

Z250D LZ250D

SERVICE MANUAL

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.

CAUTION:

USE UNLEADED STRAIGHT GASOLINE ONLY

- Gasoline containing lead can cause performance loss and engine damage.
- Do not use gasoline mixed with oil during the break-in period or anytime thereafter.

YAMALUBE 2-STROKE OUTBOARD OIL IS RECOMMENDED.

**Z250D, LZ250D
SERVICE MANUAL
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How to use this manual

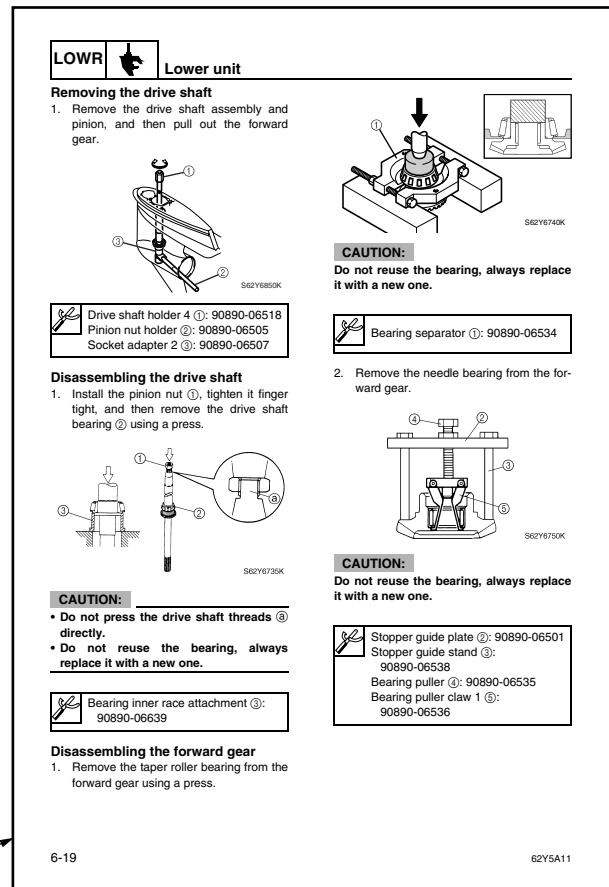
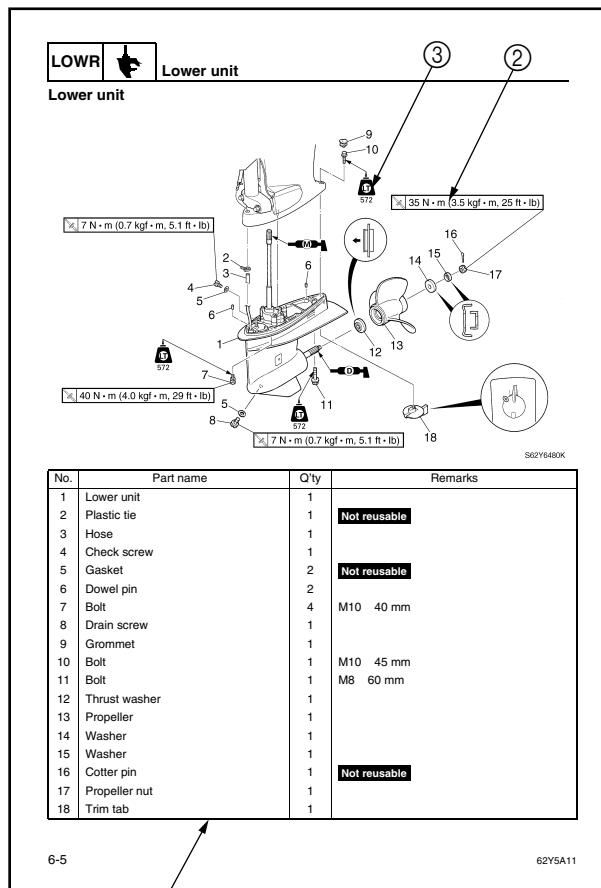
Manual format

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 part names and part quantities, as well as bolt and screw 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."



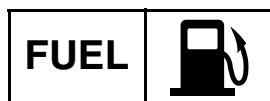
Symbols

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

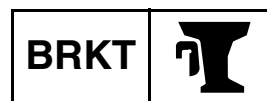
General information



Fuel system



Bracket unit



Specifications



Power unit



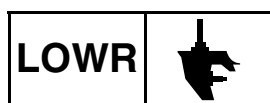
Electrical systems



Periodic checks and adjustments



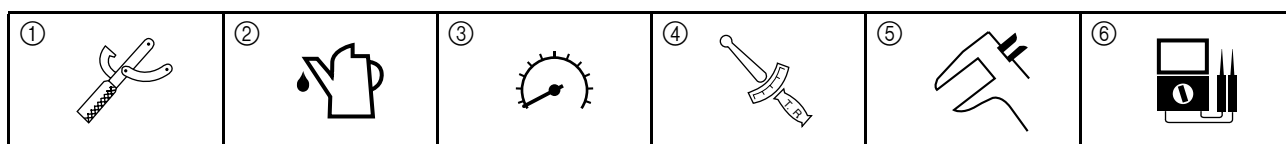
Lower unit



Troubleshooting

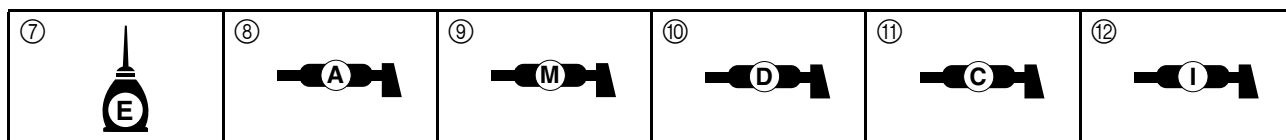


Symbols ① to ⑥ indicate specific data.



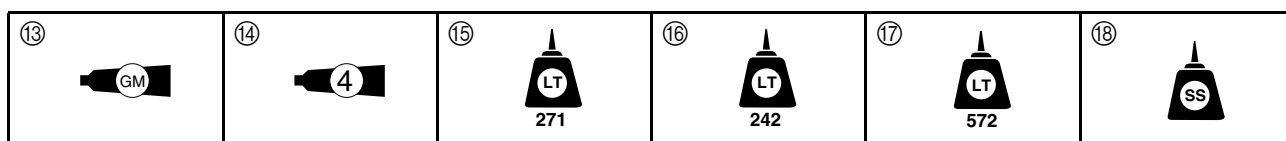
- ① Special tool
- ② Specified oil or fluid
- ③ Specified engine speed
- ④ Specified tightening torque
- ⑤ Specified measurement
- ⑥ Specified electrical value (resistance, voltage, electric current)

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



- ⑦ Apply 2-stroke outboard 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 No. 4
- ⑮ Apply LOCTITE 271 (red)
- ⑯ Apply LOCTITE 242 (blue)
- ⑰ Apply LOCTITE 572
- ⑱ Apply silicon sealant



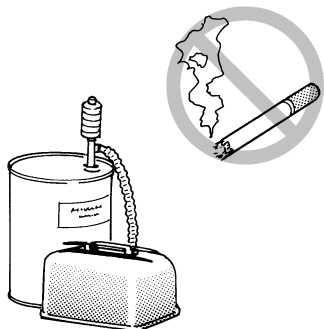
Safety while working

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

Fire prevention

Gasoline is highly flammable.

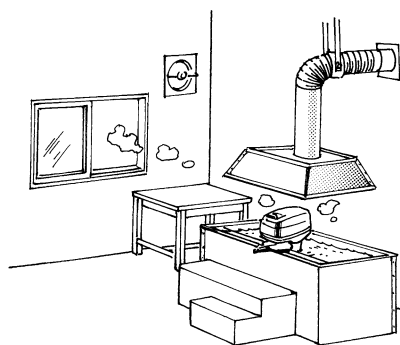
Keep gasoline and all flammable products away from heat, sparks, and open flames.



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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.

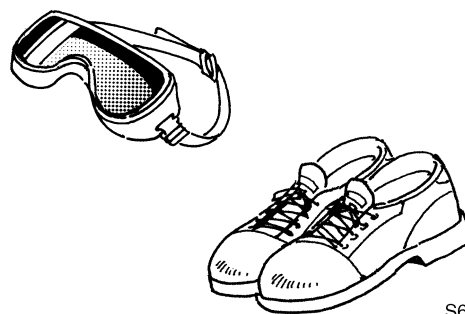


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Self-protection

Protect your eyes by wearing safety glasses or safety goggles during all operations involving drilling and grinding, or when using an air compressor.

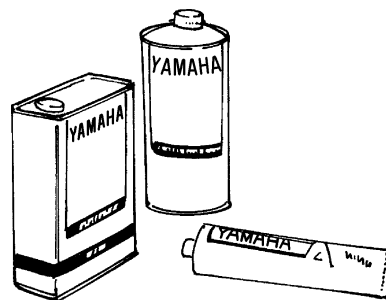
Protect your hands and feet by wearing protective gloves and safety shoes when necessary.



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Parts, lubricants, and sealants

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



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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.

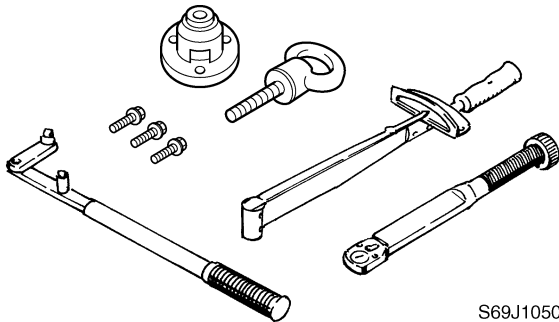
1. Maintain good standards of personal and industrial hygiene.
2. Change and wash clothing as soon as possible if soiled with lubricants.
3. Avoid contact with skin. Do not, for example, place a soiled rag in your pocket.
4. Wash hands and any other part of the body thoroughly with soap and hot water 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 service tools

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



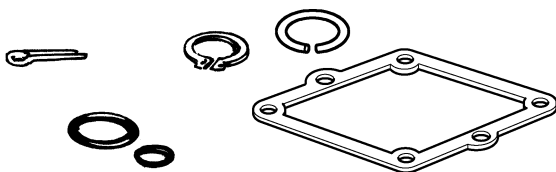
S69J1050

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

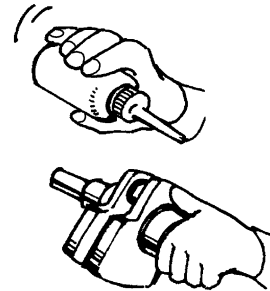
Always use new gaskets, seals, O-rings, cotter pins, circlips, etc., when installing or assembling parts.



S69J1060

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.



S69J1070

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.

Identification

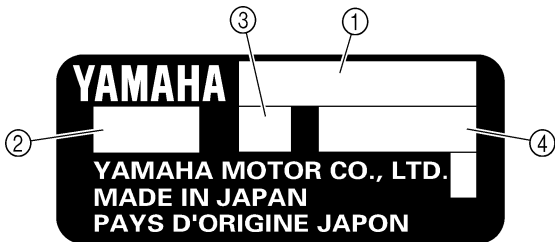
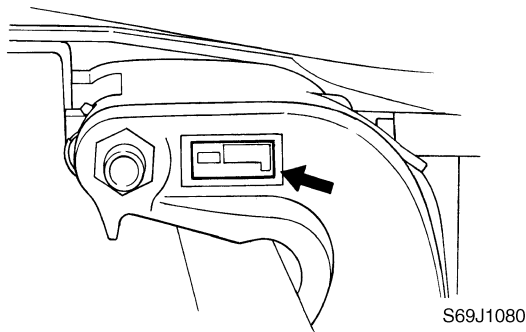
Applicable models

This manual covers the following models.

Applicable models
Z250DETO, LZ250DETO

Serial number

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



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

Model name	Approved model code	Starting serial No.
Z250DETO	60V	X: 1000001–
		U: 1000001–
LZ250DETO	60W	X: 1000001–
		U: 1000001–

Features and benefits

Cylinder body and cylinder head

Hemispherical combustion chambers have been incorporated in the cylinder head to realize a high compression ratio of 6.2.

The exhaust ports have been chamfered to reduce loss of the exhaust gases.

Also, an exhaust shell has been adopted to allow exhaust gases flow out smoothly.

The plateau honing process has been used in the cylinder sleeves to reduce friction.

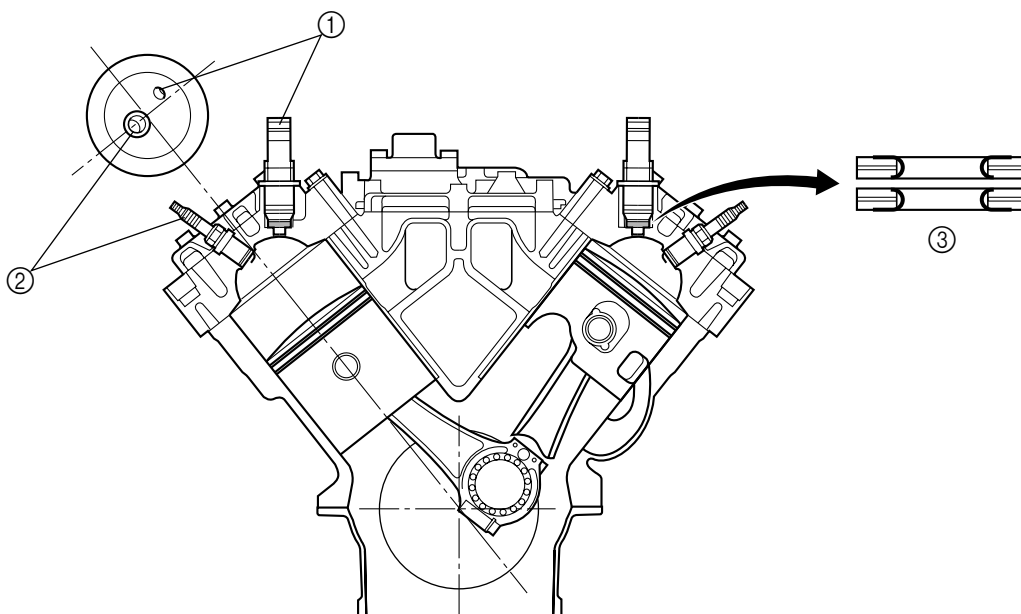
The spark plugs have been offset from the center of the cylinder head to keep the fuel injectors away from high temperatures.

The fuel injectors are located on the exhaust side of the combustion chambers. Fuel is injected toward the tumble due to scavenging to obtain the optimum air-fuel mixture.

Special twin corrugated washers have been adopted in the injectors to prevent fuel in an injector from carbonizing due to exhaust heat.

NOTE:

Install the washers so that the shorter metal guard ends contact each other.



S60V1130

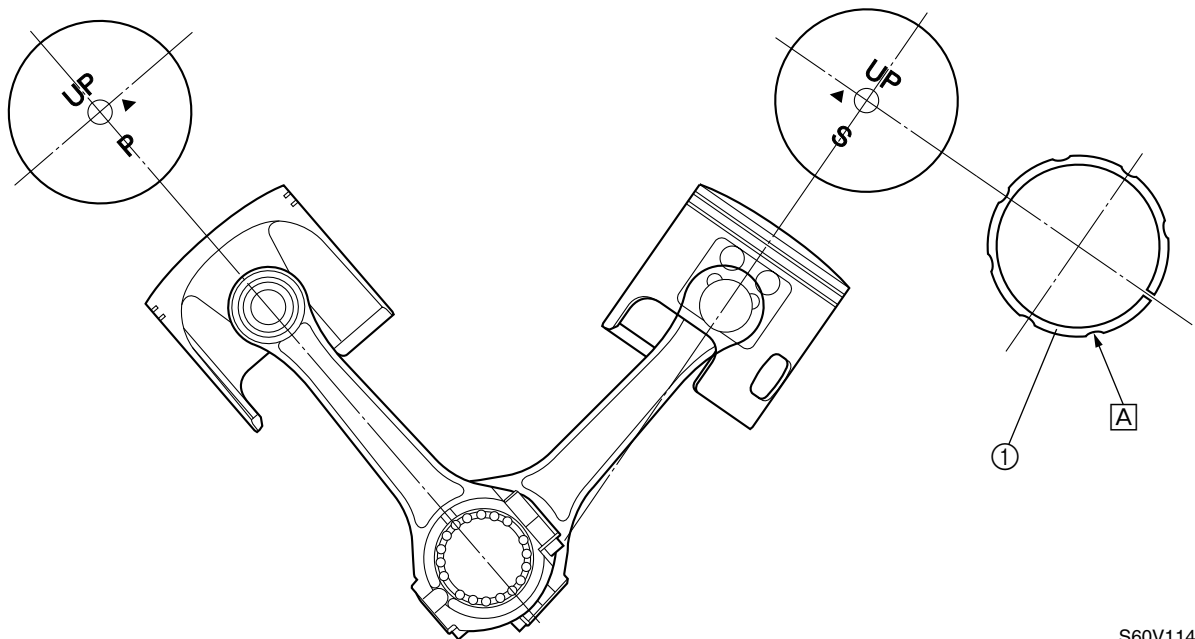
- ① Injector
- ② Spark plug
- ③ Corrugated washers



Pistons and connecting rods

The pistons and connecting rods have been processed as follows to increase durability.

- Heat resisting, lightweight aluminum forged pistons have been adopted.
- Highly carbonized connecting rods have been adopted.
- The piston rings have been processed with a hard chrome plating that has a thickness of 50 microns.
- The big end bearings have been processed with 18 rollers, 2 rollers more than those of the VX250 (250C), and with oil grooves around the outer race of the bearings.
- The small ends of the connecting rods have been processed with a special heat treatment.
- Oil grooves have been processed around the outer peripheries of the 2nd piston rings.



S60V1140

① 2nd piston ring

A Oil groove

Fuel injection pumps

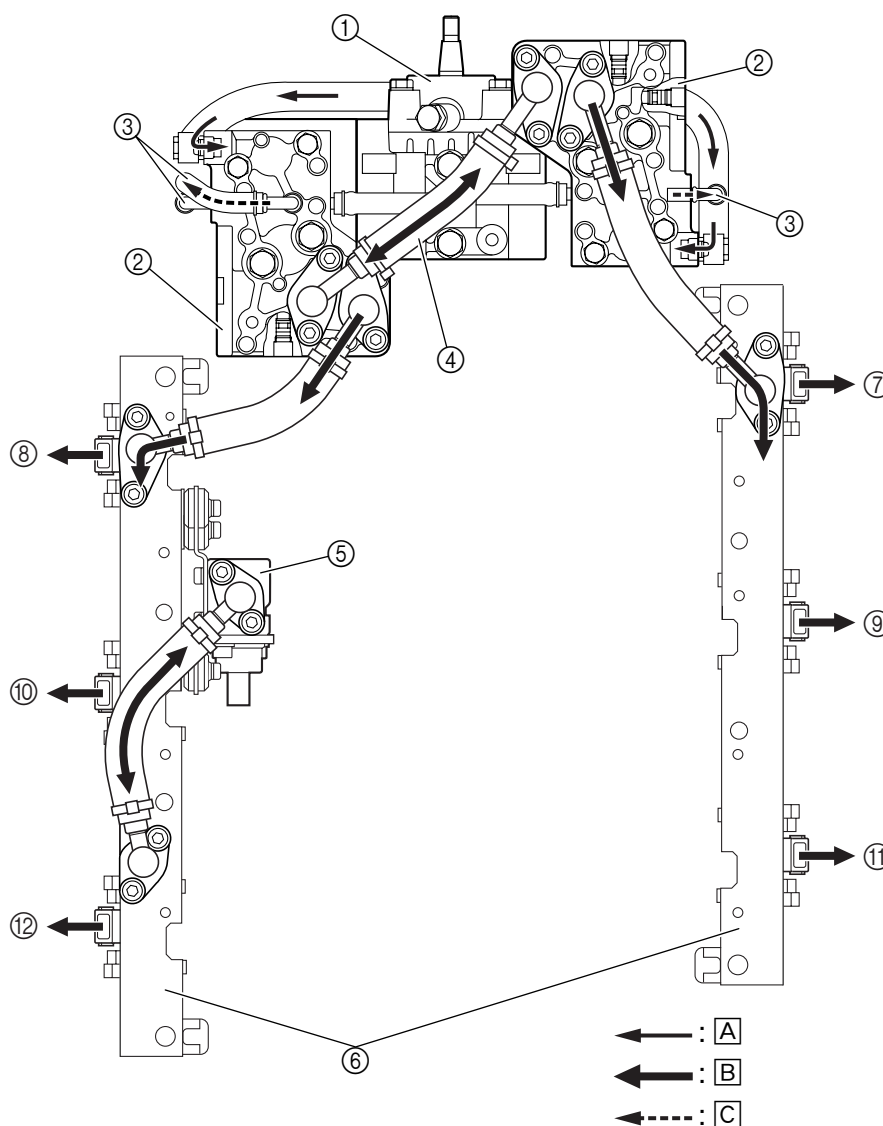
Twin fuel injection pumps with pressure regulators have been adopted to obtain a high fuel pressure of 7 MPa (71 kg/cm², 1,015 psi).

The fuel injection pressure is detected by the fuel pressure sensor installed on the fuel rail. Protectors have been incorporated on the fuel pressure sensor to reduce vibrations conducting to the sensor.

High-pressure fuel injection obtains a better air-fuel mixture due to finer atomization.

CAUTION:

Do not disassemble the fuel injection pumps. The proper facilities and special service tools are required to reassemble them.



S60V1150

- ① Fuel pump drive unit
- ② High-pressure fuel pump with pressure regulator
- ③ Fuel return hose
- ④ Pressure equalizing pipe
- ⑤ Fuel pressure sensor
- ⑥ Fuel rail

- ⑦ Injector #1
- ⑧ Injector #2
- ⑨ Injector #3
- ⑩ Injector #4
- ⑪ Injector #5
- ⑫ Injector #6

- [A] Medium-pressure fuel (suction)
- [B] High-pressure fuel
- [C] Fuel return



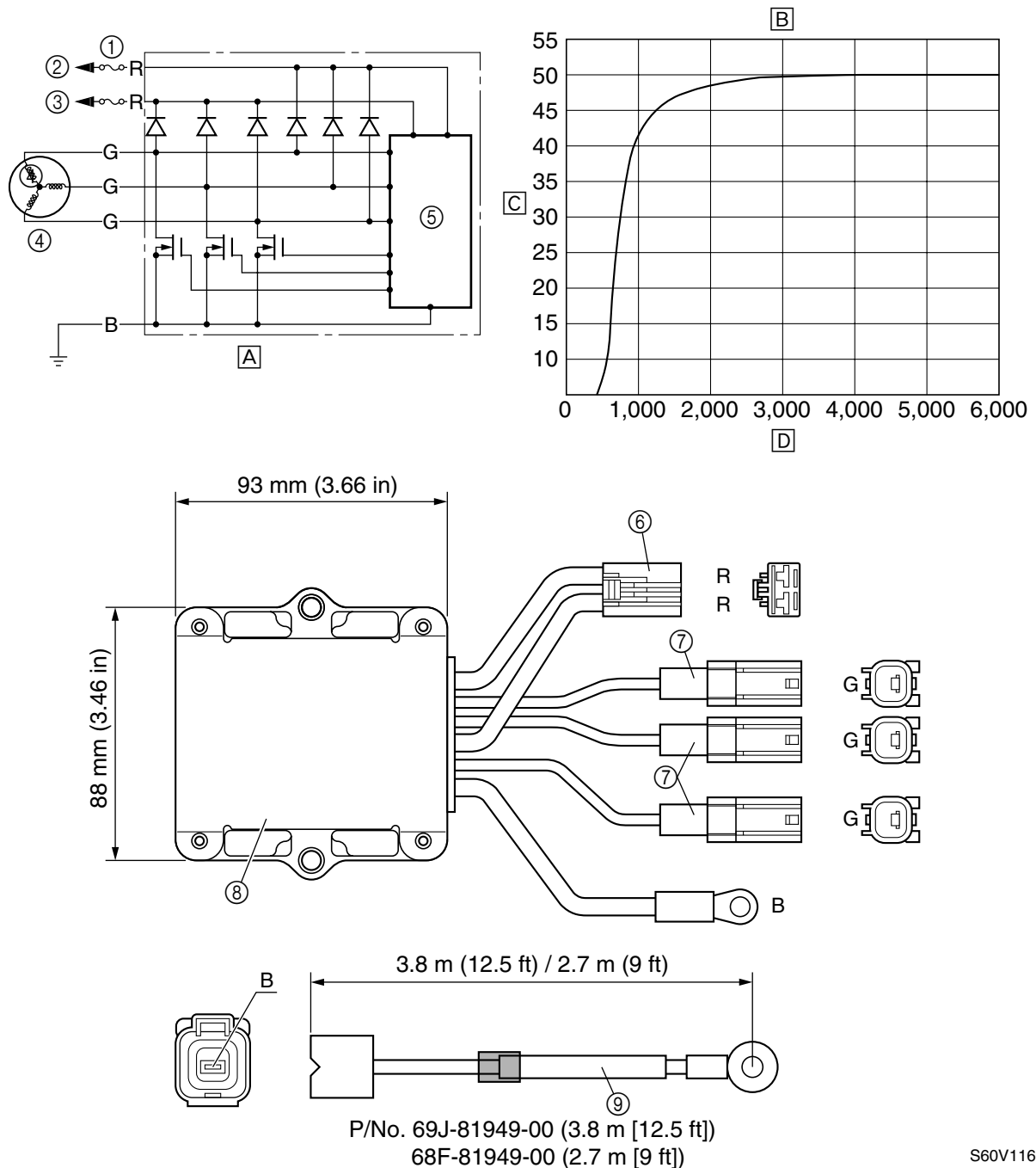
Flywheel magnet

A large capacity Rectifier Regulator has been adopted to obtain a charging current of 50 amperes for battery charging capabilities.

An isolator has been incorporated into the Rectifier Regulator unit.

NOTE:

An optional battery charging cable has been made available for use with an accessory battery.



S60V1160

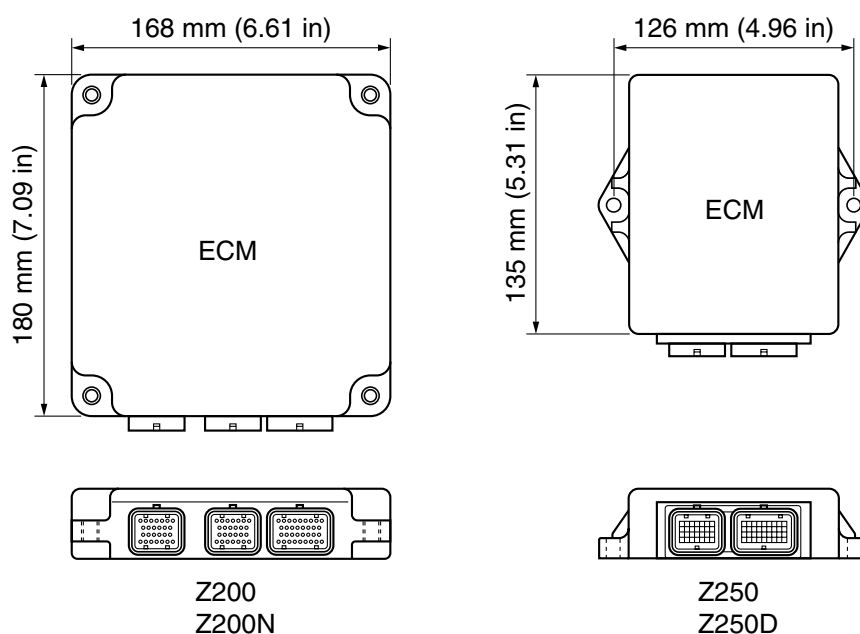
- ① Fuse
- ② Battery 1
- ③ Battery 2
- ④ Lighting coil
- ⑤ Control circuit

- ⑥ Blue
- ⑦ Black
- ⑧ Rectifier Regulator unit
- ⑨ Isolator cable (optional)

- [A] Charging circuit
- [B] Charging output
- [C] Charging current (A)
- [D] Engine speed (r/min)

ECM (Electronic Control Module)

A small and lightweight ECM has been adopted to make the surrounding components compact.

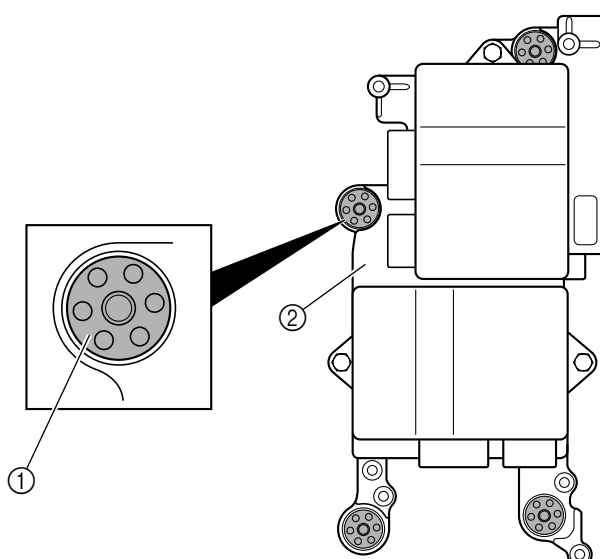


S60V1170

Silicon grommets (navy blue) have been adopted for installing the ECM and injector driver brackets, and to reduce vibration conducting from the engine.

CAUTION:

Do not apply fuel or oil to the grommets, otherwise they can be damaged.

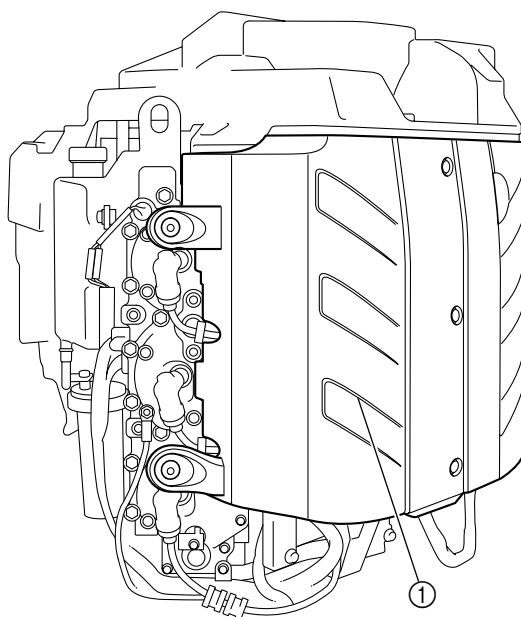


S60V1180

- ① Silicon grommet (navy blue)
- ② ECM and injector drivers mounting bracket



A large cover has been adopted to protect the electrical components from water.

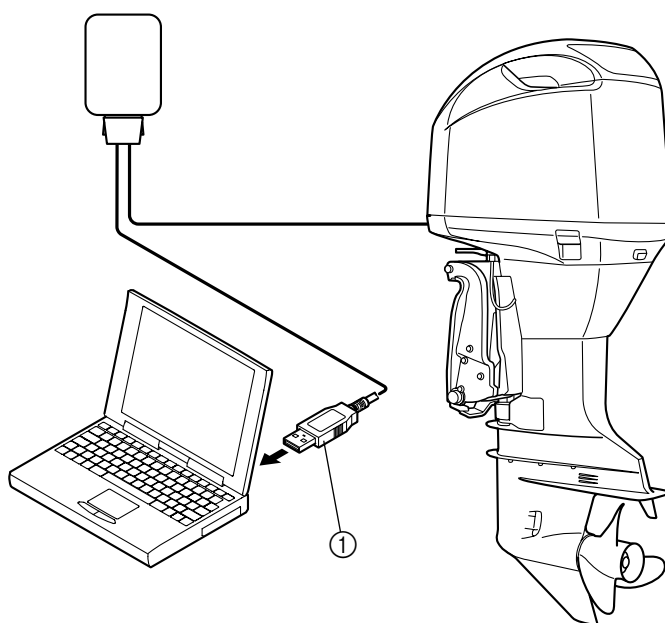


S60V1190

① Large electrical component cover

The memory in the ECM has been increased from 128 bytes to 256 bytes to expand the functions of the YDIS.

A communication cable with a USB connector has been made available.



S60V1200

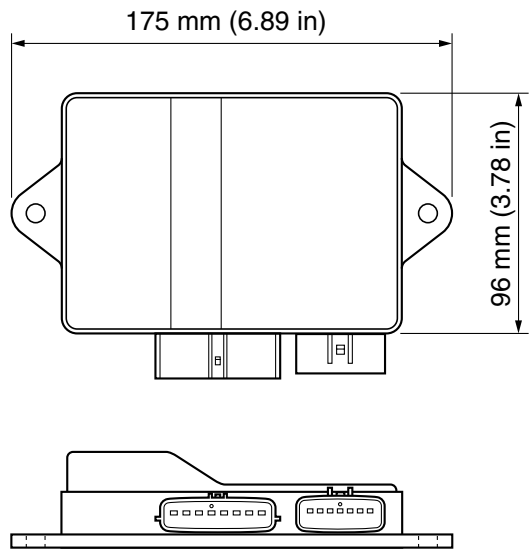
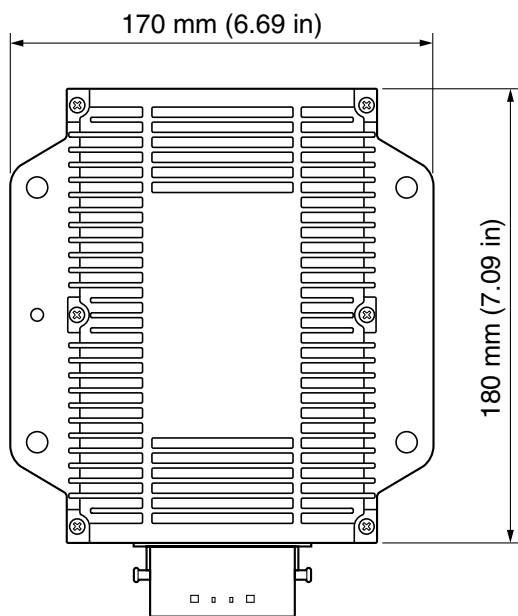
① USB connector

Injector drivers

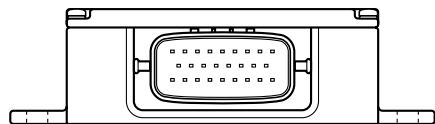
Twin small and lightweight injector drivers have been adopted to make the surrounding components compact.

Maintenance has been made easy and low cost for replacing the driver has been obtained.

1



Z250
Z250D



Z200
Z200N

S60V1210

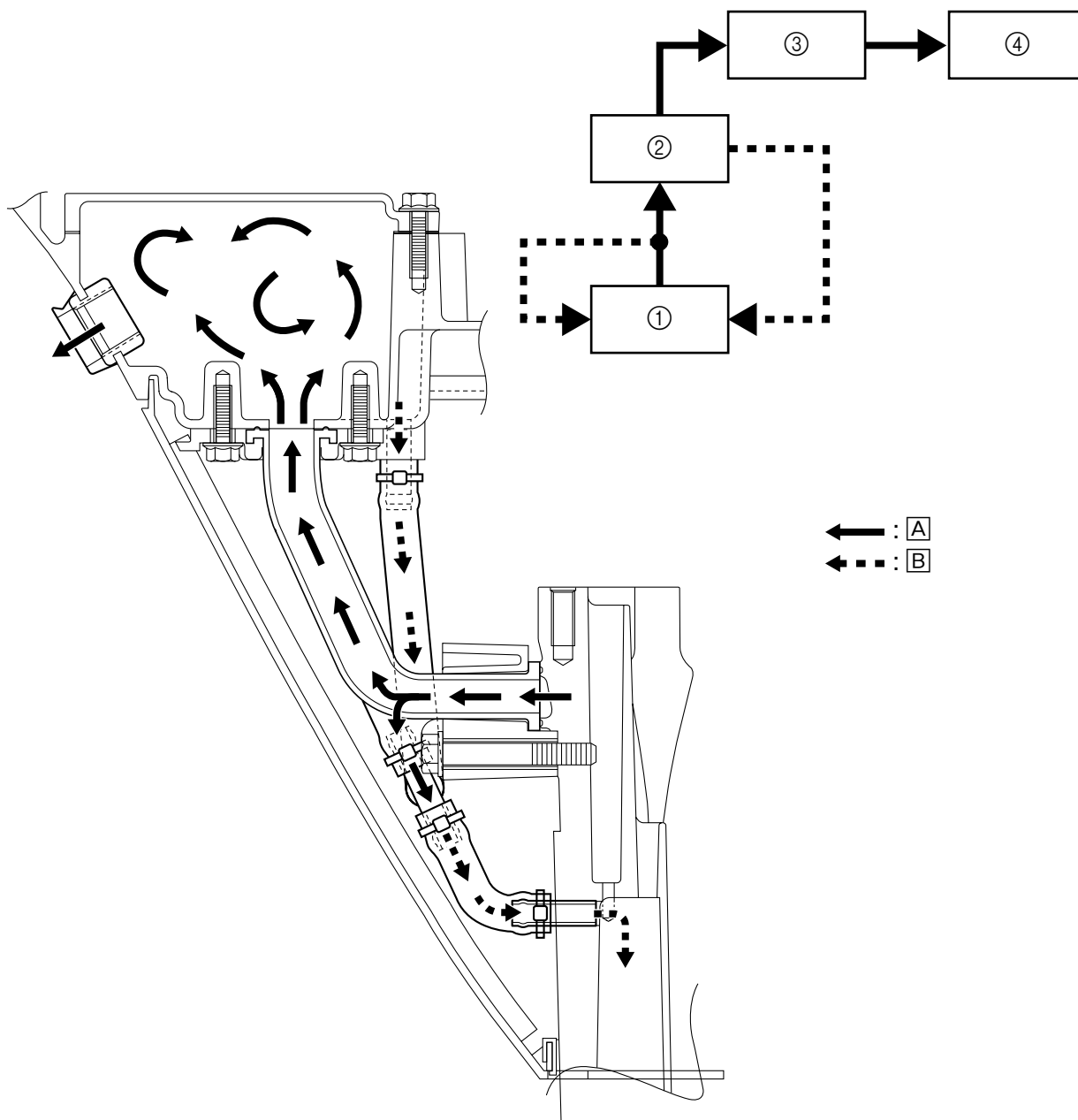


Idle silencer

An idle silencer has been incorporated in the bottom cowling.

Exhaust gases are led into the idle silencer from the upper case and expanded, and then discharged into the atmosphere.

The idle hole has been positioned higher at the rear of the bottom cowling to decrease the resistance of the exhaust back pressure.



S60V1220

- ① Upper case
- ② Silencer
- ③ Idle hole
- ④ Atmosphere

- ⬅ : A Exhaust gas/water
- ⬅ : B Water

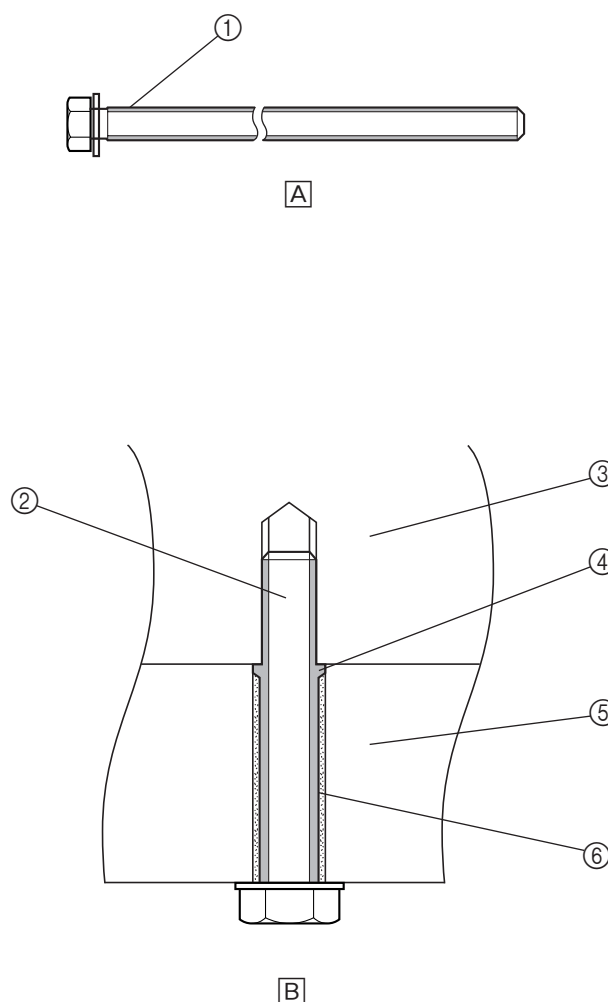
Power unit mounting bolts

Bolts coated with a sealing agent have been adopted to provide a sealing function to the bolts. The sealing agent secures the axial force of the bolts after they are tightened to the specified torque, thus preventing the bolts from coming loose. The sealing agent also helps prevent the bolts from sticking if salt water enters into the thread holes and crystallizes.

Also, the bolts can be removed even if corroded particles have collected in and choked the bolt holes because the sealing agent also acts as an insulator. As a result, servicing such as removing the power unit has been made easy.

NOTE:

Clean the bolt surface, and then apply LOCTITE 572 to the bolt to act as a sealing agent when reusing the power unit mounting bolts.



S60V1230

- ① Sealing agent coating
- ② Bolt
- ③ Cylinder block
- ④ Sealing agent
- ⑤ Upper case
- ⑥ Corroded particles

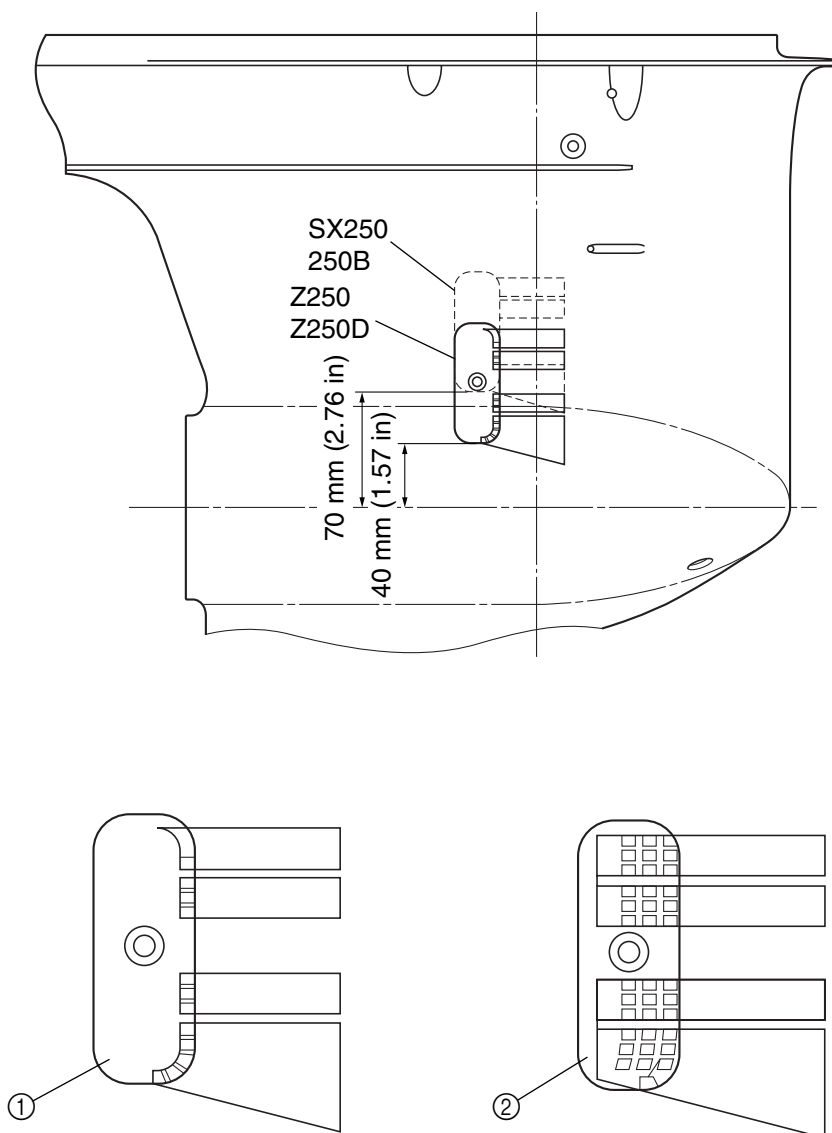
- [A] Power unit mounting bolt
- [B] Bolt hole description



Cooling water inlet

A low positioned cooling water inlet, which is 30 mm (1.18 in) lower than that of the SX250 (250B), has been adopted to secure the cooling water supply.

An optional dynamic pressure type inlet cover to secure the cooling water supply has been made available if the outboard motor is to be mounted at an elevated position.



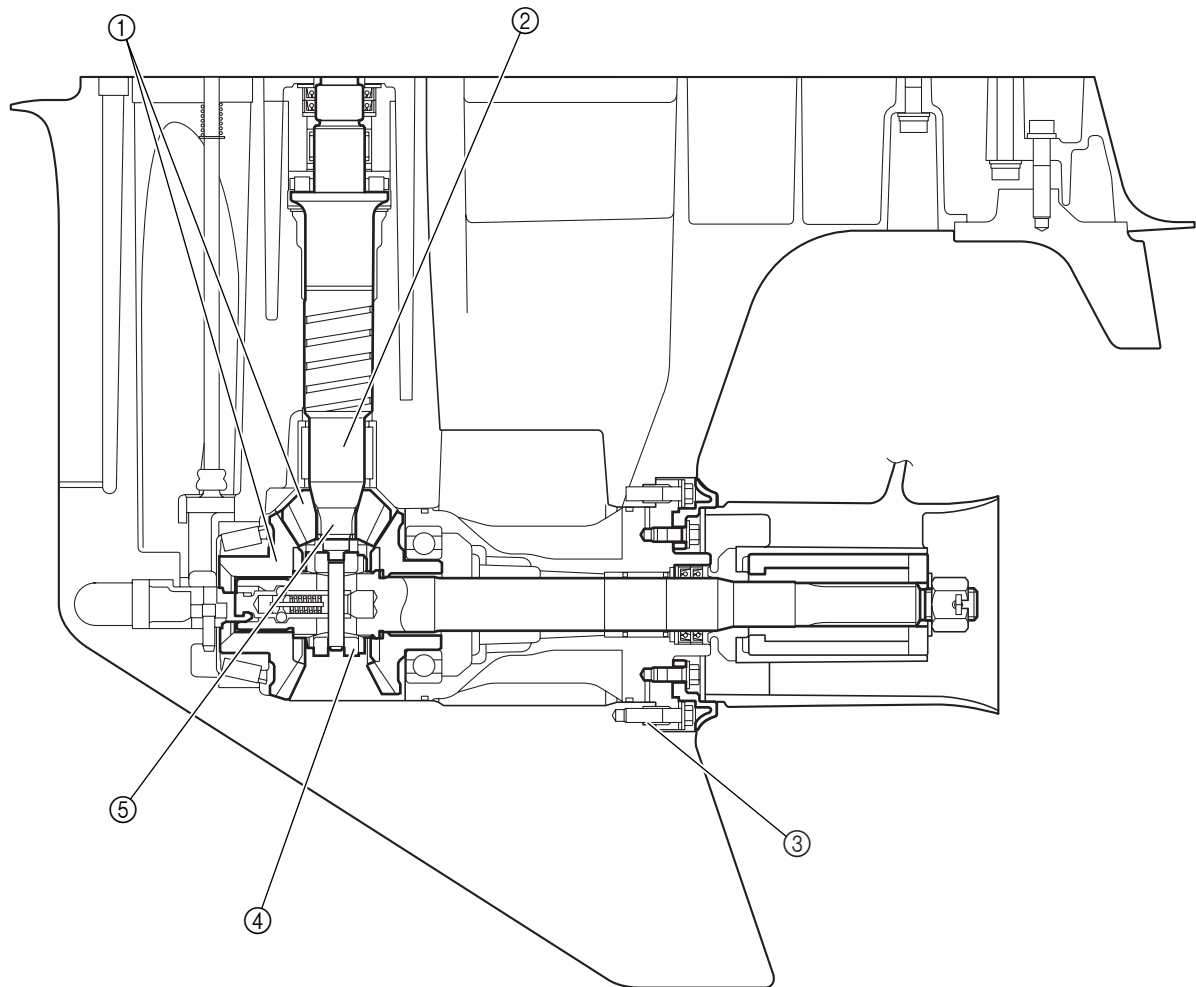
S60V1250

① Dynamic pressure inlet cover (optional)

② Standard inlet cover

Transmission components

Materials have been modified, and the heat treatment and shot peening processes have been applied to the transmission components to increase durability.



S60V1260

- ① Shot peening processing
- ② Form rolling processing
- ③ Collar added
- ④ Cemented steel with shot peening processing
- ⑤ 13-tooth spline



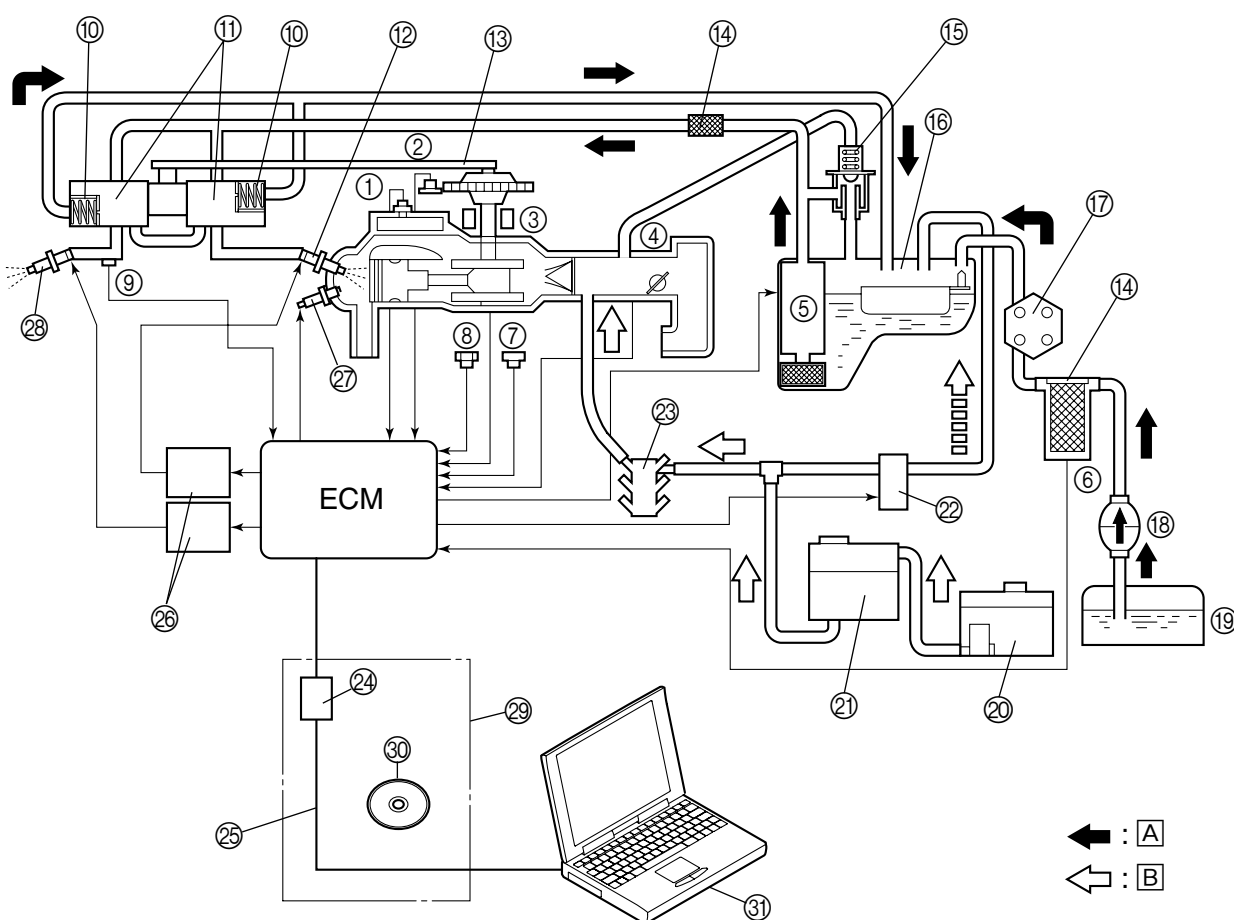
Technical tips

Electronic control system

The electronic control system ensures optimum combustion under various operating conditions to provide a high power output with low fuel consumption and low emissions.

The ECM (Electronic Control Module) mainly controls ignition timing, fuel injection timing, and fuel injection volume with various signals received from sensors equipped on the outboard motor.

The Yamaha Self-Diagnosis function has been incorporated in the ECM for easier servicing. Troubleshooting the outboard motor can be accomplished by monitoring the engine conditions and operating the electrical components with a personal computer and the optional Yamaha Diagnostic System (YDIS) software.



S60V1270

- | | | |
|---------------------------------|---------------------------|---------------------------|
| ① Engine temperature sensor | ⑭ Fuel filter | ⑳ Spark plug |
| ② Crank position sensor | ⑮ Fuel pressure regulator | ㉑ Injectors #2, #5, #6 |
| ③ Pulser coil | ⑯ Vapor separator | ㉒ Service tool (optional) |
| ④ Throttle position sensor | ⑰ Fuel pumps | ㉓ Software (CD-ROM) |
| ⑤ Electric fuel pump | ⑱ Primer pump | ㉔ Personal computer |
| ⑥ Water detection switch | ㉒ Fuel tank | |
| ⑦ Atmospheric pressure sensor | ㉑ Remote oil tank | |
| ⑧ Intake air temperature sensor | ㉒ Oil tank | |
| ⑨ Fuel pressure sensor | ㉓ Electric oil pump | |
| ⑩ High-pressure fuel regulator | ㉔ Oil pump | |
| ⑪ High-pressure fuel pump | ㉕ Adapter | |
| ⑫ Injectors #1, #3, #4 | ㉖ Communication cable | |
| ⑬ Drive belt | ㉗ Injector drivers | |

- [A] Gasoline
 [B] Oil

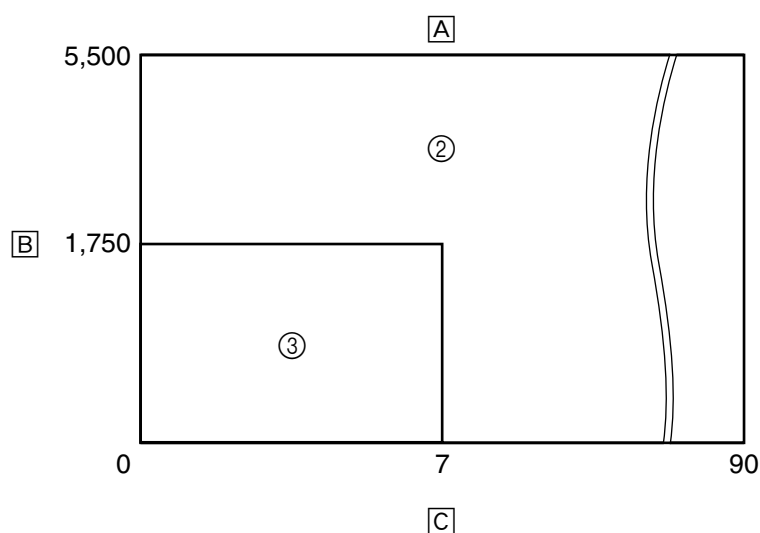
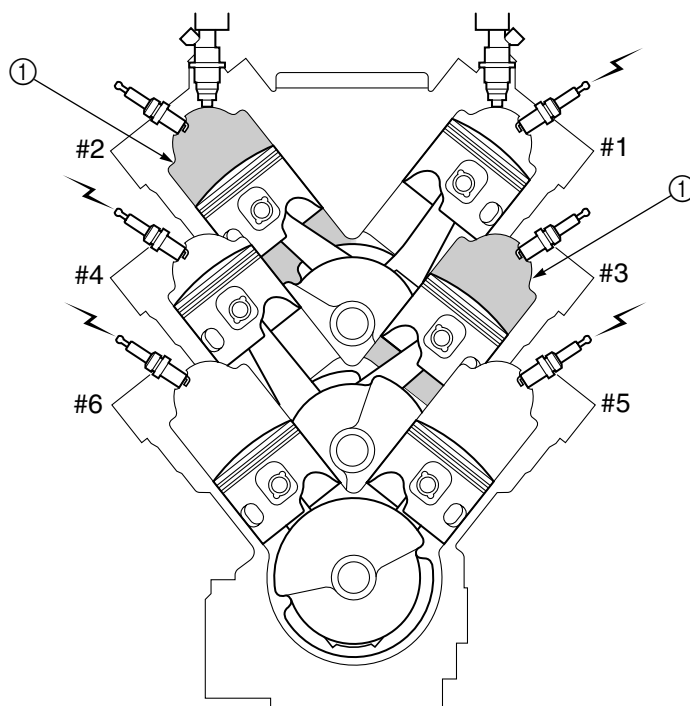
Partial cylinder operation

This outboard motor controls the partial cylinder operation when the gear shift is in the neutral position to reduce vibration and noise and to obtain a lower fuel consumption.

When the neutral position of the gear shift is detected by the shift position switch, the ECM shuts off the ignition and fuel injection of cylinders #2 and #3.

If the throttle valves are opened further, the ignition and fuel injection of cylinders #5 and #6 are also shut off.

When the gear shift is shift into gear, all cylinders are activated.



S60V1280

- ① Shut off
- ② Cylinders #1 and #4 activated
- ③ Cylinders #1, #4, #5 and #6 activated

- Ⓐ Partial cylinder operation in neutral
- Ⓑ Engine speed (r/min)
- Ⓒ Throttle valve opening angle (degree)


Fail-safe control

If the electrical components malfunction, the ECM controls the ignition and fuel injection as shown in the table.

Faulty component	Criterion	Ignition control	Fuel control
Pulser coil	Incorrect signal	Fixed to 7° BTDC	Injection stopped as follows:
			Faulty coil Injection stopped cylinder
			#1 #6
			#2 #1
			#3 #2
			#4 #3
			#5 #4
			#6 #5
Crank position sensor	No signal	Fixed to 7° BTDC	Fixed to 127° BTDC
Throttle position sensor	Throttle opening angle is detected at -4.1° or less, or 90° or more	Fixed output to 4.8 V	
Engine temperature sensor	Resistance is detected at 0.35 kΩ or less, or 701 kΩ or more	Fixed to 7° BTDC	Normal control
Atmospheric pressure sensor	Pressure is detected at 25 kPa (0.25 kgf/cm ²) or less, or 114 kPa (1.16 kgf/cm ²) or more	Normal control	Fixed output to 101 kPa (1 kgf/cm ²)
Intake air temperature sensor	Temperature is detected at -40 °C (-40 °F) or less, or 80 °C (176 °F) or more	Normal control	Fixed output to 5 °C (41 °F)
Fuel pressure sensor	Signal is detected at 0.2 V or less, or 4.7 V or more	Normal control	Fixed output to 7 MPa (71 kgf/cm ²)
Injectors	No signal at 2,000 r/min or less	Fixed to 7° BTDC	Normal control
Shift position switch	Off signal is detected while cranking engine	Normal control	

Warning control

This outboard motor is equipped with warning control functions to avoid serious engine damage. The engine speed is limited to approximately 2,000 r/min if the engine overheats, if there is insufficient oil, if there is water in the fuel, or if a dual engine system (DES) is operated.

When a switch turns on, the engine speed is controlled as shown in the table.

Overheat switch	Oil level sensor/low oil signal	DES signal	Water detection switch	Throttle opening angle is less than 10°	Throttle opening angle is 10° or more	
Off				All speed range	Less than 2,000 r/min	2,000 r/min or more
On				Ignites		Misfires

Cylinders #2, #3, #5, and #6 misfire in order and in 2.5 second intervals when the engine is running at 2,000 r/min or more.

Cylinders #1 and #4 are always ignited.

The warning control mode is deactivated when the throttle opening angle is less than 10°. Even if a sensor switch turns off, the warning control mode continues.

Over-revolution control

This outboard motor is equipped with an over-revolution control system to protect the engine.

If the engine speed exceeds 6,150 r/min, the ignition and fuel injection are controlled as shown in the table.

Engine speed (r/min)	Cylinders ignited and injected	Cylinders not ignited and injected
6,149 or less	#1, #2, #3, #4, #5, #6	
6,150 to 6,174	#1, #3, #4, #5, #6	#2
6,175 to 6,199	#1, #4, #5, #6	#2, #3
6,200 to 6,224	#1, #5, #6	#2, #3, #4
6,225 to 6,249	#1, #6	#2, #3, #4, #5
6,250 or more	#1	#2, #3, #4, #5, #6

Shift cut control

This outboard motor is equipped with a shift cut system for easier shifting.

When shifting, the ignition of some cylinders is shut off as shown in the table.

Engine speed (r/min)	449 or less	450 to 2,999	3,000 or more
Shift cut switch			
Off	N/A	N/A	N/A
On	N/A	Cylinders #1, #3, and #5 misfire	N/A



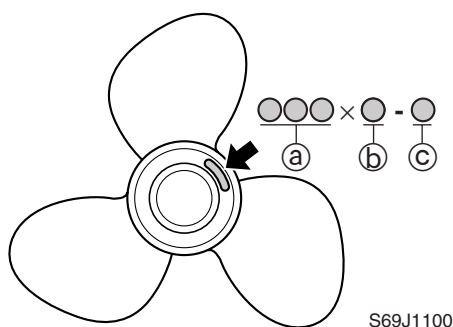
Propeller selection

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.

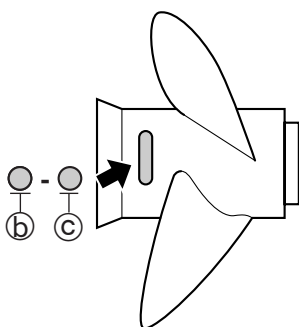
Use the following information as a guide for selecting a propeller that meets the operating conditions of the boat and the outboard motor.

Propeller size

The size of the propeller is indicated on the propeller boss end and on the side of the propeller boss.



S69J1100



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 3/8 × 23 - M	Stainless
13 3/8 × 25 - M	
13 3/4 × 17 - M2	
13 3/4 × 19 - M2	
13 3/4 × 21 - M	
14 1/2 × 19 - T	
14 1/2 × 21 - T	
14 1/2 × 23 - M	
14 3/4 × 25 - T	
14 7/8 × 21 - M	
15 × 17 - T	
15 1/8 × 27 - T	
15 1/4 × 15 - M	
15 1/4 × 17 - M	
15 1/4 × 19 - M	
15 3/4 × 13 - M	

Counter rotation model

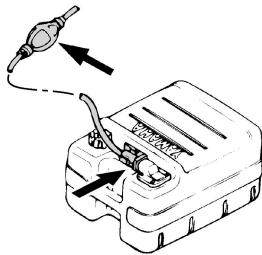
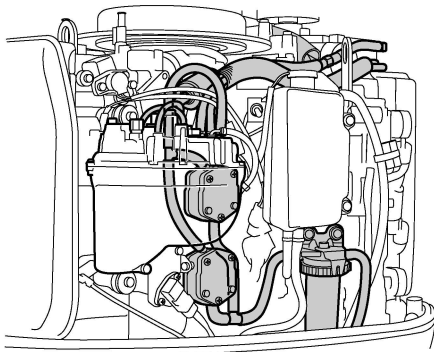
Propeller size (in)	Material
13 3/8 × 23 - ML	Stainless
13 3/4 × 17 - ML1	
13 3/4 × 19 - ML1	
13 3/4 × 21 - ML	
14 1/2 × 19 - TL	
14 1/2 × 21 - TL	
15 × 17 - TL	
15 1/4 × 15 - ML	

Predelivery checks

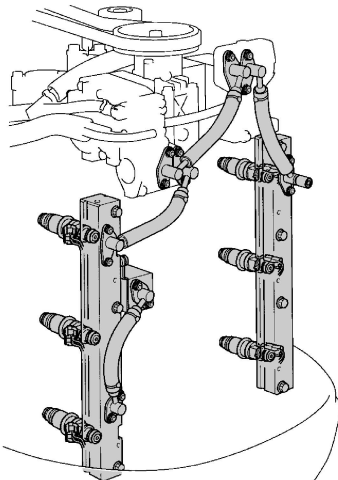
To make the delivery process smooth and efficient, the predelivery checks should be completed as explained below.

Checking the fuel system

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



S60V1010



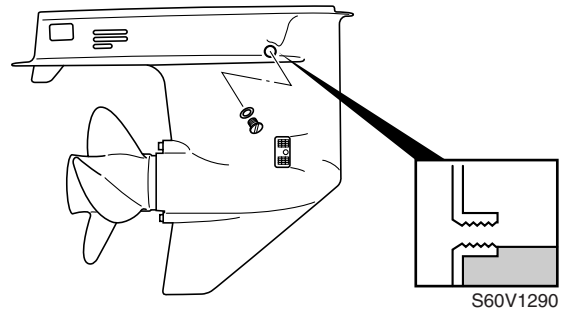
S60V1020

CAUTION:

- Use unleaded straight gasoline only.
- Do not use gasoline mixed with oil (pre-mixed fuel).

Checking the gear oil level

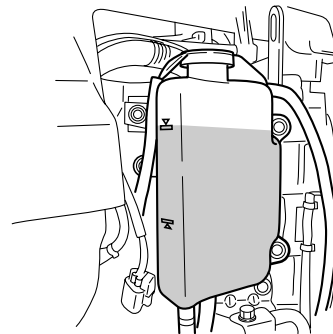
1. Check the gear oil level.



S60V1290

Checking the engine oil level

1. Check the engine oil level.
2. Make sure the oil level is between the upper and lower level marks.



S60V3260



Recommended engine oil:
YAMALUBE 2-stroke outboard
motor oil



Checking the battery

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



Recommended battery capacity:

CCA/SAE: 512 A

MCA/ABYC: 675 A

RC/SAE: 182 Minute

CCA/EN: 711 A

20HR/IEC: 100 Ah

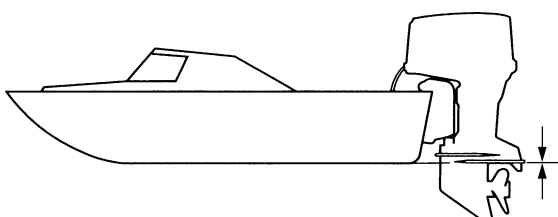
Electrolyte specified gravity:

1.280 at 20 °C (68 °F)

2. Check that the positive and negative battery leads are securely connected.

Checking the outboard motor mounting height

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.



S69J1160

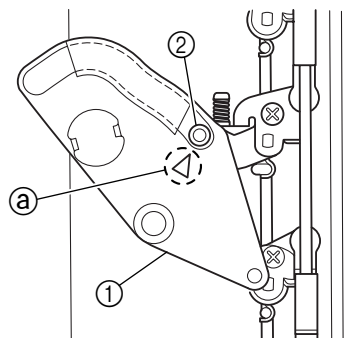
NOTE:

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 clamp bolts.

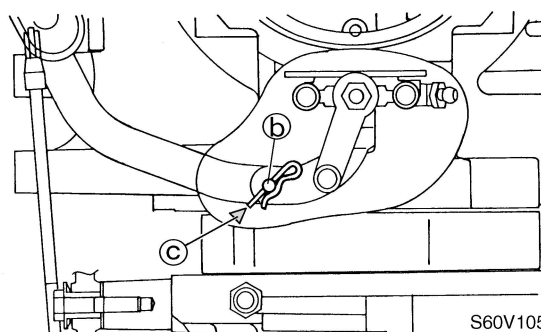
Checking the remote control cables

1. Set the remote control lever to the neutral position and fully close the throttle lever.
2. Check that the throttle cam ① is in its fully closed position and align the center of the throttle cam roller ② with the alignment mark ③.

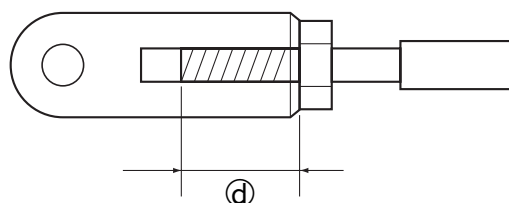


S60V1040

3. Check that the center of the set pin ④ is aligned with the alignment mark ⑤ on the bottom cowling.



S60V1050



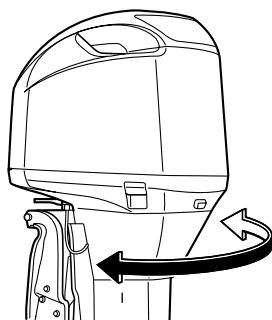
S60C1190

CAUTION:

The shift/throttle cable joint must be screwed in a minimum of 8.0 mm (0.31 in) ④.

Checking the steering system

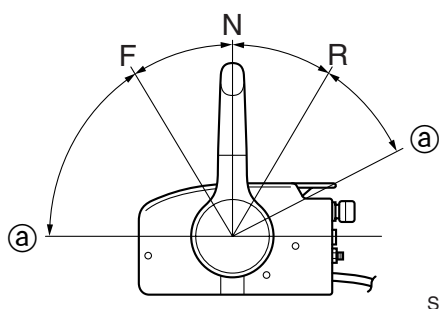
1. Check the steering friction for proper adjustment.
2. Check that the steering operates smoothly.



3. Check that there is no interference with wires or hoses when the outboard motor is steered.

Checking the gear shift and throttle operation

1. Check that the gear shift 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 (a).



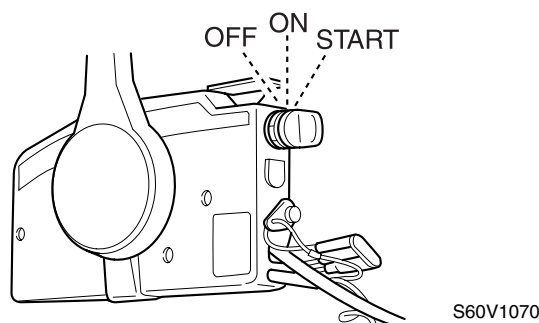
Checking the power trim and tilt system

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

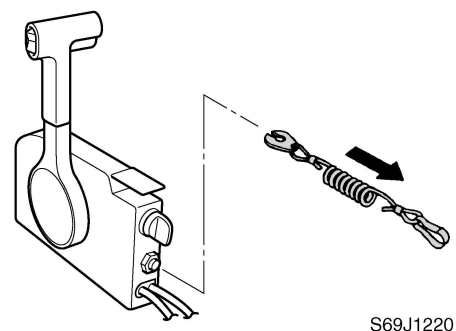
2. Check that there is no abnormal noise produced when the outboard motor is tilted up or down.
3. Check that there is no interference with wires or hoses when the tilted-up outboard motor is steered.
4. Check that the trim meter points down when the outboard motor is tilted all the way down.

Checking the engine start switch and engine shut-off switch

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



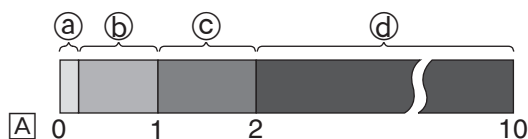
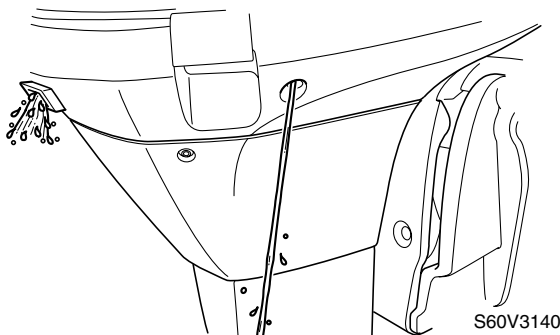
3. Check that the engine turns off when the engine shut-off cord is pulled from the engine shut-off switch.





Checking the cooling water pilot hole

1. Check that cooling water is discharged from the cooling water pilot hole.



S60V1120

[A] Hour

After test run

1. Check for water in the gear oil.
2. Check for fuel leakage in the cowling.
3. Flush the cooling water passage with fresh water using the flushing kit and with the engine running at idle.

Test run

1. Start the engine, and then check that the gear shift operates smoothly.
2. Check the engine idle speed after the engine has been warmed up.
3. Operate at trolling speed.
4. Run the outboard motor for 1 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

During the test run, perform the break-in operation in the following four stages.

1. First 10 minutes (a) of operation at idle
2. Fifty minutes (b) at 3,000 r/min or less
3. One hour (c) at 4,000 r/min or less
4. Eight hours (d) at 5,000 r/min or less with repeated wide-open-throttle operation for 5 minutes or less

Specifications

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SPEC		Specifications
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General specifications

Item	Unit	Model	
		Z250DETO	LZ250DETO
Dimension			
Overall length	mm (in)	868 (34.2)	
Overall width	mm (in)	568 (22.4)	
Overall height			
(X)	mm (in)	1,830 (72.0)	
(U)	mm (in)	1,957 (77.0)	
Boat transom height			
(X)	mm (in)	635 (25.0)	
(U)	mm (in)	762 (30.0)	
Weight			
(with stainless propeller)			
(X)	kg (lb)	252 (556)	
(U)	kg (lb)	257 (567)	
Performance			
Maximum output	kW (hp)	183.9 (250) at 5,000 r/min	
Full throttle operating range	r/min	4,500 to 5,500	
Maximum fuel consumption	L (US gal, Imp gal)/hr	74 (19.6, 16.3) at 5,500 r/min	
Idle speed	r/min	670–730	
Power unit			
Type		2-stroke, 76°, V6, HPDI	
Total displacement	cm ³ (cu. in)	3,342 (203.9)	
Bore × stroke	mm (in)	93 (3.66) × 82 (3.23)	
Compression ratio		6.2	
Control system		Remote control	
Starting system		Electric starter	
Enrichment system		Fuel injection	
Ignition control system		TCI	
Ignition timing	Degree	Cylinder #1: ATDC 9–BTDC 19	
Maximum generator output	V, A	12, 50	
Spark plug		BKR7EKU (NGK)	
Cooling system		Water	
Exhaust system		Propeller boss	
Lubrication system		Oil injection	

General specifications

Item	Unit	Model	
		Z250DETO	LZ250DETO
Fuel and oil			
Fuel type		Regular unleaded gasoline	
Fuel minimum rating	RON ^(*)	90	
	PON	86	
Engine oil ^(*)		YAMALUBE 2-stroke outboard motor oil	
Engine oil tank capacity			
Oil tank	L (US gal, Imp gal)	1.2 (0.32, 0.26)	
Remote oil tank	L (US gal, Imp gal)	10.5 (2.77, 2.31) 18.0 (4.76, 3.96)	
Gear oil type		Hypoid gear oil	
Gear oil grade	SAE	90	
Gear oil quantity	cm ³ (US oz, Imp oz)	1,150 (38.9, 40.5)	1,000 (33.8, 35.2)
Bracket unit			
Trim angle	Degree	-3 to 16	
(at 12° boat transom)			
Tilt-up angle	Degree	70	
Steering angle	Degree	30 + 30	
Drive unit			
Gear shift positions		F-N-R	
Gear ratio		1.81 (29/16)	
Reduction gear type		Spiral bevel gear	
Clutch type		Dog clutch	
Propeller shaft type		Spline	
Propeller direction (rear view)		Clockwise	Counterclockwise
Propeller ID mark		T, M	TL, ML
Electrical			
Battery minimum capacity ^(*)			
CCA/SAE	A	512	
MCA/ABYC	A	675	
RC/SAE	Minute	182	
CCA/EN	A	711	
20HR/IEC	Ah	100	

(*) RON: Research Octane Number

PON: Pump Octane Number =
(RON + Motor Octane Number)/2

(*) If 2-stroke outboard motor oil is not available, a 2-stroke NMMA-certified TC-W3 oil of equivalent quality must be used.

(*) CCA: Cold Cranking Ampere

MCA: Marine Cranking Ampere

ABYC: American Boat and Yacht Council

SAE: Society of Automotive Engineers

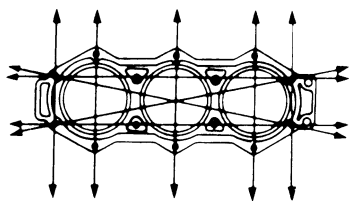
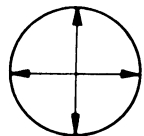
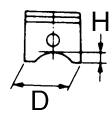
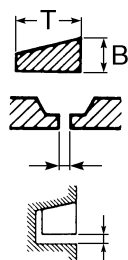
RC: Reserve Capacity

EN: European Norm (European standard)

IEC: International Electrotechnical Commission

Maintenance specifications

Power unit

Item	Unit	Model	
		Z250DETO	LZ250DETO
Power unit Minimum compression pressure*	kPa (kgf/cm ² , psi)	560 (5.6, 81)	
Cylinder heads Warpage limit  (lines indicate straightedge position)	mm (in)	0.1 (0.004)	
Cylinders Bore size Bore size limit Taper limit Out-of-round limit 	mm (in) mm (in) mm (in) mm (in)	93.000–93.020 (3.6614–3.6622) 93.100 (3.6654) 0.08 (0.0031) 0.05 (0.0020)	
Pistons Piston diameter (D) Measuring point (H) Piston-to-cylinder clearance Piston pin boss bore 	mm (in) mm (in) mm (in) mm (in)	92.840–92.860 (3.6551–3.6559) 10 (0.39) 0.155–0.161 (0.0061–0.0063) 26.004–26.015 (1.0238–1.0242)	
Piston pins Outside diameter	mm (in)	25.995–26.000 (1.0234–1.0236)	
Piston rings Top ring Dimension B Dimension T End gap Side clearance 2nd piston ring Dimension B Dimension T End gap Side clearance 	mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in)	2.05 (0.0807) 2.7–2.9 (0.106–0.114) 0.30–0.40 (0.0118–0.0157) 0.02–0.06 (0.0008–0.0024) 2.05 (0.0807) 2.7–2.9 (0.106–0.114) 0.30–0.45 (0.0118–0.0177) 0.02–0.06 (0.0008–0.0024)	

* Measuring conditions:

Ambient temperature 20 °C (68 °F), wide open throttle, with spark plugs removed from all cylinders.

The figures are for reference only.

Maintenance specifications

Item	Unit	Model	
		Z250DETO	LZ250DETO
Connecting rods			
Small end inside diameter	mm (in)	31.000–31.012 (1.2205–1.2209)	
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)	58.975–58.991 (2.3219–2.3225)	
Crankpin diameter	mm (in)	40.485–40.500 (1.5939–1.5945)	
Runout limit	mm (in)	0.02 (0.0008)	
Thermostats			
Opening temperature	°C (°F)	48–52 (118–126)	
Fully open temperature	°C (°F)	60 (140)	
Valve open lower limit	mm (in)	4.3 (0.17)	
Oil pump			
ID mark		60V00	
Bleeding		Automatic	
Reed valves			
Valve stopper height limit	mm (in)	8 (0.31)	
Valve bending limit	mm (in)	0.2 (0.008)	
Engine speed			
Engine idle speed	r/min	670–730	

Lower unit

Item	Unit	Model	
		Z250DETO	LZ250DETO
Gear backlash			
Pinion-to-forward gear	mm (in)	0.13–0.42 (0.0051–0.0165)	0.32–0.64 (0.0126–0.0252)
Pinion-to-reverse gear	mm (in)	0.64–0.93 (0.0252–0.0366)	0.57–0.96 (0.0224–0.0378)
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
Propeller shaft			
End play	mm (in)	—	0.25–0.35 (0.0098–0.0138)

SPEC		Specifications
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Electrical

Item	Unit	Model	
		Z250DETO	LZ250DETO
Ignition and ignition control system			
Ignition timing			
Cylinder #1			
at engine idle speed	Degree		ATDC 9
at 5,500 r/min	Degree		BTDC 19
Ignition spark gap	mm (in)		9 (0.35)
Spark plug gap	mm (in)		0.5–0.7 (0.020–0.028)
Ignition coil resistance			
Primary coil (R – B/W)			
at 20 °C (68 °F)	Ω		1.87–2.53
Secondary coil			
(B/W – spark plug wire)			
at 20 °C (68 °F)	kΩ		8.93–12.08
ECM output peak voltage			
(R – B/W)			
at cranking (loaded)	V		160
at 1,500 r/min (loaded)	V		260
at 3,500 r/min (loaded)	V		260
Pulser coil output peak voltage			
(W/R, W/B, W/Y, W/G,			
W/L, W/Br – B)			
at cranking (unloaded)	V		3.5
at cranking (loaded)	V		3.5
at 1,500 r/min (loaded)	V		20.0
at 3,500 r/min (loaded)	V		30.0
Pulser coil resistance ^(*1)	Ω		294–398
(W/R, W/B, W/Y, W/G,			
W/L, W/Br – B)			
Throttle position sensor			
Input voltage (O – R)	V		5
Output voltage (P – O)			
at engine idle speed	V		0.58–0.62
Crank position sensor output			
peak voltage (G/L – G/W)			
at cranking (unloaded)	V		1.5
at cranking (loaded)	V		1.5
at 1,500 r/min (loaded)	V		8.0
at 3,500 r/min (loaded)	V		10.0

(*) The figures are for reference only.

Maintenance specifications

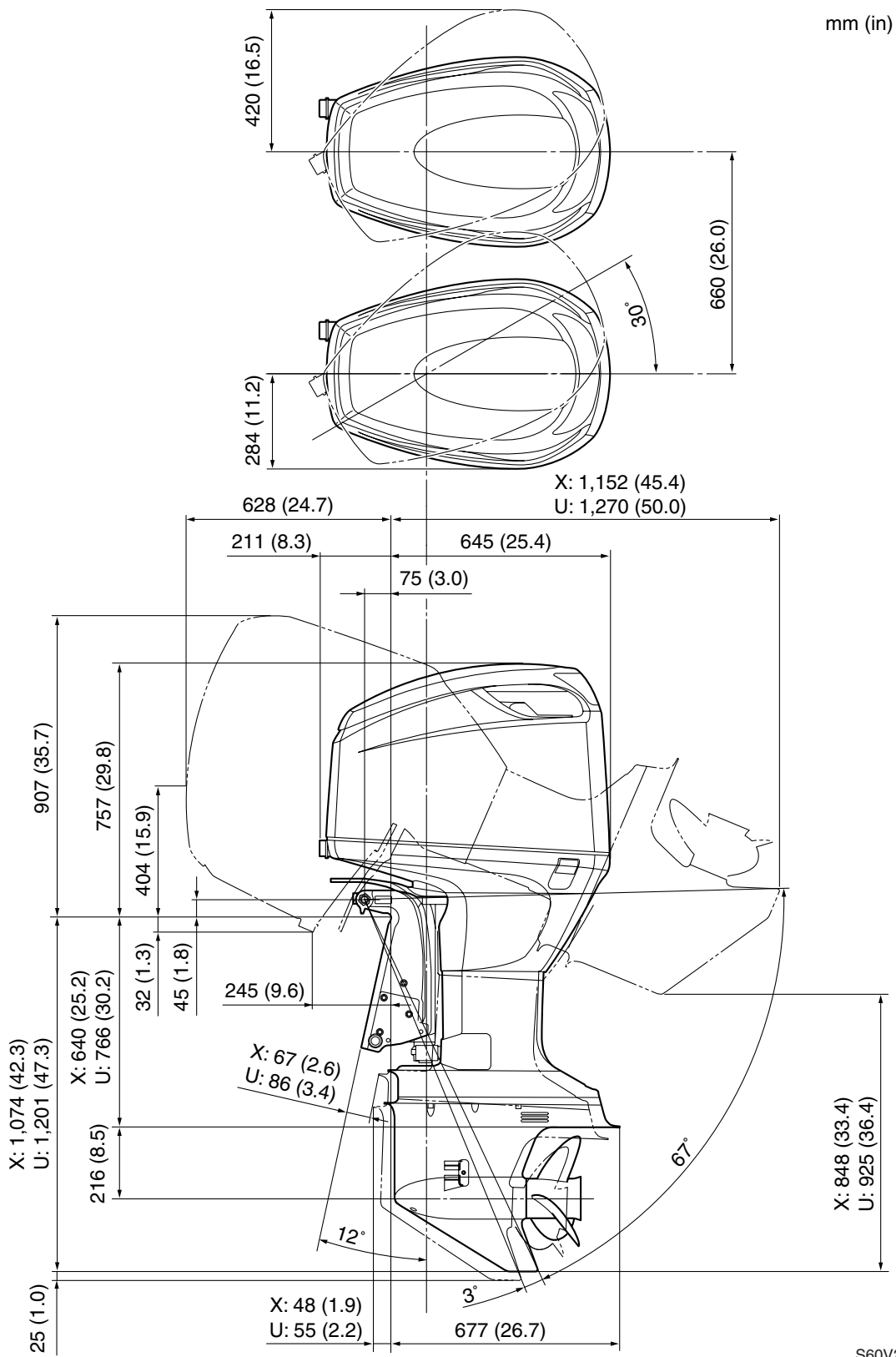
Item	Unit	Model	
		Z250DETO	LZ250DETO
Crank position sensor resistance ^(*) (G/L – G/W)	Ω	178.5–241.5	
Crank position sensor air gap	mm (in)	0.5–1.5 (0.02–0.06)	
Intake air temperature sensor resistance			
at 0 °C (32 °F)	kΩ	5.4–6.6	
at 80 °C (176 °F)	kΩ	0.3–0.4	
Engine temperature sensor resistance (B/Y – B/Y)			
at 20 °C (68 °F)	kΩ	54.2–69.0	
at 100 °C (212 °F)	kΩ	3.12–3.48	
Fuel control system			
Injector driver output peak voltage ^(*) (Pu/R – O/R, Pu/B – O/B, Pu/Y – O/Y, Pu/G – O/G, Pu/L – O/L, Pu/W – O/W)			
at cranking (loaded)	V	70	
at 1,500 r/min (loaded)	V	80	
at 3,500 r/min (loaded)	V	80	
Fuel injector resistance ^(*)			
at 20 °C (68 °F)	Ω	0.9–1.1	
Fuel pressure sensor output voltage (engine idle speed) ^(*) (O – P)	V	3.2	
Atmospheric pressure sensor input voltage (O – B)	V	5	
Starter motor			
Type		Sliding gear	
Output	kW	1.4	
Cranking time limit	Second	30	
Brushes			
Standard length	mm (in)	15.5 (0.61)	
Wear limit	mm (in)	9.5 (0.37)	
Commutator			
Standard diameter	mm (in)	29.0 (1.14)	
Wear limit	mm (in)	28.0 (1.10)	
Mica			
Standard undercut	mm (in)	0.5–0.8 (0.02–0.03)	
Wear limit	mm (in)	0.2 (0.01)	

^(*) The figures are for reference only.

Item	Unit	Model	
		Z250DETO	LZ250DETO
Charging system			
Fuse	A	20, 30, 100	
Stator coil output peak voltage (G – G)			
at cranking (unloaded)	V	5.5	
at 1,500 r/min (unloaded)	V	40	
at 3,500 r/min (unloaded)	V	90	
Stator coil resistance ^(*)			
at 20 °C (68 °F) (G – G)	Ω	0.11–0.17	
Rectifier Regulator output peak voltage (R – ground)			
at 1,500 r/min (unloaded)	V	14.5	
at 3,500 r/min (unloaded)	V	14.5	
Power trim and tilt system			
Trim sensor			
Setting resistance	Ω	9–11	
Resistance (P – B)	Ω	9–387.6	
Fluid type		ATF Dexron II	

(*) The figures are for reference only.

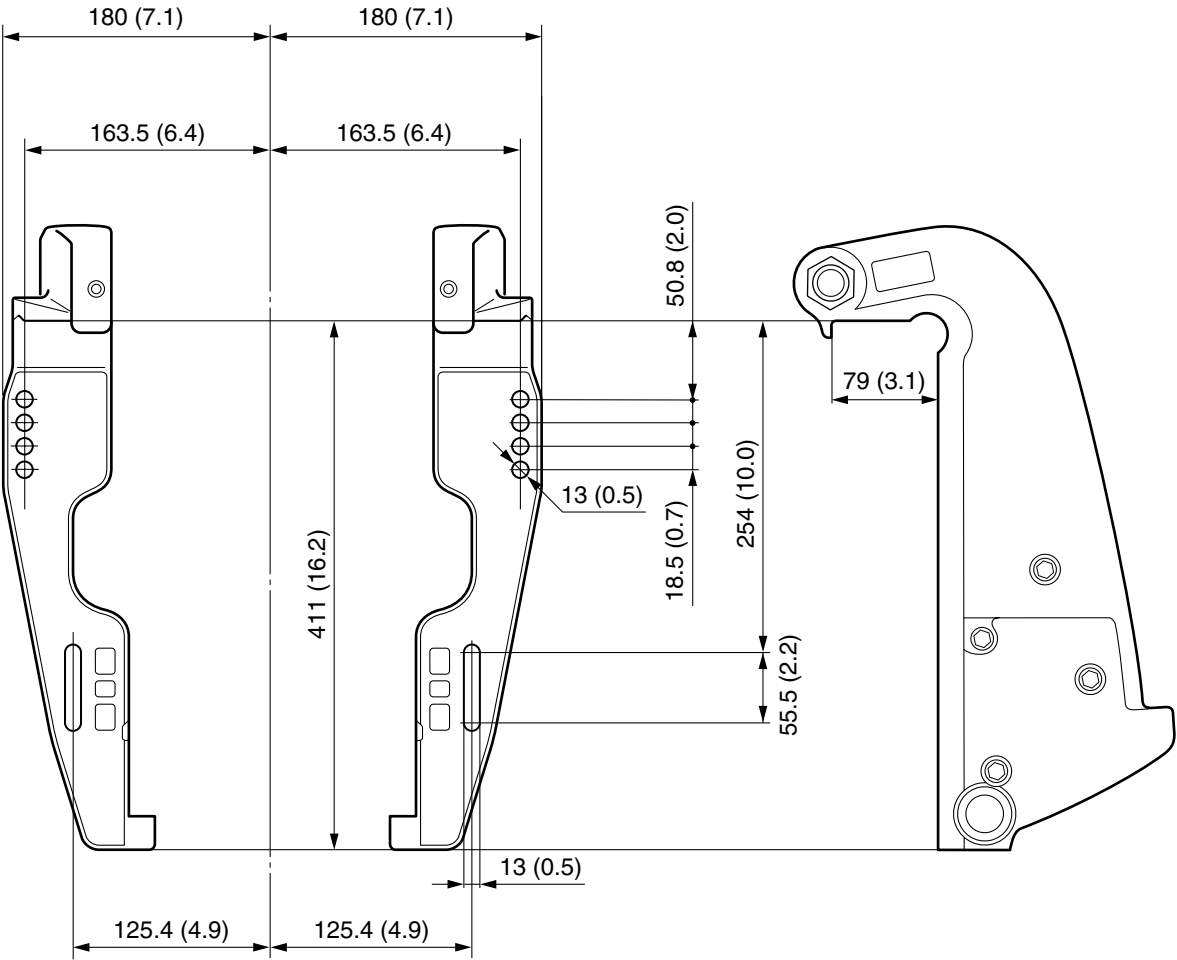
Dimensions
Exterior



S60V2010

Clamp bracket

mm (in)



S60V2020

Tightening torques

Specified torques

Part to be tightened		Thread size	Tightening torques		
			N·m	kgf·m	ft·lb
Fuel system					
Fuel pump screw		M5	3	0.3	2.2
Emergency switch		—	4	0.4	3.0
High-pressure fuel pump bolt		M8	26	2.6	19.2
Power unit					
Negative battery terminal nut		(M8)	12	1.2	8.9
Drive belt tensioner bolt		M10	39	3.9	28.8
Starter motor bolt		M8	29	2.9	21.4
Intake air temperature sensor		—	8	0.8	5.9
Rectifier Regulator bolt	1st	M6	6	0.6	4.4
	2nd		12	1.2	8.9
PTT motor lead bolt		M6	4	0.4	3.0
Shift position switch screw		M4	3	0.3	2.2
Control lever stopper screw		—	2	0.2	1.5
Connecting rod cap	1st	M9	28	2.8	20.7
	2nd		45	4.5	33.2
	3rd		Loosen completely		
	4th		28	2.8	20.7
	5th		45	4.5	33.2
Crankshaft balancer nut		(M32)	100	10.0	73.8
Crankcase bolt	1st	M10	20	2.0	14.8
	2nd		40	4.0	29.5
	1st	M6	4	0.4	3.0
	2nd		8	0.8	5.9
Cylinder head bolt	1st	M8	15	1.5	11.1
	2nd		30	3.0	22.1
Cylinder head cover bolt	1st	M6	5	0.5	3.7
	2nd		11	1.1	8.1
Exhaust outer cover bolt	1st	M6	5	0.5	3.7
	2nd		11	1.1	8.1
Flywheel nut		(M24)	190	19.0	140
Fuel rail mounting bolt		M8	23	2.3	17.0
Fuel filter cup holder mounting bolt		M6	8	0.8	5.9
Injector holder bolt		M8	26	2.6	19.2
Intake silencer mounting screw		M6	3	0.3	2.2
Reed valve mounting screw		M5	3	0.3	2.2
Intake manifold bolt		M6	13	1.3	9.6
Oil pump mounting bolt		M6	7	0.7	5.2
Pressure control valve cover bolt	1st	M6	5	0.5	3.7
	2nd		11	1.1	8.1
Shift cut switch mounting screw		M4	3	0.3	2.2

2

Part to be tightened		Thread size	Tightening torques		
			N·m	kgf·m	ft·lb
Spark plug		M14	25	2.5	18.4
Positive battery terminal nut		(M8)	9	0.9	6.6
Thermostat cover bolt		M6	11	1.1	8.1
Throttle body mounting bolt and nut	1st	M6	4	0.4	3.0
	2nd		10	1.0	7.4
Power unit mounting bolt		M8	32	3.2	23.6
Lower unit (regular rotation model)					
Exhaust guide bolt		M8	32	3.2	23.6
Gear oil check screw		M8	9	0.9	6.6
Lower case mounting bolt		M10	47	4.7	34.7
Pinion nut		(M16)	142	14.2	104.7
Propeller nut		(M18)	54	5.4	39.8
Propeller shaft housing bolt		M8	30	3.0	22.1
Trim tab mounting bolt		M10	42	4.2	31.0
Gear oil drain screw		—	9	0.9	6.6
Grease nipple		—	6	0.6	4.4
Lower unit (counter rotation model)					
Exhaust guide bolt		M8	32	3.2	23.6
Gear oil check screw		M8	9	0.9	6.6
Lower case mounting bolt		M10	47	4.7	34.7
Pinion nut		(M16)	142	14.2	104.7
Propeller nut		(M18)	54	5.4	39.8
Ring nut		—	108	10.8	79.7
Propeller shaft housing bolt		M8	30	3.0	22.1
Trim tab mounting bolt		M10	42	4.2	31.0
Gear oil drain screw		—	9	0.9	6.6
Grease nipple		—	6	0.6	4.4
Bracket unit					
Flushing hose adapter screw		M5	5	0.5	3.7
Upper case mounting bolt		M8	32	3.2	23.6
Lower exhaust guide mounting bolt		M8	22	2.2	16.2
Exhaust manifold mounting bolt		M8	25	2.5	18.4
Muffler mounting bolt		M8	25	2.5	18.4
Lower rubber mount nut		(M14)	72	7.2	53.1
Through tube nut		(M22)	22	2.2	16.2
Trim rod stopper nut		(M10)	36	3.6	26.6
Upper rubber mount nut		(M14)	72	7.2	53.1
Friction plate screw		M6	4	0.4	3.0
Power trim and tilt unit					
Blind plug			7	0.7	5.2
Gear pump housing mounting screw		M4	2	0.2	1.5
Gear pump housing bolt		M5	4	0.4	3.0
Trim down spring screw		M5	4	0.4	3.0
Main valve			11	1.1	8.1

Tightening torques

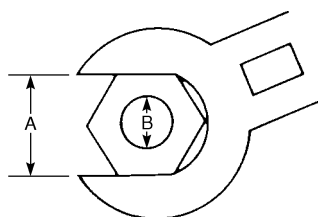
Part to be tightened	Thread size	Tightening torques		
		N·m	kgf·m	ft·lb
Manual valve		2	0.2	1.5
PTT motor unit mounting bolt	M8	19	1.9	14.0
Oil pipe		15	1.5	11.1
Relief valve cap screw	M5	4	0.4	3.0
Reservoir mounting bolt	M8	19	1.9	14.0
Reservoir cap	M12	7	0.7	5.2
Tilt cylinder end screw		90	9.0	66.4
Tilt rod		55	5.5	40.6
Trim cylinder end screw		160	16.0	118
Trim rod		38	3.8	28.0
Valve plate bolt	M6	7	0.7	5.2
PTT unit mounting bolt	M10	42	4.2	31.0

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 torque is reached. Unless otherwise specified, 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
8 mm	M5	5	0.5	3.6
10 mm	M6	8	0.8	5.8
12 mm	M8	18	1.8	13
14 mm	M10	36	3.6	25
17 mm	M12	43	4.3	31



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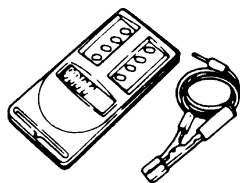
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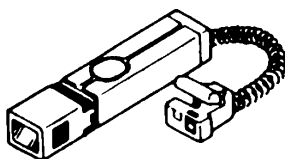
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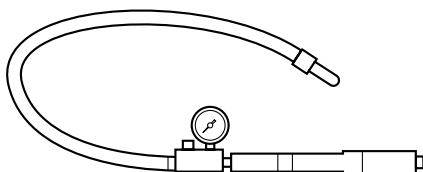
Special service tools



Digital tachometer
90890-06760



Timing light
90890-03141



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 (1 month)	50 hours (3 months)	100 hours (6 months)	200 hours (1 year)	
Top cowling						
Top cowling fit	Check/adjust				○	3-4
Fuel system						
Fuel system	Check	○	○	○		3-4
Fuel filter (water separator)	Clean/replace	○	○	○		3-5
Fuel tank	Clean				○	—
High-pressure fuel pump oil ^(*)	Check				○	3-5
Power unit						
Drive belt ^(*)	Check				○	3-6
Spark plugs	Clean/adjust/replace	○	○	○		3-6
Cooling water passages ^(*)	Clean		○	○		3-8
Oil tank water drain	Check/clean	○	○	○		—
Outboard motor exterior	Check	○	○	○		—
Control system						
Idle speed	Check/adjust	○		○		3-8
Throttle position sensor	Check/adjust				○	4-26
Throttle link	Check/adjust				○	4-25
Throttle pick-up timing	Check/adjust				○	4-25
Power trim and tilt unit						
Power trim and tilt unit	Check				○	3-11
Power trim and tilt operation	Check	○	○	○		3-11
Lower unit						
Gear oil	Change	○		○		3-12
Propeller	Check	○	○	○		3-13
General						
Anodes	Check/replace		○	○		3-14
Battery	Check/charge	○ (every month)				3-14
Bolts and nuts	Tighten	○				—
Lubrication points	Lubricate			○		3-15
Exhaust leakage	Check	○	○	○		—
Water leakage	Check	○	○	○		—
Wiring and connectors	Check/reconnect	○	○	○		—

**NOTE:**

- (*1) Be sure to change the high-pressure fuel pump oil every 1,000 hours of operation or every 5 years.
- (*2) Be sure to replace the drive belt every 1,000 hours of operation or every 5 years.
- (*3) The engine should be flushed with fresh water after operating in salt, turbid, or muddy water.
-

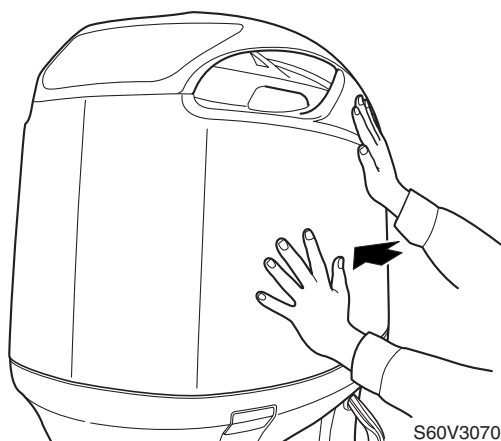
CAUTION:

If the flywheel magnet cover is removed to service the outboard motor, be sure to check that the fuel hoses are routed correctly before installing it.

Top cowling

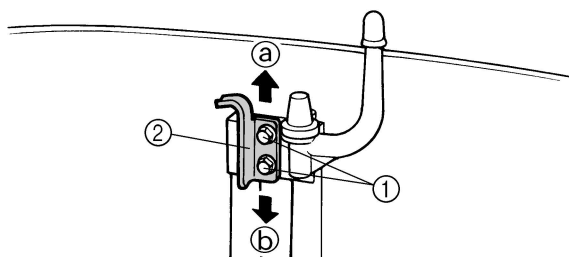
Checking the top cowling

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



S60V3070

2. Loosen the bolts ①.
3. Move the hook ② up or down slightly to adjust its position.



S69J3020

NOTE:

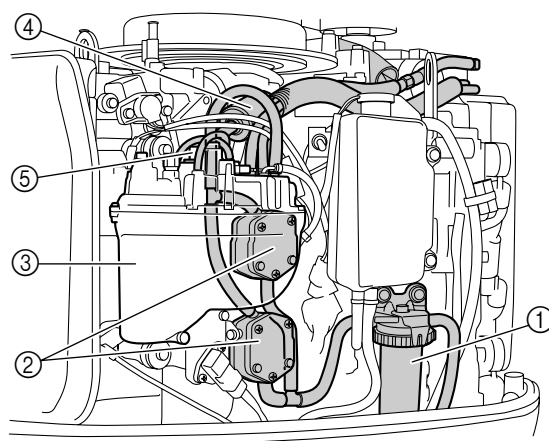
- To loosen the fitting, move the hook in direction ①.
- To tighten the fitting, move the hook in direction ②.

4. Tighten the bolts.
5. Check the fitting again and, if necessary, repeat steps 2–4.

Fuel system

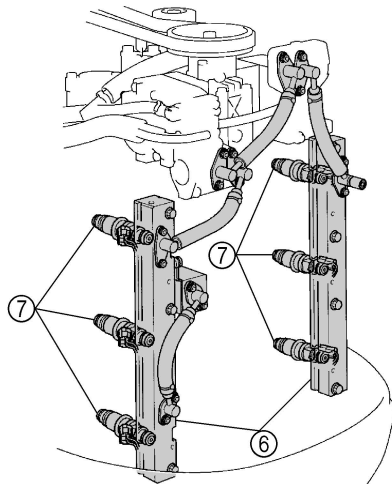
Checking the fuel joint and fuel hoses (fuel joint-to-fuel injector)

1. Remove the flywheel magnet cover and ignition coil cover.
2. Check the low-pressure fuel hose connections and fuel joints for leaks. Replace if necessary. Also, check the fuel filter ① and fuel pumps ② for leaks or deterioration. Replace if necessary.
3. Check the medium-pressure fuel hose connections and fuel joints for leaks. Replace if necessary. Also, check the vapor separator ③, fuel filter ④, and pressure regulator ⑤ for leaks or deterioration. Replace if necessary.



S60V3080

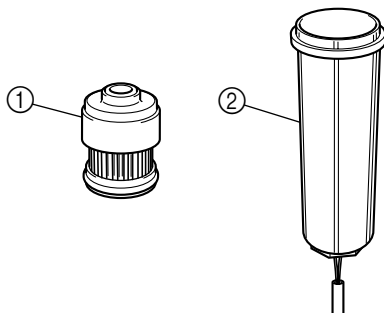
4. Check the high-pressure fuel hose connections for leaks. Replace if necessary. Also, check the fuel rails ⑥ and fuel injectors ⑦ for leaks or damage. Replace if necessary.



S60V3090

Checking the fuel filter

1. Check the fuel filter element ① for dirt and residue and check the fuel filter cup ② for foreign substances and cracks. Clean with straight gasoline and replace the cup if necessary.



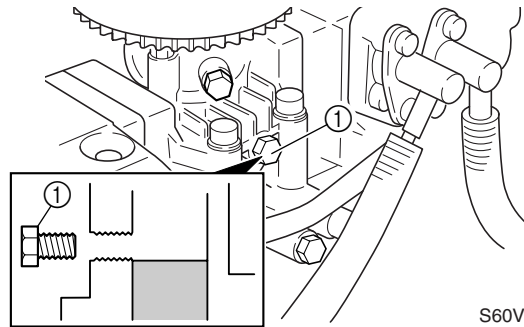
S60V3100

NOTE:

Be sure not to spill any fuel when removing the fuel filter cup.

Checking the high-pressure fuel pump gear oil level

1. Remove the flywheel magnet cover.
2. Remove the check bolt ①, and then check the gear oil level in the high-pressure fuel pump.



S60V3230

NOTE:

If the oil is at the correct level, the oil should overflow out of the check hole when the check bolt is removed.

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

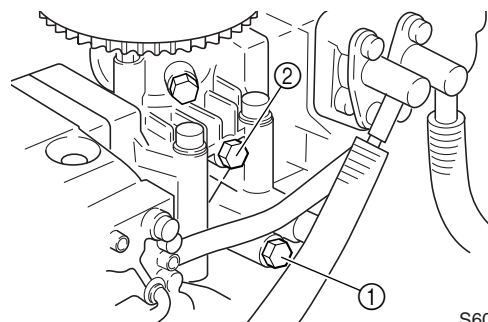


Recommended gear oil:
Hypoid gear oil SAE 90

4. Install the check bolt.

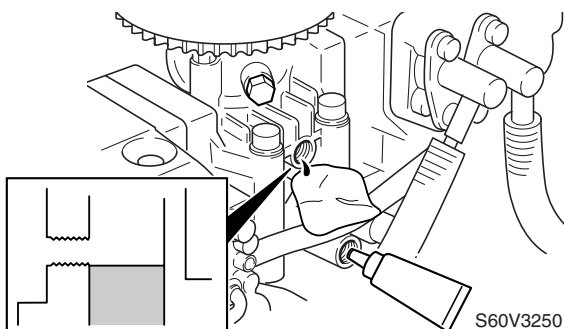
Changing the high-pressure fuel pump gear oil

1. Remove the flywheel magnet cover.
2. Place a drain pan under the drain bolt, remove the drain bolt ①, then the check bolt ② to drain the oil.



S60V3240

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



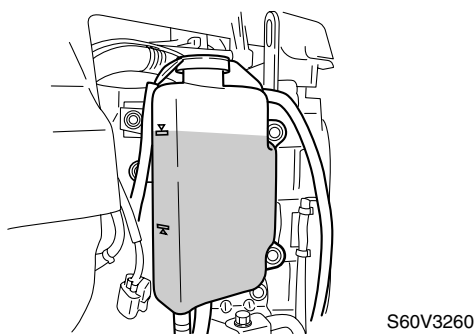
 Recommended gear oil:
Hypoid gear oil SAE 90
Oil quantity:
45 cm³ (1.5 US oz, 1.6 Imp oz)

4. Install the check bolt and quickly install the drain bolt.
5. Install the flywheel magnet cover.

Power unit

Checking the engine oil level

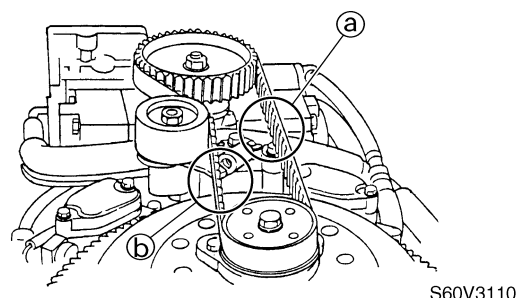
1. Place the outboard motor in an upright position.
2. Check the engine oil level.
3. Make sure the oil level is between the upper and lower level marks.



 Recommended engine oil:
YAMALUBE 2-stroke outboard
motor oil

Checking the drive belt

1. Remove the flywheel magnet cover.
2. While turning the flywheel magnet clockwise, check the interior (a) and the exterior (b) of the drive belt for cracks, damage, or wear. Replace if necessary.

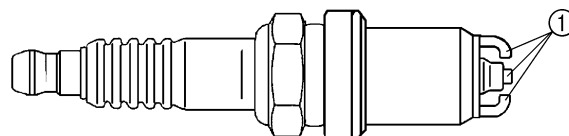


Replacing the drive belt

NOTE: For replacement procedures, see Chapter 5, "Removing the drive belt and sprockets" and "Installing the sprockets and drive belt."

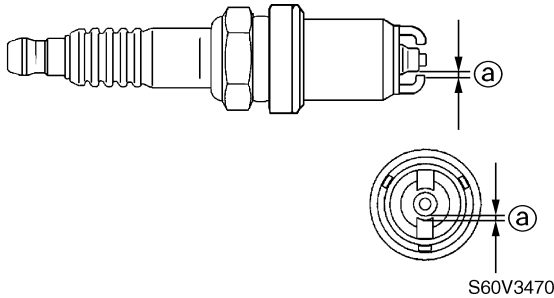
Checking the spark plugs

1. Disconnect the spark plug wires, and then remove the spark plugs.
2. Clean the electrodes (1) with a spark plug cleaner or wire brush. Replace the spark plug if necessary.



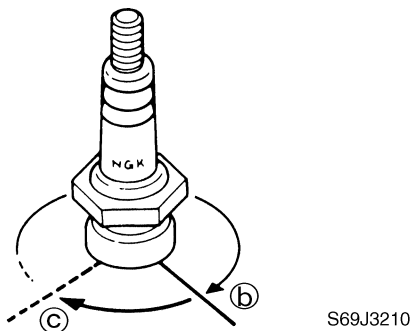
S60V3460

3. Check the electrodes for erosion and excessive carbon or other deposits, and the gasket for damage. Replace the spark plug if necessary.
4. Check the spark plug gap ①. Adjust if out of specification.



Specified spark plug:
BKR7EKG (NGK)
Spark plug gap ①:
0.5–0.7 mm (0.020–0.028 in)

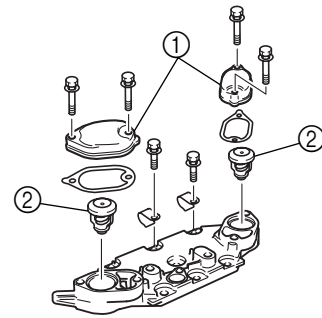
5. Install the spark plugs, tighten them finger tight ②, then to the specified torque with a spark plug wrench ③.



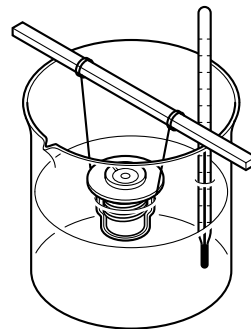
Spark plug:
25 N·m (2.5 kgf·m, 18.4 ft·lb)

Checking the thermostats

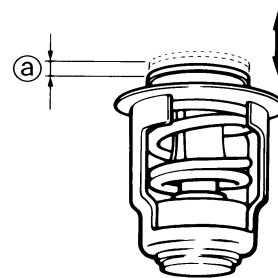
1. Remove the flywheel magnet cover.
2. Remove the covers ① and thermostats ②.



3. Suspend the thermostats in a container of water.
4. Place a thermometer in the water and slowly heat the water.



5. Check the thermostat valve opening at the specified water temperatures. Replace if out of specification.



Water temperature	Valve lift ①
48–52 °C (118–126 °F)	0 mm (0 in) (valve begins to lift)
above 60 °C (140 °F)	more than 4.3 mm (0.17 in)

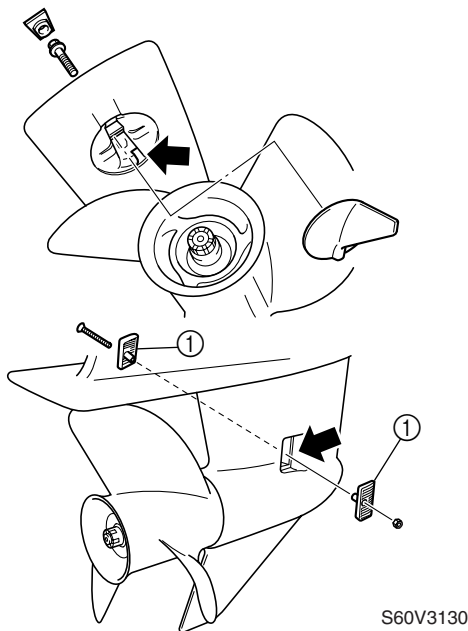
6. Install the thermostats and covers, and then tighten the cover bolts to the specified torque.



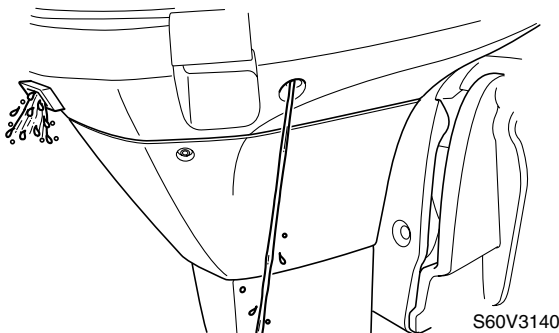
Thermostat cover bolt:
11 N·m (1.1 kgf·m, 8.1 ft·lb)

Checking the cooling water passage

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



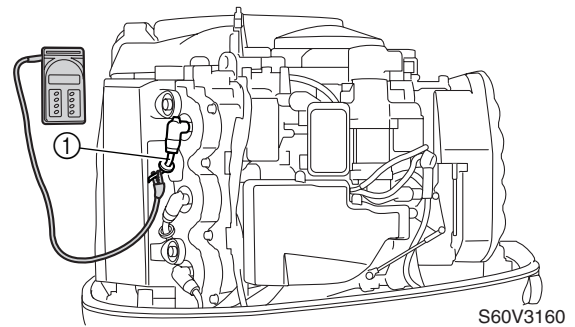
2. Place the lower unit in water, and then start the engine.
3. Check for water flow at the cooling water pilot hole. If there is no water flow, check the cooling water passage inside the out-board motor.



Control system

Checking the engine idle speed

1. Start the engine and warm it up for 5 minutes.
2. Attach the special service tool to spark plug wire #1 ①, and then check the engine idle speed. Adjust if out of specification.

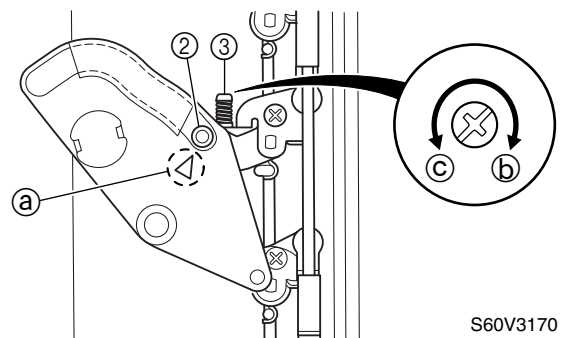


Digital tachometer: 90890-06760



Engine idle speed: 670–730 r/min

3. Check that the center of the throttle cam roller ② is aligned with the alignment mark ①.
4. Turn the throttle stop screw ③ in direction ④ or ⑤ until the specified engine idle speed is obtained.



NOTE:

- To increase the idle speed, turn the throttle stop screw in direction ④.
- To decrease the idle speed, turn the throttle stop screw in direction ⑤.

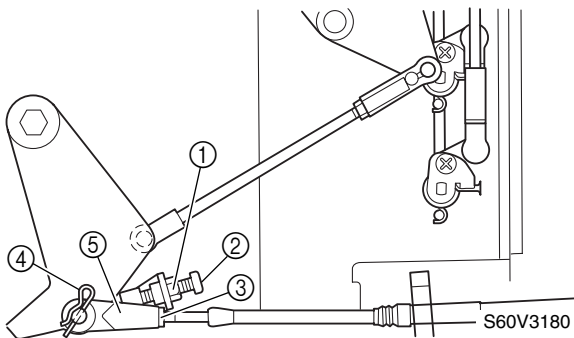
5. Press down on the throttle cam and tighten throttle adjusting screw #4 by turning it counterclockwise.

Adjusting the throttle cable

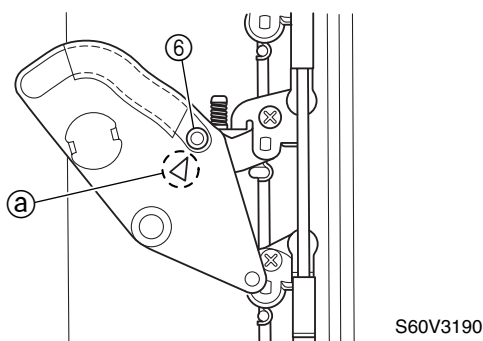
NOTE:

- Be sure to synchronize the throttle valves before adjusting the throttle cable.
- For synchronizing procedures, see Chapter 4, "Synchronizing the throttle valves."

1. Loosen the locknut ① and stopper screw ②.
2. Loosen the locknut ③, remove the clip ④, and then disconnect the throttle cable joint ⑤.

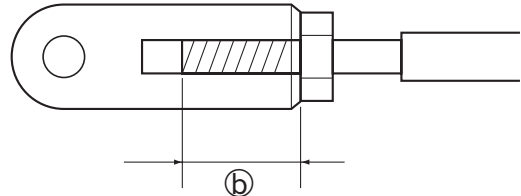


3. Set the remote control lever to the fully closed position.
4. Align the center of the throttle cam roller ⑥ with the alignment mark ⑦.



5. Tighten the stopper screw until it contacts the throttle lever.
6. Tighten the locknut.

7. Adjust the position of the throttle cable joint until its hole is aligned with the set pin on the throttle lever.



S69J3200

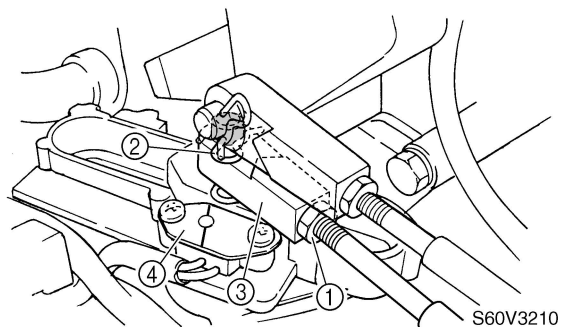
CAUTION:

The throttle cable joint must be screwed in a minimum of 8.0 mm (0.31 in) ⑧.

8. Connect the cable joint, install the clip, and then tighten the locknut.
9. Check the throttle cable for smooth operation and adjust the cable length, if necessary, repeat steps 1–8.

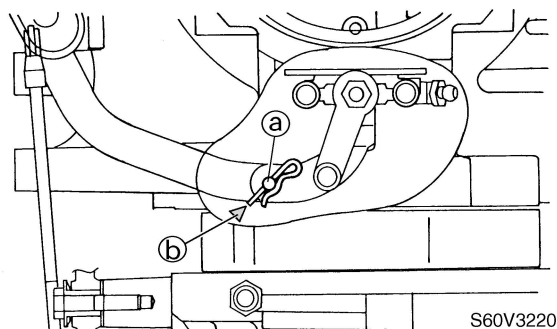
Checking the gear shift operation

1. Check that the gear shift operates smoothly when shifting from neutral into forward or reverse. Adjust the shift cable length if necessary.
2. Set the gear shift to the neutral position.
3. Loosen the locknut ①, remove the clip ②, and then disconnect the shift cable joint ③.

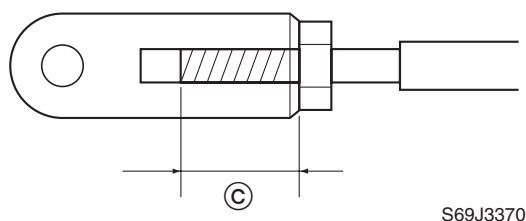


S60V3210

4. Adjust the position of the shift lever until the pin on the lever is aligned with the line on the shift position switch plate ④.
5. Align the center of the set pin ① with the alignment mark ② on the bottom cowl-
ing.



6. Adjust the position of the shift cable joint until its hole is aligned with the set pin.

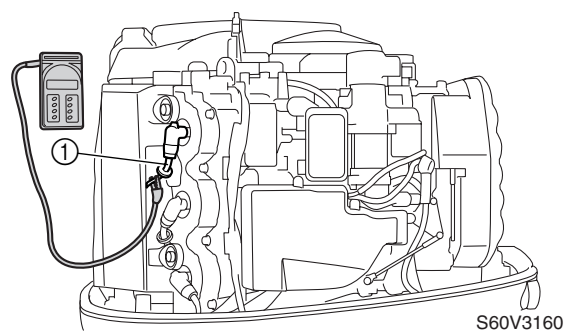
**CAUTION:**

The shift cable joint must be screwed in a minimum of 8.0 mm (0.31 in) ③.

7. Connect the cable joint, install the clip, and then tighten the locknut.
8. Check the gear shift for smooth operation and adjust the shift cable length, if necessary, repeat steps 3–7.

Checking the ignition timing

1. Start the engine and warm it up for 5 minutes.
2. Attach the special service tool to spark plug wire #1 ①, and then check the engine idle speed. Adjust if out of specification.

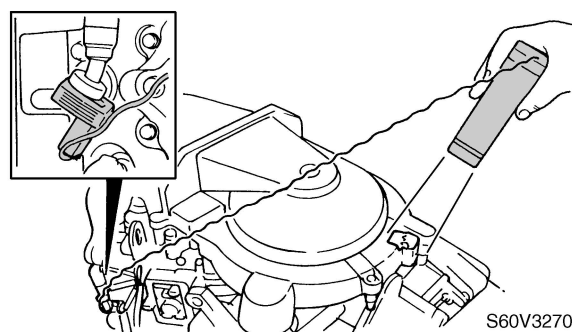


Digital tachometer: 90890-06760



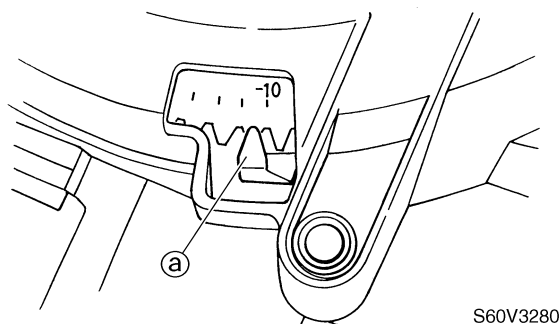
Engine idle speed: 670–730 r/min

3. Attach the special service tool to spark plug wire #1.



Timing light: 90890-03141

4. Check that the pointer ① is within the specified ignition timing range on 8th flywheel magnet.

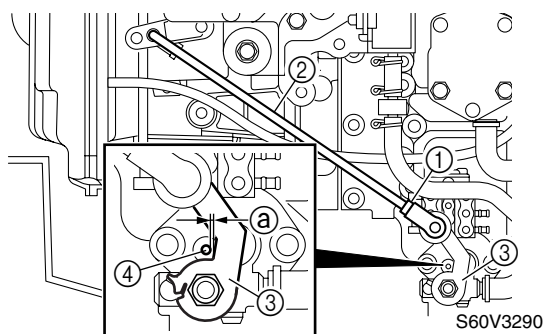


Ignition timing at engine idle speed:
ATDC 6°–ATDC 12°

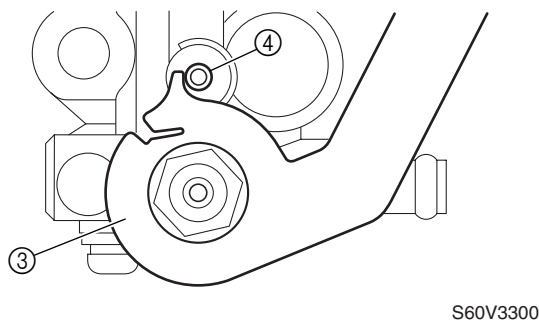
Oil injection system

Adjusting the oil pump link rod

1. Loosen the locknut ① and then disconnect the oil pump link rod ②.
2. Fully close the throttle valves.
3. Adjust the oil pump link rod so that there is a 1 mm (0.4 in) gap ③ between the oil pump lever ③ (in the fully closed position) and the stopper ④.



4. Connect the oil pump link rod.
5. Check that the oil pump lever ③ contacts the stopper ④ when the throttle valve is in the fully open position.



Power trim and tilt unit

Checking the power trim and tilt operation

1. Fully tilt the outboard motor up and down a few times and check the entire trim and tilt range for smooth operation. Check the power trim and tilt fluid level if necessary.

NOTE:

Be sure to listen to the winding sound of the power trim and tilt motor for smooth operation.

2. Fully tilt the outboard motor up, and then support it with the tilt stop lever ① to check the lock mechanism of the lever.



Checking the power trim and tilt fluid level

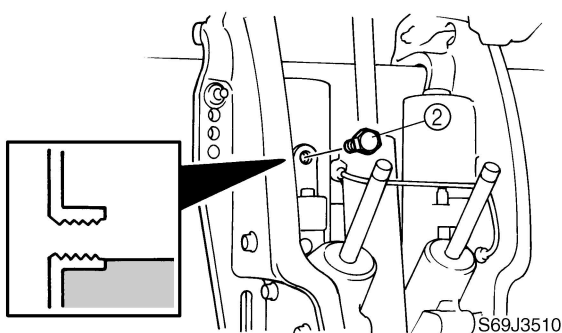
1. Fully tilt the outboard motor up, and then support it with the tilt stop lever ①.



⚠ 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. Remove the reservoir cap ②, and then check the fluid level in the reservoir.



NOTE:

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

3. If necessary, 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, and then tighten it to the specified torque.

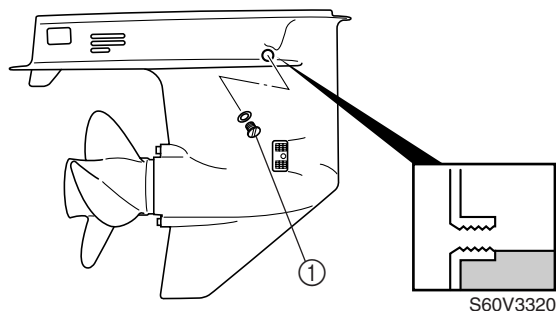


Reservoir cap:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

Lower unit

Checking the gear oil level

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



NOTE:

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

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

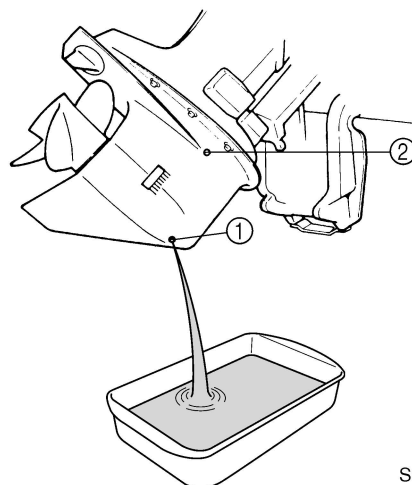


Recommended gear oil:
Hypoid gear oil
SAE: 90

4. Install the check screw.

Changing the gear oil

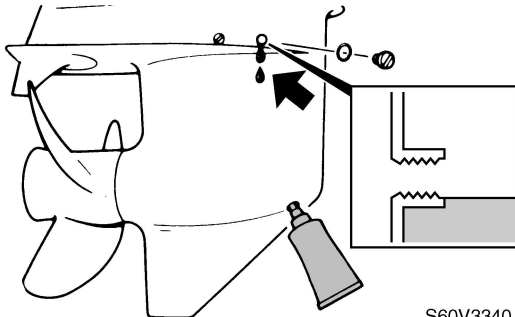
1. Tilt the outboard motor up slightly.
2. Place a drain pan under the drain screw ①, remove the drain screw, then the check screw ② to drain the oil.



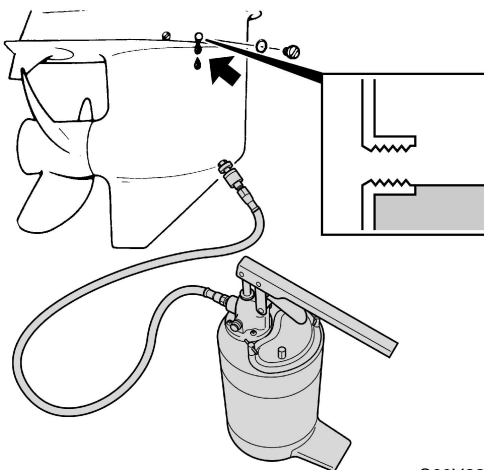
S60V3330

3. Check the oil for metal, discoloration, and its viscosity. Check the internal parts of the lower case if necessary.

4. Insert a 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.



S60V3340



S60V3350



Recommended gear oil:

Hypoid gear oil

SAE: 90

Oil quantity:

Regular rotation model:

1,150 cm³

(38.9 US oz, 40.5 Imp oz)

Counter rotation model:

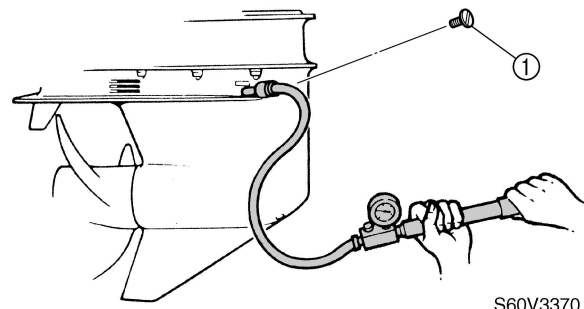
1,000 cm³

(33.8 US oz, 35.2 Imp oz)

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

Checking the lower unit for air leakage

1. Remove the check screw ①, and then install the special service tool.



S60V3370



Leakage tester: 90890-06840

2. Apply the specified pressure to check that the pressure is maintained in the lower unit for at least 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 when removing the pressure/vacuum tester from the lower unit.

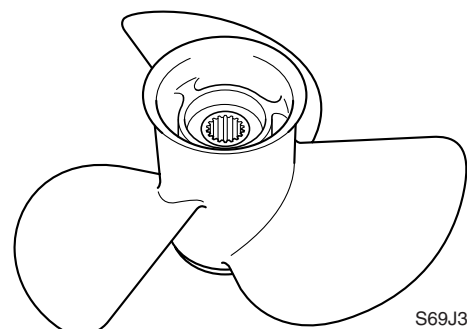


Lower unit holding pressure:
100 kPa (1.0 kgf/cm², 14 psi)

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. Replace if necessary.

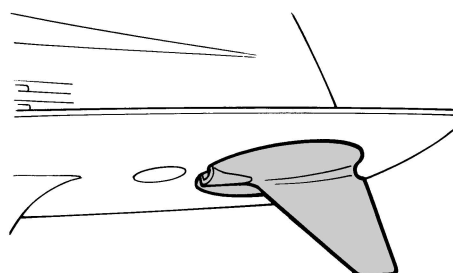
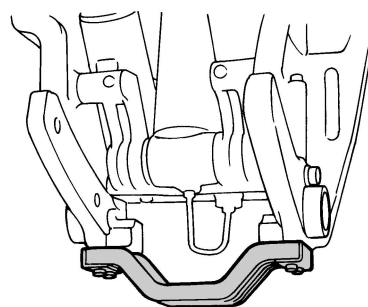
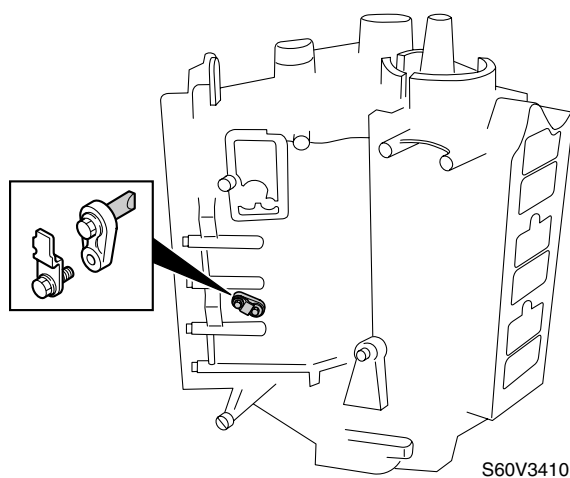
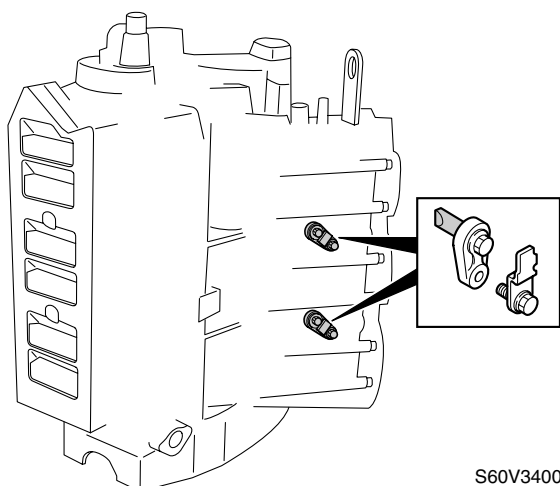
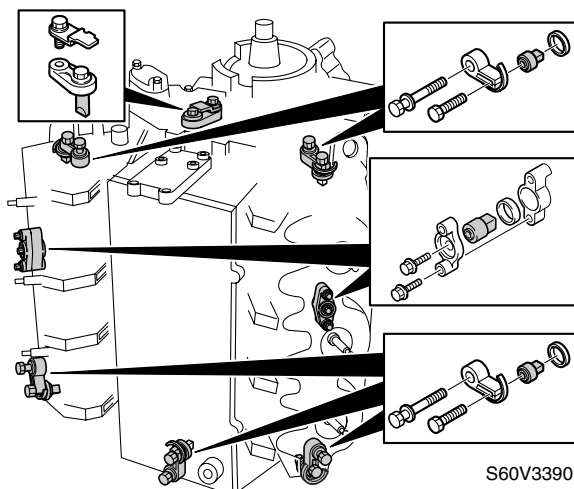


S69J3580

General

Checking the anodes

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



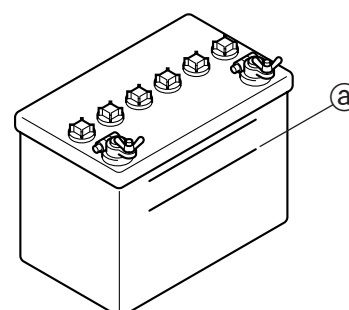
CAUTION:

Do not oil, grease, or paint the anodes or the trim tab, otherwise they will be ineffective.

2. Replace the anodes or 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 the level is between the maximum and minimum level marks.





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

⚠ WARNING

Battery electrolyte is dangerous; it contains sulfuric acid which is poisonous and highly caustic.

Always follow these preventive 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 flames (e.g., welding equipment, lighted cigarettes).
- DO NOT SMOKE when charging or handling batteries.

KEEP BATTERIES AND ELECTROLYTE OUT OF REACH OF CHILDREN.

NOTE:

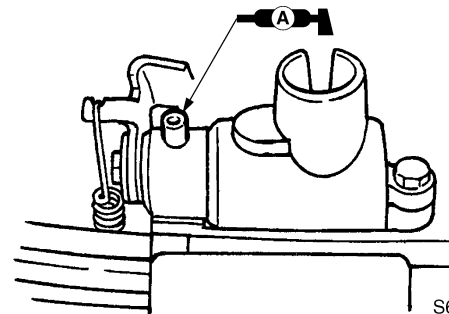
- Batteries vary per manufacturer. The procedures mentioned in this manual may not always apply, therefore, consult the instruction manual of the battery.
- Disconnect the negative battery lead first, then the positive battery lead.



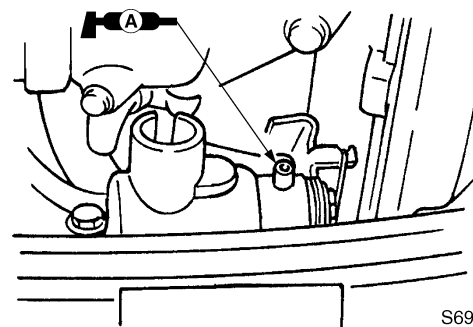
Electrolyte specific gravity:
1.280 at 20 °C (68 °F)

Lubricating the outboard motor

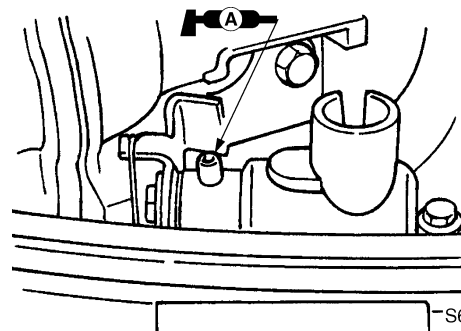
1. Apply water resistant grease to the areas shown.



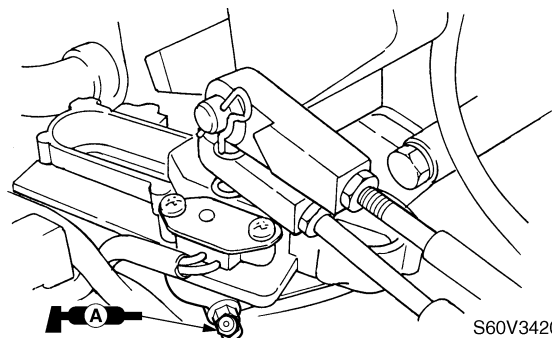
S69J3630



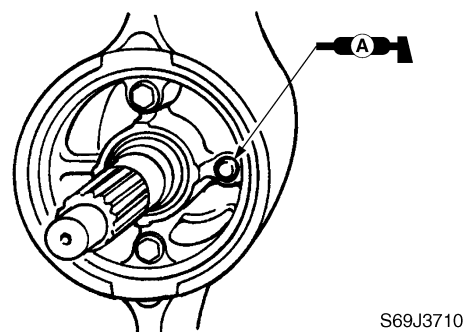
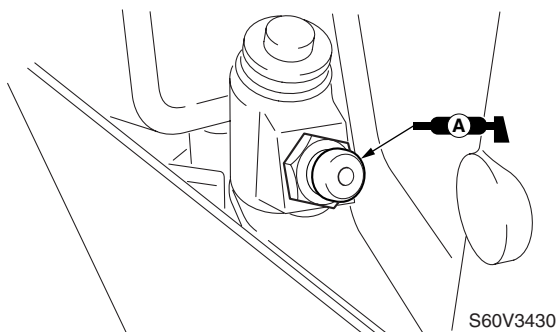
S69J3640



S69J3650

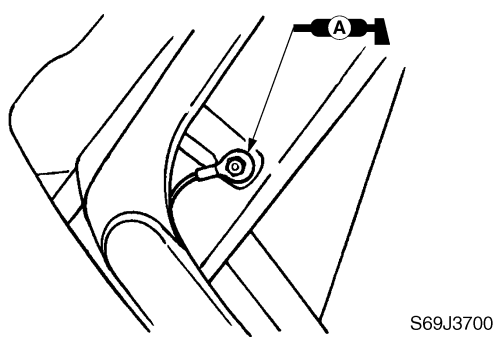
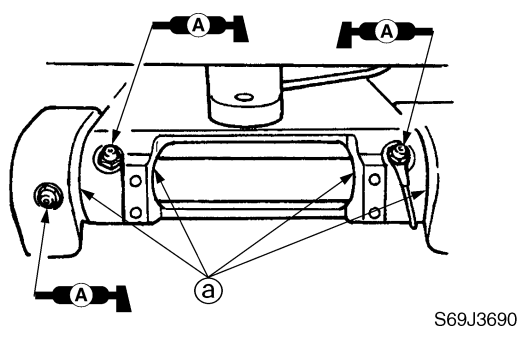
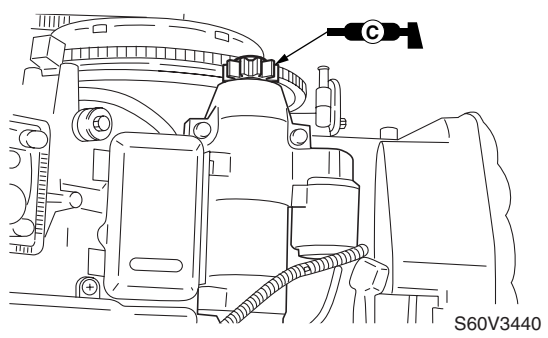
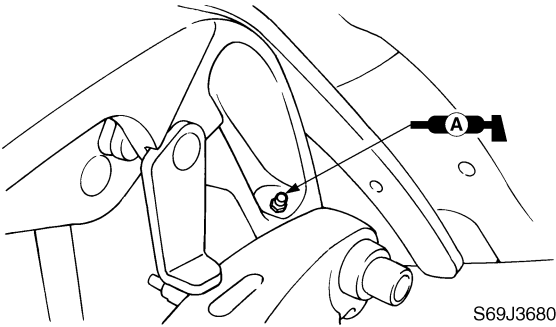
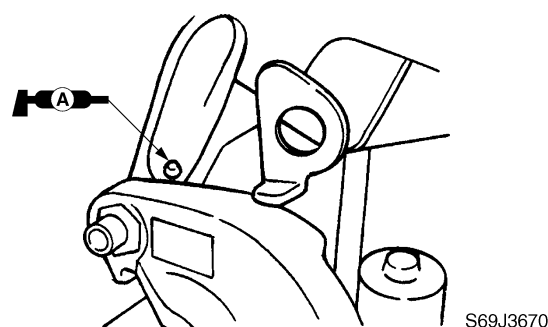


S60V3420

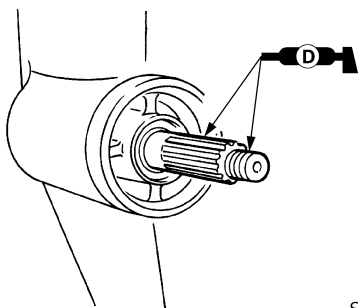


NOTE: _____
Apply grease to the grease nipple until it flows from the bushings ①.

2. Apply low temperature resistant grease to the areas shown.

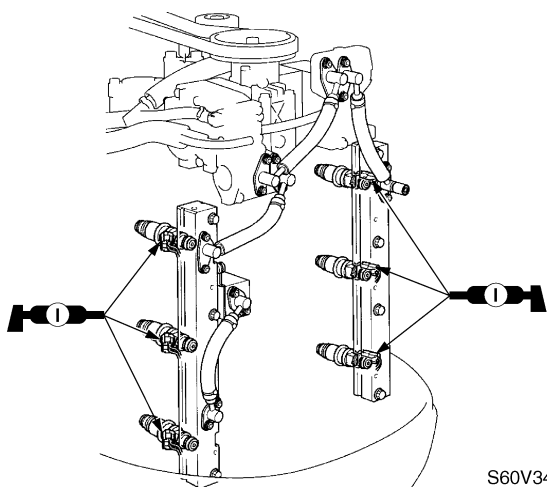


3. Apply corrosion resistant grease to the areas shown.



S69J3720

4. Apply injector grease to the areas shown.



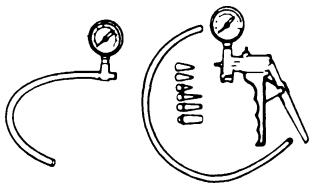
S60V3450



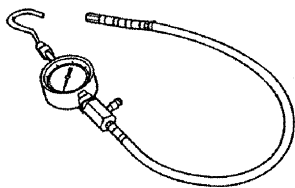
Fuel system

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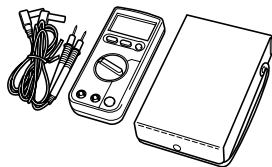
Special service tools



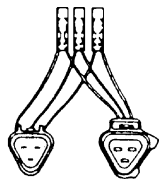
Vacuum/pressure pump gauge set
90890-06756



Fuel pressure gauge
90890-06786



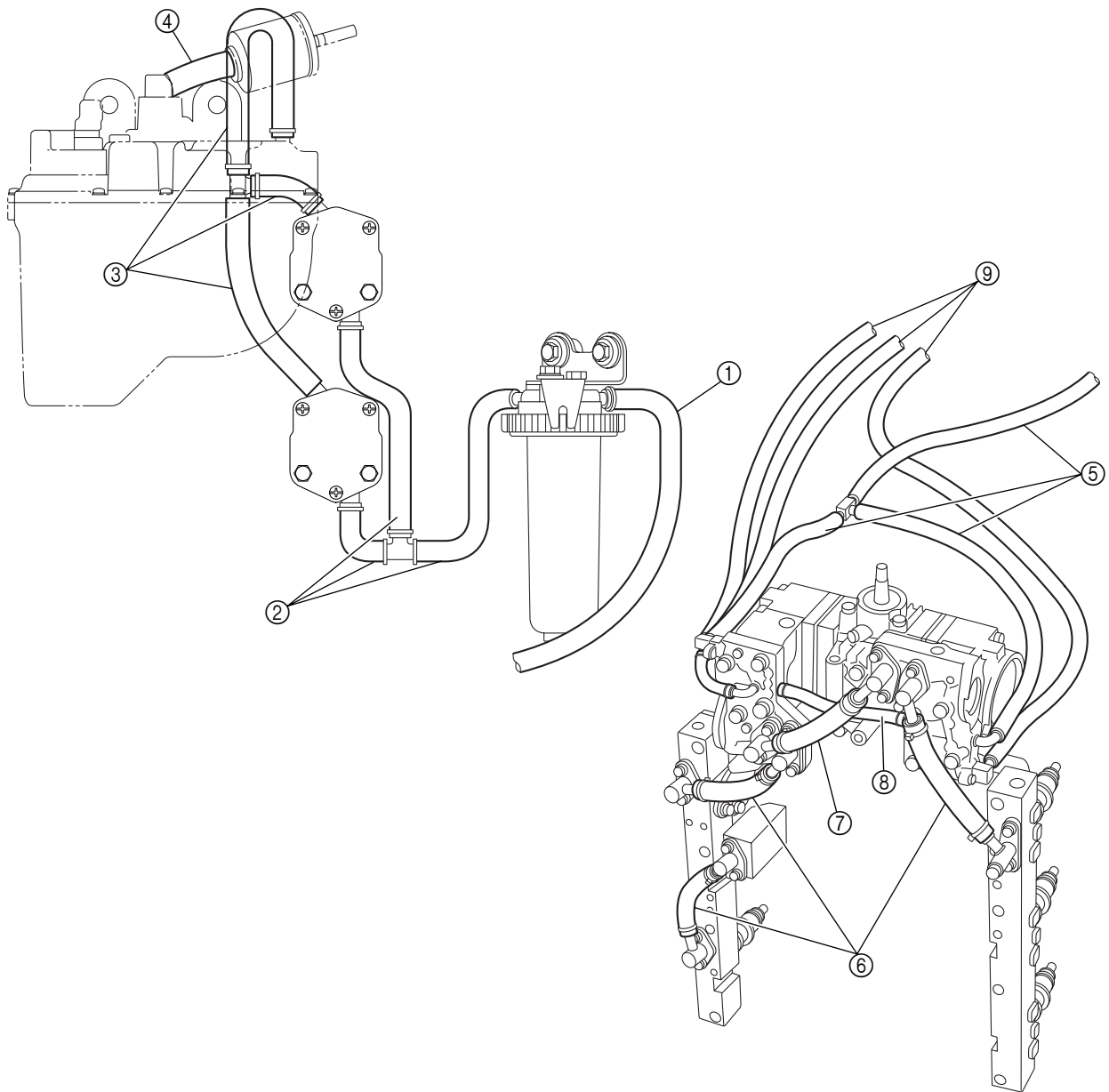
Digital circuit tester
90890-03174



Test harness (3 pins)
90890-06757

Hose routing

Fuel hoses and fuel pipes

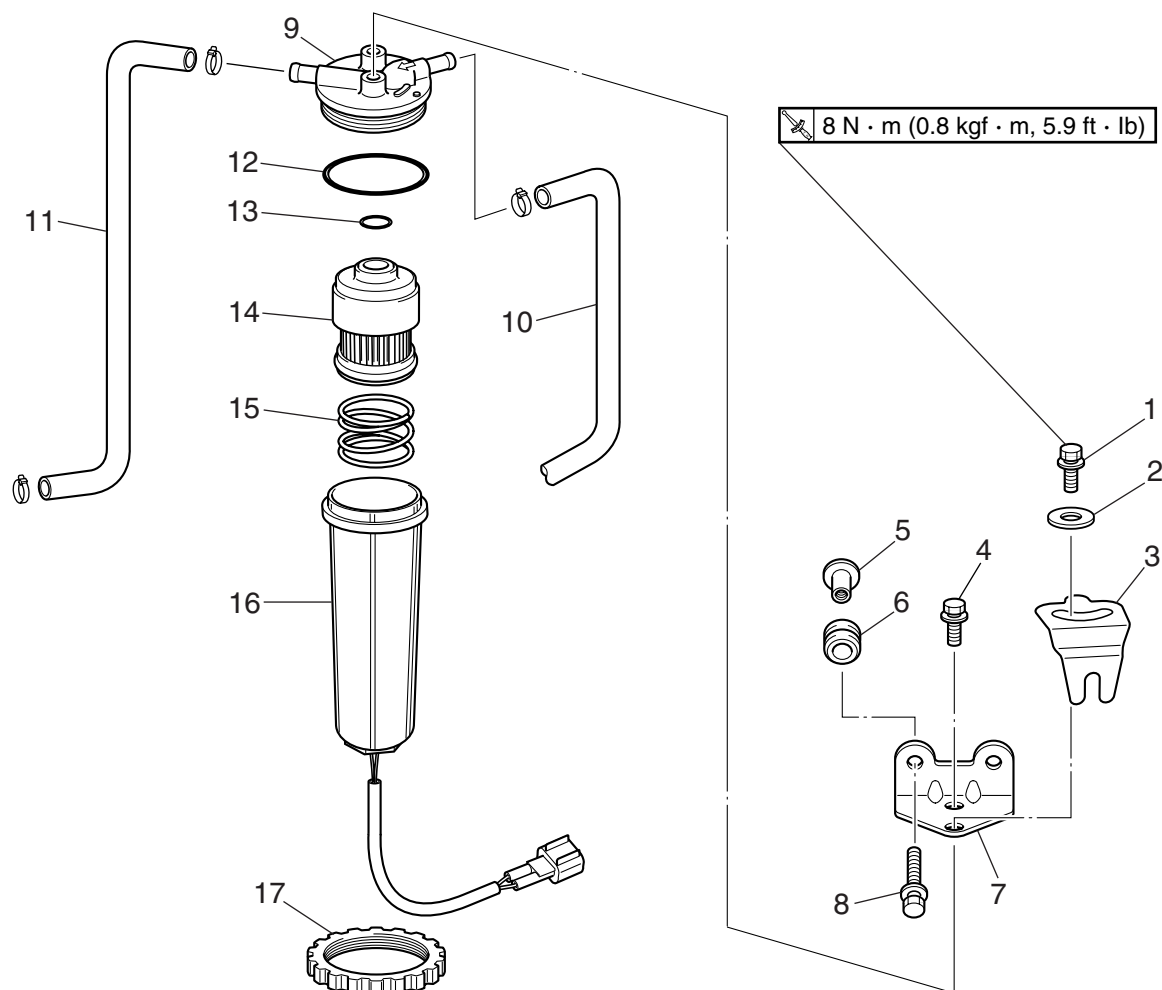


S60V4120

- ① Fuel hose (fuel tank-to-fuel filter)
- ② Fuel hose (fuel filter-to-fuel pump)
- ③ Fuel hose (fuel pump-to-vapor separator)
- ④ Medium-pressure fuel hose (vapor separator-to-fuel filter)
- ⑤ Medium-pressure fuel hose (fuel filter-to-high-pressure fuel pump)
- ⑥ High-pressure fuel pipe (high-pressure fuel pump-to-fuel rail)
- ⑦ High-pressure fuel pipe (high-pressure fuel pump-to-high-pressure fuel pump)
- ⑧ Fuel hose (high-pressure fuel pump-to-high-pressure fuel pump)
- ⑨ Fuel hose (high-pressure fuel pump-to-vapor separator)



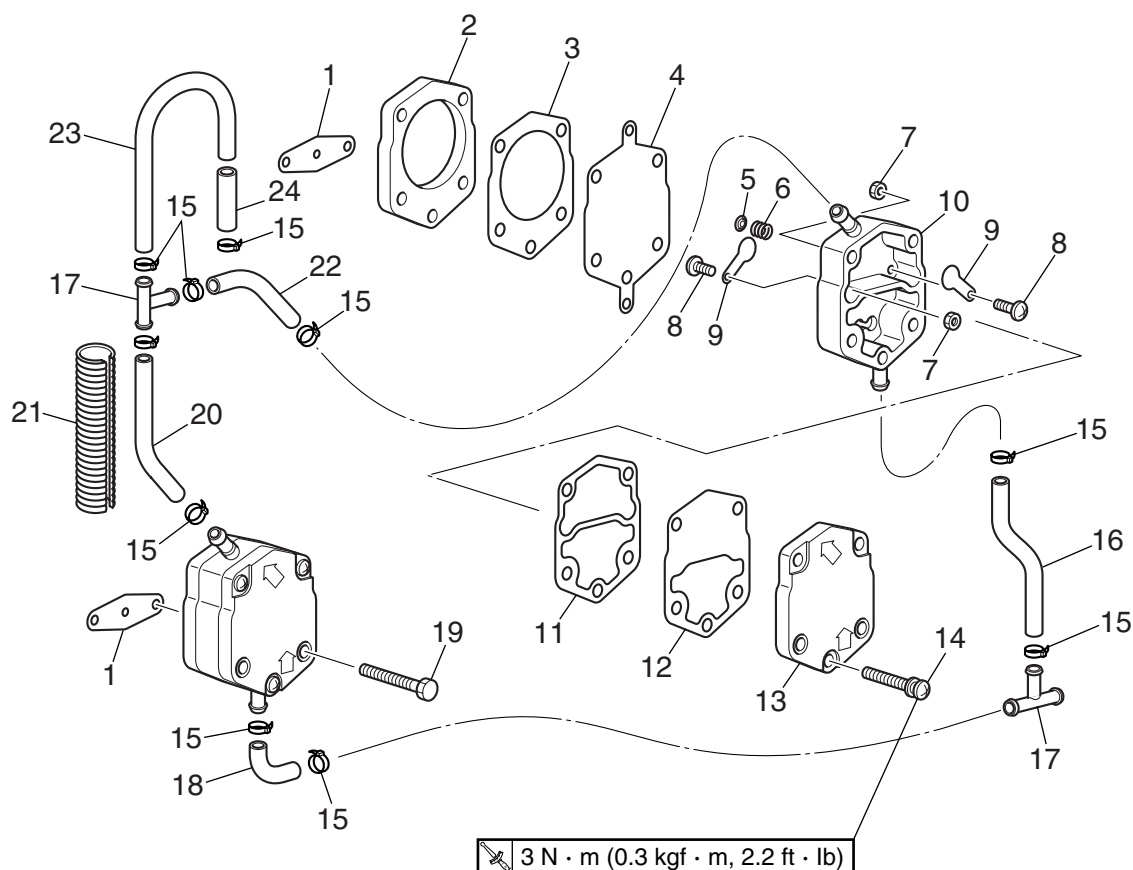
Fuel filter



S60V4090

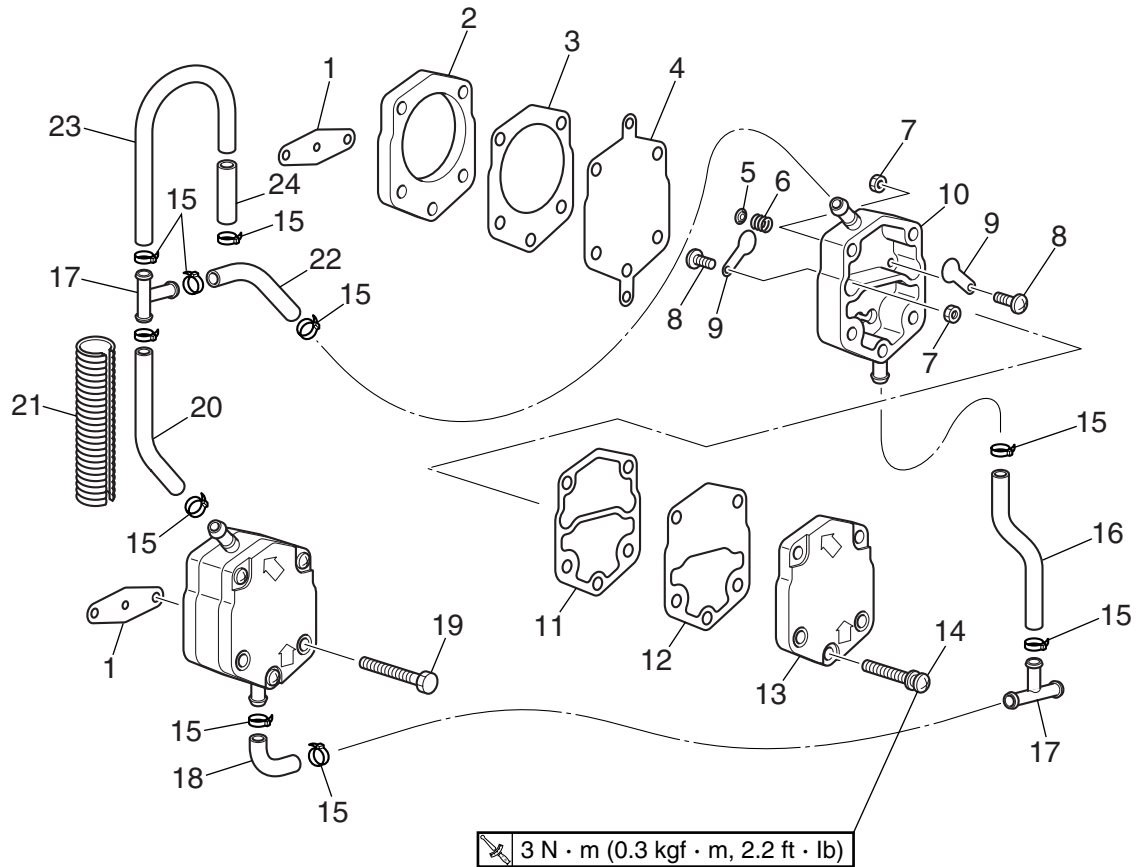
No.	Part name	Q'ty	Remarks
1	Bolt	1	M6 × 16 mm
2	Washer	1	
3	Holder	1	
4	Bolt	1	M6 × 14 mm
5	Collar	2	
6	Grommet	2	
7	Bracket	1	
8	Bolt	2	M6 × 25 mm
9	Cap	1	
10	Fuel hose	1	
11	Fuel hose	1	
12	O-ring	1	Not reusable
13	O-ring	1	Not reusable
14	Fuel filter element	1	
15	Spring	1	
16	Cup	1	
17	Nut	1	

Fuel pump



S60V4100

No.	Part name	Q'ty	Remarks
1	Gasket	2	Not reusable
2	Base	2	
3	Gasket	2	Not reusable
4	Diaphragm	2	
5	Plate	2	
6	Spring	2	
7	Nut	8	
8	Screw	8	ø3 × 6 mm
9	Valve	8	
10	Body	2	
11	Gasket	2	Not reusable
12	Diaphragm	2	
13	Cover	2	
14	Screw	6	ø5 × 35 mm
15	Plastic tie	10	Not reusable
16	Fuel hose	1	
17	Joint	2	

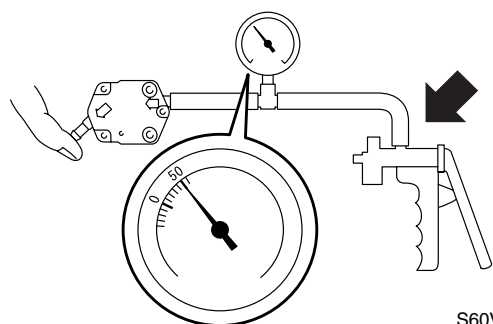


S60V4100

No.	Part name	Q'ty	Remarks
18	Fuel hose	1	M6 × 50 mm
19	Bolt	4	
20	Fuel hose	1	
21	Corrugated tube	1	
22	Fuel hose	1	
23	Fuel hose	1	
24	Hose	1	

Checking the fuel pumps

1. Place a drain pan under the fuel hose connections, and then disconnect the fuel hoses from the fuel pumps.
2. Connect the special service tool to the fuel pump inlet.
3. Cover the fuel pump outlet with a finger, and then apply the specified positive pressure. Check that there is not air leakage.



S60V4130

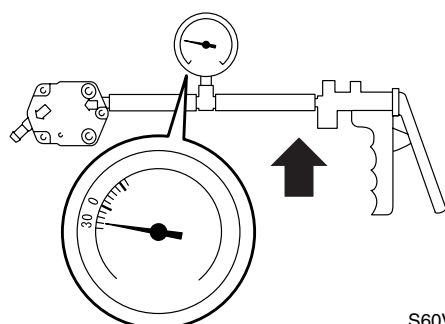


Vacuum/pressure pump gauge set:
90890-06756



Specified pressure:
50 kPa (0.5 kgf/cm², 7.3 psi)

4. Apply the specified negative pressure and check that there is no air leakage.



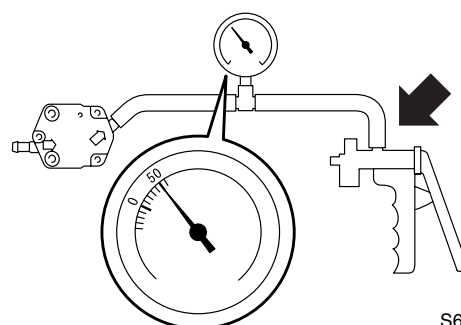
S60V4140



Specified pressure:
30 kPa (0.3 kgf/cm², 4.4 psi)

5. Connect the special service tool to the fuel pump outlet.

6. Apply the specified positive pressure and check that there is no air leakage. Disassemble the fuel pump if necessary.



S60V4150



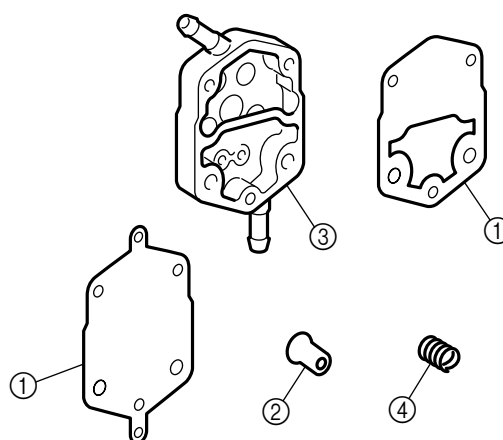
Specified pressure:
50 kPa (0.5 kgf/cm², 7.3 psi)

NOTE:

Assemble the fuel pump valve to the fuel pump body, and moisten the inside of fuel pump with gasoline to ensure a better seal.

Disassembling the fuel pumps

1. Disassemble the fuel pumps.
2. Check the diaphragms ① for tears or damage. Replace if necessary.
3. Check the valves ② for bends or damage. Replace if necessary. Also, check the fuel pump bodies ③ and springs ④ for damage. Replace if necessary.



S60V4160

4. Clean the fuel pump bodies.



Assembling the fuel pumps

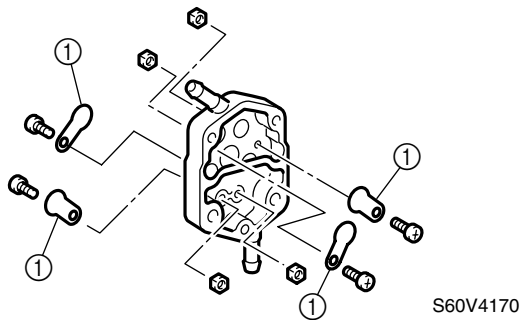
NOTE:

Clean the parts and soak the valves and the diaphragms in gasoline before assembly to obtain prompt operation of the fuel pumps when starting the engine.

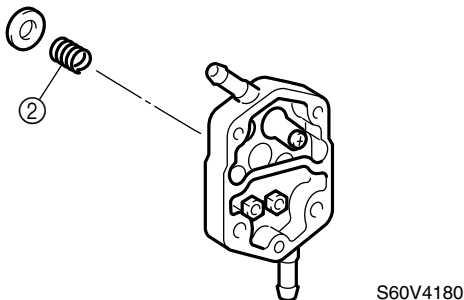
NOTE:

Make sure that the gaskets and diaphragms are kept in place through the assembly process.

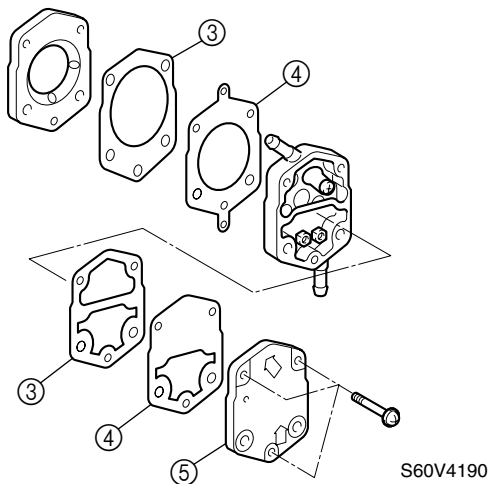
1. Install the valves ① onto the fuel pump body.



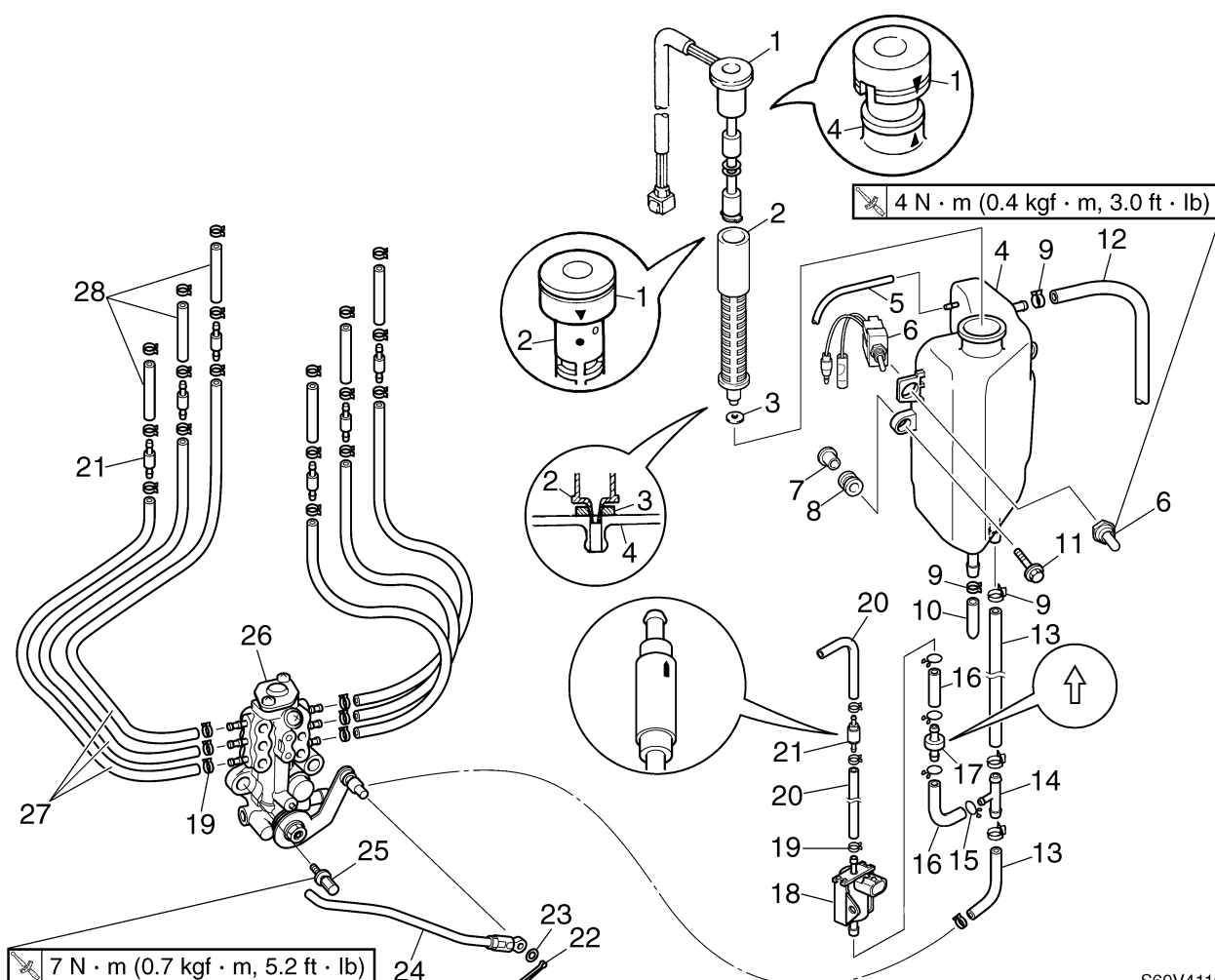
2. Install the spring ②.



3. Install new gaskets ③, the diaphragms ④, and cover ⑤.

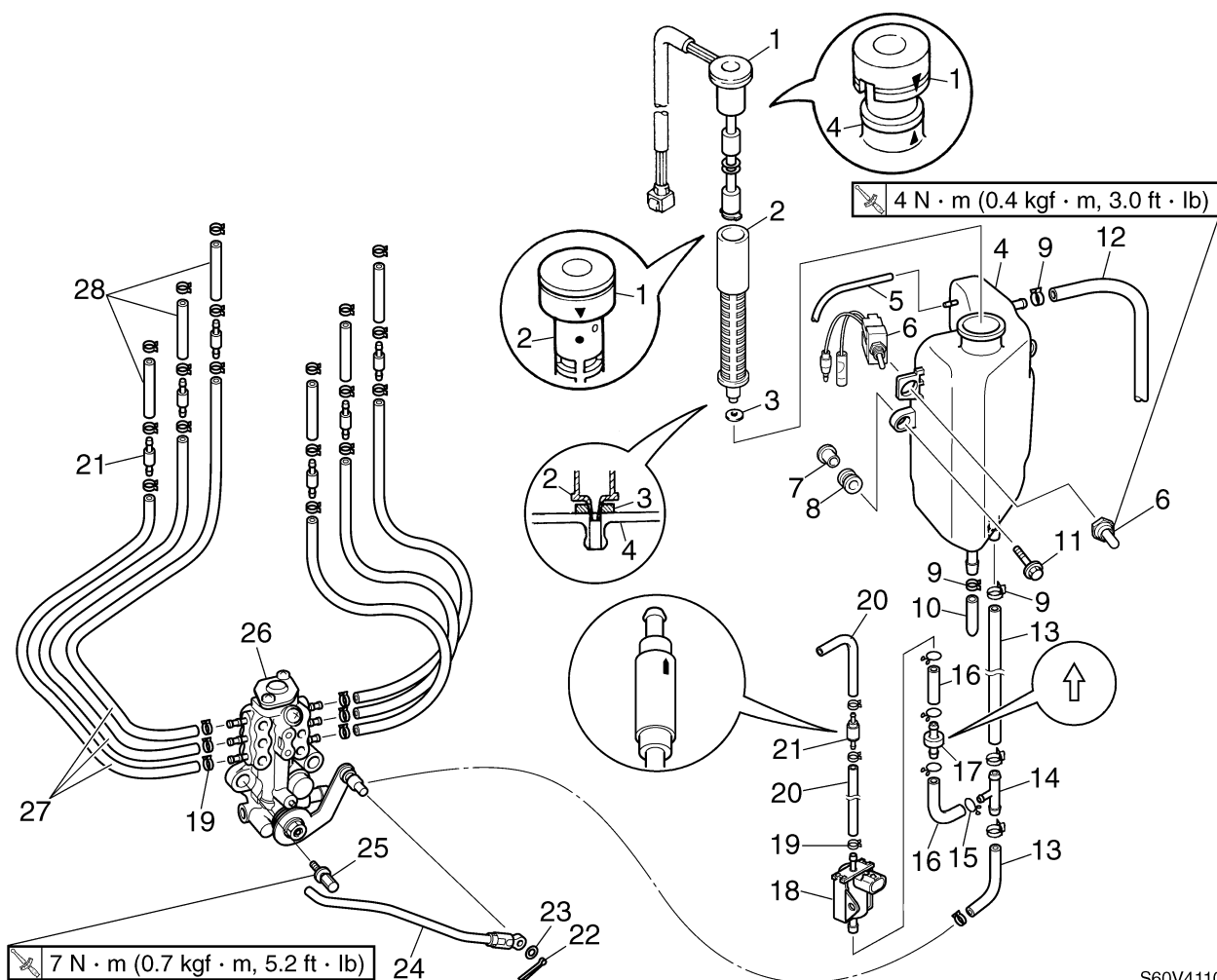


Oil injection system



S60V4110

No.	Part name	Q'ty	Remarks
1	Oil level sensor	1	Not reusable M6 × 30 mm
2	Oil filter	1	
3	Washer	1	
4	Oil tank	1	
5	Air vent hose	1	
6	Emergency switch	1	
7	Collar	3	
8	Grommet	3	
9	Plastic tie	6	
10	Cap	1	
11	Bolt	3	
12	Oil hose	1	
13	Oil hose	2	
14	Joint	1	
15	Clip	4	
16	Oil hose	2	
17	Check valve	1	

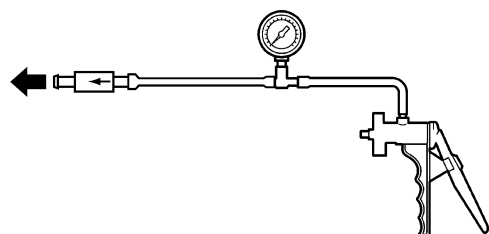
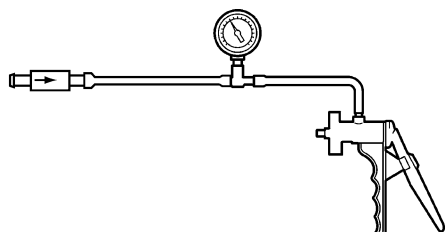


S60V4110

No.	Part name	Q'ty	Remarks
18	Electric oil pump	1	M6 × 20 mm
19	Clamp	27	
20	Oil hose	2	
21	Check valve	7	
22	Pin	1	
23	Washer	1	
24	Oil pump link rod	1	
25	Bolt	2	
26	Oil pump	1	
27	Oil hose	6	
28	Oil hose	6	

Checking the check valve

1. Connect the special service tool to the check valve.
2. Apply pressure to each check valve port.
Replace if necessary.



S60V4200



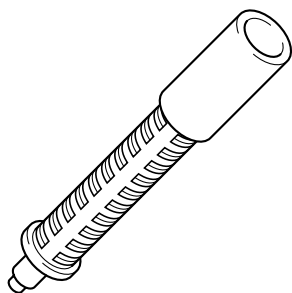
Vacuum/pressure pump gauge set:
90890-06756

NOTE:

Check that no air comes out of the opposite end of the check valve.

Checking the oil filter

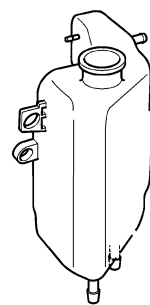
1. Check the oil filter for dirt, residue, or cracks. Clean or replace if necessary.



S60V4210

Checking the oil tank

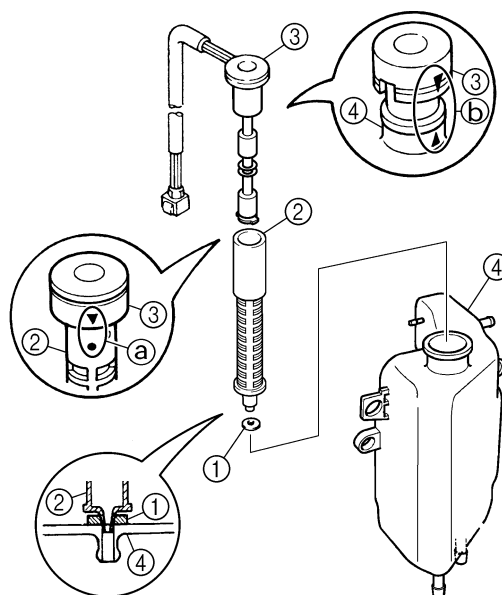
1. Check the oil tank for cracks, leaks, or damage. Replace if necessary.



S60V4220

Assembling the oil tank

1. Install the washer ①, oil filter ②, and oil level sensor ③ into the oil tank ④.



S60V4230

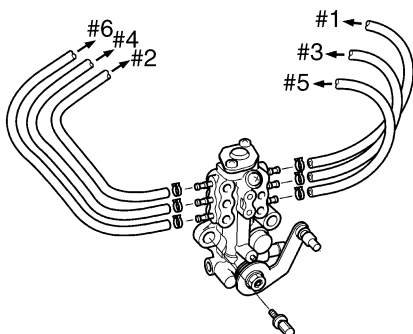
NOTE:

- Align the alignment marks (a) on the oil filter ② and oil level sensor ③.
- Align the alignment marks (b) on the oil level sensor ③ and oil tank ④.



Installing the oil pump

1. Connect the oil hoses to the oil pump.
2. Install the oil pump, and then tighten the bolts to the specified torque.



S60V4240



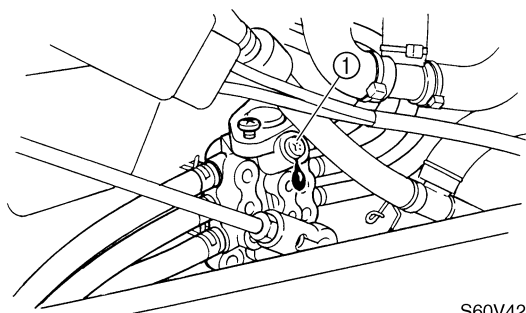
Oil pump bolt:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

Bleeding the oil injection system

CAUTION:

- Use unleaded straight gasoline only.
- Do not use gasoline mixed with oil (pre-mixed fuel).

1. Place rags around the air bleed screw ① to catch any oil that might spill.



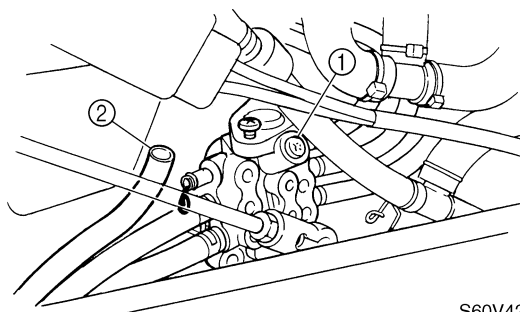
S60V4250

2. Fill the oil tank with engine oil.



Recommended engine oil:
YAMALUBE 2-stroke outboard
motor oil

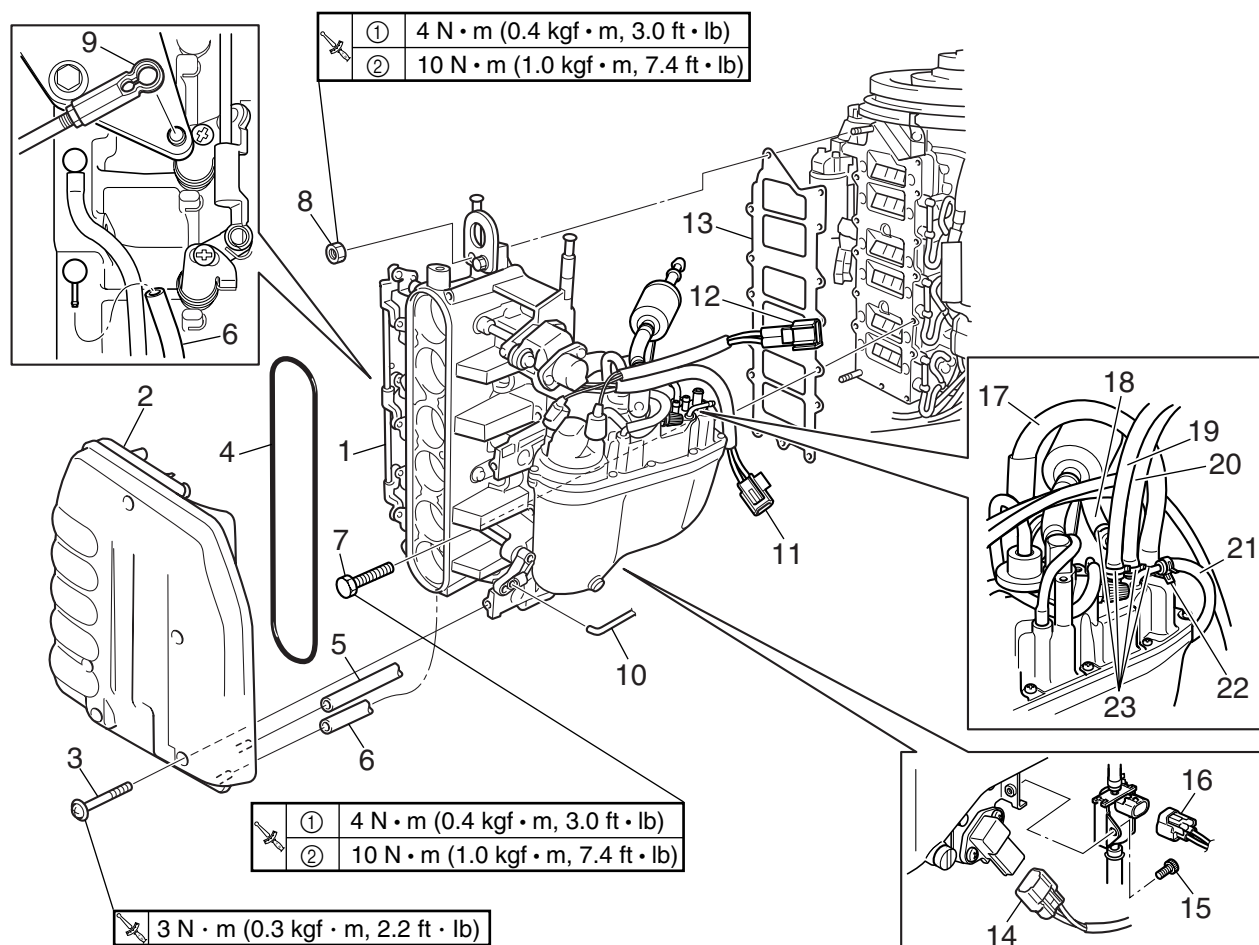
3. Disconnect the oil pump link rod joint from the oil pump lever.
4. Start the engine and let it idle.
5. Loosen the air bleed screw ① and make sure that both the oil and air bubbles flow out.
6. When there are no air bubbles left, tighten the air bleed screw.
7. Disconnect an oil pump feed hose ② from the oil pump.



S60V4260

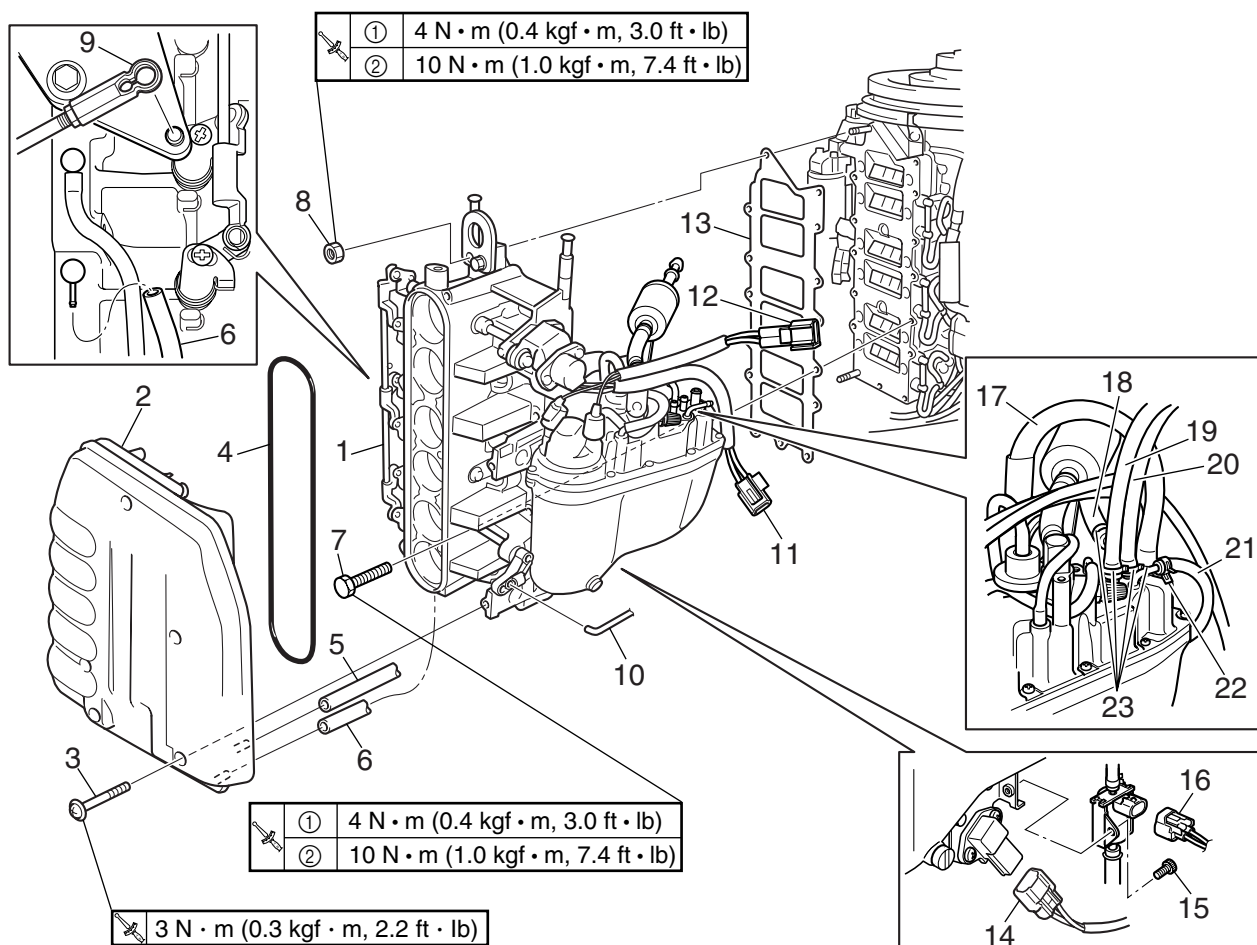
8. Check that oil flows from the oil pump.
9. Connect the oil pump feed hose.
10. Connect the oil pump link rod joint to the oil pump lever.

Throttle body assembly and vapor separator



S60V4010

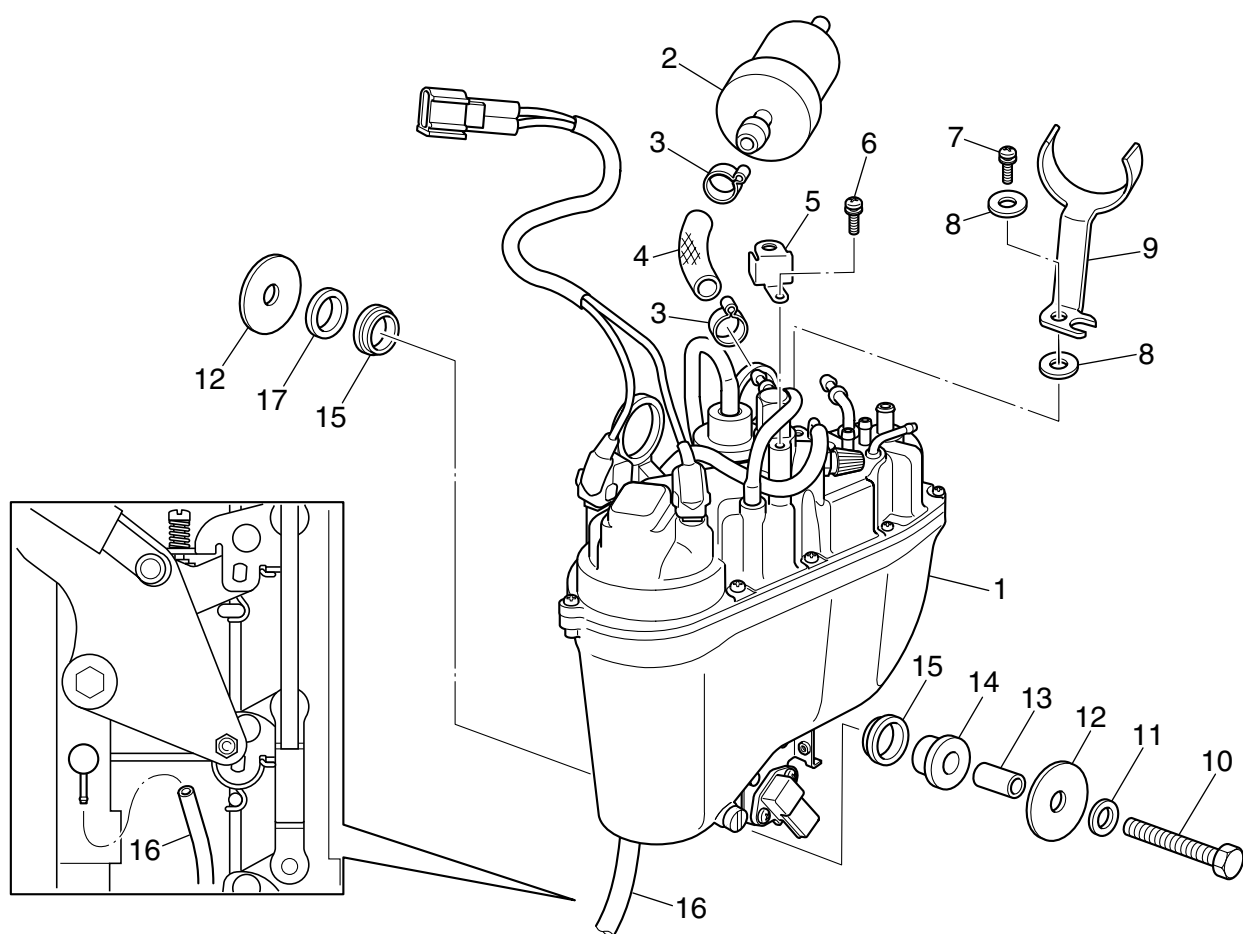
No.	Part name	Q'ty	Remarks
1	Throttle body assembly	1	
2	Intake silencer	1	
3	Screw	6	ø6 × 45 mm
4	Seal	1	
5	Hose	1	
6	Hose	1	
7	Bolt	12	M6 × 60 mm
8	Nut	2	
9	Throttle link rod	1	
10	Oil pump link rod	1	
11	Throttle position sensor coupler	1	
12	Electric fuel pump coupler	1	
13	Gasket	1	Not reusable
14	Atmospheric pressure sensor coupler	1	
15	Bolt	1	M6 × 12 mm
16	Electric oil pump coupler	1	
17	Fuel inlet hose	1	



S60V4010

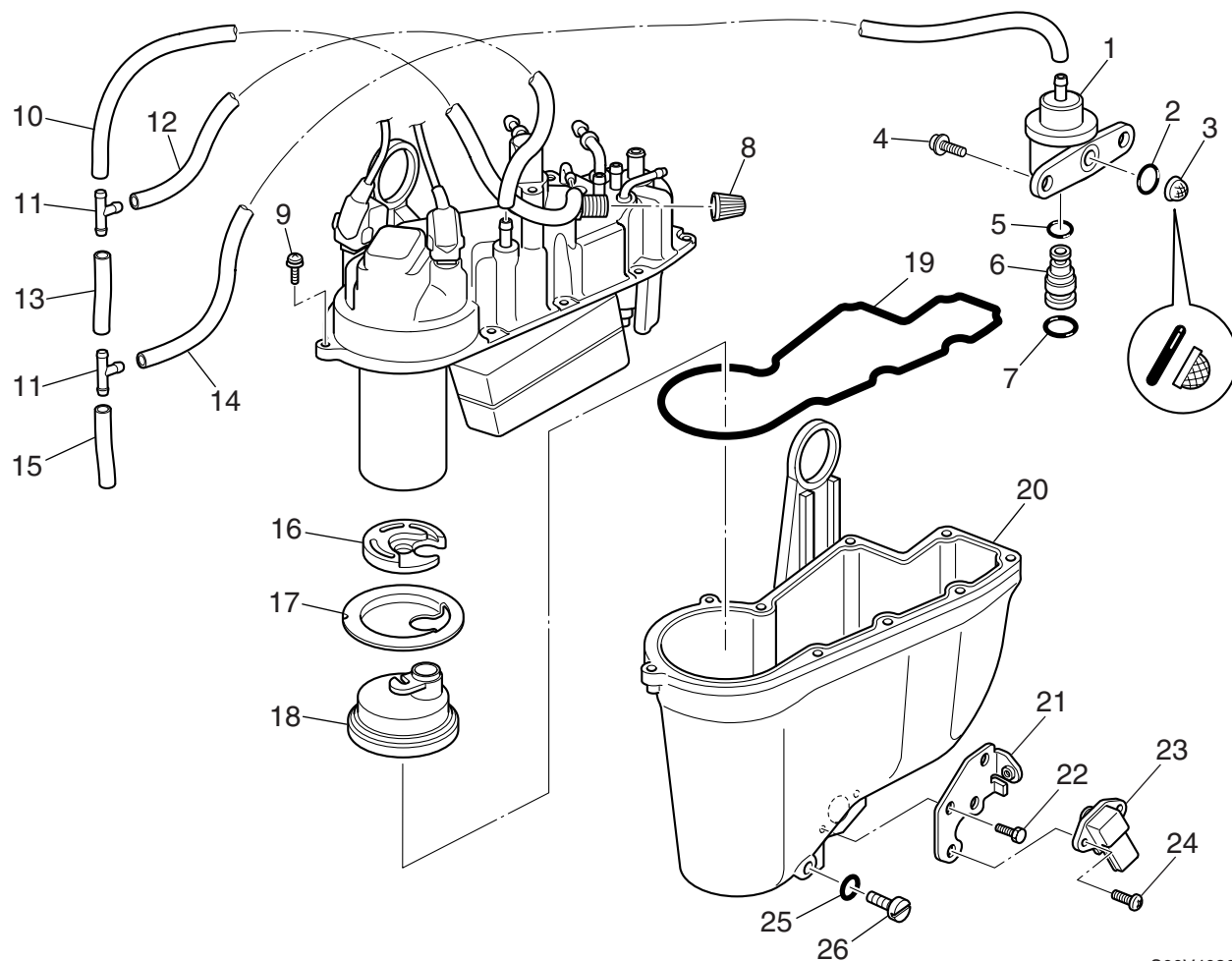
No.	Part name	Q'ty	Remarks
18	Fuel hose	1	Not reusable
19	Fuel hose	1	
20	Fuel hose	1	
21	Oil hose	1	
22	Clamp	1	
23	Plastic tie	4	

Throttle body assembly and vapor separator



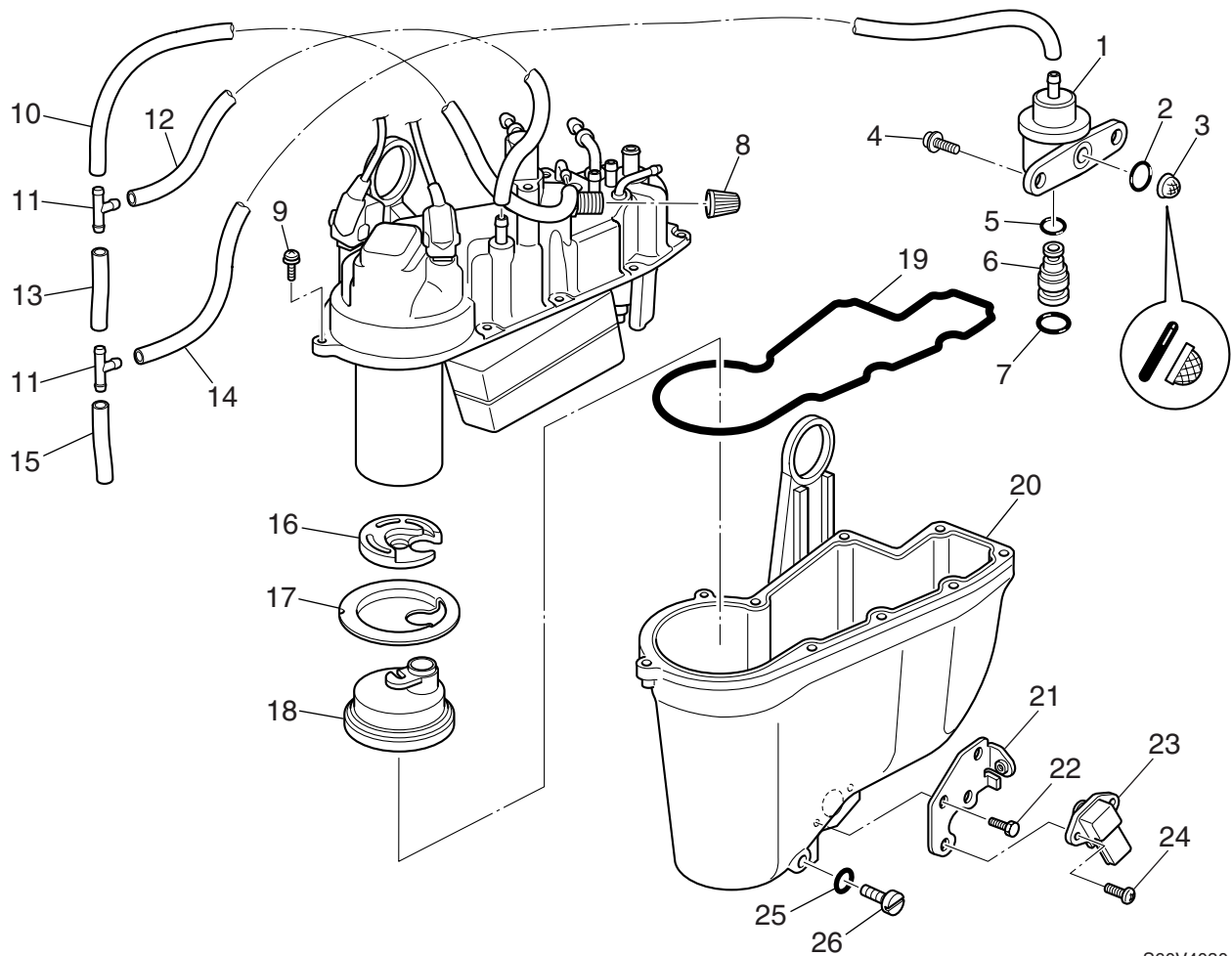
S60V4020

No.	Part name	Q'ty	Remarks
1	Vapor separator	1	
2	Fuel filter	1	
3	Clamp	2	Not reusable
4	Fuel hose	1	
5	Holder	1	
6	Screw	1	ø4 × 10 mm
7	Screw	1	ø4 × 15 mm
8	Washer	2	
9	Holder	1	
10	Bolt	3	M6 × 35 mm
11	Washer	3	
12	Washer	6	
13	Collar	3	
14	Grommet	3	
15	Collar	6	
16	Hose	1	
17	Grommet	3	



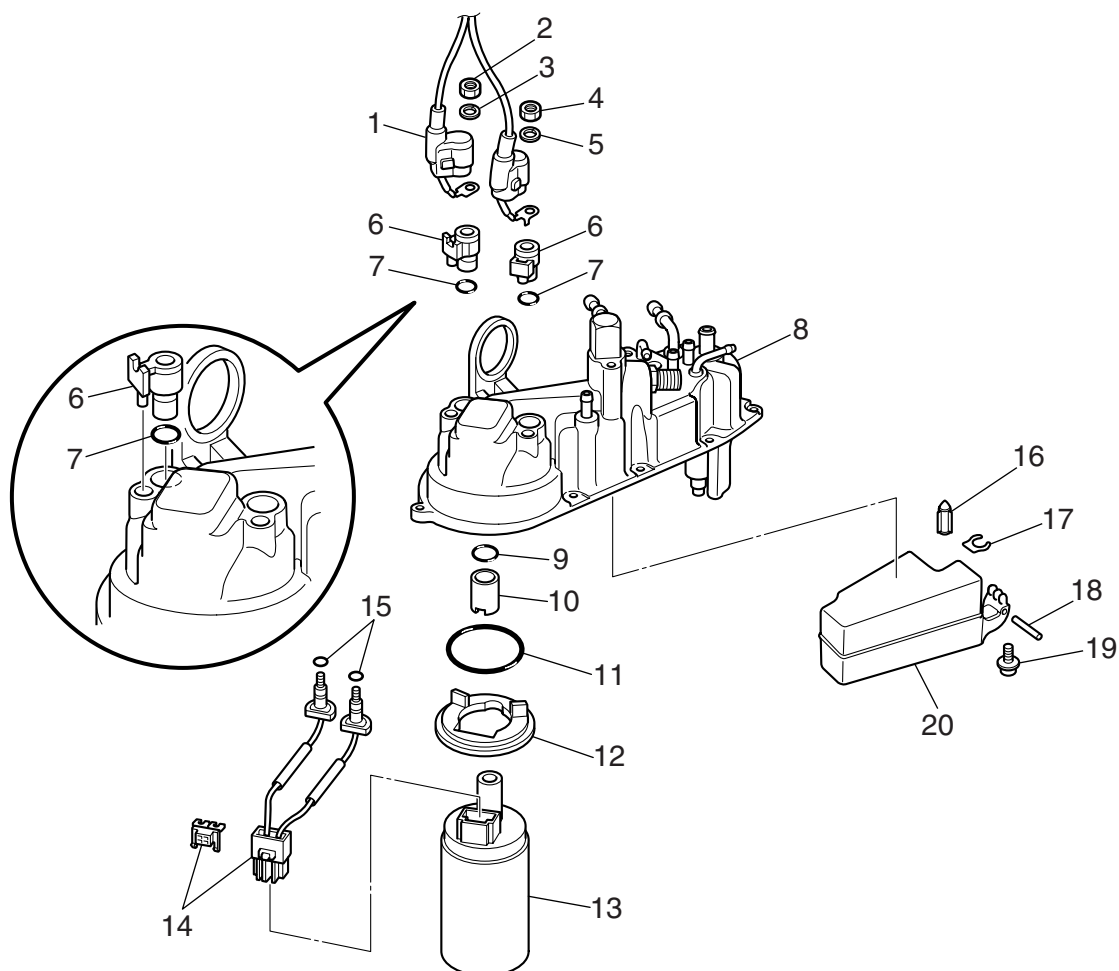
S60V4030

No.	Part name	Q'ty	Remarks
1	Pressure regulator	1	
2	O-ring	1	Not reusable
3	Filter	1	
4	Screw	2	M6 × 14 mm
5	O-ring	1	Not reusable
6	Joint	1	
7	O-ring	1	Not reusable
8	Cap	1	
9	Screw	9	ø4 × 16 mm
10	Hose	1	
11	Joint	2	
12	Hose	1	
13	Hose	1	
14	Hose	1	
15	Hose	1	
16	Damper	1	
17	Holder	1	



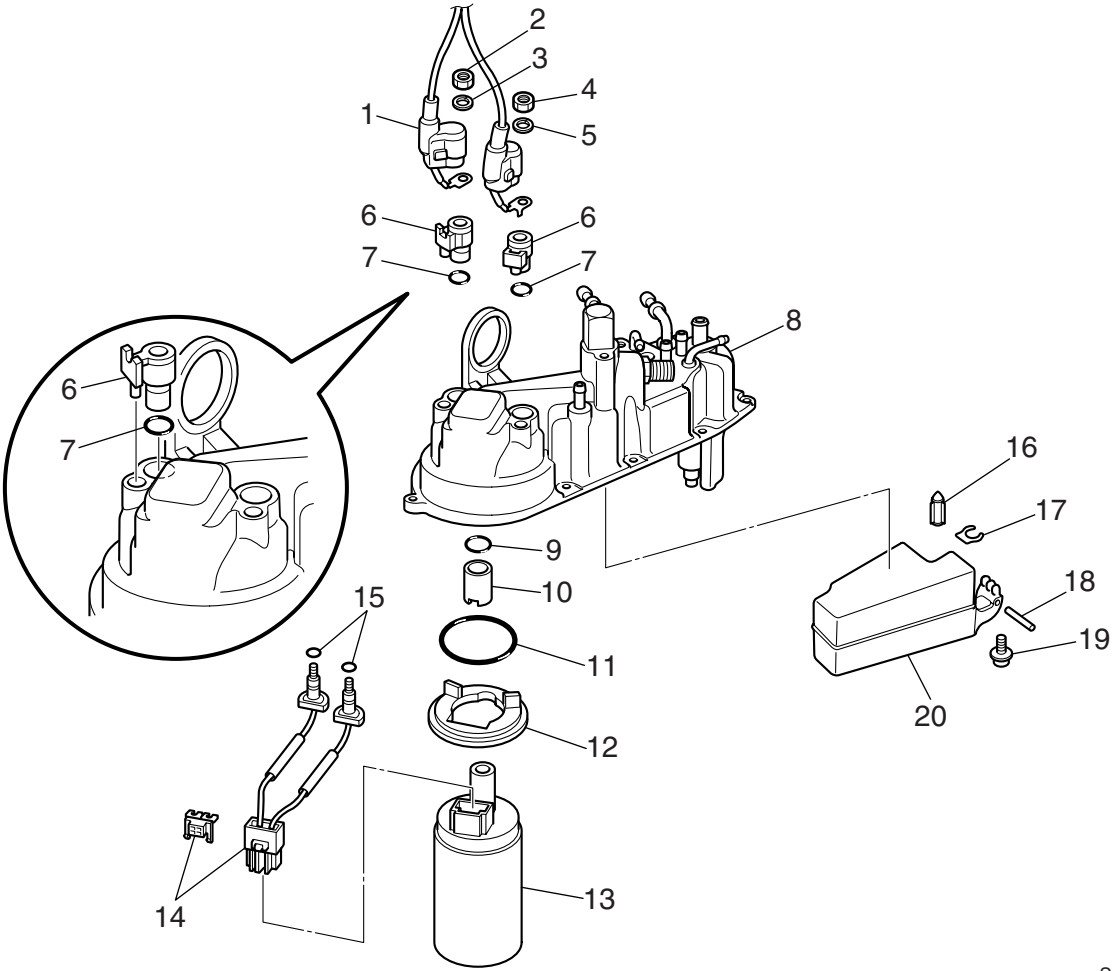
S60V4030

No.	Part name	Q'ty	Remarks
18	Filter	1	
19	Gasket	1	Not reusable
20	Float chamber	1	
21	Bracket	1	
22	Bolt	2	M6 × 20 mm
23	Atmospheric pressure sensor	1	
24	Screw	2	ø6 × 20 mm
25	O-ring	1	Not reusable
26	Drain screw	1	



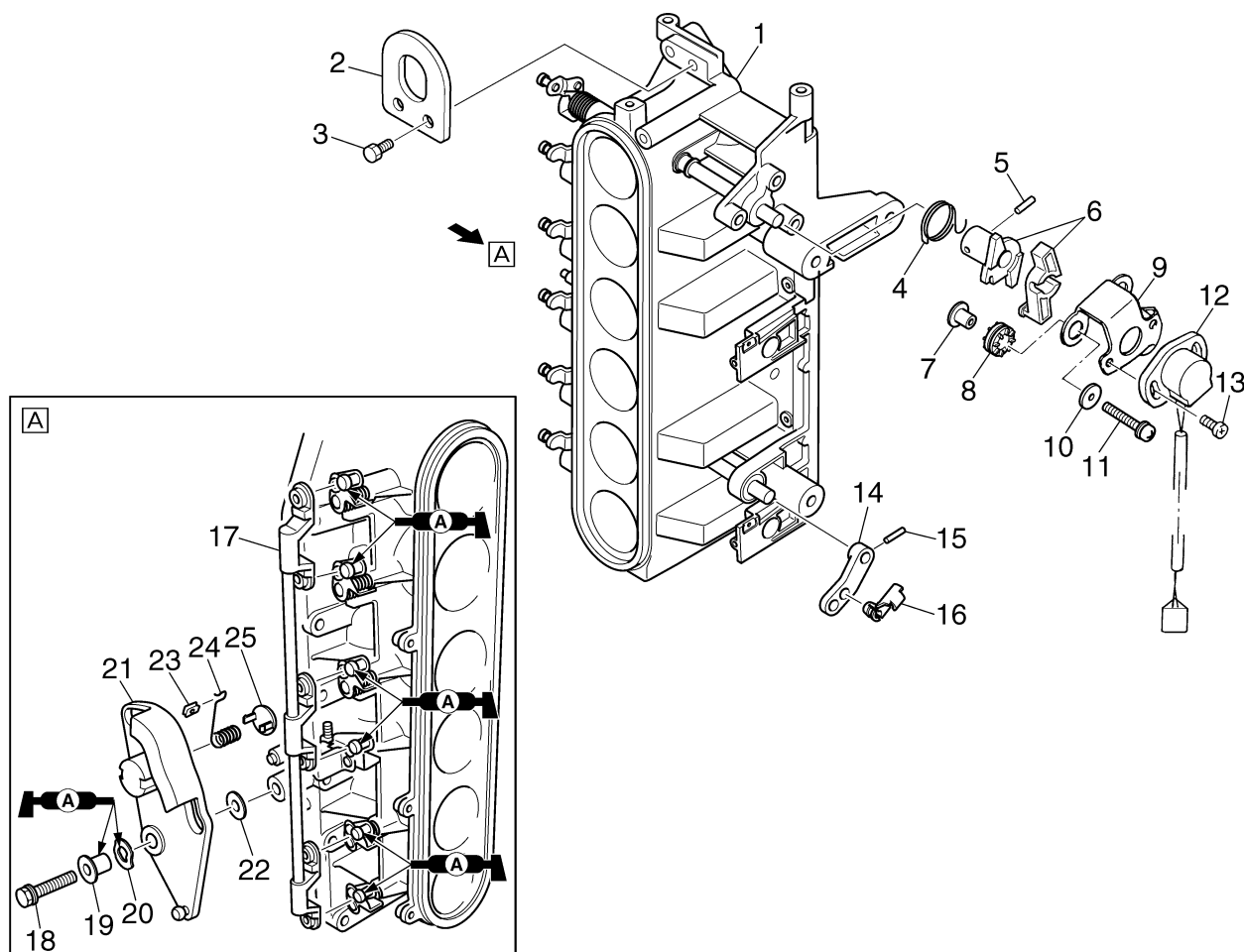
S60V4040

No.	Part name	Q'ty	Remarks
1	Electric fuel pump lead	1	
2	Nut	1	ø4 mm
3	Washer	1	
4	Nut	1	ø5 mm
5	Washer	1	
6	Insulator	2	
7	O-ring	2	Not reusable
8	Cover	1	
9	O-ring	1	Not reusable
10	Collar	1	
11	O-ring	1	Not reusable
12	Plate	1	
13	Electric fuel pump	1	
14	Terminal	1	
15	O-ring	2	Not reusable
16	Needle valve	1	
17	Clip	1	



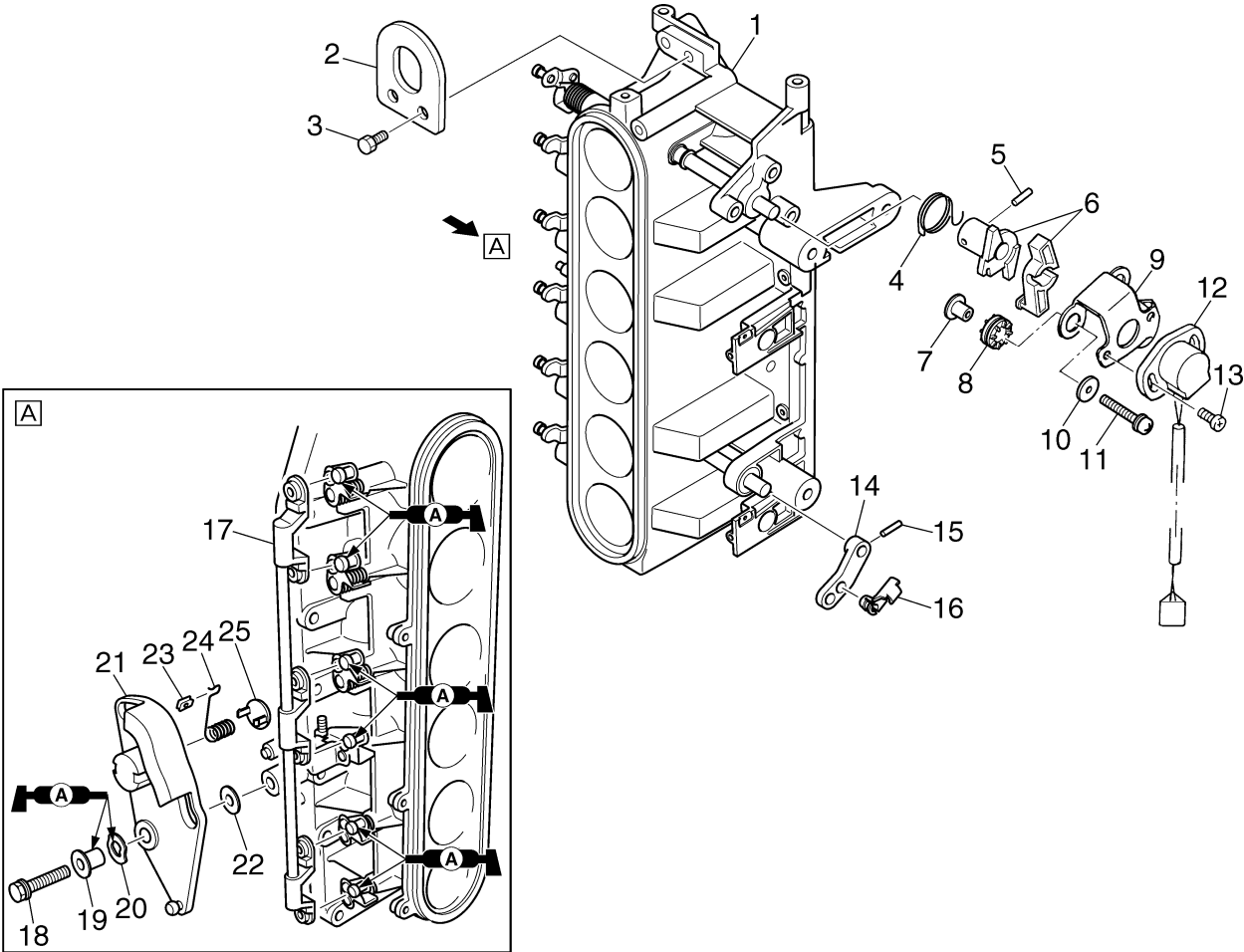
S60V4040

No.	Part name	Q'ty	Remarks
18	Pin	1	ø4 × 7 mm
19	Screw	1	
20	Float	1	



S60V4050

No.	Part name	Q'ty	Remarks
1	Throttle body	1	
2	Engine hanger	1	
3	Bolt	1	M6 × 20 mm
4	Spring	1	
5	Pin	1	
6	Lever	1	
7	Collar	2	
8	Grommet	2	
9	Bracket	1	
10	Washer	2	
11	Screw	2	ø5 × 30 mm
12	Throttle position sensor	1	
13	Screw	2	ø5 × 12 mm
14	Lever	1	
15	Pin	1	
16	Joint	1	
17	Link rod	1	



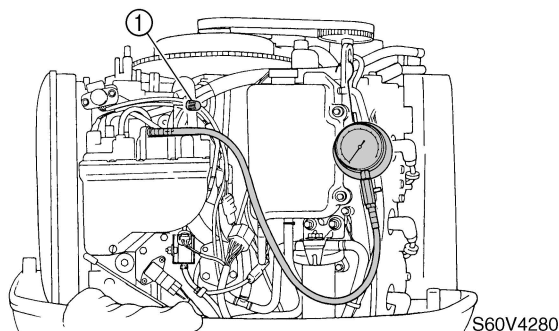
S60V4050

No.	Part name	Q'ty	Remarks
18	Bolt	1	M6 × 30 mm
19	Collar	1	
20	Wave washer	1	
21	Throttle cam	1	
22	Washer	1	
23	Stopper	1	
24	Spring	1	
25	Cap	1	



Measuring the fuel pressure (medium-pressure fuel line)

1. Remove the flywheel magnet cover.
2. Remove the cap ①.
3. Connect the fuel pressure gauge to the pressure check valve.



Fuel pressure gauge: 90890-06786

⚠ WARNING

- When connecting the fuel pressure gauge, first cover the connection between the gauge and the vapor separator pressure check valve with a clean, dry rag to prevent fuel from leaking out.
- Gently screw in the gauge until it is firmly connected.

4. Turn the engine start switch to ON, and then measure the fuel pressure within 5 seconds.

NOTE:

The fuel pressure decreases 5 seconds after the engine start switch is turned to ON.



Fuel pressure:
350 kPa (3.5 kgf/cm², 50.8 psi)

5. Measure the fuel pressure 5 seconds after turning the engine start switch to ON.



Fuel pressure:
300 kPa (3.0 kgf/cm², 43.5 psi)

6. Start the engine, warm it up for 5 minutes, and then measure the fuel pressure. If below specification, check the medium-pressure fuel line and the vapor separator.



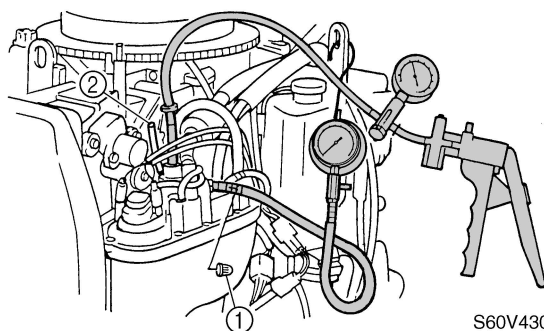
Fuel pressure:
350 kPa (3.5 kgf/cm², 50.8 psi)

⚠ WARNING

- Before measuring the fuel pressure, make sure that the breather nut is tightened securely.
- Do not loosen the breather nut while measuring the fuel pressure. Loosening the breather nut can cause fuel to spray out creating a fire hazard.
- After measuring the fuel pressure, cover the end of the hose with a clean, dry rag, point the hose downward, and then loosen the breather nut to drain the remaining fuel from the hose and gauge.
- When storing the fuel pressure gauge, make sure that the breather nut is tightened securely.

Checking the pressure regulator

1. Remove the flywheel magnet cover.
2. Remove the cap ①.
3. Connect the fuel pressure gauge to the pressure check valve.
4. Disconnect the pressure regulator hose ②, and then connect the special service tools to the pressure regulator.



S60V4300



Fuel pressure gauge: 90890-06786
Vacuum/pressure pump gauge set:
90890-06756

⚠ WARNING

- When connecting the fuel pressure gauge, first cover the connection between the gauge and the vapor separator pressure check valve with a clean, dry rag to prevent fuel from leaking out.
- Gently screw in the gauge until it is firmly connected.

5. Start the engine and let it idle.
6. Check that the fuel pressure reduces when vacuum pressure is applied to the pressure regulator. If the fuel pressure does not reduce, replace the pressure regulator.

⚠ WARNING

- Before measuring the fuel pressure, make sure that the breather nut is tightened securely.
- Do not loosen the breather nut while measuring the fuel pressure. Loosening the breather nut can cause fuel to spray out creating a fire hazard.
- After measuring the fuel pressure, cover the end of the hose with a clean, dry rag, point the hose downward, and then loosen the breather nut to drain the remaining fuel from the hose and gauge.
- When storing the fuel pressure gauge, make sure that the breather nut is tightened securely.

NOTE:

When the vacuum pressure reaches the specified level, the fuel pressure reduces.

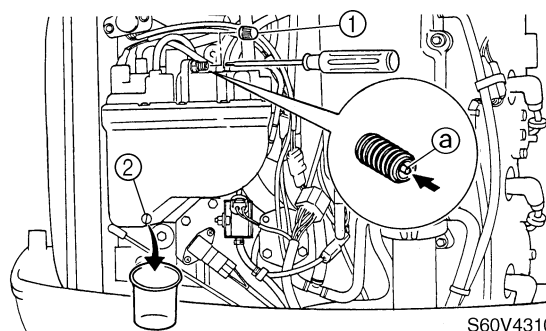
Reducing the fuel pressure (medium-pressure fuel line)

1. Remove the flywheel magnet cover.
2. Remove the cap ①.
3. Cover the pressure check valve ② of the vapor separator with a rag, and then press in the pressure check valve ② using a thin screwdriver to release the fuel pressure.

⚠ WARNING

Always reduce the fuel pressure in the medium-pressure fuel line before servicing the line or the vapor separator. If the fuel pressure is not released, pressurized fuel may spray out.

4. Place a container under the vapor separator.
5. Press in the pressure check valve using a thin screwdriver, and then remove the drain screw ② to drain the fuel from the vapor separator.



S60V4310

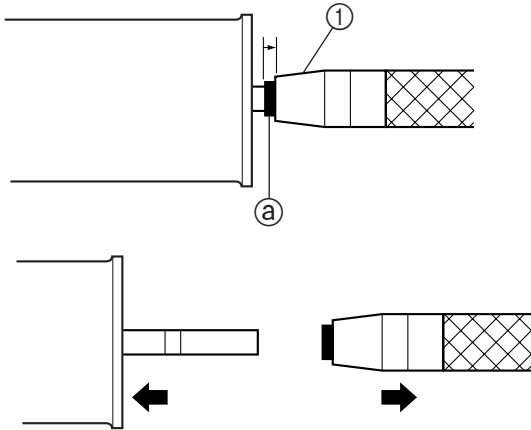
⚠ WARNING

Reduce the fuel pressure before removing the vapor separator drain screw, or pressurized fuel will spray out and may result in serious injury.



Disconnecting the medium-pressure fuel hose joint

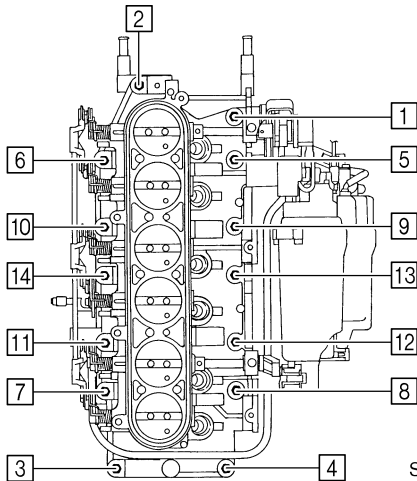
1. Push the collar ② into the hose joint ① with a flat head screwdriver, and then slide the fuel filter out from the hose joint.



S60V4320

Removing the throttle body assembly

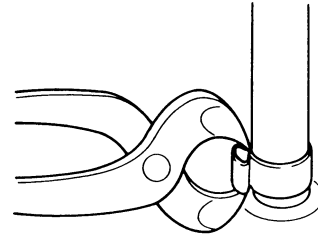
1. Remove the throttle body assembly bolts and nuts in the sequence shown.



S60V4330

Removing the medium-pressure fuel hose clamps

1. Remove the medium-pressure fuel hose clamps by cutting the crimped section of the clamp.



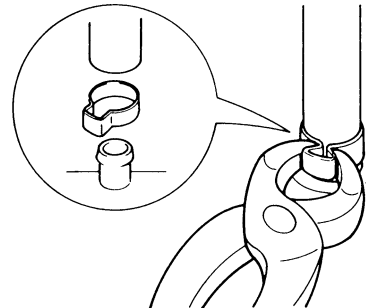
S69J4030

CAUTION:

If the medium-pressure fuel hose clamps are removed without cutting the crimp first, the fuel hose could be damaged.

Installing the medium-pressure fuel hose clamps

1. Crimp the medium-pressure fuel hose clamps properly to securely fasten them.



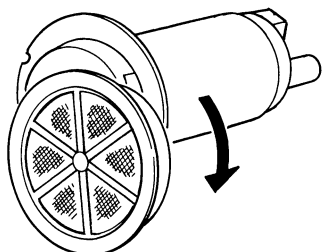
S69J4040

⚠ WARNING

Do not reuse the fuel hose clamps, always replace them with new ones.

Removing the electric fuel pump filter

1. Remove the electric fuel pump filter, damper holder, and rubber damper from the electric fuel pump.

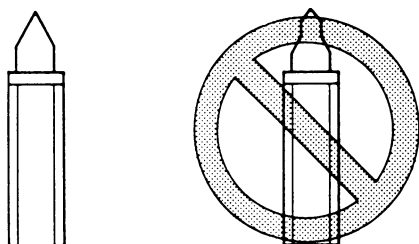


S60V4335

NOTE: _____
To remove the filter, turn it clockwise.

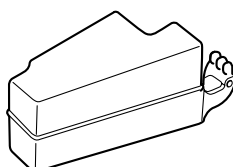
Checking the vapor separator

1. Check the needle valve for bends or wear. Replace if necessary.



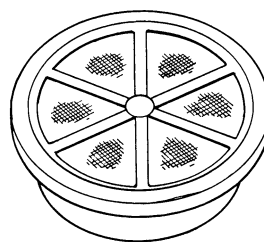
S69J4080

2. Check the float for deterioration. Replace if necessary.



S60V4340

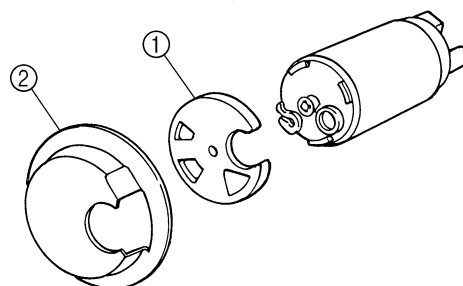
3. Check the filter for dirt or residue. Clean if necessary.



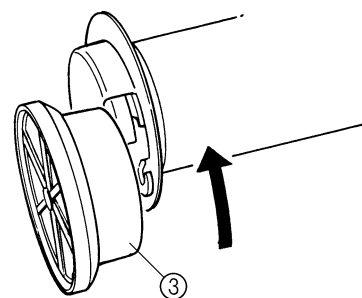
S60V4350

Installing the electric fuel pump filter

1. Install the rubber damper ①, damper holder ②, and electric fuel pump filter ③ onto the electric fuel pump.



S60V4360



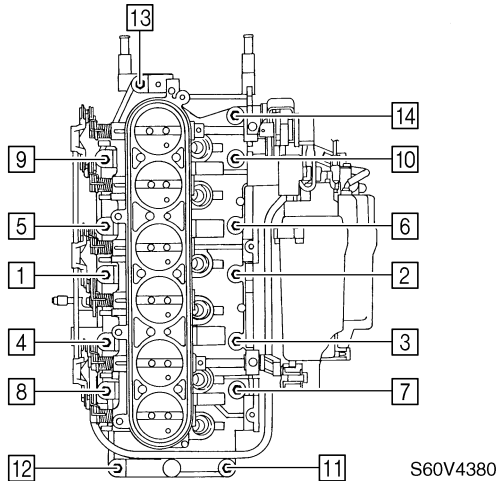
S60V4370

- NOTE:** _____
- Make sure that the damper holder is correctly installed on the rubber damper.
 - To install the filter, firmly push it onto the electric fuel pump, and then turn it counter-clockwise until it clicks.



Installing the throttle body assembly

1. Install the new gasket and throttle body assembly, and then tighten the bolts and nuts to the specified torque in two stages and in the sequence shown.



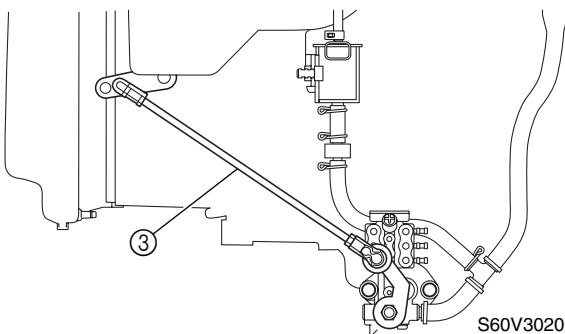
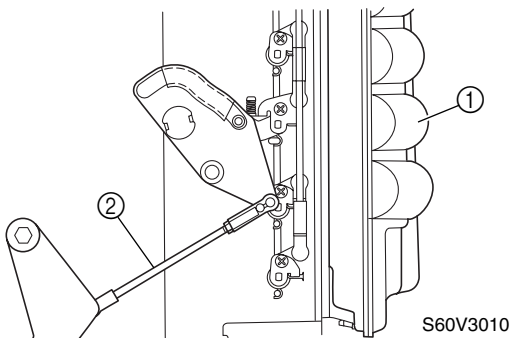
Throttle body bolt and nut:

1st: 4 N·m (0.4 kgf·m, 3.0 ft·lb)

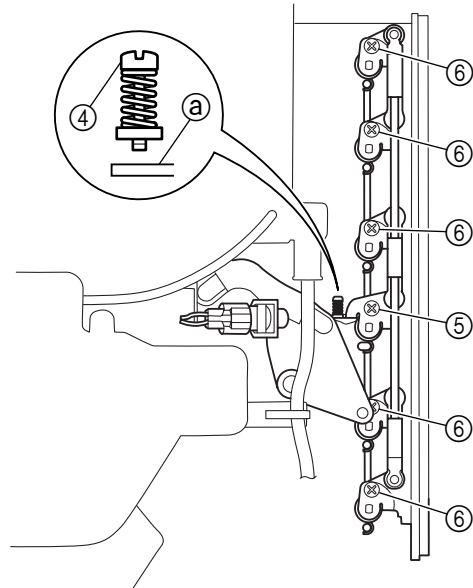
2nd: 10 N·m (1.0 kgf·m, 7.4 ft·lb)

Synchronizing the throttle valves

1. Remove the intake silencer ①.
2. Disconnect the throttle link rod ② and the oil pump link rod ③.



3. Loosen the throttle stop screw ④ until it no longer contacts the stopper ⑤.
4. Loosen throttle adjusting screw #4 ⑤ by turning it clockwise.
5. Check that all the throttle valves are fully closed.

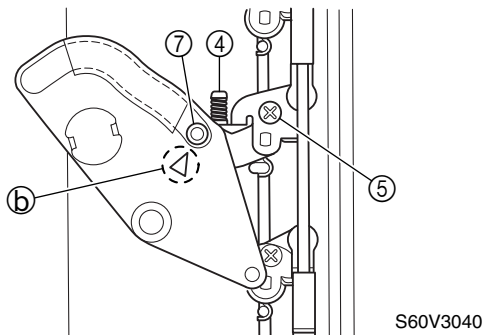


NOTE:

If all the throttle valves are not fully closed, loosen throttle adjusting screws #1, #2, #3, #5, and #6 ⑥ by turning them counterclockwise, and then tighten them.

6. Connect the oil pump link rod.
7. Align the center of the throttle cam roller ⑦ with the alignment mark ⑥, and then turn throttle adjusting screw #4 ⑤ counterclockwise.
8. Turn the throttle stop screw ④ in until the throttle valves start to open.
9. Connect the test harness (3 pins) to the throttle position sensor.

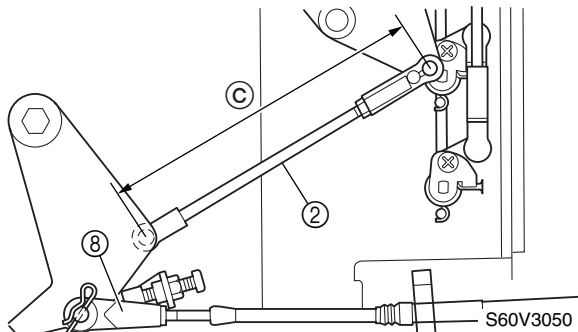
10. Turn the engine start switch to ON, and then turn the throttle stop screw in until the throttle position sensor output voltage is within specification.





Throttle position sensor output voltage at engine idle speed:
Pink (P) – Orange (O)
0.58–0.62 V

11. Disconnect the throttle cable joint ⑧.
12. Adjust the throttle link rod length ③, and then connect the throttle link rod ②.





Throttle link rod length ③:
151.5 mm (6.0 in)

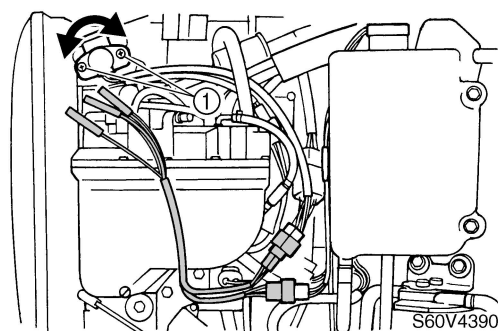
13. Install the intake silencer.
14. Adjust the throttle cable length.

NOTE: _____
For adjustment procedures, see Chapter 3, “Adjusting the throttle cable.”

Adjusting the throttle position sensor

NOTE: _____
Before adjusting the throttle position sensor output voltage, synchronize the throttle valves.

1. Remove the flywheel magnet cover.
2. Loosen the throttle stop screw until it no longer contacts the stopper.
3. Connect the test harness (3 pins) to the throttle position sensor.
4. Turn the engine start switch to ON.
5. Loosen the throttle position sensor screws ①.
6. Adjust the position of the throttle position sensor until the specified output voltage is obtained.





Test harness (3 pins): 90890-06757
Digital circuit tester: 90890-03174



Throttle position sensor output voltage with throttle fully closed:
Pink (P) – Orange (O)
0.48–0.52 V

4



7. Tighten the throttle position sensor screws.
8. Turn the throttle stop screw in until the throttle valves start to open.
9. Turn the throttle stop screw in until the throttle position sensor output voltage is within specification.



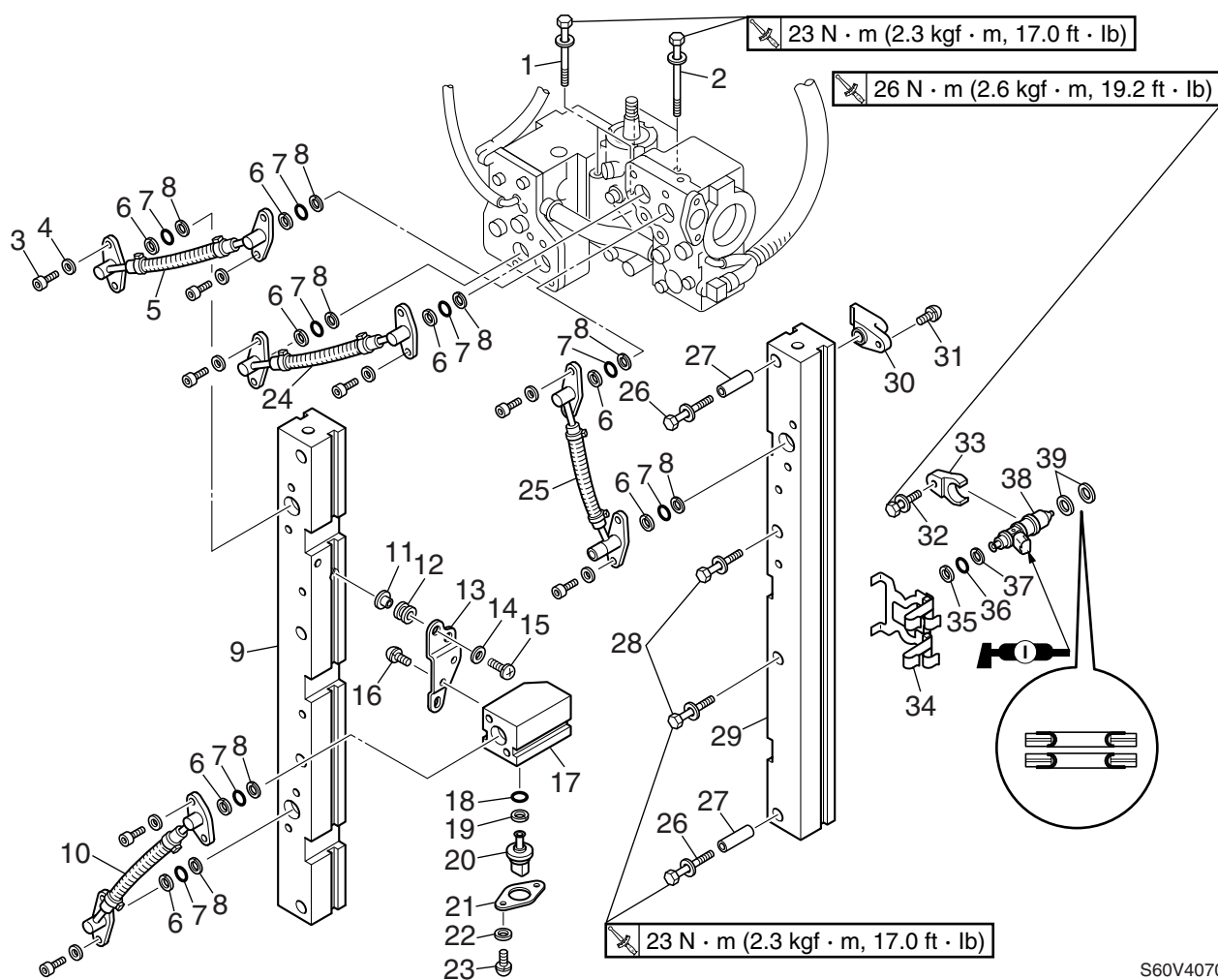
Throttle position sensor output voltage at engine idle speed:

Pink (P) – Orange (O)

0.58–0.62 V

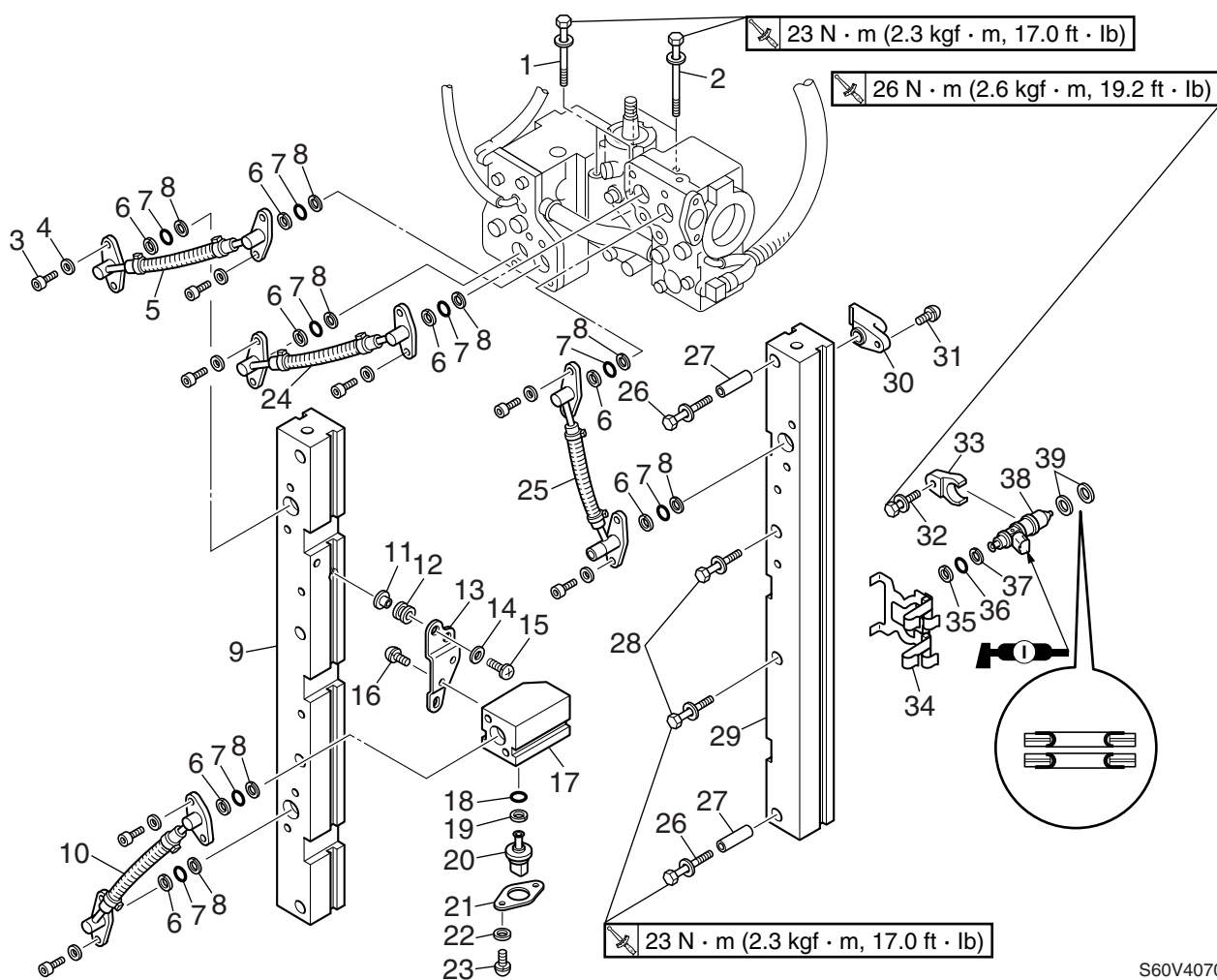
10. Start the engine and let it idle.
11. Check the throttle position sensor output voltage is within specification. If out of specification, repeat steps 1–10.

High-pressure fuel line



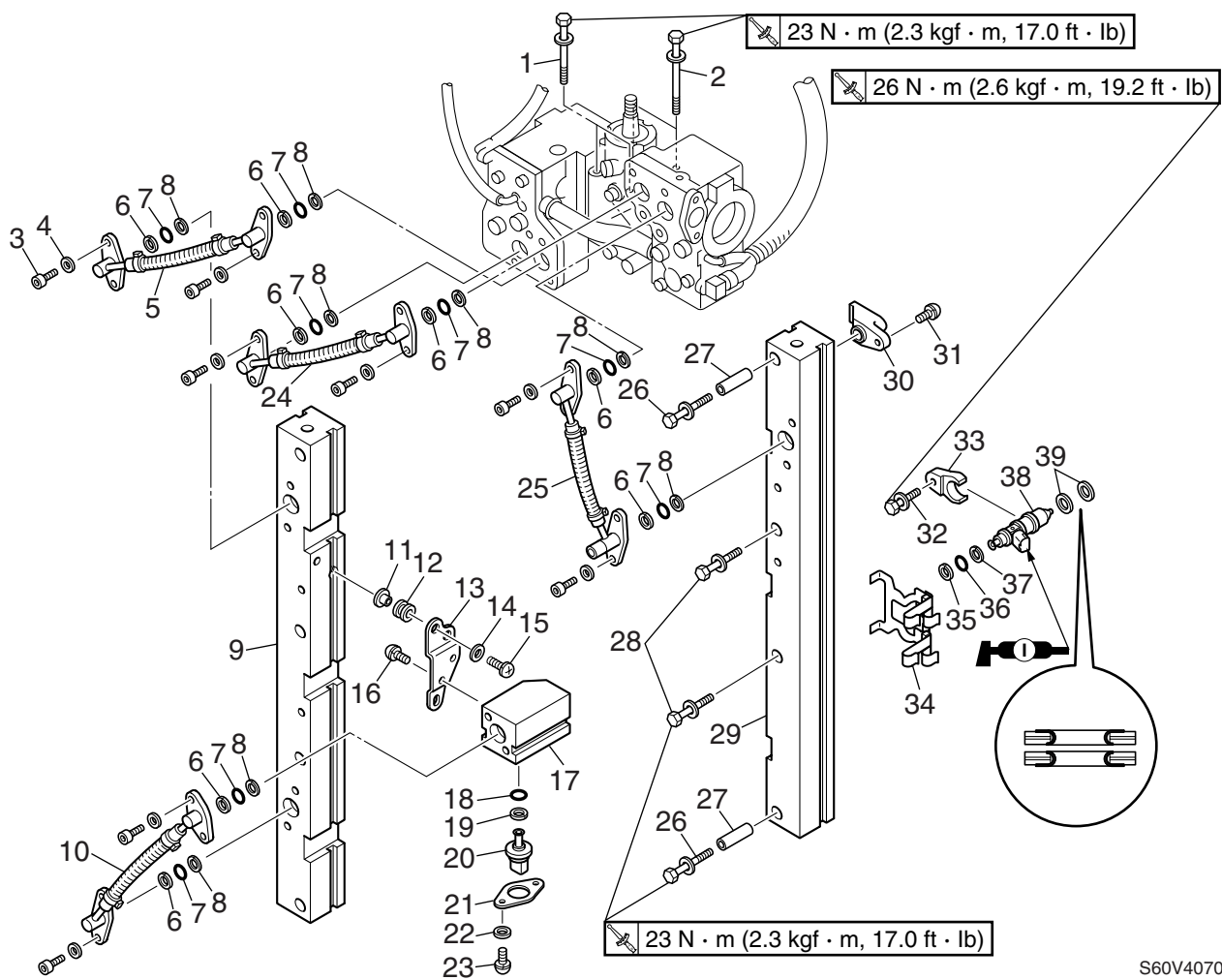
S60V4070

No.	Part name	Q'ty	Remarks
1	Bolt	2	M8 × 70 mm
2	Bolt	2	M8 × 90 mm
3	Bolt	16	M6 × 16 mm
4	Washer	16	
5	Fuel pipe	1	
6	Backup ring	8	Not reusable
7	O-ring	8	Not reusable
8	Backup ring	8	Not reusable
9	Fuel rail (port side)	1	
10	Fuel pipe	1	
11	Collar	3	
12	Grommet	3	
13	Bracket	1	
14	Washer	3	
15	Screw	3	ø5 × 25 mm
16	Screw	2	ø5 × 14 mm
17	Fuel rail	1	



S60V4070

No.	Part name	Q'ty	Remarks
18	O-ring	1	Not reusable
19	Backup ring	1	Not reusable
20	Fuel pressure sensor	1	
21	Plate	1	
22	Washer	2	
23	Bolt	2	M6 × 16 mm
24	Fuel pipe	1	
25	Fuel pipe	1	
26	Bolt	4	M8 × 70 mm
27	Collar	4	
28	Bolt	4	M8 × 55 mm
29	Fuel rail (starboard side)	1	
30	Insulator	4	
31	Screw	4	ø4 × 10 mm
32	Bolt	6	M8 × 25 mm
33	Holder	6	
34	Holder	6	

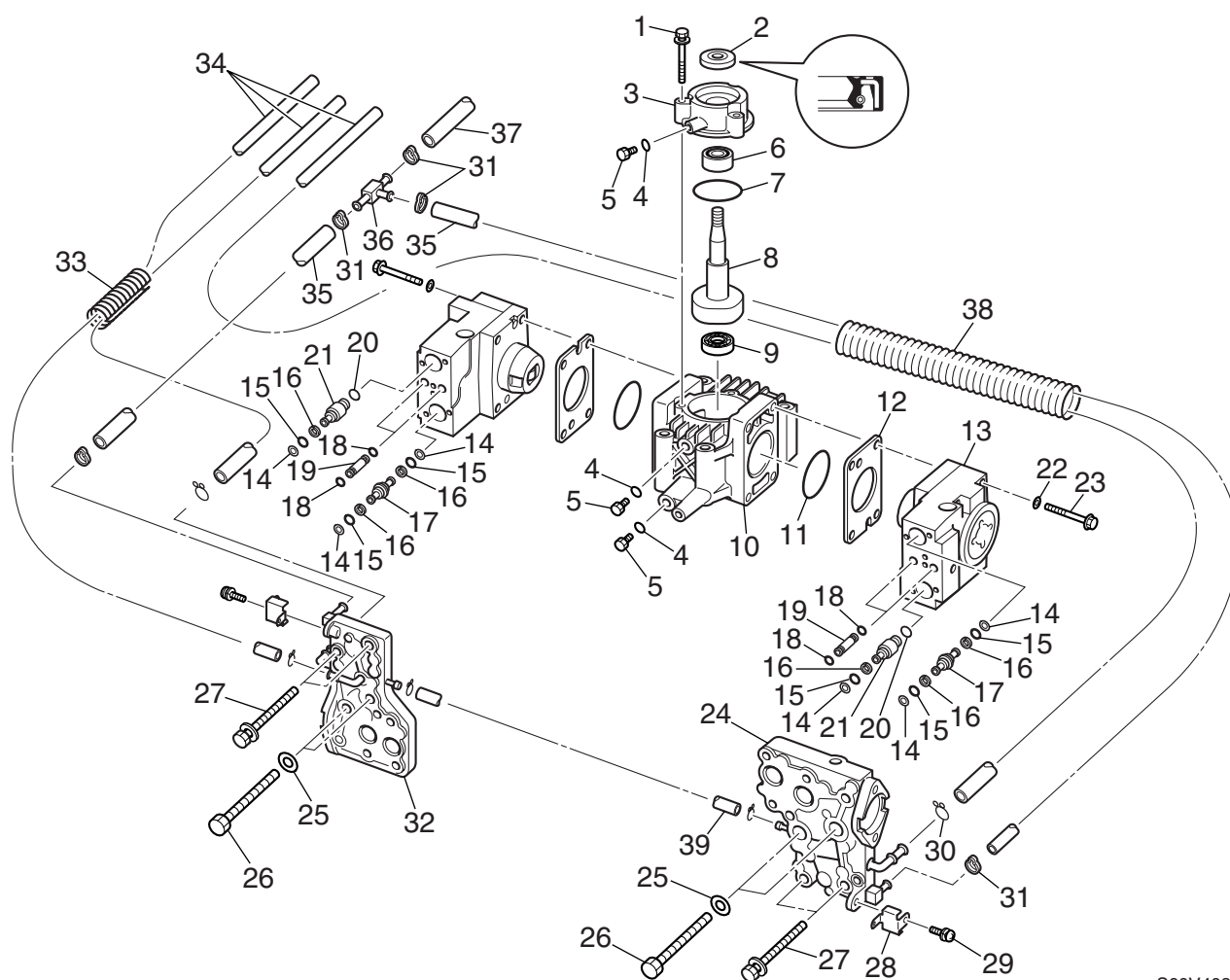


S60V4070

No.	Part name	Q'ty	Remarks
35	Gasket	6	Not reusable
36	O-ring	6	Not reusable
37	Gasket	6	Not reusable
38	Fuel injector	6	
39	Gasket	12	Not reusable

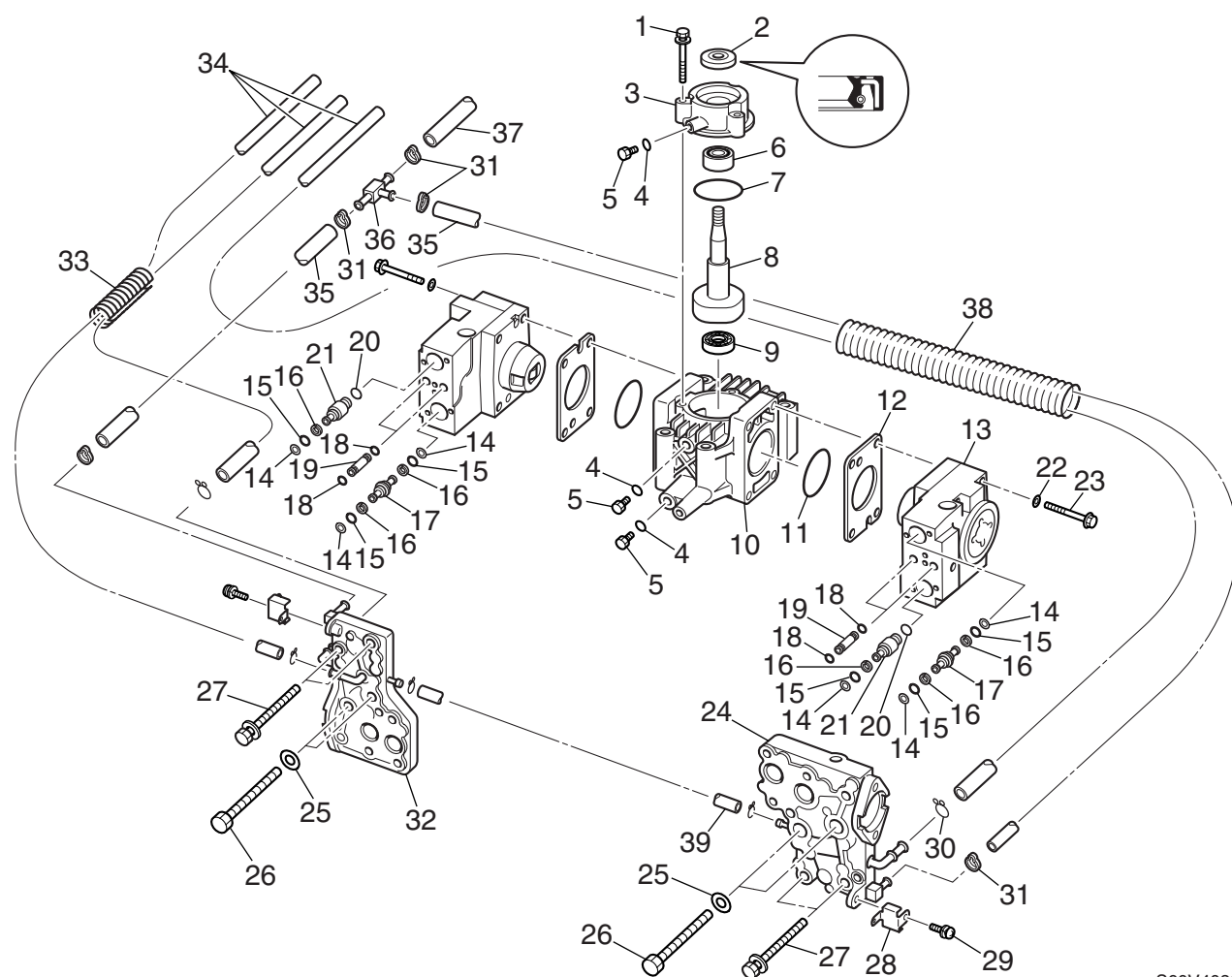


High-pressure fuel pump



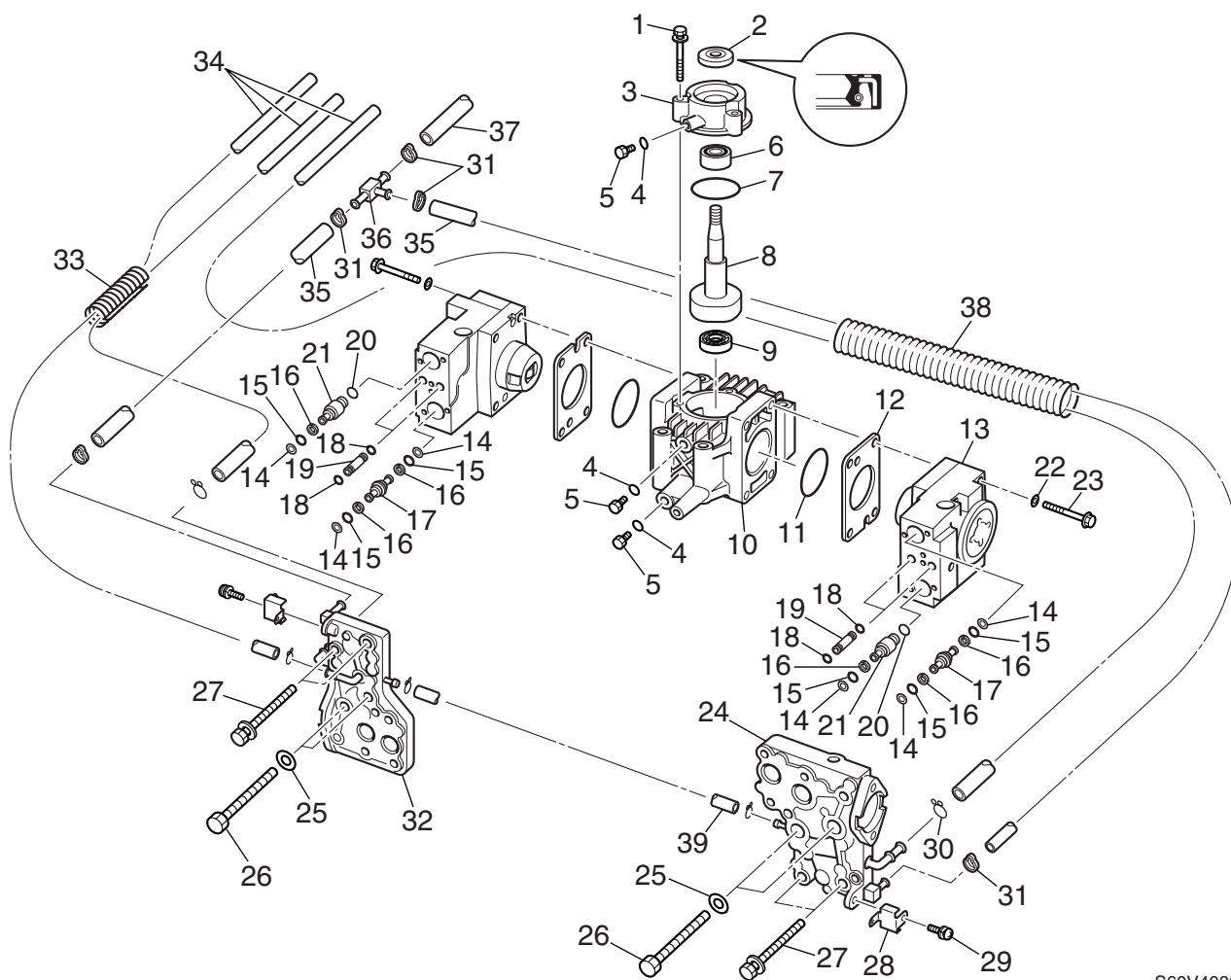
S60V4080

No.	Part name	Q'ty	Remarks
1	Bolt	3	M6 × 35 mm
2	Oil seal	1	Not reusable
3	Cover	1	
4	O-ring	3	Not reusable
5	Bolt	3	M8 × 10 mm
6	Ball bearing	1	Not reusable
7	O-ring	1	Not reusable
8	Camshaft	1	
9	Ball bearing	1	Not reusable
10	High-pressure fuel pump body	1	
11	O-ring	2	Not reusable
12	Gasket	2	Not reusable
13	High-pressure fuel pump	2	
14	Backup ring	6	Not reusable
15	O-ring	6	Not reusable
16	Backup ring	6	Not reusable
17	Joint	2	



S60V4080

No.	Part name	Q'ty	Remarks
18	O-ring	4	Not reusable
19	Joint	2	
20	O-ring	2	Not reusable
21	Joint	2	
22	Washer	8	
23	Bolt	8	M8 × 70 mm
24	High-pressure fuel pump cover	1	
25	Washer	4	
26	Bolt	4	M8 × 40 mm
27	Bolt	4	M6 × 35 mm
28	Holder	2	
29	Screw	2	ø4 × 10 mm
30	Clip	4	
31	Clamp	5	Not reusable
32	High-pressure fuel pump cover	1	
33	Corrugated tube	1	
34	Fuel hose	3	

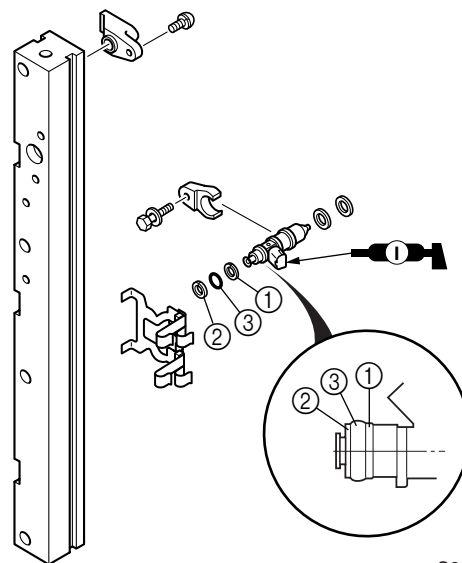
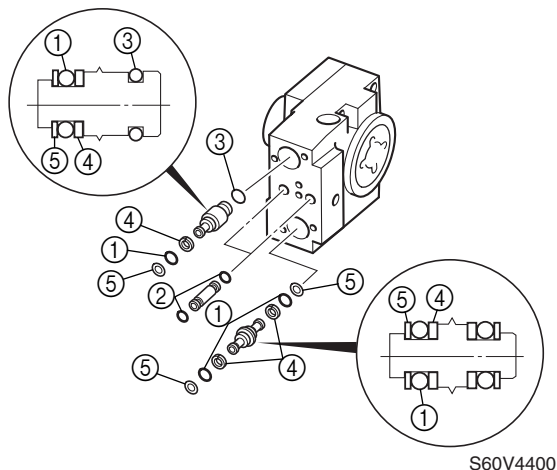


S60V4080

No.	Part name	Q'ty	Remarks
35	Fuel hose	2	
36	Joint	1	
37	Fuel hose	1	
38	Corrugated tube	1	
39	Fuel hose	1	

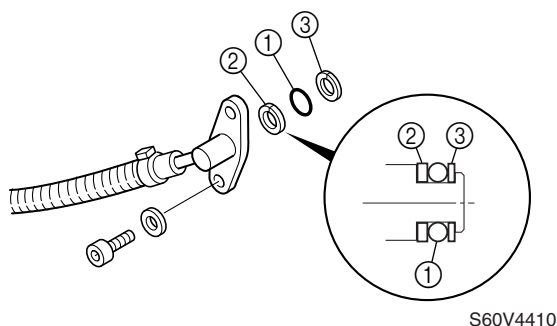
Installing the joints

1. Install new O-rings ①, ②, and ③, and new backup rings ④ and ⑤ onto the joints.
2. Install the joints into the high-pressure fuel pump.



Installing the fuel pipes

1. Install new O-rings ① and new backup rings ② and ③ into the fuel pipes.
2. Install the fuel pipes onto the high-pressure fuel pump and fuel rails.



Installing the fuel injectors

1. Install new gaskets ① and ②, and new O-ring ③.
2. Install the fuel injectors onto the fuel rails.

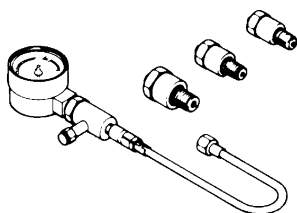


Power unit

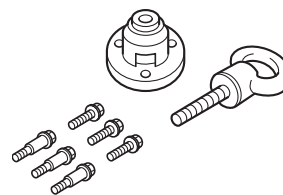
Special service tools	5-1
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Checking the compression pressure	5-2
Removing the drive belt and sprockets	5-15
Checking the drive belt and sprockets.....	5-15
Installing the sprockets and drive belt	5-16
Removing the power unit.....	5-17
Removing the flywheel magnet	5-19
Removing the stator coil and pulser coil.....	5-19
Removing the starter motor	5-20
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Removing the intake manifold	5-22
Checking the reed valve	5-22
Cylinder head	5-23
Removing the cylinder head	5-25
Checking the cylinder head	5-25
Exhaust and cylinder cover	5-26
Removing the exhaust cover	5-28
Checking the pressure control valve	5-28
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Cylinder block	5-33
Removing the crankcase	5-36
Removing the piston and connecting rod assemblies and crankshaft assembly	5-37
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Checking the bearings.....	5-39
Checking the piston diameter	5-39
Checking the cylinder bore	5-39
Checking the piston clearance	5-40
Checking the piston rings	5-40
Checking the piston ring side clearance	5-40
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Checking the piston pin	5-41
Checking the connecting rod small end axial play.....	5-41
Checking the connecting rod big end side clearance	5-41
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Assembling the crankshaft	5-42
Assembling the crankshaft roller bearings.....	5-43
Assembling the oil seal housing	5-44
Assembling the piston and connecting rod assemblies.....	5-44
Assembling the power unit	5-45
Installing the power unit.....	5-49

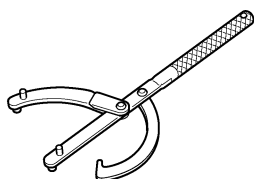
Special service tools



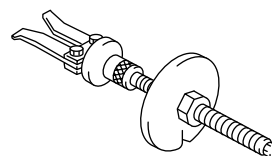
Compression gauge
90890-03160



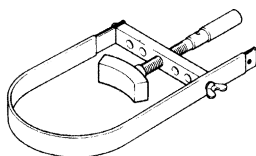
Flywheel puller
90890-06521



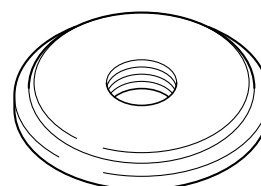
Rotor holder
90890-01235



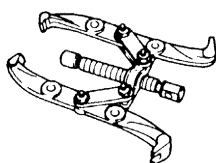
Bearing outer race puller assembly
90890-06523



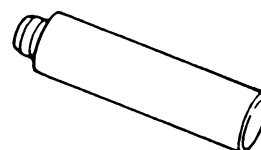
Sheave holder
90890-01701



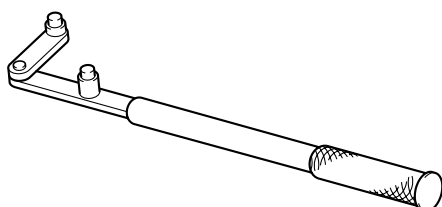
Bearing outer race attachment
90890-06623, 90890-06624



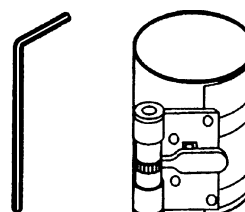
Gear puller
90890-06540



Driver rod LS
90890-06606



Flywheel holder
90890-06522

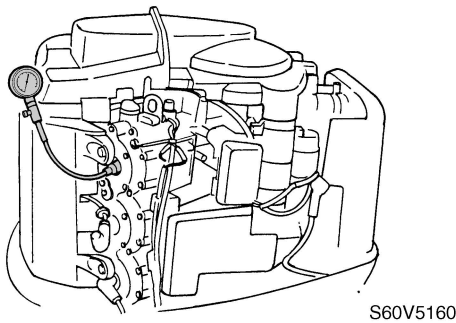


Piston ring compressor
90890-05158

Power unit

Checking the compression pressure

1. Start the engine, warm it up for 5 minutes, and then turn it off.
2. Remove the engine shut-off cord from the engine shut-off switch on the remote control box.
3. Remove all spark plugs, and then install the special service tools into a spark plug hole.



S60V5160

CAUTION:

Before removing the spark plugs, blow compressed air in the spark plug well to clear out any dirt or dust that may fall into the cylinder.



Compression gauge: 90890-03160

4. Fully open the throttle, and then crank the engine until the reading on the compression gauge stabilizes.

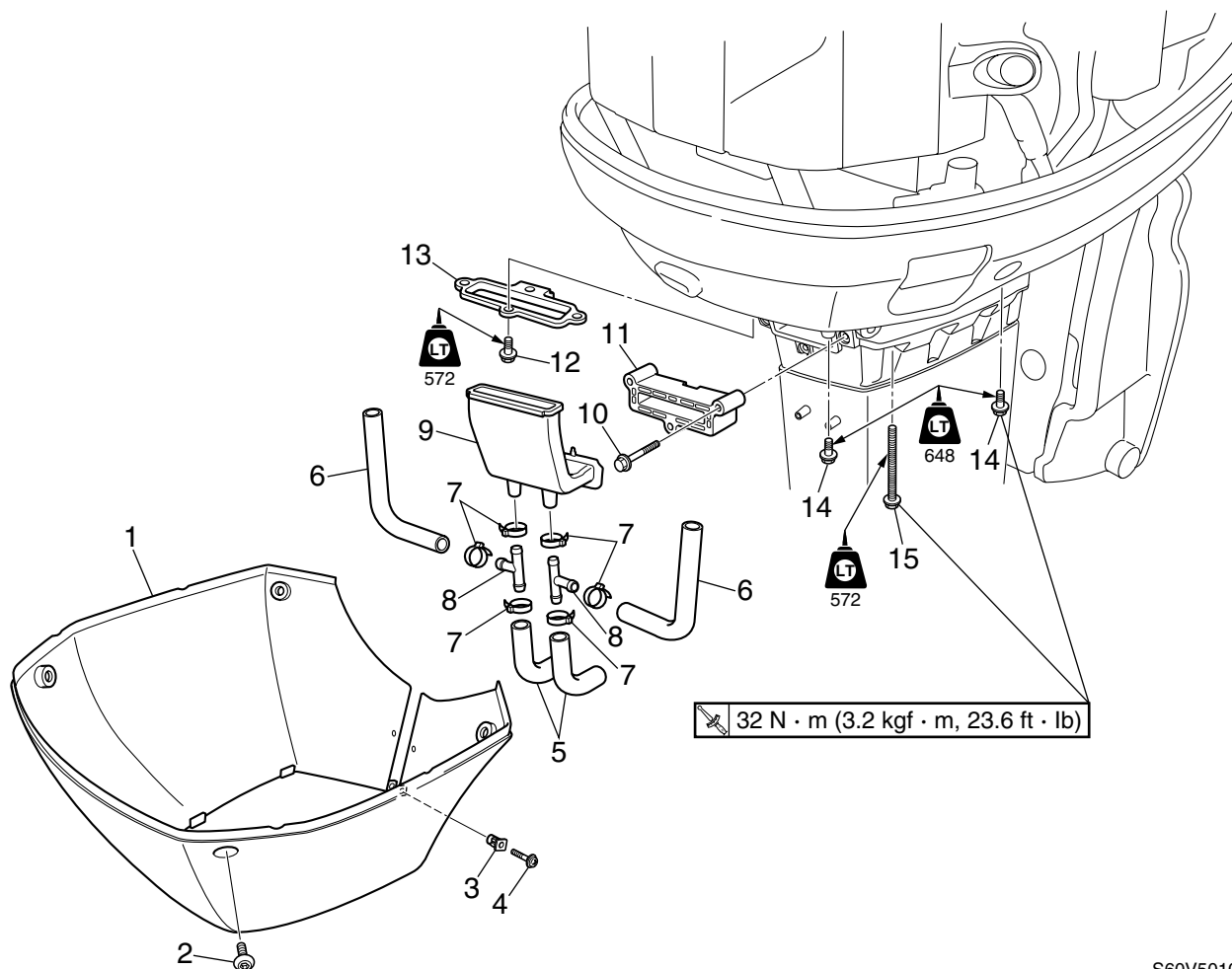


Minimum compression pressure
(reference data):
560 kPa (5.6 kgf/cm², 81 psi)

5. If the compression pressure is below specification and the compression pressure for each cylinder is unbalanced, add a small amount of engine oil to the cylinders, and then check the compression pressure again.

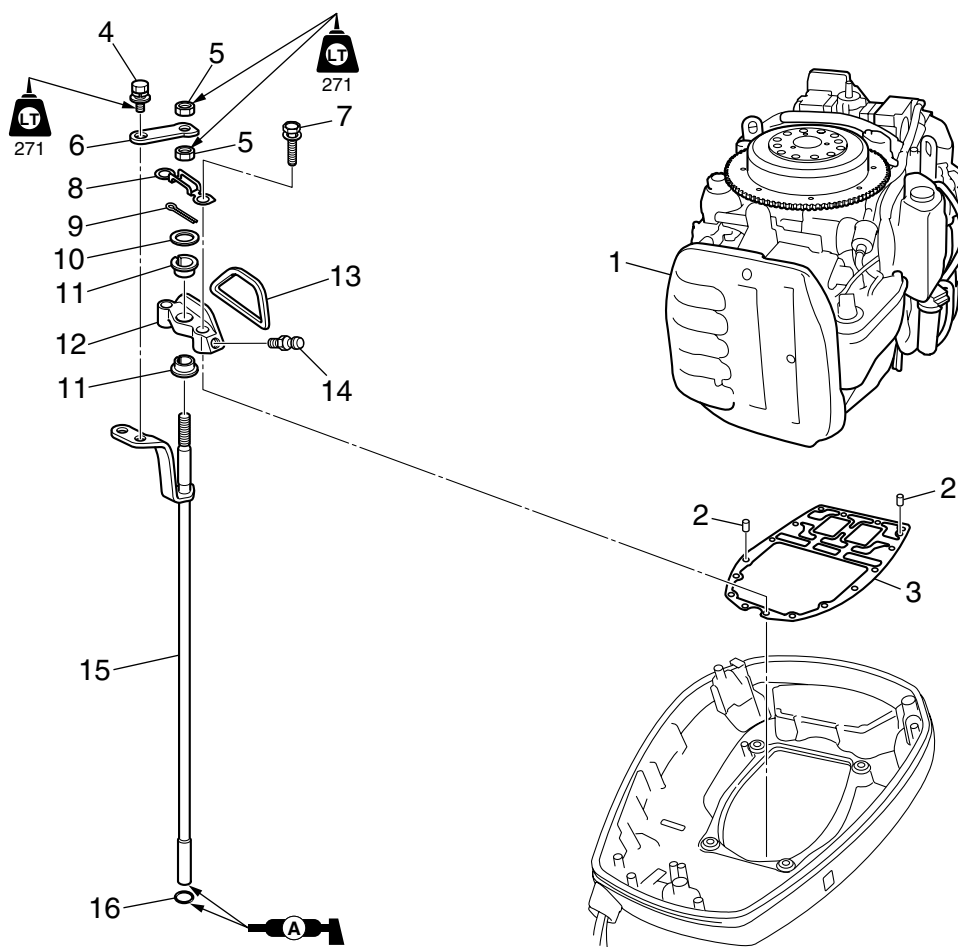
NOTE:

- If the compression pressure increases, check the pistons and piston rings for wear. Replace if necessary.
- If the compression pressure does not increase, check the cylinder sleeves, cylinder head gasket, and cylinder head. Replace if necessary.



S60V5010

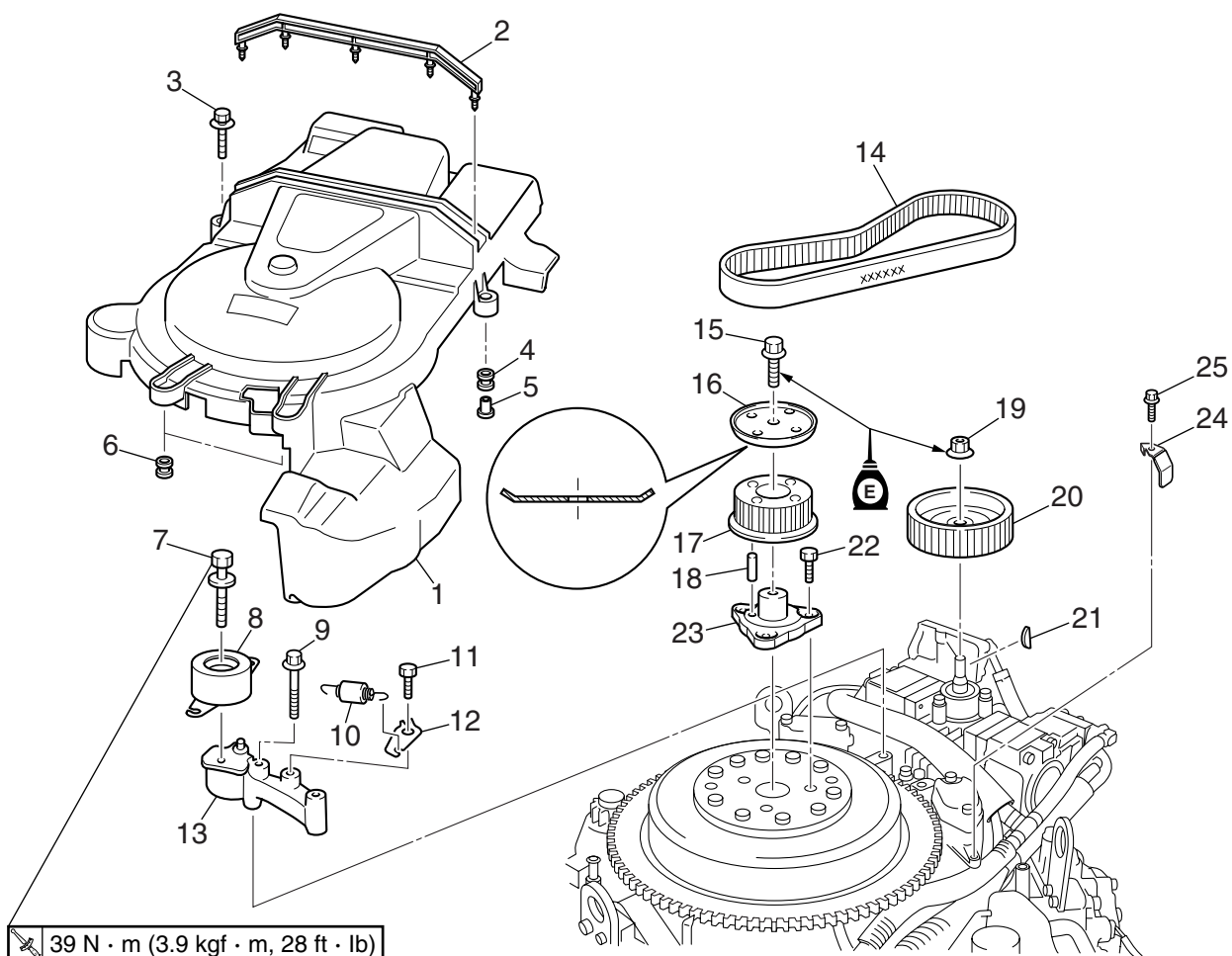
No.	Part name	Q'ty	Remarks
1	Apron	1	
2	Bolt	4	M6 × 16 mm
3	Clamp	1	
4	Screw	1	ø4 × 16 mm
5	Hose	2	
6	Hose	2	
7	Plastic tie	6	Not reusable
8	Joint	2	
9	Joint	1	
10	Bolt	3	M8 × 55 mm
11	Bracket	1	
12	Bolt	4	M6 × 16 mm
13	Plate	1	
14	Bolt	6	M8 × 30 mm
15	Bolt	8	M8 × 135 mm



S60V5020

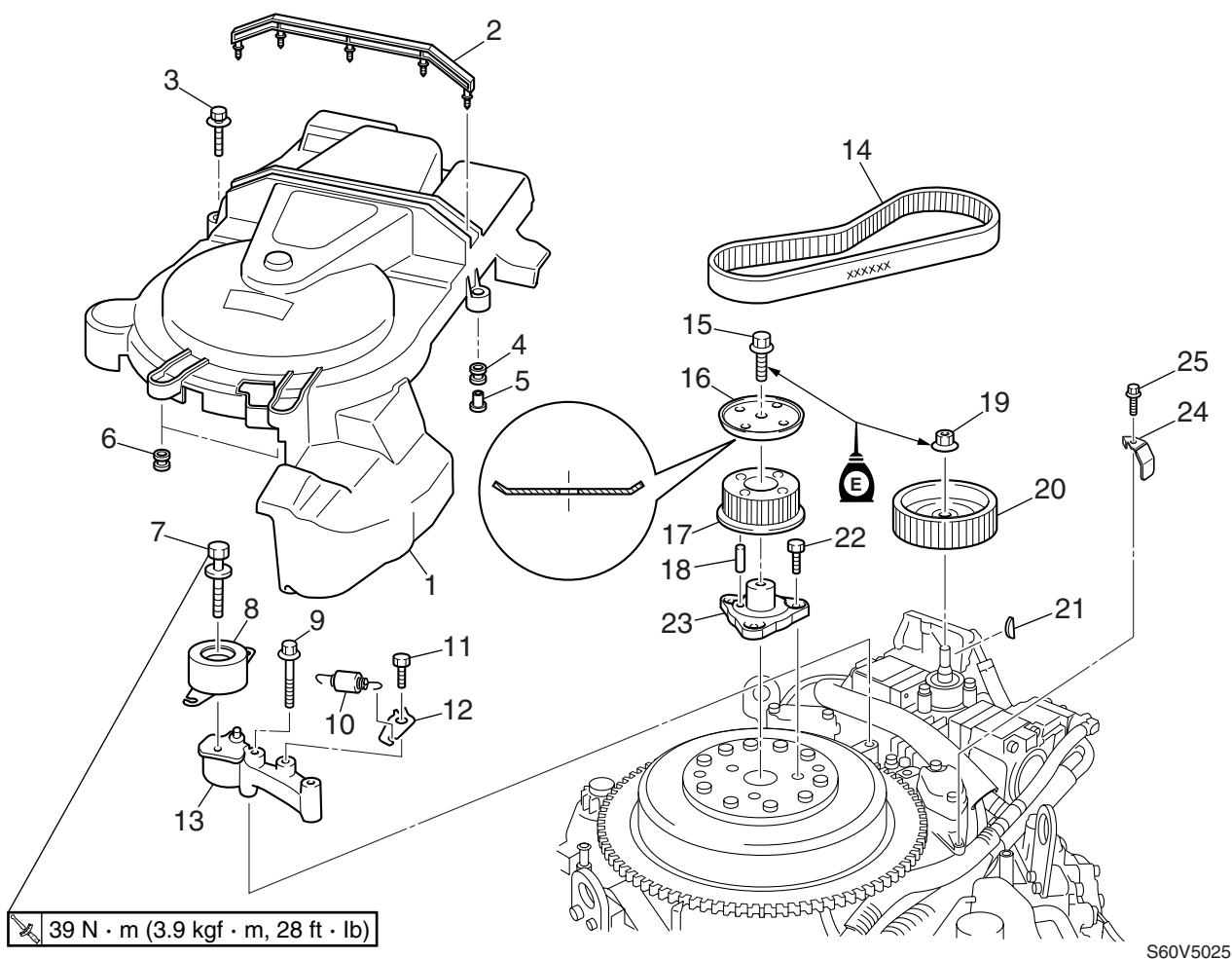
5

No.	Part name	Q'ty	Remarks
1	Power unit	1	
2	Dowel	2	Not reusable
3	Gasket	1	Not reusable
4	Bolt	1	M6 × 12 mm
5	Nut	2	
6	Plate	1	
7	Bolt	2	M6 × 30 mm
8	Spring plate	1	
9	Pin	1	Not reusable
10	Washer	1	
11	Bushing	2	
12	Bracket	1	
13	Grommet	1	
14	Grease nipple	1	
15	Shift rod	1	
16	O-ring	1	Not reusable

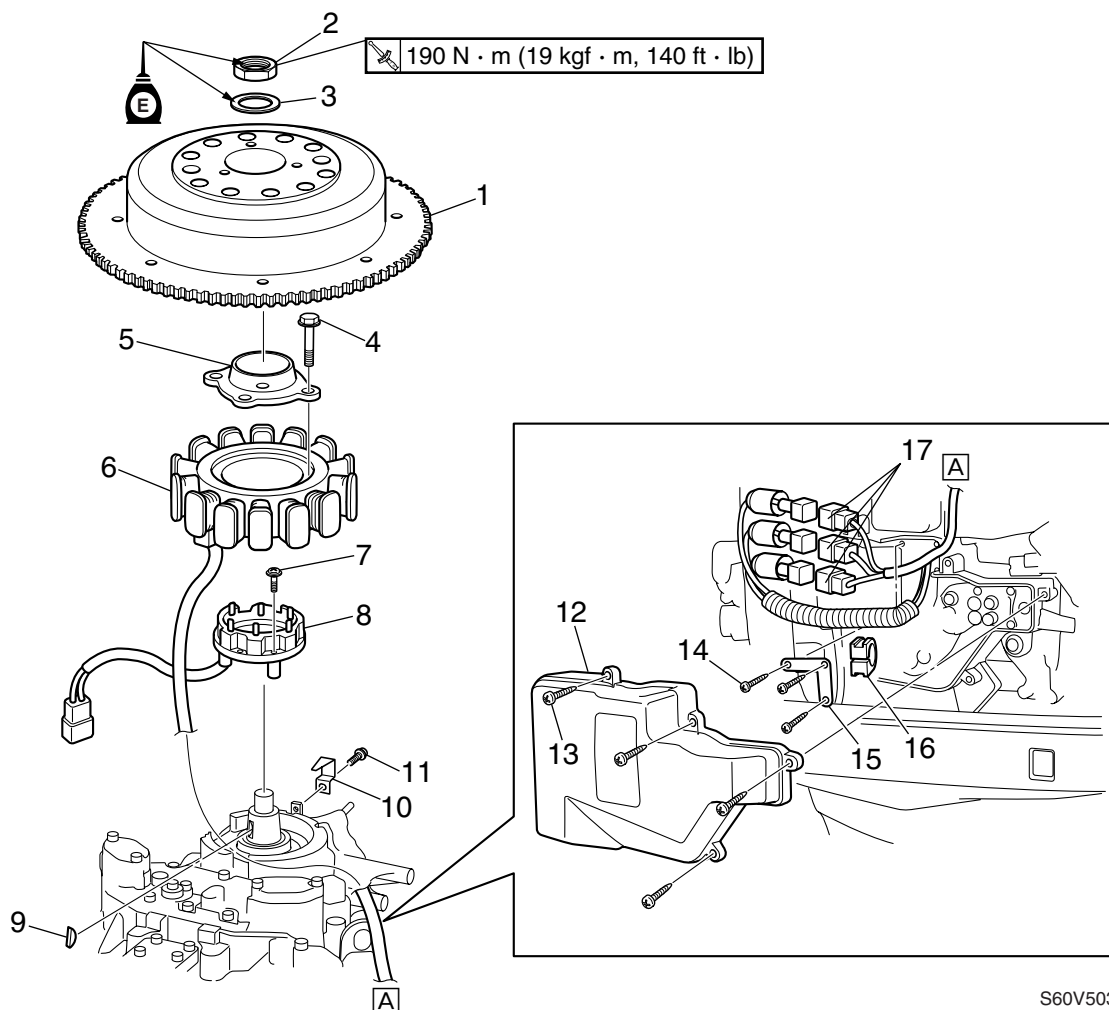


S60V5025

No.	Part name	Q'ty	Remarks
1	Flywheel magnet cover	1	
2	Damper	1	
3	Bolt	2	M6 × 30 mm
4	Grommet	2	
5	Collar	2	
6	Grommet	2	
7	Bolt	1	M10 × 45 mm
8	Tensioner	1	
9	Bolt	2	M8 × 55 mm
10	Spring	1	
11	Bolt	1	M8 × 12 mm
12	Holder	1	
13	Bracket	1	
14	Drive belt	1	
15	Bolt	1	M8 × 25 mm
16	Plate	1	
17	Drive sprocket	1	

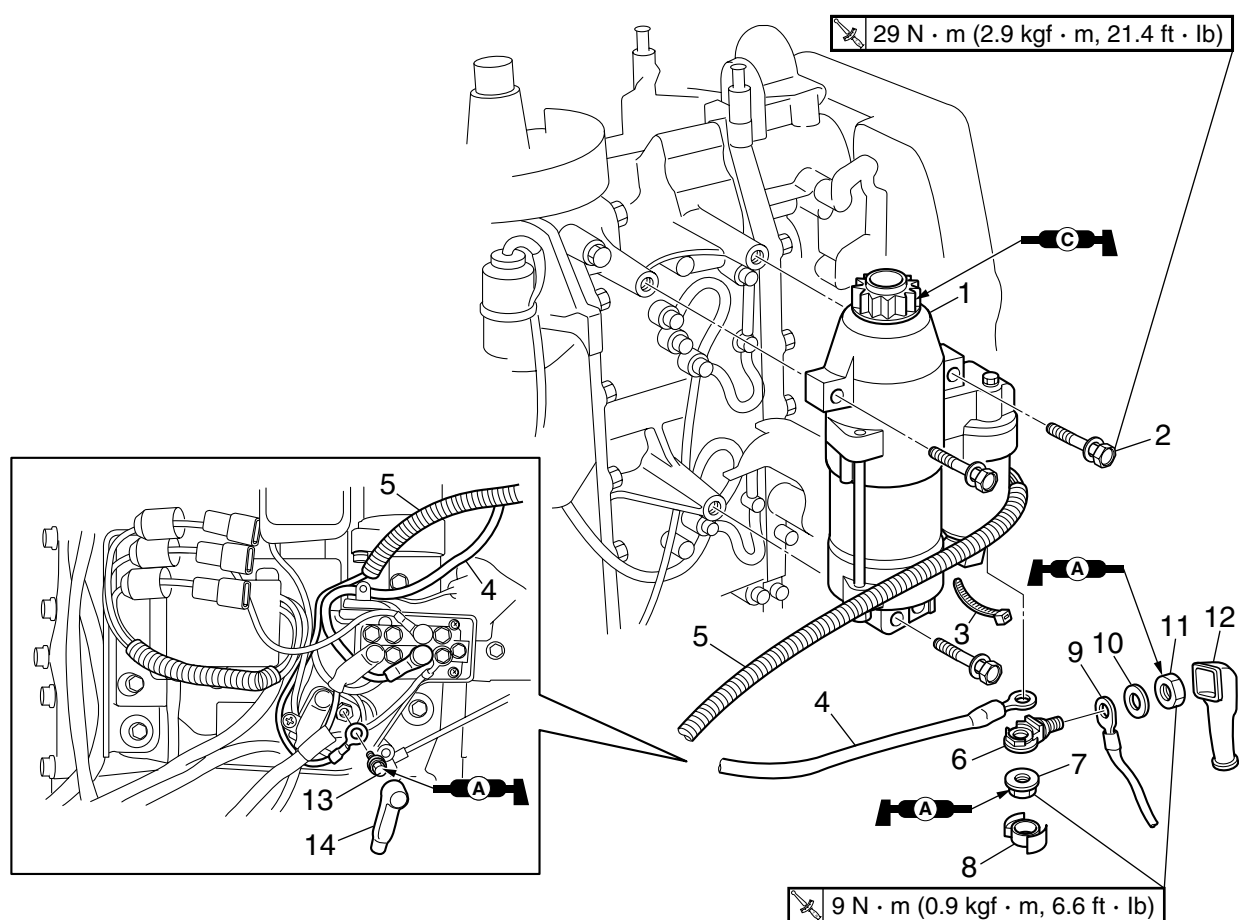


No.	Part name	Q'ty	Remarks
18	Dowel	1	
19	Nut	1	
20	Driven sprocket	1	
21	Woodruff key	1	
22	Bolt	3	M8 × 12 mm
23	Bracket	1	
24	Clamp	1	
25	Bolt	1	M5 × 12 mm

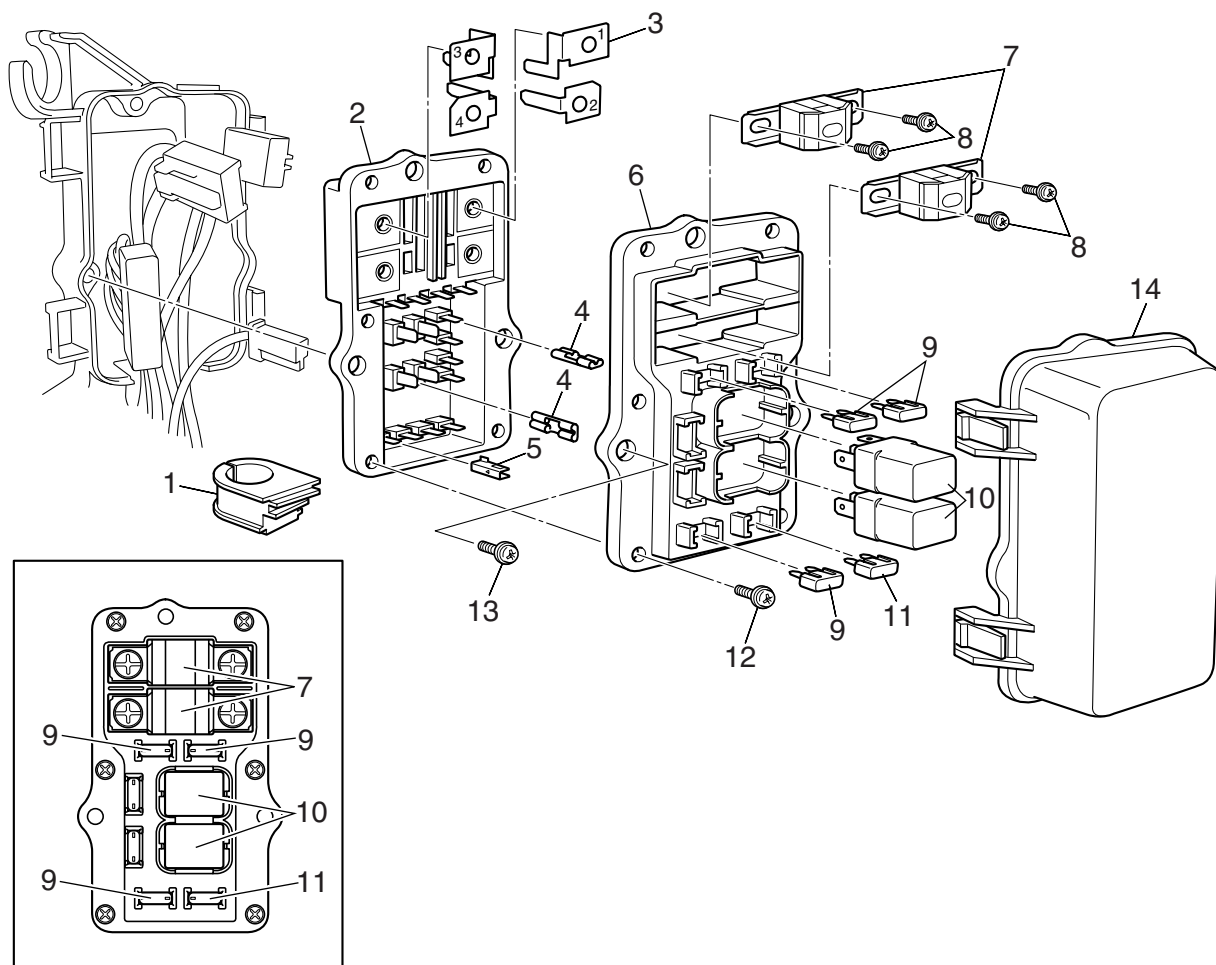


S60V5030

No.	Part name	Q'ty	Remarks
1	Flywheel magnet	1	
2	Nut	1	
3	Washer	1	
4	Bolt	4	M6 × 35 mm
5	Holder	1	
6	Stator coil	1	
7	Screw	3	ø5 × 30 mm
8	Pulser coil	1	
9	Woodruff key	1	
10	Pointer	1	
11	Screw	1	ø6 × 10 mm
12	Cover	1	
13	Screw	4	
14	Screw	3	ø5 × 16 mm
15	Holder	1	
16	Grommet	1	
17	Stator coil coupler	3	

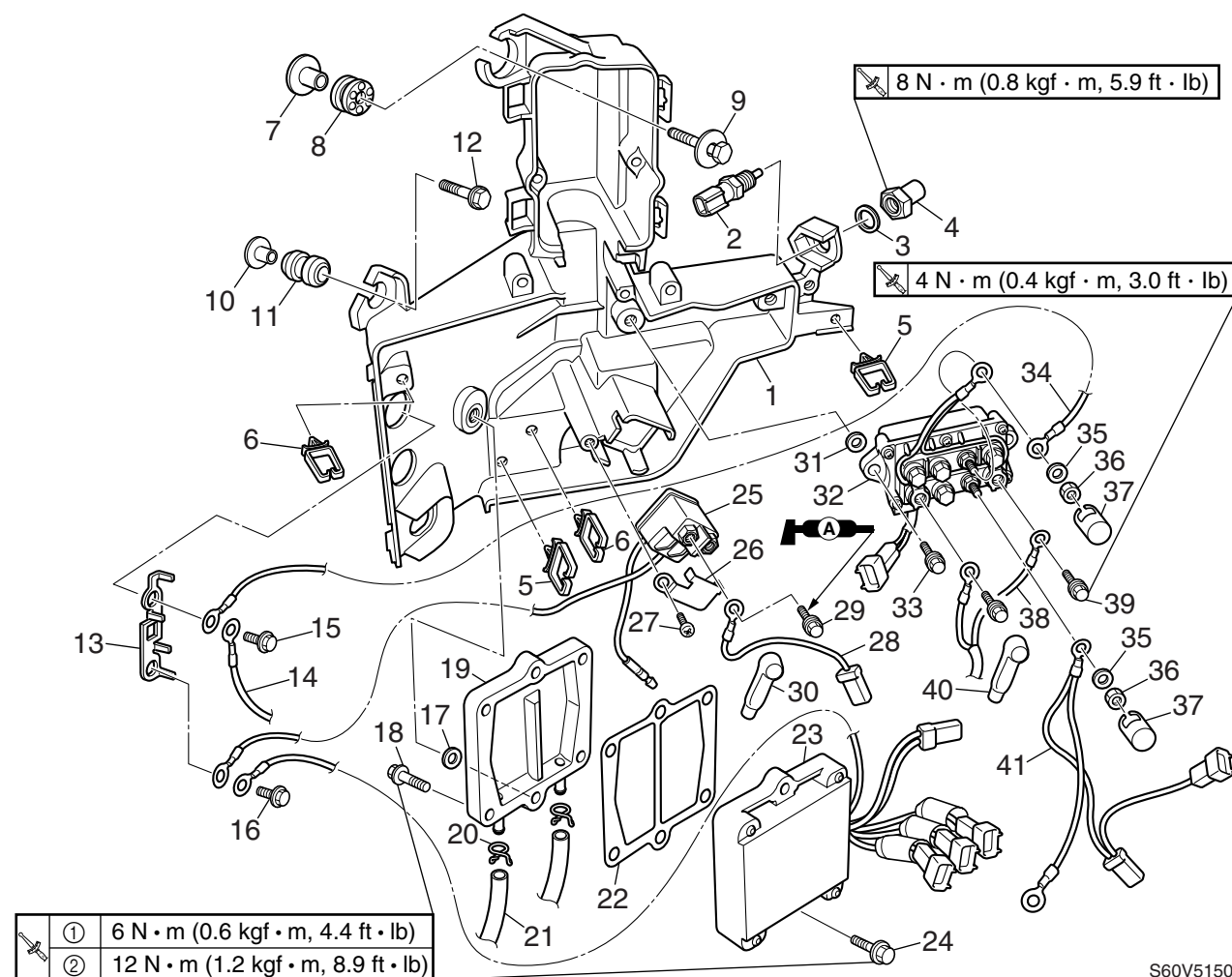


No.	Part name	Q'ty	Remarks
1	Starter motor	1	
2	Bolt	3	M8 × 45 mm
3	Plastic tie	1	Not reusable
4	PTT relay lead	1	
5	Starter relay lead	1	
6	Terminal	1	
7	Nut	1	
8	Cap	1	
9	Positive battery lead	1	
10	Washer	1	
11	Nut	1	
12	Cap	1	
13	Bolt	1	M6 × 10 mm
14	Cap	1	



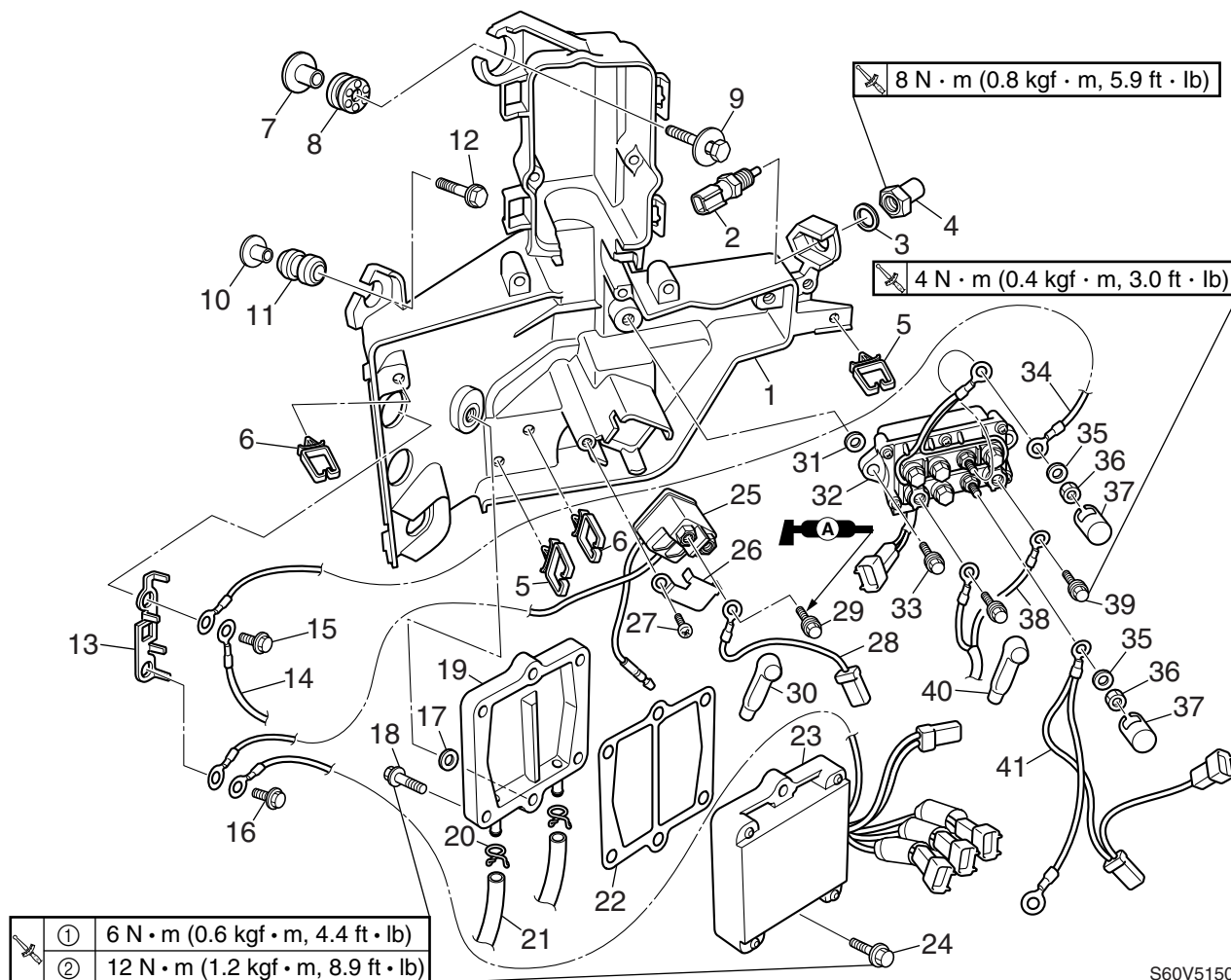
S60V5140

No.	Part name	Q'ty	Remarks
1	Grommet	1	
2	Fuse holder	1	
3	Terminal plate	4	
4	Terminal	8	
5	Terminal	8	
6	Fuse holder	1	
7	Fuse	2	100 A
8	Screw	4	ø5 × 10 mm
9	Fuse	3	20 A
10	Relay	2	
11	Fuse	1	30 A
12	Screw	6	ø5 × 16 mm
13	Screw	3	ø3 × 10 mm
14	Cover	1	



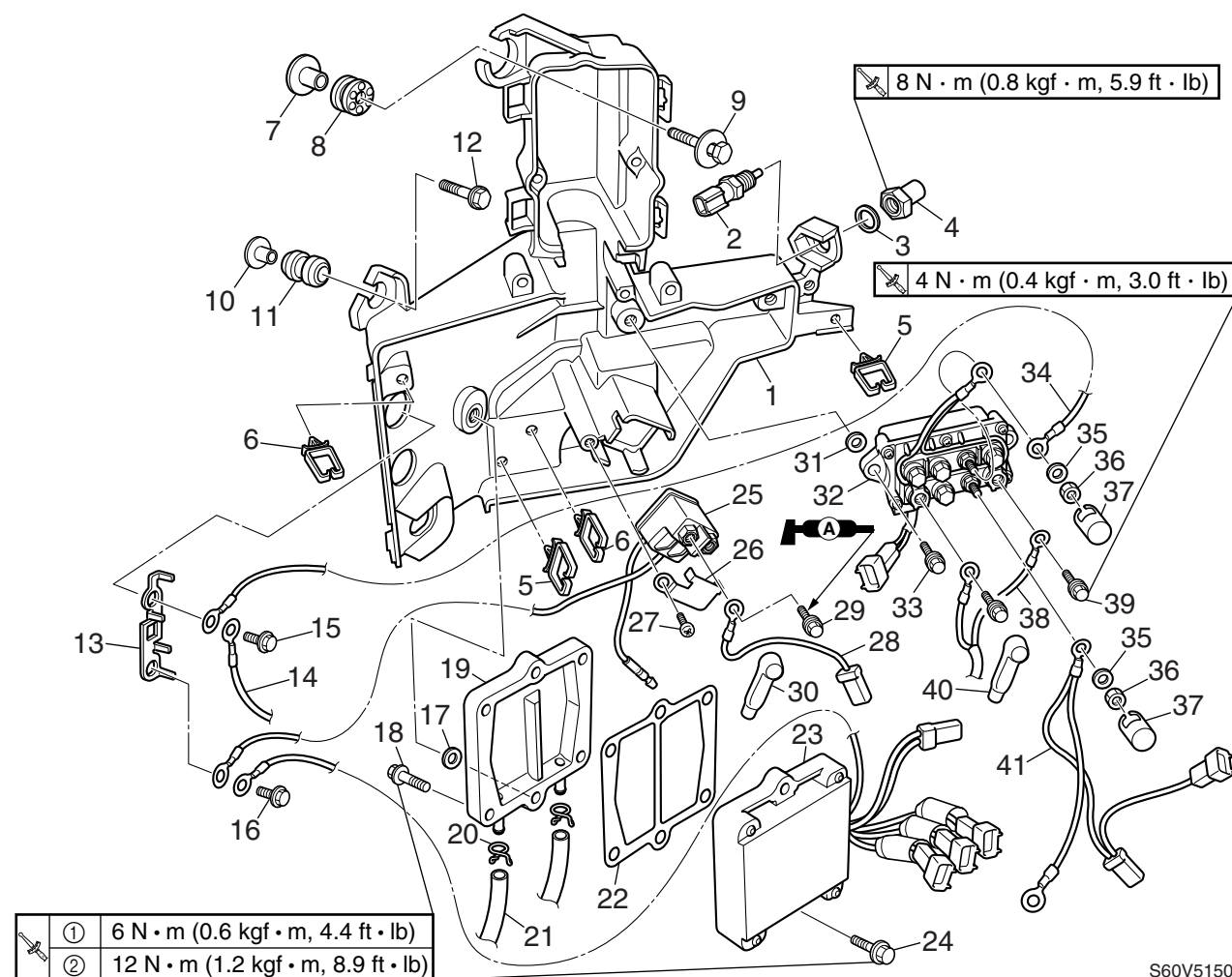
S60V5150

No.	Part name	Q'ty	Remarks
1	Junction box	1	
2	Intake air temperature sensor	1	
3	Washer	1	
4	Nut	1	
5	Holder	2	
6	Holder	2	
7	Collar	3	
8	Grommet	3	
9	Bolt	3	M6 × 35 mm
10	Collar	1	
11	Grommet	1	
12	Bolt	1	M6 × 25 mm
13	Connector	1	
14	Ground lead	1	
15	Bolt	1	M6 × 12 mm
16	Bolt	1	M6 × 12 mm
17	Washer	2	



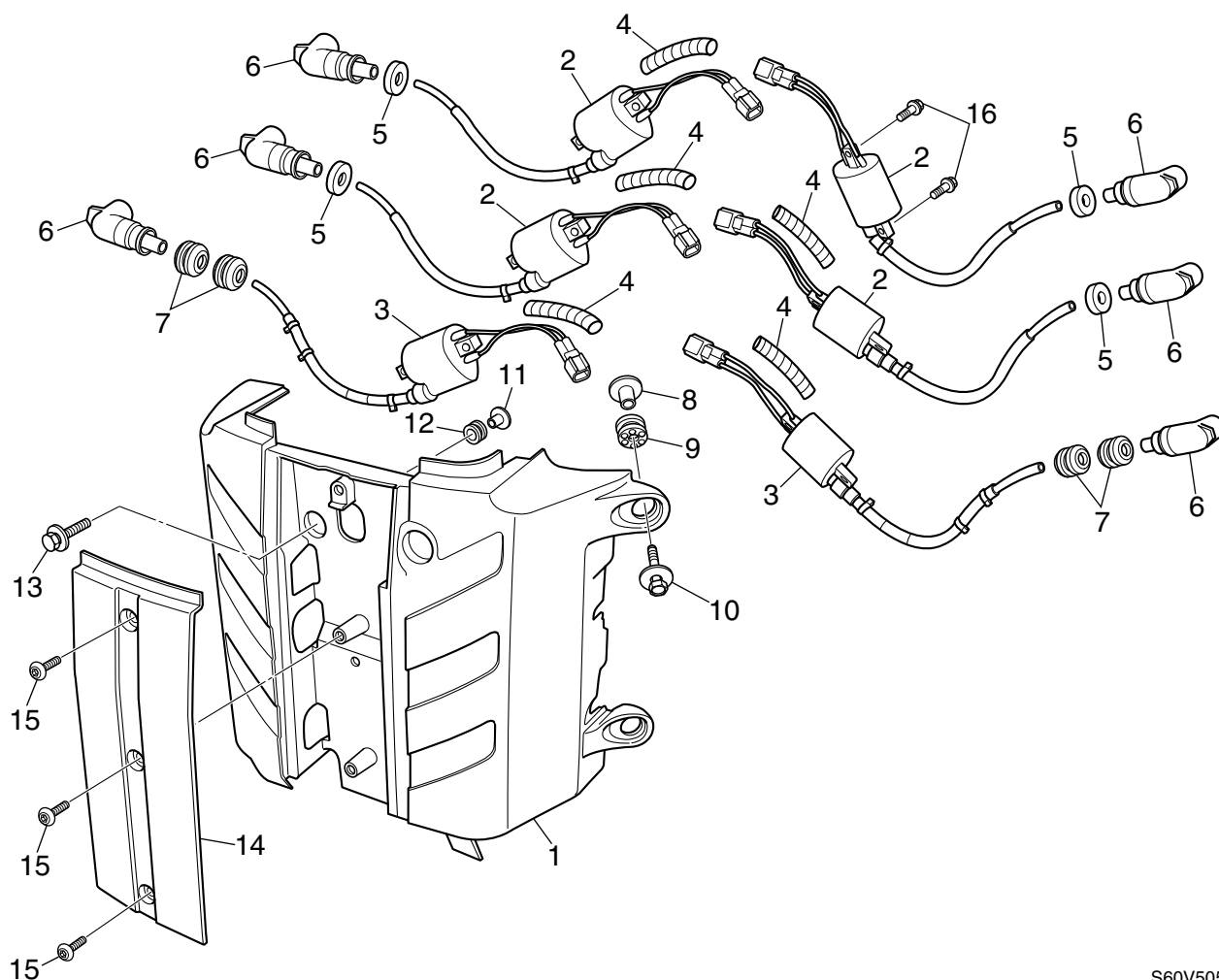
S60V5150

No.	Part name	Q'ty	Remarks
18	Bolt	4	M6 × 25 mm
19	Cover	1	
20	Clip	2	
21	Cooling water hose	2	
22	Gasket	1	Not reusable
23	Rectifier Regulator	1	
24	Bolt	2	M6 × 30 mm
25	Starter relay	1	
26	Holder	1	
27	Screw	1	ø6 × 20 mm
28	Starter relay lead	1	
29	Bolt	1	M6 × 10 mm
30	Cap	1	
31	Washer	2	
32	Power trim and tilt relay	1	
33	Bolt	2	M6 × 30 mm
34	Ground lead	1	



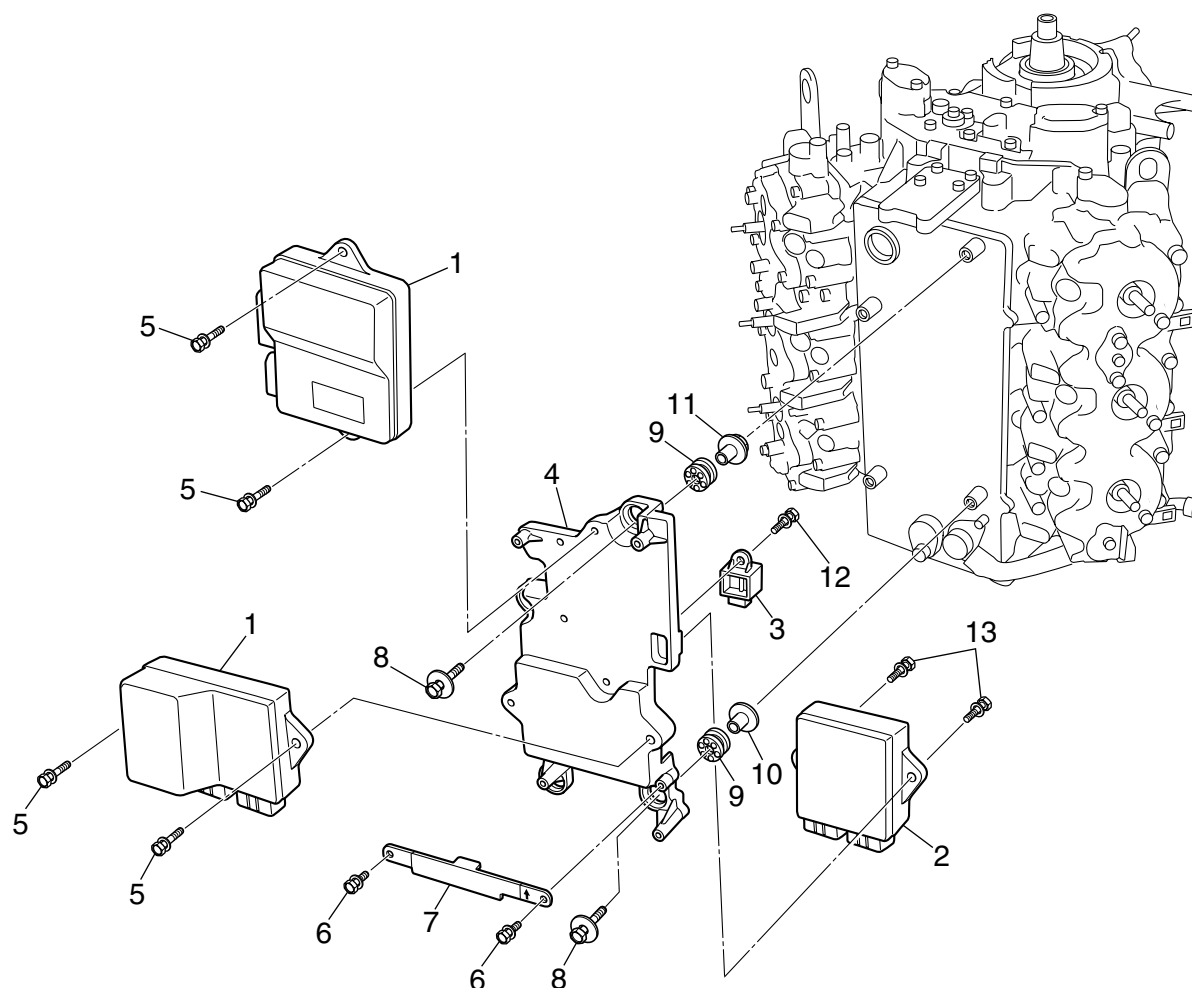
S60V5150

No.	Part name	Q'ty	Remarks
35	Washer	2	M6 × 10 mm
36	Nut	2	
37	Cap	2	
38	PTT motor lead	1	
39	Bolt	2	
40	Cap	1	
41	PTT relay lead	1	



S60V5050

No.	Part name	Q'ty	Remarks
1	Ignition coil cover	1	
2	Ignition coil	4	Cylinders #1, #2, #3, and #4
3	Ignition coil	2	Cylinders #5 and #6
4	Hose	5	
5	Grommet	4	
6	Spark plug cap	6	
7	Grommet	4	
8	Collar	4	
9	Grommet	4	
10	Bolt	4	M6 × 35 mm
11	Collar	4	
12	Grommet	4	
13	Bolt	4	M6 × 30 mm
14	Cover	1	
15	Bolt	3	M6 × 14 mm
16	Bolt	12	M5 × 20 mm



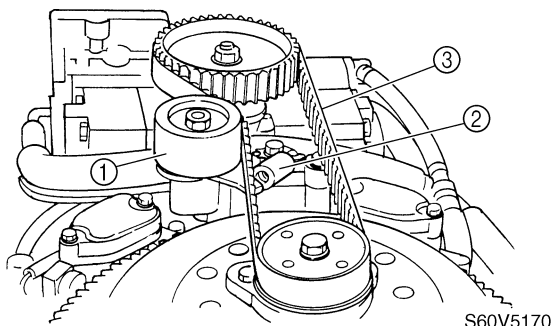
S60V5060

No.	Part name	Q'ty	Remarks
1	Injector driver	2	
2	ECM	1	
3	Fuel pump relay	1	
4	Bracket	1	
5	Bolt	2	M6 × 20 mm
6	Bolt	2	M6 × 14 mm
7	Holder	1	
8	Bolt	4	M6 × 35 mm
9	Grommet	4	
10	Collar	2	
11	Collar	2	
12	Bolt	1	M6 × 16 mm
13	Bolt	2	M6 × 25 mm

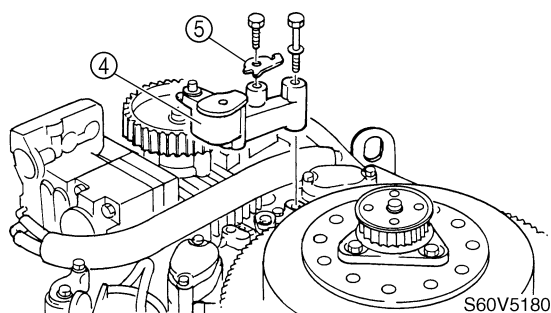


Removing the drive belt and sprockets

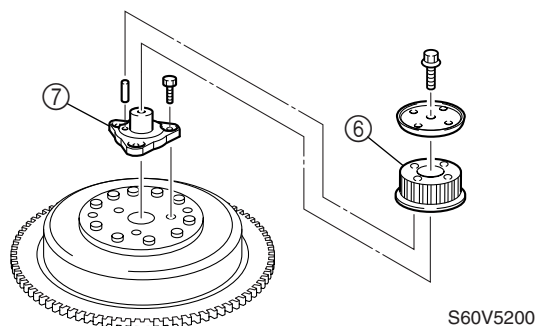
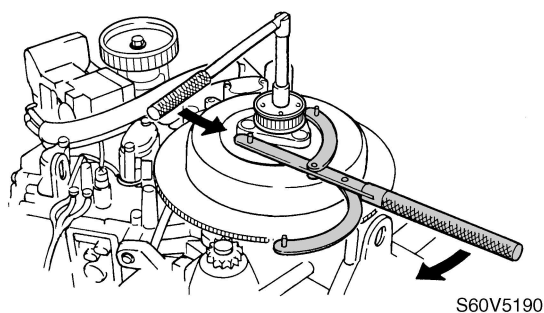
1. Remove the flywheel magnet cover.
2. Remove the drive belt tensioner ① and the tensioner spring ②, and then remove the drive belt ③.



3. Remove the tensioner bracket ④ and spring holder ⑤.

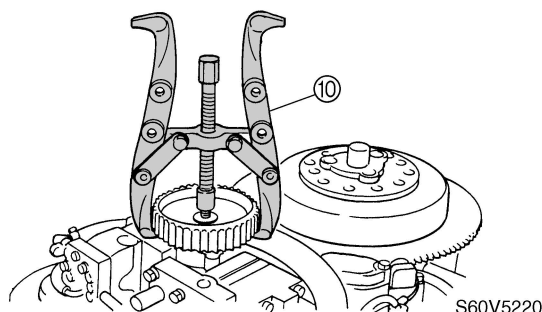
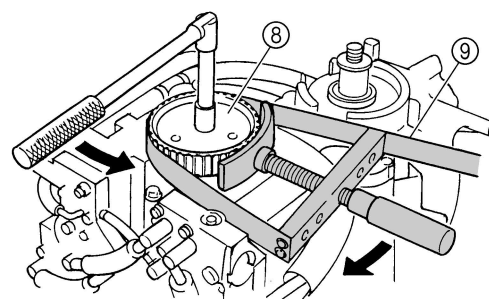


4. Remove the drive sprocket ⑥ and the drive sprocket bracket ⑦.



Rotor holder: 90890-01235

5. Remove the driven sprocket ⑧.

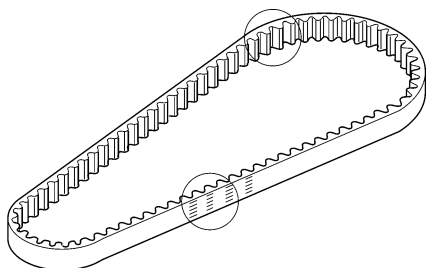


Sheave holder ⑨: 90890-01701

Gear puller ⑩: 90890-06540

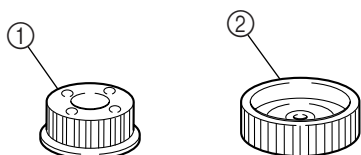
Checking the drive belt and sprockets

1. Check the interior and exterior of the drive belt for cracks, damage, or wear. Replace if necessary.



S69J5570

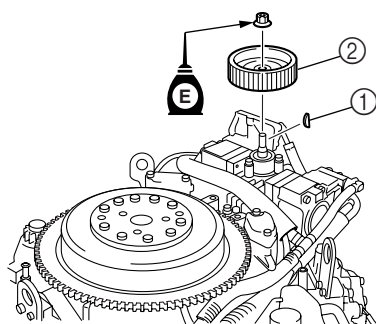
2. Check the drive sprocket ① and driven sprockets ② for cracks, damage, or wear. Replace if necessary.



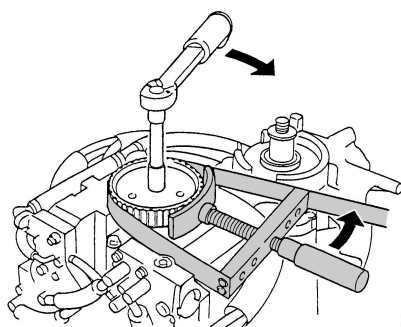
S60V5230

Installing the sprockets and drive belt

1. Install the Woodruff key ①, then the driven sprocket ②.



S60V5240

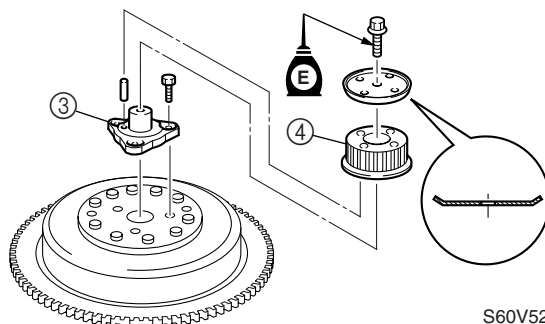


S60V5250

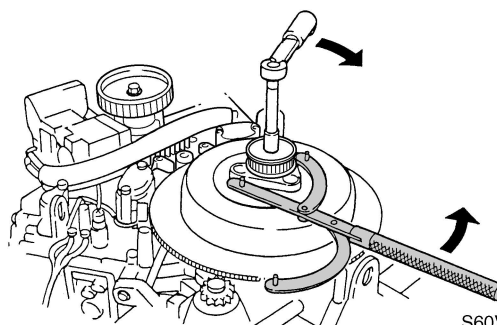


Sheave holder: 90890-01701

2. Install the drive sprocket bracket ③ and the drive sprocket ④.



S60V5260

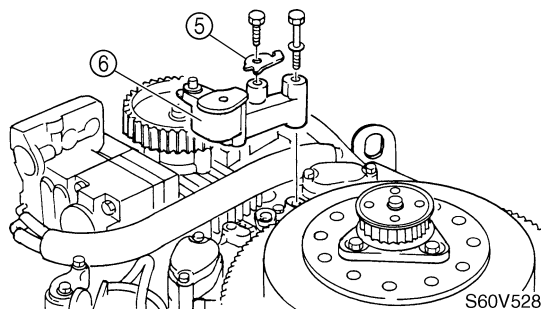


S60V5270



Rotor holder: 90890-01235

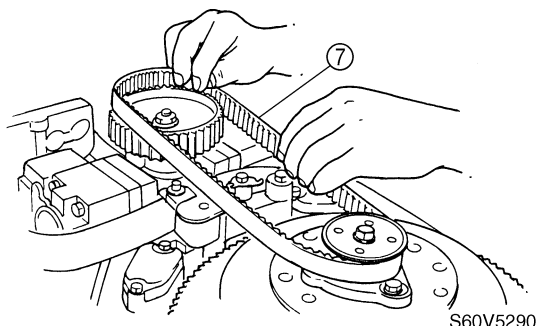
3. Install the spring holder ⑤ and tensioner bracket ⑥.



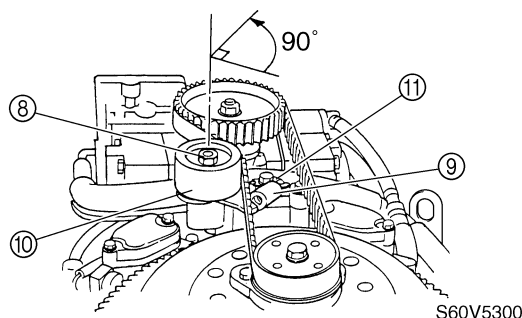
S60V5280



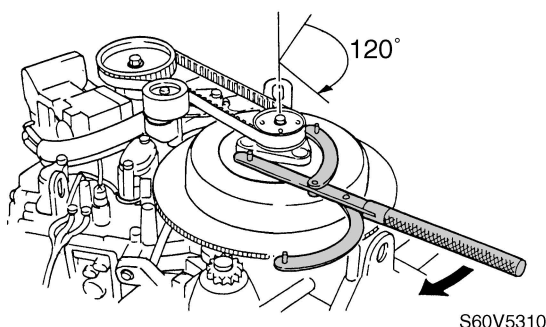
4. Install the drive belt ⑦ from the drive sprocket side with its part number in the upright position, and then turn the belt a half turn counterclockwise to align it.



5. Finger tighten the drive belt tensioner bolt ⑧, and then loosen it 90°.
6. Install the tensioner spring ⑨ onto the drive belt tensioner ⑩ and spring holder ⑪.



7. Turn the flywheel magnet 120° clockwise to take up the drive belt slack.

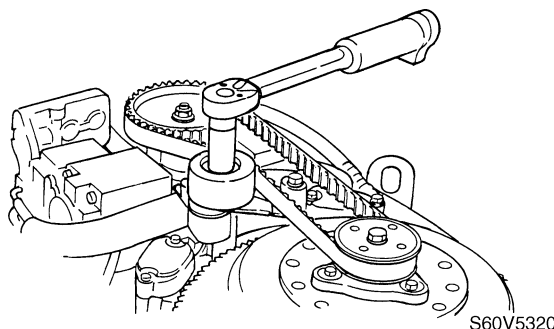


NOTE: Do not turn the flywheel magnet counterclockwise.



Rotor holder: 90890-01235

8. Tighten the drive belt tensioner bolt to the specified torque.



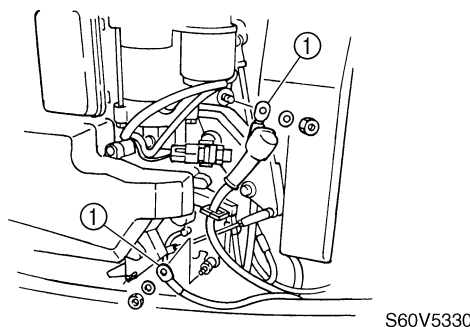
Drive belt tensioner bolt:
39 N·m (3.9 kgf·m, 28.8 ft·lb)

Removing the power unit

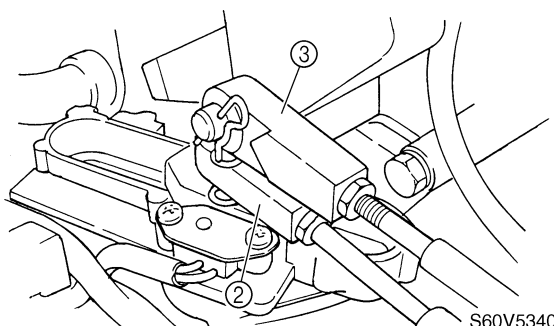
NOTE:

It is recommended to loosen the flywheel magnet nut before removing the power unit to improve working efficiency.

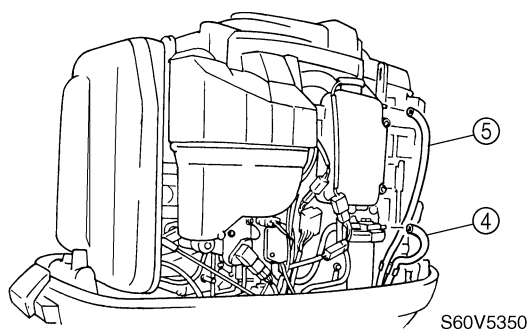
1. Disconnect the battery leads ①.



2. Disconnect the shift cable ② and the throttle cable ③.

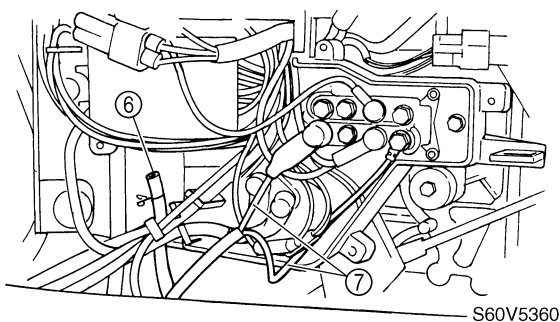


3. Disconnect the fuel hose ④ and the oil hose ⑤.

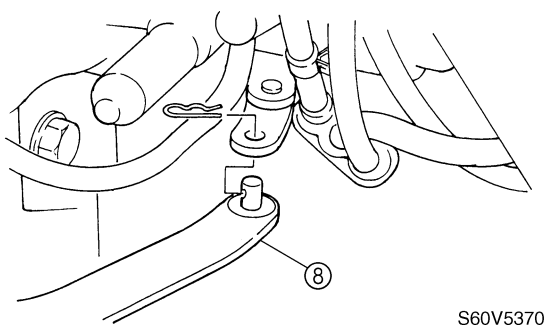


4. Remove the flywheel magnet cover.

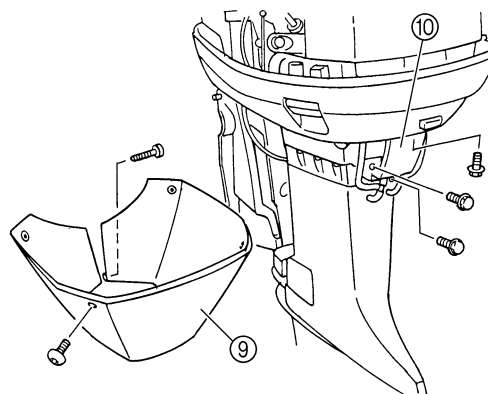
5. Remove the junction box cover, and then disconnect the cooling water hose ⑥ and the PTT motor leads ⑦.



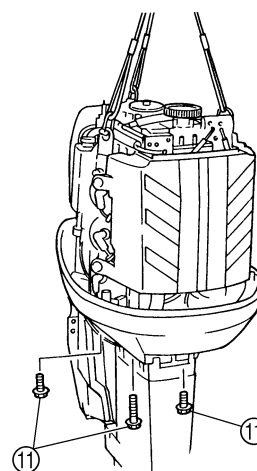
6. Disconnect the PTT switch coupler and the shift lever ⑧.



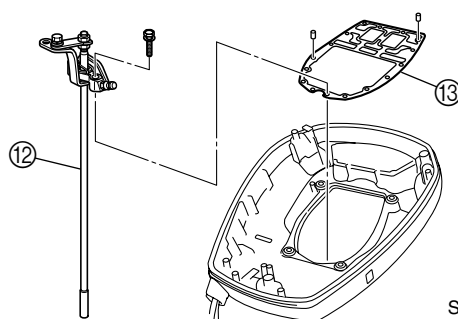
7. Remove the apron ⑨ and the hose joint assembly ⑩.



8. Remove the bolts ⑪, then the power unit.



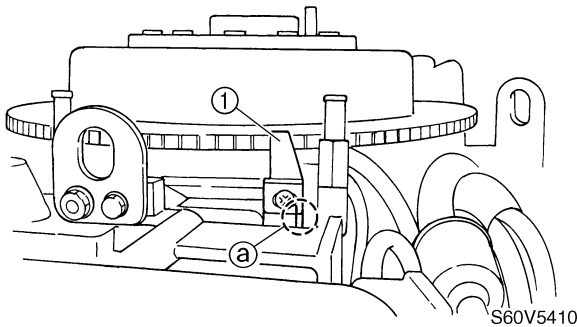
9. Remove the shift rod assembly ⑫ and gasket ⑬.





Removing the flywheel magnet

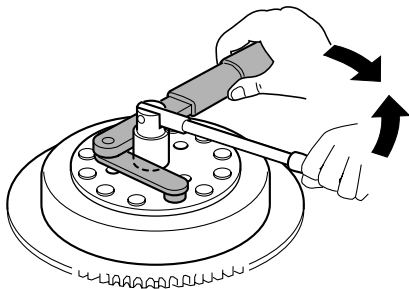
1. Remove the pointer ①.



NOTE:

Make an alignment mark ㊤ at the installation point of the pointer, and then remove the pointer ①.

2. Loosen the flywheel magnet nut.



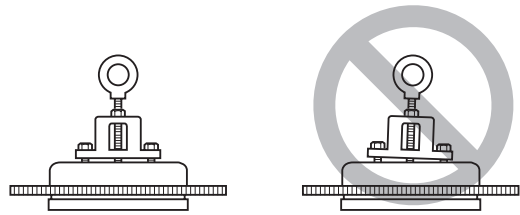
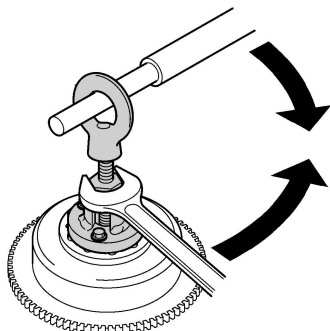
CAUTION:

Apply force in the direction of the arrows shown, to prevent the flywheel holder from slipping off easily.



Flywheel holder: 90890-06522

3. Remove the flywheel magnet.



S60V5470

CAUTION:

To prevent damage to the engine or tools, screw in the flywheel puller set bolts evenly and completely so that the flywheel puller plate is parallel to the flywheel magnet.

NOTE:

Apply force to the crankshaft end until the flywheel magnet comes off the tapered portion of the crankshaft.

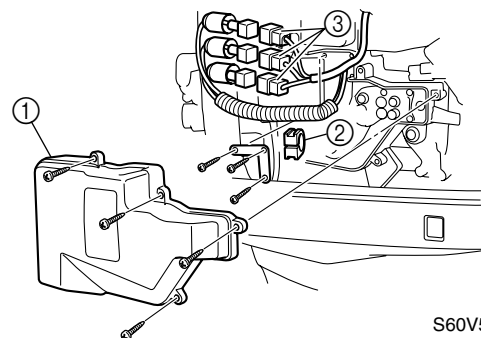


Flywheel puller: 90890-06521

4. Remove the Woodruff key.

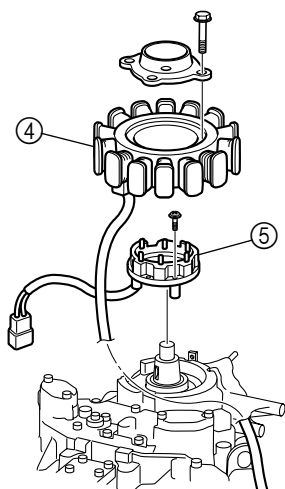
Removing the stator coil and pulser coil

1. Remove the junction box cover ①, and then remove the grommet ②.
2. Disconnect the stator coil couplers ③.



3. Disconnect the pulser coil coupler.

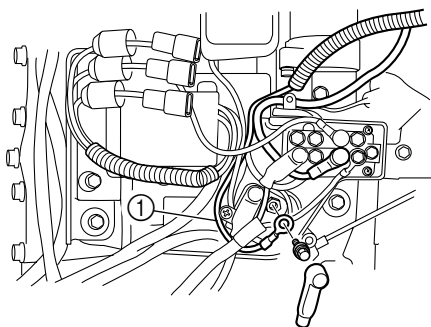
4. Remove the stator coil ④ and pulser coil ⑤.



S60V5490

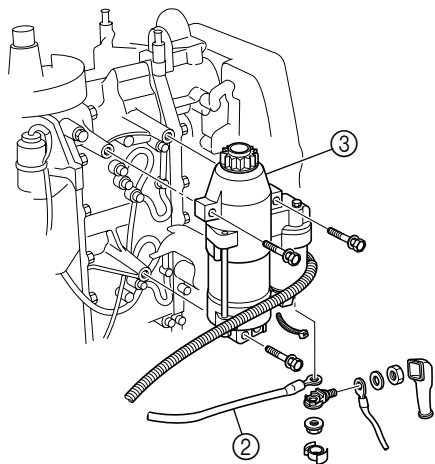
Removing the starter motor

1. Disconnect the starter relay lead ① from the starter relay.



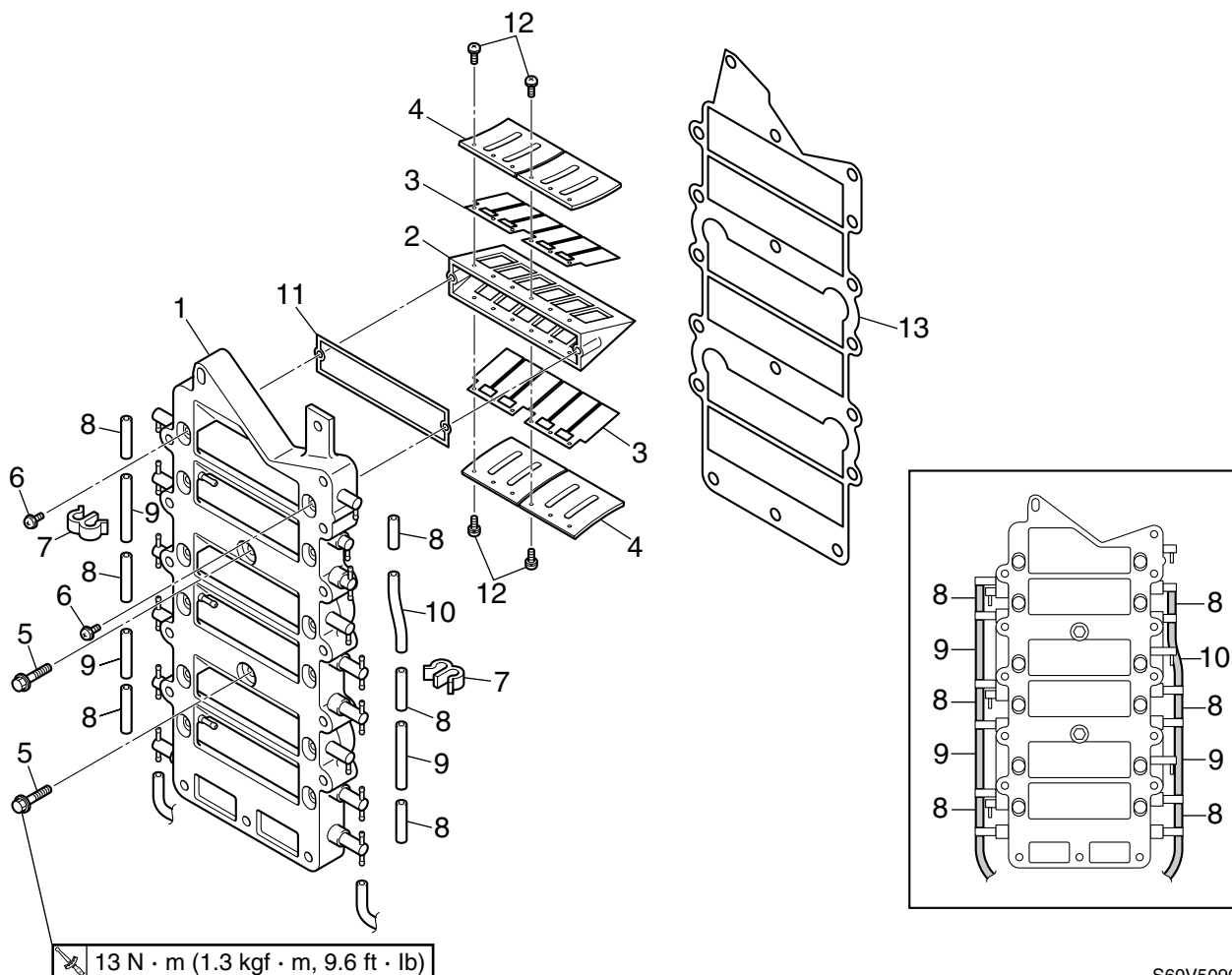
S60V5500

2. Disconnect the PTT relay lead ② from the starter motor.
3. Remove the starter motor ③.



S60V5510

Intake manifold



S60V5090

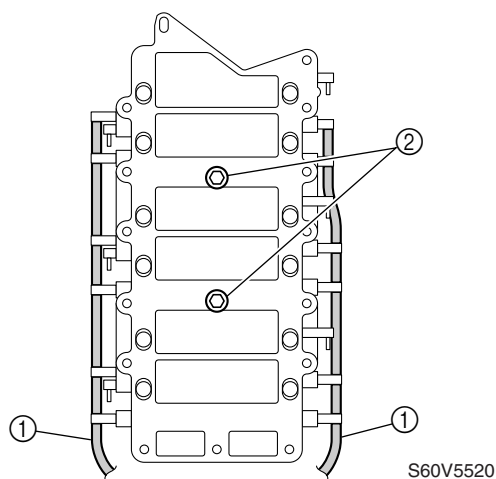
No.	Part name	Q'ty	Remarks
1	Intake manifold	1	M6 × 30 mm ø5 × 16 mm Not reusable ø3 × 6 mm Not reusable
2	Reed valve seat	6	
3	Reed valve	24	
4	Stopper	24	
5	Bolt	2	
6	Screw	12	
7	Holder	2	
8	Hose	6	
9	Hose	3	
10	Hose	1	
11	Gasket	6	
12	Screw	72	
13	Gasket	1	

Removing the intake manifold

1. Disconnect the hoses ①.
2. Remove the intake manifold bolts ②, and then remove the intake manifold.

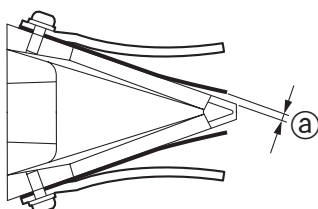


Valve stopper height ⑥:
8 mm (0.31 in)



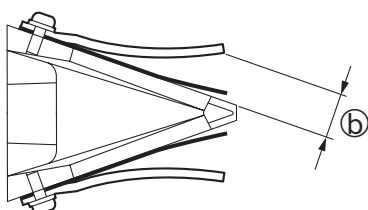
Checking the reed valve

1. Check the reed valves for bends ③. Replace if out of specification.



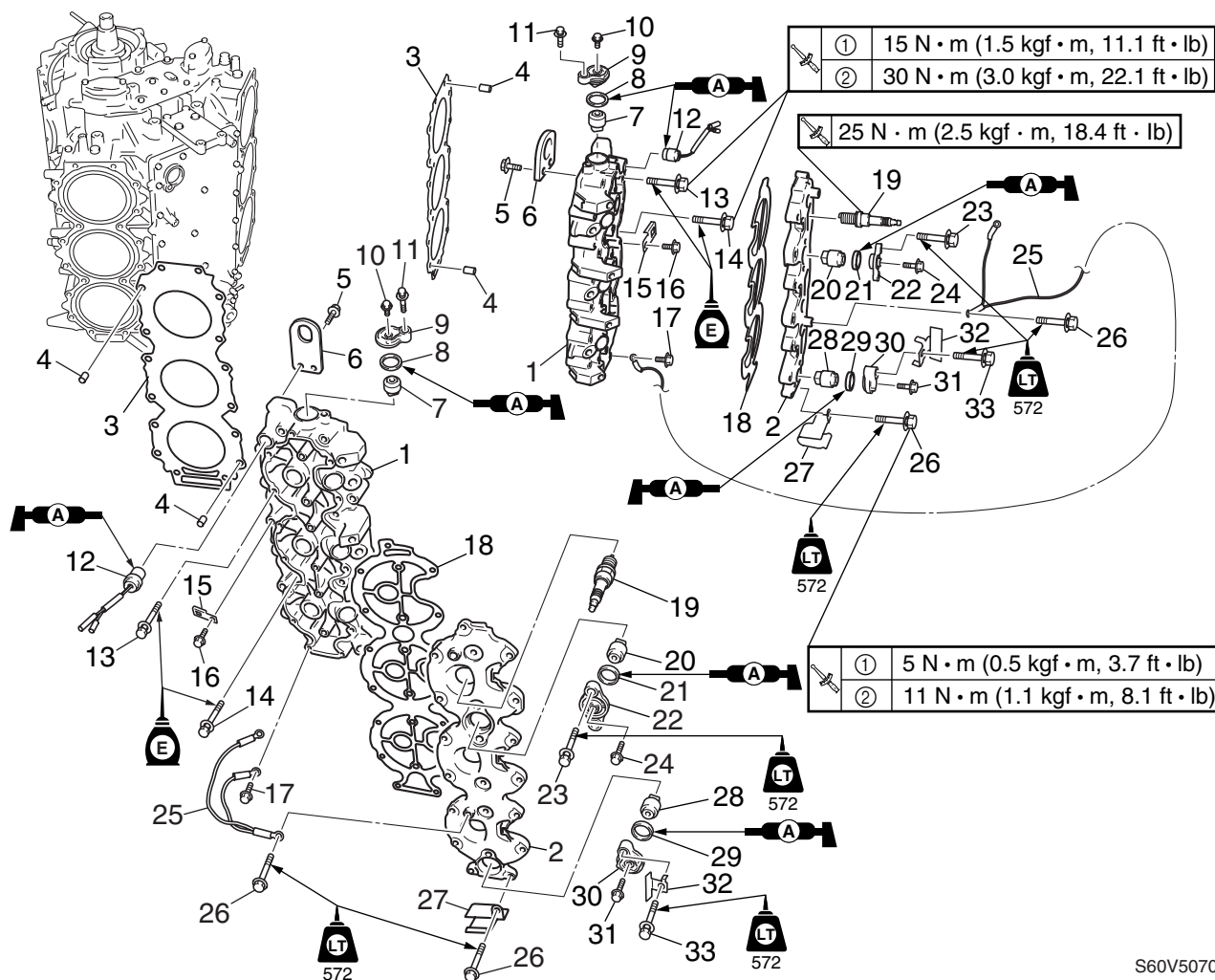
Valve bend limit ③:
0.2 mm (0.008 in)

2. Measure the valve stopper height ④. Replace if out of specification.



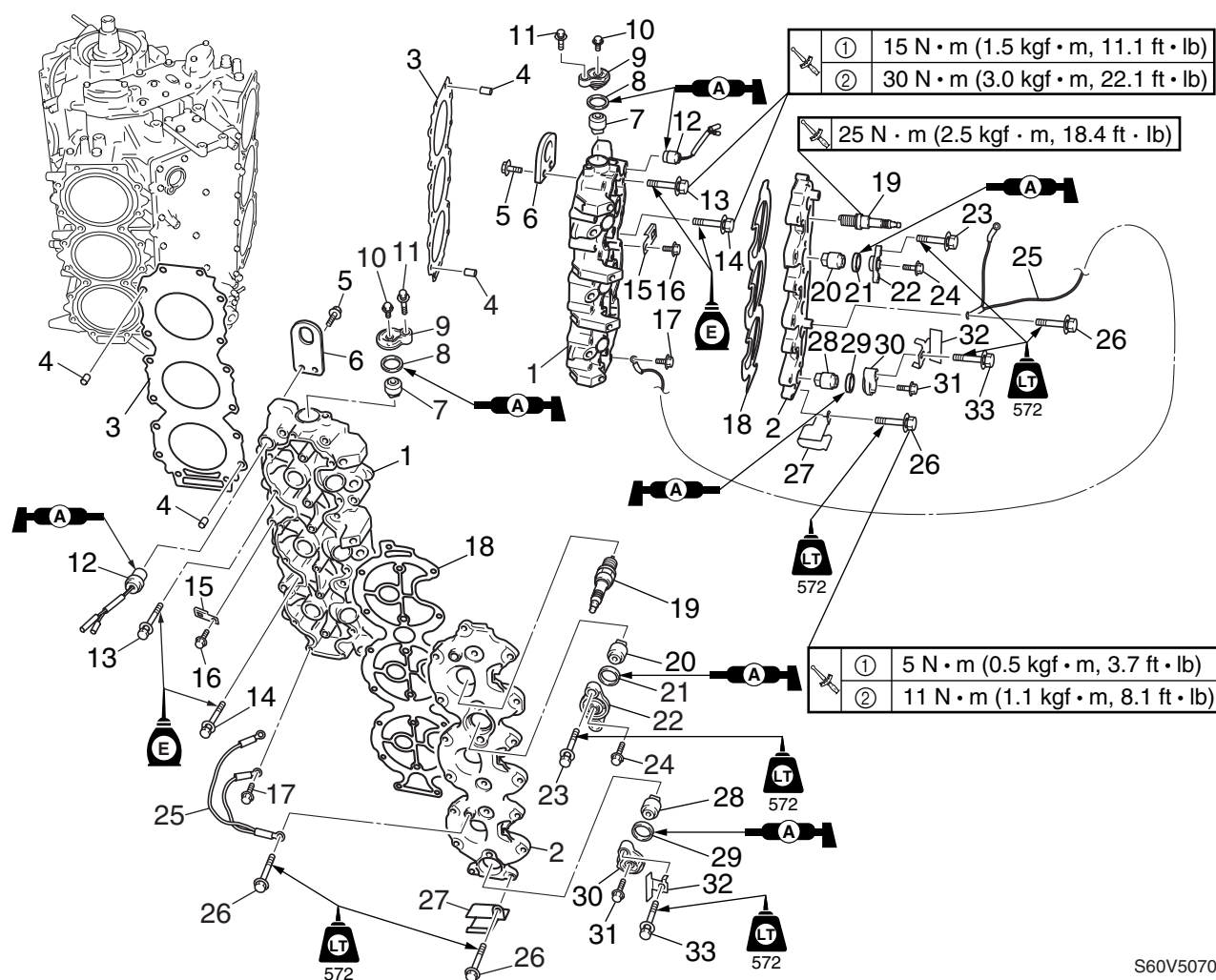


Cylinder head



S60V5070

No.	Part name	Q'ty	Remarks
1	Cylinder head	2	
2	Cylinder head cover	2	
3	Gasket	2	Not reusable
4	Dowel	4	
5	Bolt	4	M6 × 20 mm
6	Engine hanger	2	
7	Anode	2	
8	Grommet	2	
9	Cover	2	
10	Bolt	2	M6 × 20 mm
11	Bolt	2	M8 × 35 mm
12	Thermoswitch	2	
13	Bolt	36	M8 × 70 mm
14	Bolt	4	M8 × 60 mm
15	Plate	3	
16	Bolt	3	M6 × 12 mm
17	Bolt	2	M6 × 12 mm



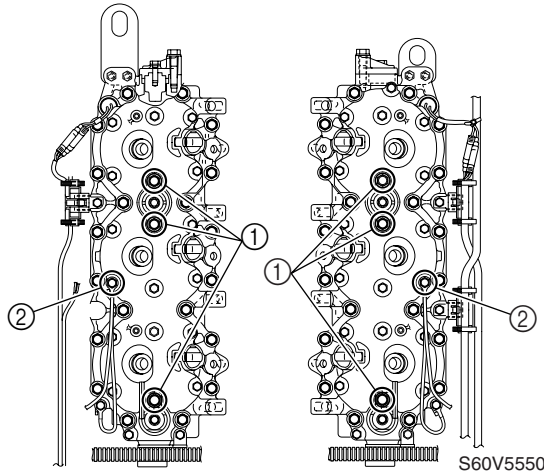
S60V5070

No.	Part name	Q'ty	Remarks
18	Gasket	2	Not reusable
19	Spark plug	6	
20	Anode	2	
21	Grommet	2	
22	Cover	2	
23	Bolt	4	M8 × 45 mm
24	Bolt	2	M6 × 20 mm
25	Ground lead	2	
26	Bolt	36	M6 × 30 mm
27	Holder	2	
28	Anode	2	
29	Grommet	2	
30	Cover	2	
31	Bolt	2	M6 × 20 mm
32	Plate	2	
33	Bolt	2	M8 × 45 mm

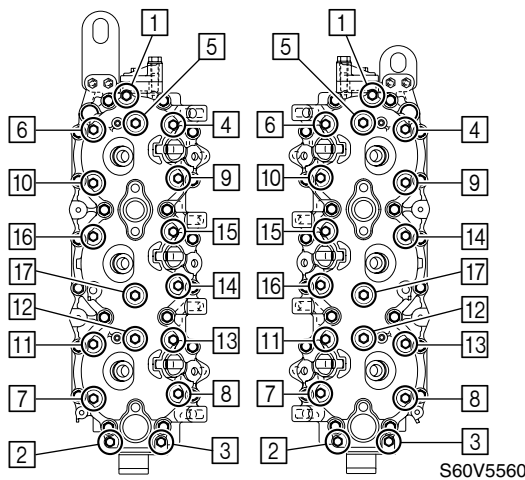


Removing the cylinder head

1. Remove the spark plugs.
2. Remove the anode cover bolts ① and ground lead bolts ②.



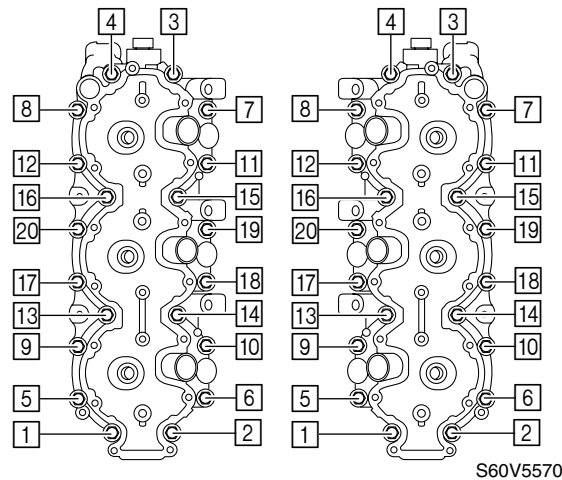
3. Remove the cylinder head cover bolts in the sequence shown.



4. Remove the cylinder head bolts in the sequence shown.

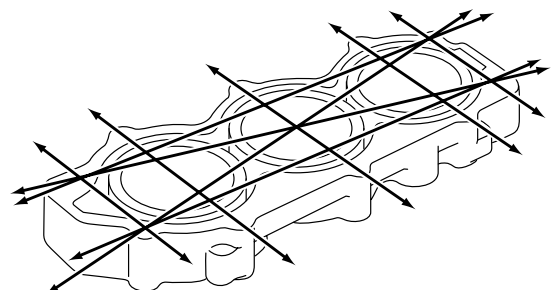
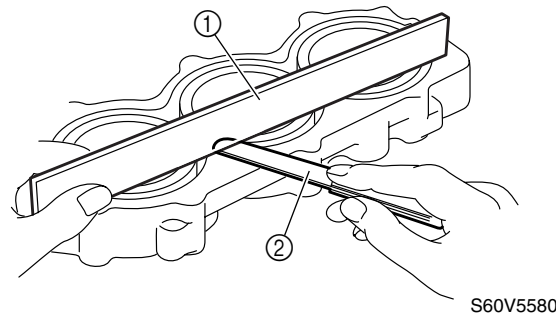
CAUTION:

Do not scratch or damage the mating surfaces of the cylinder head and cylinder block.



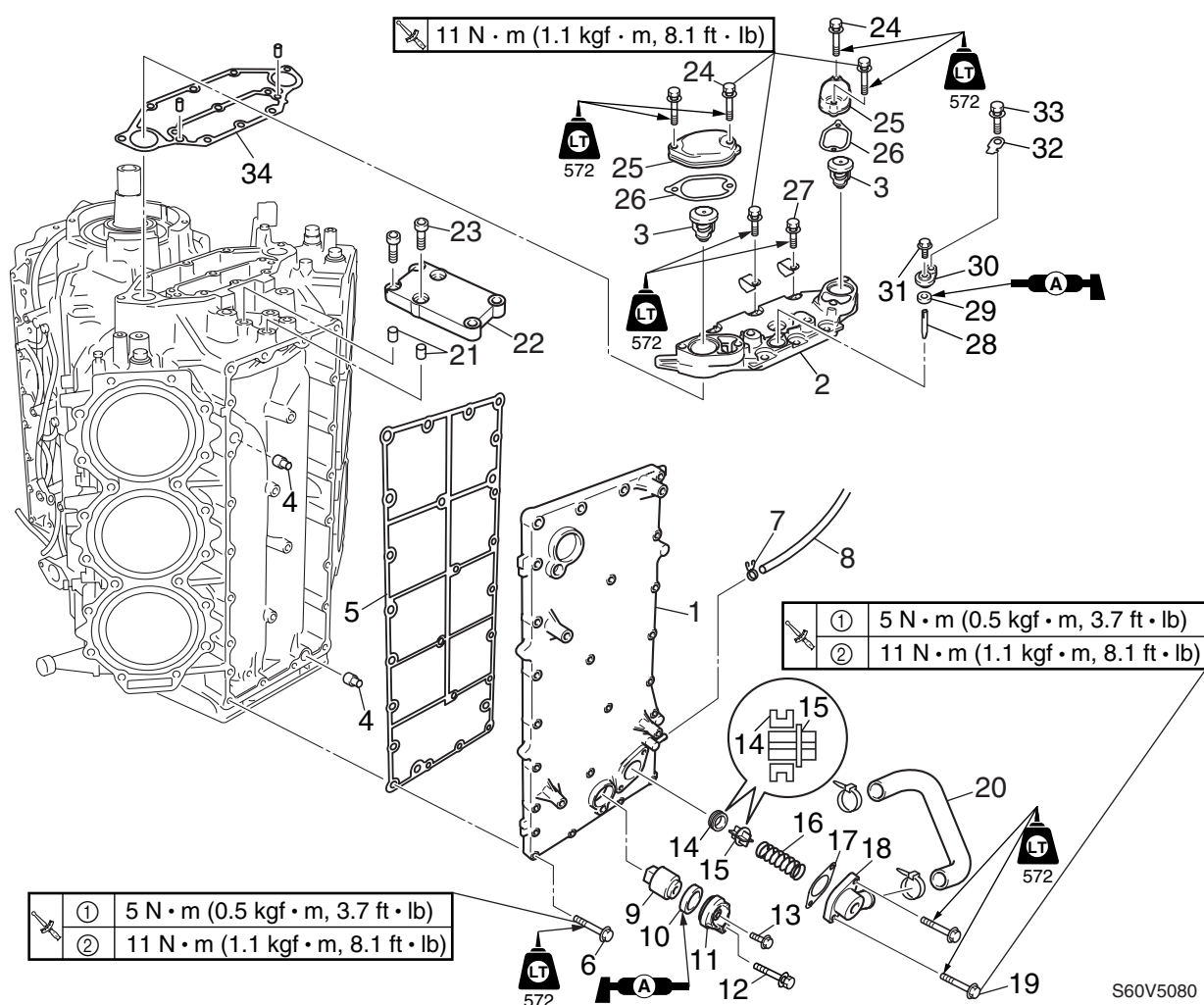
Checking the cylinder head

1. Eliminate carbon deposits from the combustion chambers and check for deterioration.
2. Check the cylinder head warpage using a straightedge ① and thickness gauge ② in four directions as shown. Replace if out of specification.

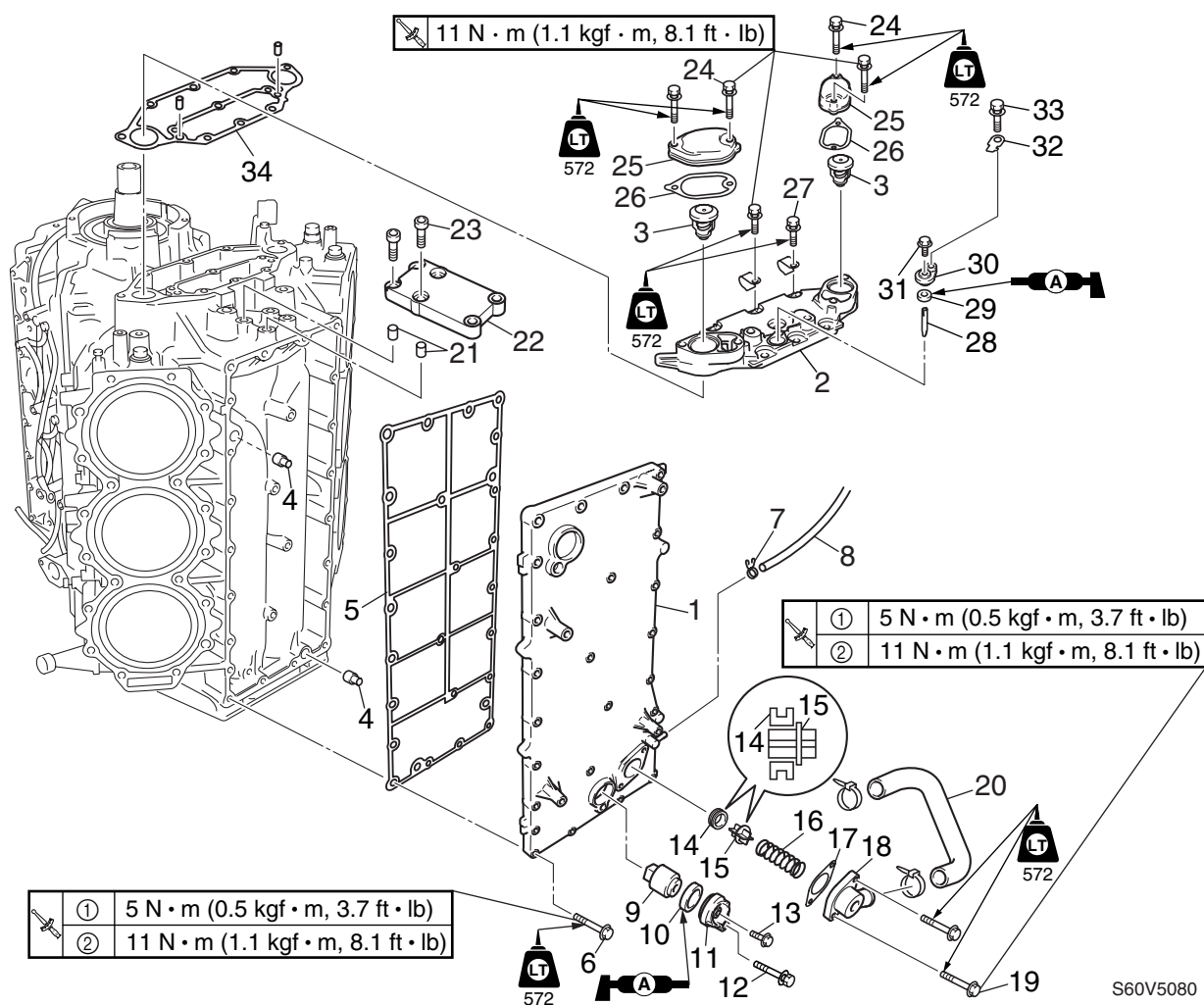


Cylinder head warpage limit:
0.1 mm (0.004 in)

Exhaust and cylinder cover



No.	Part name	Q'ty	Remarks
1	Exhaust outer cover	1	
2	Cover	1	
3	Thermostat	2	
4	Collar	2	
5	Gasket	1	Not reusable
6	Bolt	25	M6 × 25 mm
7	Clamp	1	
8	Hose	1	
9	Anode	1	
10	Grommet	1	
11	Cover	1	
12	Bolt	1	M8 × 30 mm
13	Bolt	1	M6 × 20 mm
14	Grommet	1	
15	Pressure control valve	1	
16	Spring	1	
17	Gasket	1	Not reusable

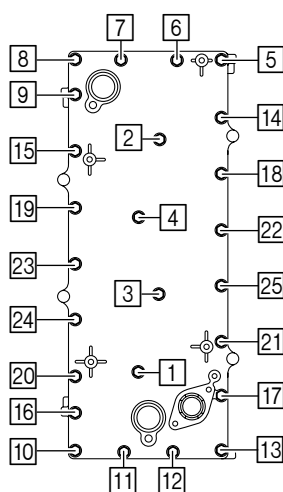


S60V5080

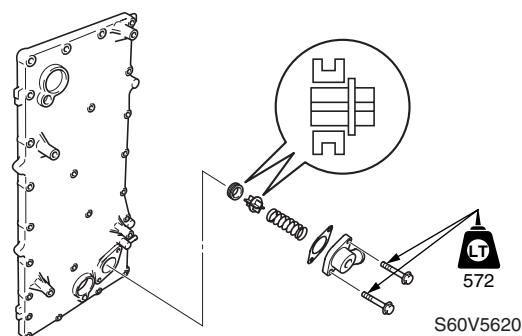
No.	Part name	Q'ty	Remarks
18	Cover	1	
19	Bolt	2	M6 × 20 mm
20	Hose	1	
21	Dowel	2	
22	Bracket	1	
23	Bolt	4	M8 × 25 mm
24	Bolt	4	M6 × 55 mm
25	Cover	2	
26	Gasket	2	Not reusable
27	Bolt	7	M6 × 20 mm
28	Anode	1	
29	Grommet	1	
30	Cover	1	
31	Bolt	1	M5 × 12 mm
32	Plate	1	
33	Bolt	1	M6 × 20 mm
34	Gasket	1	Not reusable

Removing the exhaust cover

1. Remove the exhaust cover bolts in the sequence shown.



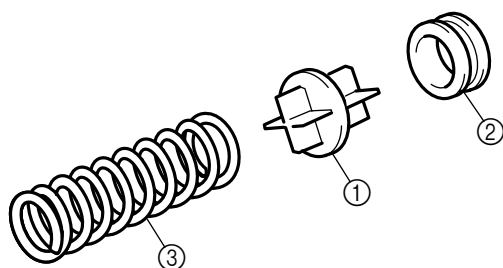
S60V5600



Pressure control valve cover bolt:
1st: 5 N·m (0.5 kgf·m, 3.7 ft·lb)
2nd: 11 N·m (1.1 kgf·m, 8.1 ft·lb)

Checking the pressure control valve

1. Remove the pressure control valve.
2. Check the pressure control valve ① for wear or damage. Replace if necessary.
3. Check the grommet ② for deformation. Replace if necessary.
4. Check the spring ③ for fatigue or deformation. Replace it if necessary.



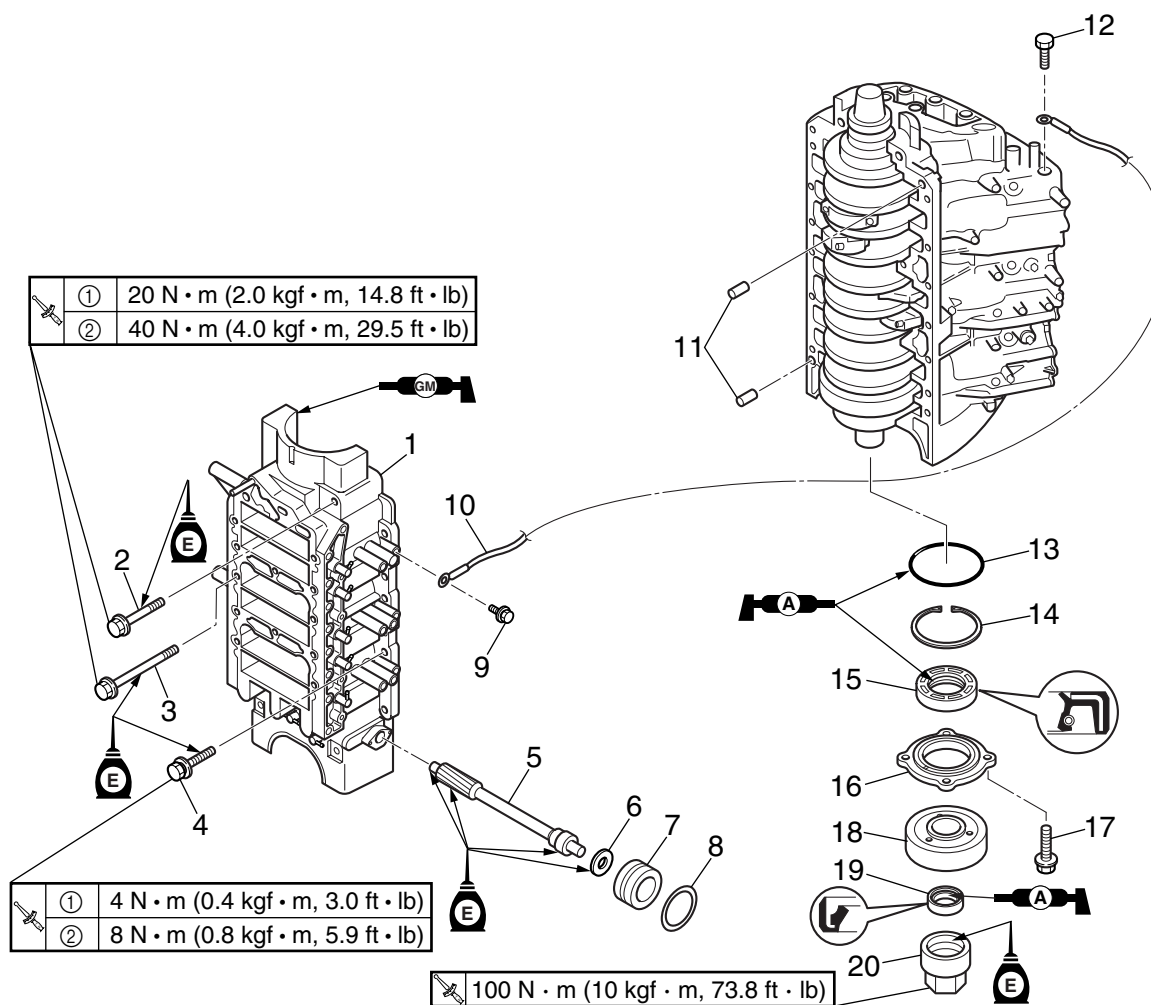
S60V5610

Installing the pressure control valve

1. Install a new gasket and the pressure control valve, and then tighten the bolts to the specified torques in two stages.

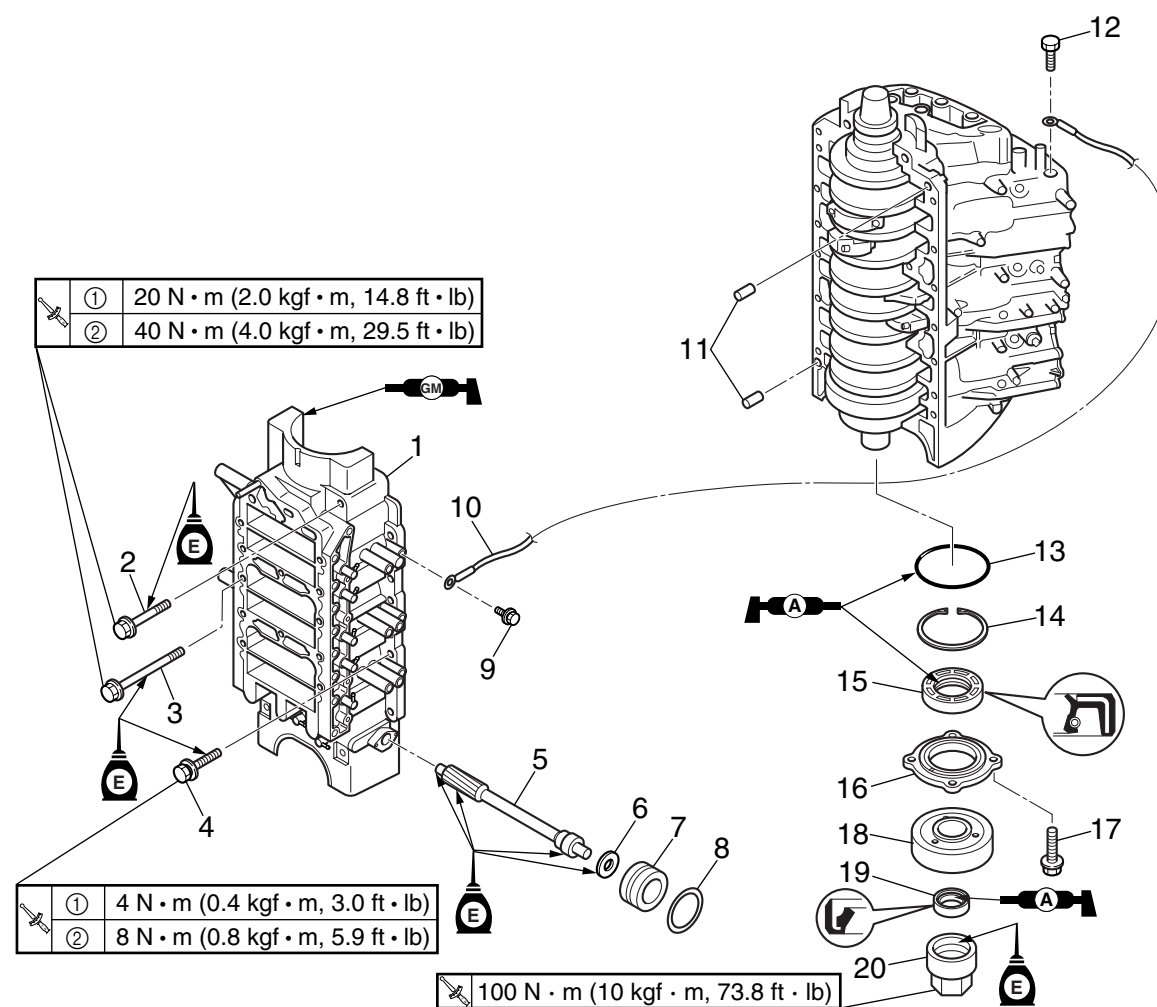


Crankcase



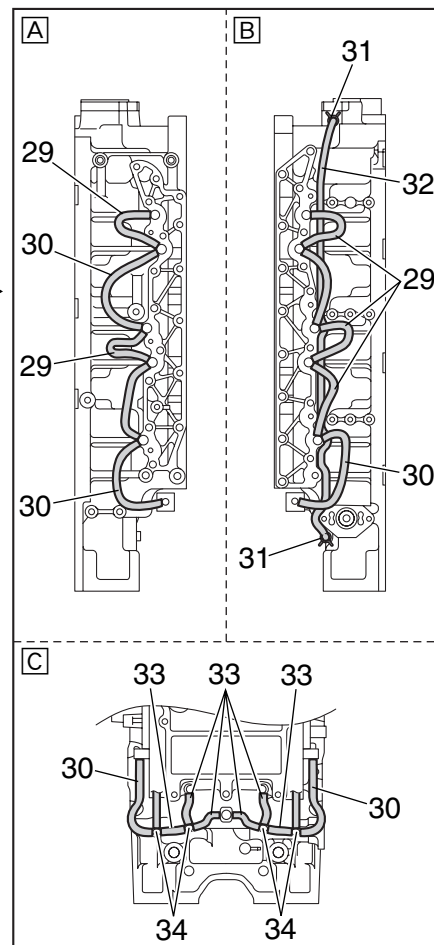
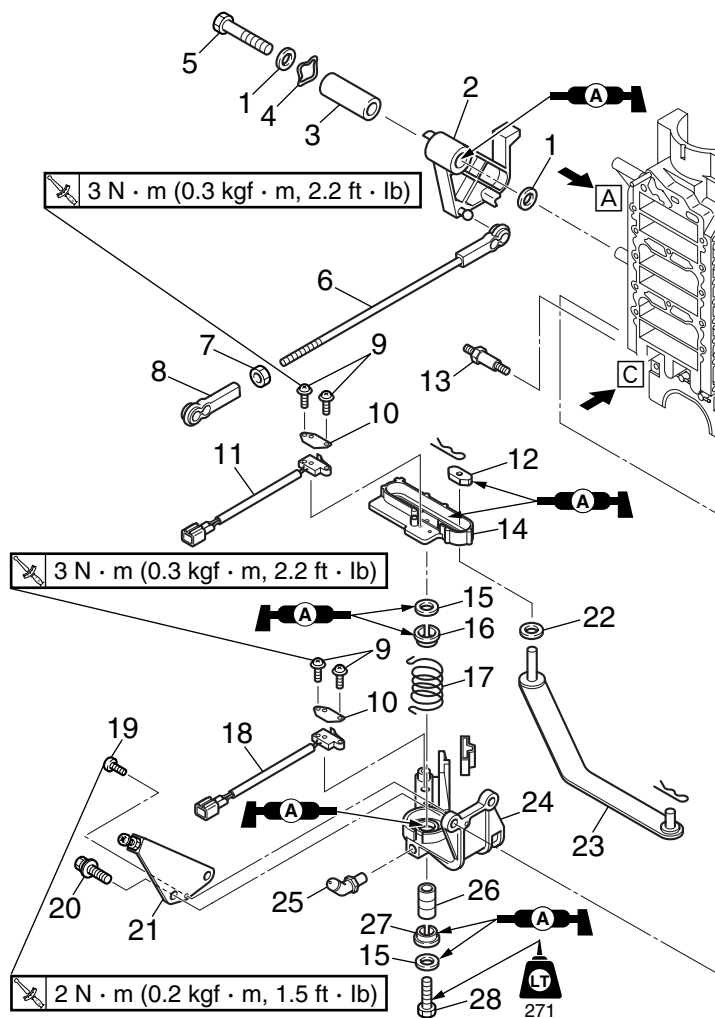
S60V5100

No.	Part name	Q'ty	Remarks
1	Crankcase	1	
2	Bolt	4	M10 × 90 mm
3	Bolt	4	M10 × 130 mm
4	Bolt	14	M6 × 30 mm
5	Oil pump driven gear	1	
6	Washer	1	
7	Grommet	1	
8	O-ring	1	Not reusable
9	Bolt	1	M6 × 12 mm
10	Ground lead	1	
11	Dowel	2	
12	Bolt	1	M6 × 12 mm
13	O-ring	1	Not reusable
14	Circlip	1	
15	Oil seal	1	Not reusable
16	Housing	1	
17	Bolt	4	M6 × 20 mm



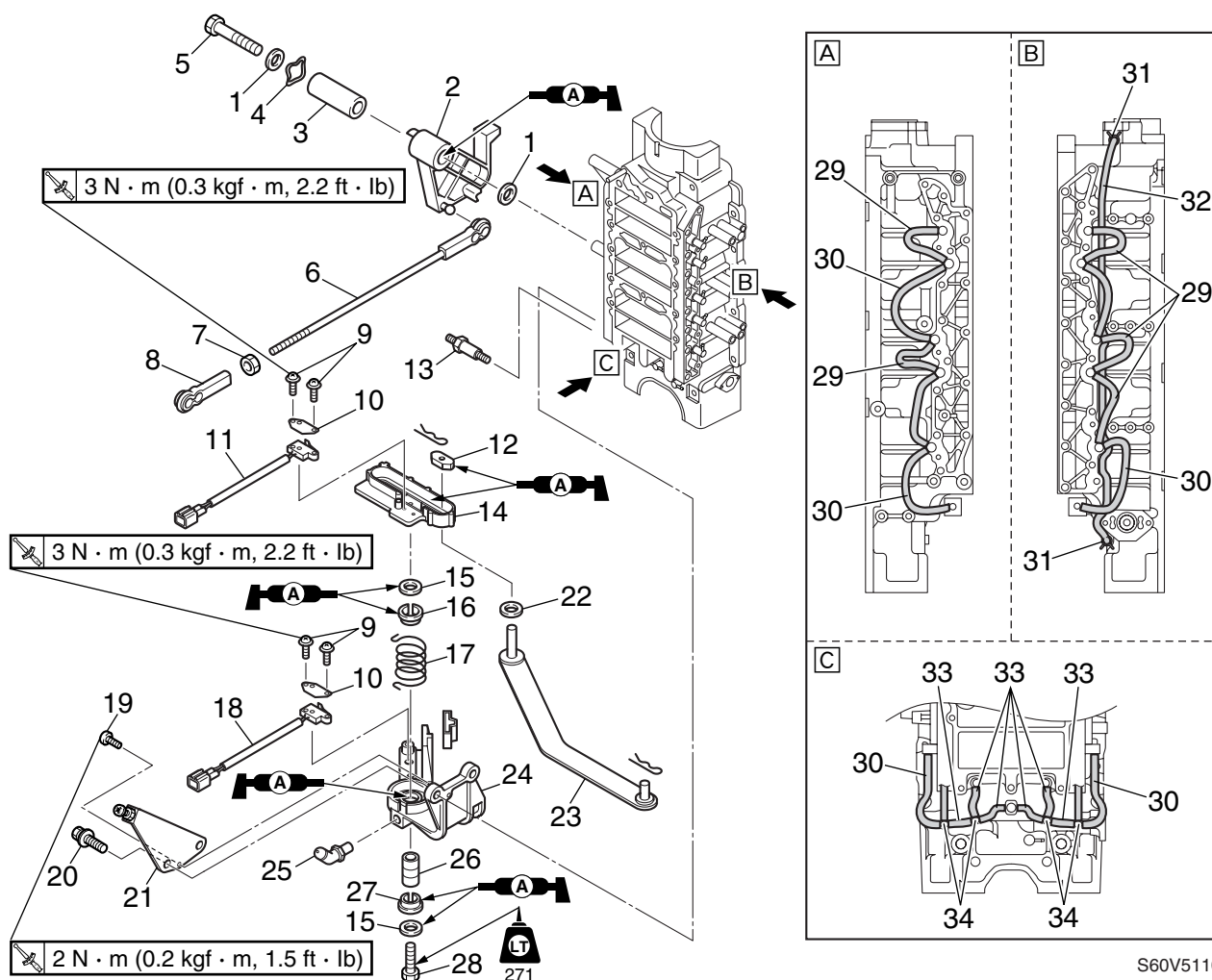
S60V5100

No.	Part name	Q'ty	Remarks
18	Crankshaft balancer	1	Not reusable
19	Oil seal	1	
20	Nut	1	



S60V5110

No.	Part name	Q'ty	Remarks
1	Washer	2	M8 × 45 mm
2	Throttle lever	1	
3	Collar	1	
4	Wave washer	1	
5	Bolt	1	
6	Throttle link rod	1	ø4 × 16 mm
7	Nut	1	
8	Joint	1	
9	Screw	4	
10	Plate	2	
11	Shift position switch	1	M8 × 11 mm
12	Bushing	1	
13	Bolt	1	
14	Bracket	1	
15	Washer	2	
16	Bushing	1	
17	Spring	1	



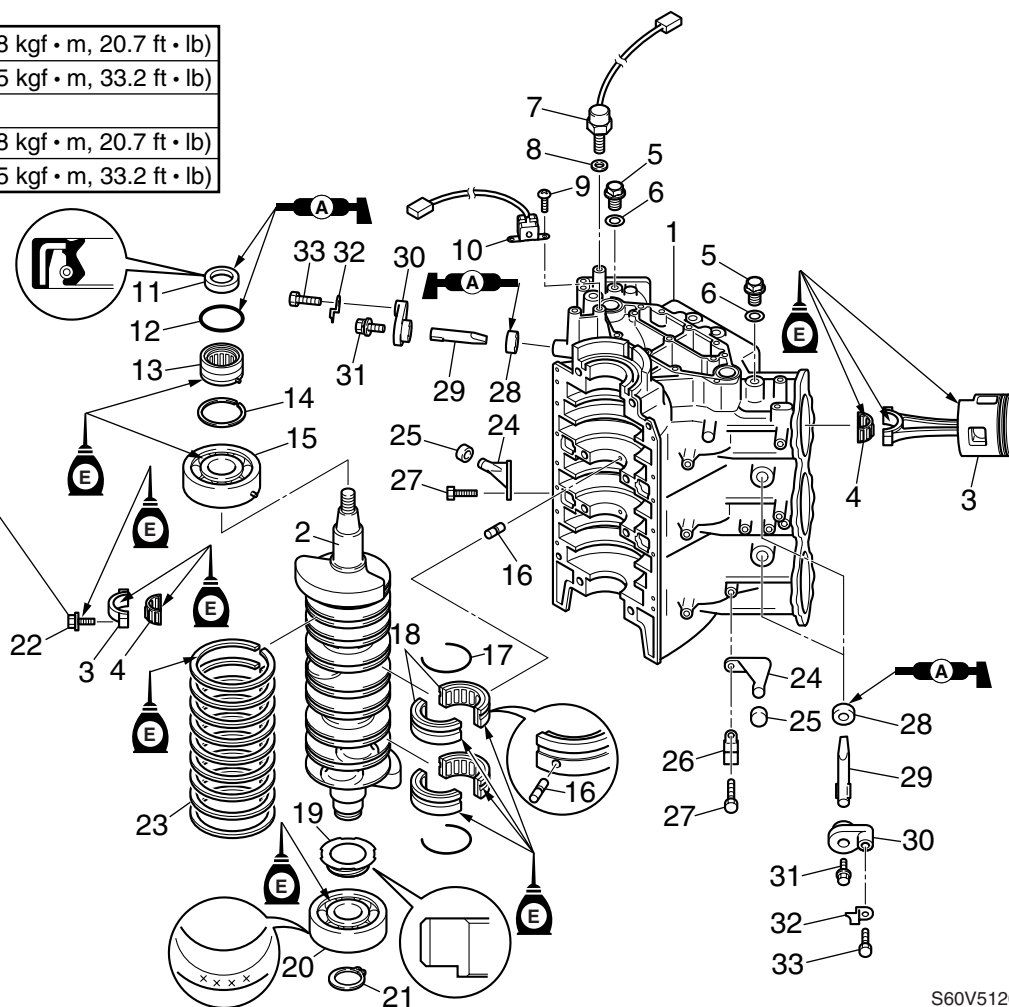
S60V5110

No.	Part name	Q'ty	Remarks
18	Shift cut switch	1	M6 × 16 mm
19	Screw	1	
20	Bolt	2	
21	Stopper screw assembly	1	
22	Washer	1	
23	Shift lever	1	
24	Bracket	1	
25	Grease nipple	1	
26	Collar	1	
27	Bushing	1	
28	Bolt	1	M8 × 35 mm
29	Hose	6	
30	Hose	3	
31	Clamp	2	
32	Hose	1	
33	Hose	6	
34	Joint	4	



Cylinder block

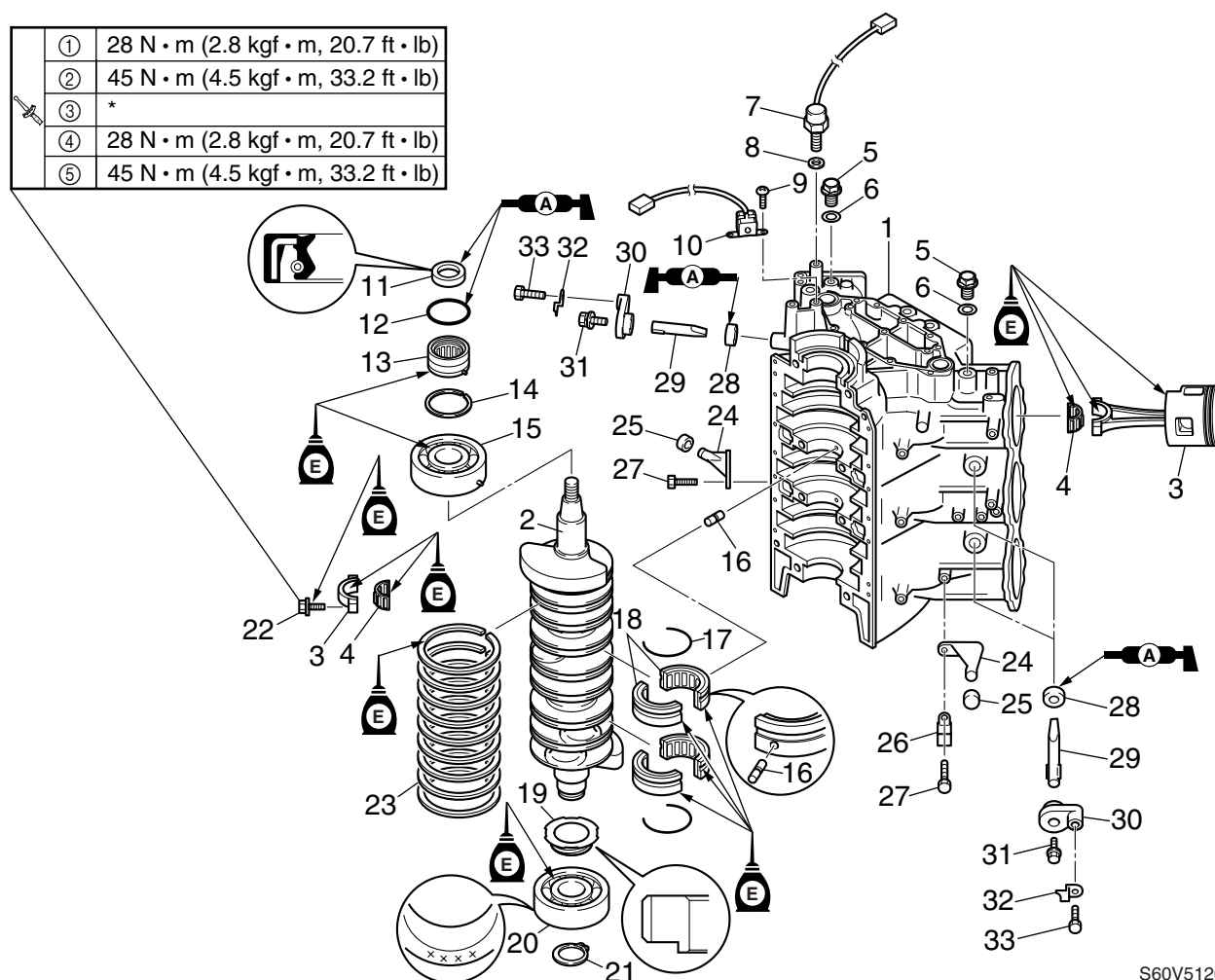
①	28 N · m (2.8 kgf · m, 20.7 ft · lb)
②	45 N · m (4.5 kgf · m, 33.2 ft · lb)
③	*
④	28 N · m (2.8 kgf · m, 20.7 ft · lb)
⑤	45 N · m (4.5 kgf · m, 33.2 ft · lb)



S60V5120

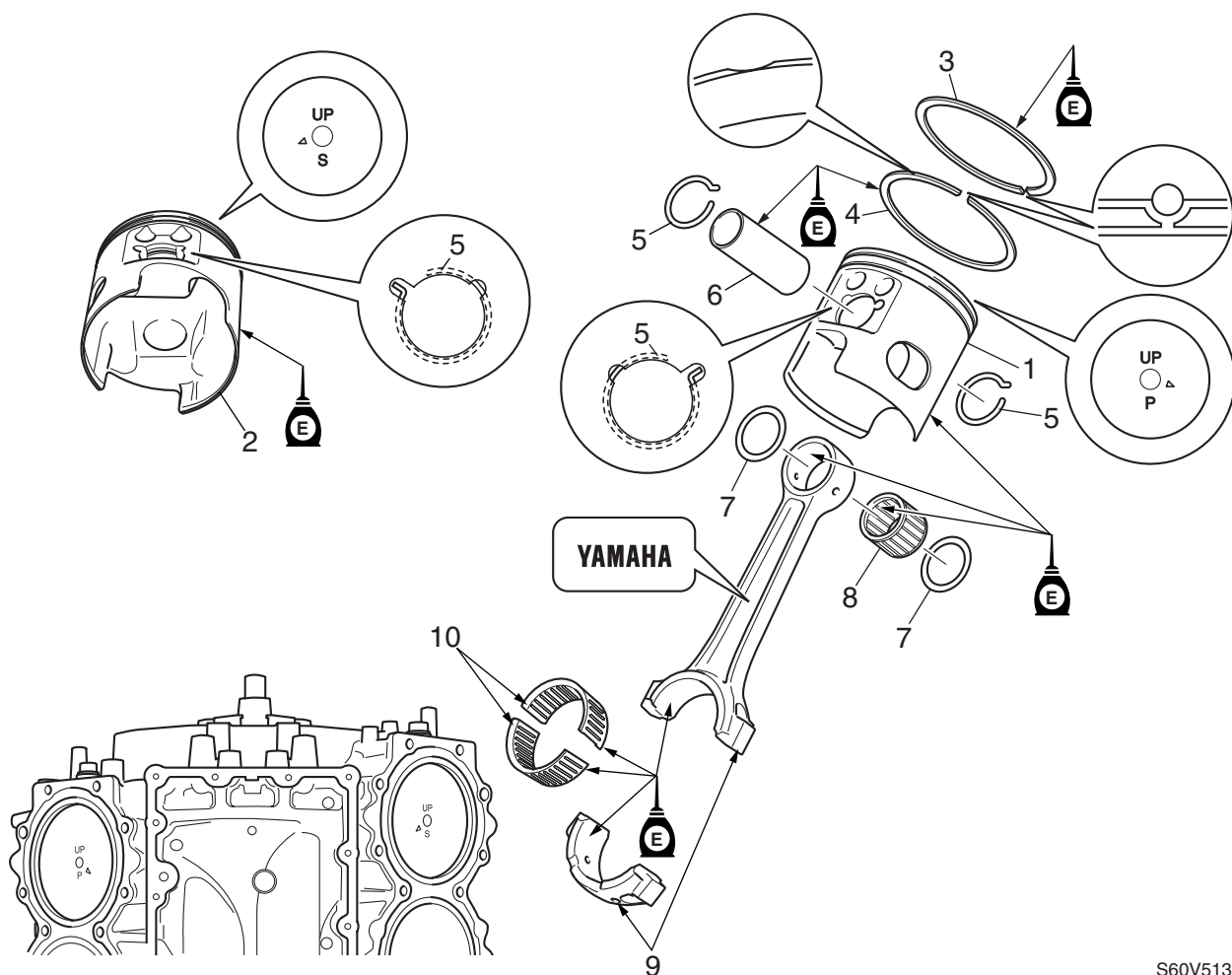
No.	Part name	Q'ty	Remarks
1	Cylinder block	1	
2	Crankshaft	1	
3	Piston and connecting rod assembly	6	
4	Connecting rod bearing	6	
5	Bolt	2	M14 × 12 mm
6	Gasket	2	Not reusable
7	Engine temperature sensor	1	
8	Gasket	1	Not reusable
9	Screw	2	ø5 × 12 mm
10	Crank position sensor	1	
11	Oil seal	1	Not reusable
12	O-ring	1	Not reusable
13	Roller bearing	1	
14	Stopper ring	1	
15	Ball bearing	1	Not reusable
16	Pin	2	

*: Loosen completely



S60V5120

No.	Part name	Q'ty	Remarks
17	Circlip	2	
18	Main bearing	2	
19	Oil pump drive gear	1	
20	Ball bearing	1	Not reusable
21	Circlip	1	
22	Bolt	12	M9 × 28 mm
23	Seal ring	9	
24	Stopper	2	
25	Cap	2	
26	Holder	1	
27	Bolt	4	M6 × 20 mm
28	Grommet	3	
29	Anode	3	
30	Cover	3	
31	Bolt	3	M5 × 12 mm
32	Plate	3	
33	Bolt	3	M6 × 20 mm

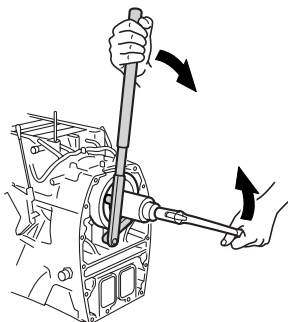


S60V5130

No.	Part name	Q'ty	Remarks
1	Piston	3	Starboard
2	Piston	3	Port
3	Top ring	6	
4	2nd piston ring	6	
5	Clip	12	Not reusable
6	Piston pin	6	
7	Washer	12	
8	Needle bearing	6	
9	Connecting rod	6	
10	Connecting rod bearing	6	

Removing the crankcase

1. Remove the crankshaft balancer nut.



S60V5640

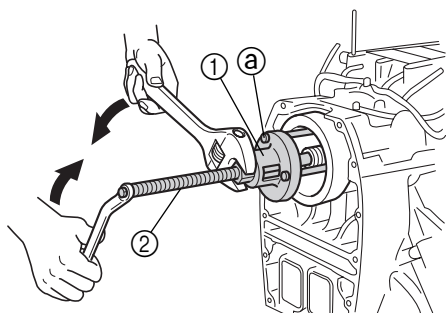
CAUTION:

Apply force in the direction of the arrows shown, to prevent the flywheel holder from slipping off easily.

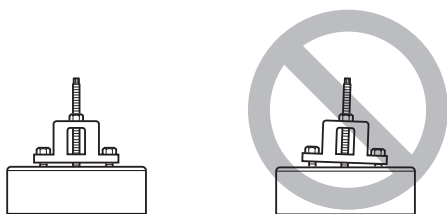


Flywheel holder: 90890-06522

2. Remove the crankshaft balancer.



S60V5670



S60V5680

CAUTION:

To prevent damage to the engine or tools, screw in the flywheel puller specified bolts evenly and completely so that the flywheel puller plate is parallel to the crankshaft balancer.

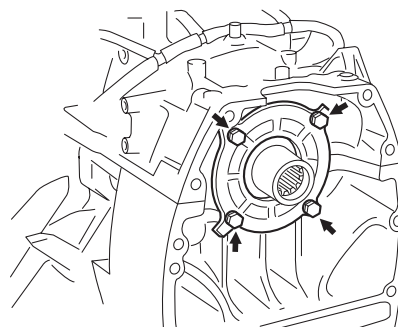
NOTE:

- Apply force to the crankshaft end until the crankshaft balancer comes off the tapered portion of the crankshaft.
- Use bolts ① with the specified measurements.



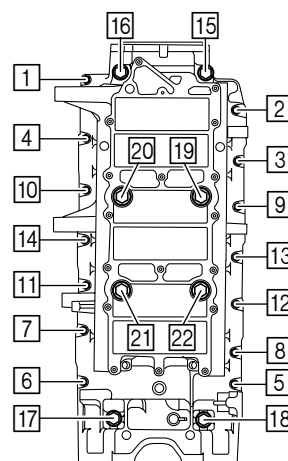
Flywheel puller ①: 90890-06521
Bearing outer race puller assembly ②:
90890-06523
Specified bolts ③: M8 × 80 mm

3. Remove the oil seal housing.



S60V5690

4. Remove the crankcase bolts in the sequence shown.

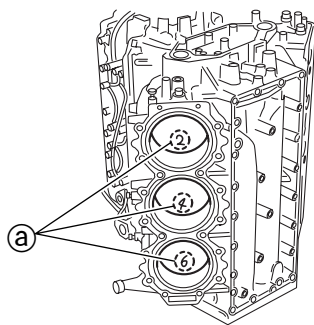


S60V5700

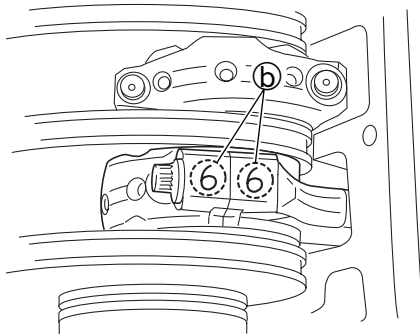


Removing the piston and connecting rod assemblies and crankshaft assembly

1. Remove the connecting rod bolts and the connecting rod caps, and then remove the piston and connecting rod assemblies.



S60V5710

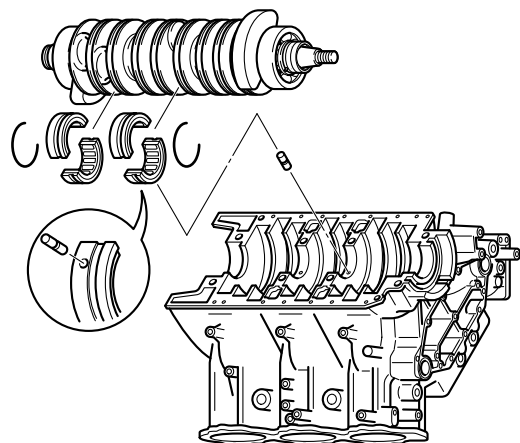


S60V5720

NOTE:

- Be sure to keep the bearings in the order as they were removed.
- Mark each piston with the identification number ③ of the corresponding cylinder. Also, mark each connecting rod and connecting rod cap with an identification number ⑥ as shown.
- Do not mix the connecting rods and caps. Keep them organized in their proper groups.

2. Remove the crankshaft assembly.



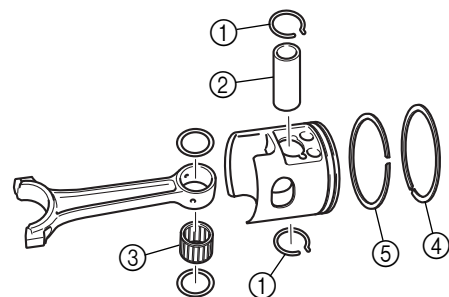
S60V5730

NOTE:

Be sure to keep the bearings in the order as they were removed.

Disassembling the piston and connecting rod assemblies

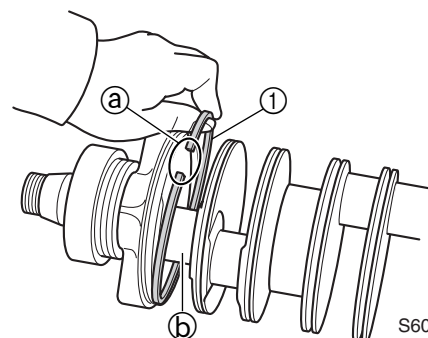
1. Remove the clips ① with pliers, and then remove the piston pin ② and needle bearing ③.
2. Remove the top ring ④ and 2nd piston ring ⑤.



S60V5740

Disassembling the crankshaft

1. Remove the seal rings ①.

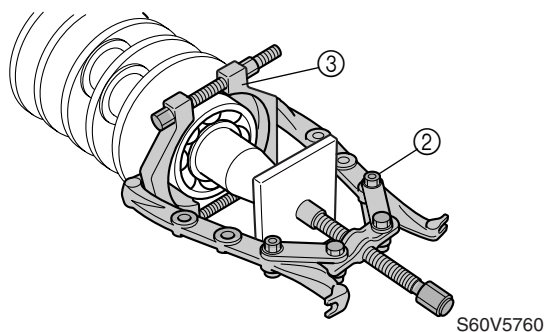


S60V5750

NOTE:

To remove the seal rings ①, widen the seal ring end gap ②, and then remove the ring from the groove and the crankpin ③.

2. Remove the roller bearing.
3. Remove the upper ball bearing.

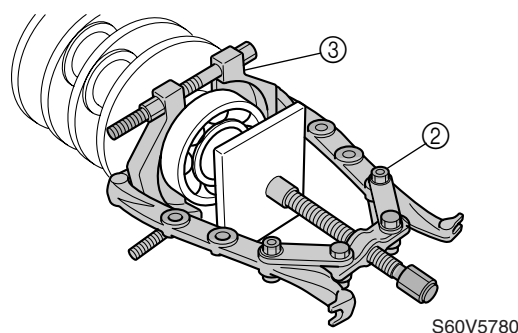
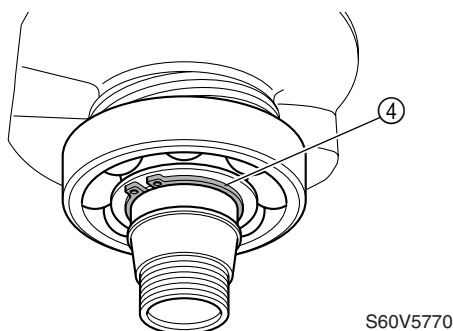
**CAUTION:**

Do not reuse the ball bearing, always replace it with a new one.



Gear puller ②: 90890-06540
Bearing separator ③:
(commercially available)

4. Remove the circlip ④, and then remove the lower ball bearing.

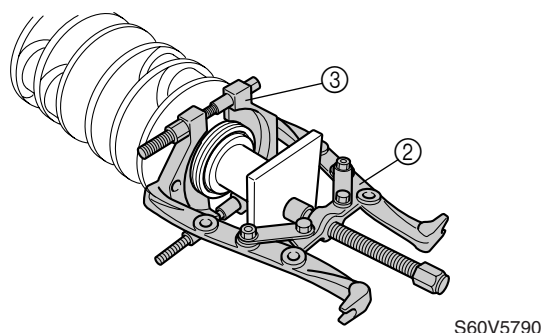
**CAUTION:**

Do not reuse the ball bearing, always replace it with a new one.



Gear puller ②: 90890-06540
Bearing separator ③:
(commercially available)

5. Remove the oil pump drive gear.

**⚠ WARNING**

Do not reuse the oil pump drive gear, always replace it with a new one.



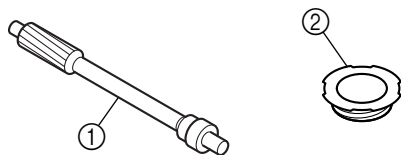
Gear puller ②: 90890-06540
Bearing separator ③:
(commercially available)

5



Checking the oil pump driven gear and the oil pump drive gear

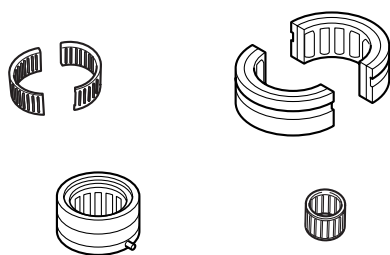
1. Check the oil pump driven gear ① and the oil pump drive gear ② for cracks, damage, or wear. Replace if necessary.



S60V5800

Checking the bearings

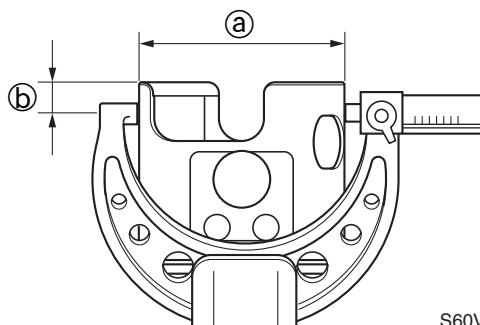
1. Check the bearings for pitting or rumbling. Replace if necessary.



S60V5810

Checking the piston diameter

1. Measure the piston outside diameter at the specified measuring point. Replace if out of specification.



S60V5820



Piston diameter (a):

92.840–92.860 mm

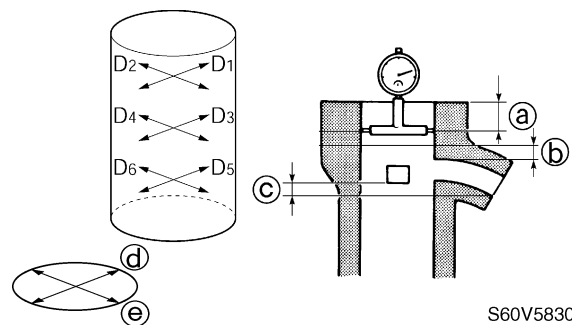
(3.6551–3.6559 in)

Measuring point (b):

10 mm (0.39 in) up from the bottom of the piston skirt

Checking the cylinder bore

1. Measure the cylinder bore (D_1 – D_6) at measuring points (a), (b), and (c), and in direction (d) (D_1 , D_3 , D_5), which is parallel to the crankshaft, and direction (e) (D_2 , D_4 , D_6), which is at a right angle to the crankshaft.



S60V5830

(a): 10 mm (0.39 in) from the cylinder block surface

(b): 5 mm (0.20 in) above the exhaust port upper edge

(c): 5 mm (0.20 in) below the scavenging port lower edge



Cylinder bore (D_1 – D_6):

93.000–93.020 mm

(3.6614–3.6622 in)

2. Calculate the taper limit. Replace or rebores the cylinder block if out of specification.



Taper limit:

D_1 – D_5 (direction (d))

D_2 – D_6 (direction (e))

0.08 mm (0.0031 in)

3. Calculate the out-of-round limit. Replace or rebores the cylinder block if out of specification.



Out-of-round limit:

$D_2 - D_1$ (measuring point ③)

$D_6 - D_5$ (measuring point ③)

0.05 mm (0.0020 in)

Checking the piston clearance

1. Calculate the piston clearance using the piston outside diameter and the cylinder bore specifications. Replace the piston and piston rings as a set or the cylinder block or all parts, or rebore the cylinder if out of specification.



Piston clearance:

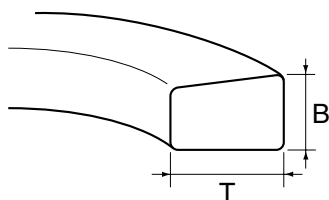
Cylinder bore – piston diameter

0.155–0.161 mm

(0.0061–0.0063 in)

Checking the piston rings

1. Check the piston ring dimensions of B and T. Replace if out of specification.



S60V5840



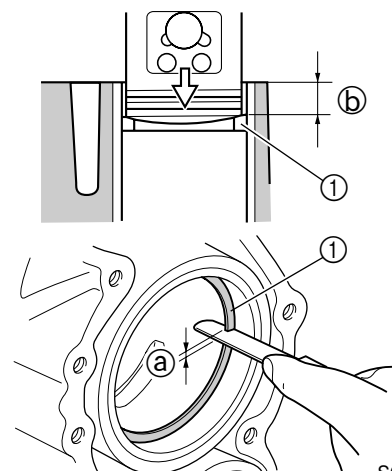
Piston ring dimensions:

Top ring and 2nd piston ring:

B: 2.05 mm (0.0807 in)

T: 2.7–2.9 mm (0.106–0.114 in)

2. Level the piston rings ① in a cylinder with a piston crown.
3. Check the piston ring end gap ③ at the specified measuring point. Replace if out of specification.



S60V5850



Piston ring end gap ③:

Top ring:

0.30–0.40 mm

(0.0118–0.0157 in)

2nd piston ring:

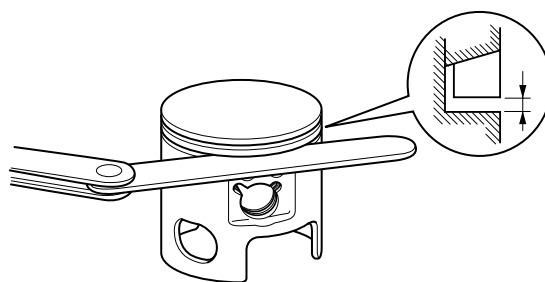
0.30–0.45 mm

(0.0118–0.0177 in)

Measuring point ③: 20 mm (0.8 in)

Checking the piston ring side clearance

1. Measure the piston ring side clearance. Replace the piston and piston rings as a set if out of specification.



S60V5860



Piston ring side clearance:

Top ring and 2nd piston ring:

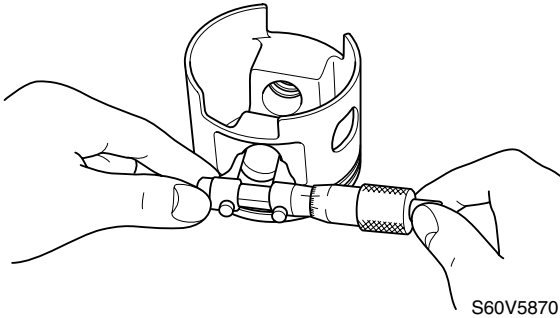
0.02–0.06 mm

(0.0008–0.0024 in)



Checking the piston pin boss bore

1. Measure the piston pin boss bore.
Replace the piston if out of specification.



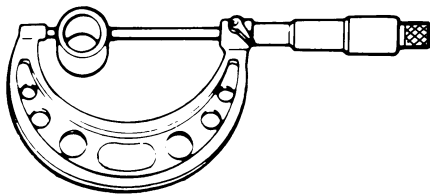
S60V5870



Piston pin boss bore:
26.004–26.015 mm
(1.0238–1.0242 in)

Checking the piston pin

1. Measure the piston pin diameter.
Replace if out of specification.



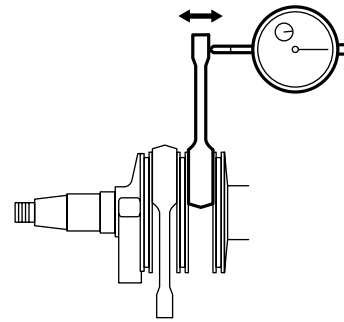
S69J5C30



Piston pin diameter:
25.995–26.000 mm
(1.0234–1.0236 in)

Checking the connecting rod small end axial play

1. Measure the connecting rod small end axial play. Replace the bearing and connecting rod if out of specification.



S60V5880



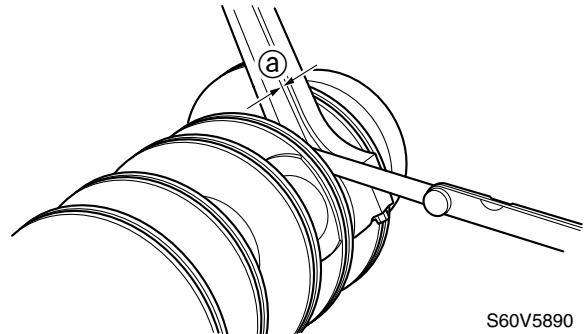
Connecting rod small end axial play limit:
2.0 mm (0.079 in)

NOTE:

To measure the axial play, set the dial gauge at the connecting rod small end and parallel to the crankshaft.

Checking the connecting rod big end side clearance

1. Measure the connecting rod big end side clearance ①. Replace the connecting rod or crankshaft or both if out of specification.



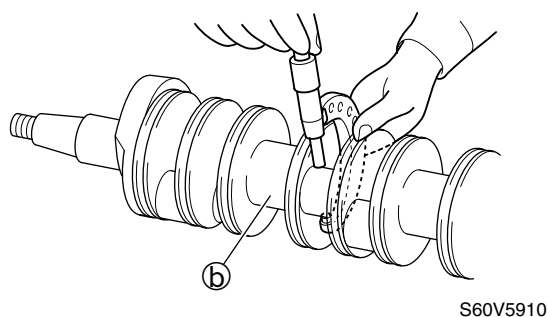
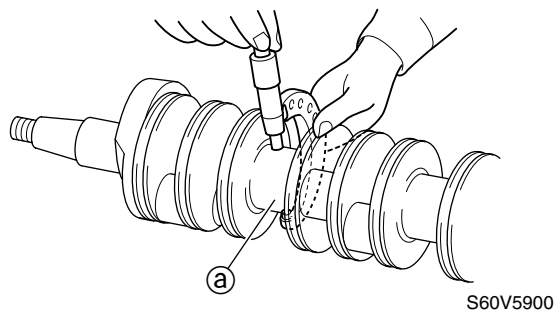
S60V5890



Connecting rod big end side clearance ①:
0.12–0.26 mm (0.0047–0.0102 in)

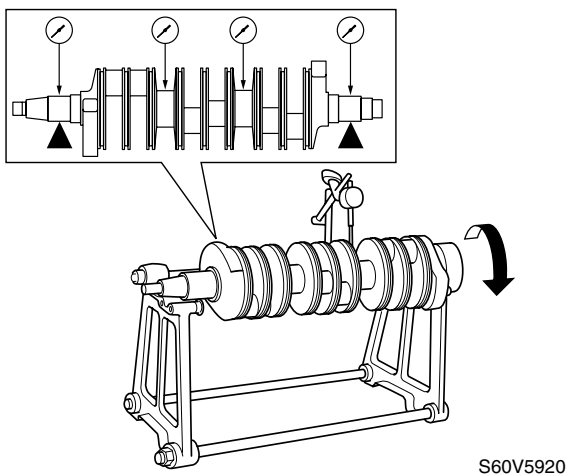
Checking the crankshaft

1. Measure the crankshaft journal diameter ① and crankpin diameter ②. Replace the crankshaft if out of specification.



	Crankshaft journal diameter ①:
	58.975–58.991 mm
	(2.3219–2.3225 in)
	Crankpin diameter ②:
	40.485–40.500 mm
	(1.5939–1.5945 in)

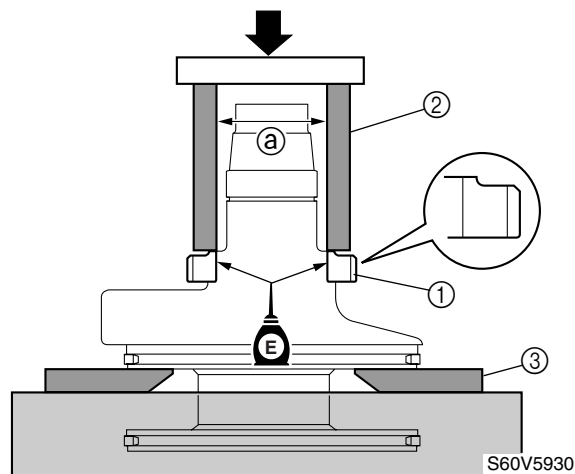
2. Measure the crankshaft runout. Replace the crankshaft if out of specification.



Crankshaft runout limit:
0.02 mm (0.0008 in)

Assembling the crankshaft

1. Install the oil pump drive gear ①.



CAUTION:

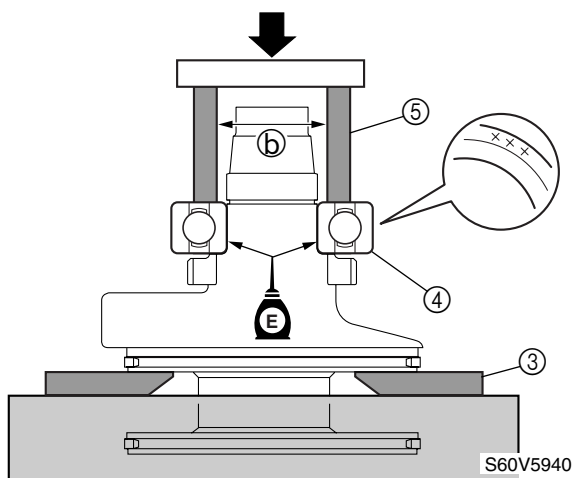
Do not reuse the oil pump drive gear, always replace it with a new one.



General pipe ②:
① = 50 mm (1.97 in)
Bearing separator ③:
(commercially available)



2. Install the lower ball bearing ④, then the circlip.



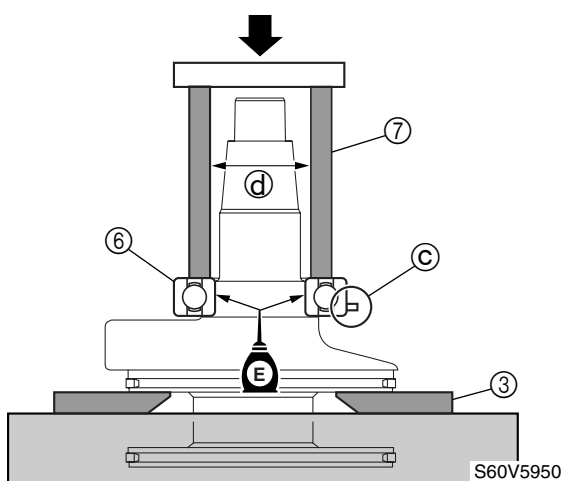
CAUTION:

Do not reuse the ball bearing, always replace it with a new one.



General pipe ⑤:
 $\phi = 40$ mm (1.57 in)
 Bearing separator ③:
 (commercially available)

3. Install the upper ball bearing ⑥.



CAUTION:

Do not reuse the ball bearing, always replace it with a new one.

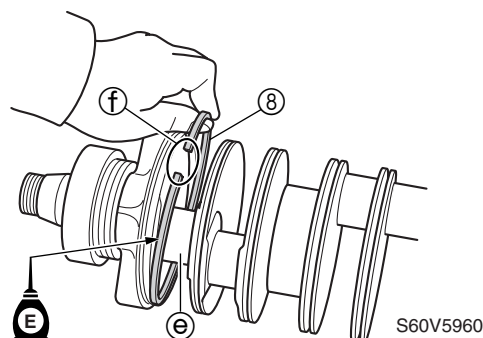
NOTE:

Install the upper ball bearing with the projection ③ facing toward the crankshaft.



General pipe ⑦:
 $\phi = 45$ mm (1.77 in)
 Bearing separator ③:
 (commercially available)

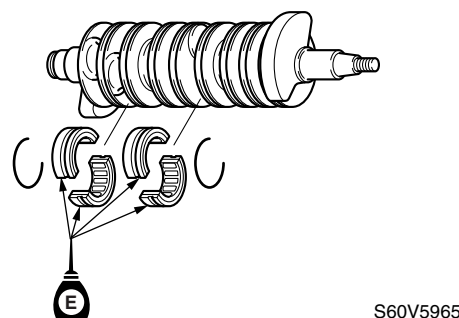
4. Install the seal rings ⑧.



NOTE:

First pass the seal ring ⑧ over the crankpin ⑨, and then widen the seal ring end gap ① to install the ring into the crankshaft groove.

5. Install the main bearings onto the crankshaft.

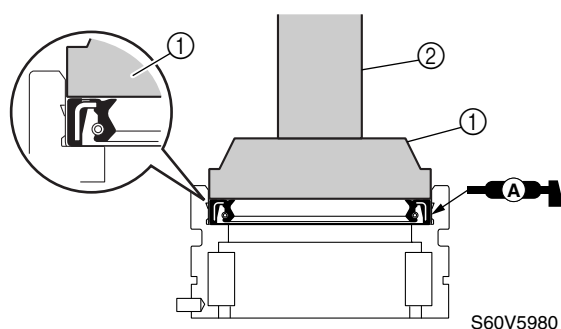


NOTE:

Face the dowel hole on the main bearings toward the bottom of the power unit.

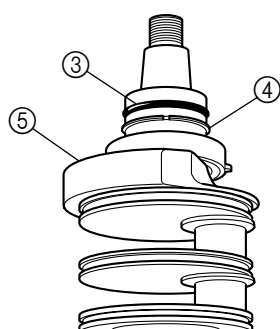
Assembling the crankshaft roller bearings

1. Apply grease to the new oil seal, and then install it into the roller bearing.



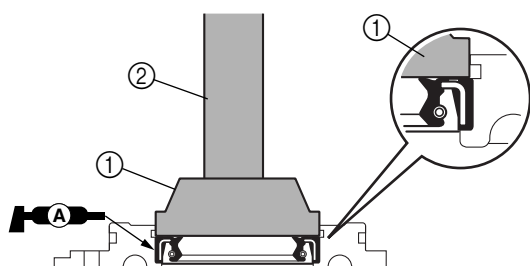
Bearing outer race attachment ①:
90890-06624
Driver rod LS ②: 90890-06606

2. Install a new O-ring ③ and the stopper ring ④ onto the roller bearing, and then install the roller bearing assembly onto the crankshaft ⑤.



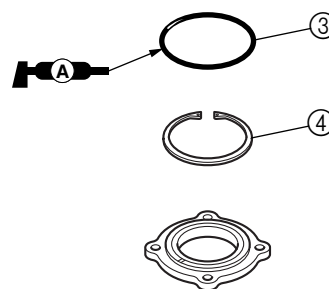
Assembling the oil seal housing

1. Apply grease to the new oil seal, and then install it into the oil seal housing.



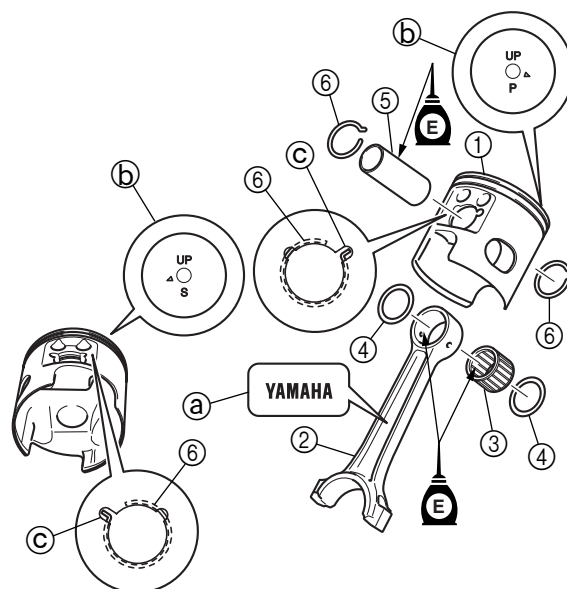
Bearing outer race attachment ①:
9080-06623
Driver rod LS ②: 90890-06606

2. Install a new O-ring ③ and the circlip ④ into the oil seal housing.



Assembling the piston and connecting rod assemblies

1. Assemble the pistons ①, connecting rods ②, needle bearings ③, washers ④, piston pins ⑤, and new piston pin clips ⑥.

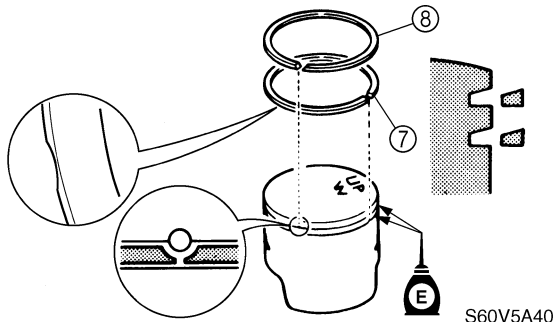


NOTE:

- Face the embossed "YAMAHA" mark ① on the connecting rod in the same direction as the "UP" mark ② on the piston.
- Always use new piston pin clips.
- Be sure to align the piston pin clip end with the piston pin slot ③.



2. Install the 2nd piston ring ⑦ and top ring ⑧ onto the pistons.



CAUTION:

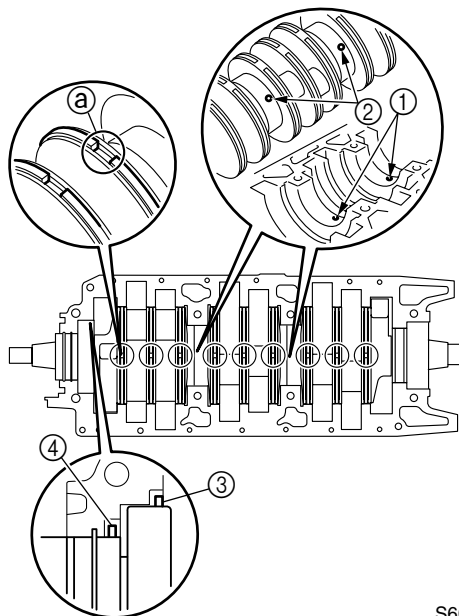
Do not scratch the pistons or break the piston rings.

NOTE:

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

Assembling the power unit

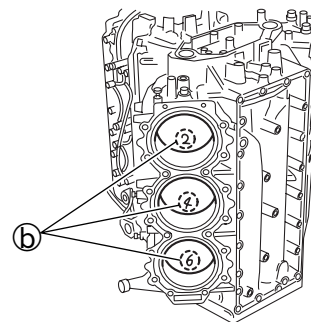
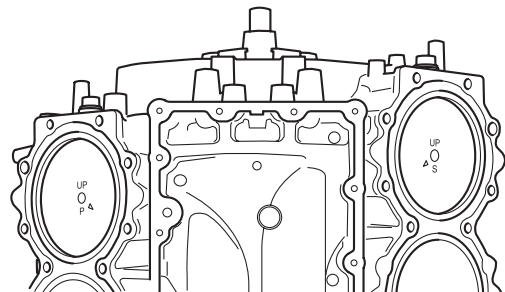
1. Set the crankshaft in the cylinder block.

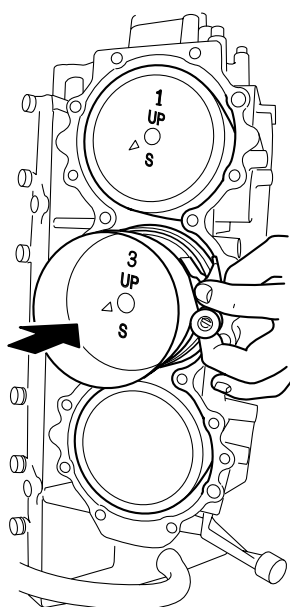


NOTE:

- Fit dowels ① on the cylinder block into the dowel holes ② in the main bearings.
- Align the projection ③ of the upper ball bearing and the projection ④ of the needle bearing with the groove in the crankshaft.
- Align the seal ring end gaps ⑤ with the crankcase center line.

2. Install the pistons into the cylinders with the "UP" mark on the piston crown facing towards the flywheel magnet.





S60V5A80

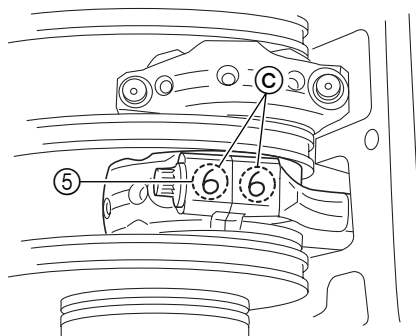
NOTE:

- Apply engine oil to the pistons and piston rings before installation.
- Be sure to install the piston and connecting rod assemblies into the corresponding cylinders according to the marks ⑥ made during disassembly. Also, be sure to install the assemblies with an “S” mark on the star-board side, and the assemblies with a “P” mark on the port side.



Piston ring compressor:
90890-05158

3. Install the connecting rod bearings and connecting rod caps onto the connecting rods, and then tighten the connecting rod bolts ⑤ to the specified torques in five stages.



S60V5A90

NOTE:

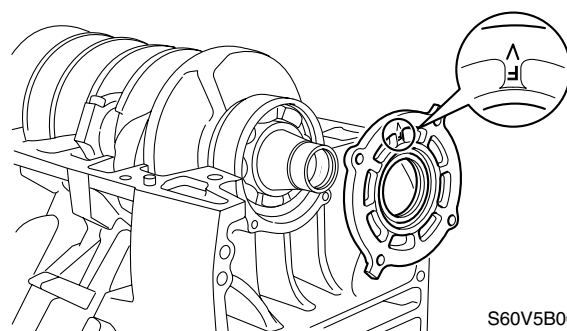
- Align the identification numbers ③ on the connecting rod caps and connecting rods, which you made during disassembly.
- Apply engine oil to the connecting rod bearings, connecting rod caps, and connecting rod bolts before installation.



Connecting rod bolt ⑤:

- 1st: 28 N·m (2.8 kgf·m, 20.7 ft·lb)
- 2nd: 45 N·m (4.5 kgf·m, 33.2 ft·lb)
- 3rd: Loosen completely
- 4th: 28 N·m (2.8 kgf·m, 20.7 ft·lb)
- 5th: 45 N·m (4.5 kgf·m, 33.2 ft·lb)

4. Install the oil seal housing onto the cylinder block.

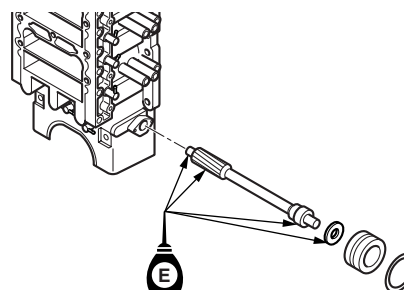


S60V5B00

NOTE:

Install the oil seal housing with the “F” mark facing toward the crankcase.

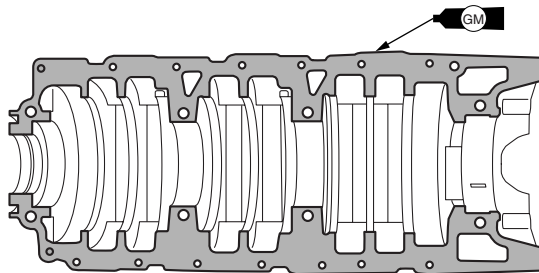
5. Install the oil pump driven gear onto the crankcase.



S60V5B10



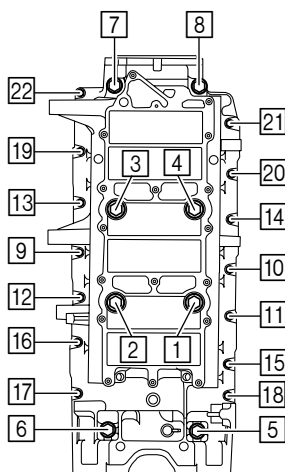
6. Apply Gasket Maker to the mating surface of the crankcase.



S60V5B20

NOTE: Do not get any Gasket Maker on the journals.

7. Install the crankcase onto the cylinder block, and then tighten the crankcase bolts to the specified torques in two stages and in the sequence shown.



S60V5B30

- NOTE:**
- Apply engine oil to the crankcase bolts before installation.
 - Tighten crankcase bolts **1-8** to the specified torques in two stages first, and then tighten crankcase bolts **9-22** to the specified torques in two stages.

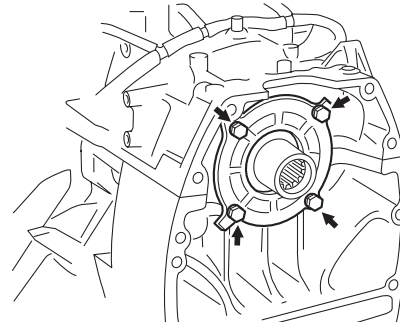


- 1-8** Crankcase bolt (M10):
1st: 20 N·m (2.0 kgf·m, 14.8 ft·lb)
2nd: 40 N·m (4.0 kgf·m, 29.5 ft·lb)
9-22 Crankcase bolt (M8):
1st: 4 N·m (0.4 kgf·m, 3.0 ft·lb)
2nd: 8 N·m (0.8 kgf·m, 5.9 ft·lb)



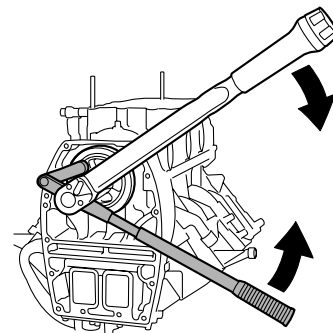
- 1-4** Crankcase bolt:
M10 × 130 mm
5-8 Crankcase bolt:
M10 × 90 mm

8. Tighten the oil seal housing bolts.



S60V5690

9. Install the crankshaft balancer, and then tighten the crankshaft balancer nut to the specified torque.



S60V5B50

CAUTION:

Apply force in the direction of the arrows shown, to prevent the flywheel holder from slipping off easily.

- NOTE:** Apply engine oil to the crankshaft and the crankshaft balancer nut before installation.

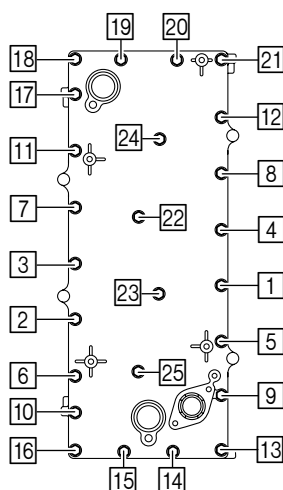


Flywheel holder: 90890-06522



Crankshaft balancer nut:
100 N·m (10 kgf·m, 73.8 ft·lb)

10. Install the dowels, new gasket, and exhaust outer cover, and then tighten the outer cover bolts to the specified torque in two stages and in the sequence shown.



S60V5B60

NOTE:

Apply LOCTITE 572 to the exhaust outer cover bolts before installation.

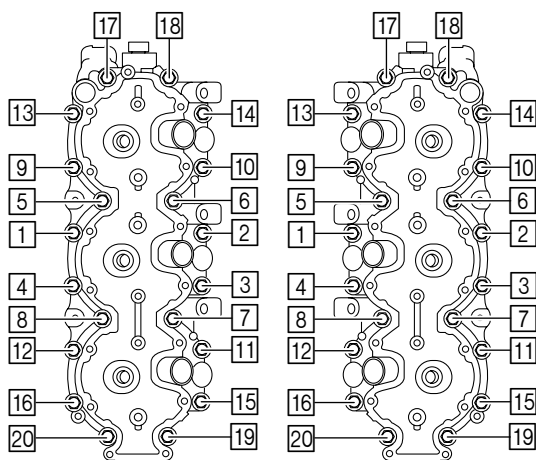


Exhaust outer cover bolt:

1st: 5 N·m (0.5 kgf·m, 3.7 ft·lb)

2nd: 11 N·m (1.1 kgf·m, 8.1 ft·lb)

11. Install the dowels, a new gasket, and the cylinder head, and then tighten the cylinder head bolts to the specified torques in two stages and in the sequence shown.



S60V5B70

NOTE:

Apply engine oil to the cylinder head bolts before installation.

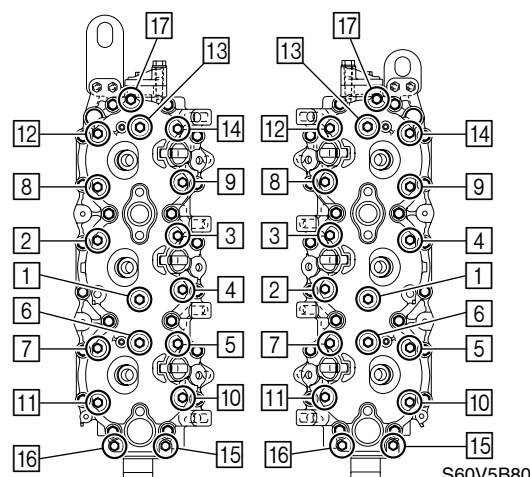


Cylinder head bolt:

1st: 15 N·m (1.5 kgf·m, 11.1 ft·lb)

2nd: 30 N·m (3.0 kgf·m, 22.1 ft·lb)

12. Install the thermostats onto the cylinder head.
13. Install a new gasket and the cylinder head cover, and then tighten the cylinder head cover bolts to the specified torques in two stages and in the sequence shown.



S60V5B80

NOTE:

Apply LOCTITE 572 to the cylinder head cover bolts before installation.



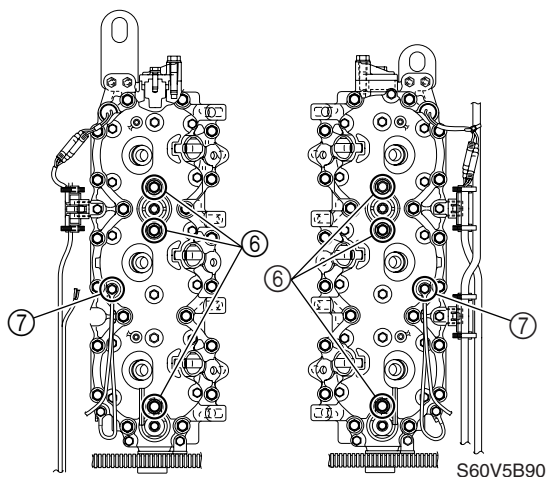
Cylinder head cover bolt:

1st: 5 N·m (0.5 kgf·m, 3.7 ft·lb)

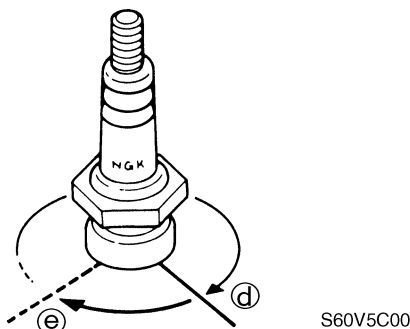
2nd: 11 N·m (1.1 kgf·m, 8.1 ft·lb)



14. Install the anode cover bolts ⑥ and ground lead bolts ⑦.



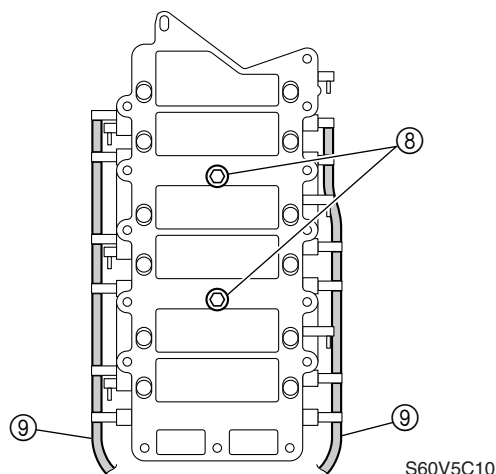
15. Install the spark plugs, tighten them finger tight ④, then to the specified torque with a spark plug wrench ⑤.



 Spark plug:
25 N·m (2.5 kgf·m, 18.4 ft·lb)

16. Install the intake manifold assembly, and then tighten the intake manifold bolts ⑧ to the specified torque.

17. Connect the hoses ⑨.

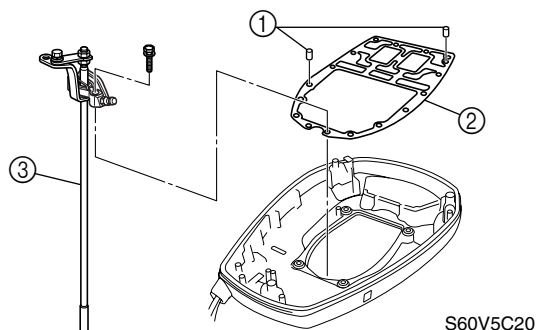


Intake manifold bolt ⑧:
13 N·m (1.3 kgf·m, 9.6 ft·lb)

18. Install the starter motor, pulser coil, and stator coil onto the power unit.

Installing the power unit

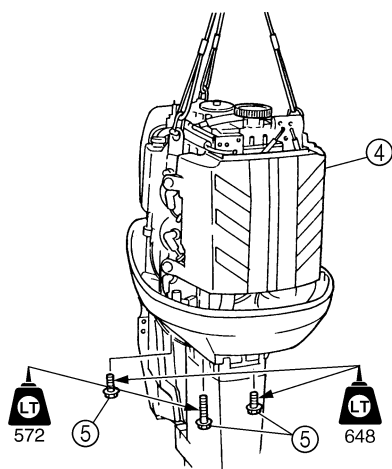
1. Clean the power unit matching surface, and install new dowels ①, a new gasket ②, and the shift rod assembly ③.



CAUTION:

Do not reuse the dowels, always replace them with new one.

2. Install the power unit ④, and then tighten the power unit mounting bolts ⑤ to the specified torque.



S60V5C30

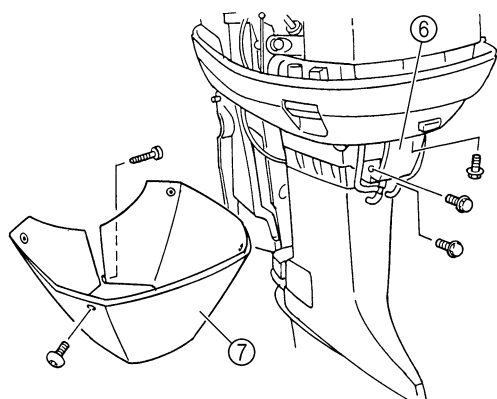
NOTE:

- Replace or reuse the power unit mounting bolts. If reusing the power unit mounting bolts, be sure to completely remove any Loctite remaining on the bolts.
- Apply LOCTITE 572 to the 135 mm bolts and LOCTITE 648 to the 30 mm bolts before installation.



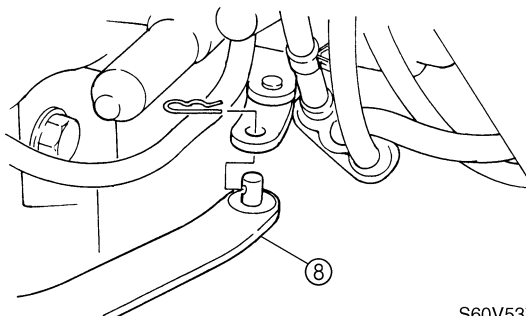
Power unit mounting bolt ⑤:
32 N·m (3.2 kgf·m, 23.6 ft·lb)

3. Install the hose joint assembly ⑥ and the apron ⑦.



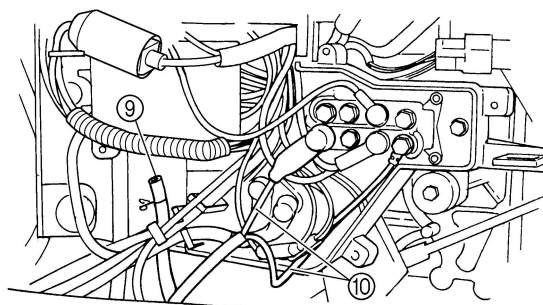
S60V5C40

4. Connect the PTT switch coupler and the shift lever ⑧.



S60V5370

5. Connect the cooling water hose ⑨ to the Rectifier Regulator.
6. Connect the PTT motor leads ⑩, and then tighten the PTT motor lead bolts to the specified torque.

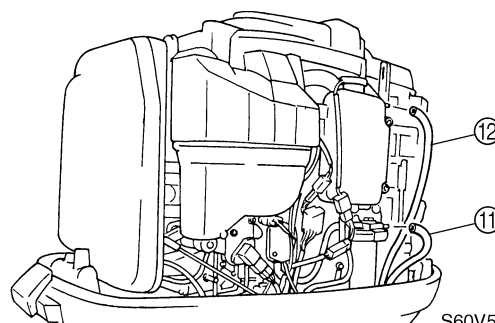


S60V5C50



PTT motor lead bolt:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

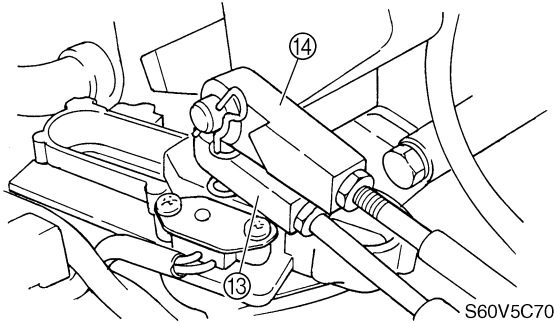
7. Install the junction box cover.
8. Connect the fuel hose ⑪ and oil hose ⑫.



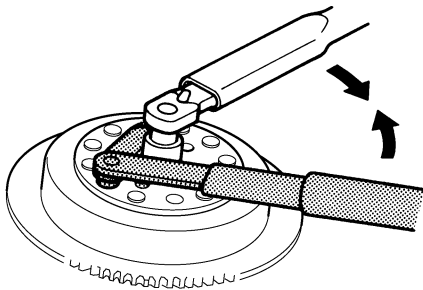
S60V5C60



9. Connect the shift cable (13) and throttle cable (14), and then adjust their lengths. For adjustment procedures, see Chapter 3, "Adjusting the throttle cable," and "Checking the gear shift operation."



10. Install the Woodruff key and flywheel magnet.
11. Tighten the flywheel magnet nut to the specified torque.



CAUTION:

Apply force in the direction of the arrows shown, to prevent the flywheel holder from slipping off easily.

NOTE:

Apply engine oil to the flywheel magnet nut before installation.

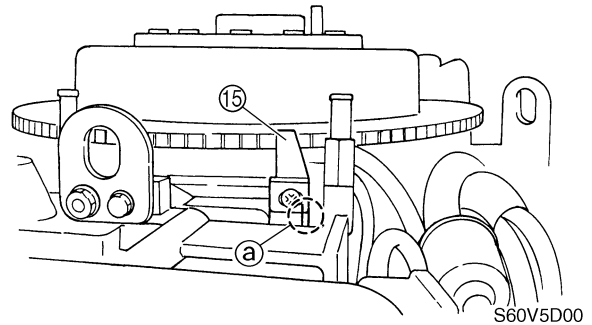


Flywheel holder: 90890-06522



Flywheel magnet nut:
190 N·m (19 kgf·m, 140 ft·lb)

12. Install the pointer (15).



NOTE:

Align the marks (a) on the pointer (15), which you made during disassembly.

13. Install all removed parts.

— MEMO —

5

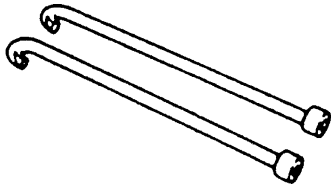


Lower unit

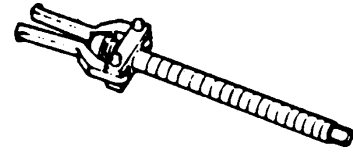
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Propeller shaft housing (regular rotation model)	6-10
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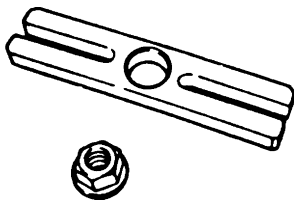
Special service tools



Bearing housing puller claw L
90890-06502



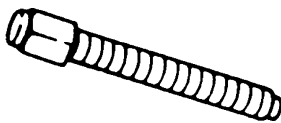
Bearing puller
90890-06535



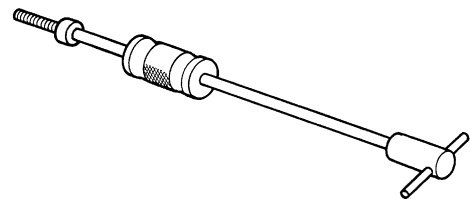
Stopper guide plate
90890-06501



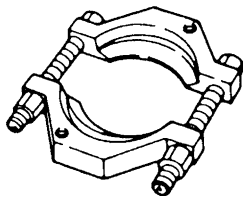
Bearing puller claw 1
90890-06536



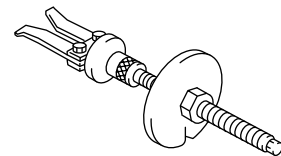
Center bolt
90890-06504



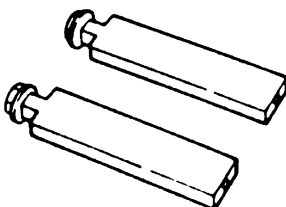
Slide hammer
90890-06531



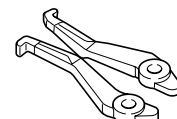
Bearing separator
90890-06534



Bearing outer race puller assembly
90890-06523



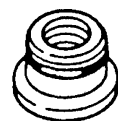
Stopper guide stand
90890-06538



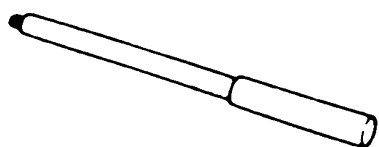
Outer race puller claw A
90890-06532



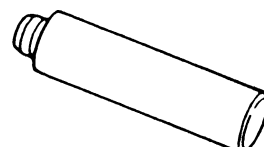
Needle bearing attachment
90890-06610, 90890-06653, 90890-06654



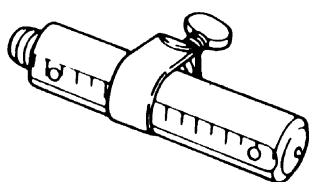
Ball bearing attachment
90890-06636, 90890-06656, 90890-06657



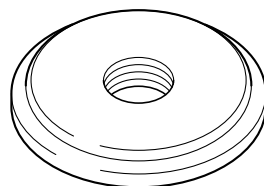
Driver rod L3
90890-06652



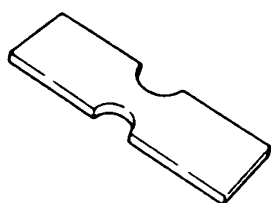
Driver rod LS
90890-06606



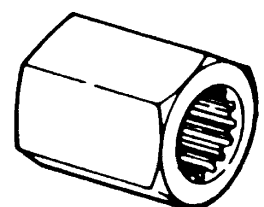
Driver rod SS
90890-06604



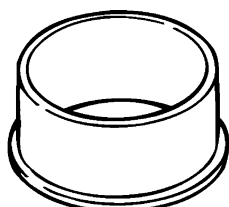
Bearing outer race attachment
90890-06622, 90890-06628, 90890-06658



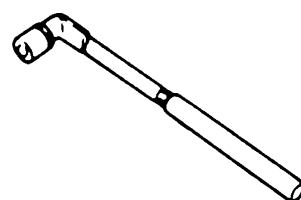
Bearing depth plate
90890-06603



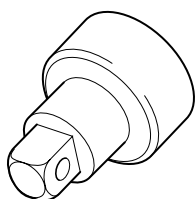
Drive shaft holder 6
90890-06520



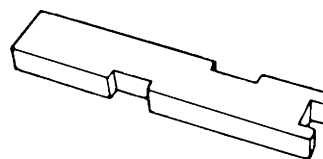
Bearing inner race attachment
90890-06640, 90890-06659



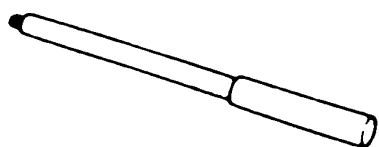
Pinion nut holder
90890-06505



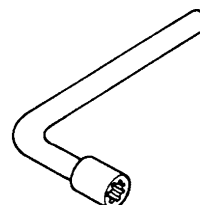
Socket adapter 3
90890-06508



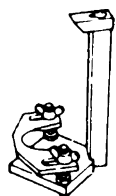
Shimming plate
90890-06701



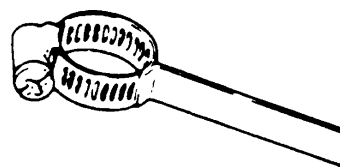
Driver rod LL
90890-06605



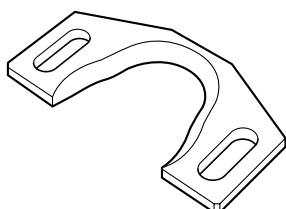
Shift rod push arm
90890-06052



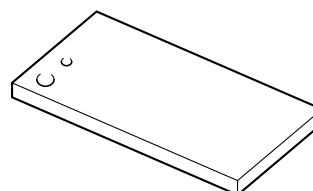
Pinion height gauge
90890-06710



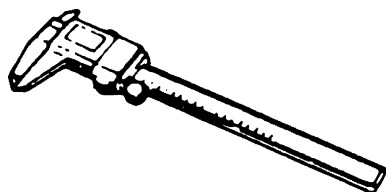
Backlash indicator
90890-06706



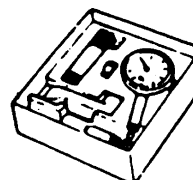
Fixing plate
90890-06711



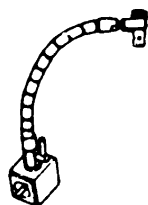
Magnet base plate
90890-07003



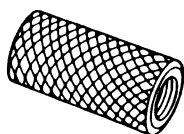
Digital caliper
90890-06704



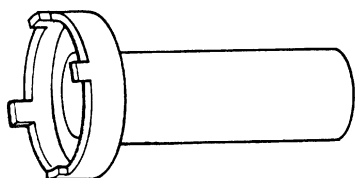
Dial gauge set
90890-01252



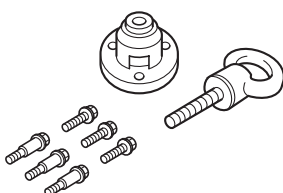
Magnet base
90890-06705



Puller head
90890-06514



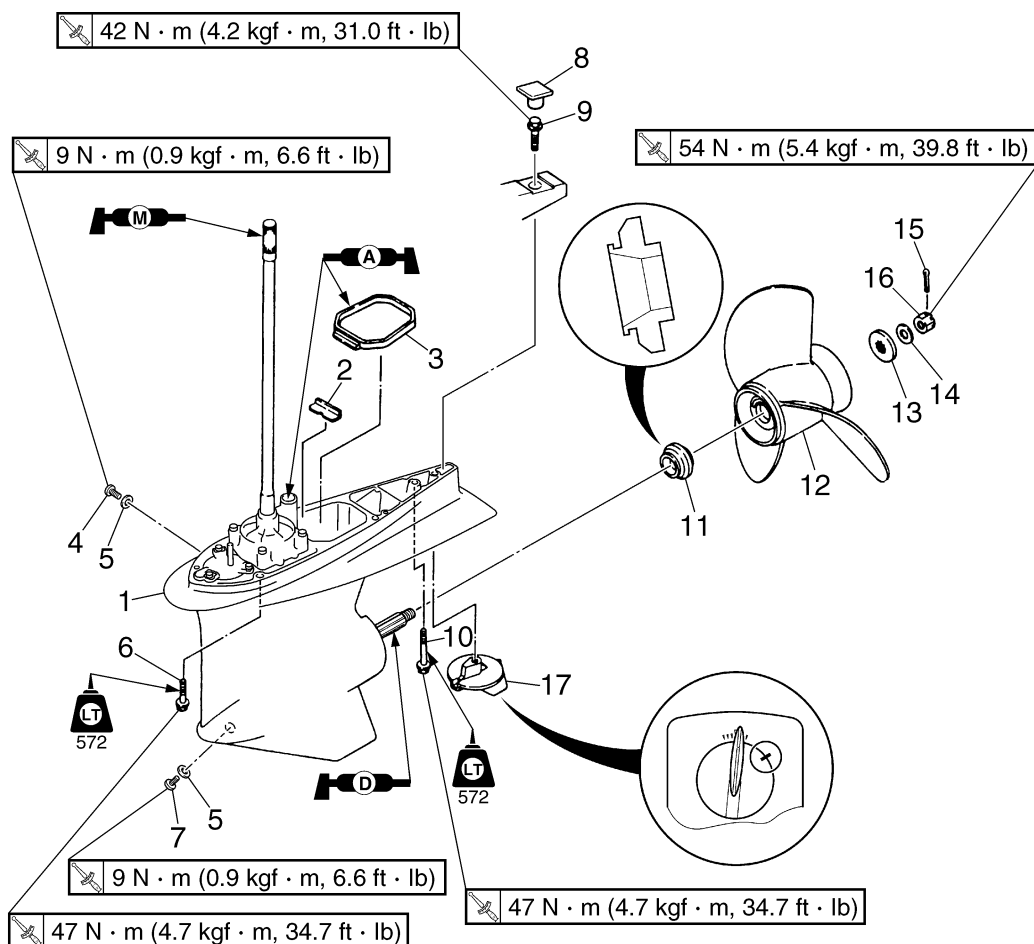
Ring nut wrench
90890-06578



Flywheel puller
90890-06521

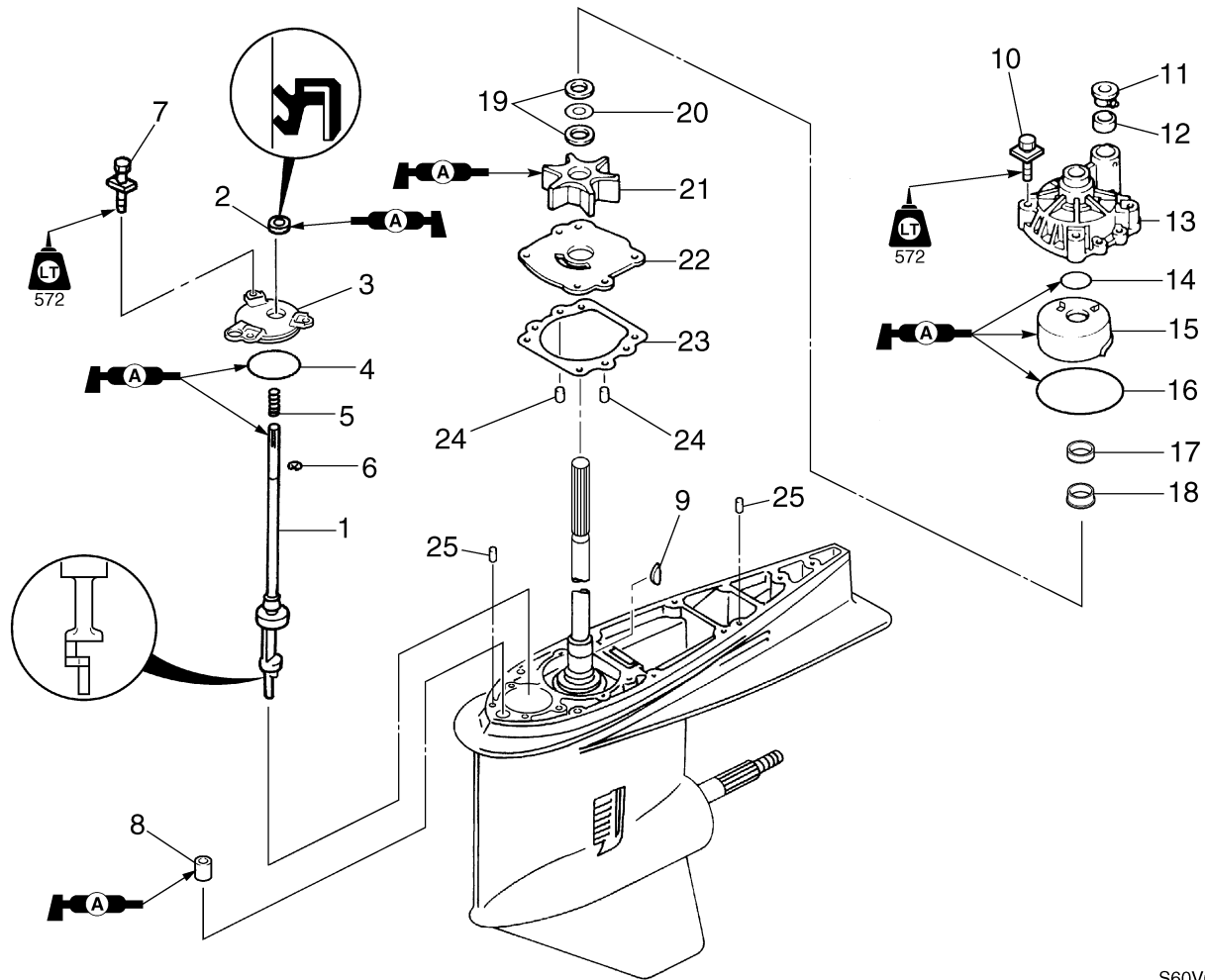


Lower unit (regular rotation model)



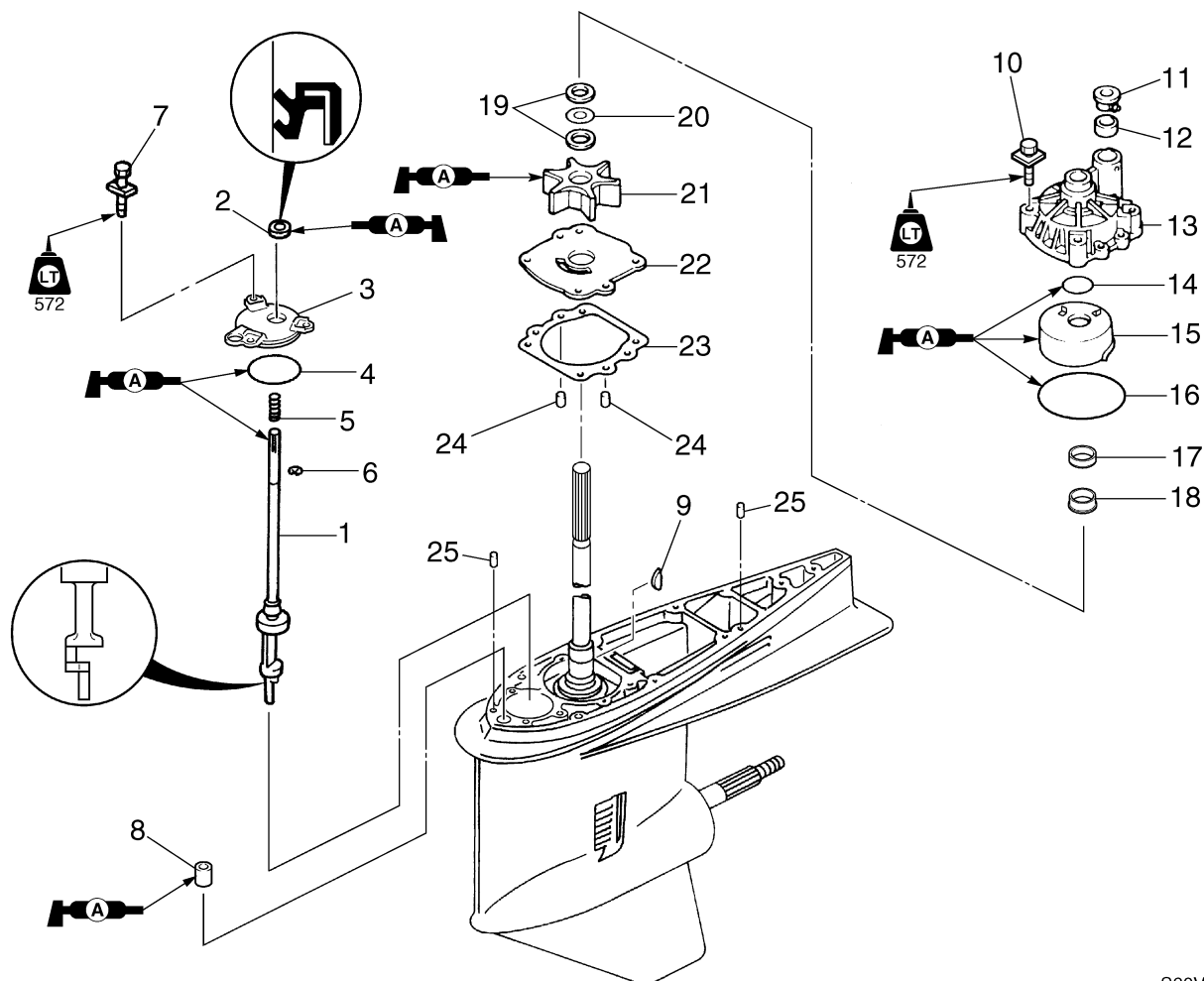
S60V6010

No.	Part name	Q'ty	Remarks
1	Lower unit	1	
2	Plate	1	
3	Rubber seal	1	
4	Check screw	1	
5	Gasket	2	Not reusable
6	Bolt	7	M10 × 45 mm
7	Drain screw	1	
8	Grommet	1	
9	Bolt	1	M10 × 44 mm
10	Bolt	1	M10 × 70 mm
11	Spacer	1	
12	Propeller	1	
13	Washer	1	
14	Washer	1	
15	Cotter pin	1	Not reusable
16	Propeller nut	1	
17	Trim tab	1	



S60V6020

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

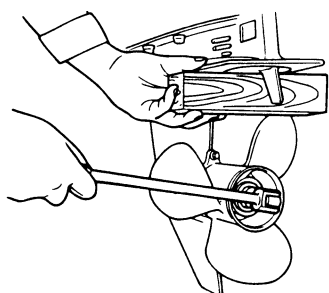


S60V6020

No.	Part name	Q'ty	Remarks
18	Spacer	1	Not reusable
19	Washer	2	
20	Wave washer	1	
21	Impeller	1	
22	Outer plate cartridge	1	
23	Gasket	1	
24	Dowel	2	
25	Dowel	2	

Removing the lower unit

1. Drain the gear oil. For draining procedures, see Chapter 3, "Changing the gear oil."
2. Set the gear shift to the neutral position, and place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then remove the propeller nut and propeller.

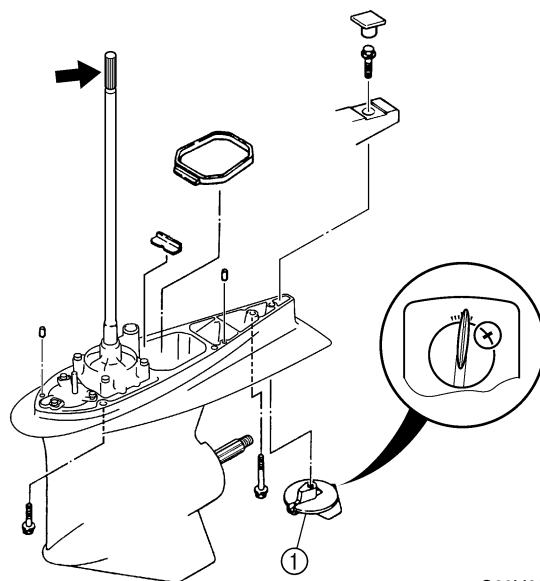


S69J6015

⚠ WARNING

- Do not hold the propeller with your hands when loosening or tightening it.
- Be sure to disconnect the battery leads from the battery and the clip from the engine shut-off switch.
- Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.

3. Mark the trim tab ① at the area shown, and then remove it.
4. Loosen the bolts, and then remove the lower unit from the upper case.



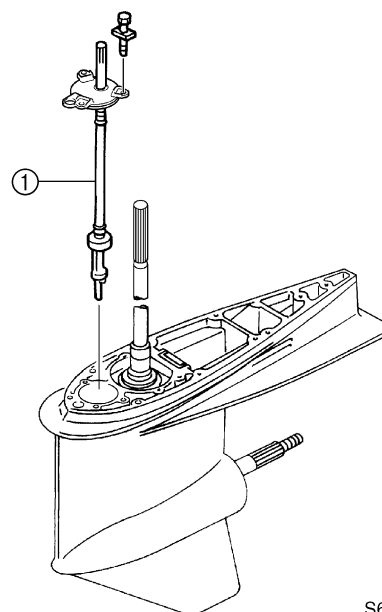
S60V6025

NOTE:

Check that there is no oil on the spline and check it for rust or wear.

Removing the water pump and shift rod

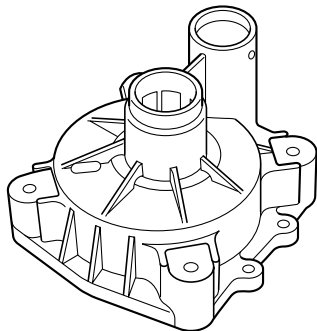
1. Remove the water pump assembly and shift rod assembly ①.



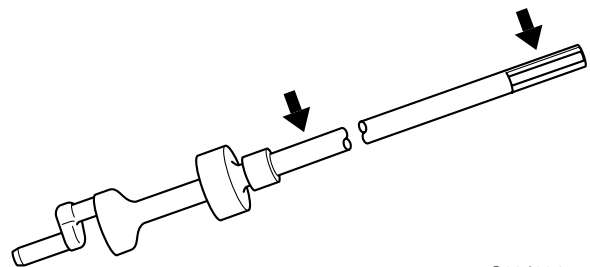
S60V6030

Checking the water pump and shift rod

1. Check the water pump housing for deformation. Replace if necessary.

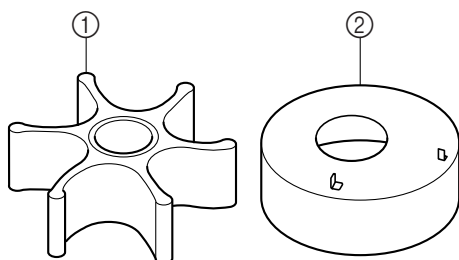


S69J6030



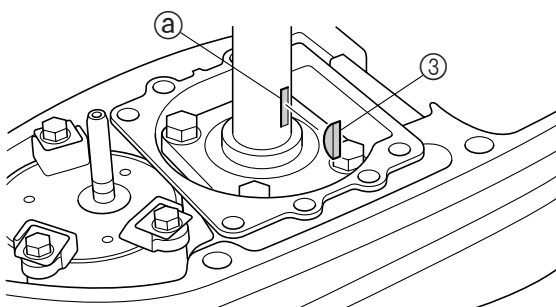
S69J6045

2. Check the impeller ① and insert cartridge ② for cracks or wear. Replace if necessary.



S69J6035

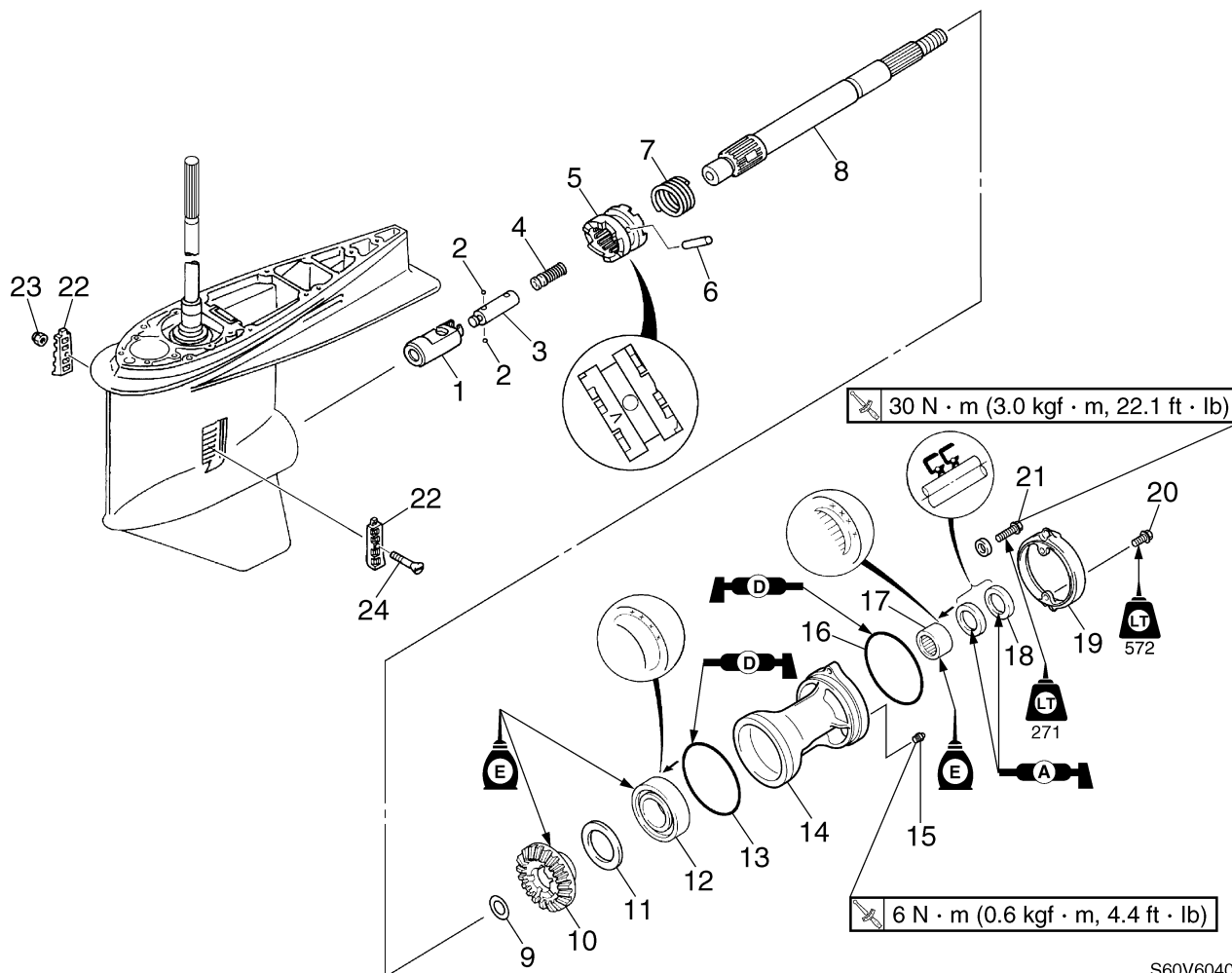
3. Check the Woodruff key ③ and the groove ④ on the drive shaft for wear. Replace if necessary.



S69J6040

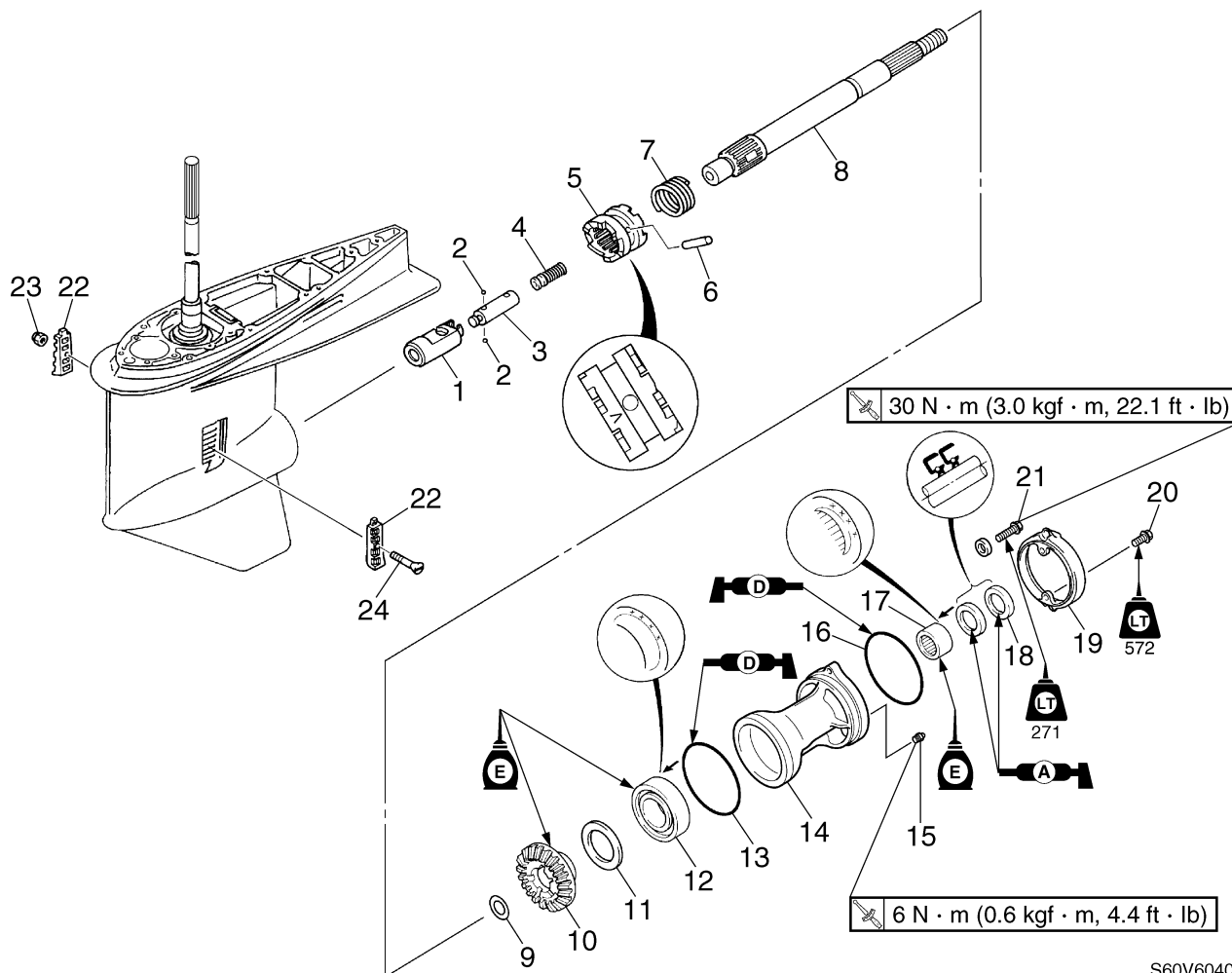
4. Check the shift rod for cracks or wear. Replace if necessary.

Propeller shaft housing (regular rotation model)



S60V6040

No.	Part name	Q'ty	Remarks
1	Shift rod joint	1	
2	Ball	2	
3	Slider	1	
4	Shift plunger	1	
5	Dog clutch	1	
6	Cross pin	1	
7	Spring	1	
8	Propeller shaft	1	
9	Washer	1	
10	Reverse gear	1	
11	Reverse gear shim	—	As required
12	Ball bearing	1	Not reusable
13	O-ring	1	Not reusable
14	Propeller shaft housing	1	
15	Grease nipple	1	
16	O-ring	1	Not reusable
17	Needle bearing	1	

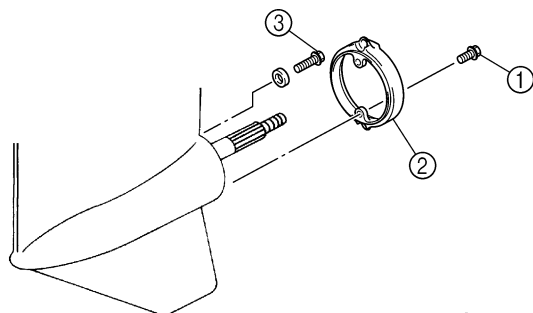


S60V6040

No.	Part name	Q'ty	Remarks
18	Oil seal	2	Not reusable M8 × 20 mm M8 × 33 mm
19	Ring	1	
20	Bolt	2	
21	Bolt	2	
22	Cooling water inlet cover	2	
23	Nut	1	
24	Screw	1	

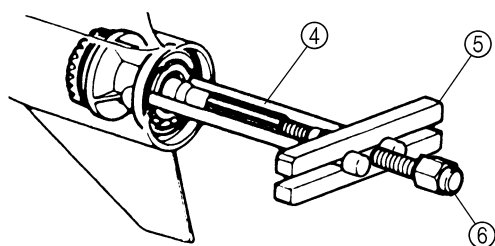
Removing the propeller shaft housing assembly

1. Remove the bolts ①, ring ②, and bolts ③.

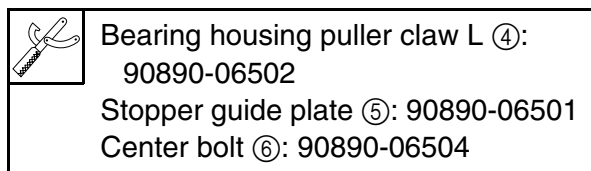


S60V6050

2. Pull out the propeller shaft housing assembly.

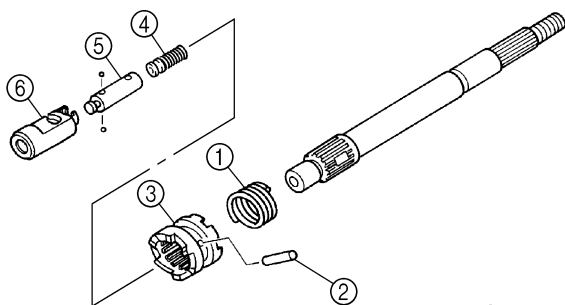


S69J6065



Disassembling the propeller shaft assembly

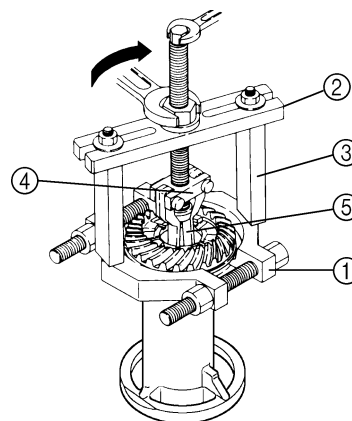
1. Remove the spring ①, then the cross pin ②, dog clutch ③, shift plunger ④, slider ⑤, and shift rod joint ⑥.



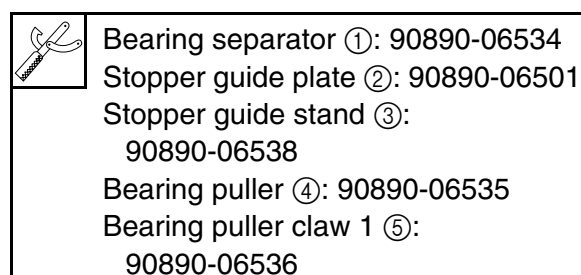
S69J6100

Disassembling the propeller shaft housing

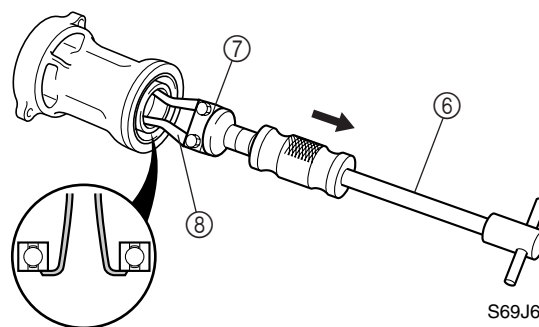
1. Remove the reverse gear and reverse gear shim(s).



S69J6075



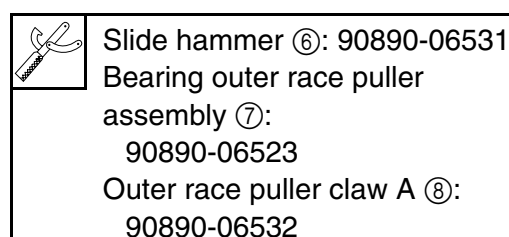
2. Remove the ball bearing.



S69J6085

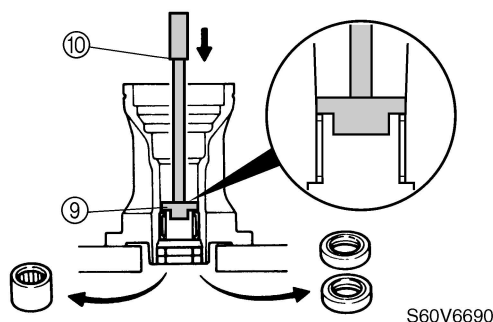
CAUTION:

Do not reuse the bearing, always replace it with a new one.





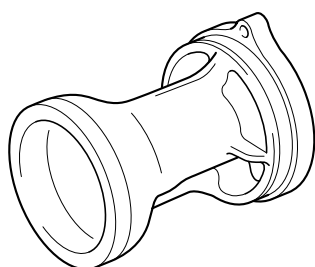
3. Remove the oil seals and needle bearing.



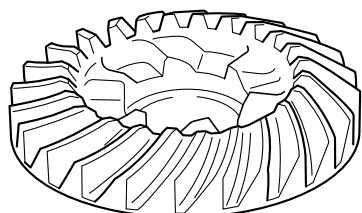
Needle bearing attachment ⑨:
90890-06653
Driver rod L3 ⑩: 90890-06652

Checking the propeller shaft housing

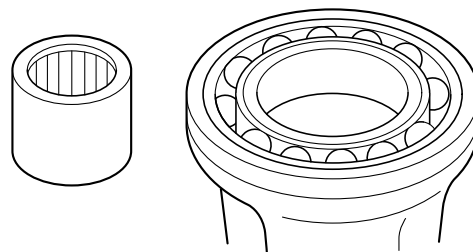
1. Clean the propeller shaft housing using a soft brush and cleaning solvent, and then check it for cracks or damage. Replace if necessary.



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

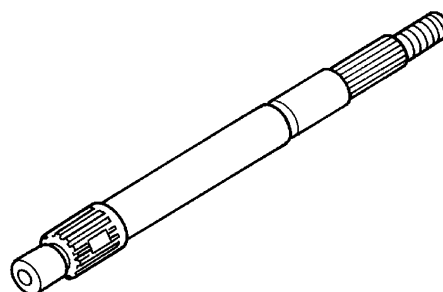


3. Check the bearings for pitting or rumbling. Replace if necessary.

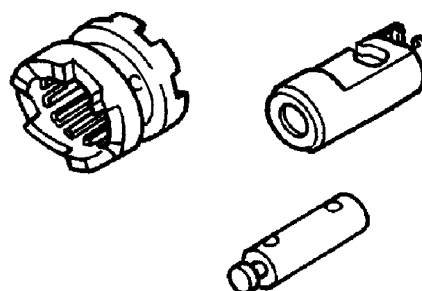


Checking the propeller shaft

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



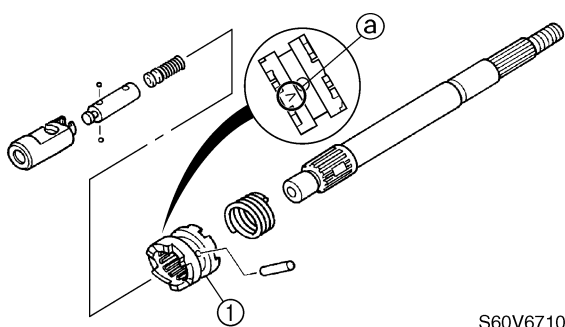
2. Check the dog clutch, shift rod joint, and shift slider for cracks or wear. Replace if necessary.



Assembling the propeller shaft assembly

1. Install the dog clutch ① as shown.

Propeller shaft housing (regular rotation model)

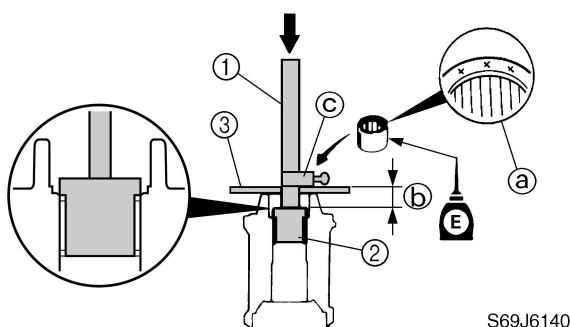


NOTE:

Install the dog clutch ① with the “V” mark ② facing toward the shift plunger.

Assembling the propeller shaft housing

1. Install the needle bearing into the propeller shaft housing to the specified depth.



NOTE:

- Install the needle bearing with the manufacture identification mark ② facing toward the oil seal (propeller side).
- When using the driver rod, do not strike the special tool in a manner that will force the stopper ③ out of place.

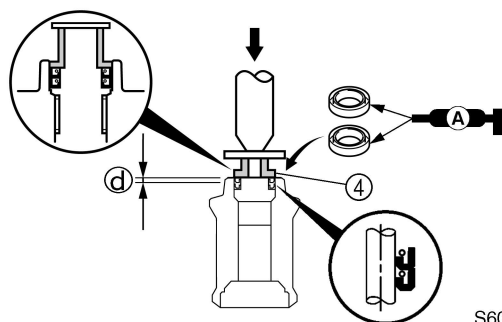


Driver rod SS ①: 90890-06604
Needle bearing attachment ②:
90890-06610
Bearing depth plate ③: 90890-06603



Depth ④:
25.05–25.55 mm (0.986–1.006 in)

2. Apply grease to the new oil seals, and then install them into the propeller shaft housing to the specified depth.



NOTE:

Install an oil seal halfway into the propeller shaft housing, then the other oil seal.

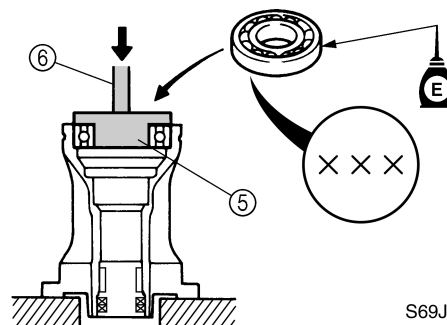


Bearing inner race attachment ④:
90890-06640



Depth ④:
4.75–5.25 mm (0.187–0.207 in)

3. Install the ball bearing into the propeller shaft housing.



NOTE:

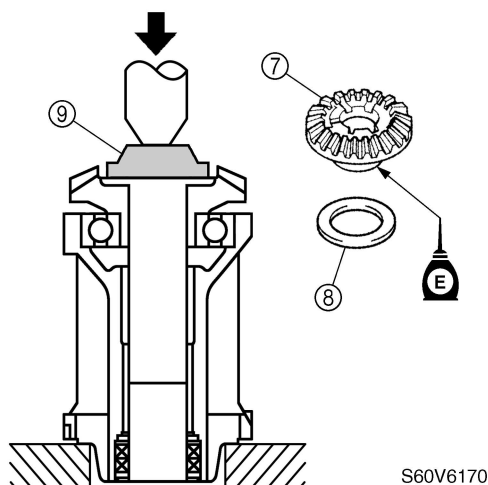
Install the ball bearing with the manufacture identification mark facing toward the propeller shaft housing.



Ball bearing attachment ⑤:
90890-06656
Driver rod LS ⑥: 90890-06606



4. Install the reverse gear ⑦ and original shim(s) ⑧ into the propeller shaft housing using a press.



CAUTION:

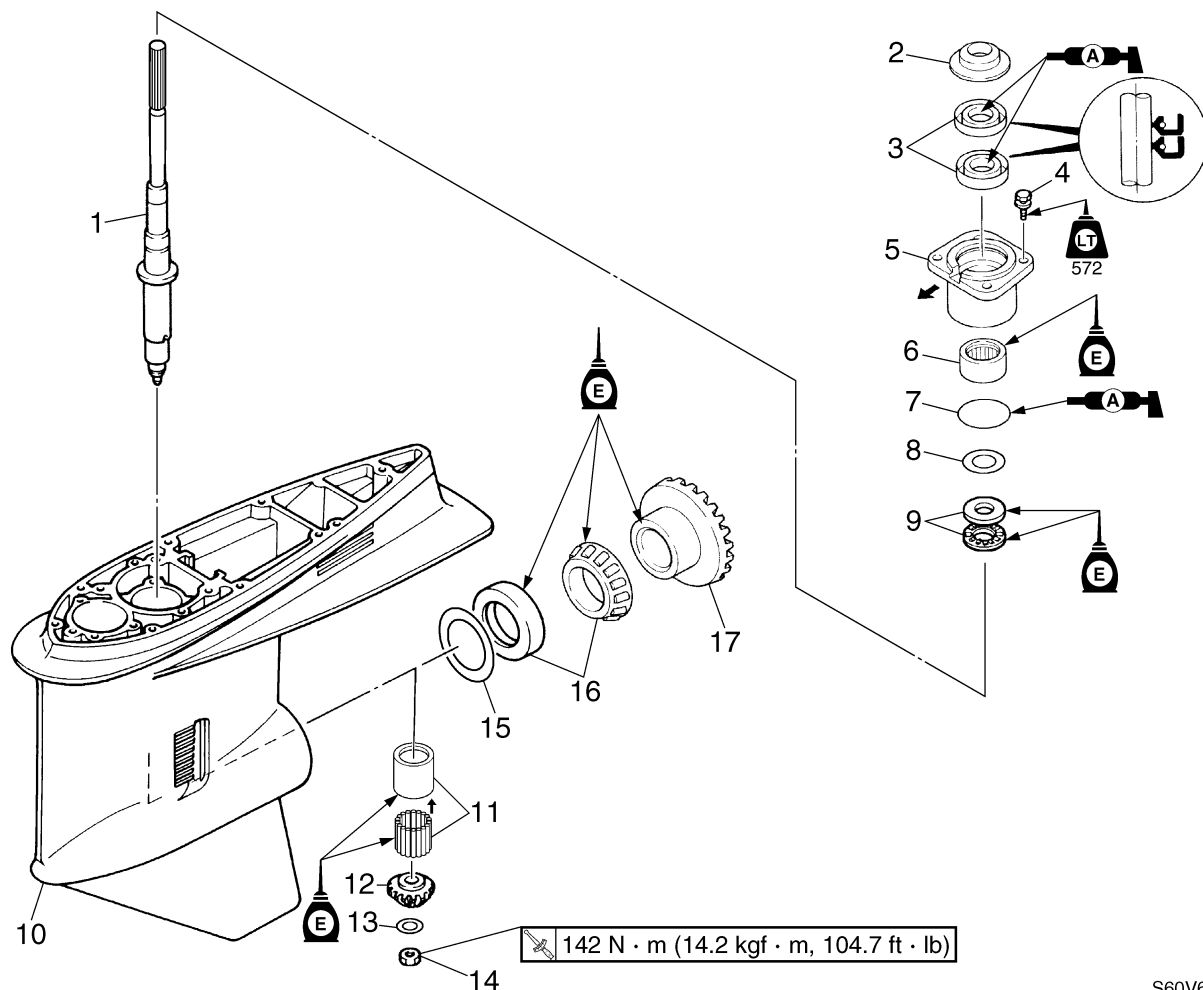
Add or remove shim(s), if necessary, if replacing the reverse gear or ball bearing.



Bearing outer race attachment ⑨:
90890-06622

Propeller shaft housing (regular rotation model) / Drive shaft and lower case (regular rotation model)

Drive shaft and lower case (regular rotation model)



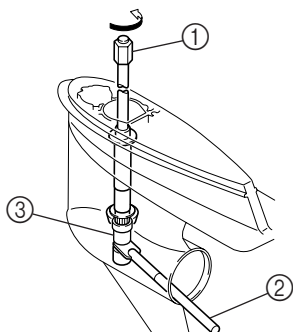
S60V6180

No.	Part name	Q'ty	Remarks
1	Drive shaft	1	
2	Cover	1	
3	Oil seal	2	Not reusable
4	Bolt	4	M8 × 25 mm
5	Drive shaft housing	1	
6	Needle bearing	1	
7	O-ring	1	Not reusable
8	Pinion shim	—	As required
9	Thrust bearing	1	
10	Lower case	1	
11	Needle bearing assembly	1	
12	Pinion	1	
13	Washer	1	
14	Nut	1	
15	Forward gear shim	—	As required
16	Taper roller bearing assembly	1	Not reusable
17	Forward gear	1	



Removing the drive shaft

1. Remove the drive shaft, drive shaft housing, and pinion, and then pull out the forward gear.



S60V6570



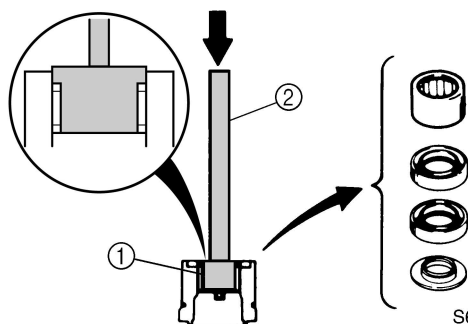
Drive shaft holder 6 (1): 90890-06520

Pinion nut holder (2): 90890-06505

Socket adapter 3 (3): 90890-06508

Disassembling the drive shaft housing

1. Remove the cover, oil seals, and needle bearing.



S69J6185

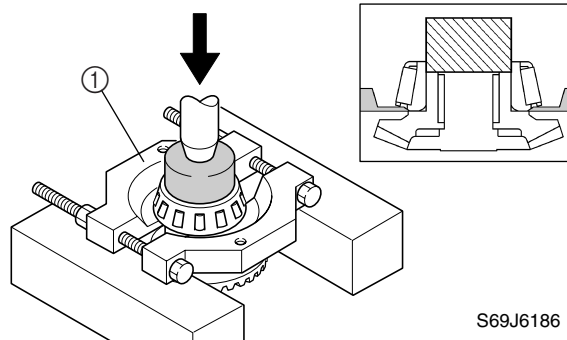


Needle bearing attachment (1):
90890-06610

Driver rod L3 (2): 90890-06652

Disassembling the forward gear

1. Remove the taper roller bearing from the forward gear using a press.



S69J6186

CAUTION:

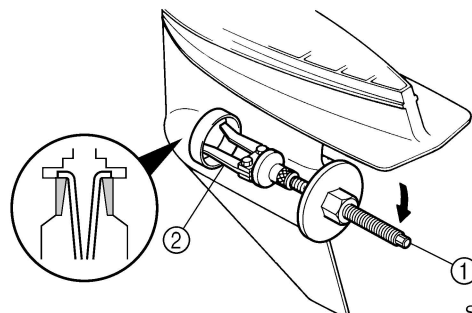
Do not reuse the bearing, always replace it with a new one.



Bearing separator (1): 90890-06534

Disassembling the lower case

1. Remove the taper roller bearing outer race and shim(s).



S60V6200

NOTE:

Install the claws as shown.



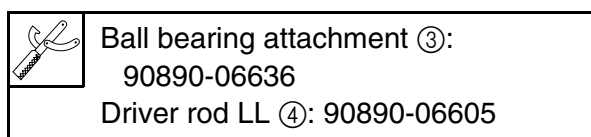
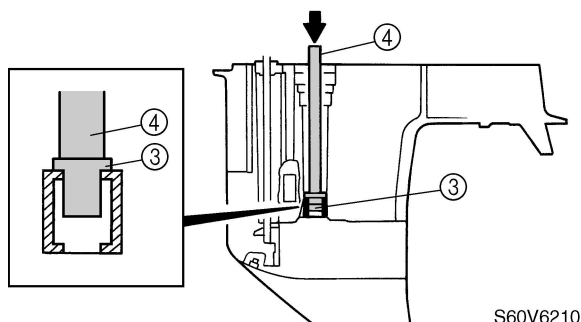
Bearing outer race puller
assembly (1):

90890-06523

Outer race puller claw A (2):

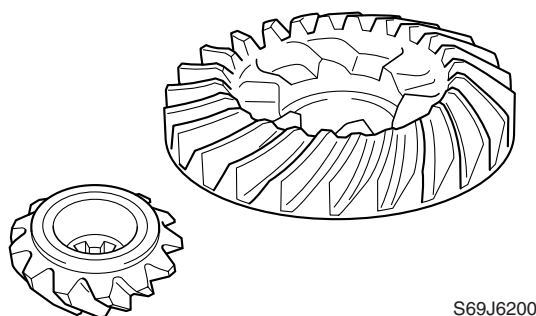
90890-06532

2. Remove the needle bearing.



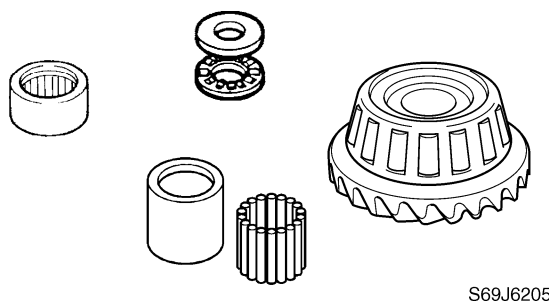
Checking the pinion and forward gear

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



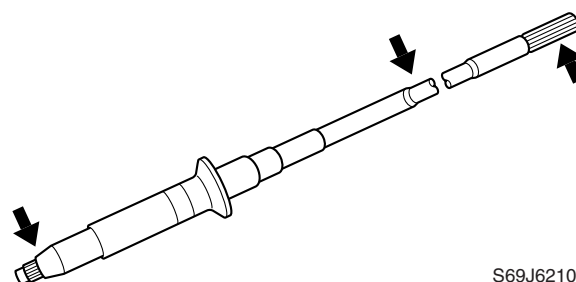
Checking the bearings

1. Check the bearings for pitting or rumbling. Replace if necessary.



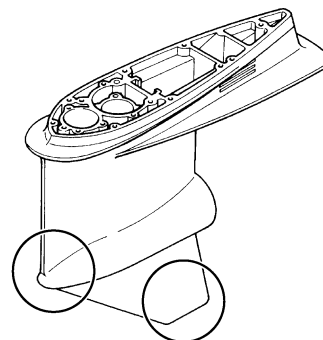
Checking the drive shaft

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



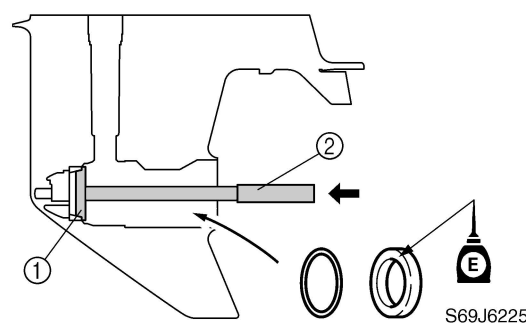
Checking the lower case

1. Check the skag and torpedo for cracks or damage. Replace the lower case if necessary.



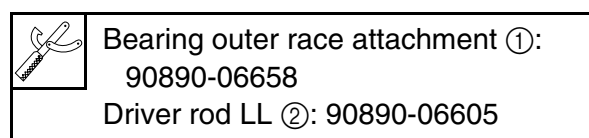
Assembling the lower case

1. Install the original shim(s) and taper roller bearing outer race.



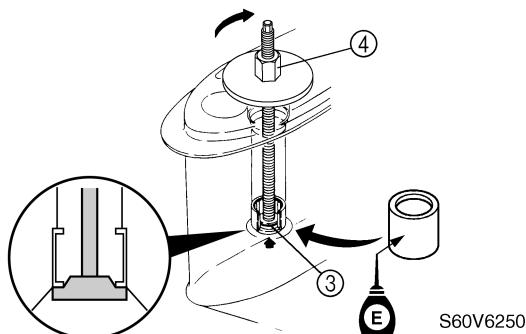
CAUTION:

Add or remove shim(s), if necessary, if replacing the forward gear or lower case.





2. Install the needle bearing outer case into the lower case.



NOTE:

Apply engine oil to the needle bearing outer case before installation.



Bearing outer race attachment ③:
90890-06628
Bearing outer race puller
assembly ④:
90890-06523

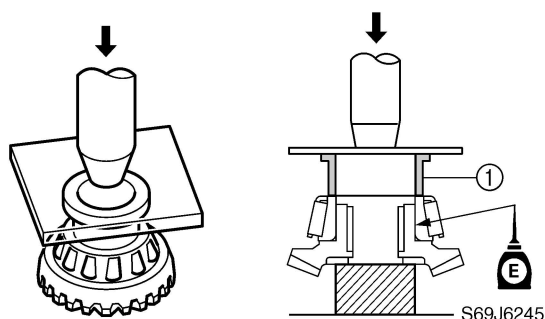
3. Install the needle bearing into the needle bearing outer case.

NOTE:

Apply engine oil or grease to the needle bearing before installation.

Assembling the forward gear

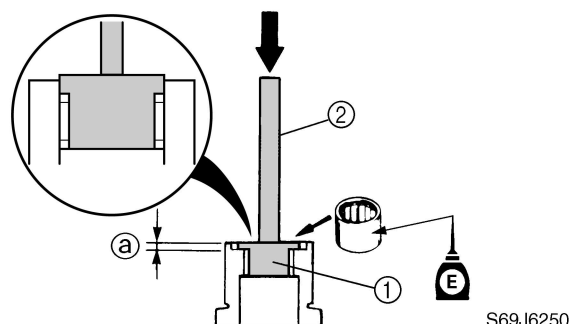
1. Install a new taper roller bearing into the forward gear using a press.



Bearing inner race attachment ①:
90890-06659

Assembling the drive shaft housing

1. Install the needle bearing into the drive shaft housing to the specified depth.

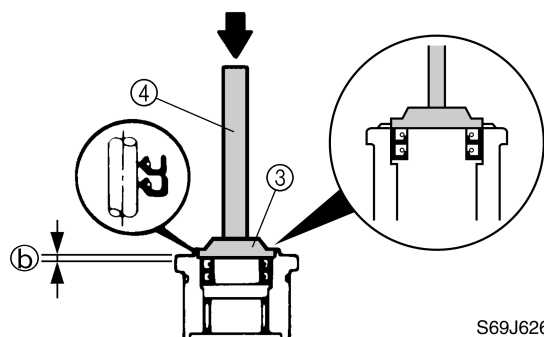


Needle bearing attachment ①:
90890-06610
Driver rod L3 ②: 90890-06652



Depth ②:
4.25–4.75 mm (0.167–0.187 in)

2. Apply grease to the new oil seals, and then install them into the drive shaft housing to the specified depth.



NOTE:

Install an oil seal halfway into the drive shaft housing, then the other oil seal.



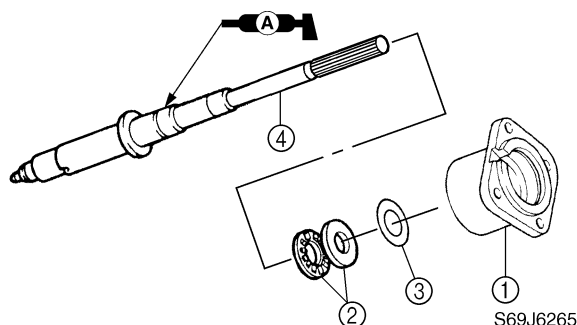
Bearing outer race attachment ③:
90890-06628
Driver rod LS ④: 90890-06606



Depth ③:
0.25–0.75 mm (0.01–0.03 in)

Installing the drive shaft

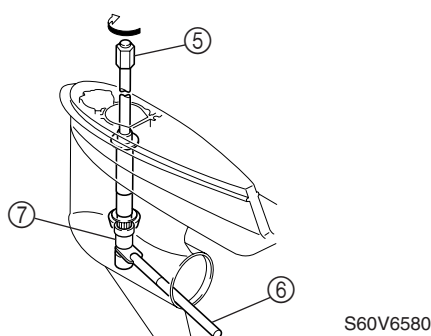
1. Install the forward gear into the lower case.
2. Install the drive shaft housing ①, thrust bearing ②, and original shim(s) ③ onto the drive shaft ④.



CAUTION:

Add or remove shim(s), if necessary, if replacing the drive shaft housing or drive shaft.

3. Install the drive shaft and drive shaft housing into the lower case, then the pinion and pinion nut, and then tighten the nut to the specified torque.



NOTE:

Install the drive shaft by lifting it up slightly, then aligning it with the pinion and the spline of the drive shaft.



Drive shaft holder 6 ⑤: 90890-06520
Pinion nut holder ⑥: 90890-06505
Socket adapter 3 ⑦: 90890-06508

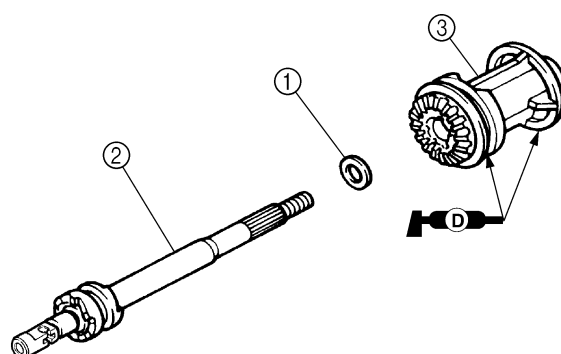


Pinion nut:
142 N·m (14.2 kgf·m, 104.7 ft·lb)

4. Tighten the drive shaft housing bolts.

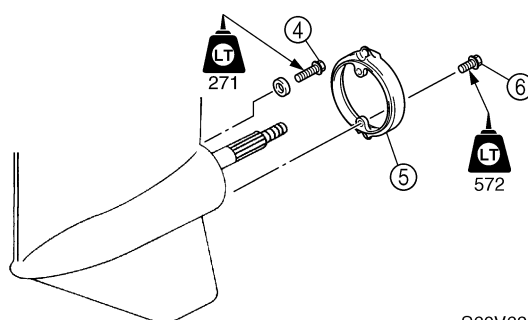
Installing the propeller shaft housing

1. Install the washer ① and propeller shaft assembly ② into the propeller shaft housing assembly ③.
2. Apply grease to the new O-rings.



S69J6280

3. Install the propeller shaft housing assembly into the lower case, and then tighten the bolts ④ to the specified torque.
4. Install the ring ⑤ and bolts ⑥.



S60V6290

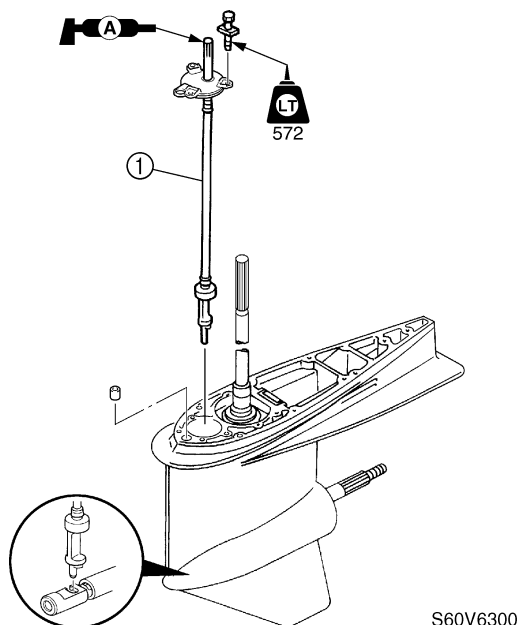


Propeller shaft housing bolt ④:
30 N·m (3.0 kgf·m, 22.1 ft·lb)

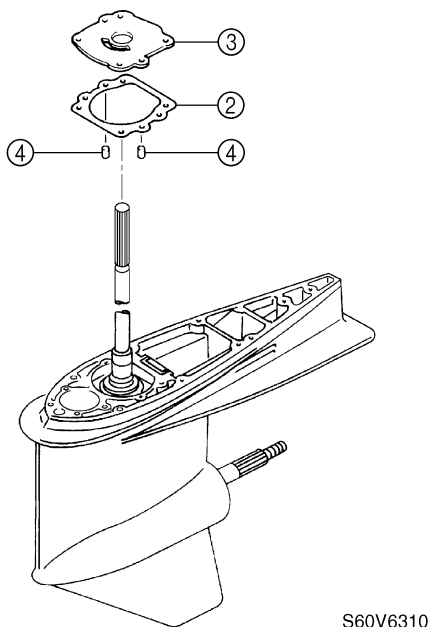


Installing the water pump and shift rod

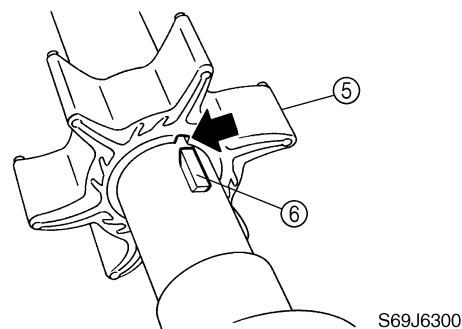
1. Install the shift rod assembly ①.



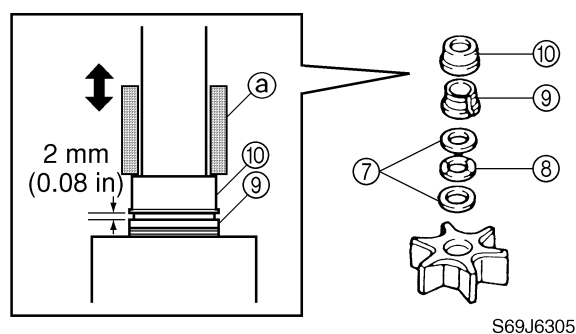
2. Install a new gasket ②, the outer plate cartridge ③, and dowels ④.



3. Install the Woodruff key into the drive shaft.
4. Align the groove on the impeller ⑤ with the Woodruff key ⑥, and then install the impeller onto the drive shaft.



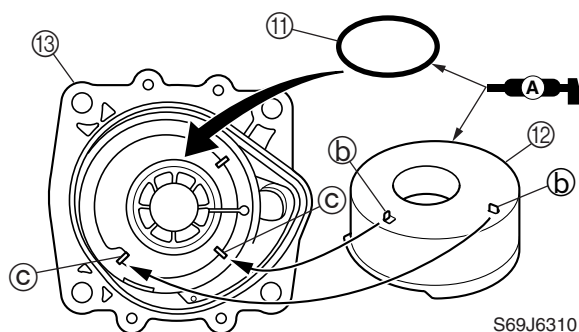
5. Install the washers ⑦, wave washer ⑧, spacer ⑨, and collar ⑩ onto the drive shaft.



NOTE:

- The collar and spacer should fit together firmly.
- While pulling the drive shaft up, install the collar with an appropriate tool ① that fits over the drive shaft as shown.

6. Install the O-ring ⑪ and insert cartridge ⑫ into the pump housing ⑬.

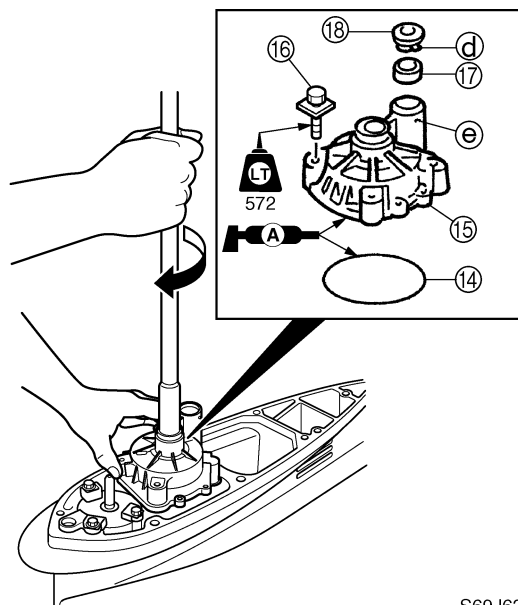


NOTE:

Align the insert cartridge projections ① with the holes ② in the pump housing.

Drive shaft and lower case (regular rotation model)

7. Install the O-ring ⑭ and pump housing assembly ⑮ into the lower case, tighten the bolts ⑯, and then install the seal ⑰ and cover ⑱.



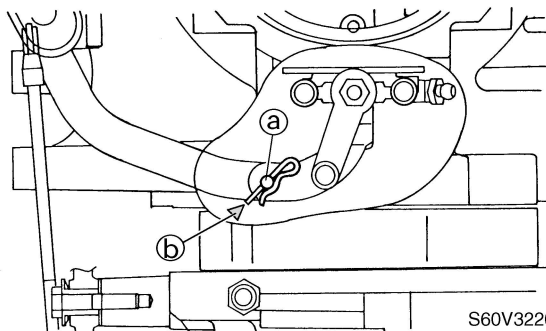
S69J6315

NOTE:

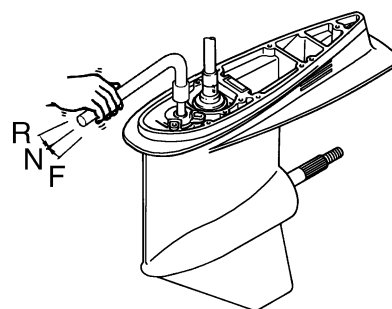
- When installing the pump housing, apply grease to the inside of the housing, and then turn the drive shaft clockwise while pushing down the pump housing.
- Align the cover projection ㉔ with the hole ㉕ in the pump housing.

Installing the lower unit

1. Set the gear shift to the neutral position at the lower unit.
2. Align the center of the set pin ㉖ with the alignment mark ㉗ on the bottom cowl-ing.



S60V3220

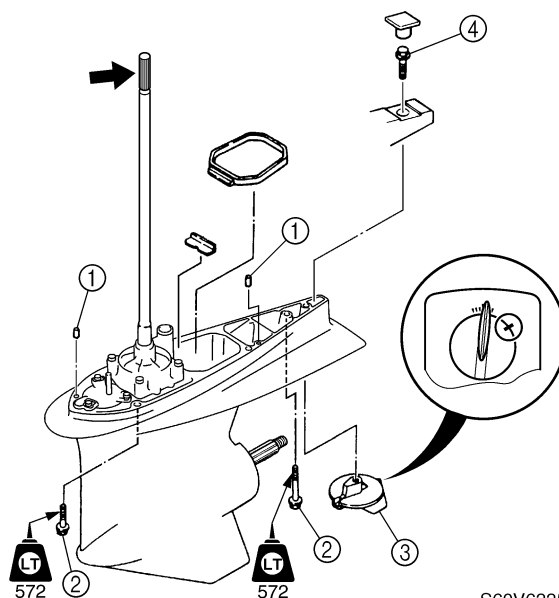


S60V6330



Shift rod push arm: 90890-06052

3. Install the two dowels ① into the lower unit.
4. Install the lower unit into the upper case, and then tighten the lower case mounting bolts ② to the specified torque.
5. Install the trim tab ③ to its original position, and then tighten the trim tab bolt ④ to the specified torque.



S60V6335

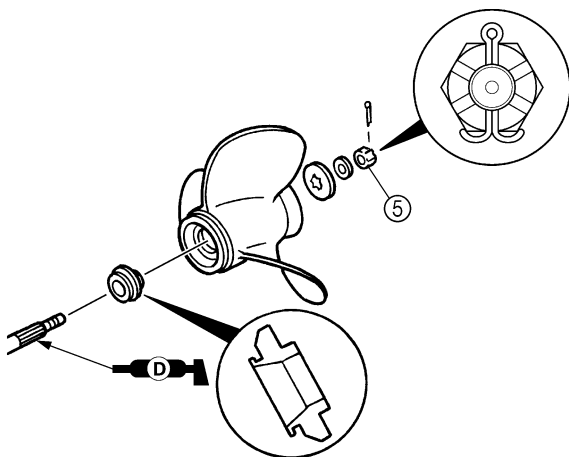


Lower case mounting bolt ②:
47 N·m (4.7 kgf·m, 34.7 ft·lb)
Trim tab bolt ④:
42 N·m (4.2 kgf·m, 31.0 ft·lb)

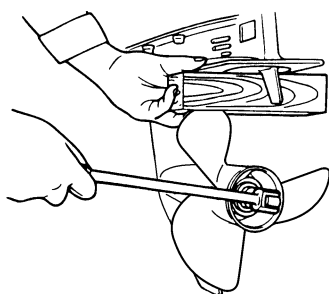
6



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



S60V6650



S69J6340

⚠ WARNING

- Do not hold the propeller with your hands when loosening or tightening it.
- Be sure to disconnect the battery leads from the battery and the clip from the engine shut-off switch.
- Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.

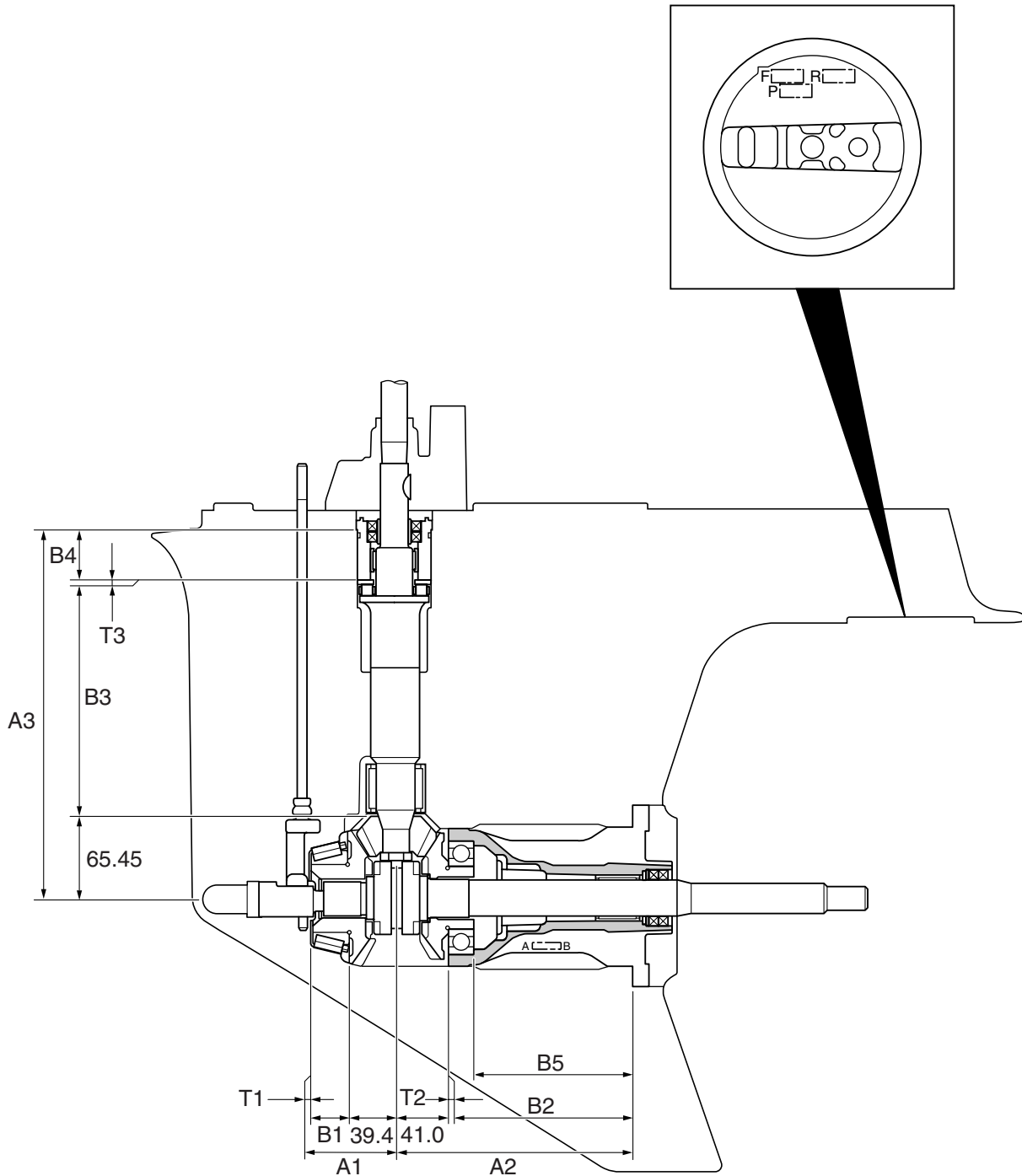
NOTE:

If the grooves in the propeller nut ⑤ do not align with the cotter pin hole, tighten the nut until they are aligned.



Propeller nut ⑤:
54 N·m (5.4 kgf·m, 39.8 ft·lb)

Shimming (regular rotation model)



6

S60V6520



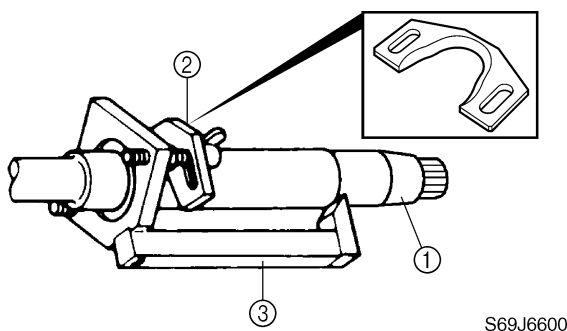
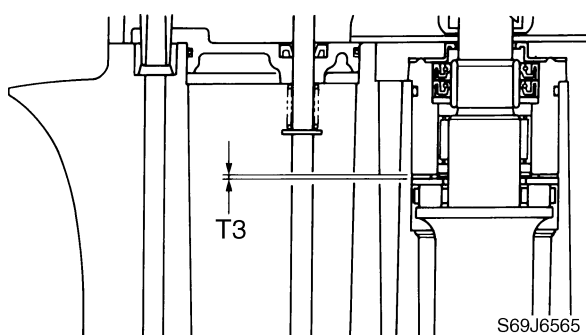
Shimming

NOTE:

- Shimming is not required when assembling the original lower case and inner parts.
- Shimming is required when assembling the original inner parts and a new lower case.
- Shimming is required when replacing the inner part(s).

Selecting the pinion shims

1. Install the special service tool onto the drive shaft ①.



NOTE:

- Select the shim thickness (T3) by using the specified measurement(s) and the calculation formula.
- Install the special service tool onto the drive shaft so that the shaft is at the center of the hole.
- Tighten the wing nuts another 1/4 of a turn after they contact the fixing plate ②.



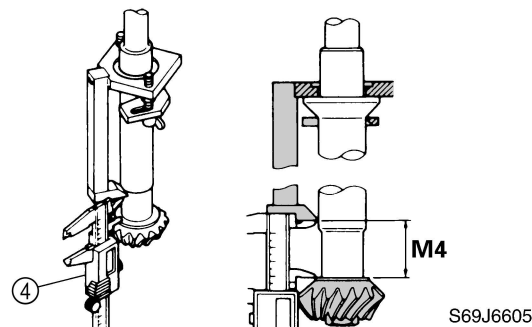
Pinion nut key ③:
90890-06710

2. Install the pinion and pinion nut, and then tighten the nut to the specified torque.



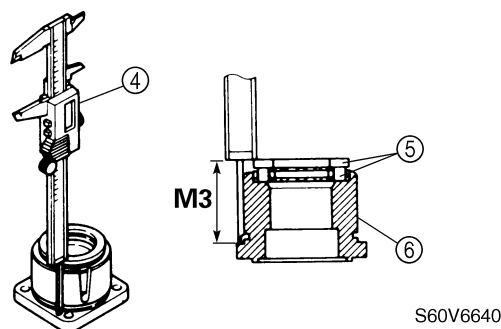
Pinion nut:
142 N·m (14.2 kgf·m, 104.7 ft·lb)

3. Measure the distance (M4) between the special service tool and the pinion as shown.



Digital caliper ④: 90890-06704

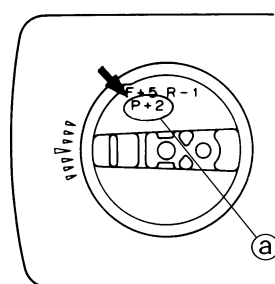
4. Turn the thrust bearing ⑤ two or three times to seat the drive shaft housing ⑥, and then measure the housing height (M3) as shown.



NOTE:

Measure the thrust bearing at three points to find the height average.

5. Calculate the pinion shim thickness (T3) as shown in the examples below.



S69J6555

NOTE:

“P” is the deviation of the lower case dimension from standard. The “P” mark ① is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the “P” mark is unreadable, assume that “P” is zero and check the backlash when the unit is assembled.

Calculation formula:

$$\text{Pinion shim thickness (T3)} = 81.55 + P/100 - M3 - M4$$

Example:

If “M3” is 50.75 mm and “M4” is 30.52 mm and “P” is (–5), then

$$\begin{aligned} T3 &= 81.55 + (-5)/100 - 50.75 - 30.52 \text{ mm} \\ &= 81.55 - 0.05 - 50.75 - 30.52 \text{ mm} \\ &= 0.23 \text{ mm} \end{aligned}$$

6. Select the pinion shim(s) (T3) 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 thicknesses:

0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

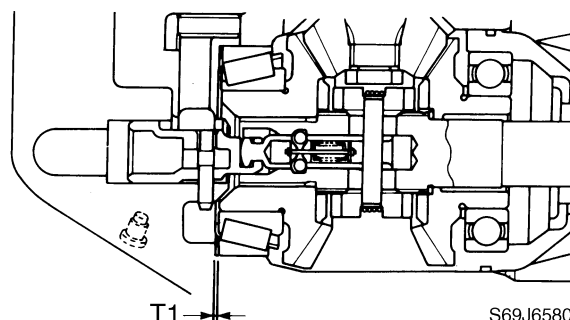
Example:

If “T3” is 0.23 mm, then the pinion shim is 0.22 mm.

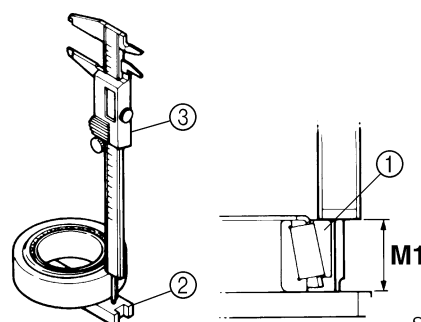
If “T3” is 0.70 mm, then the pinion shim is 0.68 mm.

Selecting the forward gear shims

1. Turn the taper roller bearing outer race ① two or three times to seat the rollers, and then measure the bearing height (M1) as shown.



S69J6580



S69J6615

NOTE:

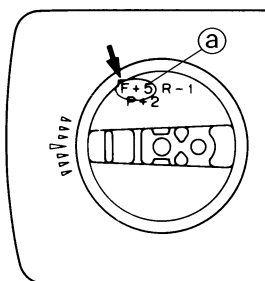
- Select the shim thickness (T1) by using the specified measurement(s) and the calculation formula.
- Measure the bearing outer race at three points to find the height average.



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



- Calculate the forward gear shim thickness (T1) as shown in the examples below.



S69J6570

NOTE:

"F" is the deviation of the lower case dimension from standard. The "F" mark (a) is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the "F" mark is unreadable, assume that "F" is zero and check the backlash when the unit is assembled.

Calculation formula:

$$\text{Forward gear shim thickness (T1)} = 29.50 + F/100 - M1$$

Example:

If "M1" is 29.10 mm and "F" is (+5), then

$$T1 = 29.50 + (+5)/100 - 29.10 \text{ mm}$$

$$= 29.50 + 0.05 - 29.10 \text{ mm}$$

$$= 0.45 \text{ mm}$$

- Select the forward gear shim(s) (T1) 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 thicknesses:

0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

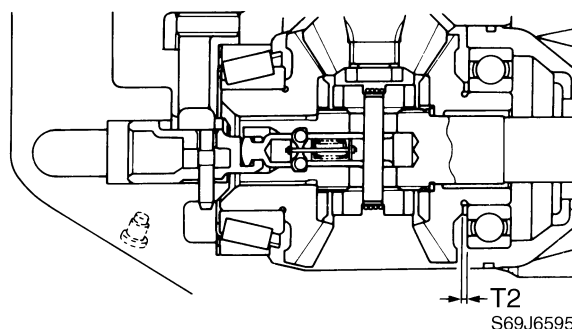
Example:

If "T1" is 0.45 mm, then the forward gear shim is 0.42 mm.

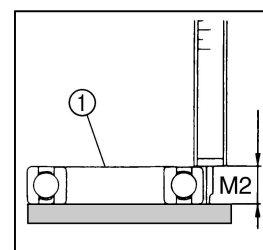
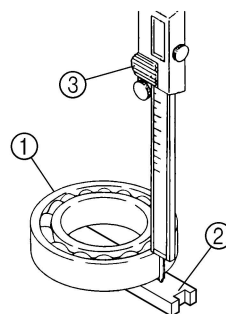
If "T1" is 0.60 mm, then the forward gear shim is 0.58 mm.

Selecting the reverse gear shims

- Turn the ball bearing (1) two or three times, and then measure the bearing height (M2) as shown.



S69J6595



S69J6620

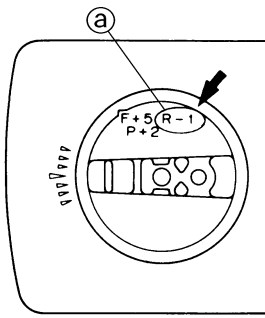
NOTE:

- Select the shim thickness (T2) by using the specified measurement(s) and the calculation formula.
- Measure the bearing outer race at three points to find the height average.

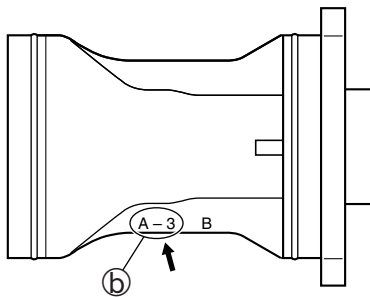


Shimming plate (2): 90890-06701
Digital caliper (3): 90890-06704

- Calculate the reverse gear shim thickness (T2) as shown in the examples below.



S69J6585



S69J6625

NOTE:

“R” is the deviation of the lower case dimension from standard, and “A” is the deviation of the propeller shaft housing from standard. The “R” mark ① is stamped on the trim tab mounting surface of the lower case, and the “A” mark ② is stamped on the propeller shaft housing in 0.01 mm units. If the “R” mark or “A” mark is unreadable, assume that “R” and “A” are zero and check the backlash when the unit is assembled.

Calculation formula:

$$\text{Reverse gear shim thickness (T2)} = 21.00 + R/100 - A/100 - M2$$

Example:

If “M2” is 19.92 mm and “R” is (+3) and “A” is (−5), then

$$\begin{aligned} T2 &= 21.00 + (+3)/100 - (-5)/100 - 19.92 \text{ mm} \\ &= 21.00 + 0.03 + 0.05 - 19.92 \text{ mm} \\ &= 1.16 \text{ mm} \end{aligned}$$

3. Select the reverse gear shim(s) (T2) 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 thicknesses:

0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

Example:

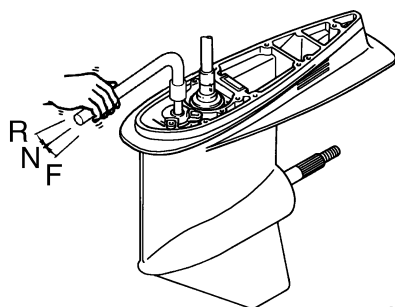
If “T2” is 1.16 mm, then the reverse gear shim is 1.15 mm.

If “T2” is 1.20 mm, then the reverse gear shim is 1.18 mm.



Backlash (regular rotation model) Measuring the forward and reverse gear backlash

1. Remove the water pump assembly.
2. Set the gear shift to the neutral position at the lower unit.

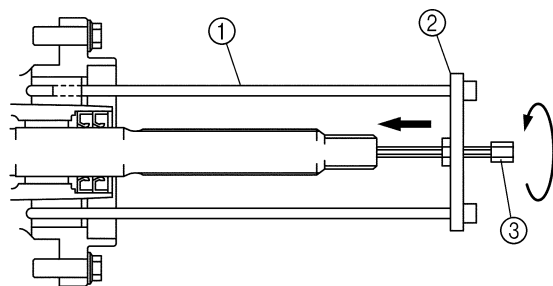


S60V6330



Shift rod push arm: 90890-06052

3. Install the special service tool so that it pushes against the propeller shaft.



S60V6545

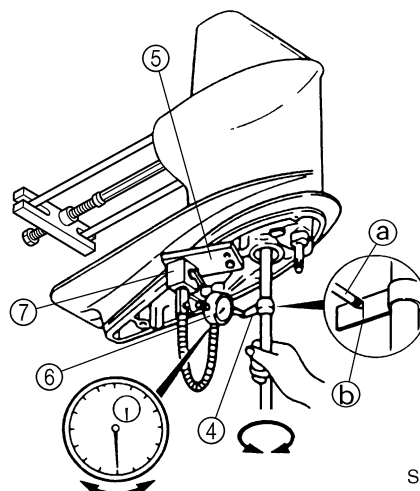
NOTE: Tighten the center bolt while turning the drive shaft until the drive shaft can no longer be turned.



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

4. Install the backlash indicator onto the drive shaft (22.4 mm [0.88 in] in diameter), then the dial gauge onto the lower unit.

5. Set the lower unit upside down.



S60V6555

NOTE: Install the dial gauge so that the plunger ① contacts the mark ② on the backlash indicator.



Backlash indicator ④: 90890-06706
Magnet base plate ⑤: 90890-07003
Dial gauge set ⑥: 90890-01252
Magnet base ⑦: 90890-06705

6. Slowly turn the drive shaft clockwise and counterclockwise and measure the backlash when the drive shaft stops in each direction.



Forward gear backlash:
0.13–0.42 mm (0.0051–0.0165 in)

7. Add or remove shim(s) if out of specification.

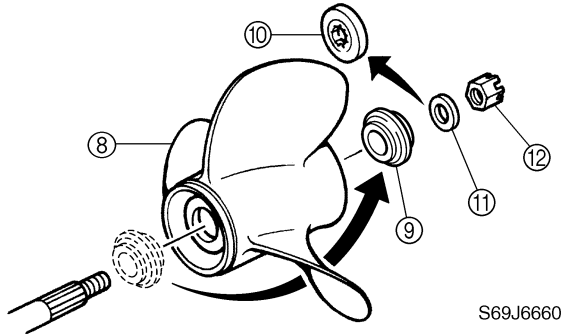
Forward gear backlash	Shim thickness
Less than 0.13 mm (0.0051 in)	To be decreased by $(0.28 - M) \times 0.78$
More than 0.42 mm (0.0165 in)	To be increased by $(M - 0.28) \times 0.78$

M: Measurement

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

Backlash (regular rotation model)

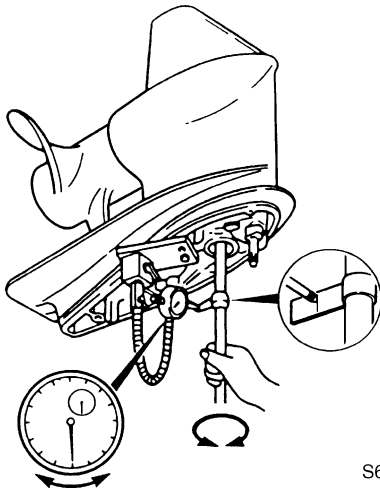
8. Remove the special service tools from the propeller shaft.
9. Apply a load to the reverse gear by installing the propeller ⑧, the spacer ⑨ (without the washer ⑩), then the washer ⑪ as shown.



NOTE:

Tighten the propeller nut ⑫ while turning the drive shaft until the drive shaft can no longer be turned.

10. Slowly turn the drive shaft clockwise and counterclockwise and measure the backlash when the drive shaft stops in each direction.



Reverse gear backlash:
0.64–0.93 mm (0.0252–0.0366 in)

11. Add or remove shim(s) if out of specification.

Reverse gear backlash	Shim thickness
Less than 0.64 mm (0.0252 in)	To be increased by $(0.79 - M) \times 0.78$
More than 0.93 mm (0.0366 in)	To be decreased by $(M - 0.79) \times 0.78$

M: Measurement

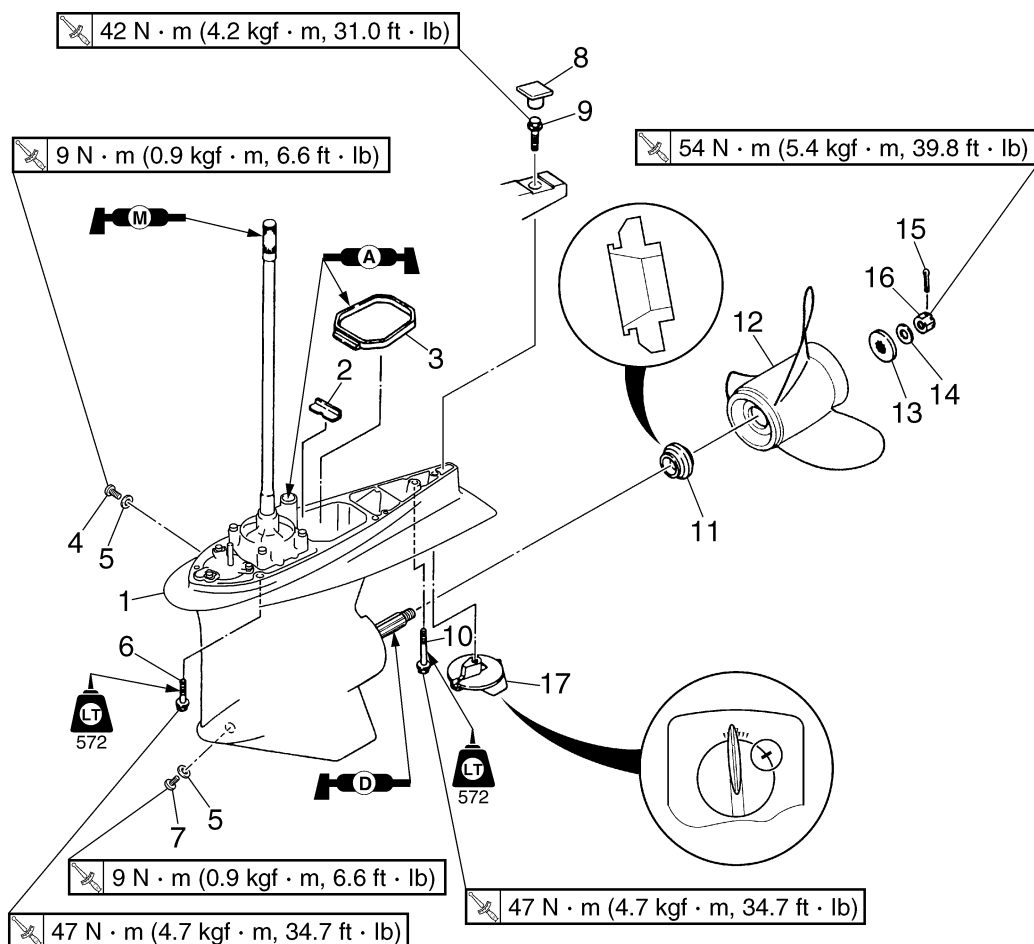
Available shim thicknesses:

0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

12. Remove the special service tools, and then install the water pump assembly.

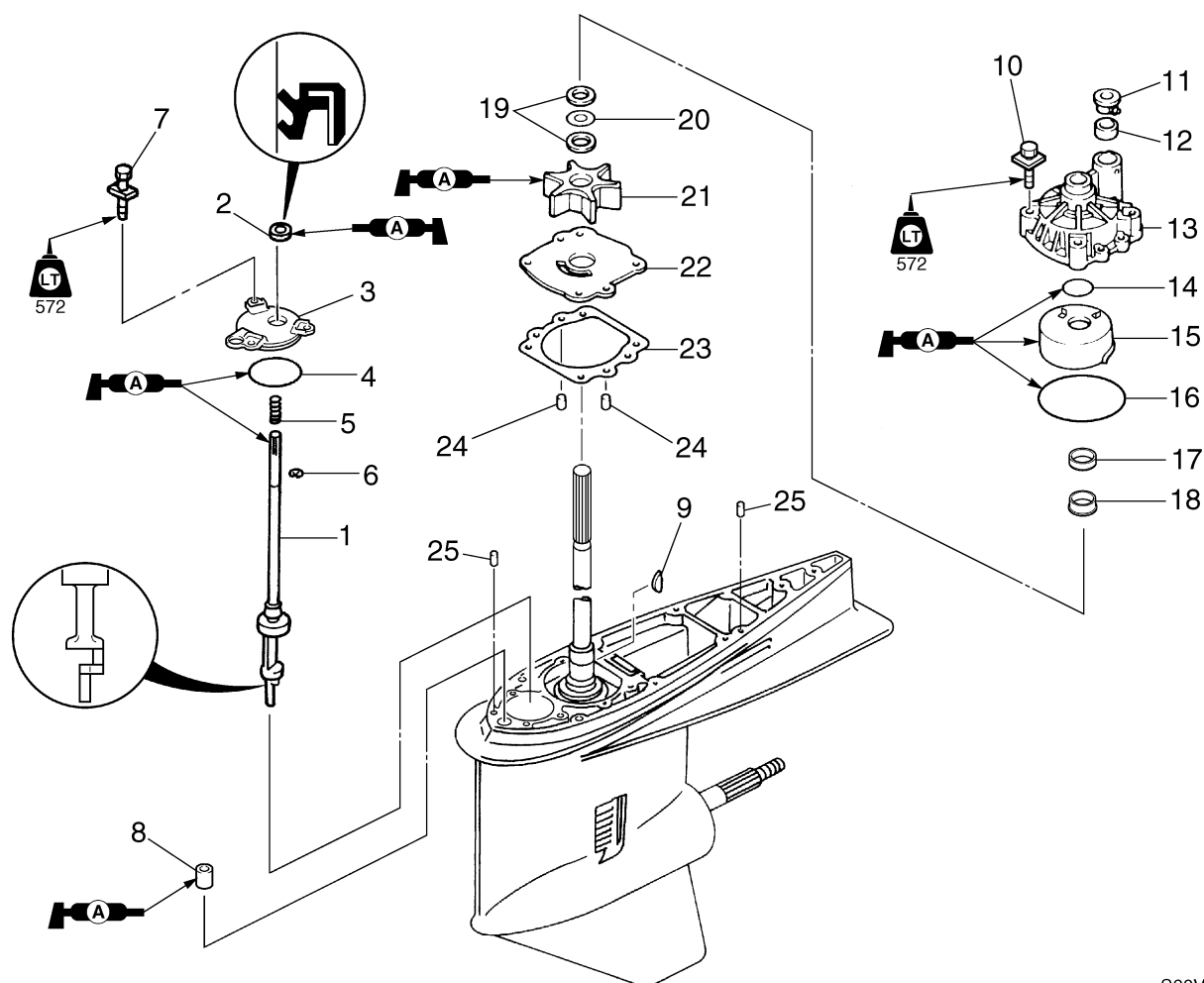


Lower unit (counter rotation model)



S60V6340

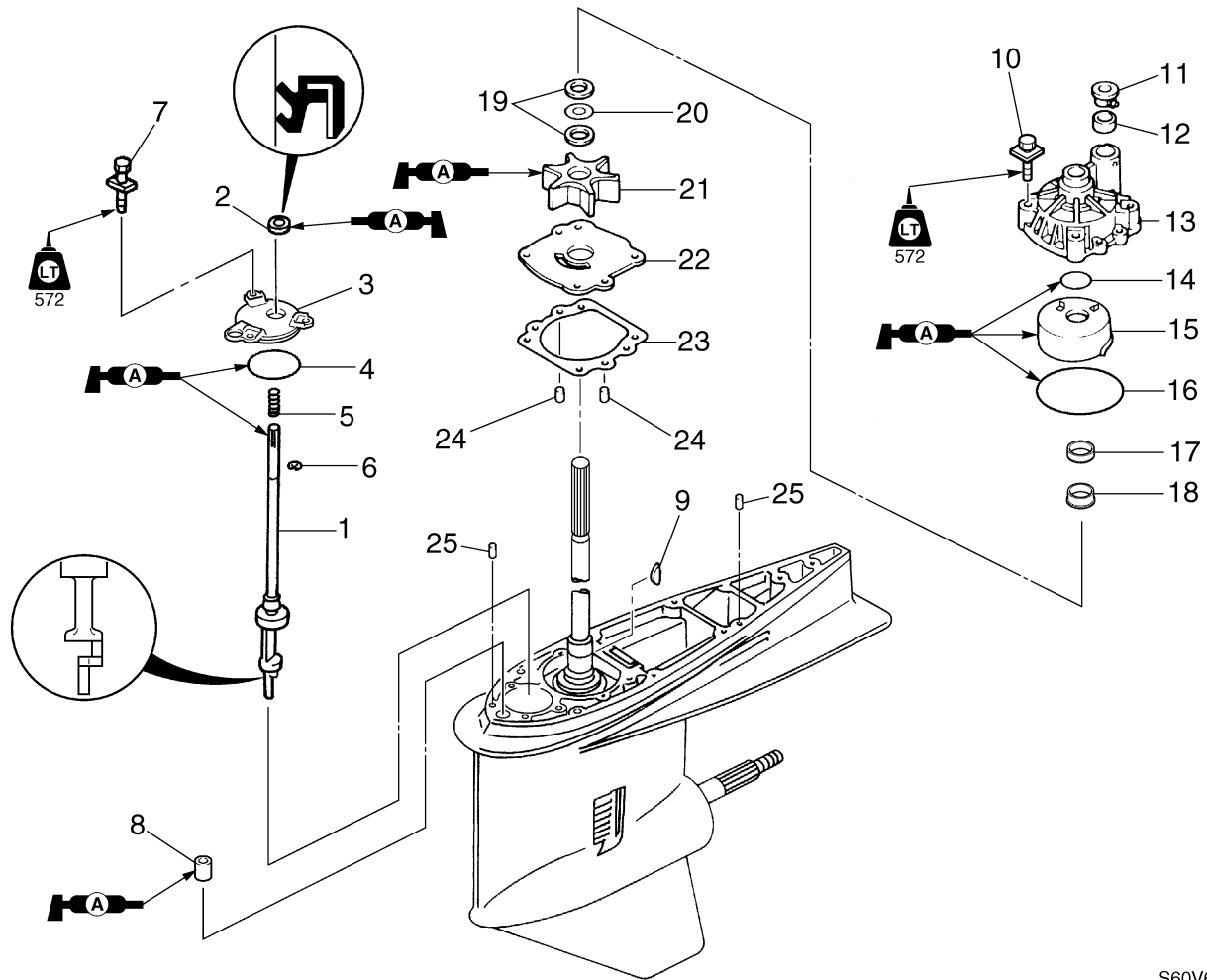
No.	Part name	Q'ty	Remarks
1	Lower unit	1	
2	Plate	1	
3	Rubber seal	1	
4	Check screw	1	
5	Gasket	2	Not reusable
6	Bolt	7	M10 × 45 mm
7	Drain screw	1	
8	Grommet	1	
9	Bolt	1	M10 × 44 mm
10	Bolt	1	M10 × 70 mm
11	Spacer	1	
12	Propeller	1	
13	Washer	1	
14	Washer	1	
15	Cotter pin	1	Not reusable
16	Propeller nut	1	
17	Trim tab	1	



S60V6350

6

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

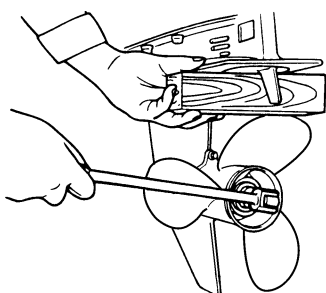


S60V6350

No.	Part name	Q'ty	Remarks
18	Spacer	1	Not reusable
19	Washer	2	
20	Wave washer	1	
21	Impeller	1	
22	Outer plate cartridge	1	
23	Gasket	1	
24	Dowel	2	
25	Dowel	2	

Removing the lower unit

1. Drain the gear oil. For draining procedures, see Chapter 3, "Changing the gear oil."
2. Set the gear shift to the neutral position, and place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then remove the propeller nut and propeller.

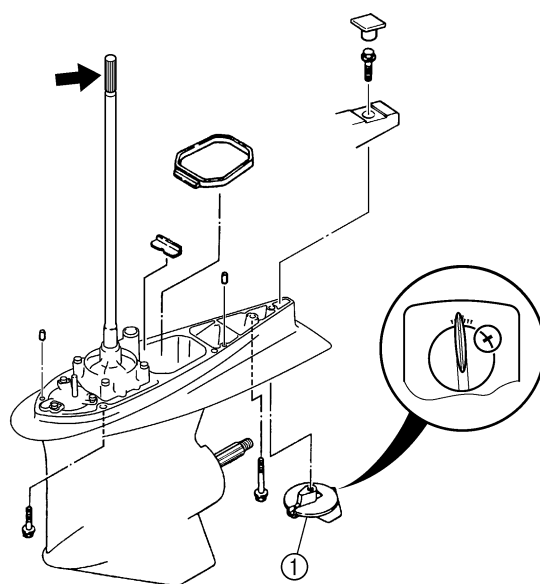


S69J6545

⚠ WARNING

- Do not hold the propeller with your hands when loosening or tightening it.
- Be sure to disconnect the battery leads from the battery and the clip from the engine shut-off switch.
- Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.

3. Mark the trim tab ① at the area shown, and then remove it.
4. Loosen the bolts, and then remove the lower unit from the upper case.



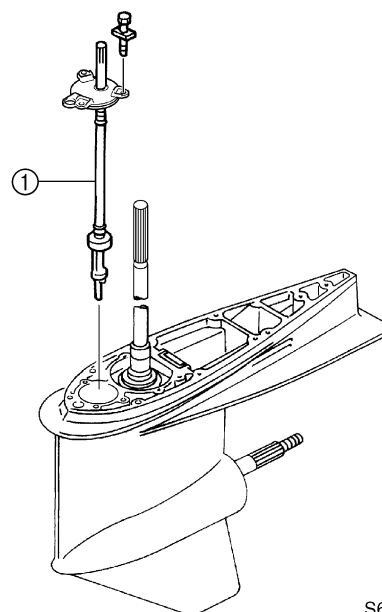
S60V6355

NOTE:

Check that there is no oil on the spline and check it for rust or wear.

Removing the water pump and shift rod

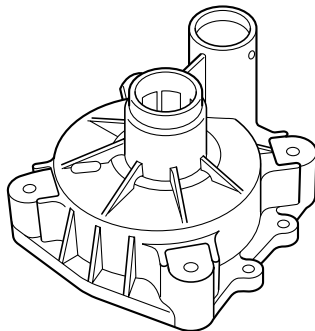
1. Remove the water pump assembly and shift rod assembly ①.



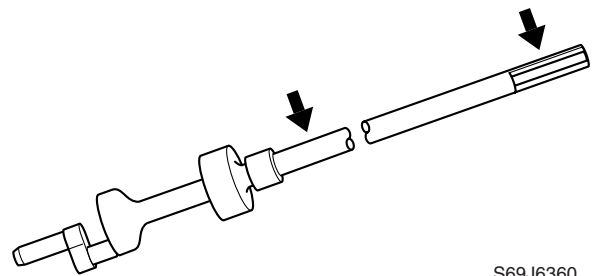
S60V6030

Checking the water pump and shift rod

1. Check the water pump housing for deformation. Replace if necessary.

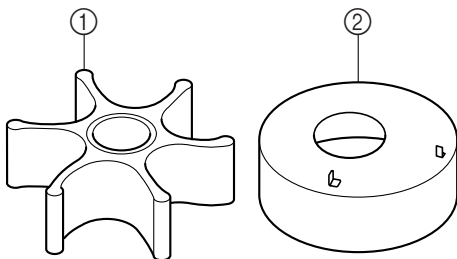


S69J6030



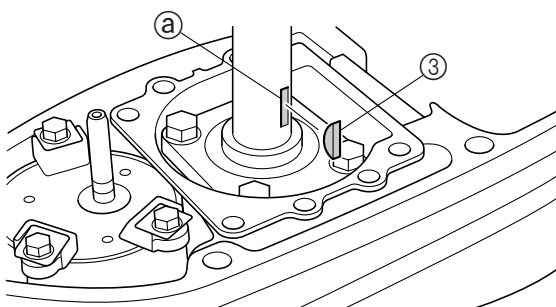
S69J6360

2. Check the impeller ① and insert cartridge ② for cracks or wear. Replace if necessary.



S69J6035

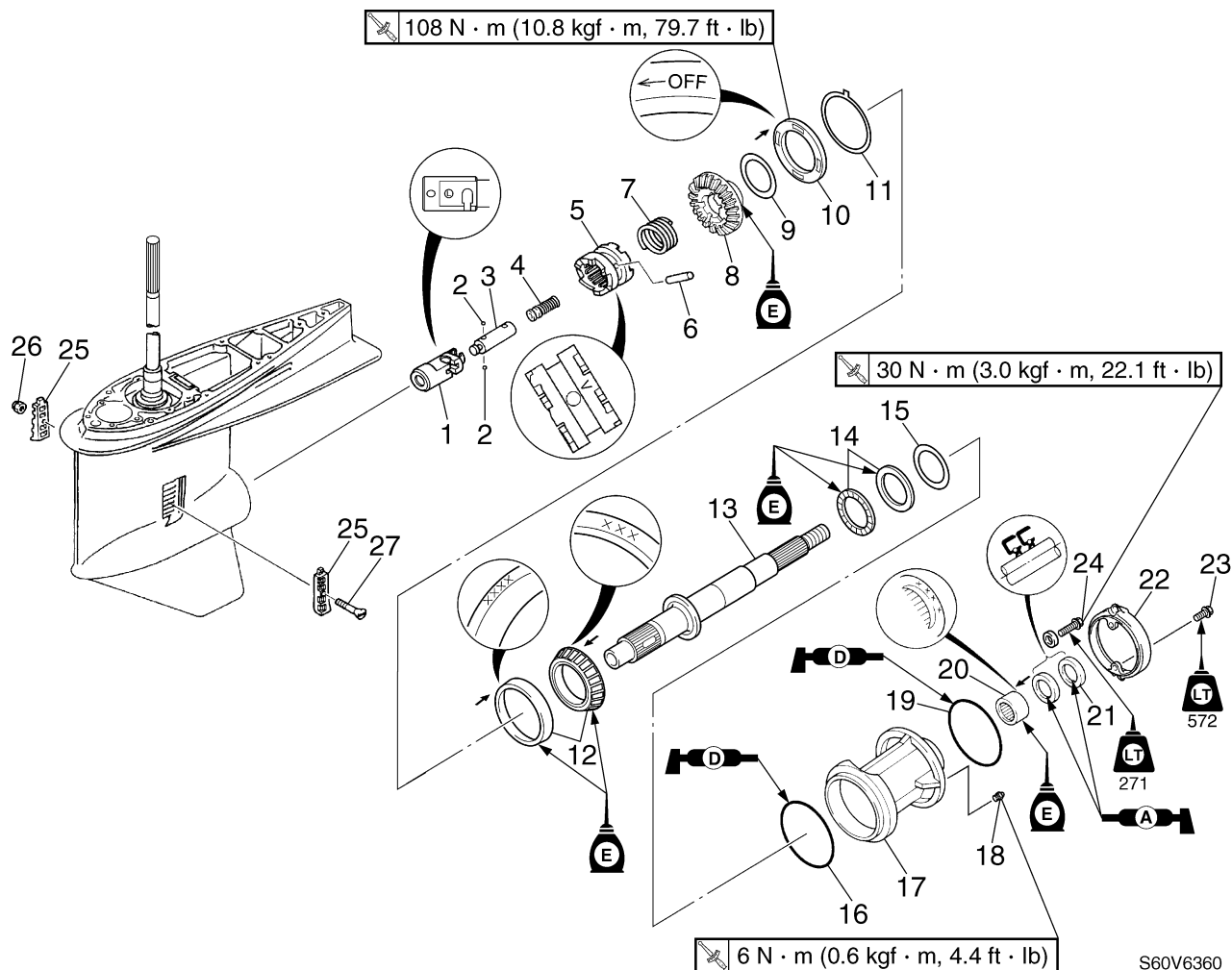
3. Check the Woodruff key ③ and the groove ④ on the drive shaft for wear. Replace if necessary.



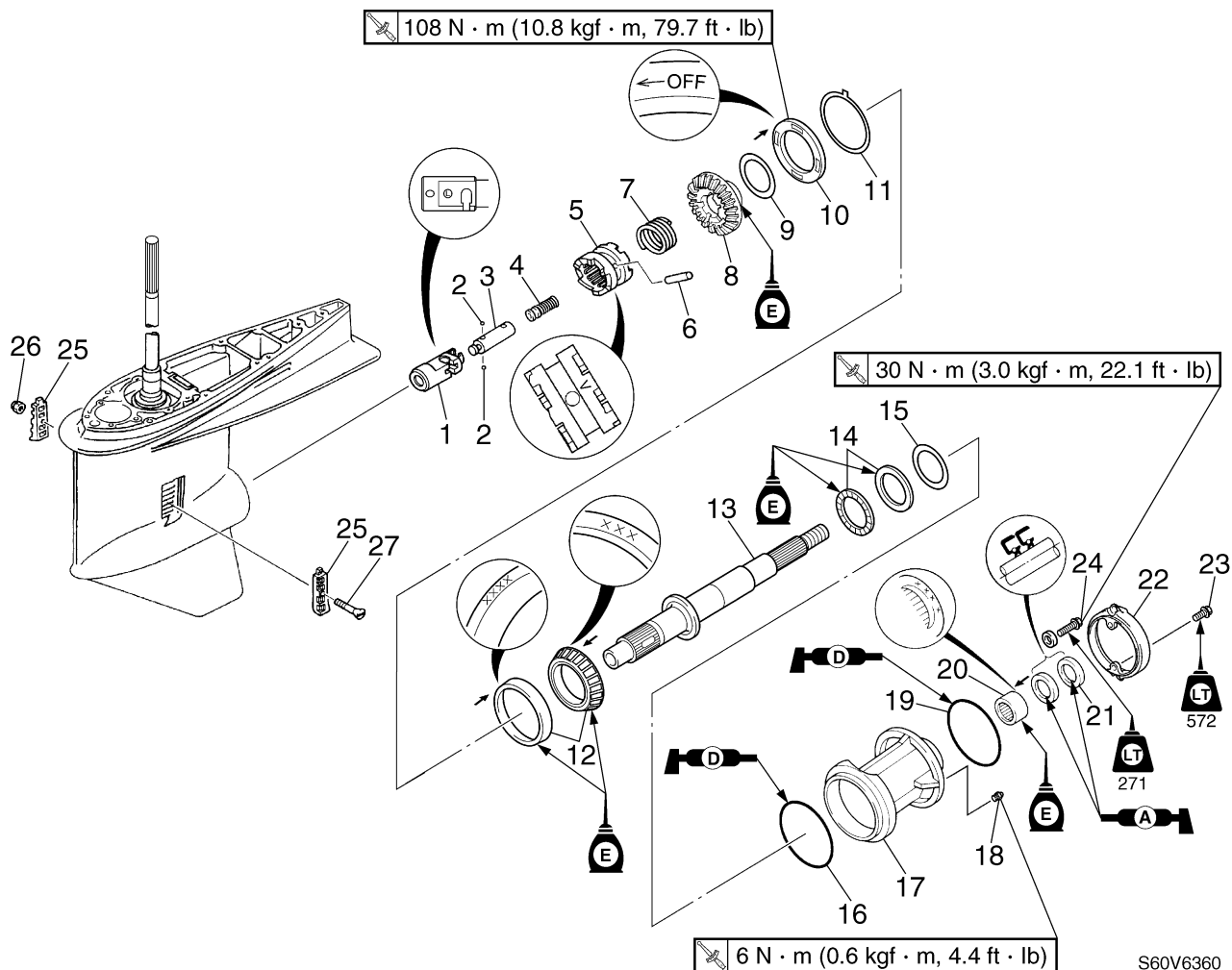
S69J6040

4. Check the shift rod for cracks or wear. Replace if necessary.

Propeller shaft housing (counter rotation model)



No.	Part name	Q'ty	Remarks
1	Shift rod joint	1	
2	Ball	2	
3	Slider	1	
4	Shift plunger	1	
5	Dog clutch	1	
6	Cross pin	1	
7	Spring	1	
8	Forward gear	1	
9	Forward gear shim	—	As required
10	Ring nut	1	
11	Claw washer	1	
12	Taper roller bearing assembly	1	Not reusable
13	Propeller shaft	1	
14	Thrust bearing	1	
15	Propeller shaft shim	—	As required
16	O-ring	1	Not reusable
17	Propeller shaft housing	1	

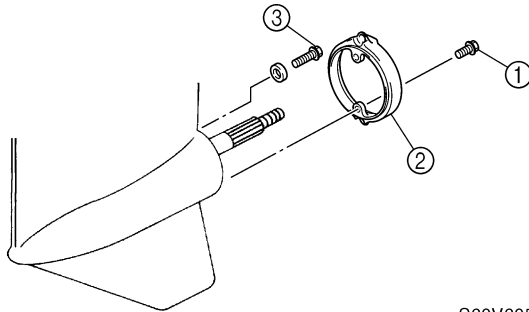


S60V6360

No.	Part name	Q'ty	Remarks
18	Grease nipple	1	
19	O-ring	1	Not reusable
20	Needle bearing	1	
21	Oil seal	2	Not reusable
22	Ring	1	
23	Bolt	2	M8 × 20 mm
24	Bolt	2	M8 × 33 mm
25	Cooling water inlet cover	2	
26	Nut	1	
27	Screw	1	

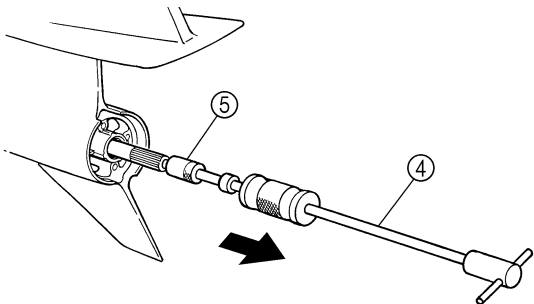
Removing the propeller shaft housing assembly

1. Remove the bolts ①, ring ②, and bolts ③.



S60V6050

2. Pull out the propeller shaft housing assembly.



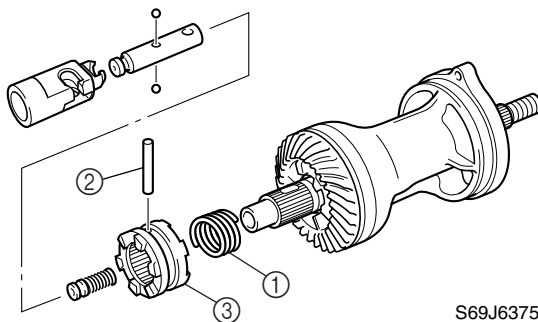
S69J6370



Slide hammer ④: 90890-06531
Puller head ⑤: 90890-06514

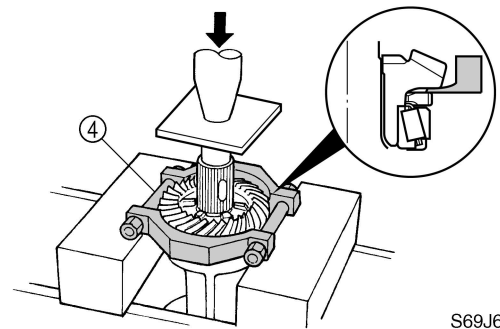
Disassembling the propeller shaft housing

1. Remove the spring ①, then the cross pin ②, dog clutch ③, slider, shift plunger, and shift rod joint.



S69J6375

2. Remove the forward gear and forward gear shim(s) from the propeller shaft housing using a press.

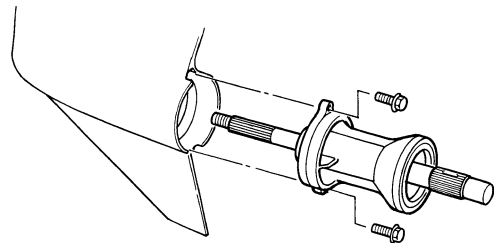


S69J6380



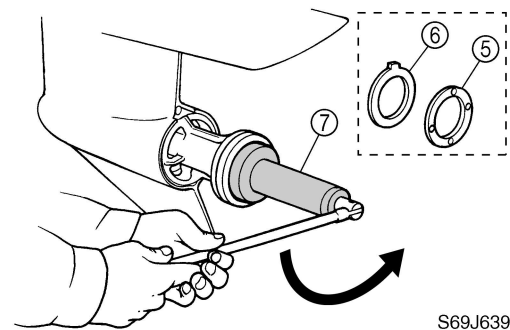
Bearing separator ④: 90890-06534

3. Install the propeller shaft assembly in the reverse direction into the lower case.



S69J6385

4. Remove the ring nut ⑤ and claw washer ⑥.



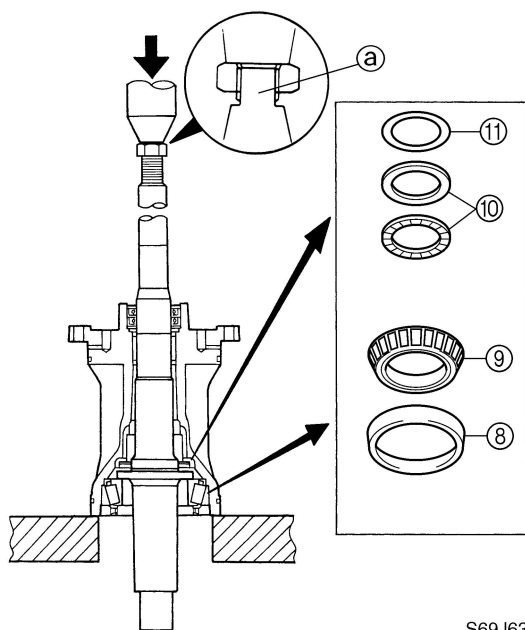
S69J6390



Ring nut wrench ⑦: 90890-06578



5. Remove the bearing outer race ⑧, taper roller bearing ⑨, thrust bearing ⑩, and propeller shaft shim(s) ⑪ using a press.

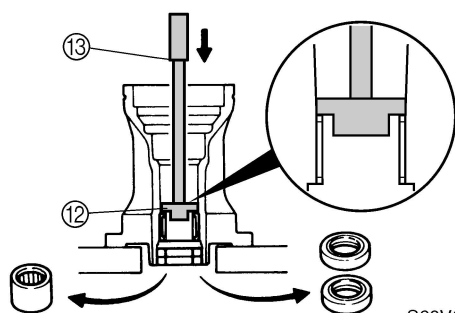


S69J6395

CAUTION:

- Do not press the propeller shaft threads ① directly.
- Do not reuse the taper roller bearing, always replace it with a new one.

6. Remove the oil seals and needle bearing.



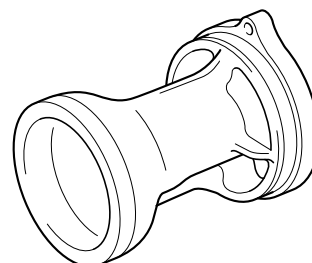
S60V6720



Needle bearing attachment ⑫:
90890-06653
Driver rod L3 ⑬: 90890-06652

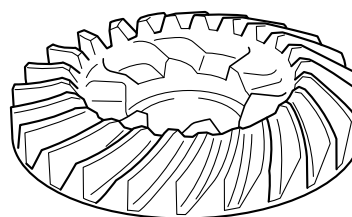
Checking the propeller shaft housing

1. Clean the propeller shaft housing using a soft brush and cleaning solvent, and then check it for cracks or damage. Replace if necessary.



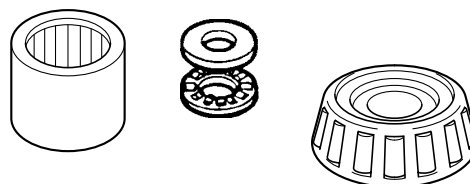
S69J6105

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



S69J6110

3. Check the bearings for pitting or rumbling. Replace if necessary.

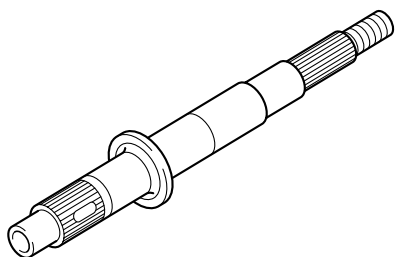


S69J6410

Checking the propeller shaft

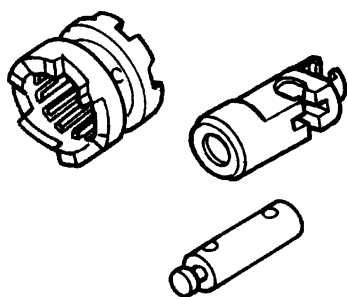
1. Check the propeller shaft for bends or wear. Replace if necessary.

Propeller shaft housing (counter rotation model)



S69J6415

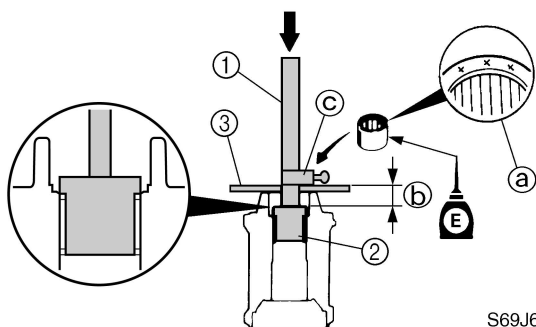
2. Check the dog clutch, shift rod joint, and shift slider for cracks or wear. Replace if necessary.



S69J6420

Assembling the propeller shaft housing

1. Install the needle bearing into the propeller shaft housing to the specified depth.



S69J6140

NOTE:

- Install the needle bearing with the manufacture identification mark (a) facing toward the oil seal (propeller side).
- When using the driver rod, do not strike the special tool in a manner that will force the stopper (C) out of place.

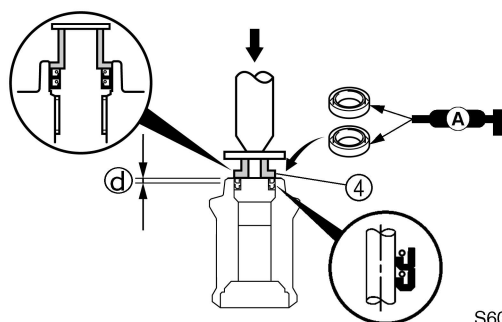


Driver rod SS ①: 90890-06604
Needle bearing attachment ②:
90890-06610
Bearing depth plate ③: 90890-06603



Depth (b):
25.05–25.55 mm (0.986–1.006 in)

2. Apply grease to the new oil seals, and then install them into the propeller shaft housing to the specified depth.



S60V6680

NOTE:

Install an oil seal halfway into the propeller shaft housing, then the other oil seal.



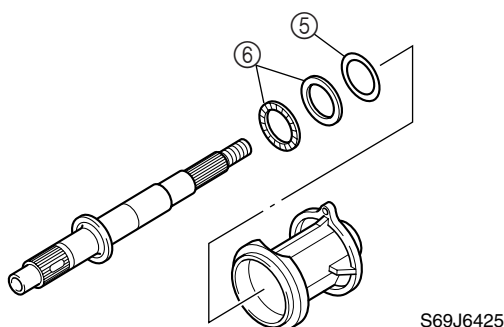
Bearing inner race attachment ④:
90890-06640



Depth (d):
4.75–5.25 mm (0.187–0.207 in)



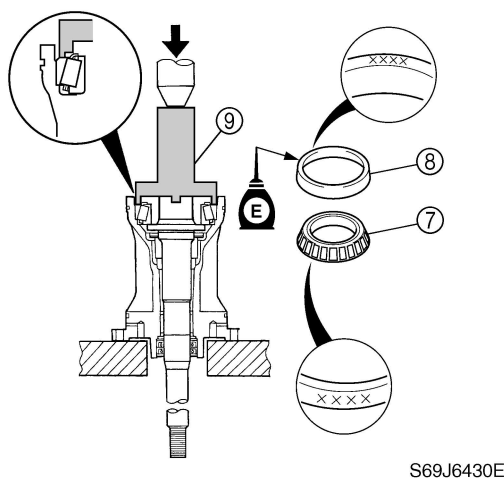
3. Install the original shim(s) ⑤ and thrust bearing ⑥ with the propeller shaft into the propeller shaft housing.



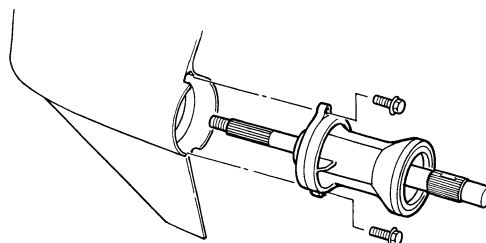
CAUTION:

Add or remove shim(s), if necessary, if replacing the propeller shaft, the thrust bearing, or the propeller shaft housing.

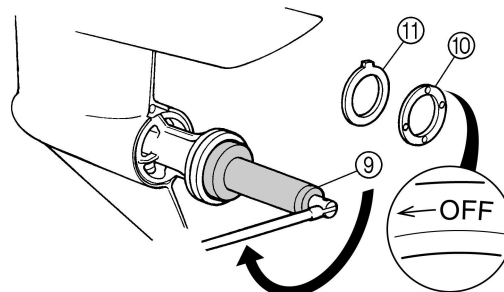
4. Install the new taper roller bearing ⑦ and bearing outer race ⑧ into the propeller shaft housing using a press.



5. Install the propeller shaft assembly in the reverse direction into the lower case.



6. Install the ring nut ⑩ and claw washer ⑪, and then tighten the ring nut to the specified torque.

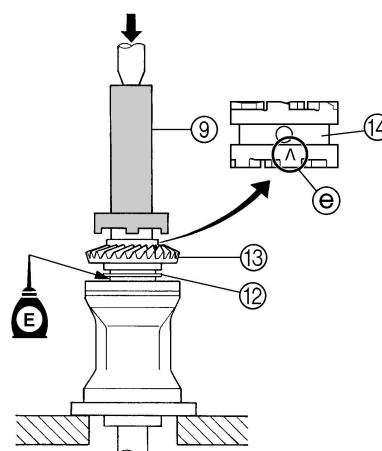


Ring nut wrench ⑨: 90890-06578



Ring nut ⑩:
108 N·m (10.8 kgf·m, 79.7 ft·lb)

7. Install the original shim(s) ⑫, forward gear ⑬, and dog clutch ⑭ using a press.



CAUTION:

Add or remove shim(s), if necessary, if replacing the forward gear or taper roller bearing.

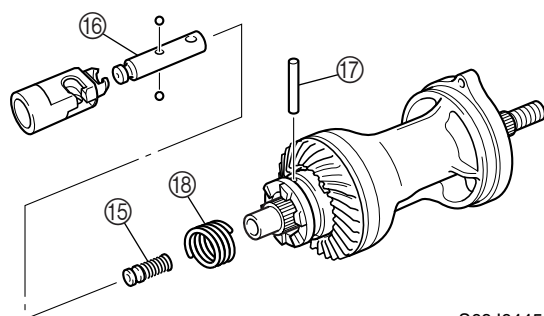
NOTE:

Install the dog clutch ⑭ with the “V” mark ㊟ facing toward the forward gear.



Ring nut wrench ⑨: 90890-06578

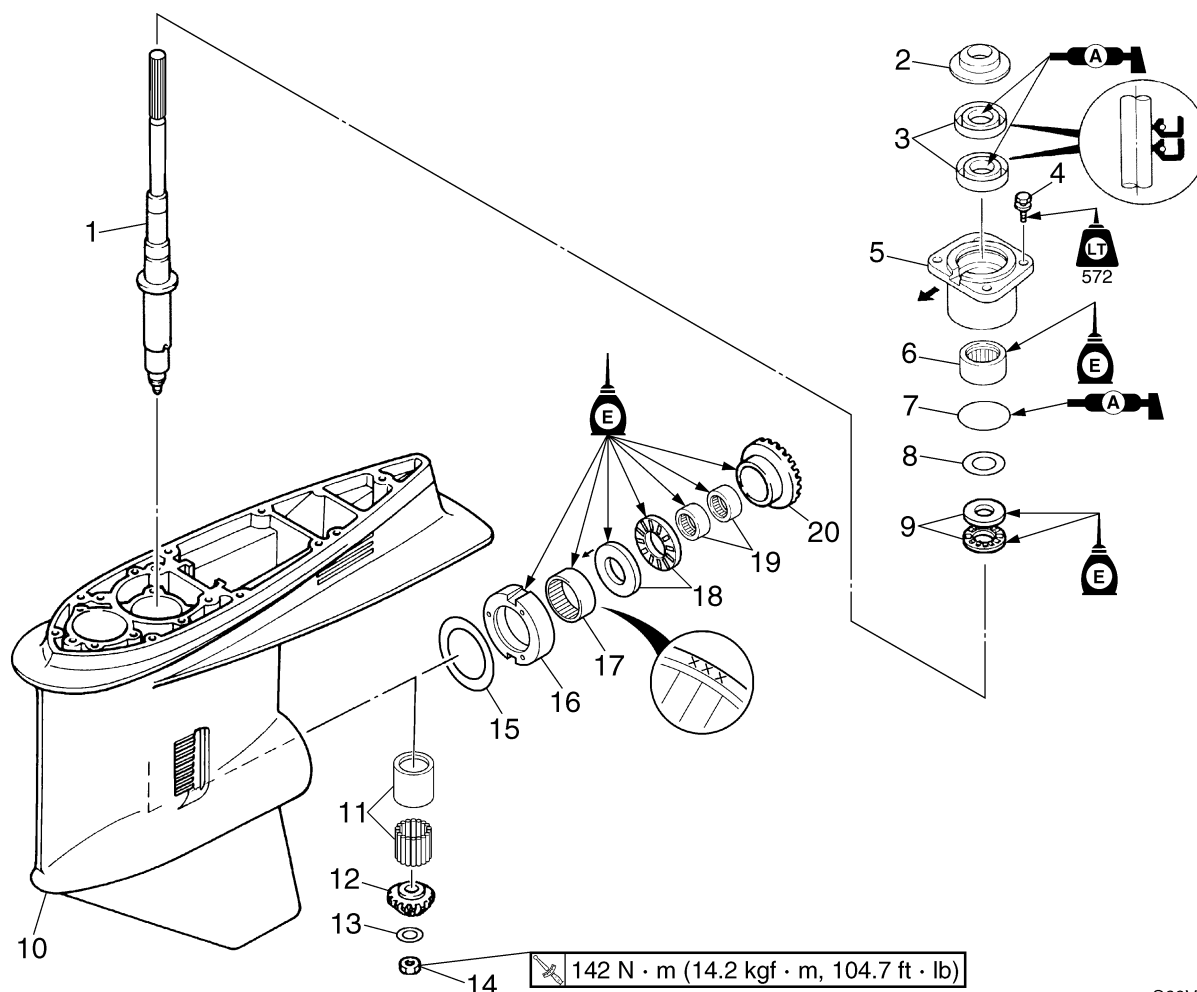
8. Install the shift plunger ⑮ and slider ⑯ into the propeller shaft, and then install the cross pin ⑰ and spring ⑱.



S69J6445

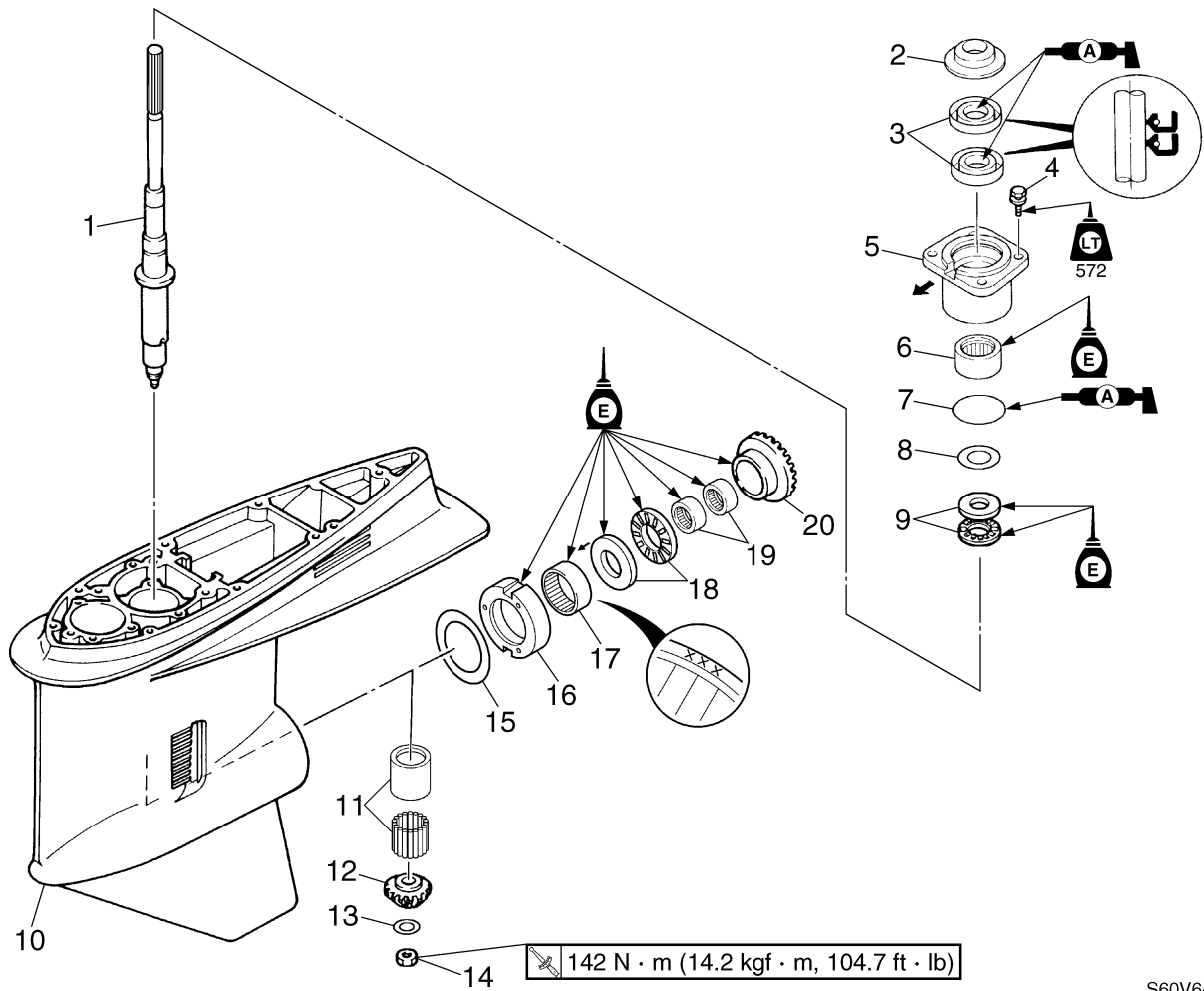


Drive shaft and lower case (counter rotation model)



S60V6420

No.	Part name	Q'ty	Remarks
1	Drive shaft	1	
2	Cover	1	
3	Oil seal	2	Not reusable
4	Bolt	4	M8 × 25 mm
5	Drive shaft housing	1	
6	Needle bearing	1	
7	O-ring	1	Not reusable
8	Pinion shim	—	As required
9	Thrust bearing	1	
10	Lower case	1	
11	Needle bearing	1	
12	Pinion	1	
13	Washer	1	
14	Nut	1	
15	Reverse gear shim	—	As required
16	Retainer	1	
17	Needle bearing	1	



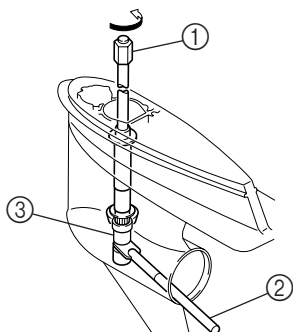
S60V6420

No.	Part name	Q'ty	Remarks
18	Thrust bearing	1	Not reusable
19	Needle bearing	2	
20	Reverse gear	1	



Removing the drive shaft

1. Remove the drive shaft assembly and pinion, and then pull out the reverse gear and thrust bearing.



S60V6570



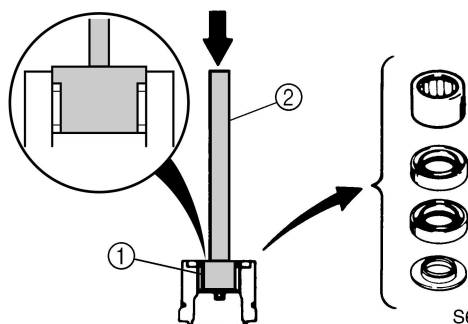
Drive shaft holder 6 (1): 90890-06520

Pinion nut holder (2): 90890-06505

Socket adapter 3 (3): 90890-06508

Disassembling the drive shaft housing

1. Remove the cover, oil seals, and needle bearing.



S69J6185

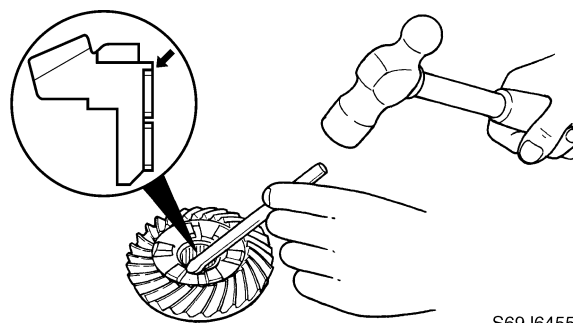


Needle bearing attachment (1):
90890-06610

Driver rod L3 (2): 90890-06652

Disassembling the reverse gear

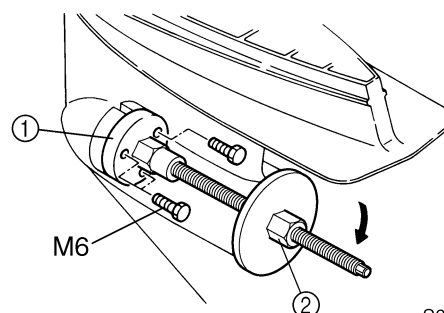
1. Remove the needle bearing from the reverse gear using a chisel.



S69J6455

Disassembling the lower case

1. Remove the retainer and shim(s).



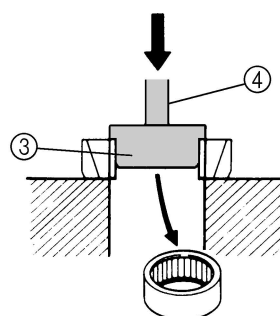
S60V6430



Flywheel puller (1): 90890-06521

Bearing outer race puller
assembly (2):
90890-06523

2. Remove the needle bearing from the retainer.



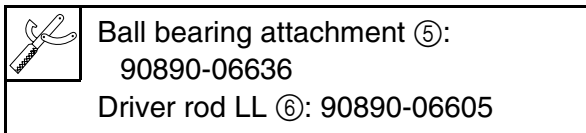
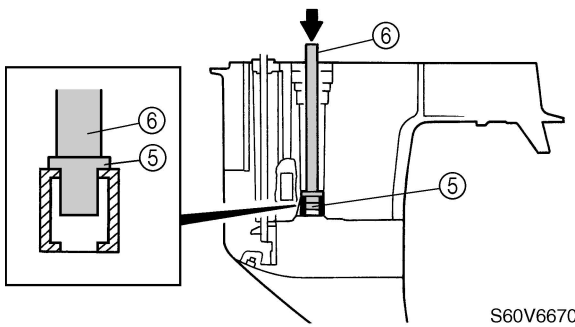
S69J6470



Needle bearing attachment (3):
90890-06654

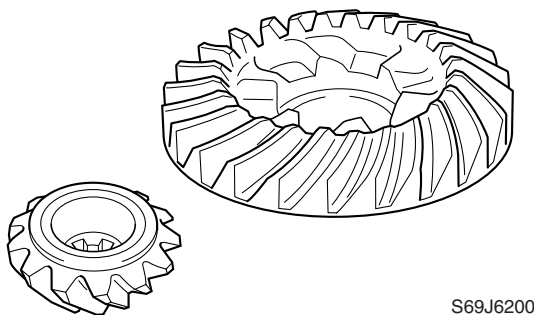
Driver rod L3 (4): 90890-06652

3. Remove the needle bearing from the lower case.



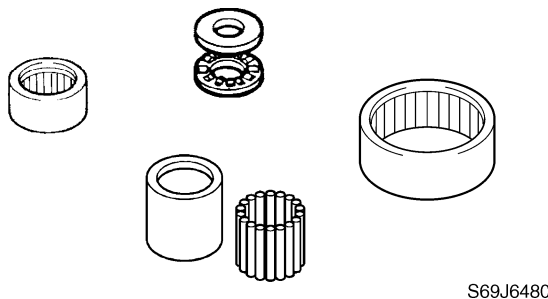
Checking the pinion and reverse gear

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



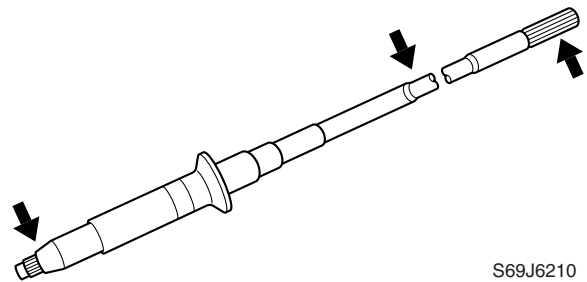
Checking the bearings

1. Check the bearings for pitting or rumbling. Replace if necessary.



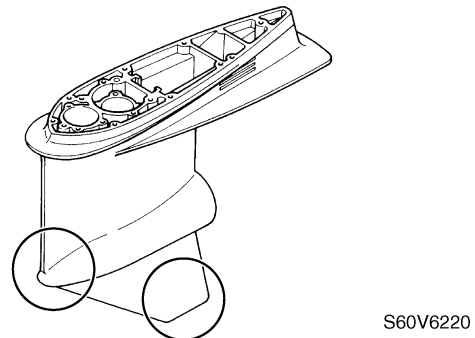
Checking the drive shaft

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



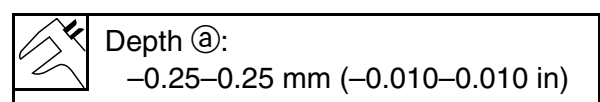
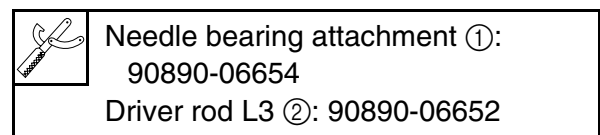
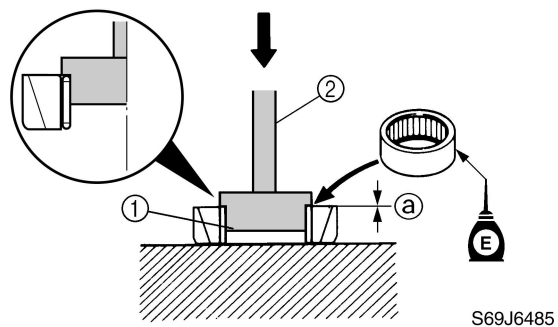
Checking the lower case

1. Check the skeg and torpedo for cracks or damage. Replace the lower case if necessary.



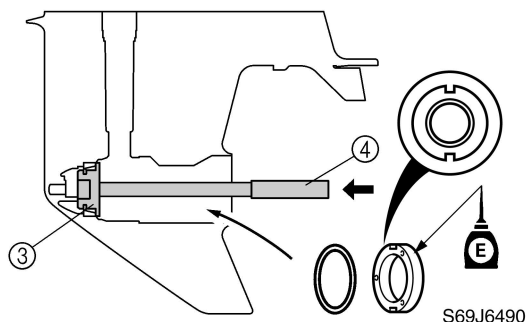
Assembling the lower case

1. Install the needle bearing into the retainer to the specified depth.





2. Install the original shim(s) and retainer into the lower case.



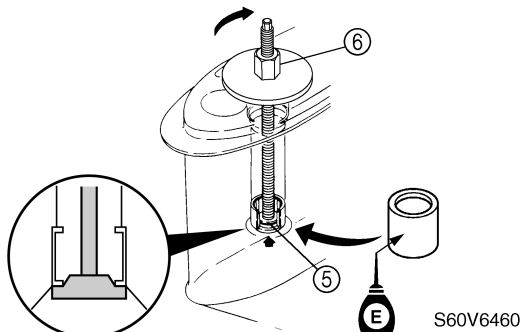
CAUTION:

Add or remove shim(s), if necessary, if replacing the forward gear or lower case.



Ball bearing attachment (3):
90890-06657
Driver rod LL (4): 90890-06605

3. Install the needle bearing outer case into the lower case.



NOTE:

Apply engine oil to the needle bearing outer case before installation.



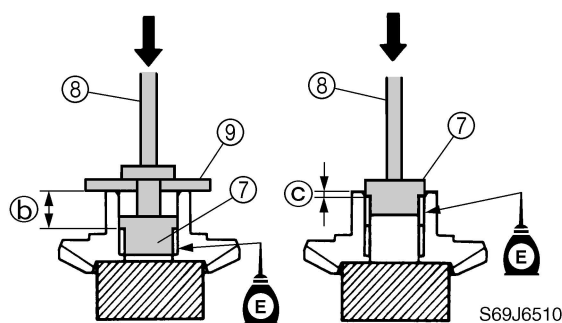
Bearing outer race attachment (5):
90890-06628
Bearing outer race puller assembly (6):
90890-06523

4. Install the needle bearing into the needle bearing outer case.

NOTE:

Apply engine oil or grease to the needle bearing before installation.

5. Install the new needle bearings into the reverse gear to the specified depth.



Needle bearing attachment (7):
90890-06653
Driver rod SS (8): 90890-06604
Bearing depth plate (9): 90890-06603

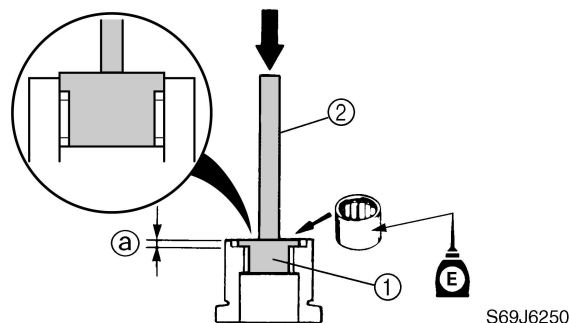


Depth (b):
20.75–21.25 mm (0.817–0.836 in)
Depth (c):
4.25–4.75 mm (0.167–0.187 in)

6. Install the thrust bearing and reverse gear into the lower case.

Assembling the drive shaft housing

1. Install the needle bearing into the drive shaft housing to the specified depth.

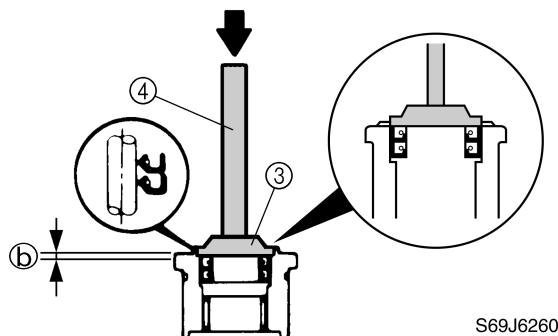


Needle bearing attachment (1):
90890-06610
Driver rod LS (2): 90890-06606



Depth ①:
4.25–4.75 mm (0.167–0.187 in)

2. Apply grease to the new oil seals, and then install them into the drive shaft housing to the specified depth.



NOTE:
Install an oil seal halfway into the drive shaft housing, then the other oil seal.



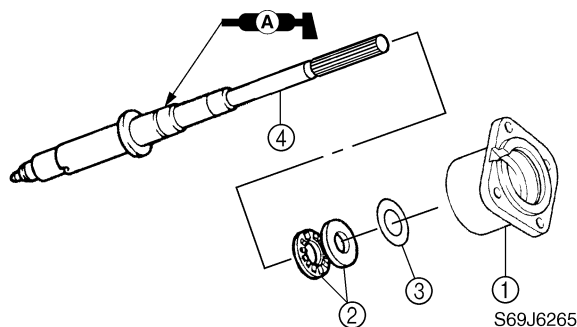
Bearing outer race attachment ③:
90890-06628
Driver rod L3 ④: 90890-06652



Depth ②:
0.25–0.75 mm (0.01–0.03 in)

Installing the drive shaft

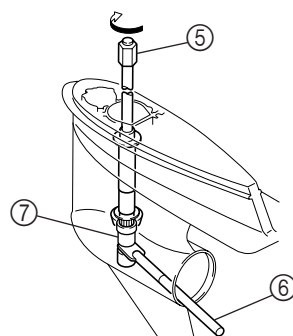
1. Install the reverse gear into the lower case.
2. Install the drive shaft housing ①, thrust bearing ②, and original shim(s) ③ onto the drive shaft ④.



CAUTION:

Add or remove shim(s), if necessary, if replacing the drive shaft housing or drive shaft.

3. Install the drive shaft and drive shaft housing into the lower case, then the pinion and pinion nut, and then tighten the nut to the specified torque.



NOTE:
Install the drive shaft by lifting it up slightly, then aligning it with the pinion and the spline of the drive shaft.



Drive shaft holder 6 ⑤: 90890-06520
Pinion nut holder ⑥: 90890-06505
Socket adapter 3 ⑦: 90890-06508



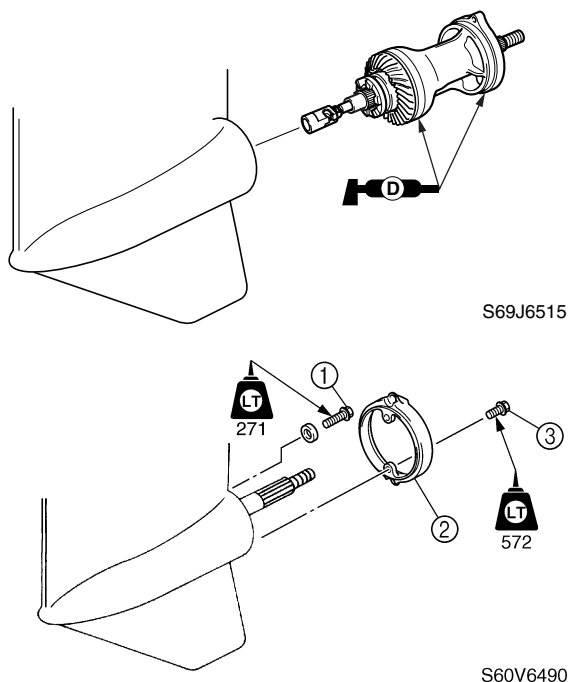
Pinion nut:
142 N·m (14.2 kgf·m, 104.7 ft·lb)

4. Tighten the housing bolts.



Installing the propeller shaft housing

1. Install the propeller shaft housing assembly into the lower case, and then tighten the bolts ① to the specified torque.
2. Install the ring ② and bolts ③.



NOTE:

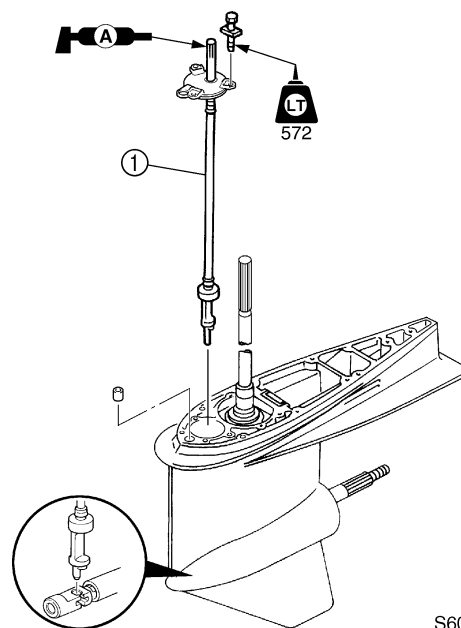
Apply grease to the new O-rings before installation.



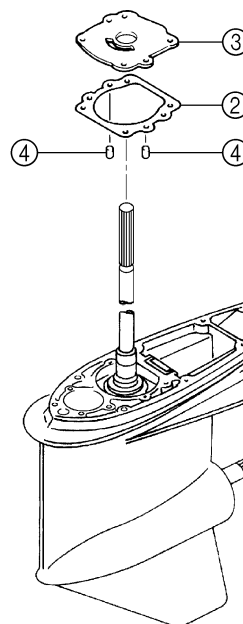
Propeller shaft housing bolt ①:
30 N·m (3.0 kgf·m, 22.1 ft·lb)

Installing the water pump and shift rod

1. Install the shift rod assembly ①.

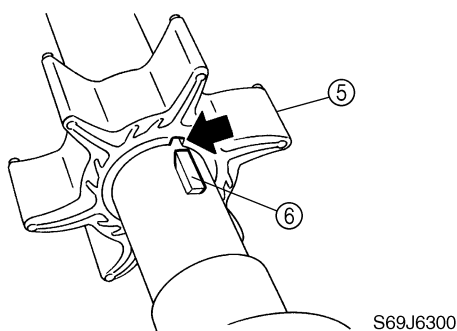


2. Install a new gasket ②, the outer plate cartridge ③, and dowel pins ④.

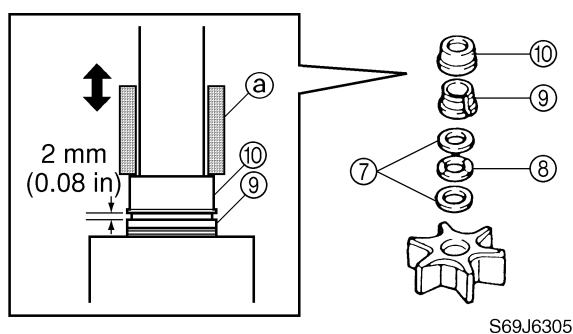


3. Install the Woodruff key into the drive shaft.
4. Align the groove on the impeller ⑤ with the Woodruff key ⑥, and then install the impeller onto the drive shaft.

Drive shaft and lower case (counter rotation model)

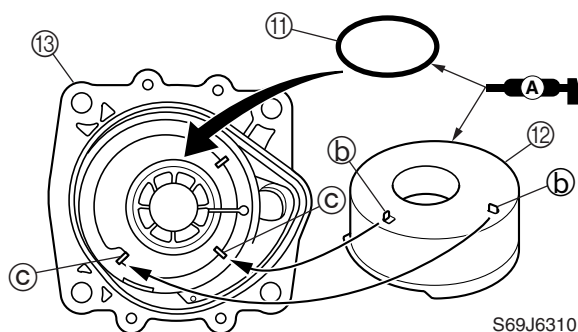


5. Install the washers (7), wave washer (8), spacer (9), and collar (10) onto the drive shaft.



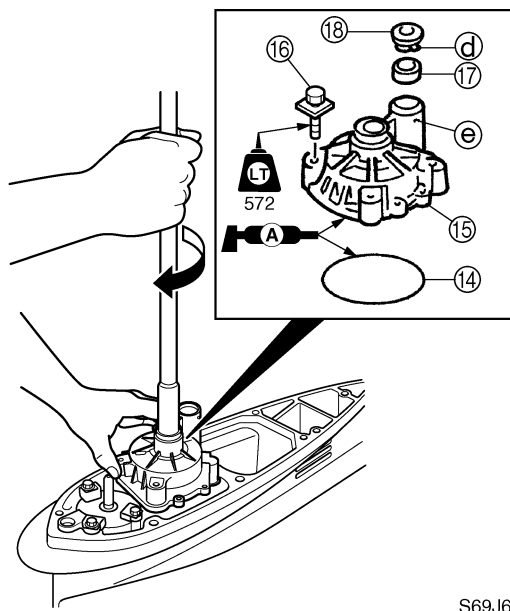
- NOTE:**
- The collar and spacer should fit together firmly.
 - While pulling the drive shaft up, install the collar with an appropriate tool (a) that fits over the drive shaft as shown.

6. Install the O-ring (11) and insert cartridge (12) into the pump housing (13).



- NOTE:**
- Align the insert cartridge projections (b) with the holes (c) in the pump housing.

7. Install the O-ring (14) and pump housing assembly (15) into the lower case, tighten the bolts (16), and then install the seal (17) and cover (18).

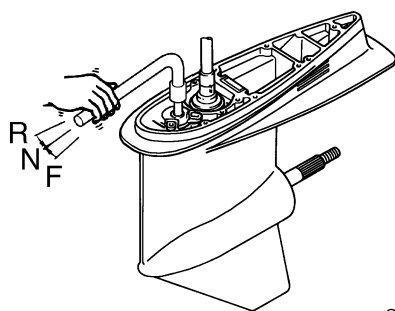
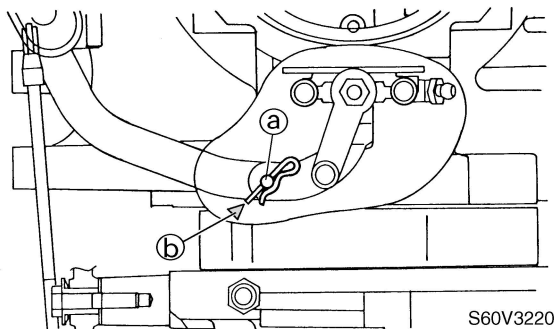


- NOTE:**
- When installing the pump housing, apply grease to the inside of the housing, and then turn the drive shaft clockwise while pushing down the pump housing.
 - Align the cover projection (d) with the hole (e) in the pump housing.



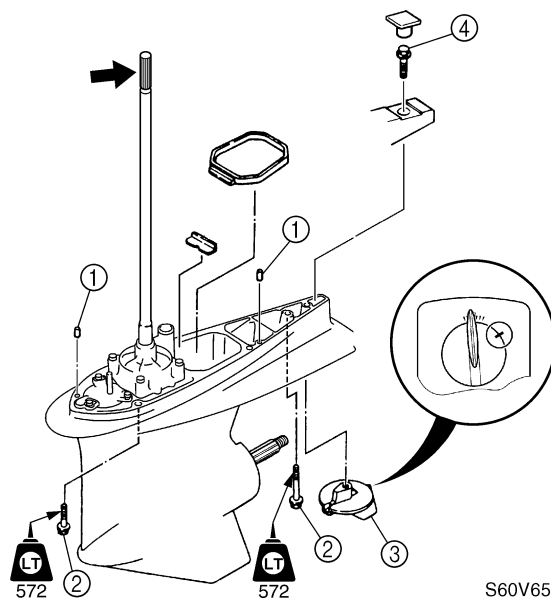
Installing the lower unit

1. Set the gear shift to the neutral position at the lower unit.
2. Align the center of the set pin ① with the mark ② on the bottom cowling.



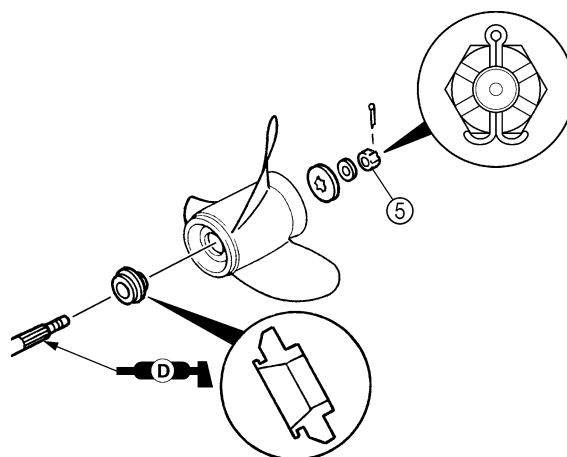
Shift rod push arm: 90890-06052

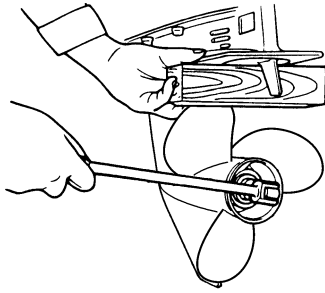
3. Install the two dowel ① into the lower unit.
4. Install the lower unit into the upper case, and then tighten the lower case mounting bolts ② to the specified torque.
5. Install the trim tab ③ to its original position, and then tighten the bolt ④ to the specified torque.



Lower case mounting bolt ②:
47 N·m (4.7 kgf·m, 34.7 ft·lb)
Trim tab bolt ④:
42 N·m (4.2 kgf·m, 31.0 ft·lb)

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





S69J6540

⚠ WARNING

- Do not hold the propeller with your hands when loosening or tightening it.
- Be sure to disconnect the battery leads from the battery and the clip from the engine shut-off switch.
- Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.

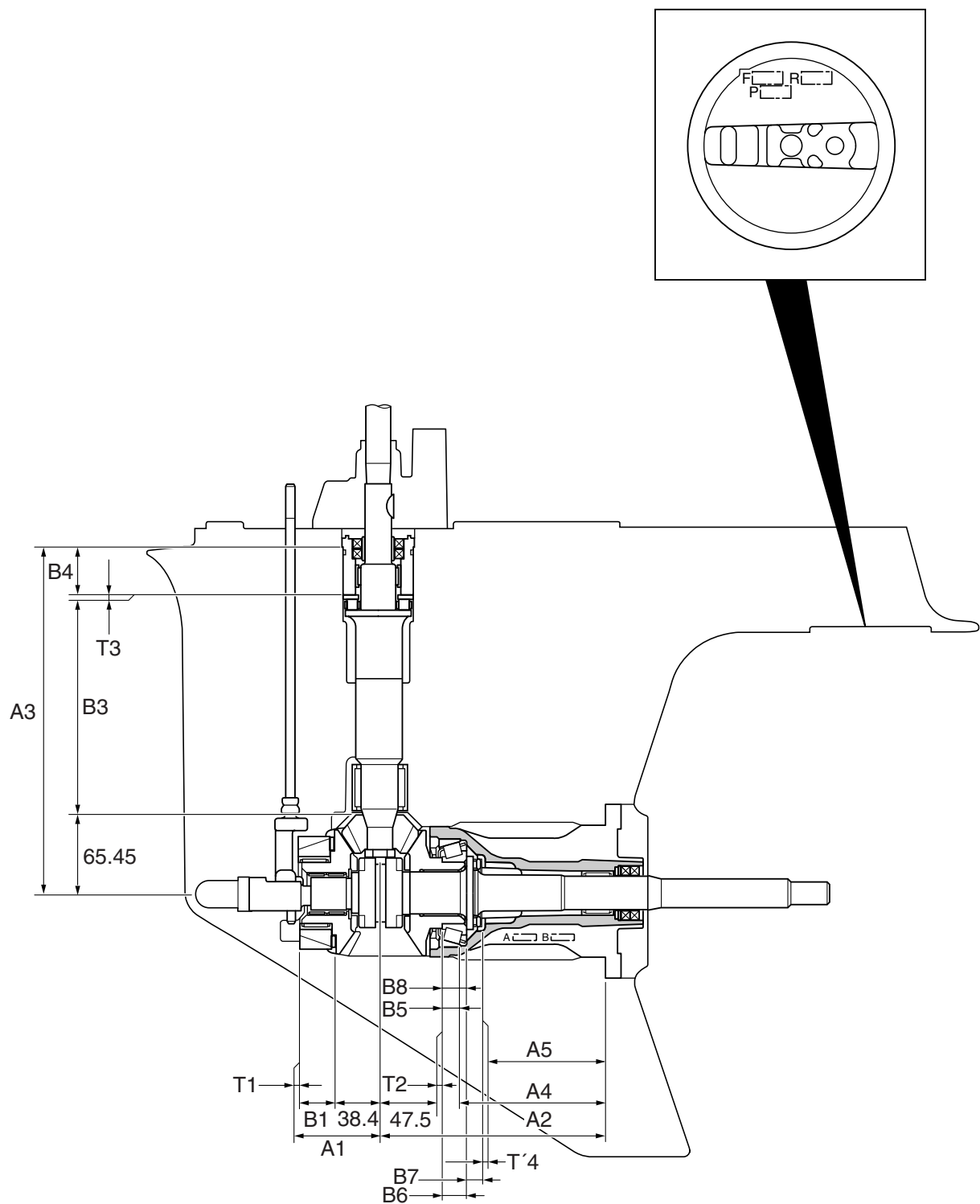
NOTE:

If the grooves in the propeller nut ⑤ do not align with the cotter pin hole, tighten the nut until they are aligned.



Propeller nut ⑤:
54 N·m (5.4 kgf·m, 39.8 ft·lb)

Shimming (counter rotation model)



S60V6550

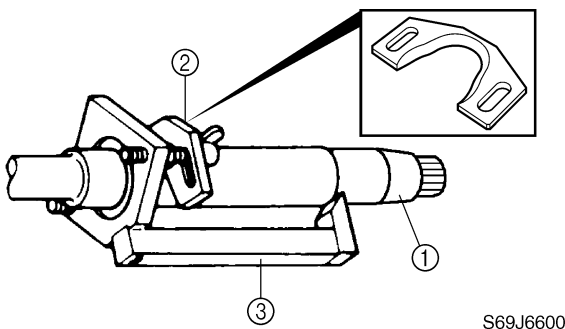
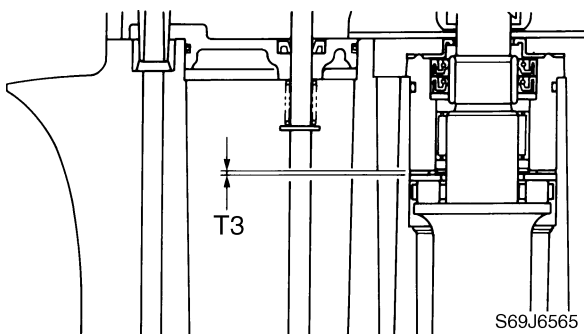
Shimming

NOTE:

- Shimming is not required when assembling the original lower case and inner parts.
- Shimming is required when assembling the original inner parts and a new lower case.
- Shimming is required when replacing the inner part(s).

Selecting the pinion shims

1. Install the special service tools onto the drive shaft ①.



NOTE:

- Select the shim thickness (T3) by using the specified measurement(s) and the calculation formula.
- Install the special service tool onto the drive shaft so that the shaft is at the center of the hole.
- Tighten the wing nuts another 1/4 of a turn after they contact the fixing plate ②.

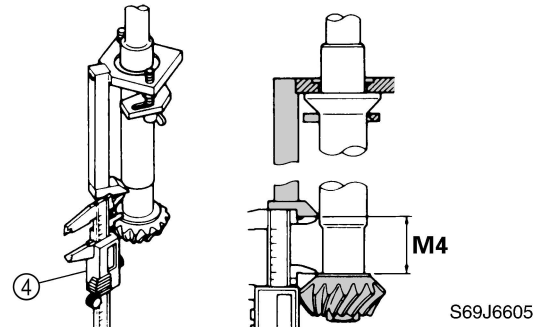
 Pinion height gauge ③:
90890-06710

2. Install the pinion and pinion nut, and then tighten the nut to the specified torque.



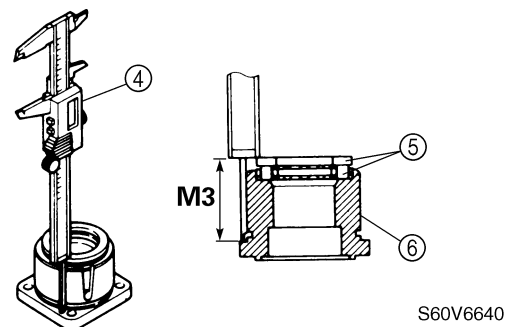
Pinion nut:
142 N·m (14.2 kgf·m, 104.7 ft·lb)

3. Measure the distance (M4) between the special service tool and the pinion as shown.



Digital caliper ④: 90890-06704

4. Turn the thrust bearing ⑤ two or three times to seat the drive shaft housing ⑥, and then measure the housing height (M3) as shown.

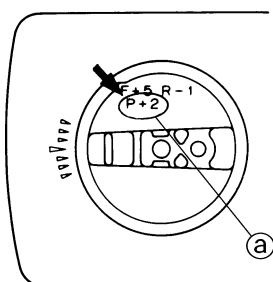


NOTE:

Measure the thrust bearing at three points to find the height average.



5. Calculate the pinion shim thickness (T3) as shown in the examples below.



S69J6555

NOTE:

“P” is the deviation of the lower case dimension from standard. The “P” mark **a** is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the “P” mark is unreadable, assume that “P” is zero and check the backlash when the unit is assembled.

Calculation formula:

$$\text{Pinion shim thickness (T3)} = 81.55 + P/100 - M3 - M4$$

Example:

If “M3” is 50.75 mm and “M4” is 30.52 mm and “P” is (–5), then

$$\begin{aligned} T3 &= 81.55 + (-5)/100 - 50.75 - 30.52 \text{ mm} \\ &= 81.55 - 0.05 - 50.75 - 30.52 \text{ mm} \\ &= 0.23 \text{ mm} \end{aligned}$$

6. Select the pinion shim(s) (T3) 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 thicknesses:

0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

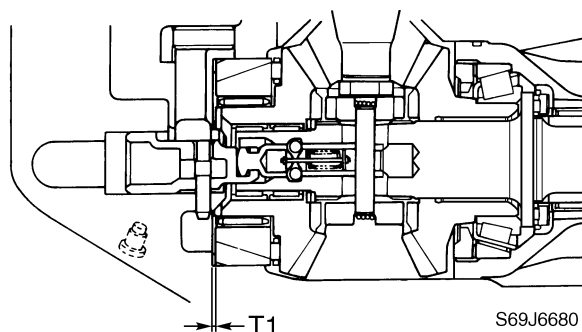
Example:

If “T3” is 0.23 mm, then the pinion shim is 0.22 mm.

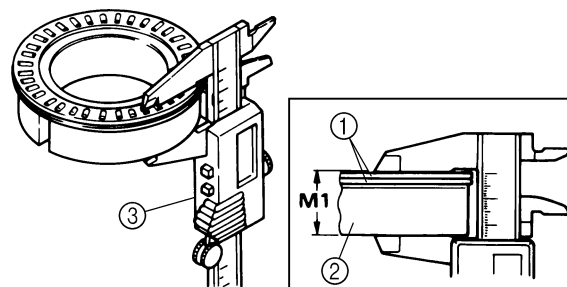
If “T3” is 0.70 mm, then the pinion shim is 0.68 mm.

Selecting the reverse gear shims

- Turn the thrust bearing ① two or three times to seat the bearing retainer ②, and then measure the bearing height (M1) as shown.



S69J6680



S69J6710

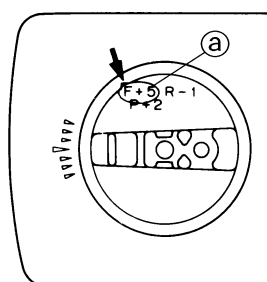
NOTE:

- Select the shim thickness (T1) by using the specified measurement(s) and the calculation formula.
- Measure the bearing retainer at three points to find the height average.



Digital caliper ③: 90890-06704

- Calculate the reverse gear shim thickness (T1) as shown in the examples below.



S69J6570

NOTE:

“F” is the deviation of the lower case dimension from standard. The “F” mark ① is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the “F” mark is unreadable, assume that “F” is zero and check the backlash when the unit is assembled.

Calculation formula:

$$\text{Reverse gear shim thickness (T1)} = 30.60 + F/100 - M1$$

Example:

If “M1” is 29.90 mm and “F” is (+5), then
 $T1 = 30.60 + (+5)/100 - 29.90 \text{ mm}$
 $= 30.60 + 0.05 - 29.90 \text{ mm}$
 $= 0.75 \text{ mm}$

3. Select the reverse gear shim(s) (T1) 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 thicknesses:

0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

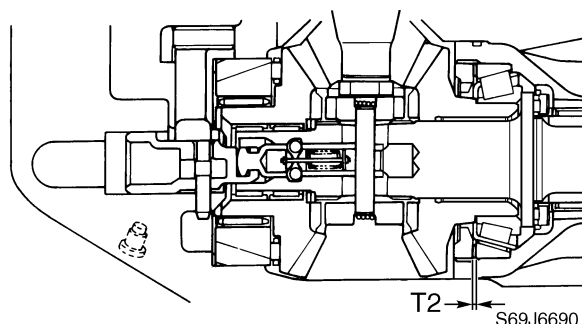
Example:

If “T1” is 0.75 mm, then the reverse gear shim is 0.72 mm.

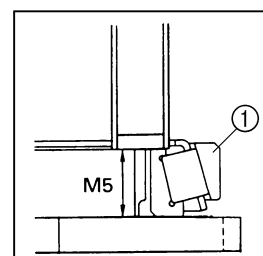
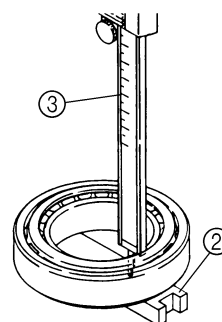
If “T1” is 0.80 mm, then the reverse gear shim is 0.78 mm.

Selecting the forward gear shims

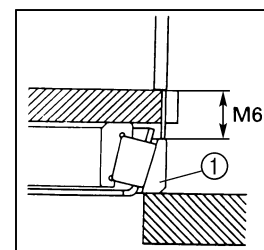
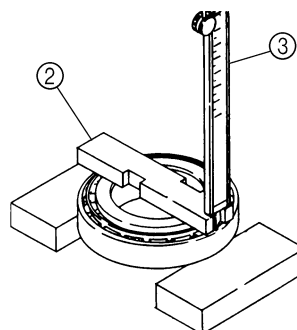
1. Turn the taper roller bearing outer race ① two or three times to seat the rollers, and then measure the bearing height (M5) and (M6) as shown.



S69J6690



S69J6715



S69J6720

NOTE:

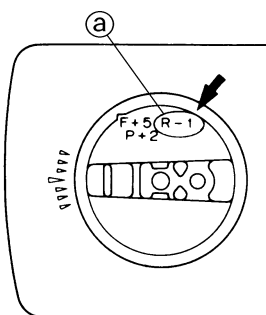
- Select the shim thickness (T2) by using the specified measurement(s) and the calculation formula.
- Measure the taper roller bearing at three points to find the height average.



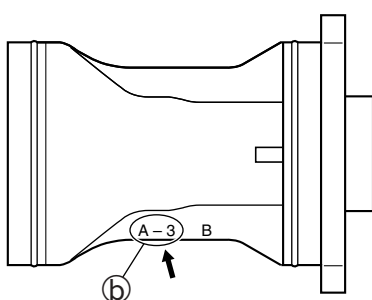
Shimming plate ②: 90890-06701
 Digital caliper ③: 90890-06704



- Calculate the forward gear shim thickness (T2) as shown in the examples below.



S69J6585



S69J6625

NOTE:

"R" is the deviation of the lower case dimension from standard, and "A" is the deviation of the propeller shaft housing dimension from standard. The "R" mark (a) is stamped on the trim tab mounting surface of the lower case, and the "A" mark (b) is stamped on the propeller shaft housing in 0.01 mm units. If the "R" mark or "A" mark is unreadable, assume that "R" and "A" are zero and check the backlash when the unit is assembled.

Calculation formula:

$$\text{Forward gear shim thickness (T2)} = 8.45 + R/100 - A/100 - M5 + M6$$

Example:

If "M5" is 22.95 mm and "M6" is 15.73 mm and "R" is (+1) and "A" is (+6), then
 $T2 = 8.45 + (+1)/100 - (+6)/100 - 22.95 + 15.73 \text{ mm}$
 $= 8.45 + 0.01 - 0.06 - 22.95 + 15.73 \text{ mm}$
 $= 1.18 \text{ mm}$

- Select the forward gear shim(s) (T2) 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 thicknesses:

0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

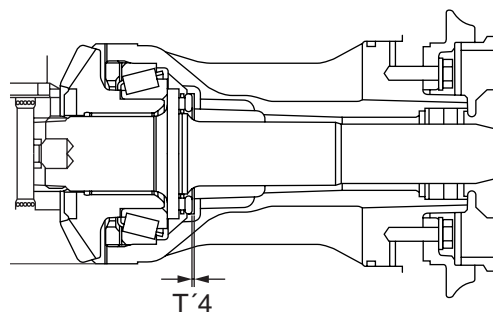
Example:

If "T2" is 1.18 mm, then the forward gear shim is 1.15 mm.

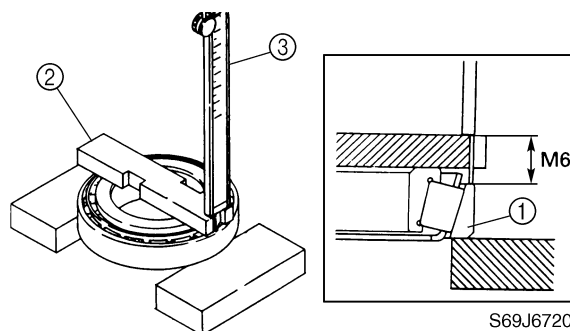
If "T2" is 1.20 mm, then the forward gear shim is 1.18 mm.

Selecting the propeller shaft shims

- Turn the taper roller bearing outer race ① two or three times to seat the rollers, and then measure the bearing height (M6) as shown.



S69J6705



S69J6720

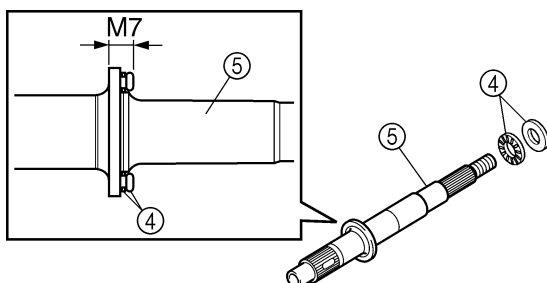
NOTE:

- Select the shim thickness (T'4) by using the specified measurement(s) and the calculation formula.
- Measure the taper roller bearing at three points to find the height average.



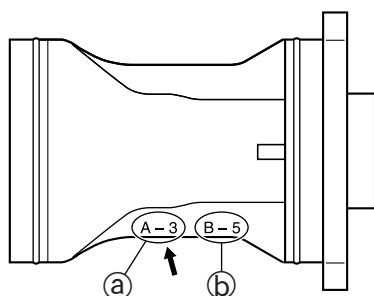
Shimming plate ②: 90890-06701
Digital caliper ③: 90890-06704

2. Install the thrust bearing ④ onto the propeller shaft ⑤, and then measure the propeller shaft flange and thrust bearing thickness (M7) as shown.



S69J6696

3. Calculate the propeller shaft shim thickness (T4) as shown in the examples below.



S69J6626

NOTE:

“A” and “B” are the deviation of the propeller shaft housing dimension from standard. The “A” mark ① and “B” mark ② are stamped on the propeller shaft housing in 0.01 mm units. If the “A” mark or “B” mark is unreadable, assume that “A” and “B” are zero and check the free play when the unit is assembled.

Calculation formula 1:

$$\text{Propeller shaft shim thickness (T4)} = 29.00 + A/100 - B/100 - M6 - M7$$

Example:

If “M6” is 15.73 mm and “M7” is 12.50 mm and “A” is (+6) and “B” is (–5), then

$$\begin{aligned} T4 &= 29.00 + (+6)/100 - (-5)/100 - 15.73 - 12.50 \text{ mm} \\ &= 29.00 + 0.06 + 0.05 - 15.73 - 12.50 \text{ mm} \\ &= 0.88 \text{ mm} \end{aligned}$$

4. Round the numerals for the propeller shaft shim(s) (T4) as follows.

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

Example:

If “T4” is 0.88 mm, then the propeller shaft shim is 0.85 mm.

If “T4” is 0.90 mm, then the propeller shaft shim is 0.88 mm.

5. Calculate and select the propeller shaft shim thickness (T'4) as shown in the examples below.

Calculation formula 2:

$$\text{Propeller shaft shim thickness (T'4)} = T4 - 0.30$$

Example:

If “T4” is 0.85 mm, then

$$\begin{aligned} T'4 &= 0.85 - 0.30 \text{ mm} \\ &= 0.55 \text{ mm} \end{aligned}$$

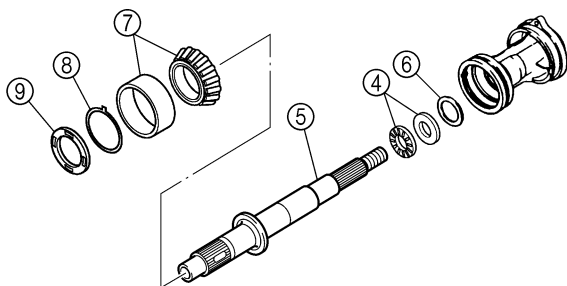
Available shim thicknesses:

0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

6. If the “A” mark or “B” mark is unreadable, measure the propeller shaft free play as shown.



7. Install the shim(s) ⑥, thrust bearing ④, propeller shaft ⑤, taper roller bearing ⑦, and claw washer ⑧, and then tighten the ring nut ⑨ to the specified torque.



S60V6620

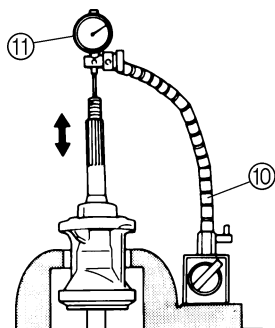


Ring nut wrench: 90890-06578



Ring nut ⑨:
108 N·m (10.8 kgf·m, 79.7 ft·lb)

8. Measure the propeller shaft free play. Reselect the propeller shaft shim(s) (T'4), if out of specification.



S69J6701



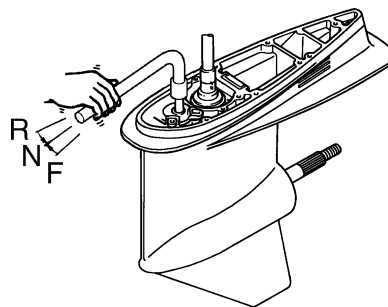
Propeller shaft free play:
0.25–0.35 mm (0.0098–0.0138 in)



Magnet base ⑩: 90890-06705
Dial gauge set ⑪: 90890-01252

Backlash (counter rotation model) Measuring the forward and reverse gear backlash

1. Remove the water pump assembly.
2. Set the gear shift to the neutral position at the lower unit.

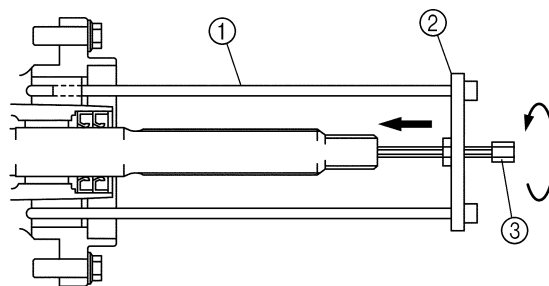


S60V6330



Shift rod push arm: 90890-06052

3. Install the special service tool so that it pushes against the propeller shaft.



S60V6545

NOTE: _____
Tighten the center bolt while turning the drive shaft until the drive shaft can no longer be turned.

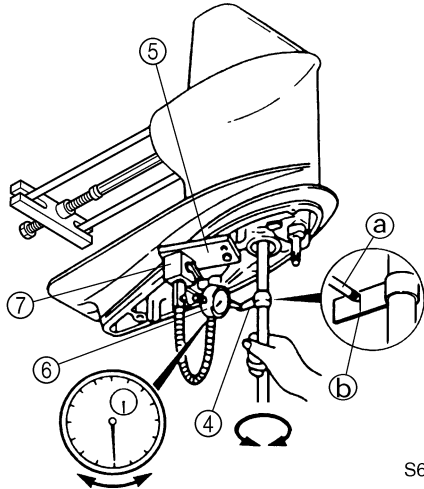


Bearing housing puller claw L ①:
90890-06502
Stopper guide plate ②: 90890-06501
Center bolt ③: 90890-06504

4. Install the backlash indicator onto the drive shaft (22.4 mm [0.88 in] in diameter), then the dial gauge onto the lower unit.

Shimming (counter rotation model) / Backlash (counter rotation model)

5. Set the lower unit upside down.



S60V6555

NOTE:

Install the dial gauge so that the plunger (a) contacts the mark (b) on the backlash indicator.



Backlash indicator (4): 90890-06706
Magnet base plate (5): 90890-07003
Dial gauge set (6): 90890-01252
Magnet base (7): 90890-06705

6. Slowly turn the drive shaft clockwise and counterclockwise and measure the backlash when the drive shaft stops in each direction.



Forward gear backlash:
0.32–0.64 mm (0.0126–0.0252 in)

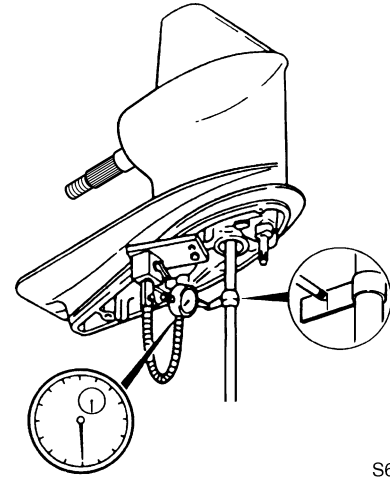
7. Add or remove shim(s) if out of specification.

Forward gear backlash	Shim thickness
Less than 0.32 mm (0.0126 in)	To be decreased by $(0.48 - M) \times 0.78$
More than 0.64 mm (0.0252 in)	To be increased by $(M - 0.48) \times 0.78$

M: Measurement

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

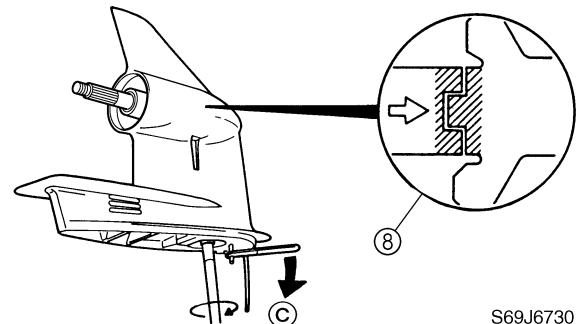
8. Remove the special service tools from the propeller shaft.



S60V6560

9. Turn the shift rod to the reverse position (c) with the shift rod push arm.

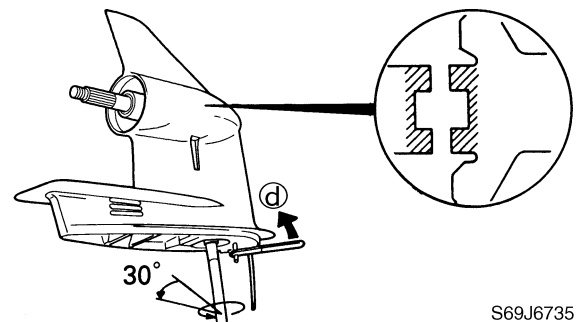
10. Turn the drive shaft clockwise until the dog clutch (8) is fully engaged.



S69J6730

11. Turn the shift rod to the neutral position (d) with the shift rod push arm.

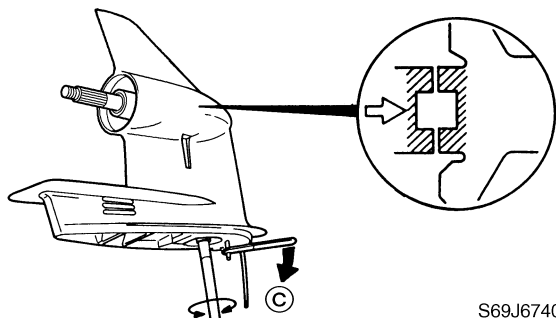
12. Turn the drive shaft counterclockwise approximately 30°.



S69J6735



13. Turn the shift rod to the reverse position © with the shift rod push arm.
14. Slowly turn the drive shaft clockwise and counterclockwise and measure the backlash when the drive shaft stops in each direction.



S69J6740

NOTE:

When measuring the reverse gear backlash, turn the shift rod push arm towards the reverse position © with force.



Reverse gear backlash:
0.57–0.96 mm (0.0224–0.0378 in)

15. Add or remove shim(s) if out of specification.

Reverse gear backlash	Shim thickness
Less than 0.57 mm (0.0224 in)	To be decreased by $(0.77 - M) \times 0.78$
More than 0.96 mm (0.0378 in)	To be increased by $(M - 0.77) \times 0.78$

M: Measurement

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and
0.50 mm

16. Remove the special service tools, and then install the water pump assembly.

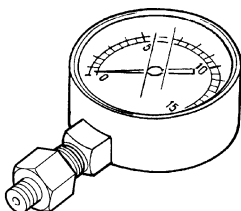
— MEMO —

Bracket unit

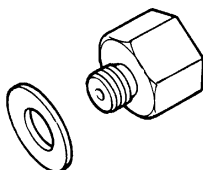
Special service tools	7-1
Bottom cowling	7-2
Upper case, steering arm, swivel bracket, and clamp brackets	7-6
Disassembling the upper case	7-13
Checking the upper case	7-13
Assembling the upper case	7-14
Removing the steering arm	7-15
Installing the steering arm	7-16
Installing the upper case.....	7-17
Removing the power trim and tilt unit	7-17
Removing the clamp brackets	7-18
Installing the clamp brackets	7-18
Installing the power trim and tilt unit	7-18
Adjusting the trim sensor	7-19
Power trim and tilt unit	7-21
Disassembling the power trim and tilt motor.....	7-28
Checking the power trim and tilt motor	7-28
Assembling the power trim and tilt motor	7-29
Checking the hydraulic pressure	7-30
Disassembling the gear pump	7-32
Disassembling the relief valve	7-33
Disassembling the tilt cylinder and trim cylinders	7-33
Checking the reservoir.....	7-35
Checking the tilt cylinder and trim cylinders	7-35
Checking the valves	7-36
Checking the filters	7-36
Checking the gear pump	7-37
Assembling the relief valve.....	7-37
Assembling the gear pump.....	7-38
Assembling the tilt ram	7-38
Assembling the trim rams	7-39
Installing the tilt cylinder	7-40
Installing the trim rams	7-40
Installing the power trim and tilt motor.....	7-41
Installing the reservoir	7-42
Installing the tilt ram.....	7-42
Bleeding the power trim and tilt unit.....	7-43
Not installed.....	7-43
Built-in.....	7-44

Power trim and tilt electrical system.....	7-45
Checking the fuse.....	7-46
Checking the power trim and tilt relay	7-46
Checking the power trim and tilt switch	7-47
Checking the trim sensor.....	7-47

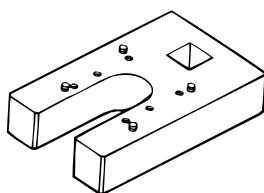
Special service tools



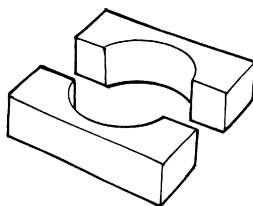
PTT oil pressure gauge assembly
90890-06580



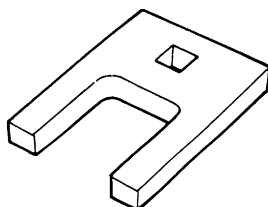
PTT oil pressure gauge adapter
90890-06581



Cylinder-end screw wrench
90890-06544

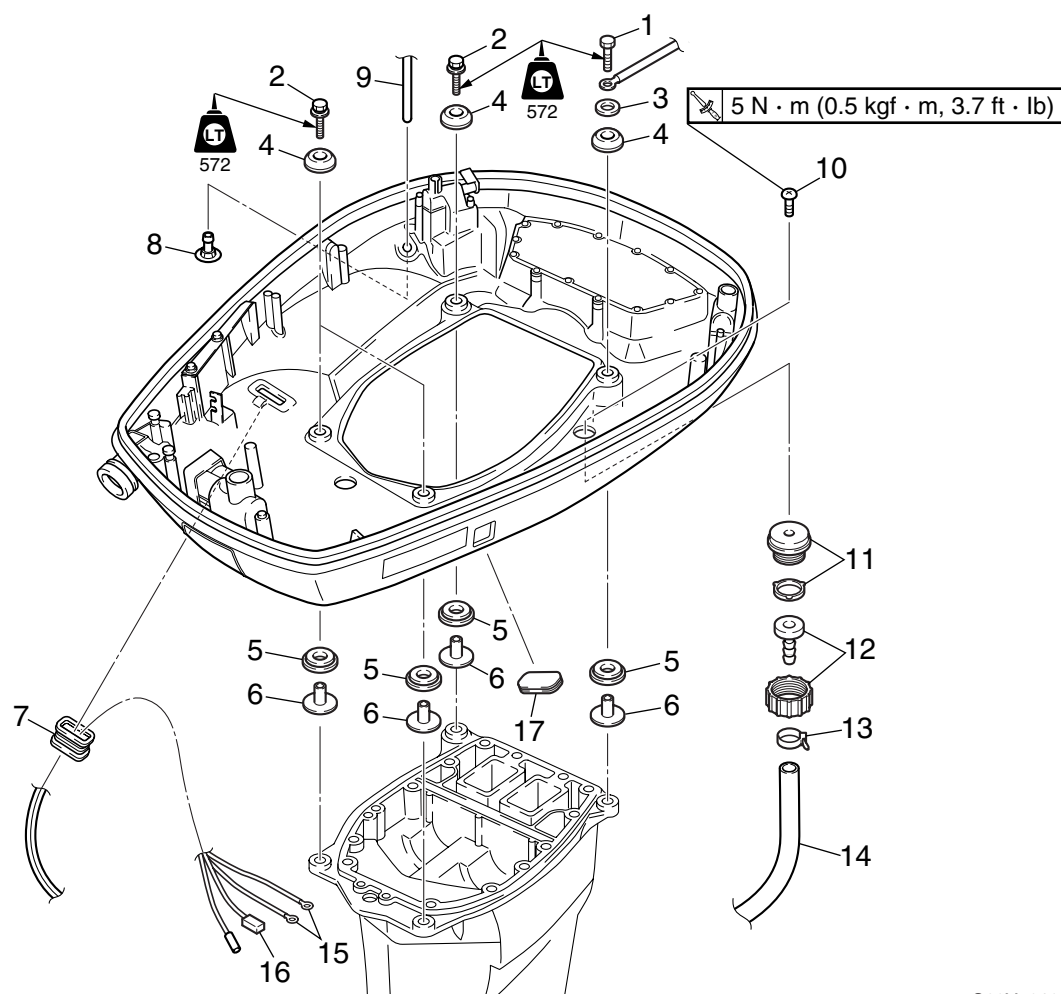


PTT piston vice attachment
90890-06572



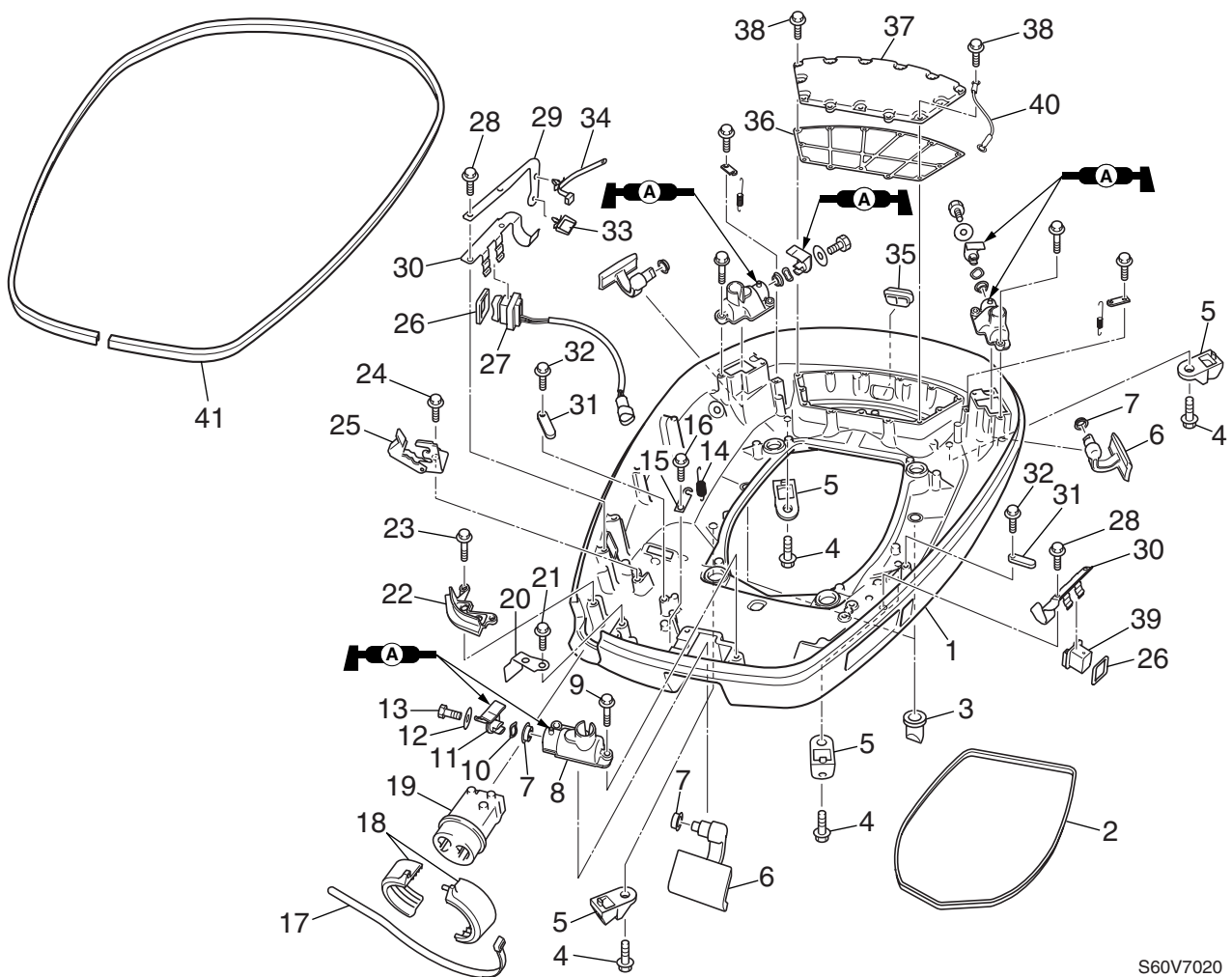
Tilt rod wrench
90890-06569

Bottom cowling



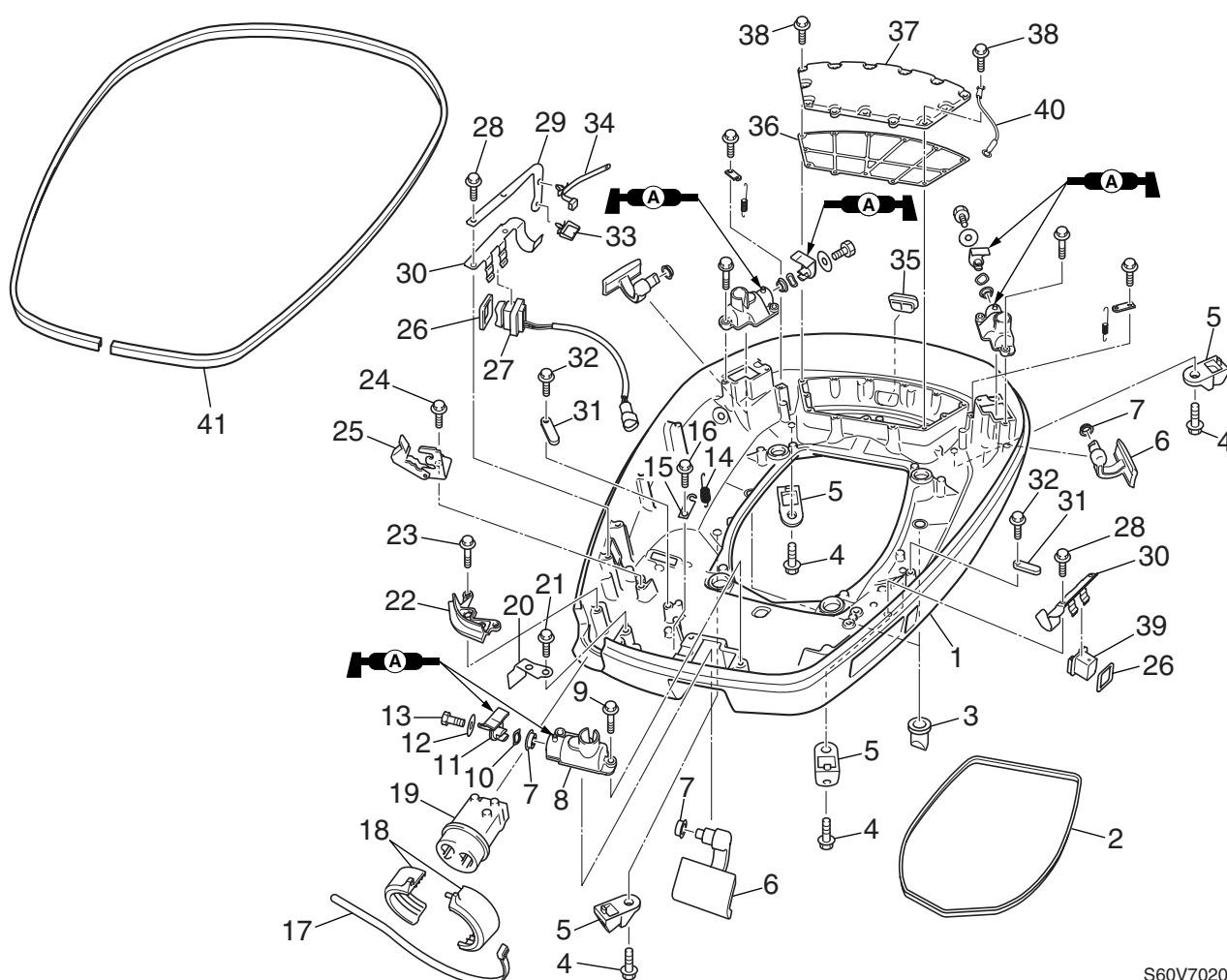
S60V7010

No.	Part name	Q'ty	Remarks
1	Bolt	1	M8 × 35 mm
2	Bolt	3	M8 × 35 mm
3	Washer	1	
4	Grommet	4	
5	Grommet	4	
6	Collar	4	
7	Grommet	1	
8	Cooling water pilot hole	1	
9	Pilot water hose	1	
10	Screw	1	M5 × 20 mm
11	Adapter	1	
12	Hose joint	1	
13	Plastic tie	1	Not reusable
14	Flushing hose	1	
15	PTT motor lead	1	
16	Trim sensor coupler	1	
17	Grommet	1	



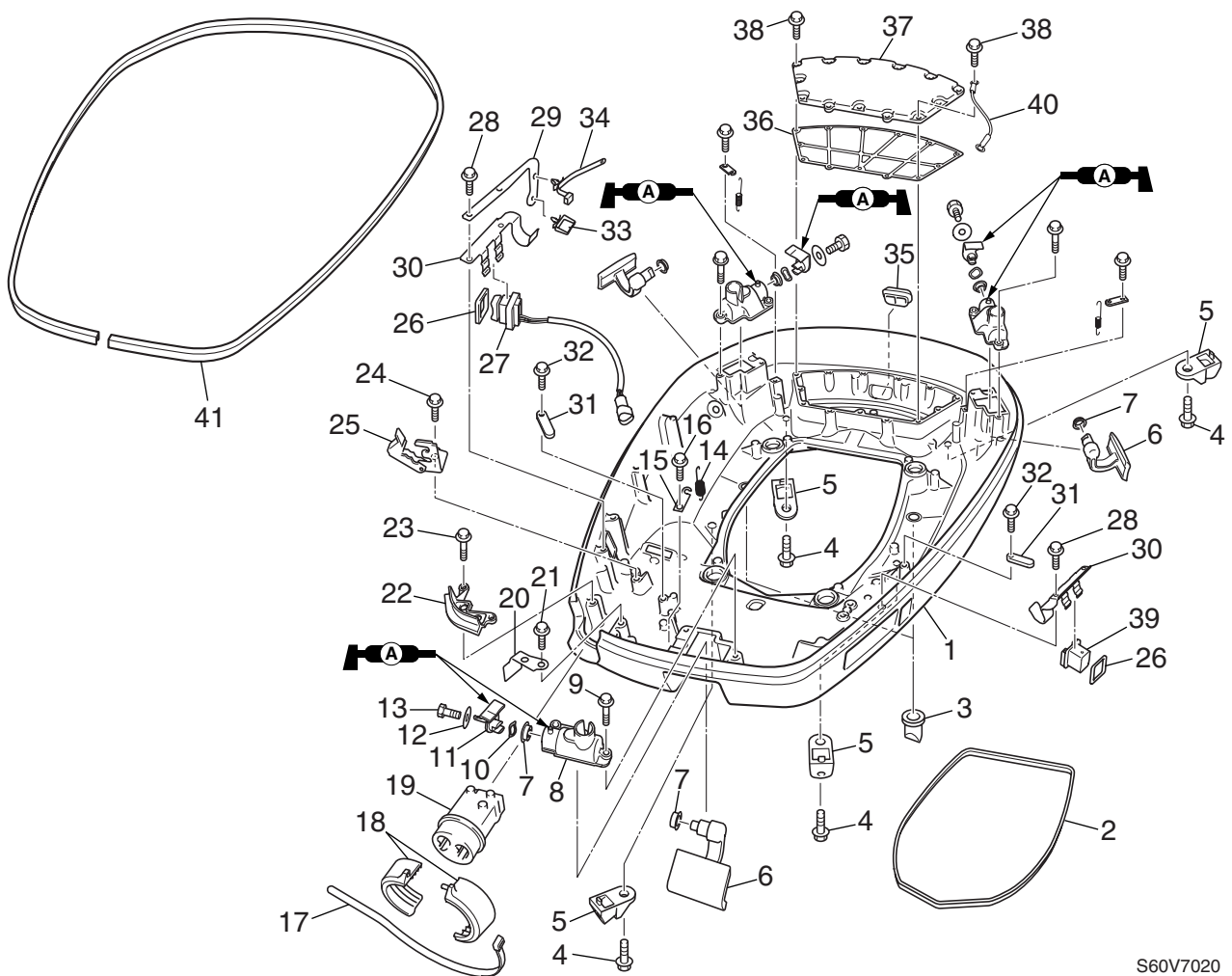
S60V7020

No.	Part name	Q'ty	Remarks
1	Bottom cowling	1	
2	Rubber seal	1	
3	Grommet	2	
4	Bolt	4	M6 × 16 mm
5	Bracket	4	
6	Cowling lock lever	3	
7	Bushing	6	
8	Plate	3	
9	Bolt	6	M6 × 30 mm
10	Wave washer	3	
11	Lever	3	
12	Washer	3	
13	Bolt	3	M6 × 16 mm
14	Spring	3	
15	Hook	3	
16	Bolt	3	M6 × 16 mm
17	Plastic tie	1	



S60V7020

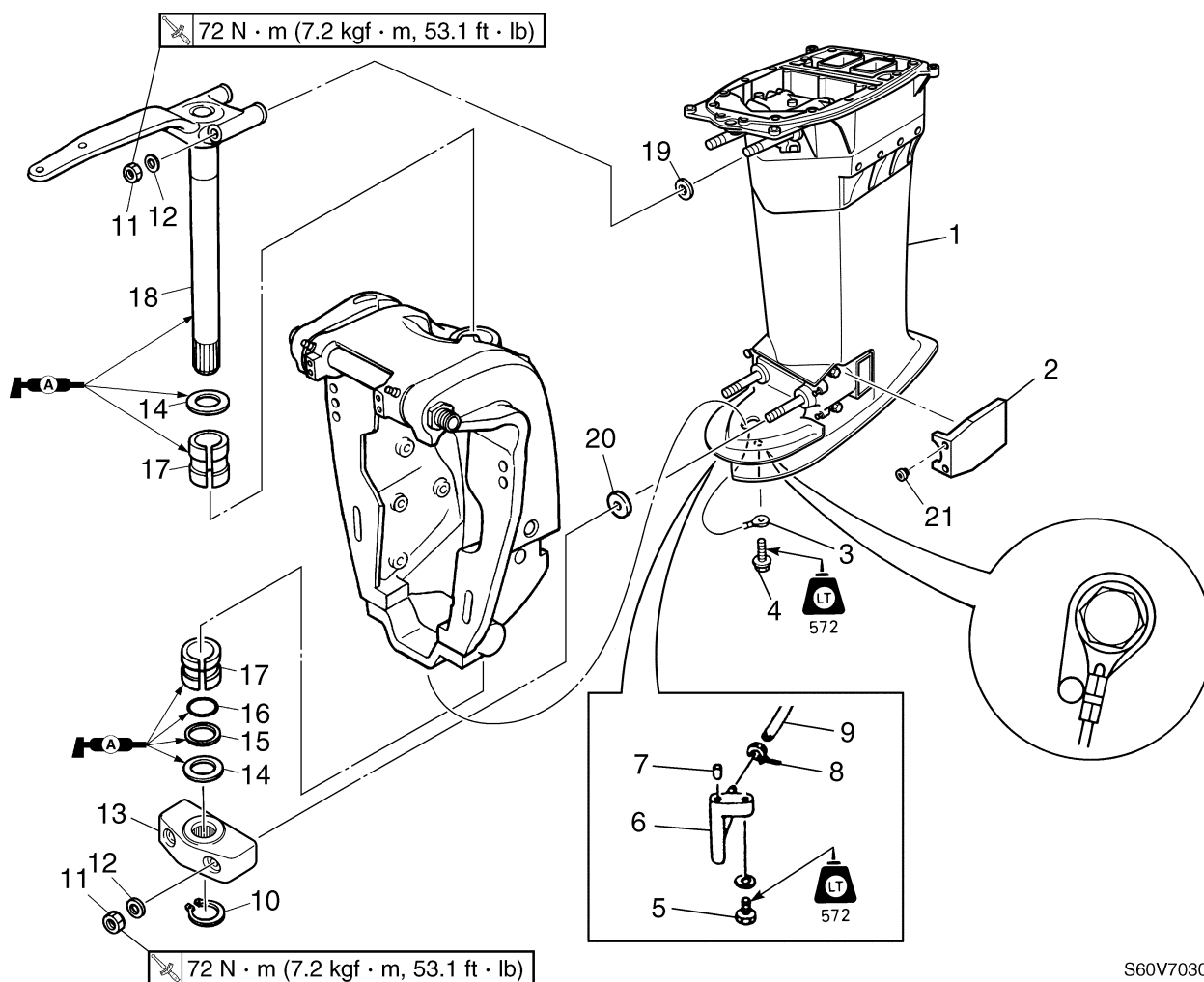
No.	Part name	Q'ty	Remarks
18	Holder	1	
19	Grommet	1	
20	Holder	1	
21	Bolt	1	M6 × 25 mm
22	Retaining plate	1	
23	Bolt	2	M6 × 25 mm
24	Bolt	1	M6 × 16 mm
25	Cable holder	1	
26	Grommet	2	
27	Power trim and tilt switch	1	
28	Bolt	4	M6 × 20 mm
29	Bracket	1	
30	Bracket	2	
31	Plate	1	
32	Bolt	1	M6 × 20 mm
33	Holder	1	
34	Plastic tie	1	



S60V7020

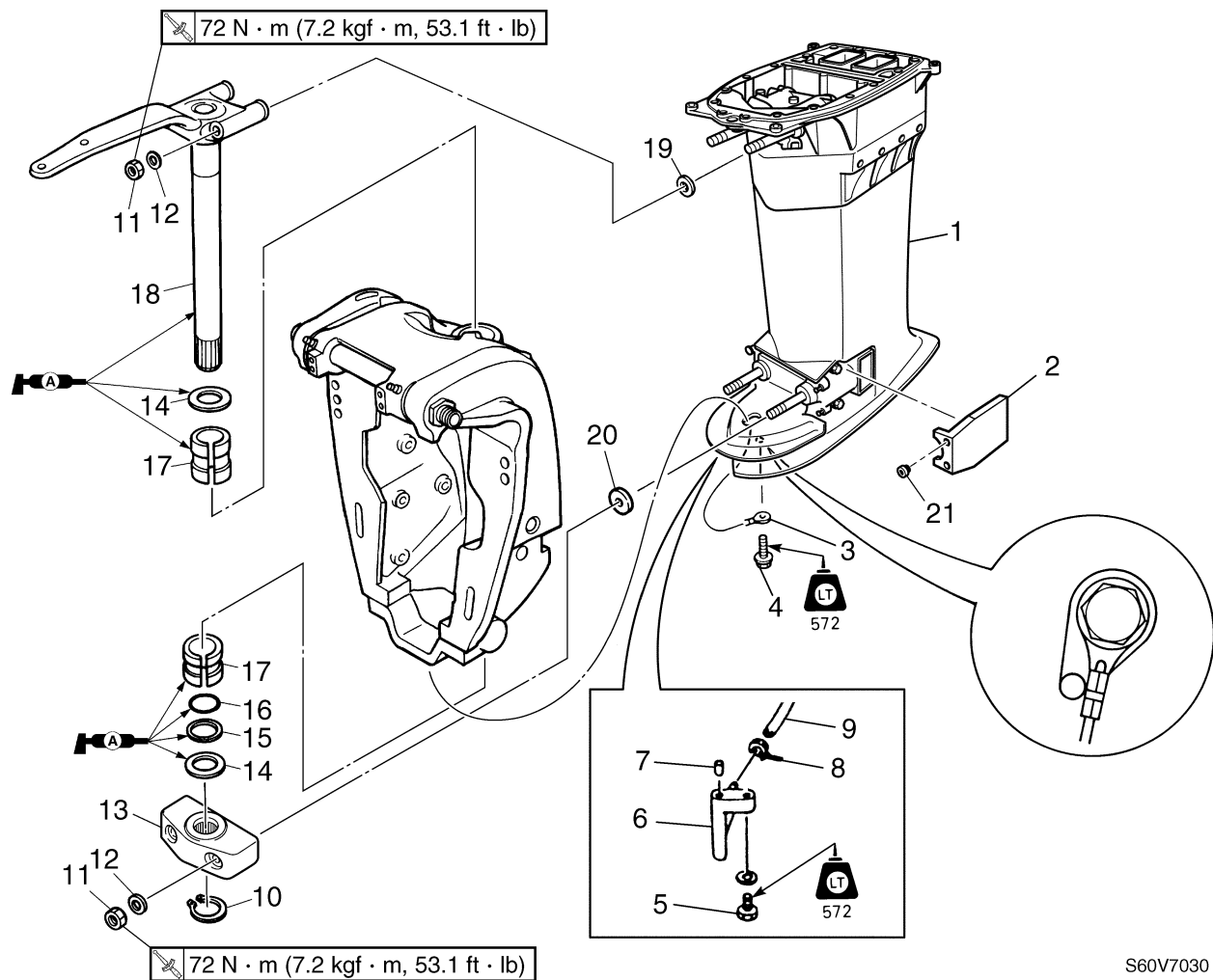
No.	Part name	Q'ty	Remarks
35	Grommet	1	Not reusable M6 × 20 mm
36	Gasket	1	
37	Cover	1	
38	Bolt	13	
39	Cover	1	
40	Ground lead	1	
41	Rubber trim	1	

Upper case, steering arm, swivel bracket, and clamp brackets



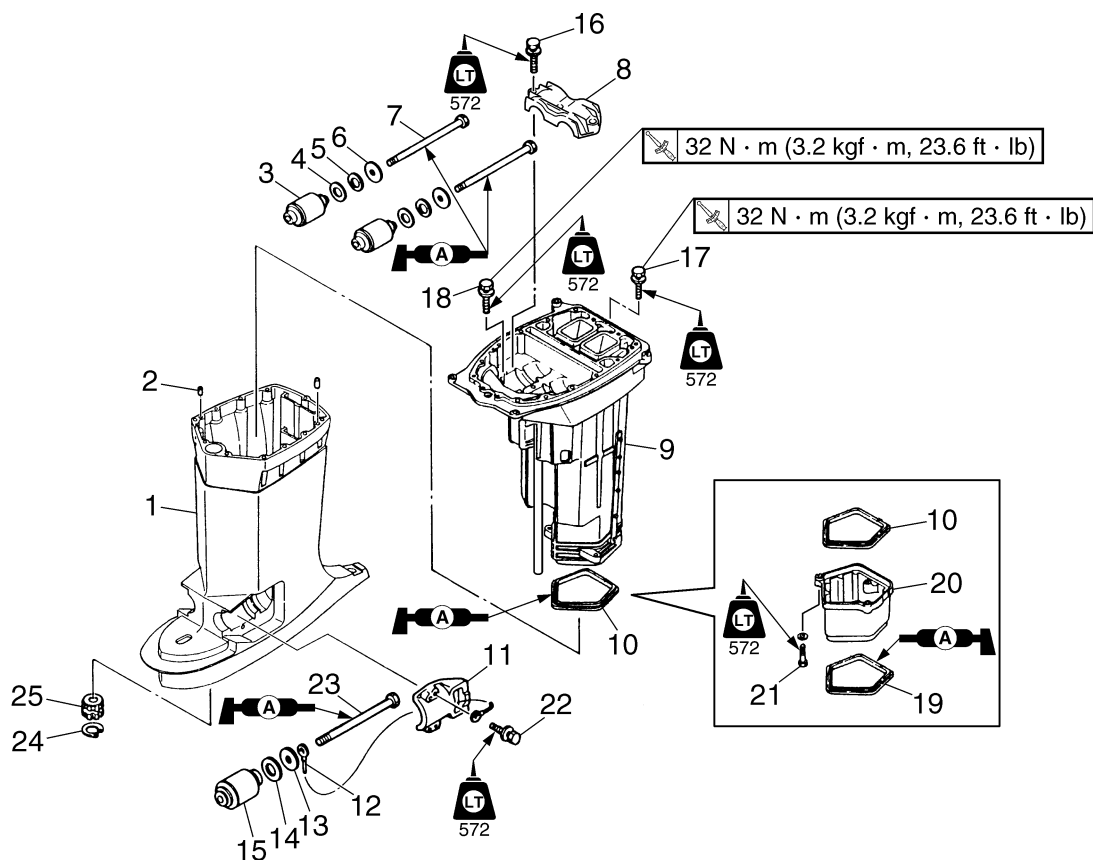
S60V7030

No.	Part name	Q'ty	Remarks
1	Upper case assembly	1	
2	Cover	2	
3	Ground lead	1	
4	Bolt	1	M6 × 10 mm
5	Bolt	1	M6 × 17 mm
6	Adapter	1	
7	Dowel	1	
8	Plastic tie	1	Not reusable
9	Hose	1	
10	Circlip	1	
11	Nut	4	
12	Washer	4	
13	Steering yoke	1	
14	Washer	2	
15	Bushing	1	
16	O-ring	1	Not reusable
17	Bushing	2	



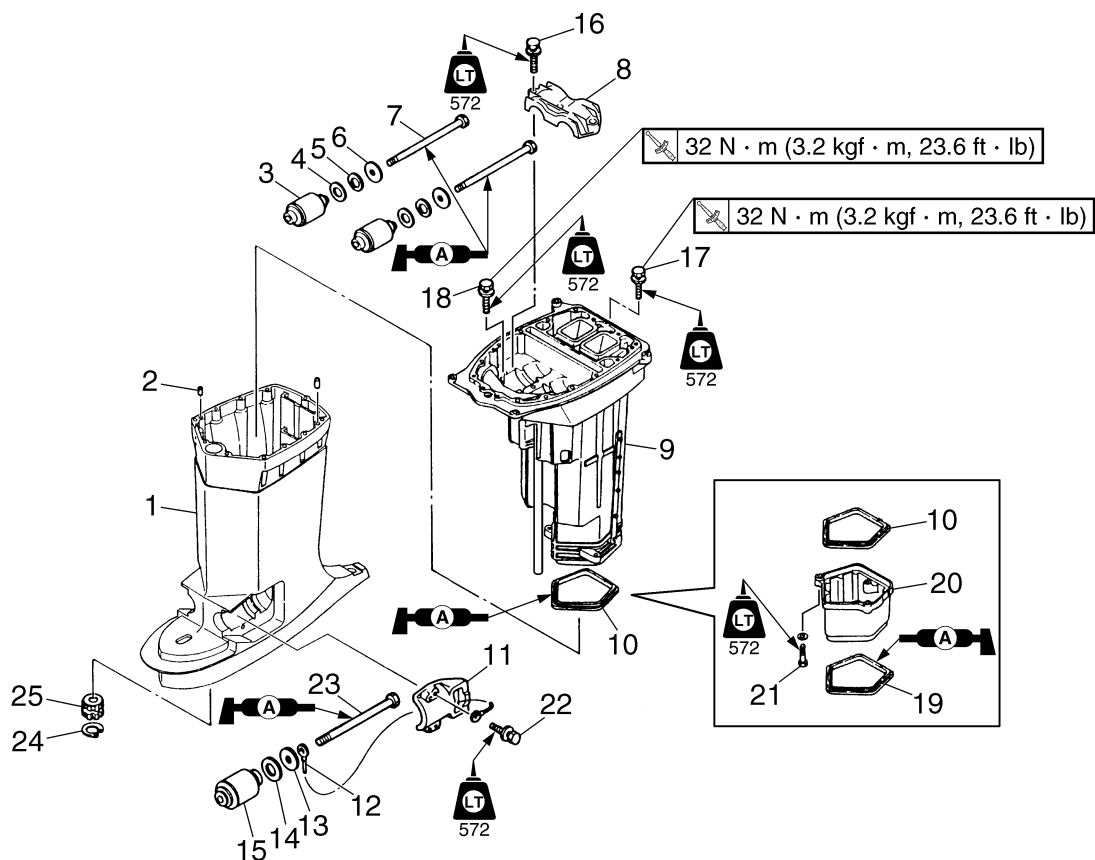
No.	Part name	Q'ty	Remarks
18	Steering arm	1	
19	Washer	2	
20	Washer	2	
21	Grommet	4	

Upper case, steering arm, swivel bracket, and clamp brackets



S60V7040

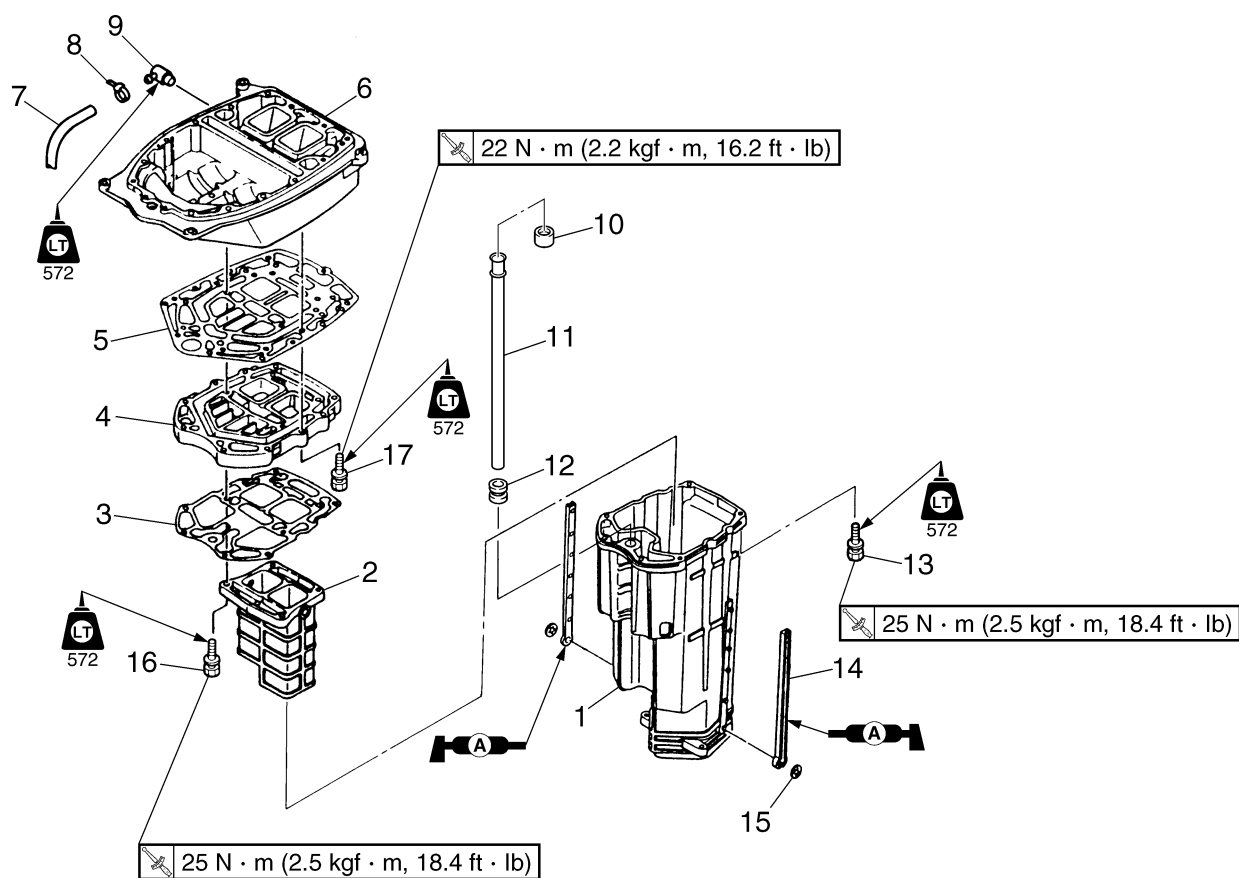
No.	Part name	Q'ty	Remarks
1	Upper case	1	
2	Dowel	2	
3	Upper mount	2	
4	Washer	2	
5	Washer	2	
6	Washer	2	
7	Bolt	2	M14 × 190 mm
8	Bracket	1	
9	Muffler assembly	1	
10	Gasket	1	Not reusable
11	Mount housing	2	
12	Ground lead	1	
13	Washer	2	
14	Washer	2	
15	Lower mount	2	
16	Bolt	3	M10 × 45 mm
17	Bolt	1	M8 × 45 mm



S60V7040

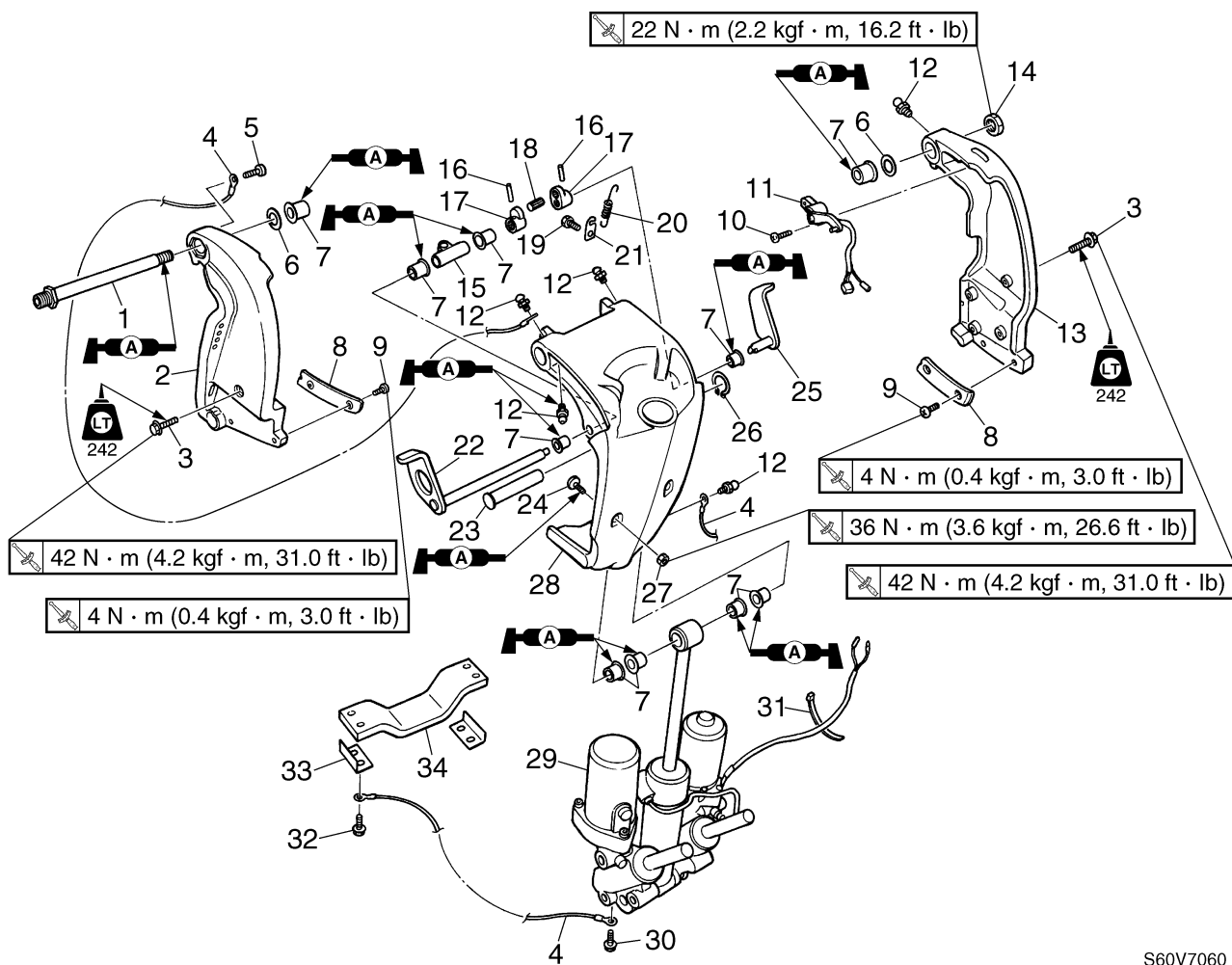
No.	Part name	Q'ty	Remarks
18	Bolt	2	M8 × 30 mm
19	Gasket	1	U-transom model Not reusable
20	Muffler	1	U-transom model
21	Bolt	2	M6 × 35 mm / U-transom model
22	Bolt	4	M10 × 45 mm
23	Bolt	2	M14 × 205 mm
24	Circlip	1	
25	Bushing	1	

Upper case, steering arm, swivel bracket, and clamp brackets



S60V7050

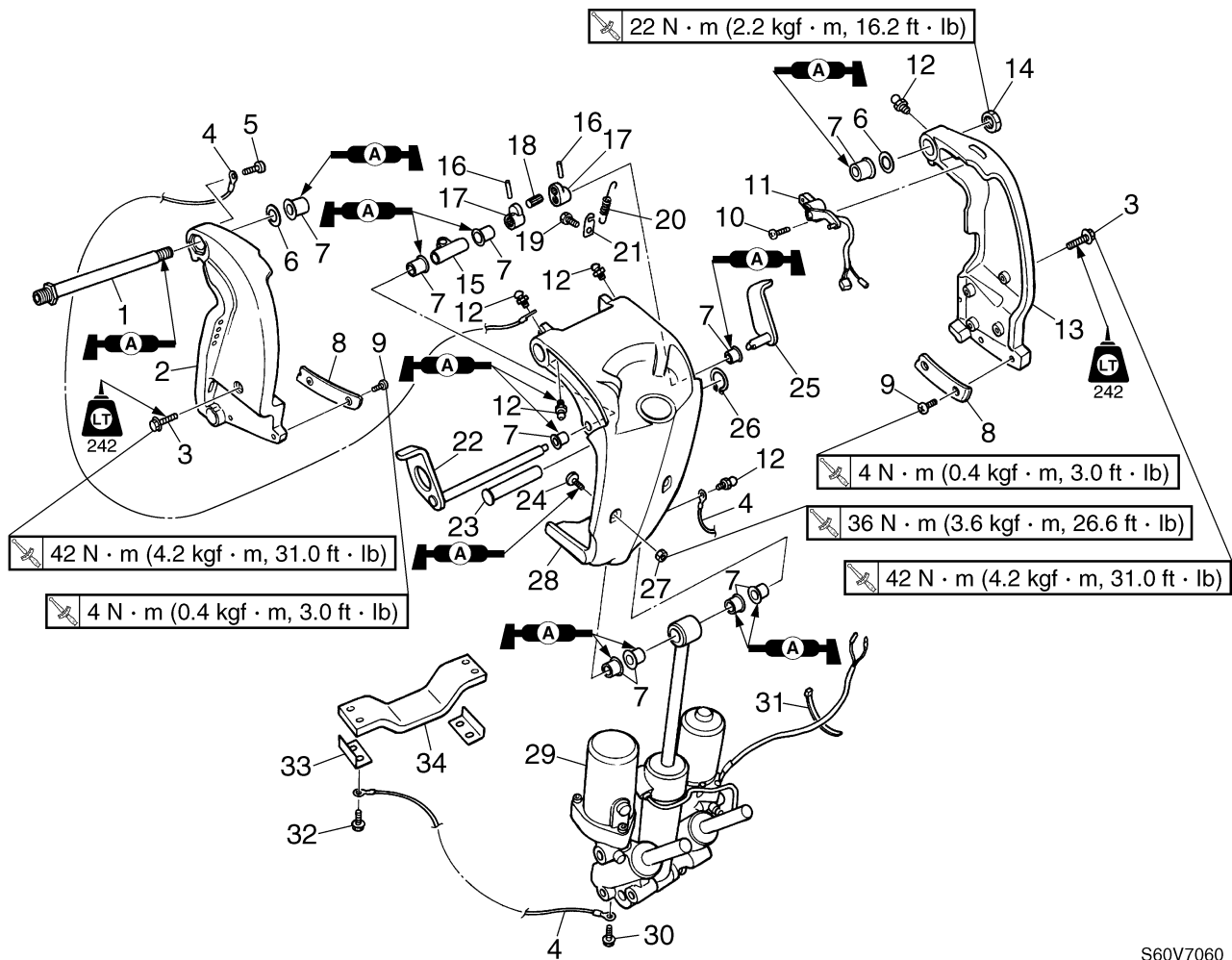
No.	Part name	Q'ty	Remarks
1	Muffler	1	
2	Exhaust manifold	1	
3	Gasket	1	Not reusable
4	Lower exhaust guide	1	
5	Gasket	1	Not reusable
6	Upper exhaust guide	1	
7	Flushing hose	1	
8	Plastic tie	1	Not reusable
9	Joint	1	
10	Rubber seal	1	
11	Pipe	1	
12	Rubber seal	1	
13	Bolt	6	M8 × 50 mm
14	Rubber damper	2	
15	Clip	2	
16	Bolt	4	M8 × 50 mm
17	Bolt	4	M8 × 35 mm



S60V7060

No.	Part name	Q'ty	Remarks
1	Through tube	1	
2	Port clamp bracket	1	
3	Bolt	8	M10 × 45 mm
4	Ground lead	3	
5	Screw	1	ø6 × 10 mm
6	Washer	2	
7	Bushing	10	
8	Friction plate	2	
9	Screw	4	ø6 × 10 mm
10	Screw	2	ø6 × 15 mm
11	Trim sensor	1	
12	Grease nipple	6	
13	Starboard clamp bracket	1	
14	Self-locking nut	1	
15	Collar	1	
16	Pin	2	
17	Tilt lever joint	2	

Upper case, steering arm, swivel bracket, and clamp brackets

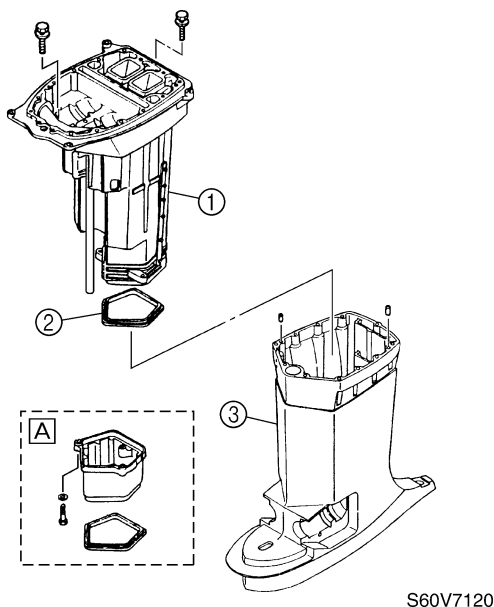


S60V7060

No.	Part name	Q'ty	Remarks
18	Pin	1	M6 × 10 mm
19	Bolt	1	
20	Spring	1	
21	Spring holder	1	
22	Port tilt stop lever	1	
23	Shaft	1	M6 × 10 mm
24	Trim stopper	2	
25	Starboard tilt stop lever	1	M6 × 10 mm
26	Circlip	1	
27	Nut	2	M6 × 10 mm
28	Swivel bracket	1	
29	Power trim and tilt unit	1	M6 × 10 mm
30	Bolt	1	
31	Plastic tie	4	M6 × 25 mm
32	Bolt	4	
33	Bracket	2	M6 × 25 mm
34	Anode	1	

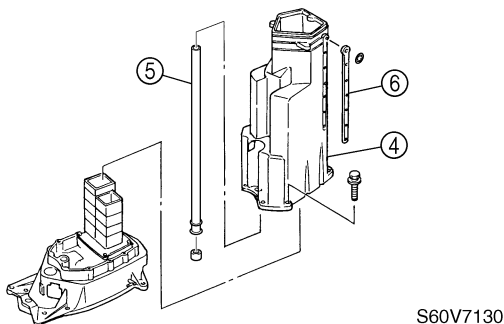
Disassembling the upper case

1. Remove the muffler assembly ① and gasket ② from the upper case ③.

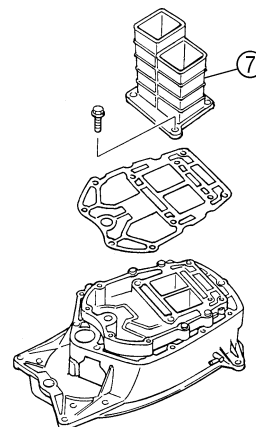


A U-transom model

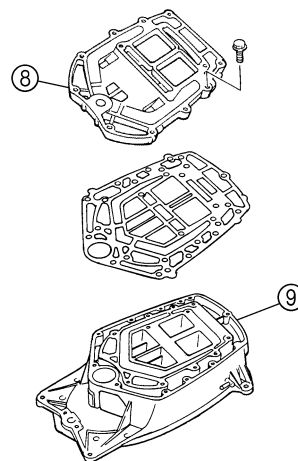
2. Remove the muffler ④, cooling water pipe ⑤, and rubber damper ⑥.



3. Remove the exhaust manifold ⑦.

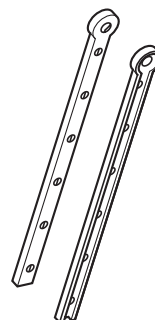


4. Remove the lower exhaust guide ⑧ from the upper exhaust guide ⑨.



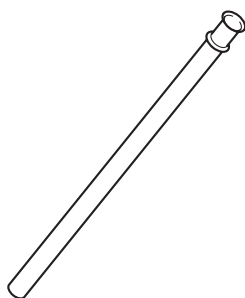
Checking the upper case

1. Check the rubber damper for deterioration. Replace if necessary.



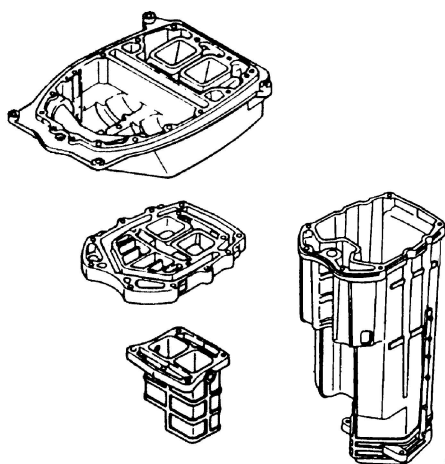
2. Check the cooling water pipe for deformation or corrosion. Replace if necessary.

Upper case, steering arm, swivel bracket, and clamp brackets



S60V7170

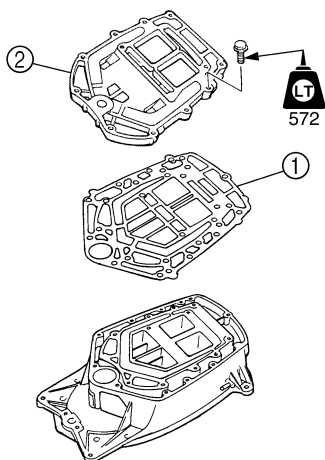
3. Check the exhaust guide, exhaust manifold, and muffler for damage or corrosion. Replace if necessary.



S60V7180

Assembling the upper case

1. Install a new gasket (1), the lower exhaust guide (2), and bolts, and then tighten the bolts to the specified torque.

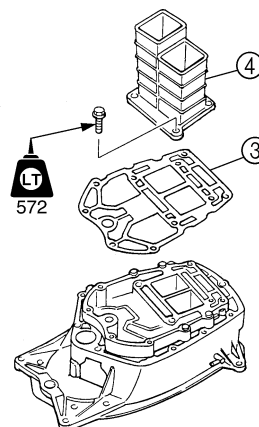


S60V7190



Lower exhaust guide bolt:
22 N·m (2.2 kgf·m, 16.2 ft·lb)

2. Install a new gasket (3), the exhaust manifold (4), and bolts, and then tighten the bolts to the specified torque.

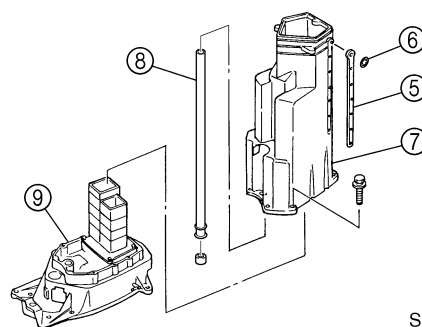


S60V7200



Exhaust manifold bolts:
25 N·m (2.5 kgf·m, 18.4 ft·lb)

3. Install the rubber damper (5) and clip (6) onto the muffler (7).
4. Install the cooling water pipe (8) onto the muffler (7).
5. Install the muffler (7) onto the exhaust guide (9), and then tighten the bolts to the specified torque.



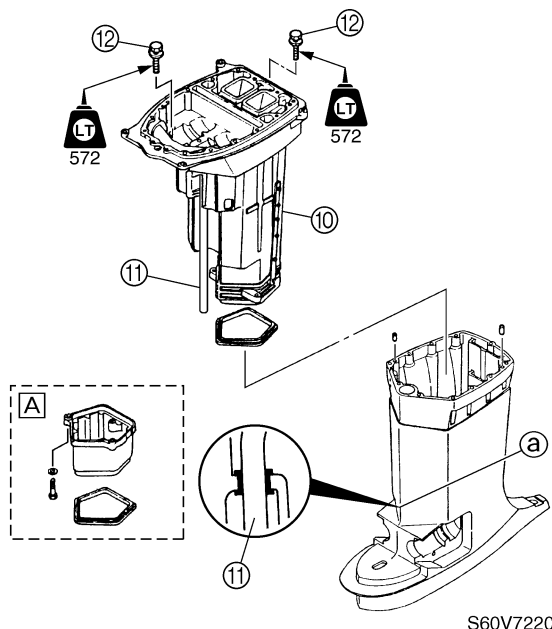
S60V7210



Muffler bolt:
25 N·m (2.5 kgf·m, 18.4 ft·lb)



6. Install the muffler assembly ⑩ by inserting the tip of the cooling water pipe ⑪ into the joint hole ⑨ of the upper case.
7. Tighten the muffler assembly bolts ⑫ to the specified torque.

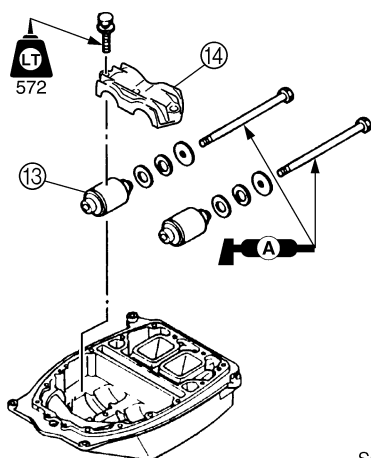


A U-transom model

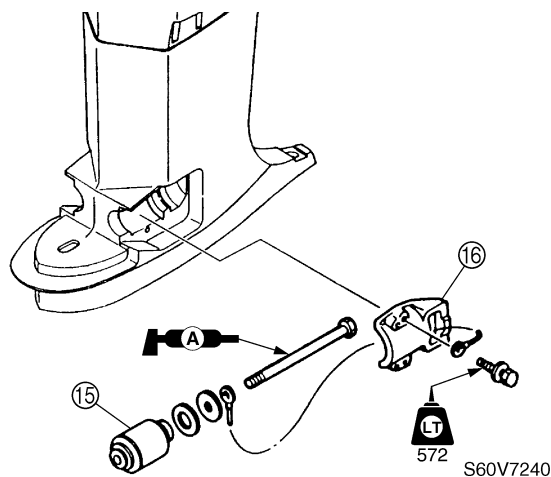


Muffler assembly bolt ⑫:
32 N·m (3.2 kgf·m, 23.6 ft·lb)

8. Install the upper mounts ⑬ and bolts into the upper case.
9. Install the bracket ⑭ and bolts.

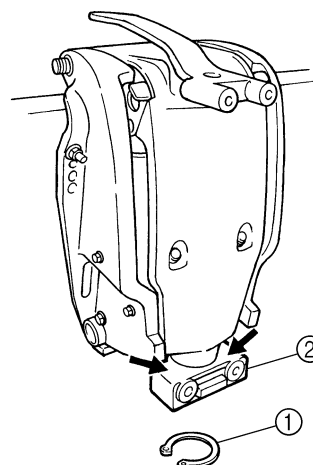


10. Install the lower mounts ⑮ and mount housings ⑯.



Removing the steering arm

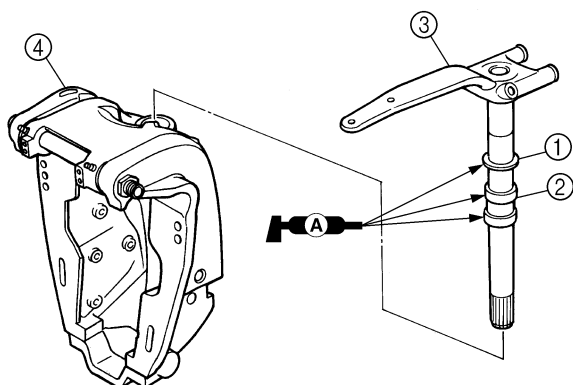
1. Remove the circlip ①.
2. Remove the steering yoke ② by striking it with a plastic hammer.



3. Remove the steering arm from the swivel bracket by pulling the arm off the bracket.

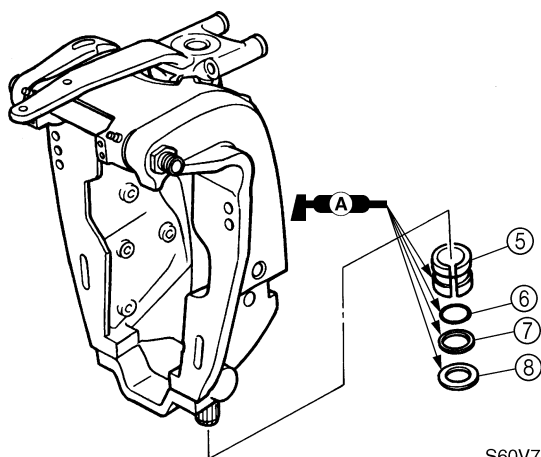
Installing the steering arm

1. Install the washer ① and bushing ② onto the steering arm ③.
2. Place the swivel bracket ④ in an upright position, and then install the steering arm onto the swivel bracket.



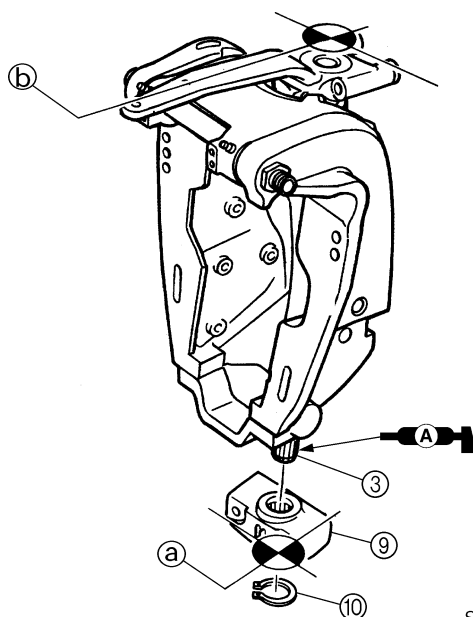
S69J7080

3. Install the bushing ⑤, O-ring ⑥, bushing ⑦, and washer ⑧ onto the swivel bracket.



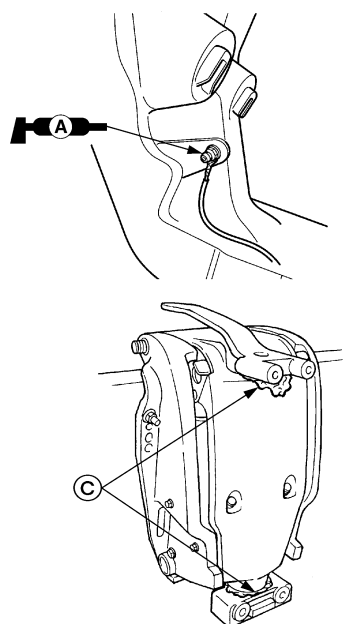
S60V7700

4. Install the steering arm ③ into the steering yoke ⑨ by aligning the center ① of the yoke with the center ② of the steering arm.
5. Install the circlip ⑩.



S69J7090

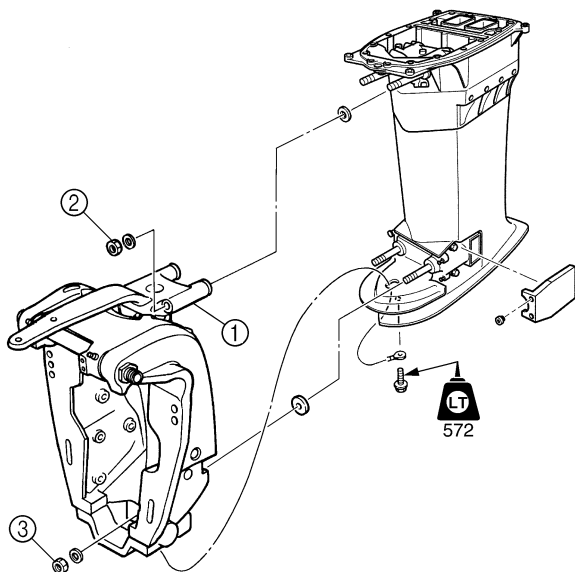
6. Inject grease into the grease nipple until grease comes out from both the upper and lower bushings ③.



S69J7095

Installing the upper case

1. Install the upper and lower mounting bolts into the swivel bracket ① simultaneously.
2. Install the upper mounting nut ② and lower mounting nut ③, and then tighten them to the specified torques.



S60V7250



Upper mounting nut ②:
72 N·m (7.2 kgf·m, 53.1 ft·lb)
Lower mounting nut ③:
72 N·m (7.2 kgf·m, 53.1 ft·lb)

Removing the power trim and tilt unit

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



S60V3310

⚠ 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:

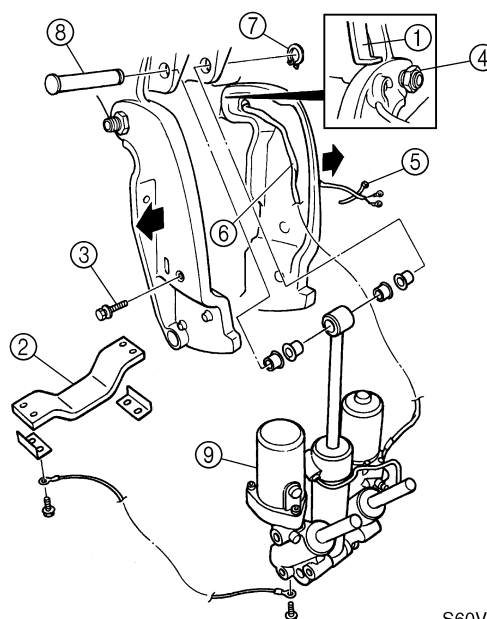
If the power trim and tilt does not operate, loosen the manual valve and tilt the outboard motor up manually.

2. Remove the anode ② and bolts ③.
3. Loosen the self-locking nut ④, and then move the clamp brackets slightly in the direction of the arrows.

⚠ WARNING

Do not remove the tilt stop lever ① from the clamp brackets.

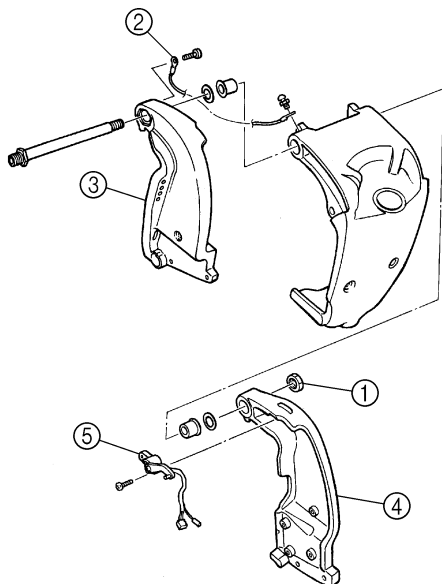
4. Remove the plastic ties ⑤, and then pull out the PTT motor lead ⑥.
5. Remove the circlip ⑦, then the shaft ⑧.
6. Remove the power trim and tilt unit ⑨.



S60V7260

Removing the clamp brackets

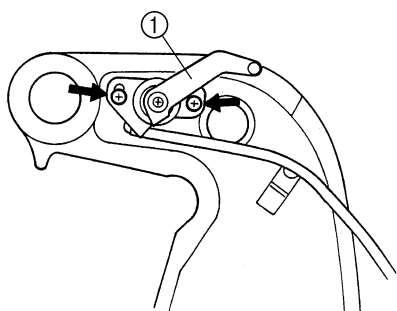
1. Remove the self-locking nut ① and ground lead ②, then clamp brackets ③ and ④.
2. Remove the trim sensor ⑤.



S69J7120

Installing the clamp brackets

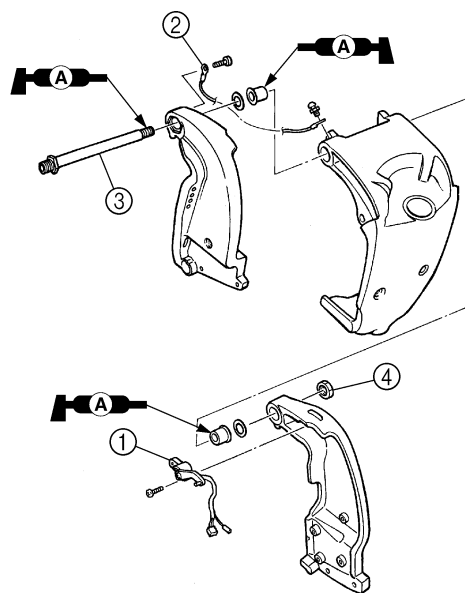
1. Install the trim sensor ① onto the star-board clamp bracket.



S69J7125

NOTE: _____
Adjust the trim sensor ① after installing the power trim and tilt unit.

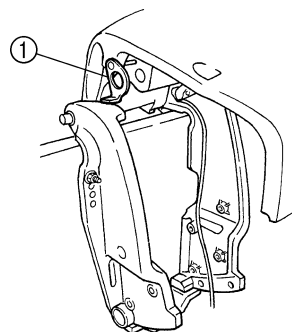
2. Assemble the clamp brackets and the swivel bracket by connecting the ground lead ②, installing the through tube ③, then tightening the self-locking nut ④ finger tight.



S69J7130

Installing the power trim and tilt unit

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



S60V7270

NOTE: _____
After tilting up the outboard motor, be sure to support it with the tilt stop lever ①.



2. Install the PTT unit mounting bolts ② onto both clamp brackets together with the power trim and tilt unit ③, and then tighten them to the specified torque.



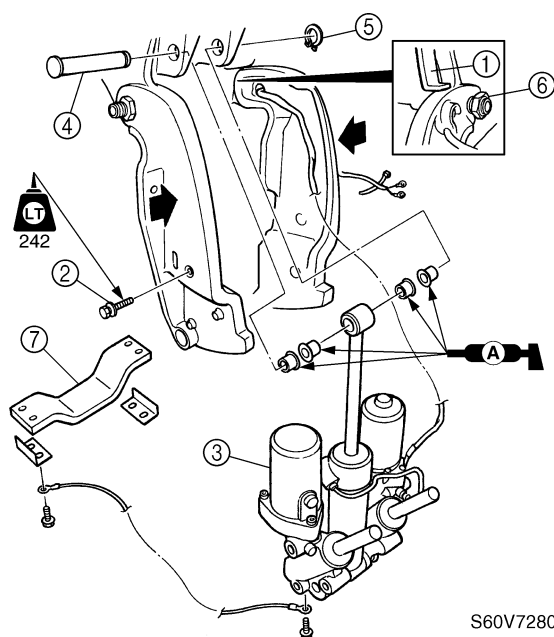
PTT unit mounting bolt ②:
42 N·m (4.2 kgf·m, 31.0 ft·lb)

3. Install the tilt ram upper end into the swivel bracket with the shaft ④ and circlip ⑤.
4. Tighten the through tube nut ⑥ to the specified torque.

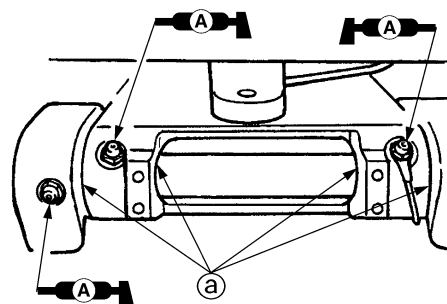
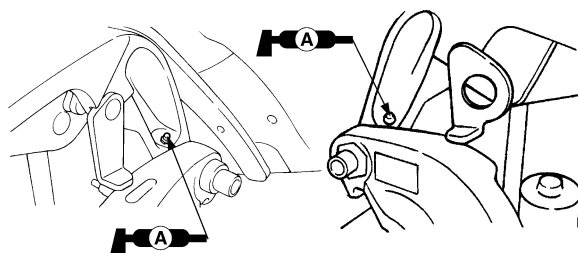


Through tube nut ⑥:
22 N·m (2.2 kgf·m, 16.2 ft·lb)

5. Install the anode ⑦.



6. Inject grease into all grease nipples until grease comes out from the bushings ⑧.



S69J7145

Adjusting the trim sensor

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



S60V3310

⚠ WARNING

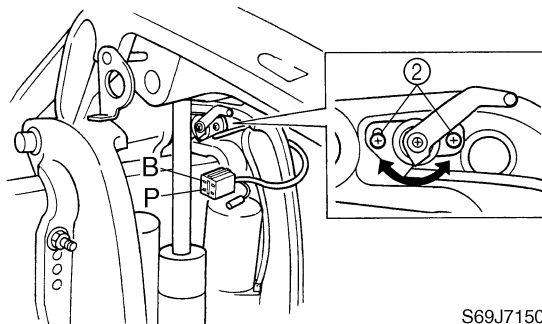
After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.

2. Loosen the cam screws ②.
3. Adjust the position of the trim sensor, and then tighten the screws ② finger tight.
4. Fully tilt the outboard motor down.

5. Measure the trim sensor setting resistance. Repeat steps 1–5 if out of specification.

	Trim sensor setting resistance: Pink (P) – Black (B) 9–11 Ω at 20 °C (68 °F)
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6. Tighten the screws ②.



7. Fully tilt the outboard motor up, and then support it with the tilt stop lever.

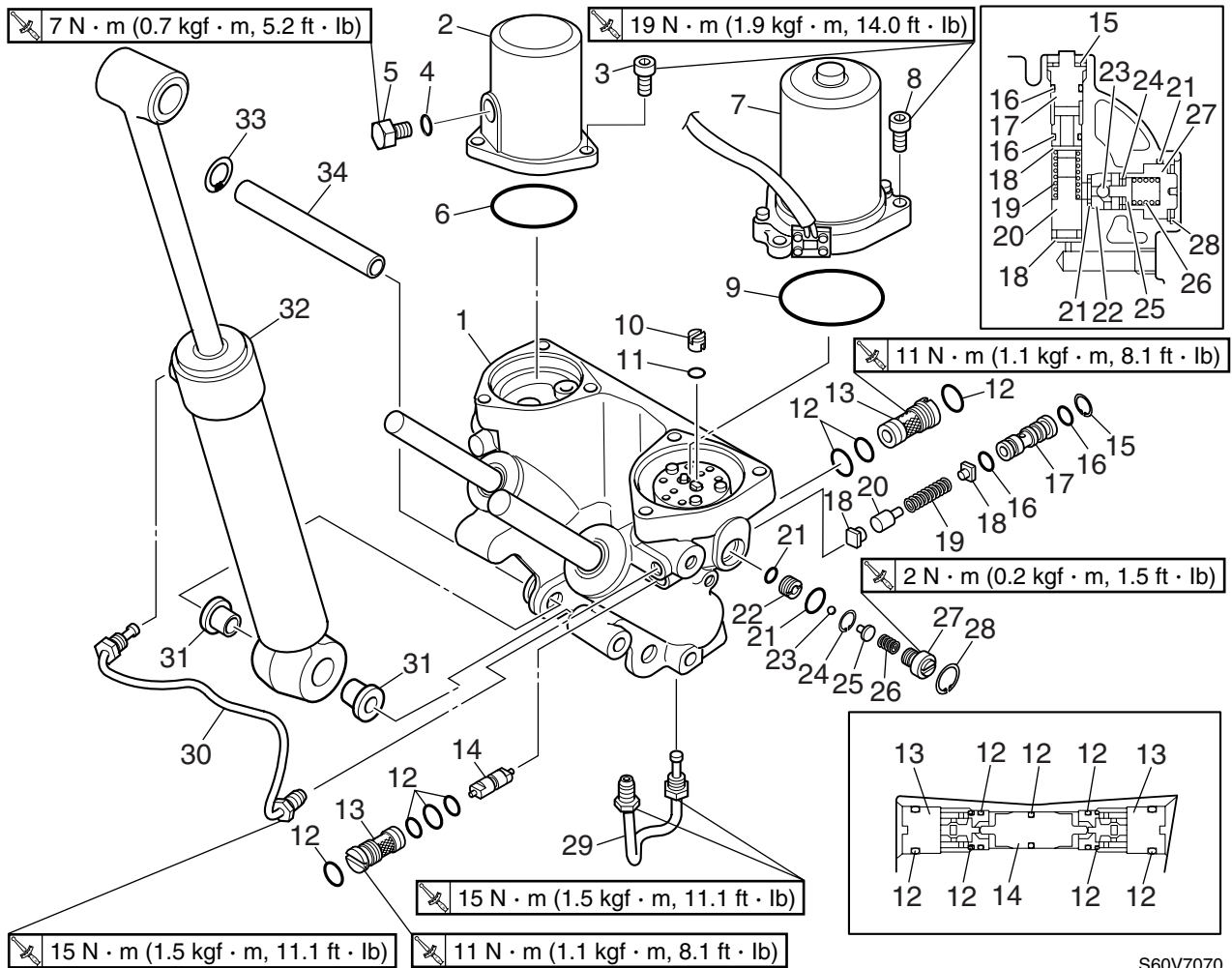
⚠ WARNING

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.

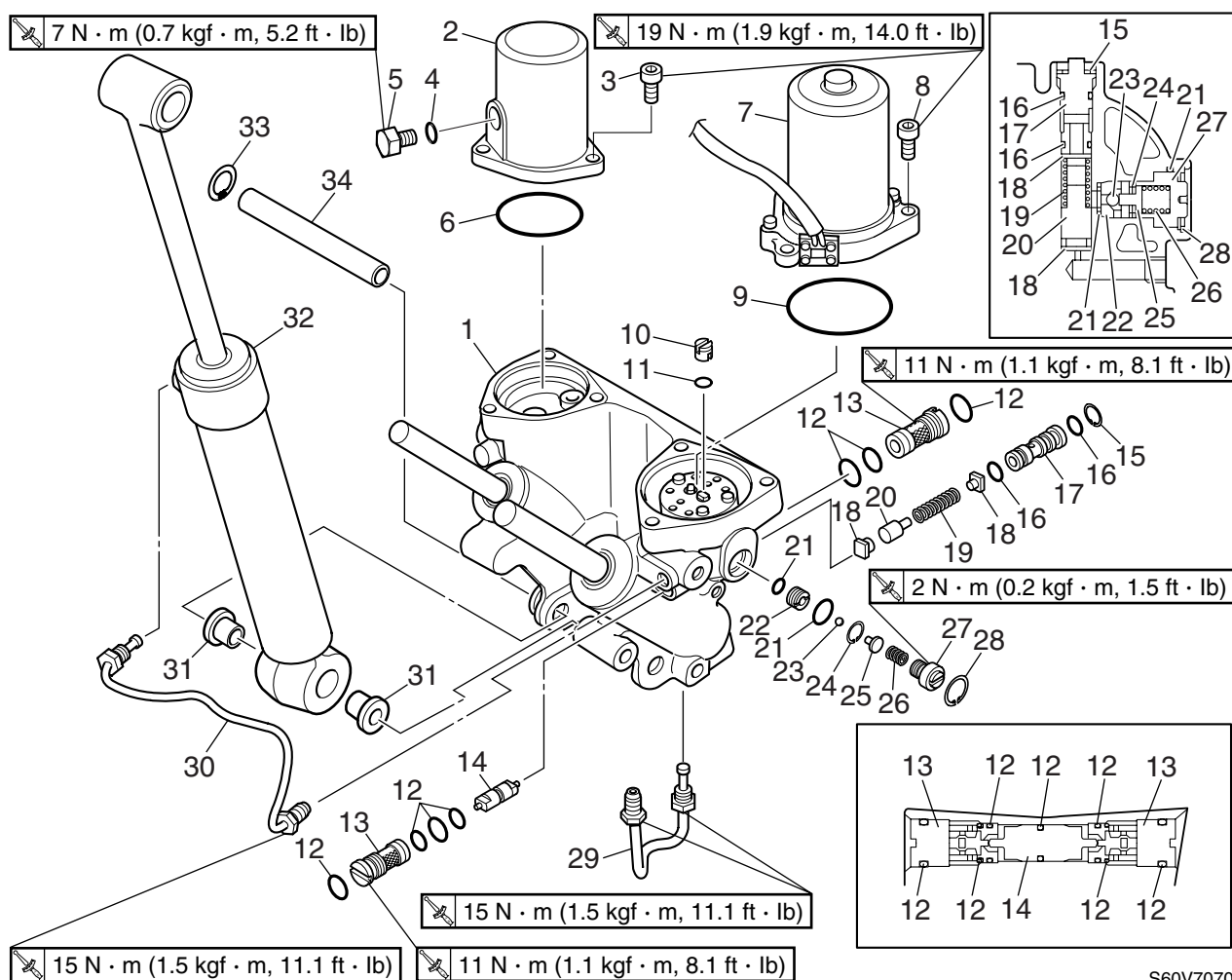
8. Measure the trim sensor resistance. Check the trim sensor if out of specification.

	Trim sensor resistance: Pink (P) – Black (B) 247.6–387.6 Ω at 20 °C (68 °F)
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Power trim and tilt unit

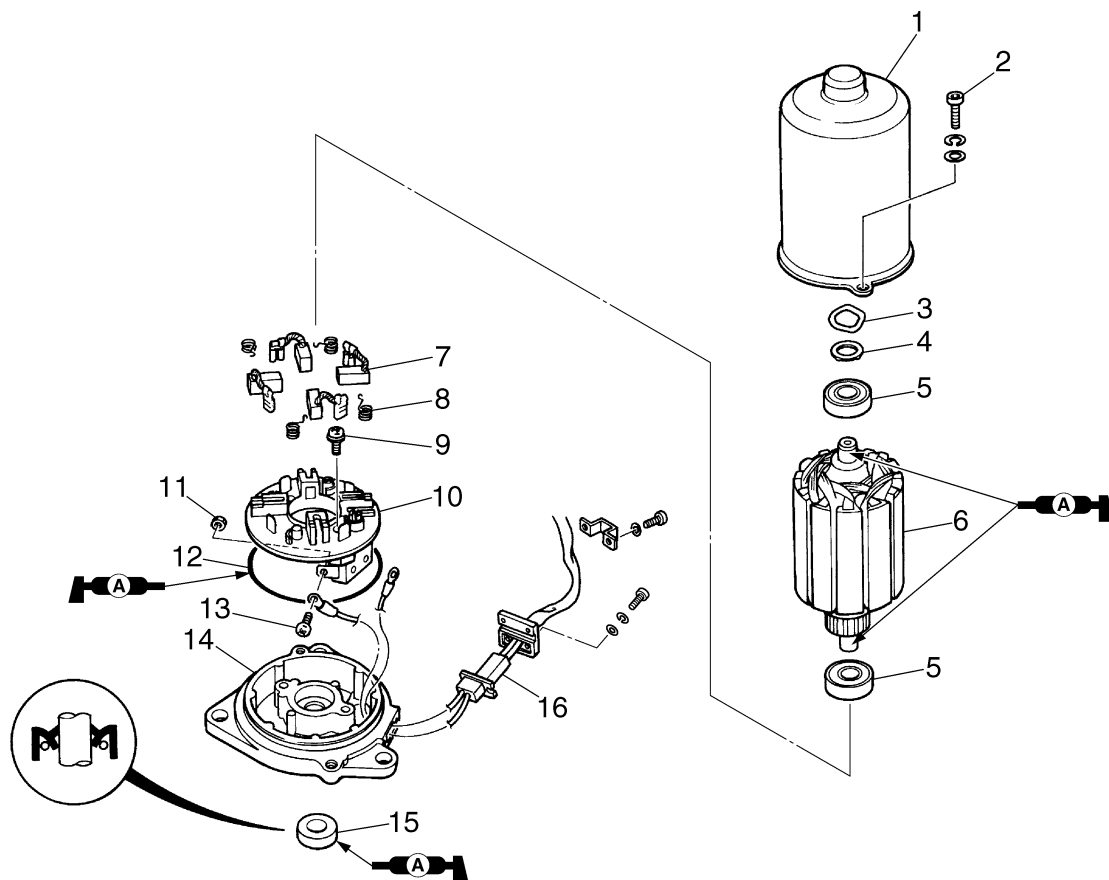


No.	Part name	Q'ty	Remarks
1	Cylinder block	1	
2	Reservoir	1	
3	Bolt	3	M8 × 20 mm
4	O-ring	1	Not reusable
5	Reservoir cap	1	
6	O-ring	1	Not reusable
7	Power trim and tilt motor	1	
8	Bolt	3	M8 × 20 mm
9	O-ring	1	Not reusable
10	Joint	1	
11	O-ring	1	Not reusable
12	O-ring	7	Not reusable
13	Main valve	2	
14	Piston	1	
15	Circlip	1	
16	O-ring	2	Not reusable
17	Retainer	1	



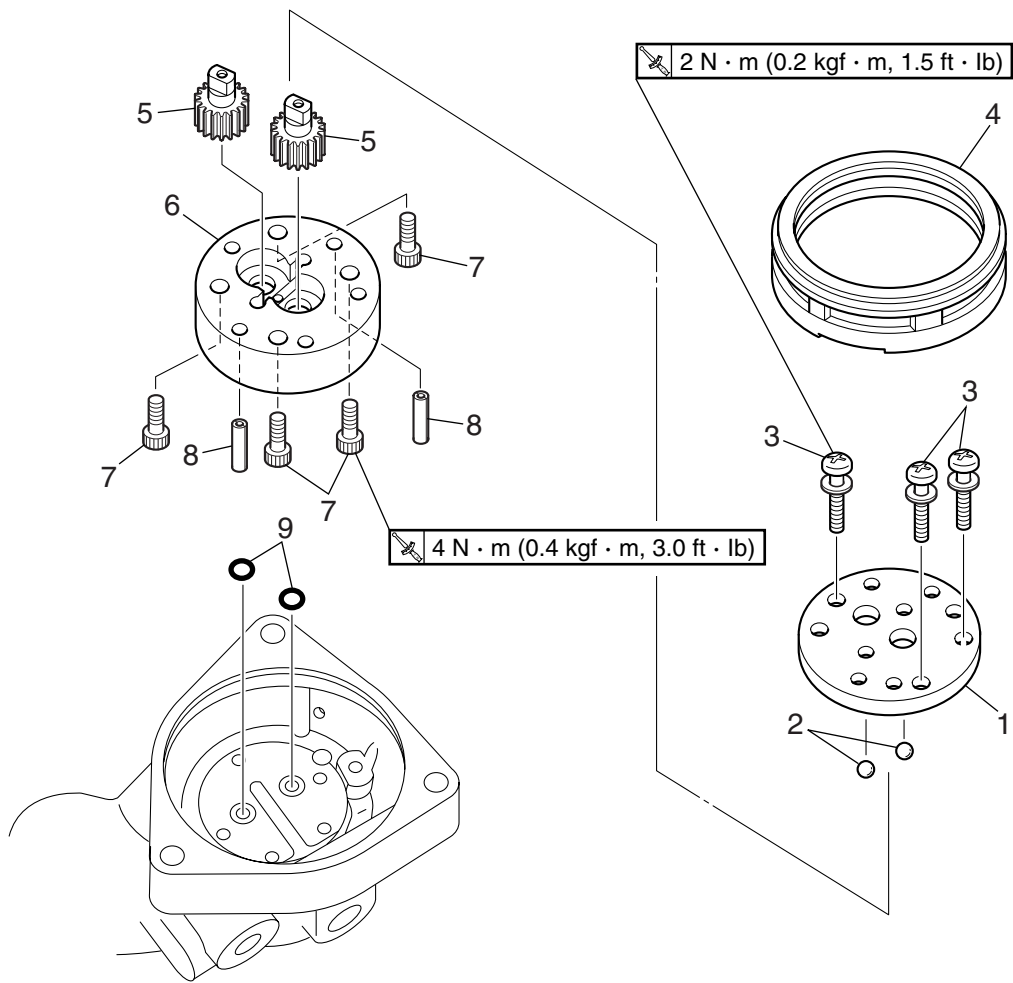
S60V7070

No.	Part name	Q'ty	Remarks
18	Valve seal	2	Not reusable
19	Spring	1	
20	Spring seat	1	
21	O-ring	2	
22	Valve seat	1	
23	Ball	1	
24	Circlip	1	
25	Actuator pin	1	
26	Spring	1	
27	Manual valve	1	
28	Circlip	1	
29	Pipe	1	
30	Pipe	1	
31	Bushing	1	
32	Tilt cylinder assembly	1	
33	Circlip	1	
34	Shaft	1	



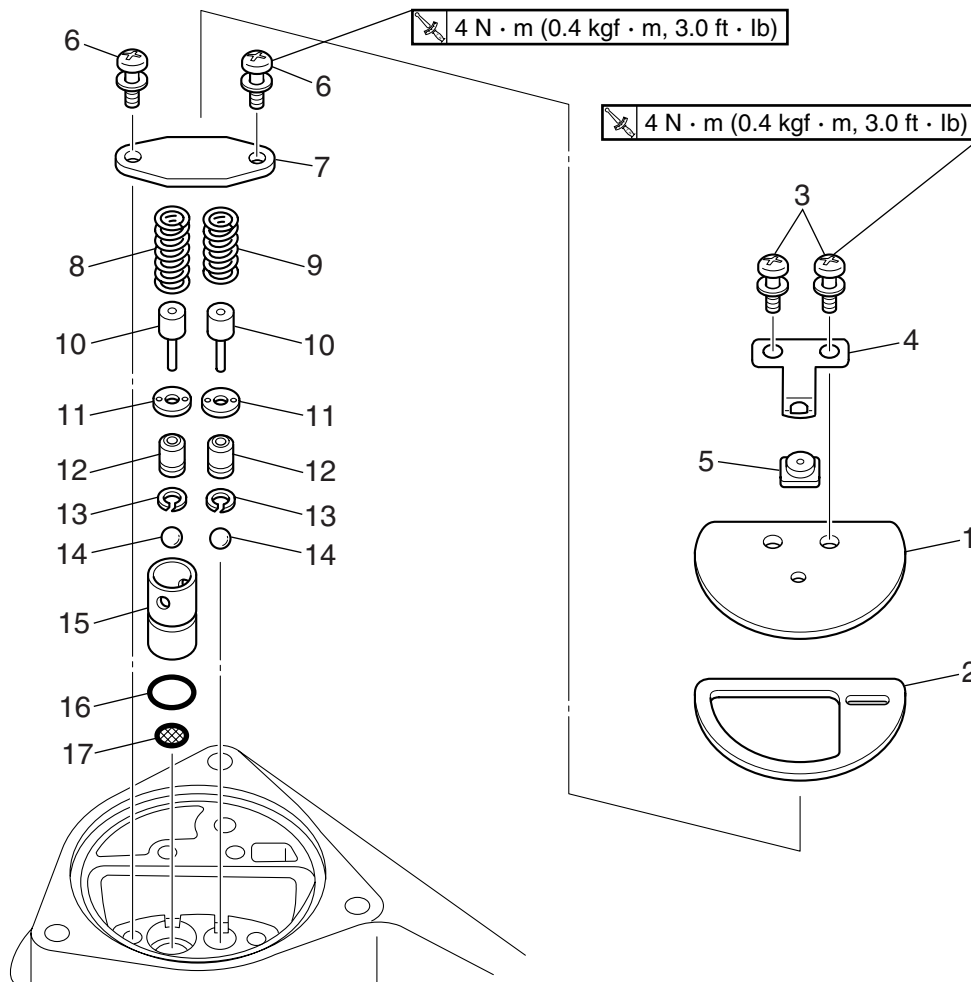
S60V7090

No.	Part name	Q'ty	Remarks
1	Yoke	1	
2	Bolt	2	M5 × 12 mm
3	Wave washer	1	
4	Washer	1	
5	Bearing	2	
6	Armature	1	
7	Brush	4	
8	Spring	4	
9	Screw	2	ø4 × 12 mm
10	Brush holder	1	
11	Nut	2	
12	O-ring	1	Not reusable
13	Screw	2	ø4 × 6 mm
14	PTT motor base	1	
15	Oil seal	1	Not reusable
16	PTT motor lead	1	



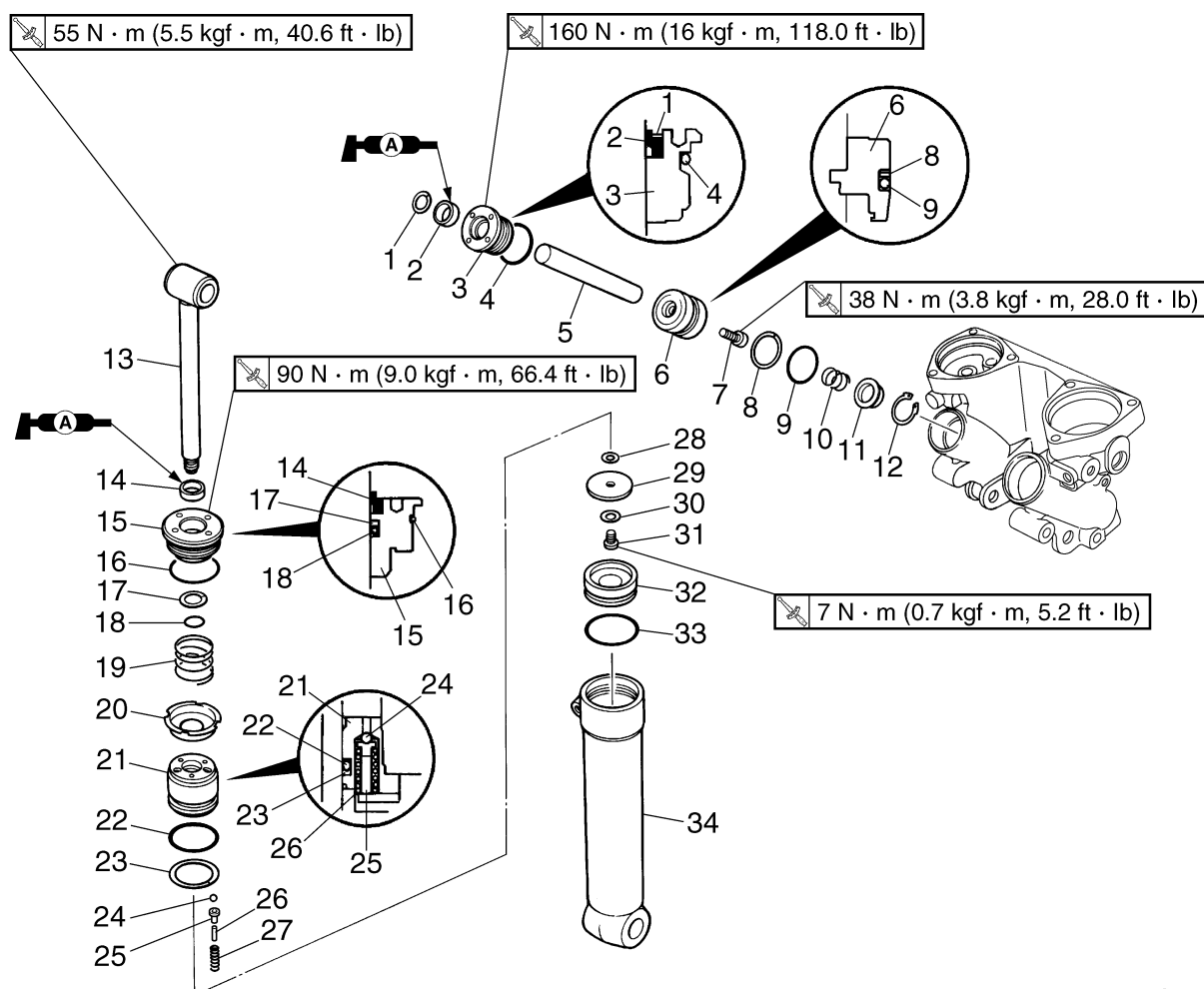
S60V7100

No.	Part name	Q'ty	Remarks
1	Gear housing 1	1	ø4 × 30 mm
2	Ball	2	
3	Screw	3	
4	Gear pump filter	1	M5 × 12 mm
5	Drive gear	2	
6	Gear housing 2	1	
7	Bolt	4	Not reusable
8	Pin	2	
9	O-ring	2	



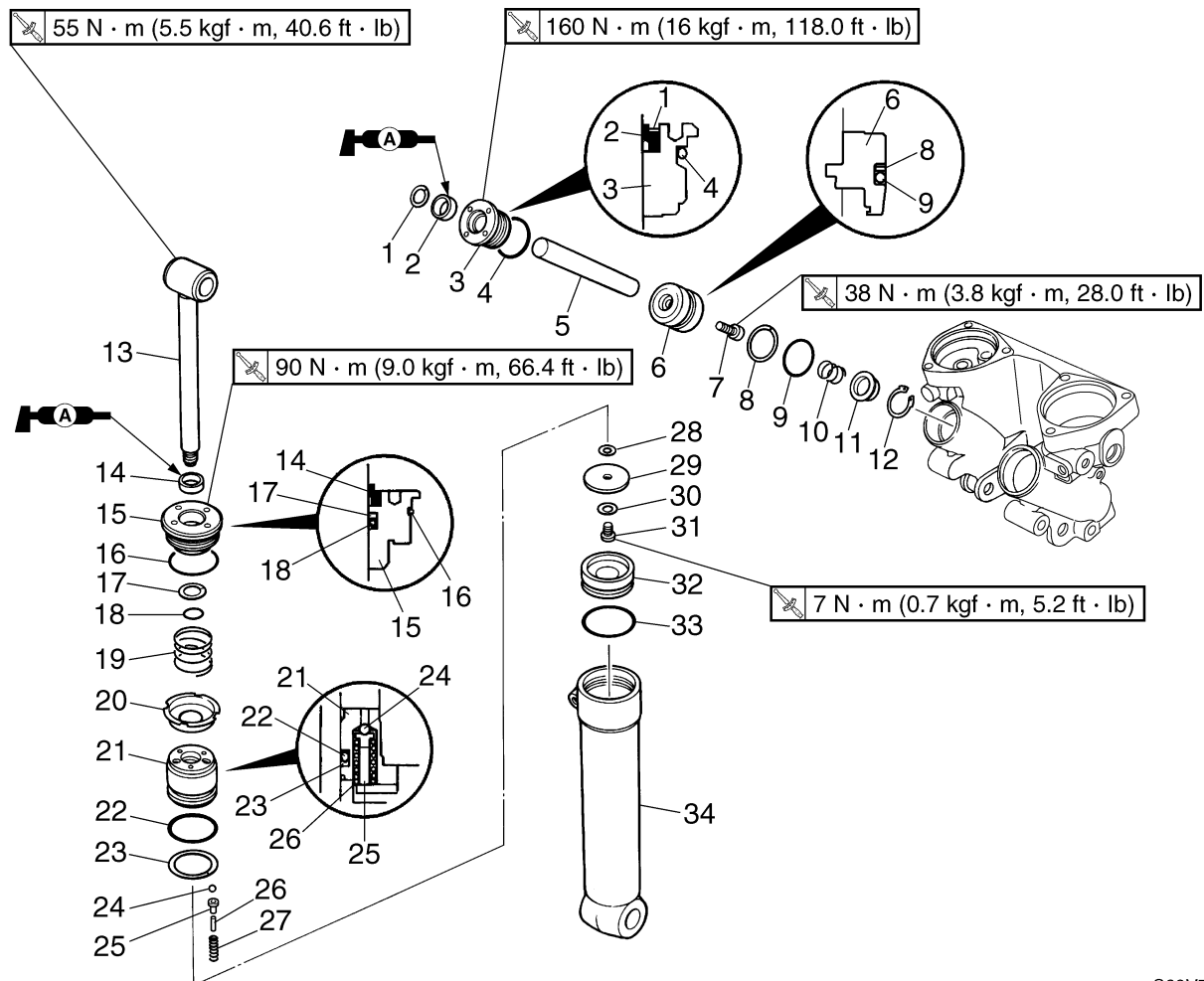
S60V7110

No.	Part name	Q'ty	Remarks
1	Trim down plate	1	ø5 × 10 mm ø5 × 10 mm Not reusable
2	Seal	1	
3	Screw	2	
4	Trim down spring	1	
5	Valve seal	1	
6	Screw	2	
7	Relief valve plate	1	
8	Up-relief valve spring	1	
9	Down-relief valve spring	1	
10	Pin	2	
11	Washer	2	
12	Valve seat	2	
13	Valve seal	2	
14	Ball	2	
15	Relief valve	1	
16	O-ring	1	
17	Relief valve filter	1	



S60V7080

No.	Part name	Q'ty	Remarks
1	Circlip	2	
2	Dust seal	2	Not reusable
3	Trim cylinder end screw	2	
4	O-ring	2	Not reusable
5	Trim ram	2	
6	Trim piston	2	
7	Bolt	2	M8 × 20 mm
8	Backup ring	2	
9	O-ring	2	Not reusable
10	Spring	2	
11	Adapter	2	
12	Circlip	2	
13	Tilt ram	1	
14	Dust seal	1	Not reusable
15	Tilt cylinder end screw	1	
16	O-ring	1	Not reusable
17	Backup ring	1	

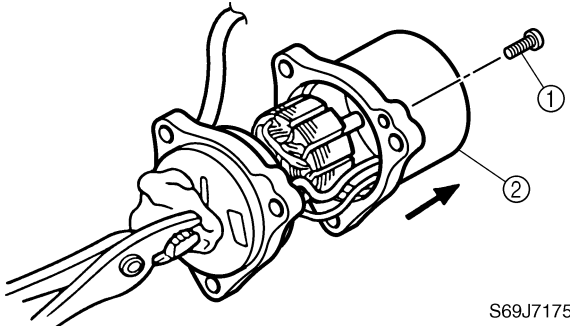


S60V7080

No.	Part name	Q'ty	Remarks
18	O-ring	1	Not reusable
19	Spring	1	
20	Adapter	1	
21	Tilt piston	1	
22	O-ring	1	Not reusable
23	Backup ring	1	
24	Ball	5	
25	Pin	5	
26	Pin	5	
27	Spring	5	
28	Washer	1	
29	Plate	1	
30	Washer	1	
31	Bolt	1	M6 × 10 mm
32	Free piston	1	
33	O-ring	1	Not reusable
34	Tilt cylinder	1	

Disassembling the power trim and tilt motor

1. Remove the PTT motor screws ①, then the yoke ②.



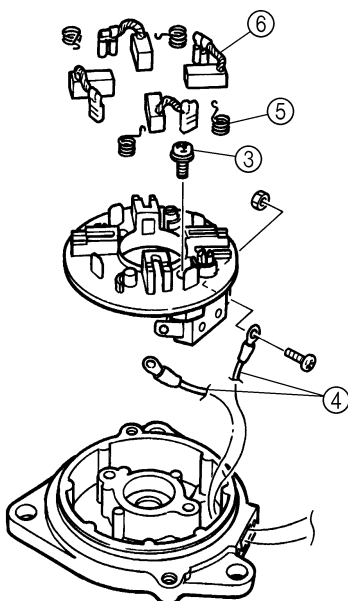
CAUTION:

Do not allow grease or oil to contact the commutator.

NOTE:

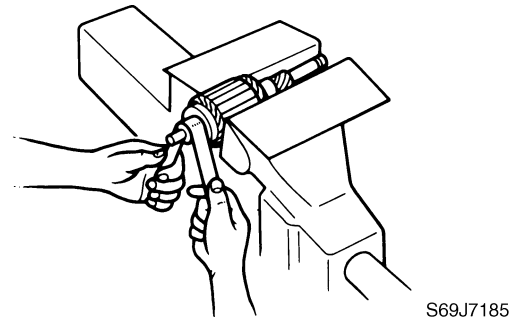
Place a clean cloth over the end of the armature shaft and carefully pull the armature from the yoke with pliers as shown.

2. Remove the screws ③, disconnect the PTT motor leads ④, and then remove the springs ⑤ and brushes ⑥.

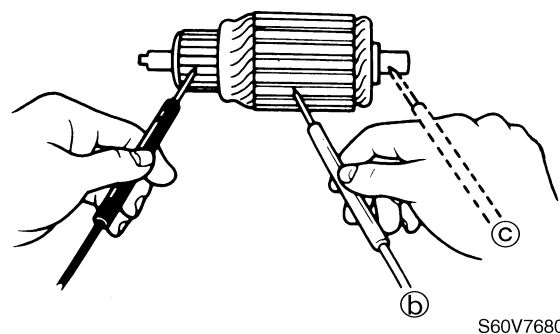
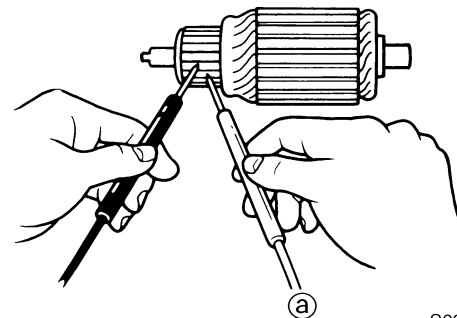


Checking the power trim and tilt motor

1. Check the commutator for dirt or foreign substances. Clean with #600 grit sandpaper if necessary.

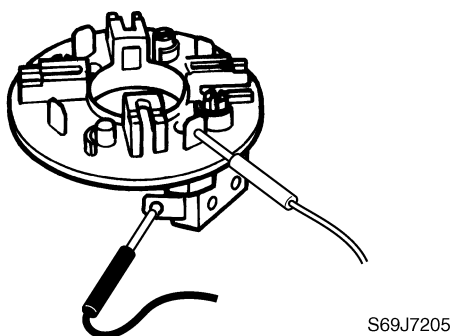


2. Check the commutator undercut for dirt or foreign substances. Clean with compressed air if necessary.
3. Check the armature coil for continuity. Replace if out of specification.

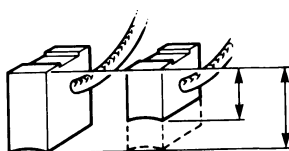


Armature coil continuity	
Commutator segments ①	Continuity
Segment-laminations ②	No continuity
Segment-shaft ③	No continuity

- Check the circuit breaker for continuity. Replace the brush holder if there is no continuity.



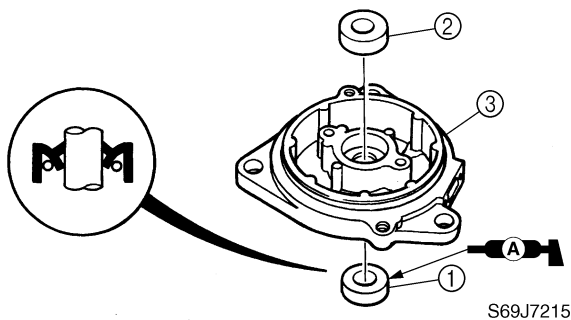
- Check the brush for wear. Replace if necessary.



- Check the base for corrosion or damage. Replace if necessary.
- Check the bearing for damage or wear. Replace if necessary.

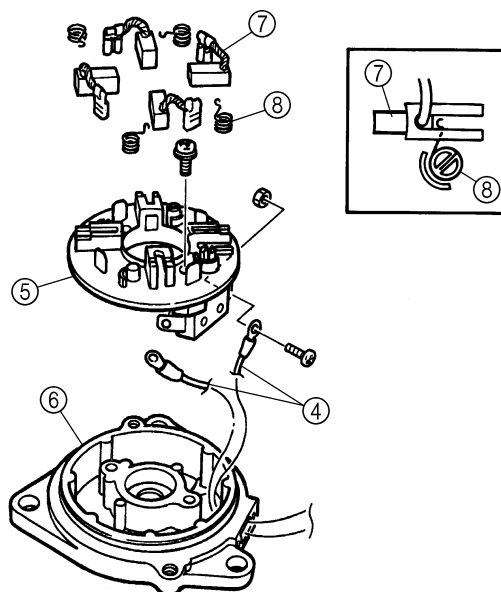
Assembling the power trim and tilt motor

- Install a new oil seal ① and the bearing ② into the motor base ③ as shown.

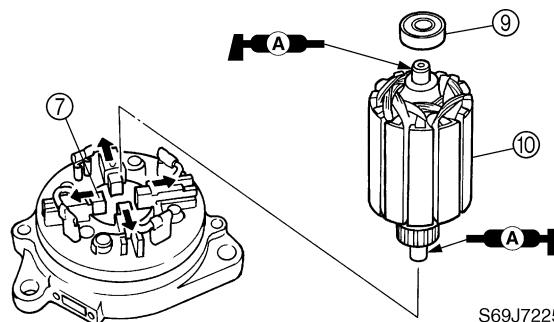


- Connect the PTT motor leads ④ to the brush holder ⑤, and then install the brush holder ⑤ to the motor base ⑥.

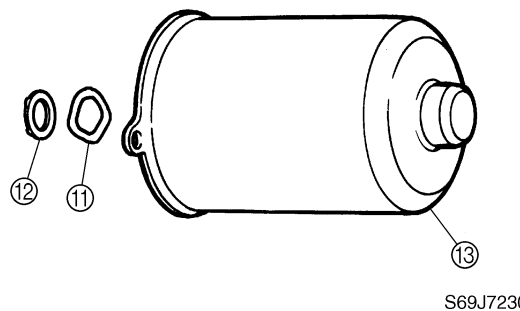
- Install the brushes ⑦ and springs ⑧ onto the brush holder as shown.



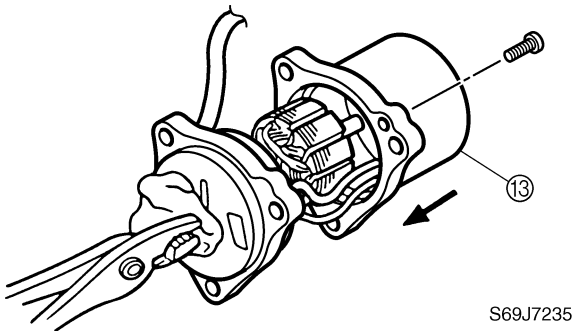
- Install the bearing ⑨ onto the armature ⑩.
- Push the brushes ⑦ into the holders, and then install the armature ⑩.



- Install the wave washer ⑪ and washer ⑫ into the yoke ⑬.



7. Install a new O-ring and the yoke ⑬ into the motor base.

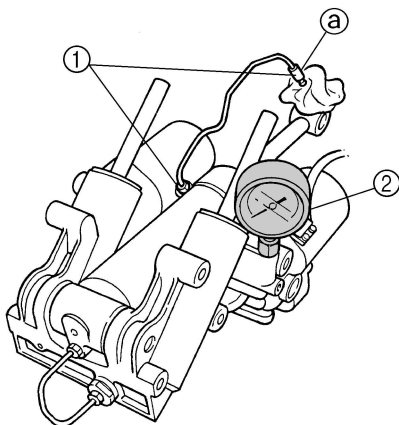


NOTE:

Place a clean cloth over the end of the armature shaft and carefully push the armature from the yoke with a pair of pliers as shown.

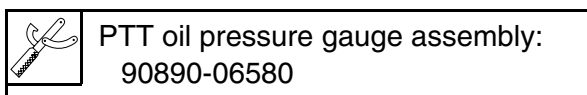
Checking the hydraulic pressure

1. Check the hydraulic pressure. Check the internal parts if out of specification.
2. Fully extend the power trim and tilt rams.
3. Loosen the pipe joints ①, and then remove the pipe joint ②.
4. Install the PTT oil pressure gauge assembly ②.

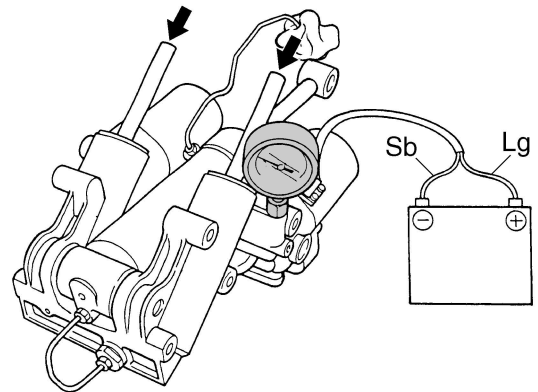


NOTE:

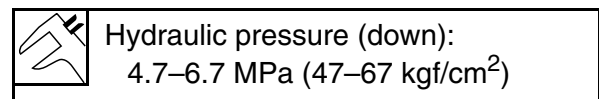
Wrap the removed pipe joint ② in a rag.



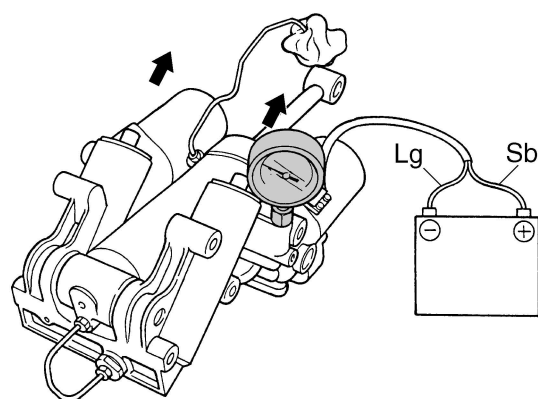
5. Connect the PTT motor leads to the battery terminals to retract the trim ram, and then measure the hydraulic pressure.



Ram	PTT motor lead	Battery terminal
Down	Light green (Lg)	⊕
	Sky blue (Sb)	⊖



6. Reverse the PTT motor leads between the battery terminals to fully extend the trim and tilt rams.



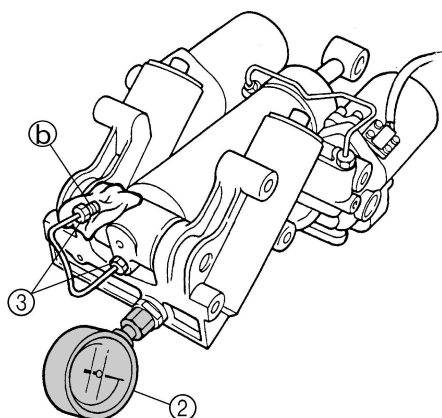
Ram	PTT motor lead	Battery terminal
Up	Sky blue (Sb)	⊕
	Light green (Lg)	⊖

7. Remove the PTT oil pressure gauge assembly ②.
8. Install the pipe joint ①, and then tighten the pipe joints to the specified torque.



Pipe joint ①:
 15 N·m (1.5 kgf·m, 11.1 ft·lb)

9. Connect the PTT motor leads to the battery terminals to fully retract the trim and tilt rams.
10. Loosen the pipe joints ③, and then remove the pipe joint ⑥.
11. Install the PTT oil pressure gauge assembly ②.



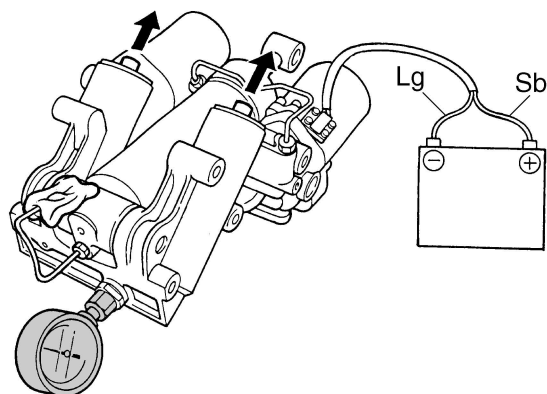
S69J7255

NOTE: _____
 Wrap the removed pipe joint ⑥ in a rag.



PTT oil pressure gauge assembly:
 90890-06580

12. Connect the PTT motor leads to the battery terminals to extend the trim ram, and then measure the hydraulic pressure.

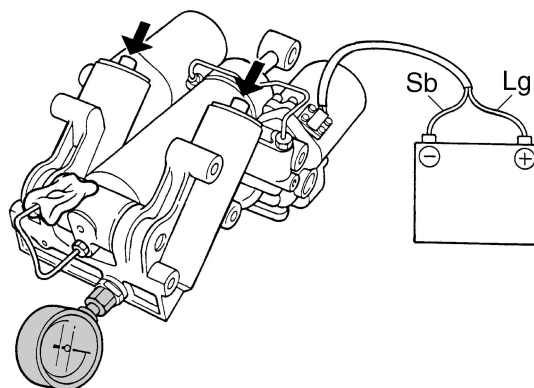


S69J7260



Hydraulic pressure (up):
 11.3–13.3 MPa (113–133 kgf/cm²)

13. Reverse the PTT motor leads between the battery terminals to fully retract the trim and tilt rams.



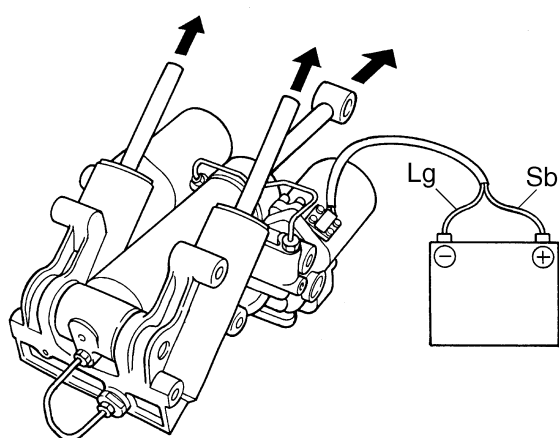
S69J7265

14. Remove the PTT oil pressure gauge assembly ②.
15. Install the pipe joint ⑥, and then tighten the pipe joints to the specified torque.



Pipe joint ③:
 15 N·m (1.5 kgf·m, 11.1 ft·lb)

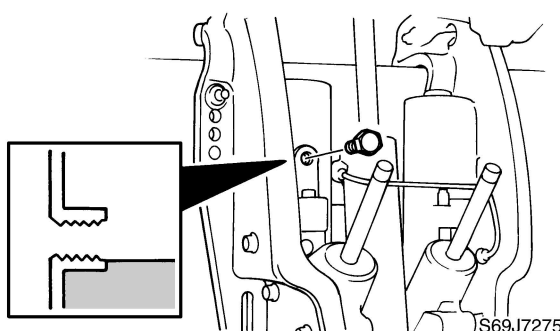
16. After measuring the hydraulic pressure, connect the PTT motor leads to the battery terminals to fully extend the trim and tilt rams.



S69J7270

17. Remove the reservoir cap, and then check the fluid level in the reservoir.

18. If necessary, add fluid of the recommended type to the correct level.



S69J7275

NOTE:

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

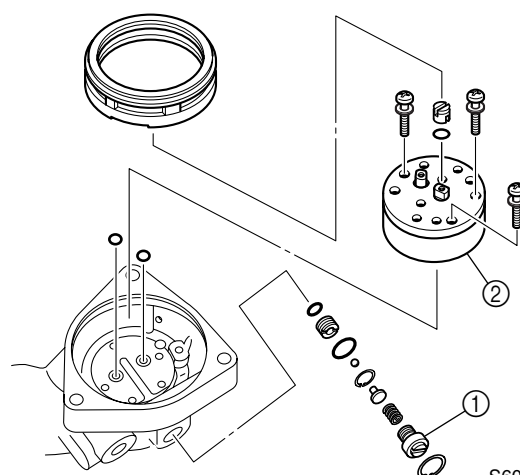


Recommended power trim and tilt fluid:
ATF Dexron II

19. Install the reservoir cap.

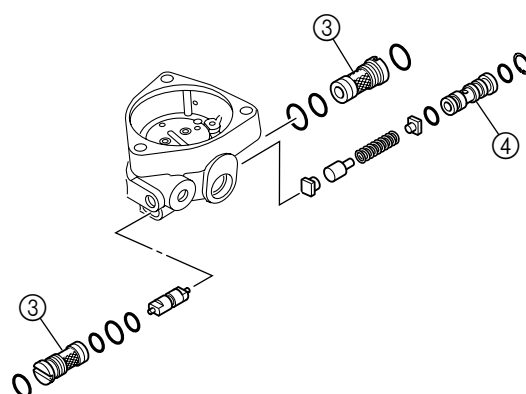
Disassembling the gear pump

1. Remove the manual valve ① and gear pump ②.



S60V7320

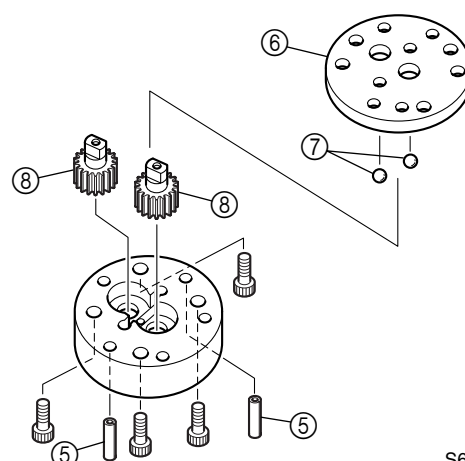
2. Remove the main valves ③ and retainer ④.



S60V7330

3. Remove the pins ⑤.

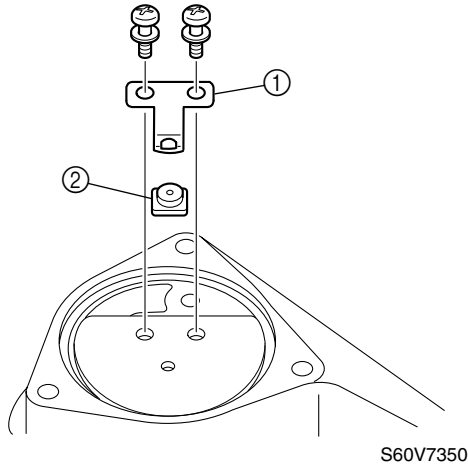
4. Remove gear housing 1 ⑥, then the balls ⑦ and drive gears ⑧.



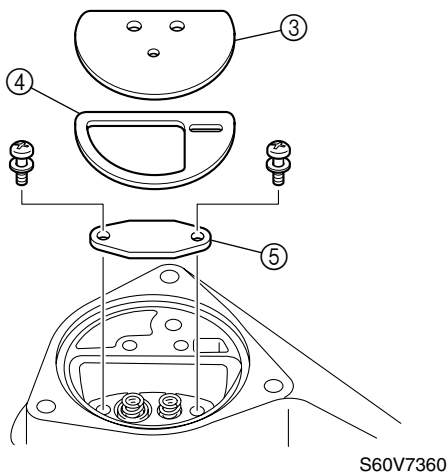
S60V7340

Disassembling the relief valve

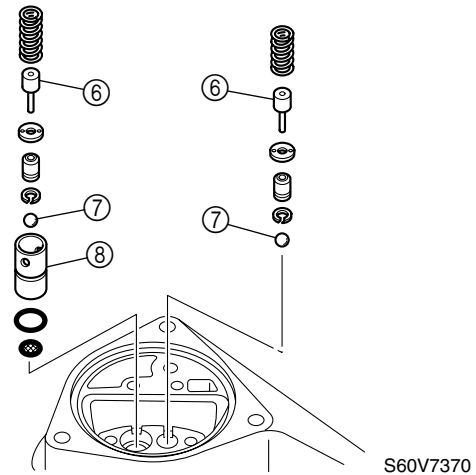
1. Remove the trim down spring ① and valve seal ②.



2. Remove the trim down plate ③ and seal ④, then the relief valve plate ⑤.

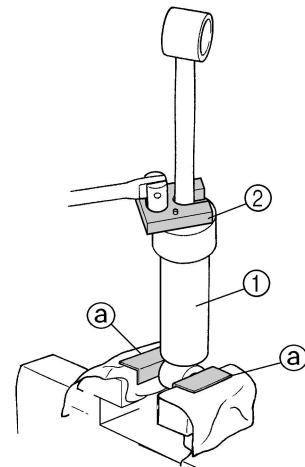


3. Remove the pins ⑥, balls ⑦, and relief valve ⑧.



Disassembling the tilt cylinder and trim cylinders

1. Hold the tilt cylinder ① in a vise using aluminum plates ② on both sides.
2. Loosen the tilt cylinder end screw ②, and then remove the tilt piston assembly.



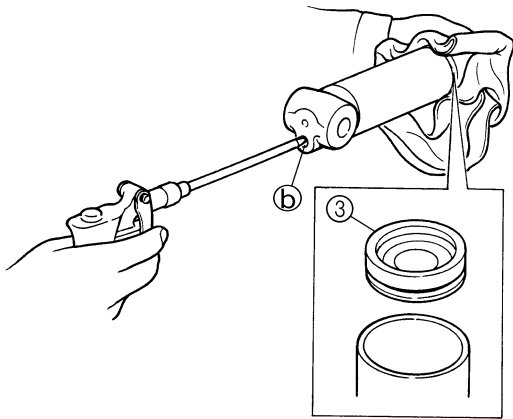
⚠ WARNING

Make sure that the rams are fully extended before removing the end screw.



Cylinder-end screw wrench:
90890-06544

3. Drain the power trim and tilt fluid.
4. Blow compressed air through the hole ⑥ to remove the free piston ③.



S69J7305

⚠ WARNING

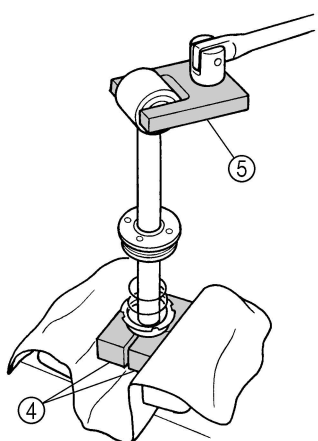
Never look into the tilt cylinder opening when removing the free piston. The free piston and power trim and tilt fluid can be forcefully expelled out.

NOTE:

Be sure to cover the opposite end of the tilt cylinder with a rag.

5. Hold the tilt piston in a vise using the special service tool (4) on both sides.

6. Remove the tilt ram.



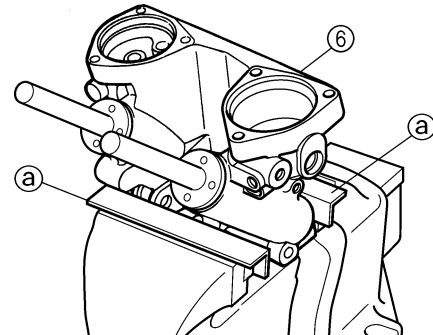
S69J7310



PTT piston vice attachment (4):
90890-06572

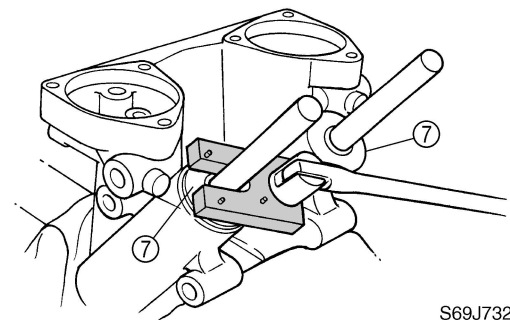
Tilt rod wrench (5): 90890-06569

7. Hold the cylinder block (6) in a vise using aluminum plates (a) on both sides.



S60V7380

8. Loosen the trim cylinder end screws (7), and then remove them.



S69J7320

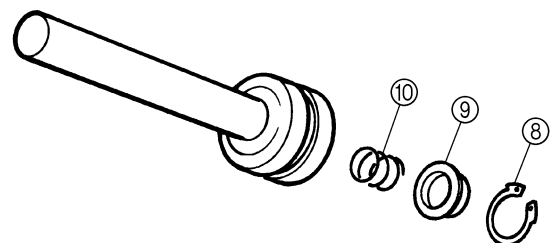


Cylinder-end screw wrench:
90890-06544

9. Remove the trim piston assemblies.

10. Drain the power trim and tilt fluid.

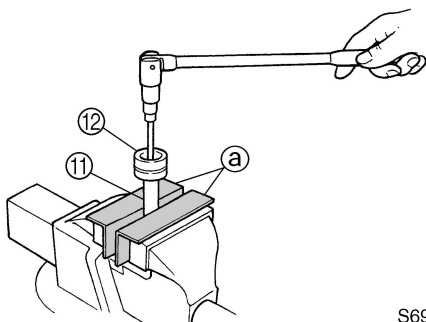
11. Remove the circlip (8), adapter (9), and spring (10) from the trim piston assemblies.



S69J7325

12. Hold the trim ram ⑪ in a vise using aluminum plates ⑨ on both sides.

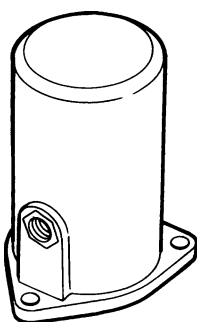
13. Remove the trim piston ⑫.



S69J7330

Checking the reservoir

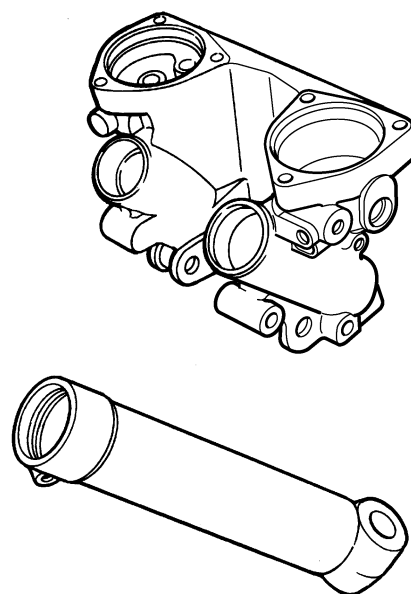
1. Check the reservoir for cracks or corrosion. Replace if necessary.



S69J7335

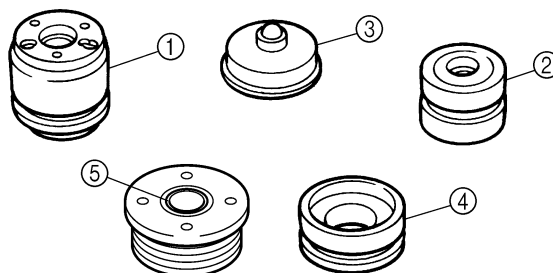
Checking the tilt cylinder and trim cylinders

1. Check the power trim and tilt unit for cracks or corrosion. Replace if necessary.
2. Check the inner walls of the cylinder block and tilt cylinder for scratches. Replace if necessary.



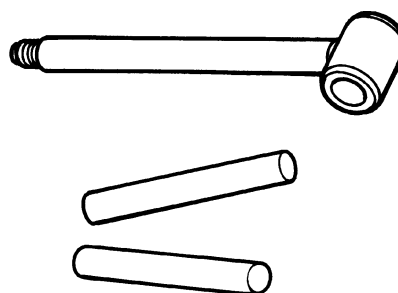
S60V7390

3. Check the outer surface of the tilt piston ①, trim piston ②, adapter ③, free piston ④, and oil seal of end screw ⑤ for scratches. Replace if necessary.



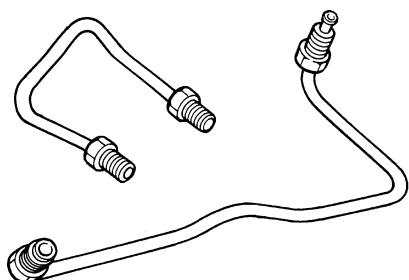
S69J7345

4. Check the trim and tilt rams for bends or excessive corrosion. Polish with #400–600 grit sandpaper if there is light rust or replace if necessary.



S69J7350

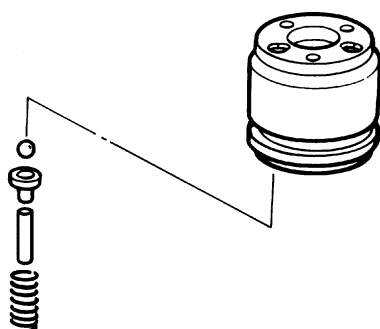
5. Check the pipes for cracks or corrosion. Replace if necessary.



S69J7355

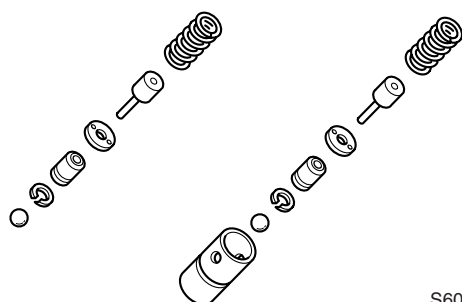
Checking the valves

1. Check the operation of the tilt piston absorber valves and the valves for dirt or residue. Clean if necessary.



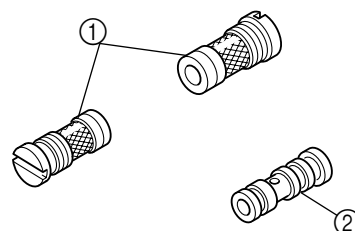
S60V7400

2. Check the up-relief valve and down-relief valve for dirt or residue. Clean if necessary.



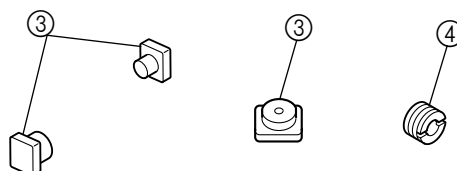
S60V7410

3. Check the main valve ① and retainer ② for dirt or residue. Replace if necessary.



S60V7420

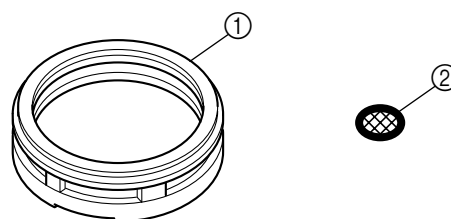
4. Check the valve seal ③ and valve seat ④ for dirt or residue. Replace if necessary.



S60V7430

Checking the filters

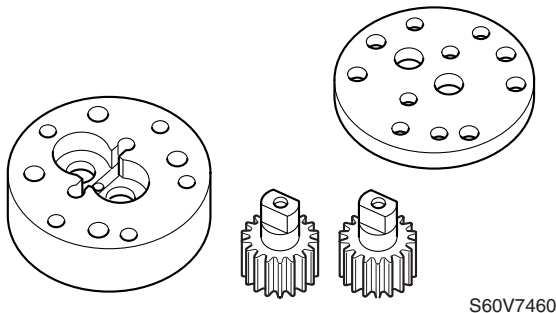
1. Check gear pump filter ① and relief valve filter ② for dirt or residue. Clean if necessary.



S60V7440

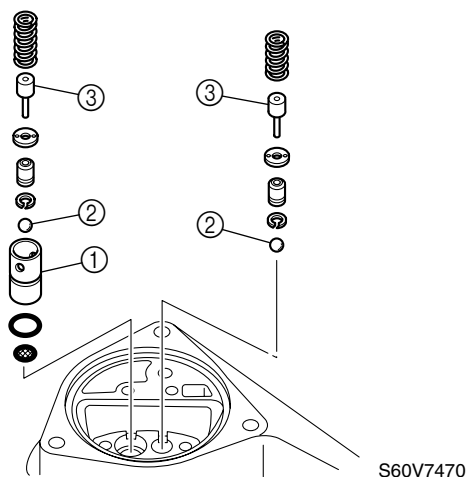
Checking the gear pump

1. Check the drive gear for damage or excessive wear. Replace if necessary.
2. Check the gear pump housing for scratches. Replace if necessary.

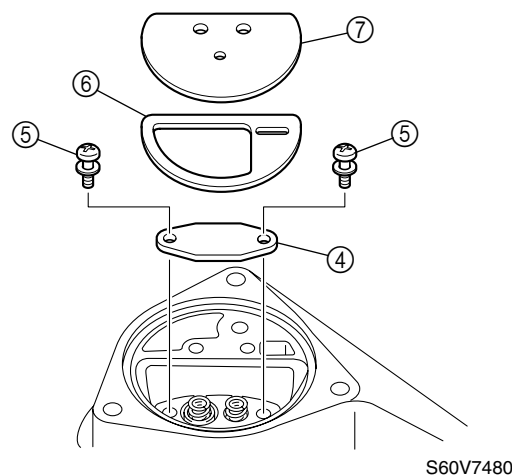


Assembling the relief valve

1. Install the relief valve ①, balls ②, and pins ③.



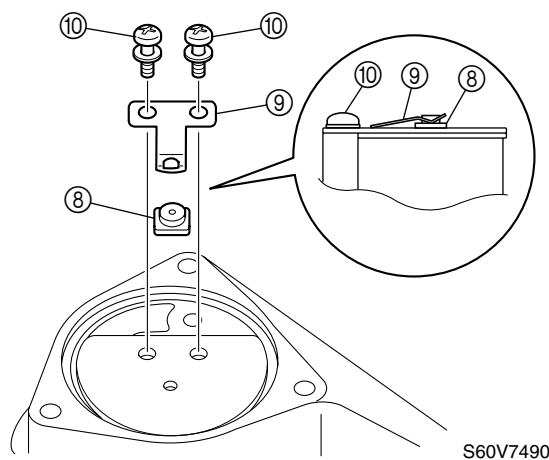
2. Install the relief valve plate ④ by installing the screws ⑤, then tighten them to the specified torque.
3. Install the seal ⑥ and tilt down plate ⑦.





Relief valve plate screw:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

4. Install the valve seal ⑧ and trim down spring ⑨, and then tighten the screws ⑩ to the specified torque.

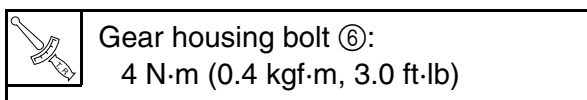
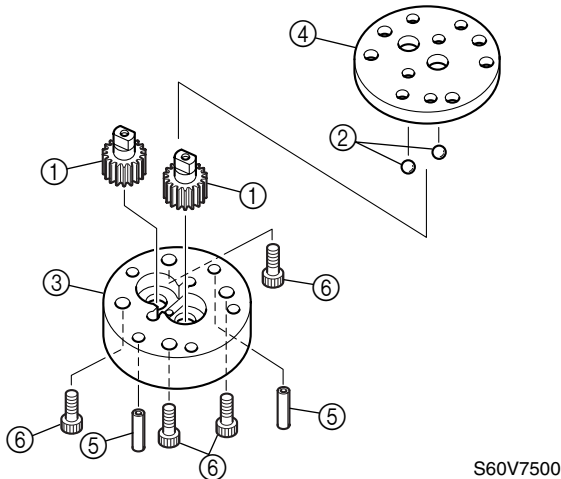




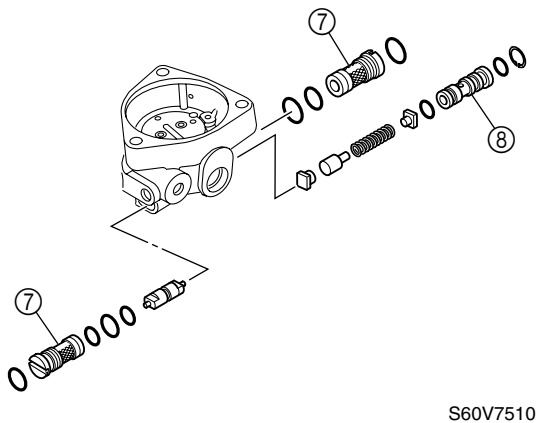
Trim down spring screw:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

Assembling the gear pump

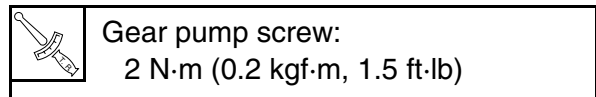
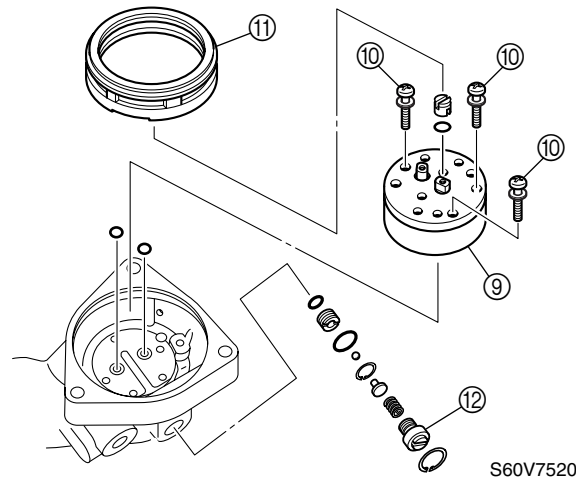
1. Install the drive gears ① and balls ② into gear housing 2 ③.
2. Install gear housing 1 ④, then the pins ⑤.
3. Tighten the bolts ⑥ to the specified torque.



4. Install the main valves ⑦ and retainer ⑧.

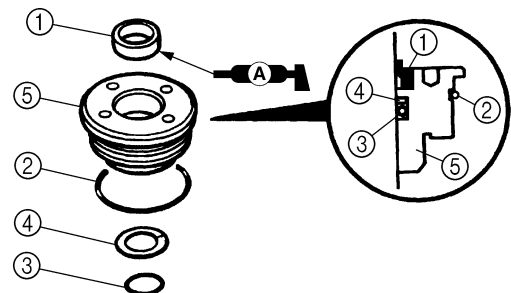


5. Install the gear pump ⑨ by installing the screws ⑩, then tightening them to the specified torque.
6. Install the gear pump filter ⑪.
7. Install the manual valve ⑫.

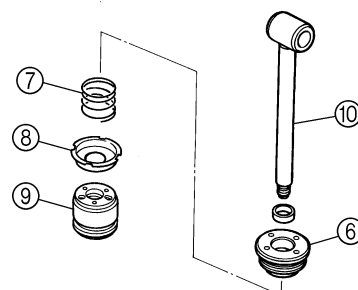


Assembling the tilt ram

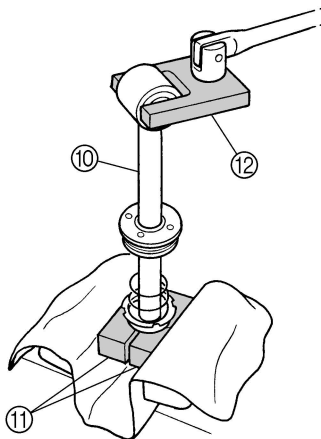
1. Install a new dust seal ①, O-rings ② and ③, and the backup ring ④ into the tilt cylinder end screw ⑤.



2. Install the tilt cylinder end screw assembly ⑥, spring ⑦, adapter ⑧, and tilt piston ⑨ onto the tilt ram ⑩.



3. Hold the tilt piston in a vise using the special service tool ⑪ on both sides.
4. Tighten the tilt ram ⑩ to the specified torque.



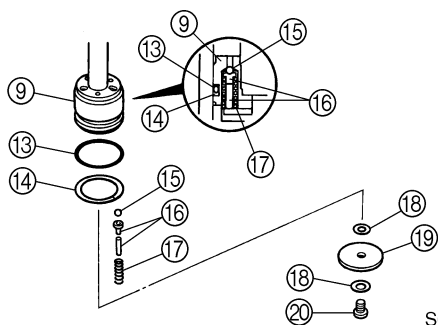
S69J7420

PTT piston vice attachment ⑪:
90890-06572

Tilt rod wrench ⑫: 90890-06569

Tilt ram ⑩:
55 N·m (5.5 kgf·m, 40.6 ft·lb)

5. Install a new O-ring ⑬ and the backup ring ⑭ into the tilt piston ⑨.
6. Install the balls ⑮, pins ⑯, and springs ⑰ as shown.
7. Install the washers ⑱, plate ⑲, and bolt ⑳ into the tilt piston ⑨, and then tighten the bolt to the specified torque.

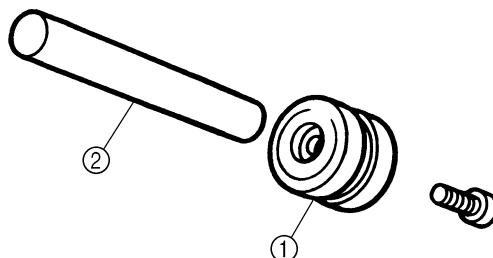


S60V7530

Tilt piston bolt ⑳:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

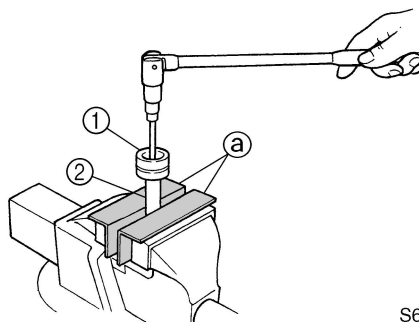
Assembling the trim rams

1. Install the trim piston ① onto the trim ram ②.



S60V7540

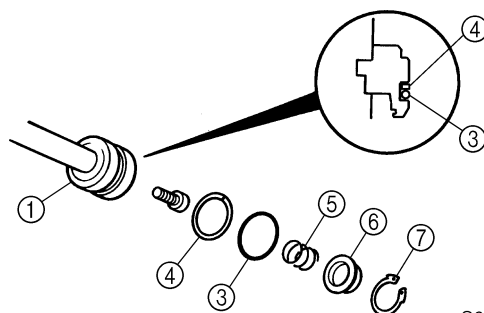
2. Hold the trim ram ② in a vise using aluminum plates ③ on both sides.
3. Tighten the trim piston bolt to the specified torque.



S69J7435

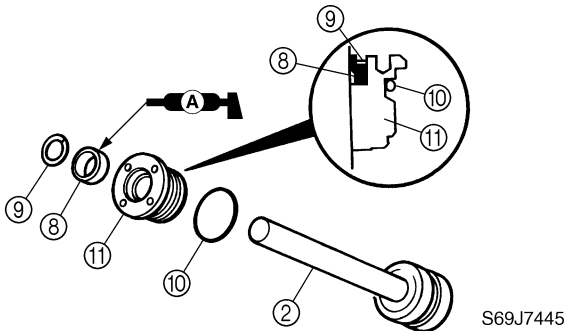
Trim piston bolt:
38 N·m (3.8 kgf·m, 28.0 ft·lb)

4. Install a new O-ring ③, the backup ring ④, spring ⑤, adapter ⑥, and circlip ⑦ into the trim piston ①.



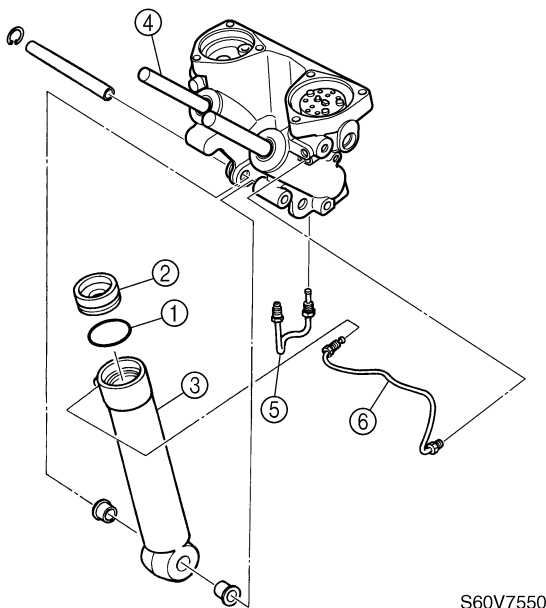
S60V7545

5. Install a new oil seal ⑧, the circlip ⑨, and a new O-ring ⑩ into the trim cylinder end screw ⑪.
6. Install the trim cylinder end screw ⑪ onto the trim ram ②.



Installing the tilt cylinder

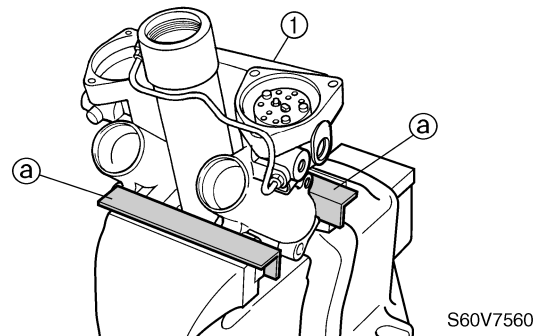
1. Install a new O-ring ① onto the free piston ②.
2. Push the free piston ② into the tilt cylinder ③ until it bottoms out.
3. Install the tilt cylinder ③ onto the cylinder block ④.
4. Install pipes ⑤ and ⑥, and then tighten the pipe joints to the specified torque.



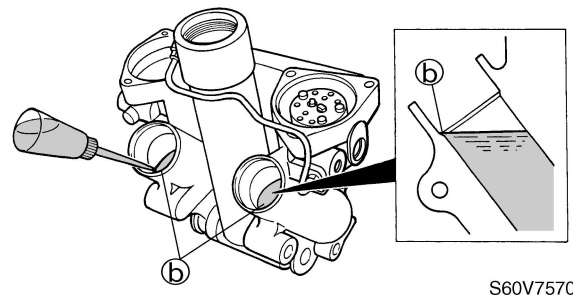
 Pipe joint ⑤ and ⑥:
15 N·m (1.5 kgf·m, 11.1 ft·lb)

Installing the trim rams

1. Hold the cylinder block ① in a vise using aluminum plates ② on both sides.



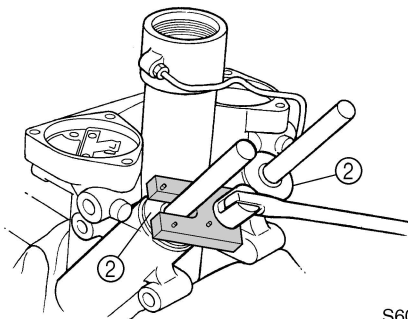
2. Fill the trim cylinders with the recommended fluid to the correct level ③ as shown.



 Recommended power trim and tilt fluid:
ATF Dexron II



3. Install the trim piston assembly into the trim cylinder, and then tighten the trim cylinder end screw ② to the specified torque.



S60V7580

⚠ WARNING

Do not push the trim rams down while installing them into the trim cylinders. Otherwise, the power trim and tilt fluid may spurt out from the unit.



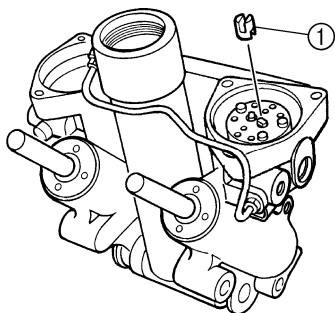
Cylinder-end screw wrench:
90890-06544



Trim cylinder end screw ②:
160 N·m (16.0 kgf·m, 118 ft·lb)

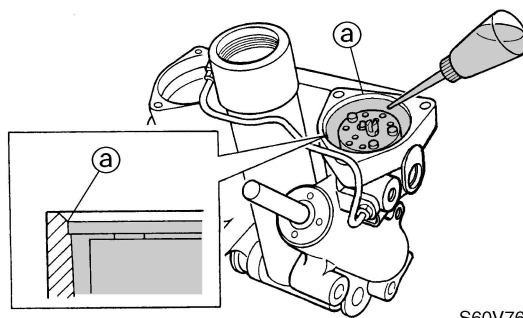
Installing the power trim and tilt motor

1. Install the joint ① into the pump housing.



S60V7590

2. Fill the pump housing with the recommended fluid to the correct level ③ as shown.



S60V7600



Recommended power trim and tilt fluid:

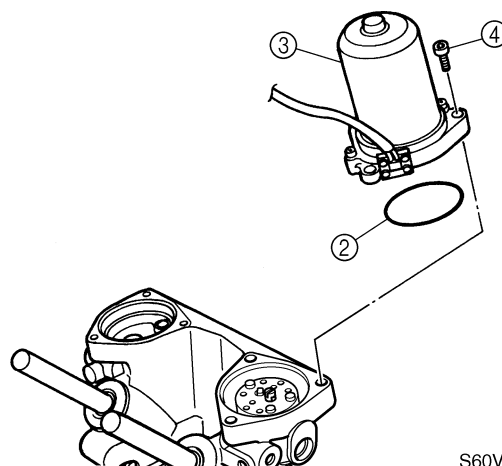
ATF Dexron II

3. Remove all of the air bubbles with a syringe or suitable tool.

NOTE:

Turn the joint with a screwdriver, and then remove any air between the pump gear teeth.

4. Install a new O-ring ② and the power trim and tilt motor ③, and then tighten the bolts ④ to the specified torque.



S60V7610

NOTE:

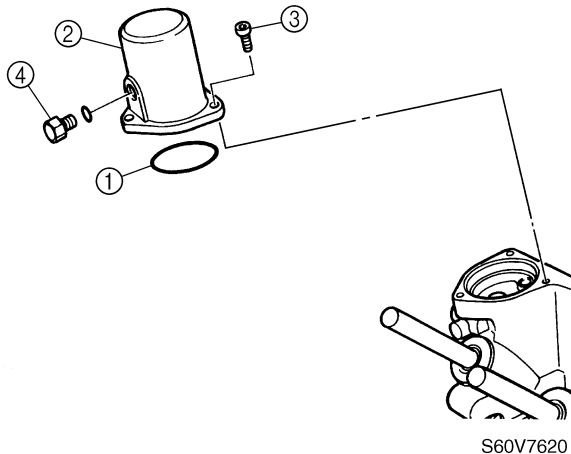
Align the armature shaft with the recess in the joint.



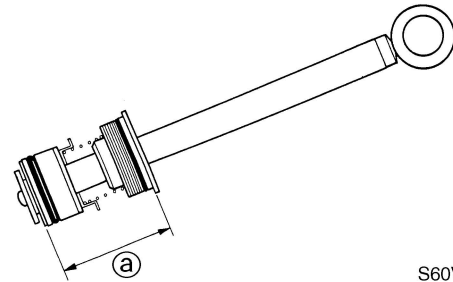
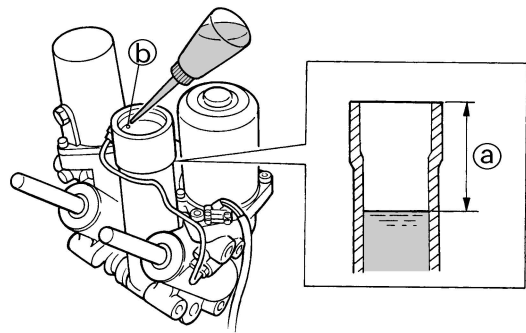
PTT motor bolt ④:
19 N·m (1.9 kgf·m, 14.0 ft·lb)

Installing the reservoir

1. Install a new O-ring ① and the reservoir ②, and then tighten the bolts ③ to the specified torque.
2. Install the reservoir cap ④, and then tighten it to the specified torque.



Reservoir bolt ③:
19 N·m (1.9 kgf·m, 14.0 ft·lb)
Reservoir cap ④:
7 N·m (0.7 kgf·m, 5.2 ft·lb)



S60V7710

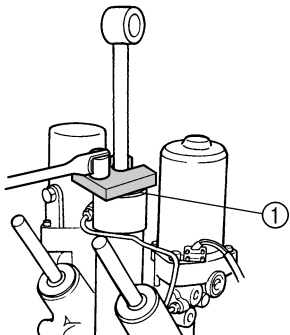


Recommended power trim and tilt
fluid:
ATF Dexron II

Installing the tilt ram

1. Fill the tilt cylinder with the recommended fluid to the correct level (a) as shown.
2. Add a small amount of the recommended fluid through the cylinder block hole (b) as shown.

- Install the tilt piston assembly into the tilt cylinder, and then tighten the tilt cylinder end screw ① to the specified torque.



S69J7495

WARNING

To prevent the power trim and tilt fluid from spurting out due to internal pressure, the tilt ram should be kept at full length.

NOTE:

Place the tilt cylinder end screw at the bottom of the tilt ram and install the tilt piston assembly into the tilt cylinder.



Cylinder-end screw wrench:
90890-06544

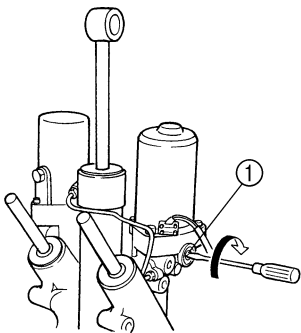


Tilt cylinder end screw:
90 N·m (9.0 kgf·m, 66.4 ft·lb)

Bleeding the power trim and tilt unit

Not installed

- Tighten the manual valve ① by turning it clockwise.



S69J7500

- Place the power trim and tilt unit in an upright position.

- Check the fluid level in the reservoir.

NOTE:

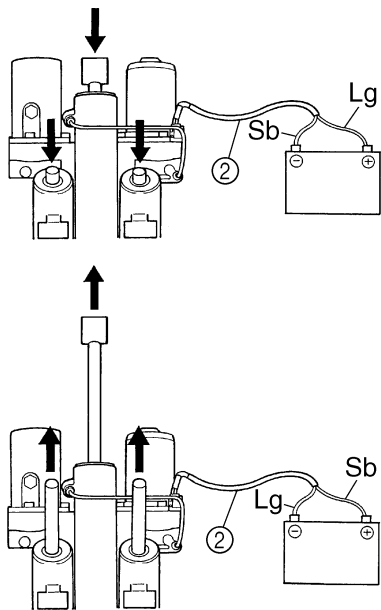
The fluid level should be at the brim of the filler hole.

- If necessary, add sufficient fluid of the recommended type to the correct level.



Recommended power trim and tilt fluid:
ATF Dexron II

- Install the reservoir cap.
- Connect the PTT motor leads ② to the battery terminals.



S69J7505

Ram	PTT motor lead	Battery terminal
Up	Sky blue (Sb)	⊕
	Light green (Lg)	⊖
Down	Light green (Lg)	⊕
	Sky blue (Sb)	⊖

Power trim and tilt unit / Bleeding the power trim and tilt unit

- Reverse the PTT motor leads between the battery terminals to fully extend the tilt ram and trim rams, and then reverse them again to fully retract the rams.

NOTE:

- Repeat this procedure so that the rams go up and down four to five times (be sure to wait a few seconds before switching the leads).
- The sound of the power trim and tilt motor will change when the rams are fully extended.
- If the rams do not move up and down easily, push and pull on the rams to assist operation.

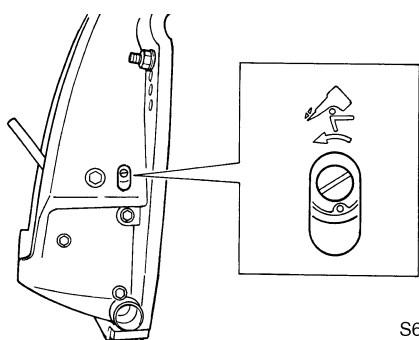
- Check the fluid level again when the rams are fully extended. Add sufficient fluid, if necessary, and then repeat step 7.

NOTE:

Repeat this procedure until the fluid remains at the correct level.

Built-in

- Loosen the manual valve by turning it counterclockwise until it cannot be turned further.



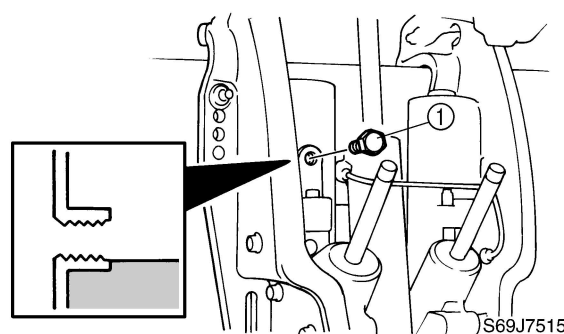
- Fully tilt the outboard motor up, and then release it and let it lower by its own weight four to five times.
- Tighten the manual valve by turning it clockwise.
- Let the fluid settle for 5 minutes.

- Push and hold the power trim and tilt switch in the up position until the outboard motor is fully tilted up.
- Support the outboard motor with the tilt stop lever, and then let the fluid settle for 5 minutes.

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.

- Remove the reservoir cap ①, and then check the fluid level in the reservoir.
- If necessary, add sufficient fluid of the recommended type to the correct level.



NOTE:

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



Recommended power trim and tilt fluid:
ATF Dexron II

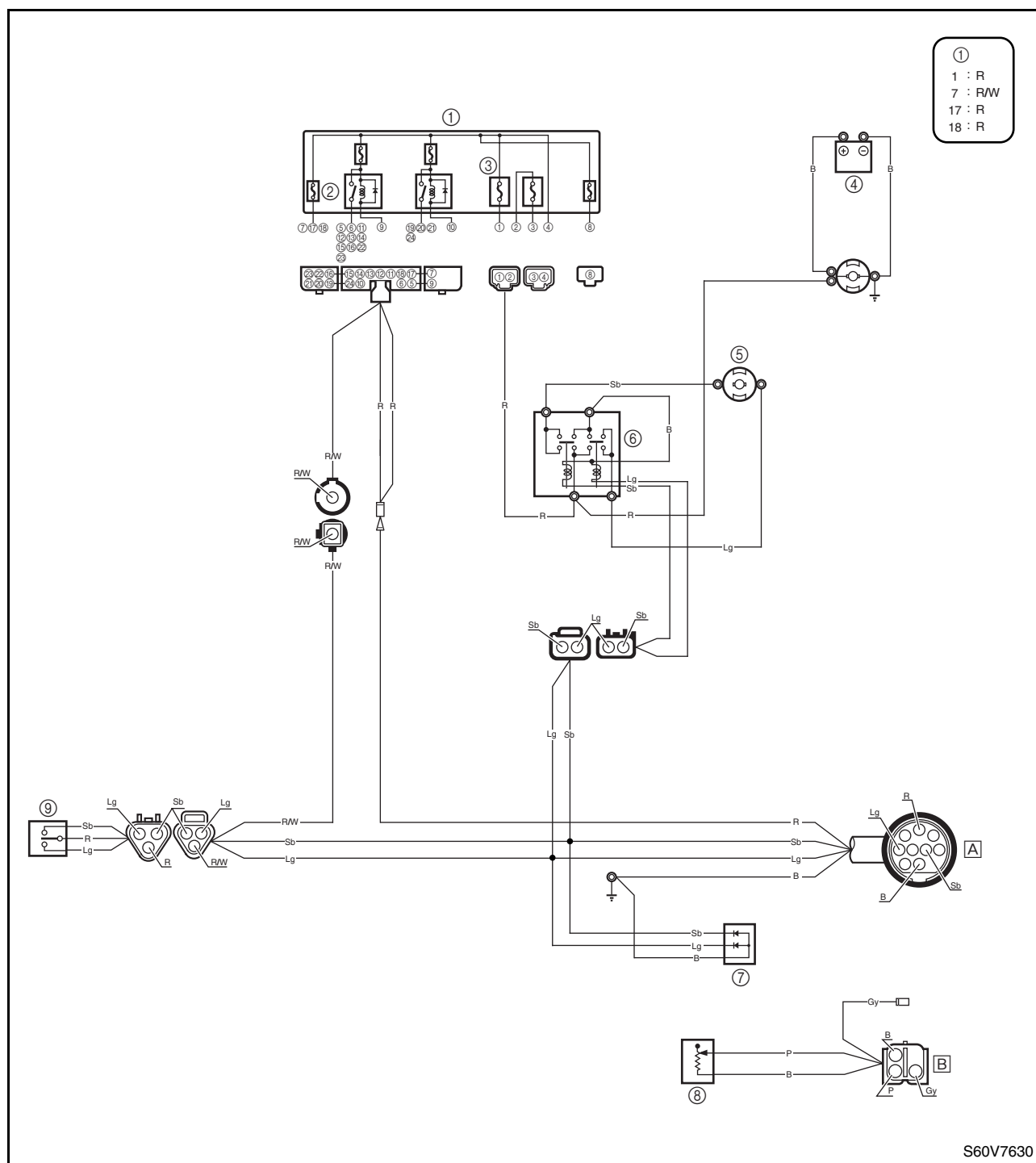
- Install the reservoir cap.

NOTE:

Repeat this procedure until the fluid remains at the correct level.



Power trim and tilt electrical system



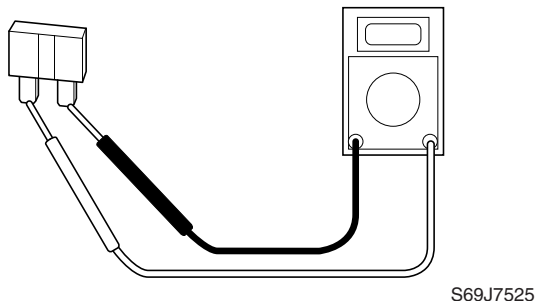
- ① Fuse holder
- ② Fuse (20 A)
- ③ Fuse (100 A)
- ④ Starting battery
- ⑤ Power trim and tilt motor
- ⑥ Power trim and tilt relay
- ⑦ Diode
- ⑧ Trim sensor
- ⑨ Power trim and tilt switch

- [A] To remote control box/switch panel
- [B] To trim meter

- B : Black
- Gy : Gray
- Lg : Light green
- P : Pink
- R : Red
- Sb : Sky blue
- R/W : Red/white

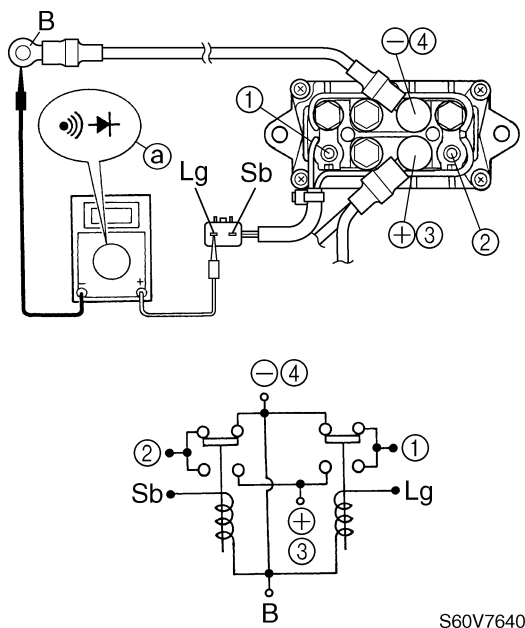
Checking the fuse

1. Check the fuse for continuity. Replace if there is no continuity.



Checking the power trim and tilt relay

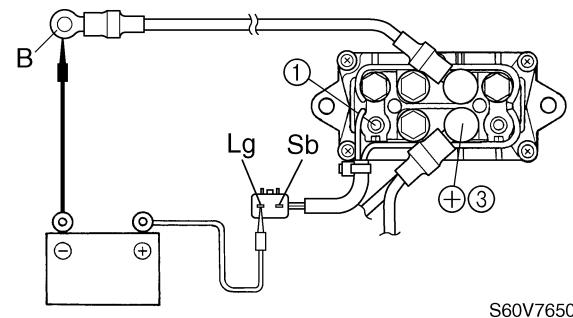
1. Check the power trim and tilt relay for continuity. Replace if out of specification.



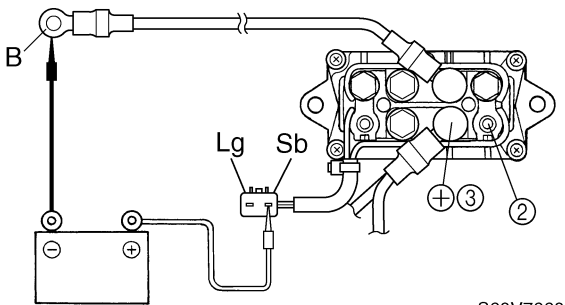
NOTE: Be sure to set the measurement range ① shown in the illustration when checking for continuity.

Power trim and tilt relay continuity	
Sky blue (Sb) – Black (B) Light green (Lg) – Black (B)	Continuity
Terminal ① – Terminal ④ Terminal ② – Terminal ④	Continuity
Terminal ① – Terminal ③ Terminal ② – Terminal ③	No continuity

2. Connect the digital circuit tester between power trim and tilt relay terminals ① and ③.
3. Connect the light green (Lg) lead to the positive battery terminal and the black (B) lead to the negative battery terminal as shown.
4. Check for continuity between terminals ① and ③. Replace if there is no continuity.



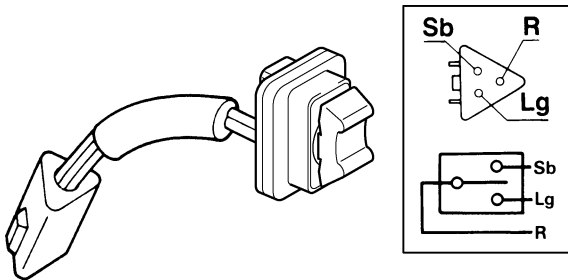
- Connect the digital circuit tester between power trim and tilt relay terminals ② and ③.
- Connect the sky blue (Sb) lead to the positive battery terminal and the black (B) lead to the negative battery terminal as shown.
- Check for continuity between terminals ② and ③. Replace if there is no continuity.



S60V7660

Checking the power trim and tilt switch

- Check the power trim and tilt switch for continuity. Replace if out of specification.

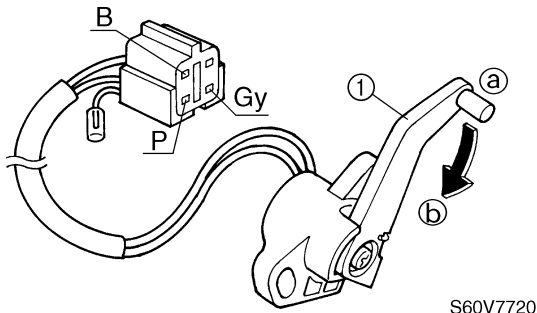


S60V7730

	Lead color		
Switch position	Sky blue (Sb)	Red (R)	Lightgreen (Lg)
Up	○	○	
Free			
Down		○	○

Checking the trim sensor

- Measure the trim sensor resistance. Replace if out of specification.



S60V7720

NOTE: Turn the lever ① and measure the resistance as it gradually changes.



Trim sensor resistance:

Pink (P) – Black (B)

247.6–387.6 Ω at 20 °C (68 °F) ①

9–11 Ω at 20 °C (68 °F) ②

— MEMO —

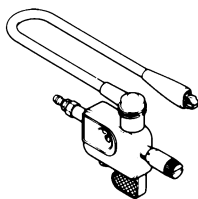


Electrical systems

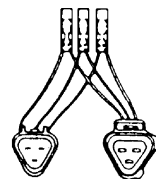
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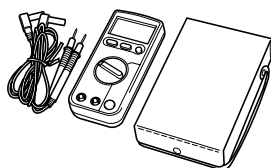
Special service tools



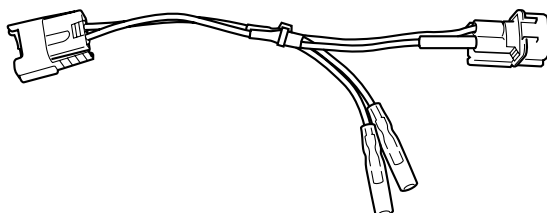
Ignition tester
90890-06754



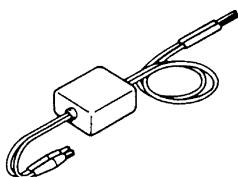
Test harness (3 pins)
90890-06757



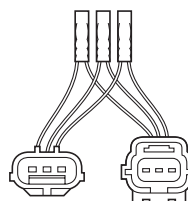
Digital circuit tester
90890-03174



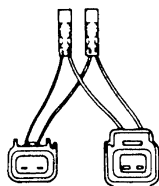
Test harness (2 pins)
90890-06861



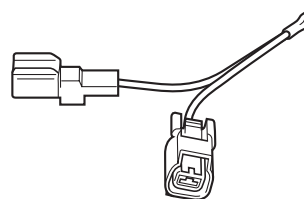
Peak voltage adaptor
90890-03172



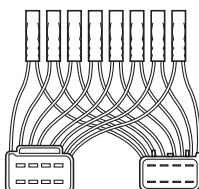
Test harness (3 pins)
90890-06769



Test harness (2 pins)
90890-06767



Test harness (1 pin)
90890-06788



Test harness (8 pins)
90890-06779

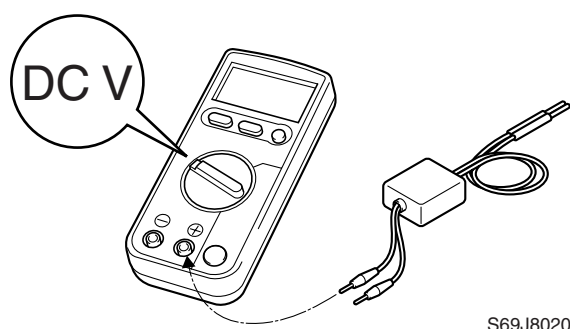
Checking the electrical components

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 12 V.

The condition of the ignition system can be determined by measuring the peak voltage. Cranking speed is effected 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.



⚠ WARNING _____

When checking the peak voltage, do not touch any of the connections of the digital 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 Ω 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.

NOTE: _____

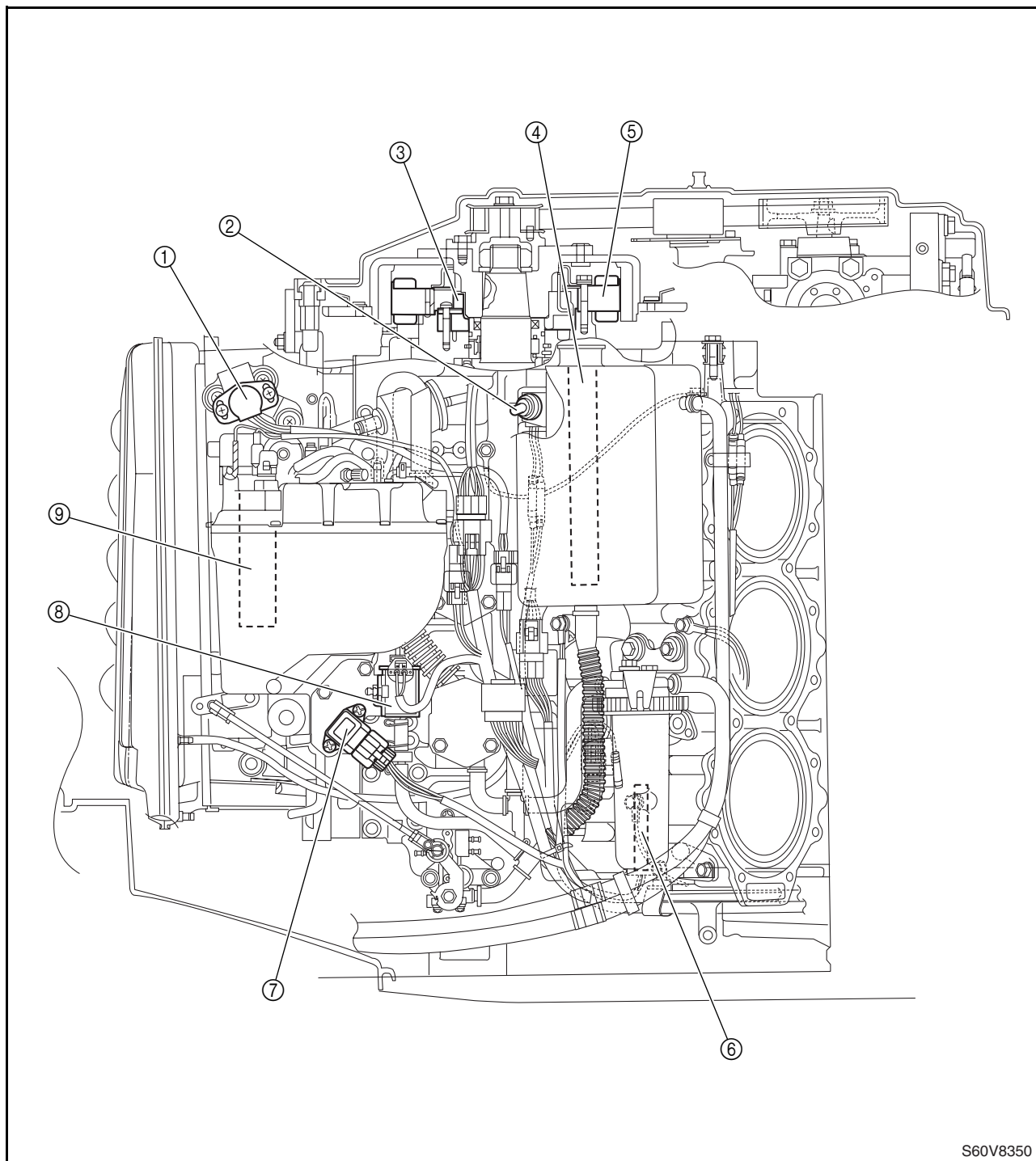
Obtain the internal resistance of the digital circuit tester by connecting both of its probes and checking the display.

Correct value =
displayed measurement – internal
resistance



Electrical components

Port view

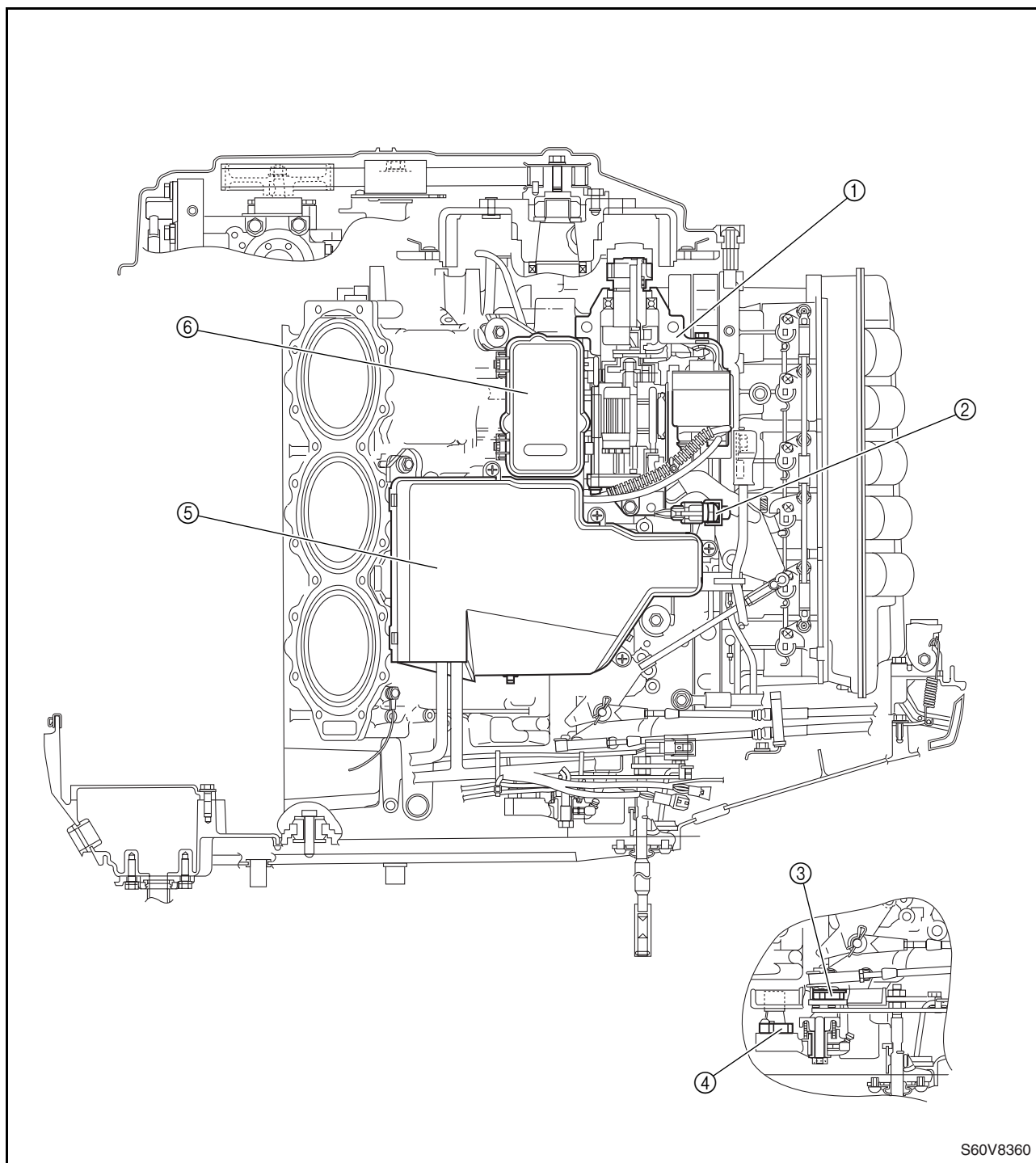


S60V8350

- ① Throttle position sensor
- ② Emergency switch
- ③ Pulser coil
- ④ Oil level sensor
- ⑤ Stator coil
- ⑥ Water detection switch
- ⑦ Atmospheric pressure sensor
- ⑧ Electric oil pump

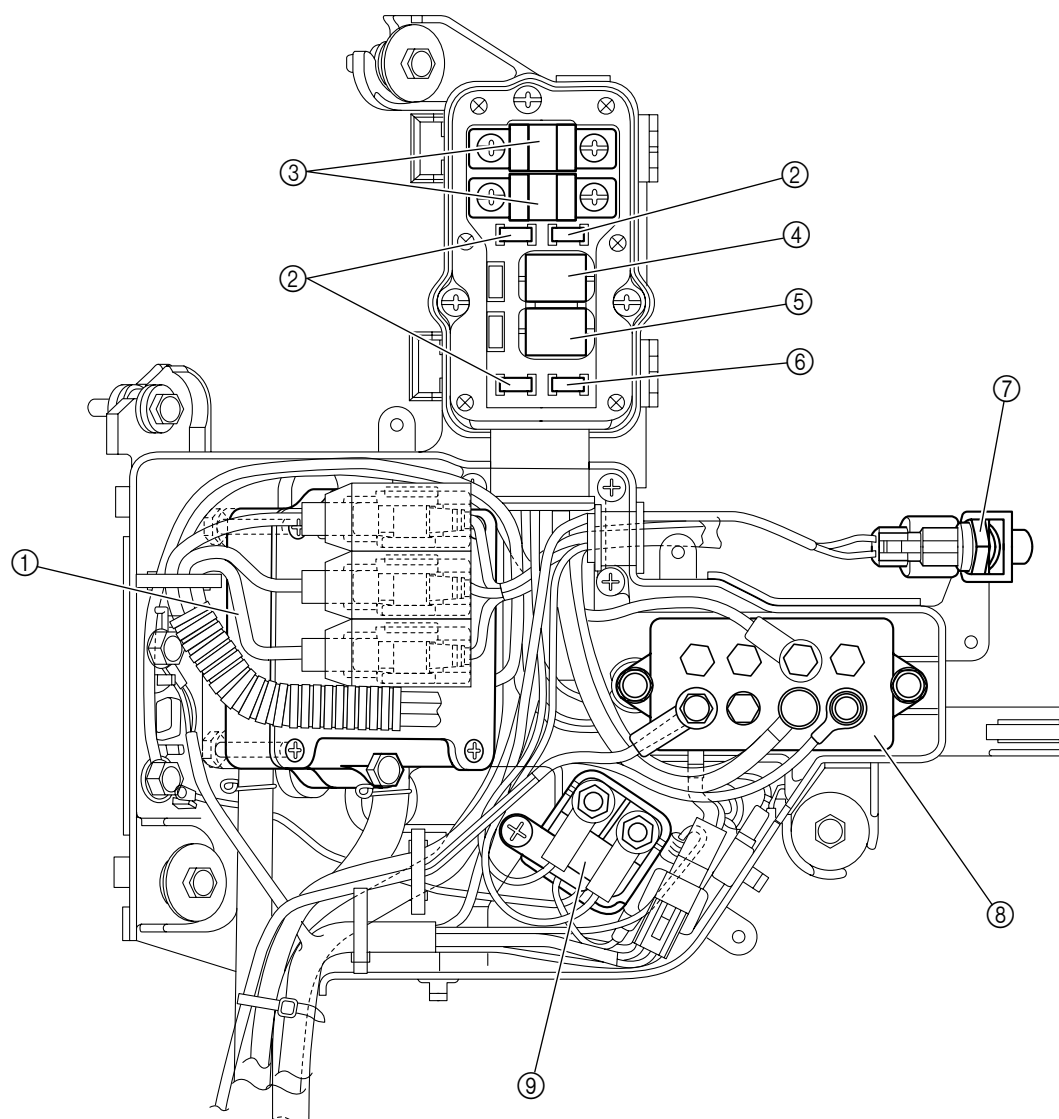
- ⑨ Electric fuel pump

Starboard view



S60V8360

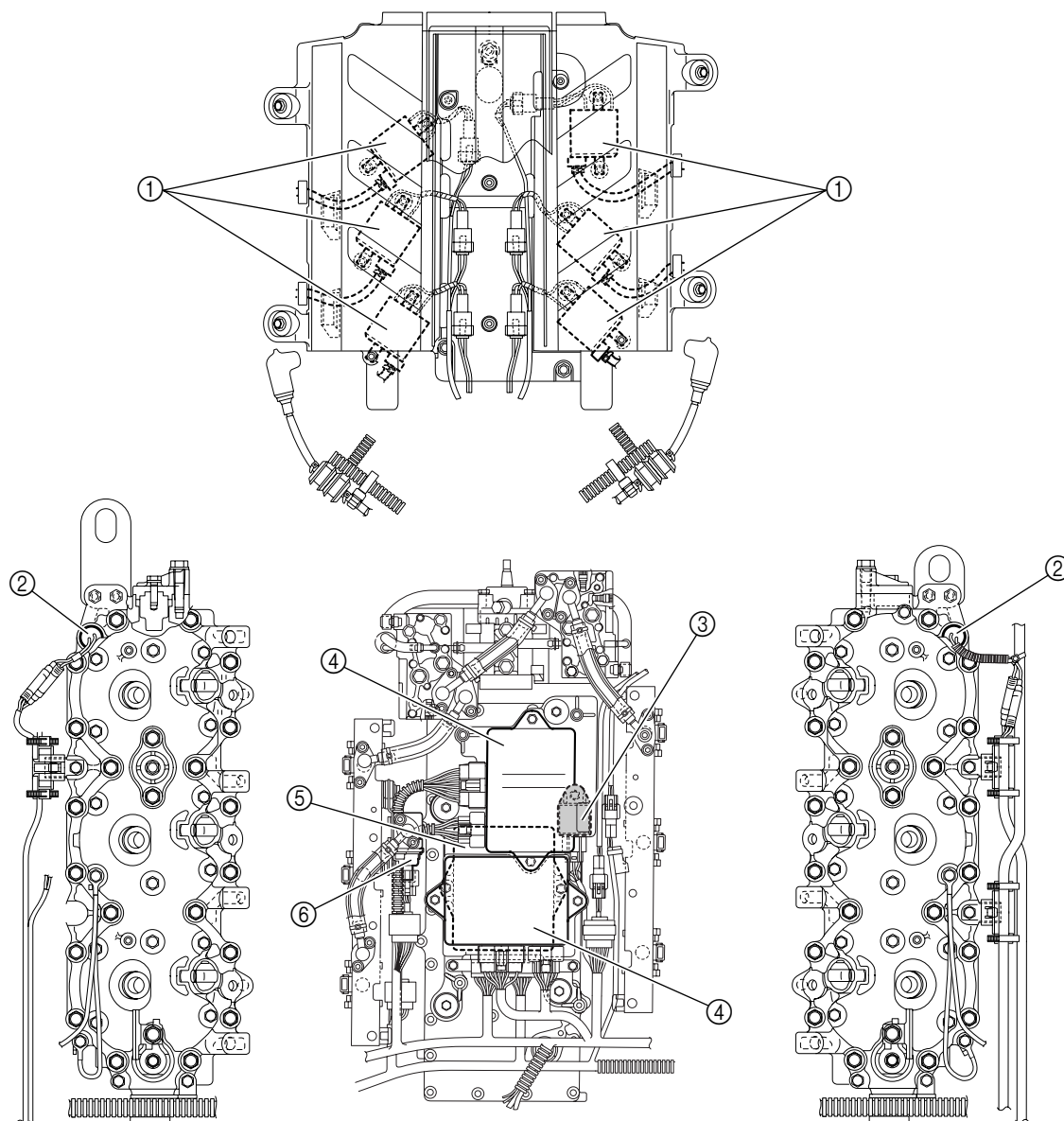
- ① Starter motor
- ② Intake air temperature sensor
- ③ Shift position switch
- ④ Shift cut switch
- ⑤ Junction box
- ⑥ Fuse holder


Junction box assembly


S60V8370

- ① Rectifier Regulator
- ② Fuse (20 A)
- ③ Fuse (100 A)
- ④ Main relay
- ⑤ Driver relay
- ⑥ Fuse (30 A)
- ⑦ Intake air temperature sensor
- ⑧ Power trim and tilt relay
- ⑨ Starter relay

Aft view

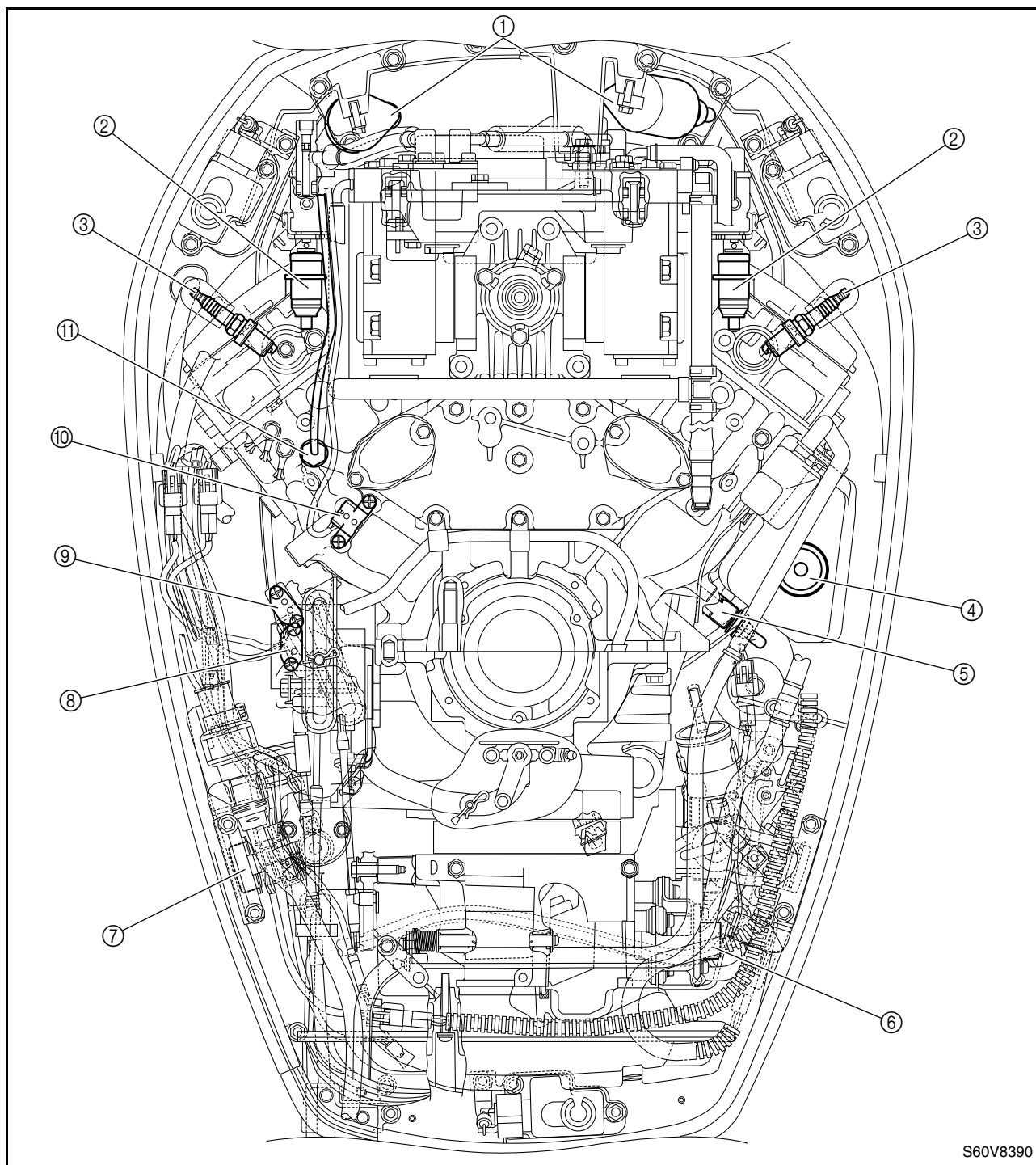


S60V8380

- ① Ignition coil
- ② Thermoswitch
- ③ Fuel pump relay
- ④ Injector drivers
- ⑤ ECM
- ⑥ Fuel pressure sensor



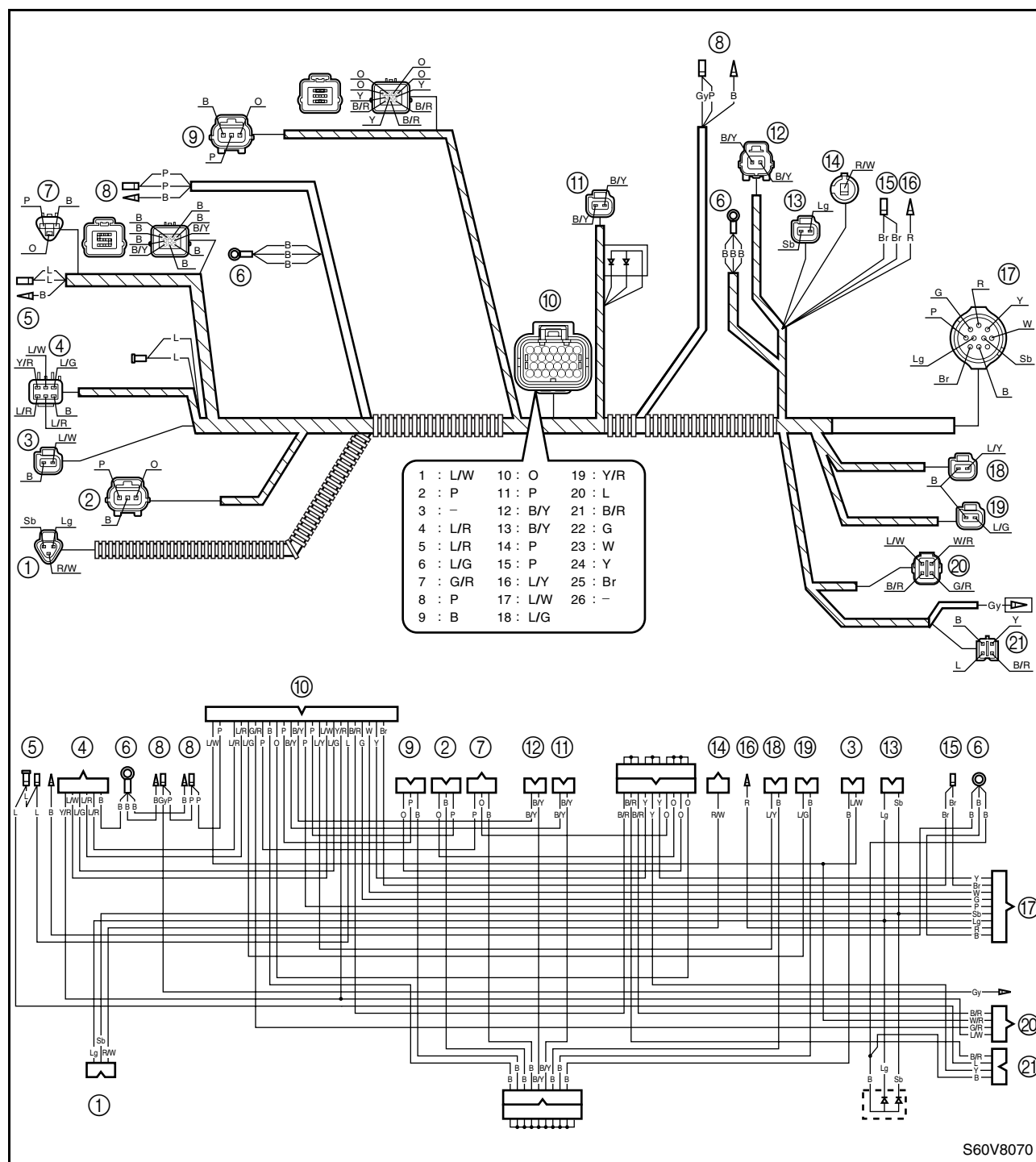
Top view



S60V8390

- ① Ignition coil
- ② Fuel injector
- ③ Spark plug
- ④ Oil level sensor
- ⑤ Emergency switch
- ⑥ Throttle position sensor
- ⑦ Power trim and tilt switch
- ⑧ Shift position switch
- ⑨ Shift cut switch
- ⑩ Crank position sensor
- ⑪ Engine temperature sensor

Wiring harness

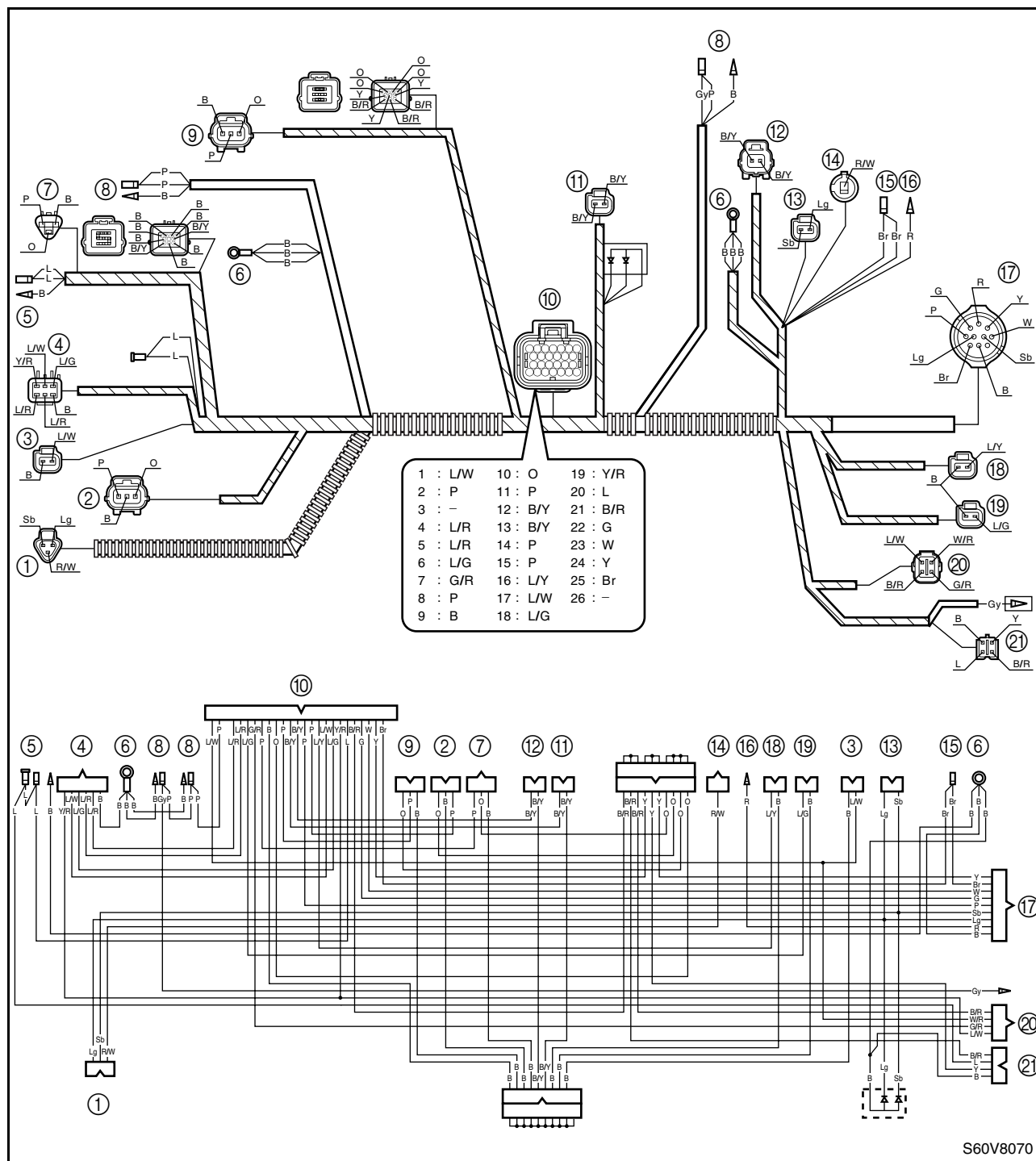


Connect to:

- ① Power trim and tilt switch
- ② Atmospheric pressure sensor
- ③ Water detection switch
- ④ Oil level sensor
- ⑤ Emergency switch
- ⑥ Ground
- ⑦ Throttle position sensor
- ⑧ Thermoswitch

- ⑨ Fuel pressure sensor
- ⑩ ECM
- ⑪ Engine temperature sensor
- ⑫ Intake air temperature sensor
- ⑬ Power trim and tilt relay
- ⑭ Fuse holder
- ⑮ Starter relay
- ⑯ Fuse holder
- ⑰ Remote control
- ⑱ Shift cut switch

- ⑲ Shift position switch
- ⑳ Oil level meter
- ㉑ Remote oil tank

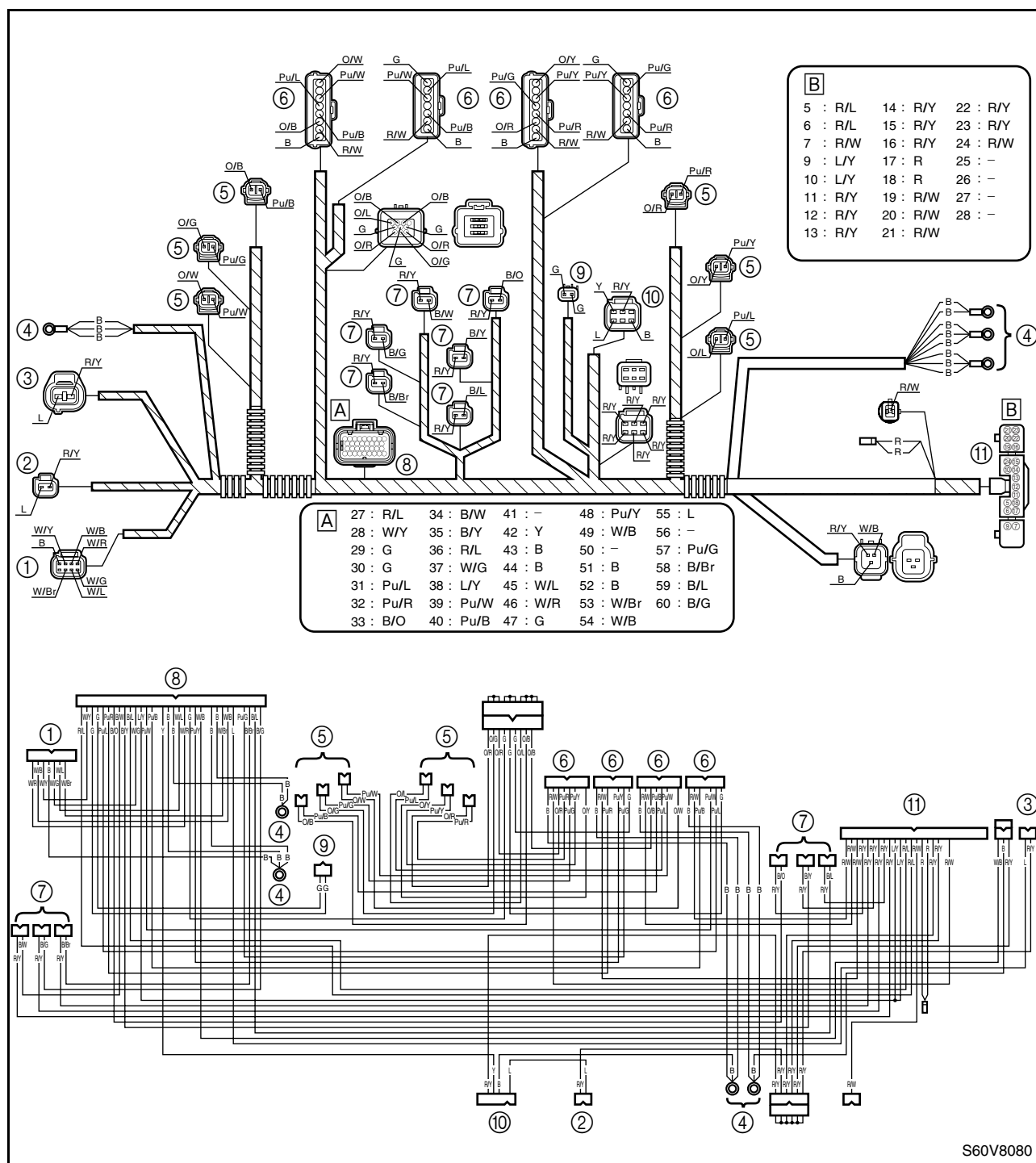


S60V8070

B : Black
 Br : Brown
 G : Green
 Gy : Gray
 L : Blue
 Lg : Light green
 O : Orange
 P : Pink
 R : Red
 Sb : Sky blue

W : White
 Y : Yellow
 B/R : Black/red
 B/Y : Black/yellow
 G/R : Green/red
 L/G : Blue/green
 L/R : Blue/red
 L/W : Blue/white
 L/Y : Blue/yellow
 R/W : Red/white

W/R : White/red
 Y/R : Yellow/red

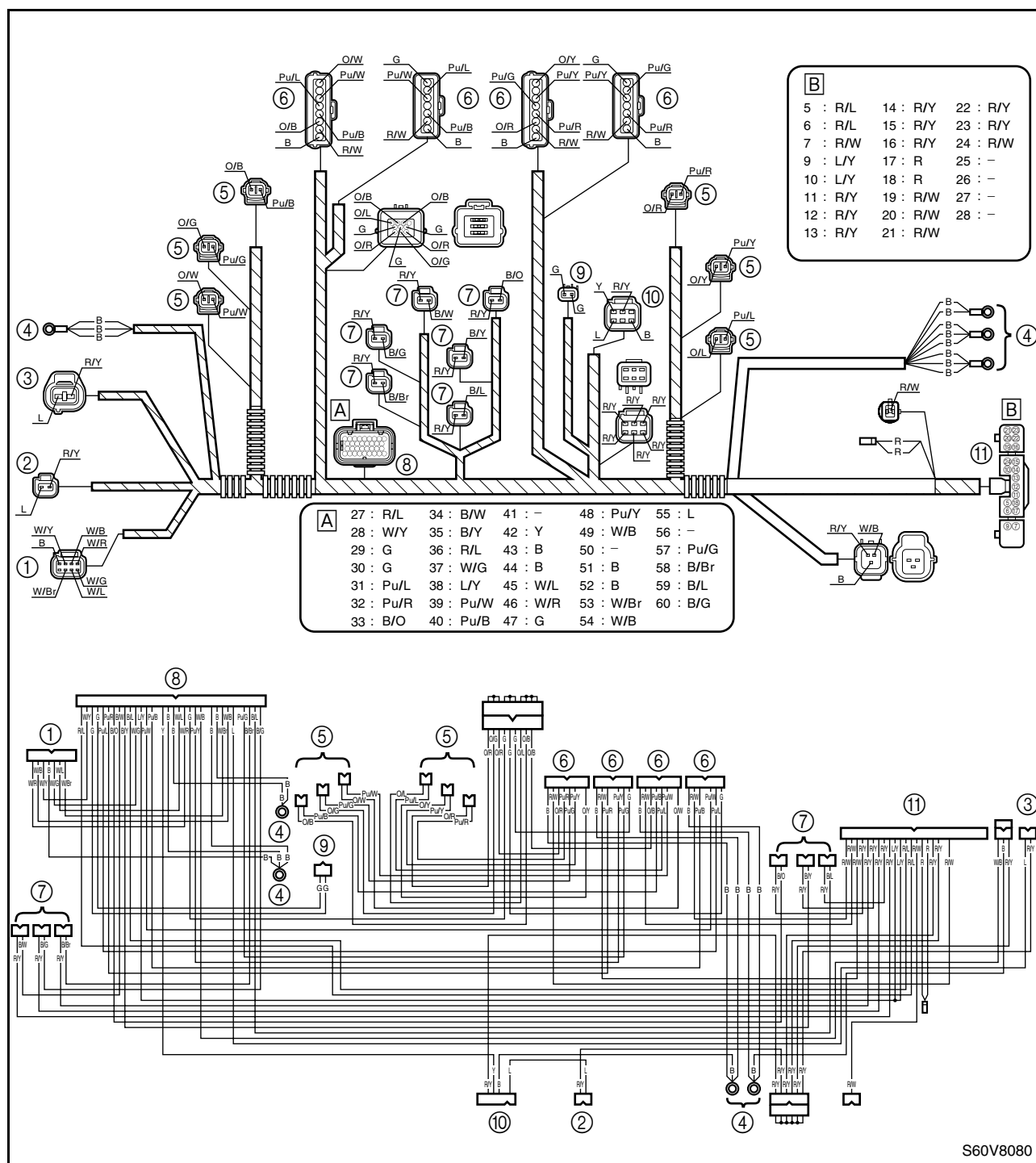


S60V8080

Connect to:

- ① Pulser coil
- ② Electric fuel pump
- ③ Electric oil pump
- ④ Ground
- ⑤ Fuel injector
- ⑥ Injector drivers
- ⑦ Ignition coil
- ⑧ ECM

- ⑨ Crank position sensor
- ⑩ Fuel pump relay
- ⑪ Fuse holder



S60V8080

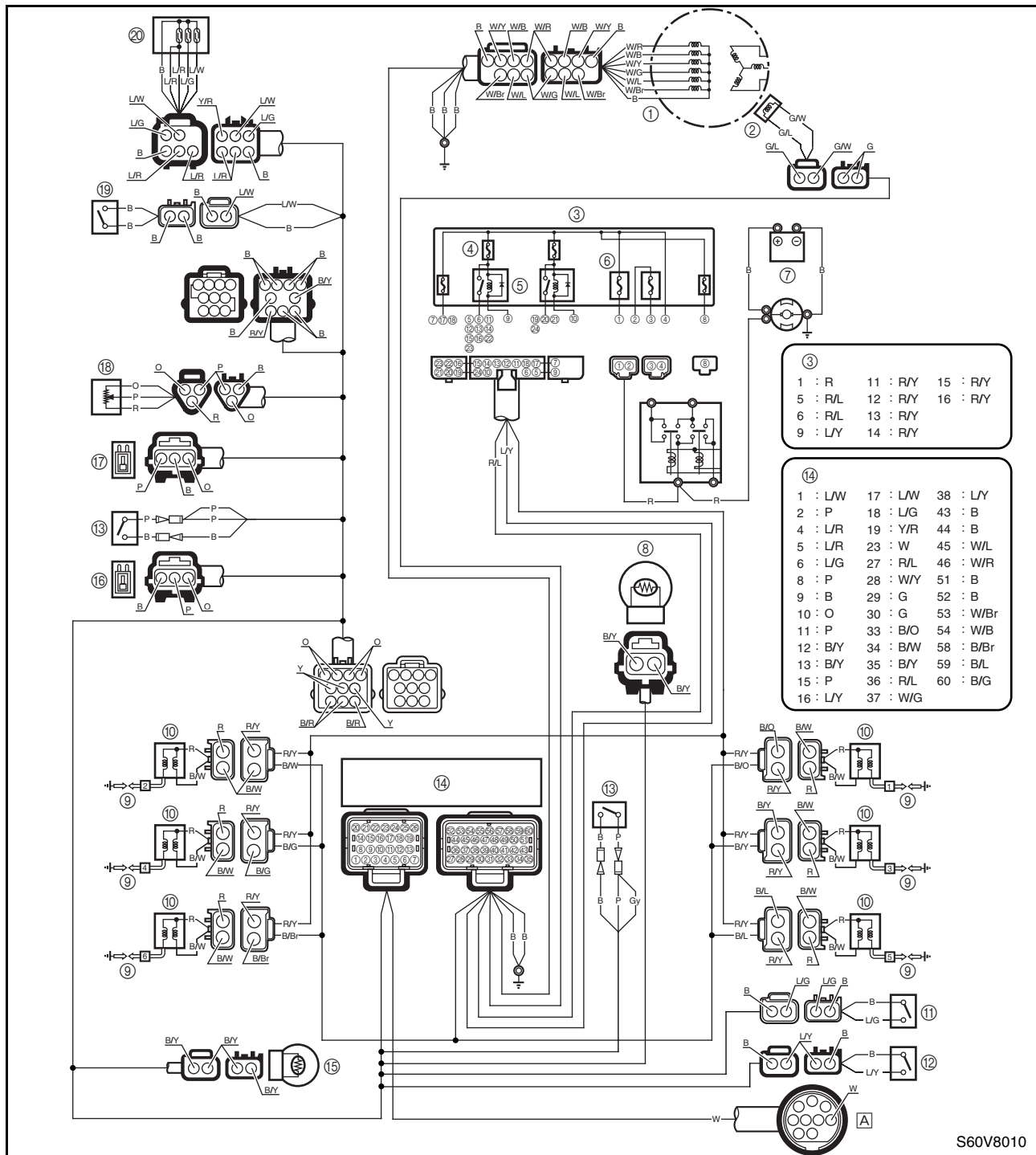
B : Black
 G : Green
 L : Blue
 R : Red
 Y : Yellow
 B/Br : Black/brown
 B/G : Black/green
 B/L : Black/blue
 B/W : Black/white
 B/Y : Black/yellow

L/Y : Blue/yellow
 O/B : Orange/black
 O/G : Orange/green
 O/L : Orange/blue
 O/R : Orange/red
 O/W : Orange/white
 O/Y : Orange/yellow
 Pu/B : Purple/black
 Pu/G : Purple/green
 Pu/L : Purple/blue

Pu/R : Purple/red
 Pu/W : Purple/white
 Pu/Y : Purple/yellow
 R/L : Red/blue
 R/W : Red/white
 R/Y : Red/yellow
 W/B : White/black
 W/Br : White/brown
 W/G : White/green
 W/L : White/blue

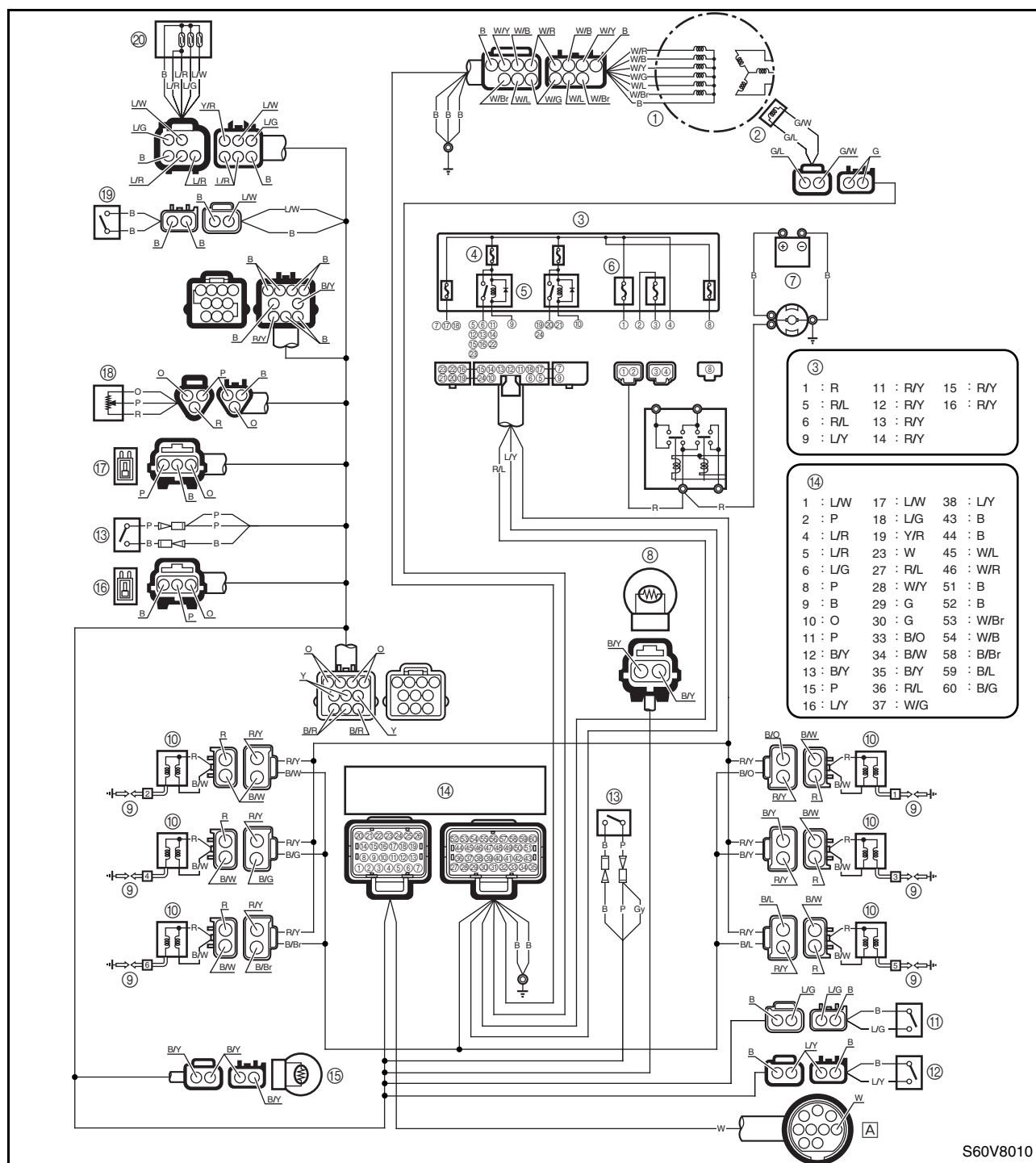
W/R : White/red
 W/Y : White/yellow

Ignition and ignition control system



- ① Pulser coil
- ② Crank position sensor
- ③ Fuse holder
- ④ Fuse (20 A)
- ⑤ ECM main relay
- ⑥ Fuse (100 A)
- ⑦ Battery
- ⑧ Intake air temperature sensor
- ⑨ Spark plug
- ⑩ Ignition coil
- ⑪ Shift position switch
- ⑫ Shift cut switch
- ⑬ Thermoswitch
- ⑭ ECM
- ⑮ Engine temperature sensor
- ⑯ Fuel pressure sensor
- ⑰ Atmospheric pressure sensor
- ⑱ Throttle position sensor
- ⑲ Water detection switch
- ⑳ Oil level sensor

Ⓐ To remote control box/switch panel



S60V8010

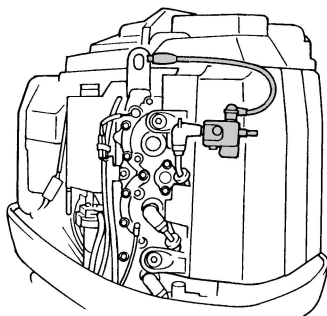
B : Black
G : Green
O : Orange
P : Pink
R : Red
W : White
Y : Yellow
B/Br : Black/brown
B/G : Black/green
B/L : Black/blue

B/O : Black/orange
B/R : Black/red
B/W : Black/white
B/Y : Black/yellow
G/L : Green/blue
G/W : Green/white
L/G : Blue/green
L/R : Blue/red
L/W : Blue/white
L/Y : Blue/yellow

R/L : Red/blue
R/Y : Red/yellow
W/B : White/black
W/Br : White/brown
W/G : White/green
W/L : White/blue
W/R : White/red
W/Y : White/yellow
Y/R : Yellow/red

Checking the ignition spark gap

1. Disconnect the spark plug caps from the spark plugs.
2. Connect a spark plug cap to the special service tool.

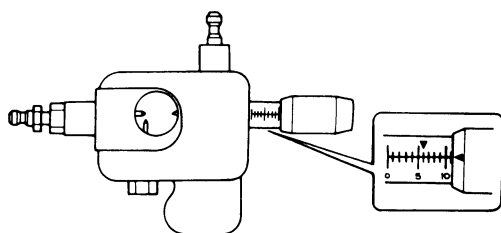


S60V8100



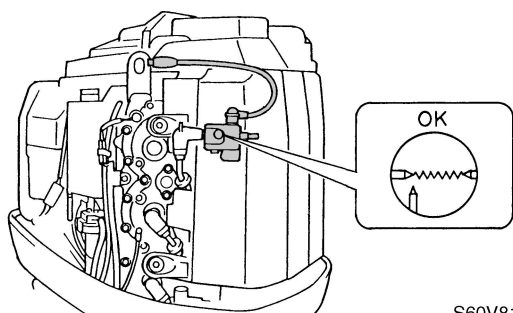
Ignition tester: 90890-06754

3. Set the spark gap length on the adjusting knob.



S69J8140

4. Crank the engine and observe the spark through the discharge window of the spark gap tester. Check the ignition coil if below specification.



S60V8120

⚠ WARNING

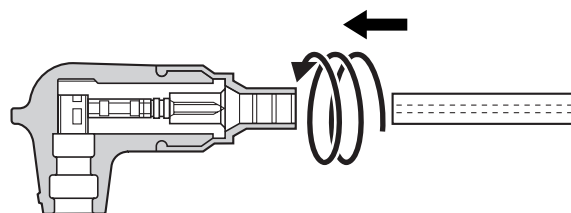
- Do not touch any of the connections of the spark gap tester leads.
- Do not let sparks leak out of the removed spark plug caps.
- Keep flammable gas or liquids away, since this test can produce sparks.



Ignition spark gap: 9 mm (0.35 in)

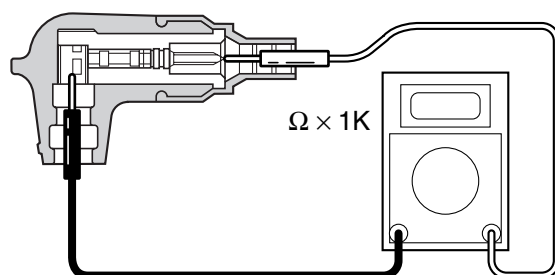
Checking the spark plug caps

1. Remove the spark plug caps from the spark plug wires by turning the caps counterclockwise.



S60V8130

2. Measure the spark plug cap resistance. Replace if out of specification.



S60V8140



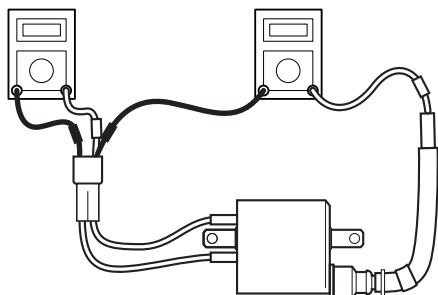
Spark plug cap resistance:
4–6 kΩ

Checking the ignition coils

1. Remove the spark plug wires from the spark plugs.
2. Remove the harness cover and disconnect the ignition coil coupler.



3. Remove the ignition coil cover.
4. Remove the spark plug caps from the spark plug wires.
5. Measure the ignition coil resistance. Replace if out of specification.



S60V8150



Ignition coil resistance:

Primary coil:

Red (R) – Black/white (B/W)

1.78–2.53 Ω at 20 °C (68 °F)

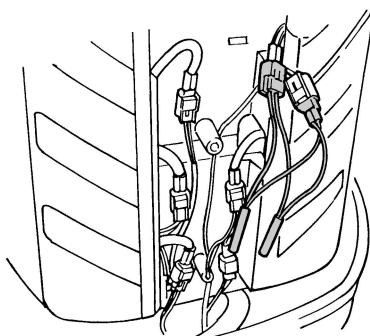
Secondary coil:

Black/white (B/W) – Spark plug wire

8.93–12.08 kΩ at 20 °C (68 °F)

Checking the ECM

1. Remove the harness cover and disconnect a ignition coil coupler.
2. Connect the test harness (2 pins) to the ignition coil.
3. Measure the ECM output peak voltage. If below specification, measure the pulser coil output peak voltage. Replace the ECM if the output peak voltage of the pulser coil is above specification.



S60V8160



Digital circuit tester: 90890-03174

Peak voltage adaptor: 90890-03172

Test harness (2 pins): 90890-06767



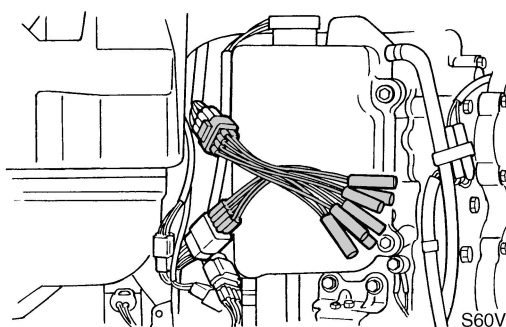
ECM output peak voltage:

Red (R) – Black/white (B/W)

r/min	Loaded		
	Cranking	1,500	3,500
DC V	160	260	260

Checking the pulser coil

1. Disconnect the pulser coil coupler.
2. Connect the test harness (8 pins) to the pulser coil.
3. Measure the pulser coil output peak voltage. Replace the pulser coil if below specification.



S60V8170



Digital circuit tester: 90890-03174

Peak voltage adaptor: 90890-03172

Test harness (8 pins): 90890-06779



Pulser coil output peak voltage:

White/red (W/R) – Black (B)

White/black (W/B) – Black (B)

White/yellow (W/Y) – Black (B)

White/green (W/G) – Black (B)

White/blue (W/L) – Black (B)

White/brown (W/Br) – Black (B)

r/min	Unloaded	Loaded	
		Cranking	
DC V	3.5	3.5	30.0



Pulser coil resistance
(use as reference):
294–398 Ω

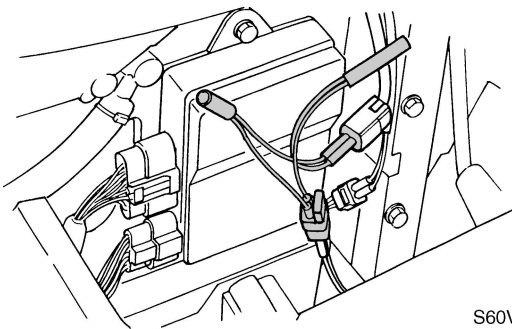
Checking the crank position sensor

1. Remove the harness cover bolts, and then pull back the ignition coil cover.

NOTE:

The ignition coils are connected to the ignition coil cover. Do not remove the ignition coil cover.

2. Connect the test harness (2 pins) to the crank position sensor.
3. Measure the crank position sensor output peak voltage. Replace the crank position sensor if below specification.



S60V8180



Digital circuit tester: 90890-03174
Peak voltage adaptor: 90890-03172
Test harness (2 pins): 90890-06767



Crank position sensor output peak voltage:
Green/blue (G/L) –
Green/white (G/W)

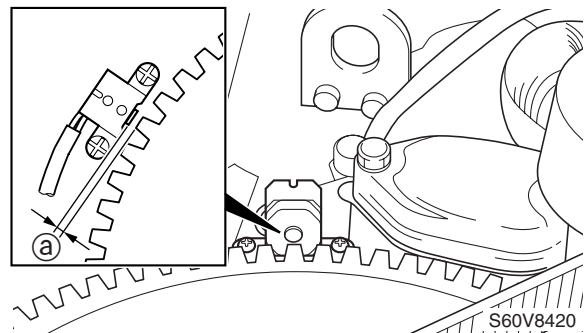
r/min	Unloaded		Loaded	
	Cranking		1,500	3,500
DC V	1.5	1.5	8.0	10.0



Crank position sensor resistance
(use as reference):
Green/blue (G/L) –
Green/white (G/W)
178.5–241.5 Ω

Checking the crank position sensor air gap

1. Remove the flywheel magnet cover.
2. Measure the crank position sensor air gap ②. Adjust if out of specification.

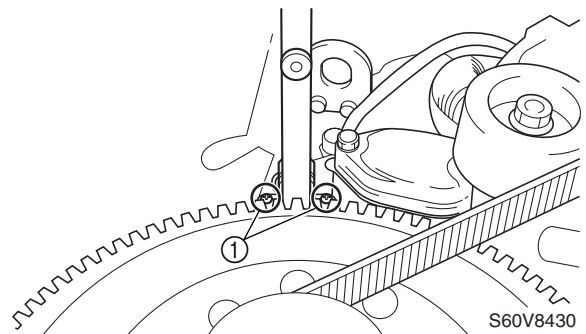


S60V8420



Crank position sensor air gap:
0.5–1.5 mm (0.02–0.06 in)

3. Loosen the screws ① and adjust the crank position sensor air gap.



S60V8430

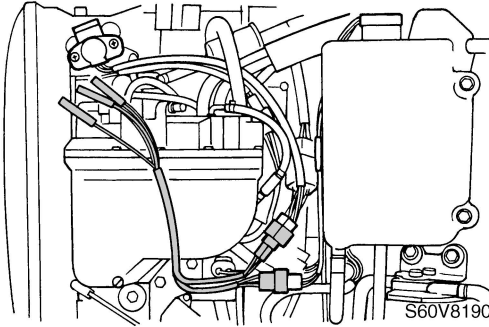
4. Tighten the screws, and then check the crank position sensor air gap. Adjust if necessary.

Checking the throttle position sensor

1. Connect the test harness (3 pins) to the throttle position sensor.
2. Turn the engine start switch to ON.



3. Measure the throttle position sensor input voltage. Replace the ECM if out of specification.
4. Measure the throttle position sensor output voltage. Adjust the throttle position sensor if out of specification.



Test harness (3 pins): 90890-06757



Throttle position sensor input voltage:

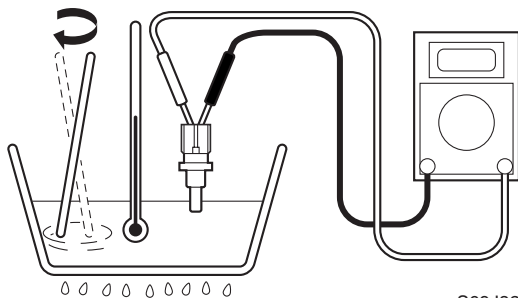
Orange (O) – Red (R)
5 V

Throttle position sensor output voltage:

Pink (P) – Orange (O)
0.58–0.62 V

Checking the intake air temperature sensor

1. Place the intake air temperature sensor in a container of water and slowly heat the water.



2. Measure the intake air temperature sensor resistance. Replace if out of specification.



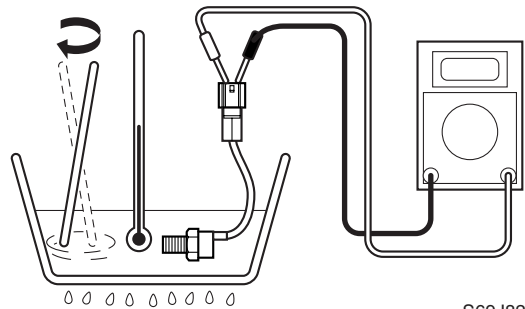
Intake air temperature sensor resistance:

at 0 °C (32 °F): 5.4–6.6 kΩ

at 80 °C (176 °F): 0.3–0.4 kΩ

Checking the engine temperature sensor

1. Place the engine temperature sensor in a container of water and slowly heat the water.



2. Measure the engine temperature sensor resistance. Replace if out of specification.



Engine temperature sensor resistance:

Black/yellow (B/Y) –

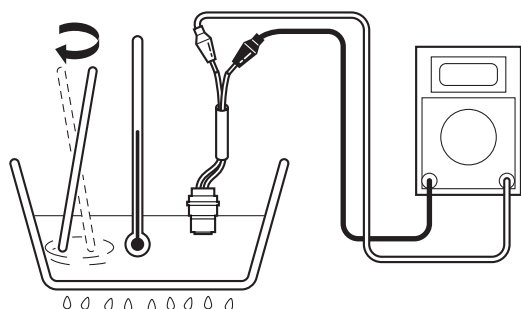
Black/yellow (B/Y)

at 20 °C (68 °F): 54.2–69.0 kΩ

at 100 °C (212 °F): 3.12–3.48 kΩ

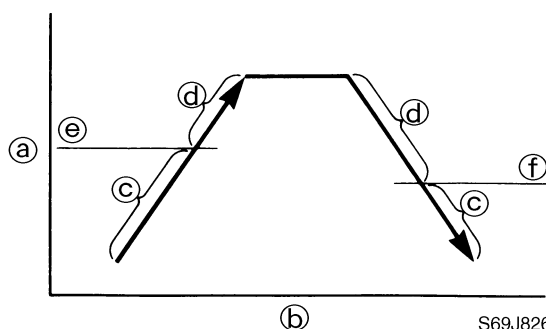
Checking the thermostwitches

- Place the thermostwitches in a container of water and slowly heat the water.



S69J8250

- Check the switches for continuity at the specified temperatures. Replace if out of specification.



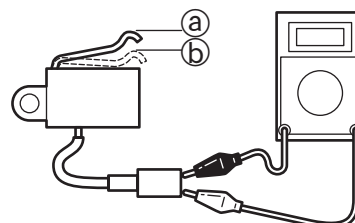
S69J8260

- Ⓐ Temperature
- Ⓑ Time
- Ⓒ No continuity
- Ⓓ Continuity

Thermostwitch continuity temperature:
Pink (P) – Black (B)
Ⓔ: 84–90 °C (183–194 °F)
Ⓕ: 60–74 °C (140–165 °F)

Checking the shift cut switch

- Check the shift cut switch for continuity. Replace if there is no continuity.

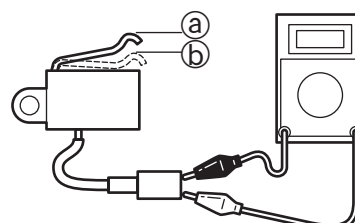


S69J8270

Switch position	Lead color	
	Blue/yellow (L/Y)	Black (B)
Free Ⓐ		
Push Ⓑ		

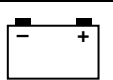
Checking the shift position switch

- Check the shift position switch for continuity. Replace if there is no continuity.

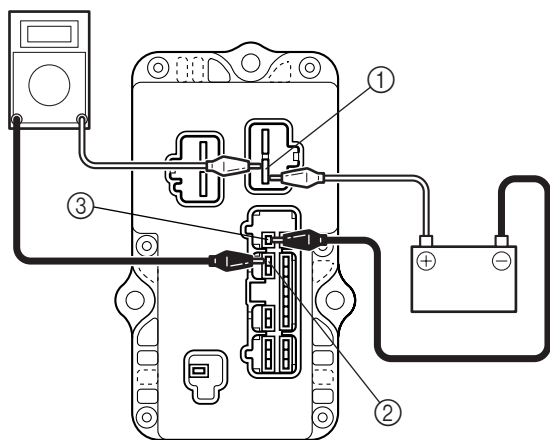


S69J8270

Switch position	Lead color	
	Blue/green (L/G)	Black (B)
Free Ⓐ		
Push Ⓑ		

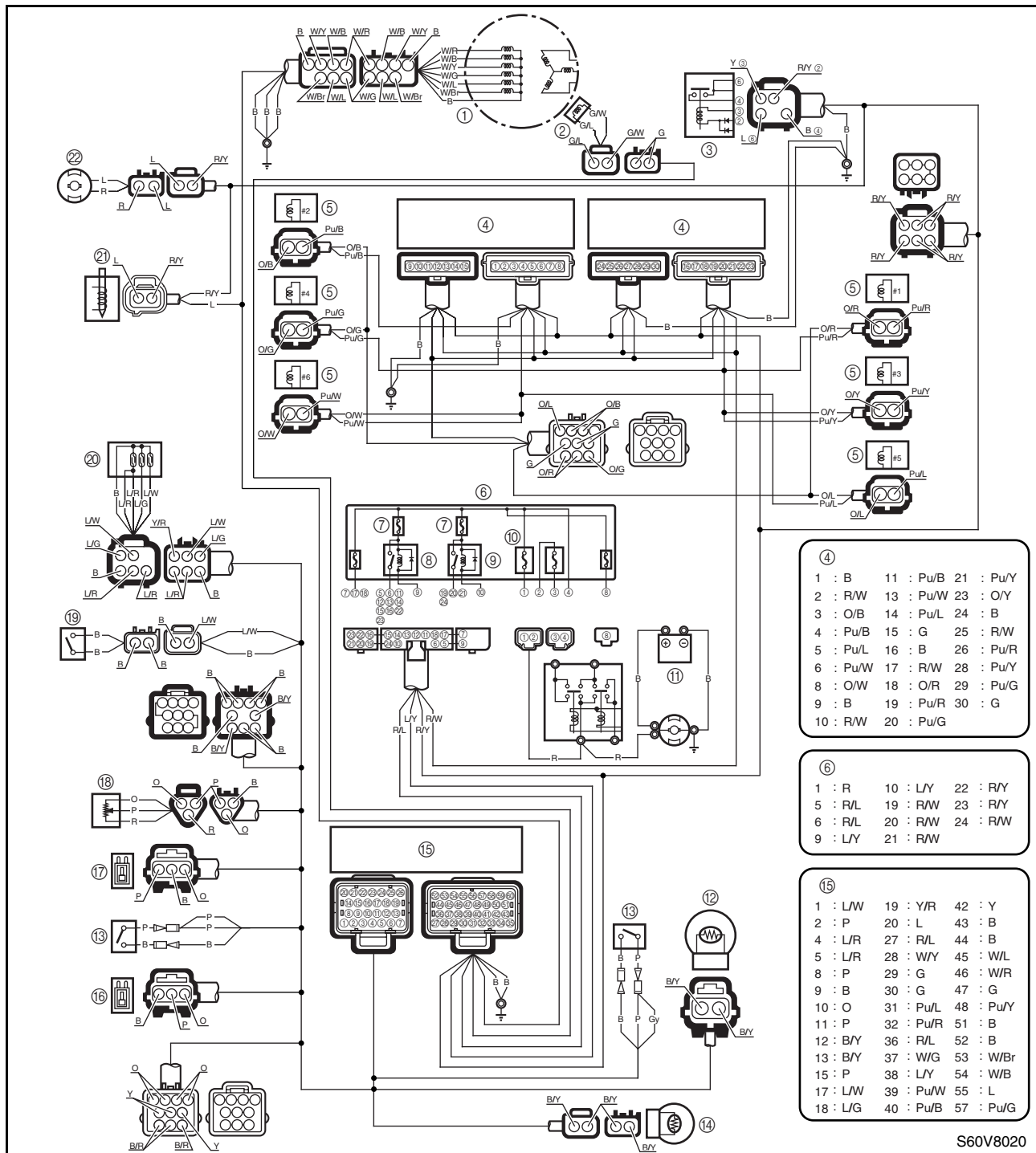
**Checking the ECM main relay**

1. Remove the fuse holder cover, and then remove the fuse holder.
2. Connect the digital circuit tester leads to ECM main relay terminals ① and ②.
3. Connect positive battery terminal to the ECM main relay terminal ①.
4. Connect the negative battery terminal to the ECM main relay terminal ③.
5. Check for continuity between the ECM main relay terminals. Replace if there is no continuity.
6. Check that there is no continuity between the relay terminals after disconnecting a battery terminal from ECM main relay terminal ① or ③. Replace if there is continuity.

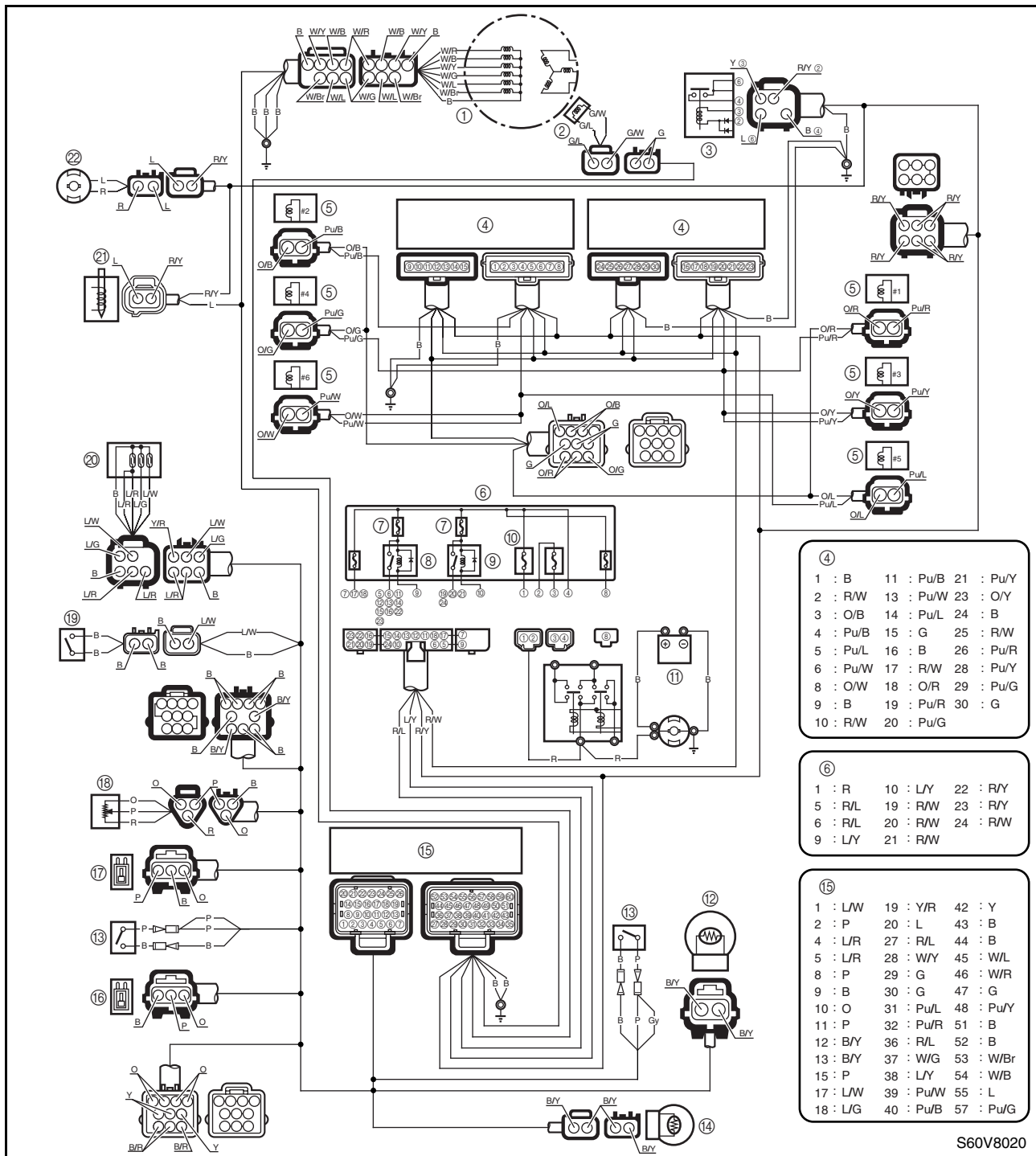


S60V8450

Fuel control system



- | | | |
|-------------------------|---------------------------------|----------------------|
| ① Pulser coil | ⑪ Battery | ⑳ Electric oil pump |
| ② Crank position sensor | ⑫ Intake air temperature sensor | ㉑ Electric fuel pump |
| ③ Fuel pump relay | ⑬ Thermoswitch | |
| ④ Injector drivers | ⑭ Engine temperature sensor | |
| ⑤ Fuel injector | ⑮ ECM | |
| ⑥ Fuse holder | ⑯ Fuel pressure sensor | |
| ⑦ Fuse (20 A) | ⑰ Atmospheric pressure sensor | |
| ⑧ ECM main relay | ⑱ Throttle position sensor | |
| ⑨ Injector driver relay | ㉒ Water detection switch | |
| ⑩ Fuse (100 A) | ㉓ Oil level sensor | |



S60V8020

B : Black
 G : Green
 Gy : Gray
 L : Blue
 O : Orange
 P : Pink
 R : Red
 Y : Yellow
 B/R : Black/red
 B/Y : Black/yellow

G/L : Green/blue
 G/W : Green/white
 L/G : Blue/green
 L/R : Blue/red
 L/W : Blue/white
 L/Y : Blue/yellow
 O/B : Orange/black
 O/G : Orange/green
 O/L : Orange/blue
 O/R : Orange/red

O/W : Orange/white
 O/Y : Orange/yellow
 Pu/B : Purple/black
 Pu/G : Purple/green
 Pu/L : Purple/blue
 Pu/R : Purple/red
 Pu/W : Purple/white
 Pu/Y : Purple/yellow
 R/L : Red/blue
 R/W : Red/white

R/Y : Red/yellow
 W/B : White/black
 W/Br : White/brown
 W/G : White/green
 W/L : White/blue
 W/R : White/red
 W/Y : White/yellow
 Y/R : Yellow/red

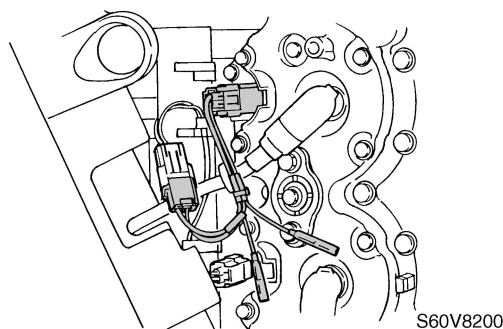
Checking the injector drivers

1. Remove the harness cover bolts, and then pull back the ignition coil cover ①.

NOTE:

The ignition coils are connected to the ignition coil cover. Do not remove the ignition coil cover.

2. Connect the test harness (2 pins) to the fuel injector.
3. Measure the injector driver output peak voltage. If below specification, measure the fuel injector resistance or replace the injector drivers.



Digital circuit tester: 90890-03174
Peak voltage adaptor: 90890-03172
Test harness (2 pins): 90890-06861

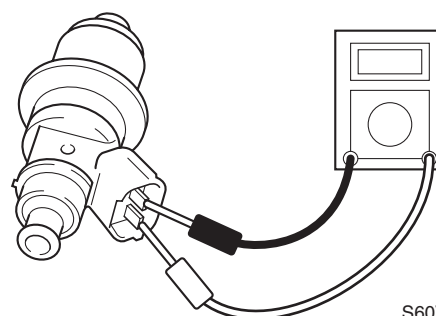


Injector driver output peak voltage
(use as reference):

Purple/red (Pu/R) –
Orange/red (O/R)
Purple/black (Pu/B) –
Orange/black (O/B)
Purple/yellow (Pu/Y) –
Orange/yellow (O/Y)
Purple/green (Pu/G) –
Orange/green (O/G)
Purple/blue (Pu/L) –
Orange/blue (O/L)
Purple/white (Pu/W) –
Orange/white (O/W)

r/min	Loaded		
	Cranking	1,500	3,500
DC V	70	80	80

4. Measure the resistance of the fuel injectors. Replace if out of specification.



Digital circuit tester: 90890-03174



Fuel injector resistance
(use as reference):
0.9–1.1 Ω at 20 °C (68 °F)

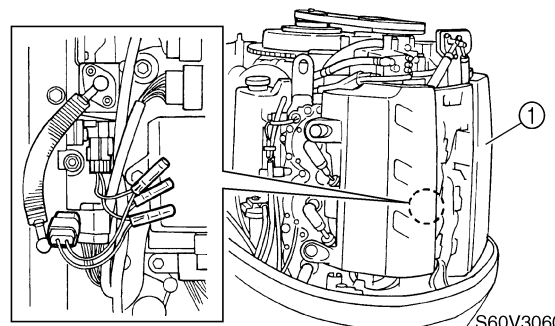
Checking the fuel pressure sensor

1. Remove the flywheel magnet cover.
2. Remove the harness cover bolts, and then pull back the ignition coil cover ①.

NOTE:

The ignition coils are connected to the ignition coil cover. Do not remove the ignition coil cover.

3. Connect the test harness (3 pins) between the fuel pressure sensor and the wiring harness as shown.



Test harness (3 pins): 90890-06769



- Start the engine and warm it up for 5 minutes, and then measure the fuel pressure sensor output voltage. If out of specification, check the high-pressure fuel line and the mechanical fuel pump or replace the fuel pressure sensor.



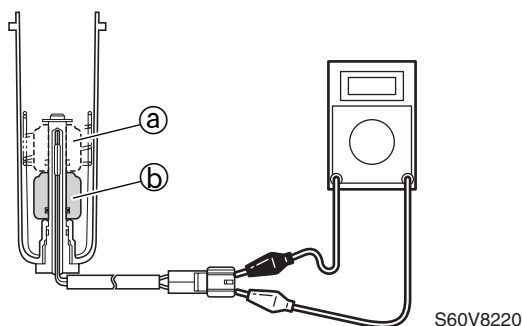
Fuel pressure sensor output voltage (use as reference):

Orange (O) – Pink (P)

3.2 V at 670–730 r/min

Checking the water detection switch

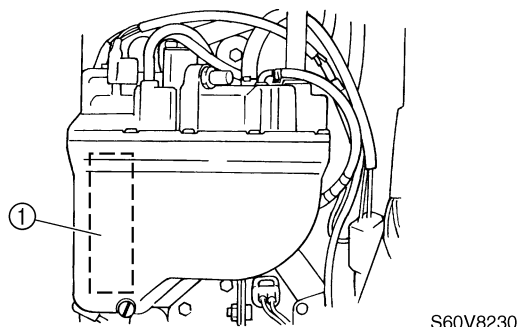
- Check the water detection switch for continuity. Replace if there is no continuity.



Float position	Lead color	
	Black (B)	Black (B)
On (a)		
Off (b)		

Checking the electric fuel pump

- Turn the engine start switch to ON.
- Listen for the operating sound of the electric fuel pump (1).

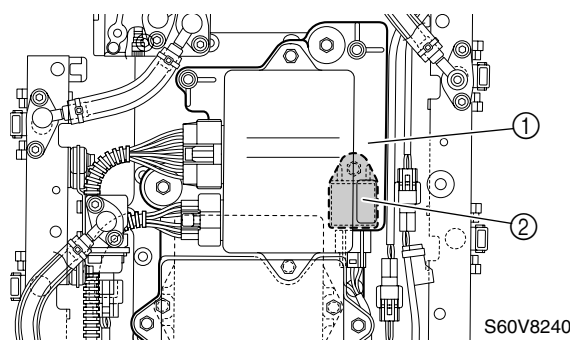


NOTE:

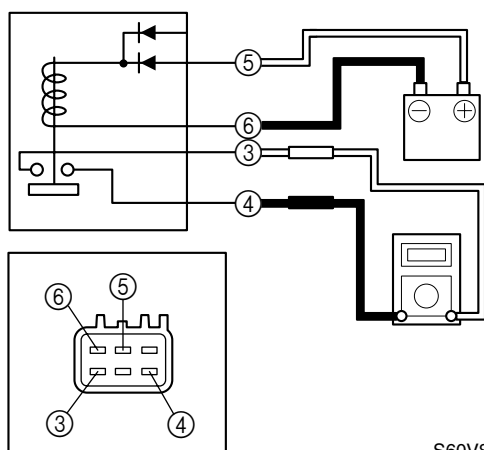
After the engine start switch is turned to ON, the electric fuel pump will operate for 5 seconds.

Checking the electric fuel pump relay

- Remove the ignition coil cover.
- Remove the bracket (1), then the electric fuel pump relay (2).



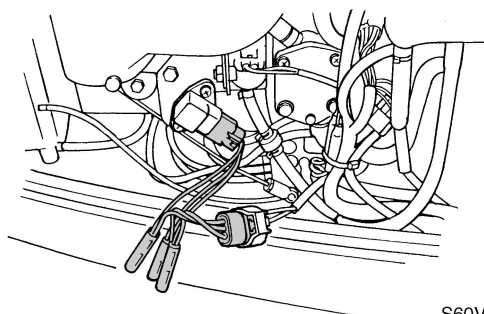
- Connect the digital circuit tester leads to electric fuel pump relay terminals (3) and (4).
- Connect the positive battery terminal to the electric fuel pump relay terminal (5).
- Connect the negative battery terminal to the electric fuel pump relay terminal (6).
- Check for continuity between the electric fuel pump relay terminals. Replace if there is no continuity.
- Check that there is no continuity between the relay terminals after disconnecting a battery terminal from electric fuel pump relay terminal (5) or (6). Replace if there is continuity.



S60V8250

Checking the atmospheric pressure sensor

1. Connect the test harness (3 pins) to the atmospheric pressure sensor.
2. Turn the engine start switch to ON.
3. Measure the atmospheric pressure sensor input voltage. Check the wiring harness or coupler. Replace the atmospheric pressure sensor if out of specification.



S60V8260

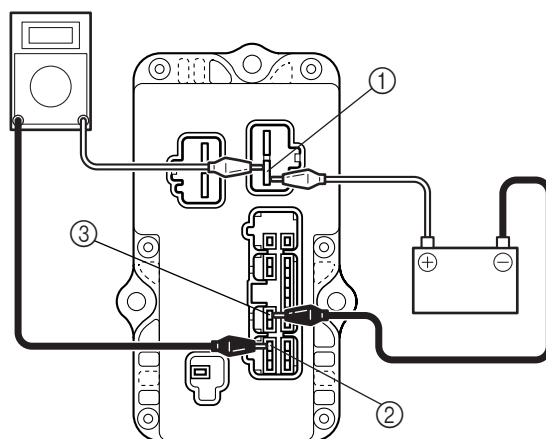


Digital circuit tester: 90890-03174
Test harness (3 pins): 90890-06769



Atmospheric pressure sensor input voltage:
Orange (O) – Black (B)
5 V

2. Connect the digital circuit tester leads to terminals ① and ②.
3. Connect the terminal ① to the positive battery terminal.
4. Connect the terminal ③ to the negative battery terminal.
5. Check for continuity between the injector driver relay terminals. Replace if there is no continuity.
6. Check that there is no continuity between the terminals after disconnecting terminal ① or ③. Replace if there is continuity.



S60V8460

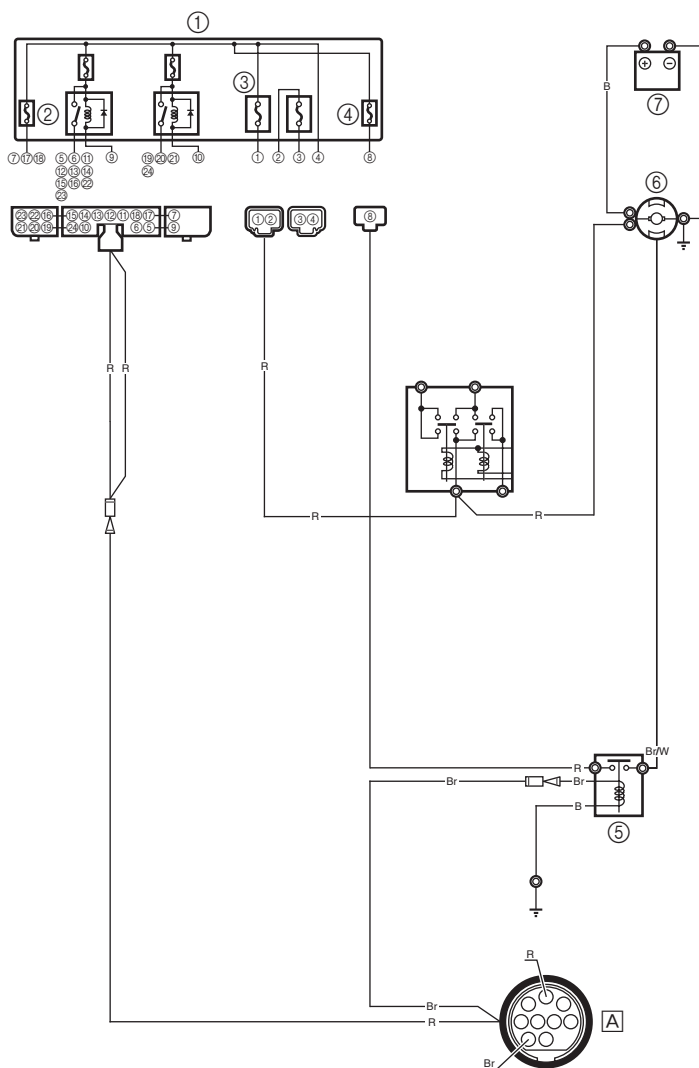
Checking the injector driver relay

1. Remove the fuse holder cover, then the fuse holder.



Starting system

②
1 : R
8 : R
17 : R
18 : R



S60V8030

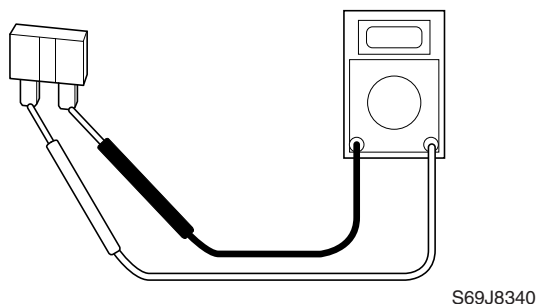
- ① Fuse holder
- ② Fuse (20 A)
- ③ Fuse (100 A)
- ④ Fuse (30 A)
- ⑤ Starter relay
- ⑥ Starter motor
- ⑦ Battery

B : Black
Br : Brown
R : Red
Br/W : Brown/white

Ⓐ To remote control box/switch panel

Checking the fuses

1. Check the fuses for continuity. Replace if there is no continuity.

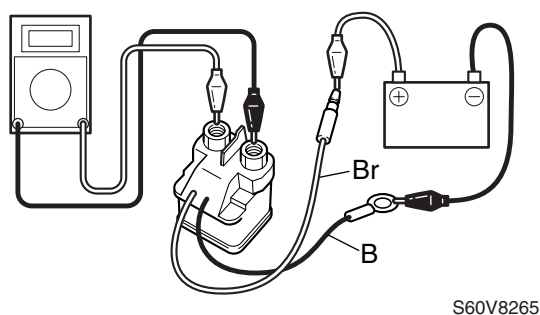


Checking the wiring harness (10 pins)

1. Check the wiring harness for continuity. Replace if there is no continuity.

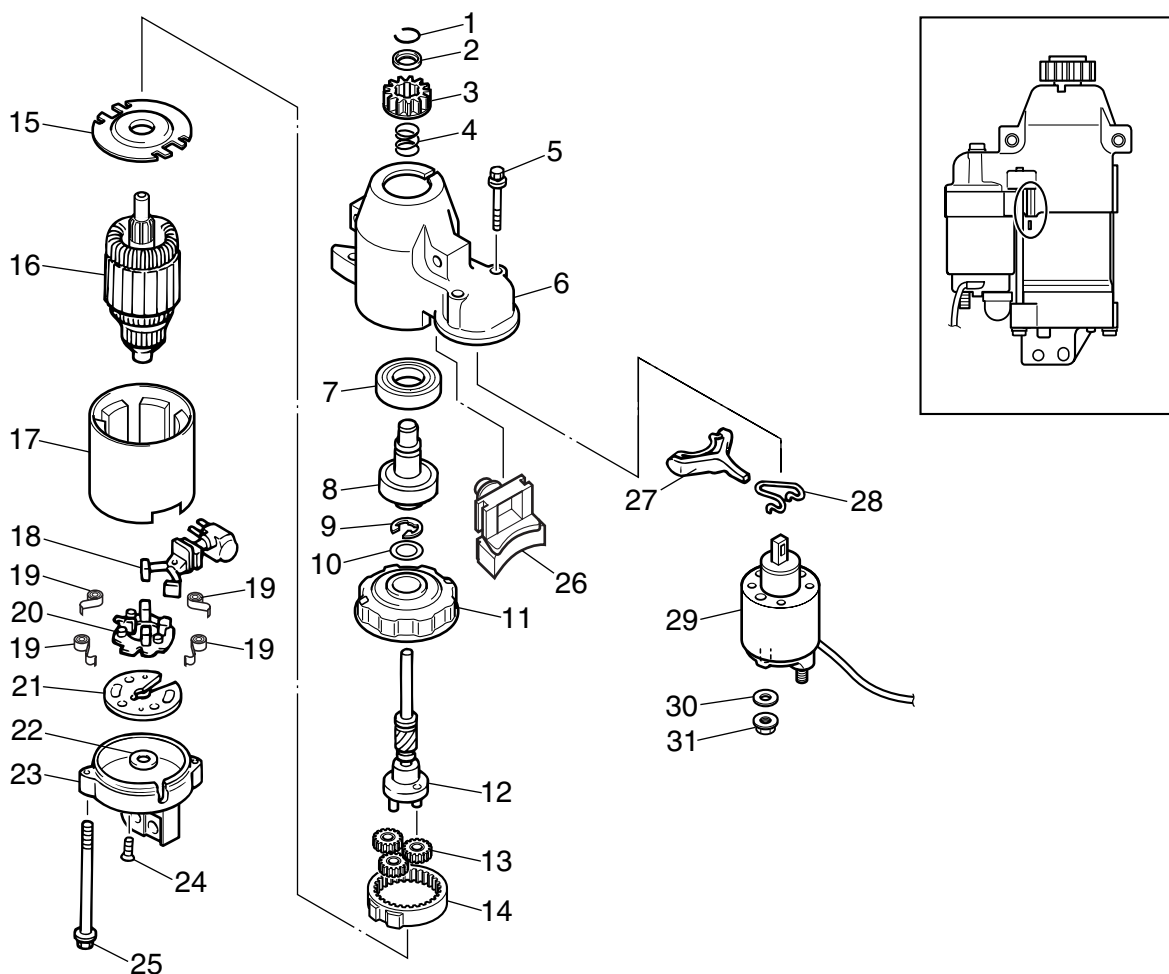
Checking the starter relay

1. Connect the digital circuit tester leads to the starter relay terminals.
2. Connect the positive battery terminal to the brown (Br) lead.
3. Connect the negative battery terminal to the black (B) lead.
4. Check for continuity between the starter relay terminals. Replace if there is no continuity.
5. Check that there is no continuity between the starter relay terminals after disconnecting a battery terminal from the brown or black lead. Replace if there is continuity.



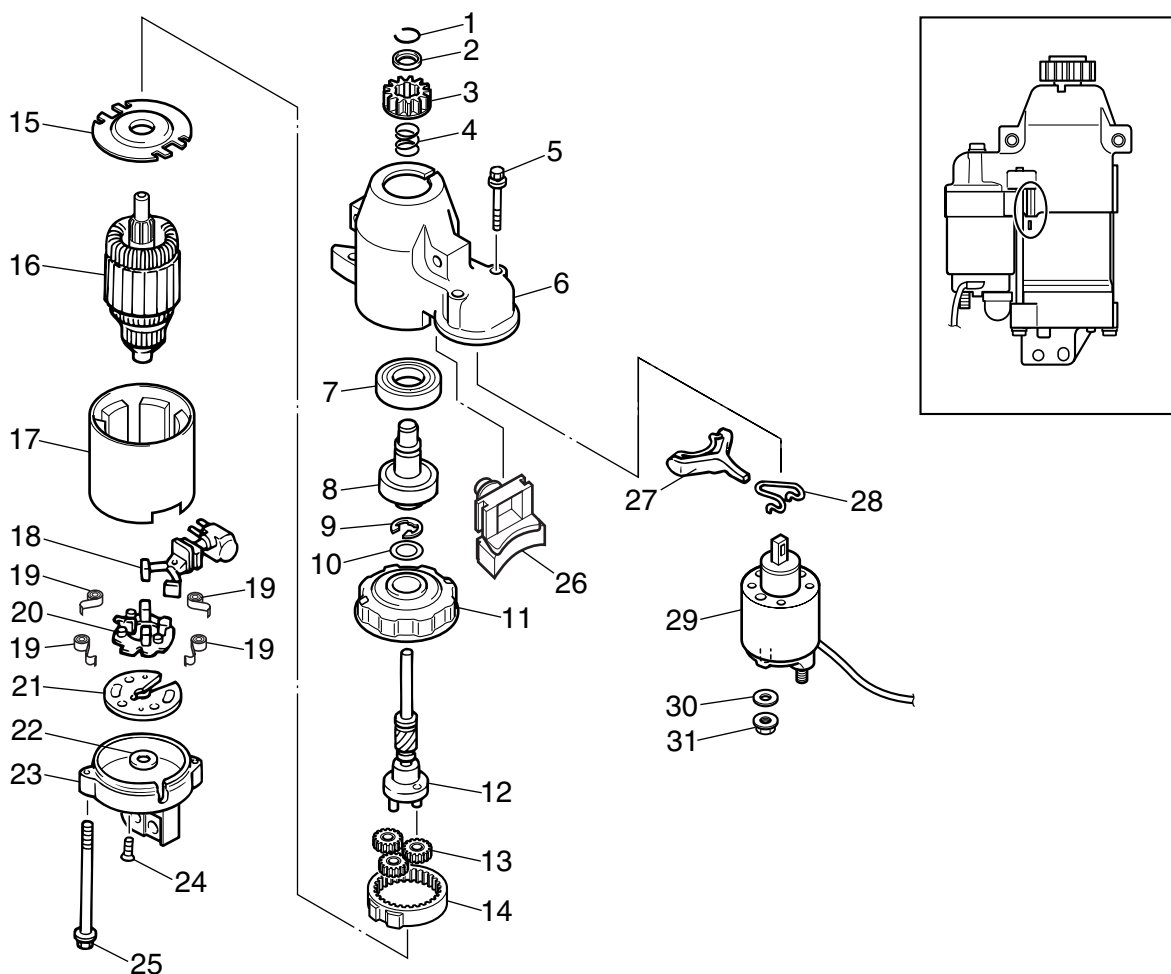


Starter motor



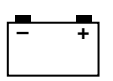
S60V8270

No.	Part name	Q'ty	Remarks
1	Clip	1	M6 × 35 mm Not reusable
2	Pinion stopper	1	
3	Starter motor pinion	1	
4	Spring	1	
5	Bolt	2	
6	Housing	1	
7	Bearing	1	
8	Clutch assembly	1	
9	E-clip	1	
10	Washer	1	
11	Bracket	1	
12	Pinion shaft	1	
13	Planetary gear	3	
14	Outer gear	1	
15	Plate	1	
16	Armature	1	
17	Stator	1	



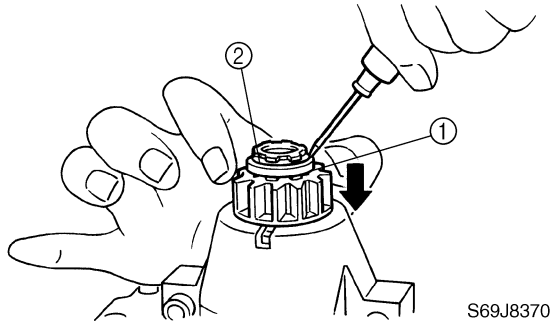
S60V8270

No.	Part name	Q'ty	Remarks
18	Brush assembly	1	
19	Brush spring	4	
20	Brush holder	1	
21	Plate	1	
22	Washer	1	
23	Bracket	1	
24	Screw	2	ø4 × 15 mm
25	Bolt	2	M6 × 120 mm
26	Rubber seal	1	
27	Shift lever	1	
28	Spring	1	
29	Magnet switch assembly	1	
30	Washer	1	
31	Nut	1	



Removing the starter motor pinion

1. Slide the pinion stopper ① down as shown, and then remove the clip ②.



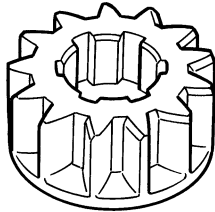
S69J8370

NOTE:

Remove the clip with a thin screwdriver.

Checking the starter motor pinion

1. Check the teeth of the pinion for cracks or wear. Replace if necessary.



S69J8380

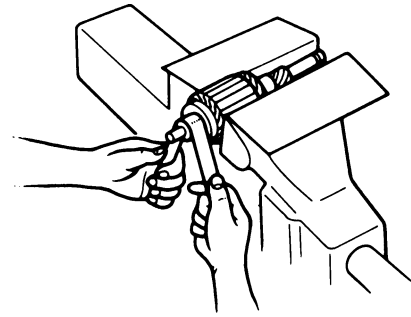
2. Check for smooth operation. Replace if necessary.

NOTE:

Turn the pinion counterclockwise to check that it operates smoothly and turn it clockwise to check that it locks in place.

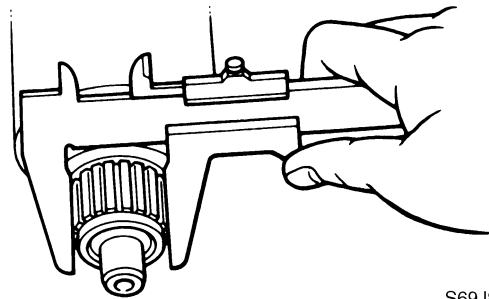
Checking the armature

1. Check the commutator for dirt. Clean with #600 grid sandpaper and compressed air if necessary.



S69J8390

2. Measure the commutator diameter. Replace the armature if out of specification.

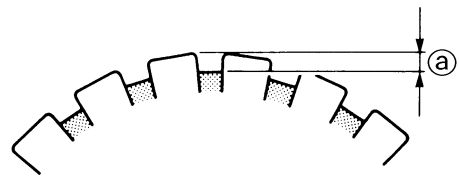


S69J8400



Commutator diameter limit:
28.0 mm (1.10 in)

3. Measure the commutator undercut (a). Replace the armature if out of specification.

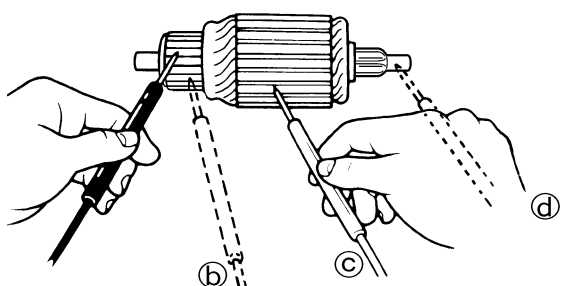


S69J8410



Commutator undercut limit (a):
0.2 mm (0.01 in)

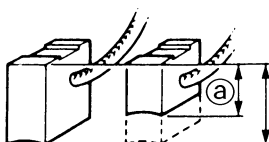
4. Check the armature for continuity. Replace if out of specifications.



Armature continuity	
Commutator segments (b)	Continuity
Segment – Armature core (c)	No continuity
Segment – Armature shaft (d)	No continuity

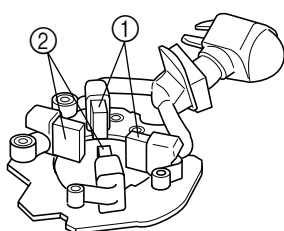
Checking the brushes

1. Measure the brush length. Replace the brush assembly if out of specification.



Brush length limit (a): 9.5 mm (0.37 in)	
---	--

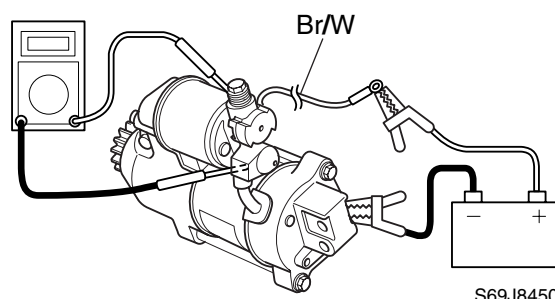
2. Check the brush holder assembly for continuity. Replace if out of specifications.



Brush continuity	
Brush ① – Brush ②	No continuity

Checking the magnet switch

1. Connect the tester leads between the magnet switch terminals as shown.
2. Connect the positive battery lead to the brown and white (Br/W) lead.
3. Connect the negative battery lead to the starter motor body.



CAUTION:

Do not connect the battery for more than one second, otherwise the magnet switch can be damaged.

4. Check that there is continuity between the magnet switch terminals. Replace if there is no continuity.
5. Check that there is no continuity after the negative battery terminal is removed. Replace if there is continuity.

NOTE:

The starter motor pinion should be pushed out while the magnet switch is on.

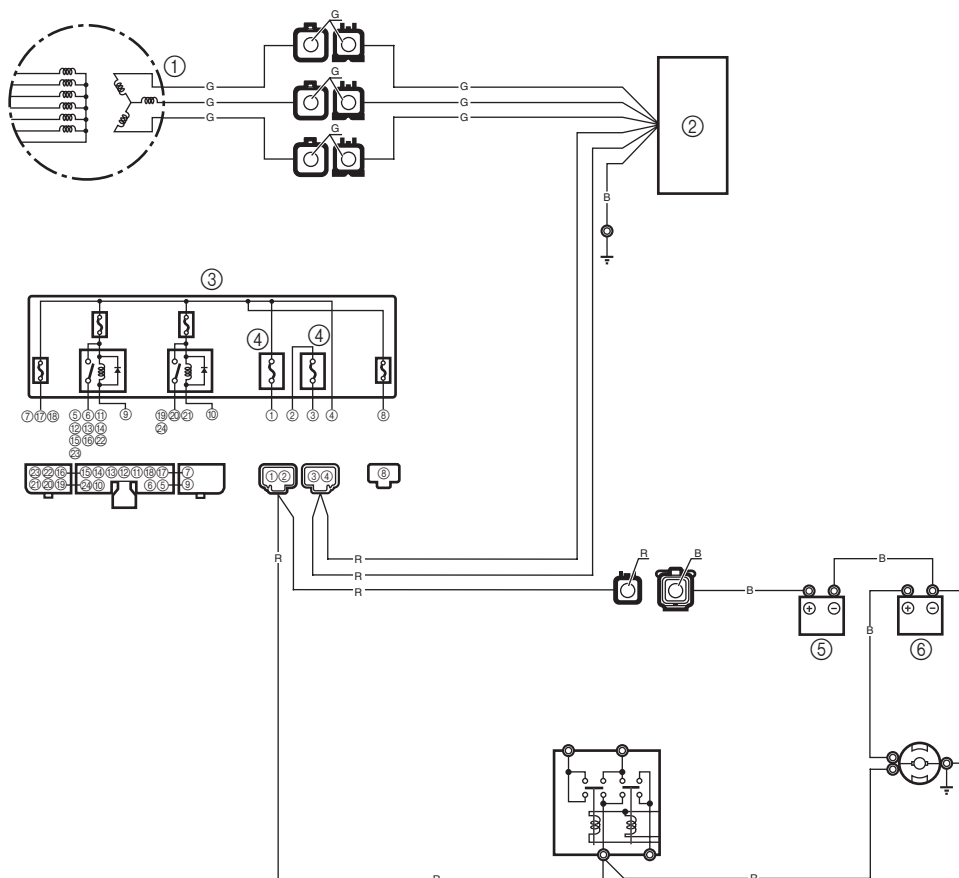
Checking the starter motor operation

1. Check the operation of the starter motor after installing it onto the power unit.



Charging system

②
1 : R
2 : R
3 : R
4 : R



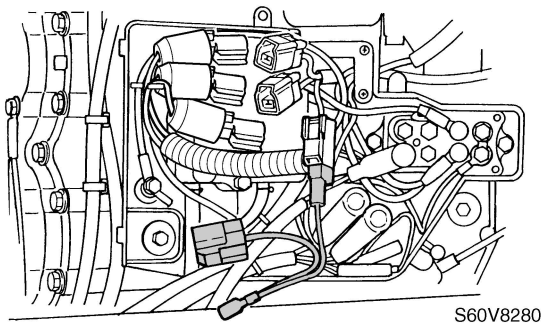
S60V8040

- ① Stator coil
- ② Rectifier Regulator
- ③ Fuse holder
- ④ Fuse (100 A)
- ⑤ Accessory battery
- ⑥ Battery

B : Black
G : Green
R : Red

Checking the stator coil

- 1. Remove the junction box cover and disconnect the stator coil coupler.
- 2. Connect the test harness (1 pin) to the stator coil.
- 3. Measure the stator coil output peak voltage. Replace the stator coil if below specification.



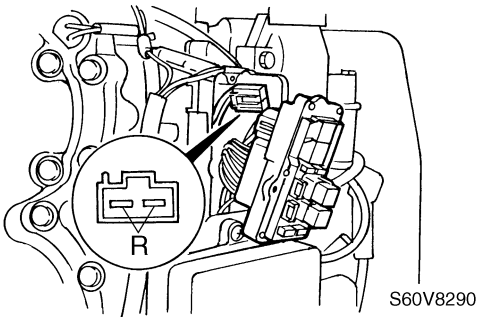
Digital circuit tester: 90890-03174
Peak voltage adaptor: 90890-03172
Test harness (1 pin): 90890-06788

Stator coil output peak voltage: Green (G) – Green (G)			
r/min	Unloaded		
	Cranking	1,500	3,500
DC V	5.5	40	90

Stator coil resistance
(use as reference):
Green (G) – Green (G)
0.11–0.17 Ω at 20 °C (68 °F)

Checking the Rectifier Regulator

- 1. Remove the fuse holder and disconnect the Rectifier Regulator coupler (blue).
- 2. Measure the Rectifier Regulator output peak voltage. If below specification, measure the stator coil output voltage. Replace the Rectifier Regulator if the output peak voltage of the stator coil is above specification.

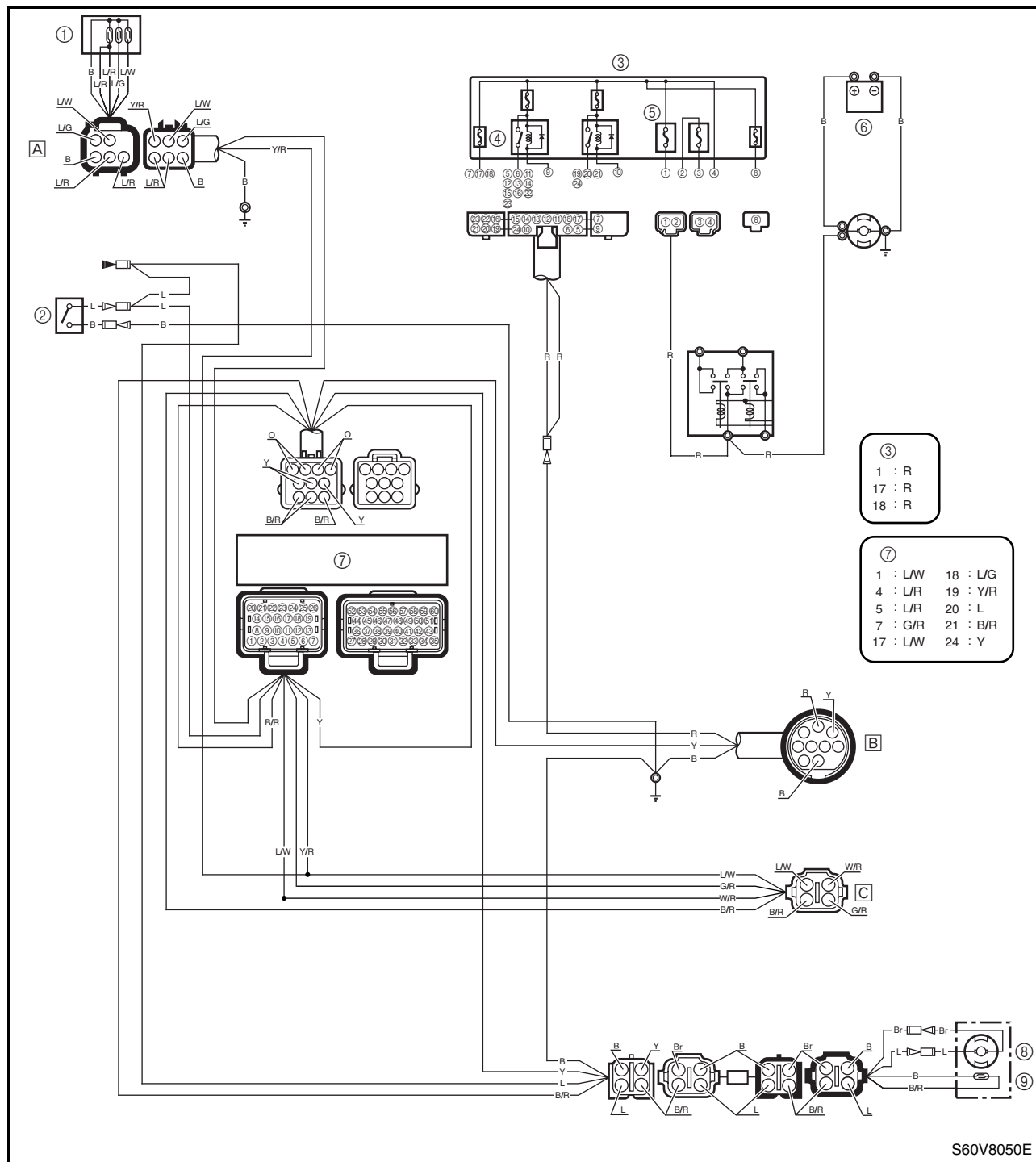


Digital circuit tester: 90890-03174
Peak voltage adaptor: 90890-03172

Rectifier Regulator output peak voltage: Red (R) – Ground		
r/min	Unloaded	
	1,500	3,500
DC V	14.5	14.5



Oil feed pump control system



S60V8050E

- ① Oil level sensor
- ② Emergency switch
- ③ Fuse holder
- ④ Fuse (20 A)
- ⑤ Fuse (100 A)
- ⑥ Battery
- ⑦ ECM
- ⑧ Oil pump (remote oil tank)

- ⑨ Oil level sensor (remote oil tank)
- Ⓐ To diagnostic indicator (special service tool)
- Ⓑ To remote control box/switch panel
- Ⓒ To oil level warning indicator

B : Black
 Br : Brown
 L : Blue
 O : Orange
 R : Red
 Y : Yellow
 B/R : Black/red
 G/R : Green/red
 L/G : Blue/green
 L/R : Blue/red

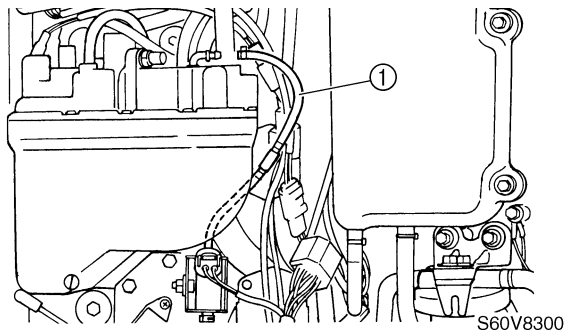
L/W : Blue/white
 R/Y : Red/yellow
 W/B : White/black
 W/R : White/red
 Y/R : Yellow/red

Checking the electric oil pump

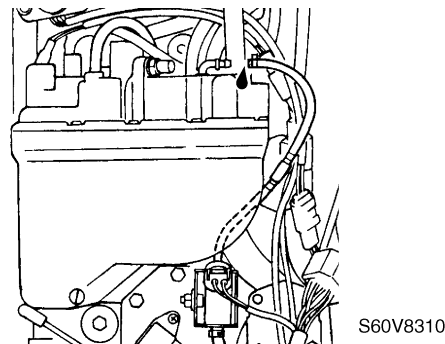
CAUTION:

- Use unleaded straight gasoline only.
- Do not use gasoline mixed with oil (pre-mixed fuel)

1. Remove the flywheel magnet cover and disconnect the electric oil pump hose ① from the vapor separator.



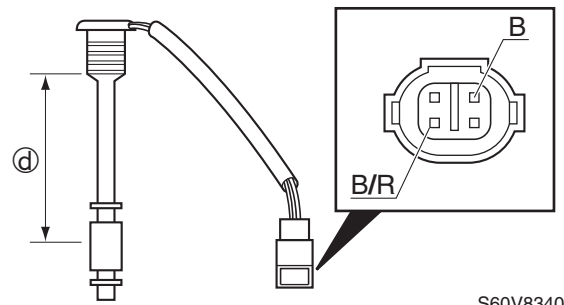
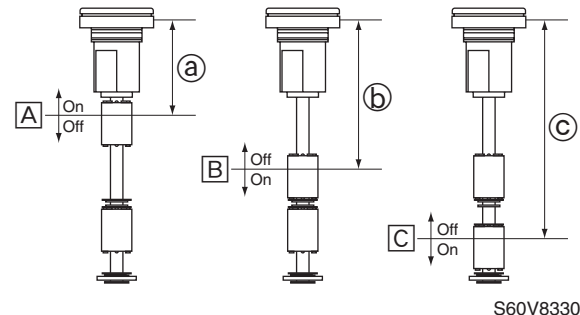
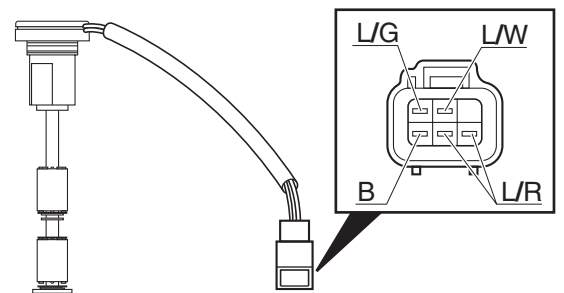
2. Wrap the end of the electric oil pump hose with a rag.
3. Start the engine and let it idle.
4. Check that the oil flows from the electric oil pump hose end. If no oil flows from the hose end, replace the electric oil pump.



5. Connect the electric oil pump hose.

Checking the oil level sensor

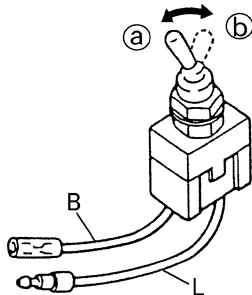
1. Check the oil level sensor for continuity. Replace if there is no continuity.



 Float position	Lead color			
	Black (B)	Blue/white (L/W)	Blue/green (L/G)	Blue/red (L/R)
A On	○	○		
A Off				
B On	○		○	
B Off				
C On	○			○
C Off				
 Float distance: a: 53–57 mm (2.09–2.24 in) b: 83–87 mm (3.27–3.43 in) c: 126.5–130.5 mm (4.98–5.14 in) d: 150–153 mm (5.91–6.02 in)				

Checking the emergency switch

1. Check the emergency switch for continuity. Replace if there is no continuity.



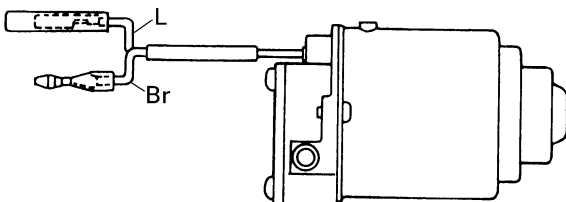
S60V8400

	Switch position	Lead color	
		Blue (L)	Black (B)
	Home (a)		
	On (b)	○ —	— ○

2. Check that the emergency switch returns automatically to the home position from the on position when released. Replace if necessary.

Checking the oil pump (remote oil tank)

1. Connect the positive battery terminal to the blue (L) lead.
2. Connect the negative battery terminal to the brown (Br) lead.
3. Listen for the operating sound of the oil pump (remote oil tank). Replace if there is no sound.

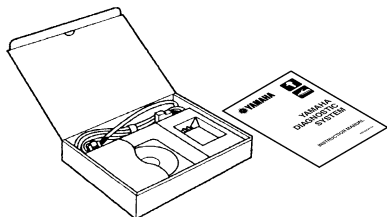


S60V8410

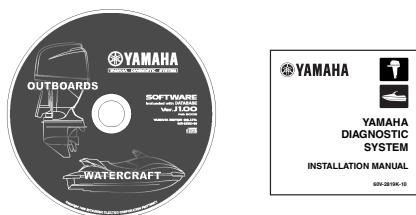
Troubleshooting

Special service tools	9-1
Yamaha Diagnostic System	9-2
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Operating	9-4
Troubleshooting	9-57
Power unit.....	9-58
Self-diagnosis.....	9-75
Diagnosing the electronic control system	9-75

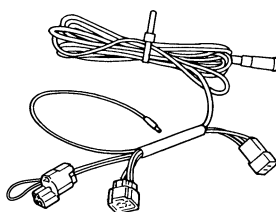
Special service tools



Yamaha Diagnostic System
60V-85300-00



Yamaha Diagnostic System
60V-WS853-00



Diagnostic flash indicator B
90890-06865

Yamaha Diagnostic System

Introduction

Features

The newly developed Yamaha Diagnostic System provides quicker detection and analysis of engine malfunctions for quicker troubleshooting procedures than traditional methods.

By connecting your computer to the ECM (Electronic Control Module) of an outboard motor using the communication cable, this software can be used to display sensor data and data stored in the ECM on a computer's monitor.

If this software is run on Microsoft Windows® 95, Windows 98, Windows Me, Windows 2000, or Windows XP the information can be displayed in colorful graphics. Also, the software can be operated using either a mouse or a keyboard.

In addition, the data for the main functions (Diagnosis, Diagnosis record, Engine monitor, and Data logger) can be saved on a disk or printed out.

Functions

1. **Diagnosis:** With the engine main switch ON, each sensor's status and each ECM diagnosis code or item is displayed. This enables you to find malfunctioning parts and controls quickly.
2. **Diagnosis record:** Sensors that had been activated and ECM diagnostic codes that have been recorded are displayed. This allows you to check the outboard motor's record of malfunctions.
3. **Engine monitor:** Each sensor status and the ECM data are displayed while the engine is running. This enables you to find malfunctioning parts quickly.
4. **Stationary test:** With the engine off, the ignition, fuel injection, electric fuel pump, electric oil pump, electric fuel feed pump, and ISC valve are checked. These tests can be performed quickly.
5. **Active test:** With the engine running, each firing cylinder has dropped and the engine speed is checked for changes to determine whether the cylinder is malfunctioning, and the ISC valve is checked as well. These tests can be performed quickly.
6. **Data logger:** Displays 20 minutes of recorded data for two or more of the items stored in the ECM. In addition, the operating time as compared to the engine speed and the total operating time are displayed. This allows you to check the operating status of the engine.
7. **Some files:** Lets you select and run other applications while continuing to run the diagnostic program.

Contents

1. Software (1)
2. Adapter (1)
3. Communication cable (1)
4. Instruction Manual (1)
5. Installation Manual (1)

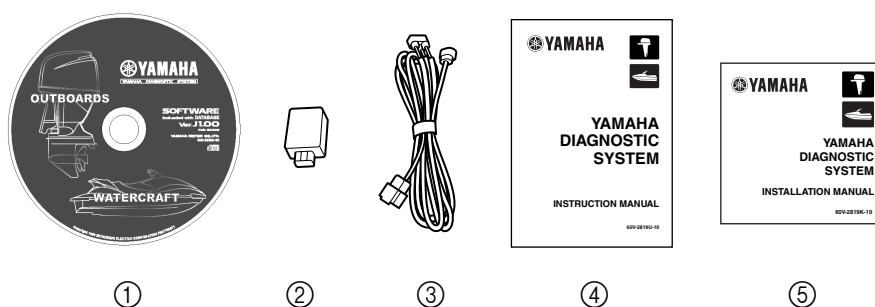


Fig. 1

Hardware requirements

Make sure that your computer meets the following requirements before using this software.

Computer:	IBM-compatible computer
Operating system:	Microsoft (Windows 95,) Windows 98, Windows Me, Windows 2000, or Windows XP (English version)
CPU:	
Windows 95/98:	i486X, 100 MHz or higher (Pentium 100 MHz or higher recommended)
Windows Me/2000:	Pentium, 166 MHz or higher (Pentium 233 MHz or higher recommended)
Windows XP:	Pentium, 300 MHz or higher (Pentium 500 MHz or higher recommended)
Memory:	
Windows 95/98:	16 MB or more (32 MB or more recommended)
Windows Me:	32 MB or more (64 MB or more recommended)
Windows 2000:	64 MB or more (128 MB or more recommended)
Windows XP:	128 MB or more (256 MB or more recommended)
Hard disk free space:	20 MB or more (40 MB or more recommended)
Drive:	CD-ROM drive
Display:	VGA (640 × 480 pixels), (SVGA [800 × 600 pixels] or more recommended) 256 or more colors
Mouse:	Compatible with the operating systems mentioned above
Communication port:	RS232C (Dsub-9 pin) port, USB port
Printer:	Compatible with the operating systems mentioned above

NOTE:

- The amount of memory and the amount of free space on the hard disk differs depending on the computer.
 - Using this software while there is not enough free space on the hard disk could cause errors and result in insufficient memory.
 - This software will not run properly on some computers.
 - When starting up this program, do not start other software applications.
 - Do not use the screen saver function or the energy saving feature when using this program.
 - If the ECM is changed, restart the program.
 - Window XP is a multiuser operating system, therefore, be sure to end this program if the login user is changed.
 - The USB adapter cannot be used with Windows 95.
-

Operating

Connecting the computer to the outboard motor

NOTE:

Be sure to use the enclosed communication cable to connect the computer and adapter to the outboard motor.

1. Quit any applications that are running, and then turn off the computer.
2. Connect the communication cable to the 3-pin communication coupler of the outboard motor, the adapter, and the communication port of your computer.

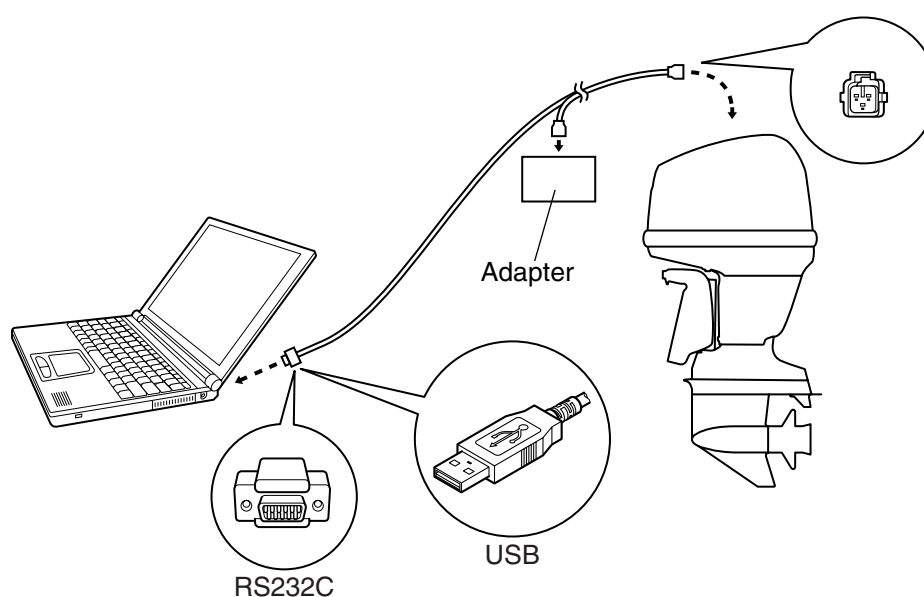


Fig. 2

NOTE:

Use either the COM1 or COM2 port, and, if necessary, set the serial port as specified in the computer's manual. Set the serial port where the RS232C (Dsub-9 pin) cable is connected to COM1 or COM2.

NOTE:

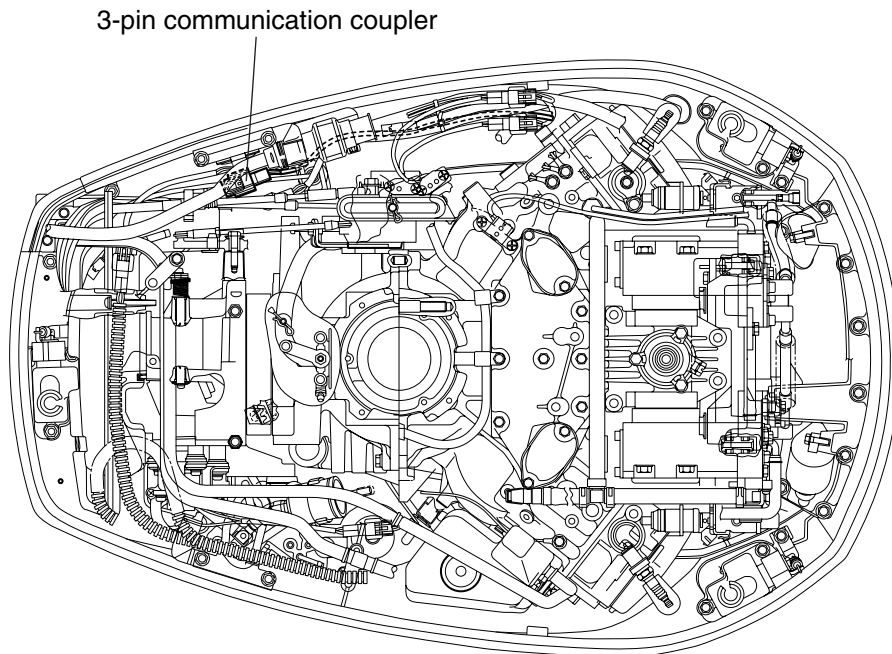
If using the USB adapter, be sure that you have installed the USB driver.

3. Connect the remote control to the outboard motor.
4. Connect the 12 V battery to the outboard motor.

NOTE:

The following items should be checked before starting the Yamaha Diagnostic System.

- The battery is properly charged and its specific gravity is within specification.
- There are no incorrect wiring connections.
- Wiring connections are properly secured and are not rusty.
- There are enough fuel and oil in each tank.

Connecting the communication cable to the outboard motor**Models: HPDI series 3.3L****Top view****Fig. 3**

Opening the yamaha diagnostic system

1. Turn the main switch of the outboard motor to ON.
2. Turn on your computer and start up (Windows 95), Windows 98, Windows Me, Windows 2000, or Windows XP.

NOTE:

The USB adapter cannot be used with Windows 95.

3. From the taskbar at the bottom of your computer screen, click the **Start** button (Fig. 4), point to **Programs**, and then click **YAMAHA DIAGNOSTIC SYSTEM**.

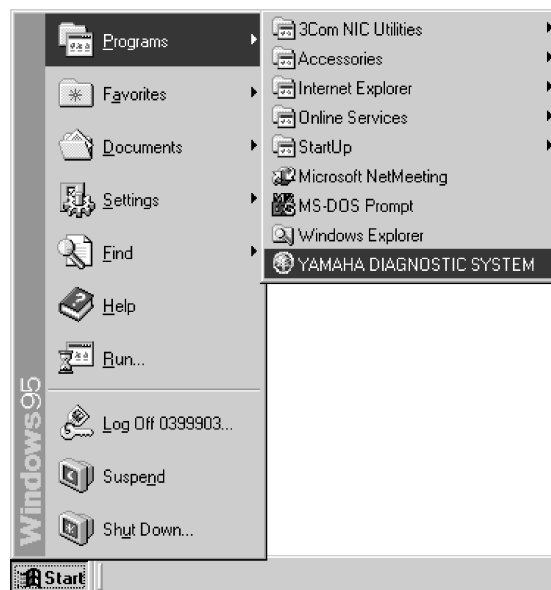


Fig. 4

4. Open the Yamaha Diagnostic System window. (Fig. 5) After about three seconds the display will automatically go to the first menu, or click or press any key to go to the first menu. (See fig. 6.)



Fig. 5

First menu

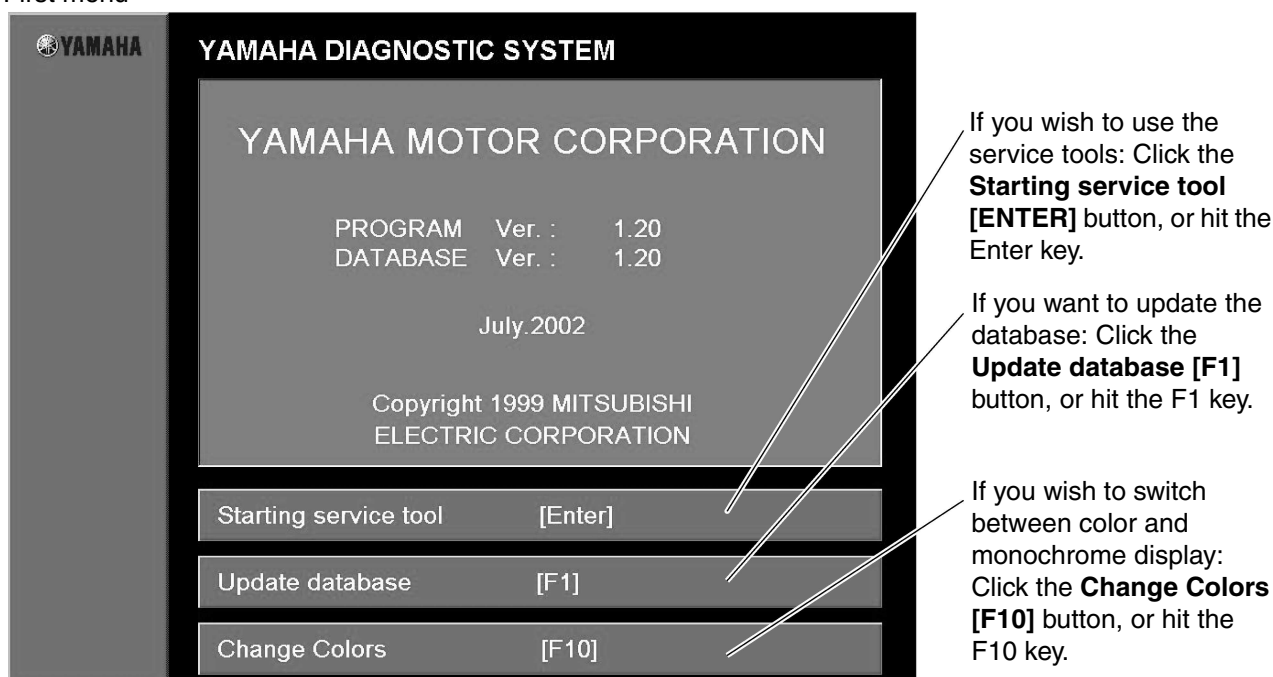


Fig. 6

- Click the **Starting service tool [Enter]** button or press the Enter key on your keyboard. (Fig. 7)

First menu

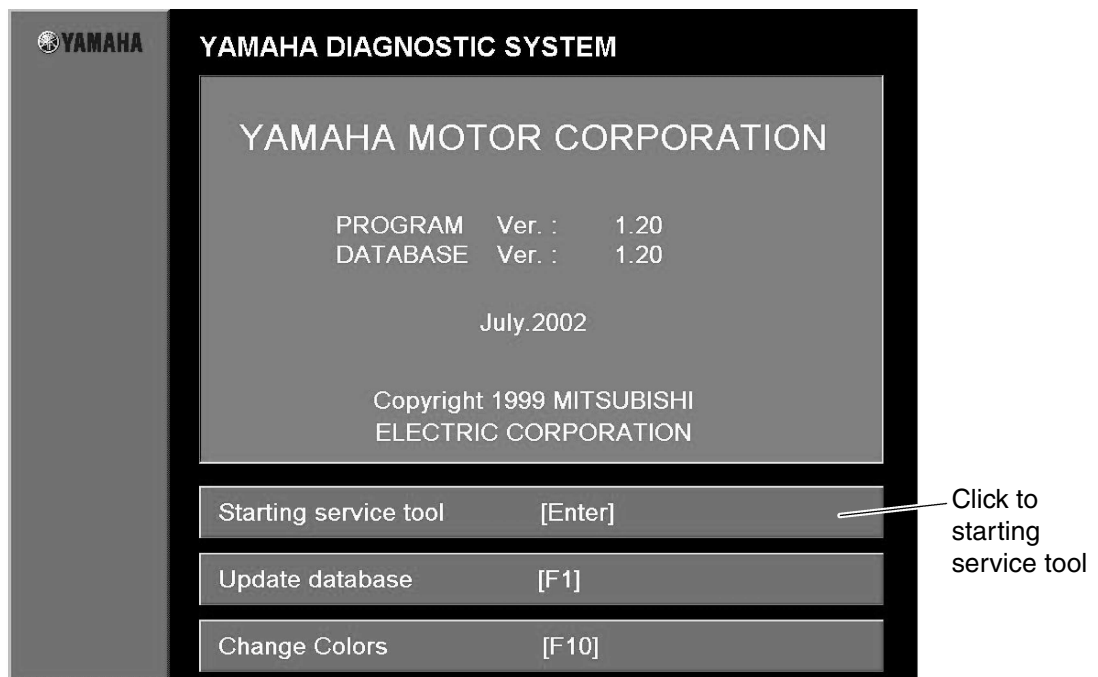


Fig. 7

NOTE:

- If an error message appears and the program stops operating, follow the error messages.
- If the program doesn't start, an error message will explain the problem. If the program doesn't start and an error message is not displayed, the cause of the problem is most likely insufficient computer memory.

6. Click or press any key to display the main menu.

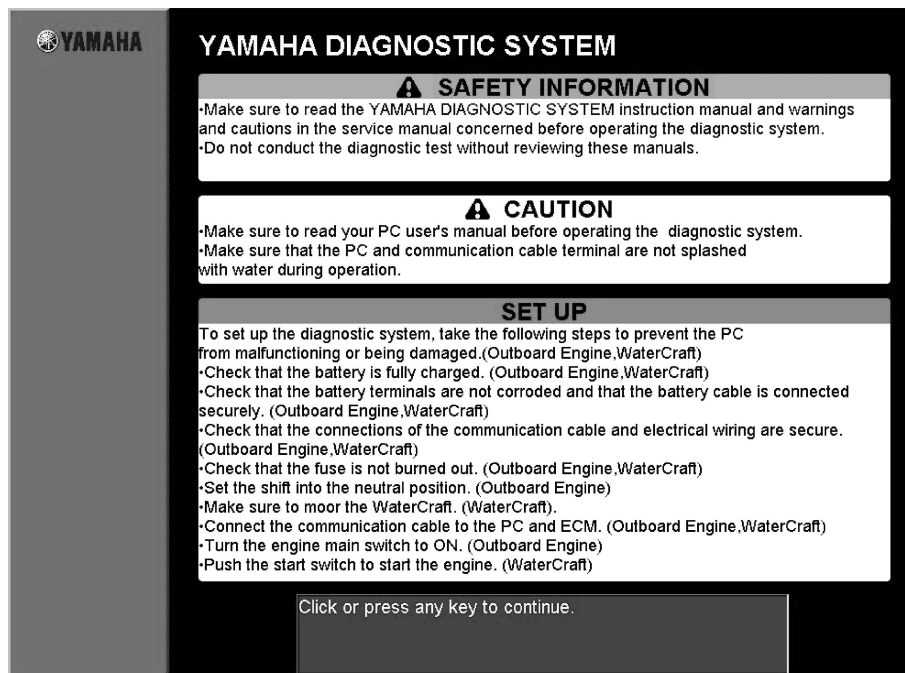


Fig. 8

NOTE:

If a diagnosis record is stored in the ECM, "Diagnosis record available," appears as a confirmation message before the Main Menu is displayed. (Fig. 9)

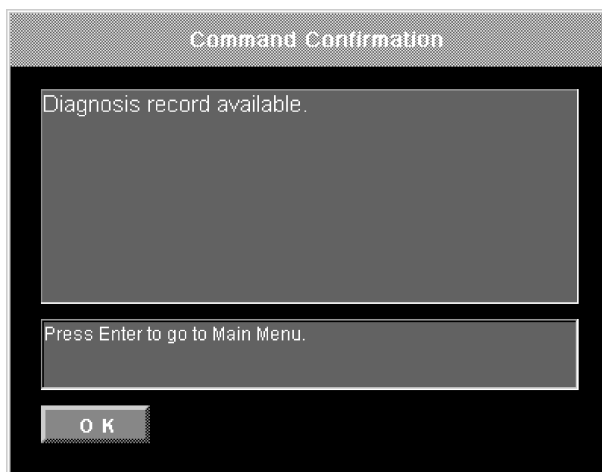


Fig. 9

Selecting commands from the main menu

Eight commands appear in the Main Menu. Select a command in any of the following two ways.

Two ways to select command:

- Move the mouse pointer over the selected command (① or ②) until it appears as a finger mark, and then click the selected command.
- Press any key number (1–8) corresponding to the selected command.

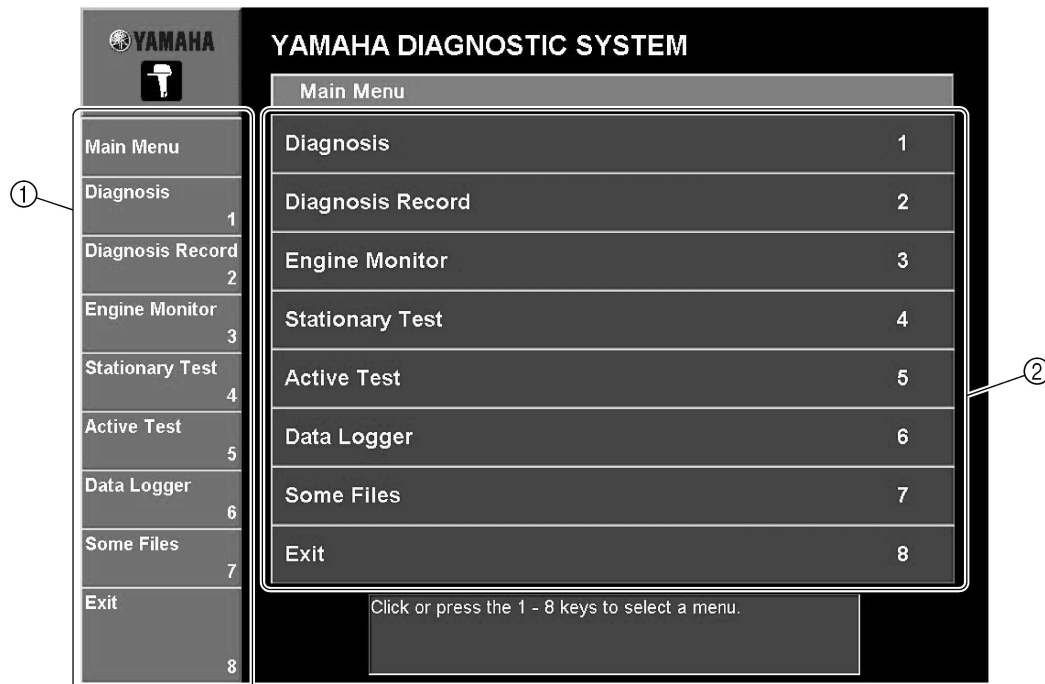


Fig. 10

NOTE: _____
 Some commands may not be available depending on the model of the outboard motor. If the command is not available, “Unavailable” appears to the right of the command. (Fig. 11)

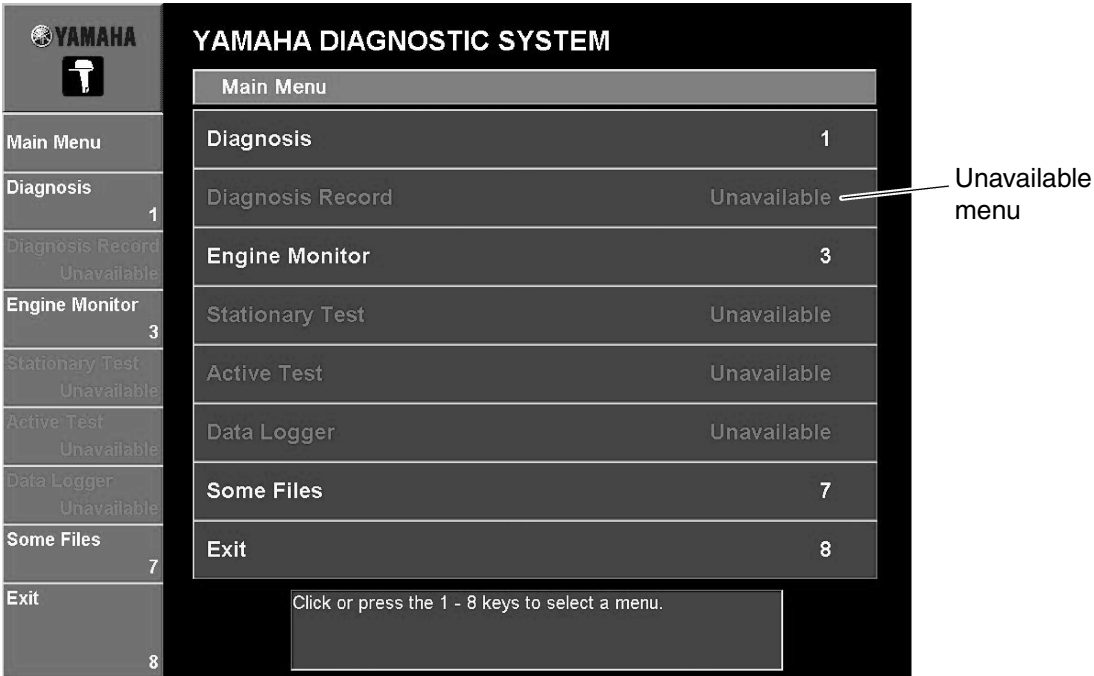


Fig. 11

Explanation of each command**1. Diagnosis**

The diagnosis codes, their corresponding part name, the diagnosing results, and the diagnostic criteria are listed.

List of items:

Condition of coils (pulser coil and crank position coil)

Condition of sensors (water temperature sensor, throttle position sensor, atmospheric pressure sensor, intake air temperature sensor, fuel pressure sensor)

Condition of battery (battery voltage)

Operation of switches (water detection switch, shift position switch, engine stop lanyard switch, thermostat switch, and shift cut switch)

Condition of operation (injectors)

2. Diagnosis record

The diagnosis code, its corresponding part name, the time of occurrence, and the total operation hours are listed. This command enables you to check the record of malfunctions, which will assist in reducing troubleshooting time. In addition, the diagnostic codes of malfunctions that have occurred can be deleted from the ECM.

The items are the same as those listed above for *Diagnosis*, except no record of engine stop lanyard switch.

1. Engine speed maximum
Indicates all-time peak engine speed (RPM), and time of its occurrence.
2. Fuel pressure minimum
Indicates all-time minimum recorded fuel-pressure value, and time of occurrence.
3. Over rev. control record
Indicates the number of times that over-rev prevention control has been triggered during motor's operating life to date.
4. Overheat record
Indicates the number of times that the overheat switch has been activated during motor's operating life to date.

NOTE:

If you have deleted data from the ECM, the program will reflect only the data recorded following the last reset.

3. Engine monitor

3-1. Monitoring of Digital Signals

The input signal of each sensor for the ECM is displayed.

In addition, the sensing item that is displayed can be changed.

Sensing items:

Sensors (water temperature sensor, throttle position sensor, atmospheric pressure sensor, intake air temperature sensor, fuel pressure sensor)

Voltage system (battery voltage)

Switches (water detection switch, shift position switch, engine stop lanyard switch, thermoswitch, and shift cut switch)

Operation signals (ignition, injectors, electric oil pump)

3-2. Graphing Feature

The graphing feature allows you to generate custom graphs of monitored engine data. The program reads the incoming monitor signals and creates the graph accordingly.

You are free to select the signals to be used for graphing, and you can freely adjust the various graphing parameters. You can also save graphs and monitored signal data to disk, and recall this data at any time for viewing offline.

4. Stationary test

With the engine off, operation tests are performed.

Test items:

Spark ignition coil for each cylinder

Fuel injector for each cylinder

Operation of the electric fuel pump

Operation of the electric oil pump

5. Active test

With the engine running, operation tests are performed.

Test items:

Dropped cylinder

6. Data logger

Two out of six items (engine speed, fuel pressure, battery voltage, throttle position, water temperature, engine temperature) are selected and 20 minutes of their recorded data are displayed on a graph. The operating time as compared to the engine speed and the total operating time are also displayed.

NOTE:

Only the six items that correspond to each model are displayed.

7. Some files

Lets you select and run other applications while continuing to run the diagnostic program.

NOTE: _____

This program may not work correctly on some computer configurations (on some OS/hardware combinations).

8. Exit

The program is exited.

Diagnosis

The diagnosis codes of malfunctions recorded in the outboard motor's ECM, the diagnosis codes' corresponding part name, the results of the diagnosis, and the condition of the part are listed. Eight items can be displayed at one time. To check the other items, scroll the display.

Other than Normal will be highlighted in red and will be listed from the top

YAMAHA		YAMAHA DIAGNOSTIC SYSTEM			
		Diagnosis	ECM No.:60V8591A00		
		Code	Item	Result	Condition
		14	Crank position sensor	Irregular	Irregular signal
		13	Pulser coil	Normal	
		15	Water temp sensor	Normal	
		18	Throttle position sensor	Normal	
		19	Battery voltage	Normal	
		22	Atmospheric press sensor	Normal	
		23	Intake temp sensor	Normal	
		25	Fuel press sensor	Normal	

1. Check wiring for proper connection or damage.
 2. Check sensor resistance.
 3. Check output peak voltage.

Print [F1] Use UP and DN arrow keys to scroll page.
 Use LH and RH arrow keys to move page up or down.
Save [F2] Press F1 to print, F2 to save.

Displays keyboard operations.

Displays troubleshooting procedures for selected code.

Fig. 12

Operating procedure:

Select the code number that you wish to view a diagnosis record for by either clicking it or pressing the up or down arrow keys on your keyboard.

To scroll the display and view other items, click ▲ or ▼ in the scroll bar, or press the up or down arrow keys on your keyboard.

NOTE:

- Items where "Normal" does not appear in the **Result** column are displayed at the top of the list.
- The selected code is highlighted in light blue and its confirmation procedure is displayed below the table.

Print

By selecting the **Print** command in the Diagnosis, Diagnosis record, Engine monitor, or Data logger mode, the data from the corresponding window can be printed.

1. Click the **Print [F1]** button or press the F1 key on your keyboard. The **Print** dialog box is displayed. (Fig. 13)

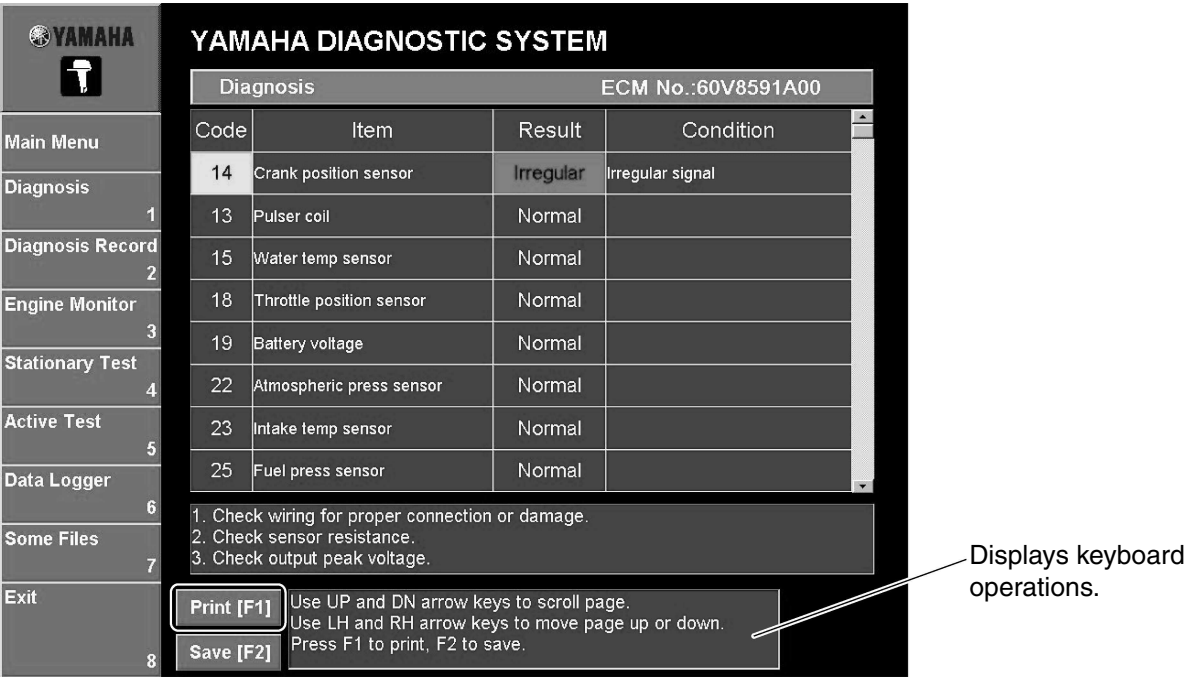


Fig. 13

2. Specify the printer, the printing range, and the number of copies to be printed.

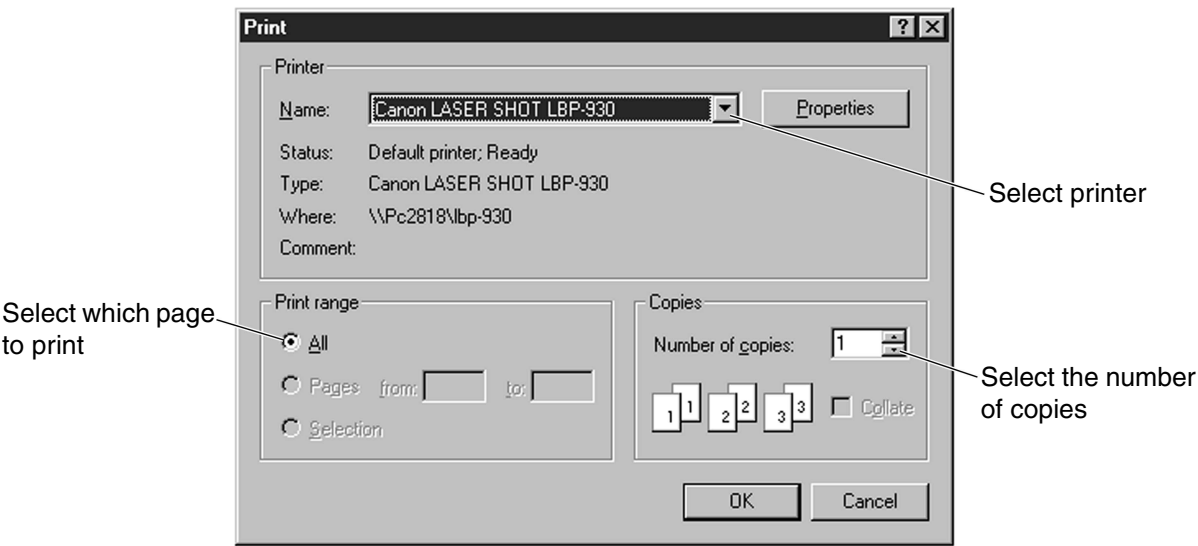


Fig. 14

- Click the **OK** button to begin printing.
To cancel printing, click the **Cancel** button.

NOTE:

The Print Screen function in Windows cannot be used since scroll data cannot be printed.

Save

By selecting the **Save** command in the Diagnosis, Diagnosis record, Engine monitor, or Data logger mode, the corresponding data can be saved on a disk.

Operating procedure:

- Click the **Save [F2]** button or press the F2 key on your keyboard. The **Save As** dialog box is displayed. (Fig. 15)

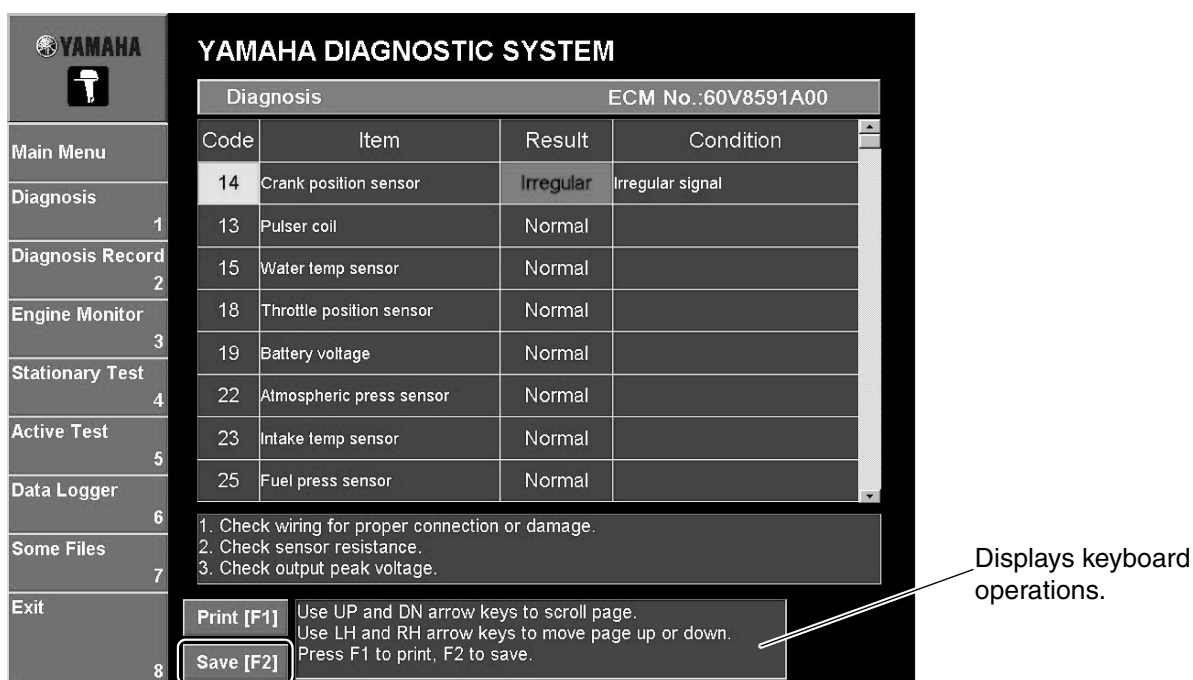


Fig. 15

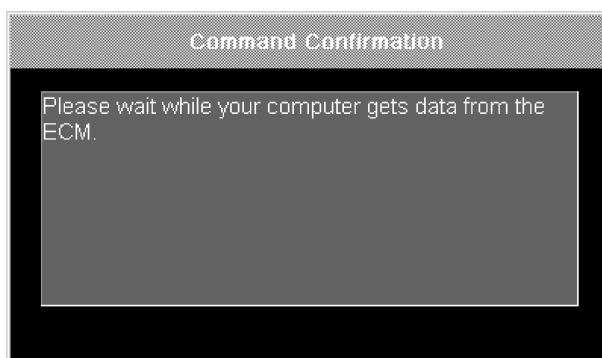


Fig. 16

2. Select the disk and folder where the data will be saved and specify its file name. (Fig. 17)

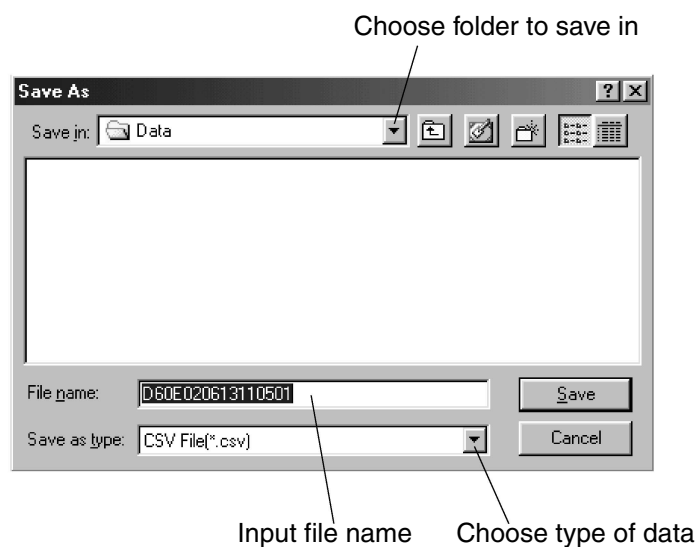


Fig. 17

NOTE:

The default file name is assigned as shown below.

Example: D 60E 02 06 13 1105 XX .csv
ID code Model Year Month Day Time File serial number

- Click the **Save** button to save the data.
To cancel saving, click the **Cancel** button. (Fig. 17)
- If Microsoft Excel (version 97 or later) is installed on your computer, you can save the data onto a one-page US Letter-size form as shown below.

[illegible]

Fig. 18

Diagnosis record

The diagnosis codes of malfunctions that have been recorded in the outboard motor's ECM, the diagnostic codes' corresponding part name, and the time when the malfunctions occurred are listed. A maximum of 7 items can be displayed at one time. The last item displayed is for the water detection switch only. The latest occurrence appears on top. In addition, diagnosis codes stored in the ECM can be deleted.

1. Engine speed maximum
Indicates all-time peak engine speed (RPM), and time of its occurrence.
2. Fuel pressure minimum
Indicates all-time minimum recorded fuel-pressure value, and time of occurrence.
3. Over rev. control record
Indicates the number of times that over-rev prevention control has been triggered during motor's operating life to date.
4. Overheat record
Indicates the number of times that the overheat switch has been activated during motor's operating life to date.

NOTE:

- Please never run the engine with the fuel supply cut off, as doing so may cause inappropriate values to be recorded.
- If you have deleted data from the ECM, the program will reflect only the data recorded following the last reset.

The screenshot shows the Yamaha Diagnostic System interface. On the left is a vertical menu with options: Main Menu, Diagnosis, Diagnosis Record, Engine Monitor, Stationary Test, Active Test, Data Logger, Some Files, and Exit. The main display area shows the 'Diagnosis Record' screen for ECM No.: 60V8591A00. It lists 7 items, with the first item being 'Diagnosis Record is unavailable.' Below this, a table displays engine history information:

Item	Result
Engine speed maximum	6825 [r/min] 201.5
Fuel pressure minimum	5.2 [MPa] 113.4
Over rev. control record	25 [Times]
Overheat record	1 [Times]
Total hours of operation	2507

At the bottom, there are buttons for 'Print [F1]', 'Save [F2]', and 'Delete [F3]'. A text box explains: 'Use UP and DN arrow keys to select item. Press F3 to delete. Press F1 to print, F2 to save.'

Annotations on the right side of the image:

- Pointing to the 'Diagnosis Record is unavailable.' message: 'If no problems have been recorded, the message area will display a message indicating that there are no recorded problems.'
- Pointing to the engine history table: 'Displays engine history information. (Fields will be left empty if recorded data does not exist in the ECM.)'
- Pointing to the count values (25 [Times], 1 [Times]): 'Displays count values. (Fields will be left empty if recorded data does not exist in the ECM.)'

Fig. 19

YAMAHA DIAGNOSTIC SYSTEM

Diagnosis Record ECM No.:60V8591A00

No.	Code	Item	Occurred
1	13	Pulser coil	96.6
2			
3			
6	27	Water in fuel	233.3
7		Over heat	249.5

Item	Result
Engine speed maximum	6825 [r/min] 201.5
Fuel pressure minimum	5.2 [MPa] 113.4
Over rev.control record	25 [Times]
Overheat record	1 [Times]
Total hours of operation	2507

1. Check wiring for proper connection or damage.
2. Check coil resistance.
3. Check output peak voltage.

Print [F1] Use UP and DN arrow keys to select item.
Press F3 to delete.
Save [F2] Press F1 to print, F2 to save. Delete [F3]

Shows total hours of operation.

Shows checking procedure corresponding to the selected code.

Indicates operations available from the computer keyboard.

Fig. 20

NOTE:

When a Diagnosis record is not available, "Diagnosis Record is unavailable" is displayed. (Fig. 21)

YAMAHA DIAGNOSTIC SYSTEM

Diagnosis Record ECM No.:60V8591A00

No.	Code	Item	Occurred
1		Diagnosis Record is unavailable.	
2			
3			
6			
7			

Item	Result
Engine speed maximum	6825 [r/min] 201.5
Fuel pressure minimum	5.2 [MPa] 113.4
Over rev.control record	25 [Times]
Overheat record	1 [Times]
Total hours of operation	2507

Print [F1] Use UP and DN arrow keys to select item.
Press F3 to delete.
Save [F2] Press F1 to print, F2 to save. Delete [F3]

Fig. 21

Deleting diagnosis record in the ECM:

1. Select the item that you wish to delete by either clicking it or pressing the up or down arrow keys on your keyboard.

NOTE:

The selected code is highlighted in light blue.

2. Click the **Delete [F3]** button or press the F3 key on your keyboard. (See fig. 21.) A confirmation message appears. (Fig. 22, 23)

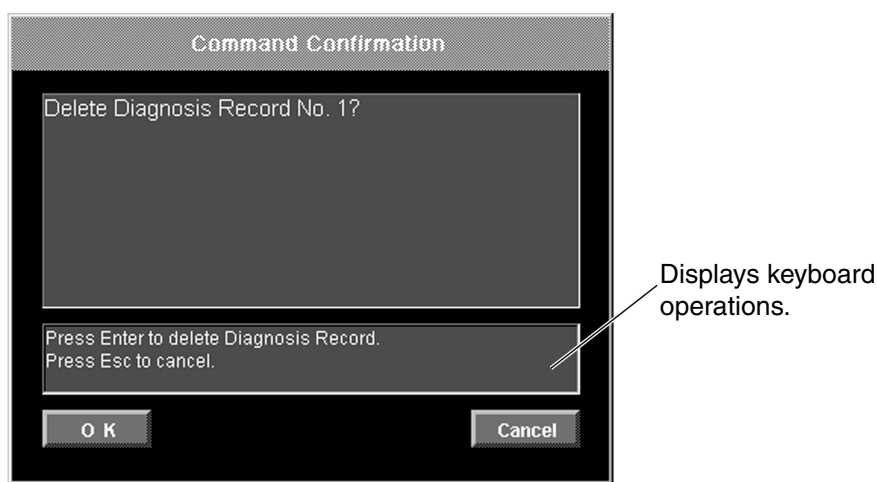


Fig. 22

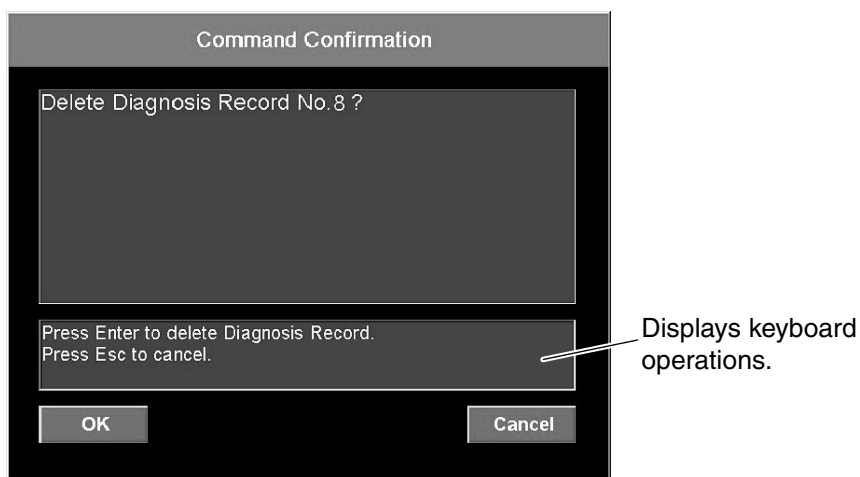


Fig. 23

NOTE:

Record No. 8 is the maximum engine speed value, while Record No. 9 is the minimum fuel-pressure value. Note that the over-rev. control count and overheat count cannot be deleted.

- Click the **OK** button or press the Enter key on your keyboard. (Fig. 22, 23) The selected item is deleted. To cancel deleting the item, click the **Cancel** button or press the Esc key on your keyboard.

NOTE:

If an error occurs while an item is being deleted, an error message appears. Follow the instructions that appear in the error message. (Fig. 24)

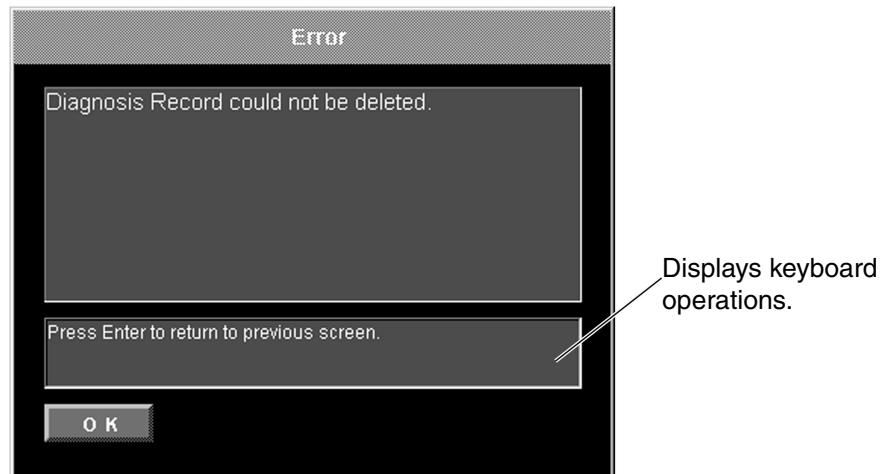


Fig. 24

Engine monitor

⚠ WARNING

Do not use the Engine Monitor function to check the engine condition while operating a boat, otherwise you may become distracted, which could result in a collision.

CAUTION:

Be sure to avoid splashing water on the laptop computer, adapter, and communication cable, and to avoid damaging them with strong sudden jolts or vibration.

The data from the ECM of the outboard motor is displayed.

Ten items can be displayed at one time. To view the other items, scroll the display. Displayed items can be changed as necessary.

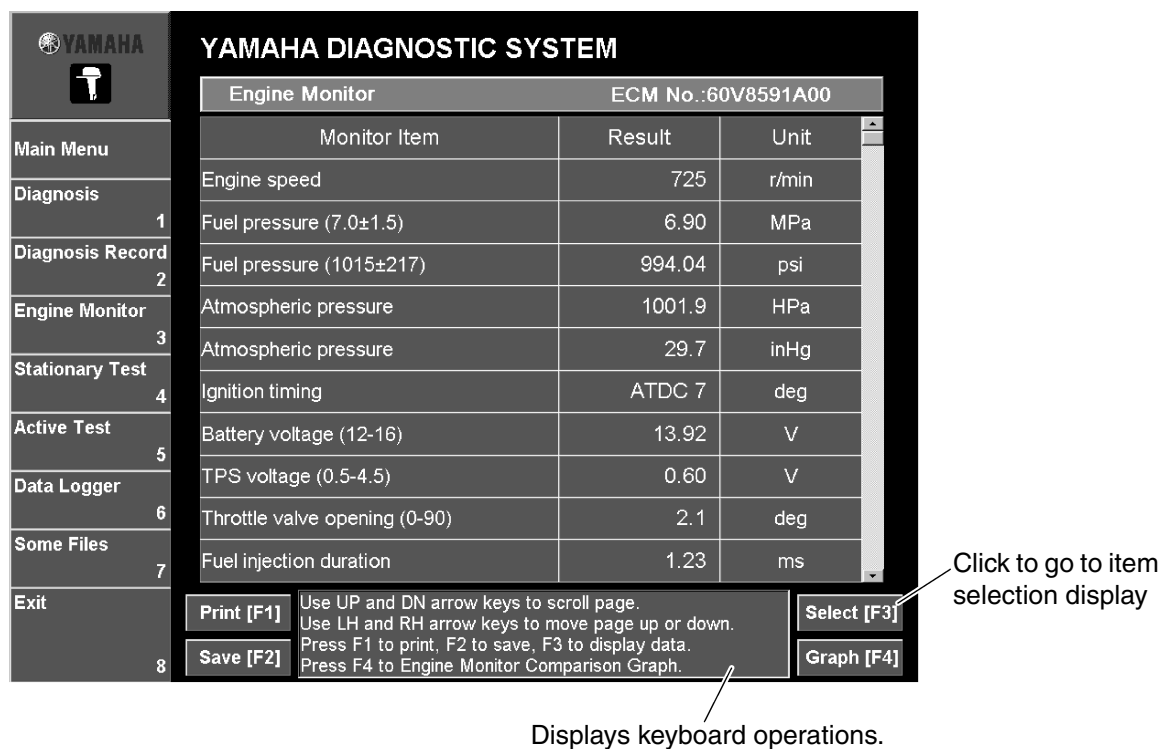


Fig. 25

NOTE:

Within the item column, the appropriate value range for each item is indicated in parentheses. If the monitored value is outside this range, the displayed value will be highlighted in red. (Fig. 26)

 YAMAHA 	YAMAHA DIAGNOSTIC SYSTEM		
		Engine Monitor	ECM No.:60V8591A00
Main Menu		Monitor Item	Result Unit
Diagnosis	1	Engine speed	3225 r/min
Diagnosis Record	2	Fuel pressure (7.0±1.5)	5.68 MPa
Engine Monitor	3	Fuel pressure (1015±217)	823.74 psi
Stationary Test	4	Atmospheric pressure	631.8 HPa
Active Test	5	Atmospheric pressure	18.7 inHg
Data Logger	6	Ignition timing	ATDC 30 deg
Some Files	7	Battery voltage (12-16)	15.23 V
Exit	8	TPS voltage (0.5-4.5)	0.00 V
		Throttle valve opening (0-90)	-10.5 deg
		Fuel injection duration	3 ms
		Print [F1]	Use UP and DN arrow keys to scroll page. Use LH and RH arrow keys to move page up or down.
		Save [F2]	Press F1 to print, F2 to save, F3 to display data. Press F4 to Engine Monitor Comparison Graph.
		Select [F3]	
		Graph [F4]	

Fig. 26

Operating procedure:

1. To scroll the display and view other items, click ▲ or ▼ in the scroll bar, or press the up or down arrow keys on your keyboard.
2. To change a displayed item, click the **Select [F3]** button or press the F3 key on your keyboard.
3. Select an item by either clicking it or pressing the up or down arrow keys on your keyboard, and then press the space bar. (Fig. 27)

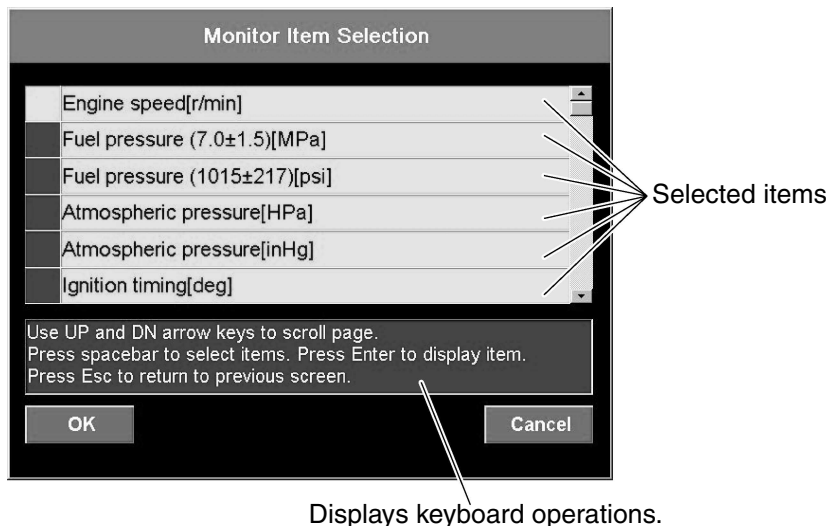


Fig. 27

NOTE:

- Selected items have a light blue background. Items that are not selected have a blue background. The box to the left of items that are being moved are light blue. Items that are not selected appear in blue.
- At initialization, all items are displayed.

4. Click the **OK** button or press the Enter key on your keyboard. The **Engine monitor** window appears. To cancel the monitor, click the **Cancel** button or press the Esc key on your keyboard. (Fig. 27)

Using the graph feature

The graph feature lets you generate a graph from the monitored engine data. The program reads the monitored input signal and generates the graph accordingly. You can also save the monitored signal data to disk so that you can regenerate and review the graphs later.

- 1. Click the **Graph [F4]** button at the bottom right of engine monitor window, or else hit the F4 key. (Fig. 25)
- 2. The program displays the comparison graph window. (Fig. 28)

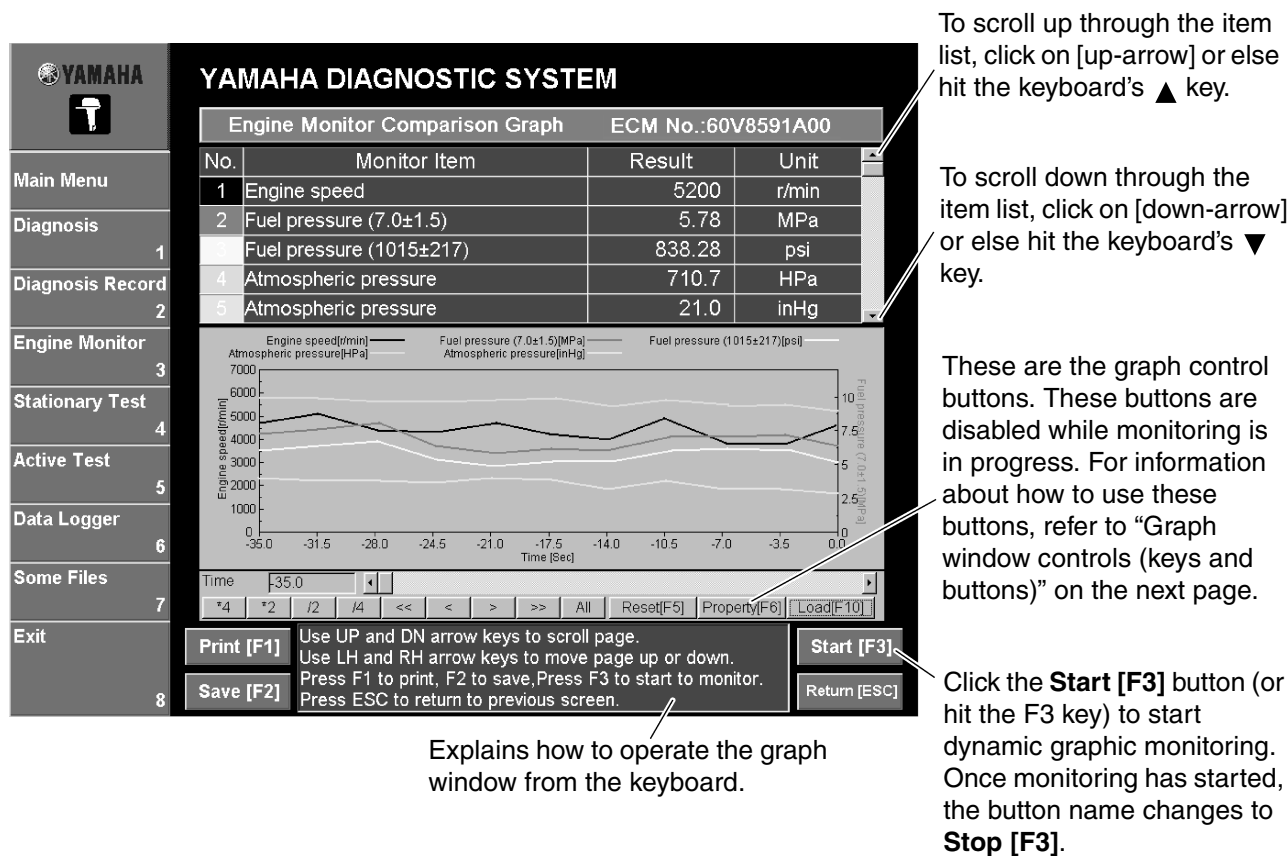


Fig. 28

- 3. Click the **Start [F3]** button or press the F3 key to begin graphing. The program reads the monitored signals (using default settings) and generates the graph accordingly. (Fig. 28)
- 4. The program automatically stops reading the signal data when the specified time elapses. You can stop data reading at any time by clicking the **Stop [F3]** button (or by pressing F3).
- 5. Click the **Save [F2]** button or press the [F2] to save the graph.

NOTE:

The default file name is assigned as shown below.

Example: L 60V 02 06 12 1817 XX .csv
 ID code Model Year Month Day Time File serial number

- 6. When you are finished with graphic monitoring, click the **Return [Esc]** button (or press the ESC key). (Fig. 28)

7. The program displays a confirmation dialog asking whether you are sure you wish to delete previously saved signal and graph data (see Fig. 29). Click the **OK** button (or press the Enter key) to save the new data (overwriting the old data). The graph window will then close.

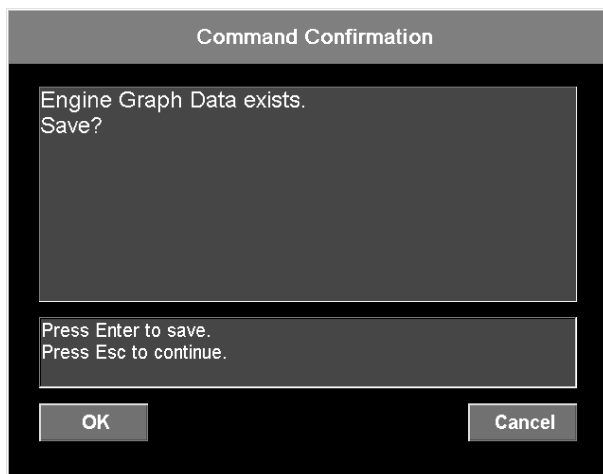


Fig. 29

Graph window controls (keys and buttons)

Keyboard	Button	Operation	Remarks
← →	 	Moves cursor in indicated direction (by one sample increment).	Disabled when monitoring.
Shift + ← →	 	Moves cursor in indicated direction (by ten sample increments).	Disabled when monitoring.
Ctrl + ← →	None	Moves cursor in indicated direction (by 100 increments).	Disabled when monitoring.
Insert		Zooms in on time axis (2x zoom, centered on cursor).	Disabled when monitoring.
Delete		Zooms out on time axis (1/2 zoom, centered on cursor).	Disabled when monitoring.
PageUp		Scrolls graph 1/4-screen to the left.	Disabled when monitoring.
PageDown		Returns graph display settings to their defaults.	Disabled when monitoring.
Space		Scrolls graph 1/4-screen to the right.	Disabled when monitoring.
F5		Deletes currently saved data and returns graph display settings to their defaults. (This feature is disabled during offline operation.)	Disabled when monitoring.
F6		Displays the graph properties window. (Note that the Logging settings are disabled during offline operation.)	Disabled when monitoring.
F10		Loads recorded data. When the coupler is connected and communication is in progress, this feature can be used to load and display the recorded data corresponding to the engine ECM No. The loaded data can be regraphed using the saved settings.	Disabled when monitoring.

8. If you wish to change the way that the program inputs and graphs the monitored data, click the **Properties [F6]** button (or press F6). (Fig. 28) This program responds by opening the graph properties window, illustrated below. To set the graph property refer to the graph setting table.

Controls On the Graph Properties Window

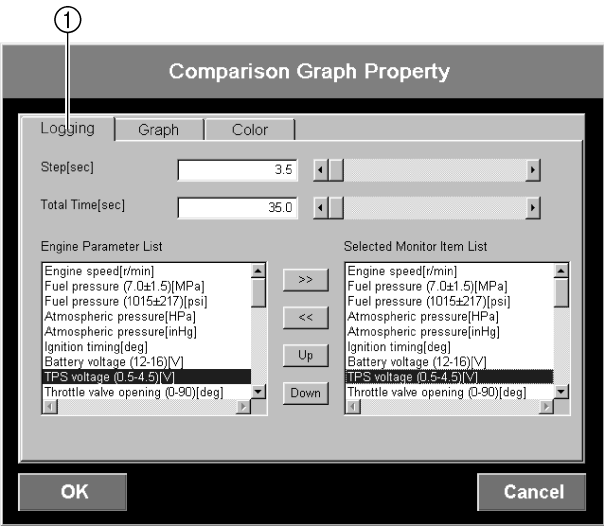


Fig. 30

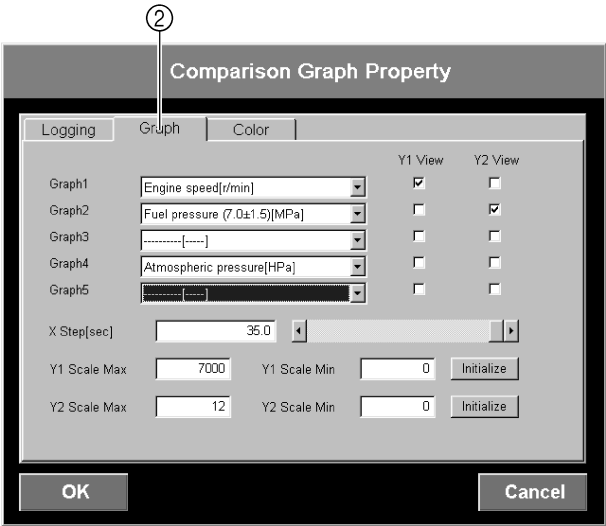


Fig. 31

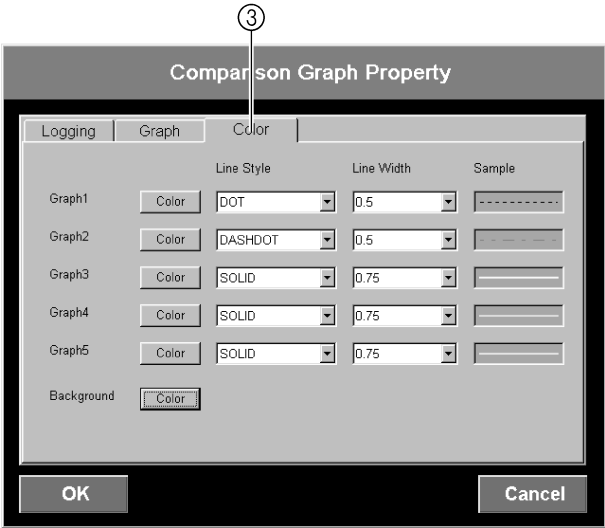


Fig. 32

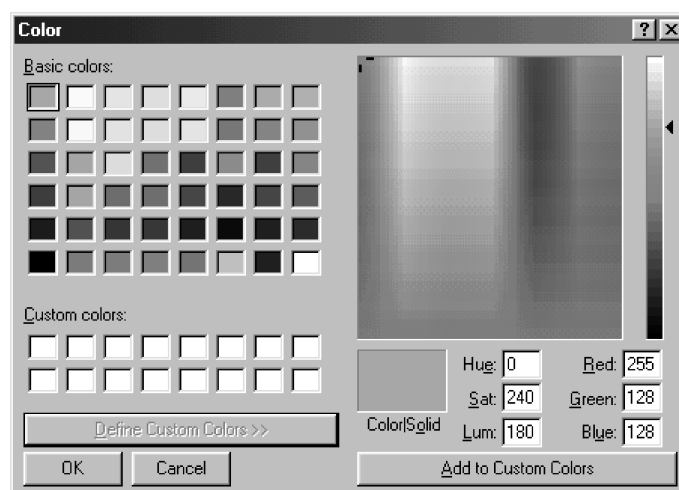


Fig. 33

Graph setting table

Tab	Property	Range
① Logging	Step (Time Interval)	Sets the period at which the program reads the signals being monitored. The minimum setting varies according to the number of items you are monitoring: starting at 0.5s for up to five items and then rising 0.5s for each multiple of five that you pass. Example: If one to five items, the available range is 0.5s to 60s. If six to ten items, the available range is 1.0s to 60s. Note: If the program is unable to read data at the exact interval that you select, it will operate at the nearest available interval.
	Total Time	Sets the total monitoring time. At 0.5s resolution: 5s to 7 hours At 60s resolution: 600s to 700 hours
	Item Display Order	Changes the order of the items on the display.
② Graph	Selects item to be plotted on graph.	Select up to a maximum of five items for display on the graph.
	X Length (Sec)	Sets the length (in seconds) for the graph's X axis. The available range is the same as the range for the Total Time setting. Example: If you set the Step setting (on the Logging sheet) to 0.5s and you set X Length to 5s, the resulting graph display will show ten discrete steps.
	Y1 Scale Max	Sets the top value for the left Y axis. The range varies according to the input step setting (the Step setting on the Logging sheet).
	Y2 Scale Max	Sets the top value for the right Y axis. The range varies according to the input step setting (the Step setting on the Logging sheet).
	Y1 View	If you check the box, the graph plots the corresponding item against the left Y axis.
	Y2 View	If you check the box, the graph plots the corresponding against the right Y axis.
③ Colors	Color	Select any color available on your system.
	Line Width	Select from five widths: 0.5pt, 0.75pt, 1.0pt, 1.5pt, 2.0pt
	Line Style	Select from four styles: solid, dashed, dot-dash, dot-dot-dash (Dashed, dot-dash, and dot-dot-dash are available only if line width is set to 1.0pt.)
	Background	Select any color available on your system.

Viewing saved graphs offline

The program allows you to view saved graph data offline. Once you have saved some graph data, you can recall it and review it with no need to connect to the ECM.

1. With the adapter disconnected, start up the Yamaha Diagnostic System on your computer.
Then click the **Starting service tool [Enter]** button, or hit the Enter key. (Fig. 34)

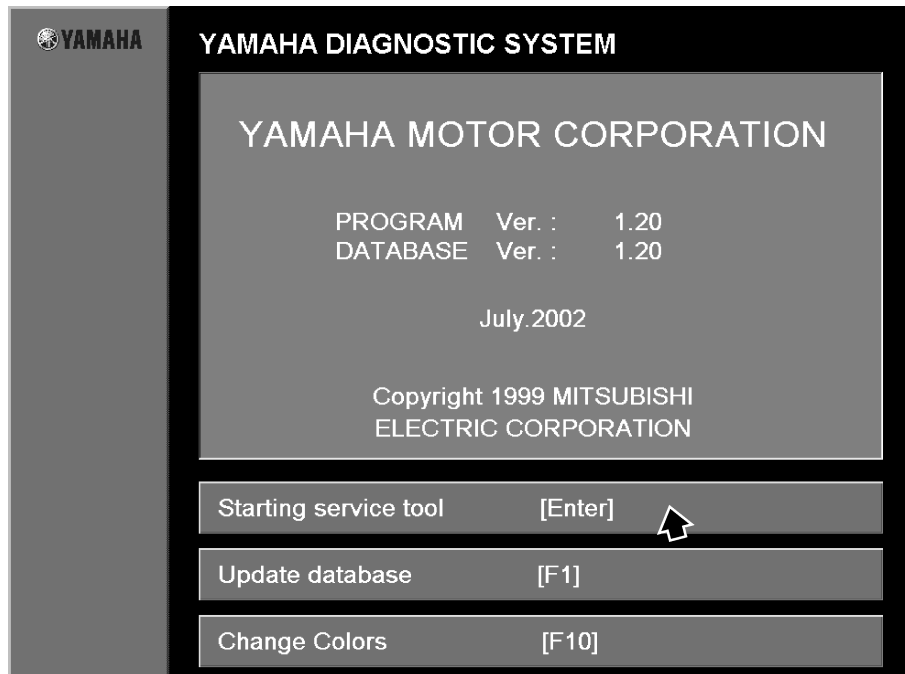


Fig. 34

2. When the “communication error” dialog appears, click the **OffLine** button. (Fig. 35)

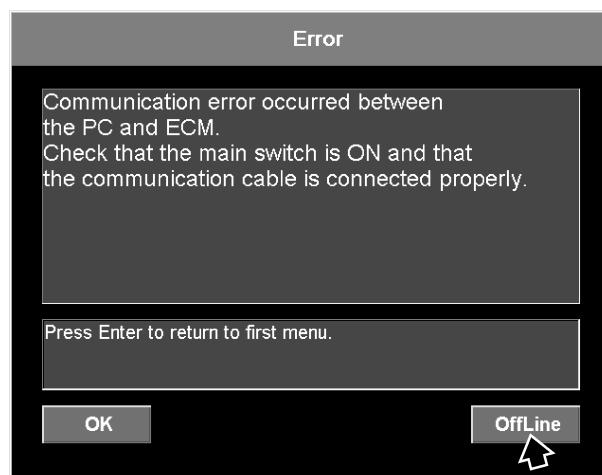


Fig. 35

3. Click the **Load [F10]** button, or hit the F10 key. (Fig. 36)

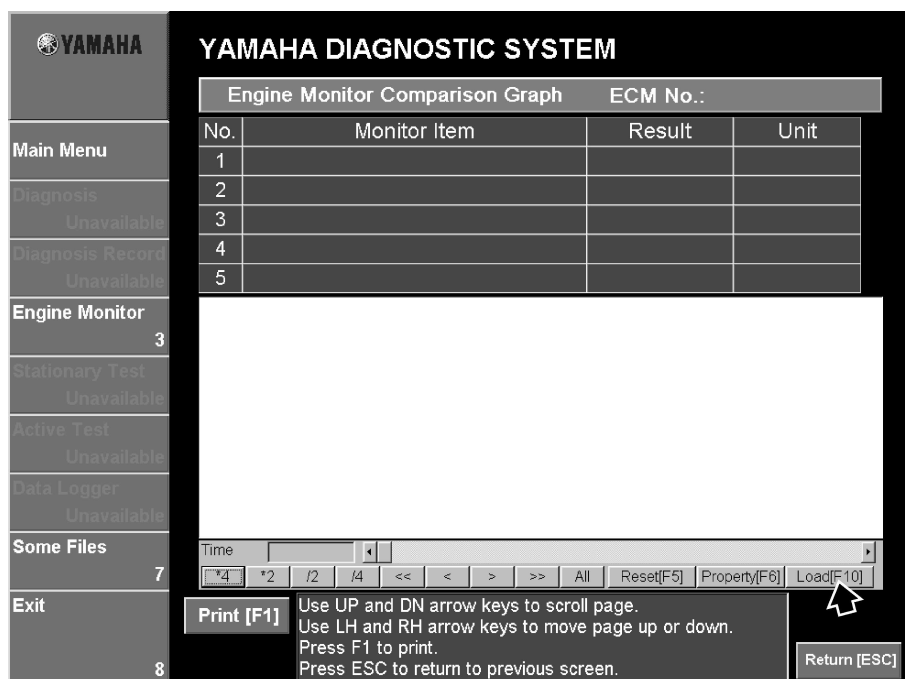


Fig. 36

4. Select the file containing the saved graph data that you want to view, and then click the **Open** button. (Fig. 37)

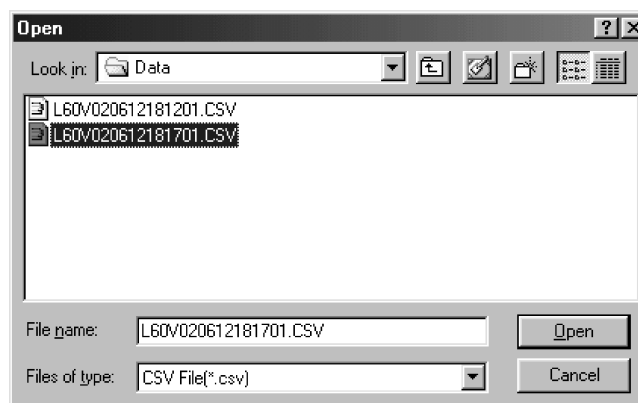


Fig. 37

NOTE: _____
Graph files no saved in the Engine Monitor Comparison Graph mode cannot be opened.

5. The program displays the selected graph data. (Fig. 38)

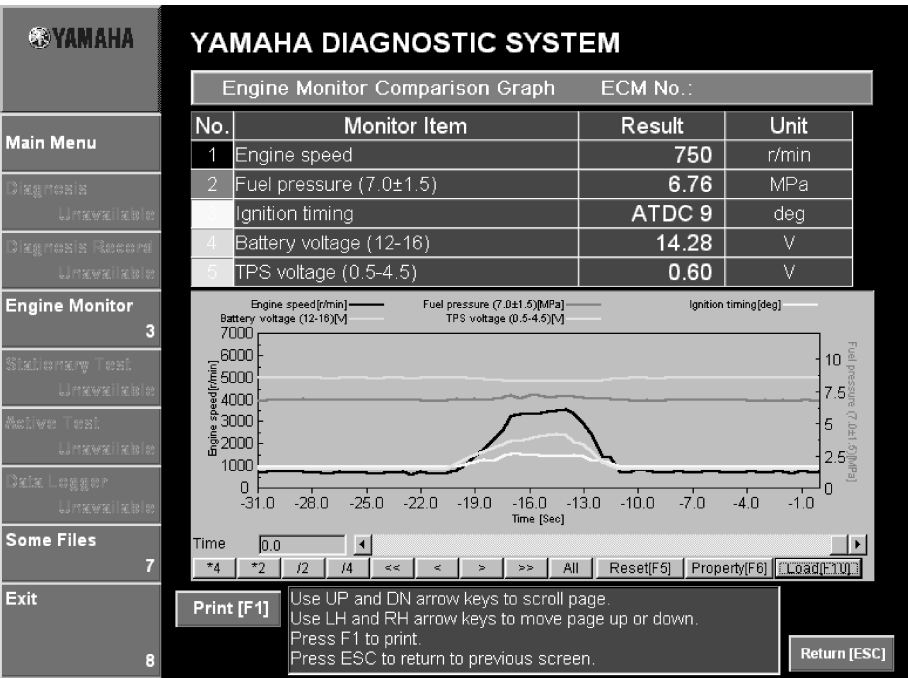


Fig. 38

NOTE: Remember that you cannot carry out actual monitoring while working offline. Offline graph operation is limited to recalling and viewing saved graph data.

Stationary test

Selecting this command displays a window where stationary tests (spark ignition coil #, operate injector #, operate electric fuel pump, operate electric oil pump) can be selected.

⚠ WARNING

Avoid clicking the Execute and Cancel buttons repeatedly, otherwise the ECM or PC may not work properly and they may be damaged.

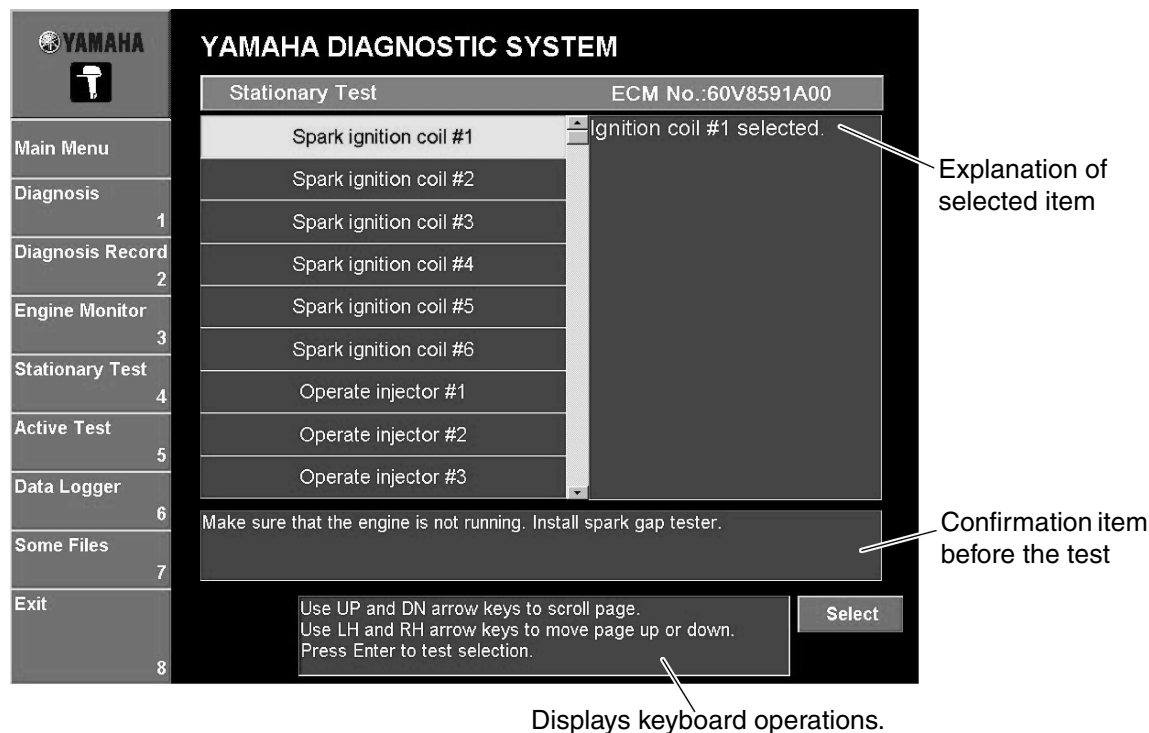


Fig. 39

Sparkign ignition coil procedure:

A voltage is applied to the ignition coil of the selected cylinder, a spark is created in the spark gap tester, and then the ignition system is checked. Five sparks are created within five seconds.

⚠ WARNING

- Do not touch any connections of the spark gap tester lead wires.
- Do not let sparks leak out of the removed spark plug cap.
- Keep flammable gas or liquids away since this test will produce sparks.

1. Select the test that you wish to perform by either clicking it or pressing the up or down arrow keys on your keyboard. (Fig. 39)

NOTE:

- Make sure that the engine is not running.
- The selected item is highlighted in light blue.
- The details of the selected test are displayed in the column on the right, and the items that must be either checked or performed before the test can start are displayed below the table.
- Only one item can be selected at one time.
- A special tool (spark gap tester 90890-06754) is needed.

2. Connect the spark plug cap of the cylinder that will be tested to the spark gap tester.
Spark gap tester: 90890-06754
3. Set the spark gap length on the adjusting knob.
Ignition spark gap: 9 mm (0.4 in)

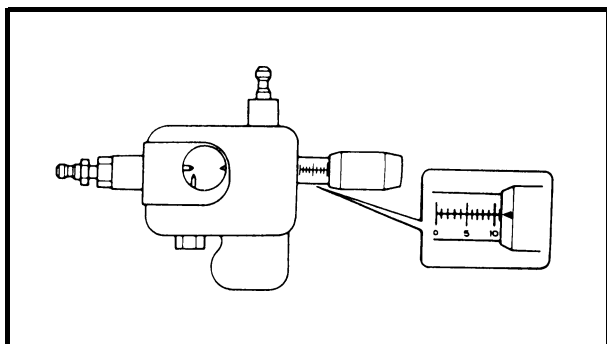


Fig. 40

4. Select the cylinder number where the spark gap tester is connected, and then click the **Select** button or press the Enter key on your keyboard. (Fig. 39)

5. Click the **Execute** button or press the Enter key on your keyboard. (Fig. 41)

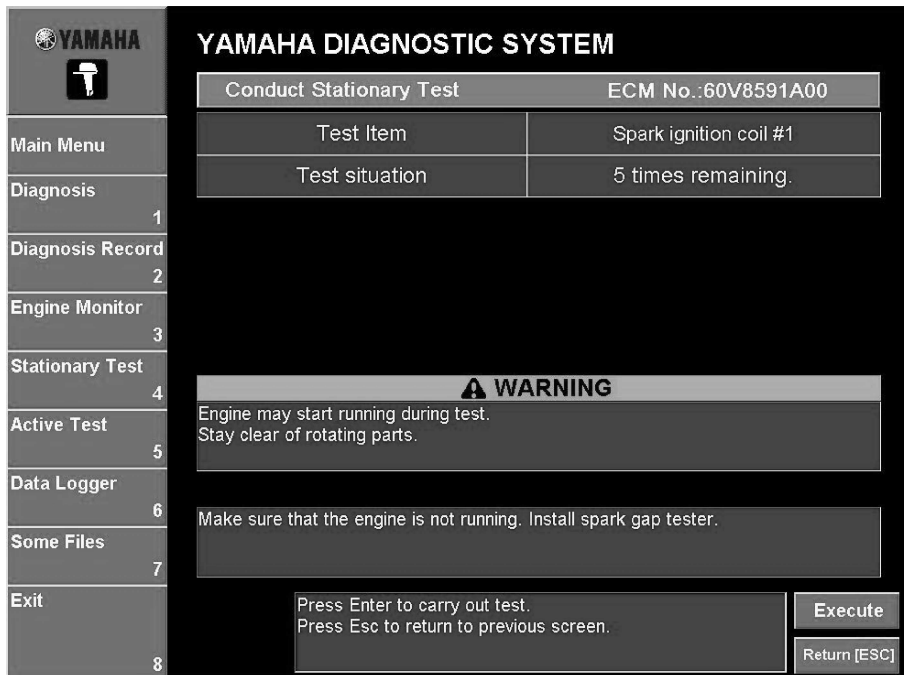
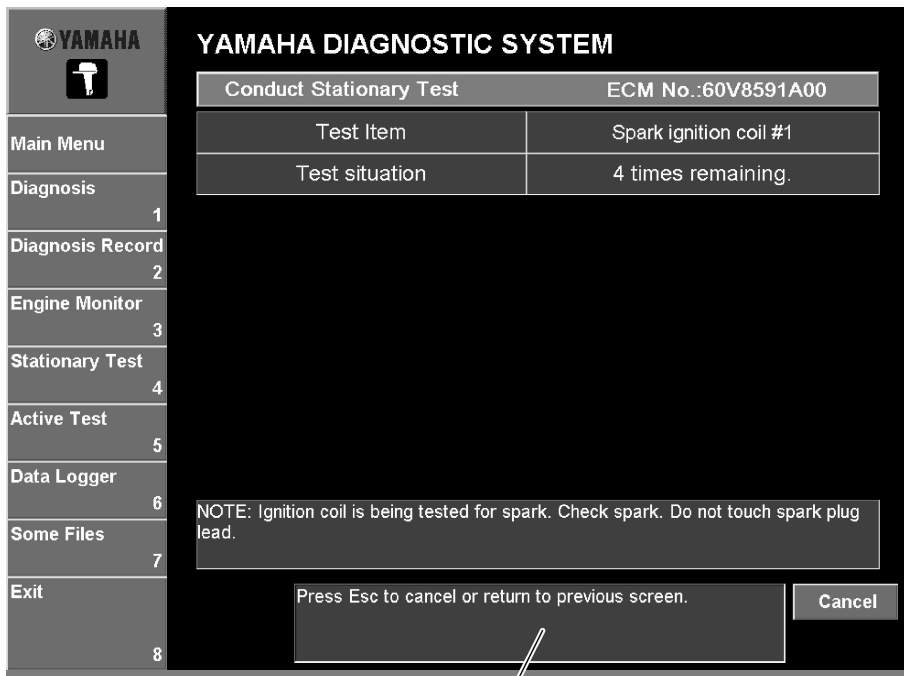


Fig. 41



Displays keyboard operations.

Fig. 42

NOTE:

If the engine is running an error message is displayed. Follow the instructions that appear. (Fig. 43)

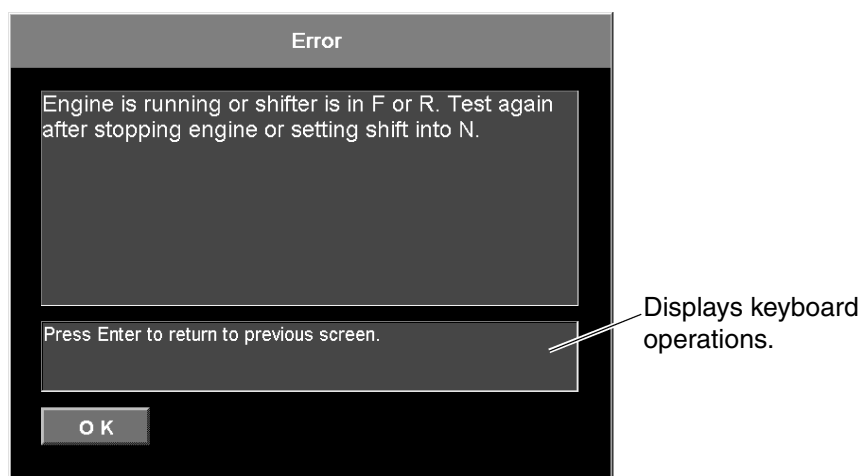


Fig. 43

6. While checking the information that appears in the **Test situation** column, follow the test instructions in the messages that are displayed. (See fig. 42.)

NOTE:

If an error occurs while the test is being performed, an error message is displayed. Follow the instructions that appear in the error message. (Fig. 44)

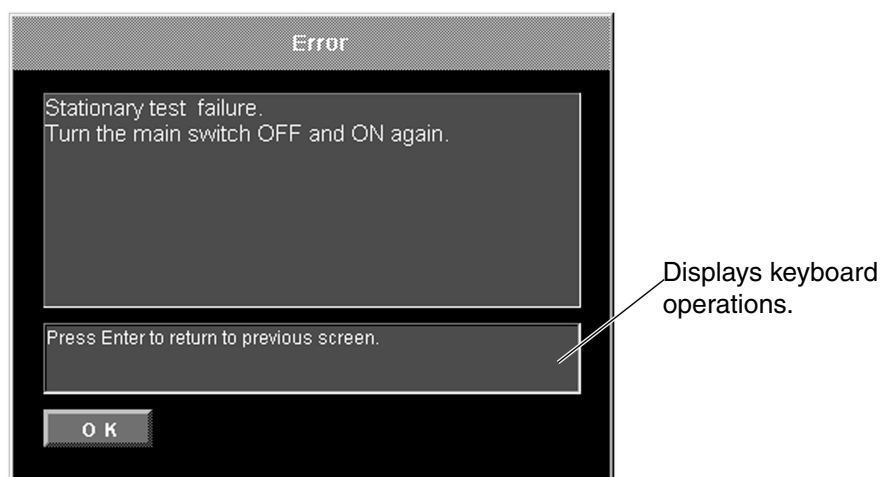


Fig. 44

7. To stop the stationary test, click the **Cancel** button. (See fig. 42.)
8. Observe the spark through the discharge window of the spark gap tester.

9. To perform the test again to the same cylinder, click the **Execute** button or press the Enter key on your keyboard. To perform the test on a different cylinder, click the **Return [ESC]** button or press the Esc key on your keyboard to return to main menu where a different test can be selected.

NOTE:

If an error occurs while the test is being performed, the following message is displayed.

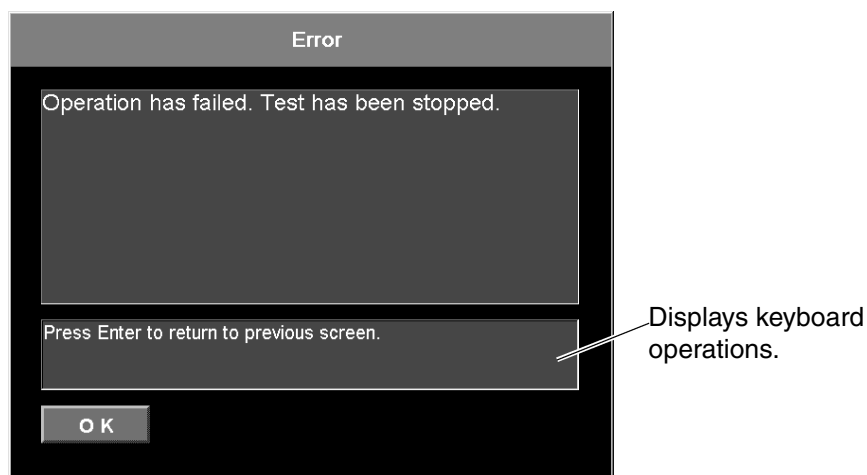


Fig. 45

Operating injector procedure:

A voltage is applied to the injector of the selected cylinder, the injector is activated, and then the fuel system is checked. The fuel is injected 20 times within two seconds.

⚠ WARNING

- Do not perform the test with the injector removed from the cylinder head or with any fuel system parts removed. High-pressure fuel may spurt out.
- When performing the this operation, keep all sparks, flames, or other sources of ignition away from the testing area. Gasoline is highly flammable.

1. Select the test that you wish to perform by either clicking it or pressing the up or down arrow keys on your keyboard. (Fig. 46)

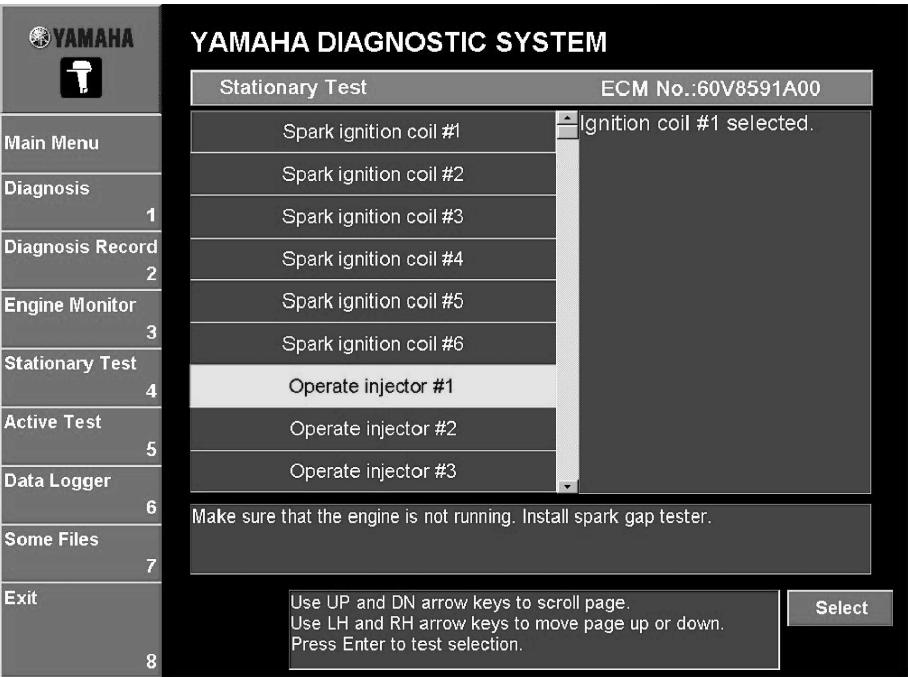


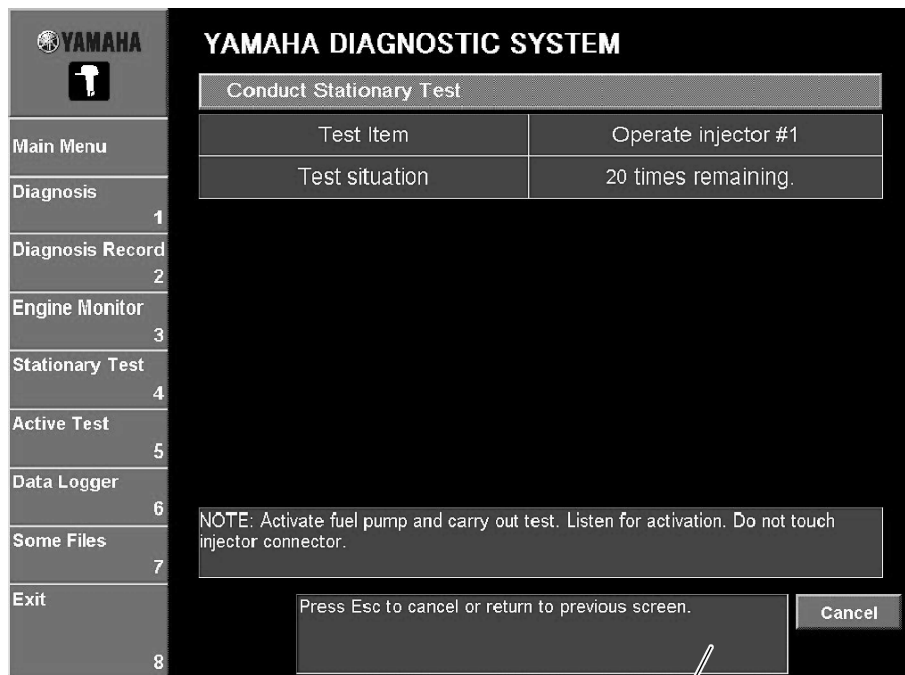
Fig. 46

NOTE:

- Make sure that the engine is not running.
- The selected item is highlighted in light blue.
- The details of the selected test are displayed in the column on the right, and the items that must be either checked or performed before the test can start are displayed below the table.
- Only one item can be selected at one time.
- Make sure that there is fuel in the fuel tank, otherwise an error will occur and the test cannot be performed.

2. Select the cylinder to be tested, and then click the **Select** button or press the Enter key on your keyboard. (Fig. 46)

3. Click the **Execute** button or press the Enter key on your keyboard. (Fig. 47)



Displays keyboard operations.

Fig. 47

NOTE:

If an error occurs while the test is being performed, an error message is displayed. Follow the instructions that appear.

4. Listen to the operating sound of the injector for the cylinder being tested.

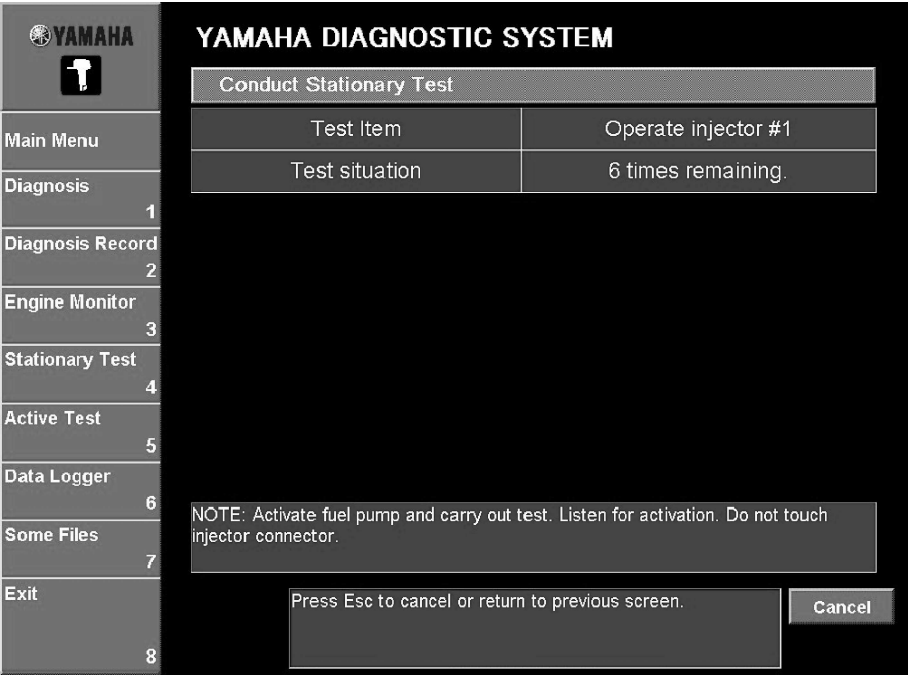


Fig. 48

⚠ WARNING Do not touch the injector connector.

NOTE: Before activating the injector, operate the electric fuel pump for ten seconds in order to build up fuel pressure.

5. To perform the test again on the same cylinder, click the **Execute** button or press the Enter key on your keyboard. To perform the test on a different cylinder, click the **Return [ESC]** button or press the Esc key on your keyboard to return to the window where a different test can be selected. (Fig. 49)

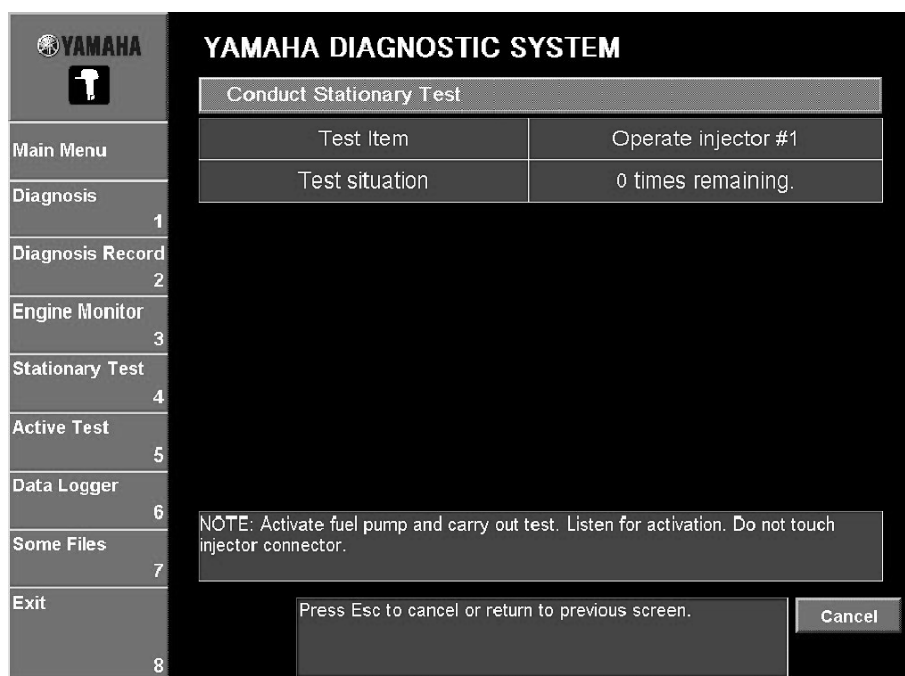


Fig. 49

CAUTION:

Do not test the same cylinder three or more times, otherwise the spark plug insulator may be damaged.

Operating the electric fuel pump:

A voltage is applied to the electric fuel pump, the electric fuel pump is operated, and then the fuel system is checked. The electric fuel pump is operated for ten seconds.

⚠ WARNING

- **Do not perform the test with the injector removed from the cylinder head or with any fuel system parts removed. High-pressure fuel may spurt out.**
- **When performing this operation, keep all sparks, flames, or other sources of ignition away from the testing area. Gasoline is highly flammable.**

NOTE:

Make sure that there is fuel in fuel tank, otherwise an error will occur and the test cannot be performed.

1. Select the test to be performed, and then click the **Select** button or press the Enter key on your keyboard. (Fig. 50)

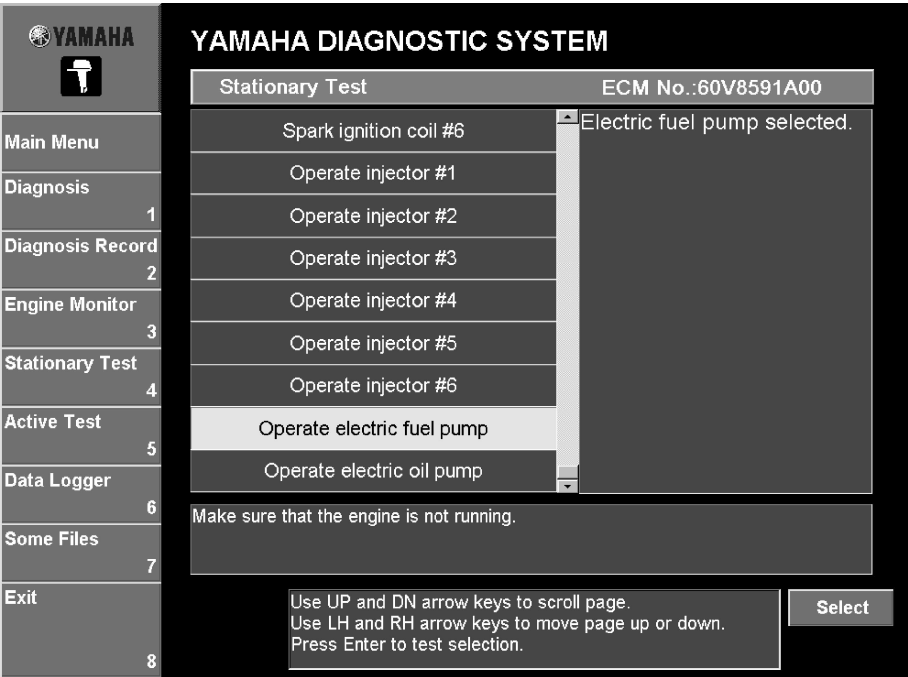
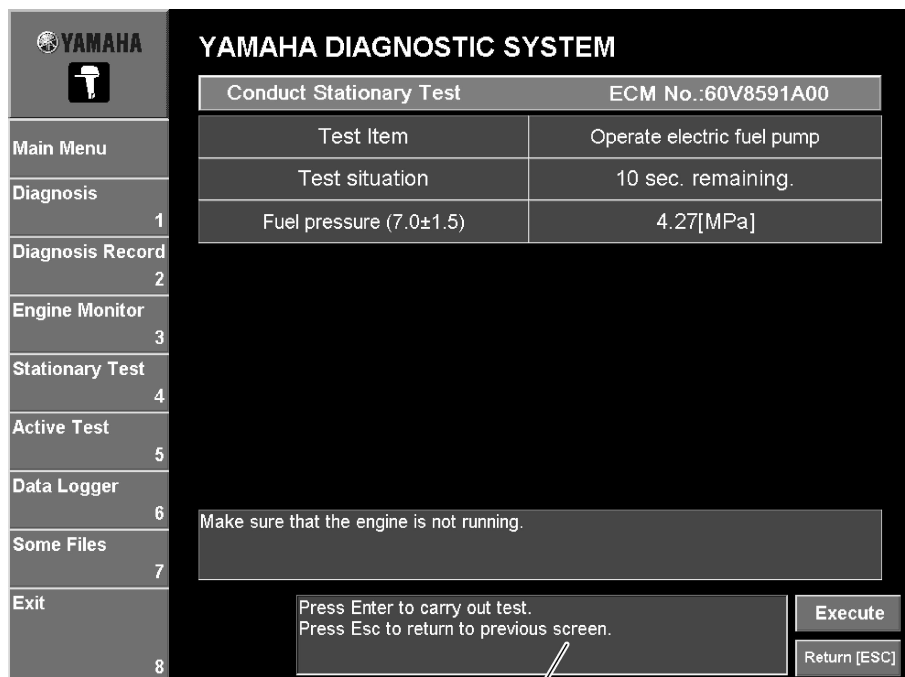


Fig. 50

- NOTE:**
- Make sure that the engine is not running.
 - The selected item is highlighted in light blue.
 - The details of the selected test are displayed in the column on the right, and the items that must be either checked or performed before the test can start are displayed below the table.
 - Only one item can be selected at one time.

- Click the **Execute** button or press the Enter key on your keyboard. (Fig. 51)



Displays keyboard operations.

Fig. 51

NOTE:

If an error occurs while the test is being performed, an error message is displayed. Follow the instructions that appear.

- Listen to the operating sound of the electric fuel pump.

4. To perform the test again click the **Execute** button or press the Enter key on your keyboard. To perform a different test, click the **Return [ESC]** button or press the Esc key on your keyboard to return to the window where a different test can be selected. (Fig. 52)

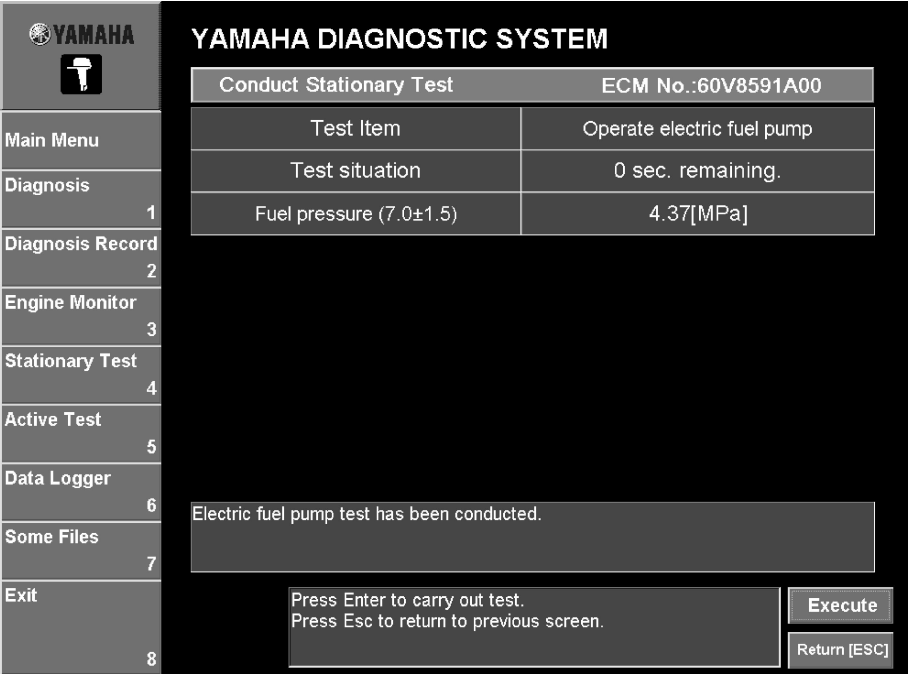


Fig. 52

Operating electric oil pump procedure:

The electrical oil pump is operated by a signal sent from the ECM for six seconds. This checks if oil has been spurted out from the electrical oil pump.

1. Select the test to be performed, and then click the **Select** button or press the Enter key on your keyboard. (Fig. 53)

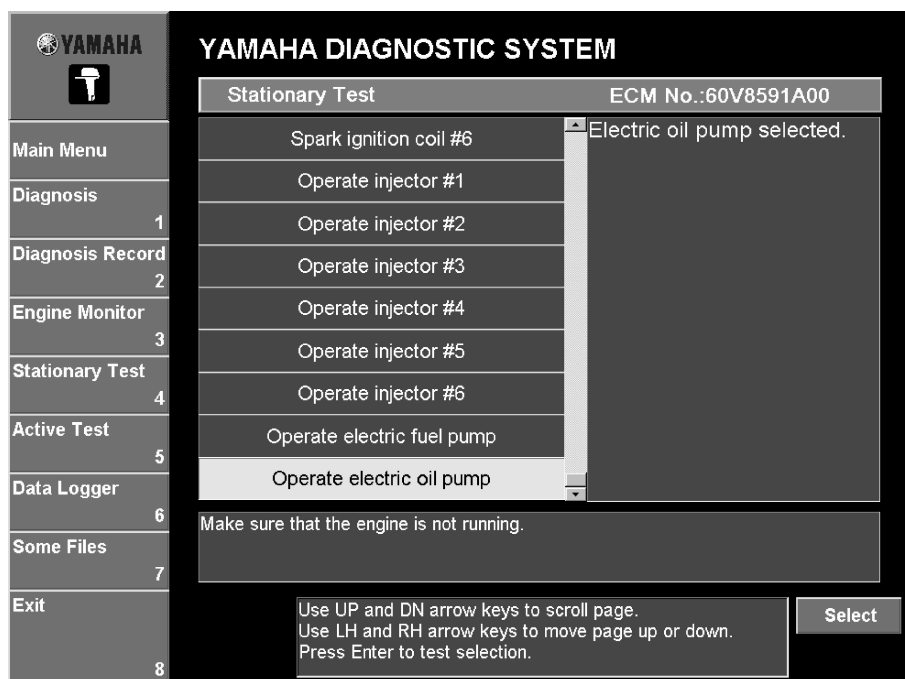


Fig. 53

NOTE:

- Make sure that the engine is not running.
- The selected item is highlighted in light blue.
- The details of the selected test are displayed in the column on the right, and the items that must be either checked or performed before the test can start are displayed below the table.
- Only one item can be selected at one time.

2. Remove the oil hose ① from the vapor separator inlet ②. (Fig. 54)

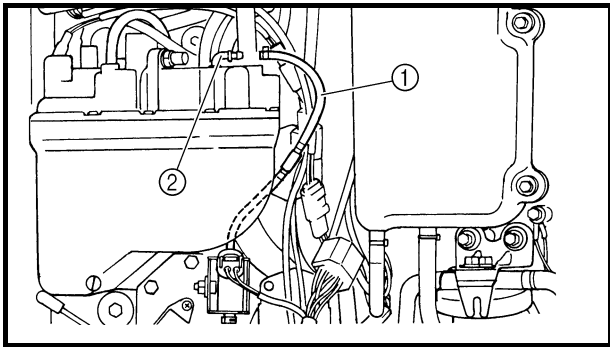
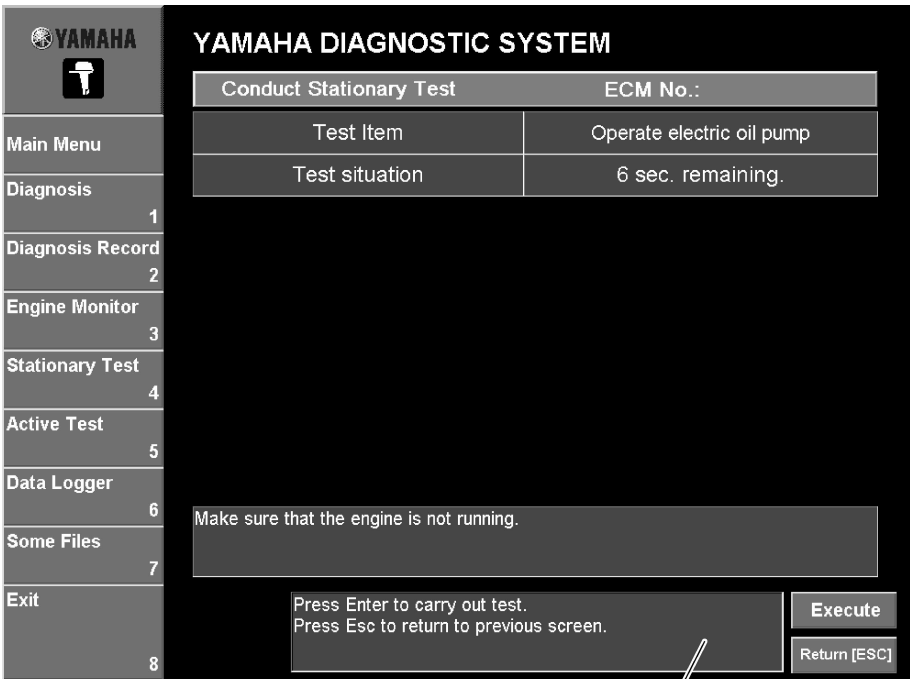


Fig. 54

CAUTION:

Do not allow any air to enter the oil hose during the test.

3. Click the **Execute** button or press the Enter key on your keyboard. (Fig. 55)



Displays keyboard operations.

Fig. 55

NOTE:

If an error occurs while the test is being performed, an error message is displayed. Follow the instructions that appear.

4. Check that oil flows from the electric oil pump hose end. (Fig. 56)

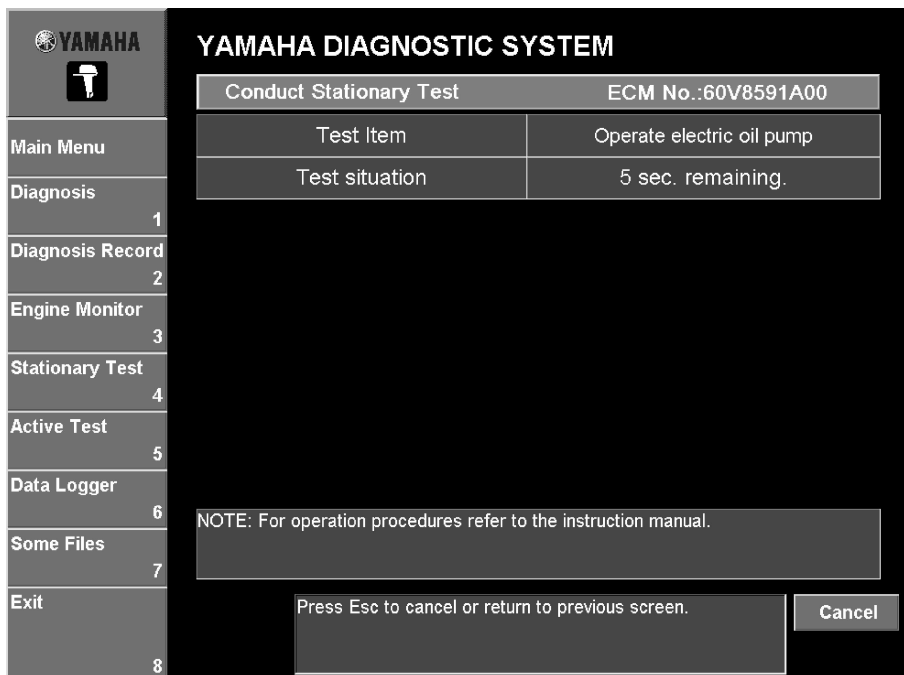


Fig. 56

5. To perform the test again click the **Execute** button or press the Enter key on your keyboard. To perform a different test, click the **Return [ESC]** button or press the Esc key on your keyboard to return to the window where a different test can be selected.

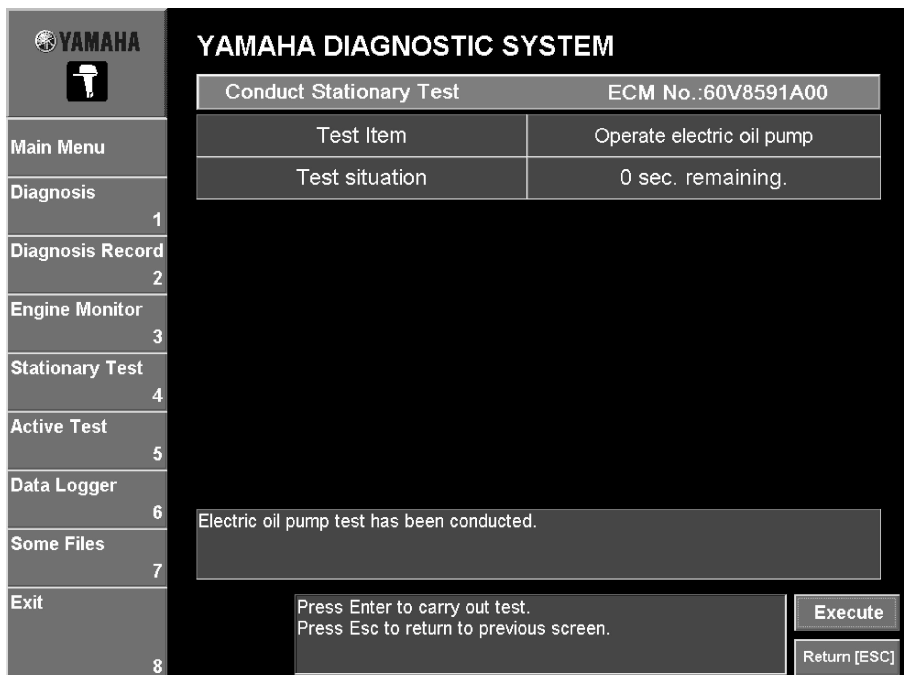


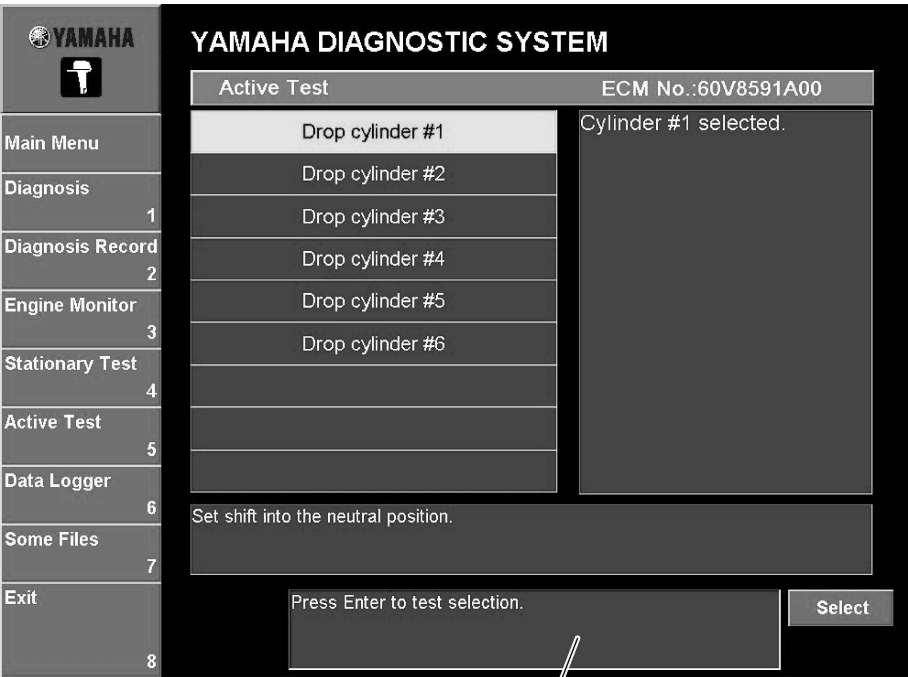
Fig. 57

6. After the test is finished, install the oil hose.

NOTE: _____
Make sure that there is no air in the oil hose.

Active test
Selecting this command displays a window where active tests can be selected.

⚠ WARNING _____
Avoid clicking the Execute and Cancel buttons repeatedly, otherwise the ECM or PC may not work properly and they may be damaged.



Displays keyboard operations.

Fig. 58

NOTE: _____
The test can be carried out while the engine is running and the shift is in the neutral position. It is not possible to carry out the test while the boat is running.

Dropping a cylinder:

Start the engine and observe the changes in engine speed for 20 seconds.

For the first ten seconds operate all six cylinders, and then stop one cylinder for five seconds. For the last five seconds operate all six cylinders.

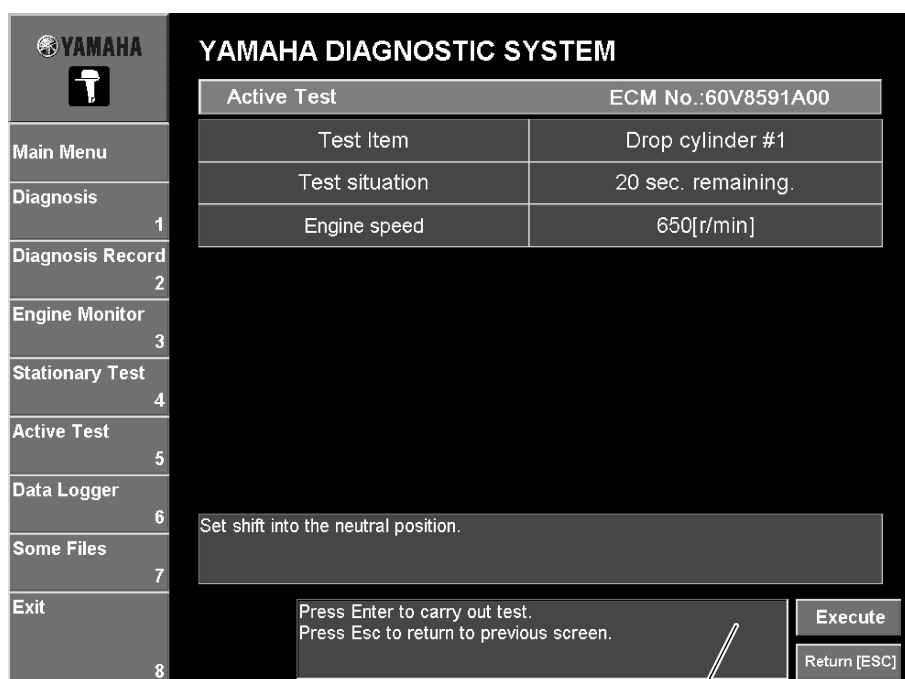
A screen that allows you to select which ignition and fuel to cut is displayed.

1. Select which ignition and fuel you wish to cut by either clicking it or pressing the up or down arrow keys on your keyboard. (Fig. 58)

NOTE:

- Set the shift into the neutral position.
- The selected item is highlighted in light blue.
- The details of the selected test are displayed in the column on the right, and the items that must be either checked or performed before the test can start are displayed below the table.
- Only one item can be selected at one time.

2. Click the **Select** button or press the Enter key on your keyboard. (Fig. 58)
3. Start the engine.
4. Click the **Execute** button or press the Enter key on your keyboard. (Fig. 59)



Displays keyboard operations.

Fig. 59

NOTE:

If the engine is not running, an error message is displayed. Follow the instructions that appear. (Fig. 60)

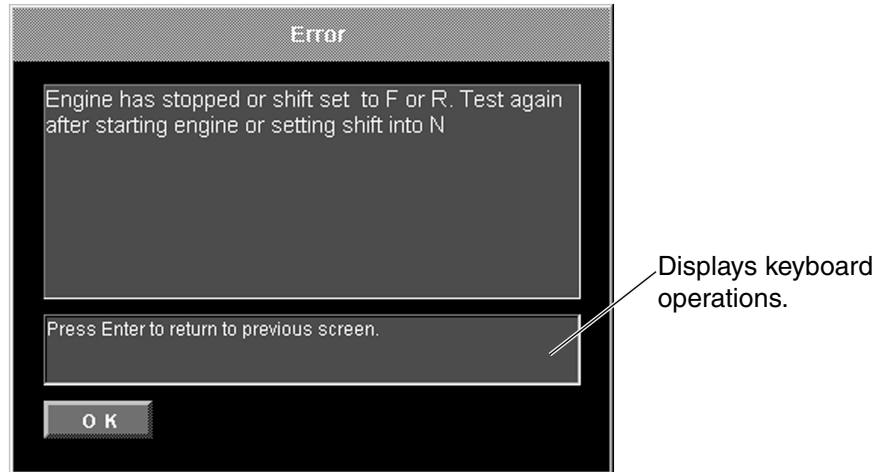


Fig. 60

5. While checking the information that appears beside **Test situation** and **Engine Speed**, follow the test instructions in the messages that are displayed. (Fig. 59)

NOTE:

If an error occurs while the test is being performed, an error message is displayed. Follow the instructions that appear. (Fig. 61)

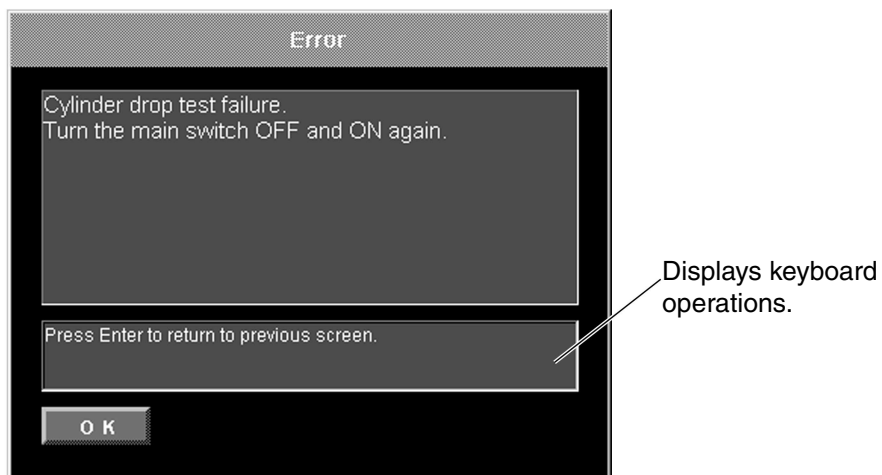


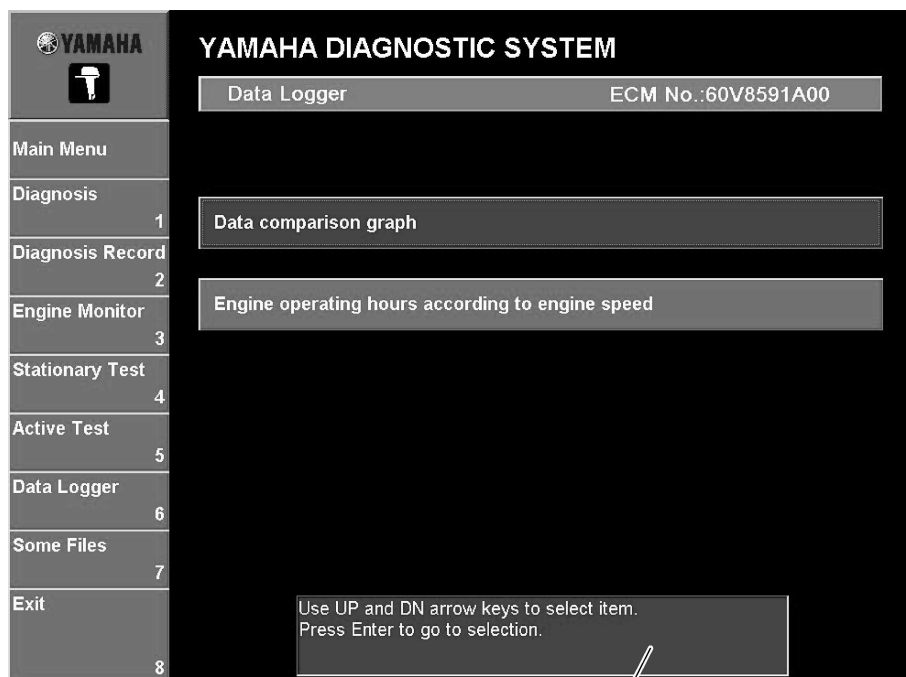
Fig. 61

6. To perform the test again on the same cylinder, click the **Execute** button or press the Enter key on your keyboard. To perform a different test, click the **Return [ESC]** button or press the Esc key on your keyboard to return to the window where a different test can be selected.

Data logger

Monitor item selection

A window that allows you to select the **Data comparison graph** or the **Engine operating hours according to engine speed** appears.



Displays keyboard operations.

Fig. 62

Operating procedure:

1. Select the desired item by either clicking it or pressing the up or down arrow keys on your keyboard. (Fig. 62)
2. Press the Enter key on your keyboard. The window of the selected item is displayed. (Fig. 62)

Data display item selection

A window that allows you to select the items that will be graphed. No more than two items can be displayed.

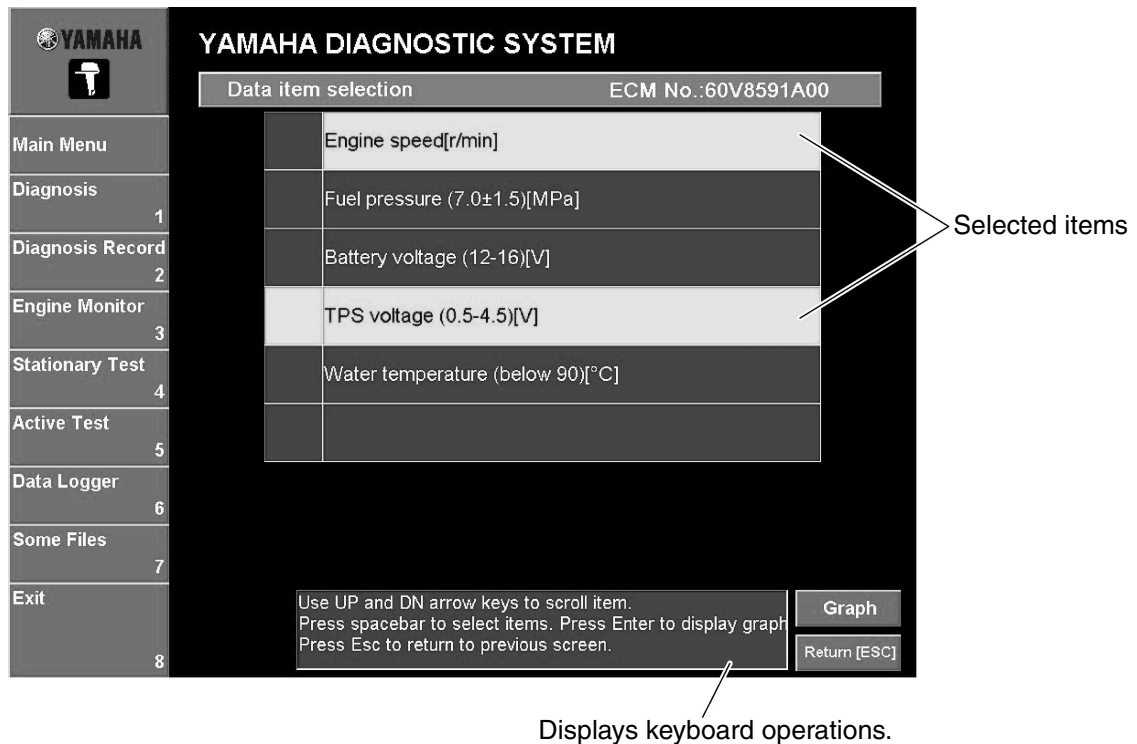


Fig. 63

Operating procedure:

1. Select the desired items by either clicking them or pressing the up or down arrow keys on your keyboard, and then press the space bar. (Fig. 63)

NOTE:

- Selected items have a light blue background. Items that are not selected have a blue background. The box to the left of items that are being moved are light blue. Items that are not selected appear in blue.
- At initialization, **Engine speed [r/min]** is selected.

2. Click the **Graph** button or press the Enter key on your keyboard. (Fig. 63) The **Data comparison** window is displayed.

Data comparison graph

A line graph appears with the items selected in the **Data display item selection** window on the vertical axes and the **Time before engine stop** on the horizontal axis. (Fig. 64)

Diagnosis records

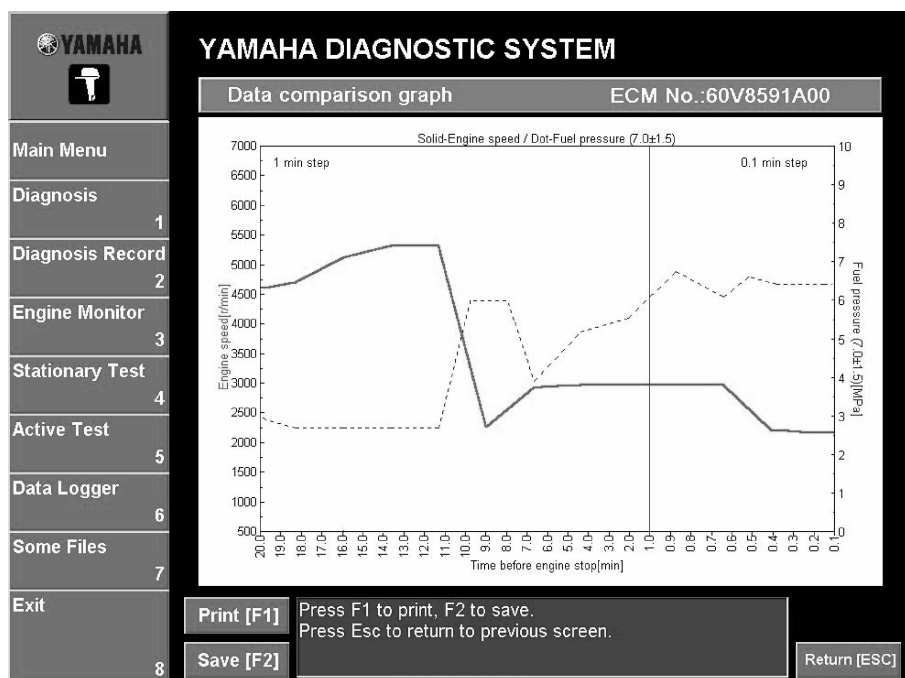


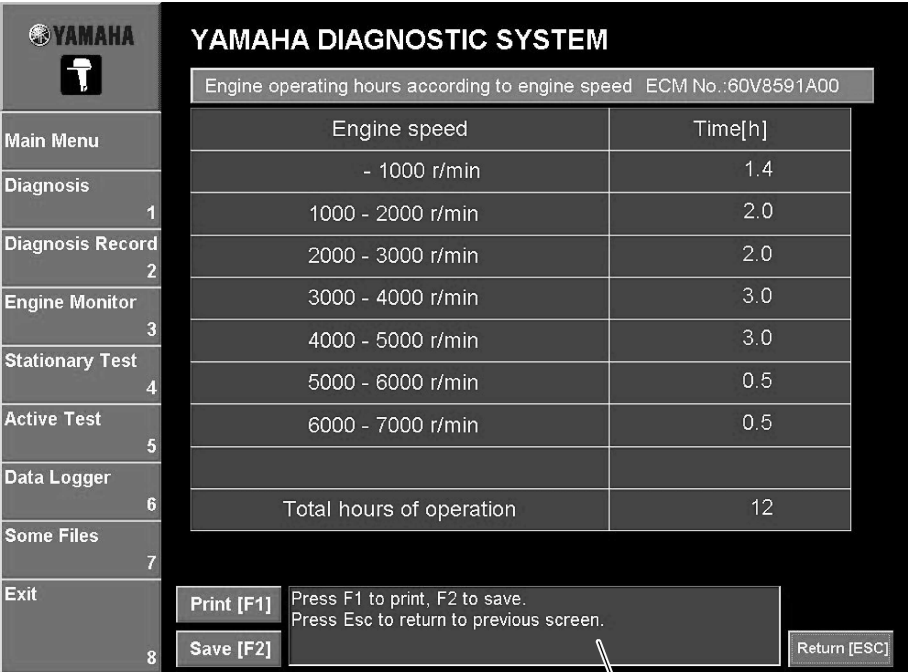
Fig. 64

NOTE:

- The item on the left vertical axis is graphed with a solid line and the item on the right vertical axis is graphed with a dotted line.
- Although the engine is running, graphs do not show the present engine condition. It displays the value at the time the Enter key on your keyboard was pressed in the **Monitor item selection**.

Engine operating hours according to engine speed

The operating hours as compared to the engine speed and the total operating hours are displayed. (Fig. 65)



Displays keyboard operations.

Fig. 65

A window is displayed showing the amount of hours that the engine is operated at each engine speed range.

- NOTE:**
- Although the engine is running the displayed time refers to the added hours until the Data logger starts.
 - The sum of the **Engine operating hours according to engine speed** is not equal to the total hours of operation since the hours are rounded to one decimal.

Some files

This feature lets you select and run other applications while continuing to run the diagnostic system.



Fig. 66

NOTE:

This program may not work correctly on some computer configurations (on some OS/hardware combinations).

Exit

The program is exited.

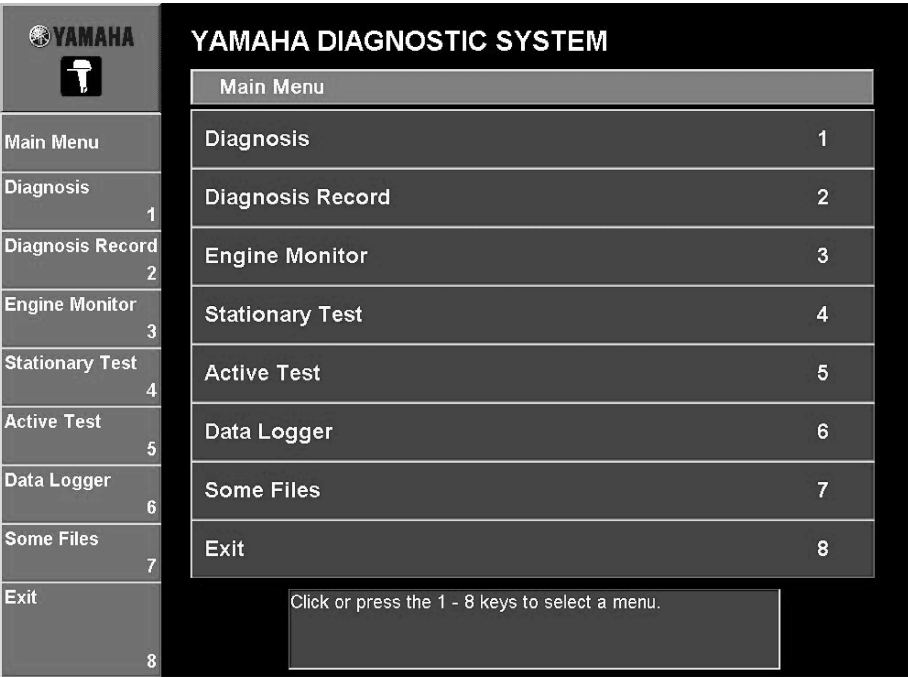


Fig. 67

Operating procedure:

Click the **OK** button or press the Enter key on your keyboard to exit the program.
To cancel exiting the program, click the **Cancel** button or press the Esc key on your keyboard.
(Fig. 68)

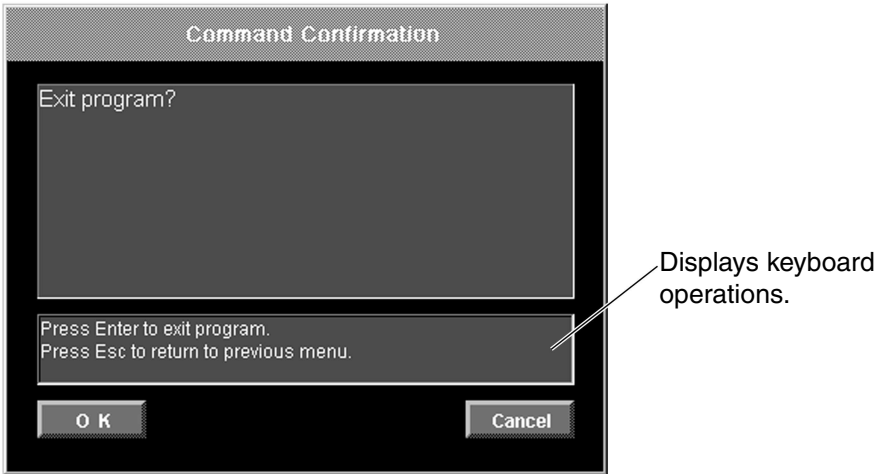


Fig. 68

Troubleshooting

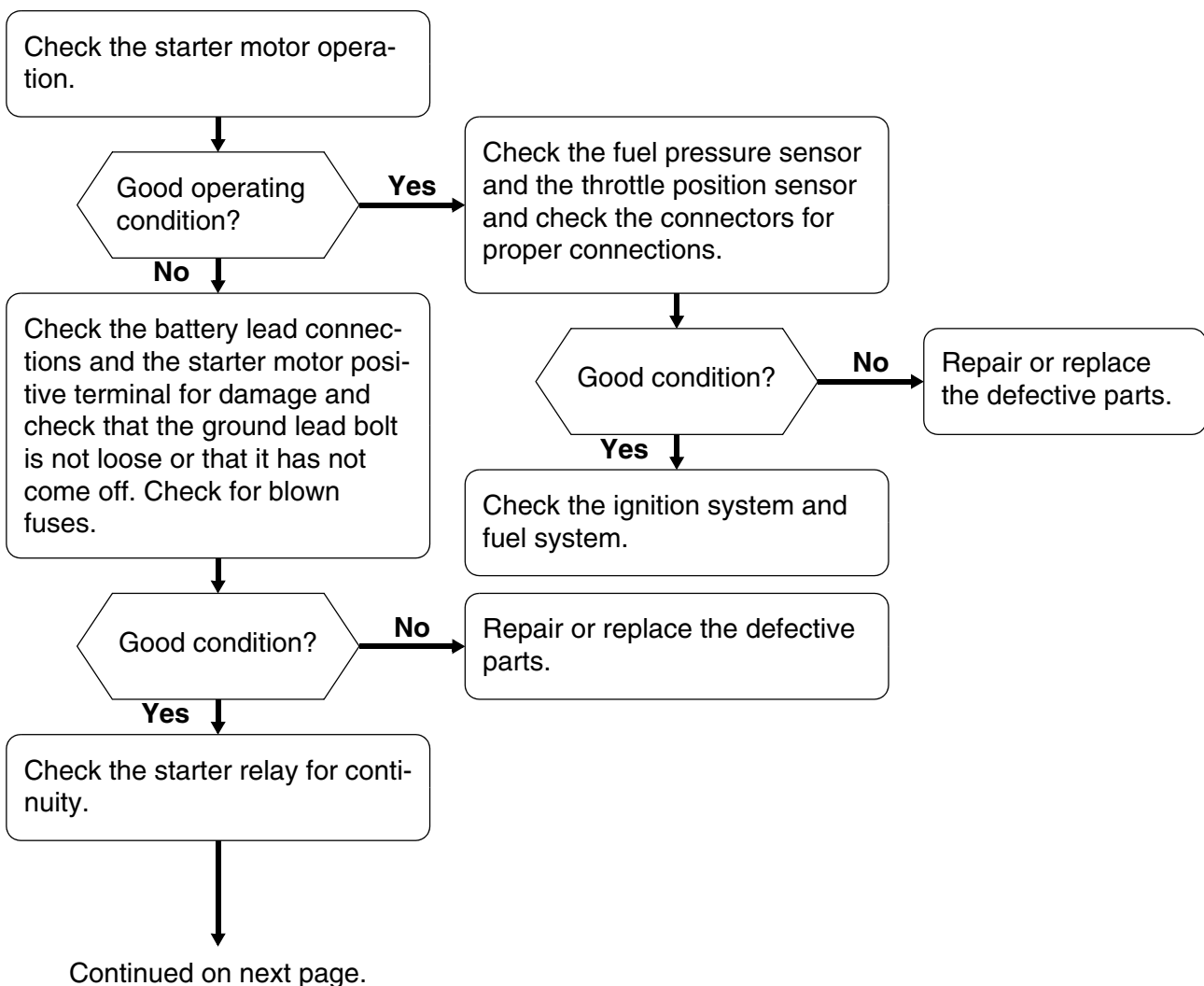
Error content	Cause	Action
Communication cable related error occurs	Main switch is turned OFF.	Turn the main switch to ON.
	Communication cable is disconnected.	Connect communication cable between the laptop computer's communication port and 3-pin communication coupler of the outboard motor.
	Battery is disconnected from the outboard motor.	Connect battery to outboard motor.
	The battery voltage is below 12 V.	Connect battery of 12 V or higher.
	The USB driver has not been installed.	Install the USB driver.
Application does not start	The hardware does not meet the requirements to operate this application.	Use a computer that meets the specified hardware requirements.
	YDS.exe is not installed in application directory.	If YDS.exe is not found in the application directory, install the application again.
	Other application (Service tool) is already in operation.	Quit the application in operation, since two applications (Service tool) cannot be operated simultaneously.
Application related error occurs	Error message "Program file or Database file is not installed properly. Please install again." is displayed.	Install program file or database file again.
Database related error occurs	Error message "Database files are not installed properly. Please update again." is displayed.	Update database again.
	Error message "System file not found #####.###." is displayed.	The database is not applicable to communication with ECM. Update database to correspond to ECM.
Incorrect fonts on screen	The computer language does not correspond to the application.	Use a computer that operates the required operating system.
When executing the stationary test or active test the test cannot be ended even if the Cancel is clicked.	Execute and Cancel buttons have been clicked more than necessary, and the ECM or PC does not operate properly.	Turn off your PC. Turn the main switch to OFF and reset the ECM.

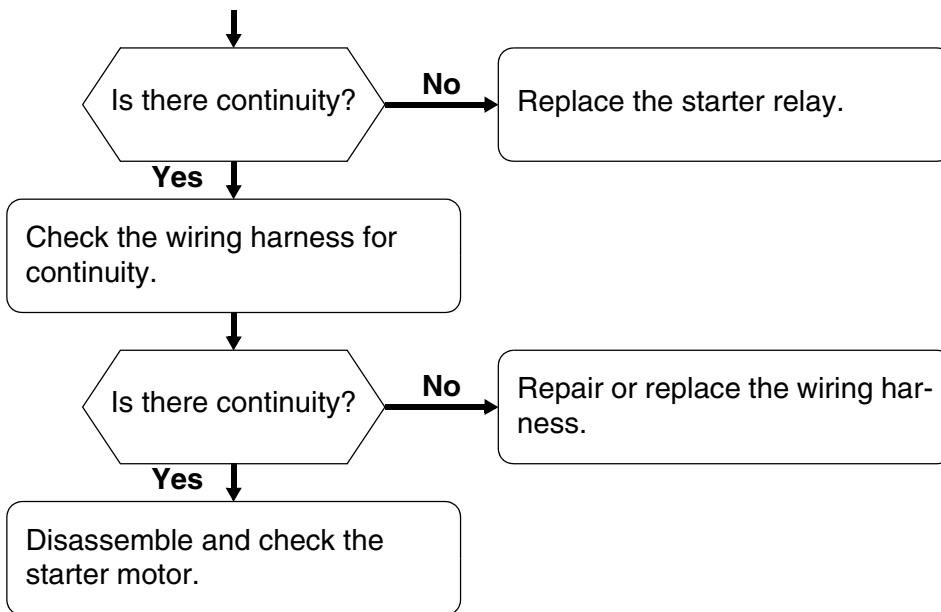
NOTE:

- Before troubleshooting the outboard motor, check the compression pressure, the mounting and rigging of the outboard motor, and the operation of the engine start switch. Also, make sure that specified fuel has been used and that the battery is fully charged.
- To diagnose a mechanical malfunction, use the troubleshooting charts for each trouble located in this chapter. Also, when checking and maintaining the outboard motor, see Chapters 3–8 for safe maintenance procedures.
- To diagnose a malfunctioning sensor or switch, use the diagnostic flash indicator to determine the cause.

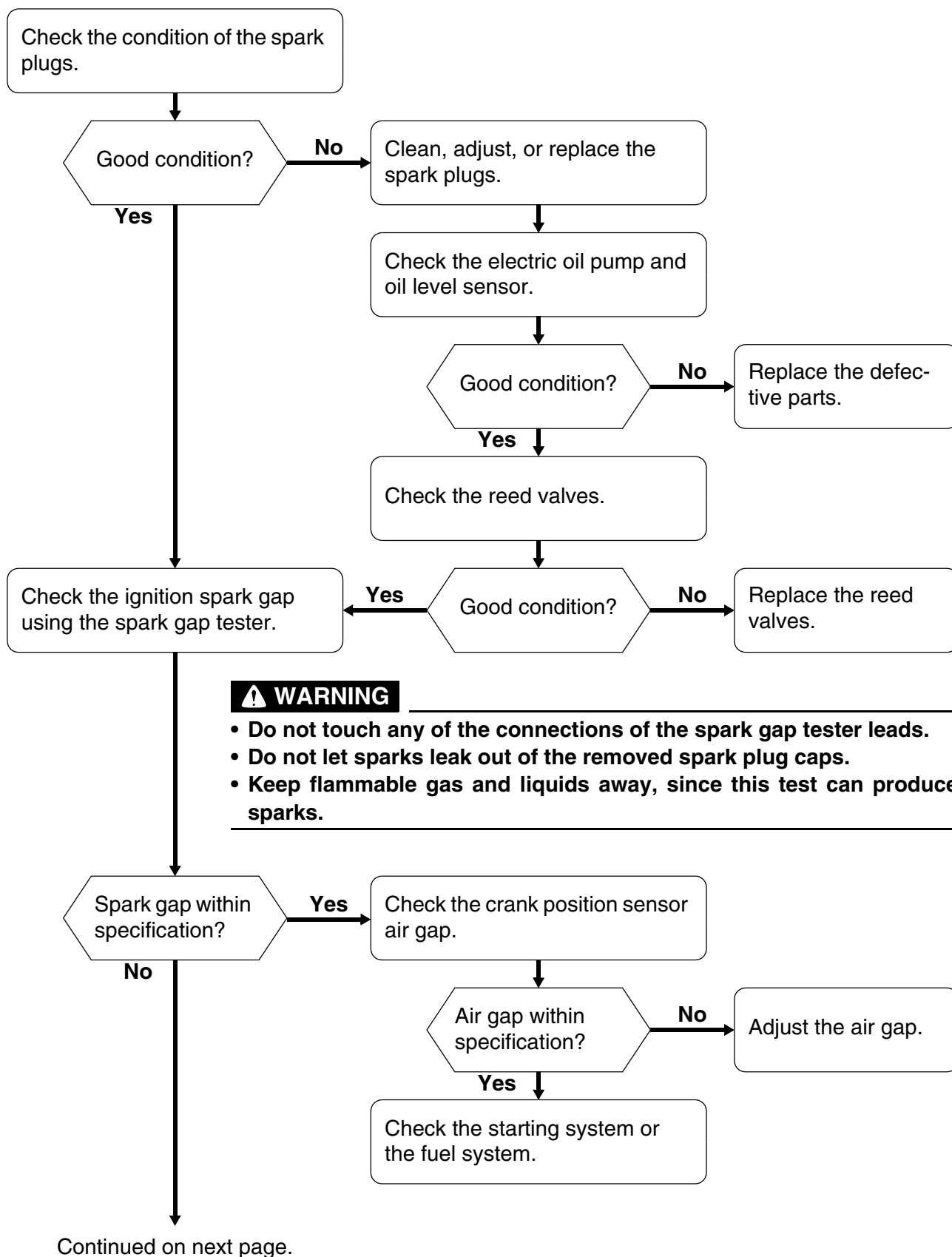
Power unit

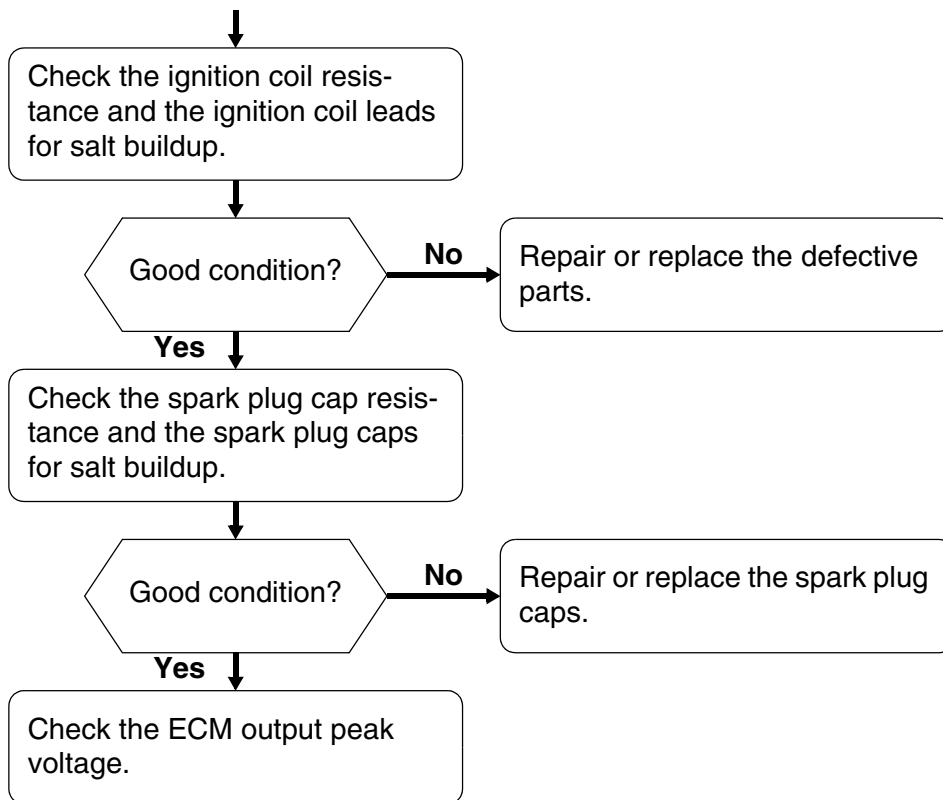
Symptom 1: Engine does not start, or starting the engine is difficult.

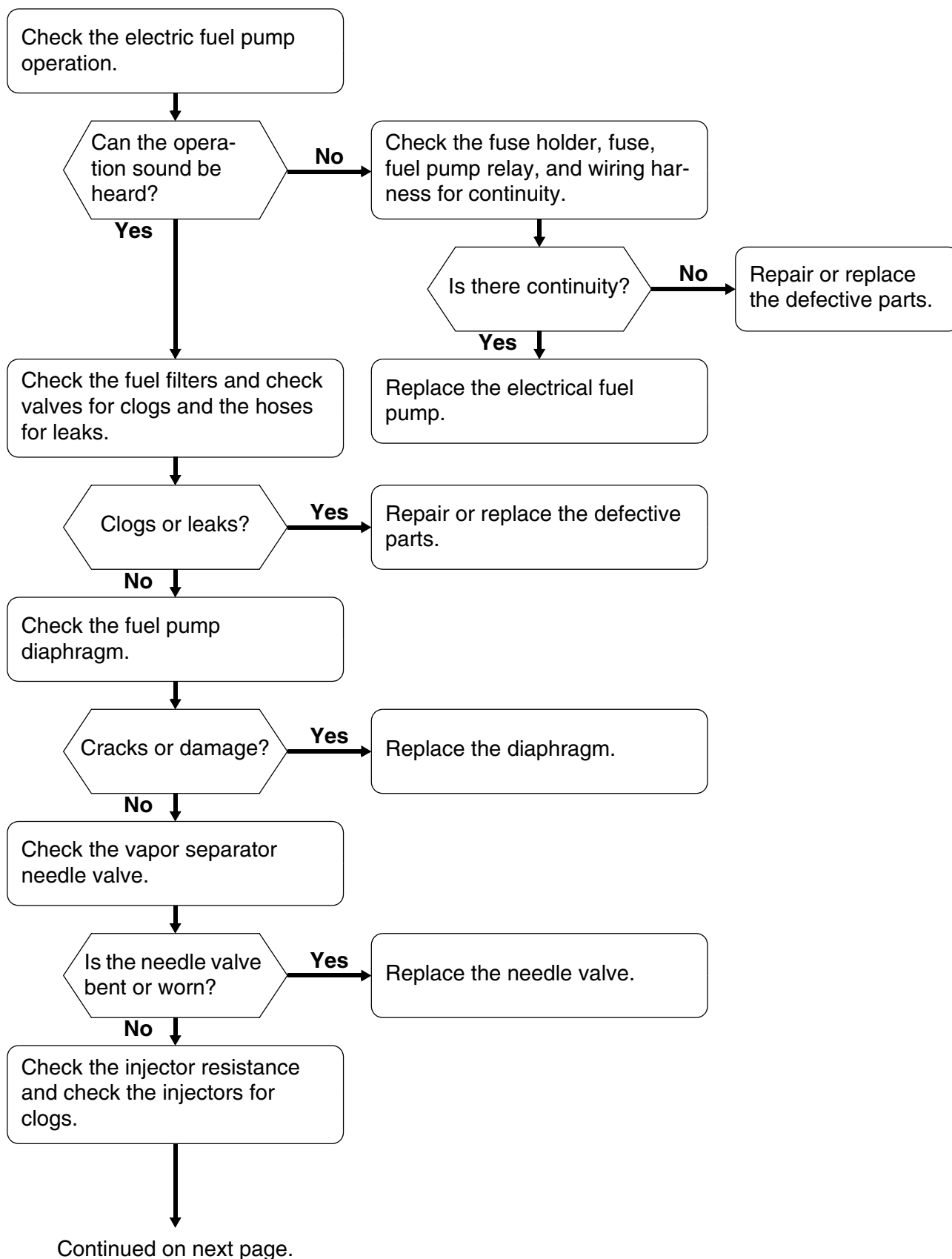
Starting system

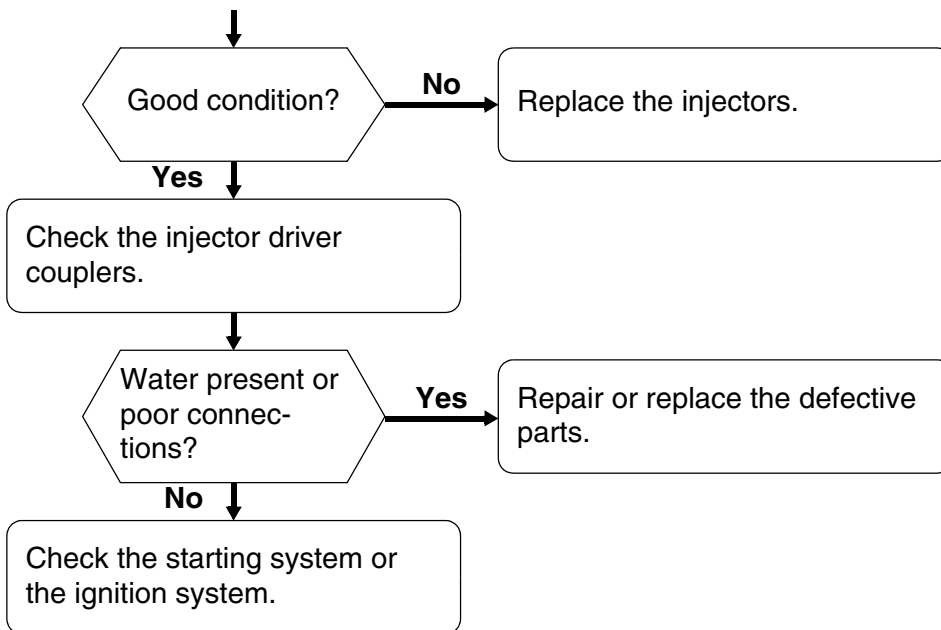


Ignition system

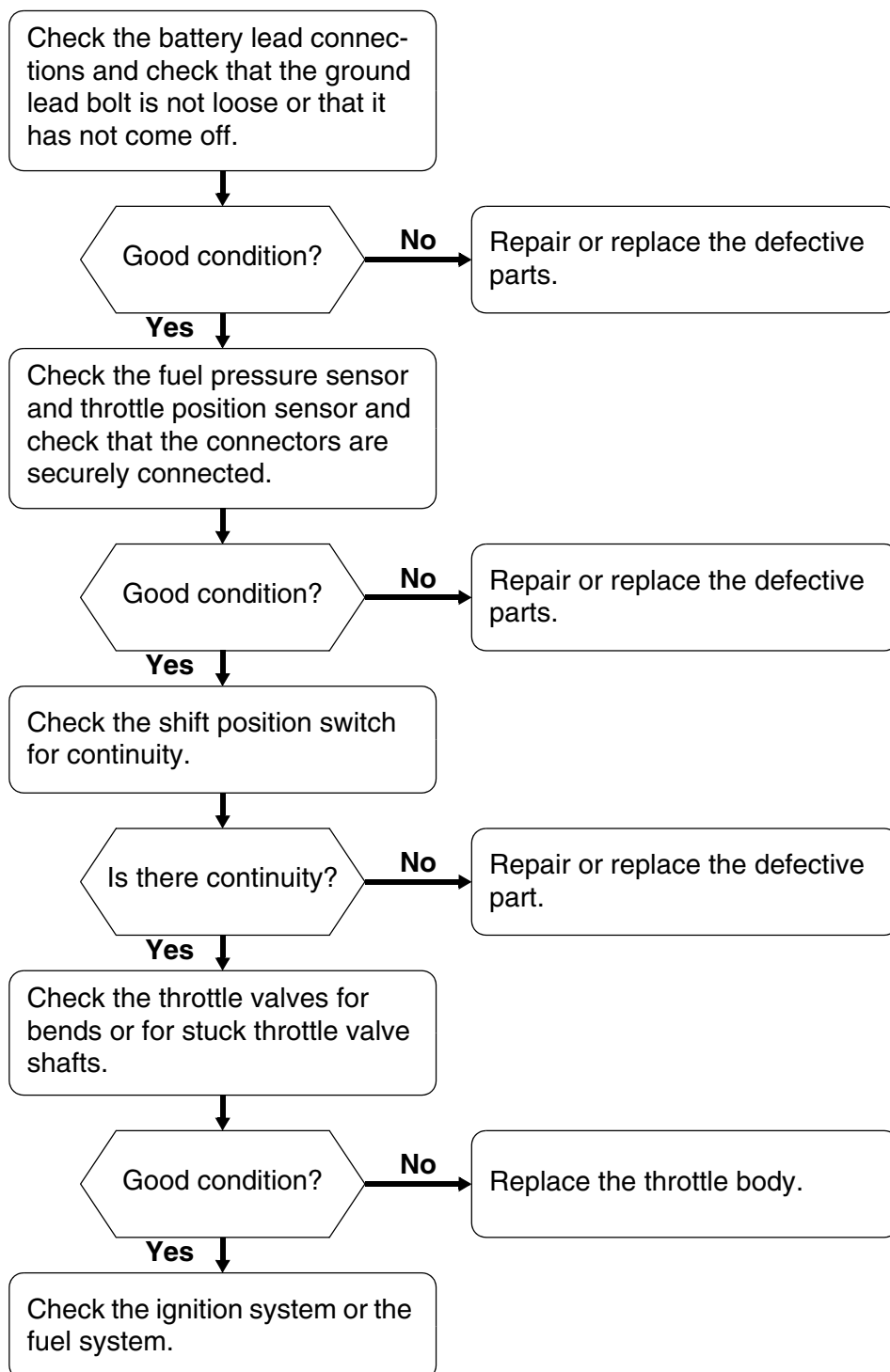




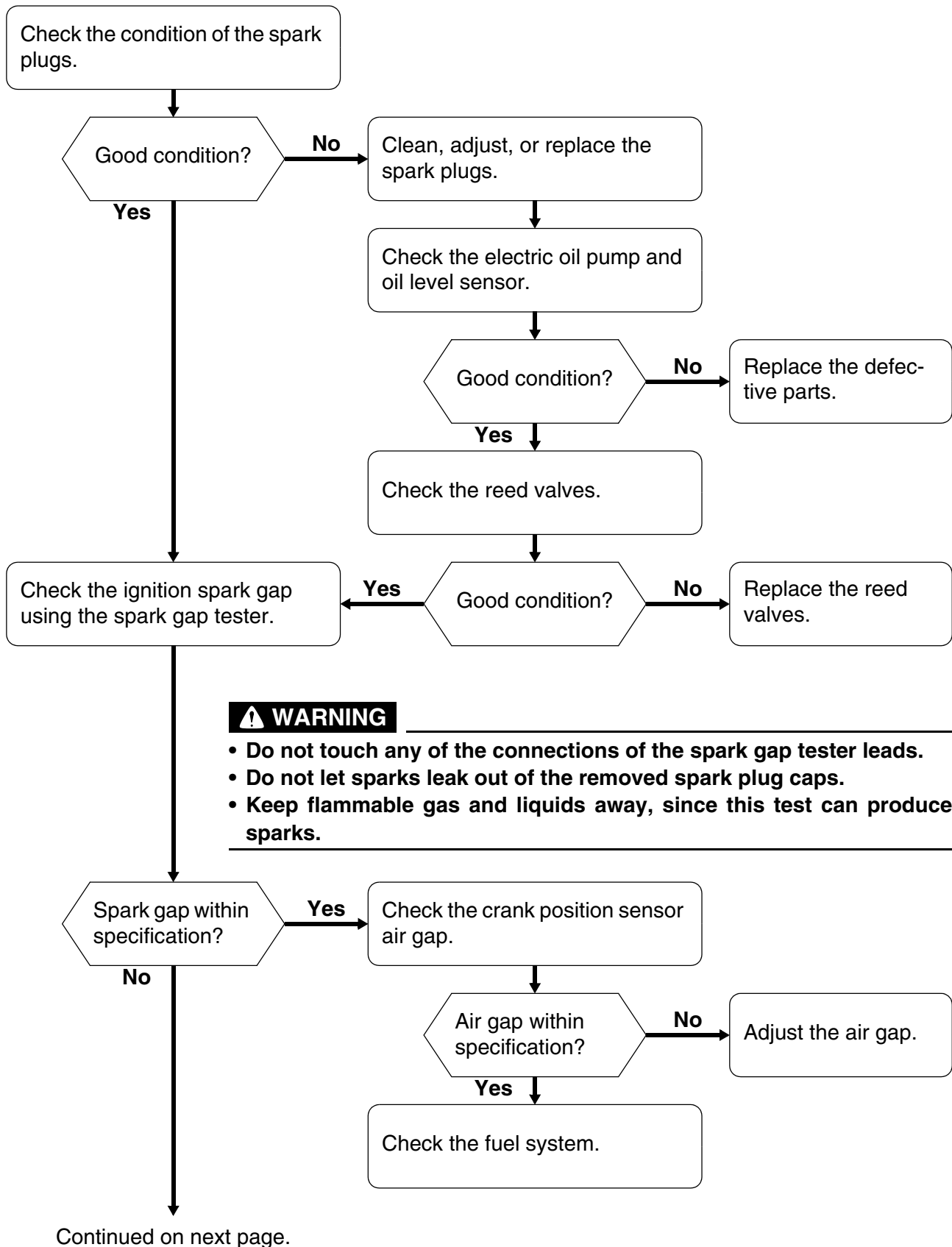
Fuel system

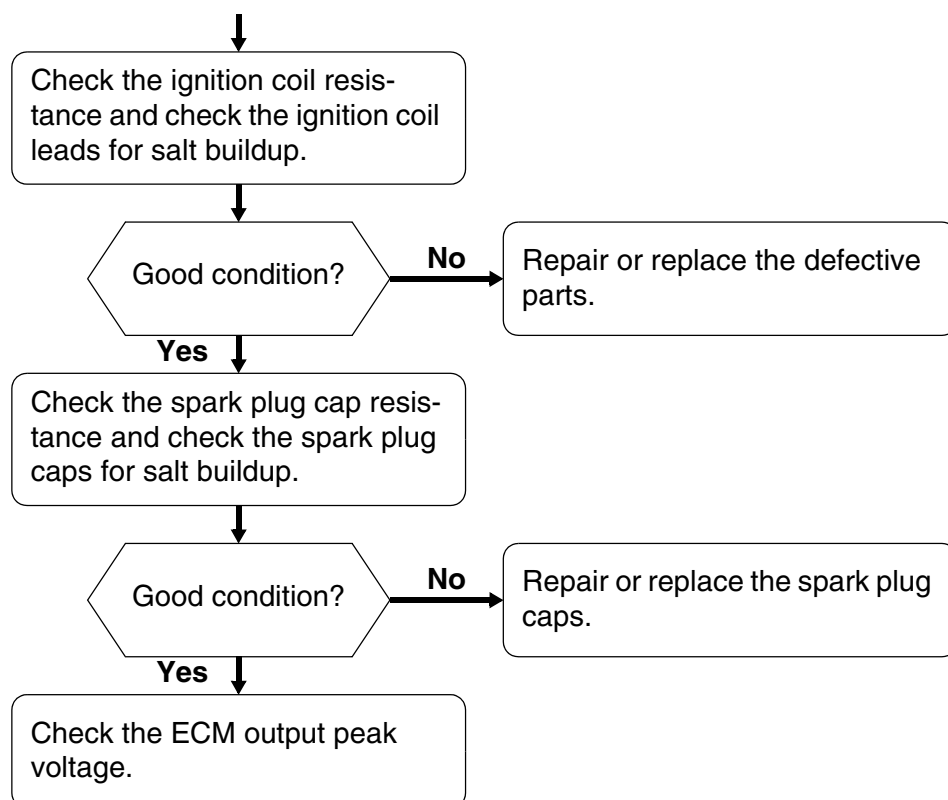


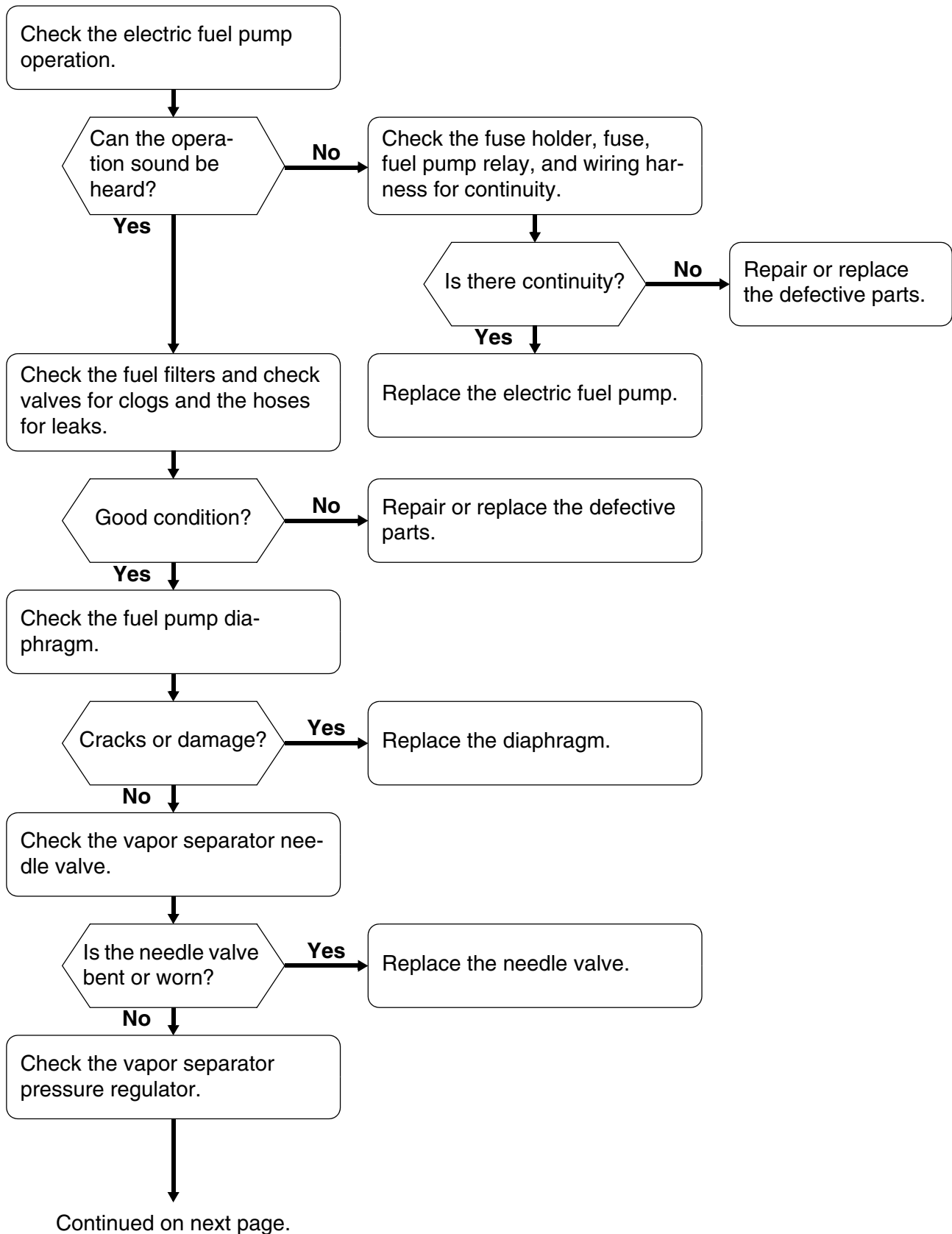
Symptom 2: Engine speed at wide open throttle is low, engine speed decreases, or engine stalls (poor acceleration or poor deceleration).

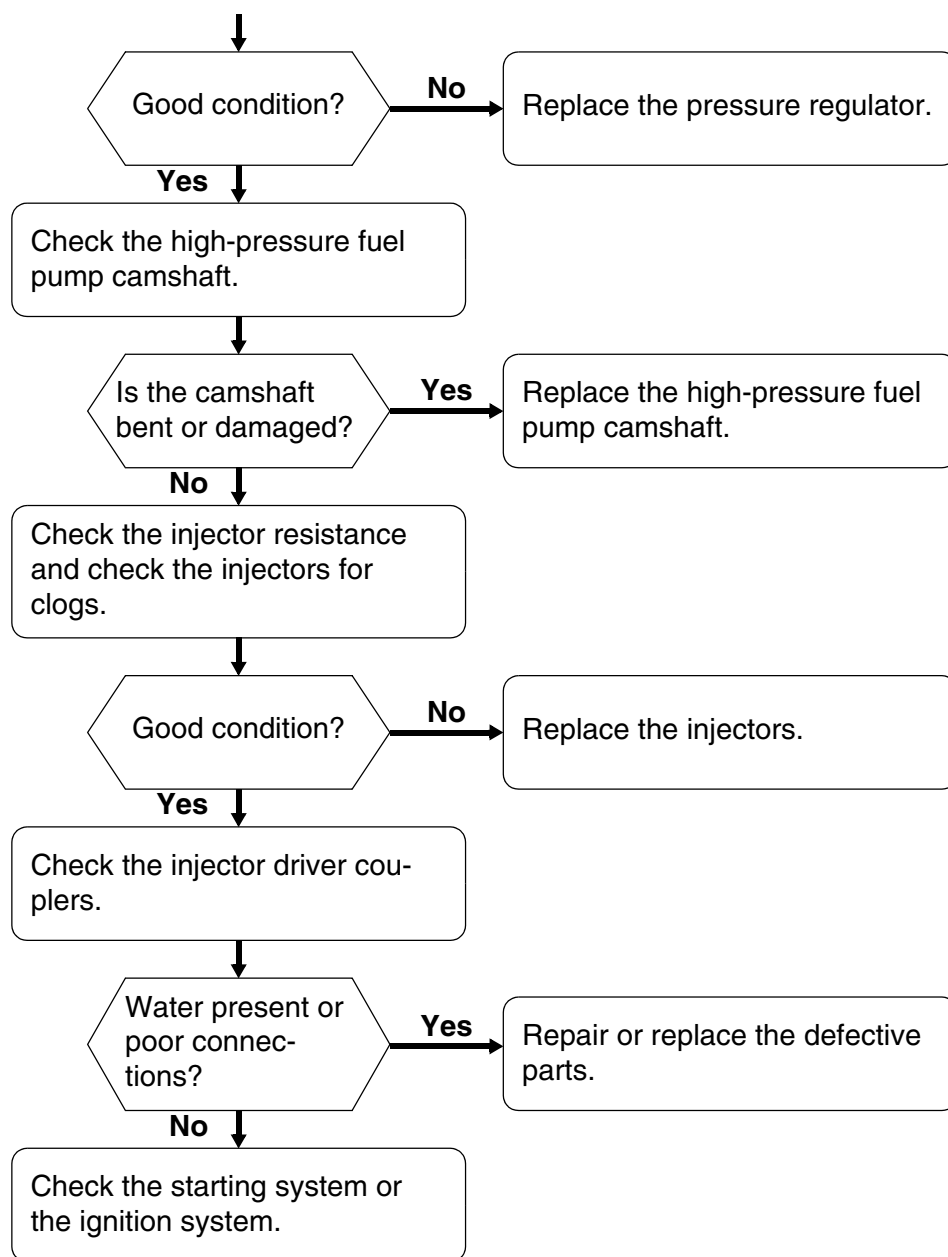


Ignition system

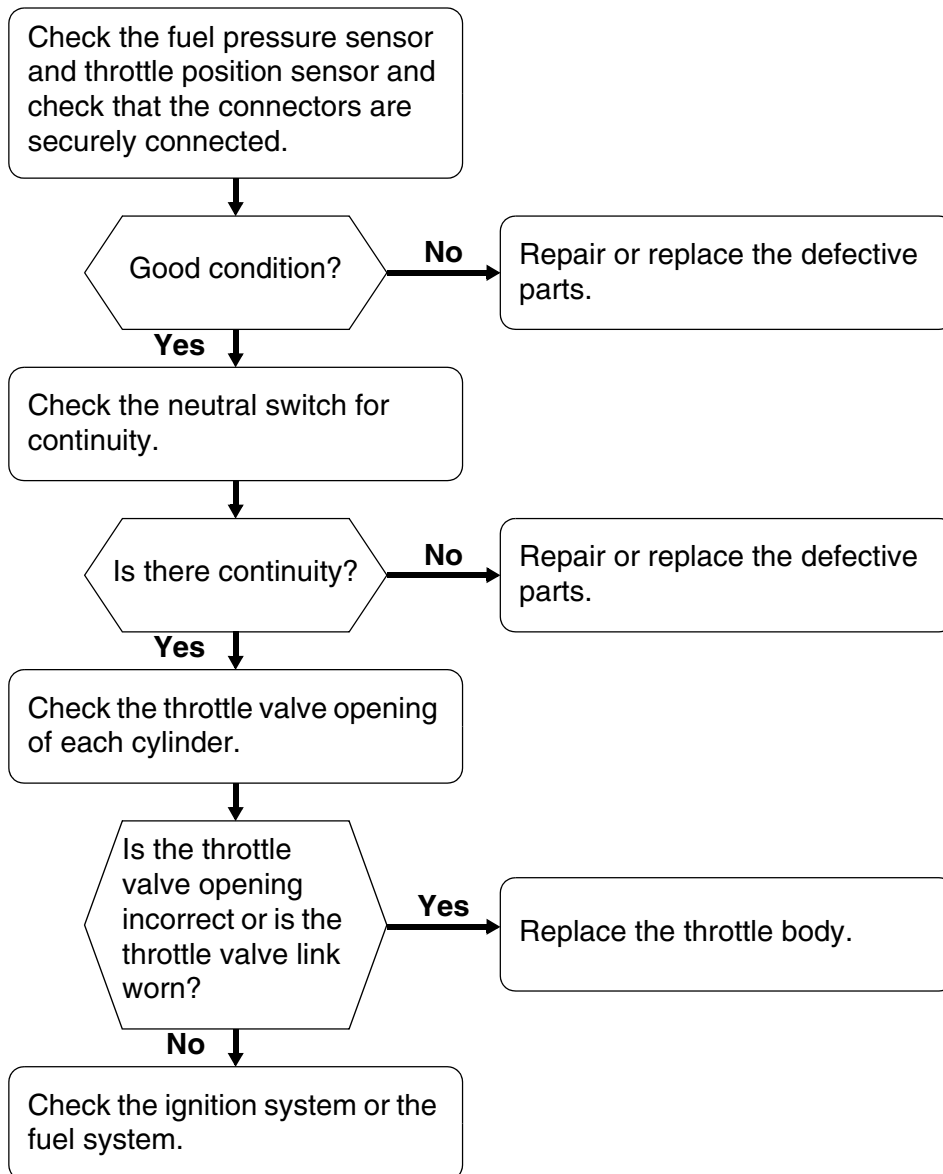




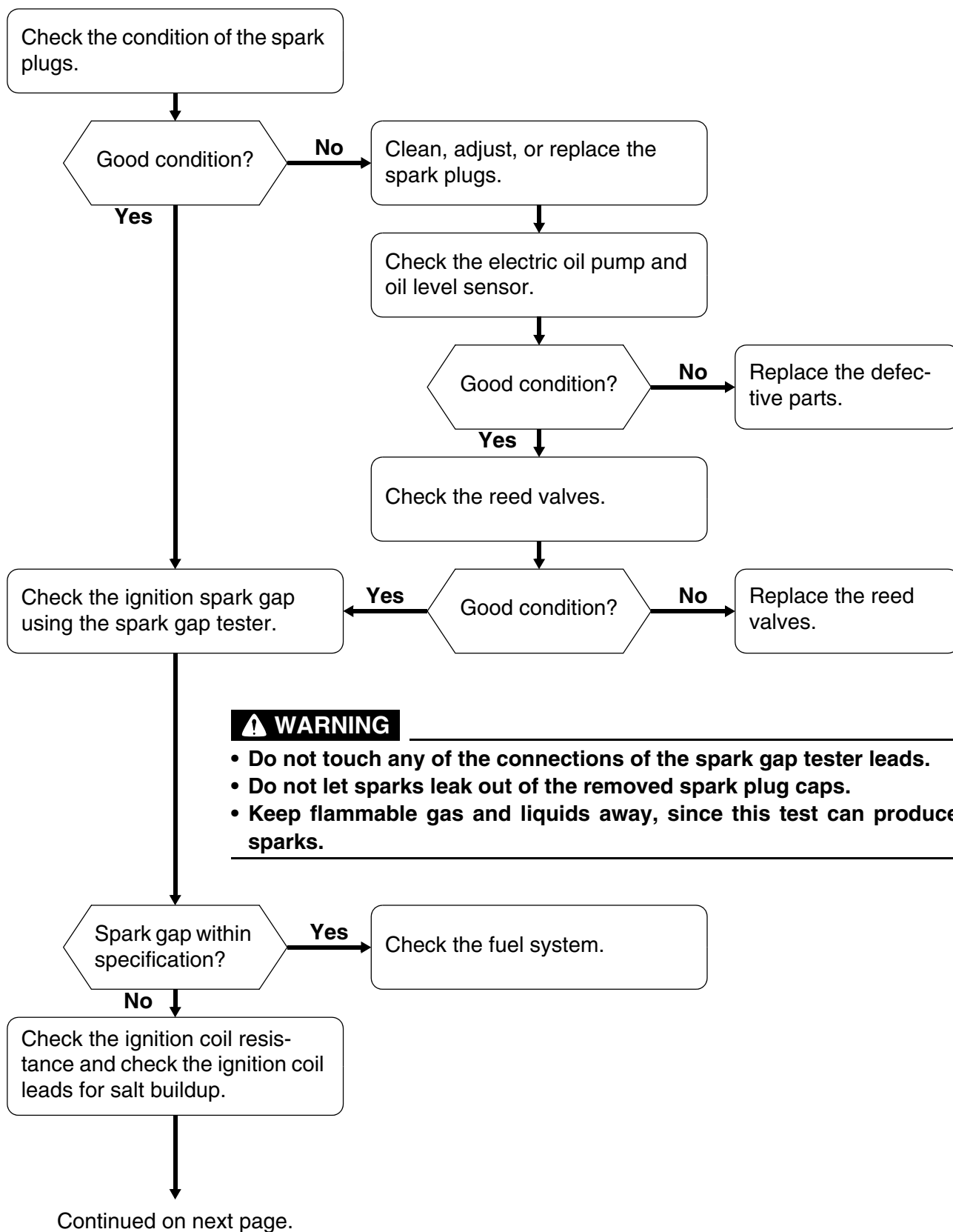
Fuel system


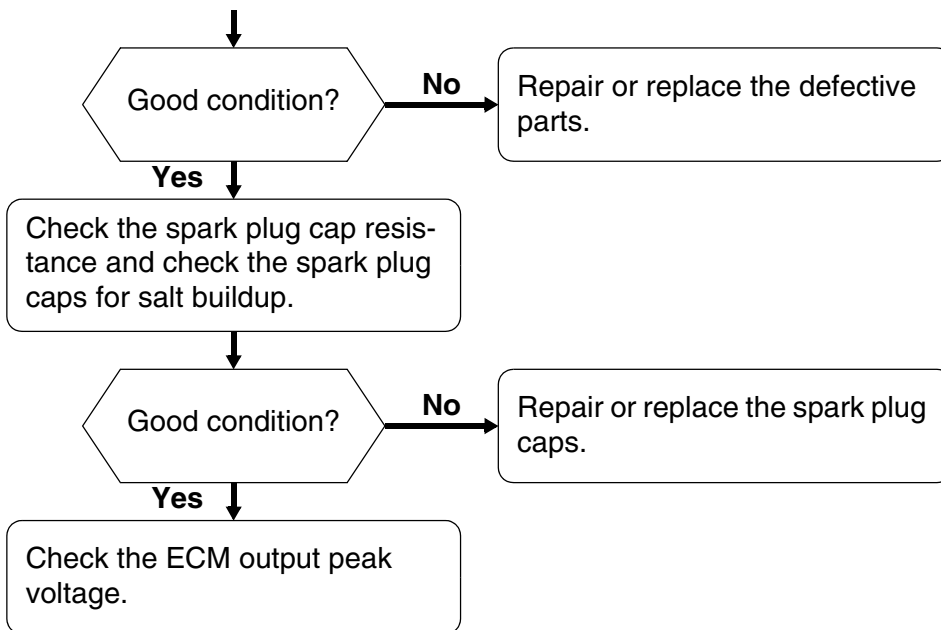


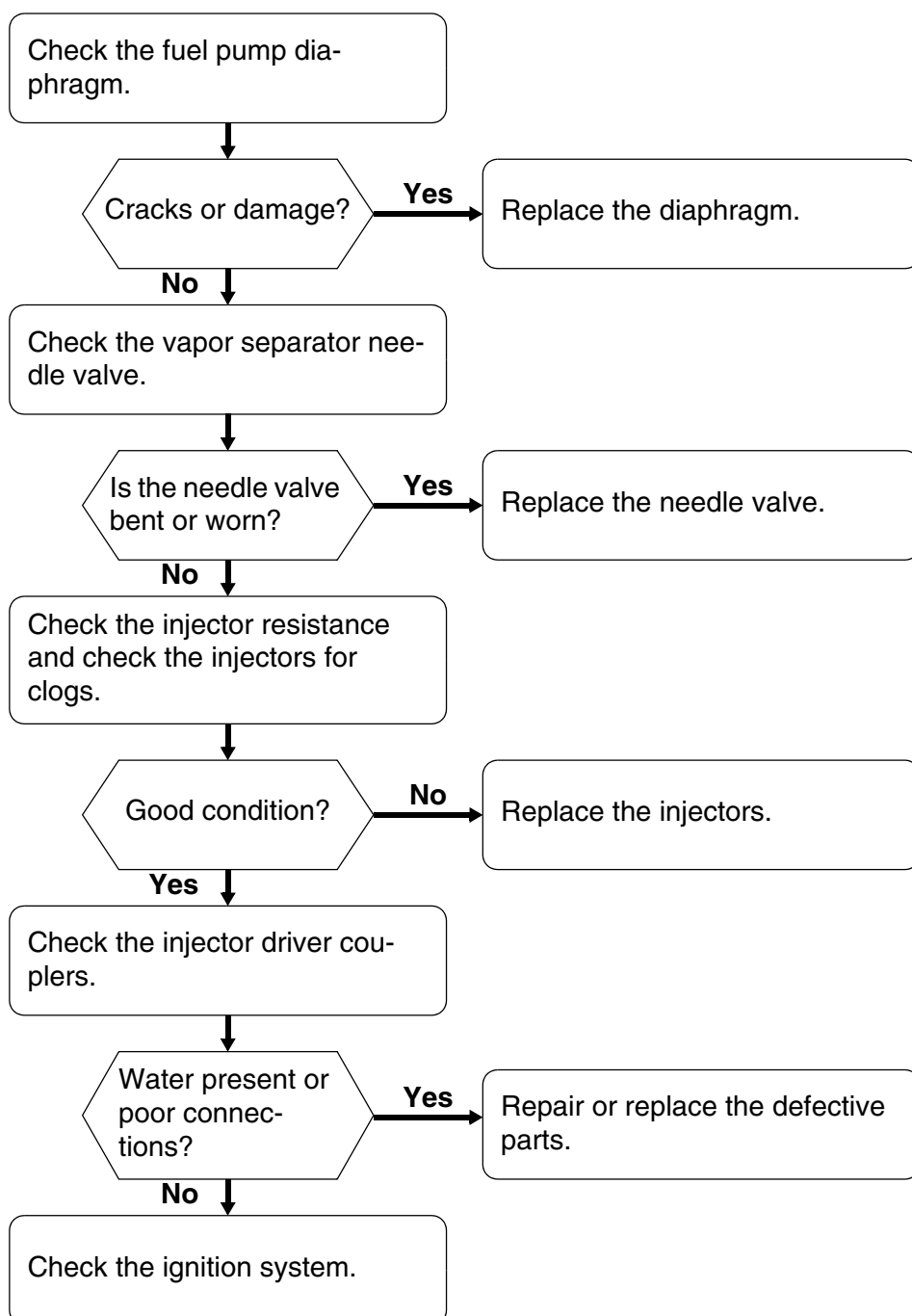
Symptom 3: Engine speed not stable at low speeds.



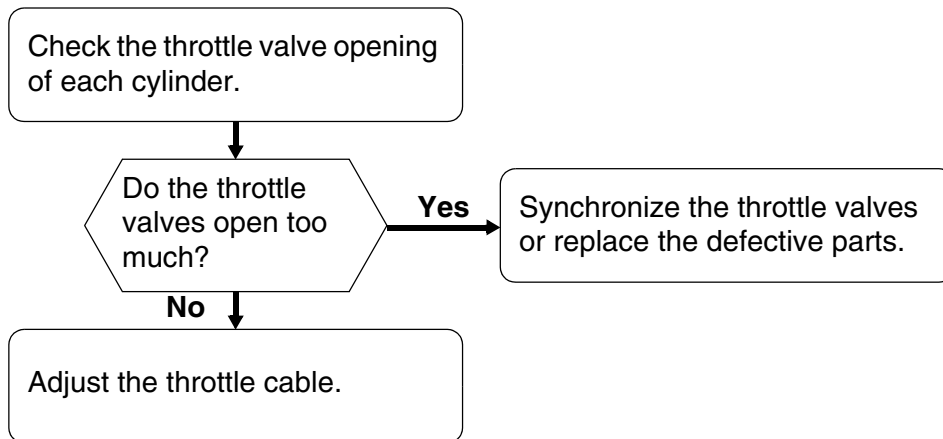
Ignition system



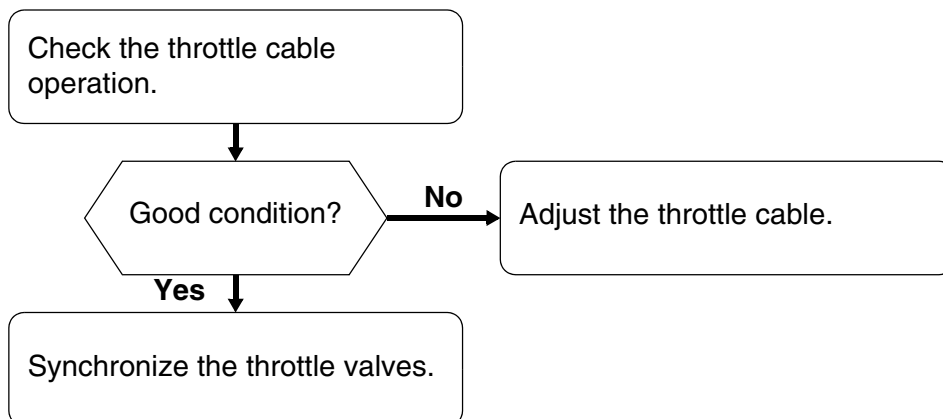


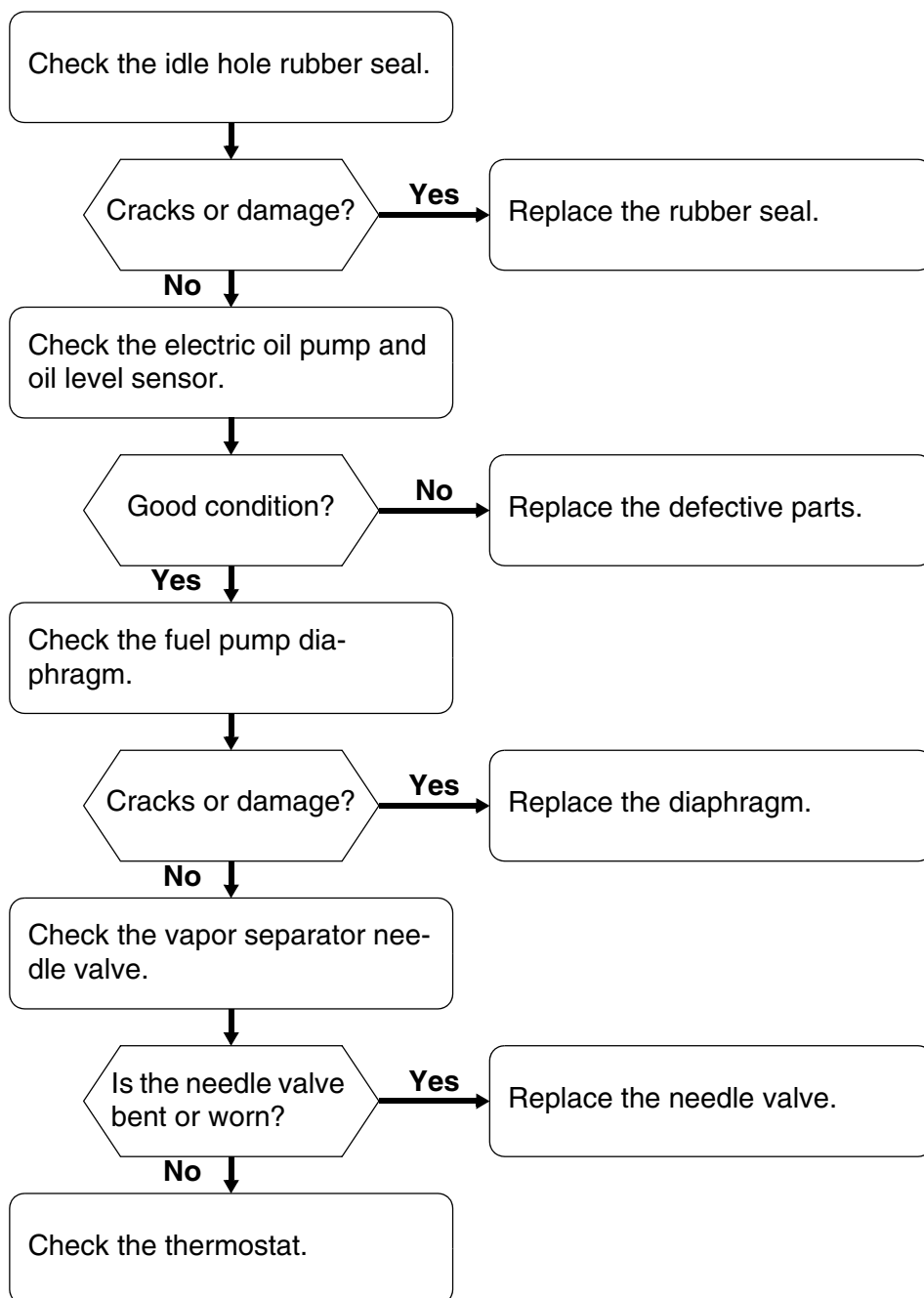
Fuel system

Symptom 4: Hunting occurs.



Symptom 5: Engine speed rises even when the throttle position is fixed.

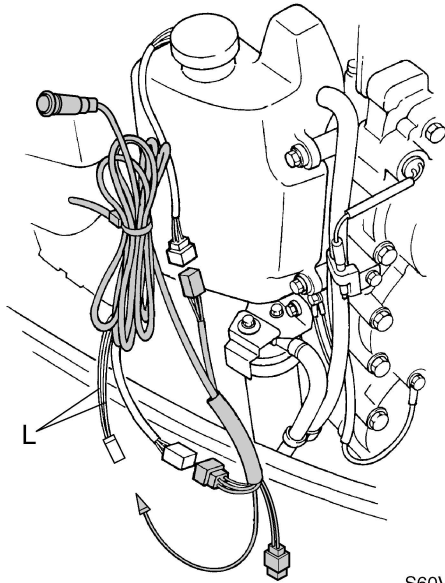


Symptom 6: Excessive white exhaust smoke.

Self-diagnosis

Diagnosing the electronic control system

1. Connect the special service tool to the outboard motor as shown.



S60V9010

NOTE:

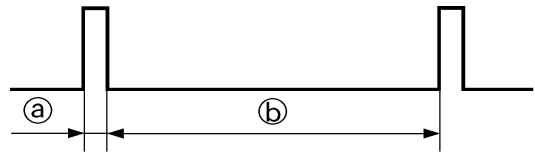
When performing this diagnosis, all of the electrical wires must be properly connected.



Diagnostic flash indicator B:
90890-06865

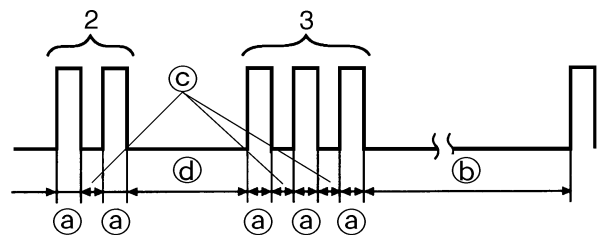
2. Start the engine and let it idle.
3. Check the flash pattern of the diagnostic flash indicator to determine if there are any malfunctions.

- Normal condition
(no defective part or irregular processing is found)
- Single flash is given every 4.95 seconds.
 - Ⓐ: Light on, 0.33 second
 - Ⓑ: Light off, 4.95 seconds



S69J9020

- Trouble code indication
Example: The illustration indicates code number 23.
- Ⓐ: Light on, 0.33 second
- Ⓑ: Light off, 4.95 seconds
- Ⓒ: Light off, 0.33 second
- Ⓓ: Light off, 1.65 seconds



S69J9030

4. If a flash pattern listed in the diagnostic code chart is displayed, check the malfunctioning part according to the flash pattern.

NOTE:

When more than one problem is detected, the light of the diagnostic flash indicator flashes in the pattern of the lowest numbered problem. After that problem is corrected, the light flashes in the pattern of the next lowest numbered problem. This continues until all of the problems are detected and corrected.

Code	Symptom
1	Normal
13	Incorrect pulser coil signal
14	Incorrect crank position sensor signal
15	Incorrect engine temperature sensor signal
18	Incorrect throttle position sensor signal
19	Incorrect battery voltage
22	Incorrect atmospheric pressure sensor signal
23	Incorrect intake air temperature sensor signal
25	Incorrect fuel pressure signal
26	Incorrect injector signal
27	Incorrect water in fuel signal
28	Incorrect shift position switch signal
44	Incorrect engine shut-off switch signal

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Wiring diagram

Z250DETO, LZ250DETO

- ① Electric fuel pump
- ② Electric oil pump
- ③ Oil level sensor
- ④ Water detection switch
- ⑤ Throttle position sensor
- ⑥ Emergency switch
- ⑦ Atmospheric pressure sensor
- ⑧ Thermoswitch
- ⑨ Power trim and tilt switch
- ⑩ Fuel pressure sensor
- ⑪ Pulser coil
- ⑫ Stator coil
- ⑬ Crank position sensor
- ⑭ Fuel injector
- ⑮ Fuel pump relay
- ⑯ Injector driver
- ⑰ Ignition coil
- ⑱ Spark plug
- ⑲ ECM
- ⑳ Diode
- ㉑ Engine temperature sensor
- ㉒ Trim sensor
- ㉓ Oil pump (remote oil tank)
- ㉔ Oil level sensor (remote oil tank)
- ㉕ Shift cut switch
- ㉖ Shift position switch
- ㉗ Power trim and tilt relay
- ㉘ Power trim and tilt motor
- ㉙ Intake air temperature sensor
- ㉚ Starter relay
- ㉛ Starter motor
- ㉜ Starting battery
- ㉝ Accessory battery
- ㉞ Fuse holder
- ㉟ Fuse (20 A)
- ㊱ ECM main relay
- ㊲ Injector driver relay
- ㊳ Fuse (100 A)
- ㊴ Fuse (30 A)
- ㊵ Rectifier Regulator

- [A] To personal computer for diagnosis
- [B] To remote control box/switch panel
- [C] To oil level warning indicator
- [D] To trim meter
- [E] To diagnostic flash indicator
(special service tool)

- (*1) Isolator cable (optional)
- (*2) Negative cable (commercially available)

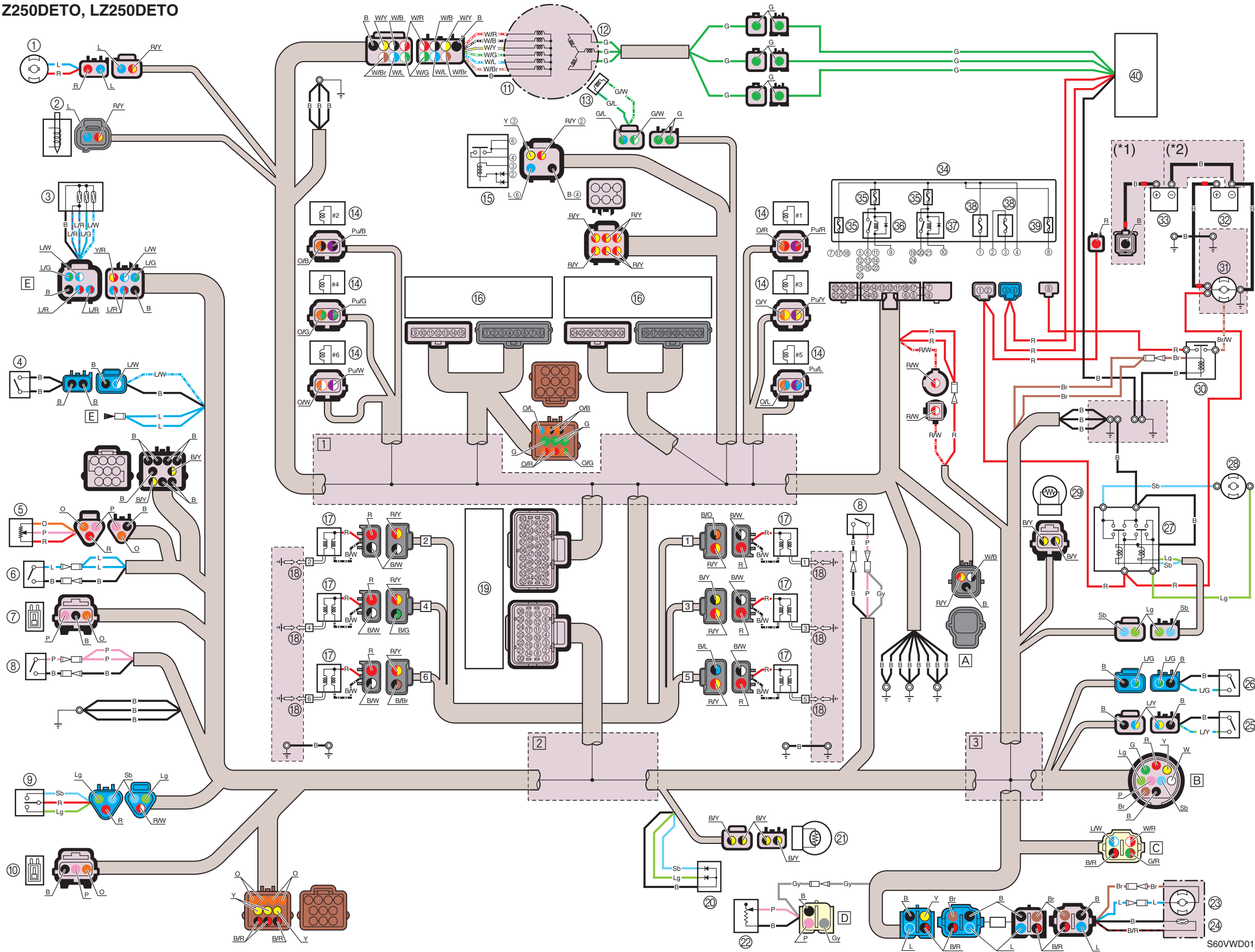
Color code

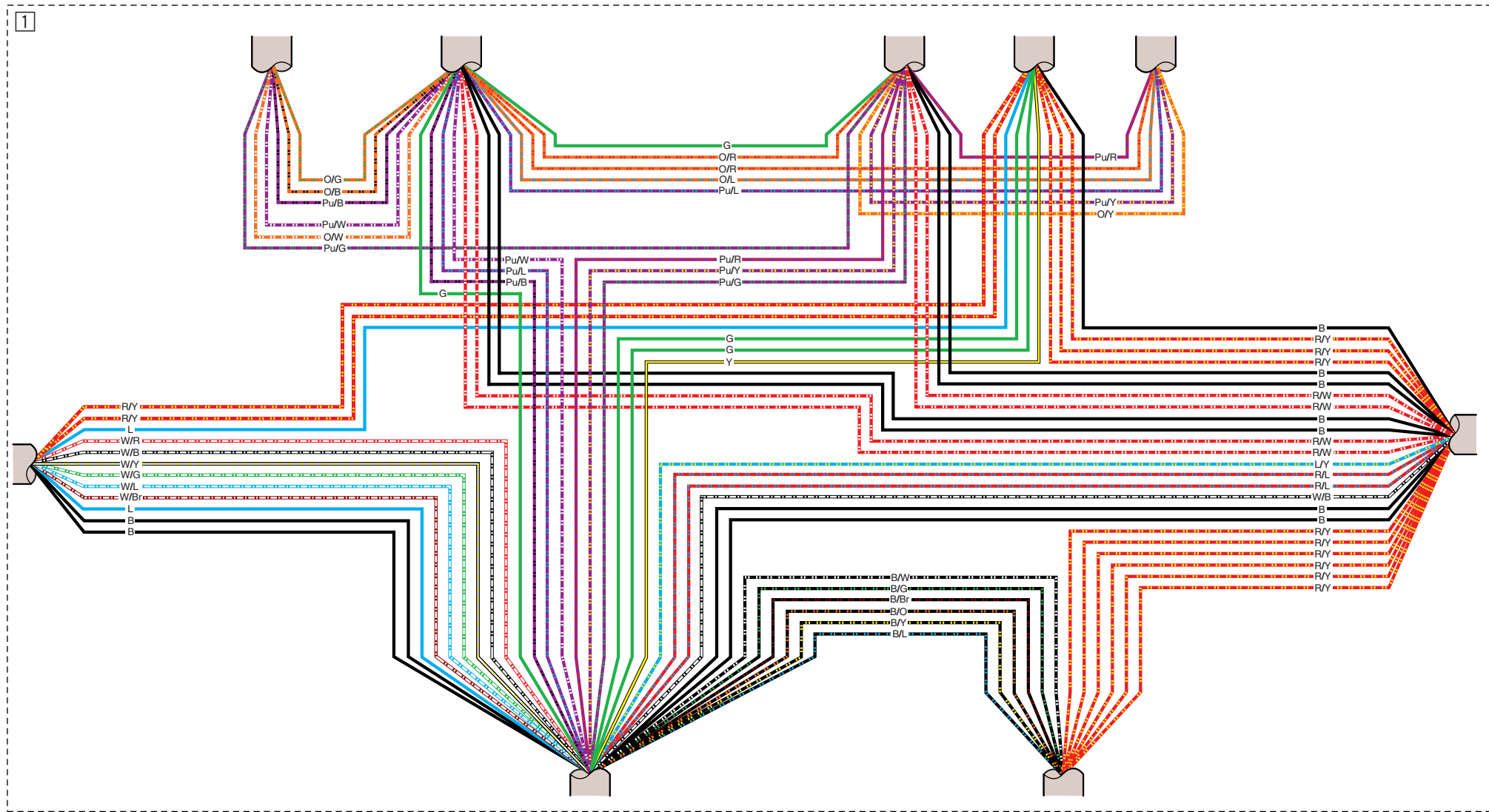
B	: Black
Br	: Brown
G	: Green
Gy	: Gray
L	: Blue
Lg	: Light green
O	: Orange
P	: Pink
R	: Red
Sb	: Sky blue
W	: White
Y	: Yellow
B/Br	: Black/brown
B/G	: Black/green
B/L	: Black/blue
B/O	: Black/orange
B/R	: Black/red
B/W	: Black/white
B/Y	: Black/yellow
G/L	: Green/blue
G/R	: Green/red
G/W	: Green/white
L/G	: Blue/green
L/R	: Blue/red
L/W	: Blue/white
L/Y	: Blue/yellow
O/B	: Orange/black
O/G	: Orange/green
O/L	: Orange/blue
O/R	: Orange/red
O/W	: Orange/white
O/Y	: Orange/yellow
Pu/B	: Purple/black
Pu/G	: Purple/green
Pu/L	: Purple/blue
Pu/R	: Purple/red
Pu/W	: Purple/white
Pu/Y	: Purple/yellow
R/L	: Red/blue
R/W	: Red/white
R/Y	: Red/yellow
W/B	: White/black
W/Br	: White/brown
W/G	: White/green
W/L	: White/blue
W/R	: White/red
W/Y	: White/yellow
Y/R	: Yellow/red



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Z250DETO, LZ250DETO





16

1 : B	11 : Pu/B	21 : Pu/Y
2 : R/W	12 : —	22 : —
3 : O/B	13 : Pu/W	23 : O/Y
4 : Pu/B	14 : Pu/L	24 : B
5 : Pu/L	15 : G	25 : R/W
6 : Pu/W	16 : B	26 : Pu/R
7 : —	17 : R/W	27 : —
8 : O/W	18 : O/R	28 : Pu/Y
9 : B	19 : Pu/R	29 : Pu/G
10 : R/W	20 : Pu/G	30 : G

19

1 : LW	21 : B/R	41 : —
2 : P	22 : G	42 : Y
3 : —	23 : W	43 : B
4 : L/R	24 : Y	44 : B
5 : L/R	25 : Br	45 : W/L
6 : L/G	26 : —	46 : W/R
7 : G/R	27 : R/L	47 : G
8 : P	28 : W/Y	48 : Pu/Y
9 : B	29 : G	49 : W/B
10 : O	30 : G	50 : —
11 : P	31 : Pu/L	51 : B
12 : B/Y	32 : Pu/R	52 : B
13 : B/Y	33 : B/O	53 : W/Br
14 : P	34 : B/W	54 : W/B
15 : P	35 : B/Y	55 : L
16 : L/Y	36 : R/L	56 : —
17 : LW	37 : W/G	57 : Pu/G
18 : L/G	38 : L/Y	58 : B/Br
19 : Y/R	39 : Pu/W	59 : B/L
20 : L	40 : Pu/B	60 : B/G

