	
4	Bolt	3	M6 x 60 mm
5	Stator assembly	1	
6	Pulser coil assembly	1	
7	Screw	4	M6 x 18 mm
8	Stopper	4	
9	Base	1	
10	Timing plate	1	
11	Screw	1	M6 x 10 mm
12	Woodruff key	1	



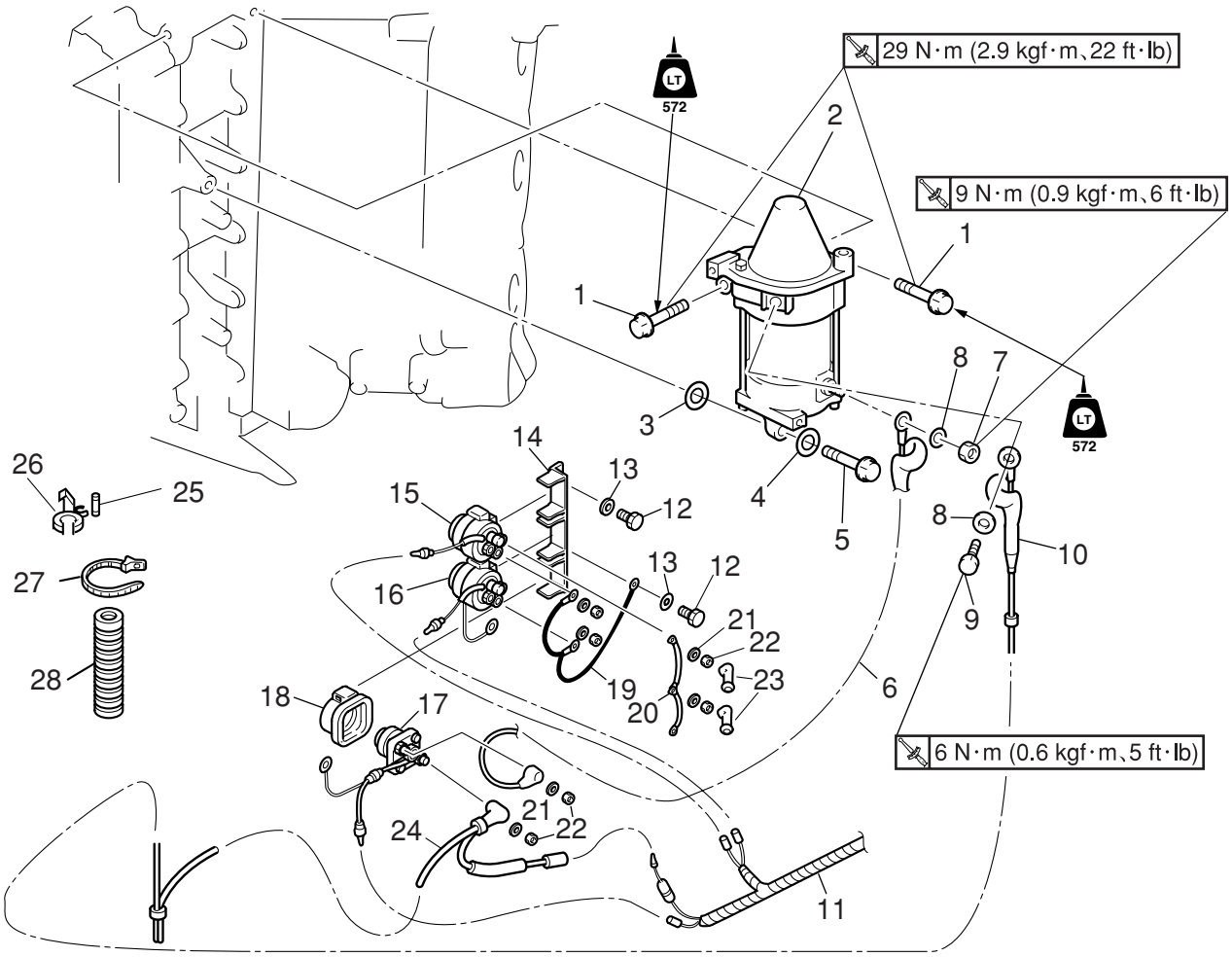
60H50035

No.	Part name	Q'ty	Remarks
1	Joint	2	
2	Nut	2	
3	Magnet control rod	1	
4	Accelerator link	1	
5	Bolt	1	M6 x 25 mm
6	Collar	1	
7	Wave washer	1	
8	Accelerator cam	1	
9	Cap	2	
10	Nut	2	
11	Fully advanced stop screw	1	
12	Spring	1	
13	Standard ignition timing adjusting screw	1	
14	Bolt	1	M8 x 45 mm
15	Washer	1	
16	Collar	1	
17	Bush	1	



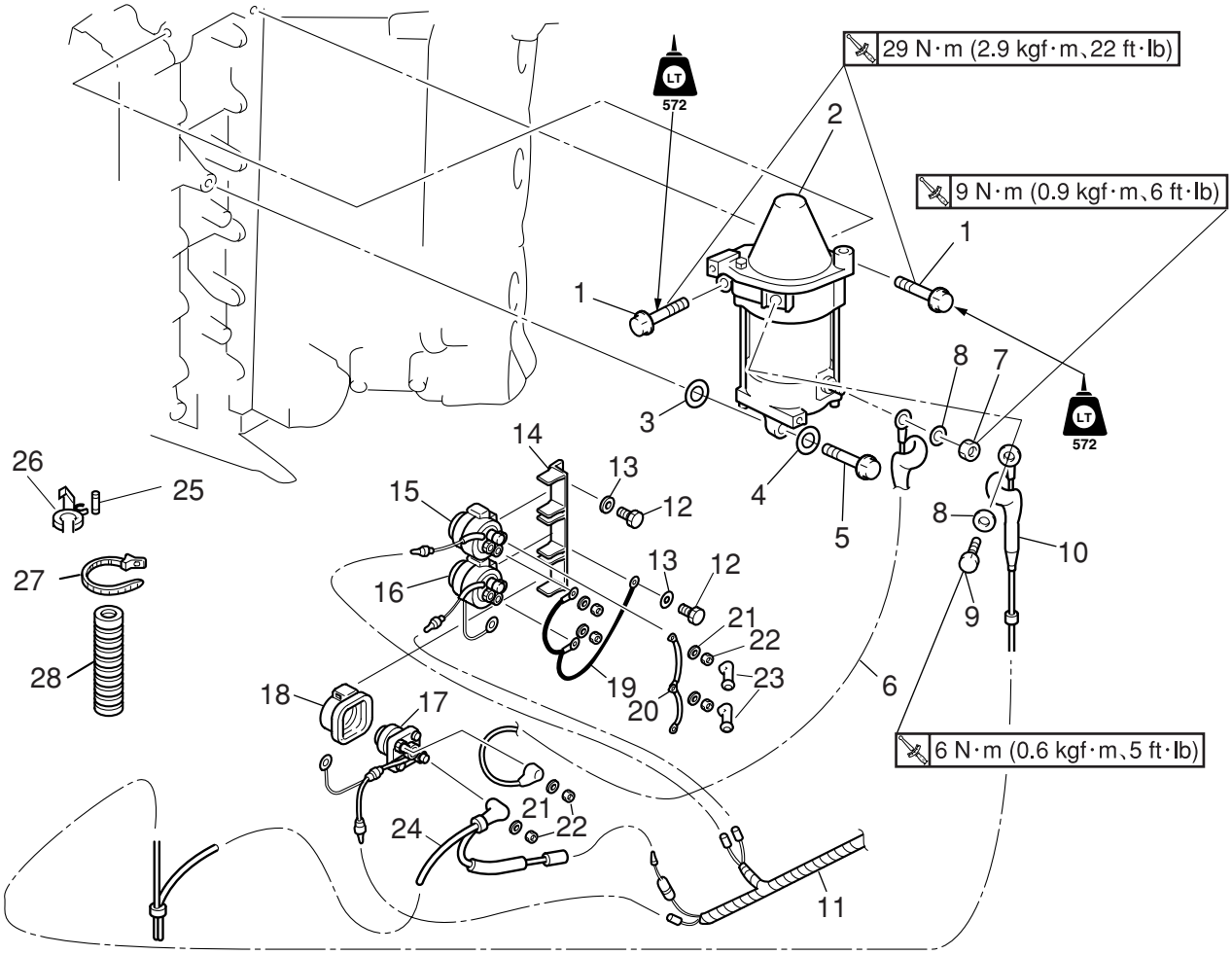
60H50035

No.	Part name	Q'ty	Remarks
18	Bush	1	
19	Spring	1	
20	Magnet control lever	1	
21	Washer	1	
22	Washer	1	
23	Shift bracket	1	
24	Bolt	2	M8 x 30 mm
25	Bush	1	
26	Clamp	1	
27	Cable joint	1	
28	Clip	1	
29	Magnet control lever	1	



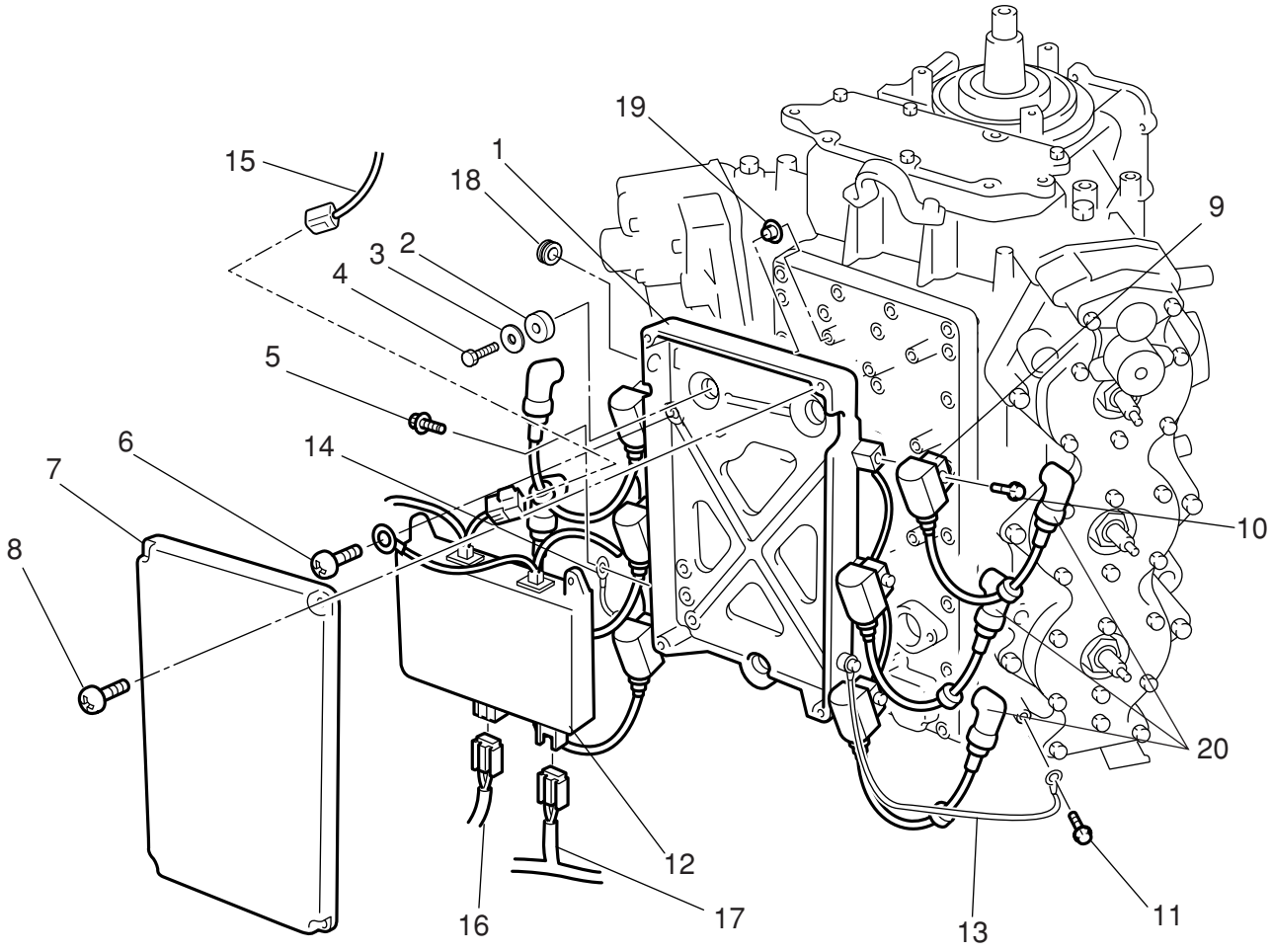
60H50040

No.	Part name	Q'ty	Remarks
1	Bolt	2	M8 x 45 mm
2	Starter motor	1	
3	Shim	1	
4	Washer	1	
5	Bolt	1	M8 x 35 mm
6	Wire lead	1	
7	Nut	1	
8	Washer	2	
9	Bolt	1	M8 x 16 mm
10	Negative battery lead	1	
11	Wiring harness	1	
12	Bolt	2	M6 x 16 mm
13	Washer	2	
14	Bracket	1	
15	PTT relay	1	Sb
16	PTT relay	1	Lg
17	Starter relay	1	



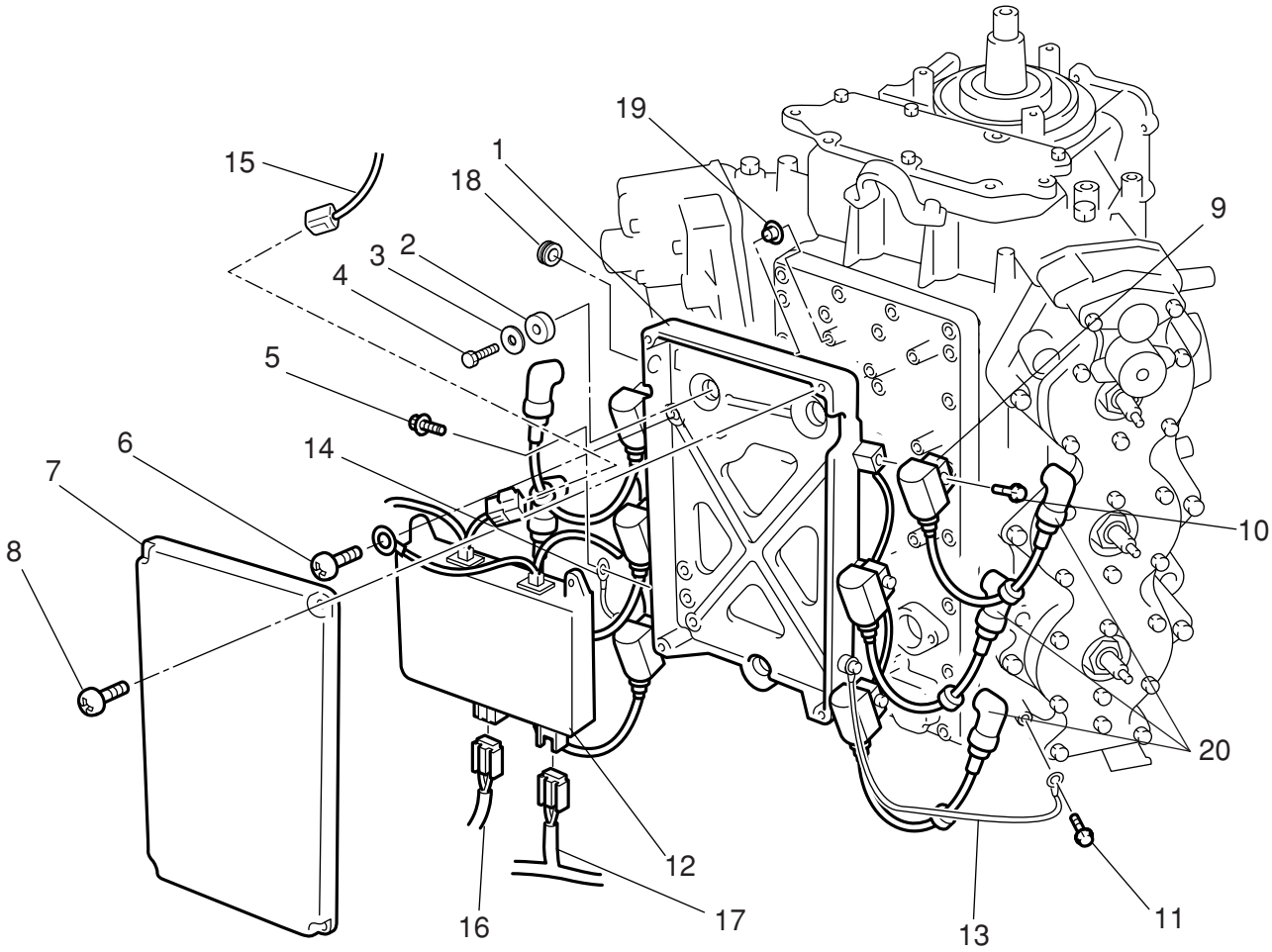
60H50040

No.	Part name	Q'ty	Remarks
18	Holder	1	
19	Wire lead	1	
20	Connector	1	
21	Washer	6	
22	Nut	6	
23	Cover	2	
24	Positive battery lead	1	
25	Fuse	1	
26	Fuse holder	1	
27	Plastic tie	1	Not reusable
28	Tube	1	



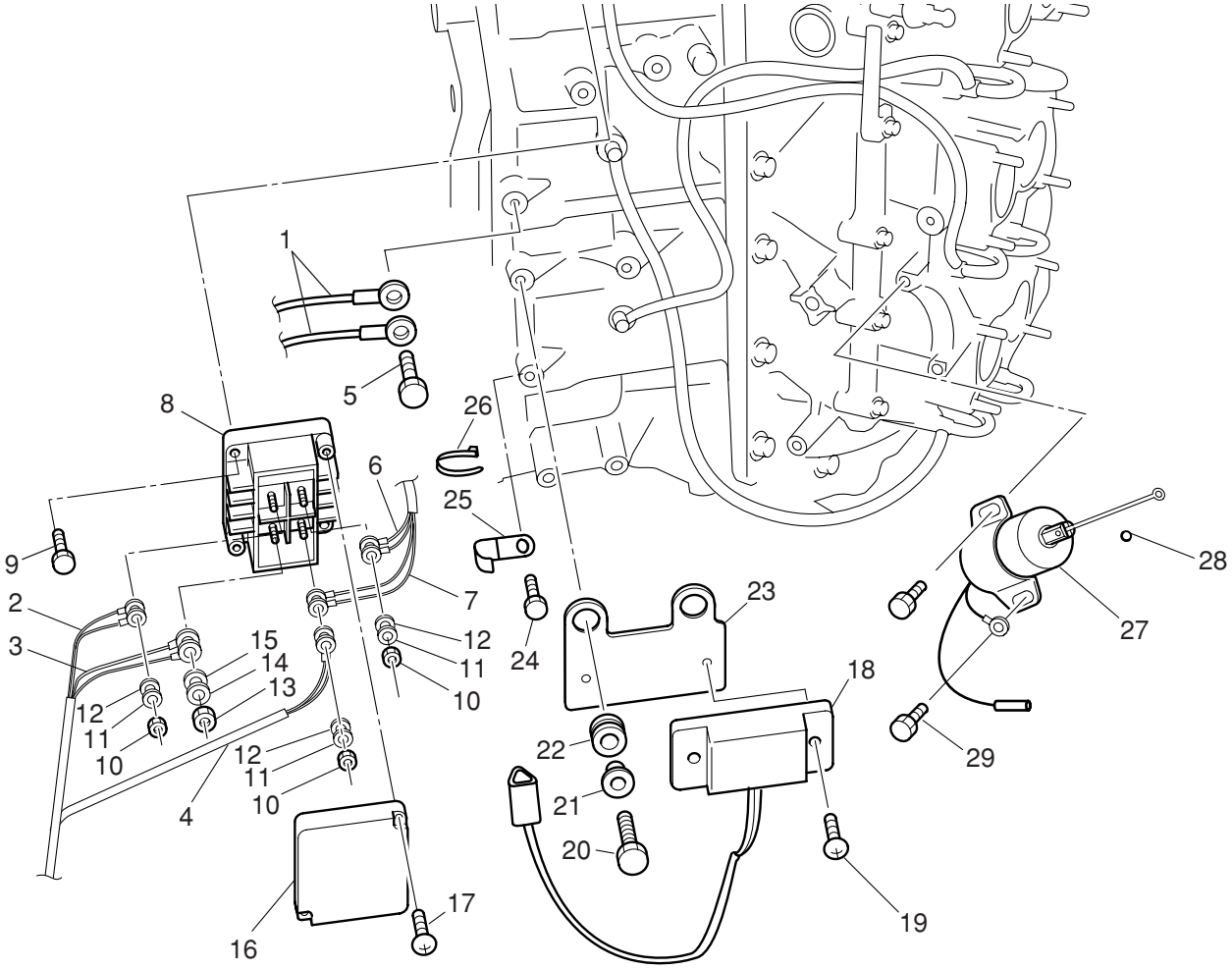
60H50050

No.	Part name	Q'ty	Remarks
1	Bracket	1	
2	Grommet	3	
3	Washer	3	
4	Bolt	3	M6 x 30 mm
5	Bolt	2	M6 x 12 mm
6	Screw	4	M6 x 19 mm
7	CDI unit cover	1	
8	Screw	4	M6 x 15 mm
9	Ignition coil	6	
10	Bolt	6	M6 x 20 mm
11	Bolt	2	M6 x 12 mm
12	CDI unit	1	
13	Wire	1	
14	Wire	1	
15	Wire	1	Charge coil
16	Wire	1	Pulser coil
17	Wiring harness	1	



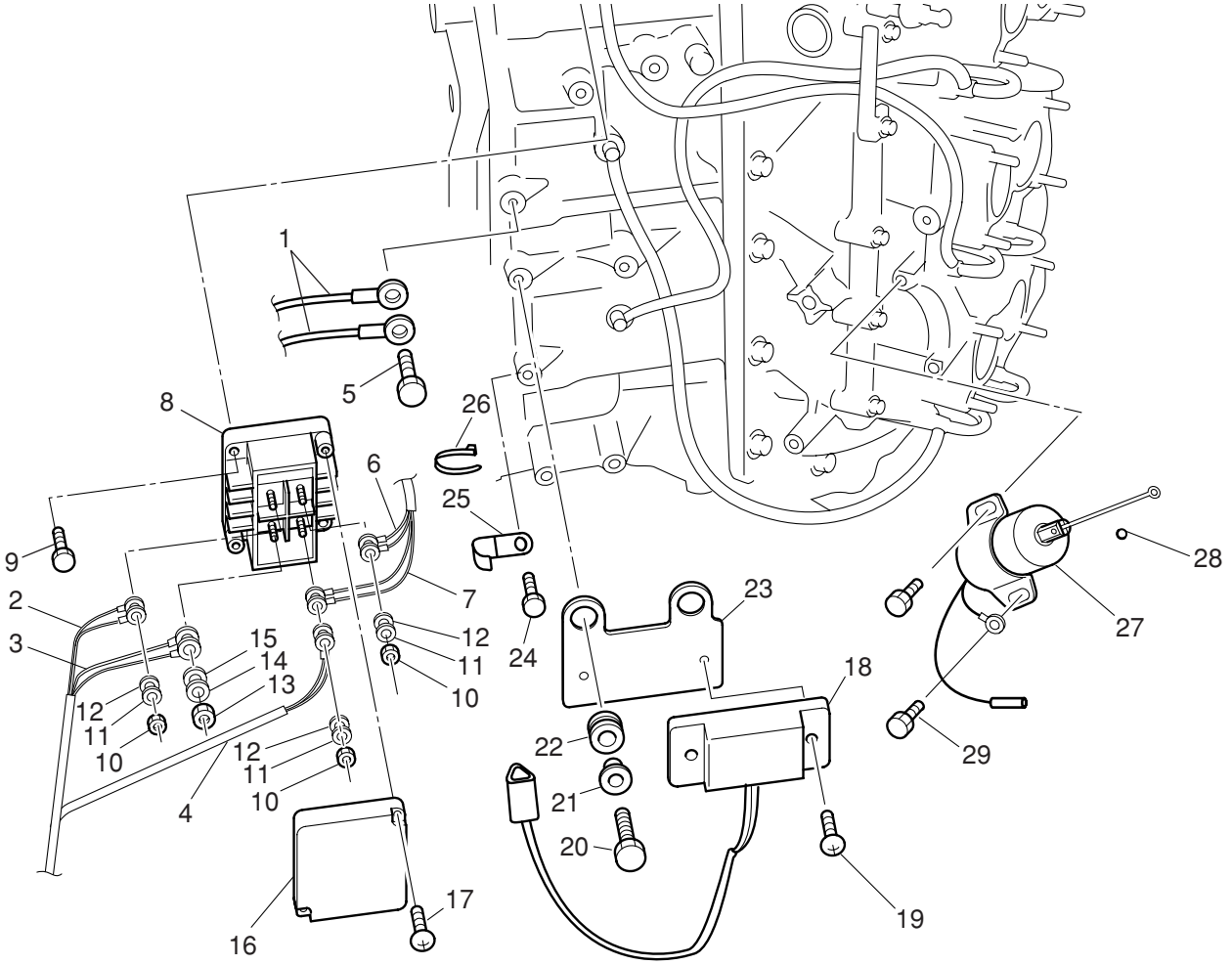
60H50050

No.	Part name	Q'ty	Remarks
18	Grommet	1	
19	Collar	3	
20	Plug cap	6	



60H50045

No.	Part name	Q'ty	Remarks
1	Wiring harness	1	B
2	Wiring harness	1	B
3	Wiring harness	1	R
4	Wiring harness	1	G
5	Bolt	1	M6 x 12 mm
6	Wire lead	1	Rectifier Regulator (G/W)
7	Wire lead	1	Rectifier Regulator (G)
8	Rectifier Regulator	1	
9	Bolt	2	M6 x 20 mm
10	Nut	3	
11	Spring washer	3	
12	Washer	3	
13	Nut	1	
14	Spring washer	1	
15	Washer	1	
16	Cover	1	
17	Screw	2	M6 x 24 mm



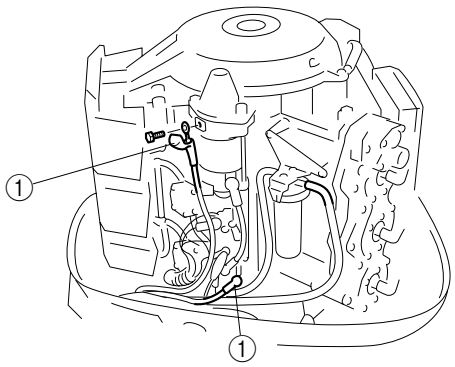
60H50045

No.	Part name	Q'ty	Remarks
18	Hour meter	1	
19	Screw	2	
20	Bolt	2	M6 x 25 mm
21	Collar	2	
22	Grommet	2	
23	Bracket	1	
24	Bolt	1	M6 x 12 mm
25	Clamp	1	
26	Plastic tie	1	Not reusable
27	Choke solenoid	1	
28	O-ring	1	Not reusable
29	Bolt	2	M6 x 15 mm

Removing the power unit

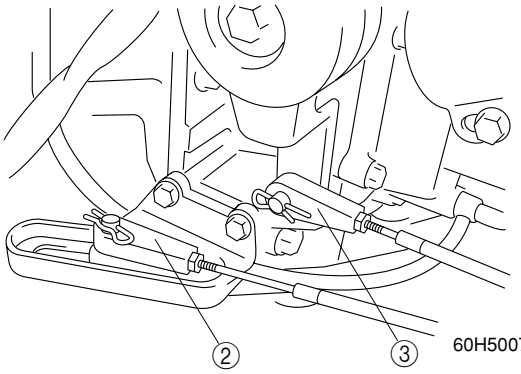
NOTE:
If the power unit is to be disassembled, it is recommended to loosen the nut on flywheel magnet assembly before removing the power unit to improve working efficiency.

1. Disconnect the battery cable ①.



60H50070

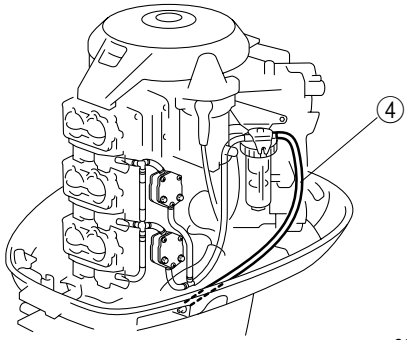
2. Disengage the remote control connector. Remove the shift cable ② and the throttle cable ③.



60H50075

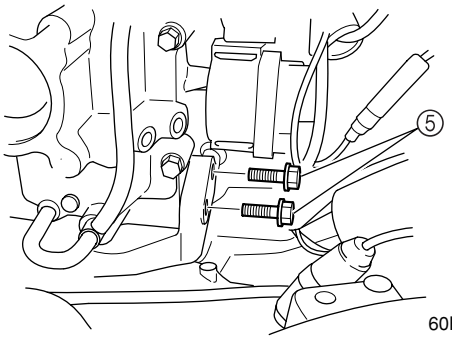
3. Remove the flywheel magnet cover and the intake silencer.

4. Disconnect the fuel hose ④.



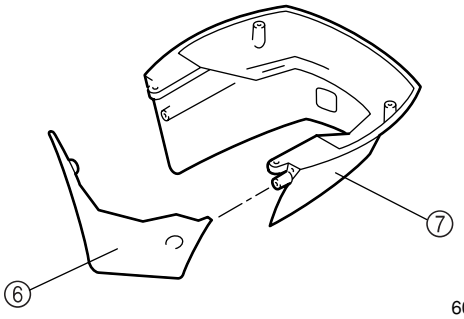
60H50080

5. Disconnect the wiring for power trim and tilt system, the pilot jet hose, and water pressure control valve hose. Remove the mounting bracket bolts ⑤ for shift rod assembly.



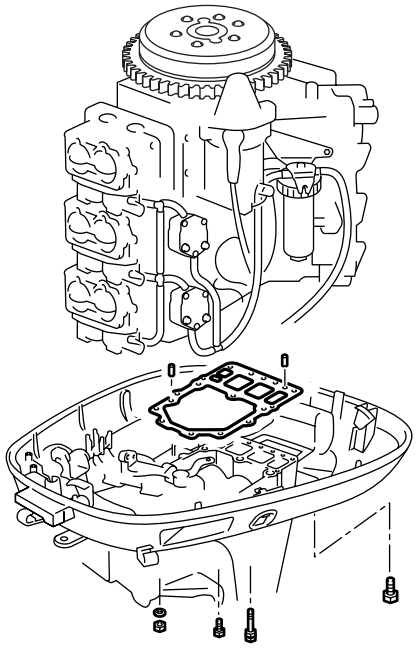
60H50085

6. Remove the upper case cover ⑥ and the apron ⑦.



60H50090

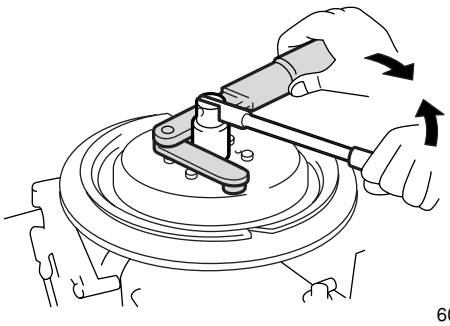
7. Lift up the power unit after removing the bolts and nuts. Remove the dowels.


60H50100

5

Removing the flywheel magnet

1. Remove the nut on the flywheel magnet.



60H50110

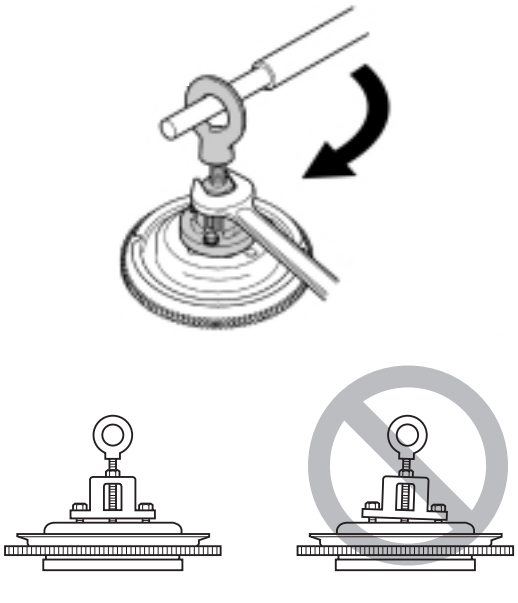
□ : 30 mm

CAUTION:

Apply force in the direction of the arrows shown. While working, take precautions against the slipping off of the flywheel holder.

Flywheel holder : 90890-06522

2. Remove the flywheel magnet.



60H50120

CAUTION:

- **Screw-in the flywheel puller set bolts evenly to the full extent.**
- **Make sure that the puller plate is set in parallel with the flywheel magnet.**

NOTE:

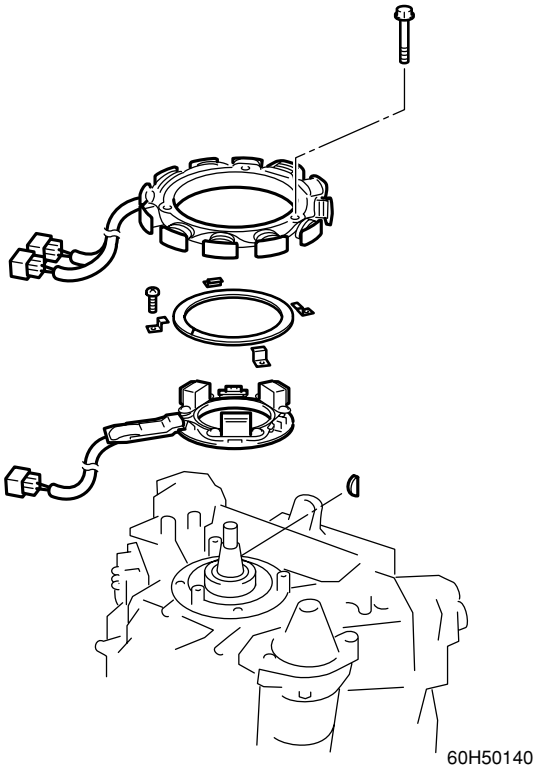
Screw-in the flywheel puller set bolt until the flywheel magnet comes off completely.

Flywheel puller : 90890-06521

3. Remove the Woodruff key.

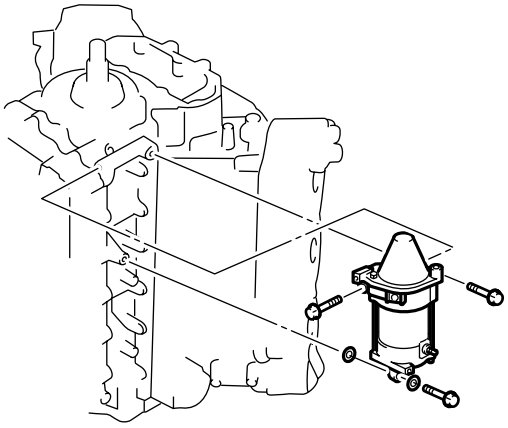
Removing the electrical components

1. Remove the stator assembly.
2. Remove the pulser coil assembly.



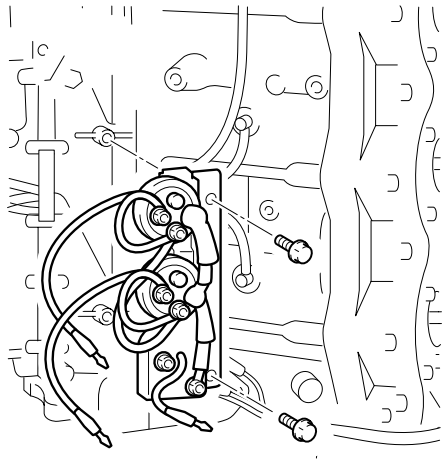
60H50140

3. Remove the starter motor.



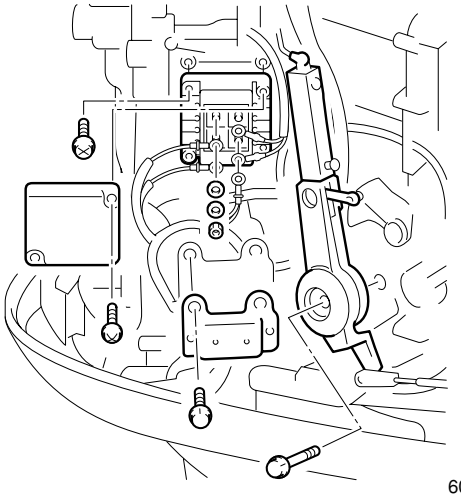
60h50150

4. Remove the starter relay, and the power trim and tilt relay assembly.



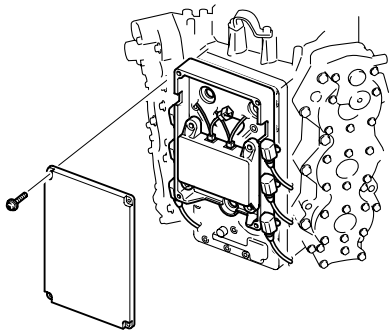
60H50160

5. Remove the Rectifier Regulator, hour meter, and magnet control lever.



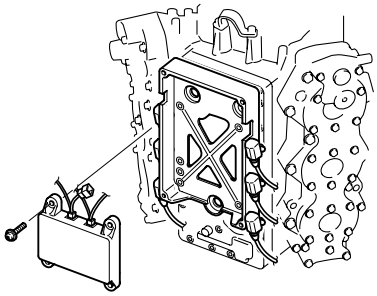
60H50170

6. Remove the CDI unit cover.



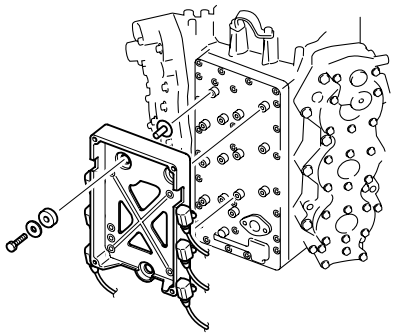
60H50180

7. Remove the CDI unit.



60H50183

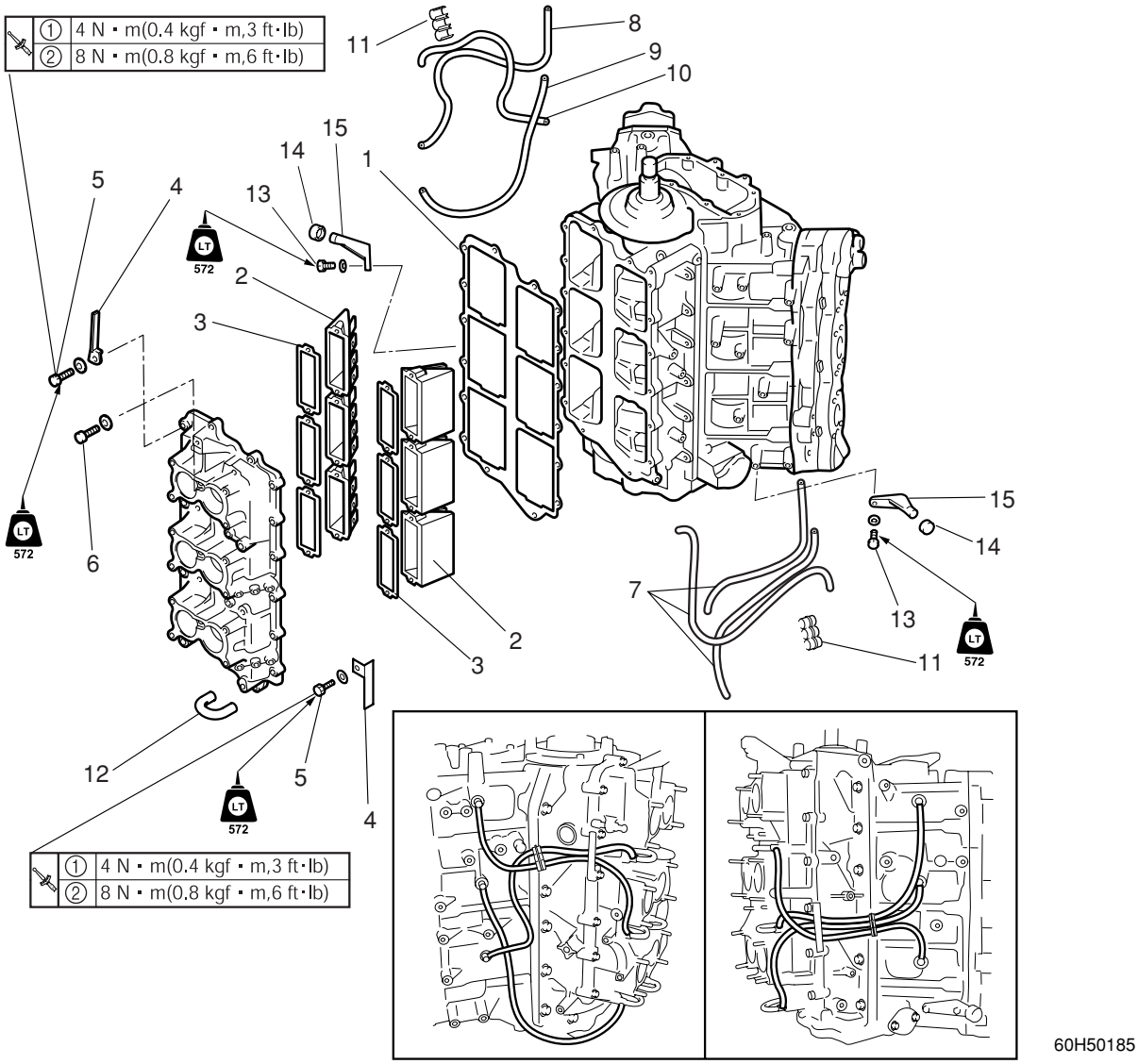
8. Remove the bracket.



60H50184

5

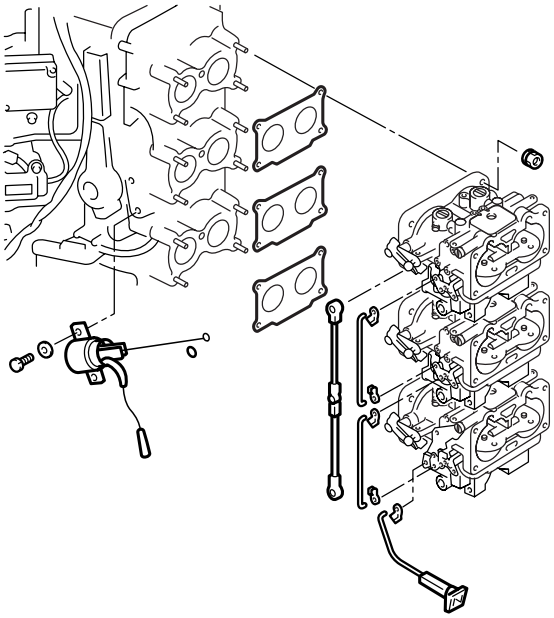
Intake manifold



No.	Part name	Q'ty	Remarks
1	Gasket	1	Not reusable
2	Reed valve	6	
3	Gasket	6	Not reusable
4	Clamp	2	
5	Bolt	16	M6 x 25mm
6	Bolt	12	M5 x 15mm
7	Hose	3	
8	Hose	1	
9	Hose	1	
10	Hose	1	
11	Clamp	2	
12	Hose	6	
13	Bolt	4	M6 x 20 mm
14	Bushing	2	
15	Damper bracket	2	

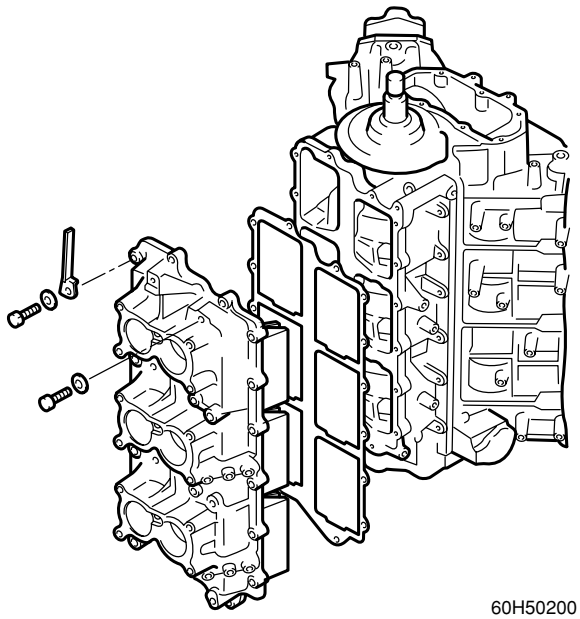
Removing the intake manifold

1. Remove the carburetor and the fuel hoses.

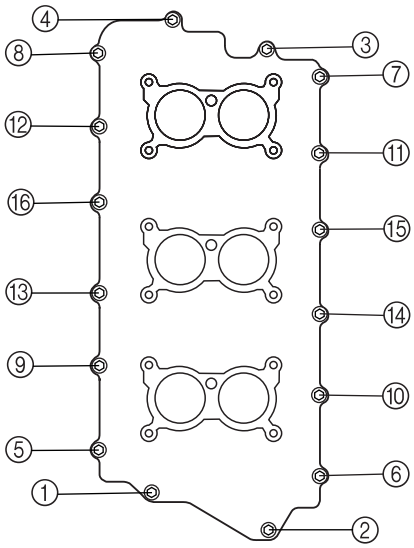


60H50190

2. Remove the intake manifold, and the reed valve plate assembly.



60H50200

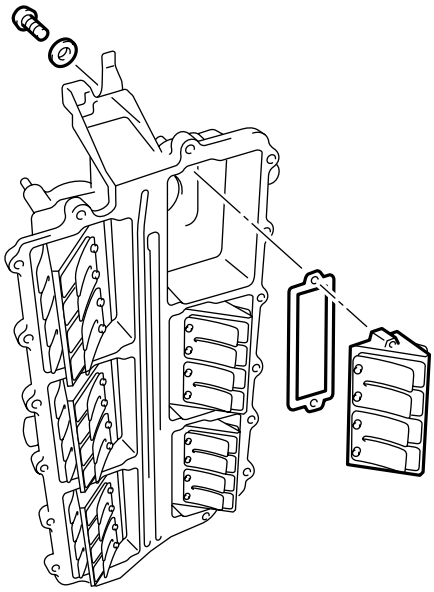


60H50215

NOTE:

Loosen the bolts in the sequence shown.

3. Remove the reed valve assembly.

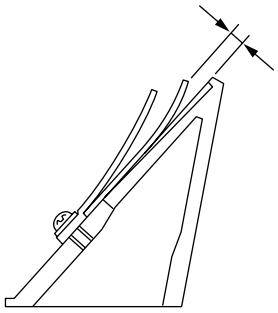


60H50210

4. Check the reed valves for cracks or damage. Replace them if necessary.

5

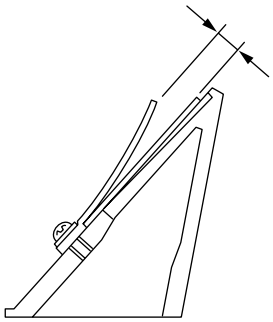
5. Check the reed valves for bending. Replace them if the bending exceeds the specified limit.



60H50220

Valve bending limit : 0.2 mm(0.08in)

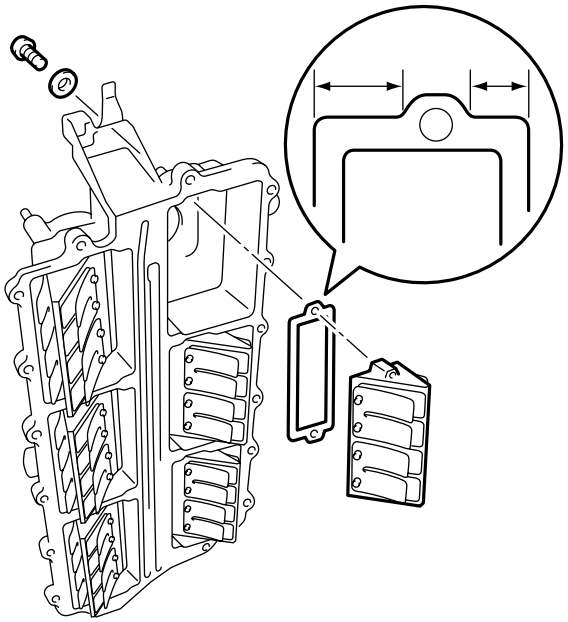
6. Measure the valve stopper height. Replace the stopper if the height exceeds the specified limit.



60H50230

Valve stopper height :
6.5 mm (0.26in)

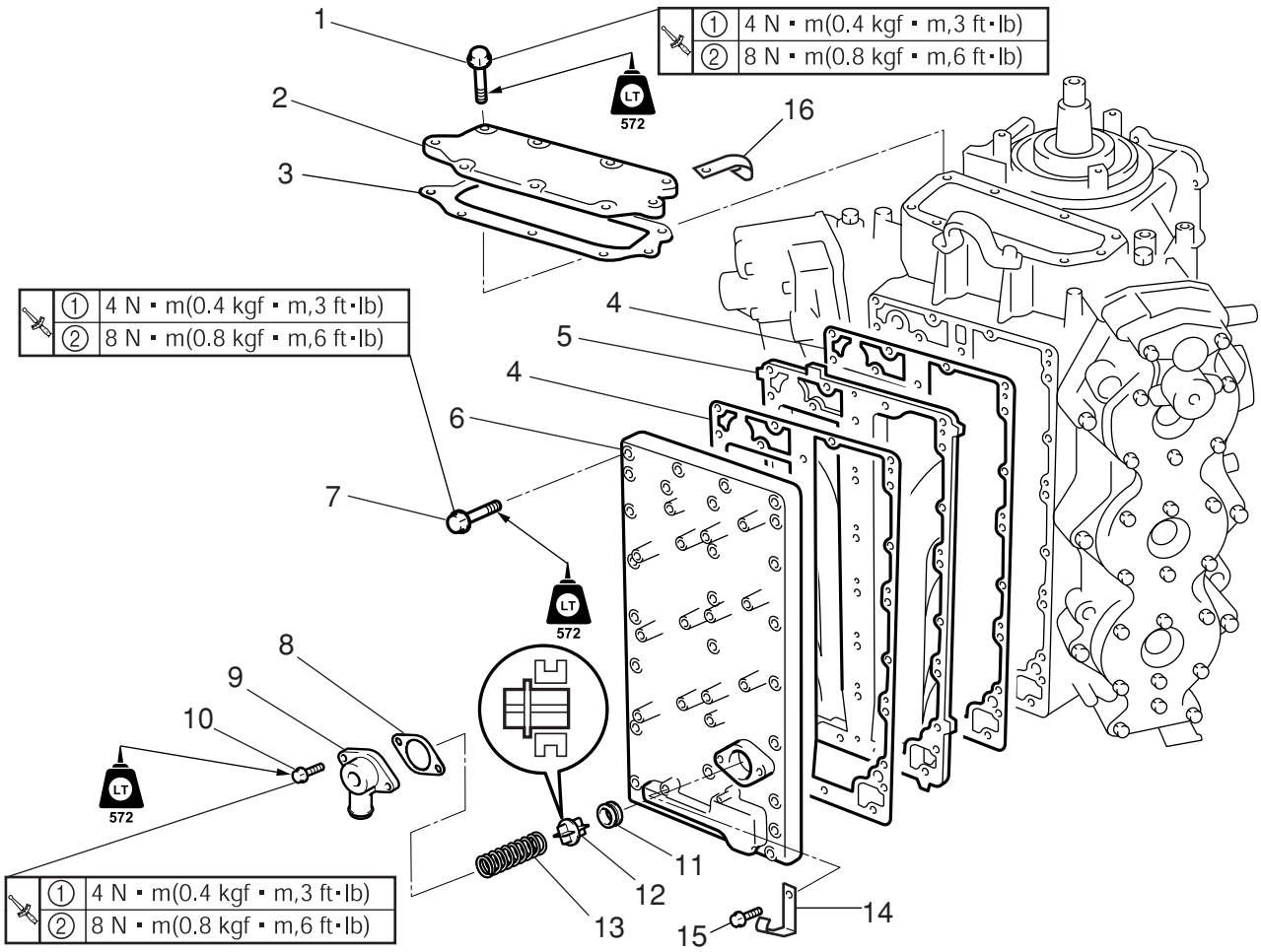
7. Install the reed valves.



60H50240

NOTE:
Use new gaskets.

Exhaust

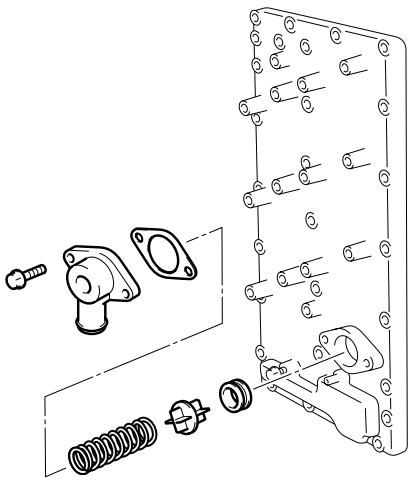


60H50255

No.	Part name	Q'ty	Remarks
1	Bolt	7	M6 x 20mm
2	Cylinder cover	1	
3	Gasket	1	Not reusable
4	Gasket	2	Not reusable
5	Exhaust inner cover	1	
6	Exhaust outer cover	1	
7	Bolt	29	M6 x 35mm
8	Gasket	1	Not reusable
9	Pressure control valve cover	1	
10	Bolt	2	M6 x 20mm
11	Pressure control valve seat	1	
12	Pressure control valve	1	
13	Spring	1	
14	Clamp	1	
15	Bolt	1	M6 x 12 mm
16	Clamp	1	

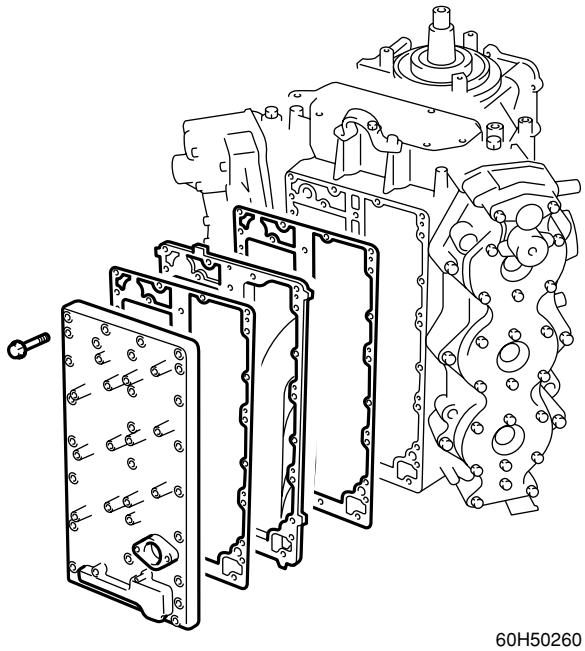
Removing the exhaust cover

1. Remove the pressure control valve.

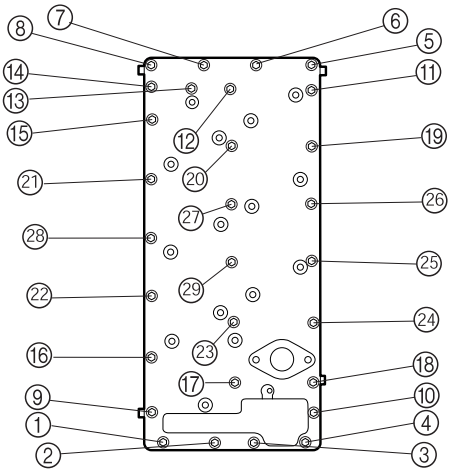


60H50250

2. Remove the exhaust outer cover, and the exhaust inner cover.



60H50260



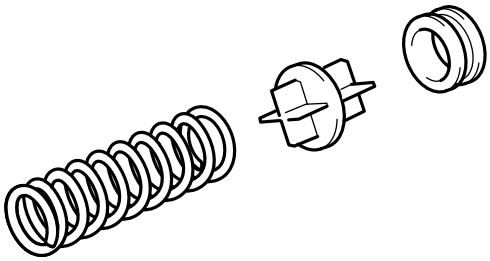
60H50265

NOTE:

Loosen the bolts in the sequence shown.

3. Remove the cylinder block exhaust inner cover.

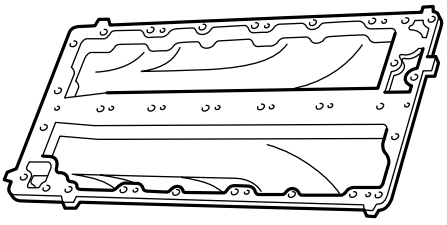
4. Check the pressure control valve for cracks or damage. Also check the pressure control valve seat for deformation. Replace them if necessary.



60H50270

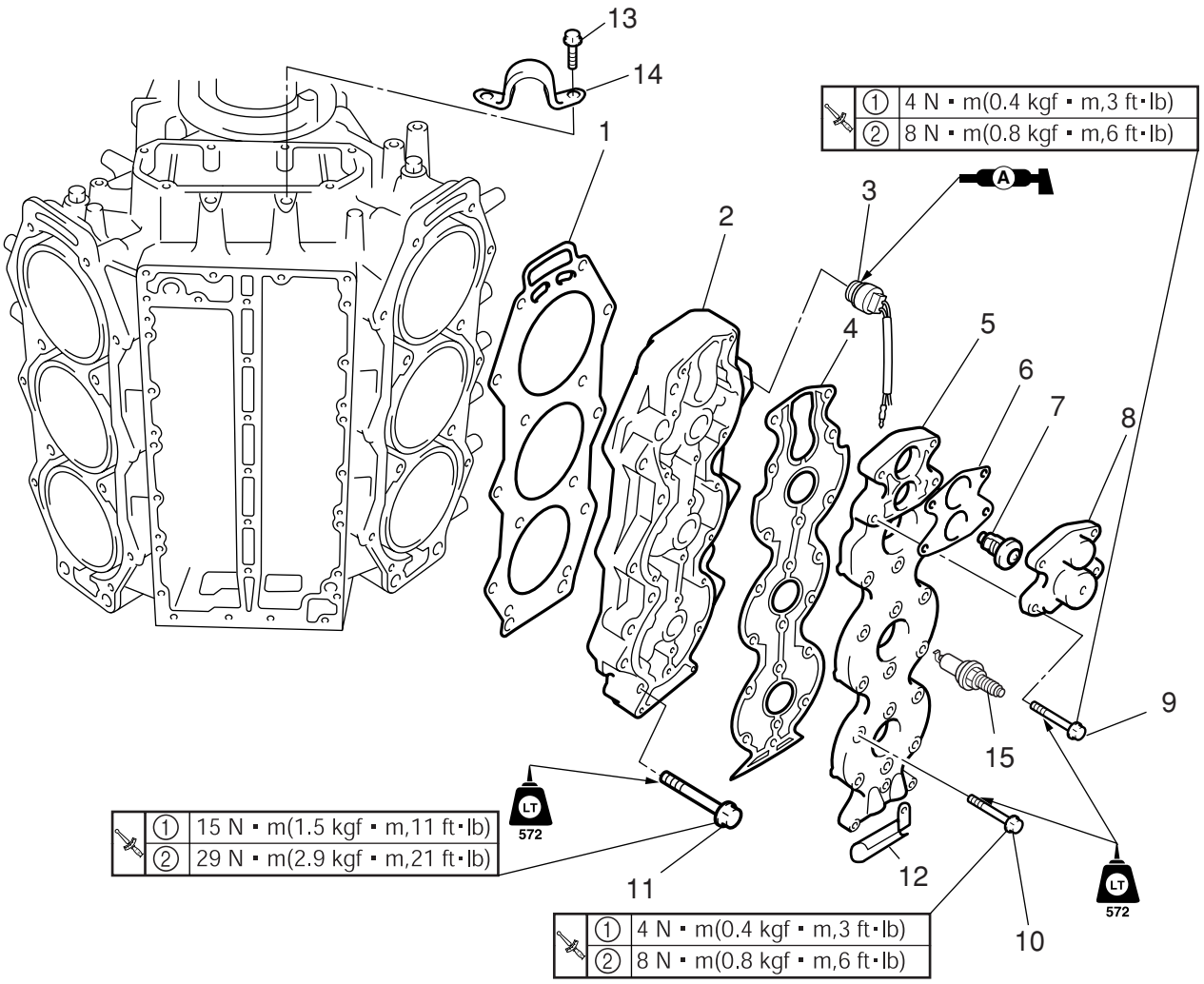
5. Check the spring for fatigue or deformation. Replace it if necessary.

6. Check the exhaust cover for distortion or corrosion. Replace it if necessary.



60H50275

Cylinder head

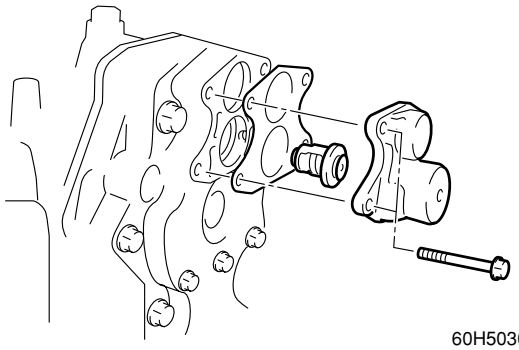


60H50280

No.	Part name	Q'ty	Remarks
1	Gasket	2	Not reusable
2	Cylinder head	2	
3	Thermoswitch	2	
4	Gasket	2	Not reusable
5	Cylinder head cover	2	
6	Gasket	2	Not reusable
7	Thermostat	2	
8	Thermostat cover	2	
9	Bolt	8	M6 x 40 mm
10	Bolt	36	M6 x 30 mm
11	Bolt	24	M8 x 60 mm
12	Clamp	1	
13	Bolt	2	M8 x 20 mm
14	Engine hanger	1	
15	Spark plug	6	

Removing the cylinder head

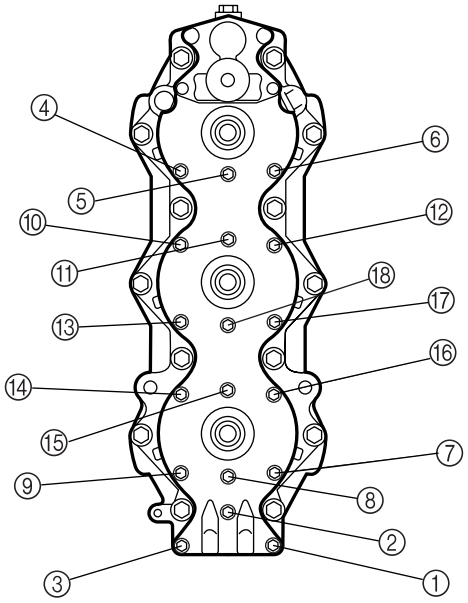
1. Remove the spark plugs.
2. Remove the thermostat cover and the thermostat.



60H50300

NOTE:
Loosen the bolts in the sequence shown.

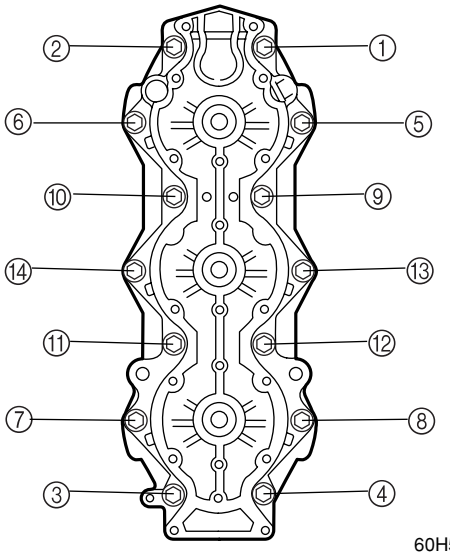
3. Remove the cylinder head cover.



60H50310

NOTE:
Loosen the bolts in the sequence shown.

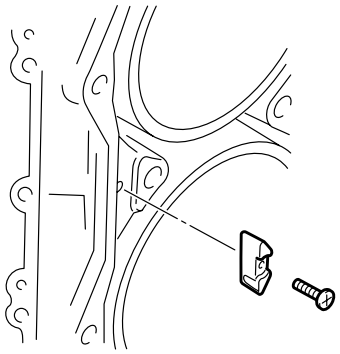
4. Remove the thermoswitch.
5. Remove the cylinder head.



60H50320

NOTE:
Loosen the bolts in the sequence shown.

6. Check the anodes on the cylinder block. Clean the anode's surface, and replace if it has been eroded into half or smaller.



60H50330

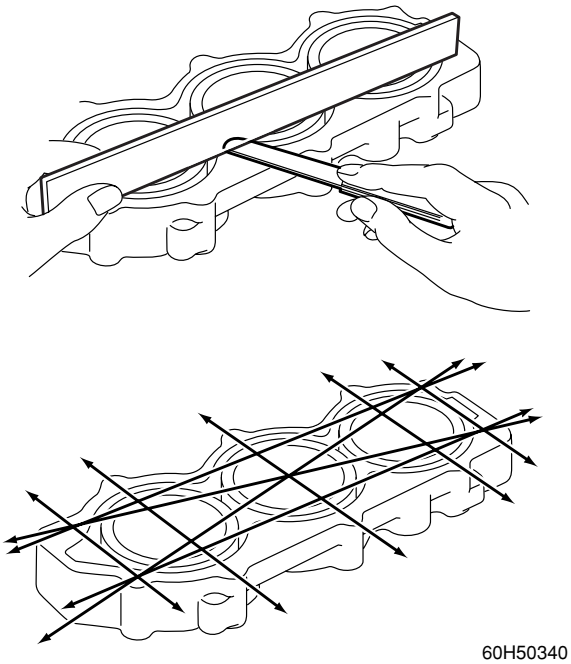
CAUTION:
Do not oil, grease, or paint the anodes, otherwise they will not be able to prevent the galvanic corrosion effectively.

7. Clean out the mineral deposits and contamination on the cylinder head. Also check the possible corrosion on the cylinder head. Replace it if necessary.

8. Remove the carbon deposits on the surface of combustion chamber.

CAUTION:
Do not scratch the contacting surface of the cylinder head and cylinder block.

9. Check the cylinder head warpage. Replace the cylinder head if measured warpage exceeds the specified limit.



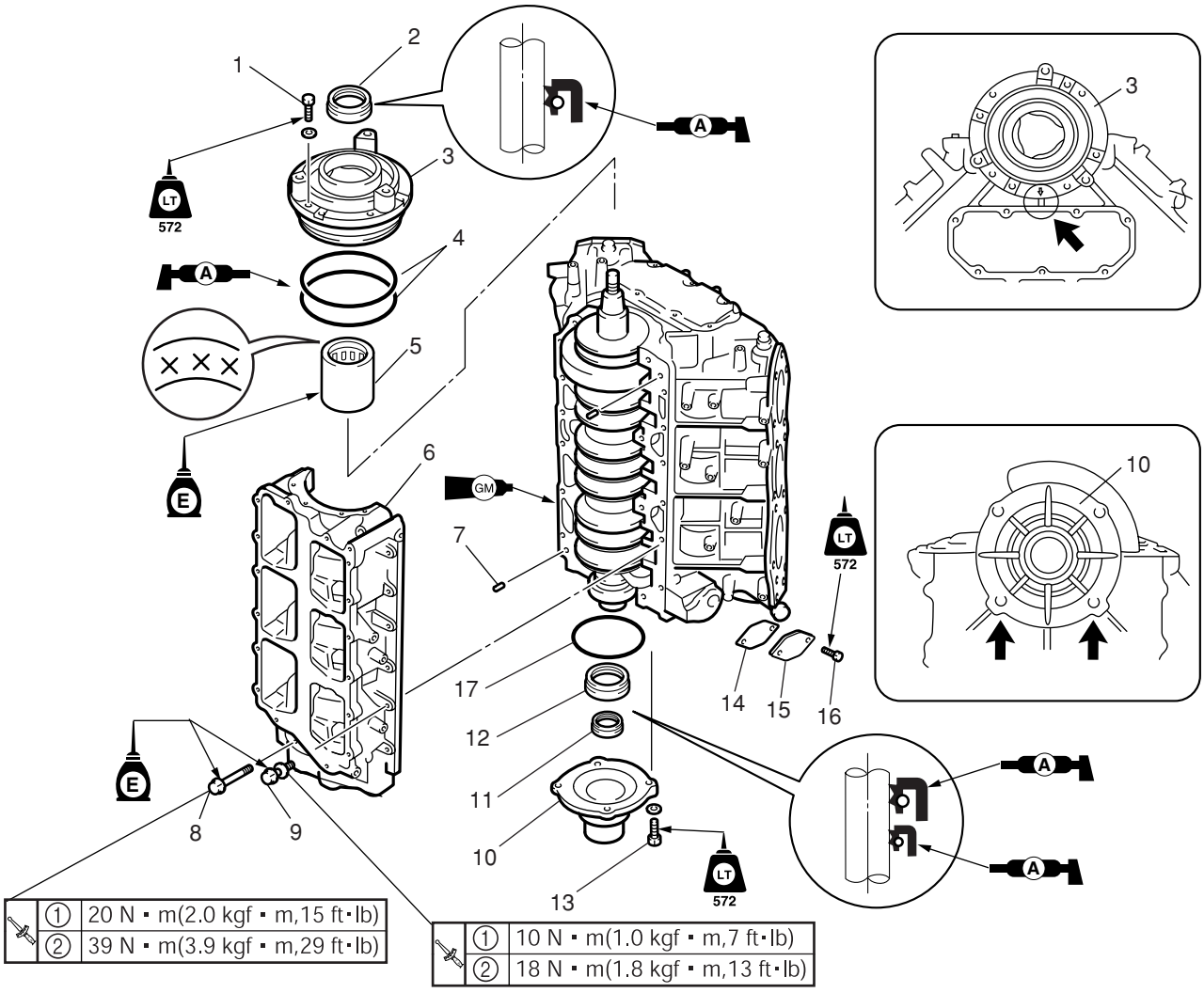
60H50340

Warpage limit: 0.1mm(0.04in)

NOTE:

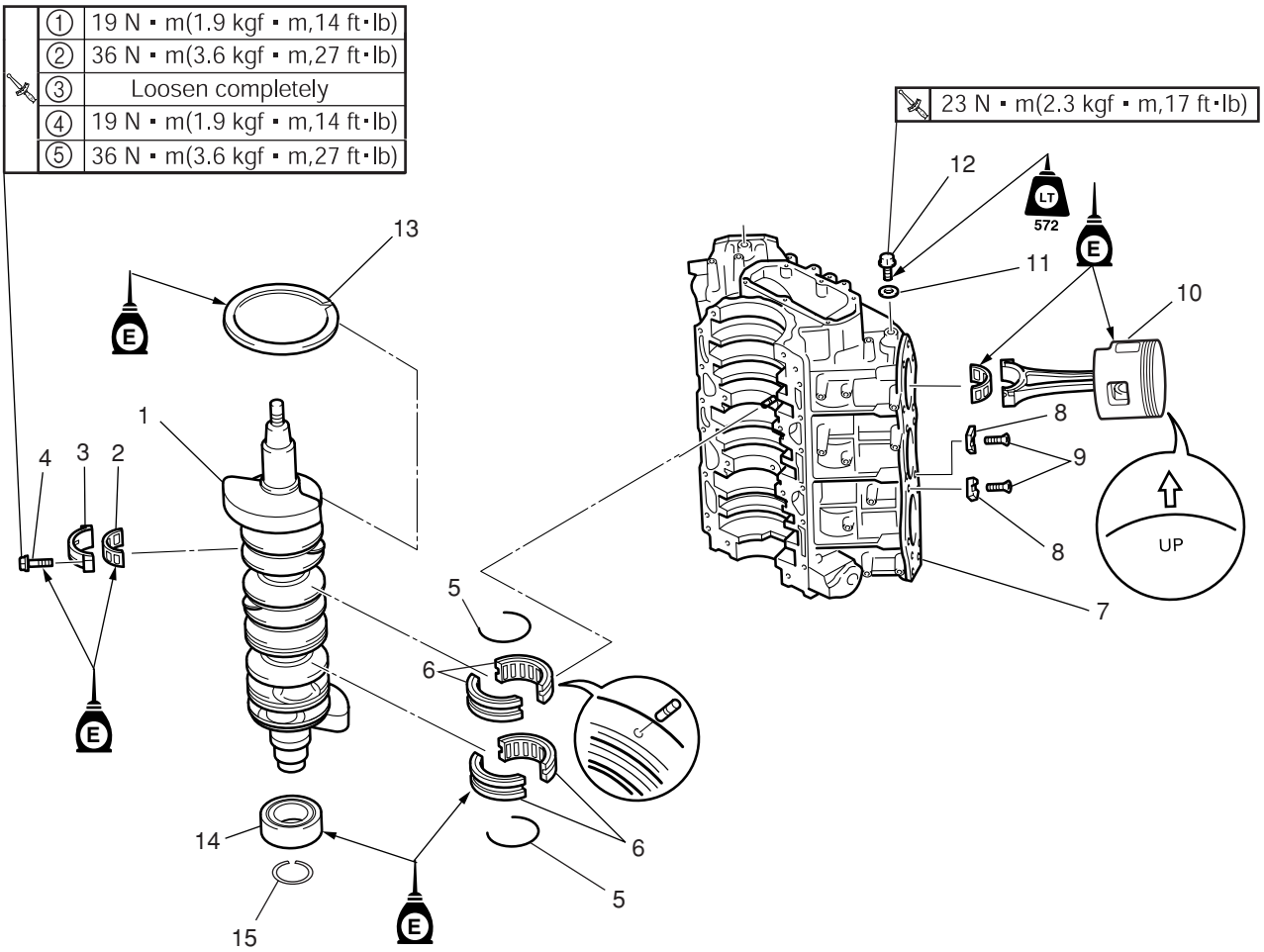
Check the warpage in the directious shown, using a straightedge and a thickness gauge.

Cylinder block



60H50350

No.	Part name	Q'ty	Remarks
1	Bolt	4	M6 x 20mm
2	Oil seal	1	Not reusable
3	Upper bearing housing	1	
4	O-ring	2	Not reusable
5	Needle bearing	1	
6	Crankcase	1	
7	Dowel	2	
8	Bolt	8	M10 x 60mm
9	Bolt	12	M8 x 30mm
10	Oil seal housing	1	
11	Oil seal	1	Not reusable
12	Oil seal	1	Not reusable
13	Bolt	4	M6 x 20mm
14	Gasket	1	Not reusable
15	Cover	1	
16	Bolt	2	M6 x 16 mm
17	O-ring	1	Not reusable

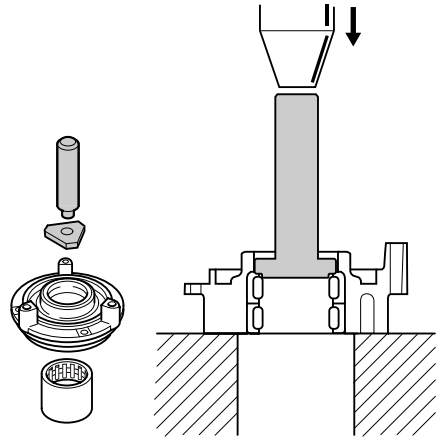


60H50360

No.	Part name	Q'ty	Remarks
1	Crankshaft	1	
2	Big-end bearing	6	
3	Connecting rod cap	6	
4	Connecting rod bolt	12	
5	Circlip	2	
6	Main journal bearing	2	
7	Cylinder block	1	
8	Anode	8	
9	Screw	8	
10	Piston/connecting rod assembly	6	
11	Gasket	2	Not reusable
12	Accessory plug	2	
13	Seal ring	9	
14	Bearing	1	
15	Cir clip	1	

Removing the crankcase

1. Remove the bearing housing.
2. Remove the O-ring, oil seal, and needle bearing from the bearing housing.

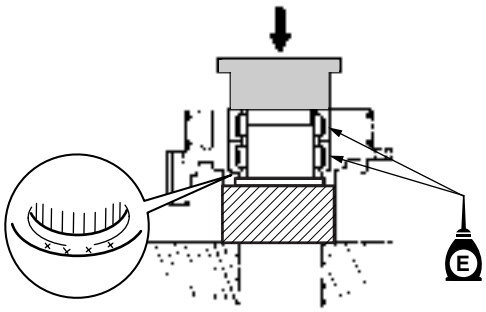


60H50370

NOTE:
Once removed, oil seal and needle bearing must be replaced with the new one.

Ball bearing attachment :
90890-06663
Driver rod LS : 90890-06606

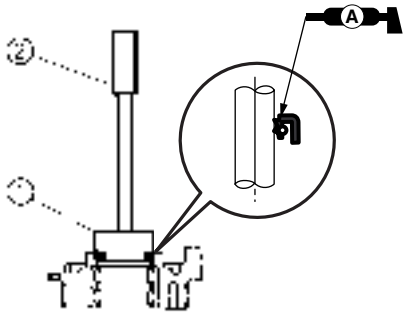
3. Install a new needle bearing into the bearing housing.



60H50380

Bearing inner race attachment :
90890-06661

4. Install a new O-ring and a new oil seal into the bearing housing.



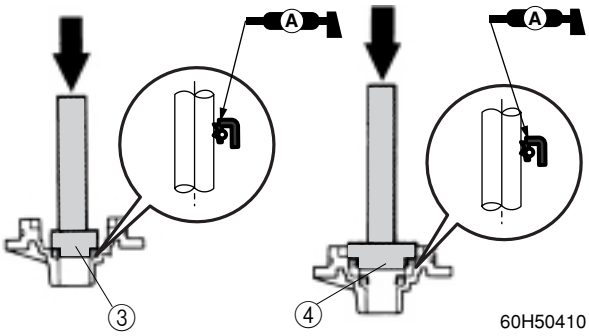
60H50390

Needle bearing attachment ①:
90890-06654
Driver rod L3 ②: 90890-06652

5. Remove the oil seal housing.

6. Remove the O-ring and oil seal.

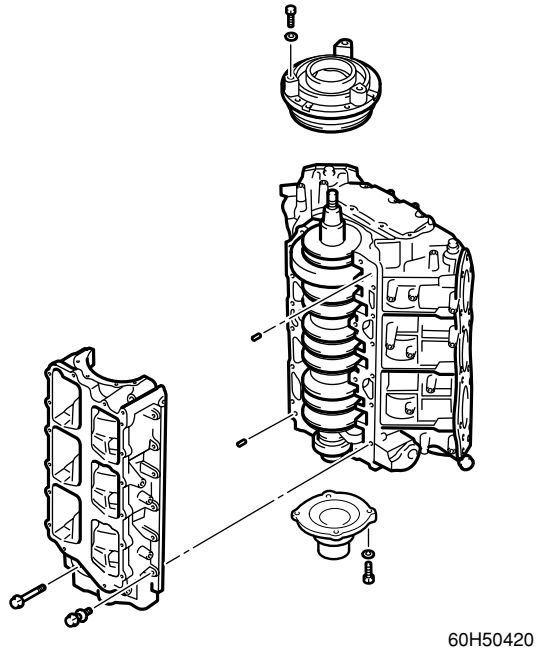
7. Install a new O-ring and a new oil seal.



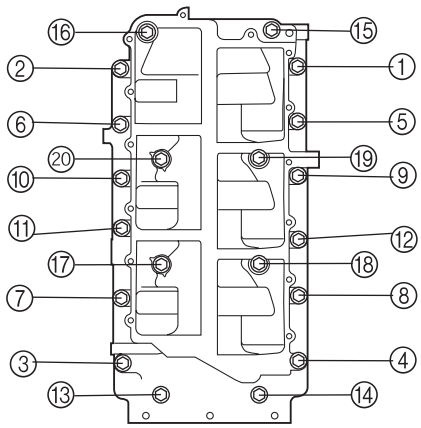
60H50410

Ball bearing attachment ③:
90890-06637
Bearing outer race attachment ④:
90890-06624
Driver rod LS : 90890-06606

8. Remove the crankcase.



60H50420

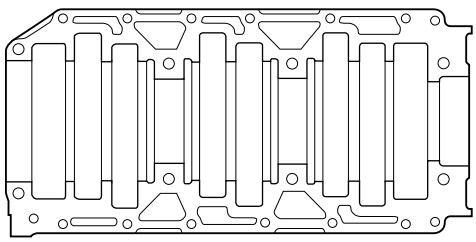


60H50425

NOTE:

Loosen the bolts in the sequence shown.

9. Check the crankcase for corrosion. Also check the mating face of the crankcase and the cylinder block for possible distortion.



60H50430

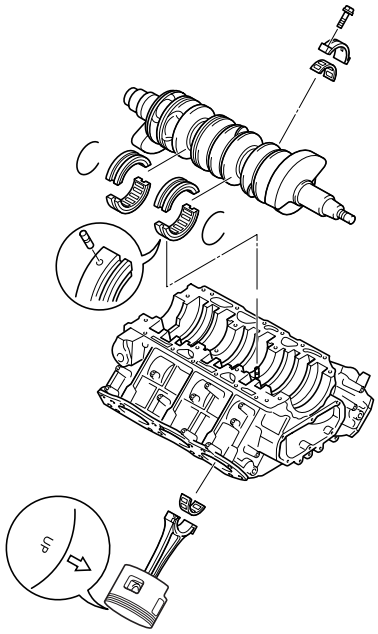
Removing the piston, connecting rod assembly, and the crankshaft

1. Loosen the connecting rod bolts to pull out the piston toward the cylinder head.

CAUTION:

- **Take precautions not to scratch the cylinder sleeve surface with the connecting rod big end when pulling out the piston.**
- **On the plane of the connecting rod / connecting rod cap mating area, mark the cylinder number from which they came with a permanent marker, so that the original condition of the mating face can be restored.**
- **Removed bearings must be sorted out and kept in order so that they will not be mixed up.**

2. Remove the crankshaft.



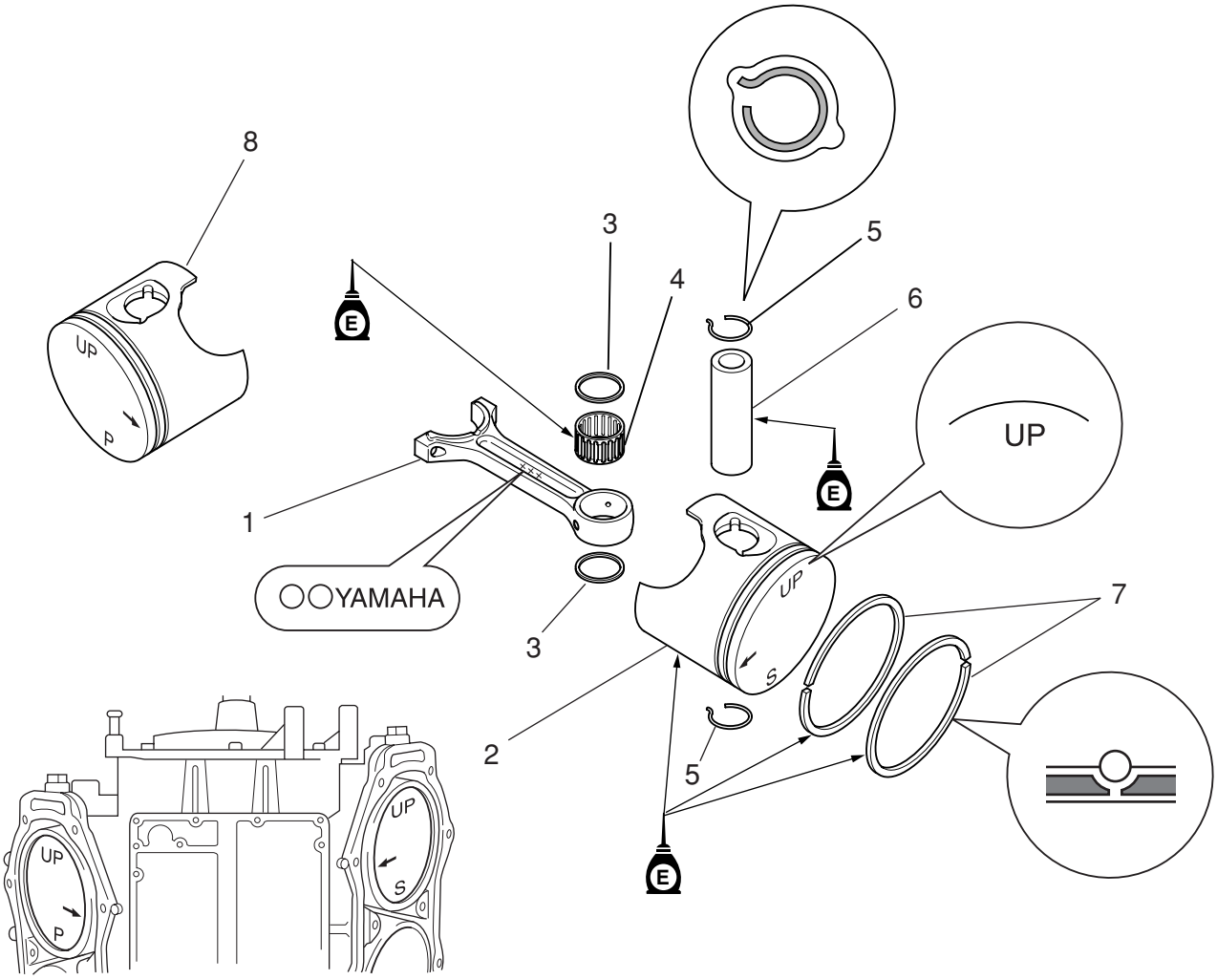
60H50440

CAUTION:

Removed roller bearings shall be placed in order on the table, with the split parts mated together.

5

Piston, Connecting rod



60H50450

No.	Part name	Q'ty	Remarks
1	Connecting rod	6	
2	Piston	3	Starboard
3	Washer	12	
4	Needle bearing	6	
5	Piston pin clip	12	Not reusable
6	Piston pin	6	
7	Piston ring set	6	
8	Piston	3	Port

Disassembling the piston, and the connecting rod assembly

1. Remove the piston pin clip, and then remove the piston pin.

2. Separate the piston from the connecting rod.

3. Remove the bearing and washer at the connecting rod small end.

4. Remove the piston ring.

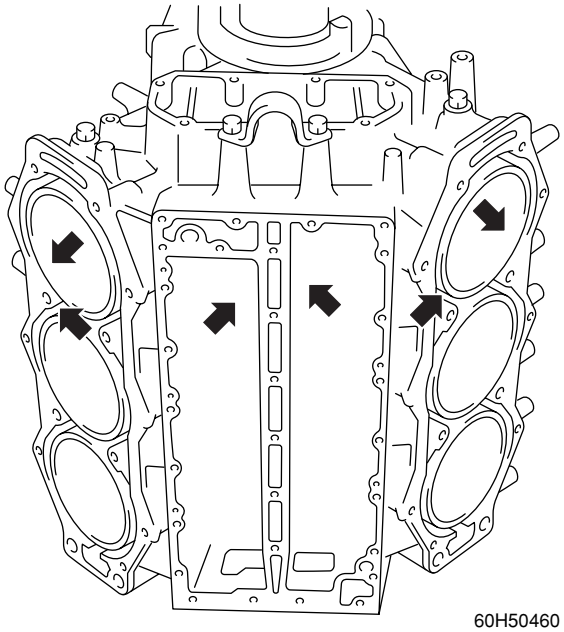
CAUTION:

Disassembled piston, piston ring, piston pin, connecting rod, and bearing must be sorted out and kept in order so that the components from different cylinders will not be mixed up.

Checking the cylinder block

1. Check the cylinder sleeve for cracks or damage.

2. Remove any rust or deposits on the cooling water passage wall, and check it for corrosion. Clean or replace if necessary.

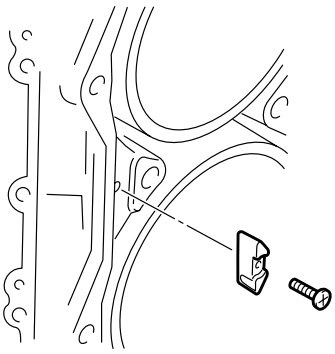


60H50460

CAUTION:

Do not scratch the contacting surfece of the cylinder head and cylinder block.

3. Check the anode. Clean the anode's surface, and replace if it has been eroded into half or smaller.



60H50470

CAUTION:

Do not oil, grease, or paint the anodes, otherwise they will not be able to prevent the galvanic corrosion effectively.

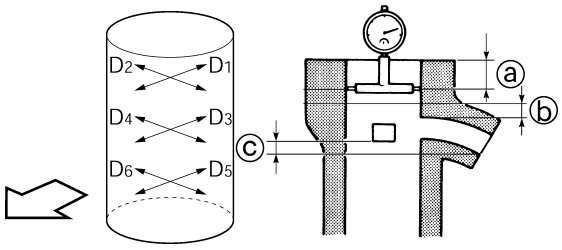
4. Remove the carbon deposit on the exhaust passage wall, and check it for cranks or damage. Replace if necessary.

CAUTION:

Do not scratch the contacting surfece of the cylinder head and cylinder block.

5

5. Measure the cylinder bore with cylinder gauge. Calculate the cylinder bore diameter (D), taper (T), and roundness (R). If the results exceeded the specified limit, rebore the cylinder sleeve, or replace the cylinder block.



60H50480

ⓐ: 10mm (0.039 in) to the cylinder head top surface
ⓑ: 5mm (0.20 in) above the exhaust port upper edge
ⓒ: 5mm (0.20 in) below the scavenging port lower edge

Specified limits
Cylinder bore diameter(D) :
90.10mm(3.5472in)
at 20 °C (68 °F)
Taper(T) : 0.08mm(0.0031in)
Out of round(R) : 0.05mm(0.0020in)
at 20 °C (68 °F)

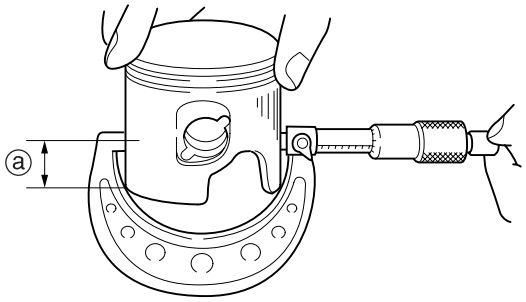
NOTE:

- Measure the cylinder bore diameter at 6 positions shown.
- To obtain the cylinder bore diameter(D), calculate the largest of D1-D6 measurements.
- Taper(T) is obtained by subtracting D5 from D1, and D6 from D2 and selecting the maximum value.
- To obtain the out of round(R), calculate the difference between D1 and D2, D3 and D4, and D5 and D6 respectively. The largest difference of the three shall apply.
- Oversize pistons is available in two sizes.

Oversize piston:
1st : 90.145 - 90.165mm
(3.5490 - 3.5498 in)
2nd : 90.395 - 90.415 mm
(3.5589 - 3.5596 in)

Checking the piston

1. Check the piston outside diameter. Replace the piston if the diameter is out of specification.



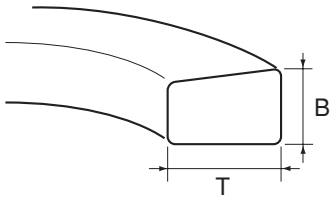
60H50490

Piston outside diameter:
89.895 - 89.915mm
(3.5392 - 3.5400 in)
at 20°C (68 °F)
ⓐ: 10 mm (0.39 in)

2. Check the piston clearance. Replace the piston and the piston ring, or the cylinder block if out of specification.

Piston clearance:
0.100 - 0.106mm (0.0039 - 0.0042 in)
at 20°C (68 °F)

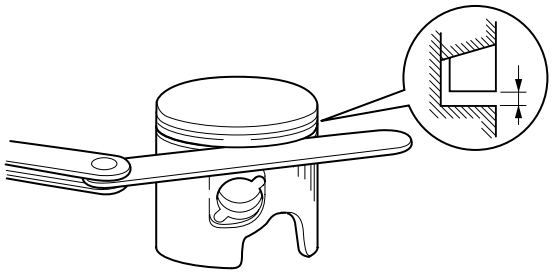
3. Check the piston ring dimensions of B and T. Replace the piston ring if the dimension is out of specification.



60H50500

Piston ring dimensions
(Top ring, Second ring):
B:1.97 - 1.99mm
(0.0776 - 0.0783 in)
T: 2.7-2.9mm (0.1063 - 0.1142 in)
at 20°C (68 °F)

4. Check the piston ring side clearance. Replace the piston and the piston rings as a set if the measurement is out of specification.

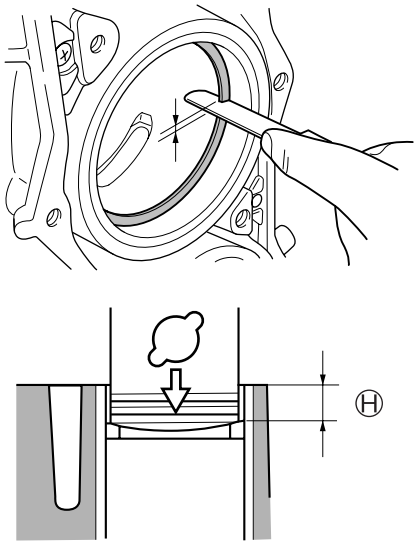


60H50515

NOTE:
- Install the piston rings in accordance with the specification, and measure the piston ring side clearance with the thickness gauge.
- Piston ring peripheral face shall be flush with piston external surface when measuring the piston ring side clearance.

Piston ring side clearance:
0.02 - 0.06mm(0.0008 - 0.0024 in)
at 20°C (68 °F)

5. Measure the piston ring end gaps. Replace the piston ring if the measurement is out of specification.

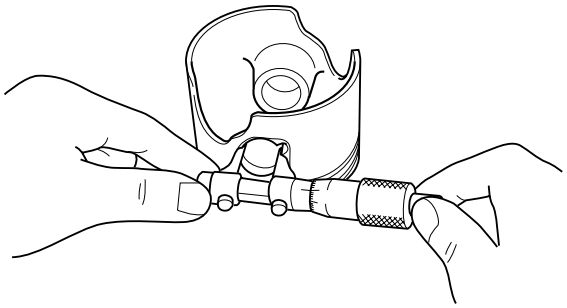


60H50520

NOTE:
Push-in the piston ring with the piston crown to the specified measuring position Ⓗ in the cylinder.
Make sure that the cylinder sleeve bore diameter falls within the specified limit.

Piston ring end gap:
0.3 - 0.4mm (0.0118 - 0.0157 in)
at 20°C (68 °F)
H: 20mm (0.79 in)

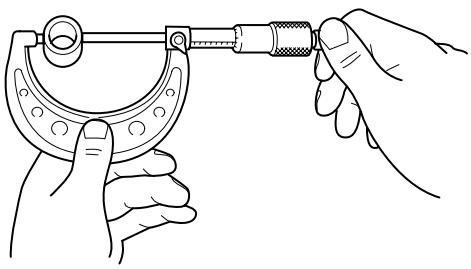
6. Measure the piston pin boss inside diameter. Replace the piston if the measurement is out of specification.



60H50530

Piston pin boss inside diameter :
23.074 - 23.085mm
(0.9084 - 0.9089 in)
at 20°C (68 °F)

7. Measure the piston pin outside diameter. Replace the piston pin if the measurement is out of specification.



60H50540

Piston pin outside diameter :
23.065 - 23.070mm
(0.9081 - 0.9083 in)
at 20°C (68 °F)

5

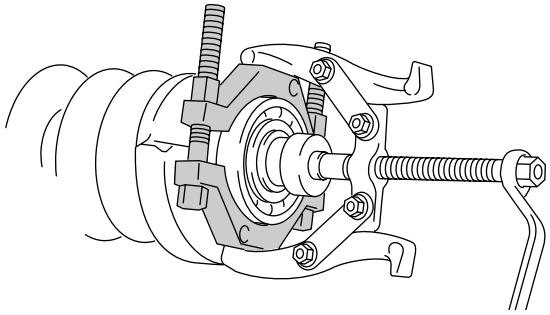
Checking the connecting rod

1. Check the internal surfaces of big end and small end for scratch. Replace if necessary.

2. Check the bearings at the small end and at the big end. Replace the bearings if necessary.

Checking the crankshaft

1. Remove the cir clip, and the crankshaft lower bearing.



60H50580

NOTE:

Use a commercially available bearing puller.

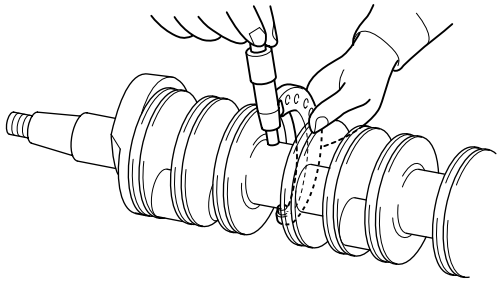
Bearing separator: 90890-06534

2. Check the bearing for run-out or roughness. Replace the bearing if necessary.

3. Remove the seal ring.

4. Check the seal ring for cranks or damage.

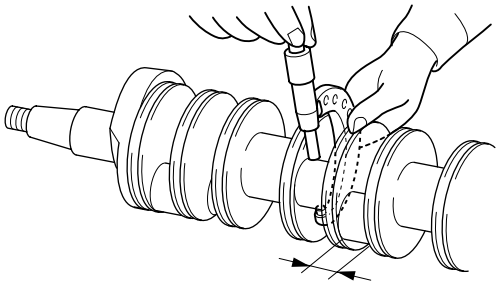
5. Measure the crankshaft journal diameter. Replace the crankshaft if the measurment is out of specification.



60H50600

Crankshaft journal diameter:
53.975 - 53.991 mm
(2.1250 - 2.1256 in)
at 20°C (68 °F)

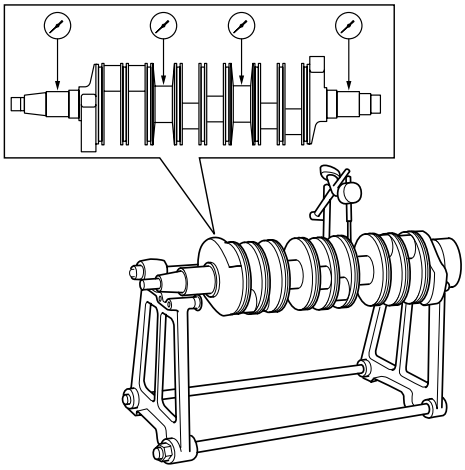
6. Measure the crank pin diameter. Replace the crankshaft if the measurment is out of specification.



60H50610

Crank pin diameter:
35.985 - 36.000 mm
(1.4167-1.4173 in)
at 20°C (68 °F)

7. Measure the crankshaft run-out.



60H50620

NOTE:

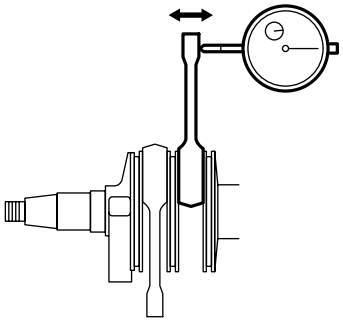
Measure the run-out at the crankshaft journals using the V-block and the dial gauge.

Run-out limit : 0.03 mm (0.0012 in)

8. Install bearings and connecting rods to the crankshaft.

Connecting rod:
1st : 19N • m (1.9kgf • m, 14 ft • lb)
2nd : 36N • m (3.6kgf • m, 27 ft • lb)
3rd : Loosen completely
4th : 19N • m (1.9kgf • m, 14 ft • lb)
5th : 36N • m (3.6kgf • m, 27 ft • lb)

9. Measure the axial play at the connecting rod big end. Replace the bearing and the connecting rod if the measurement is out of specification.

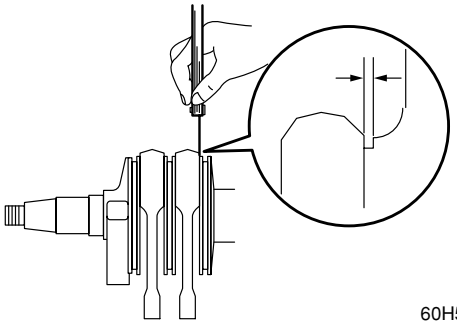


60H50640

Axial play limit:
2 mm (0.08 in)

NOTE:
For measurement, set the dial gauge at the connecting rod small end in parallel to the crank shaft.

10. Measure the connecting rod side clearance. Replace the connecting rod if the measurement is out of specification.



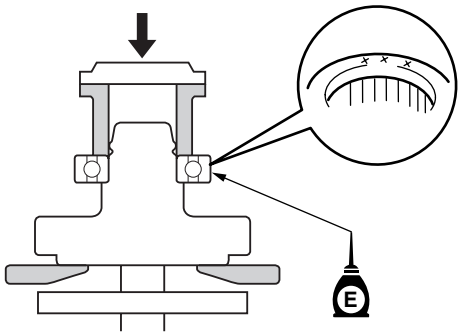
60H50630

Connecting rod side clearance:
0.12 - 0.26 mm (0.0047 - 0.0102 in)
at 20°C (68 °F)

11. Check the crankshaft journal bearings. Replace the bearings if necessary.

Installing the crankshaft

1. Install the crankshaft bearing, and the cir clip.



60H50650

Bearing inner race attachment:
90890-06662

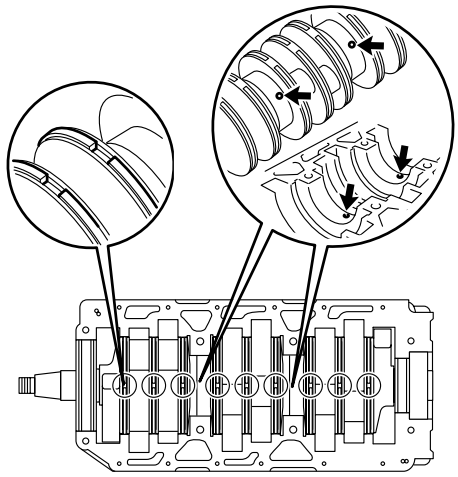
2. Install the two roller bearings to the center of crankshaft.

NOTE:
- Dowel hole on the roller bearings shall face the engine bottom.
- Install the roller bearings so that the split ends are engaged correctly.

3. Install the seal rings on the crankshaft.

5

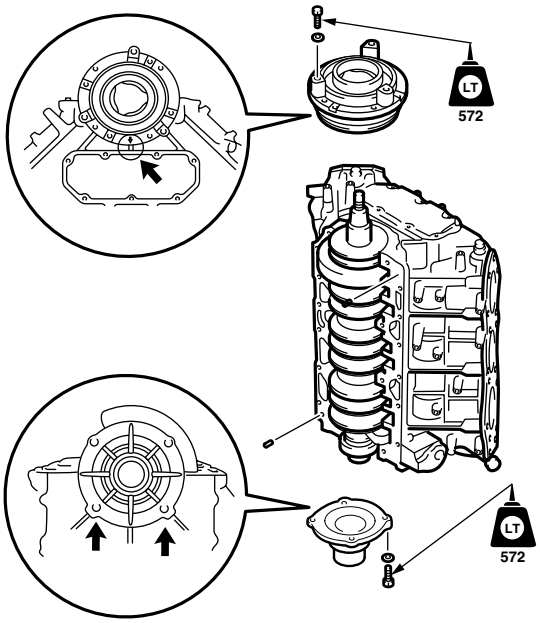
4. Assemble the crankshaft and the cylinder block.



60H50655

NOTE:
- The dowels on the cylinder block shall be fitted into the dowel holes on the roller bearings.
- Align the seal ring end gap with the crankcase center line.

5. Install the bearing housing and the oil seal housing, and temporarily tighten the bolts.

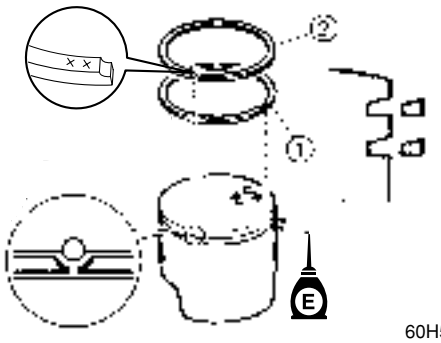


60H650665

NOTE:
- Bearing housing shall be installed with the arrow pointing to the exhaust cover.
- Oil seal housing shall be installed with the tab facing the exhaust cover.

Assembling the piston and connecting rod

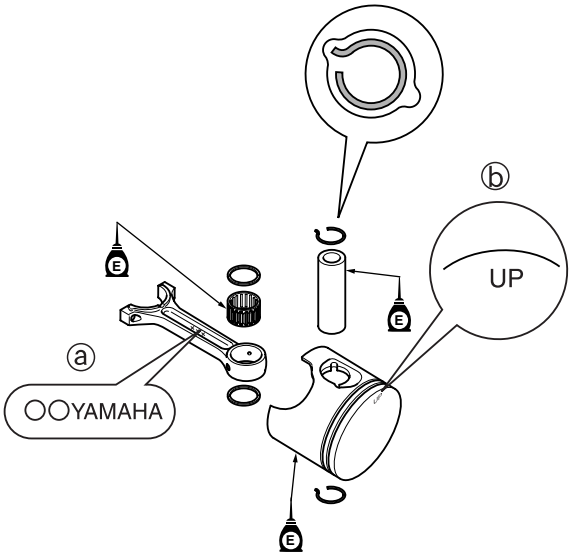
1. Install the piston rings ①,②.



60H50660

NOTE:
Install the piston rings with the recess for the locating pin facing up toward the piston crown.

2. Install the connecting rod, needle bearing, washer, piston pin, and the new clip.

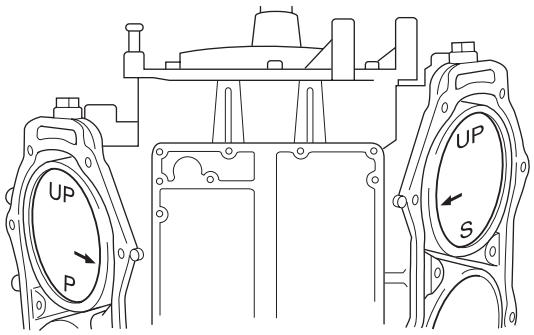


60H50670

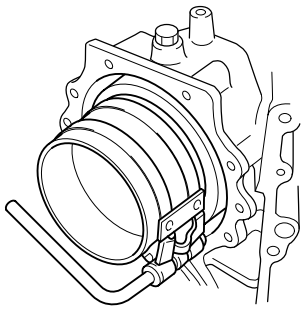
NOTE:
- As assembled, "YAMAHA" marking on the connecting rod ⓐ shall be aligned with the marking on the piston ⓑ.
- Make sure that piston and piston pin bearings are installed in the original combination.

Installing the piston and the connecting rod.

1. Insert the piston and connecting rod assembly into the cylinder.



60H50675

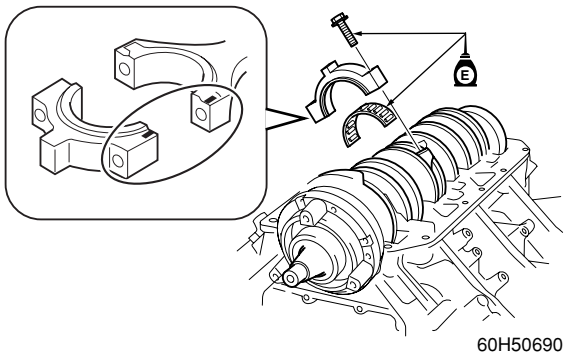


60H50680

NOTE:
- "UP"marking shall come to the upper part of the power head.
- Make sure that the piston and connecting rod assembly is inserted into the cylinder that they came from. Assemblies with "S" mark are to be installed on the starboard side, and assemblies with "P" mark are to be installed on the port side.

Piston ring compressor : 90890-05158

2. Install the connecting rod caps.



60H50690

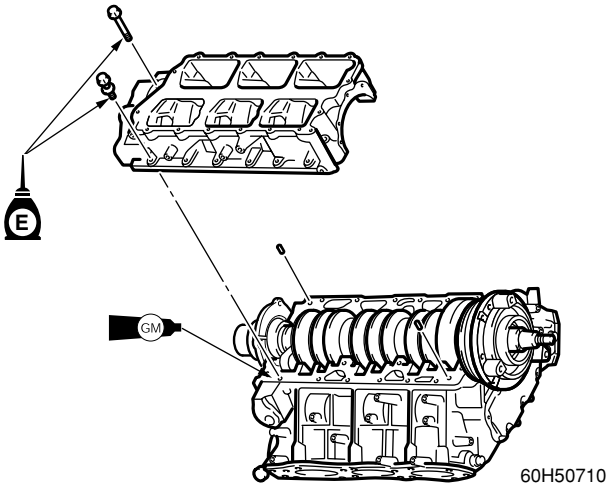
NOTE:
- Make sure that the split face of the connecting rod caps are mated correctly to the original position.
- Apply oil on the bolts' seating face and the threaded area.

3. Tighten the connecting rod bolts alternately in the follwing procedure.

Connecting rod:
1st : 19 N • m (1.9 kgf • m, 14 ft • lb)
2nd : 36 N • m (3.6 kgf • m, 27 ft • lb)
3rd : Loosen completely
4th : 19 N • m (1.9 kgf • m, 14 ft • lb)
5th : 36 N • m (3.6 kgf • m, 27 ft • lb)

4. Install the dowels.

5. Install the crankcase.

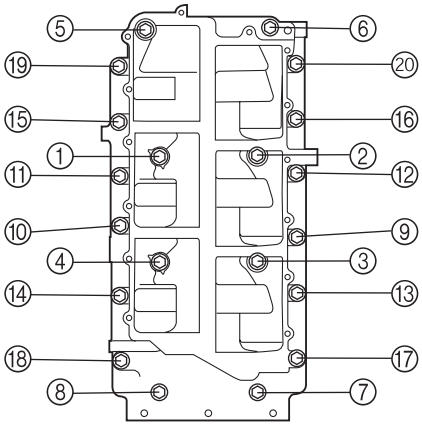


60H50710

NOTE:
Clean the mating face of the cylinder block and crankcase.
Apply thin coating of Gasket Maker on the mating face so that it will not be squeezed out of the edge.

5

6. Tighten the crankcase bolts.

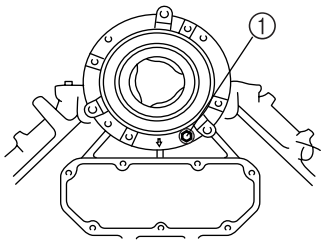


60H50720

NOTE:
Tighten the bolts to the specified torques in two stages and in the sequence shown.
Apply some oil on the bolt's seating face and the threaded area.

Crankcase bolt:
1st:
M10 bolt:
20 N • m (2.0 kgf • m, 15 ft • lb)
M8 bolt:
10 N • m (1.0 kgf • m, 7 ft • lb)
2nd:
M10 bolt:
39 N • m (3.9 kgf • m, 29 ft • lb)
M8 bolt:
18 N • m (1.8 kgf • m, 13 ft • lb)

7. Install the rest of the bolts on the bearing housing and the oil seal housing, and tighten them.

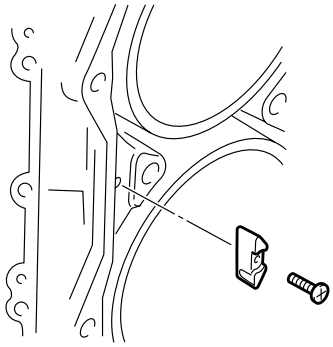


60H50730

NOTE:
Tighten the bearing housing starting with the bolt ①.

Installing the cylinder head

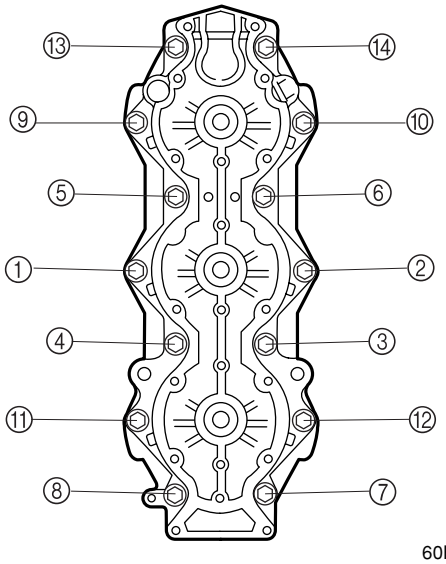
1. Check the anode on the cylinder block.



60H50735

NOTE:
Replace the anode if it has been eroded into half or smaller.

2. Install the cylinder head.

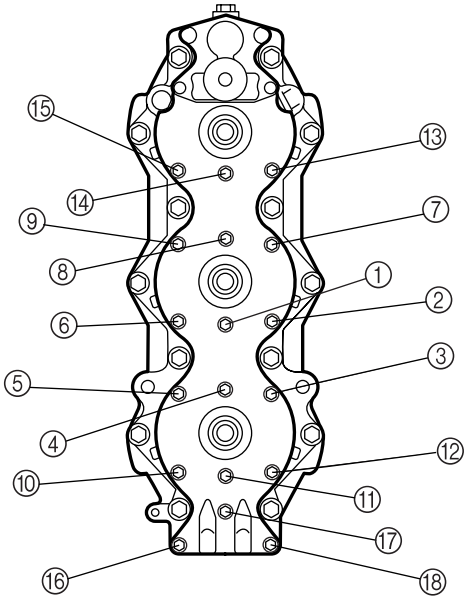


60H50740

NOTE:
- Tighten the cylinder head bolts in the sequence shown.
- Apply some oil on the bolts' seating face and the threaded area.

Cylinder head bolt:
1st : 15 N • m (1.5 kgf • m, 11 ft • lb)
2nd : 29 N • m (2.9 kgf • m, 21 ft • lb)

3. Install the cylinder head cover.



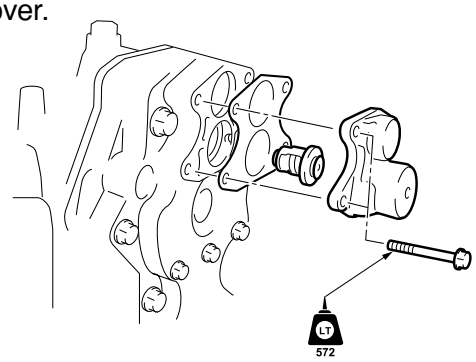
60H50750

NOTE:

Tighten the cylinder head cover bolts to the specified torque in two stages and in the sequence shown.

Cylinder head cover bolt:
1st : 4 N • m (0.4 kgf • m, 3 ft • lb)
2nd : 8 N • m(0.8 kgf • m, 6 ft • lb)

4. Install the thermostat and the thermostat cover.



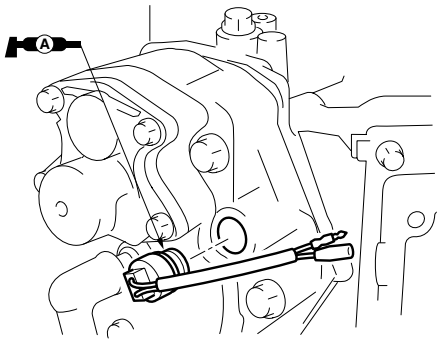
60H50760

NOTE:

Tighten the thermostat cover bolts to the specified torques in two stages and in the sequence shown.

Thermostat cover bolt:
1st : 4 N • m(0.4 kgf • m, 3 ft • lb)
2nd : 8 N • m(0.8 kgf • m, 6 ft • lb)

5. Install the thermoswitch.



60H50770

6. Install the spark plugs.

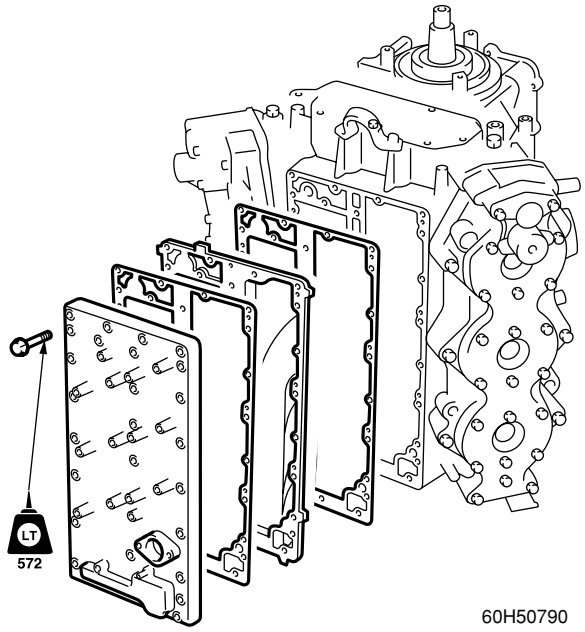
Spark plug : 25N • m(2.5kgf • m, 18 ft • lb)

5

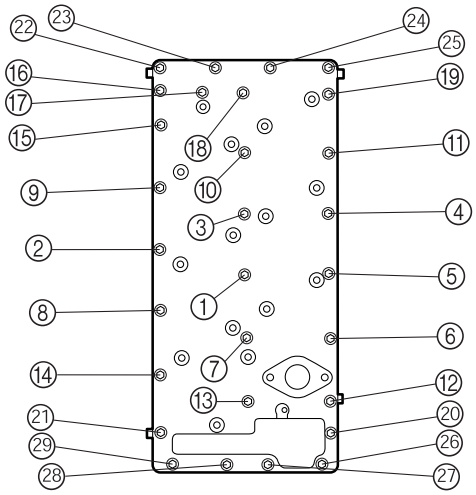
Mounting the exhaust cover

1. Install the cylinder block exhaust cover.

2. Install the exhaust outer cover, and the exhaust inner cover.



60H50790



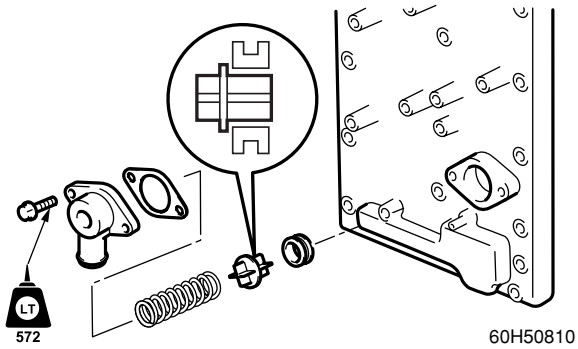
60H50800

NOTE:

Tighten the exhaust outer cover bolts to the specified torque in two stages and in the sequence shown.

Exhaust outer cover bolt:
1st : 4 N • m (0.4 kgf • m, 3 ft • lb)
2nd : 8 N • m (0.8 kgf • m, 6 ft • lb)

3. Install the pressure control valve.

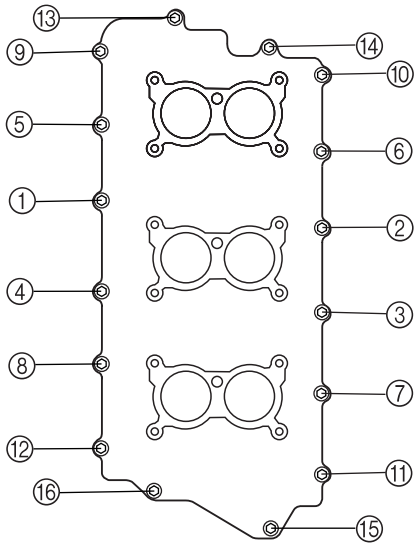


60H50810

Pressure control valve cover bolt:
1st : 4 N • m (0.4 kgf • m, 3 ft • lb)
2nd : 8 N • m (0.8 kgf • m, 6 ft • lb)

Mounting the intake manifold

1. Install the reed valve plate assembly, and the intake manifold.



60H50825

NOTE:

Tighten the intake manifold bolts to the specified torque in two stages and in the sequence shown.

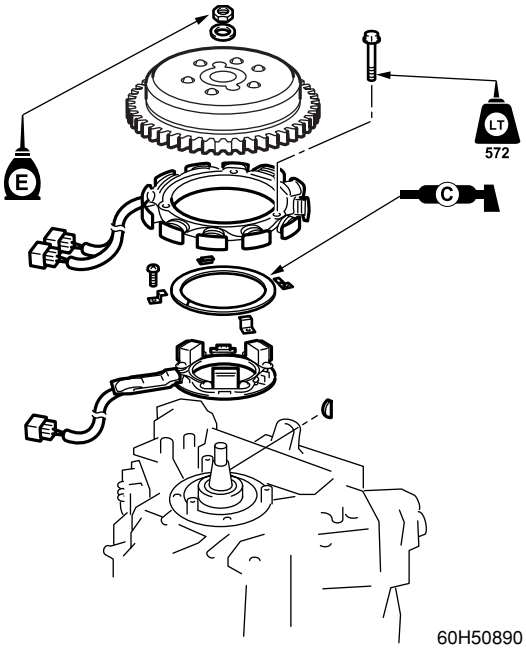
Intake manifold bolt:
1st : 4 N • m (0.4 kgf • m, 3 ft • in)
2nd : 8 N • m (0.8 kgf • m, 6 ft • in)

2. Install the hoses.

Mounting the coils

1. Install the pulser coil assembly, and the stator assembly.

2. Mount the Woodruff key, and then install the flywheel magnet.

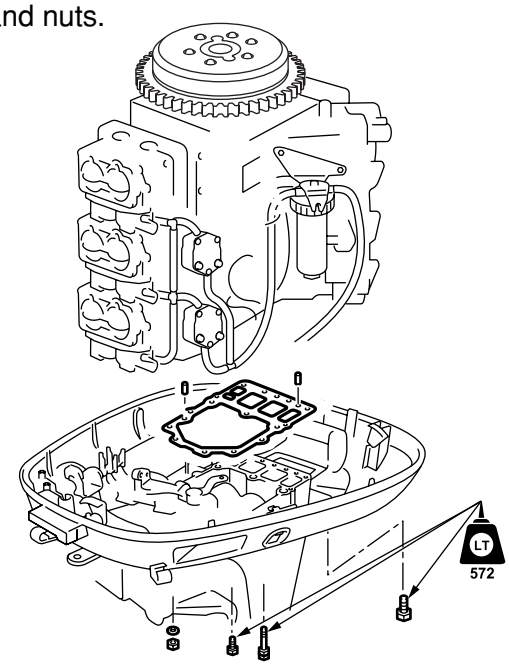


60H50890

Installing the power unit

1. Clean the mating face of the power unit and the upper case, and install dowels and new gasket.

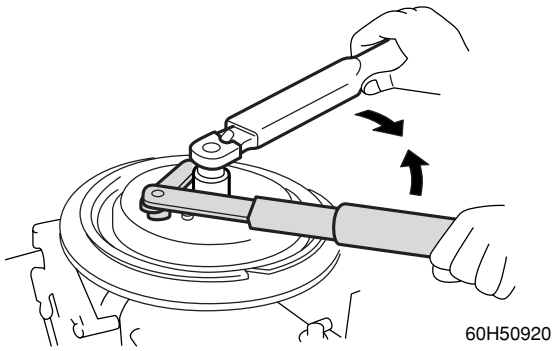
2. Install the power unit, and tighten the bolts and nuts.



60H50910

	Power unit mounting bolt : 21 N • m (2.1 kgf • m, 15 ft • lb)

3. Tighten the flywheel magnet.


60H50920

□ : 30 mm

NOTE:

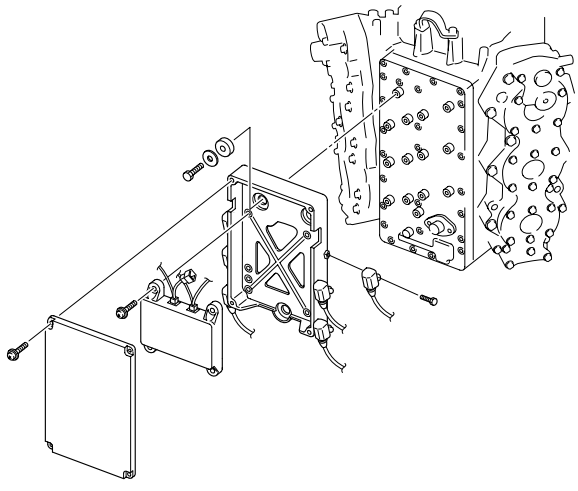
Apply some engine oil on the nut before tightening.

CAUTION:

Apply force in the direction of the arrows shown. While working, take precautions against the slipping off of the flywheel holder.

	Flywheel magnet nut: 160 N • m (16 kgf • m, 116 ft • lb)
	Flywheel holder : 90890-06522

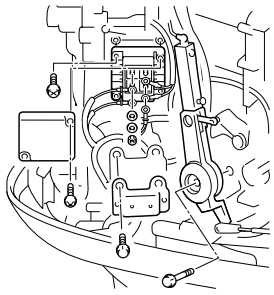
4. Install the CDI unit and the bracket.


60H50840

	Ignition coil: 8 N • m (0.8 kgf • m, 6 ft • lb)

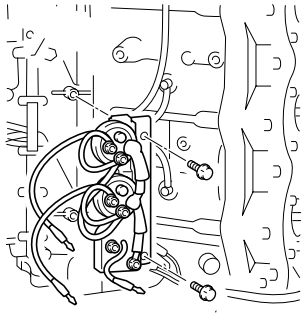
5

5. Install the Rectifier Regulator, hour meter, and the magnet control lever.



60H50850

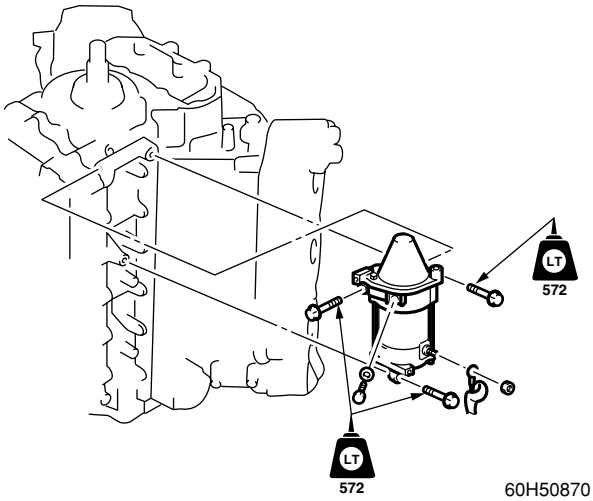
6. Install the starter relay, and the power trim and tilt relay assembly.



60H50860

	Terminal nut: 4 N • m (0.4 kgf • m, 3 ft • lb)

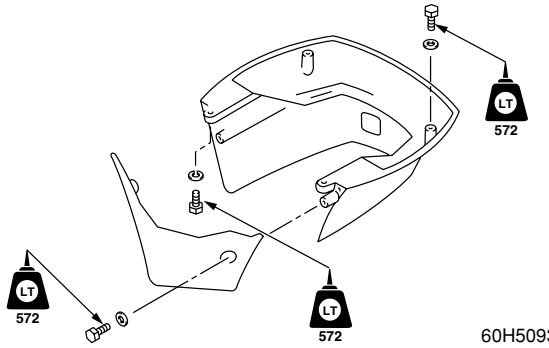
7. Install the starter motor.



60H50870

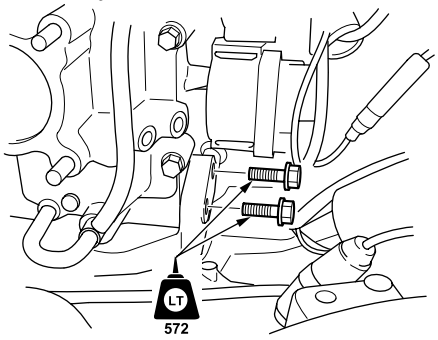
	Mounting bolt: 29N • m (2.9 kgf • m, 21 ft • lb) Terminal nut: 9N • m (0.9 kgf • m, 6 ft • lb)

8. Install the upper case cover and the apron.



60H50930

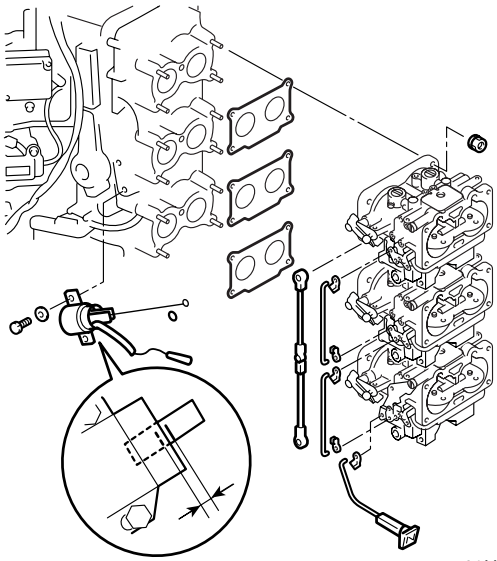
9. Install the mounting bracket for the shift rod assembly.



60H50935

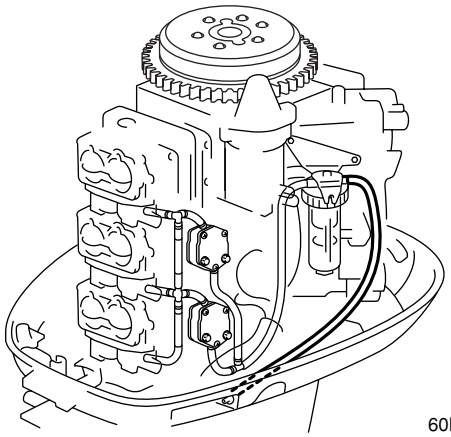
10. Connect the power trim and tilt motor leads, pilot jet hose, and water pressure control valve hose.

11. Install the carburetor.



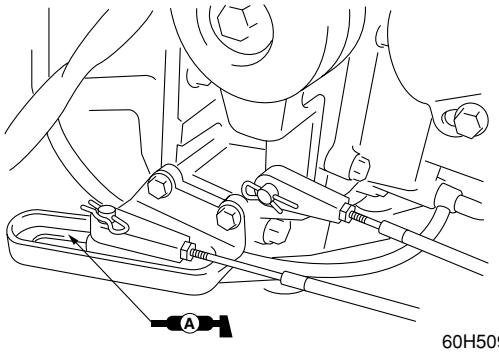
60H50940

12. Connect the fuel hoses.



60H50950

13. Connect the shift cable, and the throttle cable.



60H50960

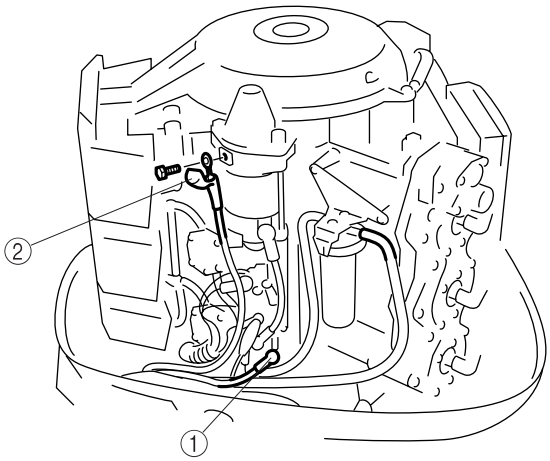
NOTE:

Adjust the shift cable and the throttle cable.

14. Install the flywheel magnet cover, and the intake silencer.

15. Connect the remote control connector.

16. Connect the battery cable.



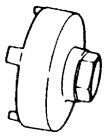
60H50970

Positive terminal nut ①:
4 N • m (0.4 kgf • m, 3 ft • lb)
Negative terminal bolt ②:
6 N • m (0.6 kgf • m, 5 ft • lb)

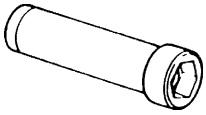
5

Lower unit

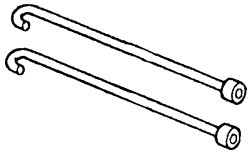
Special service tools



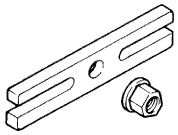
Ring nut wrench 4
90890-06512



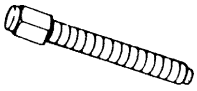
Ring nut wrench extension
90890-06513



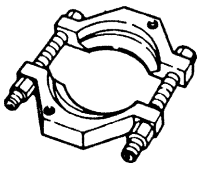
Bearing housing puller claw L
90890-06502



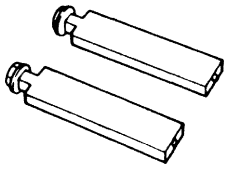
Stopper guide plate
90890-06501



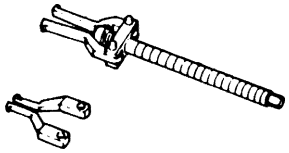
Center bolt
90890-06504



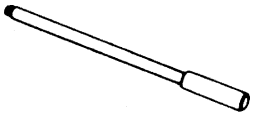
Bearing separator
90890-06534



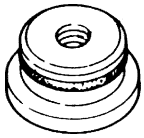
Stopper guide stand
90890-06538



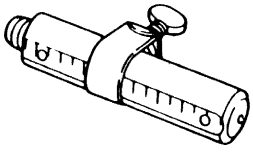
Bearing puller assembly
90890-06535



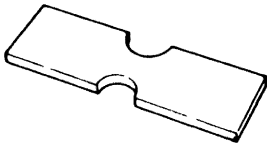
Driver rod L3
90890-06652



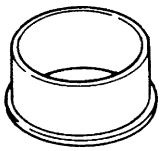
Needle bearing attachment
90890-06653, 90890-06610, 90890-06612



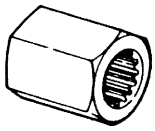
Driver rod SS
90890-06604



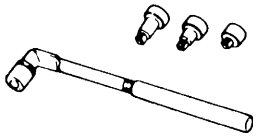
Bearing depth plate
90890-06603



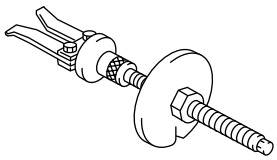
Bearing inner race attachment
90890-06642, 90890-06661, 90890-06639, 90890-06660, 90890-06662



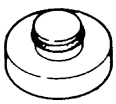
Drive shaft holder 6
90890-06520



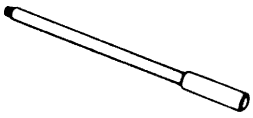
Pinion nut holder
90890-06505



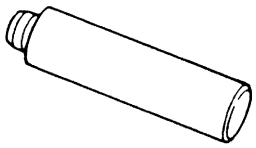
Bearing outer race puller assembly
90890-06523



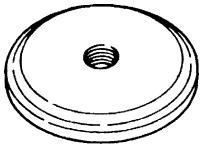
Ball bearing attachment
90890-06636, 90890-06633,90890-06629



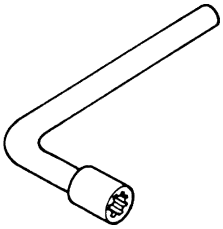
Driver rod LL
90890-06605



Driver rod LS
90890-06606

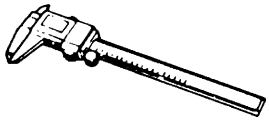


Bearing outer race attachment
90890-06619

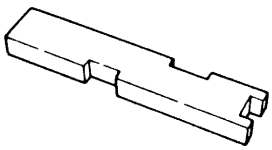


Shift rod push arm
90890-06052

Pinion height gauge
90890-06710

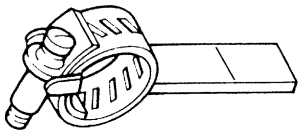


Digital caliper
90890-06704

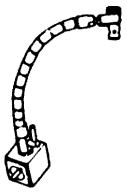


Shimming plate
90890-06701

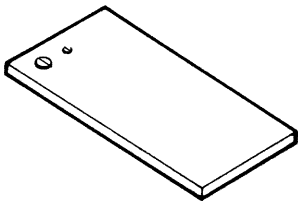
6



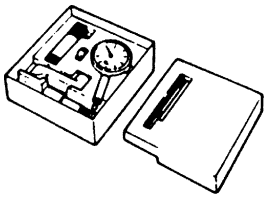
Backlash indicator
90890-06706



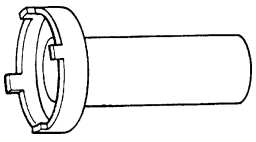
Magnet base
90890-06705



Magnet base plate
90890-07003

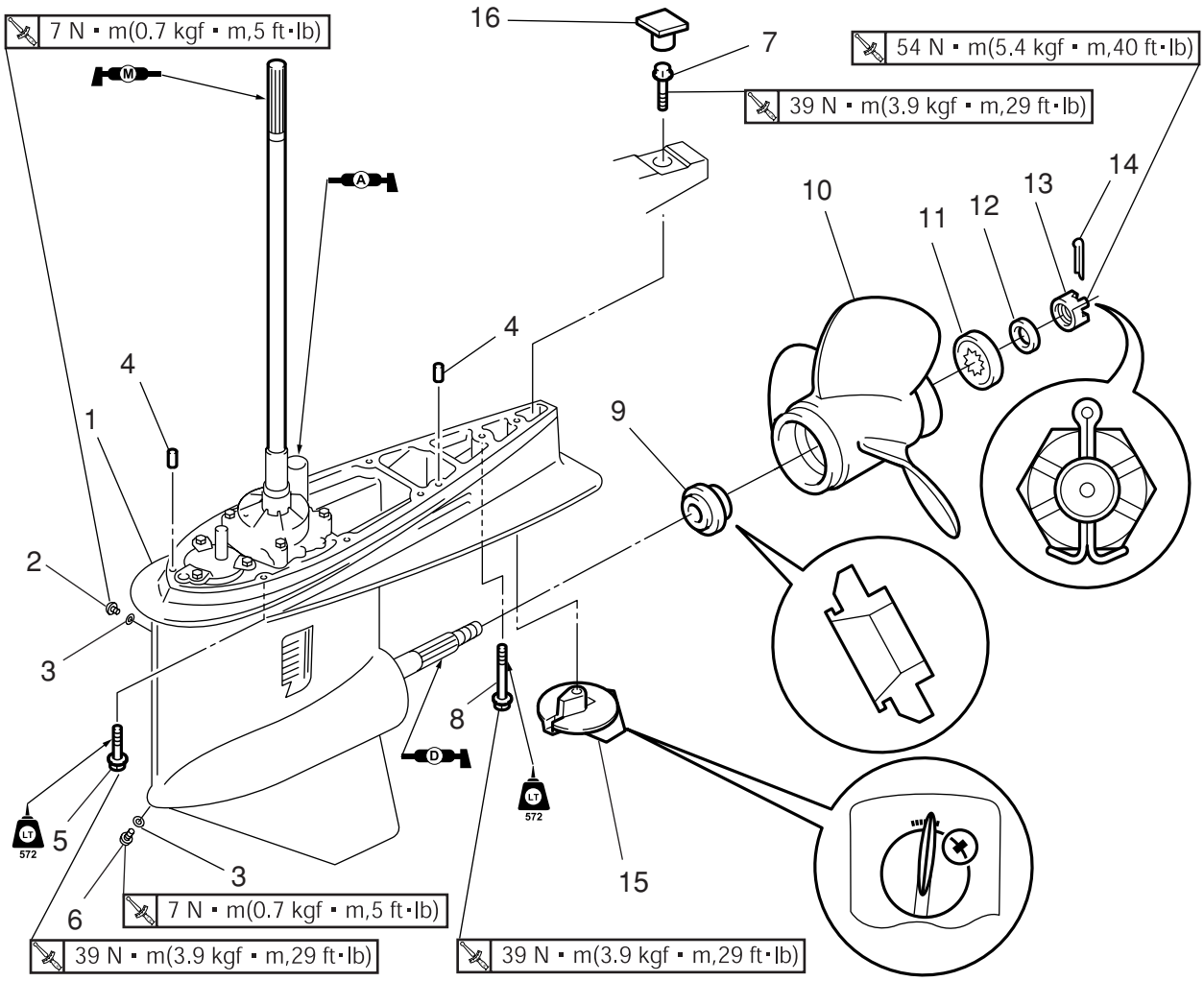


Dial gauge set
90890-01252

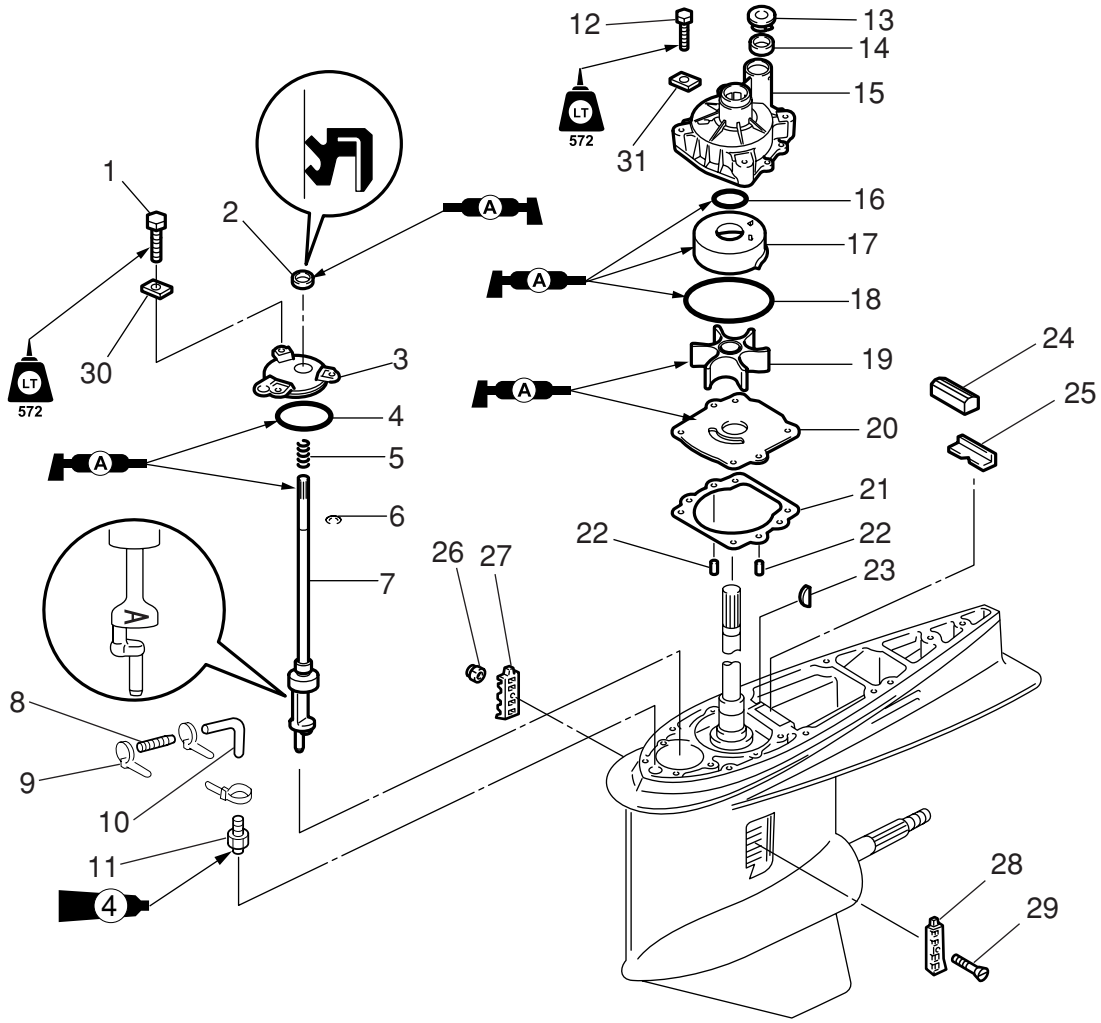


Ring nut wrench
90890-06578

Lower unit (regular rotation model)

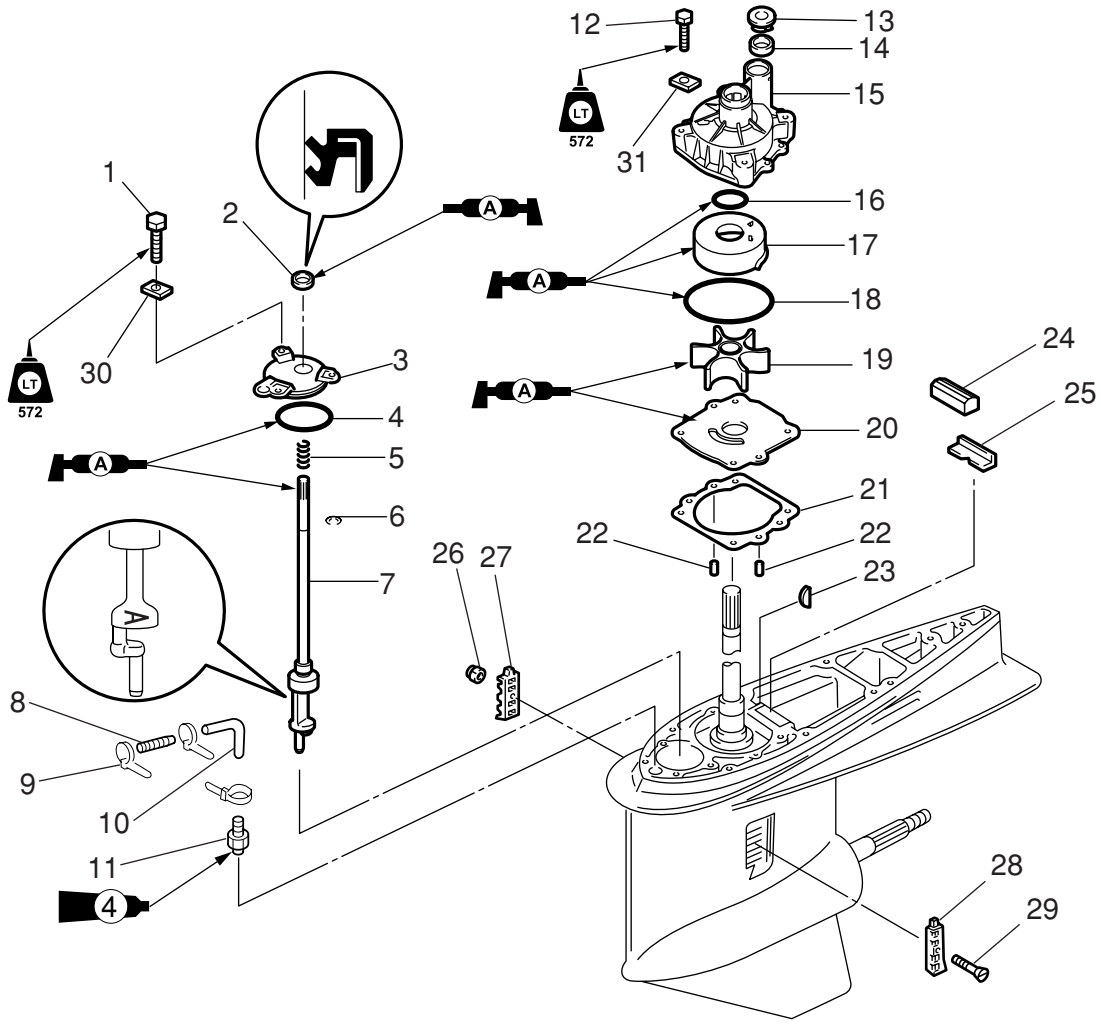


No.	Part name	Q'ty	Remarks
1	Lower unit	1	
2	Check screw	1	
3	Gasket	2	Not reusable
4	Dowel	2	
5	Bolt	6	M10 x 45mm
6	Drain screw	1	
7	Bolt	1	M10 x 45mm
8	Bolt	1	M10 x 70mm
9	Spacer	1	
10	Propeller	1	
11	Washer	1	
12	Washer	1	
13	Propeller nut	1	
14	Cotter pin	1	Not reusable
15	Trim tab	1	
16	Cap	1	



60h60020

No.	Part name	Q'ty	Remarks
1	Bolt	3	M6 x 20mm
2	Oil seal	1	Not reusable
3	Oil seal housing	1	
4	O-ring	1	Not reusable
5	Spring	1	
6	Circlip	1	Not reusable
7	Shift rod	1	
8	Joint	1	
9	Plastic tie	3	Not reusable
10	Hose	1	
11	Joint	1	
12	Bolt	4	M8 x 45mm
13	Cover	1	
14	Water seal damper	1	Not reusable
15	Water pump housing	1	
16	O-ring	1	Not reusable
17	Insert cartridge	1	



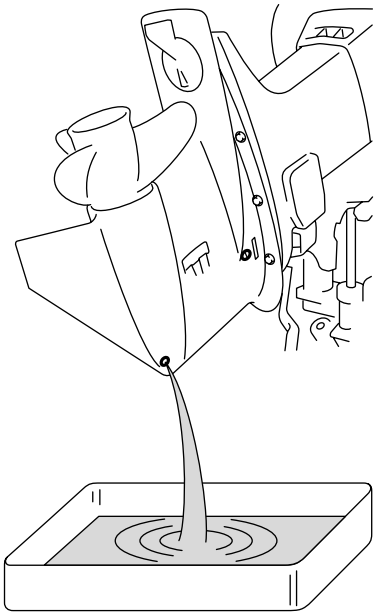
60h60020

No.	Part name	Q'ty	Remarks
18	O-ring	1	Not reusable
19	Impeller	1	
20	Outer plate cartridge	1	
21	Gasket	1	Not reusable
22	Dowel	2	
23	Woodruff key	1	
24	Seal damper	1	
25	Guide	1	
26	Nut	1	
27	Cooling water inlet cover	1	
28	Cooling water inlet cover	1	
29	Bolt	1	M5 x 45 mm
30	Washer	3	
31	Washer	4	

6

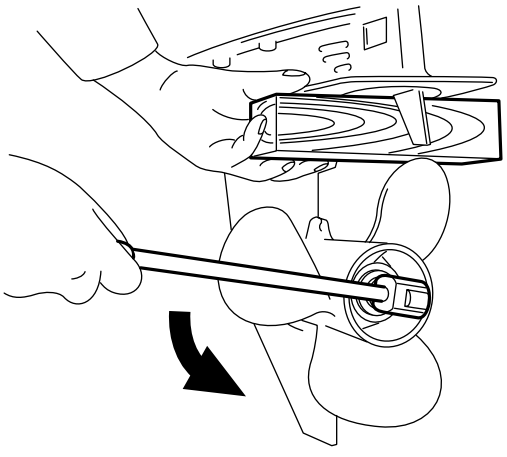
Removing the lower unit

1. Disconnect the battery cable.
2. Remove the lock plate for the engine stop switch.
3. Set the gear shift in neutral position.
4. Remove the drain screw, and the check screw to drain the gear oil.



60h30460

5. Remove the cotter pin.
6. Place a block of wood between the anti-cavitation plate and the propeller, and remove the propeller.

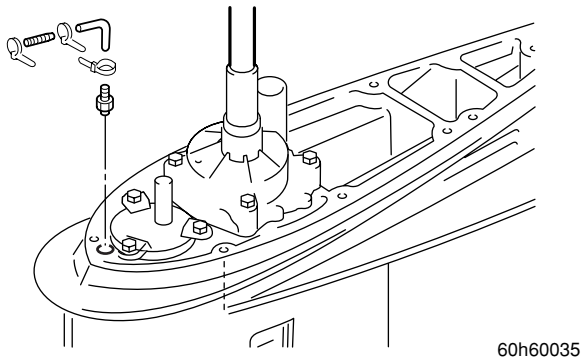


60h60030

⚠ WARNING

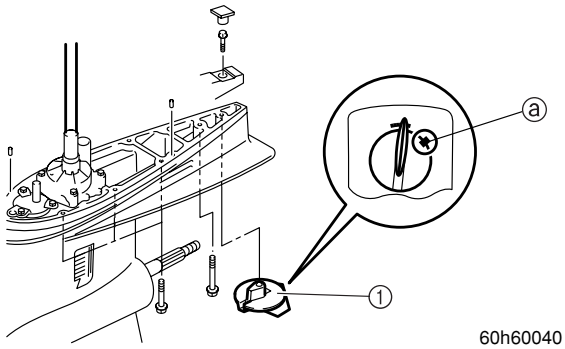
- **Place a block of wood between the anti-cavitation plate and the propeller. Do not touch the propeller with your hands.**
- **Disconnect the battery cable, and remove the lock plate for the engine stop switch to prevent the engine from starting.**

7. Disconnect the speedometer hose.



60h60035

8. Put the alignment mark ⓐ on the trim tab ① and remove it. Remove the lower unit from the upper case after loosening and removing the bolts.



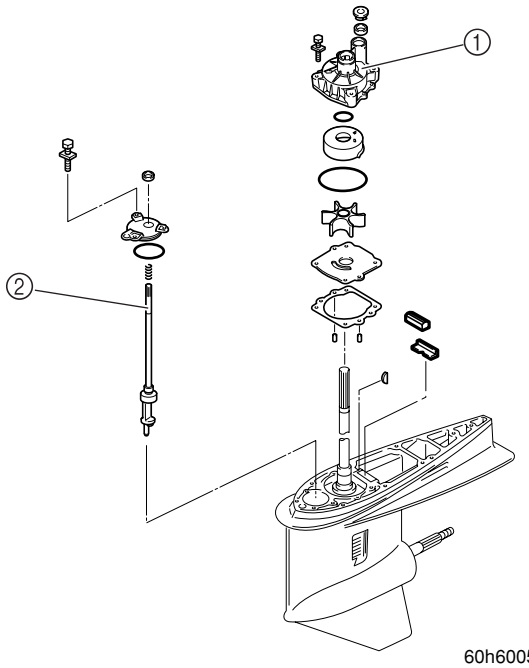
60h60040

NOTE:

Mounting bolt appears when the trim tab is removed. Make sure that the mounting bolt is removed as well.

Removing the water pump and shift rod

1. Remove the water pump ① and the shift rod ②.



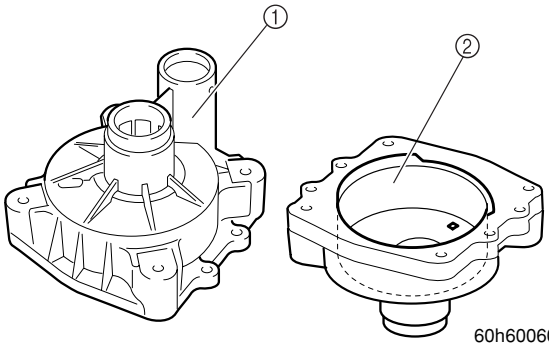
60h60050

NOTE:

- Remove the Woodruff key from the drive shaft, and then the outer plate cartridge.
- Make sure that the dowels were removed from the lower case.

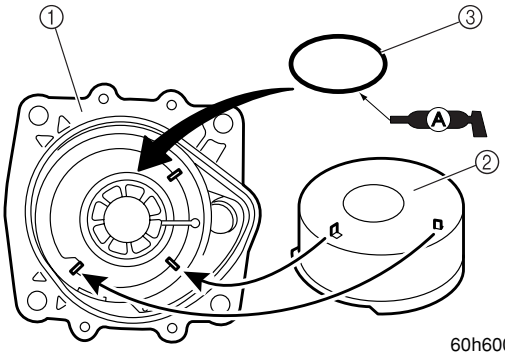
Checking the water pump and shift rod

1. Check the water pump housing ① for deformation. Also check the insert cartridge ② for wear or deformation.



60h60060

2. When the insert cartridge is removed, always replace the O-ring ③ with a new one, and insert the projection on the insert cartridge into the water pump housing hole at the time of reassembly.

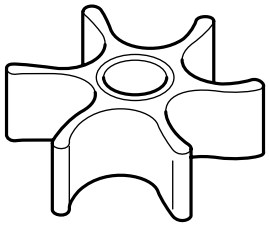


60h60070

NOTE:

When mounting the insert cartridge, apply small amount of Yamabond 4 to it, and insert the projection on the insert cartridge into the water pump housing hole.

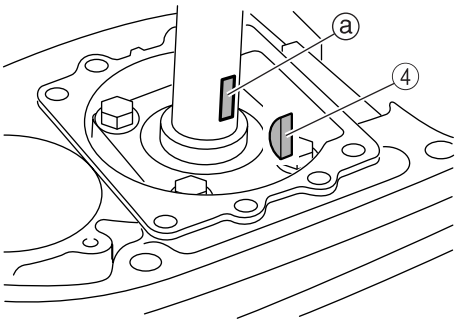
3. Check the impeller for cracks or wear. Replace if necessary.



60h60080

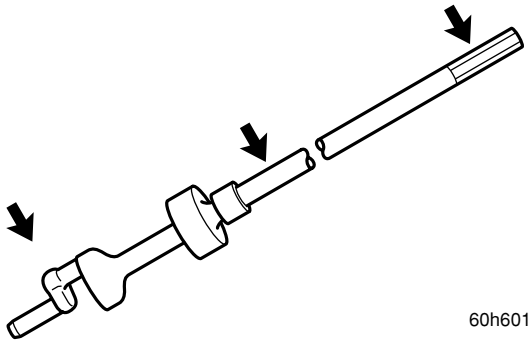
6

4. Check the Woodruff key ④ and the groove ⓐ for wear. Replace if necessary.



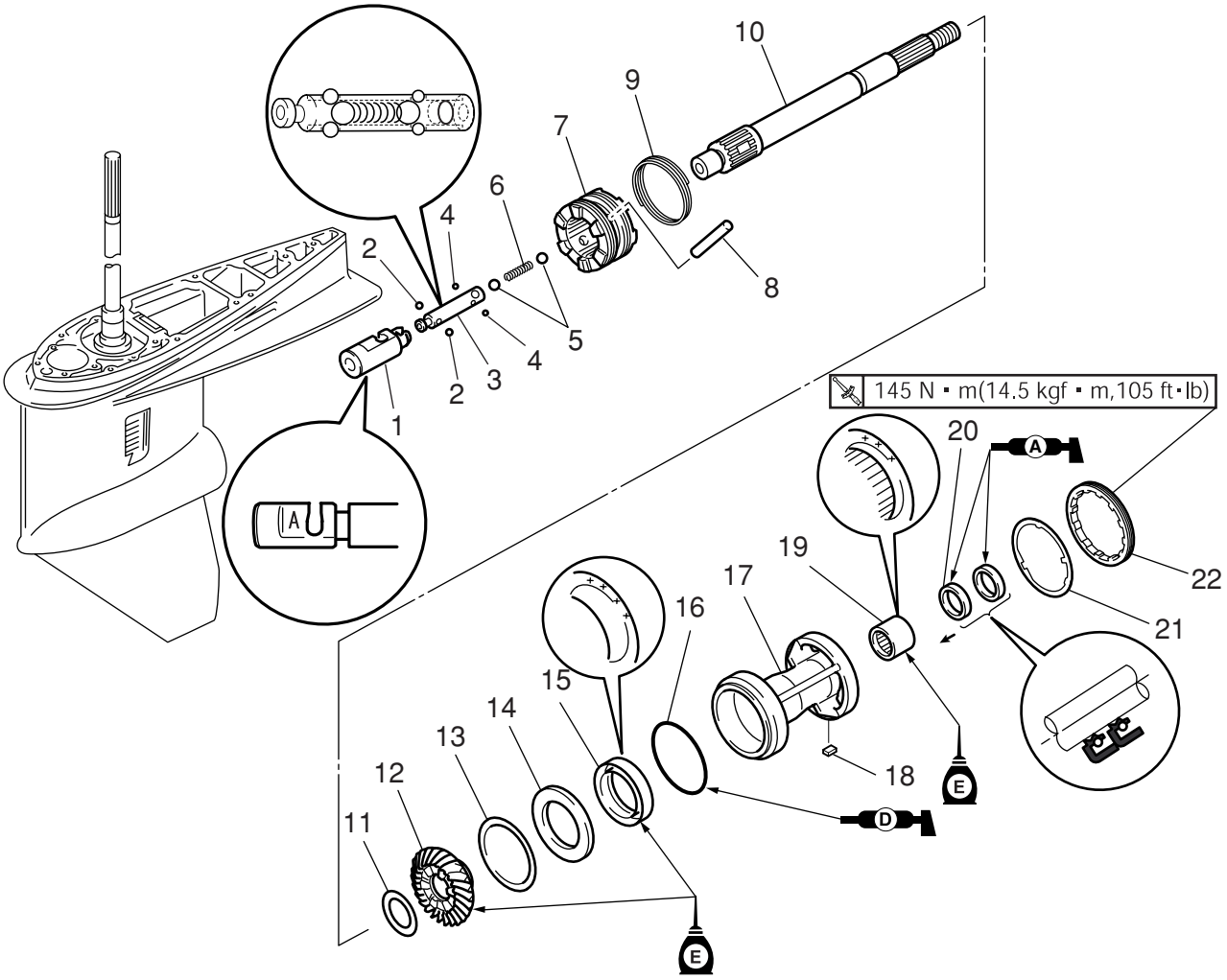
60h60090

5. Check the shift rod for deformation or wear. Replace if necessary.



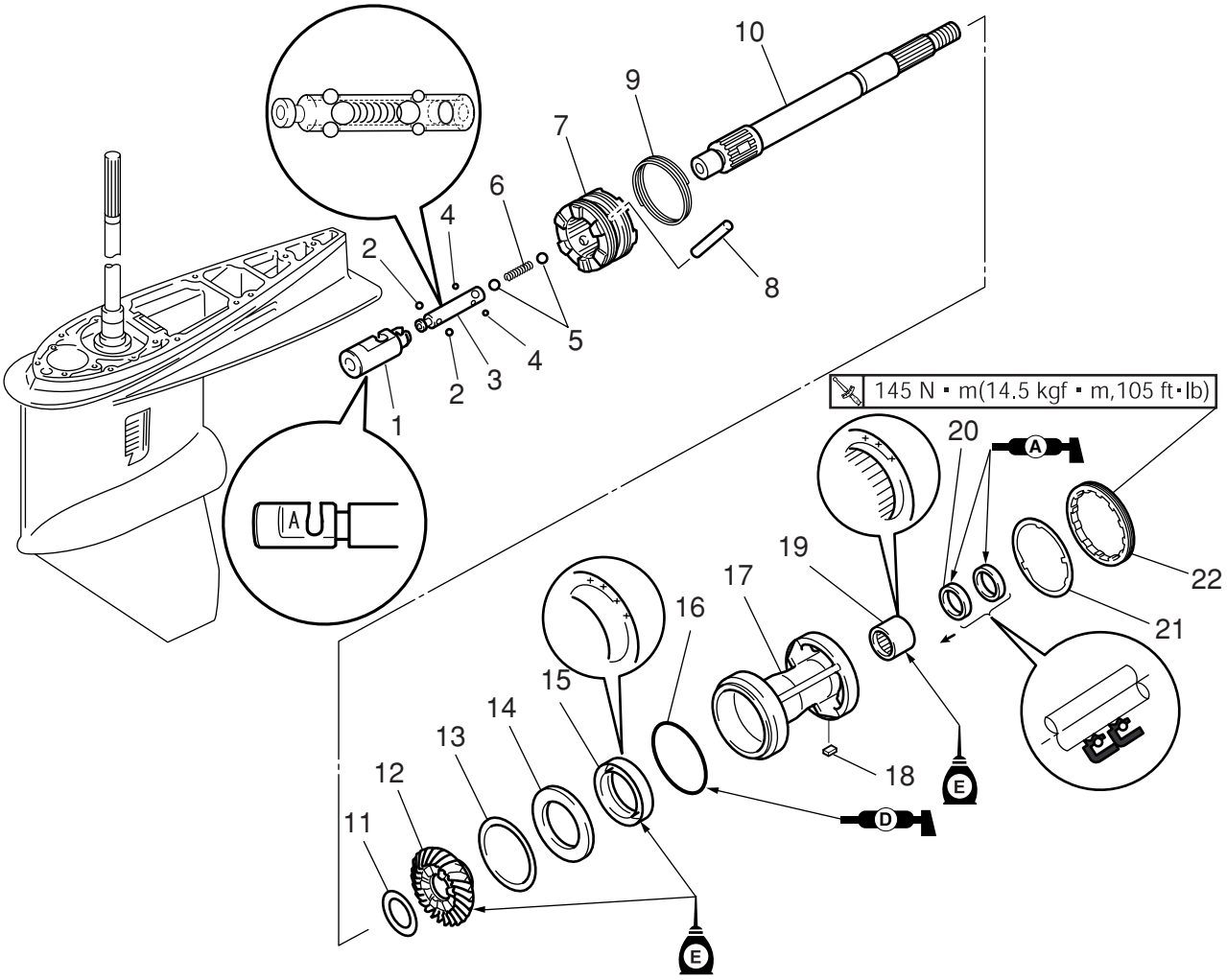
60h60100

Propeller shaft, Propeller shaft housing (regular rotation model)



60h60110

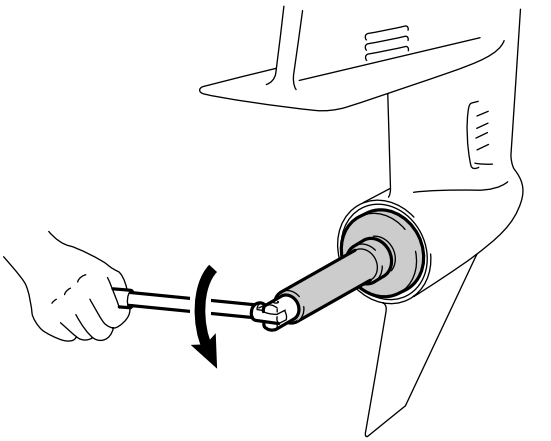
No.	Part name	Q'ty	Remarks
1	Slide shift	1	
2	Ball	2	
3	Slider	1	
4	Ball	2	
5	Ball	2	
6	Spring	1	
7	Dog clutch	1	
8	Cross pin	1	
9	Cross pin ring	1	
10	Propeller shaft	1	
11	Washer	1	
12	Reverse gear	1	
13	Reverse gear shim	*	As required
14	Thrust washer	1	
15	Ball bearing	1	Not reusable
16	O-ring	1	Not reusable
17	Propeller shaft housing	1	



No.	Part name	Q'ty	Remarks
18	Key	1	
19	Needle bearing	1	Not reusable
20	Oil seal	2	Not reusable
21	Claw washer	1	
22	Ring nut	1	

Removing the propeller shaft housing assembly.

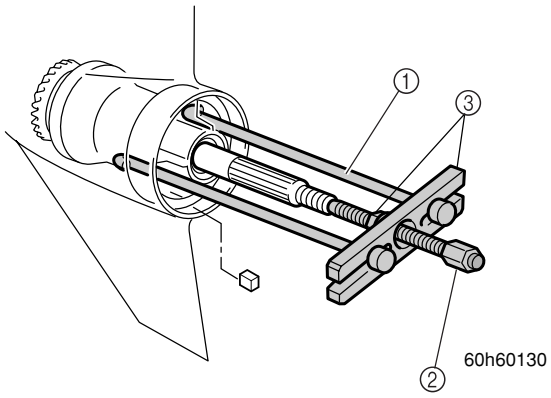
1. Pull up the claw washer tabs, and remove the ring nut.



60h60120

Ring nut wrench 4:
90890-06512
Ring nut wrench extension:
90890-06513

2. Remove the propeller shaft housing assembly, and the straight key.



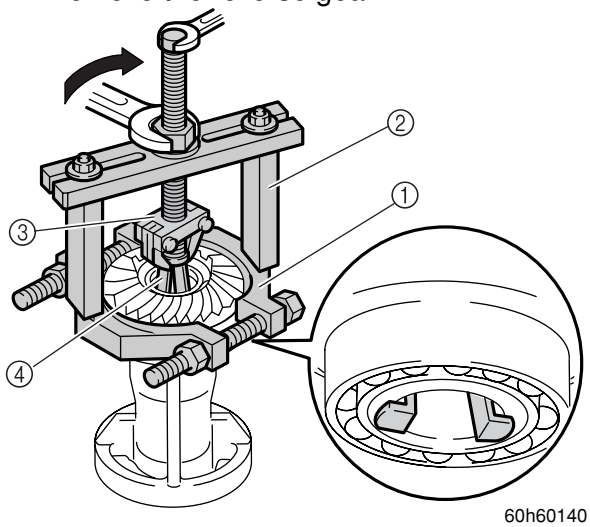
60h60130

NOTE:
Make sure that the shims left in the lower case have been removed.

Bearing housing puller claw L ①:
90890-06502
Center bolt ②:
90890-06504
Stopper guide plate ③:
90890-06501

Disassembling the propeller shaft housing assembly

1. Remove the reverse gear.



60h60140

Bearing separator ①:
90890-06534
Stopper guide stand ②:
90890-06538
Bearing puller assembly ③:
90890-06535
Bearing puller claw 1 ④:
90890-06536

NOTE:
To remove the reverse gear, squeeze-in the bearing separator between the washer plate and the reverse gear.

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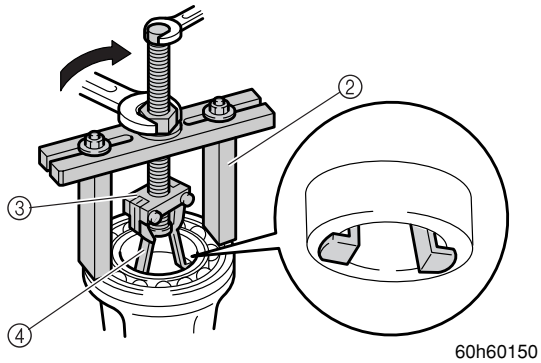
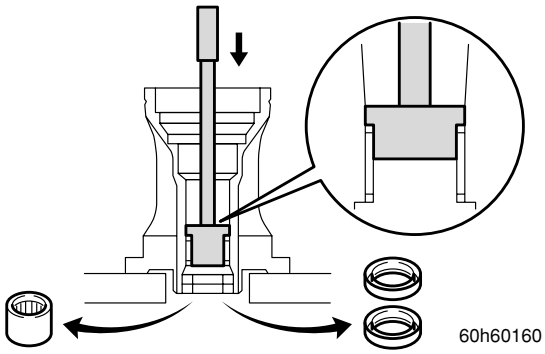
2. Remove the ball bearing.



60h60150

Stopper guide stand ②:
90890-06538
Bearing puller assembly ③:
90890-06535
Bearing puller claw 1 ④:
90890-06536

3. Remove the oil seal. Also remove the needle bearing.


60h60160

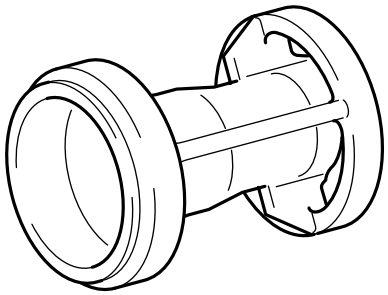
NOTE:
When the oil seal or the needle bearing is removed, always replace them with new ones.

Driver rod L3:
90890-06652
Needle bearing attachment:
90890-06653

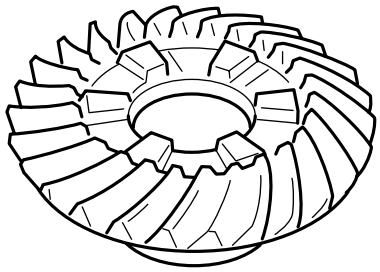
CAUTION:
Shimming is required when the reverse gear, ball bearing, or propeller shaft housing is replaced.

Checking the propeller shaft housing assembly

1. Clean the propeller shaft housing, and check it for cracks, corrosion, or damages. Replace if necessary.

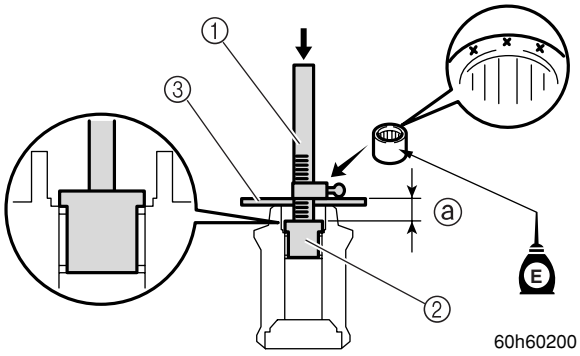

60h60170

2. Check the teeth and dogs of the reverse gear for cracks or wear. Replace the gear if necessary.


60h60180

Assembling the propeller shaft housing assembly

1. Install a new needle bearing into the propeller shaft housing to the specified depth using a press.

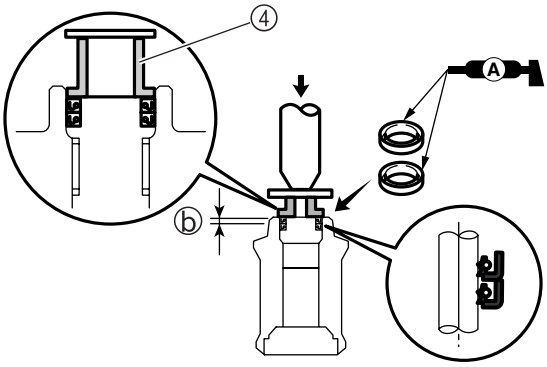


60h60200

Driver rod SS ①: 90890-06604
Needle bearing attachment ②: 90890-06610
Bearing depth plate ③: 90890-06603

Installation depth ⓐ : 24.75 - 25.25mm (0.9744 - 0.9941 in)

2. Install the new oil seals into the propeller shaft housing to the specified depth.



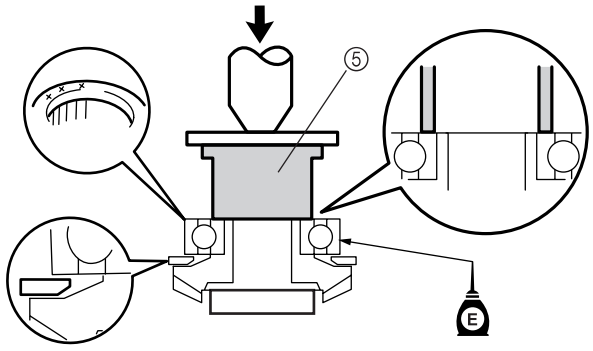
60h60210

NOTE:
First, drive-in the inner oil seal halfway into the propeller shaft housing, and then drive-in the outer oil seal to the specified depth.

Bearing inner race attachment ④: 90890-06642

Installation depth ⓑ: 4.75 - 5.25 mm (0.1870 - 0.2067 in)

3. Install the ball bearing onto the reverse gear.

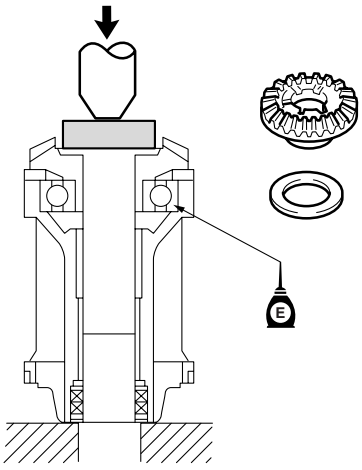


60h60220

CAUTION:
Place an appropriate plate on the dogs before using a press to prevent any damage to the gear teeth.

Bearing inner race attachment ⑤: 90890-06661

4. Install the reverse gear assembly to the propeller shaft housing.



60h60230

NOTE:
- Shimming is required when reverse gear or ball bearing is replaced.
- Place an appropriate plate on the dogs before using a press to prevent any damage to the gear teeth.

6

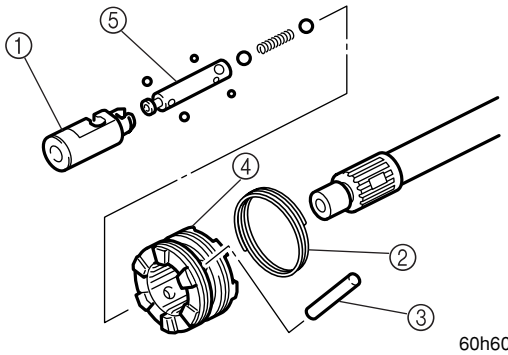
Disassembling the propeller shaft assembly

1. Remove the slide shift ①.

2. Remove the cross pin ring ②, pull out the cross pin ③, and remove the dog clutch ④.

NOTE:
Mark the dog clutch so that it will be reinstalled in correct orientation.

3. Pull out the slider assembly ⑤.

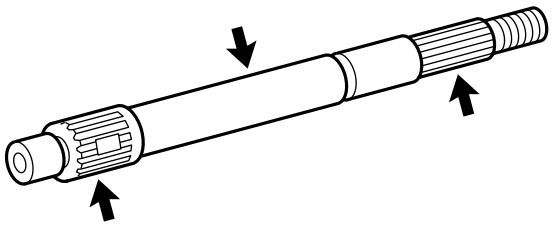


60h60250

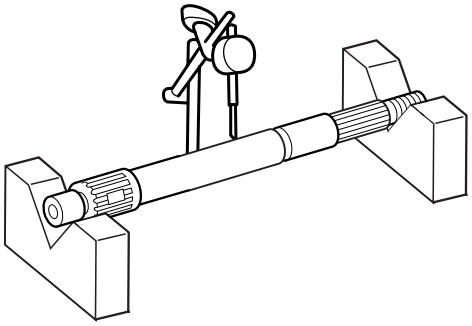
NOTE:
Take precautions so that the balls will not jump out while pulling out the slider.

Checking the propeller shaft assembly

1. Check the propeller shaft for bends for wear. Replace if necessary.

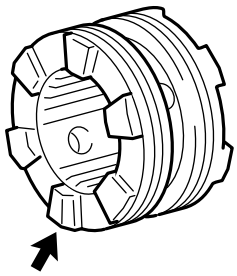

60h60260

2. Measure the propeller shaft run-out.

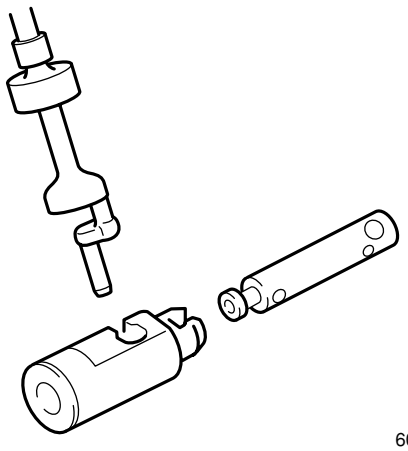

60h60265

Run-out limit: 0.05 mm (0.0020 in)

3. Check the dog clutch for breakage or wear. Replace if necessary.

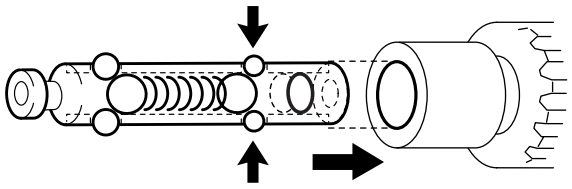

60h60270

4. Check the slide shift and the slider for wear. Replace if necessary.


60h60280

Assembling the propeller shaft assembly

1. Assemble the slider assembly.



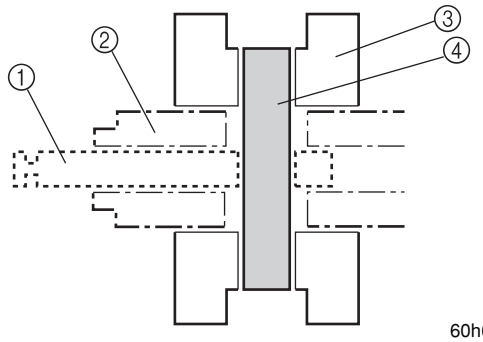
60h60290

NOTE:
It is recommended to apply grease or the like to the balls to make the assembling work easier.

2. Insert the slider assembly ① into the propeller shaft ②.

NOTE:
Make sure that the cross pin holes are aligned when inserting the slider assembly.

3. Install the dog clutch ③ in the marked orientation, and fit-in the cross pin ④.



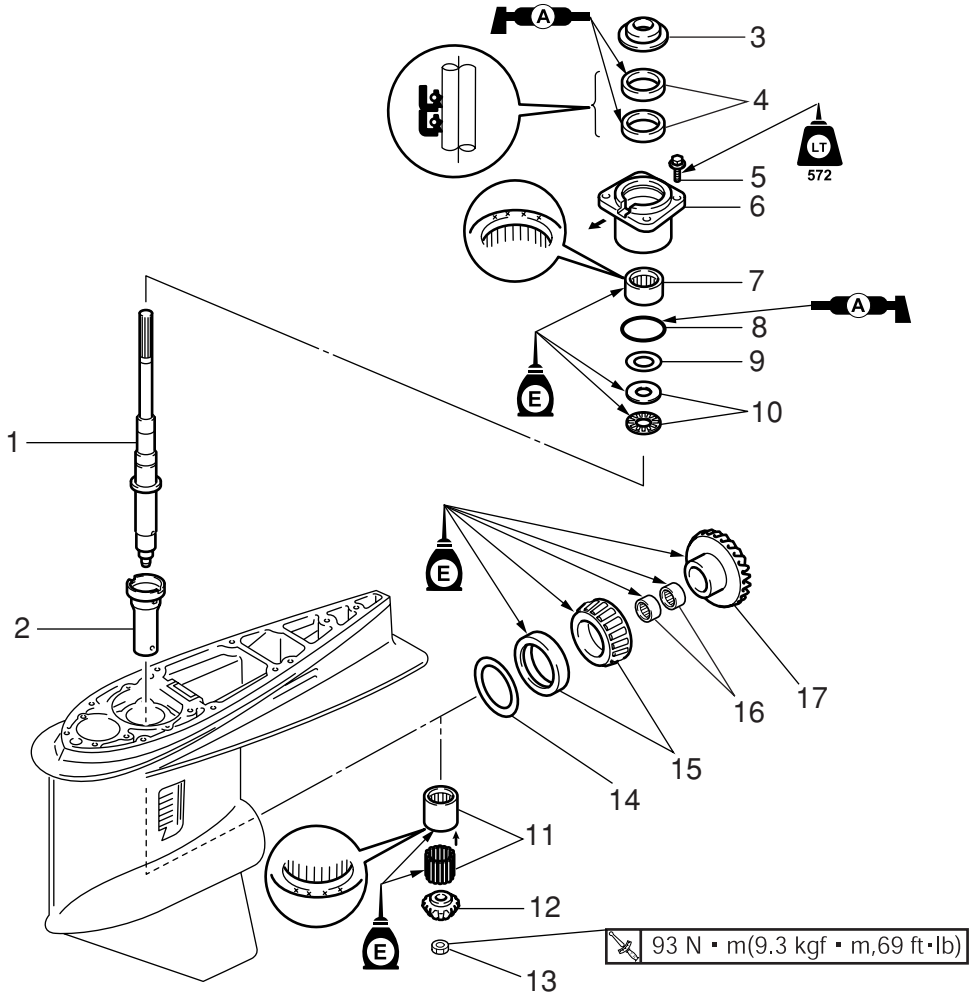
60h60295

NOTE:
A new dog clutch may be installed in either ways.

4. Install the cross pin ring.

NOTE:
Make sure that the spring is not twisted or overlaid as installed.

Drive shaft and lower case (regular rotation model)



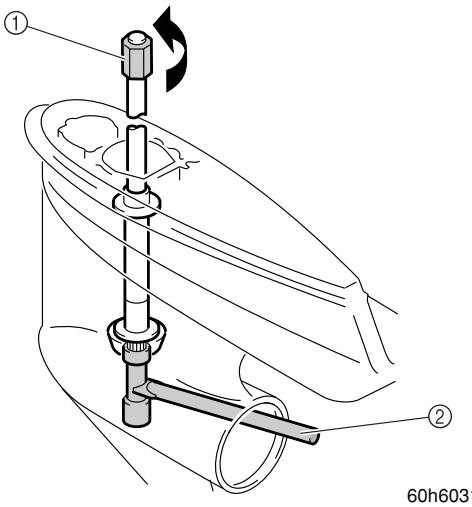
60h60300

No.	Part name	Q'ty	Remarks
1	Drive shaft	1	
2	Drive shaft sleeve	1	
3	Cover	1	Not reusable
4	Oil seal	2	Not reusable
5	Bolt	4	8 x 25mm
6	Drive shaft housing	1	
7	Needle bearing	1	
8	O-ring	1	Not reusable
9	Pinion shim	*	As required
10	Thrust bearing	1	
11	Needle bearing	1	
12	Pinion	1	
13	Nut	1	
14	Forward gear shim	1	
15	Taper roller bearing	1	Not reusable
16	Needle bearing	2	Not reusable
17	Forward gear	1	

Removing the drive shaft and forward gear

NOTE:
Shimming is required when the forward gear or taper roller bearing is replaced.

1. Loosen the pinion nut.



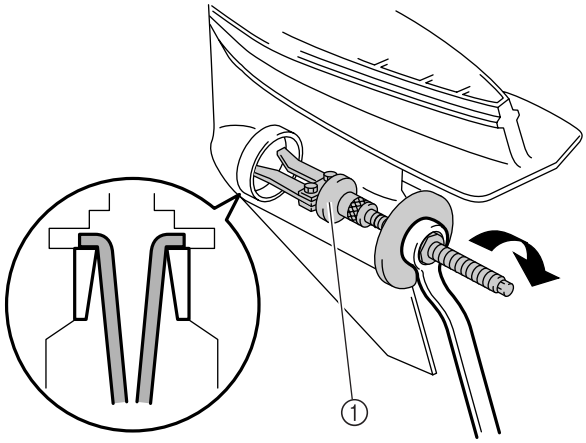
60h60310

Drive shaft holder 6 ①: 90890-06520
Pinion nut holder ②: 90890-06505
Socket adapter 3 ②: 90890-06508

2. Remove the drive shaft housing.
3. Remove the drive shaft, and then the pinion gear.
4. Remove the drive shaft sleeve.
5. Remove the forward gear.

Disassembling the lower case

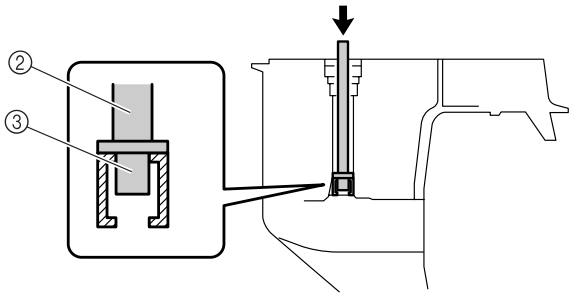
1. Remove the taper roller bearing outer race.



60h60320

Bearing outer race puller assembly ①:
90890-06523

2. Remove the needle bearing outer race.



60h60330

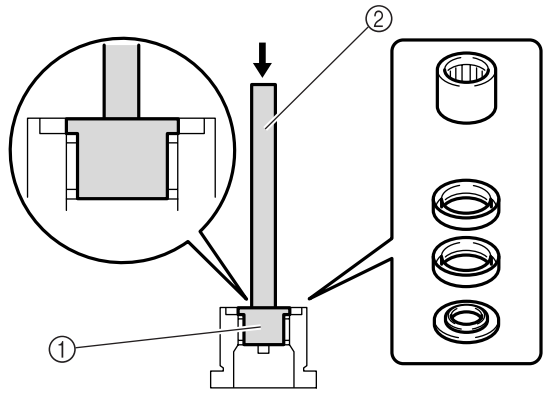
Ball bearing attachment ②:
90890-06636
Driver rod LL ③:
90890-06605

Checking the drive shaft housing

1. Check the drive shaft housing for cracks or damage. Also check the needle bearing for run-out and roughness, and the oil seals for damage. Disassemble them if necessary.

2. Remove the cover and the oil seals.

3. Remove the needle bearing.



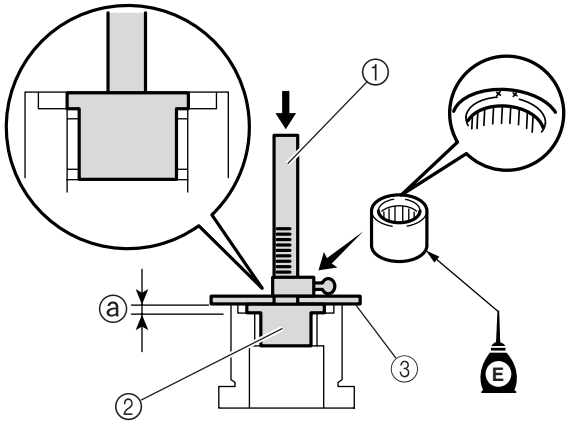
60h60340

NOTE:
When the needle bearing and oil seals are removed, always replace them with new ones.

Needle bearing attachment ①:
90890-06610
Driver rod L3 ②:
90890-06652

Assembling the drive shaft housing

1. Install the needle bearing using a press.

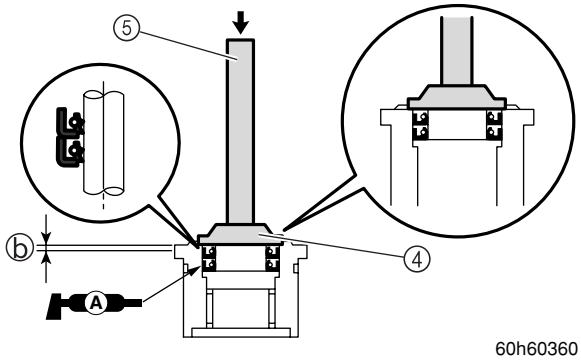


60h60350

Driver rod SS ①:
90890-06604
Needle bearing attachment ②:
90890-06610
Bearing depth plate ③:
90890-06603

Installation depth ⓐ:
5.75 - 6.25 mm (0.2264 - 0.2460 in)

2. First, drive-in the inner oil seal halfway into the drive shaft housing, and then drive-in the outer oil seal to the specified depth.



60h60360

Ball bearing attachment ④:
90890-06633
Driver rod LS ⑤:
90890-06606

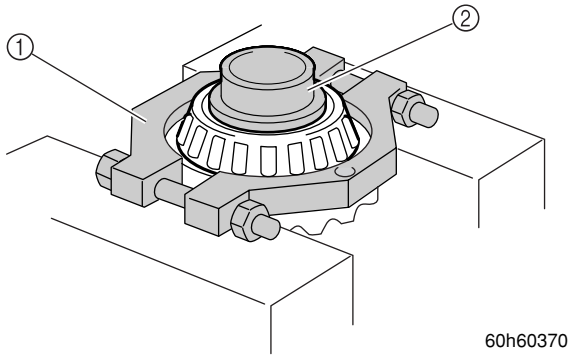
Installation depth ⓑ:
0.25 - 0.75 mm (0.0098 - 0.0295 in)

3. Install the cover.

Checking the forward gear

1. Check the teeth and dogs of the forward gear for cracks or wear. Also check the bearing for run-out or roughness. Disassemble them if necessary.

2. Remove the bearing.

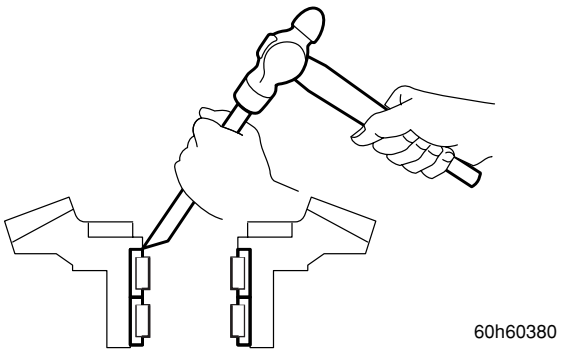


60h60370

Bearing separator ①:
90890-06534
Bearing inner race attachment ②:
90890-06639

NOTE:
When the taper roller bearing is removed, always replace it with a new one.

3. Remove the needle bearing.

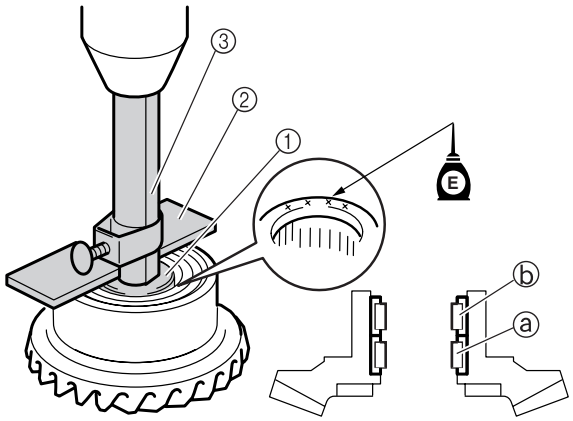


60h60380

NOTE:
When the needle bearing is removed, always replace it with a new one.

Assembling the forward gear

1. Install the needle bearing.

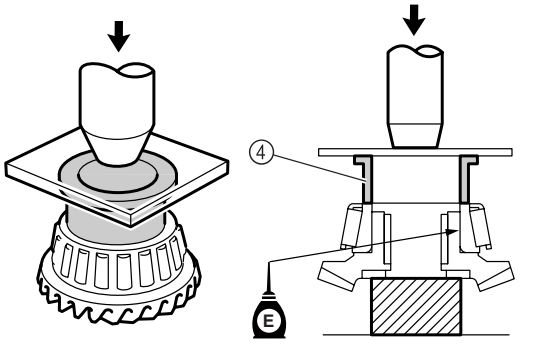


60h60390

Needle bearing attachment ①:
90890-06612
Bearing depth plate ②: 90890-06603
Driver rod SS ③: 90890-06604

Installation depth ⓐ:
20.95 - 21.45 mm(0.8248 - 0.8445 in)
Installation depth ⓑ:
4.45 - 4.95 mm (0.1752 - 0.1949 in)

2. Install a new taper roller bearing.



60h60400

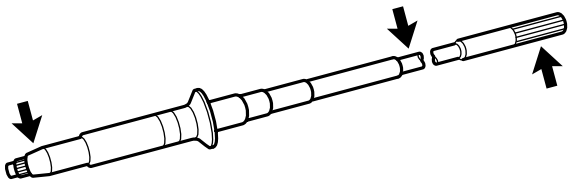
NOTE:
Shimming is required when the taper roller bearing is replaced. Record the measured height of the new taper roller bearing.

Bearing inner race attachment ④:
90890-06660

6

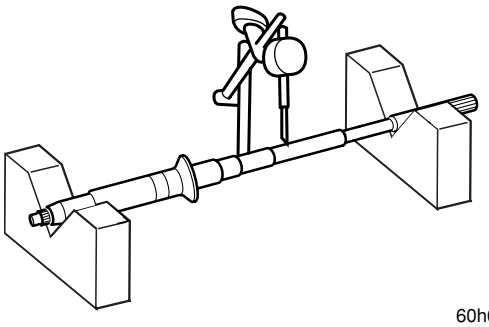
Checking the drive shaft

1. Check the drive shaft for bends or wear. Replace the shaft if necessary.



60h60410

2. Measure the drive shaft run-out.



60h60415

Run-out limit: 0.1 mm (0.0039 in)

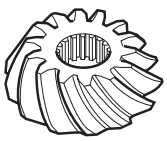
3. Check the needle bearing and the thrust bearing for run-out or roughness. Replace if necessary.

CAUTION:

Shimming is required when the thrust bearing is replaced.

Checking the pinion gear

1. Check the pinion gear teeth for cracks or wear.

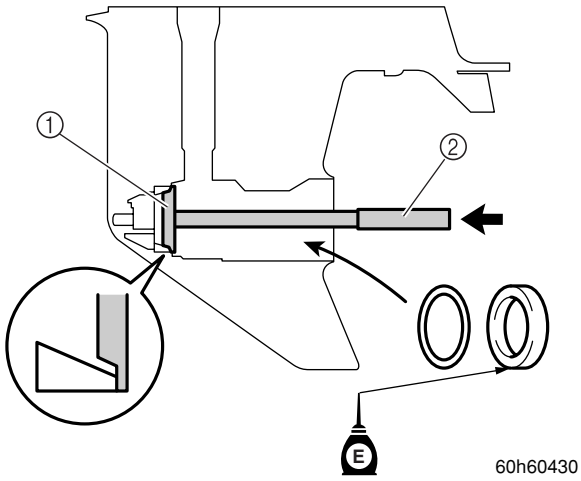


60h60420

Assembling the lower unit (regular rotation model)

Installing the lower case

1. Install the shims and the taper roller bearing outer race.



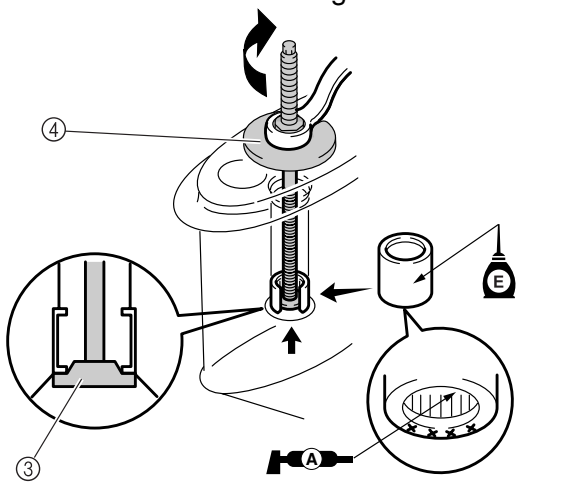
60h60430

CAUTION:

Shimming is required when the forward gear, the taper roller bearing, or the lower case is replaced. Record the measured height of the bearing.

Bearing outer race attachment ①: 90890-06619
Driver rod LL ②: 90890-06605

2. Install the needle bearing outer race



60h60440

Ball bearing attachment ③: 90890-06633
Bearing outer race puller assembly ④: 90890-06523

60H5E11

3. Install the needle bearing rollers.

NOTE:
Apply some grease on the needle bearing rollers so that they will not fall off.

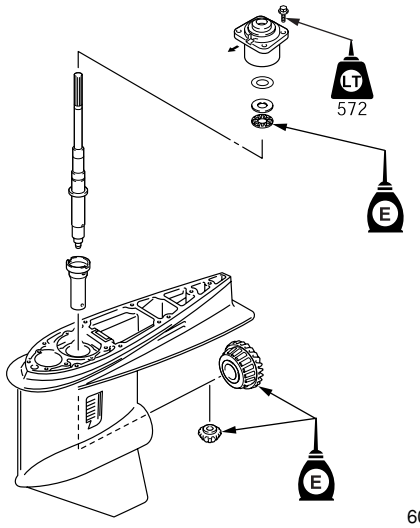
4. Install the forward gear assembly.

5. Install the drive shaft, the drive shaft sleeve, and the pinion gear. Then, temporarily tighten the nut.

CAUTION:
Shimming is required when the drive shaft housing or the drive shaft is replaced.

NOTE:
Install the drive shaft by lifting it up slightly, then aligning its splines with the pinion gear.

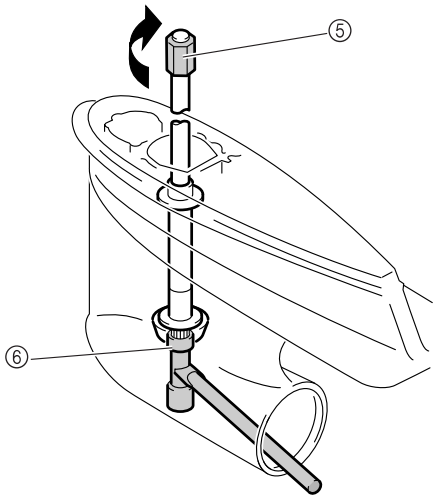
6. Insert the thrust bearing into the drive shaft, and install the drive shaft housing.



60h60450

NOTE:
Shimming is required when the thrust bearing is replaced.

7. Tighten the pinion nut.



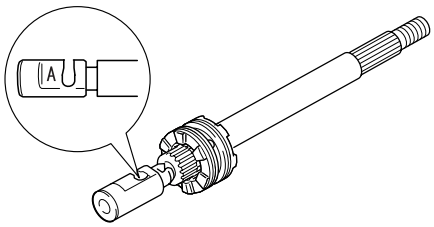
60h60460

Drive shaft holder 6 ⑤: 90890-06520
Pinion nut holder ⑥: 90890-06505
Socket adapter 3 ⑥: 90890-06508

Pinion nut:
93 N • m(9.3 kgf • m, 69 lb • ft)

8. Install the slid shift to the propeller shaft.

9. Install the propeller shaft assembly.

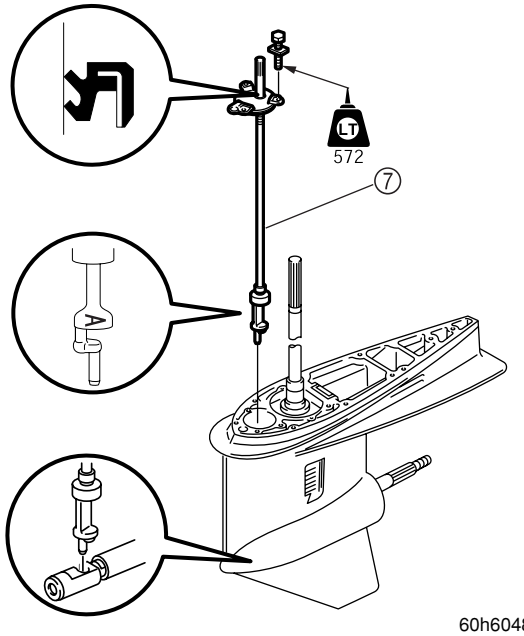


60h60475

NOTE:
- Set the dog clutch in neutral position.
- Set the shift rod joint with the stamped mark A facing upward.

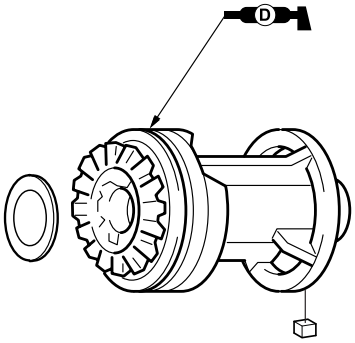
6

10. Install the shift rod ⑦ assembly, and tighten the bolt.



60h60480

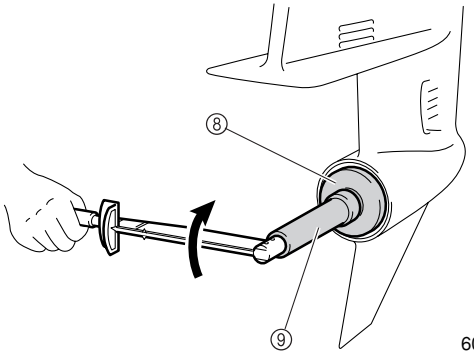
11. Install the shim(s), washer, and propeller shaft housing assembly.



60h60490

12. Align the key way, and install the key.

13. Install the claw washer, and tighten the ring nut.

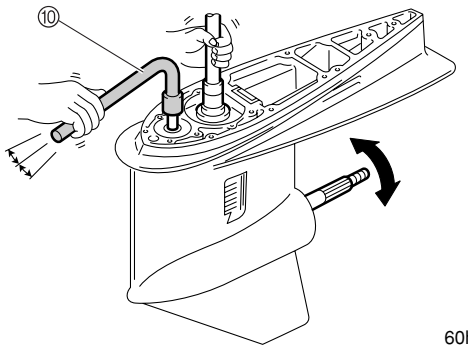


60h60500

Ring nut wrench ⑧:
90890-06512
Ring nut wrench extension ⑨:
90890-06513

Ring nut:
145 N • m (14.5 kgf • m, 105 lb • ft)

14. Make sure that the shifting mechanism works properly.



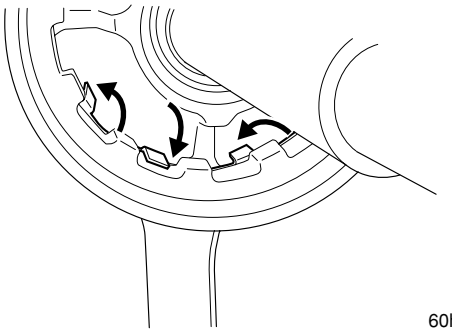
60h60510

NOTE:

Change the shift rod position to forward, to reverse, and to neutral. Make sure that propeller shaft rotating direction is correct in forward and in reverse. Also make sure that the position is correct in neutral.

Shift rod push arm ⑩:
90890-06052

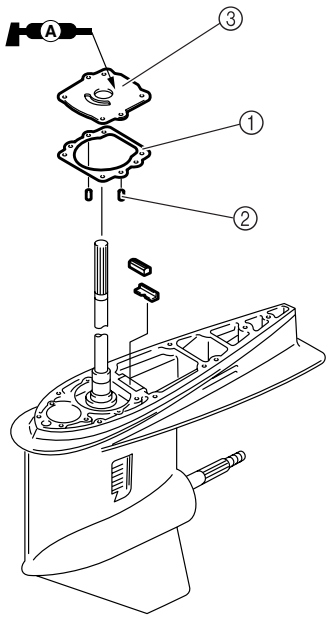
15. Bend one of the claw washer tabs toward yourself.



60h60515

Installing the water pump

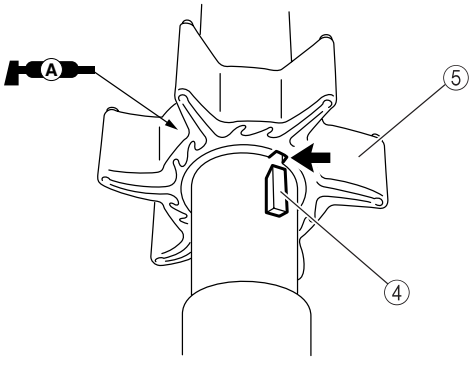
1. Install the gasket ①, the dowels ②, and the outer plate cartridge ③.



60h60520

2. Install the Woodruff key ④ into the drive shaft.

3. Install the impeller ⑤ after aligning it with the Woodruff key.

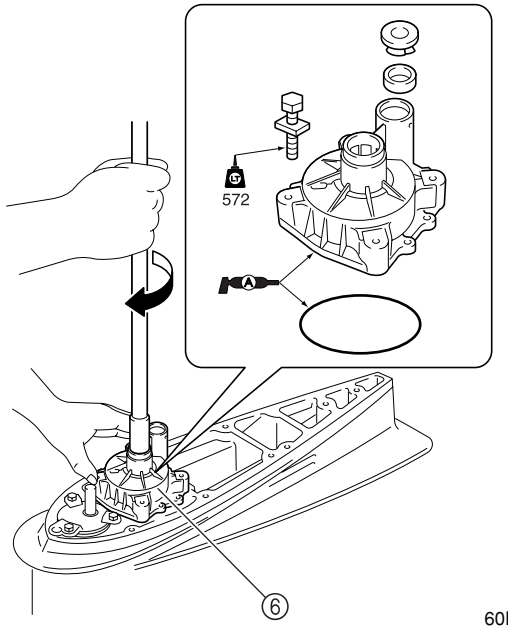


60h60530

NOTE:

- Align the groove on the impeller with the Woodruff key.
- Apply Yamaha grease A on the sliding face between the impeller and the outer plate cartridge.

4. Install the O-ring into the water pump housing assembly ⑥, and install the water pump housing on the lower case.



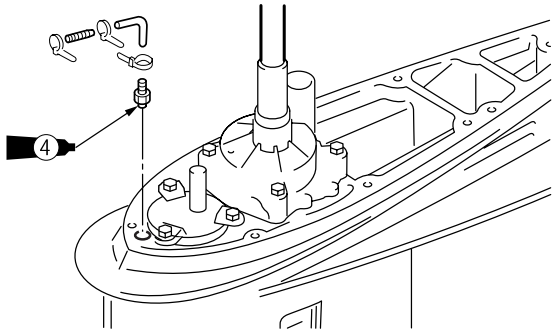
60h60540

NOTE:

To install the water pump housing, apply Yamaha grease A to the inner face of the water pump housing assembly, and then turn the drive shaft clockwise while pushing down the pump housing.

Installing the speedometer hose

1. Apply Yamabond 4 to the speedometer hose, and tighten it.

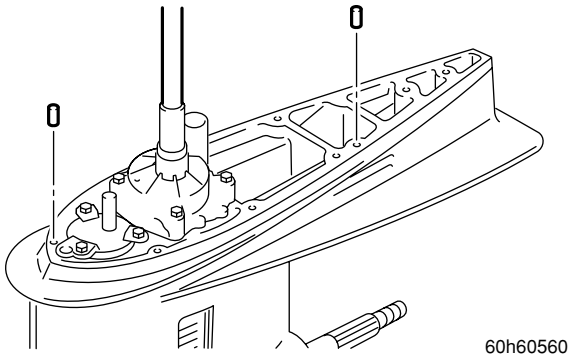


60h60550

6

Installing the lower unit

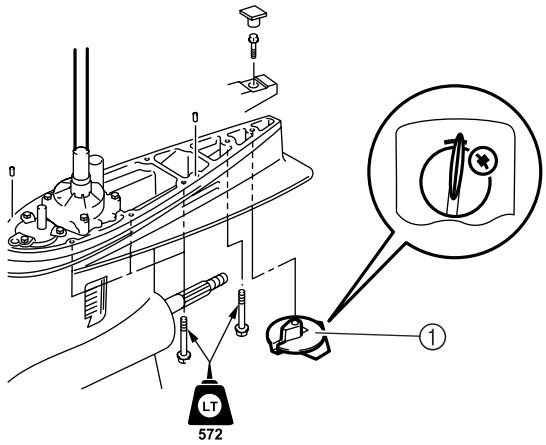
1. Install the dowels to the lower case.



60h60560

2. Make sure that the shift rod is in neutral position. Install the lower unit to the upper case, and tighten the lower case bolts to the specified torque.

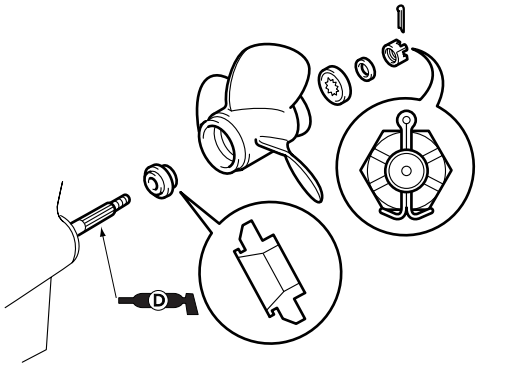
3. Install the trim tab ① to its original position, and tighten the trim tab bolt to the specified torque.



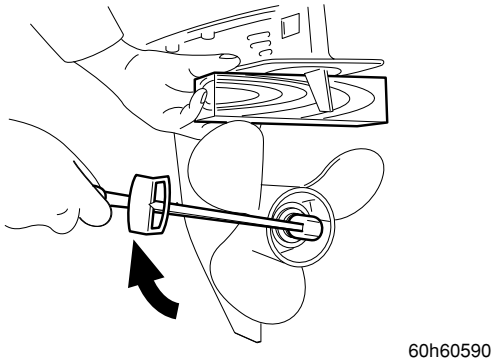
60h60570

Lower case bolt:
39 N • m(3.9 kgf • m, 29 lb • ft)
Trim tab bolt:
39 N • m(3.9 kgf • m, 29 lb • ft)

4. Install the propeller and the propeller nut. Place a block of wood between the anti-cavitation plate and the propeller to keep the propeller from turning. Then, tighten the nut to the specified torque.



60h60580



60h60590

⚠ WARNING

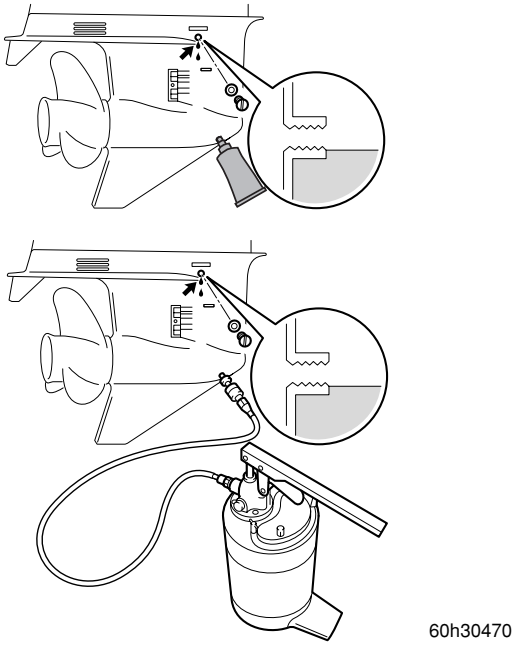
- **Place a block of wood between the anti-cavitation plate and the propeller. Do not touch the propeller with your hands.**
- **Disconnect the battery cable, and remove the lock plate for the engine stop switch, to prevent the engine from starting.**

NOTE:

If the grooves in the propeller nut do not align with the cotter pin hole, tighten the nut further until they are aligned.

Propeller nut:
54 N • m(5.4 kgf • m, 40 lb • ft)

5. Insert the gear oil tube or gear oil pump into the drain hole and fill the gear oil until it flows out of the check hole and no air bubbles are visible.

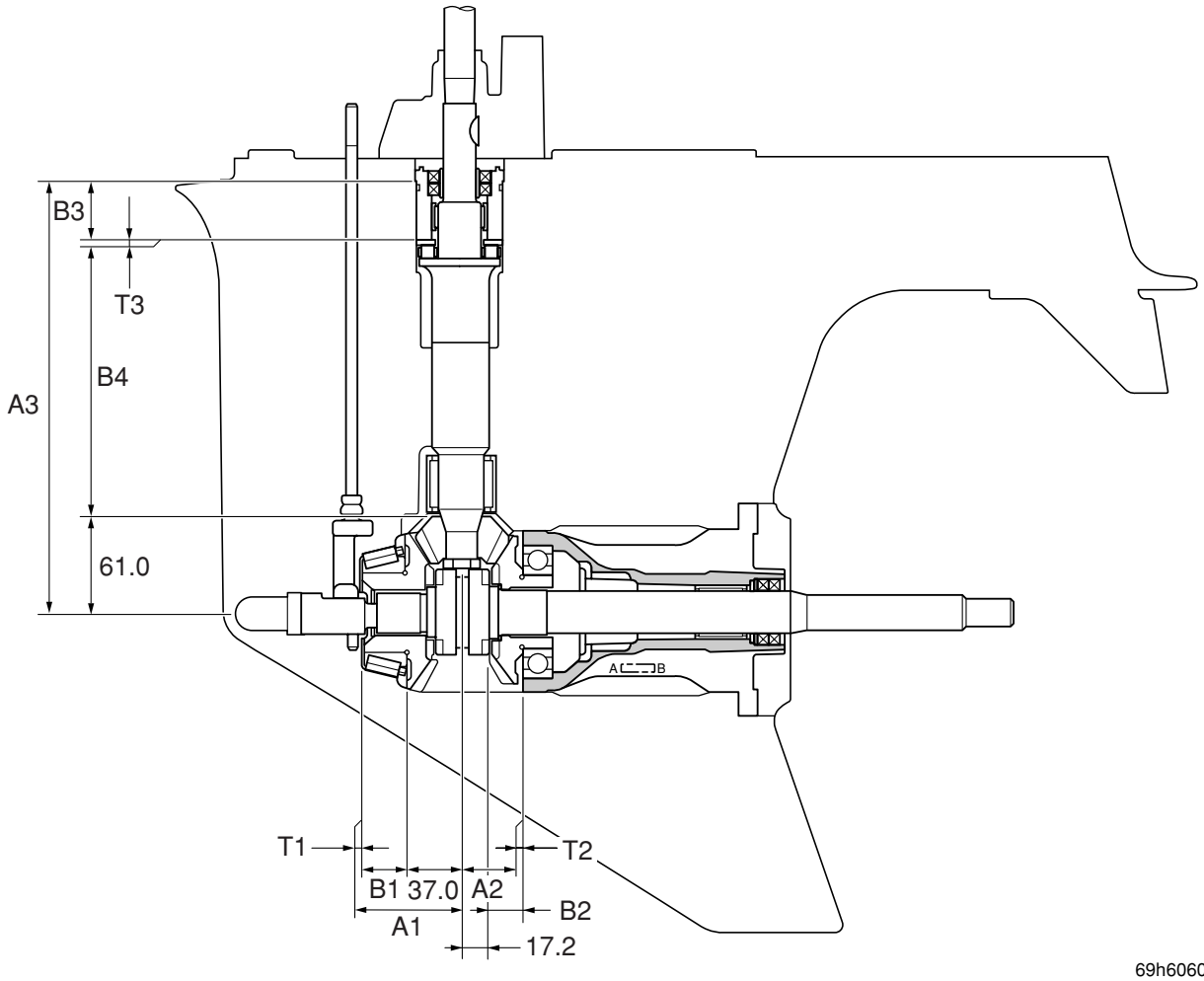


60h30470

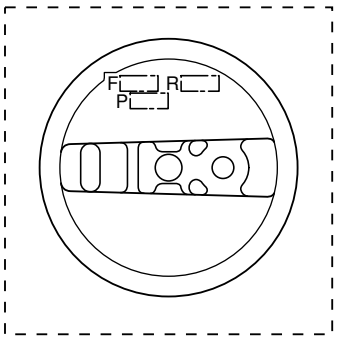
Recommended gear oil:
Hypoid gear oil
SAE: 90
Oil quantity:
Regular rotation model:
980 cm^3 (34.5 lmp oz)

6. Install the check screw, and quickly install the drain screw.

Shimming (regular rotation model)



69h60600



69h60605

Shimming

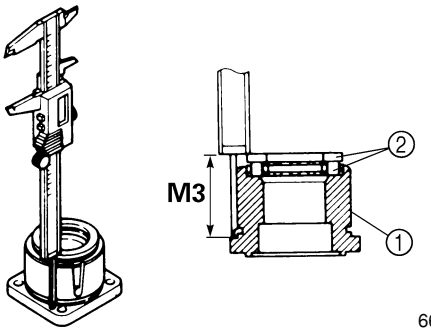
NOTE:
- Shimming is not required when the original lower case and inner parts are reused for the lower unit reassembly.
- Shimming is required if either the lower case or the assembly parts are replaced for the lower unit reassembly.

Selecting the pinion shims

NOTE:
Obtain the pinion shim thickness (T3) by using the specified measurement(s) and the calculation formula.

Calculation formula:
Pinion shim thickness
(T3)= 80.00 + P/100 – M3 – M4

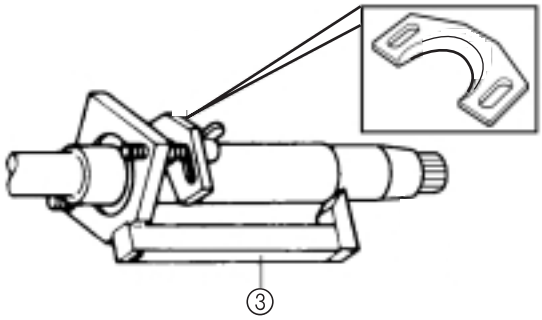
1. Measure the drive shaft housing ① and thrust washer ② height (M3) .



66h60610

NOTE:
- Install the thrust washer on the drive shaft housing, and turn the washer two or three times to make it seated properly.
- Take measurements at three points on the thrust bearing, and obtain the average.

2. Install the pinion height gauge to the drive shaft, and measure the distance between the pinion height gauge and the pinion.



60H60620

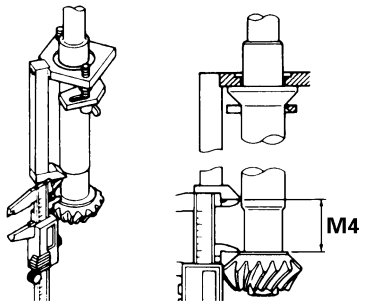
NOTE:
- Install the drive shaft in the center of the pinion height gauge.
- Tighten the wing nuts another 1/4 of a turn after they come in contact with the pinion height gauge plate.

Pinion gear nut:
93 N • m (9.3 kgf • m, 69 lb • ft)

Drive shaft holder 6: 90890-06520
Pinion height gauge ③: 90890-06710
Digital caliper: 90890-06704

3. Install the pinion gear to the drive shaft, and tighten the pinion gear nut to the specified torque.

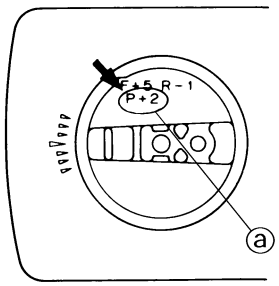
4. Measure the distance between the pinion height gauge and the pinion gear (M4).



S69j6605

6

5. Calculate the lower case standard(P/100).

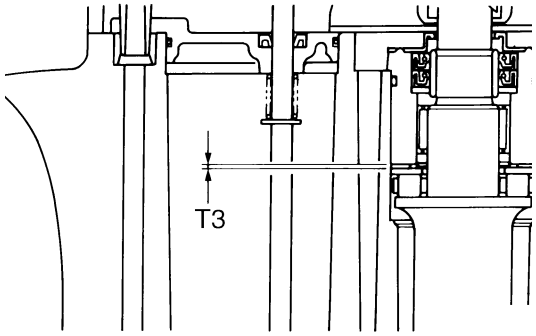


S69j6555

NOTE:

- "P" ⓐ stamped on the trim tab mounting face refers to the deviation of the lower case dimension from the standard. The numeral is in 1/100mm.
- If the numeral is unknown, assume that "P" is zero, and check the backlash when the unit is assembled. Readjustment shall be wade if the measured backlash is out of specification.

6. Calculate the pinion shim thickness.



S69j6565

Calculation formula:
Pinion shim thickness
(T3) = 80.00 + P/100 – M3 – M4

Example:

If "M3"= 46.85, "M4"= 32.52, and "P"= –5, then :

T3 = 80.00 + (–5/100) – 46.85 – 32.52
= 80.00 – 0.05 – 46.85 – 32.52
= 0.58

7. Select the pinion shim(s) as follows.

Calculated numeral at 1/100 place	Rounded numeral
1,2	0
3,4,5	2
6,7,8	5
9,10	8

Available shim thickness:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50

Example:

If "T3" is 0.58mm, then the pinion shim is 0.55 mm.

If “T3” is 0.70mm, then the pinion shim is 0.68 mm.

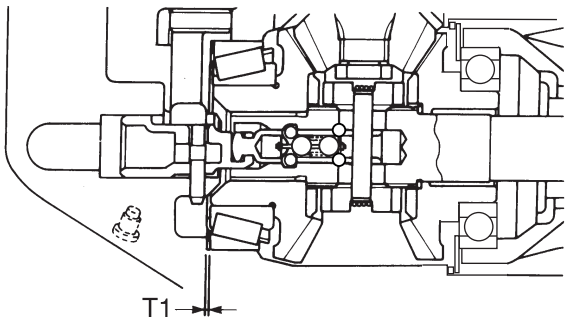
Selecting the forward gear shims

NOTE:

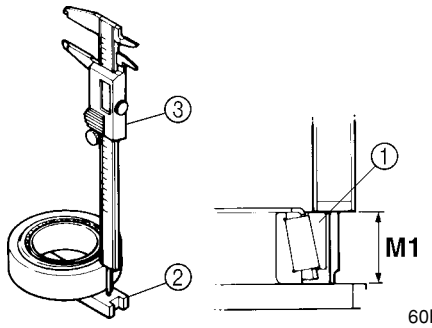
Obtain the forward gear shim thickness (T1) by using the specified measurement(s) and the calculation formula.

Calculation formula:
Forward gear shim thickness
(T1) = 28.60 + F/100 - M1

1. Measure the roller bearing height (M1).



60h60638



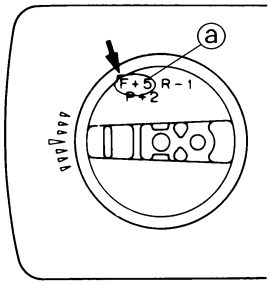
60H60640

NOTE:

- Turn the taper roller bearing outer race ① two or three times to make it seated properly.
- Take measurement at three points on the taper roller bearing, and obtain the average.

Shimming plate ②: 90890-06701
Digital caliper ③: 90890-06704

2. Calculate the lower case standard(F/100).



S69J6570

NOTE:
- "F" ⓐ stamped on the trim tab mounting face refers to the deviation of the lower case dimension from the standard. The numeral is in 1/100 mm.
- If the numeral is unknown, assume that "F" is zero, and check the backlash when the unit is assembled. Readjustment shall be made if the backlash is out of specification.

3. Calculate the forward gear shim thickness.

Calculation formula:
Forward gear shim thickness
(T1) = 28.60 + F/100 - M1

Example:
If "M1" = 28.00, and "F" = –5, then :
T1 = 28.60 + (–5/100) – 28.00
= 28.60 – 0.05 – 28.00
= 0.55

4. Select the forward gear shim(s) as follows.

Calculated numeral at 1/100 place	Rounded numeral
1,2	0
3,4,5	2
6,7,8	5
9,10	8

Available shim thickness:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50

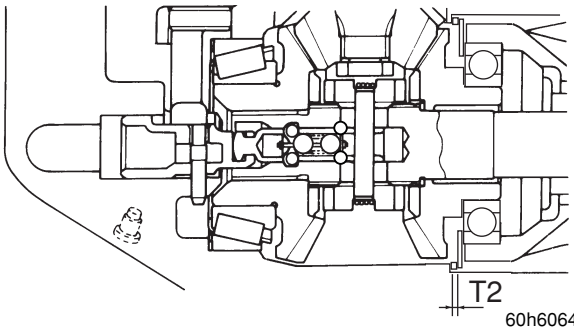
Example:
If "T1" is 0.55 mm, then the forward gear shim is 0.52 mm.
If "T1" is 0.60 mm, then the forward gear shim is 0.58 mm.

Selecting the reverse gear shims

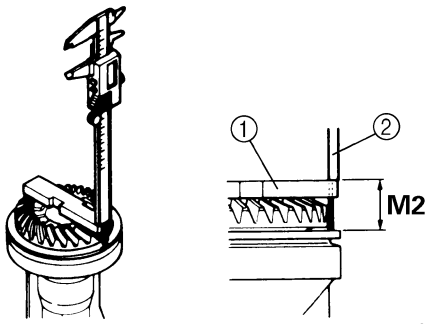
NOTE:
Obtain the reverse gear shim thickness (T2) by using the specified measurement(s) and the calculation formula.

Calculation formula:
Reverse gear shim thickness
(T2) = M2 - 29.00 - R/100

1. Measure the reverse gear shim height (M2) from the thrust washer on the propeller shaft housing.



60h60648

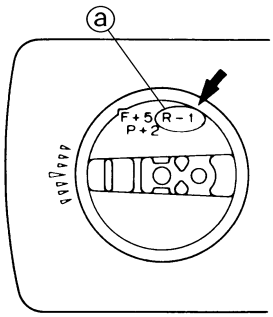


60h60650

NOTE:
Take measurements at three points on the reverse gear, and obtain the average.

Shimming plate ①: 90890-06701
Digital caliper ②: 90890-06704

2. Calculate the lower case standard(R/100).



S69j6585

NOTE:
- "R" ⓐ stamped on the trim tab mounting face refers to the deviation of the lower case dimension from the standard. The numeral is in 1/100mm.
- If the numeral is unknown, assume that "R" is zero, and check the backlash when the unit is assembled. Readjustment shall be made if the backlash is out of specification.

3. Calculate the reverse gear shim thickness.

Calculation formula:
Reverse gear shim thickness
(T2) = M2 - 29.00 - R/100

Example:
If "M2"= 30.50, and "R"= –5, then :
T2 = 30.50 – 29.00 – (–5/100)
= 30.50 – 29.00 + 0.05
= 1.45

4. Select the reverse gear shim(s) as follows.

Calculated numeral at 1/100 place	Rounded numeral
1,2	0
3,4,5	2
6,7,8	5
9,10	8

Available shim thickness:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50

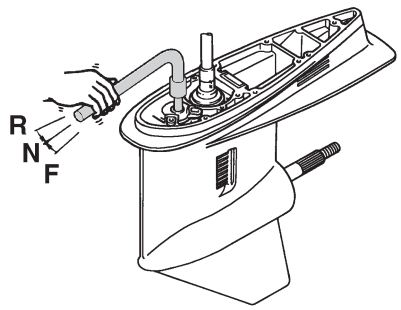
Example:
If "T2" is 1.16mm, then the reverse gear shim is 1.15 mm.
If "T2" is 1.20mm, then the reverse gear shims is 1.18 mm.

Backlash (regular rotation model)

NOTE:
- Measure the backlash before installing the water pump.
- Set the gear shift in neutral position for the measurement.
- Measure the backlash for both forward and reverse gears.

Measuring the forward and reverse gear backlash

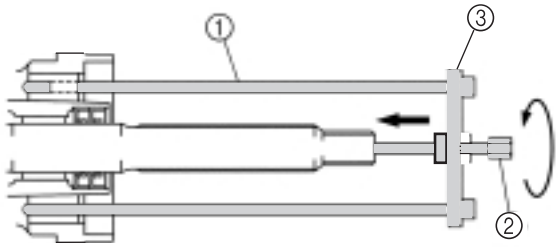
1. Set the gear shift in neutral.



S69j6635

Shift rod push arm: 90890-06052

2. Secure the propeller shaft by pressing it by the special tool.



60h60660

NOTE:
Tighten the center bolt to the specified torque.

Center bolt ②:
5 N • m (0.5 kgf • m, 4 ft • lb)

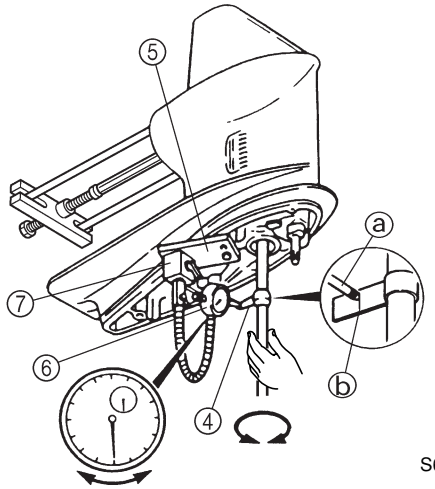
Bearing housing puller claw L ①:
90890-6502
Center bolt ②: 90890-06504
Stopper guide plate ③: 90890-06501

3. Install the backlash indicator onto the drive shaft.

NOTE:
Backlash indicator shall be installed at practicably the closest position to the lower housing.

Backlash indicator ④: 90890-06706

4. Set the dial gauge onto the lower unit, and fix it where the dial gauge plunger contacts the mark ⓑ on the backlash indicator ⓐ.

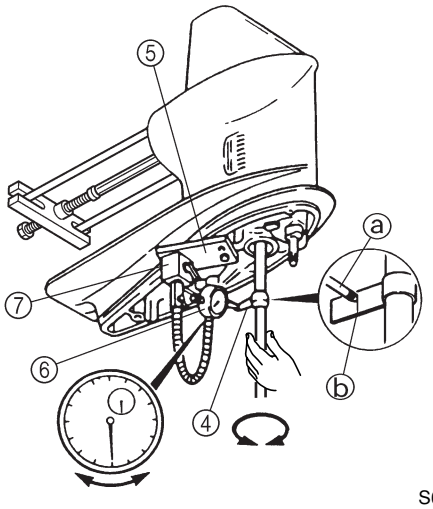


S69J6655

Magnet base plate ⑤: 90890-07003
Dial gauge set ⑥: 90890-01252
Magnet base ⑦: 90890-06705

5. Set the lower unit upside down.

6. Slowly turn the drive shaft clockwise and counterclockwise, and measure the backlash based on the dial gauge readings taken at the points where the drive shaft stops in each direction.



S69J6655

NOTE:
While checking, turn the drive shaft lightly without applying too much force.

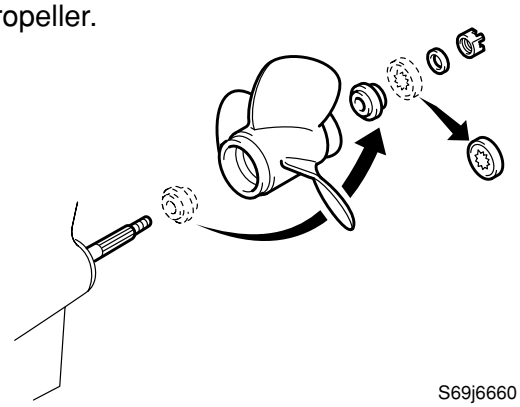
Forward gear backlash:
0.25 - 0.46 mm
(0.0098 - 0.0181 in)

Forward gear backlash M	Shim thickness(mm)
Less than 0.25 mm (0.0098 in)	To be decreased by (0.36-M) x 0.72
More than 0.46 mm (0.0181 in)	To be increased by (M-0.36) x 0.72

Available shim thickness:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50

6

7. Remove the special service tools, and secure the propeller shaft by pulling it by the propeller.

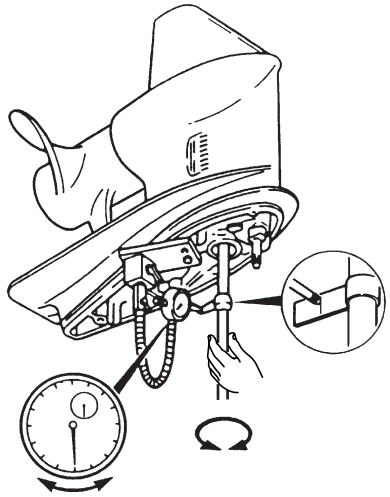


S69j6660

Propeller nut:
5 N • m (0.5 kgf • m, 4 ft • lb)

NOTE:
- Install a spacer at the back of the propeller, and tighten the propeller nut until the drive shaft does not turn any further.
- Do not install the washer.

8. Slowly turn the drive shaft clockwise and counterclockwise, and measure the backlash based on the dial gauge readings taken at the points where the drive shaft stops in each direction. Add or remove the reverse gear shim(s) if necessary.



60H60680

NOTE:
While checking, turn the drive shaft lightly without applying too much force.

Reverse gear backlash:
0.74-1.29 mm (0.0291 - 0.0508 in)

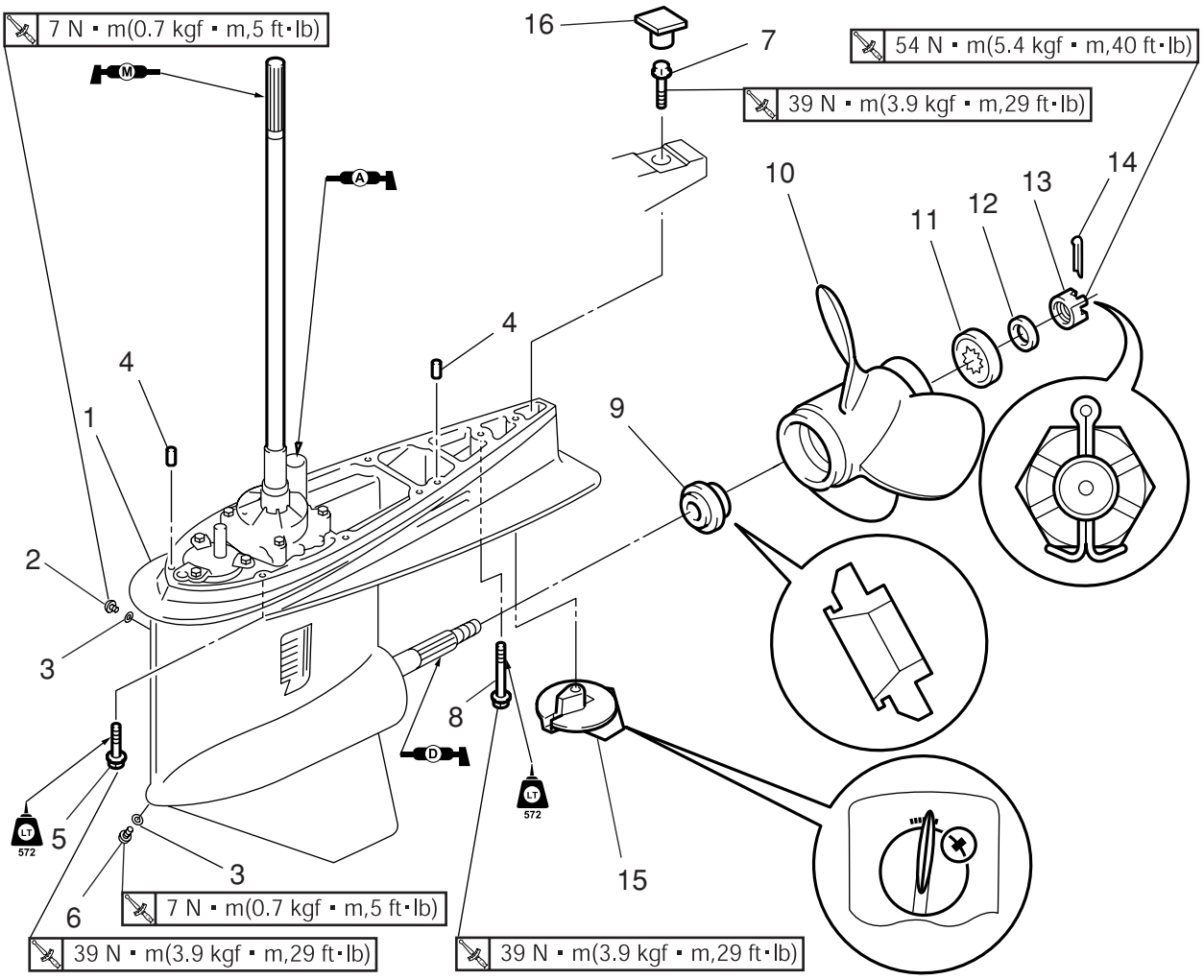
Reverse gear backlash M	Shim thickness(mm)
Less than 0.74 mm (0.0291 in)	To be decreased by (1.02-M) x 0.72
More than 1.29 mm (0.0508 in)	To be increased by (M-1.02) x 0.72

M: Measurement

Available shim thickness:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50

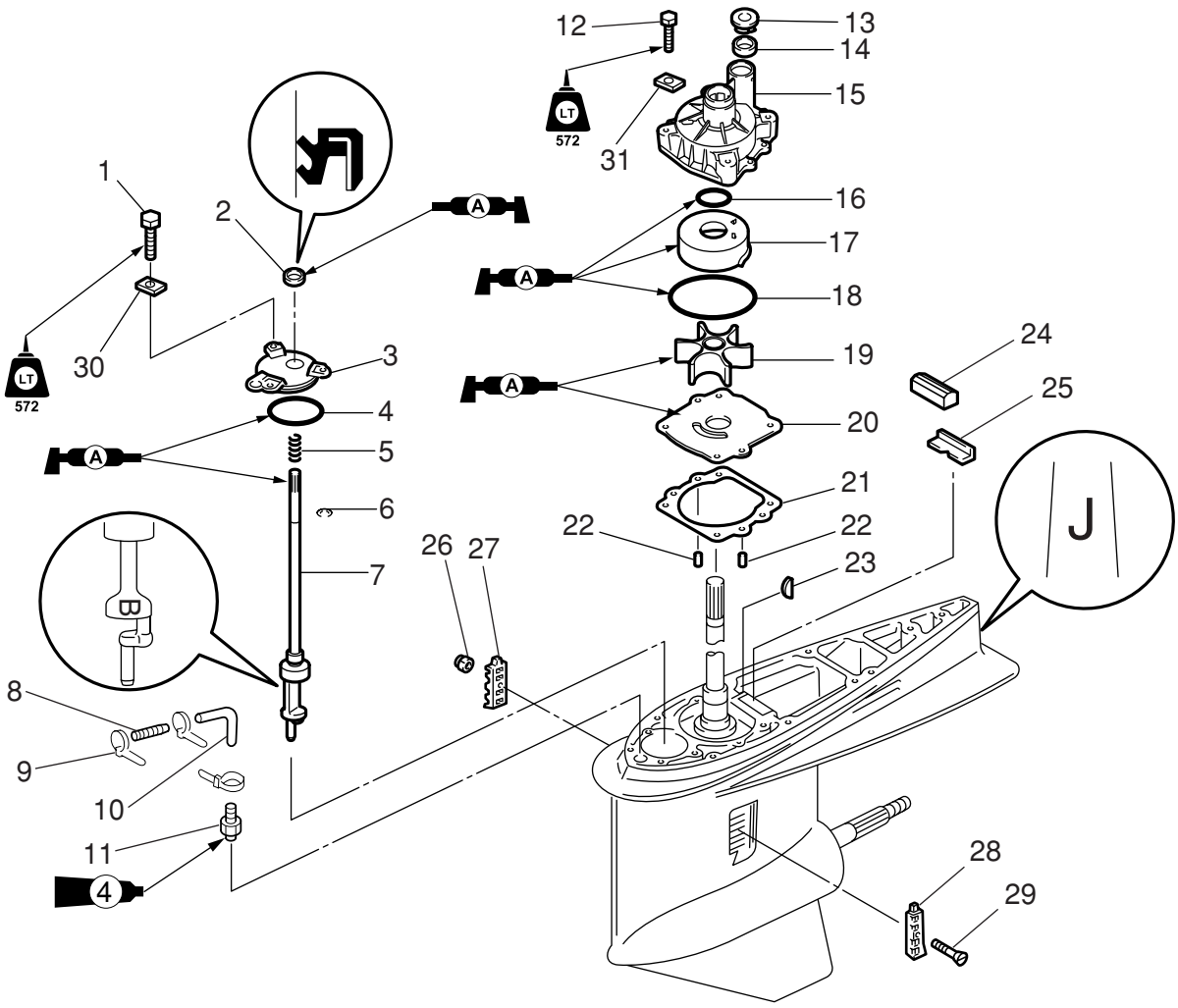
9. Remove all the special service tools, and install the water pump.

Lower unit (counter rotation model)



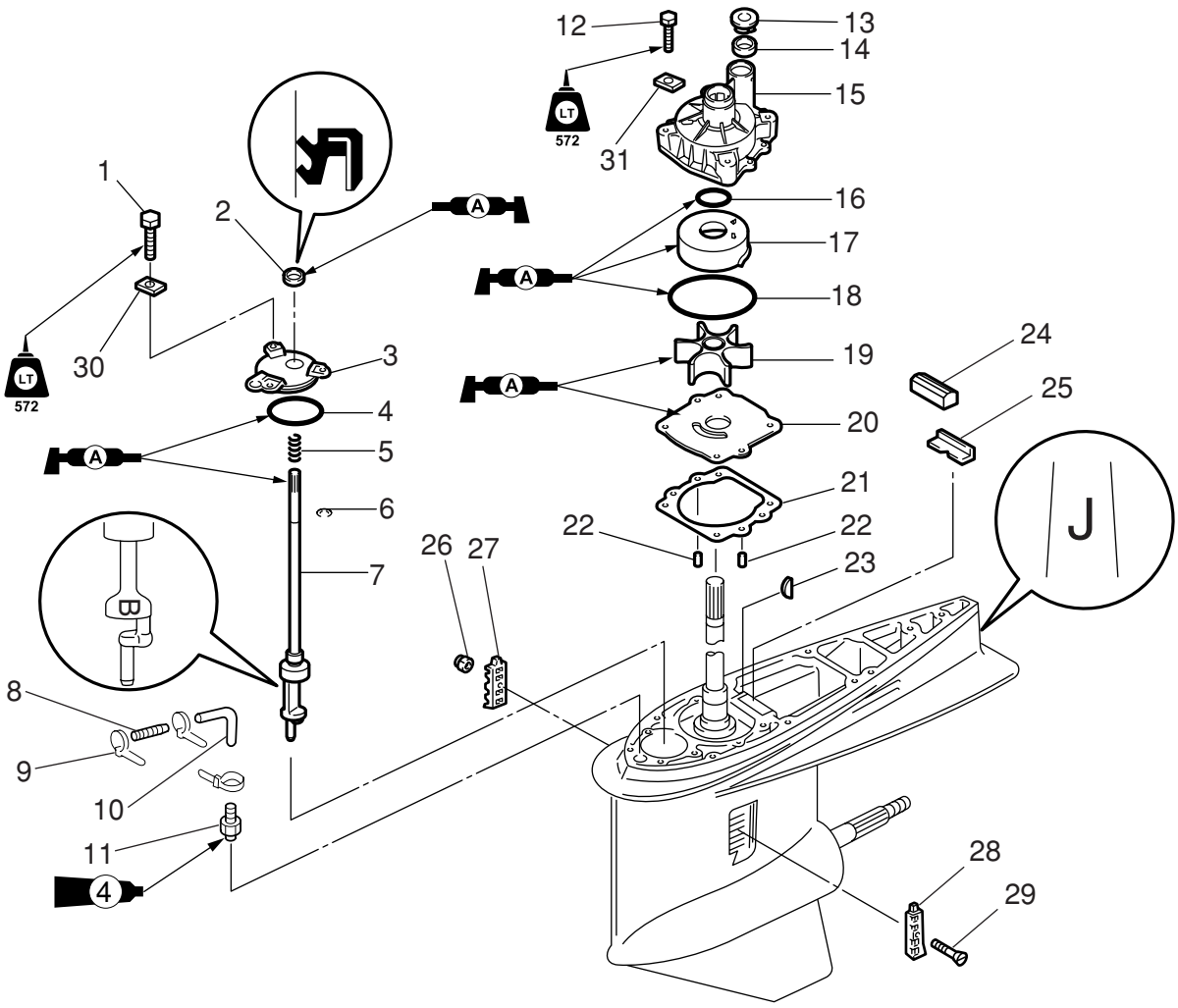
60h61010

No.	Part name	Q'ty	Remarks
1	Lower unit	1	
2	Check screw	1	
3	Gasket	2	Not reusable
4	Dowel	2	
5	Bolt	6	M10 x 45mm
6	Drain screw	1	
7	Bolt	1	M10 x 45mm
8	Bolt	1	M10 x 70mm
9	Spacer	1	
10	Propeller	1	
11	Washer	1	
12	Washer	1	
13	Propeller nut	1	
14	Cotter pin	1	Not reusable
15	Trim tab	1	
16	Cap	1	



60h61020

No.	Part name	Q'ty	Remarks
1	Bolt	3	M6 x 20mm
2	Oil seal	1	Not reusable
3	Oil seal housing	1	
4	O-ring	1	Not reusable
5	Spring	1	
6	Circlip	1	Not reusable
7	Shift rod	1	Not reusable
8	Joint	1	
9	Plastic tie	3	Not reusable
10	Hose	1	
11	Joint	1	
12	Bolt	4	M8 x 45mm
13	Cover	1	
14	Seal	1	Not reusable
15	Water pump housing	1	
16	O-ring	1	Not reusable
17	Insert cartridge	1	

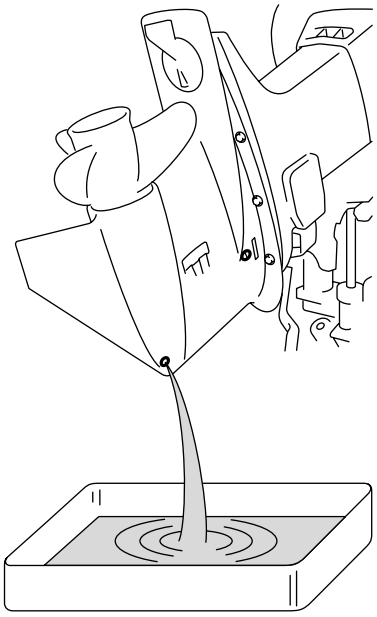


60h61020

No.	Part name	Q'ty	Remarks
18	O-ring	1	Not reusable
19	Impeller	1	
20	Outer plate cartridge	1	
21	Gasket	1	Not reusable
22	Dowel	2	
23	Woodruff key	1	
24	Seal damper	1	
25	Guide	1	
26	Nut	1	
27	Cooling water inlet cover	1	
28	Cooling water inlet cover	1	
29	Bolt	1	M5 x 45 mm
30	Washer	3	
31	Washer	4	

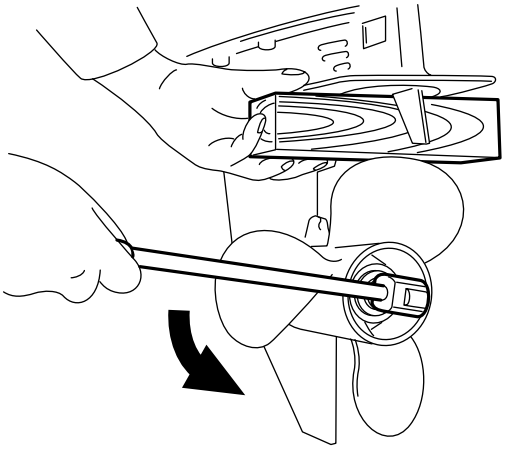
Removing the lower unit

1. Disconnect the battery cable.
2. Remove the lock plate for the engine stop switch.
3. Set the gear shift in neutral position.
4. Remove the drain screw, and the check screw to drain the gear oil.



60h30460

5. Remove the cotter pin.
6. Place a block of wood between the anti-cavitation plate and the propeller, and remove the propeller.

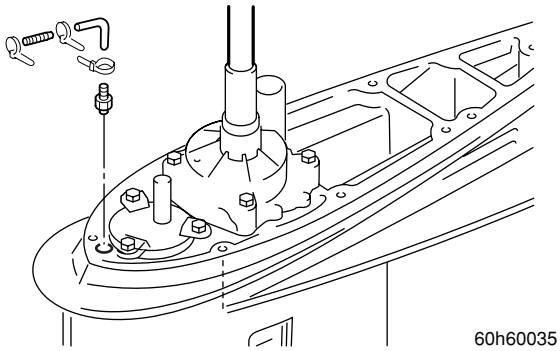


60h61030

⚠ WARNING

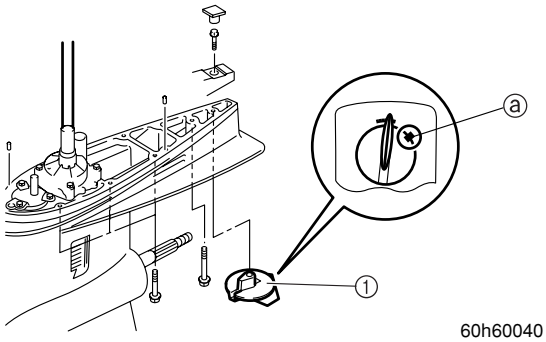
- **Place a block of wood between the anti-cavitation plate and the propeller. Do not touch the propeller with your hands.**
- **Disconnect the battery cable, and remove the lock plate for the engine stop switch to prevent the engine from starting.**

7. Disconnect the speedometer hose.



60h60035

8. Put the alignment mark ⓐ on the trim tab ① and remove it. Remove the lower unit from the upper case after loosening and removing the bolts.



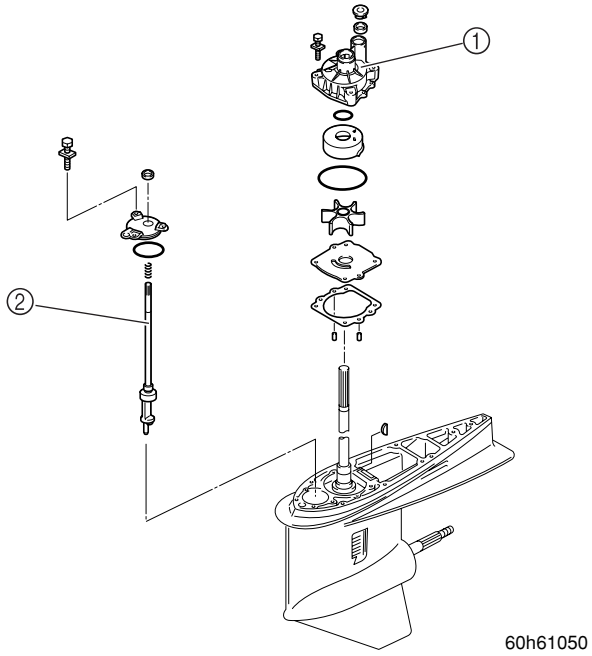
60h60040

NOTE:

Mounting bolt appears when the trim tab is removed. Make sure that the mounting bolt is removed as well.

Removing the water pump and shift rod

1. Remove the water pump ① and the shift rod ②.



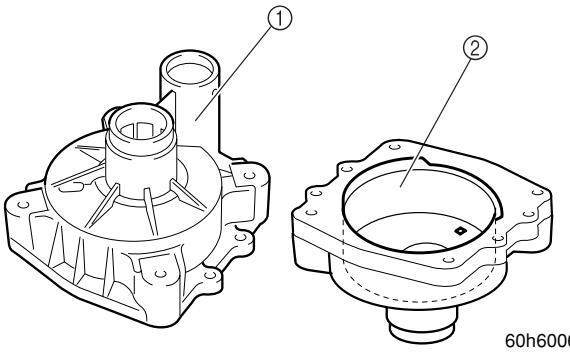
60h61050

NOTE:

- Remove the Woodruff key, from the drive shaft and then the outer plate cartridge.
- Make sure that the dowels were removed from the lower case.

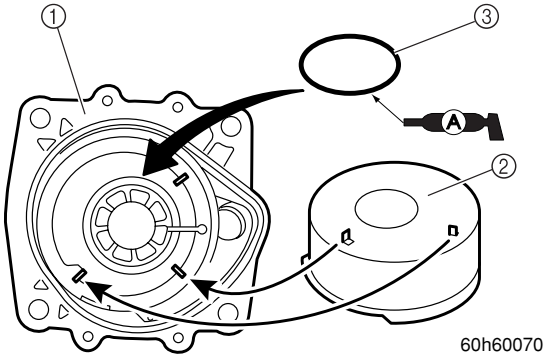
Checking the water pump and shift rod

1. Check the water pump housing ① for deformation. Also check the insert cartridge ② for wear or deformation.



60h60060

2. When the insert cartridge is removed, always replace the O-ring ③ with a new one, and insert the projection on the insert cartridge into the water pump housing hole at the time of reassembly.

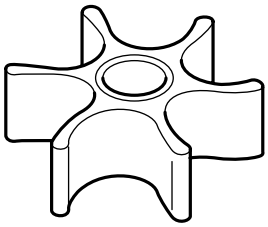


60h60070

NOTE:

When mounting the insert cartridge, apply small amount of Yamahabond 4 to it, and insert the projection on the insert cartridge into the water pump housing hole.

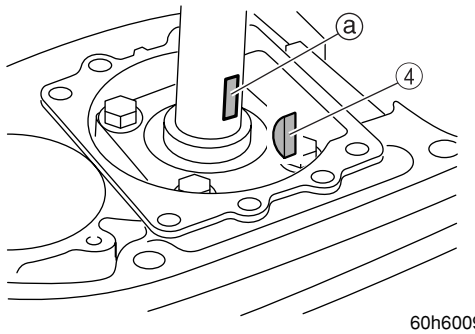
3. Check the impeller for cracks or wear. Replace if necessary.



60h60080

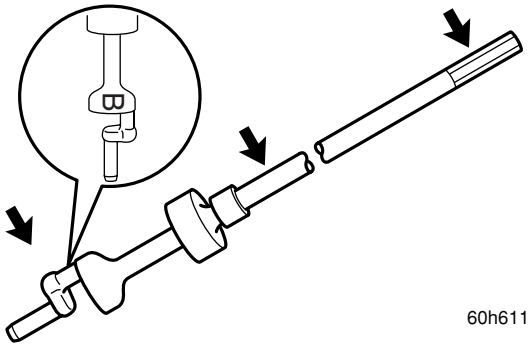
6

4. Check the Woodruff key ④ and the groove ⓐ for wear. Replace if necessary.



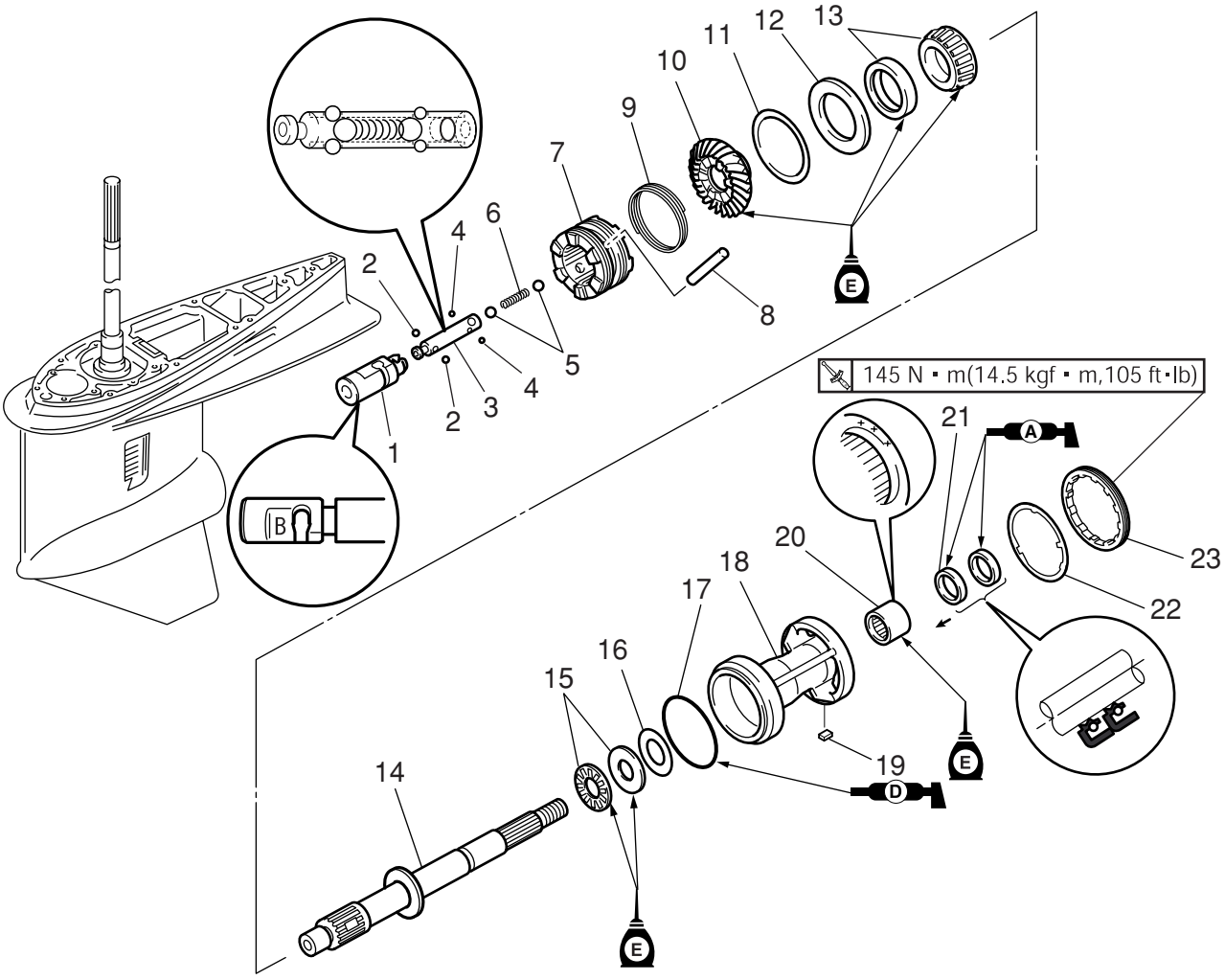
60h60090

5. Check the shift rod for deformation or wear. Replace if necessary.



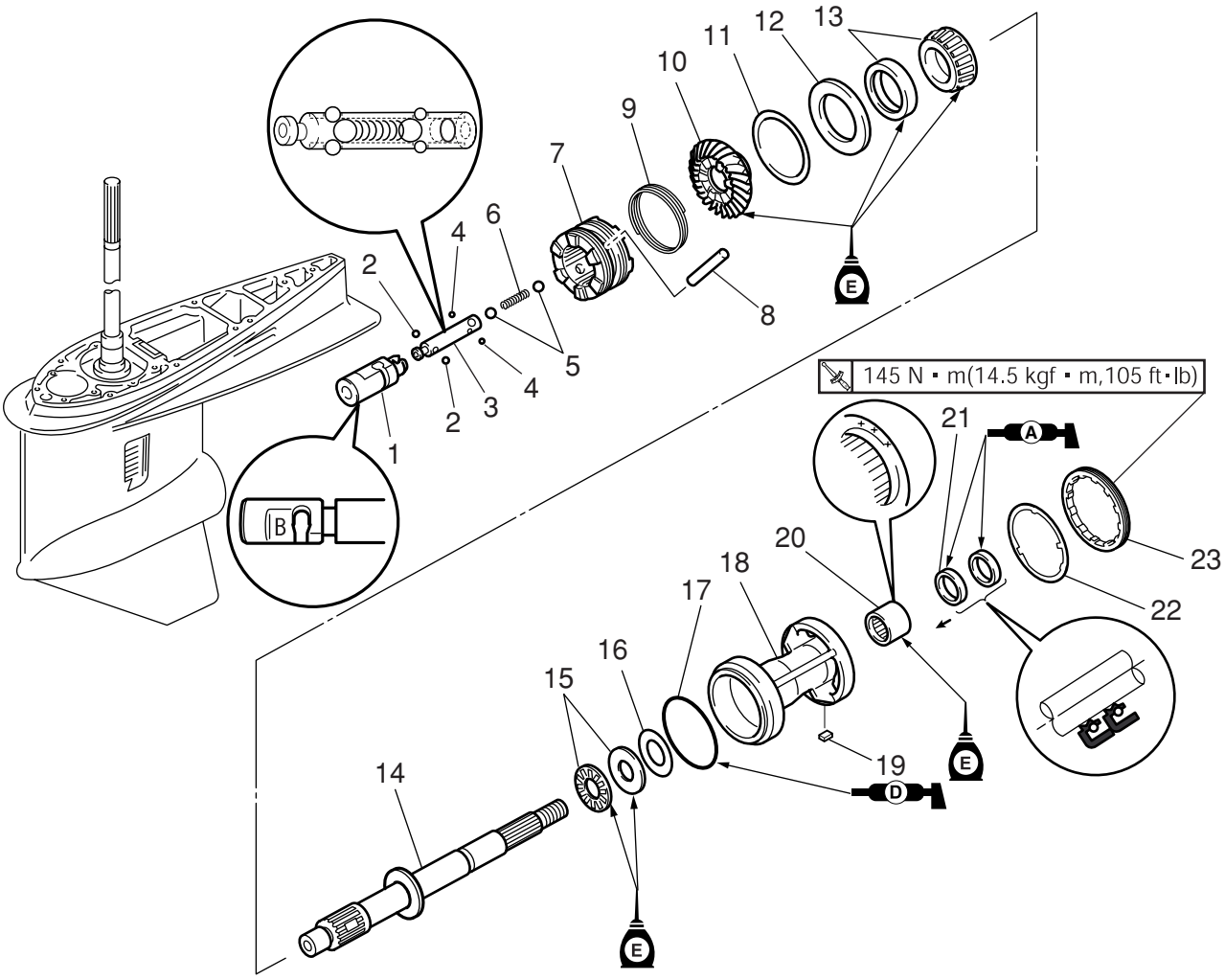
60h61100

Propeller shaft, Propeller shaft housing (counter rotation model)



60h61110

No.	Part name	Q'ty	Remarks
1	Slide shift	1	
2	Ball	2	
3	Slider	1	
4	Ball	2	
5	Ball	2	
6	Spring	1	
7	Dog clutch	1	
8	Cross pin	1	
9	Cross pin ring	1	
10	Forward gear	1	
11	Forward gear shim	*	As required
12	Thrust washer	1	
13	Taper roller bearing	1	Not reusable
14	Propeller shaft	1	
15	Thrust bearing	1	
16	Propeller shaft shim	*	As required
17	O-ring	1	Not reusable



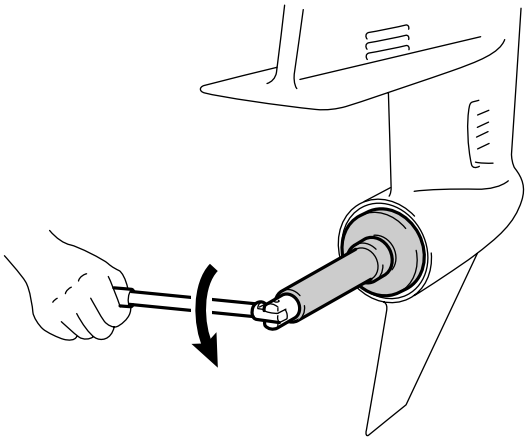
60h61110

No.	Part name	Q'ty	Remarks
18	Propeller shaft housing	1	
19	Key	1	
20	Needle bearing	1	Not reusable
21	Oil seal	2	Not reusable
22	Claw washer	1	
23	Ring nut	1	

Removing the propeller shaft housing assembly and propeller shaft

1. Pull up the claw washer tabs.

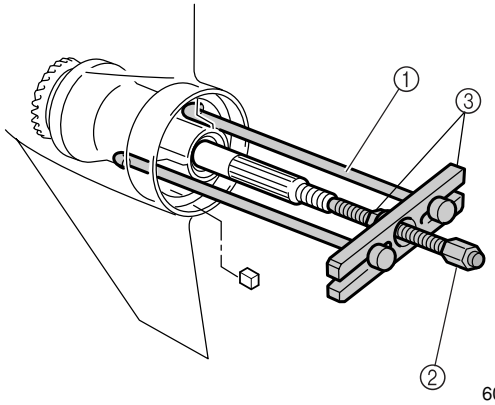
2. Remove the ring nut.



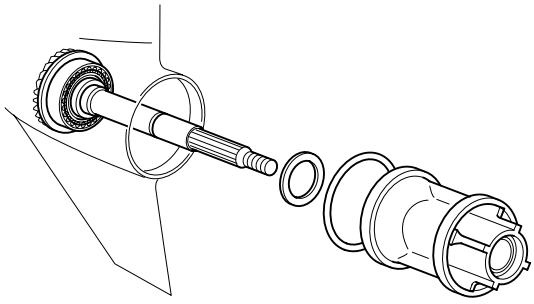
60h60120

Ring nut wrench 4:
90890-06512
Ring nut wrench extension:
90890-06513

3. Remove the propeller shaft housing.



60h60130



60h60135

NOTE:
Make sure that the shims left in the lower case have been removed.

Bearing housing puller claw L ①:
90890-06502
Center bolt ②:
90890-06504
Stopper guide plate ③:
90890-06501

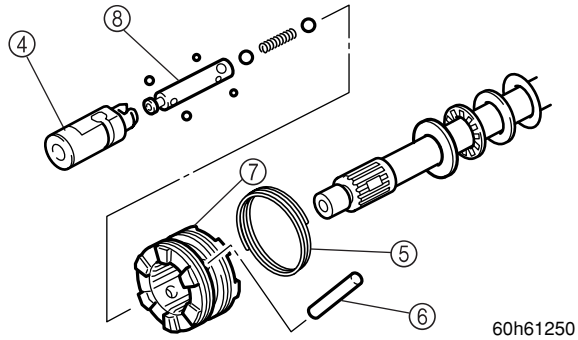
4. Remove the propeller shaft.

5. Remove the slide shift ④.

6. Remove the spring ⑤, pull out the cross pin ⑥, and remove the dog clutch ⑦.

NOTE:
Mark the dog clutch so that it will be reinstalled in correct orientation.

7. Pull out the slider assembly ⑧.

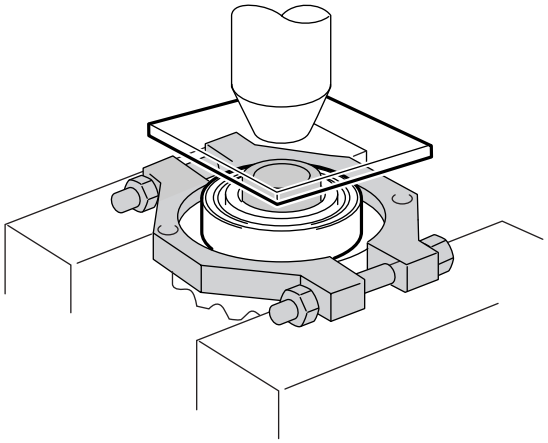


60h61250

NOTE:
Take precautions so that the ball will not jump out while pulling out the slider.

6

8. Remove the taper roller bearing from the forward gear.



60h61625

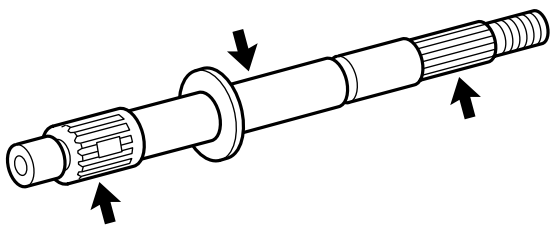
Bearing inner race attachment: 90890-06662
Bearing separator: 90890-06534

Checking the propeller shaft assembly

CAUTION:

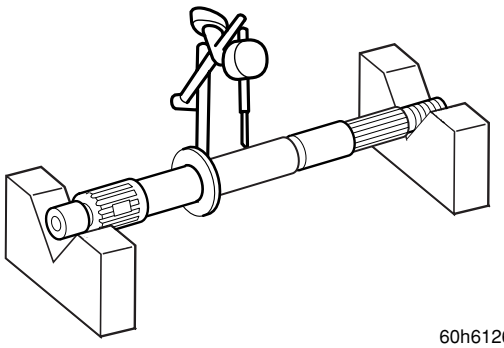
Shimming is required when forward gear, taper roller bearing, or propeller shaft housing is replaced.

1. Check the propeller shaft for bends or wear. Replace if necessary.



60h61260

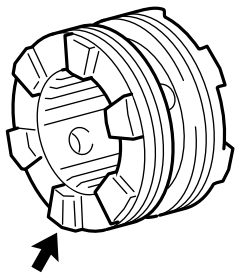
2. Measure the propeller shaft run-out.



60h61265

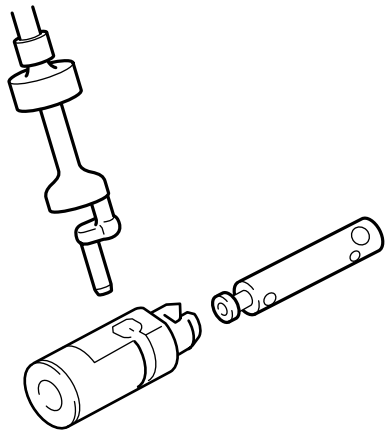
Run-out limit: 0.05 mm (0.0020 in)

3. Check the dog clutch for breakage or wear. Replace if necessary.



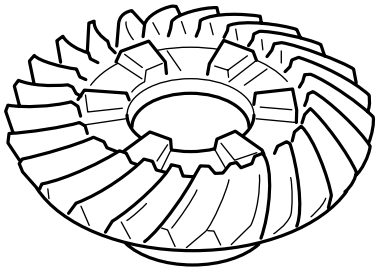
60h60270

4. Check the slide shift and the slider for wear. Replace if necessary.



60h61280

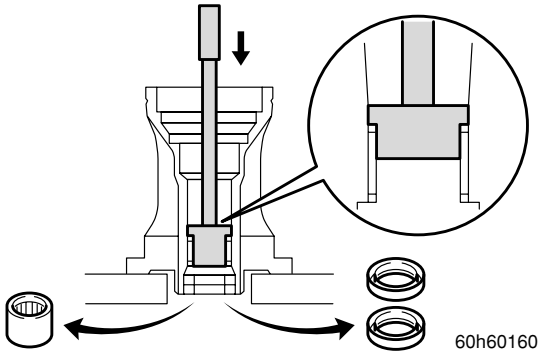
5. Check the teeth and dogs of the forward gear for cracks or wear. Replace the gear if necessary.



60h60180

Disassembling the propeller shaft housing assembly

1. Remove the oil seal. Also remove the needle bearing using a press.



60h60160

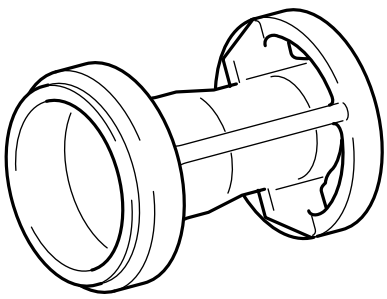
NOTE:

When the oil seal or the needle bearing is removed, always replace them with new ones.

Driver rod L3: 90890-06652
Needle bearing attachment:
90890-06653

Checking the propeller shaft housing assembly

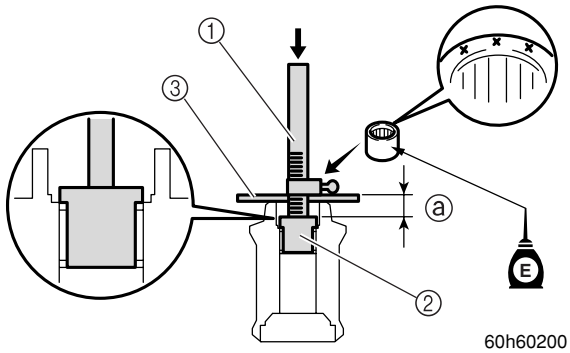
1. Clean the propeller shaft housing, and check it for cracks or damage. Replace if necessary.



60h60170

Assembling the propeller shaft and propeller shaft assembly

1. Install a new needle bearing into the propeller shaft housing to the specified depth using a press.

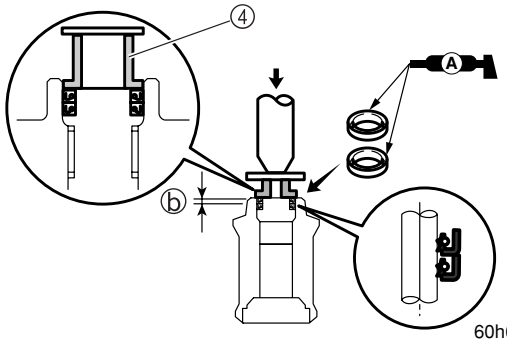


60h60200

Driver rod SS ①: 90890-06604
Needle bearing attachment ②:
90890-06610
Bearing depth plate ③: 90890-06603

Installation depth ⓐ:
24.75 - 25.25mm (0.9744 - 0.9941 in)

2. Install the new oil seals into the propeller shaft housing to the specified depth.



60h60210

NOTE:

First, drive-in the inner oil seal halfway into the propeller shaft housing, and then drive-in the outer oil seal to the specified depth.

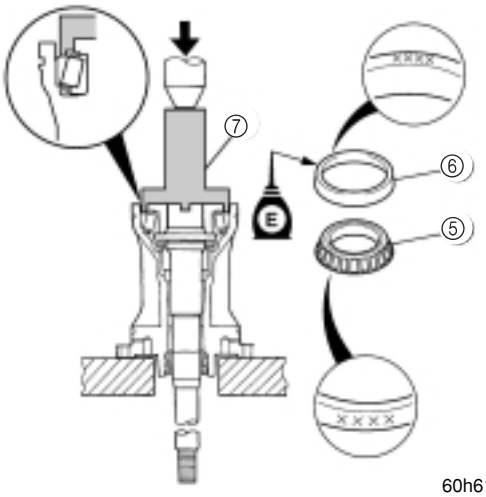
Bearing inner race attachment ④:
90890-06642

Installation depth ⓑ:
4.75-5.25 mm (0.1870 - 0.2067in)

6

3. Install the propeller shaft shim, the thrust bearing and the propeller shaft to the propeller shaft housing.

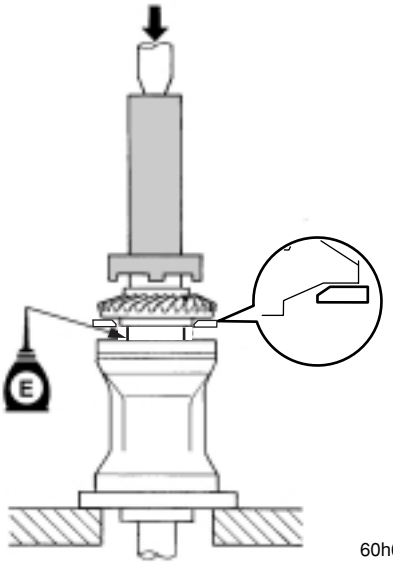
4. Install the taper roller bearing ⑤⑥ and the thrust bearing to the propeller shaft housing.



60h61220

Ring nut wrench ⑦:
90890-06578

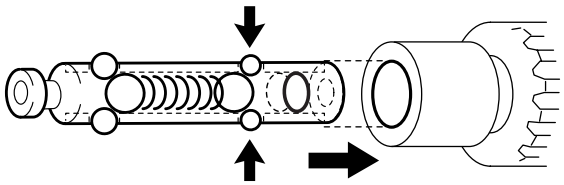
5. Install the forward gear to the propeller shaft housing sub-assembly.



60h61225

NOTE:
- Place an appropriate plate on the dogs before using a press to prevent any damage to the gear teeth.
- Shimming is required when forward gear or taper roller bearing is replaced.

6. Assemble the slider assembly.



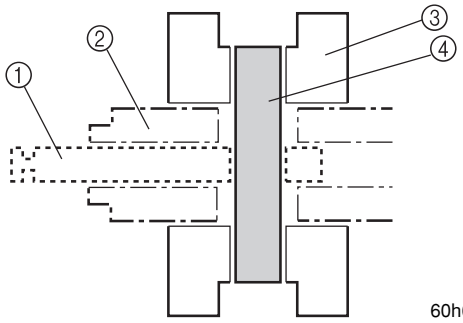
60h60290

NOTE:
It is recommended to apply grease or the like to the balls to make the assembling work easier.

7. Insert the slider assembly ① into the propeller shaft ②.

NOTE:
Make sure that the cross pin holes are aligned when inserting the slider assembly.

8. Install the dog clutch ③ in the marked orientation, and fit-in the cross-pin ④.



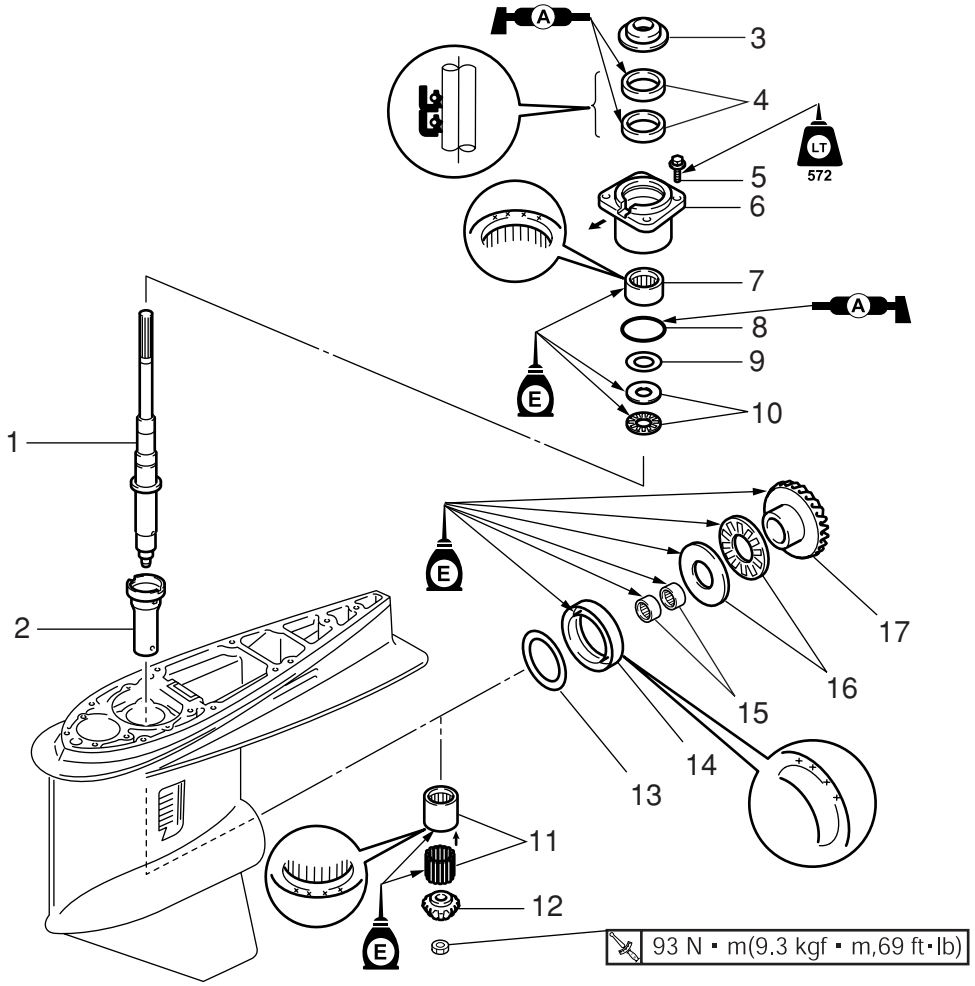
60h60295

NOTE:
A new dog clutch may be installed in either ways.

9. Install the cross pin ring.

NOTE:
Make sure that the spring is not twisted or overlaid as installed.

Drive shaft and lower case (counter rotation model)



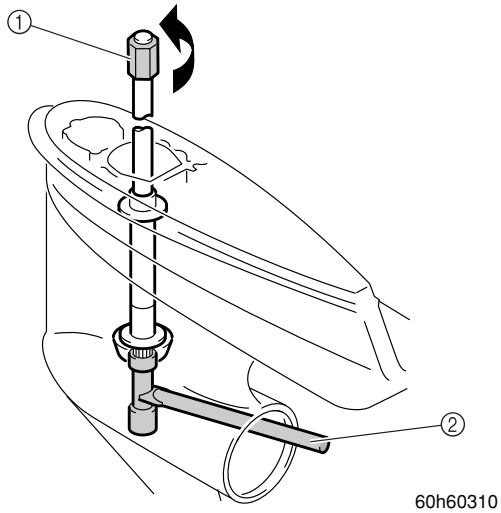
60h61300

No.	Part name	Q'ty	Remarks
1	Drive shaft	1	
2	Drive shaft sleeve	1	
3	Cover	1	
4	Oil seal	2	Not reusable
5	Bolt	4	8 x 25mm
6	Drive shaft housing	1	
7	Needle bearing	1	
8	O-ring	1	Not reusable
9	Pinion shim	*	As required
10	Thrust bearing	1	
11	Needle bearing	1	
12	Pinion	1	
13	Reverse gear shim	1	
14	Roller bearing	1	Not reusable
15	Needle bearing	2	
16	Thrust bearing	1	
17	Reverse gear	1	

Removing the drive shaft and reverse gear

NOTE:
Shimming is required when the reverse gear or taper roller bearing is replaced.

1. Loosen the pinion nut.



60h60310

Drive shaft holder 6 ①: 90890-06520
Socket adapter 3 ②: 90890-06508
Pinion nut holder ②: 90890-06505

2. Remove the drive shaft housing.

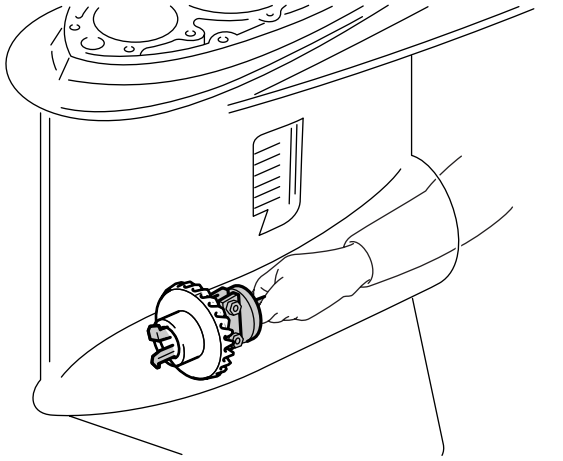
NOTE:
Note that the pinion gear shims may be stuck on the drive shaft housing.

3. Pull out the drive shaft, and remove the pinion gear.

4. Remove the drive shaft sleeve.

NOTE:
Make sure that none of the needles of the drive shaft needle bearing is missing.

5. Remove the reverse gear.

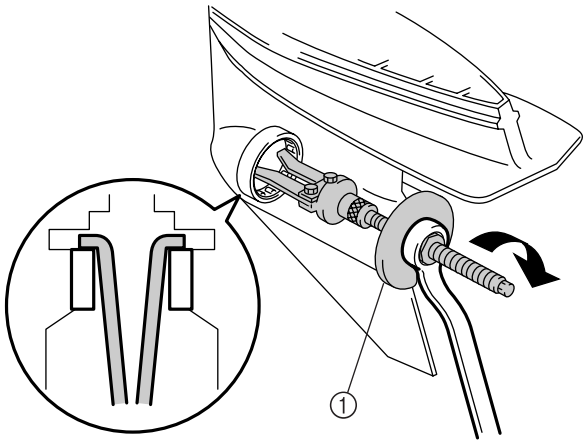

60h61323

SST Bearing puller assembly:
90890-06535

Disassembling the lower case

NOTE:
Remove the lower case only when shimming is required for the forward gear, or when replacing the taper roller bearing or needle bearing.

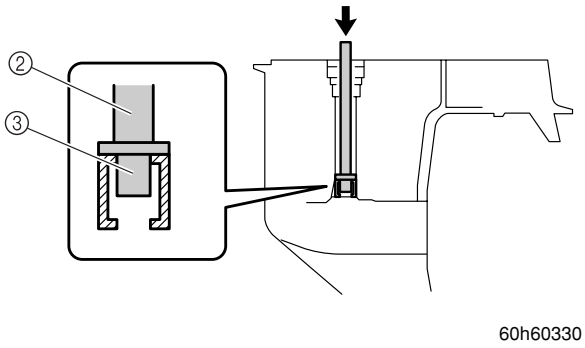
1. Remove the roller bearing.



60h61327

Bearing outer race puller assembly ①:
90890-06523

2. Remove the needle bearing outer race.



60h60330

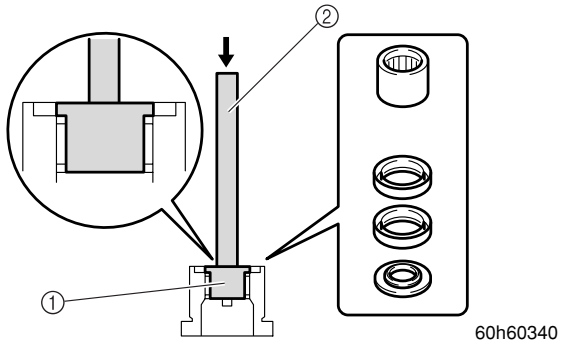
Drover rod LL ②: 90890-06605
Ball bearing attachment ③:
90890-06636

Checking the drive shaft housing

1. Check the drive shaft housing for cracks or damage. Also check the needle bearing for run-out and roughness, and the oil seals for damage. Disassemble them if necessary.

2. Remove the cover and the oil seals.

3. Remove the needle bearing.



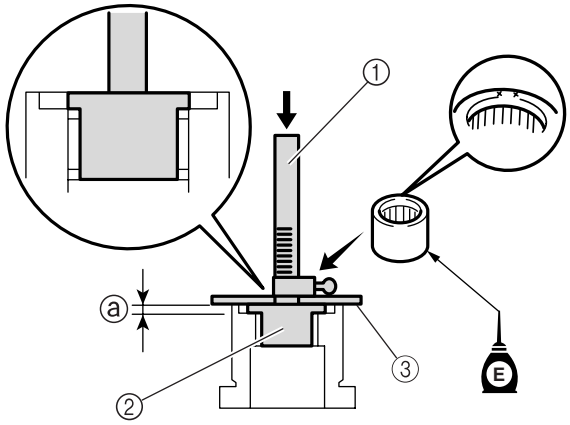
60h60340

NOTE:
When the bearing and oil seals are removed, always replace them with new ones.

Needle bearing attachment ①:
90890-06610
Driver rod L3 ②: 90890-06652

Assembling the drive shaft housing

1. Install the needle bearing.

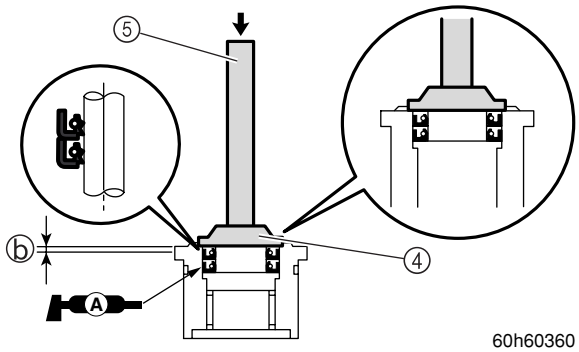


60h60350

Driver rod SS ①: 90890-06604
Needle bearing attachment ②:
90890-06610
Bearing depth plate ③:
90890-06603

Installation depth ⓐ:
5.75 - 6.25 mm
(0.2264 - 0.2460 in)

2. First, drive-in the inner oil seal halfway into the drive shaft housing, and then drive-in the outer oil seal to the specified depth.



60h60360

Ball bearing attachment ④:
90890-06633
Driver rod LS ⑤: 90890-06606

Installation depth ⓑ:
0.25 - 0.75 mm (0.099 - 0.295 in)

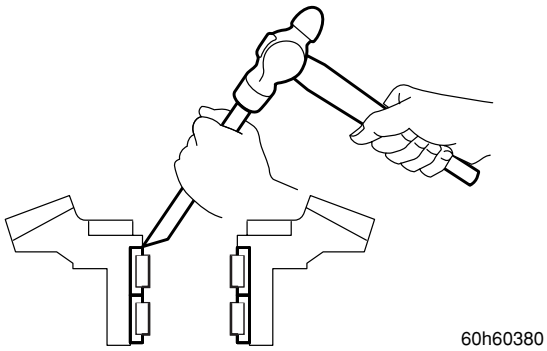
3. Install the cover.

6

Checking the reverse gear

1. Check the teeth and dogs of the reverse gear for cracks or wear. Also check the bearing for run-out and roughness.

2. Remove the needle bearing.

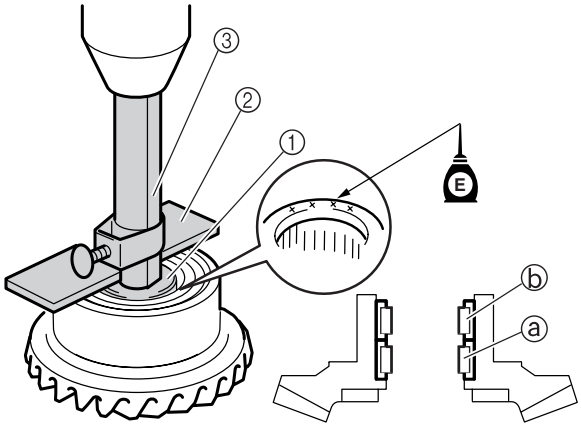


60h60380

NOTE:
When the needle bearing is removed, always replace them with a new one.

Assembling the reverse gear

1. Install the needle bearing.



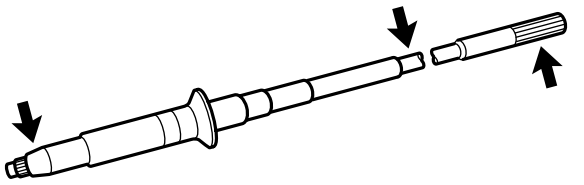
60h60390

Needle bearing attachment ①:
90890-06612
Bearing depth plate ②: 90890-06603
Driver rod SS ③: 90890-06604

Installation depth ⓐ:
20.95 - 21.45 mm(0.8248 - 0.8445 in)
Installation depth ⓑ:
4.45 - 4.95 mm(0.1752 - 0.1949 in)

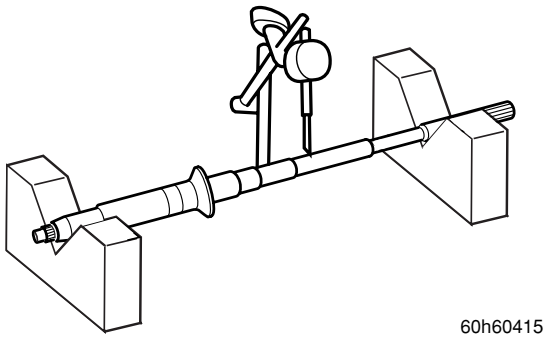
Checking the drive shaft

1. Check the drive shaft for bends or wear. Replace if necessary.



60h60410

2. Measure the drive shaft run-out.



60h60415

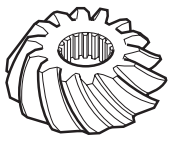
Run-out limit: 0.1 mm (0.0039 in)

3. Check the thrust bearing for run-out or roughness. Replace if necessary.

NOTE:
Shimming is required when the thrust bearing is replaced.

Checking the pinion gear

1. Check the pinion gear teeth for cracks or wear.

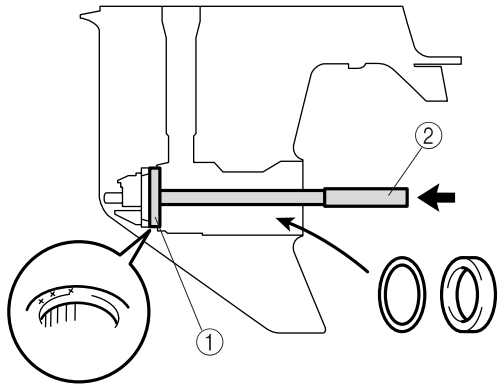


60h60420

Assembling the lower unit (counter rotation model)

Installing the lower case

1. Install the shims and the roller bearing.



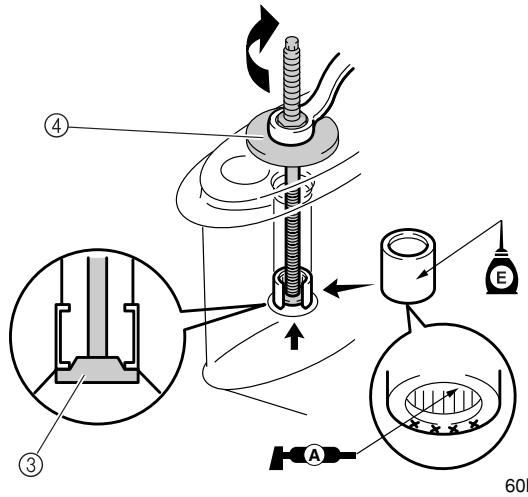
60h61410

CAUTION:

Shimming is required when the reverse gear, the roller bearing, or the lower case is replaced. Record the measured height of the bearing.

Ball bearing attachment ① :
90890-06629
Driver rod LL ② : 90890-06605

2. Install the needle bearing outer race.



60h60440

Ball bearing attachment ③:
90890-06633
Bearing outer race puller assembly ④:
90890-06523

3. Install the needle bearing rollers.

NOTE:

Apply some grease on the needle bearing rollers so that they will not fall off.

4. Install the drive shaft sleeve.

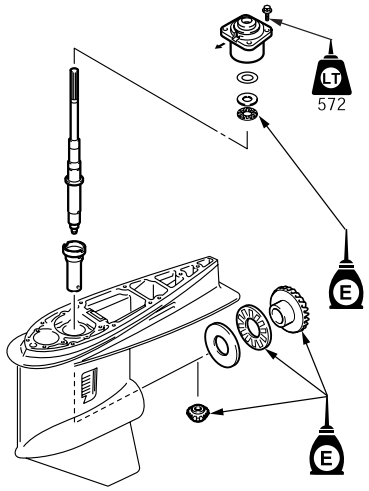
5. Install the reverse gear and the thrust bearing on the lower case.

6. Install the drive shaft and the pinion gear. Then, temporarily tighten the nut.

NOTE:

- Shimming is required when the drive shaft housing or the drive shaft is replaced.
- Install the drive shaft by lifting it up slightly, then aligning its splines with the pinion gear.

7. Install the drive shaft housing assembly.



60h61450

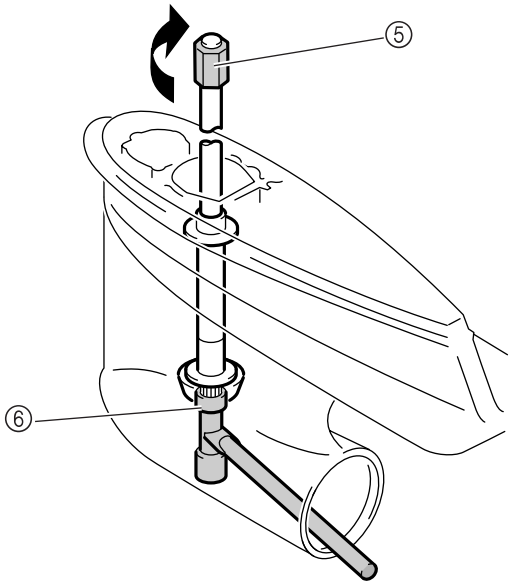
8. Insert the thrust bearing into the drive shaft, and install the drive shaft housing.

NOTE:

Shimming is required when the thrust bearing is replaced.

6

9. Tighten the pinion nut.



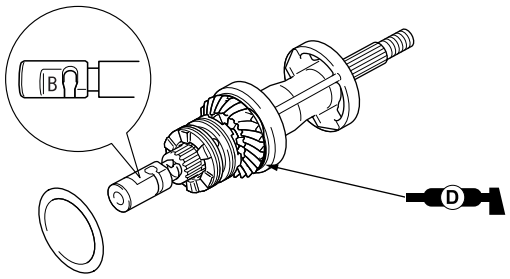
60h60460

Drive shaft holder 6 ⑤: 90890-06520
Pinion nut holder ⑥: 90890-06505
Socket adapter 3 ⑥: 90890-06508

Pinion nut:
93 N • m(9.3 kgf • m, 69 lb • ft)

10. Install the slide shift to the propeller shaft.

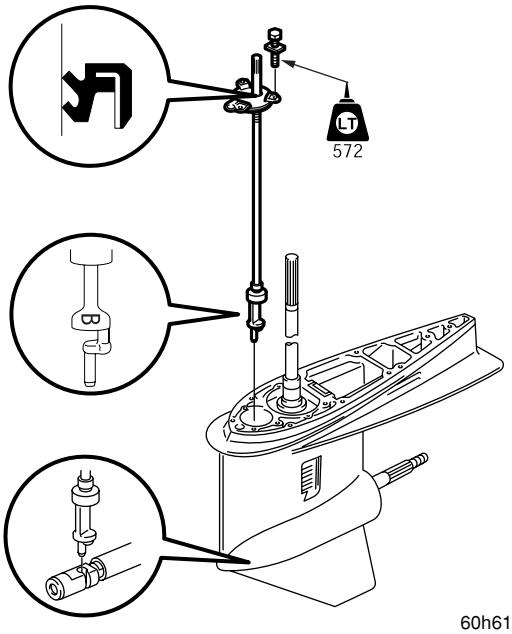
11. Install the shim(s), the propeller shaft and the propeller shaft housing assembly.



60h61470

NOTE:
Set the dog clutch in neutral position.

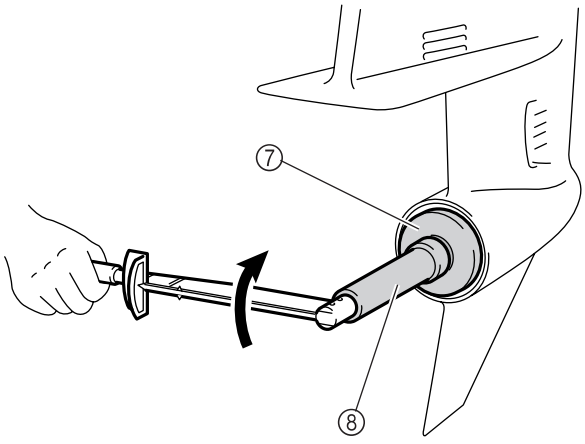
12. Install the shift rod assembly, and tighten the bolt.



60h61480

13. Align the key way, and install the key.

14. Install the claw washer, and tighten the ring nut.

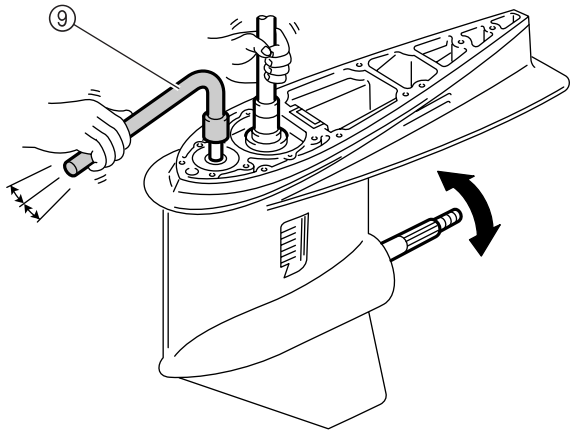


60h61500

Ring nut wrench ⑦: 90890-06512
Ring nut wrench extension ⑧:
90890-06513

Ring nut:
145 N • m (14.5 kgf • m, 105 lb • ft)

15. Make sure that the shifting mechanism works properly.



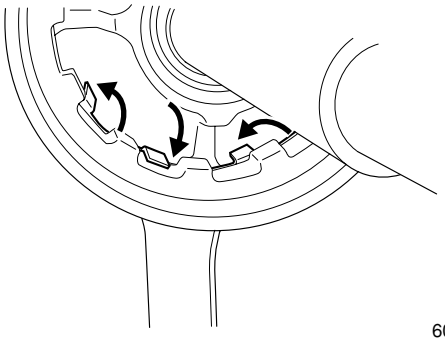
60h61510

NOTE:

Change the shift rod position to forward, to reverse, and to neutral. Make sure that propeller shaft rotating direction is correct in forward and in reverse. Also make sure that the position is correct in neutral.

	Shift rod push arm ⑨: 90890-06052

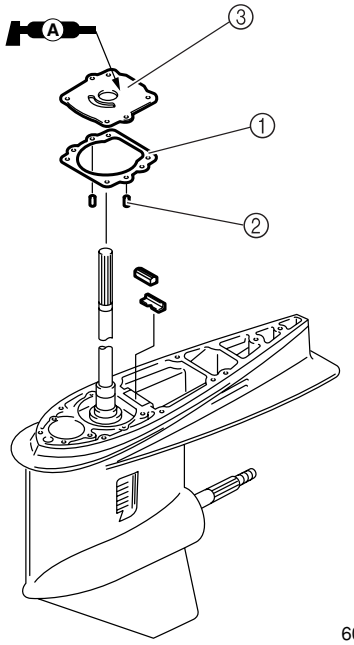
16. Bend one of the claw washer tabs toward yourself.



60h60515

Installing the water pump

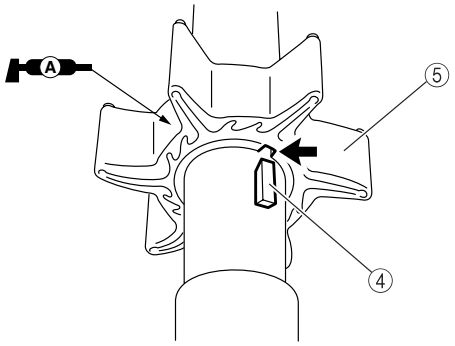
1. Install the gasket ①, the dowels ②, and the outer plate cartridge ③.



60h60520

2. Install the Woodruff key ④ into the drive shaft.

3. Install the impeller ⑤ after aligning it with the woodruff key.



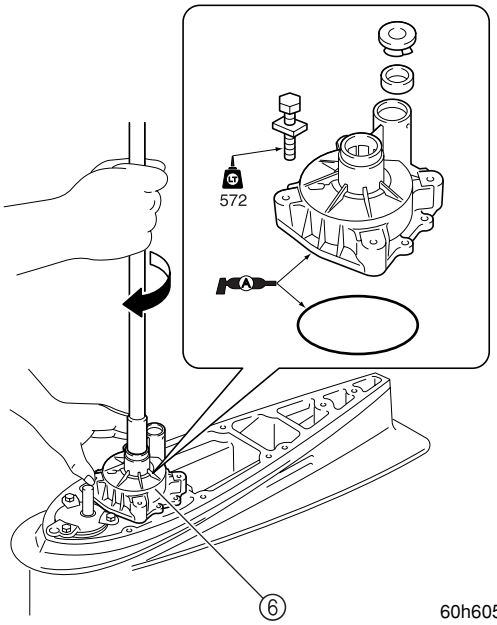
60h60530

NOTE:

- Align the groove on the impeller with the Woodruff key.
- Apply Yamaha grease A on the sliding face between the impeller and the outer plate cartridge.

6

4. Install the O-ring into the water pump housing assembly ⑥, and install the water pump housing on the lower case.



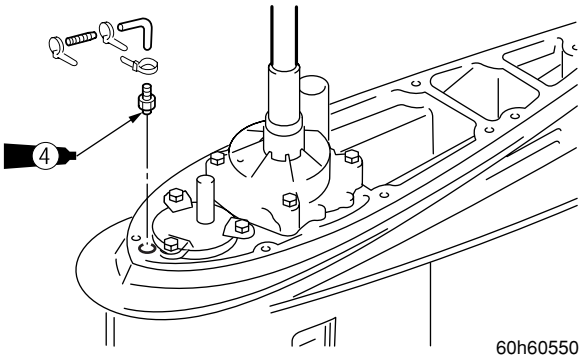
60h60540

NOTE:

To install the water pump housing, apply Yamaha grease A to the inner face of the water pump housing assembly, and then turn the drive shaft clockwise while pushing down the pump housing.

Installing the speedometer hose

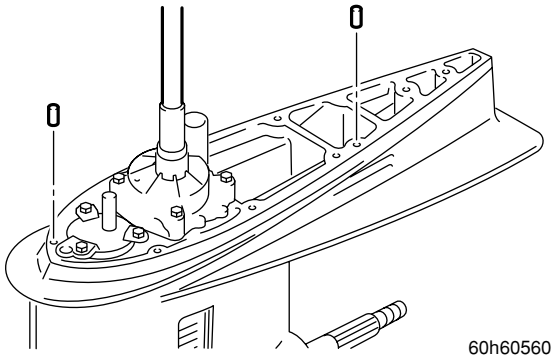
1. Apply Yamabond 4 to the speedometer hose, and tighten it.



60h60550

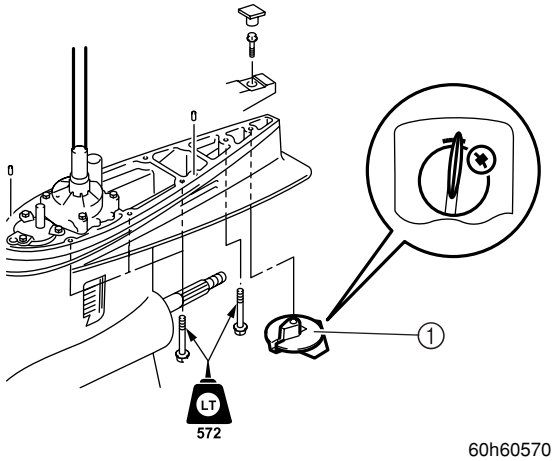
Installing the lower unit

1. Install the dowels to the lower case.


60h60560

2. Make sure that the shift rod is in neutral position. Install the lower unit to the upper case, and tighten the bolts to the specified torque.

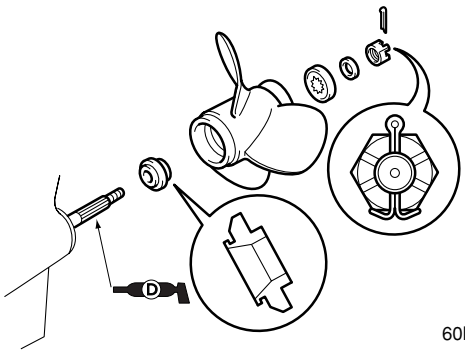
3. Install the trim tab ① to its original position, and tighten the trim tab bolt to the specified torque.



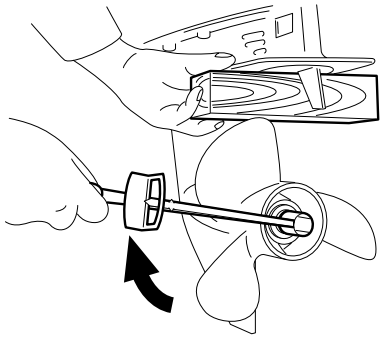
60h60570

Lower case bolt:
39N • m(3.9 kgf • m, 29 lb • ft)
Trim tab bolt:
39 N • m(3.9 kgf • m, 29 lb • ft)

4. Install the propeller and the propeller nut. Place a block of wood between the anti-cavitation plate and the propeller to keep the propeller from turning. Then, tighten the nut to the specified torque.



60h61540



60h61550

⚠ WARNING

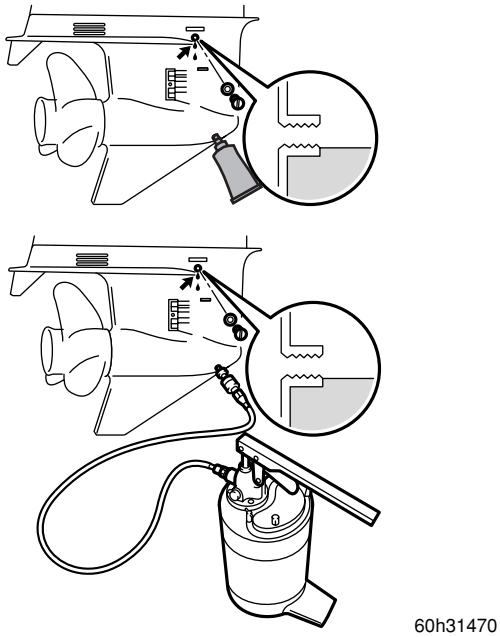
- **Place a block of wood between the anti-cavitation plate and the propeller. Do not touch the propeller with your hands.**
- **Disconnect the battery cable, and remove the lock plate for the engine stop switch, to prevent the engine from starting.**

NOTE:

If the grooves in the propeller nut do not align with the cotter pin hole, tighten the nut further until they are aligned.

Propeller nut:
54 N • m(5.4 kgf • m, 40 lb • ft)

5. Insert the gear oil tube or gear oil pump into the drain hole and fill the gear oil until it flows out of the check hole and no air bubbles are visible.



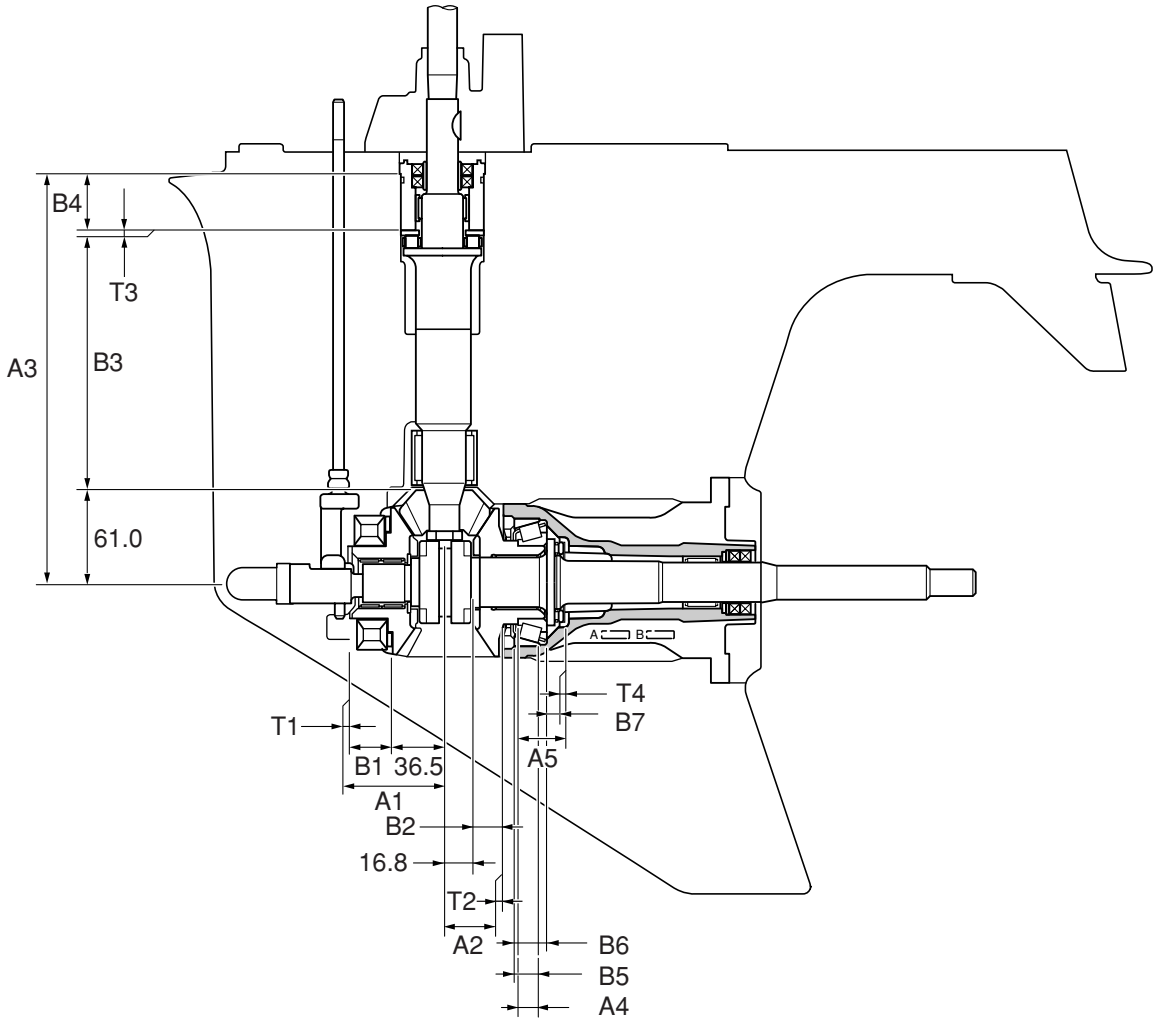
60h31470

Recommended gear oil:
Hypoid gear oil
SAE: 90
Oil quantity:
Counter rotation model:
870 cm^3 (30.6 lmp oz)

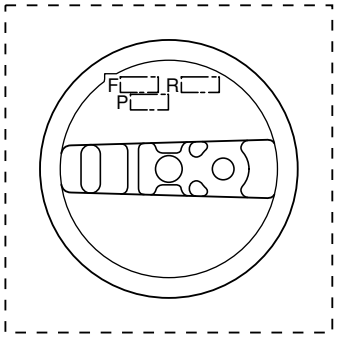
6. Install the check screw, and quickly install the drain screw.

6

Shimming (counter rotation model)



60h61600



60h61607

Shimming

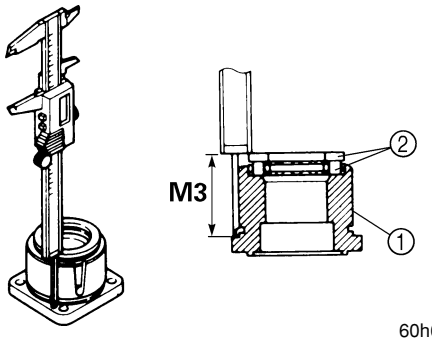
NOTE:
- Shimming is not required when the original lower case and inner parts are reused for the lower unit reassembly.
- Shimming is required if either the lower case or the assembly parts are replaced for the lower unit reassembly.

Selecting the pinion shims

NOTE:
Obtain the pinion shim thickness (T3) by using the specified measurement(s) and the calculation formula.

Calculation formula:
Pinion shim thickness
(T3) = 80.00 + P/100 - M3 - M4

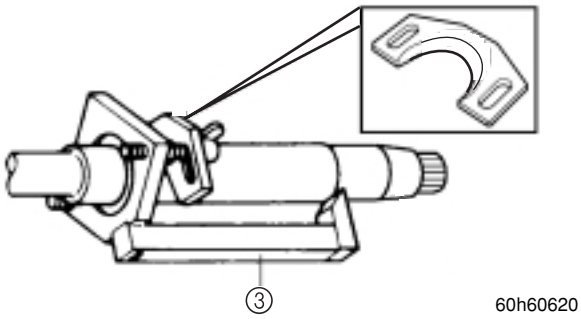
1. Measure the drive shaft housing ① and thrust washer ② height (M3) .



60h60610

NOTE:
- Set the thrust washer on the drive shaft housing, and turn it two or three times to make it seated properly.
- Take measurements at three points on the thrust bearing, and obtain the average.

2. Measure the datum distance on the drive shaft. Initially, install the pinion height gauge to the drive shaft.



60h60620

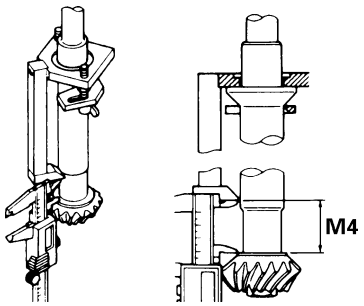
NOTE:
- Install the drive shaft in the center of the pinion height gauge.
- Tighten the wing nuts another 1/4 of a turn after they come in contact with the pinion height gauge plate.

Pinion height gauge ③:
90890-06710
Digital caliper: 90890-06704

3. Install the pinion gear to the drive shaft, and tighten the pinion gear nut to the specified torque.

Pinion gear nut:
93 N • m(9.3 kgf • m, 69 lb • ft)

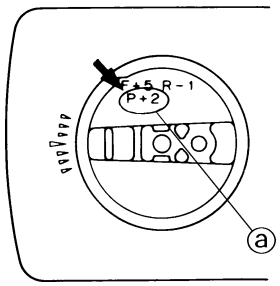
4. Measure the distance between the pinion height gauge and the pinion gear (M4).



60h60630

6

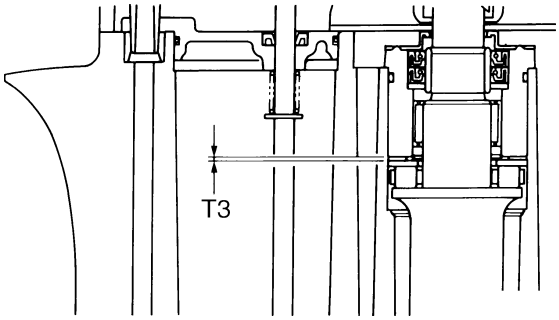
5. Calculate the lower case standard(P/100).



S69j6555

NOTE:
- "P" ⓐ stamped on the trim tab mounting face refers to the deviation of the lower case dimension from the standard. The numeral is in 1/100mm.
- If the numeral is unknown, assume that “P” is zero, and check the backlash when the unit is assembled. Readjustment shall be wade if the measured backlash is out of specification.

6. Calculate the pinion shim thickness.



S69j6565

Calculation formula:
Pinion shim thickness
(T3) = 80.00 + P/100 - M3 - M4

Example:
If "M3"= 46.85, "M4"= 32.52, and "P"= –5, then :
T3 = 80.00 + (–5/100) – 46.85 – 32.52
= 80.00 – 0.05 – 46.85 – 32.52
= 0.58

7. Select the pinion shim(s) as follows.

Calculated numeral at 1/100 place	Rounded numeral
1,2	0
3,4,5	2
6,7,8	5
9,10	8

Available shim thickness:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50

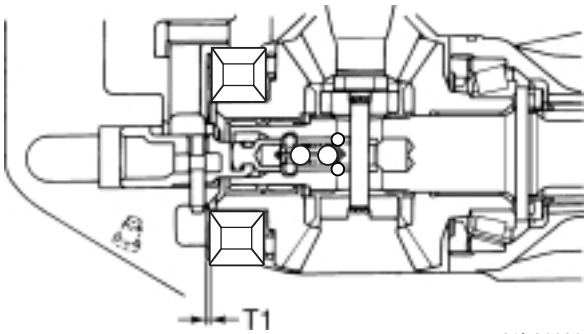
Example:
If "T3" is 0.58mm, then the pinion shim is 0.55 mm.
If "T3" is 0.70mm, then the pinion shim is 0.68 mm.

Selecting the reverse gear shims

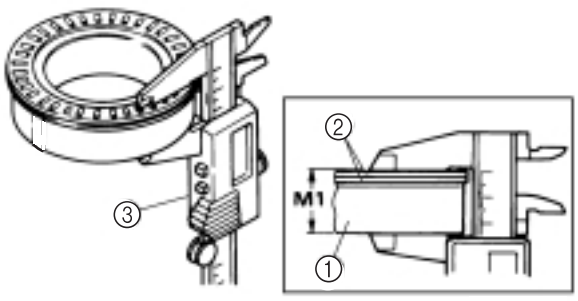
NOTE:
Obtain the reverse gear shim thickness (T1) by using the specified measurement(s) and the calculation formula.

Calculation formula:
Reverse gear shim thickness
(T1) = 29.10 + F/100 - M1

1. Measure the roller bearing ① and the thrust bearing ② height (M1).



60h61638

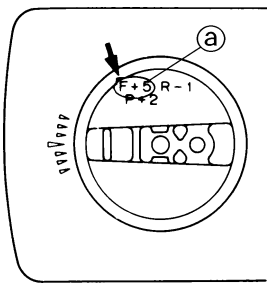


60h61640

NOTE:
- Set the thrust bearing and the race on the roller bearing, and turn them two or three times to make them seated properly.
- Measure the bearing height at three points and obtain the average.

Digital caliper ③:
90890-06704

2. Calculate the lower case standard(F/100).



69J6570

NOTE:
- "F" ⓐ stamped on the trim tab mounting face refers to the deviation of the lower case dimension from the standard. The numeral is in 1/100 mm.
- If the numeral is unknown, assume that "F" is zero, and check the backlash when the unit is assembled. Readjustment shall be made if the backlash is out of specification.

3. Calculate the reverse gear shim thickness.

Calculation formula:
Reverse gear shim thickness
(T1) = 29.10 + F/100 - M1

Example:
If "M1" = 27.95, and "F"= –5, then :
T1 = 29.10 + (–5/100) – 27.95
= 29.10 – 0.05 – 27.95
= 1.10

4. Select the reverse gear shim(s) as follows.

Calculated numeral at 1/100 place	Rounded numeral
1,2	0
3,4,5	2
6,7,8	5
9,10	8

Available shim thickness:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50

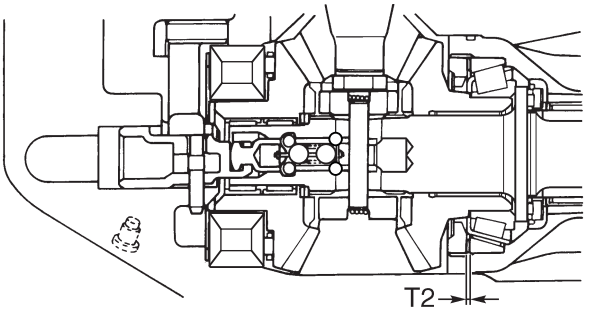
Example:
If "T1" is 0.45 mm, then the reverse gear shim is 0.42 mm.
If "T1" is 0.60 mm, then the reverse gear shim is 0.58 mm.

Selecting the forward gear shims

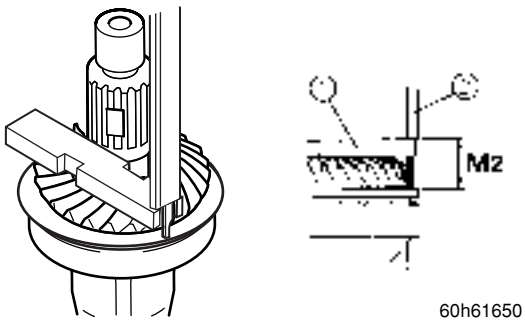
NOTE:
Obtain the forward gear shim thickness (T2) by using the specified measurement(s) and the calculation formula.

Calculation formula:
Forward gear shim thickness
(T2) = M2 - 29.50 - R/100

1. Measure the forward gear shim height (M2) from the thrust washer on the propeller shaft housing. The measurement shall be made while the dog clutch is removed from the housing.



60h61648



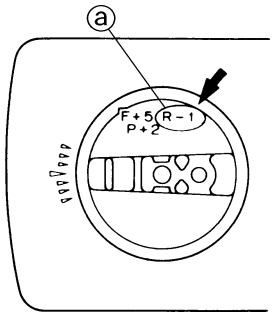
60h61650

NOTE:
Take measurements at four points on the forward gear, and obtain the average.

Shimming plate ①: 90890-06701
Digital caliper ②: 90890-06704

6

2. Calculate the lower case standard(R/100).



S69j6585

NOTE:
- "R" ⓐ stamped on the trim tab mounting face refers to the deviation of the lower case dimension from the standard. The numeral is in 1/100mm.
- If the numeral is unknown, assume that “R” is zero, and check the backlash when the unit is assembled. Shimming shall be readjusted if the backlash is out of specification.

3. Calculate the forward gear shim thickness.

Calculation formula:
Forward gear shim thickness
(T2)= M2 - 29.50 - R/100

Example:
If "M2"= 30.5, and "R"= -5, then :
T2 = 30.5 – 29.50 – (–5/100)
= 30.5 – 29.50 + 0.05
= 1.05

4. Select the forward gear shim(s) as follows.

Calculated numeral at 1/100 place	Rounded numeral
1,2	0
3,4,5	2
6,7,8	5
9,10	8

Available shim thickness:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50

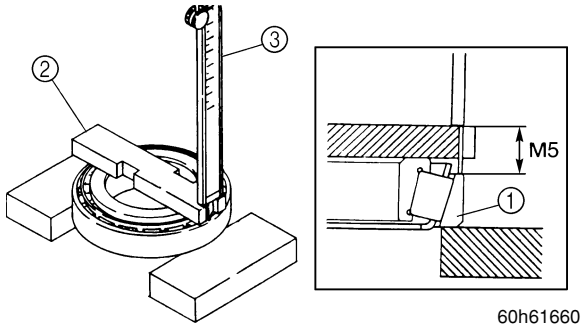
Example:
If "T2" is 1.16mm, then the reverse gear shim is 1.15 mm.
If "T2" is 1.20mm, then the reverse gear shims is 1.18 mm.

Selecting the propeller shaft shims

NOTE:
Obtain the propeller shaft shim thickness(T4)by using the specified measurement(s) and the calculation formula.

Calculation formula:
Propeller shaft shim thickness
(T4) = 29.00 - A/100 + B/100 - M5 - M6

1. Measure the height of the roller bearing outer race ① from the inner race. (M5)

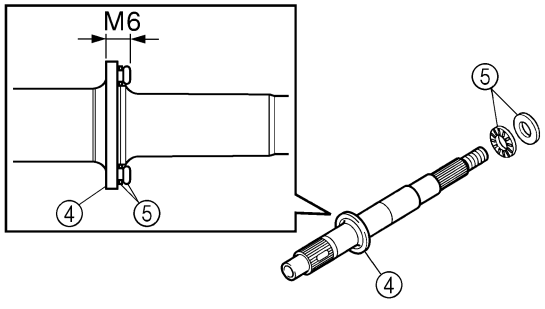


60h61660

NOTE:
Set the thrust bearing and the race on the roller bearing, turn them two or three times to make them seated properly.
Measure the bearing height at three points and obtain the average.

Shimming plate ②: 90890-06701
Digital caliper ③: 90890-06704

2. Measure the thickness of propeller shaft flange ④ and the thrust bearing ⑤ (M6)

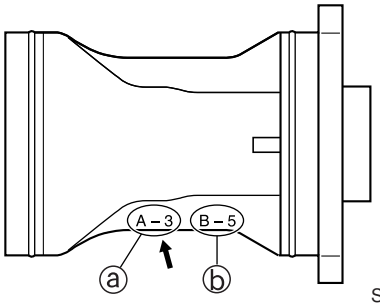


60h61670

NOTE:
Turn the thrust bearing two or three times to make it seated properly.
Measure the flange and bearing thickness at three points, and obtain the average.

Digital caliper:
90890-06704

3. Calculate the propeller shaft housing standard (A/100 and B/100).



S69J6626

NOTE:
- "A" ⓐ and "B" ⓑ stamped on the propeller shaft housing refers to the deviation of the propeller shaft housing dimension from the standard. The numeral is in 1/100mm.
- If the numerals are unknown, make calculation assuming "A" and "B" are zero, and measure the end play when the unit is assembled. Shimming shall be readjusted if the end play is out of specification.

4. Calculate the propeller shaft shim thickness.

Calculation formula:
Reverse gear shim thickness
(T4) = 29.00 – A/100 + B/100 – M5 – M6

Example:
If "M5"= 15.15, "M6"= 13.15, "A"= –5, and "B"= –5, then :
T4 = 29.00 – (–5/100) + (–5/100) – 15.15 – 13.15
= 29.00 + 0.05 – 0.05 – 15.15 – 13.15
= 0.70

5. Select the propeller shaft shim(s) as follows.

Calculated numeral at 1/100 place	Rounded numeral
1,2	0
3,4,5	2
6,7,8	5
9,10	8

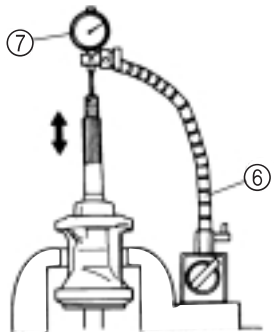
Available shim thickness:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50

Example:
If "T4" is 0.45mm, then the propeller shaft gear shim is 0.42 mm.
If "T4" is 0.60mm, then the propeller shaft gear shim is 0.58 mm.

6. If "A"and"B"on the propeller shaft housing is unknown, measure the propeller shaft end play.

7. Install the shim, the thrust bearing, the propeller shaft, and the taper roller bearing on the propeller shaft housing.

8. After installation, secure the propeller shaft housing with a vise or the like to measure the end play. Shimming shall be readjusted if the measured end play is out of specifications.



S69J6701

Propeller shaft end play:
0.25-0.35 mm (0.0098 - 0.0138 in)

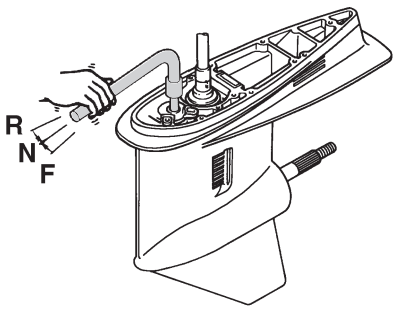
Magnet base ⑥: 90890-06705
Magnet base plate: 90890-07003
Dial gauge set ⑦: 90890-01252

Backlash (counter rotation model)

NOTE:
- Measure the backlash after removing the water pump.
- Set the gear shift in neutral position for the measurement.
- Measure the backrush for both forward and reverse gears.

Measuring the forward and reverse gear backlash

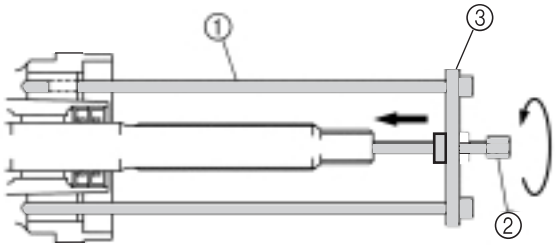
1. Set the gear shift in neutral



S69j6635

Shit rod push arm :
90890-06052

2. Secure the propeller shaft by pressing it by the special tool.



60h60660

NOTE:
Tighten the center bolt until the drive shaft cannot be turned any further.

Center bolt ②:
5 N • m (0.5 kgf • m, 4 ft • lb)

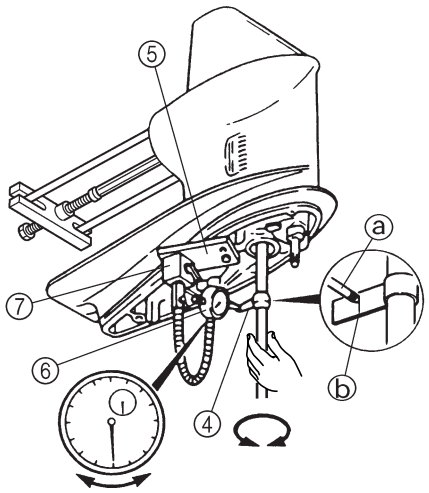
Bearing housing puller claw L ①:
90890-6502
Center bolt ②: 90890-06504
Stopper guide plate ③: 90890-6501

3. Install the backlash indicator onto the drive shaft.

NOTE:
Backlash indicator shall be installed at practicably the closest position to the lower housing, having 22.4mm of outer diameter.

Backlash indicator ③:
90890-06706

4. Set the dial gauge onto the lower unit, and fix it where the dial gauge plunger contact the mark ⓑ on the backlash indicator ⓐ.



69j6655

Magnet base plate ⑤: 90890-07003
Dial gauge set ⑥: 90890-01252
Magnet base ⑦: 90890-06705

5. Set the lower unit upside down.

6. Slowly turn the drive shaft clockwise and counterclockwise, and measure the backlash based on the dial gauge readings taken at the points where the drive shaft stops in each direction.

NOTE:
While checking, turn the drive shaft lightly without applying too much force.

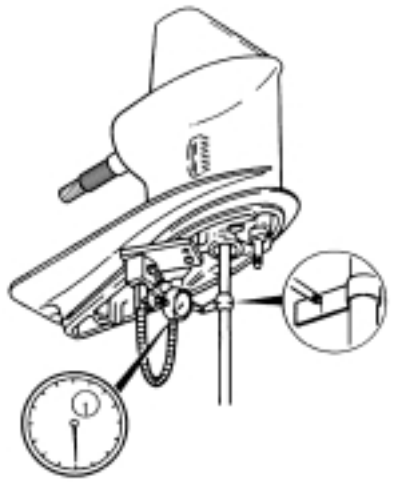
Forward gear backlash:
0.21 - 0.43 mm
(0.0083 - 0.0169 in)

Forward gear backlash M	Shim thickness(mm)
Less than 0.21 mm (0.0083 in)	To be decreased by (0.32-M) x 0.72
More than 0.43 mm (0.0169 in)	To be increased by (M-0.32) x 0.72

M : Measurement

Available shim thickness:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50

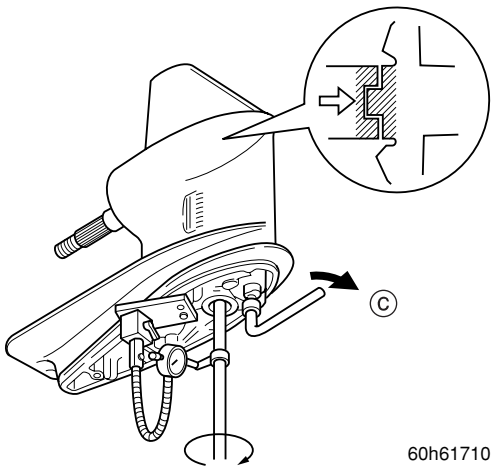
7. Remove the special service tools from the propeller shaft.



60h61700

8. Turn the shift rod into the reverse position ⓒ with the shift rod push arm.

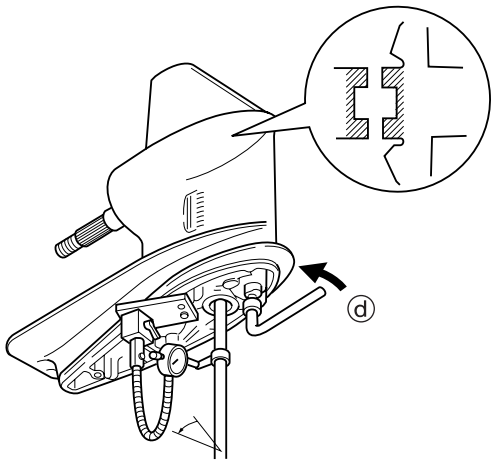
9. Turn the drive shaft clockwise until the dog clutch is fully engaged.



60h61710

10. Turn the shift rod to the neutral position ⓓ with the shift rod push arm.

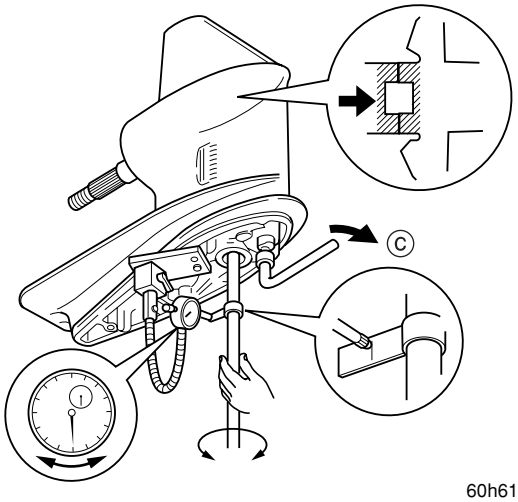
11. Turn the drive shaft counterclockwise by approximately 30°.



60h61720

12. Turn the shift rod to the reverse position ⓒ with the shift rod push arm.

13. Slowly turn the drive shaft clockwise and counterclockwise and measure the backlash when the drive shaft stops in each direction.



60h61730

Reverse gear backlash:
0.98 - 1.30 mm
(0.0386 - 0.0512 in)

6

NOTE:
When measuring the reverse gear backlash, turn the shift rod push arm towards the reverse position ⓒ with force.

14. Add or remove shim(s) if out of specification.

Reverse gear backlash M	Shim thickness(mm)
Less than 0.98 mm (0.0386 in)	To be decreased by (1.14-M) x 0.72
More than 1.30 mm (0.0512 in)	To be increased by (M-1.14) x 0.72

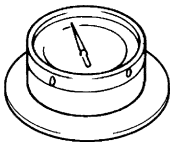
M : Measurement

Available shim thickness:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50

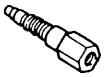
15. Remove the special service tools, and then install the water pump assembly.

Bracket unit

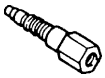
Special service tools



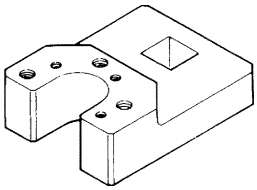
Hydraulic pressure gauge:
90890-06776



Up-relief fitting:
90890-06773

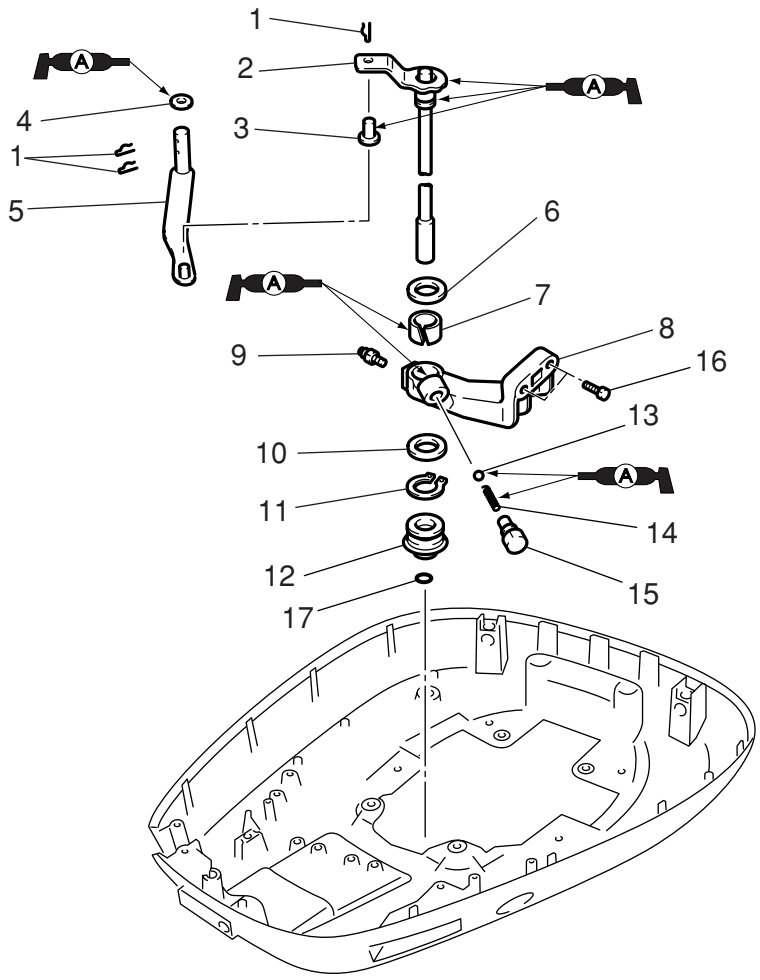


Down-relief fitting:
90890-06774



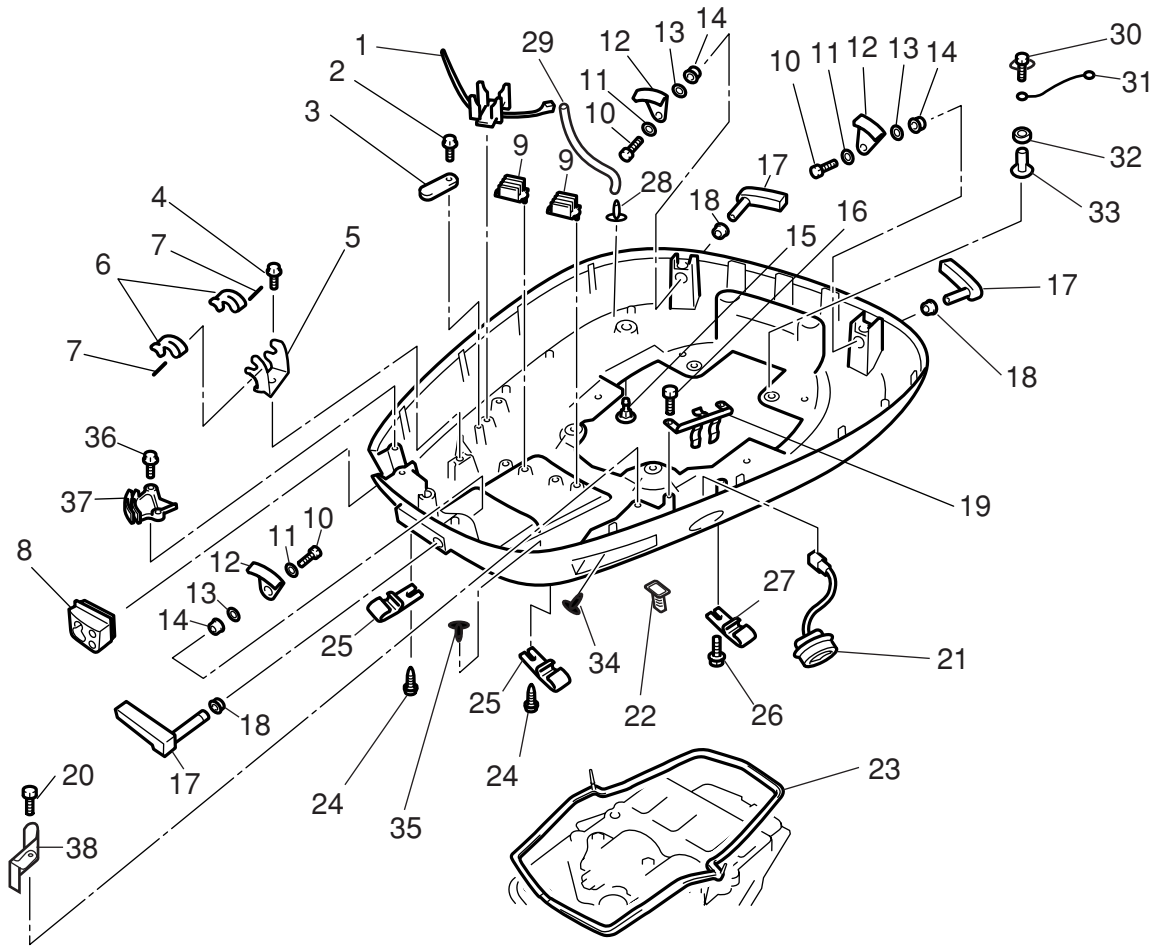
Trim & tilt wrench:
90890-06548

Bottom Cowling



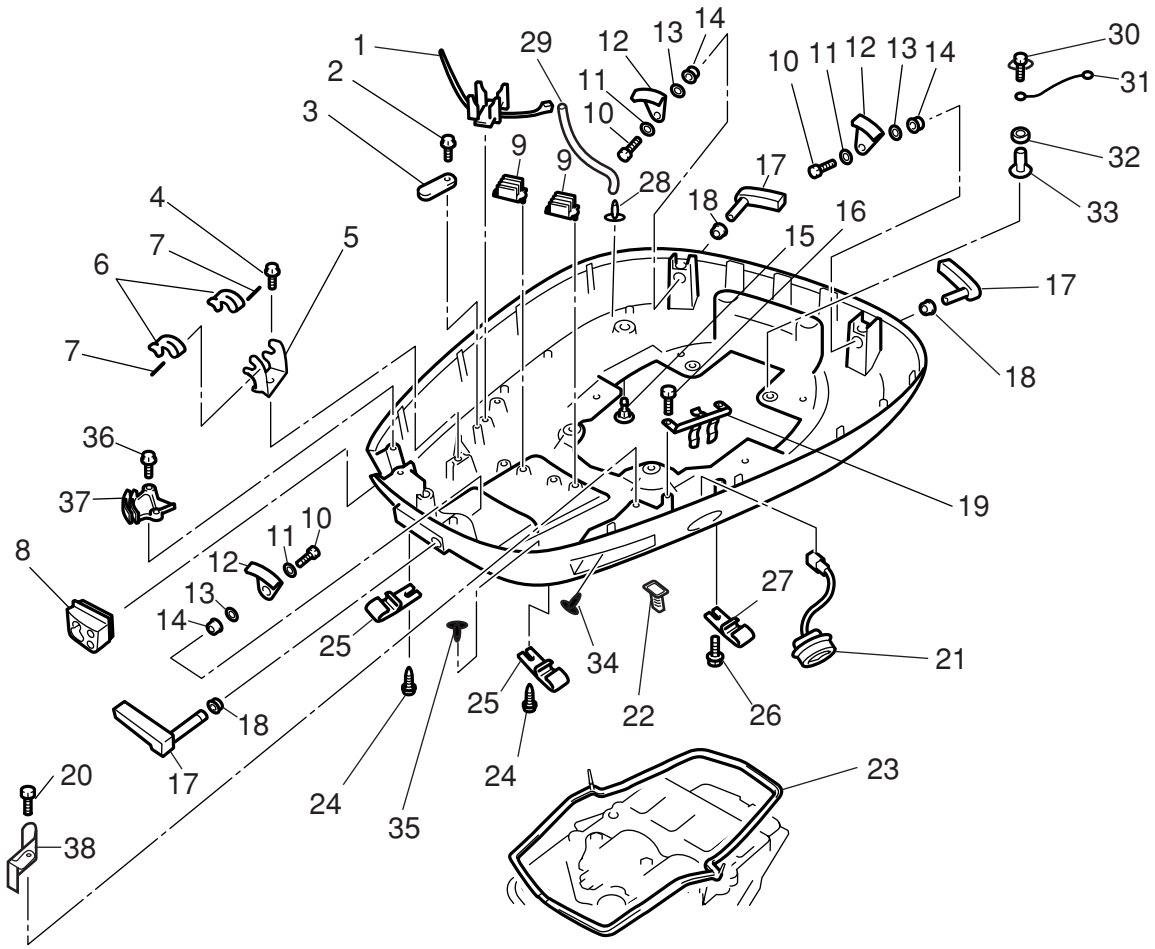
60h70010

No.	Part name	Q'ty	Remarks
1	Clip	3	
2	Shift rod	1	
3	Bush	1	
4	Washer	1	
5	Shift rod lever	1	
6	Washer	1	
7	Bush	1	
8	Shift rod bracket	1	
9	Grease nipple	1	
10	Washer	1	
11	Circlip	1	Not reusable
12	Rubber seal	1	
13	Ball	1	
14	Spring	1	
15	Bushing	1	
16	Bolt	2	M8 x 30 mm
17	O-ring	1	Not reusable



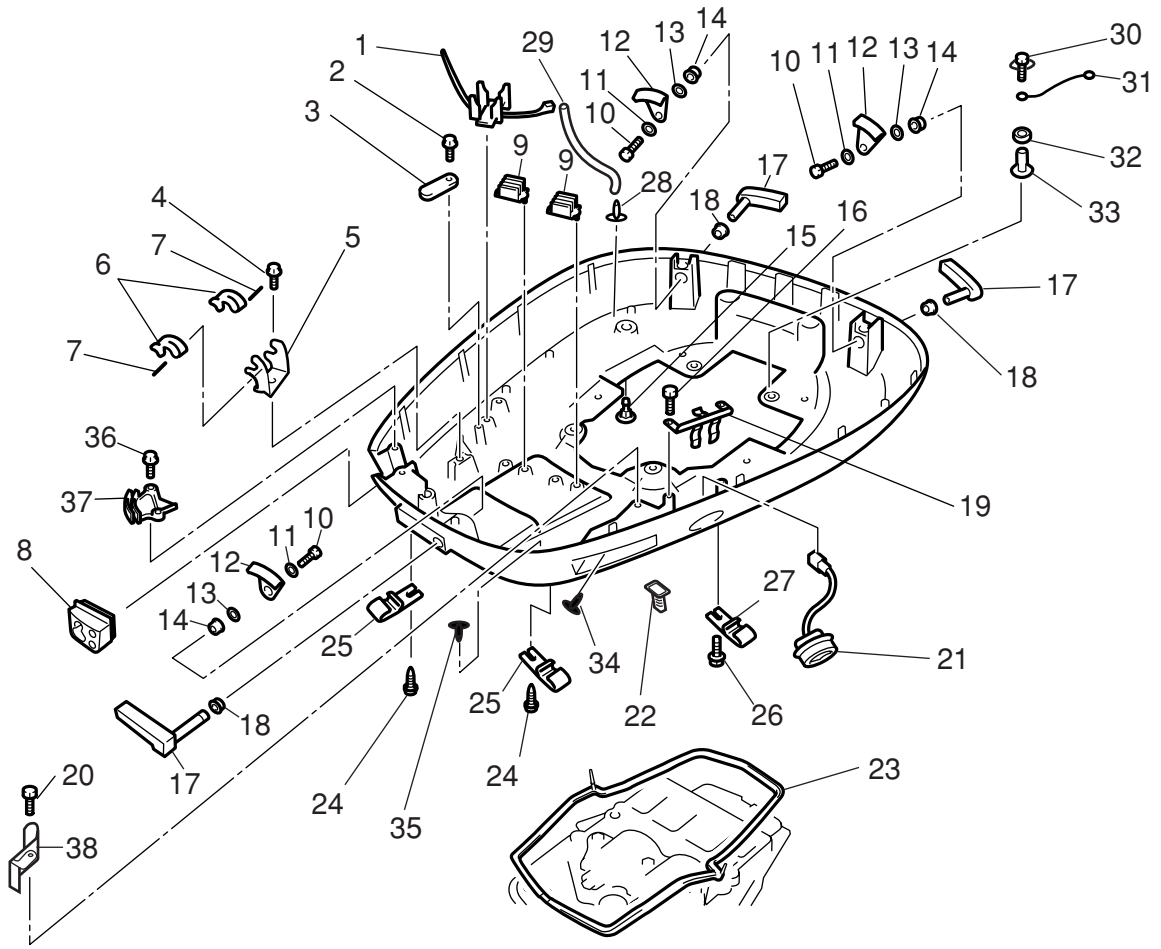
60h70020

No.	Part name	Q'ty	Remarks
1	Wire harness clamp	1	
2	Bolt	1	M6 x 20 mm
3	Plate	1	
4	Bolt	1	M8 x 20 mm
5	Bracket	1	
6	Clamp	2	
7	Pin	2	
8	Grommet	1	
9	Holder	2	
10	Bolt	3	
11	Washer	3	
12	Hook	3	
13	Washer	3	
14	Bushing	3	
15	Grommet	1	
16	Bolt	2	M6 x 10 mm
17	Lever	3	



60h70020

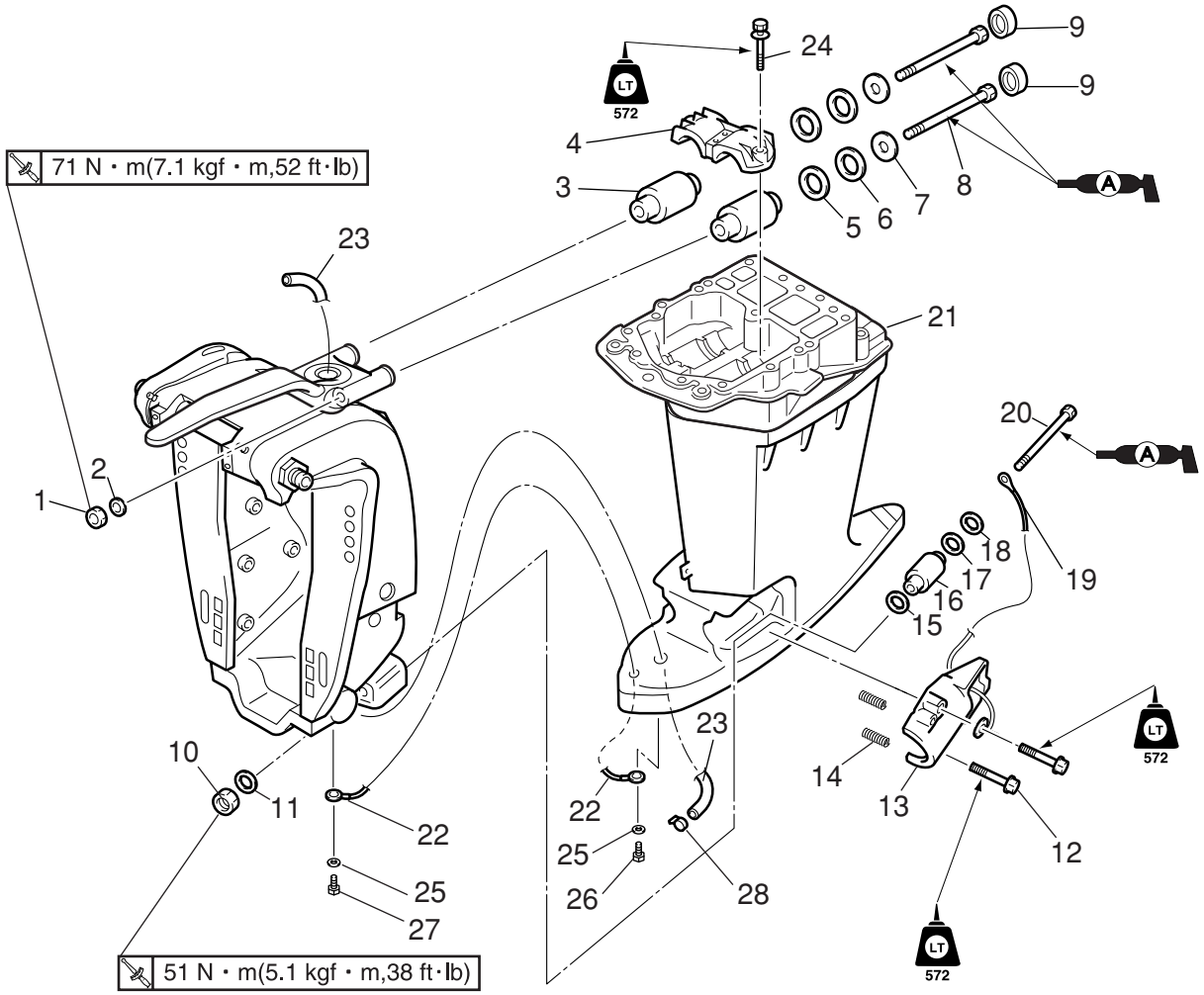
No.	Part name	Q'ty	Remarks
18	Bushing	3	
19	Trailer switch holder	1	
20	Bolt	1	M6 x 28 mm
21	Trailer switch	1	
22	Grommet	1	
23	Rubber seal	1	
24	Screw	2	
25	Clamp	2	
26	Bolt	1	M6 x 20 mm
27	Clamp	1	
28	Pilot jet	1	
29	Hose	1	
30	Bolt	4	M8 x 35 mm
31	Read	1	
32	Grommet	4	
33	Collar	4	
34	Grommet	1	



60h70020

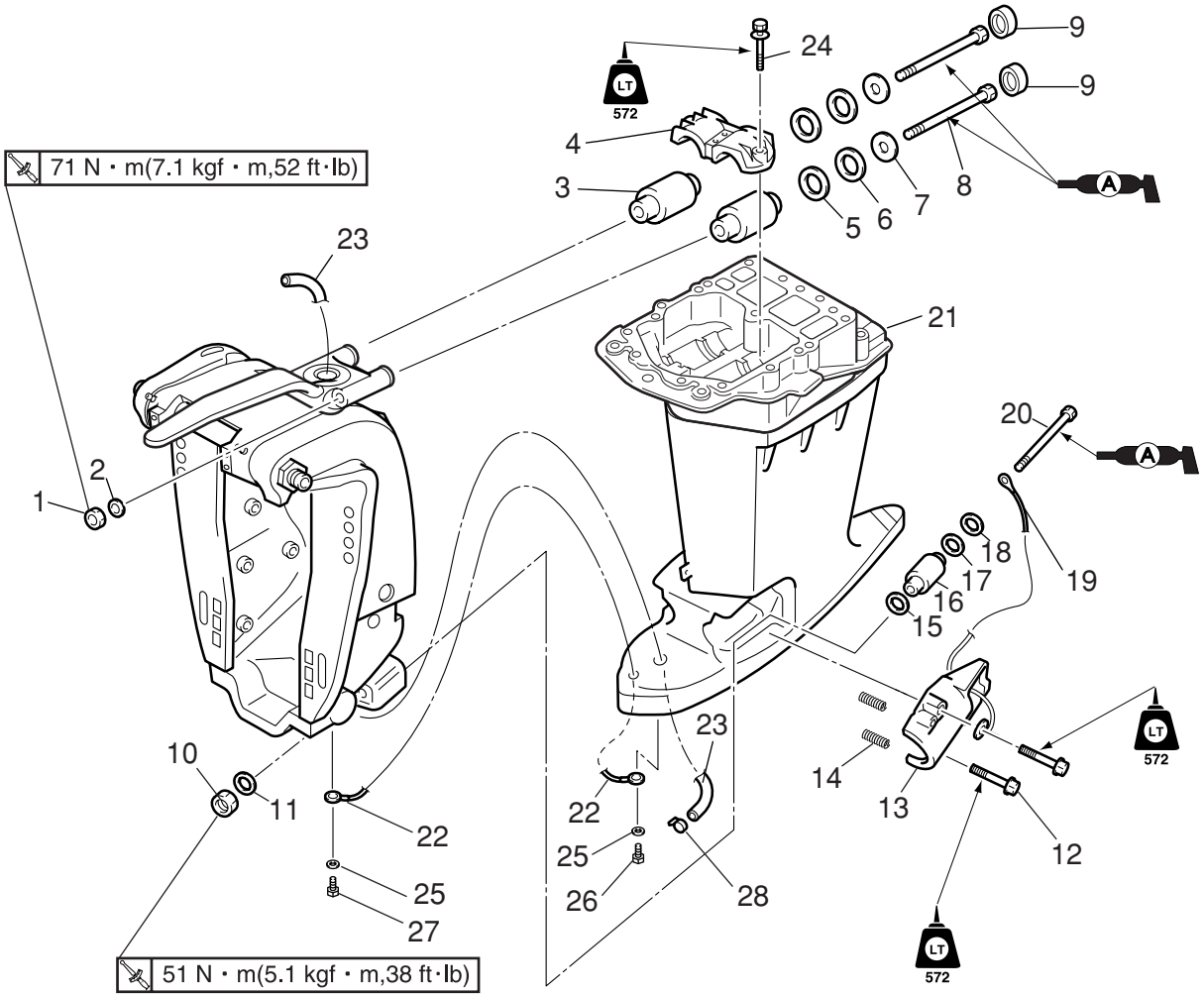
No.	Part name	Q'ty	Remarks
35	Grommet	1	
36	Bolt	2	M6 x 15 mm
37	Retaining plate	1	
38	Clamp	1	

Upper case



60h70030

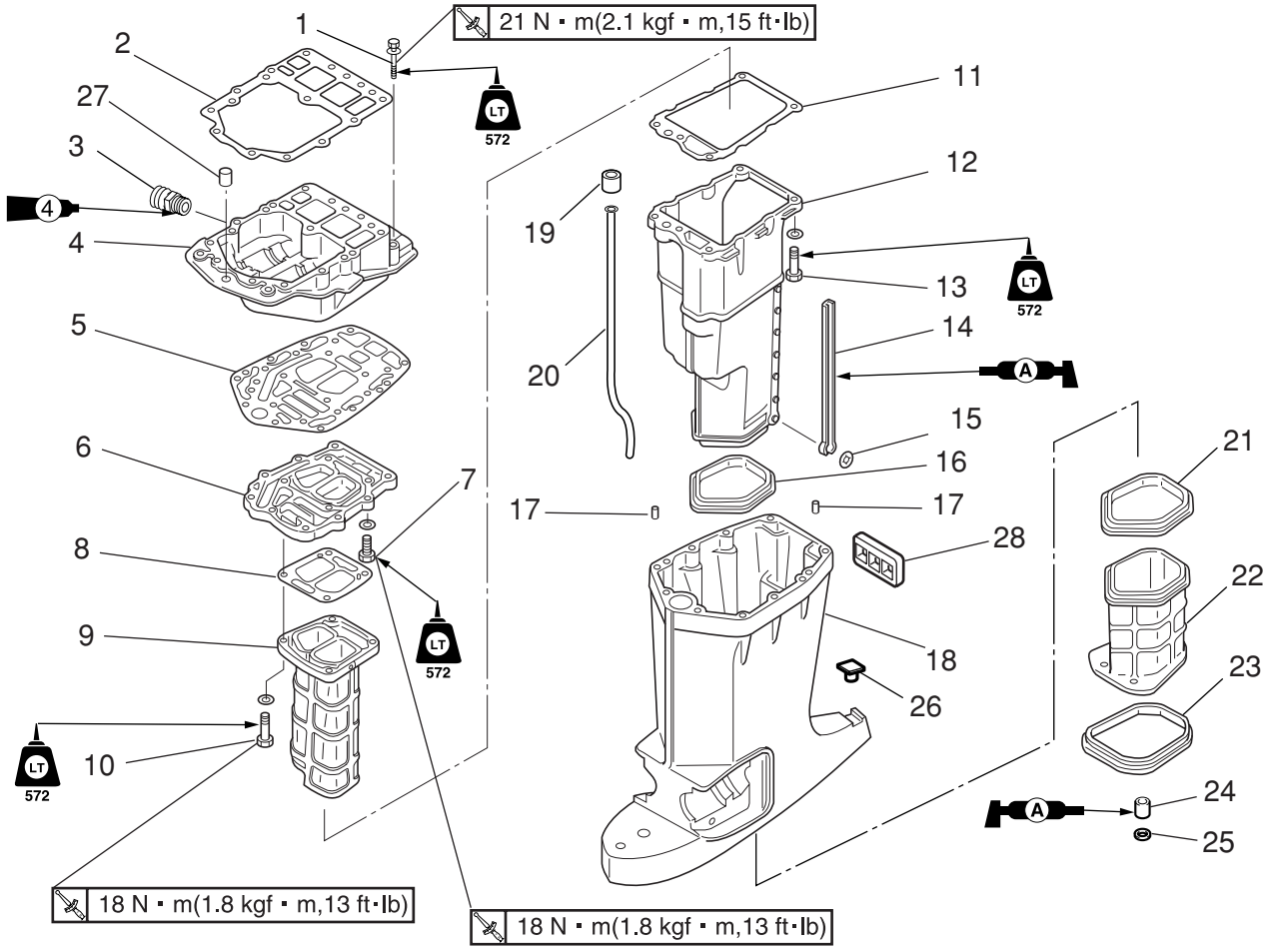
No.	Part name	Q'ty	Remarks
1	Nut	2	
2	Washer	2	
3	Upper mount	2	
4	Bracket	1	
5	Washer	2	
6	Washer	2	
7	Washer	2	
8	Bolt	2	M12 x 190 mm
9	Bushing	2	
10	Nut	2	
11	Washer	2	
12	Bolt	4	M10 x 45 mm
13	Mount housing	2	
14	Spring	4	
15	Washer	2	
16	Lower mount	2	
17	Washer	2	



60h70030

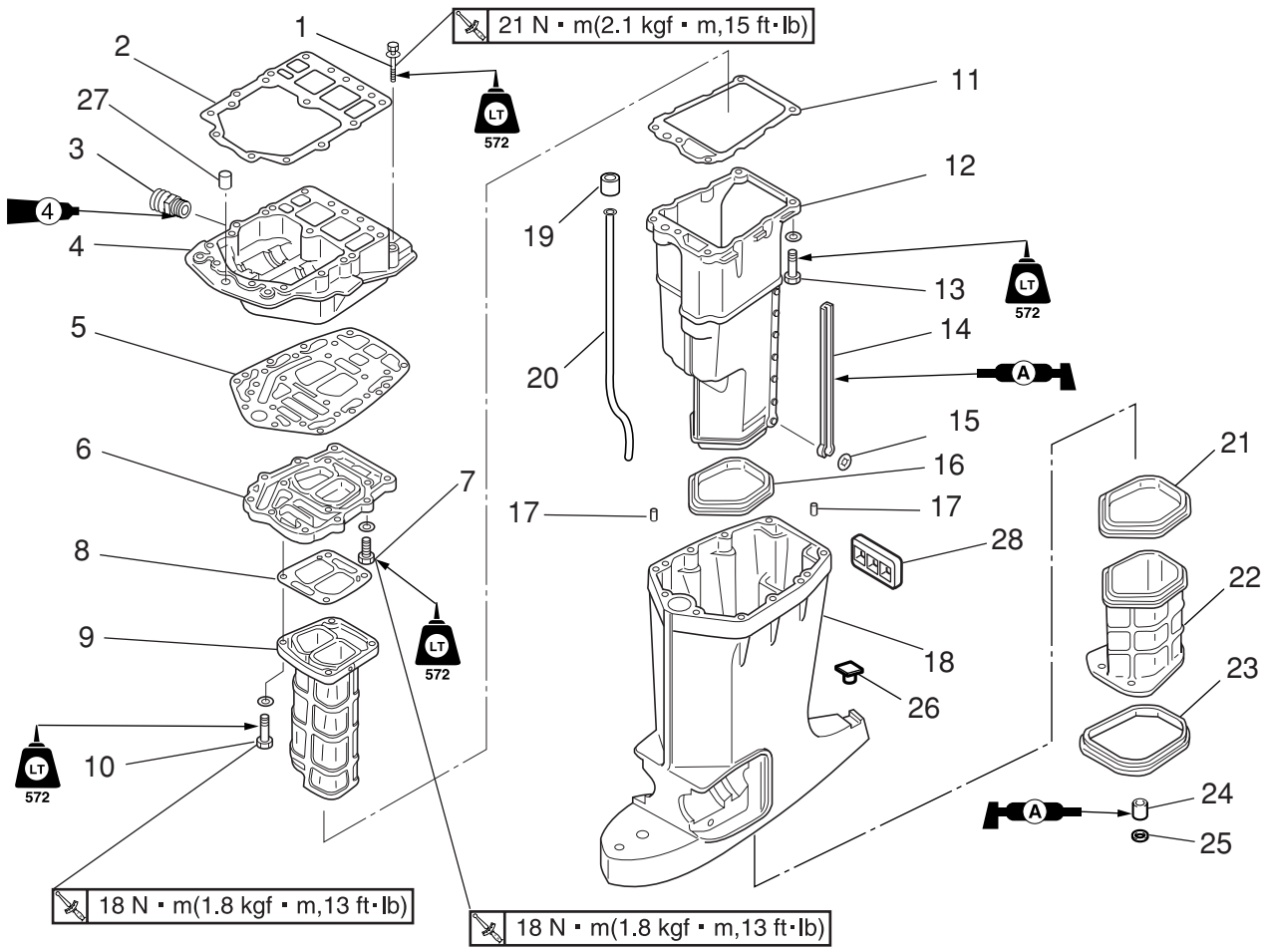
No.	Part name	Q'ty	Remarks
18	Washer	2	
19	Ground lead	1	
20	Bolt	2	M14 x 180 mm
21	Upper case assembly	1	
22	Ground lead	1	
23	Hose	1	
24	Bolt	3	M10 x 45 mm
25	Washer	2	
26	Bolt	1	M6 x 10 mm
27	Bolt	4	M6 x 30 mm
28	Plastic tie	1	Not reusable

60h70040



60h70040

No.	Part name	Q'ty	Remarks
1	Bolt	6	M8 x 45 mm
2	Gasket	1	Not reusable
3	Union joint	1	
4	Upper exhaust guide	1	
5	Gasket	1	Not reusable
6	Lower exhaust guide	1	
7	Bolt	7	M8 x 30 mm
8	Gasket	1	Not reusable
9	Exhaust manifold	1	
10	Bolt	4	M8 x 45 mm
11	Gasket	1	Not reusable
12	Muffler	1	
13	Bolt	4	M8 x 45 mm
14	Rubber damper	2	
15	Clip	2	
16	Rubber seal	1	
17	Dowel	2	



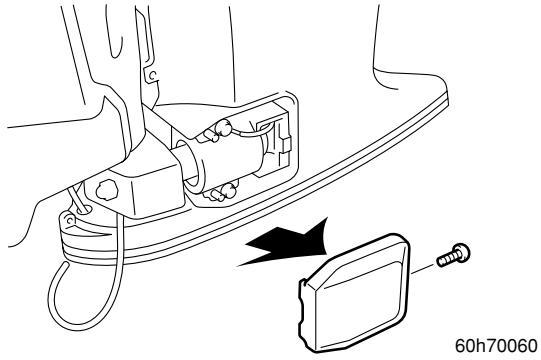
60h70040

No.	Part name	Q'ty	Remarks
18	Upper case	1	
19	Rubber seal	1	
20	Pipe	1	
21	Rubber seal	1	X transom
22	Muffler 2	1	X transom
23	Rubber seal	1	X transom
24	Bushing	1	X transom
25	Circlip	1	X transom
26	Cap	1	
27	Grommet	1	
28	Rubber seal	1	

Removing the upper case

1. Disconnect the ground lead.

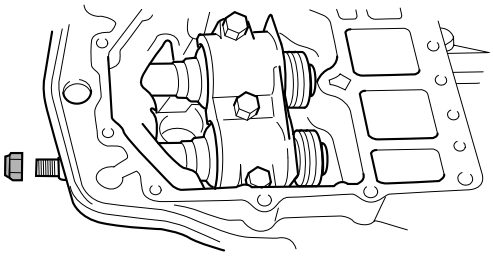
2. Remove the lower mount cover.

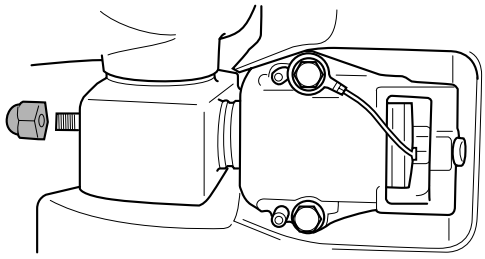


60h70060

NOTE:
Cover may pop up by the spring force. Hold it down by hand when loosening the screw.

3. Remove the lower case by loosening the upper mount and lower mount nuts.





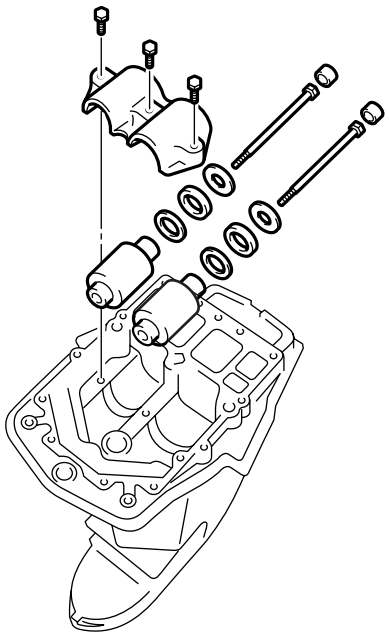
60h70065

Disassembling the upper case

1. Remove the pressure control valve hose, exhaust rubber seal, and upper exhaust guide rubber seal.

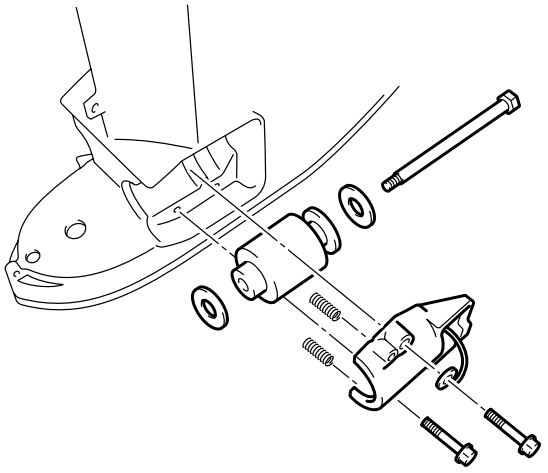
NOTE:
Upper exhaust guide rubber seal is attached with adhesive.

2. Remove the upper mount bracket.



60h70070

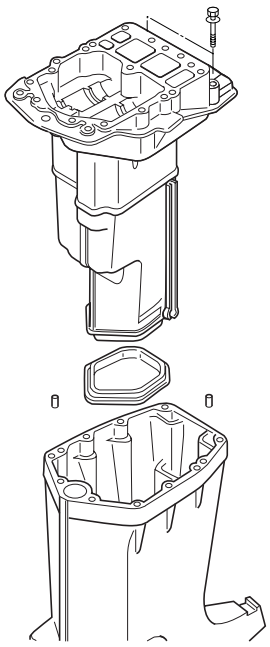
3. Remove the lower mount bracket.



60h70080

7

5. Remove the muffler assembly, the rubber seal and dowels.

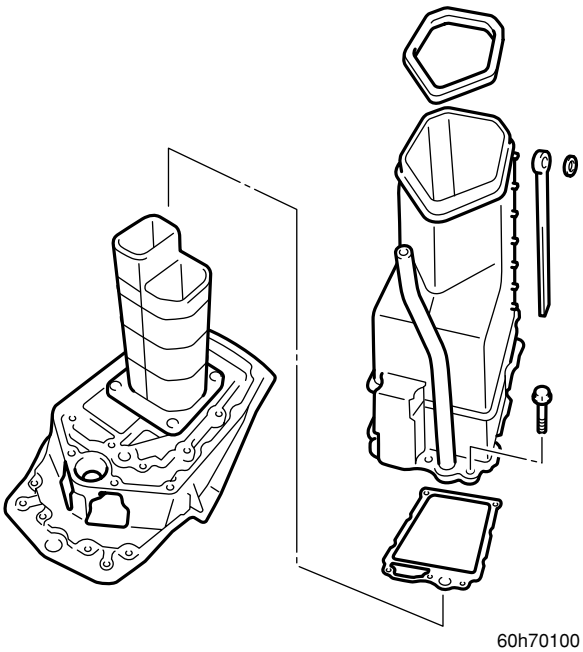


60h70090

NOTE:
In addition, remove the muffler 2 for X transom model. Muffler 2 is to be removed downward.

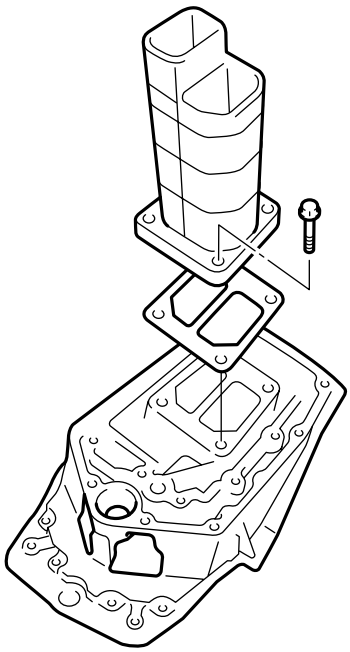
5. Remove the muffler.

6. Remove the water tube and rubber damper from the muffler.



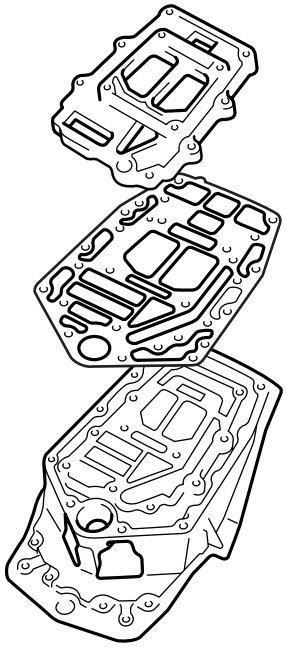
60h70100

7. Remove the exhaust manifold.



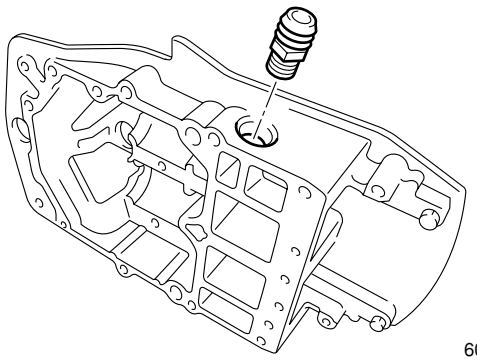
60h70110

8. Remove the lower exhaust guide.



60h70120

9. Remove the pressure control valve union joint from the upper exhaust guide.



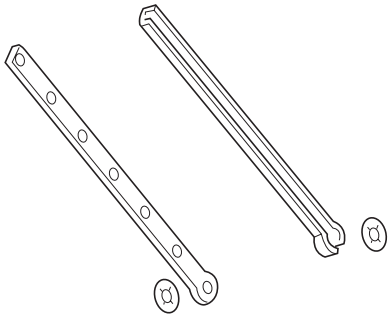
60h70130

Checking the upper case

1. Check the union joint and hose for damage. Replace if necessary.

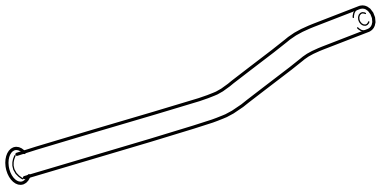
60h70140

2. Check the rubber damper for deterioration. Replace if necessary.



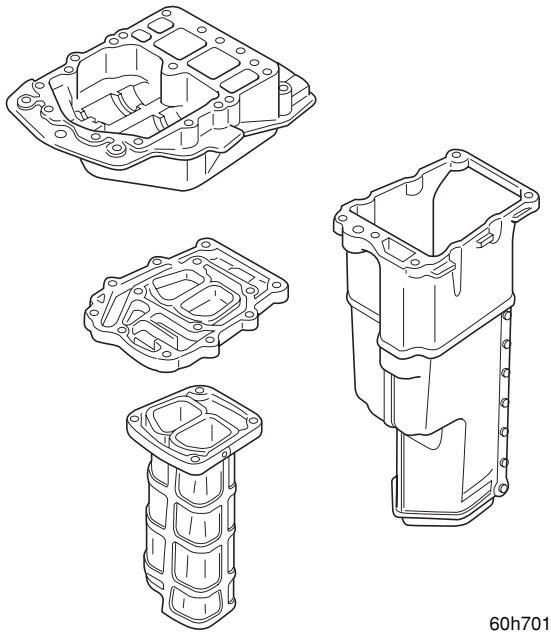
60h70150

3. Check the water tube for deformation or corrosion. Replace if necessary.



60h70160

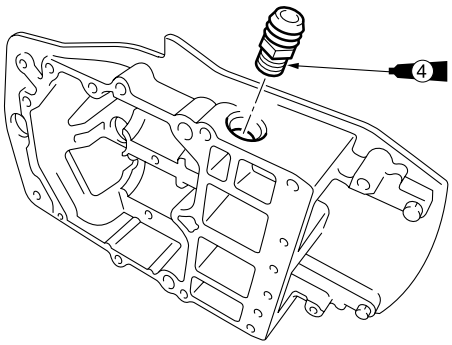
4. Check the exhaust guide, exhaust manifold, and muffler for damage or corrosion. Replace if necessary.



60h70170

Assembling the upper case

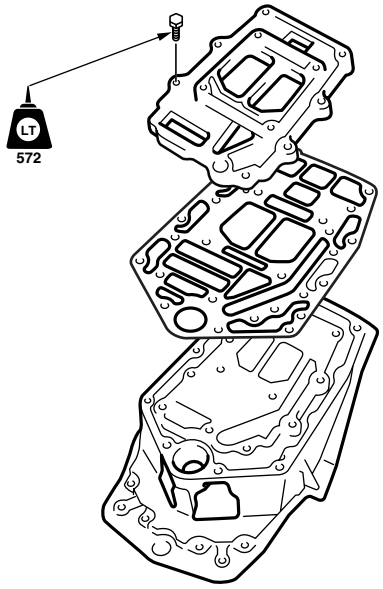
1. Install the pressure control valve union joint to the upper exhaust guide.



60h70175

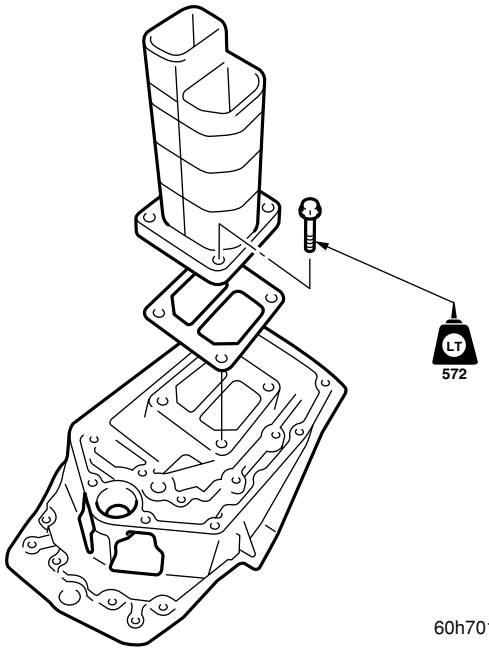
7

2. Install a new gasket and the lower exhaust guide onto the upper exhaust guide. Temporarily tighten the bolts.



60h70180

3. Install exhaust manifold and a new gasket. Tighten up all the bolts.



60h70190

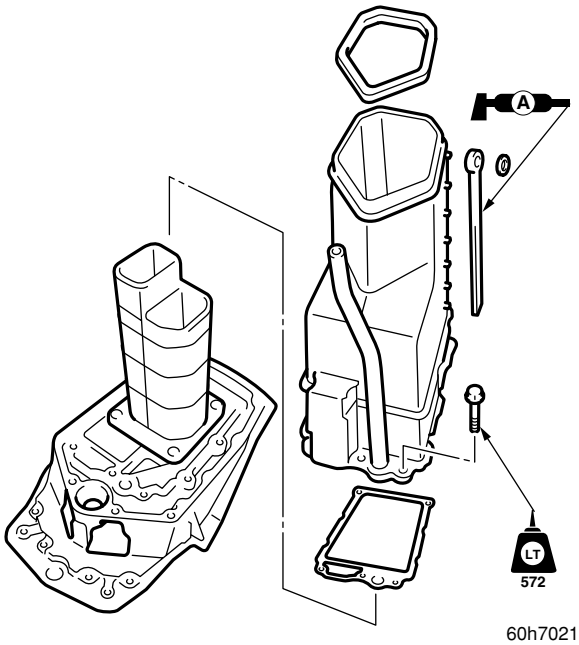
	Exhaust manifold bolts: 18 N • m(1.8 kgf • m, 13 ft • lb)

4. Install the rubber damper and spring nut on the muffler. Also install the water seal and water tube.

NOTE:
Install the water tube so that it fits in the water pump.

5. Install a new gasket on the muffler that has been fitted with the components specified above.

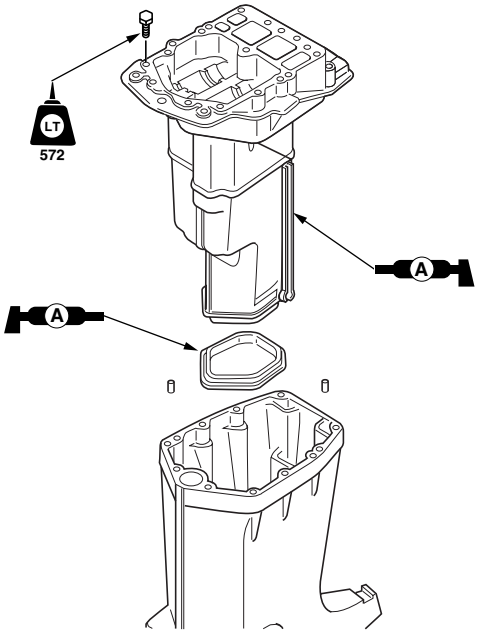
6. Install a new rubber seal on the muffler assembly. Also install the dowels and a new rubber seal on the upper case.



60h70210

NOTE:
Install the muffler 2 first for X transom model.

7. Install the muffler assembly to the upper case.



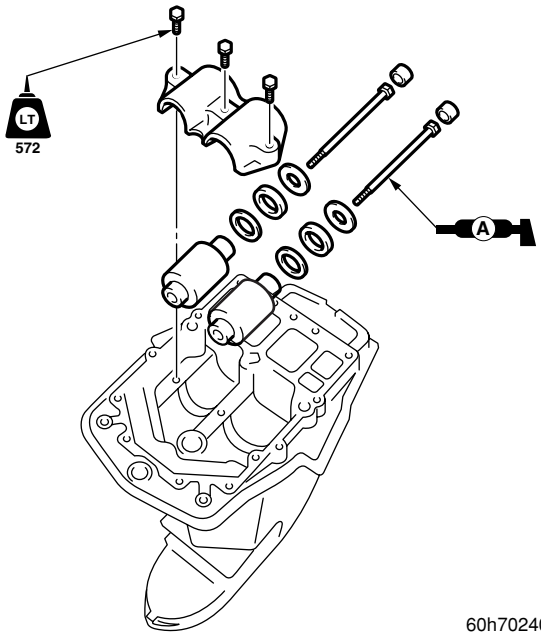
60h70230

NOTE:

Apply Yamaha grease A at the tip of water pump tube, and positively fit it into the hole on the upper case.

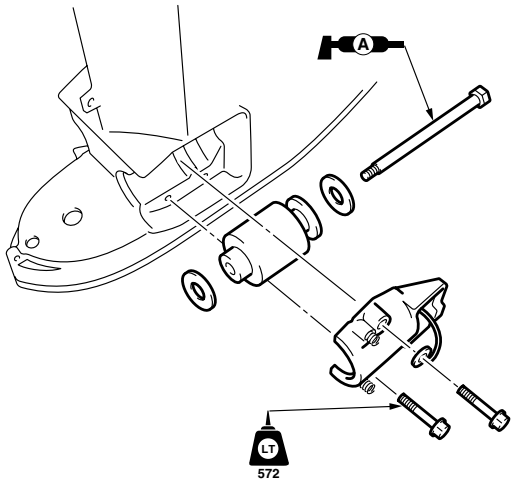
	Upper case bolts: 21 N • m (2.1 kgf • m, 5 ft • lb)

8. Install the upper mount bracket.



60h70240

9. Install the springs on the lower mount bracket, and attach the lower mount onto the upper case.



60h70250

NOTE:

Fit the spring in the groove for installation.

10. Install the pressure control valve union joint and hose, exhaust rubber seal, and upper exhaust guide rubber seal.

NOTE:

Attach the upper exhaust guide rubber seal with adhesive.

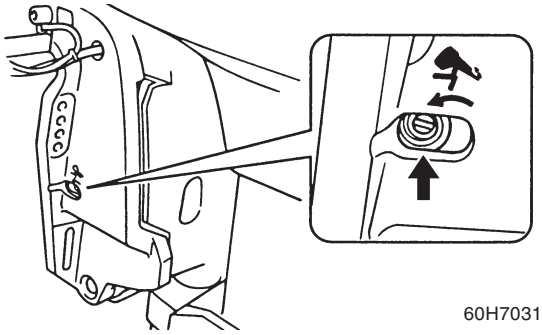
7

Power trim and tilt unit

Bleeding the power trim and tilt unit (Built-in)

NOTE:
Check the fluid level before bleeding if the power trim and tilt unit does not operate while PTT motor is working.

1. Turn the manual valve counterclockwise to the full extent.



60H70310

2. Fully tilt up the outboard motor, and release it to let it down by its own weight. Repeat this operation four or five times.

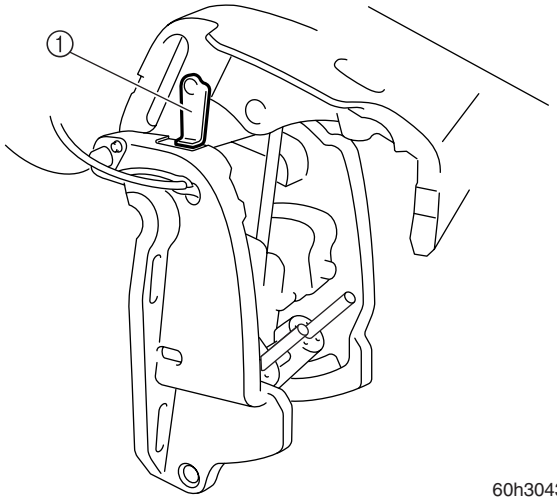
3. Turn the manual valve clockwise to the full extent.

4. Let the fluid settle for 5 minutes.

5. Push and hold the power trim and tilt switch in the up position to check that the outboard motor is fully tilted up.

NOTE:
Overhaul the power trim and tilt unit if the outboard motor cannot be tilted up to the full extent.

6. Lock the outboard motor with the tilt stop lever ①.

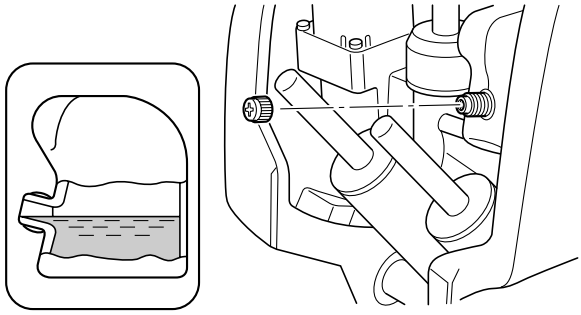


60h30430

⚠ WARNING

After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.

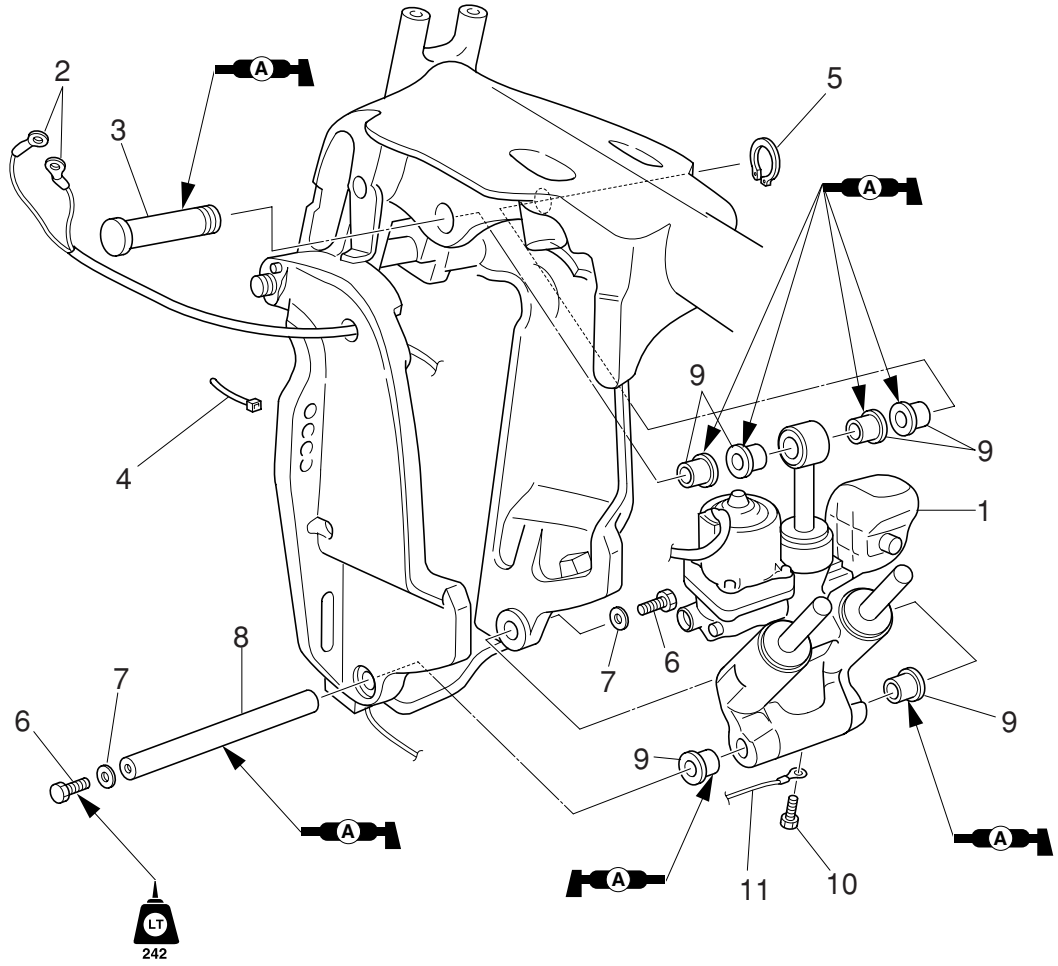
7. Remove the reservoir cap, and check the fluid level. If the level is low, add sufficient fluid of the recommended type.



60h70360

Recommended power trim and tilt fluid:
ATF Dexron II

NOTE:
Repeat the procedures described above until the fluid level becomes stable.

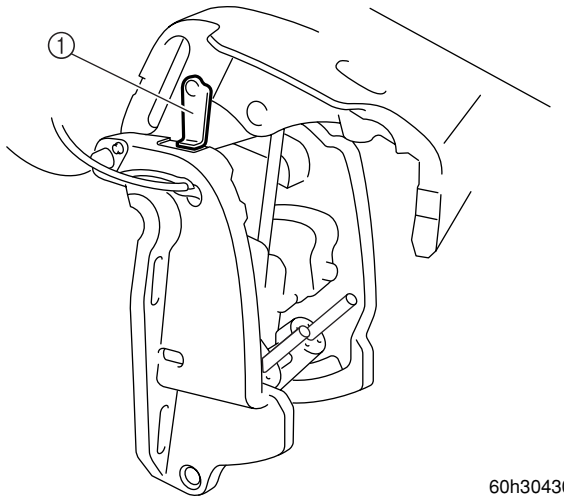


60h70290

No.	Part name	Q'ty	Remarks
1	Power trim and tilt unit	1	
2	PTT motor lead	2	
3	Shaft	1	
4	Plastic tie	3	Not reusable
5	Circlip	1	Not reusable
6	Bolt	2	M8 x 16 mm
7	Washer	2	
8	Shaft	1	
9	Bushing	6	
10	Bolt	1	M6 x 10 mm
11	Ground lead	1	

Removing the power trim and tilt unit

1. Fully tilt up the outboard motor, and lock it with the tilt stop lever ①.



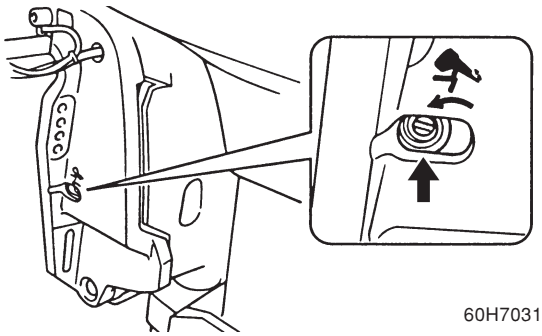
60h30430

⚠ WARNING

After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.

NOTE:

If the power trim and tilt does not operate, loosen the manual valve and tilt up the outboard motor by hands. Tighten the manual valve.

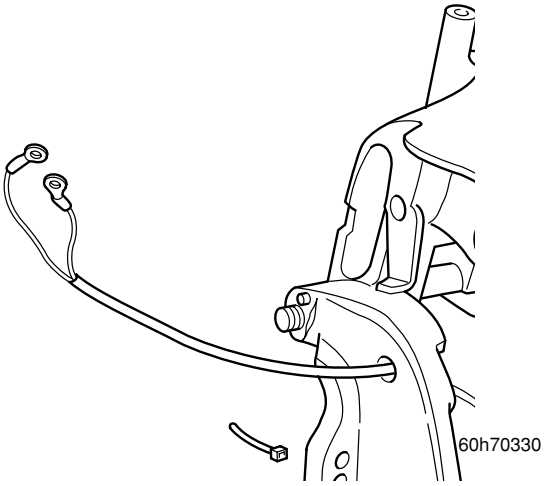


60H70310

Manual valve:
3 N • m(0.3kgf • m, 3 ft • lb)

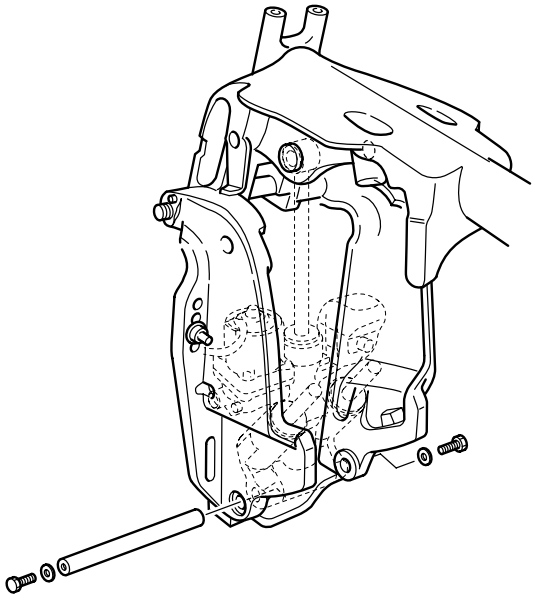
2. Disconnect the ground lead under the power trim and tilt unit.

3. Remove the plastic tie, and pull out the PTT motor lead.



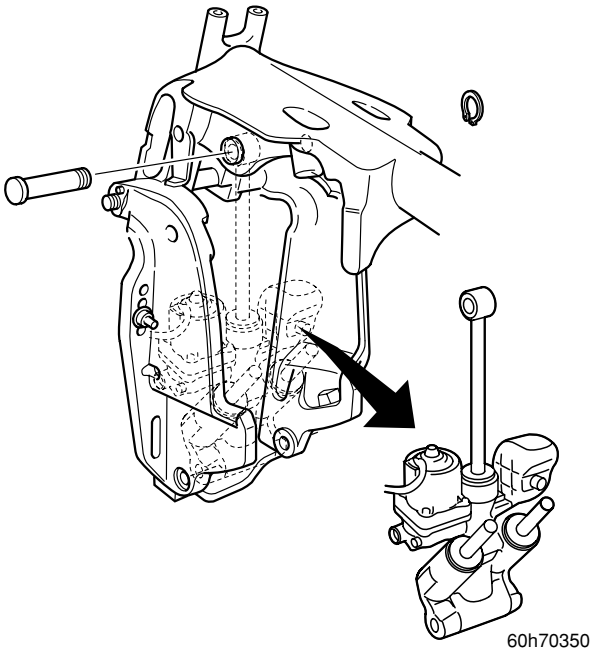
60h70330

4. Remove the bolts, and pull out the lower mount shaft.



60h70340

5. Remove the circlip, and pull out the upper mount shaft.

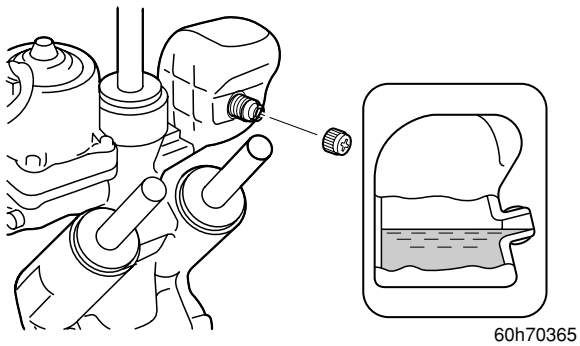

60h70350

NOTE:
Pull out the upper mount pins downwardly at an angle, while holding the power trim and tilt unit with a hand.

6. Remove the collar.

Checking the hydraulic pressure of the power trim and tilt unit

1. Check the fluid level. If it is lower than the correct level, add sufficient fluid of the recommended type. Install the reservoir cap after checking the fluid level.


60h70365

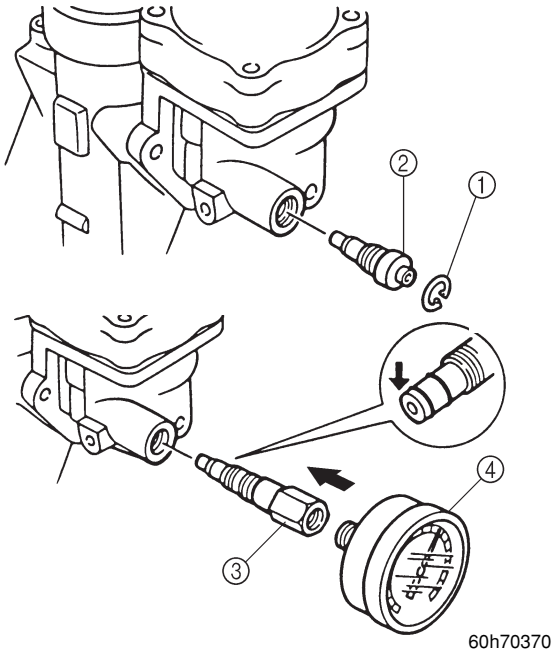
NOTE:
If the fluid is at the correct level, the fluid should overflow out of the check hole when the cap is removed.

Reservoir cap:
0.7 N • m(0.07kgf • m, 0.5 ft • lb)

Recommended power trim and tilt fluid:
ATF Dexron II

2. Fully extend the power trim and tilt rods.

3. Remove the circlip ① and manual valve ②. Install the hydraulic pressure gauge ④ and up-relief fitting ③.



60h70370

NOTE:
Quickly install the hydraulic pressure gauge and up-relief fitting so that the fluid will not flow out of the hole.

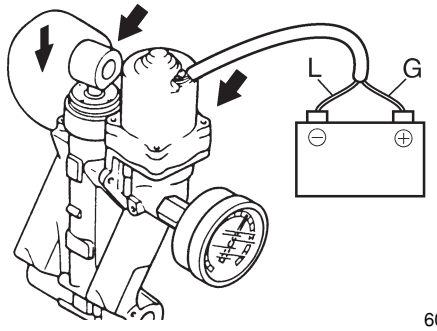
Hydraulic pressure gauge ④:
90890-06776
Up-relief fitting ③: 90890-06773

4. Tighten up the hydraulic pressure gauge and up-relief fitting.

Hydraulic pressure gauge ④:
9 N • m (0.9 kgf • m, 6 ft • lb)
Up-relief fitting ③:
4 N • m (0.4 kgf • m, 3 ft • lb)

7

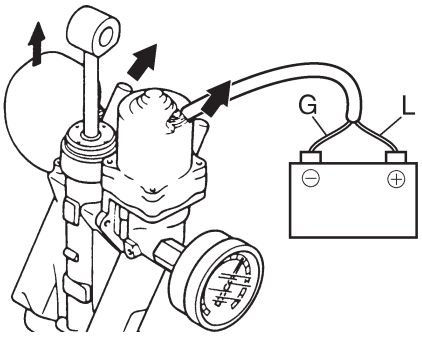
5. Connect the power trim and tilt motor leads to the battery terminals, and fully retract the trim and tilt rods.



60h70380

Rods	PTT motor leads	Battery terminal
DOWN	Green(G)	+
	Blue(L)	–

6. Connect the power trim and tilt motor leads to the battery terminals, and fully extend the trim and tilt rods. Measure the hydraulic pressure while keeping the rods at fully extended position.

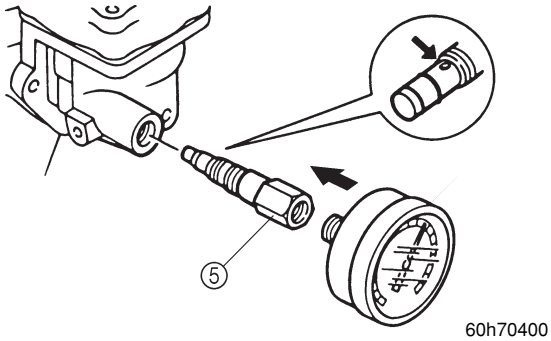


60h70390

Rods	PTT motor leads	Battery terminal
UP	Blue(L)	+
	Green(G)	–

Hydraulic pressure (UP):
10-12 Mpa(100-120 kgf/cm^2)

7. Replace the up-relief fitting with the down-relief fitting ⑤.



60h70400

Hydraulic pressure gauge:
90890-06776
Down-relief fitting :
90890-06774

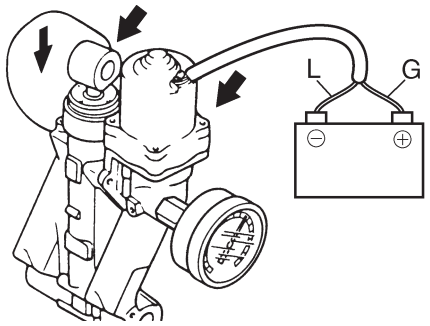
8. Tighten up the hydraulic pressure gauge and down-relief fitting.

Hydraulic pressure gauge:
9 N • m (0.9 kgf • m, 6 ft • lb)
Down-relief fitting ⑤:
4 N • m (0.4 kgf • m, 3 ft • lb)

9. Check the fluid level. If it is lower than the correct level, add sufficient fluid of the recommended type. Install the reservoir cap after checking the fluid level.

NOTE:
If the fluid is at the correct level, the fluid should overflow out of the check hole when the cap is removed.

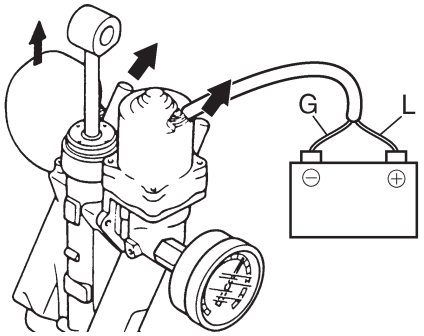
10. Connect the power trim and tilt motor leads to the battery terminals, and fully retract the trim and tilt rods. Measure the hydraulic pressure while keeping the rods at fully retracted position.



Rods	PTT motor leads	Battery terminal
DOWN	Green(G)	+
	Blue(L)	–

Hydraulic pressure (DOWN):
6-9 Mpa (60-90 kgf/cm^2)

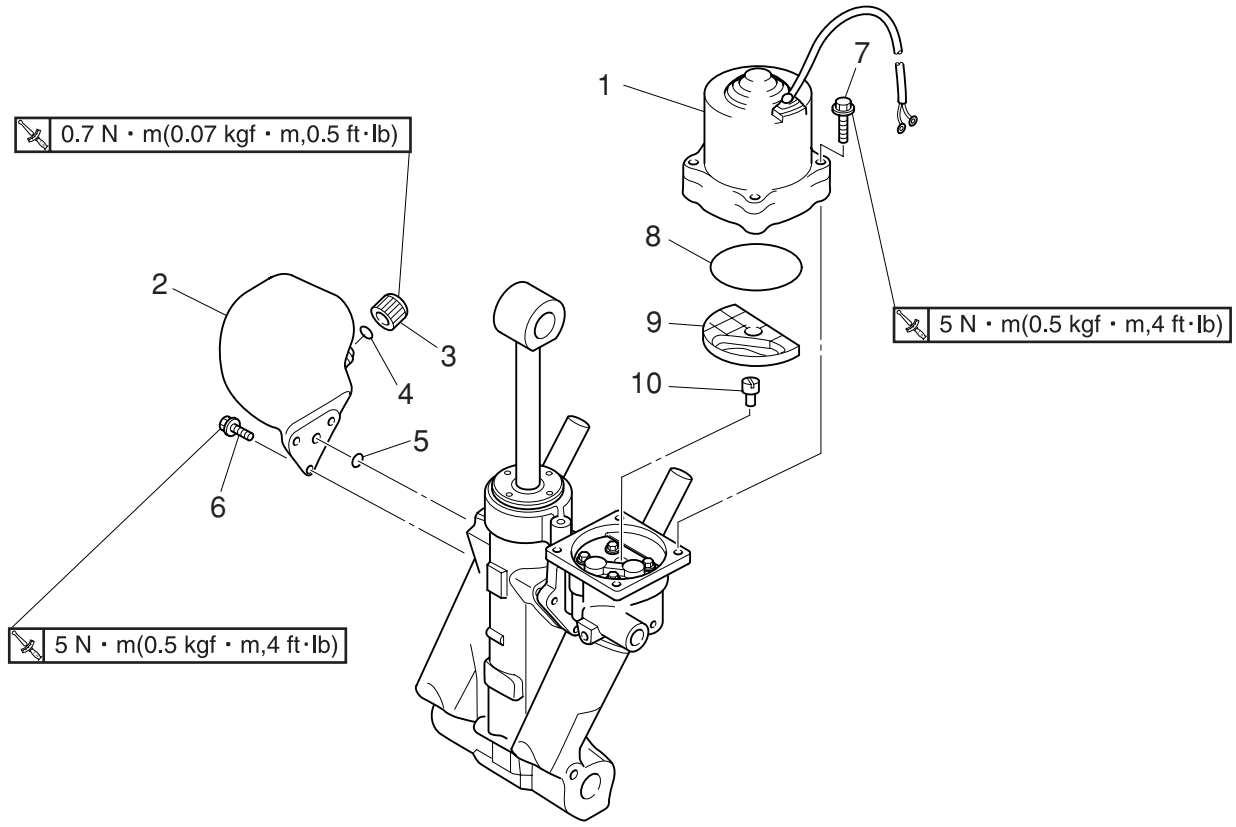
11. Connect the power trim and tilt motor leads to the battery terminals, and fully extend the trim and tilt rods.



Rods	PTT motor leads	Battery terminal
UP	Blue(L)	+
	Green(G)	–

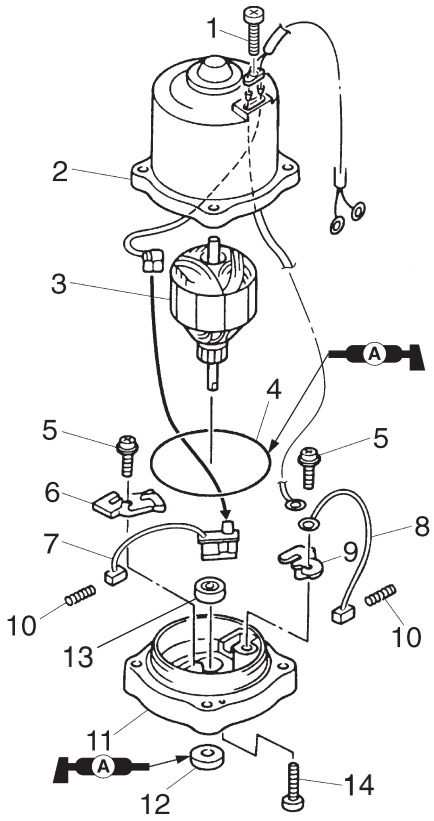
12. If the hydraulic pressure falls within the specification, remove the hydraulic pressure gauge and down-relief fitting, and reinstall the manual valve and circlip.
If the hydraulic pressure is out of specification, overhaul the power trim and tilt unit.

PTT motor and Reservoir



60h70440

No.	Part name	Q'ty	Remarks
1	Power trim and tilt motor	1	
2	Reservoir	1	
3	Reservoir cap	1	
4	O-ring	1	Not reusable
5	O-ring	1	Not reusable
6	Bolt	3	1/4 x 35 mm
7	Bolt	4	1/4 x 35 mm
8	O-ring	1	Not reusable
9	Filter	1	
10	Joint	1	

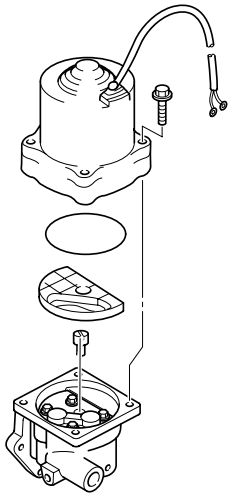


60H70445

No.	Part name	Q'ty	Remarks
1	Screw	1	M4 x 15 mm
2	Stator	1	
3	Armature	1	
4	O-ring	1	Not reusable
5	Screw	2	M4 x 10 mm
6	Brush holder	1	
7	Brush 2	1	
8	Brush 1	1	
9	Brush holder	1	
10	Brush spring	2	
11	PTT motor base	1	
12	Oil seal	1	Not reusable
13	Bearing	1	
14	Screw	2	M4 x 15 mm

Disassembling the PTT motor

1. Remove the PTT motor, O-ring, filter, and drive pin.



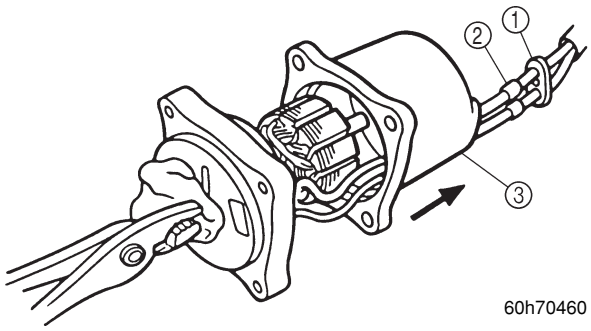
60h70450

CAUTION:

Make sure that the tilt rod and trim rods are fully extended when removing the PTT motor. If they are not, fluid may spurt out from the unit due to the internal pressure. Do not push down the tilt and trim rods while the PTT motor is removed. Fluid may spurt out from the unit.

2. Clean the filter, and check it for damage. Replace the filter if it is damaged.

3. Slide out the lead holder ① and rubber spacer ②. Then, slide out the stator ③. Remove the stator ③.



60h70460

NOTE:

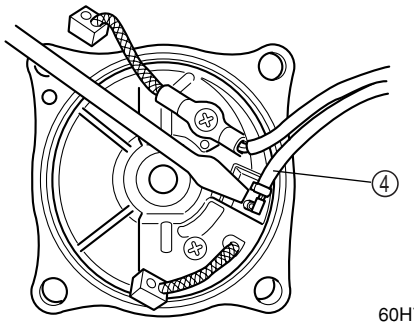
Place a clean cloth over the end of the armature shaft, and hold it with a pair of pliers, while pulling out the stator ③ carefully.

4. Remove the armature.

CAUTION:

Do not allow grease or oil to contact the commutator while working on it.

5. Disconnect the blue(L) lead ④.

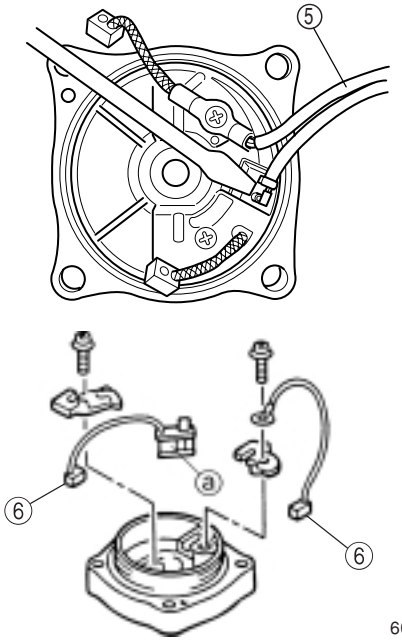


60H70470

NOTE:

Hold down the brush while pulling out the lead.

6. Disconnect the green (G) lead ⑤, and remove the brush ⑥.



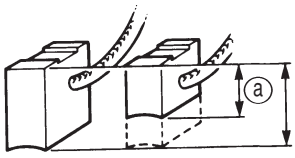
60H70480

CAUTION:

- **Do not pull out the PTT motor lead from the stator.**
- **Do not touch the bimetal ⓐ, otherwise the operation of the circuit breaker may be affected.**

Checking the PTT motor

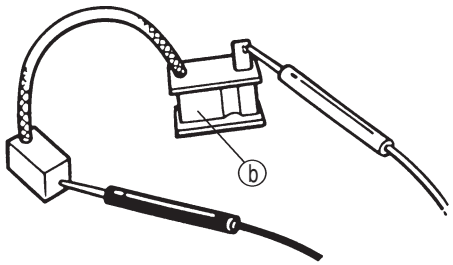
1. Check the blush length ⓐ. Replace the blush if it is shorter than the specified limit.



60h70490

Brush length limit ⓐ:
4.8 mm (0.19 in)

2. Check the brush and circuit breaker for continuity. Replace them if there is no continuity.

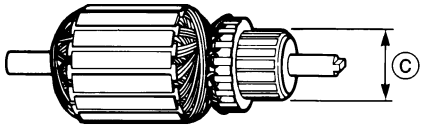


60h70500

CAUTION:

Do not touch the bimetal ⓑ, otherwise the operation of the circuit breaker may be affected.

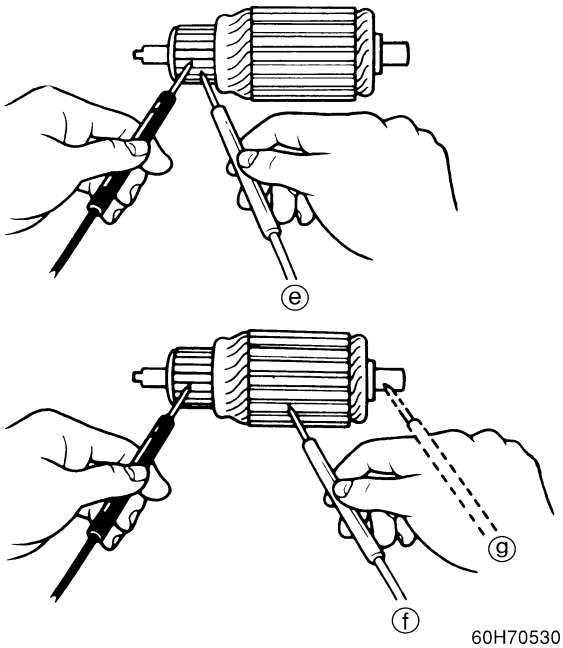
3. Check the commutator diameter. Replace it if the diameter is smaller than the limit.



60h70510

Commutator diameter limit ⓒ:
21 mm (0.83 in)

4. Check the armature coil for continuity. Replace it if the continuity is out of specification.

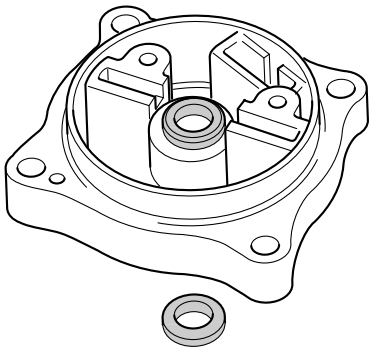


60H70530

Armature coil continuity:

Commutator segments ⓔ	Continuity
Segment ⓔ - Laminations ⓕ	No continuity
Segment ⓔ - Shaft ⓖ	No continuity

5. Check the base for cracks or damage. Check that the bearing and oil seal have no flaw. Replace if necessary.

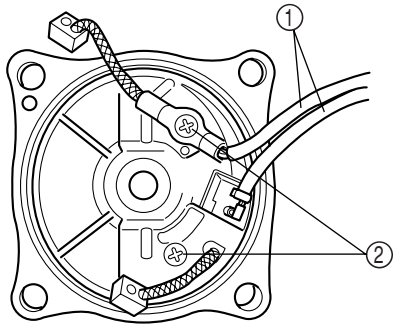


60h70540

NOTE:
When the bearings and oil seals are removed, always replace them with new ones.

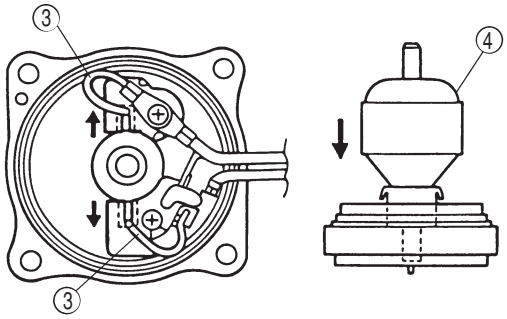
Assembling the PTT motor

1. Connect the leads ①, and tighten up the screw ②.



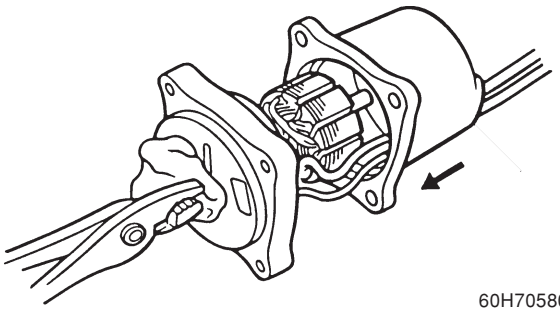
60h70560

2. Push the brush ③ into the brush holder while installing the armature ④.



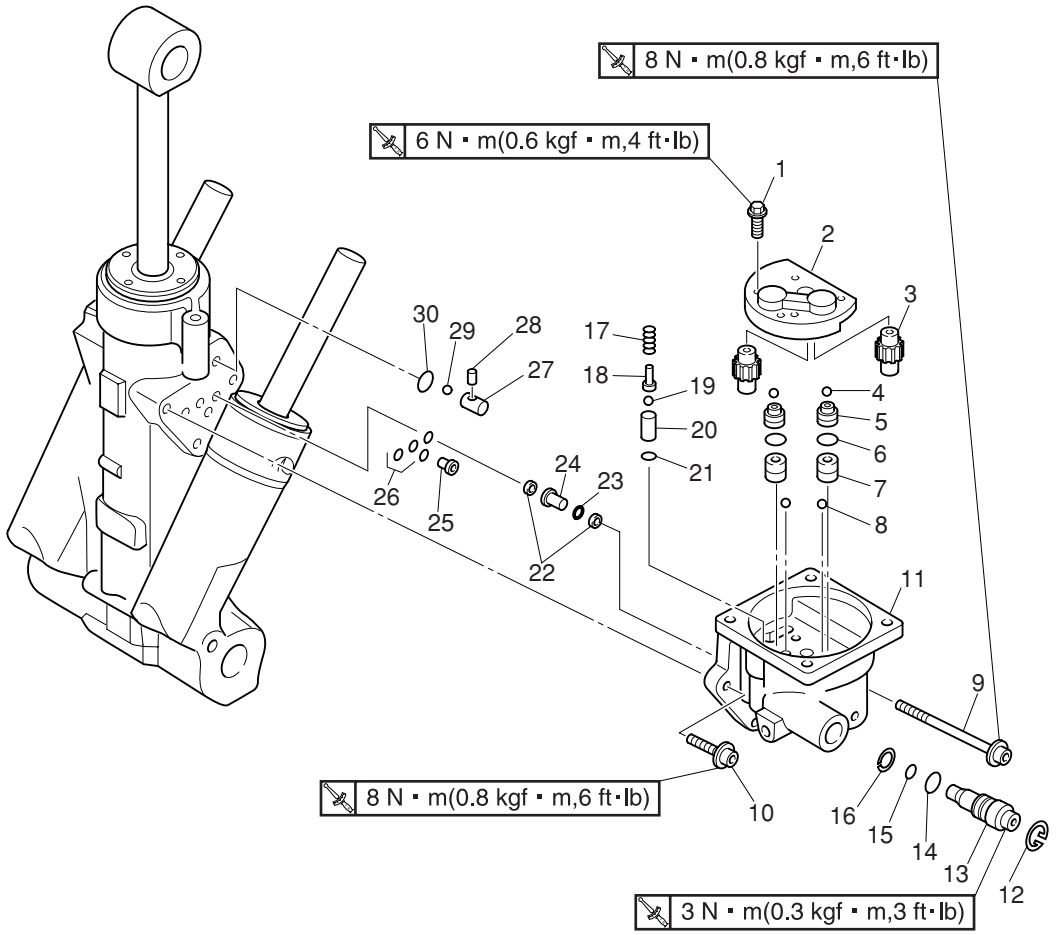
60h70570

3. Install the stator.



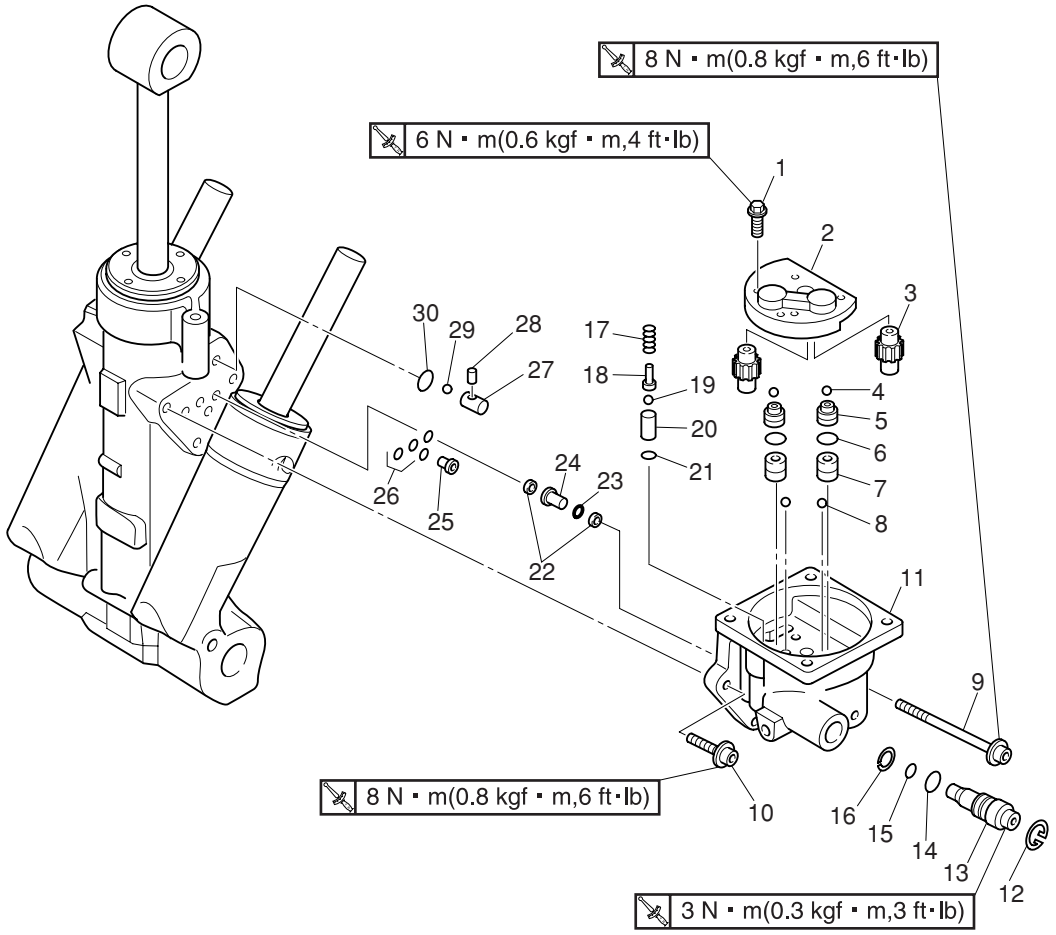
60H70580

NOTE:
Place a clean cloth over the end of the armature shaft, and hold it with a pair of pliers, while pushing-in the stator carefully.



60h70590

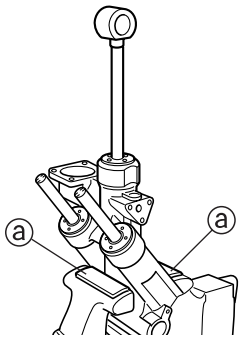
No.	Part name	Q'ty	Remarks
1	Bolt	2	M5 x 16 mm
2	Pump filter	1	
3	Gear	2	
4	Ball	2	
5	Shuttle piston	2	
6	O-ring	2	Not reusable
7	Main valve	2	
8	Ball	2	
9	Bolt	1	M8 x 85 mm
10	Bolt	2	M8 x 24 mm
11	Pump housing	1	
12	Circlip	1	Not reusable
13	Manual valve	1	
14	O-ring	1	Not reusable
15	O-ring	1	Not reusable
16	Backup ring	1	
17	Spring	1	



60h70590

No.	Part name	Q'ty	Remarks
18	Absorber valve pin	1	
19	Ball	1	
20	Up-relief valve seat	1	
21	O-ring	1	Not reusable
22	Filter	2	
23	O-ring	1	Not reusable
24	Down-relief valve	1	
25	Valve pin	1	
26	O-ring	4	Not reusable
27	Valve seat	1	
28	Pin	1	
29	Ball	1	
30	O-ring	1	Not reusable

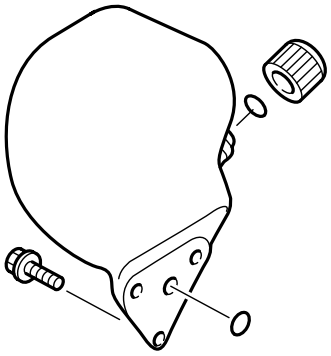
Disassembling the reservoir



60h70600

NOTE:
- Do not use rags or paper to clean the hydraulic system components. Small pieces of fibers remaining on them may cause malfunction of the system.
- Fluid may flow out while overhauling the power trim and tilt unit. Place an appropriate tray to prevent the fluid from spilling out on the floor.
- Hold the power trim and tilt unit in a vise to work on it. Put an aluminum plates ⓐ on both sides of the unit.

1. Remove the reservoir and O-ring.

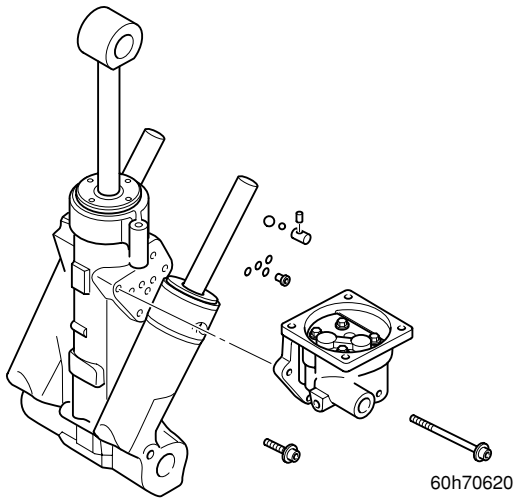

60h70610

CAUTION:
- **Make sure that the tilt and trim rods are fully extended when removing the reservoir. If they are not, fluid may spurt out from the unit due to the internal pressure.**
- **Do not push down the tilt rod and trim rods while the reservoir is removed. Fluid may spurt out from the reservoir mounting area.**

2. Drain the fluid from the reservoir to check any damage. Also check the cap and O-ring. Replace if necessary.

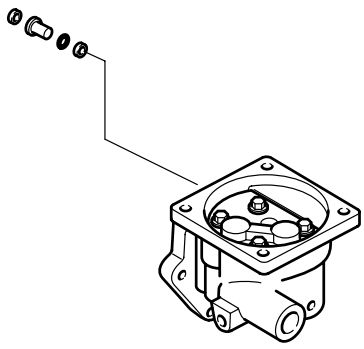
Disassembling the gear pump unit

1. Remove the gear pump unit.


60h70620

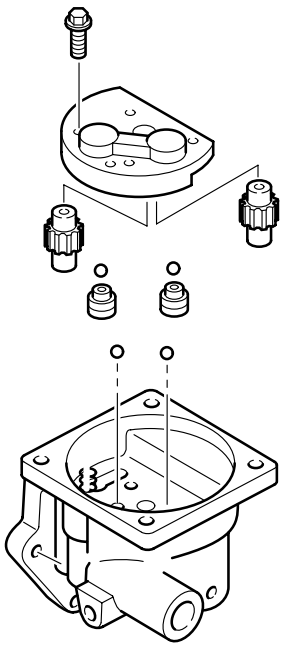
NOTE:
Make sure that the O-ring, valve pin, and check valve assembly are removed.

2. Remove the filter, down-relief valve assembly, O-ring, and filter from the gear pump unit.


60h70630

NOTE:
To remove the filter in the back, blow compressed air carefully not to make the filter jump out abruptly.

3. Remove the gear pump cover and gear pump.

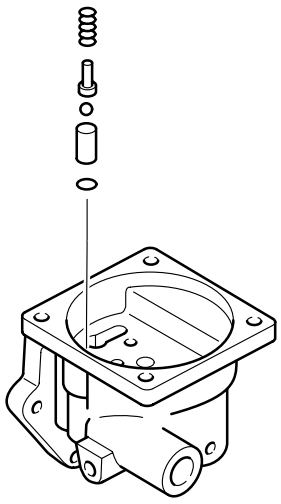


60h70640

NOTE:

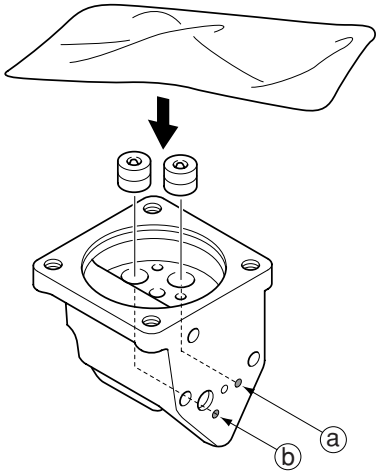
Make sure that the shuttle piston and ball are removed, since they would be stuck on the gear pump cover.

4. Remove the up-relief valve assembly.



60h70650

5. Remove the main valves.



60h70660

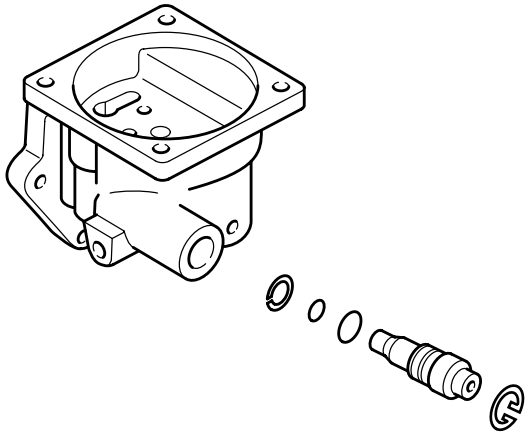
NOTE:

To remove the main valves, cover the pump housing with a clean cloth, and blow compressed air through holes ⓐ and ⓑ.

⚠ WARNING

Never look into the openings while removing the main valves.

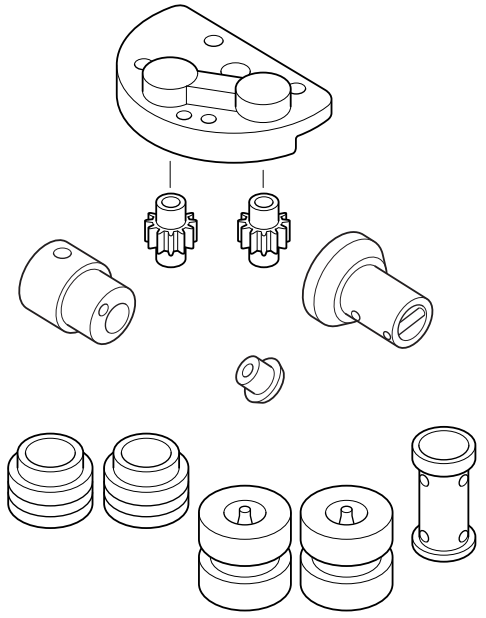
6. Remove the manual valve.



60h70670

Checking the reservoir and gear pump unit

1. Clean all the valves, pistons, balls, and filters. Check them for damages or wear. Check the gear pump for damages or wear. Replace them if necessary.



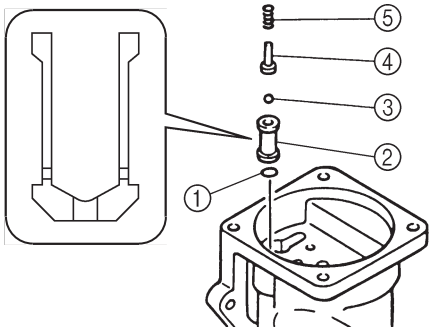
60h70680

Assembling the reservoir and gear pump unit

CAUTION:

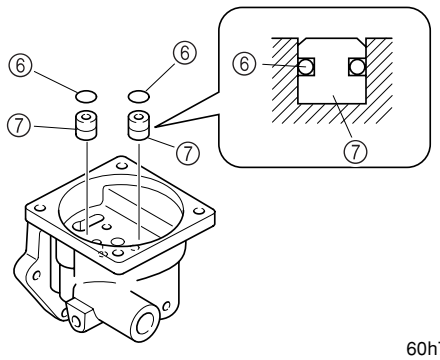
Reinstall the components and parts in their original direction and position.

1. Install a new O-ring ①, the up-relief valve seat ②, balls ③, and absorber valve pin ④, and spring ⑤ on the pump housing.



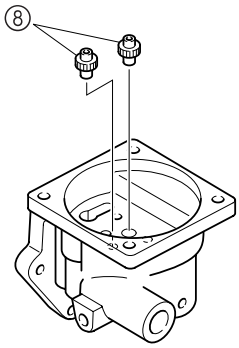
60h70690

2. Install new O-rings ⑥ on the main valves ⑦. Then, attach them on the pump housing.



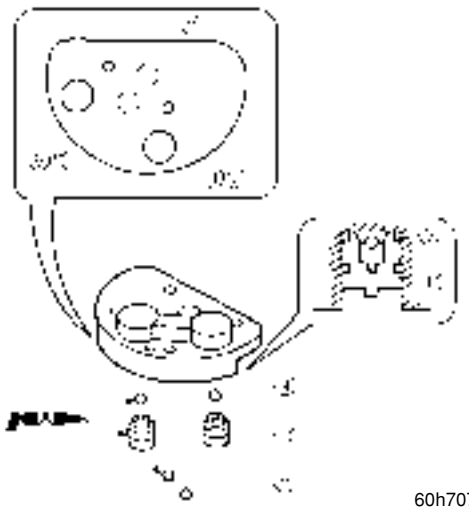
60h70700

3. Install the gear pump ⑧.



60h70710

4. Install the balls ⑨, shuttle pistons ⑩, and balls ⑪ into the gear pump cover.



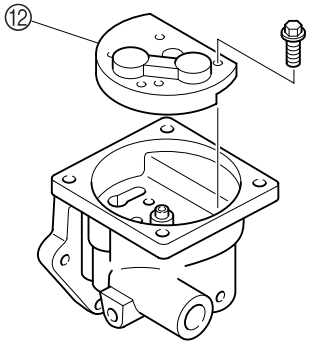
60h70720

NOTE:

Apply grease to the balls and shuttle pistons to prevent them from falling out of the gear pump.

7

5. Install the gear pump cover ⑫ on the pump housing, and temporarily tighten the mounting bolts.



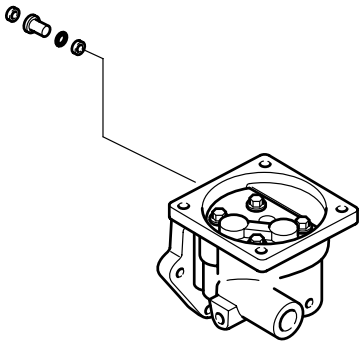
60h70730

6. Make sure that the gear pump turns smoothly by hands. Then, tighten the mounting bolts to the specified torque.

Gear pump cover bolts:
6 N • m (0.6 kgf • m, 4 ft • lb)

7. Install a new O-ring on the down-relief valve.

8. Install the filter, down-relief valve, and filter to the pump housing.



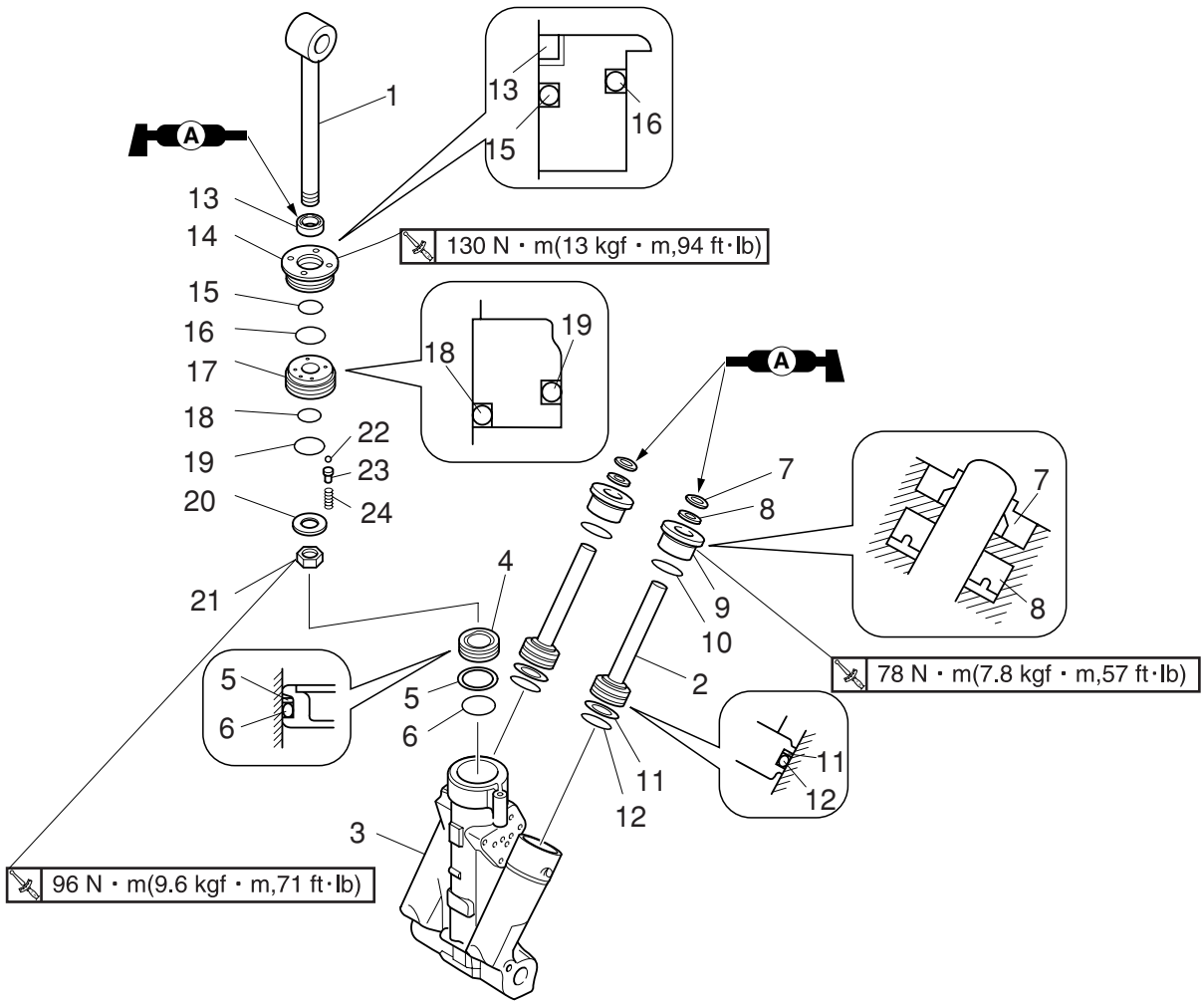
60h70740

9. Install a new O-ring to the manual valve.

10. Install the manual valve and circlip on the pump housing.

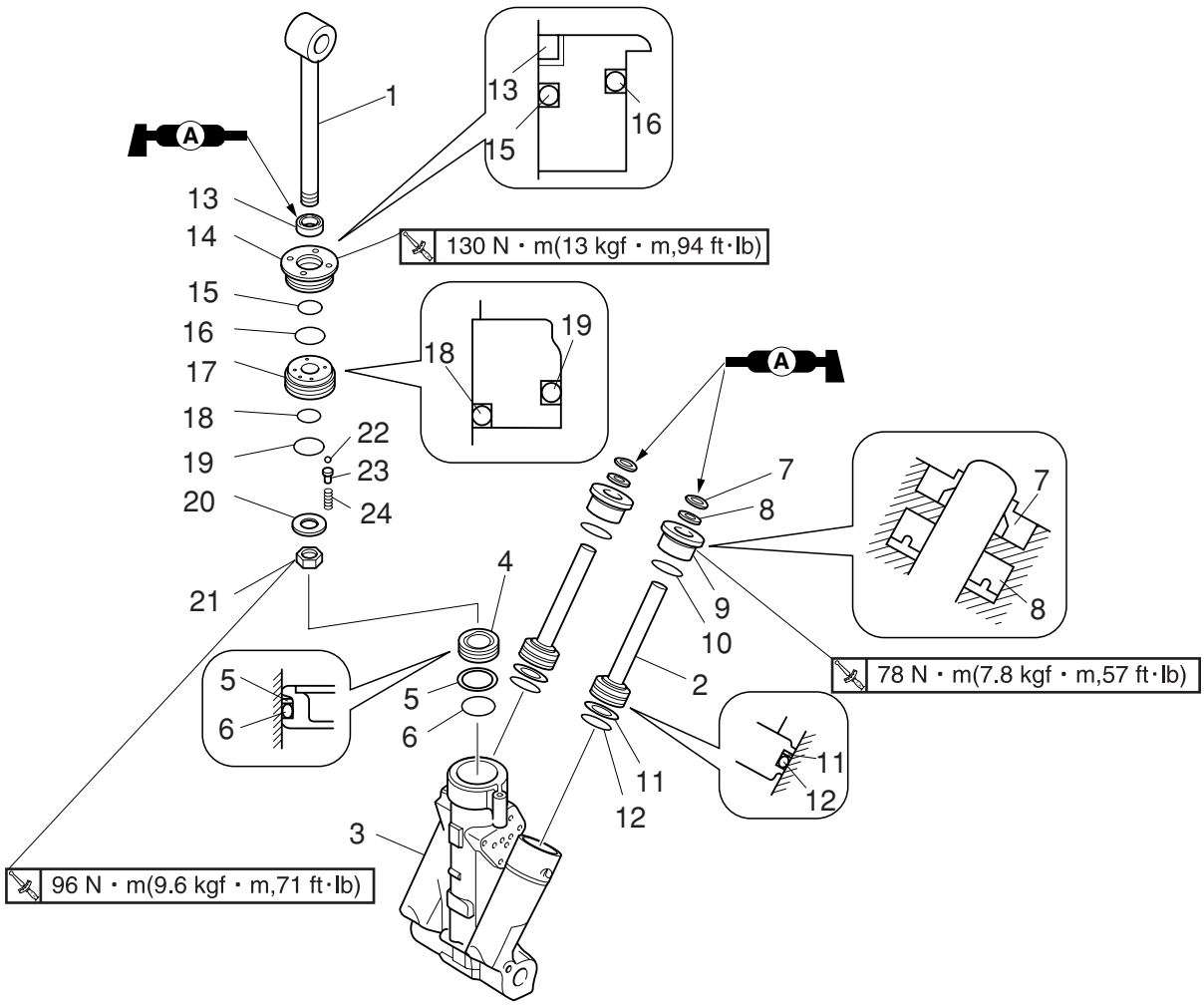
Manual valve:
3 N • m(0.3 kgf • m, 3 ft • lb)

Tilt cylinder and trim cylinder



60h70750

No.	Part name	Q'ty	Remarks
1	Tilt rod	1	
2	Trim piston assembly	2	
3	Cylinder body	1	
4	Free piston	1	
5	Backup ring	1	
6	O-ring	1	Not reusable
7	Dust seal	2	Not reusable
8	Seal	2	Not reusable
9	Trim cylinder end screw	2	
10	O-ring	2	Not reusable
11	Backup ring	2	
12	O-ring	2	Not reusable
13	Dust seal	1	Not reusable
14	Tilt cylinder end screw	1	
15	O-ring	1	Not reusable
16	O-ring	1	Not reusable
17	Tilt piston	1	

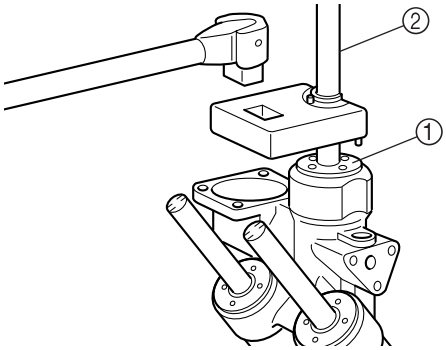


60h70750

No.	Part name	Q'ty	Remarks
18	O-ring	1	Not reusable
19	O-ring	1	Not reusable
20	Washer	1	
21	Nut	1	
22	Ball	1	
23	Valve	1	
24	Spring	1	

Disassembling the tilt cylinder and trim cylinder

1. Loosen the tilt cylinder end cap ①, and remove the tilt piston assembly ②.



60h70760

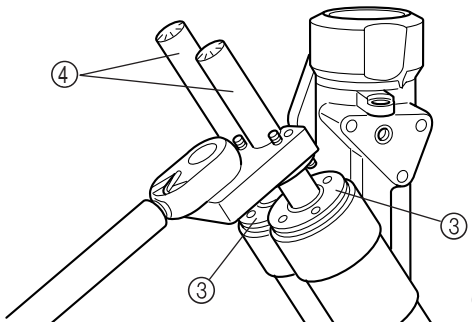
CAUTION:

Make sure that the rods are fully extended before removing the tilt cylinder end cap.

Trim & tilt wrench: 90890-06548

2. Drain the fluid.

3. Loosen the trim cylinder end cap ③, and remove the trim piston assembly ④.



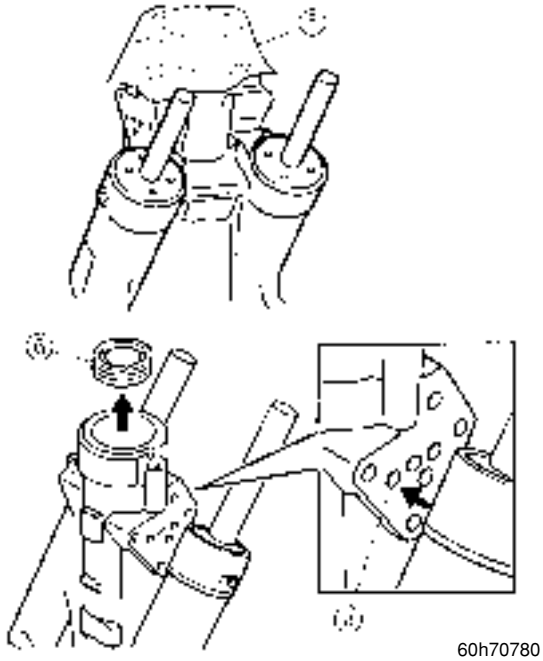
60H70770

Trim & tilt wrench: 90890-06548

4. Drain the fluid.

5. Install the trim piston assembly, and temporarily tighten the trim cylinder end cap finger tight.

6. Cover the tilt cylinder opening with a clean cloth ⑤, and blow compressed air through hole ⓐ to remove the free piston ⑥.



60h70780

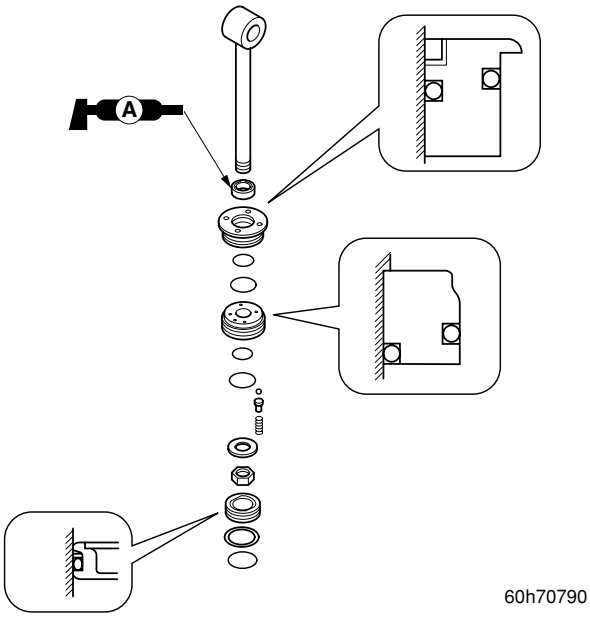
⚠ WARNING

Never look into the openings while removing the free piston.

7. Loosen the trim cylinder end cap, and remove the trim piston assembly.

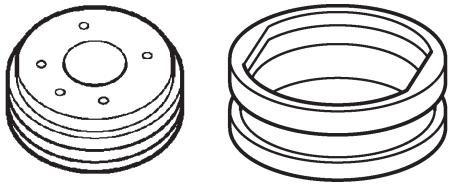
Checking the tilt cylinder and trim cylinder.

1. Disassemble the tilt piston assembly.



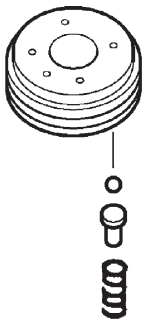
60h70790

2. Check the tilt piston and free piston for scratches. Replace if necessary.



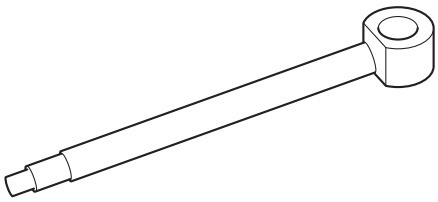
60h70800

3. Air blow the contamination on the tilt piston absorber valve. Check the valve for wear, and check the spring for deterioration.



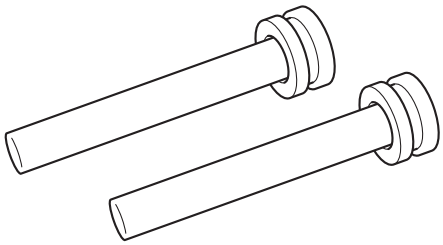
60h70810

4. Check the tilt rod for bends or corrosion. Replace if necessary.



60h70820

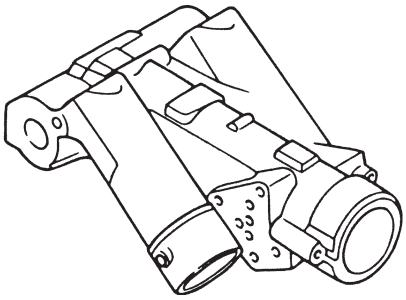
5. Check the trim piston for scratches. Replace if necessary. Check the trim rods for bends or corrosion. Replace if necessary.



60h70830

6. Remove the filter plug and filter from the tilt cylinder, and check them.

7. Check the inner walls of tilt cylinder and trim cylinder for scratches. Replace if necessary.

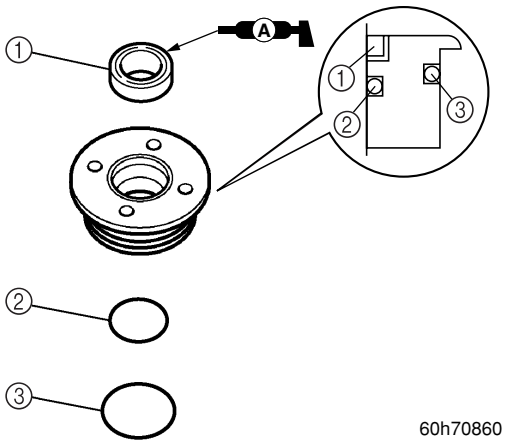


60h70850

8. Install the filter and filter plug on the tilt cylinder.

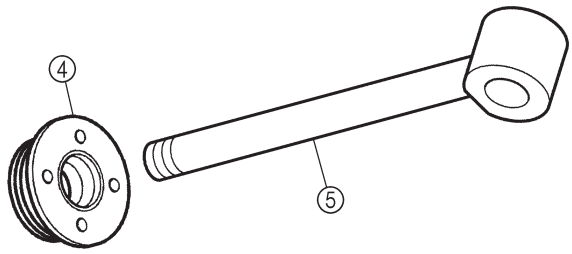
	Filter plug: 6 N • m(0.6 kgf • m, 4 ft • lb)

9. Install a new O-ring ②③ and the dust seal ① on the tilt cylinder end cap.



60h70860

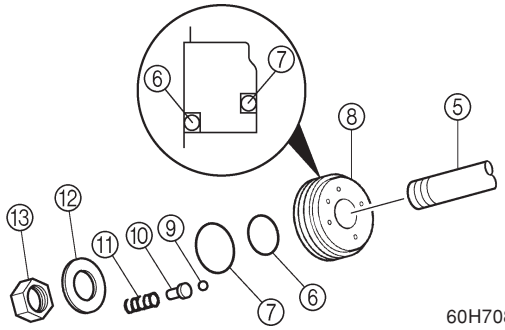
10. Install the tilt cylinder end cap ④ on the tilt rod ⑤.



60h70870

11. Install a new O-ring ⑥⑦ on the tilt piston ⑧. Also install the ball ⑨, absorber pin ⑩, and spring ⑪ in this order.

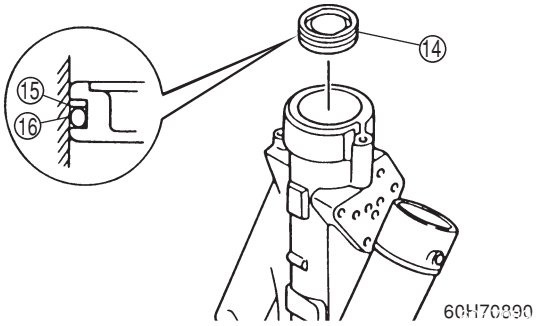
12. Install the tilt piston sub-assembly and washer ⑫ on the tilt rod ⑤, and tighten the nuts ⑬.



60H70880

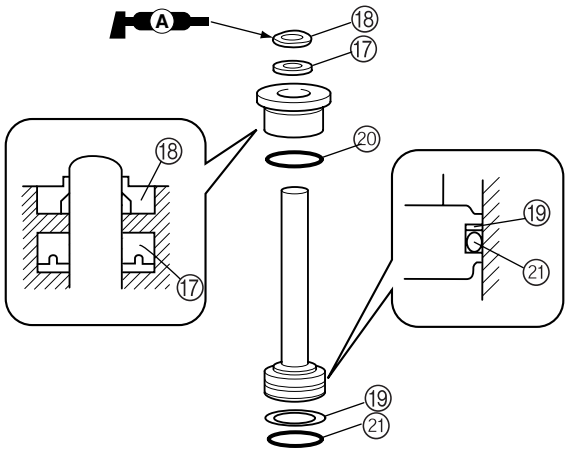
Tilt piston nut:
96 N • m (9.6 kgf • m, 71 ft • lb)

13. Install new backup ring ⑮ and the O-ring ⑯ on the free piston ⑭.



60H70890

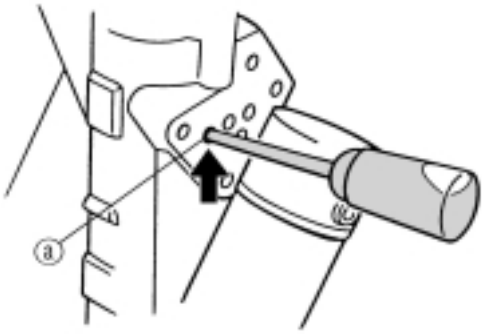
14. Install new oil seal ⑰, dust seal ⑱, backup ring ⑲, and O-ring ⑳, ㉑ on the trim cylinder end cap and the trim piston.



60h70900

Assembling the power trim and tilt unit

1. Fill the tilt cylinders with the fluid.

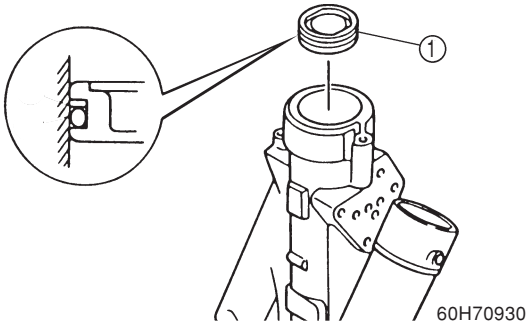


60h70920

NOTE:
Fill the tilt cylinders with the specified quantity of recommended fluid through the hole ⓐ.

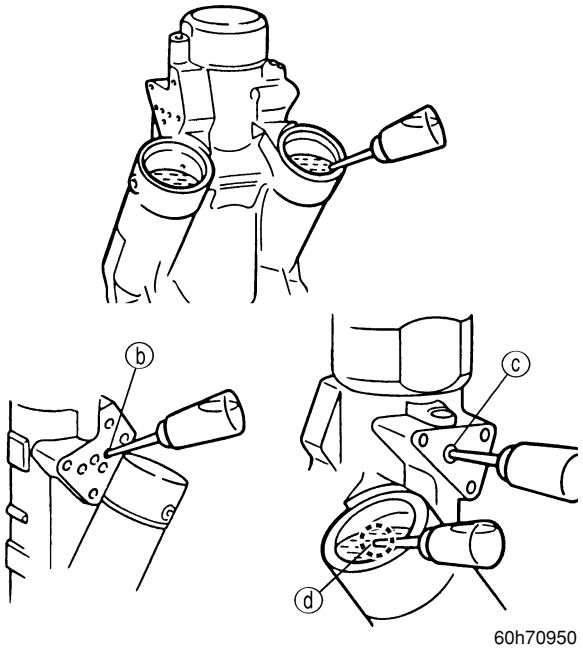
Recommended power trim and tilt fluid:
ATF Dexron II
Specified quantity:
30 cm³ (1.1 Imp oz)

2. Push-in the free piston ① to the bottom of tilt cylinder.



60H70930

3. Fill in the trim cylinders with fluid.



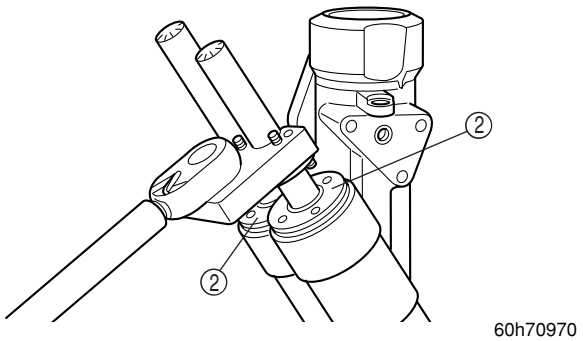
60h70950

NOTE:
Pour the recommended fluid through the holes ⓑ, ⓒ, and ⓓ until the passages are filled with the fluid.

4. Install the trim rods.

CAUTION:
Make sure that the trim rods are fully extended when they are installed.
Once installed, never push down the trim rods. It is dangerous since the fluid may spurt out from the unit.

5. Tighten up the trim rod end caps ②.

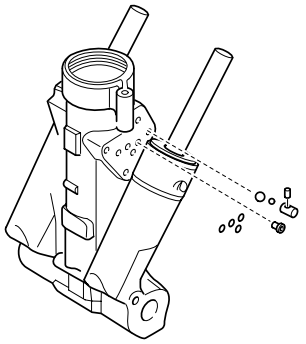


60h70970

Trim & tilt wrench: 90890-06548

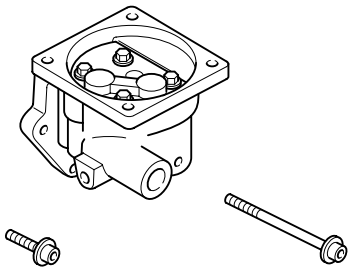
Trim rod end cap:
78 N • m(7.8 kgf • m, 57 ft • lb)

6. Install new O-ring, valve pin, and check valve assembly on the tilt cylinder.


60h70980

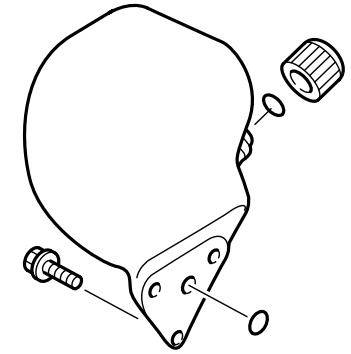
NOTE:
Refer to the illustration for the correct orientation when installing the valve pin and check valve assembly.

7. Install the gear pump unit.


60h70990

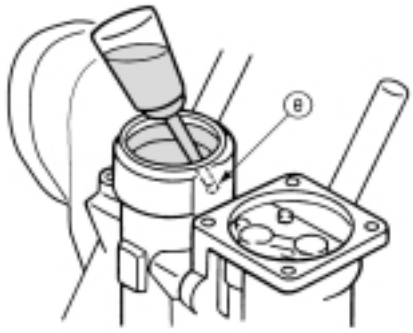
Gear pump unit mounting bolts:
8 N • m(0.8 kgf • m, 6 ft •lb)

8. Install the reservoir and a new O-ring.


60h71000

Reservoir mounting bolts:
5 N • m(0.5 kgf • m, 4 ft • lb)

9. Fill the tilt cylinder with the fluid.



60h71010

NOTE:

Pour the recommended fluid through the hole ⓔ until gear pump unit top is filled up with the fluid.

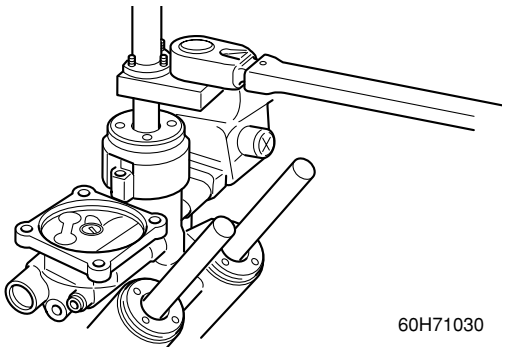
10. Install the tilt piston assembly.

60h71020

CAUTION:

- **Make sure that the tilt rod are fully extended when they are installed.**
- **Once installed, never push down the tilt rod. It is dangerous since the fluid may spurt out from the unit.**

11. Tighten up the tilt rod end cap.

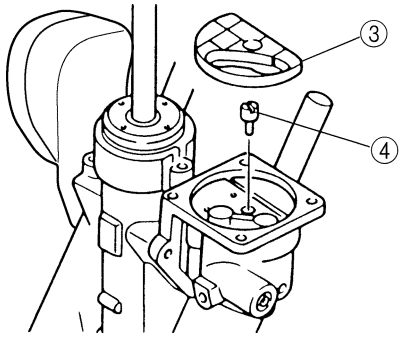


60H71030

Trim & tilt wrench: 90890-06548

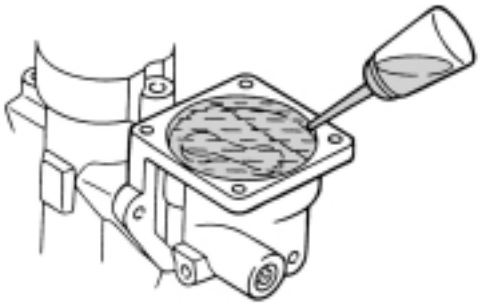
Trim rod end cap:
130 N • m(13 kgf • m, 94 ft • lb)

12. Install the joint ④ and filter ③ on the gear pump unit.



60h71040

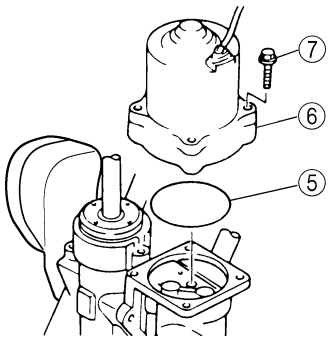
13. Make sure that the gear pump unit is filled out with the fluid to the top. Then turn the gear pump with screwdriver for air bleeding.



60h71050

7

14. Install a new O-ring ⑤ and the PTT motor ⑥. Tighten up the bolts ⑦.



60h71060

NOTE:
Align the joint and armature shaft .

PTT motor mounting bolts:
5 N • m (0.5 kgf • m, 4 ft • lb)

15. Fill the reservoir with the recommended fluid to the specified level.

NOTE:
If the fluid is at the correct level, the fluid should overflow out of the check hole when the cap is removed.

16. Install the reservoir cap.

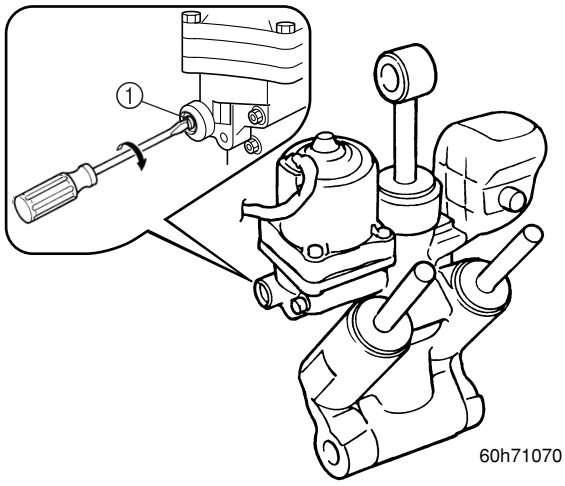
Reservoir cap:
0.7 N • m(0.07 kgf • m, 0.5 ft • lb)

17. Perform air bleeding.

18. Check the hydraulic pressure of power trim and tilt unit.

Bleeding the power trim and tilt unit

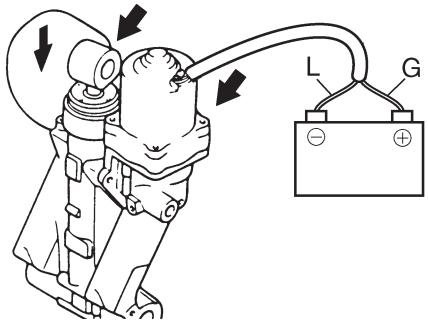
NOTE:
- Make sure that the manual valve ① is tightened up.
- Fix the power trim and tilt unit in the upright position, and check the fluid level. If it is low, add the fluid of recommended type to the correct level.



60h71070

Recommended power trim and tilt fluid:
ATF Dexron II

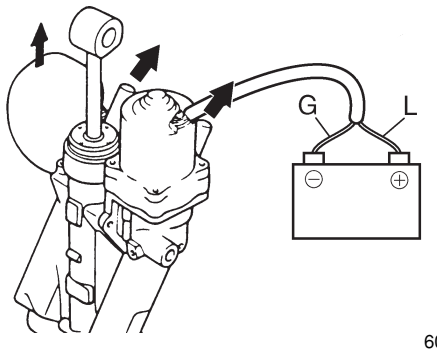
1. Connect the power trim and tilt motor leads to the battery terminals, and fully retract the trim and tilt rods.



60h71080

Rods	PTT motor leads	Battery terminal
DOWN	Green (G)	+
	Blue (L)	–

2. Connect the power trim and tilt motor leads to the battery terminals, and fully extend the trim and tilt rods.



60h71090

Rods	PTT motor leads	Battery terminal
UP	Blue (L)	+
	Green (G)	–

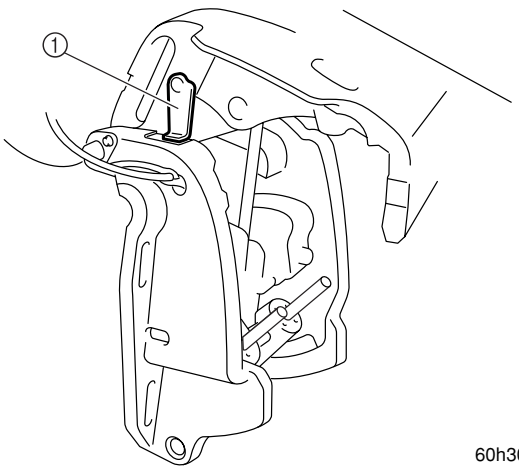
3. Repeat the procedures above for four or five times.

NOTE:
Wait for a few seconds before switching the PTT motor leads connections.
Assist the rods movement by hands if they do not operate well.

4. Check the fluid level while the tilt rod is fully extended, and add sufficient amount of recommended fluid.

Installing the power trim and tilt unit

1. Fully tilt up the outboard motor, and lock it with the tilt stop lever ①.



60h30430

⚠ WARNING

After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.

2. Install the collar.

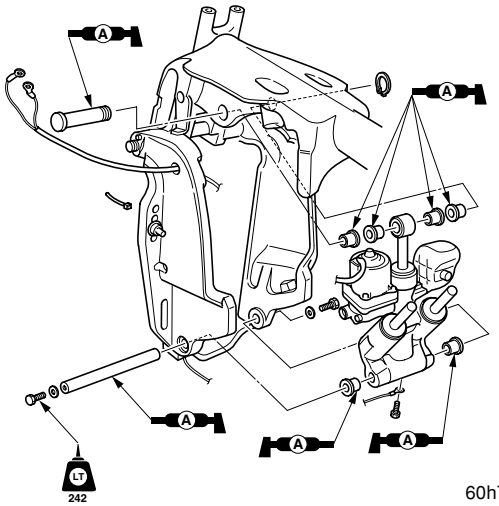
3. Insert the upper mount pins while supporting the power trim and tilt unit by hands.

4. Install the circlip.

5. Insert the lower mount pins, and tighten up the bolts.

6. Install the clamps, route the PTT motor leads through the hole, and install the clamps.

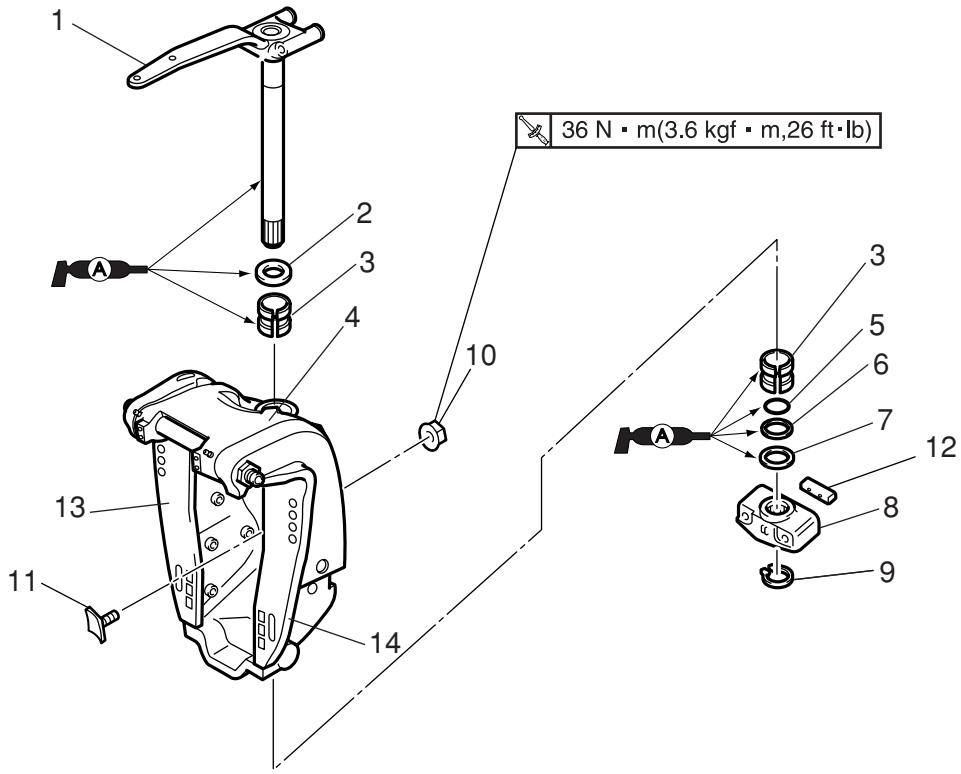
7. Connect the ground lead under the power trim and tilt unit.



60h71150

7

Steering arm



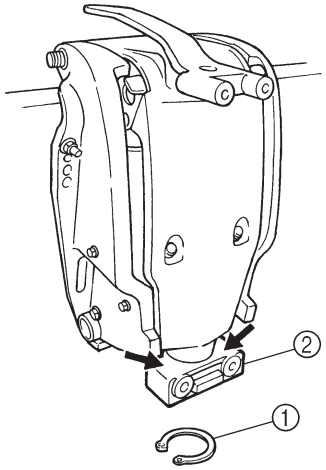
60h70035

No.	Part name	Q'ty	Remarks
1	Steering arm	1	
2	Washer	1	
3	Bushing	2	
4	Swivel bracket	1	
5	O-ring	1	Not reusable
6	Bushing	1	
7	Washer	1	
8	Steering yoke	1	
9	Circlip	1	Not reusable
10	Nut	2	
11	Thrust receiver	2	
12	Damper	1	
13	Clamp bracket	1	Starboard
14	Clamp bracket	1	Port

Removing the steering arm

1. Remove the circlip ①.

2. Remove the steering yoke ② by striking it with a plastic hammer or the like.



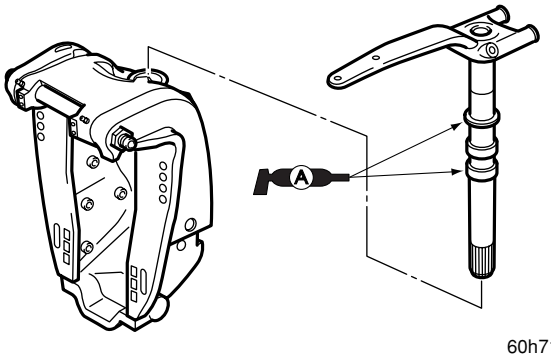
60h71170

3. Pull off the steering arm, and remove the washer, O-ring, and bushing.

Installing the steering arm

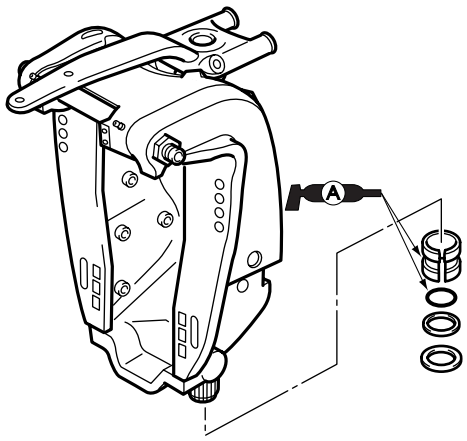
1. Install the washer and bushing onto the steering arm.

2. Place the swivel bracket in the upright position, and insert the steering arm into the swivel bracket.

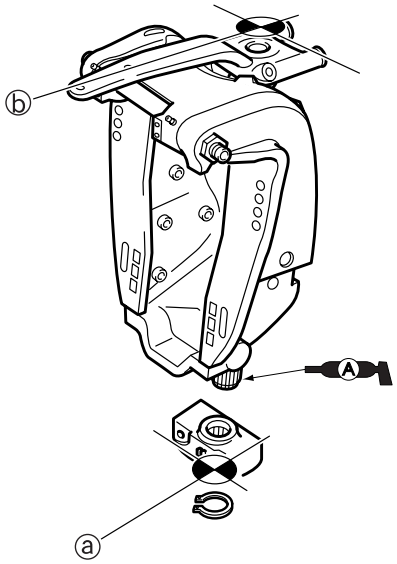


60h71180

3. Install the bushing, O-ring, and washer. Also install the steering yoke.



60h71190



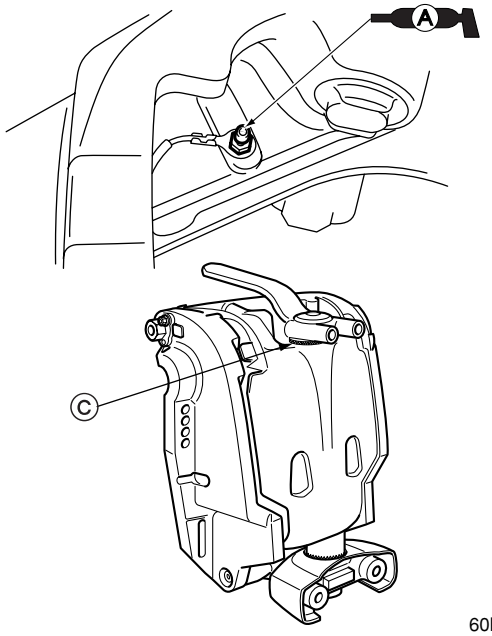
60h71200

NOTE:

Make sure that the orientation of steering yoke ⓐ and steering arm ⓑ is consistent at the time of installation.

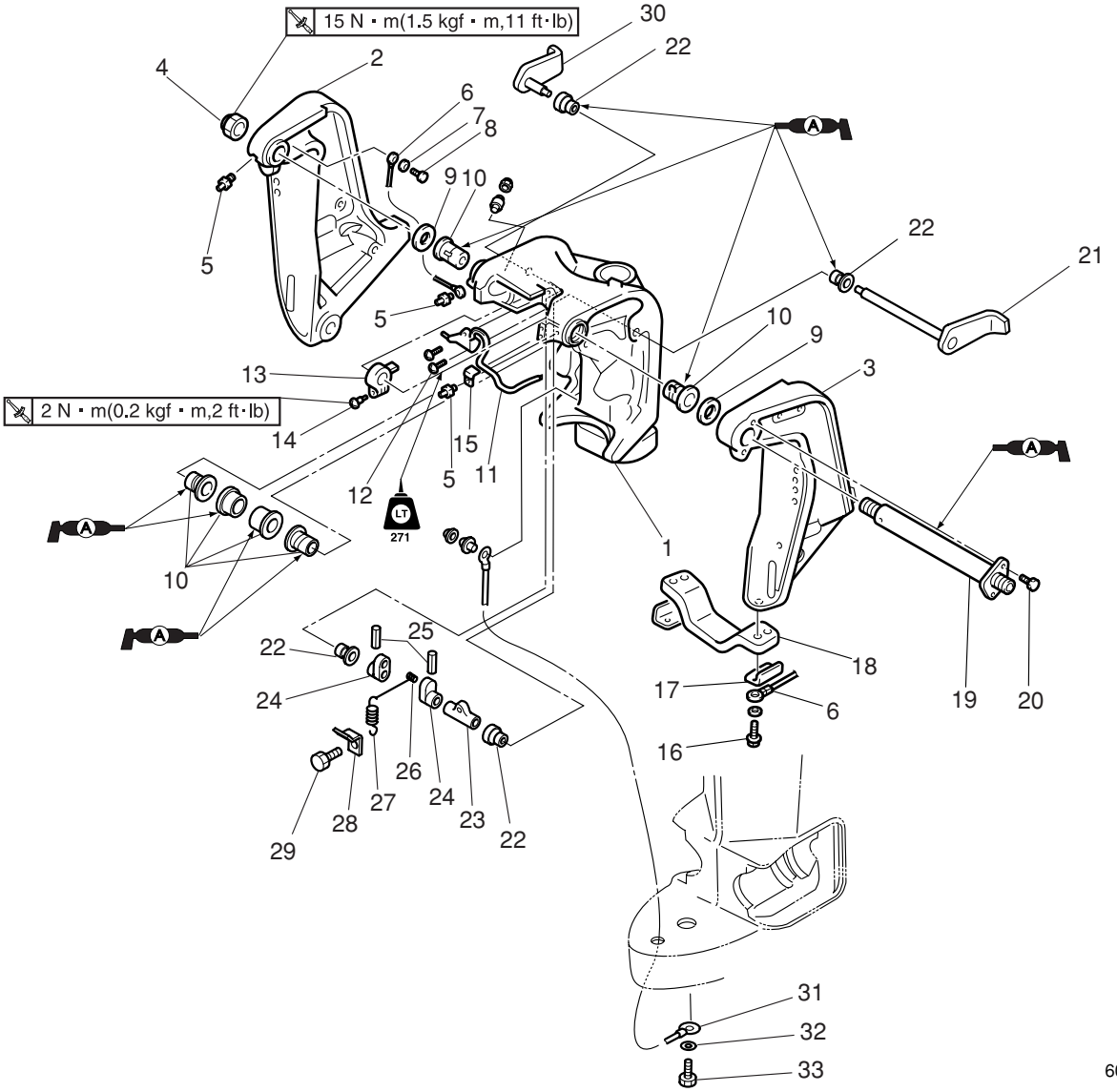
4. Install the circlip.

5. Inject Yamaha grease A through the grease nipple.

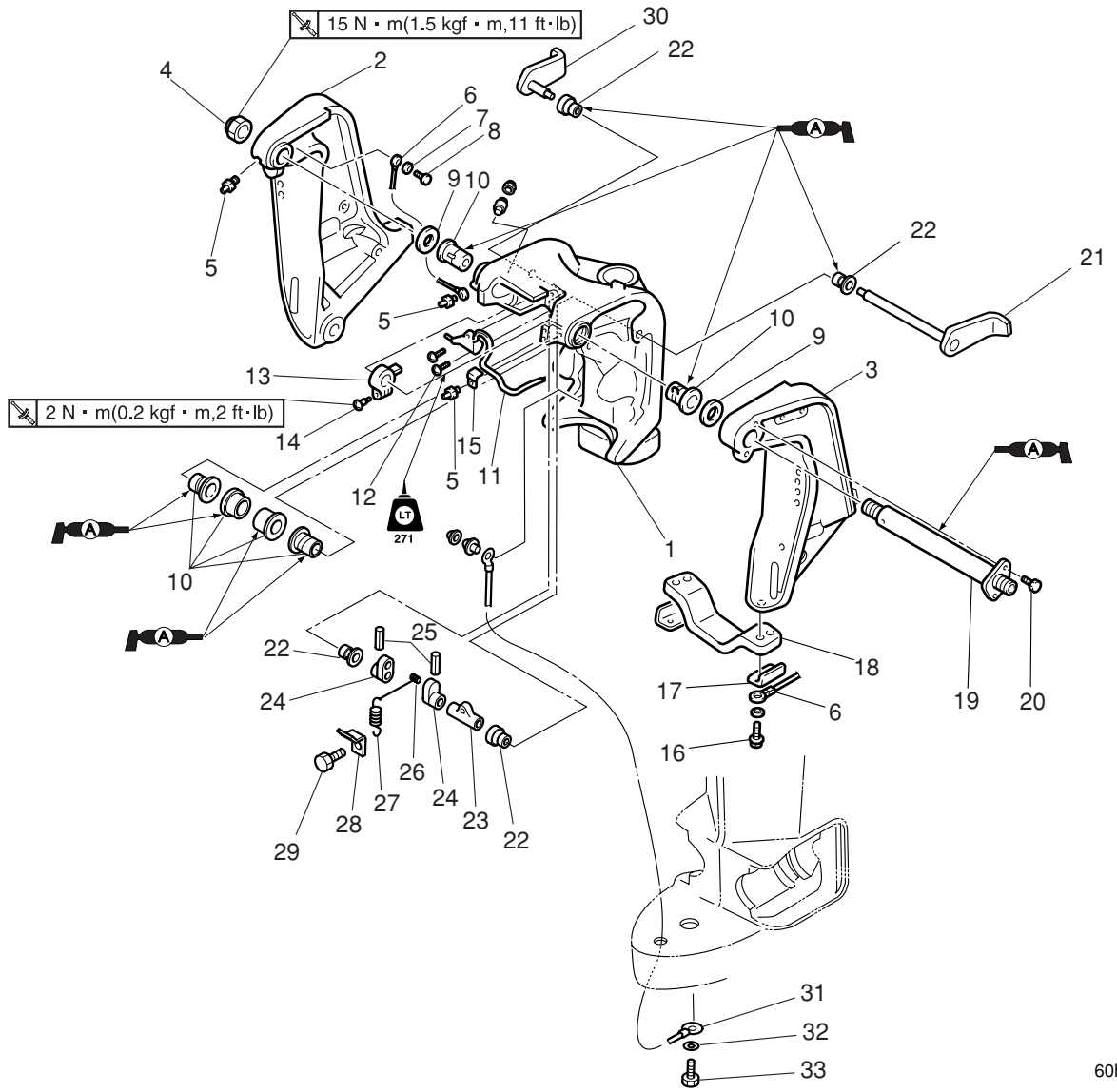


NOTE:
Inject the grease until it comes out from both the upper bushing ⓒ.

Clamp brackets



No.	Part name	Q'ty	Remarks
1	Swivel brcket assembly	1	
2	Clamp bracket	1	Starboard
3	Clamp bracket	1	Port
4	Self-locking nut	1	
5	Grease nipple	5	
6	Ground lead	1	
7	Washer	2	
8	Bolt	2	M6 x 11 mm
9	Washer	2	
10	Bushing	6	
11	Trim sensor	1	
12	Screw	2	M6 x 25 mm
13	Trim sensor cam	1	
14	Screw	1	M6 x 25 mm
15	Clamp	1	
16	Bolt	4	M6 x 30 mm
17	Bracket	2	



No.	Part name	Q'ty	Remarks
18	Anode	1	
19	Through tube	1	
20	Bolt	1	M8 x 20 mm
21	Tilt stop lever	1	
22	Bush	4	
23	Collar	1	
24	Distance collar	2	
25	Spring pin	2	
26	Pin	1	
27	Spring	1	
28	Spring hook	1	
29	Bolt	1	M6 x 10 mm
30	Tilt stop lever	1	
31	Ground lead	1	
32	Washer	1	
33	Bolt	1	M6 x 10 mm

Disassembling the clamp brackets

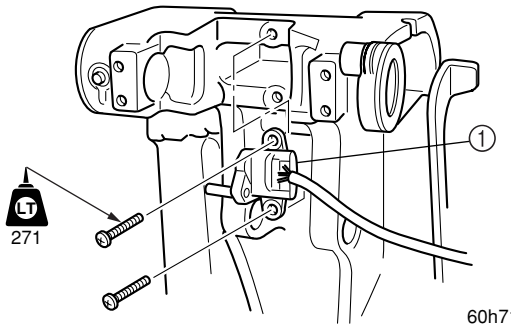
1. Remove the power trim and tilt unit.
2. Remove the anode.
3. Disconnect the ground lead.
4. Remove the self-locking nuts and bolts.
5. Pull off the through tube, and disassemble the clamp brackets, trim sensor cam, and swivel bracket.
6. Remove the trim sensor.
7. Disassemble the tilt stop lever, and remove the trim rod receiver.

Assembling the clamp brackets

1. Install the trim rod receiver.

	Trim rod receiver nuts: 36 N • m(3.6 kgf • m, 26 ft • lb)

2. Install the tilt stop lever on the swivel bracket.
3. Install the trim sensor ① and bushing on the swivel bracket.



60h71230

4. Install the through tube to go through the clamp brackets, washer, and swivel bracket in this order.

NOTE:

- Make sure that the trim sensor cam is installed between the swivel bracket holes.
- Adjust the trim sensor cam after assembly.

5. Install the bolts on the through tube, and tighten up the self-locking nut.

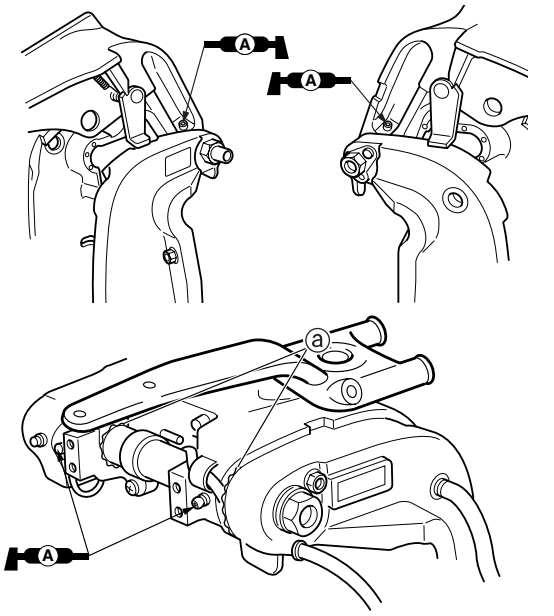
	Self-locking nut: 15 N • m (1.5 kgf • m, 11 ft • lb)

6. Install the power trim and tilt unit. Then, install the anode.

NOTE:

Install the ground lead between the power trim and tilt unit and the anode.

7. Install the ground lead between the clamp brackets and the swivel bracket.
8. Apply Yamaha grease A through the grease nipples.



60h71250

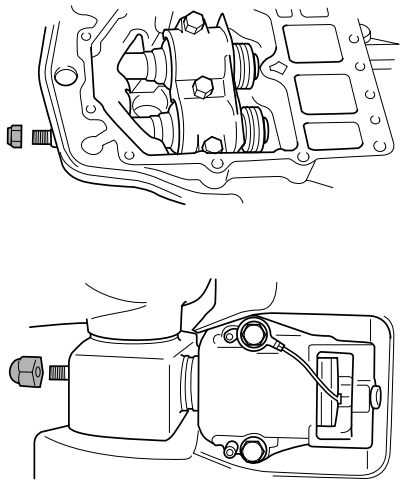
NOTE:

Apply the grease until it comes out of the bushing ⓐ.

7

Install the upper case

1. Install the upper cace and tighten the upper mount and lower mount nuts.

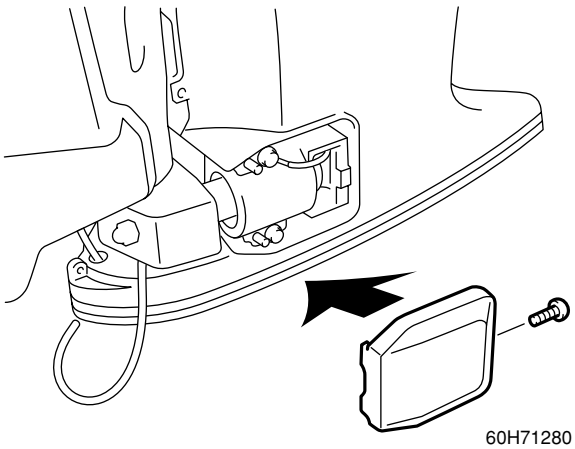


60H71260

Upper mount nuts:
71 N • m (7.1 kgf • m, 52 ft • lb)

Lower mount nuts:
51 N • m (5.1 kgf • m, 38 ft • lb)

2. Install the lower mount cover.

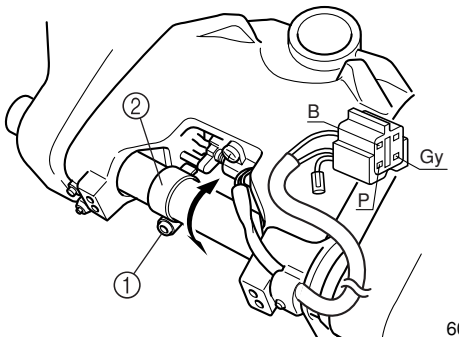


60H71280

3. Connect the ground lead.

Adjusting the trim sensor cam

1. Fully retract the power trim and tilt unit.
2. Loosen the trim sensor cam screw ①.
3. Fix the trims sensor ② cam where the specified trim sensor resistance is obtained.

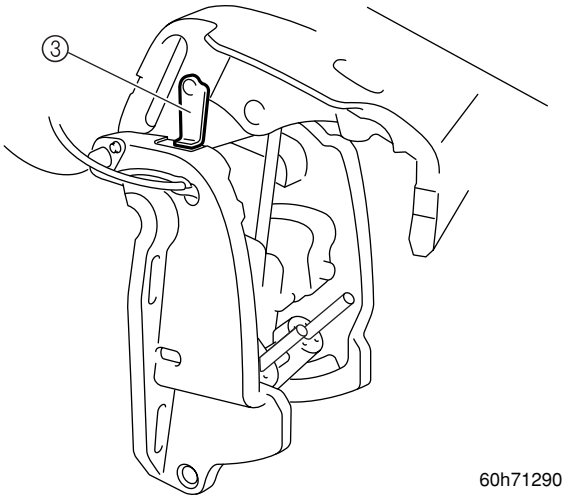


60h71270

Trim sensor resistance:
Pink (P) - Black (B)
9-11 at 20°C (68°F)

Trim sensor cam screw ①:
2 N • m(0.2 kgf • m, 2 ft • lb)

4. Fully tilt up the outboard motor, and lock it with the tilt stop lever ③.



60h71290

⚠ WARNING

After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.

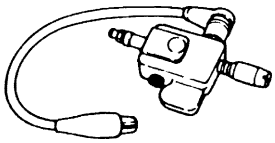
5. Check the trim sensor resistance. If the resistance is out of specification, adjust the trim sensor cam position, and check the trims sensor.

Trim sensor resistance:
Pink (P) - Black (B)
238.8-378.8 at 20°C (68°F)

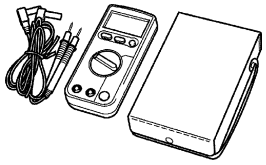
Electrical systems

8

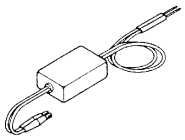
Special service tools



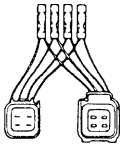
Ignition tester
90890-06754



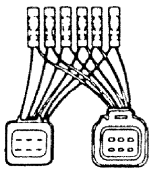
Digital circuit tester
90890-03174



Peak voltage adaptor B
90890-03172



Test harness (FWY-4)
90890-06771



Test harness (FWY-6)
90890-06772

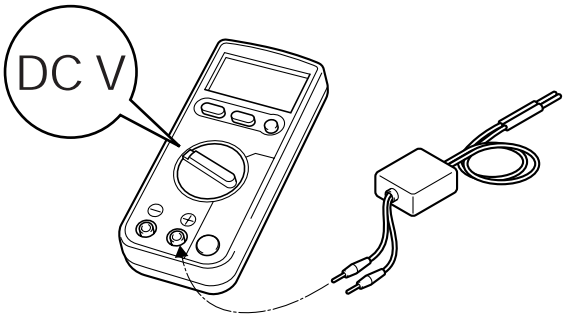
Checking the electrical components

Measuring the peak voltage

NOTE:

Before troubleshooting the peak voltage, check that all electrical connections are tight and free from corrosion, and that the battery is fully charged to 12V.

The condition of the ignition system can be determined by measuring the peak voltage. Cranking speed is affected by many factors, such as fouled or weak spark plugs, or a weak battery. If one of these factors is present, the peak voltage will be lower than specification. In addition, if the peak voltage is lower than specification the engine will not operate properly.



60h80010

⚠ WARNING

When checking the peak voltage, do not touch any of the connections of the digital circuit tester leads.

NOTE:

- Use the peak voltage adaptor with the digital circuit tester.
- When measuring the peak voltage, set the selector on the digital circuit tester to the **DC voltage mode**.
- Connect the positive pin on the peak voltage adaptor to the positive terminal of the digital circuit tester.

Measuring the lower resistance

When measuring a resistance of 10 or less with the digital circuit tester, the correct measurement cannot be obtained because of the internal resistance of the tester. To obtain the correct value, subtract the internal resistance from the displayed measurement.

Correct value =
displayed measurement
– internal resistance

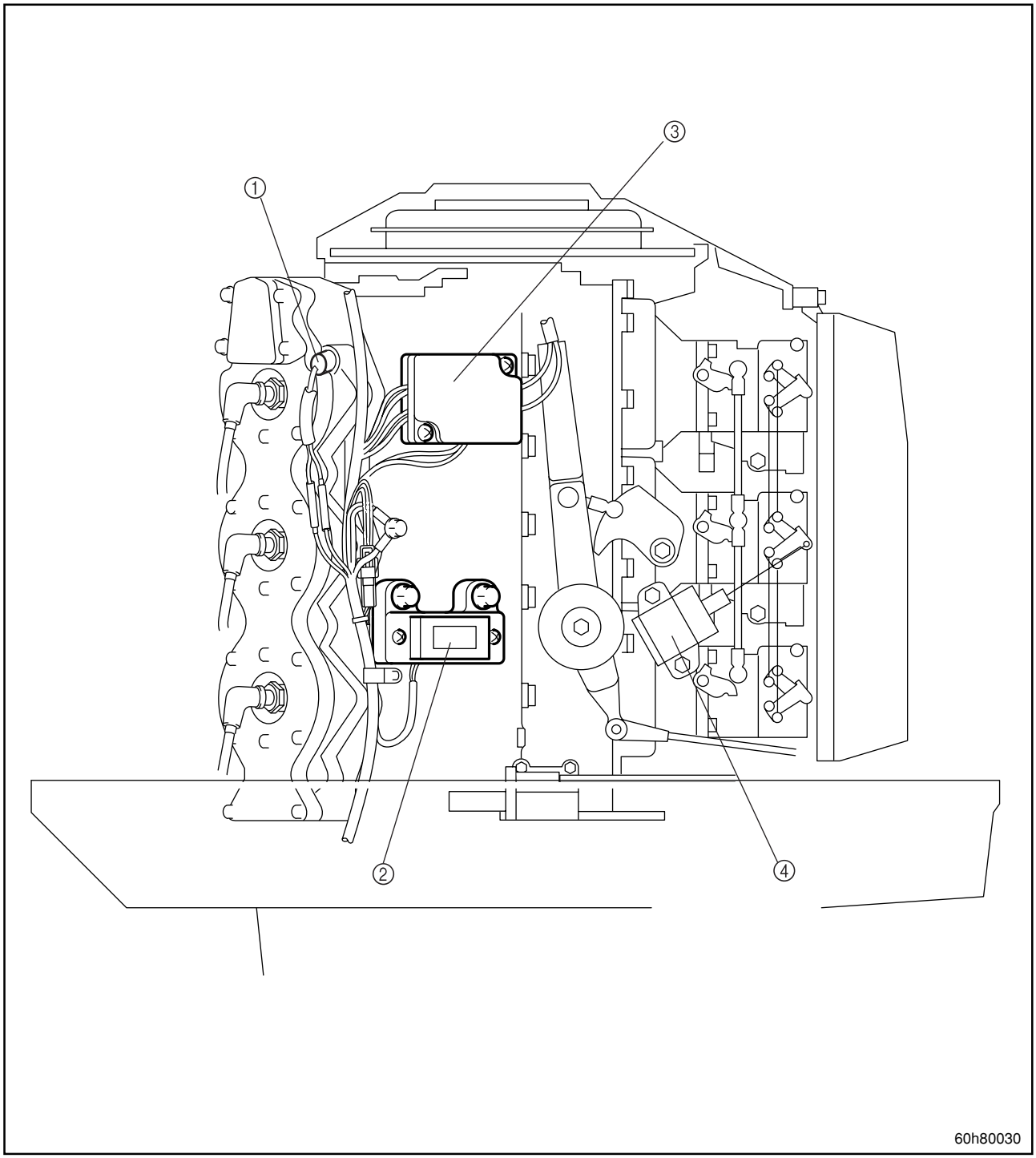
NOTE:

Obtain the internal resistance of the digital circuit tester by connecting both of its probes and checking the display.

8

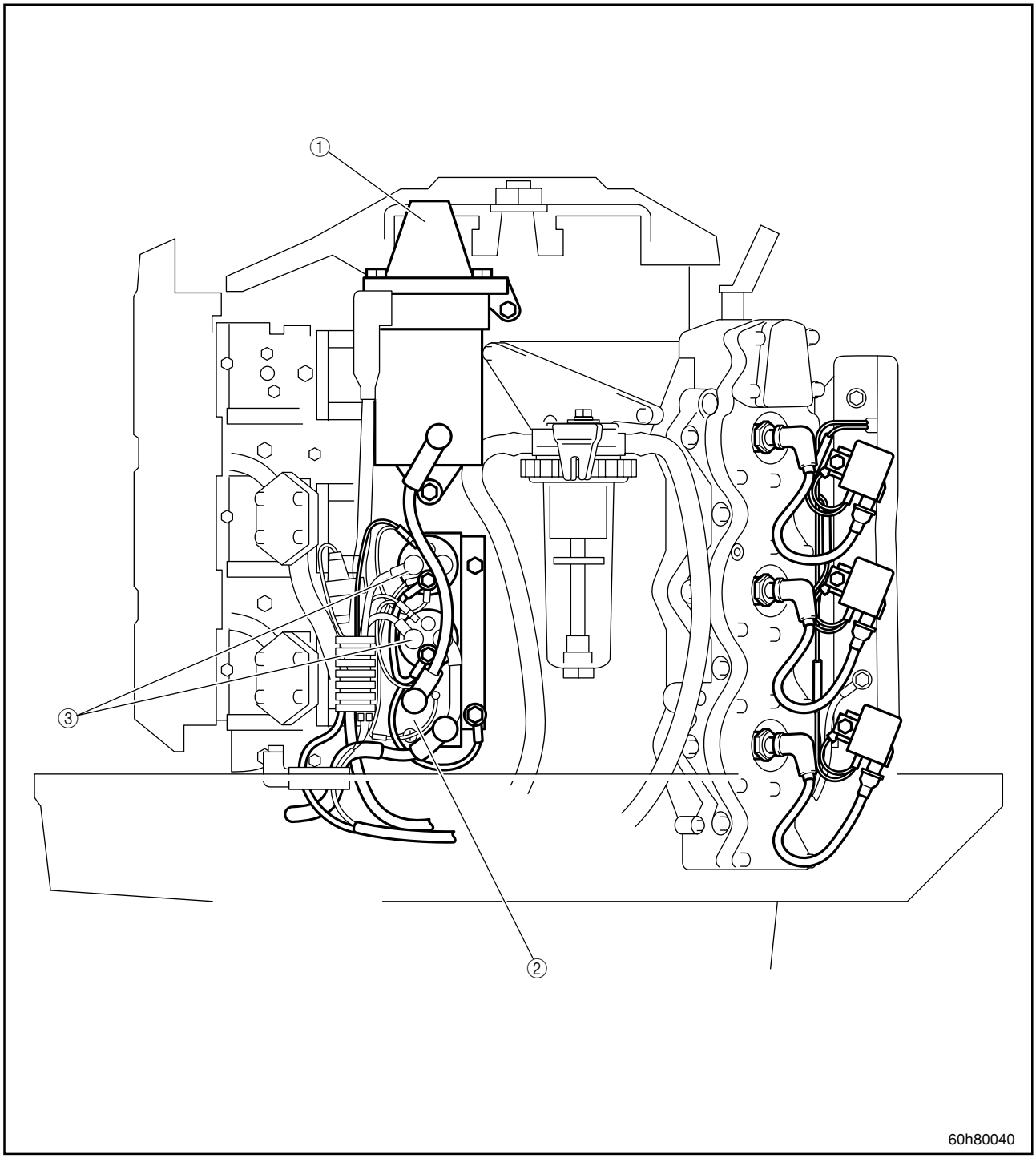
Electrical components

Starboard view



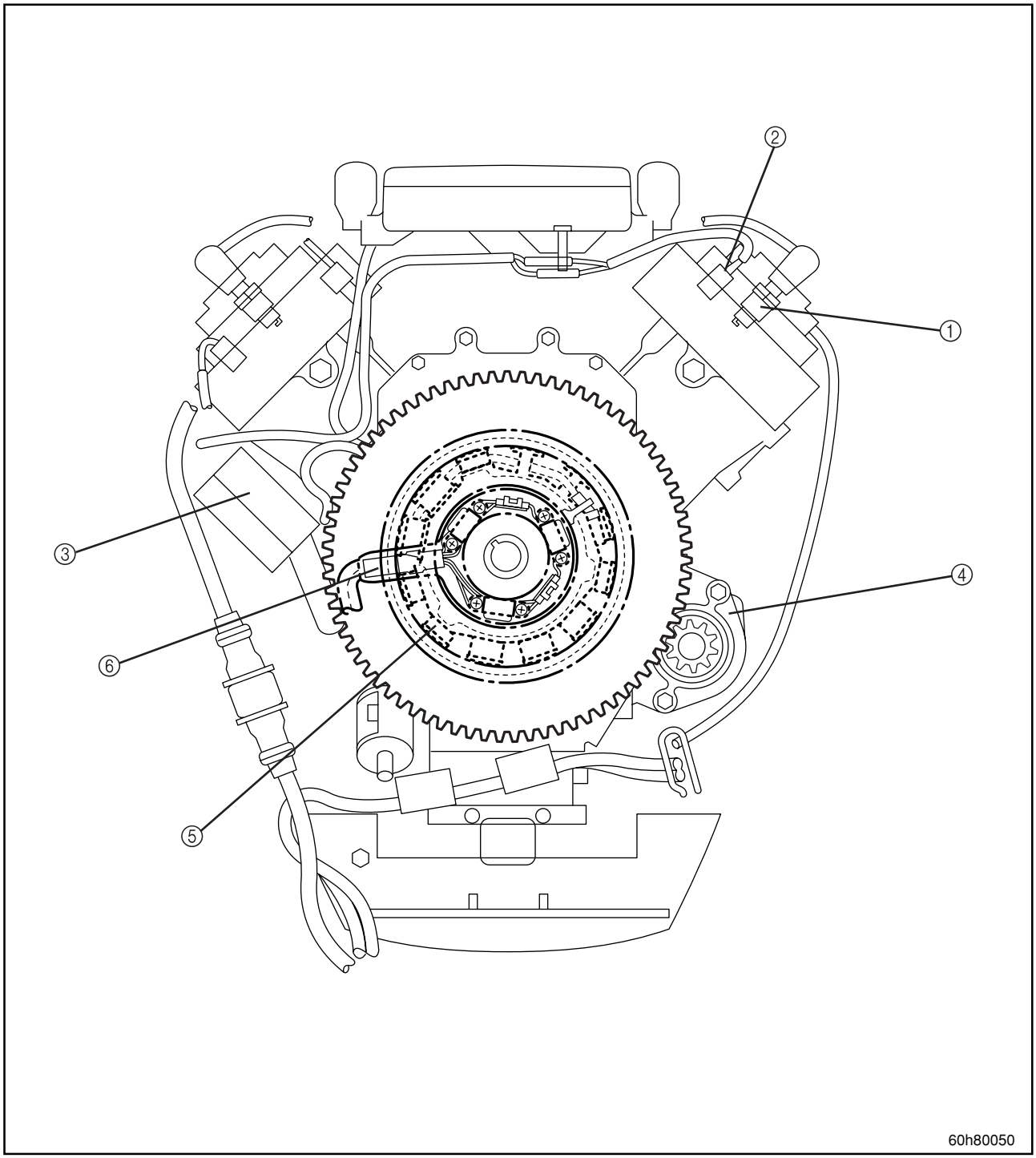
① Thermoswitch
② Hour meter
③ Rectifier Regulator
④ Choke solenoid

Port view



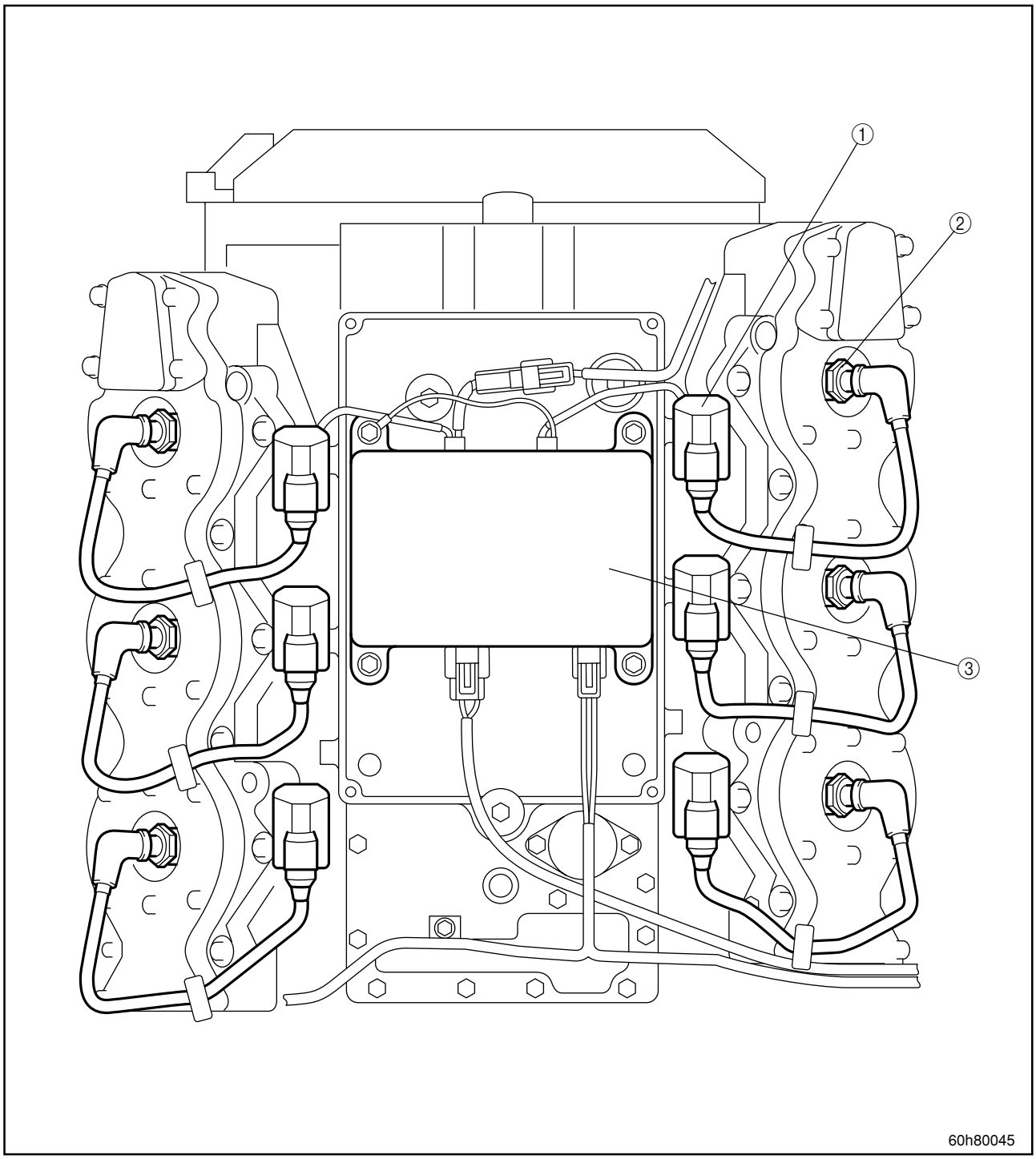
① Starter motor
② Starter relay
③ Power trim and tilt relay

Top view



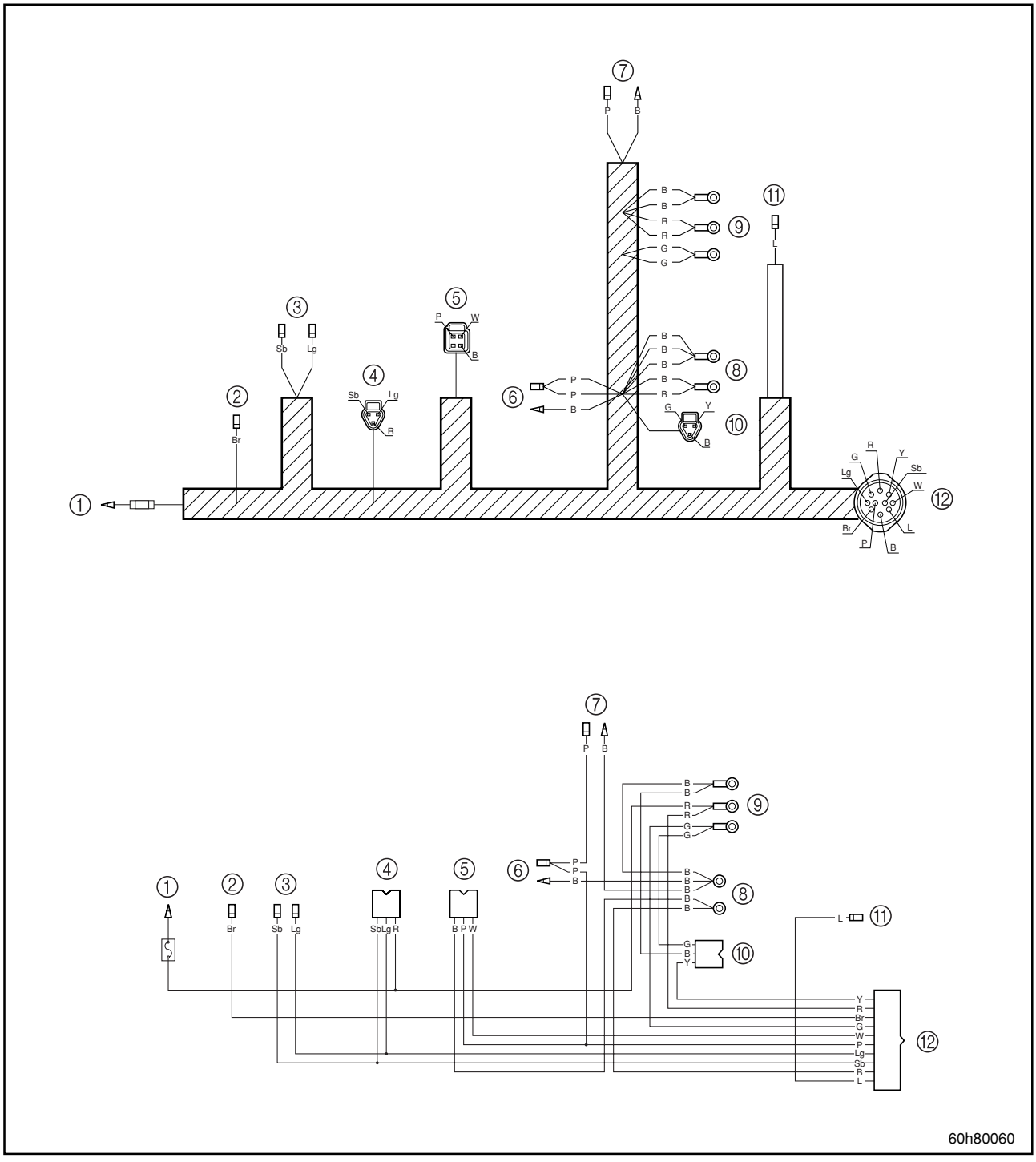
① Spark plug
② Thermoswitch
③ Rectifier Regulator
④ Starter motor
⑤ Starter coil
⑥ Pulser coil

Rear view



① Ignition coil
② Spark plug
③ CDI unit

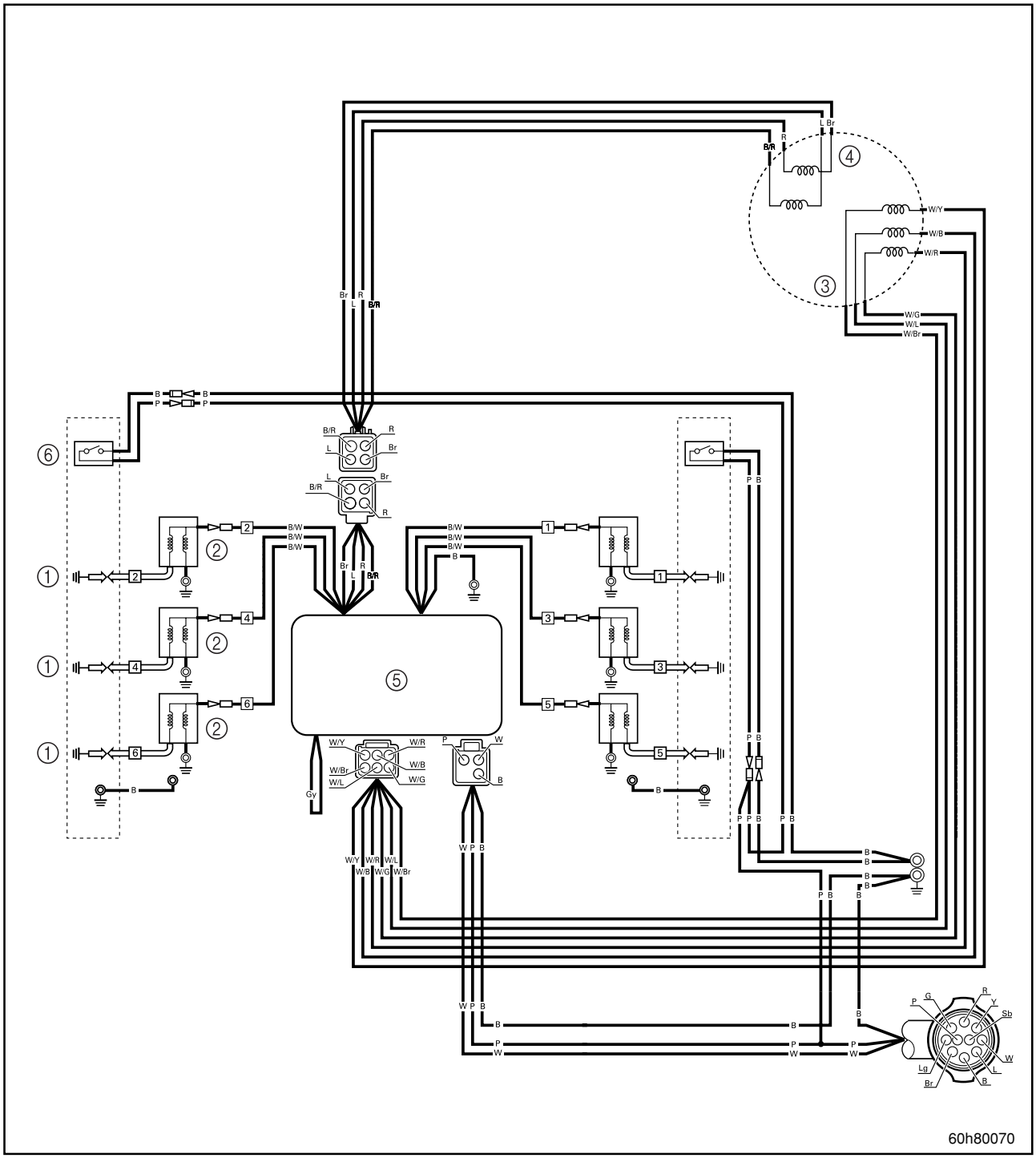
Wiring harness



Connect to:
① Battery
② Starter relay
③ Power trim and tilt relay
④ Power trim and tilt switch
⑤ CDI unit
⑥ Thermoswitch
⑦ Thermoswitch
⑧ Ground lead
⑨ Rectifier Regulator
⑩ Hour meter
⑪ Choke solenoid
⑫ Remote control

Br : Brown
Sb : Sky blue
Lg : Light green
R : Red
P : Pink
W : White
B : Black
Y : Yellow
G : Green
L : Blue

Ignition system



① Spark plug
② Ignition coil
③ Pulser coil
④ Stator coil
⑤ CDI unit
⑥ Thermoswitche

L : Blue
B : Black
Br : Brown
P : Pink
R : Red
W : White

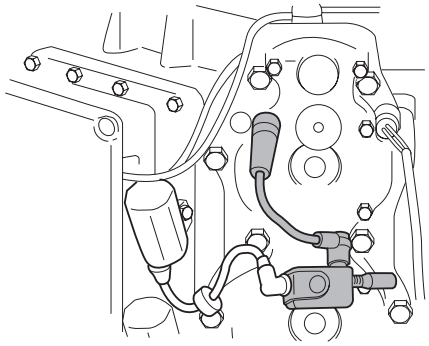
B/R : Black/Red
B/W : Black/White
W/B : White/Black
W/G : White/Green
W/R : White/Red
W/Y : White/Yellow

W/L : White/Blue
W/Br : White/Brown

8

Checking the ignition spark gap

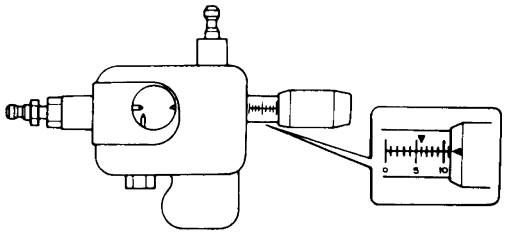
1. Disconnect the spark plug caps from the spark plugs.
2. Connect the spark gap tester to the spark plug cap.



60h80090

Ignition tester: 90890-06754

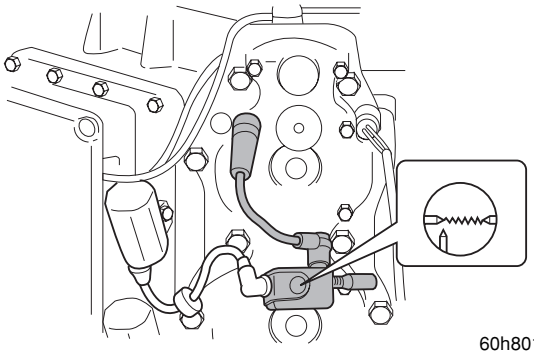
3. Set the specified spark gap length on the adjusting knob.



60h80100

Ignition spark gap: 6 mm (0.24 in)

4. Crank the engine and observe the spark through the discharge window of the spark gap tester. If it does not work properly, check the plug cap, ignition coil, or the specified peak voltages.



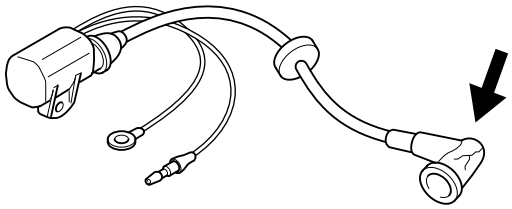
60h80110

⚠ WARNING

- **Do not touch any of the connections of the spark gap tester leads.**
- **Do not let sparks leak out of the removed spark plug caps.**
- **Keep flammable gas or liquids away, since this test can produce sparks.**

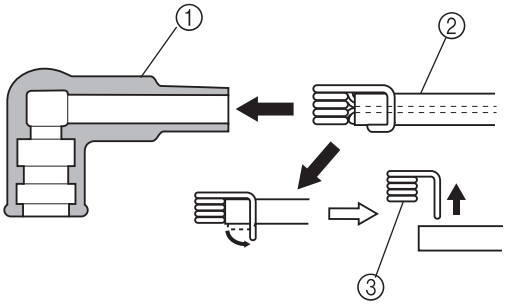
Checking and replacing the spark plug caps (Standard type)

1. Check the spark plug caps for cracks or damage. Replace if necessary.



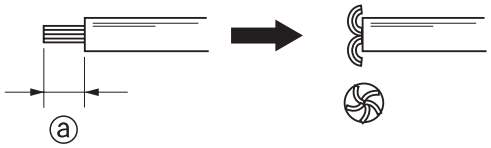
60h80120

2. Remove the spark plug cap ①, and remove the plug cap spring ③ from the spark plug wire ②.



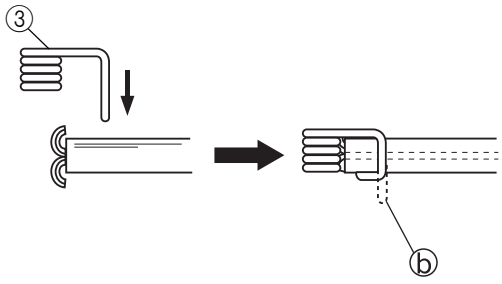
60h80123

3. Cut to remove the insulation ⓐ on the spark plug wire ② by approximately 5mm from the wire end.



60h80125

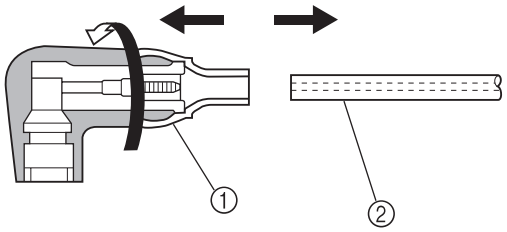
4. Press-in the plug cap spring ③ until it touches the spark plug wire ② conductor. Then bent ⓑ as shown.



60h80127

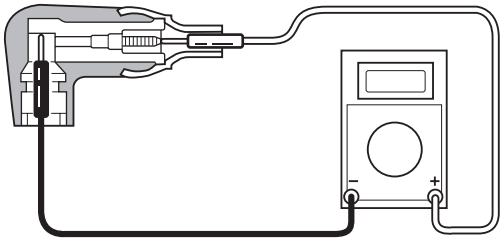
Checking the plug cap (with resister type)

1. Remove the spark plug cap ① from the spark plug wire ② by turning the cap counterclockwise.



60h80130

2. Measure the spark plug cap ① resistance.



60h80135

Spark plug cap resistance :
4.0 - 6.0 kΩ

3. Replace the plug cap ① if the resistance is out of specification.

4. Install the spark plug cap ① on the spark plug wire ② by turning the cap clockwise.

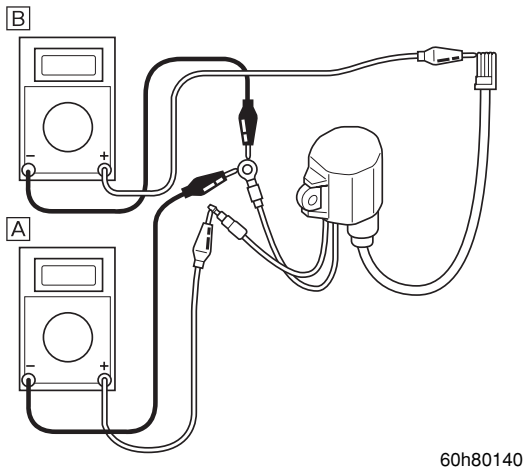
8

Checking the ignition coil

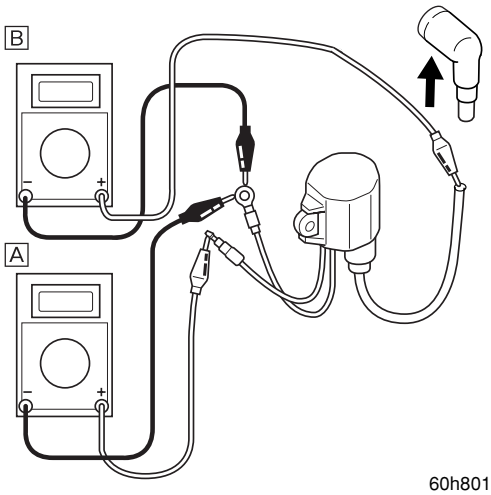
1. Remove the spark plug cap from the spark plug.

2. Disconnect the ignition coil lead.

3. Measure the ignition coil resistance. Replace if out of specification.



60h80140



60h80140

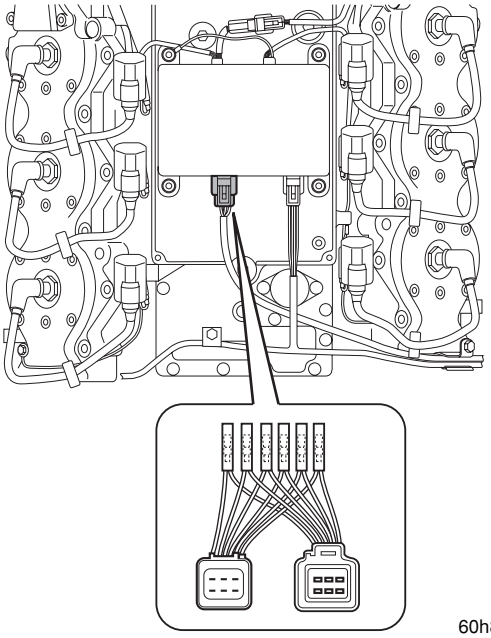
Ignition coil resistance:
Primary coil A :
Black/white (B/W) – Black (B)
0.18 – 0.24Ω at 20°C (68°F)
Secondary coil B :
Spark plug wire – Black (B)
3.26 – 4.88 kΩ at 20°C (68°F)

Checking the pulser coil

1. Remove the CDI unit cover.

2. Connect the pulser coil coupler and the CDI unit with the test harness (6 pins) .

3. Measure the pulser coil output peak voltage. If the measurement is below specification, check the leads and measure the pulser coil resistance. Replace the pulser coil if necessary.

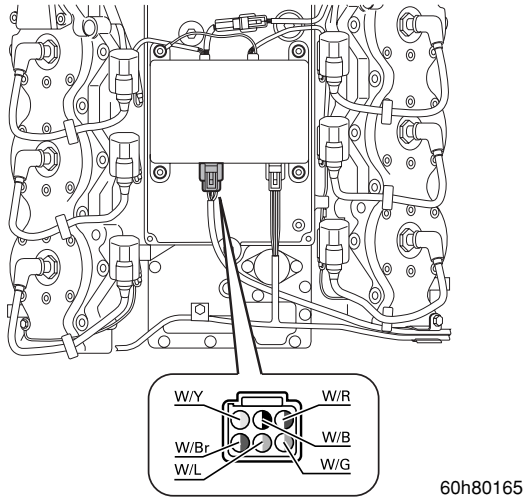


60h80160

Digital circuit tester : 90890-3174
Peak voltage adaptor B : 90890-03172
Test harness (FWY-6) : 90890-06772

Pulser coil output peak voltage :
White/black (W/B) – White/blue(W/L)
White/brown(W/Br)– White/yellow(W/Y)
White/green(W/G)– White/red(W/R)

r/min	Unloaded	Loaded		
	Cranking		1,500	3,500
DC V	2.5	2.0	9.5	16.0

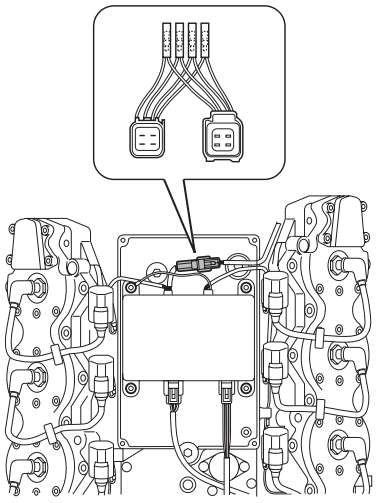


60h80165

Pulser coil resistance (use as reference):
White/black(W/B)– White/blue(W/L)
White/brown(W/Br)– White/yellow(W/Y)
White/green(W/G)– White/red(W/R)
256 - 384 Ω at 20°C (68°F)

Checking the charge coil

1. Remove the CDI unit cover.
2. Connect the charge coil and CDI unit with the test harness (4 pins).
3. Measure the charge coil output peak voltage. If the measurement is below specification, Check the leads, and measure the charge coil resistance. Replace if necessary.


60h80170

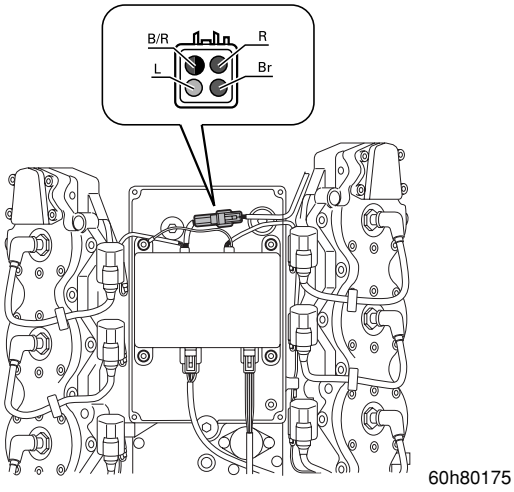
Digital circuit tester : 90890-03174
Peak voltage adapter B : 90890-03172
Test harness (FWY-4) : 90890-06771

Charge coil output peak voltage :
Brown(Br) – Red(R)

r/min	Unloaded	Loaded		
	Cranking		1,500	3,500
DC V	80	90	165	165

Charge coil peak voltage :
Blue(L) – Black/red(B/R)

r/min	Unloaded	Loaded		
	Cranking		1,500	3,500
DC V	30	30	160	165



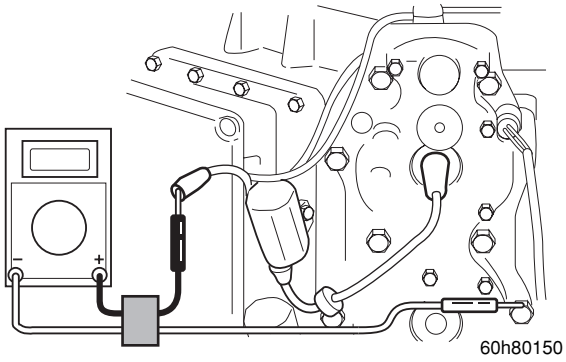
60h80175

Charge coil resistance
(use as reference):
Bron(Br)– Red(R):
428 - 642 Ω at 20°C (68°F)
Blue(L) – Black/red (B/R)
64.4 - 96.6 Ω at 20°C (68°F)

8

Checking the CDI unit

1. Connect the digital circuit tester lead to the ignition coil lead and the ground lead.
2. Measure the CDI unit output peak voltage. If the measurement is below specification, check the lead, and measure the peak output voltages of pulser coil and charge coil.


60h80150

Digital circuit tester : 90890-03174
Peak voltage adapter B : 90890-03172

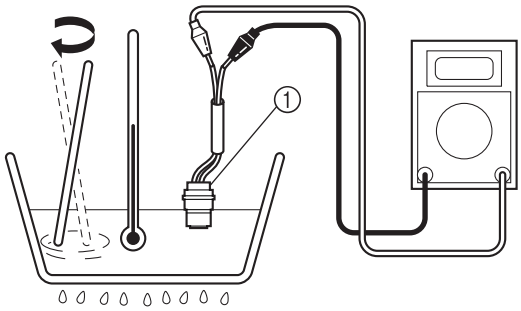
CDI unit output peak voltage :
Black/white(B/W)-ground lead

r/min	Loaded		
	Cranking	1,500	3,500
DC V	65	140	135

NOTE:
Replace the CDI unit, if output peak voltages of the pulser coil and the charge coil are on or above specifications and the CDI unit output peak voltage is below specification.

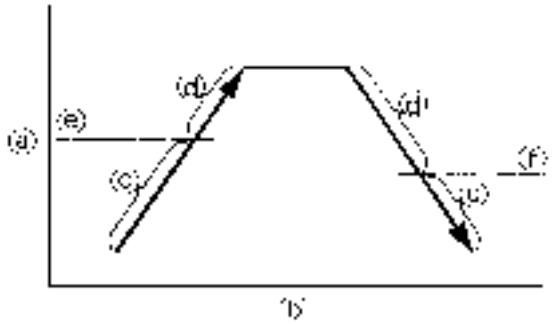
Checking the thermoswitch

1. Place the thermoswitch ① in a container with water and slowly heat the water.



60h80180

2. Check the thermoswitch ① for continuity at the specified temperature. Replace the thermoswitch ① if out of specification.

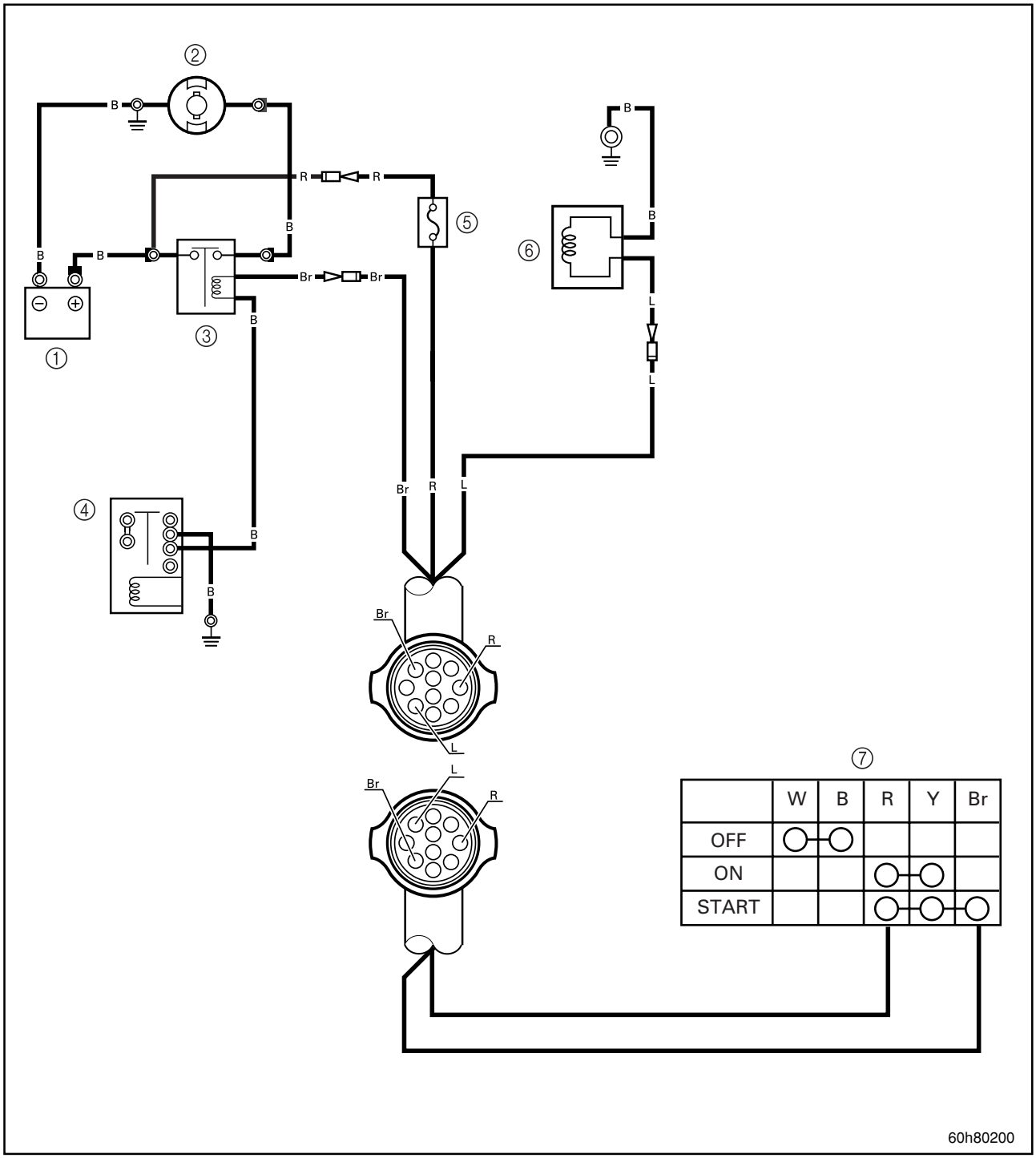


60h80190

NOTE:
Check both left and right thermoswitches.
ⓐ Temperature
ⓑ Time
ⓒ No continuity
ⓓ Continuity

Thermoswitch ① continuity temperature:
Pink(P) – Black(B)
ⓔ : 84 to 90°C (183 to 194 °F)
ⓕ : 60 to 74°C (140 to 165 °F)

Starting system



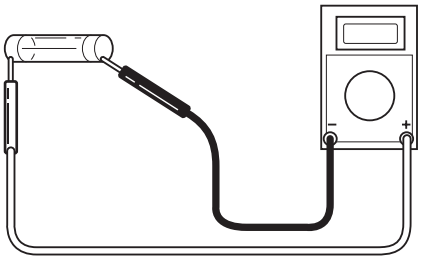
① Battery (12 volts)
② Starter motor
③ Starter relay
④ PTT down relay
⑤ Fuse (20 amps)
⑥ Choke solenoid
⑦ Key switch panel

B :Black
R :Red
Br :Brown
L :Blue
Y :Yellow

8

Checking the fuse

1. Check the fuse for continuity. Replace if there is no continuity.



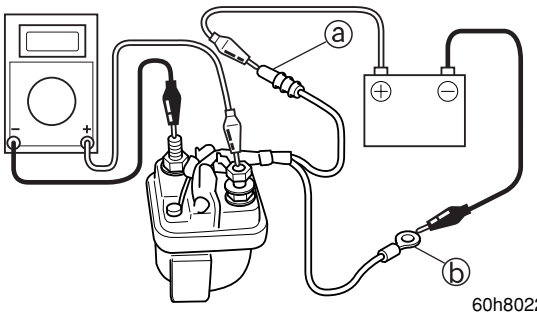
60h80210

Checking the wiring harness (10 pins)

1. Check the wiring harness for continuity. Replace if there is no continuity.

Checking the starter relay

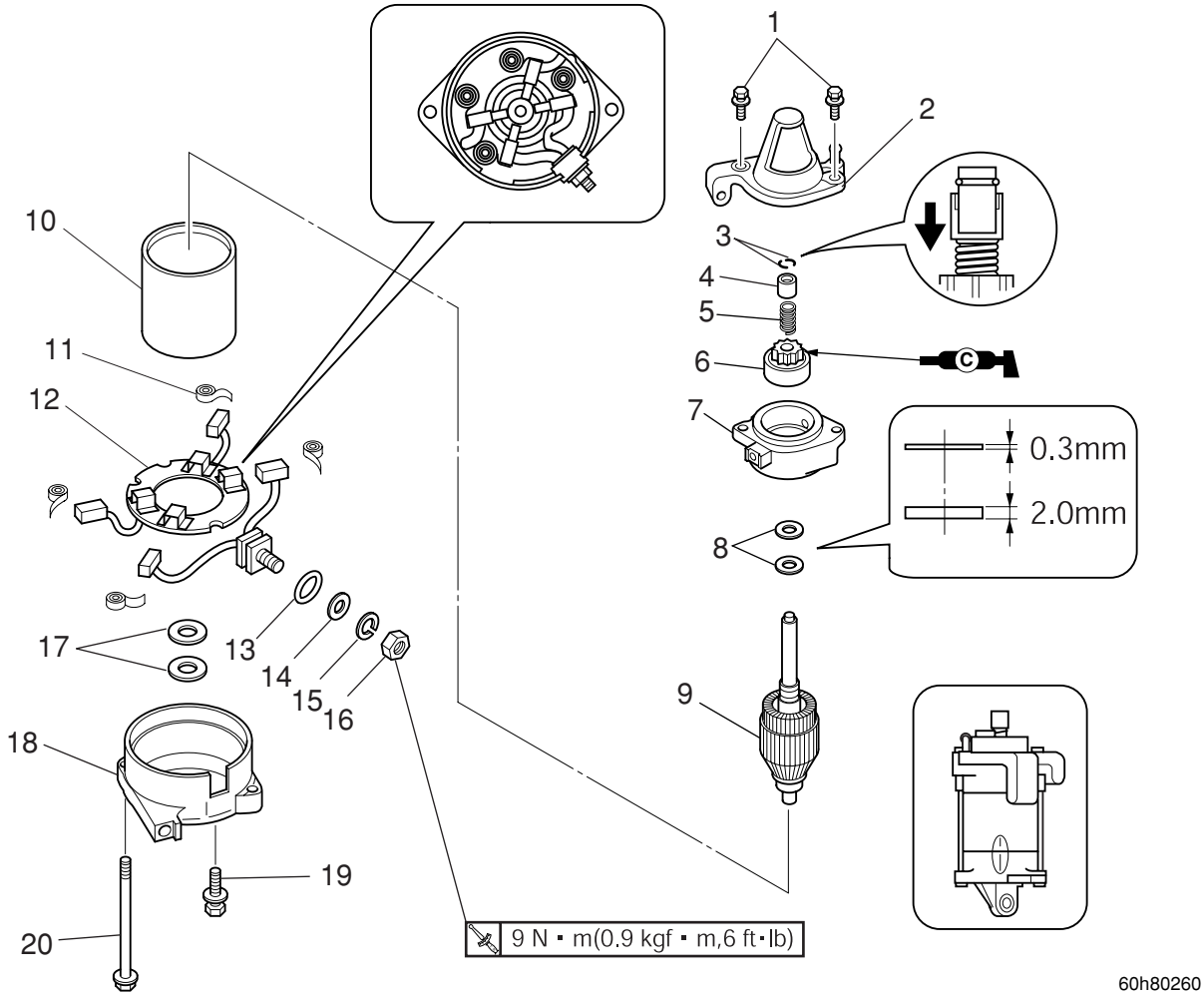
1. Connect the digital circuit tester leads to the starter relay terminals.
2. Connect the brown (Br) lead ⓐ to the positive battery terminal.
3. Connect the black (B) lead ⓑ to the negative battery terminal.
4. Check continuity between the starter relay terminals. Replace if there is no continuity.



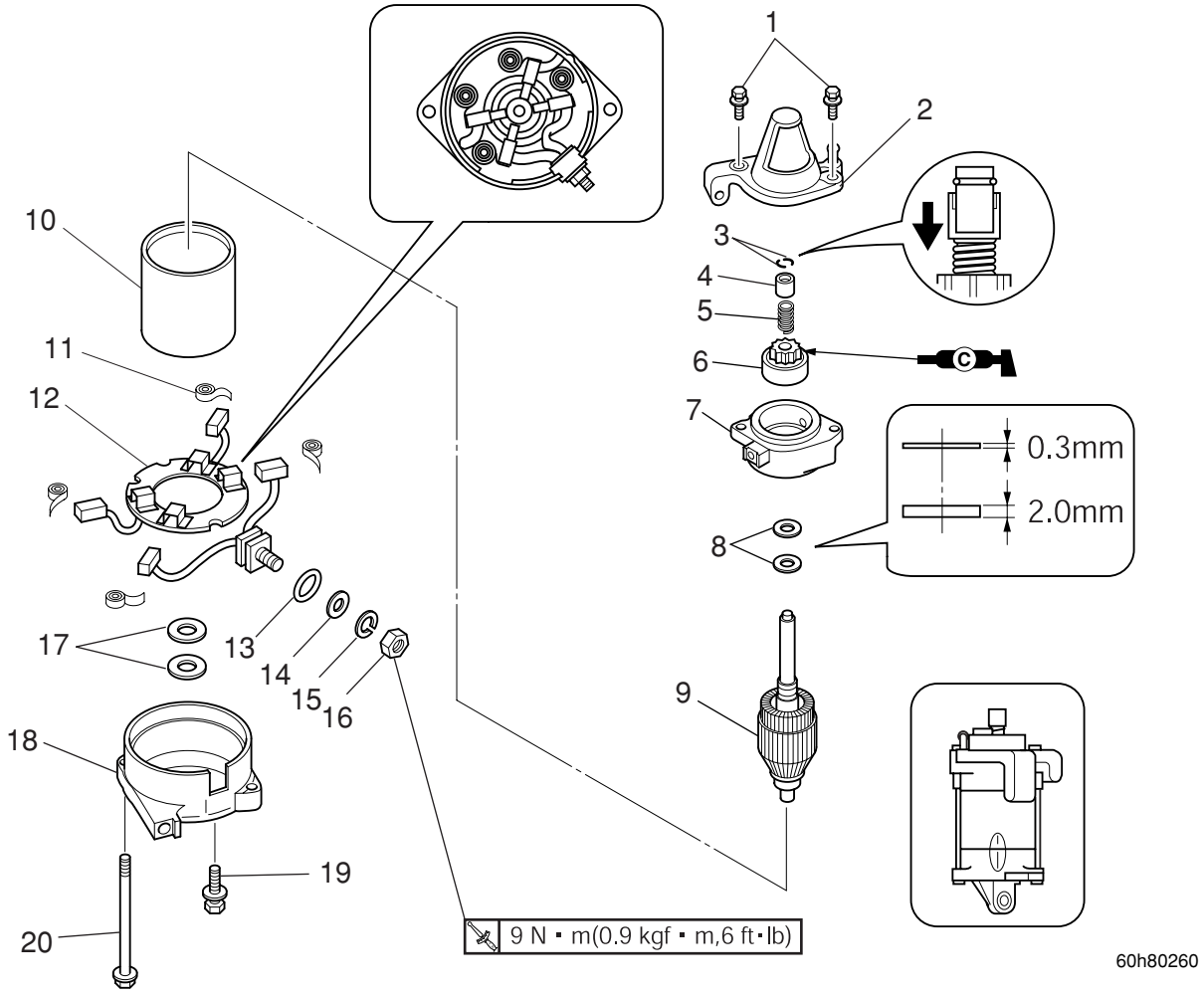
60h80220

5. Check that there is no continuity between the starter relay terminals after disconnecting the brown(Br) ⓐ or black(B) lead ⓑ . Replace if there is continuity.

Starter motor



No.	Part name	Q'ty	Remarks
1	Bolt	2	M8 x 25 mm
2	Starter motor cover	1	
3	Clip	2	
4	Pinion stopper	1	
5	Spring	1	
6	Pinion	1	
7	Housing	1	
8	Washer	2	
9	Armature	1	
10	Stator	1	
11	Spring	4	
12	Brush holder	1	
13	Washer	1	
14	Washer	1	
15	Washer	1	
16	Nut	1	
17	Washer	2	



No.	Part name	Q'ty	Remarks
18	Lower bracket	1	
19	Bolt	1	M8 x 25 mm
20	Bolt	1	M6 x 115 mm

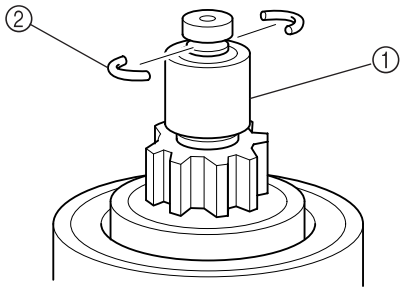
Removing the starter motor pinion

1. Remove the starter motor cover.
2. Remove the adhesive.

CAUTION:

Attach with adhesive after reassembly.

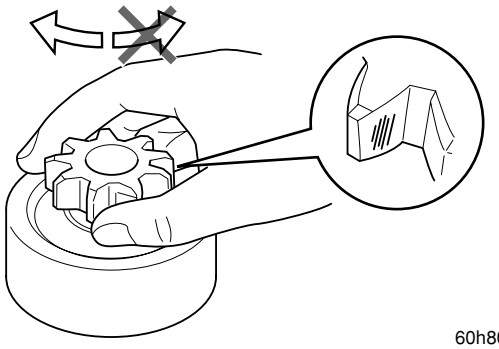
3. Push down the pinion stopper ① as shown to remove the clip ②.



60h80270

Checking the starter motor pinion

1. Check the teeth of the pinion for cracks or wear. Replace if necessary.



60h80280

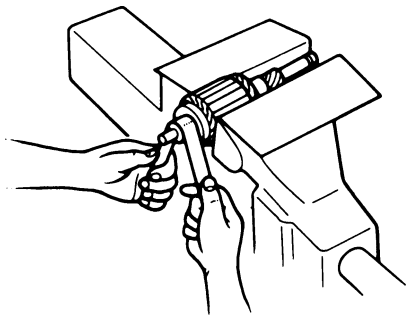
2. Check the pinion for smooth operation. Replace if necessary.

NOTE:

Turn the pinion clockwise to check that it operates smoothly, and turn it counterclockwise to check that it locks in place.

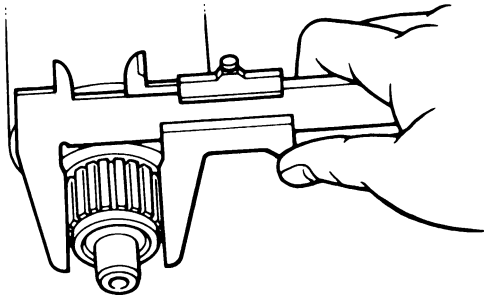
Checking the armature

1. Check the commutator for dirt. Clean with #600 grid sandpaper or by blowing the compressed air.



60h80285

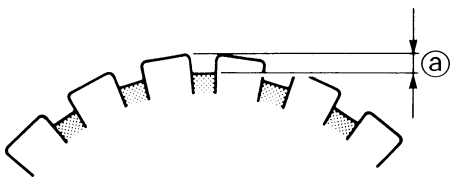
2. Measure the commutator diameter. Replace the armature if the measured diameter is smaller than the specified value.



60h80290

Commutator diameter limit:
32.0 mm (1.26 in)

3. Measure the commutator undercut ⓐ. Replace the armature if the measurement is smaller than the specified value.

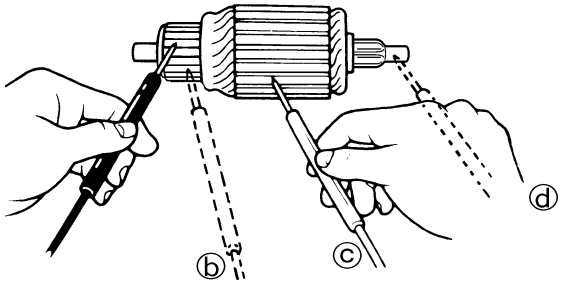


60h80300

Commutator undercut limit ⓐ:
0.2 mm (0.0079 in)

8

4. Check the armature for continuity. Replace if out of specification.

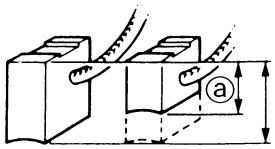


60h80310

Armature continuity:	
Commutator segments ⓑ	Continuity
Segment ⓑ - Armature core ⓒ	No continuity
Segment ⓑ - Armature shaft ⓓ	No continuity

Checking the brushes

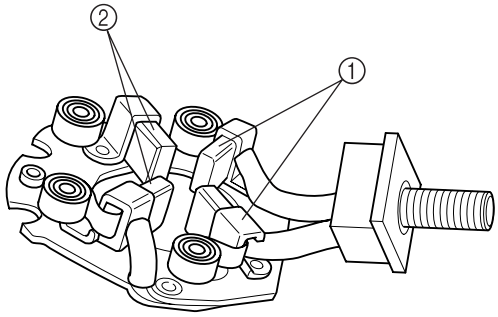
1. Measure the brush length. Replace the brush assembly if the length is shorter than the specified limit.



60h80320

Brush length limit ⓐ:
10.0 mm (0.39 in)

2. Check the brush holder assembly for continuity. Replace if out of specification.



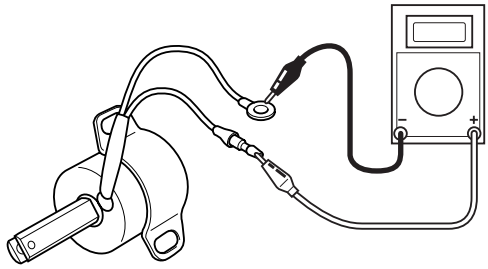
60h80330

Brush continuity	
Brush ① – Brush ②	No continuity

Choke solenoid

Checking the choke solenoid

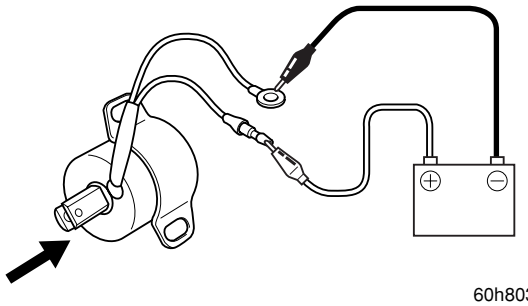
1. Disengage the choke solenoid bullet connector, and measure the choke solenoid resistance.



60h80340

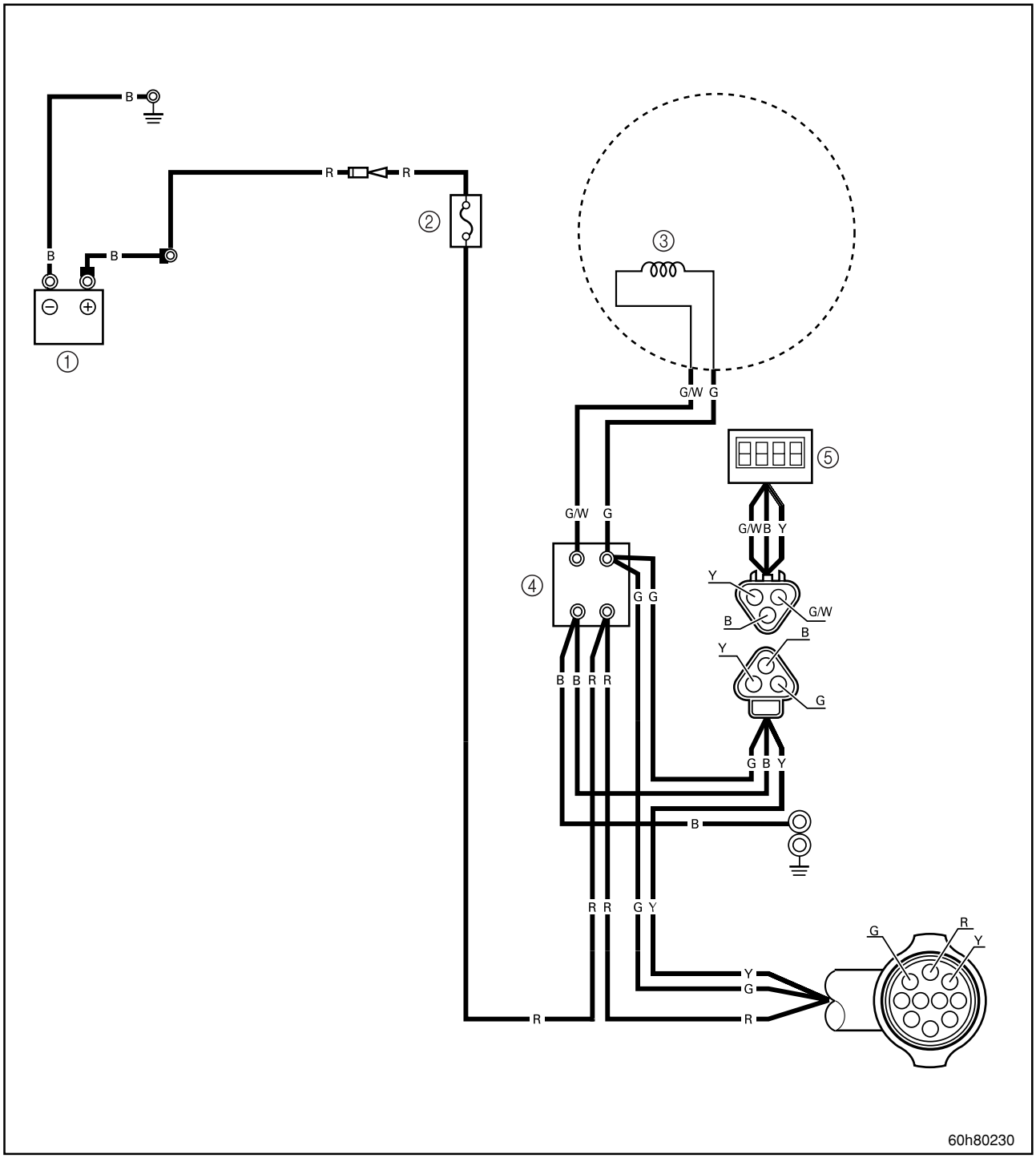
Choke solenoid resistance:
3.4 - 4.0 Ω

2. Connect the battery to the choke solenoid, and check if the plunger is pulled in.



60h80350

Charging system



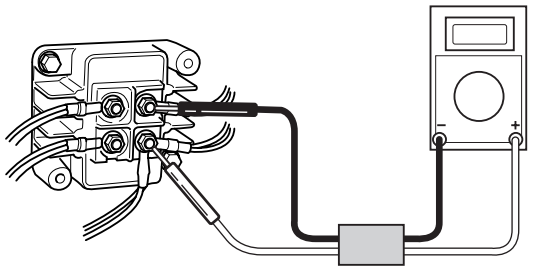
① Battery
② Fuse (20 amps)
③ Lighting coil
④ Rectifier Regulator
⑤ Hour meter

B : Black
R : Red
G : Green
Y : Yellow
G/W : Green/White

8

Checking the lighting coil

1. Remove the Rectifier Regulator cover, and connect the digital circuit tester lead to the lighting coil.
2. Measure the lighting coil output peak voltage. If the measurement is below specification, check the lead and measure the lighting coil resistance. Replace if necessary.



60h80240

Digital circuit tester : 90890-03174
Peak voltage adapter B : 90890-03172

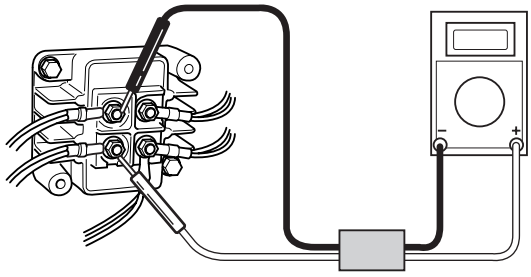
Lighting coil output peak voltage:
Green(G)- Green/white(G/W)

r/min	Unloaded		
	Cranking	1,500	3,500
DC V	3.0	20.0	50.0

Lighting coil resistance
(use as reference):
Green(G) - Green/white (G/W)
0.20 - 0.30 Ω at 20°C (68°F)

Checking the Rectifier Regulator

1. Remove the Rectifier Regulator cover, and connect the digital circuit tester lead to the Rectifier Regulator.
2. Measure the Rectifier Regulator output peak voltage. Replace the Rectifier Regulator, if the lighting coil output peak voltage is on or above specification and the Rectifier Regulator output peak voltage is below specification.



60h80250

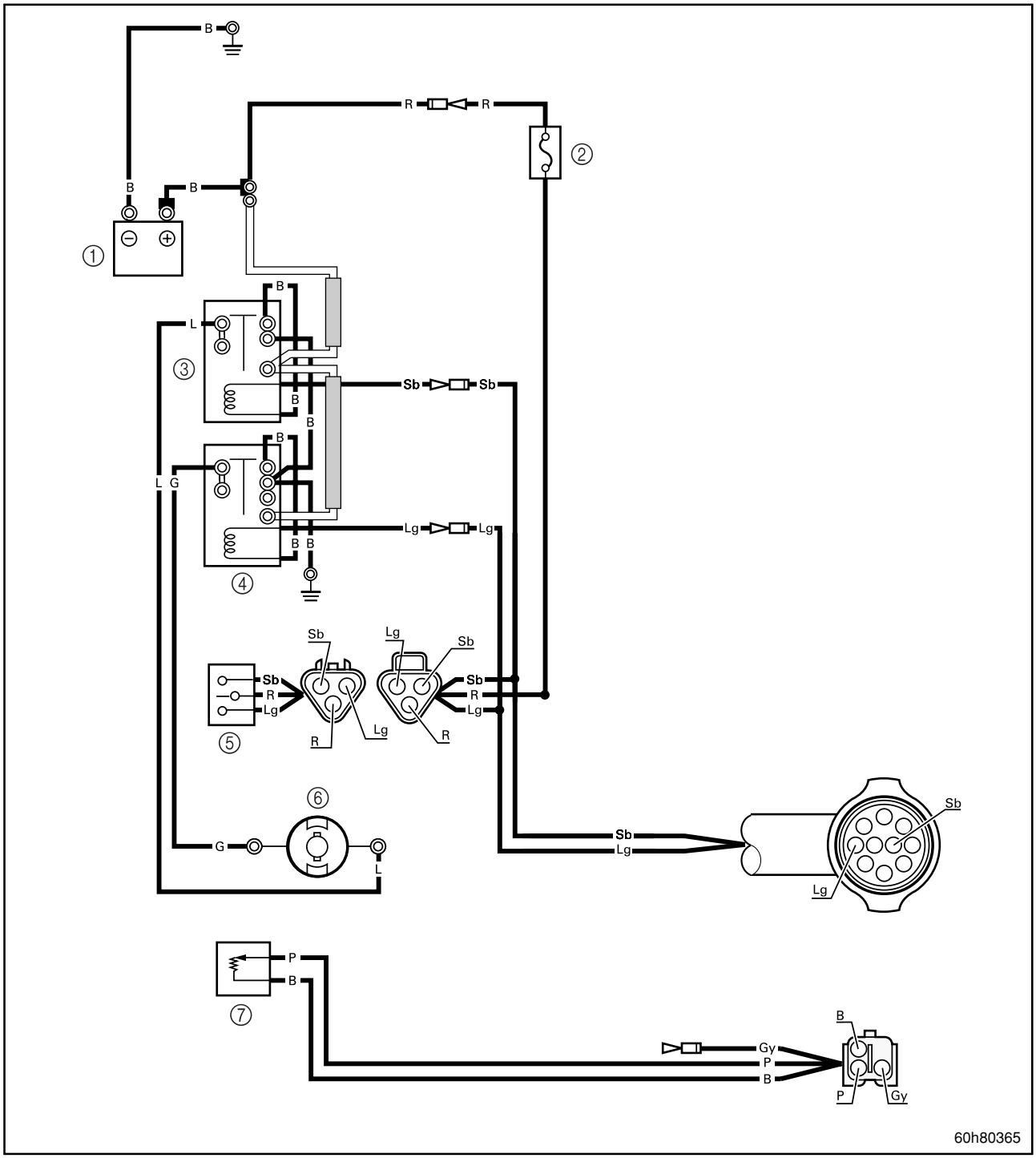
NOTE:
Disconnect the output lead (Red(R)- Black(B)) of the Rectifier Regulator when measuring the output peak voltage.

Digital circuit tester : 90890-3174
Peak voltage adaptor B : 90890-03172

Rectifier Regulator output peak voltage:
Red(R)- Black(B)

r/min	Unloaded	
	1,500	3,500
DC V	18	45

Power trim and tilt



① Battery (12 volts)
② Fuse (20 amps)
③ PTT up relay
④ PTT down relay
⑤ Trailer switch
⑥ PTT motor
⑦ Trim sender

B : Black
R : Red
Sb : Sky blue
Lg : Light green
Gy : Gray
P : Pink
G : Green
L : Blue

8

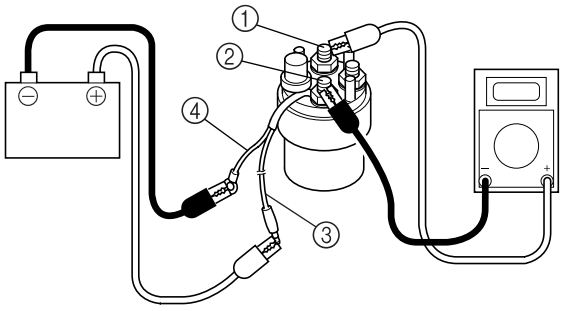
Checking the power trim and tilt relay

1. Connect the digital circuit tester between power trim and tilt relay terminals ① and ②.

2. Connect the light green (Lg) lead or sky blue (Sb) lead ③ to the positive battery terminal and the black (B) lead to ④ the negative battery terminal as shown.

3. Check the continuity between the terminals ① and ②. Replace if there is no continuity.

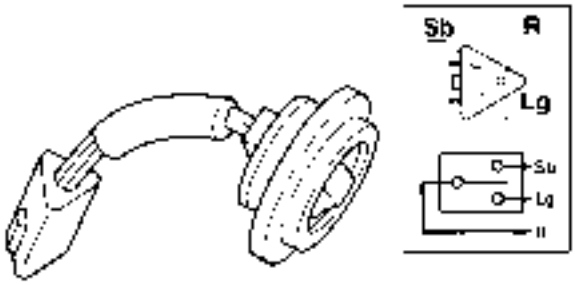
4. Disconnect the black (B) lead ④. Check for cintinuity between terminals ① and ②. Replace if there is no continuity.



60h80370

Checking the power trim and tilt switch / trailer switch

1. Check the power trim and tilt switch/trailer switch for continuity. Replace if out of specification.



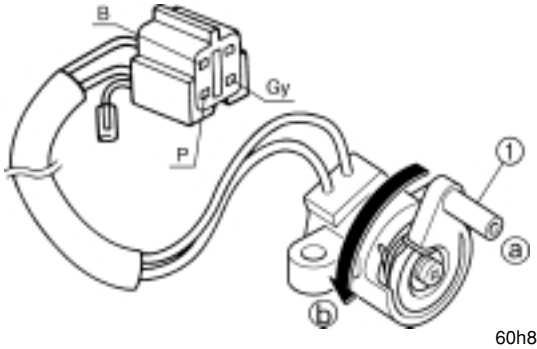
60h80360

Lead color:

Switch position	Sky blue(Sb)	Red (R)	Light green(Lg)
Up	○	○	
Free			
Down		○	○

Checking the trim sender

1. Disengage the trim sender coupler, and measure the trim sender resistance.



60h80400

Trim sender resistance:
Pink(P)- Black(B)
9 - 11 Ω at 20°C (68°F) ⓐ
239 - 379 Ω at 20°C (68°F) ⓑ

NOTE:
Turn the lever ① and make sure that the resistance changes gradually.

Troubleshooting

NOTE:

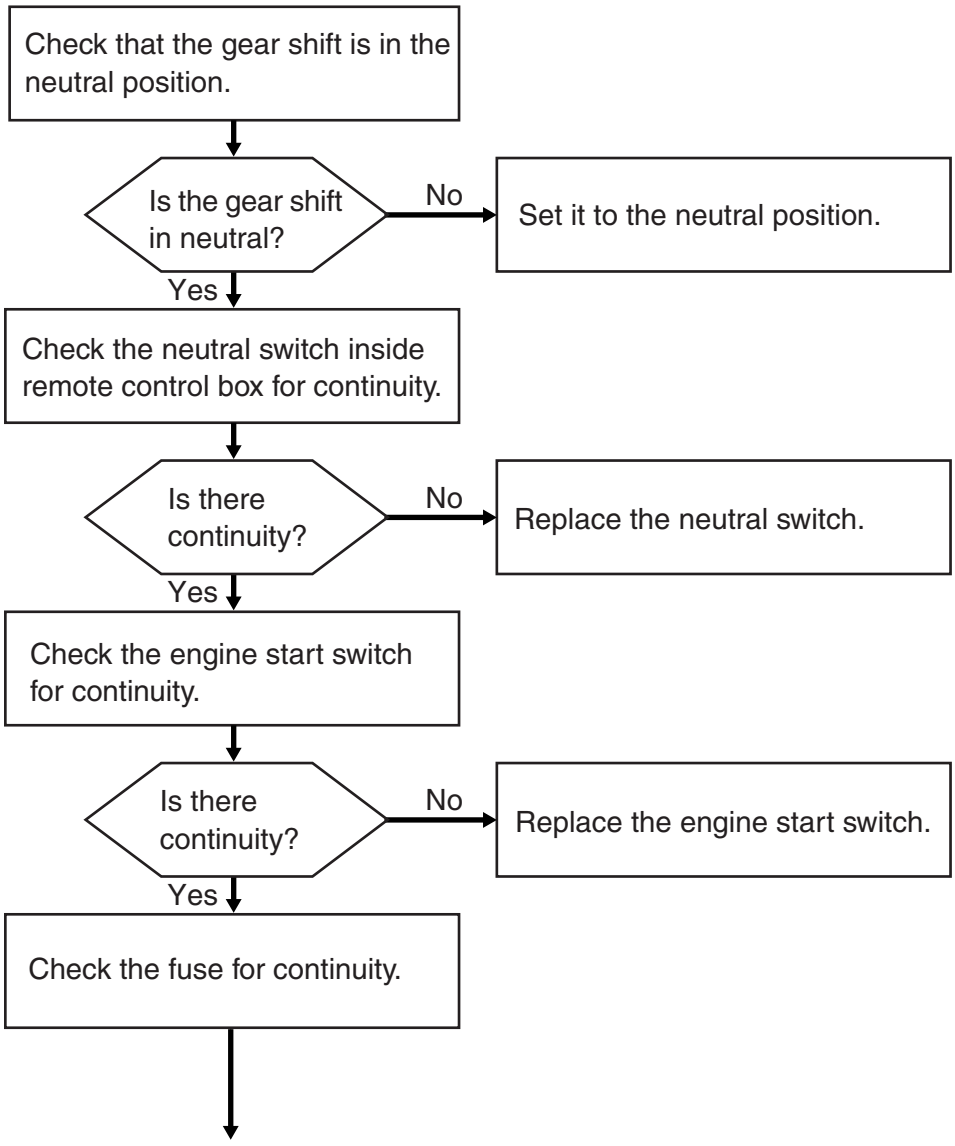
- To diagnose a mechanical malfunction, use the troubleshooting charts pertaining to the trouble located in this chapter. Also, when checking and maintaining the outboard motor, see Chapters 4–8, to check the part necessary to carry out safety maintenance.
- Check that all electrical connections are tight and free from corrosion, and that the battery is fully charged to 12 V.

Power unit

Symptom: Engine does not crank.

- Check the starting system.
- Check the power unit.

Starting system



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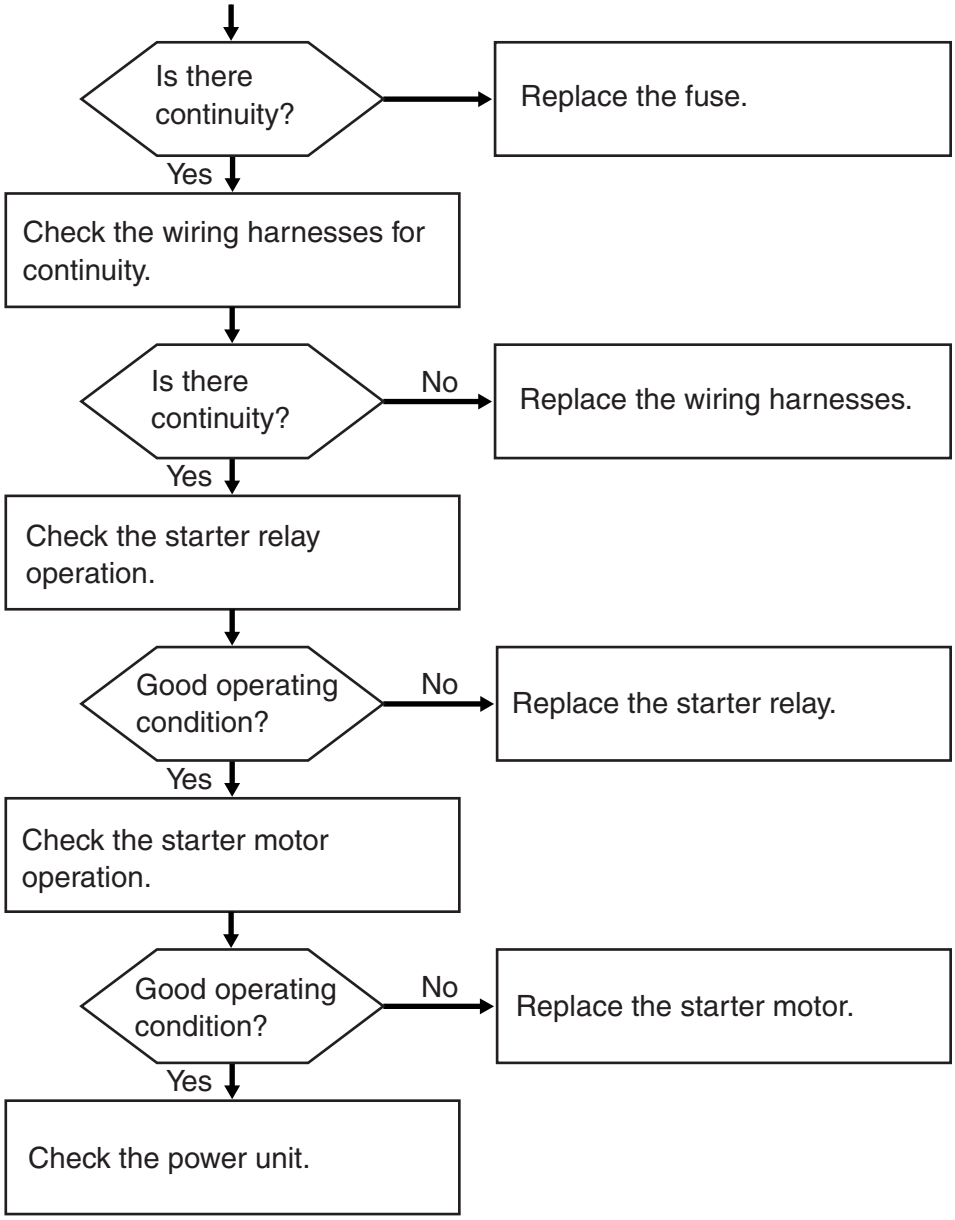
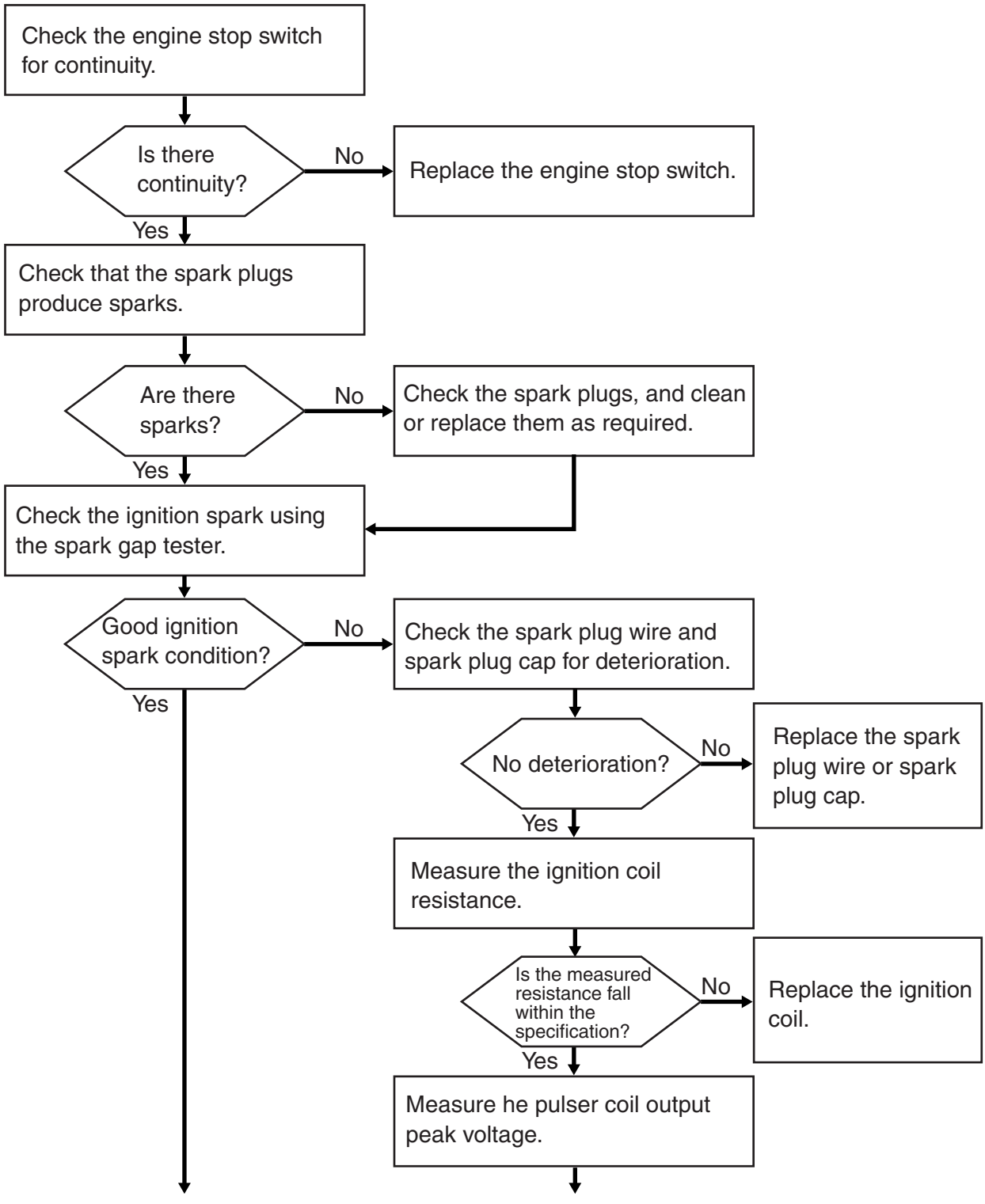

Is there continuity?
Replace the fuse.
Yes
Check the wiring harnesses for continuity.
Is there continuity?
No
Replace the wiring harnesses.
Yes
Check the starter relay operation.
Good operating condition?
No
Replace the starter relay.
Yes
Check the starter motor operation.
Good operating condition?
No
Replace the starter motor.
Yes
Check the power unit.

Symptom: Engine cranks, but will not start.
- Check the ignition system.
- Check the fuel system.
- Check the compression pressure of the power unit.

⚠ WARNING
- **Do not touch any of the connections of the spark gap tester leads.**
- **Do not let sparks leak out of the removed spark plug caps.**
- **Keep flammable gas or liquids away, since this test can produce sparks.**

Ignition system



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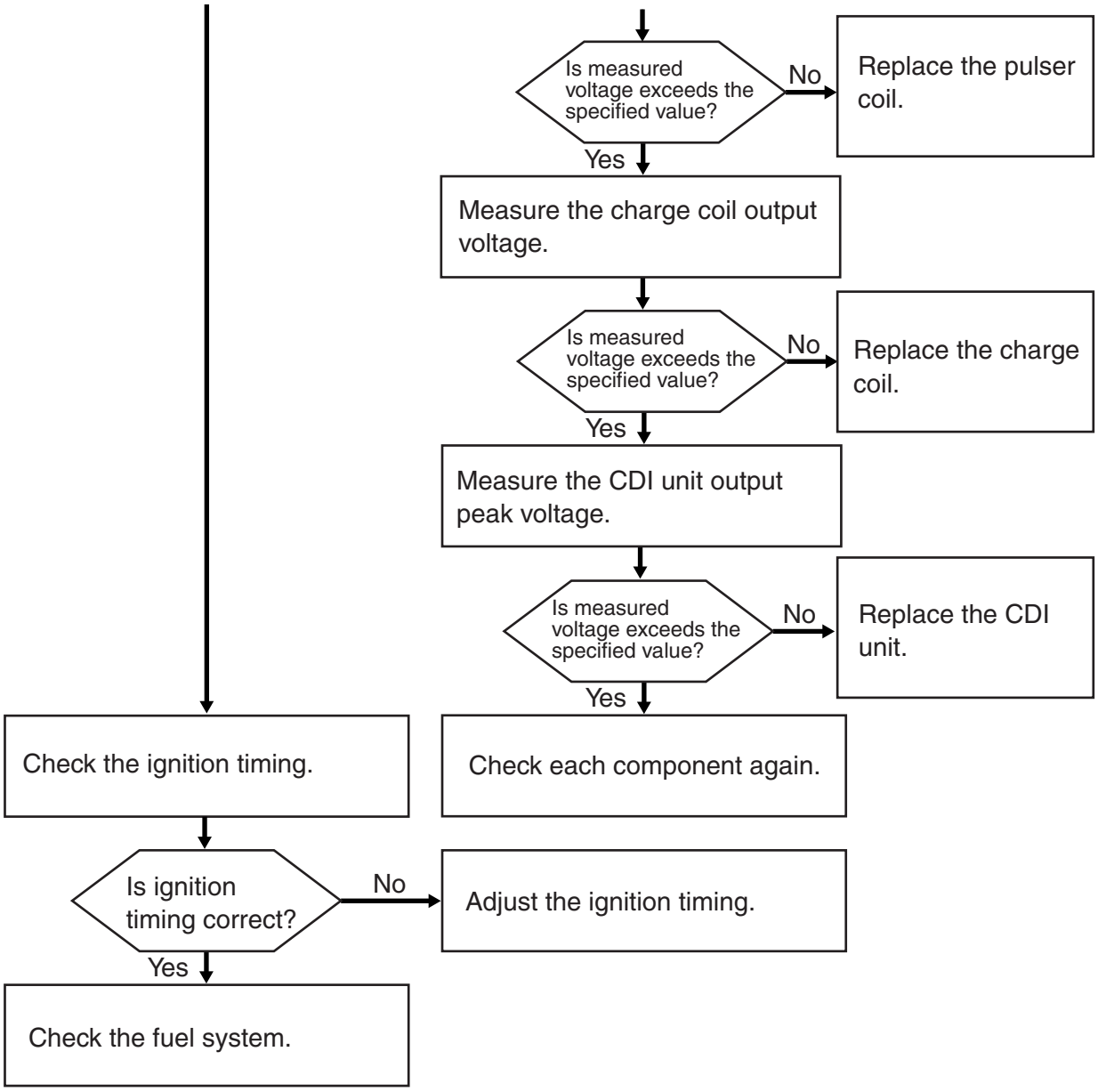
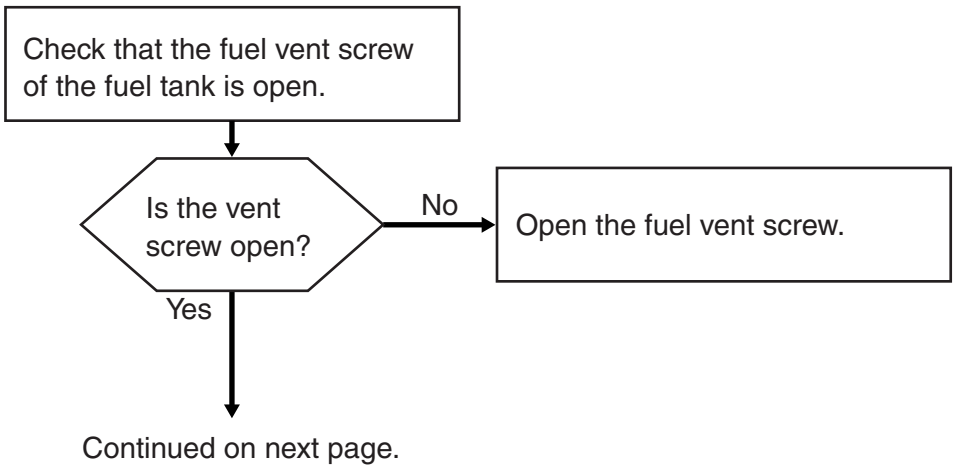


Fuel system



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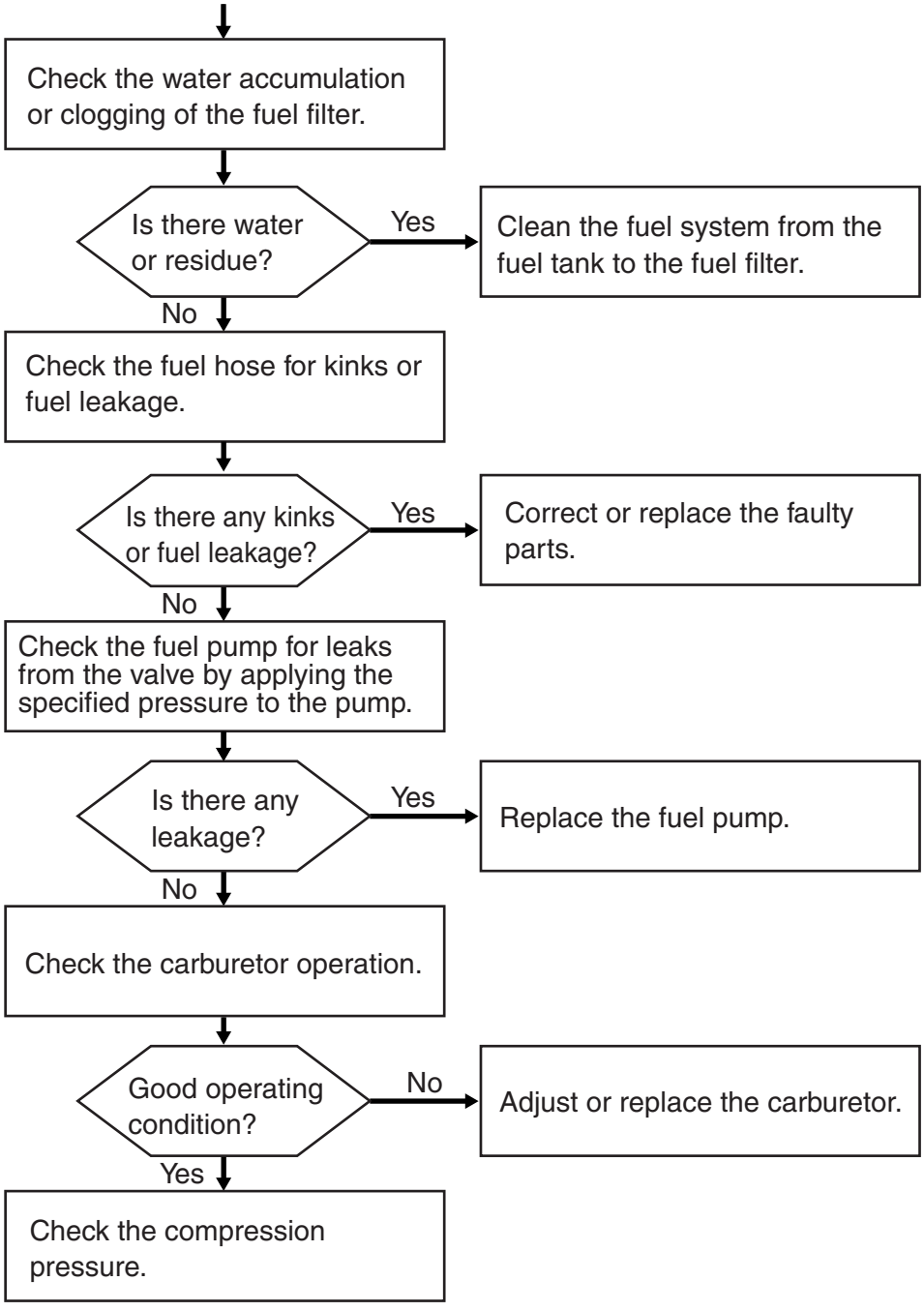
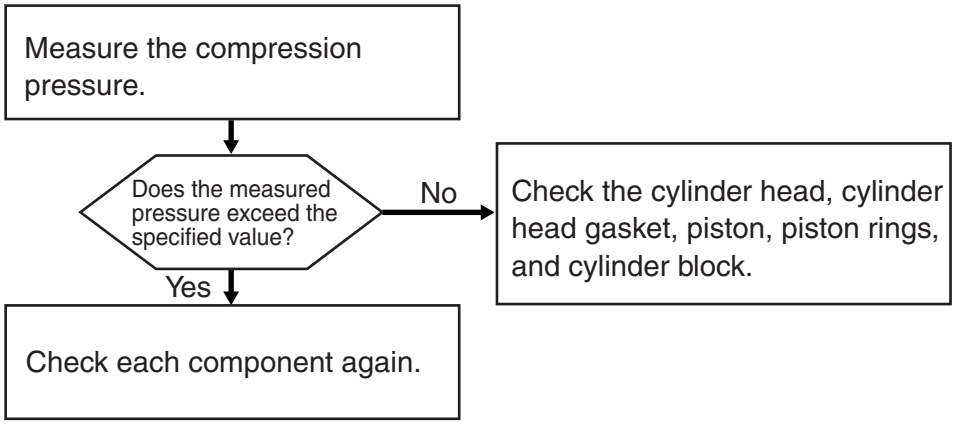


Compression pressure

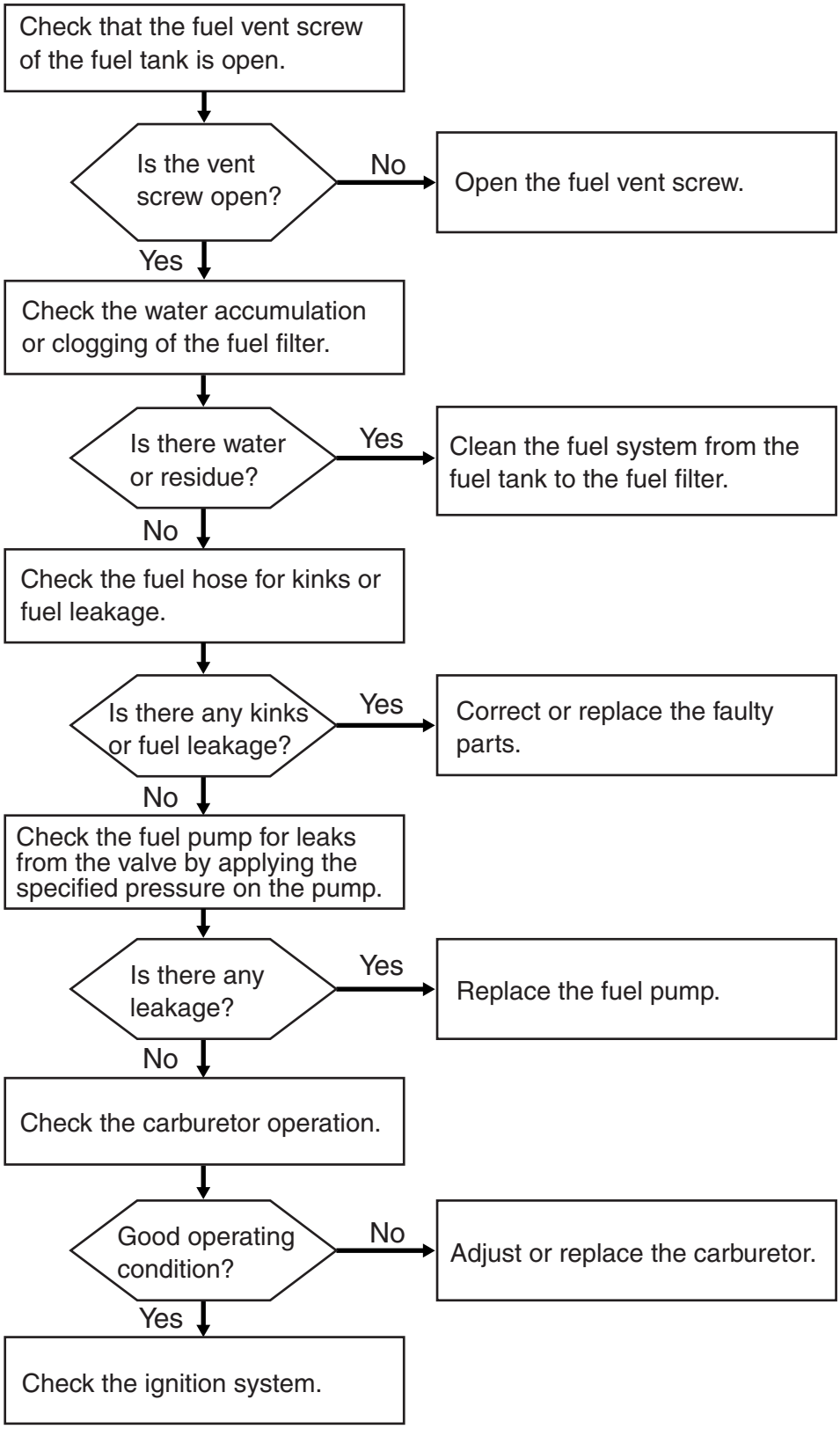


Symptom: Engine starts but does not remain on.
- Check the fuel system.
- Check the ignition system.
- Check the compression pressure of the power unit.

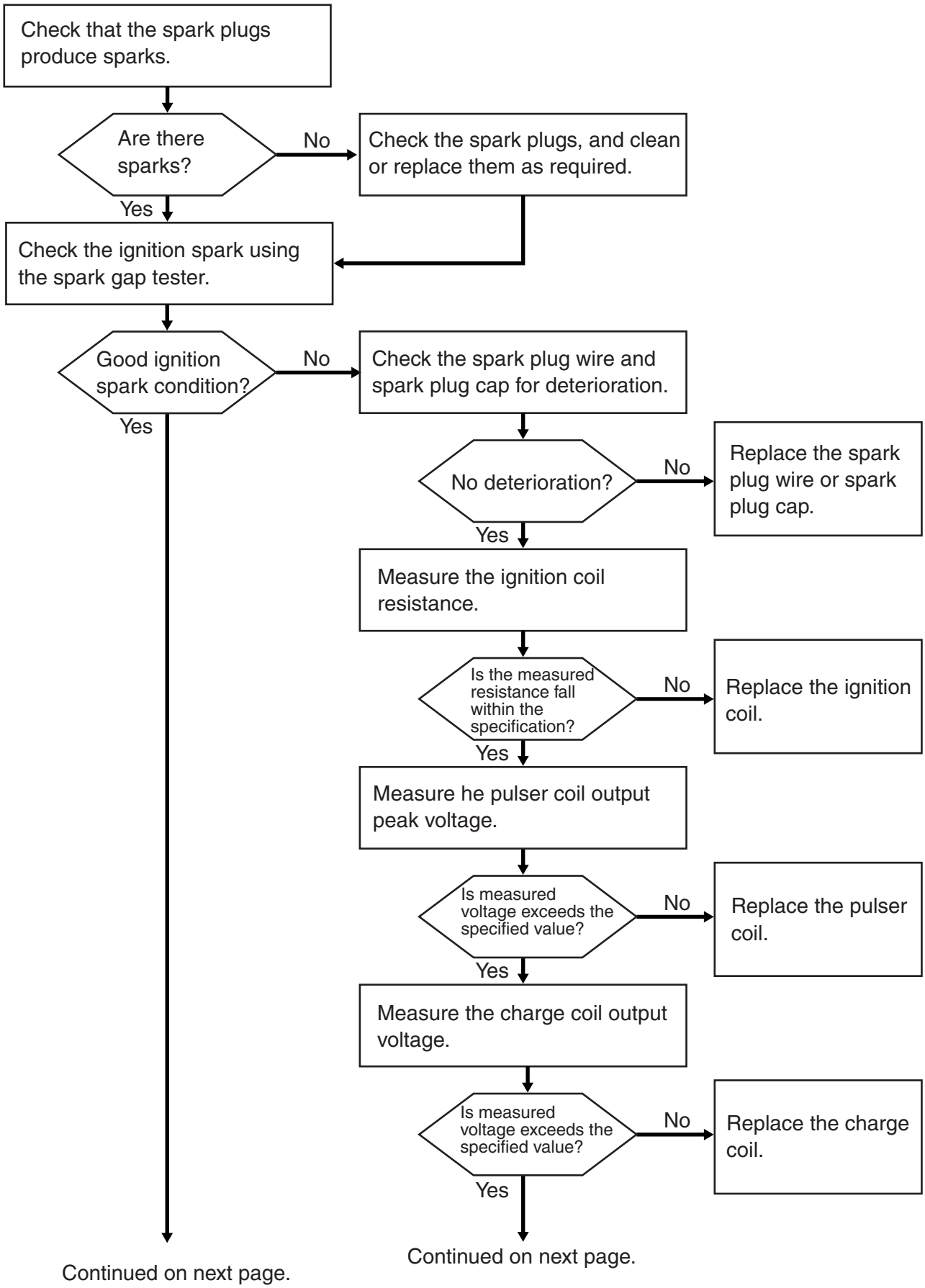
⚠ WARNING

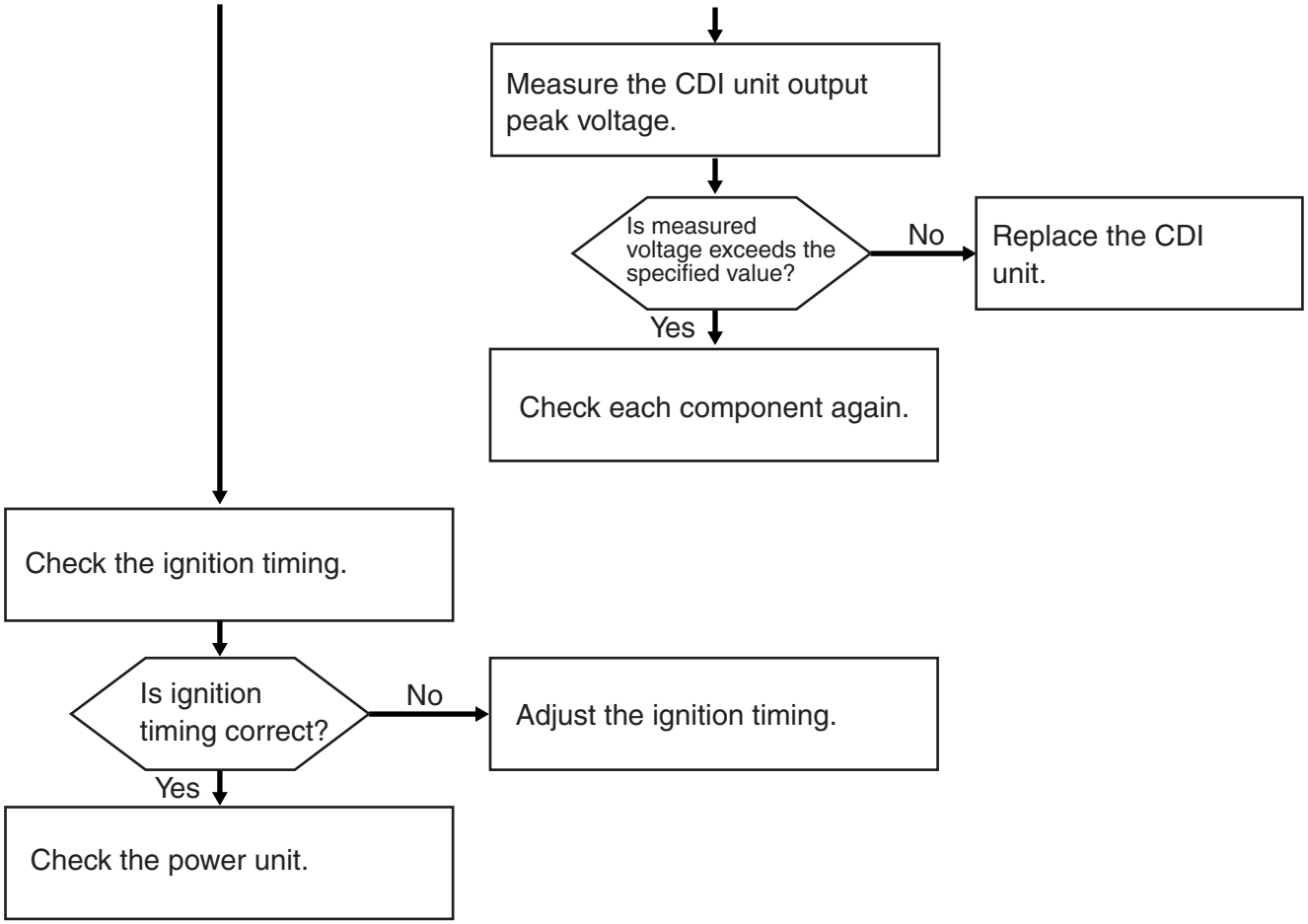
- **Do not touch any of the connections of the spark gap tester leads.**
- **Do not let sparks leak out of the removed spark plug caps.**
- **Keep flammable gas or liquids away, since this test can produce sparks.**

Fuel system

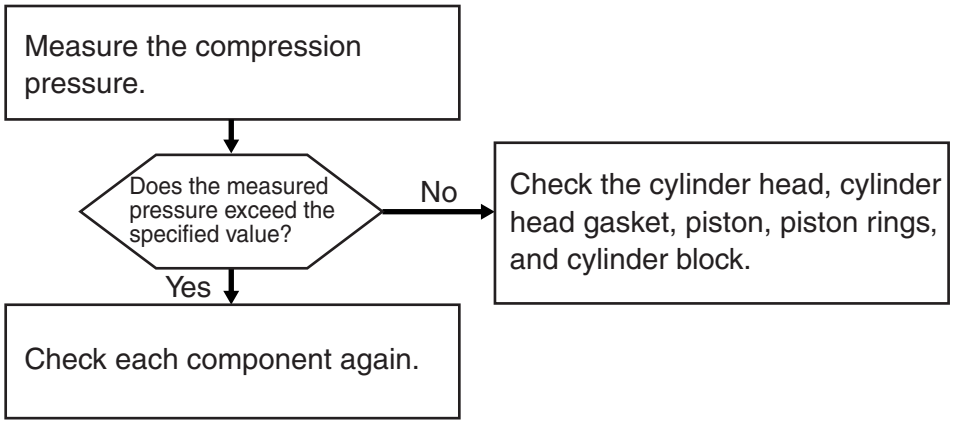


Ignition system




Measure the CDI unit output peak voltage.
Is measured voltage exceeds the specified value?
No
Replace the CDI unit.
Yes
Check each component again.
Check the ignition timing.
Is ignition timing correct?
No
Adjust the ignition timing.
Yes
Check the power unit.

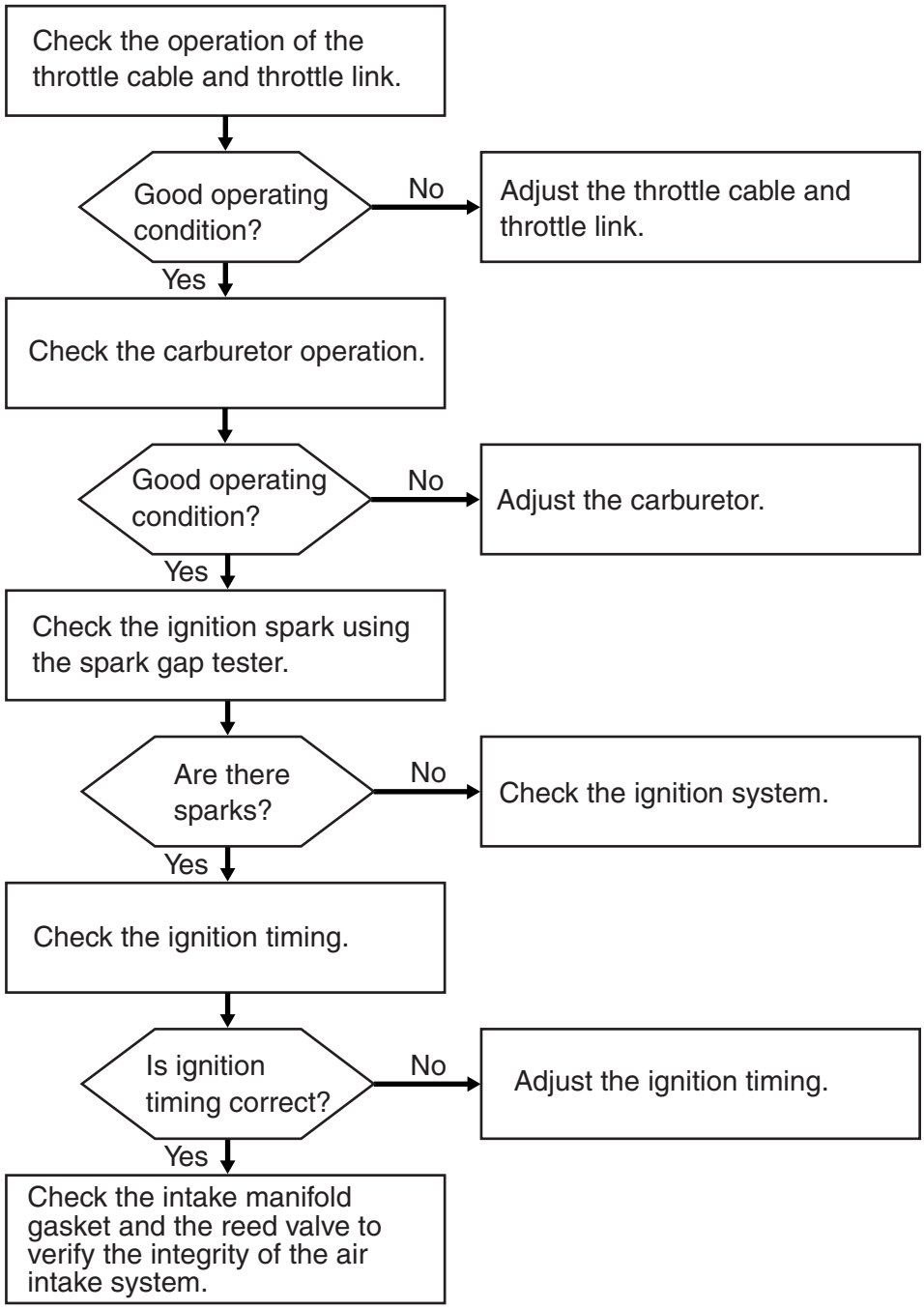
Power unit


Measure the compression pressure.
Does the measured pressure exceed the specified value?
No
Check the cylinder head, cylinder head gasket, piston, piston rings, and cylinder block.
Yes
Check each component again.

Symptom: The engine idle speed is not steady, but increases or decreases.

- Check the air intake system.
- Check the ignition system.
- Check the intake manifold.

Air intake system



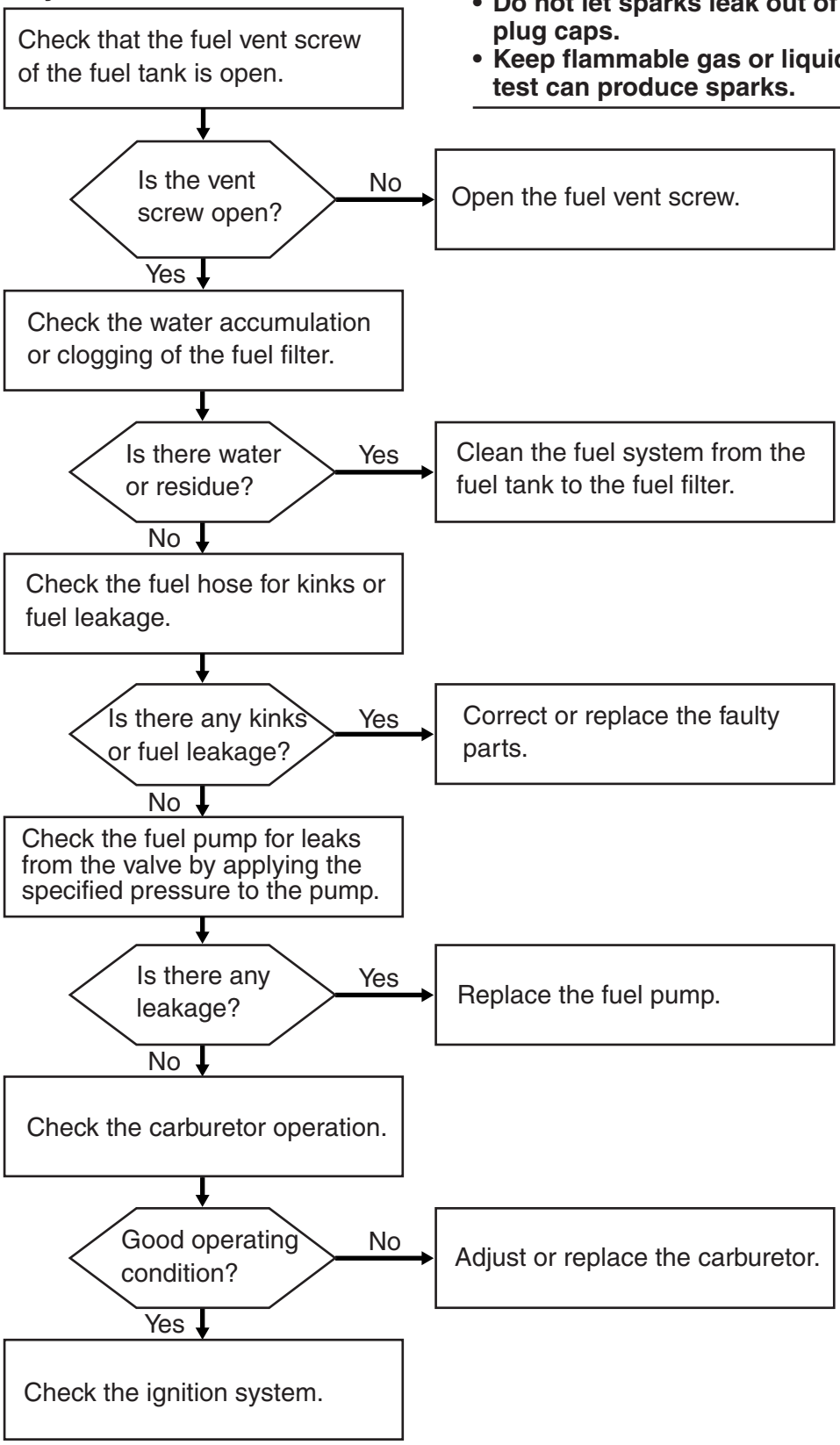
Symptom: Engine does not accelerate when the throttle is opened quickly.
The engine turns off when the throttle is opened quickly.
Hesitation or stumble is observed in the course of acceleration.

- Check the fuel system
- Check the ignition system

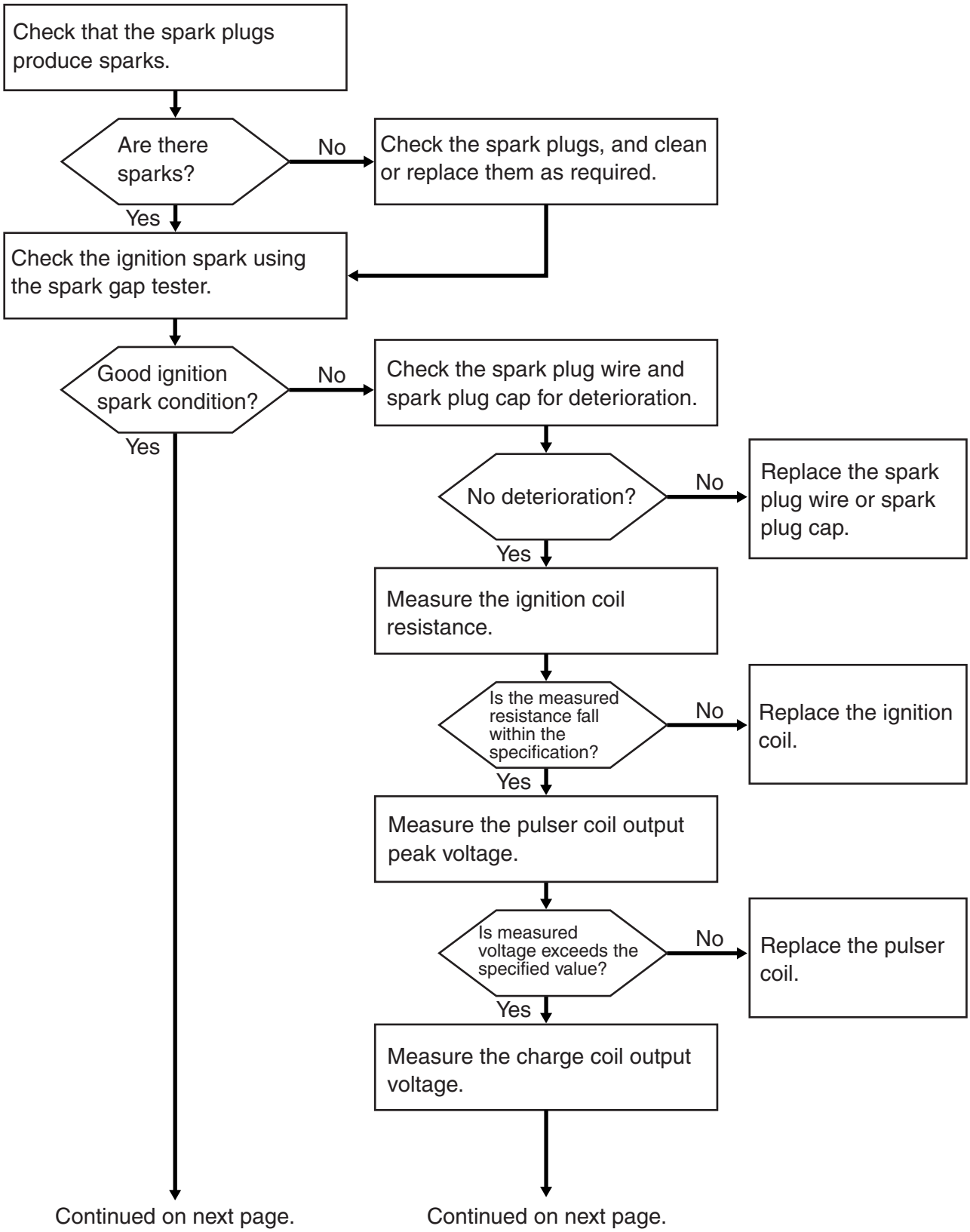
⚠ WARNING

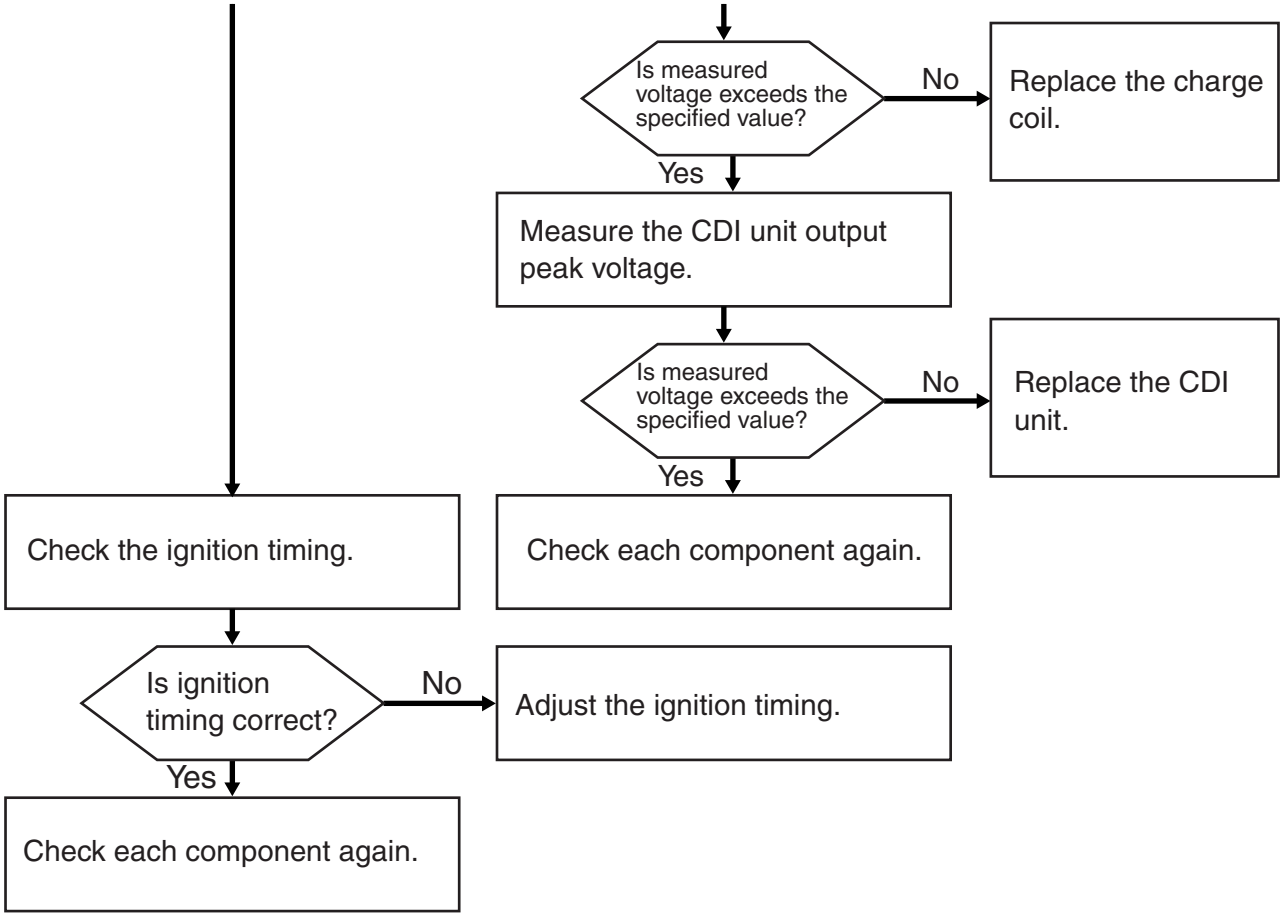
- **Do not touch any of the connections of the spark gap tester leads.**
- **Do not let sparks leak out of the removed spark plug caps.**
- **Keep flammable gas or liquids away, since this test can produce sparks.**

Fuel system



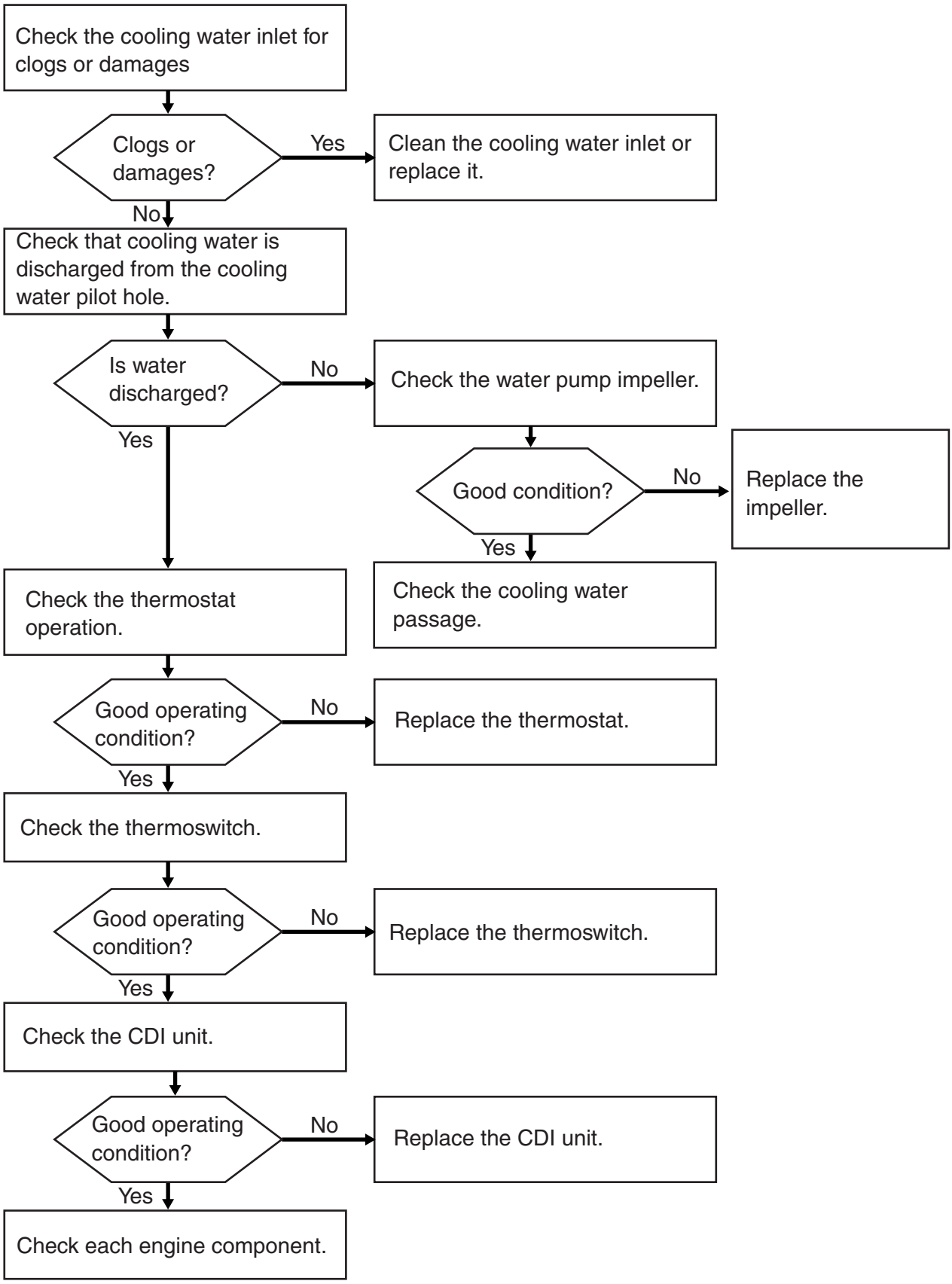
Ignition system




Is measured voltage exceeds the specified value?
No
Replace the charge coil.
Yes
Measure the CDI unit output peak voltage.
Is measured voltage exceeds the specified value?
No
Replace the CDI unit.
Yes
Check the ignition timing.
Check each component again.
Is ignition timing correct?
No
Adjust the ignition timing.
Yes
Check each component again.

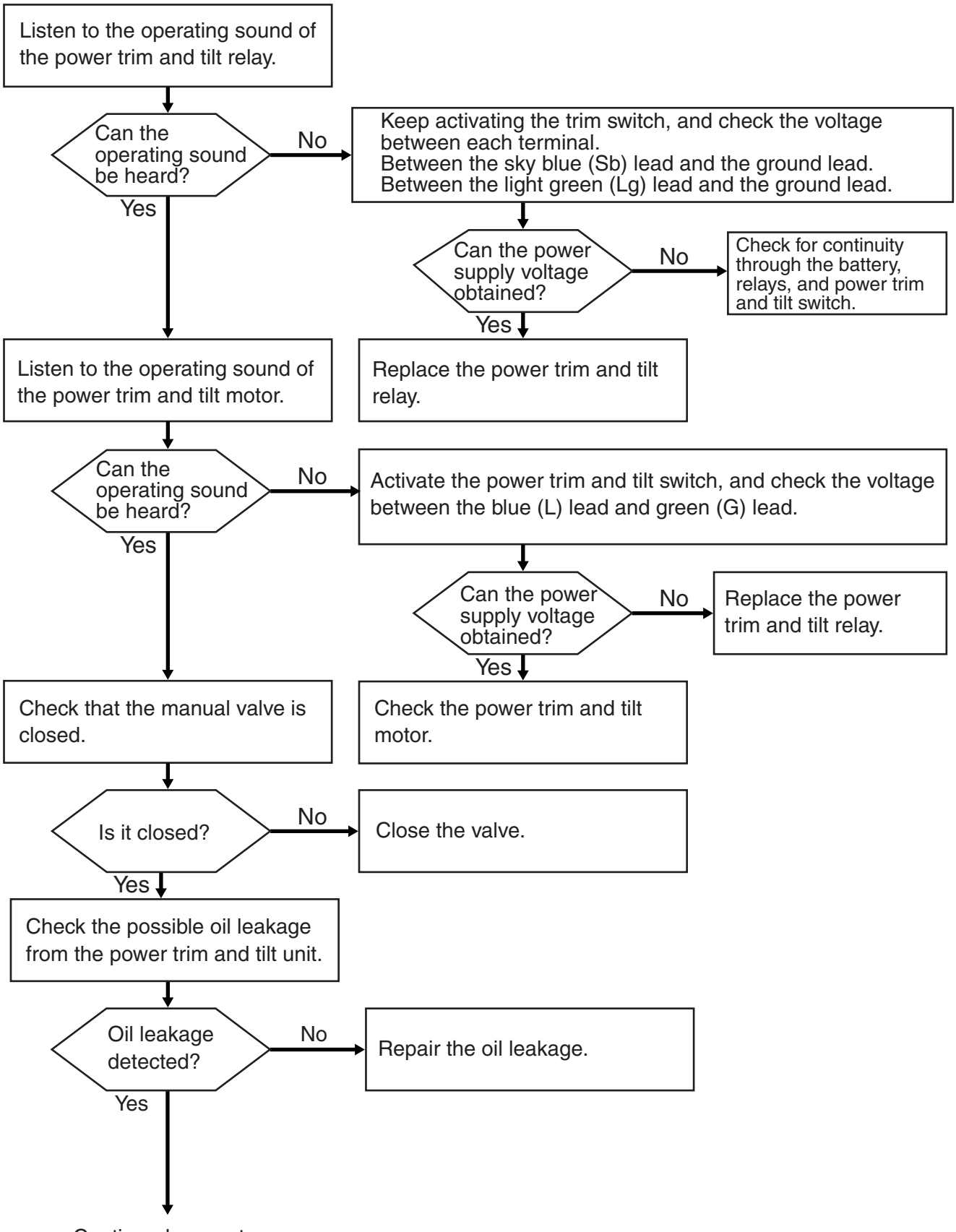
Symptom: Engine starts, but engine speed does not increase. Overheat warning buzzer is on.
• Check the cooling system.

Cooling system



Bracket unit

Symptom: Power trim and tilt unit does not operate.



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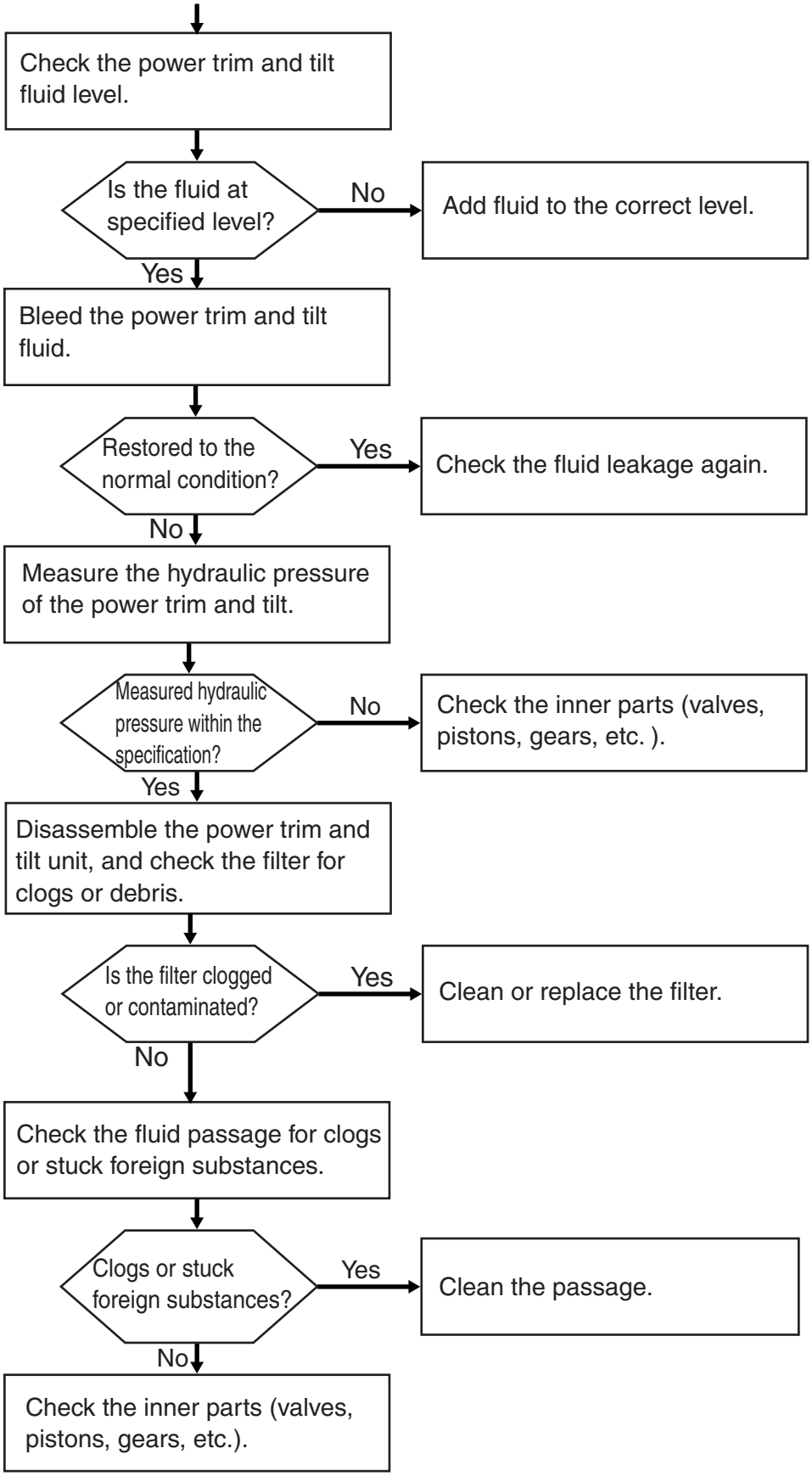
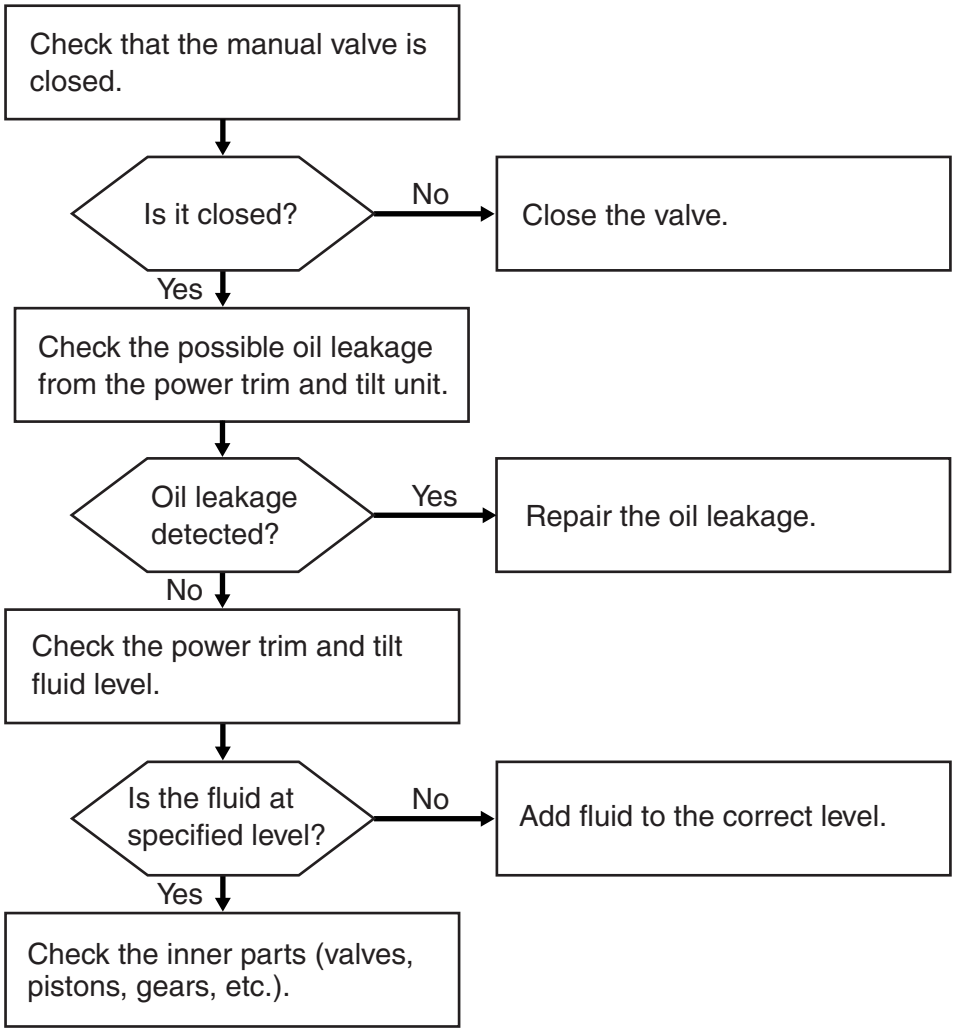
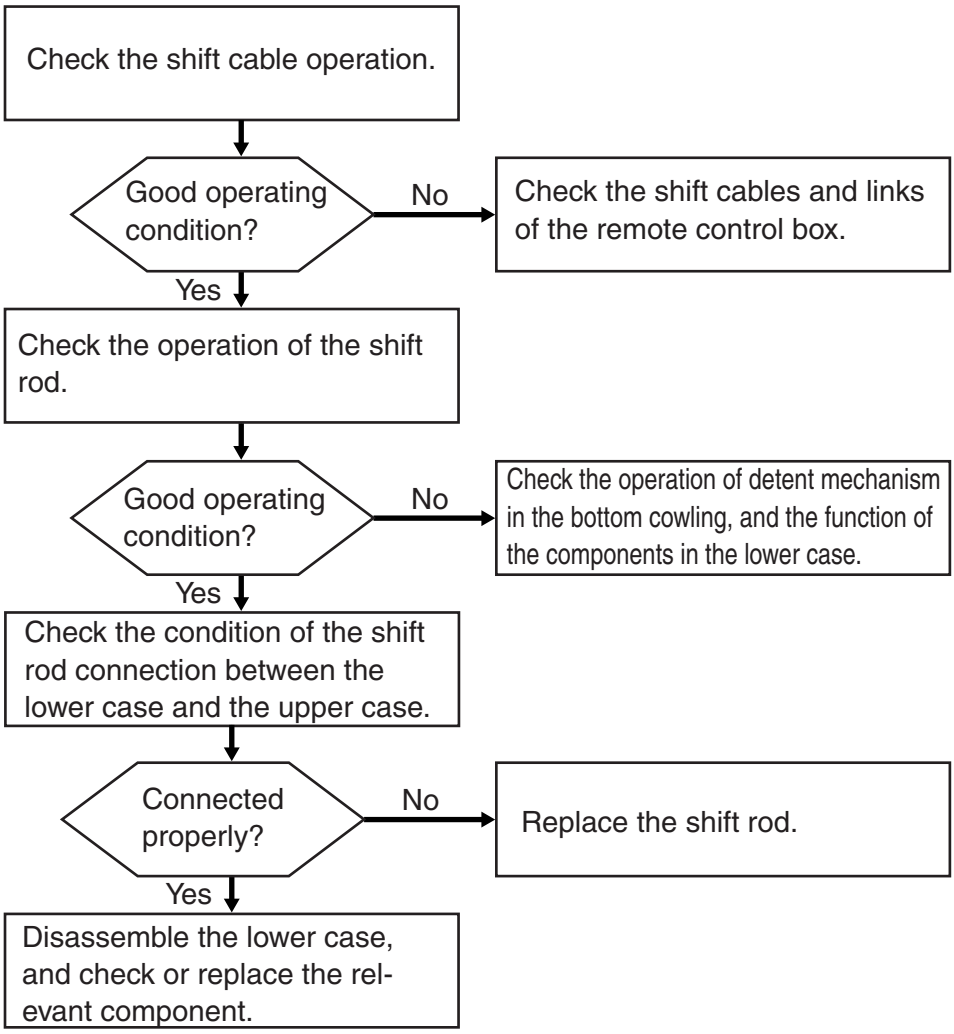

Check the power trim and tilt fluid level.
Is the fluid at specified level?
No
Add fluid to the correct level.
Yes
Bleed the power trim and tilt fluid.
Restored to the normal condition?
Yes
Check the fluid leakage again.
No
Measure the hydraulic pressure of the power trim and tilt.
Measured hydraulic pressure within the specification?
No
Check the inner parts (valves, pistons, gears, etc.).
Yes
Disassemble the power trim and tilt unit, and check the filter for clogs or debris.
Is the filter clogged or contaminated?
Yes
Clean or replace the filter.
No
Check the fluid passage for clogs or stuck foreign substances.
Clogs or stuck foreign substances?
Yes
Clean the passage.
No
Check the inner parts (valves, pistons, gears, etc.).

Symptom: Power trim and tilt unit does not hold the outboard motor up.



Lower unit

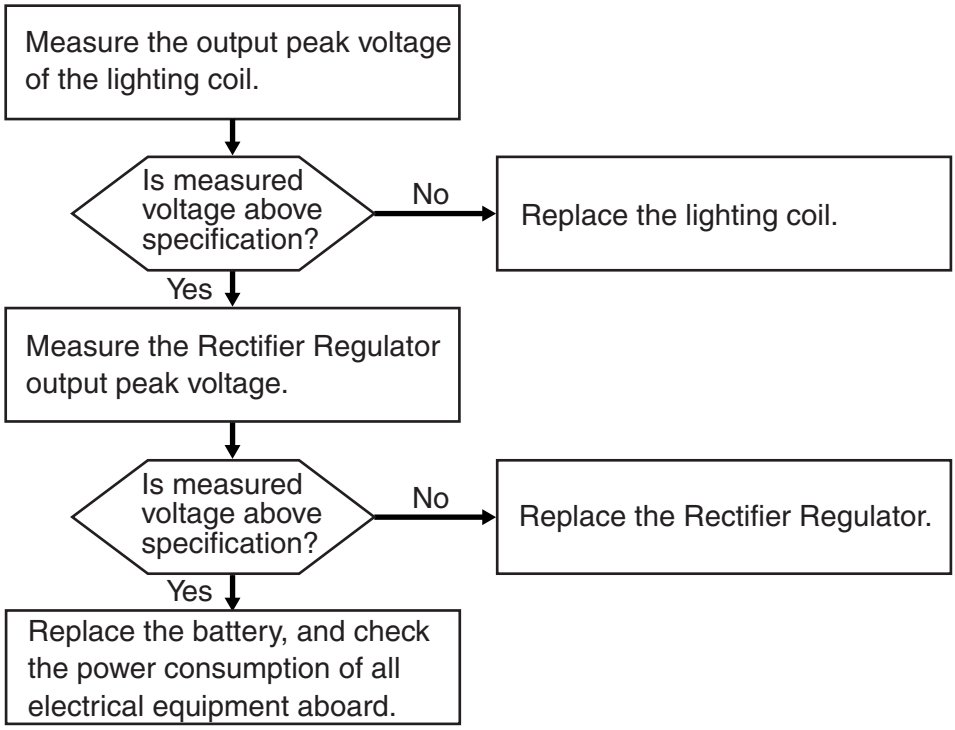
Symptom: Shift mechanism of the forward gear and reverse gear does not operate properly.



Electrical system

Symptom: Battery discharges quickly.

• Check the charging system.



A.

B.

C.

D.

E.

F.

G.

H.

I.

L.

M.

P.

R.

S.

T.

U.

V.

W.

WIRING DIAGRAM

200AET,L200AET

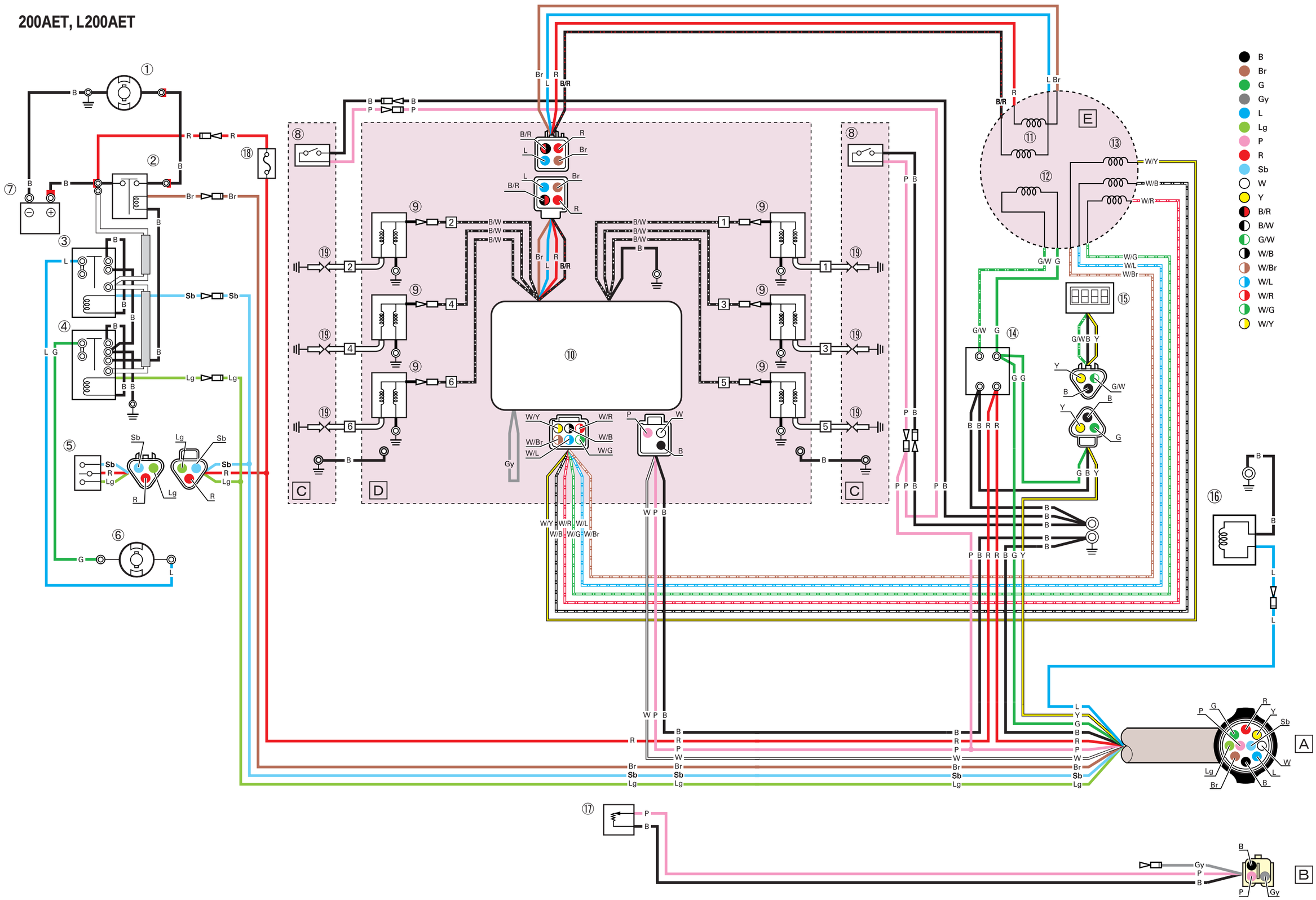
① Starter motor
② Starter relay
③ PTT up relay
④ PTT down relay
⑤ Trailer switch
⑥ PTT motor
⑦ Battery (12 volts)
⑧ Thermoswitch
⑨ Ignition coil
⑩ CDI unit
⑪ Charge coil
⑫ Lighting coil
⑬ Purser coil
⑭ Rectifier Regulator
⑮ Hour meter
⑯ Choke solenoid
⑰ Trim sender
⑱ Fuse (20 amps)
⑲ Spark plug

Ⓐ To remote control box / switch panel
Ⓑ To trim meter
Ⓒ Cylinder head
Ⓓ Cylinder body
Ⓔ CDI magnet

Color code

B	:Black
Br	:Brown
G	:Green
Gy	:Gray
L	:Blue
Lg	:Light green
P	:Pink
R	:Red
Sb	:Sky blue
W	:White
Y	:Yellow
B/R	:Black/Red
B/W	:Black/White
G/W	:Green/White
W/B	:White/Black
W/Br	:White/Brown
W/L	:White/Blue
W/R	:White/Red
W/G	:White/Green
W/Y	:White/Yellow

200AET, L200AET



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