

F225A
FL225A

SERVICE MANUAL

290435

69J-28197-3D-11

NOTICE

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

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

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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.

**F225A, FL225A
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 parts and part quantities, as well as bolt, screw, O-ring, and hose dimensions.
- ⑤ Service points regarding removal, checking, and installation are shown in individual illustrations to explain the relevant procedure.

NOTE:

For troubleshooting procedures, see Chapter 9, "Troubleshooting."

POWER **Power unit**

Cylinder head

5-25

62Y5A11

Cylinder head

No.	Part name	Q'ty	Remarks
1	Cylinder head	1	
2	Oil pump	1	
3	Cylinder head cover	1	
4	Bolt	7	M6 × 20 mm
5	Cylinder head cover gasket	1	Not reusable
6	Bolt	10	M9 × 95 mm
7	Spark plug	4	
8	Bolt	5	M6 × 25 mm
9	Dowel pin	2	
10	Cylinder head gasket	1	Not reusable
11	Grommet	4	
12	Anode	4	
13	Cover	4	

④

POWER **Power unit**

Removing the timing belt and sprockets

- Set the cylinder #1 piston position to TDC of the compression stroke by aligning the "1" mark ③ on the driven sprocket with the "▲" mark ④ on the cylinder head.
- Remove the breather hose and loosen the drive sprocket nut ①.
- Remove the tensioner ② and timing belt ⑤ from the driven sprocket side.
- Loosen the driven sprocket bolt ⑥ and remove the driven sprocket ⑦.
- Remove the nut ①, retaining plates ⑧, drive sprocket ⑨, and Woodruff key ⑩.

CAUTION:
Do not turn the drive sprocket counter-clockwise, otherwise the valve system may be damaged.

NOTE:
• Use a deep socket ② (M42) for this procedure.
• Do not turn the camshaft when loosening the drive sprocket nut.

NOTE:
Do not turn the camshaft when loosening the driven sprocket bolt.

Flywheel holder: 90890-06522

Crankshaft holder 18 ③:
90890-06562

5-21

62Y5A11

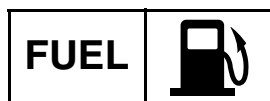
Symbols

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

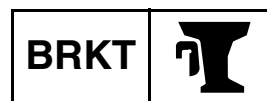
General information



Fuel system



Bracket unit



Specifications



Power unit



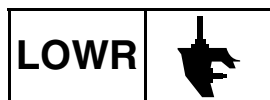
Electrical systems



Periodic checks and adjustments



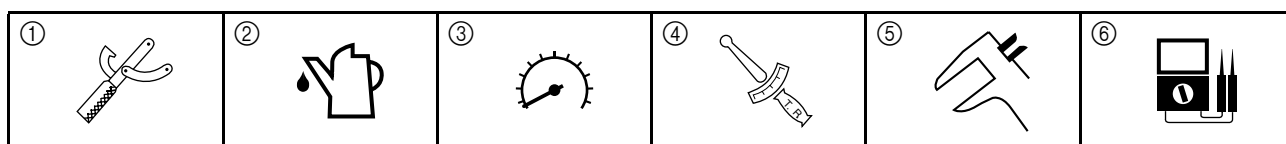
Lower unit



Troubleshooting

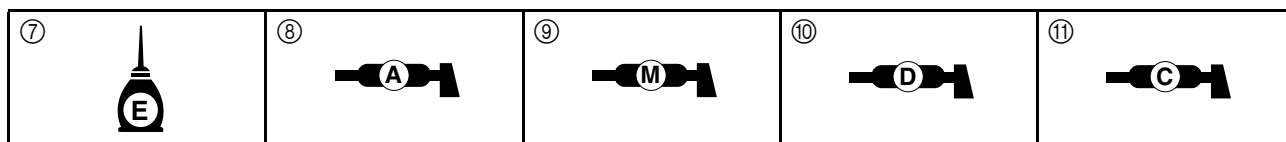


Symbols ① to ⑥ indicate specific data.



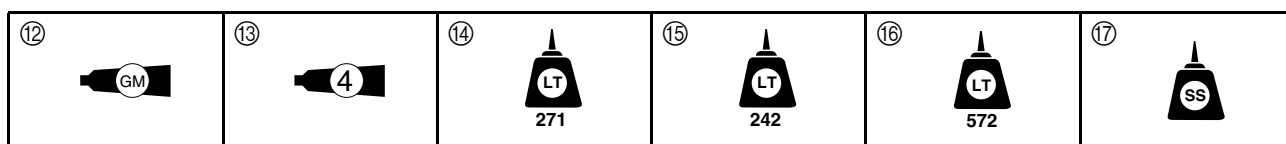
- ① Special tool
- ② Specified oil or fluid
- ③ Specified engine speed
- ④ Specified tightening torque
- ⑤ Specified measurement
- ⑥ Specified electrical value (resistance, voltage, electric current)

Symbols ⑦ to ⑪ in an exploded diagram indicate the grade of lubricant and the lubrication point.



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

Symbols ⑫ to ⑰ in an exploded diagram indicate the type of sealant or locking agent and the application point.



- ⑫ Apply Gasket Maker®
- ⑬ Apply Yamabond No. 4
- ⑭ Apply LOCTITE® No. 271 (Red)
- ⑮ Apply LOCTITE® No. 242 (Blue)
- ⑯ Apply LOCTITE® No. 572
- ⑰ Apply silicon sealant



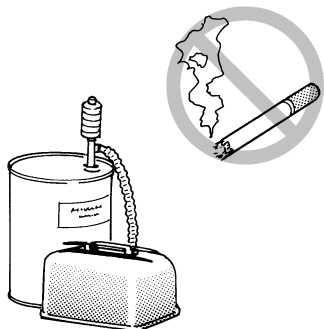
Safety while working

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

Fire prevention

Gasoline is highly flammable.

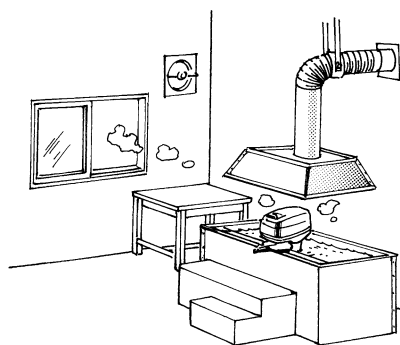
Keep gasoline and all flammable products away from heat, sparks, and open flames.



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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.

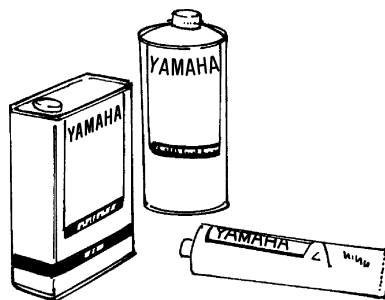
Protect your hands and feet by wearing protective gloves and safety shoes when necessary.



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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.



S69J1040

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.

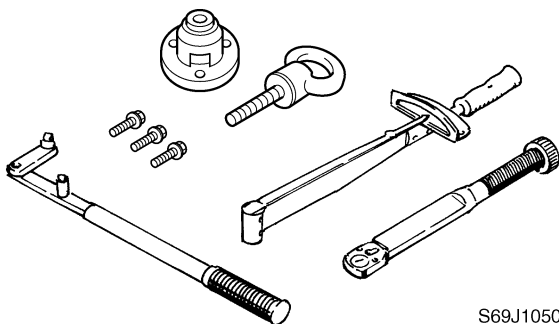
Safety while working

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

Good working practices

Special tools

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



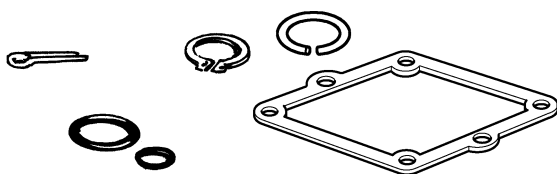
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Tightening torques

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

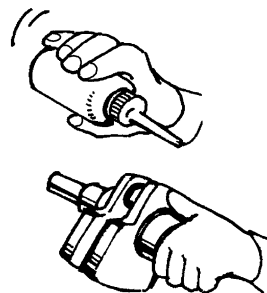
Always use new gaskets, seals, O-rings, cotter pins, circlips, etc., when installing or assembling parts.



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.

1

Identification

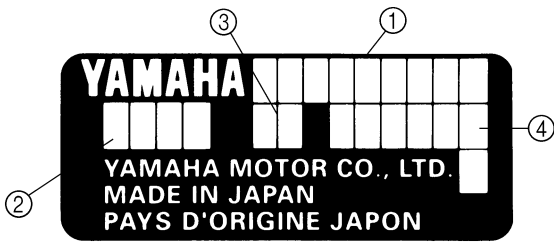
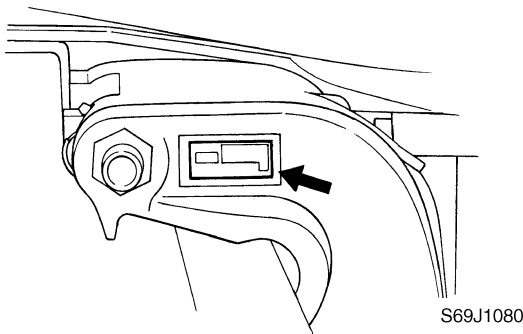
Applicable models

This manual covers the following models.

Applicable models
F225AET, FL225AET

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

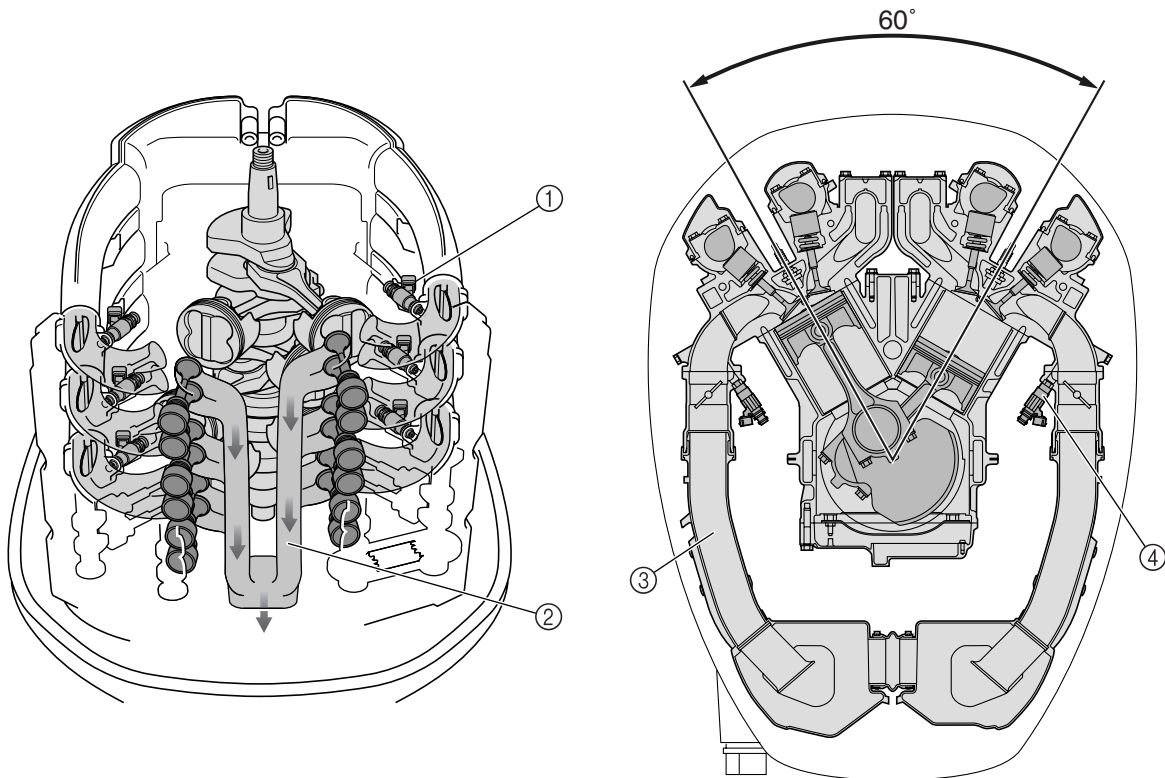
Model name	Approved model code	Starting serial No.
F225AET	69J	X: 000101–
		U: 150101–
FL225AET	69K	X: 000101–
		U: 100101–

Features and benefits

Newly developed V6 4-stroke engine

The F225 is a newly developed 60-degree V6 4-stroke engine with a very compact and lightweight design. Its size and weight are almost the same as the V6 2-stroke engines that are in current use. This F225 offers numerous advantages of a 4-stroke engine. Compared to conventional 2-stroke models, it emits much cleaner exhaust gases, offers a better fuel economy, and realizes lower noise levels at idle and full throttle.

Through the newly developed “In-bank exhaust system,” which discharges exhaust gases from the center of both banks, the engine block and the surrounding equipment have been made compact. In addition, the six independent intake passages help to achieve a high level of driveability and power output.



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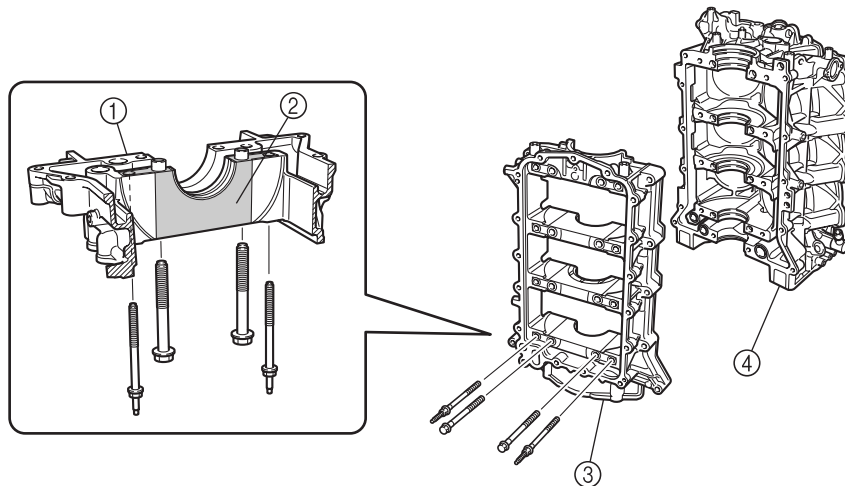
- ① Electronic Fuel Injection
- ② In-bank exhaust system
- ③ Pulse tuned long intake tracks
- ④ Individual inside track fuel injectors



Crankcase

The crankcase is made of cast aluminum, however steel has been cast into the areas for the crankshaft bearings. By distinguishing the area that requires strength from the area that allows the use of a lighter material, both weight reduction and a stronger construction have been achieved.

The caps for the crankshaft bearings are secured with four bolts to ensure a high level of assembled rigidity.



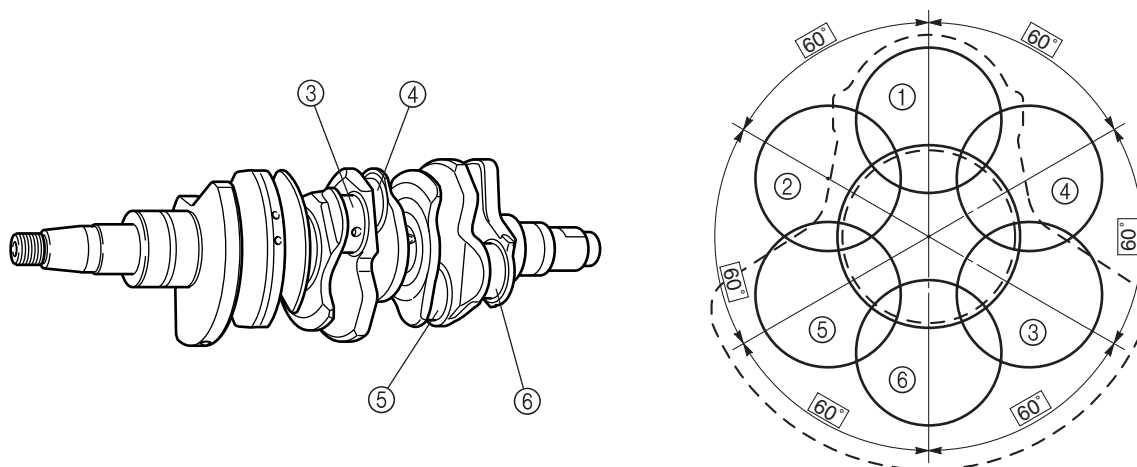
S69J1260

- ① Casted aluminum
- ② Steel

- ③ Crankcase
- ④ Cylinder block

Crankshaft

The crankshaft has been forged to realize a high-strength and high-rigidity construction. In the 60-degree V6 cylinder configuration, the crankshaft pins are staggered 60 degrees from each other.



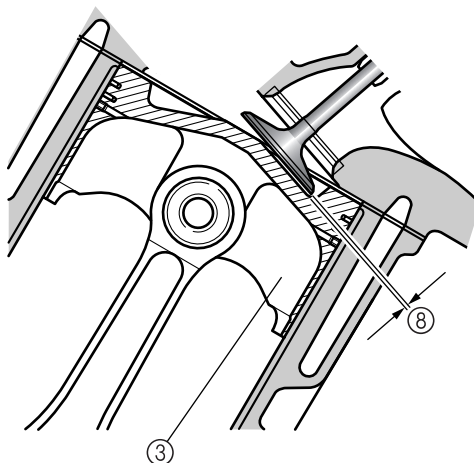
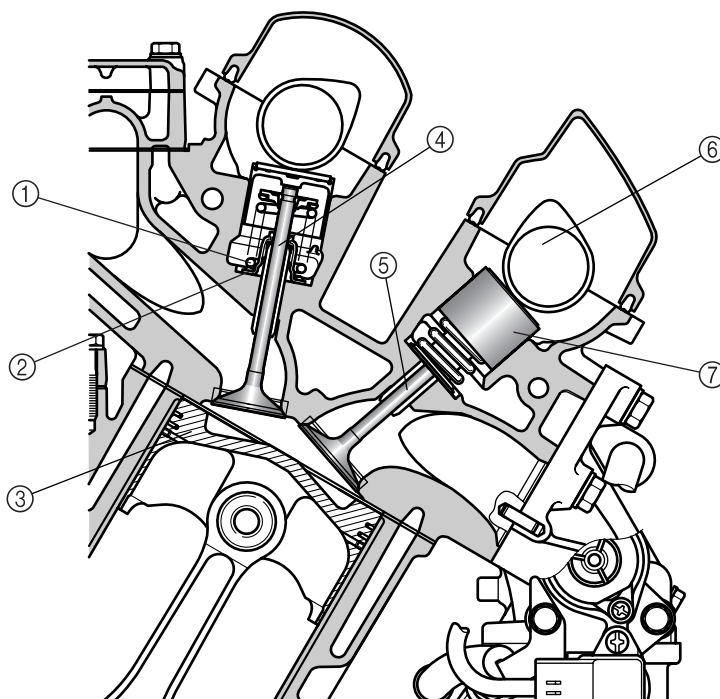
S69J1270

- ① Crankpin #1
- ② Crankpin #2
- ③ Crankpin #3

- ④ Crankpin #4
- ⑤ Crankpin #5
- ⑥ Crankpin #6

Piston

The piston has been carved out of a forged stock. To prevent the valves from coming in contact with the piston, the piston is provided with a valve recess. If the engine goes out of timing and a valve opens when the piston is at top-dead-center, this recess prevents the valve from coming in contact with the piston, thus preventing engine damage.



S69J1280

- ① Valve spring
- ② Valve seal
- ③ Piston
- ④ Valve stem

- ⑤ Intake valve
- ⑥ Intake camshaft
- ⑦ Valve lifter
- ⑧ Valve recess



Valve train system

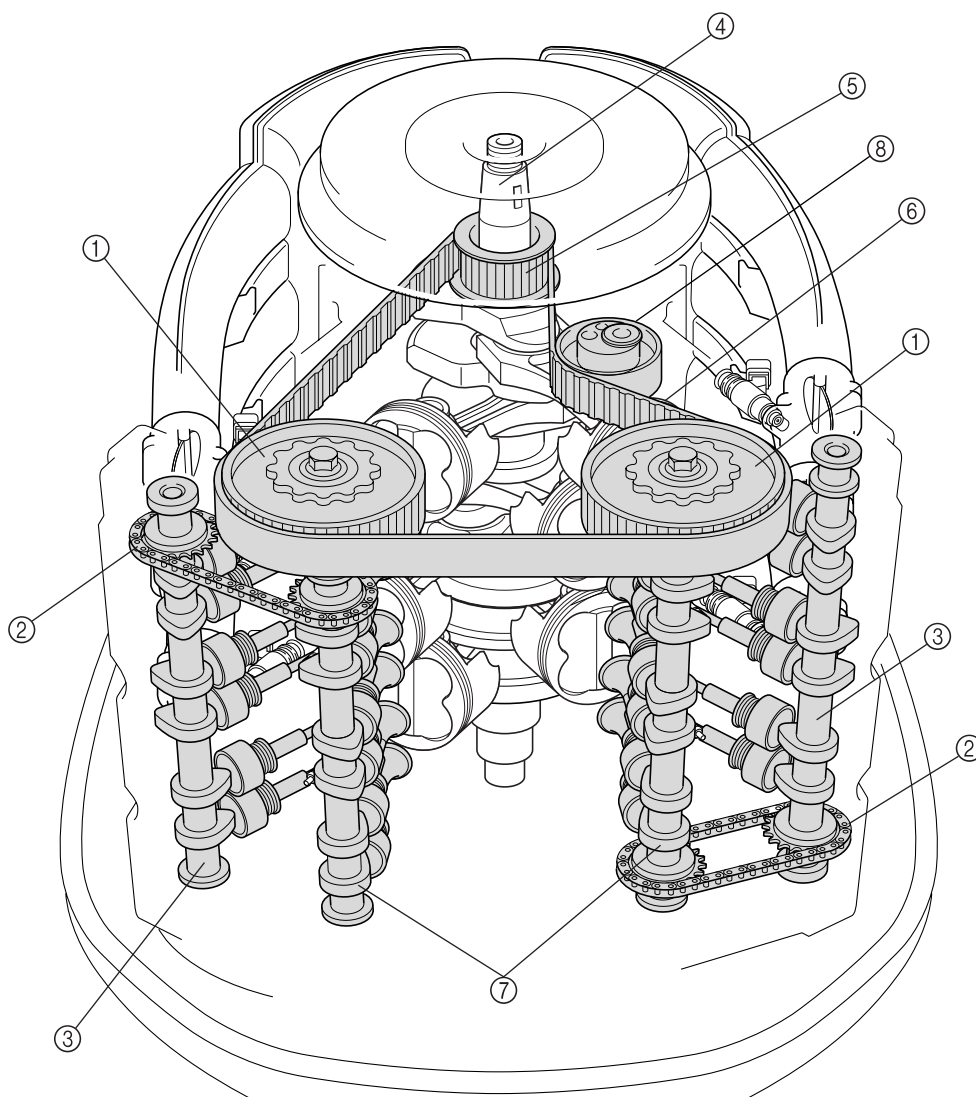
The valve train consists of a total of four camshafts, with two in each bank.

The camshafts are driven with the combination of a belt and chains. The crankshaft turns the belt to drive the exhaust camshafts in both banks. Chains connect the exhaust camshafts to the intake camshafts in the cylinder heads to drive the intake camshafts.

In addition, the timing belt offers quieter operation, and the cam chains help to achieve a compact configuration through the use of individual driven sprockets.

Timing belt

The timing belt, which is driven by the drive sprocket that is attached to the crankshaft, rotates the driven sprockets that are attached to the exhaust camshafts of both banks. The drive sprocket for the timing belt is secured to the crankshaft by four bolts, and it can be removed easily for servicing. In addition, the material of the driven sprockets has been changed from the previous metal to plastic for weight reduction.



S69J1290

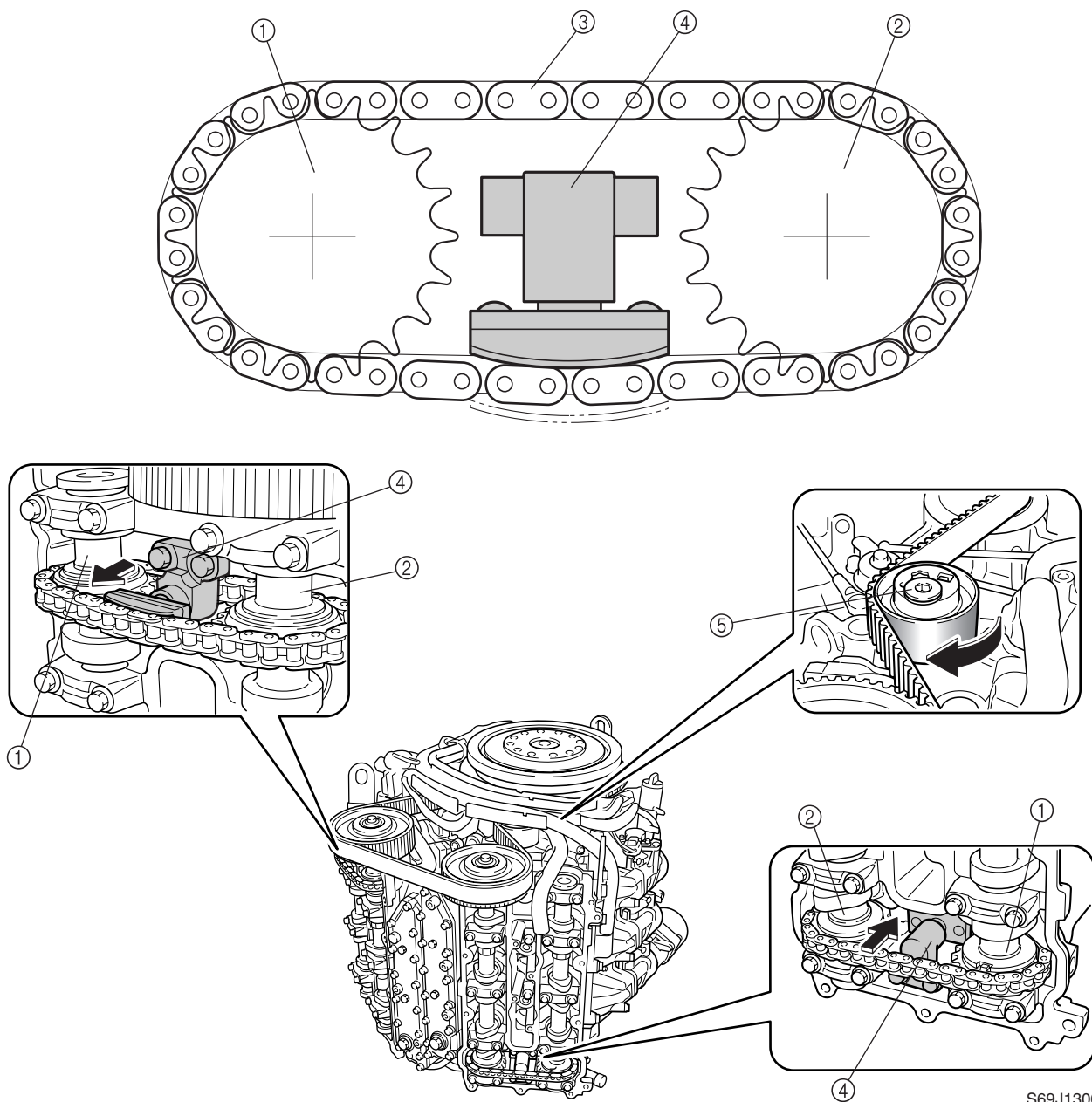
- ① Driven sprocket
- ② Timing chain
- ③ Intake camshaft
- ④ Crankshaft
- ⑤ Drive sprocket

- ⑥ Timing belt
- ⑦ Exhaust camshaft
- ⑧ Hydraulic timing belt tensioner

Tensioner

A timing chain tensioner is provided at the mid-span of the timing chain, between both camshafts. The timing chain tensioner uses the force of a spring to maintain its tension. After the engine is started, oil is pumped into the tensioner, and the resulting pressure causes the tension to increase. A total of three tensioners are used, one for the timing belt, and one for each timing chain of both banks, to maintain proper tension and to ensure the reliability of the valve train.

1



S69J1300

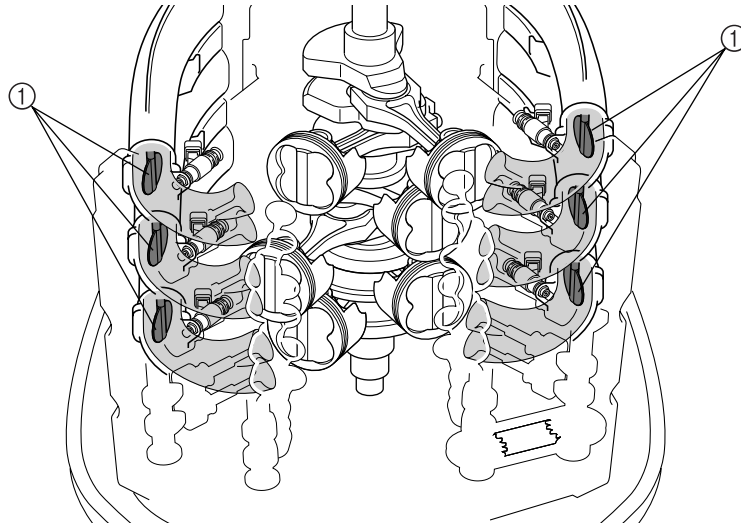
- ① Intake camshaft
- ② Exhaust camshaft
- ③ Timing chain
- ④ Timing chain tensioner
- ⑤ Hydraulic timing belt tensioner



Intake system

Throttle valve

A total of six intake throttle valves are provided, one for each cylinder. Together with the intake silencer that offers enhanced intake efficiency and the injectors that are provided at each throttle body, the throttle valves help to improve the intake efficiency of the engine. As a result, this engine produces a higher power output and realizes better driveability.



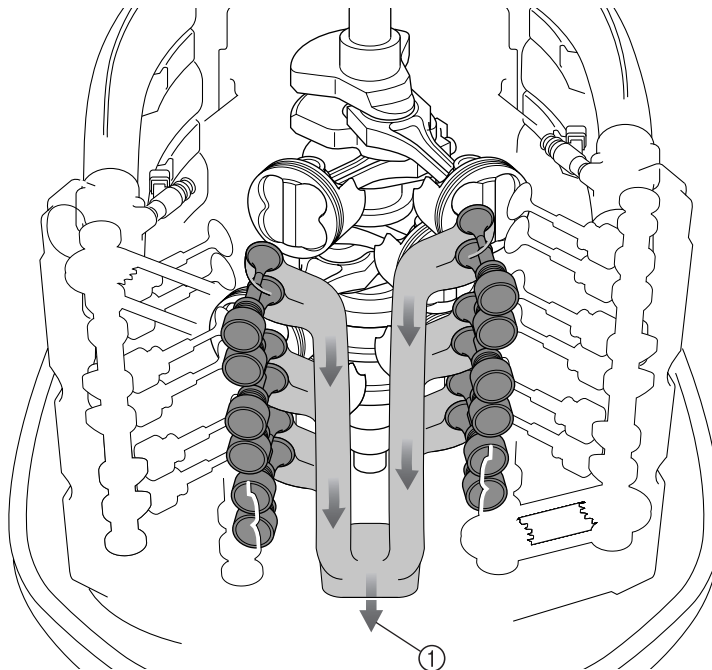
S69J1310

① Throttle valve

Exhaust system

In-bank exhaust system

The exhaust passage of the F225 is located in the V bank, a layout that is the opposite of conventional V6 engines. By providing the exhaust passage in the V bank, the engine has been made considerably more compact.



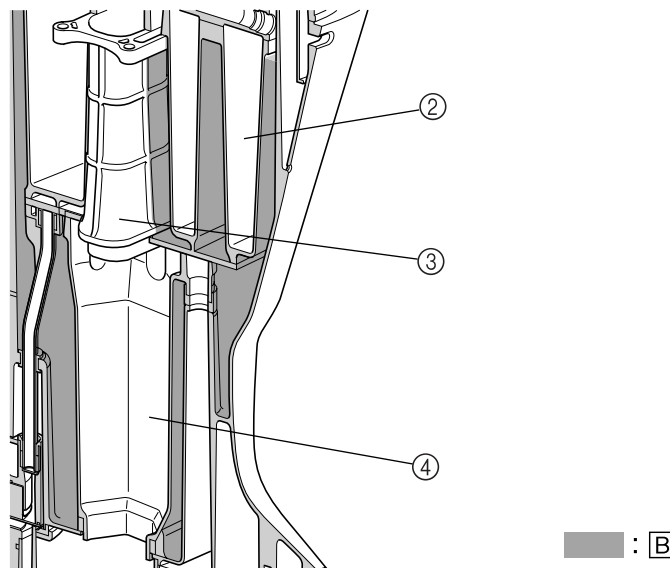
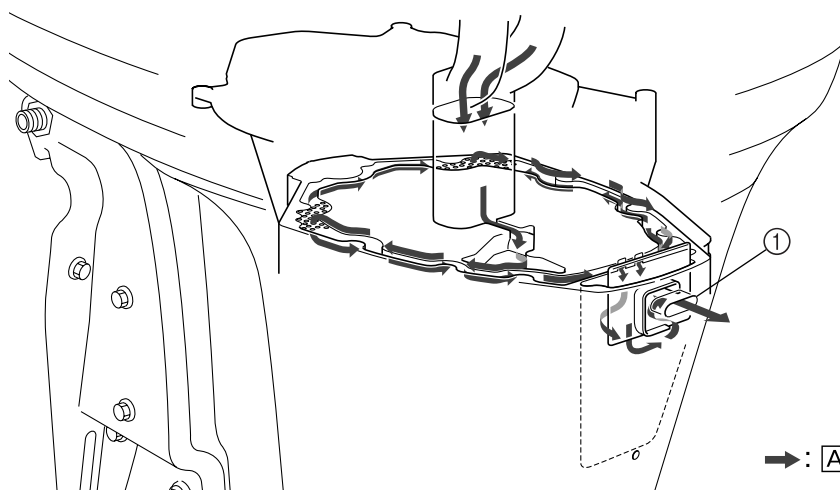
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① Exhaust gas

Exhaust passage during idle

To reduce noise when the engine is idling, the exhaust gas passage of the F225 has adopted a labyrinth construction. During idling, the exhaust gas passes through the passage on the side of the exhaust guide, and enters the upper case through a hole in the upper case gasket. When it fills the upper case, the exhaust gas enters another passage on the side of the exhaust guide through another hole in the upper case gasket. Then, it is discharged through the idle port that is provided in the upper case.

The exhaust manifold and muffler in the upper case are surrounded by the water jackets to reduce exhaust noise. The water jackets also help prevent corrosion by preventing the exterior of the exhaust manifold and muffler from coming in direct contact with the exhaust gas.



- ① Idle port
- ② Oil pan
- ③ Exhaust manifold
- ④ Muffler
- [A] Exhaust gas
- [B] Water

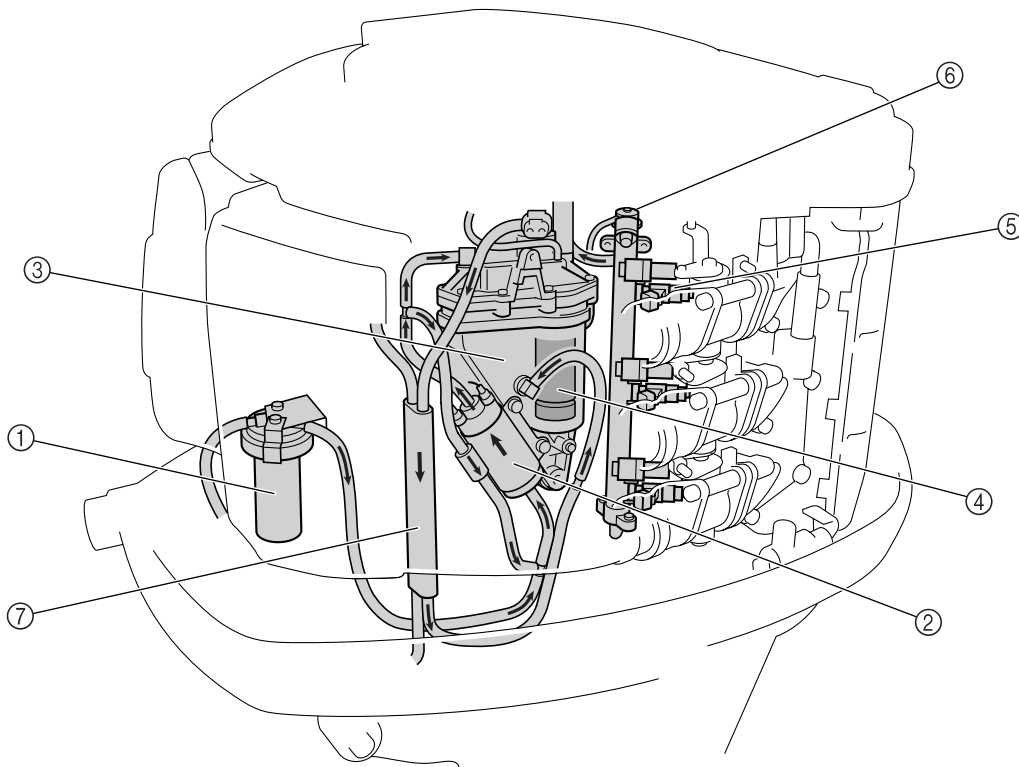
S69J1330



Fuel system

The fuel flows in the following order: fuel filter, low-pressure fuel pump, vapor separator, high-pressure fuel pump, and injectors. The excess fuel at the injectors passes through the pressure regulator and fuel cooler, and returns to the vapor separator.

When the engine start switch is turned on, the injectors of all cylinders operate before the pump relay is actuated to prevent the injectors from sticking.



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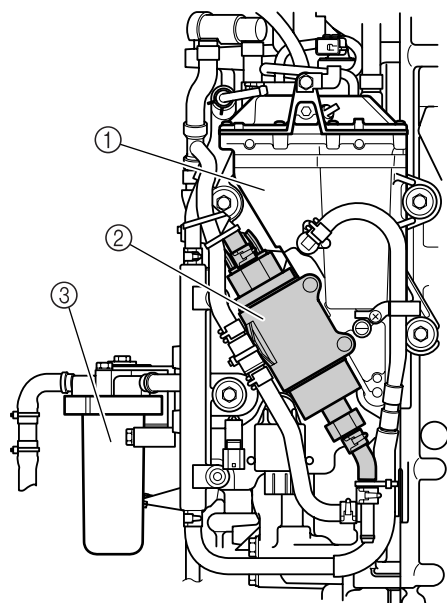
- ① Fuel filter
- ② Low-pressure fuel pump
- ③ Vapor separator
- ④ High-pressure fuel pump

- ⑤ Fuel injector
- ⑥ Pressure regulator
- ⑦ Fuel cooler

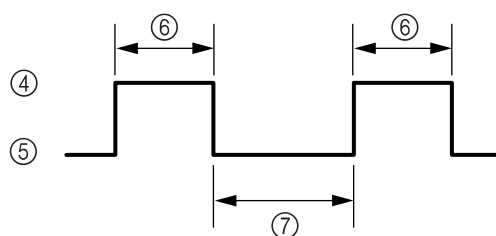
Low-pressure fuel pump

The F225 has adopted a newly developed, low-pressure electrical fuel pump, in place of the low-pressure mechanical fuel pump used in the previous electronic fuel injection system. With the adoption of the electric pump, the routing of the fuel system has been made more compact. To prevent the over-pumping of fuel, this pump operates for 10 seconds, and stops for 20 seconds when the engine is operating at low speeds.

The pump operates constantly if the engine speed is 1,200 r/min or higher, or for several seconds (which vary by ambient temperature) after the engine is started. At other times, it operates for 10 seconds, and stops for 20 seconds to prevent over-pumping.



- ① Vapor separator
- ② Low-pressure fuel pump
- ③ Fuel filter
- ④ On



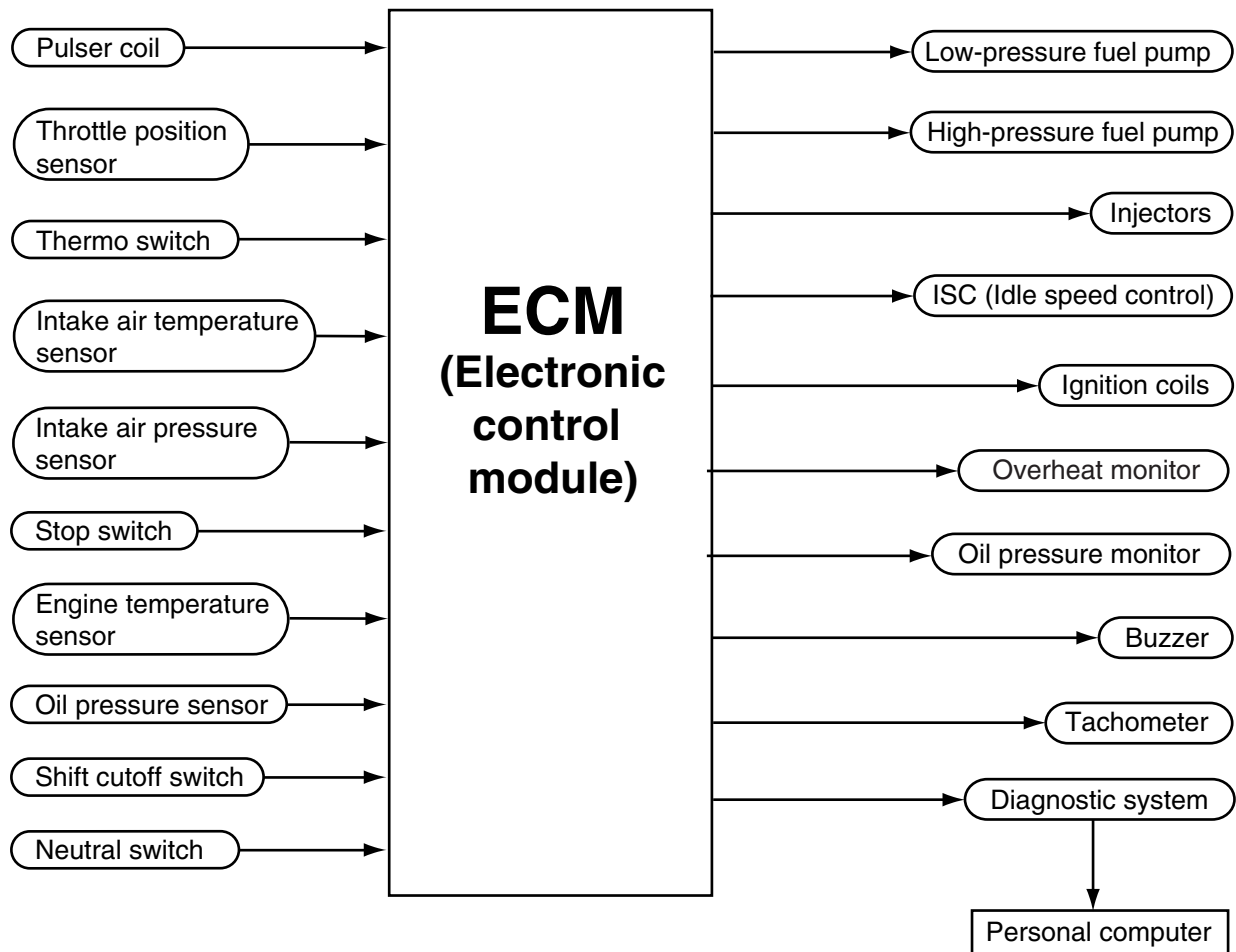
- ⑤ Off
- ⑥ 10 seconds
- ⑦ 20 seconds

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Electronic control system

The ECM of the F225 controls the ignition timing, the fuel injection timing, the fuel injection volume, and the ISC and it maintains a stoichiometric air-fuel ratio in all operating conditions, including starting and idling. Also, the ECM converts the signals from the input sensors and sends instructions to each part.

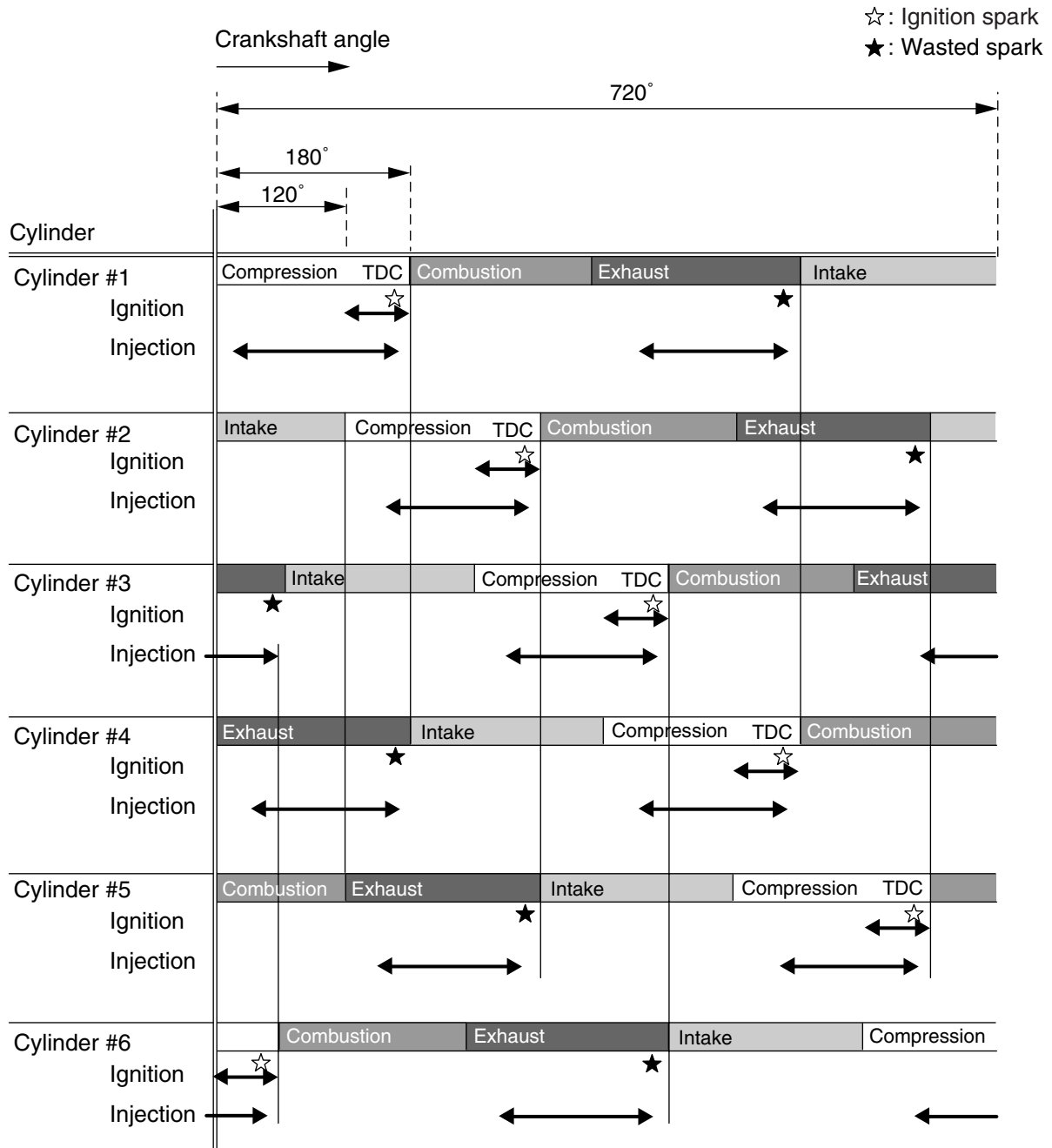


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Ignition and fuel injection timing

Firing order : #1, #2, #3, #4, #5, #6

Injection order : #1 and #4 → #2 and #5 → #3 and #6 (group injection)

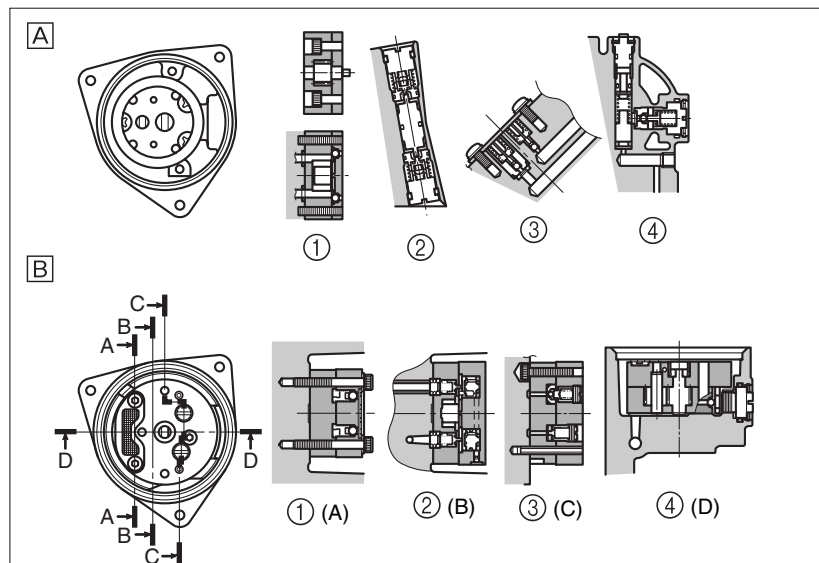
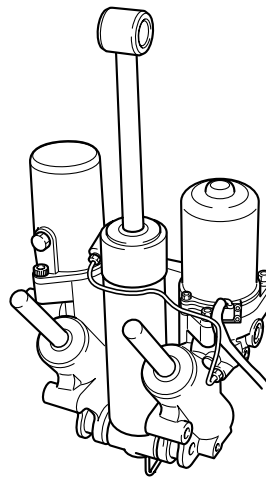


S69J1370



PTT (Power trim and tilt) unit

The PTT unit has been newly developed for the F225. Based on the field-proven 61A type, its PTT fluid passage and internal valve construction have been changed for this application. Although the valves of the 61A type have been distributed to the various areas of the gear pump housing, the valves of the new PTT unit have been concentrated in the vicinity of the gear pump to improve their serviceability. In addition, the material of the gear pump housing has been changed to enhance its corrosion resistance.



S69J1380

- ① Gear pump
- ② Main valve
- ③ Relief valve

- ④ Manual valve
- A 61A type
- B F225 type

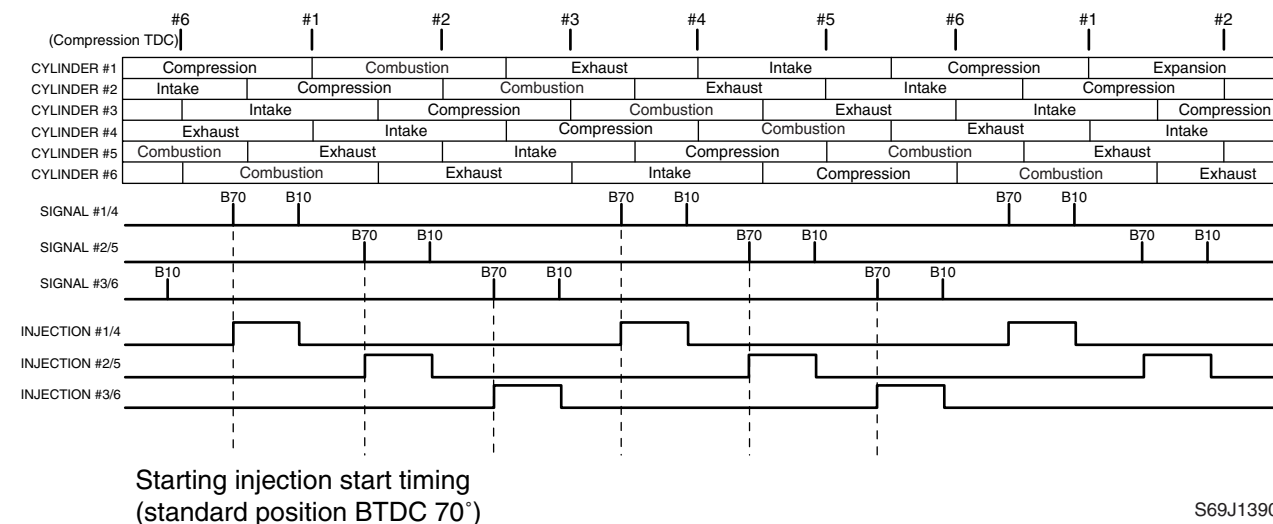
Technical tips

Fuel injection control

The F225 injects fuel simultaneously to the following cylinder pairs: #1 and #4, #2 and #5, and #3 and #6. Optimal injection timing is provided in accordance with the operating conditions of the engine.

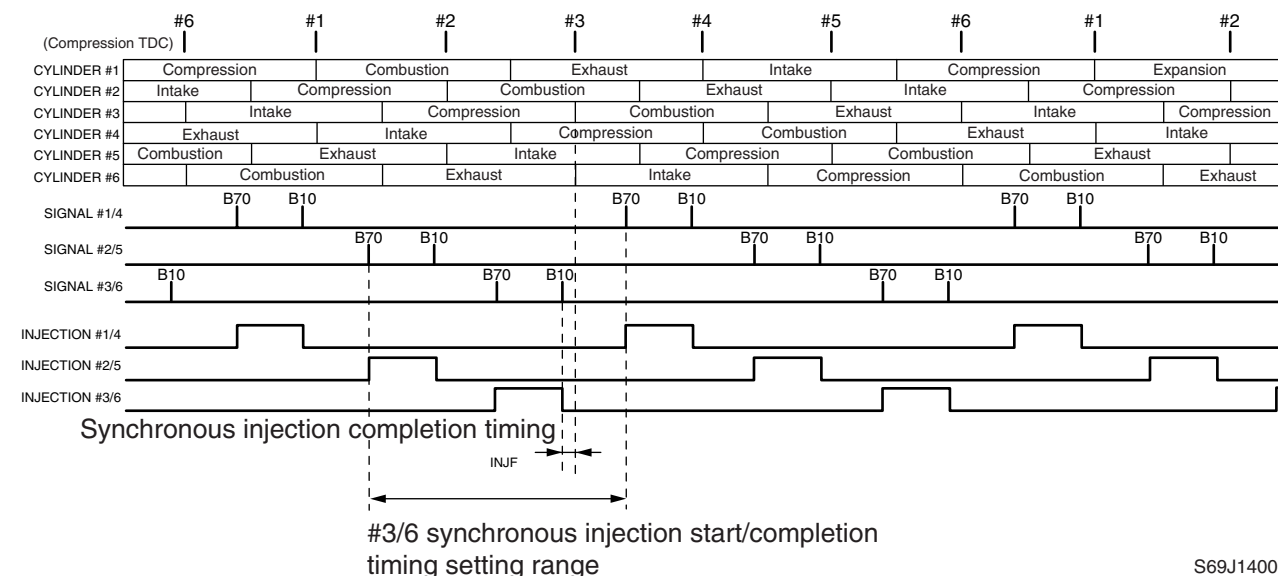
Starting fuel injection volume and injection timing

The injectors are actuated in sync with the standard crankshaft position signals (BTDC 70°) for cylinder pairs #1 and #4, #2 and #5, and #3 and #6, respectively.



Normal fuel injection volume and injection timing

To control the actuation timing of the injectors, the injection ending timing is established by using the top-dead-center of the intake stroke as the standard, for cylinder pairs #1 and #4, #2 and #5, and #3 and #6, respectively.




Over-revolution control

If the engine speed exceeds 4,500 r/min, while the shift is in neutral, ignition is stopped. The various stages of ignition cutoff are shown in the table below.

Ignition cutoff cylinder in neutral

Set speed (r/min)	#1	#2	#3	#4	#5	#6
4,500	○	○	△	○	○	△
4,750	○	○	○	○	○	○

△: Indicates a misfire at either cylinder (once, due to simultaneously firing).

○: Indicates a misfire at both cylinders (twice continuous).

If the engine speed exceeds 6,200 r/min, while the shift is in forward or reverse, the ignition is stopped. The various stages of ignition cutoff are shown in the table below.

Ignition cutoff cylinder in forward or reverse

Set speed (r/min)	#1	#2	#3	#4	#5	#6
6,200	△			△		
6,250	○			○		
6,300	○	△		○	△	
6,350	○	○		○	○	
6,400	○	○	△	○	○	△
6,450	○	○	○	○	○	○

△: Indicates a misfire at either cylinder (once, due to simultaneously firing).

○: Indicates a misfire at both cylinders (twice continuous).

Dual-engine control

When two outboard engines are used, if one of the engines enters any one of the control modes, the other engine will also control its ignition. This control is activated with the same engine speeds as with other control modes.

Shift cutoff control

If the shift cut switch is activated with the engine operating under 2,000 r/min, the system causes one or two cylinders to misfire in order to facilitate shifting. The system causes cylinders #1 and #2, or #4 and #5 to misfire when the engine speed is over 850 r/min, and cylinder #1 or #4 to misfire when the engine speed is under 850 r/min.

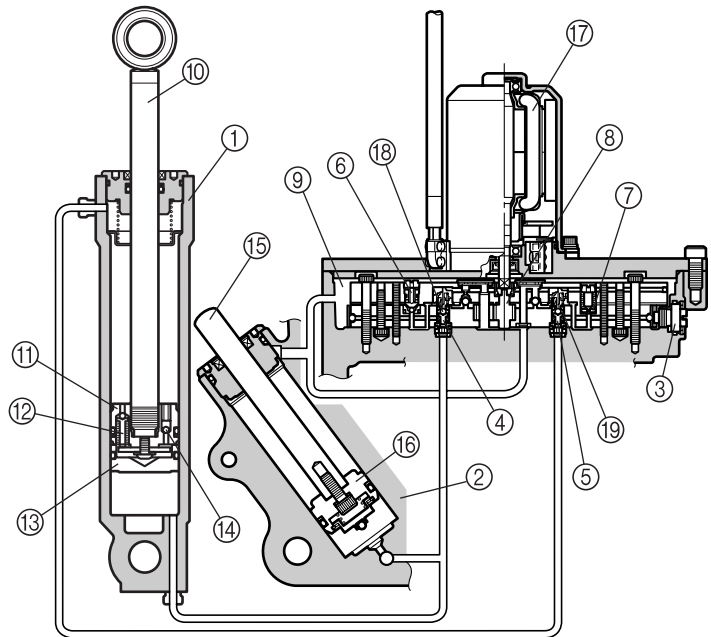
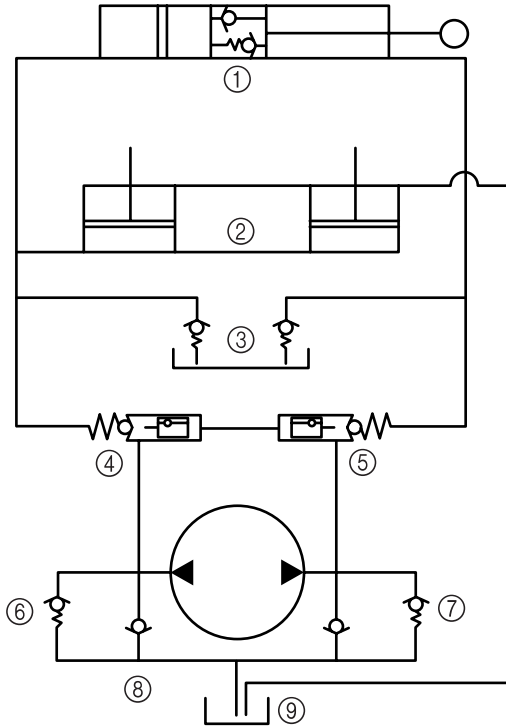
Fail-safe function table

Symptom	FAIL-SAFE FUNCTION				DIAGNOSIS CODE
	Ignition	Injection	ISC	Engine condition	
Incorrect pulser coil signal	Engine starting: Only the cylinders outputting normal signal ignite at BTDC10°, and all cylinders thereafter.	All cylinders inject simultaneously based on the cylinder that is outputting a normal signal.	Only in neutral: 900 r/min	Idle speed increases	13
Incorrect engine temperature sensor signal	Normal control	Engine temperature sensor is fixed to 40 °C to activate normal control.	Only in neutral: 900 r/min	Idle speed increases	15
Incorrect throttle position sensor signal	Ignition timing is fixed to BTDC10°.	Correction is made to the basic injection map.	Opening angle is fixed to 60%.	Idle speed increases	18
Incorrect intake air temperature sensor signal	Normal control	Intake air temperature sensor is fixed to 40 °C in order to activate normal control.	Only in neutral: 900 r/min	Idle speed increases	23
Incorrect neutral switch signal	Normal control	Normal control	Normal control	Normal control	28
Incorrect intake air pressure sensor signal	Normal control	Correction is made to the basic injection map.	Only in neutral: 900 r/min	Idle speed increases	29
Incorrect oil pressure sensor signal	Normal control	Normal control	Only in neutral: 900 r/min	Idle speed increases	39
Incorrect shift cut switch signal	Normal control	Normal control	In neutral: 900 r/min In gear: 850 r/min	Idle speed increases	45
Incorrect thermo-switch signal	Normal control	Normal control	Only in neutral: 900 r/min	Idle speed increases	46



PTT (Power trim and tilt) unit

In the newly designed PTT unit, the up-main valve, down-main valve, up-relief valve, and down-relief valve have been concentrated in the gear pump housing in order to improve the serviceability of the engine and ensure reliable operation.



S69J1410

- ① Tilt cylinder
- ② Trim cylinder
- ③ Manual valve
- ④ Up-main valve
- ⑤ Down-main valve
- ⑥ Up-relief valve
- ⑦ Down-relief valve
- ⑧ Gear pump
- ⑨ Reservoir
- ⑩ Tilt ram

- ⑪ Tilt piston
- ⑫ Tilt piston absorber
- ⑬ Free piston
- ⑭ Shock return valve
- ⑮ Trim ram
- ⑯ Trim piston
- ⑰ Power trim and tilt motor
- ⑱ Up-shuttle piston
- ⑲ Down-shuttle piston

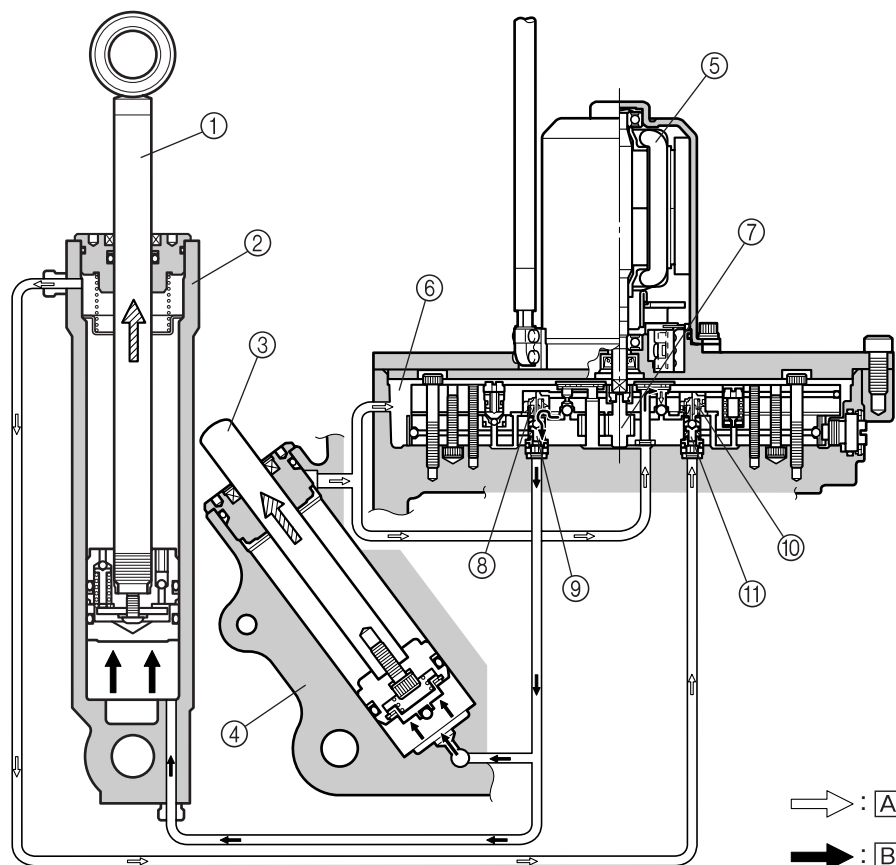
Trim-up and tilt-up function

When the PTT switch is pressed to “UP,” the power trim and tilt motor operates the gear pump and fluid pressure is generated. As a result, the fluid pressure pushes the up-shuttle piston upward, enters the trim cylinder and tilt cylinder lower chambers through the up-main valve, and then pushes the tilt ram and trim ram upward.

In addition, the fluid pushes the down-shuttle piston downward, opens the down-main valve, and returns the PTT fluid from the tilt cylinder upper chamber to the gear pump.

The fluid from the trim cylinder upper chamber then returns to the reservoir.

The tilt ram and the trim ram extend simultaneously, and after the trim ram has extended completely, the tilt ram operates to tilt up.



S69J1420

- ① Tilt ram
- ② Tilt cylinder
- ③ Trim ram
- ④ Trim cylinder
- ⑤ Power trim and tilt motor
- ⑥ Reservoir
- ⑦ Gear pump

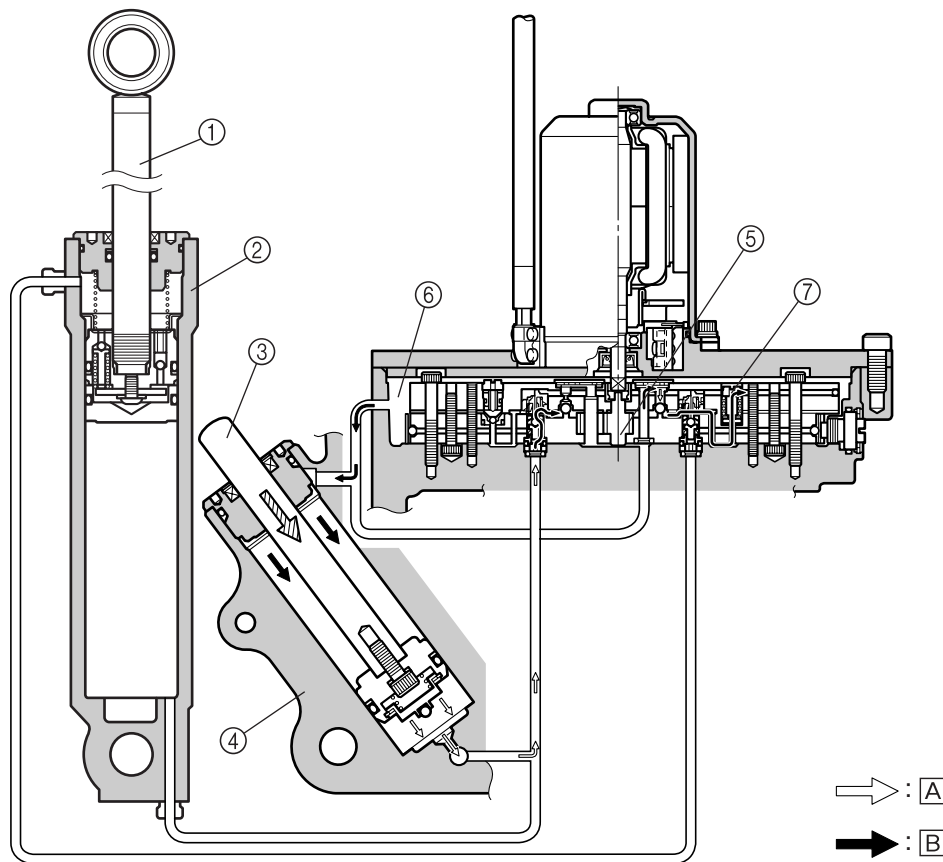
- ⑧ Up-shuttle piston
- ⑨ Up-main valve
- ⑩ Down-shuttle piston
- ⑪ Down-main valve
- A Return
- B Send



Trim ram retraction function

When the outboard motor is tilted up and held in place with the tilt stop lever and the PTT switch is pressed to “DN,” the trim ram will be retracted.

Although the gear pump attempts to draw oil from the tilt cylinder and trim cylinder lower chambers, after the PTT switch has been pressed, fluid cannot be drawn from the tilt cylinder lower chamber because the tilt ram is secured in place by the tilt stop lever. Only the PTT fluid from the trim cylinder lower chamber can be drawn, and as the fluid pressure decreases, the trim ram retracts into the trim cylinder. Since the tilt ram is secured in place, the PTT fluid pumped by the gear pump flows into the tilt cylinder upper chamber to increase fluid pressure. As a result, the down-relief valve opens, and the PTT fluid is released into the reservoir.



S69J1430

- ① Tilt ram
- ② Tilt cylinder
- ③ Trim ram
- ④ Trim cylinder
- ⑤ Gear pump

- ⑥ Reservoir
- ⑦ Down-relief valve
- ⬅ : [A] Return
- ➡ : [B] Send

Trim-down and tilt-down function

When the PTT switch is pressed to “DN,” the power trim and tilt motor operates the gear pump and fluid pressure is generated. As a result, the fluid pressure pushes the down-shuttle piston upward, enters the tilt cylinder upper chamber through the down-main valve, and then pushes the tilt ram downward.

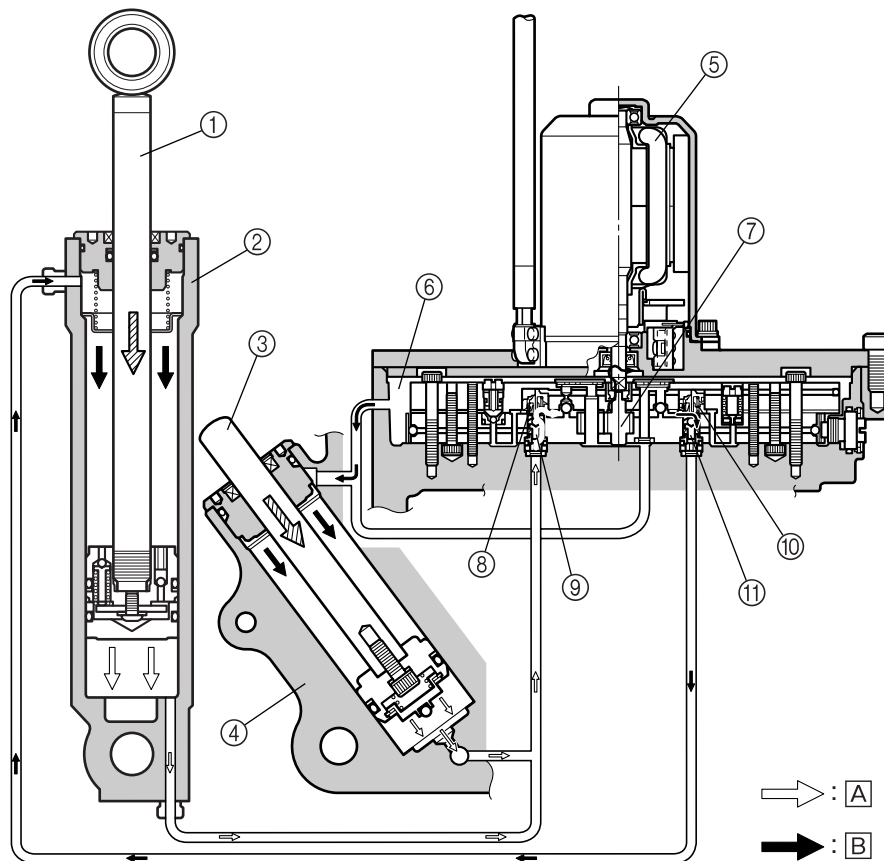
In addition, the fluid pushes the up-shuttle piston downward to open the up-main valve.

The gear pump draws the PTT fluid from the tilt cylinder and trim cylinder lower chambers, and then retracts the tilt ram and the trim ram.

Since the fluid pressure from the gear pump is applied to the tilt cylinder upper chamber, the tilt ram moves downward first.

The hydraulic oil flows into the trim cylinder upper chamber from the reservoir.

When the outboard motor comes in contact with the trim ram, the trim ram moves downward simultaneously with the tilt ram, due to its own weight and the suction of the PTT fluid by the trim cylinder lower chamber.



S69J1440

- ① Tilt ram
- ② Tilt cylinder
- ③ Trim ram
- ④ Trim cylinder
- ⑤ Power trim and tilt motor
- ⑥ Reservoir
- ⑦ Gear pump

- ⑧ Up-shuttle piston
- ⑨ Up-main valve
- ⑩ Down-shuttle piston
- ⑪ Down-main valve
- A Return
- B Send



Stationary condition

When the PTT switch is not pressed, the gear pump will not pump the fluid, the up-main valve and the down-main valve will remain closed, and the PTT unit in the system remains constant. This will allow the tilt ram and the trim ram to maintain their positions until the PTT fluid flows through the system again.

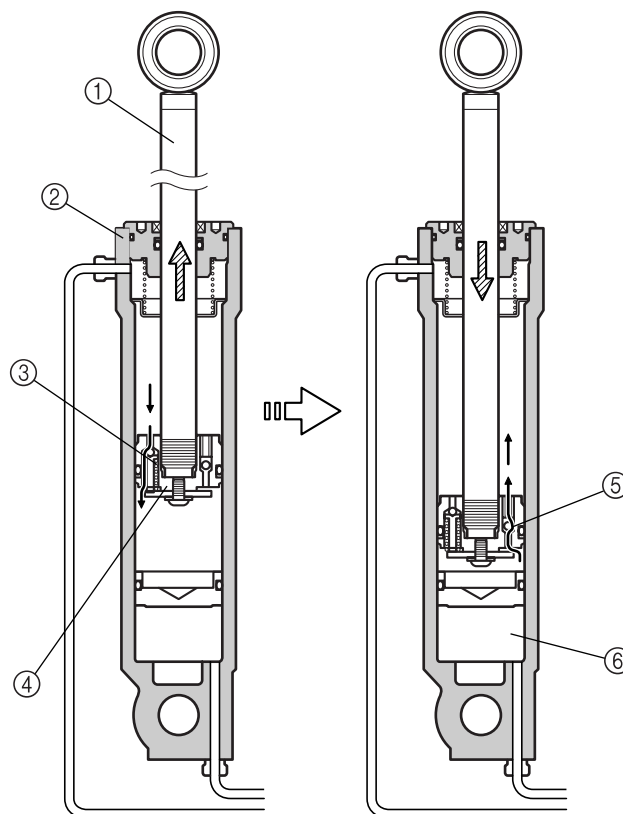
When the outboard hits something in the water

If the lower casing comes in contact with an obstacle while the boat is in operation, a sudden extension force becomes applied to the tilt ram. This force causes the fluid pressure in the tilt cylinder upper chamber to increase, and the tilt piston absorber to open and release the fluid pressure into the space between the tilt piston and the free piston. As a result, the dampening effect of the tilt piston absorber and the oil lock mechanism prevent the PTT unit from damage, before the tilt piston comes in contact with the top of the tilt cylinder.

After the collision, a force to return the outboard motor to its original position is generated due to the weight of the outboard and the thrust of the propeller.

The PTT fluid passes through the shock return valve of the tilt piston, via the free piston, and into the tilt cylinder upper chamber.

When the tilt piston comes in contact with the free piston, the tilt piston stops.

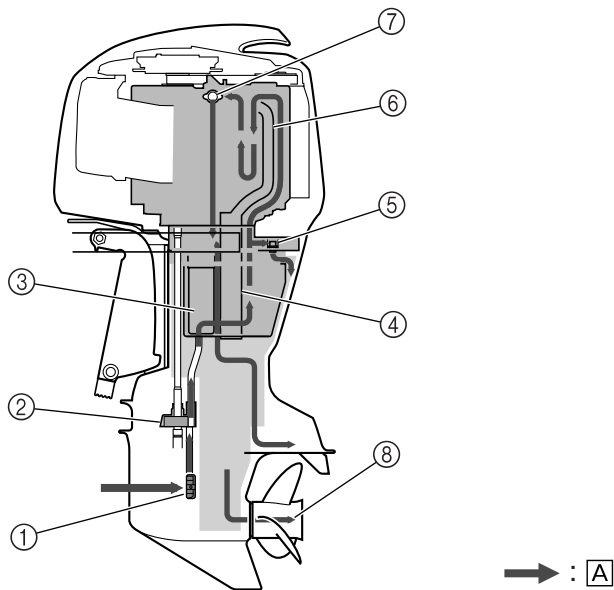


S69J1450

- ① Tilt ram
- ② Tilt cylinder
- ③ Tilt piston absorber

- ④ Tilt piston
- ⑤ Shock return valve
- ⑥ Free piston

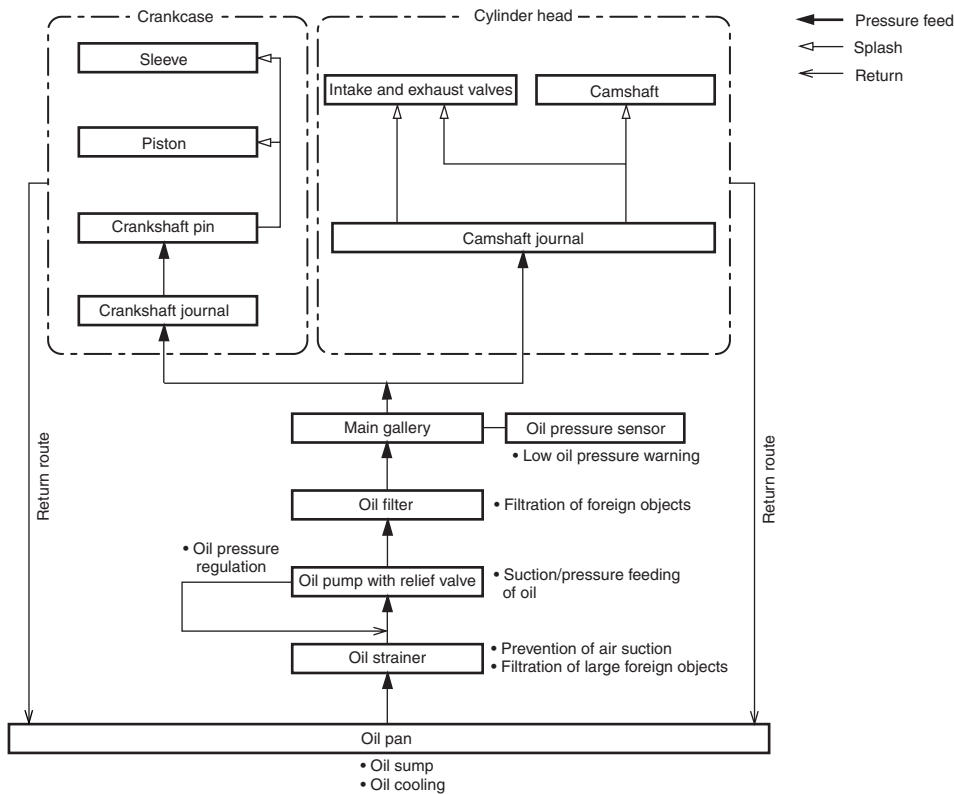
Cooling system



S69J1460

- ① Cooling water inlet
- ② Water pump
- ③ Oil pan
- ④ Exhaust pipe
- ⑤ PCV (Pressure control valve)
- ⑥ In-bank exhaust system
- ⑦ Thermostat
- ⑧ Propeller boss
- A Water

Lubrication system



S69J1470



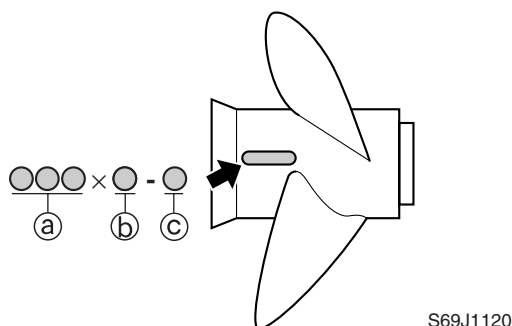
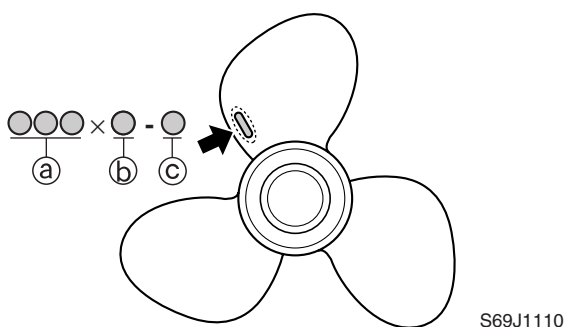
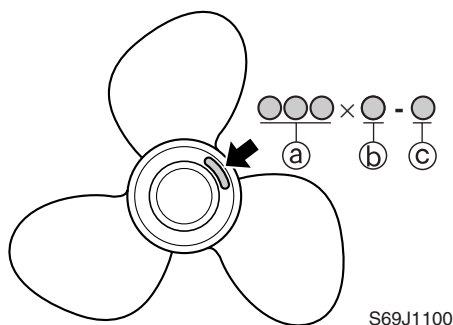
Propeller selection

The performance of a boat and outboard motor will be critically affected by the size and type of propeller you choose. Propellers greatly affect boat speed, acceleration, engine life, fuel economy, and even boating and steering capabilities. An incorrect choice could adversely affect performance and could also seriously damage the engine.

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

Propeller size

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



- Ⓐ Propeller diameter (in inches)
- Ⓑ Propeller pitch (in inches)
- Ⓒ Propeller type (propeller mark)

Selection

When the engine speed is at the full throttle operating range (5,000–6,000 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 3/4 × 17 - M	Stainless
13 3/4 × 19 - M	
13 3/4 × 21 - M	
14 1/2 × 15 - M	
14 1/2 × 19 - T	
14 1/2 × 21 - T	
14 7/8 × 21 - M	
14 7/8 × 23 - M	
15 × 17 - T	
15 1/4 × 15 - M	
15 1/4 × 17 - M	
15 1/4 × 19 - M	

Counter rotation model

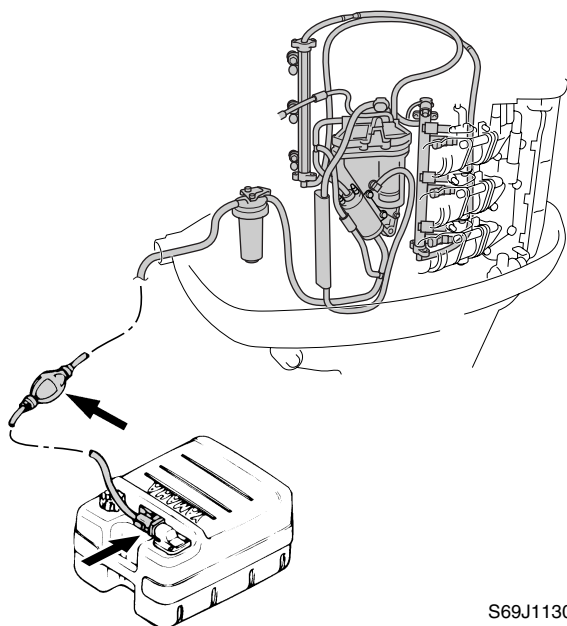
Propeller size (in)	Material
13 3/4 × 17 - ML	Stainless
13 3/4 × 19 - ML	
13 3/4 × 21 - ML	
14 1/2 × 15 - ML	
14 1/2 × 19 - TL	
14 1/2 × 21 - TL	
14 7/8 × 21 - ML	
14 7/8 × 23 - ML	
15 × 17 - TL	
15 1/4 × 15 - ML	
15 1/4 × 17 - ML	
15 1/4 × 19 - ML	

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.

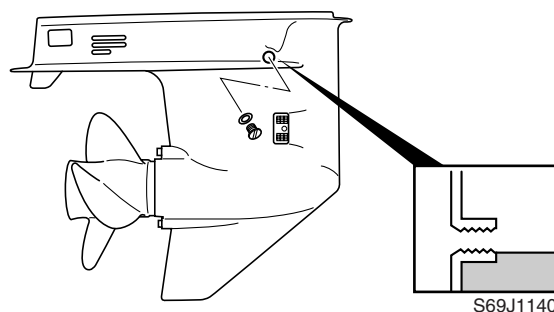


CAUTION:

This is a 4-stroke engine. Never use pre-mixed fuel.

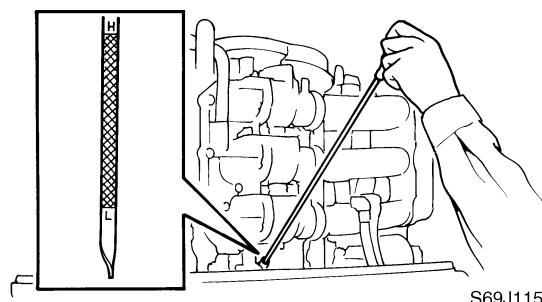
Checking the gear oil

1. Check the gear oil level.



Checking the engine oil

1. Check the oil level.



NOTE:

- If the engine oil is above the maximum level mark (H), drain sufficient oil until the level is between (H) and (L).
- If the engine oil is below the minimum level mark (L), add sufficient oil until the level is between (H) and (L).



Recommended engine oil:

4-stroke motor oil

API: SE, SF, SG, or SH

SAE: 10W-30 or 10W-40

Oil capacity:

Without oil filter replacement:

5.8 L (6.1 US qt, 5.1 Imp qt)

Checking the battery

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



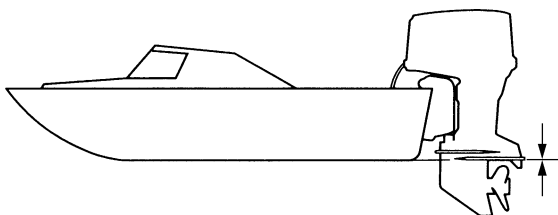
Battery capacity: 12 V–100 Ah

2. Check that the red and black battery cables 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

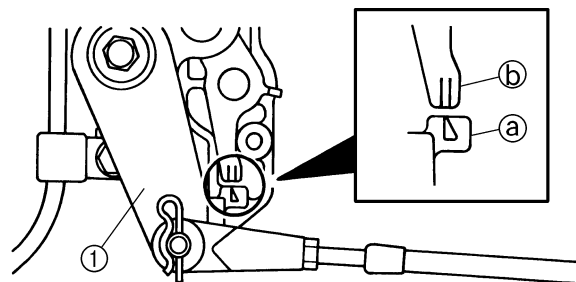
NOTE:

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.

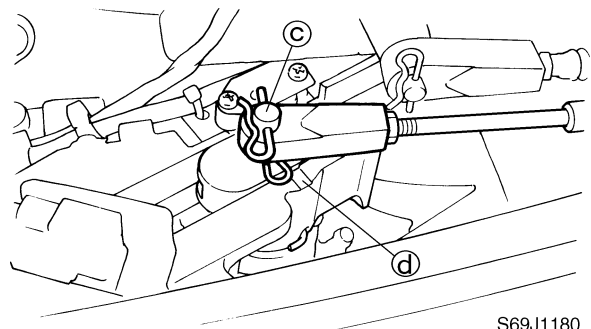
Checking the remote control cables

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 close position and the alignment mark ③ is between the alignment mark ②.

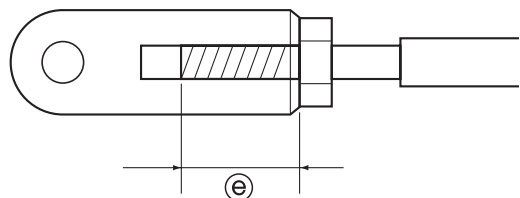


S69J1170

3. Check that the set pin ③ is in the center of the shift bracket and aligned with the alignment mark ④ on the bracket.



S69J1180



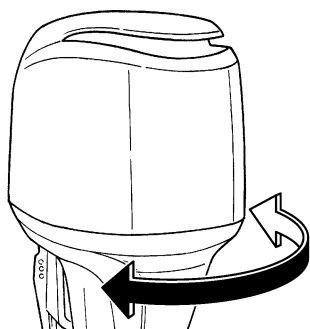
S69J1190

CAUTION:

The shift/throttle cable joint must be screwed in a minimum of 8.0 mm (0.31 in) ⑤.

Checking the steering wheel

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

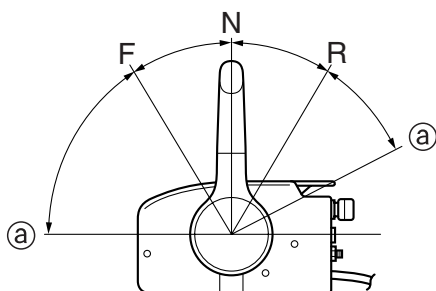


S69J1200

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

Checking the gearshift and throttle operation

1. Check that the gearshift operates smoothly when the remote control lever is shifted from neutral into forward or reverse.
2. Check that the throttle operates smoothly when the remote control lever is shifted from the fully closed position to the fully open position (a).



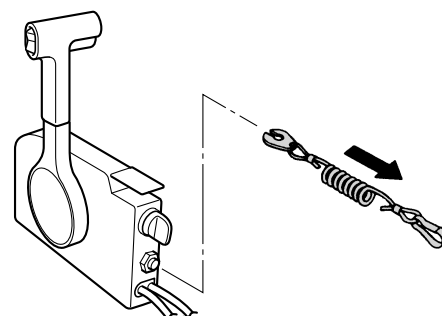
S69J1210

Checking the 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 and 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 stop switch/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 stop switch is pushed or the engine shut-off cord is pulled from the engine shut-off switch.

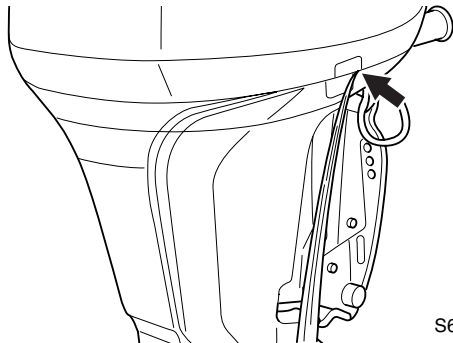


S69J1220

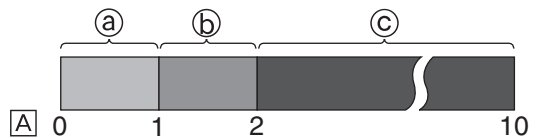


Checking the cooling water pilot hole

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



S69J1230



S69J1240

[A] Hour

After test run

1. Check for water in the gear oil.
2. Check for fuel leakage in the cowling.
3. After a test run and while the engine is at idle, flush the cooling water passage with fresh water using the flushing kit.

Test run

1. Start the engine, and then check that the gearshift 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 one hour at 2,000 r/min or at half throttle, then for another hour at 3,000 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 three stages.

1. One hour (a) at 2,000 r/min or at approximately half throttle.
2. One hour (b) at 3,000 r/min or 3/4 throttle and one minute out of every ten at full throttle.
3. Eight hours (c) at any speed, however, avoid running at full speed for more than five minutes.

Specifications

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General torques	2-15

General specifications

Item	Unit	Model	
		F225AET	FL225AET
Dimension			
Overall length	mm (in)	892 (35.1)	
Overall width	mm (in)	634 (25.0)	
Overall height			
(X)	mm (in)	1,805 (71.1)	
(U)	mm (in)	1,932 (76.1)	
Boat transom height			
(X)	mm (in)	635 (25.0)	
(U)	mm (in)	762 (30.0)	
Weight			
(with stainless propeller)			
(X)	kg (lb)	272 (600)	
(U)	kg (lb)	278 (613)	
Performance			
Maximum output	kW (hp) at 5,500 r/min	165.5 (225.0)	
Full throttle operating range	r/min	5,000–6,000	
Maximum fuel consumption	L (US gal, Imp gal)/hr at 6,000 r/min	70.0 (18.5, 15.4)	
Power unit			
Type		V6, 4-stroke, DOHC, 24 valves	
Cylinder quantity		6	
Displacement	cm ³ (cu. in)	3,352 (204.5)	
Bore × stroke	mm (in)	94.0 × 80.5 (3.70 × 3.17)	
Compression ratio		9.9	
Control system		Remote control	
Starting system		Electric	
Ignition control system		Microcomputer (TCI)	
Ignition timing	Degree	TDC–BTDC 24	
Alternator output	V, A	12, 45	
Spark plugs		LFR5A-11 (NGK)	
Cooling system		Water	
Exhaust system		Through propeller boss	
Lubrication system		Wet sump	

General specifications

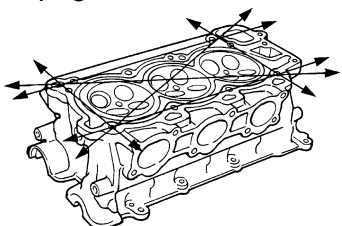
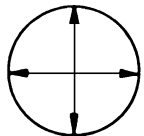
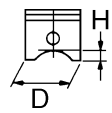
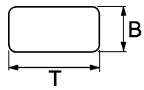
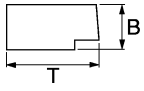
Item	Unit	Model	
		F225AET	FL225AET
Fuel and oil			
Fuel type		Regular unleaded gasoline	
Fuel rating	PON*	86	
	RON	91	
Engine oil type		4-stroke motor oil	
Engine oil grade	API	SE, SF, SG, or SH	
	SAE	10W-30 or 10W-40	
Engine oil quantity (with oil filter replacement)	L	6.0 (6.3, 5.3)	
	(US qt, Imp qt)		
(without oil filter replacement)	L	5.8 (6.1, 5.1)	
	(US qt, Imp qt)		
Gear oil type		Hypoid gear oil	
Gear oil grade	API	GL-4	
	SAE	90	
Gear oil quantity	L	1.15 (1.22, 1.01)	1.00 (1.06, 0.88)
	(US qt, Imp qt)		
Bracket			
Trim angle	Degree	−3–16	
(at 12 degree boat transom)			
Tilt-up angle	Degree	70	
Steering angle	Degree	32 + 32	
Drive unit			
Gearshift positions		F-N-R	
Gear ratio		2.00 (30/15)	
Reduction gear type		Spiral bevel gear	
Clutch type		Dog clutch	
Propeller shaft type		Spline	
Propeller direction (rear view)		Clockwise	Counterclockwise
Propeller identification mark		T, M	TL, ML
Electrical			
Battery capacity	V–Ah	12–100	

* PON: Pump Octane Number (Research Octane Number + Motor Octane Number)/2

RON: Research Octane Number

Maintenance specifications

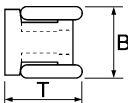
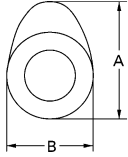
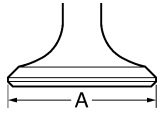
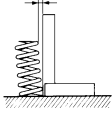
Power unit

Item	Unit	Model	
		F225AET	FL225AET
Power unit Minimum compression pressure* Lubrication oil pressure	kPa (kgf/cm ² , psi) kPa (kgf/cm ² , psi) at 700 r/min	880 (8.8, 125) 650 (6.5, 924)	
Cylinder heads Warpage limit  (lines indicate straightedge position) Camshaft cap inside diameter	mm (in) mm (in)	0.1 (0.004) 25.00–25.02 (0.9843–0.9850)	
Cylinders Bore size Taper limit Out-of-round limit	 mm (in) mm (in) mm (in)	94.00–94.02 (3.7008–3.7016) 0.05 (0.0020) 0.01 (0.0004)	
Pistons Piston diameter (D) Measuring point (H) Piston-to-cylinder clearance Piston pin boss bore	 mm (in) mm (in) mm (in) mm (in)	93.921–93.941 (3.6977–3.6985) 5 (0.2) 0.075–0.080 (0.0029–0.0031) 21.02–21.03 (0.8276–0.8280)	
Piston pins Outside diameter	mm (in)	21.00 (0.827)	
Piston rings Top ring Dimension B Dimension T End gap Side clearance 2nd 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)	1.17–1.19 (0.0461–0.0468) 2.8–3.0 (0.110–0.118) 0.15–0.30 (0.0059–0.0118) 0.04–0.08 (0.0016–0.0031) 1.17–1.19 (0.0461–0.0468) 3.6–3.8 (0.142–0.150) 0.30–0.45 (0.0118–0.0177) 0.03–0.07 (0.0012–0.0027)	

* Measuring conditions:

Ambient temperature 20 °C (68 °F), wide open throttle, with plugs disconnected from all cylinders.
The figures are for reference only.

Maintenance specifications

Item	Unit	Model	
		F225AET	FL225AET
Oil ring Dimension B Dimension T End gap Side clearance	 mm (in) mm (in) mm (in) mm (in)	2.40–2.47 (0.0945–0.0972) 2.3–2.7 (0.091–0.106) 0.15–0.60 (0.0059–0.0236) 0.04–0.13 (0.0016–0.0051)	
Camshafts Intake (A) Exhaust (A) Intake and exhaust (B) Camshaft journal diameter Camshaft journal oil clearance Camshaft runout limit	 mm (in) mm (in) mm (in) mm (in) mm (in) mm (in)	45.30–45.40 (1.7835–1.7874) 45.35–45.45 (1.7854–1.7894) 35.95–36.05 (1.4154–1.4193) 24.96–24.98 (0.9827–0.9834) 0.02–0.06 (0.0008–0.0023) 0.1 (0.004)	
Valves Valve clearance (cold) Intake Exhaust Head diameter (A) Intake Exhaust Face width (B) Intake Exhaust Seat contact width (C) Intake Exhaust Margin thickness (D) Intake Exhaust Stem diameter Intake Exhaust Guide inside diameter Intake and exhaust Stem-to-guide clearance Intake Exhaust Stem runout limit	 mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in)	0.20 ± 0.03 (0.008 ± 0.001) 0.34 ± 0.03 (0.013 ± 0.001) 34.85–35.15 (1.3720–1.3839) 29.85–30.15 (1.1752–1.1870) 2.11 (0.0831) 2.43 (0.0957) 1.1–1.4 (0.043–0.055) 1.4–1.7 (0.055–0.067) 0.7 (0.028) 1.0 (0.039) 5.477–5.492 (0.2156–0.2162) 5.464–5.479 (0.2151–0.2157) 5.51–5.52 (0.2169–0.2173) 0.01–0.02 (0.0004–0.0008) 0.01–0.02 (0.0004–0.0008) 0.01 (0.0004)	
Valve springs Free length Minimum free length Tilt limit	 mm (in) mm (in) mm (in)	44.20 (1.740) 42.60 (1.677) 1.5 (0.06)	

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SPEC		Specifications	
Item	Unit	Model	
		F225AET	FL225AET
Valve lifters Valve lifter outside diameter Valve lifter-to-cylinder head clearance	mm (in) mm (in)	32.98–33.00 (1.2984–1.2992) 0.02–0.05 (0.0008–0.0020)	
Valve shims Valve shim thickness (in 0.020 mm increments)	mm (in)	2.320–2.960 (0.0913–0.1165)	
Connecting rods Small-end inside diameter Big-end inside diameter Crankpin oil clearance Big-end bearing thickness Yellow Green Blue	mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in)	21.00 (0.827) 53.00 (2.087) 0.035–0.071 (0.0014–0.0028) 1.492–1.496 (0.0587–0.0588) 1.496–1.500 (0.0588–0.0591) 1.500–1.504 (0.0591–0.0592)	
Crankshaft Crankshaft journal diameter Crankpin diameter Crankpin width Runout limit	mm (in) mm (in) mm (in) mm (in)	62.968–62.992 (2.4791–2.4800) 49.976–50.000 (1.9676–1.9685) 21.50–21.55 (0.8465–0.8484) 0.03 (0.0012)	
Crankcase Crankshaft main journal oil clearance Upper crankcase main journal bearing thickness 1 2 3 Lower crankcase main journal bearing thickness 1 2 3 #3 main journal bearing thickness (lower) 1 2 3	mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in) mm (in)	0.025–0.050 (0.0010–0.0020) 2.494–2.500 (0.0981–0.0984) 2.498–2.504 (0.0983–0.0986) 2.502–2.508 (0.0985–0.0987) 2.494–2.500 (0.0981–0.0984) 2.498–2.504 (0.0983–0.0986) 2.502–2.508 (0.0985–0.0987) 2.492–2.500 (0.0980–0.0984) 2.496–2.504 (0.0982–0.0986) 2.500–2.508 (0.0984–0.0987)	

Maintenance specifications

Item	Unit	Model	
		F225AET	FL225AET
Oil pump			
Discharge at 97–103 °C (207–217 °F) with 10W-40 engine oil	L (US gal, Imp gal)/min at 700 r/min	8.8 (2.32, 1.94)	
Pressure	kPa (kgf/cm ² , psi)	138 (1.38, 19.62)	
Relief valve opening pressure	kPa (kgf/cm ² , psi)	529–647 (5.29–6.47, 75.22–92.00)	
Thermostats			
Opening temperature	°C (°F)	60 (140)	
Fully open temperature	°C (°F)	70 (158)	
Valve open lower limit	mm (in)	4.3 (0.17)	
Engine speed			
Engine idle speed	r/min	650–750	

Lower unit

Item	Unit	Model	
		F225AET	FL225AET
Gear backlash			
Pinion-to-forward gear	mm (in)	0.21–0.44 (0.008–0.017)	0.35–0.70 (0.014–0.028)
Pinion-to-reverse gear	mm (in)	0.70–1.03 (0.028–0.041)	0.70–1.03 (0.028–0.041)
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

Electrical

Item	Unit	Model	
		F225AET	FL225AET
Ignition and ignition control system			
Ignition timing (engine idle speed)	Degree		TDC
Pulser coil output peak voltage (W/R – B, W/B – B, W/G – B)			
at cranking (unloaded)	V		5.3
at cranking (loaded)	V		5.3
at 1,500 r/min (loaded)	V		20
at 3,500 r/min (loaded)	V		43
Pulser coil resistance ^(*) (W/R – B, W/B – B, W/G – B)	Ω		459–561
ECM output peak voltage (B/O – B, B/Y – B, B/W – B)			
at cranking (loaded)	V		252
at 1,500 r/min (loaded)	V		260
at 3,500 r/min (loaded)	V		260
Spark plug gap	mm (in)		11 (0.43)
Ignition coil resistance			
Primary coil (R/Y – B/O, R/Y – B/Y, R/Y – B/W)	Ω		1.5–1.9
Secondary coil (spark plug wire – spark plug wire)	kΩ		19.6–35.4
Throttle position sensor output voltage (P – B)	mV		695–705
Oil pressure sensor output voltage (engine idle speed) (O – B)	V		3.8
Intake air temperature sensor resistance			
at 0 °C (32 °F)	kΩ		5.4–6.6
at 80 °C (176 °F)	kΩ		0.29–0.39
Engine temperature sensor resistance (B/Y – B)			
at 20 °C (68 °F)	kΩ		54.2–69.0
at 100 °C (212 °F)	kΩ		3.12–3.48

(*) The figures are for reference only.

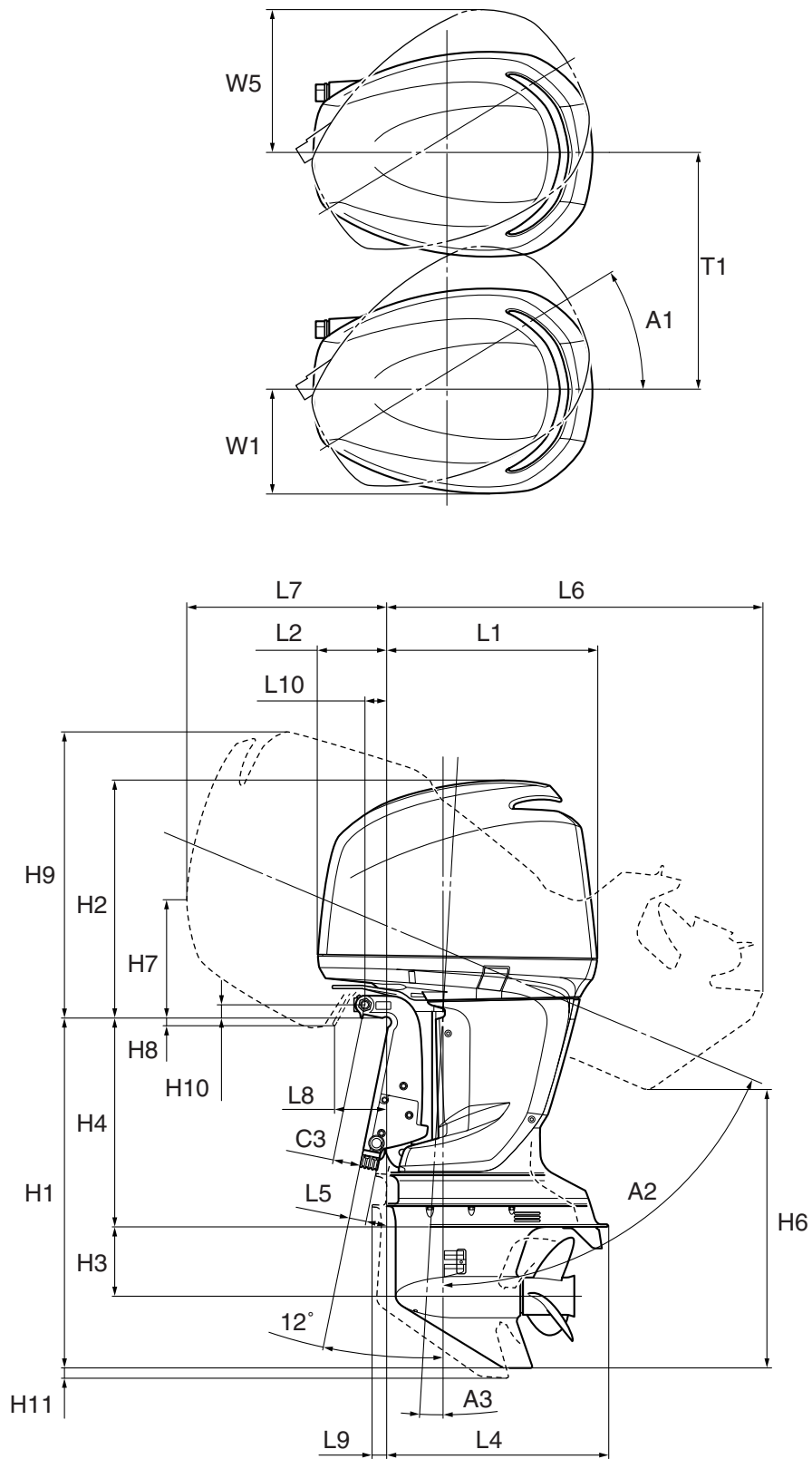
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Dimensions

Exterior

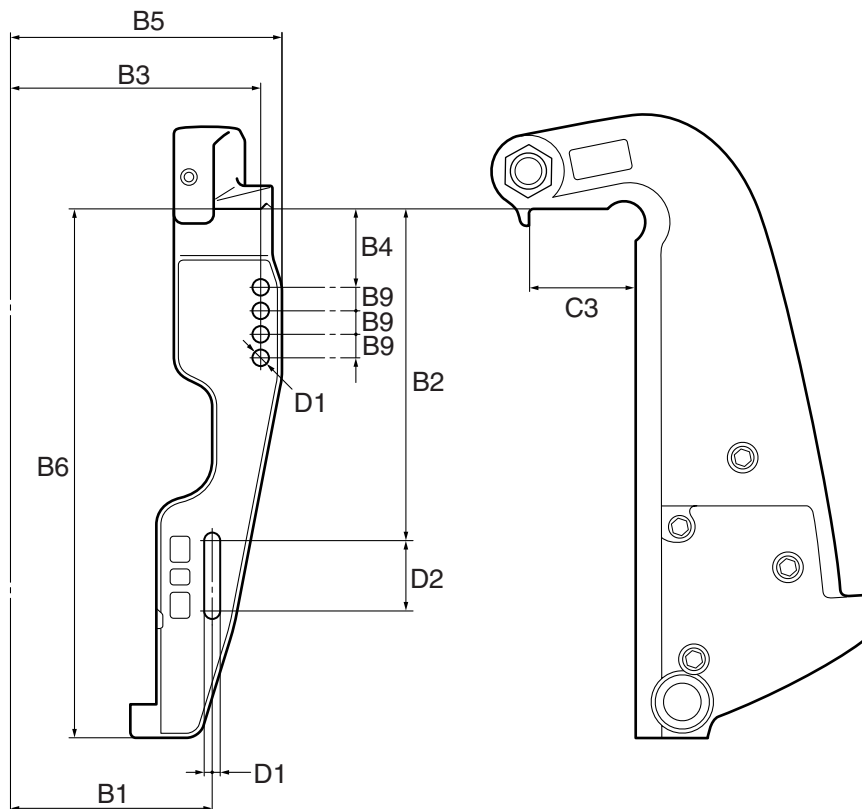


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Maintenance specifications

Symbol	Unit	Model	
		F225AET	FL225AET
L1	mm (in)	651 (25.6)	
L2	mm (in)	219 (8.6)	
L3	mm (in)	—	
L4	mm (in)	673 (26.5)	
L5	(X) mm (in)	59 (2.3)	
	(U) mm (in)	59 (2.3)	
L6	(X) mm (in)	1,155 (45.5)	
	(U) mm (in)	1,272 (50.1)	
L7	mm (in)	618 (24.3)	
L8	mm (in)	230 (9.1)	
L9	(X) mm (in)	52 (2.0)	
	(U) mm (in)	59 (2.3)	
L10	mm (in)	75 (3.0)	
H1	(X) mm (in)	1,078 (42.4)	
	(U) mm (in)	1,205 (47.4)	
H2	mm (in)	727 (28.6)	
H3	mm (in)	216 (8.5)	
H4	(X) mm (in)	643 (25.3)	
	(U) mm (in)	770 (30.3)	
H5	mm (in)	—	
H6	(X) mm (in)	847 (33.3)	
	(U) mm (in)	924 (36.4)	
H7	mm (in)	361 (14.2)	
H8	mm (in)	39 (1.5)	
H9	mm (in)	880 (34.6)	
H10	mm (in)	45 (1.8)	
H11	(X) mm (in)	25 (1.0)	
	(U) mm (in)	25 (1.0)	
W1	mm (in)	317 (12.5)	
W2	mm (in)	—	
W3	mm (in)	—	
W4	mm (in)	—	
W5	mm (in)	453 (17.8)	
W6	mm (in)	—	
A1	Degree	32	
A2	Degree	70	
A3	Degree	3	
T1	mm (in)	724 (28.5)	

Clamp bracket



S69J2140

Symbol	Unit	Model	
		F225AET	FL225AET
B1	mm (in)	125 (4.9)	
B2	mm (in)	254 (10.0)	
B3	mm (in)	163 (6.4)	
B4	mm (in)	51 (2.0)	
B5	mm (in)	180 (7.1)	
B6	mm (in)	411 (16.2)	
B7	mm (in)	—	
B8	mm (in)	—	
B9	mm (in)	19 (0.7)	
C2	mm (in)	—	
C3	mm (in)	79 (3.1)	
D1	mm (in)	13 (0.5)	
D2	mm (in)	56 (2.2)	

Maintenance specifications / Tightening torques

Tightening torques Specified torques

Part to be tightened		Thread size	Tightening torques		
			N·m	kgf·m	ft·lb
Fuel system					
Fuel filter holder bolt		M6	8	0.8	5.8
Fuel filter bracket bolt		M6	8	0.8	5.8
Intake air temperature sensor		—	4	0.4	2.9
Low-pressure fuel pump bracket bolt		M5	5	0.5	3.6
Fuel cooler nut		—	5	0.5	3.6
Float chamber bracket bolt		M8	7	0.7	5.1
High-pressure fuel pump relay nut		—	3	0.3	2.1
Vapor separator cover screw		M4	2	0.2	1.4
Link rod nut		—	4	0.4	2.9
Magnet control lever joint		—	4	0.4	2.9
Throttle cam bolt		—	8	0.8	5.8
Power unit					
PTT motor lead bolt		M6	4	0.4	2.9
Upper case cover bolt		M6	8	0.8	5.8
Apron bolt		M6	8	0.8	5.8
Power unit bolt		M9 • M10	42	4.2	30
Flywheel magnet nut		—	240	24	174
PTT relay nut		—	4	0.4	2.9
Starter relay lead bolt		M6	4	0.4	2.9
Battery cable nut		—	9	0.9	6.5
Starter motor bolt		M8	29	2.9	21
Rectifier Regulator	1st	M6	6	0.6	4.3
	2nd		12	1.2	8.7
Link rod nut		—	4	0.4	2.9
Oil pressure sensor		—	18	1.8	13
Oil filter union bolt		—	34	3.4	25
Oil filter		—	18	1.8	13
Driven sprocket bolt		M10	60	6.0	43
Timing belt tensioner bolt		—	39	3.9	28
Drive sprocket bolt		M5	7	0.7	5.1
Cylinder head cover plate screw		M4	2	0.2	1.4
Cylinder head cover bolt	1st	M6	8	0.8	5.8
	2nd		8	0.8	5.8
Camshaft cap bolt	1st	M7	8	0.8	5.8
	2nd		17	1.7	12
Exhaust cover bolt	1st	M6	6	0.6	4.3
	2nd		12	1.2	8.7
Exhaust outer cover bolt	1st	M8	14	1.4	10
	2nd		28	2.8	20
Exhaust outer cover plug		M18	55	5.5	40

2

SPEC		Specifications
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Part to be tightened		Thread size	Tightening torques		
			N·m	kgf·m	ft·lb
Timing chain tensioner bolt		M6	12	1.2	8.7
Spark plug		—	25	2.5	18
Cylinder head bolt	1st	M10	19	1.9	14
	2nd		37	3.7	27
	3rd		90°		
	1st	M8	14	1.4	10
	2nd		28	2.8	20
Engine hanger bolt		M6	12	1.2	8.7
Cooling water cover bolt		M6	12	1.2	8.7
Starboard cylinder head plug		—	23	2.3	17
Cylinder block plug		—	23	2.3	17
Engine temperature sensor		—	15	1.5	11
Connecting rod cap	1st	—	23	2.3	17
	2nd		48	4.8	35
	3rd		90°		
Baffle plate nut		—	12	1.2	8.7
Crankcase cover bolt	1st	M8	14	1.4	10
	2nd		28	2.8	20
Crankcase cover plate screw		M4	2	0.2	1.4
Oil pump screw		—	4	0.4	2.9
Crankcase stud bolt	1st	M8	25	2.5	18
	2nd		90°		
Crankcase bolt	1st	M10	40	4.0	29
	2nd		90°		
	1st	M8	14	1.4	10
	2nd		28	2.8	20
Lower unit (regular rotation model)					
Trim tab bolt		M10	43	4.3	31
Lower unit bolt		M10	47	4.7	34
Propeller nut		—	55	5.5	40
Propeller shaft housing grease nipple		—	6	0.6	4.3
Propeller shaft housing bolt		M8	30	3.0	22
Pinion nut		—	142	14.2	103
Lower unit (counter rotation model)					
Trim tab bolt		M10	43	4.3	31
Lower unit bolt		M10	47	4.7	34
Propeller nut		—	55	5.5	40
Ring nut		—	108	10.8	78
Propeller shaft housing bolt		M8	30	3.0	22
Propeller shaft housing grease nipple		—	6	0.6	4.3
Pinion nut		—	142	14.2	103
Bracket unit					
Shift rod detent bolt		—	18	1.8	13
Flushing hose adapter screw		M6	5	0.5	3.6

Tightening torques

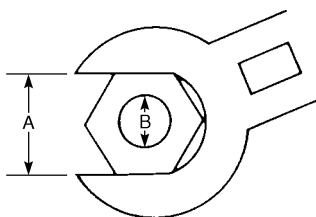
Part to be tightened	Thread size	Tightening torques		
		N·m	kgf·m	ft·lb
Upper case mount nut	—	72	7.2	52
Engine oil drain bolt	M14	27	2.7	19
Apron stay	—	8	0.8	5.8
Pressure control valve	—	8	0.8	5.8
Upper exhaust guide bolt	M8	20	2.0	14
	M10	42	4.2	30
Oil strainer bolt	M6	10	1.0	7.2
Oil pan bolt	M8	20	2.0	14
Exhaust manifold bolt	M8	20	2.0	14
Muffler bolt	M8	20	2.0	14
Baffle plate screw	M6	4	0.4	2.9
Clamp bracket self-locking nut	—	22	2.2	16
Friction plate screw	M6	4	0.4	2.9
Trim stopper nut	—	36	3.6	25
Power trim and tilt unit				
Power trim and tilt unit bolt	M10	42	4.2	30
Reservoir bolt	M8	18	1.8	13
Reservoir cap	M12	7	0.7	5.1
Manual valve	—	2	0.2	1.4
Fluid pipe	—	15	1.5	11
Trim cylinder end screw	—	160	16	115
Trim piston bolt	M8	38	3.8	27
Tilt ram	—	55	5.5	40
Tilt cylinder end screw	—	90	9.0	65
Tilt piston bolt	M6	7	0.7	5.1
Gear housing bolt	M5	7	0.7	5.1
Gear housing bracket bolt	M5	7	0.7	5.1

2

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

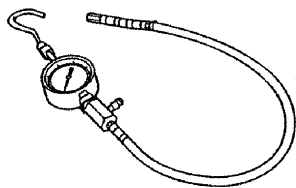


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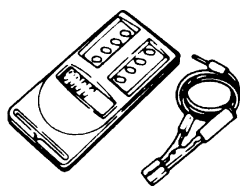


Periodic checks and adjustments

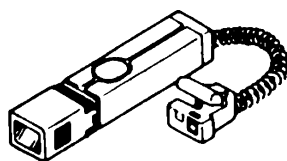
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Special service tools

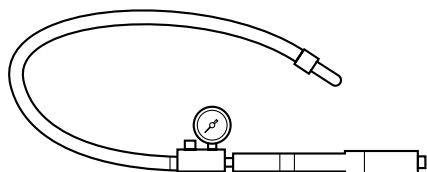
Fuel pressure gauge
90890-06786



Digital tachometer
90890-06760



Timing light
90890-03141



Leakage tester
90890-06762

Special service tools / Maintenance interval chart

Maintenance interval chart

Use the following chart as a guideline for general maintenance.

Adjust the maintenance intervals according to the operating conditions of the outboard motor.

Item	Remarks	Initial		Every			Refer to page
		10 hours (Break-in)	50 hours (3 months)	100 hours (6 months)	200 hours (1 year)	400 hours (2 years)	
Top cowling							
Top cowling fit	Check	○ (before each use)			3-4		
Fuel system							
Fuel joint and fuel hoses	Check	○ (before each use)			3-4		
Fuel filter (disposable type)	Check/replace	○		○			—
Fuel filter (water separator)	Check	○ (before each use)			3-5		
Fuel tank ^(*)	Clean				○		—
Power unit							
Engine oil	Check	○ (before each use)			3-5		
	Change	○		○			3-6
Oil filter	Change				○		3-7
Oil pump	Check					○	5-55
Timing chain	Check/replace			○ (1,000 hours or 5 years)			5-40
Chain tensioner	Check/replace					○	5-39
Timing belt ^(*)	Check/replace				○		3-8, 5-21
Valve clearance	Check/adjust					○	5-15
Spark plugs	Clean/adjust/replace	○			○		3-8
Thermostat	Check				○		5-60
Pressure control valve	Check				○		—
Flywheel magnet nut	Check	○					—
Motor exterior	Check	○ (before each use)			—		
Oil leakage	Check	○	○	○			—
Cooling water passage ^(*)	Clean	○ (after each use)			3-9		
Control system							
Throttle link	Check/adjust				○		3-9, 3-10, 3-11
Throttle cable	Check/adjust				○		3-9, 3-10, 3-11
Shift cable	Check/adjust				○		3-12
Engine idle speed	Adjust	○			○		3-13
Ignition timing	Check	○					3-15
Power trim and tilt unit							
Power trim and tilt unit	Check				○		3-15, 3-16



Item	Remarks	Initial		Every			Refer to page
		10 hours (Break-in)	50 hours (3 months)	100 hours (6 months)	200 hours (1 year)	400 hours (2 years)	
Lower unit							
Gear oil Impeller/Woodruff key	Change	○		○			3-17
	Check/replace			○ (500 hours or 30 months)			6-10, 6-38
	Oil seals			○			—
Propeller	Check	○ (before each use)					3-18
General							
Anodes/Trim tab	Check/replace	○			○		3-18
Battery	Check/charge				○		3-19
Wiring and connectors	Adjust/reconnect				○		—
Nuts and bolts ^(*4)	Tighten	○			○		—
Lubrication points	Lubricate			○			3-20

NOTE:

(*1) If equipped with a portable fuel tank.

(*2) Be sure to replace the timing belt every 1,000 hours of operation or every five years.

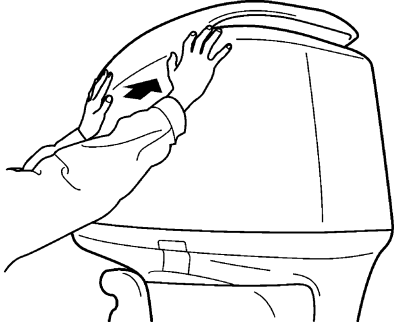
(*3) The engine should be flushed with fresh water after operating in salt, turbid, or muddy water.

(*4) Do not retighten the cylinder head and crankcase bolts.

Top cowling

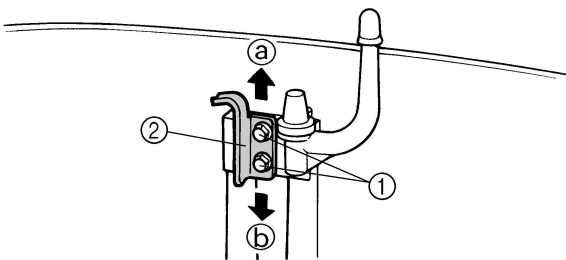
Checking the top cowling

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



S69J3010

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

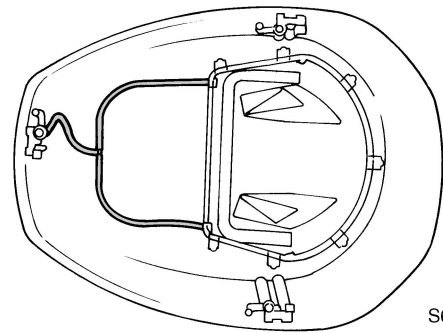


S69J3020

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.
6. Check the top cowling hose for cracks or damage. Replace if necessary.

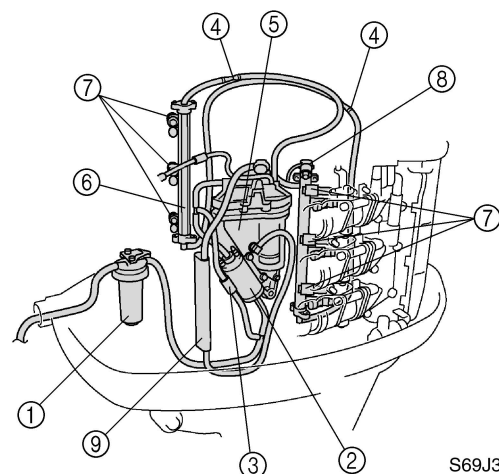


S69J3030

Fuel system

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

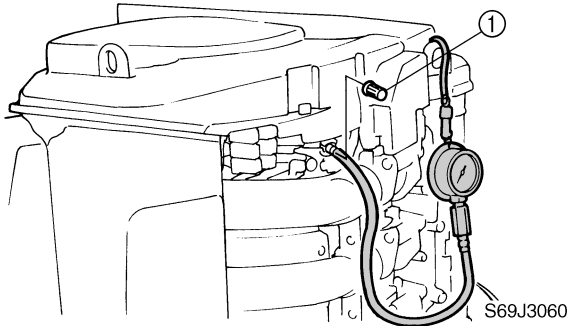
1. Remove the flywheel magnet cover and intake silencer.
2. Check the low-pressure fuel hose connections and fuel joint for leaks. Replace if necessary. Also, check the fuel filter ①, low-pressure fuel pump ②, and check valve ③ for leaks and deterioration. Replace if necessary.
3. Check the high-pressure fuel hose connections and fuel joint ④ for leaks. Replace if necessary. Also, check the vapor separator ⑤, fuel rail ⑥, fuel injector ⑦, pressure regulator ⑧, and fuel cooler ⑨ for leaks and deterioration. Replace if necessary.



S69J3040

Measuring the fuel pressure (high-pressure fuel line)

1. Remove the cap ①.
2. Install the fuel pressure gauge onto the pressure check valve.



Fuel pressure gauge: 90890-06786

3. Turn the engine start switch to ON, and then measure the fuel pressure.

NOTE: _____
After the engine start switch is turned to ON, the fuel pressure will decrease gradually.



Fuel pressure:
310 kPa (3.1 kgf/cm², 44 psi)

4. Start the engine and warm it up for 5 minutes, and then measure the fuel pressure.

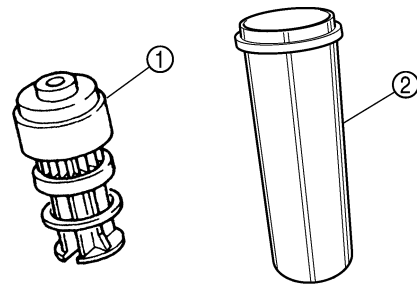
NOTE: _____
The pressure regulator can be checked since the fuel pressure (310 kPa [3.1 kgf/cm², 44 psi]), from when the engine switch is turned to ON, decreases when the engine is idling.



Fuel pressure:
270 kPa (2.7 kgf/cm², 38 psi)

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.



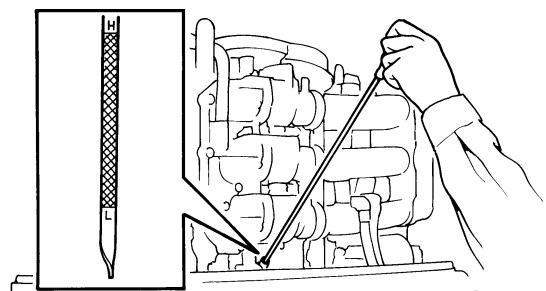
S69J3070

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

Power unit

Checking the engine oil

1. Place the outboard motor in an upright position.
2. Remove the engine oil dipstick, wipe it clean, and then insert it back into the oil filler hole.
3. Remove the dipstick again to check the oil level, and the oil for discoloration and its viscosity.



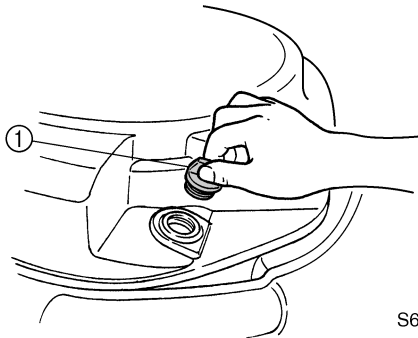
S69J3080

NOTE: _____

- Change the oil if it appears milky or dirty.
- If the engine oil is above the maximum level mark (H), drain sufficient oil until the level is between (H) and (L).
- If the engine oil is below the minimum level mark (L), add sufficient oil until the level is between (H) and (L).

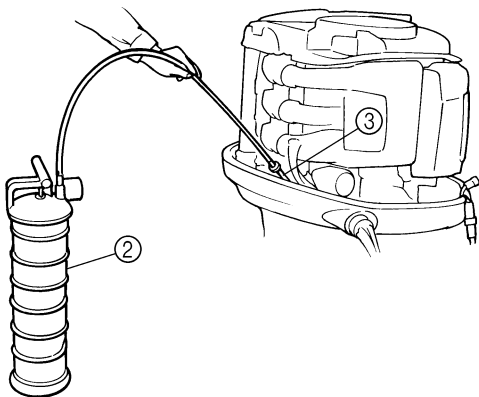
Changing the engine oil using an oil changer

1. Start the engine and warm it up.
2. Remove the engine oil dipstick and oil filler cap ①.



S69J3090

3. Insert the tube of the oil changer ② into the dipstick guide ③.



S69J3100

4. Operate the oil changer to extract the oil.

NOTE: _____
Be sure to clean up any oil spills.

5. Pour the specified amount of the recommended engine oil into the oil filler hole.



Recommended engine oil:

4-stroke motor oil

API: SE, SF, SG, or SH

SAE: 10W-30 or 10W-40

Oil quantity:

Without oil filter replacement:

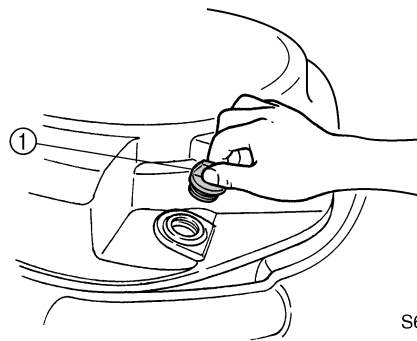
5.8 L (6.1 US qt, 5.1 Imp qt)

6. Install the oil filler cap and dipstick, and then start the engine and warm it up for 5 minutes.

7. Turn the engine off, and then check the oil level and correct it if necessary.

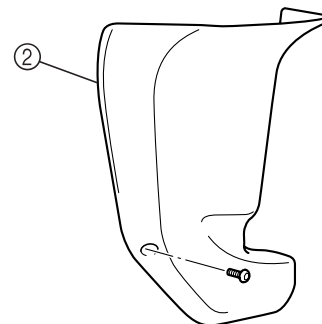
Changing the engine oil by draining it

1. Start the engine and warm it up.
2. Remove the engine oil dipstick and oil filler cap ①.



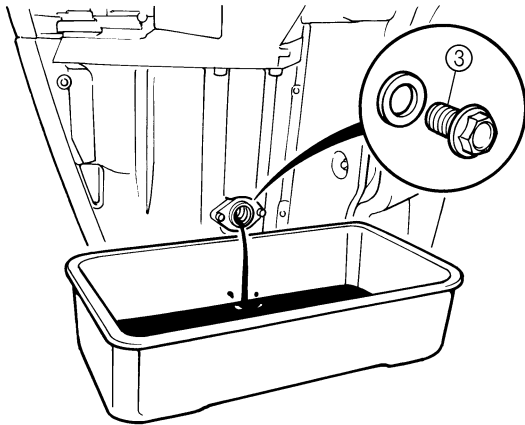
S69J3090

3. Remove the starboard apron ②.



S69J3120

4. Place a drain pan under the drain hole, and then remove the drain bolt ③ and let the oil drain completely.



S69J3130

NOTE:

Be sure to clean up any oil spills.

5. Install the drain bolt, and then tighten it to the specified torque.



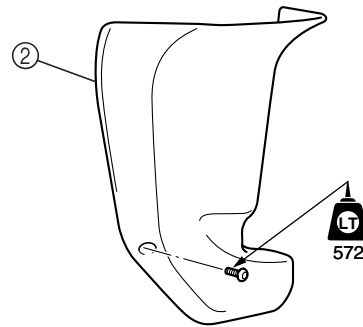
Drain bolt:
27 N·m (2.7 kgf·m, 19 ft·lb)

6. Pour the specified amount of the recommended engine oil into the oil filler hole.



Recommended engine oil:
4-stroke motor oil
API: SE, SF, SG, or SH
SAE: 10W-30 or 10W-40
Oil quantity:
Without oil filter replacement:
5.8 L (6.1 US qt, 5.1 Imp qt)

7. Install the oil filler cap and dipstick, and then start the engine and warm it up for 5 minutes.
8. Turn the engine off, and then check the oil level and correct it if necessary.
9. Install the starboard apron ②, and then tighten it to the specified torque.



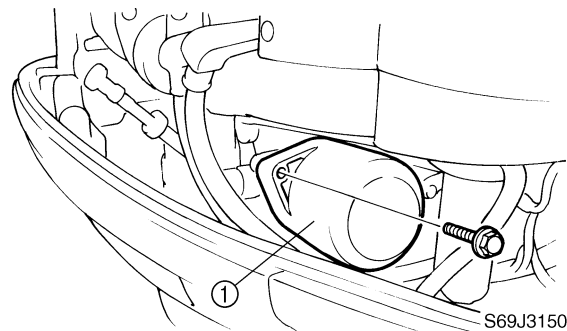
S69J3140



Apron bolt:
8 N·m (0.8 kgf·m, 5.8 ft·lb)

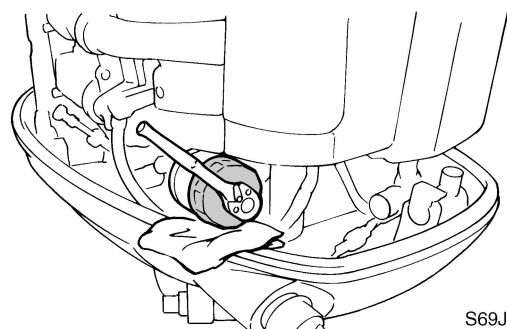
Replacing the oil filter

1. Extract the engine oil with an oil changer or drain it.
2. Remove the oil filter cover ①.



S69J3150

3. Place a rag under the oil filter, and then remove the filter using a 72.5 mm (2.9 in) oil filter wrench.



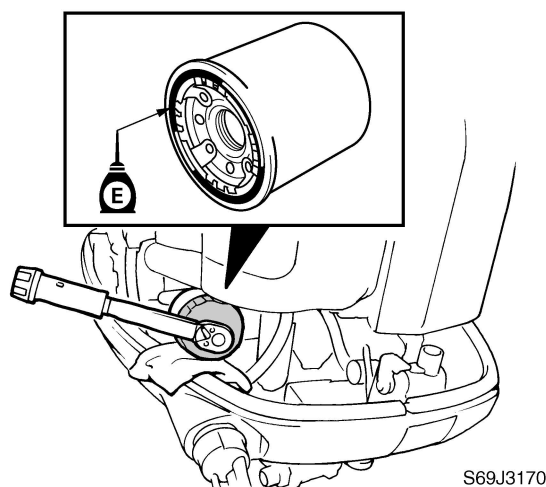
S69J3160

NOTE:

Be sure to clean up any oil spills.

4. Apply a thin coat of engine oil to the O-ring of the new oil filter.

5. Install the oil filter, and then tighten it to the specified torque using a 72.5 mm (2.9 in) oil filter wrench.



S69J3170



Oil filter: 18 N·m (1.8 kgf·m, 13 ft·lb)

6. Pour the specified amount of the recommended engine oil into the oil filler hole.



Recommended engine oil:

4-stroke motor oil

API: SE, SF, SG, or SH

SAE: 10W-30 or 10W-40

Oil quantity:

With oil filter replacement:

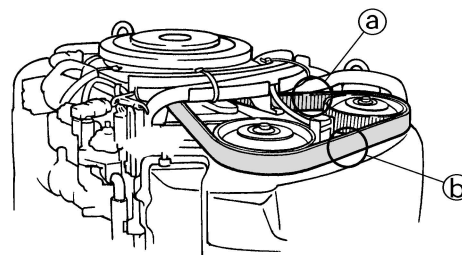
6.0 L (6.3 US qt, 5.3 Imp qt)

7. Install the oil filler cap and dipstick, and then start the engine and warm it up for 5 minutes.
8. Turn the engine off, and then check the oil level and correct it if necessary.
9. Install the oil filter cover.

Checking the timing belt

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

3. Turn the crankshaft clockwise two turns to take up slack in the timing belt.



S69J3180

Replacing the timing belt

NOTE:

For replacement procedures, see Chapter 5, "Replacing the timing belt."

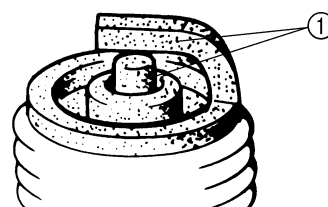
Checking the valve clearance

NOTE:

For checking procedures, see Chapter 5, "Checking the valve clearance."

Checking the spark plugs

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

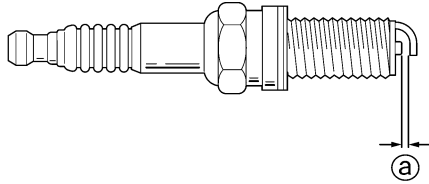


S69J3190

4. Check the electrodes for erosion and excessive carbon or other deposits, and the gasket for damage. Replace the spark plug if necessary.



5. Check the spark plug gap ①. Adjust if out of specification.

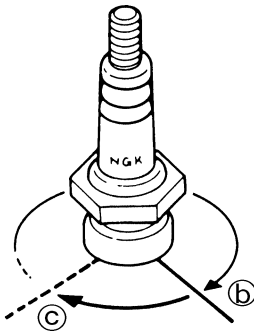


S69J3200



Specified spark plug:
LFR5A-11 (NGK)
Spark plug gap ①: 1.1 mm (0.043 in)

6. Install the spark plug, tighten it finger tight ②, then to the specified torque with a spark plug wrench ③.



S69J3210



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

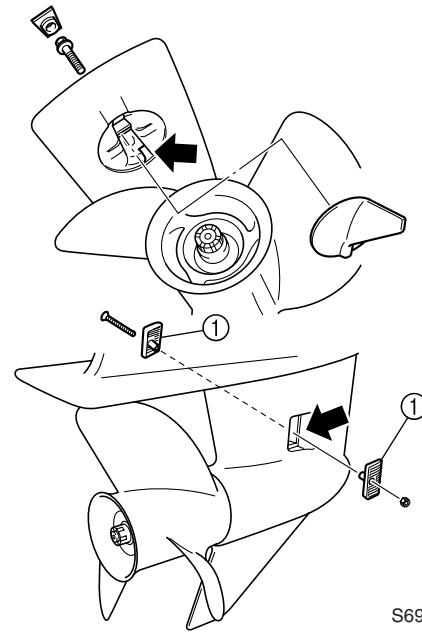
Checking the thermostat

NOTE:

For checking procedures, see Chapter 5, "Checking the thermostat."

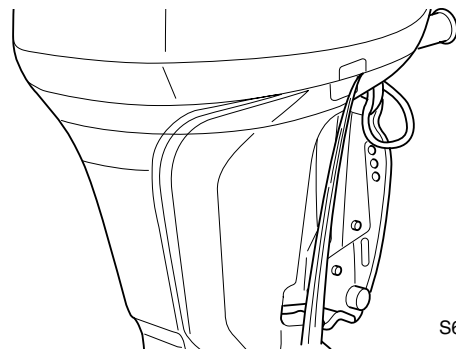
Checking the cooling water passage

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



S69J3220

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 outboard motor.

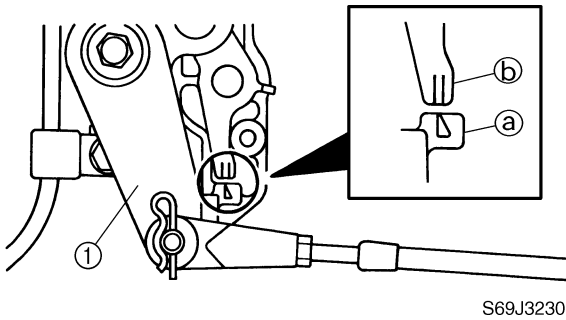


S69J3225

Control system

Checking the throttle link and throttle cable operation

1. Check that the throttle control cam ① is in its fully closed position and the alignment mark ② is between the alignment mark ③ when the remote control lever is in the neutral position. Adjust the length of the throttle cable and position of the throttle control lever if necessary.

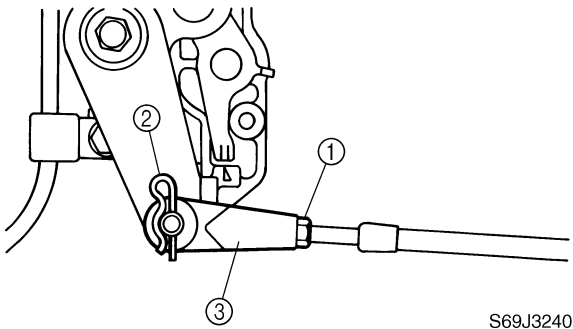


Adjusting the throttle link and throttle cable operation (with a stop bolt)

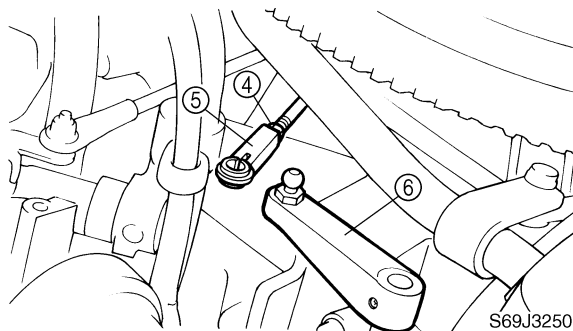
NOTE:

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

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

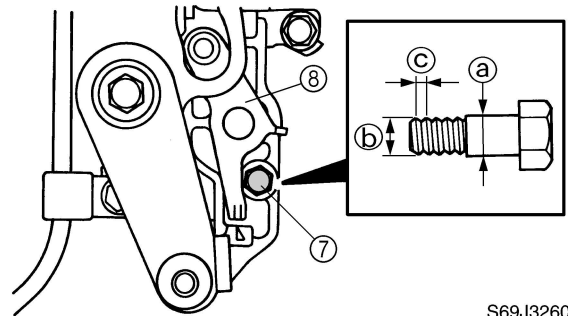


2. Loosen the locknut ④ and disconnect the link rod ⑤ from the magnet control lever ⑥.



3. Install the stop bolt (general bolt) ⑦ into the threaded hole.

4. Push the throttle control lever ⑧ against the stop bolt ⑦.



NOTE:

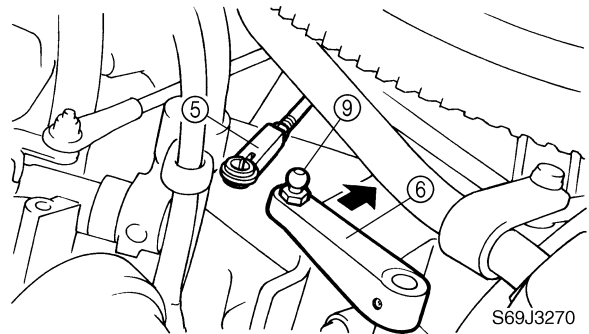
Use a general bolt with the specified measurements.



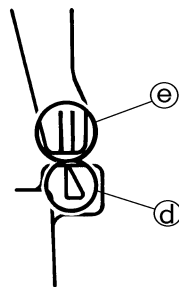
Stop bolt ⑦:

- ①: 10 mm (0.39 in)
- ②: 6.0 mm (0.24 in)
- ③: 1.0 mm (0.04 in)

5. Push the magnet control lever ⑥ in the direction of the arrow to eliminate any looseness, and then adjust the link rod ⑤ so that it aligns with the magnet control lever joint ⑨.

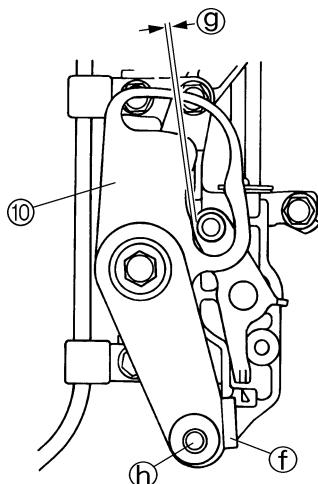


6. Install the link rod ⑤ and tighten the locknut ④.
7. Remove the stop bolt ⑦.
8. Check that the alignment mark ① is between the alignment mark ②. If not, repeat steps 2–6.



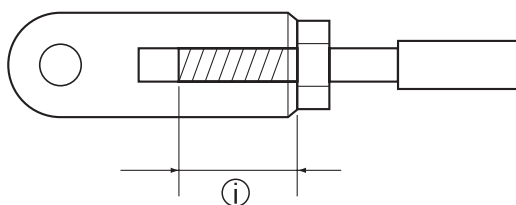
S69J3280

9. Place the throttle cam ⑩ against the fully closed stopper ⑆, and check that there is a minimum clearance ⑨ of approximately 1.0 mm (0.04 in).



S69J3290

10. Adjust the position of the throttle cable joint until its hole is aligned with the set pin ⑈ on the throttle cam.



S69J3300

CAUTION:

The throttle cable joint must be screwed in a minimum of 8.0 mm (0.31 in) ①.

11. Connect the cable joint, install the clip, and then tighten the locknut.

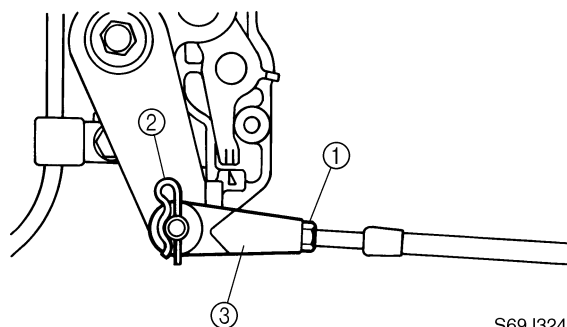
12. Check the throttle cable for smooth operation and adjust the cable length, if necessary, repeating steps 1–10.

Adjusting the throttle link and throttle cable operation (without a stop bolt)

NOTE:

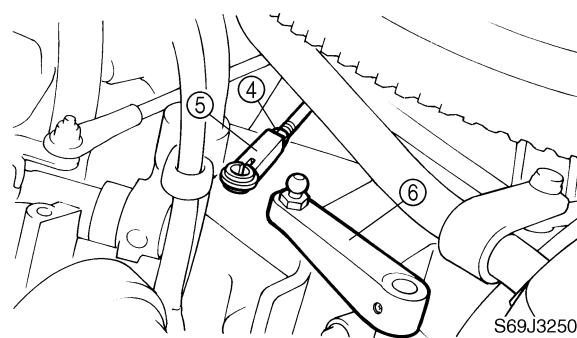
- Be sure to synchronize the throttle valves before adjusting the throttle link.
- For synchronizing procedures, see Chapter 4, "Synchronizing the throttle valve."

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



S69J3240

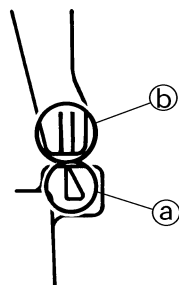
2. Loosen the locknut ④ and disconnect the link rod ⑤ from the magnet control lever ⑥.



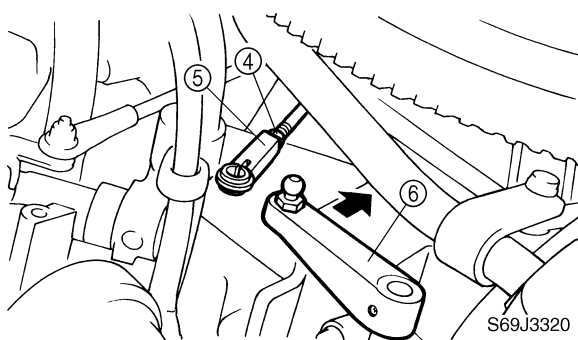
S69J3250

3. Adjust the link rod ⑤ so that the alignment mark ① is between the alignment marks ②. Then, push the magnet control lever ⑥ in the direction of the arrow to eliminate any looseness.
4. Install the link rod ⑤ and tighten the locknut ④.

5. Check that the alignment mark (a) is between the alignment marks (b). If not, repeat steps 2–4.

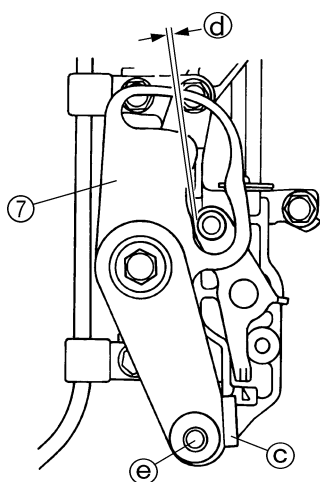


S69J3310



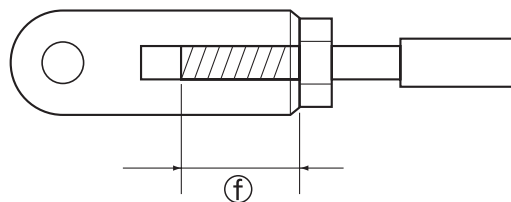
S69J3320

6. Place the throttle cam (7) against the fully closed stopper (c), and check that there is a minimum clearance (d) of approximately 1.0 mm (0.04 in).



S69J3330

7. Adjust the position of the throttle cable joint until its hole is aligned with the set pin (e) on the throttle cam.



S69J3340

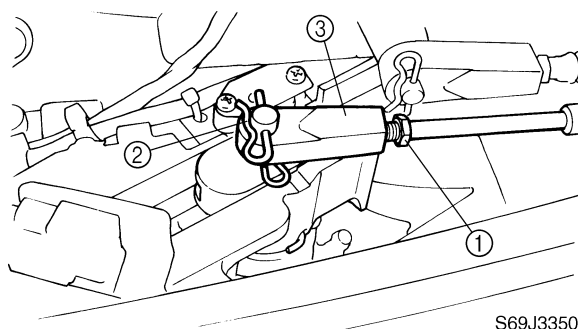
CAUTION:

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

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, repeating steps 1–7.

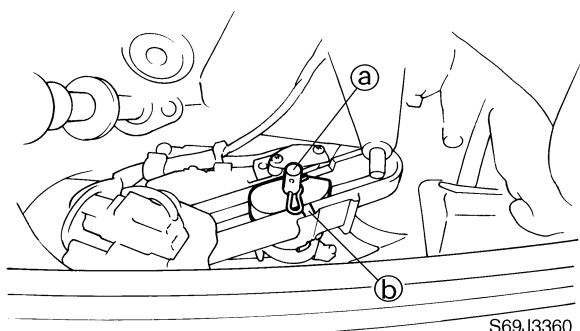
Checking the gearshift operation

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

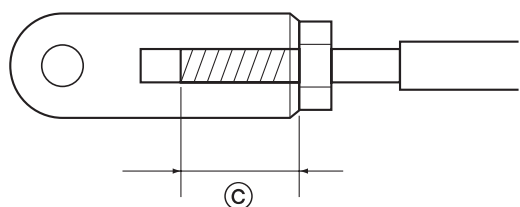


S69J3350

4. Align the set pin (a) in the center of the shift bracket and with the alignment marks (b) on the bracket.



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



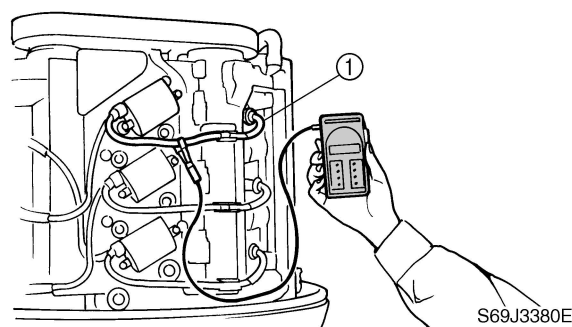
CAUTION:

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

6. Connect the cable joint, install the clip, and then tighten the locknut.
7. Check the gearshift for smooth operation and adjust the shift cable length, if necessary, repeating steps 3–6.

Checking the engine idle speed

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

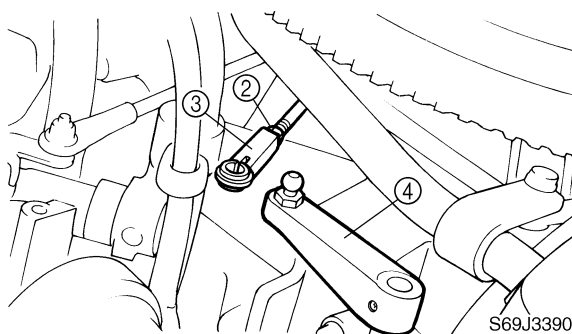


Digital tachometer: 90890-06760

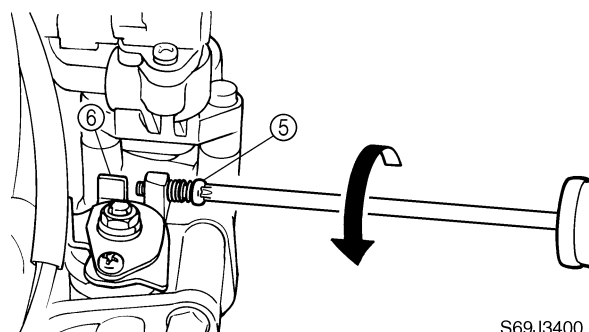


Engine idle speed: 650–750 r/min

4. Turn the engine off, loosen the locknut ②, and then disconnect the link rod ③ from the magnet control lever ④.

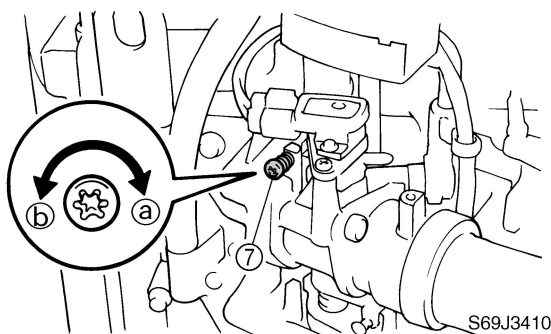


5. Loosen the port throttle stop screw ⑤ until it separates from the throttle body lever ⑥.



6. Start the engine, and then turn the starboard throttle stop screw ⑦ in direction ⑧ or ⑨ until the specified engine idle speed is obtained.

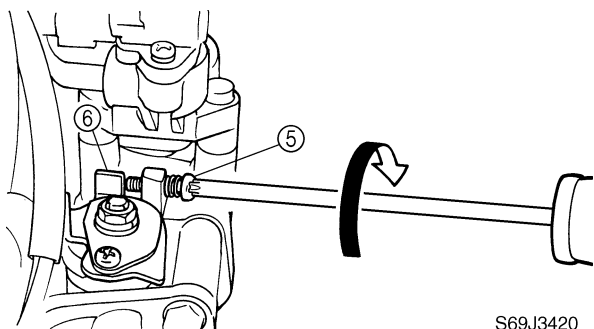
Control system



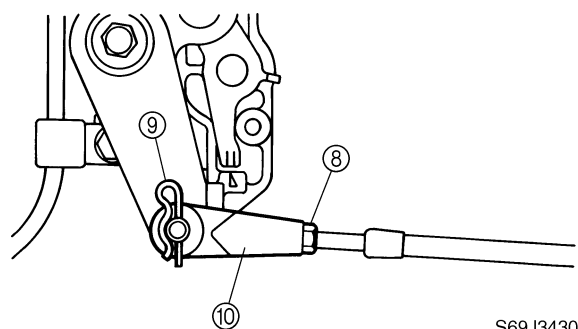
NOTE:

- To increase the idle speed, turn the throttle stop screw in direction (a).
- To decrease the idle speed, turn the throttle stop screw in direction (b).

7. Tighten the port throttle stop screw (5) until it contacts the throttle body lever (6).



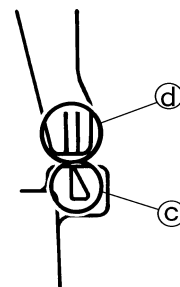
8. Loosen the locknut (8), remove the clip (9), and then disconnect the throttle cable joint (10).



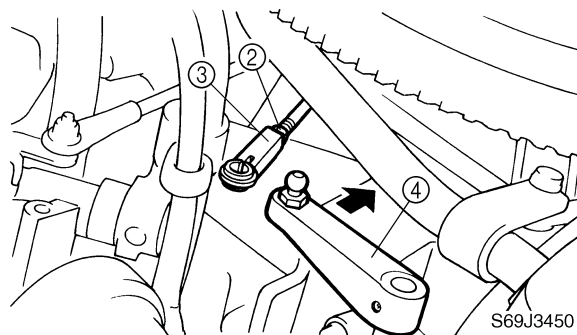
9. Adjust the link rod (3) so that the alignment mark (c) is between the alignment marks (d). Then, push the magnet control lever (4) in the direction of the arrow to eliminate any looseness.

10. Install the link rod (3), and then tighten the locknut (2).

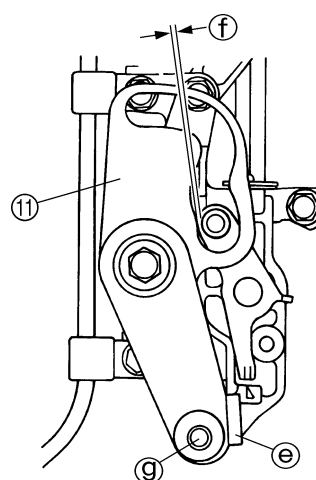
11. Check that the alignment mark (c) is between the alignment marks (d). If necessary, repeat steps 8–10.



S69J3440

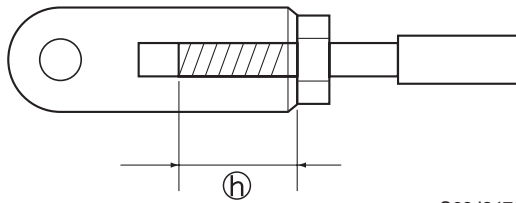


12. Place the throttle cam (11) against the fully closed stopper (e), and check that there is a minimum clearance (f) of approximately 1.0 mm (0.04 in).



S69J3460

13. Adjust the position of the throttle cable joint until its hole is aligned with the set pin (9) on the throttle cam.



S69J3470

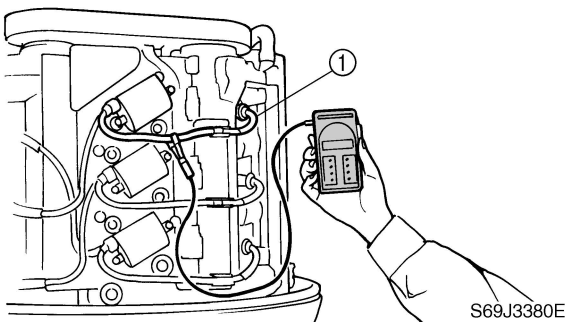
CAUTION:

The throttle cable joint must be screwed in a minimum of 8.0 mm (0.31 in) $\textcircled{h}$.

14. Connect the cable joint, install the clip, and then tighten the locknut.
15. Check the throttle cable for smooth operation and adjust the cable length, if necessary, repeating steps 8–12.

Checking the ignition timing

1. Remove the ignition coil cover.
2. Start the engine and warm it up for 5 minutes.
3. Attach the special service tool to spark plug wire #1 $\textcircled{1}$, and then check the engine idle speed. Adjust if out of specification.



S69J3380E

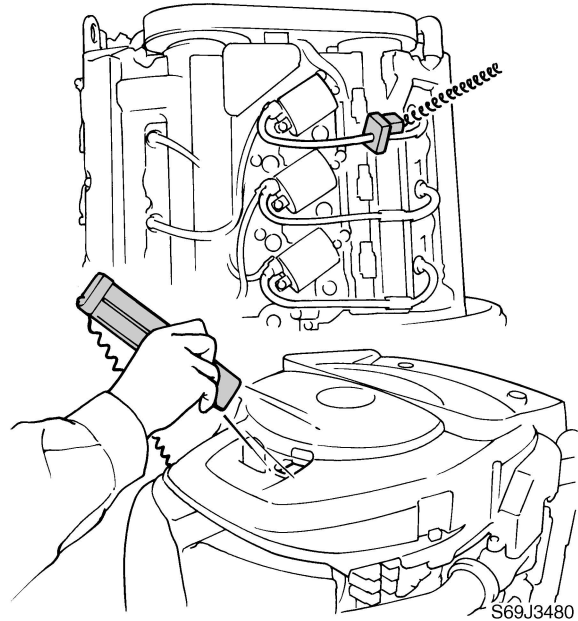


Digital tachometer: 90890-06760



Engine idle speed: 650–750 r/min

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

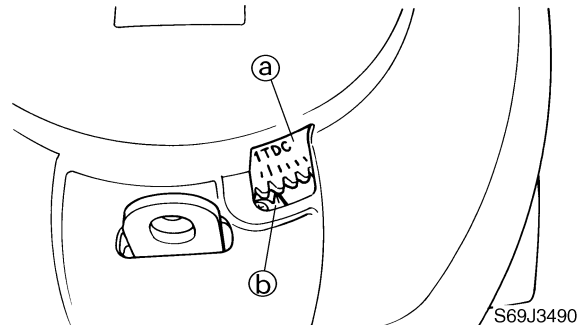


S69J3480



Timing light: 90890-03141

5. Check that the “1TDC” mark $\textcircled{a}$ on the flywheel magnet is aligned with the magnet base pointer $\textcircled{b}$.



S69J3490



Ignition timing: TDC

Power trim and tilt unit

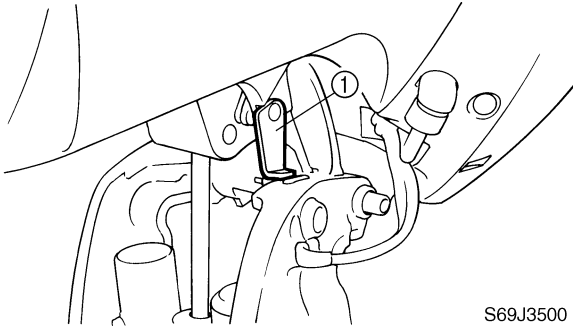
Checking the power trim and tilt operation

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:

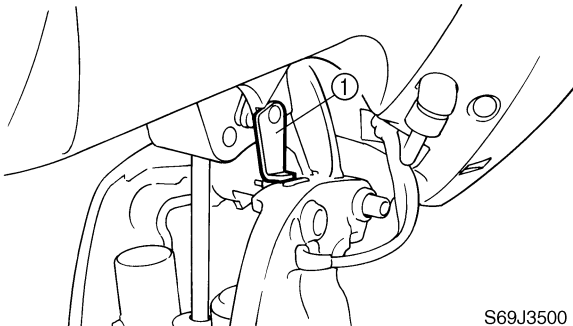
Be sure to listen to the winding sound of the power trim and tilt motor for smooth operation.

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.



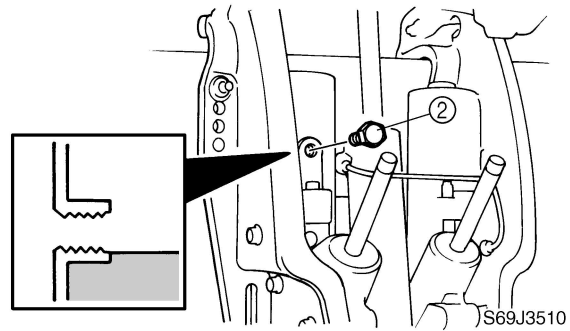
Checking the power trim and tilt fluid level

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 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.



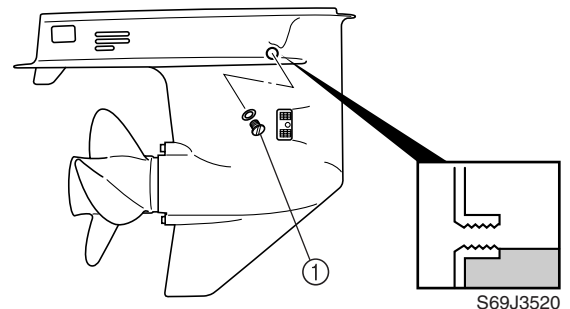
Reservoir cap:

7 N·m (0.7 kgf·m, 5.1 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.

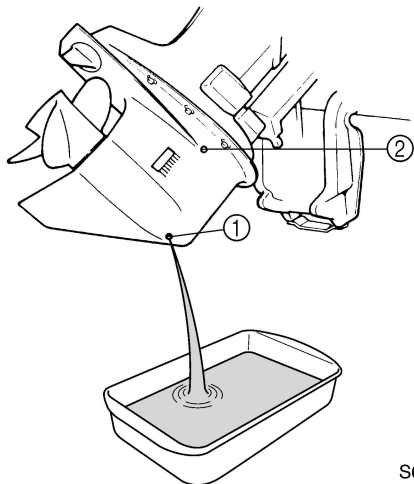


Recommended gear oil:
Hypoid gear oil
SAE: 90

4. Install the check screw.

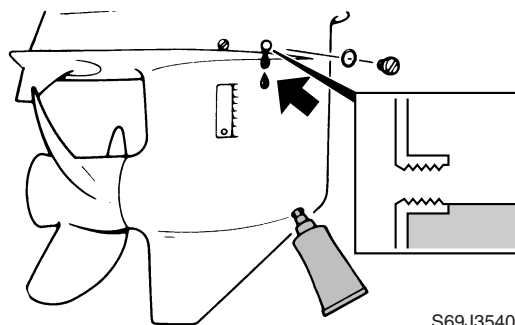
Changing the gear oil

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.

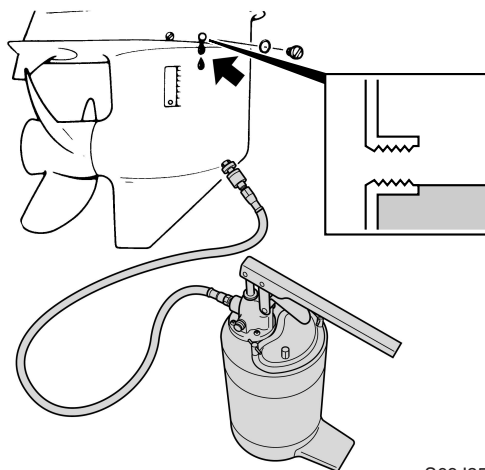


S69J3530

3. Check the oil for metal, discoloration, and its viscosity. Check the internal parts of the lower case if necessary.
4. Insert the gear oil tube or gear oil pump into the drain hole and slowly fill the gear oil until oil flows out of the check hole and no air bubbles are visible.



S69J3540



S69J3550

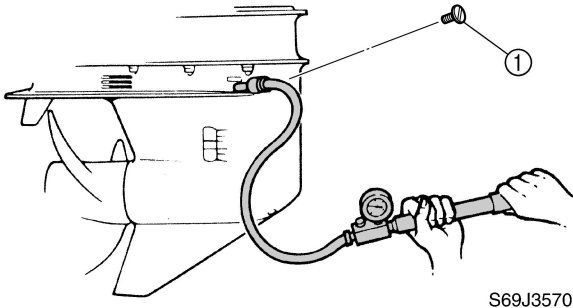


Recommended gear oil:
Hypoid gear oil
SAE: 90
Oil quantity:
Regular rotation model:
1.15 L (1.22 US qt, 1.01 Imp qt)
Counter rotation model:
1.00 L (1.06 US qt, 0.88 Imp qt)

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.



Leakage tester: 90890-06762

2. Apply the specified pressure to check whether the lower unit can hold it 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.

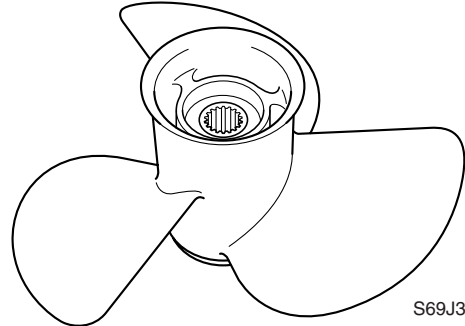


Lower unit holding pressure:
100 kPa (1.0 kgf/cm², 14 psi)

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

Checking the propeller

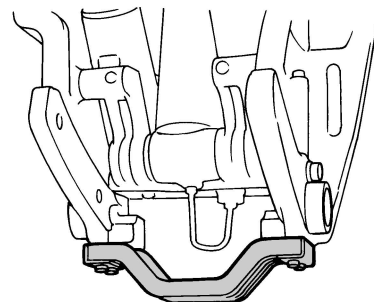
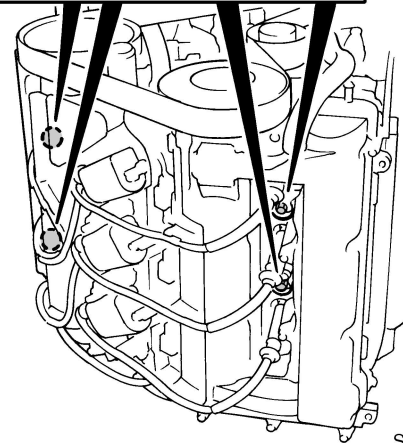
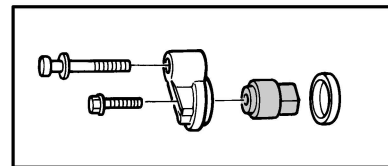
1. Check the propeller blades and splines for cracks, damage, or wear. Replace if necessary.

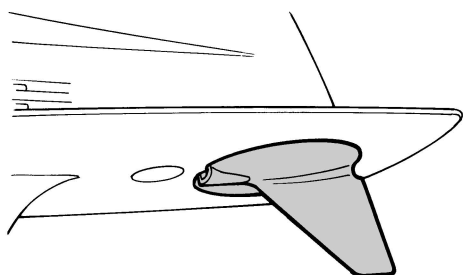


General

Checking the anodes

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





S69J3610

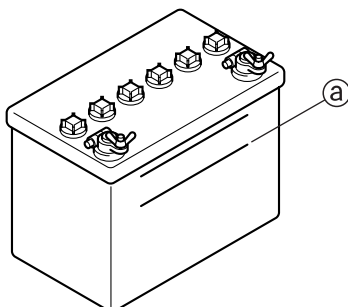
CAUTION:

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

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

Checking the battery

1. Check the battery electrolyte level. If the level is at or below the minimum level mark **@**, add distilled water until the level is between the maximum and minimum level marks.



S69J3620

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:

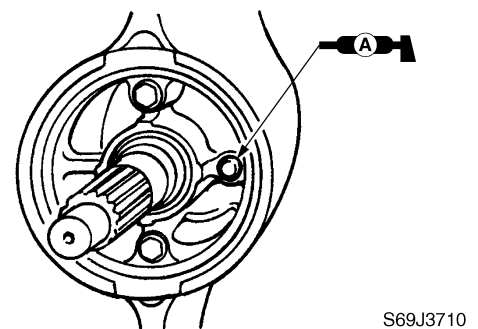
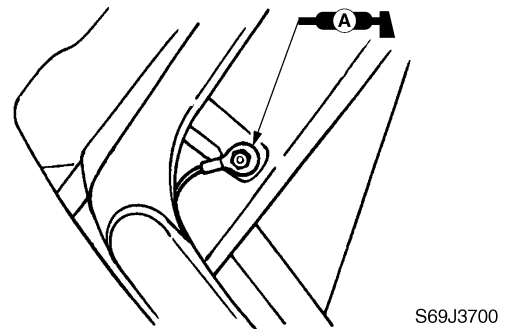
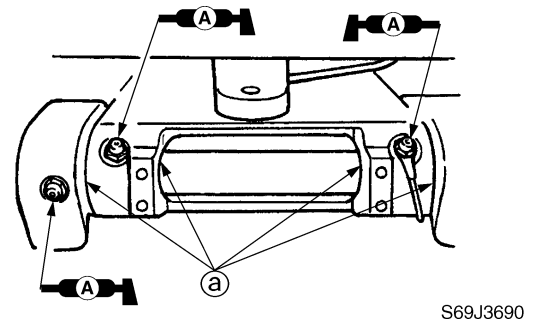
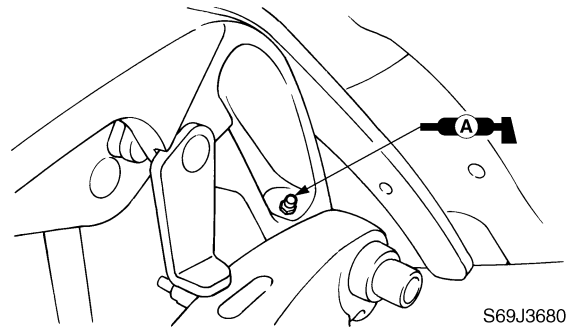
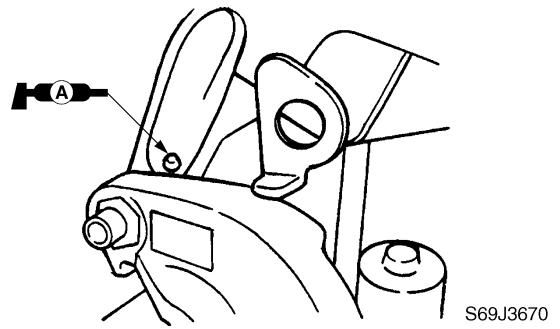
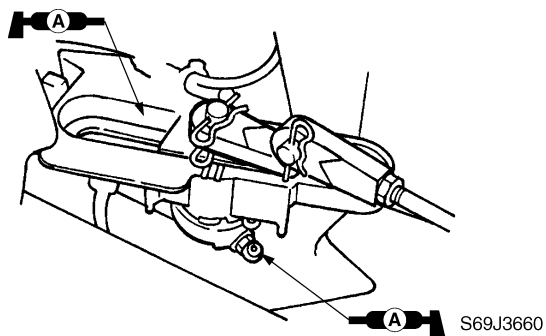
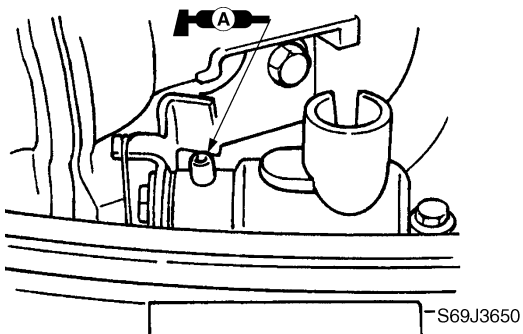
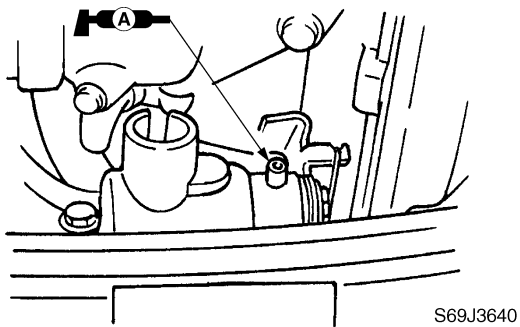
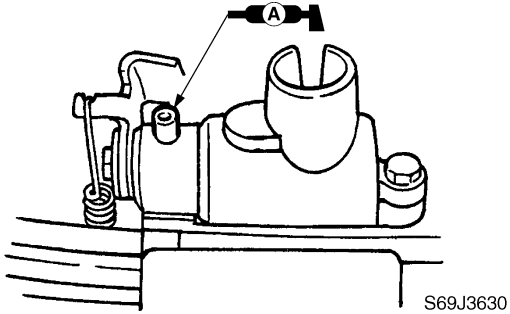
- Batteries vary per manufacturer. The procedures mentioned in this manual may not always apply, therefore, consult the instruction manual of the battery.
- Disconnect the black battery cable first, then the red battery cable.



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

Lubrication

1. Apply water resistant grease to the areas shown.

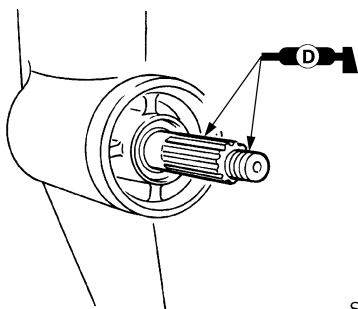


3



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

2. Apply corrosion resistant grease to the areas shown.



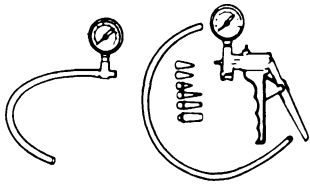
S69J3720



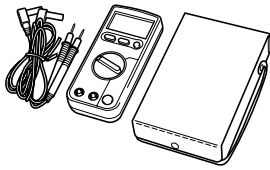
Fuel system

Special service tools	4-1
Hose routing	4-2
Fuel and blowby hoses	4-2
Intake silencer, fuel filter, and fuel pump	4-3
Vapor separator	4-5
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Installing the hose clamps	4-7
Checking the check valve	4-7
Reducing the fuel pressure	4-7
Checking the vapor separator	4-8
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Throttle control	4-13
Removing the pressure regulator	4-15
Disconnecting the high-pressure fuel hose joint	4-15
Checking the fuel injector	4-15
Checking the idle speed control (ISC)	4-15
Synchronizing the throttle valve	4-16

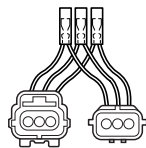
Special service tools



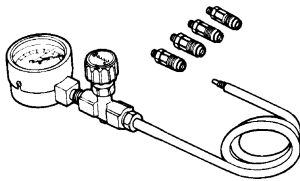
Vacuum/pressure pump gauge set
90890-06756



Digital circuit tester
90890-03174



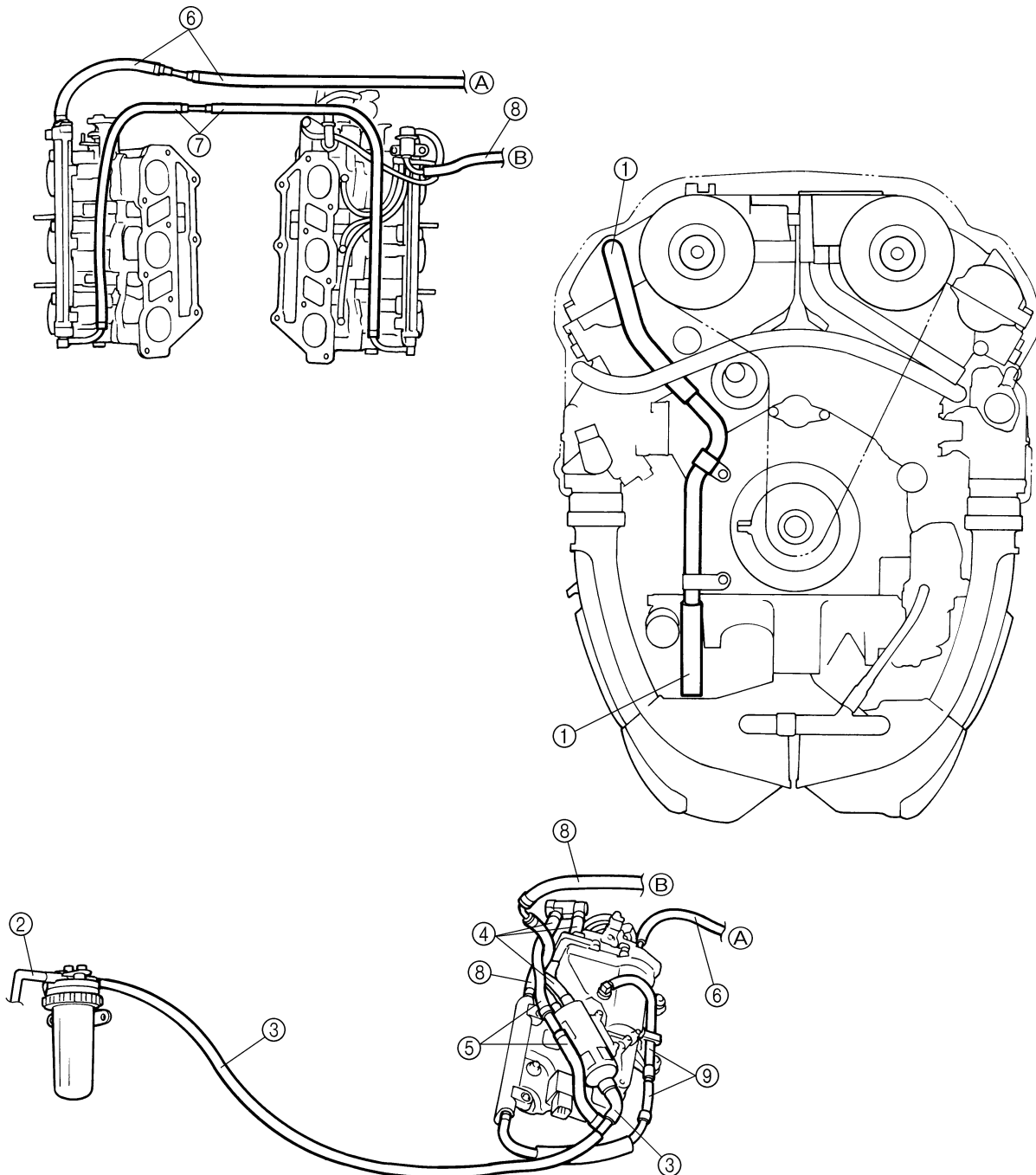
Test harness (3 pins)
90890-06793



Vacuum gauge
90890-03159

Hose routing

Fuel and blowby hoses



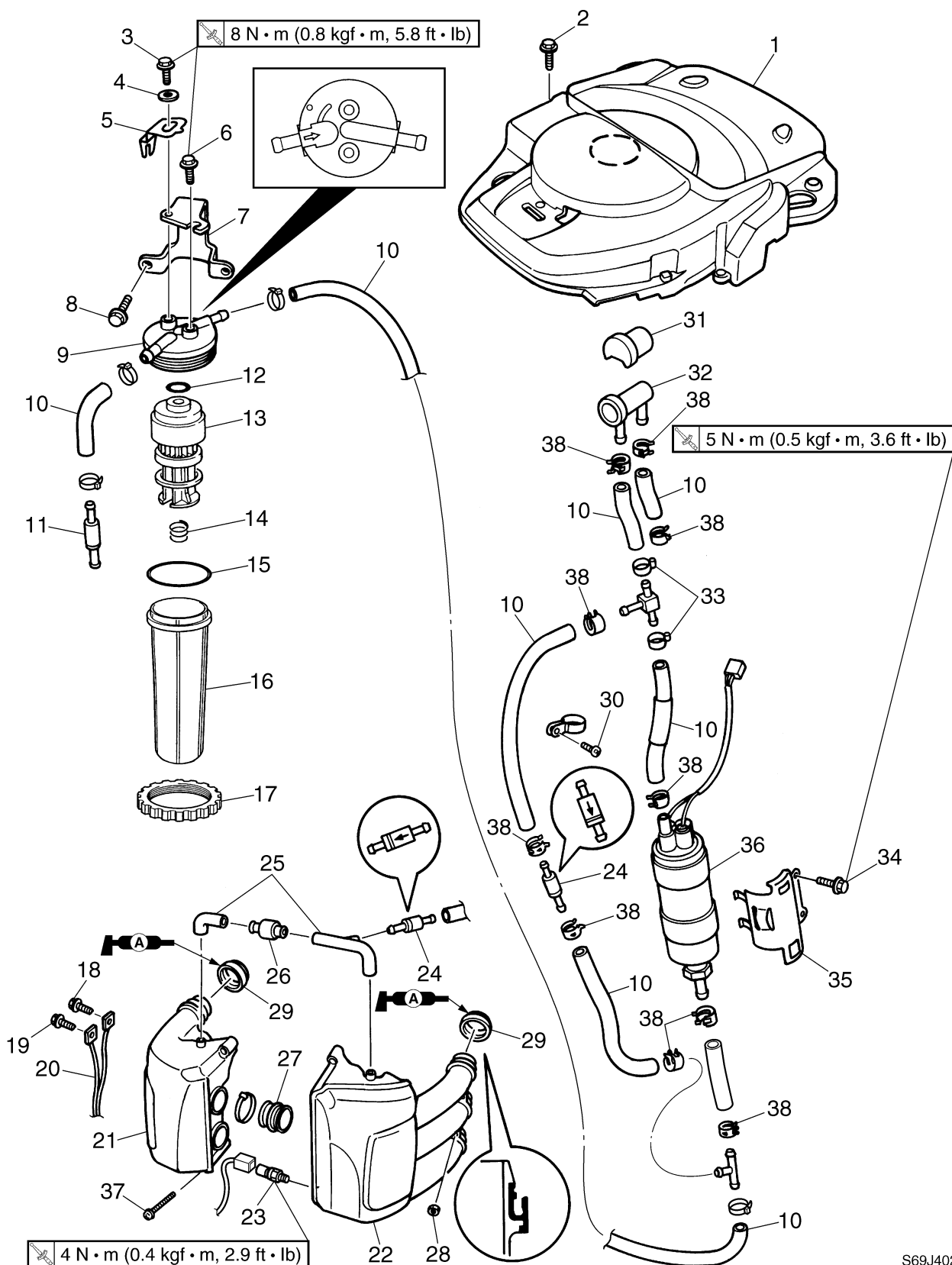
- ① Blowby hose
- ② Fuel hose (fuel joint-to-fuel filter)
- ③ Fuel hose (fuel filter-to-fuel pump)
- ④ Fuel hose (fuel pump-to-vapor separator)
- ⑤ Fuel hose (vapor separator-to-fuel pump)
- ⑥ High-pressure fuel hose
(vapor separator-to-starboard fuel rail)

- ⑦ High-pressure fuel hose
(starboard fuel rail-to-port fuel rail)
- ⑧ Fuel hose (pressure regulator-to-fuel cooler)
- ⑨ Fuel hose (fuel cooler-to-vapor separator)

S69J4010



Intake silencer, fuel filter, and fuel pump



S69J4020

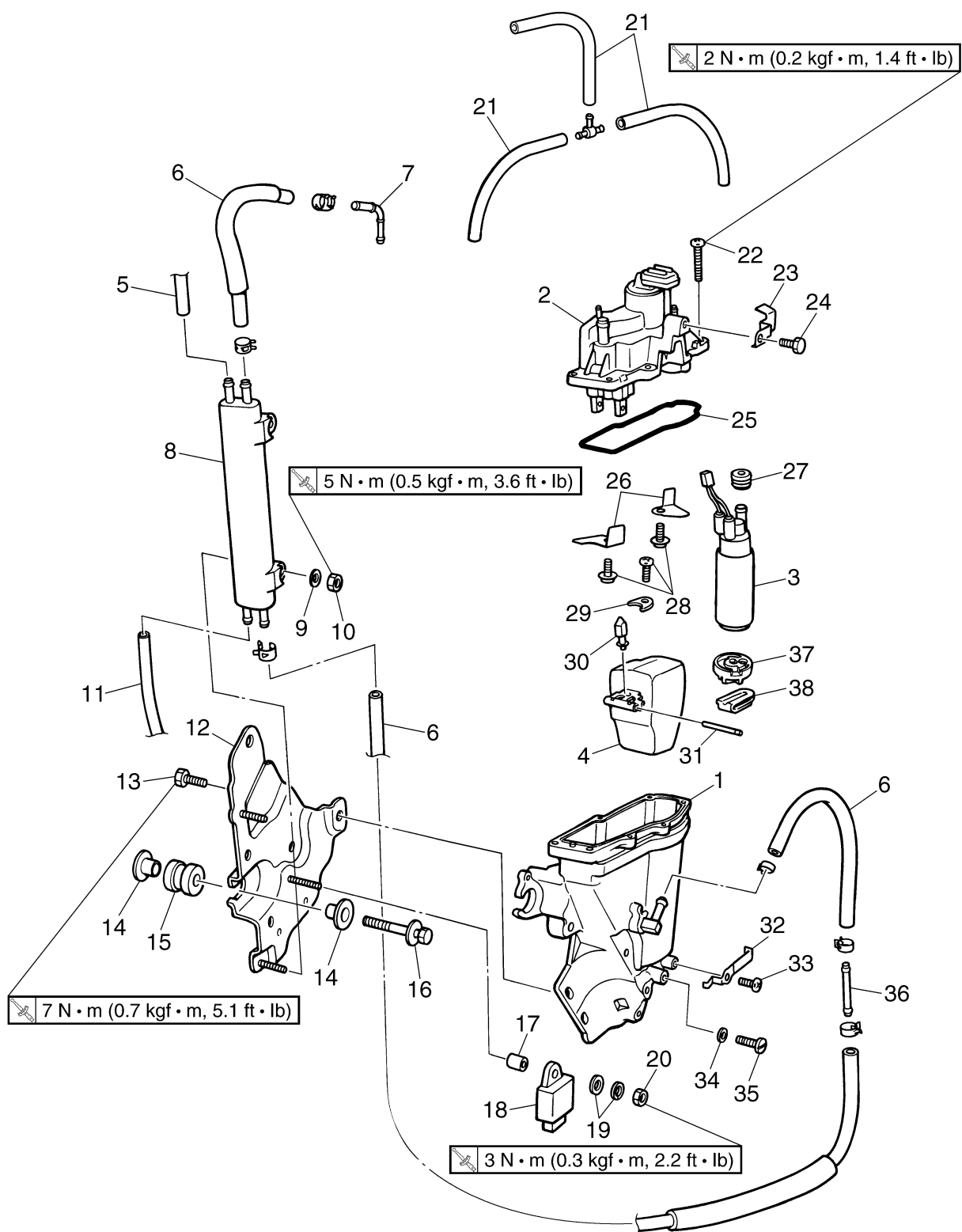
Intake silencer, fuel filter, and fuel pump

No.	Part name	Q'ty	Remarks
1	Cover	1	
2	Bolt	3	M6 × 28 mm
3	Bolt	1	M6 × 16 mm
4	Washer	1	
5	Holder	1	
6	Bolt	1	M6 × 14 mm
7	Bracket	1	
8	Bolt	2	M6 × 19 mm
9	Cap	1	
10	Fuel hose	8	
11	Fuel joint	1	
12	O-ring	1	Not reusable
13	Fuel filter element	1	
14	Spring	1	
15	O-ring	1	Not reusable
16	Cup	1	
17	Nut	1	
18	Bolt	1	M6 × 16 mm
19	Bolt	1	M7 × 20 mm
20	Battery cable	1	
21	Starboard intake silencer	1	
22	Port intake silencer	1	
23	Intake air temperature sensor	1	
24	Check valve	2	
25	Hose	2	
26	Joint	1	
27	Joint	2	
28	Nut	4	
29	Grommet	6	
30	Screw	1	M5 × 7 mm
31	Cover	1	
32	Fuel filter	1	
33	Clamp	2	
34	Bolt	2	M5 × 12 mm
35	Bracket	1	
36	Low-pressure fuel pump	1	
37	Bolt	4	M6 × 45 mm
38	Clamp	10	

4



Vapor separator



S69J4060

Vapor separator

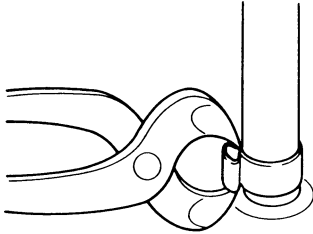
No.	Part name	Q'ty	Remarks
1	Float chamber	1	
2	Cover	1	
3	High-pressure fuel pump	1	
4	Float	1	
5	Water hose	1	
6	Fuel hose	3	
7	Joint	1	
8	Fuel cooler	1	
9	Washer	2	
10	Nut	2	
11	Water hose	1	
12	Bracket	1	
13	Bolt	3	M8 × 16 mm
14	Collar	6	
15	Bushing	4	
16	Bolt	4	M8 × 16 mm
17	Collar	1	
18	High-pressure fuel pump relay	1	
19	Washer	2	
20	Nut	1	
21	Hose	3	
22	Screw	7	M4 × 15 mm
23	Bracket	1	
24	Bolt	1	M6 × 10 mm
25	Gasket	1	Not reusable
26	Plate	2	
27	Grommet	1	
28	Screw	3	M4 × 8 mm
29	Plate	1	
30	Needle valve	1	
31	Pin	1	
32	Bracket	1	
33	Screw	1	
34	Gasket	1	
35	Drain screw	1	
36	Joint	1	
37	Filter	1	
38	Filter holder	1	

4



Removing the hose clamps

1. Remove the hose clamps by cutting the joint.



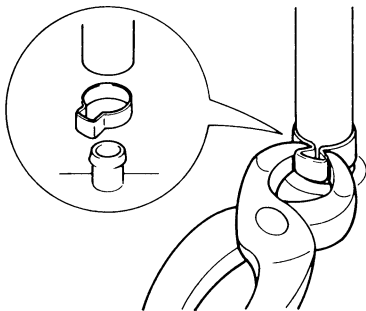
S69J4030

CAUTION:

If the hose clamps are removed without cutting the joint first, the fuel hose will be damaged.

Installing the hose clamps

1. Crimp the hose clamps properly to securely fasten them.



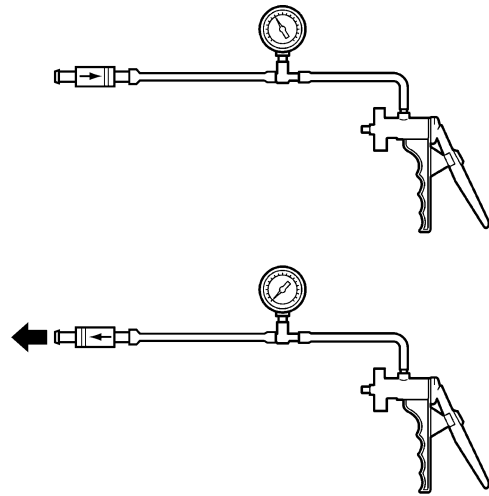
S69J4040

⚠ WARNING

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

Checking the check valve

1. Install the special service tool onto the check valve.



S69J4050



Vacuum/pressure pump gauge set:
90890-06756

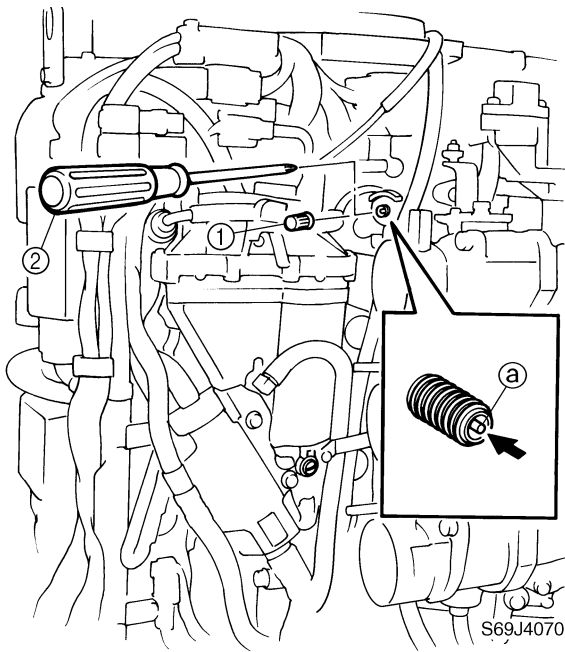
2. Apply the pressure to each check valve port. Replace if necessary.

NOTE:

Make sure no air comes out of the opposite side of the check valve.

Reducing the fuel pressure

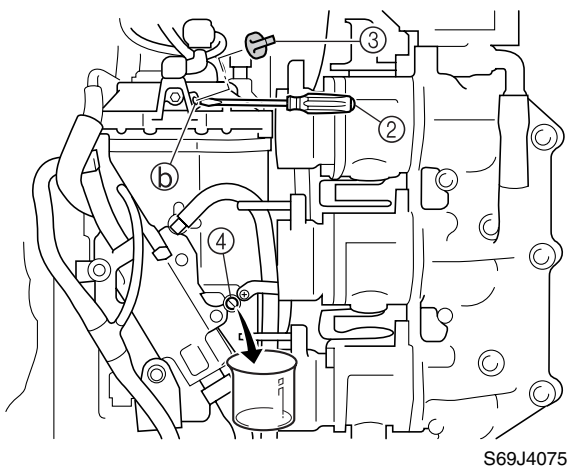
1. Remove the cap ①.
2. Cover the pressure check valve ② of the vapor separator with a rag, and then press in the valve using a thin screwdriver ③ to release the fuel pressure.



⚠ WARNING

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

3. Remove the cap ③, and then press in the valve ⑥ using a thin screwdriver ②.
4. Place a container under the vapor separator, and then drain the fuel from the separator by removing the drain screw ④.

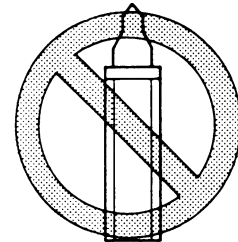
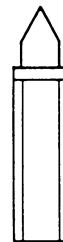


⚠ WARNING

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

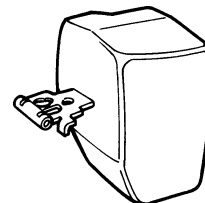
Checking the vapor separator

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



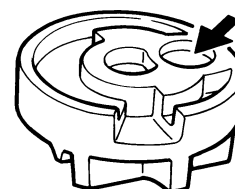
S69J4080

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



S69J4090

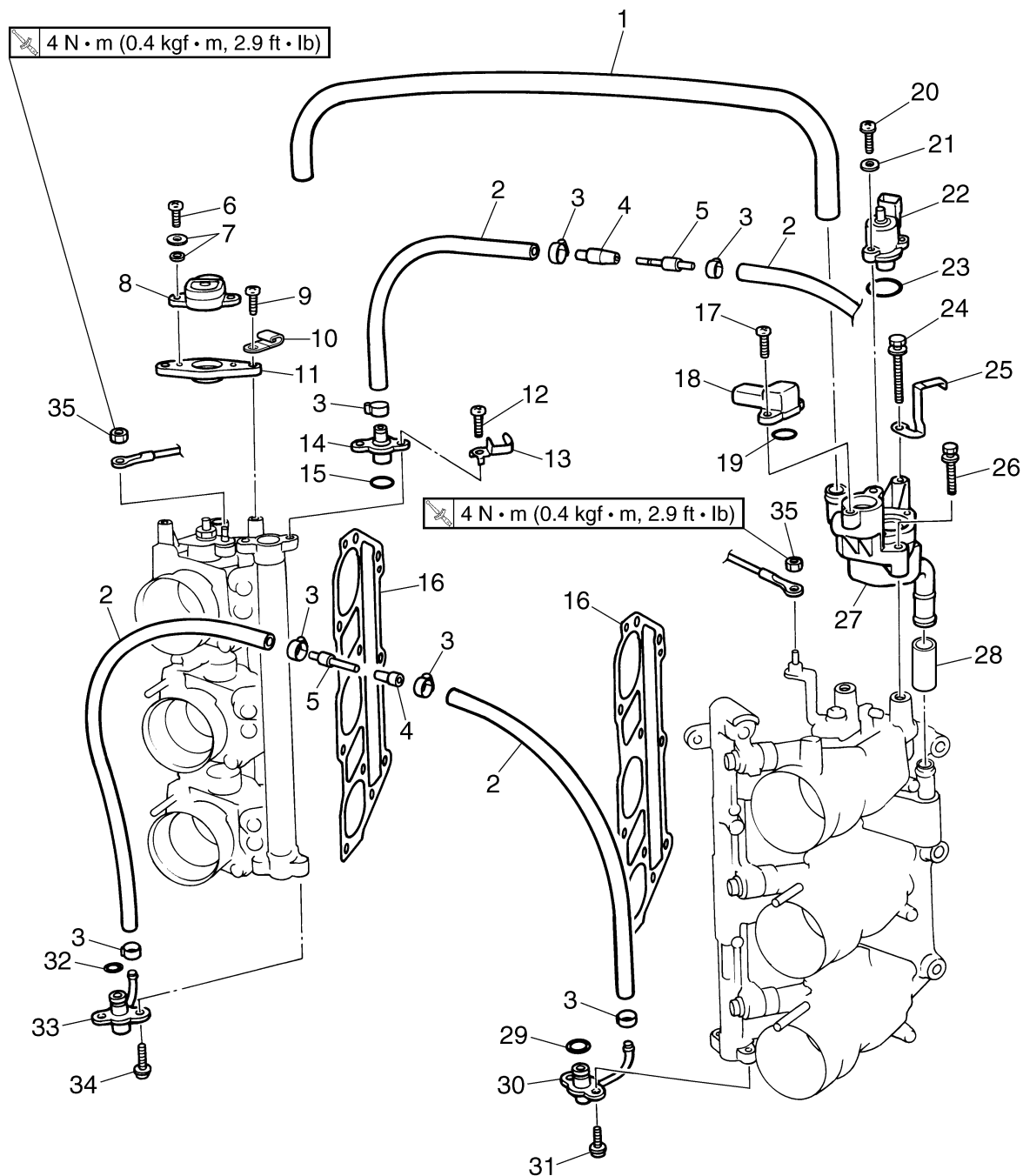
3. Check the filter for dirt or residue. Clean if necessary.



S69J4100



Intake manifold and high-pressure fuel line

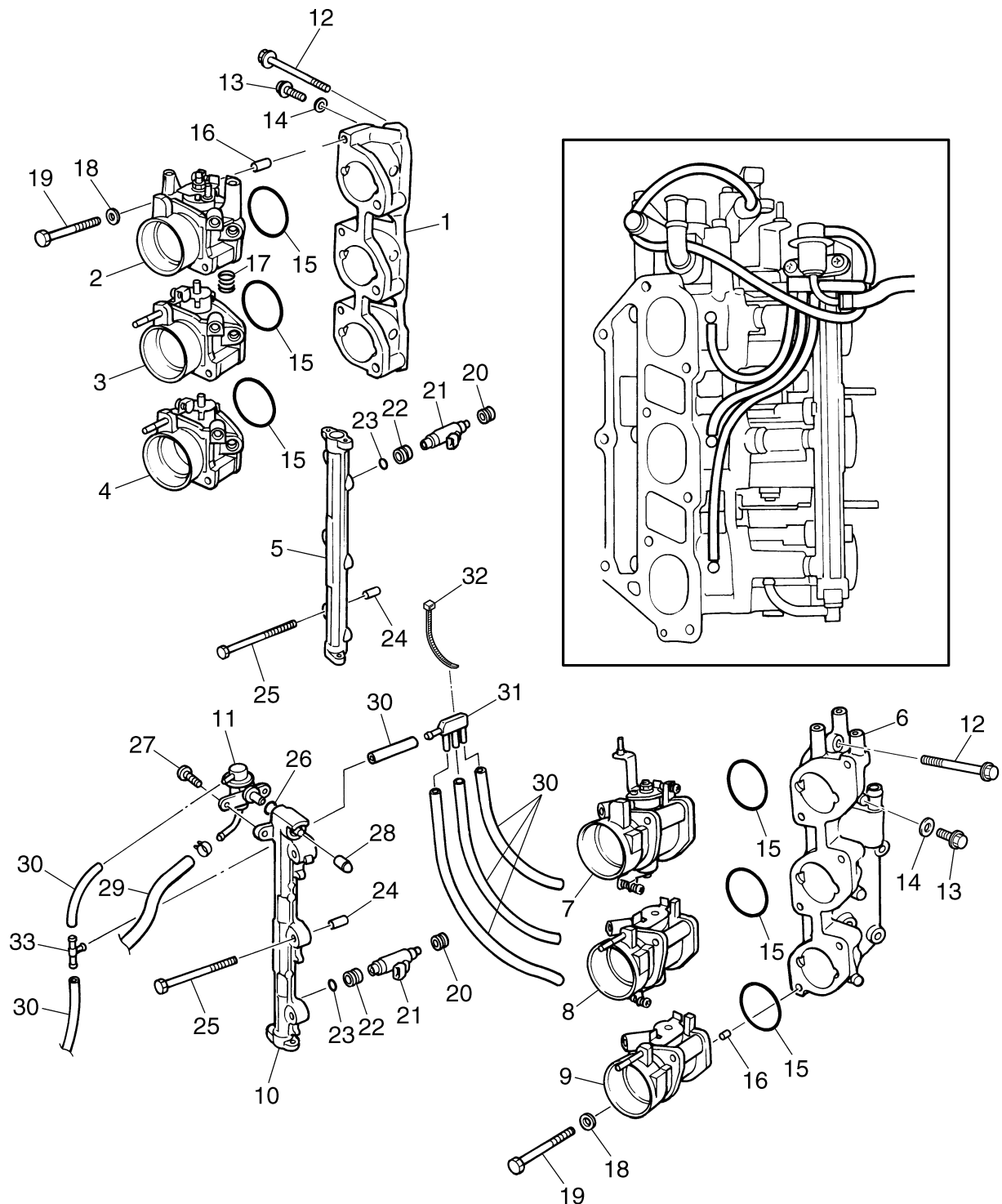


S69J4110

Intake manifold and high-pressure fuel line

No.	Part name	Q'ty	Remarks
1	Hose	1	
2	High-pressure fuel hose	4	
3	Clamp	7	
4	Joint	2	
5	Joint	2	
6	Screw	2	
7	Washer	4	
8	Throttle position sensor	1	
9	Screw	2	
10	Bracket	1	
11	Bracket	1	
12	Screw	2	M5 × 15 mm
13	Bracket	1	
14	Joint	1	
15	O-ring	1	Not reusable
16	Metal gasket	2	Not reusable
17	Screw	2	M5 × 15 mm
18	Intake air pressure sensor	1	
19	O-ring	1	Not reusable
20	Screw	3	M4 × 16 mm
21	Washer	3	
22	Idle speed control	1	
23	O-ring	1	Not reusable
24	Bolt	1	M6 × 55 mm
25	Bracket	1	
26	Bolt	2	M6 × 30 mm
27	Body	1	
28	Hose	1	
29	O-ring	1	Not reusable
30	Joint	1	
31	Screw	2	M5 × 15 mm
32	O-ring	1	Not reusable
33	Joint	1	
34	Screw	2	M5 × 15 mm
35	Nut	2	

4



S69J4120

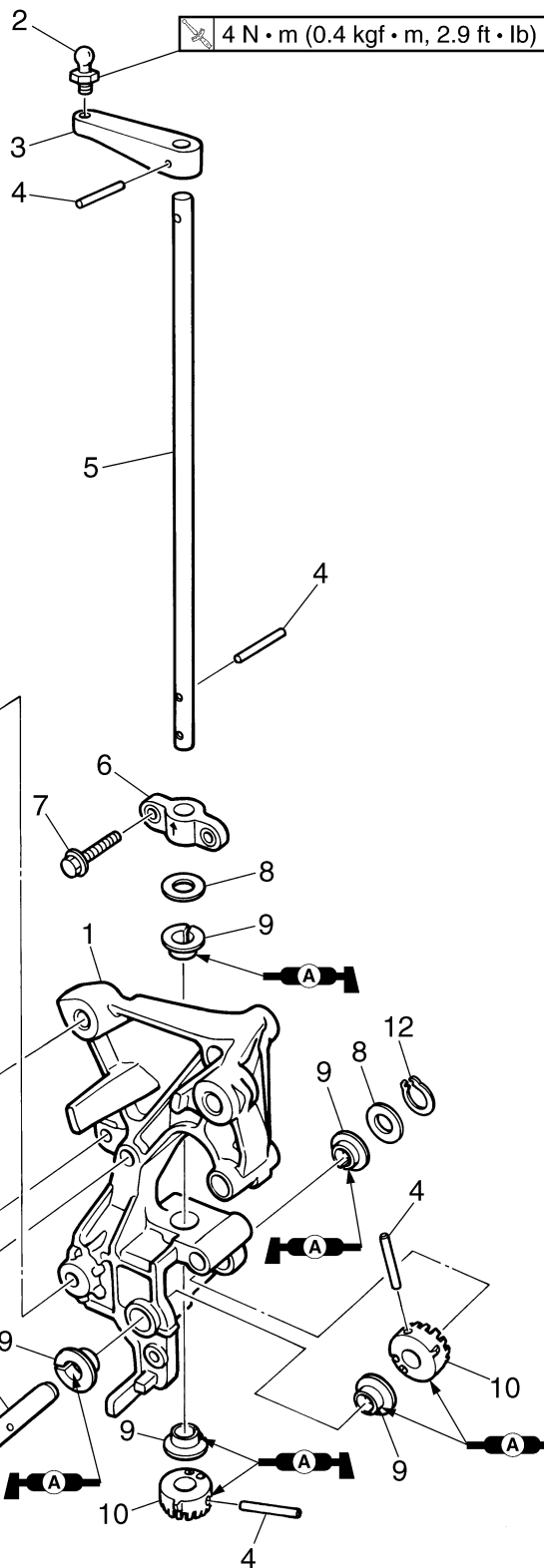
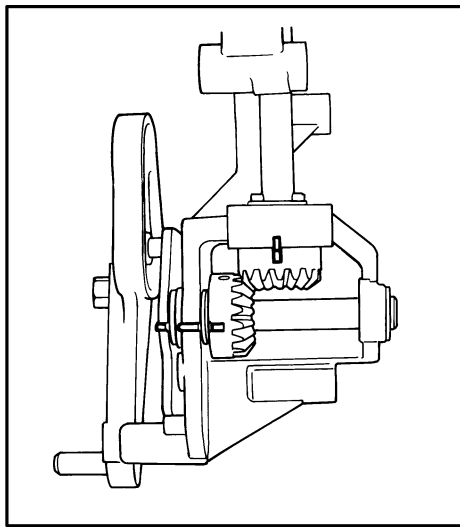
Intake manifold and high-pressure fuel line

No.	Part name	Q'ty	Remarks
1	Starboard intake manifold	1	
2	Throttle body #1	1	
3	Throttle body #3	1	
4	Throttle body #5	1	
5	Starboard fuel rail	1	
6	Port intake manifold	1	
7	Throttle body #2	1	
8	Throttle body #4	1	
9	Throttle body #6	1	
10	Port fuel rail	1	
11	Pressure regulator	1	
12	Bolt	18	M8 × 35 mm
13	Bolt	6	M6 × 10 mm
14	Gasket	6	Not reusable
15	Gasket	6	Not reusable
16	Collar	12	
17	Spring	1	
18	Washer	12	
19	Bolt	12	M8 × 80 mm
20	Rubber seal	6	
21	Fuel injector	6	
22	Grommet	6	Not reusable
23	O-ring	6	Not reusable 2.1 × 11.8 mm
24	Collar	6	
25	Bolt	6	M8 × 45 mm
26	O-ring	1	Not reusable
27	Screw	2	M6 × 12 mm
28	Cap	1	
29	Fuel hose	1	
30	Hose	6	
31	Joint	1	
32	Plastic tie	1	
33	Joint	1	

4



Throttle control



S69J4160

Throttle control

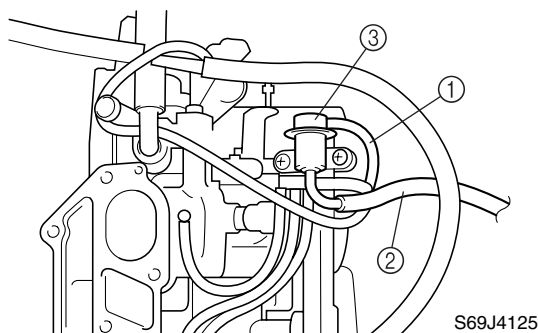
No.	Part name	Q'ty	Remarks
1	Bracket	1	M6 × 20 mm
2	Joint	1	
3	Magnet control lever	1	
4	Pin	4	
5	Shaft	1	
6	Bracket	1	
7	Bolt	2	
8	Washer	2	
9	Bushing	5	
10	Gear	2	
11	Throttle control lever	1	M6 × 14 mm
12	Circlip	1	
13	Bolt	1	
14	Wave washer	1	
15	Washer	1	
16	Throttle cam	1	
17	Spring	1	
18	Bolt	2	
19	Bracket	2	
20	Bolt	1	M8 × 20 mm
21	Terminal	1	M6 × 14 mm
22	Starter motor lead	1	
23	Bolt	1	
24	Bolt	5	M6 × 45 mm

4



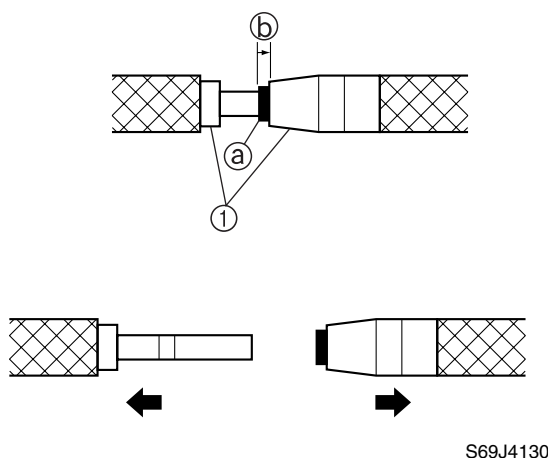
Removing the pressure regulator

1. Remove the intake silencer and the port intake manifold.
2. Disconnect the hose ① and ②, and then remove the pressure regulator ③.



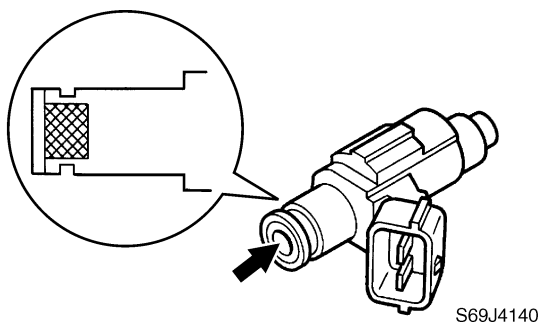
Disconnecting the high-pressure fuel hose joint

1. Disconnect the high-pressure fuel hose joint ① with the collar ② slide from the end ③ of the joint.

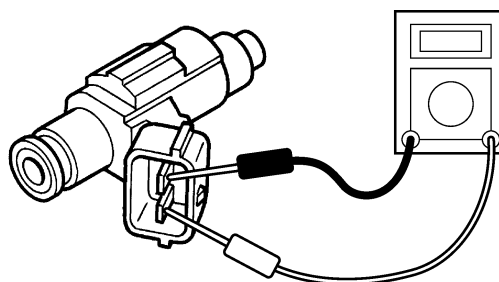


Checking the fuel injector

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



2. Measure the resistance of the fuel injectors. Replace if out of specification.



Digital circuit tester: 90890-03174



Fuel injector resistance:
14.0–15.0 Ω at 20 °C (68 °F)

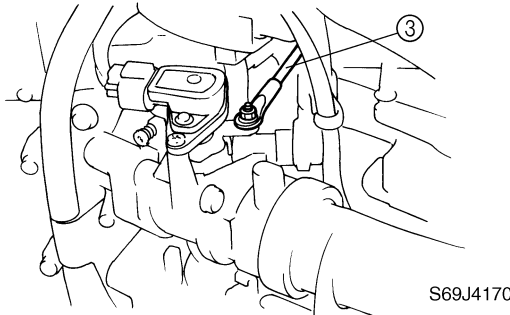
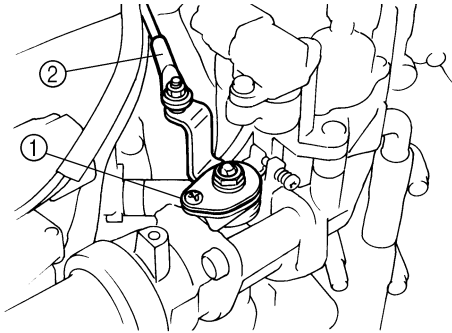
3. Check the operation of the fuel injector using the “Stationary Test” of the Yamaha Diagnostic System.

Checking the idle speed control (ISC)

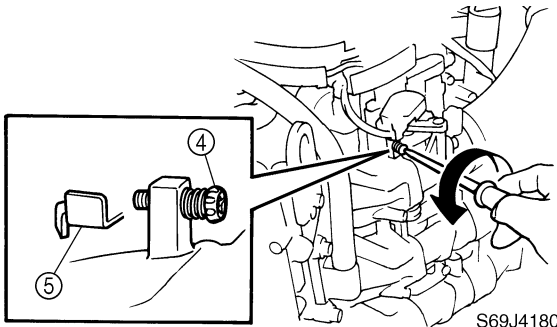
1. Check the operation of the idle speed control using the “Stationary test” or the “Active test” of the Yamaha Diagnostic System.

Synchronizing the throttle valve

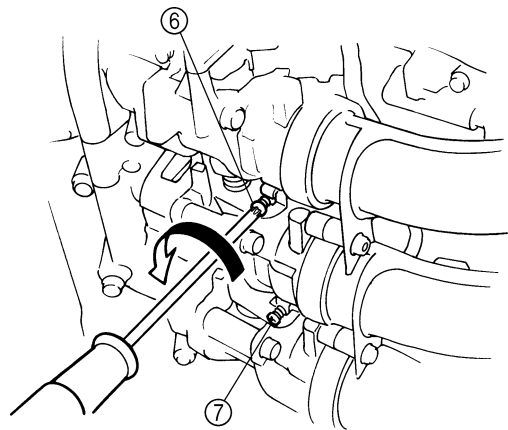
1. Loosen the bank synchronizing screw ①.
2. Remove the port link rod ② and starboard link rod ③.



3. Loosen the starboard throttle stop screw ④ until it separates from the throttle body lever ⑤.

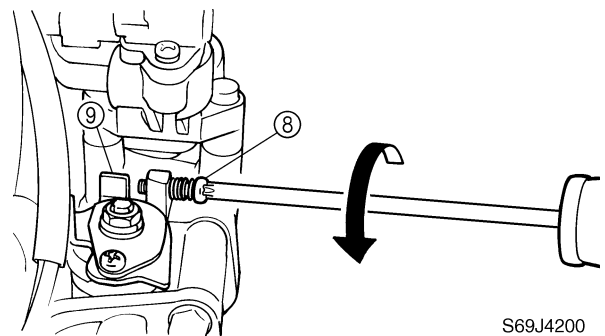


4. Loosen the synchronizing screw ⑥ of cylinder #3 to open throttle valve #3.
5. Loosen the synchronizing screw ⑦ of cylinder #5 to open throttle valve #5.



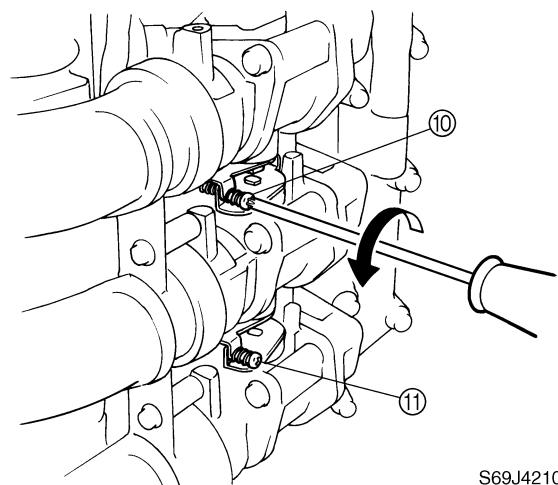
S69J4190

6. Loosen the port throttle stop screw ⑧ until it separates from the throttle body lever ⑨.



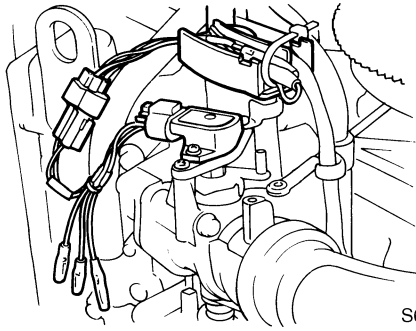
S69J4200

7. Loosen the synchronizing screw ⑩ of cylinder #4 to open throttle valve #4.
8. Loosen the synchronizing screw ⑪ of cylinder #6 to open throttle valve #6.



S69J4210

9. Connect the test harness (3 pins) to the throttle position sensor.

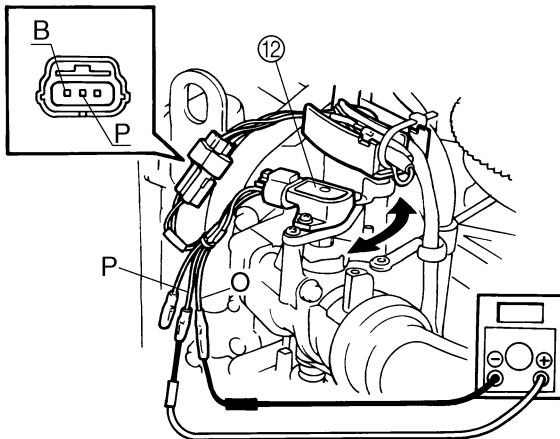


S69J4220



Test harness (3 pins): 90890-06793

10. Turn the engine start switch to ON.
11. Measure the throttle position sensor output voltage. Adjust the throttle position sensor ⑫ position if out of specification.



S69J4230

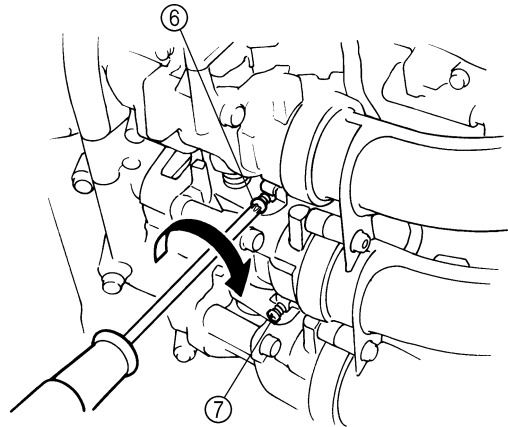


Digital circuit tester: 90890-03174



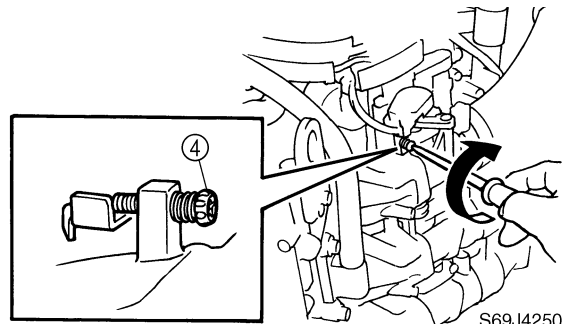
Throttle position sensor output voltage:
Pink (P) – Black (B)
 $660 \pm 5 \text{ mV}$

12. Tighten the synchronizing screw ⑥ of cylinder #3 and stop tightening it when the throttle position sensor output voltage starts to change. Similarly, tighten and adjust the synchronizing screw ⑦ of cylinder #5.



S69J4240

13. Tighten the starboard throttle stop screw ④ until the output voltage is adjusted to specification as mentioned in step 11, plus 40 mV.



S69J4250



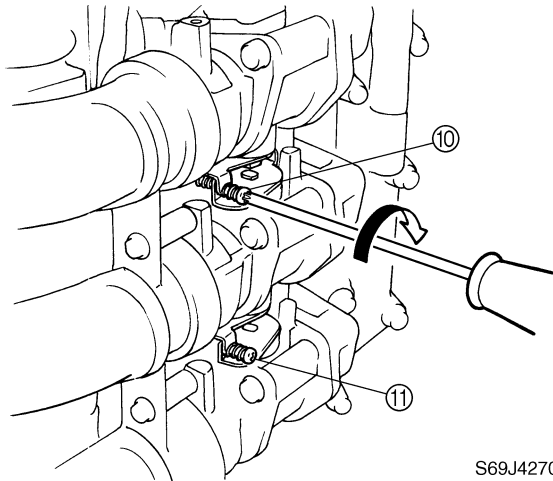
Throttle position sensor output voltage:
Pink (P) – Black (B)
 $700 \pm 5 \text{ mV}$

14. Attach a synchronizing check tool ⑬ as shown to the port #2 throttle body (to facilitate the monitoring of the throttle plate ⑭ movement).

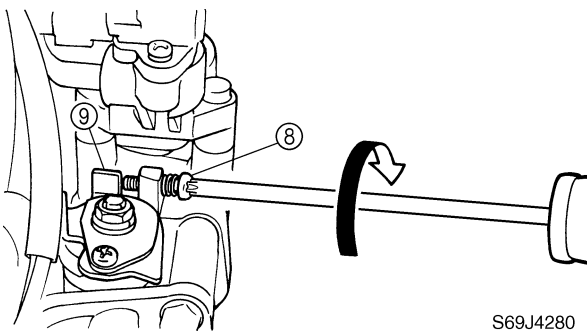


S69J4260

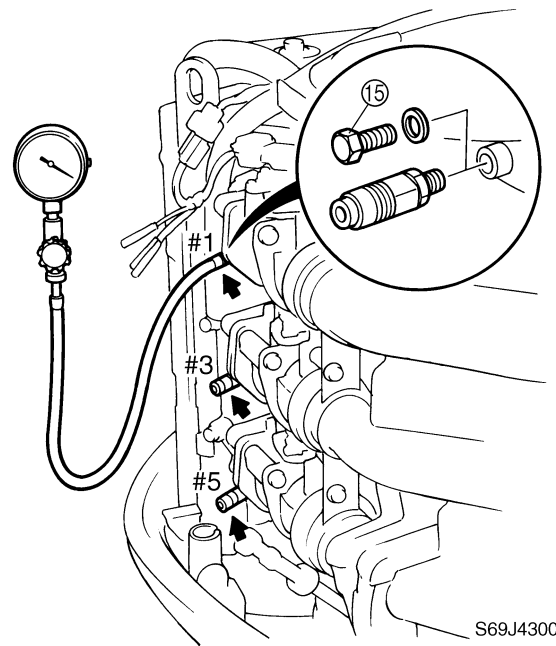
15. Tighten the synchronizing screw ⑩ of cylinder #4, and stop tightening when the throttle plate starts to move. Similarly, tighten and adjust the synchronizing screw ⑪ of cylinder #6.



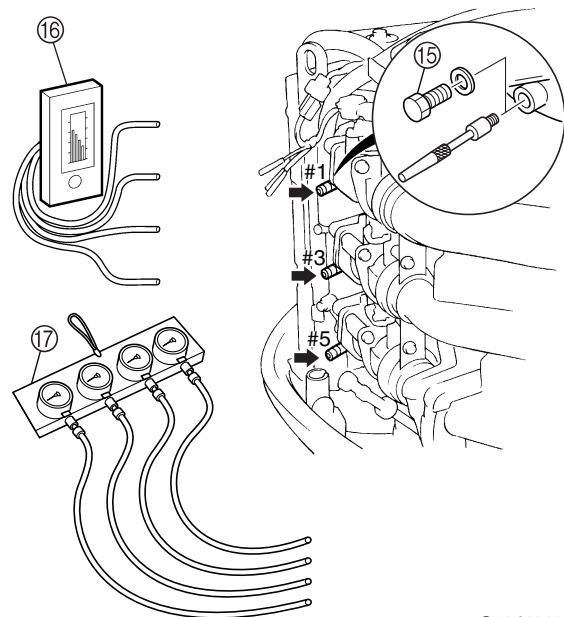
16. Tighten the port throttle stop screw ⑧ until it contacts the throttle body lever ⑨, and then turn it one additional turn.



17. Start the engine and warm it up for 5 minutes.
18. Remove the plugs ⑮ of cylinders #1, #3, and #5, and then attach the special service tool and adapters to the intake manifold as shown.



Vacuum gauge: 90890-03159



NOTE: For best results, use a vacuum gauge (commercially obtainable), like ⑮ or ⑮ shown in the illustration, that has four adapters.



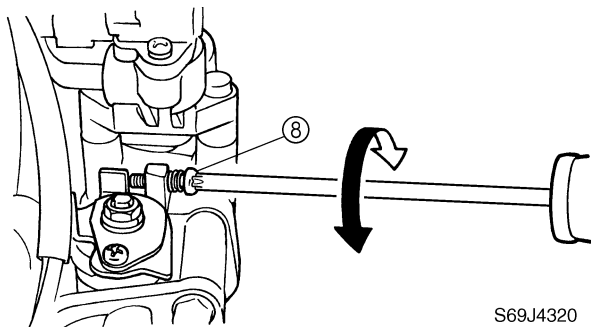
19. Measure the vacuum of cylinders #1, #3, and #5. Repeat step 12 if out of specification.



Vacuum difference between cylinders:
20 mmHg (27 mbar, 0.79 inHg)

20. Measure the vacuum of cylinders #2, #4, and #6. Repeat step 12 if out of specification.

21. Check the average vacuum difference between the port and starboard banks. Adjust the port throttle stop screw ⑧ if out of specification.



S69J4320



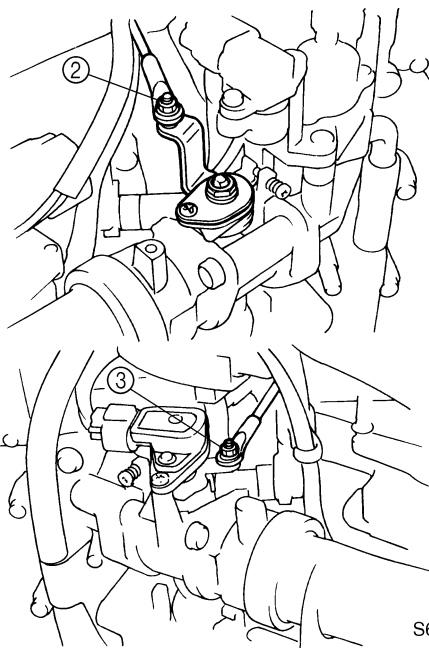
Average vacuum difference between port and starboard banks:
40 mmHg (53 mbar, 1.57 inHg)

22. Measure the throttle position sensor output voltage when the engine speed is at idle. Adjust the throttle position sensor position if out of specification.



Throttle position sensor output voltage:
Pink (P) – Black (B)
700 ± 5 mV at idle speed
(700 r/min)

23. Install the port link rod ② and starboard link rod ③.

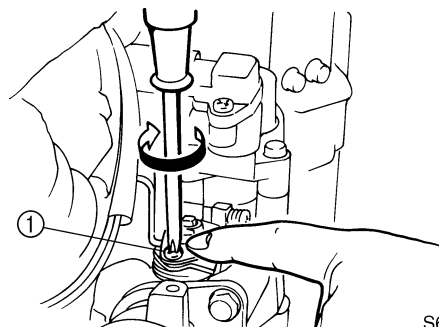


S69J4330



Link rod nut:
4 N·m (0.4 kgf·m, 2.9 ft·lb)

24. Tighten the bank synchronizing screw ①.



S69J4340

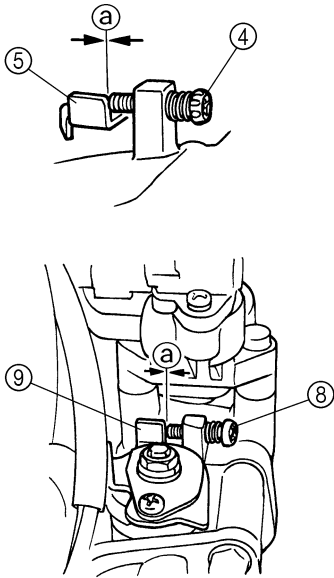
NOTE:

Tighten the screw without tilting the plate.



Bank synchronizing screw:
4 N·m (0.4 kgf·m, 2.9 ft·lb)

25. Check that there is no clearance (a) between the port and starboard throttle stop screws (4) and (8), and the throttle body levers (5) and (9). If there is any clearance, repeat step 24.



S69J4350

26. Start the engine, and when the engine speed is at idle, check the average vacuum difference between the port and starboard banks. Adjust if out of specification.



Average vacuum difference between port and starboard banks:
40 mmHg (53 mbar, 1.57 inHg)



Power unit

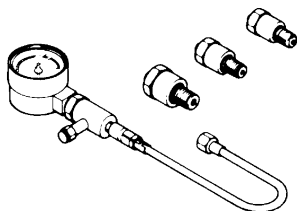
Special service tools	5-1
Power unit.....	5-3
Checking the compression pressure	5-14
Checking the oil pressure	5-14
Checking the oil pressure sensor	5-15
Checking the valve clearance.....	5-15
Replacing the timing belt	5-21
Removing the power unit.....	5-23
Removing the oil filter	5-25
Removing the timing belt and sprockets.....	5-25
Checking the timing belt and sprockets.....	5-26
Installing the sprockets and timing belt.....	5-27
Cylinder head	5-29
Removing the cylinder head	5-33
Checking the valve springs.....	5-34
Checking the valves	5-34
Checking the valve guides.....	5-35
Replacing the valve guides.....	5-35
Checking the valve seat	5-36
Refacing the valve seat	5-36
Checking the camshaft	5-38
Checking the timing chain tensioner.....	5-39
Checking the timing chain	5-40
Checking the cylinder head	5-40
Installing the valves	5-40
Installing the cylinder head	5-41

Cylinder block	5-43
Disassembling the cylinder block	5-47
Checking the piston diameter	5-47
Checking the cylinder bore	5-48
Checking the piston clearance	5-48
Checking the piston rings	5-48
Checking the piston ring grooves	5-49
Checking the piston ring side clearance	5-49
Checking the piston pin boss bore	5-49
Checking the piston pin	5-50
Checking the connecting rod small end inside diameter	5-50
Checking the connecting rod big end side clearance	5-50
Checking the crankshaft	5-50
Checking the crankpin oil clearance	5-51
Selecting the connecting rod bearing	5-52
Checking the crankshaft main journal oil clearance	5-53
Selecting the crankshaft main bearing	5-54
Disassembling the oil pump	5-55
Checking the oil pump	5-55
Assembling the oil pump	5-55
Assembling the piston and cylinder block	5-56
Checking the thermostat	5-60
Installing the power unit	5-60

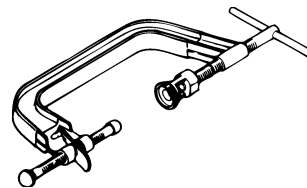


Power unit

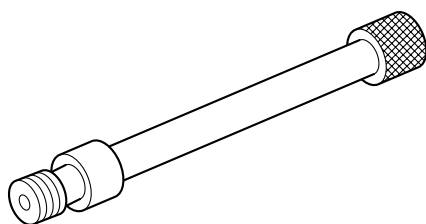
Special service tools



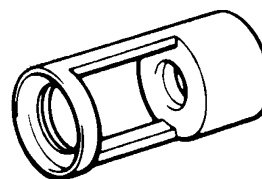
Compression gauge
90890-03160



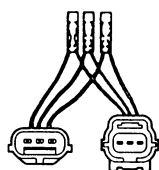
Valve spring compressor
90890-04019



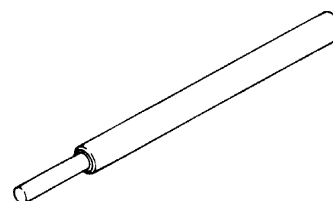
Compression gauge adaptor
90890-06563



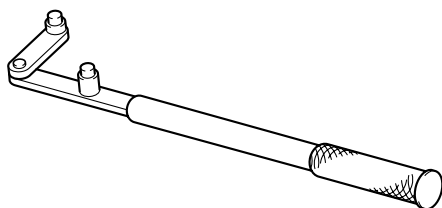
Valve spring compressor attachment
90890-06320



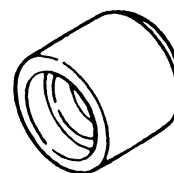
Test harness (3 pins)
90890-06769



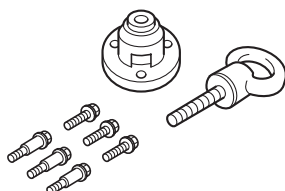
Valve guide remover/installer
90890-06801



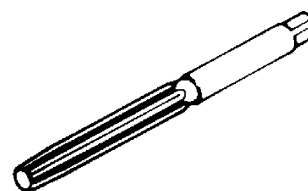
Flywheel holder
90890-06522



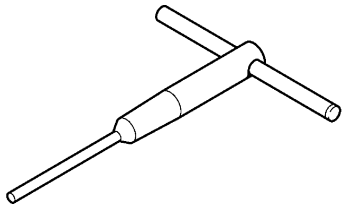
Valve guide installer
90890-06810



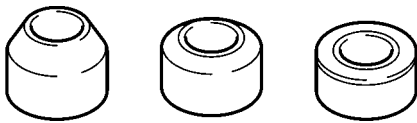
Flywheel puller
90890-06521



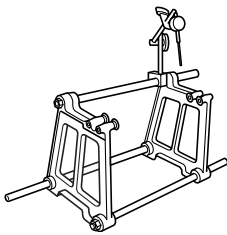
Valve guide reamer
90890-06804



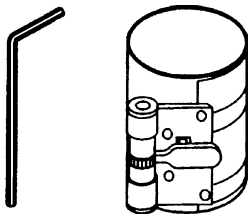
Valve seat cutter holder
90890-06316



Valve seat cutter
90890-06324, 90890-06325, 90890-06327



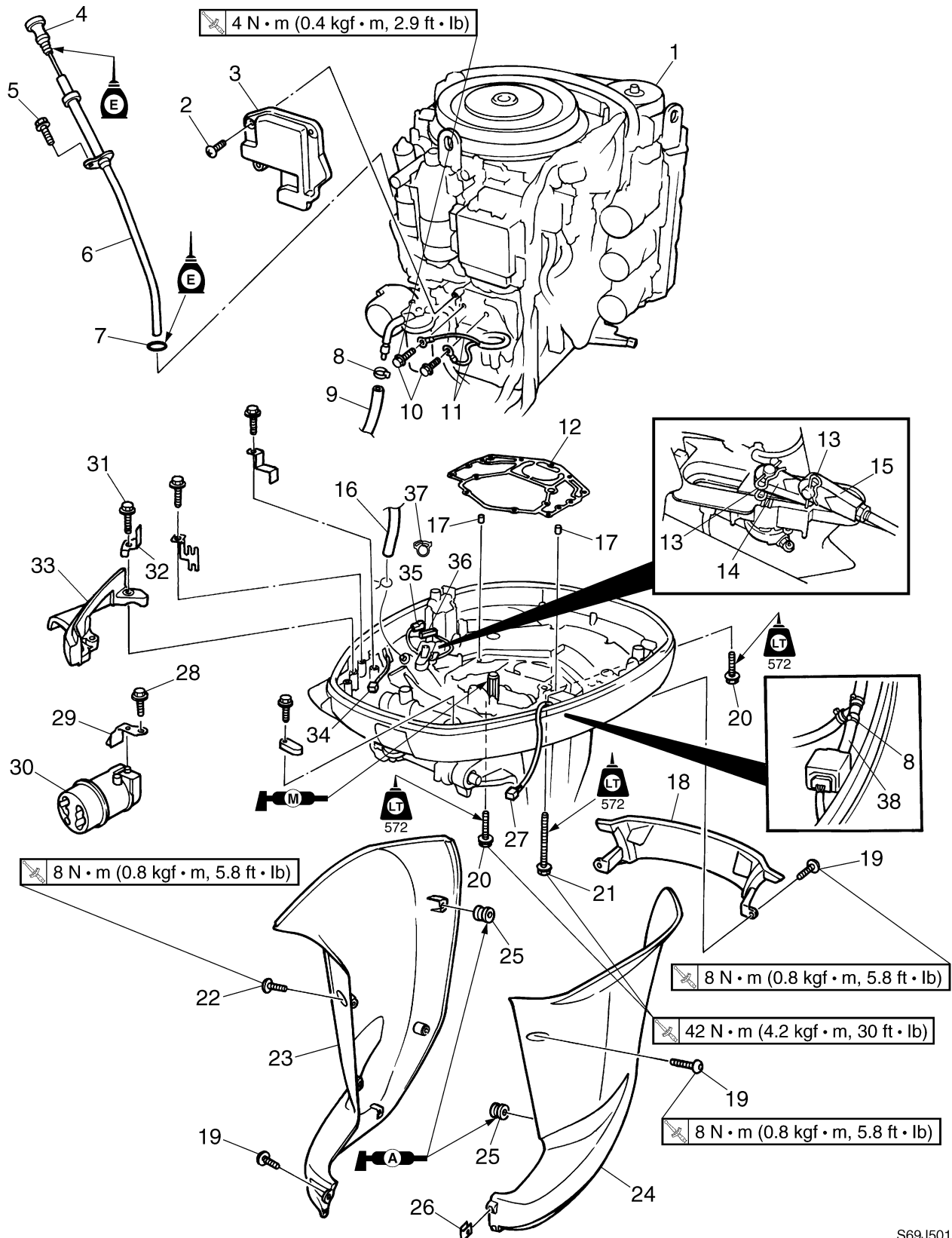
Crank stand alignment
90890-03107



Piston ring compressor
90890-05158



Power unit



S69J5010

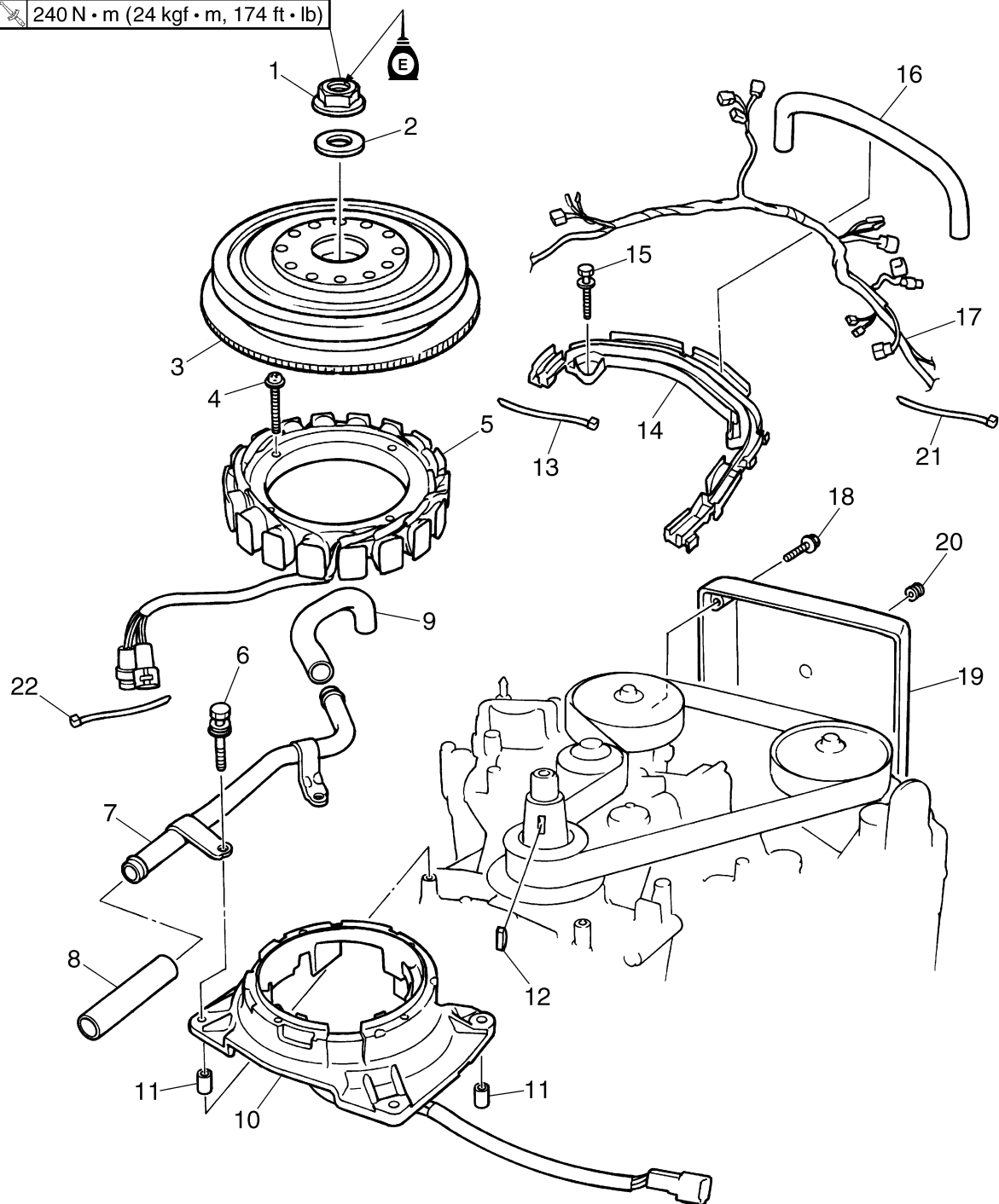
Power unit

No.	Part name	Q'ty	Remarks
1	Power unit	1	
2	Screw	4	
3	Cover	1	
4	Dipstick	1	
5	Bolt	1	M6 × 20 mm
6	Dipstick guide	1	
7	O-ring	1	Not reusable
8	Plastic tie	2	Not reusable
9	Fuel hose	1	
10	Bolt	2	M6 × 10 mm
11	PTT motor lead	2	Sky blue, light green
12	Gasket	1	Not reusable
13	Clip	2	
14	Shift cable	1	
15	Throttle cable	1	
16	Cooling water pilot hose	1	
17	Dowel pin	2	
18	Upper case cover	1	
19	Bolt	7	M6 × 14 mm
20	Bolt	7	M9 × 35 mm
21	Bolt	6	M10 × 140 mm
22	Bolt	1	M6 × 30 mm
23	Starboard apron	1	
24	Port apron	1	
25	Grommet	6	
26	Nut	2	
27	Low-pressure fuel pump driver coupler	1	
28	Bolt	1	M6 × 20 mm
29	Holder	1	
30	Grommet	1	
31	Bolt	1	M6 × 30 mm
32	Holder	1	
33	Retaining plate	1	
34	PTT switch coupler	1	
35	Shift cut switch coupler	1	
36	Neutral switch coupler	1	
37	Clamp	1	
38	Flushing device hose	1	Flushing device model

5



240 N · m (24 kgf · m, 174 ft · lb)

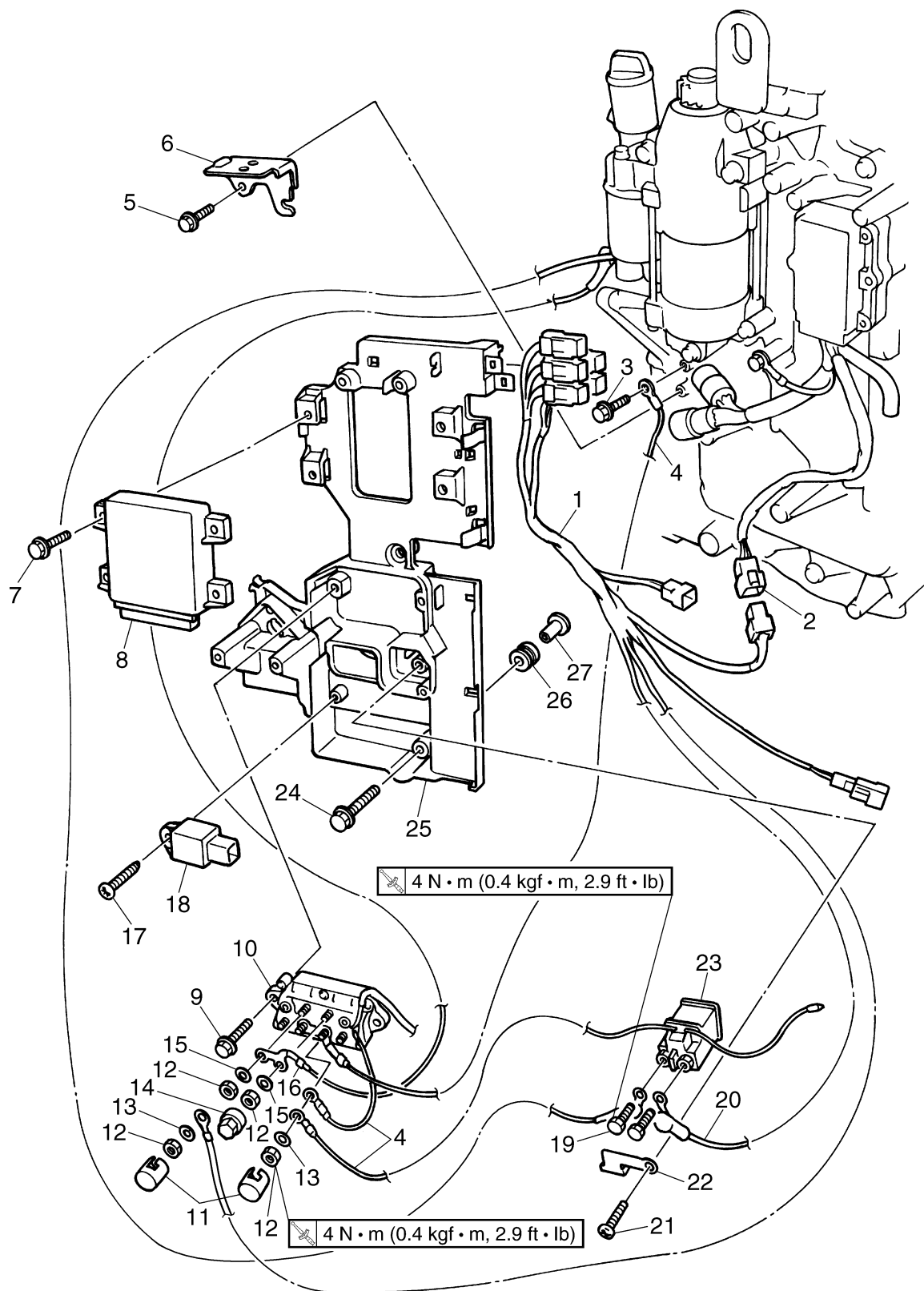


S69J5020

Power unit

No.	Part name	Q'ty	Remarks
1	Nut	1	
2	Washer	1	
3	Flywheel magnet	1	
4	Screw	4	M6 × 30 mm
5	Stator coil	1	
6	Bolt	4	M6 × 35 mm
7	Blowby hose guide	1	
8	Blowby hose	1	
9	Blowby hose	1	
10	Stator coil bracket	1	
11	Collar	2	
12	Woodruff key	1	
13	Plastic tie	5	Not reusable
14	Wiring harness guide	1	
15	Bolt	3	M6 × 35 mm
16	Idle speed control hose	1	
17	Wiring harness	1	
18	Bolt	4	
19	Ignition coil cover	1	
20	Grommet	2	
21	Plastic tie	5	Not reusable
22	Plastic tie	2	Not reusable

5

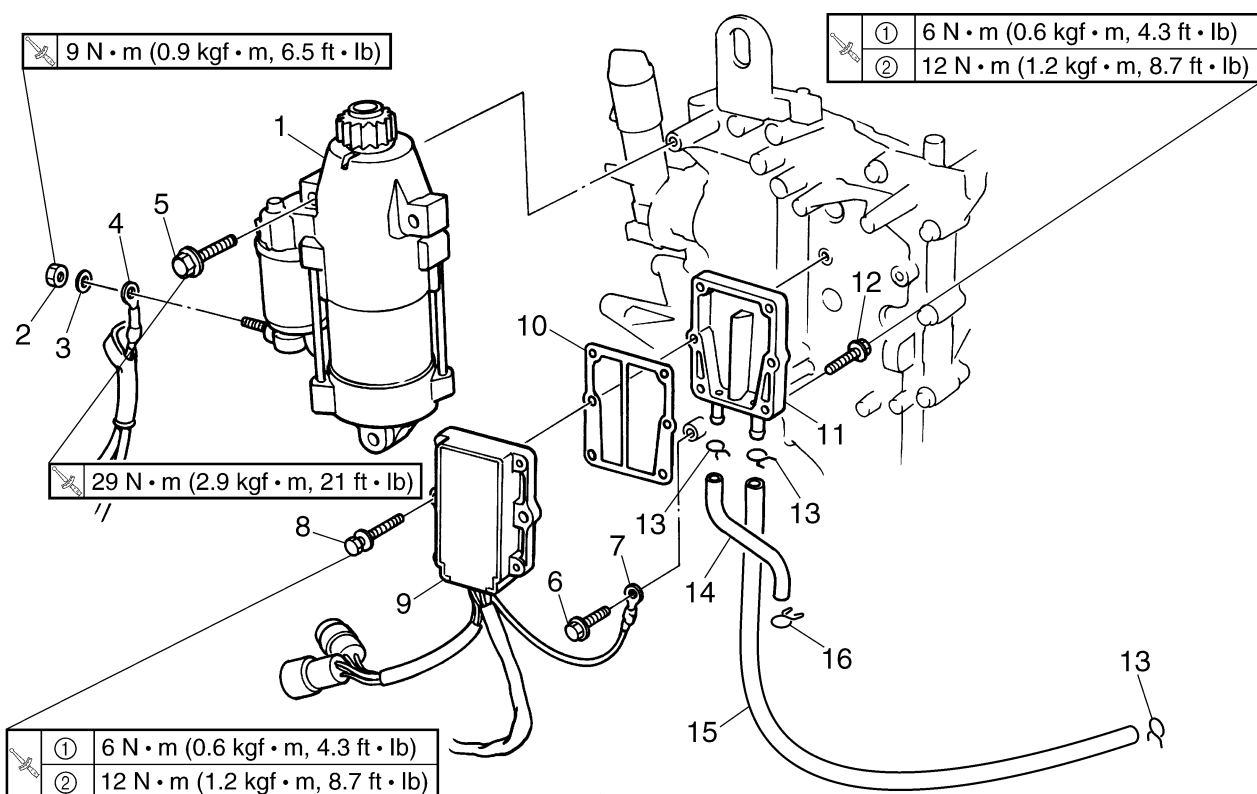


S69J5030

Power unit

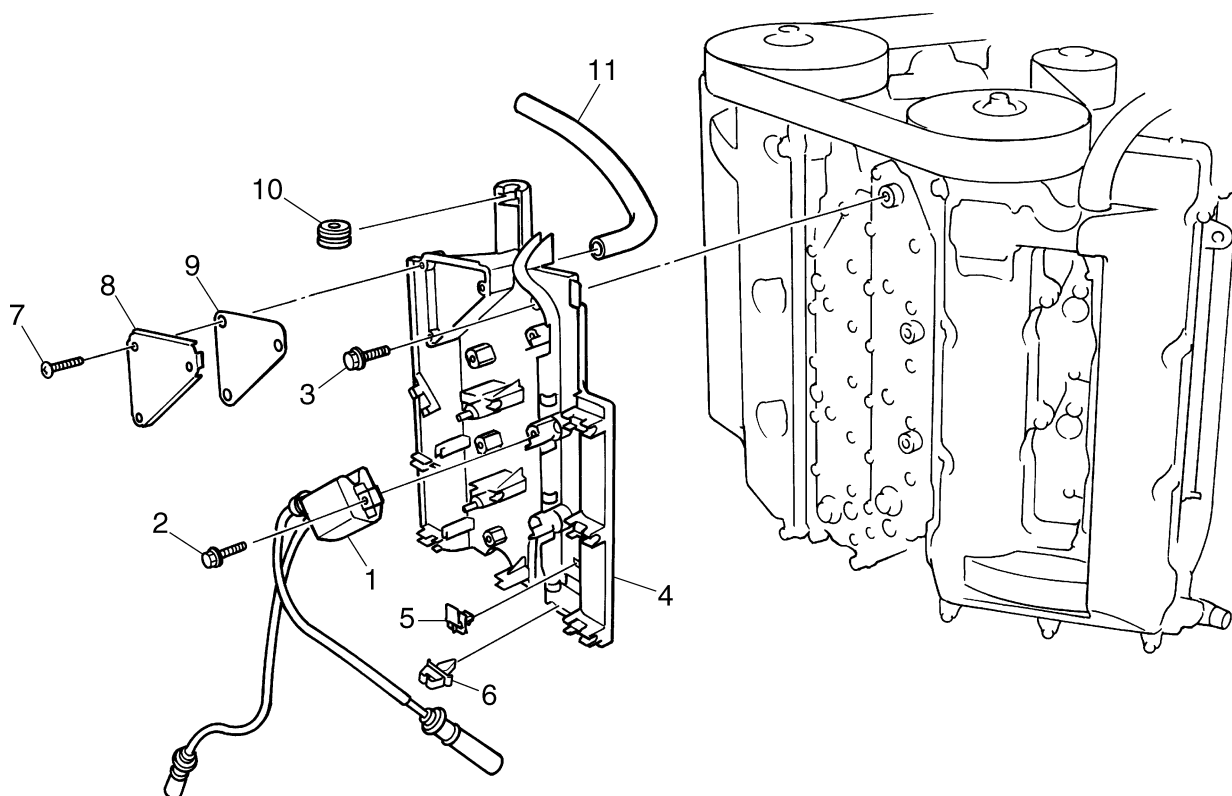
No.	Part name	Q'ty	Remarks
1	Wiring harness	1	
2	Rectifier Regulator coupler	1	
3	Bolt	1	M6 × 20 mm
4	Ground lead	3	
5	Bolt	1	M6 × 16 mm
6	Bracket	1	
7	Bolt	4	M6 × 16 mm
8	ECM	1	
9	Bolt	2	M6 × 25 mm
10	Power trim and tilt relay	1	
11	Cap	2	
12	Nut	4	
13	Washer	2	
14	Cap	1	
15	Spring washer	2	
16	Battery lead	1	Red
17	Screw	1	
18	Main relay	1	
19	Bolt	2	M6 × 10 mm
20	Starter motor lead	1	Brown/white
21	Screw	1	
22	Holder	1	
23	Starter relay	1	
24	Bolt	6	M6 × 28 mm
25	Bracket	1	
26	Grommet	6	
27	Collar	6	

5



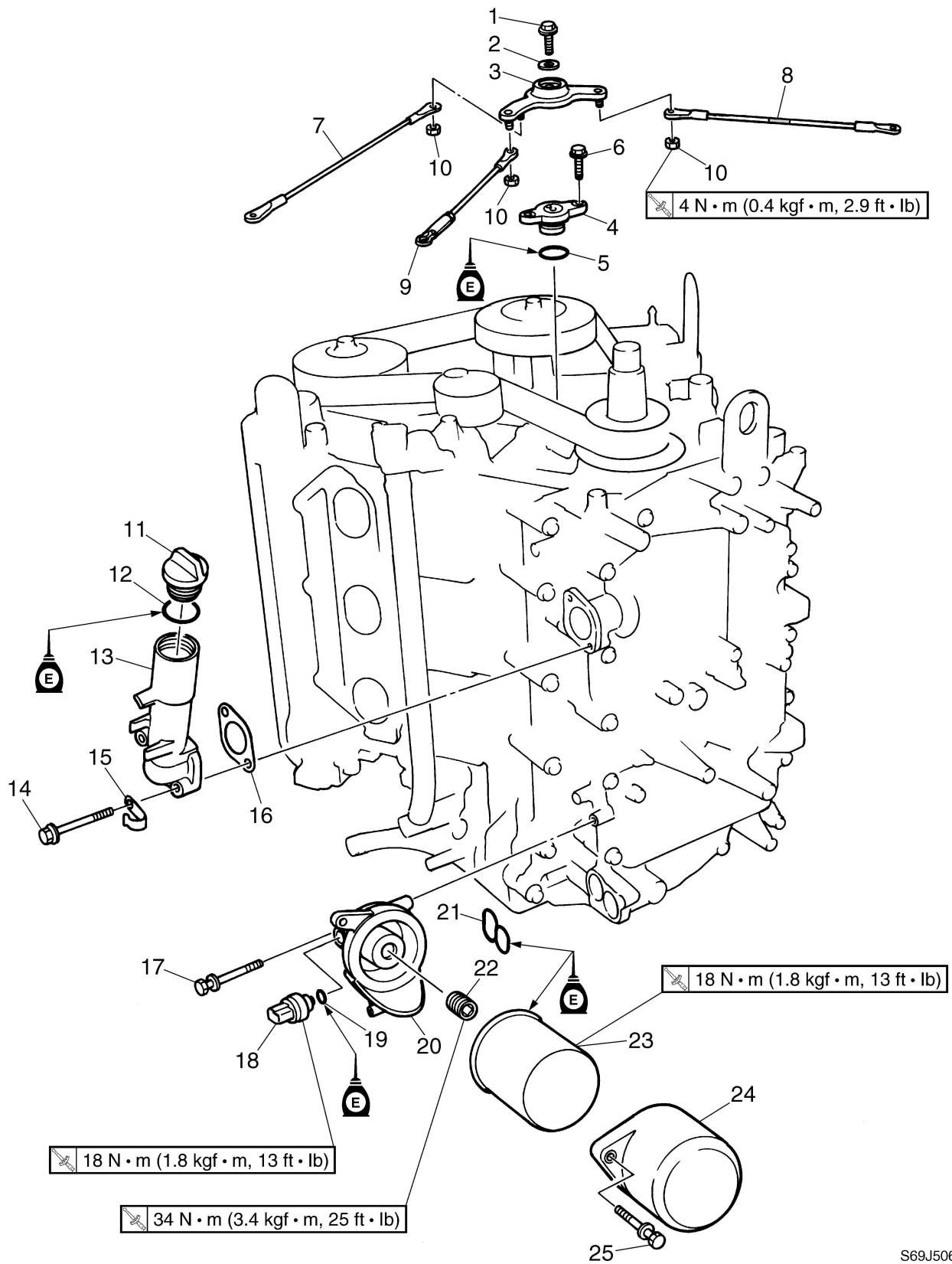
S69J5040

No.	Part name	Q'ty	Remarks
1	Starter motor	1	
2	Nut	1	
3	Spring washer	1	
4	Battery cable	1	From terminal and power trim and tilt relay
5	Bolt	3	M8 × 45 mm
6	Bolt	1	M6 × 20 mm
7	Ground lead	1	
8	Bolt	2	M6 × 35 mm
9	Rectifier Regulator	1	
10	Gasket	1	Not reusable
11	Cover	1	
12	Bolt	4	M6 × 25 mm
13	Clip	3	
14	Cooling water hose	1	Out
15	Cooling water hose	1	In
16	Clip	1	



S69J5050

No.	Part name	Q'ty	Remarks
1	Ignition coil	3	
2	Bolt	6	M6 × 20 mm
3	Bolt	6	M6 × 20 mm
4	Bracket	1	
5	Clamp	3	
6	Clamp	3	
7	Screw	3	M6 × 20 mm
8	Plate	1	
9	Gasket	1	
10	Grommet	1	
11	Idle speed control hose	1	

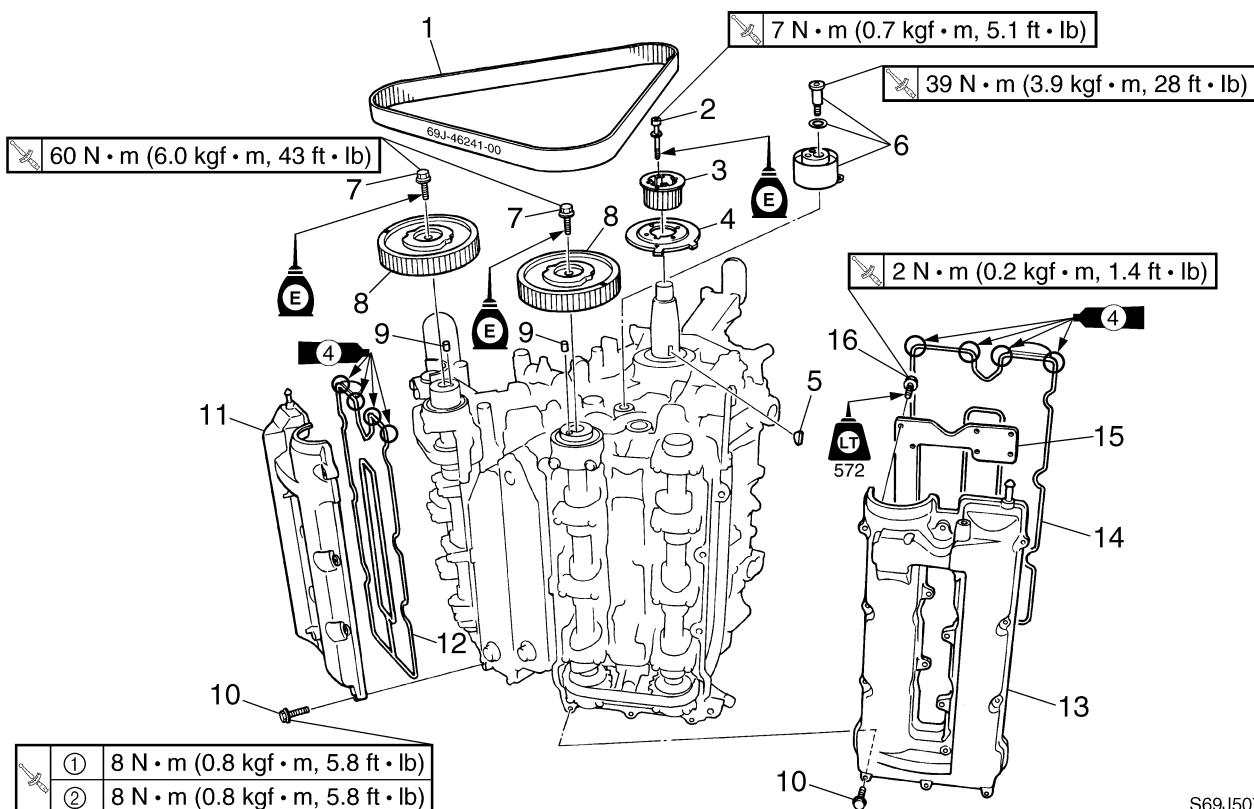


S69J5060

Power unit

No.	Part name	Q'ty	Remarks
1	Bolt	1	M6 × 30 mm
2	Washer	1	
3	Link rod arm	1	
4	Plug	1	
5	O-ring	1	Not reusable
6	Bolt	2	M6 × 20 mm
7	Link rod	1	Long
8	Link rod	1	Short
9	Link rod	1	
10	Nut	3	
11	Oil filler cap	1	
12	O-ring	1	Not reusable
13	Oil filler neck	1	
14	Bolt	2	M6 × 45 mm
15	Clamp	1	
16	Gasket	1	Not reusable
17	Bolt	3	M6 × 45 mm
18	Oil pressure sensor	1	
19	O-ring	1	Not reusable
20	Oil filter bracket	1	
21	Gasket	1	Not reusable
22	Bolt	1	
23	Oil filter	1	
24	Oil filter cover	1	
25	Bolt	1	M6 × 40 mm

5

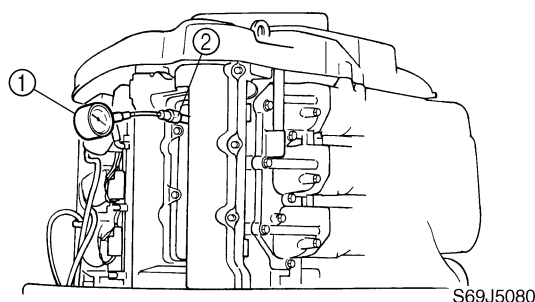


S69J5070

No.	Part name	Q'ty	Remarks
1	Timing belt	1	
2	Bolt	4	M5 × 45 mm
3	Drive sprocket	1	
4	Plate	1	
5	Woodruff key	1	
6	Timing belt tensioner	1	
7	Bolt	2	M10 × 35 mm
8	Driven sprocket	2	
9	Dowel pin	2	
10	Bolt	28	M6 × 30 mm
11	Port cylinder head cover	1	
12	Gasket	1	Not reusable
13	Starboard cylinder head cover	1	
14	Gasket	1	Not reusable
15	Plate	1	
16	Screw	8	M4 × 8 mm

Checking the compression pressure

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



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 ①:
90890-03160

Compression gauge adapter ②:
90890-06563

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



Minimum compression pressure
(reference data):
880 kPa (8.8 kgf/cm², 125 psi)

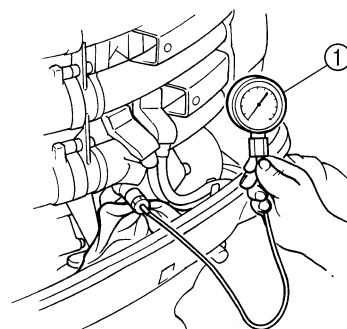
5. If the compression pressure is below specification and the compression pressure for each cylinder is unbalanced, add a small amount of engine oil to the cylinder, and then check the pressure again.

NOTE:

- If the compression pressure increases, check the piston and piston rings for wear. Replace if necessary.
- If the compression pressure does not increase, check the valve clearance, valve, valve seat, cylinder sleeve, cylinder head gasket, and cylinder head. Adjust or replace if necessary.

Checking the oil pressure

1. Place a rag under the oil pressure sensor.
2. Remove the intake silencer and oil pressure sensor, and then install an oil pressure gauge ① to the oil pressure sensor installation hole.



NOTE:

Use a pressure gauge with an adapter that has a 1/8 pitch thread.

3. Install the intake silencer.

CAUTION:

Do not start the engine when the intake silencer is not installed.

4. Start the engine, warm it up for 5 minutes, and then turn it off.



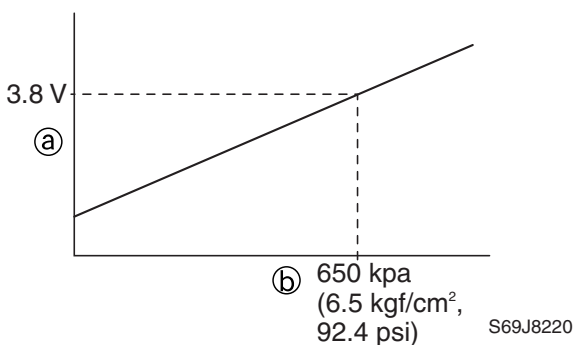
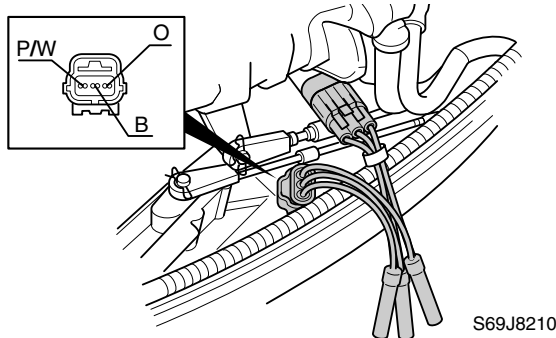
5. Check the oil pressure. Check the oil pump, oil leakage, and oil strainer if out of specification.



Oil pressure (reference data):
650 kPa (6.5 kgf/cm², 92.4 psi) at
idle speed (700 r/min)

Checking the oil pressure sensor

1. Connect the test harness (3 pins) to the oil pressure sensor.
2. Start the engine and warm it up for 5 minutes.
3. Measure the oil pressure sensor input voltage. Check the wiring harness connection or replace the ECM if out of specification.
4. Measure the oil pressure sensor output voltage. Replace if out of specification.



- Ⓐ: Output voltage
Ⓑ: Oil pressure



Test harness (3 pins): 90890-06769



Oil pressure sensor input voltage:
Pink/white (P/W) – Black (B)

5 V

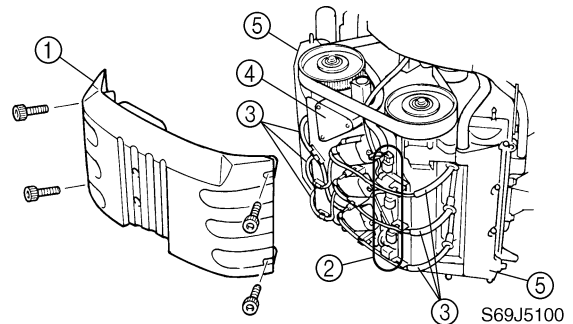
Oil pressure sensor output voltage
(reference data):

Orange (O) – Black (B)

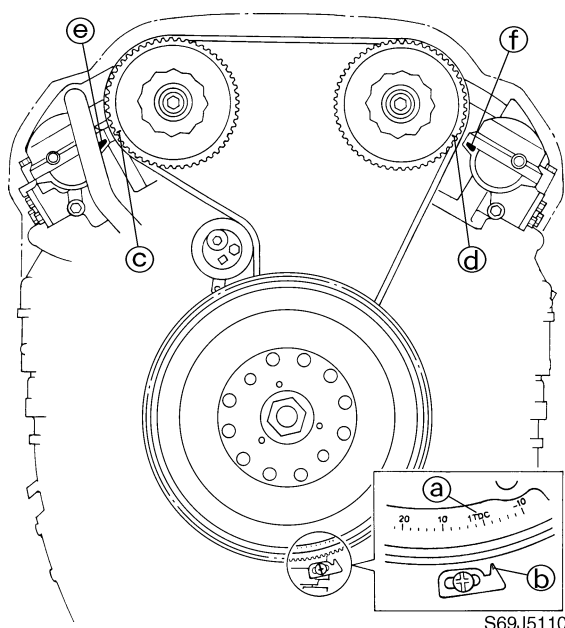
3.8 V at idle speed (700 r/min)

Checking the valve clearance

1. Remove the flywheel magnet cover and ignition coil cover ①.
2. Disconnect the ignition coil couplers ② and spark plug caps ③, and remove the ignition coil bracket ④, spark plugs, and cylinder head covers ⑤.



3. Turn the flywheel magnet clockwise and align the "1TDC" mark Ⓐ on the flywheel magnet with the pointer Ⓑ, and check that "I" marks Ⓒ and Ⓓ on the driven sprockets are aligned with marks Ⓔ and Ⓕ.

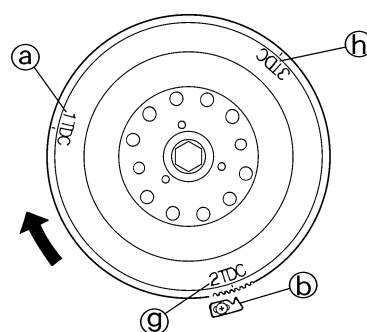


S69J5110

NOTE:

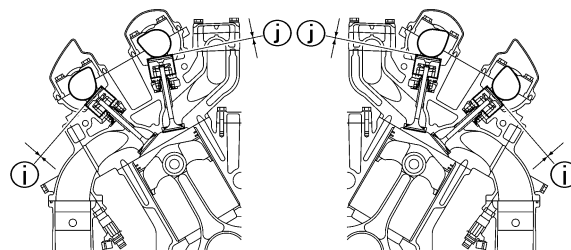
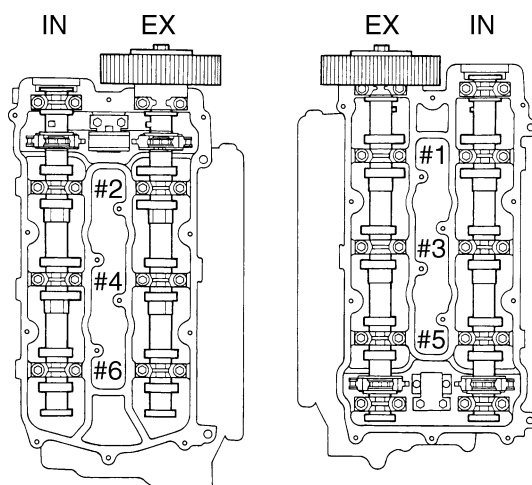
Do not turn the flywheel magnet counter-clockwise.

4. Check the intake and exhaust valve clearance for cylinder #4.
5. Turn the flywheel magnet an additional 120° clockwise and align the “2TDC” mark ⑨ on the flywheel magnet with the pointer ⑥.
6. Check the intake and exhaust valve clearance for cylinder #5.
7. Turn the flywheel magnet an additional 120° clockwise and align the “3TDC” mark ① on the flywheel magnet with the pointer ⑥.
8. Check the intake and exhaust valve clearance for cylinder #6.



S69J5120

9. Similarly, check the valve clearance of cylinders #1, #2, and #3 in order, and be sure to turn the flywheel magnet 120° clockwise each time. Adjust if out of specification.



S69J5130

NOTE:

- Check the valve clearance when the engine is cold.
- Note the measurement.



Valve clearance:

Intake ①:

0.20 ± 0.03 mm (0.008 ± 0.001 in)

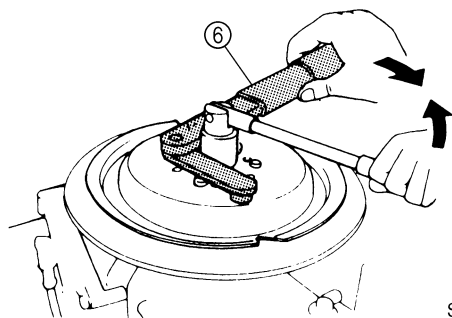
Exhaust ②:

0.34 ± 0.03 mm (0.013 ± 0.001 in)

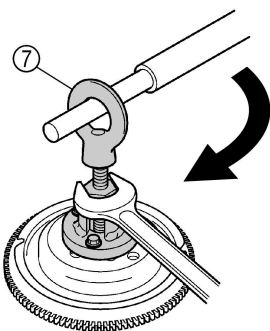


10. Turn the flywheel magnet an additional 120° clockwise and align the "1TDC" mark on the flywheel magnet with the pointer, and check that the "I" marks on the driven sprockets are aligned with the alignment marks on the cylinder head.

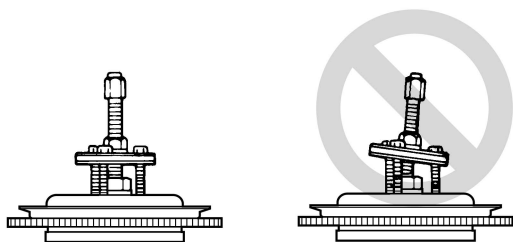
11. Remove the flywheel magnet.



S69J5160



S69J5170



S69J5180

CAUTION:

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

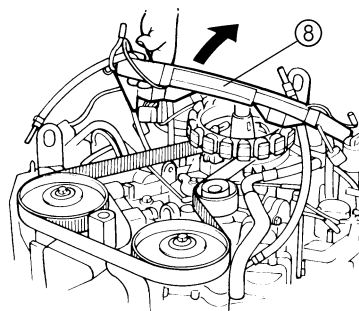
Apply force to the crankshaft end until the flywheel magnet comes off the tapered portion of the crankshaft.



Flywheel holder ⑥: 90890-06522

Flywheel puller ⑦: 90890-06521

12. Remove the wiring harness guide bolts.



S69J5190

NOTE:

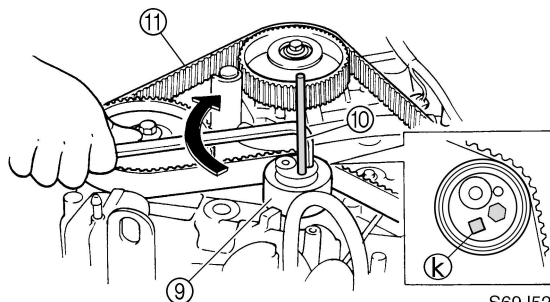
Move the wiring harness guide ⑧ to a position that will make servicing easy.

13. Using a hexagon wrench, turn the timing belt tensioner ⑨ clockwise to push the timing belt, increase strength gradually, and then insert a $\varnothing 5.0$ mm (0.2 in) pin ⑩ into the hole (K).

NOTE:

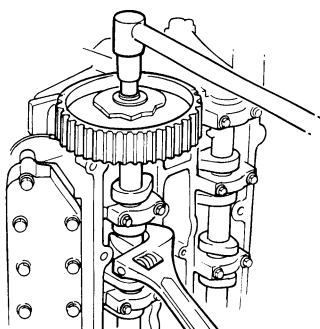
Leave the pin inserted into the timing belt tensioner until the timing belt has been installed.

14. Remove the timing belt ⑪ from the driven sprockets.



S69J5200

15. Remove the driven sprockets.

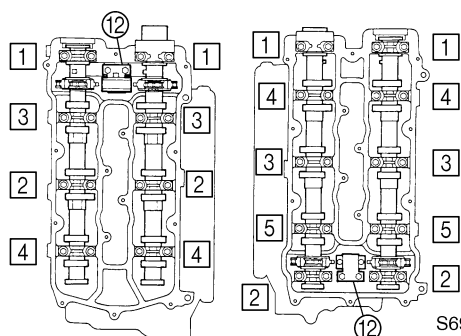


S69J5210

NOTE:

Hold the camshaft with a wrench, and be careful not to damage the driven sprocket.

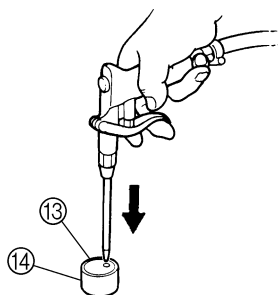
16. Remove the timing chain tensioners ⑫, then the camshaft caps in the order shown in the illustration.



S69J5220

17. Remove the camshafts and timing chains.

18. Remove the valve shim ⑬ from the valve lifter ⑭ using compressed air.



S69J5230

NOTE:

Do not mix the valve train parts. Keep them organized in their proper groups.

19. Measure the valve shim thickness with a micrometer, and then note the measurement.

20. Select the necessary valve shim by calculating its thickness with the following formula.

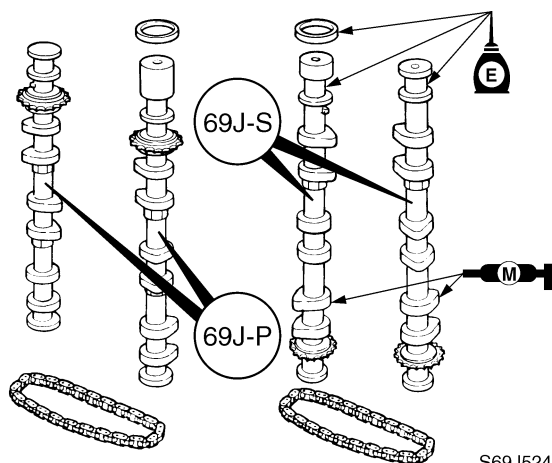
$$\text{Necessary valve shim thickness} = \text{Removed valve shim thickness} + \text{Measured valve clearance} - \text{Specified valve clearance}$$

Example:

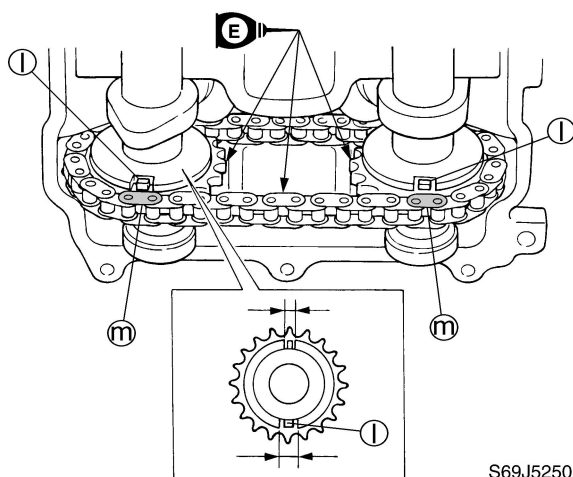
If the "Removed valve shim thickness" is 2.10 mm, the "Checked valve clearance" is 0.30 mm and the "Specified valve clearance" is 0.20 mm, then the "Necessary valve shim thickness" = $2.10 + 0.30 - 0.20 = 2.20$ mm

21. Install the necessary valve shim into the valve lifter.

22. Align the projection (wide one) ① on the camshaft sprockets to the alignment plate (gold) ⑪ on the timing chain, and then install the camshafts to the cylinder head with new oil seals.



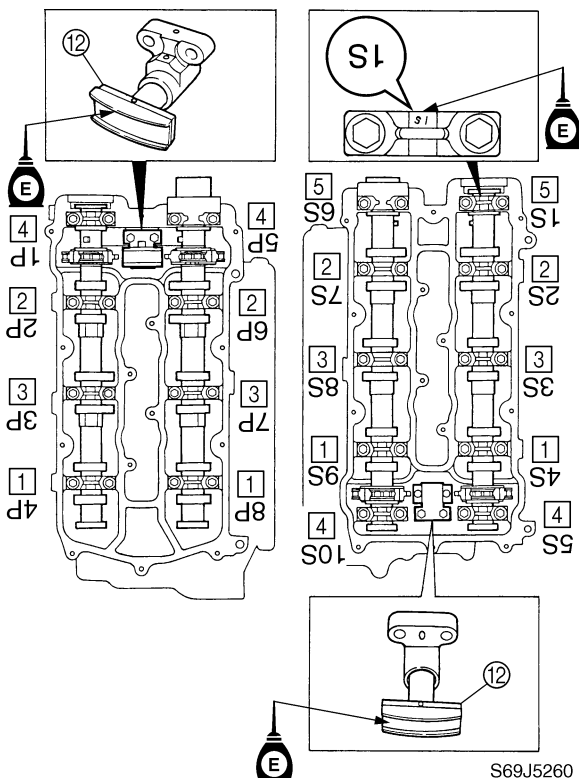
S69J5240



S69J5250

23. Install the camshaft caps, and then tighten them to the specified torque in the order shown in the illustration.

24. Install the timing chain tensioners (12), and then tighten the bolts to the specified torque in the sequence shown.



S69J5260

NOTE:

- Install the camshaft caps in the proper position as shown and with the stamped numbers facing upside down.
- Apply engine oil to the camshaft cap bolts before installation.



Camshaft cap bolt:

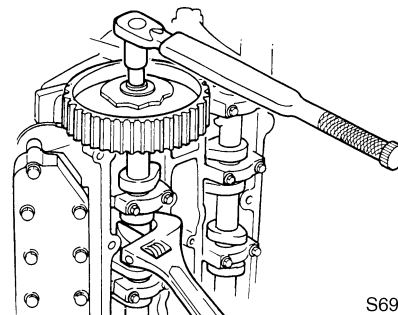
1st: 8 N·m (0.8 kgf·m, 5.8 ft·lb)

2nd: 17 N·m (1.7 kgf·m, 12 ft·lb)

Timing chain tensioner bolt:

12 N·m (1.2 kgf·m, 8.7 ft·lb)

25. Install the driven sprockets, and then tighten the bolts to the specified torque.



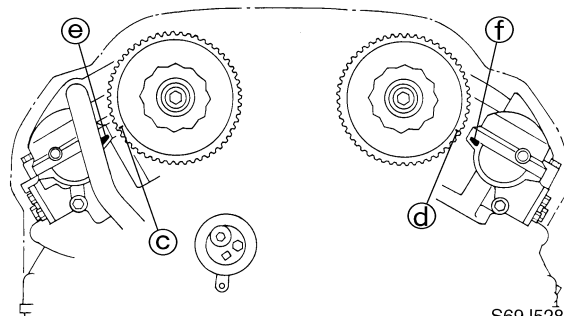
S69J5270



Driven sprocket bolt:

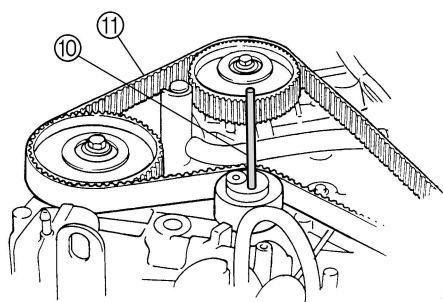
60 N·m (6.0 kgf·m, 43 ft·lb)

26. Turn the driven sprockets clockwise and align "I" marks (c) and (d) on the driven sprockets with marks (e) and (f).



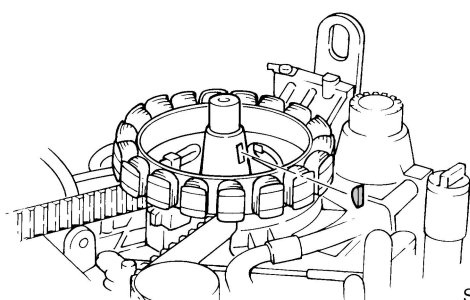
S69J5280

27. Install the timing belt (11), turn the belt from the drive sprocket side a half turn counterclockwise to align it, and then remove the pin (10).



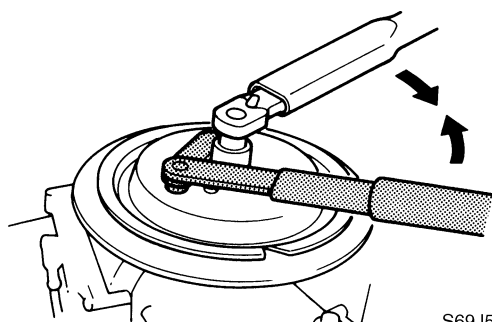
S69J5290

28. Install the Woodruff key.



S69J5300

29. Install the flywheel magnet.



S69J5320

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.

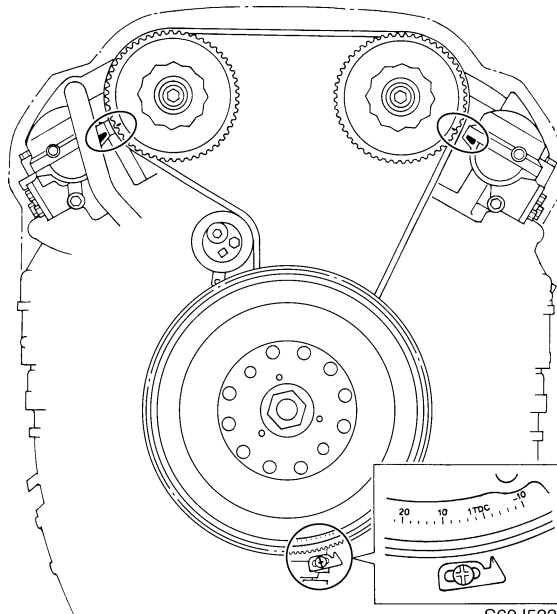


Flywheel holder: 90890-06522



Flywheel magnet nut:
240 N·m (24 kgf·m, 174 ft·lb)

30. Turn the flywheel magnet clockwise two turns, and then check that all alignment marks are aligned.



S69J5330

NOTE:

Do not turn the flywheel magnet counter-clockwise.

31. Check each valve clearance and adjust if necessary.

32. Install the spark plugs, and then tighten them to the specified torque.

33. Install the cylinder head cover bolts, and then tighten them to the specified torques in two stages.



Spark plug:
25 N·m (2.5 kgf·m, 18 ft·lb)
Cylinder head cover bolt:
1st: 8 N·m (0.8 kgf·m, 5.8 ft·lb)
2nd: 8 N·m (0.8 kgf·m, 5.8 ft·lb)

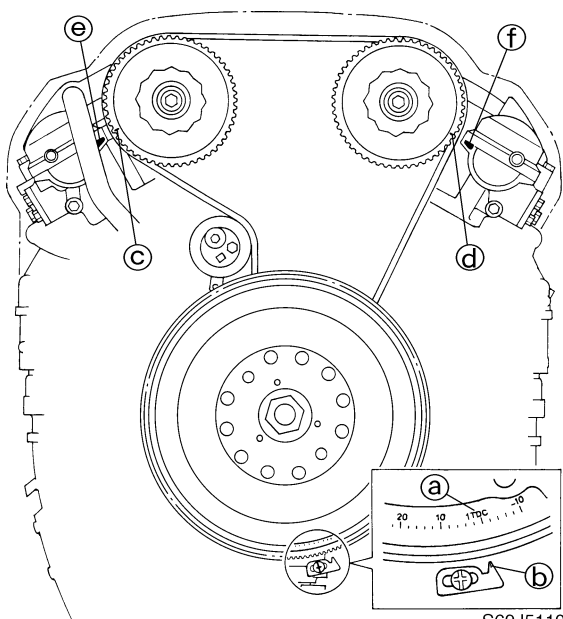
34. Install the ignition coil bracket, and connect the ignition coil couplers and spark plug caps.



35. Install the ignition coil cover, wiring harness guide, and flywheel magnet cover.

Replacing the timing belt

1. Remove the flywheel magnet cover, ignition coil cover, and intake silencer.
2. Turn the flywheel magnet clockwise and align the "1TDC" mark (a) on the flywheel magnet with the pointer (b), and check that "I" marks (c) and (d) on the driven sprockets are aligned with marks (e) and (f).

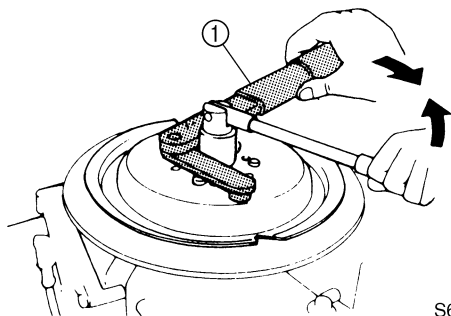


S69J5110

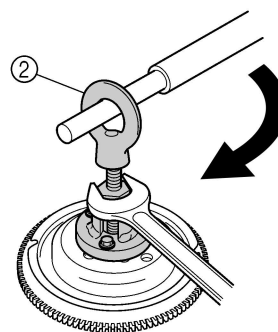
NOTE:

Do not turn the flywheel magnet counter-clockwise.

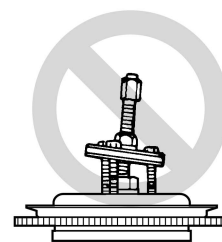
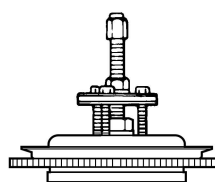
3. Remove the flywheel magnet.



S69J5360



S69J5370



S69J5180

CAUTION:

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

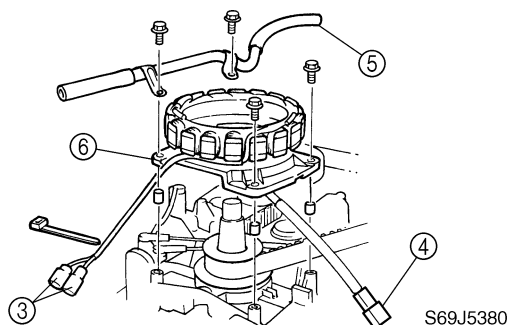
Apply force to the crankshaft end until the flywheel magnet comes off the tapered portion of the crankshaft.



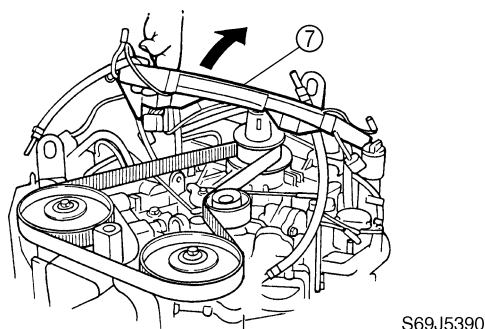
Flywheel holder (1): 90890-06522
Flywheel puller (2): 90890-06521

4. Disconnect the ignition coil couplers, idle speed control coupler, intake air pressure sensor coupler, throttle position sensor coupler, thermostats leads, idle speed control hose, high-pressure fuel hoses, neutral switch coupler, shift cut switch coupler, and starboard fuel injector couplers.

5. Disconnect the stator coil couplers ③ and pulser coil coupler ④, and remove the blowby hose ⑤ and stator coil bracket ⑥.



6. Remove the wiring harness guide bolts.



NOTE:

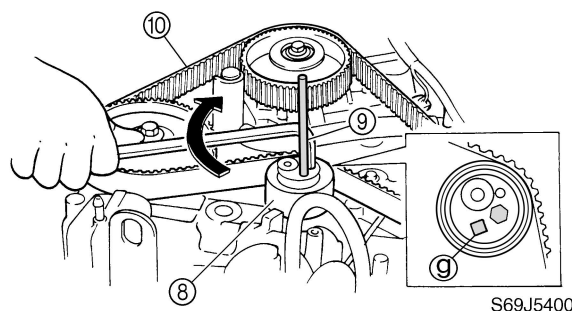
Move the wiring harness guide ⑦ to a position that will make servicing easy.

7. Using a hexagon wrench, turn the timing belt tensioner ⑧ clockwise to push the timing belt, increase strength gradually, and then insert a $\varnothing 5.0$ mm (0.2 in) pin ⑨ into the hole ⑨.

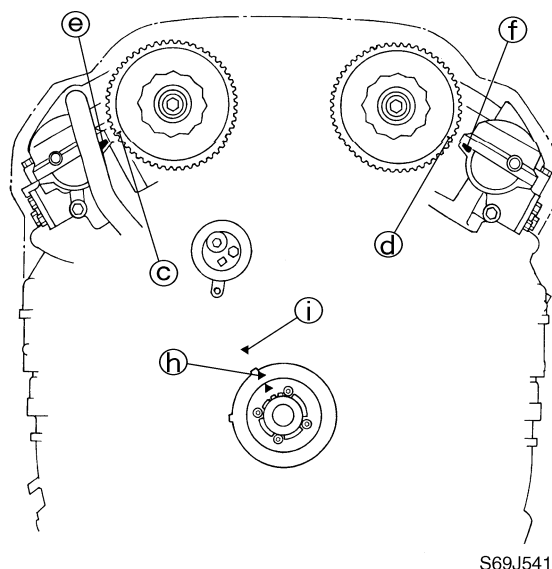
NOTE:

Leave the pin inserted into the timing belt tensioner until the timing belt has been installed.

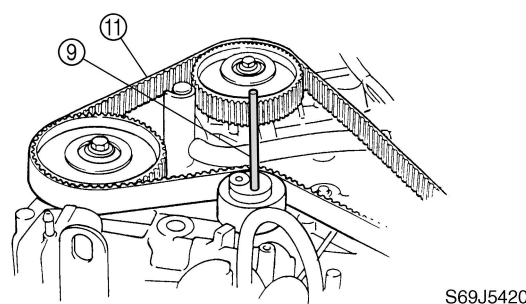
8. Remove the timing belt ⑩ from the driven sprocket side.

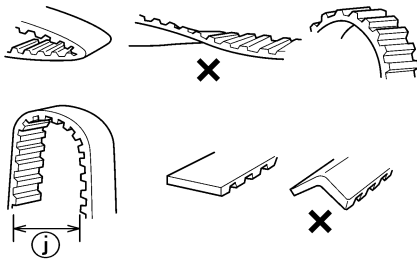


9. Check that "I" marks ③ and ④ on the driven sprockets are aligned with marks ⑤ and ⑥, and that the "▲" mark ⑦ on the plate is aligned with the "▲" mark ⑧ on the cylinder block. Align if necessary.



10. Install the timing belt ⑪ from the drive sprocket side with its part number in the upright position, turn the belt a half turn counterclockwise to align it, and then remove the pin ⑨.





S69J5430

CAUTION:

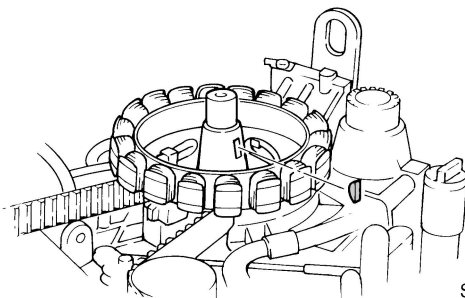
- Do not twist, turn inside out, or bend the timing belt beyond the maximum limit of 25 mm (1.0 in) ①, otherwise it may be damaged.
- Do not get oil or grease on the timing belt.

11. Turn the drive sprocket clockwise two turns, and then check that all alignment marks are aligned.

NOTE:

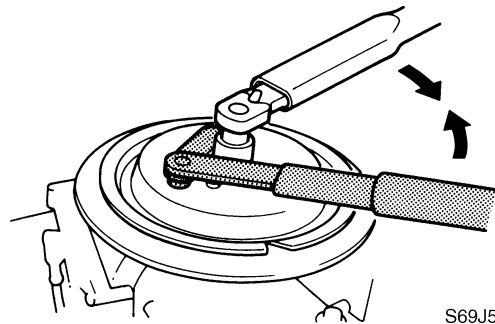
Do not turn the drive sprocket counterclockwise.

12. Install the wiring harness guide, stator coil bracket, and blowby hose, and connect the pulser coil coupler and stator coil couplers.
13. Connect all couplers, leads, and hoses.
14. Install the Woodruff key.



S69J5300

15. Install the flywheel magnet.



S69J5320

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

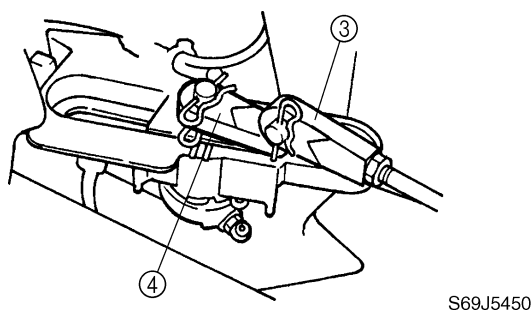
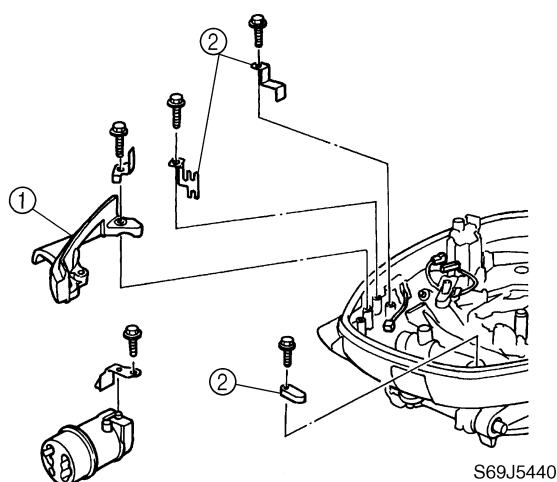


Flywheel magnet nut:
240 N·m (24 kgf·m, 174 ft·lb)

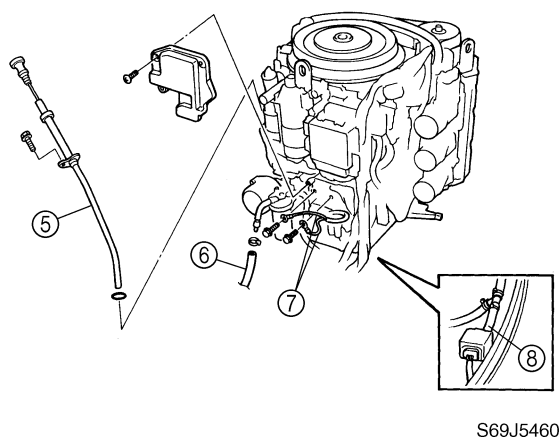
16. Install the intake silencer, ignition coil cover, and flywheel magnet cover.

Removing the power unit

1. Remove the flywheel magnet cover and intake silencer.
2. Remove the retaining plate ① and holders ②, and then disconnect the throttle cable ③ and shift cable ④.

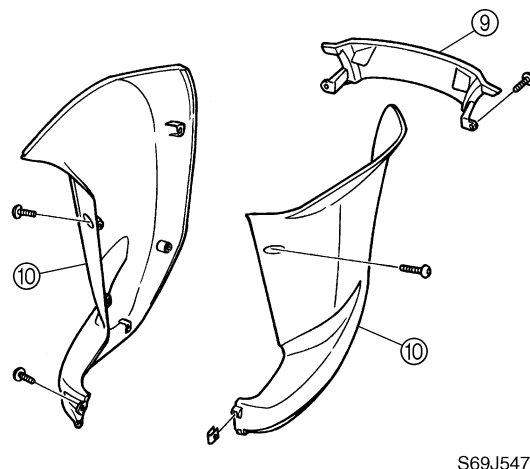


3. Remove the dipstick guide (5), and disconnect the fuel hose (6), PTT motor leads (7), and flushing device hose (flushing device model) (8).

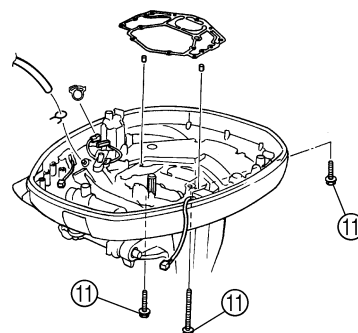
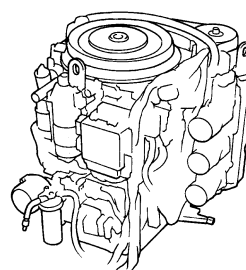


4. Disconnect the low-pressure fuel pump driver coupler, PTT switch coupler, shift cut switch coupler, neutral switch coupler, and cooling water pilot hose.

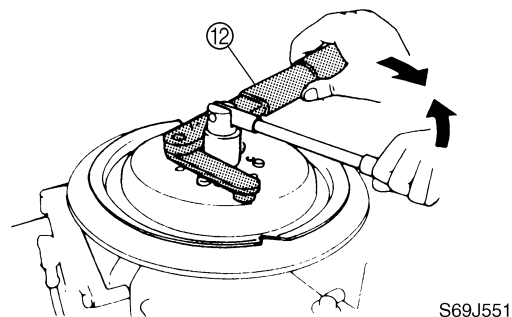
5. Remove the upper case cover (9) and aprons (10).

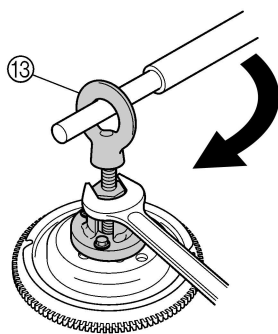


6. Remove the power unit by removing the bolts (11).

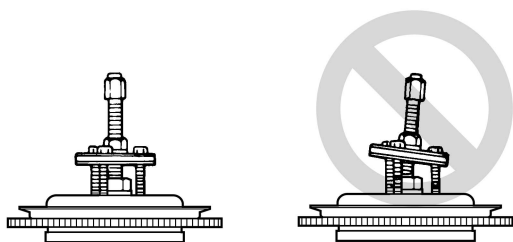


7. Remove the flywheel magnet.





S69J5520



S69J5180

CAUTION:

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

NOTE:

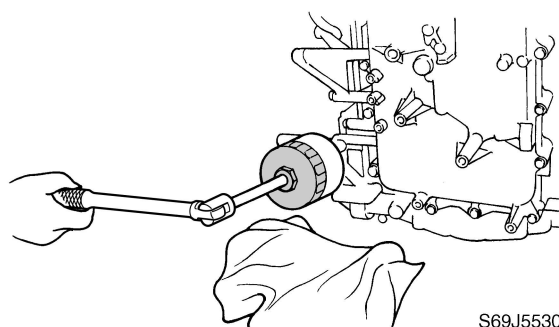
Apply force to the crankshaft end until the fly-wheel magnet comes off the tapered portion of the crankshaft.



Flywheel holder ⑫: 90890-06522
Flywheel puller ⑬: 90890-06521

Removing the oil filter

1. Place a rag under the oil filter, and then remove the filter using a 72.5 mm (2.9 in) oil filter wrench.



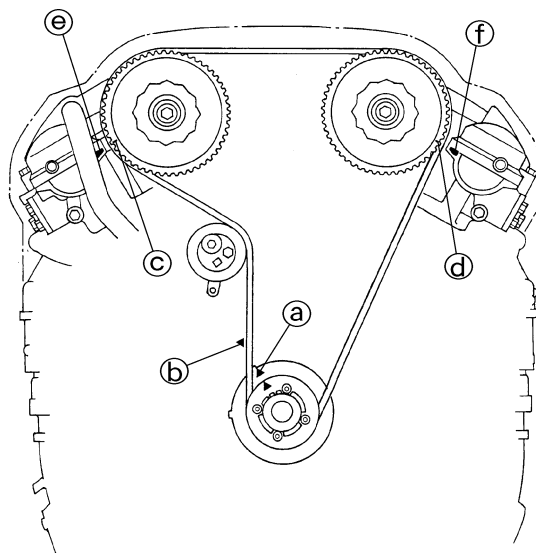
S69J5530

NOTE:

Be sure to clean up any oil spills.

Removing the timing belt and sprockets

1. Turn the drive sprocket clockwise and align the “▲” mark ① on the plate with the “▲” mark ② on the cylinder block, and check that “I” marks ③ and ④ on the driven sprockets are aligned with marks ⑤ and ⑥.

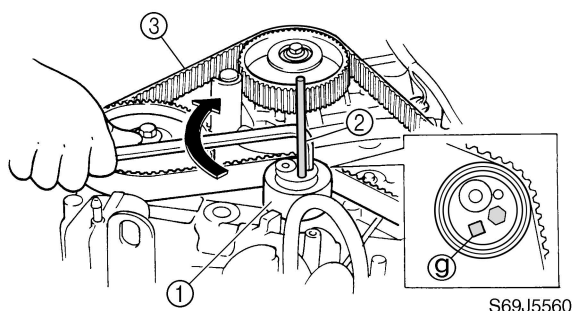


S69J5550

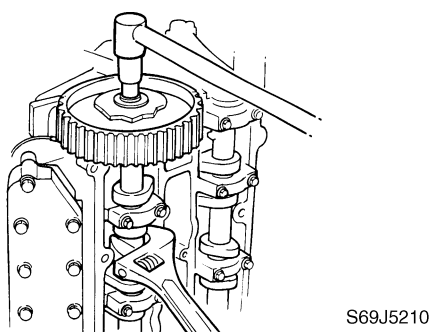
NOTE:

Do not turn the drive sprocket counterclockwise.

2. Using a hexagon wrench, turn the timing belt tensioner ① clockwise to push the timing belt, increase strength gradually, and then insert a $\varnothing 5.0$ mm (0.2 in) pin ② into the hole ③.
3. Remove the timing belt ③ from the driven sprocket side.



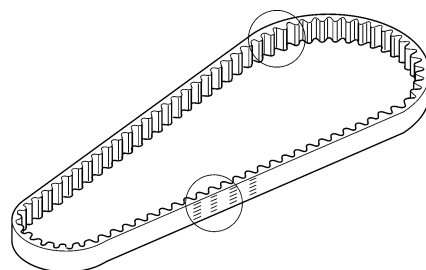
4. Remove the pin and timing belt tensioner.
5. Remove the drive sprocket and plate.
6. Remove the cylinder head covers, and then remove the driven sprockets.



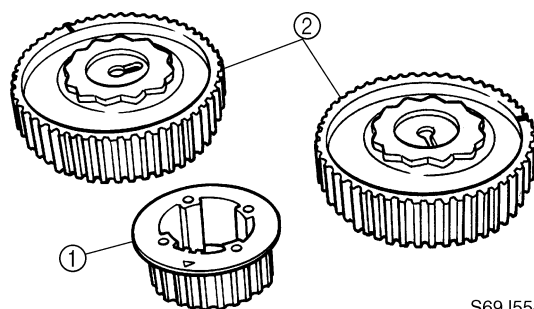
NOTE: _____
 Hold the camshaft with a wrench, and be careful not to damage the driven sprocket.

Checking the timing belt and sprockets

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



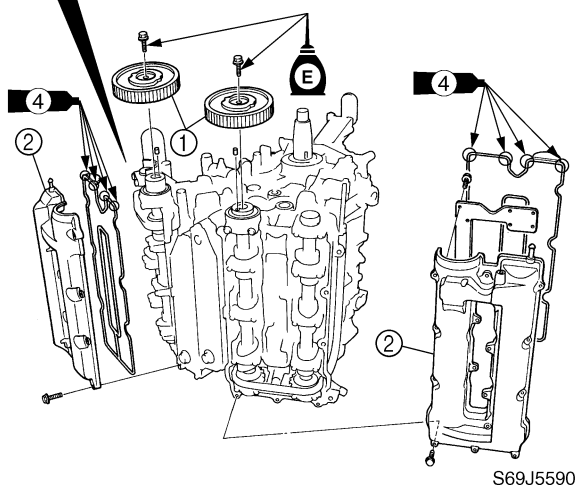
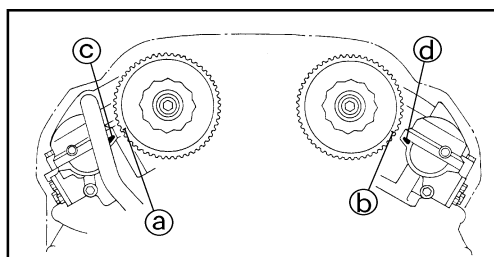
2. Check the drive sprocket ① and driven sprockets ② for cracks, damage, or wear. Replace if necessary.





Installing the sprockets and timing belt

1. Install the driven sprockets ①, and then tighten the bolts to the specified torque.
2. Check that “I” marks ③ and ④ on the driven sprockets are aligned with marks ⑤ and ⑥. Align if necessary.
3. Install the new gaskets, cylinder head cover ②, and then tighten the bolts to the specified torques in two stages.



Driven sprocket bolt:

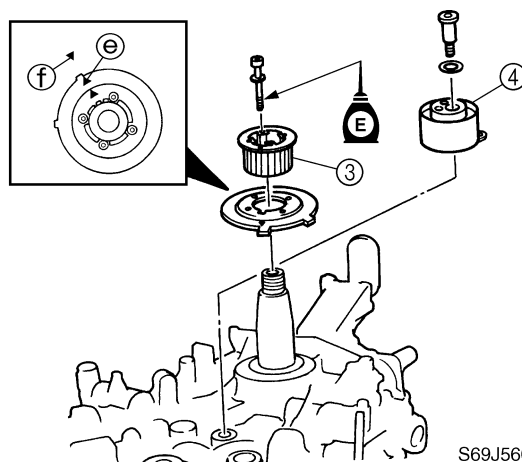
60 N·m (6.0 kgf·m, 43 ft·lb)

Cylinder head cover bolt:

1st: 8 N·m (0.8 kgf·m, 5.8 ft·lb)

2nd: 8 N·m (0.8 kgf·m, 5.8 ft·lb)

4. Install the drive sprocket ③ and timing belt tensioner ④, and then tighten the bolts to the specified torques.
5. Check that the “▲” mark ⑦ on the plate is aligned with the “▲” mark ⑧ on the cylinder block. Align if necessary.



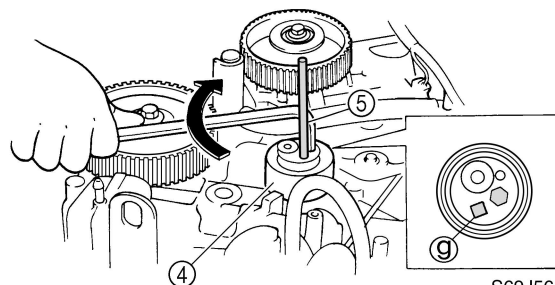
Drive sprocket bolt:

7 N·m (0.7 kgf·m, 5.1 ft·lb)

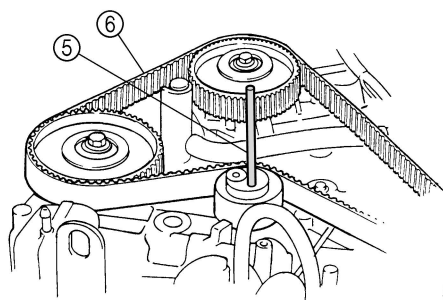
Timing belt tensioner bolt:

39 N·m (3.9 kgf·m, 28 ft·lb)

6. Using a hexagon wrench, turn the timing belt tensioner ④ clockwise to push the timing belt, increase strength gradually, and then insert a $\varnothing 5.0$ mm (0.2 in) pin ⑤ into the hole ⑥.

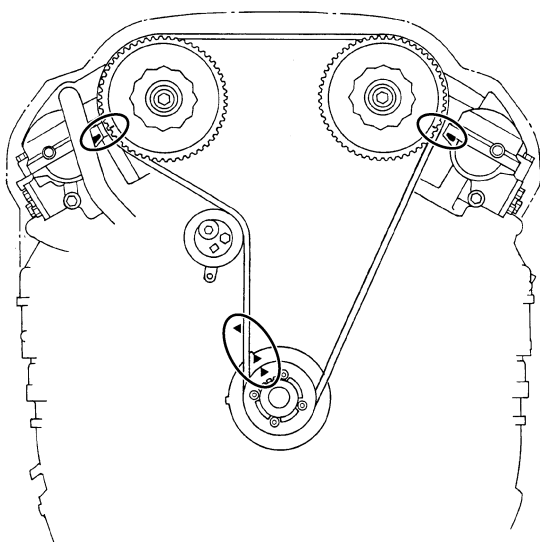


7. Install the timing belt ⑥ from the drive sprocket side with its part number in the upright position, turn the belt a half turn counterclockwise to align it, and then remove the pin ⑤.



S69J5620

8. Turn the drive sprocket clockwise two turns, and then check that the alignment marks are aligned.

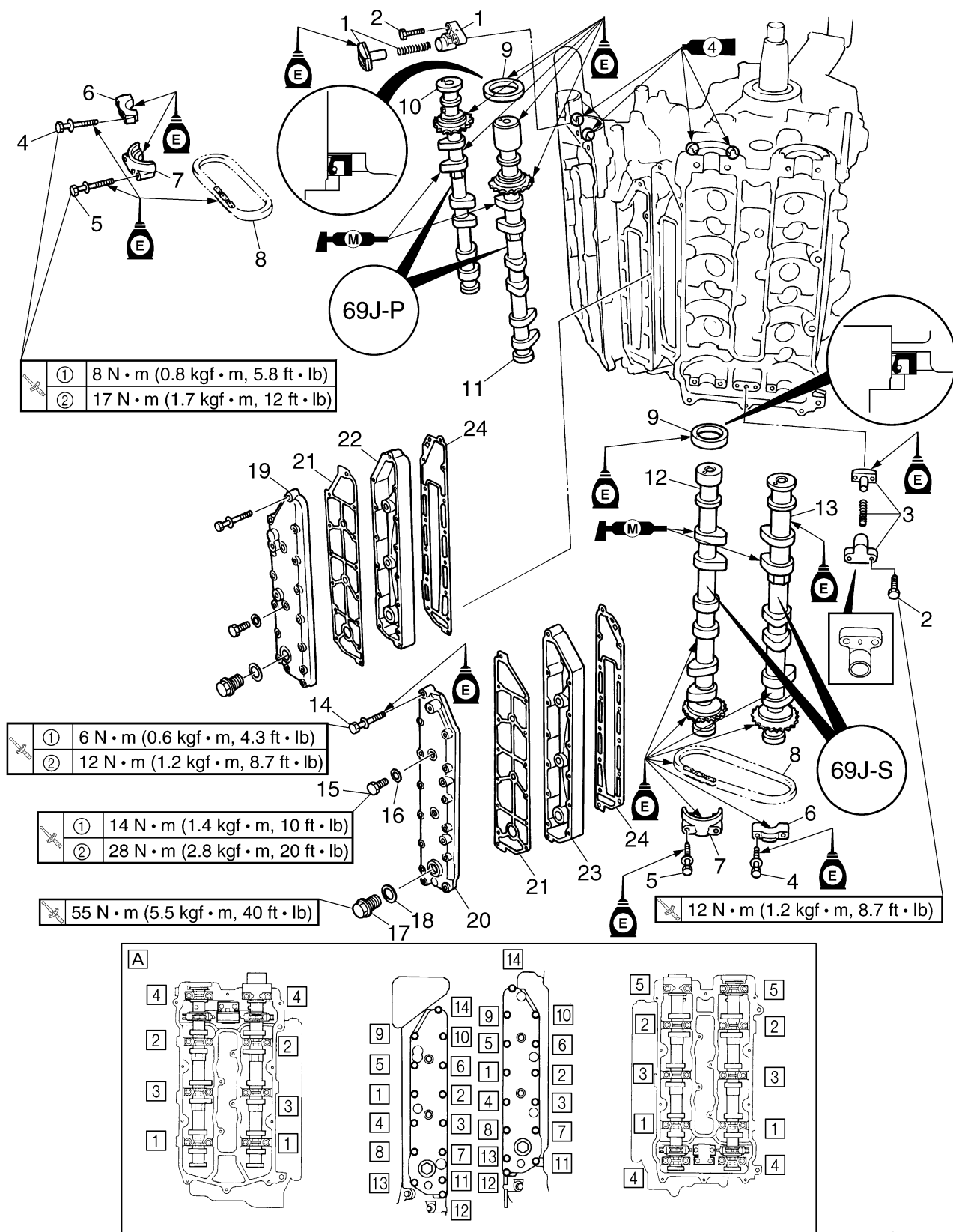


S69J5640

NOTE: _____
Do not turn the drive sprocket counterclockwise.



Cylinder head

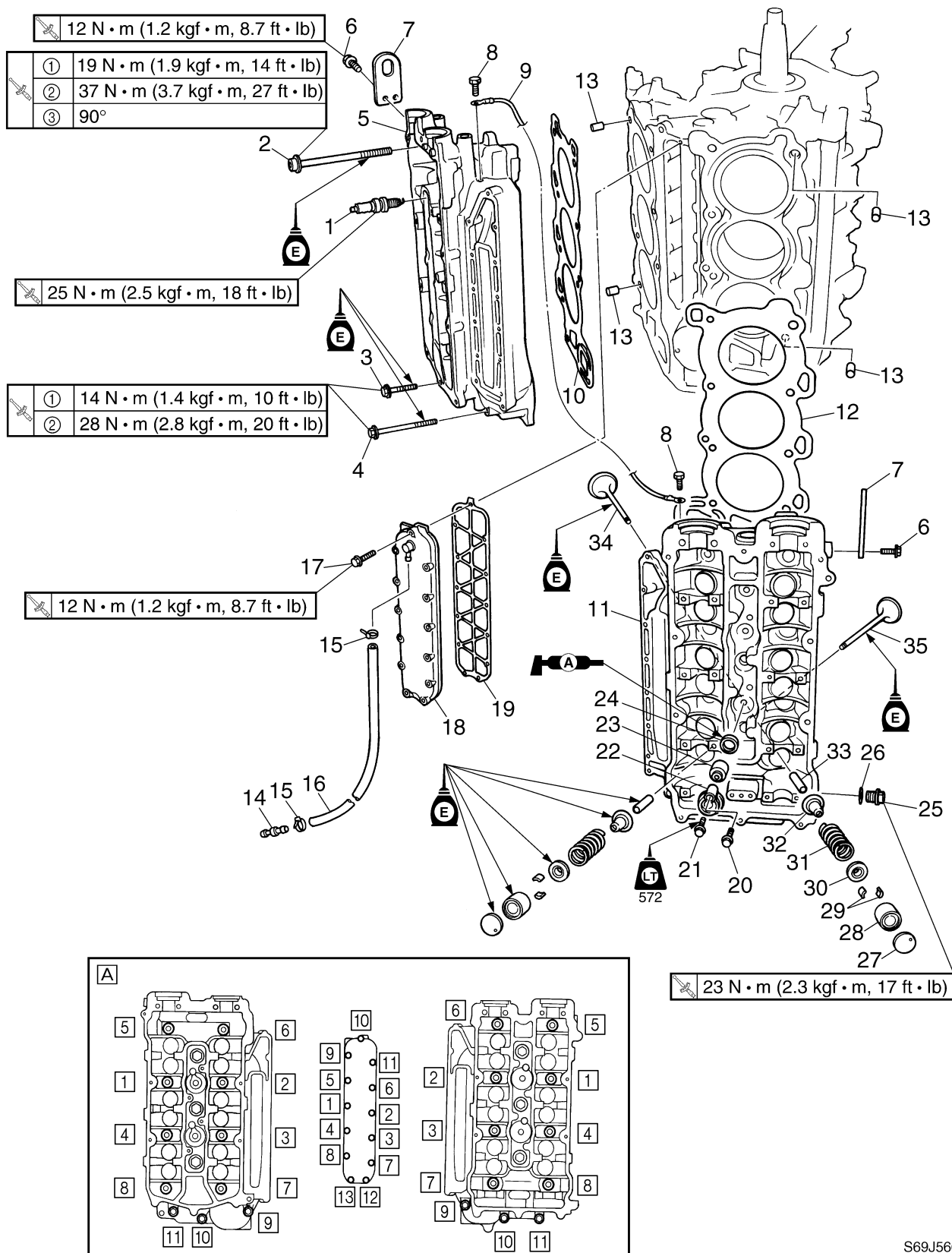


S69J5650

Cylinder head

No.	Part name	Q'ty	Remarks
1	Timing chain tensioner	1	
2	Bolt	4	M6 × 25 mm
3	Timing chain tensioner	1	
4	Bolt	32	M7 × 37 mm
5	Bolt	4	M7 × 48 mm
6	Camshaft cap	16	
7	Camshaft cap	2	
8	Timing chain	2	
9	Oil seal	2	Not reusable
10	Camshaft 3	1	
11	Camshaft 4	1	
12	Camshaft 2	1	
13	Camshaft 1	1	
14	Bolt	28	M6 × 50 mm
15	Bolt	4	M8 × 14 mm
16	Gasket	4	Not reusable
17	Plug	2	M18 × 16 mm
18	Gasket	2	Not reusable
19	Port exhaust outer cover	1	
20	Starboard exhaust outer cover	1	
21	Gasket	2	Not reusable
22	Port exhaust inner cover	1	
23	Starboard exhaust inner cover	1	
24	Gasket	2	Not reusable

A Tightening sequence



S69J5660

Cylinder head

No.	Part name	Q'ty	Remarks
1	Spark plug	6	
2	Bolt	16	M10 × 120 mm
3	Bolt	4	M8 × 55 mm
4	Bolt	2	M8 × 90 mm
5	Port cylinder head	1	
6	Bolt	4	M6 × 20 mm
7	Engine hanger	2	
8	Bolt	2	M6 × 12 mm
9	Ground lead	1	
10	Gasket	1	Not reusable
11	Starboard cylinder head	1	
12	Gasket	1	Not reusable
13	Collar	4	
14	Joint	1	
15	Plastic tie	2	Not reusable
16	Cooling water hose	1	
17	Bolt	13	M6 × 30 mm
18	Cooling water passage cover	1	
19	Gasket	1	Not reusable
20	Bolt	4	M8 × 40 mm
21	Bolt	4	
22	Cover	4	
23	Anode	4	
24	Grommet	4	
25	Plug	1	
26	Gasket	1	Not reusable
27	Valve shim	24	
28	Valve lifter	24	
29	Valve cotter	48	
30	Valve spring retainer	24	
31	Valve spring	24	
32	Valve seal	24	Not reusable
33	Valve guide	24	Not reusable
34	Exhaust valve	12	
35	Intake valve	12	

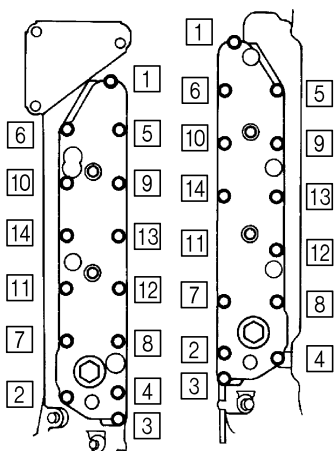
A Tightening sequence

5



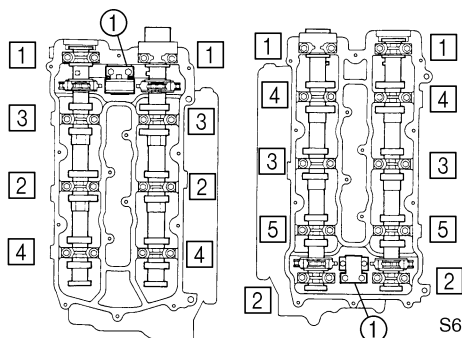
Removing the cylinder head

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



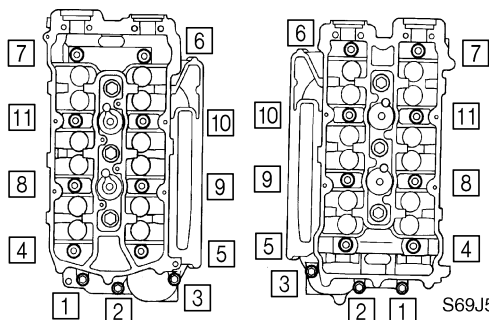
S69J5670

2. Remove the timing chain tensioner ① and camshaft caps in the sequence shown.



S69J5680

3. Remove the camshafts and timing chains, and disconnect the ground lead.
4. Remove the cylinder head bolts in the sequence shown.

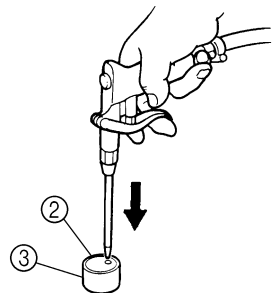


S69J5690

CAUTION:

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

5. Remove the valve shim ② from the valve lifter ③ using compressed air.

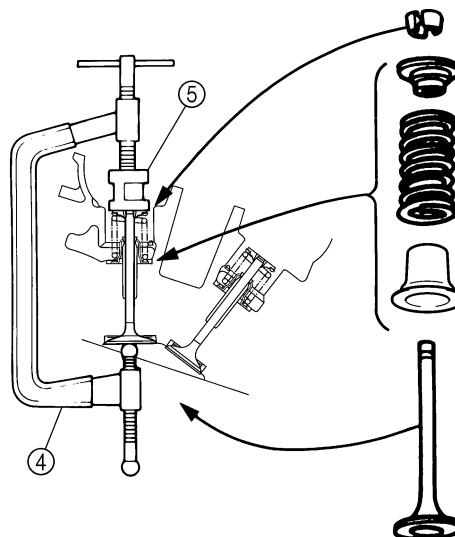


S69J5700

NOTE:

Do not mix the valve train parts. Keep them organized in their proper groups.

6. Remove the intake valve and exhaust valves.



S69J5710

NOTE:

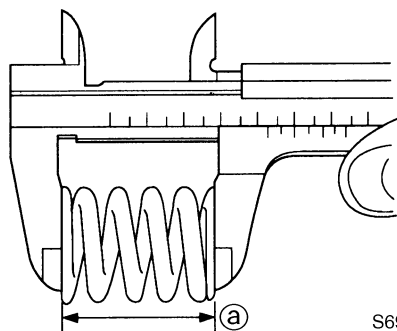
Be sure to keep the valves, springs, and other parts in the order as they were removed.



Valve spring compressor ④:
90890-04019
Valve spring compressor attachment
⑤:
90890-06320

Checking the valve springs

1. Measure the valve spring free length ①.
Replace if out of specification.

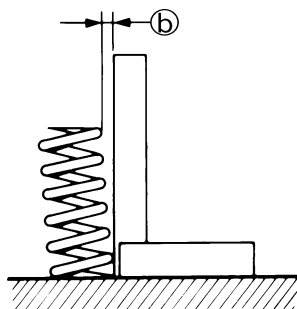


S69J5720



Valve spring free length ①:
44.20 mm (1.740 in)

2. Measure the valve spring tilt ②. Replace if out of specification.



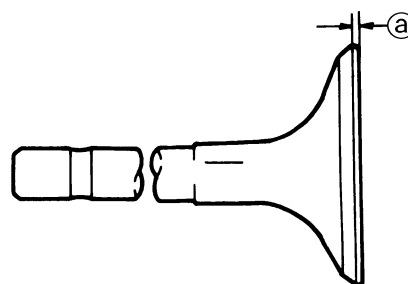
S69J5730



Valve spring tilt limit ②:
1.5 mm (0.06 in)

Checking the valves

1. Check the valve face for pitting or wear.
Replace if necessary.
2. Measure the valve margin thickness ③.
Replace if out of specification.

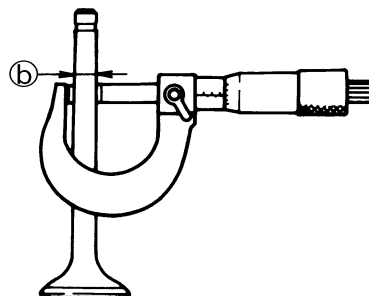


S69J5740



Valve margin thickness ③:
Intake: 0.7 mm (0.028 in)
Exhaust: 1.0 mm (0.039 in)

3. Measure the valve stem diameter ④.
Replace if out of specification.

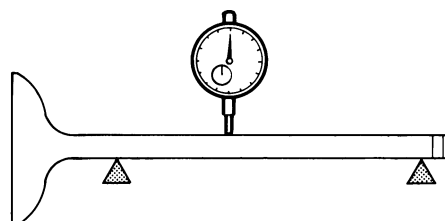


S69J5750



Valve stem diameter ④:
Intake:
5.477–5.492 mm
(0.2156–0.2162 in)
Exhaust:
5.464–5.479 mm
(0.2151–0.2157 in)

4. Measure the valve stem runout. Replace if out of specification.



S69J5760



Valve stem runout:

Intake: 0.01 mm (0.0004 in)

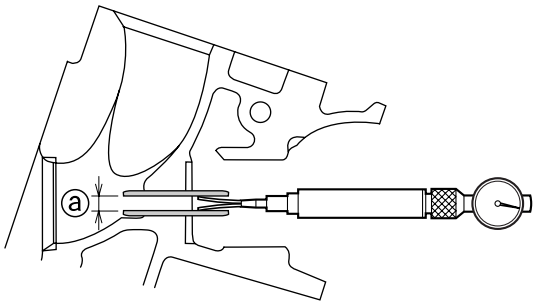
Exhaust: 0.01 mm (0.0004 in)

Checking the valve guides

NOTE:

Before checking the valve guide make sure that the valve stem diameter is within specification.

1. Measure the valve guide inside diameter **a**.



S69J5770



Valve guide inside diameter **a**:

5.51–5.52 mm (0.2169–0.2173 in)

2. Calculate the valve stem-to-valve guide clearance as follows. Replace the valve guide if out of specification.



Valve stem-to-valve guide clearance
= valve guide inside diameter – valve
stem diameter:

Intake:

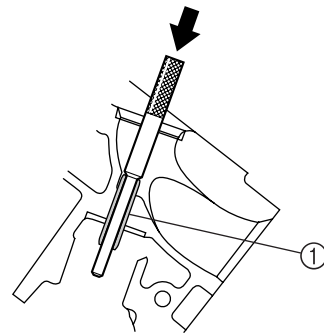
0.01–0.02 mm
(0.0004–0.0008 in)

Exhaust:

0.01–0.02 mm
(0.0004–0.0008 in)

Replacing the valve guides

1. Remove the valve guide **①** by striking the special service tool from the combustion chamber side.

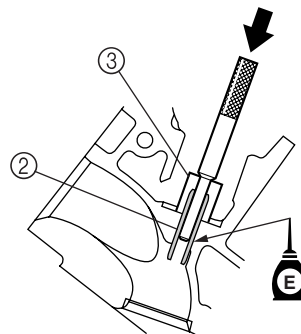


S69J5790



Valve guide remover/installer:
90890-06801

2. Install the new valve guide **②** by striking the special service tool from the camshaft side until the valve guide installer **③** contacts the cylinder head.



S69J5800

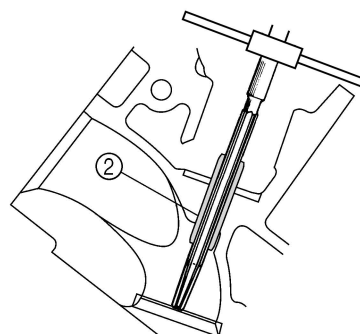
NOTE:

Apply engine oil to the surface of the new valve guide.



Valve guide remover/installer:
90890-06801
Valve guide installer: 90890-06810

3. Insert the special service tool into the valve guide **②**, and then ream the valve guide.



S69J5810

NOTE:

- Turn the valve guide reamer clockwise to ream the valve guide.
- Do not turn the reamer counterclockwise when removing the reamer.



Valve guide reamer: 90890-06804

4. Measure the valve guide inside diameter. Replace the valve guide if out of specification.



Valve guide inside diameter:
5.51–5.52 mm (0.2169–0.2173 in)

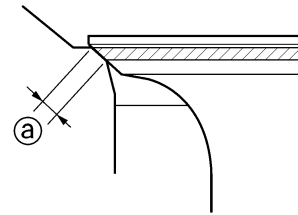
Checking the valve seat

1. Eliminate carbon deposits from the valve with a scraper.
2. Apply a thin, even layer of Mechanic's blueing dye (Dykem) onto the valve seat.
3. Lap the valve slowly on the valve seat with a valve lapper (commercially obtainable) as shown.

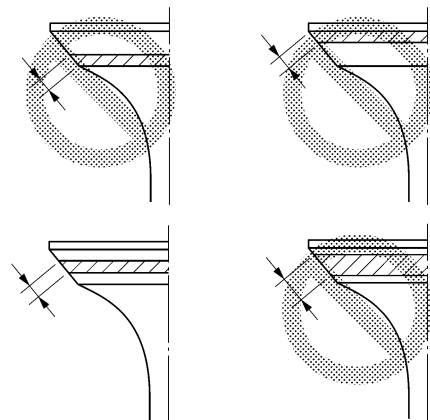


S69J5820

4. Measure the valve seat contact width $\textcircled{a}$ where the blueing dye is adhered to the valve face. Reface the valve seat if the valve is not seated properly or if the valve seat contact width is out of specification. Replace the valve guide if the valve seat contact is uneven.



S69J5830



S69J5840



Valve seat contact width $\textcircled{a}$:

Intake:

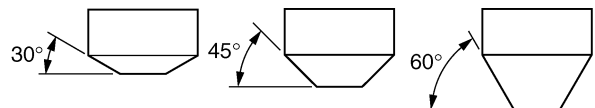
1.1–1.4 mm (0.043–0.055 in)

Exhaust:

1.4–1.7 mm (0.055–0.067 in)

Refacing the valve seat

1. Reface the valve seat with the valve seat cutter.



S69J5850



Valve seat cutter holder:

90890-06316

Valve seat cutter:

30° (intake and exhaust):

90890-06327

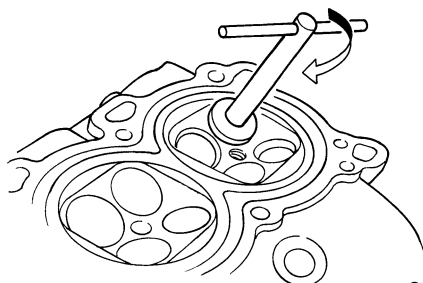
45° (intake and exhaust):

90890-06325

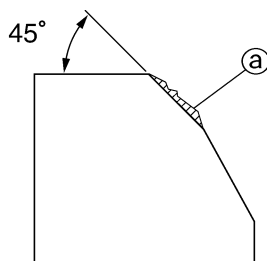
60° (intake and exhaust):

90890-06324

2. Cut the surface of the valve seat with a 45° cutter by turning the cutter clockwise until the valve seat face has become smooth.



S69J5860



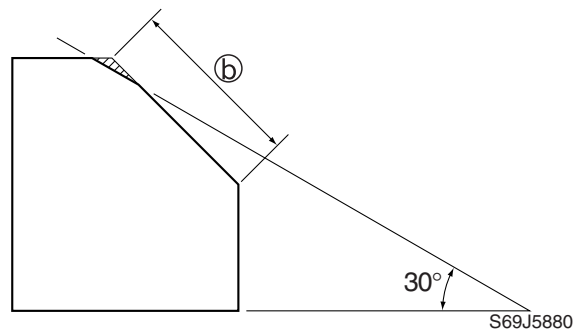
S69J5870

- (a) Slag or rough surface

CAUTION:

Do not over cut the valve seat. Be sure to turn the cutter evenly downward at a pressure of 40–50 N (4–5 kgf, 8.8–11 lbf) to prevent chatter marks.

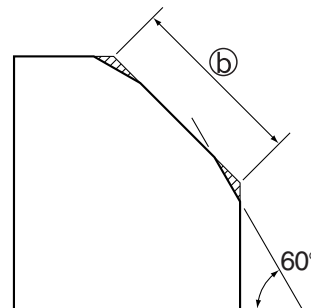
3. Use a 30° cutter to adjust the contact width of the top edge of the valve seat.



S69J5880

- (b) Previous contact width

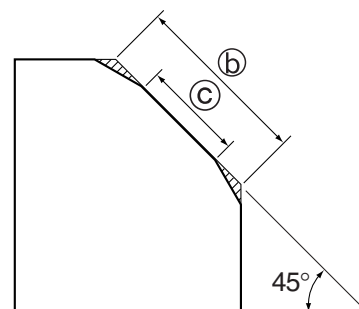
4. Use a 60° cutter to adjust the contact width of the bottom edge of the valve seat.



S69J5890

- (b) Previous contact width

5. Use a 45° cutter to adjust the contact width of the valve seat to specification.

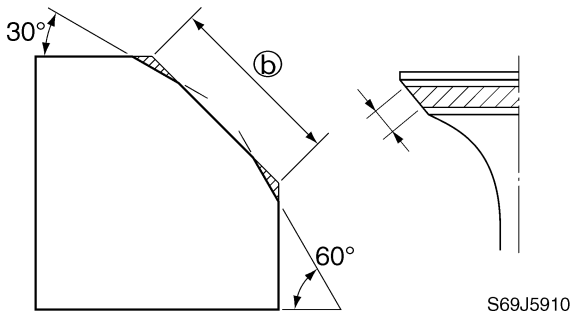


S69J5900

- (b) Previous contact width

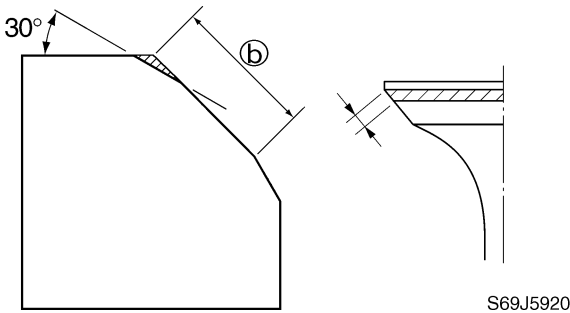
- (c) Specified contact width

6. If the valve seat contact area is too wide and situated in the center of the valve face, use a 30° cutter to cut the top edge of the valve seat, a 60° cutter to cut the bottom edge to center the area and set its width.



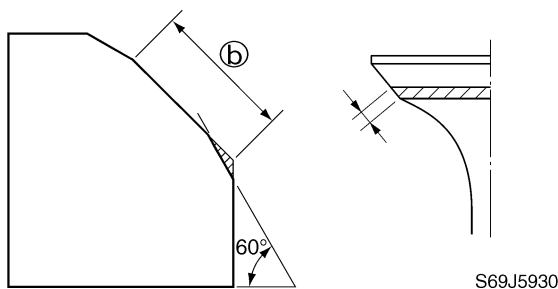
⑥ Previous contact width

7. If the valve seat contact area is too narrow and situated near the top edge of the valve face, use a 30° cutter to cut the top edge of the valve seat. If necessary, use a 45° cutter to center the area and set its width.



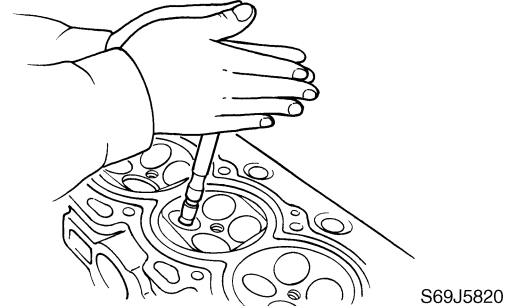
⑥ Previous contact width

8. If the valve seat contact area is too narrow and situated near the bottom edge of the valve face, use a 60° cutter to cut the bottom edge of the valve seat. If necessary, use a 45° cutter to center the area and set its width.



⑥ Previous contact width

9. Apply a thin, even layer of lapping compound onto the valve seat, and then lap the valve using a valve lapper (commercially obtainable).



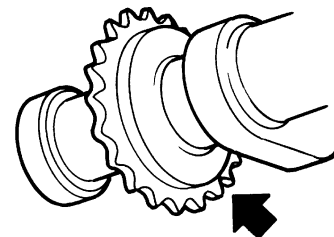
CAUTION:

Do not get the lapping compound on the valve stem and valve guide.

10. After every lapping procedure, be sure to clean off any remaining lapping compound from the cylinder head and the valve.
11. Check the valve seat contact area of the valve again.

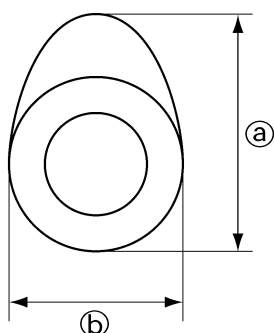
Checking the camshaft

1. Check the timing chain sprockets for damage or wear. Replace the camshaft if necessary.



S69J5940

2. Measure the cam lobe. Replace if out of specification.



S69J5950



Cam lobe (a):

Intake:

45.30–45.40 mm
(1.7835–1.7874 in)

Exhaust:

45.35–45.45 mm
(1.7854–1.7894 in)

Cam lobe (b):

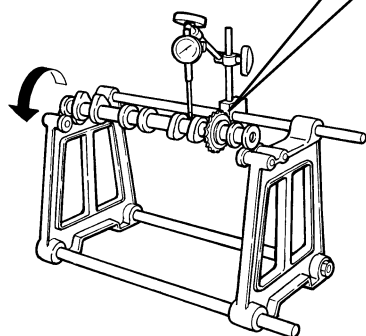
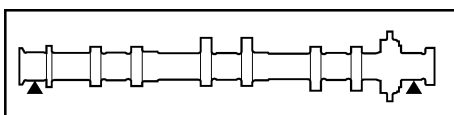
Intake:

35.95–36.05 mm
(1.4154–1.4193 in)

Exhaust:

35.95–36.05 mm
(1.4154–1.4193 in)

3. Measure the camshaft runout. Replace if out of specification.



S69J5960

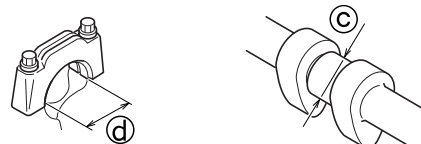


Crank stand alignment:
90890-03107



Camshaft runout limit:
0.1 mm (0.004 in)

4. Measure the camshaft journal diameter (c) and cylinder head journal inside diameter (d). Replace the camshaft and cylinder head if out of specification.



S69J5970



Camshaft journal diameter (c):

24.96–24.98 mm
(0.9827–0.9834 in)

Camshaft cap inside diameter (d):

25.00–25.02 mm
(0.9843–0.9850 in)

5. Calculate the camshaft oil clearance (e) as follows. Replace the camshaft and cylinder head as a set if out of specification.



Camshaft oil clearance (e) =

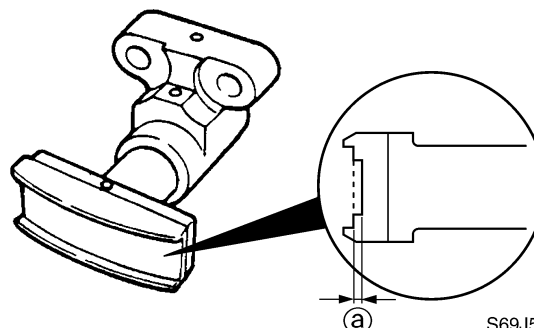
Camshaft cap inside diameter (d) –

Camshaft journal diameter (c):

0.02–0.06 mm (0.0008–0.0023 in)

Checking the timing chain tensioner

1. Measure the plunger extended length (a). Replace if out of specification.



S69J5980

NOTE:

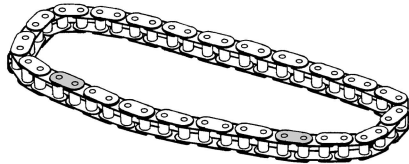
Check the timing chain tensioner every 400 hours of operation.



Timing chain tensioner wear limit (a):
1.0 mm (0.04 in) from standard

Checking the timing chain

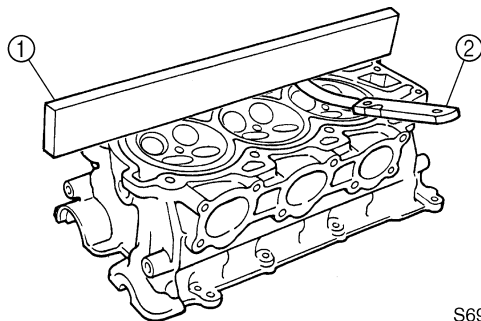
1. Check the timing chain for damage or wear. Replace if necessary.



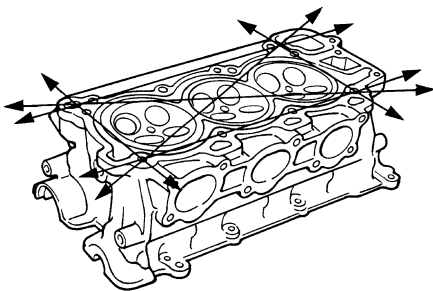
S69J5990

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 six directions as shown. Replace if out of specification.



S69J5A00



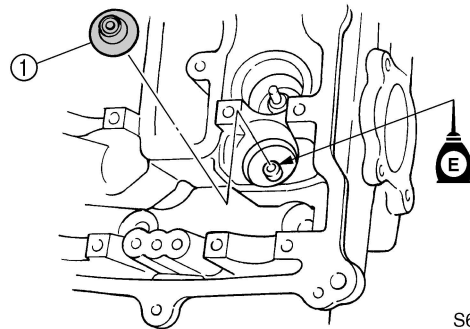
S69J5A10



Cylinder head warpage limit:
0.1 mm (0.004 in)

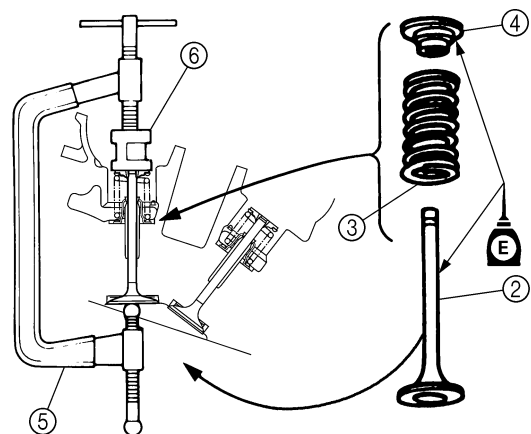
Installing the valves

1. Install the new valve seal ① to the valve guide.



S69J5A20

2. Install the valve ②, valve spring ③, and valve spring retainer ④ in the sequence shown, and then attach the special service tool.



S69J5A30

NOTE:

The valve spring can be installed in any direction.



Valve spring compressor ⑤:

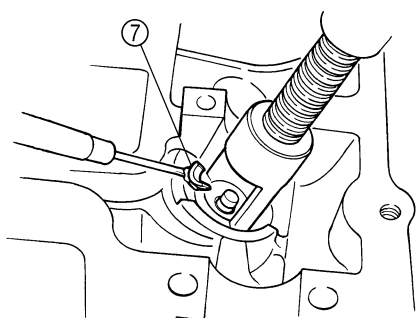
90890-04019

Valve spring compressor attachment

⑥:

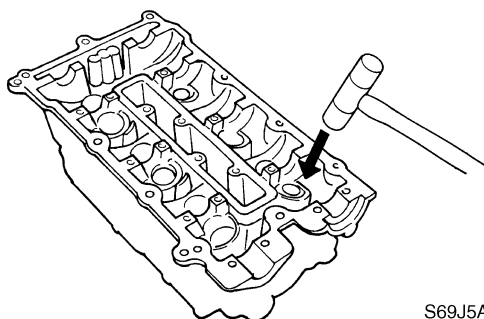
90890-06320

3. Compress the valve spring, and then install the valve cotter ⑦ using a thin screwdriver with a small amount of grease applied to it.



S69J5A40

4. Lightly tap the valve spring retainer with a plastic hammer to set the valve cotter securely.



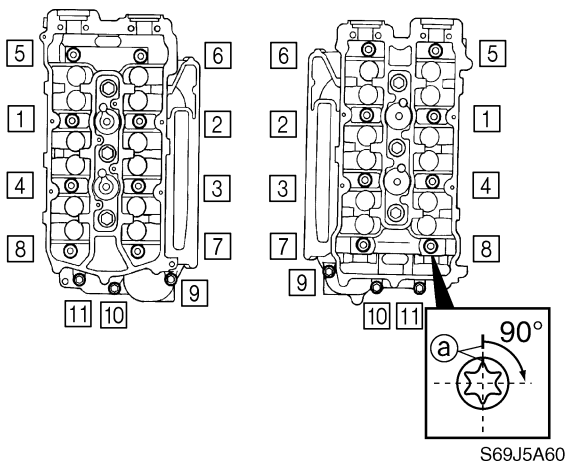
S69J5A50

NOTE:

Apply engine oil to the valve shims and valve lifters before installation.

Installing the cylinder head

1. Install the new gaskets and cylinder heads, and then tighten the bolts to the specified torques in the sequence shown.



S69J5A60

CAUTION:

Do not reuse the cylinder head gaskets, always replace them with new ones.

NOTE:

- Apply engine oil to the cylinder head bolts before installation.
- Tighten the M10 bolts to the specified torques in three stages first, and then tighten the M8 bolts to the specified torques in two stages.
- Make a mark (a) on the M10 bolts and the cylinder head, and then tighten the bolts 90° from the mark.



Cylinder head bolt (M10):

1st: 19 N·m (1.9 kgf·m, 14 ft·lb)

2nd: 37 N·m (3.7 kgf·m, 27 ft·lb)

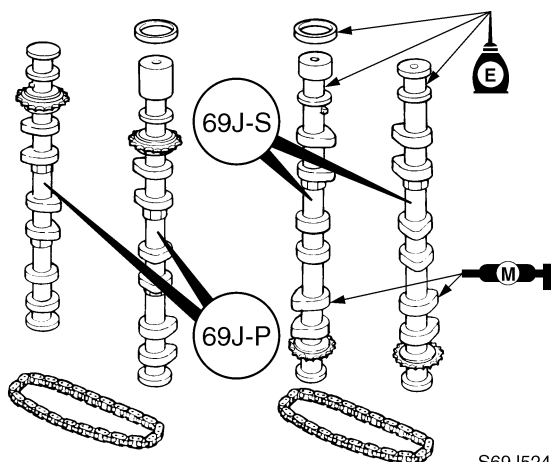
3rd: 90°

Cylinder head bolt (M8):

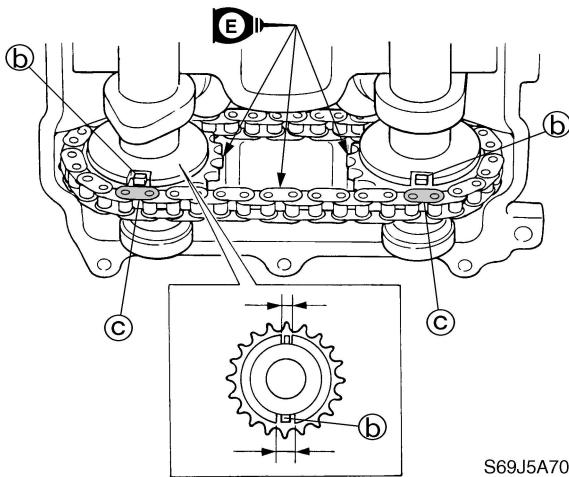
1st: 14 N·m (1.4 kgf·m, 10 ft·lb)

2nd: 28 N·m (2.8 kgf·m, 20 ft·lb)

2. Connect the ground lead.
3. Align the projection (wide one) (b) on the camshaft sprockets to the alignment plate (gold) (c) on the timing chain, and then install the camshafts to the cylinder head with new oil seals.

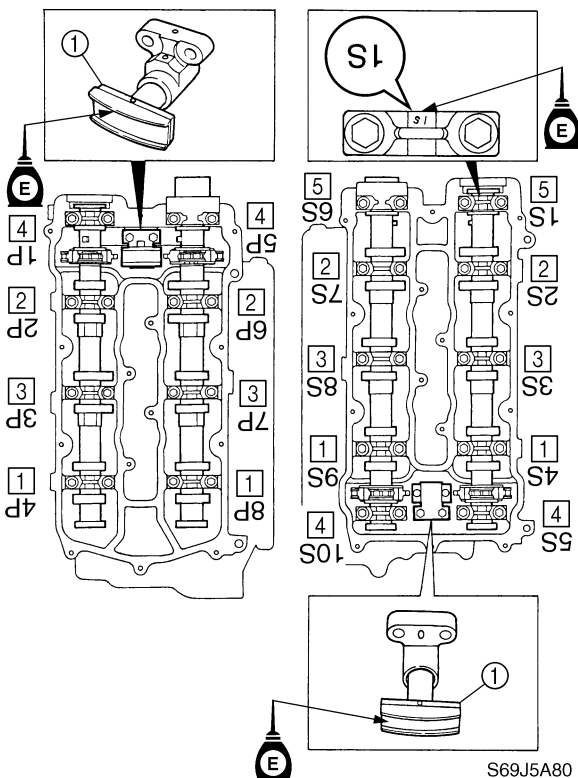


S69J5240



S69J5A70

4. Install the camshaft caps, and then tighten the bolts to the specified torques in two stages and in the sequence shown.
5. Install the timing chain tensioners ①, and then tighten the bolts to the specified torque in the sequence shown.



S69J5A80

NOTE:

- Install the camshaft caps in the proper position as shown and with the stamped numbers facing upside down.
- Apply engine oil to the camshaft cap bolts before installation.



Camshaft cap bolt:

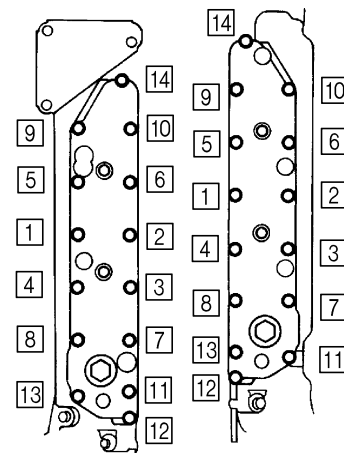
1st: 8 N·m (0.8 kgf·m, 5.8 ft·lb)

2nd: 17 N·m (1.7 kgf·m, 12 ft·lb)

Timing chain tensioner bolt:

12 N·m (1.2 kgf·m, 8.7 ft·lb)

6. Install the new gaskets and exhaust covers, and then tighten the bolts to the specified torques in two stages and in the sequence shown.



S69J5A90



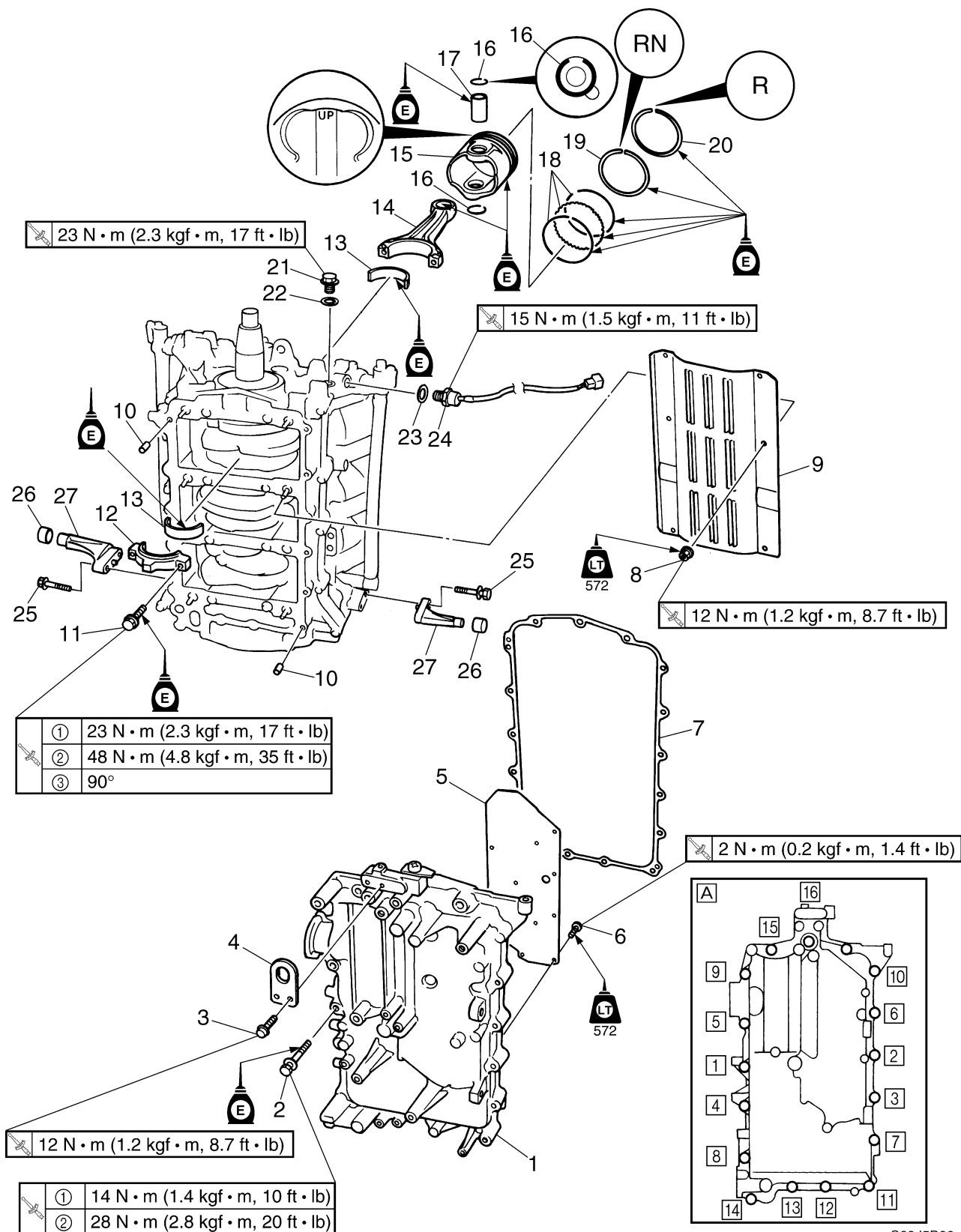
Exhaust cover bolt:

1st: 6 N·m (0.6 kgf·m, 4.3 ft·lb)

2nd: 12 N·m (1.2 kgf·m, 8.7 ft·lb)



Cylinder block



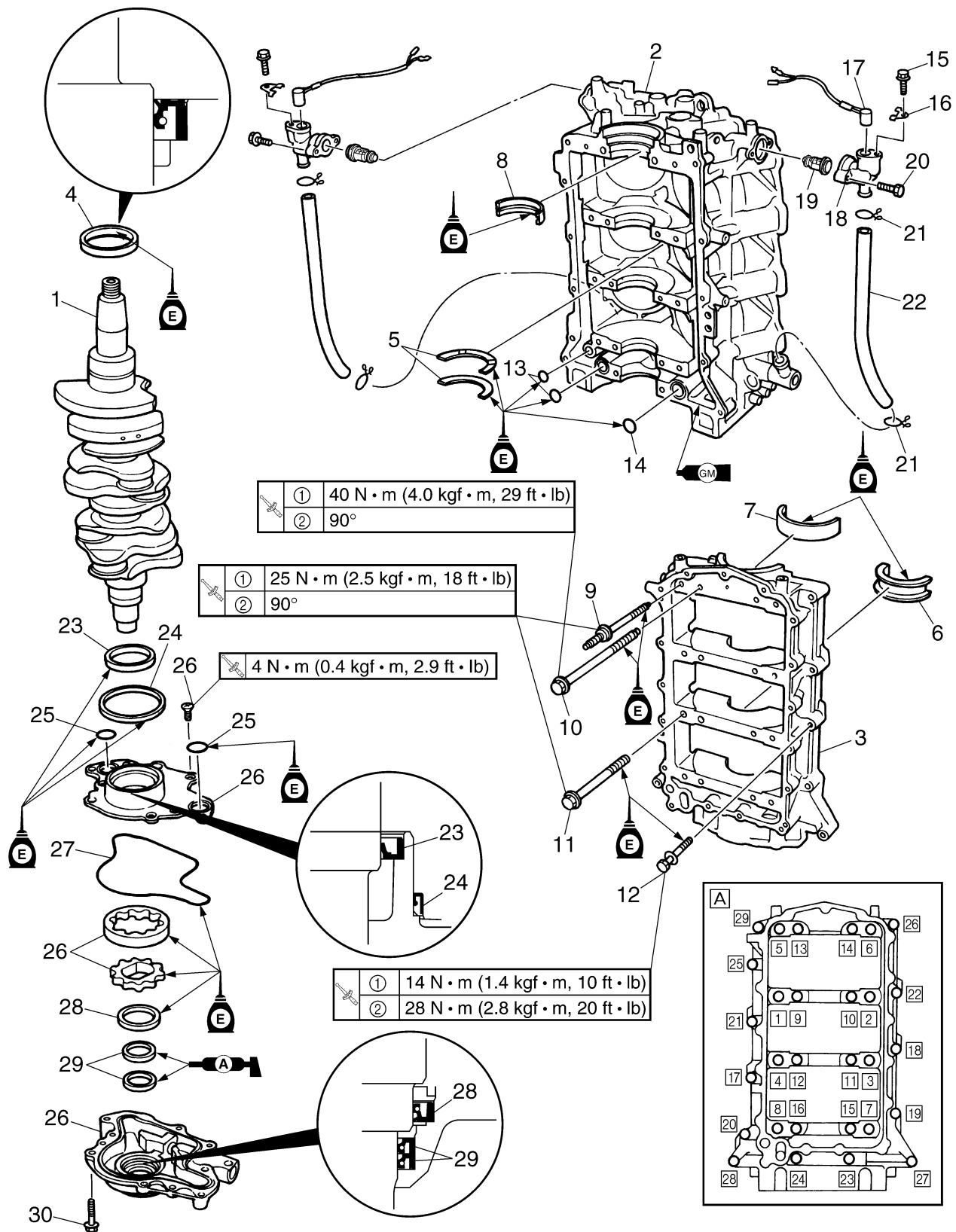
S69J5B00

Cylinder block

No.	Part name	Q'ty	Remarks
1	Crankcase cover	1	
2	Bolt	17	M8 × 45 mm
3	Bolt	2	M6 × 20 mm
4	Engine hanger	1	
5	Plate	1	
6	Screw	14	M4 × 8 mm
7	Gasket	1	Not reusable
8	Nut	6	
9	Baffle plate	1	
10	Dowel pin	2	
11	Bolt	12	Not reusable
12	Connecting rod cap	6	
13	Connecting rod bearing	12	
14	Connecting rod	6	
15	Piston	6	
16	Clip	12	Not reusable
17	Piston pin	6	
18	Oil ring	6	
19	2nd piston ring	6	
20	Top ring	6	
21	Plug	1	
22	Gasket	1	Not reusable
23	Gasket	1	Not reusable
24	Engine temperature sensor	1	
25	Bolt	4	M6 × 25 mm
26	Cap	2	
27	Stopper	2	

A Tightening sequence

5



S69J5B10

Cylinder block

No.	Part name	Q'ty	Remarks
1	Crankshaft	1	
2	Cylinder block	1	
3	Crankcase	1	
4	Oil seal	1	Not reusable
5	Thrust bearing	2	
6	Thrust bearing	1	
7	Main bearing	4	
8	Main bearing	4	
9	Stud bolt	6	M8 × 95 mm
10	Bolt	8	M10 × 105 mm
11	Bolt	2	M8 × 95 mm
12	Bolt	13	M8 × 55 mm
13	O-ring	2	Not reusable 1.9 × 22.9 mm
14	O-ring	1	Not reusable
15	Bolt	2	M6 × 20 mm
16	Holder	2	
17	Thermoswitch	2	
18	Cover	2	
19	Thermostat	2	
20	Bolt	4	M6 × 25 mm
21	Clip	4	
22	Cooling water hose	2	
23	Oil seal	1	Not reusable
24	Oil seal	1	Not reusable
25	O-ring	2	Not reusable
26	Oil pump assembly	1	
27	Gasket	1	Not reusable
28	Oil seal	1	Not reusable
29	Oil seal	2	Not reusable
30	Bolt	4	M6 × 40 mm

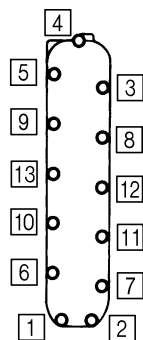
A Tightening sequence

5



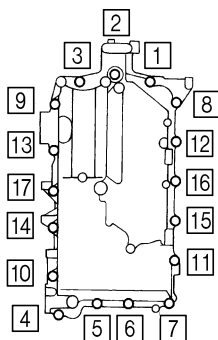
Disassembling the cylinder block

1. Remove the cooling water passage cover bolts in the sequence shown.



S69J5B20

2. Remove the crankcase cover bolts in the sequence shown.

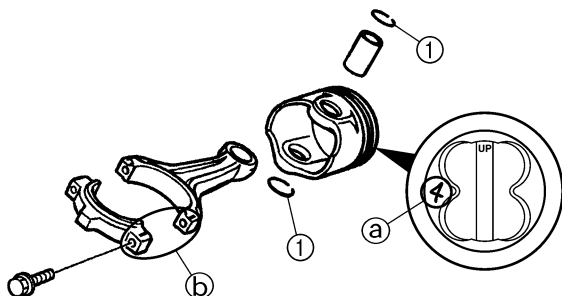


S69J5B30

NOTE:

Do not remove the ignition timing pointer from the crankcase cover.

3. Remove the baffle plate.
4. Remove the connecting rod bolts and the connecting rod caps, and then remove the connecting rod and piston assemblies.
5. Remove the clips ① with pliers, and then remove the piston.

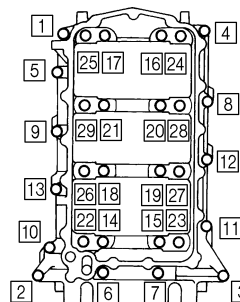


S69J5B40

NOTE:

- Be sure to keep the bearings in the order as they were removed, and to note the bearing color.
- Mark each piston with an identification number ③ of the corresponding cylinder. Also, mark each connecting rod and connecting rod cap on the up side (flywheel side) with an identification mark ④.
- Do not mix the connecting rods and caps. Keep them organized in their proper groups.

6. Remove the crankcase bolts in the sequence shown.

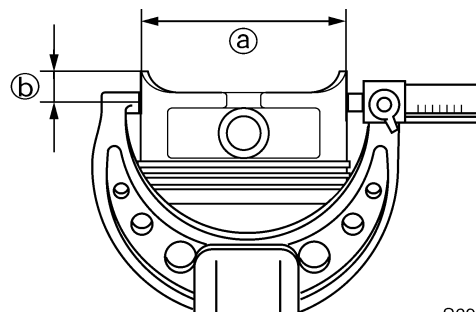


S69J5B50

7. Remove the oil pump, then the crankshaft.

Checking the piston diameter

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



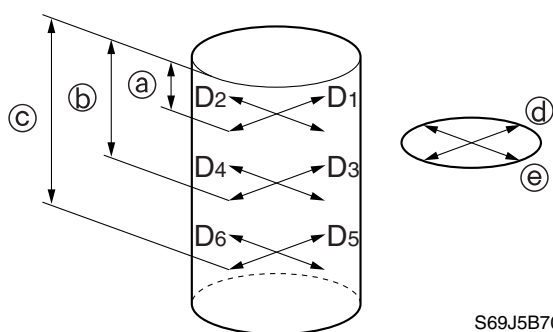
S69J5B60



Piston diameter ①:
93.921–93.941 mm
(3.6977–3.6985 in)
Measuring point ②:
5 mm (0.2 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 ①, ②, and ③, and in direction ④ (D_1 , D_3 , D_5), which is parallel to the crankshaft, and direction ⑤ (D_2 , D_4 , D_6), which is at a right angle to the crankshaft.



S69J5B70

- ① 20 mm (0.8 in)
- ② 60 mm (2.4 in)
- ③ 100 mm (3.9 in)



Cylinder bore (D_1 – D_6):
94.00–94.02 mm
(3.7008–3.7016 in)

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



Taper limit:
 D_1 – D_5 (direction ④)
 D_2 – D_6 (direction ⑤)
0.05 mm (0.0020 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 ①)
 D_6 – D_5 (measuring point ③)
0.01 mm (0.0004 in)

Checking the piston clearance

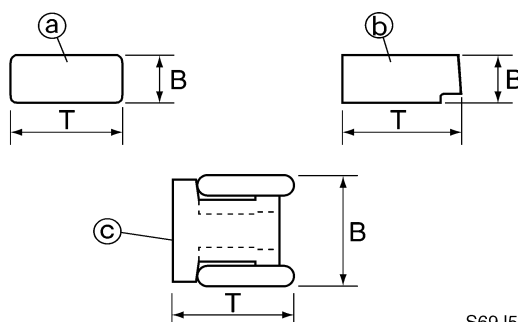
1. Rebores the cylinder or replace the piston and piston rings as a set, or the cylinder block, or all parts if out of specification.



Piston clearance:
0.075–0.080 mm
(0.0029–0.0031 in)

Checking the piston rings

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

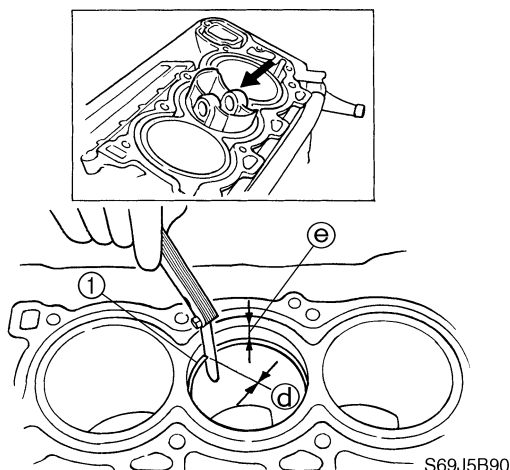


S69J5B80



Piston ring dimensions:
Top ring ①:
B: 1.17–1.19 mm
(0.0461–0.0468 in)
T: 2.8–3.0 mm (0.110–0.118 in)
Second ring ②:
B: 1.17–1.19 mm
(0.0461–0.0468 in)
T: 3.6–3.8 mm (0.142–0.150 in)
Oil ring ③:
B: 2.40–2.47 mm
(0.0945–0.0972 in)
T: 2.3–2.7 mm (0.091–0.106 in)

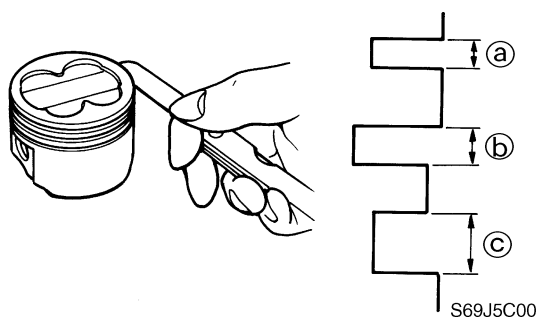
2. Level the piston ring ① in the cylinder with a piston crown.
3. Check the piston ring end gap ④ at the specified measuring point. Replace if out of specification.



	Piston ring end gap ④: Top ring: 0.15–0.30 mm (0.0059–0.0118 in) Second ring: 0.30–0.45 mm (0.0118–0.0177 in) Oil ring: 0.15–0.60 mm (0.0059–0.0236 in) Measuring point ⑤: 20 mm (0.8 in)
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Checking the piston ring grooves

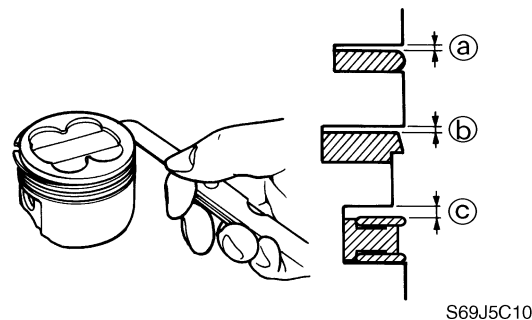
1. Measure the piston ring grooves.
Replace the piston if out of specification.



	Piston ring groove: Top ring ①: 1.23–1.25 mm (0.048–0.049 in) Second ring ②: 1.22–1.24 mm (0.048–0.049 in) Oil ring ③: 2.51–2.53 mm (0.099–0.100 in)
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Checking the piston ring side clearance

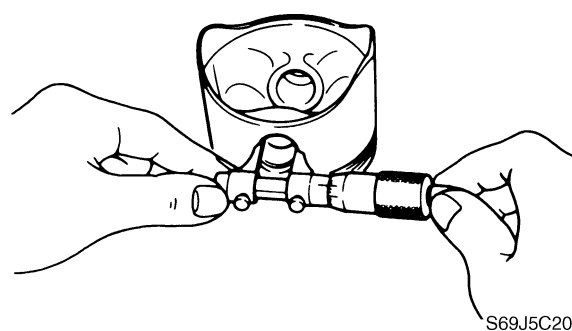
1. Measure the piston ring side clearance.
Replace the piston and piston rings as a set if out of specification.



	Piston ring side clearance: Top ring ①: 0.04–0.08 mm (0.0016–0.0031 in) Second ring ②: 0.03–0.07 mm (0.0012–0.0027 in) Oil ring ③: 0.04–0.13 mm (0.0016–0.0051 in)
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Checking the piston pin boss bore

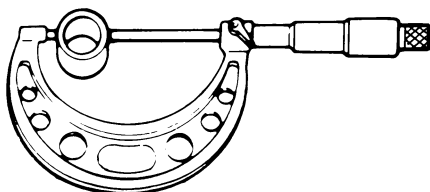
1. Measure the piston pin boss bore.
Replace the piston if out of specification.



	Piston pin boss bore: 21.02–21.03 mm (0.8276–0.8280 in)
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Checking the piston pin

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



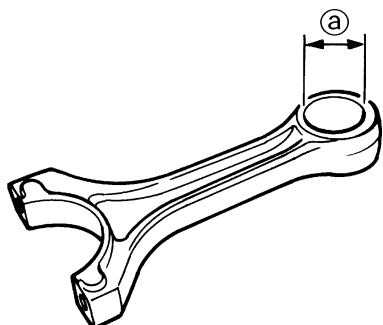
S69J5C30



Piston pin diameter:
21.00 mm (0.827 in)

Checking the connecting rod small end inside diameter

1. Measure the connecting rod small end inside diameter ①. Replace the connecting rod if out of specification.



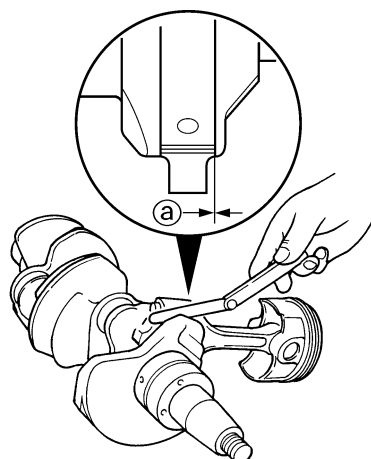
S69J5C40



Connecting rod small end inside diameter ①:
21.00 mm (0.827 in)

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.



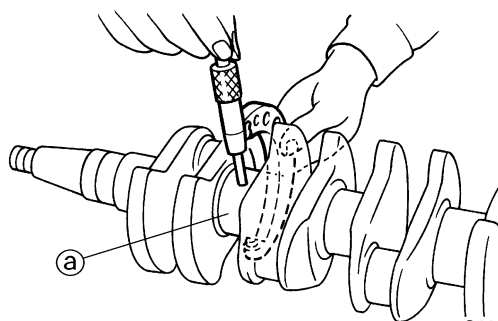
S69J5C50



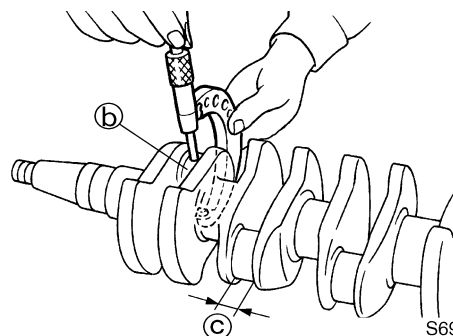
Connecting rod big end side clearance ①:
0.20–0.25 mm (0.008–0.010 in)

Checking the crankshaft

1. Measure the crankshaft journal diameter ①, crankpin diameter ②, and crankpin width ③. Replace the crankshaft if out of specification.



S69J5C60



S69J5C70



Crankshaft journal diameter ①:

62.968–62.992 mm

(2.4791–2.4800 in)

Crankpin diameter ②:

49.976–50.000 mm

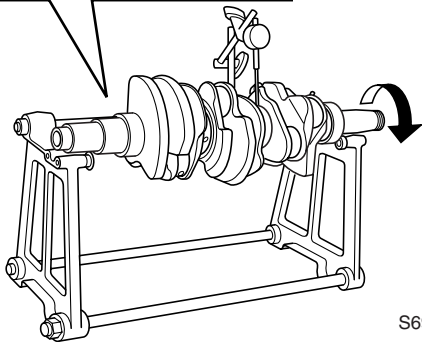
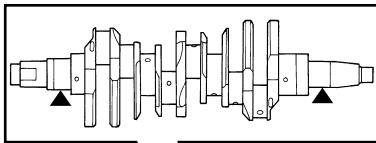
(1.9676–1.9685 in)

Crankpin width ③:

21.50–21.55 mm

(0.8465–0.8484 in)

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



S69J5C80



Crank stand alignment:

90890-03107

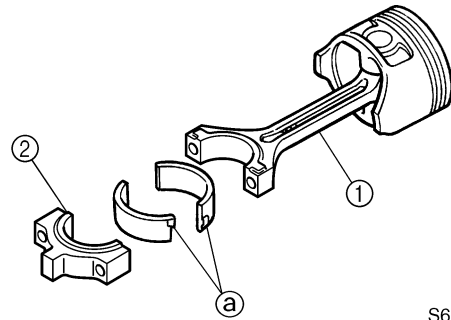


Crankshaft runout limit:

0.03 mm (0.0012 in)

Checking the crankpin oil clearance

1. Clean the bearings and the connecting rod.
2. Install the upper half of the bearing into the connecting rod ① and the lower half into the connecting rod cap ②.
3. Insert the projection ③ of the bearing into the slot on the cap and connecting rod.

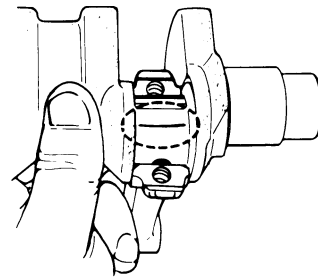


S69J5C90

NOTE:

Install the connecting rod bearings in their original positions.

4. Put a piece of Plastigauge® (PG-1) onto the crankpin, parallel to the crankshaft.

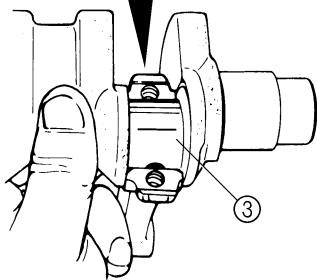
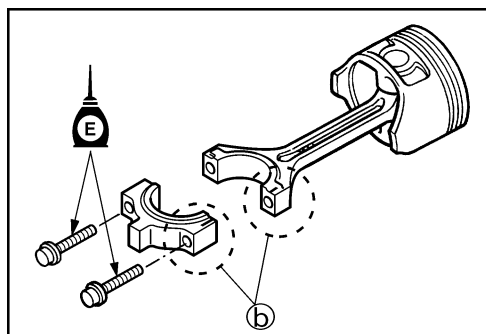


S69J5D00

NOTE:

Be sure not to put the Plastigauge (PG-1) over the oil hole in the crankpin of the crankshaft.

5. Install the connecting rod to the crankpin ③.

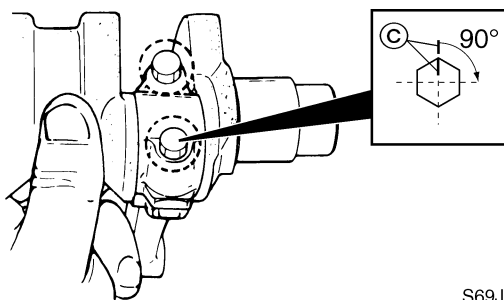


S69J5D10

NOTE:

Align the marks **b** on the connecting rod cap and connecting rod, which you made during disassembly.

6. Tighten the connecting rod bolts to the specified torques in three stages.



S69J5D20

NOTE:

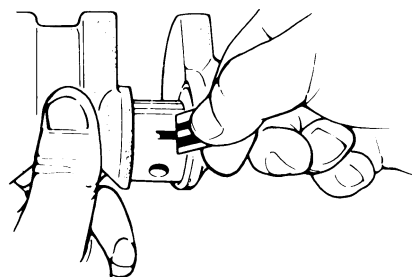
- Reuse the removed connecting rod bolts when checking the oil clearance.
- Do not turn the connecting rod until the crankpin oil clearance measurement has been completed.
- Make a mark **C** on the connecting rod bolts, connecting rod caps, and then tighten the bolts 90° from the mark.



Connecting rod bolt:

- 1st: 23 N·m (2.3 kgf·m, 17 ft·lb)
- 2nd: 48 N·m (4.8 kgf·m, 35 ft·lb)
- 3rd: 90°

7. Remove the connecting rod cap and measure the width of the compressed Plastigauge (PG-1) on each crankpin. Replace the connecting rod bearing if out of specification.



S69J5D30

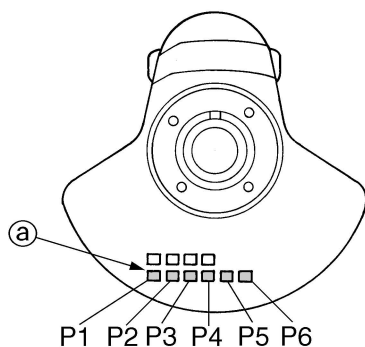
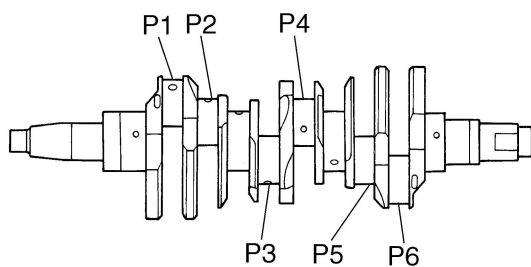


Crankpin oil clearance:

- 0.035–0.071 mm
(0.0014–0.0028 in)

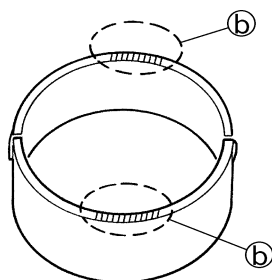
Selecting the connecting rod bearing

1. When replacing the connecting rod bearing, select the suitable bearing as follows.
2. Check the crankpin mark **a** on the crankshaft.



S69J5D40

3. Select the suitable color ⑥ for the connecting rod bearing from the table.



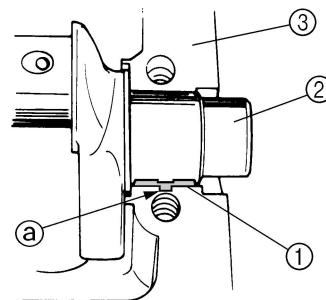
S69J5D50

Crankpin mark ⑤	Bearing color ⑥
92-00	Yellow
84-91	Green
76-83	Blue

Checking the crankshaft main journal oil clearance

1. Clean the bearings, main journals, and bearing portions of the crankcase and cylinder block.
2. Place the cylinder block upside down on a bench.
3. Install half of the bearings ① and the crankshaft ② into the cylinder block ③.

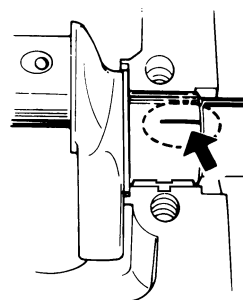
4. Insert the projection ① of the bearing into the notch in the cylinder block.



S69J5D60

NOTE: Install the main bearings in their original positions.

5. Put a piece of Plastigauge (PG-1) on each main journal parallel to the crankshaft.



S69J5D70

NOTE: Do not put the Plastigauge (PG-1) over the oil hole in the main journals of the crankshaft.

6. Install the remaining half of the bearings into the crankcase.

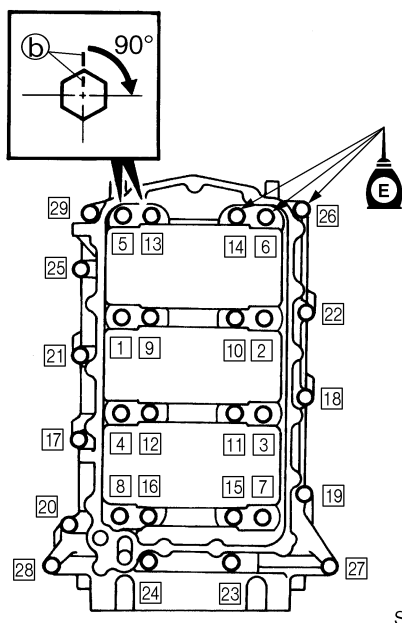
NOTE: Install the main bearings in their original positions.

7. Insert the projection of the bearing into the notch in the crankcase.

8. Install the crankcase onto the cylinder block and apply engine oil to the threads of the crankcase bolts.

Cylinder block

9. Tighten the crankcase bolts to the specified torques in two stages and in the sequence shown.



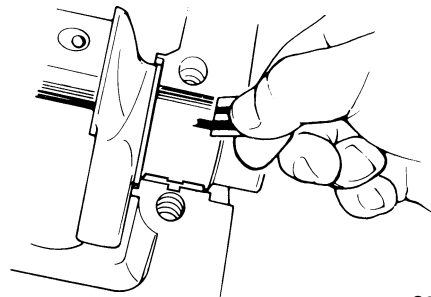
S69J5D80

NOTE:

- Crankcase bolts [1]–[16] can be reused five times.
- Do not move the crankshaft until the main journal oil clearance measurement has been completed.
- Tighten crankcase bolts [1]–[16] to the specified torques in two stages first, and then tighten crankcase bolts [17]–[29] to the specified torques in two stages.
- Make a mark (b) on the crankcase and crankcase bolts, and then tighten crankcase bolts [1]–[16] 90° from the mark.

	[1]–[8] Crankcase bolt (M8):
	1st: 25 N·m (2.5 kgf·m, 18 ft·lb)
	2nd: 90°
	[9]–[16] Crankcase bolt (M10):
	1st: 40 N·m (4.0 kgf·m, 29 ft·lb)
	2nd: 90°
	Crankcase bolt (M8):
	1st: 14 N·m (1.4 kgf·m, 10 ft·lb)
	2nd: 28 N·m (2.8 kgf·m, 20 ft·lb)

10. Remove the crankcase and measure the width of the compressed Plastigauge (PG-1) on each main journal. Replace the main bearing if out of specification.

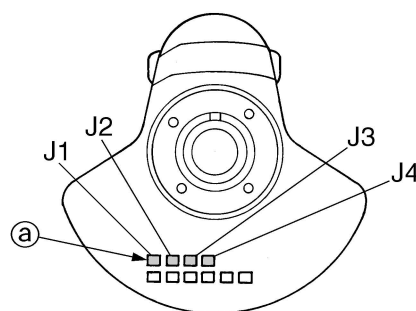
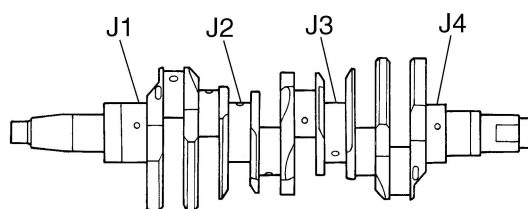


S69J5D90

	Crankshaft main journal oil clearance:
	0.025–0.050 mm
	(0.0010–0.0020 in)

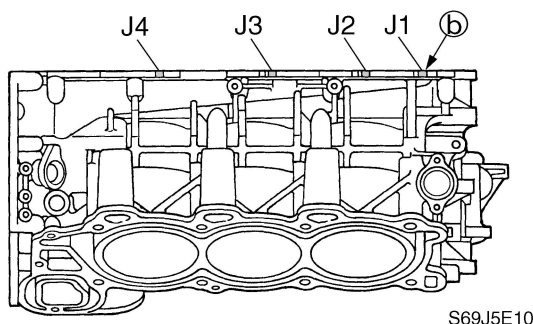
Selecting the crankshaft main bearing

1. When replacing the main bearing, select the suitable bearing as follows.
2. Check the crankshaft journal mark (a) on the crankshaft and the cylinder block mark (b) on the cylinder block.



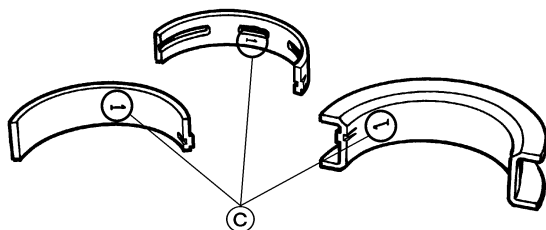
S69J5E00

5



S69J5E10

3. Select the suitable main bearing number ③ from the table.



S69J5E20

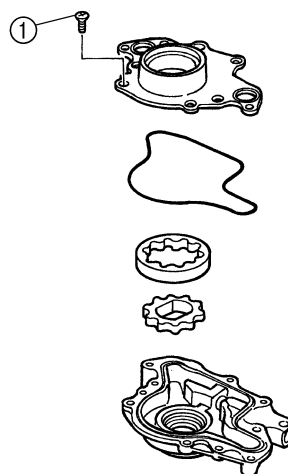
		Cylinder block mark ⑥																					
		98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19
Crankshaft journal mark ①	92	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	91	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	90	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	89	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	88	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	87	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	86	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	85	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	84	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	83	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	82	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	81	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	80	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	79	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	78	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	77	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	76	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	75	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
	74	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3
	73	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3
	72	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3
	71	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3
	70	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3
	69	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3
	68	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3

NOTE:

- Example: If the crankshaft journal mark ① is "81" and the cylinder block mark ⑥ is "04," then the main bearing number ③ is "1."
- Main bearing #3 is a thrust bearing.

Disassembling the oil pump

1. Remove the screws ① and disassemble the oil pump.



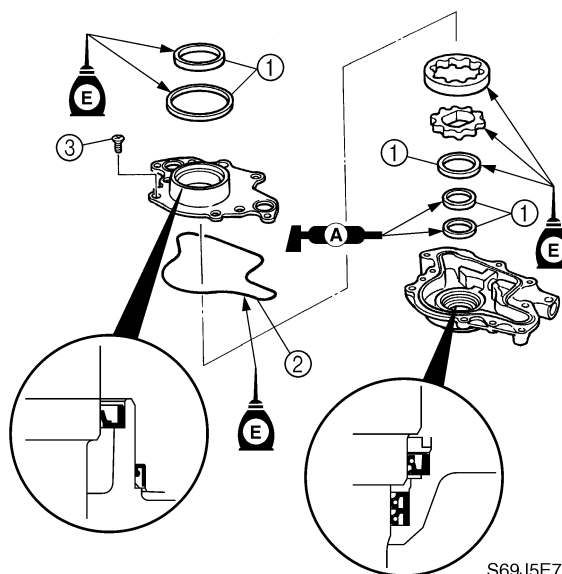
S69J5E60

Checking the oil pump

1. Check the oil seals and gasket for tears. Replace if necessary.
2. Check the teeth of the gears for cracks or wear and the oil pump case for scratches. Replace if necessary.

Assembling the oil pump

1. Replace the new oil seal ① and gasket ② if necessary, and then tighten the screws ③ to the specified torque.



S69J5E70

NOTE:

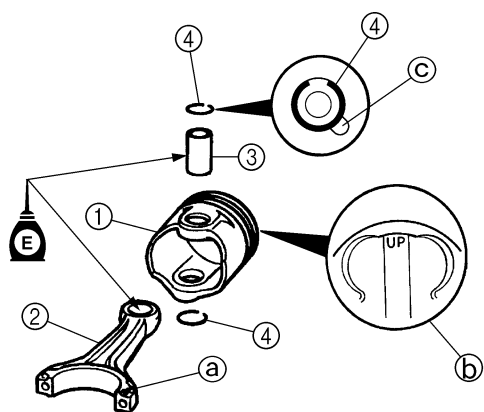
Install the oil seals using a general pipe of the proper size.



Screw ③:
4 N·m (0.4 kgf·m, 2.9 ft·lb)

Assembling the piston and cylinder block

1. Assemble the piston ①, connecting rod ②, piston pin ③, and new piston pin clips ④.

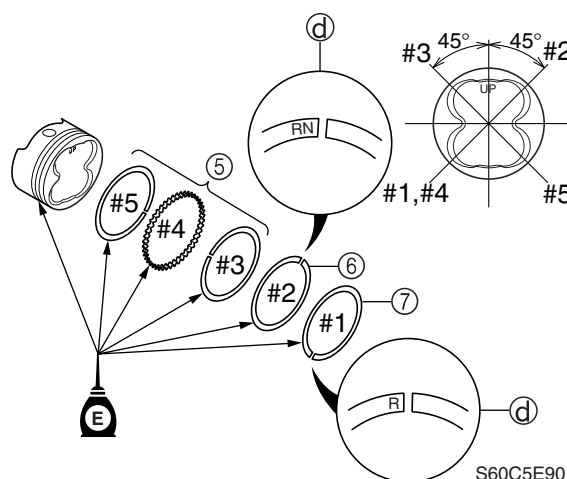


S69J5E80

NOTE:

- Face the mark (a) on the connecting rod in the same direction as the "UP" mark (b) on the piston, which you made during disassembly.
- Always use new piston pin clips, and do not allow the piston pin clip end to align with the piston pin slot (c).

2. Install the oil ring ⑤, second ring ⑥, and top ring ⑦ to the piston with the "R" mark (d) of the second ring and the "RN" mark (d) of the top ring facing upward.
3. Offset the piston ring end gaps as shown.



S60C5E90

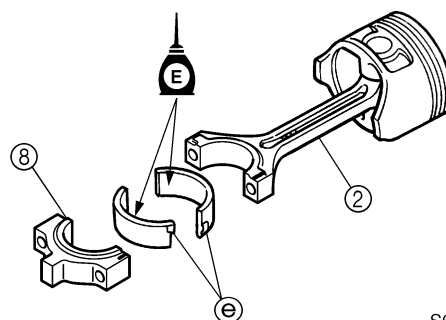
CAUTION:

Do not scratch the piston or break the piston rings.

NOTE:

After installing the piston rings, check that they move smoothly.

4. Install the upper half of the bearing into the connecting rod ② and the lower half into the connecting rod cap ⑧.
5. Insert the projection (e) of the bearing into the slot on the cap and connecting rod.



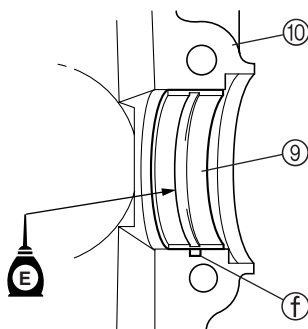
S69J5F00

NOTE:

Install the connecting rod bearings in their original positions.



6. Install half of the bearings ⑨ into the cylinder block ⑩.
7. Insert the projection ⑥ of the bearing into the notch in the cylinder block.

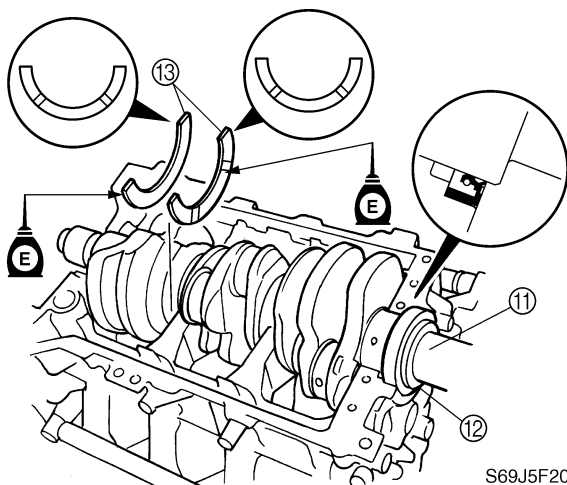


S69J5F10

NOTE:

Install the main bearings in their original positions.

8. Set the crankshaft ⑪, and oil seal ⑫, and thrust bearings ⑬ into the cylinder block as shown.



S69J5F20

NOTE:

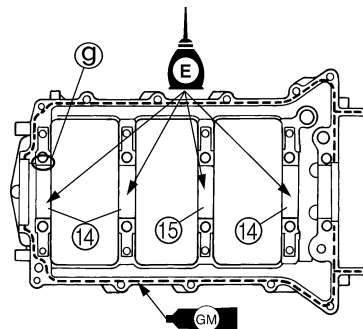
Apply engine oil to the inner oil seal and the thrust bearings before installation.

9. Install half of the bearings ⑭ and the thrust bearing ⑮ into the crankcase.

NOTE:

Install the main bearings in their original positions.

10. Apply Gasket Maker® to the mating surface of the crankcase.
11. Insert the projection ⑨ of the bearing into the notch in the crankcase.

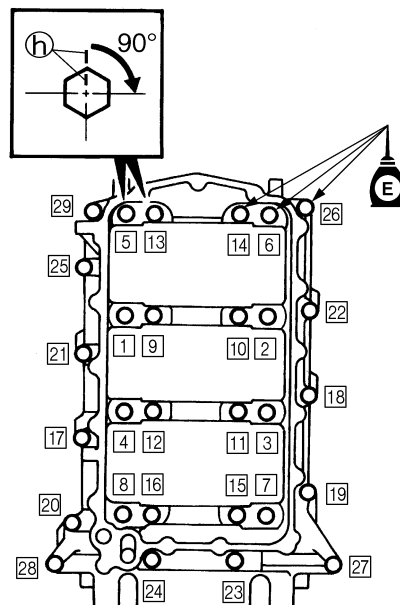


S69J5F30

NOTE:

Do not get any Gasket Maker on the journal bearings.

12. 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.



S69J5F40

CAUTION:

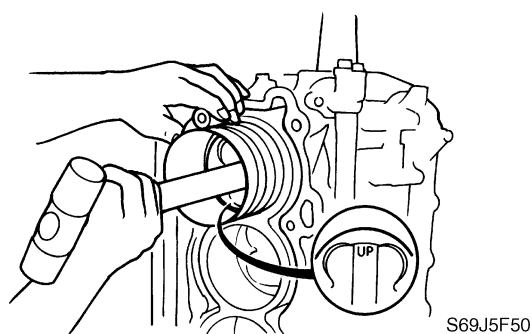
Crankcase bolts 1-16 can be reused five times.

NOTE:

- The oil seals must be installed before tightening the crankcase bolts.
- Apply engine oil to the crankcase bolts before installation.
- Tighten crankcase bolts **1-16** to the specified torques in two stages first, and then tighten crankcase bolts **17-29** to the specified torques in two stages.
- Make a mark **h** on the crankcase and crankcase bolts, and then tighten crankcase bolts **1-16** 90° from the mark.

	1-8 Crankcase bolt (M8):
	1st: 25 N·m (2.5 kgf·m, 18 ft·lb)
	2nd: 90°
	9-16 Crankcase bolt (M10):
	1st: 40 N·m (4.0 kgf·m, 29 ft·lb)
	2nd: 90°
	Crankcase bolt (M8):
	1st: 14 N·m (1.4 kgf·m, 10 ft·lb)
	2nd: 28 N·m (2.8 kgf·m, 20 ft·lb)

13. Install the piston with the “UP” mark on the piston crown facing towards the fly-wheel magnet.

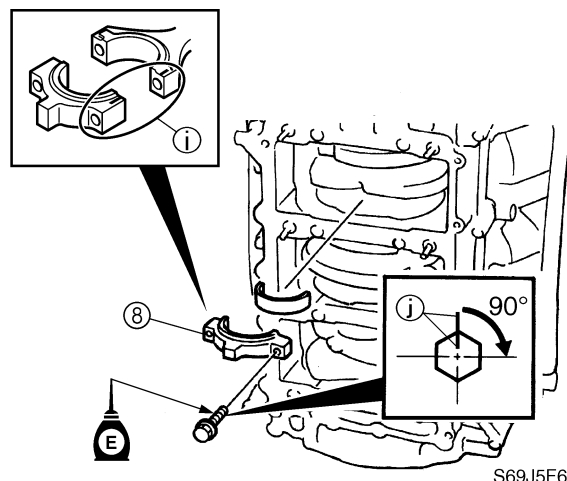


NOTE:

Apply engine oil to the side of the piston and piston rings before installation.

	Piston ring compressor:
	90890-05158

14. Install the connecting rod cap **8** to the connecting rod, and then tighten the connecting rod bolts to the specified torques in three stages.



CAUTION:

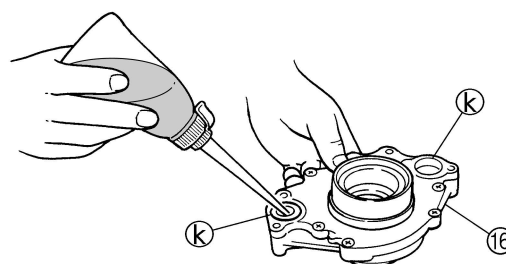
Do not reuse the connecting rod bolts, always replace them with new ones.

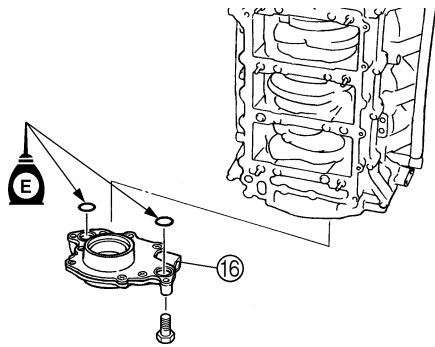
NOTE:

- Align the marks **i** on the connecting rod cap and connecting rod, which you made during disassembly.
- Apply engine oil to the connecting rod cap and connecting rod bolt before installation.
- Make a mark **i** on the connecting rod bolts and connecting rod caps, and then tighten the bolts 90° from the mark.

	Connecting rod bolt:
	1st: 23 N·m (2.3 kgf·m, 17 ft·lb)
	2nd: 48 N·m (4.8 kgf·m, 35 ft·lb)
	3rd: 90°

15. Install the oil pump **16** by aligning the oil pump gear with the crankshaft.



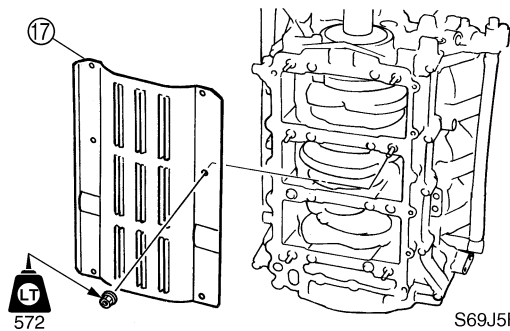


S69J5F80

CAUTION:

Before installing the oil pump, be sure to fill it with engine oil through the oil passage ①.

16. Install the baffle plate ①⑦ to the specified torque.

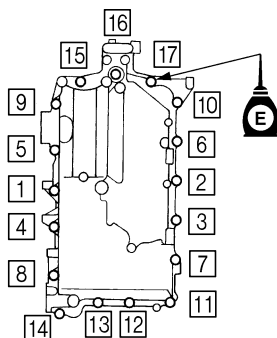


S69J5F90



Baffle plate nut:
12 N·m (1.2 kgf·m, 8.7 ft·lb)

17. Install the new gasket and crankcase cover, and then tighten the bolts to the specified torque in two stages and in the sequence shown.

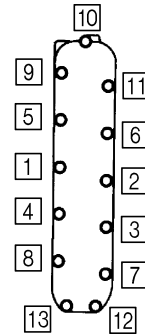


S69J5G00



Crankcase cover bolt:
1st: 14 N·m (1.4 kgf·m, 10 ft·lb)
2nd: 28 N·m (2.8 kgf·m, 20 ft·lb)

18. Install the new gasket and cooling water passage cover, and then tighten the bolts to the specified torque in the sequence shown.

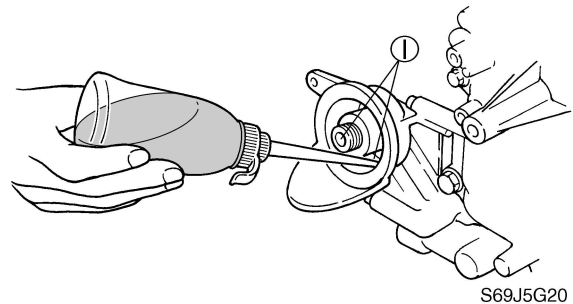


S69J5G10



Cooling water passage cover bolt:
12 N·m (1.2 kgf·m, 8.7 ft·lb)

19. Before installing the power unit, be sure to fill it with engine oil through the oil passage ① of the oil filter bracket.



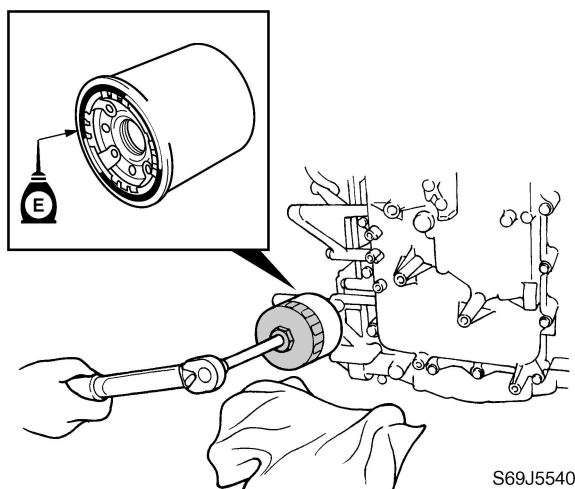
S69J5G20

NOTE:

Apply a thin coat of engine oil to the O-ring of the new oil filter before installation.

Cylinder block

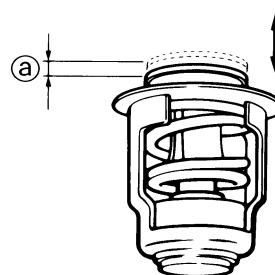
20. Install the oil filter, and then tighten it to the specified torque using a 72.5 mm (2.9 in) oil filter wrench.



S69J5540

	Oil filter: 18 N·m (1.8 kgf·m, 13 ft·lb)
--	--

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

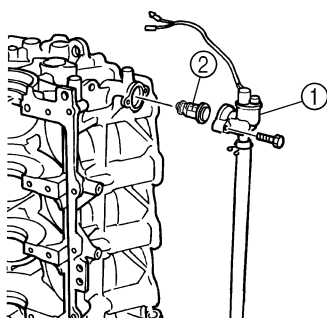


S69J5E50

	Water temperature	Valve lift ①
	60 °C (140 °F)	0 mm (0 in) (valve begins to lift)
	above 70 °C (158 °F)	more than 4.3 mm (0.17 in)

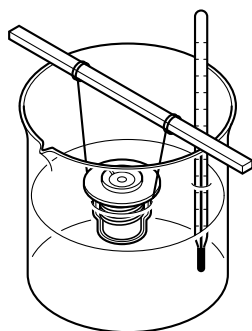
Checking the thermostat

1. Remove the cover ① and thermostat ②.



S69J5E30

2. Suspend the thermostat in a container of water.
3. Place a thermometer in the water and slowly heat the water.



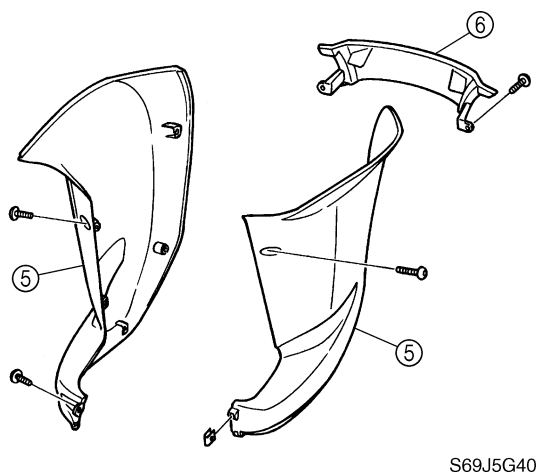
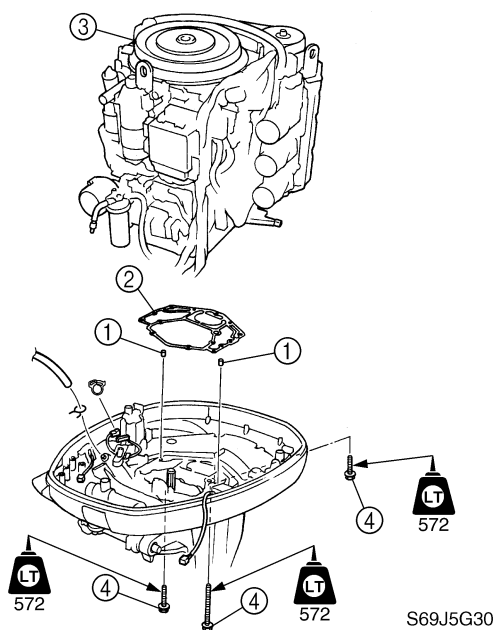
S69J5E40

5. Install the thermostat and cover.

Installing the power unit

1. Clean the power unit matching surface, and install the dowel pins ① and the new gasket ②.
2. Install the power unit ③ by installing the bolts ④, then tightening them to the specified torque.
3. Install the aprons ⑤ and upper case cover ⑥, then tighten them to the specified torque.
4. Connect the low-pressure fuel pump driver coupler, PTT switch coupler, shift cut switch coupler, neutral switch coupler, and cooling water pilot hose.

5



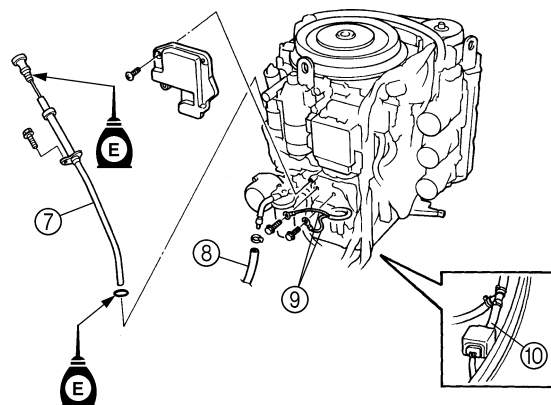
Mounting bolt ④:

42 N·m (4.2 kgf·m, 30 ft·lb)

Apron and upper case cover bolt:

8 N·m (0.8 kgf·m, 5.8 ft·lb)

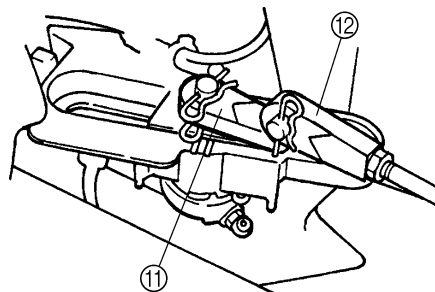
5. Install the dipstick guide ⑦, and connect the fuel hose ⑧, PTT motor leads ⑨, and flushing device hose (flushing device model) ⑩.



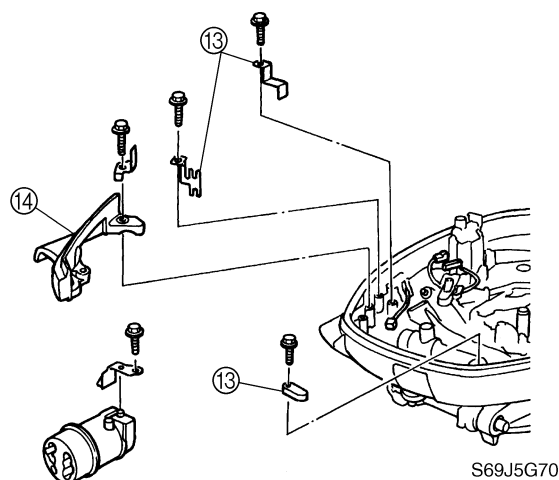
PTT motor lead bolt:

4 N·m (0.4 kgf·m, 2.9 ft·lb)

6. Connect the shift cable ⑪ and throttle cable ⑫, and then adjust their lengths. For adjustment procedures, see Chapter 3, "Checking the throttle link and throttle cable operation," and "Checking the gearshift operation."



7. Install the holders ⑬ and retaining plate ⑭.



NOTE: _____
Apply engine oil to the flywheel magnet nut before installation.



Flywheel holder: 90890-06522

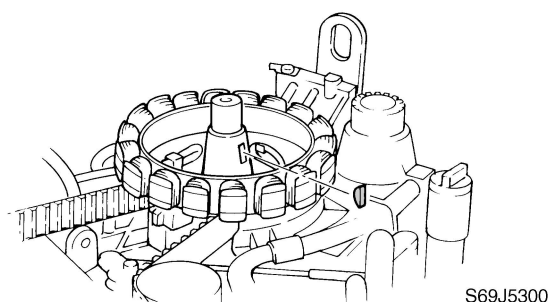


Flywheel magnet nut:
240 N·m (24 kgf·m, 174 ft·lb)

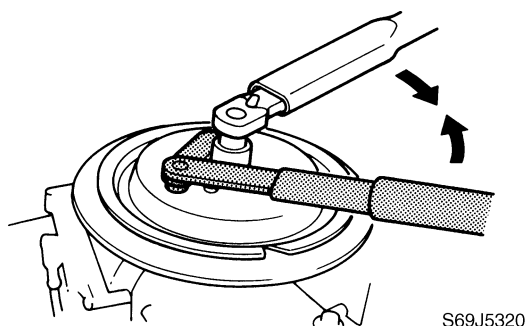
11. Reinstall the all removed parts.

8. Install the stator coil bracket and stator coil.

9. Install the Woodruff key.



10. Install the flywheel magnet.



CAUTION:

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



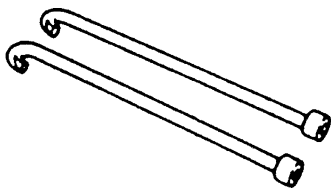
Lower unit

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Checking the water pump and shift rod	6-38

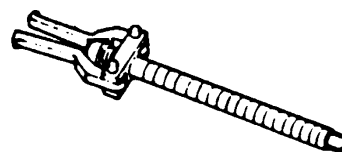
Propeller shaft housing (counter rotation model)	6-39
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Shimming	6-55
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Selecting the reverse gear shims	6-56
Selecting the forward gear shims	6-57
Selecting the propeller shaft shims	6-58
 Backlash (counter rotation model)	 6-60
Measuring the forward and reverse gear backlash	6-60



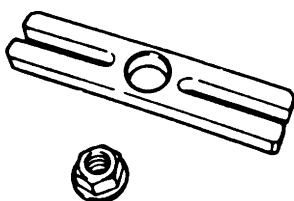
Special service tools



Bearing housing puller claw L
90890-06502



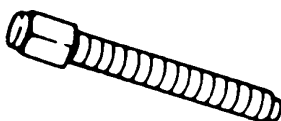
Bearing puller
90890-06535



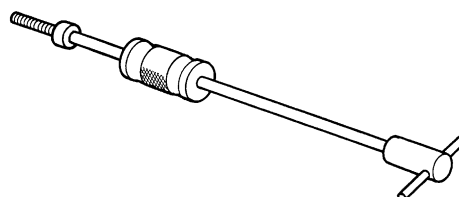
Stopper guide plate
90890-06501



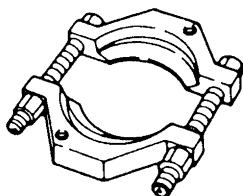
Bearing puller claw 1
90890-06536



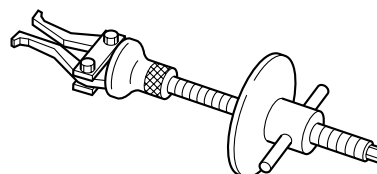
Center bolt
90890-06504



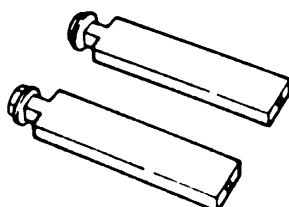
Slide hammer
90890-06531



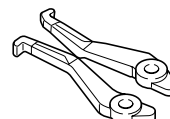
Bearing separator
90890-06534



Bearing outer race puller
90890-06523



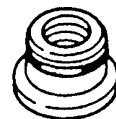
Stopper guide stand
90890-06538



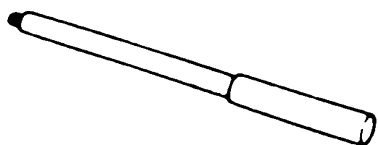
Outer race puller claw A
90890-06532



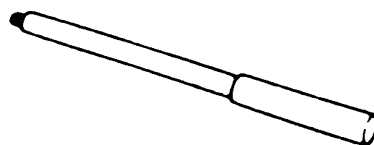
Needle bearing attachment
90890-06610, 90890-06653, 90890-06654



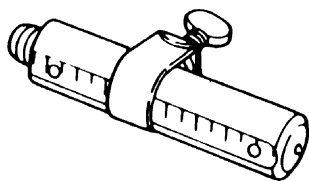
Ball bearing attachment
90890-06636, 90890-06656, 90890-06657



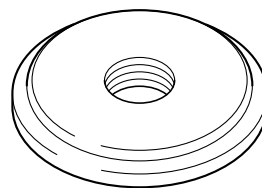
Driver rod L3
90890-06652



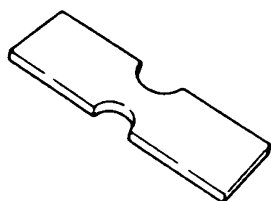
Driver rod LS
90890-06606



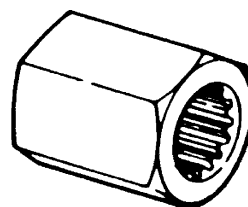
Driver rod SS
90890-06604



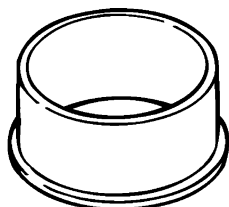
Bearing outer race attachment
90890-06622, 90890-06628, 90890-06658



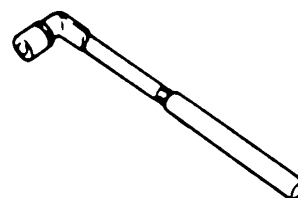
Bearing depth plate
90890-06603



Drive shaft holder 6
90890-06520



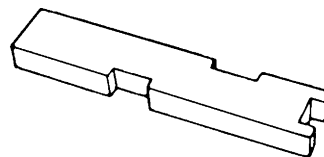
Bearing inner race attachment
90890-06640, 90890-06659



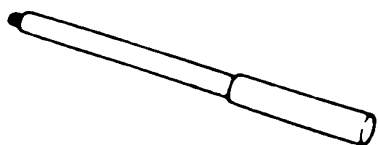
Pinion nut holder
90890-06505



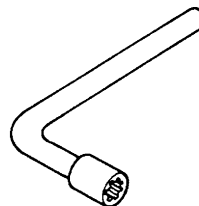
Socket adapter 3
90890-06508



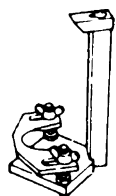
Shimming plate
90890-06701



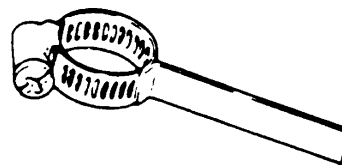
Driver rod LL
90890-06605



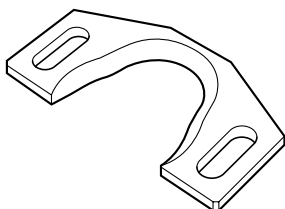
Shift rod push arm
90890-06052



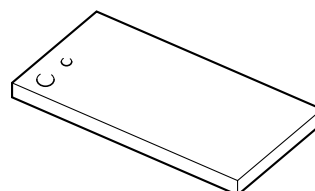
Pinion height gauge
90890-06702



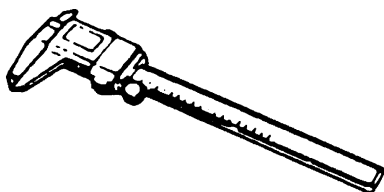
Backlash indicator
90890-06706



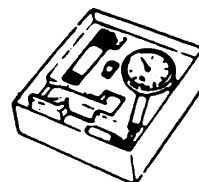
Fixing plate
90890-06711



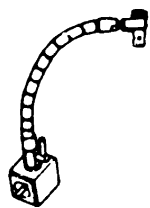
Magnet base plate
90890-07003



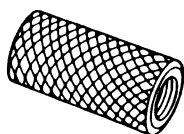
Digital caliper
90890-06704



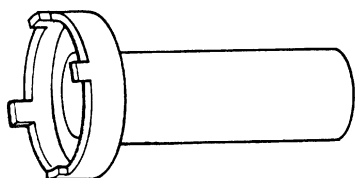
Dial gauge set
90890-01252



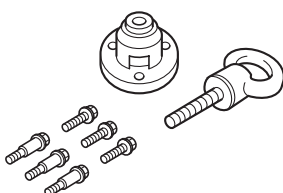
Magnet base
90890-06705



Puller head
90890-06514



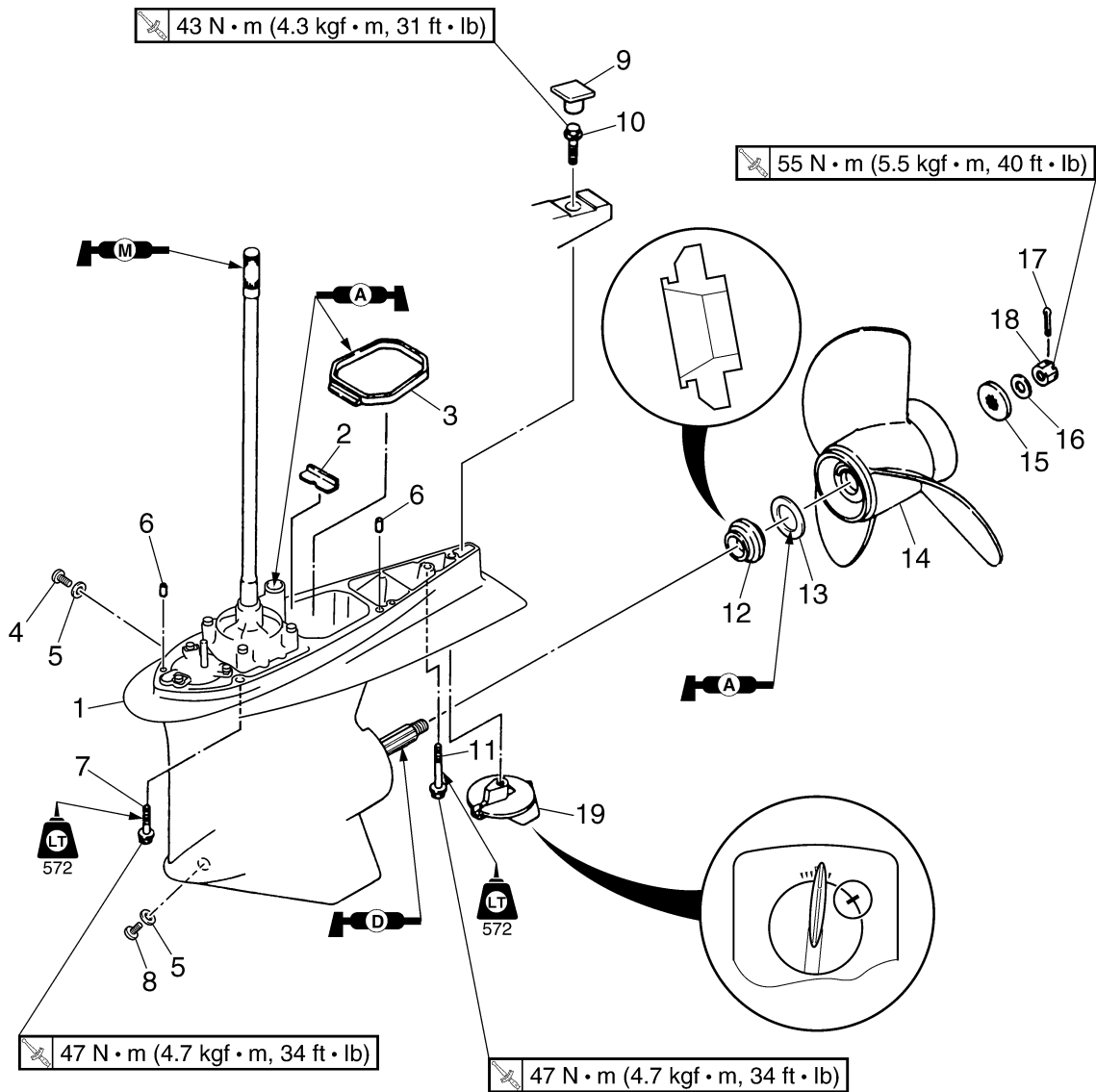
Ring nut wrench
90890-06578



Flywheel puller
90890-06521



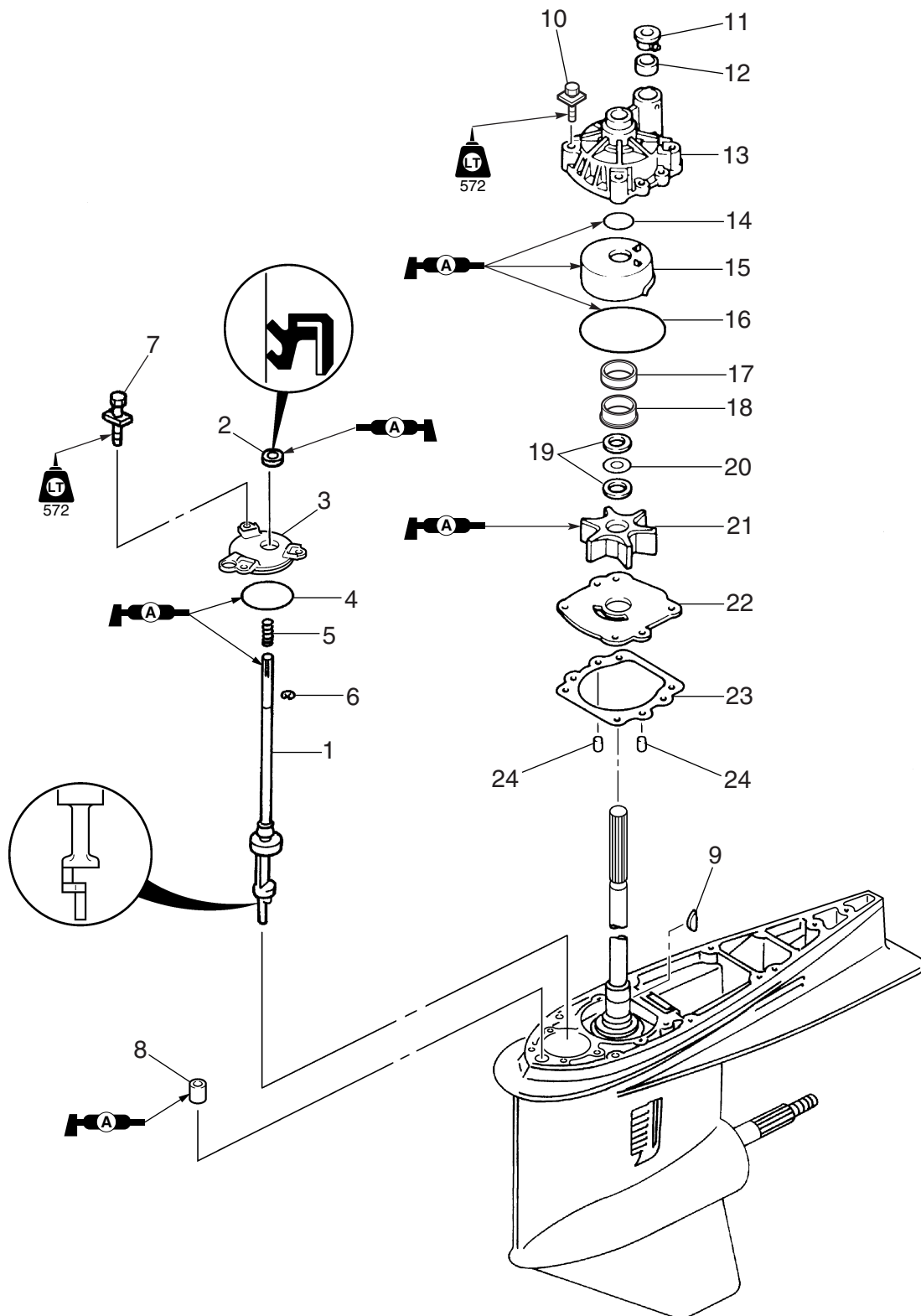
Lower unit (regular rotation model)



S69J6005

Lower unit (regular rotation model)

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	Dowel pin	2	
7	Bolt	7	M10 × 45 mm
8	Drain screw	1	
9	Grommet	1	
10	Bolt	1	M10 × 44 mm
11	Bolt	1	M10 × 70 mm
12	Spacer	1	
13	Washer	1	
14	Propeller	1	
15	Washer	1	
16	Washer	1	
17	Cotter pin	1	Not reusable
18	Propeller nut	1	
19	Trim tab	1	



S69J6010

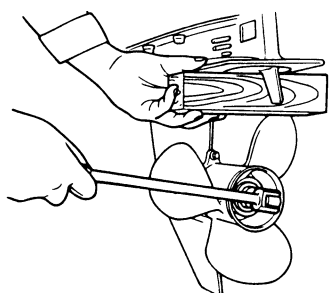
Lower unit (regular rotation model)

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 3.1 × 70.6 mm
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 2.5 × 42 mm
15	Insert cartridge	1	
16	O-ring	1	Not reusable 2.5 × 91.5 mm
17	Collar	1	
18	Spacer	1	
19	Washer	2	
20	Wave washer	1	
21	Impeller	1	
22	Outer plate cartridge	1	
23	Gasket	1	Not reusable
24	Dowel pin	2	



Removing the lower unit

1. Drain the gear oil. For draining procedures, see Chapter 3, "Changing the gear oil."
2. Set the gearshift 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.

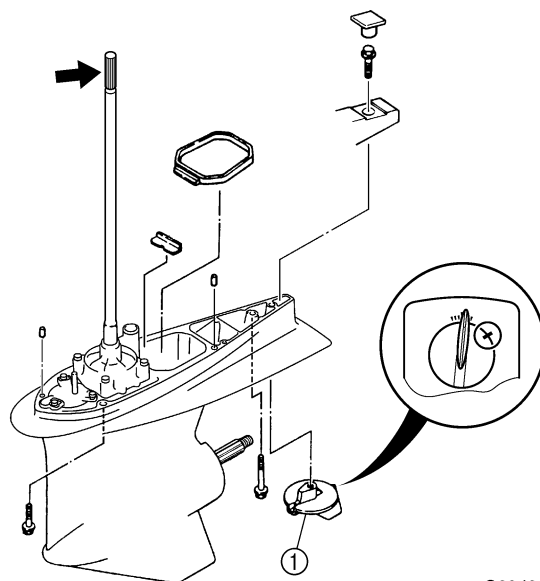


S69J6015

⚠ WARNING

Do not hold the propeller with your hands when loosening or tightening it. Be sure to disconnect the battery cables from the batteries and 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.



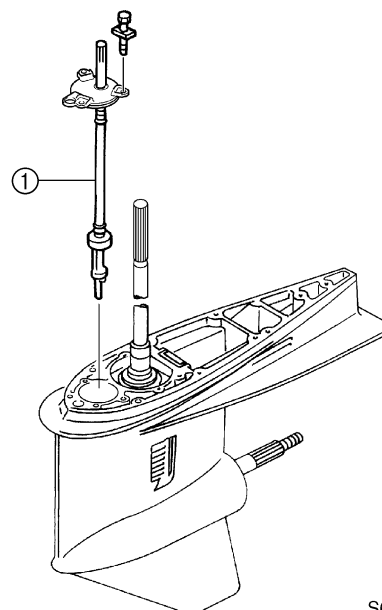
S69J6020

NOTE:

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

Removing the water pump and shift rod

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

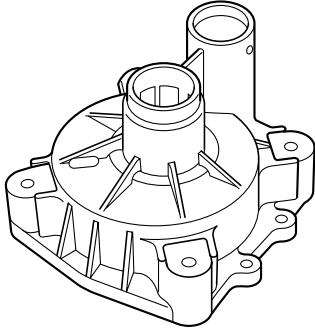


S69J6025

Lower unit (regular rotation model)

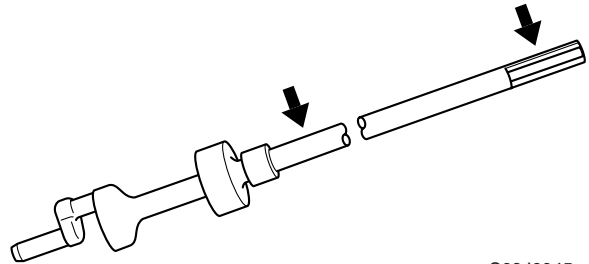
Checking the water pump and shift rod

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



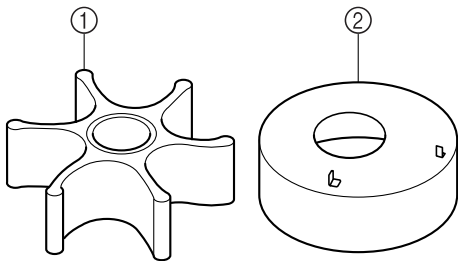
S69J6030

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



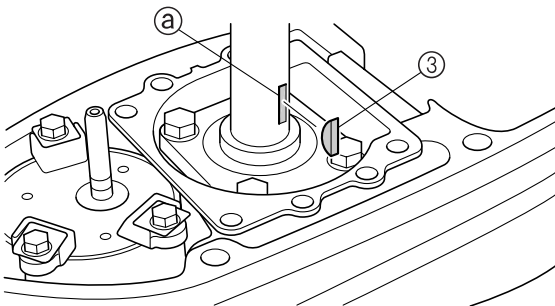
S69J6045

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



S69J6035

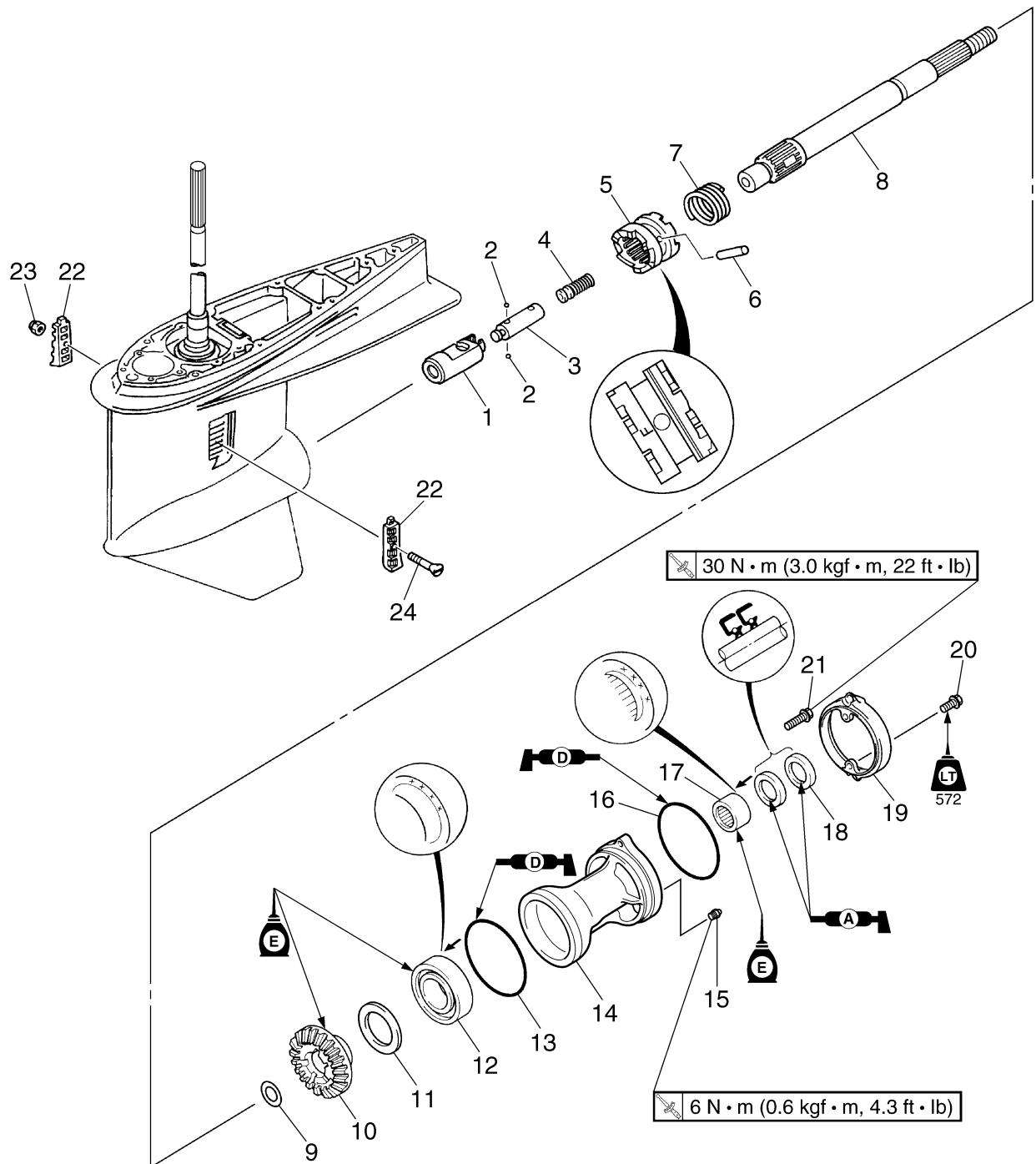
3. Check the Woodruff key ③ and the groove ④ on the drive shaft for wear. Replace if necessary.



S69J6040



Propeller shaft housing (regular rotation model)



S69J6050

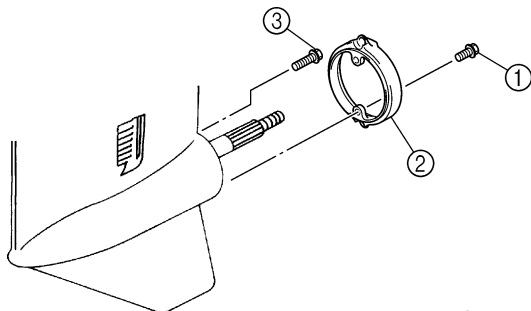
Propeller shaft housing (regular rotation model)

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	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 3.1 × 110.6 mm
14	Propeller shaft housing	1	
15	Grease nipple	1	
16	O-ring	1	Not reusable
17	Needle bearing	1	
18	Oil seal	2	Not reusable 3.1 × 110.6 mm
19	Ring	1	
20	Bolt	2	M8 × 20 mm
21	Bolt	2	M8 × 30 mm
22	Cooling water inlet cover	2	
23	Nut	1	
24	Screw	1	



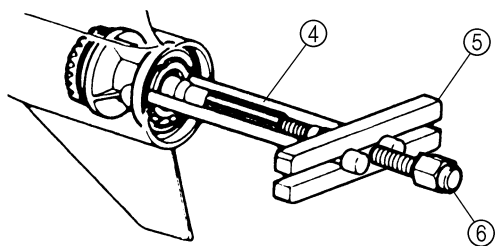
Removing the propeller shaft housing assembly

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



S69J6055

2. Pull out the propeller shaft housing assembly.



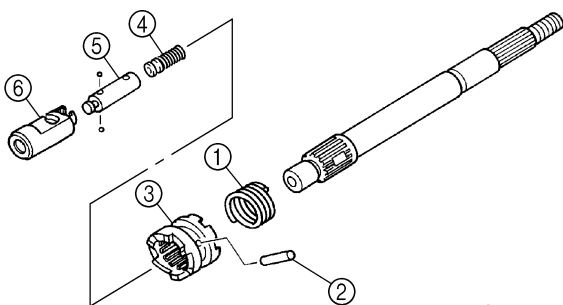
S69J6065



Bearing housing puller claw L ④:
90890-06502
Stopper guide plate ⑤: 90890-06501
Center bolt ⑥: 90890-06504

Disassembling the propeller shaft assembly

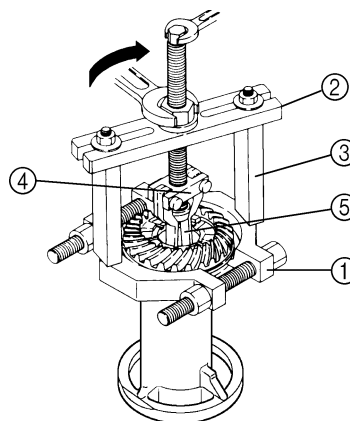
1. Remove the spring ①, and then remove the cross pin ②, dog clutch ③, slider ④, shift plunger ⑤, and shift rod joint ⑥.



S69J6100

Disassembling the propeller shaft housing

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

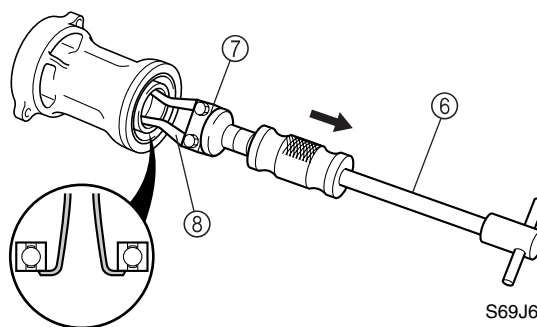


S69J6075



Bearing separator ①: 90890-06534
Stopper guide plate ②: 90890-06501
Stopper guide stand ③:
90890-06538
Bearing puller ④: 90890-06535
Bearing puller claw 1 ⑤:
90890-06536

2. Remove the ball bearing.



S69J6085

CAUTION:

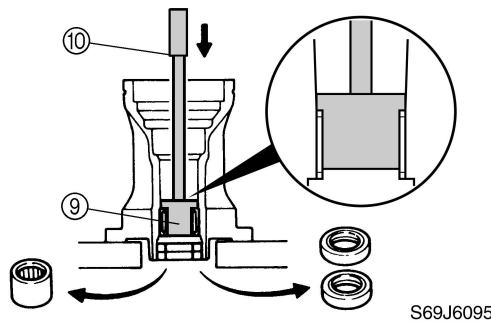
Do not reuse the bearing, always replace it with a new one.



Slide hammer ⑥: 90890-06531
Bearing outer race puller ⑦:
90890-06523
Outer race puller claw A ⑧:
90890-06532

Propeller shaft housing (regular rotation model)

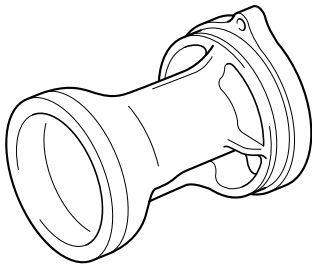
3. Remove the oil seals and needle bearing.



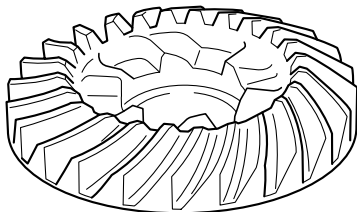
Needle bearing attachment ⑨:
90890-06653
Driver rod L3 ⑩: 90890-06652

Checking the propeller shaft housing

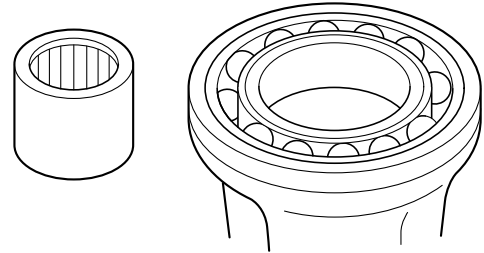
1. Clean the propeller shaft housing using a soft brush and cleaning solvent, and then check it for cracks or damage. Replace if necessary.



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

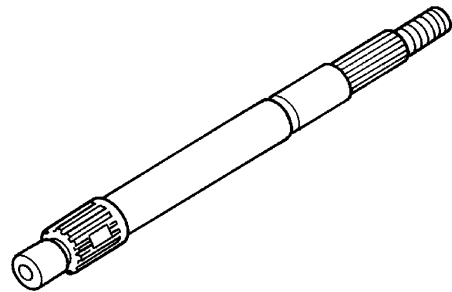


3. Check the bearings for pitting or rumbling. Replace if necessary.

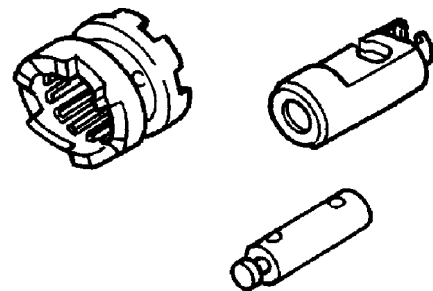


Checking the propeller shaft

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



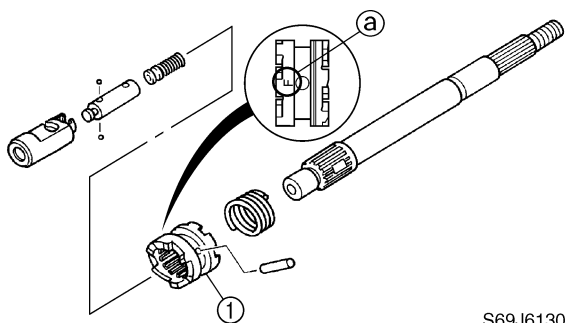
2. Check the dog clutch, shift rod joint, and shift slider for cracks or wear. Replace if necessary.





Assembling the propeller shaft assembly

1. Install the dog clutch ① as shown.



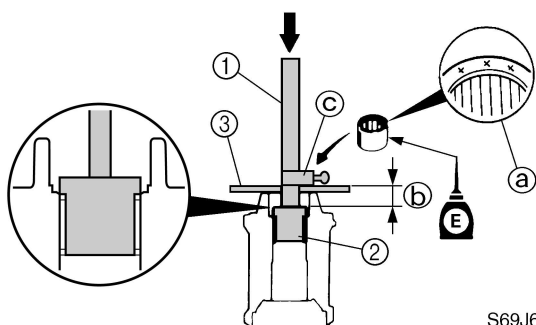
S69J6130

NOTE:

Install the dog clutch ① with the “F” 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.



S69J6140

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

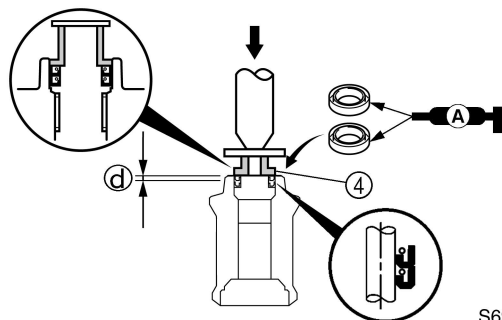
Bearing depth plate ③: 90890-06603



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.



S69J6150

NOTE:

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

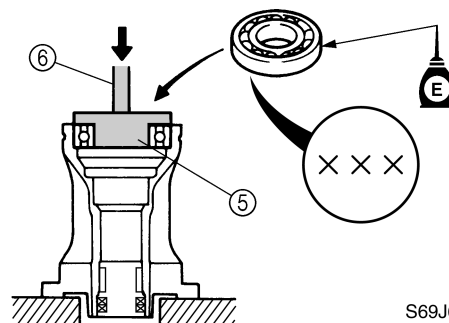


Bearing inner race attachment ④:
90890-06640



Depth ⑤:
4.75–5.25 mm (0.187–0.207 in)

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



S69J6155

NOTE:

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

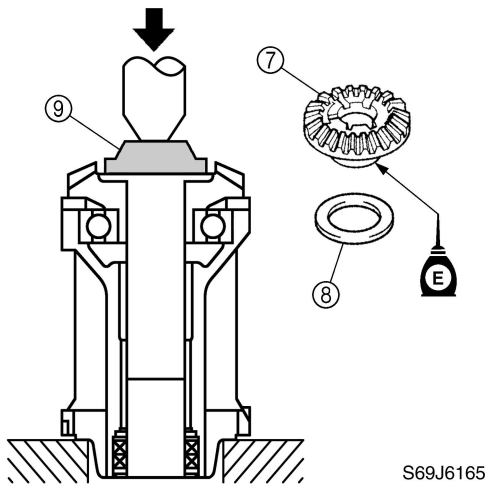


Ball bearing attachment ⑤:
90890-06656

Driver rod LS ⑥: 90890-06606

Propeller shaft housing (regular rotation model)

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



CAUTION:

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



Bearing outer race attachment ⑨:
90890-06622

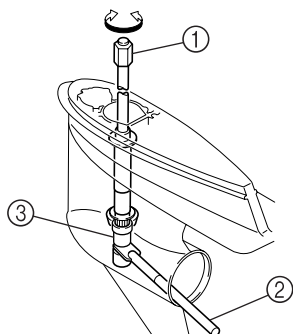
Drive shaft and lower case (regular rotation model)

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 3 × 60.5 mm
8	Pinion shim	—	As required
9	Thrust bearing	1	
10	Lower case	1	
11	Needle bearing outer case	1	
12	Needle bearing	24	
13	Pinion	1	
14	Washer	1	
15	Nut	1	
16	Forward gear shim	—	As required
17	Bearing outer race	1	Not reusable
18	Taper roller bearing	1	Not reusable
19	Forward gear	1	



Removing the drive shaft

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



S69J6180



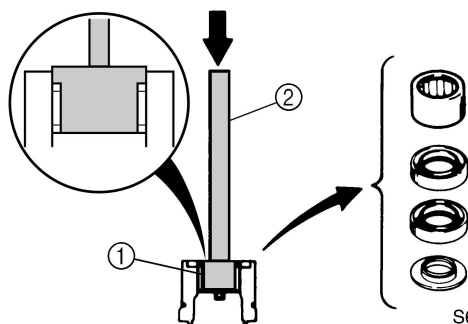
Drive shaft holder 6 ①: 90890-06520

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

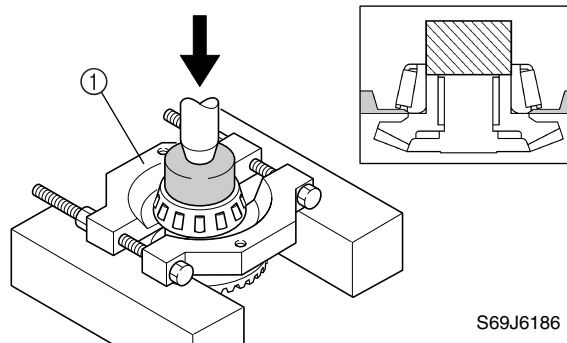


Needle bearing attachment ①:
90890-06610

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:

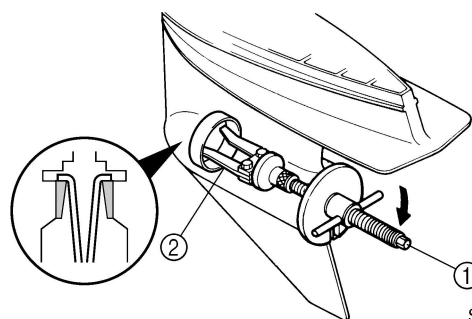
Do not reuse the bearing, always replace it with a new one.



Bearing separator ①: 90890-06534

Disassembling the lower case

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



S69J6190

NOTE:

Install the claws as shown.

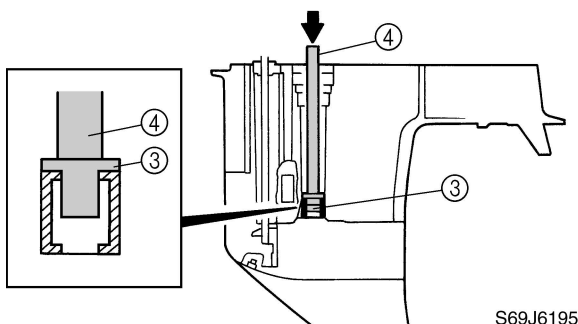


Bearing outer race puller ①:
90890-06523

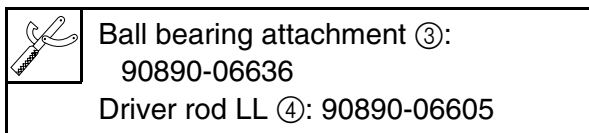
Outer race puller claw A ②:
90890-06532

2. Remove the needle bearing.

Drive shaft and lower case (regular rotation model)

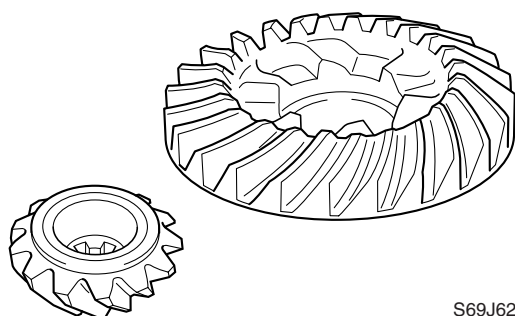


S69J6195



Checking the pinion and forward gear

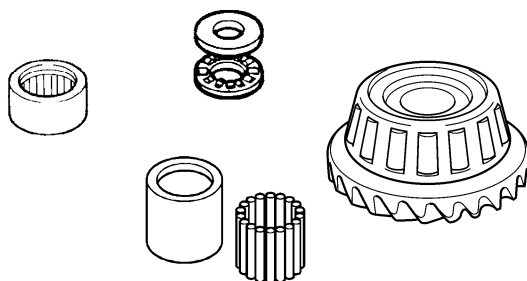
1. Check the teeth of the pinion, and the teeth and dogs of the forward gear for cracks or wear. Replace if necessary.



S69J6200

Checking the bearings

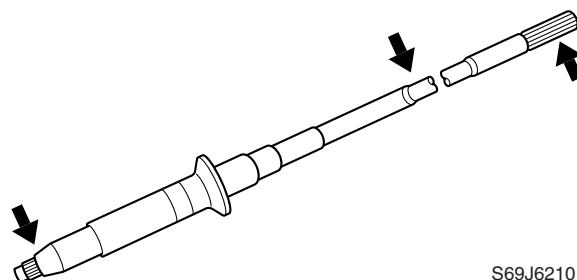
1. Check the bearings for pitting or rumbling. Replace if necessary.



S69J6205

Checking the drive shaft

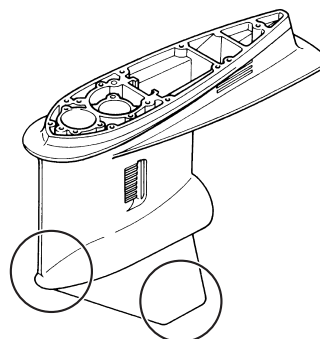
1. Check the drive shaft for bends or wear. Replace if necessary.



S69J6210

Checking the lower case

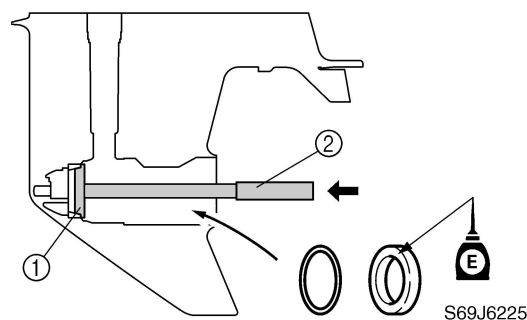
1. Check the skag and torpedo for cracks or damage. Replace if necessary.



S69J6215

Assembling the lower case

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



S69J6225

CAUTION:

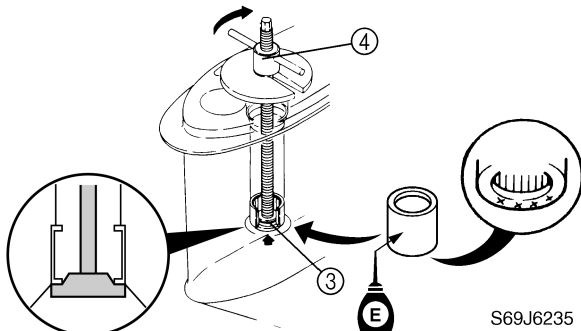
Add or remove shim(s), if necessary, when replacing the forward gear or lower case.



Bearing outer race attachment ①: 90890-06658
Driver rod LL ②: 90890-06605

6

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 ④:
90890-06523

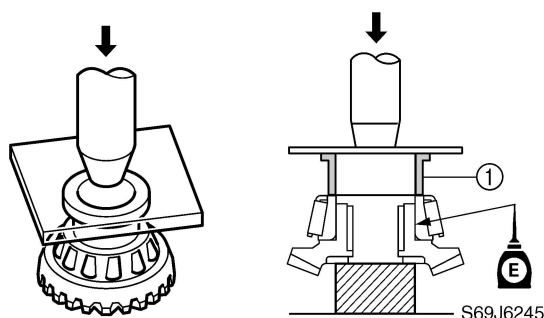
3. Install the needle bearing into the needle bearing outer case.

NOTE:

Apply engine oil or grease to the needle bearing, and then install it.

Assembling the forward gear

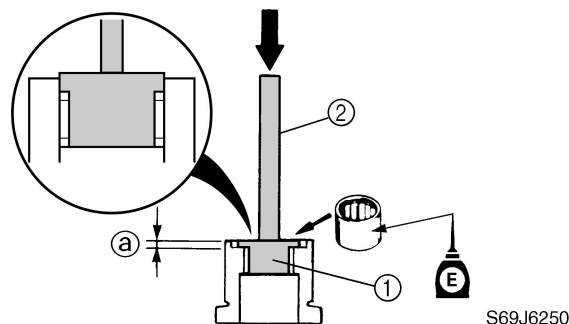
1. Install the new taper roller bearing into the forward gear using a press.



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.

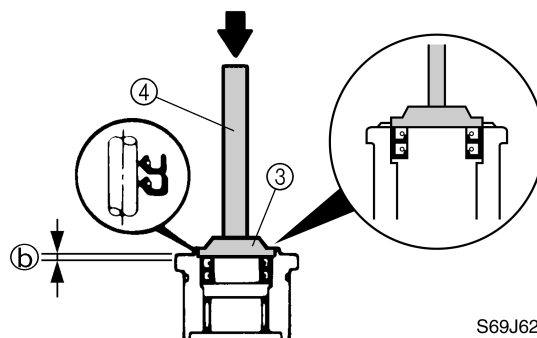


Needle bearing attachment ①:
90890-06610
Driver rod LS ②: 90890-06606



Depth (a):
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



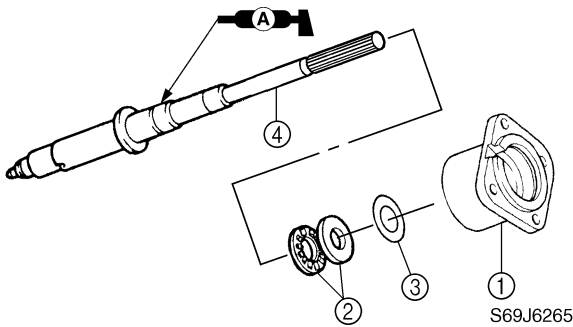
Depth (b):
0.25–0.75 mm (0.01–0.03 in)

Installing the drive shaft

1. Install the forward gear to the lower case.

Drive shaft and lower case (regular rotation model)

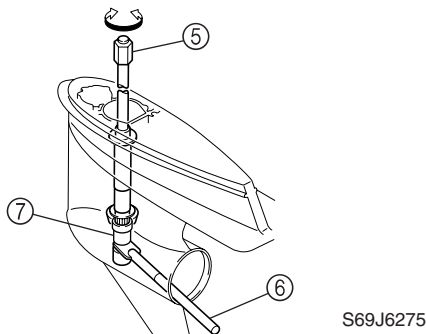
2. Install the drive shaft housing ①, thrust bearing ②, and original shim(s) ③ to the drive shaft ④.



CAUTION:

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

3. Install the drive shaft and drive shaft housing to 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

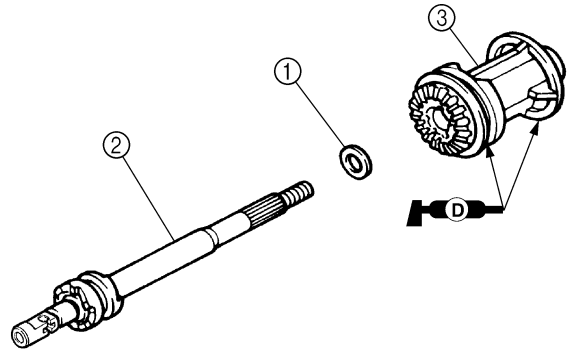


Pinion nut:
142 N·m (14.2 kgf·m, 103 ft·lb)

4. Tighten the drive shaft housing bolts.

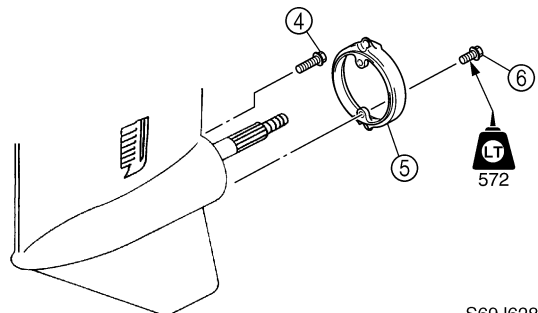
Installing the propeller shaft housing

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.
4. Install the bolts ④, ring ⑤, and bolts ⑥, and then tighten the bolts ④ to the specified torque.



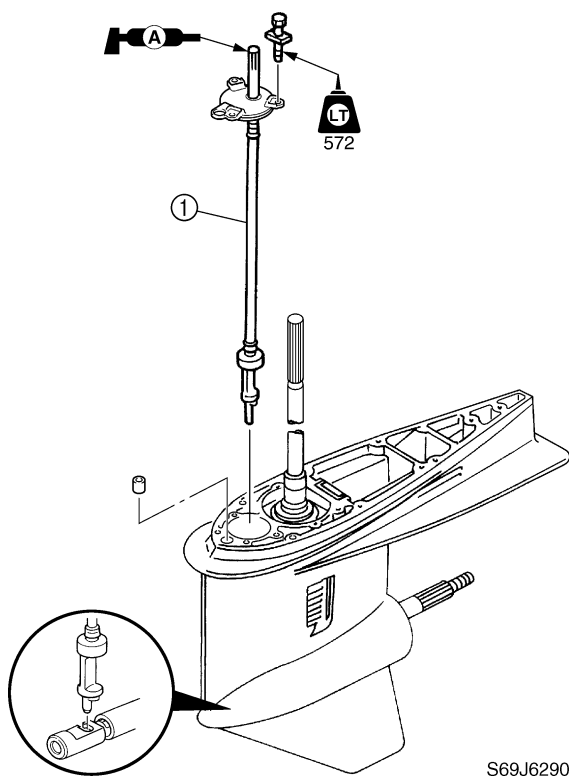
S69J6285



Propeller shaft housing bolt ④:
30 N·m (3.0 kgf·m, 22 ft·lb)

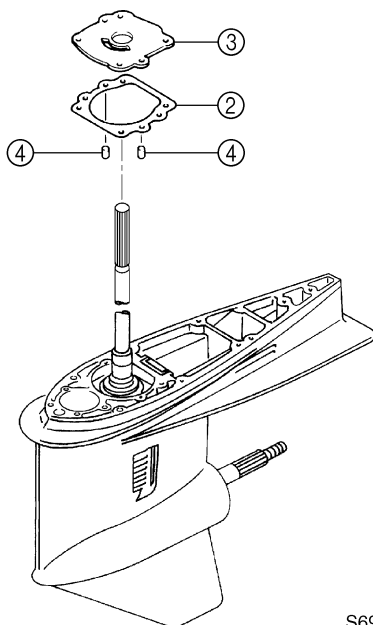
Installing the water pump and shift rod

1. Install the shift rod assembly ①.



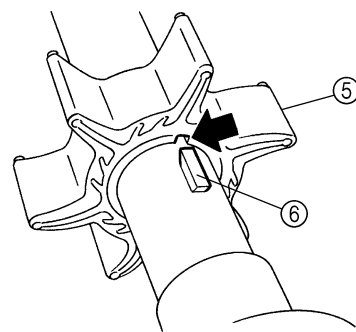
S69J6290

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



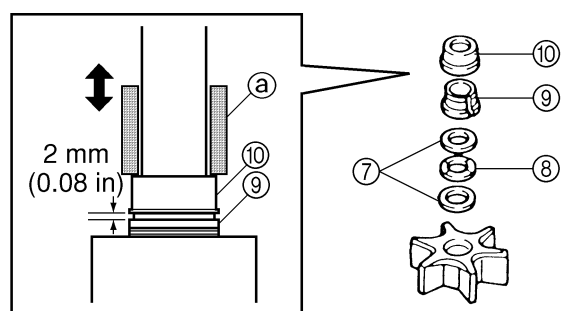
S69J6295

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 it to the drive shaft.



S69J6300

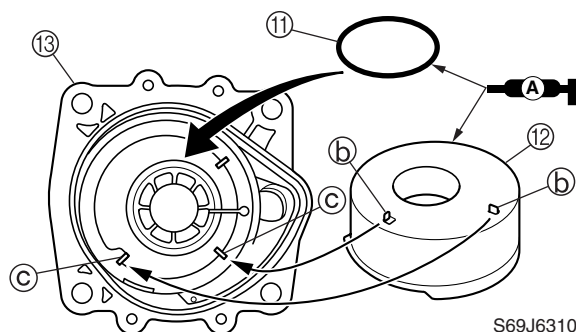
5. Install the washers (7), wave washer (8), spacer (9), and collar (10) to the drive shaft.



S69J6305

- 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).

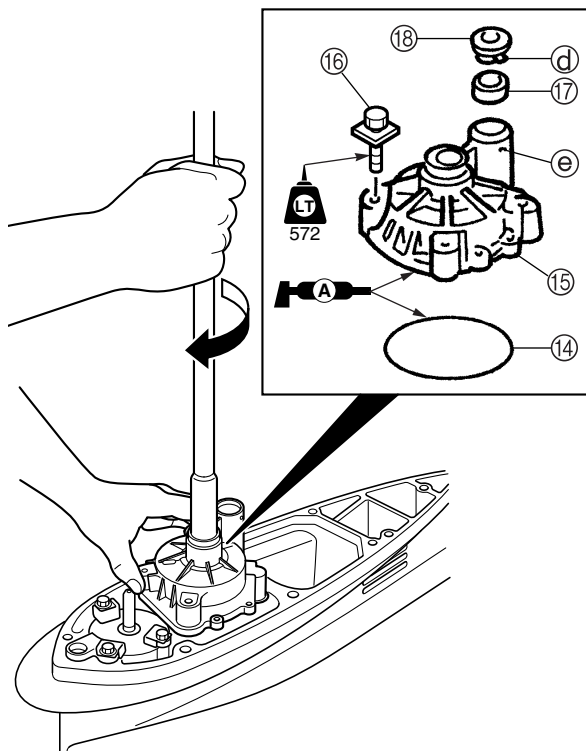


S69J6310

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



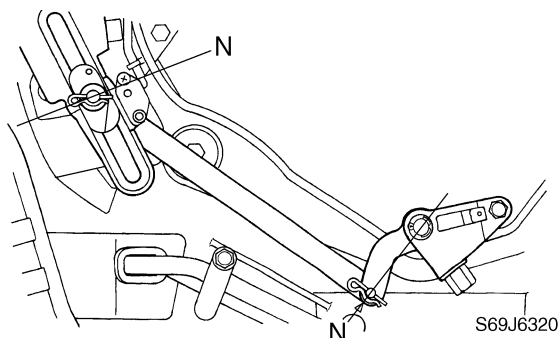
S69J6315

NOTE:

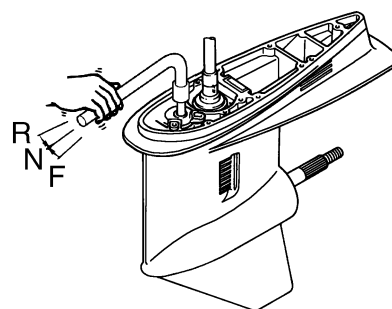
- When installing the pump housing, apply grease to the inside of the housing, and then turn the drive shaft clockwise while pushing down the pump housing.
- Align the cover projection ⑱ with the hole ⑫ in the pump housing.

Installing the lower unit

1. Set the gearshift to the neutral position at the lower unit.



S69J6320

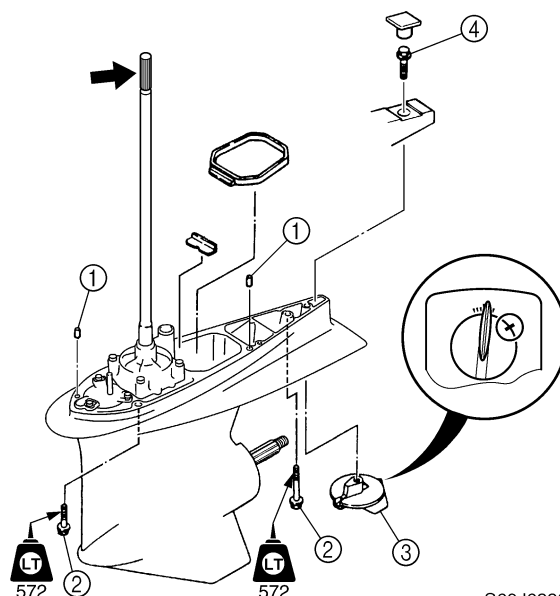


S69J6325



Shift rod push arm: 90890-06052

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



S69J6330



Lower case bolts ②:

47 N·m (4.7 kgf·m, 34 ft·lb)

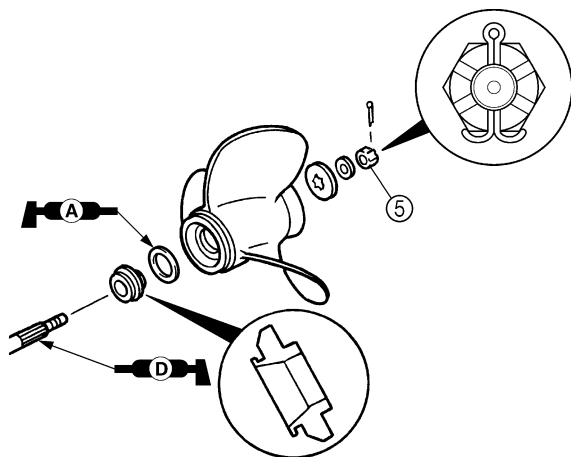
Trim tab bolt ④:

43 N·m (4.3 kgf·m, 31 ft·lb)

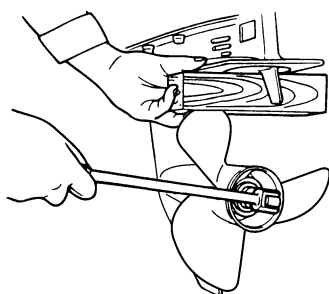
6



5. 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.



S69J6335



S69J6340

⚠ WARNING

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

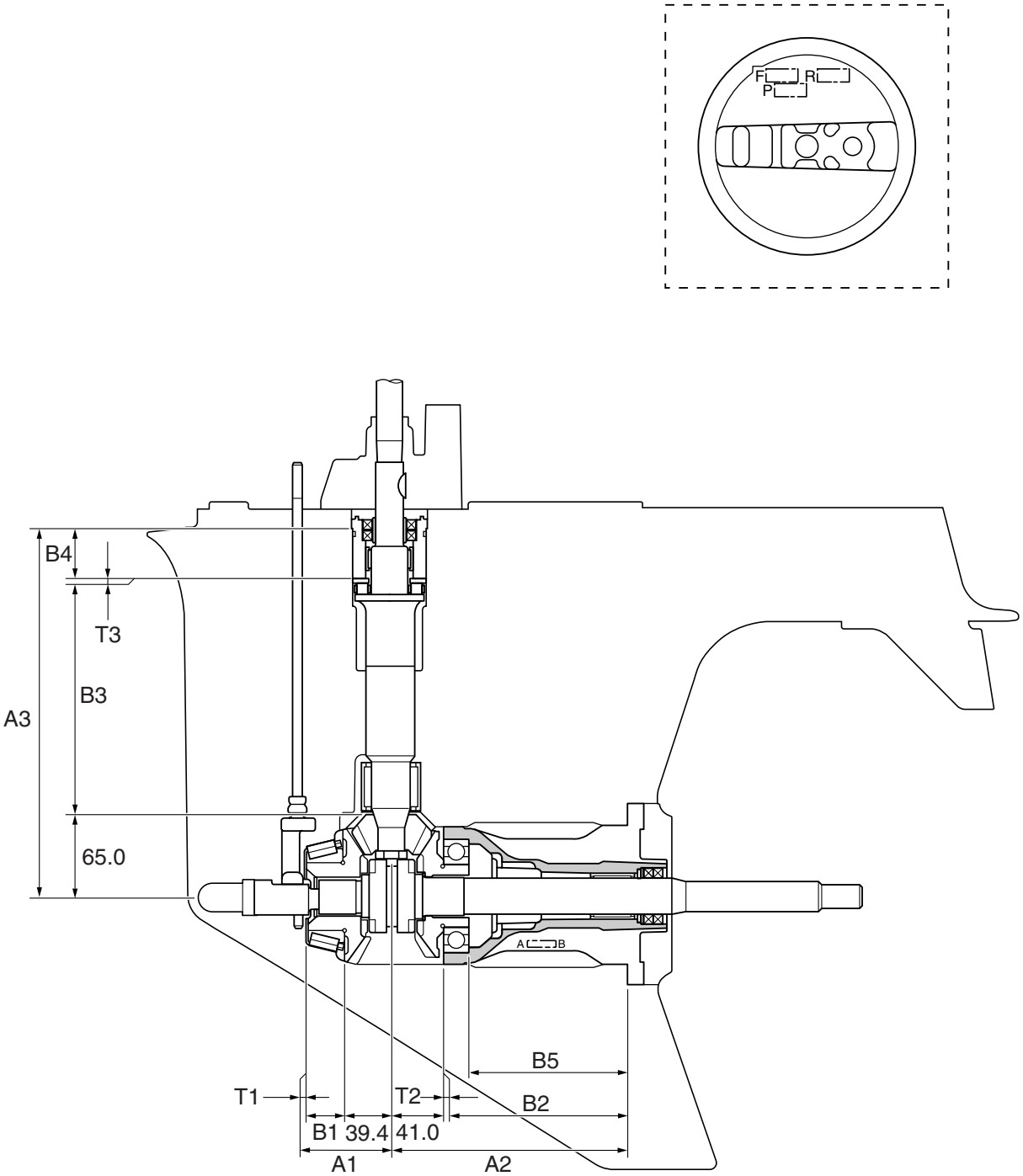
NOTE:

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:
55 N·m (5.5 kgf·m, 40 ft·lb)

Shimming (regular rotation model)



6

S69J6550



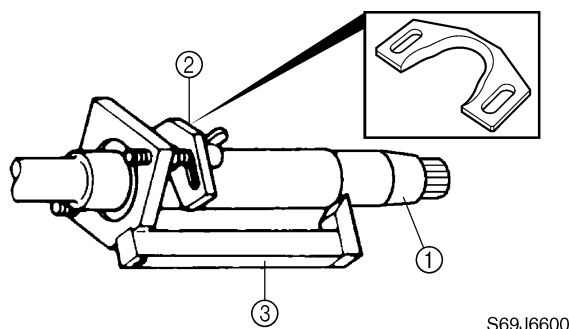
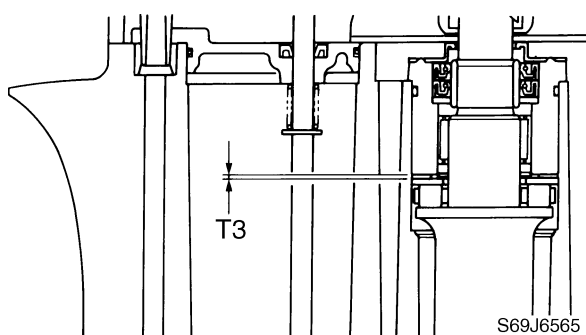
Shimming

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 drive shaft ① to the shimming tools.



NOTE:

- Select the shim thickness (T3) by using the specified measurement(s) and the calculation formula.
- Install the shimming tool to 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.



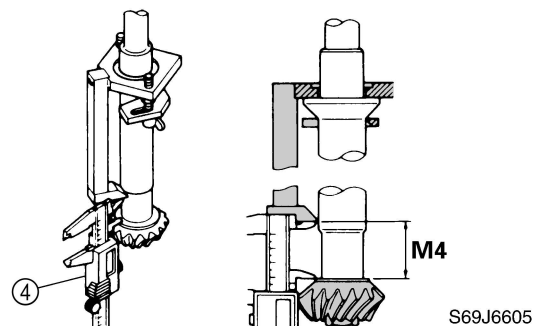
Pinion height gauge ③:
90890-06702

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



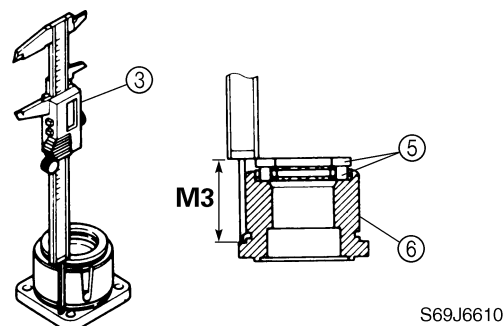
Pinion nut:
142 N·m (14.2 kgf·m, 103 ft·lb)

3. Measure the distance (M4) between the shimming 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.

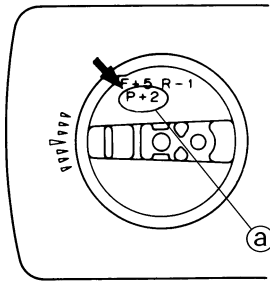


NOTE:

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

Shimming (regular rotation model)

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:

$$\text{Pinion shim thickness (T3)} = 82.00 + P/100 - M3 - M4$$

Example:

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

$$\begin{aligned} T3 &= 82.00 + (-5)/100 - 50.75 - 30.52 \text{ mm} \\ &= 82.00 - 0.05 - 50.75 - 30.52 \text{ mm} \\ &= 0.68 \text{ mm} \end{aligned}$$

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

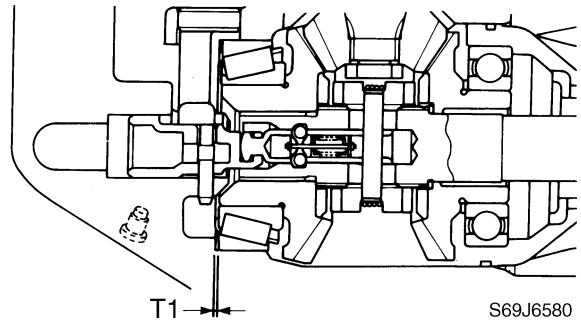
Example:

If “T3” is 0.68 mm, then the pinion shim is 0.65 mm.

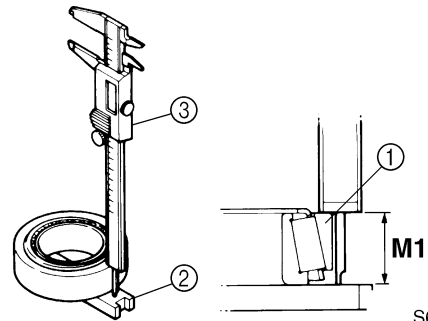
If “T3” is 0.70 mm, then the pinion shim is 0.68 mm.

Selecting the forward gear shims

- 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:

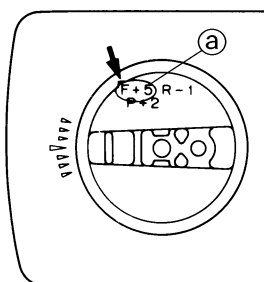
- Select the shim thickness (T1) by using the specified measurement(s) and the calculation formula.
- Measure the bearing outer race at three points to find the height average.



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:

$$\begin{aligned} \text{If "M1" is 29.10 mm and "F" is (+5), then} \\ T1 &= 29.50 + (+5)/100 - 29.10 \text{ mm} \\ &= 29.50 + 0.05 - 29.10 \text{ mm} \\ &= 0.45 \text{ mm} \end{aligned}$$

- 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

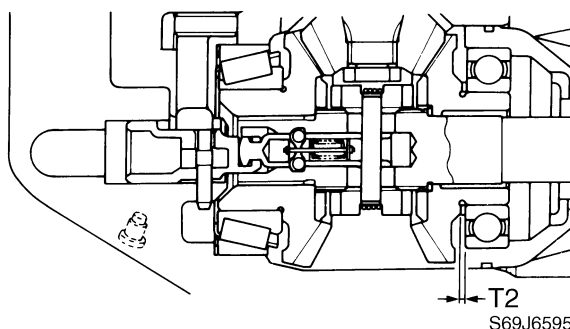
Example:

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

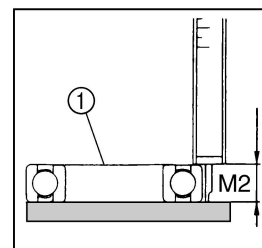
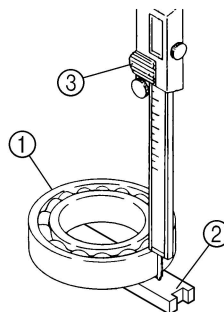
If "T1" is 0.60 mm, then the forward gear shim is 0.58 mm.

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:

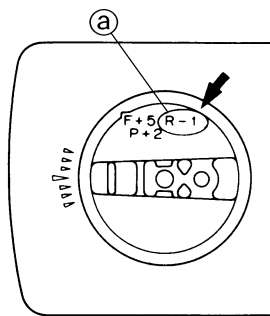
- Select the shim thickness (T2) by using the specified measurement(s) and the calculation formula.
- Measure the reverse gear at three points to find the height average.



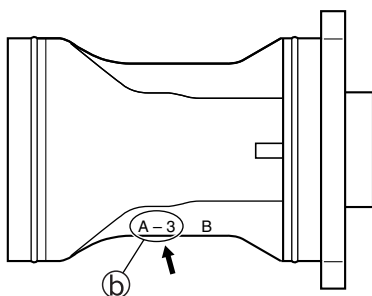
Shimming plate (2): 90890-06701
Digital caliper (3): 90890-06704

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

Shimming (regular rotation model) / Backlash (regular rotation model)



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 (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:

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

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.

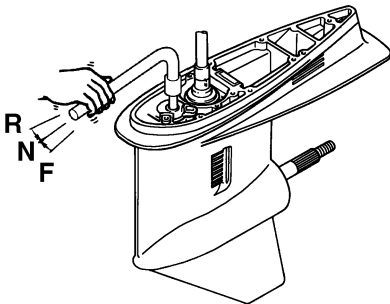
If “T2” is 1.20 mm, then the reverse gear shim is 1.18 mm.

Backlash

(regular rotation model)

Measuring the forward and reverse gear backlash

1. Remove the water pump assembly.
2. Set the gearshift to the neutral position.

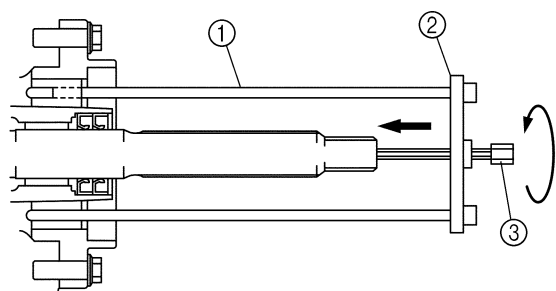


S69J6635



Shift rod push arm: 90890-06052

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



S69J6645

NOTE:

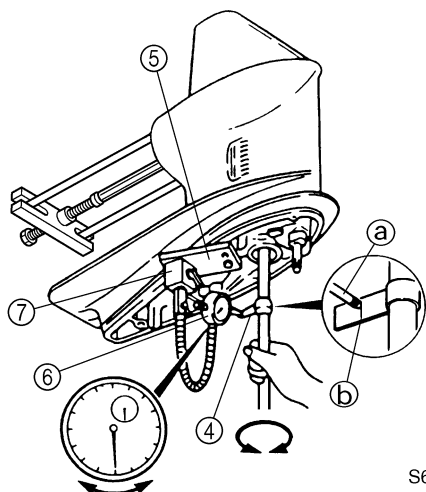
Tighten the universal puller or center bolt while turning the drive shaft until the drive shaft can no longer be turned.



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.



S69J6655

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:
0.21–0.44 mm (0.008–0.017 in)

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

Forward gear backlash	Shim thickness
Less than 0.21 mm (0.008 in)	To be decreased by $(0.33 - M) \times 0.71$
More than 0.44 mm (0.017 in)	To be increased by $(M - 0.33) \times 0.71$

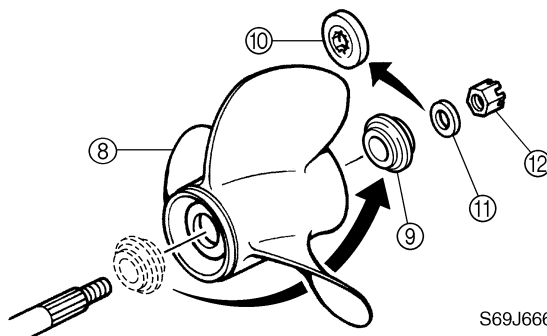
M: Measurement

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.

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.



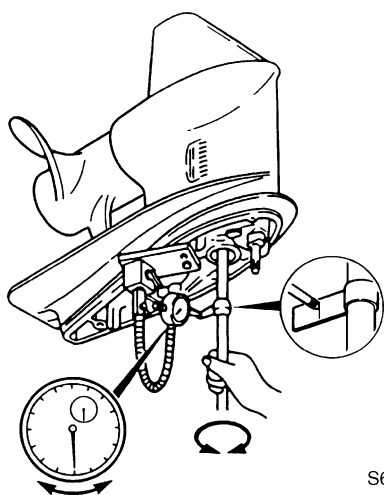
S69J6660

Backlash (regular rotation model)

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:
0.70–1.03 mm (0.028–0.041 in)

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

Reverse gear backlash	Shim thickness
Less than 0.70 mm (0.028 in)	To be increased by $(0.87 - M) \times 0.71$
More than 1.03 mm (0.041 in)	To be decreased by $(M - 0.87) \times 0.71$

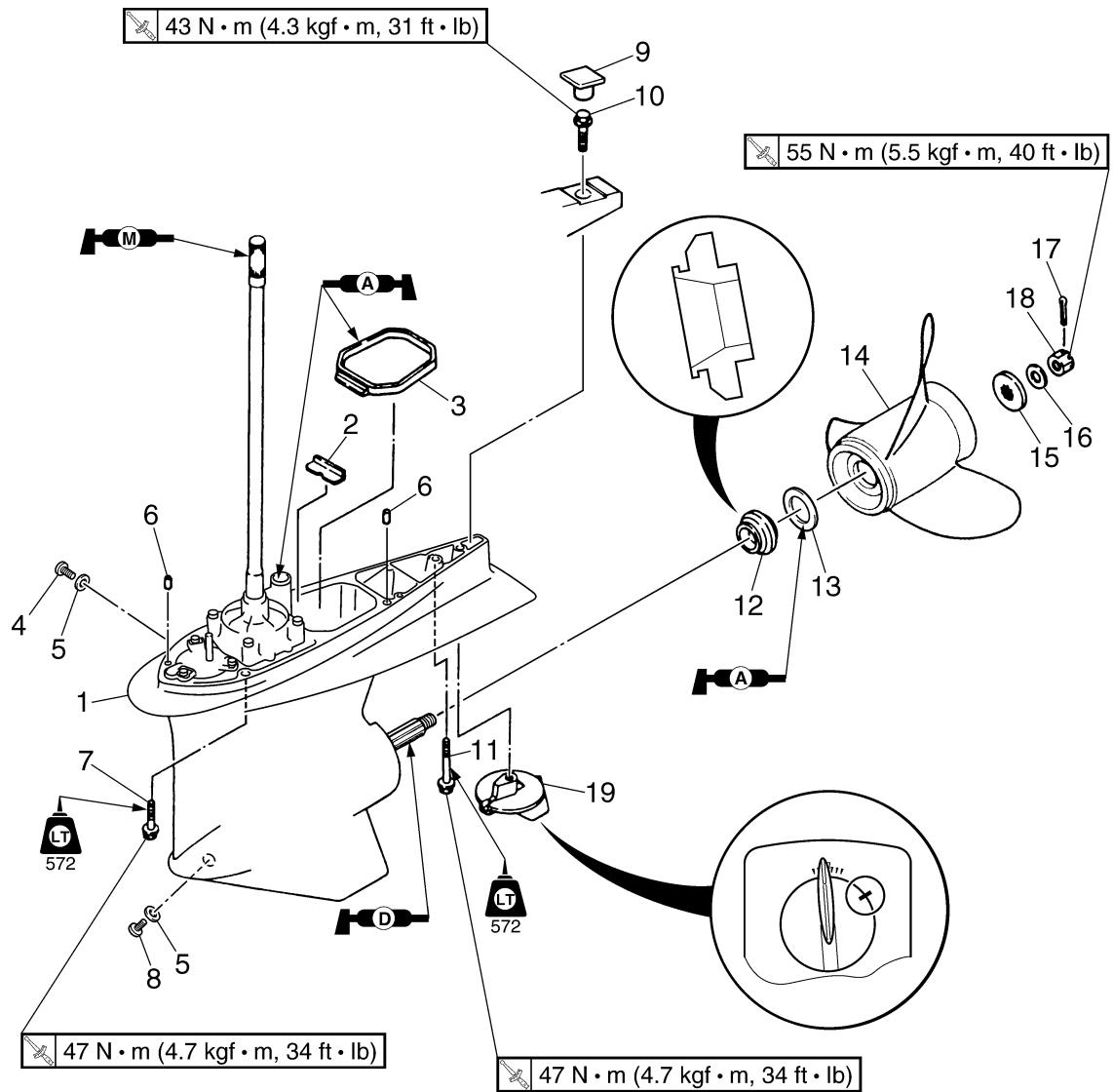
M: Measurement

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.



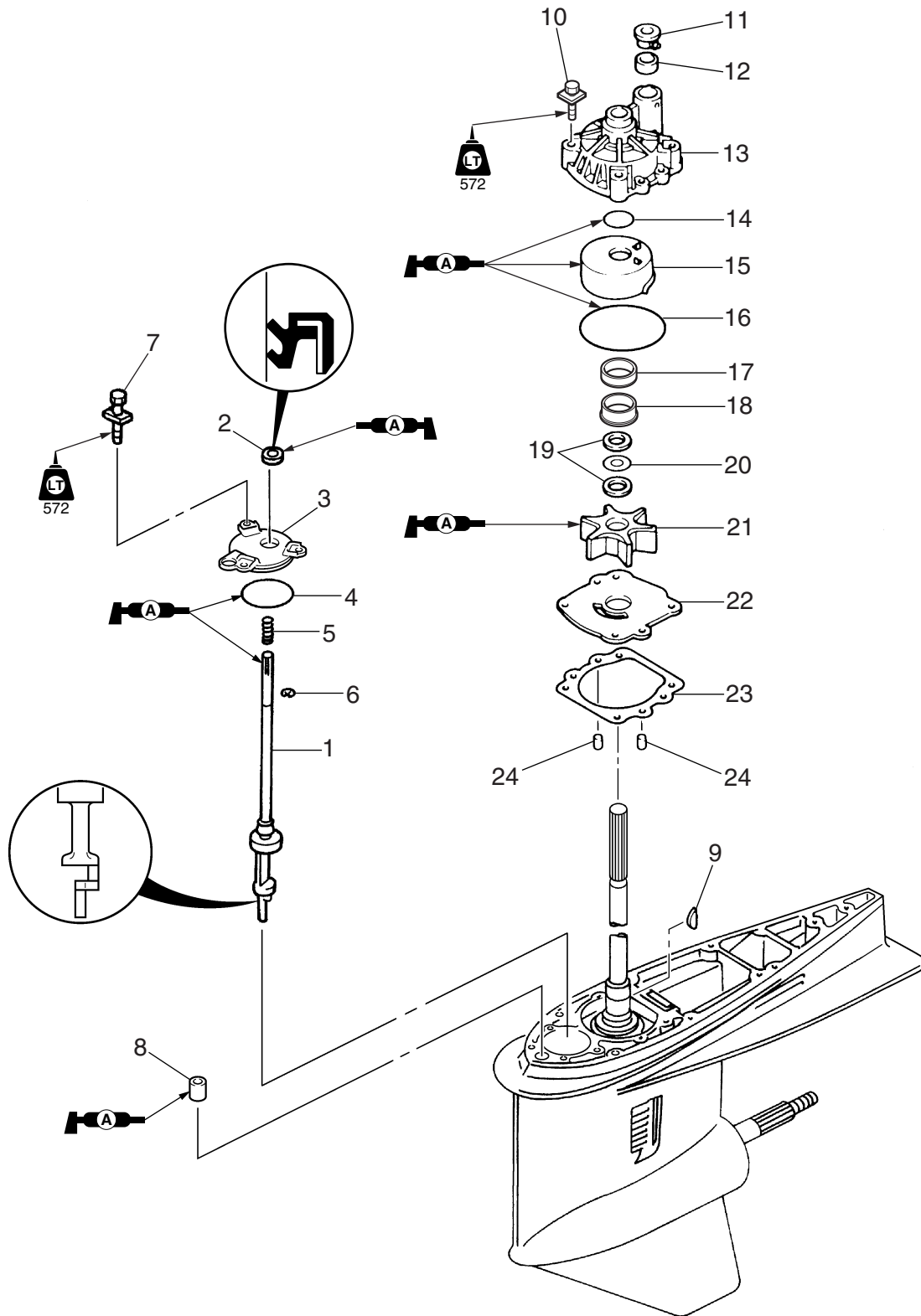
Lower unit (counter rotation model)



S69J6345

Lower unit (counter rotation model)

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	Dowel pin	2	
7	Bolt	7	M10 × 45 mm
8	Drain screw	1	
9	Grommet	1	
10	Bolt	1	M10 × 44 mm
11	Bolt	1	M10 × 70 mm
12	Spacer	1	
13	Washer	1	
14	Propeller	1	
15	Washer	1	
16	Washer	1	
17	Cotter pin	1	Not reusable
18	Propeller nut	1	
19	Trim tab	1	



S69J6350

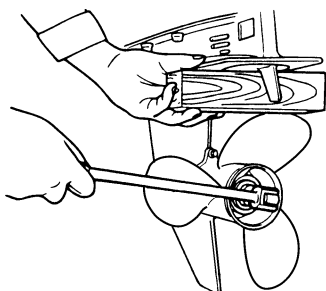
Lower unit (counter rotation model)

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 3.1 × 70.6 mm
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 2.5 × 42 mm
15	Insert cartridge	1	
16	O-ring	1	Not reusable 2.5 × 91.5 mm
17	Collar	1	
18	Spacer	1	
19	Washer	2	
20	Wave washer	1	
21	Impeller	1	
22	Outer plate cartridge	1	
23	Gasket	1	Not reusable
24	Dowel pin	2	



Removing the lower unit

1. Drain the gear oil. For draining procedures, see Chapter 3, "Changing the gear oil."
2. Set the gearshift 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.

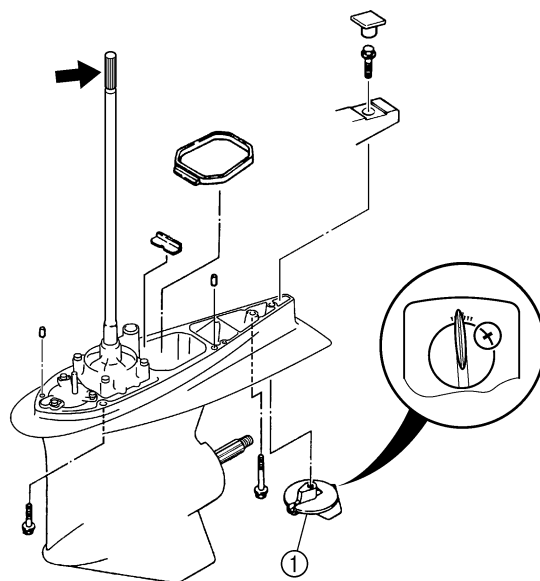


S69J6545

⚠ WARNING

Do not hold the propeller with your hands when loosening or tightening it. Be sure to disconnect the battery cables from the batteries and 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.



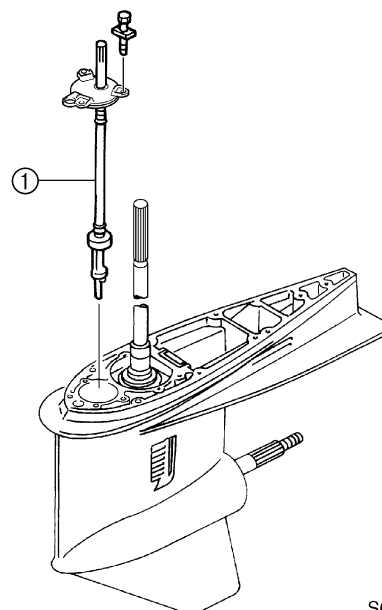
S69J6355

NOTE:

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

Removing the water pump and shift rod

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

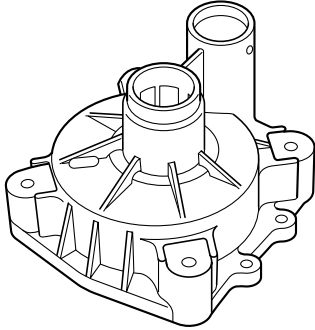


S69J6025

Lower unit (counter rotation model)

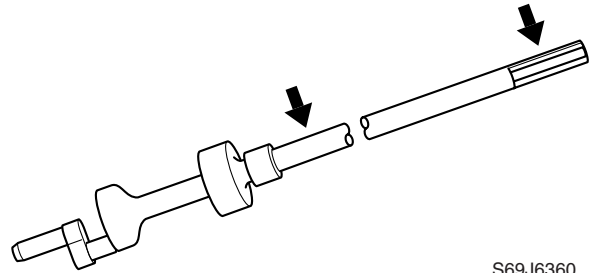
Checking the water pump and shift rod

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



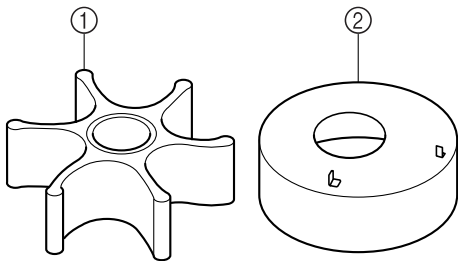
S69J6030

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



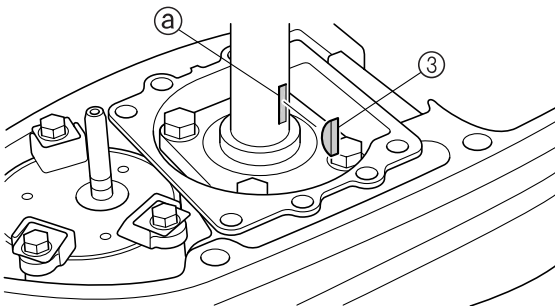
S69J6360

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



S69J6035

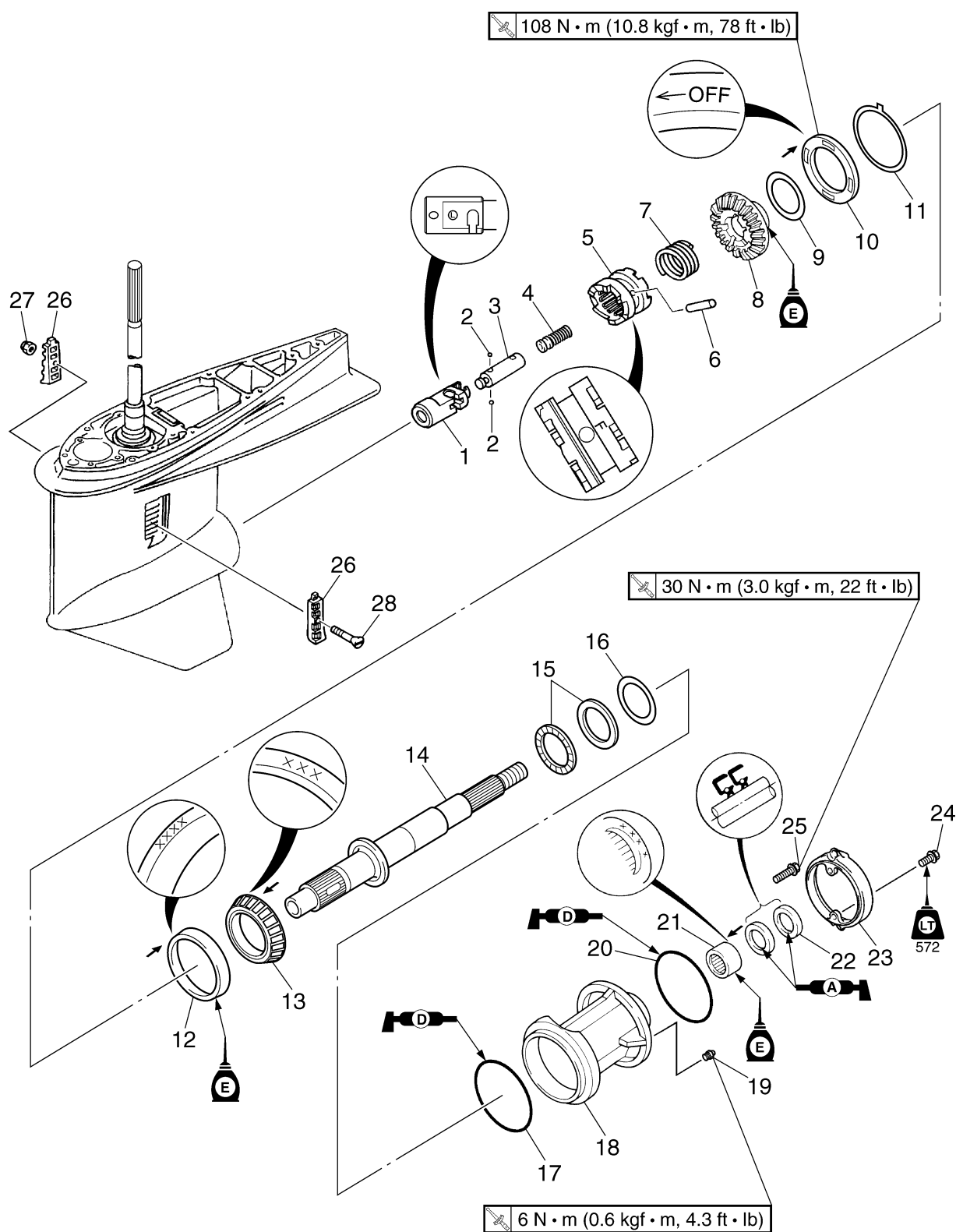
3. Check the Woodruff key ③ and the groove ④ on the drive shaft for wear. Replace if necessary.



S69J6040



Propeller shaft housing (counter rotation model)



S69J6365

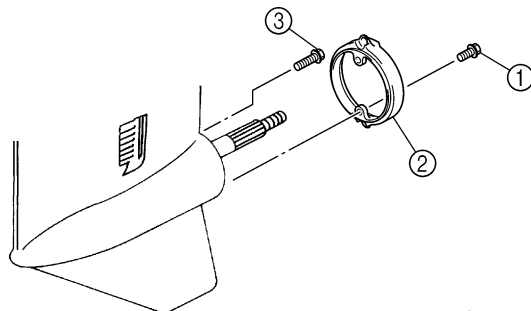
Propeller shaft housing (counter rotation model)

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	Bearing outer race	1	Not reusable
13	Taper roller bearing	1	Not reusable
14	Propeller shaft	1	
15	Thrust bearing	1	
16	Propeller shaft shim	—	As required
17	O-ring	1	Not reusable 3.1 × 110.6 mm
18	Propeller shaft housing	1	
19	Grease nipple	1	
20	O-ring	1	Not reusable
21	Needle bearing	1	
22	Oil seal	2	Not reusable 3.1 × 110.6 mm
23	Ring	1	
24	Bolt	2	M8 × 20 mm
25	Bolt	2	M8 × 30 mm
26	Cooling water inlet cover	2	
27	Nut	1	
28	Screw	1	



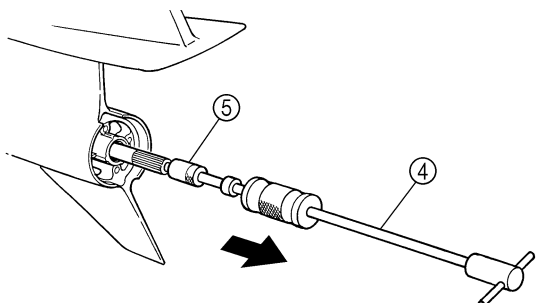
Removing the propeller shaft housing assembly

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



S69J6055

2. Pull out the propeller shaft housing assembly.



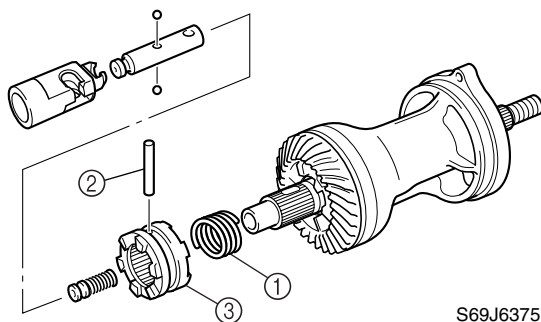
S69J6370



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

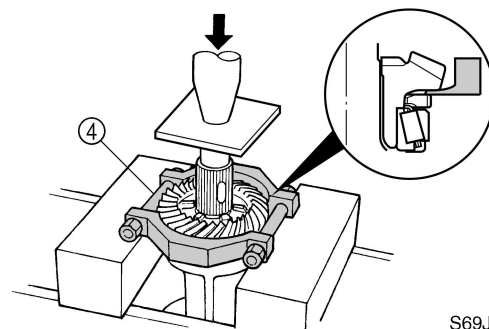
Disassembling the propeller shaft housing

1. Remove the spring ①, and then remove 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.

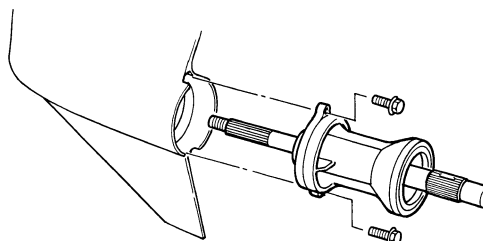


S69J6380



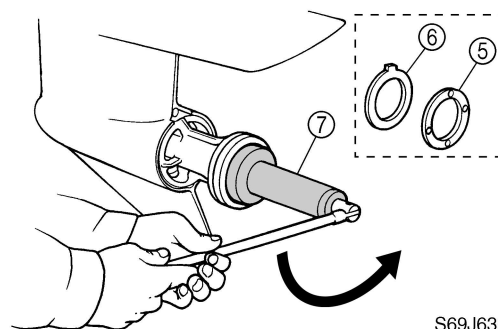
Bearing separator ④: 90890-06534

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.



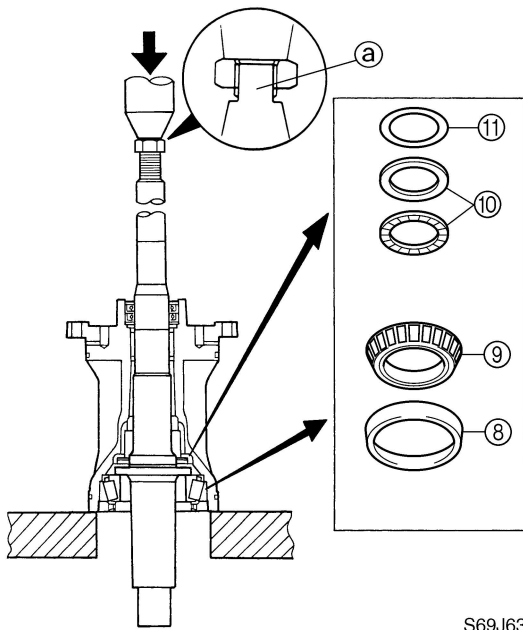
S69J6390



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.

Propeller shaft housing (counter rotation model)

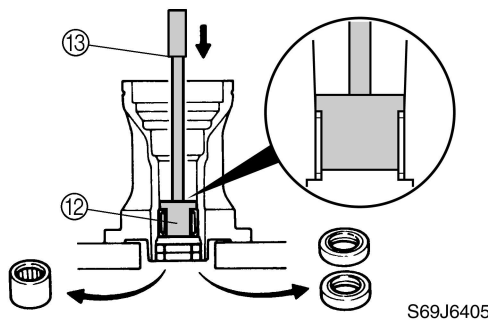


S69J6395

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.



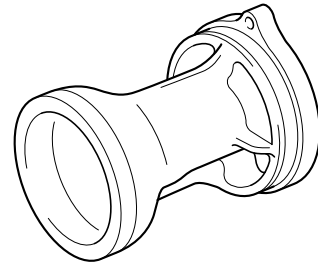
S69J6405



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

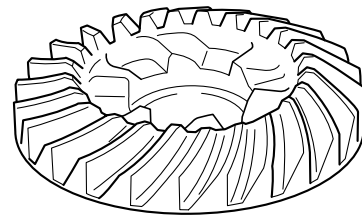
Checking the propeller shaft housing

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



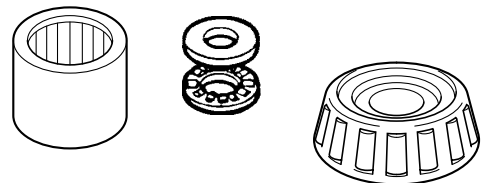
S69J6105

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



S69J6110

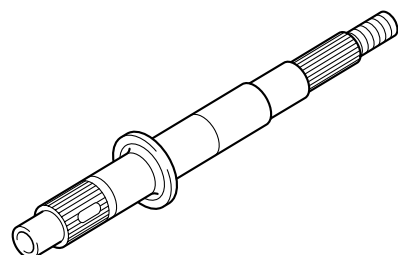
3. Check the bearings for pitting or rumbling. Replace if necessary.



S69J6410

Checking the propeller shaft

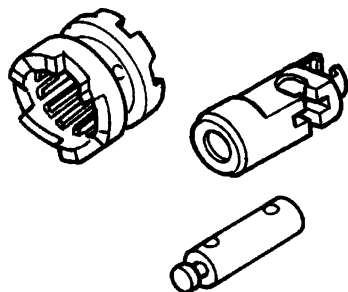
1. Check the propeller shaft for bends or wear. Replace if necessary.



S69J6415



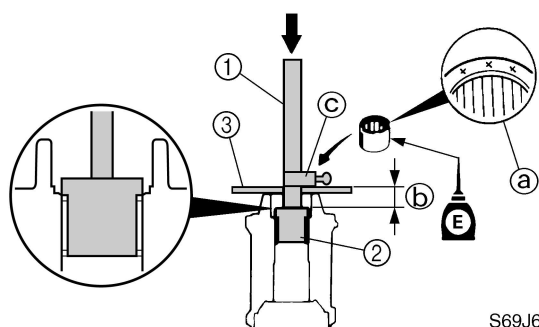
2. Check the dog clutch, shift rod joint, and shift slider for cracks or wear. Replace if necessary.



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

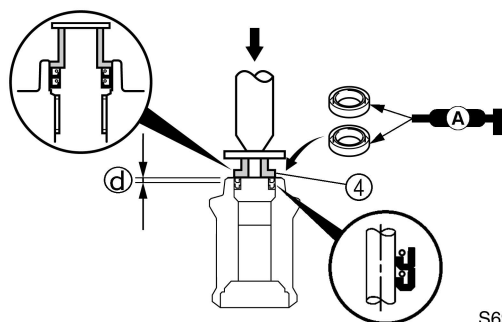
Bearing depth plate (3): 90890-06603



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.



S69J6150

NOTE:

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



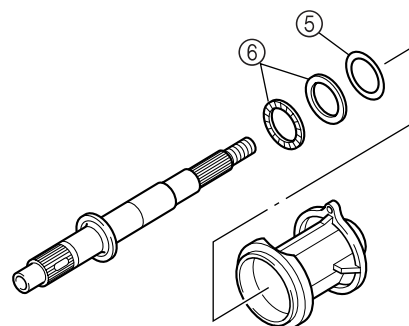
Bearing inner race attachment (4):
90890-06640



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.



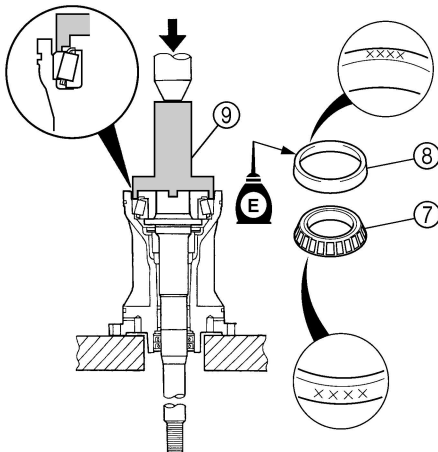
S69J6425

CAUTION:

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

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

Propeller shaft housing (counter rotation model)

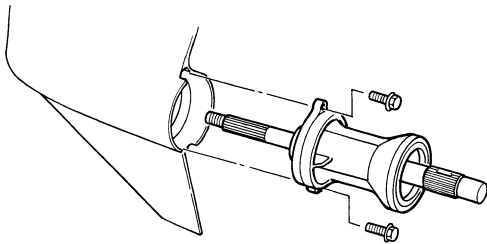


S69J6430E



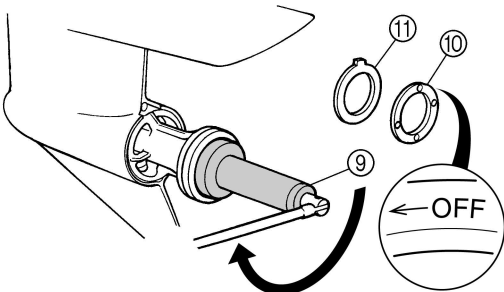
Ring nut wrench ⑨: 90890-06578

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



S69J6385

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



S69J6435

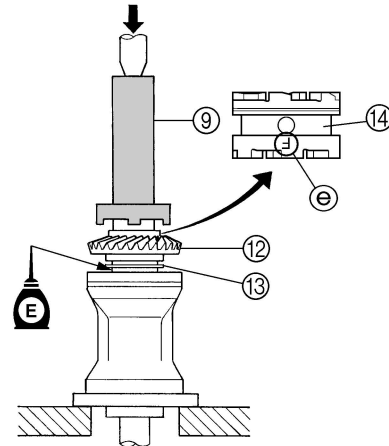


Ring nut wrench ⑨: 90890-06578



Ring nut ⑩:
108 N·m (10.8 kgf·m, 78 ft·lb)

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



S69J6440E

NOTE: _____
Install the dog clutch ⑭ with the “F” mark ⑤ facing toward the forward gear.

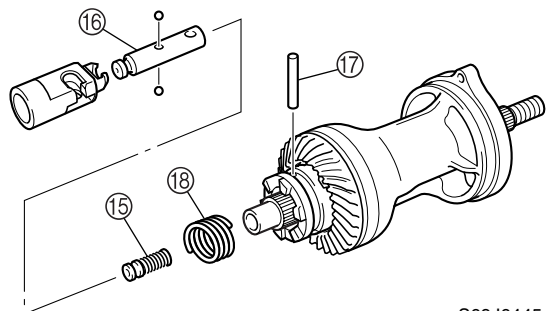
CAUTION:

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



Ring nut wrench ⑨: 90890-06578

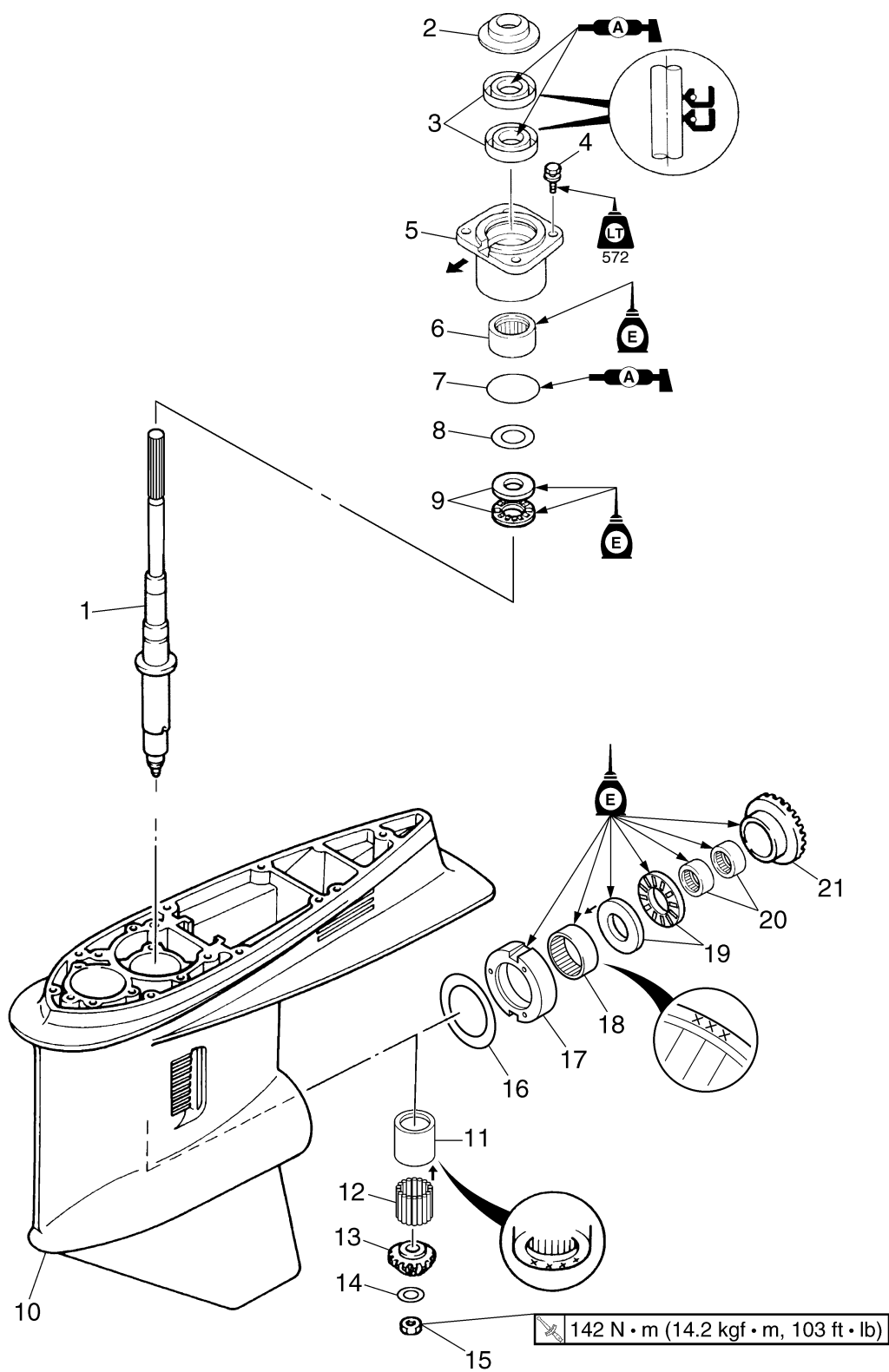
8. Install the shift plunger ⑮ and slider ⑯ into the propeller shaft, and then install the cross pin ⑰ and spring ⑱.



S69J6445



Drive shaft and lower case (counter rotation model)



S69J6450

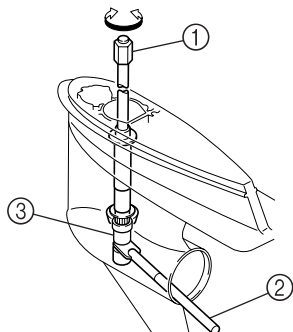
Drive shaft and lower case (counter rotation model)

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 3 × 60.5 mm
8	Pinion shim	—	As required
9	Thrust bearing	1	
10	Lower case	1	
11	Needle bearing case	1	
12	Needle bearing	24	
13	Pinion	1	
14	Washer	1	
15	Nut	1	
16	Reverse gear shim	—	As required
17	Retainer	1	
18	Needle bearing	1	
19	Thrust bearing	1	
20	Needle bearing	2	Not reusable
21	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.



S69J6180



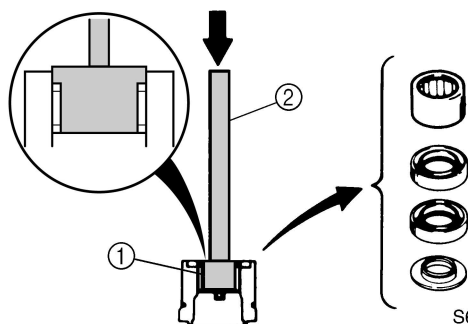
Drive shaft holder 6 (1): 90890-06520

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

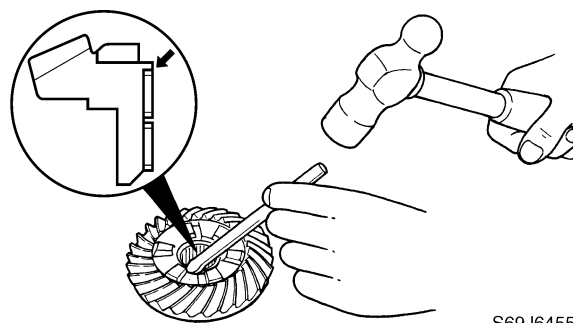


Needle bearing attachment (1):
90890-06610

Driver rod L3 (2): 90890-06652

Disassembling the reverse gear

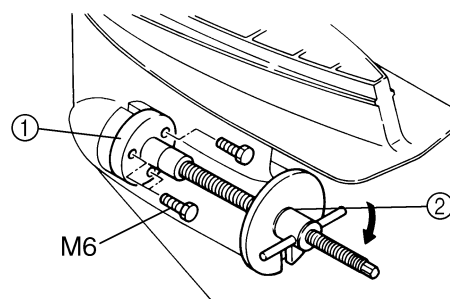
1. Remove the needle bearing from the reverse gear using a chisel.



S69J6455

Disassembling the lower case

1. Remove the retainer and shim(s).



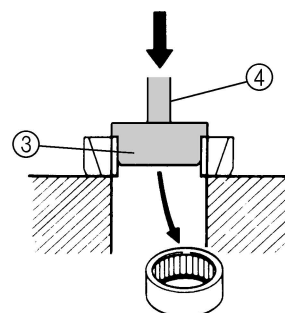
S69J6465



Flywheel puller (1): 90890-06521

Bearing outer race puller (2):
90890-06523

2. Remove the needle bearing from the retainer.



S69J6470

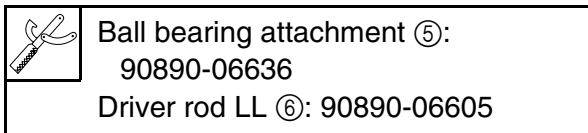
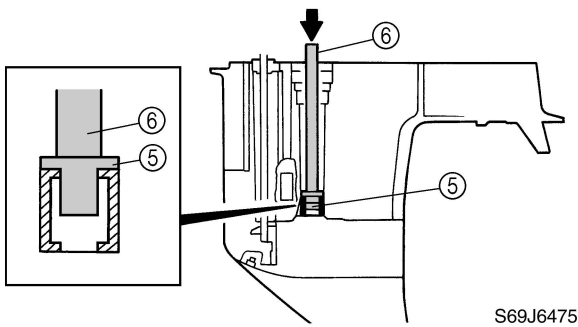


Needle bearing attachment (3):
90890-06654

Driver rod L3 (4): 90890-06652

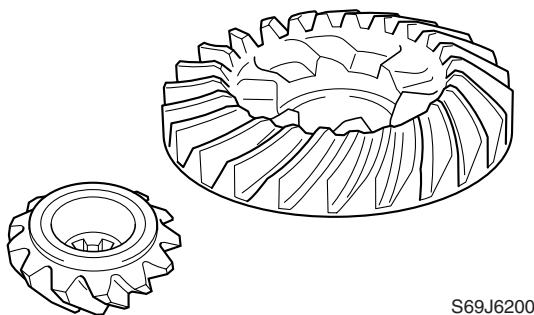
3. Remove the needle bearing.

Drive shaft and lower case (counter rotation model)



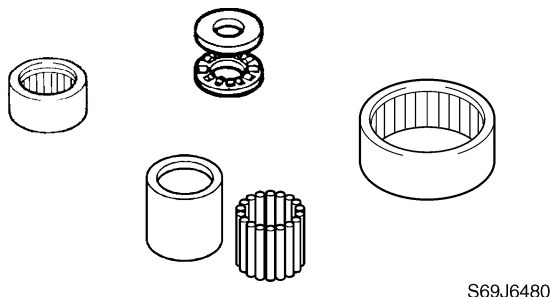
Checking the pinion and reverse gear

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



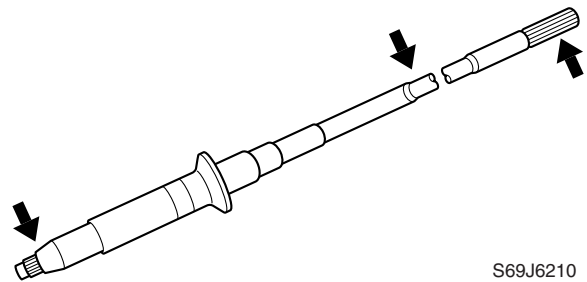
Checking the bearings

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



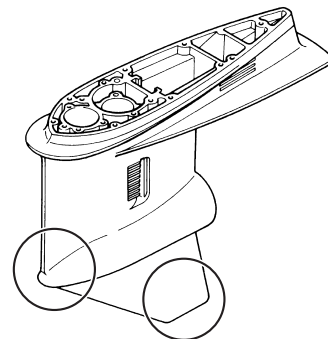
Checking the drive shaft

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



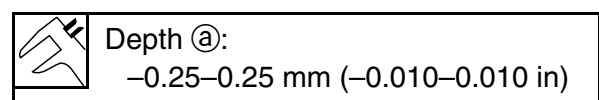
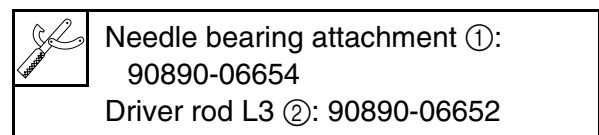
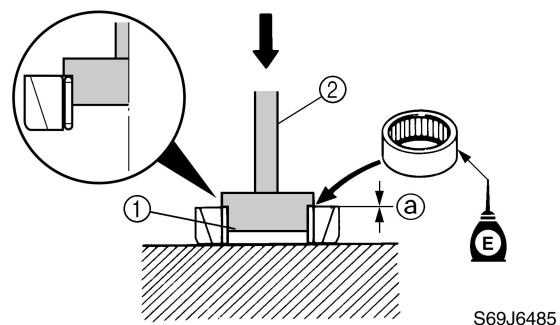
Checking the lower case

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



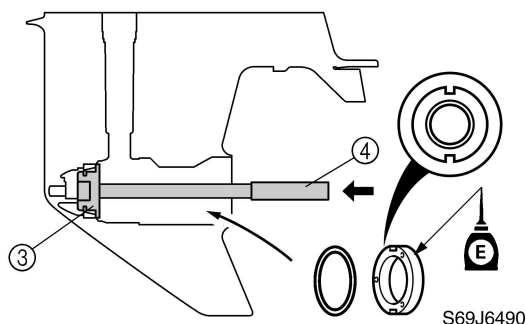
Assembling the lower case

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



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

6



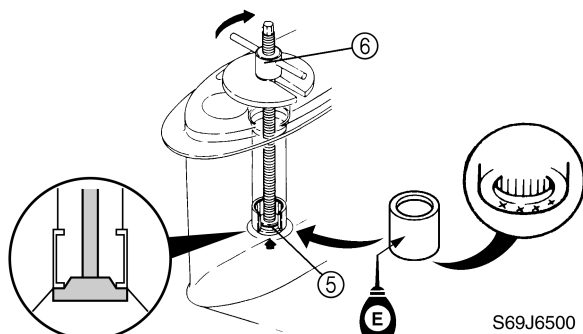
CAUTION:

Add or remove shim(s), if necessary, when 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.



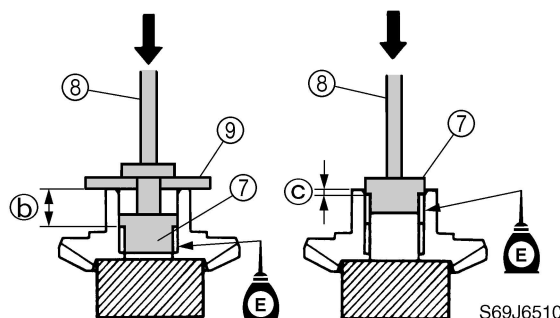
Bearing outer race attachment (5):
90890-06628
Bearing outer race puller (6):
90890-06523

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

NOTE:

Apply engine oil or grease to the needle bearing, and then install it.

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

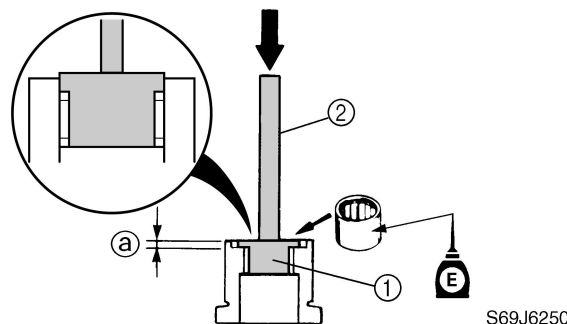


Depth (b):
20.75–21.25 mm (0.817–0.836 in)
Depth (c):
4.25–4.75 mm (0.167–0.187 in)

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.



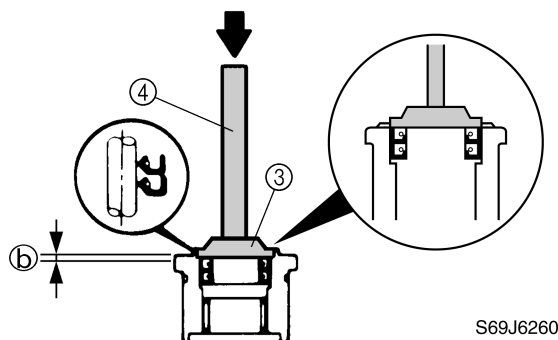
Needle bearing attachment (1):
90890-06610
Driver rod LS (2): 90890-06606



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

Drive shaft and lower case (counter rotation model)

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



S69J6260

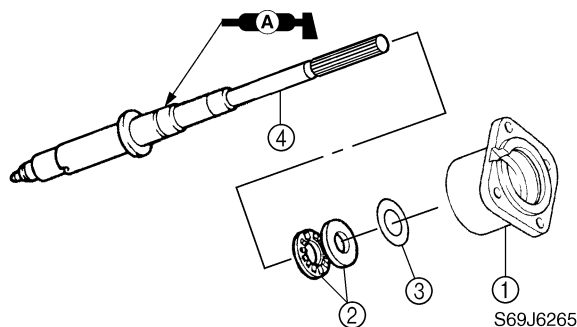
NOTE: Install an oil seal halfway into the drive shaft housing, then the other oil seal.

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

	Depth (b): 0.25–0.75 mm (0.01–0.03 in)
--	---

Installing the drive shaft

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

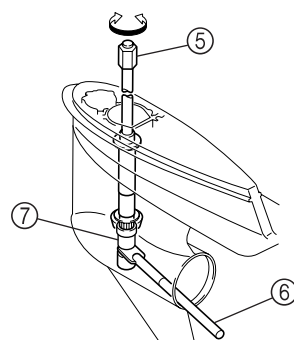


S69J6265

CAUTION:

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

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



S69J6275

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

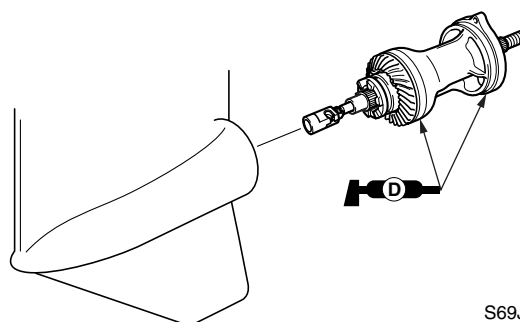
	Drive shaft holder 6 (5): 90890-06520 Pinion nut holder (6): 90890-06505 Socket adapter 3 (7): 90890-06508
--	--

	Pinion nut: 142 N·m (14.2 kgf·m, 103 ft·lb)
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4. Tighten the housing bolts.

Installing the propeller shaft housing

1. Install the propeller shaft housing assembly into the lower case.

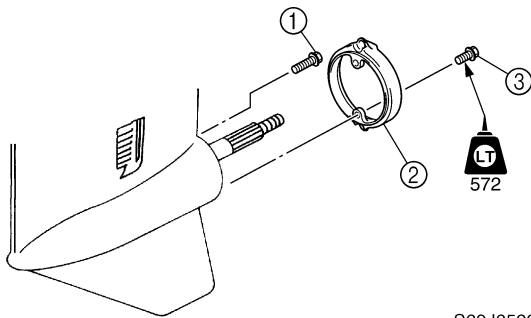


S69J6515

NOTE: Apply grease to the new O-rings before installation.



2. Install the bolts ①, ring ②, and bolts ③, and then tighten the bolts ① to the specified torque.



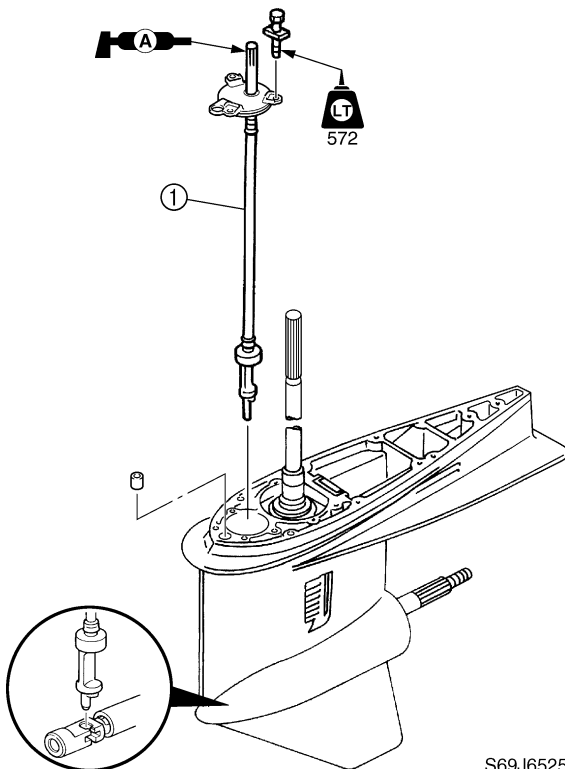
S69J6520



Propeller shaft housing bolt ①:
30 N·m (3.0 kgf·m, 22 ft·lb)

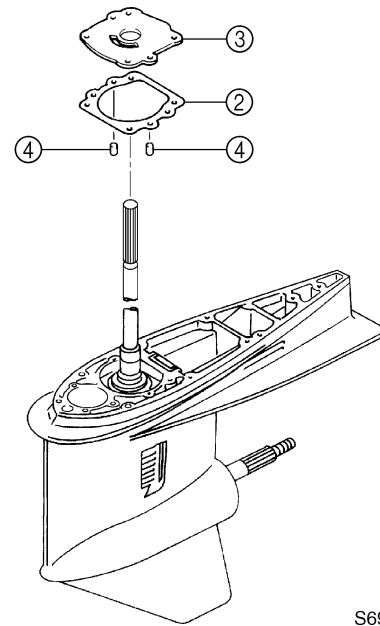
Installing the water pump and shift rod

1. Install the shift rod assembly ①.



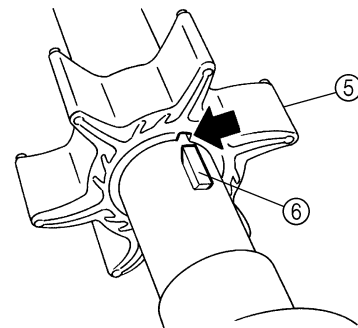
S69J6525

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



S69J6295

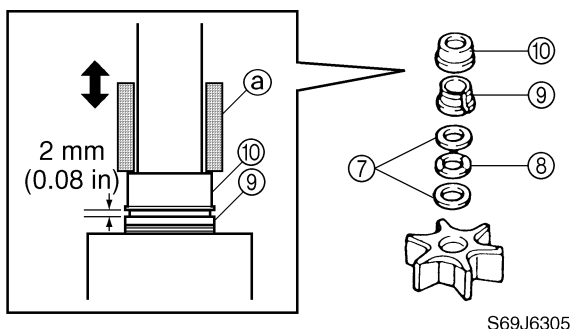
3. Install the Woodruff key into the drive shaft.
4. Align the groove on the impeller ⑤ with the Woodruff key ⑥, and then install it to the drive shaft.



S69J6300

Drive shaft and lower case (counter rotation model)

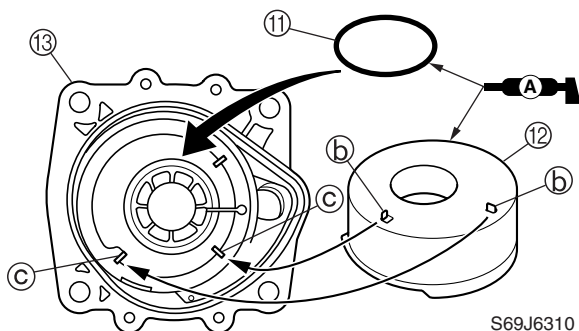
5. Install the washers ⑦, wave washer ⑧, spacer ⑨, and collar ⑩ to the drive shaft.



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.

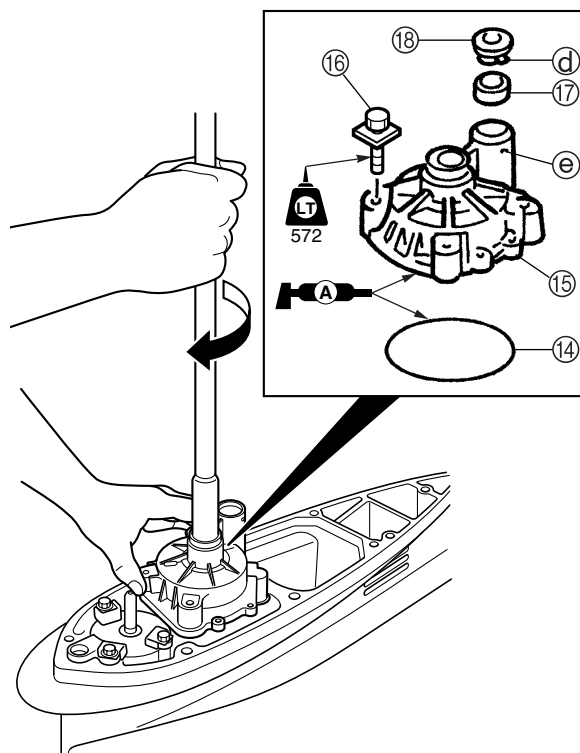
6. Install the O-ring ⑪ and insert cartridge ⑫ into the pump housing ⑬.



NOTE:

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

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.

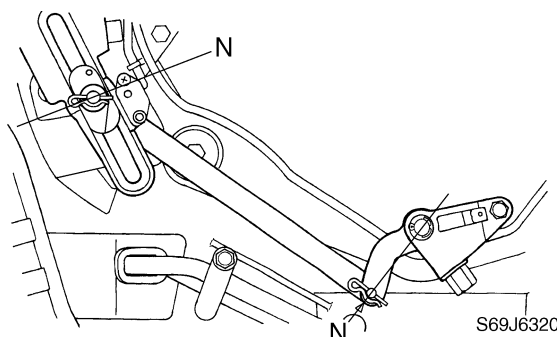


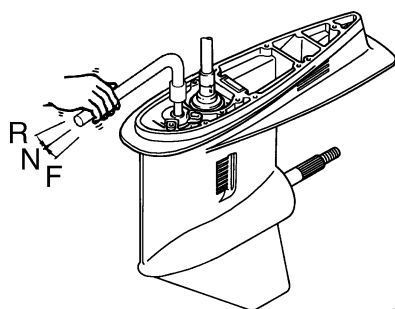
NOTE:

- 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 ① with the hole ② in the pump housing.

Installing the lower unit

1. Set the gearshift to the neutral position at the lower unit.



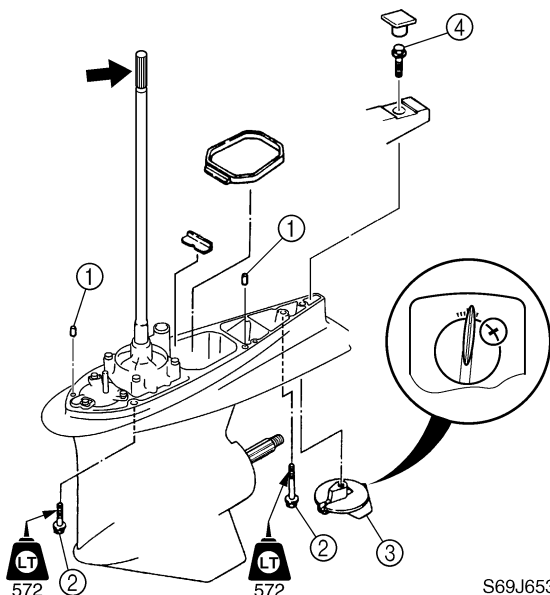


S69J6325



Shift rod push arm: 90890-06052

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

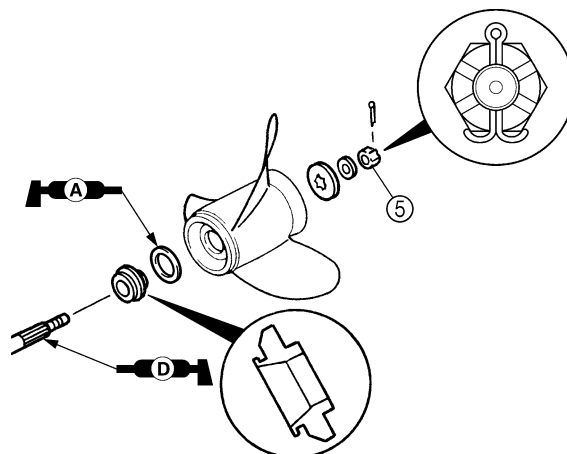


S69J6530

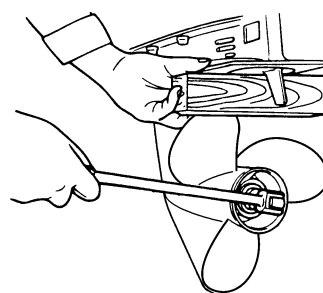


Lower case bolts ②:
47 N·m (4.7 kgf·m, 34 ft·lb)
Trim tab bolt ④:
43 N·m (4.3 kgf·m, 31 ft·lb)

5. 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.



S69J6535



S69J6540

⚠ WARNING

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

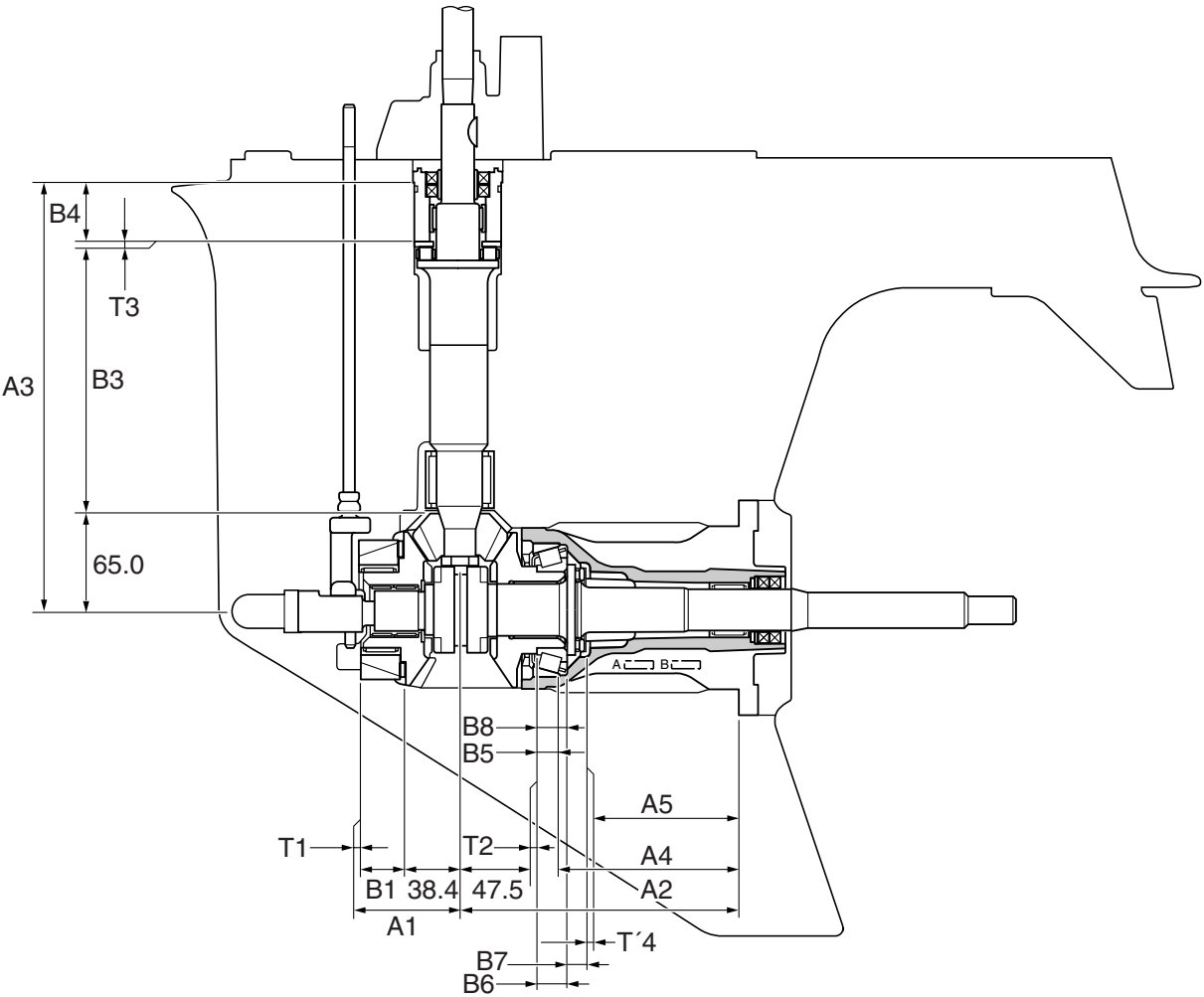
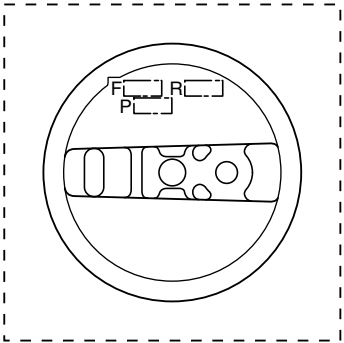
NOTE:

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:
55 N·m (5.5 kgf·m, 40 ft·lb)

Shimming (counter rotation model)



6

S69J6670



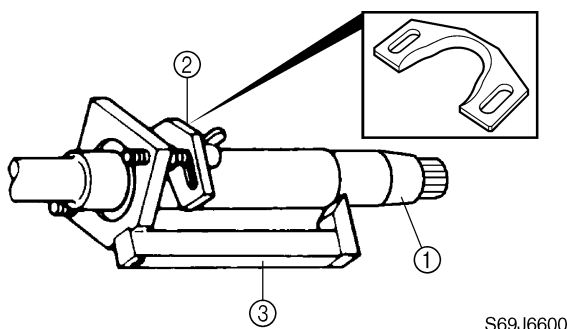
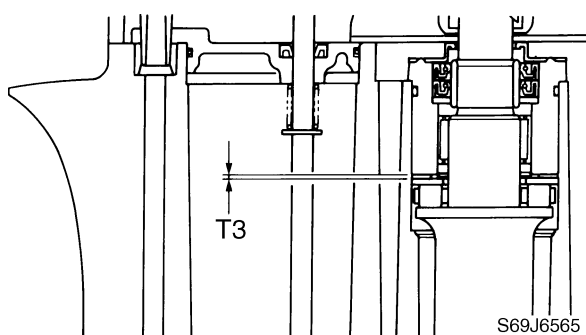
Shimming

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 drive shaft ① to the shimming tools.



NOTE:

- Select the shim thickness (T3) by using the specified measurement(s) and the calculation formula.
- Install the shimming tool to 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.



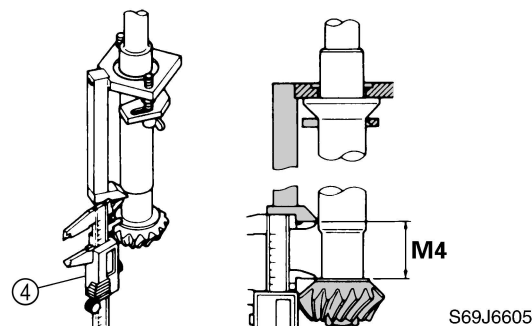
Pinion height gauge ③:
90890-06702

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



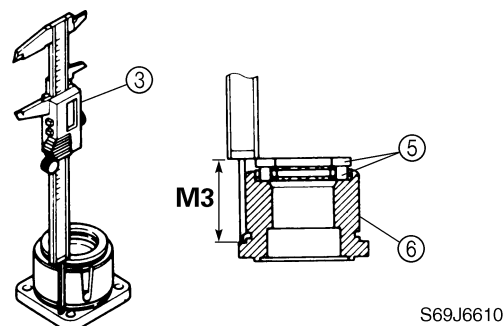
Pinion nut:
142 N·m (14.2 kgf·m, 103 ft·lb)

3. Measure the distance (M4) between the shimming 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.

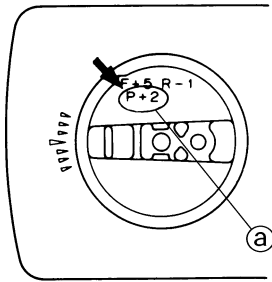


NOTE:

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

Shimming (counter rotation model)

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 ③ 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:

$$\text{Pinion shim thickness (T3)} = 82.00 + P/100 - M3 - M4$$

Example:

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

$$\begin{aligned} T3 &= 82.00 + (-5)/100 - 50.75 - 30.52 \text{ mm} \\ &= 82.00 - 0.05 - 50.75 - 30.52 \text{ mm} \\ &= 0.68 \text{ mm} \end{aligned}$$

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

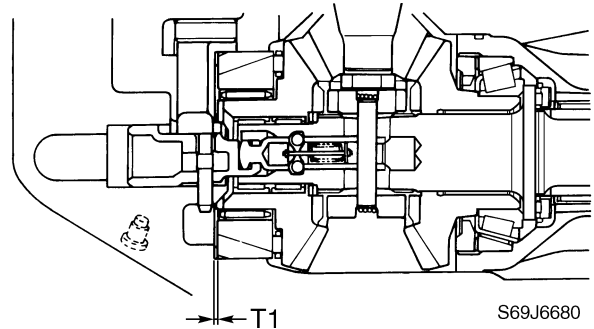
Example:

If “T3” is 0.68 mm, then the pinion shim is 0.65 mm.

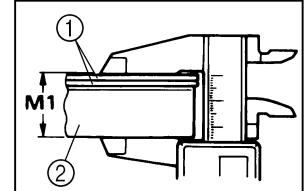
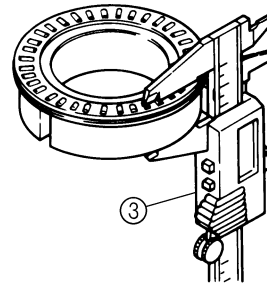
If “T3” is 0.70 mm, then the pinion shim is 0.68 mm.

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:

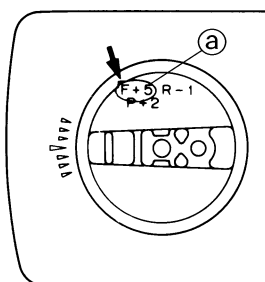
- Select the shim thickness (T1) by using the specified measurement(s) and the calculation formula.
- Measure the bearing retainer at three points to find the height average.



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 (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:

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

Example:

$$\begin{aligned} \text{If "M1" is 29.90 mm and "F" is (+5), then} \\ T1 &= 30.60 + (+5)/100 - 29.90 \text{ mm} \\ &= 30.60 + 0.05 - 29.90 \text{ mm} \\ &= 0.75 \text{ mm} \end{aligned}$$

- 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

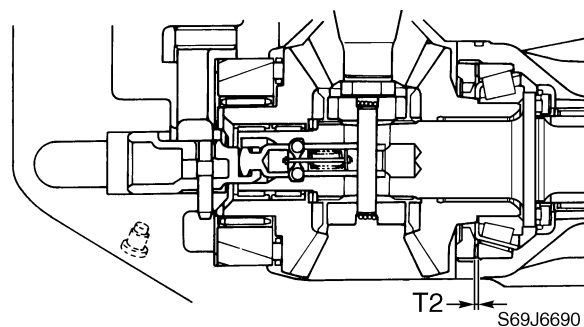
Example:

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

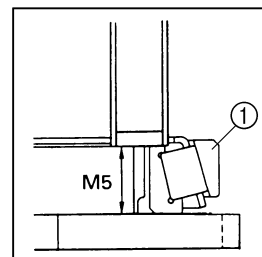
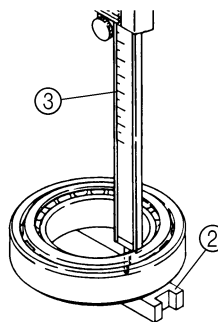
If "T1" is 0.80 mm, then the reverse gear shim is 0.78 mm.

Selecting the forward gear shims

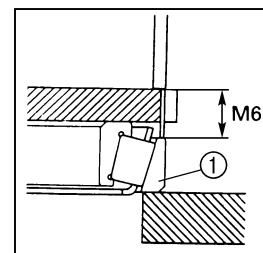
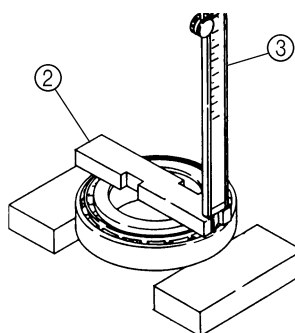
- Turn the taper roller bearing outer race ① two or three times to seat the rollers, and then measure the bearing height (M5) and (M6) as shown.



S69J6690



S69J6715



S69J6720

NOTE:

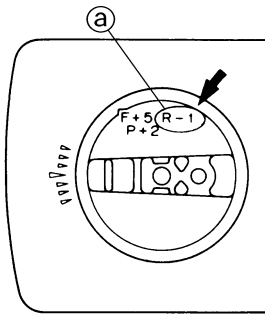
- Select the shim thickness (T2) by using the specified measurement(s) and the calculation formula.
- Measure the taper roller bearing at three points to find the height average.

Shimming (counter rotation model)

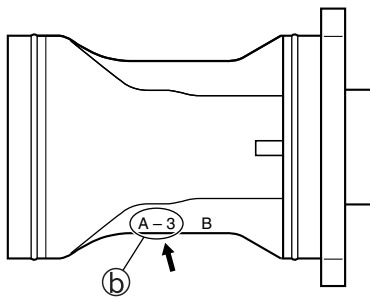


Shimming plate ②: 90890-06701
Digital caliper ③: 90890-06704

- 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

$$\begin{aligned} T2 &= 8.45 + (+1)/100 - (+6)/100 - 22.95 + 15.73 \text{ mm} \\ &= 8.45 + 0.01 - 0.06 - 22.95 + 15.73 \text{ mm} \\ &= 1.18 \text{ mm} \end{aligned}$$

- 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

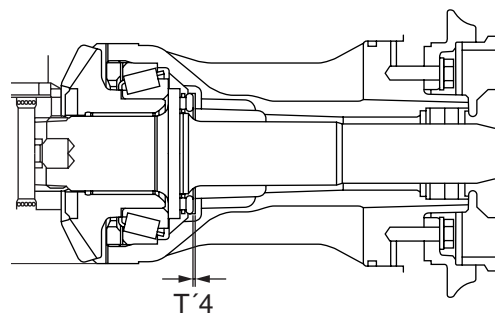
Example:

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

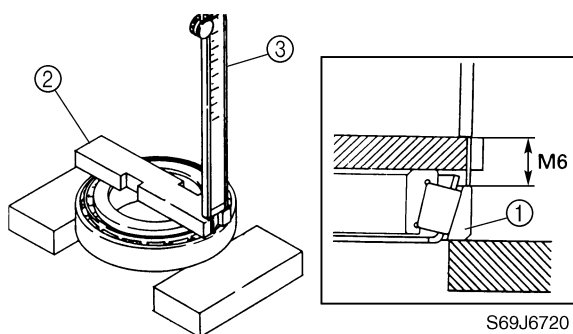
If "T2" is 1.20 mm, then the forward gear shim is 1.18 mm.

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



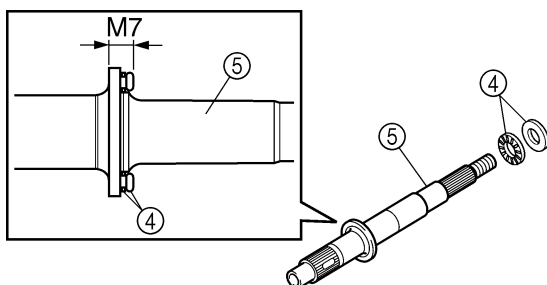
NOTE:

- 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.

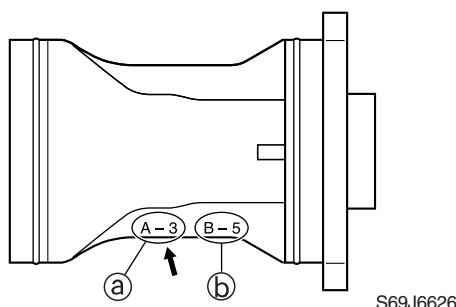


Shimming plate ②: 90890-06701
Digital caliper ③: 90890-06704

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



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



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

$$T4 = 29.00 + (+6)/100 - (-5)/100 - 15.73 - 12.50 \text{ mm}$$

$$= 29.00 + 0.06 + 0.05 - 15.73 - 12.50 \text{ mm}$$

$$= 0.88 \text{ mm}$$

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

$$T'4 = 0.85 - 0.30 \text{ mm}$$

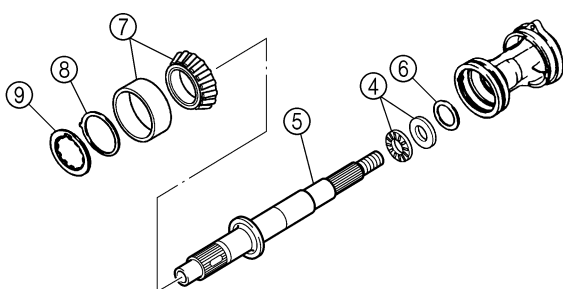
$$= 0.55 \text{ mm}$$

Shimming (counter rotation model) / Backlash (counter rotation model)

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.



S69J6697

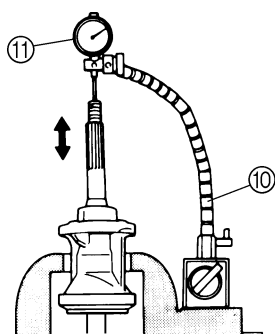


Ring nut wrench: 90890-06578



Ring nut ⑨:
108 N·m (10.8 kgf·m, 78 ft·lb)

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



S69J6701



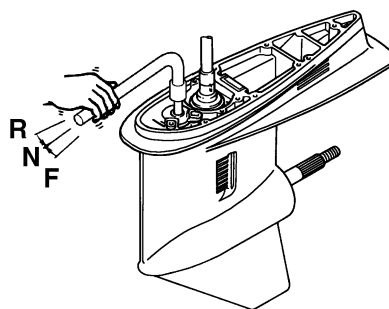
Propeller shaft free play:
0.25–0.35 mm (0.010–0.014 in)



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 gearshift to the neutral position.

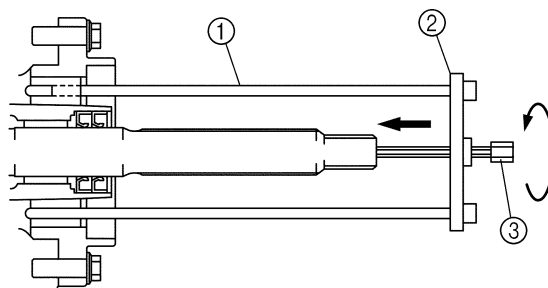


S69J6635



Shift rod push arm: 90890-06052

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



S69J6645

NOTE:

Tighten the universal puller or center bolt while turning the drive shaft until the drive shaft can no longer be turned.

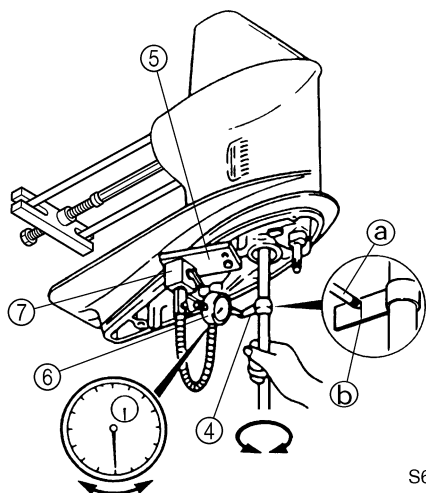


Bearing housing puller claw L ①:
90890-06502
Stopper guide plate ②: 90890-06501
Center bolt ③: 90890-06504

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.



S69J6655

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:
0.35–0.70 mm (0.014–0.028 in)

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

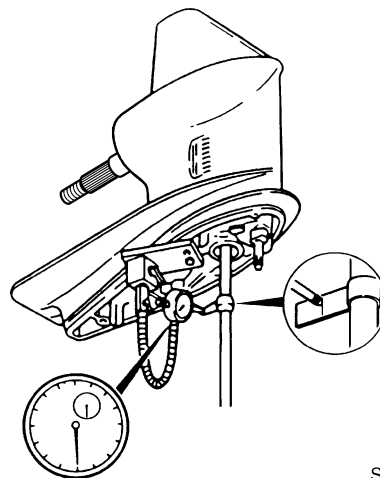
Forward gear backlash	Shim thickness
Less than 0.35 mm (0.014 in)	To be decreased by $(0.53 - M) \times 0.71$
More than 0.70 mm (0.028 in)	To be increased by $(M - 0.53) \times 0.71$

M: Measurement

Available shim thicknesses:

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

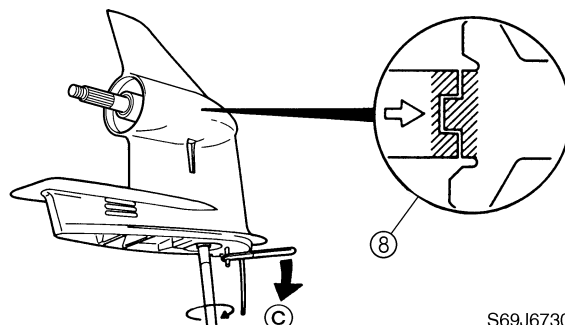
8. Remove the special service tools from the propeller shaft.



S69J6725

9. Turn the shift rod into the reverse position (c) with the shift rod push arm.

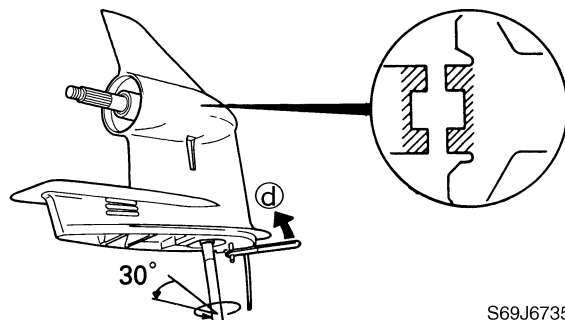
10. Turn the drive shaft clockwise until the dog clutch (8) is fully engaged.



S69J6730

11. Turn the shift rod to the neutral position (d) with the shift rod push arm.

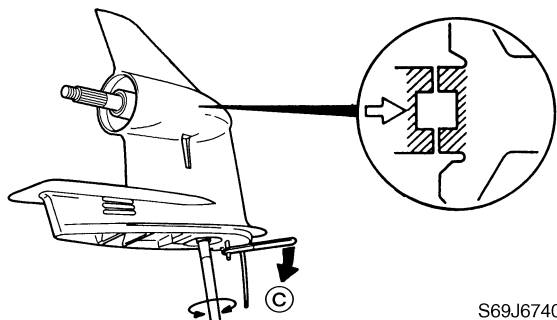
12. Turn the drive shaft counterclockwise approximately 30°.



S69J6735

Backlash (counter rotation model)

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:
0.70–1.03 mm (0.028–0.041 in)

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

Reverse gear backlash	Shim thickness
Less than 0.70 mm (0.028 in)	To be decreased by $(0.87 - M) \times 0.71$
More than 1.03 mm (0.041 in)	To be increased by $(M - 0.87) \times 0.71$

M: Measurement

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

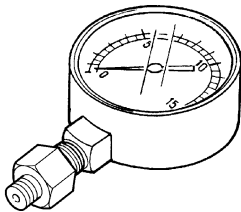
16. Remove the special service tools, and then install the water pump assembly.

Bracket unit

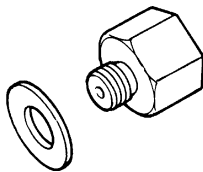
Special service tools	7-1
Bottom cowling	7-3
Upper case, steering arm, swivel bracket and clamp brackets	7-7
Draining the engine oil	7-13
Disassembling the oil pan	7-13
Checking the oil strainer	7-13
Assembling the oil pan	7-13
Removing the steering arm	7-15
Installing the steering arm	7-16
Installing 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	7-27
Checking the power trim and tilt motor	7-27
Assembling the power trim and tilt motor	7-28
Checking the hydraulic pressure	7-29
Disassembling the gear pump	7-31
Disassembling the tilt cylinder and trim cylinders	7-32
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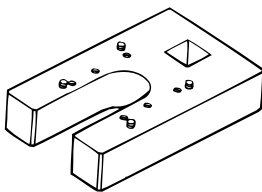
Special service tools



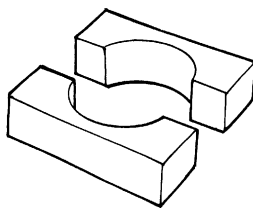
PTT oil pressure gauge assembly
90890-06580



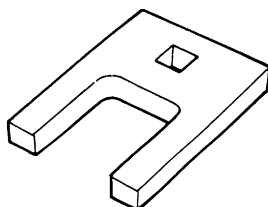
PTT oil pressure gauge adapter
90890-06581



Cylinder-end screw wrench
90890-06544



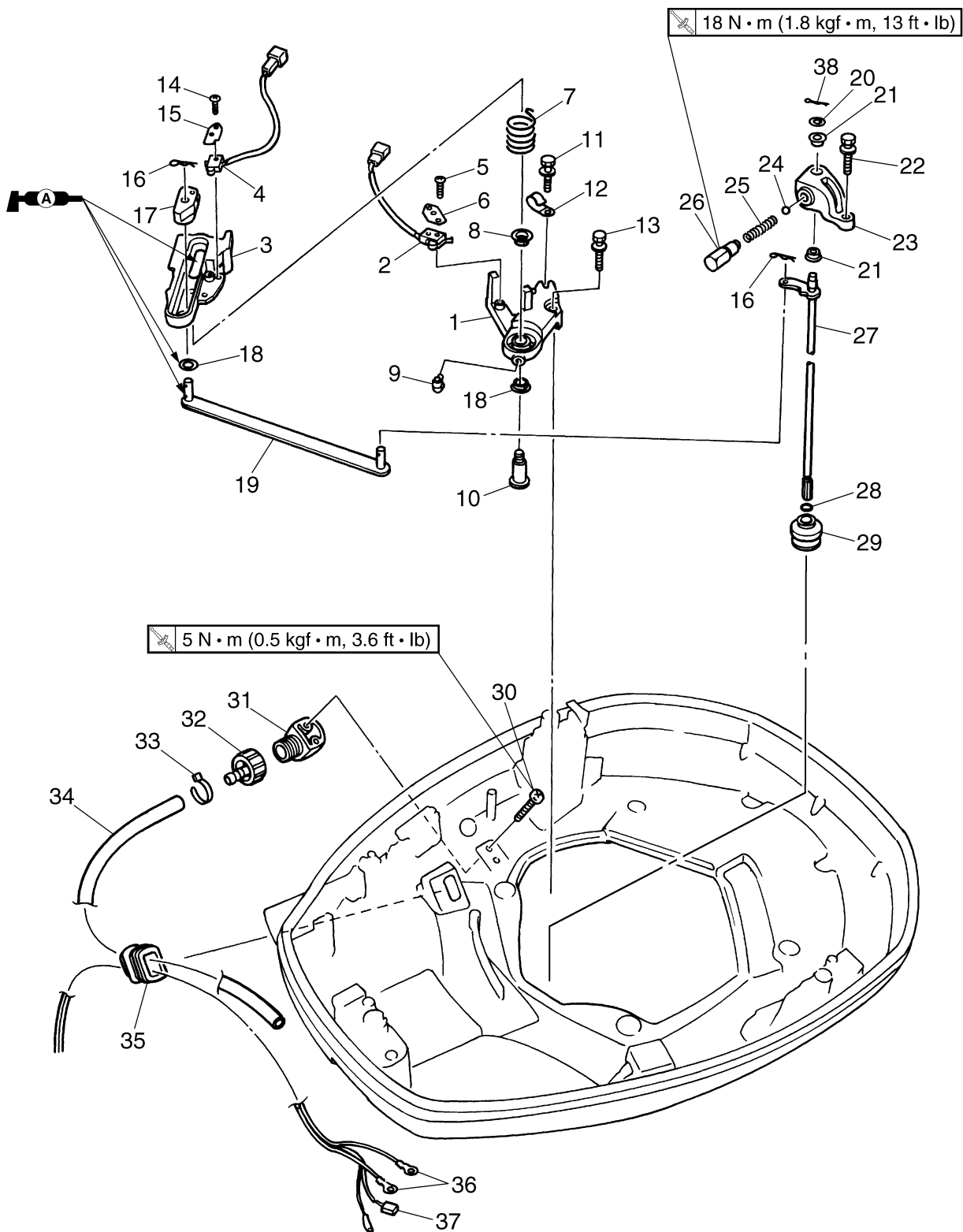
PTT piston vice attachment
90890-06572



Tilt rod wrench
90890-06569

— MEMO —

Bottom cowling

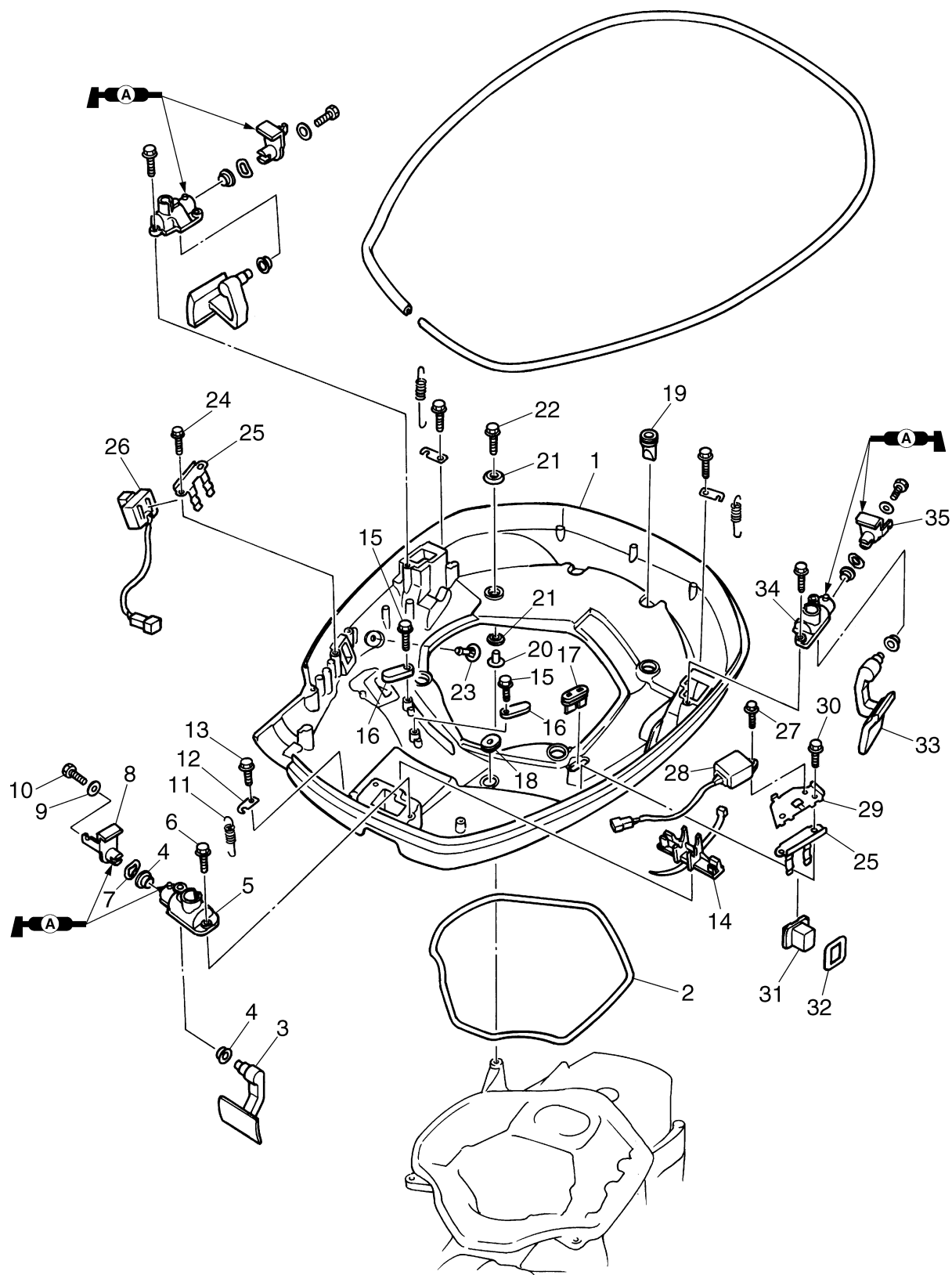


S69J7005

Bottom cowling

No.	Part name	Q'ty	Remarks
1	Bracket	1	
2	Shift cut switch	1	
3	Bracket	1	
4	Neutral switch	1	
5	Screw	2	M4 × 16 mm
6	Plate	1	
7	Spring	1	
8	Bushing	2	
9	Grease nipple	1	
10	Bolt	1	
11	Bolt	1	M6 × 35 mm
12	Clamp	1	
13	Bolt	1	M6 × 35 mm
14	Screw	2	M4 × 16 mm
15	Plate	1	
16	Clip	2	
17	Bushing	1	
18	Washer	1	
19	Shift lever	1	
20	Washer	1	
21	Bushing	2	
22	Bolt	1	M6 × 30 mm
23	Bracket	1	
24	Ball	1	
25	Spring	1	
26	Bolt	1	
27	Shift rod	1	
28	O-ring	1	Not reusable 1.9 × 12.6 mm
29	Grommet	1	
30	Screw	1	M6 × 20 mm
31	Adapter	1	
32	Hose joint	1	
33	Plastic tie	1	Not reusable
34	Flushing hose	1	11 × 650 mm
35	Grommet	1	
36	PTT motor lead	1	
37	Trim sensor coupler	1	
38	Cotter pin	1	

7



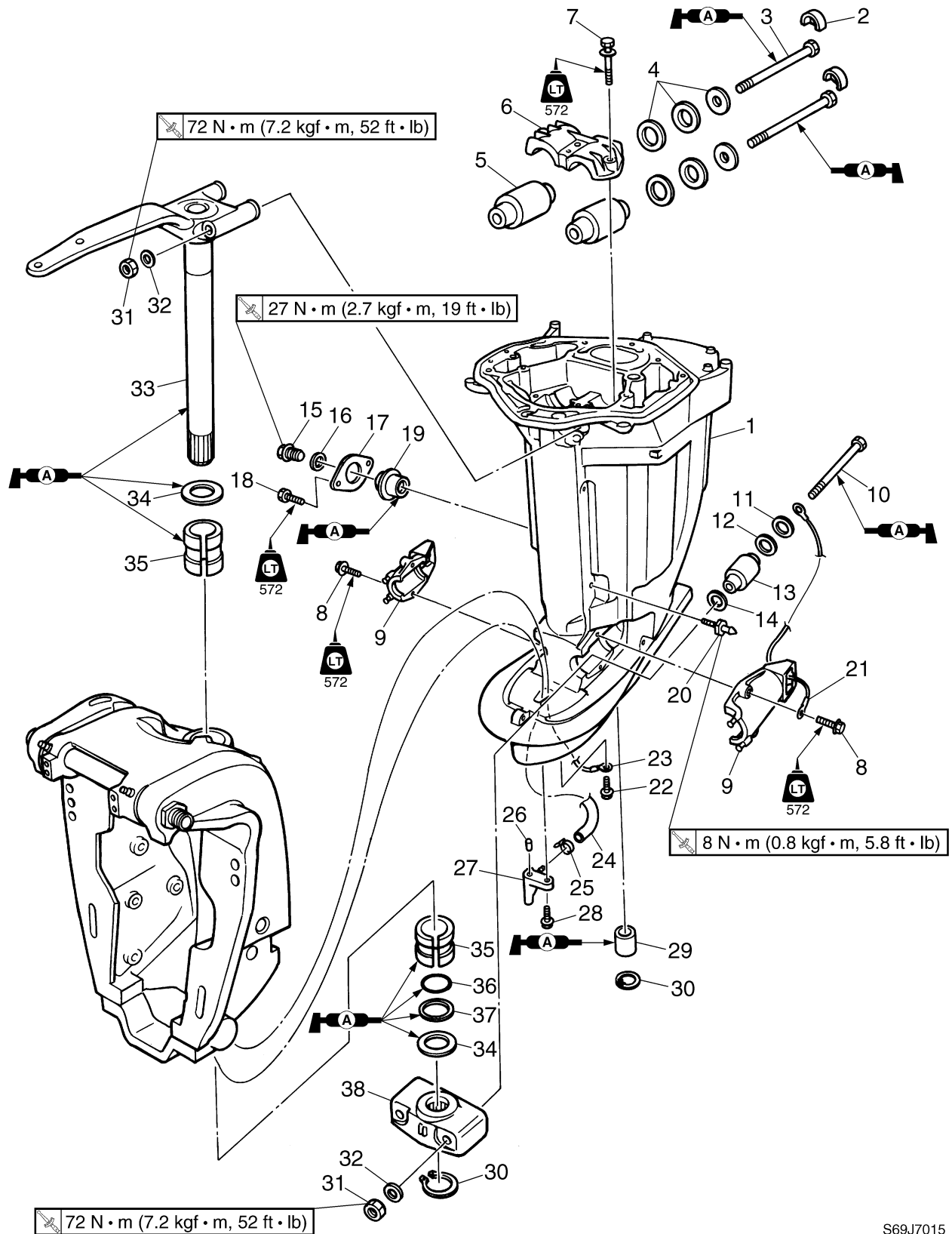
S69J7010

Bottom cowling

No.	Part name	Q'ty	Remarks
1	Bottom cowling	1	
2	Rubber seal	1	
3	Cowling lock lever	2	
4	Bushing	6	
5	Plate	2	
6	Bolt	6	M6 × 30 mm
7	Wave washer	3	
8	Lever	2	
9	Washer	3	
10	Bolt	3	M6 × 20 mm
11	Spring	3	
12	Hook	3	
13	Bolt	3	M6 × 20 mm
14	Bracket	1	
15	Bolt	2	M6 × 25 mm
16	Plate	2	
17	Grommet	2	
18	Grommet	1	
19	Grommet	2	
20	Collar	4	
21	Grommet	8	
22	Bolt	4	M6 × 30 mm
23	Cooling water pilot hole	1	
24	Bolt	2	M6 × 20 mm
25	Bracket	2	
26	Trailer switch	1	
27	Bolt	1	M6 × 18 mm
28	Low-pressure fuel pump driver	1	
29	Bracket	1	
30	Bolt	2	M6 × 20 mm
31	Cover	1	
32	Gasket	1	
33	Cowling lock lever	1	
34	Plate	1	
35	Lever	1	

7

Upper case, steering arm, swivel bracket and clamp brackets

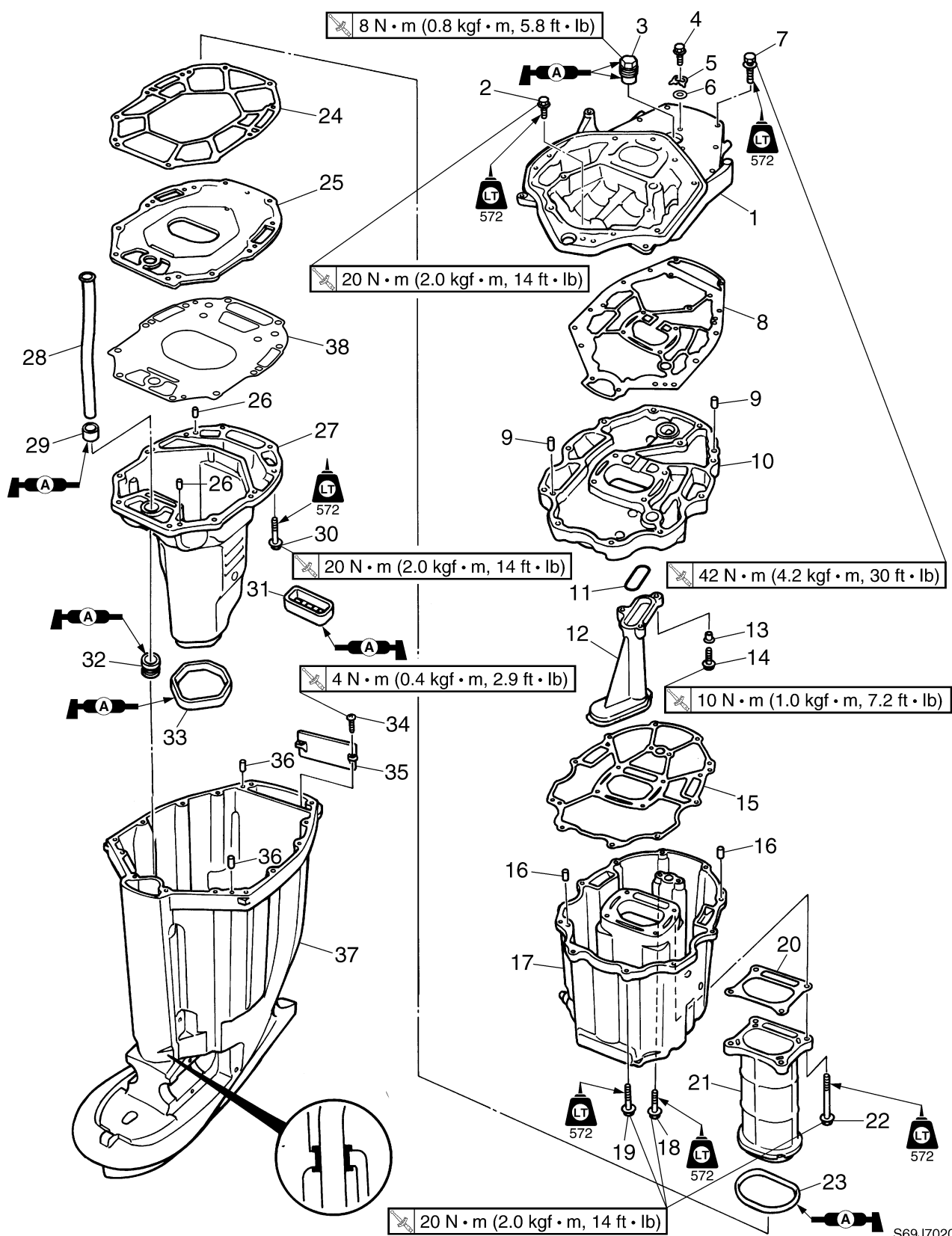


S69J7015

Upper case, steering arm, swivel bracket and clamp brackets

No.	Part name	Q'ty	Remarks
1	Upper case assembly	1	
2	Damper	2	
3	Bolt	2	M14 × 190 mm
4	Washer	6	
5	Upper mount	2	
6	Bracket	1	
7	Bolt	3	M10 × 40 mm
8	Bolt	4	M10 × 40 mm
9	Mount housing	2	
10	Bolt	2	M14 × 205 mm
11	Washer	2	
12	Rubber washer	2	
13	Lower mount	2	
14	Washer	2	
15	Drain bolt	1	M14 × 12 mm
16	Metal gasket	1	Not reusable
17	Cover	1	
18	Bolt	2	M6 × 14 mm
19	Damper	1	
20	Apron stay	6	
21	Ground lead	1	
22	Bolt	1	M6 × 10 mm
23	Ground lead	1	
24	Hose	1	
25	Plastic tie	1	
26	Dowel pin	1	
27	Adapter	1	
28	Bolt	1	M6 × 25 mm
29	Drive shaft bushing	1	
30	Circlip	2	
31	Nut	4	
32	Washer	4	
33	Steering arm	1	
34	Washer	2	
35	Bushing	2	
36	O-ring	1	Not reusable
37	Bushing	1	
38	Steering yoke	1	

7

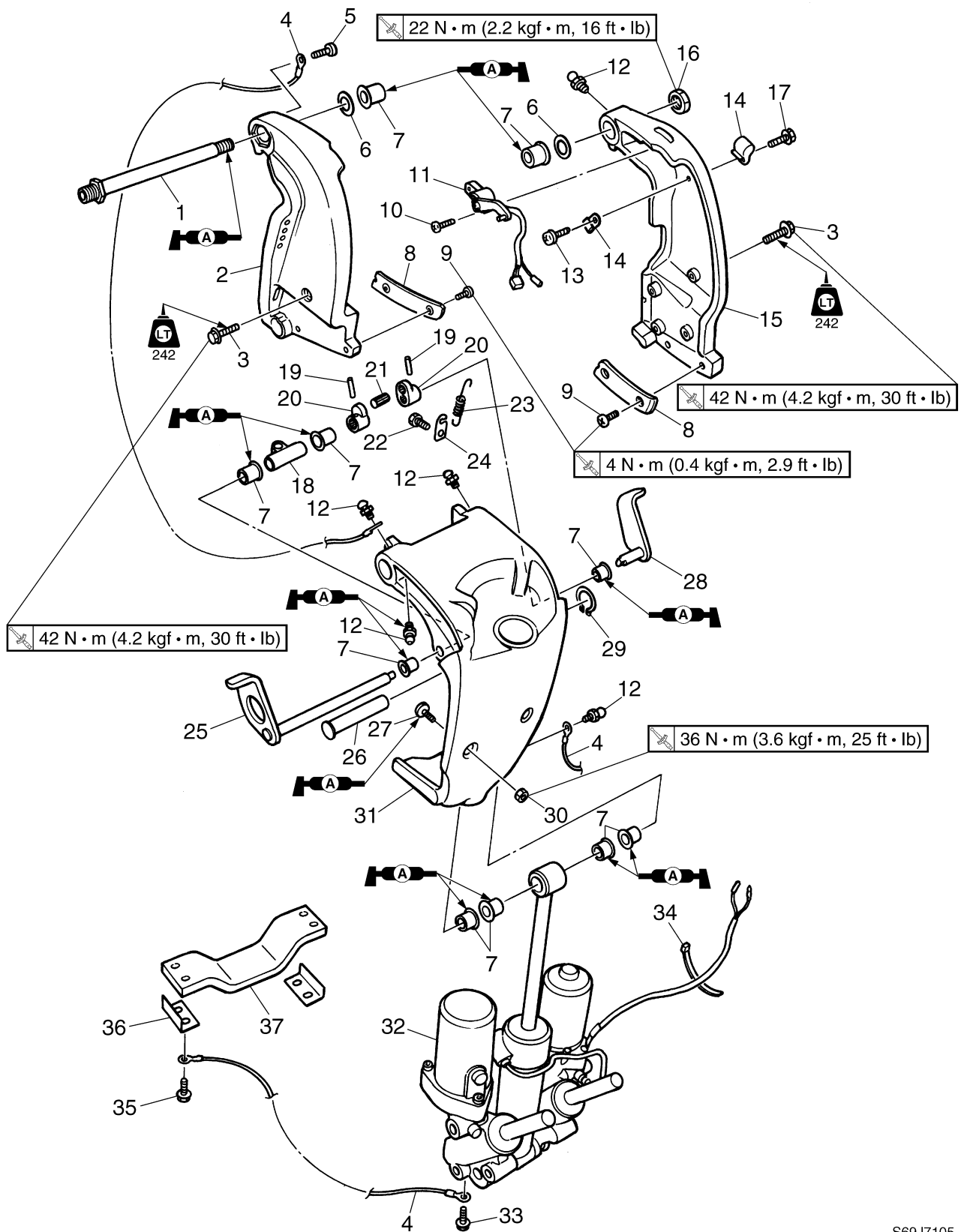


S69J7020

Upper case, steering arm, swivel bracket and clamp brackets

No.	Part name	Q'ty	Remarks
1	Upper exhaust guide	1	
2	Bolt	2	M8 × 35 mm
3	Pressure control valve	1	
4	Bolt	1	M6 × 20 mm
5	Plate	1	
6	Collar	1	
7	Bolt	7	M10 × 45 mm
8	Gasket	1	Not reusable
9	Dowel pin	2	
10	Lower exhaust guide	1	
11	Gasket	1	Not reusable
12	Oil strainer	1	
13	Collar	3	
14	Bolt	3	M6 × 25 mm
15	Gasket	1	Not reusable
16	Dowel pin	2	
17	Oil pan	1	
18	Bolt	2	M8 × 30 mm
19	Bolt	10	M8 × 60 mm
20	Gasket	1	Not reusable
21	Exhaust manifold	1	
22	Bolt	4	M8 × 90 mm
23	Exhaust seal	1	
24	Gasket	1	Not reusable
25	Plate	1	
26	Dowel pin	2	
27	Muffler	1	
28	Cooling water pipe	1	
29	Rubber seal	1	
30	Bolt	10	M8 × 35 mm
31	Muffler seal	1	
32	Rubber seal	1	
33	Rubber seal	1	
34	Screw	2	M6 × 16 mm
35	Baffle plate	1	
36	Dowel pin	2	
37	Upper case	1	
38	Gasket	1	Not reusable

7



S69J7105

Upper case, steering arm, swivel bracket and clamp brackets

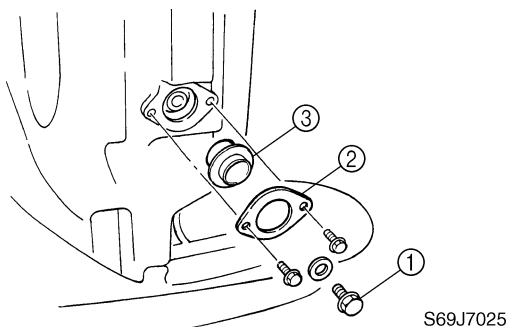
No.	Part name	Q'ty	Remarks
1	Through tube	1	
2	Port clamp bracket	1	
3	Bolt	8	M10 × 45 mm
4	Ground lead	3	
5	Screw	1	
6	Washer	2	
7	Bushing	10	
8	Friction plate	2	
9	Screw	4	M6 × 10 mm
10	Screw	2	M6 × 15 mm
11	Trim sensor	1	
12	Grease nipple	6	
13	Screw	1	M6 × 12 mm
14	Clamp	2	
15	Starboard clamp bracket	1	
16	Self-locking nut	1	
17	Bolt	1	M6 × 14 mm
18	Collar	1	
19	Pin	2	
20	Tilt stop lever joint	2	
21	Pin	1	
22	Bolt	1	M6 × 10 mm
23	Spring	1	
24	Spring holder	1	
25	Port tilt stop lever	1	
26	Shaft	1	
27	Trim stopper	2	
28	Starboard tilt stop lever	1	
29	Circlip	1	
30	Nut	2	
31	Swivel bracket	1	
32	Power trim and tilt unit	1	
33	Bolt	1	M6 × 10 mm
34	Plastic tie	4	
35	Bolt	4	M6 × 25 mm
36	Bracket	2	
37	Anode	1	

7



Draining the engine oil

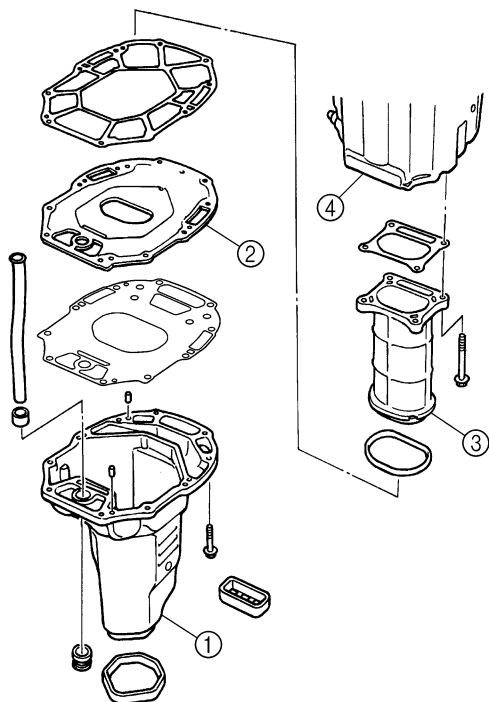
1. Place a drain pan under the drain hole, and then remove the drain bolt ① and let the oil drain completely.
2. Remove the cover ② and damper ③.



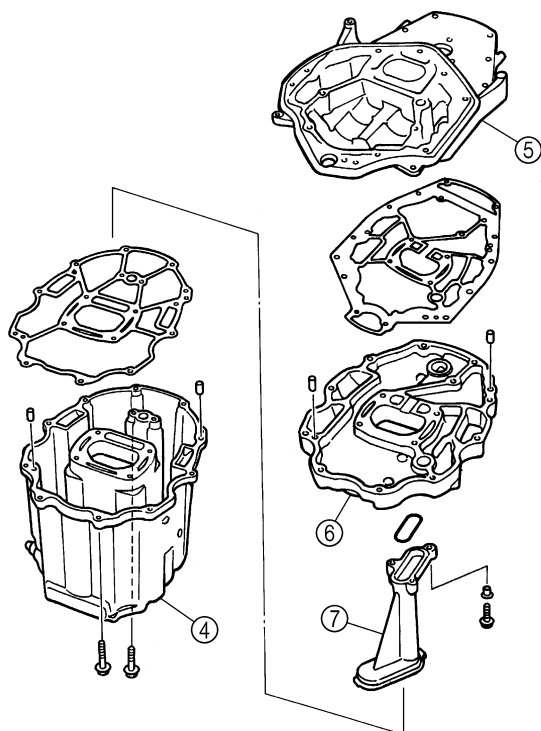
3. Remove the upper and lower mounting nut, and then remove the upper case.
4. Remove the muffler assembly from the upper case.

Disassembling the oil pan

1. Remove the muffler ①, plate ②, and exhaust manifold ③ from the oil pan ④.



2. Remove the oil pan ④ from the upper exhaust guide ⑤ and lower exhaust guide ⑥.
3. Remove the oil strainer ⑦ from the lower exhaust guide ⑥.

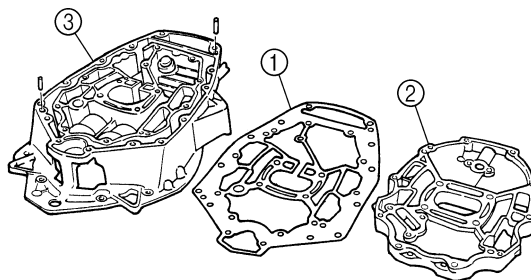


Checking the oil strainer

1. Check the oil strainer for dirt and residue. Clean if necessary.

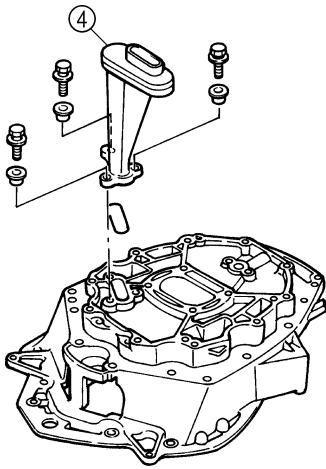
Assembling the oil pan

1. Install the gasket ① and lower exhaust guide ② onto the upper exhaust guide ③.

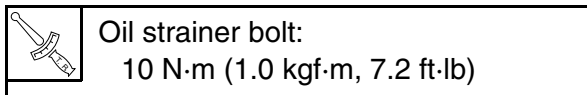


Upper case, steering arm, swivel bracket and clamp brackets

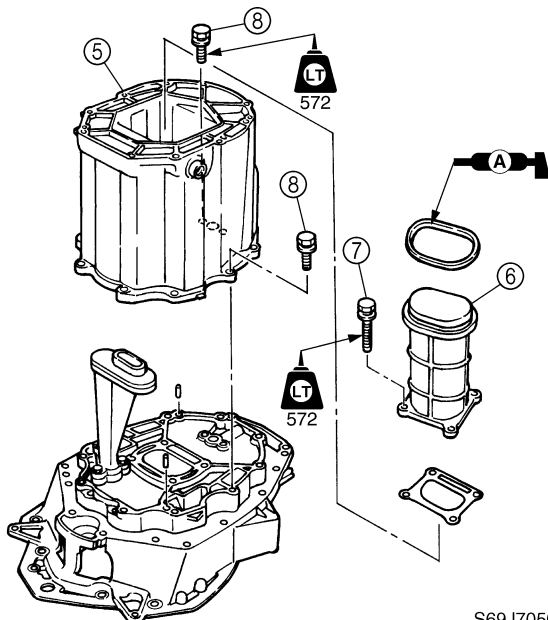
2. Install the oil strainer ④ and bolts, and then tighten the bolts to the specified torque.



S69J7045

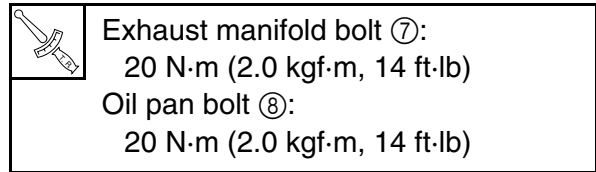


3. Install the oil pan ⑤, and then tighten the bolts finger tight.
4. Install the exhaust manifold ⑥ and bolts, and then tighten the bolts finger tight.

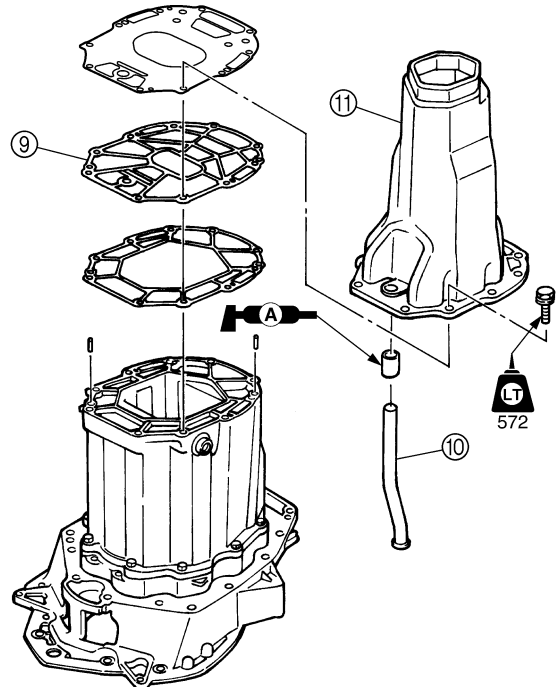


S69J7050

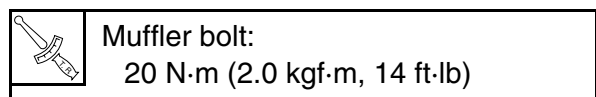
5. Tighten the exhaust manifold bolts ⑦, then the oil pan bolts ⑧, and then tighten them to the specified torques.



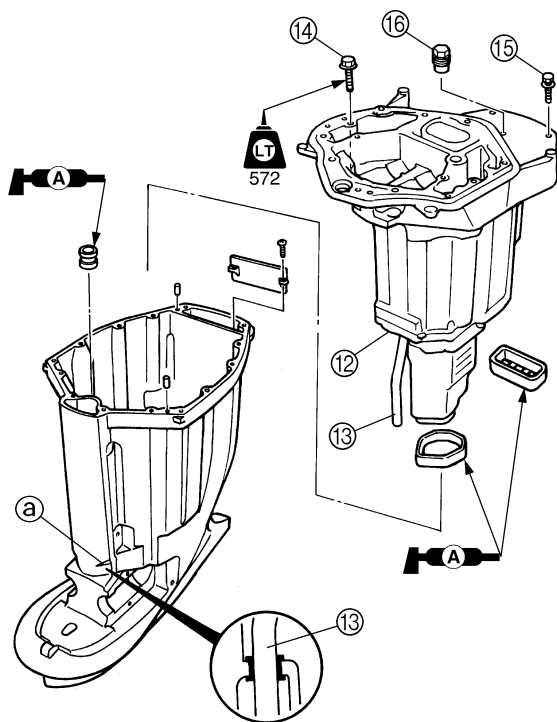
6. Install the plate ⑨.
7. Install the cooling water pipe ⑩ into the muffler ⑪.
8. Install the muffler ⑪ and bolts into the oil pan, and then tighten the bolts to the specified torque.



S69J7055



9. Install the muffler assembly ⑫ by inserting the tip of the cooling water pipe ⑬ into the joint hole ⑬ of the upper case.
10. Install muffler assembly bolts ⑭ and ⑮, and pressure control valve ⑯, and then tighten them to the specified torques.

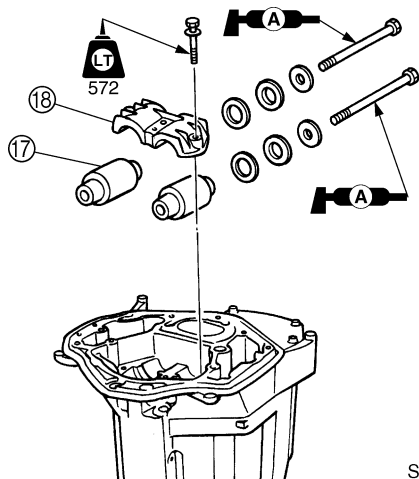


S69J7060

	Muffler assembly bolt ⑭:
	20 N·m (2.0 kgf·m, 14 ft·lb)
	Muffler assembly bolt ⑮:
	42 N·m (4.2 kgf·m, 30 ft·lb)
	Pressure control valve ⑯:
	8 N·m (0.8 kgf·m, 5.8 ft·lb)

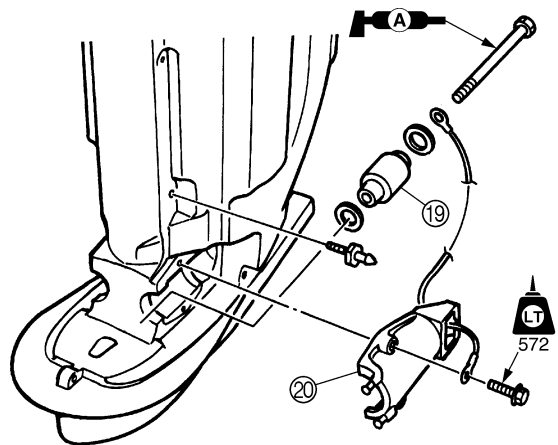
11. Install the upper mounts ⑰ and bolts into the upper case.

12. Install the bracket ⑬ and bolts.



S69J7065

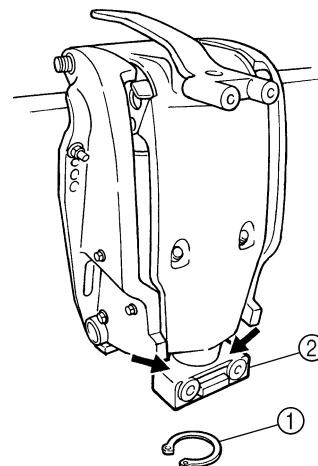
13. Install the lower mounts ⑲ and mount housings ⑳.



S69J7070

Removing the steering arm

1. Remove the circlip ①.
2. Remove the steering yoke ② by striking it with a plastic hammer.



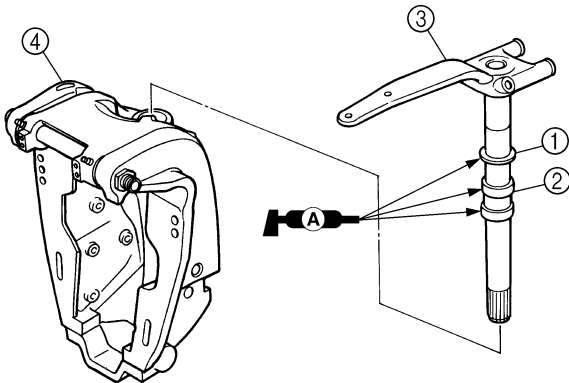
S69J7075

3. Remove the steering arm from the swivel bracket by pulling the arm off the bracket.

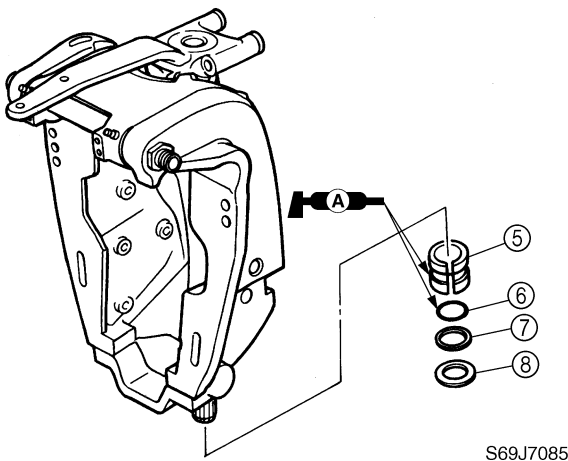
Upper case, steering arm, swivel bracket and clamp brackets

Installing the steering arm

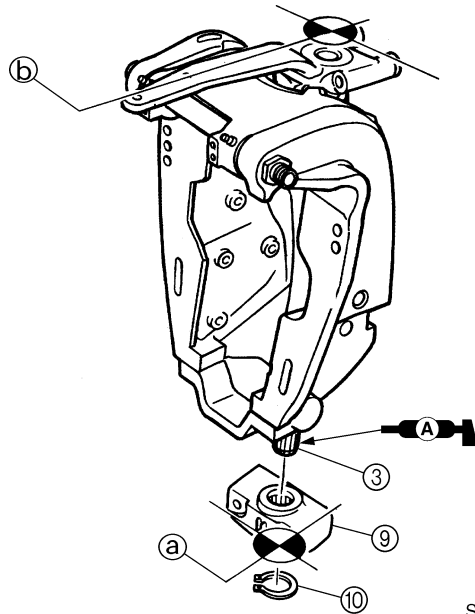
1. Install the washer ① and bushing ② onto the steering arm ③.
2. Place the swivel bracket ④ in an upright position, and then install the steering arm onto the swivel bracket.



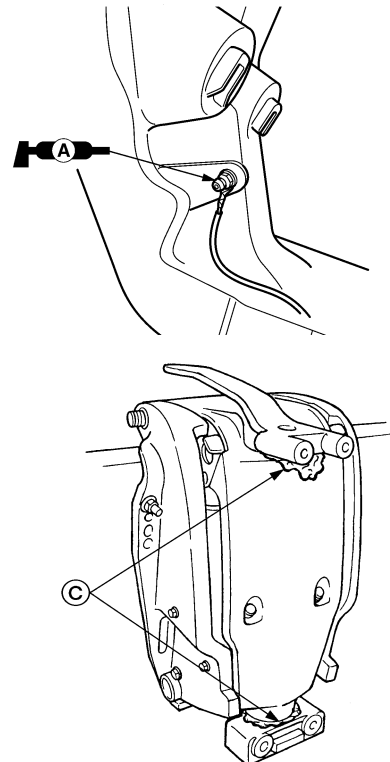
3. Install the bushing ⑤, O-ring ⑥, bushing ⑦, and washer ⑧ onto the swivel bracket.



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.



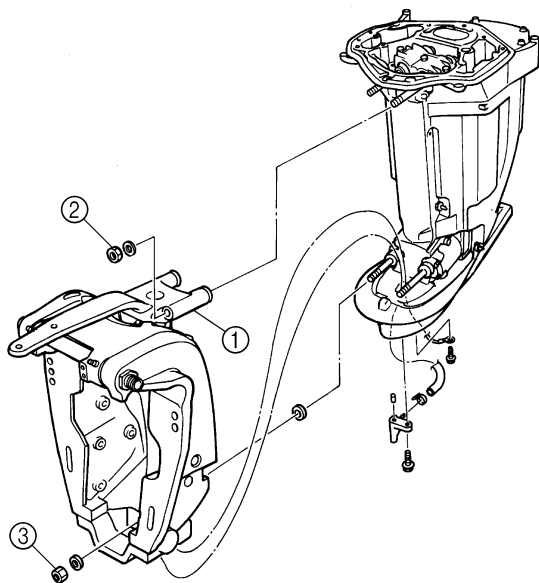
6. Inject grease into the grease nipple until grease comes out from both the upper and lower bushings ③.





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.



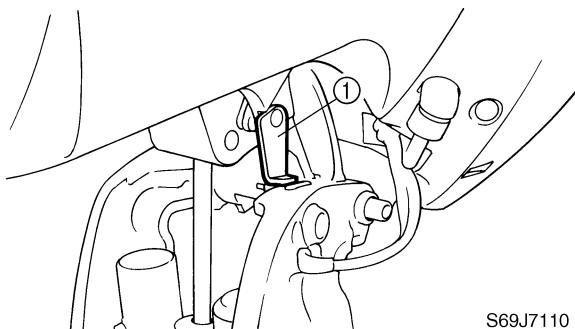
S69J7100



Upper mounting nut ②:
72 N·m (7.2 kgf·m, 52 ft·lb)
Lower mounting nut ③:
72 N·m (7.2 kgf·m, 52 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.



S69J7110

⚠ 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:

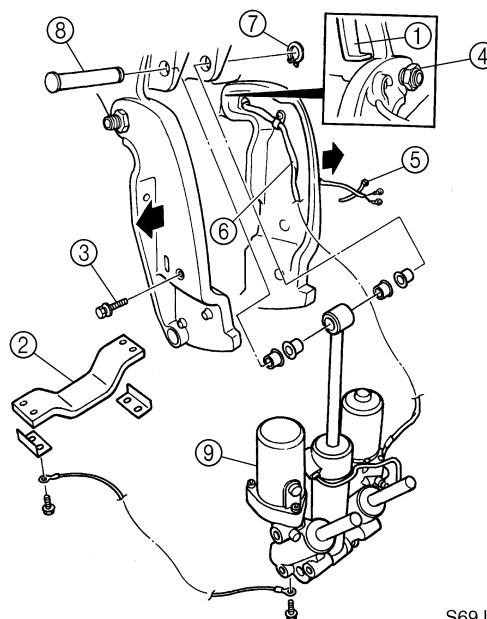
If the power trim and tilt does not operate, loosen the manual valve and tilt the outboard motor up manually.

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.

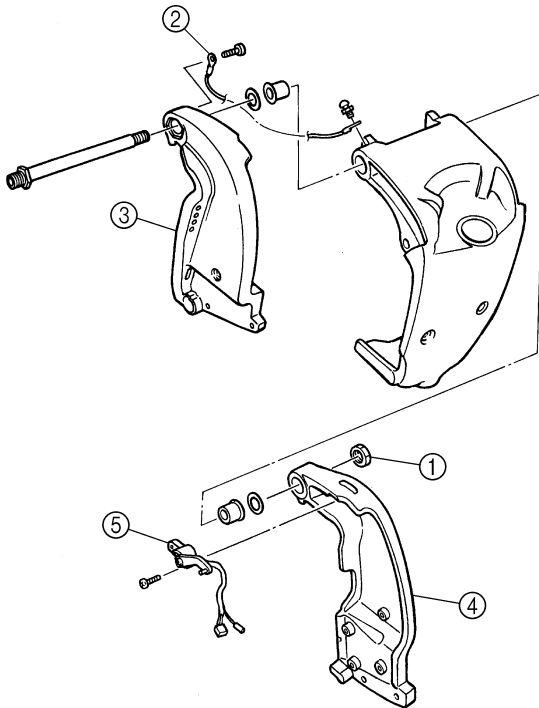


S69J7115

Upper case, steering arm, swivel bracket and clamp brackets

Removing the clamp brackets

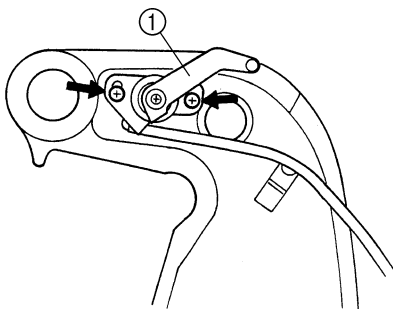
1. Remove the self-locking nut ① and ground lead ②, then clamp brackets ③ and ④.
2. Remove the trim sensor ⑤.



S69J7120

Installing the clamp brackets

1. Install the trim sensor ① onto the port clamp bracket.

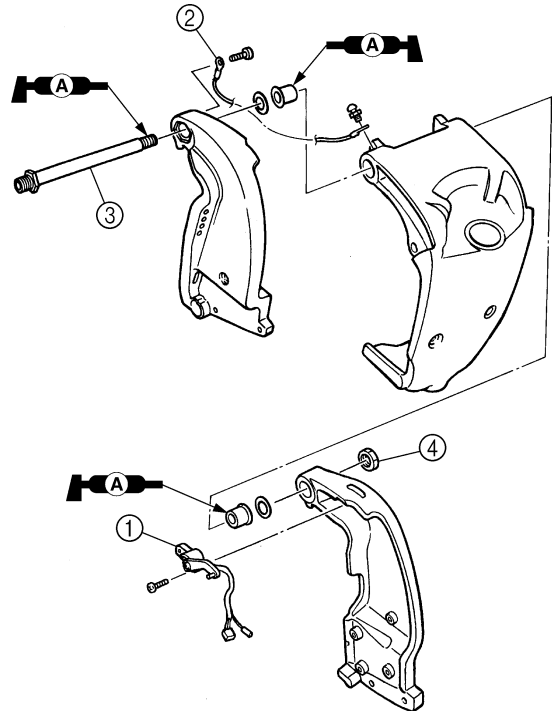


S69J7125

NOTE:

Adjust the trim sensor after installing the power trim and tilt unit.

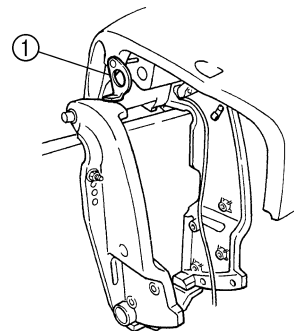
2. Assemble the clamp brackets and the swivel bracket by connecting the ground lead ②, installing the through tube ③, then tightening the self-locking nut ④ finger tight.



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.



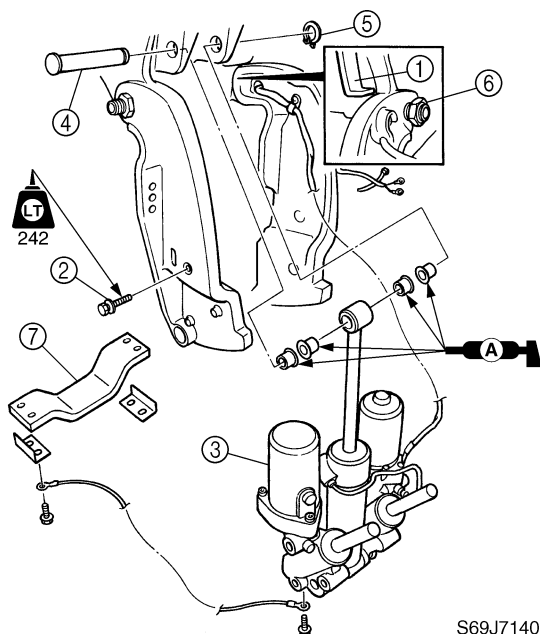
S69J7135

NOTE:

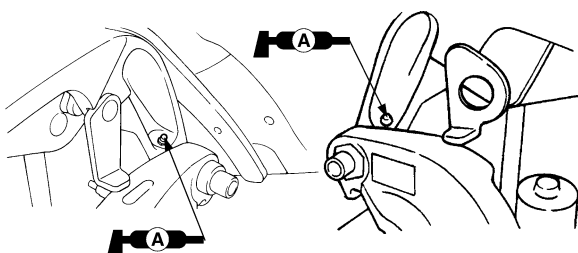
After tilting up the outboard motor, be sure to support it with the tilt stop lever.

2. Install the bolts ② onto both clamp brackets together with the power trim and tilt unit ③.

3. Install the tilt ram upper end into the swivel bracket with the shaft ④ and circlip ⑤.
4. Tighten the self-locking nut ⑥ to the specified torque.
5. Remove the anode ⑦.

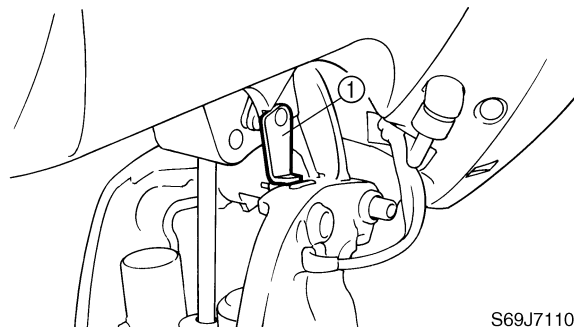


6. Inject grease into all grease nipples until grease comes out from the bushings ①.



Adjusting the trim sensor

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



⚠ WARNING

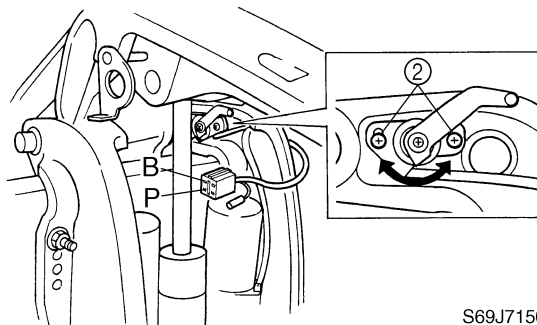
After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.

2. 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 resistance. Repeat steps 1–5 if out of specification.



Trim sensor resistance:
Pink (P) – Black (B)
9–11 Ω at 20 °C (68 °F)

6. Tighten the screws ②.



Upper case, steering arm, swivel bracket and clamp brackets

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.

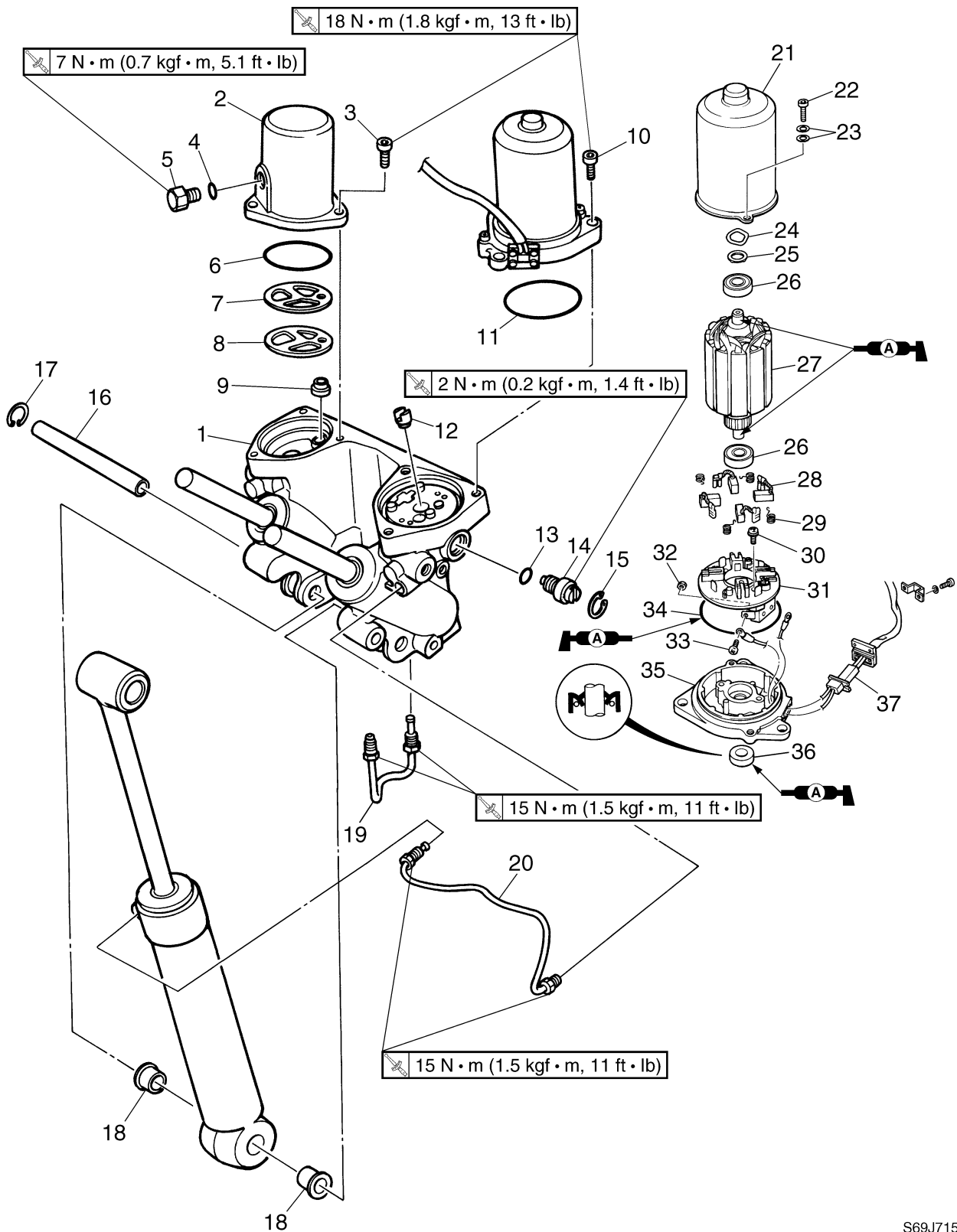


Trim sensor resistance:

Pink (P) – Black (B)

247.6–387.6 Ω at 20 °C (68 °F)

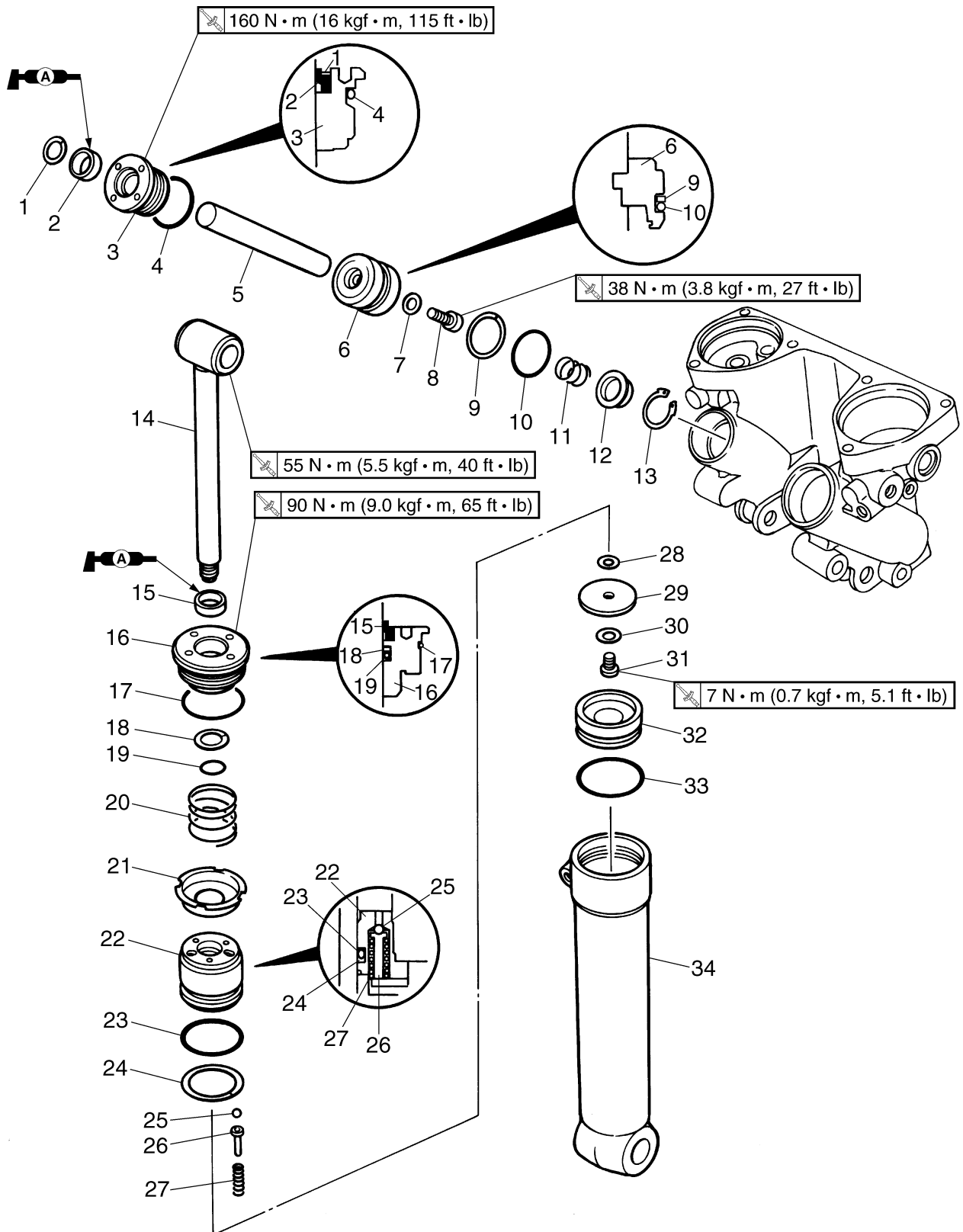
Power trim and tilt unit



S69J7155

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 1.9 × 12.6 mm
5	Reservoir cap	1	M12 × 10 mm
6	O-ring	1	Not reusable
7	Sheet	1	
8	Filter	1	
9	Spacer	1	
10	Bolt	3	M8 × 20 mm
11	O-ring	1	Not reusable 2.4 × 22.6 mm
12	Joint	1	
13	O-ring	1	Not reusable
14	Manual valve	1	
15	Circlip	1	
16	Shaft	1	
17	Circlip	1	
18	Bushing	2	
19	Pipe	1	
20	Pipe	1	
21	Yoke	1	
22	Bolt	2	M5 × 12 mm
23	Washer	4	
24	Wave washer	1	
25	Washer	1	
26	Bearing	2	
27	Armature	1	
28	Brush	4	
29	Spring	4	
30	Screw	2	M4 × 12 mm
31	Brush holder	1	
32	Nut	2	
33	Screw	2	M4 × 6 mm
34	O-ring	1	Not reusable
35	PTT motor base	1	
36	Oil seal	1	Not reusable
37	PTT motor lead	1	

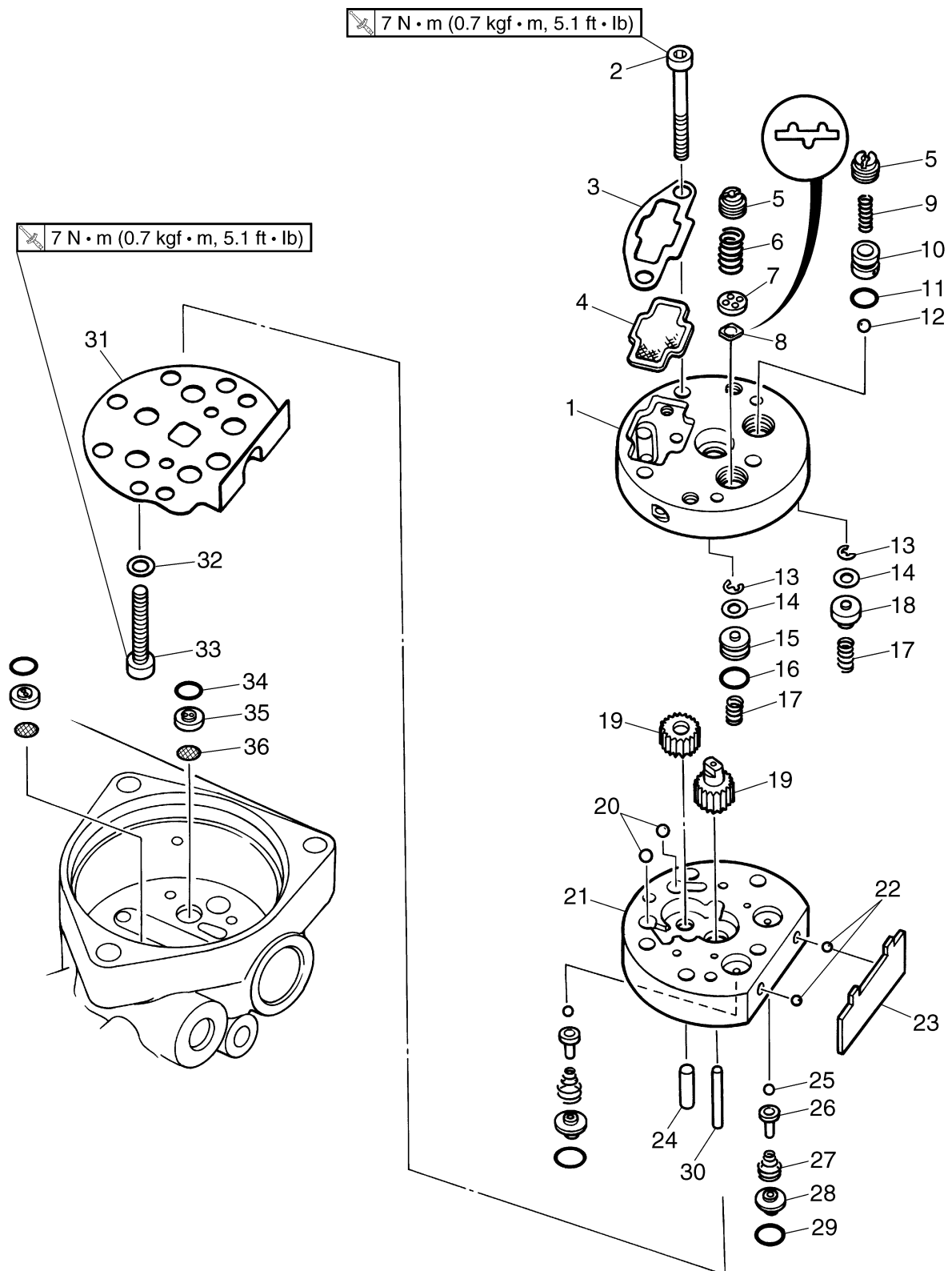


S69J7165

Power trim and tilt unit

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	Washer	2	
8	Bolt	2	M8 × 20 mm
9	Backup ring	2	
10	O-ring	2	Not reusable
11	Spring	2	
12	Adapter	2	
13	Circlip	2	
14	Tilt ram	1	
15	Dust seal	1	Not reusable
16	Tilt cylinder end screw	1	
17	O-ring	1	Not reusable
18	Backup ring	1	
19	O-ring	1	Not reusable
20	Spring	1	
21	Adapter	1	
22	Tilt piston	1	
23	O-ring	1	Not reusable
24	Backup ring	1	
25	Ball	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	

7



S69J7170

Power trim and tilt unit

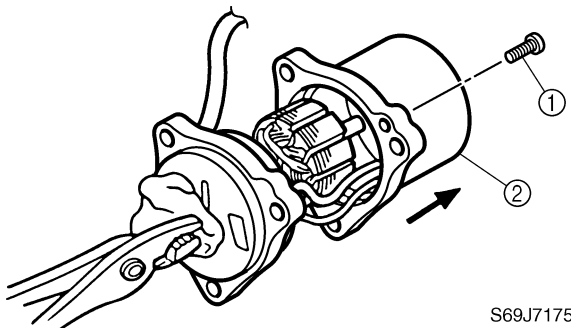
No.	Part name	Q'ty	Remarks
1	Gear housing 1	1	
2	Bolt	3	M5 × 40 mm
3	Plate	1	
4	Filter	1	
5	Valve lock screw	2	
6	Down-relief spring	1	
7	Valve support pin	1	
8	Relief valve seal	1	
9	Up-relief spring	1	
10	Valve support pin	1	
11	O-ring	1	Not reusable 1.8 × 11.35 mm
12	Ball	1	
13	Circlip	2	
14	Main valve seal	2	
15	Shuttle piston	1	
16	O-ring	1	Not reusable
17	Return spring	2	
18	Shuttle piston	1	
19	Drive gear	2	
20	Ball	2	
21	Gear housing 2	1	
22	Ball	2	
23	Manual release spring	1	
24	Dowel pin	1	
25	Ball	2	
26	Pin	2	
27	Spring	2	
28	Spacer	2	
29	O-ring	2	Not reusable 1.9 × 9.6 mm
30	Dowel pin	2	
31	Bracket	1	
32	Washer	2	
33	Bolt	2	M5 × 25 mm
34	O-ring	2	Not reusable 1.9 × 9.6 mm
35	Spacer	2	
36	Filter	2	

7



Disassembling the power trim and tilt motor

1. Remove the PTT motor screws ①, then the yoke ②.



S69J7175

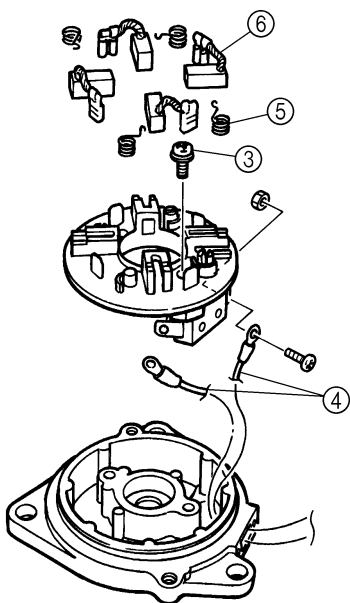
CAUTION:

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 a pair of pliers as shown.

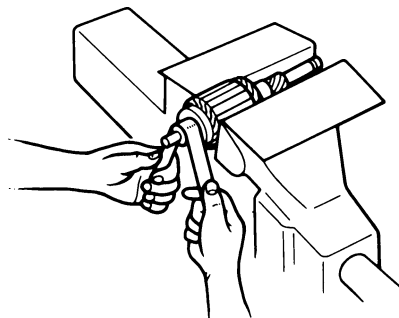
2. Remove the screws ③, disconnect the PTT motor leads ④, and then remove the springs ⑤ and brushes ⑥.



S69J7180

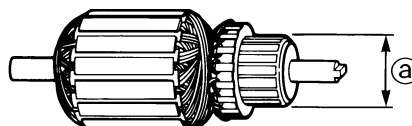
Checking the power trim and tilt motor

1. Check the commutator for dirt or foreign substances. Clean with #600 grit sandpaper if necessary.



S69J7185

2. Check the commutator undercut for dirt or foreign substances. Clean with compressed air if necessary.
3. Measure the commutator diameter ①. Replace if out of specification.

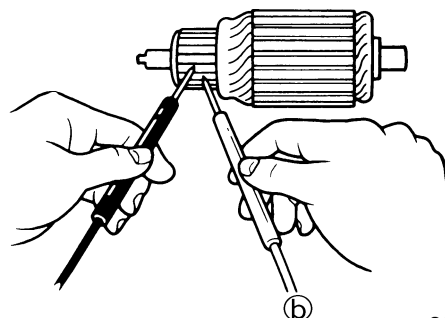


S69J7190



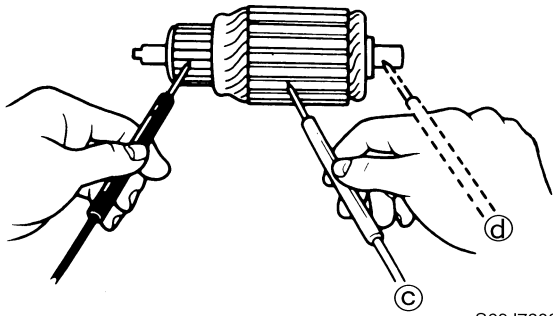
Commutator diameter limit ①:
25.0 mm (0.98 in)

4. Check the armature coil for continuity. Replace if out of specifications.



S69J7195

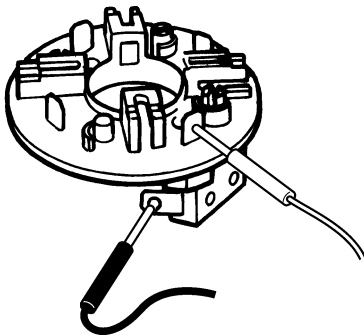
Power trim and tilt unit



S69J7200

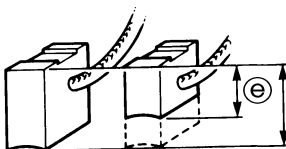
Armature coil continuity	
Commutator segments (b)	Continuity
Segment-laminations (c)	No continuity
Segment-shaft (d)	No continuity

5. Check the circuit breaker for continuity. Replace the brush holder if there is no continuity.



S69J7205

6. Measure the brush length. Replace if out of specification.



S69J7210

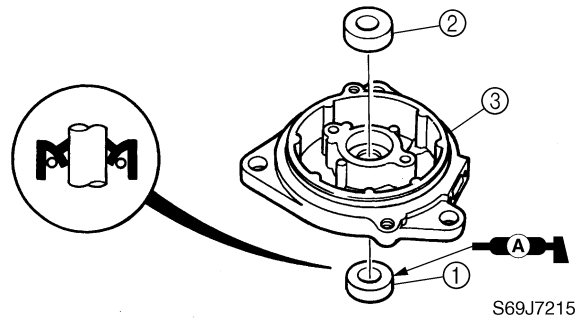
Brush length limit (c): 4.0 mm (0.16 in)	
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7. Check the base for corrosion or damage. Replace if necessary.

8. Check the bearing for damage or wear. Replace if necessary.

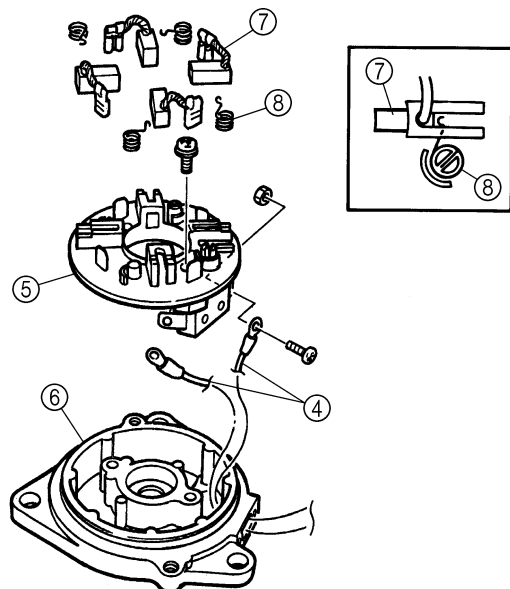
Assembling the power trim and tilt motor

1. Install the new oil seal (1) and bearing (2) into the motor base (3) as shown.



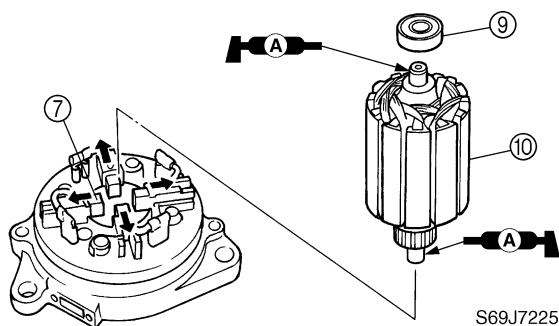
S69J7215

2. Connect the PTT motor leads (4) to the brush holder (5) and then install the brush holder (5) to the motor base (6).
3. Install the brushes (7) and springs (8) to the brush holder as shown.

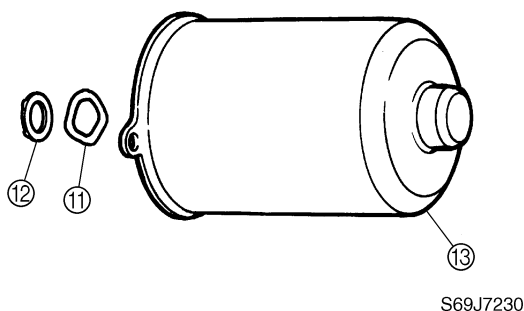


S69J7220

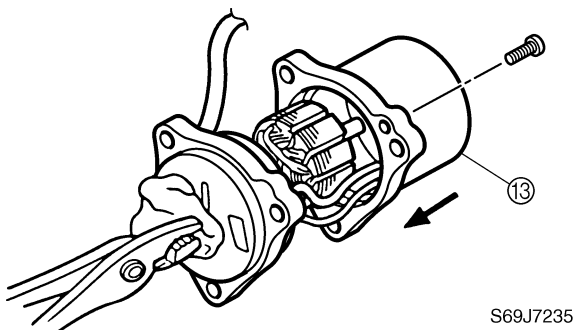
4. Install the bearing (9) to the armature (10).
5. Push the brushes (7) into the holders, and then install the armature (10).



6. Install the wave washer ⑪ and washer ⑫ into the yoke ⑬.



7. Install the new O-ring and yoke ⑬ to the motor base.

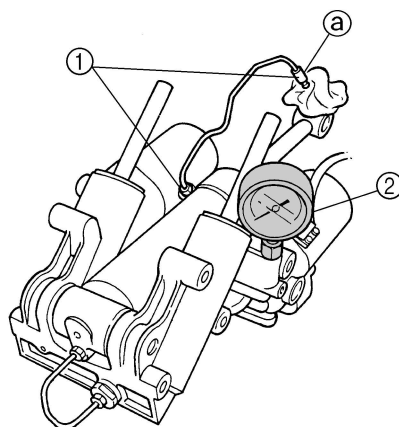


NOTE: _____
Place a clean cloth over the end of the armature shaft and carefully push the armature from the yoke with a pair of pliers as shown.

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 adapter set ②.

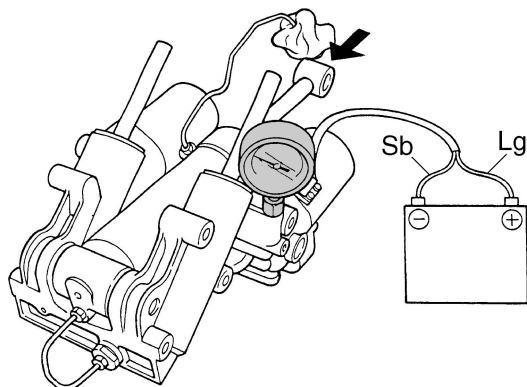


NOTE: _____
Cover the removed pipe joint ② with a rag.



PTT oil pressure gauge adapter set:
90890-06580

5. Connect the PTT motor leads to the battery terminals to retract the tilt ram, and then measure the hydraulic pressure.



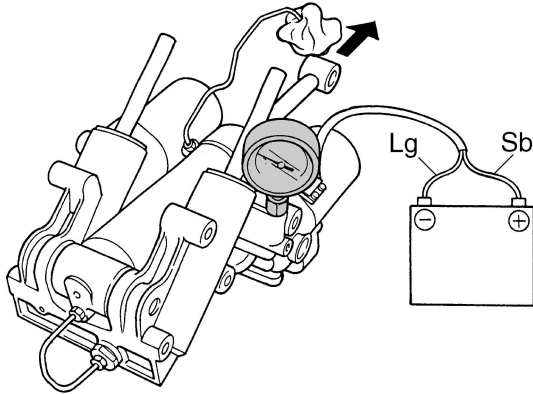
Ram	PTT motor lead	Battery terminal
Down	Light green (Lg)	⊕
	Sky blue (Sb)	⊖



Hydraulic pressure (down):
6.7–8.7 MPa (68–89 kgf/cm²)

Power trim and tilt unit

6. Reverse the PTT motor leads between the battery terminals to fully extend the trim and tilt rams.



S69J7250

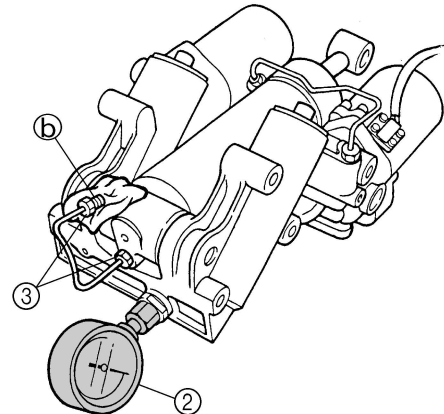
Ram	PTT motor lead	Battery terminal
Up	Sky blue (Sb)	⊕
	Light green (Lg)	⊖

7. Remove the PTT oil pressure gauge adapter set ②.
8. Install the pipe joints ①, and then tightening them to the specified torque.



Pipe joint ①:
15 N·m (1.5 kgf·m, 11 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 adapter set ②.



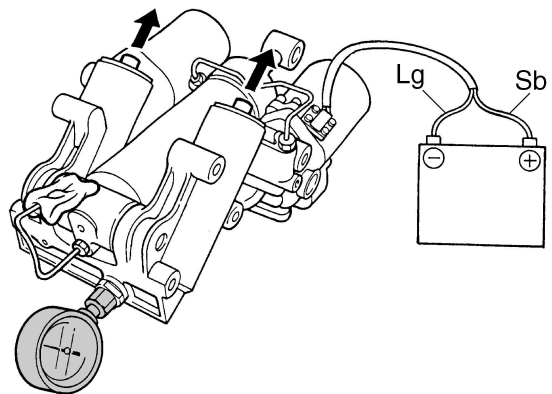
S69J7255

NOTE: _____
Cover the removed pipe joint ⑥ with a rag.



PTT oil pressure gauge adapter set:
90890-06580

12. Connect the PTT motor leads to the battery terminals to extend the tilt ram, and then measure the hydraulic pressure.

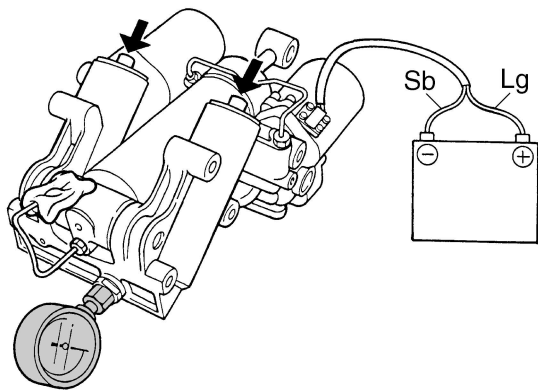


S69J7260



Hydraulic pressure (up):
12.2–14.2 MPa (124–145 kgf/cm²)

13. Reverse the PTT motor leads between the battery terminals to fully retract the trim and tilt rams.



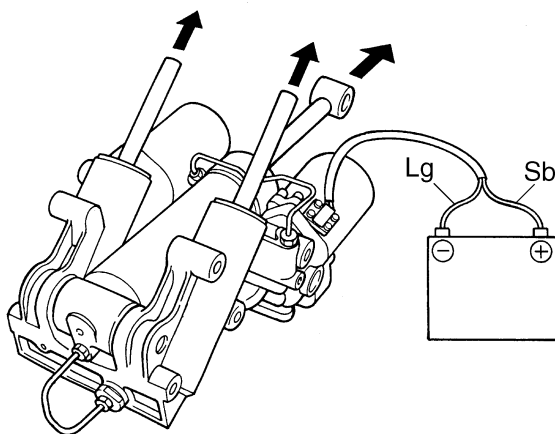
S69J7265

14. Remove the PTT oil pressure gauge adapter set ②.
15. Install the pipe joints ③, and then tightening them to the specified torque.



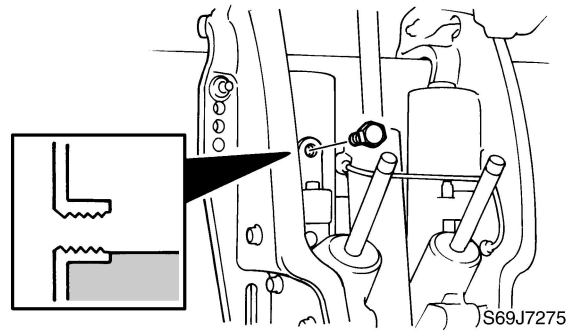
Pipe joint ③:
 15 N·m (1.5 kgf·m, 11 ft·lb)

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.

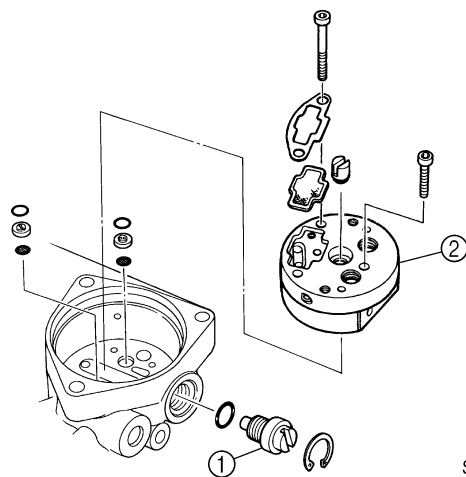


Recommended power trim and tilt fluid:
ATF Dexron II

19. Install the reservoir cap.

Disassembling the gear pump

1. Remove the manual valve ① and gear pump ②.



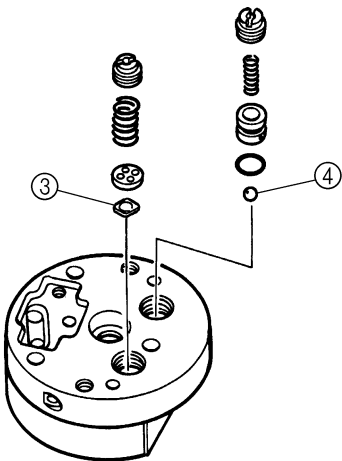
S69J7280

2. Remove the relief valve seal ③ and ball ④.

Power trim and tilt unit

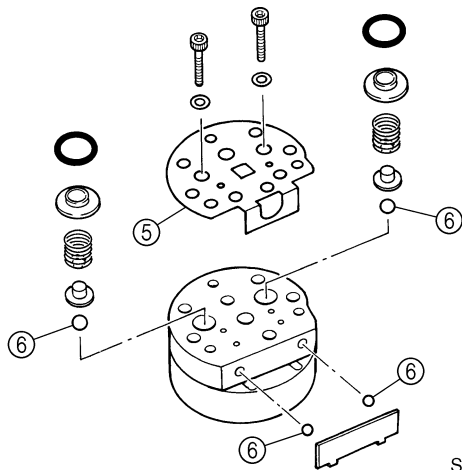
Disassembling the tilt cylinder and trim cylinders

1. Hold the tilt cylinder ① in a vise using aluminum plates ③ on both sides.
2. Loosen the tilt cylinder end screw ②, and then remove the tilt piston assembly.



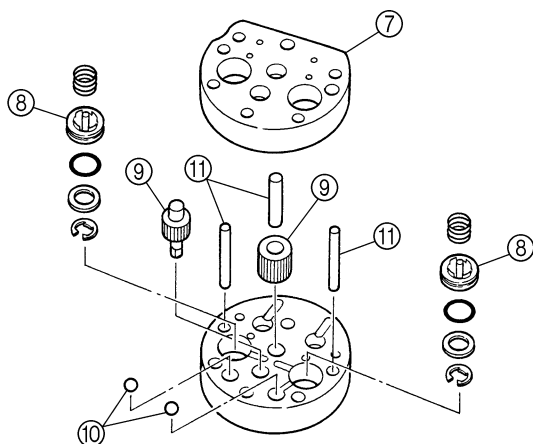
S69J7285

3. Remove the bracket ⑤, then the balls ⑥.

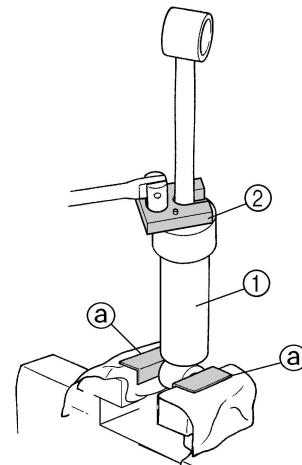


S69J7290

4. Remove the gear housing 2 ⑦, then the shuttle pistons ⑧.
5. Remove the drive gear ⑨, balls ⑩, and dowel pins ⑪.



S69J7295



S69J7300

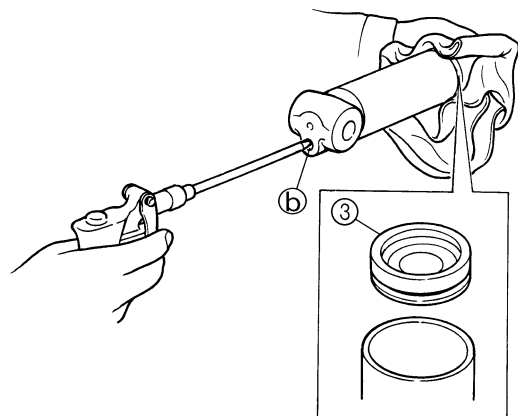
⚠ WARNING

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. Remove the free piston ③, and then blow compressed air through the hole ⑥ while holding down the cloth.



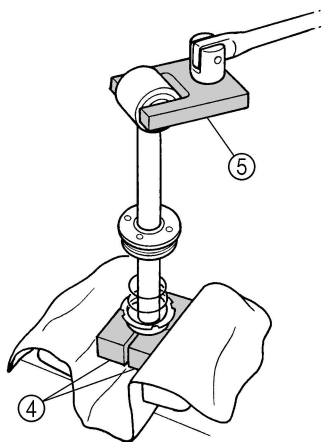
S69J7305



⚠ WARNING

Never look into the tilt cylinder opening because the free piston and power trim and tilt fluid may be expelled out forcefully.

5. Hold the tilt piston in a vise using the special service tool ④ on both sides.
6. Remove the tilt ram.



S69J7310

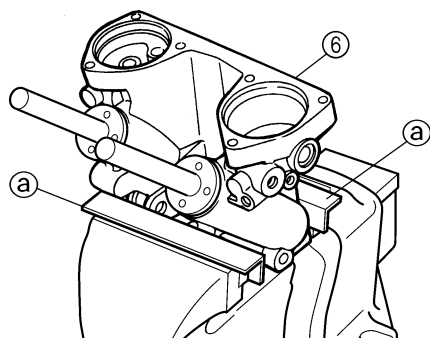


PTT piston vice attachment ④:

90890-06572

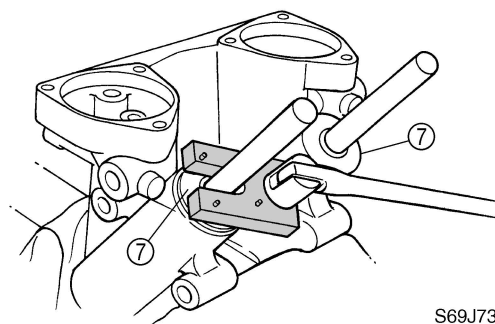
Tilt rod wrench ⑤: 90890-06569

7. Hold the cylinder block ⑥ in a vise using aluminum plates ① on both sides.



S69J7315

8. Loosen the trim cylinder end screws ⑦, and then remove them.



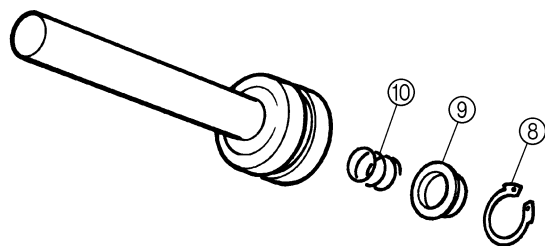
S69J7320



Cylinder-end screw wrench:

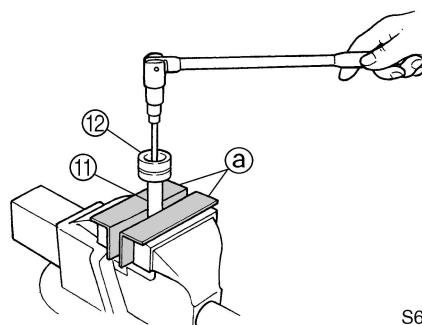
90890-06544

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

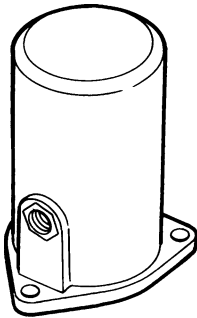
12. Hold the trim ram ⑪ in a vise using aluminum plates ① on both sides.
13. Remove the trim piston ⑫.



S69J7330

Checking the reservoir

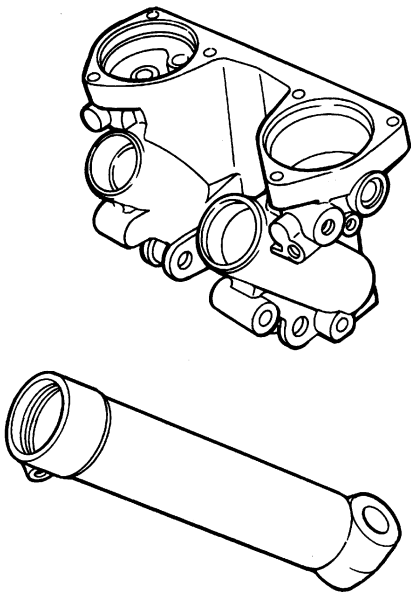
1. Check the reservoir for cracks or corrosion. Replace if necessary.



S69J7335

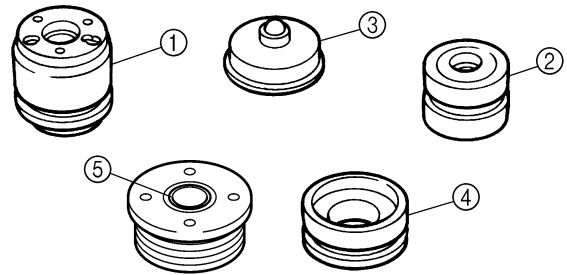
Checking the tilt cylinder and trim cylinder

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.



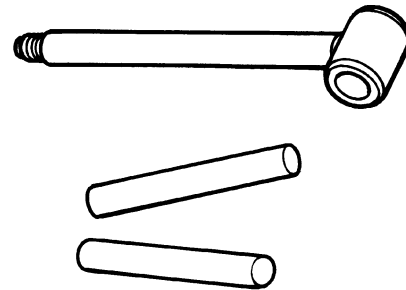
S69J7340

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.



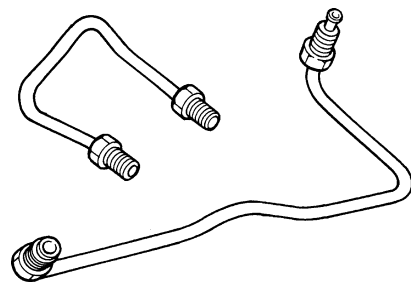
S69J7345

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

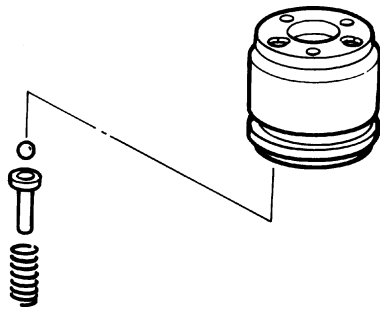
5. Check the pipes for cracks or corrosion. Replace if necessary.



S69J7355

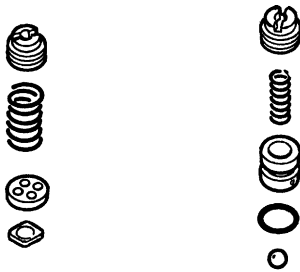
Checking the valves

1. Check the operation of the tilt piston absorber valves and the valves for dirt or residue. Clean if necessary.



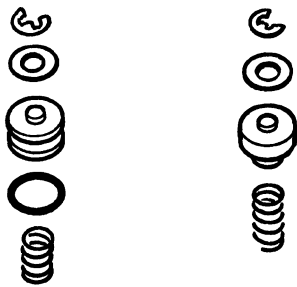
S69J7360

2. Check the up-relief valve and down-relief valve for dirt or residue. Clean if necessary.



S69J7365

3. Check the main valves for dirt or residue. Clean if necessary.



S69J7370

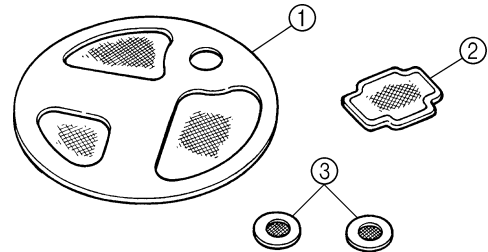
4. Check the absorber valves for dirt or residue. Clean if necessary.



S69J7375

Checking the filters

1. Check gear pump filters ① and ②, and shuttle piston filters ③ for dirt or residue. Clean if necessary.



S69J7380

Checking the gear pump

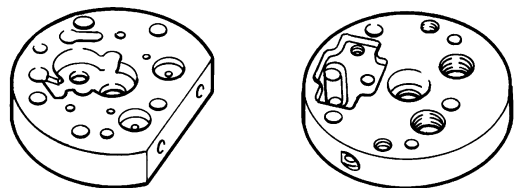
1. Check the drive gear for damage or excessive wear. Replace if necessary.



S69J7385

Checking the gear pump housing

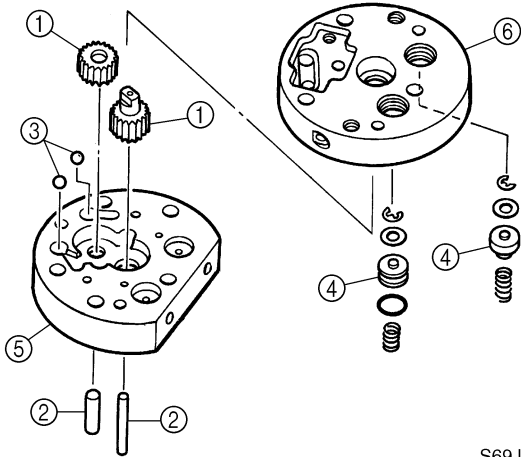
1. Check the gear pump housing for scratches. Replace if necessary.



S69J7387

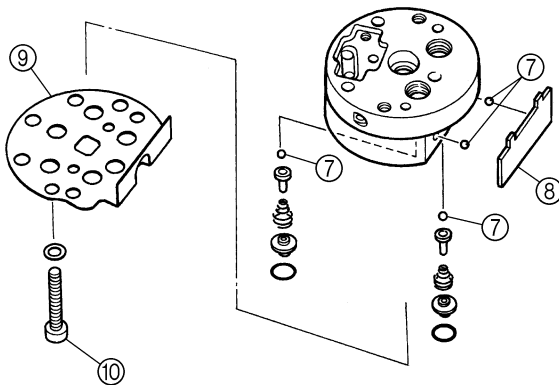
Assembling the gear pump

1. Install the drive gears ①, dowel pins ②, balls ③, and shuttle pistons ④ into the gear housing 1 ⑤.
2. Install the gear housing 2 ⑥.



S69J7390

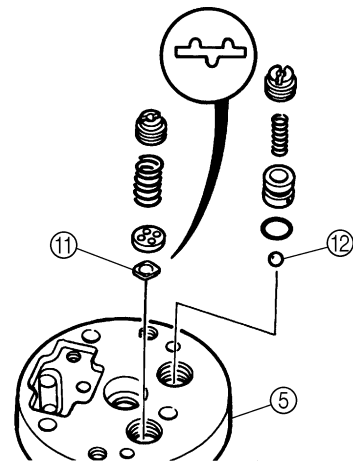
3. Install the balls ⑦, manual release spring ⑧, and bracket ⑨ by installing the bolts ⑩, then tightening them to the specified torque.



S69J7395

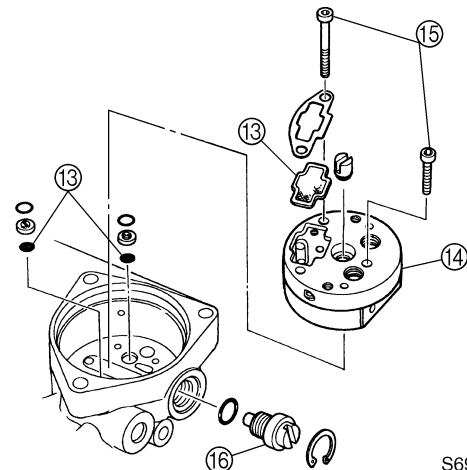
 Gear pump bracket bolt ⑩:
7 N·m (0.7 kgf·m, 5.1 ft·lb)

4. Install the relief valve seal ⑪ and ball ⑫ into the gear housing 1 ⑤.



S69J7400

5. Install the filters ⑬ and gear pump ⑭ by installing the bolts ⑮, then tightening them to the specified torque.
6. Install the manual valve ⑯.

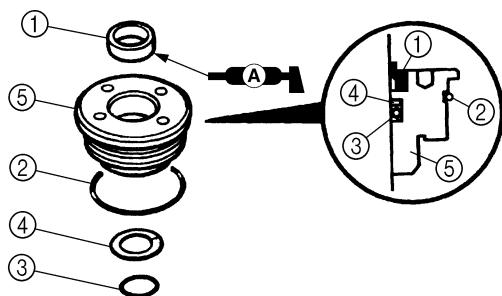


S69J7405

 Gear pump bolt ⑮:
7 N·m (0.7 kgf·m, 5.1 ft·lb)

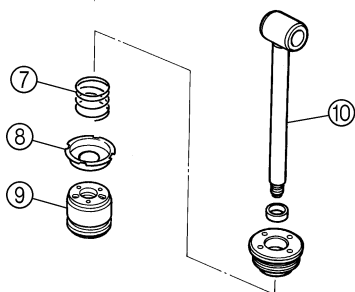
Assembling the tilt ram

1. Install the new dust seal ①, O-rings ② and ③, and backup ring ④ into the tilt cylinder end screw ⑤.



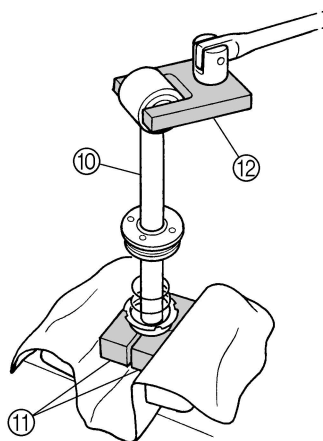
S69J7410

2. Install the tilt cylinder end screw (6), spring (7), adapter (8), and tilt piston (9) to the tilt ram (5).



S69J7415

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



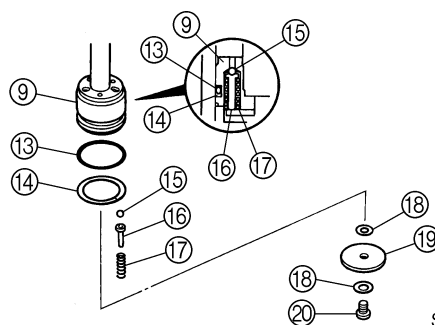
PTT piston vice attachment (11):
90890-06572

Tilt rod wrench (12): 90890-06569



Tilt ram (10):
55 N·m (5.5 kgf·m, 40 ft·lb)

5. Install the new O-ring (13) and backup ring (14) into the tilt piston (9).
6. Install the balls (15), absorber valve pins (16), and springs (17) as shown.
7. Install the washers (18), plate (19), and bolt (20) to the tilt piston (9), and then tighten the bolt to the specified torque.



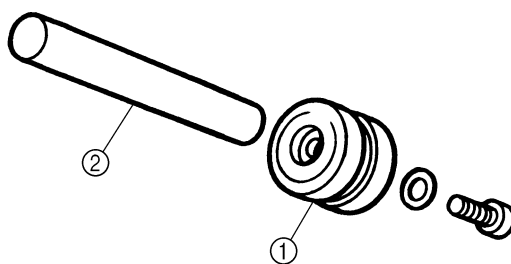
S69J7425



Tilt piston bolt (20):
7 N·m (0.7 kgf·m, 5.1 ft·lb)

Assembling the trim rams

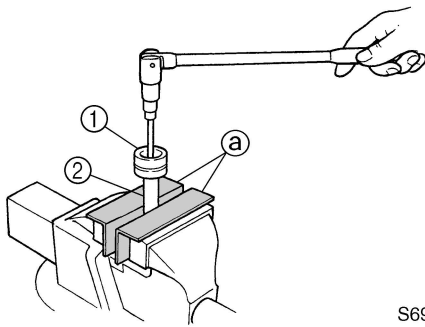
1. Install the trim piston (1) to the trim ram (2).



S69J7430

2. Hold the trim ram (2) in a vise using aluminum plates (a) on both sides.
3. Tighten the trim piston bolt to the specified torque.

Power trim and tilt unit

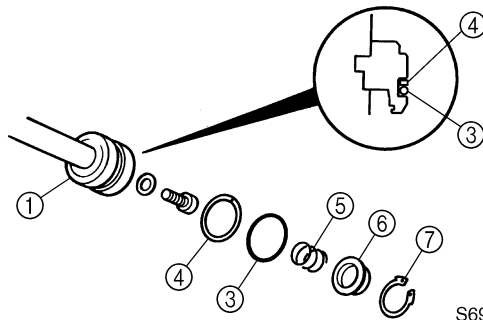


S69J7435



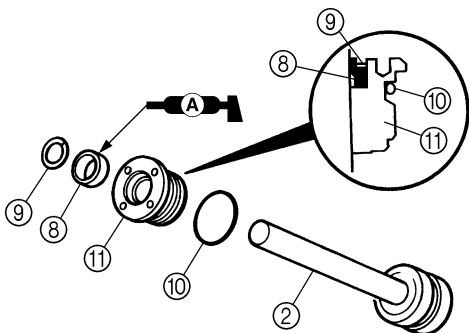
Trim piston bolt:
38 N·m (3.8 kgf·m, 27 ft·lb)

4. Install the new O-ring (3), backup ring (4), spring (5), adapter (6), and circlip (7) to the trim piston (1).



S69J7440

5. Install the new oil seal (8), circlip (9), and new O-ring (10) into the trim cylinder end screw (11).
6. Install the trim cylinder end screw (11) into the trim ram (2).

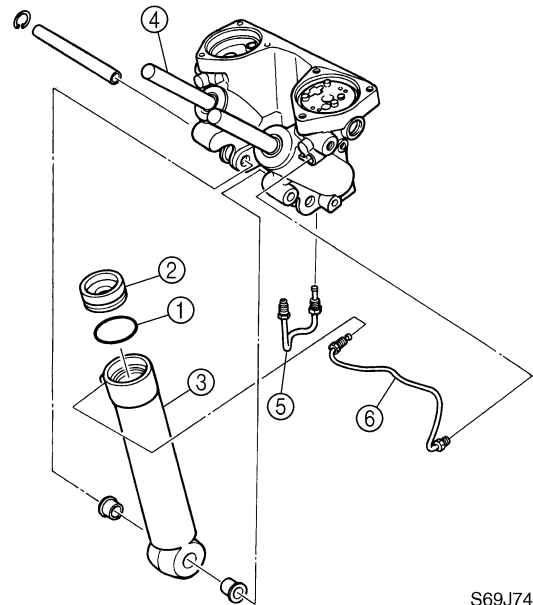


S69J7445

Installing the tilt cylinder

1. Install the new O-ring (1) to 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) to the cylinder block (4).
4. Install pipes (5) and (6), and then tighten them to the specified torque.



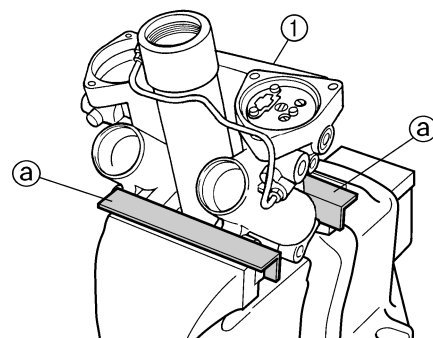
S69J7450



Pipe joint (5) and (6):
15 N·m (1.5 kgf·m, 11 ft·lb)

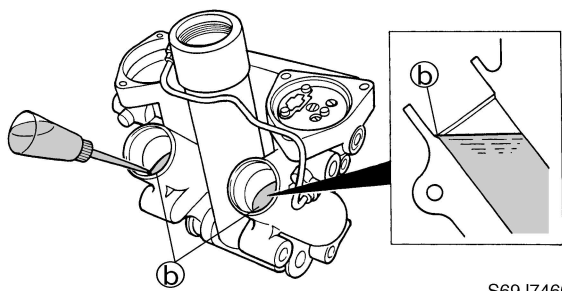
Installing the trim rams

1. Hold the cylinder block (1) in a vise using aluminum plates (a) on both sides.



S69J7455

2. Fill the trim cylinders with the recommended fluid to the correct level (b) as shown.



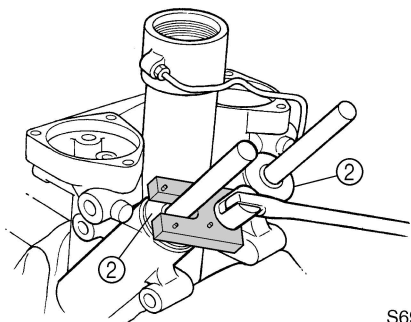
S69J7460



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.



S69J7465

⚠ 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.



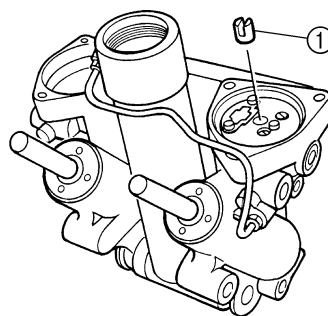
Cylinder-end screw wrench:
90890-06544



Trim cylinder end screw ②:
160 N·m (16 kgf·m, 115 ft·lb)

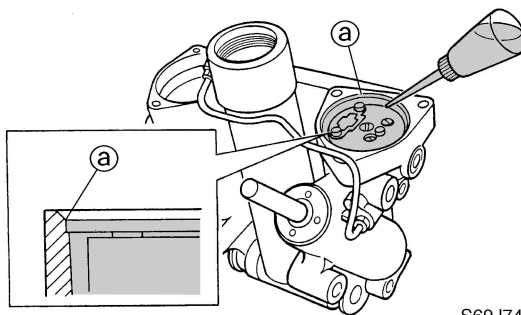
Installing the power trim and tilt motor

1. Install the joint ① into the pump housing.



S69J7470

2. Fill the pump housing with the recommended fluid to the correct level ① as shown.



S69J7475



Recommended power trim and tilt fluid:

ATF Dexron II

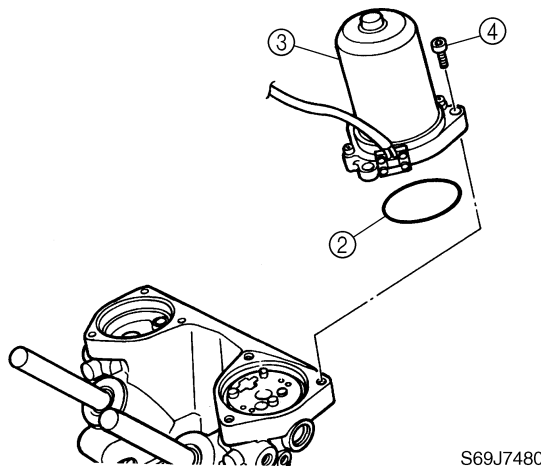
3. Remove all of the air bubbles with a syringe or suitable tool.

NOTE:

Turn the joint with a screwdriver, and then remove any air between the pump gear teeth.

4. Install the new O-ring ②, power trim and tilt motor ③, and then tighten the bolts ④ to the specified torque.

Power trim and tilt unit



NOTE:

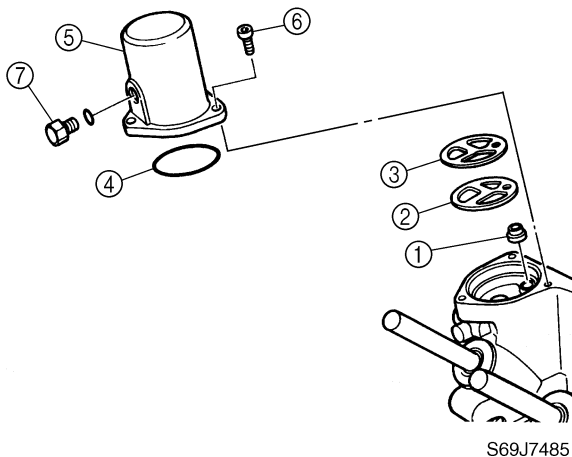
Align the armature shaft with the recess in the joint.



PTT motor bolt ④:
18 N·m (1.8 kgf·m, 13 ft·lb)

Installing the reservoir

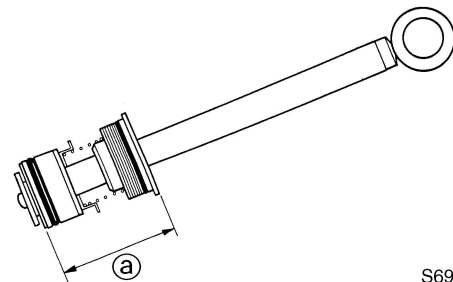
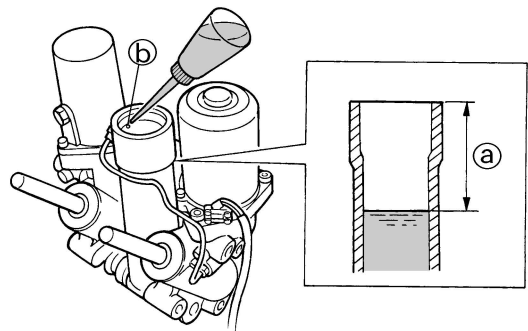
1. Install the spacer ①, filter ② and sheet ③ to the cylinder block.
2. Install the new O-ring ④ and reservoir ⑤, and then tighten the bolts ⑥ to the specified torque.
3. Install the reservoir cap ⑦, and then tighten it to the specified torque.



Reservoir bolt ⑥:
18 N·m (1.8 kgf·m, 13 ft·lb)
Reservoir cap ⑦:
7 N·m (0.7 kgf·m, 5.1 ft·lb)

Installing the tilt ram

1. Fill the tilt cylinder with the recommended fluid to the correct level ① as shown.
2. Add a small amount of the recommended fluid through the cylinder block hole ② as shown.

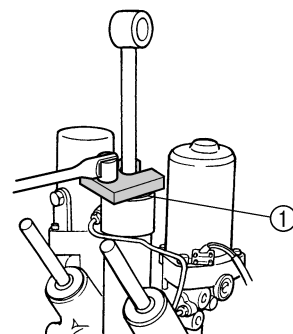


S69J7490



Recommended power trim and tilt fluid:
ATF Dexron II

3. 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

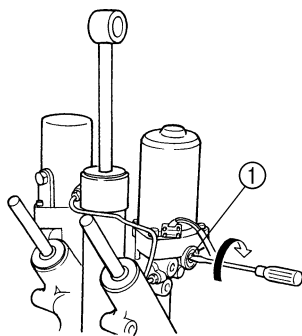


Trim cylinder end screw:
 90 N·m (9.0 kgf·m, 65 ft·lb)

Bleeding the power trim and tilt unit

Not installed

1. Tighten the manual valve ① by turning it clockwise.



S69J7500

2. Place the power trim and tilt unit in an upright position.
3. Check the fluid level in the reservoir.

NOTE:

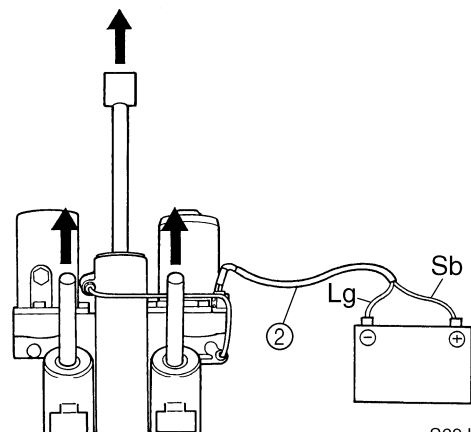
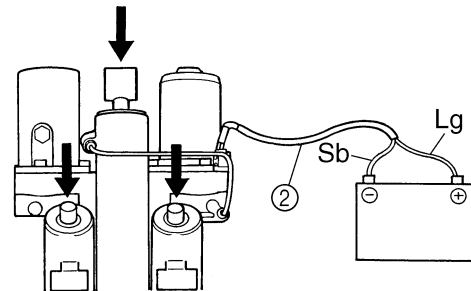
The fluid level should be at the brim of the filler hole.

4. If necessary, add sufficient fluid of the recommended type to the correct level.



Recommended power trim and tilt fluid:
 ATF Dexron II

5. Install the reservoir cap.
6. 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)	⊖

7. 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.

Power trim and tilt unit / Bleeding the power trim and tilt unit

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.

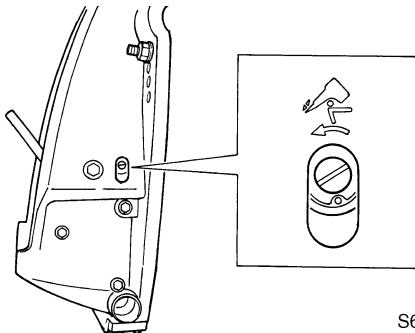
8. Check the fluid level again when the rams are fully extended. Add sufficient fluid, if necessary, and then repeat step 7.

NOTE:

Repeat this procedure until the fluid remains at the correct level.

Built-in

1. Loosen the manual valve by turning it counterclockwise until it cannot be turned further.



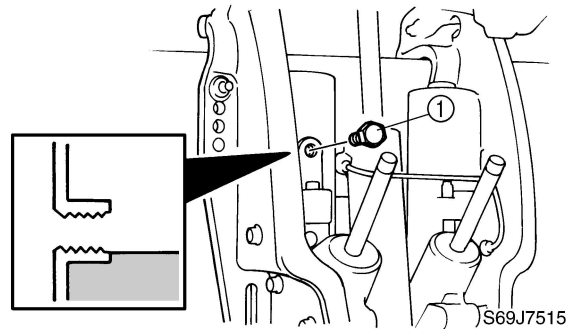
2. Fully tilt the outboard motor up, and then release it and let it lower by its own weight four to five times.
3. Tighten the manual valve by turning it clockwise.
4. Let the fluid settle for 5 minutes.
5. Push and hold the power trim and tilt switch in the up position until the outboard motor is fully tilted up.

6. 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.

7. Remove the reservoir cap ①, and then check the fluid level in the reservoir.
8. 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

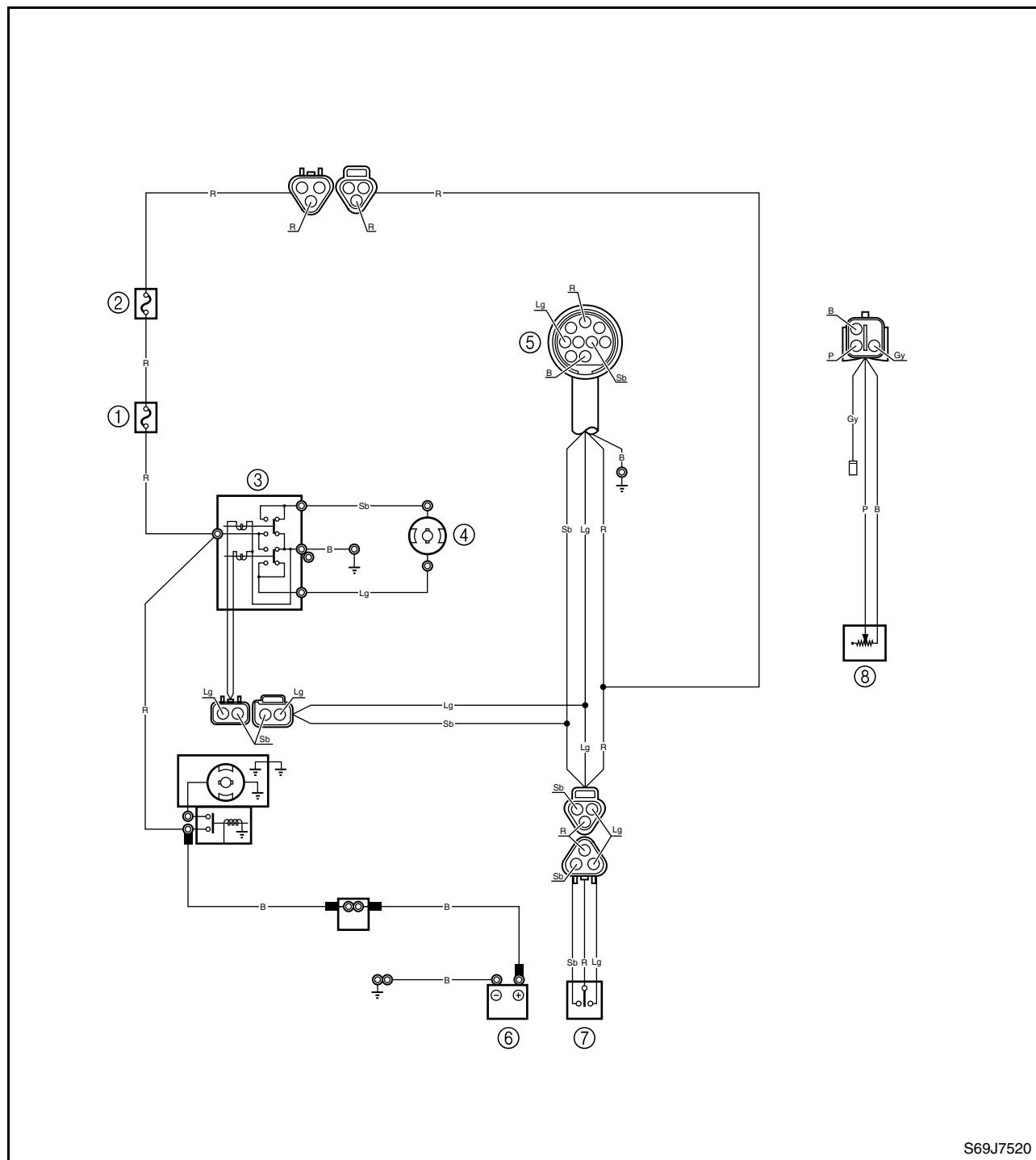
9. Install the reservoir cap.

NOTE:

Repeat this procedure until the fluid remains at the correct level.



Power trim and tilt electrical system



S69J7520

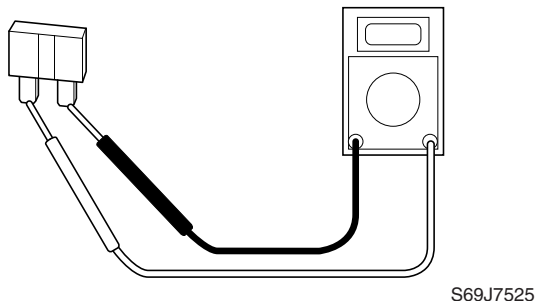
- ① Fuse (30 A)
- ② Fuse (20 A)
- ③ Power trim and tilt relay
- ④ Power trim and tilt motor
- ⑤ 10-pin coupler
- ⑥ Battery
- ⑦ Power trim and tilt switch
- ⑧ Trim sensor

- B : Black
- Gy : Gray
- Lg : Light green
- P : Pink
- R : Red
- Sb : Sky blue

Power trim and tilt electrical system

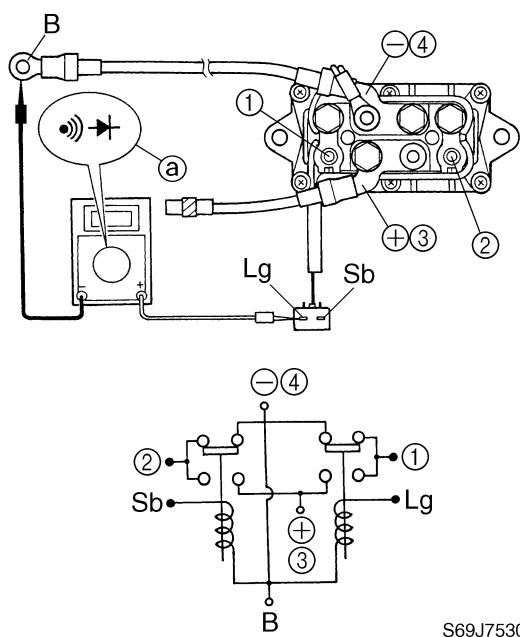
Checking the fuse

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.

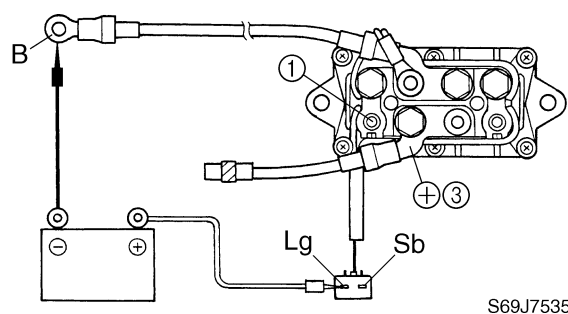


NOTE:

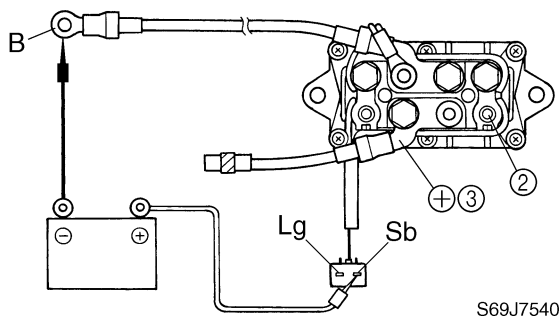
Be sure to set the measurement range ① shown in the illustration when checking for continuity.

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.



5. Connect the digital circuit tester between power trim and tilt relay terminals ② and ③.
6. Connect the sky blue (Sb) lead to the positive battery terminal and the black (B) lead to the negative battery terminal as shown.
7. Check for continuity between terminals ② and ③. Replace if there is no continuity.



NOTE: Turn the lever ① and measure the resistance as it gradually changes.

Trim sensor resistance:

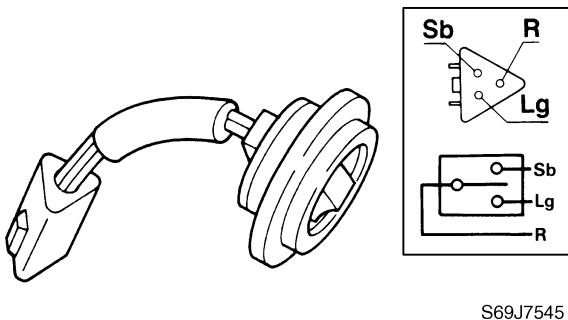
Pink (P) – Black (B)

9–11 Ω at 20 °C (68 °F) ①

247.6–387.6 Ω at 20 °C (68 °F) ②

Checking the power trim and tilt switch

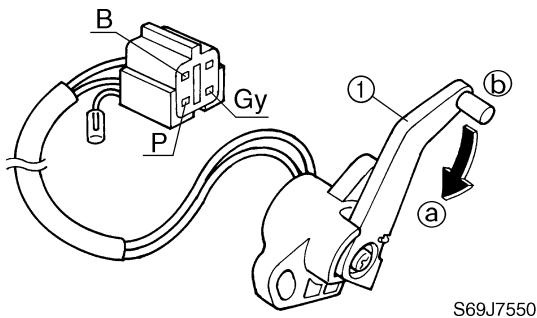
1. Check the power trim and tilt switch for continuity. Replace if out of specification.



	Lead color		
Switch position	Skyblue (Sb)	Red (R)	Lightgreen (Lg)
Up			
Free			
Down			

Checking the trim sensor

1. Measure the trim sensor resistance. Replace if out of specification.

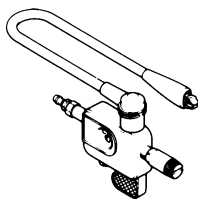




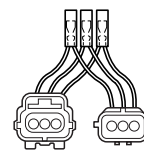
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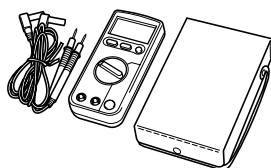
Special service tools



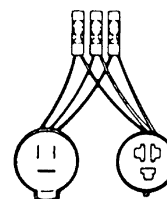
Ignition tester
90890-06754



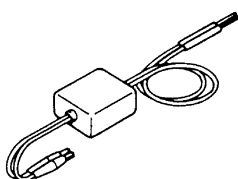
Test harness (3 pins)
90890-06793



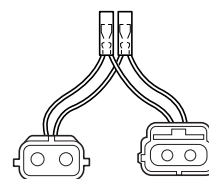
Digital circuit tester
90890-03174



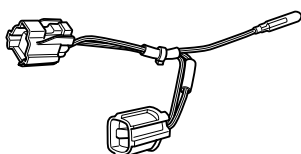
Test harness (3 pins)
90890-06770



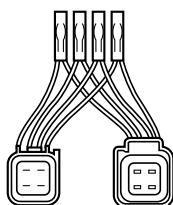
Peak voltage adaptor
90890-03172



Test harness (2 pins)
90890-06787



Test harness (2 pins)
90890-06792



Test harness (4 pins)
90890-06771

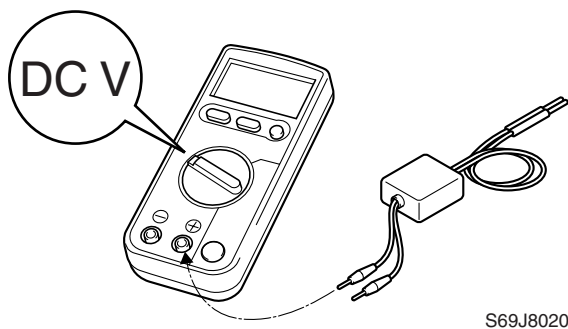
Checking the electrical components

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: _____

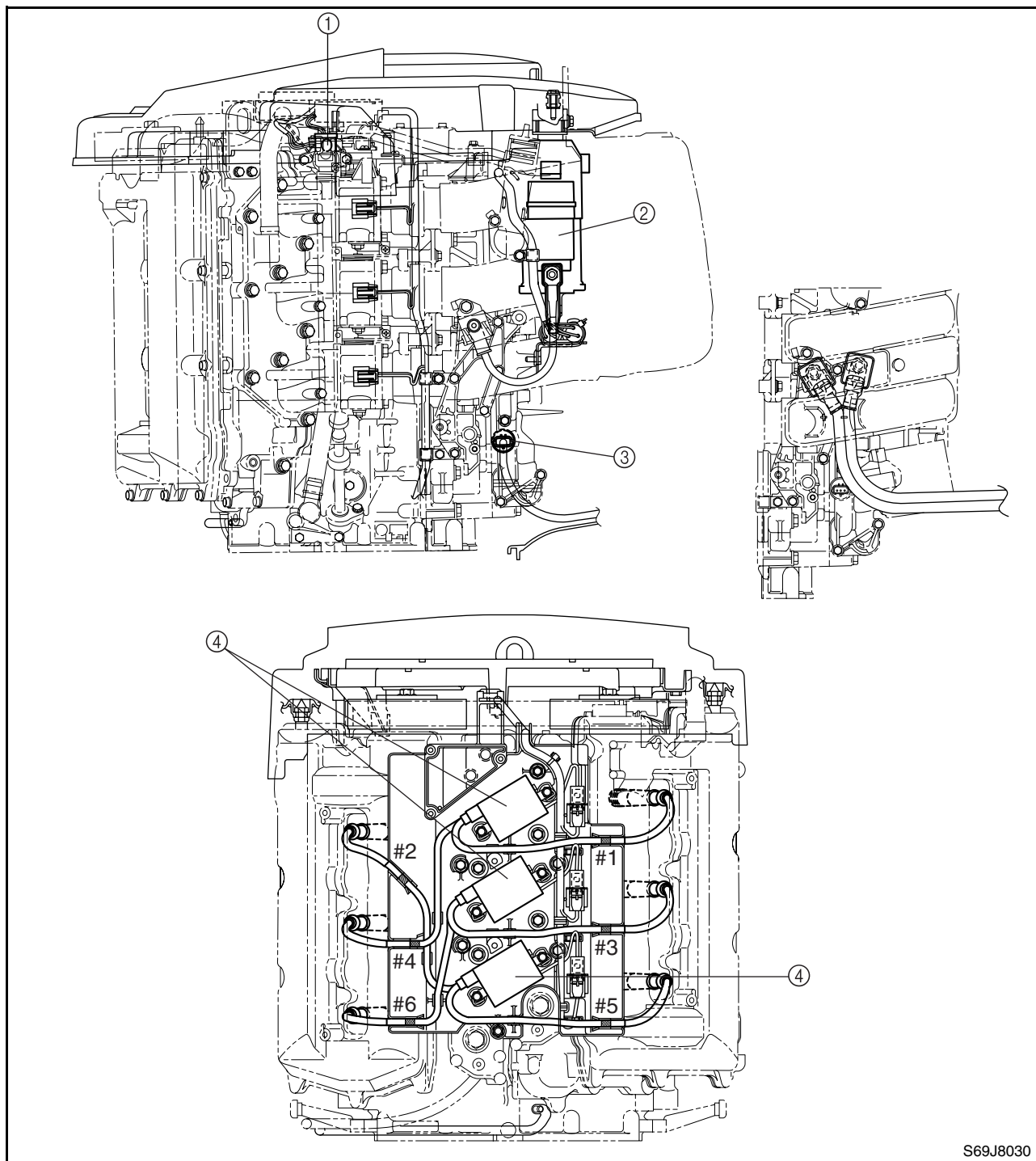
Obtain the internal resistance of the digital circuit tester by connecting both of its probes and checking the display.

Correct value = displayed measurement – internal resistance



Electrical components

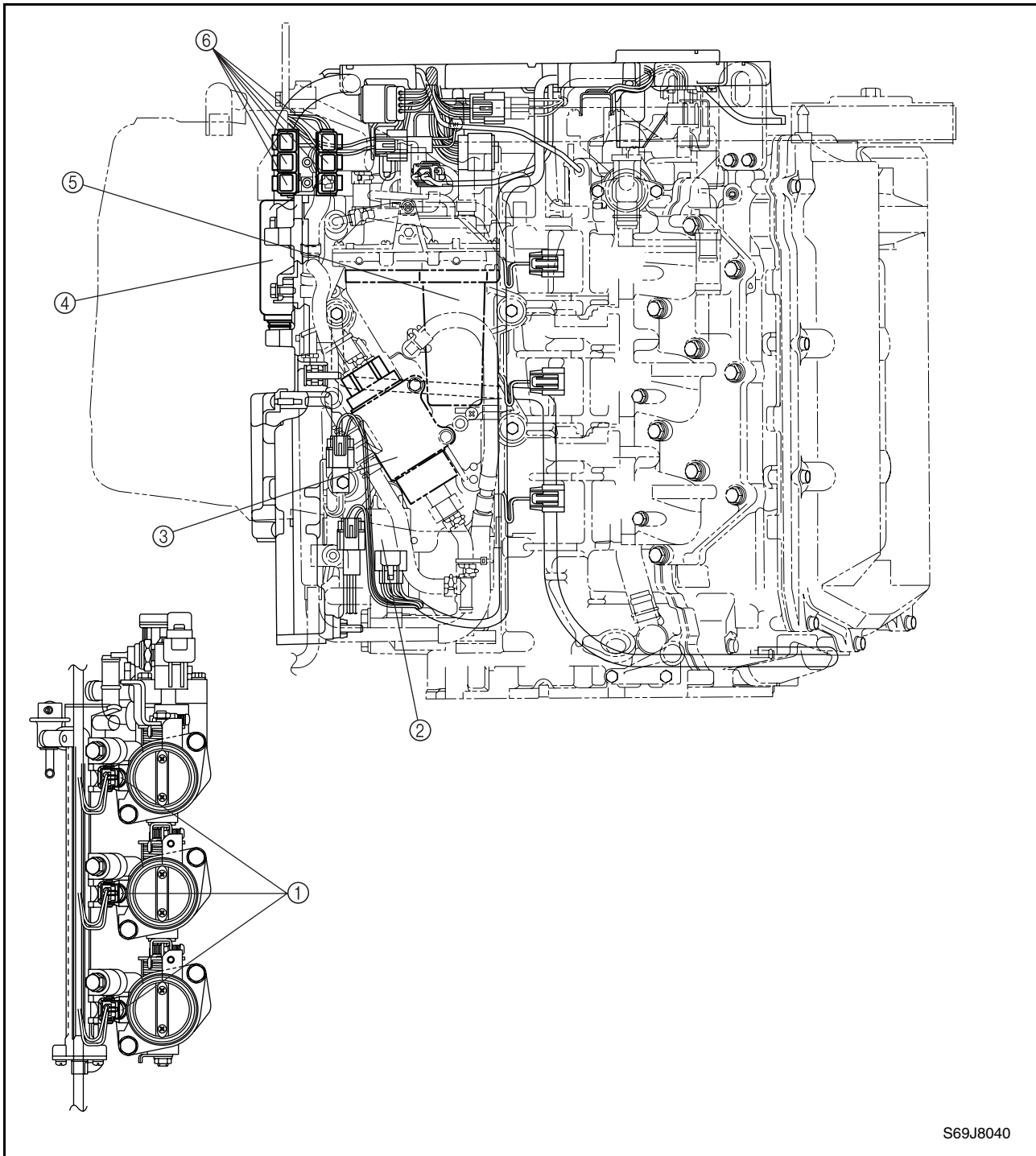
Starboard and rear views



S69J8030

- ① Thermoswitch
- ② Starter motor
- ③ Oil pressure sensor
- ④ Ignition coils

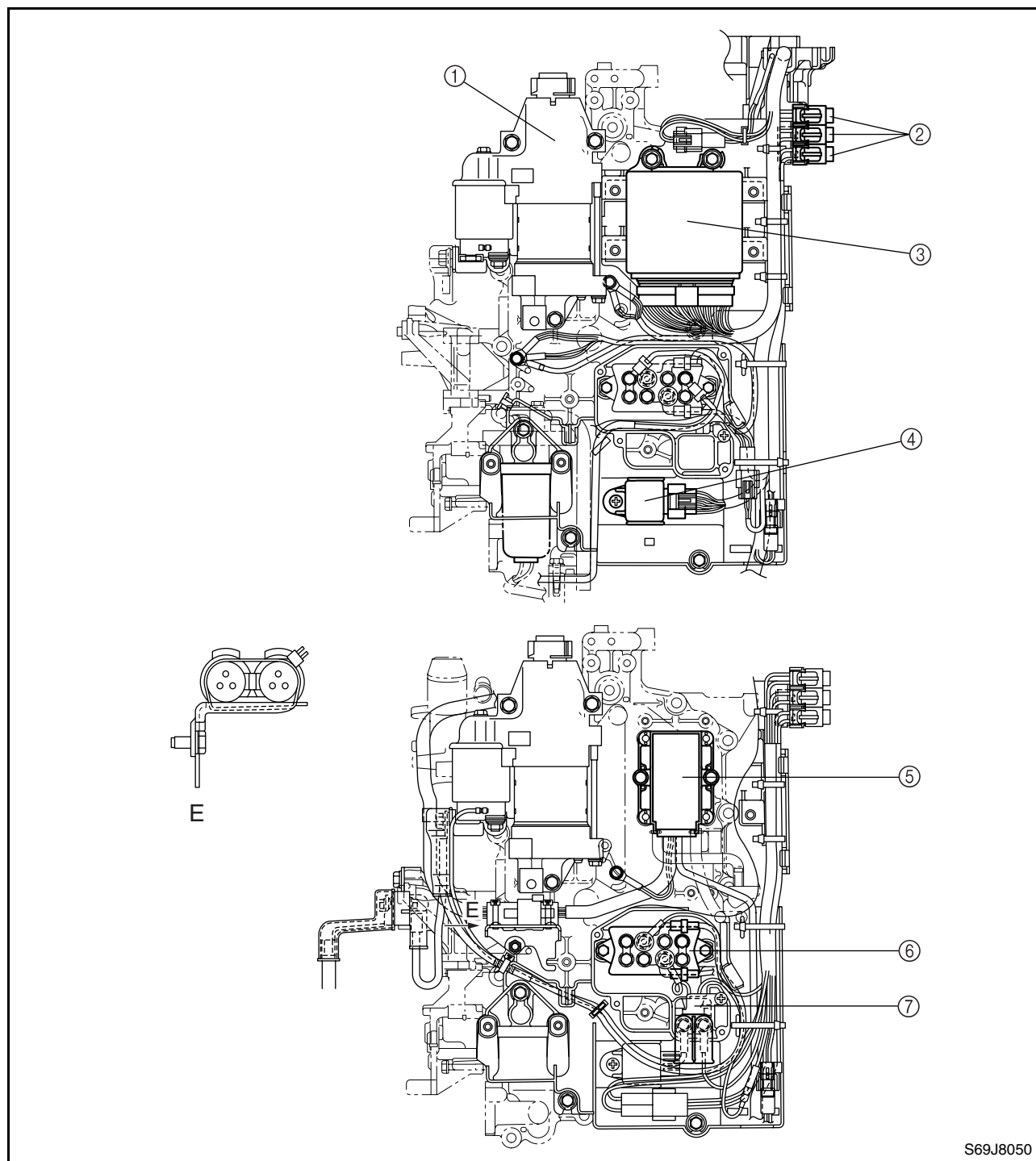
Port view



- ① Fuel injectors
- ② High-pressure fuel pump relay
- ③ Low-pressure fuel pump
- ④ ECM
- ⑤ High-pressure fuel pump
- ⑥ Fuses



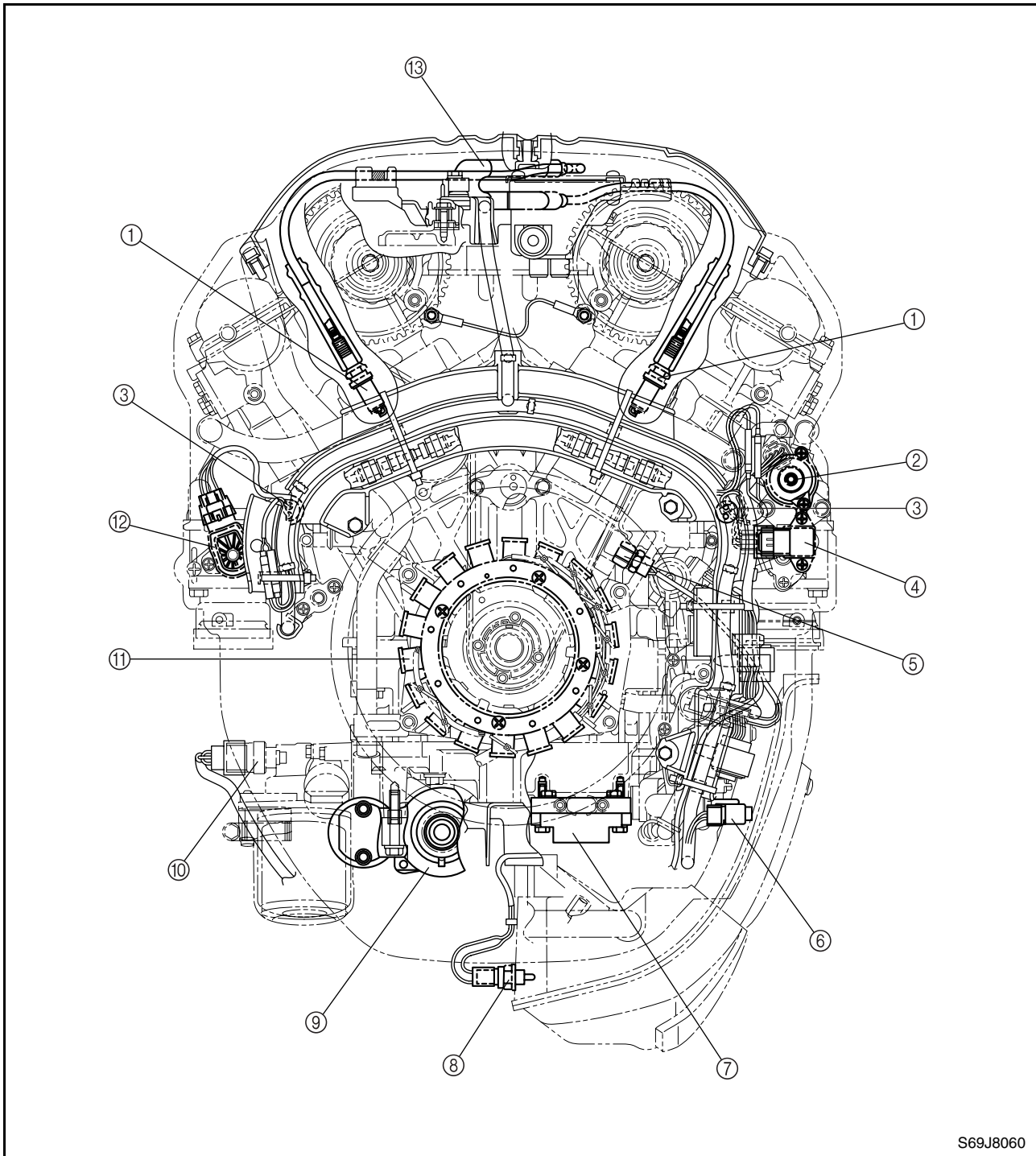
Front view



S69J8050

- ① Starter motor
- ② Fuses
- ③ ECM
- ④ Main relay
- ⑤ Rectifier Regulator
- ⑥ Power trim and tilt relay
- ⑦ Starter relay

Top view

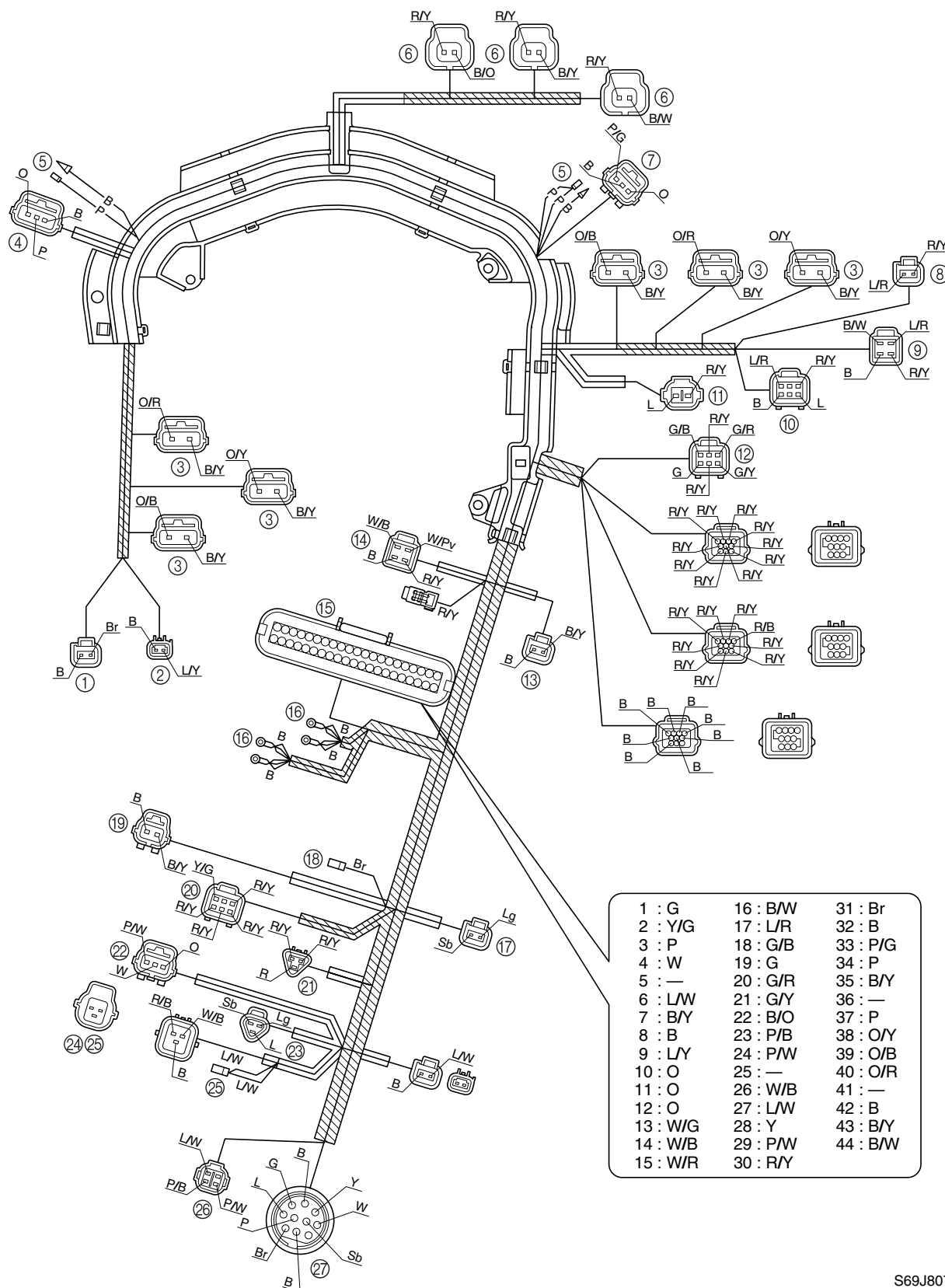


S69J8060

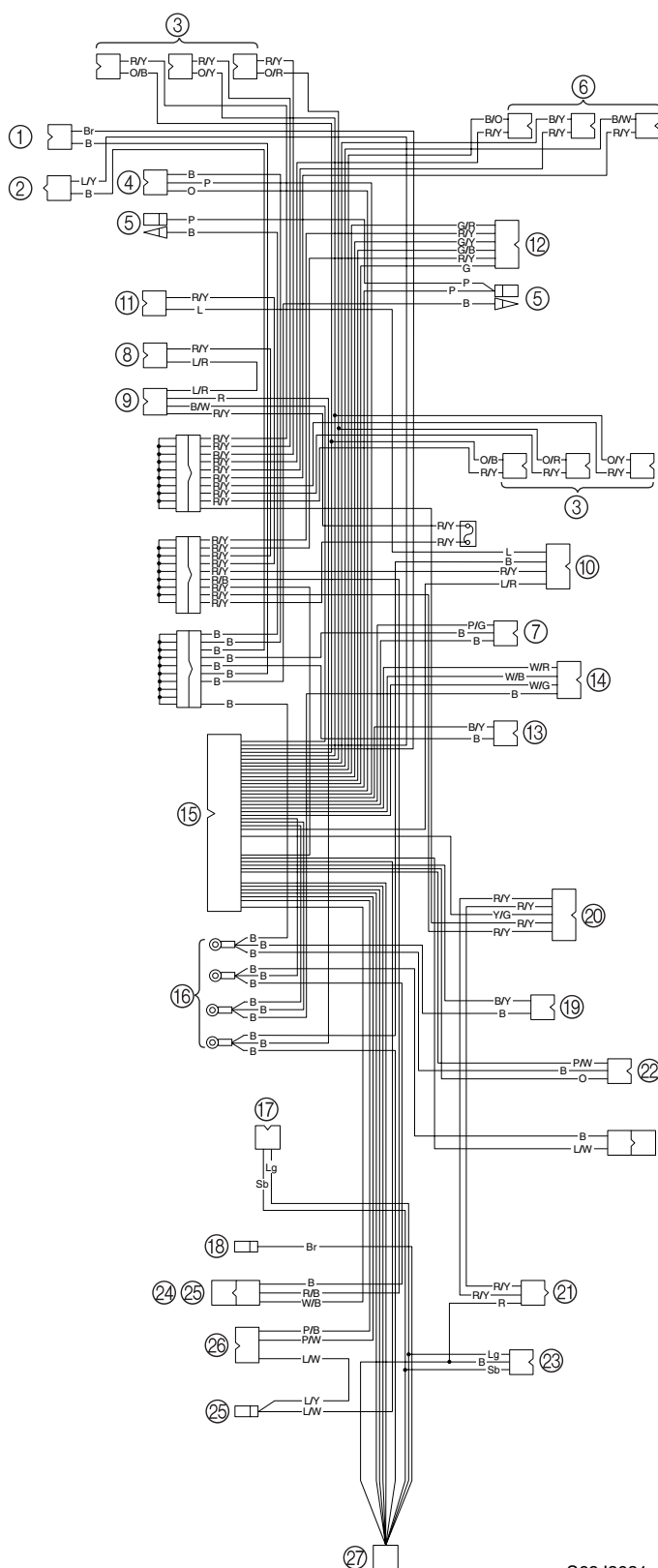
- | | |
|---------------------------------|----------------------------|
| ① Spark plugs | ⑪ Stator coil |
| ② Idle speed control | ⑫ Throttle position sensor |
| ③ Thermoswitches | ⑬ Ignition coils |
| ④ Intake air pressure sensor | |
| ⑤ Engine temperature sensor | |
| ⑥ Fuses | |
| ⑦ Rectifier Regulator | |
| ⑧ Intake air temperature sensor | |
| ⑨ Starter motor | |
| ⑩ Oil pressure sensor | |



Wiring harness



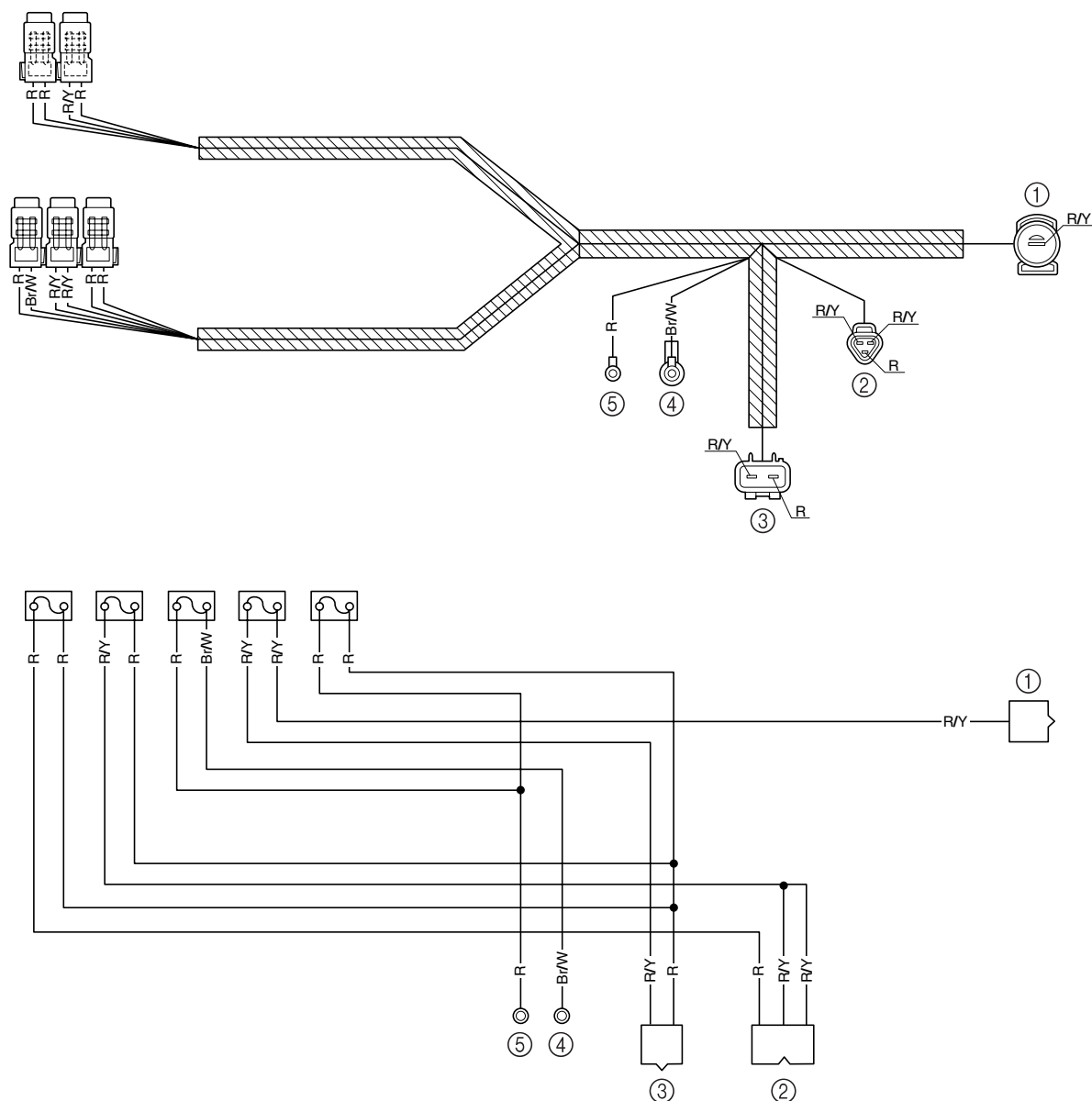
S69J8071



Connect to:

- ① Neutral switch
- ② Shift cut switch
- ③ Fuel injector
- ④ Throttle position sensor
- ⑤ Thermoswitch
- ⑥ Ignition coil
- ⑦ Intake air pressure sensor
- ⑧ Low-pressure fuel pump
- ⑨ Low-pressure fuel pump driver
- ⑩ High-pressure fuel pump relay
- ⑪ High-pressure fuel pump
- ⑫ Idle speed control
- ⑬ Engine temperature sensor
- ⑭ Pulser coil
- ⑮ ECM
- ⑯ Ground
- ⑰ Power trim and tilt relay
- ⑱ Starter relay
- ⑲ Intake air temperature sensor
- ⑳ Main relay
- ㉑ Fuse (20 A)
- ㉒ Oil pressure sensor
- ㉓ Power trim and tilt switch
- ㉔ Computer
- ㉕ Diagnostic indicator
- ㉖ Warning indicator
- ㉗ Remote control

S69J8081



S69J8090

Connect to:

- ① Starter motor
- ② Wiring harness
- ③ Rectifier Regulator
- ④ Starter relay
- ⑤ Power trim and tilt relay

B : Black
Br : Brown
G : Green

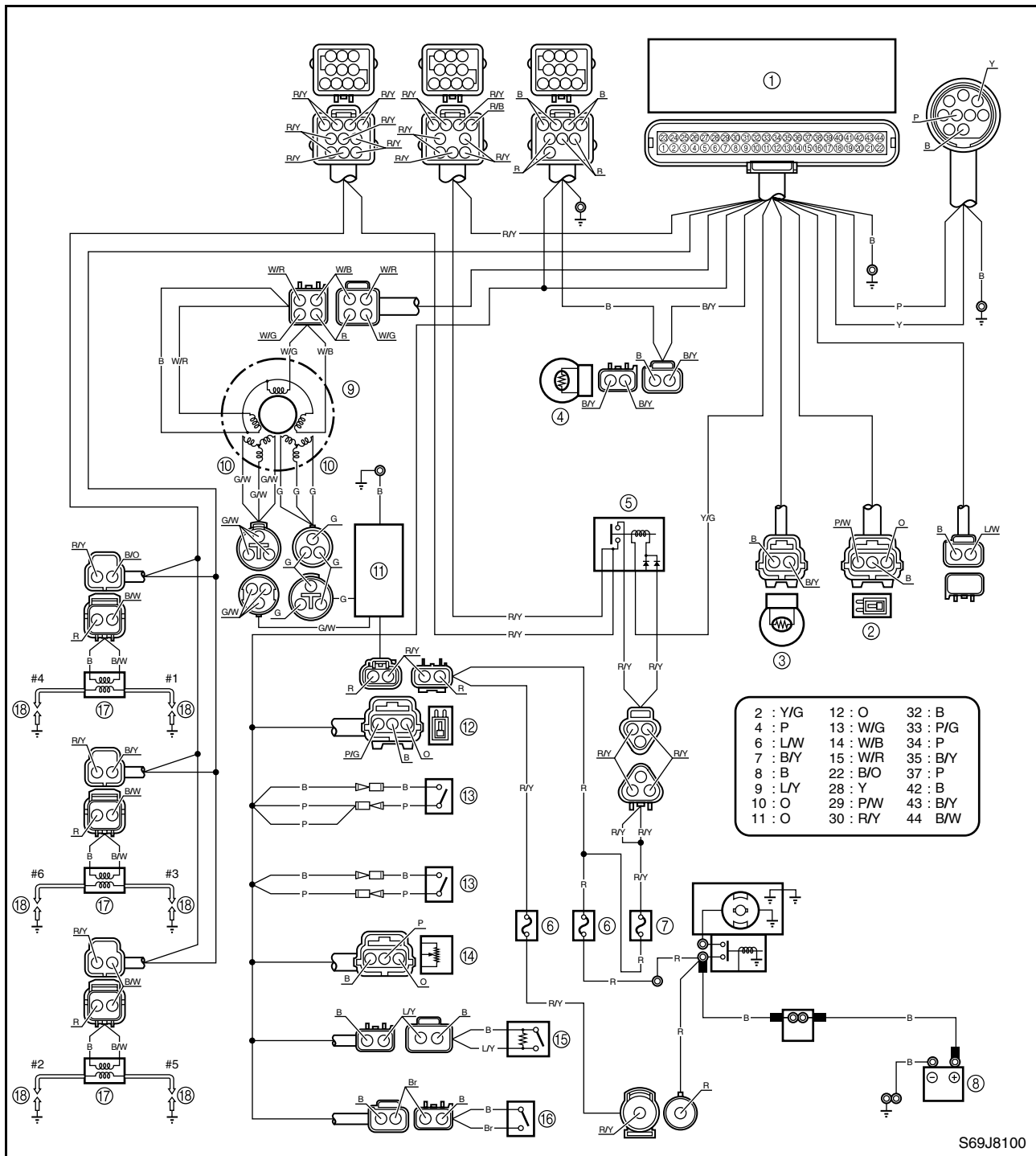
Gy : Gray
L : Blue
Lg : Light green
O : Orange
P : Pink
R : Red
Sb : Sky blue
W : White
Y : Yellow
B/O : Black/orange
B/W : Black/white

B/Y : Black/yellow
Br/W : Brown/white
G/B : Green/black
G/R : Green/red
G/W : Green/white
G/Y : Green/yellow
L/R : Blue/red
L/W : Blue/white
L/Y : Blue/yellow
O/B : Orange/black
O/R : Orange/red

O/Y : Orange/yellow
P/B : Pink/black
P/G : Pink/green
P/W : Pink/white
R/B : Red/black
R/Y : Red/yellow
W/B : White/black
W/G : White/green
W/R : White/red
Y/G : Yellow/green

Wiring harness / Ignition and ignition control system

Ignition and ignition control system



- ① ECM
- ② Oil pressure sensor
- ③ Intake air temperature sensor
- ④ Engine temperature sensor
- ⑤ Main relay
- ⑥ Fuse (30 A)
- ⑦ Fuse (20 A)
- ⑧ Battery

- ⑨ Pulser coil
- ⑩ Stator coil
- ⑪ Rectifier Regulator
- ⑫ Intake air pressure sensor
- ⑬ Thermoswitch
- ⑭ Throttle position sensor
- ⑮ Shift cut switch
- ⑯ Neutral switch
- ⑰ Ignition coil

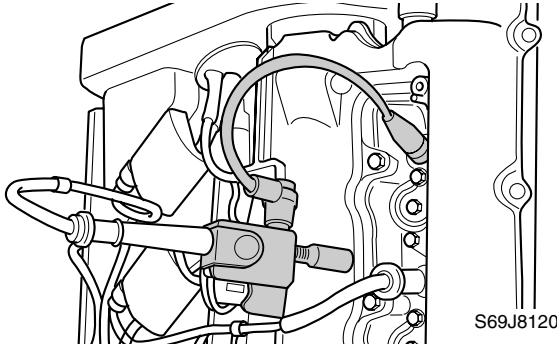
- ⑱ Spark plug
- B : Black
 Br : Brown
 G : Green
 O : Orange
 P : Pink
 R : Red
 Y : Yellow
 B/O : Black/orange

- B/W : Black/white
 B/Y : Black/yellow
 L/Y : Blue/yellow
 P/G : Pink/green
 P/W : Pink/white
 R/Y : Red/yellow
 W/B : White/black
 W/G : White/green
 W/R : White/red
 Y/G : Yellow/green



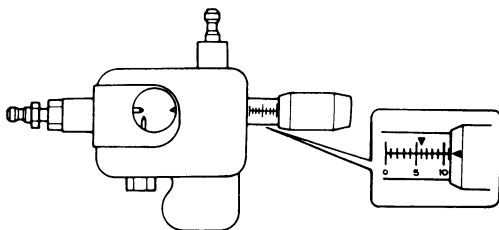
Checking the ignition spark gap

1. Remove the ignition coil cover and disconnect the spark plug caps from the spark plugs.
2. Connect a spark plug cap to the special service tool.

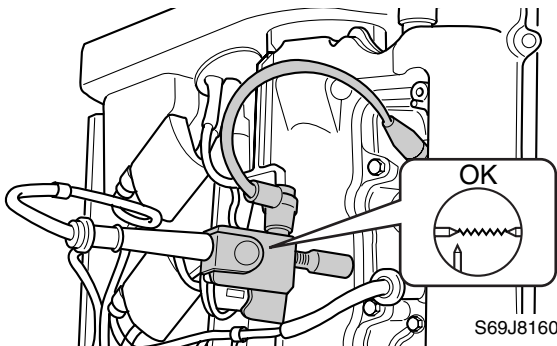


Ignition tester: 90890-06754

3. Set the spark gap length on the adjusting knob.



4. Crank the engine and observe the spark through the discharge window of the spark gap tester. Check the ignition coil if out of specification.



⚠ WARNING

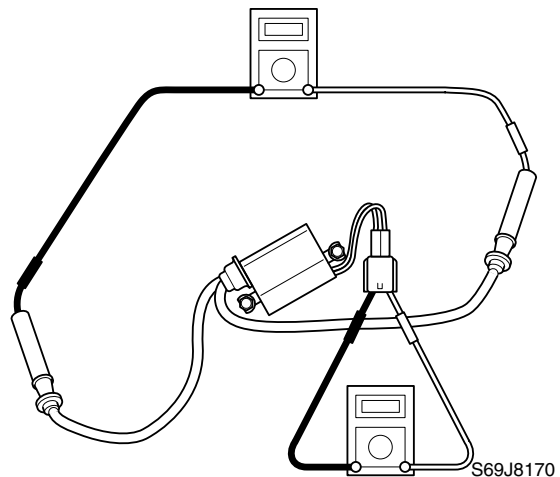
- Do not touch any of the connections of the spark gap tester leads.
- Do not let sparks leak out of the removed spark plug caps.
- Keep flammable gas or liquids away, since this test can produce sparks.



Ignition spark gap: 11 mm (0.43 in)

Checking the ignition coil

1. Remove the spark plug wires from the spark plugs.
2. Disconnect the ignition coil coupler.
3. Measure the ignition coil resistance. Replace if out of specification.



Ignition coil resistance:

Primary coil:

Red/yellow (R/Y) –

Black/orange (B/O)

Red/yellow (R/Y) –

Black/yellow (B/Y)

Red/yellow (R/Y) –

Black/white (B/W)

1.5–1.9 Ω at 20 °C (68 °F)

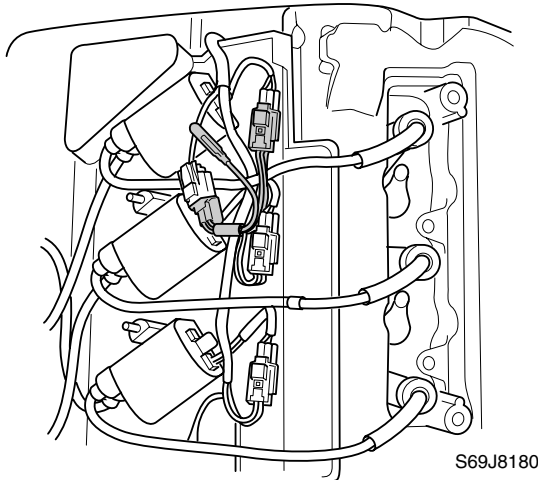
Secondary coil:

Spark plug wire – Spark plug wire

19.6–35.4 k Ω at 20 °C (68 °F)

Checking the ECM

1. Remove the ignition coil cover and disconnect the 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.



Digital circuit tester: 90890-03174
Peak voltage adaptor: 90890-03172
Test harness (2 pins): 90890-06792

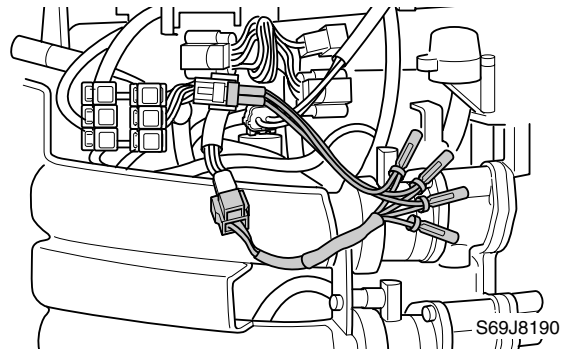


ECM output peak voltage:
Black/orange (B/O) – Ground
Black/yellow (B/Y) – Ground
Black/white (B/W) – Ground

r/min	Loaded		
	Cranking	1,500	3,500
DC V	252	260	260

Checking the pulser coil

1. Remove the flywheel magnet cover and disconnect the pulser coil coupler.
2. Connect the test harness (4 pins) to the pulser coil.
3. Measure the pulser coil output peak voltage. Replace the pulser coil if below specification.



Digital circuit tester: 90890-03174
Peak voltage adaptor: 90890-03172
Test harness (4 pins): 90890-06771



Pulser coil output peak voltage:
White/red (W/R) – Black (B)
White/black (W/B) – Black (B)
White/green (W/G) – Black (B)

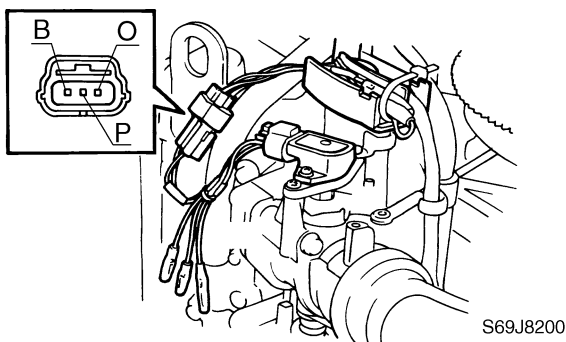
r/min	Unloaded	Loaded	
	Cranking	1,500	3,500
DC V	5.3	5.3	20
			43



Pulser coil resistance (use as reference):
White/red (W/R) – Black (B)
White/black (W/B) – Black (B)
White/green (W/G) – Black (B)
459–561 Ω at 20 °C (68 °F)

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): 90890-06793



Throttle position sensor input voltage:

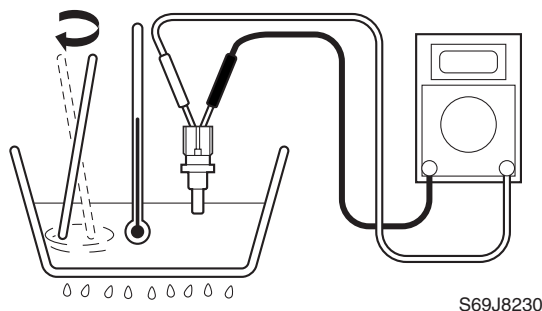
Orange (O) – Black (B)
5 V

Throttle position sensor output voltage:

Pink (P) – Black (B)
695–705 mV

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.

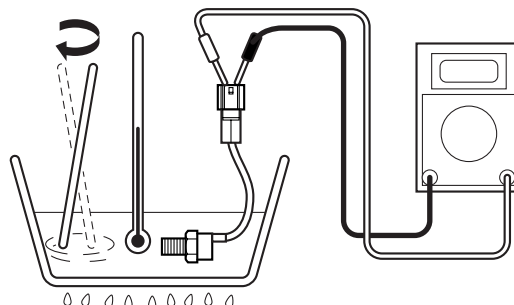


Intake air temperature sensor resistance:

at 0 °C (32 °F): 5.4–6.6 kΩ
at 80 °C (176 °F): 0.29–0.39 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.



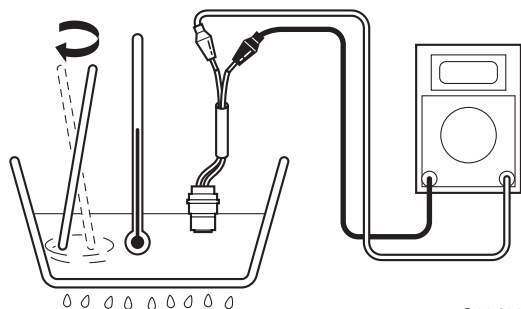
Engine temperature sensor resistance:

Black/yellow (B/Y) – Black (B)
at 20 °C (68 °F): 54.2–69.0 kΩ
at 100 °C (212 °F): 3.12–3.48 kΩ

Ignition and ignition control system

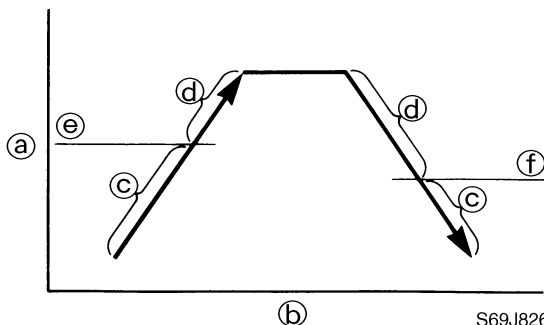
Checking the thermoswitch

1. Place the thermoswitch in a container of water and slowly heat the water.



S69J8250

2. Check the switch for continuity at the specified temperatures. Replace if out of specification.



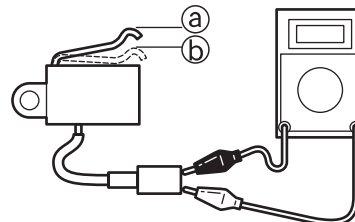
S69J8260

- (a) Temperature
- (b) Time
- (c) No continuity
- (d) Continuity

Thermoswitch continuity temperature:
Pink (P) – Black (B)
Ⓔ: 84–90 °C (183–194 °F)
Ⓕ: 68–82 °C (154–179 °F)

Checking the shift cut switch

1. Check the shift cut switch for continuity. Replace if there is no continuity.

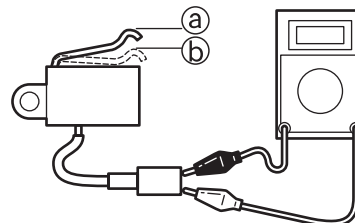


S69J8270

Switch position	Lead color	
	Blue/yellow (L/Y)	Black (B)
Free (a)		
Push (b)		

Checking the neutral switch

1. Check the neutral switch for continuity. Replace if there is no continuity.



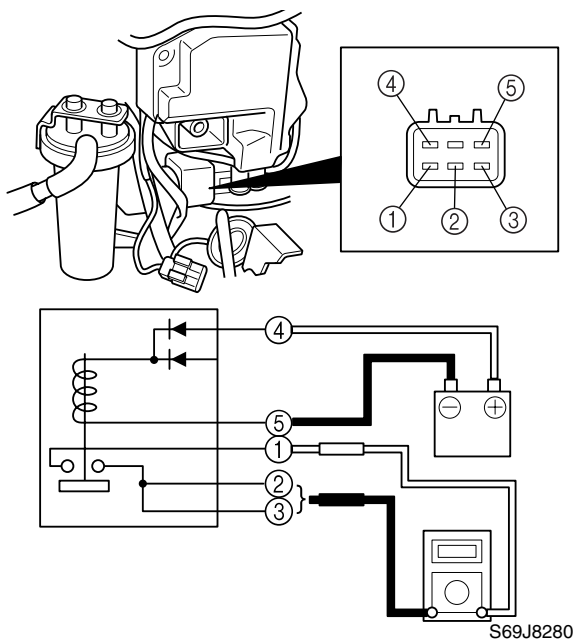
S69J8270

Switch position	Lead color	
	Brown (Br)	Black (B)
Free (a)		
Push (b)		



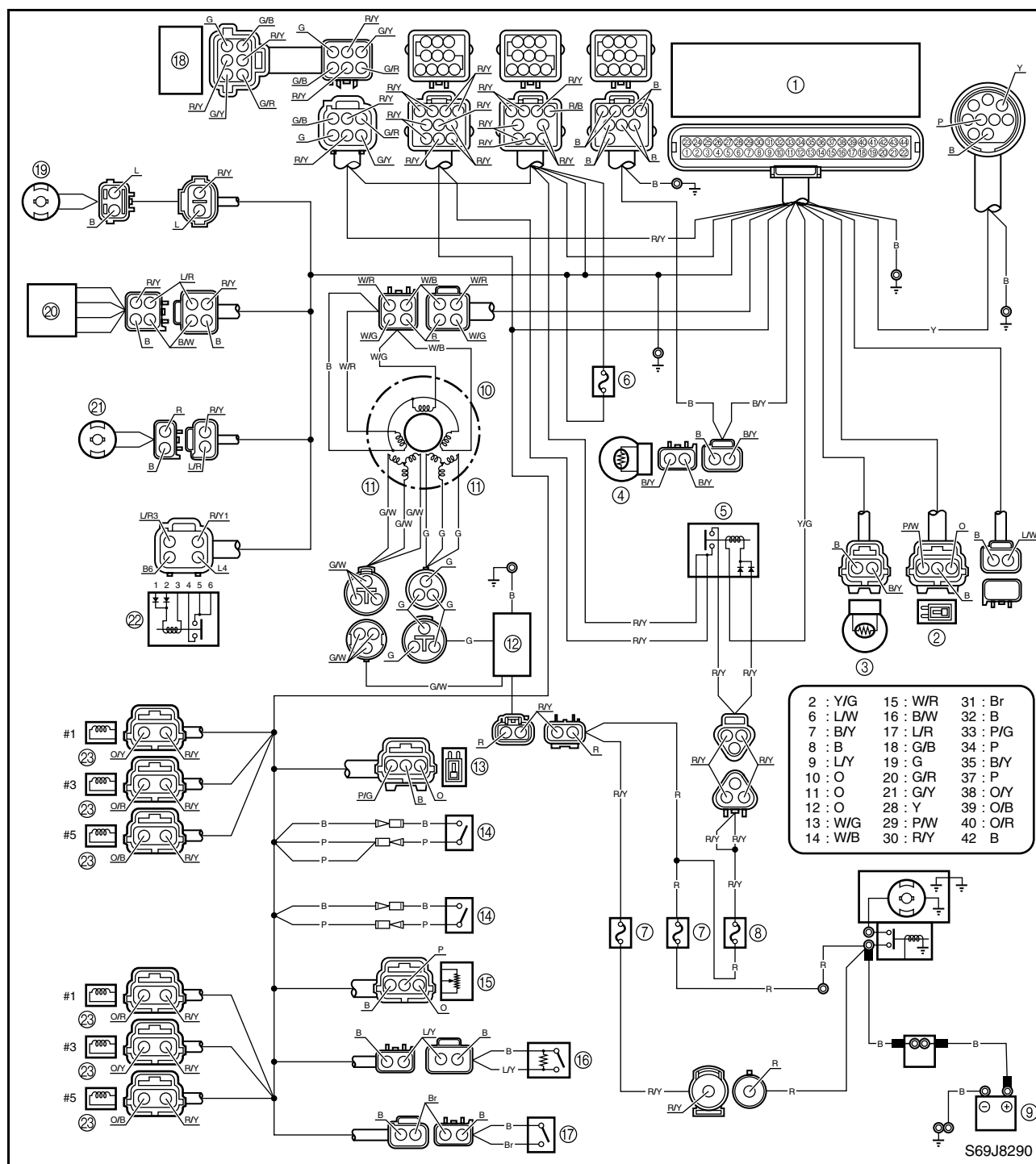
Checking the main relay

1. Connect the digital circuit tester leads to main relay terminals ①, ②, and ③.
2. Connect the terminal ④ to the positive battery terminal.
3. Connect the terminal ⑤ to the negative battery terminal.
4. Check for continuity between the main relay terminals. Replace if there is no continuity.
5. Check that there is no continuity between the main relay terminals after disconnecting terminal ④ or ⑤. Replace if there is continuity.

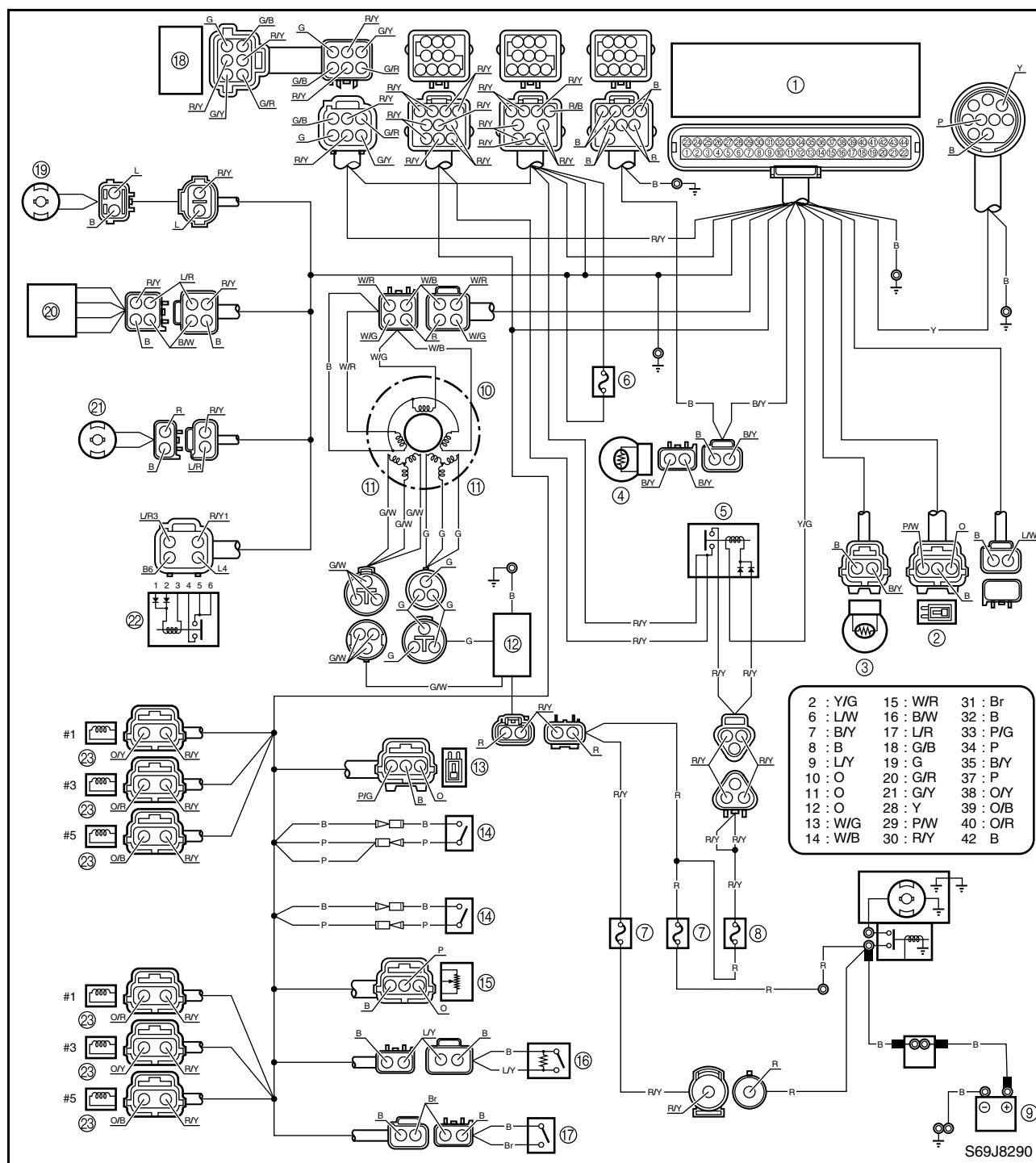


Ignition and ignition control system / Fuel control system

Fuel control system



- | | | |
|---------------------------------|---------------------------------|---------------------------------|
| ① ECM | ⑪ Stator coil | ⑳ Low-pressure fuel pump driver |
| ② Oil pressure sensor | ⑫ Rectifier Regulator | |
| ③ Intake air temperature sensor | ⑬ Intake air pressure sensor | |
| ④ Engine temperature sensor | ⑭ Thermoswitch | |
| ⑤ Main relay | ⑮ Throttle position sensor | |
| ⑥ Fuse (5 A) | ⑯ Shift cut switch | |
| ⑦ Fuse (30 A) | ⑰ Neutral switch | |
| ⑧ Fuse (20 A) | ⑱ Idle speed control | |
| ⑨ Battery | ㉑ Low-pressure fuel pump | |
| ⑩ Pulser coil | ㉒ High-pressure fuel pump relay | |
| | ㉓ Fuel injector | |



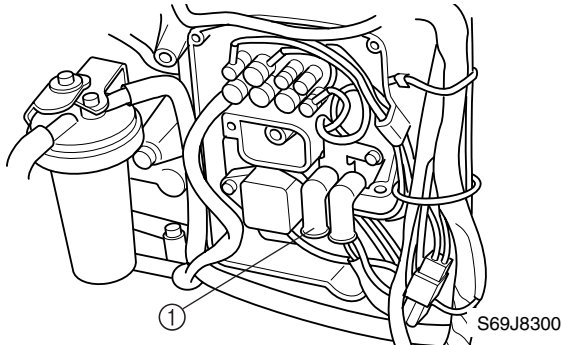
B : Black
 Br : Brown
 G : Green
 L : Blue
 O : Orange
 P : Pink
 R : Red
 Y : Yellow
 B/W : Black/white
 B/Y : Black/yellow

G/B : Green/black
 G/R : Green/red
 G/W : Green/white
 G/Y : Green/yellow
 L/R : Blue/red
 L/Y : Blue/yellow
 O/B : Orange/black
 O/R : Orange/red
 O/Y : Orange/yellow
 P/G : Pink/green

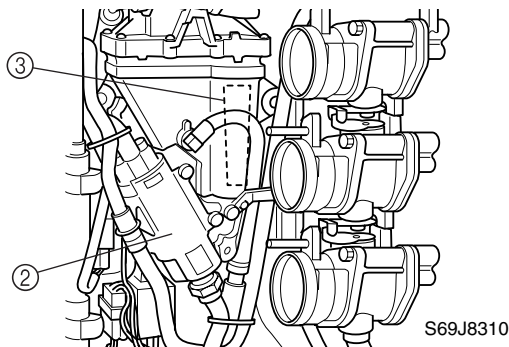
P/W : Pink/white
 R/Y : Red/yellow
 W/B : White/black
 W/G : White/green
 W/R : White/red
 Y/G : Yellow/green

Checking the low-pressure fuel pump and high-pressure fuel pump

1. Disconnect the starter relay lead (brown lead) ① to prevent the engine from starting.



2. Turn the engine start switch to ON.
3. Listen for the operating sound of the low-pressure fuel pump ② and high-pressure fuel pump ③. Replace if there is no sound.



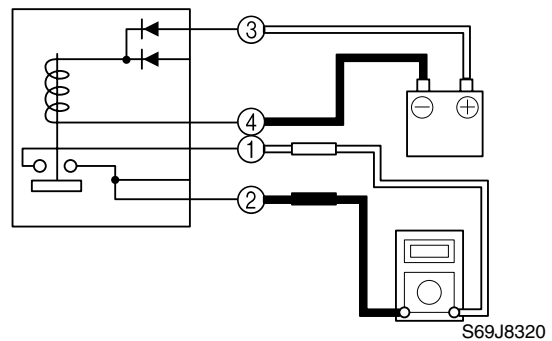
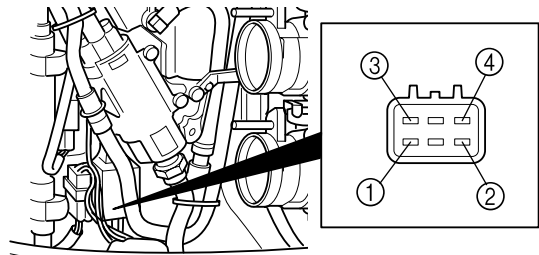
NOTE:

After the engine start switch is turned to ON, the low-pressure fuel pump will operate for 10 seconds and the high-pressure fuel pump will operate for 5 seconds.

Checking the high-pressure fuel pump relay

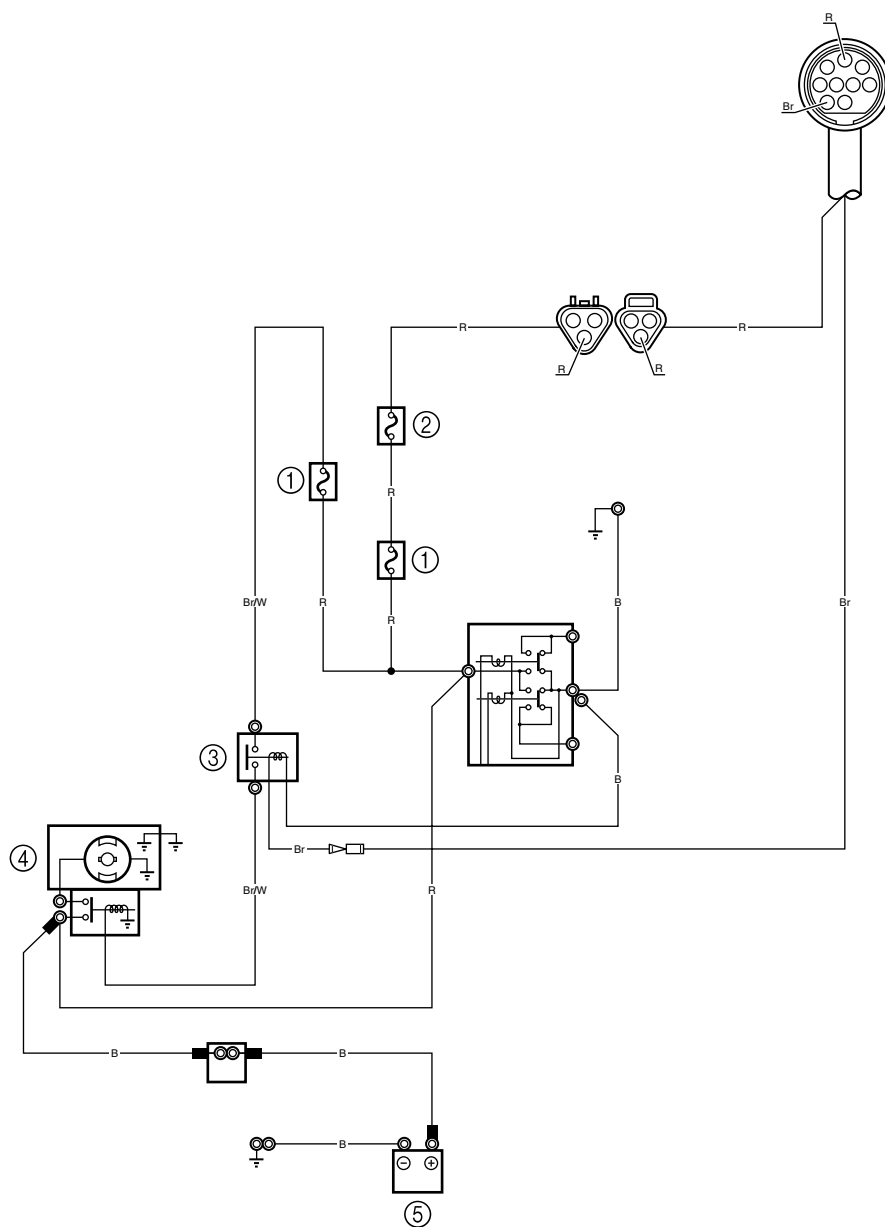
1. Connect the digital circuit tester leads to high-pressure fuel pump relay terminals ① and ②.
2. Connect the terminal ③ to the positive battery terminal.
3. Connect the terminal ④ to the negative battery terminal.

4. Check for continuity between the high-pressure fuel pump relay terminals. Replace if there is no continuity.
5. Check that there is no continuity between the high-pressure fuel pump relay terminals after disconnecting terminal ③ or ④. Replace if there is continuity.





Starting system



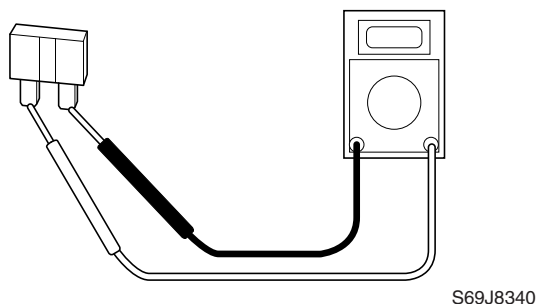
S69J8330

- ① Fuse (30 A)
- ② Fuse (20 A)
- ③ Starter relay
- ④ Starter motor
- ⑤ Battery

B : Black
Br : Brown
R : Red
Br/W : Brown/white

Checking the fuse

1. Check the fuse for continuity. Replace if there is no continuity.

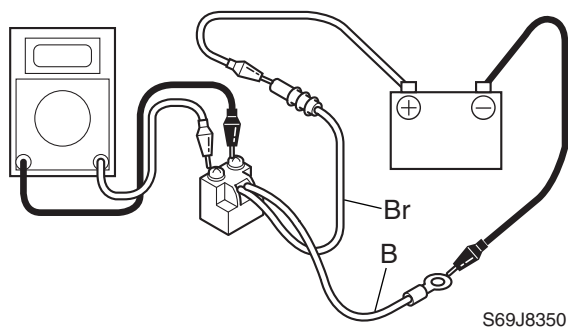


Checking the wiring harness (10 pins)

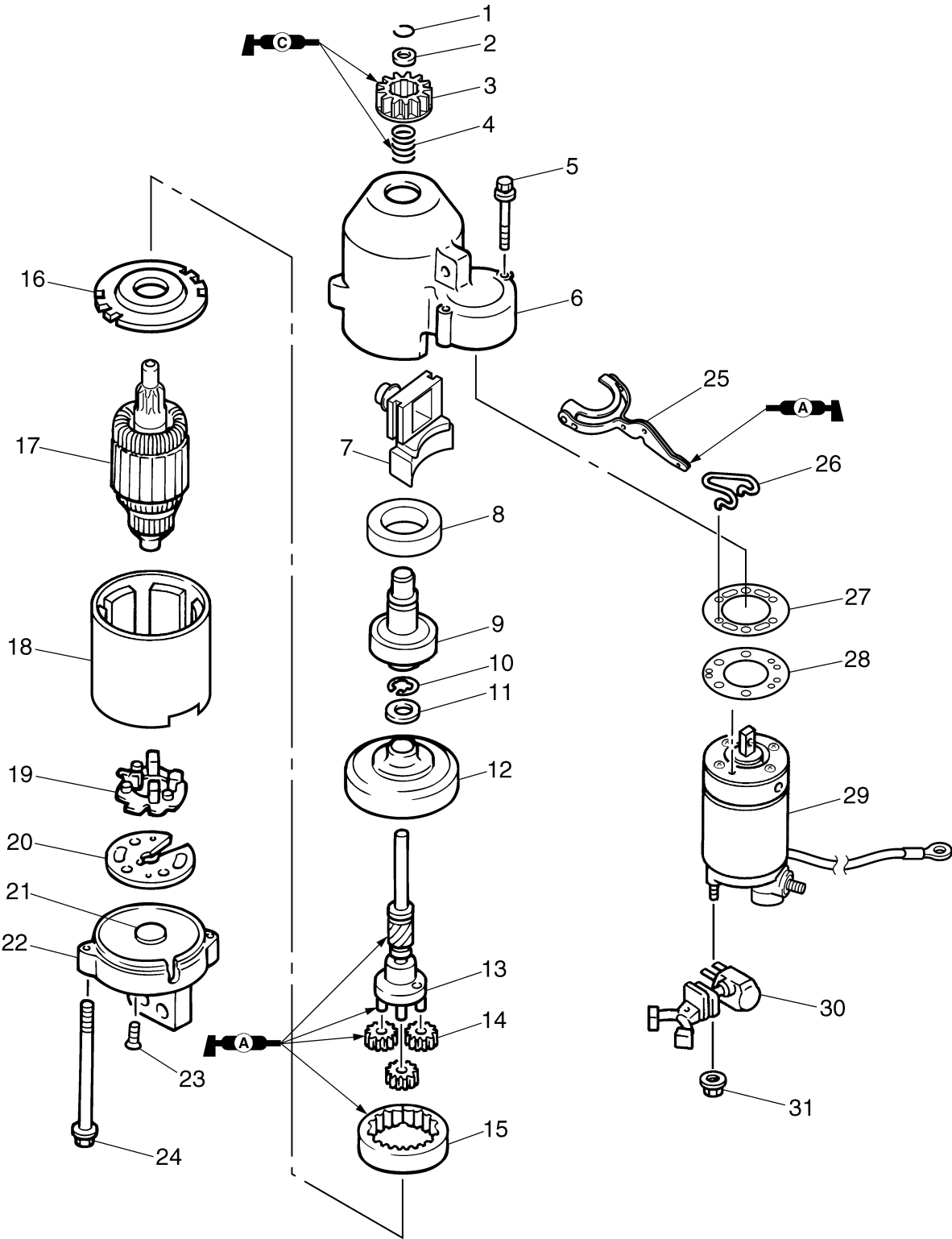
1. Check the wiring harness for continuity. Replace if there is no continuity.

Checking the starter relay

1. Connect the digital circuit tester leads to the starter relay terminals.
2. Connect the brown (Br) lead to the positive battery terminal.
3. Connect the black (B) lead to the negative battery terminal.
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 the brown or black lead. Replace if there is continuity.



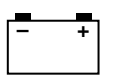
Starter motor



S69J8360

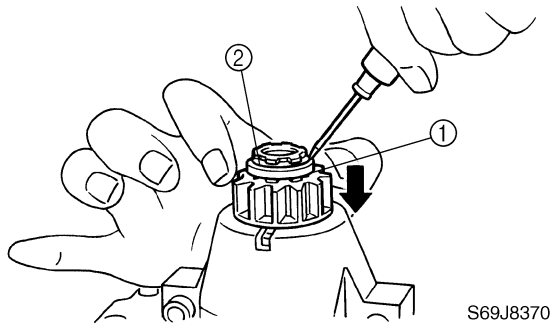
Starter motor

No.	Part name	Q'ty	Remarks
1	Clip	1	
2	Pinion stopper	1	
3	Starter motor pinion	1	
4	Spring	1	
5	Bolt	2	M6 × 35 mm
6	Housing	1	
7	Rubber seal	1	
8	Bearing	1	
9	Clutch assembly	1	
10	E-clip	1	Not reusable
11	Thrust washer	1	
12	Center bracket	1	
13	Pinion shaft	1	
14	Planetary gear	3	
15	Outer gear	1	
16	Plate	1	
17	Armature	1	
18	Stator	1	
19	Brush holder assembly	1	
20	Plate	1	
21	Thrust washer	1	
22	Lower bracket	1	
23	Screw	2	M4 × 15 mm
24	Bolt	2	M6 × 120 mm
25	Shift lever	1	
26	Spring	1	
27	Metal gasket	1	
28	Gasket	1	Not reusable
29	Magnet switch	1	
30	Brush assembly	1	
31	Nut	1	



Removing the starter motor pinion

1. Slide the pinion stopper ① down as shown, and then remove the clip ②.



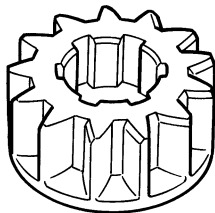
S69J8370

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

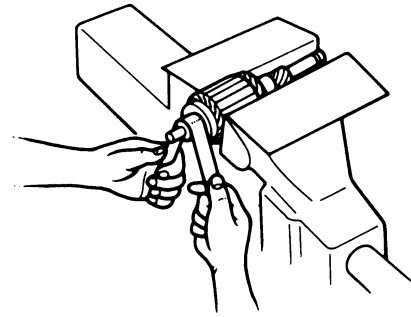
2. Check for smooth operation. Replace if necessary.

NOTE:

Turn the pinion counterclockwise to check that it operates smoothly and turn it clockwise to check that it locks in place.

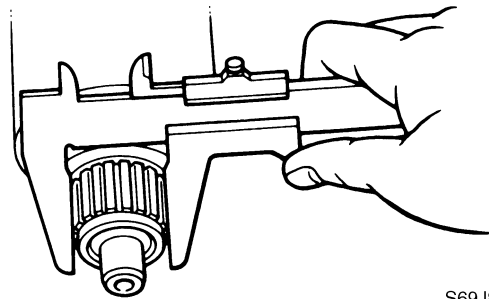
Checking the armature

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.

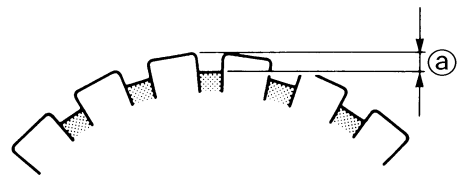


S69J8400



Commutator diameter limit:
28.0 mm (1.10 in)

3. Measure the commutator undercut (a). Replace the armature if out of specification.

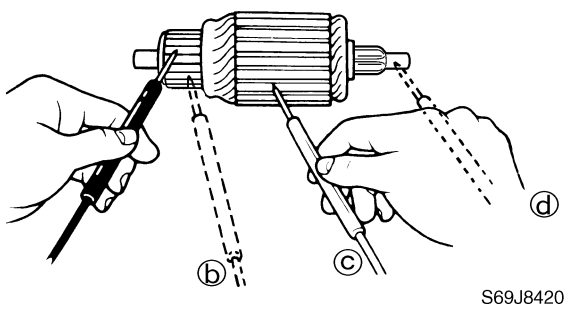


S69J8410



Commutator undercut limit (a):
0.2 mm (0.01 in)

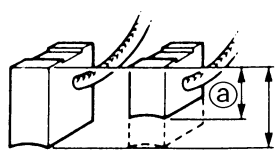
4. Check the armature for continuity. Replace if out of specifications.



Armature continuity	
Commutator segments (b)	Continuity
Segment – Armature core (c)	No continuity
Segment – Armature shaft (d)	No continuity

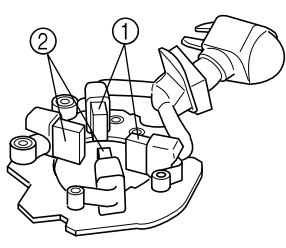
Checking the brushes

1. Measure the brush length. Replace the brush assembly if out of specification.



	Brush length limit (a): 9.5 mm (0.37 in)
---	---

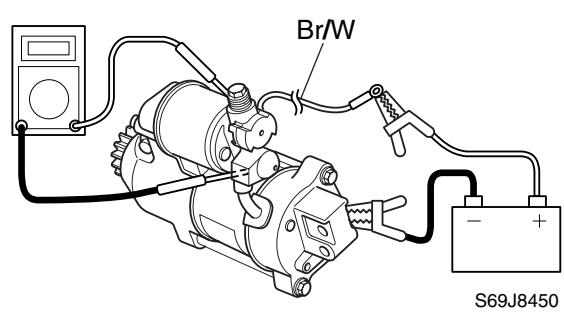
2. Check the brush holder assembly for continuity. Replace if out of specifications.



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 terminal to the black and white (B/W) lead.
3. Connect the negative battery terminal to the starter motor body.



CAUTION: Do not connect the battery for more than one second, otherwise the magnet switch may 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.

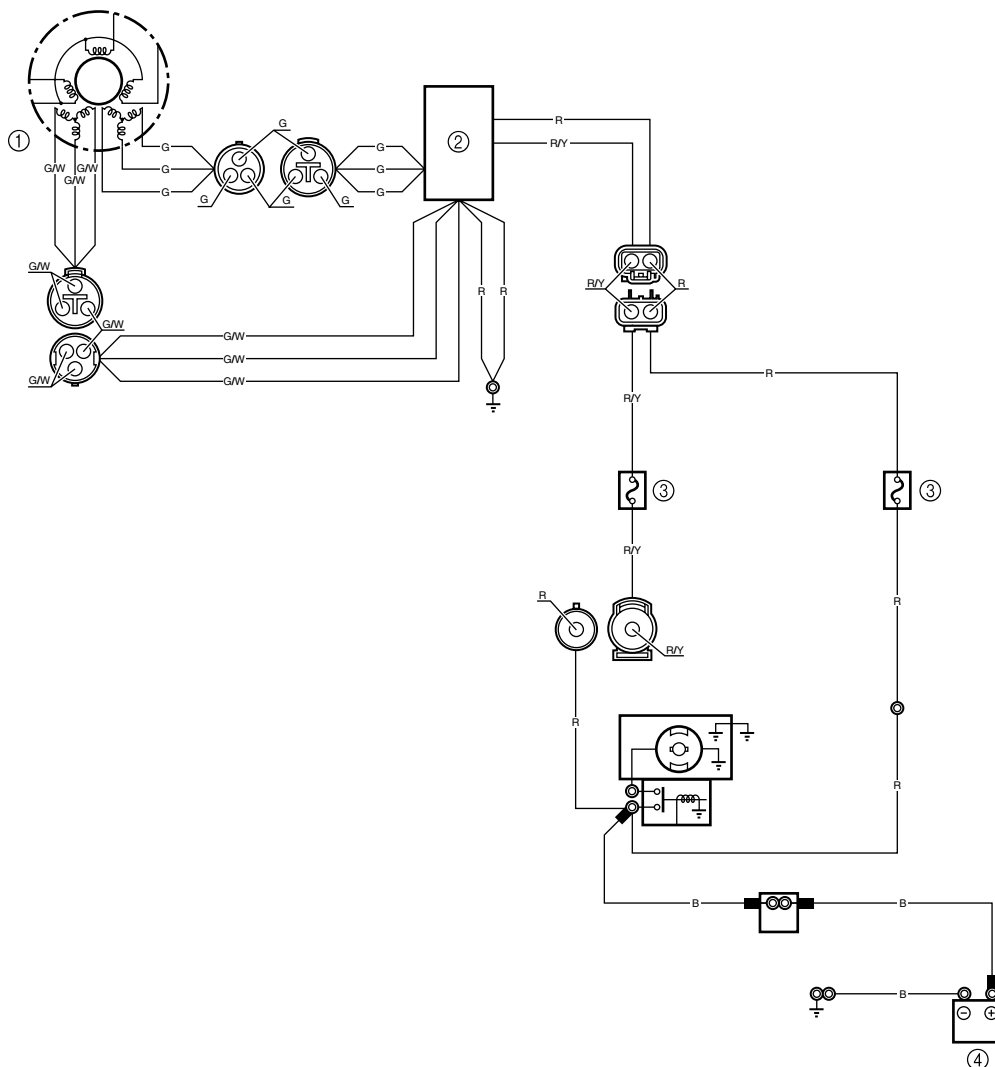
NOTE: The starter motor pinion should be pushed out while the magnet switch is on.

Checking the starter motor operation

1. Check the operation of the starter motor after installing it to the power unit.



Charging system



S69J8460

- ① Stator coil
- ② Rectifier Regulator
- ③ Fuse (30 A)
- ④ Battery

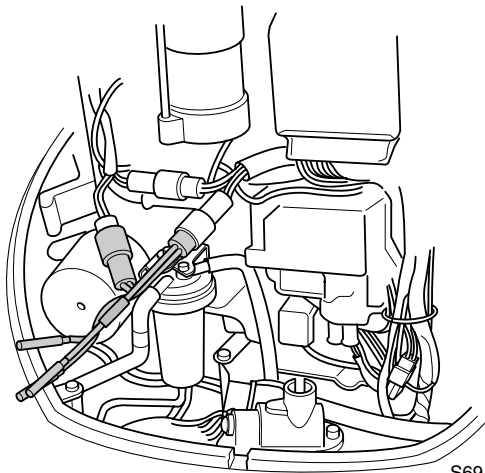
B : Black
 G : Green
 R : Red
 G/W : Green/white
 R/Y : Red/yellow

Checking the stator coil

- 1. Remove the intake silencer and disconnect the stator coil coupler.
- 2. Connect the test harness (3 pins) to the stator coil.
- 3. Install the intake silencer.

CAUTION: Do not start the engine when the intake silencer is not installed.

- 4. 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 (3 pins): 90890-06770



Stator coil output peak voltage:
Green (G) – Green (G)

r/min	Unloaded		
	Cranking	1,500	3,500
DC V	10	42	93

Green/white (G/W) – Green/white (G/W)

r/min	Unloaded		
	Cranking	1,500	3,500
DC V	9.0	34	78



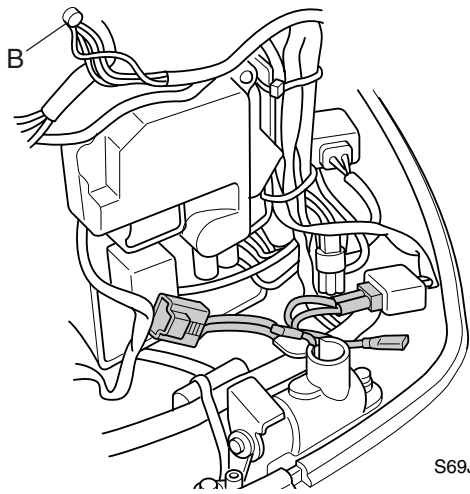
Stator coil resistance
(use as reference):
Green (G) – Green (G)
0.24–0.41 Ω at 20 °C (68 °F)
Green/white (G/W) –
Green/white (G/W)
0.21–0.30 Ω at 20 °C (68 °F)

Checking the Rectifier Regulator

- 1. Remove the intake silencer and disconnect the Rectifier Regulator coupler.
- 2. Connect the test harness (2 pins) to the Rectifier Regulator.
- 3. Install the intake silencer.

CAUTION: Do not start the engine when the intake silencer is not installed.

- 4. Measure the Rectifier Regulator output peak voltage. If below specification, measure the stator coil output peak voltage. Replace the Rectifier Regulator if the output peak voltage of the stator coil is above specification.



NOTE: Disconnect the output lead coupler (red and red/yellow lead) of the Rectifier Regulator when measuring the output peak voltage.



Digital circuit tester: 90890-03174
 Peak voltage adaptor: 90890-03172
 Test harness (2 pins): 90890-06787



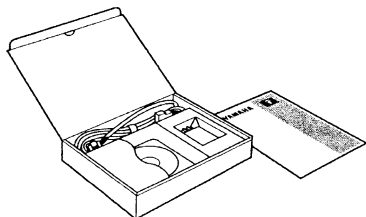
Rectifier Regulator output peak voltage:
 Red (R) – Black (B)
 Red/yellow (R/Y) – Black (B)

r/min	Unloaded	
	1,500	3,500
DC V	13	13

Troubleshooting

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Troubleshooting	9-46
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Bracket unit	9-56
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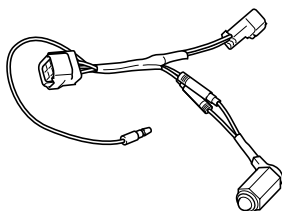
Special service tools



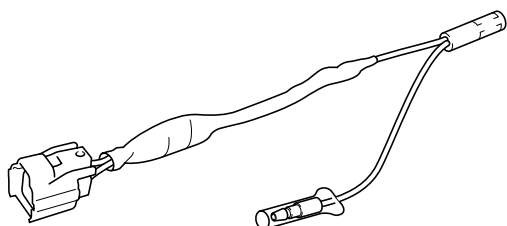
Yamaha Diagnostic System
68F-85300-01



Yamaha Diagnostic System
(upgrade)
68F-2819K-10



Diagnostic flash indicator 4
90890-06795



Diagnostic flash adaptor
90890-06794

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 laptop 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 laptop computer's monitor.

If this software is run on Microsoft Windows® 95, Windows 98, Windows Me, or Windows 2000 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 start switch set to 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 the ISC valve is checked as well. These tests can be performed quickly.
6. **Data logger:** From the data stored in the ECM, at least two items of 13 minutes of recorded data are displayed on a graph. 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. **ECM No.:** The ECM part number is displayed.

Contents

1. Software (1)
2. Adapter (1)
3. Communication cable (1)
4. Instruction Manual (1)
5. Installation Manual (1)

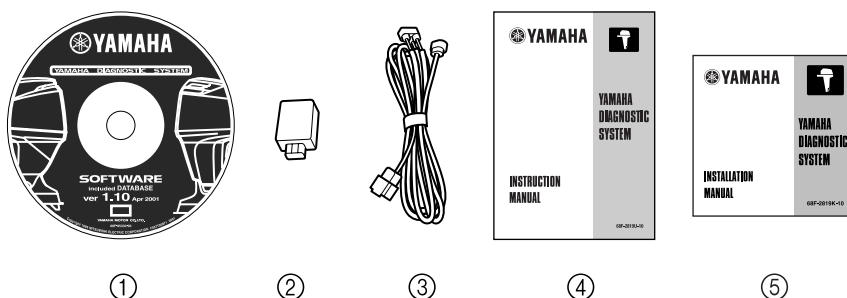


Fig. 1

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.

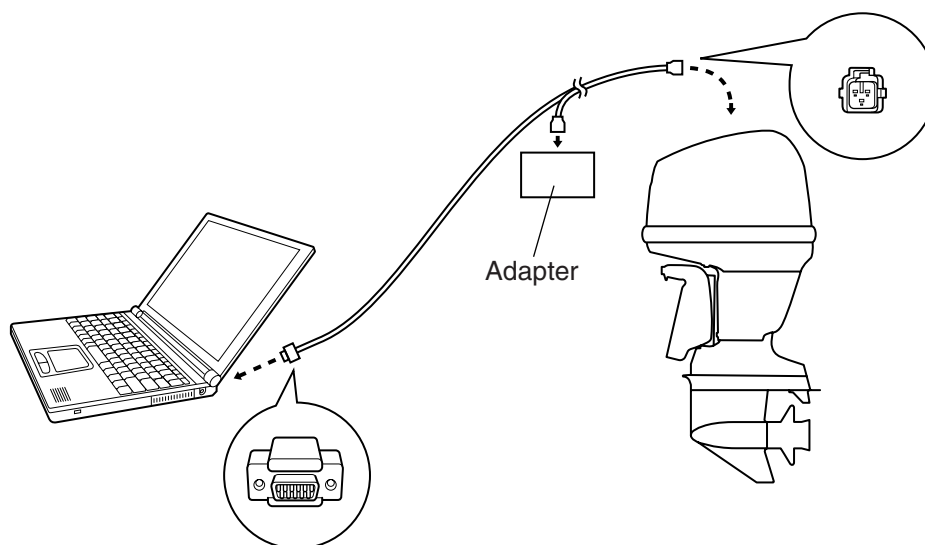


Fig. 2

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.

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

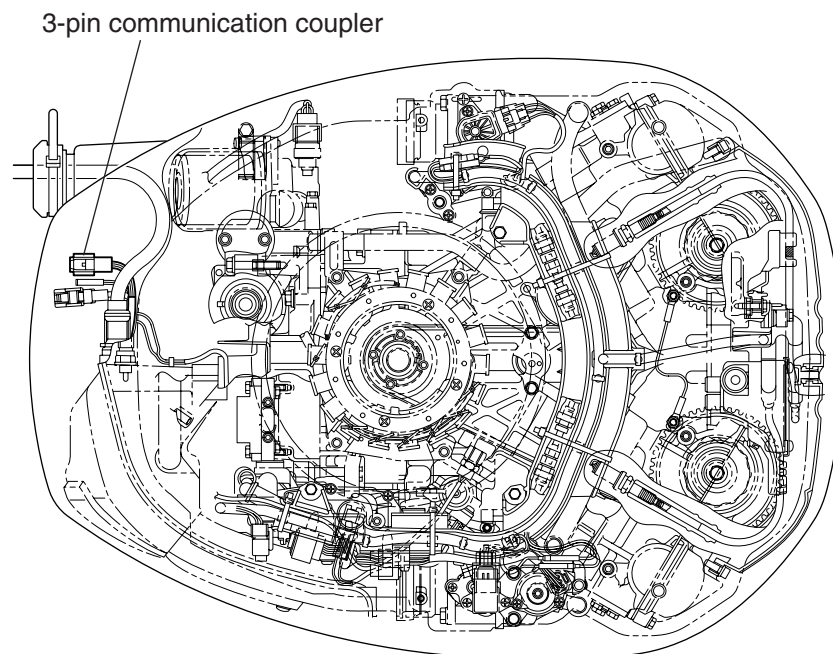


Fig. 3

Opening the Yamaha Diagnostic System

1. Turn the engine start switch of the outboard motor to ON.
2. Turn on your computer and start up Windows 95, Windows 98, Windows Me, or Windows 2000.
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**.

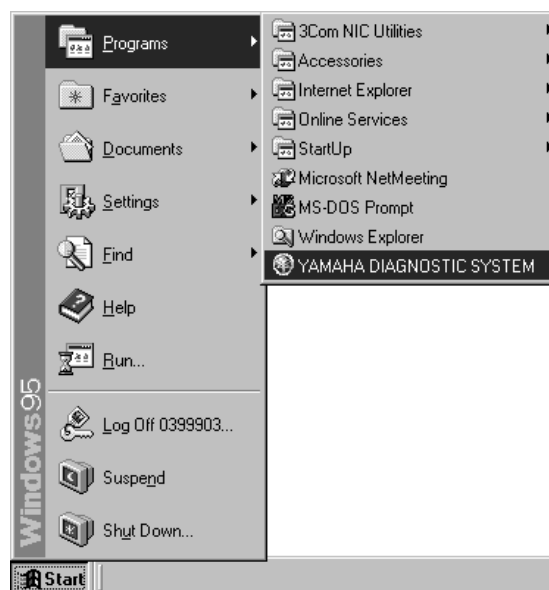


Fig. 4

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

5. Click the **Starting service tool [Enter]** button or press the Enter key on your keyboard. (Fig. 6)

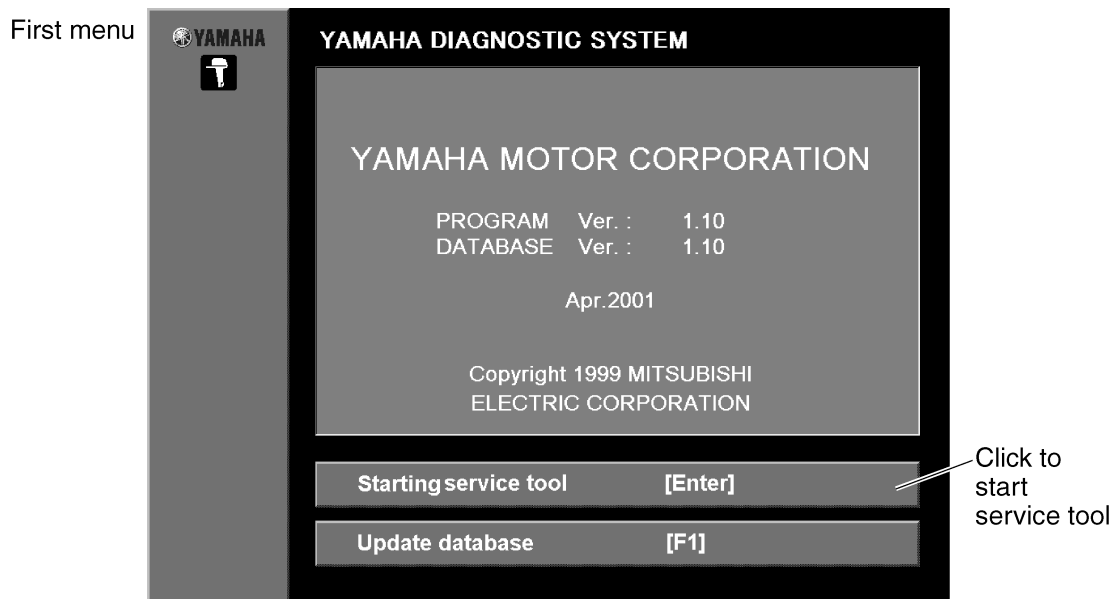


Fig. 6

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.

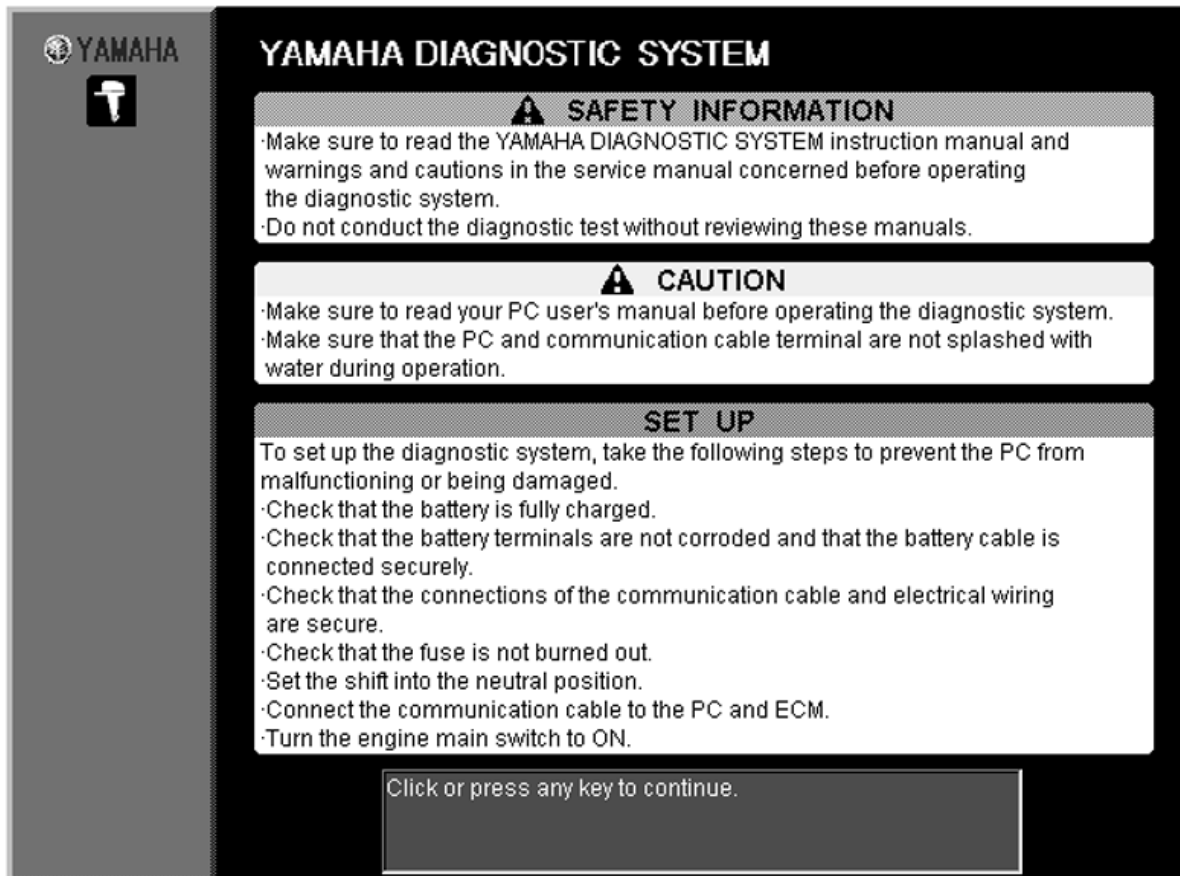


Fig. 7

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. 8)

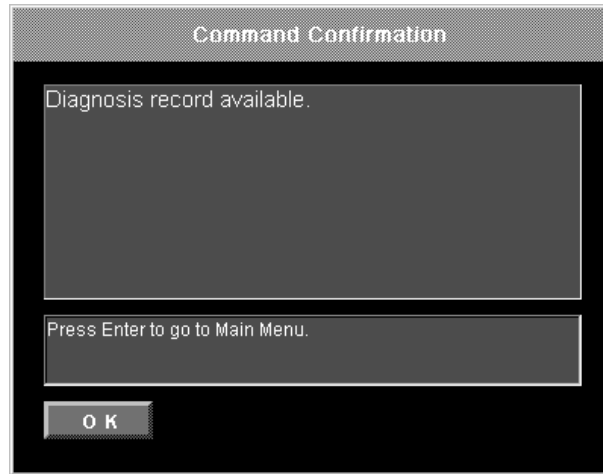


Fig. 8

Selecting commands from the main menu

Eight commands appear in the Main Menu. Select a command in any of the following three ways.

Three 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.

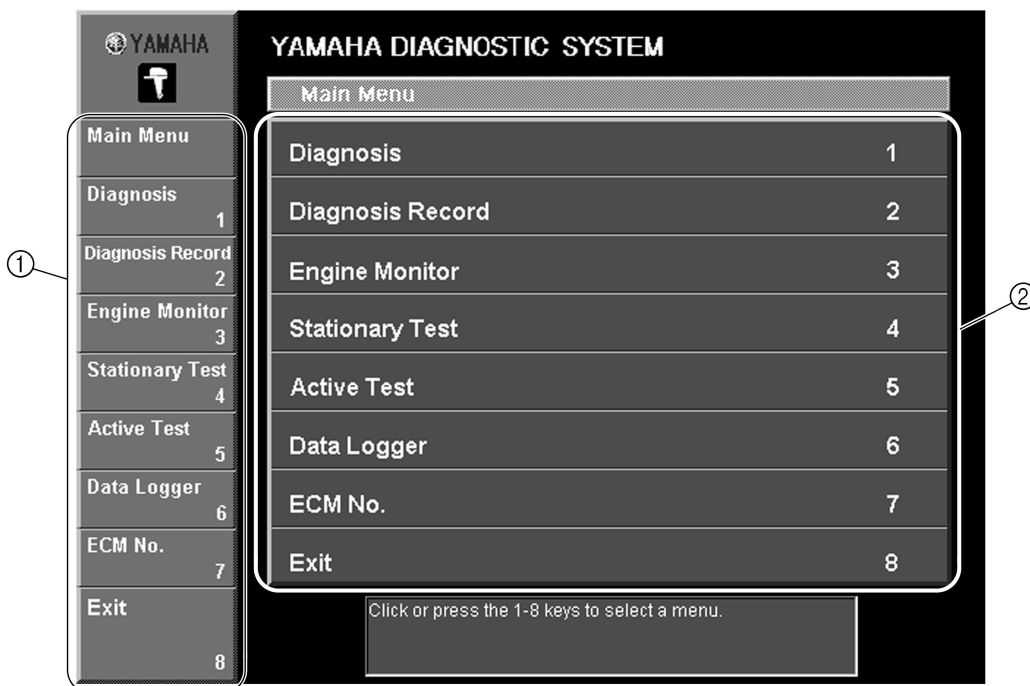


Fig. 9

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)

Condition of sensors (throttle position sensor, intake air temperature sensor, intake air pressure sensor, and oil pressure sensor)

Condition of battery (battery voltage)

Operation of switches (shift position switch, engine stop lanyard switch, thermo switch, and shift cut switch)

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.

3. Engine monitor

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 (throttle position sensor, intake air temperature sensor, intake air pressure sensor, and oil pressure sensor)

Voltage system (battery voltage)

Switches (shift position switch, engine stop lanyard switch, thermoswitch, and shift cut switch)

Operation signals (ignition, injectors)

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 fuel feed pump

Operation of the ISC valve

5. Active test

With the engine running, operation tests are performed.

Test items:

Fully open ISC valve

Angle of ISC valve opening

6. Data logger

Two out of six items (engine speed, battery voltage, throttle position, intake air pressure, engine temperature, and oil pressure) are selected and 13 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.

7. ECM No.

The ECM part number and model information are displayed.

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 Main Menu Diagnosis 1 Diagnosis Record 2 Engine Monitor 3 Stationary Test 4 Active Test 5 Data Logger 6 ECM No. 7 Exit 8	YAMAHA DIAGNOSTIC SYSTEM			
	Diagnosis			
	Code	Item	Result	Condition
	18	Throttle position sensor	Irregular	Out of specification
	23	Intake temp sensor	Irregular	Out of specification
	29	Intake press sensor	Irregular	Out of specification
	13	Pulser coil	Normal	
	15	Engine temp sensor	Normal	
	19	Battery voltage	Normal	
	27	Water in fuel	No	
28	Shift position switch	Normal		
1. Check the throttle position sensor with Engine Monitor. 2. Check wiring for proper connection or damage. 3. Check sensor resistance. 4. Check input and output 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 troubleshooting procedures for selected code.

Displays keyboard operations.

Fig. 10

NOTE:

Some items may not be available depending on the model of the outboard motor. Refer to the corresponding Service Manual for further information.

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. 11)

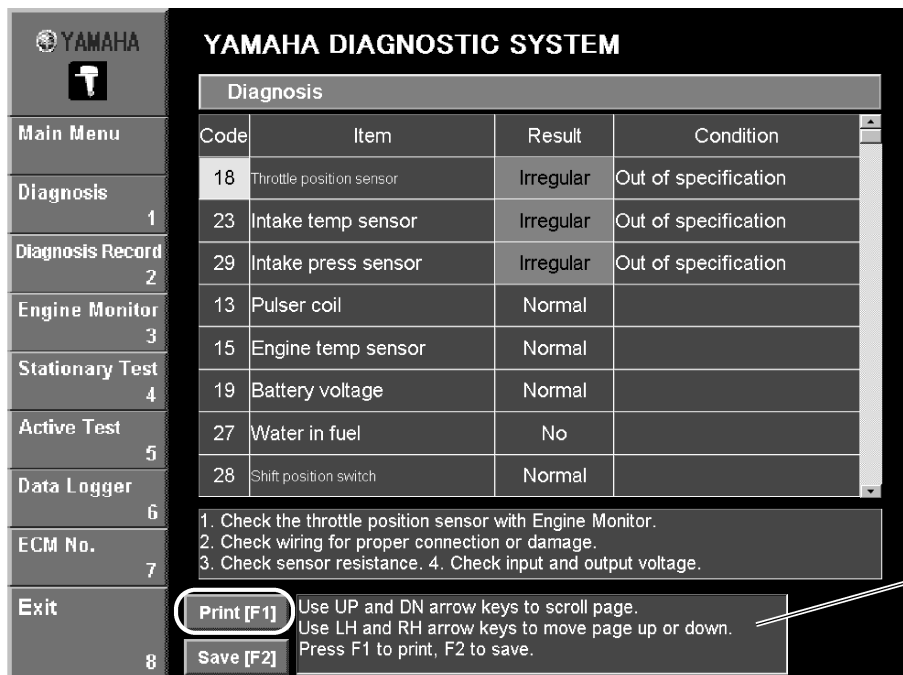


Fig. 11

2. Specify the printer, the printing range, and the number of copies to be printed.

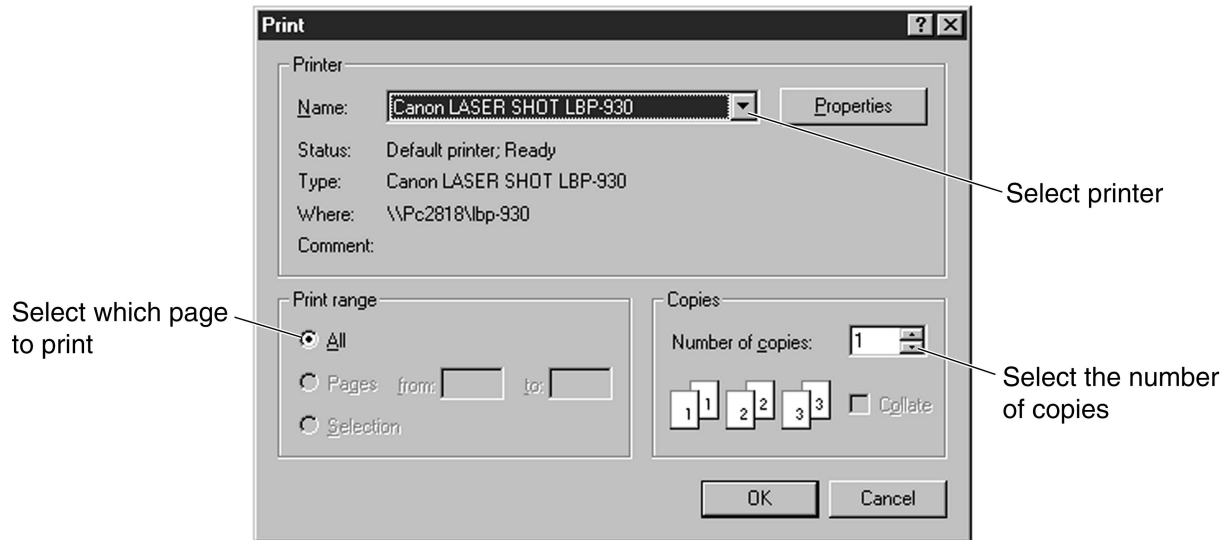


Fig. 12

3. 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:

1. Click the **Save [F2]** button or press the F2 key on your keyboard. The **Save As** dialog box is displayed. (Fig. 13)

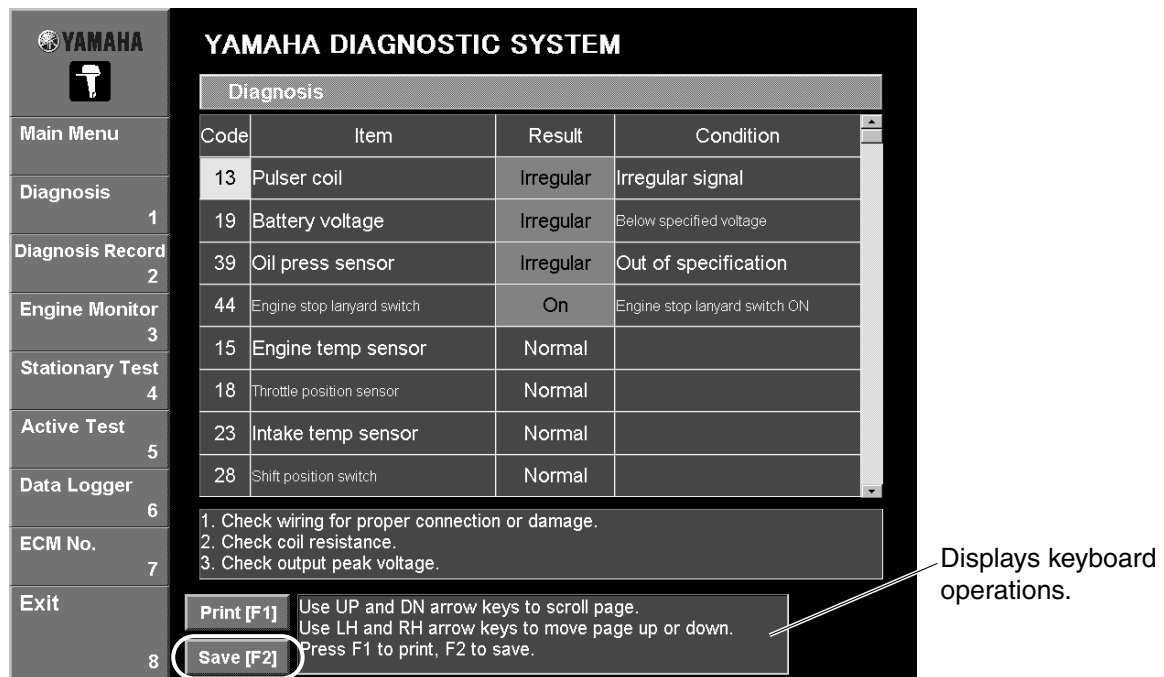


Fig. 13

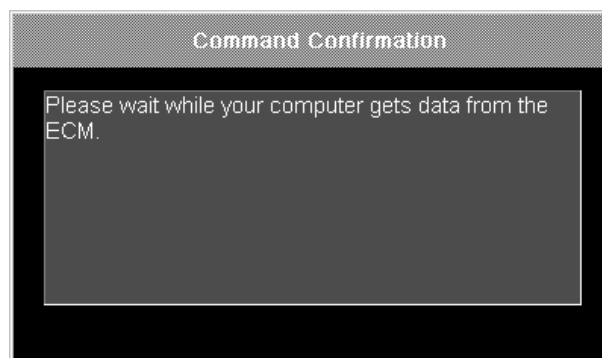


Fig. 14

2. Select the disk and folder where the data will be saved and specify its file name. (Fig. 15)

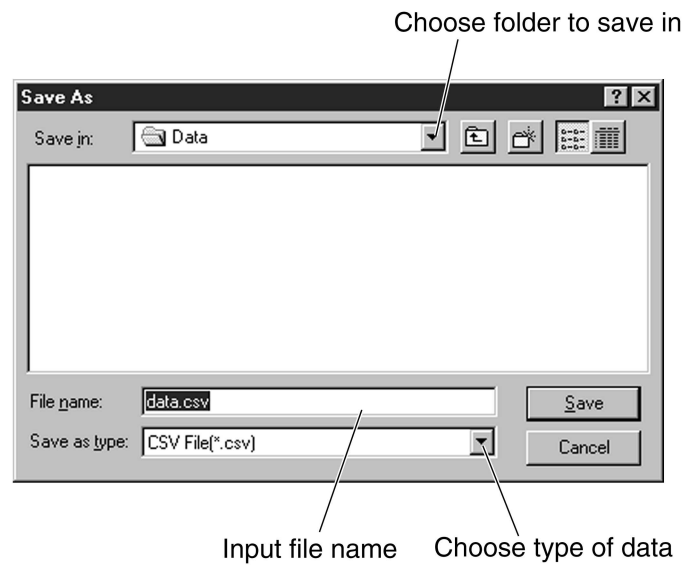


Fig. 15

3. Click the **Save** button to save the data.
To cancel saving, click the **Cancel** button. (Fig. 15)

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 six items can be displayed at one time. The latest occurrence appears on top. In addition, diagnosis codes stored in the ECM can be deleted.

YAMAHA DIAGNOSTIC SYSTEM

Diagnosis Record

No.	Code	Item	Occurred
1	23	Intake temp sensor	0.1
2	28	Shift position switch	0.6
3	18	Throttle position sensor	0.6

Total hours of operation: 1

1. Check the intake temp sensor with Engine Monitor.
2. Check wiring for proper connection or damage.
3. Check sensor resistance.

Print [F1] Use the UP and DN arrow keys to select item.
Press F3 to delete.
Save [F2] Press F1 to print, F2 to save. Delete[F3]

Displays time of occurrence

Displays troubleshooting procedures for selected code.

Displays keyboard operations.

Fig. 16

NOTE:

Some items may not be available depending on the model of the outboard motor.

NOTE: _____
 When a Diagnosis record is not available, “Diagnosis Record is unavailable” is displayed. (Fig. 17)

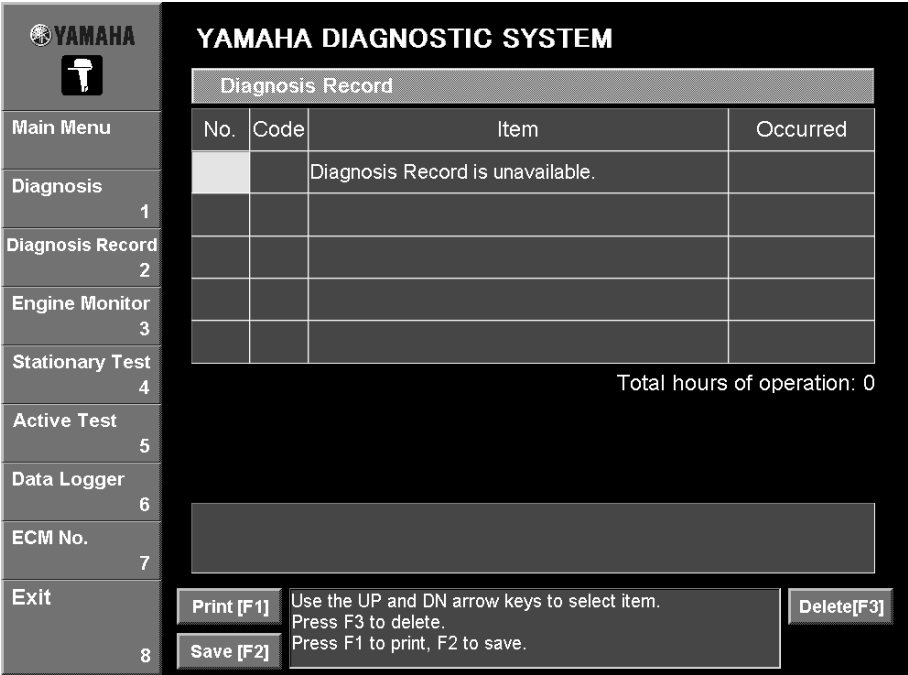


Fig. 17

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. 17.) A confirmation message appears. (Fig. 18)

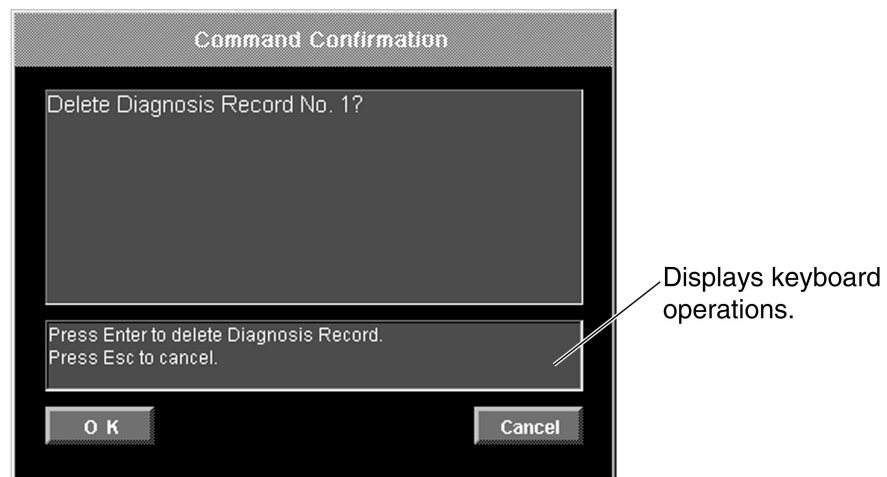


Fig. 18

3. Click the **OK** button or press the Enter key on your keyboard. (Fig. 18) 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. 19)

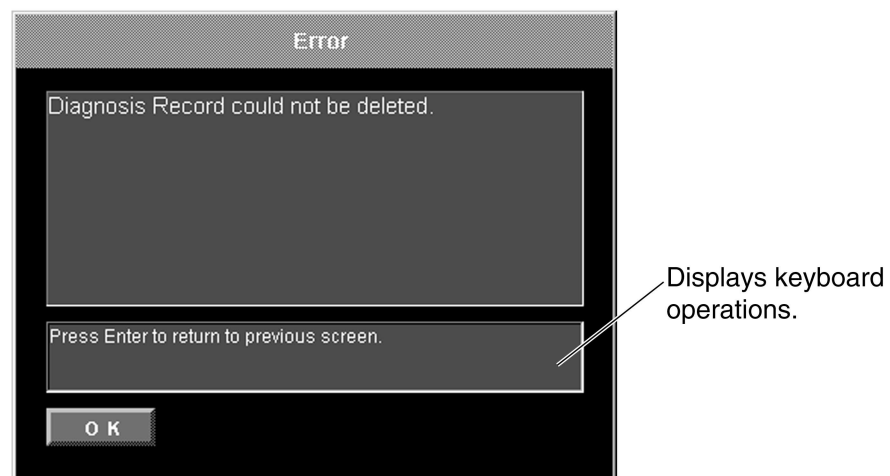


Fig. 19

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.

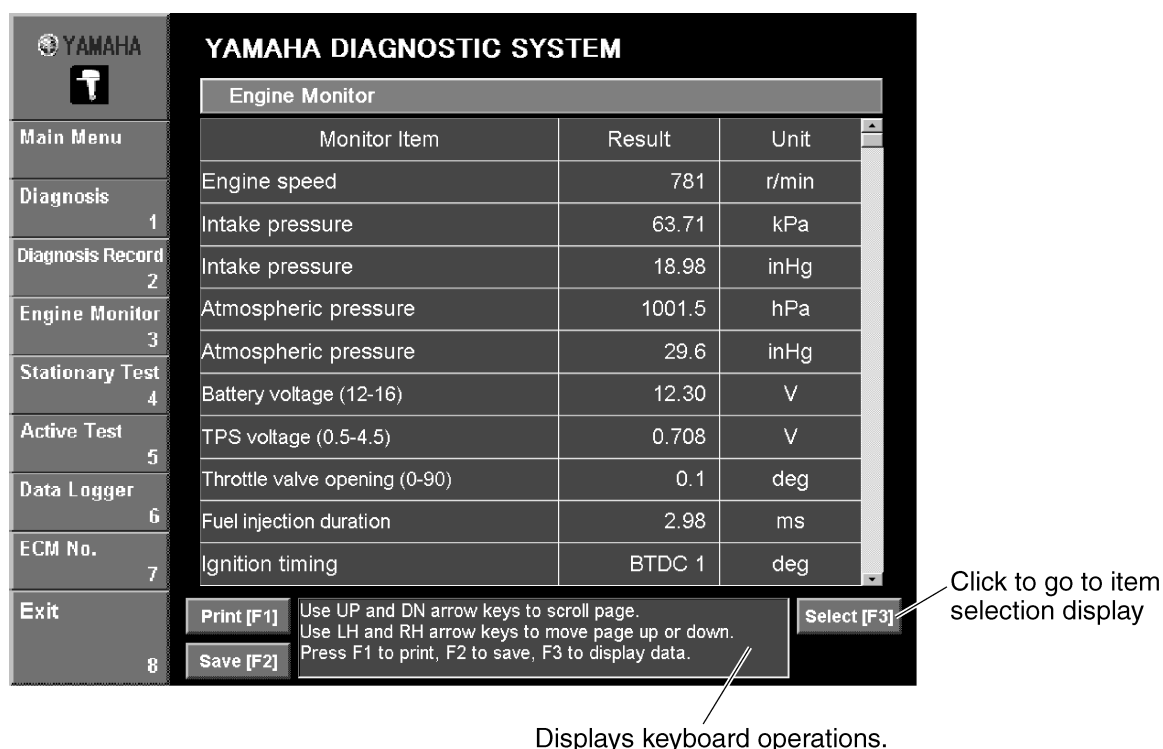


Fig. 20

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. 21)

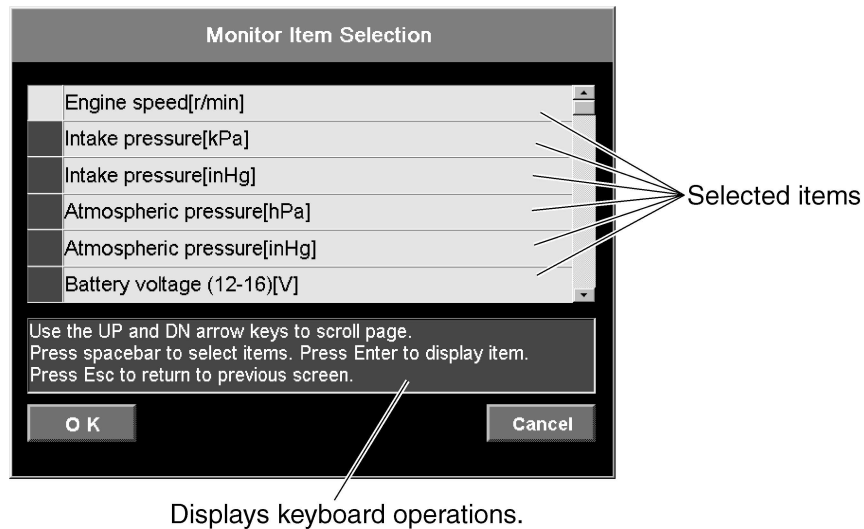


Fig. 21

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. 21)

Stationary test

Selecting this command displays a window where stationary tests (spark ignition coil #, operate injector #, operate electric fuel pump, operate electric fuel feed pump, and operate ISC valve) 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.

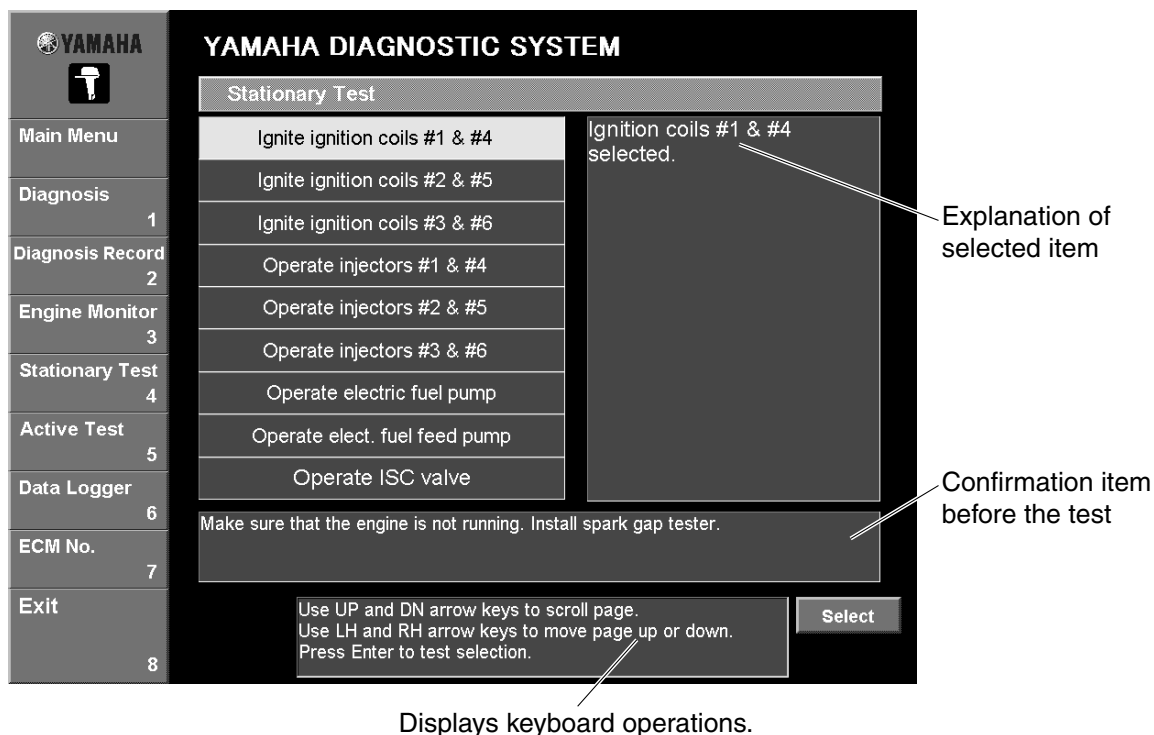


Fig. 22

Sparking 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. 22)

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)

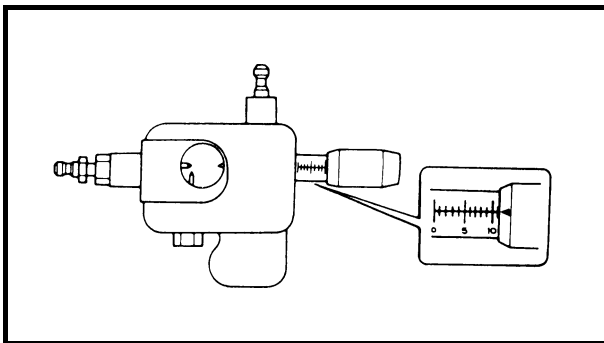


Fig. 23

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. 22)

5. Click the **Execute** button or press the Enter key on your keyboard. (Fig. 24)

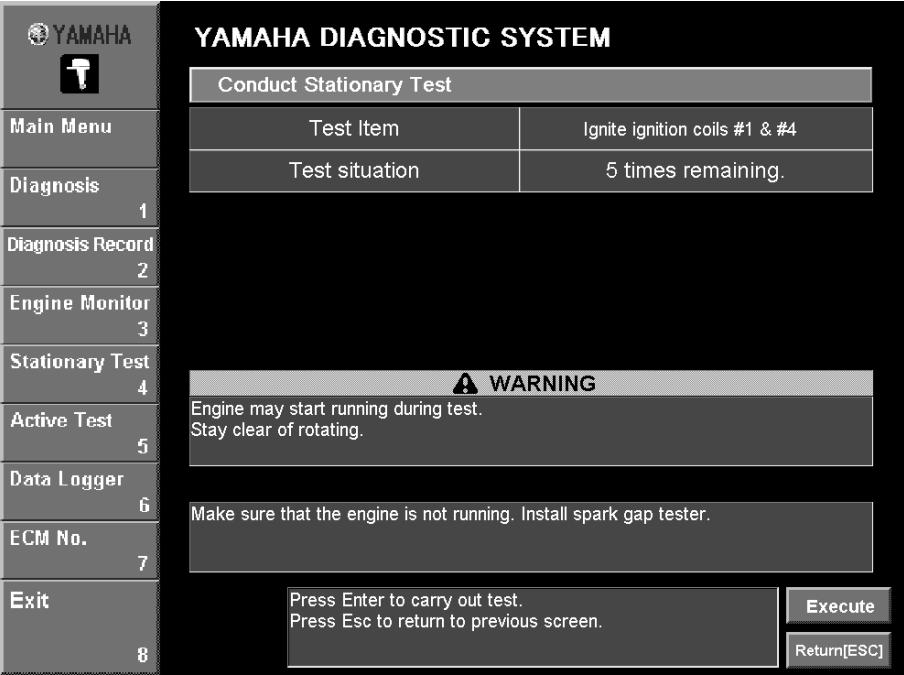
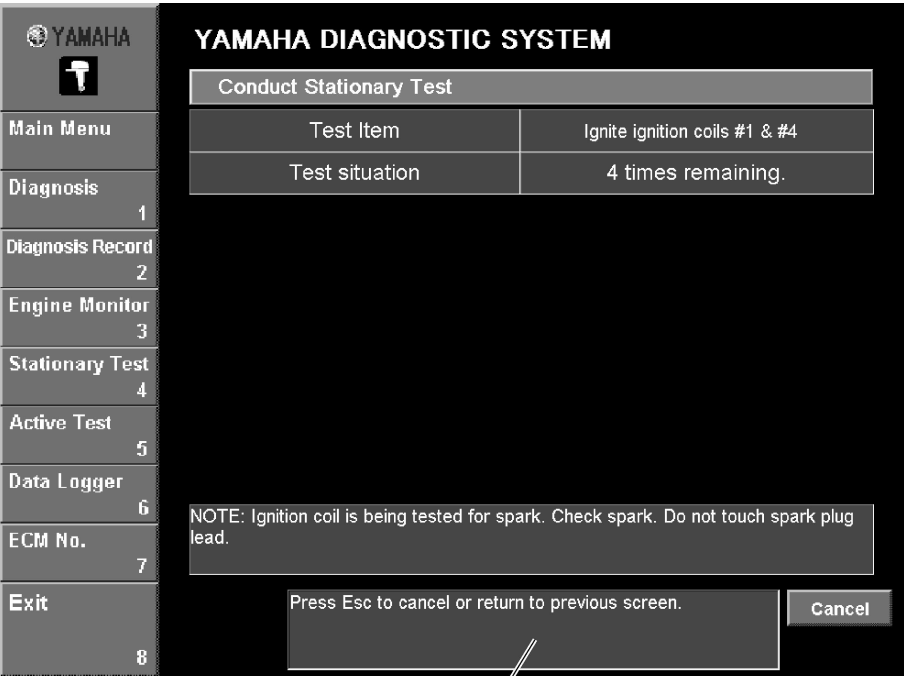


Fig. 24



Displays keyboard operations.

Fig. 25

NOTE:

If the engine is running an error message is displayed. Follow the instructions that appear. (Fig. 26)

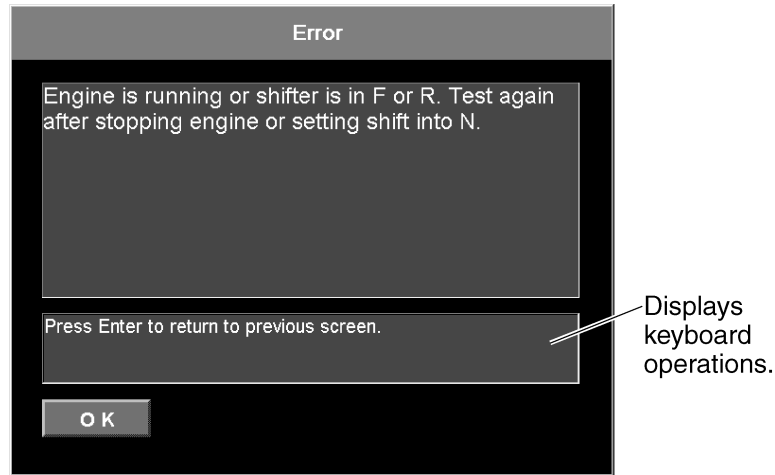


Fig. 26

6. While checking the information that appears in the **Test situation** column, follow the test instructions in the messages that are displayed. (See fig. 25.)

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. 27)

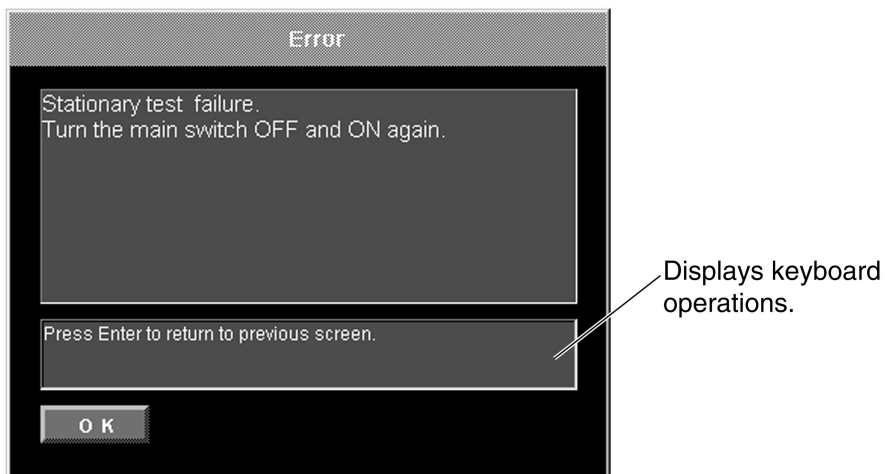


Fig. 27

7. To stop the stationary test, click the **Cancel** button. (See fig. 25.)
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. 28

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. 29)

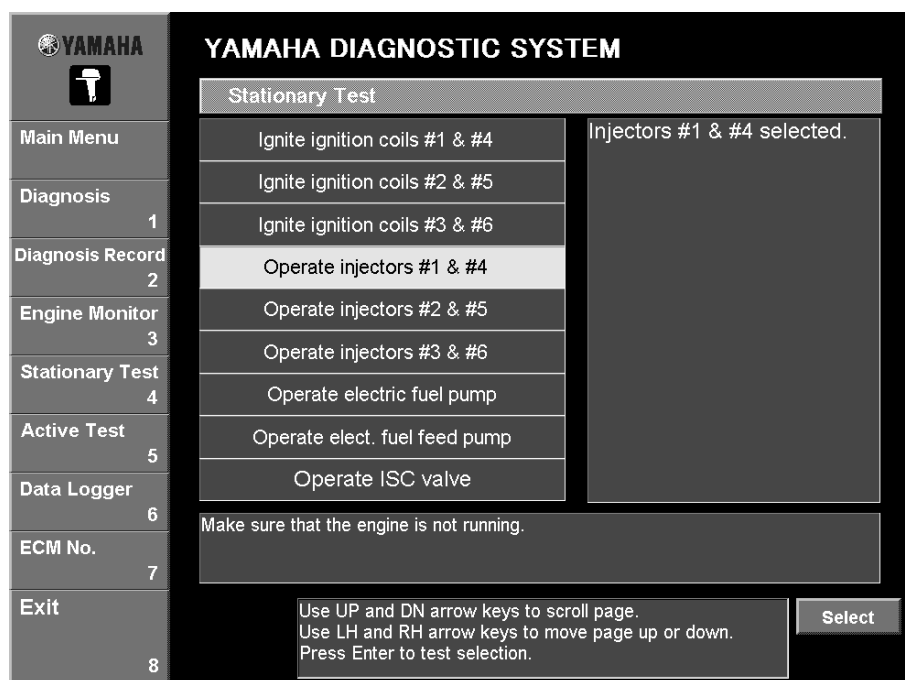


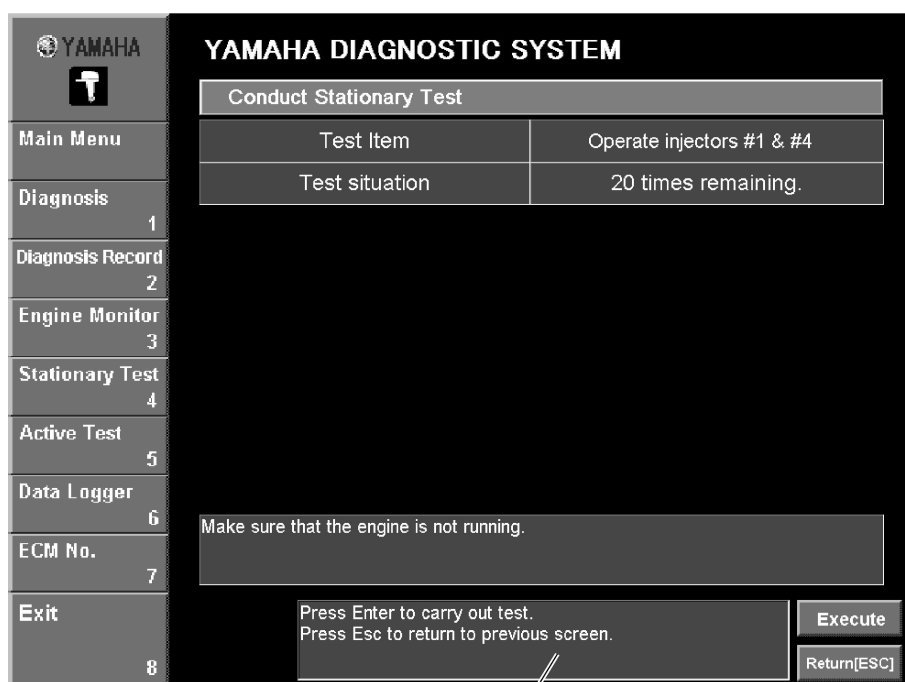
Fig. 29

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. 29)

3. Click the **Execute** button or press the Enter key on your keyboard. (Fig. 30)



Displays keyboard operations.

Fig. 30

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 injector for the cylinder being tested.

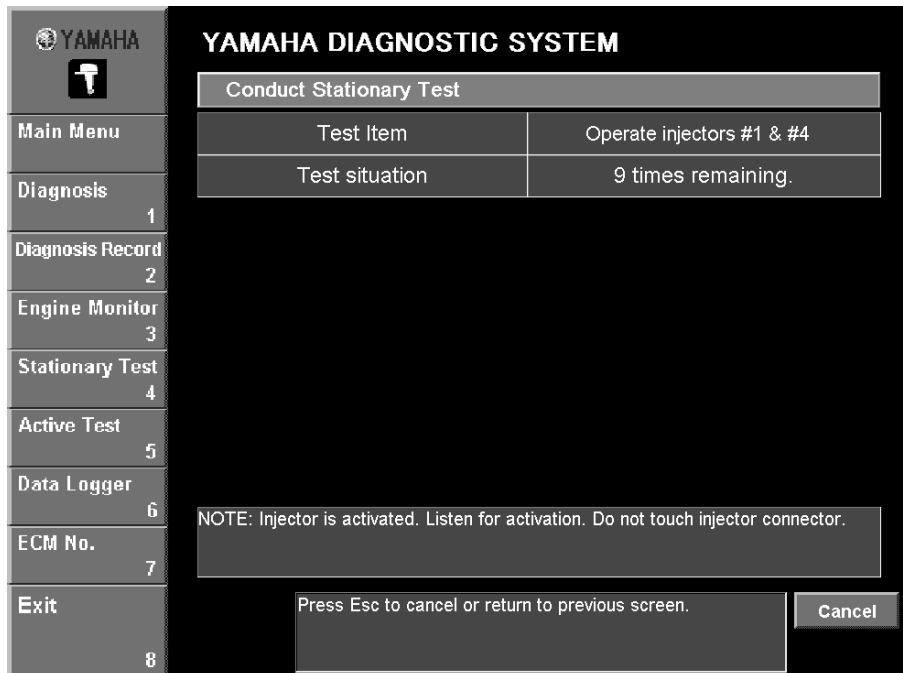


Fig. 31

⚠ 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. 32)

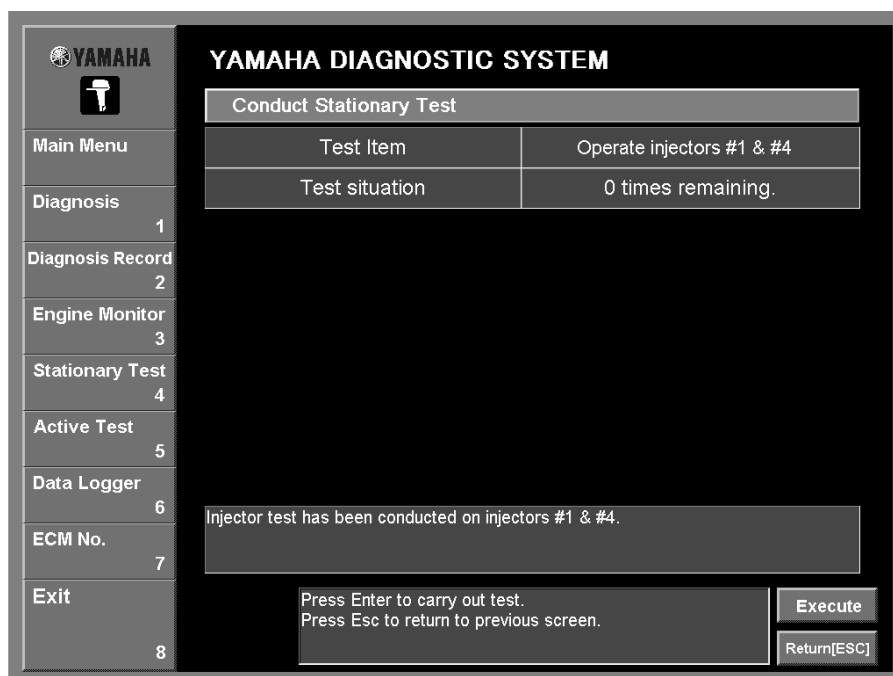


Fig. 32

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. 33)

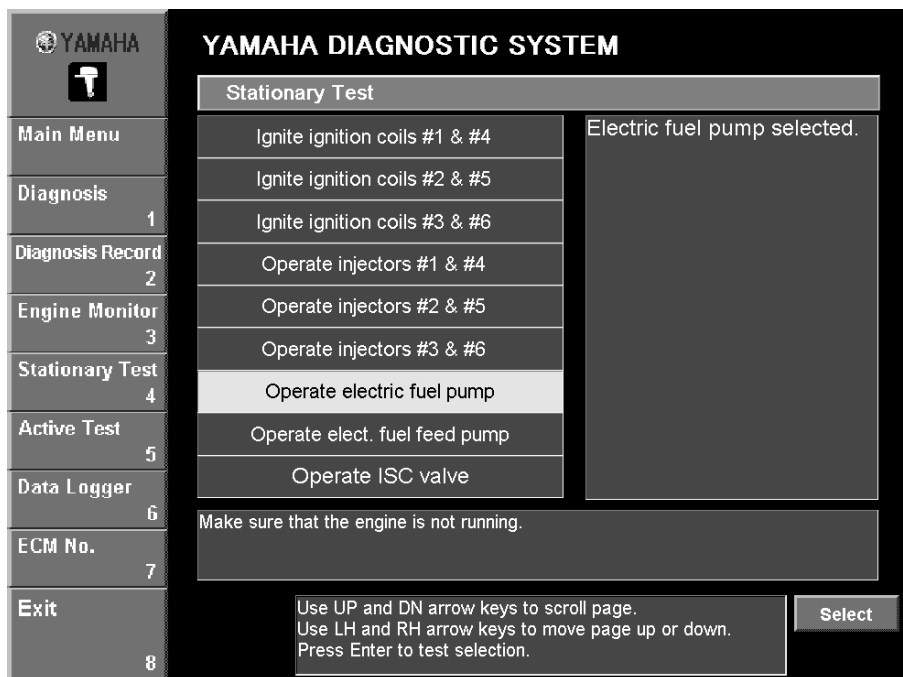
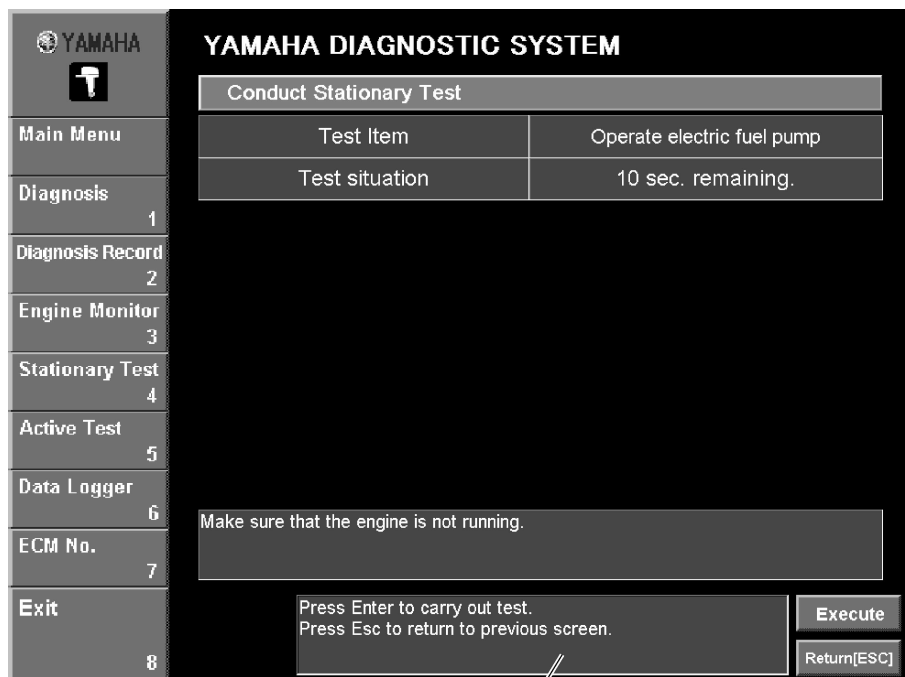


Fig. 33

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. 34)



Displays keyboard operations.

Fig. 34

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.

Yamaha Diagnostic System

- 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. 35)

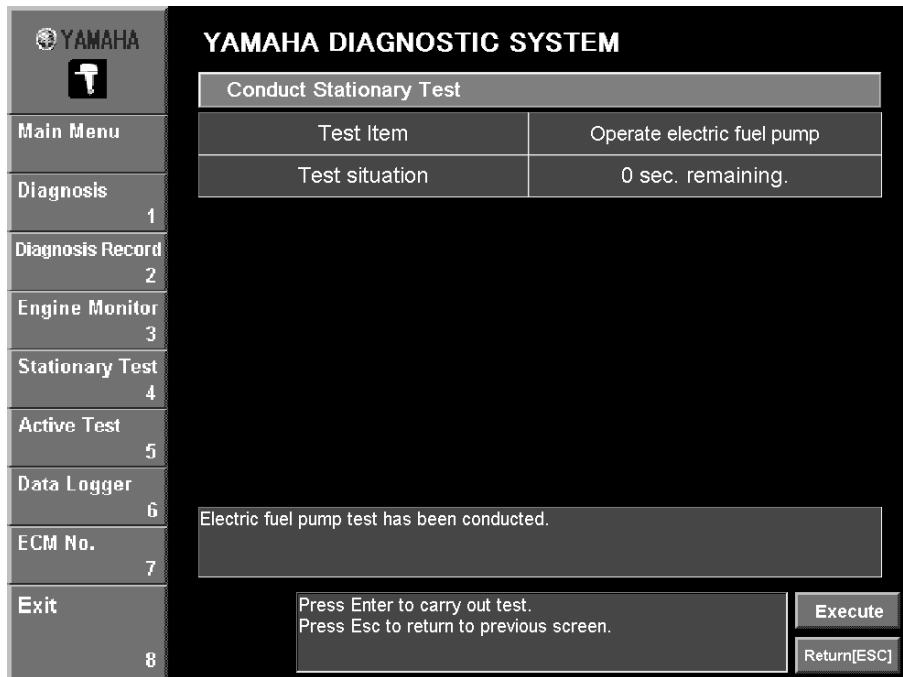


Fig. 35

Operating the electric fuel feed pump:

Operate the fuel feed pump (low-pressure pump) and listen to its operating sound. The operating time is ten seconds.

NOTE:

Carry out this test after priming the engine. If the fuel pump is not supplied with fuel when it is operated, the pump may be burned.

1. Select the test to be performed, and then click the **Select** button or press the Enter key on your keyboard. (Fig. 36)

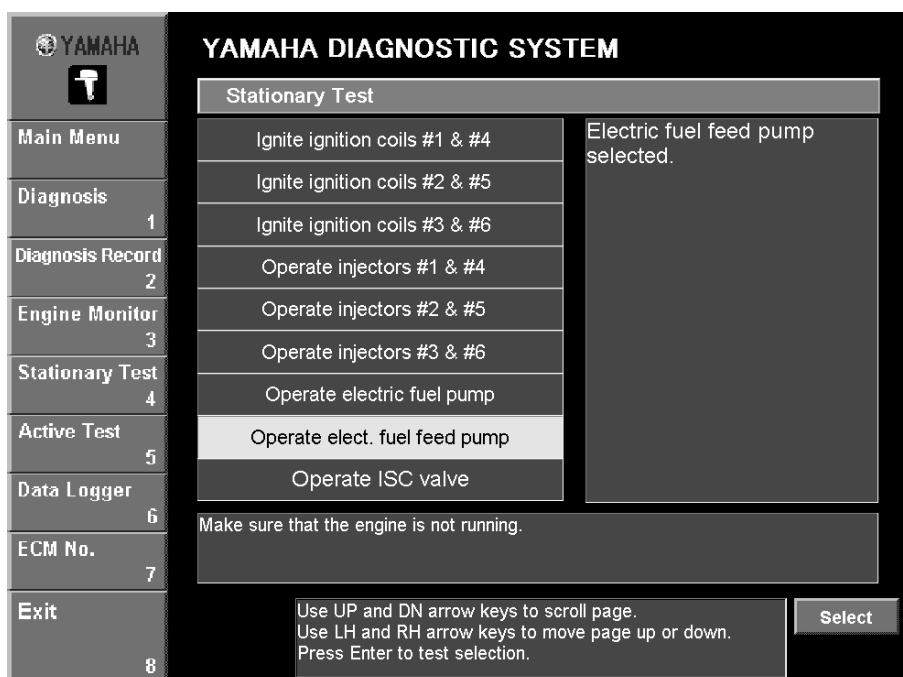


Fig. 36

2. Click the **Execute** button or press the Enter key on your keyboard. (Fig. 37)

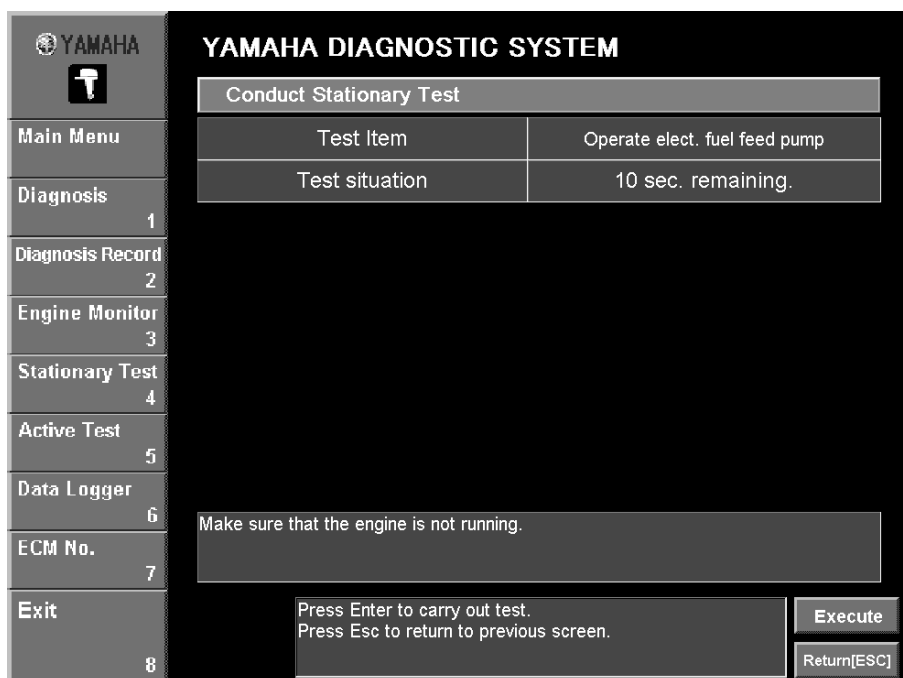


Fig. 37

- Listen to the operating sound of the fuel feed pump.

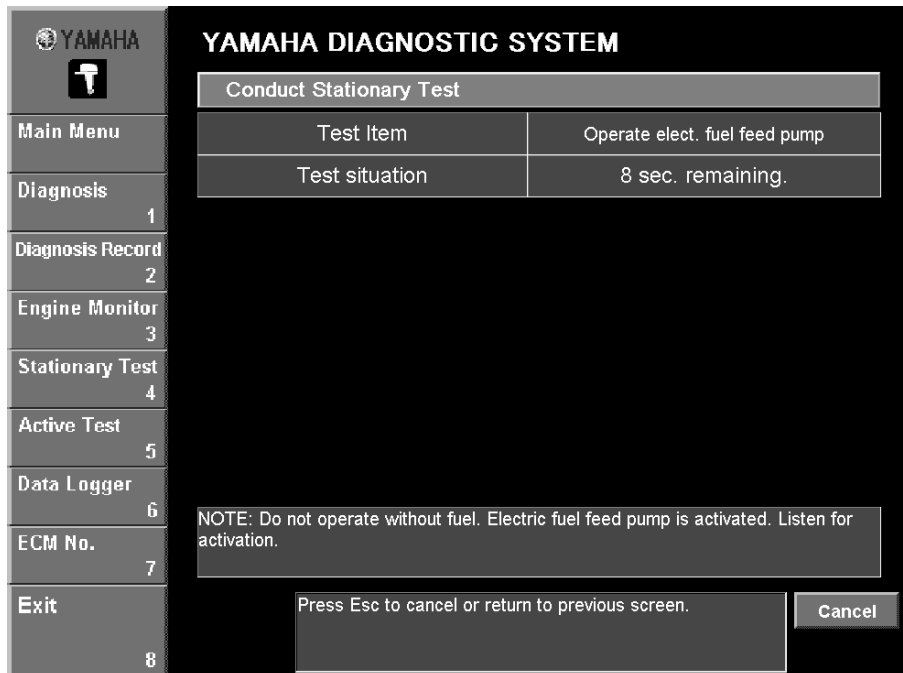


Fig. 38

- To test again, click the **Execute** button or press the Enter key on your keyboard. To perform a different test, click the **Return** button or return to the test selection menu or press the ESC key on your keyboard.

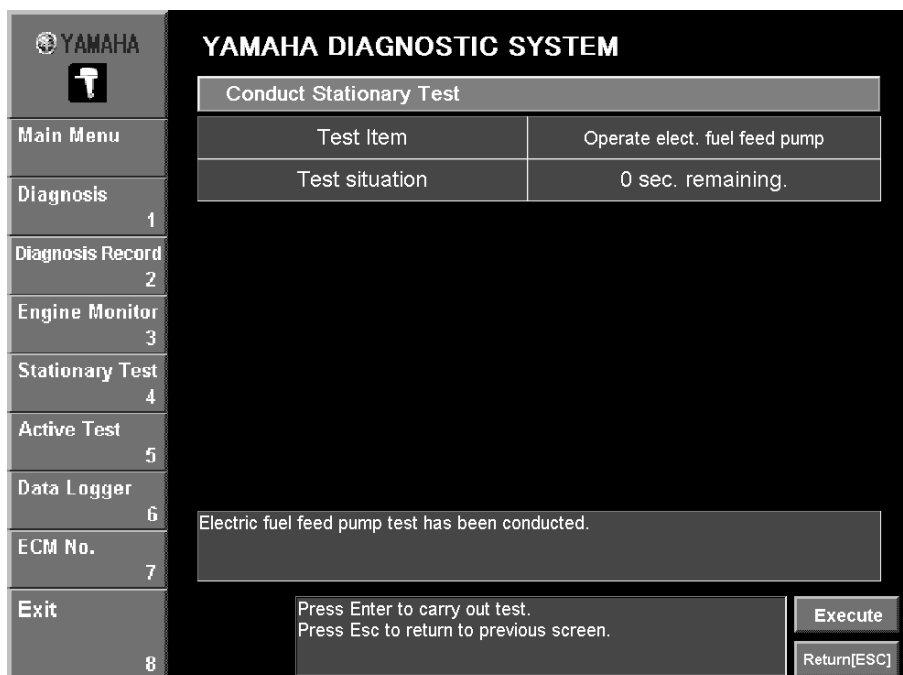


Fig. 39

Operating the ISC valve:

Operate the ISC valve and listen to its operating sound. The operating time is three seconds.

1. Select the test to be performed, and then click the **Select** button or press the Enter key on your keyboard. (Fig. 40)

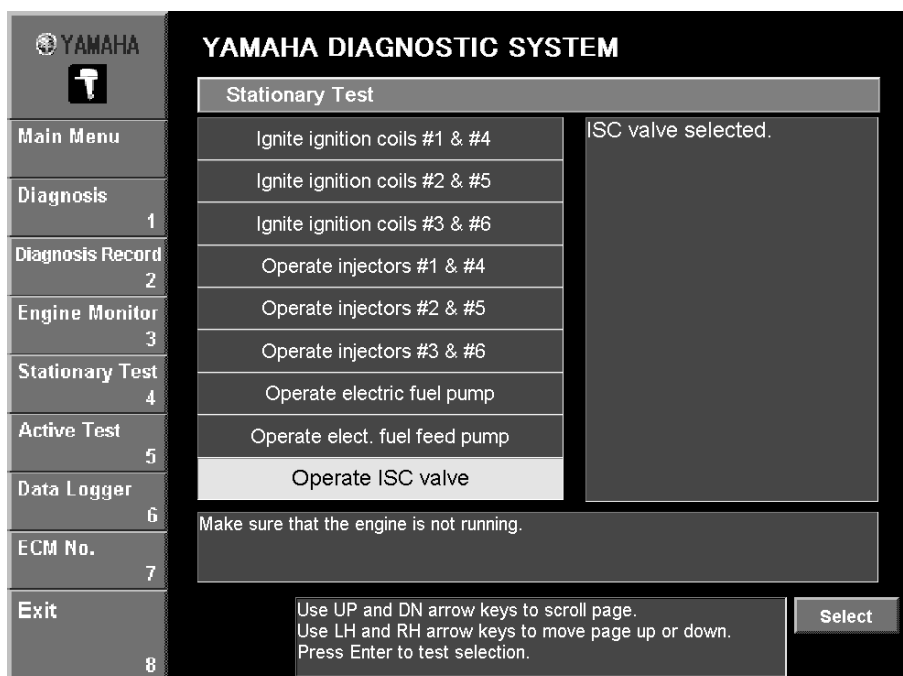


Fig. 40

2. Click the **Execute** button or press the Enter key on your keyboard. (Fig. 41)

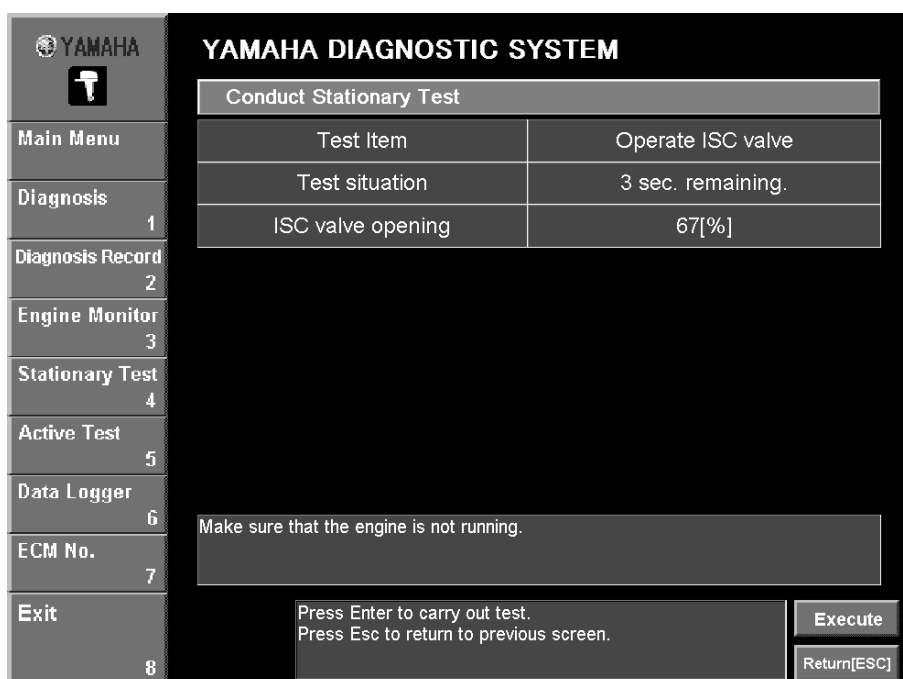


Fig. 41

- Listen to the operating sound of the ISC valve.

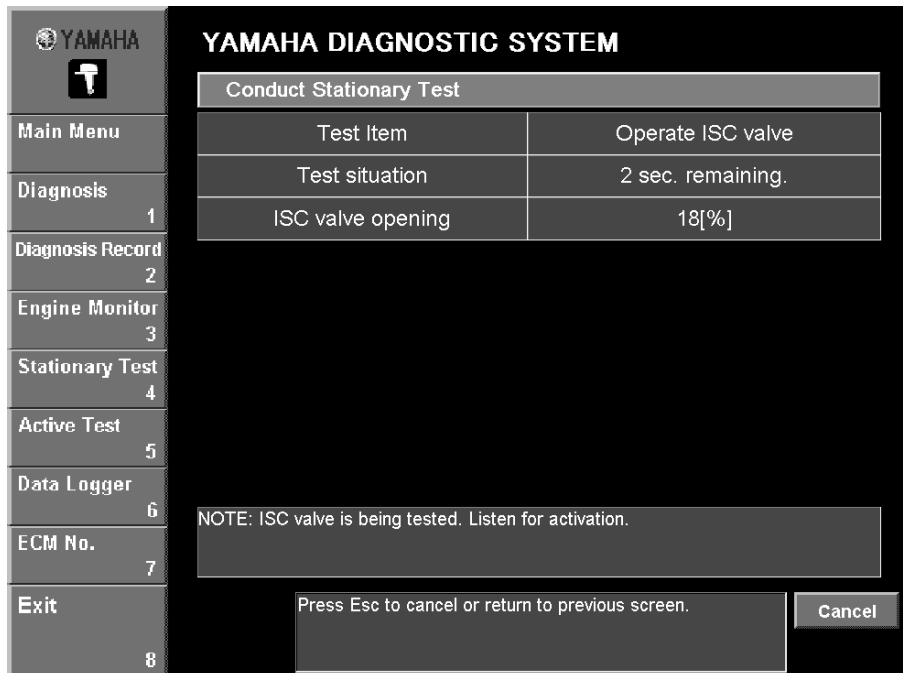


Fig. 42

- To test again, click the **Execute** button or press the Enter key on your keyboard. To perform a different test, click the **Return** button to return to the test selection menu or press the ESC key on your keyboard.

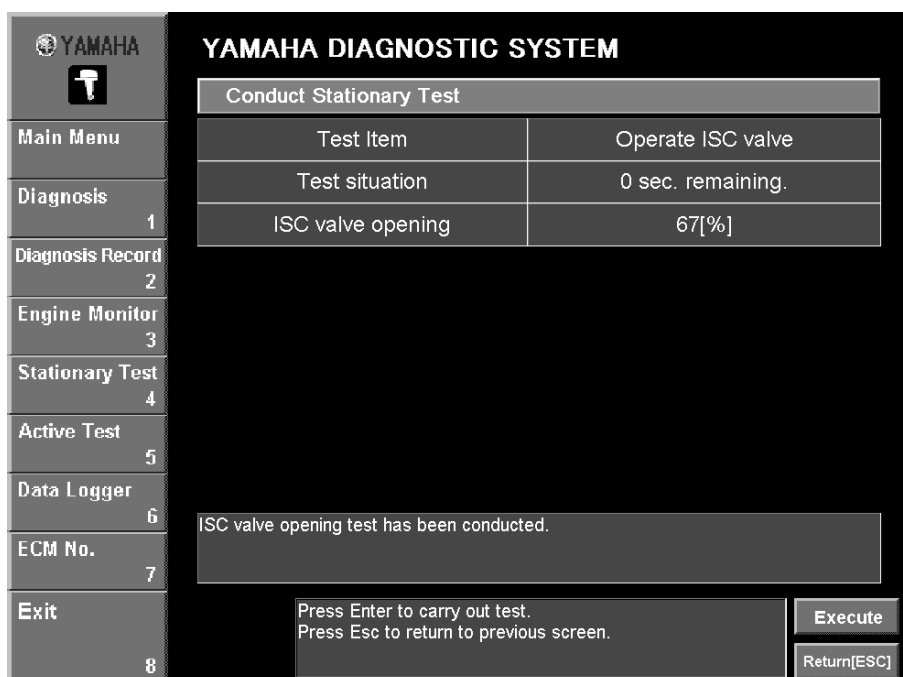


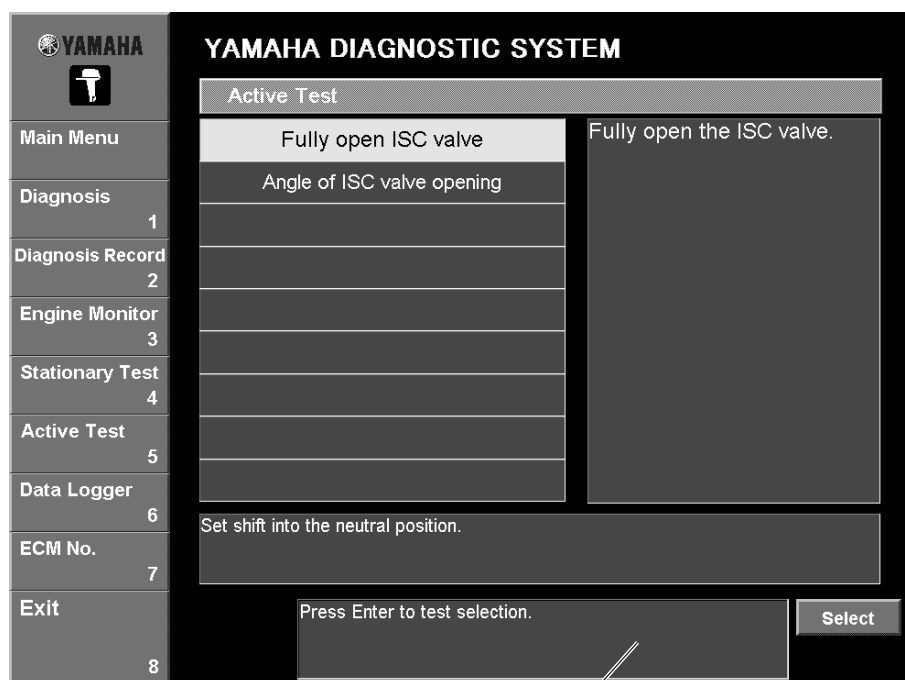
Fig. 43

Active test

Selecting this command displays a window where active tests (fully open ISC valve and angle of ISC valve opening) 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. 44

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.

Fully opening the ISC valve:

When the shift is in neutral and the engine is idling, fully open the ISC valve, and then check that the engine speed revs up, and that the intake valves are normal. The operating time is two seconds.

⚠ WARNING

When the ISC valve is fully open the engine speed will increase, therefore do not put the shift into gear.

1. Select the test to be performed, and then click the **Select** button or press the Enter key on your keyboard.

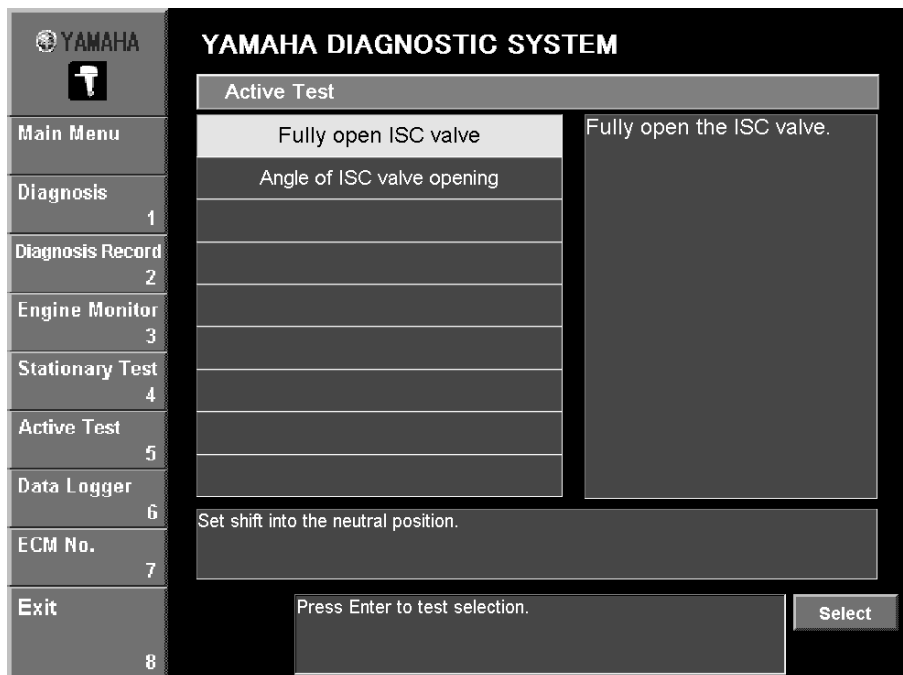


Fig. 45

2. Click the **Execute** button or press the Enter key on your keyboard. (Fig. 46)

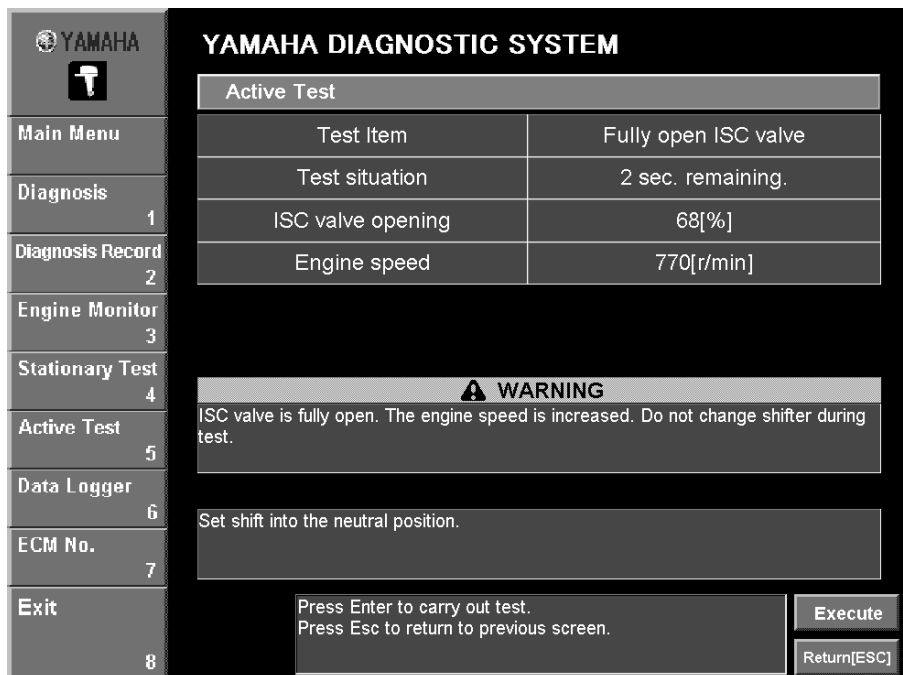


Fig. 46

3. The ISC valve is fully open. Check that the engine speed revs up.

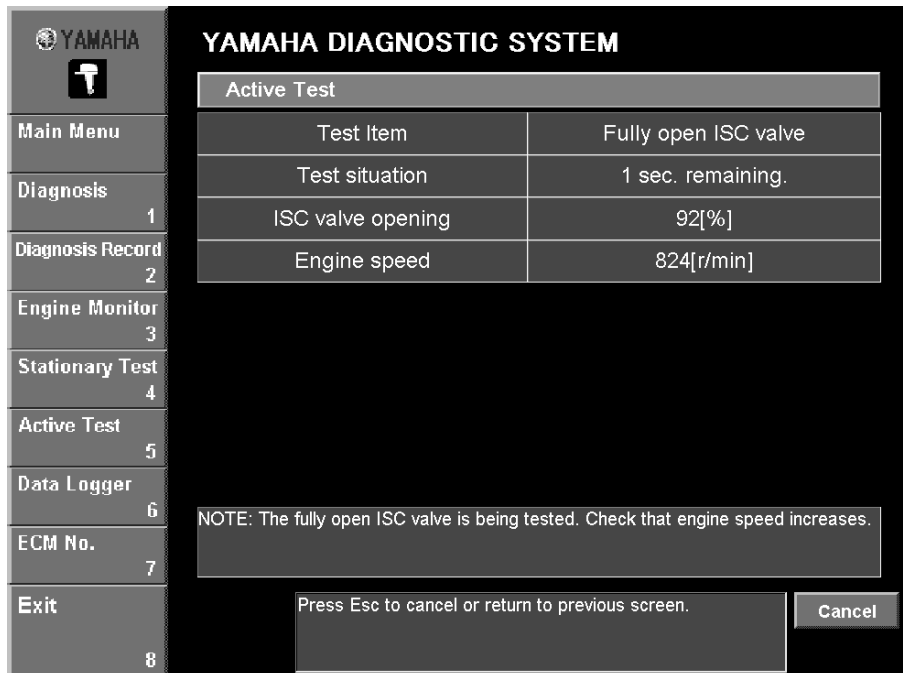


Fig. 47

4. To test again, click the **Execute** button or press the Enter key on your keyboard. To perform a different test, click the **Return** button to return to the test selection menu or press the ESC key on your keyboard.

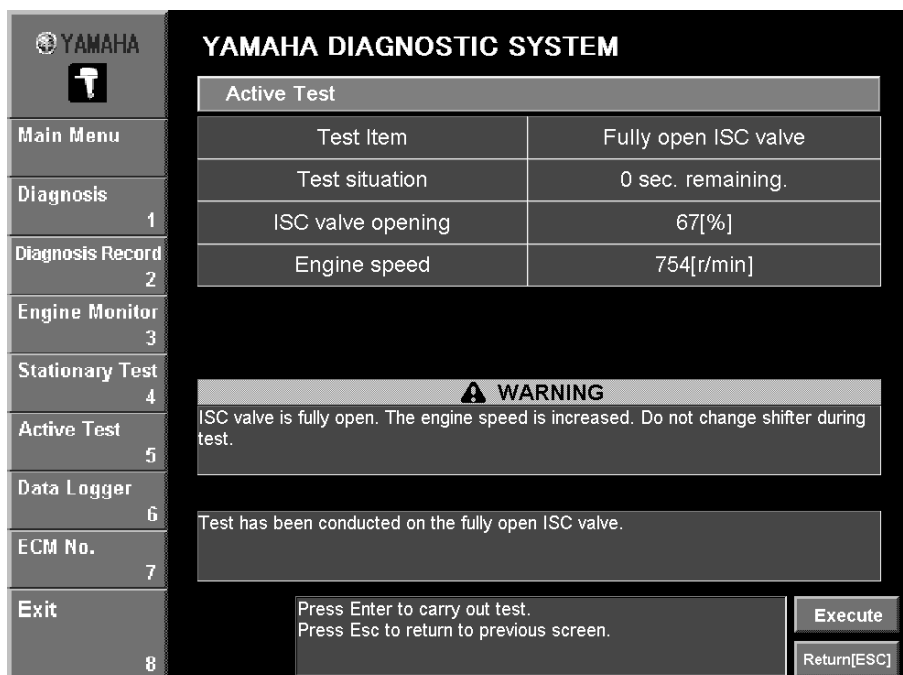


Fig. 48

Opening the ISC valve angle:

Set the opening angle of the ISC valve, and adjust the air volume when the engine is idling. The operating time is 30 minutes.

Before testing warm the engine up.

1. Select the test to be performed, and then click the **Select** button or press the Enter key on your keyboard.

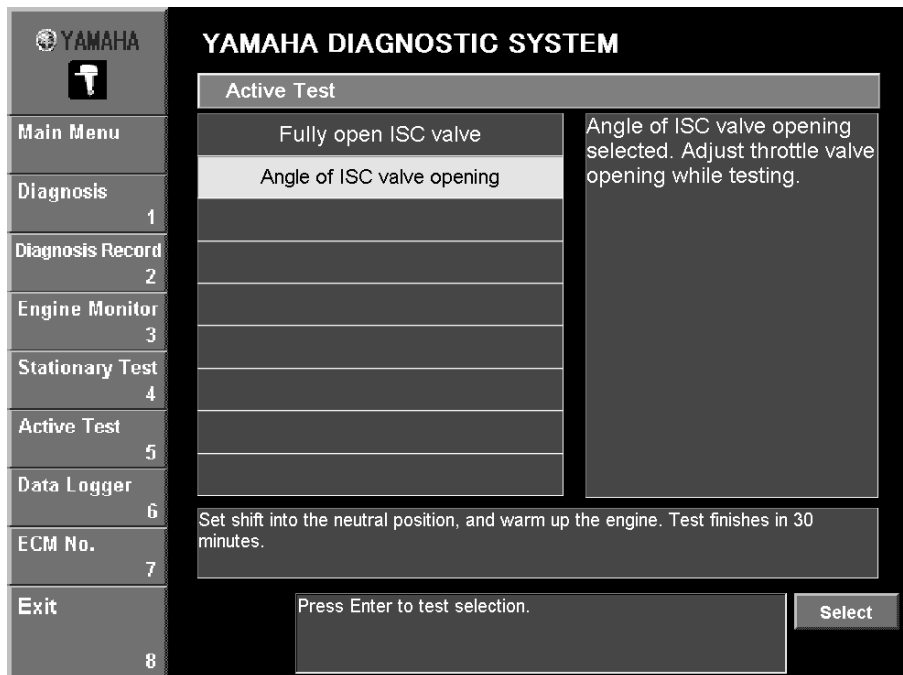


Fig. 49

2. Click the **Execute** button or press the Enter key on your keyboard. (Fig. 50)

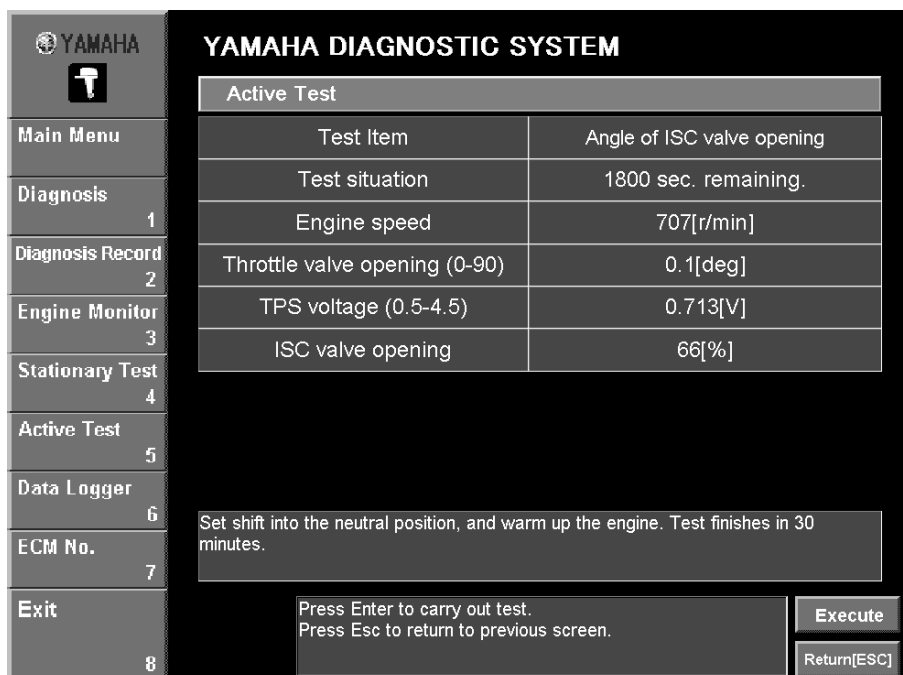


Fig. 50

3. Check the opening angle of the ISC valve is set. Refer to the service manual for adjusting procedures. After 30 minutes have passed, the test will end automatically.

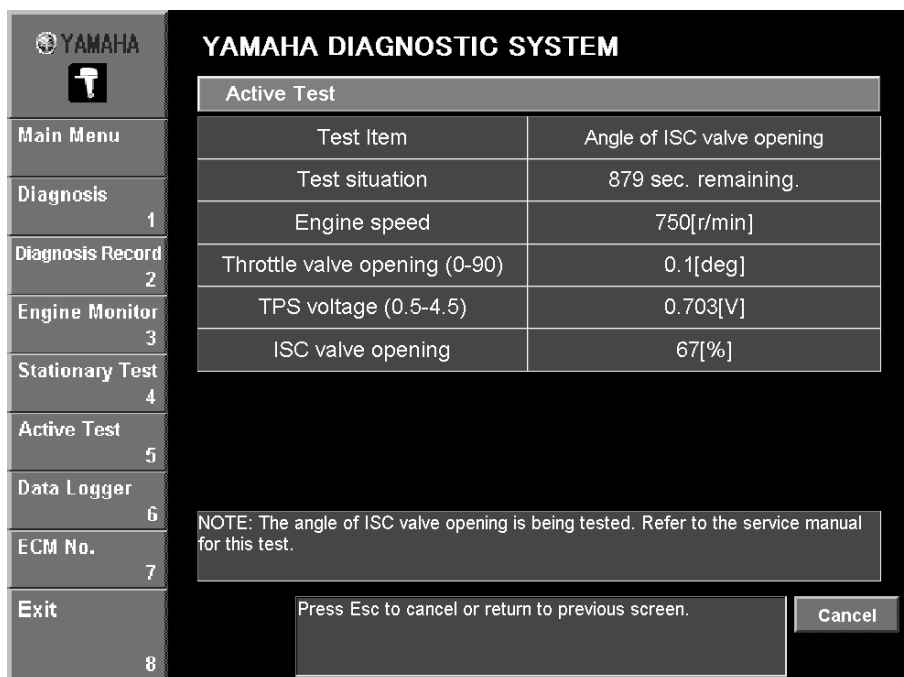


Fig. 51

4. To test again, click the **Execute** button or press the Enter key on your keyboard. To perform a different test, click the **Return** button to return to the test selection menu or press the ESC key on your keyboard.

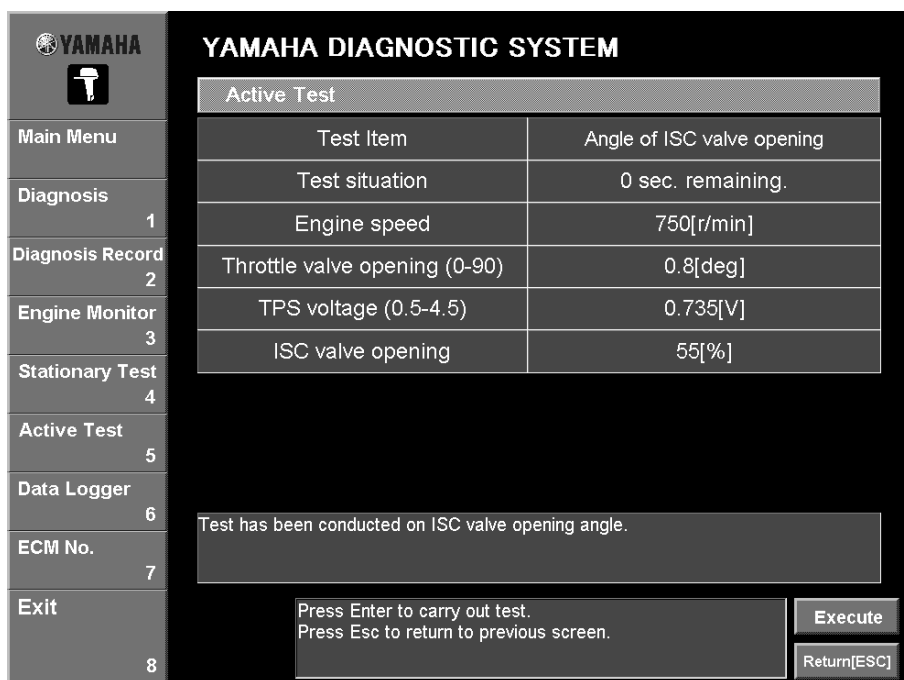


Fig. 52

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.

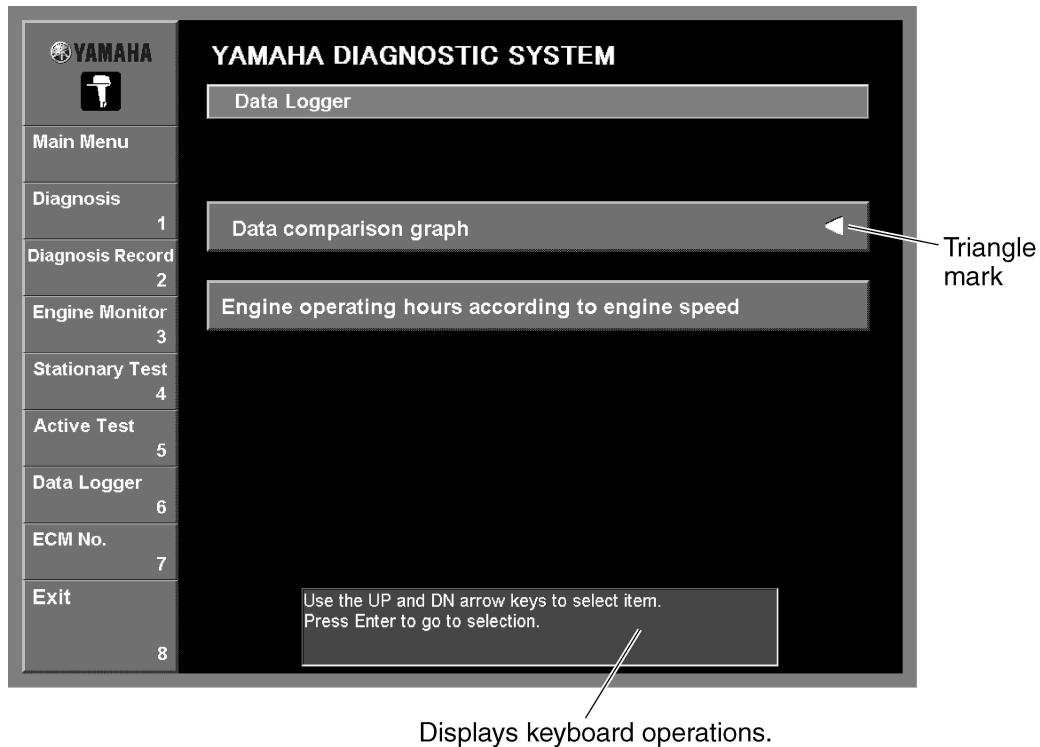


Fig. 53

Operating procedure:

1. Select the desired item by either clicking it or pressing the up or down arrow keys on your keyboard. (Fig. 53)

NOTE:

A triangle appears to the right of the selected item.

2. Press the Enter key on your keyboard. The window of the selected item is displayed. (Fig. 53)

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.

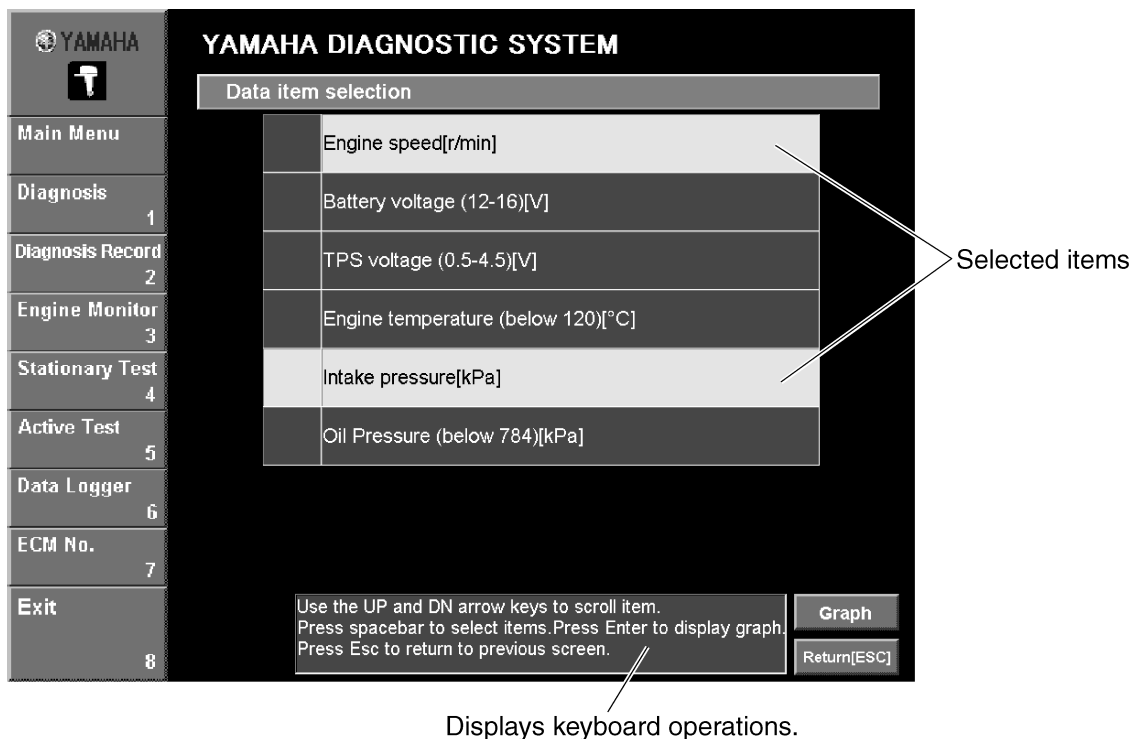


Fig. 54

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. 54)

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. 54) The **Data comparison** window is displayed. (See fig. 55.)

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. 55)

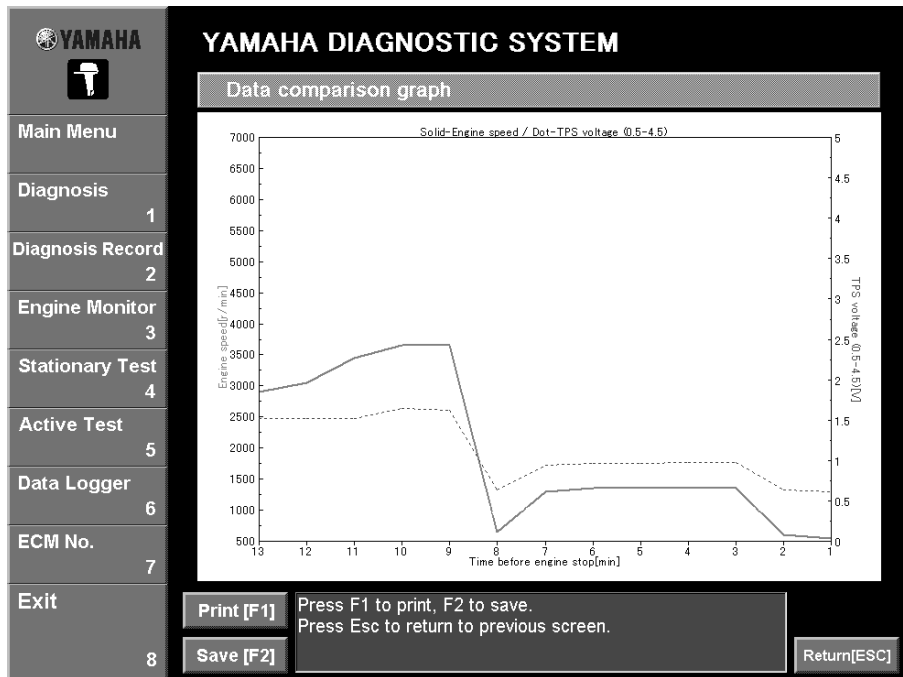


Fig. 55

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. 56)

YAMAHA DIAGNOSTIC SYSTEM		
Engine operating hours according to engine speed		
Main Menu	Engine speed	Time[h]
	- 1000 r/min	1.1
Diagnosis 1	1000 - 2000 r/min	0.0
	2000 - 3000 r/min	0.0
Diagnosis Record 2	3000 - 4000 r/min	0.0
	4000 - 5000 r/min	0.0
Engine Monitor 3	5000 - 6000 r/min	0.0
	6000 - 7000 r/min	0.0
Stationary Test 4		
Active Test 5		
Data Logger 6		
ECM No. 7		
Exit 8	Engine hours	1

Print [F1]

Save [F2]

Press F1 to print, F2 to save.
 Press Esc to return to previous screen.

Return[ESC]

Displays keyboard operations.

Fig. 56

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.

ECM No.

The ECM part number of the outboard motor is read from the ECM and is displayed. (Fig. 57)

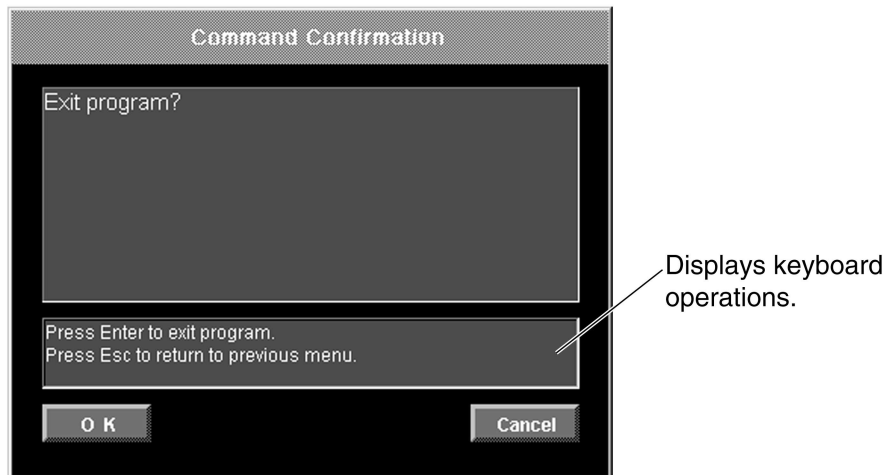


Fig. 57

Exit

The program is exited.

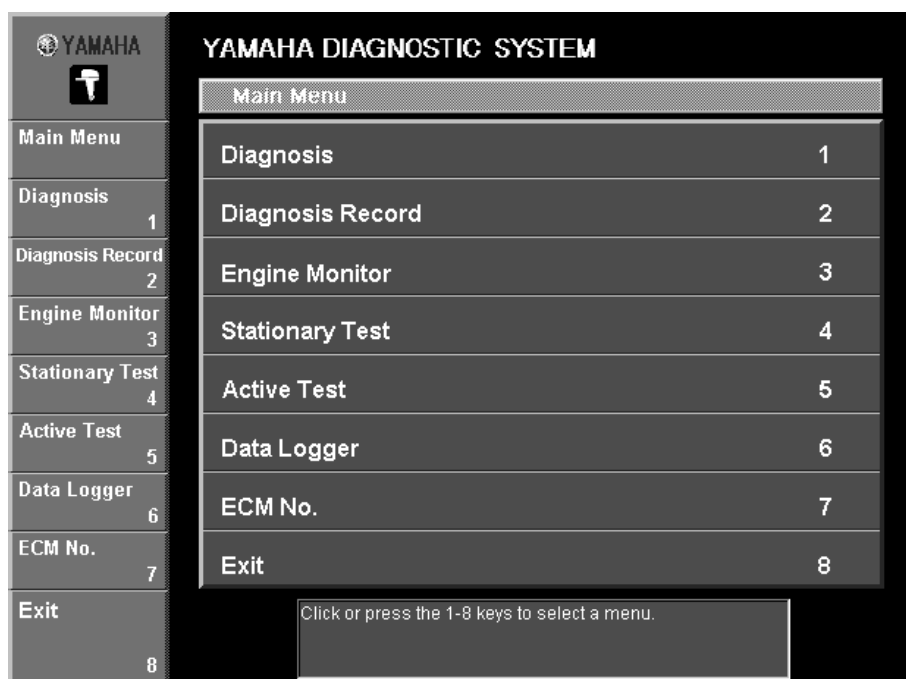


Fig. 58

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. 59)

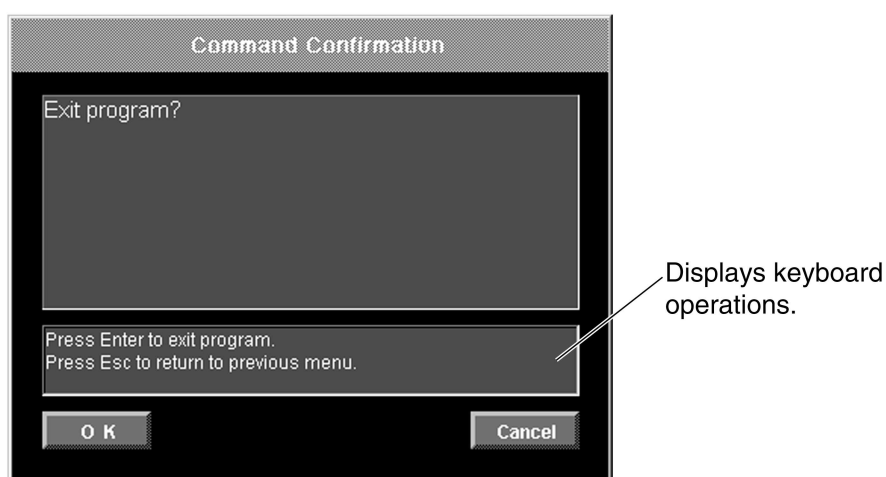


Fig. 59

Troubleshooting

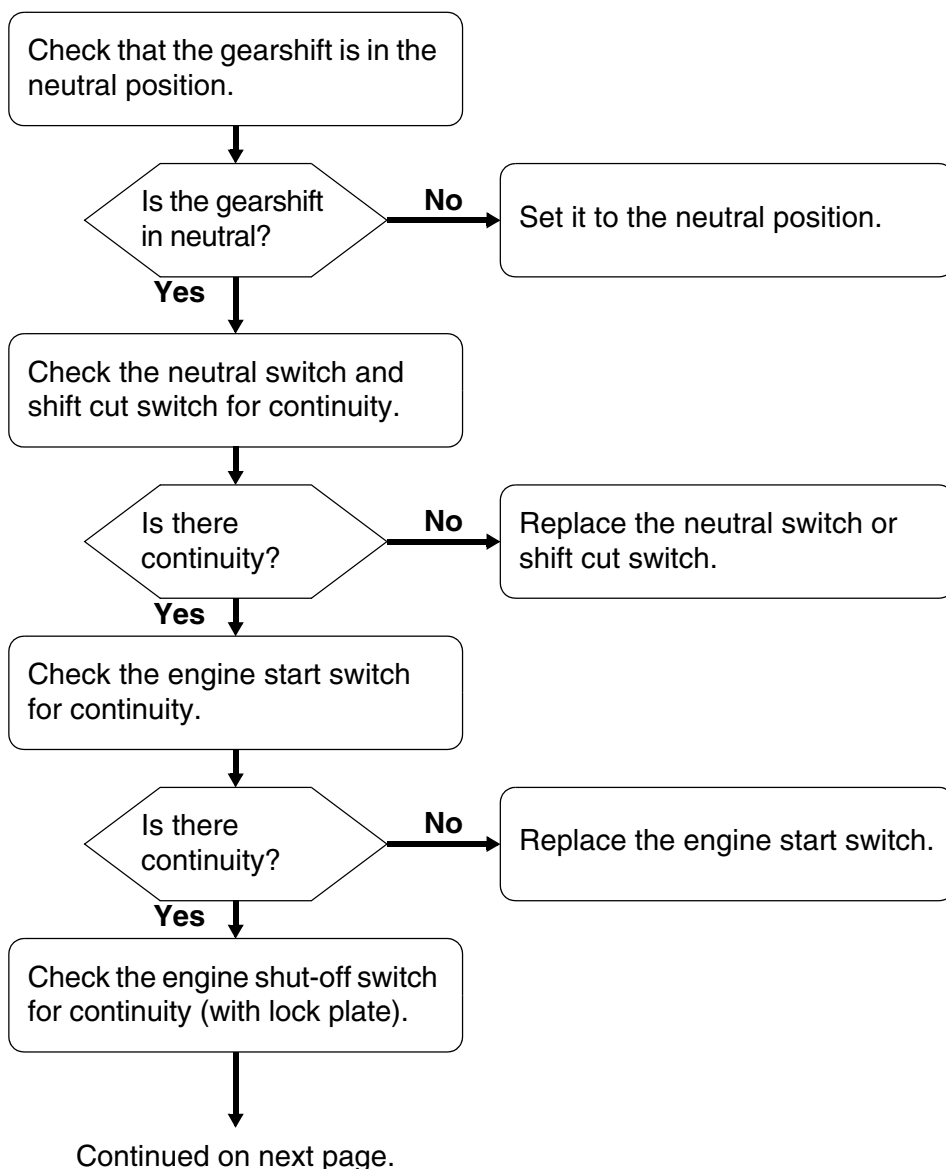
Error content	Cause	Action
Communication cable related error occurs	Engine start switch is turned OFF.	Turn the engine start switch to ON.
	Communication cable is disconnected.	Connect communication cable between the laptop computer's communication port and 3-pin communication coupler of the outboard 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.
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 engine start switch to OFF and reset the ECM.

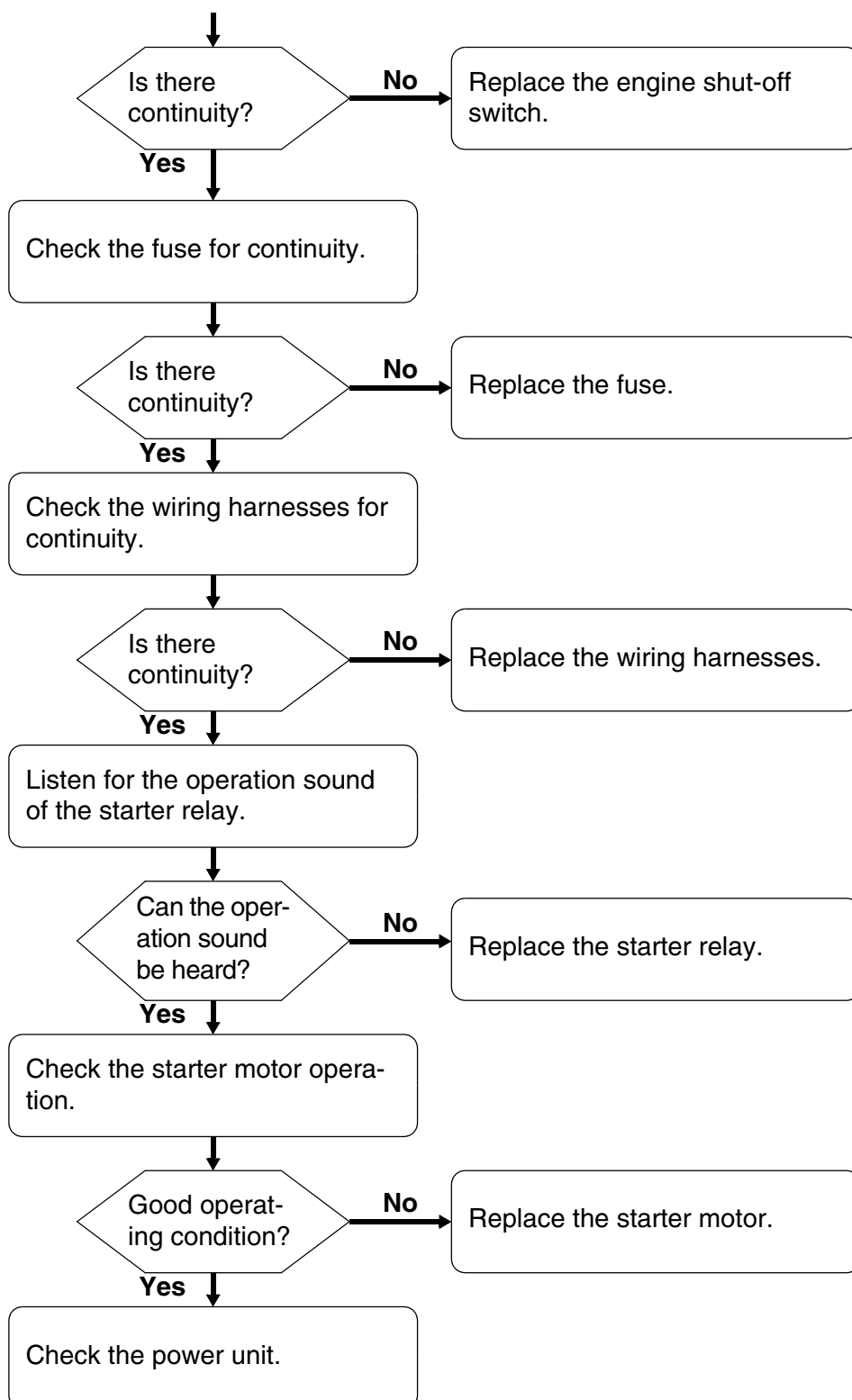
NOTE:

- To diagnose a mechanical malfunction, use the troubleshooting charts pertaining to the trouble located in this chapter. Also, when checking and maintaining the outboard motor, see Chapters 4–8 for safe maintenance procedures.
- Check that all electrical connections are tight and free from corrosion, and that the battery is fully charged to 12 V.
- To diagnose a malfunctioning sensor or switch, use the diagnostic flash indicator to determine the cause.

Power unit**Symptom: Engine does not crank.**

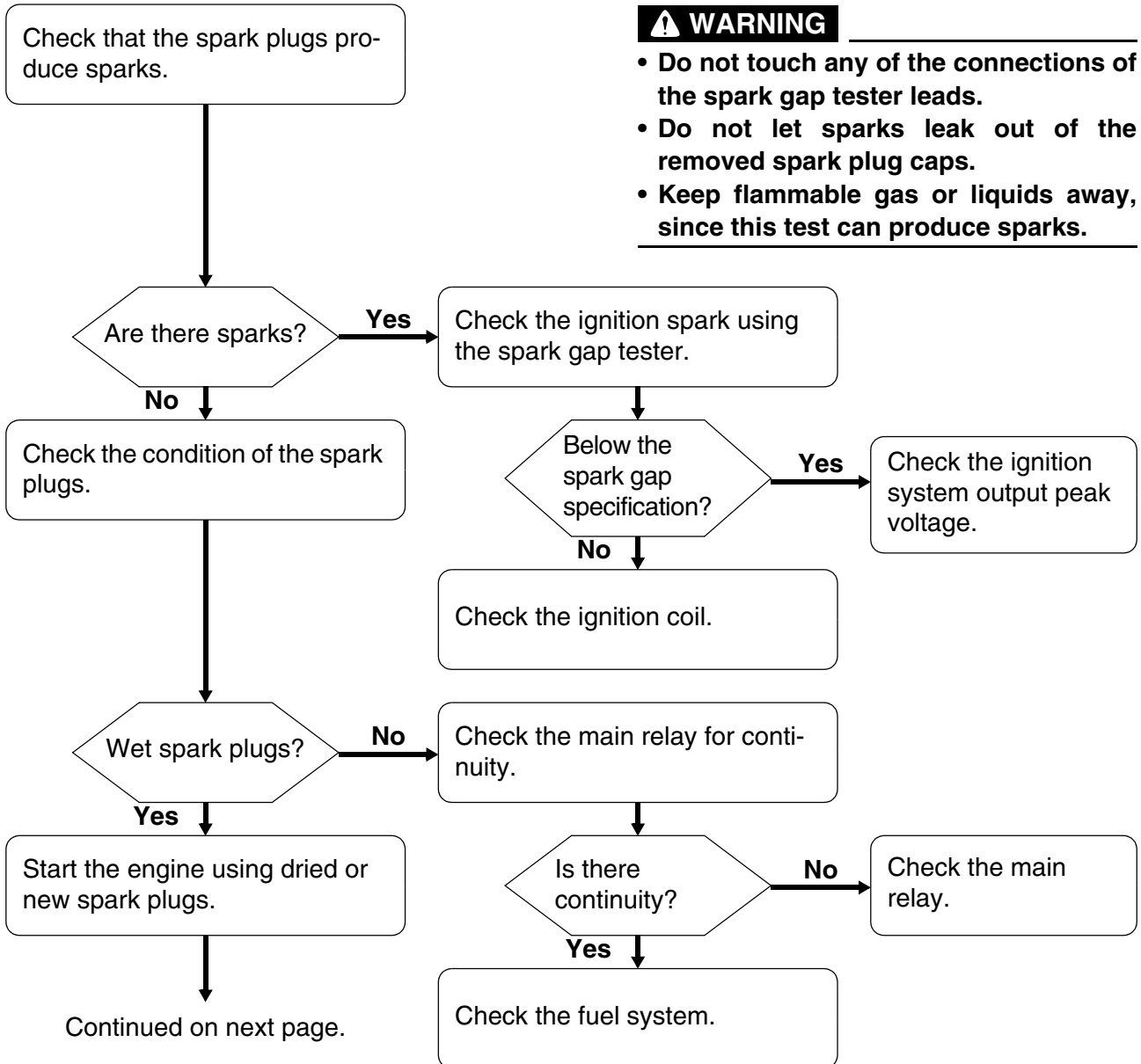
- Check the starting system.
- Check the power unit.

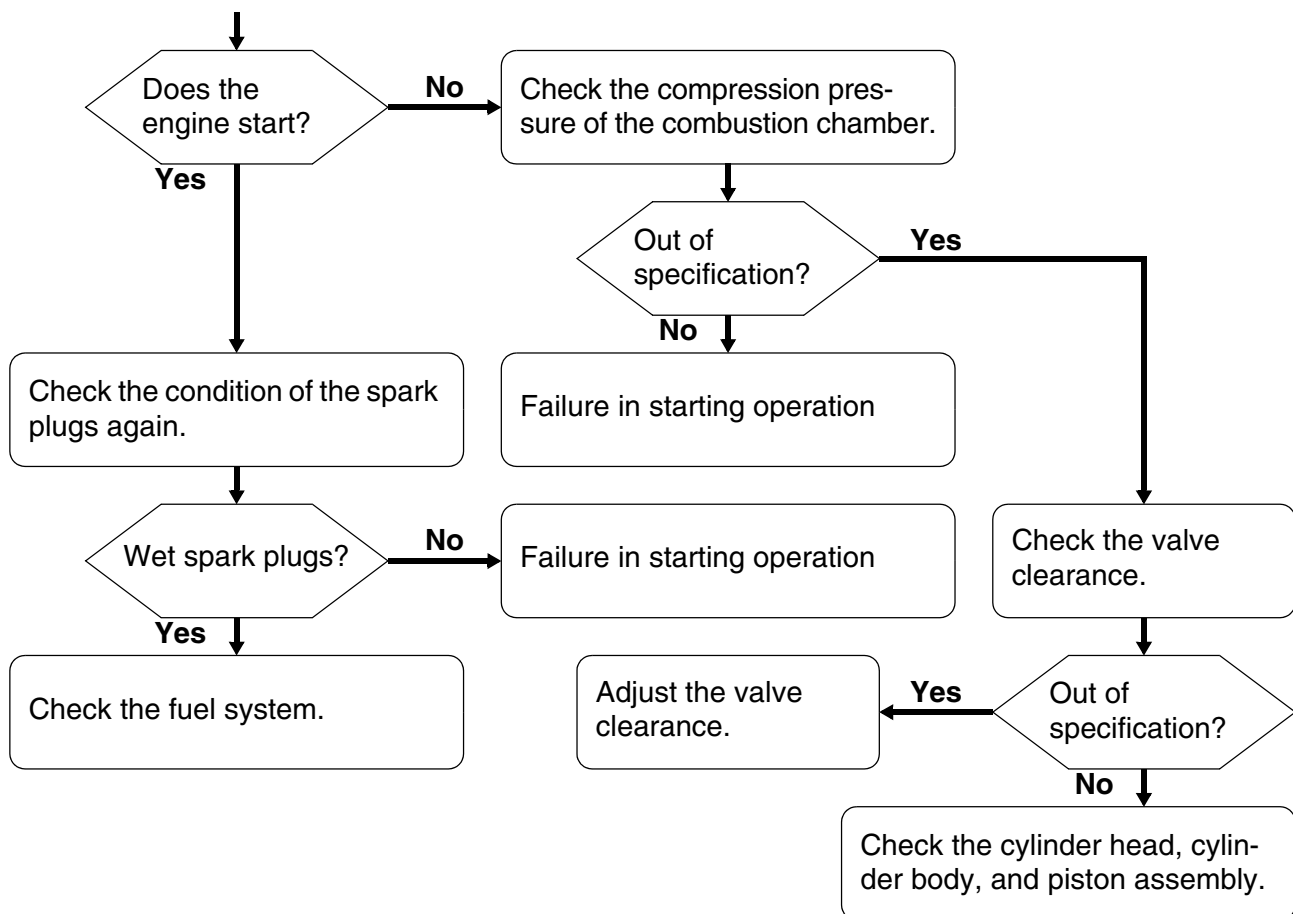




Symptom: Engine cranks, but will not start (engine shut-off switch is operating normally).

- Check the ignition system.
- Check the fuel system.
- Check the compression pressure of the power unit.

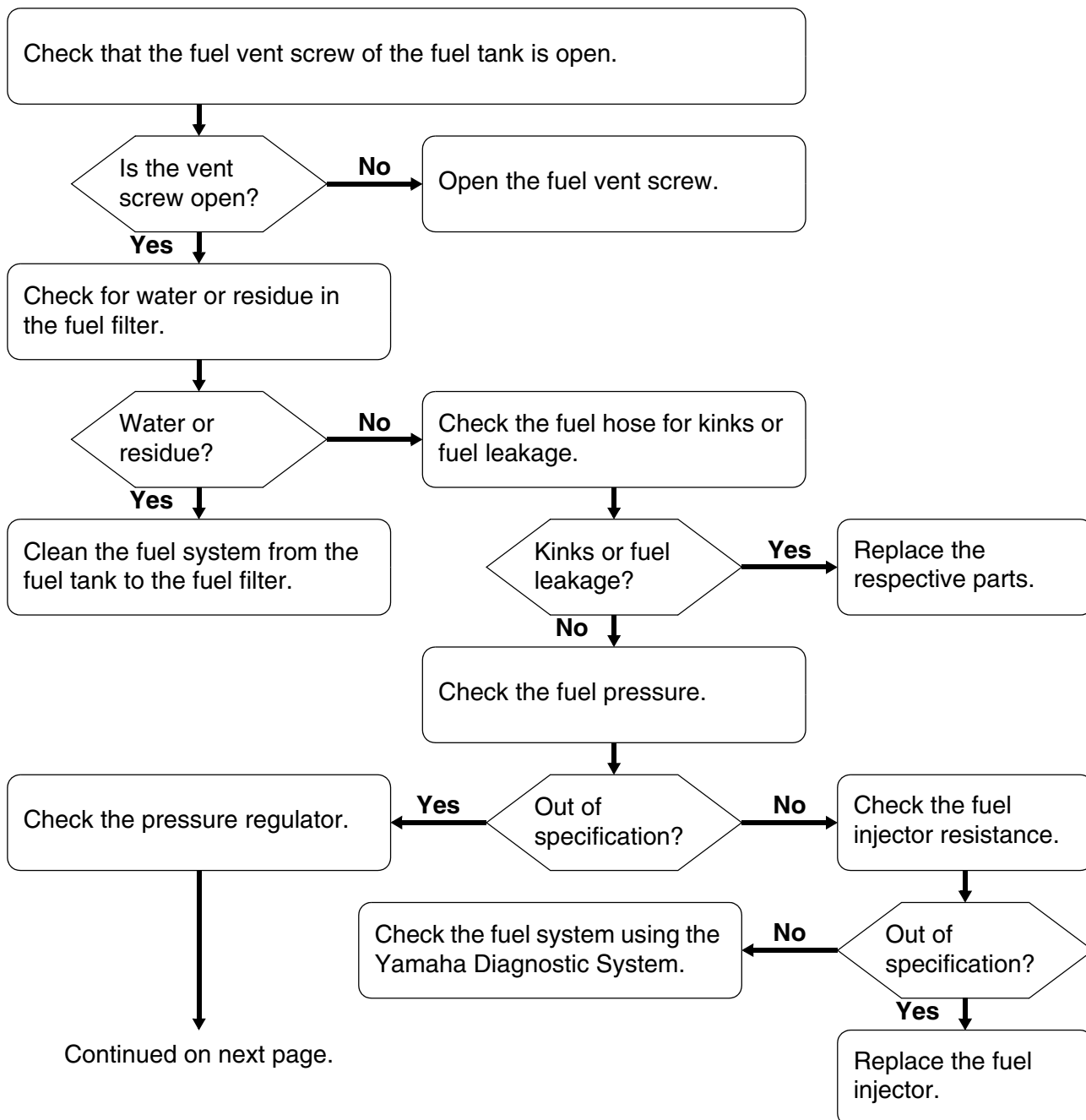


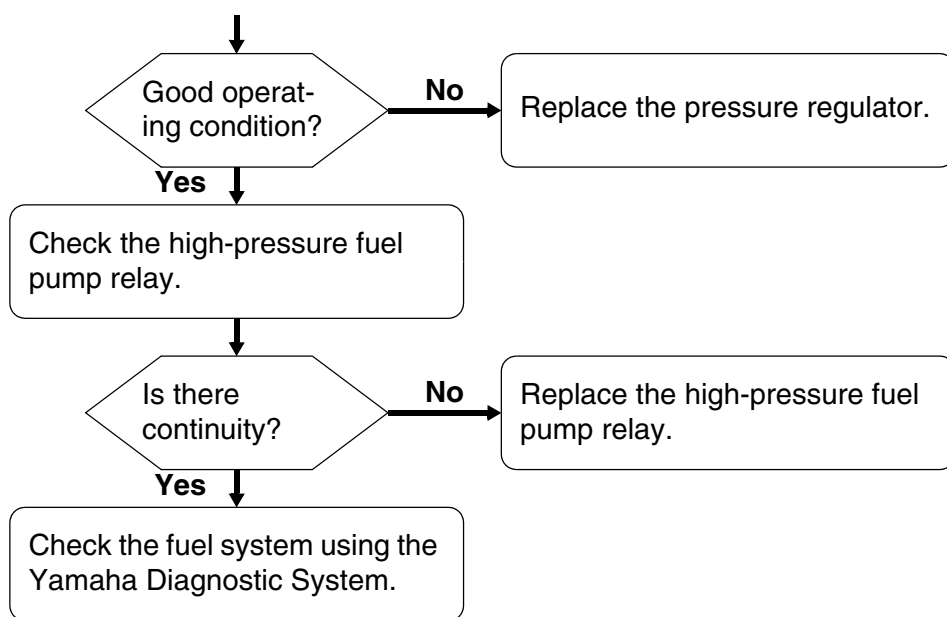


Symptom: Engine can be started, but does not remain on.

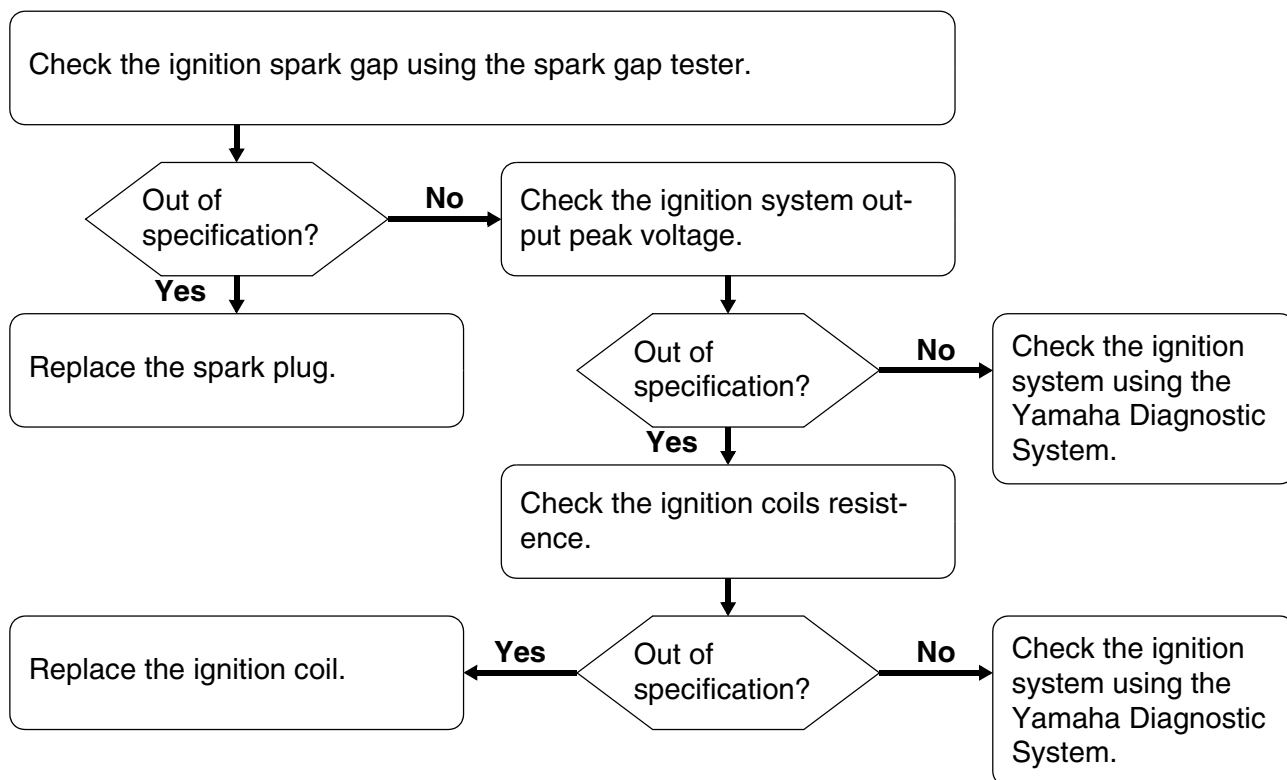
- Check the fuel system.
- Check the ignition system.
- Check the compression pressure of the power unit.

Fuel system

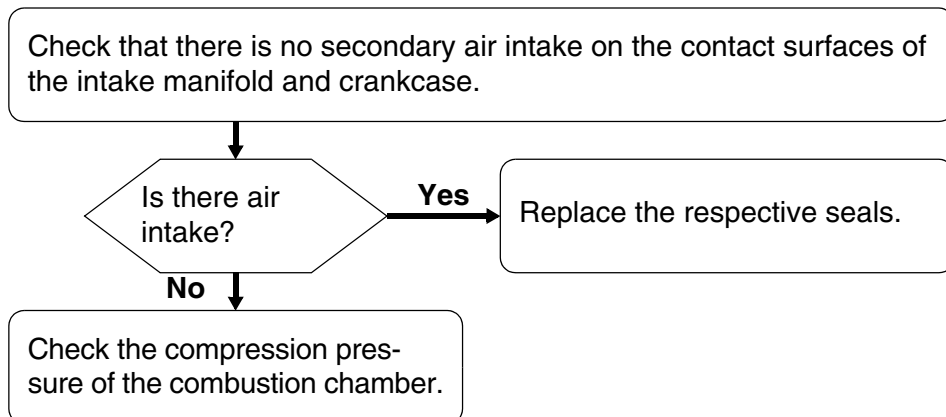




Ignition system

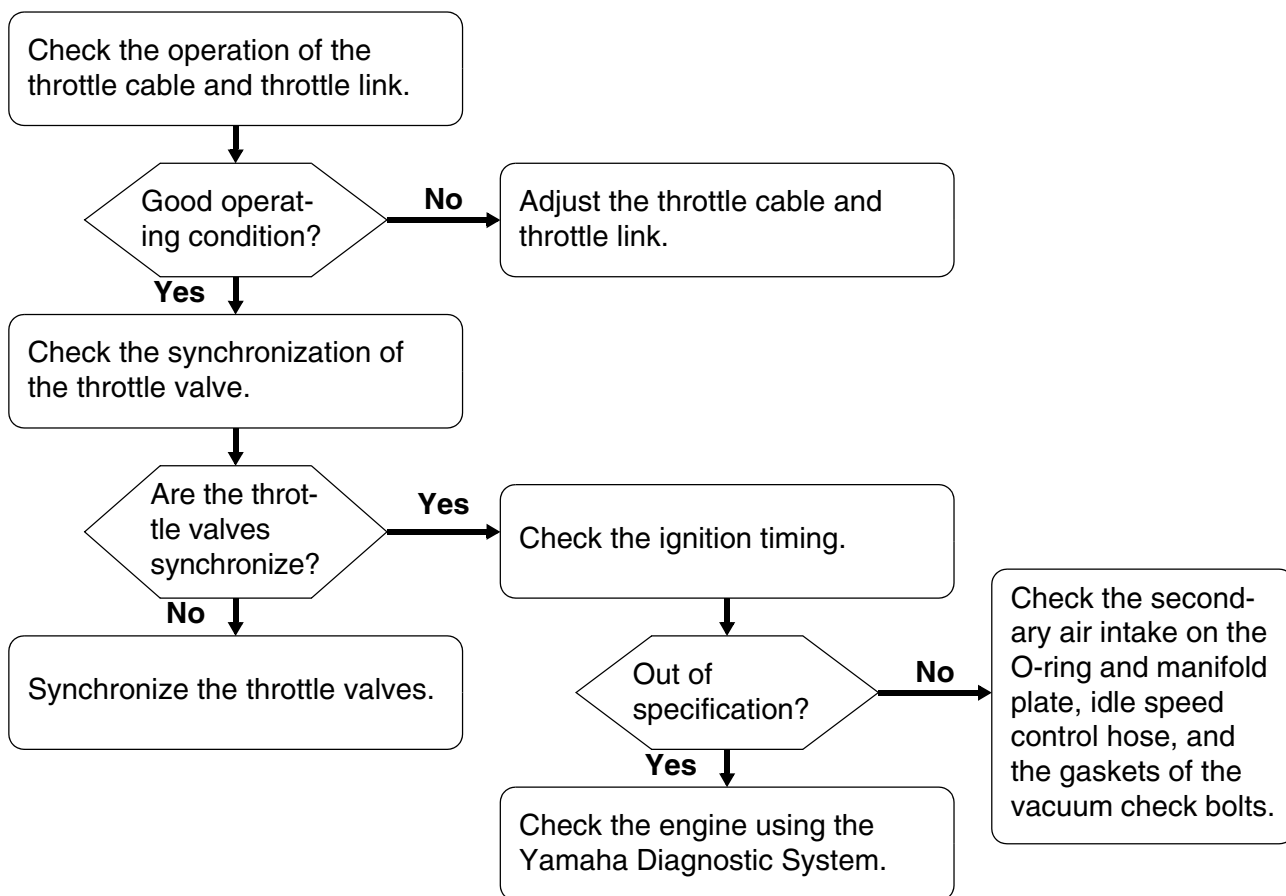


Compression pressure



Symptom: The engine idle speed is not steady, but increases or decreases.

- Check the intake manifold.
- Check the air intake system.
- Check the ignition system.



Symptom: Engine does not accelerate when the throttle is opened quickly.

The engine turns off when the throttle is opened quickly.

Acceleration is tardy and the engine is likely to stop at any moment.

- Check the engine using the diagnostic flash indicator or the Yamaha Diagnostic System.

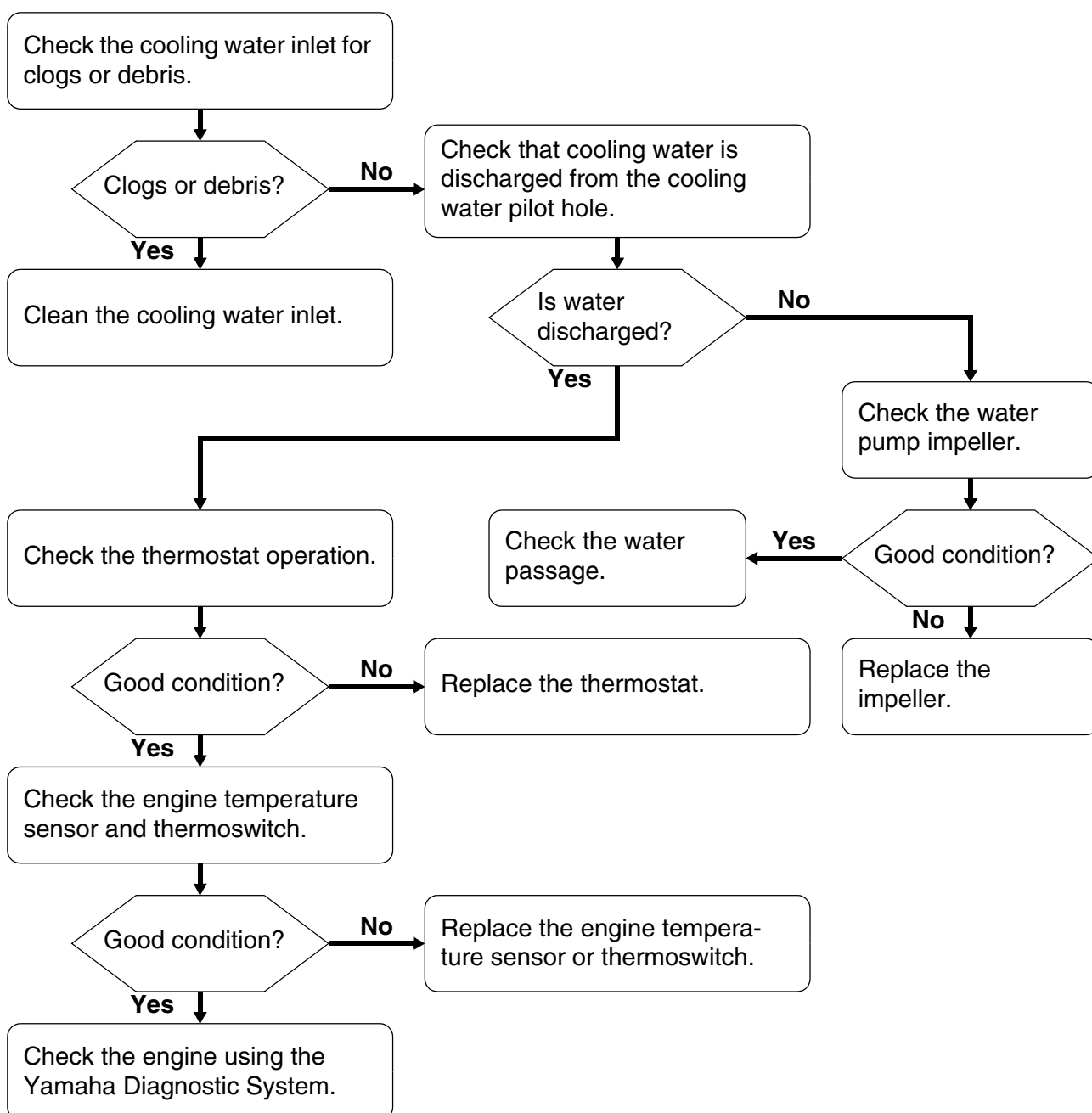
Symptom: Engine can run, but engine speed will not increase.

Overheat warning indicator is on.

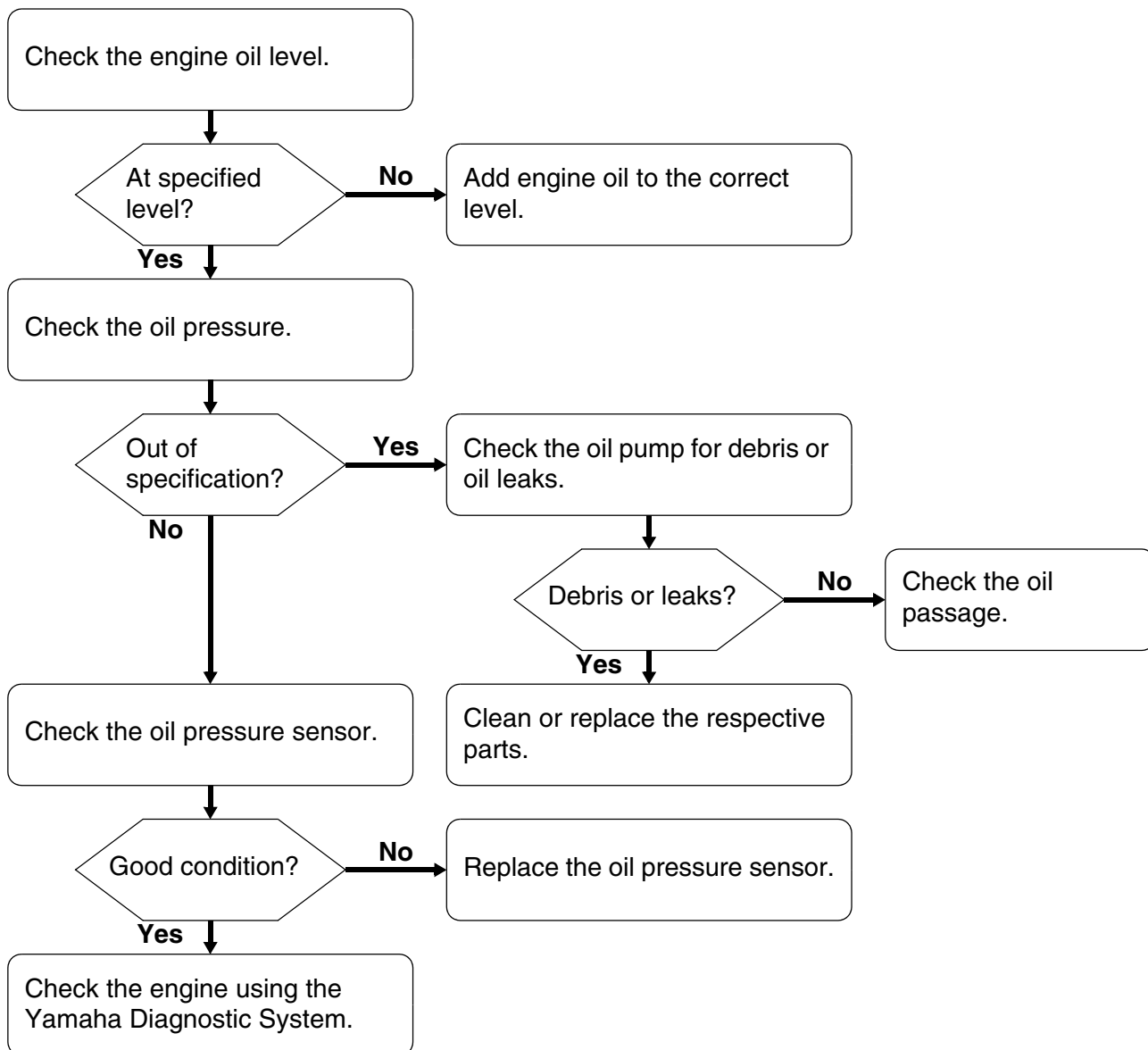
Oil pressure warning indicator is on.

Warning indicator is on and buzzer is sounding.

- Check the cooling system.
- Check the lubrication system.

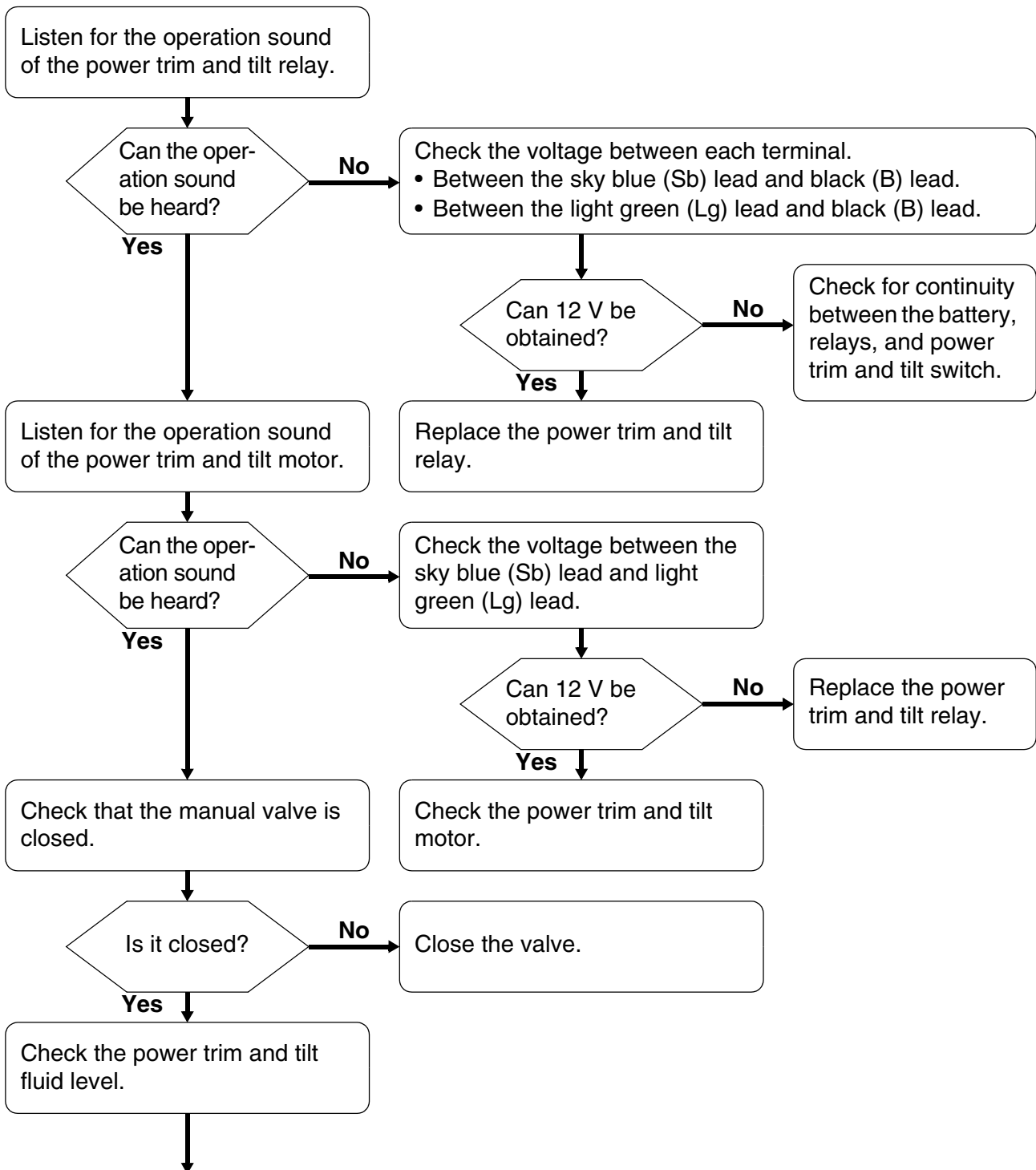
Cooling system

Lubrication system

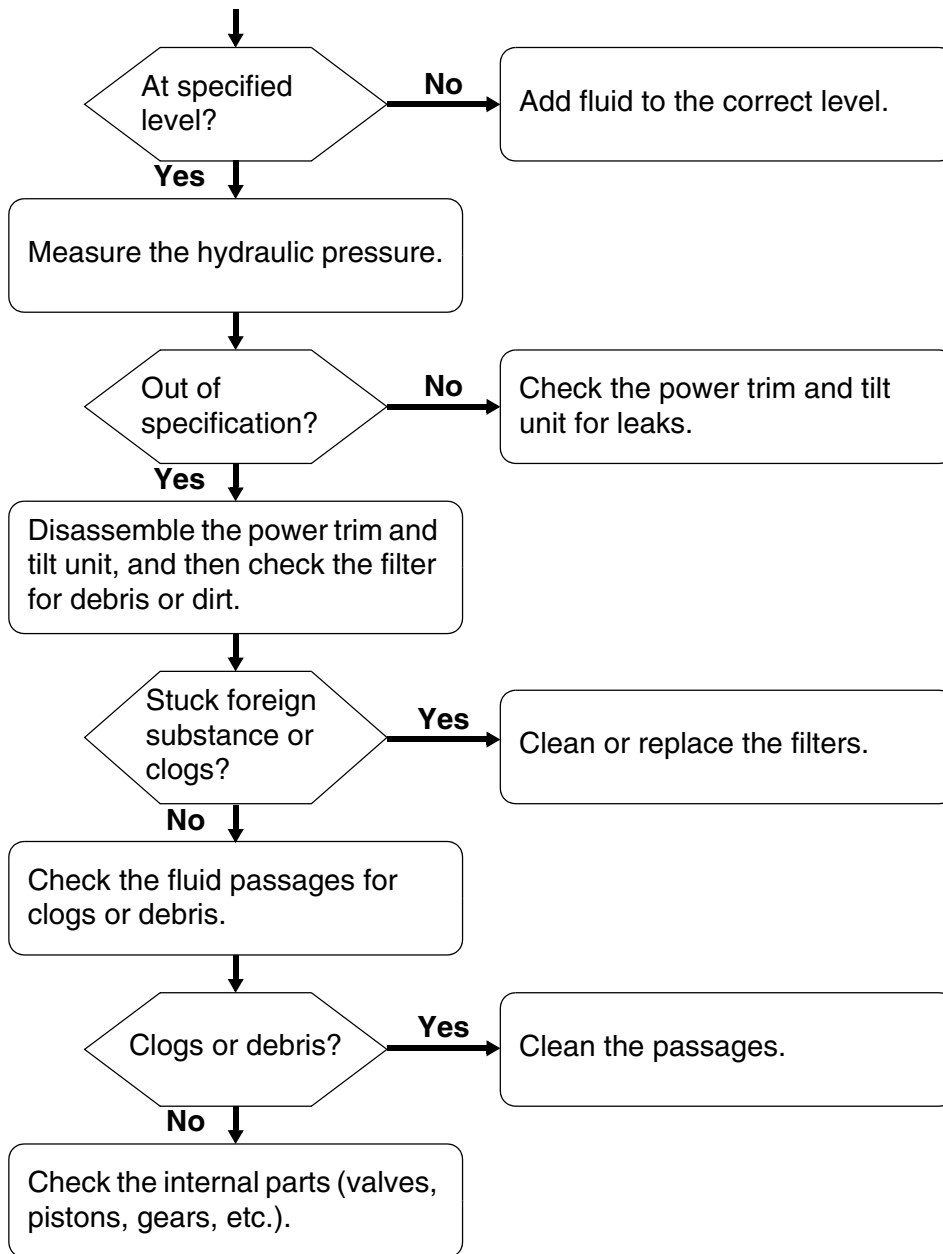


Bracket unit

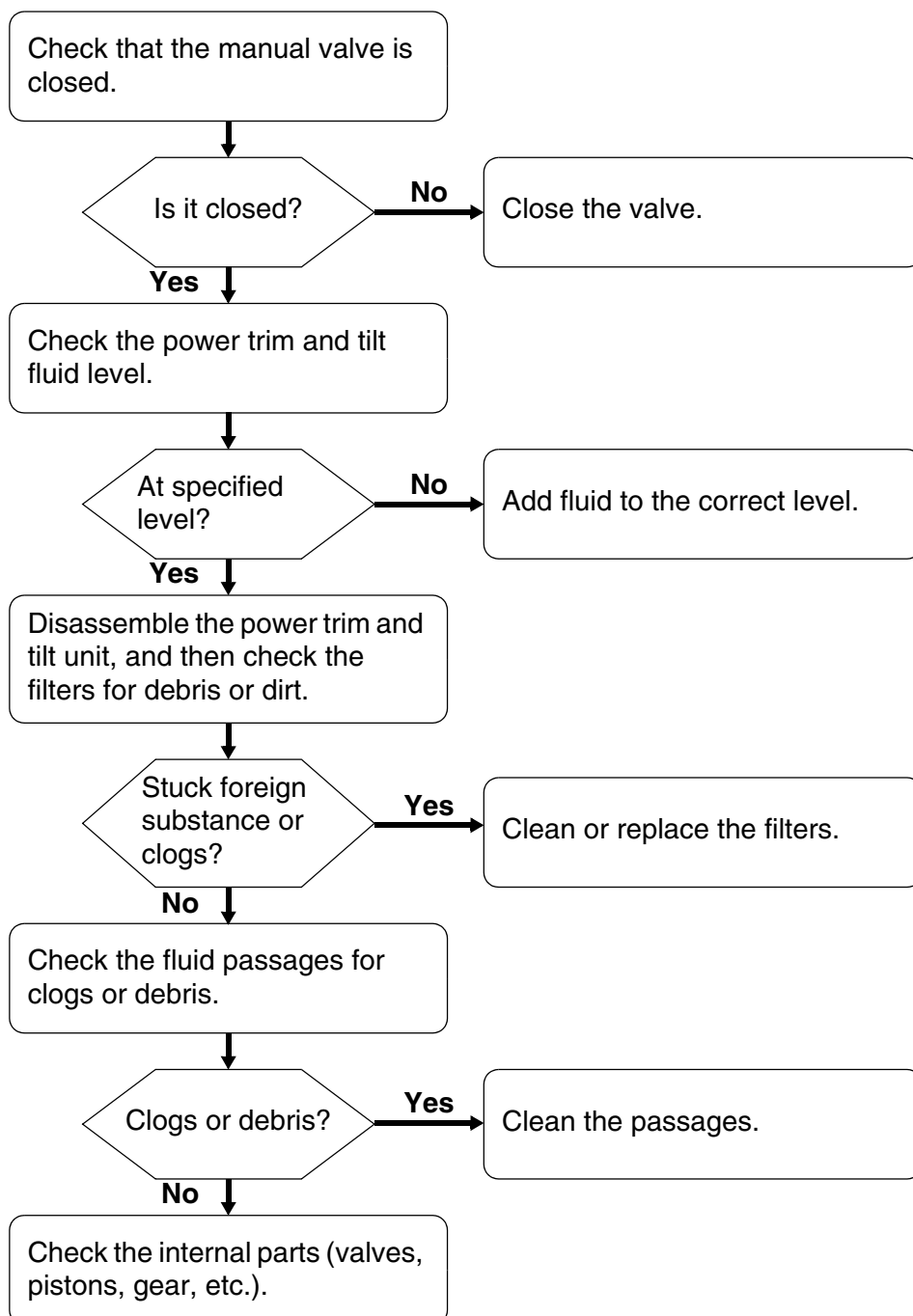
Symptom: Power trim and tilt unit does not operate.



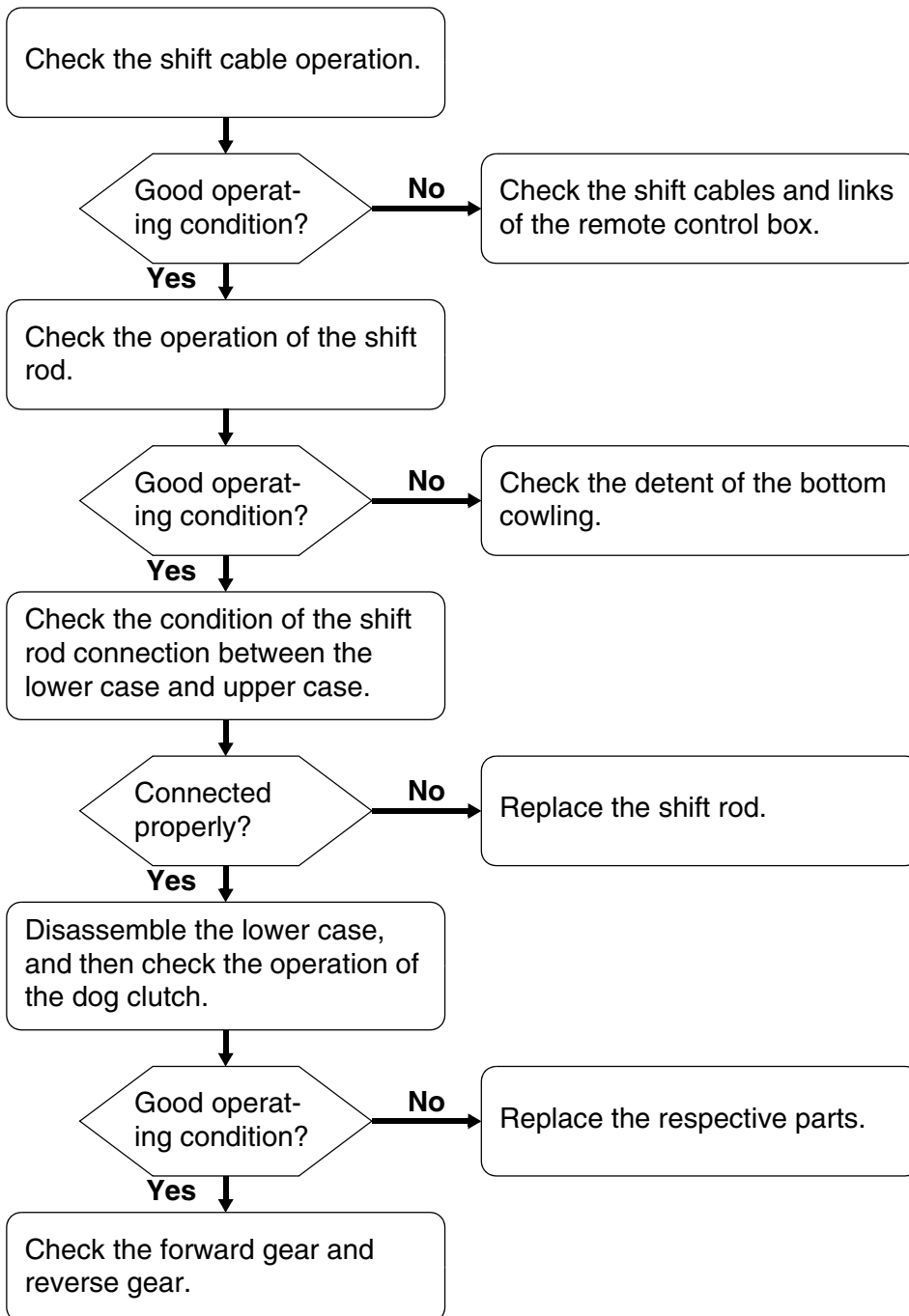
Continued on next page.



Symptom: Power trim and tilt unit does not hold the outboard motor up.



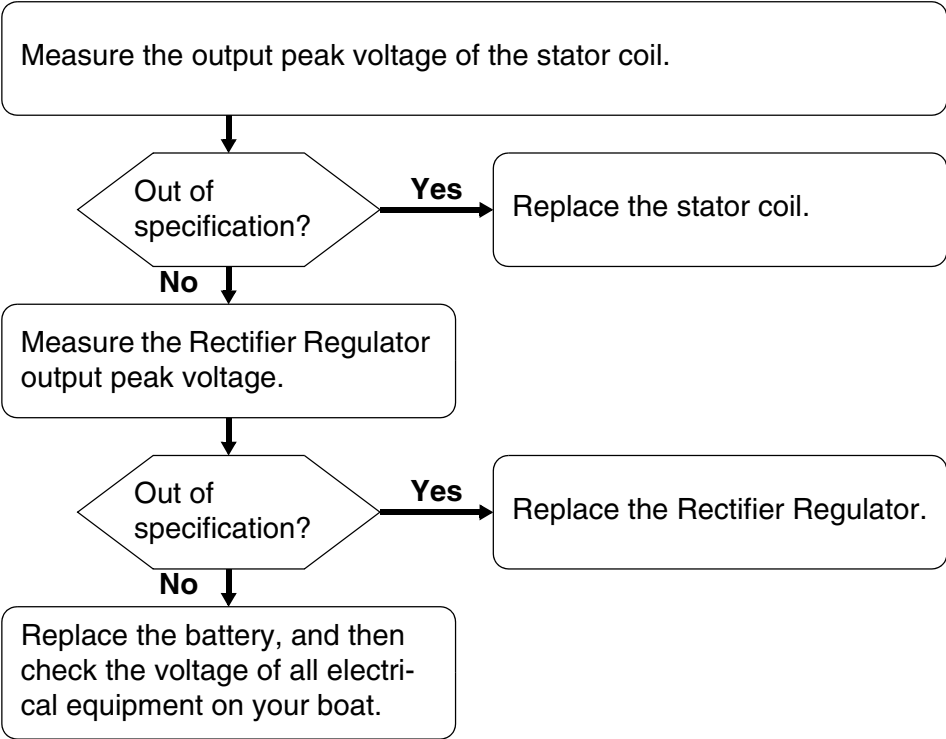
Symptom: Shift mechanism of the forward gear and reverse gear does not operate properly.



Electrical systems

Symptom: Battery becomes weaker quickly.

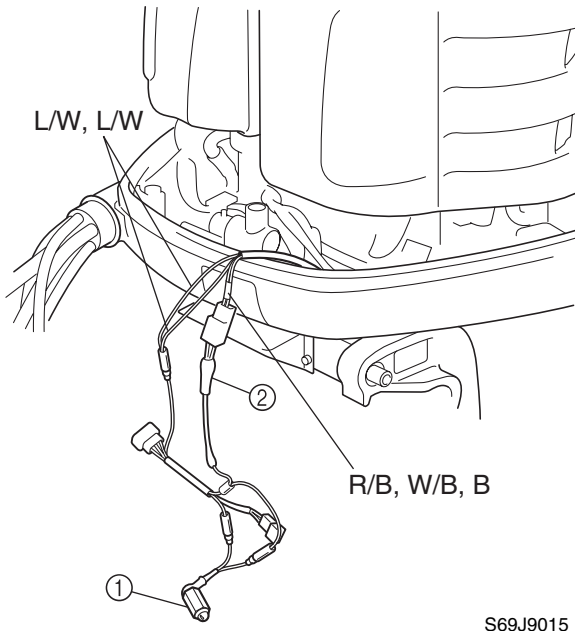
- Check the charging system.



Self-diagnosis

Diagnosing the electronic control system

1. Connect the special tools to the outboard motor as shown.



S69J9015

NOTE:

When performing this diagnosis, all of the electrical wires must be properly connected.



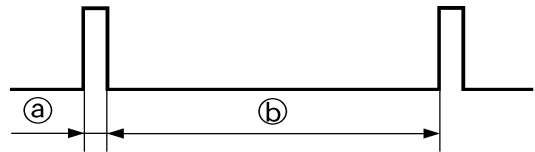
Diagnostic flash indicator 4 ①:

90890-06795

Diagnostic flash adaptor ②:

90890-06794

2. Start the engine and let it idle.
3. Check the flash pattern of the diagnostic 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.
 - ①: Light on, 0.33 second
 - ②: Light off, 4.95 seconds

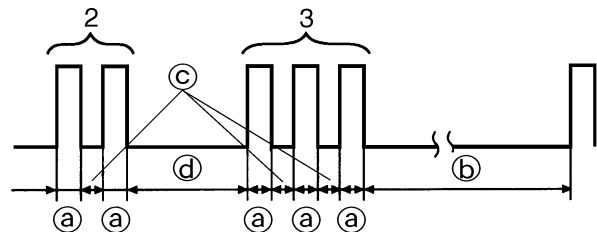


S69J9020

• Trouble code indication

Example: The illustration indicates code number 23.

- ①: Light on, 0.33 second
- ②: Light off, 4.95 seconds
- ③: Light off, 0.33 second
- ④: Light off, 1.65 seconds



S69J9030

4. If a flash pattern listed in the diagnosis 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 tester 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
15	Incorrect engine temperature sensor signal
18	Incorrect throttle position sensor signal
19	Incorrect battery voltage
23	Incorrect intake air temperature sensor signal
28	Incorrect neutral switch signal
29	Incorrect intake air pressure sensor signal
37	Incorrect idle speed control signal
39	Incorrect oil pressure sensor signal
45	Incorrect shift cut switch signal
46	Incorrect thermoswitch signal
44	Incorrect engine stop switch signal

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WIRING DIAGRAM F225AET, FL225AET

- ① Low-pressure fuel pump
- ② Low-pressure fuel pump driver
- ③ High-pressure fuel pump relay
- ④ High-pressure fuel pump
- ⑤ Idle speed control
- ⑥ Fuel injector
- ⑦ Spark plug
- ⑧ Ignition coil
- ⑨ Intake air pressure sensor
- ⑩ Thermoswitch
- ⑪ Engine temperature sensor
- ⑫ Pulser coil
- ⑬ Stator coil
- ⑭ Rectifier Regulator
- ⑮ Throttle position sensor
- ⑯ Shift cut switch
- ⑰ Neutral switch
- ⑱ ECM
- ⑲ Fuse (5 A)
- ⑳ Fuse (30 A)
- ㉑ Fuse (20 A)
- ㉒ Starter relay
- ㉓ Starter motor
- ㉔ Power trim and tilt relay
- ㉕ Power trim and tilt motor
- ㉖ Trim sensor
- ㉗ Battery
- ㉘ Intake air temperature sensor
- ㉙ Main relay
- ㉚ Oil pressure sensor
- ㉛ Power trim and tilt switch

- [A] To warning indicator
- [B] To remote control
- [C] To trim meter
- [D] To computer
- [E] To diagnostic indicator

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/O	: Black/orange
B/W	: Black/white
B/Y	: Black/yellow
Br/W	: Brown/white
G/B	: Green/black
G/R	: Green/red
G/W	: Green/white
G/Y	: Green/yellow
L/R	: Blue/red
L/W	: Blue/white
L/Y	: Blue/yellow
O/B	: Orange/black
O/R	: Orange/red
O/Y	: Orange/yellow
P/B	: Pink/black
P/G	: Pink/green
P/W	: Pink/white
R/B	: Red/black
R/Y	: Red/yellow
W/B	: White/black
W/G	: White/green
W/R	: White/red
Y/G	: Yellow/green



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